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## Air Force Develops New, Deployable, Energy Systems

By Donna Lindner  
*Air Force Research Laboratory*

WRIGHT-PATTERSON AIR FORCE BASE, Ohio — Today's expeditionary military forces require steady, reliable energy sources to power worldwide missions.

Diverse field environments and a move towards cost-effective, resilient and agile energy supplies are driving a new look in the way the Defense Department powers a mission – and

the Air Force Research Laboratory's Advanced Power Technology Office leads the innovation from the front.

The APTO forward operating base of the future project plays a critical role in changing the way forward deployed forces will power missions in the future. The on-going project hopes to meet the Air Force Civil Engineer Center's 2035 vision to create a totally deployable, self-sustaining

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*Part of the Air Force Research Laboratory's forward operating base of the future demonstration is one complete expeditionary microgrid system, pictured here during Basic Expeditionary Airmen Skills Training at Joint Base San Antonio-Lackland, Texas, Feb. 25, 2016. The project evaluates energy reduction technologies such as shelter insulation and efficient heating, ventilation and air conditioning systems. (Air Force photo/Donna Lindner)*



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- See how energy played into Earth Day celebrations
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# AFRL helps to ‘lighten’ C-5 energy footprint

By Marisa Alia-Novobilski  
*Air Force Research Laboratory*

WRIGHT-PATTERSON AIR FORCE BASE, Ohio – Finding ways to integrate technologies that are cleaner, lighter, multifunctional and energy efficient to reduce fuel costs and maintain the force’s aging fleet is a primary mission driver of work by the Air Force Research Laboratory’s Advanced Power Technology Office, based out of the AFRL Materials and Manufacturing Directorate.

And, once again, the APTO team is proving that novel advances in aerospace material can make a big difference in aircraft fuel savings, maintenance and durability.

A new, lightweight composite RAM Air Inlet system for the C-5M Super Galaxy Transport Aircraft is set to begin a six-month operational flight demonstration test this month, as a

two-year, APTO-led project draws to a close.

The new air inlet pieces, designed to replace legacy aluminum honeycomb air inlets on the C-5, weigh less, cost less to manufacture and have a greater corrosion resistance than traditional inlet systems, increasing part life and aircraft availability while reducing maintenance costs.

“Novel advances in materials and technology today can save the Air Force money over the long term,” said Capt. Randall Hodkin, aviation project manager for APTO. “This is a small part that alone may not affect overall fuel savings, but there are about 1,000 [aluminum panels] on a C-5. We’re demonstrating a proof of concept for technology that can make a big difference.”

During aircraft periodic depot maintenance, or PDM, typically four to five C-5 aircraft are taken out of service

for complete servicing that includes calibration of landing gear, specific part maintenance, application of new paint coatings and beyond. Depot maintainers noticed a trend towards corrosion in a number of the traditional aluminum RAM air inlets on the C-5 during the maintenance cycle.

Though aerospace grade aluminum has excellent corrosion resistance properties, the C-5 fleet is aging. As an aircraft is continually subjected to atmospheric conditions that may include corrosives such as oxygen, water vapor and salt, the material used on the aircraft may start to corrode, with pitting and etching appearing on the surface. If left untreated, this corrosion can eventually lead to cracks or material failure.

The APTO team was approached to design a more corrosion resistant air inlet piece that could mitigate the corrosion issue and also be lighter, more durable and cost efficient to produce and maintain. This would also help address a shortage in the number of spare legacy air inlet pieces on hand to replace corroded parts. If these run out, an aircraft might be out of service even longer as maintainers would need time to repair versus replace the damaged parts.

Working in collaboration with the

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*The RAM Air Inlet is located beneath the wing of an aircraft where it takes in outside air to feed cooling systems during flight. The Air Force Research Laboratory’s Advanced Power Technology Office is testing a new, lightweight composite RAM Air Inlet system for the C-5M Super Galaxy Transport Aircraft intended to replace legacy air inlets, providing a lightweight, cost-effective alternative to maintain the fleet. (U.S. Air Force courtesy photo)*

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power system. Progress over the past year has been enormous, resulting in new cross-service collaborations, successful equipment demonstrations and more.

“We learned a lot over the past year,” said Air Force 1st Lt. Jason Goins, project engineer. “We demonstrated feasibility and where to go next in terms of making complete microgrid systems. Pieces of individual equipment have been demonstrated separately, and by combining them into a microgrid we learned how well they worked synergistically.”

Housed in a 10-foot-long trailer, a mobile, hybrid energy storage and management system able to supply renewable energy power for forward operating bases is the latest addition to

the APTO-led effort to meet the long-term energy needs of military forces. Batteries and a microgrid command, control and communication software package can act as a power source, better able to supply on-site, mobile energy for expeditionary forces.

“We are taking what we learned and applying it to a rapidly deployable system,” Goins said. “We are looking at something that will be set up and deployed in an hour. If you can power a shelter in 30 minutes with affordable solar and wind, that’s spectacular.”

In addition to providing a reliable, steady source of power, the team is exploring solar panels that can be shot by a bullet and still remain operational.

The team is also working with industry to create a lightweight wind power package. This would employ a

ground-based system with a bladed turbine that can be cranked up into the air to generate wind power.

The trailer’s open software system and architecture has played a critical role in enabling cross-service collaboration with the Army. The Army’s Research, Development and Engineering Command’s Communications-Electronics Research, Development and Engineering Center is performing joint testing and development of the mobile energy management system trailer. The results will be used to develop tactical microgrid standards.

In the coming months and years, the team plans to continue its partnership with the Army and look at ways to collaborate on developing standard policies and equipment for microgrids.

## APTO research may increase fuel savings

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C-5 Systems Program Office, the Air Mobility Command fuel efficiency office, the University of Dayton Research Institute, or UDRI, Applied Composites Engineering, or ACE, and others, an air inlet comprised of a fiberglass honeycomb core with a carbon shell was designed to replace the corroded parts. Fiberglass lines the aerodynamic surfaces on the new inlet to mitigate potential galvanic corrosion that can occur when bonding an incompatible metal to aluminum parts. Stainless and titanium fasteners complete the inlet package, aimed at preventing corrosion in areas of installation.

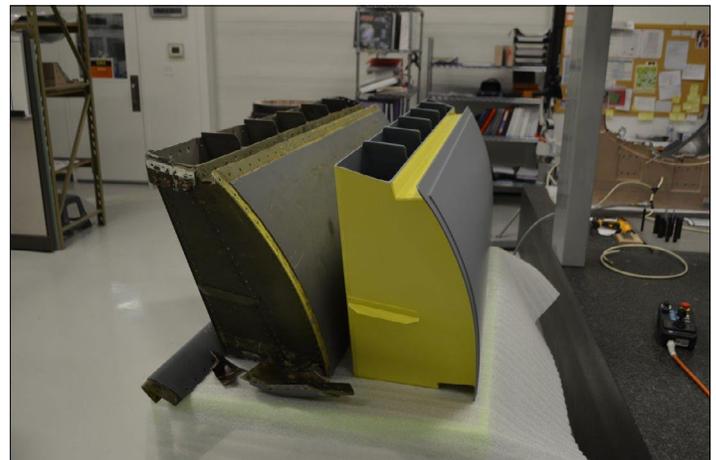
Since the design data for the original parts did not exist as the pieces were manufactured so long ago, engineers reverse-engineered a legacy part to make sure they could develop this equivalent, if not better, air inlet. Legacy inlet components were 3-D scanned and modeled to develop baseline technical data for a new part, which the Air Force now has on record.

The newly-engineered composite inlets were subject to significant testing ranging from material coupon tests to bird strike, hail impact and weather and corrosion testing in the laboratory environment to make sure they would meet the same stringent standards of the old parts.

“This new part is as strong, if not stronger,” said Hodkin. “It’s a well-made part.”

The resulting piece is 19-percent lighter than legacy inlets, weighing only 34 pounds versus 42. Moreover, the new air inlet costs almost \$100,000 less per part to produce — a significant savings over the lifecycle of the aircraft.

“This is a small part, but you are still saving a significant amount of money per part,” said Hodkin. “So not only can you cut weight and improve corrosion durability, but you can do it economically as well.”



*The Air Force Research Laboratory’s Advanced Power Technology Office is testing a new, lightweight composite RAM Air Inlet system (right) for the C-5M Super Galaxy Transport Aircraft. (U.S. Air Force courtesy photo)*

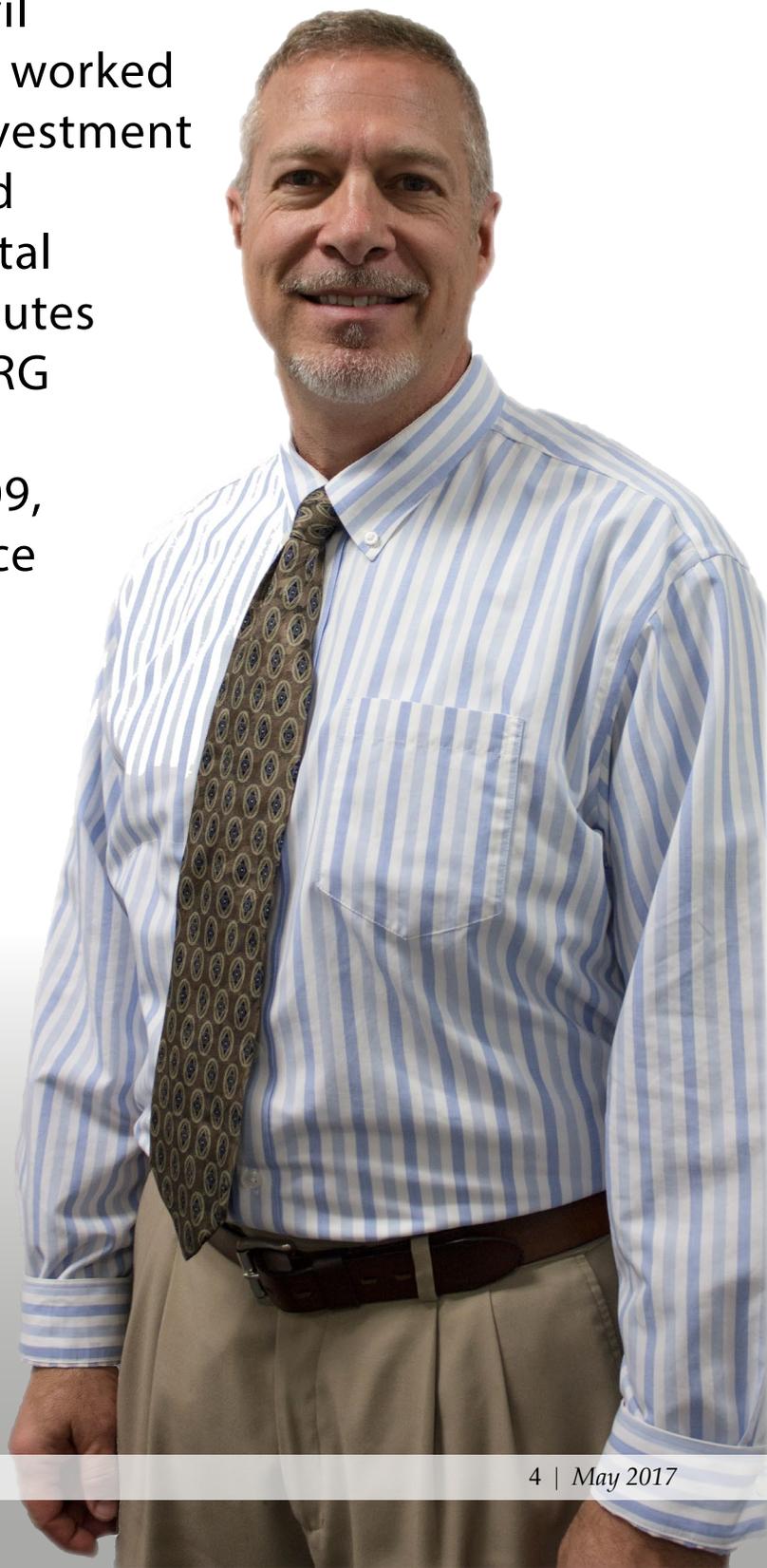
Once flight testing is complete, the composite air inlet will be analyzed for performance. A determination will be made for either further improvement of the part or approval to transition the inlet for installation on other aircraft in the fleet.

Either way, the APTO team views this as a success for demonstrating the ability of state-of-the-art materials and technologies to augment the Air Force effort towards increased energy resilience.

“This is a demonstration of how advances in materials and technology can save the Air Force money,” said Hodkin. “The Air Force is focused on improving operational energy, and we’re helping to meet that need.”

## Renewable Energy Subject Matter Expert Air Force Civil Engineer Center

Rits never truly left Air Force energy after retiring as an Air Force civil engineering officer in 2008. He worked on the Energy Conservation Investment Program where he orchestrated the standup of the energy capital investment branch, which executes \$250 million per year for the NRG Sustainment Restoration and Modernization program. In 2009, he took on a role at the Air Force Civil Engineer Support Agency as a branch chief where he saw AFCESA transition into AFCEC. His next venture was to become the base civil engineer at Royal Air Force Menwith Hill, United Kingdom. In that capacity, Rits managed energy resilience requirements on a daily basis, which prepared him for his return to AFCEC Energy in his new SME role.



### 1. In your own words, what does doing the job of the renewable energy SME entail?

As the Air Force moves to strengthen its facility energy assurance posture, renewable energy investment opportunities can be a force multiplier in structuring the means to provide additional resilience to the critical mission utility infrastructure. The Installation Energy Master Plans should identify single-point vulnerabilities as well as opportunities to enhance energy resilience in support of the installations' missions. Microgrids, alternative and redundant energy production, and storage can often be enhanced with renewables, especially ones that reliably produce power when needed. In coordination with the Office of Energy Assurance, the energy surety and electrical SMEs, this SME position will help the Air Force develop a comprehensive approach to bolstering energy assurance to meet mission needs across the Air Force enterprise. My vision is to help enable the Air Force to meet its critical mission requirements with cost-effective and resilient energy systems,

coupled with renewable energy sources where applicable.

### 2. What services will you provide to the energy managers?

I bring my experiences from both base-level infrastructure leadership as well as energy investment management to help provide focus and clarity to meeting the needs of the base and Air Force as a whole. As always, I will be available with the rest of the renewable energy team here at AFCEC if anyone needs guidance on an existing or prospective project.

### 3. What are you here to do for the Air Force?

As a SME, I'm here to balance the Air Force resiliency requirements with the purchase and production of cost effective utilities in our resource-constrained environment. While every base would like to think that it has significant energy resilience requirements, the reality is that the high investment costs of resilience should be reserved for only the highest priority critical infrastructure vulnerabilities, not "peanut butter spread" across the Air Force. That

being said, there is likely some minimum accepted level of resilience that should be expected to be provided by the utility providers for all its customers, as well as Air Force installations.

### 4. What are your goals for this position?

I would like to help refine AFCEC Energy's role in energy resilience investments, and to work the resilience requirements away from one SME position within energy. I'd like energy resiliency to be incorporated into every civil engineering program manager's business as part of operational risk management.

### 5. Anything you'd like to add?

I'd like to thank the AFCEC team for welcoming me onboard, it feels great to be back. I plan to be value added, and not a stumbling block for progress. I encourage everyone who needs assistance with renewable energy, energy resiliency or their Installation Energy Master Plans to reach out to us through the AFCEC Reachback Center at [afcec.rbc@us.af.mil](mailto:afcec.rbc@us.af.mil).

## Eglin's energy program contributes to DOD environmental award

By Mike Spaits  
Team Eglin Public Affairs

EGLIN AIR FORCE BASE, Fla. — The Defense Department announced April 21, Eglin Air Force Base was named winner of the 2017 Secretary of Defense Environmental Award for Sustainability.

The award is given to the installation that best extends the longevity of its resources by preventing or eliminating pollution at the source, and practicing efficiency and sustainability in the use of raw materials, energy, waste or other resources.

In addition to its environmental conservation programs, like recycling and the prescribed burn program, the installation's energy program was lauded for its use of

renewable resources.

They furthered the national goal of pursuing alternative energy sources by facilitating and breaking ground for a 30-megawatt solar photovoltaic array project on 245 acres of Eglin property, raising Eglin's percentage of renewable energy sources to 19 percent.

"Being recognized six times out of the last seven years as the best in the Department of Defense reflects the truly exceptional team we have guiding Eglin's environmental stewardship," said Brig. Gen. Christopher Azzano, 96th Test Wing commander. "I couldn't be more proud of them, for their service and for demonstrating the complementary nature of our military mission and environmental conservation. This team is truly a global leader in environmental and energy management."

# Schriever emphasizes energy conservation for Earth Day

By Senior Airman Arielle Vasquez  
50th Space Wing Public Affairs

SCHRIEVER AIR FORCE BASE, Colo. – The 50th Civil Engineer Squadron led efforts to remind Airmen at Schriever Air Force Base how crucial energy and water savings are for the nation and the world.

“Earth Day reminds everyone that we all share the planet,” said Abe Irshid, Schriever energy manager. “Sharing the Earth means taking responsibility for what people use and how they use it. It is a day to think about the environmental challenges people face and how to solve them. The best thing anyone can do for the environment is rethink the way they use resources and to use less; the fewer resources and products used, the less waste there is.”

The Air Force energy program includes the conservation of fuel oil, electricity, natural gas and water to improve overall efficiency and resiliency efforts. The Schriever program focuses on reducing demand and cost for electricity, natural gas and water.

“Energy, in its various forms, is absolutely critical to the success of the Air Force’s operations,” said Albert Fernandez, 50th CES civil engineer. “Fuel makes it possible for the flight of our aircraft, the launch of our satellites, the running of our support ground vehicles and the power, heating and cooling of our buildings in support of our main weapon systems.”

The Air Force estimates it spent more

than \$8.45 billion on energy in 2016. Schriever alone spent more than \$7.4 million last year to power its facilities, including water costs.

Irshid said installation engineers typically measure savings through reduction in the installation's financial obligations for electricity, gas and water. During the past five years, these bills have been reduced by approximately \$1 million.

“Schriever continues to reduce energy intensity, reduce water intensity and increase renewable energy,” he said. “Initiatives taken toward this include replacing large boilers and chillers to

provide cheaper heat and cooling for buildings, evaluating and reducing building energy loss using aerial infrared technology and searching for aging water pipe leaks.”

The 50th CES is also evaluating future efforts such as capturing wind energy, installing solar arrays and replacing multiple facilities’ interior lighting systems with LED lights.

Although only one day of the year is dedicated to Earth Day, the goal is to incorporate energy and water savings awareness into daily activities and to continue our efforts year-round, Irshid said.

Conserve Today. Secure Tomorrow.



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