

Residential Solar Array for Distributed Generation

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Summary by Kevin Davidson

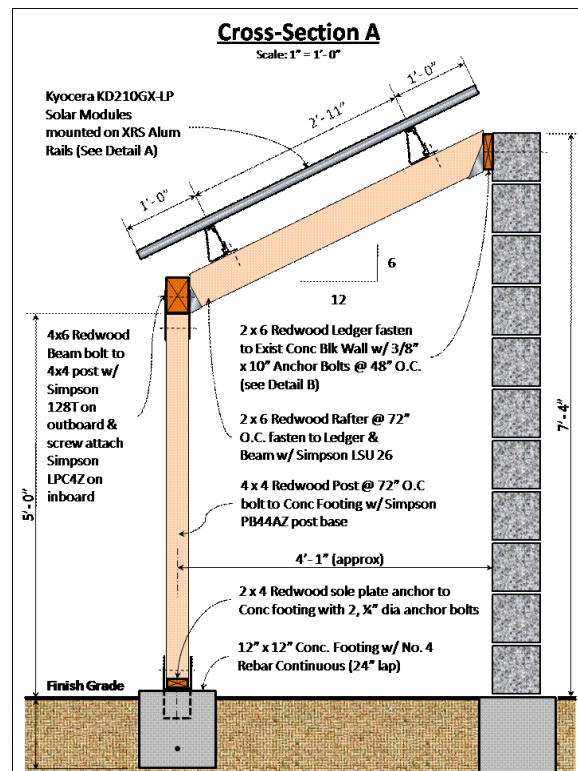
Here are a few photos of my newly completed 3.0 kW solar array in my backyard. Project costs were \$15,000 including building permits of which utility rebates and state & federal tax credits should compensate me for 80% of the expense in the 1st year.

Project Steps



In August, 2009, having some vacation time, and a little encouragement and financial support from my fiancé Catherine, I thought it would be good to help stimulate the local economy by designing and constructing my own backyard, grid-tied solar array. The array consists of 14, Kyocera KD210GX-LP solar modules connected in-series to produce 372.4 DC volts and up to 7.9 amps at the inverter, a Xantrex GT 3.3. Construction began in early September after receiving a building permit from the City of Kingman the last week of August and concluded in mid-November.

The array is some 45' long and is supported by a redwood structure consisting of 2x and 4x lumber. The post bases sit on a concrete footing (2 cu yds) and the rafters are attached to an existing 11 course masonry wall (7'-4") with a 2x ledger. Orientation is due south with a 6:12 pitch designed to maximize output in April and October when skies are generally clear and temperatures are cooler. Aside from the concrete pour courtesy of Doug Brotherton and the electrical wiring from Glenn Roehl of Sunquest Solar, the design and construction and installation are my own. The City of Kingman's plan check review was remarkably quick (less than 4 working days), a benefit of not having to compete with other projects in the queue due to the slow-down in the construction industry. Aside from the Cross-Section (shown at right), the construction drawings consisted of a Plot Plan, foundation plan, framing plan, single-line electrical wiring plan, front elevation and construction details as required (see exhibit board).





The support structure uses a series of Simpson Strong-Tie connectors and a few dozen bolts with 14, 3/8" x 10" hex-head bolts used to secure the ledger to the wall, some of it being solid grouted requiring a new hammer drill (not included in the project cost) and 38, 1/2" x 5" hex-head bolts to attach the eight post bases (2 per base) and 22 bolts for the straps connecting the 4x4 posts to the 4x6 beams (one 18' long and two 12' long). That, and a pound of 1 1/4" number 10 wood screws to fasten the rafters to the beams and ledger should give the structure some longevity.

A significant savings was also had from Northern Arizona Wind and Sun whose 30th Anniversary Sale reduced the costs of each PV panel to \$570. With a \$3.00 per DC watt rebate from Unisource Energy Services, \$1,000 tax credit from Arizona and a comparable Federal credit, my out-of-pocket costs will be \$3,000 and paid back through reduced energy bills in six to seven years. The inverter was also purchased from Northern Arizona Wind and Sun and is located some 50' from the east end of the array.



The system's daily output has been averaging over 17 kWhrs on clear days since commissioning on November 15th with an overall average of 15 kWhrs per day. Peak hourly output on December 24th was 1,609 watts per hour over nine hours and fifteen minutes on-line for a total of 15,014 watts. On the spring equinox, output was 1,728 watts per hour over eleven hours and thirty-six minutes on-line equaling 20,049 watts. The graph shows that air temperature also affects production. The correlation between hourly output and air temperature is fairly predictable with warmer days reducing hourly output and cooler days increasing output. This leads to daily production in spring being equal to or better than those days around the summer solstice.

