Solar+ Home: Comfortable Home, Minimal Bills, No CO2 Emissions

February 22, 2019

Tom Hoff
Founder and Chief Research Officer
www.cleanpower.com
Mission
Advancing the energy transformation

Team
Utility, energy and software professionals

Software
PowerClerk
SolarAnywhere
WattPlan
Key Steps to a Solar+ Home

- Implement electrical and building shell efficiency
- Electrify everything, including transportation
- Power with solar
- Match solar with loads by either controlling loads or using storage
Solar+ Home Energy Consumption

![Bar chart showing energy consumption categories: Baseload, Non-HVAC, Water Heating, Air Conditioning, Space Heating, Automobile.]
Power Monitoring System

- Cooktop
- Refrigerator
- EV
- PV
- Heat pump water heater
- Main service

- Oven
- Microwave
- Dishwasher
- Heat pump space heater
- Washer and dryer
- Main service
Validation: 4½ Years of Results

**EV**
- 2nd EV Added 10/18

**PV**
- Refrigerator
- Lights & Misc.
- Space Heating
- Water Heating
- Cooking
- Laundry
- Dishwashing

**Usage**
- 7/14 to 6/15
- 7/15 to 6/16
- 7/16 to 6/17
- 7/17 to 6/18
- 7/18 to 1/19

- 10,000 kWh
- 7,500 kWh
- 5,000 kWh
- 2,500 kWh
- 0 kWh

- Warm Winter
- Switched to Heat Pump
- Completed Shell Investments

* Laundry used 24 therms/yr of gas until 11/18
** 2nd EV Added 10/18
Solar+ Home

35 year old, 3,000 ft² House in Napa, CA
after installation of SunPower 6 kW-DC PV System
Mini-Split Heat Pump Heats Home

- **Indoor Unit**
- **Outdoor Unit**
- **Thermally insulated shades**
Become All-Electric by Eliminating Natural Gas Appliances

Heat Pump Dryer

Induction Cooktop
Optimize Seasonal Window Screen Usage

Shade south-facing windows in summer

23 Btu/ft\(^2\)-hr (6% solar heat gain)

Remove screens in winter

231 Btu/ft\(^2\)-hr (~60% solar heat gain)*

*Measured value is comparable to reported window spec of 62% SHGC
Have Good Attic Ventilation using Passive Ventilation and Roof Shading

Intake vents allow air to have clear path and exit ridge vent removing hot air trapped by the radiant barrier

PV shades roof
Reduce AC Consumption using Thermal Mass and Nighttime Ventilation

Hottest Week of 2015

Thermal mass & efficient shell slow heat gain
Nighttime ventilation provides cooling

9 kWh/day
Load (kW)

Result: House is cooled without air conditioning

Note: a similar, very inefficient house used 57 kWh per day during the same week
Resources

- Blog: 5-minute video

- Detailed white paper