

Long before **GREEN** was an important step in our society Animal Ark was practicing **GREEN**.

Renewable Energy at Animal Ark

Since it moved to its present location in 1981, Animal Ark has not been connected to the commercial power grid. For the most part, the decision to be *off grid* was economic, as the cost to extend the power grid lines to the property would have been nearly \$75,000. Because it was less expensive, the operators of Animal Ark chose to install and use a propane-fueled generator to produce their electrical power. The conversion of the facility to renewable electrical energy resources, primarily solar and wind, is a “work in progress” that continues to grow as new renewable sources are added to the system.

Until 2001, the generator was the primary electrical source to power appliances and lights, to pump water and to charge batteries. The water was pumped from the well into an elevated storage tank that provided water at gravity-fed pressure for domestic and irrigation uses. A bank of 6 Trojan L-16, 350 Amp-hour batteries was used to provide electrical power through a 1200-Watt inverter for appliances and lighting when the generator wasn't running.

The Caretaker's Quarters



Pioneered in 1981 by the founders, Aaron and Diana Hiibel, the caretaker's quarters is a classic *passive solar* home in design and construction. Sunlight floods into the *atrium* through the large, south facing windows and heats air that is carried throughout the building by naturally occurring convective air currents. The back wall of the atrium is constructed of masonry laid rock, which not only serves as a structural component of the home but also as *thermal mass* to help

regulate the interior temperature. The thermal mass, or *Trombe*, wall absorbs and releases heat much more slowly than the surrounding air and serves to slow down and reduce temperature fluctuations that would normally occur by absorbing and storing heat during the daytime and releasing it throughout the night. The thermal mass absorbs and releases enough heat, or cool, to maintain the home in a comfortable temperature range for up to three days.

The home is also *bermed* on the east, north and west sides, meaning that it is built partially into the surrounding earth. Because the earth, below three to four feet under the surface, maintains a constant temperature in the 50-degree Fahrenheit range, this practice dramatically reduces the heating and cooling loads (the need to add or remove heat) for the home.

Domestic hot water is provided by a 40-gallon, passive solar tank mounted on the south-facing roof and to compensate for cloudy winter days, there is a wood-fired stove for back-up heating.

The caretaker's quarters has a normal array of household appliances and office equipment including: a propane refrigerator, regular lighting, a TV/VCR, central vacuum system, dish washer, washing machine, microwave oven, coffee maker, three computers, printers and a copy machine. Since June of 2001, the power to operate the building has been supplied by the Large Solar Array and the Wind generator.

The Large Solar Array



Installed in June, 2001, using *photovoltaic* modules donated by Sierra Pacific Power Company (SPPCo), the array consists of sixty modules, or panels, mounted on a fixed mounting system that can be raised or lowered on

the north side to allow for seasonal tracking of the sun. As the name photovoltaic implies, the array uses sunlight (*photo*) to generate electricity (*voltaic*). Each of the 60 Solarex modules, in full sunlight, generates 64 Watts of electricity at 12 volts of direct current (12VDC). The array is wired in three groups of modules: two groups of 18 modules each and one group of 24 modules. Each module group is wired in a series and parallel configuration so that the electrical output of each group, and the array, is at 24VDC. The array generates an annualized average of 19,200 watt-hours (19.2 kWh) of electricity per day. The average home in the Reno-Sparks area uses 21.7 kWh of electricity per day (SPPCo), but, because they specifically use energy-efficient appliances and lighting, the solar array produces more than enough power to meet all of Animal Ark's needs. The power generated by the array is fed to the Powerhouse through a fused, underground wiring system.

The Wind Turbine



Situated on the ridge-top behind and to the east of the Large Solar Array, the Whisper H80HVLV wind generator is mounted on a twenty-six foot tall folding tower. At winds of 24-mph, the wind generator, with its 10-foot long blades, will produce 950 Watts of power at 120VAC (volts, alternating current). Most household appliances and lights use this type (120VAC) of power. The power from the wind generator is also fed to the Powerhouse through underground wiring and a charge controller.

In April of 2007 this wind generator was replaced by a Bergey XL.1 Wind Turbine which is a superior machine. It has a "slow mode" rotor idling when batteries are charged. It also uses an oversized low speed permanent magnet alternator which is much quieter than the old unit.

The Powerhouse

Set between the Large Solar Array and the Food Prep / Restroom building is the Powerhouse. It houses: two Trace 4024 inverters, connected in tandem to provide 240 volt alternating current to the food prep building and caretaker quarters. A 1750 Amp-hour battery with a power vent installed to prevent damage from the gasses given off during battery charging was replaced in April 2007 by 12, 4V 1900 AH Batteries which more than doubled the storage capacity. A 15 Kilowatt diesel generator serves as a backup power source.



Irrigation



Water to irrigate the landscaping at Animal Ark comes from a 500' deep well that can be found just to the east of the Powerhouse. A small PV array powers a 48VDC Sunrise submersible well pump that supplies water to the silver 3,000 gallon tank located near the wind generator. The well is not a very good producer, so the pumping time must also be regulated. The small PV module at the wellhead, which powers an intermittent timer for the pump, accomplishes this.



Ponds and Streams

At the Leopard, Black Bear, Asian Tiger and Wolf enclosures, you will find small arrays that each power a SunCentric™ centrifugal pump. The pumps produce 40 gallons per minute flow for the streams and ponds in the enclosures. To maintain water quality, all of the water for each stream / pond system is circulated through a swimming pool sand filter while the streams are running. The water used for the back-flush cleaning cycle of the filters is directed to nearby vegetation for irrigation. Except for the array at the black bear enclosure, the small arrays are mounted on passive sun-tracking systems that improve the array's collection efficiency by up to 25%.



The Food Prep / Restroom Building

Housed in the Food Prep area of the building, are three food freezers, a microwave oven, a conventional coffee maker, exhaust fans, lighting and chargers for the 2-way radios that the staff use for communication. The large PV array and the wind turbine provide all of the power for this building. The freezers are all ultra-efficient, chest models that use minimal power each day. The restrooms are provided with skylights for lighting during the day and timer-switched fluorescent lighting for the occasional times when they are used at night.

Admissions / Gift Shop

In April of 2004, the power system for the Admissions/Gift shop and shop building was added. It has its own solar array, charge controller and Outback inverter to provide 120 volts of alternating current to the building. It has the capability of being expanded by the addition of a second stacking inverter and additional solar panels.



2008 will bring the addition of a solar charged electric fence and gate enclosing the entire facility for security purposes.

Special thanks to

Sierra Pacific Power Company

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