



Emerson Environmental

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

# Tuning Up Your Home: Residential Energy Efficiency Retrofits and Modifications

“What can I do at my house to  
use less energy?”

Presented by:

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Emerson Environmental

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# Why Increase Efficiency?



- Save Money
- Reduce Greenhouse Gas Emissions
- Increase Property Value
- Bragging Rights
- Comfort

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).



# What's a Kilowatt?

- A watt is a unit of electrical power
  - a 100 watt incandescent bulb
- A kilowatt (kW) is equal to 1000 watts
  - 10 of the 100 watt bulbs burning at once

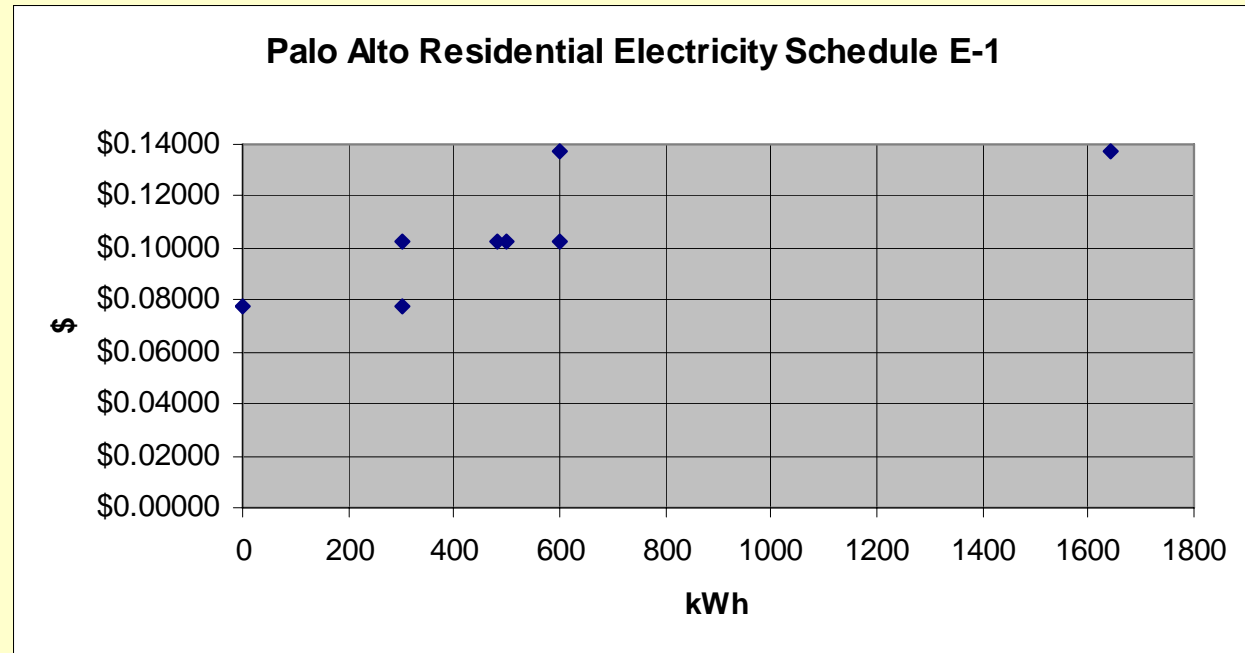


- A kilowatt-hour (kWh) is a unit of electric energy
  - 10 of the 100 w. bulbs burning for 1 hour = 1 kWh



# Your Electricity Rate

Electricity rates generally depend on how much electricity you use.



© Emerson Environmental, LLC

## Palo Alto Residential Rate Schedules

E-1: 1-300 kWh \$0.07729 301-600 \$0.10266 601+ \$0.13698

E-1-G: 1-300 kWh \$0.09229 301-600 \$0.11766 601+ \$0.15198

480.5 kWh/mo = Avg. San Mateo County Residence

500 kWh/mo = Avg. New CA 2000 sq. ft. Residence

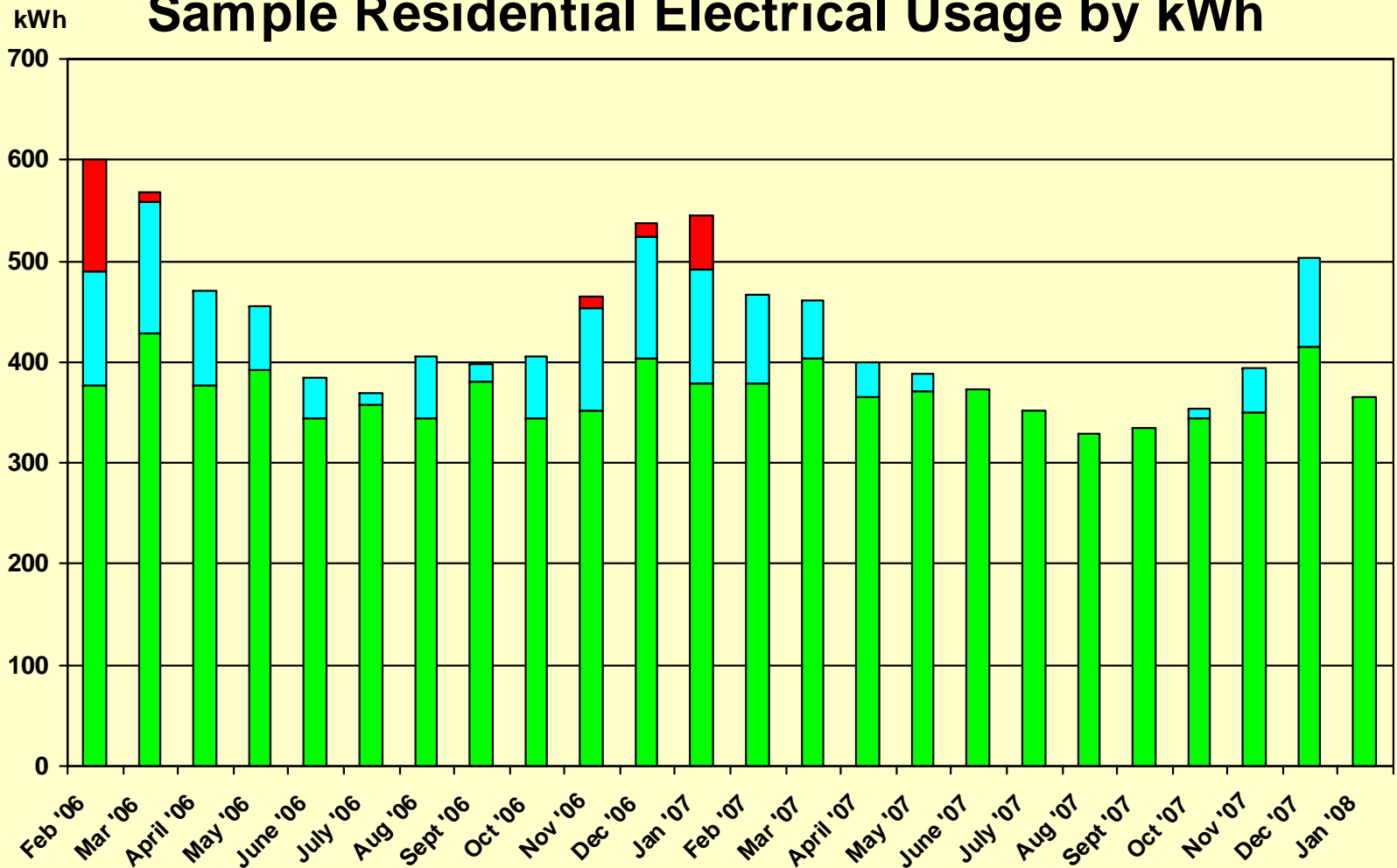
1641 kWh/mo = Avg. Atherton Residence



# Seasonal Electricity Use

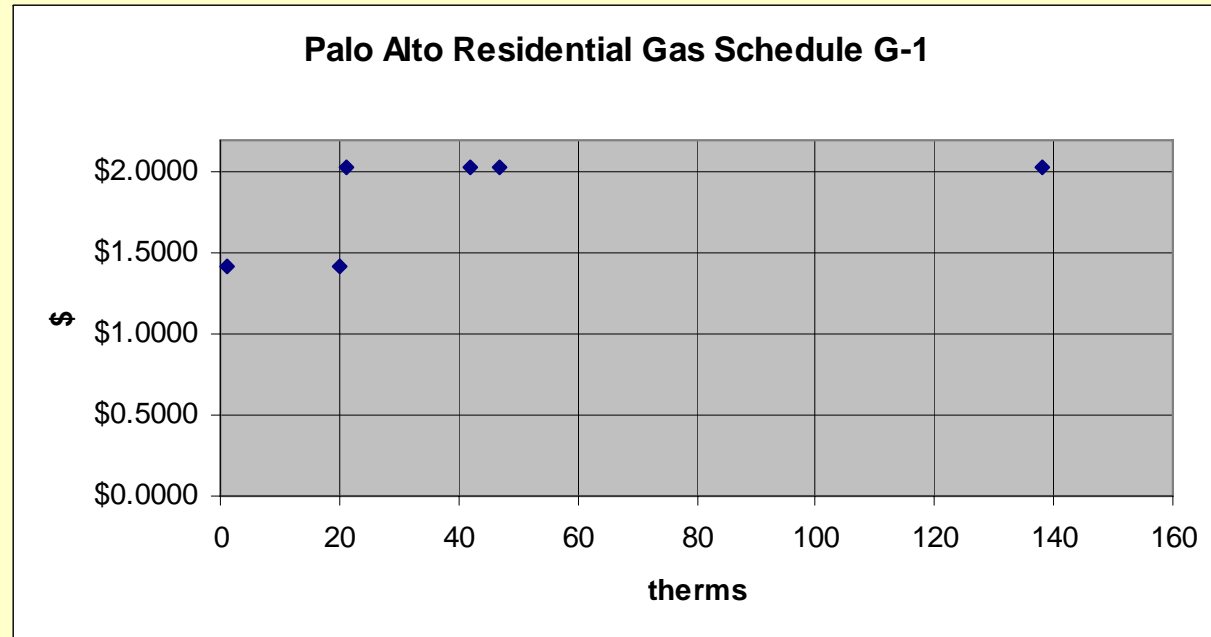
## Sample Residential Electrical Usage by kWh

If you track your energy bills, you will likely see seasonal differences due to heating, cooling, and seasonal lighting loads.



# Your Gas Rate

Gas rates generally depend on how much gas you use.

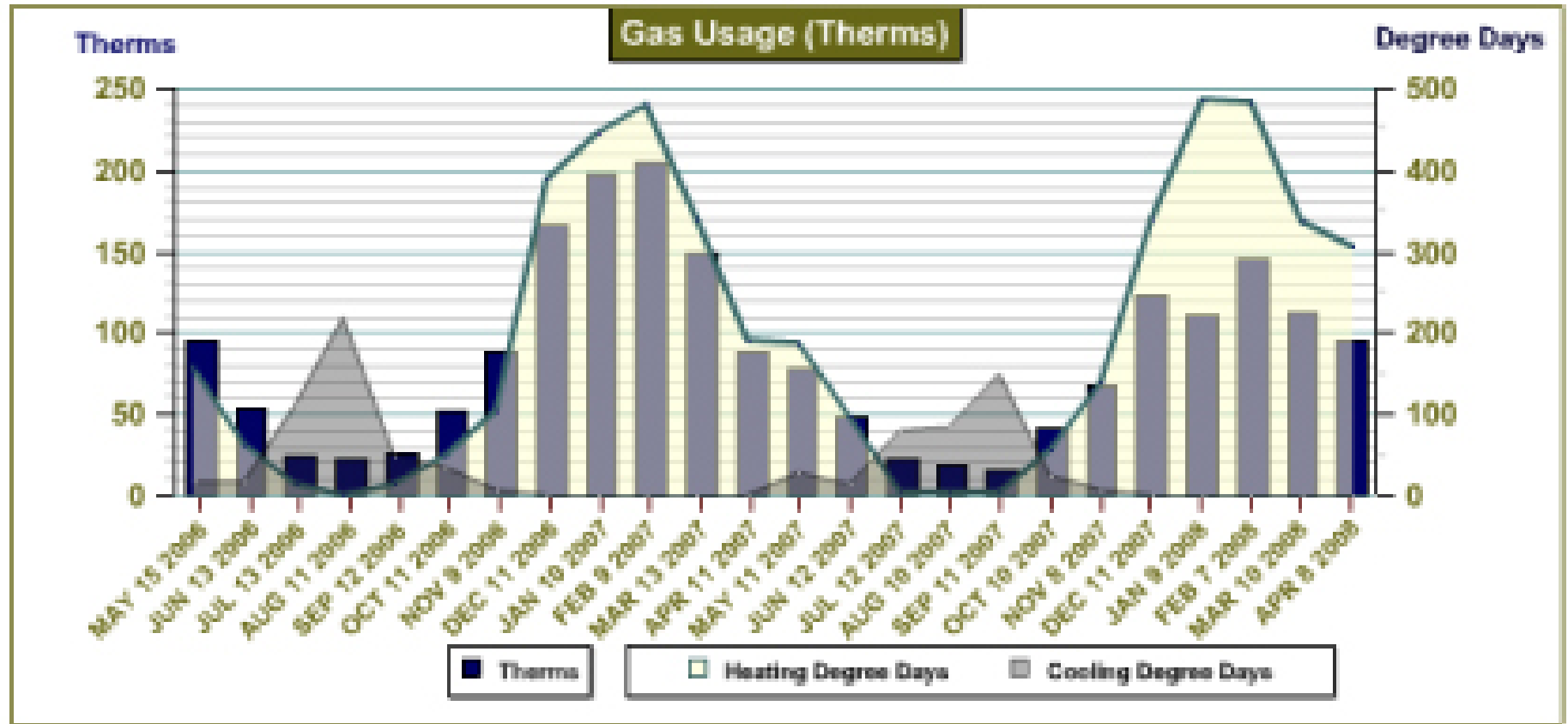


© Emerson Environmental, LLC

Palo Alto Residential Rate Schedule G-1:  $\$5.25 +$   
1-20 summer [1-96 in winter] therms  $\$1.4226$   
20+ summer [96+] therms  $\$2.0386$   
42 therms/mo = Avg. New CA 2000 sq. ft. Residence  
47 therms/mo = Avg. San Mateo County Residence  
138 therms/mo = Avg. Atherton Residence



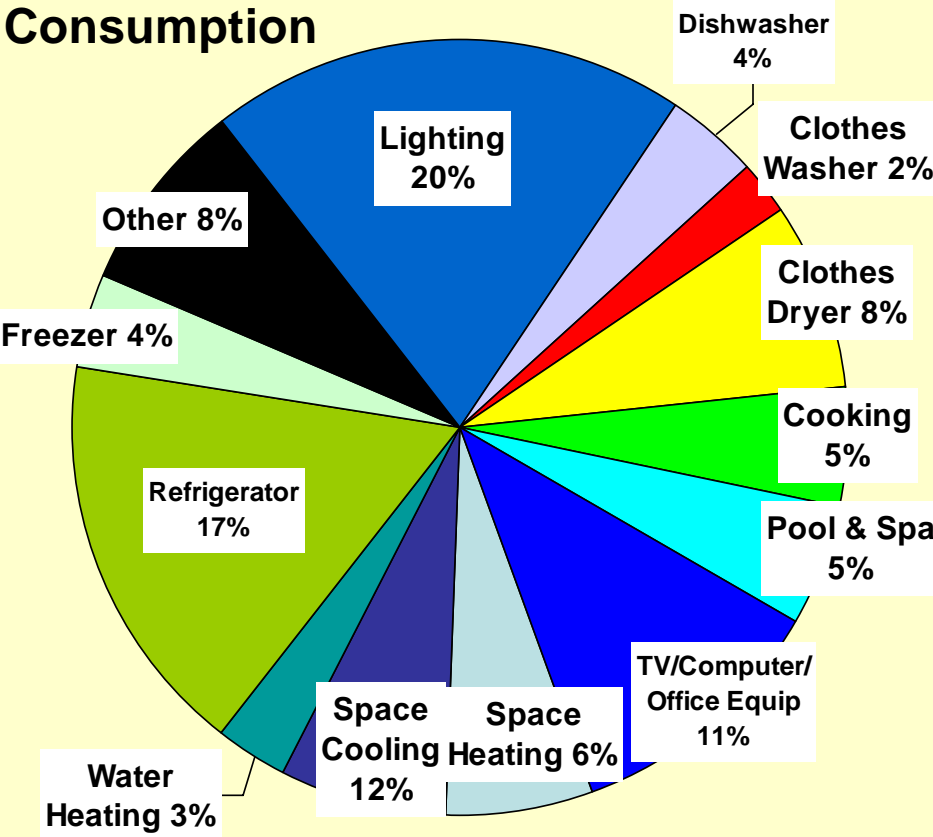
# Your Gas Use



Graphics: PG&E

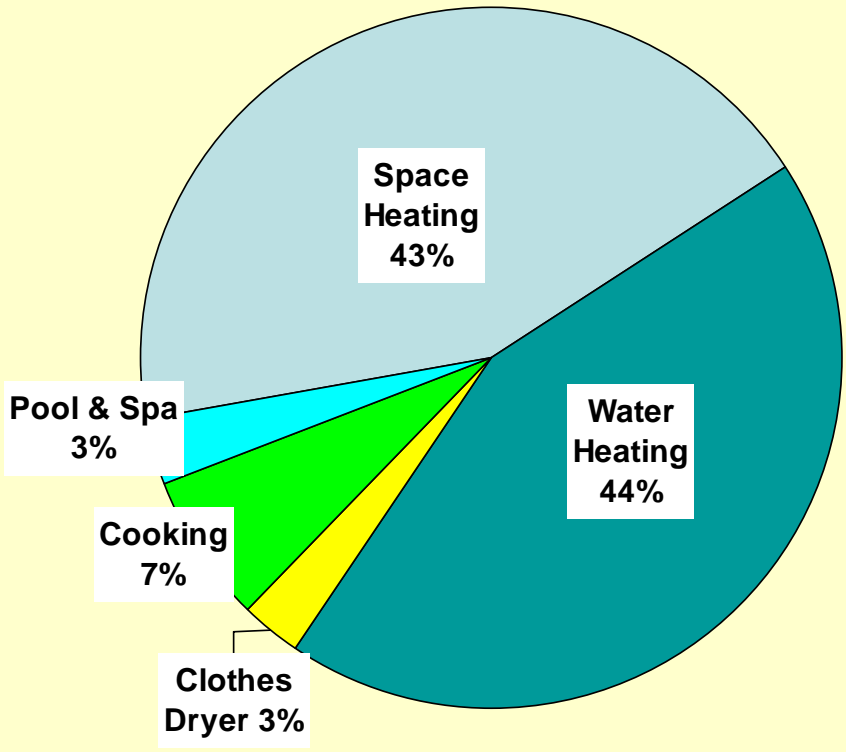
# Current Energy Use

**Cal. 2004 Residential Electricity Consumption**



Data: Rufo & North, Itron, for Cal. Energy Comm'n, *Assessment of Long-Term Electronic Energy Efficiency Potential in California's Residential Sector*, Fig. 7.3.3 (2007); David Johnson, *What's Working*, for Build It Green (2007)

**Residential Gas Consumption**



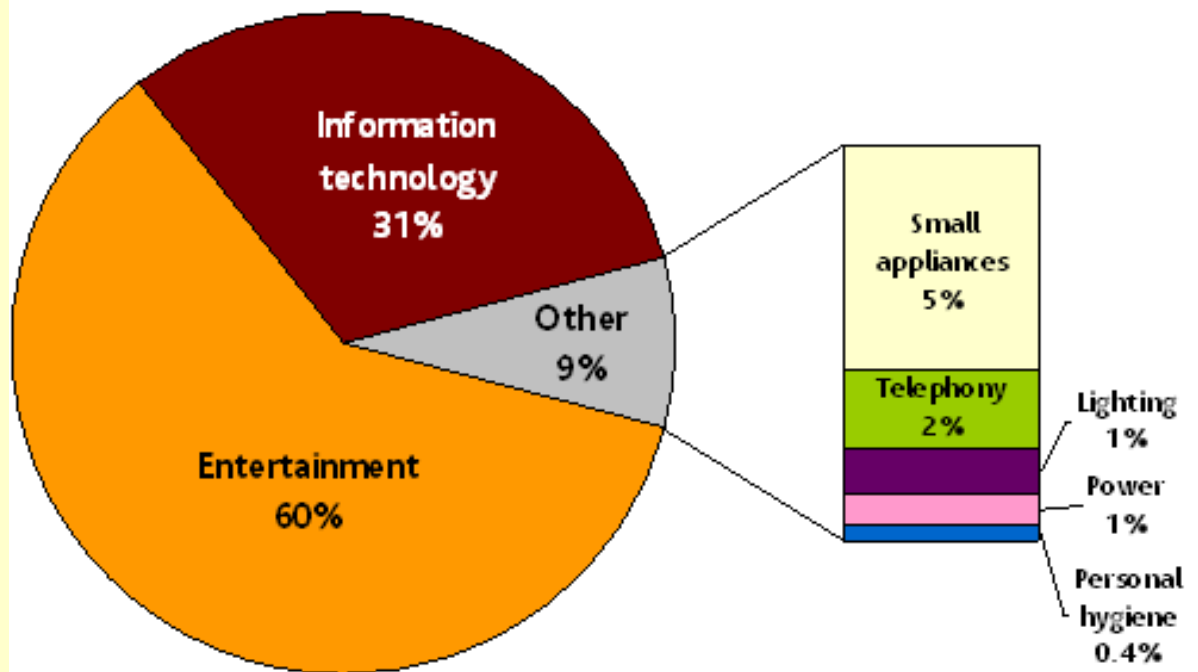
Data: David Johnson, *What's Working*, for Build It Green (2007), citing CA Energy Comm'n; graphics © Emerson Environmental, LLC

# Plug Loads – Typical CA Home

- Electronic products cost approx. **\$150** per year to power.
- Plug loads account for more than **15%** of the energy used by the home.
- Entertainment and information technology account for **over 90%** of the electricity used by plug load devices.

PRODUCT	NATIONAL ANNUAL COST	PG&E Tier 5 ANNUAL COST
20-cu.-ft. refrigerator (a newer top-freezer)	\$50	170
25-cu.-ft. refrigerator (a newer side-by-side)	65	220
32-inch picture-tube	40	140
36-inch picture-tube	50	170
37-inch LCD	50	170
40-inch LCD	55	180
56-inch rear-projection	65	220
42-inch plasma, 720p	70	240
52-inch LCD	80	270
50-inch plasma, 720p	80	270
50-inch plasma, 1080p	110	380

Based on Consumer Reports, "Power Play: What it Costs to Run a Big Screen TV" (March 2008) (national cost: Dept. of Energy 2007 nat'l avg price 10.65¢/kwh).



# Current Residential Water Use

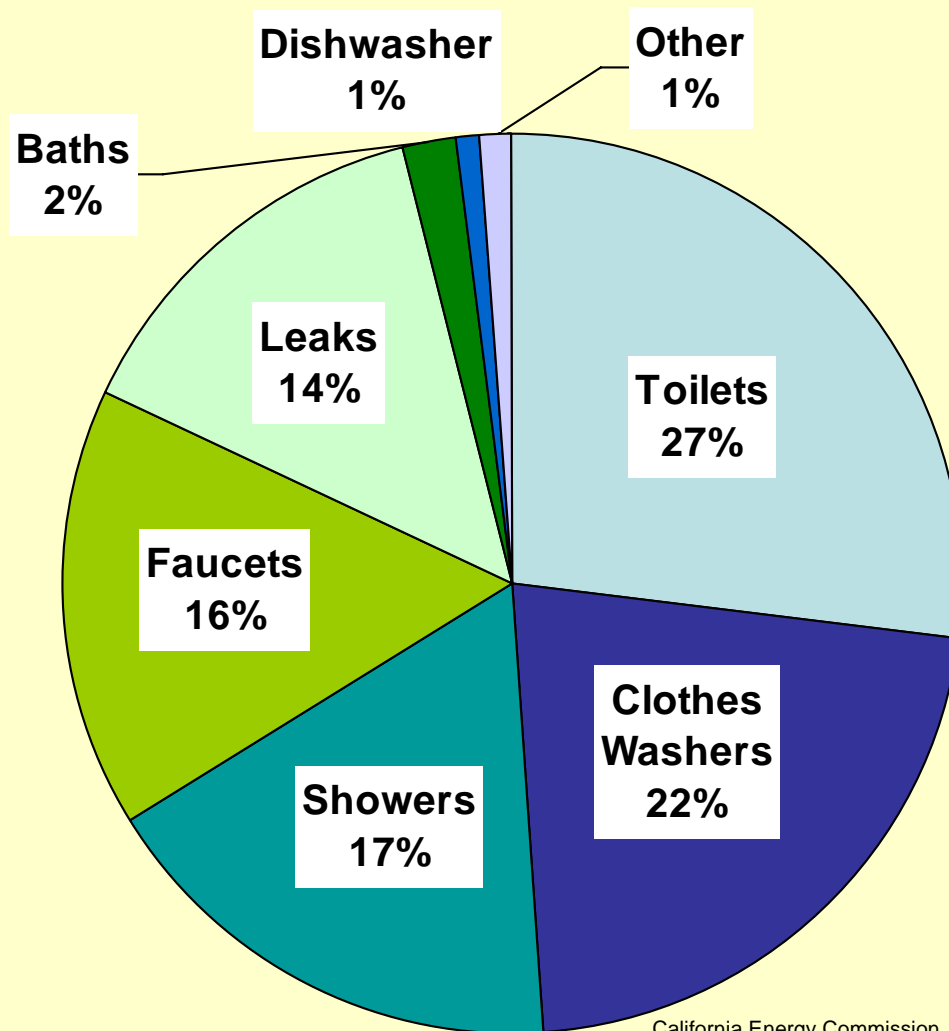


- Think of water as energy.
- Energy is used in water supply and conveyance, pre-use treatment, distribution and system pressurization, heating and cooling, and wastewater treatment.
- Water-related energy use consumes 19% of the California's electricity and 30% of its natural gas.

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

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

# Current Residential Water Use



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

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

# Incentives

City of Palo Alto Website - Residential - Windows Internet Explorer

http://www.cityofpaloalto.org/depts/ut/temp/residential/default.asp


File Edit View Favorites Tools Help

Google palo alto utilities Search Bookmarks Check AutoFill palo alto utilities

City of Palo Alto Website ... X City of Palo Alto Website - Gr...

Home Living in Palo Alto Business in Palo Alto Visiting Palo Alto Environment in Palo Alto Arts, Parks & Recreation Know Zone **Departments** Emergency Information


Utilities Home Previous Page Residential Home Bill Payment Residential Rates Rebates Programs Sustainability



## utilities


Contact Us	
Location:	250 Hamilton Avenue Palo Alto, CA 94301
Telephone:	Phone: 650-329-2181 Fax: 650-617-3142
Hours:	Mon-Thu 7:30-5:30pm Fri 8-5pm (Closed Alt Fri.)

## Residential Services



The City of Palo Alto has many programs to help you save money and help the environment. You can make the world a better place by using our water and energy efficiency programs, [PV Partners rebate](#), [Solar Water Heating incentive](#), [on-line energy audits](#), and so much more.

[more]



Our secure customer service website provides [access to your account](#) from your own computer. You can view financial and consumption information and use the following services:

- ▶ View your account's current balance and due date
- ▶ Access your billing history including payments and charges
- ▶ See historical usage data
- ▶ Update or add your phone number and/or e-mail
- ▶ Send a secure message about your account

## Paying My Bill


- ▶ [Residential Rates](#)
- ▶ [Customer Service](#)
- ▶ [Low Income Rate Discount](#)
- ▶ [New Billing System and Account Number Changes](#)

## Rebates and Programs

- ▶ [On-Line Energy Audit](#)
- ▶ [SMART Energy Gas and Electric Rebates](#)
- ▶ [Refrigerator Recycling](#)
- ▶ [Residential Water Programs](#)
- ▶ [Low Income Appliance Replacement \(REAP\)](#)
- ▶ [New Construction Rebates](#)
- ▶ [Stormwater Rebates](#)
- ▶ [Summer 2009 Workshops](#)

## Renewable Energy

- ▶ [PV Partners \(Solar Electric\)](#)
- ▶ [Solar Water Heating](#)
- ▶ [PaloAltoGreen](#)
- ▶ [Summer 2009 Workshops](#)



# Free Measures to Save Money (and Energy)

- Turn off lights and electronics when leaving a room.
- Turn down water heater thermostat to 120°F.
- Set thermostats to 68°F in winter when you're home, and down to 55°F when you go to bed or when you're away. (Programmable thermostats do this automatically.) But – if you have to choose between a shorter nighttime set-back or a larger furnace, go with the smaller furnace.



# Free Measures to Save Money (and Energy)

- Use energy-saving settings on washing machines, clothes dryers, dishwashers, and refrigerators.
- Wash clothes in cold water and only full loads.
- Don't waste water, hot or cold, inside or outside your home.

Based on R. Heede, *Homemade Money* (Rocky Mountain Inst. 1995)



# Free Measures to Save Money (and Energy)

- Clean your refrigerator's condenser coils once a year.



Based on R. Heede, *Homemade Money* (Rocky Mountain Inst. 1995)

# Free Measures to Save Money (and Energy) (cont.)

- Air-dry your clothes.
- Repair leaky faucets and toilets.
- Close drapes and windows during sunny summer days and after sunset in the winter.

Based on R. Heede, *Homemade Money* (Rocky Mountain Inst. 1995)



# Simple & Inexpensive Ways to Lower Your Energy Bill in 1 Year

- Install a standard, water-saving 2.5-gallon-per-minute (or less) showerhead. (\$5-15)
- Install water-efficient faucet heads for your kitchen and bathroom sinks. (\$2 each)

**Water Conservation: Replacing Inefficient Fixtures**

Product	Inefficient Product (gpm) <sup>1</sup>	Standard Product (gpm)	Gallons of Water Saved per		
			per Minute	per Day <sup>2</sup>	per Year <sup>3</sup>
Kitchen Aerator	3.5	2.5	1	8.1	2,957
Sink Aerator	3.5	2.2	1.3	10.53	3,843
Showerhead	5	2.2	2.8	14.84	5,417
<b>Total:</b>				<b>33</b>	<b>12,217</b>

**Water Conservation: Replacing Standard Fixtures with Low-Flow Fixtures**

Product	Standard Product (gpm) <sup>1</sup>	Low-Flow Product (gpm)	Gallons of Water Saved per		
			per Minute	per Day <sup>2</sup>	per Year <sup>3</sup>
Kitchen Aerator	2.5	2	0.5	4.05	1,478
Sink Aerator	2.2	1	1.2	9.72	3,548
Showerhead	2.2	1.75	0.45	2.39	871
<b>Total:</b>				<b>16</b>	<b>5,897</b>

<sup>1</sup>gpm – gallons per minute

<sup>2</sup>based on a total household use of 5.3 minutes per capita per day for showers and 8.1 minutes per capita per day for kitchen and sink aerators

<sup>3</sup>based on use for 365 days per year

Based on Metropolitan North Georgia Water Planning District (2006)



# Simple & Inexpensive Ways to Lower Your Energy Bill in 1 Year

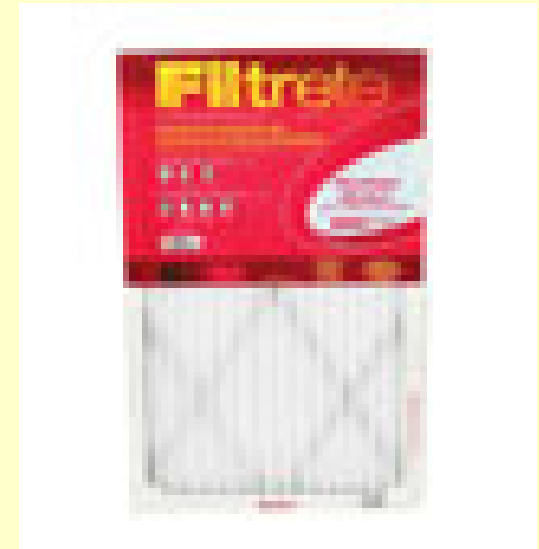
- Install a programmable thermostat and use it.\* (\$25-75)
- In the attic and basement, seal the air leaks a cat could crawl through, and replace and reputty broken windowpanes. (~\$40)
- Install an R-7 or R-11 water heater wrap if your water heater isn't pre-insulated. (\$15-25)

Based on R. Heede, *Homemade Money* (Rocky Mountain Inst. 1995)

# Simple & Inexpensive Ways to Lower Your Energy Bill in 1 Year

(cont.)

- Clean or change the air filter on your warm-air heating system during winter and on air conditioning units in the summer. (\$4-15) But don't use an "ultra pure" filter, as it may negatively impact your furnace's efficiency.
- Insulate the first three feet of hot and inlet cold water pipes. (\$6)



# Simple & Inexpensive Ways to Lower Your Energy Bill in 1 Year

(cont.)



- Install compact fluorescent light bulbs in the fixtures you use most. (\$6-30)



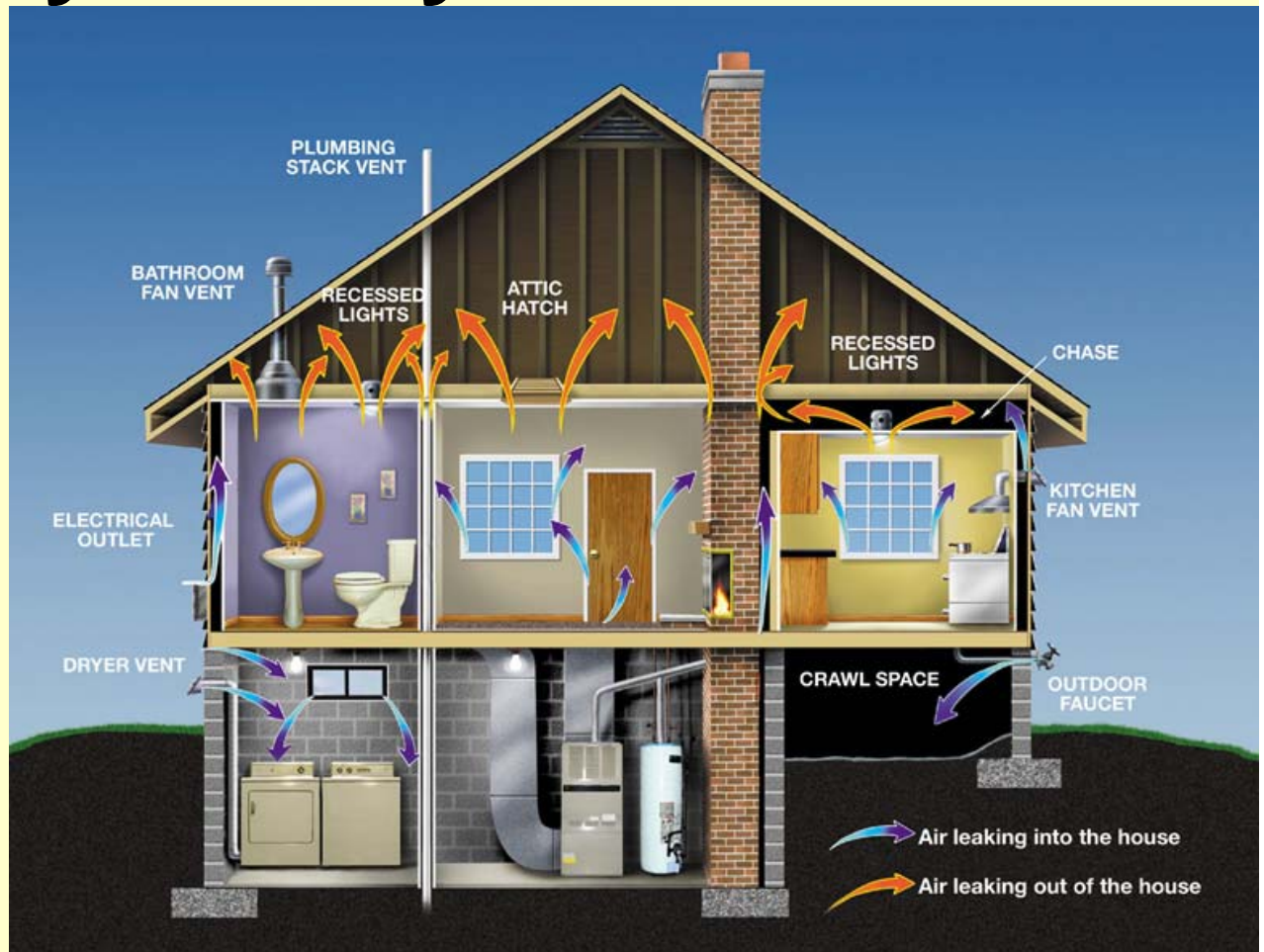
	100w Incandescent	23w CFL
Watts	100 w	23 w
Hours used	8000 hrs	8000 hrs
# of bulbs required	8	1
Cost per bulb	\$0.63	\$2.00
Total bulb cost	\$5.04	\$2.00
Energy used	800 kWh	184 kWh
Energy cost per kWh	\$0.12	\$0.12
Energy cost total	\$96.00	\$22.08
Total Cost	\$101.04	\$24.08
Savings with CFL		\$76.96



# Getting Serious: Measures that Cost More, with 1-3 year Pay Back

Get a comprehensive energy audit, including a blower door test to identify sources of air leaks.

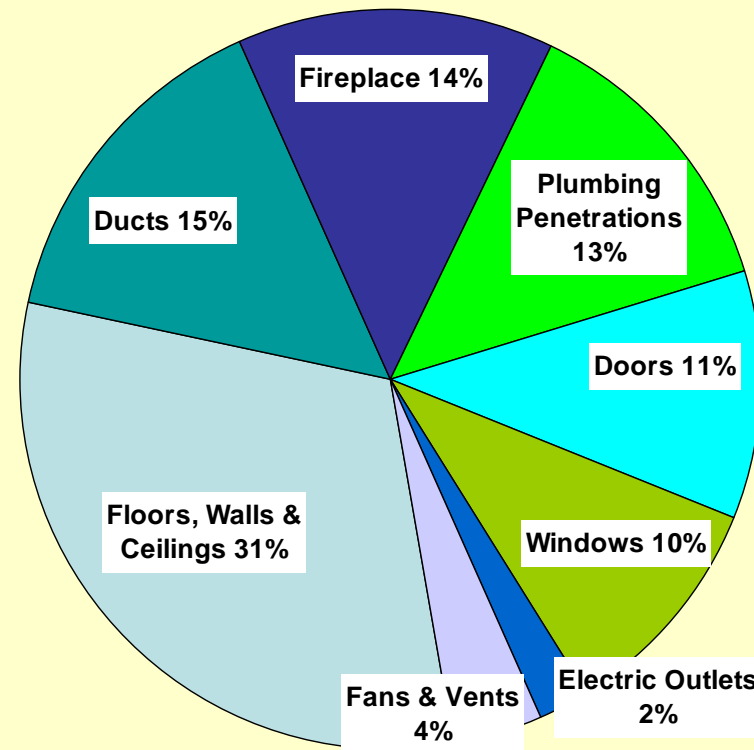
Text R. Heede, *Homemade Money* (Rocky Mountain Inst. 1995); graphics Energy Star



# Getting Serious: Measures that Cost More, with 1-3 year Pay Back

- Caulk and weatherize all leaks identified by the test. Start with the attic and basement first (especially around plumbing and electrical penetrations, and around the framing that rests on the foundation), then weatherize windows and doors.

Primary Air  
Infiltration Locations



R. Heede, *Homemade Money* (Rocky Mountain Inst. 1995)

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

Residential Energy Efficiency

# Getting Serious: Measures that Cost More, with 1-3 year Pay Back (cont.)

- Seal and insulate air ducts.



Based on R. Heede, *Homemade Money* (Rocky Mountain Inst. 1995)

# Getting Serious: Measures that Cost More, with 1-3 year Pay Back (cont.)

- Have heating and cooling systems tuned up every year or two and determine if a replacement is needed. Don't oversize.
- Install additional faucet aerators, efficient showerheads, and programmable thermostats.
- Make insulating shades for your windows, or add insulating storm windows; shade sunny windows or add solar gain control films.
- Insulate hot water pipes wherever they are accessible.



# Going All the Way: Expensive Measures Taking 3-15 Years for Pay-Back

- Attic: increase attic insulation to R-38 in mild climates. (Better yet, go all the way to R-50.)
- Walls: adding wall insulation is more difficult and expensive, but may be cost-effective if your house is uncomfortable.
- Install more compact fluorescent bulbs. Put them in all your frequently used fixtures.
- Consider installing occupancy sensors with these lights to automatically turn lights off when the room is unoccupied.

Based on R. Heede, *Homemade Money* (Rocky Mountain Inst. 1995)

# Going All the Way: Expensive Measures Taking 3-15 Years for Pay-Back (cont.)

- Replace exterior incandescent lights with compact fluorescents and put them on a timer or motion sensor if they're on more than a couple of hours a night.
- Convert to solar water heating, especially if you do not have natural gas as a heating source.
- Remodel utilizing passive solar design elements.

Based on R. Heede, *Homemade Money* (Rocky Mountain Inst. 1995)

# Going All the Way: Expensive Measures Taking 3-15 Years for Pay-Back (cont.)

- Upgrade your water heater, furnace/boiler, air conditioners, and appliances to more efficient models. Newer units may be far more efficient. Also, if you've weatherized and insulated, you'll be able to downsize the heating and cooling system.
- Upgrade to double-pane, low-emissivity windows, if replacement is needed.

Based on R. Heede, *Homemade Money* (Rocky Mountain Inst. 1995)



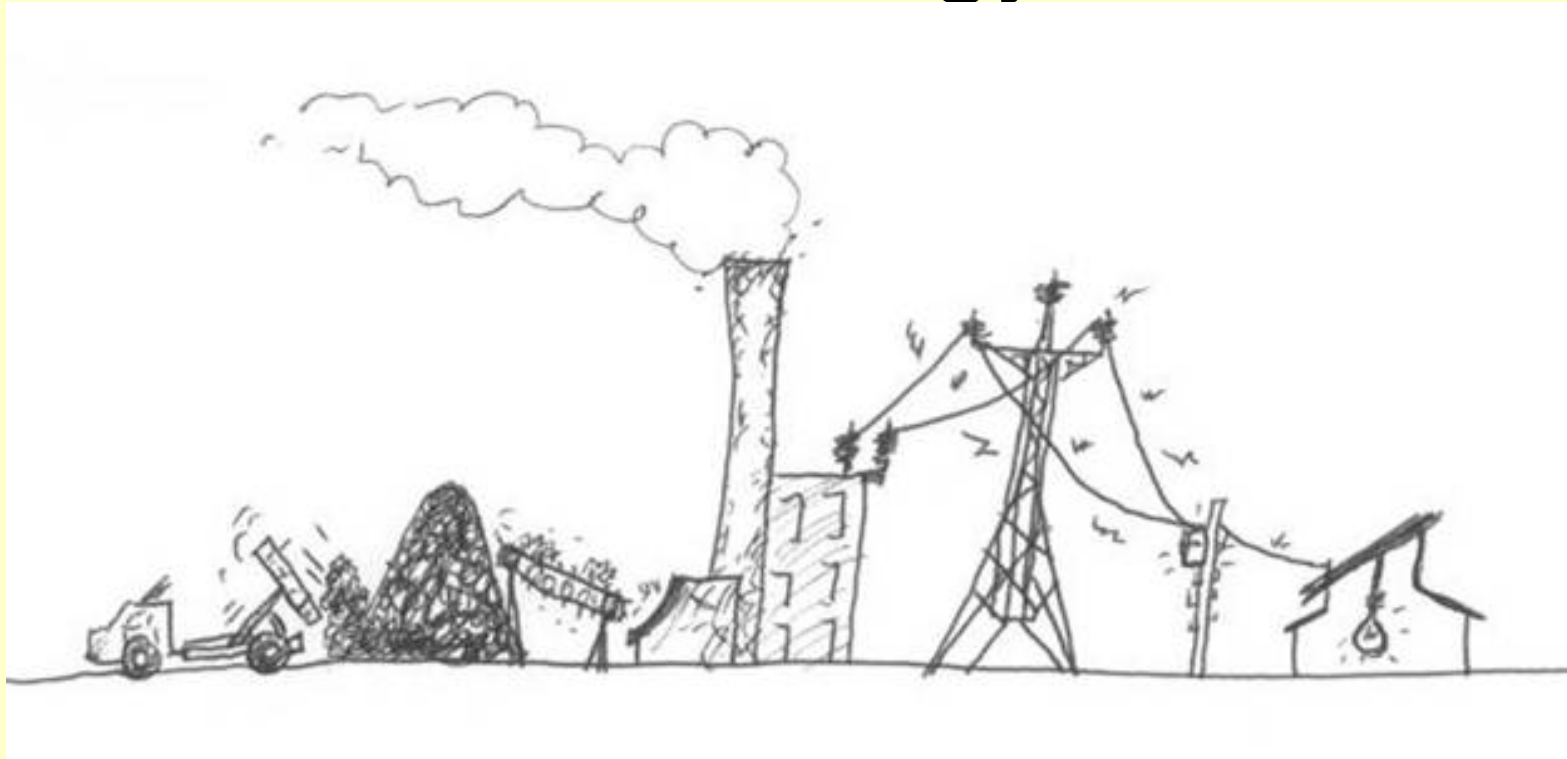
# Going All the Way: Expensive Measures Taking 3-15 Years for Pay-Back (cont.)

- Replace high-flow toilets with modern water-efficient toilets.
- Install awnings or build removable trellises over windows that overheat your home in the summer, especially on west or south windows.
- Plant a tree to shade your largest west window in summer. You won't save any money for years, but you'll get an A+ for long-range vision.

Based on R. Heede, *Homemade Money* (Rocky Mountain Inst. 1995)



# Home-Based Energy Production



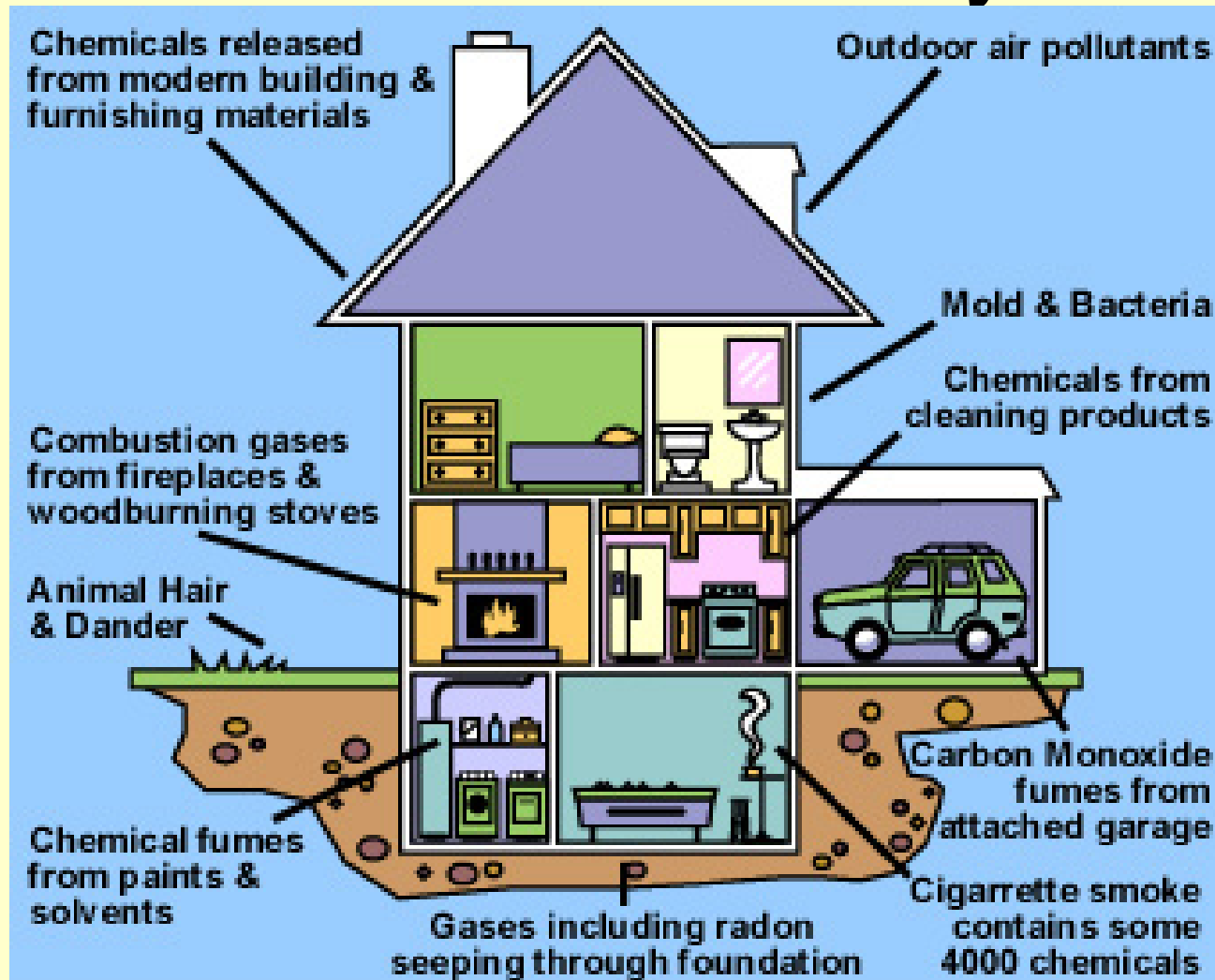
Mining Transportation Refinement Generation Transmission Transform Use  
??% X 50% x 90% x 60% x 90% x 95% x 5% = 1.6%

Efficiencies multiply . . . Net energy is less than 1.6%!

Data and Figure: David Johnson, What's Working, for Build It Green (2007)



# Indoor Air Quality



Graphics: U.S. Environmental Protection Agency, Air Pollution Control Orientation Course, Indoor Air Pollution



# Indoor Air Quality

- Beware of back-drafting burners, including older gas furnaces, stoves, and water heaters – be sure to properly ventilate
- Install a Carbon Monoxide detector in sleeping areas
- Avoid indoor toxics – formaldehyde off-gassing from cabinetry, furniture, or fiberglass insulation; housecleaning products; ozone-generating “air treatment” equipment; citrus or pine cleaning products
- If it smells like a beach ball, throw it away
- Eliminate and avoid mold growth and excess moisture

# Resources

- Palo Alto Home Energy Analysis:  
<http://www.city.palo-alto.ca.us/forms/homeenergy/home-energy.htm>

The screenshot shows a Windows Internet Explorer browser window displaying the Palo Alto Home Energy Analysis website. The browser's address bar shows the URL: <http://www.city.palo-alto.ca.us/forms/homeenergy/home-energy.htm>. The website header features the "CITY of PALO ALTO" logo. Below the logo is a navigation menu with links for Home, Living in Palo Alto, Business in Palo Alto, Visiting Palo Alto, Environment in Palo Alto, Recreation in Palo Alto, Know Zone, Departments, and Emergency Info. The "Utilities Home" link is highlighted. The main content area is titled "Home Energy Analysis" and includes a "Welcome to City of Palo Alto Utilities Home Energy Center" message. A "Get Started..." section prompts users to complete their home profile by entering their ZIP code. A "Contact Us" box provides the following information: Location: 250 Hamilton Avenue, Palo Alto, CA 94301; Telephone: 650-329-2161; Fax: 650-329-2154; Hours: Mon-Thu 7:30-5:30pm, Fri 8-5pm (Closed Alt Fri.). A "Learn" section offers energy tools to help users get answers, including "Improve", "Analyze", "Learn", and "Save". A "Summer" section notes that summer is the best time to tackle energy efficiency. The footer of the website features the Emerson Environmental logo.

# Resources

- Home Energy Saver on-line audit:  
<http://hes.lbl.gov/>
- Dept. of Energy Do-it-Yourself Energy Audit:  
[http://www.eere.energy.gov/consumer/your\\_home/energy\\_audits/index.cfm/mytopic=11170](http://www.eere.energy.gov/consumer/your_home/energy_audits/index.cfm/mytopic=11170)

# Resources



- Web sites, including Energy Star
- Books:
  - Richard Heede, *Homemade Money*
  - *No-Regrets Remodeling: Creating a Comfortable, Healthy Home That Saves Energy*
- Professional Energy Auditors, such as
  - Suzanne Emerson, Emerson Environmental





# Emerson Environmental

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## Questions?

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