

Load Management Standards Workshop on Customer Education and Needs

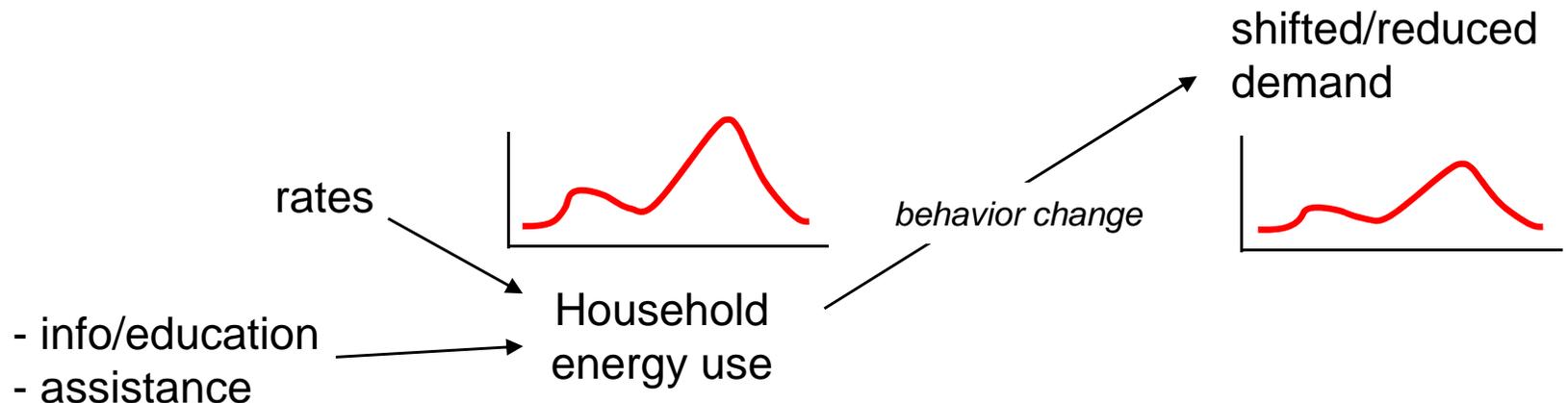


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WORKSHOP TOPICS

- ❑ Potential customer impacts
- ❑ Customer needs to enable effective response (to TOU, etc.)
- ❑ Education/assistance for customers
- ❑ Possible LM standards



Observations

- These are important questions
- New behavioral role in policy – need to *engage* the energy user
- New services, communications, tools, and strategies required
- Permanent and temporary *behavior change* required
 - TOU means *changing habits*
 - CPP means *constant attention/information* or *automated control*

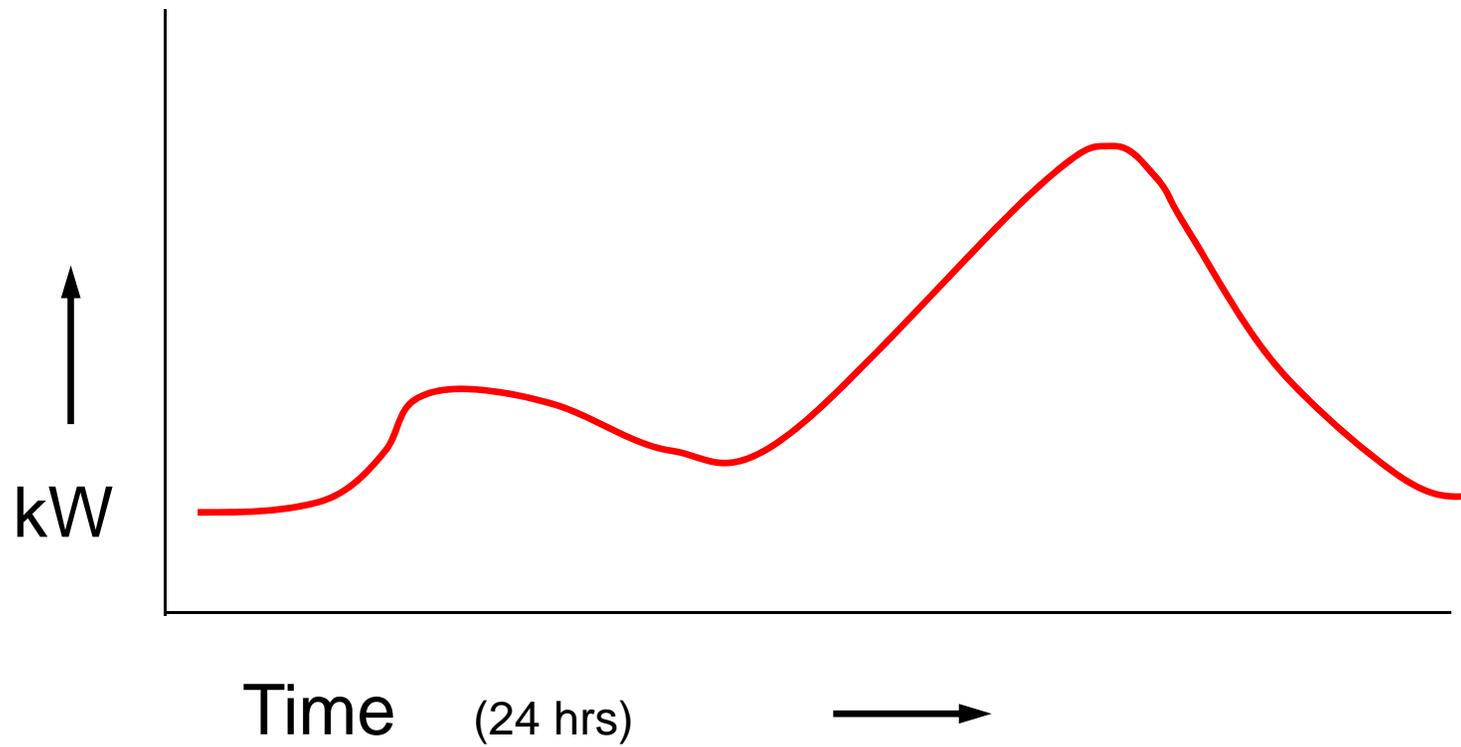
Observations

- Not likely to be easy
- Response not what we might expect
- Uncertainties can be reduced through research

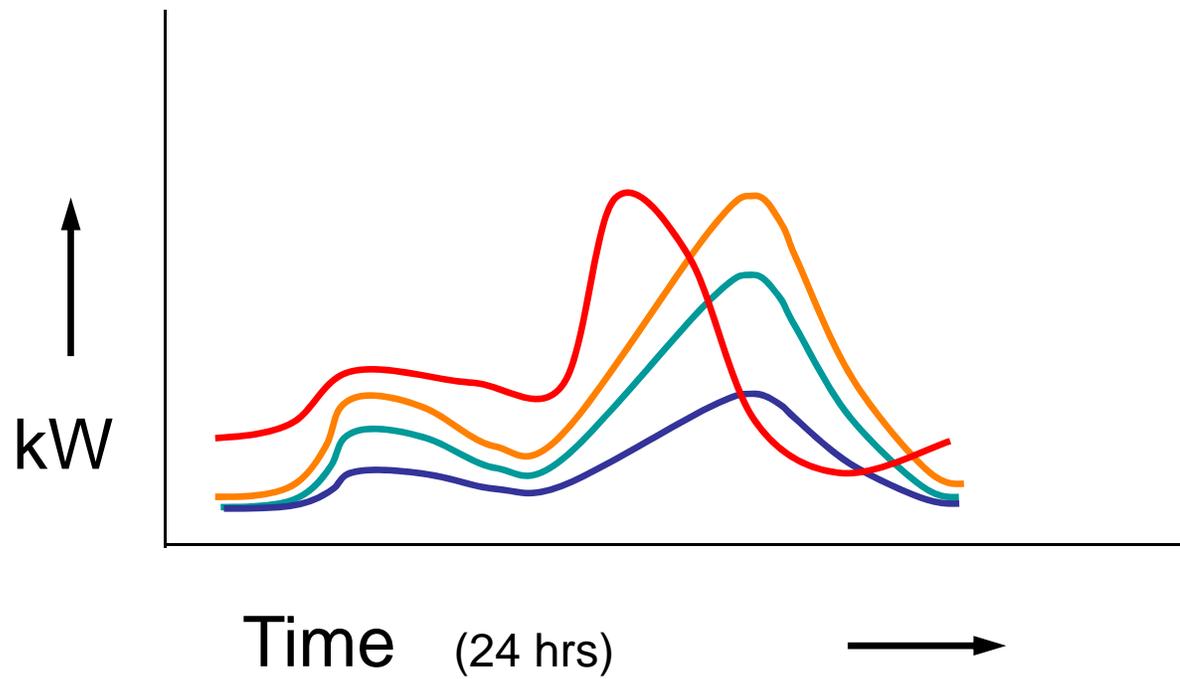
Points I'll cover

- ✓ Idealized loads – what we're trying to change
- ✓ Impacts, perceptions & responses vary
- ✓ Information environment & education issues
- ✓ Real loads, real systems & real research needs

Idealized load profile

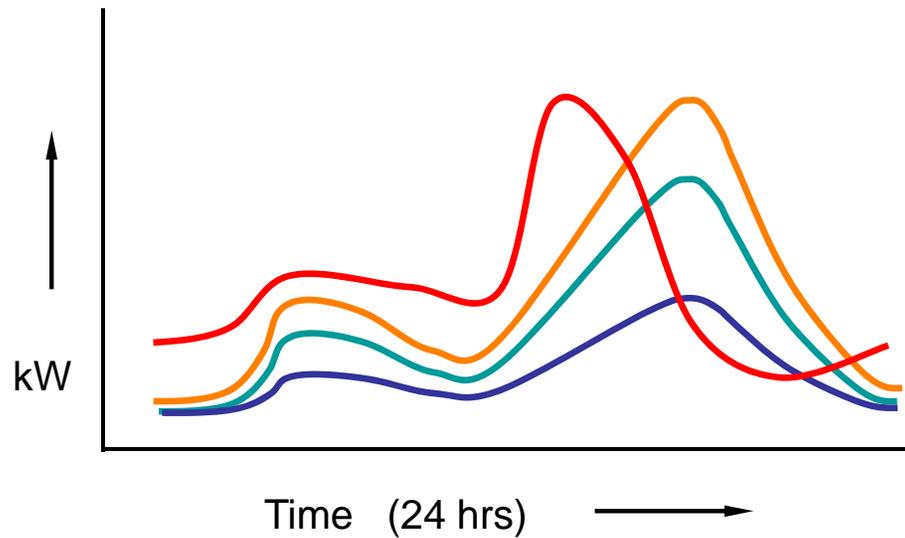


Similar across households

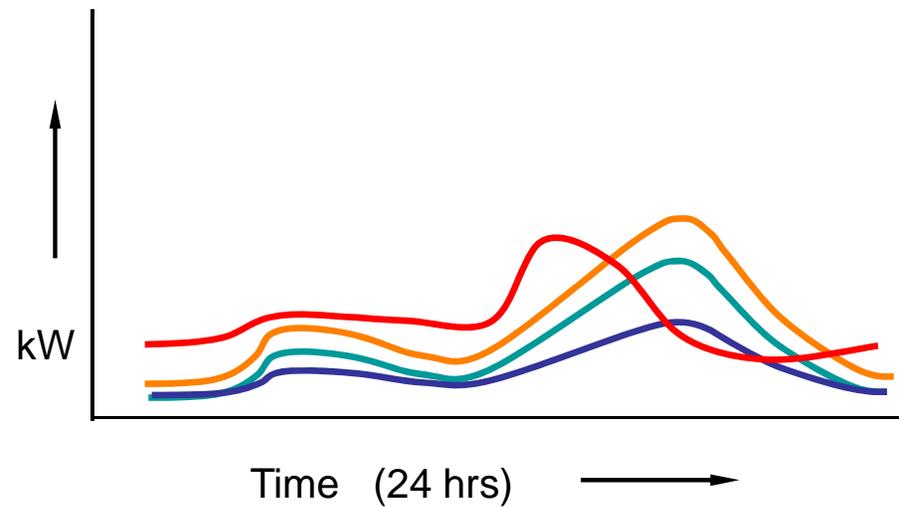


Desired effects of policies

Before TOU, etc.



After TOU, etc.



Mechanisms: How can rates/incentives affect usage?

A variety of imaginable responses

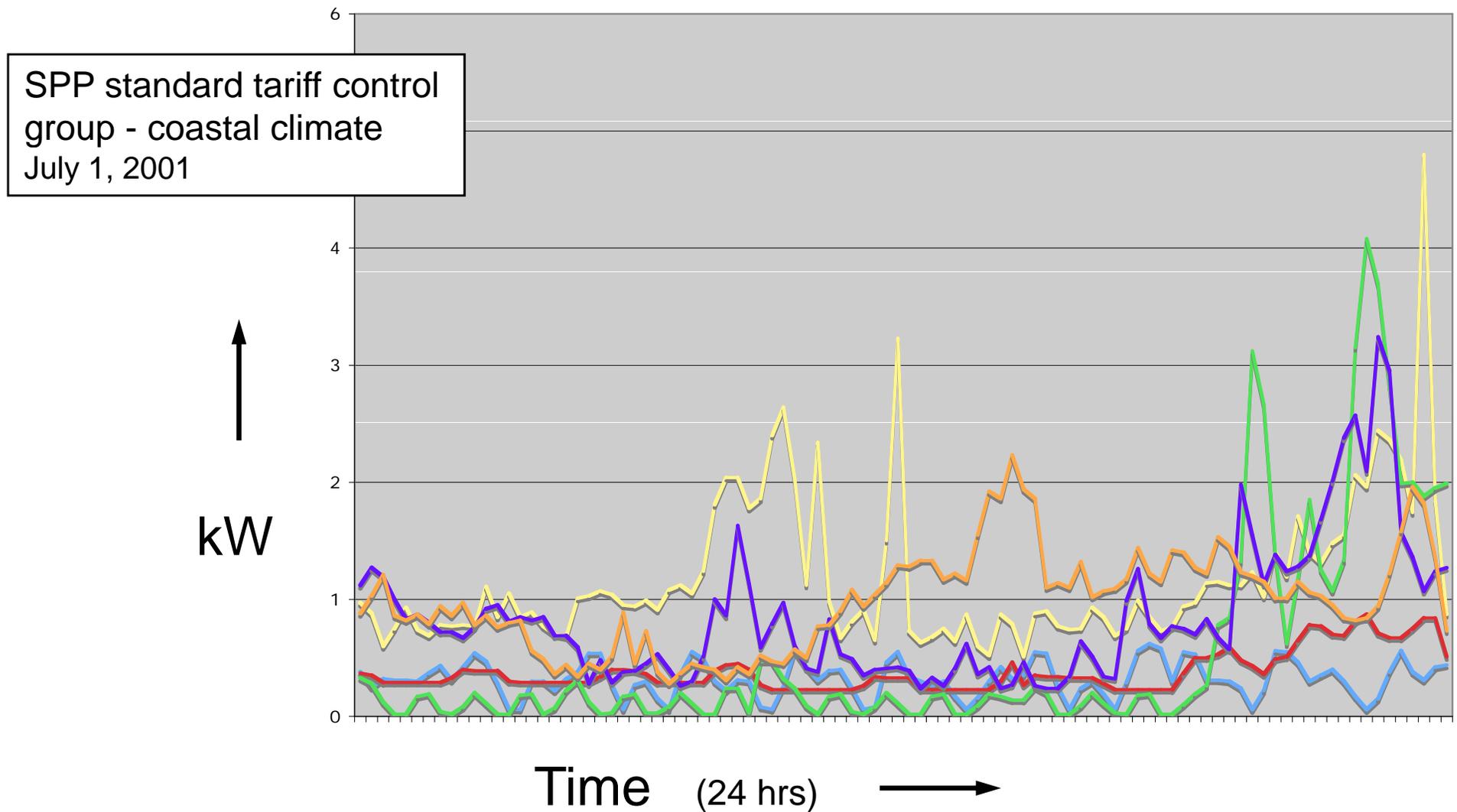
- Changes in perspective (recognition of peak problem and need for response)
- Changes in behavior
 - Shifting loads to off-peak times
 - On-peak conservation
- Long-term hardware/building changes
 - Permanent efficiency (lowers both on and off-peak demand)

POTENTIAL IMPACTS ON CUSTOMERS AND THEIR RESPONSES

- Highly variable
- Depends upon real energy use patterns – idealized loads don't exist
- Awareness & interest – key response factors
- Perceptions and actions governed by:
 - Understandings
 - Resources
 - Constraints
- Impacts and responses not what might be imagined

Real data – same day, same weather

6 households



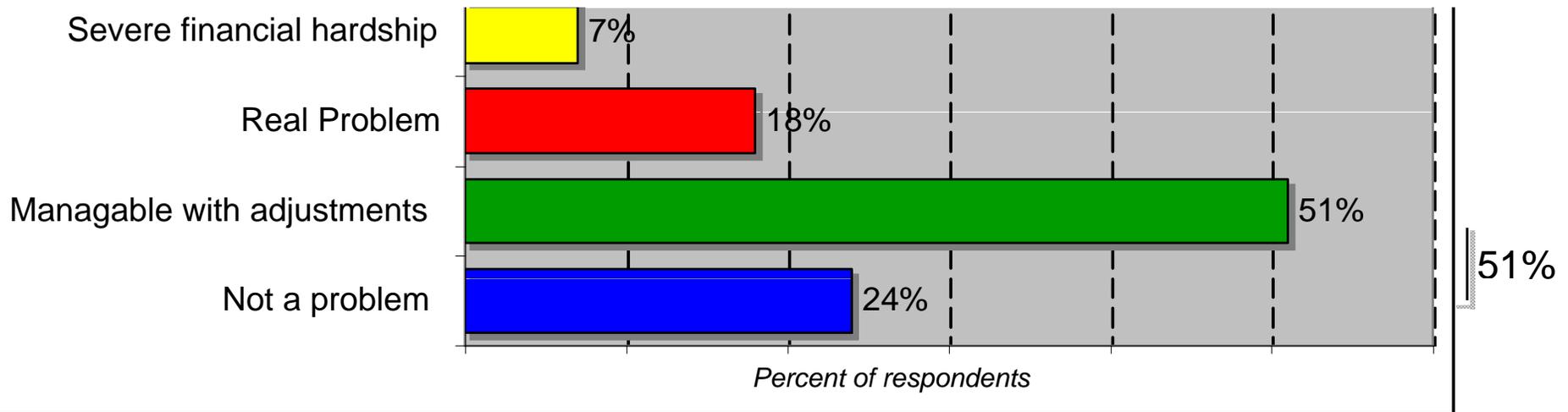
Possible impacts of rates (TOU and/or CPP)

- Positive benefit – load shape perfectly matches rates
- Little/no impact (good load shape match)
- Cost impact / not noticed
- Cost impact noticed / little budget effect
- Significant impact → time shifting of usage
- Sig impact → conservation / EE (may or may not match peak)
- Sig impact → failed shift / conservation attempts
- Sig impact → budget crunch / reduced \$\$ for other needs
- Sig impact → crisis, welfare decline and failure to pay

And ... changing over time from one category to another

Observed with 30% natural gas price increase

Northern California
Winter 2005-06

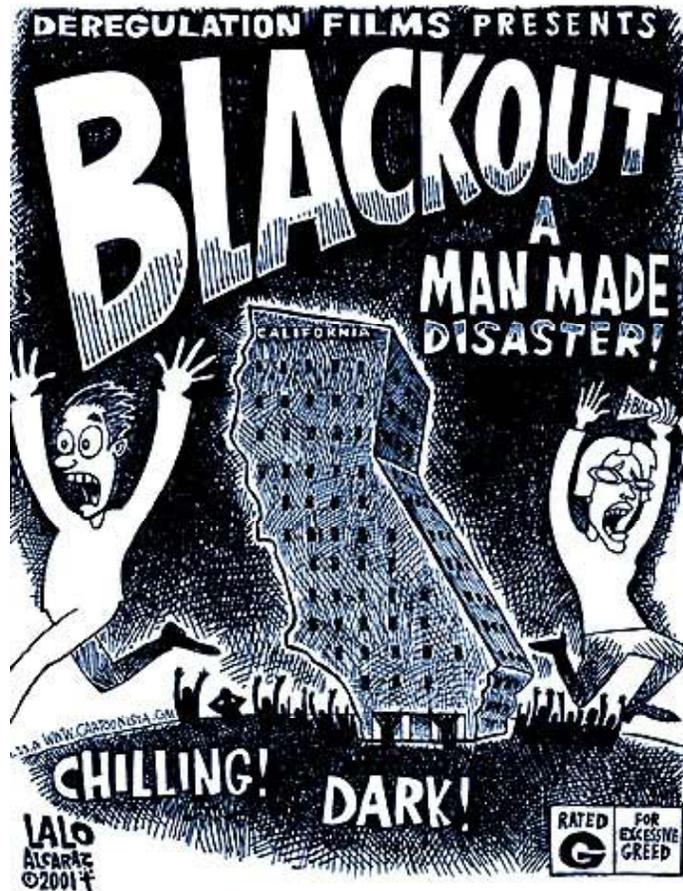


- “severe hardship” or “real problem” (25% overall)
 - Low income - less than \$35k (33%)
 - African American (38%)
 - Latino (34%)
- “cut back spending” – renters (61%) owners (45%)

Customer behavioral responses

- Used less heat/lowering temperatures (67%)
- Substituted non-NG fuels (electricity, wood) (13%)
- Stopped using heat (10%)
- Less water and/or laundry (19%)
- Used less electricity (10%)
- Managed doors and windows (7%)
- Home EE improvements (7%)

Insights from 2001-02 California Crisis



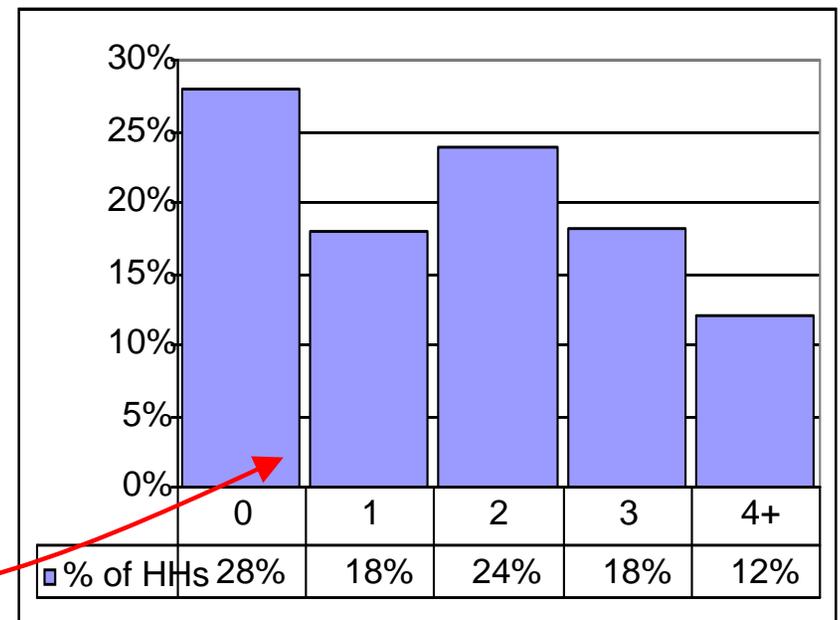
- Supply disruption
- Utility bankruptcy
- State as power buyer
- Conservation needed
 - Only **hardware incentives** on offer \$990M
 - Risky requests for **voluntary conservation** 5,000MW

Flex your
POWER 

Impacts and behavioral response

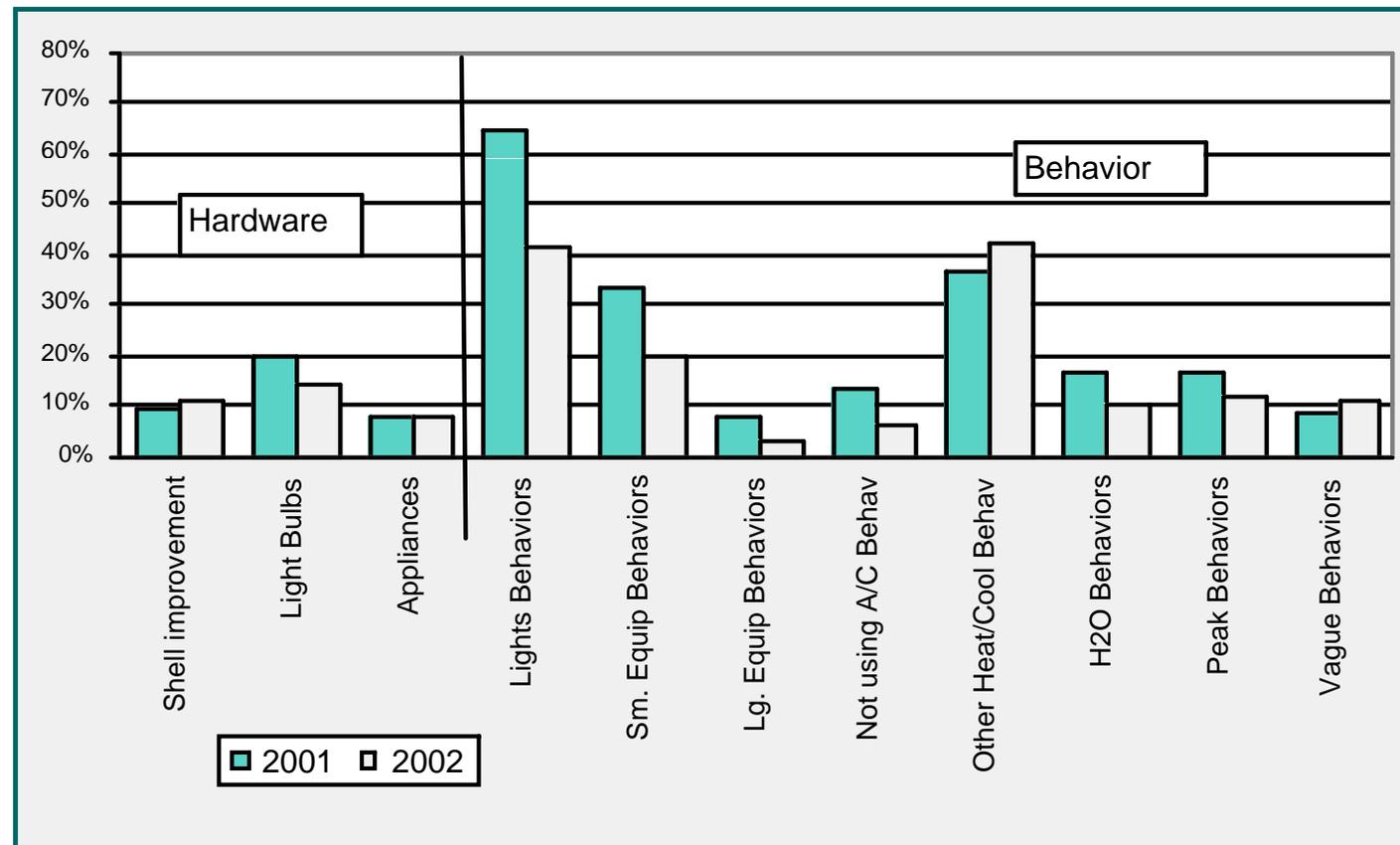
- Surprising widespread response
- Altruistic, civic, environmental motives
- Real system peak reduction
- Peak load shifting requested, but little was reported
- Large proportions did little or nothing

Number of conservation behaviors reported



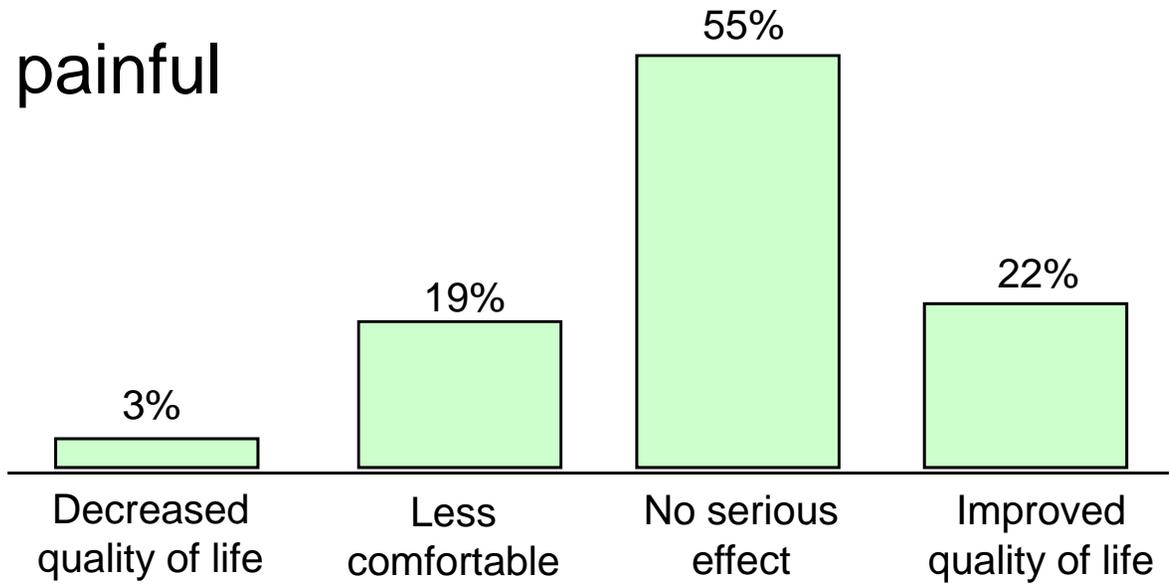
Behavior Change

- People did what they weren't asked to do
- Surprising contributor: turning off air conditioners



The good news

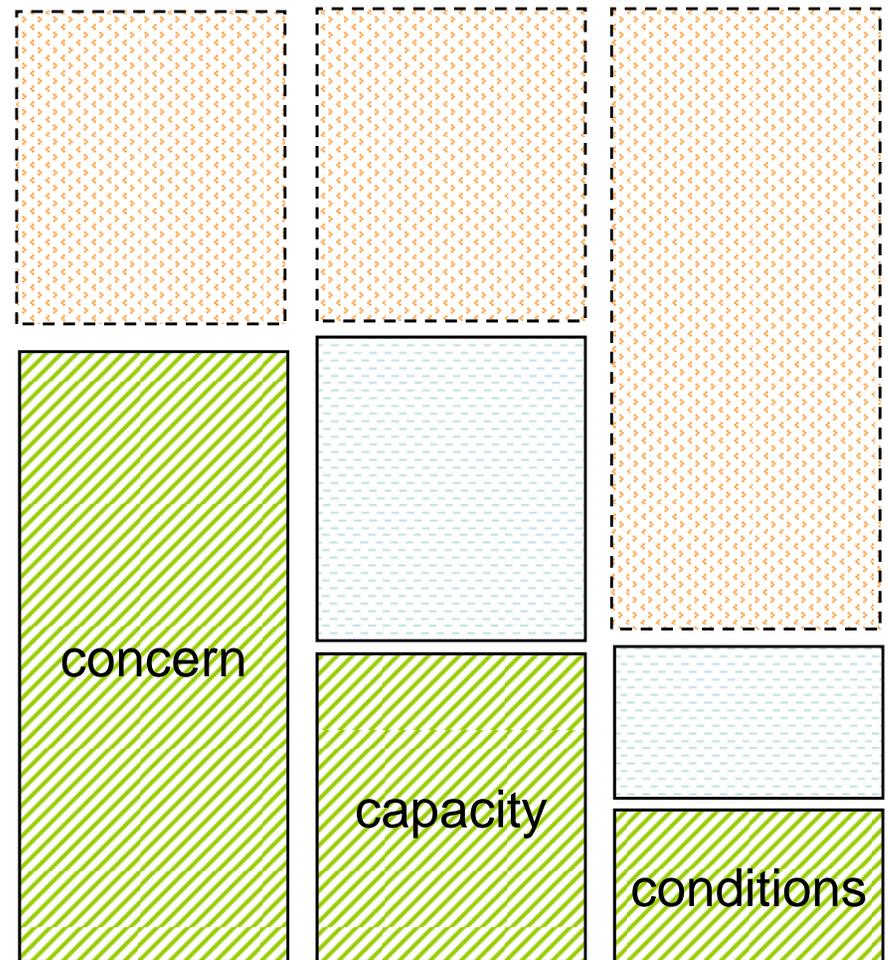
- Behavior change not painful



- Pessimism about energy future problems
- See need for lifestyle change
- Want action by business & government

Modest expectations: Prerequisites for conservation action

- **Concerns**
Problems are real, salient, actionable
- **Capacities**
Knowledge, skills, resources
- **Conditions**
Time, attention, products, suppliers



INFORMATION ENVIRONMENT

What do people know? Not much . . .

- Bills infrequent and unintelligible
- Media coverage and “tips” simplistic
- Energy flows (purposely) invisible
- No feedback from use or conservation action
- Habits, rules-of-thumb, heuristics crucial

Education issues

- More involved than simply *providing information*
- Quality and effectiveness of information/ messaging depends on:
 - Content (“what’s said”)
 - Form (“how it’s said”)
 - Context (“when & where” it’s said, and “what else is being said”)
 - Delivery mechanism (“who is saying it, to whom”)
- Many ways to get it wrong / seldom done right

Energy literacy: Potentially a daunting task

- Universal education in the U.S.
- Emphasis on news and current affairs
- Growth of higher education
- High drop-out rates
- Poor performance = limited grasp of the subject matter
- Myths and misunderstandings: 20% of Americans believe sun revolves around the earth
- Best guess: few people see energy bills or energy information and have more than a superficial understanding

STATE OF OUR KNOWLEDGE about customer behavior and energy loads

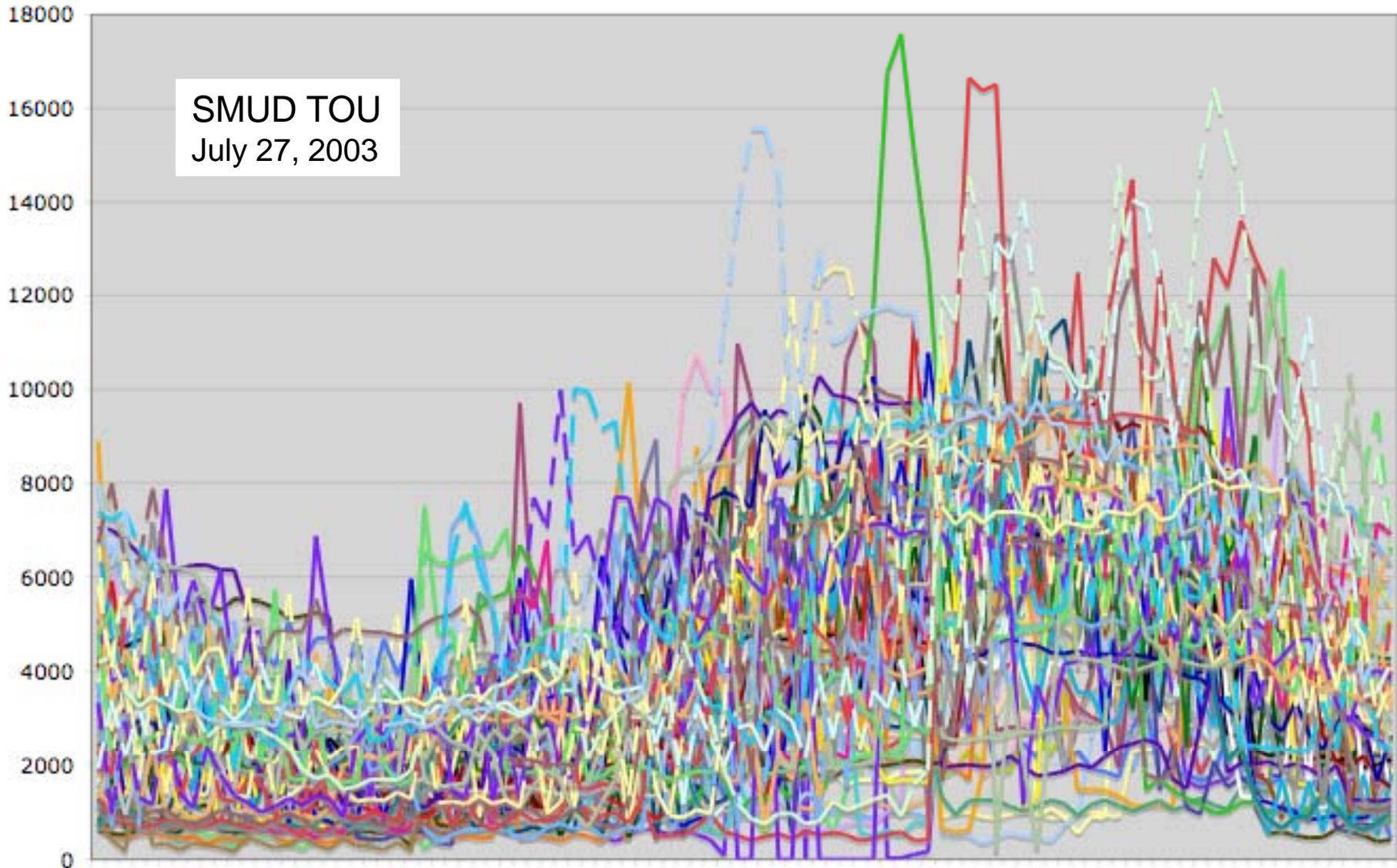
- Limited basis for information/education programs
- Wide diversity of loads and behaviors
- Household demand system is extremely complex
- Range of research needs

Limited capacity to differentiate load profiles and advise customers

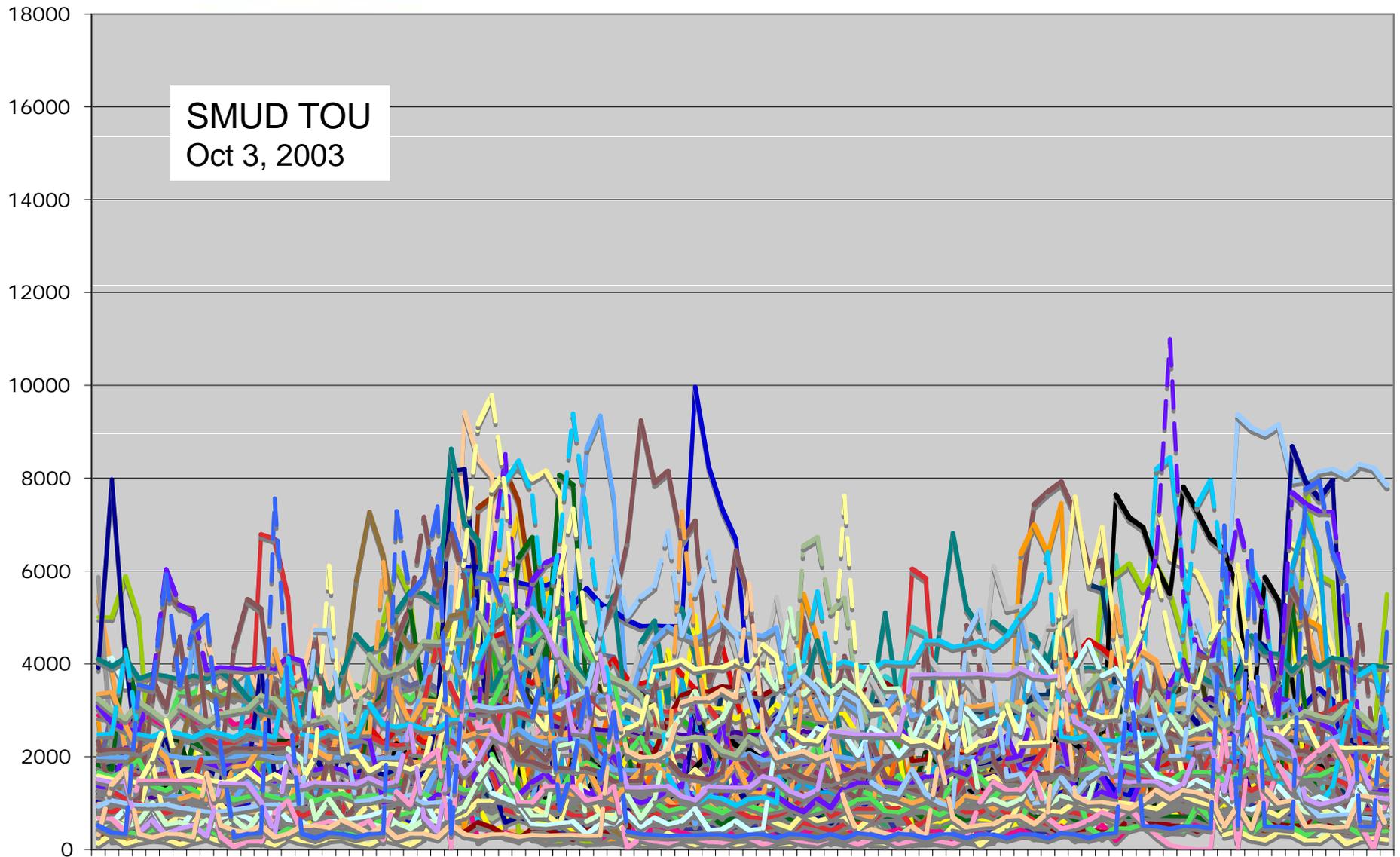
- Energy efficiency information generic
- Little experience differentiating households and segmenting
- EE encourages “technical fix” not behavior change
- Tailored assessment historically costly and risky (e.g., home performance testing)
- Feedback crude and not real-time
- Decline in sub-metering and other forms of household-level analysis (mass of new data on the way)

Reality bites: Real loads

70 households



Even in mild weather



Household energy use is a complex system



- Interacting elements – internal and external to HH
- Not easily reduced to simple explanations & models

Demand shaped by a diversity of factors

Complex relationships and interactions among . . .

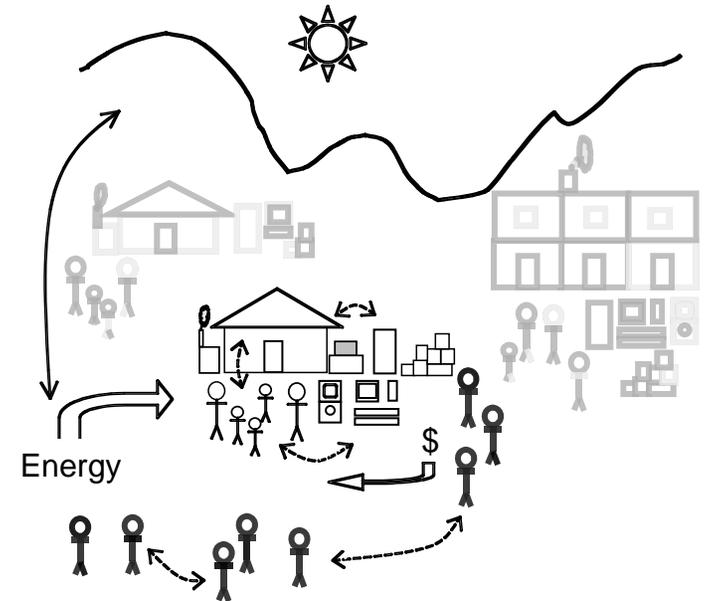
- Environment/climate/weather effects
- Building characteristics and thermal performance
- Technologies/systems and appliances
- Behaviors – associated with:
 - Household composition (numbers and ages)
 - Social characteristics (income, ownership, ethnicity, etc.)

Model of annual kWh
(Northern California, 2006)

| | B | Sig. |
|----------------------|-----------|------|
| CDD (100s) | -27.70 | .53 |
| HDD (100s) | -43.00 | .25 |
| Zone 2 | -1,162.24 | .31 |
| Zone 3 | -212.02 | .85 |
| Zone 4 | -2,592.61 | .02 |
| Zone 5 | -3,216.19 | .00 |
| Single Family | 2,648.55 | .00 |
| Duplex/Tri, Town/Row | 1,619.58 | .04 |
| Apartment or Condo | 1,860.78 | .01 |
| Bldg Sqft (1000s) | 642.21 | .04 |
| Built 1984-96 | 319.29 | .32 |
| Built 1997-04 | 308.42 | .48 |
| Income (\$10,000s) | 134.43 | .00 |
| Owner | 773.72 | .01 |
| Latino | -1,296.16 | .00 |
| African American | 631.40 | .19 |
| Asian | -1,005.11 | .07 |
| N of adults 18+ | 857.97 | .00 |
| N 13-17 yrs | 1,326.28 | .00 |
| N 6-12 yrs | 421.94 | .02 |
| N Infant - 5 yrs | 16.90 | .94 |
| (Intercept) | 3,384.01 | .08 |
| R-sq = .40 | | |

Before detailed feedback and advice: Research required

- Residential consumption patterns & load profiles
- Basic elements & structure of loads & peaks (what's producing the patterns?)
- Dynamics of stability & change (internal & external to HH system)
- More precise targets for *electricity and natural gas* efficiency, conservation and carbon reductions
- Comparing/evaluating policy strategies and outcomes



Which brings us to . . .

