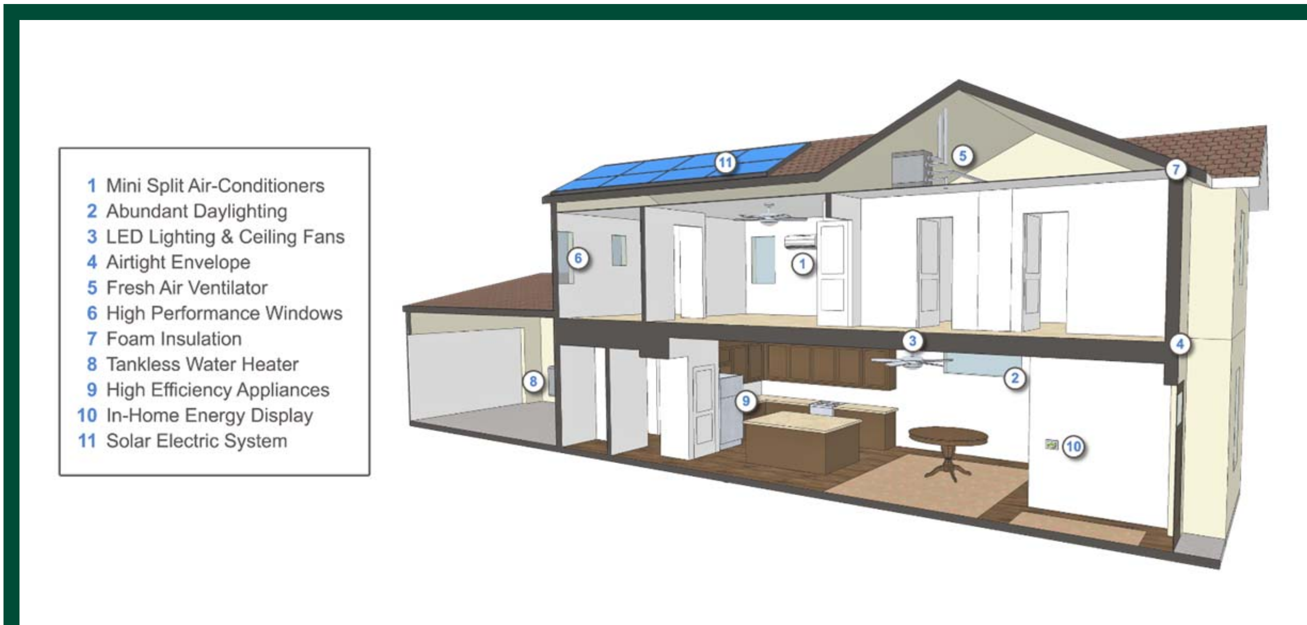
Emerging Products

Zero Net Energy New Home

ET11SCE2030 Report



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Disclaimer

EXECUTIVE SUMMARY

Southern California Edison's (SCEs) Emerging Technologies Program (ETP) partnered with an industry-leading homebuilder to design and construct a new, replicable, affordable Zero Net Energy (ZNE) single-family home. This ZNE home – now built and occupied in Ontario, CA – aims to demonstrate to the Southern California homebuilder community that ZNE homes can be constructed using prevalent building practices and sold for a reasonable incremental cost.

The three main tasks of this project are to: identify a progressive homebuilder with expert experience in the new construction home industry, collaborate with the homebuilder to design and construct a ZNE home based on mutually agreed upon technologies and practices, and learn from all facets of the new home industry to help overcome existing market barriers to ZNE homes.

Some of the key findings of this project include:

- **Lower Incremental Cost:** The incremental cost associated with building a ZNE home in Southern California can be lower than previously presumed; approximately \$30K (\$16/ft²) or 9% of the total value of the home in the city of Ontario.
- **Influence of the Finance Industry:** The finance industry, including lenders, realtors, and appraisers, play a huge role in packaging a business case for ZNE homes and consequently the mass-adoption of ZNE homes; these entities need to be engaged urgently if ZNE homes are to become mandated in new construction by 2020.
- **Larger Market Demand:** There may be a larger market demand for ZNE homes than previously suggested, especially with homeowners whose energy bills are a larger percentage of their overall expenses.
- **Key Homebuilder Relationships:** Homebuilder relationships with key subcontractors, product vendors, and energy consultants can heavily drive the prevalence of building practices used in the market; these trades must be engaged in order to gain market acceptance of ZNE strategies.
- **Energy Code Compliance Software:** Building energy code compliance software is heavily relied upon by homebuilders and their energy consultants to make energy design decisions; accordingly, these tools should be advanced to better support key ZNE strategies.
- **Residential Distributed Generation Systems:** Residential distributed generation systems (solar-electric systems) are becoming so affordable that they are becoming more cost effective than other low-cost energy efficient technologies and strategies.

Table 1 summarizes the energy-efficiency measures (EEMs) used in the ZNE home, their projected cumulative annual energy savings, and their cumulative incremental costs.

Table 1. Cumulative Energy-Efficiency Measures – Path to ZNE

Energy-Efficiency Measure (EEM)	Annual Energy Cost	Annual Electricity Use (kWh)	Annual Gas Use (Therms)	Energy Use Intensity (EUI)	Percent Reduction (%)	Cost of Measures
Baseline – Standard Home	$1,710	9,229	387	31.52	0%	$0
+ Heat Pump, Ductless Mini-Splits	$1,475	8,538	225	23.19	26%	$5,625
+ Appliances Upgrades	$1,290	7,512	225	21.61	31%	$5,926
+ Heat Recovery Ventilator	$1,274	7,416	225	21.47	32%	$11,926
+ Condensing Tankless DHW	$1,257	7,416	201	20.39	35%	$12,841
+ Spray Foam Cavity Insulation	$1,171	6,906	201	19.61	38%	$19,531
+ LED Lighting & Occupancy Sensors	$1,107	6,492	201	18.97	40%	$22,479
+ Adv. Framing & One-Coat Stucco	$1,105	6,477	201	18.95	40%	$26,990
+ 4.56 kW PV System & CAHP Rebate (not EEMs)	-$5	-2,951	101	0.01	100%	$29,370

Additionally, the ZNE home was equipped with circuit-level monitoring equipment. Once a full year of monitoring data has been collected, a second comprehensive report will be released shortly after. The second phase report will discuss the project’s monitoring approach in detail and will summarize the home’s measured performance results.

ABBREVIATIONS AND ACRONYMS

ASHRAE	American Society of Heating, Refrigerating and Air Conditioning
CEC	California Energy Commission
CLTEESP	California Long Term Energy Efficiency Strategic Plan
CPUC	California Public Utilities Commission
DHW	Domestic Hot Water
DOE	Department of Energy
EEM	Energy-Efficiency Measure
ETP	Emerging Technologies Program
EUI	Energy Use Intensity (kBTU/ft^2/year)
HVAC	Heating, Ventilation and Air-Conditioning
IDSM	Integrated Demand Side Management
IOU	Investor-Owned Utility
kBTU	Thousand British Thermal Units
kWh	Kilowatt Hour
LED	Light Emitting-Diode
PV	Photovoltaic (Solar Panels)
SCE	Southern California Edison
TDV	Day and Time Valuation
ZNE	Zero Net Energy

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INTRODUCTION

Southern California Edison's (SCE) Emerging Technologies Program (ETP) collaborated with an industry-leading homebuilder to demonstrate residential integrated demand side management (IDSM) solutions and to support statewide Zero Net Energy (ZNE) goals. This project work primarily entails designing and constructing a demonstration ZNE home in Ontario, CA in order to help increase market awareness and penetration of proven energy-efficient technologies and practices. As a demonstration showcase home, this project does not assess individual technologies but rather multiple technologies in a whole-building approach.

It should be noted that several ZNE homes have been built in California prior to this home, so the feasibility of constructing ZNE homes is not necessarily a question of high significance nor is it the focus of this work. A higher-priority question that this work aims to address is the replicability and affordability of ZNE homes. Are ZNE homes a good value proposition? If not, why? In accordance with this focus, throughout the project, an emphasis was placed on using existing proven technologies, using existing homebuilder supply chains, and to the greatest extent possible, preserving the homebuilder's schedules and business processes.

With a wider lens, this project and its findings are intended to support the California Public Utility Commission's (CPUC) California's Long Term Energy Efficiency Strategic Plan (CLTEESP or Strategic Plan) and to help document and overcome any perceptible market barriers associated with its goals. The Strategic Plan embraces four programmatic goals - known as "Big Bold Energy Efficiency Strategies" that are intended to guide market transformation in key sectors and to galvanize market players. The goals are:

- All new residential construction in California will be ZNE by 2020;
- All new commercial construction in California will be ZNE by 2030;
- Heating, Ventilation and Air Conditioning (HVAC) will be transformed to ensure that its energy performance is optimal for California's climate; and
- All eligible low-income customers will be given the opportunity to participate in the low income energy efficiency program by 2020.

This project is directly related to bullets 1 and 3 of the Big Bold Energy Efficiency Strategies. In addition to supporting the Strategic Plan, this project and its findings are intended to support a variety of related energy efficiency efforts and programs statewide, including but not limited to: ZNE and new construction pilot programs, Codes & Standards efforts such as CASE reports and statewide training programs, incentive-based programs such as the California Advanced Homes, and California Solar Initiative and Savings By Design.

BACKGROUND

This project was initiated in response to a number of California policies and initiatives. The following outlines some of the main drivers for this project, starting from more general and moving to the more specific.

CUSTOMER ENERGY EFFICIENCY PROGRAMS IN CALIFORNIA

California has been a national leader in energy efficiency since the 1970's – per capita energy use has remained flat, while the rest of the United States has increased by about 33 percent[i]. This success is largely due to the state's unique energy-efficiency framework. Ratepayer-funded energy efficiency programs are administered by the California Public Utilities Commission (CPUC), which also oversees California's Investor-Owned Utilities (IOUs). California's IOUs consist of: Pacific Gas & Electric Company (PG&E), San Diego Gas & Electric Company (SDG&E), Southern California Gas Company (SoCalGas), and Southern California Edison (SCE). Through these utilities, and with the help of a key policy mechanism called "decoupling", the state and the CPUC are able to actualize significant energy savings. Decoupling removes the pressures placed on utilities to sell as much energy as possible by eliminating the relationship between revenues and sales volumes[ii]. Instead, earnings for these IOUs can be based on other factors such as customer satisfaction, infrastructure development, system reliability and energy efficiency. This policy framework enables and motivates California's largest utilities to continuously expand energy efficiency programs on behalf of their customers without compromising their own businesses.

CALIFORNIA LONG TERM ENERGY EFFICIENCY STRATEGIC PLAN

In 2008, the CPUC adopted a long-term plan aimed at making energy efficiency a way of life in California; this plan is called the California Long Term Energy Efficiency Strategic Plan (CLTEESP) [iii]. The CLTEESP is a comprehensive roadmap for energy efficiency in California through the year 2020 and beyond. On behalf of their customers and in support of the CPUC's vision, California's IOUs have embraced the CLTEESP, making energy efficiency a high priority resource in meeting California's energy needs. One of the primary objectives of the Strategic Plan is that all newly constructed homes will be ZNE by the year 2020.

Another key, related element of California's strategic vision for a secure energy future is loading order. Loading order is California's list of priorities for operating California's electricity system in the best long-term interests of consumers, ratepayers, and taxpayers. The loading order calls for, decreasing electricity consumption by increasing energy efficiency and conservation, reducing demand during peak periods through demand response and meeting new generation needs first with renewable and distributed generation resources and then with clean fossil-fueled generation[iv]. This means that when making energy related decisions, energy efficiency and demand response should take precedence over new distributed generation resources. The loading order was adopted by the State of California in 2003.

ZERO NET ENERGY BUILDINGS

California is committed to achieving several ZNE building goals over the next twenty years which are boldly outlined in the aforementioned CLTEESP. In relation to this project, the most notable of these goals is that "all new residential construction in California will be zero net energy by 2020". Plainly described, a ZNE building is one that produces at least as much energy as it uses annually. However, this definition allows for a broad spectrum of interpretation depending on how one wants to account for energy and the parameters of the project site. Though there are many variations of ZNE, five major definitions of ZNE currently are:

- **ZNE Site:** The most common definition of ZNE; a ZNE Site building produces at least as much energy as it uses annually when accounted for at the building site. All fuels used and generated within the site such as electricity, natural gas, and propane are converted to a common metric, typically Thousand British Thermal Units (kBTUs).
- **ZNE Source:** A ZNE Source building produces at least as much energy as it uses annually when accounted for at the source. A calculation of source energy encompasses energy used to generate and deliver energy to the site. Site-to-source energy factors are used to adjust energy values per fuel type. For example, since approximately two-thirds of the energy used to create electricity is lost during the generation and transmission process, a site-to-source energy factor of 3.37 is used for electricity. A site-to-source energy factor of 1.12 is used for natural gas.
- **ZNE Emissions:** A ZNE Emissions building produces at least as many carbon emissions offsets through renewable energy to compensate for the total carbon emissions generated through on-site energy consumption. This calculation typically includes not only emissions associated with building operation, but also carbon emissions generated during the construction of the building, and even the embodied energy of the materials used in building construction. In some cases, the carbon emissions associated with commuting to and from the site are also considered as part of this ZNE calculation. Emissions may include other gases beyond carbon dioxide, such as nitrogen oxides, and sulfur oxides. This is the most ambitious definition of ZNE.
- **ZNE Cost:** A ZNE Cost building looks at building energy use from a purely economic perspective. In a ZNE Cost building, the income generated on-site by the sale of surplus electricity is at least as much as the cost of purchased energy. This accounting method is typically settled annually, not monthly, and is highly dependent on the customer's utility surplus compensation rates.
- **ZNE Equivalent (TDV):** A ZNE Equivalent building produces at least as much societal energy as it uses annually when accounted for at the building site. Societal energy is calculated using a methodology called time dependent valuation (TDV), which values energy differently depending on time, day and season of use, geographic location, and fuel type. Weighting factors are used for every hour of the year to better reflect actual costs to users, to the utility system, and to society. For this reason, it is also known as Societal ZNE.[v]

Because the concept of ZNE is relatively new, varying governments, organizations and policies have adopted ZNE via varying ZNE definitions. For example, the European Union has adopted the ZNE Source definition while the United States Military, Department of Energy (DOE), and American Society of Heating, Refrigerating and Air Conditioning (ASHRAE) use a site-based ZNE definition. At the time of this project's inception, it was thought that ZNE Site was California's frontrunner for choice of definition. As such, this project was planned and evaluated using the ZNE Site definition as the home's design, construction, and performance goal. Since, it has since been decided that ZNE Equivalent (Societal ZNE) will be the definition by which the state attempts to achieve its ZNE goals. Given this, it is important to mention that a ZNE Site goal is believed to be more difficult to achieve than a ZNE Equivalent goal.

EMERGING TECHNOLOGIES PROGRAM

The Emerging Technologies Program (ETP) is a statewide energy efficiency program that aims to advance the introduction of proven energy-efficient technologies, applications, and analytical tools that are not yet widely adopted in California. As part of that work, the ETP directly supports the CPUC's CLTEESP goals by focusing a share of its efforts on whole-building approaches.

PROJECT SCOPE

The project scope of this can be broken up into nine major tasks:

1. Identify an industry partner (an expert in homebuilding) for collaboration with SCE to design, construct, occupy, and monitor a newly constructed ZNE home.

2. Select one of the homebuilder partner's existing model home designs and available sites with the highest potential for future replicability as a ZNE home.

3. Establish an energy baseline and energy performance goals based on benchmarking tools and utility bills from similar homes in the surrounding area.

4. Evaluate applicable energy efficiency measures (EEMs) for the given ZNE home using predictive building energy simulation software (eQUEST®).

5. Select EEMs and renewable energy technologies; design and specify them into construction drawing sets.

6. Builder to construct the ZNE home with the selected EEMs and renewable energy technologies; document the process.

7. Educate potential stakeholders, including homebuyers, of the benefits associated with the ZNE home, its associated EEMs and renewable energy technologies.

8. Monitor the EEMs and renewable energy technologies by end-use for no less than one year of post-occupancy.

9. Disseminate project findings to stakeholders.

IDENTIFYING AN INDUSTRY PARTNER

To help address ZNE market barriers and policy implications, SCE intentionally sought to partner with an industry-leading production homebuilder. These entities are known to have unmatched success with developing, marketing and selling new homes. A competitive process was administered in order to identify the right partner for the project. The competing homebuilders' were interviewed in-person and their existing work, communities, and floor plans were reviewed for ZNE potential before being selected. The selected homebuilder demonstrated extensive qualifications, a comprehensive understanding of the residential market, and a high degree of willingness to collaborate with SCE throughout the selection process.

SITE SELECTION

The selected partner homebuilder is active in many communities within SCE's service territory. One of these communities in particular, in Ontario, CA (Figure 1) was chosen for a ZNE demonstration home. The neighborhood is marketed towards first-time homebuyers and offers single-family and multi-family options in a range of in-demand prices. The community is well master-planned with ample shared community space, is located in a hub of successful new home developments and also makes environmental elements a priority; utilizing drought tolerant landscaping and solar systems as standard. A single-family lot within the community was selected as an ideal location for the ZNE demonstration.

FIGURE 1. RESIDENTIAL COMMUNITY IN ONTARIO, CA

Instead of designing an entirely new home from scratch for a demonstration, it was decided that an existing floor plan could be modified in order to achieve the ZNE goal. Using one of the homebuilder's existing designs afforded several major benefits. First, it was more cost-effective and time-efficient to start with a "base" building. Second, it helped to assimilate the concept of ZNE building practices to the homebuilder's sub-contractors by starting with a building they were already familiar with. Finally and most importantly, it enabled a comparison between the costs of a "standard home" versus a "ZNE home". One of the most common questions regarding a highly energy-efficient home is how much it costs in comparison to a standard home without the energy efficiency upgrades. Using an existing floor plan made it easier to make this comparison.

A two-story plan (Figure 2) – with 1,828 ft² of conditioned floor area and 400 ft² of unconditioned garage floor area – was selected as the baseline because of its inherent aggressive energy-efficient features, previous sales success, and replicability. Before adjusting the existing home's design towards ZNE, the home already included: ample access to daylight, high-performance double glazed low-e windows, 2x6 wall framing and a tankless water heater. This home was verified to be 36% better than California's 2008 Building Code and was already equipped with a 1.72 kilowatt (kW) roof top solar system; this was considered very progressive when compared to other newly constructed homes in Southern California at that time.

FIGURE 2. ZNE HOME FLOOR PLANS

ESTABLISHING ENERGY GOALS

In order to meet the home's energy performance goal (ZNE), an energy baseline had to be established. The energy baseline is used to represent how much energy the home (as is) is predicted to use over the course of a year. The baseline was used as a starting point for determining how aggressive EEMs should be in order to meet the ZNE design goal. The baseline energy metric (Site ZNE), assumes all fuels consumed on site (electricity and gas) are converted to a common unit: kBTU.

A popular benchmarking resource offered by the U.S. Energy Information Agency called the Residential Energy Consumption Survey (RECS) 2001-2005 provides aggregated data from real building surveys. This is a good resource with a large national sample size. Referring to pertinent characteristic groups within this data yields a baseline range from 33 to 54 kBTU/ft^2/year. RECS provides a fair baseline range and helps to gain a sense of energy baselines nationally. It was determined however, that a more accurate baseline approximation can be generated from local utility billing data.

Residential electricity billing accounts within a quarter mile radius of the project site were polled in aggregate. This data was further filtered to include only homes with similar characteristics. These characteristics include homes within a band of 1,500 – 2,000 square feet (SF), homes built after 1990, two-story homes, and homes that have four bedrooms. After tuning the dataset, the sample size of homes within all subcategories mentioned totaled 222 homes. Based on those 222 homes the estimated baseline energy use intensity (EUI) was projected to be approximately 33 kBTU/ft²/year. The RECS data was higher by about 20% on average. It is also of interest to note that compliance software (EnergyPro) would have estimated a standard home baseline to be approximately 26 kBTU/ft²/year; approximately 22% lower than local utility billing data (Table 2).

TABLE 2. EUI BASELINES – RECS & BILLING ACCOUNTS

DATASET	# OF HOUSEHOLDS	AVE. EUI
2005 RECS, U.S.	111.1 M	42.4
2005 RECS, California	12.1 M	41.7
2005 RECS, 1500-1999 SF	15.4 M	53.8
2005 RECS, <2,000 CDD & <4,000 HDD	24 M	38.8
2005 RECS, Made 2000-2005	9.2 M	33.4
2005 RECS, Single-Family Detached	8 M	48.7
Local Billing Data, All Accounts	1,910	35.2
Local Billing Data, 2-Stories	571	32.6
Local Billing Data, 1,500-2,000 SF	627	33.9
Local Billing Data, 4 Bedrooms	568	33.9
Local Billing Data, Made After 1990	390	32.2
Local Billing Data, All Subcategories	222	32.8
Energy Compliance Software (Projected)	-	26
Project Baseline	-	33

EVALUATING ENERGY EFFICIENCY MEASURES

After establishing an energy baseline, a building energy simulation model was created to represent the baseline home's design. The energy model was calibrated to the previously agreed energy baseline (33 kBTU/ft²/year) so that more accurate predictions could be made with regards to energy design decisions. The energy model was informed by construction drawing sets and by information extracted from a detailed energy audit of a very similar home within the same community. Auditing a comparable home (same floor plan and design in the same community) helped to fine tune some of the energy model's more obscure inputs, such as the building's airtightness and framing factors which are highly dependent on local construction practices. Diagnostic equipment such as an infrared camera, light meter, ultrasonic leak detector and a blower door test were used to get a better feel for the home's construction. Alignment with on-site research highly improved the reliability of the simulation results and was critical to calibrating the baseline model. A summary of the model's baseline simulation inputs and baseline simulation results can be found in Appendix C.

The primary building energy simulation tool used for this project was eQUEST®, a widely used and industry accepted building energy prediction tool. This tool enables users to run hourly calculations for a whole year and provide detailed information about the building's envelope constructions, lighting, HVAC, operational schedules and local site. Figure 3 shows a view of the eQUEST model; the two grey planes are meant to emulate shading effects from neighbors. Additional simulations tools were used for more specific analysis tasks; for example Ecotect® Analysis and DAYSIM were used for daylighting analysis, while RETScreen® was used for solar-thermal analysis.

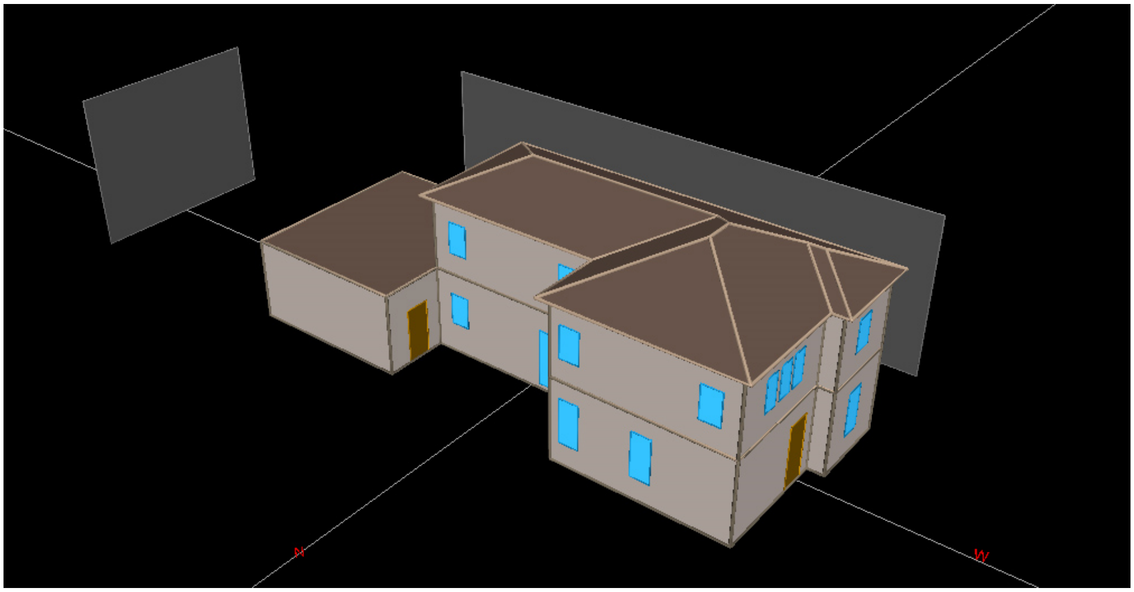

FIGURE 3. BUILDING ENERGY MODEL USING EQUEST

SELECTING & DESIGNING ENERGY EFFICIENCY MEASURES

With a calibrated energy model created to represent a baseline home, a variety of EEMs could be simulated and compared in an attempt to identify the best energy saving strategies for this particular site. Annual energy savings via eQUEST, preliminary costing data and constructability/replicability elements were all considered amongst a collaborative team before deciding to accept or reject potential EEMs. Qualitative factors were also weighed, as using a purely quantitative approach could have jeopardized the future sale of the home.

Largely, EEM selections were through a three part decision process. First the EEMs were analyzed in eQUEST to determine potential annual energy savings; those with substantial energy savings potential above the baseline were considered for costing exercises. Next, preliminary cost estimates generated by the homebuilder were used to prioritize those EEMs by a simple payback period. Finally, auxiliary non-energy/cost factors were considered before accepting or rejecting the EEMs with the highest simple paybacks. Some of these non-energy/cost factors include constructability/replicability, indoor air quality, marketability, and aesthetics. As a demonstration home, cost, replicability, and marketability were considered to be very important decision-drivers and in some cases overruled implications of the simple payback analysis. One example of this was the decision to reject a whole house fan and accept a heat recovery ventilator. A whole house fan showed to have good energy savings in eQUEST, yet the local marketability of this technology made it very unattractive. This community in Ontario is adjacent to dairy farms, where residents can at times be disturbed by the smell of manure. Installing a technology that introduces large amounts of this unfiltered air did not seem like a favorable idea. Although whole house fans will be a Code requirement in 2013 in this California climate zone, it was decided that this will be a poor application. Inversely, quantitative analysis of a heat recovery ventilator (HRV) was projected to have a longer simple payback period because of a higher first cost, yet determined to be a good application for this home. An HRV meets the whole house fresh air requirements through a balanced system (air in, equals air out) while providing the home with continuous air filtration, mitigating some of the issues with local air smells. This system also provides an invaluable non-energy service to the future homeowner which is an increased indoor air quality in an area with very high rates of asthma. Some of the EEMs that were simulated, cost-estimated, and considered but did not make the final cut, include: a hydronic space heating system, a whole house fan, window upgrades, loose fill insulation, an evaporatively cooled condensing unit, structurally-insulated panels and a solar thermal system. A summary of the energy savings results for each potential EEM can be found in Appendix C.

Figure 4 summarizes the analytical path taken to get to ZNE via the chosen EEMs. The EEMs are cumulative moving from the left to right. The first bar on the far left shows the baseline home's EUI broken up by end-use. Plug loads, heating, and domestic hot water acting as the largest contributors to energy use in the baseline home. As EEMs are added to the original design, the total energy steadily decreases to the point where the remainder can be offset by on-site energy generation. In Figure 4 the bar furthest to the right represents the ZNE designed home with all the EEMs included, a 43% decrease in estimated annual energy consumption from the already energy-efficient baseline home.

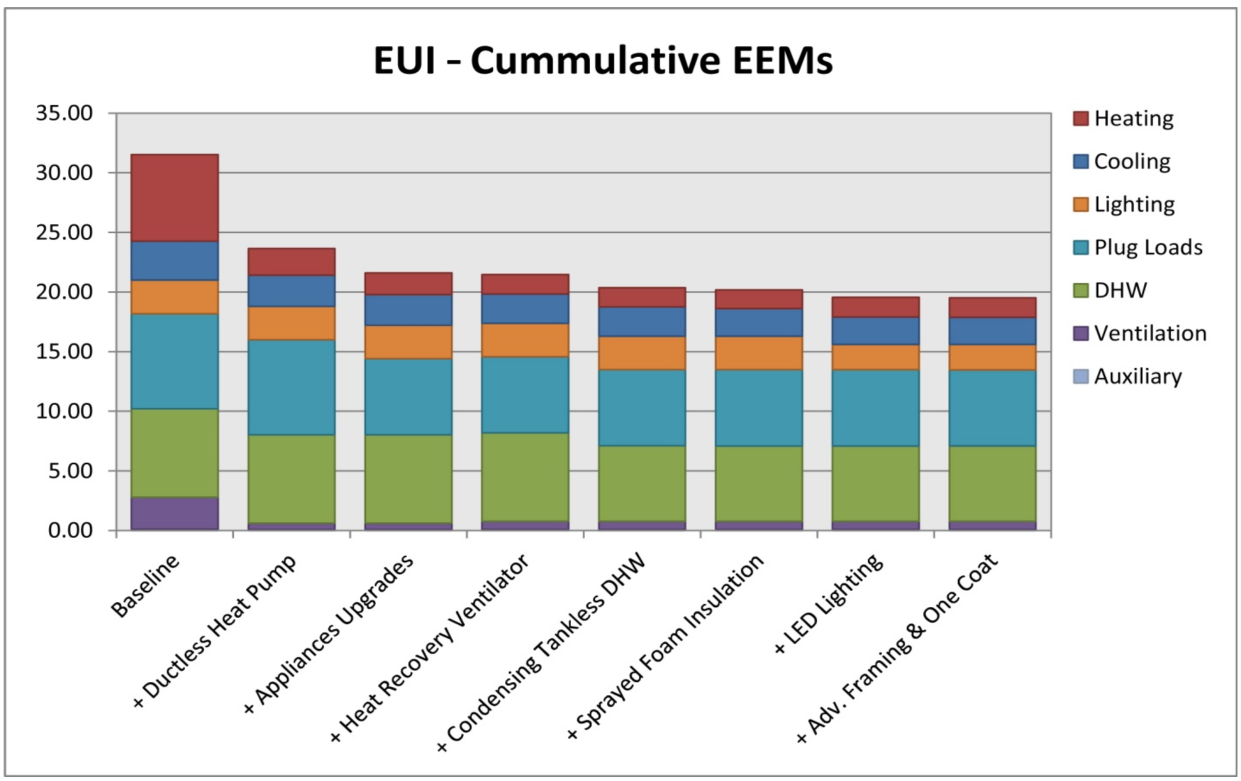

FIGURE 4. PATH TO ZNE – CUMULATIVE EUI OF EEMS

Once the EEMs were selected, the homebuilder's design drawings were updated to reflect the appropriate technologies and practices. Below is a summary of each of the selected EEMs used in the ZNE home.

- **Ductless Mini-Split Air-Conditioner:** The home's heating and cooling are provided by a highly energy efficient heat pump split system. The refrigeration cycle in the system is powered by a DC inverter-driven twin rotary compressor. The system includes an outdoor air-cooled condenser with a rated capacity of 36,000 Btu/h for cooling and 43,000 Btu/h for heating. The condenser serves a total of four indoor ductless wall-mounted units; each containing an evaporator and a quiet fan. Because there are no air-ducts used by this system, energy losses due to duct leakage are omitted. Similarly, energy losses due to system static pressure are considerably reduced. The primary energy savings from this system are achieved through zoned (or dedicated) heating and cooling, as opposed to heating or cooling the entire home when heating or cooling is needed in only part of the home. The indoor units are equipped with advanced controls including multi-speed fan settings, allowing occupants to control each thermal zone independently and achieve higher levels of thermal comfort.
- **Appliances Upgrades:** EnergyStar® appliances such as the refrigerator, dishwasher, clothes washer and clothes dryer (gas) were included in the home. A variety of appliances are typically offered to homebuyers as optional upgrades. The appliances selected were the most energy-efficient amongst those typically offered.
- **Heat Recovery Ventilator (HRV):** The air-to-air heat exchanger used in the home is a critical component to the building's energy-efficient design. With increased levels of insulation and airtightness, the fresh air in homes and indoor air quality become more and more important. This unit is placed in the attic and supplies the home with between 40-157 cubic feet per minute (CFM) of continuous fresh air while simultaneously recycling the heat or coolth from the stale air being exhausted. The HRV's ventilation rate can be user-adjusted using low and high speed operation to satisfy or exceed CA's Residential T-24 whole-building fresh air requirement. The HRV includes electronically commutated motors and a cross flow polypropylene heat recovery core, yielding a sensible heat recovery efficiency of 73% and an apparent sensible efficiency of 78%. In 2011, the city of Ontario was listed by TIME Magazine to be the third most air-polluted city in the U.S.[vi]. Therefore, although the HRV is considered to be an additional cost when compared to a standard home, the HRV is thought to be highly justified when compared to the benefits. The energy-efficient unit provides the airtight home, in an area with very poor air-quality, with continuous, filtered fresh air. The HRV uses between 35-100 watts.
- **Condensing Tankless DHW Heater:** Natural gas tankless water heaters are becoming the standard in newly constructed homes. These water heaters do not require water storage tanks because a higher temperature combustion process occurs within the units. However, these water heaters produce high-temperature gas byproducts that must be vented through non-corrosive materials (often expensive steel). Similar to a typical tankless domestic hot water heater, a natural gas condensing tankless water heater includes a secondary heat exchanger that captures the residual heat from the gas byproduct to pre-heat incoming cold water. This enables the water heater to perform at efficiencies of up to 97% and provide from 0.3 to 8.0 gallons of hot water per minute.

- **Sprayed Form Insulation:** A minimum of 2” of closed-cell polyurethane foam was sprayed into the home’s exterior wall cavities, and a minimum of 3” of the same material was sprayed onto the underside of the roof. This material is rated at R-6.5 per inch and is associated with additional auxiliary benefits. Some of these benefits include an overall increased insulation quality over batts (less prone to installation defects), increased structural rigidity because of the stiffness of the material when it dries, an increase in weatherproofing and resistance to water damage (closed-cell foams are often certified as an air barrier and vapor retarder when applied in thicknesses of more than 1.5”.), and an overall increased airtightness for the entire home. Increased airtightness means less space heating and cooling. Blower door tests were conducted on this home and on a nearly-identical home (baseline home with same community, same floor plan and same construction team) for comparison. This home performed 56% better than the baseline home on the blower door test. Typical residential new construction practice is to place roof insulation on the attic floor, making the attic an unconditioned, ventilated space. For this home, roof insulation was adhered directly to the underside of the roof deck, making the attic an unvented semi-conditioned space. This departure from the norm was spurred by the goal to increase to the home’s overall airtightness, and to demonstrate that unvented attics are a viable strategy for high-performance homes. This claim is supported by many built examples throughout the country as well as numerous publications; most notably the Department of Energy's recent publication of Spray Foam Insulation Under Plywood and Oriented Strand Board Roof Sheathing[vii].
- **LED Lighting:** Recessed LEDs luminaires were used to provide general indoor lighting. These are highly efficient luminaires using 14 watts to generate 620 lumens (44 lumens/watt). These luminaires are also dimmable, have a CRI of 85 and include diffusers to help reduce instances of potential glare. The LED lights help to reduce the overall electrical lighting power density from 0.48 watts/ft² to 0.32 watts/ ft² (33% reduction from baseline).
- **Advanced Framing & One-Coat Stucco System:** This measure includes both advanced framing strategies deployed on site as well as a one-coat stucco system. Advanced framing techniques are a collection of wood framing strategies that reduce the total amount of wood used to construct a building and increase its effective insulation potential while maintaining the homes structural integrity. Some of the specific advanced framing strategies that were used on this home include ladder backing where interior partitions meet exterior walls, two-stud corners with drywall clips instead of three stud corners, and reducing cripples below and above windows. Along with the advanced framing, some additional air sealing was done as the house was being framed. For example, a continuous foam gasket was placed between the sill plate and the concrete floor slab and at the sill/sub-floor connection on the second floor. All of these strategies took little to no additional effort when compared to standard practice, increased the thermal efficiency of the building envelope and saved the homebuilder some lumber and cost. The one-coat stucco system, including 1” of high-density polystyrene (EPS), was applied to the exterior side of the wall framing and sheathing. This system contributes an additional R-4 to the exterior wall assemblies. In comparison to traditional three-coat systems, these exterior cladding systems only require one base coat (reducing labor), reduce cladding weight, and provide a continuous exterior thermal layer. The unfinished one-coat stucco system is shown in Figure 5.

FIGURE 5. ZNE HOME DURING CONSTRUCTION

It is worth mentioning again that the baseline home included several high-performance energy features that warranted no upgrade. As a result, the ZNE home also includes double pane low-e windows with vinyl frames. At the time of construction these windows were National Fenestration Rating Council rated with a Solar Heat Gain Coefficient of 0.23 and a U-Value of 0.34, which is considered high-performing even in today's new construction practices. The home was also designed to allow for ample daylighting through windows, transoms, and clearstories; providing regularly occupied spaces with enough natural light during the day that very little electric light is needed.

It was decided during the EEM selection process that an in-home energy display would be provided for the future occupant, and that the homebuyer would be given the choice of an energy display on the wall, an application installed on their iPod or integrated in their TV. The in-home device is integrated into the occupant's TV and gives the occupant real-time feedback on how much energy is being used and which devices are using the most energy. Though the device will likely contribute to some degree of energy savings for the home, it was decided that this amount cannot be estimated with a high enough degree of certainty. Thus, energy savings associated with the in-home energy display were omitted from the energy analysis.

The aforementioned EEMs all contribute to reducing the homes overall energy consumption, which is in alignment with the first priority of the State's loading order. Secondarily, the home's energy generation system (in this case, solar-electric panels) was sized to meet the remaining projected energy demand of the home. However, it is especially difficult to estimate the remaining energy demand of a home when the occupancy of that home is unknown. For built-to-sell newly constructed homes or resale homes where occupancies are not known, occupancies should be estimated by the home's square footage, number of bedrooms, and other known factors. If information about the home's occupancy is known in a ZNE application, energy generation resources should be sized to meet the home's annual energy demand as closely as possible. Over-generation of energy can imply an oversized system and wasted costs. Under-generation can imply an undersized system that prevents the home from achieving the ZNE goal.

The original baseline home design inherently included a 1.72 kW solar-electric system as standard. It was estimated that an additional 2.84 kW of Photovoltaic (solar panels) capacity (4.56 kW system capacity total) would be needed to meet the ZNE goal. A dual input inverter was used to allow for optimal energy generation from two differently directed sub-arrays. The total solar-electric system is anticipated to produce 6,189 kilowatt-hours annually.

CONSTRUCTION

Construction of the ZNE home was carefully observed, not only to help ensure installation quality of the EEMs, but also to document any periphery findings related to the industry's reaction to ZNE technologies and strategies. A more detailed discussion on the home's framing and construction can be found in Appendix B. Prior to construction of the home, meetings with the site manager and lead contractors (framing, mechanical, electrical, drywall, plumbing, etc.) were held to communicate design intent and to highlight areas where "business-as-usual" would not work. For instance, installation of the sprayed-foam insulation had to be carefully sequenced with the site manager, insulation contractors and stucco contractor in order to avoid enclosing areas where insulation needed to be, for example behind bath tubs. Because a large majority of the contractors hired to construct the ZNE home were highly experienced yet new to the ZNE process, education played a large role in actualizing the home and also in proliferating awareness of ZNE technologies and practices, which was a primary goal of this project. Some of the key takeaways from the construction process include:

- The framing contractor needed ample support in understanding the intent of advanced framing techniques and energy savings concepts.
- In some cases, framing sub-contractors were willing to use increased unnecessary amounts of lumber to build at faster rates; they were accustomed to framing a certain way and didn't want to take the time to learn new methods.
- Minimal air sealing techniques were inherently used to construct the home.
- Some trades were of the perception that homes should be built with some leakiness to avoid the home feeling stuffy.
- There was a general lack of understanding with regards to ventilation concepts with some trades referring to the energy code as the only rationale for providing ventilation in some cases.

Commissioning is the process of verifying, in new construction, proper installation and operation of the building's subsystems. For this home, commissioning was a critical step to ensure proper installation of the intended EEMs. The commissioning process helped to identify and remedy several potential issues. At different stages of the construction process, building diagnostics were administered on the home to extract additional construction tidbits.

Blower door tests were done at strategic points throughout the construction process in order to assess the home's overall airtightness. The first blower door test was performed after the rigid foam insulation was applied to the exterior of the wall framing then spray foam was applied from the inside of the house to the exterior walls and underside of the roof sheathing. This first test was already showing the ZNE house to have significantly less air leakage than the baseline home. At this stage, additional air sealing was done; the application of three cans of foam sealant and seven tubes of caulking reduced the air leakage by approximately 30%. This proved to be one of the most economical energy saving steps performed during the ZNE home's construction. The second blower door test occurred after the exterior stucco was applied and the drywall was hung and taped. This test showed a fair amount less air leakage than the first test, yet still had a substantial effect. A third blower door test was conducted when the ZNE house was completed but still vacant. This test showed a slight increase in air leakage over the previous test due to envelope penetrations introduced by mechanical, plumbing, electrical, and data equipment. A final blower door test was administered post-occupancy, where the home's air leakage shot up by 400 CFM (nearly 37%). Interestingly enough, the drastic increase in air leakage was attributed to a full-height doggy-door installed by the homeowner on an exterior sliding door. In summary: the baseline home was measured at 1522 cubic feet per minute at 50 pascals of pressure (CFM50), the ZNE Home as designed was measured at 672 CFM50, and the final occupied home was measured at 1089 CFM50.

Infrared imagery was used to examine insulation qualities and to locate potential areas of high thermal conductivity and air leakage. Light meters were used to measure interior illuminance levels. In addition to these diagnostics, the home was required to undergo diagnostics and third party verification (HERS ratings) in order to comply with building energy code requirements.

By the end of the construction, the community's site manager seemed to be very happy with the finished product and even hoped to manage similar projects in the future. He has since completed his obligations at this community, and has gone on to be the site manager at another large community in Southern California where he will share some of the techniques and practices he learned while constructing this ZNE home. The constructed home can be seen in Figure 6.

FIGURE 6. CONSTRUCTED ZNE NEW HOME

The city of Ontario's Building Department was also engaged throughout construction and allowed the project team to communicate the intent of any non-traditional practices being used in the ZNE home; any potential concerns were addressed before applying for a building permit. Additionally, through the statewide Codes & Standards program, a one-day educational session was provided to the Department's plan examiners and building inspectors. The theme of the session, 2013 Compliance for High Performance Homes, once again helped to proliferate awareness of ZNE technologies and practices within the building industry. Many of the technologies showcased in the educational session were used in the ZNE home.

EDUCATING BUYERS

Education is an essential part of the ZNE home process, not only through design and construction, but also when communicating ZNE homes to the general market. The original project plan was to first design and build the ZNE home, then secondly ramp up educating and marketing efforts towards market acceptance of ZNE homes. The feedback received previously, from surveys administered at the community's Grand Opening event, indicated that there was a general market for green homes in the area; "30% of the entire sample would pay $16,000 or more for these attributes beyond homes that had none of them" (survey findings are in Appendix A). Given that, some interest in the home was expected, yet assumed it would sit on the market for a few months as a model home, open to the public, until the home sale was finalized. Surprisingly, during construction, several potential homebuyers expressed interest in buying the ZNE home for a premium, even though there were very similar standard homes still available in the community. Figure 7 was given to on-site realtors and was used to communicate the above-standard features planned for inclusion in the ZNE home. Not too long afterwards the home was committed to a first-time homebuyer, mid-construction, for a premium. Presently, nearly all of the standard-built homes in this residential community (of over 250 units) are purchased; sales in the community persisted through the economic recession. Thus, the higher-than-expected demand for ZNE homes in this community is at least partially-attributed to the community's general marketability.

FIGURE 7. ZERO NET ENERGY HOME FEATURES

Once a buyer was identified for the ZNE home, a special ZNE home orientation was scheduled to explain each of the EEMs in detail. The extent of the monitoring process was also explained in detail during the orientation. The ZNE home is visited quarterly to ensure monitoring quality and to generally address any of the homeowners concerns or questions regarding the EEMs.

ENERGY MONITORING

The home will be monitored for at least one year of post-occupancy. Electrical consumption (kWh) and demand (kW) will be monitored at the end-use level including interior lighting, exterior lighting, domestic hot water, heating & cooling, ventilation, plug loads, the rooftop solar-electric system and each major appliance. Monthly gas usage will be pulled from the homeowner's billing data (with their permission) in order to account for domestic hot water, a gas dryer, and a gas stove and oven. Additionally, the home has been outfitted with localized environmental data loggers to record temperature, relative humidity, and CO_2 levels on an hourly basis. There are six environmental data loggers on-site: four in the occupied home (one per each thermal zone), one in the attic, and one outside to record outdoor conditions. Select plug load devices are also being monitored on an hourly basis, including the homes two flat screen TVs and set top box. Once the monitoring data has been collected, a more comprehensive description of the monitoring approach, hardware, data analysis, and discussion of results will be compiled in a separate report.

COST CONSIDERATIONS

When it comes to ZNE homes, two of the most commonly asked questions are: “How much does ZNE cost?” (the investment), and, “How much are people willing to pay for ZNE?” (the return). The answer to these questions can vary depending on the building type, location, size, and many other factors. However, in attempt to provide some initial clarity to these questions, Table 3summarizes the project level incremental cost figures associated with this ZNE demonstration home in Ontario, CA.

The incremental cost of ZNE to this homebuilder, for this home, in this community, at that time, was approximately $30K (or about 9% of the value of the total home). Prior to this project, the project team had received initial feedback from reputable homebuilders that the incremental cost of a ZNE home was between $50-$80K per home. The fact that the incremental cost was determined to be much lower than this is a significant finding. In Table 3 the “standard home” is the baseline home without the ZNE features. These figures include the costs of renewable generation.

TABLE 3. PROJECT INCREMENTAL COST FIGURES

PROJECT FIGURE	INCREMENTAL COST
Standard home cost to homebuyer	$330K
ZNE home cost to homebuyer	$348K
Incremental cost to homebuyer	$18K
Standard home cost to builder	$230K
ZNE home cost to homebuilder	$260K
Incremental cost to homebuilder	$30K
Net value of ZNE to homebuilder	-$12K
SCE participation reimbursement to homebuilder	$12K

Table 4 shows that the homebuilder invested an additional $30K to take a standard home to ZNE, yet the homebuyer only paid an additional $18K. One of the biggest lessons-learned on this project is that the success of ZNE homes heavily relies on the home finance/lending communities. Even though the homebuilder invested an incremental amount of money in the ZNE home (versus their business-as-usual home) they could not recoup the same amount or more through the sale of the home because the home was appraised by the financier/bank at a lower amount. Understandably, replicating this ZNE home would not be a sound business decision for the homebuilder. Had they recouped the total investment cost or more, it would have been a sound investment, driving them to be more inclined to replicate the process on future projects. On ZNE projects it is crucial to engage finance entities to help ensure that investments made in the ZNE home are reflected in market value.

Although it is surprising that a homebuyer purchased this ZNE home mid-construction for a substantial incremental cost ($18K), the market’s upper limit was not identified. Plainly, the second commonly asked question, “How much are people willing to pay for ZNE?” could not be answered. Another buyer, or even the same buyer, may have been willing to pay the full incremental cost or more for the ZNE home, making a business case for ZNE. This was a real possibility given that there was interest from multiple potential buyers on this home. Yet in consequence, knowing that there is some market interest in ZNE, (but not quite to what extent) the partner homebuilder will likely replicate some of the strategies used in the ZNE home, but not the entire concept until a sound business case is evident.

KEY HOMEBUILDER RELATIONSHIPS

Not surprisingly, the homebuilder's subcontractors, product vendors, and energy consultants all influenced the home's energy design in differing magnitudes. Throughout, the project team was reminded of how critical it is to maintain communicative transparency with each other and to key members of the team. Open communication with key team members helped to actualize the agreed upon EEMs and foster a learning environment for evolving best practices through a variety of trades. In some cases, garnering agreement from the homebuilder on specific EEMs meant dealing with concerns raised by their subcontractors. One such example occurred with installing spray foam insulation to the underside of the roof deck. Some of the homebuilder's subcontractors expressed anecdotal concerns about this strategy, posing that water could build up between the roof insulation and roof deck and eventually cause major roof damage to the home. Once the differences between open-cell and closed-cell foams were articulated, and scientific documentation was provided in support of the strategy, the team agreed to proceed with the idea. This could not have happened through direct communication with the homebuilder alone.

ENERGY CODE COMPLIANCE SOFTWARE

In regards to energy Code compliance, the baseline home was 36% better than Title-24 2008 while the ZNE home turned out to be 30% better than Title-24 2008. This discrepancy seems counter-intuitive and worth articulating further. It is postulated that the primary reason for the discrepancy is that the energy analysis in this project was geared towards a goal of ZNE Site, which is based on site energy. Title-24's margin of compliance and utility incentives are based on TDV (similar to ZNE Equivalent), not site energy. Refer to the Background section of this report for more information regarding these two definitions. It is important to note that the results of these two definitions can differ drastically. It should also be noted that Title-24's 2008 margin of compliance is not directly tied to the State's long term ZNE goal; this means that a home that is 100% better than Title-24 is not necessarily a ZNE building. Eventually, the CA Building Code will lead residential new construction to ZNE by 2020, but for the time being, the margins of compliance that correlate to a ZNE building are still being understood. Meanwhile, homebuilders and their energy consultants rely heavily on energy compliance tools because for several reasons; they are fairly easy to use, they have to use them for compliance anyway (unless they want to follow the very unpopular prescriptive approach), and they generate estimated utility incentives which can make or break energy strategies for homebuilders. These compliance tools were primarily developed to assist building designers in complying with a minimum building energy standard in California, not necessarily with ZNE or high-performance homes in mind. These same compliance tools are notoriously limited with regards to modeling many popular ZNE strategies, some of which were used in this home. Energy compliance tools are monumental in bringing the general homebuilder community up to a minimum standard, yet are poor in applications facilitating progressive energy design as well as poor at guiding ZNE home design.

RESIDENTIAL DISTRIBUTED GENERATION

Distributed generation in the form of solar-electricity is becoming more popular and more affordable by the day. One concern unearthed through this project is that distributed generation can become so affordable and efficient in the near future that other low cost energy efficiency measures can be trumped by PV if decisions are defaulted to simple payback. Industry education of loading order and resource prioritization should be increased in order to help mitigate this potential issue. Utility rates and incentives should also consider restructuring to reflect this market evolution.

DISSEMINATE FINDINGS

One of the primary objectives of this project is to identify and overcome market barriers associated with newly constructed ZNE homes. Engaging with a variety of stakeholders within Southern California's housing industry has been a key vehicle to help accomplish this. This project afforded a great deal of interaction with expert homebuilders, but also afforded indispensable interaction with leading residential energy consultants, experienced construction trades, residential finance professionals and the general homebuilding community at large. Through these interactions a great deal of valuable information was attained, ranging from detailed findings that can only be found on the job-site, to high-level developer strategies that can only be attained from working closely with expert homebuilders. Though it is impossible to include every project finding in this report, best efforts have been made in attempt to document and consolidate the most important findings. This report is publicly available through the Emerging Technologies Coordination Council website (etcc-ca.com).

This project and its findings are intended to support a variety of energy efficiency efforts and programs statewide, including but not limited to: ZNE and new construction pilot programs, Codes & Standards efforts such as CASE reports and Statewide training programs, incentive-based programs such as the California Advanced Homes, California Solar Initiative, and Savings By Design.

In addition to this project report, many other periphery dissemination activities took place in an attempt to communicate findings and overcome market barriers. A Builder Open Forum was held at the ZNE home in Ontario on March of 2013. At this event, the public was invited to tour the fully-constructed home and encouraged to ask the project team detailed questions about the design, construction, and marketing/business approach. The forum, which was orchestrated with help from the Building Industry Association Orange County (BIAOC), aimed to incite an open-dialogue amongst leaders in the Southern California homebuilder community about construction methods, financing, true investment costs, and value propositions. In attendance were homebuilders, architects, engineers, energy consultants, building appraisers, construction experts and members of the City of Ontario building department. The event invite and attendee survey results are included in Appendix D. The project team also participated and presented at numerous well-attended dissemination events, including but not limited to the events listed in Table 4.

TABLE 4. INDUSTRY EVENT PARTICIPATION

DATE	EVENT	ROLE
2011-10-08	Community Homebuyer Grand Opening	Administered surveys
2012-09-24	International Building Performance Simulation Association LA	Presented
2012-10-15	2012 Emerging Technologies Summit	Guided Tour
2012-10-25	City of Ontario Building Department Compliance Training	Presented
2012-11-06	ASHRAE SoCal & IBPSA-LA Joint Meeting	Presented
2013-03-28	Builder Open Forum at the ZNE Home in Ontario	Hosted & Presented
2013-09-12	SoCal Chapter Appraisal Institute Fall Conference	Presented
2013-09-26	Association of Energy Engineers SoCal Conference	Presented
2013-10-10	U.S. Solar Decathlon Symposium on Production Homebuilding	Panelist

CONCLUSIONS

Some of the key findings of this project include:

- The incremental cost associated with building a ZNE home in Southern California can be lower than previously presumed; approximately \$30K (\$16/ft^2) or 9% of the total value of the home in the city of Ontario.
- The finance industry, including lenders, realtors, and appraisers, play a huge role in packaging a business case for ZNE homes and consequently the mass-adoption of ZNE homes; these entities need to be engaged urgently if ZNE homes are to become mandated in new construction by 2020.
- There may be a larger market demand for ZNE homes than previously suggested, especially with homeowners whose energy bills are a larger percentage of their overall expenses.
- Homebuilder relationships with key subcontractors, product vendors, and energy consultants can heavily drive the prevalence of building practices used in the market; these trades must be engaged in order to gain market acceptance of ZNE strategies.
- Building energy code compliance software is heavily relied upon by homebuilders and their energy consultants to make energy design decisions; accordingly, these tools should be advanced to better support key ZNE strategies.
- Residential distributed generation systems (solar-electric systems) are becoming so affordable that they are becoming more cost effective than other low-cost energy efficient technologies and strategies.

RECOMMENDATIONS

Though the cost figures presented in this report are a good start, it is recommended that other similar projects be done in order to verify the incremental costs associated with building and selling ZNE new homes in SCE territory. This type of information is of tremendous value and will likely be the basis for ZNE residential new construction pilot programs and eventually incentive-based programs, significantly assisting with the achievement of the state's ZNE goals. Accordingly, detailed findings such as incremental costs, sales figures, and property valuations should be verified by a larger sample size to ensure quality of information. Additionally, other similar projects will help to confirm or dispel the costing and sales success seen with this demonstration.

For ZNE homes it is recommended that financiers/lenders be engaged through the design process. However, from this project's experience, engaging financiers/lenders in this matter is difficult, progressive appraisers are far and few, and the issue of accurately valuating ZNE homes is a major roadblock in California. To meet California's ZNE goals, it is highly recommended that the State help educate the finance industry (especially real estate underwriters) on subjects in energy-efficiency, demand response and distributed generation. This includes supporting public datasets used to provide energy-efficiency related comparable sales (or comps), which are sold properties used to justify valuation.

It is also recommended that residential building energy simulation tools be advanced to better support the industry in pursuing the State's ZNE goals. These tools are the primary design vehicles for making building energy decisions in California and the table at which many building energy conversations occur. More capabilities for popular ZNE strategies should be incorporated and Code compliance results should clearly align with an established ZNE goal before 2020.

APPENDIX A: COMMUNITY GRAND OPENING SURVEY RESULTS

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Please find attached the raw data and summaries / graphs from this past weekend's Grand Opening

Our methodology is to interview one adult per prospect group and our Capture Agents allow each group to determine who that spokesperson will be. Most groups at least have eye contact within the group as they answer questions so there can be SOME extrapolation possible that the answers represent more than the individual actually answering. If different people within the group answer individual questions, we still record this as the answer for the principal respondent. If there is dissention within the group, we will still only take one survey from them and will watch them sort out among themselves.

Our Capture Agent collected 44 individual surveys and we believe that represents about 130 visitors, based on the observed makeup of prospect groups. Most groups were either 2 or 4 adults.

The graphs are self-explanatory, but as always, the real value is in the individual surveys. Each of you may well want to analyze for some specifics, but we have found some trends that should interest you.

1. We looked to see if the education component was worthwhile.

   Other than those who already considered themselves "VERY KNOWLEDGEABLE" (2% of the total sample) or "EXPERT" (9% of the total) regarding Zero Net Energy, 48% of the entire sample increased their self-identified level of knowledge by 1 grade. Another 7% moved themselves up two categories.

   Thus 55% of those without much information about ZNE learned enough to identify themselves as more expert than previously.

   16% of the total sample got no value from the education, as they were NOT VERY KNOWLEDGEABLE before and after their tour.

   5% were SOMEWHAT KNOWLEDGEABLE before and after, but this may not be as strong a condemnation as the previous group. This group may simply feel that they learned enough to realize they need to learn more.

   Another 7% were KNOWLEDGEABLE before and after. We do not have a conclusion about the value they would put to the experience.

   We did notice that one respondent, 2% of the total sample self-described as KNOWLEDGEABLE before the tour and NOT VERY KNOWLEDGEABLE after. We have seen this effect elsewhere and it seems to indicate that the respondent DID learn how little they actually did know beforehand. Our normal analysis of this type of response is actually positive. It typically shows there was important value to the engagement...actually UNlike situations where people show no change at all after an information or training session. Our conclusion is supported by this respondent's other answers. They will DEFINITELY "perform similar Energy Efficiency measures

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on (his / her) home." This respondent will also DEFINITELY "share your positive learning experience with others?" They acknowledged that this was a positive learning experience and will share it with FAMILY. In the raw data, note how little he / she believes the ZNE package costs and how long they believe is an acceptable payback period.

2. We looked at who would **not** tell others about ZNE and why.

   Of those who would not share their "positive learning experience" regarding ZNE all were only SOMEWHAT or NOT VERY knowledgeable about ZNE after their tour. All of them came as NOT VERY KNOWLEDGEABLE. 75% of THIS group saw the ZNE package as $16,000 or more, and looked for a 7+ year payback as the necessary cost savings to make this an attractive enough proposition to buy.

3. We looked at the relationship between "additional cost over OTHER new homes that do NOT have all these attributes" and the time that respondents "would ... need to recover that cost in energy savings."

   30% of the entire sample would pay $16,000 or more for these attributes beyond homes that had none of them. Of THIS group, 93% will look for a payback of over 7 years. The remainder would need a 4-6 year payback.

   Of the 5% who would pay $12-16,000 for ZNE, half would look for a payback of 7 or more years, and the other half would look for 4-6 years.

   This is powerful information and completely different from thousands of other responses we have received in the past year. We have some conclusions later in this report. The sample is large enough to be valid and the results are so strong as to be very persuasive.

   (It does empower the sales team to discuss payback periods with whatever information Edison can provide. In all other situations we have studied, the payback period actually needs to be soft-pedaled or ignored. In those situations, the thrust is more to enviro-consciousness, the right thing and treading lightly upon the land.)

   Statistically, the second largest group of respondents (25% of the entire sample) would pay $8-12,000 for ZNE.

   36% of THAT group looks for a 2-4 year payback, and 27% can justify 2-4 years.

   27% expect the payback period from energy cost savings to be 7 or more years.

   9% seek a 1-2 year payback by energy cost savings.

   Of the entire sample, two-thirds would pay over $8000 (to an undefined ceiling) for ZNE. 63% of this group will expect a payback of over 7 years. Another 19% require a payback in 4-6 years.

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82% are also indicating that they will be in this next home for at least 4 years.

4. Observations

The results were surprising to us. In our teleconference with Will and tern from SCE, we indicated that in approximately 22,000 survey responses in the past year, we have seen statistically 0% of respondents indicate that energy, energy-cost, ZEN or ZNE, sustainable to be a prime motivator for the selection of a new home.

all our research showed that prospects would accept green, energy-saving, etc. but would not seek it out. Nor would they pay for it. Some of our member-clients simply allocate their "green" attributes as a marketing cost, not recoverable, but giving them a competitive advantage over other builders who do not include these items.

We specifically designed this series of questions to solicit respondents' "buy in" and posed questions that asked them what THEY WOULD PAY and how long they would need to have that extra cost returned to them in energy cost savings.

> "Based on the energy efficient features of these homes, what do you think is the additional **cost over OTHER new homes** that do NOT have all these attributes?"
>
> "To make that package attractive **to you**, in choosing a new home, how quickly **would you need** to recover that cost in energy savings?"

We were prepared for more answers that respondents would pay nothing / negligible more. In all of surveys so far, that has been the case. In other surveys to which we are privy, the payback period is typically one year.

We were able to survey 100% of those who actually visited the ZNE display area. Our results were so consistent...and so contrary to all others' that we need to account for them.

We believe that the event drew more than typical numbers of energy- and enviro-conscious guests.

was successful in drawing those who were most likely to appreciate the ZNE advantages.

Perhaps they self-selected and those that were not so inclined simply did not attend...or did not proceed to the ZNE area.

However, for a grand opening to attract the 130 people WE saw is still a strong indication.

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Anecdotally, we saw the sales team demonstrating their models and actually imparting the ZNE benefits to guests so they were able to quantify a cost / value, calculate their individual payback periods...and perhaps also include other non-energy-cost-saving advantages.

We observed as well that guests NEEDED this explanation and were not very inclined to inform themselves via a static display.

5. CONCLUSIONS

At least 57% of the guests derived substantial, measurable value from the presentation.

91% of the entire sample is prepared to spread the word.

66% would pay at least $8000 more for ZNE as demonstrated

82% of those prepared to spend $8000 or more for ZNE require a payback in 4 or more years... and therefore also believe they will be in this home for 4 years.

The value of ZNE must be presented in person, supported by visual displays.

If marketing outreach is focused on those who are driven by environmental or energy-savings issues, unlike the bulk of research (ours included) shows, this buyer group will pay more and spread the cost over many years.

have obviously tapped into a vein that has eluded others. We obviously cannot tell if this is a successful draw limited where there are several competitors nearby, but it is something we have not seen in California from Chula Vista to the Southern end of the Napa Valley, nor in the Austin-San Antonio corridor.

We look forward to watching this matter and will be honored to be part of other research to assist you reaching that buyer who has, so far, eluded other builders.

APPENDIX B: BASELINE CONSTRUCTION, DIAGNOSTICS & HOME INSPECTION

ZNE New Home - Demonstration Showcase

Baseline Construction Analysis & Narrative

A detailed set of framing and construction recommendations were provided to our partner homebuilder for use on the ZNE home, and for future homebuilding applications. These recommendations were based on detailed reviews of the homes structural framing plans as well as with thorough on-site evaluations of their construction practices. The homebuilder chose to implement most of the analysis team's framing and construction recommendations in the ZNE home. Some of the measures and their standard practice are listed here:

- 2x6 framing 24" on center where possible; standard practice is 2x6 framing 16" on center.
- Two stud corners (California corners) with drywall clips; standard practice is three stud corners to provide backing for drywall.
- Ladder backing at partition connections; standard practice is to use backing studs.
- Wall framing factor was reduced from 26% to 18%.
- One coat stucco system (with 1" extruded polystyrene); standard practice is a three coat stucco system.
- A continuous foam gasket placed between the sill plate and the concrete floor slab; there is not a standard practice for this procedure.
- Foam gaskets placed behind wall receptacles; there is not a standard practice for this procedure.
- Sealants applied to double studs, plates, and envelope penetrations; there is not a standard practice for this procedure.
- Home airtightness reduced from 1522 cubic feet per minute (CFM) to 672 CFM at 50 pascals of pressure.

One of the main goals of the framing analysis is to reduce the framing factor by as much as possible. Reduction of the framing factor will have a two-fold effect. The first goal is to save lumber, labor and money; the second goal is to increase the home's overall effective insulation value by replacing wood with insulation.

Another goal is to increase the airtightness of the building envelope. During this study, we first took a looked at what the homebuilder was currently building and took steps to document the construction and benchmark the energy performance of the standard floor plan. In order to confirm the envelope airtightness we performed a blower door test on a very similar home that had the same floor plan and was developed by the same builder within the same community. The purpose of the Blower Door test was to see if there was value in implementing airtight drywall approach or another building envelope tightening method (which would likely include some framing component). A regular home inspection by a certified home inspector was also completed in order to help benchmark the existing construction qualities.

When assessing the very similar home in the framing stage, we looked at it with the eye of applying Advanced Framing Techniques, Optimum Value Engineering (OVE), Airtight Drywall Approach (ADA) and possible innovative insulation methods. The building being constructed had far more lumber in the envelope than what was necessary. It was noted that within the wall framing approximately 40 wall studs could be removed per floor of the two story home, without compromising the structural integrity of the home. This number includes fractions of full-length studs such as cripples and trimmers (jack studs). This number was very significant and represented an energy-efficiency (EE) measure that could provide significant savings toward the goal of reaching ZNE.

The framing inspection brought to light other issues that had previously been overlooked. For example, the home was using a radiant barrier that was factory laminated to the underside of the roof sheathing. This radiant barrier had a residue on the foil from the application of a fire retardant. We brought this to the attention of homebuilder and let them know that the residue was cancelling out much of the benefit they were hoping to gain by installing the radiant barrier. This issue was resolved.

The walls were being constructed utilizing 2x6 studs, 16 inches on center. When we recommended framing 24" on center, the homebuilder revealed that that the home was actually designed with 24" on center framing, yet they came to find that their framing sub-contractor was absorbing the additional cost of lumber in order to frame with familiar practices; which was 16" on center. Unfortunately this attitude is indicative of many tradesmen and presents a major roadblock to successful energy efficient construction projects. It was explained that with some small adjustments, they could use substantially less lumber and actually complete the framing faster and make at least as much money on the job if not more. If at all possible, having a seasoned EE construction consultant on-site during critical portions of the construction process is one of the best insurance policies for a successful project.

While contemplating the new framing design in order to maximize energy efficiency, much thought was given to try and maximize the energy savings that could be squeezed from the design and yet have minimal impact on the on-site and off-site workflow processes of the builder, sub-contractors, and the tradesmen. We did not want to trigger major training sessions or extremely intense, skilled on-site oversight during the construction phase. For this reason some rather aggressive advanced framing methods were not recommended to the homebuilder.

ZNE New Home - Demonstration Showcase

Baseline Blower Door Test Results

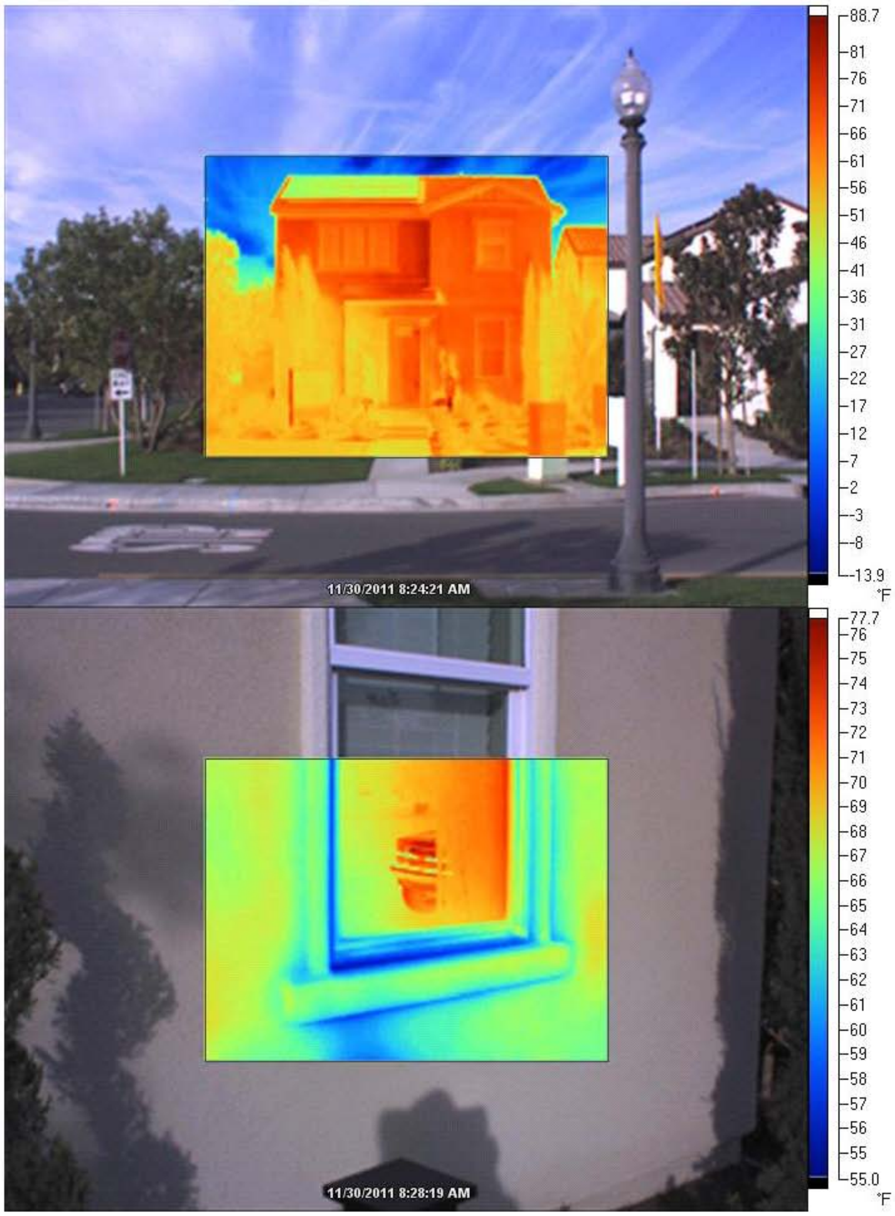
Ron Kliewer, BPI certified Building Analyst, Certification # 5020349 Submitted 12/8/11
Blower door test at -50 Pascals of pressure, tested at: 1522CFM
Blower door test performed on 11/30/11
Estimated Outside air temperature: 58 degrees Fahrenheit
Preliminary visual inspection of the building envelope revealed the following conditions:

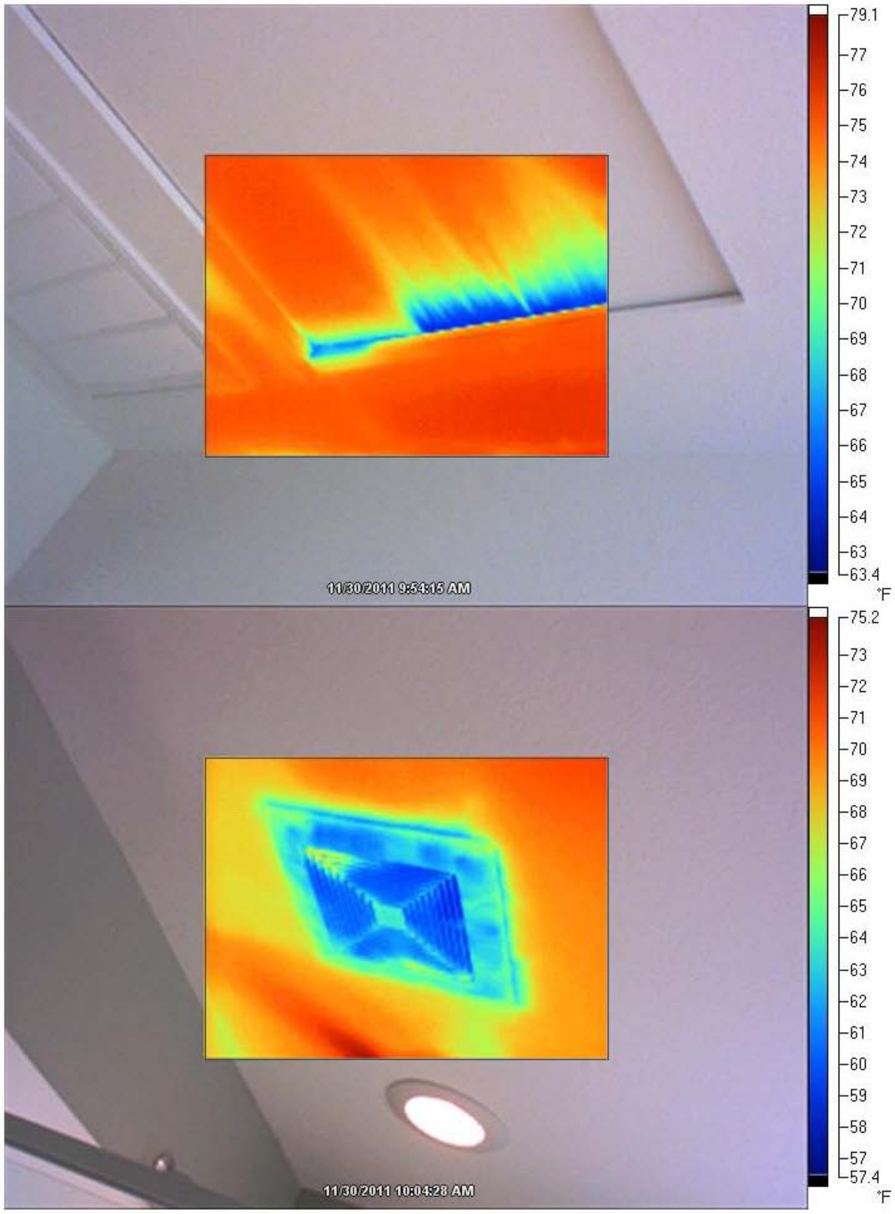
- During the pressure test with the house de-pressurized to -50 Pascals, the following was observed:
- The attic access hatch was extremely leaky, with a strong breeze emitting from the perimeter of the hatch.
- Windows were not leaking much air.
- Most light switches and electrical outlets showed significant air infiltration, though some showed only slight or no infiltration at all.
- The house tested 9.99 Air Changes per Hour @ -50 Pascals. At the current site conditions, this equals .322 Air Changes per Hour (ACH) Natural pressure.
- This is near the Building Air Standard recommended air exchange rate of .35 Air Changes per hour Natural.

Recommendations:
Air sealing, I recommend the blower door be utilized during air sealing activities in order to monitor the air exchange rate to leave the house no tighter than .35 ACH nat., thereby avoiding the necessity of adding mechanical ventilation make-up air. However, the house could be more energy efficient with mechanical ventilation and air sealing to tighter standards, at additional expense.

ZNE New Home

Baseline Infrared Thermography

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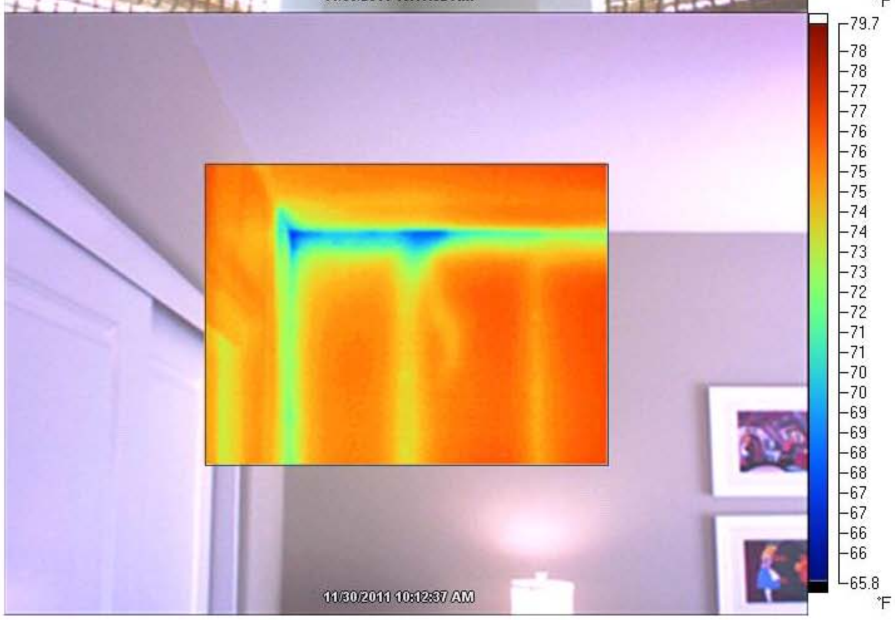
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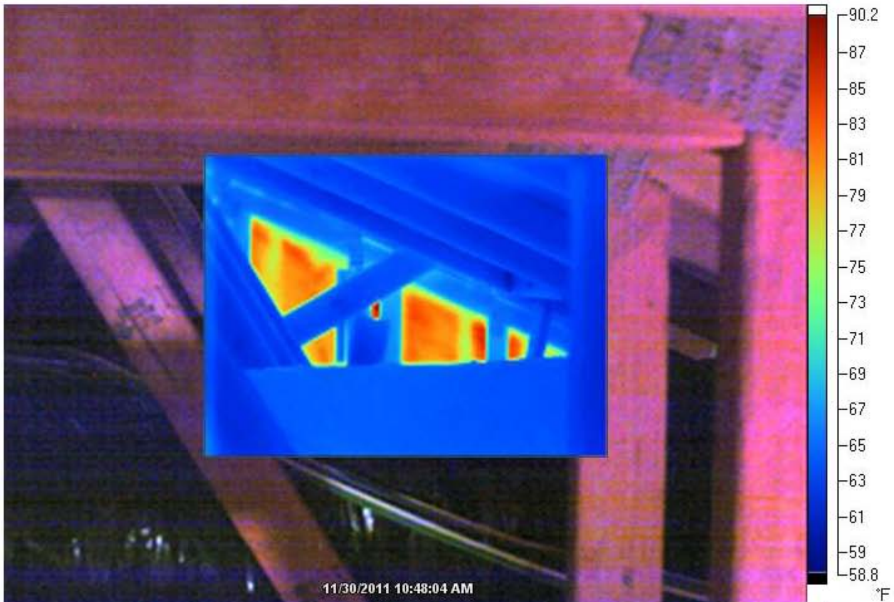
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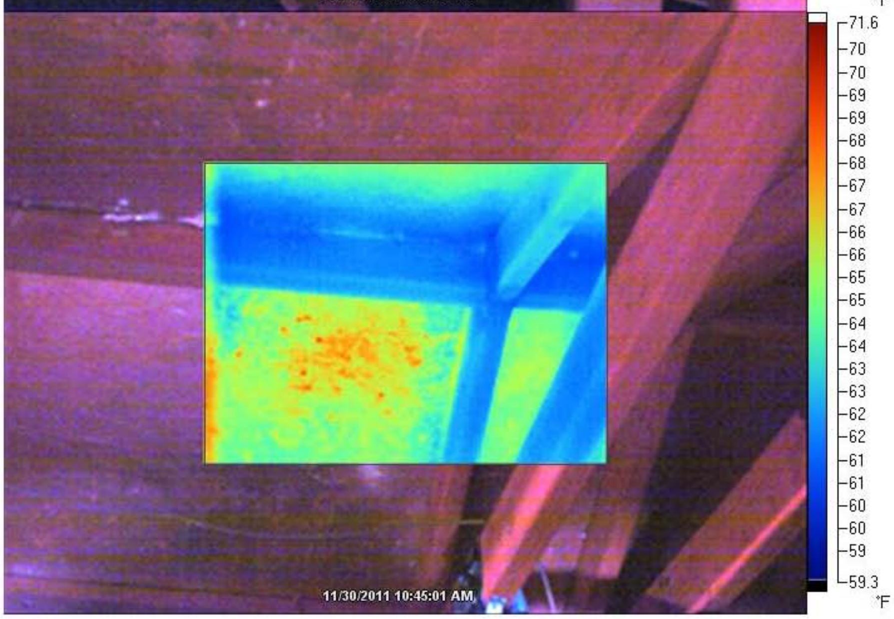
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Inspection Report

Property Address:

Ontario CA 91761

Front of Home

Innovative Inspections

Joey Dodge
1010 Via Zapata
Riverside, CA 92507

Date: 11/29/2011	Time: 09:31 AM	Report ID: 1169
Property: Ontario CA 91761	**Customer:** William Vicent	**Real Estate Professional:**

Comment Key or Definitions

The following definitions of comment descriptions represent this inspection report. All comments by the inspector should be considered before purchasing this home. Any recommendations by the inspector to repair or replace suggests a second opinion or further inspection by a qualified contractor. All costs associated with further inspection fees and repair or replacement of item, component or unit should be considered before you purchase the property.

Inspected (IN) = I visually observed the item, component or unit and if no other comments were made then it appeared to be functioning as intended allowing for normal wear and tear.

Not Inspected (NI)= I did not inspect this item, component or unit and made no representations of whether or not it was functioning as intended and will state a reason for not inspecting.

Not Present (NP) = This item, component or unit is not in this home or building.

Repair or Replace (RR) = The item, component or unit is not functioning as intended, or needs further inspection by a qualified contractor. Items, components or units that can be repaired to satisfactory condition may not need replacement.

In Attendance: Customer	**Type of building:** Single Family (2 story)	**Approximate age of building:** New Construction
Temperature: 65 degrees	**Weather:** Cloudy	**Ground/Soil surface condition:** Damp
Rain in last 3 days: No	**Radon Test:** No	**Water Test:** No

1. Roofing

The home inspector shall observe: Roof covering; Roof drainage systems; Flashings; Skylights, chimneys, and roof penetrations; and Signs of leaks or abnormal condensation on building components. The home inspector shall: Describe the type of roof covering materials; and Report the methods used to observe the roofing. The home inspector is not required to: Walk on the roofing; or Observe attached accessories including but not limited to solar systems, antennae, and lightning arrestors.

Styles & Materials

Roof Covering:	Sky Light(s):	Chimney (exterior):
Tile	None	N/A

Items

1.0 ROOF COVERINGS

Comments: Inspected

1.1 ROOF DRAINAGE SYSTEMS

Comments: Inspected

The roof of the home was inspected and reported on with the above information. While the inspector makes every effort to find all areas of concern, some areas can go unnoticed. Roof coverings and skylights can appear to be leak proof during inspection and weather conditions. Our inspection makes an attempt to find a leak but sometimes cannot. Please be aware that the inspector has your best interest in mind. Any repair items mentioned in this report should be considered before purchase. It is recommended that qualified contractors be used in your further inspection or repair issues as it relates to the comments in this inspection report.

2. Exterior

The home inspector shall observe: Wall cladding, flashings, and trim; Entryway doors and a representative number of windows; Garage door operators; Decks, balconies, stoops, steps, areaways, porches and applicable railings; Eaves, soffits, and fascias; and Vegetation, grading, drainage, driveways, patios, walkways, and retaining walls with respect to their effect on the condition of the building. The home inspector shall: Describe wall cladding materials; Operate all entryway doors and a representative number of windows; Operate garage doors manually or by using permanently installed controls for any garage door operator; Report whether or not any garage door operator will automatically reverse or stop when meeting reasonable resistance during closing; and Probe exterior wood components where deterioration is suspected. The home inspector is not required to observe: Storm windows, storm doors, screening, shutters, awnings, and similar seasonal accessories; Fences; Presence of safety glazing in doors and windows; Garage door operator remote control transmitters; Geological conditions; Soil conditions; Recreational facilities (including spas, saunas, steam baths, swimming pools, tennis courts, playground equipment, and other exercise, entertainment, or athletic facilities); Detached buildings or structures; or Presence or condition of buried fuel storage tanks. The home inspector is not required to: Move personal items, panels, furniture, equipment, plant life, soil, snow, ice or debris that obstructs access or visibility.

Styles & Materials

Siding Style:
Cement stucco

Siding Material:
Wood

Exterior Entry Doors:
Wood
Steel
Insulated glass

Appurtenance:
Porch

Driveway:
Concrete

Items

2.0 WALL CLADDING FLASHING AND TRIM
Comments: Inspected

2.1 DOORS (Exterior)
Comments: Inspected

2.2 WINDOWS
Comments: Inspected

2.3 DECKS, BALCONIES, STOOPS, STEPS, AREAWAYS, PORCHES, PATIO/ COVER AND APPLICABLE RAILINGS
Comments: Inspected

2.4 VEGETATION, GRADING, DRAINAGE, DRIVEWAYS, PATIO FLOOR, WALKWAYS AND RETAINING WALLS (With respect to their effect on the condition of the building)
Comments: Inspected

The property is designed, so all water drains away from the home.

2.5 EAVES, SOFFITS AND FASCIAS
Comments: Inspected

The exterior of the home was inspected and reported on with the above information. While the inspector makes every effort to find all areas of concern, some areas can go unnoticed. Please be aware that the inspector has your best interest in mind. Any repair items mentioned in this report should be considered before purchase. It is recommended that qualified contractors be used in your further inspection or repair issues as it relates to the comments in this inspection report.

3. Garage

Styles & Materials

Garage Door Type:	Garage Door Material:	Auto-opener Manufacturer:
N/A	N/A	N/A

Items

3.0 GARAGE CEILINGS
Comments: Inspected

3.1 GARAGE WALLS (INCLUDING FIREWALL SEPARATION)
Comments: Inspected

3.2 GARAGE FLOOR
Comments: Inspected

3.3 GARAGE DOOR (S)
Comments: Inspected

3.4 OCCUPANT DOOR FROM GARAGE TO INSIDE HOME
Comments: Inspected

3.5 GARAGE DOOR OPERATORS (Report whether or not doors will reverse when met with resistance)
Comments: Not Inspected

Garage was finished on all sides, so I could not inspect door for operation.

4. Interiors

The home inspector shall observe: Walls, ceiling, and floors; Steps, stairways, balconies, and railings; Counters and a representative number of installed cabinets; and A representative number of doors and windows. The home inspector shall: Operate a representative number of windows and interior doors; and Report signs of abnormal or harmful water penetration into the building or signs of abnormal or harmful condensation on building components. The home inspector is not required to observe: Paint, wallpaper, and other finish treatments on the interior walls, ceilings, and floors; Carpeting; or Draperies, blinds, or other window treatments.

Styles & Materials

Ceiling Materials:
Drywall

Wall Material:
Drywall

Floor Covering(s):
Carpet
Hardwood T&G
Tile

Interior Doors:
Hollow core

Window Types:
Thermal/Insulated

Cabinetry:
Wood

Countertop:
Solid Surface Countertop

Items

4.0 CEILINGS
Comments: Inspected

4.1 WALLS
Comments: Inspected

4.2 FLOORS
Comments: Inspected

4.3 COUNTERS AND A REPRESENTATIVE NUMBER OF CABINETS
Comments: Inspected

4.4 DOORS (REPRESENTATIVE NUMBER)
Comments: Inspected

4.5 WINDOWS (REPRESENTATIVE NUMBER)
Comments: Inspected

The interior of the home was inspected and reported on with the above information. While the inspector makes every effort to find all areas of concern, some areas can go unnoticed. The inspection did not involve moving furniture and inspecting behind furniture, area rugs or areas obstructed from view. Please be aware that the inspector has your best interest in mind. Any repair items mentioned in this report should be considered before purchase. It is recommended that qualified contractors be used in your further inspection or repair issues as it relates to the comments in this inspection report.

5. Structural Components

The Home Inspector shall observe structural components including foundations, floors, walls, columns or piers, ceilings and roof. The home inspector shall describe the type of Foundation, floor structure, wall structure, columns or piers, ceiling structure, roof structure. The home inspector shall: Probe structural components where deterioration is suspected; Enter under floor crawl spaces, basements, and attic spaces except when access is obstructed, when entry could damage the property, or when dangerous or adverse situations are suspected; Report the methods used to observe under floor crawl spaces and attics; and Report signs of abnormal or harmful water penetration into the building or signs of abnormal or harmful condensation on building components. The home inspector is not required to: Enter any area or perform any procedure that may damage the property or its components or be dangerous to or adversely effect the health of the home inspector or other persons.

Styles & Materials

Foundation:
Poured concrete

Floor Structure:
Slab

Wall Structure:
Wood

Roof Structure:
Engineered wood trusses

Roof-Type:
Gable

Method used to observe attic:
From entry
Walked

Attic info:
Attic access
Light in attic

Items

5.0 FOUNDATIONS, BASEMENTS AND CRAWLSPACES (Report signs of abnormal or harmful water penetration into the building or signs of abnormal or harmful condensation on building components.)
Comments: Inspected

5.1 CEILINGS (structural)
Comments: Inspected

5.2 ROOF STRUCTURE AND ATTIC
Comments: Inspected

Due to the configuration of the engineered roof trusses, forced air handling components, and structure of the roof, some areas of the attic could not be inspected. However, we could not find any problems with the areas that were inspected.

The structure of the home was inspected and reported on with the above information. While the inspector makes every effort to find all areas of concern, some areas can go unnoticed. Please be aware that the inspector has your best interest in mind. Any repair items mentioned in this report should be considered before purchase. It is recommended that qualified contractors be used in your further inspection or repair issues as it relates to the comments in this inspection report.

6. Plumbing System

The home inspector shall observe: Interior water supply and distribution system, including: piping materials, supports, and insulation; fixtures and faucets; functional flow; leaks; and cross connections; Interior drain, waste, and vent system, including: traps; drain, waste, and vent piping; piping supports and pipe insulation; leaks; and functional drainage; Hot water systems including: water heating equipment; normal operating controls; automatic safety controls; and chimneys, flues, and vents; Fuel storage and distribution systems including: interior fuel storage equipment, supply piping, venting, and supports; leaks; and Sump pumps. The home inspector shall describe: Water supply and distribution piping materials; Drain, waste, and vent piping materials; Water heating equipment; and Location of main water supply shutoff device. The home inspector shall operate all plumbing fixtures, including their faucets and all exterior faucets attached to the house, except where the flow end of the faucet is connected to an appliance. The home inspector is not required to: State the effectiveness of anti-siphon devices; Determine whether water supply and waste disposal systems are public or private; Operate automatic safety controls; Operate any valve except water closet flush valves, fixture faucets, and hose faucets; Observe: Water conditioning systems; Fire and lawn sprinkler systems; On-site water supply quantity and quality; On-site waste disposal systems; Foundation irrigation systems; Spas, except as to functional flow and functional drainage; Swimming pools; Solar water heating equipment; or Observe the system for proper sizing, design, or use of proper materials.

Styles & Materials

Water Source: Public	**Water Filters:** (We do not inspect filtration systems)	**Plumbing Water Distribution (inside home):** Copper PEX
Washer Drain Size: 2" Diameter	**Plumbing Waste:** ABS	**Water Heater Power Source:** Gas (quick recovery)
Water Heater Capacity: Tankless	**Manufacturer:** RINNAI	**Water Heater Location:** Garage

Items

6.0 PLUMBING DRAIN, WASTE AND VENT SYSTEMS

Comments: Inspected, Repair or Replace

The p-trap on waste line is leaking at the master bath sink. I recommend a qualified person to correct as needed.

6.0 Picture 1

6.1 PLUMBING WATER SUPPLY AND DISTRIBUTION SYSTEMS AND FIXTURES

Comments: Inspected

The water pressure of approximately 50 PSI is within the County of San Bernardino's recommend range. FYI

6.1 Picture 1

6.2 HOT WATER SYSTEMS, CONTROLS, CHIMNEYS, FLUES AND VENTS

Comments: Inspected

6.3 MAIN WATER SHUT-OFF DEVICE (Describe location)

Comments: Inspected

The main shut off is located outside in the ground.

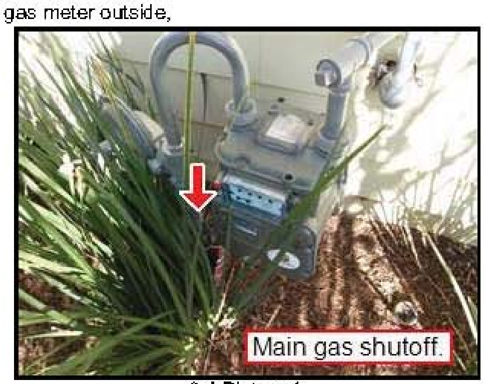
6.3 Picture 1

6.3 Picture 2

6.4 MAIN FUEL SHUT OFF (Describe Location)

Comments: Inspected

The main fuel shut off is at gas meter outside,



6.4 Picture 1

7. Electrical System

The home inspector shall observe: Service entrance conductors; Service equipment, grounding equipment, main over current device, and main and distribution panels; Amperage and voltage ratings of the service; Branch circuit conductors, their over current devices, and the compatibility of their ampacities and voltages; The operation of a representative number of installed ceiling fans, lighting fixtures, switches and receptacles located inside the house, garage, and on the dwelling's exterior walls; The polarity and grounding of all receptacles within six feet of interior plumbing fixtures, and all receptacles in the garage or carport, and on the exterior of inspected structures; The operation of ground fault circuit interrupters; and Smoke detectors. The home inspector shall describe: Service amperage and voltage; Service entry conductor materials; Service type as being overhead or underground; and Location of main and distribution panels. The home inspector shall report any observed aluminum branch circuit wiring. The home inspector shall report on presence or absence of smoke detectors, and operate their test function, if accessible, except when detectors are part of a central system. The home inspector is not required to: Insert any tool, probe, or testing device inside the panels; Test or operate any over current device except ground fault circuit interrupters; Dismantle any electrical device or control other than to remove the covers of the main and auxiliary distribution panels; or Observe: Low voltage systems; Security system devices, heat detectors, or carbon monoxide detectors; Telephone, security, cable TV, intercoms, or other ancillary wiring that is not a part of the primary electrical distribution system; or Built-in vacuum equipment.

Styles & Materials

Electrical Service Conductors:
Below ground

Panel capacity:
125 AMP

Panel Type:
Circuit breakers

Electric Panel Manufacturer:
SIEMENS

Branch wire 15 and 20 AMP:
Copper

Wiring Methods:
Conduit

Items

7.0 SERVICE ENTRANCE CONDUCTORS

Comments: Inspected

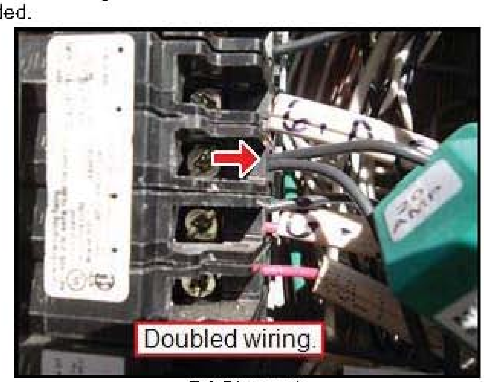
7.1 SERVICE AND GROUNDING EQUIPMENT, MAIN OVERCURRENT DEVICE, MAIN AND DISTRIBUTION PANELS

Comments: Inspected

7.2 BRANCH CIRCUIT CONDUCTORS, OVERCURRENT DEVICES AND COMPATIBILITY OF THEIR AMPERAGE AND VOLTAGE

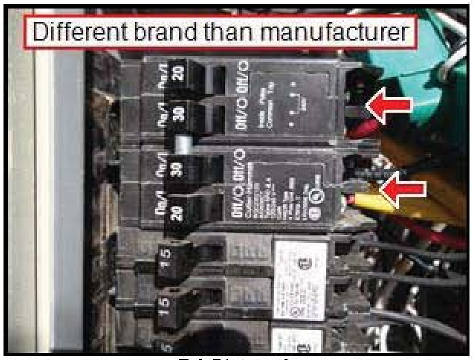
Comments: Inspected

(1) The panel has some doubled wiring at circuits. I recommend a licensed electrical contractor inspect further and correct as needed.



7.2 Picture 1

(2) A few circuit breakers in main panel are of a different brand than the panel manufacturer. The manufacturer requires that in order for the panel to be safe, only their brand is allowed to be used inside the panel. Even though these circuit breakers are all "UL approved," they are not approved to be used in panels of different manufacturers unless so indicated on the panel label.



7.2 Picture 2

7.3 CONNECTED DEVICES AND FIXTURES (Observed from a representative number operation of ceiling fans, lighting fixtures, switches and receptacles located inside the house, garage, and on the dwelling's exterior walls)
Comments: Inspected

7.4 POLARITY AND GROUNDING OF RECEPTACLES WITHIN 6 FEET OF INTERIOR PLUMBING FIXTURES, AND ALL RECEPTACLES IN GARAGE, CARPORT, EXTERIOR WALLS OF INSPECTED STRUCTURE
Comments: Inspected

7.5 OPERATION OF GFCI (GROUND FAULT CIRCUIT INTERRUPTERS)
Comments: Inspected

All GFCI outlets were operable at the time of inspection.

7.6 LOCATION OF MAIN AND DISTRIBUTION PANELS
Comments: Inspected

The main panel box is located at the side of home (Street Side).

8. Heating / Central Air Conditioning

The home inspector shall observe permanently installed heating and cooling systems including: Heating equipment; Cooling Equipment that is central to home; Normal operating controls; Automatic safety controls; Chimneys, flues, and vents, where readily visible; Solid fuel heating devices; Heat distribution systems including fans, pumps, ducts and piping, with supports, insulation, air filters, registers, radiators, fan coil units, convectors; and the presence of an installed heat source in each room. The home inspector shall describe: Energy source; and Heating equipment and distribution type. The home inspector shall operate the systems using normal operating controls. The home inspector shall open readily openable access panels provided by the manufacturer or installer for routine homeowner maintenance. The home inspector is not required to: Operate heating systems when weather conditions or other circumstances may cause equipment damage; Operate automatic safety controls; Ignite or extinguish solid fuel fires; or Observe: The interior of flues; Fireplace insert flue connections; Humidifiers; Electronic air filters; or The uniformity or adequacy of heat supply to the various rooms.

Styles & Materials

Heat Type: Forced Air	**Energy Source:** Gas	**Number of Heat Systems (excluding wood):** One
Heat System Brand: CARRIER	**Ductwork:** Insulated	**Filter Type:** Disposable
Types of Fireplaces: None	**Number of Woodstoves:** None	**Cooling Equipment Type:** Air conditioner unit
Cooling Equipment Energy Source: Electricity	**Central Air Manufacturer:** CARRIER	**Number of AC Only Units:** One

Items

8.0 HEATING EQUIPMENT
Comments: Not Inspected

Due to security cover over thermostatic controls, I could not inspect operation.

8.1 DISTRIBUTION SYSTEMS (including fans, pumps, ducts and piping, with supports, insulation, air filters, registers, radiators, fan coil units and convectors)
Comments: Inspected

All system components are new.

8.2 PRESENCE OF INSTALLED HEAT SOURCE IN EACH ROOM
Comments: Not Inspected

Vents are in

8.3 CHIMNEYS, FLUES AND VENTS (for fireplaces, gas water heaters or heat systems)
Comments: Not Present

8.4 SOLID FUEL HEATING DEVICES (Fireplaces, Woodstove)
Comments: Not Present

8.5 GAS/LP FIRELOGS AND FIREPLACES
Comments: Not Present

8.6 COOLING AND AIR HANDLER EQUIPMENT
Comments: Not Inspected

Due to security cover over thermostatic controls, I could not inspect operation.

The heating and cooling system of this home was inspected and reported on with the above information. While the inspector makes every effort to find all areas of concern, some areas can go unnoticed. The inspection is not meant to be technically exhaustive. The inspection does not involve removal and inspection behind service door or dismantling that would otherwise reveal something only a licensed heat contractor would discover. Please be aware that the inspector has your best interest in mind. Any repair items mentioned in this report should be considered before purchase. It is recommended that qualified contractors be used in your further inspection or repair issues as it relates to the comments in this inspection report.

9. Insulation and Ventilation

The home inspector shall observe: Insulation and vapor retarders in unfinished spaces; Ventilation of attics and foundation areas; Kitchen, bathroom, and laundry venting systems; and the operation of any readily accessible attic ventilation fan, and, when temperature permits, the operation of any readily accessible thermostatic control. The home inspector shall describe: Insulation in unfinished spaces; and Absence of insulation in unfinished space at conditioned surfaces. The home inspector shall: Move insulation where readily visible evidence indicates the need to do so; and Move insulation where chimneys penetrate roofs, where plumbing drain/waste pipes penetrate floors, adjacent to earth filled stoops or porches, and at exterior doors. The home inspector is not required to report on: Concealed insulation and vapor retarders; or Venting equipment that is integral with household appliances.

Styles & Materials

Attic Insulation:
Batt
R-30 or better

Ventilation:
Gable vents
Soffit Vents
Low Profile Roof Vents

Exhaust Fans:
Fan with light
Fan

Dryer Power Source:
Gas Connection

Dryer Vent:
None

Items

9.0 INSULATION IN ATTIC

Comments: Inspected

Insulation is about ten inches thick or just over 36.6 R-Value.

9.1 VENTILATION OF ATTIC AND FOUNDATION AREAS

Comments: Inspected

9.2 VENTING SYSTEMS (Kitchens, baths and laundry)

Comments: Not Inspected

(1) Exhaust fans were disconnected at the time of inspection.

(2) The exhaust fan is just short from reaching the exterior and terminates in the attic space. Vent pipes that terminate in attic space can sometimes cause moisture that can lead to mold or cause condensation. This is for informational purpose to you.

9.2 Picture 1

The insulation and ventilation of the home was inspected and reported on with the above information. While the inspector makes every effort to find all areas of concern, some areas can go unnoticed. Venting of exhaust fans or clothes dryer cannot be fully inspected and bends or obstructions can occur without being accessible or visible (behind wall and ceiling coverings). Only insulation that is visible was inspected. Please be aware that the inspector has your best interest in mind. Any repair items mentioned in this report should be considered before purchase. It is recommended that qualified contractors be used in your further inspection or repair issues as it relates to the comments in this inspection report.

10. Built-In Kitchen Appliances

The home inspector shall observe and operate the basic functions of the following kitchen appliances: Permanently installed dishwasher, through its normal cycle; Range, cook top, and permanently installed oven; Trash compactor; Garbage disposal; Ventilation equipment or range hood; and Permanently installed microwave oven. The home inspector is not required to observe: Clocks, timers, self-cleaning oven function, or thermostats for calibration or automatic operation; Non built-in appliances; or Refrigeration units. The home inspector is not required to operate: Appliances in use; or Any appliance that is shut down or otherwise inoperable.

Styles & Materials

Dishwasher Brand:
WHIRLPOOL

Disposer Brand:
BADGER

Exhaust/Range hood:
VENTED
WHIRLPOOL

Range/Oven:
WHIRLPOOL

Built in Microwave:
WHIRLPOOL

Items

10.0 DISHWASHER
Comments: Inspected

10.1 RANGES/OVENS/COOKTOPS
Comments: Inspected

10.2 RANGE HOOD
Comments: Inspected

10.3 TRASH COMPACTOR
Comments: Inspected

10.4 FOOD WASTE DISPOSER
Comments: Inspected

10.5 MICROWAVE COOKING EQUIPMENT
Comments: Inspected

The built-in appliances of the home were inspected and reported on with the above information. While the inspector makes every effort to find all areas of concern, some areas can go unnoticed. Please be aware that the inspector has your best interest in mind. Any repair items mentioned in this report should be considered before purchase. It is recommended that qualified contractors be used in your further inspection or repair issues as it relates to the comments in this inspection report.

APPENDIX C: BUILDING ENERGY SIMULATION INPUTS & RESULTS

BUILDING ENERGY SIMULATION INPUT SUMMARY

	Baseline	Zero Net Energy
Simulation Software	eQUEST/DOE2.2	eQUEST/DOE2.2
Simulation Weather	CA, Chino AP TMY3	CA, Chino AP TMY3
Floor Construction	concrete slab on grade	concrete slab on grade
Calculated Floor R-Value	1.42	1.42
Wall Construction	wood, 2x6, 16" o.c.	wood, 2x6, 16" o.c.
Wall Insulation	R-19 batts	2" ccSPF polyurethane + 1" EPS
Calculated Wall R-Value	12.82	17.52
Roof Construction	wood, 2x6, 24" o.c.	wood, 2x6, 24" o.c.
Roof Finish	concrete tile	concrete tile
Roof Solar Reflective Index	25	25
Roof Insulation	R-38 batts	3" ccSPF polyurethane
Calculated Roof R-Value	28.57	22.03
Window Construction	vinyl low-e	vinyl low-e
Window VLT	0.52	0.52
Window SHGC	NA	NA
Window SC	0.26	0.26
Window U-Value	0.34	0.34
Door Construction	wood opaque	wood opaque
Door R-value	2	2
Infiltration	1522 CFM50	750 CFM50
Thermal Comfort Range	70˚ - 75˚	70˚ - 75˚
Supply Temps	55˚ - 105˚	55˚ - 105˚
Heating System	gas furnace	electric heat pump
Heating Capacity	56,000 BTU/h	43,000 BTU/h
Heating Efficiency	1.119 HIR	0.238 EIR
Cooling System	air cooled condenser	electric heat pump
Cooling Capacity	42,000 BTU/h	36,000 BTU/h
Cooling Efficiency	0.256 EIR	0.220 EIR
Fan Exhaust	65 CFM continuous	65 CFM continuous
Air Distribution System	ducted	NA
Air Distribution Insulation	R-6 batts	NA
Air Distribution R-value	4.2	NA
Max Air Supply	1500 CFM	NA
Hot Water System	instant gas	condensing instant gas
Hot Water Efficicency	1.22 HIR	1.04 HIR
Appliance Power Density	0.5	0.5
Lighting Power Density	0.5	0.25
Schedules	T-24 ACM + custom	T-24 ACM + custom
Number of Occupants	4	4

BUILDING ENERGY SIMULATION SCHEDULES

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
	Occupancy																								
	Hour	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**
Weekdays	Fraction	90	90	90	90	90	90	90	70	40	30	30	30	30	30	30	30	30	50	90	90	90	90	90	90
Saturday	Fraction	90	90	90	90	90	90	90	70	50	50	50	50	50	50	50	50	50	70	90	90	90	90	90	90
Sunday	Fraction	90	90	90	90	90	90	90	70	50	50	50	50	50	50	50	50	50	70	90	90	90	90	90	90
Holidays	Fraction	90	90	90	90	90	90	90	70	50	50	50	50	50	50	50	50	50	70	90	90	90	90	90	90
	Fans																								
	Hour	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**
Weekdays	On/Off	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Saturday	On/Off	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Sunday	On/Off	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Holidays	On/Off	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Cooling																								
	Hour	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**
Weekdays	Temp F°	78	78	78	78	78	78	75	75	75	75	78	78	78	78	78	78	78	78	75	75	75	75	75	75
Saturday	Temp F°	78	78	78	78	78	78	75	75	75	75	78	78	78	78	78	78	78	78	75	75	75	75	75	75
Sunday	Temp F°	78	78	78	78	78	78	75	75	75	75	78	78	78	78	78	78	78	78	75	75	75	75	75	75
Holidays	Temp F°	78	78	78	78	78	78	75	75	75	75	78	78	78	78	78	78	78	78	75	75	75	75	75	75
	Heating																								
	Hour	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**
Weekdays	Temp F°	65	65	65	65	65	65	68	68	68	68	65	65	65	65	65	65	65	65	68	68	68	68	68	68
Saturday	Temp F°	65	65	65	65	65	65	68	68	68	68	65	65	65	65	65	65	65	65	68	68	68	68	68	68
Sunday	Temp F°	65	65	65	65	65	65	68	68	68	68	65	65	65	65	65	65	65	65	68	68	68	68	68	68
Holidays	Temp F°	65	65	65	65	65	65	68	68	68	68	65	65	65	65	65	65	65	65	68	68	68	68	68	68
	Hot Water																								
	Hour	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**
Weekdays	Fraction	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55
Saturday	Fraction	8	5.4	5	5	5	5	5.7	12	27	47	47	33	32	47	76	72	69	63	55	47	38	30	22	14
Sunday	Fraction	8.1	5.4	5	5	5	5	5	5.4	8.9	20	27	23	30	43	57	65	47	34	35	21	20	20	19	14
Holidays	Fraction	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Lighting																								
	Hour	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**
Weekdays	Fraction	0	0	0	0	0	20	50	50	0	0	0	0	0	0	0	0	0	0	90	90	90	80	60	30
Saturday	Fraction	11	1.3	0	0	0	1.6	12	31	48	43	7.2	0	0	0	0	0	13	77	90	89	85	74	57	34
Sunday	Fraction	11	1.3	0	0	0	1.6	12	31	48	43	7.2	0	0	0	0	0	13	77	90	89	85	74	57	34
Holidays	Fraction	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Process																								
	Hour	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**
Weekdays	Fraction	20	20	20	20	20	20	80	80	40	40	40	40	40	40	40	50	20	90	90	70	50	50	50	30
Saturday	Fraction	20	20	20	20	20	20	80	80	40	40	40	40	40	40	40	50	20	90	90	70	50	50	50	30
Sunday	Fraction	20	20	20	20	20	20	80	80	40	40	40	40	40	40	40	50	20	90	90	70	50	50	50	30
Holidays	Fraction	20	20	20	20	20	20	80	80	40	40	40	40	40	40	40	50	20	90	90	70	50	50	50	30
	Receptacle																								
	Hour	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**
Weekdays	Fraction	20	20	20	20	20	20	80	80	40	40	40	40	40	40	40	50	20	90	90	70	50	50	50	30
Saturday	Fraction	20	20	20	20	20	20	80	80	40	40	40	40	40	40	40	50	20	90	90	70	50	50	50	30
Sunday	Fraction	20	20	20	20	20	20	80	80	40	40	40	40	40	40	40	50	20	90	90	70	50	50	50	30
Holidays	Fraction	20	20	20	20	20	20	80	80	40	40	40	40	40	40	40	50	20	90	90	70	50	50	50	30

Based on CA T-24 2008 Residential ACM Manual and adjusted to match site conditions

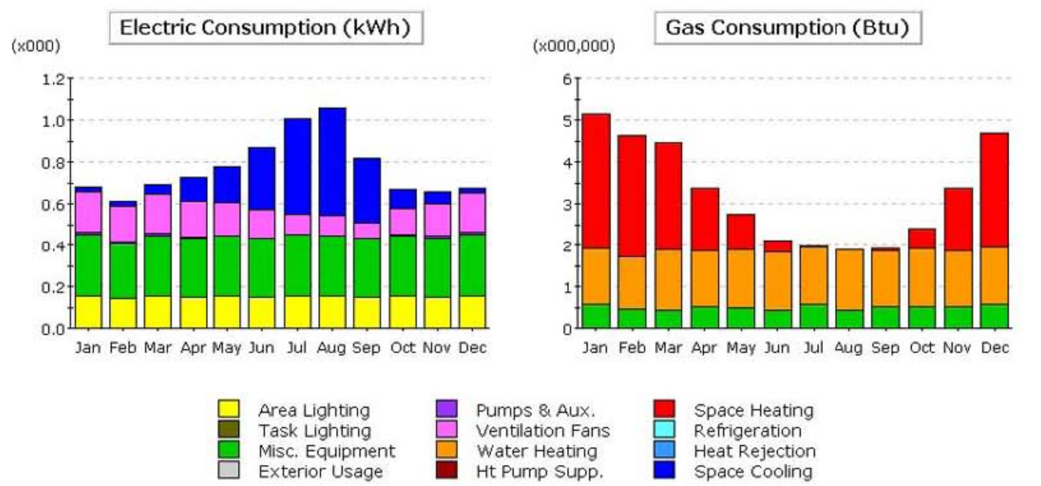
ENERGY EFFICIENCY MEASURES SAVINGS

	Annual Savings (%)	Annual Savings (EUI)	Annual Savings (kWh)	Annual Savings (therms)	Annual Savings ($)	Description
Windows Upgrade	1.1%	0.36	27	7	$11	From R-3 to R-9.1, Serious Windows 925, NFRC values
Envelope Airtightness	0.1%	0.02	14	0	$3	From 1,522 cfm to 750 cfm measured at 50 Pa (.32 to .15 ACH natural) , continuous air barrier and joint sealing
Loose Fill Insulation	0.5%	0.15	39	2	$9	From R-3 / inch to R-3.8 / inch in walls & attic, cellulose, 35.94% wall derating, 25.82% ceiling derating
Sprayed Foam Insulation, Open Cell	0.8%	0.26	80	3	$18	From R-3 / inch to R-4.8 / inch in walls & attic, phenolic, 35.94% wall derating, 25.82% ceiling derating
Sprayed Foam Insulation, Closed Cell	1.4%	0.45	144	5	$32	From R-3 / inch to R-8 / inch in walls & attic, polyurethane, 35.94% wall derating, 25.82% ceiling derating
Foam Board Insulation, Exterior	0.8%	0.25	78	3	$18	Added R-5 in wall assembly, extruded polystyrene, airtightness from 1,522 cfm to 750 cfm (.32 to .15 ACH nat), full thermal break
Advanced Framing Techniques	0.3%	0.08	24	1	$6	Wall framing factor reduced from 25.94% to 16%, increased insulation areas/values
Indirectly Conditioned Attic	0.0%	0.00	-3	0	$0	Attic airtightness from 1.5 ACH to .16 ACH, attic insulation on the underside of roof instead of the attic floor
Radiant Barrier	0.0%	0.00	2	0	$1	Inside film resistance from .68 to 1.35, aluminum foil layer stapled to underside of roof sheathing
Cool Roof	-0.2%	-0.05	-2	-1	$0	Roof material solar absorptance reduced from .7 to .35, spectrally selective roof tiles
LED Upgrades	1.1%	0.33	453	-8	$80	Lighting Power Density (LDP) reduction of .5 to .27
Occupancy Sensors	0.4%	0.12	198	-4	$35	One sensor per main circuit, 10% reduction in overall electrical lighting
Appliances Upgrades	4.3%	1.36	1062	-6	$188	Appliance power density from .5 to .35, refrigerator, dish washer and clothes washer efficiency upgrades
Increased HVAC Efficiencies	2.5%	0.80	466	2	$94	From SEER 13 to 18 and from AFUE 95% to 97.7%, central furnace w/ DX
Ducted Multi Split Heat Pump	20.6%	6.51	-500	162	$3	From SEER 13 to 15 and 3.8 COP, reduced capacity from 42 KBtu/h to 36 KBtu/h, variable speed fan
Ductless Multi Split Heat Pump	26.4%	8.33	691	162	$235	From SEER 13 to 17.5 and 4.2 COP, reduced capacity from 42 KBtu/h to 36 KBtu/h, reduced static pressure, variable speed fan
Radiant Space Heating	7.3%	2.32	251	43	$78	Hot water distribution (hydronic) with baseboard radiators for space heating, high efficiency condensing boiler and circulation pump
Combined Hydronic Heating & DHW	22.7%	7.17	196	153	$139	Hot water distribution (hydronic) with baseboard radiators for space heating & DHW, common 80 gallon tank and circulation pump

Evaporatively Cooled Condensing Unit	2.8%	0.87	566	0	$111	Evaporatively cooled condenser and high efficiency indoor evaporator
High Efficicency Tankless DHW	3.4%	1.08	0	24	$17	From Energy Factor increase of .82 to .96 using higher efficicency natural gas condensing tankless DHW system
Heat Recovery Ventilator	3.5%	1.11	51	23	$25	Heating & cooling energy recovery using flat plate exhanger, existing continuous exhaust reduced
Whole House Fan	3.0%	0.94	615	0	$121	Central ventilation fan (low power rating) reduced cooling and increase natural vent when conditions are appropriate
Natural Ventilation	-0.4%	-0.12	70	-5	$10	Assumes 50% probability that occupants will open windows for cooling when conditions are appropriate
Solar Thermal DHW	11.5%	3.64	-27	82	$106	Assumes solar fraction of .6 of total DHW requirement, estimated demand of 55 gal/water/day and 60 gallon tank

eQUEST (v.3.64, DOE2.2) calculated with adjusted CA T-24 2008 Residential ACM Manual schedules

Project/Run: GreenDoor, Baseline - Baseline DesiRun Date/Time: 12/12/12 @ 15:47



Electric Consumption (kWh x000)

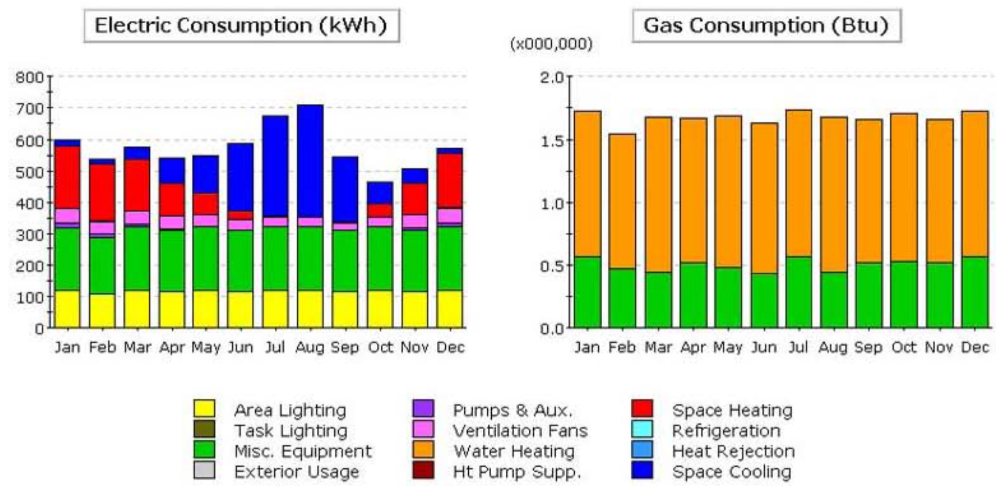
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	0.03	0.02	0.05	0.12	0.17	0.30	0.46	0.51	0.31	0.09	0.06	0.03	2.13
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	-	-	-	-	-	-	-	-	-	-	-	-	-
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	-	-	-	-	-	-	-	-	-	-	-	-	-
Vent. Fans	0.19	0.18	0.19	0.17	0.16	0.14	0.10	0.10	0.07	0.13	0.15	0.19	1.76
Pumps & Aux.	0.02	0.01	0.01	0.01	0.00	0.00	-	-	-	0.00	0.01	0.01	0.07
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	0.29	0.26	0.29	0.28	0.29	0.28	0.29	0.29	0.28	0.29	0.28	0.29	3.45
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	0.16	0.14	0.15	0.15	0.15	0.15	0.16	0.15	0.15	0.16	0.15	0.16	1.83
Total	0.68	0.61	0.69	0.73	0.77	0.87	1.01	1.06	0.82	0.67	0.66	0.67	9.23

Gas Consumption (Btu x000,000)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	-	-	-	-	-	-	-	-	-	-	-
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	3.23	2.91	2.56	1.51	0.84	0.29	0.03	0.00	0.05	0.49	1.52	2.76	16.18
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	1.36	1.26	1.45	1.35	1.42	1.40	1.37	1.45	1.35	1.39	1.34	1.37	16.51
Vent. Fans	-	-	-	-	-	-	-	-	-	-	-	-	-
Pumps & Aux.	-	-	-	-	-	-	-	-	-	-	-	-	-
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	0.56	0.47	0.44	0.51	0.48	0.43	0.56	0.44	0.51	0.52	0.52	0.56	5.99
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	5.15	4.63	4.45	3.37	2.74	2.12	1.96	1.89	1.91	2.40	3.37	4.69	38.68

eQUEST 3.64.7130 Monthly Energy Consumption by Enduse Page 1

Project/Run: GreenDoor, ZNE - 7 Run Date/Time: 12/12/12 @ 14:55



Electric Consumption (kWh)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	18.9	14.6	37.7	82.1	117.7	213.3	318.9	353.5	205.3	68.4	45.6	18.2	1,494.4
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	196.2	181.4	161.6	103.6	67.5	26.9	3.3	-	4.1	41.3	99.7	172.0	1,057.6
HP Supp.	0.9	1.2	-	-	-	0.2	-	-	-	-	0.9	2.2	5.4
Hot Water	-	-	-	-	-	-	-	-	-	-	-	-	-
Vent. Fans	46.3	41.0	43.2	39.7	38.2	34.2	31.2	32.1	23.9	32.4	39.3	46.2	447.6
Pumps & Aux.	12.7	7.9	8.6	5.1	1.1	0.4	-	-	-	1.6	10.0	12.3	59.8
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	205.1	185.2	204.8	198.4	204.9	198.2	205.1	204.8	198.5	205.0	198.5	205.1	2,413.7
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	116.4	106.0	118.2	113.9	117.6	114.4	117.2	118.2	114.0	116.9	113.2	117.2	1,383.2
Total	596.6	537.3	574.1	542.8	546.9	587.6	675.7	708.6	545.9	465.6	507.1	573.3	6,861.5

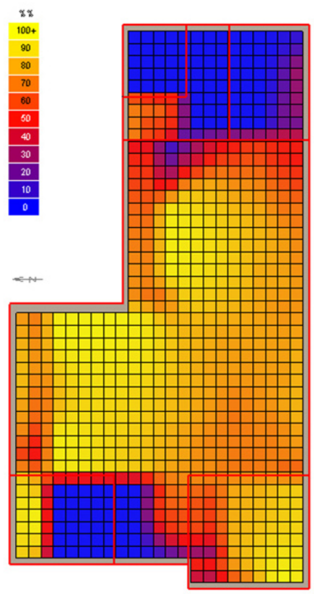
Gas Consumption (Btu x000,000)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	-	-	-	-	-	-	-	-	-	-	-
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	-	-	-	-	-	-	-	-	-	-	-	-	-
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	1.16	1.08	1.24	1.15	1.21	1.19	1.17	1.24	1.15	1.19	1.14	1.17	14.08
Vent. Fans	-	-	-	-	-	-	-	-	-	-	-	-	-
Pumps & Aux.	-	-	-	-	-	-	-	-	-	-	-	-	-
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	0.56	0.47	0.44	0.51	0.48	0.43	0.56	0.44	0.51	0.52	0.52	0.56	5.99
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	1.72	1.54	1.68	1.66	1.69	1.62	1.73	1.68	1.66	1.71	1.65	1.73	20.07

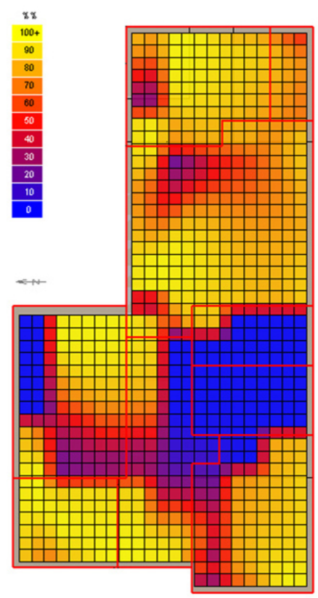
eQUEST 3.64.7130 Monthly Energy Consumption by Enduse Page 1

ZNE NEW HOME

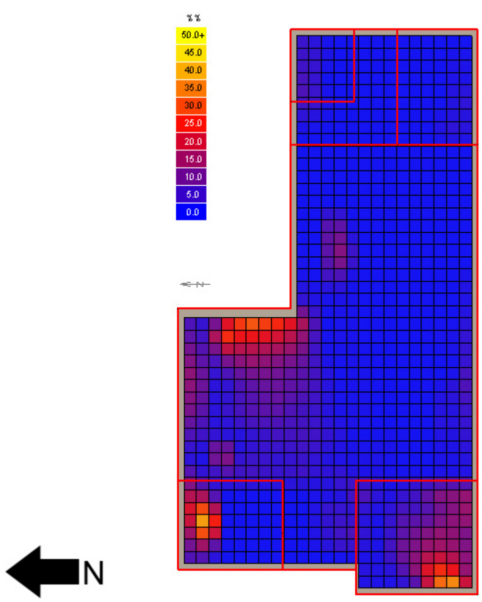
Daylighting Analysis



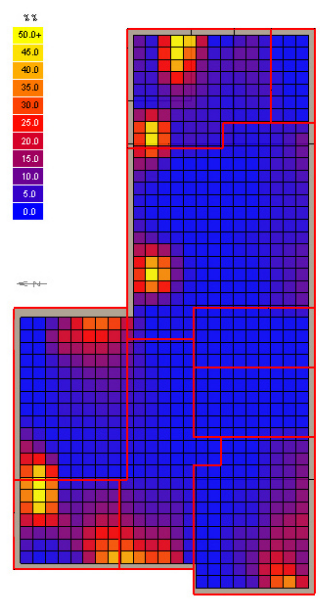
Daylit Hours - First Floor



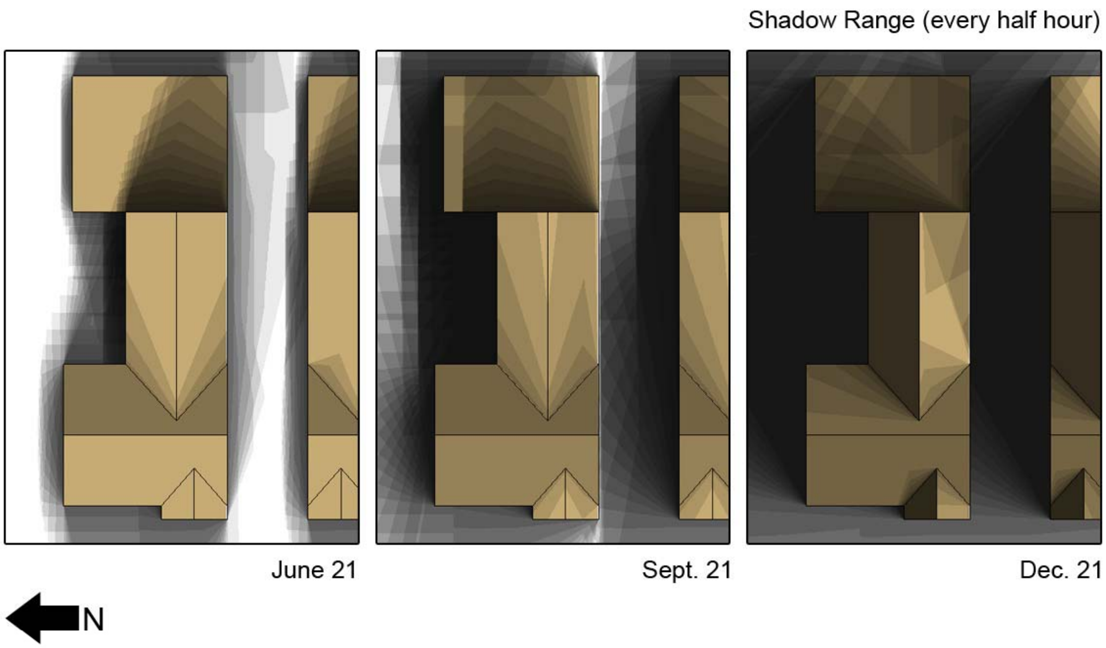
Daylight Hours - Second Floor

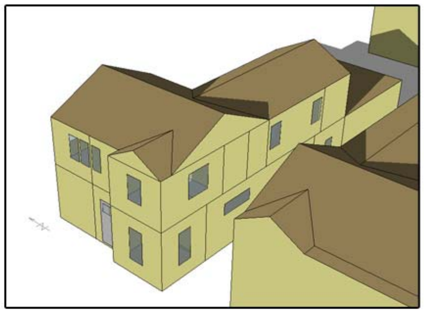


Overly Daylit Hours - First Floor

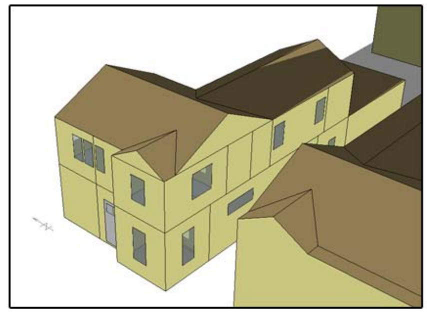


Overly Daylit Hours - Second Floor


Shadow Range (every half hour)
June 21
Sept. 21
Dec. 21
N



9-21 4:30PM



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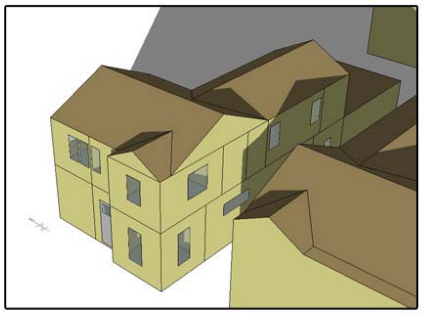
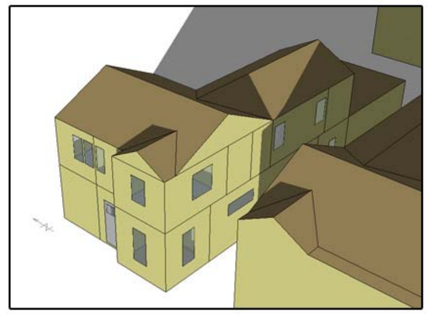


12-21 4:00PM



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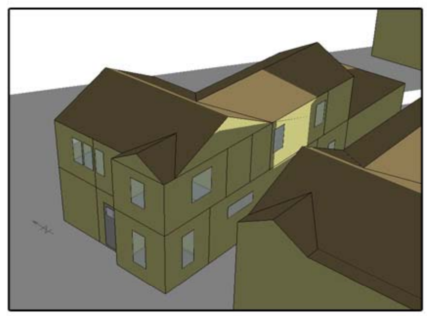

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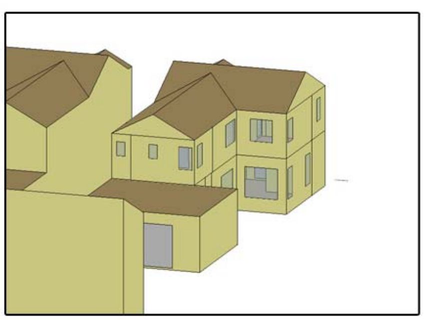

View From Sun 6-21 6:00AM

View From Sun 6-21 5:30PM

APPENDIX D: BUILDER OPEN FORUM INVITATION & ATTENDEE SURVEY RESULTS

Anyvite

ZNE Production Home: A Builder's Open Forum

Date & Time: Thursday, March 28 at 2:00PM

Zero Net Energy (ZNE) homes are no longer a question of feasibility, but rather a question of replicability and marketability. To address these questions, ---------- has partnered with Southern California Edison to design, build, and monitor a new ZNE production home. The project is aimed specifically at minimizing costs and making the ZNE statewide goal a standard reality for replication in the near future.

Please join ---------- and Southern California Edison on a tour of the newly constructed ZNE home in Ontario, CA. We will have a lively exchange regarding ZNE policy drivers, financial analyses, and construction lessons-learned. This event specifically targets the homebuilder community, and will encourage an open dialogue of feedback and shared experiences among participants.

ZNE Production Home - A Builder's Open Forum

Survey Results 3/28/2013
# of Attendees = 35
Sample Size = 15

	Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Agree
1. After attending this event I have increased my knowledge of high-performance home construction practices.	0	0	0	1	14
2. After having visited this home I have increased my knowledge on measures used in high-performance homes.	0	0	0	1	14
3. This event addressed questions or concerns I had regarding high-performance home construction.	0	0	0	2	13
	Unlikely	**Somewhat Unlikely**	**Neutral**	**Somewhat Likely**	**Likely**
4. How likely are you to implement some of the measures presented or demonstrated?	0	0	1	7	7
	Yes	**No**			
5. Are you currently implementing similar energy efficiency measures?	5	10			

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[v] A. Traber, J. Leahy, A. Rider, K. Kokernak, J. Morton (2012), Defining Zero Net Energy: One Utility's Approach. http://www.aceee.org/files/proceedings/2012/data/papers/0193-000362.pdf

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