TECHNOLOGY AND RESEARCH INITIATIVE FUND

FY 2016 Annual Report

September 1, 2016
As required by A.R.S. § 15-1648 (D)

BOARD OF Regents
ARIZONA'S PUBLIC UNIVERSITIES

EDUCATE · DISCOVER · IMPACT

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ARIZONA BOARD OF REGENTS
TECHNOLOGY AND RESEARCH INITIATIVE FUND (TRIF) ANNUAL REPORT

For the Fiscal Year Ended June 30, 2016

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TRIF Executive Summary

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Technology and Research Initiative Fund (TRIF)

BACKGROUND

- Proposition 301 increased the state's sales tax to be dedicated to K-12, the community colleges, and Arizona's public universities. Collection of the tax began on June 1, 2001, and will continue through June 30, 2021.

- Using Proposition 301 revenue, A.R.S. §15-1648 establishes the Technology and Research Initiative Fund (TRIF) in the State Treasurer's Office and gives the Arizona Board of Regents (ABOR) the responsibility to administer the fund.

- TRIF monies are continuously appropriated to ABOR and do not lapse at the end of the fiscal year.

TRIF BUDGET

- The Arizona Board of Regents approves the TRIF budgets and business plans in 5-year cycles. The FY 2017-2021, final 5-year, project plans were approved by the Board in June 2016 using the sales tax forecast from the JLBC. These business plans are available on the ABOR web site at: www.azregents.edu.

- In FY 2015-16, TRIF received approximately $69.7 million in revenue. The revenue for the current 5-year period, FY 2012-2016, is approximately $376.2 million. Total TRIF revenue received to date since the inception of the program in June 2001 is over $892 million.

- The TRIF statute includes a 20 percent limitation on use of TRIF funds for capital projects expenditures.

2016 FINANCIALS

This year ABOR received $6,203,829 in excess of the TRIF revenue anticipated budgets. These excess funds were distributed to the three universities in August and are reflected as "carry forward" amounts in their financials.

(continued)

TRIF INITIATIVES

► Pursuant to A.R.S. §15-1648(C), TRIF monies will be used to support initiatives and projects that meet one or more of the following criteria:

- Promote university research, development, and technology transfer related to the knowledge-based global economy
- Expand access to baccalaureate or post-baccalaureate education for time-bound and place-bound students
- Implement final recommendations from the Governor's Task Force on Higher Education and/or the Arizona Partnership for the New Economy
- Develop programs that will prepare students to contribute in high technology industries located in Arizona

► Priority will be given to proposals that involve collaboration between and among the universities and/or collaboration with private industry or public sector agencies.

► The above criteria are included in ABOR Policy 3-412, along with formats for submission of proposals and other guidelines.

► The universities' investments of TRIF funds are limited to and focused in four research areas and one workforce development area:

Research investment areas:
Improving Health
Water, Environmental, and Energy Solutions
National Security Systems
Space Exploration and Optical Solutions

Workforce development investment areas:
Higher Education Access for Workforce Development

TRIF REPORTING

► A.R.S. §15-1648(D) requires the Board to submit to the Governor and the Legislature by September 1 of each year a report of prior year TRIF expenditures.

► The FY 2016 TRIF report, along with previous reports, is available on the ABOR web site.

► The board adopted TRIF five-year project plans detailing anticipated budgets and expected outcomes are also available on the ABOR website.

July 31, 2016


ASU
ARIZONA STATE
UNIVERSITY

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Arizona State University is advancing research, innovation, strategic partnerships, entrepreneurship and economic development through research discovery, creation of new technology and workforce development. The Technology Research Initiative Fund is key to this important progress. Our portfolio of select programs receiving TRIF support help grow the Arizona economy, providing a high return on investment for Arizona taxpayers.

During the TRIF cycle of FY12 through FY16, ASU invested in three focus areas:

- **Improving Health** encompasses use-inspired, collaborative research that advances human health and quality of life.
- **National Security Systems** addresses the critical research and technology of the security, defense and aerospace sectors.
- **Water, Environmental and Energy Solutions** integrates research efforts that create solutions to the challenges posed by urbanization and the increasing demands for energy, water, food and clean air.

At ASU we have designed our knowledge enterprise to be a pipeline where research generates new knowledge that can flow to technology development and be spun out into products and businesses that contribute to Arizona's economy. We invest TRIF in ways that will accelerate research and the resulting solutions and economic impacts.

In the past year a total of $164.5M in new funding from external sources has been awarded across the three focus areas, providing employment opportunities for highly skilled workers and job training for undergraduate and graduate students. This year a total of 566 undergraduates, 967 graduate students, 201 post-doctoral appointees and 45 research faculty were involved in TRIF-supported research. In addition, TRIF research results in new technology and opportunities for new companies. This year 6 new startup companies were founded based on technology from TRIF-supported research and 34 new patents were issued.

"ASU's knowledge enterprise is designed for discovery – to launch, advance and address global challenges in health, security and sustainability and to create solutions that can be implemented in our community and the world at large. All this improves the livelihood of citizens, creates jobs, raises performance and productivity and drives economic development in concrete ways. TRIF represents a sound investment by the Arizona taxpayers that elevates the strength of our economy and prestige of our state."

– Sethuraman Panchanathan,
executive vice president of the knowledge enterprise
chief research and innovation officer

IMPROVING HEALTH

TRIF-enabled researchers in Improving Health initiatives are approaching health at microscopic and macro levels, from developing new vaccines to creating methods to treat wastewater city-wide. Our innovative approaches and the positive health impacts that result have earned us rankings among the top universities for U.S. Department of Health and Human Services funding, including the National Institutes of Health, (#9) and for research expenditures among institutions without a medical school (#10).

Programs supported in the Improving Health focus area and associated goals:

- The ***Biodesign Institute*** impacts today's critical global challenges in health care, sustainability and security by developing solutions inspired by natural systems and translating those solutions into commercially viable products and clinical practices.
- ***Complex Adaptive Systems*** (CAS) represents a unique framework for biomedicine. Initiatives led by CAS include the nonprofit National Biomarker Development Alliance (NBDA) which is bringing innovative and focused solutions to critical research in biomarkers.
- The ***Center for Games and Impact*** partners with scientists and game developers to harness the power of gaming platforms, theory and technology for application in health, economics and sustainability.
- The ***Decision Theater Network*** (DTN) engages researchers and leaders across each of the TRIF focus areas to visualize and identify solutions to complex problems. With locations in Tempe and in Washington, D.C., DTN facilities provide the latest expertise in collaborative computing and display technologies for data visualization, modeling and simulation.

"TRIF funds that have been directed to the Biodesign Institute over the years are creating a profound ripple effect. As important discoveries continue to emerge, the reputation of Arizona as a hotbed of scientific ideas, inspiration and impact rises. Biodesign's workforce advances science and the strength of Biodesign scientific research has been a tremendous draw. ASU – and Arizona – is attracting the best and the brightest."

– Josh LaBaer
interim executive director for the Biodesign Institute

Summary of Accomplishments

Each year TRIF investments in our Improving Health portfolio are leveraged to secure new external funding awards and to expand our portfolio of research and technology for maximum impact.

Results – Impact

- Biodesign Institute researchers were awarded over $50M in external funding this year and made key discoveries and technology developments. These include **first steps towards finding alternatives to the dangers of opioids** and new options in treating chronic pain; developing a rapid **paper-based diagnostic that will detect the presence of Zika** expected to cost less than $1; designing a new generation of **blood-based diagnostic tests for breast cancer**; and developing a **paradigm-shifting treatment of wastewater** which removes and disposes of contaminants. In addition, researchers partnering with Banner Health are working to **find answers to Alzheimer's disease**.
- The NBDA initiative under CAS is leading preparations for the **first global adaptive trial for glioblastoma multiforme** (GBM), the most common and deadly adult brain tumor. The program will enroll patients in the U.S., China and Australia this year and **Vice President Biden has already commended the program** as a model of transdisciplinary biomedicine.
- DTN is partnering with The McCain Institute of International Leadership to **address infant mortality in the megacity of Lago, Nigeria**. By modeling different city-wide transportation scenarios, the team has found solutions that will significantly decrease infant mortality, such as opening Bus Rapid Transit lanes to women in emergency situations.
- The Center for Games and Impact has **secured over $2.3 million in continued external funding** from several sources including the Intel Foundation and the National Science Foundation to advance research and outreach that enables digital literacy, a critical skill for today's citizens that improves livelihoods. Current programs are focused **empowerment of young women in Africa** and maximizing **STEM career opportunities** including in the health sciences for target populations such as Latino youth.

"GBM AGILE, the product of a team of over 140 leaders in neurosurgery, neuro-oncology, research and advocacy, shows that TRIF investments can bring innovative solutions to intractable problems with the power to transform an area like clinical trials – and change individuals' lives."

- Anna Barker, co-director, CAS and director, NBDA

NATIONAL SECURITY SYSTEMS

ASU takes a multi-faceted approach to security research that includes innovative public-private partnerships. As a result, our National Security Systems portfolio aligns with cutting-edge development in the security sector and research leads directly to implementable solutions.

Programs supported in the National Security Systems focus area and associated goals:

- The ***Global Security Initiative*** (GSI) tackles "wicked problems" characterized by challenges with complex interdependencies without clear solutions. This initiative explores issues in climate security, cybersecurity, data and analytics security, and human security.
- The ***Space Technology and Science Initiative*** (NewSpace) leverages ASU's expertise in space-related science, technology and operations to build the future of America's commercialized space programs. NewSpace is developing partnerships with companies in Arizona and the Southwest, where private commercial spaceports and rocket factories are increasingly becoming an integral part of the space landscape.
- The ***Flexible Electronics and Display Center*** (FEDC) is a global leader in flexible electronics manufacturing. This public-private partnership demonstrates ASU's manufacturing capabilities and has created a powerful innovation infrastructure to drive economic growth. Together with the ***MacroTechnology Works Initiative*** (MTWI), ASU is advancing fundamentally new manufacturing capabilities for emerging transformational technologies including, but not limited to, large-area and flexible hybrid electronics.

"'TRIF investment was vital to the successful launch of the GSI Cybersecurity and Digital Forensics (CDF) Center, leading to development of proactive cyber strategies and partnerships to protect critical infrastructure and information both here at home and nationally. CDF is working closely with local industry to continue to establish Arizona as the leader in cybersecurity innovation and training."

– Nadya Bliss, director, Global Security Initiative

Summary of Accomplishments

Initiatives supported in the National Security Systems focus area have been awarded new funding, developed technology that has the potential to radically change the way we approach security and health monitoring, established new partnerships with industry and small businesses and strengthened our partnership with the U.S. Army.

Results – Impact

- Unique advances in cybersecurity by GSI include **establishing the Center for Cybersecurity and Digital Forensics** (CDF), which captured **$6.9 million in external funding** during its inaugural year. CDF helps Arizona businesses ensure the security of their customers, technologies and operations through cutting-edge research, in addition to providing much-needed talent to fill critical cybersecurity positions.
- NewSpace research director Craig Hargrove was **awarded one of two NASA SIMPLEX CubeSat missions and a grant of $6 million** to oversee a CubeSat missions to orbit the moon and measure hydrogen levels as an indicator of potential water. In addition, a public event sponsored by NewSpace **brought Bill Nye, Planetary Resources and Virgin Galactic before 3,000 students and community members** to discuss the role of entrepreneurial innovation in expanding access to space.
- A new rapid technology development collaboration was established this year between FEDC and the Biodesign Institute. Already this year the collaboration has resulted in the demonstration of **three significant advances in wearable biomedical technology**: a low-cost, compact point-of-care device and two health applications of a wearable flexible light emitter.
- Working with ASU's School of Computing, Informatics, and Decision Systems Engineering and the University of Southern California, DTN is **building a simulation tool for large-scale training exercises for the U.S. Army**. The training environment has the capacity for social media based mapping and tracking based on real-time social media data.

"TRIF seed funding catalyzed and enabled a new dynamic partnership between the Biodesign Institute and FEDC that otherwise would not have been realized. This new collaboration is poised to achieve immense tangible and intangible return on investment in the coming years."

-Gregory Raupp, director, Macro Technology Works

WATER, ENVIRONMENTAL AND ENERGY SOLUTIONS

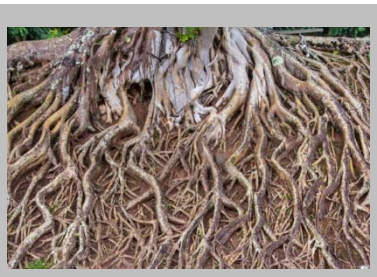
Our increasingly urbanized and resource-constrained world needs creative, science-based solutions. ASU research supported by TRIF in the Water, Environmental and Energy Solutions portfolio is developing these solutions which flow from the university into our communities where they are having measurable impact on citizens and our environment.

Programs supported in the Water, Environmental and Energy Solutions focus area and associated goals:

- The ***LightWorks*** initiative brings together ASU's energy activities and broad sustainability strengths to tackle complex energy problems. Capabilities range from basic research on biofuels and new materials discovery for photovoltaics to the applied developments of complex algorithms coupling weather forecasts with electrical grid distributions.
- The ***Julie Ann Wrigley Global Institute of Sustainability*** (ASU Wrigley Institute) advances research, education and business practices for an urbanizing world. Its four cornerstones of education, research, business practices and global partnerships, and transformation transcend disciplines, campuses and institutional boundaries.
- The ***Center for Bio-mediated and Bio-inspired Geotechnics*** (CBBG) and the ***NanoEnabled Water Treatment Technologies*** (NEWT) center are new National Science Foundation-funded Engineering Research Centers (ERC). ASU is leading the CBBG ERC and is a partner in the NEWT ERC. These centers represent the forefront of engineering research and design and are poised to tackle imminent sustainability issues by developing applied solutions.

"With TRIF support, the CBBG can develop and commercialize applications in the emerging field of biogeotechical engineering to fortify structures and landscapes against the destructive forces of natural disasters and improve methods of cleaning up soil and groundwater contaminants to restore land."

– Edward Kavazanjian, Regents' Professor and director, CBBG



Summary of Accomplishments

Programs in the Water, Environmental and Energy Solutions portfolio operate at local and global scales to address issues of sustainability.

Results – Impact

- LightWorks researchers were **awarded $38 million** for three projects based nationally and internationally addressing **energy sustainability and innovative workforce development** including engaging veterans.
- The ASU Wrigley Institute leveraged TRIF funding to submit **over $27 million in grant proposals** to support sustainability research. In addition, the institute conducted local and international education including the **Profitable Small Scale Farming workshop** held locally and **sustainability education training** that engaged multiple partners including the World Bank.
- CBBG and the NEWT center were **awarded over $20 million** from the National Science Foundation. CBBG is advancing geotechnical engineering to address infrastructure and environmental challenges. The NEWT center is partnering with industry and developing a testbed for water purification to address pressing problems such as lead in drinking water.
- DTN has partnered with the ASU Walton Sustainability Solutions Initiative and nine Valley cities through a funded intergovernmental agreement to model the financial and environmental **impacts of implementing green organic waste recycling programs** in the Phoenix metropolitan area.

"Through TRIF support we have established a center for drinking water treatment systems that use the unique properties of nanomaterials, which is leading to patents, student support, outreach and education, and spinoff companies in the near future."

– Paul Westerhoff, professor and director of the NEWT center

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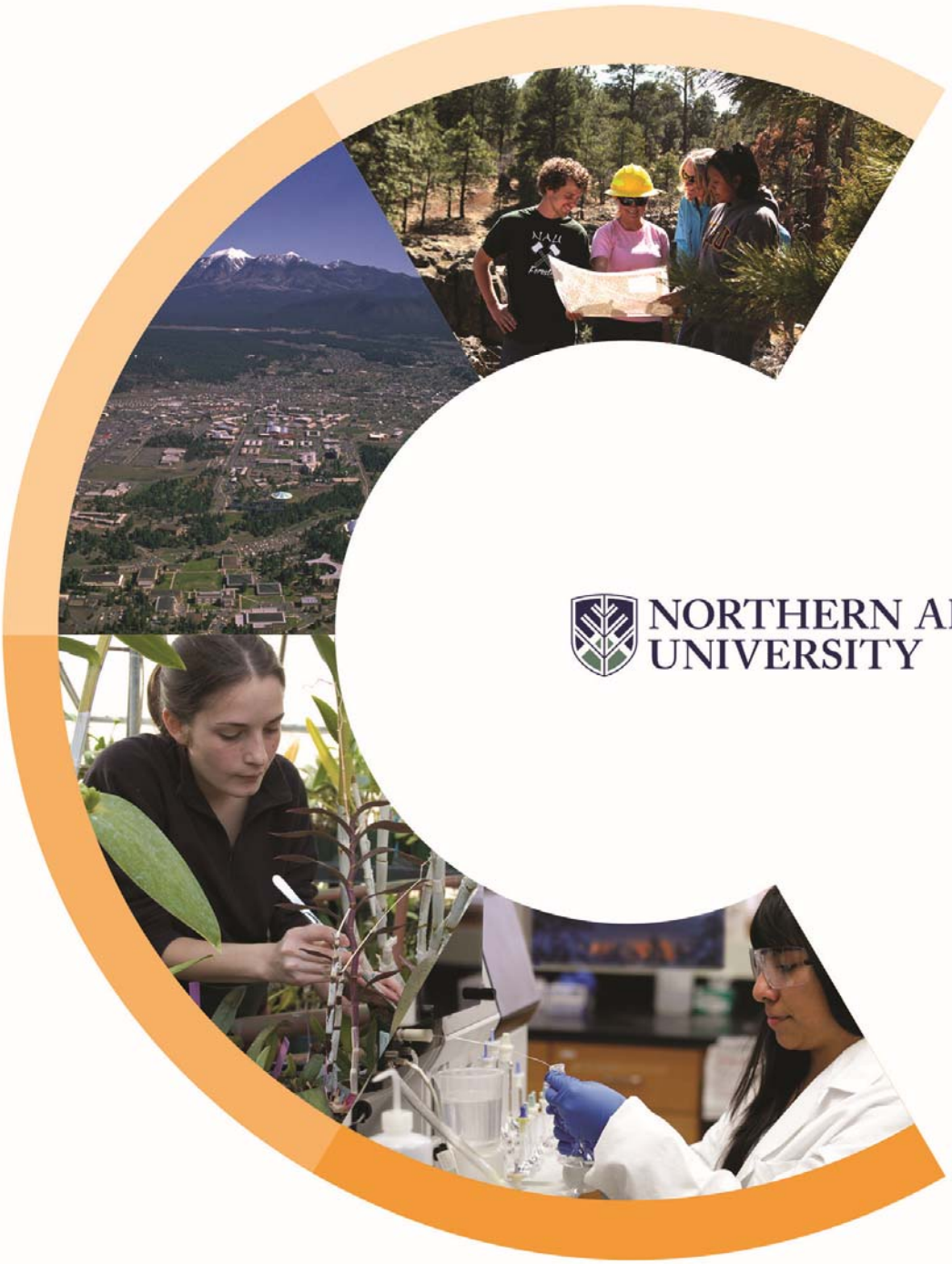

NORTHERN ARIZONA UNIVERSITY

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The three initiatives under Northern Arizona University's TRIF Business Plan continue to generate a positive return on investment. Since the Arizona Board of Regents approved the FY12-FY16 plan in spring 2011, **Water, Energy and Environmental Solutions (WEES), Improving Health (iHealth)** and **Access and Workforce Development (AWD)** have demonstrated the resonance and reach of NAU's strengths in research and workforce development. NAU's historical strength in environmental and climate sciences, biosciences, and healthcare serve as the foundation upon which the WEES and iHealth initiatives build increasingly visible and ambitious programs that contribute to Arizona's economic vitality. The university's AWD initiative supports the state's economic growth through the development and delivery of courses and degree programs that support workforce development in high demand areas like health, teacher education, and business and nonprofit management.

"We have used TRIF investments to develop interdisciplinary research across several strategic areas with big data computing as a core catalyst for research growth. TRIF funding has also been a major catalyst for technology transfer and workforce development in critical high-demand fields. Through these and other strategic TRIF investments, NAU makes important contributions to the communities of northern Arizona and throughout the state."

William "Bill" Grabe
Vice President for Research

Investment: In FY16, NAU invested TRIF funds across these noted initiatives in strategic ways. We continued to invest in research capacity by providing start-up funds to attract new, research-intensive faculty and by building more and stronger institutional partnerships in areas such as healthcare, land management, and biodiversity. Research centers that were developed under the FY12-FY16 business plan continue to attract high-productivity researchers from other institutions, faculty with backgrounds in private sector R&D, and undergraduate and graduate students who are trained in advanced research techniques. The university's Extended Campuses division invested TRIF funds in the implementation of a new pathway tool designed to help community college faculty and staff better assist students transferring to NAU under our 2NAU joint admission partnerships.

Impact: The financial impact of the university's TRIF investments in research exceeded our FY16 goal by 15 percent. Where our TRIF investments have been the most substantial over the five-year business period ending June 30, 2016—i.e., research centers—the returns have been the most impressive. Over 80 percent of FY16 financial impact was realized through the activities of NAU research centers. Our technology transfer returns were also impressive; we exceeded both our goals for invention disclosures and for U.S. patents issued by 100 percent. TRIF AWD investments impacted the 2NAU program, NAU's joint admission program with nearly every Arizona community college, by growing participants in the program 33 percent in FY16. The funding also supported Quality Matters for online and blended course design and the implementation of a Blackboard shell template for all courses.

Dr. Emily Cope was recruited to NAU from UC San Francisco in FY16. Cope received her BS and PhD in Biological Sciences from NAU. As Assistant Professor in the Center for Microbial Genetics and Genomics, Cope will study the role of airway microbiota in chronic inflammatory diseases.

WATER, ENERGY & ENVIRONMENTAL SOLUTIONS (WEES)

Northern Arizona University manages two programs under the TRIF WEES initiative. Both of these programs—**"Climate and Energy Solutions"** and **"Solutions for Arizona's Rural Landscapes"**— are based on the understanding that Arizona's natural resource base drives the viability of key economic activities of tourism, farming, ranching, and recreation.

Through rigorous scientific research, sound scientific and technical assistance, and information transfer to landowners, managers, and stakeholders, NAU's efforts under the WEES initiative contribute towards minimizing the risks of catastrophic wildfires and rebuilding a strong forest products economy in Arizona, maintaining affordable and secure water resources across the state, and resolving multiple-use conflicts through collaborative planning and analysis.

Goals

- **Ecological Restoration Institute (ERI).** Provide leadership to develop solutions to the costly environmental problem of degraded forest health, water quality, and availability of alternative energy fuel in the form of biomass and biodiesel. Contribute to workforce development by providing quality undergraduate and graduate funding, fieldwork, and education in forest restoration.
- **Landscape Conservation Initiative (LCI).** Engage students, decision makers, and the public in meaningful dialog, grounded in robust science, to help forge solutions to landscape conservation and sustainable community development. Forge new solutions to environmental challenges through applied biological science, collaborative planning and field-based training.
- **Ecosystem Science and Society Center (Ecoss).** Conduct research on ecosystems—from the cell to the globe—and investigate how they respond to and shape environmental change. Train future scientists, and communicate discoveries to the public.
- **Merriam-Powell Center for Environmental Research (MPCER).** Expand and market the availability of field stations, experimental arrays, and facilities for geospatial analysis and biodiversity studies. Such expanded capability and visibility will be aimed both at increased leveraging of grant funding and at a transition toward self-sustaining status for the field stations and facilities.

NAU researchers Faith Walker and Carol Chambers celebrate the opening of the Ancient DNA Lab alongside President Rita Cheng and other NAU leaders. Thanks to the new lab, topics including archaeology, wildlife, immunology, and environmental and climate science may be explored by NAU faculty, students and the public. The Ancient DNA Lab will showcase the region and help attract projects using ancient DNA from other parts of the world as well.

Courtesy of NAU News

Professor Tom Whitham's research team has been awarded $100,000 from the Nina Mason Pulliam Charitable Trust to create a model for restoring degraded habitat along Arizona's Little Colorado River. "Our goal is not to restore for past or even current conditions, but to pre-store to forecasted future conditions," said Whitham. The project will provide internships for Native American students through the Southwest Conservation Corps Ancestral Lands Program, with mentoring from individuals within the Navajo Nation, Arizona Game and Fish Department, National Park Service, and other land management agencies.

Courtesy of NAU News

Summary of Accomplishments

Northern Arizona University's investments under the TRIF Water, Energy and Environmental Solutions (WEES) initiative demonstrated financial return and impact in FY2016 through research innovation, new research partnerships and increased research capacity that will ultimately stimulate economic activity across the state.

Results – Impact

- Northern Arizona University faculty who have received TRIF funds through the WEES initiative were awarded $12 million in new external grants in FY2016.
- The Merriam Powell Center for Environmental Research received a $3.2 million grant from the National Science Foundation to establish the Lepidoptera of North America Network, or LepNet, to digitize and create an online data portal that integrates nearly three million North American butterfly and moth specimen records. This national effort, led by NAU, involves partners such as Harvard University's Museum of Comparative Zoology and the McGuire Center for Lepidoptera and Biodiversity.
- NAU researchers Michael Shafer and Paul Flikkema have been awarded $601,896 to develop an unmanned aerial vehicle (UAV) to find animals in the wild that are carrying tiny transmitting tags. The grant, from the National Science Foundation, is for instrument development with the goal of quickly distributing information to the scientific community.
- NAU's Center for Ecosystem Science and Society received $3.5 million in research support from the U.S. Department of Energy and NASA to investigate changes in the Arctic and their impacts on ecosystems.
- Michael Shafer, Assistant Professor of Mechanical Engineering, was awarded a $634,000 grant from the National Science Foundation to develop energy-harvesting technologies for monitoring marine mammals. The project, which will focus on elephant seals for the initial experiments, involves a collaboration with the University of California, Santa Cruz.
- In FY16, NAU Professors Catherine "Kitty" Gehring and Michelle Mack were elected as fellows of the Ecological Society of America. "Both have made outstanding contributions to ecosystems science, and both have raised considerably the profile of NAU as a leading center for environmental research", said Bill Grabe, NAU Vice President for Research. Gehring's fellowship is a result of her outstanding contributions in the field of community genetics and the role of plant genetics in defining microbial communities. Mack's fellowship recognizes her seminal research contributions in plant ecology and her leadership in climate science and fire ecology.

Wally Covington, Regents Professor of Forestry, was recognized with the **Biswell Lifetime Achievement Award from the Association of Fire Ecology**, honoring his pioneering research in dry, frequent-fire forests of the West. Covington founded NAU's Ecological Restoration Institute in 2000. "If you would have asked me 10, 20 years ago if I were optimistic about our forests' future I would have said no. But today, I am hopeful," he said. "We have made monumental strides in solving our forest health and fire problem. Mainly, unprecedented large-scale restoration projects like 4FRI that are using best available science to ensure resilient, healthy forest ecosystems for future generations."

Courtesy of NAU News

IMPROVING HEALTH: INVESTING IN BIOTECHNOLOGY AND BIOENGINEERING

Northern Arizona University's mission under the iHealth initiative is to strengthen and expand Arizona's biosciences economy by building increased research capacity in the biosciences/bioengineering and health research, and by translating the resulting discoveries and new knowledge into economic activity through technology transfer.

Goals

- **Build Capacity in Technology Transfer. S**trengthen internal capacity in technology transfer by implementing a vigorous technology transfer strategy that maximizes the potential for NAU research outcomes to lead to commercial products and services, yielding economic benefit for the state of Arizona.
- **Catalyze development of intellectual property (IP).** Provide project-based financial support to faculty whose research has the potential to generate outcomes suitable for licensing to established companies and/or the formation of spin-offs. NAU is building and strengthening relationships with state-wide partners to enhance technical assistance necessary to grow successful spin-offs.
- **Build institutional capacity to expand bioscience research.** Implement competitive internal grant programs that make targeted, strategic investments in bioscience-related research. These investments strengthen the institution's commitment to and participation in the statewide Arizona Bioscience Roadmap.
- **Invest in the Center for Microbial Genetics and Genomics.** Invest in and enhance synergies between Northern Arizona University and the Translational Genomics Research (TGen) Institute through the support of jointly appointed individuals.
- **Strengthen the northern anchor of Arizona's biomedical corridor.** Expand existing research efforts targeted at biomedical, translational, and community health research. It establishes strong partnerships with medical centers and communities in the region, such as Flagstaff Medical Center and North Country Healthcare.

Assistant Professor O'neil Guthrie, a researcher and clinical audiologist who joined NAU in 2015, studies the risk of auditory problems among test subjects exposed to sustained noise and jet fuel. **Guthrie was approached by Air Force officials who wanted to learn more about hearing loss among airmen.** "What we found is that at low levels, [the noise and jet fuel] is not toxic to the ears but toxic to the brain," said Guthrie, explaining that inhaling fuel is a more direct pathway to the brain. "Over time, these small exposures could accumulate and affect the brain's function." The National Institutes of Health, the Department of Defense and the Veterans Administration funded Guthrie's research. He said his findings may have implications for establishing guidelines for individuals working around fuel and noise, including those employed at airports, and in the military.

Courtesy of NAU News

Summary of Accomplishments

In FY15, researchers and research centers receiving TRIF funding under the iHealth initiative demonstrated their ability to leverage NAU's TRIF investments in ways that generated increased externally sponsored research dollars, new partnerships with research performing institutions, and valuable, intensive research opportunities for NAU graduate and undergraduate students.

Results - Impact

- Northern Arizona University faculty who have received TRIF funds through the iHealth initiative were awarded over $7 million in new external grants in FY2016.
- In FY2016, NAU and TGen were awarded an Australian patent for a rapid, one-hour test that will precisely identify a family of antibiotic-resistant staph infections broadly referred to as MRSA. "We hope this technology will be adopted worldwide by hospitals and clinics, and will help identify and isolate these dangerous and difficult-to-eliminate infections that have come to plague our medical institutions," said Keim, Cowden Endowed Chair of Microbiology at NAU, and director of NAU's Center for Microbial Genetics and Genomics. "The result should be more rapid diagnosis, improved treatment of patients, and reduced medical costs."
- Paul Keim received $998,213 from the U.S. Department of Homeland Security (DHS) to generate high-quality draft genome sequences of *B. anthracis* from the Middle East and North Africa. These sequences will be used to differentiate strains of anthrax and, eventually, to produce a foundation for source attribution and successful prosecution of biocrimes emanating from these regions. Keim also received $423,958 from the DHS to generate DNA sequences and to develop a detailed phylogenetic analysis of *C. botulinum* strains. Julie Baldwin, Professor of Health Sciences, received $773,335 from the NARBHA (Northern Arizona Regional Behavioral Health Authority) Institute to conduct an assessment of health equity needs and intervention opportunities in Northern Arizona.
- An interdisciplinary team of researchers from NAU's Athletic Training Program and the Department of Psychological Sciences received $400,000 from the NCAA and U.S. Department of Defense for the project, "Changing the Culture of Concussion Reporting: A Cultural Analysis and Implementation Model". *(sidebar)*
- David Wagner, Associate Director of NAU's Center for Microbial Genetics and Genomics (MGGen), received a $490,000 grant from the U.S. Department of Agriculture to study *Babesia*, the organism, carried by ticks, which is responsible for cattle fever. Wagner's team will gather samples from Mexico to expand knowledge of the tick populations, movements and ability to persist in the environment.

(l-r) Monica Lininger (Assistant Professor of Athletic Training); Ann Huffman (Associate Professor of Psychological Sciences); Heidi Wayment (Professor of Psychological Sciences), and Debbie Craig (Professor of Athletic Training) will study how organizational culture relates to concussion reporting among athletes, coaches and staff. "Concussions are unique in the field of athletic injuries because the decision whether to keep playing is less clear," said Craig, the study PI. "Everyone must believe that it is OK to report concussions. This will be a significant cultural shift from the current American football culture. Our goal is to facilitate that shift."

Courtesy of NAU News

ACCESS AND WORKFORCE DEVELOPMENT (AWD)

For over 30 years, NAU has served rural and urban communities throughout Arizona, providing opportunities for place- or time-bound citizens to continue their educational progress. Access and Workforce Development (AWD) focuses on teachers, health-care professionals, trained managers, and information technology professionals. The eLearning Center (ELC) improves student learning and supports successful degree completion through engaging and effective use of technology, providing services in instructional design, instructional technical implementation and training, creative media design and development, and learning technology administration and help desk providing frontline and second tier support for all technologies used in teaching.

Goals:

- **Continue the AWD initiative.** Make quality programs available in locations and through delivery methods that align with market demand and student need. Courses can be completed in as little as seven weeks and numerous programs allow students to transfer as many as 90 credit hours from an Arizona community college, leaving only 30 units needed to complete a bachelor's degree through NAU. Students can reach out to their local NAU contact or use the Extended Campuses Service Center, which is available by toll-free phone, email, and online chat for a wide range of student support services.

- **Expand 2NAU participation.** Encourage community college students to identify as a university student with an objective of earning a four-year degree early in their college career. Upon starting classes at an Arizona community college, they have the opportunity to also participate in a joint admissions program with NAU, and take advantage of resources offered through both institutions. This ensures they follow the most efficient and inexpensive path to a four-year degree, while also having access to the quality programs and resources at NAU. Students are encouraged to persist and are eligible for a scholarship after demonstrating superior academic achievement and continuous enrollment.

"The TRIF AWD initiative has provided pathways for Northern Arizona University's time- and place-bound students across Arizona to complete a four-year degree."

Astrid Klocke
Interim Vice President for Extended Campuses

- **Launch a new pathway tool.** Help community college faculty and staff understand how to help students interested in NAU is an extension of our 2NAU joint admission partnerships. The online tool, Transfer Academic Plan http://transferplan.ec.nau.edu/#/, launched in November of 2015, provides a recommended course sequence at each of the community colleges that best prepares students for NAU. The pathways maximize the number of units taken at the community college and provide a clear, smoothtransfer plan to baccalaureate completion at NAU.

- **Continue the eLearning Center.** Provide instructional and creative design work by supporting and collaborating with faculty to create engaging learning environments that effectively convey course concepts.

Summary of Accomplishments

Through Northern Arizona University's AWD, students are offered access to the outstanding educational opportunities offered at NAU, while also benefiting from the most affordable four-year degree options in the state of Arizona. ELC works with faculty on publications and presentations, and ELC staff actively present at national venues such as the EDUCAUSE Learning Initiative and The Teaching Professor conferences. The ELC recently received a grant from the Association of Public and Land Grant Universities to accelerate the adoption of adaptive courseware. This program will individualize learning with the focus on underserved populations and first generation college students.

Results - Impact

- NAU has joint admission agreements with nearly every Arizona community college, which expands its mission to provide affordable and accessible education throughout Arizona. The 2NAU joint admission program provides access to a four-year degree through seamless transition from the community college to NAU. Currently, there are 8,350 participants in the program, a 33% increase since June of 2015.
- Each fall and spring anywhere from 200 -500 2NAU joint admission students begin taking classes at NAU.
- The ELC Instructional Design team completed more than 120 intensive design consultations with faculty in all colleges for courses that were delivered in all modalities, in all term formats, and at all levels; undergraduate, masters, and doctoral. The ELC Instructional Technologists team participated in over 350 faculty consultations leading to 56 new and redesigned courses. Over 200 instructors attended in-person ELC Workshops. Over 4,500 instructors and students enrolled in self-paced courses such as Bb Learn for Instructors, Collaborative Learning Using Technology, and Pedagogy & Practice in Blended Learning Design.

ELC Instructional Designers, John Doherty & Matt Minister, consulting with new NAU faculty at the May 2016 Teaching Seminar.

- The Creative Media Design Team supported over 125 faculty projects for graphics, media, or course websites.
- The ELC continues to grow support in the areas of Quality Matters (a national program for consistent and high quality online and blended course design), blended learning (especially in large enrollment courses), and implementation of a template for online and in-person courses using Blackboard shells.
- The learning technology administration and help desk managed and supported Blackboard Learn at NAU with over 13.5 million user sessions last year. The Help Desk offers instructional technology support to faculty via phone, email and walk-in basis, and handled almost 14,000 support requests assisting over 2000 faculty, staff, or students. ELC evaluated, tested, and installed various learning technology integrations with our learning management system, rolled out a new service: In class Blackboard exam support, using student technology (BYOD: bring your own device).

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THE UNIVERSITY OF ARIZONA

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At the University of Arizona, TRIF advances the economic development of the State of Arizona by catalyzing innovative research in target areas of high impact while facilitating the translation and commercialization of research results into new products and services that promote the health, security, and prosperity of Arizona. UA is delivering results to benefit Arizona – overall our research and development enterprise grew, and exceeded the Arizona Board of Regents activity metric. A key to our success is our interdisciplinary approach that knows no boundaries, reflected in UA's ranking by *Nature* to be the 55th most collaborative among all universities worldwide.

Dr. Kimberly Andrews Espy, Senior Vice President for Research

"We are leveraging our TRIF support in a way to help make our community and state a better place to live through research and discovery."

Improving Health supports UA researchers tackling complex and pressing health problems of critical importance to Arizona and the nation, as well as major challenges in the agricultural life sciences. TRIF investments has helped to team world-class plant, animal, and human biologists, engineers, physician-scientists, and computational scientists to develop solutions for challenges such as clinical diseases, hunger, and age-related cognitive decline – all critical challenges facing Arizona citizens. A historic $43M grant in precision medicine highlights UA's prominence in finding new ways to improve health.

Space Exploration and Optical Solutions incubates novel research directions to spawn future technologies and impact regional economic development by leveraging research resources to benefit small and large businesses, and expand educational opportunities for Arizona students. UA's lead in the American Institute for Manufacturing Integrated Photonics, part of the National Network of Manufacturing Innovation, promotes our world reputation in optics/photonics and teams us with industry and government partners.

Water, Environmental and Energy Solutions projects are helping secure adequate supplies of clean water for Arizona's economic vitality, provide the knowledge to optimize the sustainable use of lands, create a state that is resilient in the face of drought and other extreme events, and lead the creation of a vibrant renewable energy industry in Arizona. The newly opened Water & Energy Sustainable Technology Center is host to $6.4M research and technology development grants.

Tech Launch Arizona, supports the commercialization of research and generates new companies suitable for professional investment financing. TLA builds connections between the talents of UA faculty, researchers and students, the experience of entrepreneurs and investors, and the facilities and programs of Tech Parks Arizona and the Arizona Center for Innovation, all with the goal of creating the optimal commercialization pathway for each invention to maximize its social and economic impact.

IMPROVING HEALTH

TRIF investments in **Improving Heath** have allowed the BIO5 Institute to bring together world-class plant, animal, and human biologists, engineers, physician-scientists, and computational scientists to develop bold solutions for complex challenges such as disease, hunger, water safety, and cognitive decline- critical challenges facing Arizona.

Goals

- Foster collaborative projects that address major challenges in the biosciences, biomedicine, and biotechnology and forge significant progress on novel treatments for asthma, cancer, valley fever, diabetes, sudden cardiac death, malnutrition, and Alzheimer's and other age-related brain diseases.
- Strengthen and expand translational research by recruiting the best and brightest faculty to Arizona and supporting projects that will advance the development of new medicines, devices, diagnostics, and nutritional and therapeutic strategies.
- Engage and train our future generations of scientists by maintaining successful outreach and internship programs to promote experiential learning and STEM literacy in the state.
- Expand shared resources in computational biology, imaging, high throughput screening, genomics, proteomics, and cell analysis across all biological disciplines in order to expedite large-scale, team science grants that will boost federal research funding, serve as a resource for local industry, and create new services and companies in Arizona.
- Promote an entrepreneurial culture in which scientists work across disciplines to accelerate commercial translation of research breakthroughs.

Lalitha Madhavan, MD, PhD
Dr. Madhavan is studying novel stem-cell biology and its applications toward understanding and treating devastating **neurodegenerative disorders** such as Parkinson's disease.

Victor Hruby, PhD
A biopharmaceutical startup company has licensed technology developed at UA by a team including Dr. Victor Hruby, representing a new direction for therapies to treat **depression and associated disorders** like anxiety.

Janet Funk, MD, PhD
A research team led by **Dr. Funk** has found that the Indian spice, turmeric, is as effective for treating **arthritis** as some pharmaceuticals. The project is currently moving from the laboratory to patient testing.

Summary of Accomplishments

IH is helping to prevent and cure disease in our state's most vulnerable
Dr. Fernando Martinez is leading a $27M national clinical study with the aim to develop a new method to prevent asthma in young children – using pathogens from ordinary house dust. The study will enroll more than 1,000 babies, 6 to 18 months old, who are considered at high risk for developing asthma. On the other end of the spectrum, Dr. Michael Kuhns and his research team are learning how immune systems change over time with the goal of better tailoring immune-therapeutics and vaccine strategies for the elderly, by studying the immune responses of aging mice.

Researchers in IH are working on cutting edge solutions to health and environmental challenges
Dr. Jennifer Barton is identifying biomarkers and creating optical imaging tools that will enable the first effective screening system for ovarian cancer. In collaboration with UA researchers in physiology, medical imaging, and obstetrics and gynecology, Barton is working to create novel techniques that will help identify early, subtle changes in tissue. Meanwhile, Dr. Kasey Ernst was awarded one of only five National Science Foundation grants to predict the spread of Zika virus, and Dr. Michael Riehle is studying the biology of mosquitoes in order to discover prevention tactics and cures to mosquito-borne illnesses like the Zika virus.

Helping those that help others
Drs. Jeff Burgess and Shane Snyder are leading a federally funded firefighter safety project ($1.5M) intended to reduce cancer risks among first responders and investigators by analyzing their exposure to carcinogens. Cancer is a leading cause of death among firefighters with exposure to carcinogens occurs through skin contamination and inhalation of smoke, diesel exhaust and other chemical gases, vapors and particulates. Working closely with the Tucson Fire Department, the research team will evaluate exposure to carcinogens throughout the work shift, measure biomarkers of carcinogenic effect and test the effectiveness of interventions to reduce carcinogen exposure.

Results – Impact

- BIO5 researchers generated $56M in new grant awards, more than a 6x return on TRIF investment.
- 301 graduate students, 348 undergraduate students, and 158 post-docs enabled through assistantships, wages, scholarships, grants, and research experiences
- BIO5 researchers authored more than 452 scientific publications, including in Nature, Science, New England Journal of Medicine, and Journal of the American Medical Association.
- 19 new invention disclosures, 19 patent applications filed, 1 new patent issued, 1 new startup company, 3 licenses and options

SPACE EXPLORATION AND OPTICAL SOLUTIONS

The TRIF **Space Exploration and Optical Solutions** initiative, incubates novel research directions that are the basis of tomorrow's technologies, impacts regional economic development by leveraging the University's world-renowned optics education and research resources, and expands educational opportunities for Arizona students in optics.

Goals

- Leverage TRIF funds to obtain at least a 10X return on investment through increased external research funding.
- Identify and support key optics faculty hires in strategic areas of Arizona need and/or opportunity across the UA campus.
- Create new shared imaging and photonics infrastructure and facilities that broadly benefit the research and education mission of the University, Arizona and US.
- Support Arizona workforce development directly through increased student fellowships and enhance UA's outreach to companies and under-represented populations in Arizona to help increase the number of trained minority students.
- Encourage commercialization of research results, helping the creation of new start-up companies and expanding innovation activities.

US Vice President Joe Biden and Thomas Koch, Dean and Professor, College of Optical Sciences

"TRIF funding has been absolutely instrumental in establishing the foundation of University of Arizona's leadership role in AIM Photonics, a $600M public/private partnership and the largest yet of the new federally launched Manufacturing Innovation Institutes."

Summary of Accomplishments

SEOS lands major new initiative

FY16 investments in the TRIF Space Exploration and Optical Solutions program have resulted in major new initiatives that provide outstanding opportunities for faculty innovation, powerful additions to UA's research infrastructure, unique educational opportunities for students, and compelling new outreach and collaborative linkages with industry.

Notable among these is UA's leadership role in the American Institute for Manufacturing Integrated Photonics, part of the National Network of Manufacturing Innovation. This Institute includes the

"stars" of industry – –Intel, Cisco, IBM, Infinera, GE, Raytheon, Boeing, and many others - and has enabled UA's faculty and students to have access and contribute to world-leading chip-scale photonics technologies in partnership with top tech companies.

Leveraging TRIF dollars

Outstanding advances in the field of Image Science are providing powerful support to the technology base for UA's *Never Settle* Strategic Plan. Examples include the success of the Center for Gamma Ray Imaging (CGRI), which benefited from TRIF support to generate outstanding research advances, intellectual property, and graduate students. CGRI recently received a $5.7M grant from NIH for five additional years of operation. Also in Image Science, Prof. Amit Ashok leveraged TRIF funding to secure over $2M in funding from DARPA, DHS, and the National Cancer Institute.

Amit Ashok, Ph.D., Assistant Professor, Optical Sciences

"TRIF support has been a huge factor in the successful launch of my research program, which has now expanded to over $2M of funding into promising new directions for UA. This has recently included a $1.3M DARPA program to explore fundamental limits on our ability to see behind opaque objects based on sophisticated analysis of light scattered off the surrounding scene."

TRIF funding has been leveraged in securing the $32.2M NSF funding received to date for the prestigious Center for Integrated Access Networks (CIAN) Engineering Research Center led by Nasser Peyghambarian, now in its 8th year. CIAN's high-impact technical leadership has put Arizona on the national stage in the future of internet technology, and has developed technological synergies with AIM Photonics.

The TRIF Space Exploration and Optical Solutions initiative supports extensive Workforce Development with salary support to 47 graduate and post-doc students in the Colleges of Science, Engineering, and Optical Sciences during the past year. Outreach events are focused on both industry and community, including the Research Experience for Undergraduates and Research Experience for Teachers, and Expect Academic Success in STEM, which have now become successful annual events targeting Native American secondary school faculty and students.

Results – Impact

- $74M in new TRIF-seeded research funding
- Funded 47 graduate student research assistantships and post-docs, 8 undergraduate students
- 1 new start-up company, 36 invention disclosures, 57 patents filed, 14 patents issued, 10 licenses and options with $364,00 of royalty income
- 252 journal publications and scientific conference presentations

Matt Kupinski (left), Professor of Optical Sciences, with Lars Furenlid, Joint Professor of Medical Imaging and Optical Sciences (right), and recent PhD graduate Cecile Chaix (center)

"TRIF funding has enabled us to support outstanding graduate students and provide the strong UA commitment that enabled $5.7M NIH funding for the next five years of our Center for Gamma Ray Imaging."

WATER, ENVIRONMENTAL AND ENERGY SOLUTIONS

The **Water, Environmental and Energy Solutions (WEES)** initiative is developing innovative, practical solutions necessary for water, environmental, and energy sustainability in Arizona that are applied globally in other semi-arid regions facing increasing demands on natural resources and the uncertainties of drought and extreme events. WEES projects are helping secure adequate supplies of clean water for Arizona's economic vitality, provide a knowledge foundation to optimize sustainable stewardship of Arizona's lands, create an Arizona that is resilient in the face of climate variability, and lead the creation of a vibrant renewable energy industry in our state.

Goals

- Build on the UA's world-renowned expertise in water and climate variability and its emerging excellence in the renewable energy sector to enhance multidisciplinary collaboration for science, technology, and resource management
- Focus on use-inspired research performed by multidisciplinary teams that will result in innovative, practical solutions for Arizona and beyond.
- Leverage investment in strategic areas to increase public, private funding and to increase the rate of commercialization of research results in tech and industry.
- Train a new generation of scientists, engineers, and other professionals in these critical areas to meet state and national needs.

University of Arizona's Center for Environmentally Sustainable Mining has expanded its Gardenroots project to Apache, Cochise, and Greenlee counties. The program trained 100 citizens and 55 families to collect soil, water, and plant samples to ensure safe consumption of homegrown vegetables in areas impacted by mining.

Summary of Accomplishments

WEES invests in research and technology to expand Arizona's resource options and economy
The Water & Energy Sustainable Technology (WEST) Center, opened in fall 2015, was awarded $6.4M in federal funding to address water sustainability, and in its first year, already boasts $500,000 from industry giants such as Dow Chemical and SC Johnson Corp to partner in developing new water solutions. Through their research, experts at WEST advance water reuse and energy sustainability options for Arizona. Other WEES investments in new advanced DNA analysis equipment benefit Arizona's growers by providing low cost, yet highly innovative methodology for detection of microbial pathogens in agricultural water.

A team of UA faculty designed an "intelligent building envelope" in which artificial intelligence and new materials are integrated into a building to allow automatic prediction and response to internal and external environmental changes, reducing water and energy consumption. WEES-supported faculty hiring has positioned the UA to address essential topics such as extreme weather forecasting, ecosystem biodiversity, and the market impacts of drought and other climate variability outcomes.

WEES-funded solar energy workshops held in Tucson, Florence, and Prescott gave Arizona teachers, students, farmers, gardeners, and 4-H leaders hands-on experience assembling and metering portable solar PV systems.

WEES engages Arizona stakeholders

Beyond the Mirage, a unique online video clip assembly system and hour-long documentary reached 1000s of Arizonans, including K-12 students in five Arizona school districts. Providing a compelling look at water in the West, the project won the $100K Arizona Community Foundation: Water Consciousness Challenge prize. The documentary was selected for national syndication. Researchers working with the Navajo Nation and the Bureau of Reclamation designed and implemented practical, affordable solar-powered desalination technologies that produced potable drinking water from brackish groundwater in rural Arizona.

WEES seeds future success

Growth in industry partnerships and research funding led the Renewable Energy Network to expand and become the Arizona Institute for Energy Solutions. This new institute promotes development of resilient solutions in the energy, water, and food nexus sufficient to sustain and enhance our society. The WEES-funded Carson Scholars program trains outstanding interdisciplinary PhD students in methods for communicating their research to a broad audience. Thanks in part to this training, Carson scholars Arica Crootof, Fiona Gladstone, and Carly Nichols received prestigious Borlaug Fellowships in Global Food Security ($up to 40,000 each).

Results – Impact

- $44M in new grants and gifts to the UA from WEES investments in faculty and research
- 212 graduate students, 104 undergraduate students, and 23 post-docs enabled through assistantships, wages, scholarships, grants, and research experiences
- 19 new invention disclosures, 19 patent applications filed, 1 new patent issued, 1 new startup company, 3 licenses and options
- 76 hosted workshops, conferences, and other events

TECH LAUNCH ARIZONA

Tech Launch Arizona has a key leadership role in the UA's mission to commercialize research results to contribute to the economic development of southern Arizona and the nation. TLA fosters innovation, expedites the transfer of technology into the marketplace and generates new companies suitable for professional investment financing. Through comprehensive services, TLA builds connections between the talents of our faculty, researchers and students, the experience of entrepreneurs and investors, and the facilities and programs of Tech Parks Arizona and the Arizona Center for Innovation, all with the goal of creating the optimal commercialization pathway for each invention to maximize its social and economic impact.

For example, Akhu Therapeutics, Inc., launched in FY16, is a startup based on UA patented technology developed by UA professors Minying Cai, Ph.D. and Victor Hruby, Ph.D., both in the Department of Chemistry and Biochemistry in the College of Science. The company is commercializing a new peptide-based melanocortin (MC5R) blocker that represents a new direction for therapies to address disorders like depression.

Palash Gangopadhyay, Ph.D., inventor and research scientist in the College of Optical Sciences, received an Asset Development award to further develop a novel nano battery technology, which has now been licensed to Votronix USA.

Goals

- Engage faculty researchers to encourage participation in the commercialization process and promote a culture of service excellence
- Expedite movement of UA research-derived intellectual property into the commercial sphere and foster the development of these assets along the appropriate commercial trajectories
- Advance the local and global impacts of knowledge creation through community and industry partnerships
- Grow the UA's return on its efforts through an enhanced reputation, a larger economic impact in Arizona, increased industry-sponsored research, and greater licensing revenues
- Expand the Asset Demonstration Program from the former Proof of Concept (POC) Program to enable a wider range of asset demonstration activities, including performance and efficacy data

Summary of Accomplishments

Bringing a positive impact to our community

TLA fulfills a central role in UA's mission of creating a positive impact on the Tucson and southern Arizona economies. As of the fiscal year's June 30 close, it has achieved all of its performance metrics defined by the Arizona Board of Regents (ABOR). In direct support of UA's Strategic Plan, *Never Settle,* these metrics not only represent increases over the previous year, but also mark all-time highs.

UA President Ann Weaver Hart, TLA Vice President David Allen, and the cohort of 2016 I-Squared Awards honorees, all of whom were recognized for their inventions and contributions to the technology commercialization ecosystem.

A key measure of TLA's regional economic influence is the creation of startup companies founded upon university-developed technologies. Over the past five fiscal years, UA has created 45 new Arizona-based companies in one of the toughest economic climates in years. In 2015, Walmart announced it will use SinfoníaRx's proprietary software to proactively monitor prescription medications and identify potential problems within a patient's regimen. Tech Launch Arizona facilitated the licensing of the medication therapy management technology invented at the UA's College of Pharmacy to UA startup SinfoníaRx in 2013.

Supporting researchers and their work

To help successfully launch the highest potential new technologies, TLA directly funds validation of technology and market alignment activities under the Asset Development Program. The program provides technical, business and financial support to faculty and researchers to address specific technological and commercial dimensions of promising inventions, enabling movement to commercialization. More than $2.6 million has been committed to the program since its initiation in FY13 to promote UA inventions and discoveries, with significant emphasis on awards to faculty and researchers in biosciences, optics, and renewable energy—target industries as defined by the Arizona Commerce Authority (ACA). In FY16, 27 UA inventions were granted POC Program awards, with 24 in the above-mentioned targeted industries.

Results – Impact

- 250 invention disclosures (a 17% increase from FY15)
- 97 licenses and options (a 17% increase from FY15), including 49 exclusive licenses, options
- 278 U.S. patent applications filed and 36 U.S. patents issued (a 39% increase and 3% increase)
- Exclusive licenses that are the foundation of 14 UA startup companies, 7 in Arizona
- $2.7M in revenue from royalties and patent reimbursements for intellectual property (a 15% increase from FY15)

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BOARD OF Regents

ARIZONA'S PUBLIC UNIVERSITIES

EDUCATE · DISCOVER · IMPACT

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ABOR TRIF FUNDS

TRIF funds allocated to the board office are used to support positions and projects that advance Arizona's public universities in accordance with Arizona law, Board guidelines and strategic plan. Each project is intended to further the goals outlined in Arizona public universities' strategic plan and strengthen the Board's ability to provide oversight of the universities' research and Arizona's workforce development activities.

The following six projects recieve funding as ABOR TRIF funded initiatives.

NATIONAL STUDENT CLEARINGHOUSE

The investment in the National Student Clearinghouse is made to improve reporting on postsecondary activity on Arizona's higher school graduates, relevant to the state's workforce and economic objectives. ABOR uses the Clearinghouse data to produce Arizona's college going and college completion reports.

EDUCATION ADVISORY BOARD

The Education Advisory Board (EAB) provides tools to help the universities achieve maximum efficiency. The EAB provides support and research centered on university quality and efficiency.

ARIZONA COMMERCE AUTHORITY

The Arizona Board of Regents and the Arizona Commerce Authority jointly sponsored a staff position to connect industry needs to university contacts and resources to advance technology transfer and commercialization efforts.

BIOACCEL

BioAccel has helped to identify connections of market need to university research and early innovation in medical technology.

ARIZONA SCITECH

The SciTech Festival supports a statewide partnership network to promote STEM education, increase the pipeline of qualified, skilled Arizonans, and build the State's innovaton and economic base.

TECHNOLOGY INFRASTRUCTURE

TRIF investment supports the licensing and training associated with our Tableau applications.

REGENTS' INNOVATION FUND

The Regents' Innovation Fund (RIF) continues to be instrumental in supporting the research activities of the universities, and in contributing toward the collaborative efforts among the universities and with community partners.

As part of the September 2015 Board meeting, the Regents approved funding for three additional RIF projects. These projects were designed and submitted by a tri-university collaborative effort. The Digital Research Infrastructure: Live Data project (originally funded in Sept 2012) was approved for additional funding. Two new projects, Peptide Array Core Track, and theThree Photon Microscope Project, received the remaining available funds.

Better than anticipated sales tax revenues provided additional funds to support one additional project: the Business Intelligence Infrastructure.

PEPTIDE ARRAY CORE TRACK SYSTEM

This investment will upgrade the current facility with a track system that will partially automate array fabrication and will afford greater processing consistency. This will result in improved capacity, improved array quality, and increases user safety.

Peptide array fabrication involves the integration of solid-phase chemistry, high volume/high resolution electronics fabrication methods and standard biological assay platforms into a single, novel approach for molecular assay and discovery.

The diagnostic application of this technology has already been demonstrated successfully on over 30 diseases as disparate as brain cancer, Alzheimer's, Lupus, Valley Fever and recently Ebola. The facility engages in translating technology to the industrial sector, as is evident by the creation of two spinout companies in Arizona (HealthTell and Calviri) and the engagement of several other established companies (Merck, Sanofi, Merial).

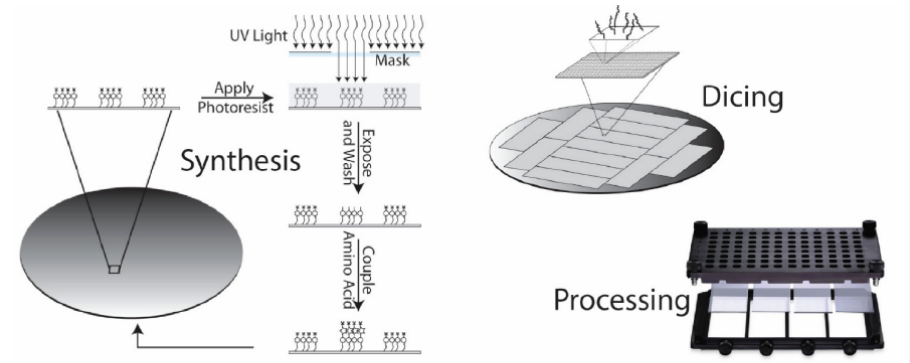


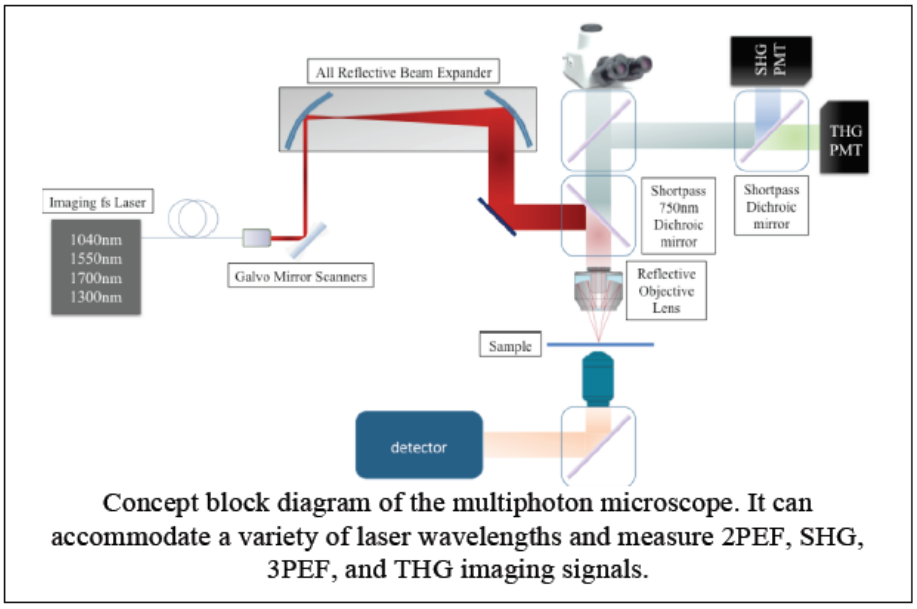
Figure 1: Synthesizing and processing molecules on surfaces using electronics fabrication equipment. Light is used to define where each new molecular component is attached to the surface during synthesis. The wafer is then diced into microscope-slide shaped pieces than then can be processed using standard equipment common in biological research and clinical application.

LIVE DATA: ESTABLISHING A DIGITAL RESEARCH INFRASTRUCTURE FOR ARIZONA'S 21ST CENTURY UNIVERSITIES RESEARCH ENTERPRISE

The Live Data project has been funded for a third time and encompasses the efforts of several projects: Digital Research Infrastructure, AEGIS and Live Data. All three projects enable Arizona's universities to be more competitive when applying for research grants and encourage university collaboration. The current funding covers the annual subscription to Elsevier's Experts product. The Experts system serves as a platform for research sponsors and industry to better understand the tremendous talent and capabilities that exist across our state's universities. By providing a comprehensive, easily navigated and public-facing presentation of our capabilities, this project has the obvious potential of attracting new financial sponsorship from government, private sector and nonprofit sources. https://aus.pure.elsevier.com/

A UNIQUE ARIZONA RESOURCE: THREE-PHOTON MICROSCOPE

The overall goal of this effort is to build and make broadly available a unique, enabling multiphoton microscope. The microscope will have available two-photon excited fluorescence, second harmonic generation, three-photon excited fluorescence and third harmonic generation imagng. The advantages of resolution and dept fo imaging are greater thancurrent multiphoton microscopes. The requirement on the laser areso specialized that no three-photon microscope is commercially available.



Concept block diagram of the multiphoton microscope. It can accommodate a variety of laser wavelengths and measure 2PEF, SHG, 3PEF, and THG imaging signals.

BUSINESS INTELLIGENCE INFRASTRUCTURE

The objective of the Business Intelligence (BI) project is the implementation of a public-facing and internal ABOR-metrics dashboard. Emphasis will be on significant improvements in the data visualization, plus the ability to drill down along pre-set demographic dimensions in a self-service mode. Dashboards will support comaprision of goals, actuals, and projections along with comparisons of actuals with peer institutions where comparable public data exists.

As a secondary objective, implement the internal-facing Tableau Server environment as a multi-institution shared resource so that additional capacity can be utilized by all institutins to further the practice of data visualization.

System Summary

TRIF Metrics and Financials

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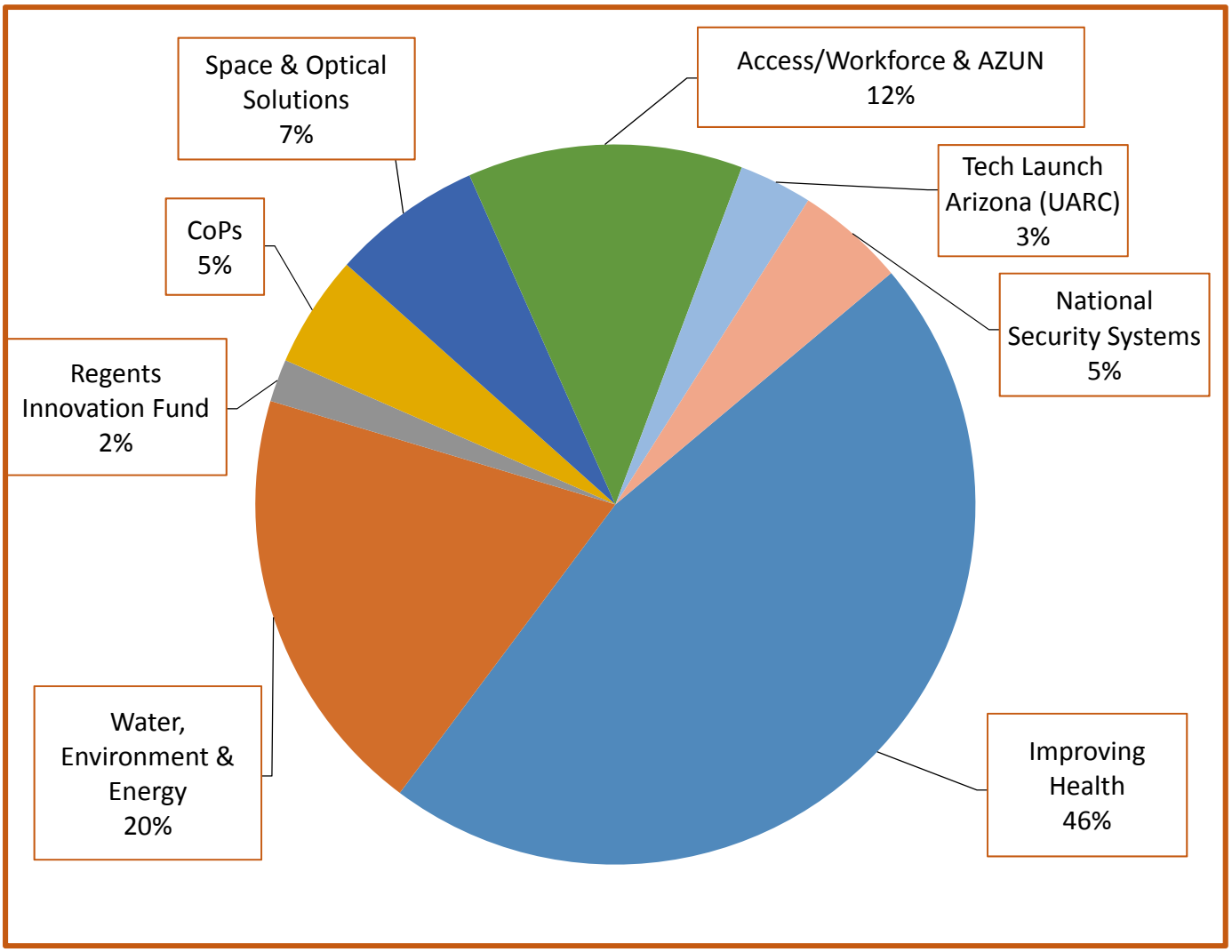
ARIZONA UNIVERSITY SYSTEM
TECHNOLOGY AND RESEARCH INITIATIVE FUND (TRIF)
FY 2012-2016

	FY 2012 ACTUAL	*FY 2013 ACTUAL*	*FY 2014 ACTUAL*	*FY2015 ACTUAL*	*FY 2016 ACTUAL*	*FY 2016 BUDGET*
REVENUE						
Carryforward	$ 3,142,709	$ 7,151,749	$ 7,688,082	$ 7,531,736	$ 11,706,430	$ 11,706,429
TRIF Revenue	57,256,220	58,464,496	66,720,070	68,438,425	69,703,797	65,993,684
TOTAL REVENUE	**$ 60,398,929**	**$ 65,616,245**	**$ 74,408,152**	**$ 75,970,161**	**$ 81,410,227**	**$ 77,700,113**
EXPENDITURES						
OPERATING						
Personal Services	$ 19,115,118	$ 20,768,253	$ 23,679,972	$ 23,456,465	$ 23,238,704	$ 25,835,193
ERE	6,422,325	7,104,053	7,908,115	7,978,672	8,189,830	9,114,902
All Other Operating	14,649,793	19,066,524	18,661,268	17,242,841	28,837,526	21,726,239
Grants/Projects	659,993	1,923,049	3,178,080	1,356,294	1,599,370	4,600,131
TOTAL OPERATING	**40,847,228**	**48,861,879**	**53,427,435**	**50,034,272**	**61,865,430**	**61,276,465**
CAPITAL						
Building Renovation	400,126	140,000	1,416,656	290,683	1,049,826	1,430,367
Debt Service	6,430,990	6,206,984	8,288,221	9,240,960	6,723,991	10,043,863
ASU Polytechnic/West COPs	3,716,100	3,719,300	3,709,400	3,704,000	3,707,500	3,707,500
AZUN	500,000	500,000	500,000	500,000	500,000	500,000
Equipment Acquisition	962,046	-	-	481,633	104,141	741,991
TOTAL CAPITAL	**12,009,262**	**10,566,284**	**13,914,277**	**14,217,276**	**12,085,458**	**16,423,721**
EXPENDITURES TOTAL	**$ 52,856,490**	**$ 59,428,163**	**$ 67,341,712**	**$ 64,251,548**	**$ 73,950,888**	**$ 77,700,186**
SUMMARY BY PROGRAM AREA						
Access/Workforce Development	6,602,968	6,397,615	6,989,710	6,719,434	7,981,303	8,018,901
Improving Health	24,670,151	27,202,002	32,855,199	31,257,013	34,060,980	33,363,645
National Security Systems Initiative	1,628,600	2,126,300	1,983,800	2,059,800	3,599,900	5,661,000
Space Exploration and Optical Solutions	4,059,940	4,381,674	4,051,062	4,389,409	4,968,515	5,027,975
Water, Environment and Energy Solutions	8,996,196	10,302,034	11,035,632	10,025,800	14,277,644	13,551,845
UARC: Tech Launch Arizona	1,334,442	1,999,593	2,262,558	2,330,330	2,414,928	2,419,189
Regents Innovation Fund	659,993	1,923,049	1,428,080	1,000,000	1,408,000	1,941,824
ASU Polytechnic COPS	2,082,600	2,082,100	2,077,300	2,076,400	2,077,700	2,077,700
ASU West COPS	1,633,500	1,637,100	1,632,100	1,627,600	1,629,800	1,629,800
AZUN	1,069,734	1,201,403	1,103,078	2,148,801	1,100,000	1,100,000
PROGRAM AREA TOTAL	**52,738,124**	**59,252,870**	**65,418,519**	**63,634,587**	**73,518,770**	**74,791,879**
EXPENDITURES TOTAL	**$ 52,738,124**	**$ 59,252,870**	**$ 65,418,519**	**$ 63,634,587**	**$ 73,518,770**	**$ 74,791,879**

*ABOR received $6,203,829 in excess of the TRIF revenue anticipated budgets.
These funds were distributed to the three universities in August and are reflected as "carry forward" in their financials.

FY 2016 SYSTEM ACTUAL TRIF EXPENDITURES



Improving Health	$ 34,060,980
Water-Environment	$ 14,277,644
Regents Innovation Fund	$ 1,408,000
CoPs	$ 3,707,500
Space & Optical Solutions	$ 4,968,515
Access/Workforce & AZUN	$ 9,081,303
Tech Launch Arizona (UARC)	$ 2,414,928
National Security Systems	$ 3,599,900


ASU
ARIZONA STATE
UNIVERSITY

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ARIZONA STATE UNIVERSITY
TECHNOLOGY AND RESEARCH INITIATIVE FUND (TRIF)
FY 2012 - 2016

	FY 2012 ACTUAL	*FY 2013 ACTUAL*	*FY 2014 ACTUAL*	*FY2015 ACTUAL*	*FY 2016 ACTUAL*	*FY 2016 BUDGET*
REVENUE						
Carryforward	$ 790,200	$ 1,788,900	$ 2,349,600	$ 2,132,500	$ 2,919,700	$ 2,919,627
TRIF Revenue	23,848,700	25,091,200	26,944,700	28,357,727	28,866,000	28,866,000
TOTAL REVENUE	**$ 24,638,900**	**$ 26,880,100**	**$ 29,294,300**	**$ 30,490,227**	**$ 31,785,700**	**$ 31,785,627**
EXPENDITURES						
OPERATING						
Personal Services	$ 7,684,500	$ 7,722,700	$ 8,446,600	$ 8,953,600	$ 9,688,900	$ 10,405,600
ERE	2,883,800	2,782,000	2,950,800	3,096,700	3,372,800	3,780,100
All Other Operating	6,479,000	7,362,900	8,676,200	8,119,200	13,480,100	8,357,100
TOTAL OPERATING	**17,047,300**	**17,867,600**	**20,073,600**	**20,169,500**	**26,541,800**	**22,542,800**
CAPITAL						
Building Renovation	-	-	25,500	-	-	1,000,000
Debt Service	2,086,600	2,943,600	3,353,300	3,697,100	1,112,200	4,535,400
ASU Poly/ASU West COPs	3,716,100	3,719,300	3,709,400	3,704,000	3,707,500	3,707,500
TOTAL CAPITAL	**5,802,700**	**6,662,900**	**7,088,200**	**7,401,100**	**4,819,700**	**9,242,900**
TOTAL EXPENDITURES	**$ 22,850,000**	**$ 24,530,500**	**$ 27,161,800**	**$ 27,570,600**	**$ 31,361,500**	**$ 31,785,700**
SUMMARY BY INITIATIVE						
National Security Systems Initiative	$ 1,628,600	$ 2,126,300	$ 1,983,800	$ 2,059,800	$ 3,599,900	$ 5,661,000
Improving Health	13,974,400	14,877,300	17,931,000	17,390,200	17,587,800	16,597,000
Water, Environment and Energy Solutions	3,530,900	3,807,700	3,537,600	4,416,600	6,466,300	5,820,200
ASU Polytechnic COPS	2,082,600	2,082,100	2,077,300	2,076,400	2,077,700	2,077,700
ASU West COPS	1,633,500	1,637,100	1,632,100	1,627,600	1,629,800	1,629,800
TOTAL EXPENDITURES	**$ 22,850,000**	**$ 24,530,500**	**$ 27,161,800**	**$ 27,570,600**	**$ 31,361,500**	**$ 31,785,700**

ARIZONA STATE UNIVERSITY

IMPROVING HEALTH FOCUS AREA

PERFORMANCE ANALYSIS	Actual FY 12	Actual FY 13	Actual FY 14	Actual FY 15	Actual FY 16	Projected FY 16
TRIF EXPENDITURES						
Total	$ 13,974,400	$ 14,877,300	$ 17,931,000	$ 17,390,200	$ 17,587,800	$ 16,597,000
FINANCIAL IMPACT OF TRIF INVESTMENT						
Sponsored Awards	$ 54,537,411	$ 61,184,668	$ 67,217,416	$ 60,740,785	$ 99,876,745	$ 98,000,000
Gifts & Other Sources	40,505	390,000	2,245,202	1,778,849	760,965	40,000
Royalty Income	821,889	156,201	1,068,587	555,715	224,027	800,000
TOTAL	**55,399,805**	**61,730,869**	**70,531,205**	**63,075,349**	**100,861,737**	**98,840,000**
TECHNOLOGY TRANSFER ACTIVITY						
Invention Disclosures Transacted	45	70	41	56	90	95
US Patents Issued	0	5	13	6	25	6
Licenses and Options Executed	13	29	26	21	14	18
Startup Companies	2	1	1	4	3	1
WORKFORCE CONTRIBUTION						
Academic and Postdoctoral Appointees	38	155	119	116	146	175
Graduate Students	111	87	80	103	468	110
Undergraduate Students	73	90	70	52	247	70

ARIZONA STATE UNIVERSITY

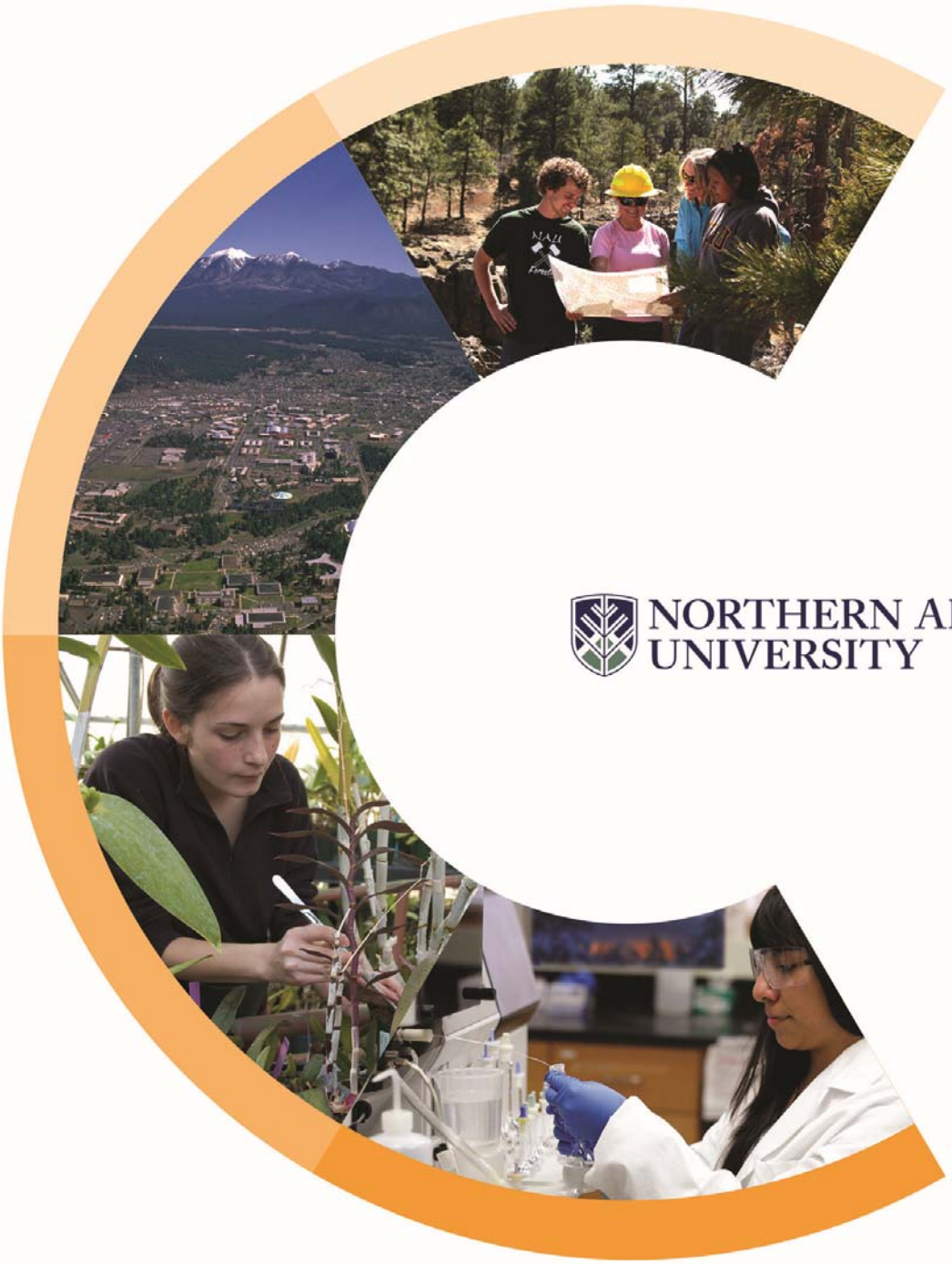
NATIONAL SECURITY SYSTEMS FOCUS AREA

PERFORMANCE ANALYSIS	Actual FY 12	Actual FY 13	Actual FY 14	Actual FY 15	Actual FY 16	Projected FY 16
TRIF EXPENDITURES						
Total	$ 1,628,600	$ 2,126,300	$ 1,983,800	$ 2,059,800	$ 3,599,900	$ 5,661,000
FINANCIAL IMPACT OF TRIF INVESTMENT						
Sponsored Awards	$ 12,618,000	$ 23,010,570	$ 34,269,118	$ 34,308,540	$ 39,073,994	$ 70,000,000
Gifts & Other Sources	-	-	-	-	-	10,000
Royalty Income	128,250	82,500	1,265,956	30,000	20,000	725,000
TOTAL	**12,746,250**	**23,093,070**	**35,535,074**	**34,338,540**	**39,093,994**	**70,735,000**
TECHNOLOGY TRANSFER ACTIVITY						
Invention Disclosures Transacted	9	7	32	25	47	30
US Patents Issued	0	3	13	7	9	2
Licenses and Options Executed	2	3	28	4	5	4
Startup Companies	0	0	0	0	3	0
WORKFORCE CONTRIBUTION						
Academic and Postdoctoral Appointees	0	6	15	35	72	25
Graduate Students	17	40	23	26	359	20
Undergraduate Students	0	8	8	15	178	5

ARIZONA STATE UNIVERSITY

WATER, ENVIRONMENTAL AND ENERGY SOLUTIONS FOCUS AREA

PERFORMANCE ANALYSIS	Actual FY 12	Actual FY 13	Actual FY 14	Actual FY 15	Actual FY 16	Projected FY 16
TRIF EXPENDITURES						
Total	$ 3,530,900	$ 3,807,700	$ 3,537,600	$ 4,416,600	$ 6,466,300	$ 5,820,200
FINANCIAL IMPACT OF TRIF INVESTMENT						
Sponsored Awards	$ 12,122,712	$ 12,392,507	$ 14,598,426	$22,030,094	$ 25,543,321	$ 17,000,000
Gifts & Other Sources	-	-	-	8,446,221	4,650,382	25,000
Royalty Income	252,018	184,720	55,018	152,798	-	610,000
TOTAL	**12,374,730**	**12,577,227**	**14,653,444**	**$30,629,113**	**30,193,703**	**17,635,000**
TECHNOLOGY TRANSFER ACTIVITY						
Invention Disclosures Transacted	0	1	8	28	3	12
US Patents Issued	1	4	2	3	0	4
Licenses and Options Executed	3	1	8	5	1	12
Startup Companies	0	0	0	0	0	1
WORKFORCE CONTRIBUTION						
Academic and Postdoctoral Appointees	7	17	11	33	28	20
Graduate Students	36	77	49	102	140	35
Undergraduate Students	13	78	23	153	141	15



NORTHERN ARIZONA UNIVERSITY

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NORTHERN ARIZONA UNIVERSITY
TECHNOLOGY AND RESEARCH INITIATIVE FUND (TRIF)
FY 2012 - 2016

	FY 2012 ACTUAL	*FY 2013 ACTUAL*	*FY 2014 ACTUAL*	*FY2015 ACTUAL*	*FY 2016 ACTUAL*	*FY 2016 BUDGET*
REVENUE						
Carryforward	$ 1,630,638	$ 1,821,191	$ 1,566,408	$ 866,212	$ 1,951,075	$ 1,951,075
TRIF Revenue	11,157,019	11,492,061	13,163,391	13,426,899	13,679,266	12,438,500
TOTAL REVENUE	**$ 12,787,657**	**$ 13,313,252**	**$ 14,729,799**	**$ 14,293,111**	**$ 15,630,341**	**$ 14,389,575**
EXPENDITURES						
OPERATING						
Personal Services	$ 4,630,588	$ 5,337,771	$ 6,113,394	$ 5,945,506	$ 5,462,340	$ 5,999,308
ERE	1,497,041	1,684,731	1,946,342	2,008,168	1,865,197	2,063,984
All Other Operating	1,641,711	3,960,958	3,477,778	2,407,583	4,658,409	3,945,463
TOTAL OPERATING	**7,769,340**	**10,983,460**	**11,537,514**	**10,361,257**	**11,985,946**	**12,008,755**
CAPITAL						
Building Renovation			1,391,156	290,683	1,049,826	430,367
Debt Service	1,344,390	263,384	434,917	708,463	708,463	708,463
Equipment Acquisition	962,046			481,633	104,141	741,991
AZUN	500,000	500,000	500,000	500,000	500,000	500,000
TOTAL CAPITAL	**2,806,436**	**763,384**	**2,326,073**	**1,980,779**	**2,362,430**	**2,380,821**
TOTAL EXPENDITURES	**$ 10,575,776**	**$ 11,746,844**	**$ 13,863,587**	**$ 12,342,036**	**$ 14,348,376**	**$ 14,389,576**
SUMMARY BY INITIATIVE						
Access/Workforce Development	$ 6,602,968	$ 6,397,615	$ 6,989,710	$ 6,719,434	$ 7,981,303	$ 8,018,901
AZUN	1,069,734	1,201,403	1,103,078	2,148,801	1,100,000	1,100,000
Improving Health	1,253,436	2,130,689	2,281,436	2,372,761	2,416,740	2,635,337
Water, Energy, Environmental Solutions	1,649,638	2,017,137	3,489,363	1,101,040	2,850,333	2,635,337
TOTAL EXPENDITURES	**$ 10,575,776**	**$ 11,746,844**	**$ 13,863,587**	**$ 12,342,036**	**$ 14,348,376**	**$ 14,389,575**

NORTHERN ARIZONA UNIVERSITY
WEES and IMPROVING HEALTH

PERFORMANCE ANALYSIS	Actual FY 12	Actual FY 13	Actual FY 14	Actual FY 15	Actual FY 16	Projected FY 16
TRIF EXPENDITURES						
Total	10,775,776	11,746,844	13,863,587	12,342,216	5,231,074	12,438,500
FINANCIAL IMPACT OF TRIF INVESTMENT						
Sponsored Awards	14,105,945	11,848,074	17,711,283	20,395,581	19,029,829	16,501,960
Gifts & Other Sources	1,500,000	0	0	1,000,000	0	50,000
Intellectual Property Income	22,276	25,462	32,075	69,365	5,286	23,100
TOTAL	**15,628,221**	**11,873,536**	**17,743,358**	**21,464,946**	**19,035,115**	**16,575,060**
TECHNOLOGY TRANSFER ACTIVITY						
Invention Disclosures Transacted	17	18	24	27	50	25
US Patents Issued	1	2	3	2	6	3
Licenses and Options Executed	1	0	1	1	1	5
Startup Companies	1	0	1	1	0	1
WORKFORCE CONTRIBUTION						
Postdoctoral Appointees	11	17	22	11	38	18
Graduate Students	92	44	187	99	96	130
Undergraduate Students	200	251	233	360	209	250

ACCESS/WORKFORCE DEVELOPMENT/E-LEARNING

PERFORMANCE MEASURE	FY 12 Actuals	FY 13 Projected	FY13 Actuals	FY 14 Projected	FY14 Actuals	FY 15 Projected	FY15 Actuals	FY 16 Projected	FY 16 Actuals
RETURN ON INVESTMENT (ROI)									
Annual impact of Graduates on Economy[1]	$10.4M	$11.3 M	$11.3 M	$12.4 M	$12.4 M	$13.5 M	$13.5 M	$14.7 M	$14.7 M
TECHNOLOGY TRANSFER/CURRICULUM INNOVATIONS									
Web/Hybrid/Enhanced Courses Developed[2]	141	125	506[2a]	155	612	180	650	200	686
Faculty Developing Courses[3]	265	225	420	250	485	300	331	350	392
Increase in Student Technology Literacy[4]	4,122	3,300	2,676	3,800	7,108	4,000	7,810	4,200	7,933
Degree/Certificate Programs Offered[5]	49	43	48	46	46	49	49	52	42
INDUSTRY OUTREACH									
Business/Nonprofit Collaborations[6,A]	203	110	263	125	298	140	261	155	282
WORKFORCE CONTRIBUTIONS									
Number of Students Served by A/WD[7]	3,772	3,377	3,616	3,681	3,695	4,013	3,433	4,374	3,912
PARTNERSHIPS/COLLABORATIONS									
Community College/NAU Students[8]	3,077	3,999	3,444	4,359	4,573	4,751	6,336	5,179	8,350
Community College to NAU Programs[9,B]	71	93	79	95	85	97	94	99	105

[1] Estimated based on U.S. Census Bureau Data for annual increase in earnings by a baccalaureate-trained worker compared to high school degree starting in FY12
[2] Includes Web, hybrid, IT-enhanced, redesigns and quality review process compliance.
[2a] Reflects correction to FY13 Actuals.
[3] The number of faculty participating in course development, design and redesign.
[4] Number of students completing a course with significant or advanced technical fluency skills.
[5] Number of degrees supported by TRIF A/WD funding.
[6] Organizations (business, industry, nonprofits, school districts) with formal or informal relationships with Northern Arizona University related to TRIF A/WD
[7] Reporting based on number of students eligible to enroll in programs supported by A/WD funding.
[8] Number of students participating in the Northern Arizona University joint admissions or who transfer from a community college to NAU.
[9] Program paths for a student to seamlessly transition from a given community college to NAU.
[A] Variance between projected and actual number of collaborations reflects an increased focus on outreach and recruitment efforts.
[B] Variance between projected and actual programs due to the recategorization of Bachelor of Arts in Liberal Studies (BAILS) degrees to Bachelors of Interdisciplinary Studies (BIS) degrees.

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THE UNIVERSITY OF ARIZONA

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UNIVERSITY OF ARIZONA
TECHNOLOGY AND RESEARCH INITIATIVE FUND (TRIF)
FY 2012 - 2016

	FY 2012 ACTUAL	*FY 2013 ACTUAL*	*FY 2014 ACTUAL*	*FY2015 ACTUAL*	*FY 2016 ACTUAL*	*FY 2016 BUDGET*
REVENUE						
Carryforward		$ 1,476,104	$ 1,795,547	$ 2,065,932	$ 3,997,708	$ 3,997,780
TRIF Revenue	20,128,459	21,371,920	23,235,333	24,653,799	25,158,531	22,677,000
TOTAL REVENUE	**$ 20,128,459**	**$ 22,848,024**	**$ 25,030,880**	**$ 26,719,731**	**$ 29,156,239**	**$ 26,674,780**
EXPENDITURES						
OPERATING						
Personal Services	$ 6,711,059	$ 7,576,482	$ 8,990,322	$ 8,357,929	$ 7,905,607	$ 9,298,985
ERE	2,013,928	2,600,007	2,974,069	2,817,961	2,895,811	3,231,418
All Other Operating	6,527,242	7,735,989	6,500,657	6,710,664	10,694,148	9,344,377
TOTAL OPERATING	**15,252,229**	**17,912,478**	**18,465,048**	**17,886,554**	**21,495,566**	**21,874,780**
CAPITAL						
Building Renovation	400,126	140,000	-	-	-	-
Debt Service	3,000,000	3,000,000	4,500,004	4,835,397	4,903,328	4,800,000
TOTAL CAPITAL	**3,400,126**	**3,140,000**	**4,500,004**	**4,835,397**	**4,903,328**	**4,800,000**
TOTAL EXPENDITURES	**$ 18,652,355**	**$ 21,052,478**	**$ 22,965,052**	**$ 22,721,951**	**$ 26,398,894**	**$ 26,674,780**
SUMMARY BY INITIATIVE						
Improving Health	$ 9,442,315	$ 10,194,012	$ 12,642,763	$ 11,494,052	$ 14,056,440	$ 14,131,308
Space & Optical Sciences	4,059,940	4,381,674	4,051,062	4,389,409	4,968,515	5,027,975
Water, Environmental, Energy Solutions	3,815,658	4,477,197	4,008,669	4,508,160	4,961,011	5,096,308
Tech Launch Arizona (UARC)	1,334,442	1,999,593	2,262,558	2,330,330	2,412,928	2,419,189
TOTAL EXPENDITURES	**$ 18,652,355**	**$ 21,052,476**	**$ 22,965,052**	**$ 22,721,951**	**$ 26,398,894**	**$ 26,674,780**

UNIVERSITY OF ARIZONA

TECHNOLOGY AND RESEARCH INITIATIVE FUND (TRIF)
IMPROVING HEALTH

PERFORMANCE ANALYSIS	Actual FY 12	Actual FY 13	Actual FY14	Actual FY 15	Actual FY 16	Projected FY 16
TRIF EXPENDITURES						
Total	$ 9,442,315	$ 10,194,012	$ 12,642,763	$ 11,494,052	$ 14,056,440	$ 14,131,308
FINANCIAL IMPACT OF TRIF INVESTMENT						
Sponsored Awards	57,727,313	39,332,176	50,077,598	64,444,304	56,005,087	54,000,000
Gifts & Other Sources	581,469	594,746	300,040	612,415	463,256	500,000
Royalty Income	122,429	12,500	28,500	64,029	1,993	-
TOTAL	**$ 58,431,211**	**$ 39,939,422**	**$ 50,406,138**	**$ 65,120,748**	**$ 56,470,336**	**$ 54,500,000**
TECHNOLOGY TRANSFER ACTIVITY						
Invention Disclosures Transacted	15	10	28	37	39	32
US Patents Issued	2	3	2	5	3	1
Licenses and Options Executed	4	0	8	8	4	10
Startup Companies	0	0	1	2	4	0
WORKFORCE CONTRIBUTION						
Postdoctoral Appointees	80	86	96	178	158	135
Graduate Students	179	189	244	376	301	320
Undergraduate Students	209	324	325	424	348	320

UNIVERSITY OF ARIZONA

TECHNOLOGY AND RESEARCH INITIATIVE FUND (TRIF)
SPACE EXPLORATION AND OPTICAL SOUTIONS

PERFORMANCE ANALYSIS	Actual FY 12	Actual FY 13	Actual FY 14	Actual FY15	Actual FY 16	Projected FY 16
TRIF EXPENDITURES						
Total	$ 4,059,940	$ 4,381,674	$ 4,051,062	$ 4,389,409	$ 4,968,516	$ 5,027,975
FINANCIAL IMPACT OF TRIF INVESTMENT						
Sponsored Awards	49,376,201	54,965,135	45,218,973	61,081,430	73,045,638	65,000,000
Gifts & Other Sources	237,436	428,842	359,749	390,526	510,225	510,000
Royalty Income	187,572	150,777	97,056	113,208	363,543	200,000
TOTAL	**$ 49,801,209**	**$ 55,544,754**	**$ 45,675,778**	**$ 61,585,164**	**$ 73,919,406**	**$ 65,710,000**
TECHNOLOGY TRANSFER ACTIVITY						
Invention Disclosures Transacted	48	37	19	38	31	60
US Patents Issued	14	9	4	13	14	20
Licenses and Options Executed	14	6	8	13	9	21
Startup Companies	2	1	1	0	1	3
WORKFORCE CONTRIBUTION						
Postdoctoral Appointees	10	10	11	12	10	12
Graduate Students	34	50	45	40	37	37
Undergraduate Students	7	18	9	8	8	9

UNIVERSITY OF ARIZONA

TECHNOLOGY AND RESEARCH INITIATIVE FUND (TRIF)
WATER, ENVIRONMENTAL AND ENERGY SOLUTIONS

PERFORMANCE ANALYSIS	Actual FY 12	Actual FY 13	Actual FY 14	Actual FY 15	Actual FY 16	Projected FY 16
TRIF EXPENDITURES						
Total	$ 3,815,658	$ 4,477,197	$ 4,008,669	$ 4,508,160	$ 4,961,011	$ 5,096,308
FINANCIAL IMPACT OF TRIF INVESTMENT						
Sponsored Awards	26,366,576	30,024,250	46,878,228	30,560,426	40,401,459	23,100,000
Gifts & Other Sources	3,433,880	3,676,766	3,267,587	4,013,983	3,879,889	3,800,000
Royalty Income	0	0	15,000	74,186	0	500,000
TOTAL	**$ 29,800,456**	**$ 33,701,016**	**$ 50,160,815**	**$ 34,648,595**	**$ 44,281,348**	**$ 27,400,000**
TECHNOLOGY TRANSFER ACTIVITY						
Invention Disclosures Transacted	19	21	26	16	19	10
US Patents Issued	2	2	1	4	1	3
Licenses and Options Executed	1	1	4	10	3	7
Startup Companies	1	1	1	2	1	1
WORKFORCE CONTRIBUTION						
Postdoctoral Appointees	87	49	41	108	23	85
Graduate Students	321	314	255	279	212	270
Undergraduate Students	122	85	99	112	104	120

BOARD OF Regents

ARIZONA'S PUBLIC UNIVERSITIES

EDUCATE · DISCOVER · IMPACT

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ABOR SYSTEM OFFICE
TECHNOLOGY AND RESEARCH INITIATIVE FUND (TRIF)
FY 2012 - 2016

	FY 2012 ACTUAL	*FY 2013 ACTUAL*	*FY 2014 ACTUAL*	*FY2015 ACTUAL*	*FY 2016 ACTUAL*	*FY 2016 BUDGET*
REVENUE						
Carryforward	$ 721,871	$ 2,065,554	$ 1,976,527	$ 2,467,092	$ 2,837,947	$ 2,837,947
TRIF Revenue	2,122,042	509,315	3,841,837	2,000,000	2,000,000	2,012,184
TOTAL REVENUE	**$ 2,843,913**	**$ 2,574,869**	**$ 5,818,364**	**$ 4,467,092**	**$ 4,837,947**	**$ 4,850,131**
EXPENDITURES						
OPERATING						
Personal Services	$ 88,971	$ 131,300	$ 129,656	$ 199,430	$ 181,857	$ 131,300
ERE	27,555	37,315	36,904	55,843	56,022	39,400
All Other Operating	1,840	6,678	6,633	5,394	4,869	79,300
TOTAL OPERATING	**118,366**	**175,293**	**173,193**	**260,667**	**242,748**	**250,000**
GRANTS/PROJECTS						
Pass Through to Universities			1,750,000			
Regents Innovation Fund	659,993	1,923,049	1,428,080	1,000,000	1,408,000	1,941,824
Other				356,294	191,370	2,658,307
TOTAL GRANTS/PROJECTS	**659,993**	**1,923,049**	**3,178,080**	**1,356,294**	**1,599,370**	**4,600,131**
TOTAL EXPENDITURES	**$ 778,359**	**$ 2,098,342**	**$ 3,351,273**	**$ 1,616,961**	**$ 1,842,118**	**$ 4,850,131**
SUMMARY BY INITIATIVE						
Pass Through to Universities			1,750,000			
Regents Innovation Fund:						
Center for the Future of Arizona	225,000	325,000				
HRAA/CTSA	325,000					
National Student Clearinghouse	49,302	49,869	48,427		-	100,000
Collaboration				17,669	-	693,038
SciVal		202,000		50,000		
Graduate Research Grants		230,000				
IT Research (ABOR)		16,180	54,980	28,840		
Regent Innovation Fund Grants		1,100,000	1,231,950	1,000,000	1,408,000	1,941,824
Other	60,691		92,723	259,785	191,370	1,865,269
TOTAL EXPENDITURES	**$ 659,993**	**$ 1,923,049**	**$ 3,178,080**	**$ 1,356,294**	**$ 1,599,370**	**$ 4,600,131**

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