

SynerGreen

Home Perfection

WHOLE BUILDING PERFORMANCE ASSESSMENT

Sample Residence

Diagnostic Testing Results and Improvement Plan

December 27, 2009



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Client Information

Date of Site Assessment: December 19, 2009

Client Name: David Sample
Address: 2137 Sample Drive
City: Penngrove
State: CA
Zip Code: 94951
Phone: (707) 799-0000
E-Mail:

SynerGreen Consultant: Allen Gates
Phone: (707) 537-9459
Email: allen.g@synergreen.com

Building Information and Weather Conditions

Number of Occupants: 3
Number of Floors: 1
Square Feet: 2000
Year Built: 1964 - remodeled/addition in 2003
Outdoor Temp: 50°
Outdoor Humidity: 78%
Wind Speed: Mild
Indoor Temp: 60°
Indoor Humidity: 75%

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Clients Requests

To evaluate the energy efficiency of the home and provide a report outlining recommendations for cost effective, long term improvements that will increase the comfort, safety and efficiency of the home.

Client's Concerns

1. Perform an energy audit that measures all the components of the house in order to determine how the house can perform at optimum energy efficiency
2. The house is hot in the summer in Ben's room and cold in the winter months
3. The house needs to be comfortable, safe and healthy
4. Energy consumption needs to be at a minimum while maintaining maximum comfort

Facts

The house is a one-story structure; the orientation (entrance) of the house is facing south west. The house has a crawl space with polyurethane moisture barrier. The warm air supply ductwork is located in the crawl space; there is no insulation between the floor joists cavities. There is no attic (except in the hallway and bath area). There is one 50,000 BTU furnace and one 60 gallon (est.) natural gas water heater that service the house. The house has no air conditioning. The garage was remodeled into a family room with radiant hydronic heat.



Dining Room Area



SynerGreen Findings – Summary

Description	Your House	Building Performance Stds	Variance	Recommendations
Interior of House				
Air Infiltration	2950 CFM ₅₀ .46 ACH	<1800 CFM ₅₀ .35 ACH	1150 CFM ₅₀ 27% higher	Seal around the fireplace and install a “chimney balloon” in the chimney flue Seal around the windows and sliding glass doors and other areas such as plumbing penetrations under the sinks, etc.
Duct Leakage	23% or 200 CFM ₂₅	*<15% or 158 CFM ₂₅ **<6% or 63 CFM ₂₅	28% higher 218% higher	Seal existing duct air leakage to < 15%, if feasible and install dampers where appropriate, or Install new ductwork with dampers and seal air leakage to < 6%
Utility Bill Analysis	\$.80Ft ²	<\$0.40 Ft ²	<\$0.40 Ft ² est.	Electric - Air sealing efforts and fluorescence fixtures and lamps Natural Gas - Furnace and duct sealing efforts
Insulation				
• Attic	R-14 est.	≥R-38	<R-24 est.	Add insulation to ≥ R-38 above the hall and bath areas
• Roof	R-19	R-19	undetermined	If feasible, from the exterior, insulate and seal roof cavities around the perimeter of the house
• Floors	none	R-19	R-19	Add R-19 insulation between the floor joists
• Walls	insulated	R-19	undetermined	None – some of the insulation is not performing well
Crawl Space	unsealed	seal		Seal the crawl space area (along the perimeter and all electrical, mechanical & plumbing penetrations)
Lighting Efficiency		CFL's	undetermined	Change all lighting to fluorescence
Windows & Doors	dual pane glass, alum. frames	dual pane glass, vinyl frames	undetermined	Air seal around the sliding glass door frames and door framing Install energy efficient window coverings
Appliances				
• Furnace	2000 est. – 81% Eff.	95% Efficiency	14%	None, unless upgrading from open to sealed combustion or to increase efficiency or to a photovoltaic system
• Refrigerator	2003	Energy Star	undetermined	None
• Washer	2003	Energy Star	undetermined	None
• Dryer	2003	Energy Star	undetermined	None

Note: It is recommended that before any major energy improvement measures and crawl space air sealing efforts are made, further investigation to determine if roof insulation, and proper air sealing around the exterior perimeter of the house, is possible without a major undertaking and is cost efficient.

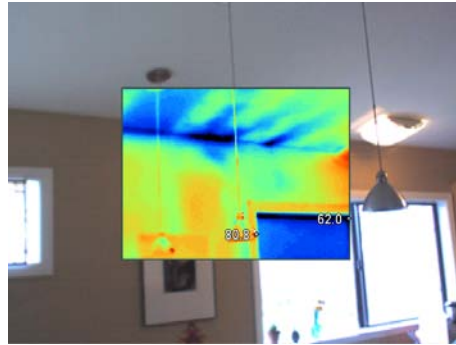
* California Building Code standard for new duct systems installed in existing homes

** California Building Code standard for new duct systems installed in new construction

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Interior of House



Air Infiltration

House air leakage was measured at 2,950 CFM₅₀ or 27% higher than building science performance standards

1. Un-sealed electrical, plumbing and mechanical penetrations from the crawl space and attic are pulling in outside air to the living area or leaking inside air out, depending on pressure differences
2. Baseboards leak air from the un-sealed crawl space areas
3. Top plates leak air from the un-sealed attic
4. The fireplace leaks air through the damper and the framed openings around the chimney
5. Air leakage occurs between the building material and the sliding glass doors



Duct Measurements

Furnace	1050 CFM
Duct Leakage	200 CFM ₂₅ or 23%
Supply Air (CFM)	Living Room
	West grill 95
	Center grill 78
	East grill 70
	Master bedroom
	West grill 69
	Master Bath 71
	Guest Bath 69
	Bedroom 2 70
	Bedroom 1 81
	Computer Room 98
	Kitchen Area 99
	Laundry Room <u>64</u>
Total	929

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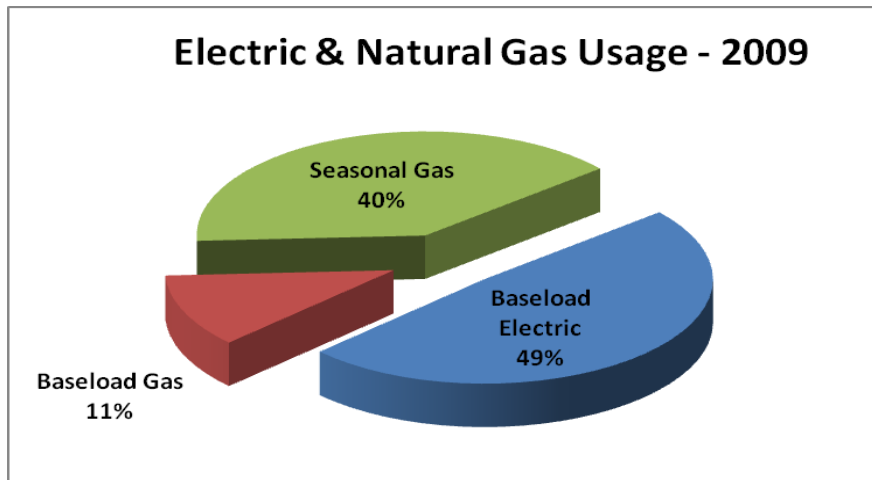
Utility Bill Analysis

Utility bills are a useful tool for gauging a building's energy efficiency and measuring energy savings from retrofits. Both improvement in comfort and economic benefits from energy consumption are compared to the costs in order to set priorities and make decisions. Energy is measured by the kilowatt hour (kWh) for electricity, therm for natural gas and gallons for propane.

Energy consumption is classified into 2 categories: seasonal consumption and base-load consumption. *Seasonal consumption consists of heating and cooling usage. Base-load consumption consists of all other, to include water heating, refrigeration, clothes dryer, lighting, entertainment center, spa, swimming pool, etc.*

Energy Consumption Categories

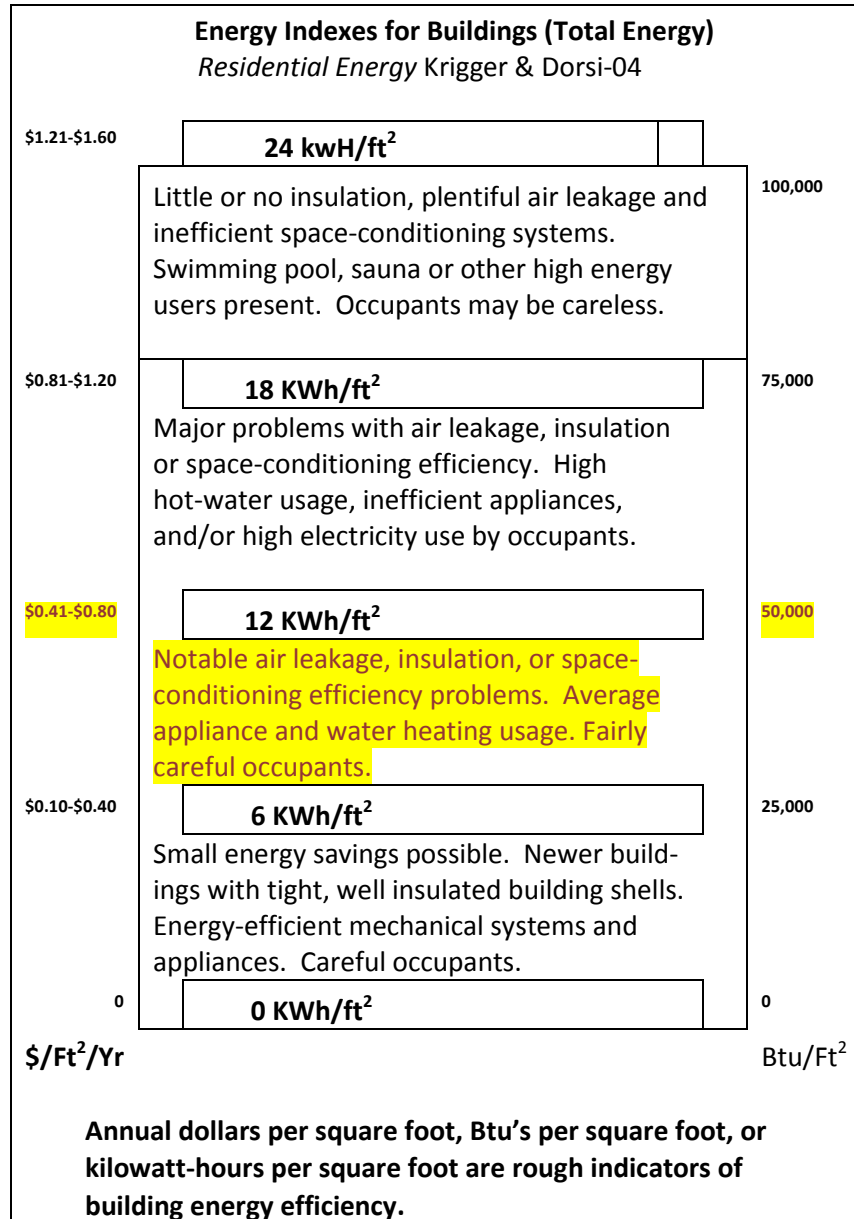
1. Annual base load consumption:	Electric	\$ 783 = \$ 0.39 Ft ² - 49%
	Natural Gas	\$ 183 = \$ 0.09 Ft ² - 11%
2. Annual seasonal consumption:	Electric	N/A
	Natural Gas	\$ 636 = \$ 0.32 Ft ² - 40%
	Totals	\$1,601 = \$ 0.80 Ft ² - 100%



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The “Energy Indexes for Buildings” table shown below is a guide in assessing building energy efficiency.



Seasonal and base load numbers are estimated using an industry accepted formula shown in *Residential Energy* by Krigger & Dorsi.

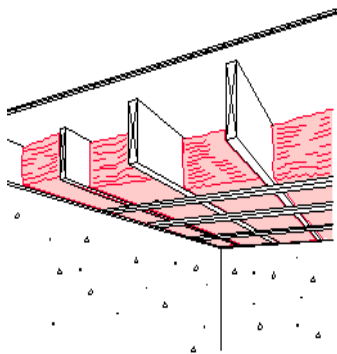


Insulation

Attic

1. Attic insulation R-value is difficult to determine since it was not uniformly installed. The attic has fiberglass batt insulation that measures at the high point of approximately 4" equaling a "fair" R-value equivalent of 14
2. There are some areas in the attic that have displaced insulation or no insulation in the ceiling cavities

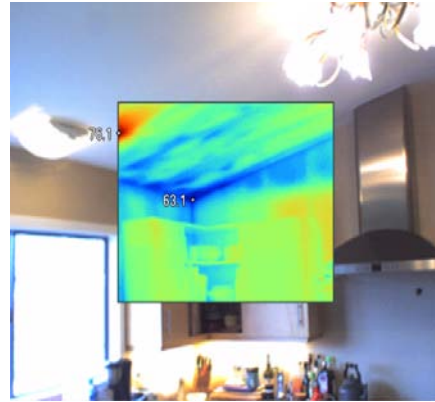
Unless your home was specially constructed for energy efficiency, you can usually reduce your energy bills by adding more insulation. Many older homes have less insulation than homes built today, but adding insulation to a newer home may also pay for itself within a few years. Before you insulate, you should make sure that your home is properly air sealed.



Floor

1. There is no insulation located between the floor joists
2. The hot water copper pipes are not insulated

Heat loss through an un-insulated floor over a vented crawl space can be significant. Depending on the size of your home, you can save \$50 or more in heating costs each year by insulating your floor. Do not insulate your floor if the crawl space is not well-vented (it should have at least two vent openings to provide cross ventilation), or if the floor is over a heated space, such as a finished basement.



Walls

1. There are areas in the wall cavity that lack proper insulation
2. Some areas in the wall appear to be colder than other areas indicating the possibility of improperly installed insulation or no insulation

Effective wall insulation is the most complex component of the building envelope to insulate, air seal, and control moisture. The keys to an effective wall are:

1. Air tight construction –all air leaks sealed in the wall during construction or remodeling and prior to insulation installation.
2. Moisture control – exterior rain drainage system, continuous air barrier, vapor barrier located on the appropriate side of the wall.
3. Complete insulation coverage– no gaps or compressed insulation in cavity insulation, continuous insulated sheathing.



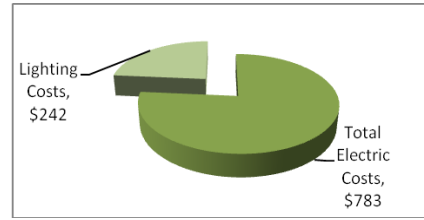
Crawl Space

1. There are no signs of water intrusion.
2. Un-sealed pipe, electrical and mechanical penetrations resulting in crawl space air entering into the living space through the floor assemblies.
3. There are no dampers on the supply ducts to regulate airflow.

Properly sealing and conditioning a crawlspace is one of the main components of an energy efficient home. When your crawlspace is not influenced by outside air conditions the amount of energy required to heat and cools your home is dramatically reduced. Crawlspace Doctor is committed to constantly updating our methods to achieve the highest level of energy efficiency according to Energy Star and other energy studies.

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Lighting Efficiency

Lighting costs amount to approximately \$242 or 31% of total electric costs.

All lighting should be changed to fluorescence lamps. Saving lighting energy requires either reducing electricity consumed by the light source or reducing its on-time usage:

1. Relamping – lowering wattage by replacing lamps or replacing fixtures
2. Reducing the light source's on-time by improving lighting controls or by educating lighting users to turn off lights in unoccupied rooms
3. Daylighting – replacing electric lights with natural light



Windows & Sliding Doors

1. The windows are low-e clear, dual-pane with aluminum frames
2. The sliding glass doors are low-e clear, dual-pane glass with aluminum frames

Aluminum frame windows and doors remain the most conductive frame and are prone to condensation problems in winter months.

Window selection criteria depend on a number of factors including: climate coldness (in heating degree days "HDD"), its sun exposure (both winter and summer), the window's orientation and the light, ventilation and heat it's expected to provide. U-factor is the most important criteria for cold climates. U-factors for windows range from 1 to about 0.18. A U-factor of 0.40 is often given as a minimum for cold climates, but lower is better to minimize heat transmission and window condensation.

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Appliances



Furnace

50,000 BTU (40,000 BTU output)
81.6% efficient
1050 CFM output



Refrigerator

2005



Dish Washer

2005

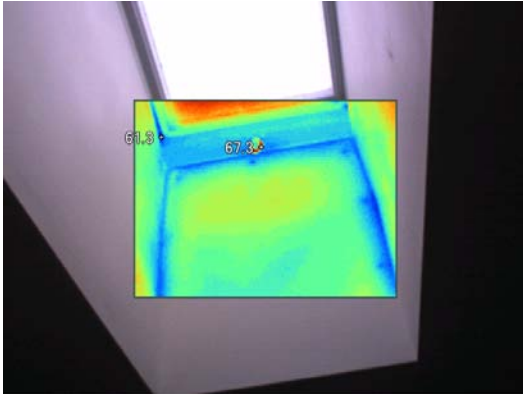


Washer and Dryer

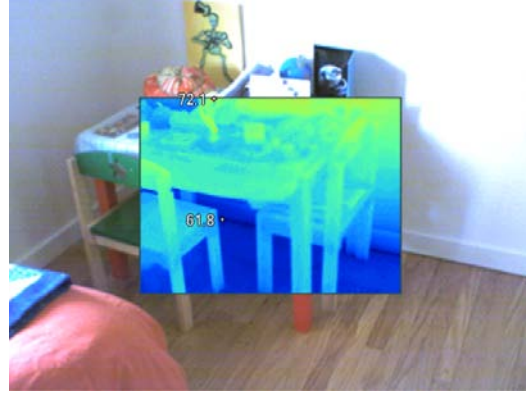
2005

Your appliances are reasonably up-to-date and appear to be in good working order. Little cost savings would be gained by replacement at this time.

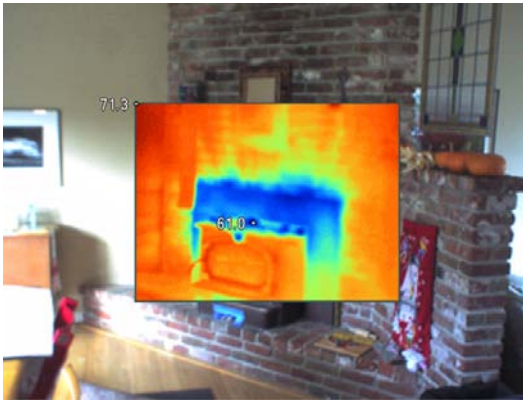
Additional Infrared Images



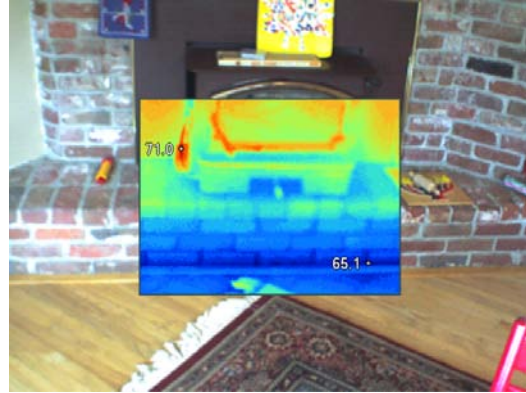
Cold skylight area



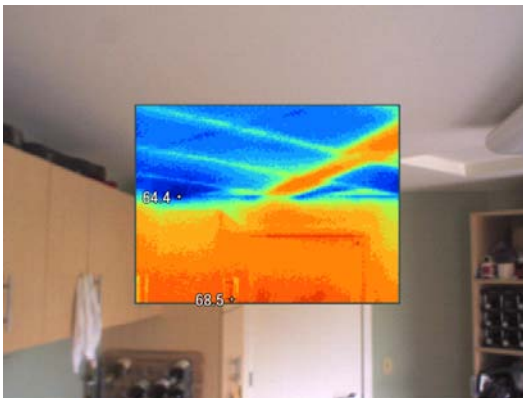
Cold bottom-plate floor area



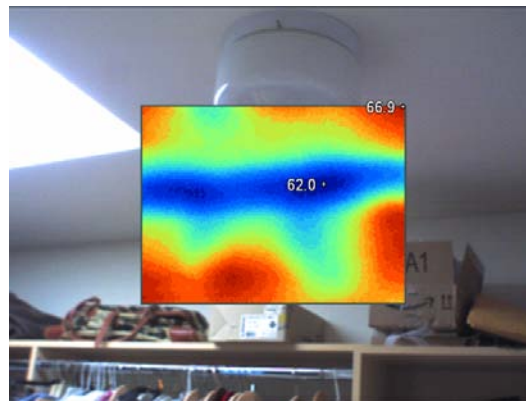
Cold fireplace damper area



Cold floor area



Cold ceiling area



Cold top-plate area

Recommendations

Exterior

1. Change out incandescent light bulbs/fixtures to fluorescent lighting.
2. Check the feasibility of added roof insulation placed through the eaves and air sealing efforts around the exterior perimeter of the house.

Interior

1. House
 - A. Seal window and door frames/trim to wall connections and baseboards to floor connections with interior latex clear caulking to reduce air infiltration.
 - B. Air from the wall assemblies is communicating with the living space air.
 - C. The furnace closet needs to be isolated from the living area. Proper combustion air ductwork needs to be installed.
 - D. The front door, when closed, needs to be air sealed. The existing weather-stripping, adjusted several times, is not performing properly; the door framing may be out-of-plumb.
 - E. Install energy efficient window coverings to prevent warm air converting to cold in the winter.
2. **Kitchen - The kitchen exhaust fan, when operating on the "high" mode is depressurizing the conditioned space and creating a safety condition if the combustion furnace back-drafts.**
3. Furnace - Seal around the furnace plenum for air leakage.
4. Bedrooms - When the bedroom doors are closed and the furnace is running, inadequate return air flow creates comfort issues and mechanical problems.
 - A. Install return air transfer grills from the bedrooms to the existing return air grill located in the hallway (SE grill).
 - B. Upgrade size and provide for filtration for the return air grill located in the hallway (NE grill).
5. Attic - Hallway and bathroom areas
 - A. Seal all electrical, plumbing and mechanical penetrations.
 - B. Seal around the top plate areas, if accessible.
 - C. Install blown-in cellulose insulation to a minimum value of R-38.
 - D. Weather-strip and insulate the attic hatch.
3. Crawl Space
 - A. Seal all sub-floor penetrations (electrical, plumbing and mechanical).
 - B. Seal other areas that are open to the conditioned space.
 - C. Install insulation on the hot water pipes.
 - D. Install floor joists insulation in each cavity.
 - E. Seal the existing ductwork, as feasible, or install new ductwork in accordance with ACCA Manual D Standards.
4. Lighting - Change out the remainder of incandescent light bulbs for florescent lighting or LED.