

Large-Production Home Builder Experience with Zero Energy Homes

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ABSTRACT

Since 2001, a large production builder in San Diego, California, SheaHomes, has developed and sold 306 homes in two communities with zero energy home (ZEH) features. These are highly energy-efficient homes with solar water heating and solar electric (photovoltaic, or PV) systems. Of the 306 homes sold, 293 have solar water heating and 96 have 1.2-kW solar electric systems with net metering as standard features. Buyers of another 164 homes could opt for 1.2-kW systems. Most had the option to upgrade to 2.4 kW. The National Renewable Energy Laboratory has been following this development.

The paper describes the builder's experience in deciding on, building, and marketing ZEH homes. Also described are the distribution of energy features among the homes sold, whether the PV systems were purchased as optional or standard equipment, and system sizes.

The builder experienced both benefits and costs. The builder partnered with energy companies to provide the ZEH package. The builder's experience with media coverage and its value is described. Also discussed is the interface between the builder and the utility company in terms of net metering and interconnectivity issues. Builder education of homebuyers about the energy features of their homes is described. The builder's experience with the California rebates on PV systems is also described.

The paper discusses the decision of the builder not to pursue further construction of ZEHs until more analysis is completed on home buyer response to these homes, resale value, and costs of building conventional and ZEHs of the same design and size.

Finally, the paper discusses a new building permit program in San Diego that is fostering the construction of ZEHs by a few other builders, not including SheaHomes.

Introduction and Background

SheaHomes began closing on homes in its San Angelo and Tiempo development at Scripps Highlands in April 2001 and sold out the 306-home development 31 months later in November 2003. The homes ranged in price from \$437,900 to \$840,938. The Scripps Highlands area, situated on a mesa north of San Diego just off I-15, is considered highly desirable. The view from the area includes rolling hills, valleys, and the Pacific Ocean 15 miles to the west.

A member of the SheaHomes staff, Ryan Green, was instrumental in the inception and initiation of the ZEH concept at San Angelo and Tiempo. Green had attended a seminar on ZEHs at the National Renewable Energy Laboratory (NREL) during 2000 at which he was familiarized with the concept and potential of zero energy homes. Enthused about his new knowledge, Green returned to San Diego and became a champion of the ZEH concept at SheaHomes as they planned their San Angelo and Tiempo developments at Scripps Highlands.

SheaHomes decided to pursue the idea by partnering with ConSol, Inc. on the design of 5-star Energy Star Homes (homes that exceed California's Title 24 standards for energy efficiency), with Sun Systems, Inc. to provide solar water heating for the homes, and with AstroPower to provide PV systems. SheaHomes decided to call its homes "high performance" homes to reflect the solar and energy efficiency features of the homes. Although, technically speaking, the homes are not ZEHs because they do not provide, in the net, all of their own energy, they are the closest example of ZEHs offered by a large-production home builder in the United States.

Working with ConSol, Sun Systems, and AstroPower, SheaHomes designed its San Angelo and Tiempo developments in such a way that all of its homes were highly energy efficient, including solar radiant barriers and special window treatments. In addition, each home was to have a solar water pre-heating system, resembling a skylight, to bring heated water to the hot water tank in the garage. Natural gas is used to bring the pre-heated water to the desired temperature. AstroPower reviewed the site plans and designated the homes that could be suitable for grid-tied photovoltaic (or GPV) systems.

Ryan Green wanted to use San Angelo and Tiempo as a field experiment to discover whether there were markets for the ZEH concept he had embraced so enthusiastically. Therefore, instead of offering GPV as a standard feature for all the homes that were suitable for it, he decided to only make standard GPV available on a portion of the suitable homes. For homes with GPV as a standard feature, Green decided to include a 1.2 kW system as standard, and offer an optional upgrade to a 2.4 kW system for \$4,000. For the remaining homes suitable for PV, GPV systems (either 1.2 kW for \$6,000 or 2.4 kW for \$10,000) would be offered as an optional upgrade.

In essence, then, the buyers of homes with GPV systems as a standard feature had their costs rolled into the price of the home and did not have to make a separate purchase decision about GPV, except to determine whether they wanted to upgrade. Buyers of homes for which a GPV system was not available did not have to make a choice at all. On the other hand, buyers of homes for which an optional GPV system was available had to (1) make a decision about something they barely understood or didn't understand at all, and (2) whether to pay an extra \$6,000 to \$10,000.¹ In the context of hundreds of decisions buyers had to make at the time of home purchase on all manner of options, such as paint colors, flooring, rooms, and countertops—all of which are well understood choices—the purchase of GPV was a difficult decision to make.

Green had not understood at the time that the field experiment he had designed stacked the deck in such a way as to make it difficult for buyers to opt for GPV. He also had not fully understood the implications of the fact that sales staff—who are there to sell new homes—would also have to sell PV systems one buyer at a time. Nonetheless, SheaHomes proceeded with its innovative project to build and market ZEHs in San Diego.

This paper discusses the builder experience with the Scripps Highlands ZEH development in San Diego in terms of SheaHomes' competitiveness in offering the ZEHs, actual sales of the homes, the benefits of the project to SheaHomes, and costs of the project. Lessons learned from the SheaHomes experiment are then discussed. Finally, a new initiative in San Diego to foster the building of new sustainable homes is described.

¹ By comparison, buyers could upgrade from granite tile to solid granite countertops in their sizable kitchens for \$10,000.

Findings are based on multiple data sources. The first author of the paper is the principal investigator of a market assessment of zero energy homes in California. This study's first phase involved qualitative data collection from early buyers of SheaHomes (cf. Farhar, Coburn, and Collins 2002). These findings were used to initiate a quantitative investigation and to construct a set of questionnaires for further data collection from SheaHomes buyers and homebuyers in a nearby comparison community of conventional homes. Findings from the quantitative phase of the study are reported in Farhar, Coburn, and Murphy (2004).

Interviews were conducted with Ryan Green and Dale Holbrook, SheaHomes, San Diego, and with various members of the SheaHomes staff between 2002 and 2004, including Teri Shusterman, Diane Rivera, Pam Beaird, and Pattie Walker. In addition, Kirk Stokes of Altair Energy, a PV systems and services provider, was interviewed as was Scott Anders of the San Diego Regional Energy Center, Rob Hammon of ConSol, Inc., Marc Roper of AstroPower, and Tom Bohner of Sun Systems, Inc.

SheaHomes also provided documentation in the form of contractor reports, copies of videotapes of television broadcasts, newspaper clippings, and other materials.

Are ZEHs a Competitive Product?

To address the issue of whether SheaHomes could offer ZEHs and still be a competitive builder, we compared the mean sales price, the mean square footage, and the price per square foot between the 306 SheaHomes in the San Angelo and Tiempo communities, and those in an adjacent 103-home community of conventional new homes offered by a different builder. Although they were built to Title 24 codes, these comparison homes offered no special energy efficiency or solar features. Also, like San Angelo and Tiempo, they had no Mello-Roos tax requirements.² Table 1 summarizes the data.

Table 1. Sales Prices and Sizes of SheaHomes and Comparison Homes

Variable	Shea Homes	Comparison Homes	Significance
Mean sales price	\$601, 984	\$615, 029	n.s.
Mean square footage	3091 sq. ft.	2860 sq. ft.	t = 5.961; d.f. = 405; p ≤ .000
Mean price per square foot	\$195.96	\$215.89	t = 6.569; d.f. = 405; p ≤ .000

The data support the conclusion that SheaHomes was able to deliver highly energy-efficient homes equipped with solar water heating systems, 39% of which also included a GPV system at a competitive price. In fact, despite their quality and amenities, the SheaHomes cost less per square foot than their competitors⁷.

As discussed in Farhar, Coburn, and Murphy (2004), 10 of the SheaHomes had already been resold by January 2004, with increases in property values averaging 42% after having been

² Mello-Roos taxes are a form of property taxation for new home developments passed by the legislature; these taxes provide for the development of new infrastructure such as roads and schools. Certain land holdings, including the Scripps Highlands parcel owned by SheaHomes, were exempted from Mello-Roos taxes at the time the bill was passed.

owned from 10 to 29 months. The increase in value for the SheaHomes averaged \$227,592. The highest resale price was \$930,000 for a home with a 1.2 kW PV system owned for 23 months. The increase in SheaHomes resale prices were proportionally higher than were those of nearby 6 comparison homes resold in the same time period.

Actual Sales of Homes

SheaHomes closed on its 306 San Angelo and Tiempo homes from April 26, 2001, to November 21, 2003, a period of 31 months. The company reported that the homes sold at the same rate as conventional homes would have. The 103 homes in the comparison community built by a different builder first closed on May 22, 2001, and last closed on November 10, 2003, a period of 30 months.

Of the 306 homes SheaHomes sold at Scripps Highlands, 96 were offered with a 1.2 kW GPV system with net metering as a standard feature. Purchasers of homes with GPV as a standard feature could choose to upgrade their GPV systems to 2.4 kW. Buyers of another 164 homes could opt for either a 1.2 kW or a 2.4 kW system. Not all homes at Scripps Highlands could have GPV systems. Fifteen percent were not suitable for GPV systems because (a) they had limited roof space, (b) their orientation was not suitable, or (c) they were built before solar features were made available. The first 13 homes built had only the energy-efficiency features (and no solar features), making them the equivalent of 5-star Energy Star homes.

The percentage of the SheaHomes that actually have GPV is an important study question. Table 2 shows that 39% of the SheaHomes have GPV systems and 61% do not. But only 260 homes, or 85% of the homes in the development, could have had GPV systems because of the limitations noted.

Table 2. Percentage of SheaHomes with GPV Systems

Type of home	n	%
With GPV system	120	39
Without GPV system	186	61
Total	306	100

A key question for Ryan Green and SheaHomes was how many homebuyers would opt to purchase a GPV system. Now that the entire development has been built out and sold, it is possible to show the final outcome of that experiment. SheaHomes elected to put a standard 1.2 kW system (12 panels) on 96 (or 31%) of the 306 homes. Buyers of houses with the standard systems could choose to upgrade the GPV system by doubling its size to a 2.4 kW system (24 panels) for a price of \$4,000. Only 8 (8%) of these 96 buyers chose to do so. On the remaining 164 homes available for the GPV option, 24 buyers (15%) elected to purchase a 12-panel system for \$6,000 or a 24-panel system for \$10,000.³ In total, then, the percentage of buyers electing to purchase PV systems was small: only 12% of households (n = 32) chose an optional PV system or an upgrade. Table 3 summarizes the data.

³ These prices increased to \$7,000 and \$11,000, respectively, later in the construction process.

Table 3. Numbers and Percentages of SheaHomes with and without PV Systems

Type of house	n	%
With optional GPV system (wholly or in part)	32	12
With standard GPV system only	88	34
GPV system not elected	140	54
Total that could have had GPV system	260	100
GPV not available	46	
Total homes	306	

Of all the GPV homes (n = 120), 73% came with a 1.2 kW system as a standard feature; the remaining 27% involved a homeowner decision to opt for a system or an upgrade to the standard system. Of the 260 homes sold that could have had GPV systems, 46% actually have them; 54% do not. More of the 260 homes that could have had GPV involve standard rather than optional systems—34% of the homes have standard GPV systems and 12% of the homes have an optional system purchase or upgrade. Most of the GPV systems are the smaller 1.2 kW systems. Table 4 summarizes the data.

Table 4. Number and Percentages of GPV Homes

Types of GPV Systems on SheaHomes	n	% (n=120)	% (n=260)
1. 1.2 kW GPV system as standard feature	88	73	34
2. Optional 1.2 kW GPV system	16	13	6
3. Optional 2.4 kW GPV system	8	7	3
4. Standard 1.2 kW system and an optional upgrade to a 2.4 kW system	8	7	3
Total homes with GPV systems	120	100	46
Homes with optional systems only (Categories 2 and 3)	24	20%	9%
Homes involving optional systems (Categories 2, 3, and 4)	32	27%	12%
Homes involving standard systems (Categories 1 and 4)	96	80%	37%
GPV systems that were 1.2 kW systems	104	87%	40%
GPV systems that were 2.4 kW systems	16	13%	6%

An important question is whether more GPV systems will be installed in a development if they are offered as a standard feature or offered only as an option. Table 4 shows that 73% of the GPV systems sold came standard on the house and another 7% were standard with an upgrade. Fewer than one-third (27%) of the systems purchased were optional or upgraded systems.

Taken together, these data show that the vast majority of buyers (88%) chose not to make a separate decision to purchase or upgrade a GPV system. But they also show that almost half of the buyers (46%) did indeed purchase a GPV system. Qualitative data (Farhar, Coburn and Collins 2002) and preliminary quantitative data (Farhar, Coburn, and Murphy 2004) show that buyers found it easier to purchase a GPV system when they did not have to make a separate decision about it. Buyers also found it difficult to make the trade-off between a GPV system on the one hand and amenities that improved the aesthetics of their home on the other hand (e.g., solid granite countertops, special window sills, or upgraded flooring). These seemed to some buyers to be options in a totally different class (e.g., a choice about equipment versus a choice about improving their homes' aesthetics). Finally, some of the data suggest that buyers who chose not to get the GPV thought that it was too expensive.⁴

Benefits to the Builder

SheaHomes accomplished a complex technical and institutional achievement in completing the San Angelo and Tiempo developments. Besides selling out the 306-home development in 31 months, the builder also sold almost half of them with GPV systems. Four major benefits appeared to accrue to SheaHomes because of their involvement in ZEH construction: (1) forging partnerships with organizations interested in solar energy and energy efficiency, (2) media coverage, (3) enhanced reputation through becoming an innovator with ZEH technology, and (4) greater exposure to the home buying market.

Forging Partnerships

SheaHomes increased its involvement with a number of business, non-profit, and governmental organizations as a direct result of its decision to build ZEHs. For example, the builder has worked with the U.S. Department of Energy's (DOE) Zero Energy Homes initiative; NREL; the California Energy Commission (CEC); AstroPower; Sun Systems; ConSol, Inc.; San Diego Gas and Electric (SDG&E); and the San Diego Regional Energy Office. Such partnerships probably give SheaHomes a business edge in innovative home building techniques and energy technologies. They provide a network of resources to which SheaHomes can turn for information about best construction practices and market research. These partnerships help to establish SheaHomes as a leader in the field of energy features in new housing. It is difficult to put a dollar value on such resources, but such contacts are generally understood to be "coin of the realm."

Media Exposure

By its own contractor's estimate, SheaHomes received, without cost, print and broadcast media coverage on the San Angelo and Tiempo developments that approximated one million dollars in publicity value between January and August of 2001 alone. The coverage included San Diego television evening news, local newspapers, and trade journals.

⁴Although GPV might be seen as expensive in an absolute sense, this perspective clearly results from buyers being unaware of the usual unsubsidized costs of PV systems, which are generally at least double those offered at Scripps Highlands.

Enhanced Reputation

Because nearly half of all buyers at SheaHomes' Scripps Highlands development purchased GPV systems, it seems reasonable to say that SheaHomes was successful in marketing innovative ZEHs with efficiency and solar features. In doing this, SheaHomes in San Diego established its reputation as a visionary company willing to offer quality products that provide value to its customers and also benefits to the broader San Diego community. Though the project was difficult for the company, SheaHomes has no doubt benefited through the increased goodwill of the community by attempting and carrying out this project. These qualitative benefits are likely to be longer range in nature than the immediate impacts on the bottom line, and will be unfolding for years to come.

Greater Exposure to the Once and Future Home Buying Market

Owing in part to media coverage and also to high demand for housing in the San Diego market, SheaHomes experienced a large volume of visitors to its Visitor Center (there were no model homes in the early stages of the development). Many were curious about the development's solar features, although they were not seriously shopping for a new home. (Collins 2003). Conceivably, a small percentage of these visitors might shop for a new home in the future; they will have been exposed to SheaHomes and to the ZEH concept.

Costs to the Builder

The ZEH experience was something of a double-edged sword for SheaHomes. Several of the benefits also involved costs. For example, although SheaHomes climbed a steep learning curve regarding the incorporation of energy features into its new housing products, there was a cost in terms of staff time. Some lessons were hard won. It was difficult for SheaHomes to anticipate the problems it would encounter in these uncharted waters.

- **Costs of building ZEHs.** There were significant costs involved in the building of ZEHs, especially in the installation and interconnection of GPV systems. SheaHomes found that, despite rebates for both solar water heating systems (\$750 from SDG&E for each system) and GPV systems (50% of system cost from the CEC), offering the ZEHs did not result in an economic advantage to them. GPV systems were expensive and few buyers opted for them. The builder believes some of the market interest may have occurred because of the electricity price spikes in San Diego in 2001. Buyers have now become accustomed to higher electricity rates, the company believes. Although SheaHomes indicates the ZEHs did not sell any faster because of the energy features, the Scripps Highlands development sold out a year faster than planned. The builder attributes this to the desirability of the Scripps Highlands location.
- **Climbing the learning curve.** SheaHomes had no staff experienced in ZEHs except Ryan Green. The learning curve associated with producing the ZEHs was characterized as "enormous," including all the new language and acronyms. SheaHomes found climbing this curve to be a painful experience.
- **Transaction costs of selling and scheduling installation of optional GPV systems.** Because SheaHome buyers had the option of upgrading GPV systems that came as a

standard feature of the home, or adding a 1.2-kW or a 2.4-kW GPV system to their home, sales staff had to explain GPV itself and the different ways the home buyer could purchase it. In addition to this time-consuming chore, the SheaHomes staff had to schedule the installation of the two sizes of GPV systems on a house-by-house basis. The fact that this was burdensome was illustrated by an anecdote from a SheaHome buyer. He said: “When we were purchasing our system, it came with 12 panels. We were offered an additional 12 panels for \$7,000. We jumped on it! However, when they built the house, we discovered that they had only put on 12 panels. We contacted SheaHomes who said, ‘How about we just give you back the \$7,000?’ They really tried to get us to pass up our 12-panel addition. However, we insisted that they put in the additional 12 panels. They had to change out the inverter when they put in the additional 12 panels, and put in a new top-of-the-line inverter that enables us to monitor our electricity use on the computer. We can put it in an Excel file. What matters to me is that I want to monitor my electricity use once a month starting on the day that SDG&E reads my meter.”

- **Obtaining the rebate for GPV systems.** The CEC was offering a rebate of 50% of the installed cost of GPV systems to residential owners and businesses installing them as well as to builders including them in new homes. CEC’s application procedures for obtaining the rebate had been designed to deal with only one system at a time. Because the SheaHomes project was so innovative, the builder had to work with the CEC to invent a procedure to collect the rebate for the group of GPV systems it had purchased to install at San Angelo and Tiempo.
- **Dealing with interconnectivity issues.** Net metering legislation requires California utilities to allow net metering to zero for homes with GPV systems tied to the utility grid. This means that the electric meter at homes with GPV systems run forward and backward. SDG&E was still developing its own procedures for interconnectivity agreements with residential electricity producers when SheaHomes began building its Scripps Highlands project. The utility was sending to the homebuyers for their signatures highly complex legal documents dealing with interconnection to the utility grid appropriate for corporations. Neither SheaHomes staff nor homebuyers had any prior experience in dealing with interconnectivity issues. New homebuyers did not understand these SDG&E interconnectivity agreements and turned to the SheaHomes staff for help. The staff therefore spent a good deal of time interfacing with both SDG&E and homebuyers on interconnectivity issues. SDG&E eventually simplified its forms for residential electricity producers, who are billed separately for electricity and gas and have the option of being billed for electricity monthly or annually. However, interconnectivity still remains an issue for some of the GPV homeowners who may not yet have signed their agreements with SDG&E, and therefore whose GPV systems might not yet be functioning.
- **Tax implications.** Various state and federal income tax credits were thought to be applicable to the SheaHomes. The San Diego Regional Energy Office worked on an analysis to define the tax benefits of ZEHs and shared its findings with the SheaHomes staff. Staff spent time trying to understand the tax implications and how to explain them to the homebuyers so that they might benefit from them.

- **Education.** SheaHomes provides orientation at “Shea University” to all of its new homebuyers. These sessions are usually held in the garage of one of the homes in the development on Saturday mornings and cover many of the features of the new homes and the procedures for completing purchase, moving in, and dealing with problems. The staff responsible for orientation did not always include information on the energy features of the new homes including energy efficiency, solar water heating, and GPV. Thus, SheaHome buyers were not sufficiently briefed on the benefits of their homes in terms of energy performance.
- **Visitors.** Many general public visitors curious about the solar features, but who were not serious buyers took up staff time with their questions. In addition, SheaHomes staff handled many other professional visitors working on media stories, research, government programs, non-profit educational programs, and the like.
- **Complaints.** A few homebuyers complained about hot water systems, but the complaints did not have to do with the solar hot water systems. For example, one complaint was that it took too long for the hot water to reach the bathroom faucets located farthest from the hot water tank. This had nothing to do with the presence of solar water heating; nevertheless, in a few instances, it was perceived as such. One or two potential buyers wanted standard PV panels taken off the roof, although there is no evidence that any home sales were lost because of PV panels.
- **Competitiveness issues.** Because of its innovative position relative to energy features, SheaHomes perceived a certain amount of animosity (perhaps sparked by concern that they could be forced into dealing with ZEH technology to remain competitive) on the part of the San Diego builder community.

SheaHomes Position

According to Dale Holbrook, Vice President, San Diego Division, SheaHomes is not currently planning to build more ZEHs. The company remains interested in the concept and will engage in continuing analysis of the costs of constructing ZEHs compared with conventional homes, and the market acceptance of ZEHs. They are awaiting the results of the study of market acceptance of ZEHs being conducted at NREL (cf. Farhar, Coburn, and Murphy 2004).

SheaHomes believes that its experiment shows that few buyers are interested enough in ZEHs to opt for the GPV systems. The data on actual sales bears out that conclusion. The corporate position is that GPV, if offered as a standard feature, could raise the homes’ prices beyond a competitive level.

New Developments in San Diego

The City of San Diego has, as part of its sustainability initiative, recently started an Expedite program to accelerate the permitting process for building homes with PV systems. The city had adopted a broad goal of achieving 50 MW of self-generated renewable electricity within the next five years. As a tangible step to encourage builders to include energy efficiency and PV in their new homes, the city’s Expedite program, in essence, puts builders who plan to include solar PV as a standard feature in their homes at the front of the line to receive building permits.

Usually, the permitting process for an undeveloped piece of land takes approximately 24 months. The city cuts that time down to 6 to 9 months if the PV system planned for the home provides 50% of the estimated electricity needs of the home, based on Title 24's estimate of electricity use per square foot. Although it cost the city nothing to implement it, the Expedite program results in a small revenue stream because the city charges a \$500 fee for an Expedite application.

The builder can benefit from the program because builders pay finance charges on loans for property they own and are waiting for a building permit to develop. These charges vary, of course, but can often range from \$2,000 to \$4,000 a month. If it takes 24 months to obtain a building permit, the finance charges at the high end of this example could total \$96,000. If the Expedite program results in a building permit in only 6 months, the builder would pay only \$24,000 instead of \$96,000 in finance charges, thus saving \$72,000. In addition, the San Diego builder can recoup half of the installed system cost because of the CEC rebates; therefore, the costs that need to be passed along to the home buyer are only 50% of the actual installed PV system cost. This price premium ranges from \$8,000 to \$10,000 per home. Because housing demand in San Diego is high, buyers readily pay this premium; in fact, at least one builder's homes are 100% pre-sold. The company believes that PV may add value to its marketing campaign. It appears that the worst-case scenario for builders is that PV does not interfere with their sales (and may increase the dollar value of sales) while it saves them appreciably in finance charges.

Of course, with houses in the Expedite program, the PV homebuyers don't have the option of selecting a PV system for their homes; it comes as a standard feature. Buyers are always free to purchase a conventional rather than a ZEH home. But, all other things being equal, the buyers benefit from purchasing a home with PV as a standard feature because: (1) they don't have to decide about an unfamiliar but expensive technology, (2) they should enjoy significant savings on their electricity bills for at least 20 years, (3) they will probably realize appreciated resale value for their homes when they sell, and (4) the GPV system cost is rolled into their home mortgage, the monthly incremental cost of which should be less than their electricity savings.

Conclusions

SheaHomes is an industry leader in offering quality upscale energy-efficient solar homes. That position still remains, despite the fact that the company is not pursuing ZEH concepts in any of its current developments in the San Diego area. If another builder aggressively pursues the offer of PV homes and establishes a reputation in this area, SheaHomes could eventually lose the specific competitive advantage that it currently enjoys. SheaHomes has kept the door open on future use of ZEHs but wants to better understand costs and benefits before committing to another project.

Several lessons can be learned from the Scripps Highlands experience:

- In general, new home sales staff must emphasize selling homes and are more effective at doing so than at selling PV. If PV is offered as a standard feature, the sales staff doesn't have to take the time to sell the PV option.

- If PV is offered as a standard feature, many more PV systems will be sold than if it is offered as an option.
- SheaHomes may have spent more time in the management of ZEHs within its Scripps Highlands development than it had expected. A ZEH champion internal to the company is important to successful project planning and implementation.⁵ One of the SheaHomes sales associates was particularly dedicated to the concept, and sold many of the homes with PV systems.
- A typical builder concern is that they do not want their homes to cost more than those offered by competitor builders. Evidence from the Scripps Highlands project—and from information gathered elsewhere—suggests that new homebuyers willingly pay for homes with a standard PV system whose price reflects the inclusion of that system, at least at subsidized cost.
- It is difficult for buyers to make a PV purchase decision on an optional basis because the technology is complex, unfamiliar, and costly, and buyers are unfamiliar with the benefits of PV systems.
- Rolling the cost of PV into homebuyers' mortgages by including PV in the price of the home will streamline the process of PV purchase, resulting in a probable net win for the home buyer through reduced electricity bills.
- The utility company could also be a winner. Large home developments with self-generating net-metered electricity on each home should contribute to peak shaving of SDG&E's summer afternoon loads. Because peak electricity costs significantly more than baseload electricity, this result could benefit SDG&E and its ratepayers.
- Interconnectivity agreements need further streamlining to benefit all parties concerned.
- PV service providers⁶ should handle the technical details of PV installation, interconnection with the utility grid, obtaining rebates, and related services so that the inclusion of PV in the large-scale home development project becomes a "no-brainer" for the builder. SheaHomes bought PV systems directly from the manufacturer and kept the middleman role internal to the company.
- Offering PV as an option does not appear to be profitable for large-production builders. The transaction costs of scheduling optional PV systems in the construction schedule were higher than they would have been if every home had a PV system and its installation were routine. The transaction costs of sales staff having to educate and sell buyers on PV would be reduced if PV comes as a standard feature on all of the homes in a development.

The transaction time involved in selling PV systems as options is very likely too high for large-production home builders. Future new home developments should feature highly energy-efficient homes with solar water heating and PV systems as standard, not optional, features. Such homes will be more profitable for builders and sales staff, more beneficial for utility load profiles, and more cost-effective for homebuyers.

⁵ Unfortunately, Ryan Green had left SheaHomes for an opportunity to work with another builder before construction on San Angelo and Tiempo began. Even though the project was then assigned to an experienced supervisor, he, too, eventually left it, and no other dedicated and trained champion remained, except for one member of the sales staff.

⁶ For example, Altair Energy, a national PV service provider with its headquarters in Golden, Colorado, provides these services.

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