

Western's monthly energy efficiency and renewable energy newsletter dedicated to customer activities and sharing information on energy services.

## Teamwork brings large solar project to Colorado Springs

**W**ith a little help from Colorado Springs Utilities, the Air Force added to its already impressive solar portfolio this summer, flipping the switch on a 6-megawatt, ground-mounted photovoltaic array at the U.S. Air Force Academy (USAFA).

Partially funded by the Recovery Act, the project is a great example of how public-private partnership can make big things happen that are good for all involved. Under a 25-year power purchase agreement, Colorado Springs Utilities buys the solar power from solar developer SunPower, which owns, operates and maintains the plant on Academy grounds. USAFA paid the utility an \$18.3-million, one-time connection charge to deliver the power, which meets 11 percent of its electricity needs and saves the Academy \$550,000 annually in energy costs alone. The Academy expects to receive as much as \$775,000 annually for the sale of renewable energy certificates.



**The completed 6-megawatt solar array on the southeastern corner of the U.S. Air Force Academy near Colorado Springs, Colo., is visible to drivers on Interstate 25. (Photo by Colorado Springs Utilities)**

The solar array also contributes to several goals: USAFA's "Net Zero Initiative" to get 100 percent of its energy from on-base renewable or green resources, the Air Force's goal of 25 percent renewable energy by 2025 and Colorado Springs Utilities' goal of producing 20 percent of its energy through renewable sources by 2020.

### Players come together

The solar partnership began with USAFA approaching Colorado Springs Utilities in 2009. The Academy had received \$18 million in Federal stimulus funds to provide

solar power through installation of a renewable energy system. At that point, the utility had already been working with the Academy to privatize its gas, electric and water services. "Colorado Springs Utilities owns the 600-ampere electrical distribution system, so it just wouldn't have been practical to put a middle man in between," explained USAFA Project Manager Russell Hume.

The nonprofit power provider welcomed the opportunity to play a role in developing their first utility-scale project. "In addition to meeting

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our energy goals, this project will create national visibility and reinforce our reputation as an innovative, leading-edge city—one committed to environmental stewardship,” said Utilities’ Communications Manager Mark Murphy. “We believe it will also pave the way for more renewable energy projects in the years ahead.”

That keen sense of responsibility to the environment was reflected in the extensive assessment process. The Academy involved cadets in the preliminary siting process for the array as part of their studies. The cadet and Academy input was forwarded to the utility’s environmental staff. The findings indicated that siting the array on the more open, eastern border of the Academy not only preserved trees, but also increased its power production. “It was a challenging, but very worthwhile process that also provided the cadets with a hands-on educational experience,” recalled Murphy.

Another choice that maximized power production was bringing in a private developer who was eligible

for the Federal investment tax credits. “Partnering with SunPower enabled us to double the size of the array at no additional cost to the Academy,” Murphy explained.

### Everybody, build!

The innovative manufacturer’s technology was a key factor in awarding the contract. SunPower’s high-efficiency panels, operating at 22 percent efficiency and combined with a tracker system to follow the sun’s movement, increases sunlight capture by up to 25 percent, according to the company. Without the tracking system, the same number of panels covering the same 30-acre site would have generated only about 4 MW instead of six.

While SunPower and USAFA were working on the solar array, Colorado Springs Utilities was designing and building almost two miles of 600 ampere interconnection from the array to the USAFA south substation. The utility also laid a fiber optic link for real-time smart meters, which will monitor the system.

It was a good thing that so many parties were working together because meeting the tight 18-month deadline was no easy feat. Construction crews had to work through the winter months, but the array was completed and generating electricity by March 2011. USAFA held the official dedication ceremony in June.

### Part of the (energy) plan

The solar array has not only put the Air Force Academy 6 MW closer to its goal of energy independence, but also has formed alliances that

will help build on that success. Or, as Hume has noted, a solar array is not by itself an energy plan.

The Air Force Academy unveiled its Falcon Green energy plan in April 2010, and Colorado Springs Utilities has supported its goals with technical assistance and energy-efficient upgrades. “In addition to developing renewable energy, we’ve been pursuing conservation and energy-efficiency goals,” Hume said. “We’ve already seen savings from simple measures like turning off computers at night and mandating set points on thermostats.”

The utility is currently installing individual electric meters on each Academy building that will enhance facility managers’ ability to monitor real-time electric use. Meter data will also be useful in developing energy consumption profiles for further engineering studies.

USAFA has worked with the utility to identify load shaving opportunities and other energy saving and generating opportunities. Colorado Springs Utilities has consulted with the Academy on projects like integrating a small concentrated solar array used for cadet research, and developing a propane air-mix plant, microturbine applications in water pipelines and biofuel technology.

Colorado Springs Utilities has built a strong, collaborative relationship with one of its largest customers. That’s good, not only for load management and renewables development, but for allowing the municipal utility to play its part in national security. ⚡

## Energy Services Bulletin

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visit <http://ww2.wapa.gov/sites/western/es/pubs/esb/Pages/esb1.aspx>

# Hill Air Force Base uses FEMP program to grow energy savings

**E**nergy independence for Hill Air Force Base is not just a goal, but a process that the military installation near Salt Lake City, Utah, has been working on steadily since commissioning its own dedicated landfill-gas (LFG) power plant in 2005.

The award-winning project that started with two Caterpillar generators supplying 1.2 MW added a third in March 2008 to nearly double its generation to 2.3 MW. The base also installed a 200-kW photovoltaic system June 2009, the first step toward larger solar development. “The expansion was built into the original contract,” said Base Utility Manager David Abbott.



**This Caterpillar generator is part of a power plant that turns landfill gas into power for Hill Air Force Base. (Photo by Hill Air Force Base)**

## Funding improvements

The contract Abbott referred to is the \$3 million Energy Savings Performance Contract (ESPC) awarded to the base by the Federal Energy Management Program (FEMP). FEMP launched the program to help Federal facilities make energy-efficiency improvements without up-front capital costs.

The ESPC establishes a partnership between a Federal agency and an energy service company to identify, fund and implement improvements at the agency. The improvements must generate enough cost savings to pay for the project over the term of the contract. Hill AFB partnered with Ameresco to build and operate the LFG power plant for a 20-year period. Once the contract expires, the additional cost savings for the base continue to accrue.

As of May 2011, ESPC projects at Federal agencies throughout the country have saved an estimated 32.8 trillion Btu annually. These savings translate into \$3 billion in reduced Federal spending, proving once



**The solar array may be only 200 kW now, but it was built to grow up to 1 MW. (Photo by Hill Air Force Base)**

again the value of investing in energy efficiency.

## Streamlining for more savings

While the performance contracts were great for helping Federal facilities become more energy self-sufficient, awarding a stand-alone contract could be very complex and time-consuming. Recognizing that greater savings come from an integrated approach to energy

management, the Department of Energy created the Super ESPC

These “umbrella” contracts, or task orders, allow agencies to undertake multiple energy projects under the same contract, as Hill AFB has done with Ameresco. The energy services company was able to expand the LFG power plant and construct the PV array

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## Workshop *from page 4*

Wyandotte, Mich., Municipal Services is restyling itself as a geothermal utility. With state and Federal energy-efficiency funding, the municipality is drilling loop wells in utility easements. Eventually, when enough customers have installed heat pumps, they will be able to share loops, creating an economy of scale.

Wyandotte residents who install GSHPs pay them off through low monthly surcharges on their electric bills. General Manager Melanie McCoy noted that the payback to the utility is about 30 years, similar to a water main project. "It is not a big money maker for us, but it is worth it for the benefits," she said.

### Why utilities should care

Utilities that have adopted GSHPs have found that the systems are great for load factor and use

resources more efficiently, including renewable resources. In Colorado, the average demand savings for geexchange homes is 2.1 kW in the summer, and even greater at 2 a.m. on a winter night. In Austin, Texas, GSHPs provide peak demand savings every month of the year.

Both Phil Zimmer of DMEA and Keith Swilley of Gulf Power Company in Florida cite high customer satisfaction as a by-product of GSHPs. McCoy added that economic development was a strong factor in Wyandotte launching its geexchange program.

And yet geexchange systems are still waiting for their moment while younger technologies like electric vehicles are hailed as the next big thing. "They both build load and help make America less dependent on fossil fuels," Bony said. "Utilities should be promoting both technologies."

### What's next?

Tri-State is doing its part to spread the word by hosting the workshop at its headquarters and providing conference call access for members who couldn't make the trip. The workshop was also recorded so Tri-State members who missed it can request a copy from Ebenkamp.

CoGEHPA will be working with GEO and the Geothermal Working Group of Colorado to plan more events to advance geothermal energy development in the state. Colorado utilities that would like to encourage the adoption of GSHPs can join CoGEHPA. Utilities outside Colorado should contact their state geothermal working groups or join the International Ground Source Heat Pump Association. ⚡

For links to more resources,  
visit <http://ww2.wapa.gov/sites/western/es/pubs/esb/Pages/esb3.aspx>

## Hill Air Force Base

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without having to go through separate procurement processes. FEMP awarded Hill AFB a technology-specific ESPC, designed to encourage the use of emerging renewable energy technologies, including biomass-based fuels and PV.

Under the same contract, Ameresco also completed several energy-efficiency upgrades on base facilities. The base upgraded 878 light fixtures in a 295,000-sqft manufacturing facility to T5 high-

output lamps for an annual savings of \$12,240. By implementing a regular maintenance schedule for surveying steam traps, the Air Force has saved tax payers \$930,498 annually. "There are 3,200 steam traps in the base's heating system, so the savings really add up," said Abbott.

### More generation possible

The LFG power plant may have reached its expansion capacity with the third generator, but Hill AFB still has untapped solar potential. "The inverter and transformer on the current system are sized for 1 MW," Abbott explained.

Overall, Abbott noted, Hill AFB's energy projects have been a win for everyone involved. In FY 2010 alone, the LFG power plant saved more than 50,734 million btu and 14,865 MWh—roughly equal to more than \$689,150. Getting production experience, he added, is just part of the process.

*(To learn how Energy Services Performance Contracting can help Federal agencies meet their energy-saving goals, contact a FEMP financing specialist.) ⚡*

For links to more resources,  
visit <http://ww2.wapa.gov/sites/western/es/pubs/esb/Pages/esb2.aspx>



### Question:

What can you tell me about microturbine generating systems and their performance characteristics? I read about a 30-kilowatt system operating at the Pacific Northwest National Laboratory.

### Answer:

Microturbines are generators that produce between 25 and 500 kW. The systems are prepackaged with a small combustion turbine, generator, controls, interconnection and protective switchgear. The smallest units (Capstone 30-kW power plants) are not much larger than a refrigerator.

The electrical generating efficiency of microturbines is in the 20- to 30-percent range, where efficiency is “electrical Btu out” divided by “input fuel Btu” (when using the lower heating value or LHV rating for the fuel). For instance, the Capstone C30 has a generating efficiency of about 25 percent at 70 degrees F. The efficiency falls off at higher temperatures.

The California Energy Commission reports that equipment costs range from \$700 to \$1,100 per kW. Adding heat recovery increases the cost by \$75 to \$350 per kW. Installation costs vary, but tend to be 30 to 50 percent of the total system cost.

The economics of an installation improve greatly when waste heat can be recovered and used for water heating or preheating. Facilities with a combined electrical and thermal load, such as hospitals, hotels and schools, often use this technology in cogeneration applications. Waste heat recovery

uses more than 50 percent of the fuel input energy.

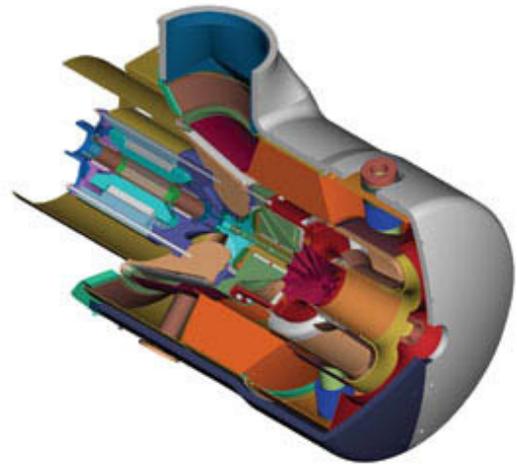
### Applications

Microturbines make the most economic sense for facilities that have large and constant thermal loads, where electrical rates are high and natural gas prices are low. Also, facilities that have access to a “free fuel” supply, such as landfill biogas (link to Hill AFB story) and digester biogas from wastewater treatment plants, can make a microturbine project work.

Several years ago, Pacific Northwest National Laboratory demonstrated distributed generation using a 30-kW microturbine. During peak demand, Bonneville Power Administration shed load by using the internet to turn off or cycle air handlers and remotely start the microturbine. This is not a typical use for microturbines due to their high cost and relatively low electrical generating efficiency (compared to a conventional single-cycle large-scale gas turbine). However, it may make sense in areas with time-of-day rates with extremely high demand charges (i.e. exceeding \$20 per kW). Using the turbine only during peak periods also eliminates the possibility of waste heat recovery.

### Product information

Microturbines are manufactured in various ratings by several companies including Capstone Turbines, Ingersoll Rand and Elliott Energy Systems. You can learn more background on the technology from



Utilities around the world use Capstone C30 microturbines to turn landfill gas into clean energy. (Artwork by Capstone)

“Microturbines: Power to the People,” in *Distributed Energy*, Nov/Dec 2004. It features an interview with Capstone Corporate Communications Director Keith Field. In the interview, Field states that the Capstone 30 kW unit is fuel-flexible; it can run on gaseous fuels or liquid fuels. Microturbines can also use landfill gas, digester gas and biodiesel for fuel.

### More resources

- California Energy Commission *Distributed Energy Resource Guide*
- Case study: *Sauk County Landfill, Wisconsin* (PDF file) Capstone
- “Landfill: Old Landfill, New Tricks” *Waste Age*, June 1, 2002  
This article discusses a turbine installation at the Jamacha Landfill Gas Utilization Project in San Diego, Calif. One landfill, the Lopez Canyon landfill in Lake View Terrace, Calif., produces electrical energy with fifty 30 kW microturbines. ⚡

For links to more resources,  
visit <http://ww2.wapa.gov/sites/western/es/pubs/esb/Pages/esb4.aspx>

## Website of the month: biomass power roundup

**W**ith the release of the report, 2011 U.S.

Billion-Ton Update: Biomass Supply for a Bioenergy and Bioproducts Industry, utilities may want to take another look at ways to fit biomass into their power supply. Here are some web resources to jumpstart your research.

### The benefits, the basics

The Department of Energy believes that biomass resources have a big role to play in the new energy economy. The congressionally appointed Biomass R&D Technical Advisory Committee found that the United States could replace 30 percent of current U.S. petroleum consumption with biomass fuels by 2030. Biofuels can not only reduce our dependence on imported oil and gas, they can support agriculture, forestry and rural economies and create jobs in biorefineries that make the products.

While biomass fuels take many different forms and have even more uses, the majority of web resources related to biomass focus heavily on biofuels for the transportation sector. Still, most websites have some pages dedicated to biopower, using biomass resources for heat, generation or combined heat and power.

Start your research with the Power Scorecard's page on electricity from biomass. This website, which compares the environmental impacts of different forms of generation, provides a clear overview of biomass power plants. Though focused mainly on transportation fuels, the Bioenergy



**Fuels for Schools and Beyond is a program that promotes installing biomass systems to heat public buildings. (Artwork by Fuels for Schools)**

Science Center's A-to-Z glossary will get you up to speed on the industry terminology. Visit the "Did U Know?" page for concise explanations of basic biomass concepts. The National Resource Defense Council's page on biomass energy addresses the issue of sustainability, including land and water use and food-for-fuel tradeoffs.

### Old-fashioned heating

Converting staff cars and service fleets to ethanol or biodiesel is one way to "green" utility operations, but it is by no means the only option. Wood waste-fired boilers can provide efficient and sometimes less expensive heat for large facilities and consumers alike.

The U.S. Department of Agriculture Forest Service program called Fuels for Schools and Beyond and encourages the use of wood biomass as a renewable, natural resource for heat and power generation in public and private buildings. Program partners and staff provide technical and financial assistance for implementing community biomass energy projects. Eligible facilities range from small schools to universities, community centers, hospitals, prisons, tribal-owned facilities, residential, commercial, and industrial facilities, to district energy systems.

Five of the six state forestry departments that participate in this program are in Western's territory: Nevada, Utah, Montana, Wyoming and North Dakota. Fuels for Schools also has a list of state forestry biomass programs outside its six-state region that can put clients in contact with resources to assist them such as an architectural and engineering firms, energy service companies, economic development agencies and more.

The new generation of clean-burning wood and pellet heating systems may offer consumers a cost-effective alternative to electric space heating or propane heat, as well as a way to help winter-peaking utilities manage their load. Some municipalities restrict wood burning for air quality, so utilities should check local restrictions before creating a rebate program and only promote the cleanest technologies.

### On a larger scale

Forestry, agricultural and food processing wastes offer opportunities for both industrial operations and power providers, especially where there is a need for heat as well as electricity.

Anaerobic digesters at Haubenschild Farms in Minnesota and Midwest Dairy Institute provide

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combined heat and power for dairy operations while controlling odor. See the report, Cooperative Approaches for Implementation of Dairy Manure Digesters, from the USDA Rural Development Program to learn more.

Capturing heat and power from brewing waste is becoming a common practice at small breweries like New Belgium in Colorado and the Sierra Nevada Brewing Company in California. A study for the Colorado Governor's Energy Office, Economic Feasibility Study of Colorado Anaerobic Digester Projects, looks at the costs associated with several types of biopower opportunities.

Utilities, too, are finding ways to put waste products to good use, displacing fossil fuels in generation. Colorado Springs Utilities is working on a project to replace up to 75,000 tons of coal at its Drake power plant with biomass from nearby aging pine forests, pine beetle kill and urban wood waste. Municipal and other waste streams provide methane to

power waste water treatment at East Bay Municipal Utility District in northern California. The common thread running through all these projects is the disposal of waste materials that would have to be otherwise managed at the expense of business owners or taxpayers.

### Feedstock, funding

One of the main attractions of biomass systems powered with organic wastes is that feedstock seems to be everywhere. When evaluating a biomass project, the availability of the feedstock and the plant's proximity to the supply are critical considerations.

Utilities serving rural, agricultural and forested areas may have the most opportunities, but cities have plenty of biomass streams, too. Use the National Bioenergy Routing Model, developed by Oak Ridge National Laboratory for the Bioenergy Knowledge Discovery Framework (KDF) offers several modeling tools for evaluating fuel resources.

KDF's Bioenergy Library has a wealth of resources covering biofuel distribution, enduse and production, and feedstock logistics and production. Most of the papers are highly technical in nature, but still useful to visitors who are serious about developing biofuel projects.

Of course, nothing gets built without money. Farmers, ranchers and rural small businesses can apply to USDA's Rural Energy for America Program for grants to purchase and install renewable energy systems and make energy efficiency improvements.

Rural utilities with potential biopower projects could use the USDA Energy Matrix to search for funding. The navigational aide helps users sort through USDA's extensive offering of energy related programs. Other sites that can connect developers with project financing include the Database of State Incentives for Renewable Energy, Grants.gov and FedOpps. ⚡

For links to more resources,  
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