ASU to provide energy, water systems support for US Air Force

Air Force to draw on the university's expertise for infrastructure resilience efforts at installations around the world

By Lisa Irish, ASU News
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When power goes out at a military base, electric water pumps stop working. That can disrupt aircraft maintenance and cooling systems for sensitive equipment, as well as meals and showers for personnel.

Improving the ability to avoid, adapt and recover from these interruptions is critically important to the success of military missions.

The Department of the Air Force has selected Arizona State University as a technical services partner to help strengthen the energy and water systems that support its missions.

A new 10-year Intergovernmental Support Agreement, or IGSA, gives the Air Force a way to draw on the university's expertise for specific infrastructure resilience efforts at installations around the world.

Technical leadership in the ASU Metis Center for Infrastructure and Resilience work to evaluate, plan and deploy infrastructure systems that are future-proof and adapt to changing conditions.

Professors Mikhail Chester and Nathan Johnson, who serve as co-directors, are positioning the center to serve as the interdisciplinary hub for the university's work under the IGSA. These projects also support the ASU National Security Impact Ecosystem, coordinated in part by Chris Howard, executive vice president and chief operating officer of ASU.

Through the agreement, the Air Force can issue task orders, or individual project assignments, to ASU for work, says Chester, ranging from large-scale infrastructure and systems analysis to software and hardware development, including developing digital twins of installation infrastructure for energy and water systems.

These efforts are providing technical services to planning, operations and maintenance, and that type of relationship comes with different expectations than research and development agreements, Johnson says.

ASU researchers may also be asked to perform circuit studies and power engineering, analyze and plan water networks, evaluate new technologies and processes, create frameworks and checklists to accelerate military construction projects, or draft military services policy guidance, Johnson says.

At the agreement signing in Washington, D.C., Nancy Balkus, deputy assistant secretary of the U.S. Air Force, emphasized the collaboration's role in keeping installations "ready and resilient and capable of projecting power under any circumstance."

Connecting water and energy systems

The Metis Center helps infrastructure managers create effective, resilient integrated systems. The center's research team, including 60 faculty members, students and staff working on various projects, has completed $14.2 million in projects for military services in the past 10 years, and is currently working on $5.6 million in active projects.

Chester is the Helmick Professor of Infrastructure Resilience in the School of Sustainable Engineering and the Built Environment, part of the Ira A. Fulton Schools of Engineering. He directs ASU's Resilient Infrastructure Laboratory.

Johnson directs the Laboratory for Energy And Power Solutions, or LEAPS, and is a professor in The Polytechnic School.

"To respond to this growing demand, Nate and I are now co-directors of Metis Center," Chester says. "He leads LEAPS activities, and I coordinate Resilient Infrastructure Lab work."

Chester's infrastructure resilience and systems expertise complements Johnson's work in microgrids, distributed energy systems and applied energy technology. Between them, the Metis Center team is able to work across infrastructure challenges, from large-scale power and water delivery to building-scale controls.

The Resilient Infrastructure Laboratory develops solutions to ensure that infrastructure delivers services, protects people and adapts to future conditions, while LEAPS provides practical, scalable solutions that combine power generation, storage, smarter grids, workforce development and finance. Together, these capabilities enable the Metis Center to help the Air Force identify vulnerabilities across an installation's infrastructure and develop energy and water solutions to address them.

"This move consolidates expertise and expands work into data centers, digital twins, cybersecurity, warfare and life cycle assessment through the Metis Center," Chester says. "We'll be involving new faculty leadership to help us lead these thrusts."

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To understand an installation's water resilience, leaders need to know how much water its mission and essential functions require and how they could maintain those functions if supplies were interrupted, says Mindy Kimball, assistant director for research at LEAPS and a researcher in The Polytechnic School. Kimball is a retired U.S. Army colonel.

"That's more than backup plans or extra storage of supplies," Kimball says. "Resilience may also look like having alternative solutions to keep the mission going in different ways in spite of water supplies being disrupted."

Military bases face a growing list of challenges around maintaining reliable energy and water. These include an aging power grid, rising electricity demand from facilities such as data centers, integration of newer technologies like microgrids, and diminishing water resources.

Water disruptions can also affect energy systems. Some heating and cooling systems need water to operate, and many power systems rely on liquid cooling, she says. At coal plants and some natural gas plants, heated water produces steam that turns turbines to generate electricity. Water systems, in turn, depend on electricity for pumping and treatment.

While commercially available technologies could reduce energy consumption or improve efficiency, few are available for installations with buildings and infrastructure ranging from 10 to 100 years old.

"We hope to assess and evaluate technologies like electricity metering, energy control systems and even on-site power generation and storage solutions," Kimball says.

Several installations in the U.S. are looking at microgrids to gain more control and autonomy over the power supply on their bases, she says. These local electricity networks can disconnect from the main grid and operate independently.

"We will be evaluating how those microgrids might be designed and built to give each unique installation the size and type of energy technology they need to meet their mission requirements," Kimball says.

The assessments could help military leaders identify vulnerabilities and prioritize maintenance and upgrades that support readiness, Kimball says.

"We're building the capacity to address these challenges at significant cost savings to the defense community while deploying the knowledge, technologies and solutions that we've developed," Chester says.

The agreement allows the Air Force to draw on ASU capabilities demonstrated through defense research and testing, Johnson says.

"The nature of the relationship between ASU and the Pentagon is also different, as we're now working hand in hand with the armed services on base and in the Pentagon, rather than working on science and projects in a lab environment," Johnson says. "Deliverables are tangible solutions that provide resilience and cost-savings benefits."

Learning opportunities for veterans, students

The agreement will create learning opportunities for students, guided directly by staff researchers responsible for the tasks and deliverables to the military, Kimball says.

The LEAPS team, based at The Polytechnic School, brings expertise in infrastructure systems, including energy, water, logistics and civil works, as well as an energy proving ground and modeling equipment tailored specifically for power and energy systems to the project.

“We have a core team of more than 15 faculty members, 20 students, and staff and collaborators in more than 10 groups across ASU,” Kimball says.

About a third of the team are veterans who are now faculty members, staff or students at ASU, Kimball says.

ASU’s sizable veteran population understands the unique challenges faced at military installations.

“Veterans appreciate the significance of the impact they could have on enhancing mission capabilities for the military and see this as a way to continue their service to the nation beyond their time in uniform,” Kimball says.

What’s next

ASU is committed to creating a lasting impact in Arizona, the U.S. and the world in alignment with the university’s charter. Those efforts coincide with the U.S. military’s innovative, evolving agreements and focus on readiness.

“Through this IGSA, our team can leverage the work we’re already doing, with the expertise we consistently cultivate and apply our solutions-oriented research to real-world issues that directly benefit the critical needs for national defense,” Kimball says. “These solutions not only benefit military installations, but they also improve the resilience of communities around the bases.”

In the long term, this collaboration could give the Metis Center the capacity to respond to energy and water resilience challenges across all branches of the military, Chester says.

“We have unique expertise to address — across scales — technology, operations and system design challenges at cost savings to the defense community,” he says.

This story originally appeared on ASU News.

Main image



From left: Nathan Johnson, Mindy Kimball and Mikhail Chester, researchers in the Metis Center at Arizona State University, will lead the university’s work under a new 10-year Intergovernmental Support Agreement, or IGSA, with the U.S. Air Force to provide solutions to strengthen energy and water resilience across installations worldwide. Photo by Lisa Irish/ASU

Text image(s)



From left: Mindy Kimball, Mikhail Chester and Nathan Johnson. Photo by Lisa Irish/ASU