

# Growing Arizona

Technology and Research Initiative Fund (TRIF) at work





# Creating the conditions for prosperity

Arizona's Technology and Research Initiative Fund (TRIF) creates an ecosystem that empowers businesses to succeed in our state. Arizona's long-term commitment to research attracts and generates companies that advance emerging technologies and helps them stay ahead of disruptive trends. Our universities provide the talent, knowledge and infrastructure companies need to be competitive. In turn, they create stable, high-wage jobs and invest in their communities – a “virtuous cycle” of economic growth and human well-being for generations to come.

Arizona State University transforms TRIF investment into big gains for Arizona. From FY 2002–2023, TRIF funding to ASU has:

- Provided training and experience to over 20,500 graduate students and postdoctoral scholars and over 11,000 undergraduate students.
- Enabled 1,022 U.S. patents.
- Supported the launch of 272 startup companies.

**ASU ranks No. 9 among the world's top universities for U.S. utility patents issued in 2023, and No. 7 in the U.S.**



# How does TRIF work?

TRIF enables research and innovation that advances our state's economy and improves human lives and well-being.

1

## Conduct research and develop technologies

Universities are the ideal place to conduct the high-risk and long-term research needed for truly transformative innovation.

2

## Protect IP

ASU innovators work with Skysong Innovations, the university's intellectual property management organization, to secure patent protection.

3

## Scale and commercialize

Just as universities are the best place for early-stage research, the private sector is ideal for scaling and commercializing technologies. Skysong Innovations brings ASU inventions to market by:

- Securing licensing agreements with existing companies so they can market the technologies.
- Advancing new startup companies to move early-stage innovations deeper into product development.

4

## Benefit society

These companies make new solutions accessible, create jobs and contribute to the state economy.

A small portion of the sales taxes generated goes back into TRIF to fuel tomorrow's innovations.



# Saving lives and improving health



## Taking telehealth to the next level

Telemedicine offers many benefits to patients and providers, saving time and lowering costs while reducing exposure to germs. But it has drawbacks, such as the inability to check a patient's vital signs. Phoenix-based Mindset Medical offers a virtual health platform that lets patients easily connect with doctors without requiring special equipment, passwords or apps.

The company has licensed technology developed at ASU that will allow providers to capture vital signs through a patient's smartphone. The technology is currently in clinical trials to support FDA approval. Founded in 2016, Mindset Medical also joined the 2021 cohort of the [Mayo Clinic](#) and [ASU MedTech Accelerator](#), which provides entrepreneurial training, resources and mentoring to early-stage medical device and health care technology companies.

## Attacking Alzheimer's earlier

ASU scientists have found that a simple nutrient could make a big impact in the fight against Alzheimer's disease. Multiple ASU studies have linked a deficiency of the essential nutrient choline with Alzheimer's. In fact, people with the most severe disease pathology have the lowest levels of choline in their bloodstream. The scientists also showed that taking choline supplements throughout life reduces the inflammatory state in the Alzheimer's brain, which may have implications for other brain diseases as well.



ASU is also developing innovative tools to detect neurological diseases earlier, giving people more time to pursue treatment options and care plans. Aural Analytics is an ASU spinout company with technology that monitors speech changes to detect disease early and assess disease progression. Neuroassessments LLC is another spinout company using a simple motor test to screen people for dementia in the clinic or at home.

**More than 1 in 10  
Arizonans over age 65  
have Alzheimer's disease.**

(source: Alzheimer's Association)



## Removing 'forever chemicals' from drinking water

PFAS (per- and polyfluoroalkyl substances) are called "forever chemicals" because they can take thousands of years to break down in the environment. They have also been linked to serious health problems. Unfortunately, more than 60% of the U.S. population is exposed to PFAS through their drinking water.

Researchers at ASU have developed a technology that can safely remove PFAS from water using microbes. The technology, called a membrane biofilm reactor, is already being used to remove nitrate and perchlorate from water in partnership with APTwater in California. The researchers are now preparing to lab test PFAS-contaminated water for field sites.



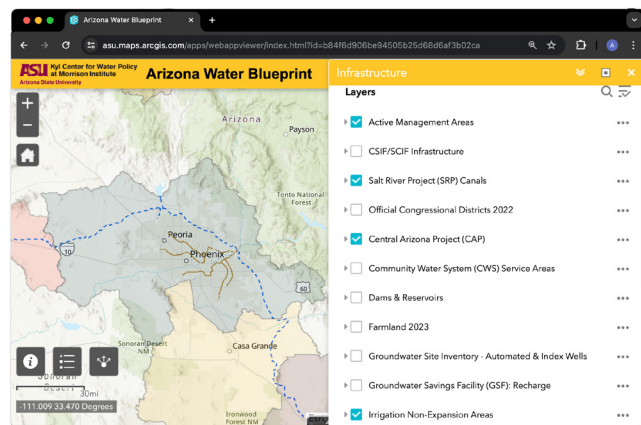


# Creating solutions for air, water and energy

## Keeping the water flowing

Arizona's population has grown by about a million people each decade since the 1960s. But through wise management, our state's water use is about the same today as it was in the 1950s. ASU helps Arizona policymakers protect our precious desert water – today and into the future – through powerful tools and expertise.

The [Arizona Water Blueprint](#) is an interactive hub of information about state water resources and policy. It provides data visualizations and in-depth multimedia content on critical water policy topics. The [Colorado River Visualization Enterprise \(CuRVE\)](#) models the Arizona impacts of Colorado River climate, hydrologic and management scenarios on community water systems,



agricultural districts, tribal communities and industries across multiple decades. These systems help leaders quickly understand the effects of different decisions on our water supply.



## Helping the dust settle

Central Arizona is known for airborne dust and storms that endanger drivers and irritate locals' lungs. But we have a hidden ally — a community of bacteria native to the desert soil. These bacteria form a biocrust that acts like a sticky net to hold down dust.

In many places, activities like farming and construction have disturbed the layer of biocrust on top of the soil. It can take decades for biocrust to grow back on its own, but ASU scientists are working to shorten that process to just a year or two. They are cultivating biocrust in the lab that can flourish when replanted in the wild and help restore depleted soil.



Replanting biocrust is a long-term solution, but farmers also need a short-term fix for fields they leave fallow. Another ASU research team is creating a chemical treatment that hardens the topsoil. In collaboration with Pinal County farmers, both teams are testing their solutions in the field.





# Protecting human safety and security

## Hacking the hackers

Computer hackers launched more than 6 billion malware attacks worldwide in 2023, posing a threat to organizations and individuals alike. On a typical day, a large corporation may receive tens of thousands of security alerts warning about possible malware. With such a high volume of threats, prevention is the best option.

ASU spinout company CYR3CON created software that uses artificial intelligence, machine learning and data mining – along with knowledge of the workings of online hacker communities – to predict where hackers are likely to strike next. The software helps organizations map their vulnerabilities to real-world threats and prioritize weaknesses that need to be addressed.

An ASU professor founded the company after creating technologies at ASU with help from a team of students. CYR3CON advanced the ASU-patented technologies and later sold its IP to Cyber Security Works, a company that helps organizations detect, prioritize and fix IT vulnerabilities.

## Securing the supply chain

Counterfeiting is a problem that plagues almost every industry, causing not just financial losses but also risks to human health and national security. Combating this problem requires technologies and controls that ensure the authenticity and traceability of parts throughout the entire supply chain.

ASU startup DENSEC ID has developed “fingerprints for things” – secure, item-unique physical identifiers that ensure product authenticity and provide transparency and trust in supply chains. The “fingerprints” use a unique and unclonable pattern that provides a distinctive identity to securely link items in the real world to their associated information in the cloud. The inexpensive, spoof-resistant, tamper-resistant identifiers can be placed directly on goods – from forklifts to microchips – for supply chain security.



# Pioneering a new space age



## Training tomorrow's space professionals

Expanding industries require a capable workforce to grow in tandem. ASU is supplying the commercial space industry with a diverse, skilled and experienced talent pipeline to propel the sector to new heights. ASU's [Interplanetary Initiative](#) develops innovative educational options that provide learners from all disciplines with the skills needed to advance space exploration.

- The Introduction to Satellite Operations course, developed in collaboration with Qwaltec, provides the foundational knowledge and skills essential for a career in satellite operations.
- The bachelor of science degree in technological leadership prepares students to effectively solve problems with technological solutions.
- The Interplanetary Initiative Undergraduate Research Scholars Program connects students from any major to interdisciplinary research opportunities that emphasize humanity's future in space.
- The ASU Space Student Ambassador program is a competitive leadership and professional development program for outstanding undergraduate students from across ASU with a passion for space.
- The SciTech Space Leadership Certificate is a three-course series for aerospace scientists and engineers getting ready to lead large space missions and projects.

## Powering the new space economy

As the commercial spaceflight industry grows, so do its energy requirements. It's estimated that the space solar capacity alone needs to increase by three to four orders of magnitude to meet industry demands. Arizona-based company Solestial is rising to this challenge with the development of cost-effective, reliable solar energy generation technologies.

Based on ASU research, the company's signature offerings include ultra thin solar panels capable of withstanding the harsh conditions of space. The panels are built with defect-engineering capabilities to self-cure radiation damage, which could improve longevity and power the expansion of humans into the solar system. In 2022, Solestial secured a \$10 million funding round led by Airbus Ventures.



# Empowering a thriving workforce

## Leading a semiconductor revolution

Americans depend on chips and advanced semiconductors for work, travel, health and national security, yet only 12% of the world's microchips are produced in the U.S. today. Arizona is on the forefront of national efforts to advance these vital technologies and increase domestic chip production.

ASU is a key player in making that a reality, from shoring up the industry's talent pipeline through the Ira A. Fulton Schools of Engineering, solidifying ties with industry, and working with local leadership to attract TSMC's most advanced American manufacturing plant to Phoenix. Industry partners can take advantage of ASU's MacroTechnology Works, a one-of-a-kind research space that enables experimentation at scale – speeding new innovations to market.

The state now leads the nation in recent private sector semiconductor investments, attracting \$64 billion from 2021 to 2024. These include a \$270 million investment to create the Materials-to-Fab

**ASU is No. 2 in the U.S.  
for employability among  
public universities.**

(source: Global Employability University  
Ranking and Survey 2024)

Center, a world-class shared research, development and prototyping facility housed at MacroTechnology Works. The center was formed through an alliance between ASU and Applied Materials Inc., a leader in materials engineering solutions used to produce virtually every new chip in the world.

ASU also leads the Southwest Advanced Prototyping Hub, funded with \$40 million by the 2022 CHIPS and Science Act. The SWAP Hub brings together more than 150 leading corporate, startup, academic and national lab partners from the semiconductor and defense sectors to jump-start microelectronics projects.



**Small businesses make up 99.9% of all U.S. companies and account for 62.7% of net jobs created since 1995.**

(source: U.S. Small Business Administration)

### Supporting community entrepreneurs

The J. Orin Edson Entrepreneurship + Innovation Institute plays a pivotal role in sustaining and advancing the Arizona economy. By supporting a wide array of ventures, from local businesses like pizza shops and clothing retailers to high-tech industries such as robotics and space exploration, the institute ensures that diverse economic sectors flourish. The institute's comprehensive programs provide aspiring business owners with the knowledge, resources and mentorship needed to succeed. The institute's focus on practical application and real-world impact translates into measurable economic benefits for the region.



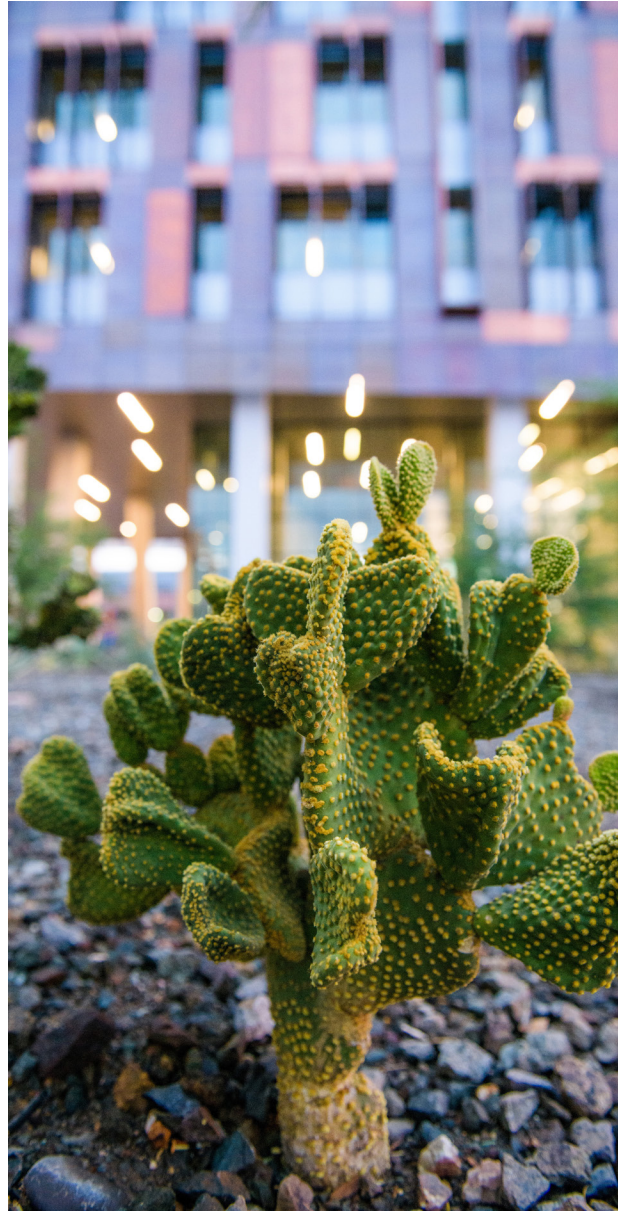
### Lighting the path to a positive future

The Luminosity Lab is a student-led R&D lab that provides funded research opportunities to students across academic backgrounds. The lab has partnered with about 40 companies, putting interdisciplinary student teams to work solving business challenges while gaining valuable, hands-on experience. Notable successes include:

- Charlotte, a comprehensive lunar rover, was named a finalist in the 2022 NASA BIG Idea Challenge. The ASU team achieved the highest Technology Readiness Level of any other finalists.
- Jotted, an automated note-taking tool, won the 2021 Red Bull Basement global competition, beating finalists from 44 countries.
- An innovative face mask designed to prevent the spread of COVID-19 won the million-dollar XPRIZE challenge in 2020.
- Check Up allows doctors at Phoenix Children's to make virtual rounds through a Zoom-enabled app.
- Next-Gen Debrief, co-developed with airmen from Luke Air Force Base, uses 3D augmented reality to redefine the post-flight debrief process. The project was a top-five finalist in the Spark Tank Air Force innovation challenge in 2021.

**Employers rate problem-solving skills (89%) and ability to work in a team (79%) as the top qualities they seek in job applicants.**

(source: National Association of Colleges and Employers Job Outlook 2024 survey)



Learn more about  
TRIF's impact at  
[research.asu.edu/trif](https://research.asu.edu/trif)