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Home Energy Saving Analysts

Home Energy Efficiency Report

Property Address: [redacted]

City, State, ZIP: [redacted]

Date of Site Visit to Property: **May 12, 2009**

Site Visit and Report by: **Rick Meyer,** CHEERS® Certified Existing Home Analyst

Summary

I have conducted an energy inspection and analysis of your home at [redacted], CA. Using the building plans and my observations from an on-site visit, I created a simulation model of its energy consumption using EnergyPro 4 software provided by California Home Energy Rating Services, CHEERS. The model was reviewed by Sharon Block of Block Energy Design in Santa Cruz, CA and Douglas Beaman Associates of Modesto. We created a CF-1R report of the same type that is used to verify that new homes in California meet the current 2005 energy code. I assumed that trees and foliage that might shade the passive solar windows, solar water heating panels and photovoltaic panels are kept trimmed to prevent shading. Only electrical loads associated with heating are included in the analysis and not lighting, appliances or electronics. Costs of heating the hot tub and pool were also excluded from the analysis. The CF-1R report, attached, was produced in this case to project energy costs and not to certify compliance. It is unsigned and has not and should not be filed with the state or your local building department.

I am happy to report that the CF-1R report for your home shows 26.3% less energy than a "comparable" brand new California home of the same size and location as your home that just meets the 2005 energy standard and draws all its energy from public utilities. However, your home uses no energy from PG&E. It includes a photovoltaic system and has no air conditioner, so the 26.3% figure needs to be adjusted to fairly reflect the lower energy costs of operating your home.

The analysis software calculates that 28% of the energy used to operate the home is used for air conditioning but the home does not use air conditioning and instead relies on natural ventilation and a moderately reflective roof. There is no adjustment available to eliminate the cooling load from the CF-1R compliance calculations built in to the software – this adjustment must be made externally. Also, the analysis includes the electrical consumption for the fan (air handler) in the backup forced air furnace and the pumps in the backup hydronic heating system – these are the only real electrical loads included in the analysis. During a typical January, when these two loads are predicted to be highest due to required heating, consumption is predicted to be no more than 45 kWh (CF-1R report page 9). The available output of the photovoltaic system (see below) during the same typical January is estimated to be 264 kWh, several times the load of the fan and pumps. Assuming that the battery bank associated with the photovoltaic system is sufficient to store enough electricity to run the fan and pumps during periods when the sun is not shining, we can therefore adjust the predicted energy consumption of your home downwards by its entire electrical load: the air conditioner that is not present, the fan and the pumps. We are left with only the 63.3% of the energy that is propane.

If we adjust the predicted energy usage downward by this additional factor we find that the home is estimated to use only 46.7% of the externally supplied energy of a conventional new home equipped with central heating and air conditioning.

I attribute the exceptional predicted performance of the house to the following features:

- Passive solar heating incorporating a south facing row of windows heating an exposed concrete floor
- Passive cooling by opening sliding glass doors, windows and the central skylights, visible in the photo on the cover page
- Extra thermal mass in concrete slabs, interior walls and the loft that smoothes night to day fluctuations in temperature
- R19 insulation in the walls and R30 insulation in the ceiling
- A solar water heater
- Propane heating equipment with high AFUE efficiencies of about 94%
- An efficient radiant heat distribution system for the first floor
- Forced air ducts that are within the insulated crawl space and the conditioned area of the home
- Double-paned windows and double-paned low e^2 skylights at the peak of the roof

The row of passive solar windows is shown in this photo:

The photovoltaic panels are visible on the roof and far left, and the solar water heating panel is visible in the lower left.

The high level of performance is achieved despite the relatively large areas of glass in skylights, windows and sliding glass doors that provide daylighting of the interior and views of the countryside. The energy savings from the daylighting features of the home cannot modeled in the compliance software we use.

Daylighting results in reduced electrical energy consumption by reducing the need for artificial lighting. If there were a way to adjust for daylighting, the 46.7% figure would be even lower.

Energy Cost Savings Estimation

The CF-1R estimates the propane cost for your home as $494 per year compared with $586 per year for the reference house, for a savings of $92 per year.

Your home is projected to use $214 per year in electricity compared with $365 for the reference house, for a savings of $150 per year. The projected electricity loads include only for heating and cooling and not lighting, other appliances or electronics.

Since your house uses no air conditioning, its electrical usage is projected to be less, so we can deduct 1.022 kBTU/sqft/year, amounting to 3091 kBTU/year after multiplying by 3024 square feet. Converting to kWh at .293 kWh/kBTU, electrical cooling load is 905.5 kWh per year. At $0.12 / KWh rate used in the calculations, the report included $108.66 in cooling costs. Deducting this amount from the reported electricity costs of $214 per year, leaves only $105.34 in electrical costs. Since the photovoltaic system can produce $635.12 in electricity per year, according to the analysis in the next section, there are no net electrical costs associated with baseline loads, and the PV system can produce a surplus of $529.78 in electricity to power appliances and other equipment not included in the baseline calculations of the CF-1R report.

Annual savings compared with the reference home are thus $150 for propane, and $365 + $529.78 = $894.78 for electricity for a total of $1044.78 per year, assuming all available PV power is used.

A rational buyer of your home should be willing to offer extra money for the lower annual energy cost savings from purchasing your home, compared with a typical offering price that is based on comparable sales of homes that are evaluated with no regard to energy costs. Comparables would typically have energy costs no better than a new 2005 standard house and usually worse when the comparables are not new homes. We calculate the present value of 30 years worth of savings at $16,060.83, with a discount rate of 5%. This assumes that that the buyer would pay a cost increment of $16,060.83 for energy savings that was financed as part of a 30 year fixed rate mortgage at 5% interest rate,

Since your home was built in 1983 and may be compared by buyers with older comparables that are even less energy efficient than the new reference home used in these calculations, and the energy savings from daylighting are not accounted for, the value of the energy efficiency of your home is probably understated by a significant but unknowable amount. On the other hand, some portion of these savings would probably be achieved only by replacing or repairing components in the solar water heating, PV system, Voyager boiler and Carrier furnace during the 30 year period. No allowance for these maintenance and replacement costs was made.

Carbon Footprint

We estimate that the energy efficiency features of your home save 3155 kWh of electricity and 71 therms of propane per year compared with the conventional reference home. This amounts to 1653 +

923 = 2576 pounds of carbon dioxide emissions per year. For this “carbon footprint” calculation we use PG&E’s emissions rates of 0.524 lbs CO_2 per kWh of electricity and 13 lbs CO_2 per therm of propane. The Intergovernmental Panel on Climate Change, set up by the U.N., the U.S. Environmental Protection Agency and the California Energy Commission have all determined that man-made carbon dioxide and other greenhouse gasses are almost certainly the cause of global climate change. By owning a home with a low carbon footprint, you are helping to reduce the threats of climate change and reducing the need for new fossil fuel plants to be built.

Photovoltaic System

The house contains a photovoltaic (PV) electric system, with an array on the roof, and a supplementary panel near the deck. The orientation of the panels in azimuth is ideal at due south. Both arrays can be manually tilted in one axis to compensate for the seasonal variations in the angle of the sun in the sky. Trace Engineering Model SW4024 inverters, with an efficiency of 86%, convert the DC power from the panels into AC for the house electrical system. A battery bank stores electricity. A backup generator is available for use in periods of low solar radiation or when electrical loads exhaust the battery bank.

The useful output of the system was modeled in the PVWATTS calculator from the National Renewable Energy Laboratory (NREL), which is sponsored by the U.S. Dept. of Energy. The results are given in the table below.

AC Energy
&
Cost Savings

Station Identification	
Cell ID:	0174348
State:	California
Latitude:	37.5 ° N
Longitude:	122.0 ° W
PV System Specifications	
DC Rating:	3.00 kW
DC to AC Derate Factor:	0.716
AC Rating:	2.15 kW
Array Type:	1-Axis Tracking
Array Tilt:	37.5 °
Array Azimuth:	180.0 °
Energy Specifications	
Cost of Electricity:	12.5 ¢/kWh

Results			
Month	Solar Radiation ($kWh/m^2/day$)	AC Energy (kWh)	Energy Value ($)
1	4.19	264	33.00
2	5.56	321	40.12
3	6.41	409	51.12
4	7.76	474	59.25
5	8.25	526	65.75
6	8.69	523	65.38
7	9.11	565	70.62
8	8.57	531	66.38
9	8.05	480	60.00
10	6.72	416	52.00
11	5.00	304	38.00
12	4.19	268	33.50
Year	6.88	5081	635.12

Because weather patterns vary from year-to-year, the values in the table are better indicators of long-term performance than performance for a particular month or year. PV performance is largely proportional to the amount of solar radiation received, which may vary from the long-term average by ± 30% for monthly values and ± 10% for yearly values.

For these variations and the uncertainties associated with the weather data and the model used to model the PV performance, future months and years may be encountered where the actual PV performance is less than or greater than the values shown in the table. The variations may be as much Because weather patterns vary from year-to-year, the values in the table are better indicators ofBecause

Because weather patterns vary from year-to-year, the values in the table are better indicators of long-term performance than performance for a particular month or year. PV performance is largely proportional to the amount of solar radiation received, which may vary from the long-term average by ± 30% for monthly values and ± 10% for yearly values.

For these variations and the uncertainties associated with the weather data and the model used to model the PV performance, future months and years may be encountered where the actual PV performance is less than or greater than the values shown in the table. The variations may be as much as 40% for individual months and up to 20% for individual years. Compared to long-term performance over many years, the values in the table are accurate to within 10% to 12%.

For purposes of these calculations, we assume that trees and other foliage are kept trimmed so they do not shade the PV panels. We also assume that the panels are cleaned and tilted regularly throughout the year to compensate for the seasonal variation of the sun's angle in the sky.

The $635.12 annual dollar value of the electricity generated assumes a $0.125 cost per kilowatt hour that is typical of the state average cost and assumes that all the electricity generated is used. Generated electricity is stored in a bank of batteries. If the batteries are charged to reach their full capacity, further electricity is not stored and no further savings are generated until a load discharges them.

The remaining useful life of the PV system is unknown. However, assuming a 30 year remaining life, the present value of the stream of savings generated by the photovoltaic system, assuming a 5% interest rate $9,763.35, less unknown maintenance and repair costs. This is the amount that a rational buyer would be willing to pay for the savings, assuming they could be financed as part of a mortgage at an interest rate of 5%. Assuming a 15 year remaining life, the present value of the savings would be $6,592.33, less unknown maintenance and repair costs.

Solar Water Heating System

The house is equipped with a solar water heating system, Model 302L by Solahart Industries, with a 240 vac electric booster. It supplies domestic hot water, and contributes heat to the hydronic radiant system on the first floor. It has a tank capacity of 300 liters, and two solar collectors, each with a gross surface area of 21.4 square feet. Using February 2009 independent ratings from Solar Rating and Certification Corporation, 1679 Clearlake Road, Cocoa, Florida 32922-5703, for Climate Zone 3, I determined that the system has a solar energy factor of 1.7 and is estimated to save 2100 kWh per year. At $0.125 per kWh, the annual savings generated by the system in heating costs would be $262.50. Using the Solar Fraction Calculator for SRCC Rated Systems, (OG-300 from the California Energy Commission) assuming that the electric booster provides heating that supplements the solar contribution, I determined the solar fraction is 53%, which was entered into the EnergyPro model. The model therefore accounts for the energy contribution of the system. The solar fraction calculation is attached as an appendix.

The estimated annual performance is based on the following conditions:

- Hot water load 64.3 gallons (243 liters) per day drawn throughout the day with the maximum loads occurring at 8 am and 8 pm.
- Water mains temperature Varied monthly using Zone 3 values.
- Collector orientation Facing south at a tilt of 22.6 degrees.
- Distance from collector to tank 25 feet (7.6 meters) pipe length (each way),
- 16 feet (4.9 meters) vertical rise.
- Backup heater set point 125 degrees F (51.7 degrees C)
- Weather conditions for California climate Zone 3 data from the California Energy Commission
- Air temperature around indoor tanks Tair + [(72-Tair)/3]

For reference, a conventional 50 gallon electric water heater with an energy factor of 0.9 would consume 4,400 kilowatt hours (kWh) per year under these conditions and a 50 gallon gas water heater with an energy factor of 0.6 would consume 215 therms (including delivered energy and losses).

The remaining lifetime of the solar water heating system is unknown. However, assuming a remaining life of 30 years, and a discount rate of 5%, the present value of the $262.50 savings per year would be $4,035.27, less costs of maintenance and repairs. Assuming a 15 year remaining life, the savings are worth $2,724.66 less costs of maintenance and repair.

Methodology

This report is based on, detailed measurements and an inspection of the property identified on the cover page by our analyst during a site visit. The methods we use to conduct the energy survey are recommended by California Home Energy Efficiency Rating Services (CHEERS®), a public benefit, non-profit organization established in cooperation with the state and utility companies. CHEERS also periodically monitors our work for quality control. Some of our methods are recommended by the California Building Performance Contractor's Association. There are certain standard elements to all our inspections, but we also adapt our methods and analysis to the unique situation found at each house. Our work was performed under a signed contract that contains important warranties and limitations on liability that you may wish to refer to in connection with your review of this report.

Some of the data we collected was entered into EnergyPro/Rate Tool software, which has been approved by the State of California for this use and is made available to us through CHEERS. We used EnergyPro to create an energy simulation model of your house taking into account the dimensions and insulation value and other properties of all walls, ceilings, floors, doors and windows. We also research and model the efficiency of your heating and air conditioning systems, leakage rates and many other factors. The model predicts energy use of your house using typical hourly temperatures in your climate area.

This report also describes additional tests and recommendations that do not appear on the CHEERS Rating Report.

Your CF1-R Report

Note that the report gives your home a Compliance Margin of 26.3% on page 1. In the state of California, new buildings must now meet energy efficiency standards defined by the California Energy Commission and contained in Title 24 of the California Code. New houses must be analyzed and rated by HERS analysts like ourselves and our reports submitted to building departments for approval, along with the plans. Existing homes are not required to be rated in California.

We use the same software to help you, an existing homeowner, as we use to verify compliance with the regulations. The report tells you how your house compares with a house like yours but built to the current 2005 standards. The analysis that we have performed for you is not required by law and you are not required to make any recommended improvements, but doing so will save money and reduce your carbon footprint in the long run. Many improvements also bring heath, safety and comfort benefits. A high compliance margin may improve its resale value as buyers become more aware of energy rating systems such as HERS (the one used for this report) GreenPoint, Energy Star, and Leadership in Energy and Environmental Design (LEED) and assign a value to energy and carbon savings.

The score for your house is calculated by comparing the energy use projected by our model of your house to a hypothetical house the same size and location and features as yours, but built to the 2005 standard assuming both house are connected to public utilities.

Houses whose compliance margin is significantly negative usually have cost effective measures that can be taken to improve their scores and reduce gas and electric bills. (A new more stringent set of standards and a new way of calculating the HERS score are expected to go into effect in August 2009.)

Certificate Of Compliance : Residential (Part 1 of 4) CF-1R

[redacted]

[redacted]

[redacted] [redacted]

5/21/2009
Date

Building Permit #

Plan Check/Date

Field Check/Date

EnergyPro — **Compliance Method**

CA Climate Zone 04 — **Climate Zone**

TDV (kBtu/sf-yr)	Standard Design	Proposed Design	Compliance Margin
Space Heating	17.23	13.02	4.21
Space Cooling	17.66	10.22	7.44
Fans	3.47	2.10	1.37
Domestic Hot Water	10.07	10.07	0.00
Pumps	1.06	1.06	0.00
Totals	49.49	36.47	13.02
Percent better than Standard:			26.3%

BUILDING COMPLIES - HERS VERIFICATION REQUIRED

Building Type: [X] Single Family [ ] Addition [ ] Multi Family [ ] Existing + Add/Alt

Building Front Orientation: **(S) 180 deg**

Fuel Type: **Propane**

Fenestration:

Area: **841** ft^2 **Avg. U:** **0.59**

Ratio: **27.8%** **Avg. SHGC:** **0.57**

Total Conditioned Floor Area: **3,024** ft^2

Existing Floor Area: **n/a** ft^2

Raised Floor Area: **0** ft^2

Slab on Grade Area: **930** ft^2

Average Ceiling Height: **12.5** ft

Number of Dwelling Units: **1.00**

Number of Stories: **2**

BUILDING ZONE INFORMATION

Zone Name	Floor Area	Volume	# of Units	Zone Type	Thermostat Type	Vent Hgt.	Vent Area
Voyager SA130-45=DHW	1,512	12,096	0.50	Conditioned	Setback	8	n/a
Carrier Furnace	1,512	25,704	0.50	Conditioned	Setback	8	n/a

OPAQUE SURFACES

Type	Frame	Area	U-Fac.	Insulation Cav.	Insulation Cont.	Act. Azm.	Tilt	Gains Y / N	Condition Status	JA IV Reference	Location / Comments
Wall	None	192	0.048	None	R-24.0	60	90	X	Existing	13-D5	1st Floor
Wall	Wood	30	0.074	R-19	R-0.0	120	90	X	Existing	09-A5	1st Floor
Wall	Wood	40	0.074	R-19	R-0.0	0	90	X	Existing	09-A5	1st Floor
Wall	Wood	272	0.074	R-19	R-0.0	180	90	X	Existing	09-A5	1st Floor
Wall	Wood	352	0.074	R-19	R-0.0	300	90	X	Existing	09-A5	1st Floor
Wall	Wood	30	0.074	R-19	R-0.0	240	90	X	Existing	09-A5	1st Floor
Wall	Wood	323	0.074	R-19	R-0.0	60	90	X	Existing	09-A5	2nd Floor
Wall	Wood	26	0.074	R-19	R-0.0	180	110	X	Existing	09-A5	2nd Floor
Roof	Wood	631	0.036	R-30	R-0.0	180	26	X	Existing	02-A9	2nd Floor
Roof	Wood	631	0.036	R-30	R-0.0	60	26	X	Existing	02-A9	2nd Floor
Roof	Wood	615	0.036	R-30	R-0.0	300	26	X	Existing	02-A9	2nd Floor
Wall	Wood	19	0.074	R-19	R-0.0	120	90	X	Existing	09-A5	2nd Floor
Door	None	10	0.500	None	R-0.0	120	90	X	Existing	28-A4	2nd Floor
Wall	Wood	40	0.074	R-19	R-0.0	0	90	X	Existing	09-A5	2nd Floor
Wall	Wood	80	0.074	R-19	R-0.0	180	90	X	Existing	09-A5	2nd Floor
Wall	Wood	250	0.074	R-19	R-0.0	300	90	X	Existing	09-A5	2nd Floor
Wall	Wood	32	0.074	R-19	R-0.0	240	90	X	Existing	09-A5	2nd Floor

[redacted] — Project Title

Date: 5/21/2009

FENESTRATION SURFACES

#	Type			Area	U-Factor[1]		SHGC[2]		True Azm.	Tilt	Cond. Stat.	Glazing Type	Location/ Comments
1	Window	Right	(SE)	10.0	0.580	116-A	0.65	116-B	120	90	Existing	Double Non Metal Clear	1st Floor
2	Window	Front	(S)	10.0	0.580	116-A	0.65	116-B	180	90	Existing	Double Non Metal Clear	1st Floor
3	Window	Front	(S)	10.0	0.580	116-A	0.65	116-B	180	90	Existing	Double Non Metal Clear	1st Floor
4	Window	Front	(S)	42.0	0.790	116-A	0.70	116-B	180	90	Existing	Double Metal Clear	1st Floor
5	Window	Front	(S)	42.0	0.790	116-A	0.70	116-B	180	90	Existing	Double Metal Clear	1st Floor
6	Window	Left	(NW)	12.0	0.580	116-A	0.65	116-B	300	90	Existing	Double Non Metal Clear	1st Floor
7	Window	Left	(NW)	12.0	0.580	116-A	0.65	116-B	300	90	Existing	Double Non Metal Clear	1st Floor
8	Window	Left	(SW)	10.0	0.580	116-A	0.65	116-B	240	90	Existing	Double Non Metal Clear	1st Floor
9	Window	Right	(NE)	19.5	0.600	116-A	0.56	COG	60	90	Existing	Glass Blocks	2nd Floor
10	Window	Right	(NE)	6.8	0.580	116-A	0.65	116-B	60	90	Existing	Double Non Metal Clear	2nd Floor
11	Window	Right	(NE)	6.8	0.580	116-A	0.65	116-B	60	90	Existing	Double Non Metal Clear	2nd Floor
12	Window	Right	(NE)	6.8	0.580	116-A	0.65	116-B	60	90	Existing	Double Non Metal Clear	2nd Floor
13	Window	Right	(NE)	13.0	0.990	116-A	0.74	116-B	60	90	Existing	Single Non Metal Clear	2nd Floor
14	Window	Front	(S)	28.7	0.580	116-A	0.65	116-B	180	110	Existing	Double Non Metal Clear	2nd Floor
15	Window	Front	(S)	28.7	0.580	116-A	0.65	116-B	180	110	Existing	Double Non Metal Clear	2nd Floor
16	Window	Front	(S)	28.7	0.580	116-A	0.65	116-B	180	110	Existing	Double Non Metal Clear	2nd Floor
17	Window	Front	(S)	28.7	0.580	116-A	0.65	116-B	180	110	Existing	Double Non Metal Clear	2nd Floor
18	Window	Front	(S)	28.7	0.580	116-A	0.65	116-B	180	110	Existing	Double Non Metal Clear	2nd Floor
19	Window	Front	(S)	28.7	0.580	116-A	0.65	116-B	180	110	Existing	Double Non Metal Clear	2nd Floor

1. Indicate source either from NFRC or Table 116A. 2. Indicate source either from NFRC or Table 116B.

INTERIOR AND EXTERIOR SHADING

#	Exterior Shade Type	SHGC	Window Hgt.	Window Wd.	Overhang Len.	Overhang Hgt.	Overhang LExt.	Overhang RExt.	Left Fin Dist.	Left Fin Len.	Left Fin Hgt.	Right Fin Dist.	Right Fin Len.	Right Fin Hgt.
1	Bug Screen	0.76												
2	Bug Screen	0.76												
3	Bug Screen	0.76												
4	Bug Screen	0.76												
5	Bug Screen	0.76												
6	Bug Screen	0.76												
7	Bug Screen	0.76												
8	Bug Screen	0.76												
9	Bug Screen	0.76												
10	Bug Screen	0.76	4.5	1.5	4.0	1.5	11.0	11.0						
11	Bug Screen	0.76	4.5	1.5	4.0	1.5	11.0	11.0						
12	Bug Screen	0.76	4.5	1.5	4.0	1.5	11.0	11.0						
13	Bug Screen	0.76												
14	Bug Screen	0.76	7.5	3.8	6.0	0.2	0.0	0.0						
15	Bug Screen	0.76	7.5	3.8	6.0	0.2	0.0	0.0						
16	Bug Screen	0.76	7.5	3.8	6.0	0.2	0.0	0.0						
17	Bug Screen	0.76	7.5	3.8	6.0	0.2	0.0	0.0						
18	Bug Screen	0.76	7.5	3.8	6.0	0.2	0.0	0.0						
19	Bug Screen	0.76	7.5	3.8	6.0	0.2	0.0	0.0						

THERMAL MASS FOR HIGH MASS DESIGN

Type	Area (sf)	Thick. (in.)	Heat Cap.	Cond.	Inside R-Val.	JA IV Reference	Condition Status	Location/ Comments
Frame Wall, Gyp. Board	1,120	0.12	13	0.09	0	n/a	Existing	1st Floor / Interior Mass
Frame Wall, Gyp. Board	30	0.12	13	0.09	0	09-A5	Existing	1st Floor / Exterior Mass
Frame Wall, Gyp. Board	40	0.12	13	0.09	0	09-A5	Existing	1st Floor / Exterior Mass
Frame Wall, Gyp. Board	272	0.12	13	0.09	0	09-A5	Existing	1st Floor / Exterior Mass
Frame Wall, Gyp. Board	30	0.12	13	0.09	0	09-A5	Existing	1st Floor / Exterior Mass

PERIMETER LOSSES

Type	Length	R-Val.	Insulation Location	JA IV Reference	Condition Status	Location/ Comments
Slab Perimeter	119	R-10	Fully insulated slab	27-D20	Existing	1st Floor

[redacted]
Project Title

5/21/2009
Date

FENESTRATION SURFACES

#	Type			Area	U-Factor[1]		SHGC[2]		True Azm.	Tilt	Cond. Stat.	Glazing Type	Location/ Comments
20	Window	Front	(S)	28.7	0.580	116-A	0.65	116-B	180	110	Existing	Double Non Metal Clear	2nd Floor
21	Window	Front	(S)	28.7	0.580	116-A	0.65	116-B	180	110	Existing	Double Non Metal Clear	2nd Floor
22	Skylight	Front	(S)	69.0	0.370	NFRC	0.29	NFRC	180	26	Existing	Velux Comfort (75) Lowe2/Arg	2nd Floor
23	Skylight	Right	(NE)	69.0	0.370	NFRC	0.29	NFRC	60	26	Existing	Velux Comfort (75) Lowe2/Arg	2nd Floor
24	Skylight	Left	(NW)	10.5	0.660	116-A	0.63	116-B	300	26	Existing	Double Thermal Break Clear	2nd Floor
25	Skylight	Left	(NW)	6.0	0.660	116-A	0.63	116-B	300	26	Existing	Double Thermal Break Clear	2nd Floor
26	Skylight	Left	(NW)	69.0	0.370	NFRC	0.29	NFRC	300	26	Existing	Velux Comfort (75) Lowe2/Arg	2nd Floor
27	Window	Right	(SE)	11.0	0.580	116-A	0.65	116-B	120	90	Existing	Double Non Metal Clear	2nd Floor
28	Window	Front	(S)	20.0	0.580	116-A	0.65	116-B	180	90	Existing	Double Non Metal Clear	2nd Floor
29	Window	Front	(S)	20.0	0.580	116-A	0.65	116-B	180	90	Existing	Double Non Metal Clear	2nd Floor
30	Window	Left	(NW)	42.0	0.790	116-A	0.70	116-B	300	90	Existing	Double Metal Clear	2nd Floor
31	Window	Left	(NW)	42.0	0.790	116-A	0.70	116-B	300	90	Existing	Double Metal Clear	2nd Floor
32	Window	Left	(NW)	42.0	0.790	116-A	0.70	116-B	300	90	Existing	Double Metal Clear	2nd Floor
33	Window	Left	(SW)	10.0	0.580	116-A	0.65	116-B	240	90	Existing	Double Non Metal Clear	2nd Floor

1. Indicate source either from NFRC or Table 116A. 2. Indicate source either from NFRC or Table 116B.

INTERIOR AND EXTERIOR SHADING

#	Exterior Shade Type	SHGC	Window		Overhang				Left Fin			Right Fin		
			Hgt.	Wd.	Len.	Hgt.	LExt.	RExt.	Dist.	Len.	Hgt.	Dist.	Len.	Hgt.
20	Bug Screen	0.76	7.5	3.8	6.0	0.2	0.0	0.0						
21	Bug Screen	0.76	7.5	3.8	6.0	0.2	0.0	0.0						
22	None	1.00												
23	None	1.00												
24	None	1.00												
25	None	1.00												
26	None	1.00												
27	Bug Screen	0.76												
28	Bug Screen	0.76												
29	Bug Screen	0.76												
30	Bug Screen	0.76	7.0	6.0	4.0	1.5	11.0	11.0						
31	Bug Screen	0.76	7.0	6.0	4.0	1.5	11.0	11.0						
32	Bug Screen	0.76	7.0	6.0	4.0	1.5	11.0	11.0						
33	Bug Screen	0.76												

THERMAL MASS FOR HIGH MASS DESIGN

Type	Area (sf)	Thick. (in.)	Heat Cap.	Cond.	Inside R-Val.	JA IV Reference	Condition Status	Location/ Comments
Concrete, Heavyweight	930	6.00	28	0.98	0	27-D20	Existing	1st Floor / Slab on Grade
Frame Wall, Gyp. Board	904	0.12	13	0.09	0	n/a	Existing	2nd Floor / Interior Mass
Frame Wall, Gyp. Board	323	0.12	13	0.09	0	09-A5	Existing	2nd Floor / Exterior Mass
Frame Wall, Gyp. Board	446	0.12	13	0.09	0	n/a	Existing	2nd Floor / Interior Mass
Frame Wall, Gyp. Board	2,804	0.12	13	0.09	0	n/a	Existing	2nd Floor / Interior Mass

PERIMETER LOSSES

Type	Length	R-Val.	Insulation Location	JA IV Reference	Condition Status	Location/ Comments

Certificate Of Compliance : Residential (Part 2 of 4) CF-1R

[redacted]
Project Title

Date: 5/21/2009

FENESTRATION SURFACES

#	Type	Area	U-Factor[1]	SHGC[2]	True Azm.	Tilt	Cond. Stat.	Glazing Type	Location/ Comments

1. Indicate source either from NFRC or Table 116A. 2. Indicate source either from NFRC or Table 116B.

INTERIOR AND EXTERIOR SHADING

#	Exterior Shade Type	SHGC	Window Hgt.	Window Wd.	Overhang Len.	Overhang Hgt.	Overhang LExt.	Overhang RExt.	Left Fin Dist.	Left Fin Len.	Left Fin Hgt.	Right Fin Dist.	Right Fin Len.	Right Fin Hgt.

THERMAL MASS FOR HIGH MASS DESIGN

Type	Area (sf)	Thick. (in.)	Heat Cap.	Cond.	Inside R-Val.	JA IV Reference	Condition Status	Location/ Comments
Concrete, Heavyweight	608	2.00	28	0.98	0	n/a	Existing	2nd Floor / Interior Mass
Frame Wall, Gyp. Board	631	0.12	13	0.09	0	02-A9	Existing	2nd Floor / Exterior Mass
Frame Wall, Gyp. Board	631	0.12	13	0.09	0	02-A9	Existing	2nd Floor / Exterior Mass
Frame Wall, Gyp. Board	615	0.12	13	0.09	0	02-A9	Existing	2nd Floor / Exterior Mass
Frame Wall, Gyp. Board	19	0.12	13	0.09	0	09-A5	Existing	2nd Floor / Exterior Mass

PERIMETER LOSSES

Type	Length	R-Val.	Insulation Location	JA IV Reference	Condition Status	Location/ Comments

[redacted]
Project Title

5/21/2009
Date

FENESTRATION SURFACES

#	Type	Area	U-Factor[1]	SHGC[2]	True Azm.	Tilt	Cond. Stat.	Glazing Type	Location/ Comments

1. Indicate source either from NFRC or Table 116A. 2. Indicate source either from NFRC or Table 116B.

INTERIOR AND EXTERIOR SHADING

#	Exterior Shade Type	SHGC	Window Hgt.	Window Wd.	Overhang Len.	Overhang Hgt.	Overhang LExt.	Overhang RExt.	Left Fin Dist.	Left Fin Len.	Left Fin Hgt.	Right Fin Dist.	Right Fin Len.	Right Fin Hgt.

THERMAL MASS FOR HIGH MASS DESIGN

Type	Area (sf)	Thick. (in.)	Heat Cap.	Cond.	Inside R-Val.	JA IV Reference	Condition Status	Location/ Comments
Frame Wall, Gyp. Board	40	0.12	13	0.09	0	09-A5	Existing	2nd Floor / Exterior Mass
Frame Wall, Gyp. Board	80	0.12	13	0.09	0	09-A5	Existing	2nd Floor / Exterior Mass
Frame Wall, Gyp. Board	250	0.12	13	0.09	0	09-A5	Existing	2nd Floor / Exterior Mass
Frame Wall, Gyp. Board	32	0.12	13	0.09	0	09-A5	Existing	2nd Floor / Exterior Mass

PERIMETER LOSSES

Type	Length	R-Val.	Insulation Location	JA IV Reference	Condition Status	Location/ Comments

Certificate Of Compliance : Residential (Part 3 of 4) CF-1R

[redacted]
Project Title

5/21/2009
Date

HVAC SYSTEMS

Location	Heating Type	Minimum Eff	Cooling Type	Minimum Eff	Condition Status	Thermostat Type
Voyager SA130-45=DHW	Combined Hydronic	see below	No Cooling	13.0 SEER	Existing	Setback
Carrier Furnace	Central Furnace	94% AFUE	No Cooling	13.0 SEER	Existing	Setback

HVAC DISTRIBUTION

Location	Heating	Cooling	Duct Location	Duct R-Value	Condition Status	Ducts Tested?
Voyager SA130-45=DHW	Radiant Floor	Ducted	Conditioned	4.2	Existing	No
Carrier Furnace	Ducted	Ducted	Conditioned	4.2	Existing	No

Hydronic Piping

System Name	Pipe Length	Pipe Diameter	Insul. Thick.
Voyager SA130-45	0	0.50	0.50

WATER HEATING SYSTEMS

System Name	Water Heater Type	Distribution	# in Syst.	Rated Input (Btu/hr)	Tank Cap. (gal)	Condition Status	Energy Factor or RE	Standby Loss (%)	Tank Insul. R-Value Ext.
Voyager SA130-45	Large Gas	Recirc/Timer	1	130,000	45	Existing	0.95	3.15%	0.0

Multi-Family Central Water Heating Details

Control	Hot Water Pump #	HP	Type	Hot Water Piping Length (ft) In Plenum	Outside	Buried	Add 1/2" Insulation

REMARKS

Off grid house on south facing slope

COMPLIANCE STATEMENT

This certificate of compliance lists the building features and specifications needed to comply with Title 24, Parts 1 and 6 of the California Code of Regulations, and the administrative regulations to implement them. This certificate has been signed by the individual with overall design responsibility. The undersigned recognizes that compliance using duct design, duct sealing, verification of refrigerant charge and TXVs, insulation installation quality, and building envelope sealing require installer testing and certification and field verification by an approved HERS rater.

Designer or Owner (per Business & Professions Code)

Name:
Title/Firm: William Arthur Patrick
Address: [redacted]
Telephone: Lic. #:

(signature) (date)

Documentation Author

Name: Rick Meyer
Title/Firm: BLOCK ENERGY DESIGN
Address: 150 Felker St., Ste. H
Santa Cruz, CA 95060
Telephone: (831) 454-9956

(signature) (date)

Enforcement Agency

Name:
Title/Firm:
Address:
Telephone:

(signature) (date)

[redacted]

Project Title | 5/21/2009 Date

Special Features and Modeling Assumptions

The local enforcement agency should pay special attention to the items specified in this checklist. These items require special written justification and documentation, and special verification to be used with the performance approach. The local enforcement agency determines the adequacy of the justification, and may reject a building or design that otherwise complies based on the adequacy of the special justification and documentation submitted.

	Plan	Field
The DHW System "Voyager SA130-45" is a Large Gas water heater with Pilot Loss = 0 btuh.		
The DHW System "Voyager SA130-45" includes a Solar System with a 53.0% Solar Fraction (see CF-SR).		
The Existing Water Heater "Voyager SA130-45" has an EF less than the Table R3-11 CEC Default Vintage Values.		
The HVAC System "Voyager SA130-45=DHW" is a Combined Hydronic System that uses a Boiler for DHW and Space Heating.		
An Air Retarding Wrap must be installed per the manufacturer's specifications that must comply with ASTM E1677-95.		
HIGH MASS Design - Thermal Mass: 1120 sqft Frame Wall, Gyp. Board Interior Mass, Extra 0.12" at All 1st Floor		
HIGH MASS Design - Thermal Mass: 192 sqft Wood Cavity Wall Exterior Mass, 0.00" thick at All 1st Floor		
HIGH MASS Design - Thermal Mass: 30 sqft Frame Wall, Gyp. Board Exterior Mass, 0.62" thick at All 1st Floor		
HIGH MASS Design - Thermal Mass: 40 sqft Frame Wall, Gyp. Board Exterior Mass, 0.62" thick at All 1st Floor		
HIGH MASS Design - Thermal Mass: 272 sqft Frame Wall, Gyp. Board Exterior Mass, 0.62" thick at All 1st Floor		
HIGH MASS Design - Thermal Mass: 30 sqft Frame Wall, Gyp. Board Exterior Mass, 0.62" thick at All 1st Floor		
HIGH MASS Design - Thermal Mass: 930 sqft Exposed Slab Floor, 6.00" thick at All 1st Floor		
An Air Retarding Wrap must be installed per the manufacturer's specifications that must comply with ASTM E1677-95.		

HERS Required Verification

Items in this section require field testing and/or verification by a certified home energy rater under the supervision of a HERS provider using approved testing and/or verification methods.

	Plan	Field
The HVAC System "Voyager SA130-45=DHW" has Ducts, Plenums and the HVAC unit located totally within Conditioned space. A certified HERS rater must visually verify the installation of the HVAC unit and all Ducts and Plenums.		
The HVAC System "Carrier Furnace" has Ducts, Plenums and the HVAC unit located totally within Conditioned space. A certified HERS rater must visually verify the installation of the HVAC unit and all Ducts and Plenums.		
The HVAC System "Carrier Furnace" has the HVAC unit and no more than 12 feet of Ducts and Plenums located outside conditioned space. A certified HERS rater must visually verify the installation of all Ducts and Plenums.		

[redacted] 5/21/2009

Project Title | Date

Special Features and Modeling Assumptions

The local enforcement agency should pay special attention to the items specified in this checklist. These items require special written justification and documentation, and special verification to be used with the performance approach. The local enforcement agency determines the adequacy of the justification, and may reject a building or design that otherwise complies based on the adequacy of the special justification and documentation submitted.

	Plan	Field
HIGH MASS Design - Thermal Mass: 904 sqft Frame Wall, Gyp. Board Interior Mass, Extra 0.12" at 2nd Floor + Loft		
HIGH MASS Design - Thermal Mass: 323 sqft Frame Wall, Gyp. Board Exterior Mass, 0.62" thick at 2nd Floor + Loft		
HIGH MASS Design - Thermal Mass: 446 sqft Frame Wall, Gyp. Board Interior Mass, Extra 0.12" at 2nd Floor + Loft		
HIGH MASS Design - Thermal Mass: 2804 sqft Frame Wall, Gyp. Board Interior Mass, Extra 0.12" at 2nd Floor + Loft		
HIGH MASS Design - Thermal Mass: 608 sqft Concrete, Heavyweight Interior Mass, 2.00" thick at 2nd Floor + Loft		
HIGH MASS Design - Thermal Mass: 631 sqft Frame Wall, Gyp. Board Exterior Mass, 0.62" thick at 2nd Floor + Loft		
HIGH MASS Design - Thermal Mass: 631 sqft Frame Wall, Gyp. Board Exterior Mass, 0.62" thick at 2nd Floor + Loft		
HIGH MASS Design - Thermal Mass: 615 sqft Frame Wall, Gyp. Board Exterior Mass, 0.62" thick at 2nd Floor + Loft		
HIGH MASS Design - Thermal Mass: 19 sqft Frame Wall, Gyp. Board Exterior Mass, 0.62" thick at 2nd Floor + Loft		
HIGH MASS Design - Thermal Mass: 40 sqft Frame Wall, Gyp. Board Exterior Mass, 0.62" thick at 2nd Floor + Loft		
HIGH MASS Design - Thermal Mass: 80 sqft Frame Wall, Gyp. Board Exterior Mass, 0.62" thick at 2nd Floor + Loft		
HIGH MASS Design - Thermal Mass: 250 sqft Frame Wall, Gyp. Board Exterior Mass, 0.62" thick at 2nd Floor + Loft		
HIGH MASS Design - Thermal Mass: 32 sqft Frame Wall, Gyp. Board Exterior Mass, 0.62" thick at 2nd Floor + Loft		

HERS Required Verification

Items in this section require field testing and/or verification by a certified home energy rater under the supervision of a HERS provider using approved testing and/or verification methods.

	Plan	Field

ENERGY USE AND COST SUMMARY ECON-1

PROJECT NAME [redacted]

DATE 5/21/2009

Rate: Electric PG&E Q_Yes **Fuel Type:** Electricity

	STANDARD			PROPOSED			MARGIN		
	Energy Use (kWh)	Peak Demand (kW)	Cost ($)	Energy Use (kWh)	Peak Demand (kW)	Cost ($)	Energy Use (kWh)	Peak Demand (kW)	Cost ($)
Jan	48	0	6	45	0	5	3	0	0
Feb	94	7	11	59	5	7	35	2	4
Mar	70	5	8	40	3	5	30	2	3
Apr	204	6	24	123	5	14	81	1	9
May	215	7	25	110	7	13	105	1	12
Jun	538	8	62	355	9	41	183	-1	21
Jul	563	7	65	366	7	42	197	0	23
Aug	591	10	68	369	8	43	222	2	26
Sep	431	11	50	192	9	22	239	2	28
Oct	237	7	27	97	6	11	140	1	16
Nov	119	6	14	57	4	7	61	2	7
Dec	46	0	5	42	0	5	4	0	0
Year	**3,155**	**11**	**$ 365**	**1,856**	**9**	**$ 214**	**1,299**	**2**	**$ 150**

Rate: Gas PG&E Q **Fuel Type:** Propane

	STANDARD			PROPOSED			MARGIN		
	Energy Use (therms)	Peak Demand (kBtu/hr)	Cost ($)	Energy Use (therms)	Peak Demand (kBtu/hr)	Cost ($)	Energy Use (therms)	Peak Demand (kBtu/hr)	Cost ($)
Jan	88	72	115	80	101	103	8	-29	11
Feb	60	61	75	50	90	62	11	-29	13
Mar	46	58	58	33	85	40	14	-27	17
Apr	39	42	48	26	68	32	13	-26	16
May	19	41	24	17	68	21	3	-27	3
Jun	15	27	18	14	22	17	1	5	1
Jul	14	4	17	14	4	17	0	0	0
Aug	14	4	17	14	4	17	0	0	0
Sep	14	10	17	13	4	16	0	7	0
Oct	21	40	26	20	63	25	1	-23	1
Nov	54	57	67	43	84	53	11	-27	14
Dec	81	69	104	71	99	89	10	-30	14
Year	**464**	**72**	**$ 586**	**393**	**101**	**$ 494**	**71**	**-29**	**$ 92**

Annual Totals	Energy	Demand	Cost	Cost/sqft	Virtual Rate
Electricity	**1,856 kWh**	**9 kW**	**$ 214**	**$ 0.07/sqft**	**$ 0.12/kWh**
Propane	**393 therms**	**101 kBtu/hr**	**$ 494**	**$ 0.16/sqft**	**$ 1.26/therm**
		Total	**$ 708**	**$ 0.23/sqft**	

The values shown here are based upon the results of an EnergyPro Compliance energy analysis that uses Title 24 profiles as specified in the Residential ACM manual.