

Schlepping Toward Sustainability: One Couple's Quest to Shrink Its Environmental Footprint

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Ordway Solar Power Plant

Building Sustainability at Cal
UC Berkeley

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Outline

- Global thinking
- Local acting
 - Example: a couple from the People's Republic of Berkeley
 - You

What do we know about climate?

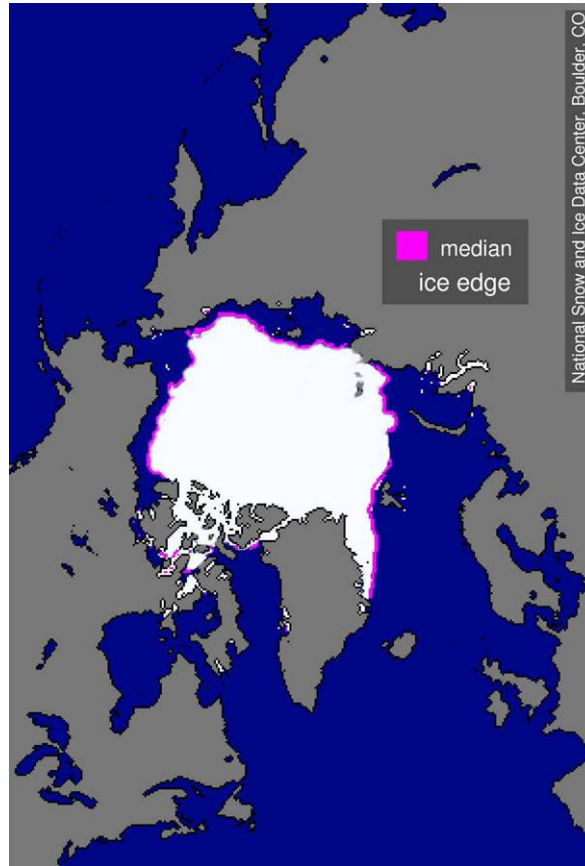
- **“Unequivocal”** that the earth’s climate is warming
- **More than 90% certainty** that human emissions of CO₂ and other greenhouse gases are the cause

(Findings from IPCC 2007 WGI, AR4)



Going, going, gone?

September 16, 2007



6573231 square km

The difference between median minimum arctic ice coverage and the extent on Sept. 16, 2007 is equal to the area of Alaska and Texas combined (2.61 M sq. km or 1 M sq. miles). http://nsidc.org/news/press/2007_seaiceminimum/20070810_index.html

Regional climate change good news

- A one-meter rise in sea level would return the size of San Francisco Bay to its 1850 glory

Bay Conservation and Development Commission

Regional climate change bad news

- That same one-meter rise in sea level would flood \$100 Billion in real estate and infrastructure

Bay Conservation and Development Commission

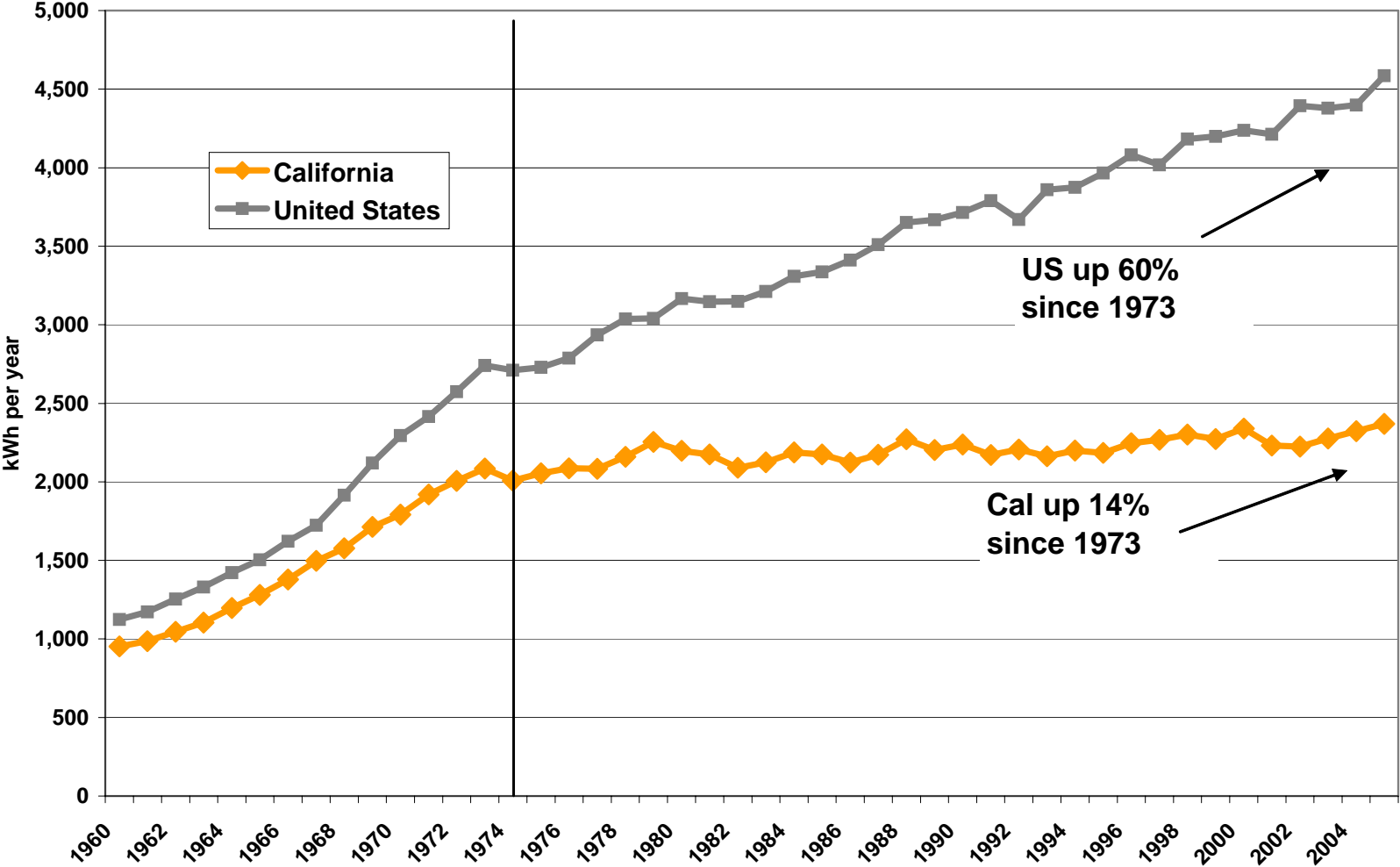
Our options

- Adapt–modify human systems to make them more flexible and resilient
- Suffer–accept what comes (but what comes is likely to be costly in lives, ecosystem damage, and economic disruption)
- **Mitigate–reduce emissions**

Slide courtesy Jon Koomey

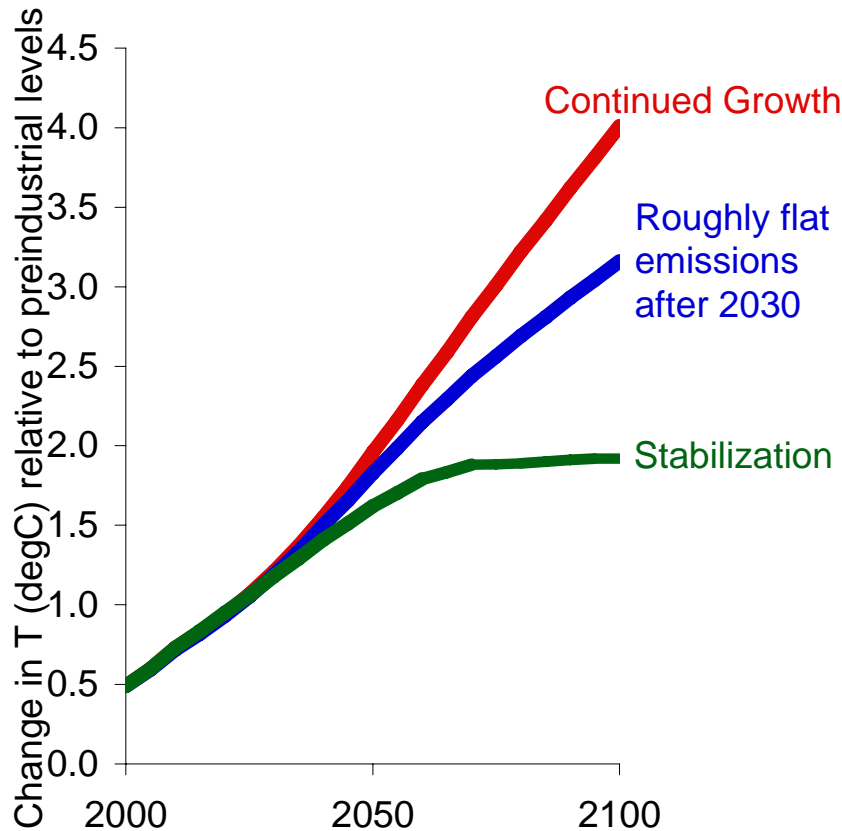
Laurels(?)

Per Capita Residential Electricity Consumption

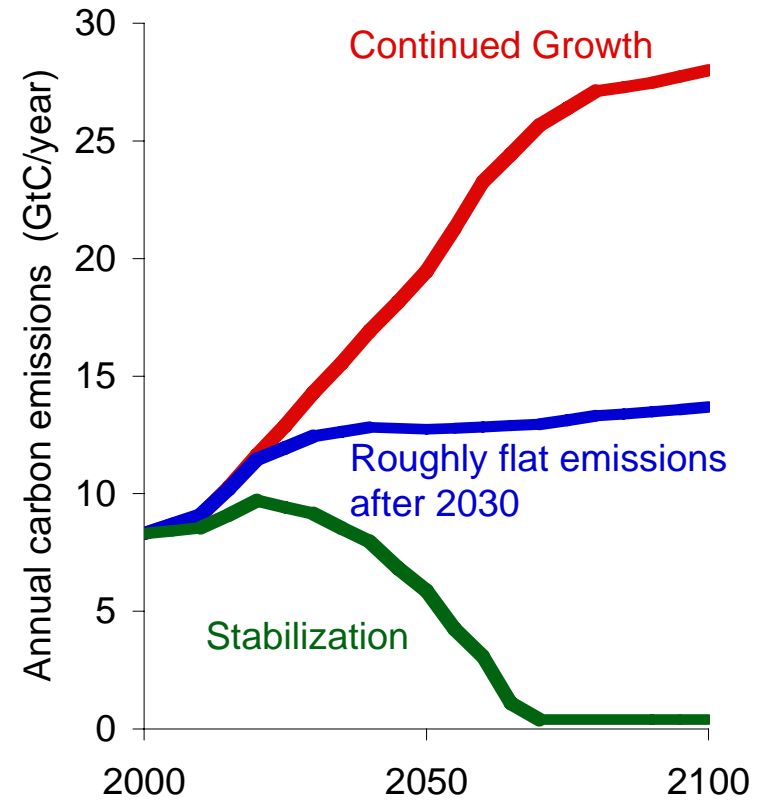


California Population: 21M in 1970, 28M in 1990, 37M in 2005

Halting growth in world carbon emissions is not enough



Change in world temperatures



World C emissions

Continued growth and flat emissions scenario are taken from the IIASA GGI database (A2r and B2, respectively). Stabilization case is adapted from the B2 480 ppm scenario. <http://www.iiasa.ac.at/web-apps/ggi/GgiDb/>

Those Berkeley Wackos, (part 1) Berkeley City Slogan(?)



Don Asmussen, 2008 SF Chronicle

Those Berkeley Wackos, (part 1, con't)



Those Berkeley Wackos, (part 1, con't)



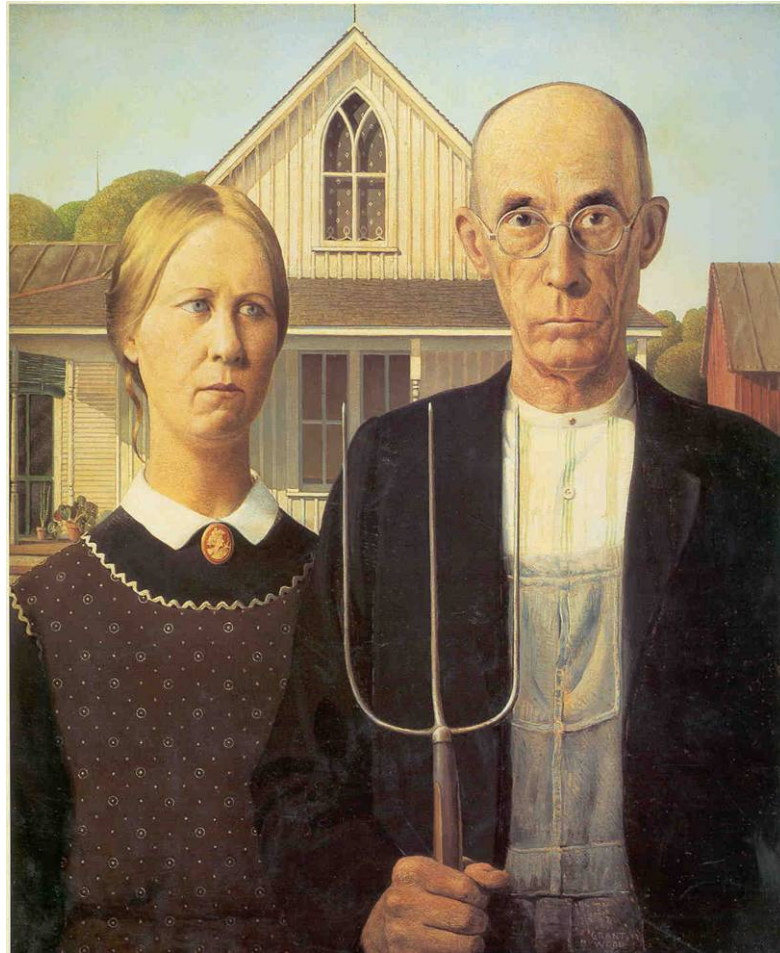
Those Berkeley Wackos (part 2):

Berkeley Climate Action Plan

- Homes and business to produce as much energy as they use by 2050
- Residents and workers rely on public transit, walking and biking
- Cars would run on alternative fuels and electricity
- No waste would be sent to landfills
- Most of the food eaten in Berkeley would be produced within a few hundred miles

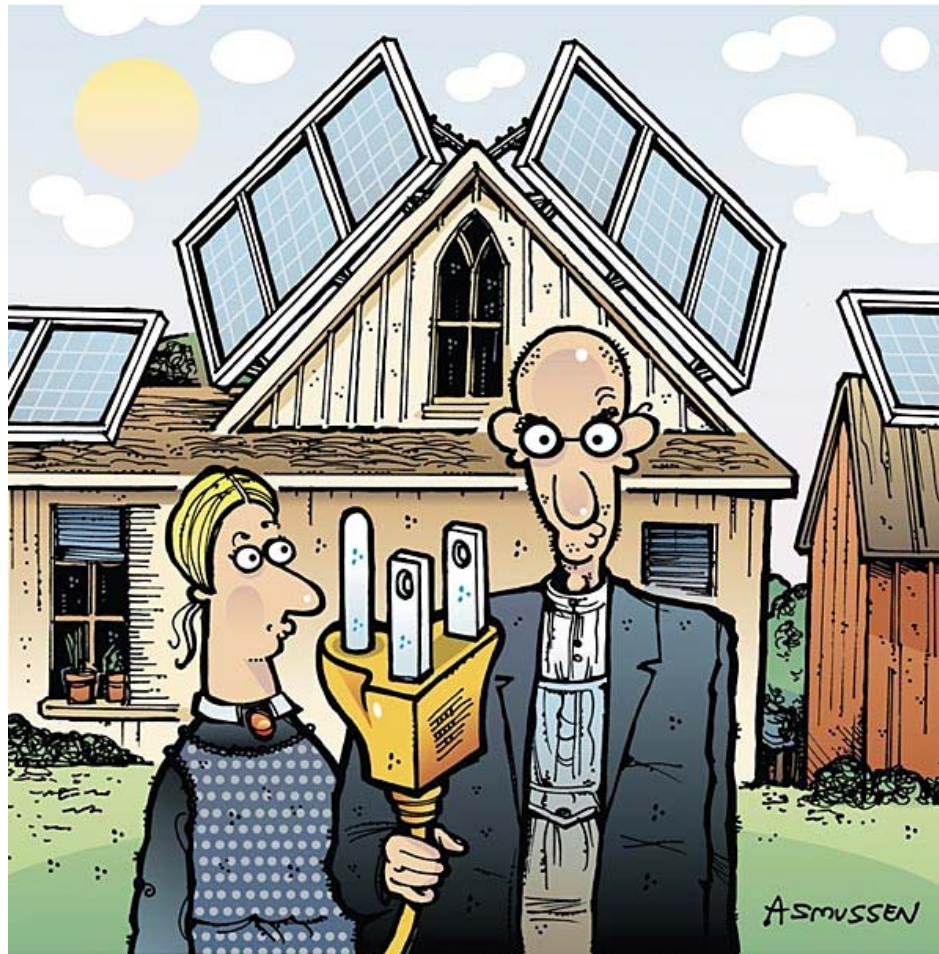
American Gothic

by Grant Wood, 1930



Berkeley Gothic

by Don "The Bad Reporter" Asmussen, 2008



Liz and Steve

(Those Berkeley Wackos, Part 3)

by John Lee, 2008



SFC / John Lee

“A Deeper Shade of Green: Counting Volts in Berkeley”, Sam Whiting, SF Chronicle
<http://www.sfgate.com/cgi-bin/article.cgi?f=/c/a/2008/06/22/CM3L10HMNE.DTL>

1440 Ordway: Measures to Date

- Wall and ceiling insulation
- Solar domestic water heating system
- Fluorescent lighting
- Energy Star appliances
- Standby loss reduction (80W residual inc. lighting)
- Photovoltaic (solar electric) systems
- Electric vehicle
- Window and door retrofits
- Low water use fixtures, turf removal, drip irrigation, informal gray and rain water use

Solar Water Heater, Cool Roof



Lightbulbs are a good start, but



Bizarro, June 2007

A Solar “Barn Raising”: Ordway Solar Power Plant Unit One



Off with the old roof...

...out with the old rafters...



...in with the new.



New roof deck (sustainable lumber)



...roofing, then posts and racks for
the array of modules...



...almost there, cookie break...



...aligning the first module...



....the modules go on with a blur...



Sit of approval from Inspecteur Catseau.



Solar Power Plant Unit One, Skylights, Solar Clothes Dryer, Neighbor's PV



Electric Car added in 2004

- Greatly reduced our gasoline usage (~80%)
- Wiped out surplus PV electricity (3 mi/kWh)



Dontcrush.com became PlugInAmerica

Ordway Solar Power Plant Unit 2

Like Unit 1, grid-tie only; 2.5 kW AC rating



Ordway Solar Power Plant Unit 2



Units 1 and 2, Neighbor's PV and Sunroom, Berkeley EcoHouse



“Westbrae Solar Power Collective”

Keeping Up with the Joneses, Berkeley Style

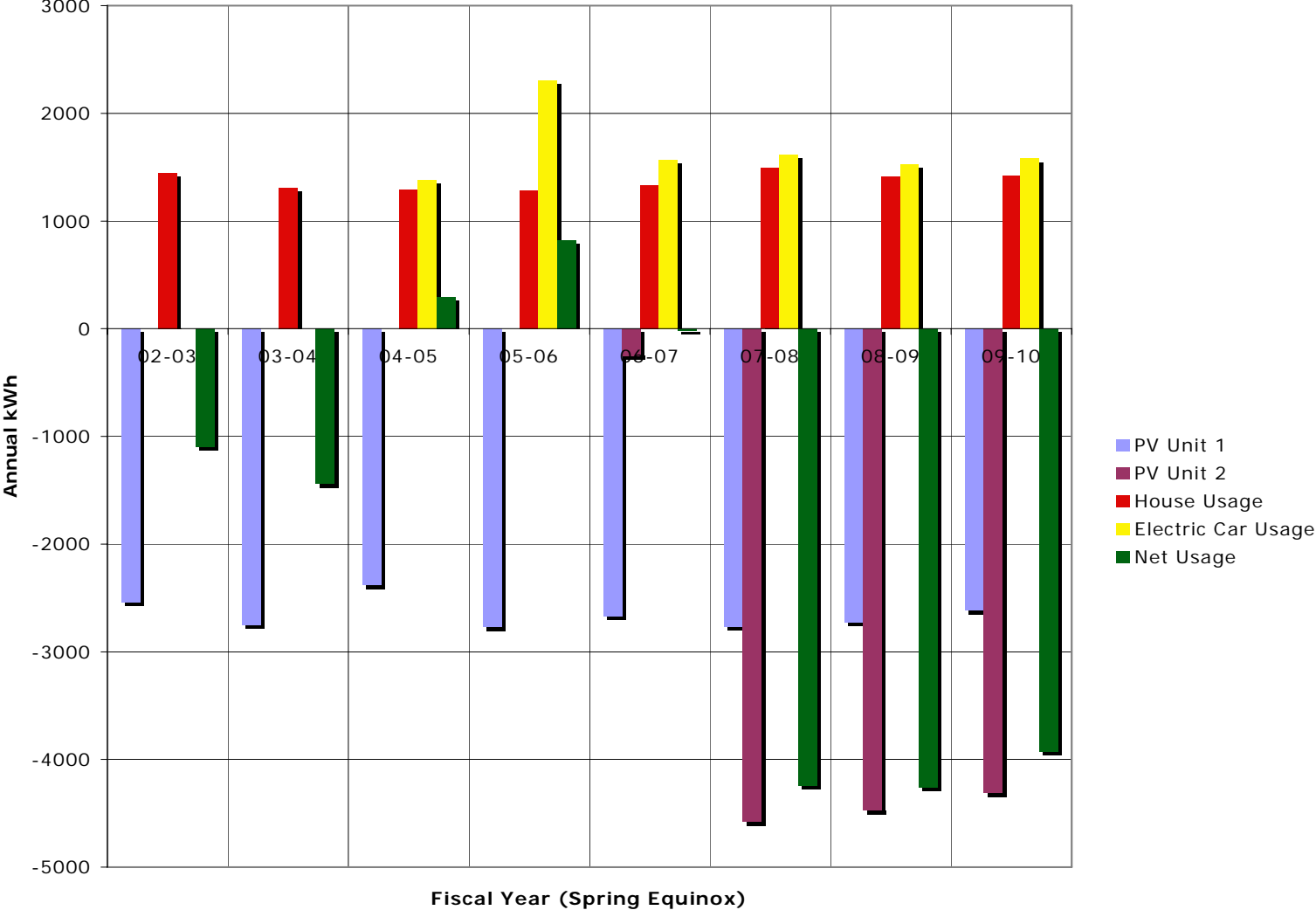


Solar PV systems to date: 38

Solar DHW systems to date: 12

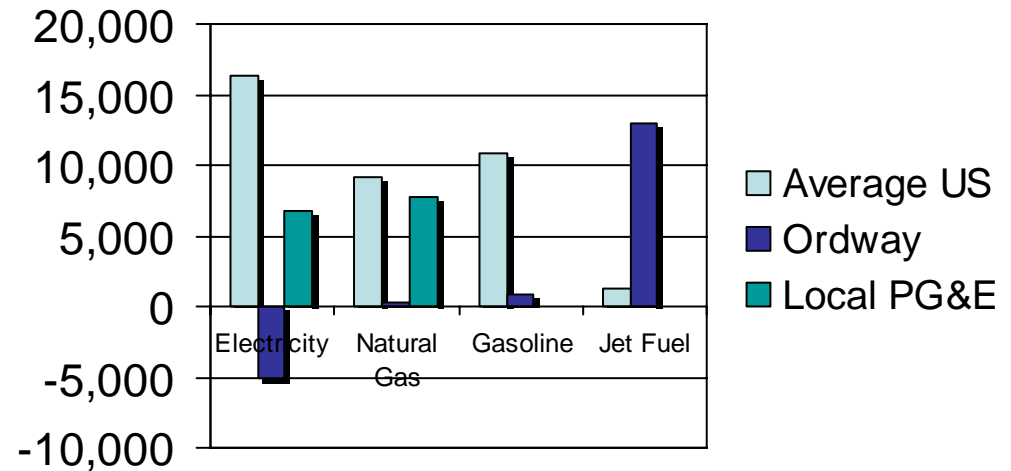
Alternative fuel vehicles to date: many
(biodiesel, SVO, electric, CNG)

Ordway Solar Power Plant Annual Totals



Carbon Comparison

- Typical US household annual carbon footprint:
 - 38,000 pounds CO₂e:
 - electricity 16,000 (11,000 kWh)
 - natural gas 9100 (760 therms)
 - gasoline 9500 (560 gallons)
 - jet fuel 1300 (980 miles)
- OSPF carbon footprint:
 - 9,000 pounds
 - electricity -5100 (-4200 kWh)
 - natural gas 250 (21 therms)
 - gasoline 820 (42 gallons)
 - jet fuel 13,000 (ca. 10,000 miles)
- SF Area PG&E:
 - Electricity 5600 kWh
 - Gas 640 therms



- Bonneville Environmental Foundation
<http://www.b-e-f.org/calc>

1440 Ordway: what next?

(continuous improvement)

- Additional insulation (floor, etc.)
- Cistern for rain water use
- Waste water heat recovery
- On-demand hot water pump(s)
- Fireplace removal
- More vampire/standby eradication
- More window retrofits
- Hydronic heat pump space and water heating system
- Certifications:
 - Wildlife Habitat (NWF) www.nwf.org/backyard
 - Energy Star or LEED (when available)
 - Bay-Friendly Garden www.stopwaste.org/home/index.asp?page=8

Power-pipe drainwater heat recovery



All-electric home?



If done well, can be very green

Berkeley Climate Action Plan

Ordway Solar Power Plant Report Card

- Homes and business to produce as much energy as they use by 2050
 - DONE 48 years ahead of schedule
- Residents and workers rely on public transit, walking and biking
 - DONE 51 years ahead of schedule
- Cars would run on alternative fuels and electricity
 - DONE 46 years ahead of schedule
- No waste would be sent to landfills
 - Still room for improvement at typical 6 oz/week
- most of the food eaten in Berkeley would be produced within a few hundred miles
 - Probably not; more data needed

What you can do

- Make a commitment
- Set goals
- Baseline your impact
- Plan steps of progress
- Implement plan
- Track progress
- Iterate

Try “Low Carbon Diet” with Berkeley Ecology Center materials:

<http://ecologycenter.org/climatechange/>

You can't manage what you don't measure

Read your electric, gas, and water meters and track usage

Track your vehicle fuel usage and air miles

Plug loads:



P3 International Kill-a-Watt Electricity Usage Monitor. \$22 at Amazon.com. Measures watts, kilowatt-hours (over time), and other stuff. Just plug your device into it and plug it into the wall, and you're ready to go.

Slide courtesy Jon Koomey

Footprint Calculators and Offsets

- Cool California:
 - <http://coolcalifornia.org/calculator>
- Wikipedia—links to eco, carbon, water:
 - http://en.wikipedia.org/wiki/Ecological_footprint#External_links
- Earthday Footprint/Redefining Progress
 - <http://www.myfootprint.org/>
- Nature Conservancy
 - <http://www.nature.org/initiatives/climatechange/calculator/>
- Bonneville Environmental Foundation
 - <http://www.b-e-f.org//carbon/calc>
- Terrapass
 - <http://www.terrapass.com/>
- Others...

Show and tell—some ideas

- “Don’t leave home without them”
 - Nylon, not paper or plastic
 - Bandana vs. paper towels, napkins
 - Travel mug, water bottle vs. disposables
- Low and no-cost home energy savers
 - Compact fluorescent lamps
 - Showerheads
 - Clothesline
 - REAL duct tape for sealing ducts
 - Switches

Show and tell—more ideas

- Water savings
 - Showerheads (again!)
 - Aerators
 - Shut-off valves
 - Shut-off nozzles
 - Water-use measurement
 - Leak detection

Solar Clothes Dryers

- 1 GW at California peak for Residential Clothes Dryers
 - Ideal time for drying
- Non-energy benefits (e.g.)
 - Clothes smell better, last longer
 - Kills germs
 - Fewer fires (13k/yr: 15 deaths, 300 injuries--FEMA)
- Need to change restrictions

<http://right2dry.org/>

PROJECT  LIST

<http://www.laundrylist.org/>

(National Hanging Out Day, etc.)

Solar Clothes Dryers



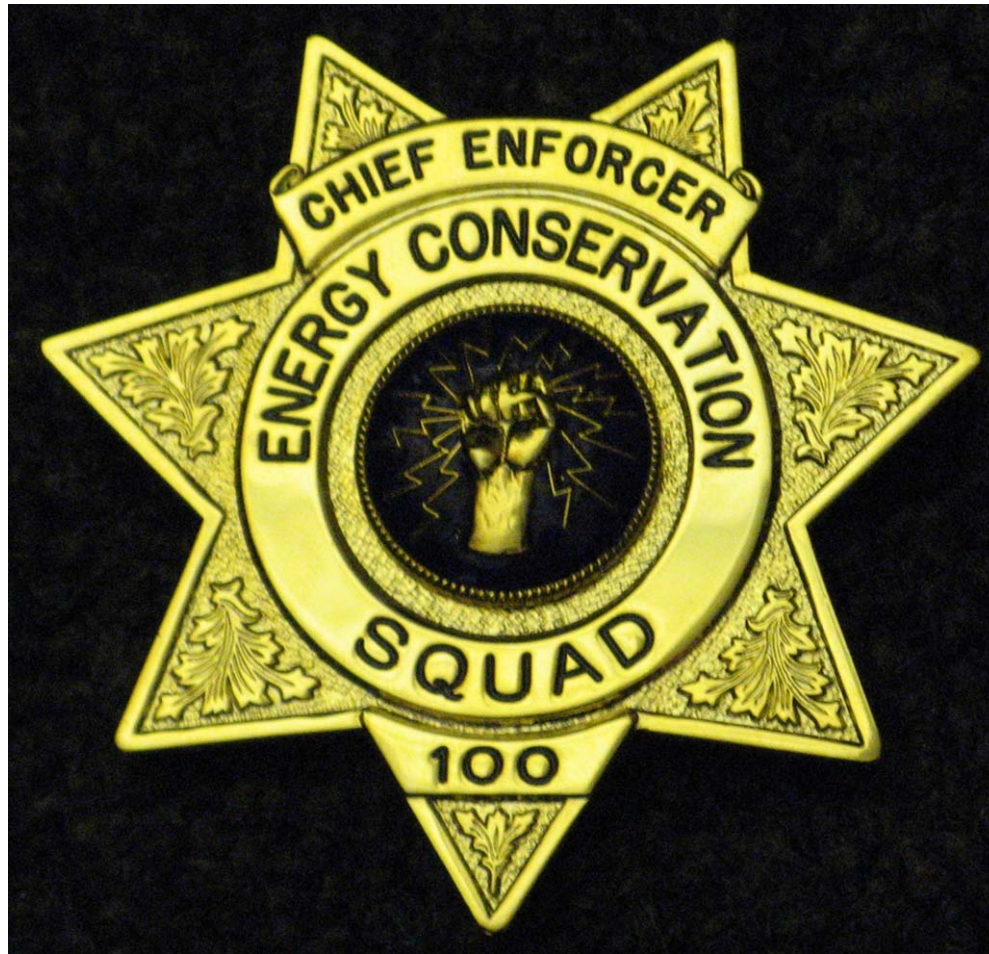
"We must all hang together, or most assuredly we will all hang separately."

- Benjamin Franklin

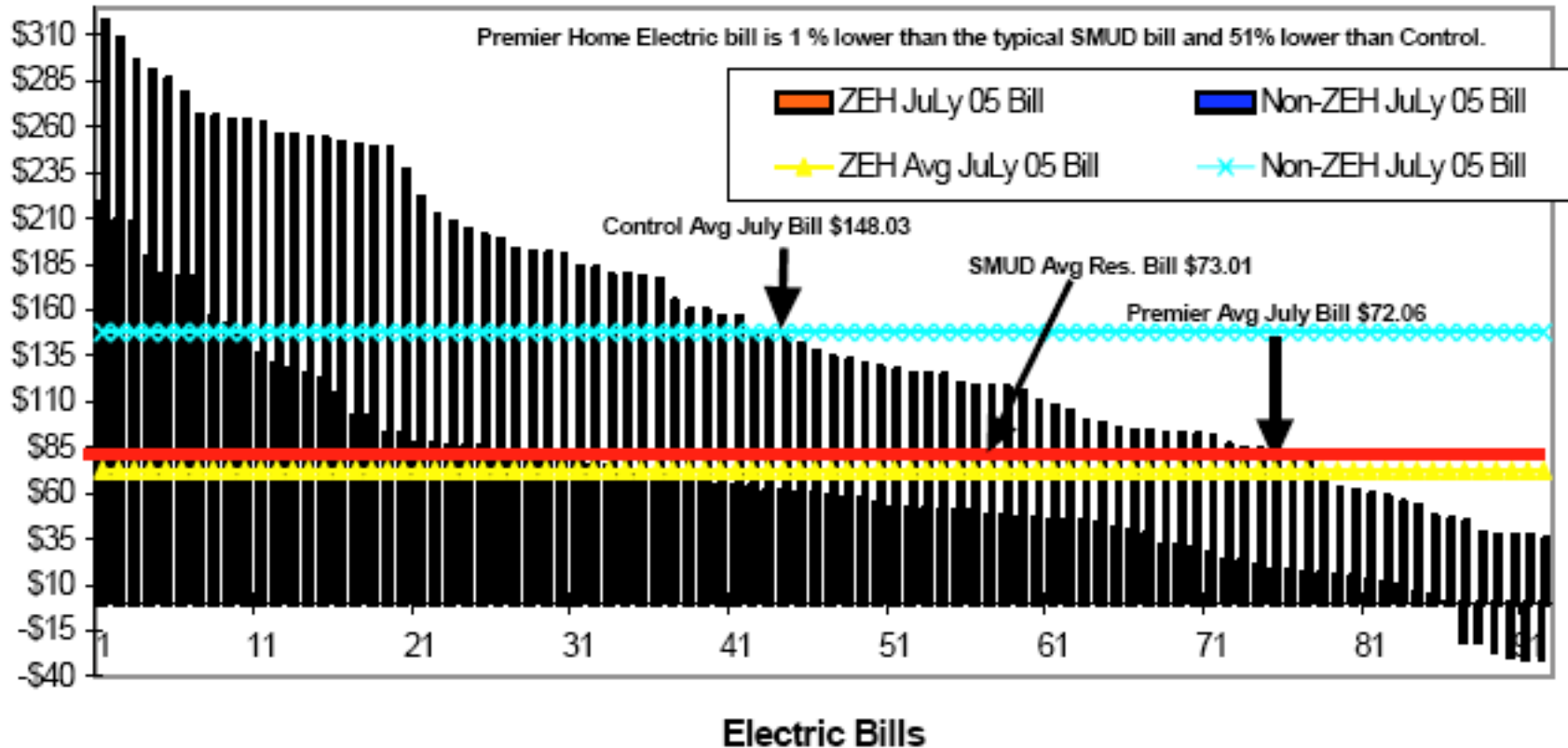
Home Energy Retrofits

- Insulate walls, ceilings, floors, and water heaters
- Do a blower door test + seal air leaks
- Install high performance shower heads
- Scrap and replace an old refrigerator (see PG&E)
- If replacing windows anyway, buy R-5 units; see DOE's R-5 program at <https://www1.eere.energy.gov/buildings/windowsvolumepurchase/>
- Lots of others—do or get an audit
 - Deep retrofit (~70% reduction)

Behavior is very effective and free



Occupants Matter



Control Home Energy Use

- No-cost
 - Turn it off/unplug it when not in use (be a vampire slayer)
 - Thermostat management
 - Shut off pilot lights in summer
- Low-cost
 - Buy (and properly use!) a programmable thermostat
 - Put motion sensors on lights
 - Power strips/plug in switches

Transportation Options

- Telecommuting
- Live near school, work and play
- Car pooling
- Trip merging
- Mass transit
- Bicycling
- Walking (we have feet...)

Driving: no-cost techniques to save lives, \$, the planet

- **Drive slower!**
- Enhance aerodynamics:
 - Keep windows rolled up when driving at speed.
 - Remove roof racks when empty
- Accelerate slo-o-owly.
- Maintain constant speed - decelerate & accelerate gently, and only when required.
 - Choose a speed slightly below the flow of traffic (right lane!) so fewer speed changes are required.
 - Predict traffic changes far ahead.
 - Use cruise control if you find your speed creeping up every time you look at the speedometer
- The accessory that uses the most engine power is the AC system. Use it only when needed
 - Better to use than open window at speed.
- Use mpg gauge to play the "I can use less energy than *THAT!*" game.
<http://www.scangauge.com/>
- Fresh Wax job. (optional)
- Proper tire inflation, low rolling resistance tires
- Check out <http://www.ecodrivingusa.com/>
- **Drive slower!**

Honda Civic VX (with trashed aerodynamics)



47 mpg EPA rating, 43 mpg real average (but NOT as shown!)

**Bicycles are not just for recreation
and sport!**



Bicycles are for transportation



- OSPP2 (~750 pounds) all hauled with bike trailer <http://www.bikesatwork.com>
- UC Berkeley bicycle resources: <http://pt.berkeley.edu/around/bike>
- Bicycle Friendly Berkeley Coalition: <http://www.bfbc.org/>
- East Bay Bicycle Coalition: <http://www.ebbc.org/>

Transportation Resources

- Safe Routes to School and Transit:
 - <http://www.saferoutesinfo.org/>
- Bicycle Friendly Communities (and Universities):
 - <http://www.bikeleague.org/programs/bicyclefriendlyamerica/>
- Local/regional (TripPlanner, RideSharing, etc):
 - <http://www.511.org/>
- Clipper (was Translink):
 - <https://www.clippercard.com/>
- Spare the Air:
 - <http://www.sparetheair.org/>



Energy Information

- Home energy saver (DIY audit):
 - <http://hes.lbl.gov/>
- PG&E (rebates, info resources):
 - <http://www.pge.com/myhome/>
- Energy Star (appliances, equipment, homes):
 - <http://www.energystar.gov/>
- *Home Energy* magazine:
 - <https://www.homeenergy.org/>
- Solar California (rebates, tax credits):
 - <http://www.gosolarcalifornia.ca.gov/>

Bay Area Home Efficiency Services

(sample)

- Advanced Home Energy
www.advancedhomeenergy.com
- Solar City Efficiency (was Building Solutions)
www.solarcity.com/residential/efficiency/
- Energy Beyond Design
<http://energybeyonddesign.com>
- Peralta Energy Group
<http://gosolar.org>
- Recurve
www.recurve.com

More you can do

- Reduce your materials use and impacts
 - Recycle,
 - Precycle: <http://www.goodguide.com>
 - Freecycle: <http://www.freecycle.org>
- Eat lower on the food chain
- Buy local
- Buy green power or offsets
- Travel less
- Check these out:
 - <http://www.storyofstuff.org>
 - <http://www.fightglobalwarming.com>
 - <http://www.arb.ca.gov/cc/cc.htm>

Recycling, Hazardous Waste, and Water Information



Stop Junk Mail: <http://www.stopjunkmail.org>

Water

East Bay Municipal Utility District:

www.ebmud.com/environment/conservation-and-recycling/watersmart-center



California Urban Water Conservation Council:

www.h2ouse.org



Take-aways

- We owe the future to begin now
- Make commitment to act, and follow through
 - Baseline and track your impact
 - Plan and implement steps of progress
 - Iterate
- Boulding's First Law: Anything that exists is possible...
- Save the planet for fun and profit!

Thanks! Questions?



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