

Case Study: The Effectiveness of Zero Energy Home Strategies in the Marketplace

*Willard Dakin and David Springer, Davis Energy Group
Bill Kelly, SunPower Corporation*

ABSTRACT

Some California home builders are combining building integrated solar generation with energy efficient technologies and green design strategies to create a market edge in the current recessed housing market. Through the combination of energy efficiency and on-site energy generation, these homes use significantly less energy than standard code-built homes in California, reducing the impact of development. These builders have established path-breaking marketing strategies to capture maximum value of their efforts, including investing in dynamic, educational showrooms that allow homebuyers to fully understand the potential cost and environmental savings. The result is accelerated home sales, and improved customer satisfaction.

The paper describes technologies used to achieve the projected savings, the strategies used to market the advantages the homes have in the marketplace, and sales results demonstrating how these builders are selling compared to their competition.

Introduction

California's Solar Initiative or Million Solar Roofs program has set a goal of 3,000 megawatts of new, solar-generated capacity by 2017 to reduce the state's dependence on non-renewable energy sources. As part of this program, the California Energy Commission administers the New Solar Homes Partnership, which provides incentives for solar systems installed in new residential construction. The program's goal is to incorporate high levels of energy efficiency and high-performing solar photovoltaic (PV) systems to help create a self-sustaining solar market where home buyers demand energy efficient, solar homes.

These "high performance" homes (HPHs) sometimes referred to as "zero energy homes" (ZEHs), combine energy efficient design and technologies with solar generation to significantly reduce annual household energy consumption. True "net zero energy" homes generate as much electricity over the year that they use. While these homes are not true "zero energy" homes (they still rely on fuel for space and water heating), they tend to provide up to 60% of the annual electricity needs of a typical household¹. HPHs have a number of advantages: improved comfort, reduced energy bills, fewer builder callbacks, and greater independence from increased utility costs.

Getting production builders to incorporate energy efficiency and solar technologies in their homes has historically been a challenge. Production builders generally are conservative and are reluctant to incorporate any design or technology that may limit their market acceptability or increase their perceived risk. During the housing boom of 2004 and 2005, builders had no

¹ Taking advantage of net metering, where the home's electric meter runs backwards when the home is producing more electricity than it is using, allows the homeowner to use the utility to store surplus energy generated for use when the sun is not shining.

trouble selling homes, and there was little incentive to add cost to homes unless there was homebuyer interest. At the same time, there was little interest in homebuyers paying for these additional features. Some California builders offered energy efficiency and PV options but due to various factors had only marginal success.

When the California housing market began to slow down in 2006, builders began to look for ways to differentiate themselves. This report discusses the results several builders in Northern California have had incorporating solar and energy efficiency as standard features to successfully differentiate their homes and increase home sales relative to other builders selling in the same areas.

Previous Studies

Studies have been conducted about the market value of energy efficiency and communities with solar electric systems. Specifically, there were previous studies (Farhar, Coburn, and Collins, 2002) (Coburn, Farhar, and Murphy, 2004) that looked at customer and builder response to high performance homes built by Shea Homes in the San Diego, California area. Two studies by ICF Consulting (Nevin, Bender and Gazan, 1999) (Nevin, Watson, 1998) evaluated the market valuation of energy efficiency. These reports did not cover solar electric technologies specifically, but did look at the resale value of energy efficiency measures.

Efficiency and Solar Strategies

Through work funded by the Department of Energy's Building America program and the California Energy Commission's Zero Energy New Homes Program, Davis Energy Group and SunPower Corporation have worked with several California builders to combine cost-effective energy efficiency (EE) technologies with grid connected solar electric (PV) systems. Through the combination of these measures, homebuilders can provide homes that significantly reduce annual utility bills, and are more comfortable.

In new construction, since the incremental cost of efficiency and PV measures can be included in the home mortgage and financed over time, simple payback is not a good indicator of cost effectiveness. A better methodology is to compare annual utility bill savings against increased mortgage costs. While PV may not be cost effective as a stand-alone measure, when combined with energy efficiency features, the annual utility bill savings may be greater than the increase in the mortgage payments, resulting in an immediate positive net cash flow. As utility costs rise, the savings to the homeowner increase.

Building homes to ENERGY STAR standards (15% better than California's Title 24 energy standards) is relatively inexpensive and can be achieved by specifying good windows, attic radiant barrier, ceiling insulation, and tight duct testing. Building homes to the next level, 35% better than Title 24, can cost the builder \$4,000 to \$5,000 more per house, and requires adding energy efficient heating and cooling equipment; efficient water heating; and additional third-party diagnostic testing and inspections, such as blower door tests, quality insulation inspections (QII), and cooling system EER verification².

PV is an effective tool to attract interested buyers, because it draws more immediate interest from homebuyers than efficiency, and the benefits from PV are easier for homeowners to

² In some areas, utility incentives may be available to help offset these costs.

grasp. The concept of selling energy back to the utility has a more direct connection to buyers' perceived monthly expenses. Combining efficiency with PV means that the PV can provide a larger fraction of the net household energy consumption, and more cost effective efficiency measures can help buy down the net incremental cost of the systems. Low-profile, building integrated photovoltaics (BIPV) are now used in many production home projects, since they provide better integration with the roof, and enhanced aesthetics.

Marketing Energy Efficiency and Solar

The booming housing market produced little market demand for the addition of energy features to homes. While there was increased buyer interest in PV, it was not widespread, and homebuyers were not demanding it. This was confirmed with the results of Shea Homes ZEH communities in San Diego (Farhar, Coburn, and Murphy 2004). It also required additional coordination and changes to standard building practices to include these features. A few progressive builders in California began building more efficient homes with PV, but mainly these were small builders looking at a niche market or builders who felt this was the "right thing" to do.

As the housing market slowed in 2006, the need for builders to differentiate themselves to boost sales provided an opportunity for HPHs. A builder could include energy and solar features in the homes they sold with the hopes of recovering the costs through improved home sales.

Selling HPH Packages as an Option

To limit risk, some builders have chosen to offer solar and efficiency as an option. The incremental cost to the homeowner for these packages is typically \$15,000 to \$20,000. This strategy is difficult to successfully implement. Even though the option can be shown to pay for itself, buyers are reluctant in adding this to the cost of their house. The option ends up competing with many other amenities and options that have a better perceived added value (such as granite countertops and hardwood floors) than the energy features. It is difficult for sales staff to sell the option because of additional time needed to explain the option and value to the buyer, and sales staff require a significant amount of knowledge and understanding to effectively sell. Additionally, when these systems are sold as an option, the cost per home is higher and coordination with field crews and sub-contractors adds additional cost and complexity.

Standard Feature

More recently, the efficiency and solar features are being included as a standard feature in all homes in a community. Installed costs are lower due to volume and standard bidding of features. It is also much easier for sales staff to sell the solar and efficiency features if it is a standard component. Builders can then choose to sell their homes for more to directly pass the cost of the features on to the buyer, or they can try to recover the costs through increased sales and lower carrying costs.

Reduced Carrying Costs

During the period that a community is open and selling homes, there are monthly operating and overhead costs that affect the builder's profit. These carrying costs include land and construction loans, salaries for field and construction crews, sales and support staff, and operating costs on the model homes. By increasing the absorption rate³ in a community, a builder can reduce the time a community is open, reducing these costs, which potentially pay for the incremental costs for the energy features.

Training and Sales

Even when high performance homes are offered as a standard feature in a community, it is still critically important that support for the program be implemented company-wide. Construction crews and subcontractors need to be cognizant of the additional field inspections involved, the differences, and the benefits that these changes provide. Sales staff needs to be trained to effectively educate potential homebuyers of the benefits and adequately answer technical questions and concerns that homeowners may have with the new features. It is also important that the sales staff is excited about the product they are selling and enthusiastic to sincerely sell the benefits included in these homes.

Providing sales displays and literature is also important to help simply and effectively communicate the features in the home to the potential buyer. The most successful builders of high performance homes are converting a garage at the sales office to a showroom dedicated to promoting and educating potential buyers about the efficiency and PV features in their homes. These showrooms include displays, examples of the energy features, as well as multimedia presentations summarizing the energy features and their benefits.

Value to Homebuyer

Homeowners benefit from the purchase of these homes through lower utility bills and the ability to recover the value of the efficiency and solar features in the resale value of their home. Combining energy efficiency and an adequately sized PV system, Davis Energy Group has shown that these homes can reduce annual energy bills by 50-70% compared to homes built to California's Title-24 code. Our studies have also shown that if the buyer were to pay for the incremental costs of these measures in their mortgage, the annual energy savings can exceed the annual mortgage increase (DOE, 2007).

While buyers express an interest in PV and EE, converting that interest into purchase decisions is always a challenge. A study conducted by American Lives for Department of Energy's Zero Energy Homes program (Warrick and Kuzsel, 2002) showed that 60% of buyers were willing to pay \$50-\$74 more per month (on their mortgage) for these features, but evidence of this in the marketplace has not been clear. The NREL study showed that the energy features were a low priority in the final purchase decision. In communities where the builders are offering HPH features standard in the down housing market, homebuyers are able to purchase homes that cost less to operate at prices competitive with homes that will cost more to operate.

³ Absorption rate is defined as the average number of homes sold per month.

Property Value Increases

Results from the NREL Shea Homes study (Coburn, Farhar, Murphy, 2004) found that HPHs increase their value at a faster rate than conventional homes values. The ICF studies (Nevin, 1998 and Nevin, 1999) determined that, on average, energy saving home features boost the price of homes by 20 times the annual dollar savings achieved with these features. This means that homebuyers purchasing an HPH will not only reduce the annual home costs from the day they buy the home, but they may also be able to recover the value of the energy and solar features. It is critical that appraisers become better educated and include efficiency and the home's utility costs in the home's appraisal. There are steps being made in California to require HERS ratings on homes upon sale, and this would help ensure that the HPH features were properly valued at resale.

Improved Comfort and Quality

HPH communities, where third party HERS inspections and testing are included as part of home construction, can provide higher quality homes. When insulation and home sealing practices are inspected, and ducts and the building envelope are tested, the homebuyer can feel more confident in the quality of the home they are purchasing. Because buyers feel that they are buying a quality home any time they purchase a home, the current perceived value may not be very high. It is important for builders who incorporate HERS inspections and tests to educate the home buying public of the value of third party inspections.

Case Study – Grupe Homes

The Grupe Company, based in Stockton, California, was one of the first builders in the area to offer efficiency and PV as standard features in all homes in a community. They had already committed to building the Carsten Crossing community in Rocklin, California (about 30 miles northeast of Sacramento) that had both solar and energy efficiency as standard features. Through this strategy they hoped to generate enough interest and market differentiation to make the community successful and profitable. Prior to construction, Grupe invested a significant amount of time and effort in training of sales staff and construction crews. The company as a whole was committed to the market strategy and generated a lot of internal interest and commitment to the product they were offering. As construction began (January 2006), the housing market began to slow down. Grupe initially considered passing some of the additional cost for the HPH features to the homebuyer, but due to the declining market, they did not think they could add cost to the homes and be successful. Grupe made a decision to sell their homes for market rate and not charge more for the energy and solar features. This gave Grupe a unique product to differentiate them from the competition.

The features included in the Grupe homes included a 2.4 kW DC building integrated PV system (provided and installed by SunPower Corporation), tankless water heating, low-E² windows, SmartVent night ventilation cooling system tied into high efficiency heating and cooling system, R-49 attic insulation with attic radiant barrier, tight ducts and building envelope, and verified quality insulation.

Grupe felt that the energy features would give them a sales advantage over their competition, and they could recover the additional costs through quicker home sales. They also hoped for additional benefits including increased publicity and improved customer satisfaction.

Absorption Rate and Economics

Grupe hoped to improve the absorption rate in the community and to cover the additional costs of the HPH features through reduced carrying costs. The incremental cost for the HPH features after incentives was \$18,350 per house (see Table 1)⁴. With 144 homes in the development, the additional cost would be \$2,642,000 for the entire community. Grupe's carrying costs for Carsten Crossing were \$311,000 per month. These costs include sales staff salaries, operating costs for the sales office and model homes, and land and construction loans for the community. In order to break even, Grupe would need to reduce carrying costs (through higher absorption rates) to cover the additional HPH features costs. At \$311,000 per month carrying costs, if the sales rates increased enough to reduce the community sales term by 8.5 months, the incremental cost of the measures on all 144 homes would be covered⁵.

Table 1. Summary of Incremental Costs

<i>System Measure</i>	<i>Incremental Cost</i>
Ceiling Insulation (R-38 to R-49)	\$ 350
Attic Radiant Barrier	\$ 740
Air Conditioning (13 SEER to 15 SEER/12 EER)	\$ 500
Furnace (80 AFUE to 94 AFUE w/ ECM blower)	\$ 770
SmartVent Night Ventilation Cooling	\$ 772
Tankless Water Heater	\$ 1,018
Fluorescent Lighting Package	\$ 625
HERS Tests and Inspections (Insulation, TXV, SEER, Blower Door, System Airflow)	\$ 500
2.5 kW PV System (net cost after rebates)	\$14,100
Utility Efficiency Rebates	\$ 1,025
Total Incremental Cost per House	\$18,350
Total Incremental Cost for Community (\$18,350 x 144 homes)	\$2,642,000

The results through 2006 and 2007 showed that Grupe outsold all of their competition in the master development of Whitney Ranch. There are eight comparable communities in the Whitney Ranch master plan that began construction at around the same time. Based on sales data from the Ryness Company (Ryness, 2008), the average absorption rate for the other communities in Whitney Ranch for 2006 and 2007 was 1.80 homes per month. At that absorption rate and with 144 homes in the Carsten Crossing community, it would take 80 months or 6 years and 8 months to build out the community. To break even, the adjusted absorption rate would have to be 2.01 sales per month. Table 2 summarizes these values.

⁴ Does not include Federal Tax credits. Builder was not eligible for efficiency credits, and solar tax credit goes to the homeowner.

⁵ \$2,642,000 total additional cost ÷ \$311,000 per month carrying costs = 8.5 months

Table 2. Grupe Sales and Operating Figures

Unit Cost for PV and EE Measures	\$18,350	per house
# of Homes in Community	144	homes
Total Cost for PV and EE Measures	\$2,642,000	for all homes
Carrying Costs at Carsten Crossing	\$311,000	per month
Required Sales Acceleration <i>(Total Cost for Measures) (Monthly Carrying Costs)</i>	8.5	months
Average Absorption Rate at Whitney Ranch	1.80	homes per month
Adjusted Absorption Rate to Break-Even	2.01	homes per month

Through community sales tracking information gathered from the Ryness Company (Ryness, 2008), home sales rates were accumulated by quarter for both 2006 and 2007.

Figure 1 below compares homes sales for 2006 through 2007 for all communities in the Whitney Ranch master plan. Carsten Crossing sales are twice the average of the other communities and 1.5 times the next highest community. Based on sales through 2007 the absorption rate at Carsten Crossing is 4.0, twice the rate necessary to cover the costs of the PV and EE features (see Figure 2).

Figure 3 shows the potential total expenditures for the Carsten Crossing community. The standard case assumes features and absorption rates similar to the other communities in the master plan. The Grupe case assumes the average absorption rate of 4.0 homes per month and the additional \$2.64 million dollars for the HPH features. Both cases assume the same monthly holding costs of \$311,000 per month. At the average absorption rate of 4.0, Carsten Crossing would cut sales time for the community by over three and a half years. This creates a savings of over 13.5 million dollars in carrying costs or a potential savings of nearly 11 million dollars after attributing the additional costs for the HPH features.

Figure 1. Whitney Ranch – Community Sales Comparisons

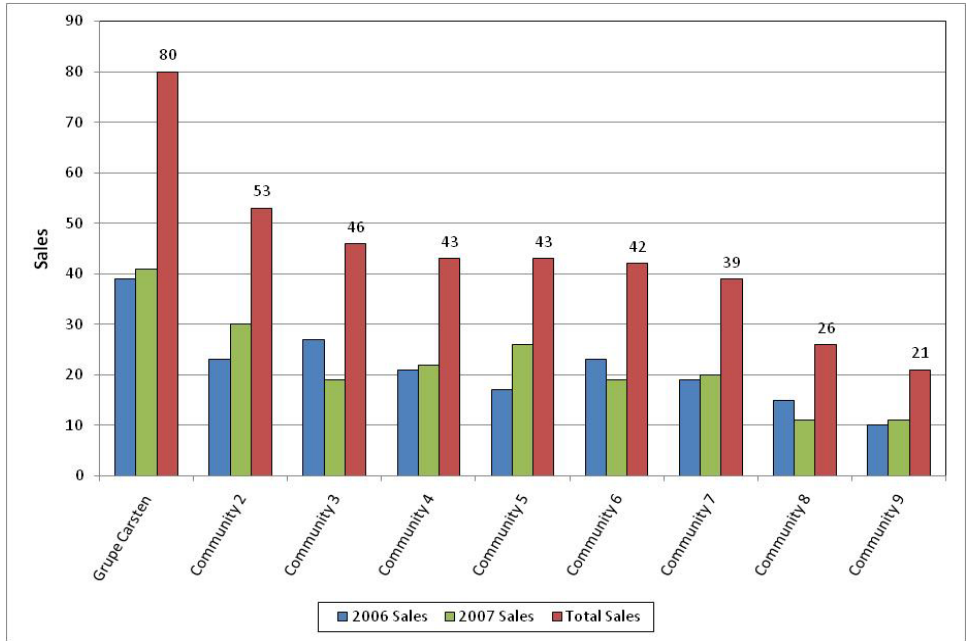


Figure 2. Carsten Crossing – Absorption Rate

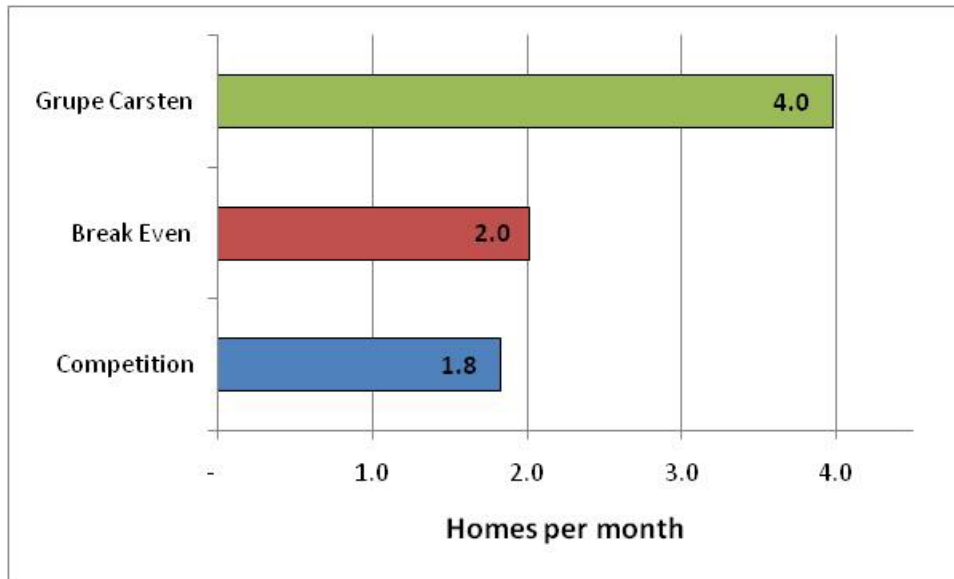
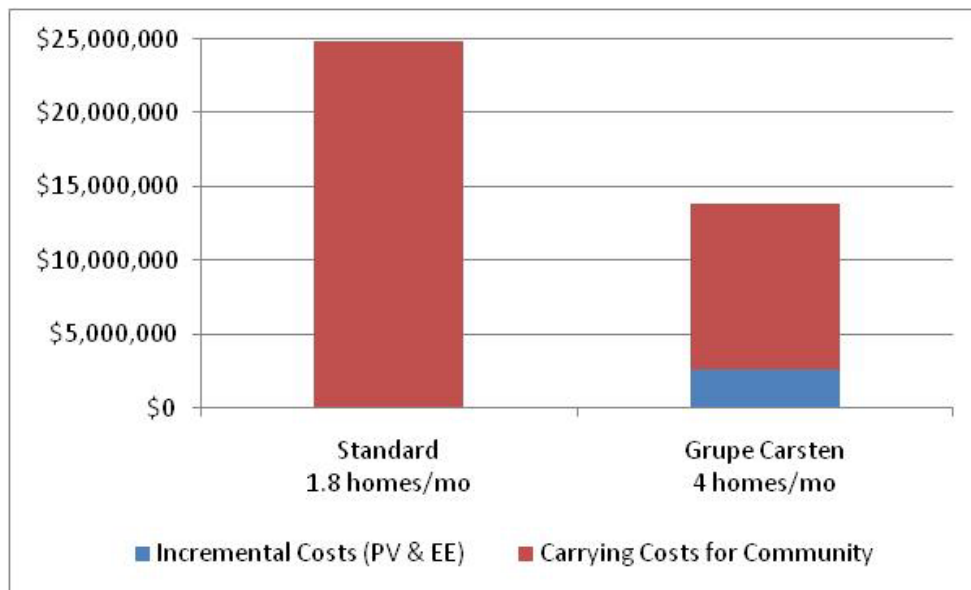


Figure 3. Community Expenditures Comparison for Community Sales Period



There could be several factors responsible for better sales rates at Carsten Crossing not related to HPH features including location, friendly sales staff, floor plan design, and other home features. But if only 20% (\$2.65 million cost of HPH features divided by \$13.5 million savings) of the improved sales results were due to these features, Grupe would have more than covered the additional cost of the measures. Put differently, if the PV and EE features reduced the sales period by 8.5 months, the program would have paid for itself.

Once in construction, the Carsten Crossing community became the first production builder to certify homes in the U. S. Green Building Council’s LEED-Homes program. Because this inclusion occurred after the sales office opened and promotional materials had been

developed, participation in LEED was not strongly used in home sales but Grupe used the green features to help market their homes. Additional components of the Carsten Crossing community that contributed to LEED certification included:

- Reduced on-site waste generation and recycling. Approximately 70% by weight of the construction waste was diverted from the landfill.
- Continuous fresh air ventilation system complying with ASHRAE 62.2, reducing occupant exposure to indoor air pollutants.
- Water efficiency measures in the landscape design
- Open space and natural habitat part of the master plan. Walking access to these areas from the community.
- Third party performance testing and inspections, including room by room airflow measurements to verify that the heating and cooling equipment performs as designed.

Homeowner Perceptions

Grupe held a homeowners' informational dinner with a question and answer session in March 2007 for the Carsten Crossing homeowners to get feedback on homeowner satisfaction and reasons for purchasing a home in Carsten Crossing. While the session was informal, there were clear trends in the responses. In most cases, PV and EE were not features that homeowners were initially looking for in their house purchase. In fact most homeowners were not even aware that homes with these features were being built. Location and appearance were the primary deciding factors in their purchase decision. The primary motivation was location, based on jobs and schools. Once deciding on the area, buyers said the floor plan was a priority. At that point, the PV and EE features were a strong selling point. Most buyers bought based on financial decisions. They felt it was a good value and liked the idea of reduced energy bills. Although environmental benefits were not the primary factor into the decision making process, many homeowners expressed satisfaction with their purchase decision and the resulting environmental benefits. All homeowners in the survey were very satisfied with their home purchase. When asked, they all said if they were to purchase another home they would select one with the energy and PV features.

Grupe also pays for homeowner move in surveys for all of their communities through a third party company. The scores coming from homebuyers in Carsten Crossing were uniformly high and as well as higher than their previous communities.

Some anecdotal evidence from the construction site supervisors also indicated that these homes had higher customer satisfaction. The site superintendant noted that he has had less customer callbacks and complaints after move in than any other community he had worked on. He credits the third party HERS inspections and testing for catching problems before move in, and keeping the quality of work high. In the beginning of construction, there were a lot of failed insulation inspections, but as the insulation contractors became aware that the work was being inspected by third party HERS raters the insulation quality improved.

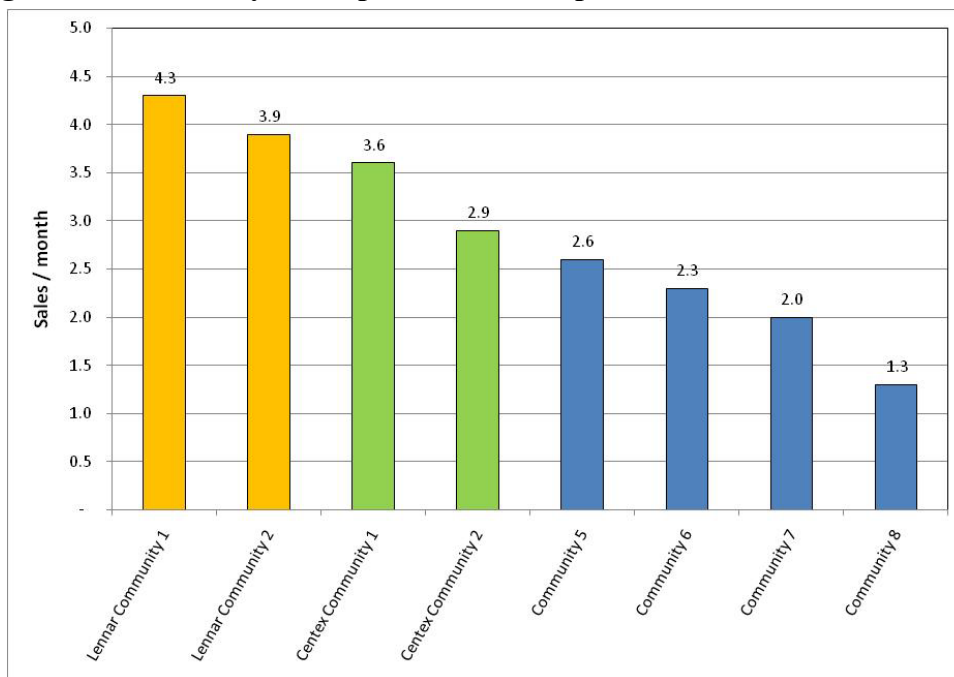
Other Examples

Since Grupe's success at Carsten Crossing, there have been other production builders who have also chosen to design communities with energy efficient features and roof-mounted

PV. Two of the other communities in Whitney Ranch revamped their product offering to include PV as a result of Grupe’s success. The Sacramento division of Lennar Homes began providing solar HPH communities in Roseville, California (adjacent to Rocklin) in late 2006, and has since expanded their number of solar communities in the Sacramento region to 14. Currently, two other divisions of Lennar are also building solar communities. Centex Homes began offering solar homes in their Roseville communities as well, in response to Lennar’s early success.

We do not have the same level of data for these other communities, but sales comparisons against non-solar communities in the area are similar. Figure 4 shows sales absorption comparisons for several new communities in Roseville, California. Both Lennar communities committed from the beginning to incorporating solar and participating in the Roseville Electric utility solar and efficiency program. Centex switched to solar and efficiency after they had opened. While the results are not as striking as the Grupe case, there is still strong evidence to suggest a market advantage to offering communities with solar and efficiency features. Lennar Homes felt that the additional cost for the HPH measures was justified with improved sales and has continued to offer and expand these features in all of their future communities in the area.

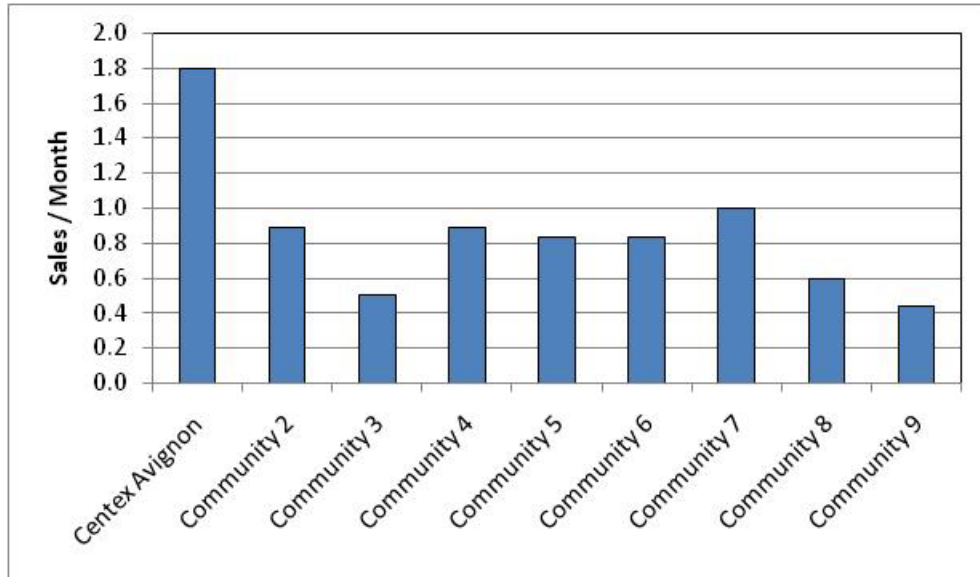
Figure 4. Community Absorption Rate Comparisons – Roseville, California



Another example of improved sales absorption rates is in the East Bay Area region of Northern California, located 30 miles inland from Oakland. In this higher end real estate market, Centex’s Bay Area division committed to a small community (30 homes) that was part of the California Zero Energy New Homes program, incorporating both solar and energy efficiency features in all homes. The community was also one of the first communities to be certified under the Green-Point Rated green building certification program. As shown in Figure 5, absorption rates through 2006 and 2007 were 1.8 times the next highest community of the same category in the region. With an average absorption rate of 1.8 homes per month, Centex was able to reduce the time it took to sell the 30 homes in the community by 13 months or more

compared to the absorption rate of Community 7, with an absorption rate of 1.0. While we do not have carrying cost data on this community, the improved absorption rate confirms the validity of this approach in a higher end market.

Figure 5. Community Absorption Rate Comparison, East Bay, California



Discussion

The success of homes built with HPH features in these communities seems to be due in part to a confluence of several factors. The increased awareness of rising energy prices, concerns of climate change, and the favorable climate for PV in California are all contributing factors. The slowdown of the housing market in the region also provided a unique opportunity to use these features to help sell homes that cost less to operate, have increased independence from rising energy costs, and are more comfortable.

While the results seem to indicate that homebuyers see value in high performance homes, it is still not clear how much of a premium, if any, they are willing to pay for these features. Studies seem to indicate that the additional cost of these measures can be more than recovered at resale, but additional studies are needed on the market value of grid-connected PV at resale, in order for builder to be able to pass these costs on to the buyer.

The early adopters in building high performance homes did so as a means to differentiate themselves in the marketplace, but with their successes, more builders are starting to adopt these features in their new communities, in order to compete with the early adopters outselling them in the same marketplace. As the market matures, further studies would be valuable to see if buyers were willing to pay more for homes with these features.

Conclusions

Sales data from several northern California communities indicate a market advantage for builders offering homes with both solar and energy efficiency standard. These advantages

include increased absorption rate, improved customer satisfaction, and reduced callbacks, all leading to better profits. Grupe and Lennar are now using the strategies that they developed in these first communities as a business model for their future communities.

As more of these communities are built, it is the hope that more buyers will demand homes with these features. Ideally, as more builders commit to building this type of home, it will transform the marketplace. Continued support through both state and federal programs is still needed to help continue the growth of the solar industry, improve how homes are built, and push for buildings that are even less dependent on non-renewable energy sources to help ensure that the state of California's aggressive goals for energy independence and carbon reductions are met.

References

- Coburn, Timothy C., Barbara C. Farhar, Megan Murphy, 2004, "Comparative Analysis of Homebuyer Response to New Zero Energy Homes", *Proceedings of the 2004 ACEEE Summer Study on Energy Efficiency in Buildings*. Washington, DC: American Council for an Energy Efficiency Economy, pp. 8.48-8.60.
- DOE, 2007, "Building America Hot / Mixed Dry Climate Report for 40% Energy Savings Milestone – Joule Report", *Building America, U.S. Department of Energy*.
- Farhar, Barbara C., Timothy Coburn, Nancy Collins, 2002. "Market Response to New Zero Energy Homes in San Diego, California", *Proceedings of the 2002 ACEEE Summer Study on Energy Efficiency in Buildings*. Washington, DC: American Council for an Energy Efficiency Economy, pp. 8.41-8.54.
- Farhar, Barbara C., Timothy Coburn, Megan Murphy, 2004. "Large Production Home Builder Experience with Zero Energy Homes", *National Renewable Energy Laboratory*. Golden, Colorado. NREL/CP-550-35913.
- Nevin, Rick, and Gregory Watson, October 1998, "Evidence of Rational Market Valuations for Home Energy Efficiency", *The Appraisal Journal*, The Appraisal Institute, Chicago, Illinois, pp. 401-409.
- Nevin, Rick, and Christopher Bender, and Heather Gazan, October 1999, "More Evidence of Rational Market Valuations for Home Energy Efficiency", *The Appraisal Journal*, The Appraisal Institute, Chicago, Illinois, pp. 454-460.