

## The Quincy, California Zero Net Energy House

**November 2015** — After its first year of occupation, the 3,265 sf Quincy Zero Net Energy House has proven that it exported over 1,500 kilowatt-hours *more energy* to its utility than it consumed. This all-electric home lies at 3,500 feet in California's northern Sierra, surrounded by higher mountains in a heating dominant 5,852 degree day climate with records of -24° and 114°F.

The single story conventional structure combines eight inch wall plates with inner and outer 2 x 4 offset studs to achieve an R-33 wall and the near elimination of thermal bridging. Windows are insulated vinyl with a .27 U-value. Ceilings are insulated to R-49, and floors (over crawl space) are R-30. The building has a heat loss of less than 20,000 Btu/hr at a winter design temperature of 10°F and is served by a three-zone, ducted 3-ton geothermal heat pump. Via its de-superheater, 3,500 Btu/hr is added to a separate hot water pre-heat tank upstream of the electric (storage) water heater, every hour that it operates. This all-electric house burns no propane, oil, or wood.

Using the utility as its electric battery, the 7.4 KW rooftop solar PV array regularly exceeds internal house loads and exports up to 7,600 watts per hour back to the grid under a Net Energy Metering program offered by Pacific Gas & Electric. Being very kind to the electric grid, this home exported over 2,700 Kwh over the four month, mid-June to mid-September peak air conditioning period, and 82% of that power was during peak and partial peak times (as defined by the utility). Geothermal heat pumps make low power draw in cooling possible by sending unwanted household heat into cool dirt rather than into hot, ambient air.



**Ground loop, geothermal heat pump, and solar PV— a potent combination to fight climate change!**

Using the shallow earth for thermal heat exchange, the home's geo heat pump is fed by 3,200 feet of horizontal slinky pipe as a closed loop heat exchanger at 7.5 foot depth in very poor alluvial sand and cobble. The 116 gallons of a water/methanol mix in this ground loop makes a trip to the end of a loop trench and returns to the heat pump in 11 minutes. The geo heat pump exceeds nameplate performance because its loop produces higher than nameplate temperatures in winter, (and cooler ones in summer). This bonus is due to its bedding, coverage and compaction in special silt, and its underground irrigation via downspouts, and surface flow captured by drainage boxes. The unusually long loop, greater than average depth, and irrigation by laser-leveled leach pipe were all used to offset poor conduction and dry underground conditions. Decent soils found in most other locations would have shortened this ground loop by up to half.

Solar photovoltaics paired with a geo heat pump system is an effective marriage of two technologies allowing all the juice to come from the sky and all the thermal energy to be accessed from or rejected to the earth. The added bonus is that it can all be done on-site, and it often serves as a distributed energy system during daytime. The house was designed and built by Bill Martin, a long-time local energy efficiency proponent. Martin is the Principal of MartinEnergetics and is President of the California Geothermal Heat Pump Association. He can be reached at [WillyCliff@gmail.com](mailto:WillyCliff@gmail.com).