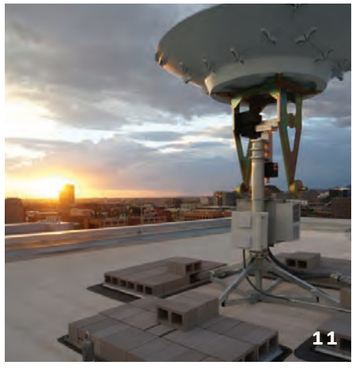
TECHNOLOGY AND RESEARCH INITIATIVE FUND

FY2017

BOARD OF Regents
ARIZONA'S PUBLIC UNIVERSITIES

EDUCATE · DISCOVER · IMPACT

Arizona State University | Northern Arizona University | The University of Arizona



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TRIF EXECUTIVE SUMMARY

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 Arizona 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 project plans in five-year cycles. The FY 2017-2021 final five-year project plans were approved by the board in June 2016 using the sales tax forecast from the Joint Legislative Budget Committee. These project plans are available on the ABOR web site at: http://www.azregents.edu/reports/research-technology-transfer

- In FY 2016-17, TRIF received approximately $72.7 million in revenue. Total TRIF revenue received to date since the inception of the program in June 2001 is over $964 million.

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

2017 FINANCIALS

This year, actual receipts were $1,206,029 below budget projections. This difference was due to a calculation used in projecting the five-year project plans. In September, the universities will be presenting updated budget projections to the board for the remaining four-year term of the funding.

TRIF INITIATIVES

TRIF monies will be used to support initiatives and projects that meet one or more of the following criteria are included in the criteria found in ABOR Policy 3-412.

The universities' investments of TRIF funds are limited to and focused in the following research and workforce development areas:

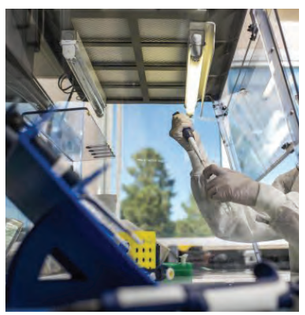
- **Improving Health**
- **Water, Environmental and Energy Solutions**
- **National Security Systems**
- **Space Exploration and Optical Solutions**
- **Higher Education Access for Workforce Development**

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 TRIF expenditures report for the prior year.

- The FY 2017 TRIF report, along with previous reports, is available on the ABOR website.

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



ASU Arizona State University

ARIZONA STATE UNIVERSITY

Investment of Technology and Research Initiative Funds (TRIF) at Arizona State University (ASU) advances research, entrepreneurship and economic development while fueling innovative solutions. These solutions result in significant return on investment to the citizens of Arizona in the form of an accelerating economy, broad access to education and training, and better livelihoods.

During the TRIF cycle of FY17 through FY21, ASU is investing in four focus areas:

- **Improving Health** encompasses use-inspired, collaborative research that advances human health and quality of life.
- **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.
- **National Security Systems** addresses the critical research and technology needs of the security, defense and aerospace sectors.
- **Access and Workforce Development** advances research and education to elevate and expand Arizona's highly skilled workforce.

In the past year, $165.4 million in new funding from external sources has been awarded to TRIF-funded initiatives such as efforts to develop a treatment for Ebola and to install a satellite tracking ground station on the Tempe campus. Across the four focus areas this year, 1,019 undergraduates, 1,344 graduate students, and 282 post-doctoral appointees and research faculty were involved in TRIF-supported research. In addition, TRIF research generates novel technology and new businesses. This year, 39 new startup companies were founded based on technology from TRIF-supported research and 48 new patents were issued.

Since 2012, ASU has leveraged TRIF investment in ways that are accelerating research, the resulting solutions and economic impacts. During this time, ASU has become the fastest growing research enterprise among U.S. institutions with more than $100 million in research expenditures and in FY17 had $518 million in annual expenditures, launched 72 spinout companies and was named an Innovation and Economic Prosperity University by the Association of Public and Land-Grant Universities (APLU). In addition, ASU was named the most innovative university in the country by U.S. News and World Report in 2016 and 2017, based on surveys of university presidents and leaders. This innovation allows us to educate and graduate more students while earning recognition for the increasing caliber of our programs and graduates.

"TRIF is critical to the advancement of ASU's knowledge enterprise. The investment has resulted in robust use-inspired research discoveries, new technologies, jobs and economic impact. This year, TRIF-enabled examples of impact include preventing veteran suicides, the development of vaccines, entrepreneurship programs and advanced materials research for explosive detection. We are proud that these endeavors enhance the learning of our students while rapidly advancing Arizona's knowledge-based economy."

– Sethuraman Panchanathan
Executive Vice President, ASU Knowledge Enterprise
Chief Research and Innovation Officer

"TRIF allows interdisciplinary conversations and collaborations that wouldn't normally happen through discipline-specific funding sources. This approach considers not only the science and engineering, but also the modeling, governance and conversations that empower these solutions to be transformed from the ideal to the practical."

"The Biodesign Institute has been an economic powerhouse for ASU, with a $1.5 billion economic impact in its first decade. The real-world impact of TRIF support has resulted in translating research into fostering 74 patents, 638 inventions, resulting in $24.1 million in annual state and local tax revenue, and supporting 3,165 jobs added annually."

– Josh LaBaer, director, Biodesign Institute

IMPROVING HEALTH

TRIF-enabled researchers in Improving Health initiatives are addressing the complex and critical challenges of health and health care. This focus area fuses biomedicine, engineering and computing through innovative approaches in partnership with leading institutions like Mayo Clinic.

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 developing standards for the discovery and effective use of biomarkers in medicine.

- The Center for Games and Impact partners with scientists and game developers to harness the power of gaming platforms, theory and technology for applications in health, economics and sustainability.

- Research Computing encompasses high-performance computing resources leveraged across the TRIF focus areas. These resources are made available to ASU researchers as well as industry and community partners, enabling the collection, management and analyses of vast and complex data sets.

- The Decision Theater Network (DTN) engages researchers and leaders across 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.

SUMMARY OF ACCOMPLISHMENTS

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

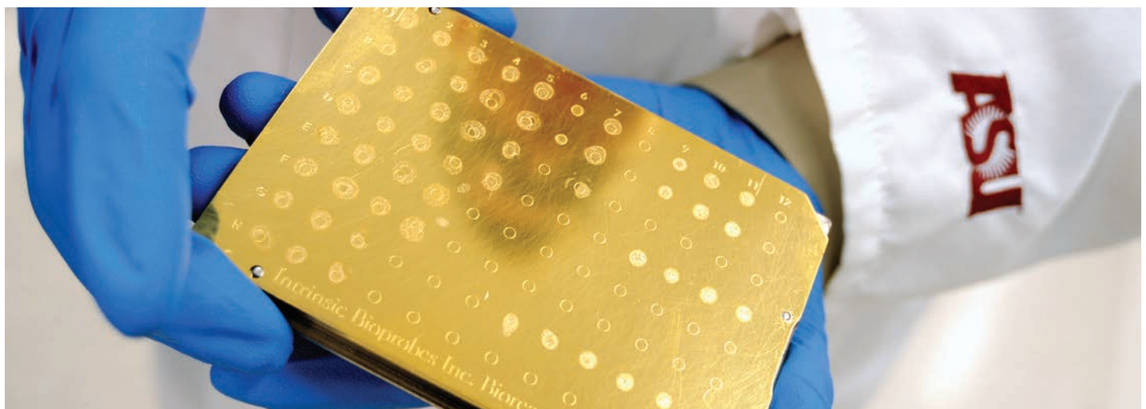
- During the past year, Biodesign Institute researchers won several new external funding awards including $8.8 million from the National Institute on Aging for research on Alzheimer's disease. Researchers also produced vaccines and therapeutics to combat Ebola, West Nile, pneumonia and other infectious diseases, and identified links between microbial gut composition, obesity and autism. In addition, construction began on Biodesign C. The 188,000-square-foot building is scheduled to open in spring 2018 and will house the world's first compact X-ray laser, which has numerous applications in health research as a key new tool for drug discovery and bioenergy research.

- The NBDA initiative under CAS is in the process of implementing new "molecular profile" standards that will be transformative across all of pathology. After raising $2 million over two years, the NBDA will launch its innovative GBM AGILE trial for glioblastoma, the deadliest form of adult brain tumors. Anna Barker, director of NBDA, also led a team of experts in drafting critical components of the 21st Century Cures Bill and was invited to attend the bill signing in December 2016 at the White House.

- The Center for Games and Impact leveraged TRIF support to advance research and outreach that enables digital literacy, a critical skill for today's citizens that improves livelihoods. This year researchers added a Spanish version to the scientific inquiry game "Mystery of Taiga River," developed a new math learning game and created a new app on the My Lifelabs platform that helps middle-school Latino students pursue STEM careers.

- Research Computing supplied 8.2 million core hours of high-performance computing to 206 researchers across campus who answered over 7,000 research questions in their analyses. In addition, Research Computing supports researchers by conceptualizing computational frameworks for their proposed research to funding agencies.

- DTN is partnering with several Arizona agencies to support analysis and data visualization of complex challenges in Arizona and beyond. This includes working with the Maricopa County Recorder to address resource allocation decisions following long lines and voter confusion during the March 2016 presidential-preference election.



"Completing the design of the transformative GBM AGILE trial protocol is one of the best examples to date of what a global network of scientists and clinicians can accomplish by crowdsourcing the knowledge needed to achieve something this innovative and potentially transformative for brain tumor patients – amazing!"

– Anna Barker, director, National Biomarker Development Alliance

WATER, ENVIRONMENTAL AND ENERGY SOLUTIONS

As our world becomes increasingly urbanized and resource-constrained, we need creative, science-based solutions. Research advanced in the Water, Environmental and Energy Solutions focus area capitalizes on the key role that Arizona can play in the future of energy technology, education and commercial development.

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

- 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 LightWorks initiative brings together ASU's energy activities and broad sustainability strengths to tackle complex energy problems. For example, the Quantum Energy and Sustainable Solar Technologies (QESST) center is an Engineering Research Center (ERC) sponsored by the National Science Foundation and the U.S. Department of Energy. QESST capabilities range from new materials discovery for photovoltaics to the applied developments of complex algorithms coupling weather forecasts with electrical grid distributions.

- The Center for Bio-mediated and Bio-inspired Geotechnics (CBBG) and the NanoEnabled Water Treatment Technologies (NEWT) center are also ERCs. ASU is leading the CBBG and is a partner in NEWT. These centers are advancing engineering research and design to tackle imminent sustainability issues by developing applied solutions for transportation, water and power, sanitation, and residential and commercial development.

- Future H2O is changing the narrative about water from one of scarcity to one of abundance and creating opportunity for change at scale for regional, national and global water systems.

SUMMARY OF ACCOMPLISHMENTS

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

- LightWorks researchers are helping to define the future of energy and the workforce that will support the necessary innovations. This year, researchers established a successful working microgrid at the Polytechnic campus as part of ASU's goal of being net carbon neutral by 2025. A $3 million project extension was awarded for the NEPTUNE project, which engages veterans on diverse energy research projects. QESST spun out three new ventures and filed four new patents. One of the new companies set a solar cell efficiency record and is already contributing funding back to QESST.

- The ASU Wrigley Institute leveraged TRIF funding to support several initiatives and research projects. Highlights from the year include: PlanetWorks launched a project to restore and remediate Arctic ice; the School of Sustainability provided training to leaders, private industry and student groups; the Sustainable Cities Network introduced Project Cities, a university-community program that pairs ASU students with a city to address specific municipal challenges; and the Food Systems Transformation Initiative developed online professional education courses for food and nutrition professionals across multiple industries.

- NEWT has established a center for drinking water treatment systems that use the unique properties of nanomaterials, which is leading to patents, papers, student support, outreach and education as well as potential spinout companies. Research at the CBBG includes developing alternatives to Portland cement, which contributes roughly 5 percent of the world's greenhouse gas through its production.

- Future H2O is establishing research and a partnership network across its five program areas including urban efficiency, corporate decision support and cross-training leaders. This year the director of Future H2O traveled to the Aspen Institute to expand visibility for Future H2O and the network.

- DTN is addressing water use and economic development in relation to lack of water rights certainty due to existing water rights. In addition, analyses and visualizations were conducted to promote "water certainty" in Cochise County and the Verde Valley.

"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, papers, student support, outreach, education and the potential for spinout companies. TRIF funding is helping to bridge the gap between fundamental university research discoveries and commercialization by larger companies. TRIF also supports exploratory work that will leverage funds to attract external industry and federal funding and foundation gifts."

– Paul Westerhoff, Regents' Professor and deputy director, NEWT center

"The TRIF investment in Interplanetary Initiatives is making possible an otherwise impossible goal – to create proof of concept for a new kind of pan-university program, one that brings together all disciplines to look toward humankind's future in space, pioneering new research processes and outcomes, and new educational priorities and methodologies. We aim to strongly connect education, industry and governance to make Arizona a national leader in strengthening the STEM workforce and education together."

– Lindy Elkins-Tanton, professor and director, School of Earth and Space Exploration

NATIONAL SECURITY SYSTEMS

ASU takes a multi-faceted approach to security research, including innovative public-private partnerships. As a result, our National Security Systems portfolio aligns with cutting-edge development in the security sector and our 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 that don't have clear solutions. This initiative explores issues in health security, economic security, resource security and cybersecurity.

- The Space Technology and Science Initiative (NewSpace) leads the integration of academic and commercial space enterprises using ASU's core strengths in space science, engineering and education. NewSpace is creating academic-commercial partnerships that bring together the most brilliant minds in the space industry sector for an unprecedented collaborative effort.

- The new Interplanetary Initiative is creating broad interdisciplinary projects that approach critical questions about our space future that are neglected elsewhere. Projects advanced by the initiative use a structured project management approach including planning outcomes and products from the start. In addition, all projects bring research into the classroom and record and track efforts in exploration learning.

SUMMARY OF ACCOMPLISHMENTS

The National Security Systems focus area has created a portfolio of university research initiatives that partner with companies in the highly competitive security, defense and aerospace sectors. These efforts are creating new potential and markets for these industries in Arizona.

- This year, GSI was awarded $8 million to support research such as understanding human-robot teams and robotic swarms. This type of work is helping to safeguard critical Arizona infrastructure by protecting against potential attacks and improving disaster response. GSI is also working with the nearly 4,000-person ASU veteran population on a project to prevent veteran suicides. Together with the Maricopa Association of Governments, GSI researchers are building partnerships to assist labor force capacity growth and economic security in Arizona.

- NewSpace partnered with NASA's Jet Propulsion Laboratory and commercial satellite provider M2 Antenna Systems to install a satellite tracking ground station on the Tempe campus. This station will have the ability to receive data and send commands to ASU and other small satellites in low Earth orbit and beyond. NewSpace also supported the School of Earth and Space Exploration's Commercial Opportunities in Space class with a special Space Business Plan Pitch Competition involving venture capitalists and investors as judges. All three student finalist teams are pursuing funding and business development opportunities.

- In its first year, the Interplanetary Initiative attracted 170 faculty members from 50 schools and centers across ASU to launch the initiative and catalyze collaboration. As a result, 13 pilot projects were designed and launched. Of these, four involve partnerships with Los Alamos National Labs and four involve partnerships with other space hardware and software companies. Also this year, NASA selected ASU's Psyche asteroid mission for full funding at $450 million as well as the Lucy mission for which ASU will design and build instrumentation.

- DTN is addressing security and defense by analyzing data to understand the efficacy of criminal rehabilitation efforts in Coconino County. The project uses data from the Arizona Computerized Criminal History System in partnership with the Arizona Department of Public Safety.

"The TRIF investment has empowered ASU to excel in cutting-edge security research in multiple domains as well as to transition that research to a diversity of stakeholders. From hosting cyber self-defense workshops to protect individuals, to spinout companies contributing to Arizona's economy, to partnering with both industry and government – all of these activities contribute to increasing the security of our citizens, communities and systems."

– Nadya Bliss, director, Global Security Initiative

"The Advanced Materials Initiative is devoted to enabling ASU's materials research community on accelerating the pace of materials innovations through strategic teaming, infrastructure development and operation analytics. It nurtures opportunities of high impact, directed toward university and state priorities in health, energy, space, exploration, security, sustainability, transportation and manufacturing."

– Bill Petuskey, professor and director, Advanced Materials Initiative

ACCESS AND WORKFORCE DEVELOPMENT

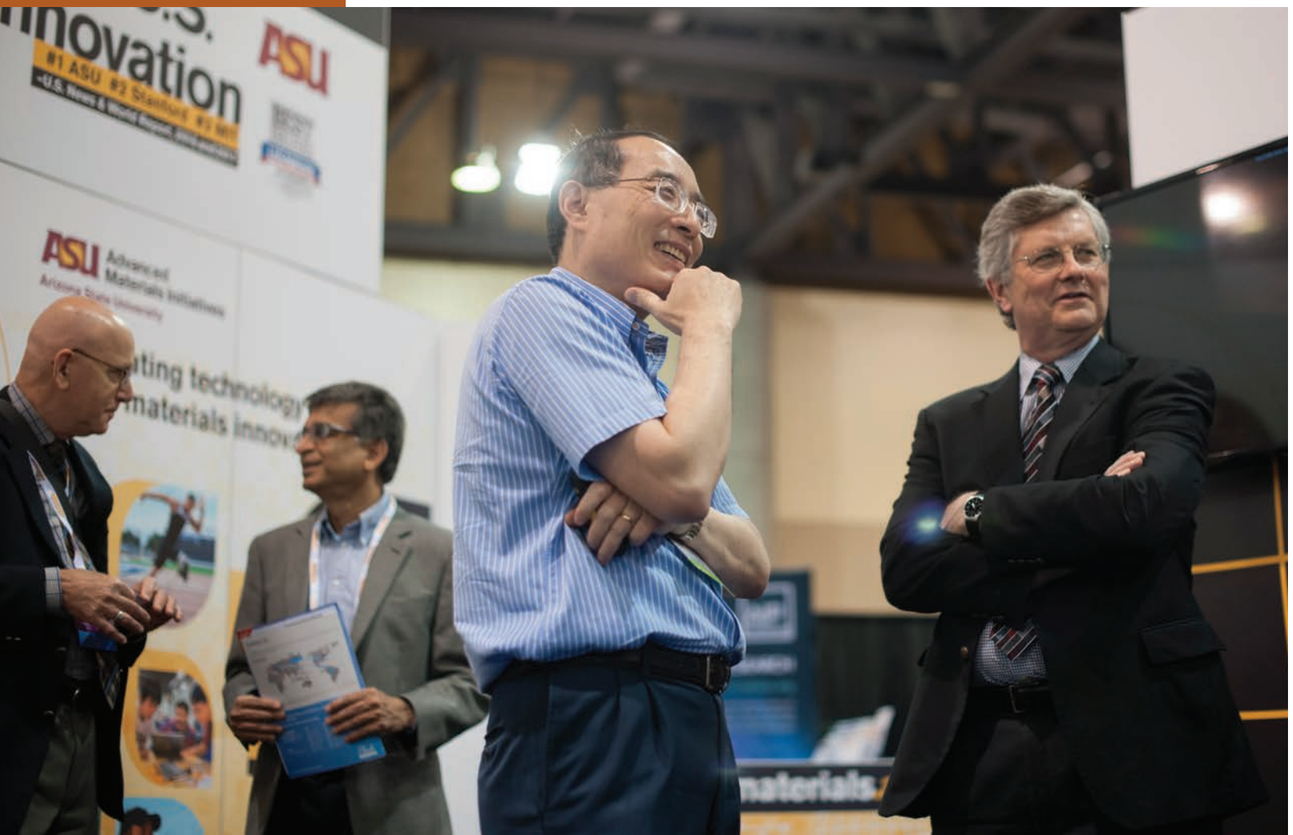
A new focus area for the FY 2017-FY 2021 TRIF funding cycle, Access and Workforce Development is addressing the real need for training and education necessary to drive Arizona's economy. ASU is leveraging its award-winning programs to advance this focus area on two fronts: (1) entrepreneurship and innovation, and (2) advanced manufacturing. The research and programs supporting these efforts work synergistically to marry innovative thinking with cutting-edge, applied technology.

Programs supported in the Access and Workforce Development focus area and associated goals:

- ASU Entrepreneurship and Innovation (E+I) provides educational opportunities, training and mentoring to students, faculty and the community. E+I is a connecting resource that opens the university's research and development capabilities, experience in innovation, and facilities to the broader community with an eye toward stimulating new ventures and improving economic outcomes.

- The new Advanced Materials Initiative enables the materials research community to accelerate the pace of innovation through strategic teaming, infrastructure development and operational analytics. It seeks to identify and nurture opportunities of high impact, especially those related to the university's priority application areas of transportation, health, energy, sustainability, construction and space exploration.

- 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.



The RISN Incubator is harnessing momentum around the concept of a circular economy in the Phoenix area, or business models built on eliminating waste by continually cycling materials back through supply chains.

SUMMARY OF ACCOMPLISHMENTS

The initiatives in the Access and Workforce Development focus area are activating and accelerating Arizona's economy. This includes programs supporting entrepreneurs and businesses from idea to market and a targeted focus on developing Arizona's advanced materials sector with its skilled workforce requirements.

- E+I partnered with the Walton Sustainability Solutions initiative and the City of Phoenix's Reimagine Phoenix to launch an incubator program associated with the new Resource Innovations and Solutions Network (RISN). The RISN Incubator is a business accelerator focused on waste-to-product innovation with the goal of rapidly advancing a circular economy in the Phoenix area. The program provides support for entrepreneurs including mentors, business training and access to technical experts. E+I was also instrumental in the acquisition of federal funding to support the commercialization of ASU research through Small Business Innovation Research/Small Business Technology Transfer initiatives.

- In its first year, the Advanced Materials Initiative built a transdisciplinary community of scholars within ASU and made a strategic investment to invigorate specific thrusts of advanced materials research. The initiative is also coordinating efforts to develop functional prototypes with potential commercial and government applications.

- FEDC and MTWI are actively leveraging the flexible display technology, developed as part of a partnership with the U.S. Army, to have broad applications in security and health. This year FEDC was awarded about $2 million to develop an explosive ordnance detector using flexible X-ray imaging arrays for use in defense and domestic settings. Additional active research projects include a collaboration with the Biodesign Institute to create new sensor arrays that could screen for diseases and another project developing novel materials that have the ability to interact with environmental sensors.

PROGRESS TOWARD GOALS

ASU's thriving knowledge enterprise is built on access, excellence and impact. Our success is demonstrated by the robust growth of ASU's research expenditures as well as top rankings of our academic programs, successful external partnerships, including many with Fortune 500 companies, and recognition as a leader by our peers. The strategic investment of TRIF funds has been instrumental in catalyzing and driving our success.

During the FY17 – FY21 TRIF funding cycle, we have identified targeted research thrusts, supported by the four TRIF focus areas, that are poised for large project acquisition and leverage ASU expertise while providing strong return on investment for the Arizona taxpayer.

These research thrusts translate directly to the projected needs of the Arizona employment sectors and include:

- **Health and Well-being**
- **Food | Energy | Water Nexus**
- **Earth and Space Exploration**
- **Industrial Transformation including Advanced Manufacturing,**
- **Advanced Materials and Future Transportation**
- **Smart Cities and Urban Resilience**
- **Internet of Things and Cybersecurity**

During the first year of the new TRIF funding cycle, we have already made notable progress toward our goals of new external funding, technology transfer activities and workforce development. This year, faculty were awarded $165.4 million in new external funding for TRIF-enabled research and new research initiatives were launched, such as the Interplanetary Initiative and the Advanced Materials Initiative. Targeted professional courses offered by programs in the ASU Wrigley Institute and business training for entrepreneurs through E+I programs are providing workforce training across skill levels. Simultaneously, ASU's TRIF initiatives are driving economic impact by strengthening existing Arizona industry and laying the groundwork for new industry growth, such as in cybersecurity.

By investing TRIF funding in ASU research efforts, Arizona taxpayers are empowering a new generation and creating a bright future for Arizona, in which our state is widely recognized as an outstanding place to work, study and live.


NORTHERN
ARIZONA
UNIVERSITY

NORTHERN ARIZONA UNIVERSITY

In spring 2016, the Arizona Board of Regents approved Northern Arizona University's bold five-year plan for the FY 2017-FY 2021 Technology and Research Initiative Fund (TRIF). Comprising all five TRIF initiatives, this plan provides a framework that leverages 15 years of impactful TRIF investment and expands NAU's capacity to invest in new areas of strategic research growth for the university. Throughout these initiatives is NAU's focus on how research, education, workforce and innovations intersect to spur the Arizona economy.

Since 2002, Northern Arizona University's TRIF investments have had a significant impact throughout Arizona, providing direct economic benefit through advances in science, workforce training and access to a higher education. NAU has consistently generated a positive return on investment through its TRIF initiatives. Water, Environmental and Energy Solutions (WEES) and Improving Health (iHealth) reflect initial initiatives built on NAU's strong research capabilities in specialty disciplines like environmental and climate sciences, biosciences and healthcare, and have driven NAU to innovate and discover while enhancing our leadership position in the region. Access and Workforce Development (AWD) supports the state's economic growth through the development and delivery of courses and degree programs that support workforce needs in high demand areas such as health, teacher education, and business and nonprofit management, particularly focused on serving communities throughout Arizona.

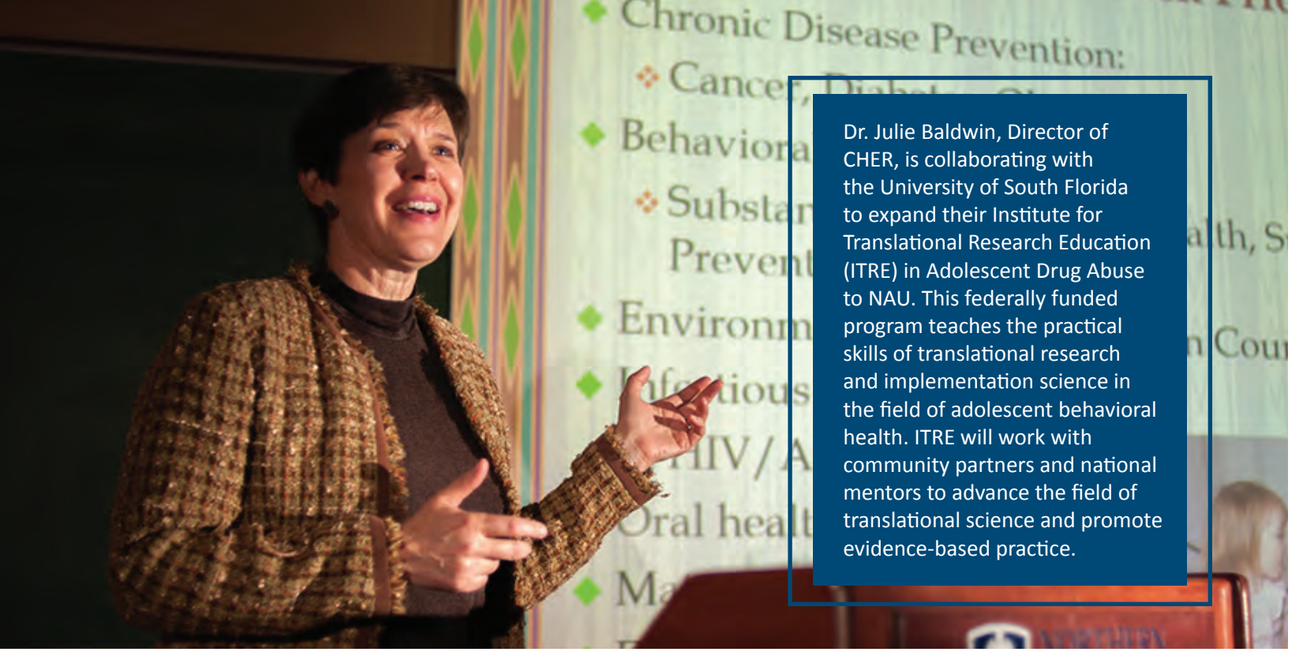
Because of our success in the original investments, in FY 2017 NAU expanded its TRIF emphasis areas with two additional initiatives, Exploring Planetary Systems and National Security Systems.

NAU's Exploring Planetary Systems initiative capitalizes on our recent recruitment of research-intensive faculty in the areas of astronomy and planetary science, while leveraging the wealth of astronomical resources found throughout Arizona to prepare a workforce that will strengthen Arizona's stature as a worldwide leader in this rapidly growing area of research.

The growing need for cutting-edge research in the critical area of cybersecurity is driving our investment in National Security Systems, an area in which NAU has already positioned itself as a leader. NAU has accelerated development of its research capacity in this area through a number of new research-intensive hires and investment in high-tech laboratories. We see this as a core national security priority that will affect thousands of Arizona businesses in the coming decade, and a highly qualified workforce will be needed to meet these challenges.

"NAU's research remains strategic and focused in critical areas that align with our strengths and regional issues in need of attention. TRIF has leveraged additional external resources leading to the accomplishments outlined in this report. Complementing our undergraduate and graduate education, research at NAU is integrated into our mission of providing a high quality education and service to our region."

– Rita Hartung Cheng, President



Dr. Julie Baldwin, Director of CHER, is collaborating with the University of South Florida to expand their Institute for Translational Research Education (ITRE) in Adolescent Drug Abuse to NAU. This federally funded program teaches the practical skills of translational research and implementation science in the field of adolescent behavioral health. ITRE will work with community partners and national mentors to advance the field of translational science and promote evidence-based practice.

IMPROVING HEALTH

Northern Arizona University's investments in the iHealth initiative focus on three areas: bioengineering/biotechology, health research initiatives (HRI) and pathogen genomics.

Bioengineering/Biotechology: Investments in the NAU Center for Bioengineering Innovation (CBI) will catalyze discoveries that improve lives, foster economic growth in Arizona and beyond, and provide cutting-edge training in bioengineering research for undergraduates and graduate students who will join the biotechnology workforce. CBI's research focuses on a wide range of areas, including personal bionics and wearable robotics, rehabilitation, hearing improvement, and materials and devices for biocompatible implants and sensors.

Health Research Initiatives: NAU is expanding its capacity to produce nationally recognized translational health research and to make discoveries in personalized medicine, infectious disease control and clinical research around a wide range of chronic health conditions. In FY 2017, NAU established the Center for Health Equity Research (CHER) to address the healthcare disparities of the state's underserved populations, including Native Americans, Hispanics and rural communities.

Pathogen Genomics: Investments in NAU's world-renowned Pathogen and Microbiome Institute (PMI) have led to the creation of intellectual property and national recognition in biosecurity. This expansion and investment in the PMI will lead to increased extramural research funding as well as startup companies formed to commercialize its discoveries. PMI's research focuses on the evolution, ecology and epidemiology of some of the most threatening disease-causing bacteria, from hospital-acquired infections to anthrax, plague and biological warfare agents.

GOALS:

- **Leverage NAU's existing research and intellectual assets to generate external funds.**
- **Create curricular innovations related to key workforce needs in the state and region.**
- **Catalyze an entrepreneurial spirit among university faculty and students.**
- **Build and strengthen partnerships with healthcare providers in Northern Arizona.**
- **Generate new biotechnology startup enterprises and jobs in the region.**

SUMMARY OF ACCOMPLISHMENTS

Northern Arizona University's TRIF investments under the Improving Health initiative range from basic, applied and translational research in human biology, bioengineering and microbiology/genomics, to clinical, community and behavioral health sciences. Through valuable partnerships with local and regional healthcare providers, research institutions and tribal communities, NAU researchers are generating discoveries and innovations that have an immediate and long-lasting impact on the health and well-being of the diverse populations of Arizona.

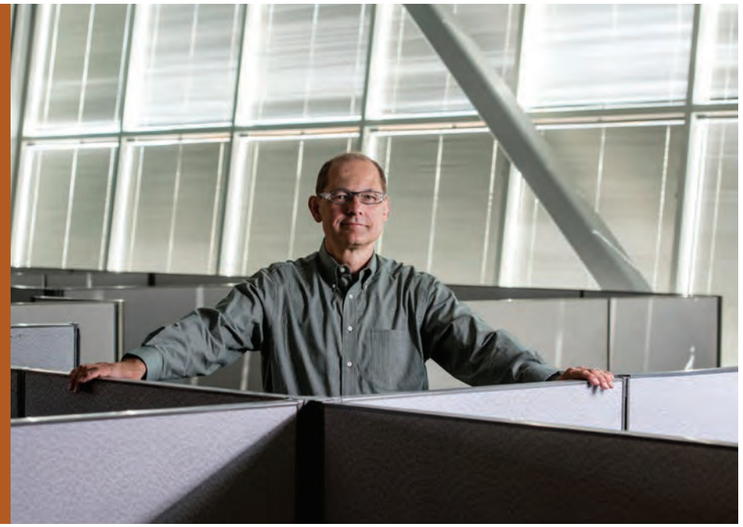
- Northern Arizona University faculty who received TRIF funds through the Improving Health initiative received $9 million in external grant funds in FY 2017.
- NAU and TGen were jointly awarded a U.S. patent for "Method of Detecting and Quantifying Coccidiodes Species," an assay that significantly reduces the time needed to diagnose and treat Valley Fever. Regents' Professor Paul Keim is the NAU lead inventor.
- TGen awarded $500,000 to PMI to study focused DNA sequencing for environmental monitoring of biothreat agents. Jason Sahl, assistant director of PMI, is the project's principal investigator.
- NAU received a $438,000 grant from the National Institutes of Health to study cognitive-communication screening and early therapy for adults with mild traumatic brain injury, led by Emi Isaki, associate professor of Communication Sciences and Disorders.
- The Arizona Biomedical Research Commission awarded $224,000 to NAU Assistant Professor Viacheslav Fofanov for a transdisciplinary project to determine the biological factors behind the high rate of tooth decay among Arizona's preschoolers.
- A new doctoral degree program in bioengineering was initiated to prepare NAU students to undertake careers in industry, government organizations, nonprofits and universities. This interdisciplinary program focuses on the areas of biomaterials and biomechanics, providing a broad-based research perspective that draws on the expertise of our faculty from unique disciplines.

Professor Frank von Hippel, who joined NAU in 2016, is the principal investigator for a pilot project funded by a $200,000 grant from the Flinn Foundation to look at perchlorate exposure in Yuma residents and potential adverse health outcomes. This partnership between NAU and the Yuma medical community will provide a new look into the effects of decades-old water contamination in the Arizona border community.

Bertrand Cambou was named an Invention Ambassador by the American Association for the Advancement of Science and the Lemelson Foundation.

Invention Ambassadors are tasked with influencing and informing public policy, including but not limited to federal and university policies, and highlighting the importance of creating and inspiring talent.

"I am going to do everything I can to promote NAU in order to receive research grants for the university," Cambou said.



NATIONAL SECURITY SYSTEMS

According to the U.S. Department of Homeland Security, the country's economic vitality and national security depend on a stable, safe and resilient cyberspace. Under the FY 2017-FY 2021 Business Plan, Northern Arizona University's investments in the National Security initiative focus on two areas: Cybersolutions and informatics and computing research (iCORE). Both programs are being delivered through NAU's new School of Informatics, Computing and Cyber Systems (SICCS).

Cybersolutions addresses key challenges for secure computing. The most obvious challenge is the need for cybersecurity and encryption that cannot be easily defeated. Novel approaches will include both software designs and embedded encryption in hardware. Reconfigurable computing represents major challenges for cybersecurity due to a need for computing programs that are adaptable and often less secure (e.g., machine learning). Cyber-physical systems will require security to ensure that computers talking to other computers are not corrupted and harm entire systems of machine-to-machine communications. The same concern can be extended to remote sensing data and smart infrastructure systems (smart cities, smart buildings and even smart cars).

iCORE researchers work with very large datasets, machine learning, remote sensing, IoT (Internet of Things) and/or reconfigurable computing. A strong operational element of iCORE is building transdisciplinary projects around computing applications and secure computing. iCORE projects, which feature collaborations with faculty from nearly every area of NAU's research enterprise — including Health Sciences, Astronomy, Engineering, Forestry, Natural Sciences, Psychology and Linguistics — offer opportunities for technical innovations, economic development and workforce training.

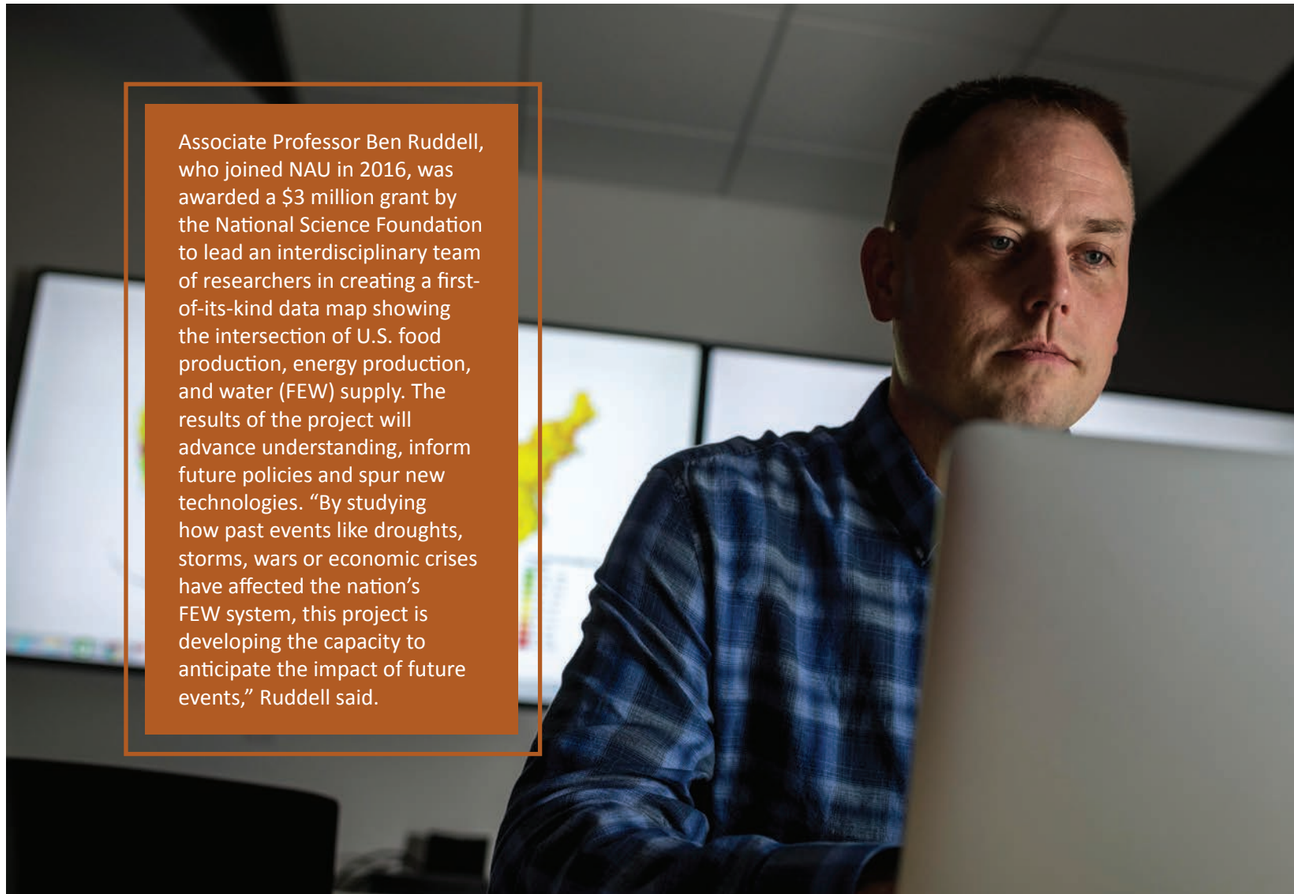
GOALS:

- **Develop new secure applications of computing and computer-systems design.**
- **Collaborate with technology-driven industry partners.**
- **Generate nationally recognized science and scholarship by integrating emerging research domains with NAU's areas of strength, including biological and environmental research.**
- **Emphasize scholarly productivity and extramural funding by creating a culture that centers on high expectations and high-impact interdisciplinary research.**
- **Provide cutting-edge training and learning opportunities to students by integrating research into existing curricular programs and building new programs that support 21st-century technological challenges.**

SUMMARY OF ACCOMPLISHMENTS

Northern Arizona University's National Security Systems initiative leverages research, discovery and training to develop and disseminate innovative and secure applications in informatics, computing and cyber systems. This will be accomplished largely through NAU's new School of Informatics, Computing and Cyber Systems (SICCS), which was formed in FY 2016 to meet the need for advanced interdisciplinary computational and data sciences, and to enable NAU to successfully compete for major external research grants in informatics, cyber systems development and cybersecurity.

- A tri-university research team, led by NAU Professor of Practice Bertrand Cambou and funded by a $400,000 grant from the Regents' Innovation Fund, is developing an end-to-end cybersecurity solution that utilizes the complex physical properties of nanomaterials.
- The U.S. Department of Homeland Security awarded $392,000 to Assistant Professor Viacheslav Fofanov to produce a single unified software package that can identify and assign statistical confidence scores for organisms present within a sample down to species level. The results of this project will enhance the rapid sequencing of complex environmental samples, making it much more economically feasible.
- A new, five-year doctoral degree program in informatics and computing was launched to prepare students to work in the transformative "fourth paradigm" of science and engineering, an interdisciplinary field relying on big data and advanced software, hardware and statistics skills.
- NASA awarded Professor Scott Goetz a $836,693 grant for an interdisciplinary research effort designed to address large-scale environmental change and its implications for social-ecological systems in Alaska and Western Canada.



Associate Professor Ben Ruddell, who joined NAU in 2016, was awarded a $3 million grant by the National Science Foundation to lead an interdisciplinary team of researchers in creating a first-of-its-kind data map showing the intersection of U.S. food production, energy production, and water (FEW) supply. The results of the project will advance understanding, inform future policies and spur new technologies. "By studying how past events like droughts, storms, wars or economic crises have affected the nation's FEW system, this project is developing the capacity to anticipate the impact of future events," Ruddell said.

ACCESS AND WORKFORCE DEVELOPMENT

NAU has a long history of success in providing affordable pathways to degree completion through innovative programming and delivery options, particularly in remote and rural Arizona. The Access and Workforce Development (AWD) Initiative addresses the needs of local employers, and their current and future employees in high-demand fields including health sciences and education, delivered away from the Flagstaff campus. In particular, non-traditional students, including a high percentage of under-represented populations, have achieved a higher education degree and career success through NAU's flexible, alternative learning models designed to address the needs and demands of our students.

Healthcare is expected to be the largest private employer in the near future and NAU has expanded both program options and delivery models to meet this growing workforce. Primary to this effort is NAU's expanded nursing programs, offering options for both full degree enrollment as well as RN-to-BSN completion programs for current nurses looking to increase marketability and salary. The programs supported through this initiative are those offered away from the Flagstaff campus through face-to-face concurrent programs around the state in partnership with community colleges, as well as through online programming, and a new competency-based RN-BSN program that began in July 2016. This variety of learning modalities brings the NAU degree directly to the student, offering flexibility and access. Enrollment in these programs in FY 2016-17 was 2,075.

NAU's legacy as a Normal School is at the foundation of the university's robust teacher education programming. Options at the undergraduate and graduate level exist on the Flagstaff campus, throughout the state and in NAU's online programming. This initiative supports expanded programming on community campuses throughout Arizona and online providing student access to a strong history of excellence in teacher education. NAU works directly with school districts around the state to satisfy unique community needs at the classroom and education administrator level. Enrollment in these programs in FY 2016-17 was 2,407.

In 2016, NAU launched a university-wide initiative to improve retention and student success for all students. Utilizing technology more efficiently and effectively, rethinking business processes and identifying opportunities to scale are central to ensuring that students have what they need when they need it. Centralizing the university advising structure has facilitated unified practices among advisors who are fully engaged in the university retention plan and have access to new technologies supporting tailored advising. Included in this endeavor has been course redesign with blended delivery models and application of adaptive learning technology. Supported by TRIF and a grant from the Association of Public and Land Grant Universities to accelerate the adoption of adaptive courseware, the first cohort of 16 faculty have redesigned courses to be offered this year.

GOALS:

- **Address workforce needs in healthcare throughout Arizona.**
- **Expand continuing education and advanced degree offerings in teacher education statewide.**
- **Expansion of student success and retention efforts for online and statewide students.**
- **Design and coordination of comprehensive teaching and learning support.**
- **Intentional course design for student success with focus on blended delivery modes and application of adaptive learning technologies.**

SUMMARY OF ACCOMPLISHMENTS

Student access to higher education is an integral component of NAU's mission and has developed into numerous program offerings in partnership with community colleges throughout Arizona as well as targeted graduate degree offerings to meet workforce needs. These longstanding partnerships provide place-based students the opportunity to take lower division coursework at their local community college campus and then transfer to NAU programs co-located at their community college to finish their four-year degree. Efforts have included increased transparency in this process through 2NAU agreements supporting co-admission to a community college and NAU and the most recently developed transfer planning tool, Jacks Path. As Arizona trails the nation in the percentage of our population having postsecondary education certificates or degrees, it is critical to continue to prioritize access that accommodates the student needs and goals as has been the focus of TRIF investments in this initiative.

NAU's Personalized Learning Program is recognized as an innovative approach to the traditional learning experience by recognizing prior knowledge and mastery of materials in lessons. Because Personalized Learning is a flat rate for a six-month subscription, the cost of degree completion for motivated students can be quite low.

NAU has expanded efforts to continue our strengths of individualized learning as we increase our enrollments and provide access to a greater number of underserved populations and first-generation college students. The adaptive courseware program allows for both acceleration and quick, effective remediation to increase student success. These efforts are assisting NAU be a highly successful personalized high-touch/high-tech learning strategy with enormous future impact in online programs and general statewide student application.

- Through Northern Arizona University's AWD investments, students are offered access to the outstanding educational opportunities, while also benefiting from the most affordable four-year degree options in the state of Arizona. One example of recognition in our online program offerings is NAU's online RN-BSN program, which recently ranked No. 18 in affordability in the best online bachelor's in nursing for 2017 - http://www.affordablecolleges.com/rankings/affordable-online-masters-secondary-education-degrees/.

- The new competency-based, Personalized Learning RN-BSN program, launched in July 2016, ended the year with 106 subscriptions and three new graduates.

- Application of the Quality Matters (QM) Rubric in online and blended courses has been expanded. QM is a national standards program for consistent and quality design for online and blended courses. Additionally, faculty development and training in online teaching was redesigned and will be implemented fall 2017. This initiative elevates efforts around course quality and consistency and will be required of all online instructors.

- The NAU e-Learning Center Instructional Design team completed more than 120 intensive design consultations with faculty in all colleges for courses delivered in all modalities.

- Over 125 faculty projects for graphics, media or course websites were completed to enhance student engagement in our online courses.

- Engaging technology integration into the classroom to support student learning is not without challenges, and the AWD initiative has supported the addition of tutorials and materials to provide self-help for faculty.

NAU continues to strengthen its “high research” designation with strategic recruiting. Professor Scott Goetz joined NAU in 2016 as the Science Lead of NASA’s Arctic Boreal Vulnerability Experiment, a 10-year effort to monitor changing ecosystems through data collected via satellite, airborne, and ground observations across Alaska and Canada.

WATER, ENVIRONMENTAL AND ENERGY SOLUTIONS

Under the FY 2017-FY 2021 Business Plan, Northern Arizona University’s investments in the WEES initiative focus on two areas: Adapting to a Changing Environment (environmental sciences) and Forest Health and Land Management (forest and land). These programs build on NAU’s historical strengths in environmental and ecosystem sciences.

Investments in environmental sciences have created two research centers at NAU: Center for Ecosystem Science and Society (Ecoss) and Merriam Powell Center for Environmental Research (MPCER). Researchers in Ecoss study the interactions of biological communities to determine how they respond to and influence environmental change. Ecoss prioritizes the training of future scientists and disseminating information about their discoveries to the public. MPCER has been instrumental in advancing cross-disciplinary environmental research and training at NAU with a focus on the Colorado Plateau.

NAU’s Forest and Land Management program invests in two research centers: the long-standing Ecological Restoration Institute (ERI) and Landscape Conservation Initiative (LCI). Investments in ERI support the development of solutions to the costly environmental problems of degraded forest health and unnatural wildfire. Losses of revenue from decreased tourism, short-term job losses, and damage to water supplies and water quality are just a few of the economic impacts that ERI’s work seeks to alleviate. Investments in LCI support applied biological research, collaborative planning and field-based educational experiences to forge new solutions to landscape-scale environmental challenges, bringing strong scientific support to public deliberation and land-management efforts across Arizona.

GOALS:

- **Leverage NAU’s existing research and intellectual assets to generate external funds.**
- **Create curricular innovations related to key workforce needs in the state and region.**
- **Catalyze an entrepreneurial spirit among university faculty and students.**
- **Build/strengthen partnerships with Arizona environmental and land-management groups.**
- **Generate new environmental business opportunities and jobs in the region.**

SUMMARY OF ACCOMPLISHMENTS

Northern Arizona University’s investments under the TRIF Water, Environment and Energy Solutions (WEES) initiative have generated increased external funding and enhanced capacity for addressing complex issues in environmental variability and ecosystem science, forest and land management, and the unique environmental challenges of the southwestern United States.

- NAU faculty who received TRIF funds through the WEES initiative received more than $10 million in external grant awards in FY 2017.
- NAU’S Land Conservation Initiative received $1.3 million from the National Science Foundation to determine how social and ecological boundaries affect priorities and outcomes, including social relationships, management decision making and ecological functioning.
- Bruce Hungate was awarded an $825,000 grant by the U.S. Department of Energy to quantitatively examine the roles of specific subsets of microorganisms in ecosystem-scale carbon cycle processes and determine their functional responses to rising soil temperatures.
- Scientists at NAU’s Merriam-Powell Center for Environmental Research, led by Assistant Research Professor Karen Haubensak, received a $335,000 grant from the Bureau of Land Management to test a new approach for restoring sagebrush landscapes degraded by cheatgrass.
- NAU’s Institute for Tribal Environmental Professionals received two grants from the EPA: $335,000 for National Tribal Air Association Operations, whose mission is to advance air quality management policies and programs, and $220,000 in support of tribal environmental training programs.
- NAU was awarded a U.S. patent for “Use of Acoustics to Disrupt and Deter Wood-Infesting Insects from and Within Trees,” a non-chemical method of treating and preventing insect infestation of trees, developed by Associate Professor Richard Hofstetter. An acoustic signal is emitted from the device, which has been shown to aggravate insects, disrupting the mating, tunneling and reproduction that kill trees.

Dr. Bruce Hungate was elected a Fellow of the American Academy of Microbiology (AAM), a prestigious leadership group of the American Society for Microbiology. Hungate’s election to AAM is recognition of the global impact of his work and a great honor for NAU. Hungate was also named a Regents’ Professor in 2016.

SPACE EXPLORATION AND OPTICAL SOLUTIONS

Under the FY 2017-FY 2021 Business Plan, Northern Arizona University's investments in the SPACE initiative focus on three areas: Solar system origins, Mars and exoplanets. These programs build on NAU's historical strengths in astronomy and planetary science, while leveraging Arizona's abundance of a world-class telescopes, observatories and state-of-the-art imaging systems.

Solar system origins researchers study the formation and evolution of the solar system, detecting and characterizing the physical and chemical properties of rocky asteroids that could potentially impact the Earth. They are looking for the elusive "Planet X," a large and undiscovered planet in the most distant regions of the solar system. They are also studying objects in the Kuiper Belt, a vast region of comets and other icy objects beyond the orbit of Neptune.

Mars researchers use spacecraft data to study the geology of the Red Planet while hunting for water and life on its surface. Faculty members and their students direct the path and daily tasks of the NASA Curiosity Rover on the surface of Mars from the NAU campus; they also build flight instruments for spacecraft bound for Mars.

Exoplanets researchers study planets orbiting distant stars using telescopes and computer simulations to characterize their physical and chemical properties. The researchers' goal is to identify which of the thousands of known exoplanets are the best candidates to harbor life and are therefore worthy of further study.

GOALS:

- **Double external research funding in astronomy and planetary science.**
- **Partner with Arizona companies to develop instrumentation for shoe-box-sized spacecraft (CubeSats).**
- **Fly a CubeSat to an extraterrestrial object, such as an asteroid.**
- **Expand partnerships with private observatories such as Lowell Observatory, FRoST and ATLAS.**
- **Build and/or operate small telescopes such as FRoST and ATLAS to detect potentially hazardous near-Earth asteroids.**
- **Continue to operate and expand the capabilities of the Astrophysical Ice Laboratory on the NAU campus.**

In April 2017, NAU launched a new Mars Rover Operations and Analysis Laboratory where researchers and students use sophisticated equipment to help command the day-to-day activities of NASA's Mars Science Laboratory Curiosity Rover operating on the surface of Mars. Assistant Professor Christopher Edwards, who joined NAU in 2016, is the director of the lab.

"We're excited to have this wonderful new facility on NAU's campus run by Dr. Edwards," President Rita Cheng said at the opening celebration for the lab. "This facility places NAU as one of a handful of prestigious institutions throughout the country actively contributing to NASA solar system exploration missions, and we're proud to add this to NAU's research portfolio."

SUMMARY OF ACCOMPLISHMENTS

As the first International Dark Sky City, Flagstaff — at 7,000 feet above sea level — is a natural location for studying astronomy and planetary sciences. Through TRIF investment in the Exploring Planetary Systems research initiative, Northern Arizona University is developing unique and cutting-edge research and academic programs in solar system origins, Mars and exoplanet research. TRIF investment allows NAU to expand its partnerships with Lowell Observatory and the U.S. Naval Observatory, and provides access to highly sought-after telescopes such as the Discovery Channel Telescope, the Flagstaff Robotic Survey Telescope and the UKIRT Infrared Telescope in Hawaii, under a partnership with The University of Arizona. NAU researchers leverage TRIF support with external funding to discover new ways of exploring space, to contribute to a new understanding of our place in the universe and to seek opportunities to translate research into economically productive innovations with commercial applications.

- Associate Professor David Trilling received a grant from NASA's Jet Propulsion Laboratory to develop a database of diameters and albedos for nearly 3,000 near Earth objects (NEOs). NEOs are key components of current and future space exploration, and their study is also relevant in developing civil defense understanding of the threat of impact.
- Assistant Professor Christopher Edwards received a grant from NASA and Stony Brook University to study the soil composition of the Mars moon Phobos. Dr. Edwards studies the surfaces of extraterrestrial planets and works on multiple NASA Mars missions, conducting planetary analog fieldwork and developing new remote sensing instruments for use in the laboratory and in space.
- The world's largest survey for so-called "extreme objects" that orbit the sun beyond the Kuiper Belt includes NAU Assistant Professor Chad Trujillo as part of its team. The co-discoverer of the dwarf planet 2012 VP113, Dr. Trujillo announced the discovery of three new objects at the far edge of the solar system, a finding that helps narrow the search for the hypothetical "Planet X."
- The addition of a new Ph.D. program in astronomy and planetary science will prepare students to work as academic, government, or industrial researchers in astronomy or planetary science. Students will use ground- and space-based telescopes to study small bodies in the solar system, spacecraft imagery to study planetary surfaces, and a state-of-the-art laboratory to study astrophysical ice analogs.

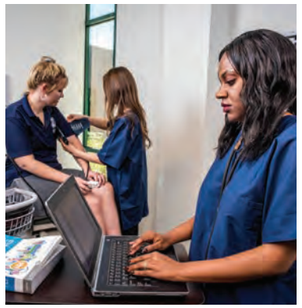
PROGRESS TOWARD GOALS

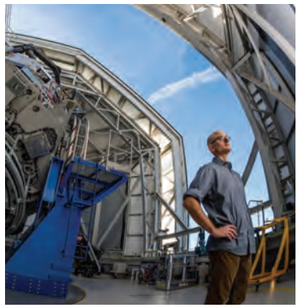
At Northern Arizona University, discovery is pursued in every direction from a vantage point here on the Colorado Plateau. Throughout NAU's history, a desire and drive to understand the world have resulted in cutting-edge research to address some of the world's most pressing challenges. NAU has built a strong history of success in providing affordable pathways to degrees through innovative degree completion and delivery options, even in remote, rural communities. In particular, non-traditional students, including a high percentage of under-represented populations, have achieved a higher education degree and career success through the university's flexible, alternative learning models, addressing the needs and demands of students throughout Arizona and providing a skilled workforce essential to the state's economic vitality.

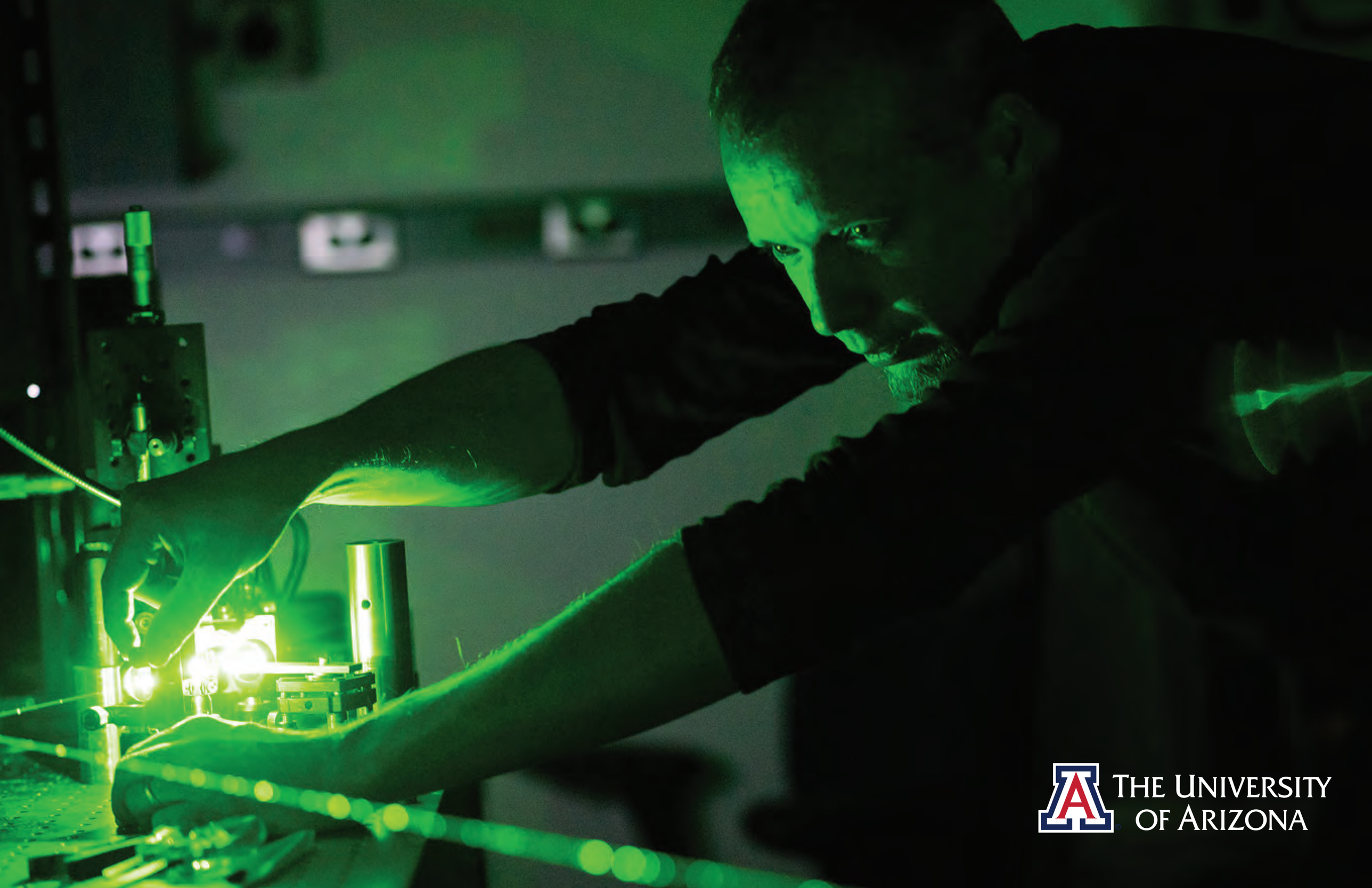
One year into the new TRIF business plan, NAU has generated impressive outcomes across the five TRIF initiatives. Strategic investments in high-research faculty, research centers and new graduate programs have enabled NAU to exceed FY 2017 TRIF financial impact goals. For example, NAU's TRIF programs generated significant activity in technology transfer, enabling NAU to meet or exceed all four performance measures: invention disclosures, patents issued, licenses and options, and startup companies. Financial impact progress under NAU's IHealth and WEES initiatives far exceeded goals, reaching 70 percent and 75 percent, respectively, of the 2021 goal in this first year alone. This strong performance in FY 2017 positions NAU to meet or exceed all of its TRIF 2021 goals.

NAU's TRIF initiative in Access, Workforce Development is aligned with NAU's mission to serve the state of Arizona through accessible education delivery models. This initiative has included the integration of technology and advanced learning designs to increase student engagement across all of NAU's campuses. The primary focus of this effort is to provide educational alternatives to attending a residential campus in order to meet both student demands for a degree and workforce needs in local communities. NAU has advanced this effort through community campuses, in partnership with community colleges, online learning and competency-based Personalized Learning program. Attaining 70 percent of the 2021 TRIF goal in this area is reflective of NAU's successful efforts. NAU graduated 1,405 nurses and teachers at locations other than Flagstaff, throughout Arizona and online last academic year (2016-2017). These graduates meet critical workforce needs and represent the opportunity to transform education and healthcare in communities where they live and work.

TRIF funding has provided the foundation for NAU to attract new external research funding, develop inventions with high potential for technology transfer, and strategically invest in workforce development. These accomplishments enhance Arizona's research enterprise and reputation while addressing critical healthcare, defense and security, land and water management and space exploration issues of today. TRIF resources have enhanced NAU's educational infrastructure and capability to prepare its students to be complex problem solvers addressing the workforce needs of today and an increasingly diversified workforce for the future. These investments develop new talent as demonstrated by the increasing numbers of NAU graduates who are staying in Arizona to live and work post-graduation, as well as the attraction of new talent to Arizona to study, teach and research.







THE UNIVERSITY OF ARIZONA

UNIVERSITY OF ARIZONA

The University of Arizona is focused on accelerating innovation in Arizona by facilitating translation of research results into new ideas, products, technologies, services and trained workforce that promote the health, security and prosperity of Arizona. Thus, the philosophy of our Technology and Research Initiative Fund (TRIF) program is to advance economic development opportunities and public benefit for Arizonans by: 1) Catalyzing research and development (R&D) activity that aligns with Arizona's targeted industry sectors of high impact; 2) Supporting the infrastructure, facilities and computing that enables cutting edge R&D; 3) Producing results that leverage our expertise and attracts outside resources to our state; and 4) Providing real-world, advanced training to develop next generation leaders who will create Arizona's bright high-technology future.

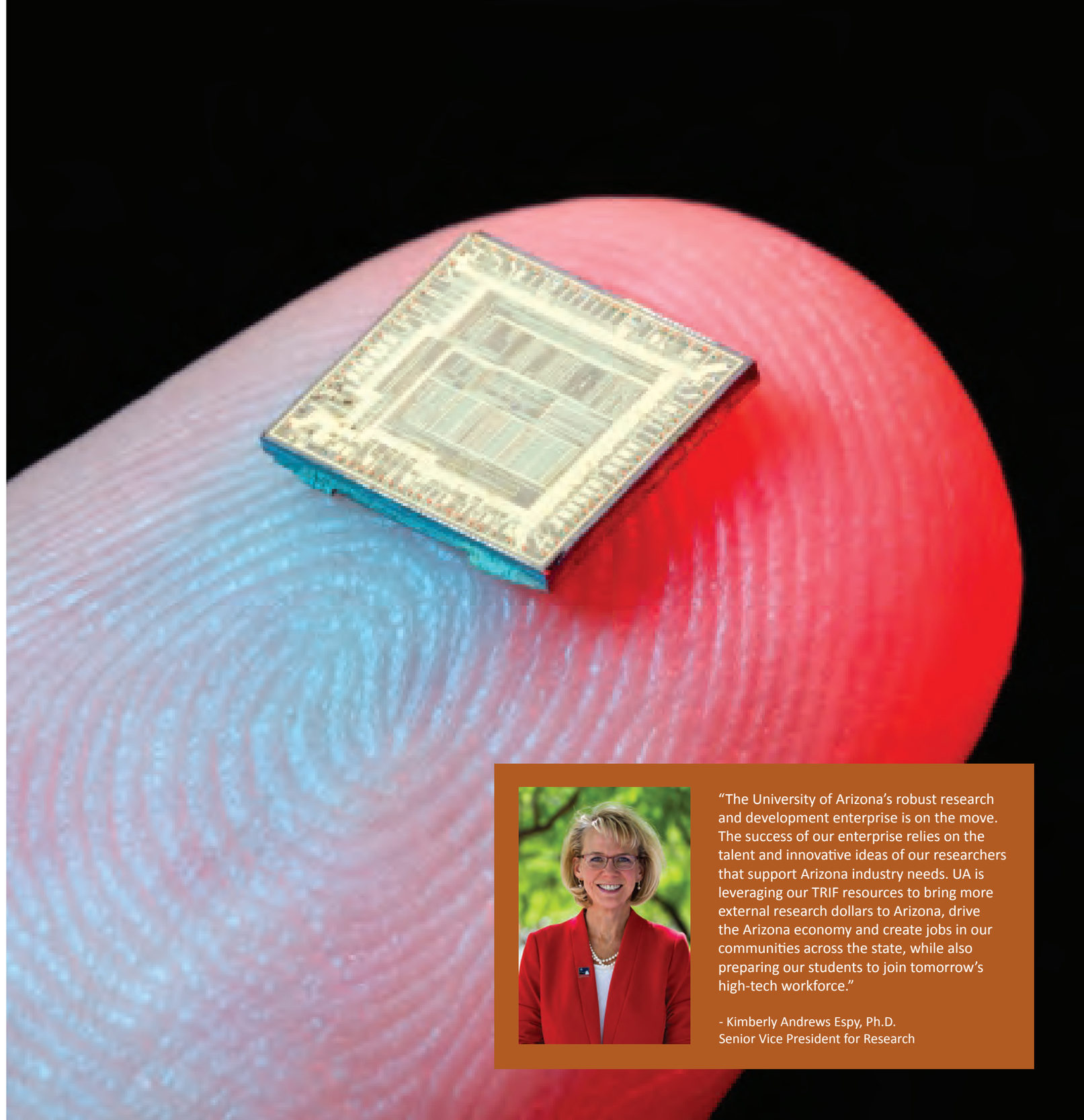
UA participates in the following TRIF initiatives:

- Improving Health: With the health challenges that many Arizonans face and bioscience technologies as a major target industry for growth identified by the Arizona Commerce Authority (ACA), UA's Improving Health TRIF initiative is focused on delivering research results – from bench to bedside – that will improve the lives and health of our citizens, create high-quality jobs within the state and engage students in science to grow our STEM workforce. Linking our two medical schools and leveraging our clinical partnership with Banner Health, the UA has secured a historic $43 million grant in precision medicine awarded by the National Institutes of Health – one of four awardees in the first round (along with Columbia University, Northwestern University and the University of Pittsburgh).

- Space Exploration and Optical Solutions: Southern Arizona is known as "Optics Valley" and Optics/Photonics is a key industry sector for Arizona called out by the Affordable Care Act (ACA). UA's strong international reputation and talent base in this area support growth in literally every industry sector identified by the ACA. TRIF resources supported the unique diamond-turning fabrication and optics molding tools for free-form imaging optics in Optical Sciences that have enabled nearly $1 million of new extramural programs.

- Water, Environmental and Energy Solutions (WEES): Arizona is a "living laboratory," and UA has a depth of experience utilizing abundant sun energy and limited water resources to grow a wide diversity of crops. WEES projects are designed to align UA's expertise with global needs – such as how to sustain the expected 9.7 billion people on Earth in 2050. WEES successes include the new Institute for Energy Solutions' expanded ability to create high-resolution weather models and power forecasts resulting in 2.7 gigawatts of renewable energy power to be included in electric utility operations in Arizona.

- National Security Systems (NSS) impacts a range of technology and research at UA and will stimulate and promote collaboration, innovation and research and development to support Arizona's high-tech economy. Arizona's aerospace and defense total exports amounts to approximately $3.47 billion and ranks fourth nationwide in aerospace industry payroll and fourth in aerospace revenue at $15 billion. Projects include a recently installed student-built telescope that will be used to help in near-Earth satellite detection for the Department of Defense.



"The University of Arizona's robust research and development enterprise is on the move. The success of our enterprise relies on the talent and innovative ideas of our researchers that support Arizona industry needs. UA is leveraging our TRIF resources to bring more external research dollars to Arizona, drive the Arizona economy and create jobs in our communities across the state, while also preparing our students to join tomorrow's high-tech workforce."

- Kimberly Andrews Espy, Ph.D.
Senior Vice President for Research

SPACE EXPLORATION AND OPTICAL SOLUTIONS

The TRIF Space Exploration and Optical Solutions initiative seeks to incubate novel, high-impact research directions that drive innovation, support regional economic development to benefit Arizona, and expand educational opportunities for Arizona students in optics, astronomy and space sciences to grow our high-tech workforce.

GOALS:

- Leverage TRIF funds to obtain at least a ten-fold return on investment through increased external research funding.
- Strengthen and expand R&D by recruiting and supporting key faculty talent to Arizona in strategic areas aligned with industry need and/or external opportunity across the UA campus to lead to new technologies and products.
- Create new shared imaging and photonics infrastructure and facilities that broadly benefit the research and education mission of the University and connect with high-tech industry.
- Support Arizona workforce development directly through increased student fellowships and enhanced university outreach to companies, including increasing the participation of under-represented populations in Arizona in STEM training.
- Encourage the commercialization of research results, helping the creation of new Arizona startup companies and expanding innovation activities.

SELECTED ACCOMPLISHMENTS

Investments in the TRIF Space Exploration and Optical Solutions initiative strongly enable faculty and student success, reflecting the strong alignment of the needs and impact for Arizona with areas in which UA faculty already have significant expertise and the capacity to grow in impact, economic opportunity and external funding when supported by this initiative. A noteworthy highlight this year has been sustainable growth in licensing revenue from intellectual property generated by faculty innovations in TRIF-supported programs.

- Bolstering seed money to bring external dollars to Arizona: The Steward Observatory (SO) has strongly leveraged TRIF seed funding to bolster its commanding position in observational astronomy, ranked No. 1 in research activity in the U.S. among the 515 U.S. universities surveyed by the National Science Foundation (NSF). (2015)

- Photonics continues to be a strategic growth area for our state and the nation. With TRIF funding highly leveraged in securing the $35.7 million NSF funding received to date for the prestigious Center for Integrated Access Networks (CIAN) Engineering Research Center led by Director Nasser Peyghambarian, now in its ninth year. In addition to $1.1 million in optical computing from the Office of Naval Research by Prof. Peyghambarian, the faculty expansion initiated with CIAN has resulted in additional funding including $1.9 million in solar photovoltaics from ARPA-E by Optical Sciences Professor Bob Norwood and cumulative $2 million from UA faculty participation in the high-visibility AIM Photonics chip-scale photonics institute in the Manufacturing USA network.

- Working to find planets outside of our solar system: Philip Hinz, an assistant professor at Steward Observatory, received TRIF funds to purchase hardware for the construction of the SHARK-NIr facility at the Large Binocular Telescope (LBT). The TRIF-SEOS support is enabling the development of a new astronomical camera for the LBT that will image exoplanets. The project has also enabled postdoc and graduate students to work side-by-side with UA researchers.

- TRIF investments in unique tools: TRIF resources used in unique diamond-turning fabrication and optics molding tools for free-form imaging optics in Optical Sciences Professor Rongguang Liang's laboratory have enabled nearly $1 million of new extramural programs this year, including grants from the National Institute of Biomedical Imaging and Bioengineering (NIBIB) in new endoscopic concepts and oral cancer screening, as well as new optics development for augmented reality funded by information technology companies.

- Technology to marketplace: A team of UA researchers, including Mahmoud Fallahi, Ph.D., professor of optical sciences; Chris Hessenius, Ph.D., research professor in optical sciences; and Michal Lokowski, a postdoc in optical sciences, created a startup called TPhotonics, Inc. While most lasers produce beams of a single or highly limited range of wavelength, the technology developed by the UA researchers allows for devices that can produce a beam and tweak its wavelength on the fly. The invention is a new kind of VECSEL or "vertical external-cavity surface emitting laser," which can generate spectrally tunable light and multiple wavelengths, from the ultraviolet to the far infrared regions of the spectrum.

FAST FACTS

- $67.4 million in new TRIF-seeded research funding.
- Supported training of 57 graduate students and post-docs, 29 undergraduate students.
- Five new start-up companies, 62 invention disclosures, 83 patents filed, 15 patents issued, 22 licenses and options with $1,256,754 of royalty income.
- Five pilot/seed grants that supported early-stage research, including:
  Development of a new astronomical camera for the LBT that will image exoplanets.
  Work to support multi-year proposals on space object characterization.

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, support resiliency in the face of variability and extreme weather events, and lead the creation of a vibrant renewable energy industry in the 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 that benefit Arizona.**
- **Strengthen and expand solutions-oriented research by recruiting the best and brightest faculty to Arizona and supporting projects that will advance the development of new thinking, technologies and development strategies.**
- **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 and private funding and boost 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 workforce needs.**

SELECTED ACCOMPLISHMENTS

The WEES investment areas are focused directly on opportunities for potential external funding, partnerships with business and high-priority workforce needs. Connecting UA research strengths to priority research areas to which funding has been allocated by federal agencies, major philanthropic foundations and for private-sector investors and businesses yields successes – like advancing Arizona's status as a global water hub for inland water reuse, partnering with both the mining and agricultural industries and developing irrigation water quality monitoring methods to help growers meet new food safety requirements.

- WEES invests in research and technology to expand Arizona's resource options and economy. The energy industry seeks high-capacity batteries that are lightweight and inexpensive to manufacture. The UA's research on conductive polymers for use with lithium-sulfur batteries provides the advancements necessary to achieve these goals. Licensing discussions with multinational chemical companies are already in progress for these products. Next-generation plastics that conduct electricity also offer mechanical flexibility and tailorable properties, giving them exceptional applications for renewable energy and clean water and for monitoring contaminants in our food supply. Semi-arid environments provide critical human and natural habitat in Arizona and throughout much of the world. UA research on the ecohydrology of these dryland systems is providing key information to protect our resources. For example, research shows the importance of preserving deep-rooted trees, such as mesquite, which move water downward through their roots during wet periods but also transport water upward to "irrigate" understory grasses during drought.

- TRIF-WEES supports engagement with Arizona stakeholders. In FY 2017, UA faculty were leaders in the Border Heat-Health Partnership, a multi-stakeholder collaboration that included cities, agencies and universities in Arizona, Texas, New Mexico, California and Mexico. This effort brought federal funding to examine the public health effects of extreme heat and future preparedness needs. In March 2017, the Water Resources Research Center attracted 325 participants to its annual conference, which focused on irrigated agriculture and stimulated in-depth dialogue between diverse sectors of the agricultural water community. In addition, the Center for Climate Adaptation Science and Solutions brought scientists and stakeholders together to find collaborative solutions related to drought, water sustainability, agriculture, electric power generation, and tribal resilience. In addition, Arizona Project Wet (APW), a UA Cooperative Extension program, ran numerous APW Teacher Academies, training more than 500 K-12 teachers and improving water instructional practices throughout the state.

- WEES partners with industry. The new Institute for Energy Solutions expanded the UA's ability to create high-resolution weather models and power forecasts. This detailed information enabled 2.7 gigawatts of renewable energy power to be included in electric utility operations in Arizona. The institute's work also helps improve energy market trading strategies and allows utilities to schedule more high-efficiency power generators, reduce costs, defer maintenance, and optimize use of battery storage.

- UA startup, concrete substitute brings environmental and structural advantages. Inventor Jinhong Zhang, Ph.D., associate professor of mining and geological engineering in the University of Arizona College of Engineering, has developed a new substitute for concrete that has a number of advantages over traditional Portland cement. The new material is lighter, stronger and less expensive to produce than concrete.

FAST FACTS

- $35 million in new grants and gifts to the UA from WEES investments in faculty and research
- 152 graduate students, 74 undergraduate students and 16 postdocs enabled through assistantships, wages, scholarships, grants and research experiences
- 18 new invention disclosures, 22 patent applications filed, three new patents issued and four licenses and options.
- 12 pilot/seed grants that supported catalytic early-stage research, including:
  Food-energy-water nexus research to design and scale up agrivoltaic ecosystems that integrate solar, water harvesting, and warm season fool and herb crops.
  Collaborative teams involving hydrologists, microbiologists, and chemists, to evaluate the fundamental earth processes of geobiological weathering, carbon cycling dynamics, and landscape stability.
  Advancements in solar technology by researching and developing bi-facial solar cells to capture and convert sunlight on both front and back surfaces; offering new mounting and application possibilities.

IMPROVING HEALTH

TRIF investments in Improving Health administered through BIO5 have brought together world-class plant, animal, and human bioscientists, engineers, physicians and computational researchers to develop bold solutions for complex challenges such as disease, hunger, water and food safety, and other environmental issues 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, degenerative eye disorders and Alzheimer's disease and other age-related brain diseases that afflict Arizonans.**

- **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 life science disciplines 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.**

SELECTED ACCOMPLISHMENTS

Improving Health (IH) areas for investment were carefully chosen to align with areas of state and national need and for which UA faculty already have significant expertise. This strategy catalyzes the capacity to expand impact, economic opportunity and external funding opportunities when supported by this initiative. Several examples include:

- IH is helping to prevent and cure disease in our state's most vulnerable. Dr. John Galgiani and other researchers at the UA's Valley Fever Center for Excellence are working with computational expert, Dr. Yves Lussier, to build genetic profiles of people who get severely ill from Valley Fever. Some genetic factors — gender, blood type, and ethnicity — already are known to put people at higher risk for the potentially deadly respiratory disease. However, the biggest risk factor is geography: More than 65 percent of all Valley Fever cases in the U.S. occur in Arizona, and 30 percent occur in California. Galgiani believes that genes may make the difference and distinguish an infection that goes unnoticed from a case that could be life threatening. This NIH-funded study is designed to promote getting treatment before Valley Fever becomes severe, and may even lead to a preventative vaccine in the longer term.

- IH is enabling novel solutions to health and environmental challenges. Dr. Monica Schmidt has found a way to prevent the loss of millions of tons of crops to a fungus each year, offering the potential to improve food security on a global level. Crops around the world are susceptible to infection by a fungus that produces aflatoxins. In addition to the impact on food security, aflatoxins can stunt childhood growth, increase risk of liver cancer and make people more susceptible to HIV and malaria. In the U.S., crops meant for human consumption are tested for aflatoxin and destroyed if the toxins reach unacceptable levels. But no testing is conducted in many developing countries around the world, especially in Africa, where people depend on consuming what they harvest. Schmidt's work has the potential to improve public health, save lives, and eliminate costly crop destruction.

- IH is fueling cutting-edge science. New investments in genomics and proteomics have put the UA at the cutting edge of precision medicine research and clinical translation with a $43 million NIH team science grant. Meanwhile, Dr. Adam Buntzman has led an effort to harness supercomputers to create the first map of the human immune system. In addition, senior faculty and five new ecosystem genomics scientists are working together to develop the interface between two disciplines crucial to sustaining the natural biosphere on earth, and managing the goods and services that ecosystems provide. The cluster hires will benefit from Keating building shared space and access to cutting-edge research resources.

- IH is supporting commercialization of research results. Local startup Avery Therapeutics, Inc., has licensed a beating heart graft technology invented at the UA College of Medicine-Tucson. Pre-clinical studies have already shown that the technology, called MyCardia™, improves heart function. The inventors – Steve Goldman, M.D., professor of medicine at the Sarver Heart Center, and Jordan Lancaster, Ph.D., who earned his doctorate in physiology from the College of Medicine-Tucson – serve as the company's chief medical and chief science officers, respectively. The Avery leadership team also includes Jen Koevary, Ph.D., chief operating officer, who earned her doctorate in biomedical engineering from the UA.

FAST FACTS

- $74.5 million in new grants and gifts to the UA from IH investments in faculty and research.
- 439 graduate students, 741 undergraduate students and 160 post-docs enabled through assistantships, wages, scholarships, grants and research experiences.
- 55 new invention disclosures, 80 patent applications filed, seven new patents issued, one new startup company and six licenses and options.
- 18 pilot/seed grants that supported catalytic early-stage research, including:
  Novel collaborative approaches toward new understanding of the biology and genetics of pancreatic cancer in order to develop more precise therapies;
  Researchers from math, geography, and public health working together to more effectively model, and ultimately limit, the spread of mosquito-borne diseases like Zika; and
  Advancement toward the development of a potent and safe peptide-based therapeutic for the treatment of cardiac and cardiovascular disease related to cognitive impairment.

NATIONAL SECURITY SYSTEMS

The mission of the new National Security Systems (NSS) initiative is to bring new external resources to Arizona, advance the state's economy by integrating academic and technical leadership through university-industry-government partnerships, and provide public benefit by helping to solve complex problems in the national defense and security space.

GOALS:

- **Leverage TRIF investments to increase external federal Department of Defense and private-sector research and development funding to scale capacity.**
- **Strengthen and expand defense and security related research by recruiting the best and brightest faculty to Arizona and supporting projects that will advance the development of new technologies and products to aid in securing our national interest.**
- **Create new shared infrastructure and facilities that broadly benefit NSS.**
- **Support workforce development directly through student research teaming experiences in partnership with defense agencies, the UA, and industry.**
- **Set the stage for innovation and commercialization of research results by spawning new invention disclosures that will support future licensing and spinout companies.**

SELECTED ACCOMPLISHMENTS:

Arizona's aerospace and defense total exports rose more than 21.8 percent from 2011 to 2014 to total $3.47 billion. With more than 1,200 Arizona-based aerospace and defense companies, Arizona is the third largest U.S. supply chain contributor. This first year of our new TRIF investment in National Security Systems initiative are centered on growing our university capabilities and infrastructure, in alignment with defense industry and federal service agency needs. Evidence of the success of our approach includes strategically driven cluster hires and new partnerships with industry, including Ball and Raytheon. NSS exceeded its targeted extramural funding in this inaugural year.

- Business development infrastructure positioned for growth: Hires included an associate director for operations and two program managers specializing in Management, Cyber Security and Space Situational Awareness (SSA). This combination of expertise is bringing in an equivalent of 70 years of experience in these fields. The UA Defense & Security Research Institute (DSRI) has also worked to partner with the United States Army Research Laboratory in multiple research disciplines, resulting in the creation of a Cooperative Research and Development Agreement that allows for collaboration between the Department of Defense and the UA to help meet and address any research gaps.

- Bolstering NSS capacity to meet a global need: UA Faculty Cluster hires for Space Situational Awareness are now completed with TRIF support. These positions were hired over multiple colleges/departments to strengthen research capabilities in SSA and to help address the global need in space situational awareness – dealing with space debris, collision and avoidance. One of the cluster hires, Dr. Vishnu Reddy, is a current TRIF award receiver in SAA. He recently worked with five undergraduate students to install a new telescope on UA's campus to showcase our capabilities and partner with federal funding agencies and industry in collaborative research. Dr. Reddy has 13 published papers this year and is providing support for multiple graduate students and projects. "I used the TRIF money to generate about ~$1 million worth of PI grant money in year one. I have another $600 thousand worth of proposals as PI in review that are based on the funds from TRIF. I have established a long-standing relationship with the United States Air Force Research Lab on space situational awareness."

- Engaging industry for collaboration: TRIF-NSS resources were leveraged to support DSRI and facilitate UA faculty engagements with Department of Defense stakeholders and industry partners in such areas as intelligence gathering, medical exploration, space systems and cyberspace operations. In a short time, the UA has seen successful partnerships with industry leaders, providing a roadmap for collaboration. With DSRI support, UA executed a new Master Research Agreement with Ball Aerospace and Raytheon. These partnerships will streamline initiating research between UA faculty and our industry partners.

- Expanding UA cyber capabilities for NSS opportunities: UA is home to CyVerse, the $100 million NSF-funded cyber infrastructure that enables multiscale, multidimensional data integration, tools, computing and analysis. With TRIF support, UA built a secure workspace within Cyverse that enabled the integration and processing of large data sets that are produced in space situational awareness work. By leveraging this already powerful asset for support of defense related needs, UA is poised to realize more external funding.

- UA security startup sets down roots to grow: Neuro-ID, a company founded on research and technology developed by University of Arizona affiliates, is commercializing software that can identify suspicious behaviors based on a computer or smartphone user's typing, touch, scrolling or mouse movements. The technology could be invaluable to government and a wide range of industries including insurance, pharmacy, health care and e-commerce. And, with the help of Tech Launch Arizona, Neuro-ID has licensed the technology from the UA. Joe Valacich, a professor in the UA Eller College of Management's Department of Management Information Systems, founded the company with his former graduate student and current assistant professor at Bringham Young University, Jeff Jenkins.

- FY 2017 investments in NSS have established DSRI's identity as a research institute and advanced UA as a potential partner with Department of Defense research facilities, active duty military installations across Arizona, and government industry partners. These new and diverse teaming opportunities have expanded the knowledge, expertise, and value of UA research infrastructure and educational prospects.

FAST FACTS

- $1 million in new TRIF-seeded research funding.
- Supported training of 17 graduate students and post-docs, 10 undergraduate students.
- Research agreements signed with Raytheon and Ball Aerospace.

PROGRESS TOWARD GOALS

The mission of the UA's Technology and Research Initiative Fund (TRIF) is to deliver economic value and public benefit to the state of Arizona by:

- **Generating new dollars from outside the state to grow R&D activity in Arizona's public universities aligned with state economic sectors and needs.**
- **Translating and commercializing R&D results to support Arizona's economic development.**
- **Accelerating workforce training to prepare students for more high-tech, well-paying jobs in Arizona.**
- **Providing public benefit through new technologies, diagnostics, devices, therapeutics and advances that positively impact quality of life and well-being.**

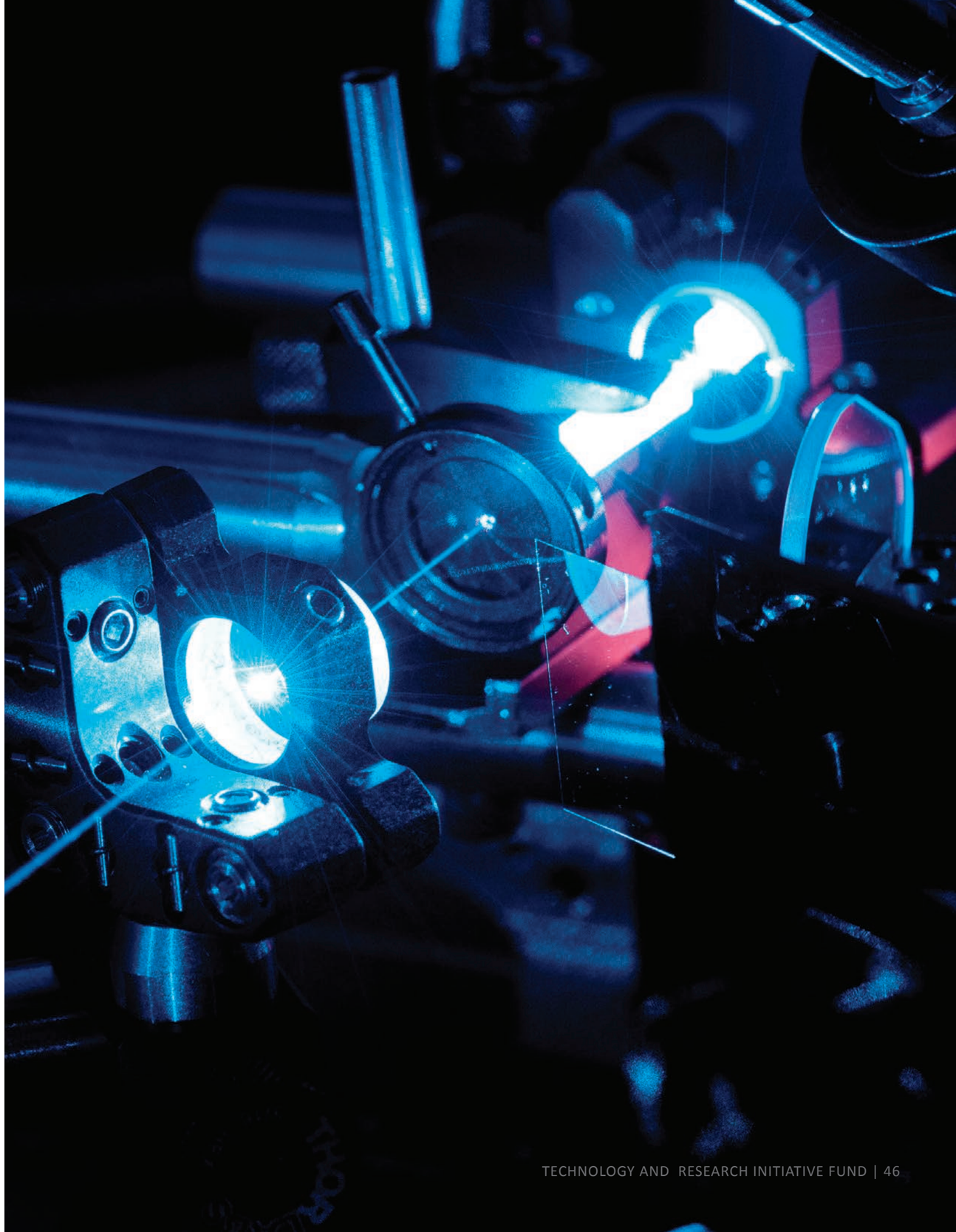
In the final five-year TRIF plan, the UA reoriented its overall investment strategy to improve alignment with Arizona's industry needs defined by the Arizona Commerce Authority and expanded the focus on hiring faculty researchers in these key areas to add talent and capacity to address challenges identified by Arizona businesses. Consistent with this strategy, UA participated in the National Security Systems initiative for the first time, leveraging our newly created Defense & Security Research Institute, coupling our recognized physical science research expertise (UA is ranked No. 2 among the 515 universities surveyed by the National Science Foundation, HERD Survey 2015) and Arizona's deep aerospace, defense, and security industry base and military installation presence.

The UA has made substantial progress toward 2021 goals. With overall TRIF expenditures of $22.13 million, UA's calculated financial impact (sponsored awards, gifts and other sources, and royalty income) of these investments was $180 million. Our FY 2017 financial impact actual exceeded our FY 2017 goal by $24 million, and was just shy of our FY 2019 goal ($183.77 million).

Technology Transfer activity also beat projections. FY 2017 invention disclosures and patents were approximately 20 percent above expectations, and the number of university startups were double the projections. The workforce contribution of TRIF investments in this first year was also strong – the number of graduate students trained exceeded projections by more than 40, and the number of undergraduates benefitting from TRIF programs was nearly twice (854) the projection (442).

Given this year was the first in the UA's refined TRIF investment strategy, the lag related to the academic cycle faculty search processes between position authorization and researcher arrival on campus affected the initiation of TRIF expenditures. Furthermore, because many of these positions targeted more experienced researchers with established programs, the search, acceptance and program transfer process was more protracted than for junior hires fresh off post-doctoral study. Risks to UA's continued success include research space availability and suitability to modern research needs, particularly given the age of UA's campus buildings and infrastructure.

Overall, the results from the UA's TRIF investment strategy in this first year of the final five-year planning period was uniformly successful, and sets the stage for further growth in the ensuing years.



BOARD OF Regents ARIZONA'S PUBLIC UNIVERSITIES

EDUCATE · DISCOVER · IMPACT

ARIZONA BOARD OF REGENTS

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's public universities' strategic plan and strengthen the board's ability to provide oversight of the universities' research and Arizona's workforce development activities.

Three general areas received funding as ABOR TRIF funded initiatives: Data/Resources/Technology, STEM/Innovation Projects, and the Regents' Innovation Fund.

DATA/RESOURCES/TECHNOLOGY

This category includes investments in the National Student Clearinghouse and Education Advisory Board, as well as supporting the business intelligence and database projects of the board office. Both the external investments as well as the internal investment have enriched the data analysis and reporting capacity of the board office. This has resulted in more robust analysis, accountability and metric reporting.

STEM/INNOVATION PROJECTS

Two major projects supporting STEM and innovation were supported this year: the BioAccel Solutions Challenge and the Arizona Technology Council/SciTech. The SciTech Festival continues to engage the citizens of Arizona in hands-on experiences with the STEM education in their community. As part of the BioAccel Solutions Challenge, ABOR was proud to support the "Regents Rivalry Award for Students." The Arizona State University team, winning the student competition, developed a wrist-based pulse oximeter designed to be used in monitoring and tracking the health of children suffering from respiratory related diseases or illnesses.

BioAccel winners of the Regents Rivalry Award for students proof-of-product pitch from ASU pose with BioAccel leadership.

BIOACCEL

There is no continuously wearable pulse oximeter available to children. This creates a stressful situation for parents of children with severe respiratory diseases, particularly while the child is sleeping. This also prevents children with severe respiratory diseases from participating in physical activity due to fears of overexertion.

The Troxie team has developed a wearable, wrist-based pulse oximeter to be used in monitoring and tracking the health of children suffering from respiratory related diseases or illnesses. Unlike current devices on the market, the Wrist-Based Pulse Oximeter provides a discrete, pediatric-specific, continuous monitoring system that is affordable without insurance and available without prescription.

REGENTS' INNOVATION FUND

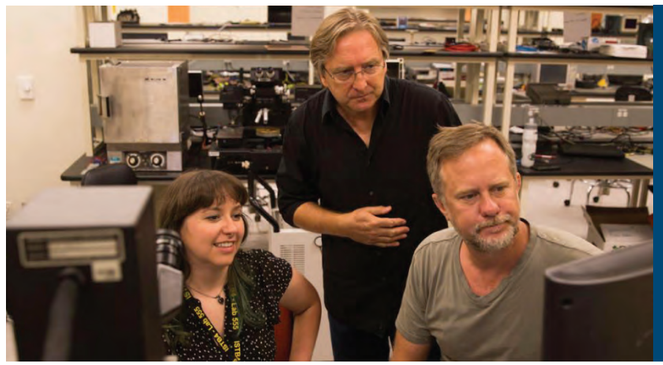
The Regents' Innovation Fund (RIF) continues to be instrumental in supporting the research activities of the universities, and in contributing toward the collaborative efforts among the universities with community partners. As part of the June 2016 board meeting, the regents approved funding for three RIF projects. These projects were designed and submitted by a tri-university collaborative effort. The Live Data: Digital Research Infrastructure-Phase III was approved for another year of funding. Two new projects received the remaining available funds: Arizona Tri-University Transportation Research Center Pilot Research Portfolio, and Exploiting Nanomaterials for End-to-End Cybersecurity Solutions.

LIVE DATA: DIGITAL RESEARCH INFRASTRUCTURE-PHASE III

This is a collaborative effort of the three universities with the aim of creating shared infrastructure and functionality that benefits the universities and provides a competitive advantage for researchers and faculty within the Arizona university system. The Live Data project continues to expand the discovery portal, giving commercial entities an easier way to discover the research outputs of the three universities and making it easier to identify potential partnerships and endeavors.

ARIZONA TRI-UNIVERSITY TRANSPORTATION RESEARCH CENTER PILOT RESEARCH PORTFOLIO

The purpose of this project is to define and develop a portfolio of transportation projects around a transportation research center. Each project addresses a state transportation need and includes a multi-disciplinary approach. The projects will be managed through the University Transportation Center and will act as an accelerator to U.S. Department of Transportation funding opportunities. The project is focusing on the I-10 corridor and roadway safety, among its multiple-project approach.

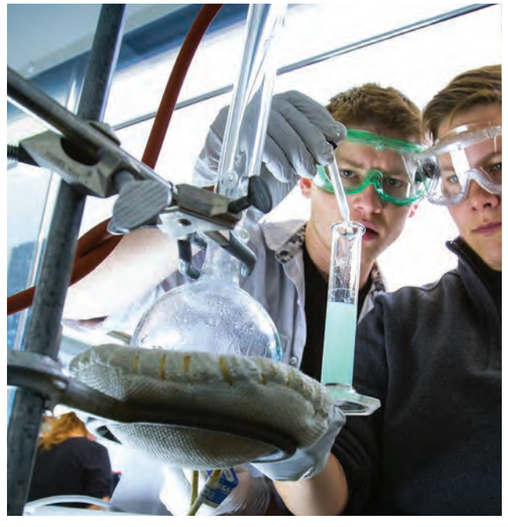


Scientists from the three universities are researching new cypersecurity methods as part of a Regents Innovation Fund grant.

EXPLOITING NANOMATERIALS FOR END-TO-END CYBERSECURITY SOLUTIONS

The project has three focus areas: 1) ID Authentication with dendrite materials; 2) Firewalls for optical communications with nanohelices; and 3) Securing the Internet of Things (IoT) with ReRAM memories. This collaborative effort will prove the concept of nanomaterials use in cybersecurity. In turn, this will encourage government agencies and public/private enterprises to support further research and commercialization of intellectual property developed under this project.

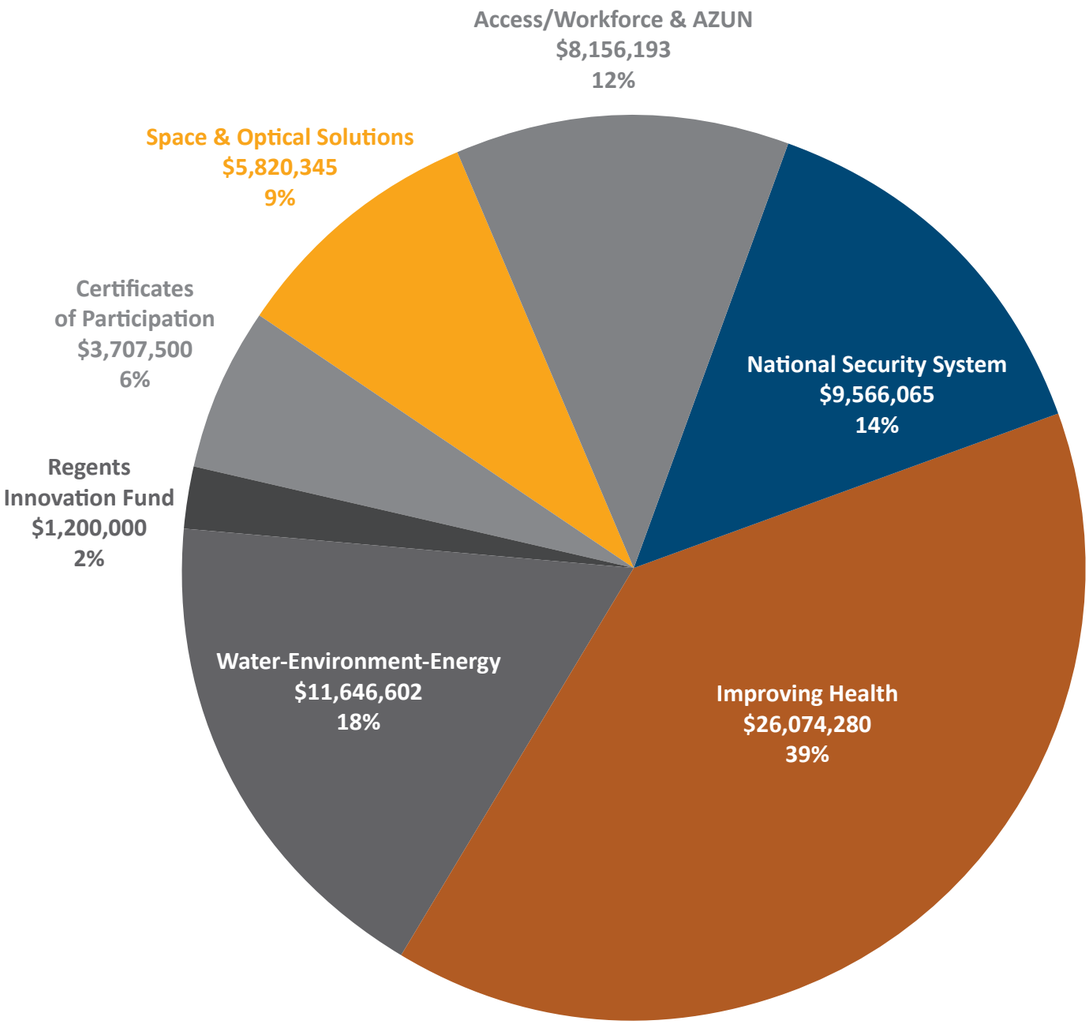
FINANCIALS & METRICS

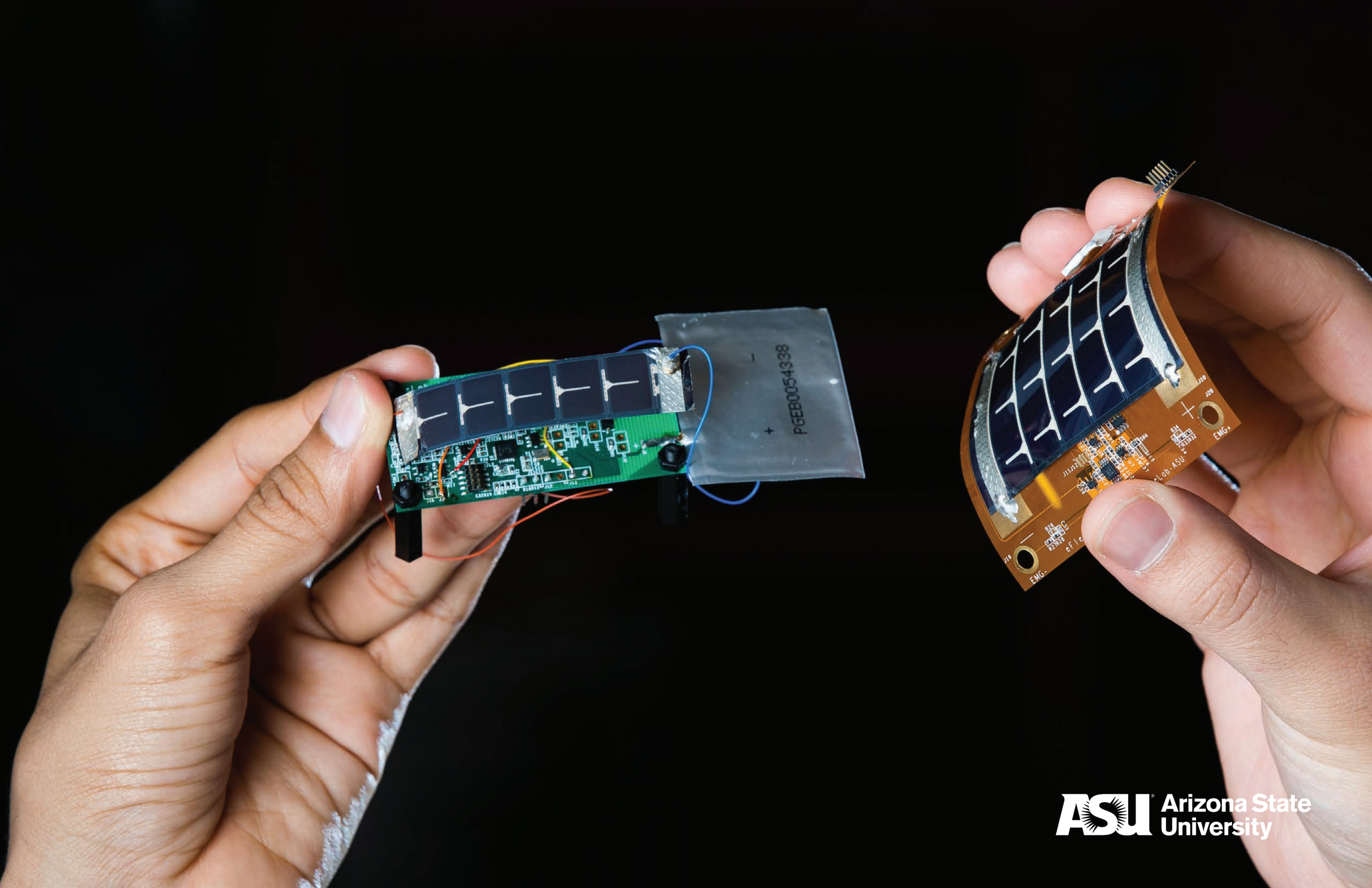


FY 2017 - 2021
ARIZONA UNIVERSITY SYSTEM
TECHOLOGY AND RESEARCH INITIATIVE FUND

	FY 2017 BUDGET	*FY 2017 ACTUAL*	*FY 2018 BUDGET*	*FY 2019 BUDGET*	*FY 2020 BUDGET*	*FY 2021 BUDGET*
REVENUE						
Carry forward		$ 4,322,940	$ 8,524,774	$ -	$ -	$ -
TRIF Revenue	74,003,500	72,797,470	76,500,000	80,300,000	84,000,000	88,000,000
TOTAL REVENUE	**$ 74,003,500**	**$ 77,120,410**	**$ 85,024,774**	**$ 80,300,000**	**$ 84,000,000**	**$ 88,000,000**
EXPENDITURES						
OPERATING	58,230,000	56,555,913	-	-	-	-
CAPITAL	10,166,000	8,088,491				
ASU Polytechnic/West COPs	3,707,500	3,707,500				
TOTAL CAPITAL	**13,873,500**	**11,795,991**	-	-	-	-
EXPENDITURES TOTAL	**$ 72,103,500**	**$ 68,351,904**	**$ -**	**$ -**	**$ -**	**$ -**
SUMMARY BY PROGRAM AREA						
Improving Health	$ 26,481,348	$ 26,074,280	$ 28,516,878	$ 29,276,574	$ 31,543,039	$ 31,403,509
Water, Environment, Energy Solutions	14,758,692	11,646,602	17,235,045	16,443,208	17,732,900	19,653,858
National Security Systems	11,641,970	9,566,065	15,224,306	11,528,567	10,893,839	10,832,795
Space Exploration and Optical Solutions	7,074,183	5,850,345	7,298,163	9,990,604	10,741,556	12,694,264
Access & Workforce Development	7,839,807	7,656,193	8,223,732	8,547,047	8,869,666	9,191,574
Regents Innovation Fund	1,200,000	1,200,000	1,000,000	1,000,000	1,000,000	1,000,000
ASU Poly/ASU West COPs	3,707,500	3,707,500	3,704,000	3,704,000	3,704,000	3,704,000
AZUN	500,000	500,000	505,000	510,000	515,000	520,000
ABOR Other	800,000	2,150,919	1,000,000	1,000,000	1,000,000	1,000,000
PROGRAM AREA TOTAL	**74,003,500**	**68,351,904**	**82,707,124**	**82,000,000**	**86,000,000**	**90,000,000**
EXPENDITURES TOTAL	**$ 74,003,500**	**$ 68,351,904**	**$ 82,707,124**	**$ 82,000,000**	**$ 86,000,000**	**$ 90,000,000**

FY 2017
ACTUAL TRIF EXPENDITURES

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FY 2017 - 2021
ARIZONA STATE UNIVERSITY
TECHOLOGY AND RESEARCH INITIATIVE FUND

	FY 2017 BUDGET	*FY 2017 ACTUAL*	*FY 2018 BUDGET*	*FY 2019 BUDGET*	*FY 2020 BUDGET*	*FY 2021 BUDGET*
REVENUE						
Carry forward			$ 395,800			
TRIF Revenue	31,025,900	30,543,488	32,622,400	34,222,400	35,822,400	37,422,400
TOTAL REVENUE	**$ 31,025,900**	**$ 30,543,488**	**$ 33,018,200**	**$ 34,222,400**	**$ 35,822,400**	**$ 37,422,400**
EXPENDITURES						
OPERATING	23,818,400	24,876,300				
CAPITAL	3,500,000	1,404,100				
ASU Poly/ASU West COPs	3,707,500	3,707,500	3,704,000	3,704,000	3,704,000	3,704,000
TOTAL EXPENDITURES	**$ 31,025,900**	**$ 29,987,900**	**$ 3,704,000**	**$ 3,704,000**	**$ 3,704,000**	**$ 3,704,000**
SUMMARY BY INITIATIVE						
Improving Health	$ 13,376,521	$ 13,541,800	$ 14,131,519	$ 14,827,611	$ 15,524,742	$ 16,222,933
Water, Environment and Energy Solutions	7,050,459	6,572,000	7,349,538	7,768,132	8,186,383	8,604,285
National Security Systems	3,561,613	3,671,700	3,769,612	3,977,610	4,185,609	4,393,608
Access & Workforce Development						
Entrepreneurship & Innovation	1,369,851	614,200	1,449,851	1,529,850	1,609,850	1,689,849
Advanced Manufacturing	1,959,956	1,880,700	2,217,881	2,415,197	2,611,816	2,807,725
TOTAL	27,318,400	26,280,400	28,918,401	30,518,400	32,118,400	33,718,400
ASU Poly/ASU West COPS	3,707,500	3,707,500	3,704,000	3,704,000	3,704,000	3,704,000
TOTAL EXPENDITURES	**$ 31,025,900**	**$ 29,987,900**	**$ 32,622,401**	**$ 34,222,400**	**$ 35,822,400**	**$ 37,422,400**

ARIZONA STATE UNIVERSITY
TECHOLOGY AND RESEARCH INITIATIVE FUND
IMPROVING HEALTH

PERFORMANCE ANALYSIS	*FY 2017 BUDGET*	*FY 2017 ACTUAL*	*FY 2018 BUDGET*	*FY2019 BUDGET*	*FY 2020 BUDGET*	*FY 2021 BUDGET*
TRIF EXPENDITURES						
Total	$ 13,376,521	$ 13,541,800	$ 14,131,519	$ 14,827,611	$ 15,524,742	$ 16,222,933
FINANCIAL IMPACT OF TRIF INVESTMENT						
Sponsored Awards	$ 77,500,000	$ 82,409,681	$ 90,750,000	$ 100,750,000	$ 110,750,000	$ 124,000,000
Gifts & Other Sources	1,100,000	723,874	1,130,000	1,160,000	1,190,000	1,220,000
Royalty Income	800,000	157,454	800,000	800,000	800,000	800,000
TOTAL	**79,400,000**	**83,291,009**	**92,680,000**	**102,710,000**	**112,740,000**	**126,020,000**
TECHNOLOGY TRANSFER ACTIVITY						
Invention Disclosures Transacted	55	81	56	57	59	60
US Patents Issued	6	31	6	6	7	7
Licenses and Options Executed	16	37	17	18	20	22
Startup Companies	2	5	2	2	3	3
WORKFORCE CONTRIBUTION						
Academic and Postdoctoral Appointees	109	145	118	126	133	143
Graduate Students	343	542	372	394	416	445
Undergraduate Students	251	267	273	289	306	328

ARIZONA STATE UNIVERSITY
TECHOLOGY AND RESEARCH INITIATIVE FUND
NATIONAL SECURITY SYSTEMS

PERFORMANCE ANALYSIS	FY 2017 BUDGET	FY 2017 ACTUAL	FY 2018 BUDGET	FY2019 BUDGET	FY 2020 BUDGET	FY 2021 BUDGET
TRIF EXPENDITURES						
Total	$ 3,561,613	$ 3,671,700	$ 3,769,612	$ 3,977,610	$ 4,185,609	$ 4,393,608
FINANCIAL IMPACT OF TRIF INVESTMENT						
Sponsored Awards	$ 36,000,000	$ 39,063,761	$ 43,000,000	$ 48,000,000	$ 53,000,000	$ 60,000,000
Gifts & Other Sources						
Royalty Income	50,000	-	50,000	50,000	50,000	50,000
TOTAL	**36,050,000**	**39,063,761**	**43,050,000**	**48,050,000**	**53,050,000**	**60,050,000**
TECHNOLOGY TRANSFER ACTIVITY						
Invention Disclosures Transacted	20	35	22	25	27	30
US Patents Issued	2	9	2	3	3	4
Licenses and Options Executed	4	4	4	4	5	5
Startup Companies	0	4	0	0	0	0
WORKFORCE CONTRIBUTION						
Academic and Postdoctoral Appointees	27	43	30	32	34	36
Graduate Students	227	338	249	265	281	303
Undergraduate Students	115	190	126	134	142	153

ARIZONA STATE UNIVERSITY
TECHOLOGY AND RESEARCH INITIATIVE FUND
WATER, ENVIRONMENTAL, ENERGY SOLUTIONS

PERFORMANCE ANALYSIS	FY 2017 BUDGET	FY 2017 ACTUAL	FY 2018 BUDGET	FY2019 BUDGET	FY 2020 BUDGET	FY 2021 BUDGET
TRIF EXPENDITURES						
Total	$ 7,050,459	$ 6,572,000	$ 7,349,538	$ 7,768,132	$ 8,186,383	$ 8,604,285
FINANCIAL IMPACT OF TRIF INVESTMENT						
Sponsored Awards	$ 23,000,000	$ 27,874,447	$ 26,000,000	$ 28,500,000	$ 30,100,000	$ 34,000,000
Gifts & Other Sources	4,250,000	4,248,699	4,380,000	4,510,000	4,650,000	4,790,000
Royalty Income	100,000	2,000	100,000	100,000	100,000	100,000
TOTAL	**27,350,000**	**32,125,146**	**30,480,000**	**33,110,000**	**34,850,000**	**38,890,000**
TECHNOLOGY TRANSFER ACTIVITY						
Invention Disclosures Transacted	12	22	12	12	13	13
US Patents Issued	2	3	2	2	2	3
Licenses and Options Executed	4	3	5	5	5	5
Startup Companies	0	1	0	0	0	0
WORKFORCE CONTRIBUTION						
Academic and Postdoctoral Appointees	29	60	31	32	33	36
Graduate Students	148	210	158	166	171	183
Undergraduate Students	179	241	190	200	206	221

ARIZONA STATE UNIVERSITY
TECHOLOGY AND RESEARCH INITIATIVE FUND
ACCESS & WORKFORCE DEVELOPMENT:
ADVANCED MANUFACTURING

PERFORMANCE ANALYSIS	FY 2017 BUDGET	FY 2017 ACTUAL	FY 2018 BUDGET	FY2019 BUDGET	FY 2020 BUDGET	FY 2021 BUDGET
TRIF EXPENDITURES						
Total	$ 1,959,956	$ 1,880,700	$ 2,217,881	$ 2,415,197	$ 2,611,816	$ 2,807,725
FINANCIAL IMPACT OF TRIF INVESTMENT						
Sponsored Awards	$ 12,500,000	$ 13,047,918	$ 16,100,000	$ 18,750,000	$ 21,250,000	$ 25,000,000
Gifts & Other Sources	100,000	112,652	100,000	100,000	100,000	100,000
Royalty Income	50,000	16,000	50,000	50,000	50,000	50,000
TOTAL	**12,650,000**	**13,176,570**	**16,250,000**	**18,900,000**	**21,400,000**	**25,150,000**
TECHNOLOGY TRANSFER ACTIVITY						
Invention Disclosures Transacted	6	27	8	9	10	12
US Patents Issued	1	5	1	1	2	2
Licenses and Options Executed	2	8	3	3	3	4
Startup Companies	1	3	1	1	1	1
WORKFORCE CONTRIBUTION						
Academic and Postdoctoral Appointees	9	33	11	12	13	14
Graduate Students	46	155	53	57	62	69
Undergraduate Students	51	75	58	64	69	77

ARIZONA STATE UNIVERSITY
TECHOLOGY AND RESEARCH INITIATIVE FUND
ACCESS & WORKFORCE DEVELOPMENT:
ENTREPRENEURSHIP & INNOVATION

PERFORMANCE ANALYSIS	FY 2017 BUDGET	FY 2017 ACTUAL	FY 2018 BUDGET	FY2019 BUDGET	FY 2020 BUDGET	FY 2021 BUDGET
TRIF EXPENDITURES						
Total	$ 1,369,851	$ 614,200	$ 1,449,851	$ 1,529,850	$ 1,609,850	$ 1,689,849
FINANCIAL IMPACT OF TRIF INVESTMENT						
Sponsored Awards	$ 2,000,000	$ 2,960,137	$ 2,750,000	$ 3,500,000	$ 4,100,000	$ 5,000,000
Gifts & Other Sources						
Royalty Income						
TOTAL	**2,000,000**	**2,960,137**	**2,750,000**	**3,500,000**	**4,100,000**	**5,000,000**
TECHNOLOGY TRANSFER ACTIVITY						
Invention Disclosures Transacted						
US Patents Issued						
Licenses and Options Executed						
Startup Companies	20	26	21	22	23	24
WORKFORCE CONTRIBUTION						
Academic and Postdoctoral Appointees	0	1	0	0	0	0
Graduate Students	25	99	26	28	29	30
Undergraduate Students	125	246	131	138	145	152

NORTHERN ARIZONA UNIVERSITY

FY 2017 - 2021
NORTHERN ARIZONA UNIVERSITY
TECHOLOGY AND RESEARCH INITIATIVE FUND

	FY 2017 BUDGET	*FY 2017 ACTUAL*	*FY 2018 BUDGET*	*FY 2019 BUDGET*	*FY 2020 BUDGET*	*FY 2021 BUDGET*
REVENUE						
Carry forward		$ 1,281,965	$ 1,815,739			
TRIF Revenue	13,659,200	13,417,994	14,159,200	14,919,200	15,659,200	16,459,200
TOTAL REVENUE	**$ 13,659,200**	**$ 14,699,959**	**$ 15,974,939**	**$ 14,919,200**	**$ 15,659,200**	**$ 16,459,200**
EXPENDITURES						
OPERATING	11,883,200	11,089,829				
CAPITAL	1,776,000	1,794,391				
TOTAL EXPENDITURES	**$ 13,659,200**	**$ 12,884,220**	**$ -**	**$ -**	**$ -**	**$ -**
SUMMARY BY INITIATIVE						
Improving Health	$ 1,949,827	$ 1,987,146	$ 2,275,585	$ 2,191,794	$ 3,201,053	$ 3,220,755
Water, Environment and Energy Solutions	2,100,733	1,547,695	1,348,167	2,267,503	2,738,905	3,369,423
National Security Systems	4,376,957	3,305,425	3,465,588	3,394,525	2,335,607	1,377,873
Space Exploration & Optical Solutions	221,683	382,661	2,308,860	2,293,378	2,620,635	3,677,149
Access & Workforce Development	4,510,000	5,161,293	4,556,000	4,602,000	4,648,000	4,694,000
AZUN	500,000	500,000	505,000	510,000	515,000	520,000
TOTAL EXPENDITURES	**$ 13,659,200**	**$ 12,884,220**	**$ 14,459,200**	**$ 15,259,200**	**$ 16,059,200**	**$ 16,859,200**

NORTHERN ARIZONA UNIVERSITY
TECHOLOGY AND RESEARCH INITIATIVE FUND
IMPROVING HEALTH

PERFORMANCE ANALYSIS	*FY 2017 BUDGET*	*FY 2017 ACTUAL*	*FY 2018 BUDGET*	*FY2019 BUDGET*	*FY 2020 BUDGET*	*FY 2021 BUDGET*
TRIF EXPENDITURES						
Total	$ 1,949,827	$ 1,987,146				
FINANCIAL IMPACT OF TRIF INVESTMENT						
Sponsored Awards	$ 2,432,046	$ 9,823,529				
Gifts & Other Sources	121,602	200,000				
Royalty Income	8,333	24,070				
TOTAL	**2,561,981**	**10,047,599**	**-**	**-**	**-**	**-**
TECHNOLOGY TRANSFER ACTIVITY						
Invention Disclosures Transacted	17	27				
US Patents Issued	1	3				
Licenses and Options Executed	1	2				
Startup Companies	1	1				
WORKFORCE CONTRIBUTION						
Academic and Postdoctoral Appointees	2	13				
Graduate Students	15	29				
Undergraduate Students	20	75				

NORTHERN ARIZONA UNIVERSITY
TECHOLOGY AND RESEARCH INITIATIVE FUND
WATER, ENVIRONMENTAL, ENERGY SOLUTIONS

PERFORMANCE ANALYSIS	*FY 2017 BUDGET*	*FY 2017 ACTUAL*	*FY 2018 BUDGET*	*FY2019 BUDGET*	*FY 2020 BUDGET*	*FY 2021 BUDGET*
TRIF EXPENDITURES						
Total	$ 2,100,733	$ 1,547,695				
FINANCIAL IMPACT OF TRIF INVESTMENT						
Sponsored Awards	$ 3,151,100	$ 11,241,109				
Gifts & Other Sources	157,555	0				
Royalty Income	8,333	0				
TOTAL	**3,316,988**	**11,241,109**	**-**	**-**	**-**	**-**
TECHNOLOGY TRANSFER ACTIVITY						
Invention Disclosures Transacted	8	5				
US Patents Issued	0	2				
Licenses and Options Executed	1	0				
Startup Companies	0	0				
WORKFORCE CONTRIBUTION						
Academic and Postdoctoral Appointees	2	17				
Graduate Students	15	50				
Undergraduate Students	150	136				

NORTHERN ARIZONA UNIVERSITY
TECHOLOGY AND RESEARCH INITIATIVE FUND
NATIONAL SECURITY SYSTEMS

PERFORMANCE ANALYSIS	*FY 2017 BUDGET*	*FY 2017 ACTUAL*	*FY 2018 BUDGET*	*FY2019 BUDGET*	*FY 2020 BUDGET*	*FY 2021 BUDGET*
TRIF EXPENDITURES						
Total	$ 4,376,957	$ 3,305,425				
FINANCIAL IMPACT OF TRIF INVESTMENT						
Sponsored Awards	$ 4,403,366	$ 5,493,136				
Gifts & Other Sources	220,168	0				
Royalty Income	8,333	6,000				
TOTAL	**4,631,867**	**5,499,136**	**-**	**-**	**-**	**-**
TECHNOLOGY TRANSFER ACTIVITY						
Invention Disclosures Transacted	4	9				
US Patents Issued	0	0				
Licenses and Options Executed	1	1				
Startup Companies	0	0				
WORKFORCE CONTRIBUTION						
Academic and Postdoctoral Appointees	2	5				
Graduate Students	6	3				
Undergraduate Students	10	10				

NORTHERN ARIZONA UNIVERSITY
TECHOLOGY AND RESEARCH INITIATIVE FUND
SPACE EXPLORATION AND OPTICAL SOLUTIONS

PERFORMANCE ANALYSIS	FY 2017 BUDGET	FY 2017 ACTUAL	FY 2018 BUDGET	FY2019 BUDGET	FY 2020 BUDGET	FY 2021 BUDGET
TRIF EXPENDITURES						
Total	$ 221,683	$ 382,661				
FINANCIAL IMPACT OF TRIF INVESTMENT						
Sponsored Awards	$ 323,289	$ 1,256,431				
Gifts & Other Sources	16,164	0				
Royalty Income	0	0				
TOTAL	**339,453**	**1,256,431**	-	-	-	-
TECHNOLOGY TRANSFER ACTIVITY						
Invention Disclosures Transacted	1	0				
US Patents Issued	0	0				
Licenses and Options Executed	0	0				
Startup Companies	0	0				
WORKFORCE CONTRIBUTION						
Academic and Postdoctoral Appointees	2	1				
Graduate Students	6	3				
Undergraduate Students	35	2				

NORTHERN ARIZONA UNIVERSITY
TECHOLOGY AND RESEARCH INITIATIVE FUND
ACCESS & WORKFORCE DEVELOPMENT

PERFORMANCE ANALYSIS	FY 2017 BUDGET	FY 2017 ACTUAL	FY 2018 BUDGET	FY2019 BUDGET	FY 2020 BUDGET	FY 2021 BUDGET
TRIF EXPENDITURES						
AWD	$ 4,510,000	$ 5,161,293				
AZUN	$ 500,000	$ 500,000				
Total	$ 5,010,000	$ 5,661,293				
FINANCIAL IMPACT OF TRIF INVESTMENT						
Annual Impact of Graduates on Economy[1]	$ 5,174,000	$ 5,147,000				
Degree/Certificate Programs Offered [2]	$ 75	$ 92				
Business/Nonprofit Collaborations [3]	$ 160	$ 211				
Number of Students Served by A/WD [4]	$ 4,000	$ 4,482				
TOTAL	**5,178,235**	**5,151,785**	-	-	-	-
WORKFORCE CONTRIBUTION						
Web/Hybrid/Enhanced Courses Developed[5]	150	191				
Faculty Developing Courses[6]	370	405				
Increase in Student Technology Literacy[7]	4,300	4,310				
Individual Faculty Trained in Teaching Technologies[8]	250	376				
Faculty Support Incidents Resolved Technologies[9]	17,000	1,359				
Faculty using Adaptive Courseware	5	16				

THE UNIVERSITY OF ARIZONA

FY 2017 - 2021
UNIVERSITY OF ARIZONA
TECHOLOGY AND RESEARCH INITIATIVE FUND

	FY 2017 BUDGET	*FY 2017 ACTUAL*	*FY 2018 BUDGET*	*FY2019 BUDGET*	*FY 2020 BUDGET*	*FY 2021 BUDGET*
REVENUE						
Carryforward		-	$ 4,707,123			
TRIF Revenue	27,318,400	26,835,988	28,918,400	30,518,400	32,118,400	33,718,400
TOTAL REVENUE	**$ 27,318,400**	**$ 26,835,988**	**$ 28,918,400**	**$ 30,518,400**	**$ 32,118,400**	**$ 33,718,400**
EXPENDITURES						
OPERATING	22,428,400	17,238,866				
CAPITAL	4,890,000	4,890,000				
TOTAL EXPENDITURES	**$ 27,318,400**	**$ 22,128,865**	**$ -**	**$ -**	**$ -**	**$ -**
SUMMARY BY INITIATIVE						
Improving Health	$ 11,155,000	$ 10,545,334	$ 12,109,774	$ 12,257,169	$ 12,817,244	$ 11,959,821
Space Exploration & Optical Solutions	6,852,500	5,467,685	8,537,340	6,407,573	6,807,612	7,680,150
Water, Environmental, Energy Solutions	5,607,500	3,526,907	7,989,106	4,156,432	4,372,623	5,061,314
National Security Systems	3,703,400	2,588,940	4,989,303	7,697,226	8,120,921	9,017,115
TOTAL EXPENDITURES	**$ 27,318,400**	**$ 22,128,865**	**$ 33,625,523**	**$ 30,518,400**	**$ 32,118,400**	**$ 33,718,400**

UNIVERSITY OF ARIZONA
TECHOLOGY AND RESEARCH INITIATIVE FUND
IMPROVING HEALTH

PERFORMANCE ANALYSIS	**Projected FY 17**	**Actual FY 17**	**Projected FY 18**	**Projected FY 19**	**Projected FY 20**	**Projected FY 21**
TRIF EXPENDITURES						
Total	11,155,000	10,545,334	11,697,093	12,257,169	12,817,244	11,959,821
			4.9%	4.8%	4.6%	-6.7%
FINANCIAL IMPACT OF TRIF INVESTMENT						
Sponsored Awards	60,000,000	74,499,075	62,400,000	64,896,000	67,491,840	70,191,514
Gifts & Other Sources	600,000	117,545	624,000	648,960	674,918	701,915
Royalty Income	50,000	16,000	52,000	54,080	56,243	58,493
TOTAL	**60,650,000**	**74,632,620**	**63,076,000**	**65,599,040**	**68,223,002**	**70,951,922**
TECHNOLOGY TRANSFER ACTIVITY						
Invention Disclosures Transacted	40	55	42	45	50	55
US Patents Issued	1	7	2	2	4	5
Licenses and Options Executed	9	6	10	11	12	13
Startup Companies	1	1	1	1	2	2
WORKFORCE CONTRIBUTION						
Postdoctoral Appointees	100	160	105	110	116	122
Graduate Students	300	439	315	331	347	365
Undergraduate Students	320	741	336	353	370	389
	5.4	7.1	5.4	5.4	5.3	5.9

FY 2017 - 2021
UNIVERSITY OF ARIZONA
SPACE EXPLORATION AND OPTICAL SOUTIONS

PERFORMANCE ANALYSIS	Projected FY 17	Actual FY 17	Projected FY 18	Projected FY 19	Projected FY 20	Projected FY 21
TRIF EXPENDITURES						
Total	$ 6,852,500	$ 5,467,685	$ 7,273,532	$ 7,697,226	$ 8,120,921	$ 9,017,115
			6.1%	5.8%	5.5%	11.0%
FINANCIAL IMPACT OF TRIF INVESTMENT						
Sponsored Awards	60,000,000	67,398,490	62,400,000	64,896,000	67,491,840	70,191,514
Gifts & Other Sources	1,000,000	525,123	1,000,000	11,000,000	1,000,000	1,000,000
Royalty Income	120,000	1,256,754	124,800	129,792	134,984	140,383
TOTAL	**$ 61,120,000**	**$ 69,180,367**	**$ 63,524,800**	**$ 76,025,792**	**$ 68,626,824**	**$ 71,331,897**
TECHNOLOGY TRANSFER ACTIVITY						
Invention Disclosures Transacted	40	50	42	45	50	55
US Patents Issued	15	14	2	2	4	5
Licenses and Options Executed	15	21	17	18	20	22
Startup Companies	1	5	1	1	2	2
WORKFORCE CONTRIBUTION						
Postdoctoral Appointees	15	2	16	17	17	18
Graduate Students	40	55	42	44	46	49
Undergraduate Students	8	29	8	9	9	10
	8.92	12.65	8.73	9.88	8.45	7.91

UNIVERSITY OF ARIZONA
TECHOLOGY AND RESEARCH INITIATIVE FUND
WATER, ENVIRONMENTAL AND ENERGY SOLUTIONS

PERFORMANCE ANALYSIS	Projected FY 17	Actual FY 17	Projected FY 18	Projected FY 19	Projected FY 20	Projected FY 21
TRIF EXPENDITURES						
Total	$ 5,607,500	$ 3,526,907	$ 6,007,534	$ 6,407,573	$ 6,807,612	$ 7,680,150
			7.1%	6.7%	6.2%	12.8%
FINANCIAL IMPACT OF TRIF INVESTMENT						
Sponsored Awards	31,000,000	28,190,149	32,240,000	33,529,600	34,870,784	36,265,615
Gifts & Other Sources	3,400,000	6,978,663	3,536,000	3,677,440	3,824,538	3,977,519
Royalty Income	750,000	8,250	780,000	811,200	843,648	877,394
TOTAL	**$ 35,150,000**	**$ 35,177,062**	**$ 36,556,000**	**$ 38,018,240**	**$ 39,538,970**	**$ 41,120,528**
TECHNOLOGY TRANSFER ACTIVITY						
Invention Disclosures Transacted	20	18	21	23	25	27
US Patents Issued	2	3	2	2	4	5
Licenses and Options Executed	6	4	7	7	8	9
Startup Companies	1	1	1	1	1	1
WORKFORCE CONTRIBUTION						
Postdoctoral Appointees	85	16	89	94	98	103
Graduate Students	270	152	284	298	313	328
Undergraduate Students	110	74	116	121	127	134
	6.27	9.97	6.09	5.93	5.81	5.35

FY 2017 - 2021
UNIVERSITY OF ARIZONA
NATIONAL SECURITY SYSTEMS

PERFORMANCE ANALYSIS	Projected FY 17	Actual FY 17	Projected FY 18	Projected FY 19	Projected FY 20	Projected FY 21
TRIF EXPENDITURES						
Total	$ 3,703,400	$ 2,588,940	$ 3,940,241	$ 4,156,432	$ 4,372,623	$ 5,061,314
			6.4%	5.5%	5.2%	15.8%
FINANCIAL IMPACT OF TRIF INVESTMENT						
Sponsored Awards	1,000,000	1,066,471	2,000,000	4,000,000	8,000,000	10,000,000
Gifts & Other Sources	0	0	100,000	125,000	150,000	175,000
Royalty Income	0	0	0	0	0	0
TOTAL	**$ 1,000,000**	**$ 1,066,471**	**$ 2,100,000**	**$ 4,125,000**	**$ 8,150,000**	**$ 10,175,000**
TECHNOLOGY TRANSFER ACTIVITY						
Invention Disclosures Transacted	0	0	0	0	3	5
US Patents Issued	0	0	0	0	0	0
Licenses and Options Executed	0	0	0	0	0	0
Startup Companies	0	0	0	0	0	0
WORKFORCE CONTRIBUTION						
Postdoctoral Appointees	2	5	5	5	6	6
Graduate Students	4	12	10	11	11	12
Undergraduate Students	4	10	10	11	11	12

BOARD OF Regents ARIZONA'S PUBLIC UNIVERSITIES

EDUCATE · DISCOVER · IMPACT

FY 2017-2021
ARIZONA BOARD OF REGENTS
TECHNOLOGY AND RESEARCH INIATIVE FUND

	FY 2017 BUDGET	*FY 2017 ACTUAL*	*FY 2018 BUDGET*	*FY 2019 BUDGET*	*FY 2020 BUDGET*	*FY 2021 BUDGET*
REVENUE						
Carry forward		$ 3,040,975	$ 1,606,112			
TRIF Revenue	2,000,000	2,000,000	2,000,000	2,000,000	2,000,000	2,000,000
TOTAL REVENUE	**$ 2,000,000**	**$ 5,040,975**	**$ 3,606,112**	**$ 2,000,000**	**$ 2,000,000**	**$ 2,000,000**
EXPENDITURES						
OPERATING	100,000	83,944				
GRANTS/PROJECTS	1,900,000	3,266,975				
TOTAL EXPENDITURES	**$ 2,000,000**	**$ 3,350,919**	**$ -**	**$ -**	**$ -**	**$ -**
SUMMARY BY INITIATIVE						
Regents' Innovation Fund Grants	$ 1,200,000	$ 1,200,000	$ 1,000,000	$ 1,000,000	$ 1,000,000	$ 1,000,000
Data/Resources/Technology	448,400	200,919	500,000	500,000	500,000	500,000
STEM/Innovation Projects	150,000	50,000	150,000	100,000	100,000	100,000
Other Initiatives	201,600	-	350,000	400,000	400,000	400,000
Over realized funds to universities		1,900,000				
TOTAL EXPENDITURES	**$ 2,000,000**	**$ 3,350,919**	**$ 2,000,000**	**$ 2,000,000**	**$ 2,000,000**	**$ 2,000,000**