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Tune Up Your HouseSM

emersonenvironmental.com

Home Performance Incentive Programs and Energy Audits

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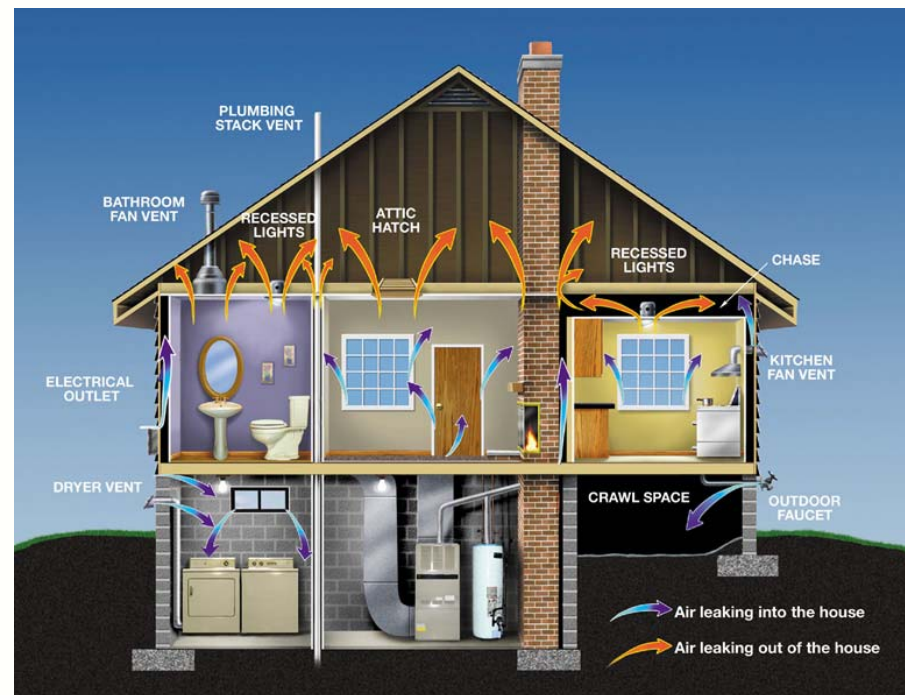
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What is an Energy Audit?

- Evaluation of energy use and recommendation for steps to reduce use
- Not a standardized definition



Energy Audit: Emerson Environmental



- Natural Gas, Electricity, Water
- Combustion safety testing
- Settings on equipment – refrigerant temp, water temp, HVAC temp & times
- Appliance efficiency
- Lighting efficiency
- Passive loads
- Air leaks; blower door test
- Attic and crawl space
 - Air leaks
 - Insulation
 - Indoor air quality



Energy Audit

- Utility bill disaggregation
- Report findings
 - Easy changes, Handyman fixes, major upgrades
 - CD with info on appliance efficiency
 - Photo pages



Thermal Envelope: Thermal Bypasses

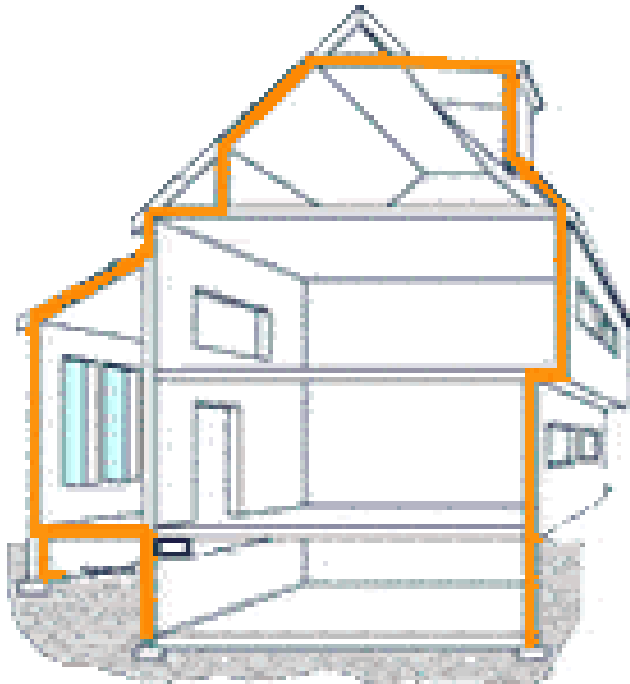


Diagram: <http://www.refreshhomes.com/info.htm>

- Where are the edges of the home's thermal envelope? Are they contiguous? Sealed? Insulated?

bathtub
fireplace
knee walls
soffits
skylights

attic access
cantilevered floor
recessed lights
whole house fan

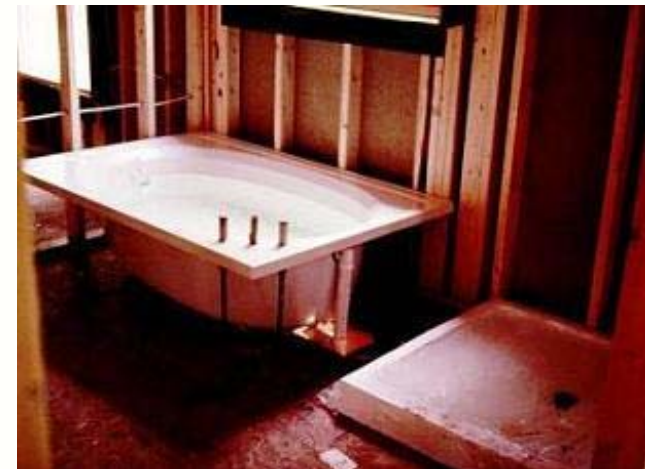
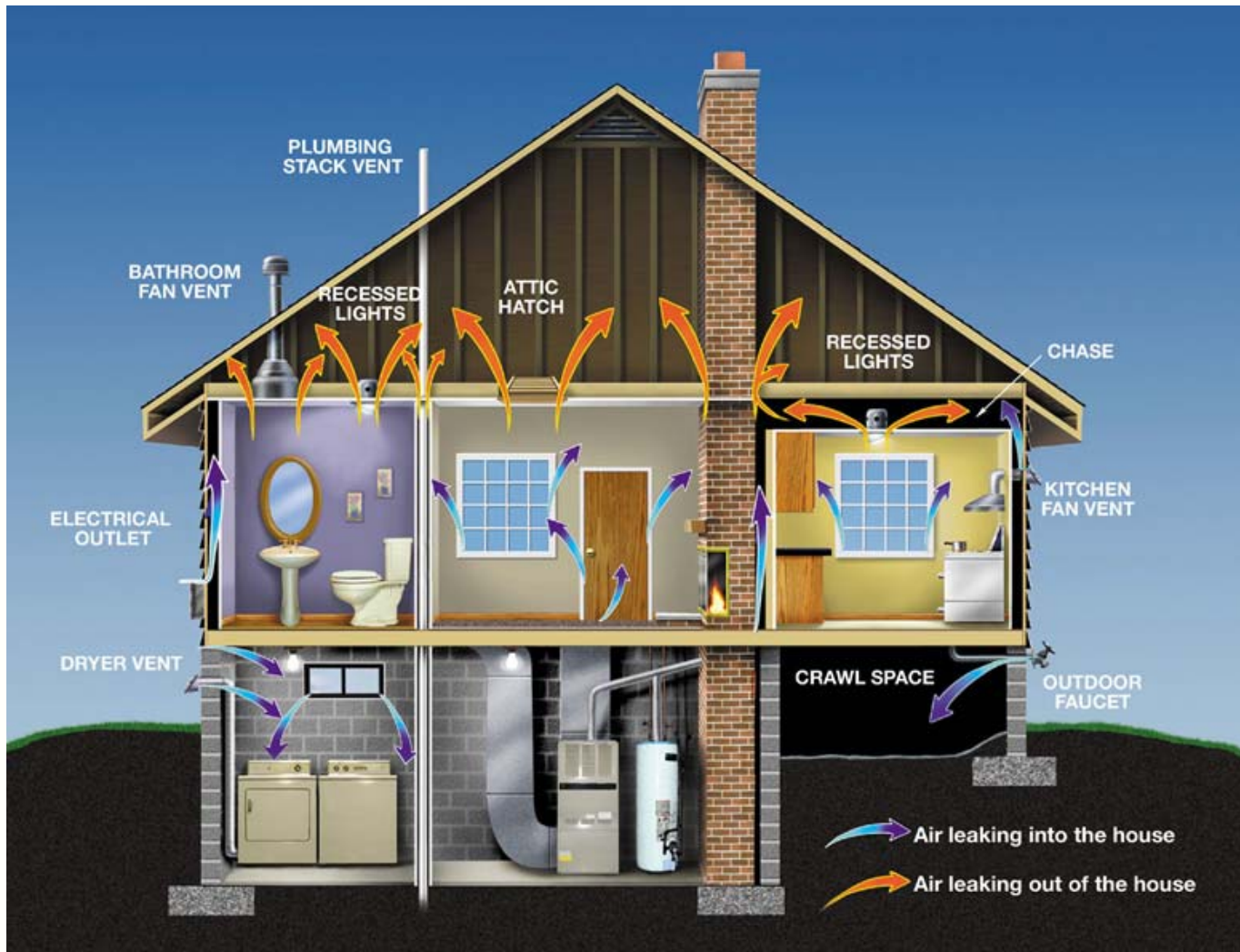


Photo: *Thermal Bypass Guide*

Seal Holes in Thermal Envelope



graphics by Energy Star

Seal Holes in Walls/Ceilings



Seal openings around plumbing lines and electrical lines.



Seal Holes in Walls/Ceilings



Seal openings
around ducts and
vent chases.

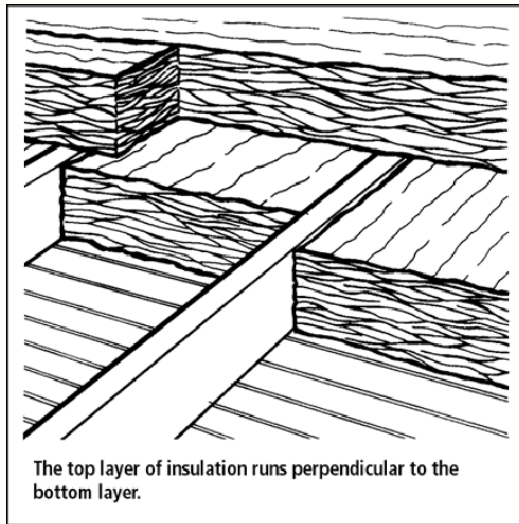
Seal Between Attic and Conditioned Space



Seal Above Crawl Space



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. Insulation needs to come into contact with all 5 sides of the joist bay to work effectively, so make sure the insulation is not gapping or compressed.



Insulate Well

Effective R Values for Fiberglass Batts

- Good—No gaps or other imperfections.
- Fair—Gaps over 2.5% of the insulated area. ($\frac{3}{8}$ inch space along a 14.5 inch batt.)
- Poor—Gaps over 5% of the insulated area. ($\frac{3}{4}$ inch space along a 14.5 inch batt.)

| | "Good" | "Fair" | "Poor" |
|----------------------------------|----------------------------------|----------------------------------|----------------------------------|
| Measured Batt Thickness (inches) | Effective R-value (2.5 per inch) | Effective R-value (1.8 per inch) | Effective R-value (0.7 per inch) |
| 0 | 0 | 0 | 0 |
| 1 | 3 | 2 | 1 |
| 2 | 5 | 4 | 1.5 |
| 3 | 8 | 5 | 2 |
| 4 | 10 | 7 | 3 |
| 5 | 13 | 9 | 3.5 |
| 6 | 15 | 11 | 4 |
| 7 | 18 | 13 | 5 |
| 8 | 20 | 14 | 5.5 |
| 9 | 23 | 16 | 6 |
| 10 | 25 | 18 | 7 |
| 11 | 28 | 20 | 8 |
| 12 | 30 | 22 | 8.5 |

Building Performance Institute, *Yellow Sheet*, derived from ASHRAE, *Heat Transmission Coefficients for Walls, Roofs, Ceilings, and Floors* (1996)

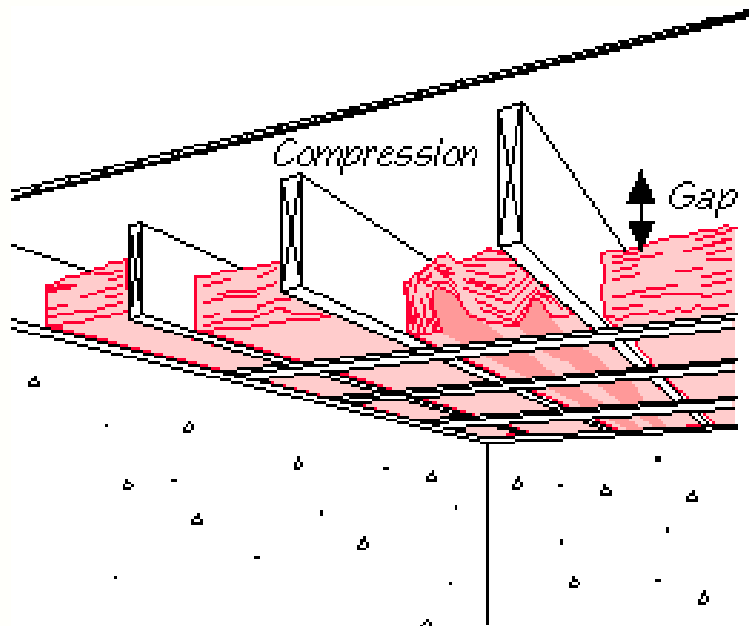


Insulate Walls

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.



Insulate Under First Floor



Two common flaws in floor insulation are gaps above the batt and compression of the batt in the cavity.



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



Seal your heat ducts, return ducts, air handlers, register boots, and connections between the boots and the floor or wall, and insulate the entire duct system to R-6 or R-8. The average duct system leaks 30%.



Energy Audit Types

- Building Performance Institute: home performance evaluation
- HERS II (Home Energy Rating System)
- Non-standardized
 - On-line or over-the-phone
 - Volunteer or Green Collar
 - Electricity use evaluation
 - Water audits
 - Other



Energy Audit: BPI

- Performed by a BPI Certified “Building Analyst Professional”
- Standardized testing procedures
 - Combustion safety testing
 - Carbon Monoxide production tested at furnace, water heater, range, oven
 - Natural gas leaks tested for
 - Backdrafting tested at furnace & water heater
 - Blower Door test for air infiltration
 - Efficiency of major appliances evaluated
 - Insulation levels evaluated
- May include
 - Duct Test
 - Lighting efficiency
 - Water fixture flow and toilet leakage test
 - Infrared thermal imaging
 - Electrical load measurements

Offered by independent auditors and companies:

- Emerson Environmental
- Energy Beyond Design
- Building Solutions
- Recurve?



Energy Audit: BPI

Advantages

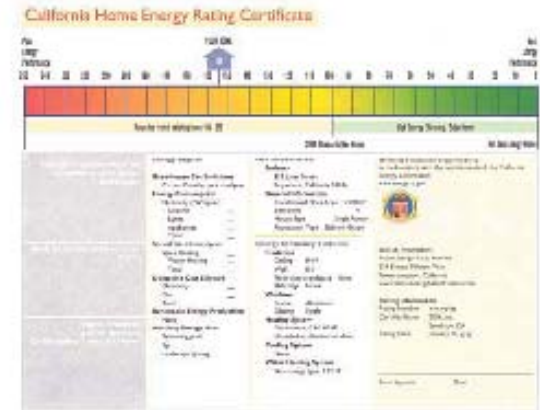
- Trained & Certified auditor
- Nationally-standardized evaluation standards
- One of the audit types used in PACE, PG&E Whole House rebates, and possible Home Star programs
- Combustion safety testing included and indoor air quality threats noted

Disadvantages

- Relatively expensive
- Report types vary
- Might not include occupant behavior recommendations, evaluation of passive electrical loads, water use
- Vested interest in recommending services he or she sells?



Energy Audit: HERS II



- Home Energy Rating system
- Awaiting Cal. Energy Commission final approval
- Standardized computer modeling of home and evaluation of major appliance and system efficiency
 - summary of existing conditions of the home (insulation, windows, major appliances, air leakage, etc.)
 - overall Rating Score of the home, as it is
 - recommended cost-effective energy updates
 - estimates of cost, annual savings, and useful life of upgrades
 - improved Rating Score after the installation of recommended upgrades
 - estimated annual total energy cost for the existing home before and after upgrades
- Offered by independent HERS Raters. See cheers.org, “find a rater”

Energy Audit: HERS II

Advantages

- Trained & Certified auditor
- State-wide standardized computer modeling, report, and score format
- One of the audit types used in PACE, PG&E Whole House rebates, and possible Home Star programs
- May qualify home for Energy Efficient Mortgage
- Marketing Advantage?

Disadvantages

- Relatively expensive
- Experienced?
- Might not include occupant behavior recommendations, evaluation of passive electrical loads, water use
- Combustion safety and indoor air quality may be omitted

Energy Audit: Non-Standardized On-line or Over-the-Phone

- PGE.com: My Home, Save Energy & Money, Energy Analyzer
- Home Energy Saver on-line audit:
<http://hes.lbl.gov/>
- Generally Includes: types of appliances, insulation levels, lighting efficiency
- See also ennovationz.com

The screenshot shows the homepage of the Home Energy Saver tool. At the top, a green banner reads "HOME ENERGY SAVER" with the tagline "The first web-based do-it-yourself energy audit tool". Below this is a navigation menu with links: "About this Site", "What's New?", "Testimonials", "Librarian", "Glossary", "FAQ", "Ask An Expert", "No/Low-Cost Tips", "Remodeling", "Local Resources", "Awards & Accolades", "Press Information", "Demo Movie", "Developers", "Students & Teachers", "Search", and "Help". The main content area features a large image of a house with the text "ENERGY EFFICIENCY" overlaid. To the right of the image is a "CALCULATOR" section with the text "Find the best ways to save energy in YOUR home!". Below this are input fields for "Enter your zip code" and "Enter previous session #", with a "Go!" button. A link "Click here to give us your feedback and help us to improve this site." is positioned above the calculator. Below the calculator, there is a section titled "Investing in a home on your street could be more profitable than investing on Wall Street." and another section "MAKING IT HAPPEN Find resources to make your home more energy efficient." At the bottom, a footer states "Money isn't all you save. Visit the ENERGY STAR website for information on energy-efficient products." and "Developed by the Environmental Energy Technologies Division at Lawrence Berkeley National Laboratory". Logos for various partners are displayed at the bottom, including the Environmental Energy Technologies Division, pier, PATH, Tri-State Energy Cooperatives, and the California Environmental Protection Agency AIR RESOURCES BOARD.

Energy Audit: Non-Standardized On-line or Over-the-Phone

Advantages

- Free
- Convenient

Disadvantages

- Info provider (you) not trained
- Evaluation generally not sufficiently site-specific
- Wacky computer simulations
- No “expert eye”
- Combustion safety and indoor air quality omitted

Energy Audit: Non-Standardized Volunteer or Green Collar



- Acterra Green@Home
 - Appliance efficiency, lighting, thermostat control, water fixture flow, occupant behavior
 - Installation of low-flow showerheads, programmable thermostat, some CFLs
- Potential Green Collar programs

Energy Audit: Non-Standardized Volunteer or Green Collar

Advantages

- Free or low cost
- Likely more detailed than on-line evaluation

Disadvantages

- Auditor not a certified energy auditor and may or may not be experienced
- Limited Scope
- Combustion safety and indoor air quality may be omitted

Energy Audit: Non-Standardized Electricity Use Evaluation

- Solar PV contractors
 - Walk-through of electric appliances
- Chris Hunt at PowerDown, powerdownus.com
 - Circuit-by-circuit analysis of standby and active loads
 - Installation of CFLs, smart strips, electric load monitoring device
 - Detailed report



Energy Audit: Non-Standardized Electricity Use Evaluation

Advantages

- Auditor has some training
- PowerDown produces detailed spreadsheets

Disadvantages

- Certified energy auditor?
- Experienced?
- Limited Scope (PV audits)
- PV salesperson has vested interest in you not reducing your electricity bill/buying a smaller PV system
- Natural gas uses?
- Combustion safety and indoor air quality omitted

Energy Audit: Non-Standardized Other

- Scope varies – May or may not include elements addressed in Certified programs
- Gas and Electricity, maybe Water
- Ennovationz
- Recurve

Energy Audit: Non-Standardized Other

Advantages

- More detailed than on-line or volunteer evaluations
- Auditor has some training

Disadvantages

- Costs vary
- Certified energy auditor?
- Experienced?
- Limited Scope?
- Vested interest in recommending services he or she sells?
- Combustion safety and indoor air quality may be omitted

Incentive Programs

- PGE – “Whole House Retrofit Plan”
- CaliforniaFirst / AB 811 / PACE
- Home Star

Incentive Programs: PGE

- Still in development. Info as of 2/18/2010.
- Prescriptive Whole House Retrofit Plan (PWHRP)
- 2 levels of incentives
- Basic Package
 - Shell measures: air sealing and combustion safety testing, duct sealing, attic insulation, hot water insulation
 - ~ \$1,000 customer incentive, TBD
- Whole House Performance: Comprehensive Package
 - Comprehensive test-in and test-out
 - HERS II rating
 - Shell measures + system upgrades (wall insulation, heating, cooling, ducting, pool pump)
 - ~ \$3,500 customer incentive, TBD
- Base Load: optionally can be included (light fixtures and controls, appliances, visual in-home displays, room air conditioners, low-flow showerheads, faucets)



Incentive Programs: CaliforniaFIRST

- San Mateo County participating in multi-county program, with grant funds for launch
- Residential Energy Action Program (REAP) has 2 parts:
 - Retrofit Bay Area: encourage homeowners to conduct energy audits and install recommended energy saving measures in their homes
 - CaliforniaFIRST: offer Property Assessed Clean Energy (PACE) (AB 811) financing, allowing property owners to finance energy efficiency and renewable energy retrofit work through a loan repaid as a line item on their property tax bills.
- Program currently in development, so specifics not available
- Scheduled to launch “Summer 2010” CaliforniaFirst.org
- California First similar to SF program:
 - Loan size: \$5K min; max. the lower of 10% of home value or \$75K
 - No credit check, but may have a requirement of 20% home equity
 - Application Fee (SF is \$300, app. on-line)
 - Interest rate lowered by Stimulus Funds (initially)
 - Repayment period 5-20 years (Sonoma avg 8)



PACE: Simple, Effective Tool

City or county creates type of land-secured financing district or similar legal mechanism



Property owners voluntarily sign-up for financing and install energy projects



Proceeds from PACE bond or other financing provided to property owner to pay for energy project



Property owner repays bond through property tax bill (up to 20 years)



Slides: Kelley McKanna & Ken Hejmanowski, Renewable Funding, "Northern California PACE Programs" (2/18/10).

Eligible Projects (in SF program)

| PROJECT CLASS | CATEGORY |
|---|---|
| Energy Efficiency | Air Sealing & Ventilation Insulation Reflective Roof Space Heating & Cooling Water Heating Window Replacement Combustion Safety |
| Renewable Energy | Solar PV Wind |
| Water Efficiency | Fixtures Landscaping |
| Other* <i>*Pending approval by the CEC</i> | Greywater Irrigation Systems Rainwater Harvesting Living Roofs Energy Storage Systems |

Slides: Kelley McKanna & Ken Hejmanowski, Renewable Funding, “Northern California PACE Programs” (2/18/10).

Project Pathways (in SF)

| Project Type | Energy Audit ¹ | Install | Duration |
|------------------|---------------------------|---|-------------------------------|
| EE | Yes | Eligible Projects identified in audit | Entire program |
| EE | No | Basic EE/H ₂ O Package + Eligible Projects | Pilot Phase ² only |
| EE + RE | Yes | Eligible Projects identified in audit and must show 20% improvement; Solar PV | Entire program |
| EE + RE | No | Basic EE/H ₂ O Package; Solar PV | Pilot Phase only |
| H ₂ O | No ³ | Eligible Projects identified in evaluation | Entire program |

¹Audits must be conducted by participating BPI contractors or HERS-II raters for residential properties or a SF Energy Watch contractor for commercial properties.

²Pilot Phase is anticipated to run through 01/1/11 but may be amended at the discretion of the City.

³Water-Wise Evaluation is required. Must follow pre- and post-install requirements of the SFPUC.

Slides: Kelley McKanna & Ken Hejmanowski, Renewable Funding, “Northern California PACE Programs” (2/18/10).

Incentive Programs:

Home Star (“Cash for Caulkers”)

- Proposed \$6 Billion Federal rebate program
- Silver Star
 - \$1,000-1,500 for each measure installed, or \$250 per appliance, up to lesser of \$3,000 or 50% of total project cost
 - Air sealing; attic, wall, & crawl space insulation; duct sealing or replacement; replacement of windows & doors, furnaces, air conditioners, heat pumps, water heaters, and appliances with high-efficiency models
- Gold Star
 - Comprehensive energy audit and implementation of variety of measures together designed to provide greater total returns in energy savings
 - BPI or HERS II energy audit and test-out
 - \$3,000 for modeled savings of 20%, plus \$1,500 for each additional 5% of modeled energy savings up to max of 50% of project cost
 - Contractors must be BPI Accredited





Emerson Environmental

Tune Up Your HouseSM

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The average California home energy usage emits 10,600 lbs. (5.3 tons) CO₂ per year.

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

Questions?

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The average CA household is responsible for 1 lb/hr CO₂ emissions, almost exclusively from fossil fuels for energy.

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