

TECHNOLOGY AND RESEARCH INITIATIVE FUND

FISCAL YEAR 2022



ABOUT THIS REPORT

This report details Arizona's public universities Technology and Research Initiative Fund (TRIF) expenditures in accordance with state law and the universities' board approved three-year plans.

Proposition 301 established TRIF through an increase in state sales tax dedicated to K-12, community colleges and Arizona's public universities. Collection of the tax began on June 1, 2001, and the proposition was extended for another 20 years in 2018. Twelve percent of collections are distributed to the Arizona Board of Regents to administer for the expansion of research, workforce development and increasing access to public higher education. TRIF monies are continuously appropriated to ABOR and do not lapse at the end of the fiscal year.

ABOUT THE ARIZONA BOARD OF REGENTS

The Arizona Board of Regents is committed to ensuring access for qualified residents of Arizona to undergraduate and graduate institutions; promoting the discovery, application, and dissemination of new knowledge; extending the benefits of university activities to Arizona's citizens outside the university; and maximizing the benefits derived from the state's investment in education.

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Executive Summary

The Arizona Board of Regents received approximately \$126 million in TRIF revenue in fiscal year 2022. Total TRIF revenue received since the inception of the program in June 2001 is well over \$1.4 billion dollars.

In fiscal year 2022, ABOR allocated TRIF funding to the universities as follows:

- ABOR Office Operating – \$2 million allocated to the board office for operating expenditures in support of administrative oversight and reporting, specific board initiatives, programs and infrastructure, and activities designed to support and promote the board’s TRIF goals and initiatives.
- Arizona Innovation Alliance – \$700,000 allocated for the Arizona Innovation Alliance to support and improve access to higher education and student attainment.
- Base Allocation Funds – \$84.8 million allocated for the universities’ board approved three-year TRIF plans. The base allocation awards 40 percent of funding to Arizona State University; 40 percent to the University of Arizona; and 20 percent to Northern Arizona University.
- General Education Assessment – \$300,000 allocated to the board office and the universities to help design and administer the general education assessments to support and improve student and workforce outcomes.
- Health Sciences and Workforce Analysis – \$3.5 million to analyze and identify factors that contribute to the success of the current structure/model and challenges that may limit its opportunities within Arizona’s existing health care landscape and workforce.
- Phoenix Biomedical Core – \$500,000 allocated for the Phoenix Biomedical Core in support of its research, technology transfer and workforce development efforts.
- Regents’ Opportunity Initiatives Funds – \$40 million allocated to the universities to support board priorities in research and to improve Arizona workforce and higher education access.
- Regents’ Research Grants Funds – \$12 million allocated to a grant funding process designed to address critical Arizona issues and problems by leveraging Arizona’s public universities’ research talent and assets.
- Sun Corridor Technology Support Payment – \$3 million allocated to support Sun Corridor technology needs to provide time- and place-bound students greater educational access.

The largest TRIF investments are in the base allocation funds expended in accordance with the universities’ board approved three-year TRIF Plans, Regents’ Research Grants and Regents’ Opportunity Initiative funds. These three areas of investment constituted 89 percent of all TRIF investments in fiscal year 2022. The sections below provide additional detail on each investment area.

Base Allocation Funds Support Each University’s Three-Year TRIF Plan

In fiscal year 2022, the board allocated \$84.8 million in TRIF base allocation funding to the universities. Arizona State University and the University of Arizona each received \$33.9 million in TRIF base allocation funding and Northern Arizona University received \$17 million.

The universities expend TRIF base allocation funds in accordance with each institution’s board-approved three-year TRIF Plans. The universities develop three-year plans to comply with A.R.S. §15-1648(C). The plan’s identified initiatives and projects must be in one or more of the following board-approved categories:

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

The universities further categorize each project or initiative from a research pipeline and infrastructure perspective as:

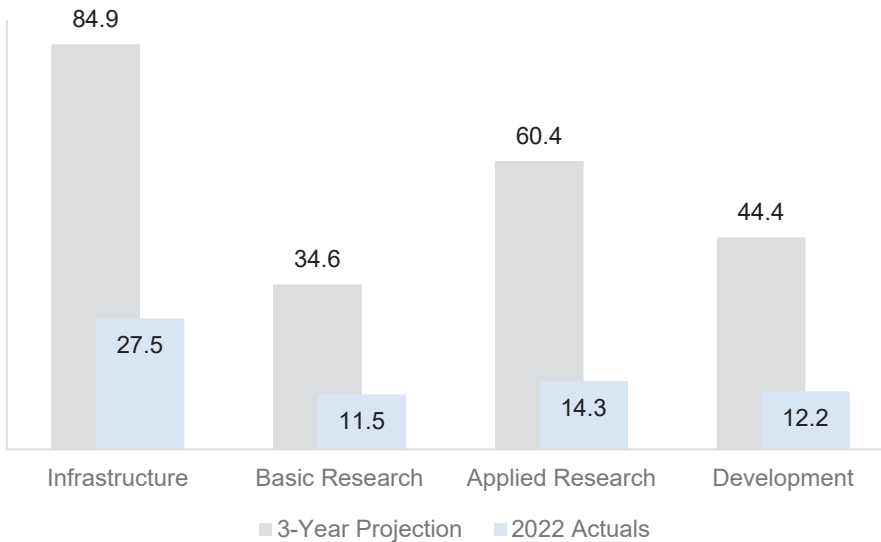
- Basic Research (10 plus years to a potential commercial product development),
- Applied Research (two to five years to a potential commercial product),
- Development (less than two years to a commercial product), and
- Infrastructure (support resources and related services used to conduct research and technology transfer).

Each university's current three-year plan is available on the ABOR website [here](#).

Arizona’s Public Universities’ FY2022 Base Allocation Expenditures

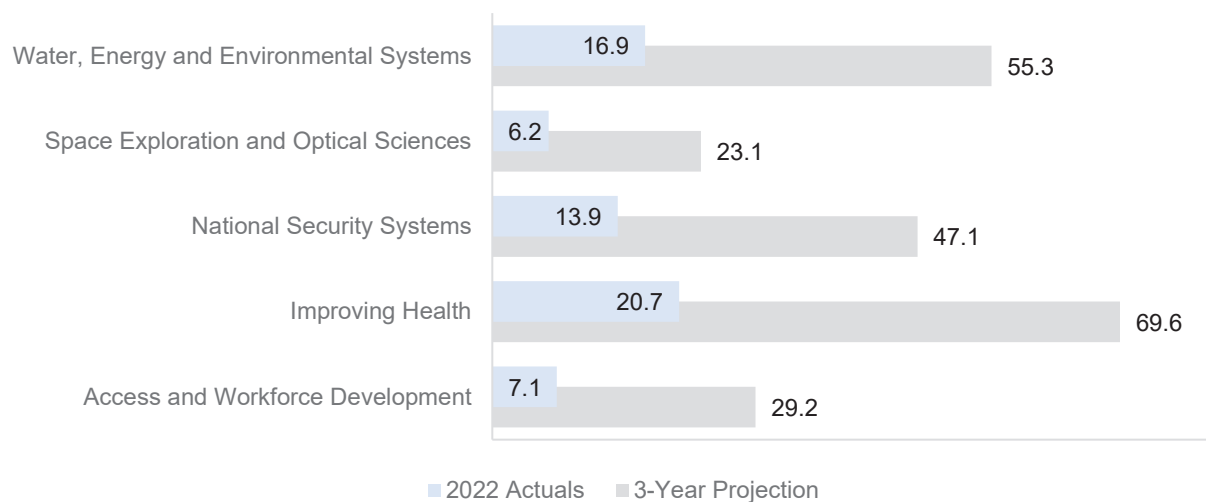
Arizona’s public universities’ largest fiscal year 2022 TRIF investment was in infrastructure. In total, the system directed \$27.5 million or 42 percent of its base allocation toward maintaining and enhancing research infrastructure. See Figure 1.

Figure 1: ABOR Enterprise FY2022 Actuals and 3-Year Projected Investments (in millions)



The largest fiscal year 2022 TRIF research area investment was in Improving Health. The system’s investment in Improving Health amounted to \$20.7 million or 32 percent of the total funds expended. See Figure 2 below.

Figure 2: ABOR Enterprise FY2022 Actuals and 3-Year Projected Investments (in millions)



ASU invests in Improving Health, Students and Research during FY2022

Arizona State University’s largest research pipeline investment was in Applied Research with \$11.5 million in fiscal year 2022. See Figure 3(a).

Arizona State University’s largest research area investment was in Improving Health with \$13.1 million in research during fiscal year 2022. See Figure 3(b).

In fiscal year 2022, thousands of graduate and undergraduate students benefitted from TRIF support. ASU also enabled a significant number of sponsored research projects through previous TRIF related research activity. See Figure 3(c).

Figure 3(a): ASU’s Research Pipeline Investments

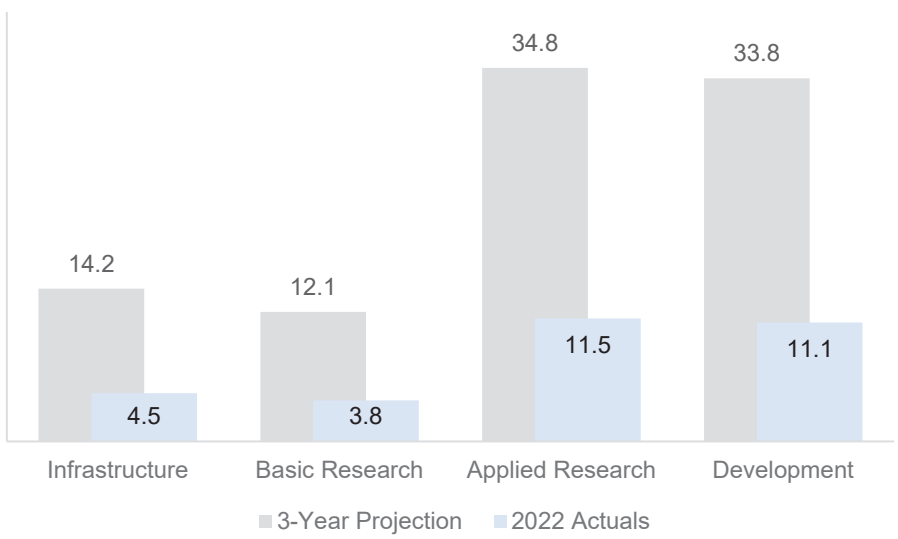


Figure 3(b): ASU’s Research Area Investments

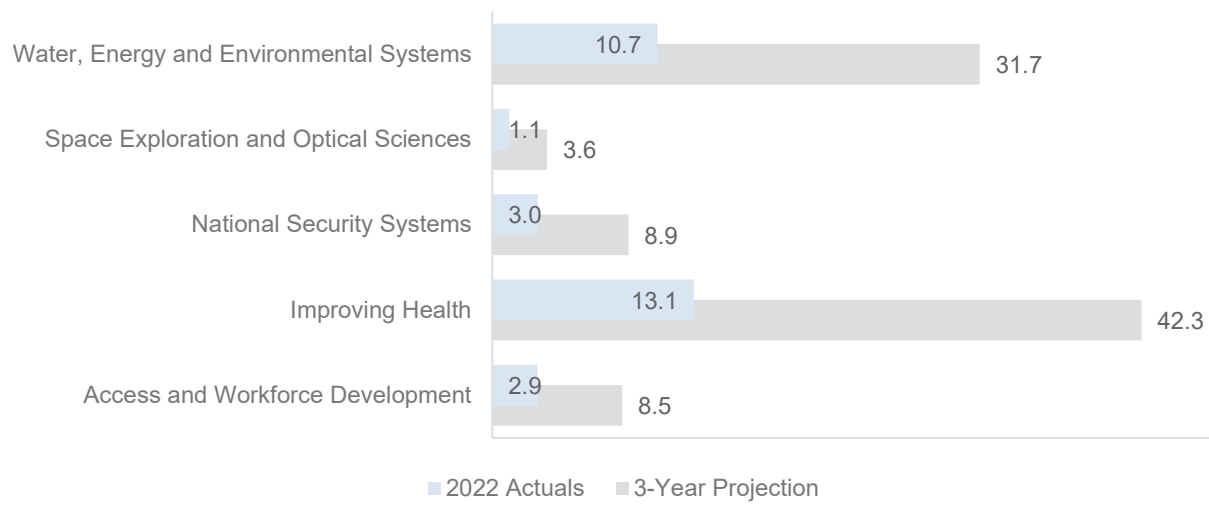


Figure 3(c): ASU’s FY2022 Actuals and 3-Year Projected TRIF Investments (in millions) and Performance Measures

Measures	2022 Projections	2022 Actuals
Faculty Startup Package Expenses	\$0	\$0
Postdocs Supported	522	521
Graduate Students	2,678	2,983
Undergraduate Students	1,366	1,396
Sponsored Project Funding	\$443,677,381	\$976,271,460
Publications in Academic Peer-Reviewed Journals	1	0
Startups	45	19

Complete details on ASU’s fiscal year 2022 TRIF investments and expenditures are found [here](#).

NAU Invests in Infrastructure, Access and Workforce Development, Students and Research in FY2022

Northern Arizona University’s largest research pipeline investment was in Research Infrastructure with \$5.7 million in fiscal year 2022. See Figure 4(a).

Northern Arizona University’s largest area of TRIF investment was in Access and Workforce Development with \$3.8 million in fiscal year 2022. See Figure 4(b).

Thousands of postdocs, graduate and undergraduate students benefit from TRIF support. NAU also enabled a significant number of sponsored research projects through previous TRIF related research activity. See Figure 4(c).

Figure 4(a): NAU’s Research Pipeline Investments

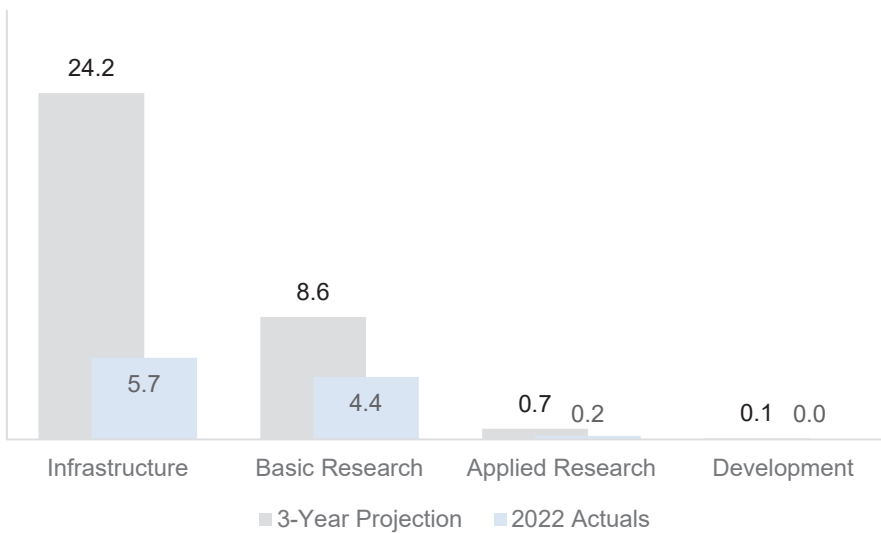


Figure 4(b): NAU’s Research Area Investments

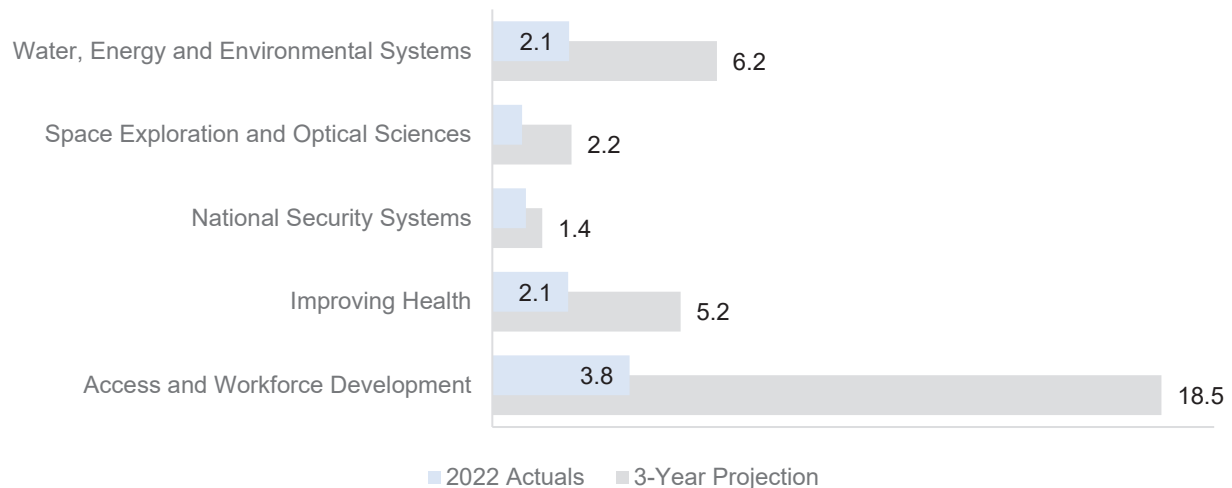


Figure 4(c): NAU’s FY2022 Actuals and 3-Year Projected TRIF Investments (in millions) and Performance Measures

Measures	2022 Projections	2022 Actuals
Faculty Startup Package Expenses	\$826,231	\$95,521
Postdocs Supported	27	31
Graduate Students	2,037	1,786
Undergraduate Students	4,352	2,130
Sponsored Project Funding	\$25,924,535	\$35,536,956
Publications in Academic Peer-Reviewed Journals	312	444
Startups	0	1

Complete details on NAU’s fiscal year 2022 TRIF investment and expenditures are found [here](#).

UArizona Invests in Infrastructure, National Security Systems, Students and Research in FY2022

The University of Arizona’s largest research pipeline investment was in Infrastructure with \$17.3 million invested in fiscal year 2022. See Figure 5(a).

The University of Arizona’s largest TRIF investment area was National Security Systems with \$10 million invested in research in fiscal year 2022. See Figure 5(b).

Thousands of UArizona postdocs, graduate and undergraduate students benefit from TRIF support. UArizona also enabled a significant number of sponsored research projects through previous TRIF related research activity. See Figure 5(c).

Figure 5(a): UArizona’s Research Pipeline Investments

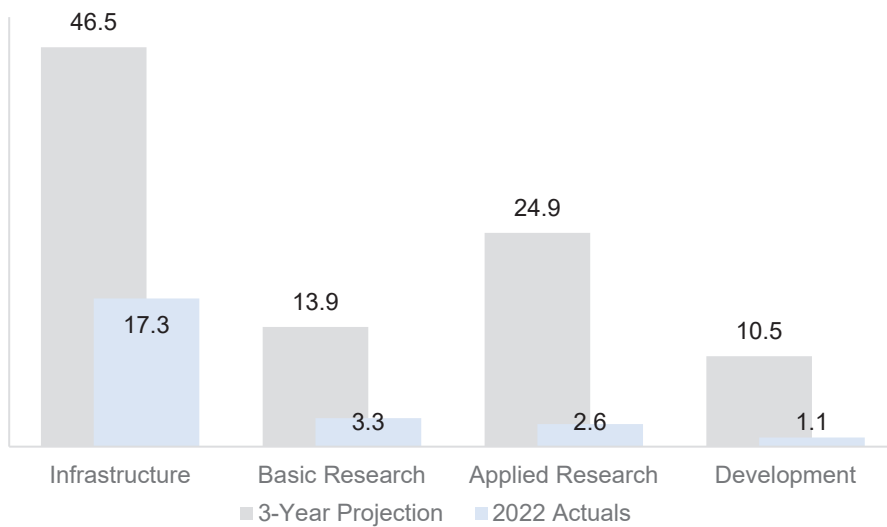


Figure 5(b): UArizona’s Research Area Investments

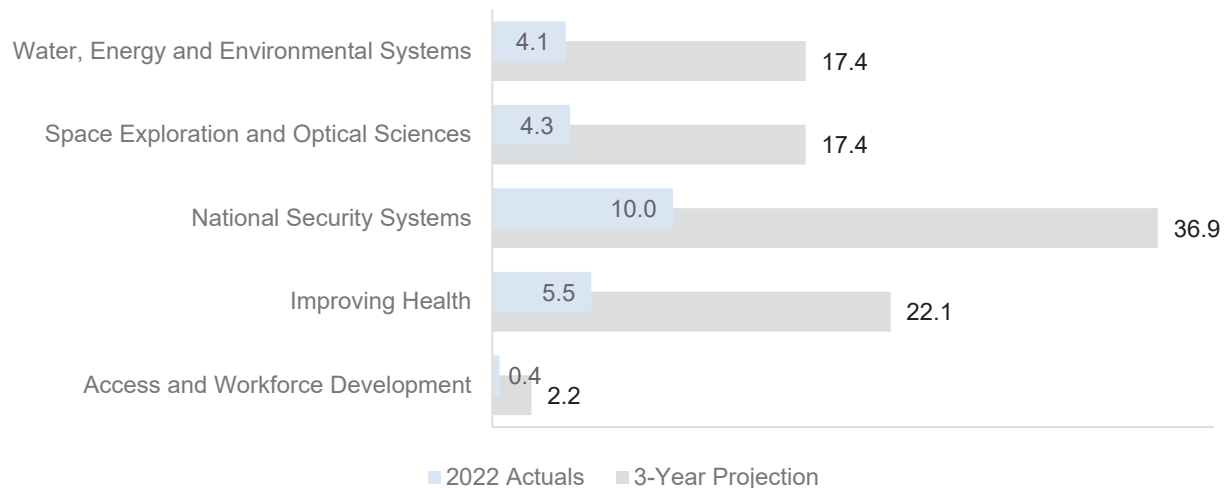


Figure 5(c): UArizona also identified a significant number of sponsored research projects enabled by previous TRIF related research activity

Measures	2022 Projections	2022 Actuals
Faculty Startup Package Expenses	\$8,120,028	\$8,006,056
Postdocs Supported	167	131
Graduate Students	487	711
Undergraduate Students	463	1,140
Sponsored Project Funding	\$154,400,002	\$321,804,988
Publications in Academic Peer-Reviewed Journals	684	768
Startups	2	3

Complete details on UArizona’s fiscal year 2022 TRIF investment and expenditures are found [here](#).

2022 Regents' Research Grants

The board allocated \$12 million to the universities through the Regents' Research Grants process. Regents' Research Grants address the state's most critical unmet needs by leveraging ASU, NAU and UArizona knowledge and creativity. The board office engaged with staff from Governor Doug Ducey's office, the Arizona Department of Administration, the Arizona Department of Environmental Quality, the Arizona Department of Health Services, and the Arizona Department of Water Resources to develop a list of significant challenges facing the state. This formed the basis for the first round of partnership and funding for the grants.

University faculty developed solutions-oriented proposals, which the agencies and board reviewed. The board awarded \$11.5 million for five Regents' Research Grants based on the state agency's evaluation and recommendation. The unallocated \$500,000 will be applied to the fiscal year 2023 Regents' Research Grants. See Figure 5.

Figure 5: List of Proposals Awarded Regents' Grants in FY2022

Proposal	Award (Millions)	Participating Universities	Award Length (Years)
Ozone emission verification, modeling, and emissions reduction strategies for Arizona	\$2.6	ASU, UArizona	3
Getting to the source of Valley Fever and dust mitigation strategies in Arizona	\$4.1	ASU, NAU, UArizona	3
Cost effective removal and detection of "forever chemicals" in Arizona water	\$1.5	NAU, UArizona	3
Cataloging and assessing Arizona abandoned mines risks	\$1.7	ASU, NAU, UArizona	3
Logistical and economic modeling of recycling options according to community size	\$1.6	ASU, NAU	3
Total	\$11.5		

The Regents' Opportunity Initiative Funds distribution occurred late in the fiscal year, and actual expenditures and outcomes for these awards will be reported as part of the fiscal year 2023 cycle.

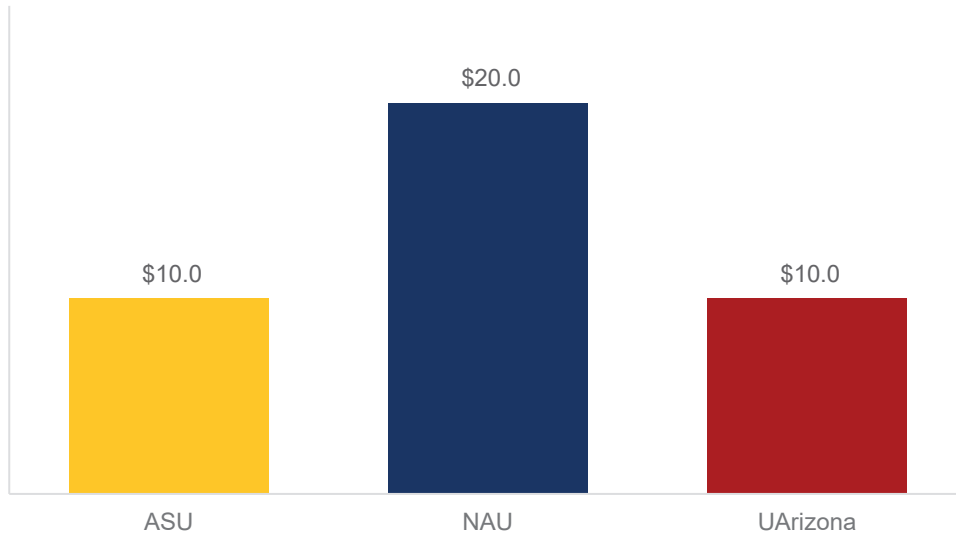
Regents' Opportunity Initiative Funds

The board awards TRIF supported Opportunity Initiative Funds for specific university projects designed to strengthen Arizona with \$40 million in Regents' Opportunity Initiative Funds awarded to the universities in fiscal year 2022. One-time funding was allocated:

- \$10 million to ASU;
- \$20 million to NAU; and
- \$10 million to UArizona.

See Figure 6.

Figure 6: TRIF Regents Opportunity Initiative Funds Awards by University (Millions)



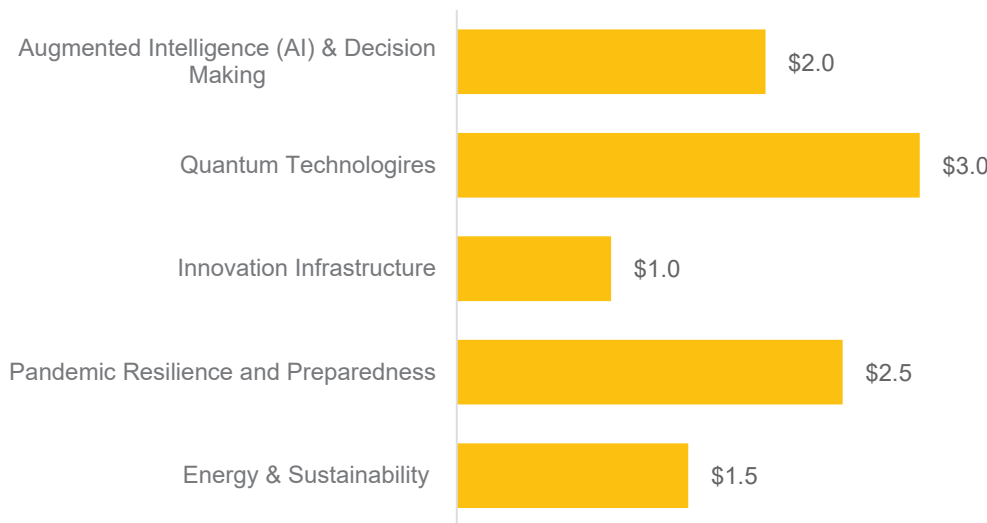
The Regents’ Opportunity Initiative awards distribution to the universities occurred late in the fiscal year, and actual expenditures and outcomes from these awards will be forthcoming during fiscal year 2023.

The information below details highlights from each university’s proposal.

ASU Regents’ Opportunity Initiative Funds

ASU Regents’ Opportunity Initiative Fund projects include Climate Challenges, Grid Security and Health Issues. See Figure 7.

Figure 7: TRIF ASU Regents’ Opportunity Initiative Fund Amounts (in millions)



A summary of ASU's Regents' Opportunity Initiative Funds follows.

Energy and Sustainability (\$1.5 Million)

ASU proposes four energy and sustainability projects and initiatives directly impacting Arizona's economy while training students for emerging industries.

Hydrogen Generation. ASU has a strong, long-term partnership with the major power utilities in the state and a recognized global leadership position in research and development in sustainable thermochemical hydrogen, syngas and ammonia research and development. This also couples directly with carbon capture for synthetic fuel production. Funds will establish integrated transdisciplinary research and training and will allow ASU to coordinate the necessary partners needed to position the university to be a major participant in this opportunity. This is an area where additional federal dollars are available to sustain the effort longer term.

Carbon Capture/Conversion. The Carbon Capture initiative is closely related to the hydrogen effort in terms of integration into overall solutions for the carbon dioxide problem and in student training at all levels. ASU's Center for Negative Carbon Emissions already has the basic technology and a strong commercial partner, but given the scale of the activity, there remain major problems in materials used, government policy, economic factors, manufacturing, and recyclability of the devices. TRIF funds will launch the project with an integrated team from across the university to accelerate research and enhance curriculum as well as facilitating the convening of critical industrial partners needed to succeed in this endeavor.

Electrification of Transportation. Electrification of private transportation in Arizona needs a network of charging stations and providing the necessary power to those stations. ASU is developing a statewide model to put a charging station network in place. ASU's Decision Theater supports this project by providing analytical tools for researchers to create models for state decision-makers to move forward.

Grid Security and Stability. Arizona needs to increase the workforce in power grid security and stability. ASU is accelerating programs to provide expanded student opportunities in this area.

Pandemic Resilience and Preparedness (\$2.5 Million)

Arizona Health Observatory. Arizona needs to optimize monitoring a wide variety of viruses, pathogens, and health threats to its population as soon as they occur. ASU is creating the Arizona Health Observatory designed to unify health data from many sources, including patient information, data from ASU-initiated institutional review board approved research and clinical trials, and publicly available data. The technical focus is in developing new or enhanced monitoring systems and analytical methods. The program will also create the associated workforce of scientists and engineers with the knowledge of how to apply the monitoring approach at scale.

Health Supply Chain Resilience. ASU is integrating existing supply chain expertise with experts in health-care delivery and forming a team to develop in concert with its Decision Theater supply chain management models both by hospitals and more broadly. The initiative provides hands-on training for students in health supply chain management.

Innovation Infrastructure (\$1 Million)

Department of Defense (DOD) Innovation Accelerator. ASU is creating an innovation accelerator capability designed to build fieldable prototypes ready for testing and training on Arizona's DOD ranges, making it possible for the DOD to work shoulder to shoulder with ASU researchers and students to

develop application as exactly needed. It is also an opportunity for ASU students to directly engage in DOD projects, gaining valuable experience needed to work either at the DOD or Arizona's DOD based industry.

Quantum Technologies (\$3 Million)

IBM Quantum Hub. IBM recently invited ASU to join the IBM Quantum program as a "Hub" partner. ASU intends workforce development in this area to support the advancement and future deployment of the quantum information system architecture. ASU plans to establish the university as an IBM Quantum Hub strategically focusing on quantum information supply chain, software engineering, education, and workforce development.

Augmented Intelligence (AI) and Decision Making (\$2 Million)

Decision Theater. Several of ASU's proposals include the use of ASU's Decision Theater as one of the approaches for collaborative analysis, deliberation and decision making. The theater's expansion and modernization are necessary to become a critical resource for Arizona decision makers.

NAU Regents' Opportunity Initiative Funds

NAU Regents' Opportunity Initiative Funds focus on Access, Attainment, Workforce. A summary of NAU's Opportunity Initiative investments follows.

Broaden Educational Attainment and Workforce Development (\$20 Million)

To broaden the impact and scope of NAU's contributions to educational attainment, workforce development and economic mobility in Arizona, NAU will design, develop, and implement a broad portfolio of innovative and evidence-based programs categorized under three action areas:

- Broadening participation;
- Increasing completion rates; and
- Reducing the completion gap and strengthening post-college outcomes.

Broadening Participation. NAU will invest in programs designed to increase the number and diversity of Arizona resident students participating in higher education, especially from underserved and rural communities.

NAU is expanding access and increasing enrollment through more inclusive recruitment, admissions, financial aid, and developmental education policies and practice for a broader range of learners. This includes students earning college credits while in high school; recent high school graduates needing developmental support in their first year; students who transfer from community colleges or tribal colleges and need differentiated support services; adults with some college credits, but no degree; and adults interested in re-skilling and up-skilling programs that will boost their earning potential and quality of life.

NAU is examining and revising its current portfolio of statewide academic programs, delivery models and student support services. These efforts will provide alignment between the unique labor demand and support needs of the communities and regions surrounding each statewide site. NAU's implementation of related actions will be data driven and well informed through the collective work of the action team.

NAU is enhancing its efforts with high schools and other stakeholders through alignment and clarity in admissions and cost of attendance, better transferability of credits earned and tailored advising.

Collaboration and support for implementing these changes will be critical to successfully achieve the desired outcomes of broadening participation through strategic policy changes.

Increasing Completion Rates and Reducing Completion Gaps. NAU is investing in programs designed to increase completion rates for all students and reduce completion gaps. Potential programs in this area include differentiated support services, high-impact academic practices, and curricular and co-curricular initiatives to improve retention rates, increase momentum toward a degree or credential, and improve graduation rates for all students.

NAU is expanding and developing new services devoted to increasing student access and success that complement the tailored academic program offerings by location and modality. The emphasis of these efforts will be on NAU statewide and online students, working to attract and serve adult learners and transfer students, particularly historically underserved populations, with barrier-free educational pathways.

NAU is coordinating oversight of its statewide infrastructure to better support aggressive student recruitment, support, and retention as well as academic program expansion and partnership development.

Strengthening Post-College Outcomes. NAU is investing in efforts designed to strengthen post-college outcomes. Potential programs include better aligning the university's educational offerings to Arizona's workforce needs, ensuring students have access to meaningful internships and experiential learning opportunities, providing students with opportunities to graduate with a degree — plus a certificate as applicable — and critical career preparedness experience in areas of high demand, improving career placements for students and serving Arizona employers with a qualified pipeline of graduates.

NAU identified data-driven demand for launching workforce offerings and development centers that can be expanded in statewide locations to provide affordable and accessible education and training, meeting people where they live and work.

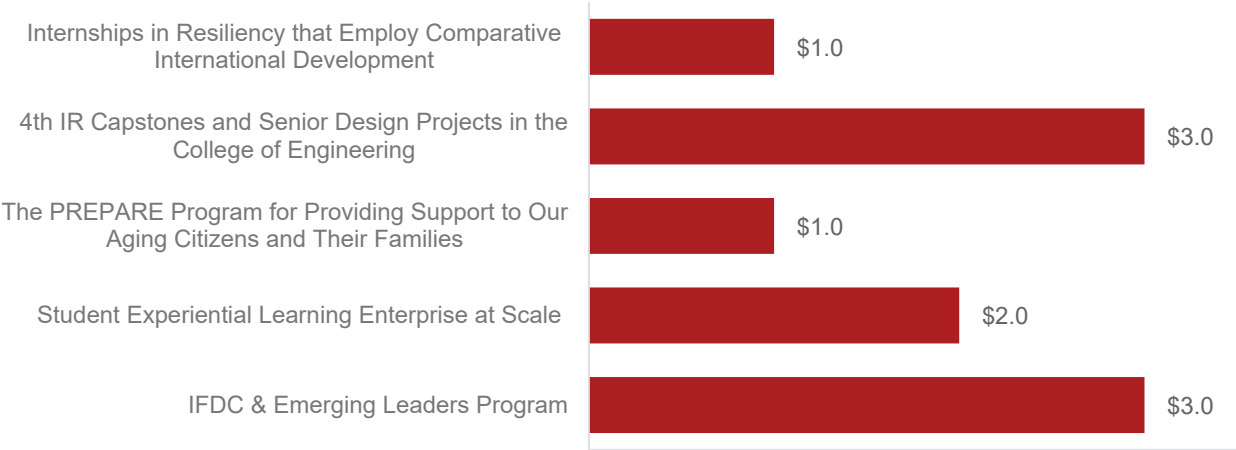
NAU is expanding internship support and placement opportunities, as well as experiential learning throughout the curriculum that will lead to increased student participation in these crucial learning and career preparation opportunities, equipping students with the tools to realize their career aspirations and attain postgraduate success in the workforce.

NAU is enhancing its career services and post-graduation placements to support and benefit both students and Arizona employers, particularly those in high need communities.

UArizona Regents’ Opportunity Initiative Funds

UArizona Regents’ Opportunity Initiative Funds include the Future of Data, Health-Care Workforce and Resiliency. See Figure 8.

Figure 8: TRIF UA Regents’ Opportunity Initiatives Fund Amounts (in millions)



A summary of UArizona’s Opportunity Initiative investments follows.

The Institute for the Future of Data and Computing’s (IFDC) Emerging Leaders Program (\$3 Million)

The IFDC focuses on capabilities that will:

- Wisely enable and employ data systems, engineering, and tools to empower these leading-edge devices;
- Seek to understand and control bias in the development of artificial intelligence and machine learning systems that learn with these data;
- Advance secure use of these data at scale, particularly for human medical and clinical research data;
- Achieve a quantum leap in research impact by delivering insights at machine scales that exceed unaided human comprehension; and
- Ensure Arizona is America’s leader in computer and data innovation.

The emerging leaders program combines support for the faculty, students, and corporate engagement efforts necessary to build the ecosystem that will drive innovation in data and computing. A training system is being developed so the entire university may engage with IFDC’s advanced data and computing infrastructure. Faculty will be supported in exploratory efforts to identify fruitful research avenues that can expand on existing corporate capabilities and interests. Students will be directly involved in these pre-competitive exploratory efforts, to not only use the research tools firsthand, but to contribute to a broader consideration of the possibilities for those research efforts that perform well. Corporate engagement will be established for internships and other experiential learning opportunities.

Student Experiential Learning Enterprise at Scale (\$2 Million)

UArizona is expanding the base of experiential learning opportunities across the university. It represents a direct acknowledgement that meaningful experiential learning is a large retention and student success factor on U.S. residential campuses, and an essential element of strategies to expand the range of research impacts that are building from the university's base of already highly productive faculty and staff in research.

The PREPARE Program for Providing Support to Our Aging Citizens and Their Families (\$1 Million)

The PREPARE program, under the leadership of the Arizona Center on Aging together with its longstanding partnerships, will align our state's geriatric workforce needs with training opportunities, and provide accessible and affordable educational opportunities for diverse students to join the health-care workforce and advance their careers.

Fourth Industrial Revolution Capstones and Senior Design Projects in the College of Engineering (\$3 Million)

The university will rapidly expand the number of capstone and senior design projects to maximize its impact as university research gains influence and leadership in the technologies, tools, and techniques of the Fourth Industrial Revolution.

Internships in Resiliency that Employ Comparative International Development (\$1 Million)

UArizona established the Arizona Institutes of Resilience (AIR) to develop knowledge and practical applications of research insights, analytical efforts, and policy studies across the globe. In parallel with AIR, the university created a new RII Division focused on Resilience and International Development, headed by Associate Vice President Greg Collins, who previously was the highest ranked senior executive service officer at the U.S. Agency for International Development. It is through this division and the resulting research and outreach programs that UArizona can validate the research and policy work conducted through AIR. Students will engage AIR through internships and gain global experience in resiliency in the process.

