



Emerson Environmental

*Tune Up Your House*<sup>SM</sup>

# Energy-Saving Fixes to Include When Remodeling

Presented by:

**Suzanne Henderson Emerson, J.D.**

Emerson Environmental

[Suzanne@EmersonEnvironmental.com](mailto:Suzanne@EmersonEnvironmental.com)

# Copyright & Disclaimer

- This presentation is protected by U.S. and international copyright laws. Reproduction, distribution, display, and use of the presentation without written permission of the speaker is prohibited.
- The information in this presentation is believed to accurately describe the technologies addressed herein and are meant to clarify and illustrate typical situations, which must be appropriately adapted to individual circumstances. These materials were prepared to be used in conjunction with a free educational program and are not intended to provide legal advice or establish legal standards of reasonable behavior. Neither Emerson Environmental nor any of its employees or agents: (1) makes any written or oral warranty, express or implied, including but not limited to the merchantability or fitness for a particular purpose; (2) assumes any legal liability or responsibility for the accuracy or completeness of any information, apparatus, product, process, method, or policy contained herein; or (3) represents that its use would not infringe any privately-owned rights, including but not limited to patents, trademarks, or copyrights. Emerson Environmental does not endorse products or manufacturers. Mention of any particular product or manufacturer in this material should not be construed as an implied endorsement.



# 7 Portola Valley Homes

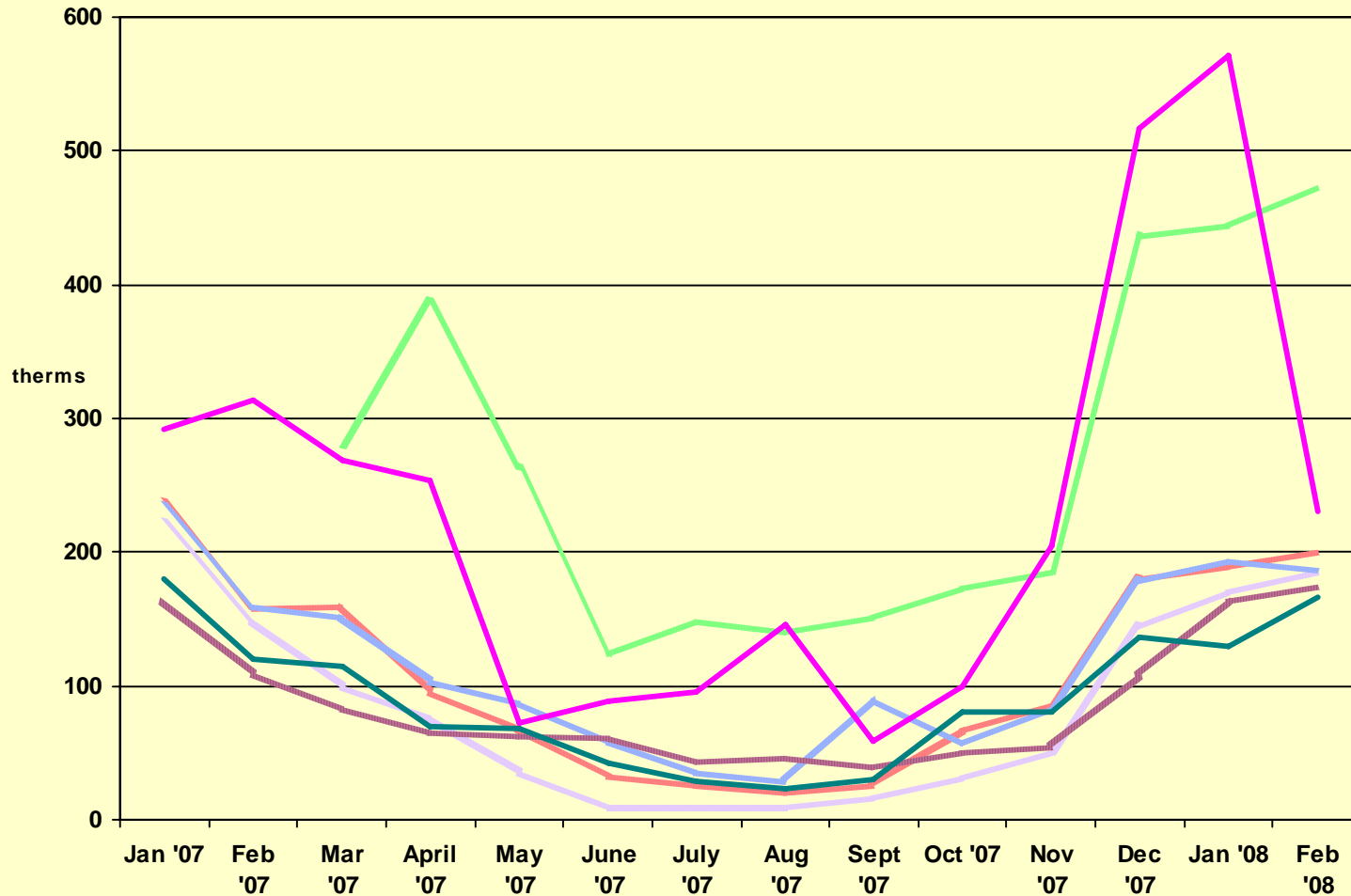
- 5-home Energy Survey performed Spring of 2008
  - Emerson Environmental, [Portola Valley Home Energy Study Report](#), May 14, 2008
  - John Hermannsson & Bo Crane, [Portola Valley Home Energy Audit Study](#), Jan. 22, 2009
  - Available at [emersonenvironmental.com/resources](http://emersonenvironmental.com/resources)
- 2 more homes in Portola Valley audited in 2008

# 7 Portola Valley Homes

Home	Square Footage	Year Built	Neighborhood	Occupants	Description
<b>A</b>	2480	1976, 1995	Woodside Highlands	2 adults, 2 children	2 story
<b>B</b>	2300	1978	Portola Valley Ranch	2 adults	1 story, flat roof
<b>C</b>	7800	1968	Westridge area	2 adults, 3 children	2 story, cathedral ceilings; pool
<b>D</b>	3500	1954 & additions	Alpine Hills	1 adult	1½ story, flat roof; pool
<b>E</b>	4200	2001	Alpine Hills	3 adults	2½ story, built into hillside
<b>F</b>	7200	2001	Westridge area	2 adults	2 story; pool
<b>G</b>	1940	1950's & addition	Woodside Highlands	2 adults	1 story, flat roof; pool

# Portola Valley Homes – Gas Use

## Gas Usage in Therms



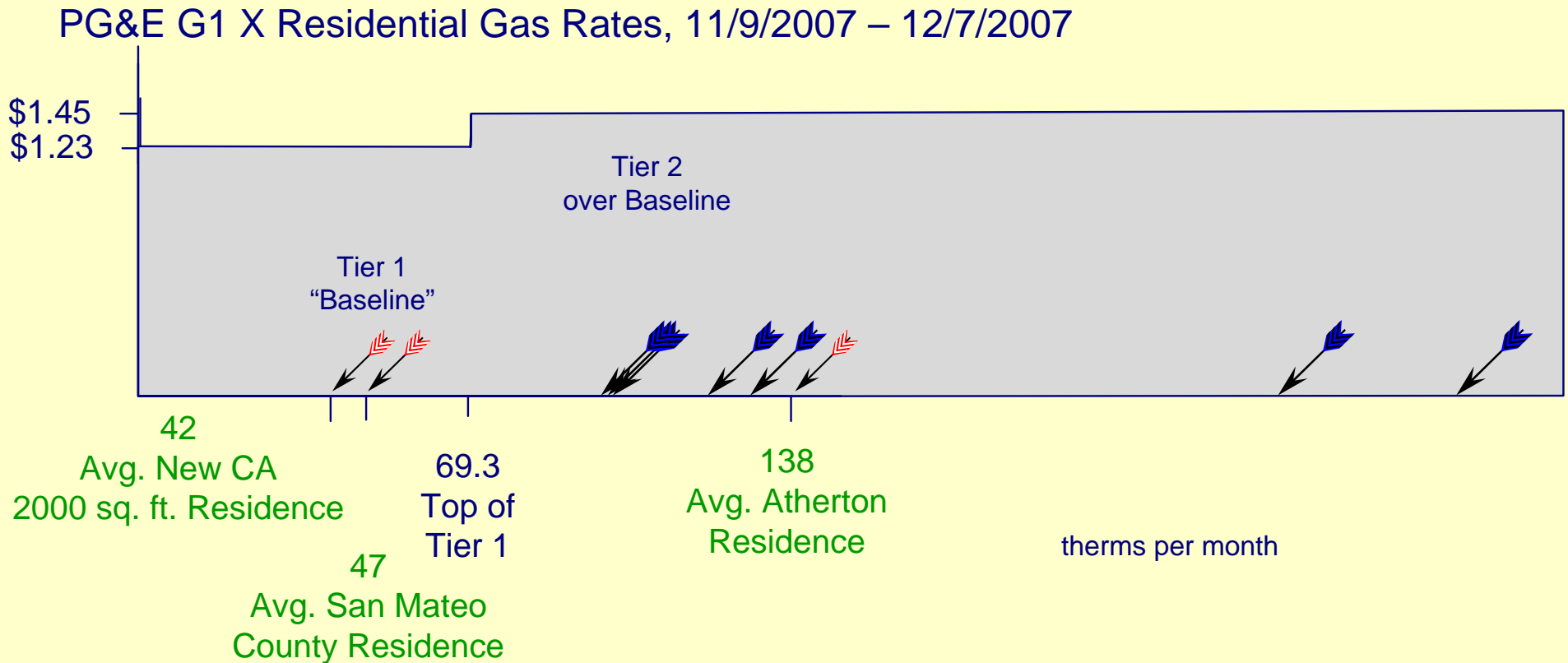
Emerson Environmental

Energy Fixes for Remodels

# Portola Valley Homes – Gas Use

Home	Therms per month	Square Footage	Year Built	Occupants	Description
C	267	7800	1968	2 adults, 3 children	2 story, cathedral ceilings; pool
F	229	7200	2001	2 adults	2 story; pool
D	118	3500	1954 & additions	1 adult	1 ½ story, flat roof; pool
A	110	2480	1976, 1995	2 adults, 2 children	2 story
G	91	1940	1950's & addition	2 adults	1 story, flat roof; pool
E	88	4200	2001	3 adults	2 ½ story
B	87	2300	1978	2 adults	1 story, flat roof

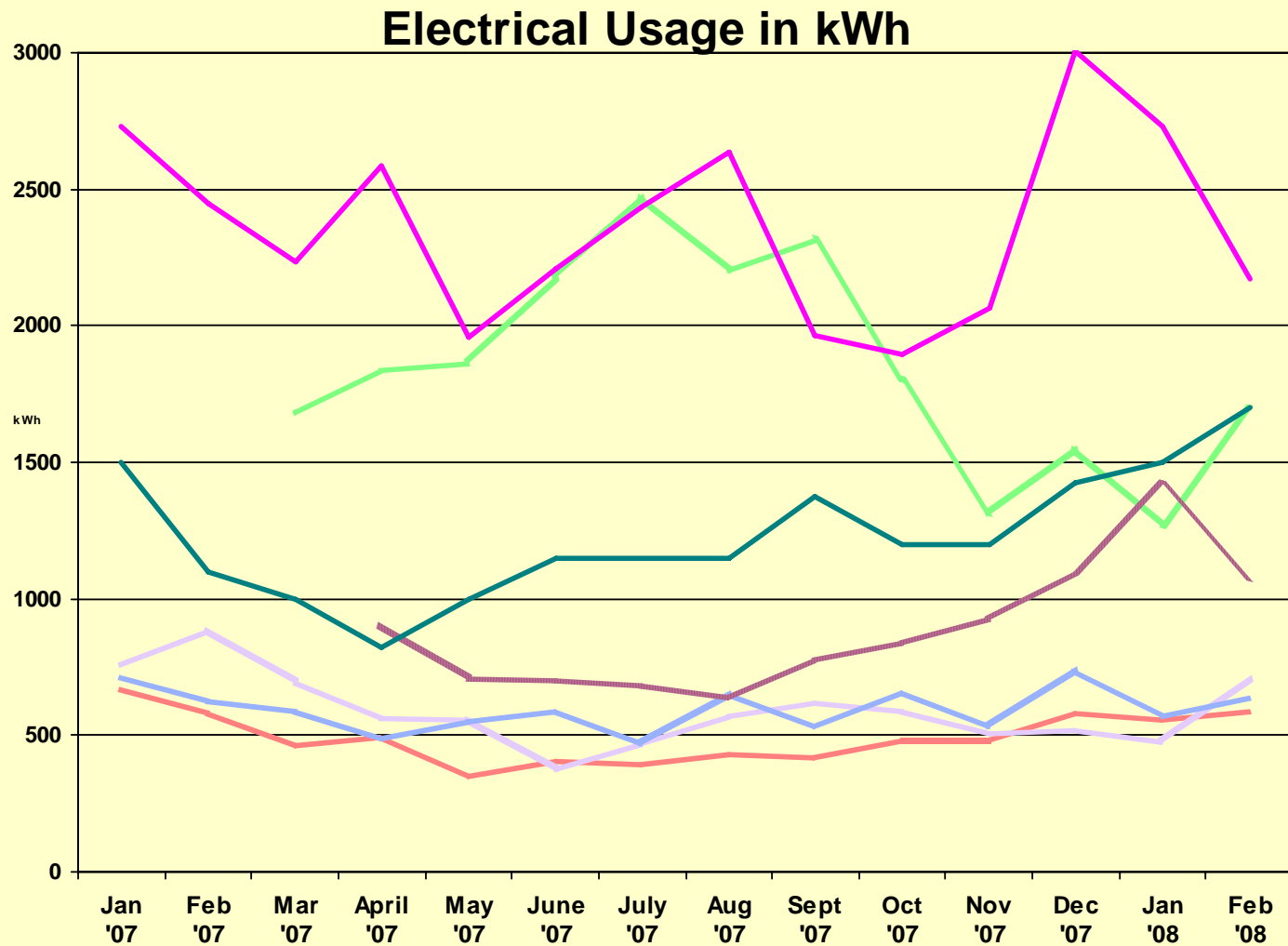
# Portola Valley Homes – Gas Use



County and Atherton data 2004, per PG&E Statistical Research Unit;  
 CA data R. Chitwood, Cal. Bldg. Performance Contractors Assn.,  
*Green Home Energy Retrofits* (2007).

© Emerson Environmental, LLC

# Portola Valley Homes – Electricity Use

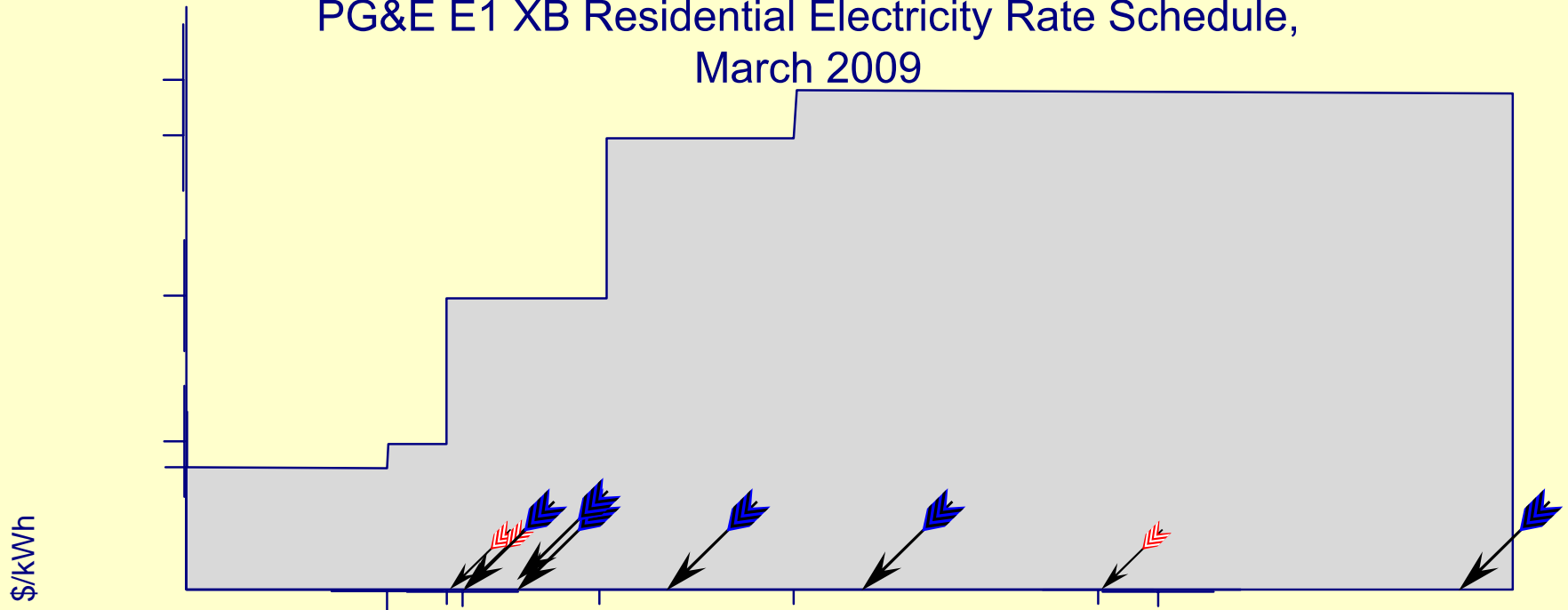


# Portola Valley Homes – Electricity Use

Home	kWh per month	Square Footage	Year Built	Occupants	Description
F	2361	7200	2001	2 adults	2 story; pool
C	1849	7800	1968	2 adults, 3 children	2 story, cathedral ceilings; pool
G	1234	1940	1950's & addition	2 adults	1 story, flat roof; pool
E	889	4200	2001	3 adults	2 ½ story
D	598	3500	1954 & additions	1 adult	1 ½ story, flat roof; pool
B	593	2300	1978	2 adults	1 story, flat roof
A	494	2480	1976, 1995	2 adults, 2 children	2 story

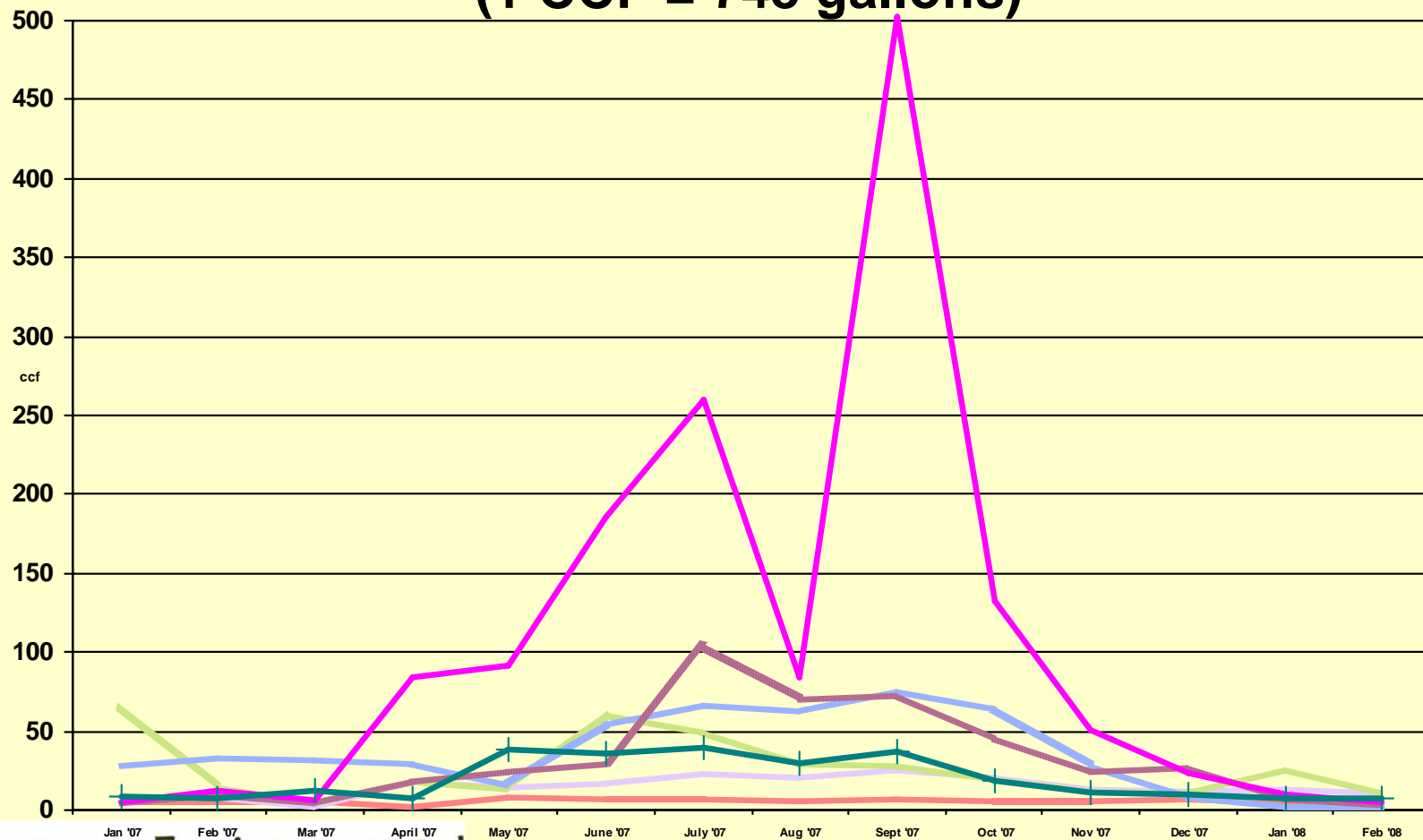
# Portola Valley Homes – Electricity Use

PG&E E1 XB Residential Electricity Rate Schedule,  
March 2009



**\$0.44098**

# Portola Valley Homes – Water Use Water Usage by CCF (1 CCF = 748 gallons)



# Portola Valley Homes – Water Use



# Remodel Scenario

- Homeowners are planning a partial remodel or addition.
- Homeowners plan to make the remodeled or new portions Green.
- What should they address to improve energy-efficiency of the home's areas not being remodeled?



# Top 5 Areas

- Lighting
- Sealing
- Insulation
- Air Ducts
- Appliances

# Lighting Efficiency



Identify incandescent bulbs that can be replaced with fluorescents.



One home has already done an impressive job of replacing incandescent bulbs with fluorescents; 2 others have begun replacing incandescents. The other homes have many opportunities to replace incandescents with energy-efficient CFLs.



# Lighting Upgrade: Savings Potential

- \$ savings potential for replacement of incandescents with CFLs is huge.
- “Using new lighting technologies can reduce lighting energy use in your home by 50% to 75%.”

U.S. Dept. of Energy, *Energy Saver\$: Tips on Saving Energy and Money at Home* at 20 (Jan. 2006).

	100w Incandescent	23w CFL
Watts	100 w	23 w
Hours used	8000 hrs	8000 hrs
# of bulbs required	8	1
Cost per bulb	\$0.63	\$2.00
Total bulb cost	\$5.04	\$2.00
Energy used	800 kWh	184 kWh
Energy cost per kWh	\$0.12	\$0.12
Energy cost total	\$96.00	\$22.08
Total Cost	\$101.04	\$24.08
Savings with CFL		<b>\$76.96</b>

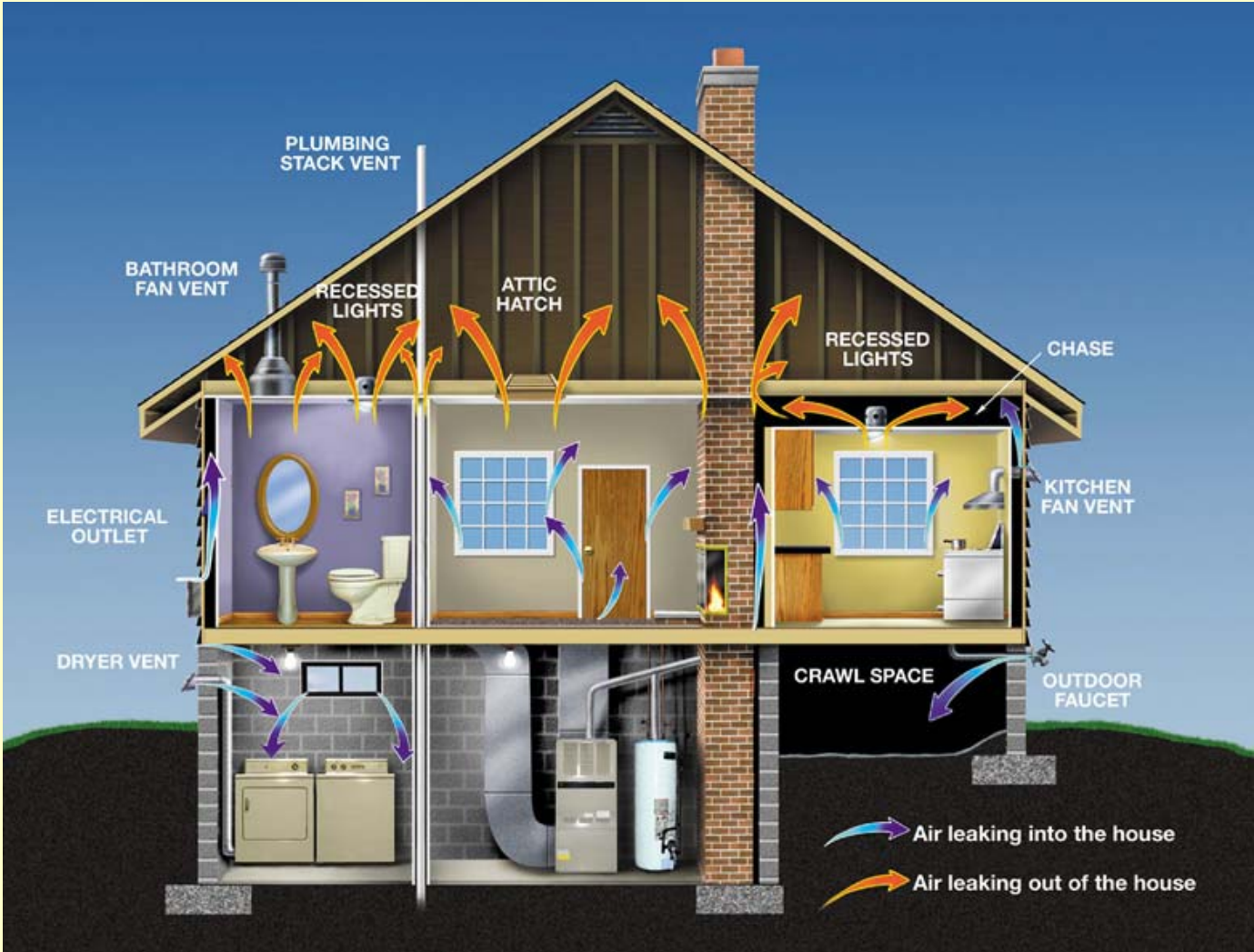
# Lighting Resources

- Hardware store
- EFl: [energyfederation.org](http://energyfederation.org)
- [1000bulbs.com](http://1000bulbs.com)
- US Dept of Energy flood contest winners  
<http://www.pnl.gov/rlamps/index.stm>

**Table 1. Technology Innovation Competition Winners**

Manufacturer	Model	Type	Wattage	Average Rated Life	Lumens
GE	FLE15/2/DV/R30	R30 Dimmable	15	6,000	720
GE	FLE15/2/R30XL	R30	15	10,000	750
PHILIPS	EL/A BR30	BR30	15	7,000	590
FEIT	ESL15R30H	R30	15	8,000	750
PHILIPS	EL/A PAR 38	PAR38	23	8,000	1250
FEIT	ESL18 PAR38H	PAR38	18	8,000	950
FEIT	BPCE23 PAR38/3	PAR38	23	8,000	1300
GE	FLE26/2/PAR38/XL	PAR38	26	10,000	1300
PHILIPS	EL/A PAR38	PAR38	20	8,000	930
SYLVANIA	CFE 19PAR38	PAR38	19	10,000	1000
FEIT	ESL 18R40H	R40	18	8,000	950
FEIT	BPCE23 R40/3	R40	23	8,000	1300
PHILIPS	EL/A R40	R40	23	8,000	1250
GE	FLE26/2/R40XL	R40	26	10,000	1300
PHILIPS	EL/A BR40	R40	20	8,000	940
SYLVANIA	CFEL 20BR40	R40	20	8,000	900

# Seal Holes in Walls & Ceilings



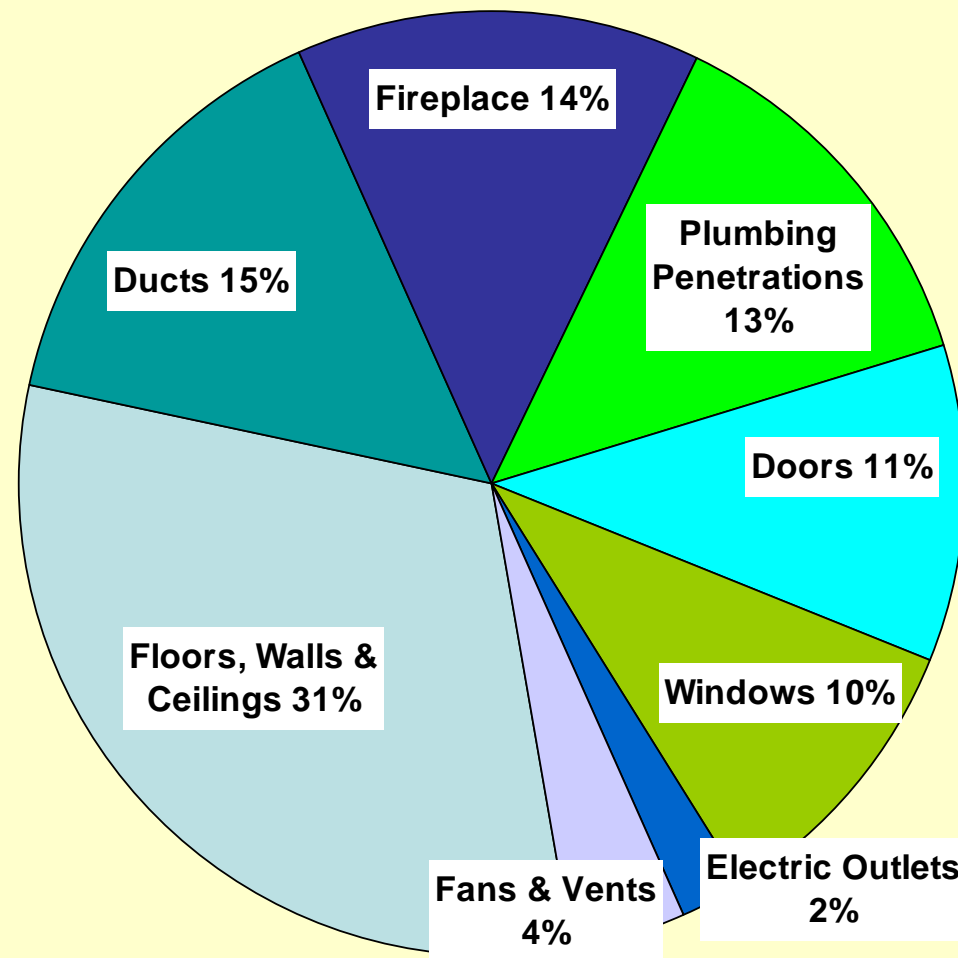
graphics by Energy Star

# Seal Holes in Walls & Ceilings

“You can increase the comfort of your home while reducing your heating and cooling needs by up to 10% by investing in proper insulation and sealing air leaks.”

*Energy Saver\$ at 4.*

## Primary Air Infiltration Locations



Data: David Johnson, What's Working, for Build It Green (2007); graphics © Emerson Environmental, LLC

# Seal Holes in Walls/Ceilings

Six homes have unsealed plumbing and/or ducting penetrations between the utility area and the conditioned portion of the home.

Seal openings around plumbing lines and electrical lines.



Wall holes around plumbing lines in Homes A & F



# Seal & Insulate Vented Utility Closet from Conditioned Space

Utility closets containing combustion equipment should be considered “outside space” with floor, wall, ceiling, and door sealing and insulation between the closet and the conditioned areas of the home. Sufficiently-sized venting must provide combustion air.



Utility closet in Home A

Three homes have furnaces located in closet space inside the conditioned area of the home and utilizing air vents from the outside to provide combustion air. The vent grilles on one home’s utility closet are insufficiently sized and dust-clogged.



# Seal Holes in Walls/Ceilings

Seal openings around ducts and vent chases.  
Assure vent flaps close properly.



Gravity flappers not closing, House A



Unsealed ceiling penetration, House G

# Seal Holes in Walls/Ceilings

Doors to exterior, garage, and vented utility closet should be well-sealed with weather-stripping and/or sealing thresholds. Repair or replace doors and windows with substantial air leakage.



Large gap visible above door in Home D

Six of seven PV homes have air leakage around one or more door.

# Seal Gaps Under Cabinets



(Under front edge of kitchen cabinets, not a PV home)

# Seal Fireplace

Six of seven PV homes have air leakage through the fireplace.

Install a sealed-combustion fireplace insert.



# Seal Between Attic and Conditioned Space

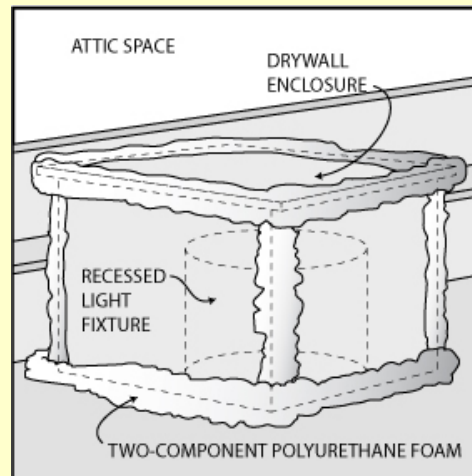
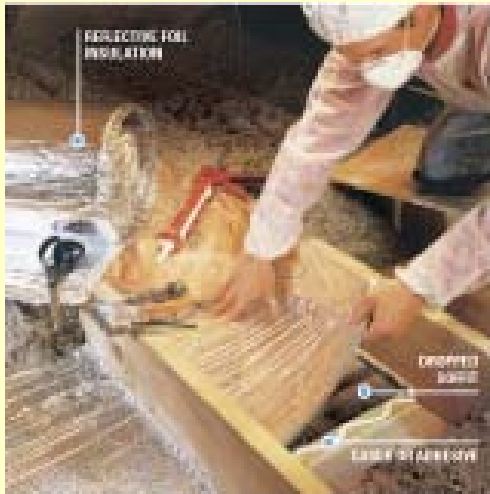


Unsealed plumbing penetrations, House F

Most of the PV homes evaluated have unsealed recessed lights, plumbing penetrations, and/or electrical penetrations between the conditioned portion of the home and the attic or roofing structure.

Replace unsealed recessed lights or retrofit sealed box over them. Seal recessed lights at edges.

# Seal Between Attic and Conditioned Space



Seal ceiling openings around plumbing, wiring, recessed lights, and fans; close off any openings to walls of the house, chimney chase, or dropped ceiling areas.

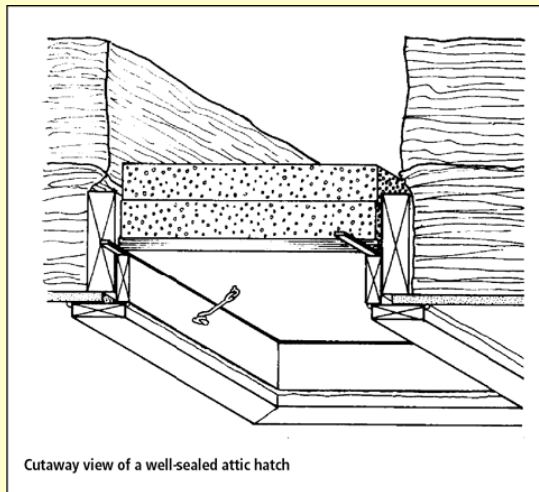
Photos: Energy Star Do-It Yourself Guide to Sealing and Insulating

# Seal Above Crawl Space



Holes around wire and pipe penetrations from crawl space in 2 PV homes

# Seal and Insulate Attic & Crawl Space Entrances



At the four homes with attic or crawl space hatches, none are sealed or insulated.



# Insulate Walls

If the home does not have wall insulation, it can be retrofitted into existing walls. To do so, holes must be drilled in the walls, either on the interior or exterior, so you should assume you will need to repaint as part of the wall insulation project.

6 of the PV homes have known or believed presence of wall insulation.



# Insulate Attic

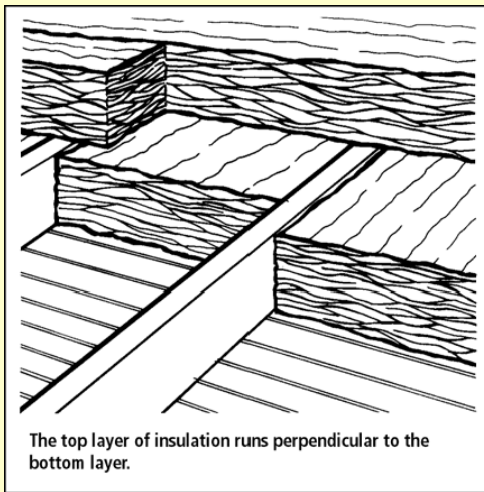


Missing attic insulation in Home A

Three of the seven homes have accessible attic insulation consisting of fiberglass batts. The average insulation level is low, though – approx. R-12. One home has a substantial number of misplaced or missing insulation batts. One home has a largely-uninsulated skylight shaft.



# Insulate Attic



Install insulation (preferably blown-in cellulose). New homes are required to have an insulation level of R-30 in their attic, but R-38 is recommended, and R-50 is great. If you have air ducts running through the attic, be sure to burry them in insulation.

“One of the most cost-effective ways to make your home more comfortable year-round is to add insulation to your attic.”

*Energy Saver\$ at 6.*

# Insulate Under First Floor

5½ of the PV homes have fiberglass batt insulation underneath the house. Three homes had insulation batts missing or fallen from their intended locations.



Fallen insulation under Portola Valley home



No insulation under original portion of House G



# Insulate Hot Water Lines

- Two homes rely primarily on hydronic radiant in-floor heating, but one did not have insulation on the hydronic pipes.
- Few of the hot water pipes in the homes are insulated.



Uninsulated pipes in two PV homes



# Seal & Insulate Ducts

Duct leakage: “20-40% losses, if located outside conditioned space — Like having 3 registers going outside.”

Max Sherman, Lawrence Berkeley National Laboratory, Green Living Forum (Aug. 30, 2007).

“You can lose up to 60% of your heated air before it reaches the register if your ducts aren’t insulated and they travel through unheated spaces such as the attic or crawlspace.”

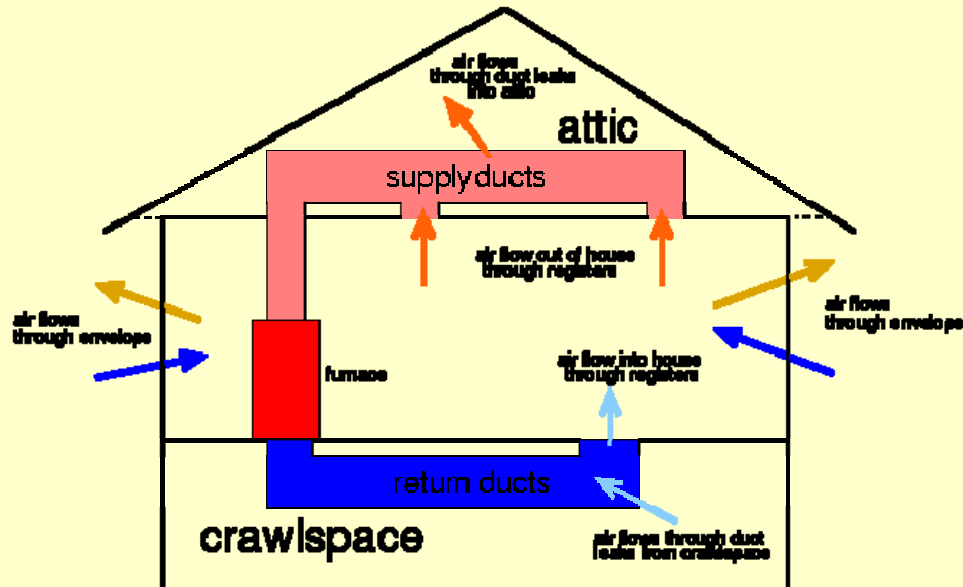
*Energy Saver\$ at 12.*



# Seal & Insulate Ducts

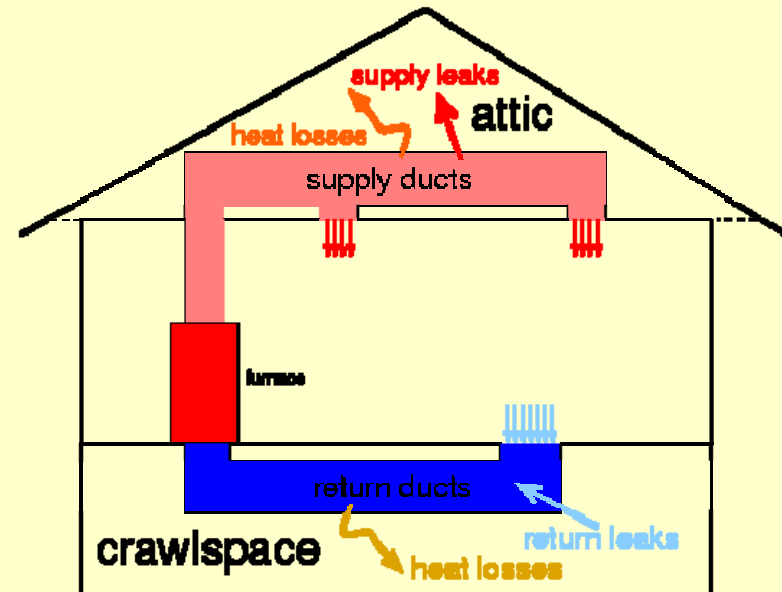
## Air flows through ducts with the system off

Duct leaks contribute additional ventilation air flows when the distribution system is not operating



## Duct losses with the system on

Duct leaks and heat conduction losses through duct walls are combined for total duct losses



Lawrence Berkeley National Laboratory

# Seal Ducts



Dark banding indicates area of duct air leakage in 2 PV homes.



Analyzed PV homes with heat ducts have moderately to extremely leaky duct systems. One home had a disconnected duct.



Disconnected duct, House G

Seal your heat ducts, return ducts, air handlers, register boots, and connections between the boots and the floor or wall.

# Seal Returns

Three of the homes have fully or partially unducted returns. One had a large gap in the return boot.



Gap in unducted return, Home G

Replace unducted returns with sealed, insulated, ducted returns.



Extremely leaky unducted return, Home B

# Insulate Ducts

Insulate the entire duct system to R-6 or R-8.

All six homes with ducted heating have insulation on most of the heat ducts, but most also have areas where duct insulation is missing or has fallen off.



Uninsulated ducts in two PV homes



# Refrigerator Retirement



FIND OUT HOW MUCH YOUR OLD REFRIGERATOR IS COSTING YOU!

- The cost of cooling a spare refrigerator or freezer is often substantial, especially if the appliance is more than 10 years old.
- See refig retirement savings calculator at [EnergyStar.gov](https://www.energystar.gov) under Appliances.



# Refrigerator Replacement



(Not PV photo)

“If you have an old style, inefficient refrigerator, it may be costing you as much as \$280 a year in electricity in areas with high electrical rates. That means that a new, more efficient model will pay for itself just from the energy savings alone.” Cal. Energy Commission, <http://www.consumerenergycenter.org/home/appliances/refrigerators.html>.

- Check efficiency of current model: [EnergyStar.gov](http://EnergyStar.gov).
- Consider size, door service, configuration.
- Shopping list: CEE Super-Efficient Home Appliances Refrigerator list [www.cee1.org](http://www.cee1.org). Aim for Tier 2 or 3 model.

# Dishwasher Efficiency



- Look for a model with a high Energy Factor.
- Shopping list: CEE Super-Efficient Home Appliances Dishwasher list [www.cee1.org](http://www.cee1.org). Aim for a product on the Tier 2 list.

# Clothes Washer



- Look for an Energy Star rated front-loading washer, to reduce water use and spin more water out of the laundry, reducing energy use by dryer. Chose a model with a low Water Factor.
- Shopping list: CEE Super-Efficient Home Appliances Refrigerator list [www.cee1.org](http://www.cee1.org). Aim for Tier 2 or 3 model.

“[N]ew washers on the market today can cut your energy use by as much as 70 percent.”

California Energy Commission,  
<http://www.consumerenergycenter.org/home/appliances/washers.html>.

# Toilet Flow Rate

Replace toilet if flow is over 1.6 gallons per flush. Preferably install a 1.28 gpf max or dual-flush toilet. See Cal. Urban Water Conservation Council

[www.cuwcc.com/toilet\\_fixtures.lasso](http://www.cuwcc.com/toilet_fixtures.lasso) for MaP test results.



Think of water as energy.

Energy is used in water supply and conveyance, pre-use treatment, distribution and system pressurization, heating and cooling, and wastewater treatment.

Water-related energy use consumes 19% of the California's electricity and 30% of its natural gas.

California Energy Commission, "California's Water-Energy Relationship" at 1, 8 (Nov. 2005) (2001 data).



# Emerson Environmental

*Tune Up Your House*<sup>SM</sup>

The average California home energy usage emits 10,600 lbs. (5.3 tons) CO<sub>2</sub> per year.

PG&E Climate Smart™ "Together we can fight climate change" (2007).

The average CA household is responsible for 1 lb/hr CO<sub>2</sub> emissions, almost exclusively from fossil fuels for energy.

Max Sherman, Lawrence Berkeley National Laboratory, *Green Living Forum* (Aug. 30, 2007)

## Questions?

Presented by:

**Suzanne Henderson Emerson, J.D.**  
Emerson Environmental  
[Suzanne@EmersonEnvironmental.com](mailto:Suzanne@EmersonEnvironmental.com)