Modern Communal Solar

By ASES (American Solar Energy Society) April 26, 2011

Neighbors in a 29-home cohousing community in rural New Hampshire pool their resources and go solar.



Photo Courtesy Richard Pendleton

You might say that an overlooked "expense" of adding solar to a home is the time and mental energy that must be invested up front. As solar is still a relatively unconventional energy source, homeowners interested in purchasing a system can spend considerable effort researching options, deciding what might be most suitable, understanding incentive programs and managing the installation.

One way to lessen such a burden is by sharing it, spreading this "expense" among many people. As residents of a cohousing community, our situation has lent itself well to this approach. We live in <u>Nubanusit Neighborhood and Farm</u> in Peterborough, N.H., where we recently teamed up with a group of neighbors to purchase photovoltaic (PV) solar panels at an economical rate — both in terms of time invested and dollars and cents.

At the end of a nine-month process, 17 homes in our community now have a total of 169 PV panels, providing 38.8 kilowatts (kW) of generating capacity that's expected to satisfy some 65 percent of these homes' electricity needs. Our own home, a three-bedroom duplex, has a nine-

panel, 2.07-kW array. By taking a shared, neighborhood-based approach, we were able to create an economy of scale that saved some 11 percent over the typical industry pricing.

Living at Nubanusit Neighborhood

There are many kinds of cohousing developments, but a central idea is that residents are consciously committed to living as a community. Cohousing is a type of collaborative housing in which residents actively participate in shaping their own neighborhood. Cohousers seek to know their neighbors and avoid the isolation of some modern neighborhoods.

Nubanusit Neighborhood and Farm has 29 homes clustered closely together on a few acres of land, surrounded by more than 100 acres of woods and farmland that we own in common. Our values stress environmental sustainability and stewardship, and interconnectedness. The physical design of the neighborhood encourages both social contact and individual space, and neighborhood-wide decisions are made by consensus, rather than by a board or by voting. As Nubanusit Neighborhood is legally organized as a condominium development, we own our individual home and share with our neighbors ownership of common land and facilities. The neighborhood includes a mix of housing types from two "quads" (each with four two-bedroom homes in it) to seven duplexes (each with a three-bedroom unit adjoining a two-bedroom unit) and seven standalone four-bedroom houses.

Like most cohousing developments, Nubanusit also has a shared community building, called the Common House, with a large kitchen and dining room where there's a community meal available Thursday evenings and potlucks on Sunday evenings. We take our two children to many community meals, but not all, as attendance is voluntary, and sometimes we're busy elsewhere or just prefer to have quiet family time. The Common House allows individual homes to be somewhat smaller than they might be otherwise. It serves essentially as an extension of our own home, as it does for everyone in the community. The Common House has two bedrooms available for visiting guests, as well as a children's room, a small library and a large multipurpose room for meetings, celebrations and other events. With the Common House and the design of individual homes, the development of Nubanusit Neighborhood and Farm stressed sustainability from the start.

Nubanusit Neighborhood residences have a highly insulated envelope, access to natural light and energy-efficient light fixtures and appliances. The windows are triple-paned and there are no fireplaces (except a shared fireplace in the Common House). For all buildings, heat and hot water are provided by a centralized wood pellet boiler system. Six stoker-fired boilers are located in the basement of the "Governor's House," a rehabbed farmhouse that contains offices upstairs. Having the heating source centralized increases efficiency over having individual boilers for each home. A wood pellet system was chosen for its local and sustainable qualities — fuel for the boilers comes from New England Wood Pellet, a nearby supplier that uses the residual waste of local wood product manufacturing. Pellets are delivered to a 25-ton silo next to the Governor's House and from there they feed automatically to the boilers through a subsurface auger. Water heated in the boiler room is circulated throughout the neighborhood by a variablefrequency-drive pump. The hot water travels through insulated pex tubing buried roughly five feet deep. In each home, the hot water feeds either individual radiant panels, each with its own

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thermostatic control, or a domestic hot water heat exchanger that feeds a storage tank. Each home also has a master control thermostat.

While solar energy was of interest to the developers of Nubanusit Neighborhood and Farm, they decided it was not cost-effective to include as part of the initial construction. Originally they intended to have all the buildings in the neighborhood on one electrical meter so that costs would be shared, but the local utility, **Public Service of New Hampshire**, required a separate meter for each home. The developers were unable to find any federal or state incentive program that would reduce their cost of installing solar as part of the initial construction of such individually metered homes. Nonetheless, the developers and architects designed the homes with solar in mind. The buildings are oriented, for the most part, with south-facing, 45-degree-angle roofs. And during construction the houses were plumbed for solar hot water systems, in anticipation of homeowners adding panels after moving in.



Photo Courtesy Richard Pendleton

Considering Solar Options

Although the neighborhood was primed to go solar, it did not happen right away. Most of the homes sold relatively quickly when first completed (or even before construction was complete). But then the economy tanked, sales slowed, and those of us who had moved in became focused on the many tasks of starting up a new, ambitious community. Solar remained on the radar, but it wasn't until 2010, nearly two years after initial construction was complete, that the community began to really focus on the topic. As with everything in a cohousing setting, we start with

conversations. And because many members of the community share strong commitments to sustainable energy, beginning the conversation came naturally. One way we gathered information and ideas was by inviting local solar experts for dinner. We hosted the owners of Green Energy Options, a USA Solar Store in Keene, N.H., and on another night we had dinner with the conference director of a nearby environmental education organization.By May 2010, an informal group had formed to begin discussing alternative energy possibilities for our community — or, as one neighbor put it, to begin exploring "possible scenarios for capturing the sun for our energy needs." By June, an e-mail discussion list had been created for those in the neighborhood interested in the topic. At first, the group's discussion was broad, looking at many different energy options (including wind, solar and even small-hydro), but we mostly focused on solar thermal and how to integrate it into the neighborhood's wood pellet boiler system. Then in the late summer, we learned that the state's main incentive program for solar PV was about to be significantly reduced. The focus shifted to PV.

The sustainable energy division of New Hampshire's Public Utilities Commission (PUC) provides a rebate for installing residential renewable electricity generation systems smaller than 5 kW. In mid-2010, this incentive program provided a rebate of \$3 per installed watt, with a maximum of \$6,000 per system. Combined with the 30 percent federal tax credit, total incentives approached 78 percent of the system cost for some Nubanusit residences. Seeing this, when we learned that the PUC would hold hearings in the fall to consider reducing or eliminating the state portion of the incentive, we decided to move forward with PV before the costs would rise significantly. At this time, not everyone joined the push for solar (for various reasons, including financial) and a half-dozen homes were still unoccupied. But by mid-September, 17 households in our neighborhood had signed up to have PV systems installed. The group selected an installer, Nashau, N.H.-based <u>KW Management</u>, and submitted applications for the state program before the PUC changed its terms. As it turned out, we did get in just under the wire — shortly after, they reduced the incentive program to a rate of \$1.25 per watt with a maximum refund of \$4,500. But because our paperwork was submitted before this change, we were locked in at the higher rate of \$3 per watt and \$6,000 maximum rebate.

Planning the Project and Neighborhood Review

Neighborhood discussions moved to a planning phase at this point. KW Management owner Mark Weissflog discussed state and federal incentives and how to size each system to the individual home. The Nubanusit Neighborhood homes were designed with energy efficiency in mind, thereby allowing a smaller system to cover more of the typical annual usage. Weissflog estimated each system's production performance using the National Renewable Energy Labratory's <u>PV Watts</u> tool (version 1), along with shading analysis with a solar pathfinder. The average production per kW was estimated at 1,200 kilowatt-hours (kWh) per year. The sizes of the installed systems vary from 1.38 kW to 3.45 kW, with each system size corresponding to the resident's energy usage. In a few cases, systems were increased in size to accommodate potential future increases in demand. Weissflog estimated that the average 2.07-kW PV system at Nubanusit Neighborhood will account for approximately 65 percent of the average home's actual usage (ranging from a low of 57 percent to over 100 percent).Weissflog chose <u>Trina</u> 230-watt solar panels, which are polycrystalline PV modules, a technology that he felt had proven its reliability and performance in our region for many years. He also chose <u>Enphase</u> microinverters, again based largely on their reliability. Using microinverters rather than a standard string inverter promised to maximize production for neighborhood arrays that figured to have problems with shading. If one panel in a shaded array has a low output, the microinverters prevent production from falling off in other more fully lit panels.

Working out the technical details with Weissflog was only part of the process. Our community requires a formal review for vetting construction projects of all kinds, and the process was relatively new and unfamiliar to many of us in the fall of 2010. Fortunately, we have an architect living in the community who has solar experience and lead the review process. The PV project fell into the largest type of project, involving "major exterior changes" to buildings. Projects of this kind are planned and executed with the help of a neighborhood Design Review Team (DRT) and are approved by consensus of all in attendance at the DRT review meetings. The process involves a fairly strict schedule of informing the community as a whole of plans, posting visual plans and other details for everyone in the neighborhood to be able to review, and meeting with the DRT team to discuss questions and possible concerns.

While there were no deal-breaker objections raised during this process, there was a lot of discussion about aesthetics, placement of the panels, and questions about how PV would fit into (and not preclude) possible future development of other renewable energy options. One neighbor was concerned that our panels were being purchased from China rather than a more local source. Weissflog said it was his first time using Chinese-made modules in his 12 years as an installer and his decision was based on financial value, reliability, and the Trina modules' performance specifications. Also, having dealt previously with manufacturers that are no longer in business, he wanted to select a manufacturer that he believed was likely to remain solvent for a long time. Another concern raised by neighbors was that there should be space left on roofs for solar hot water panels. The group had discussed the possibility of installing a centralized array of solar hot water panels to augment our wood pellet boiler system (and allow us to shut the boilers down in the summers), but we had also been considering the possibility of a distributed system in which individual homes would have solar hot water panels on them. Thus, the PV installation needed to allow space for this future possibility.



Photo Courtesy Richard Pendleton

Installing the System and Moving Forward

Plans with KW Management were finalized at the end of October. Installation began in November and continued into the early winter. The timing posed considerable challenges for the installer, as the season was colder with more snow than average years. There were days when the temperature stayed below 0°F (-18°C) until mid-morning. The installation crew leader told us that some nights he went home with numb toes and woke up the next morning not completely recovered.

The installation team began by mounting aluminum pan flashed to shingle and then three rails to support panels. Most roofs have panels three deep to cover the area best and keep the configuration close to a square. Conduit leading from the panels connects to the meters. Black conduit was selected during our community's DRT process in order to be as visually unobtrusive as possible. Installation stalled a few times due to winter storms and problems with delayed or incorrect equipment deliveries. After installation was finally complete, a "snorkel" lift that workers had used to get up to and down from the roofs was half-buried in snow and ice. It wasn't retrieved until a spring melt a couple months later. Other bumps along the way included working around vent pipes that had been placed on south-facing roofs, and making sure that the correct sets of panels were connected to the correct meters on the duplexes and quads.

Once the final installation and town planner inspections were completed, neighbors were eager to collect data on their electricity production. We were pleased to see our own panels producing

electricity even during the short gray days of a New England winter. Within four hours of connecting our nine-panel, 2.07-kW array, it had produced its first 4 kWh of electricity. In the subsequent three months (winter into early spring), it produced another 600 kWh. Going forward, we're still trying to figure out the most efficient ways to manage our unique system. Does it make more sense to insure the panels as a neighborhood or on individual insurance policies? How do we best track generation — individually and as a group? Although a monitoring system is available that works in conjunction with our Enphase Microinverters, we found that it would not monitor our neighborhood-wide system at once. Because each owner would need to purchase a separate monitoring device, we chose to purchase just one and now share it so that individual homes can periodically track production.

As it turns out, working on such a project as a group is a major benefit, but also in some ways a burden. Among the positives: The workload is shared, there's a wide pool of expertise to draw upon and there are economies of scale. But less positive: The process can become more complicated than an individual homeowner working solo and progress can slow down for everyone due to problems that are particular only to some. Decisions can be made that some individuals don't necessarily like and other people bring up complaints that might not be share by most.

This is the nature of group life. Now, on to our next challenge: heating our water with solar hot water panels!

About the Authors: *Noel White* and *Johanna Wilson-White*, along with their two children, have been residents of Nubanusit Neighborhood and Farm since 2008. You can reach them at <u>noel</u>. <u>white @ gmail . com</u>, and you can find more information about their community at <u>peterboroughcohousing.org</u>.