



Renewable Energy Case Study

F.E. Warren Air Force Base, Wyoming Wind Energy

F.E. Warren AFB, Wyo., is the proud home of three commercial scale wind turbines and was the first Air Force base in the continental United States to generate energy from wind turbines. The wind farm consists of two Vestas V47, 660 KW, and one Gamesa G87, 2MW turbine for a total of 3,320 KW. The wind energy is capable of generating 10 million kilowatt hours per year, enough to power 1,300 households.

The turbines are “grid connected” directly to the on-base distribution system. The power flows into the base distribution system, offsetting the power received from commercial energy suppliers. The Air Force has ownership of the two Vestas V47 wind turbines and associated transformers and will acquire ownership of the Gamesa G87 in FY11.

The turbines are expected to save the Air Force more than \$11.4 million in energy costs over the next 20 years. Energy produced by turbines saves \$0.052 per KWH. The annual estimated energy production is approximately \$575,000 with a simple payback period of 14 years.

The project was designed and accomplished in partnership with F.E. Warren AFB, Idaho National Laboratory, and the Air Force Civil Engineer Support Agency. The total investment in the F.E. Warren wind farm is approximately \$8.3 million.

The two 660 KW turbines were funded by Energy Conservation Investment Program funds in 2005. The third (2 MW) wind turbine generator installation was funded for testing “microgrid” capabilities; that is, disconnecting the base from commercial power supply and operating with wind and diesel gensets. It was brought on line April 2009.





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Massachusetts Military Reservation Wind Energy

Hazardous waste and groundwater contamination clean-up efforts underway at the Massachusetts Military Reservation (MMR) require a lot of energy. The environmental initiative is jointly funded by the Air Force and the Army. The MMR is located above a relatively fast-flowing, sole source aquifer that radiates in all directions from a point near the eastern border of the facility. Past fuel leaks, disposals, fire training, and wastewater operations have caused numerous large, contaminated groundwater plumes that have migrated beyond the MMR boundaries into the surrounding communities. In some cases, municipal and private water supply wells were affected.

In the 1990s, the Air Force Center for Engineering and the Environment (AFCEE) identified 80 potential hazardous waste sites and numerous areas of groundwater contamination. Since then, AFCEE has used nine groundwater cleanup systems to clean more than 13 million gallons of contaminated groundwater a day. AFCEE is conducting the cleanup and has provided replacement water supplies for the surrounding towns while depending on electricity generated by the New England energy mix which includes fossil fuel based energy. AFCEE set out to green the remediation efforts by installing a 1.5MW Fuhrlaender wind turbine in 2009. The cost of the \$4.6 million project was split between the Air Force and Army. CH2M prepared the constructability and environmental assessments and conducted the Title II oversight. Environmental Chemical Corporation was awarded the construction contract.

At a 29 percent capacity factor, the AFCEE wind turbine creates about 3,810 MWh of power annually while producing green energy. Presently about 30 percent of the electricity for the treatment plants is being generated from the wind turbine. Cost benefits are still being calculated, but recent estimates indicate the AFCEE wind turbine will save the program about \$500,000 per year. The project's return on investment is approximately seven years.

AFCEE is currently installing two additional wind turbines and expects to have them online in September 2011. CH2M prepared the constructability and environmental assessments and is conducting the Title II oversight of the project. ECC was awarded the design-build contract. Each of the two new 1.5 MW GE wind turbines will be nearly 400 feet tall. This latest project will cost a total of \$9.62 million, which includes the two turbines and building a substation to tie them into NStar's transmission lines. The new turbines will be located in the northern portion of the 22,000-acre base near the 6th Space Warning Squadron's PAVE PAWS radar station.

Eventually, the three AFCEE turbines will put enough energy into the regional electricity grid to cover 100 percent of the energy costs incurred by the Air Force and Army for cleaning up plumes of polluted groundwater created by the military's past uses of the land.





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Nellis Air Force Base, Nevada Solar Photovoltaic Array

Nellis Air Force Base, Nev., is home to one of the largest solar photovoltaic (PV) arrays in the United States. The PV array is a public-private sector partnership with no capital investment by the Air Force. Nellis provides land for the PV array through a 20-year land lease. SunPower Corporation is the designer and builder of the project. The \$100 million system is owned and operated by Fotowatio Renewable Ventures (FRV), previously MMA Renewables Ventures, LLC. The power purchase agreement (PPA) supplies power to Nellis at a guaranteed rate for two decades. The agreement allows FRV to sell the renewable energy certificates (RECs).

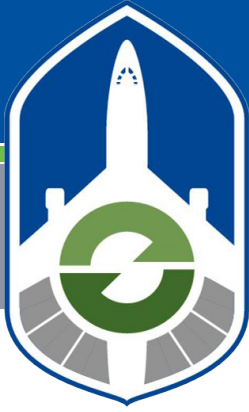
Nellis AFB competitively awarded an indefinite term utility contract to purchase the electricity generated by the array in 2007. The contract is written as a utility contract utilizing the authority of 40 USC 501b and FAR Part 41. The contract costs are paid with annual appropriations. Electricity is purchased from the PV array at a fixed rate of \$.0223/kilowatt hours with no increase throughout the life of the indefinite term contract. The Air Force does not purchase RECs from either Fotowatio or NV Energy.

The PV array spans 140 acres and generates more than 14 megawatts of clean, renewable energy. More than 72,000 solar panels contain nearly 6 million solar cells. Many of the panels, which track the sun across the sky, were placed on top of a capped landfill.

This project saves Nellis more than \$1 million a year in electricity costs. Since completion in 2007, the system has produced approximately 92,570 megawatt hours of renewable power and removed 58,056 tons of carbon emissions. The project reduces CO-2 emissions by 24,000 tons annually, which is the equivalent to planting 260,000 trees or removing 185,000 cars from the roadways.

Nellis is planning an encore. The base energy team is currently working with NV Energy on a potential PPA for power from an additional PV array. Under the new arrangement NV Energy would construct a 17MW array on approximately 150 acres of Nellis land. If awarded, construction on the new array would be complete by the summer of 2012 and more than double the PV generation at Nellis.





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Los Angeles Air Force Base, California Photovoltaic Parking Structure

Los Angeles AFB, Calif., located within an urban area, has very limited open space. To meet its goal of producing 25 percent of the base's energy requirement with renewable resources, the base decided to build a PV system over existing parking spaces.

The base has limited parking spaces so the PV system was built with a single row post support within the parking meridian as one long continuous row. The steel framing and overlying PV system overhangs the parking spaces to either side of the parking meridian.

The PV system is 32 feet wide and spans more than 800 feet. It provides clean, quiet electricity and cools 200 parking spaces during the summer months.

The PV system is rated at 320 kW and has performed flawlessly since it became operational in June 2010. Power developed by the PV system is converted from direct current, known as DC, to alternating current, known as AC, by the systems power inverter. Converted power is tied directly into the base power grid. The system produces enough electricity each year to power the base fitness center.

The project was funded through the Energy Conservation Investment Program administered by the Air Force Civil Engineer Support Agency, Tyndall AFB, Fla. AFCESA competitively bid the project and selected SEI, Inc. Local subcontractors specializing in steel fabrication and PV system installation were used. Total investment for this project including design was \$1.3 million.

The system produced approximately 0.54 MWh of renewable power during its first year of operation, offsetting 668,893 pounds of CO₂ emissions.

Los Angeles AFB also boasts a PV array on its commissary roof. Also funded with ECIP dollars, the 2008 project produces 290 kWh a day or enough electricity to power more than 10 households.





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Hill Air Force Base, Utah Landfill Gas

Hill AFB saves approximately \$400,000 a year on energy costs with the first landfill gas to energy project in the state of Utah. It is also the first Air Force installation to use a Department of Energy - Energy Savings Performance Contract (ESPC) and the DOE's first contract awarded under the Biomass and Alternative Methane Fuel Super ESPC.

The ESPC provides a guaranteed supply of low-cost electricity from a renewable energy resource by utilizing landfill gas from the nearby Davis County Landfill. With no upfront capital costs to the Air Force, Hill AFB and Ameresco Federal Solutions negotiated a 20-year, \$3 million ESPC. After construction, a unique arrangement was required since Utah is a regulated or "closed" state. A Power Purchase Agreement (PPA) was arranged with PacifiCorp, the jurisdictional electric utility, and the Air Force. The PPA allows Hill AFB to sell its renewable power to PacifiCorp under the Rate 37 schedule at a set purchase price. This incentive rate schedule approved through the Utah Public Service Commission allows Hill AFB to get paid to produce the power that offsets the public utilities distribution grid. Hill AFB uses the payments from PacifiCorp to pay down the cost of the \$3 million ESPC project.

The landfill gas project has a 17.8 year simple payback, but other high payback energy conservation measures were rolled into the ESPC task order reducing the payback to 7.26 years. Those savings will pay for the project and protects Hill AFB from rising energy costs over the next two decades.

The project was constructed with expansion in mind. Caterpillar generators de-rated for methane gas will produce 1.2MW of reliable energy that is independent from potential local power grid events, such as natural disasters or inability of the utility to provide power. Hill AFB will reduce its overall reportable energy consumption by three percent, contributing to the guidance mandated by the Energy Policy Act of 2005 and Executive Order 13423.

The Hill AFB landfill gas generator produced 15.1 million kilowatt hours in 2010, which represents nearly seven percent of the base's total electrical usage.

