Roper High-Efficiency House

The Roper house at 1001 Auburn Drive in Blacksburg was built in 1983. Jeanne and David Roper bought the house in 1995 from the second owner. It was built with double-pane windows and low-efficiency heat pumps.

Efficiency changes made:

- Downstairs high-efficiency heat pump installed in 2003.
- Upstairs high-efficiency heat pump installed in 2007.
- Attic and crawl-space insulated in 2012.
- Twenty 270-watts Solar panels installed in August 2014.
- Four 285-watts solar panels added in November 2015
- Four 290-watts solar panels added in March 2016.
- Hybrid hot-water heater installed in November 2017.

PV System Details and Operation

The Roper PV system consists of a 7.7-kW photovoltaic array.

Orientation: about 20° west of south; about 40° roof-tilt angle. (Latitude is 37° N)

- Panels: Twenty-eight SolarWorld PV panels
- Micro-inverters: Twenty-eight Enphase M250 because of shading by trees in mornings and evenings
- Pro-Solar roof mounting hardware
- Delta LA-302 Lightning Arrestor
- Cumulative energy meter for the PV array
- Enphase Envoy module for Internet access

This grid-tied PV system provides about 40% of the electrical needs of the house and electric car. The system is connected to the house's electrical service as well as to the APCO grid in a net-metering arrangement. Often all of the power produced by the array will be consumed directly by the house. During those times when the panels are producing more electricity than the house is consuming the excess electricity will flow out into the grid and we get credit at the same rate as we pay. A credit is given against the next month's bill for all excess electricity the system generates. The system operates fully automatically and requires no routine daily maintenance. Gravity keeps the panels clean because of the steep slope (40° roof-tilt angle).

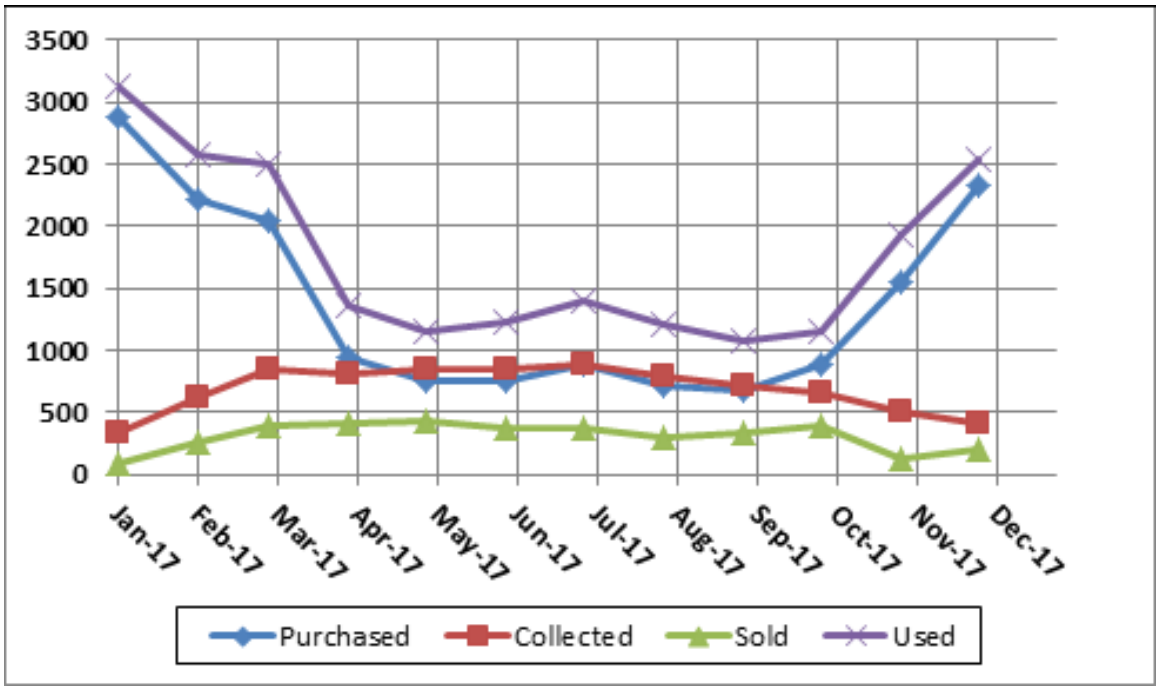
System Production and Savings

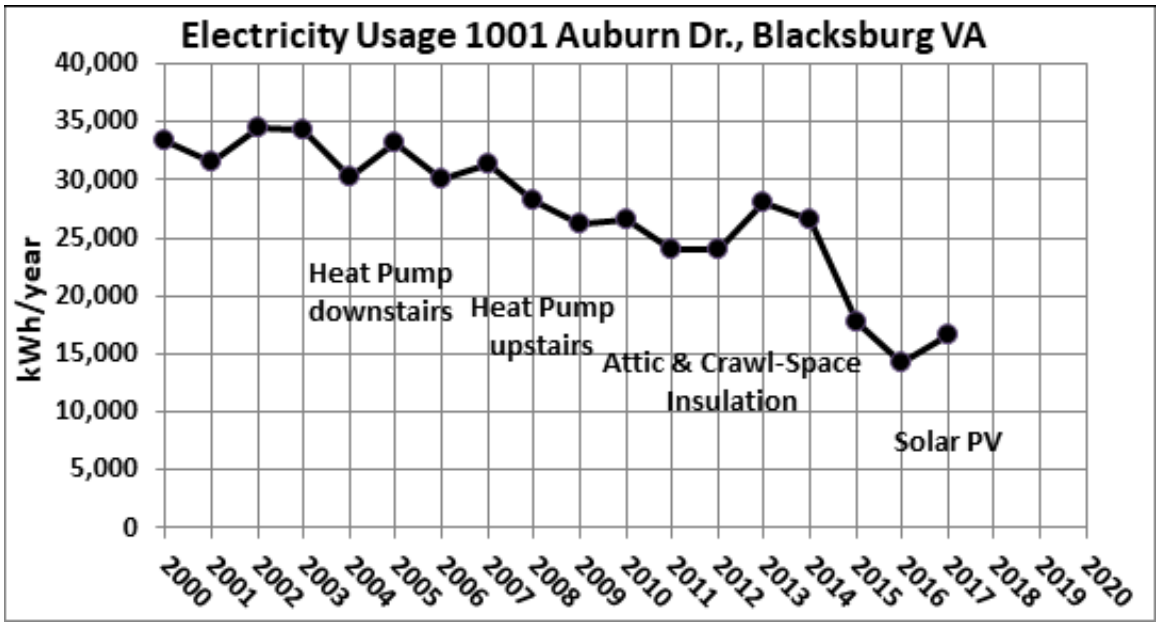
The house/car electricity consumption average is about 1700 kWh per month, and the average cost for electricity is currently about $0.12 per kWh. The kWh cost is expected to increase steadily in the future.

Taking into account partial shading, orientation, and tilt angle of the roof, the PV system is estimated to produce an average of 725 kWh per month. Collection is higher in the summer and lower in the winter. This offsets about 40% of the monthly usage. About one-third of the solar energy is used to charge the Roper electric car, currently a 2018 Tesla Model 3 Long-Range BEV.

Over its 30 year anticipated lifetime, the PV system will:

- Collect an estimated 260,000 kWh of energy from the sun.
- Keep 400,000 lbs of CO_2 out of the atmosphere. At $100/ton that gives a savings of about $20,000 for the world.
- Save a minimum of $31,000 in utility costs (assuming fixed electricity rate of $0.12/kWh).
- Cost: about $21,000 including house rafter modifications and after 30% tax credit.
- **Our main motivation was to reduce carbon emissions, rather than monthly energy cost.**





Yard Sustainable Features

- Two rotating composters.
- A digester for when composters freeze in winter.
- Extensive recycling and reuse contributions.
- 3 dry wells for putting back house and garage roof water underground.
- 2 rain barrels as water ballasts for water runoff from front house roof.
- Many large oak, maple, hickory and walnut trees for summer shade.
- Extensive flower and shrub garden for bees, butterflies, and birds.