

by Kathleen Marshall and Sean Armstrong

Photos by Kathleen Marshall (?)

**F**ort Bragg, California, is a small, rural town in Mendocino County situated on a flat bluff overlooking the Pacific Ocean. Over the last 20–30 years, Fort Bragg has seen a dramatic decline in the fishing and timber industries that traditionally sustained moderate incomes. This reality is reflected in 2010 census data that quantify Fort Bragg’s low-income population at 52%, at least half of whom are seniors.

Sean Armstrong and Michael Winkler of Redwood Energy, Garret McSorley of K.Boodjeh Architects, and the Danco Group housing developers teamed up to address the housing needs of this population by building The Cottages at Cypress, a net zero energy community. This was the team’s third 100% net zero project, but the first to build houses rather than apartments.

### The Cottages at Cypress

The Cottages at Cypress is not Fort Bragg’s first low-income housing development, but it is unique. The Cottages is the city’s first 100% net zero energy housing development and the largest one in the entire United States, and it is performing beyond the wildest hopes of its designers and developers. “Oh, we love that place,” says Jennifer Owen, special projects manager,

of the Fort Bragg Community Development Department. By “we” she means everyone at city hall, from city council members, to planning commissioners and city staff. She was delighted to hear that the residents interviewed at The Cottages were equally happy with their net zero homes (see “This Is My Home” on page 20). The development was completed in 2014 and is fully occupied.

### Fort Bragg’s Sustainability Goals

Unlike many other communities in California and around the country, Fort Bragg was already familiar with the net zero concept. The city’s general plan, updated in 2014, includes a sustainability element. The first goal of this sustainability element is to promote green building, most specifically by requiring LEED Platinum certification for all new buildings and remodels. The second goal is to decrease dependence on nonrenewable energy sources while working toward achieving a 20% reduction in greenhouse gas emissions by 2020 through the implementation of net zero efficiency in all new buildings. The Cottages at Cypress is a big step toward achieving those goals and is a role model for projects to come.

## Net Zero Energy Efficiency

A net zero energy-efficient building, or group of buildings, must create, on site, using alternatives to fossil fuels, an amount equal to the total energy that it uses over the course of a year. The point is to significantly reduce greenhouse gas emissions, as required by California Assembly Act 32, the Global Warming Solutions Act of 2006. Though the act leaves implementation to city and county governments, the city of Fort Bragg, along with a few other communities in California, seems to be ahead of the curve.

## Net Zero at The Cottages at Cypress

The Cottages at Cypress is an all-electric development. It consists of 18 one-bedroom and 6 two-bedroom cottages; one manager’s cottage; one community building; and one laundry facility. Each of the 18 one-bedroom cottages is equipped with a 4kW (DC) system, each of the 6 two-bedroom cottages is equipped with a 5 kW system, and the community building and laundry facility are equipped with a 20kW system.

The project is Energy Star certified, and all of the buildings are equipped with Energy Star-rated electric appliances. The homes are heated with high-efficiency air source mini-split heat pumps (25 SEER Fujitsu 9RLQ, with a 12 heating seasonal performance factor). GE GeoSpring air source heat pump water heaters, with an energy factor of 2.35, supply hot water.

Twenty-three of the 25 cottages have dedicated solar arrays on their roofs. These solar arrays are net metered, meaning all of the power that they produce is credited to, and used by, that particular household. Two of the cottages are too heavily shaded by tall cypress trees to warrant installing a solar array on them.



Above, 2 cottages are in too much shade for panels. Their electricity is virtual-net metered with the solar panels on the community building. Below left, 1 of 2 virtual-net metered houses. Below right, Bill's Nissan Leaf.

The solution to producing power for those cottages was to install extra panels in the community building array that are virtually net-metered. This means that Pacific Gas and Electric Company (PG&E) mathematically allocates the solar power produced, dividing the credit and billing between the three buildings.

The solar-array sizing models prepared by Redwood Energy for The Cottages predicted a surplus supply of solar energy, rating the project at 110% net zero. In other words, the models predicted that the entire development would produce 10% more electricity than it used. This design would allow each cottage enough energy to recharge one electric vehicle and to drive it 5,000 miles per year, in addition to supplying all of the household’s other electrical needs. However, in mid-August 2015, after PG&E calculated each household’s year end data for usage and production between March 2014 and March 2015, every household in The Cottages, including that of the one resident who drives a rechargeable electric car, was due to receive a rebate of \$160–200 for the excess energy its array produced. See Figure 1 for a breakdown of energy end use at The Cottages.

Roger (yes, that is his only name, and he’s listed that way in the Humboldt County phone directory), the solar guru who installed the arrays, says this appears to amount to a cumulative overproduction of about 30%, far more than anyone—builders, consultants, or installers—expected, though real-time production data, still being analyzed, seem to indicate an overproduction of 50%. As of this writing, no one knows why. Perhaps, says Roger, it’s because changing weather patterns resulted in more solar days than expected, or perhaps it’s because seniors tend to be more frugal than other people.

### Residential Electric Loads Summary for The Cottages at Cypress

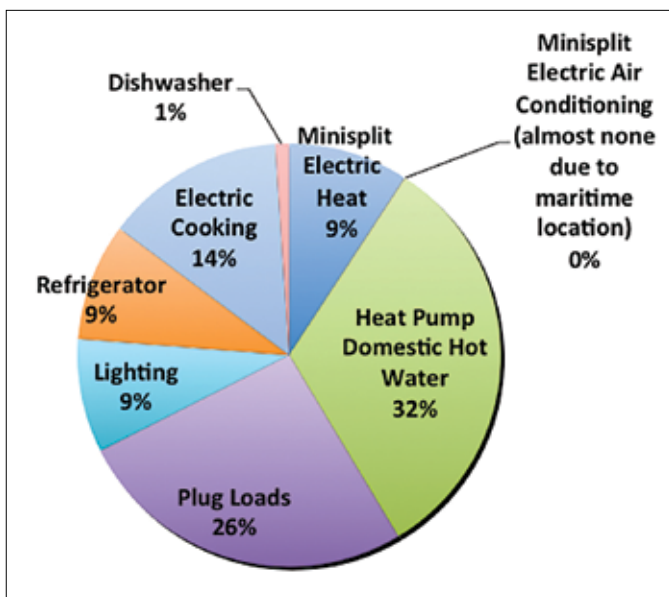


Figure 1. The highest electricity end users at The Cottages are the heat pump water heaters, followed by plug loads.

## Other Components of Net Zero Building at The Cottages

Though on-site energy production from sustainable sources is the primary component of net zero building, The Cottages' air source mini-split heat pumps for space heating, and its air source heat pump water heaters, use advanced refrigeration technology to achieve net zero goals as well. Both systems use this technology to absorb heat from the air and release it into the space or water to heat it. These systems are anywhere from 250% to 400% more energy efficient than traditional fossil-fuel-based systems; they greatly exceed code requirements (see Figure 2). They use electricity only to run a compressor and fan.

Other factors contribute to the project's net zero efficiency. The lighting is 100% LED. Double-pane windows without low-e coatings, appropriate for the generally mild climate on the Northern California coast, act as passive heaters, reducing the heating load. Adequate insulation installed according to strict guidelines further reduces heating demand.

This part of Northern California is in climate zone 1. All of the net zero features for The Cottages at Cypress, including the size of the solar arrays, are designed to be maximally effective in this climate. Net zero projects in other parts of California and in the rest of the country are individually evaluated and designed for their specific climate zones.

## Quality of Life

The residents of The Cottages at Cypress are very proud of their homes. Living in a net zero development has reduced their cost of living and improved their quality of life. They proudly show off their electricity bills, still astonished after over a year of residency that they don't have to pay a cent. They emphasize what it means to them to be warm, without having to balance their physical comfort against their finances. They



Cottages vs. the Building Code

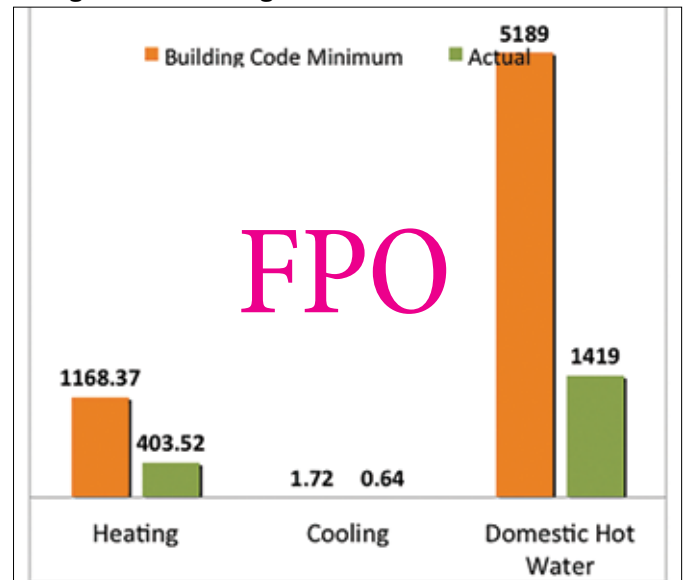


Figure 2. A comparison of Fort Bragg's Cottages at Cypress for building-code-regulated measures shows just how successful the project has been, in [units].

enjoy living in actual houses, rather than being crammed together in an apartment building. This, they say, gives them pride of ownership. They also enjoy the expansiveness of living with green space, small yards around their cottages, and a preserved wetland area at the back of the property. See "This Is My Home" for some of their stories.

## The Future of Net Zero Affordable Housing in Fort Bragg

Jennifer Owen hopes that more net zero building is in Fort Bragg's future. There is an old mill site in town that is slated to be developed for multiple uses. But if the project includes affordable



Left, the cottages under construction. Right, community building array (really shows off those solar panels!).



# This Is My Home

*Residents of The Cottages have given us permission to share some of their stories.*

## Dan and Sandy

Dan and Sandy Zaffrano have lived in Fort Bragg for 23 years—20 of those years as the owners of one of Fort Bragg’s bead stores. Before moving to The Cottages, they spent 5 years living in a motor home. Now the front stoop of their cottage sports a figurine of a Volkswagen bus with surfboards on its roof, and they’ve built a small raised garden bed just out their back door for growing seasonal vegetables. They have put down roots. Barefoot and tanned, they are pleased as punch to be living affordably and ecologically. Their low-income rent at The Cottages is comparable to what they would pay elsewhere in Fort Bragg for affordable housing, but nowhere else could they show off their less-than-zero electricity bill with such evident glee. They don’t pay a thing—not one single cent.



Sandy and Dan Zaffrano with electric bill

Ask Dan and Sandy why they’re so happy with the arrangement and they don’t use the term net zero energy. Instead they show you their electric bill, on which the monetary credit they have racked up during the season is clearly visible, along with the monthly service charge of \$3.84, which is deducted from the credit; hence, less-than-zero electricity bills. Not only that, but like other residents Dan and Sandy have earned what they call a rebate, but what is actually a year end true-up check. Their utility provider, PG&E, is paying each household wholesale value for the extra electricity over and above what they use, to the tune of \$160–200. For them, that’s a lot of money, and it’s all about the solar panels.

## Bill

Bill is 73 years old and has lived and worked in Fort Bragg for the last 43 years. He has worked at various times as a grocery clerk, as a salesman, and as the owner of a timber products company. “No last names or photos, please—not with ex-wives on the loose,” he jokes. For the last six years, Bill lived in another Fort Bragg low-income housing complex. He says that when he moved to The Cottages, the solar power was a definite draw. He loves all of that



Bill’s mosaic work: An ode to the sun.

electricity, and the heat. A few months ago, Bill discovered The Cottages’ electric-car-charging stations. He says he asked the property manager what those strange, oversized plugs were for. “Oh,” she replied, “those are for charging electric cars.” “But, if I had an electric car, I’d have to pay for that electricity—right?” Bill asked. “Oh no, it’s free like all the rest,” she answered. It turns out that Bill, who works with mosaic and stained glass at a friend’s place, was spending about \$300 a month on gas. He sold his car and leased a Nissan Leaf for \$199 per month, for a monthly savings of about \$100. His is the only electric car in the parking lot. Ironically, Roger advised the Danco Group to install enough charging stations to allow every resident to switch to an electric vehicle. Danco politely declined. Roger paid the electricians himself to install the three that are there. Bill is thrilled.

## Donna

Donna Dawson is 74 years old. She relocated to The Cottages from another low-income housing apartment complex in Fort Bragg just a few blocks away. In the ten years she lived in that apartment complex, she spent seven as manager and lived in four different units. In that time, she says, her feet and ankles were never warm, and she practically lived wrapped in blankets. Her rent increased when she moved to The Cottages, but her utility bill is nonexistent, making the rent comparable to her old rent, and predictable. She is dressed in a light tee shirt and slacks, and tells me that she is so happy to be warm. She doesn’t really know how the heater works, just that it does. She’d like to know more about the energy-efficient features of her new home. The Danco Group has put together a handbook with manufacturers’ instructions, but she is more of a hands-on learner. The property manager, Nancy Winter, is helpful, but Nancy tells us that she herself simply refers to, “the book,” and understands what’s in it no better than any of the other residents. It would be nice, they agree, if there were some follow-up, hands-on education. Chris Dart, vice president of Danco, says there are no plans to provide it. Tenant education is not a service that they, as developers, provide.

## Maureen

Maureen was dressed in a purple hat and sweater the day we met, the color highlighting her startling blue eyes. She cried, she tells me, when she found out that her low-income house would come with solar panels. Until then, she had thought solar power was only for rich people.



Maureen’s style.



Caption TK

housing, the Danco Group is not likely to build it. Chris Dart, vice president of the Danco Group, says that while adjunctive net zero features such as insulation, LED lighting, mini-split heat pumps, and heat pump water heaters, are well worth what they cost, solar arrays are just too expensive without U.S. Department of Agriculture 1% low-interest loans payable over 50 years.

Not necessarily so, counters Roger, our solar guru; there are many other ways to recoup the cost of solar array installation. Government rebate programs provide significant rebates for solar arrays. These programs include the New Solar Homes program (NSHP), and the Single Affordable Solar Homes (SASH) and Multifamily Affordable Solar Homes (MFASH) programs.


Those rebates, combined with income tax credits and accelerated depreciation available to affordable-housing developers, can bring the actual cost of a \$200,000 system—approximately the cost of installing all of The Cottages' solar arrays—down to \$20,000. That \$20,000 outlay, says Roger, is easily recouped within three years of collecting rents. Factor in the less-than-zero electricity bills, the overproduction of on-site renewable energy feeding the grid, the commensurate reduction in greenhouse gases, and the use of net zero efficient new technologies in heating and cooling, and what do you have? Well, Roger says with his quizzical, impish smile, you have a win-win situation, so Why not?

## The Bottom Line

For the developers, the bottom line for net zero building is the initial cost, or as Roger has pointed out, the perception of cost.



Maureen in front of her cottage.

For the city and county governments, the bottom line is regulatory compliance and environmental preservation. But for the residents of The Cottages at Cypress, the bottom line is affordability and comfort. Or in other words, the bottom line is dignity and pride. 

**Kathleen Marshall** is a registered nurse, a former essayist for *the Arcata Eye*, and a fiction writer. She hosts and produces a weekly half-hour interview show on public radio station KHSU, located in Arcata, California.

**Sean Armstrong** is a partner and project manager at Redwood Energy in Arcata. Redwood Energy has led the design of 650 units of net zero affordable housing, most of which will be certified LEED Platinum, in 20 different projects, for large families, seniors, farm workers, the homeless, and first-time home buyers.

**Kathleen's husband, Richard "Rocky" Drill**, helped to prepare this article. Rocky is an environmental engineer and HVAC contractor who specializes in the installation of air source mini-split heat pump systems in existing homes in Humboldt County.

## >> learn more

For some possible reasons why The Cottages produced more solar electricity than anyone involved in the project expected, see *The Impact of Energy Efficient Design and Construction on LIHTC Housing in Virginia*, Virginia Center for Housing Research at Virginia Tech for Housing Virginia, 2015. To download a copy of this report, go to [www.housingvirginia.org/Blog-2015-02-10-New-Housing-Virginia-Study-Finds-Residents-of-Energy-Efficient-Affordable-Rental-Housing.aspx](http://www.housingvirginia.org/Blog-2015-02-10-New-Housing-Virginia-Study-Finds-Residents-of-Energy-Efficient-Affordable-Rental-Housing.aspx).

For more about NSHP, SASH, and MFASH, visit the California Public Utilities Commission website: [www.cpuc.ca.gov/PUC/energy/Solar/aboutsolar.htm](http://www.cpuc.ca.gov/PUC/energy/Solar/aboutsolar.htm).