

# Reducing Our Carbon Footprint: A Low-Energy House in Berkeley, Kabul, and Washington DC

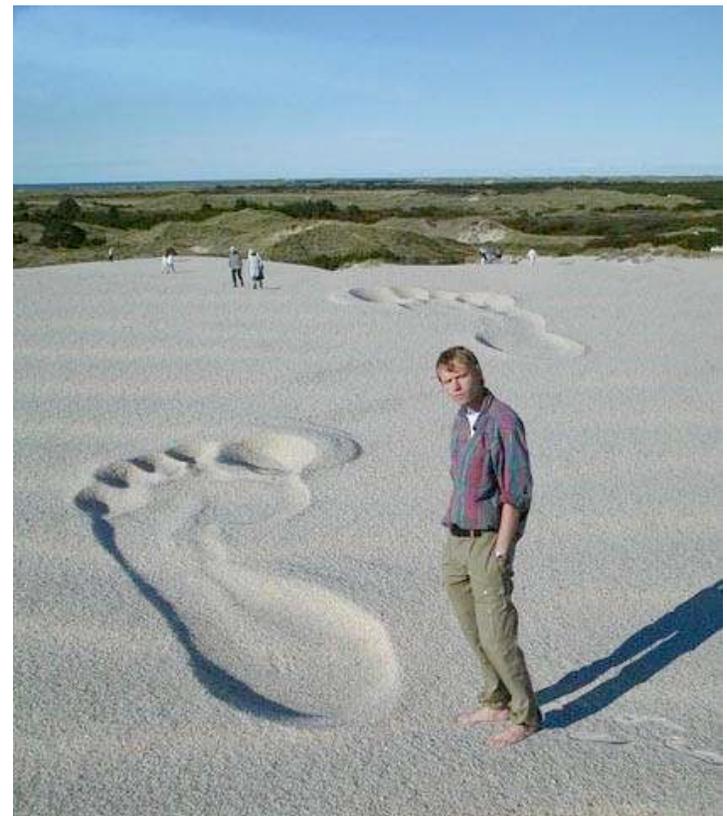


Rick Diamond

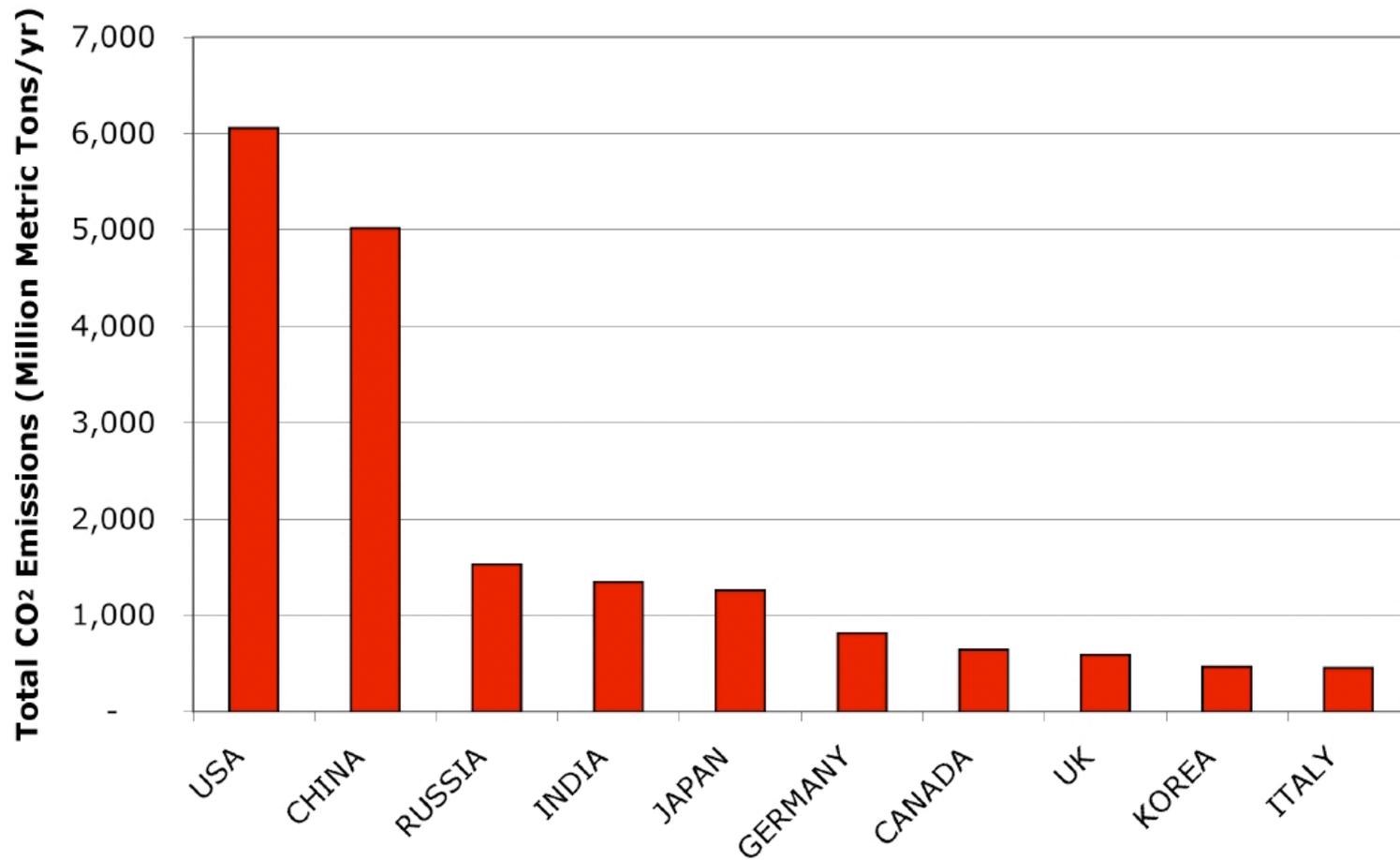
September 17, 2007

# How Big is Our Carbon Footprint?

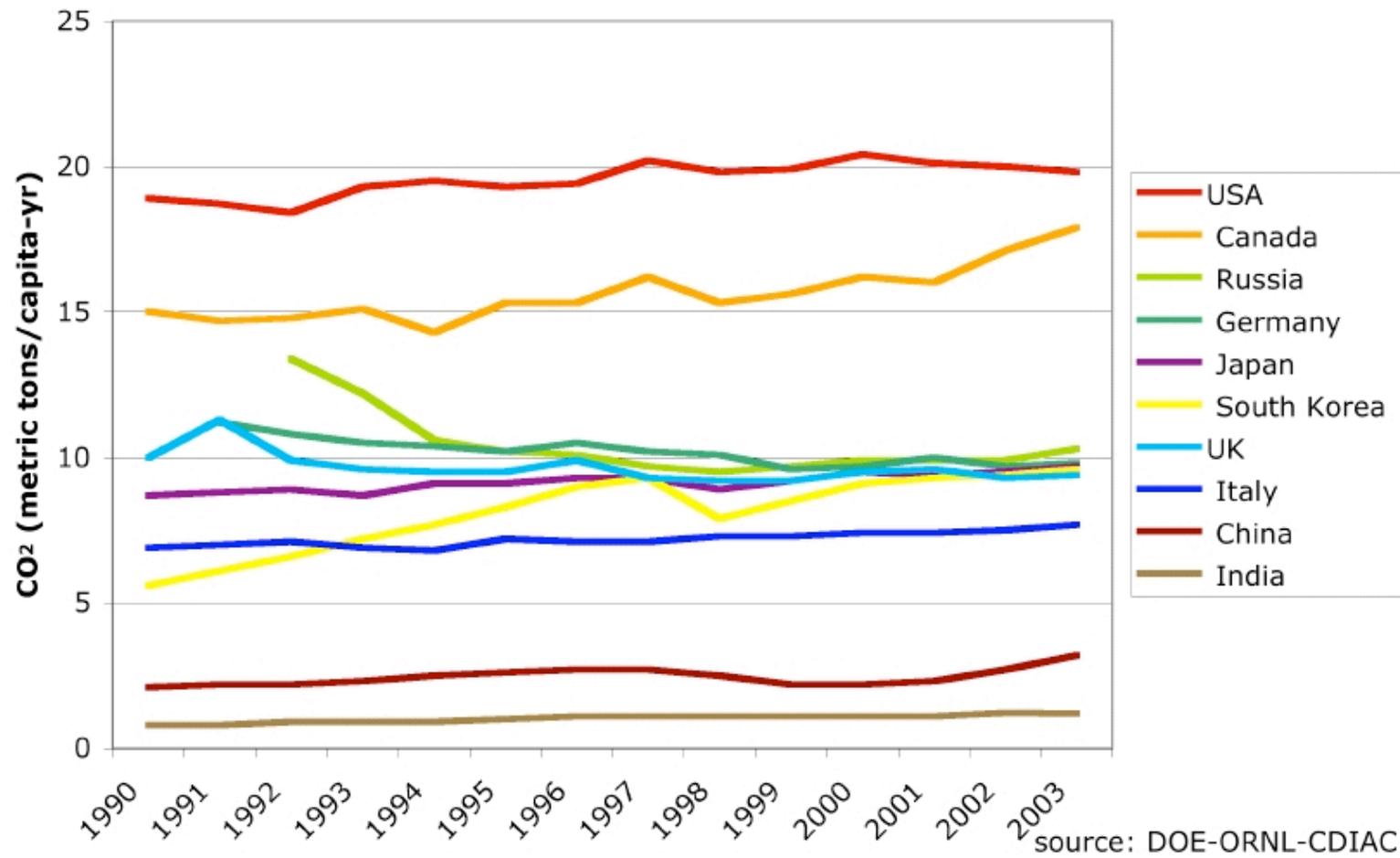
- US average is 33 lbs. of carbon/day per capita
- CA average is 18 lbs. of carbon/day per capita
- World average = 7 lbs. of carbon/day per capita



## 2004 Top Ten Countries Carbon Dioxide emissions (Million Metric Tons/year)



## Annual Carbon Dioxide Emissions per Capita Top Ten Countries 1990-2003 (metric tons CO<sub>2</sub> per capita)



# A House in Berkeley



# What Uses the Most Energy in a Typical Berkeley House?

- Space heating
- Water heating
- Computers
- TV & home entertainment
- Refrigerators
- Lights
- Something else:



# What Uses the Most Energy in a Typical Berkeley House?

• Space heating	50%	\$1,130
• Major appliances	23%	\$517
• Water heating	13%	\$290
• Small Appliances	7%	\$157
• <u>Lights</u>	<u>7%</u>	<u>\$152</u>
Total	100%	\$2,246

Source: Home Energy Saver Run #899432



# Space Heating is 30-50% of typical Berkeley House Bill

- No cost
  - Turn down thermostat
  - Close drapes at night
- Investment required
  - Install programmable thermostat (and use it)
  - Insulate ceilings, walls, floors\*
  - Seal large gaps in envelope (around chimney, etc.)
  - Seal and insulate duct work\*
  - Install ENERGY STAR furnace\*
  - Install ENERGY STAR (low-e) windows



\*PG&E rebates available

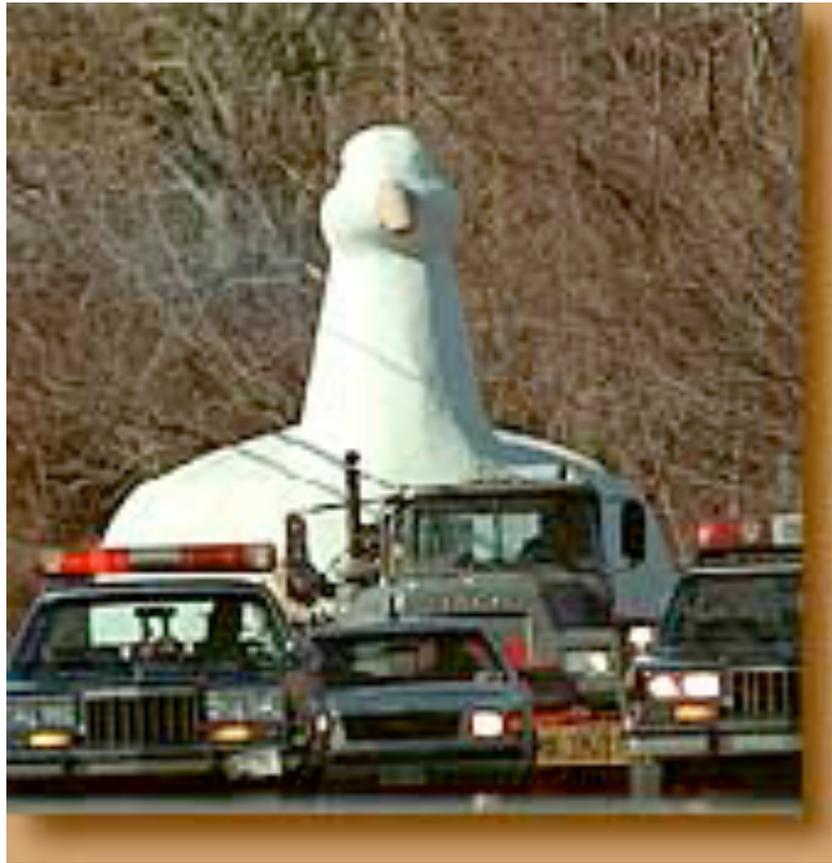
# Knob and Tube Wiring & Attic Insulation



# New Tilt Pack Windows



# Problem Ducts



# Programmable Thermostats



# Water Heating is 10-30% of Typical Berkeley House Bill

- No cost
  - Take shorter showers
  - Wash clothes in cold water
  - Wash full loads in dishwasher
  - Reduce water heater thermostat to 120°
- Investment required
  - Install low-flow showerheads
  - Insulate hot water pipes
  - Install high-efficiency gas\* or instantaneous water heater
  - Install ENERGY STAR clothes washer or dishwasher\*
  - Install solar water heater\*



\*PG&E rebates available

# Instantaneous Water Heater



# Instantaneous Water Heater Use



# What about Electricity Use?



Power Strips



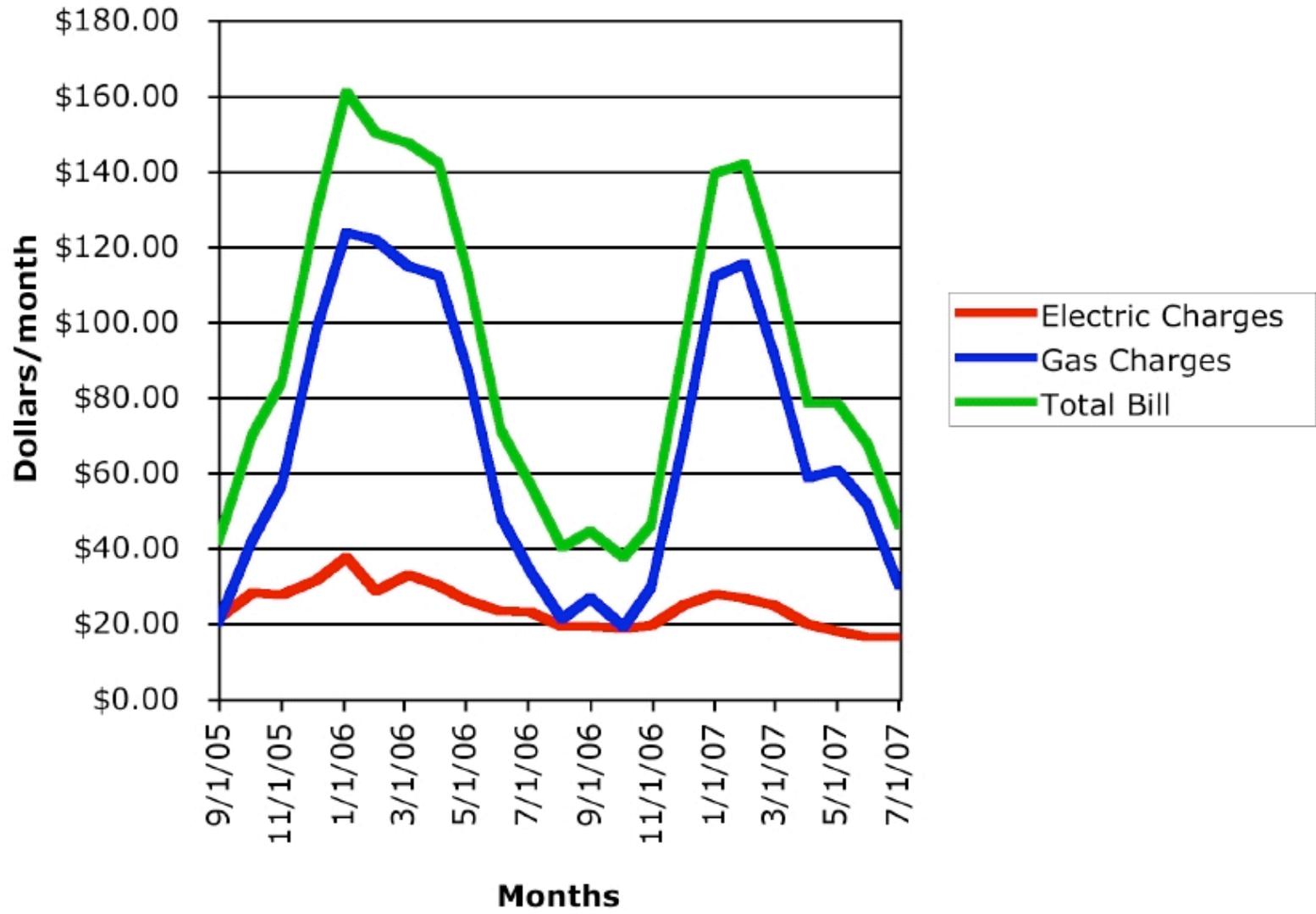
Power Strips with  
occupancy sensors

# Find a way to see where your electricity is going

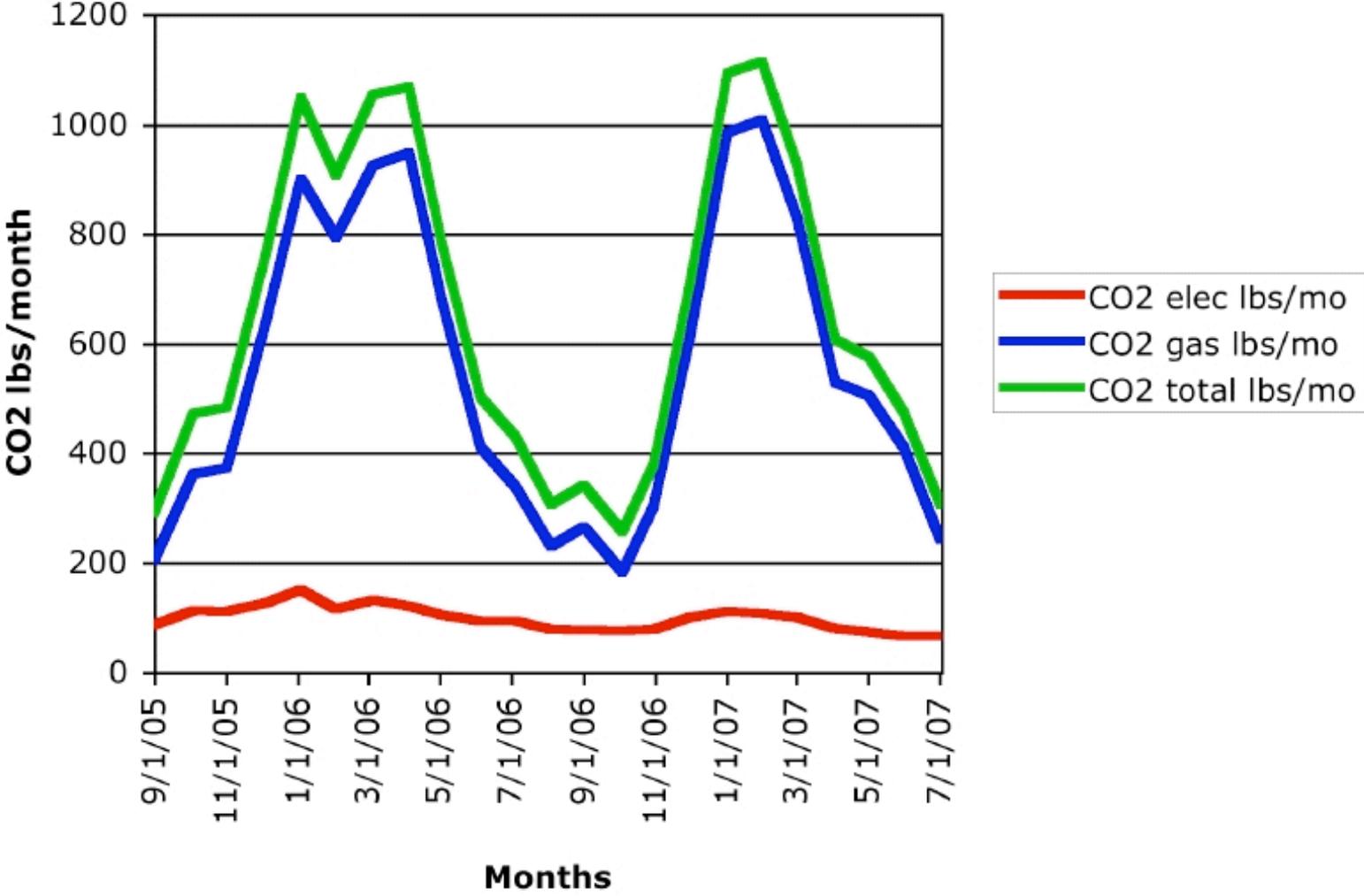
- Feedback on household electricity
- Several manufacturers:
  - *Energy Viewer*
  - *The Energy Detective*



# Energy Bills 1512 Heather Street Berkeley, California 2005-2007



**Carbon Dioxide from Household Energy Use  
1512 Heather Street 2005-2007  
(annual average = 5 pounds carbon/day)**



# Energy Use for a Basic Berkeley House (1800 ft<sup>2</sup>)

## Average Berkeley Home

- \$2,246 per year
- 5,740 kWh/yr
- 1,164 therms/yr
- **13 lbs Carbon/day per household**

## Efficient Berkeley Home

- \$1,075 per year
- 3,439 kWh/yr
- 544 therms/yr
- **6 lbs Carbon/day per household**

Source: *Home Energy Saver* Run #883631

# Annual Energy Use for 1512 Heather Street (1700 ft<sup>2</sup>)

## HES Model

- \$1,080 per year
- 2,273 kWh/yr
- 611 therms/yr
- **6 lbs Carbon/day per household**

## PG&E Bills

- \$926 per year
- 2,021 kWh/yr
- 507 therms/yr
- **5 lbs Carbon/day per household**

Source: *Home Energy Saver* Run #883639

# A national program translates to big spending:

- Low hanging fruit
  - \$168 Billion
- Big intervention
  - \$1,123 Billion
- Deep Retrofit
  - \$5,616 Billion
- Above + 3 kW PV  
for everyone
  - \$8,424 Billion



# Compared to what?

- *Iraq War* will cost \$1 Trillion over 10 years (conservative estimate)
- = \$100 billion/yr
- Cost to intervene in all U.S. homes with cost-effective energy measures = 2 years of Iraq war costs



# A House in Afghanistan



# Afghanistan Refugee Housing



# Afghan Building Materials



# Construction in Kabul

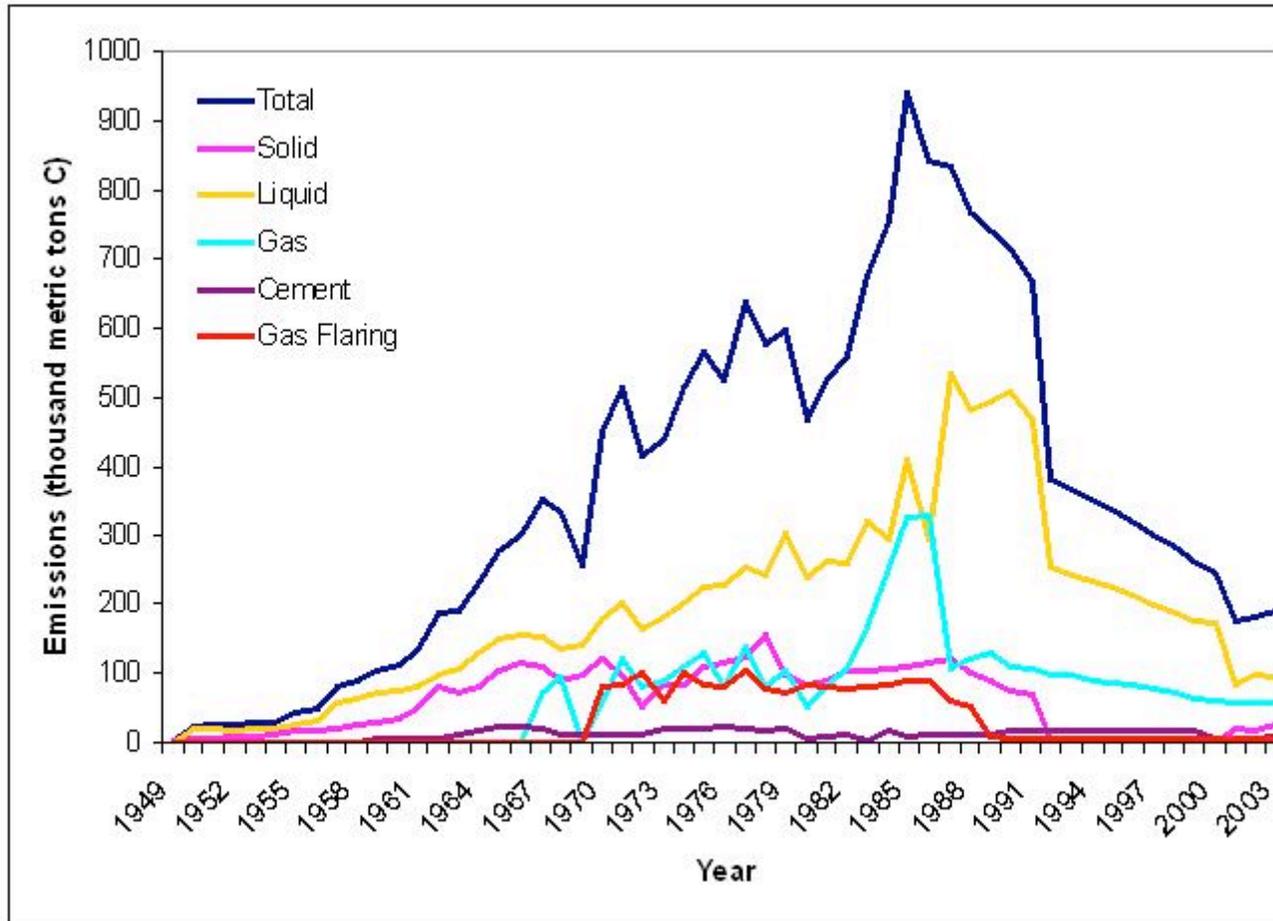


# Multistory Housing

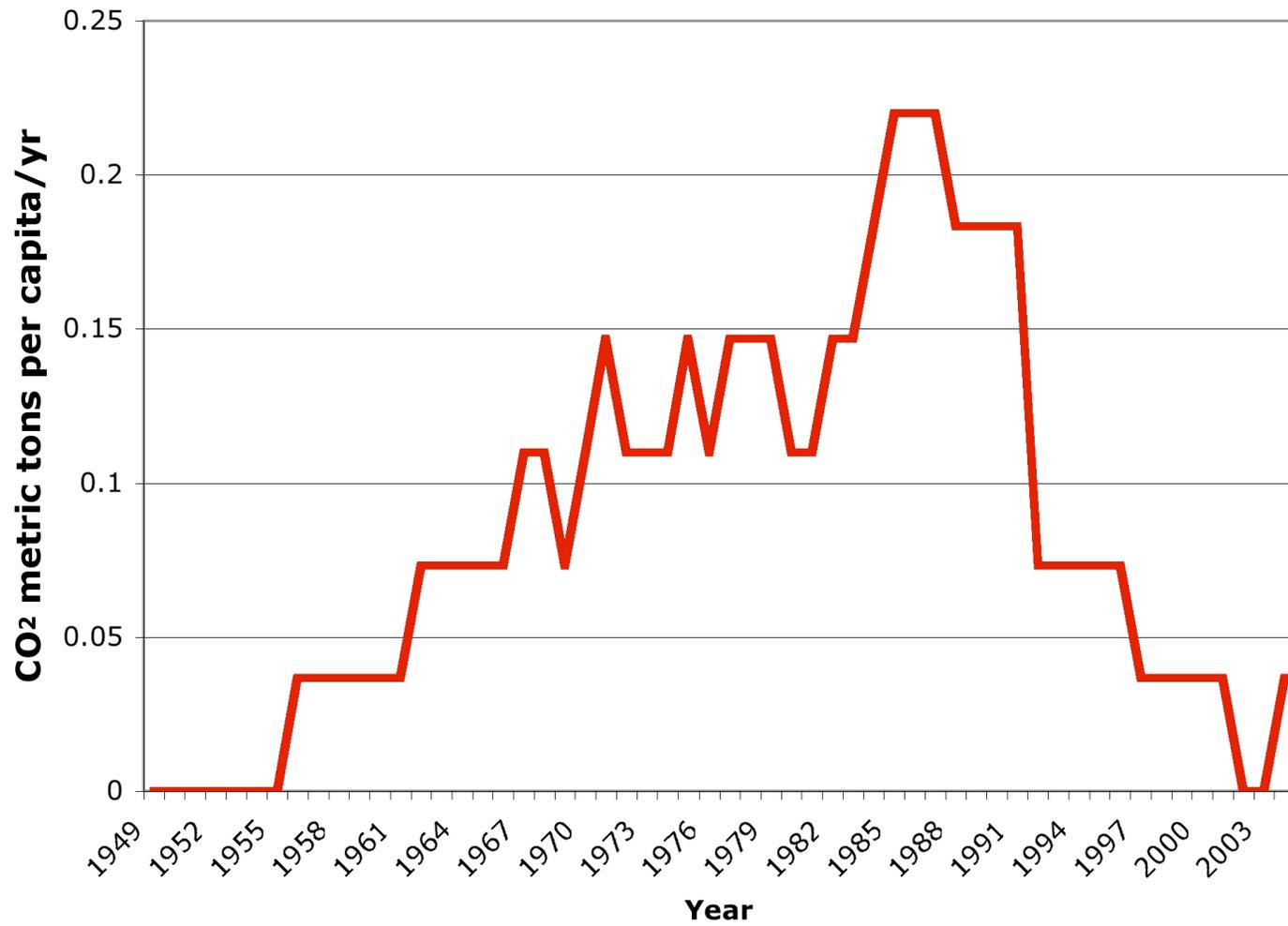


# Annual Carbon Emissions, Afghanistan 1949-2004

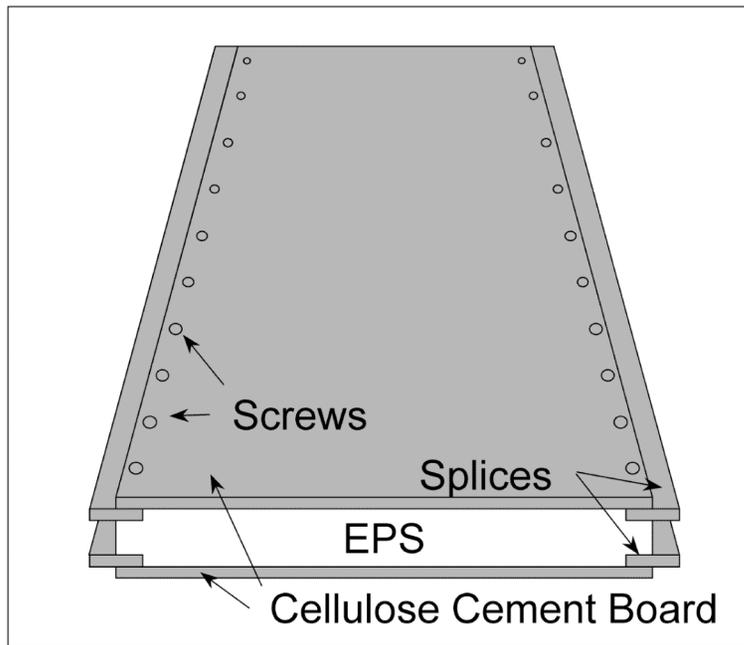
(thousand metric tons, carbon)



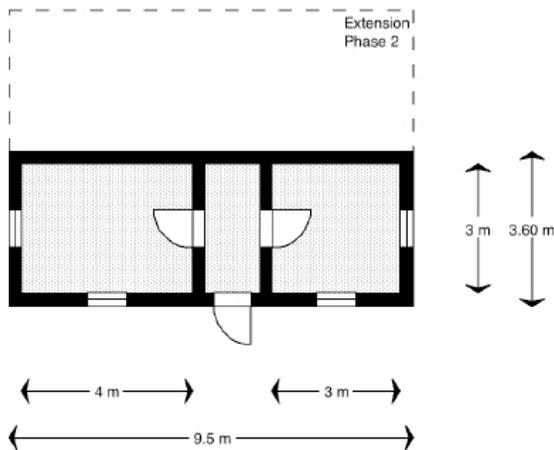
### Afghan CO<sub>2</sub> Emissions per capita 1940-2004



# Foam Panel Technology

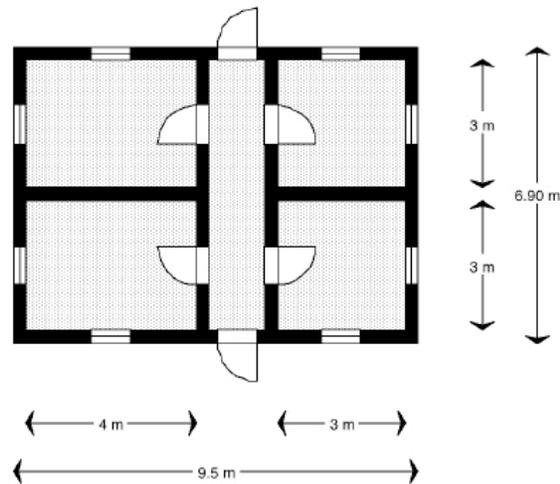


# Prototype Afghan Floor Plans



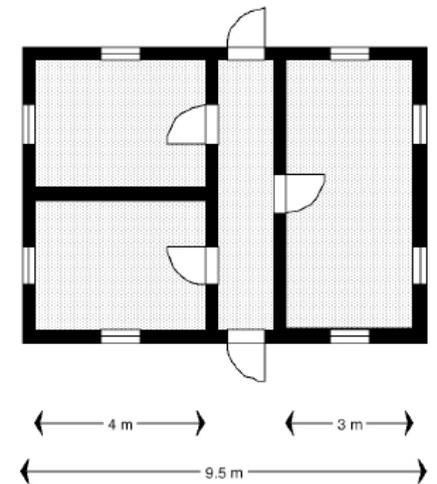
**House Plan I.1 - phase 1**

Phase 1: 34.2 sq.m.  
Living space: 21 sq.m.



**House Plan I.2a - phase 2**

Phase 2 65.6 sq.m.  
Living space: 42 sq.m.



**House Plan I.2b - phase 2**

Phase 2 65.6 sq.m.  
Living space: 42 sq.m.

# Seismic and Fire Tests for Panelized Housing



# Prototypical Afghan House



# 2005 Tsunami Destruction



# Panelized House Pilot in Turkey



# New Orleans 2005



# Post-KATRINA

80,000 families in emergency housing



# Post-Katrina Rebuilding



# Rebuilding: later that same day



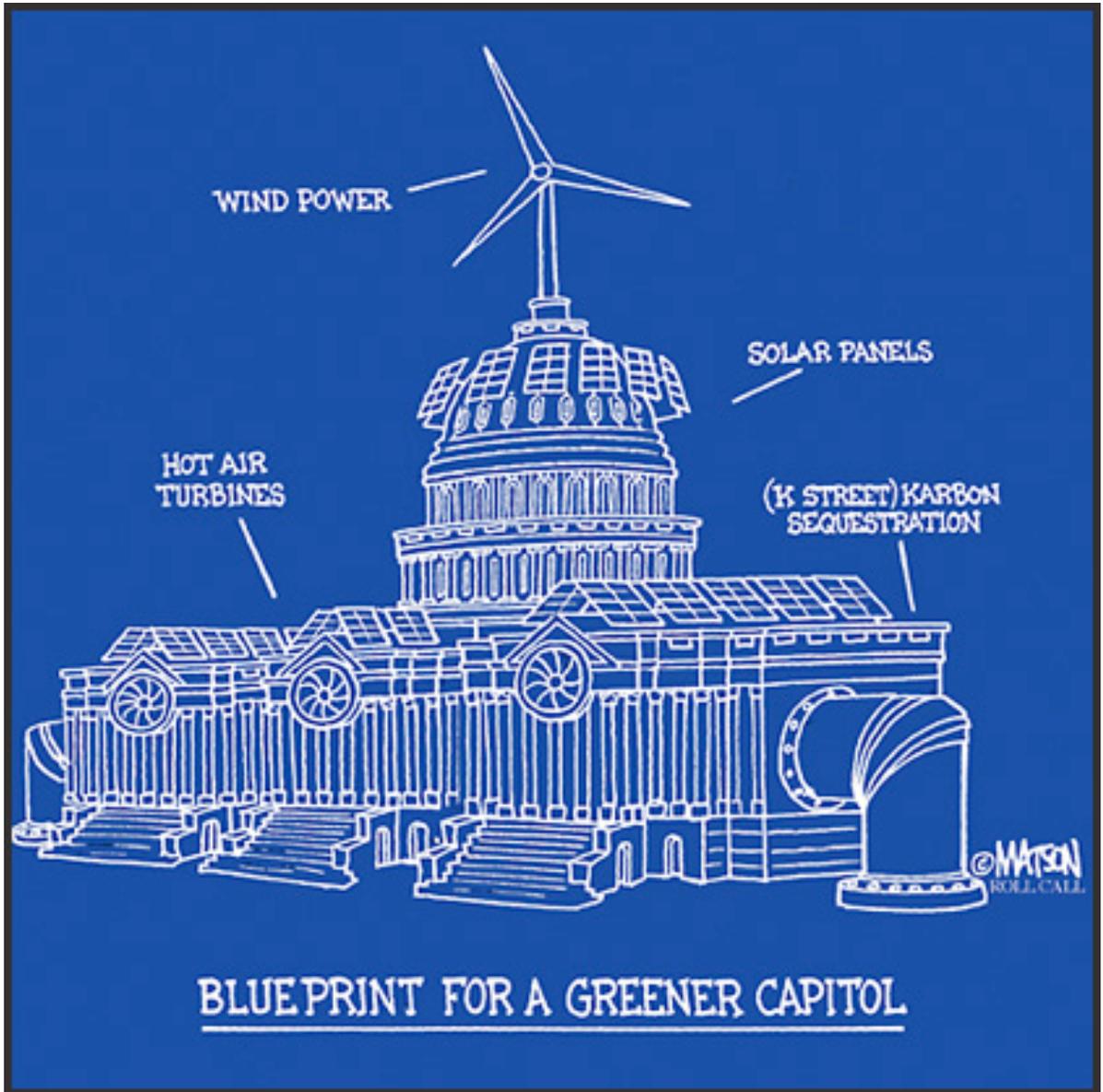
# Lessons from Afghanistan

- Need for low-cost, seismically strong, low-energy house worldwide.
- Foam panel house prototypes developed in Turkey, Sierra Leone, Gulf Coast
- *Shelter for Life* building schools and clinics in Afghanistan



# A House in Washington DC: Greening the Capitol





WIND POWER

SOLAR PANELS

HOT AIR  
TURBINES

(K STREET) CARBON  
SEQUESTRATION

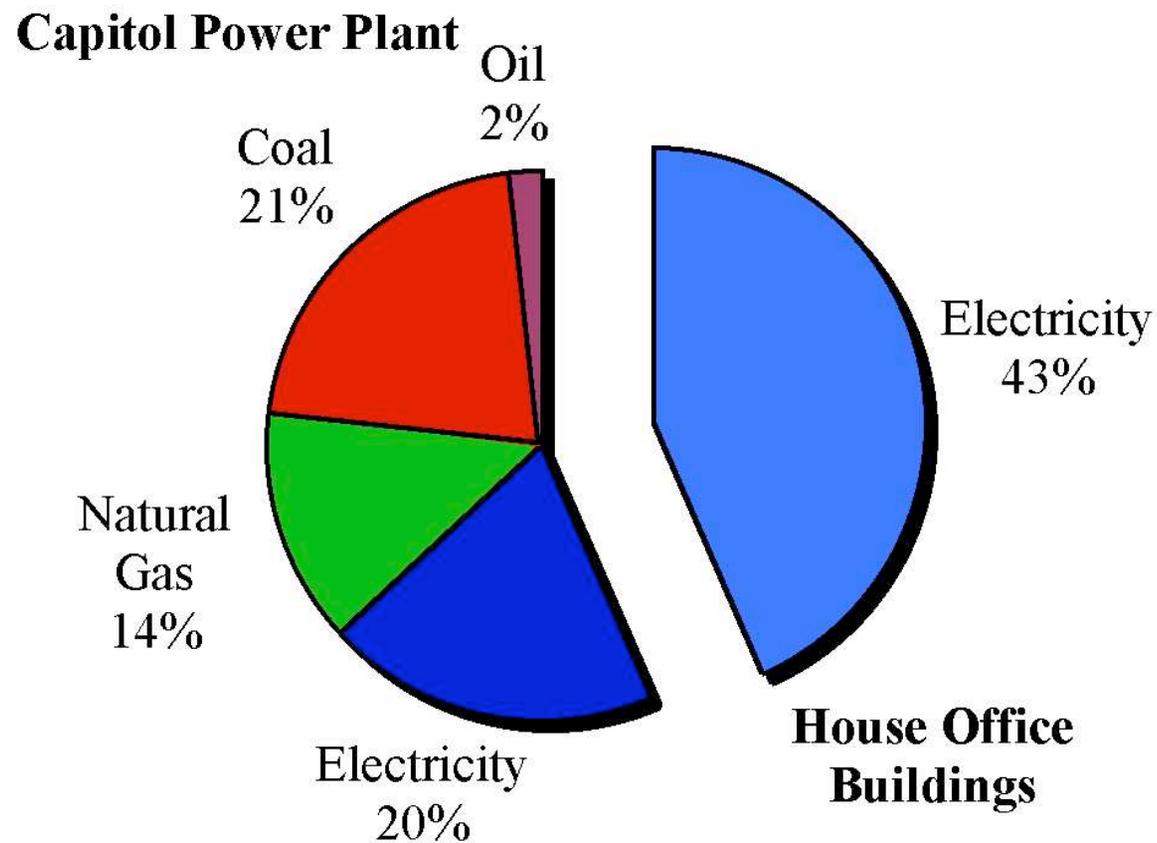
BLUEPRINT FOR A GREENER CAPITOL

© MATSON  
ROLL CALL

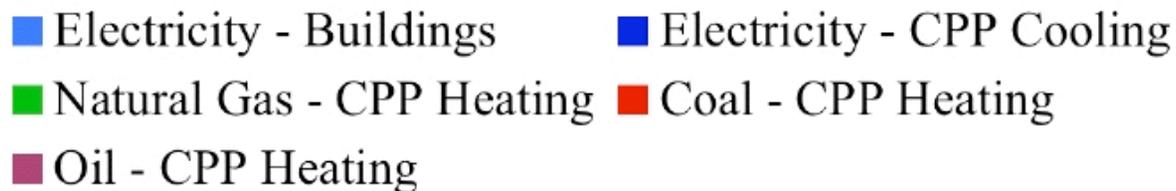
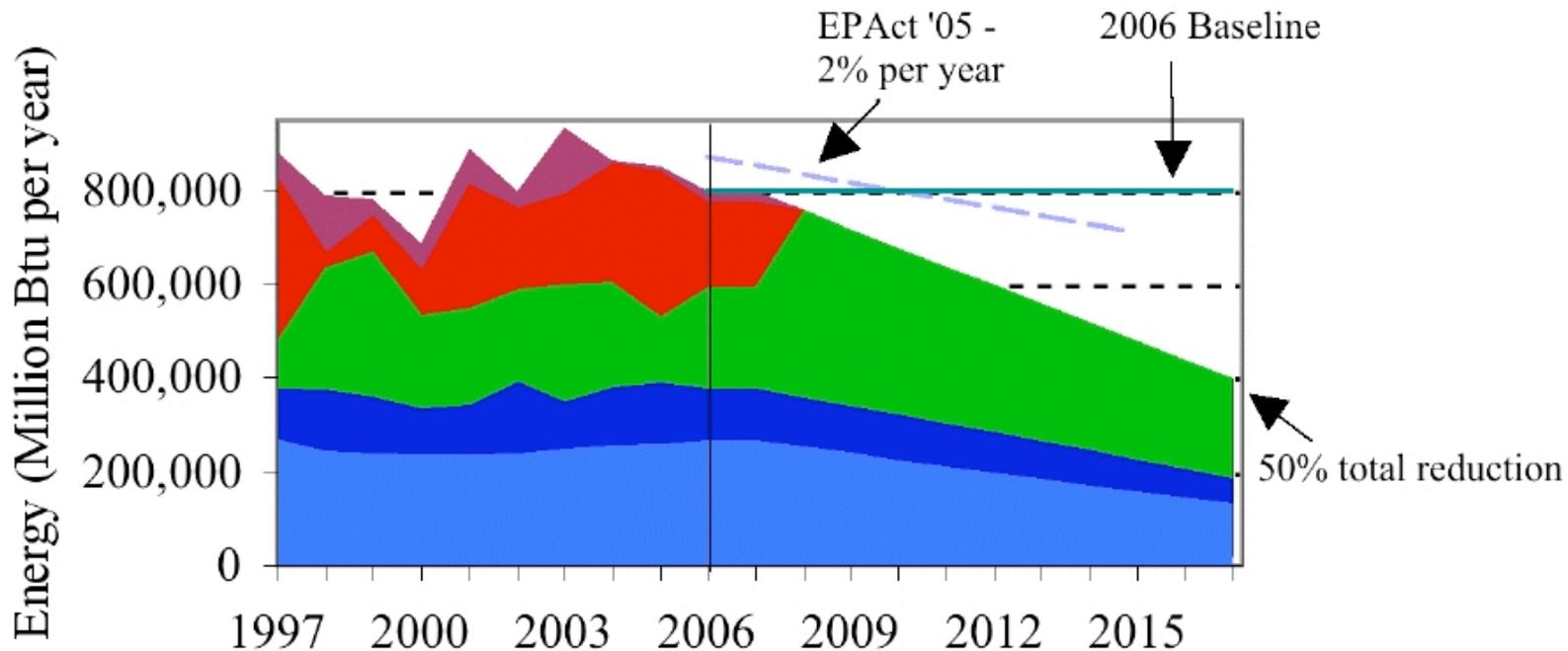
# Carbon on Capitol Hill



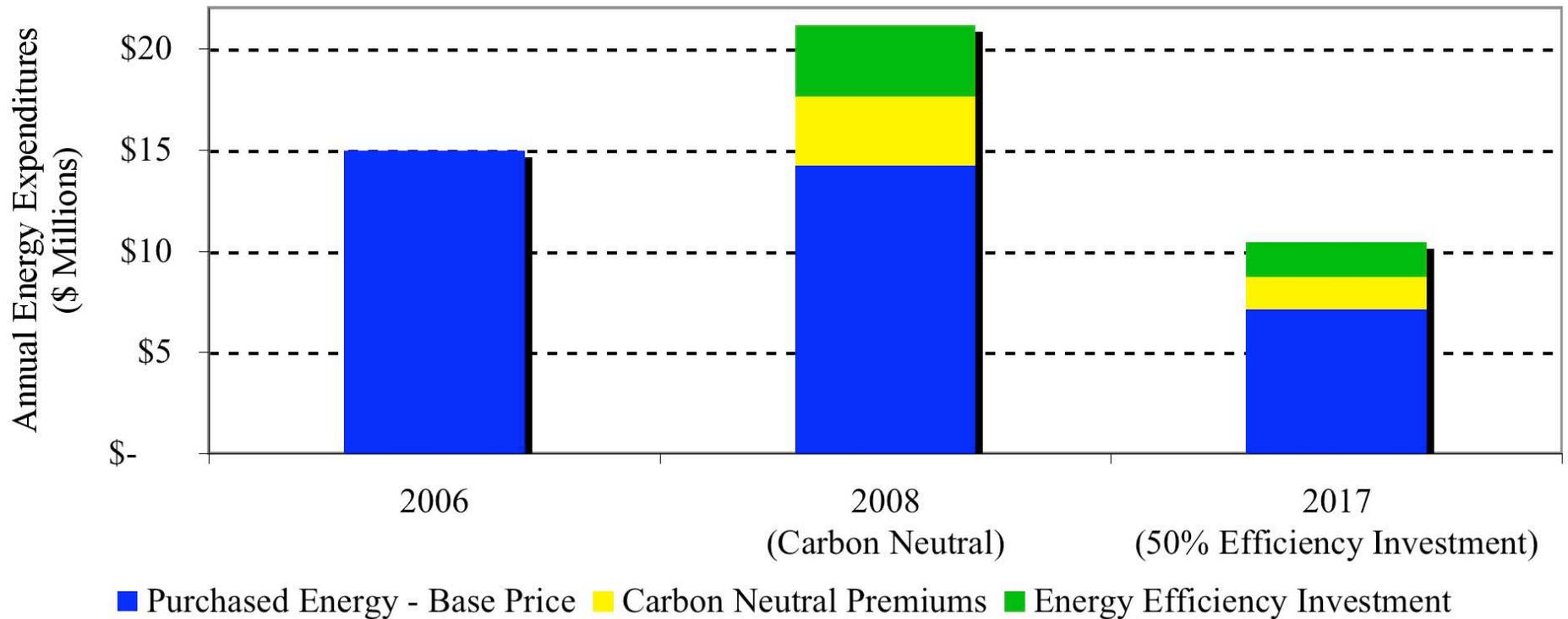
# 92,000 Tons of CO<sub>2</sub> per year coming from the House Buildings on Capitol Hill



# How to Cut Energy Consumption by 50% in Ten Years



# Greening the Capitol



# Lessons from the Capitol

Challenging project on  
three levels:

- Physical
- Symbolic
- Psychological



# What to Do Now

- Take care of your own house--work with friends and neighbors
- Connect with international efforts
- Pursue political action at local, state and federal levels.



# Reducing *Our* Carbon Footprint



# Resources, Acknowledgments & Questions

- PG&E
- Home Energy Saver
- Shelter for Life
- Federation of American Scientists
- University of Nebraska at Omaha
- Luke Powell, photos
- Speaker of the House
- Chief Administrative Officer of the House
- Community Resources for Science, Berkeley
- LBNL
- Residents of 1512 Heather Street

More Questions: [rcdiamond@LBL.gov](mailto:rcdiamond@LBL.gov)

*In Memoriam*

# Richard M. Diamond

January 7, 1924 -- September 14, 2007

