

Exploring Very Low Energy Consumption Rates in Urban California Households



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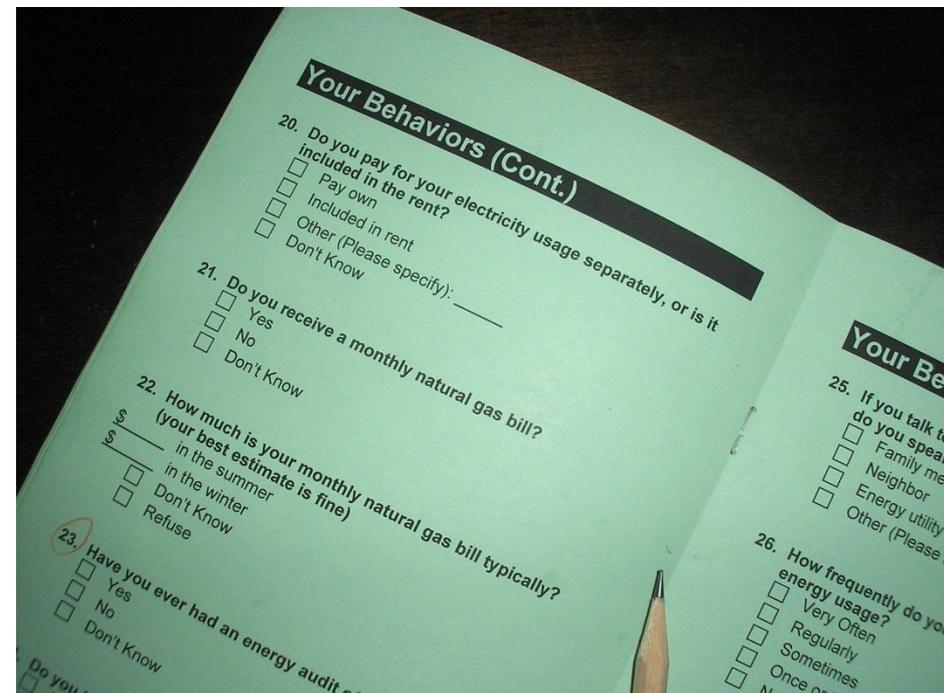
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Overview

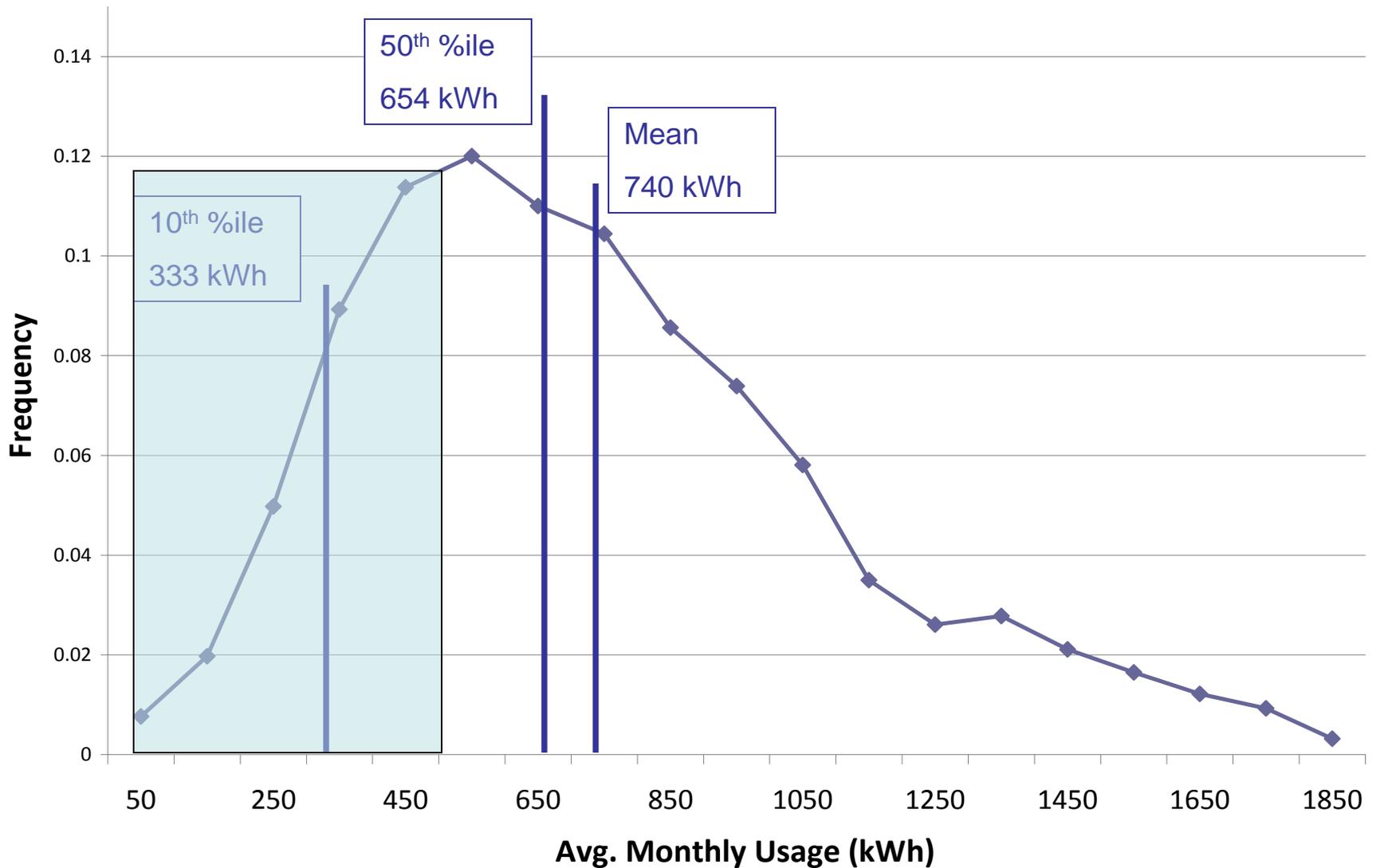
1. Why study low electricity users?
2. Methodology: Survey sample
3. Findings: Demographics, behaviors, profiles
4. Conclusions: How can insights about low usage inform policy?



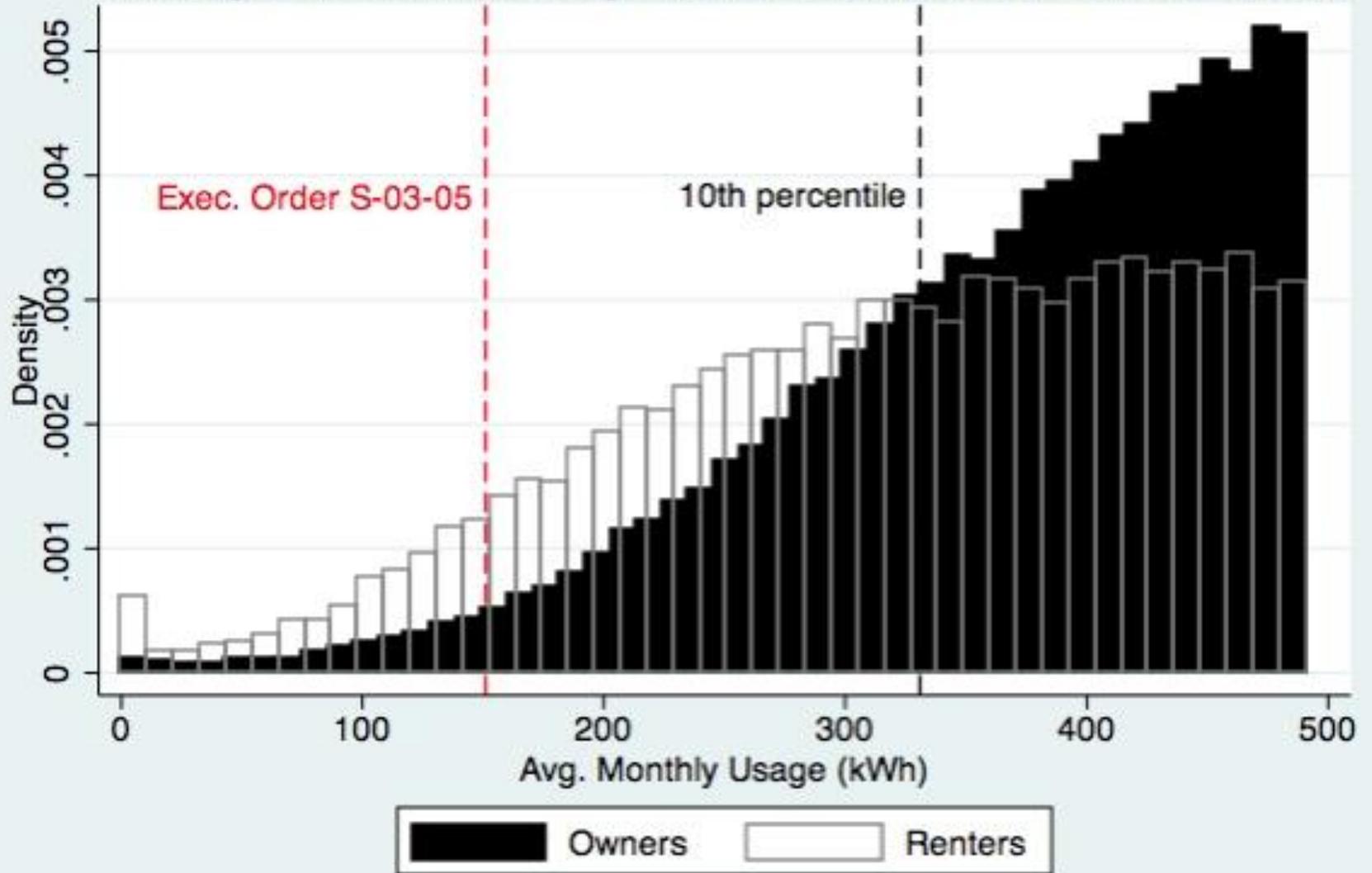
Why study low users?

- **GHG goals translate into a required 80% reduction in emissions (some of which will be achieved through renewables)**
- **Can Californians live with 80% less energy?**
- **Answer and research question: Let's examine homes that are already operating at 20% of current average electricity use**
- **Learn from the “experts,” crowdsource insights**

Residential electricity consumption distribution in SMUD territory



Average Electricity Usage for Bottom 25% of SMUD Users



Why study low users?

- **Common beliefs about low users:**

Poor, miserable, live alone, or not home.

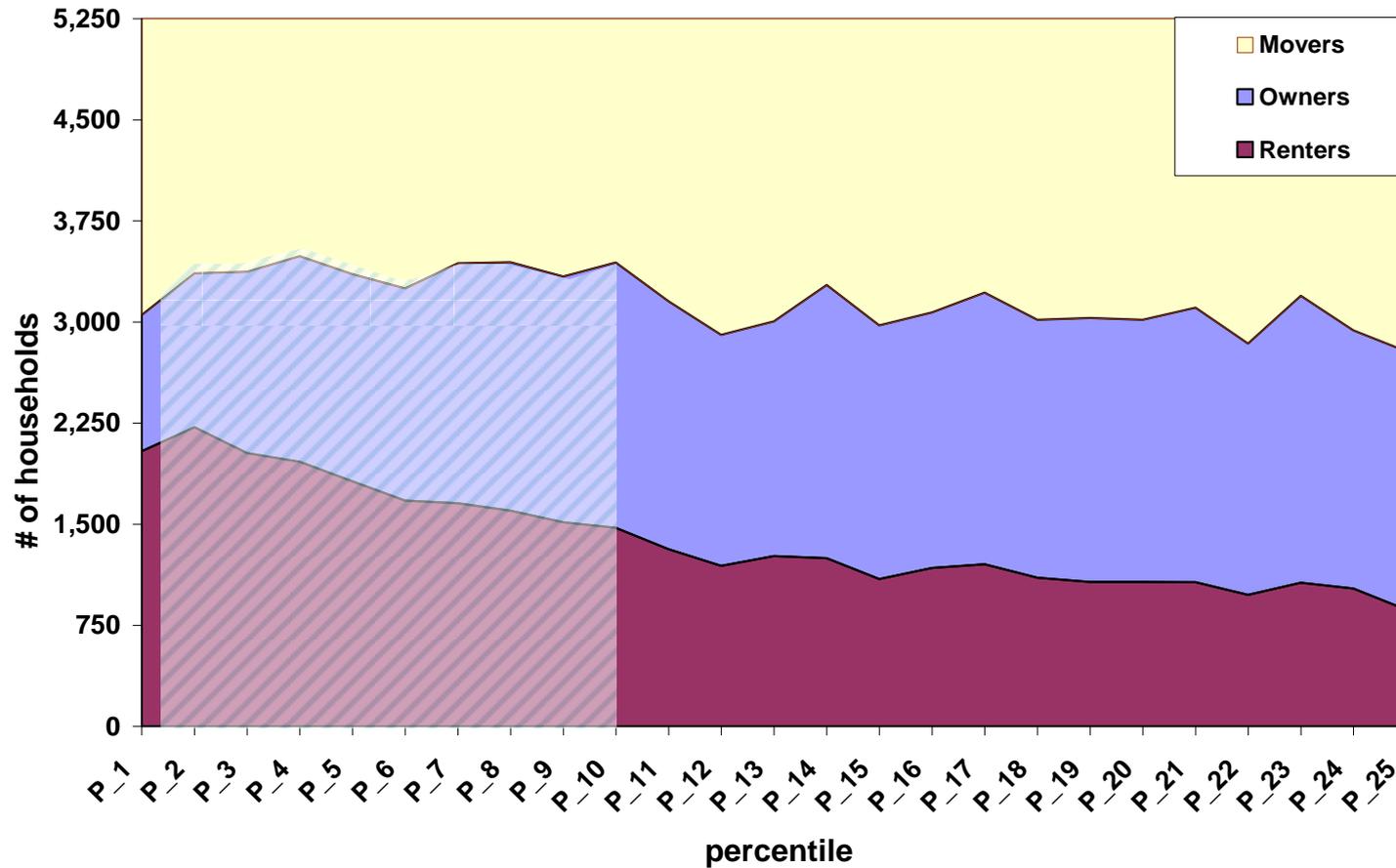
“They are not like us. There is nothing to learn from them.”

- **Are these common beliefs accurate? Without looking at our data,**
 - **Economists would note that *on average* energy use rises with income**
 - **Sociologists might observe that these *averages* tell us nothing about what combinations of circumstances correspond to low(est) use; that studying the *outliers* might offer insights**

Sampling methodology

- Target sample: Customers in lowest decile
- Removed: Recent movers and unoccupied households
- = 27,025 households (14,627 renters and 12,398 homeowners)

Renters and Homeowners in Lowest Quartile



Survey sample: Data fields

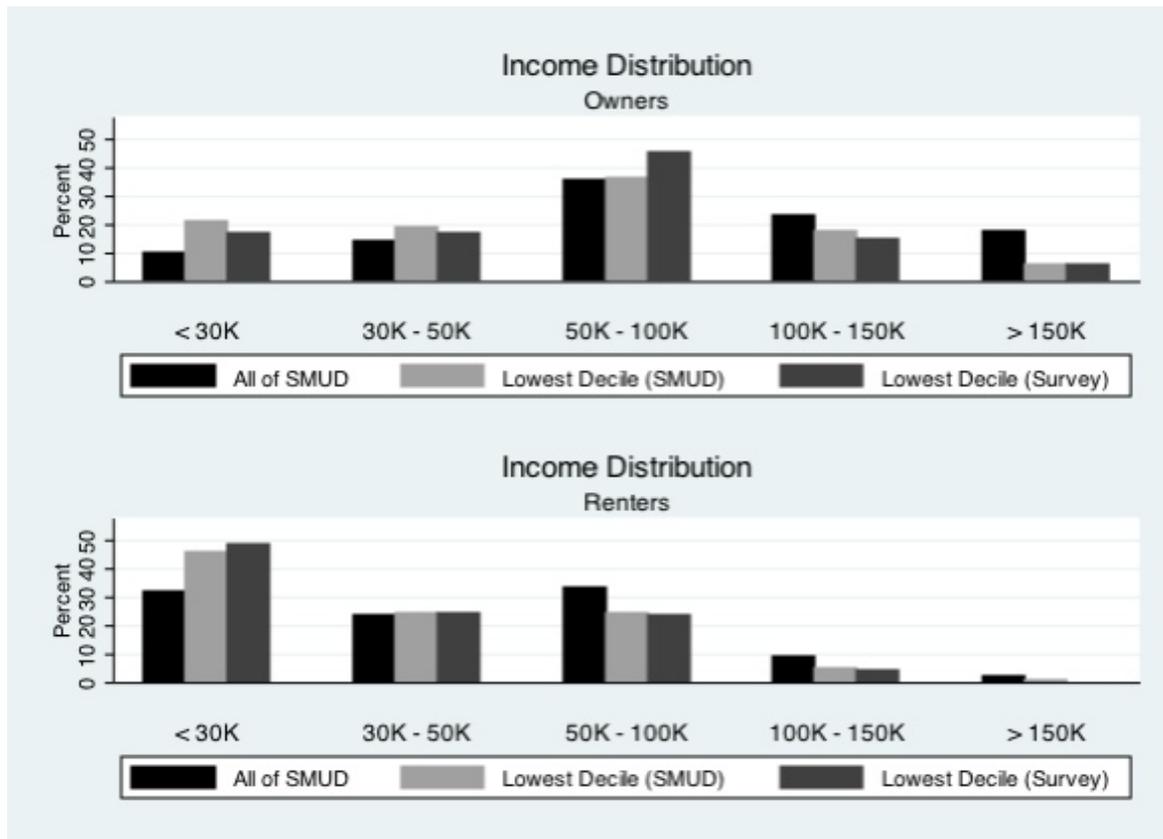
1. Contract number
2. House number
3. Dwelling type
4. Street
5. City
6. State
7. Zip
8. Ethnicity
9. Gender
10. Income
11. Number of people in home
12. Age of head of household
13. Marital status
14. Length of residence
15. Structure year
16. Square feet
17. Participation in SMUD programs
18. Monthly kWh usage from 2008-2010.
19. Peak & Off-Peak kWh usage
20. Customer names, email addresses, or telephone numbers only for the 4,550 surveys and interviews

Demographics: Low users are 'normal'

+ Low usage is real; people are home (15% - 18% response rates)

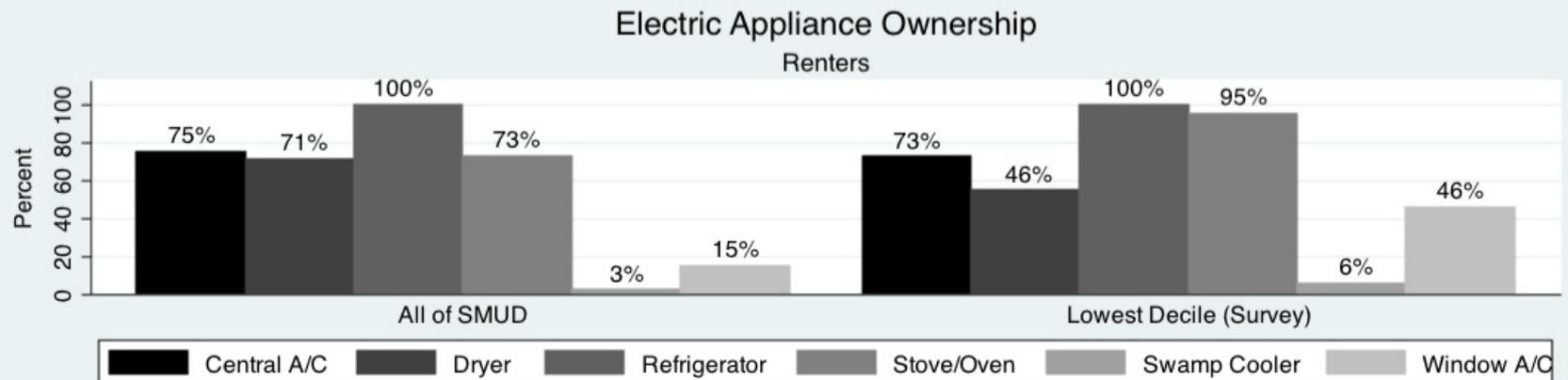
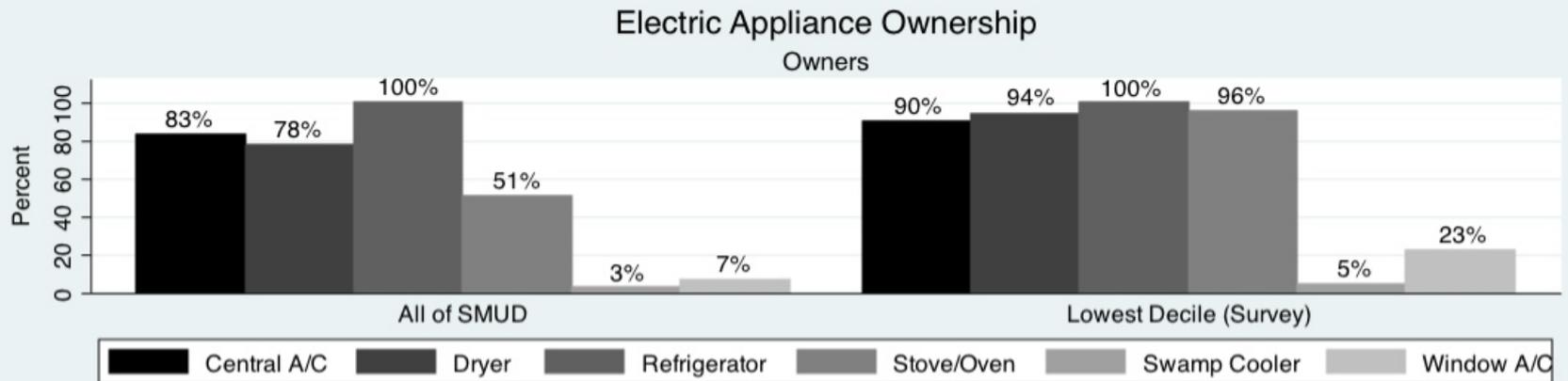
+ Demographically diverse low user population

(Income, Age, Race, Education, Square Ft.)



Low users own MORE appliances

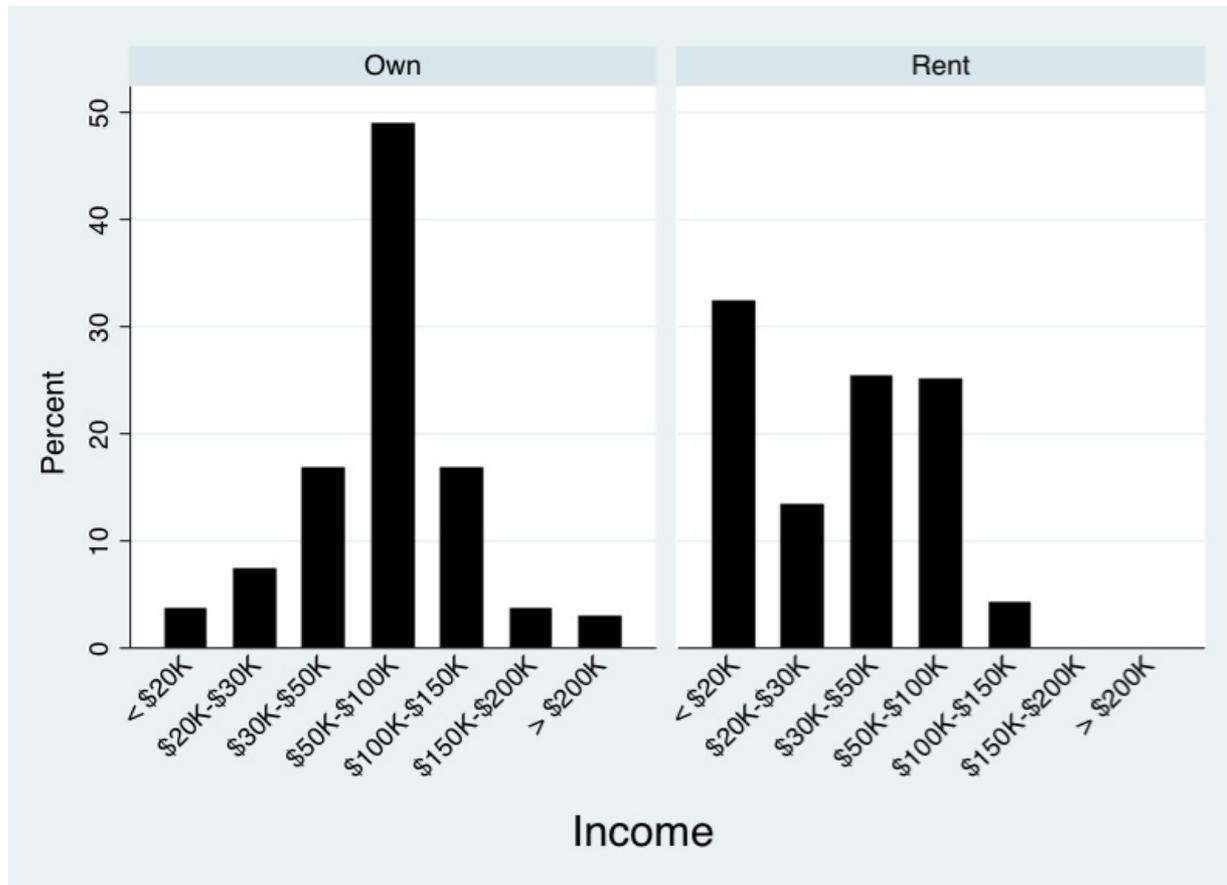
+ Electrical appliance saturations



Most low users are NOT poor

Income

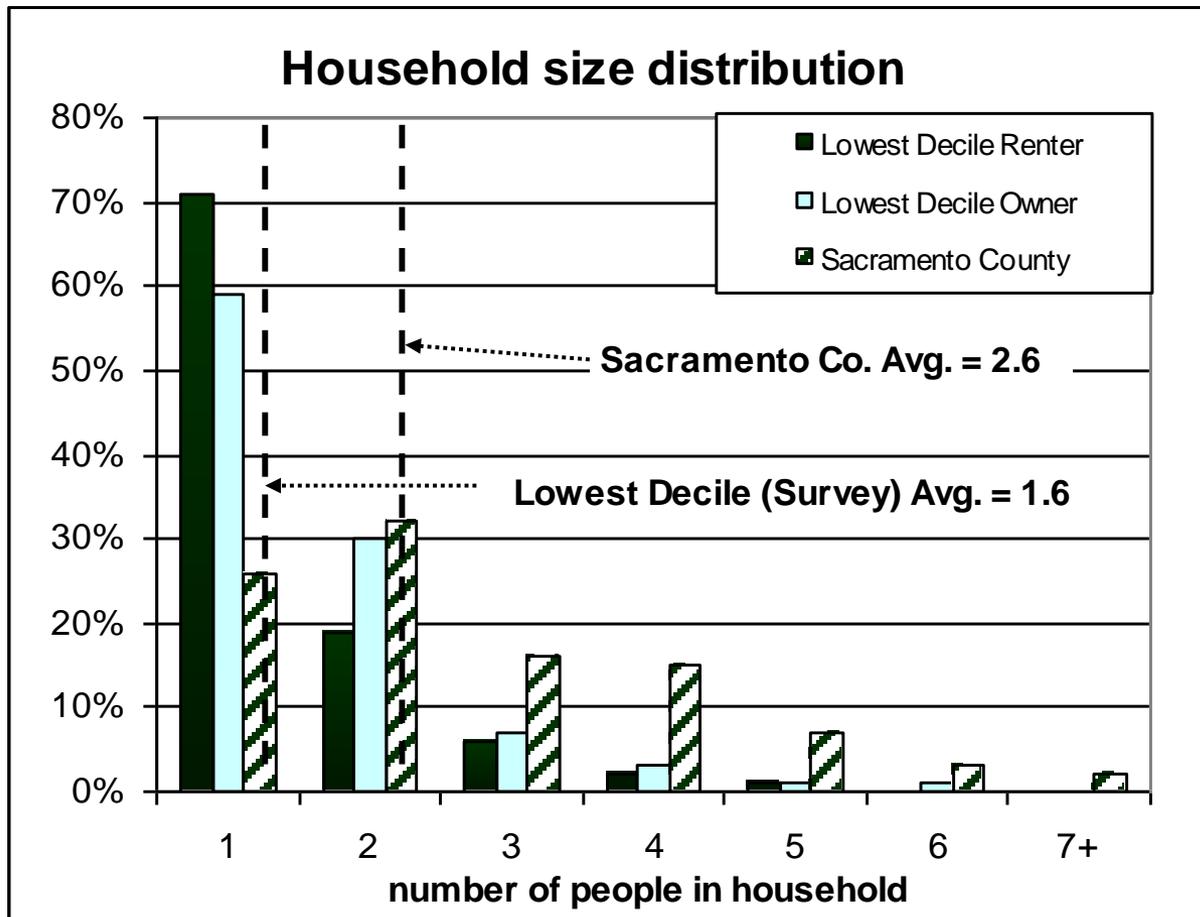
- ~~Common assumption: People use much less electricity because they are poor.~~
- Counter-hypothesis: Higher-income households appear in the lowest category.



Many low users do live alone

Demographic circumstances

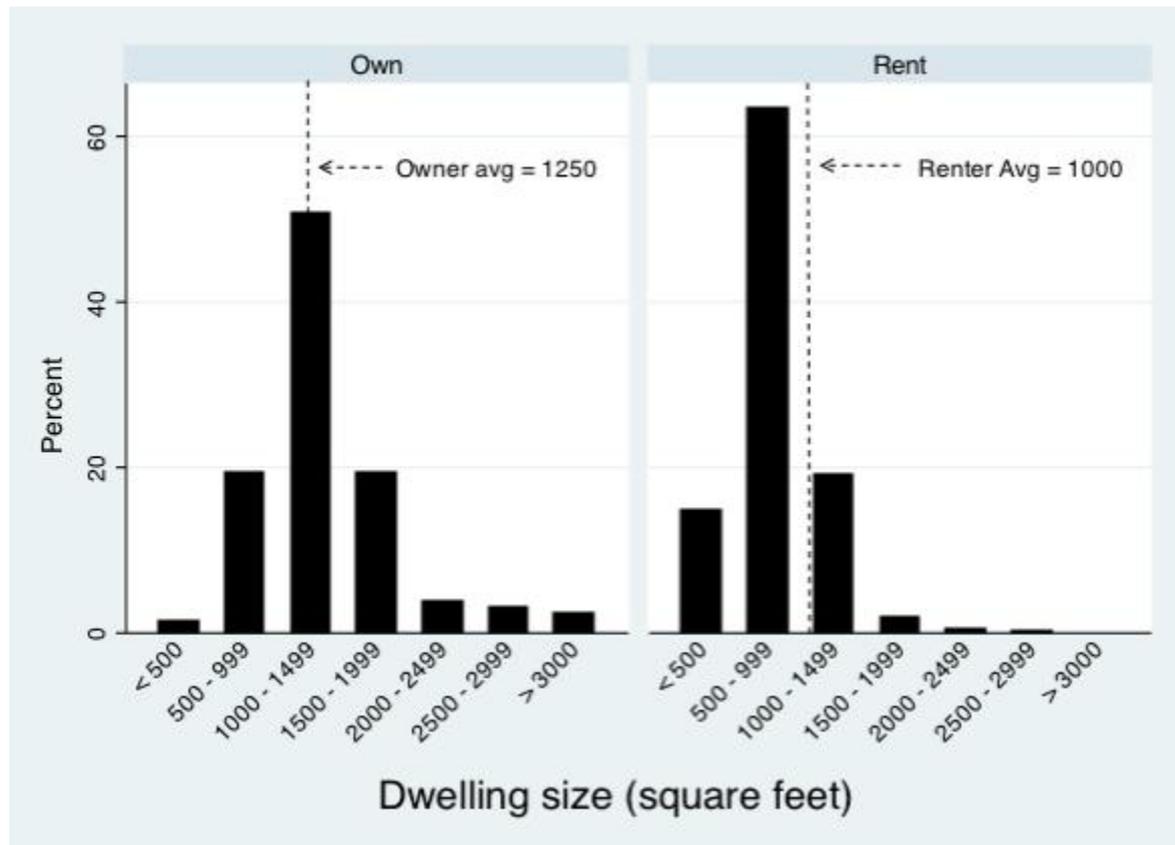
- **Common assumption: Lowest users live alone.**
- **Counter-hypothesis: Average-sized families also appear in the lowest category.**



Low users live in all sizes of homes

Physical circumstances

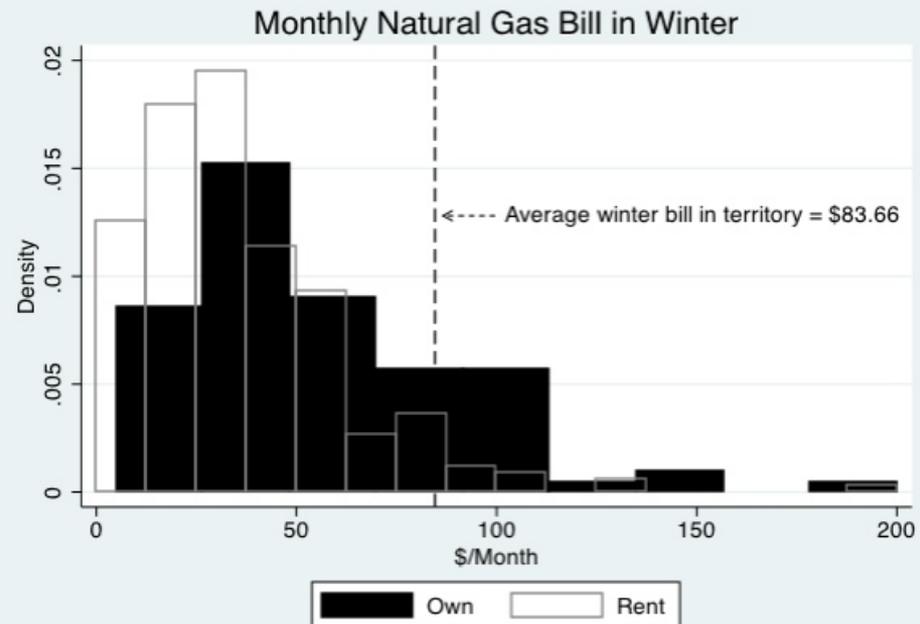
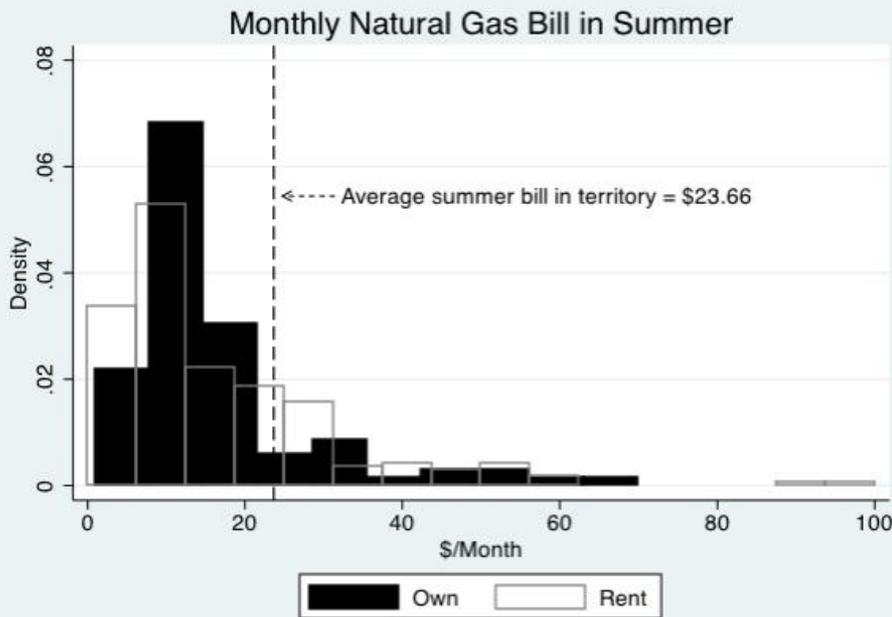
- ~~Common assumption: >70% of lowest users live in small apartments.~~
- Counter-hypothesis: >30% of households in the lowest decile are single-family and/or larger homes.



Low users also use less natural gas

Natural gas substitution

- ~~Common assumption: people who use less electricity substitute gas for domestic tasks/appliances.~~
- Counter-hypothesis: Low electricity households use no more gas on average than the population & perhaps less.

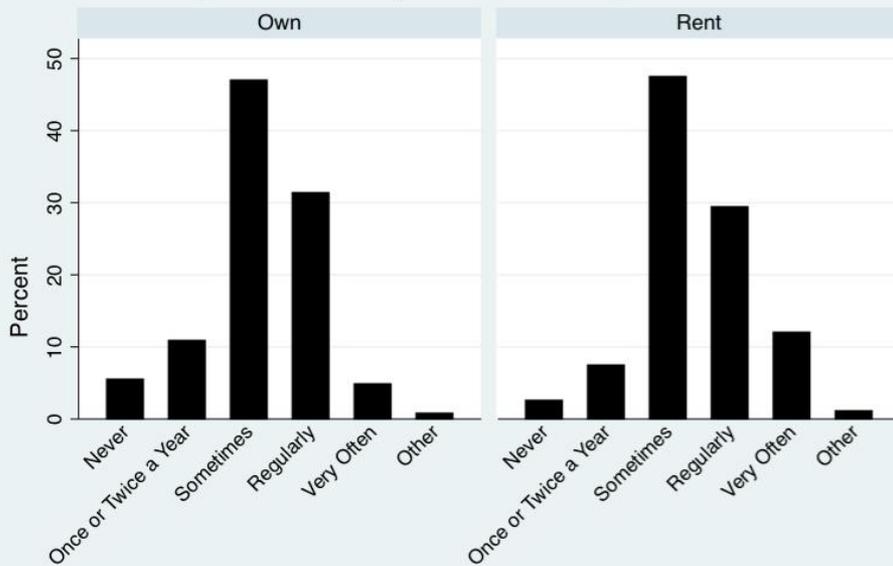


Strategies, behaviors, attitudes

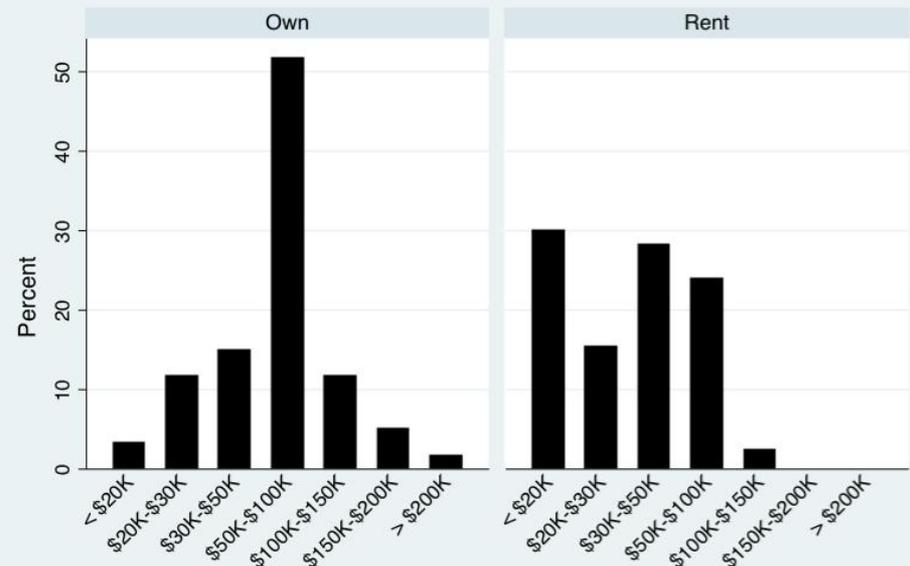
+ Diverse approaches, tactics, level of interest in & awareness of energy matters

+ Air conditioners: ownership and use, and attitudes about heat and keeping cool

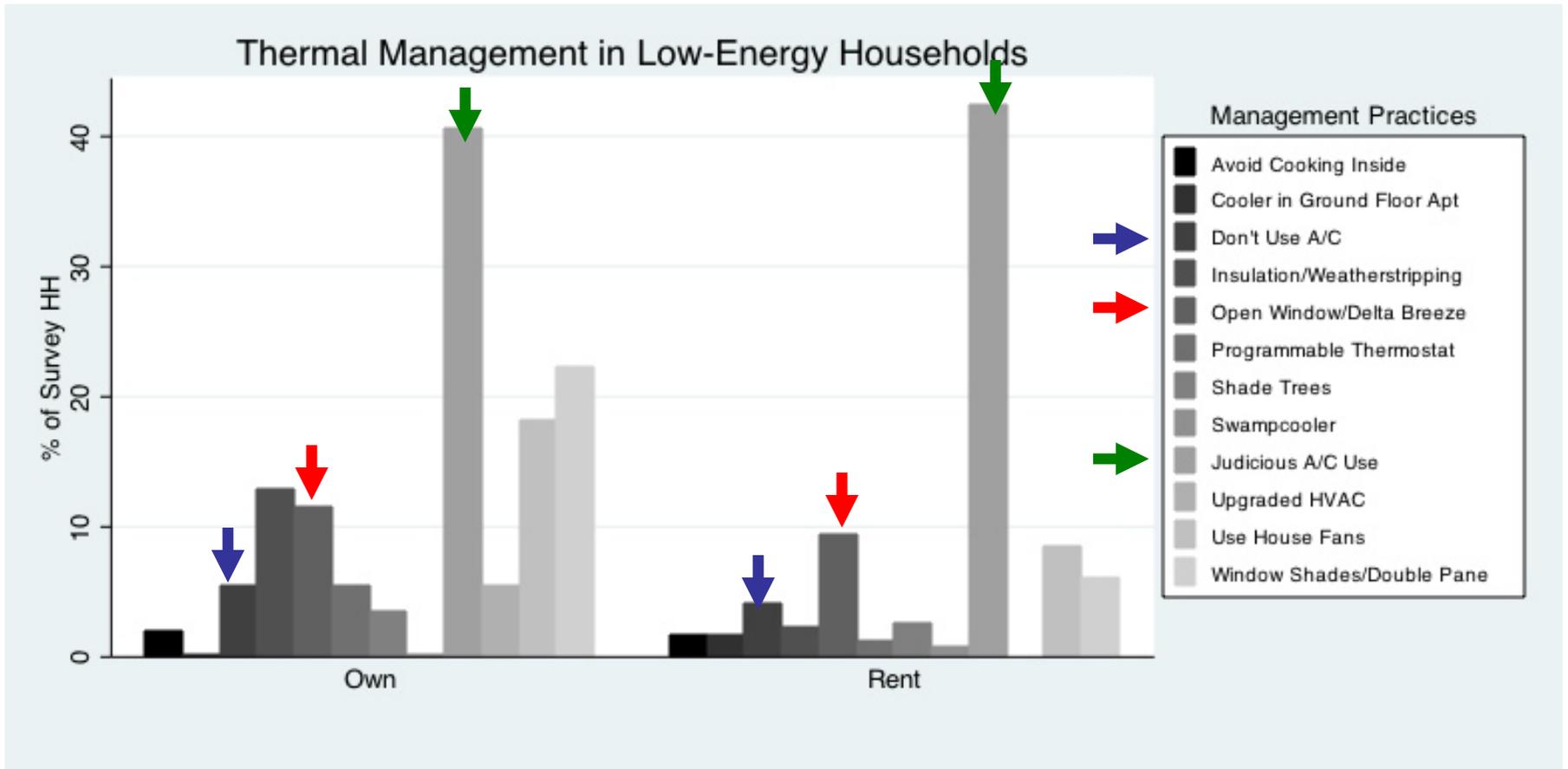
If you have A/C, how often do you use it?



Income distribution of non-A/C households



Cooling strategies – what low users say they have done to reduce their energy consumption



Low use pathways: A typology of functional equivalence

Parameter	Principles	Examples	Result
Space	Match scale to task	Space heater vs. furnace; microwave vs. oven; el. blanket vs space heater, fan vs. A/C	Reduced electricity
	Optimize physical space	Insulate, keep sunlight out, open windows	
Time/ Scheduling	Operate for shorter duration/ less frequent	Manual AC control; use timers; power strips, turn off (when gone, at night, not in room), shift to off-peak.	
	Run only full loads	Dishwasher, laundry, shower sequentially	
Sufficiency	Adequacy	Wash laundry cold	No electricity for that function
	Manual alternative	Line dry clothes	No electricity
	do without	Get rid of AC, TV, clothes dryer	
Efficiency	Upgrade to more EE version	Replace A/C, windows, CFLs, appliances	Reduced electricity

Types of low users

Types of Low Users	Description	Actions
Energy Efficiency	Actively engaged on energy, self-motivated (varying combinations of behavior and efficient technologies)	Thermal mgmt routines, upgrades
Non-Use	Actively engaged on energy, prefer to have and use less stuff	Turn off/don't have/don't use
Just How It Is	No special efforts mentioned, and little self-awareness about energy	x
Constraints	Low energy use attributed to budget, living alone, not home much, or small apartment	not emphasized

Additional research is needed to estimate the relative sizes of these categories, but the responses to our open-ended survey questions suggest at least half of the lowest decile falls into the two first groups, whose engagement with the subject of energy is generally high.

Six customer profiles

1. Well Off and Energy Efficient (19%) \$\$

2. Excellent Quality of Life (24%) ++

3. Thermally Unflappable (16%)



4. Ultra-low Users (33%)



5. Sacramento Average (22%)



6. Unhappily Low Energy (5%)



Well off and energy efficient

Well off and energy efficient (51 out of 277 = 18.5%)

- Quality of Life - Above Average or Excellent
- Education - At least a 2-year college degree
- Income - \geq \$50,000
- Home Size - $>$ 1,000 ft²
- Own all of the following electric appliances:
 refrigerator, washing machine, dryer, electric water heater,
 central A/C, dishwasher, microwave, TV, DVD, computer
- Have done something to improve their energy efficiency

Profile overlap:

	Well off and efficient	Unhappily low energy	Thermally Unflappable	Sac Average	Ultra-low	Excellent QoL
Well off and efficient	51					
Unhappily low energy	0	23				
Thermally unflappable	5	0	53			
Sac Average	2	0	7	103		
Ultra-low	12	3	31	29	208	
Excellent QoL	25	0	18	0	50	158

Conclusions:

How can insights about low usage inform policy?

1. Everyone's doing it: very low usage is not something that requires heroics or unhappiness or lots/a lack of money.
2. Because the social, demographic, and possibly motivational, distances between low users and the rest of the public is much smaller than imagined, need not **convince** but **demonstrate and communicate examples of low usage that might resonate**.
3. People are important to making low usage happen. Very low usage isn't typically something you buy or hire someone to do.
4. Expand the Conversation:
 - Celebrate lowest users
 - Crowdsource/invite public to co-produce climate solutions
 - Catalogue behavioral practices
 - Use consumption figures not energy savings
 - Set ambitious goals

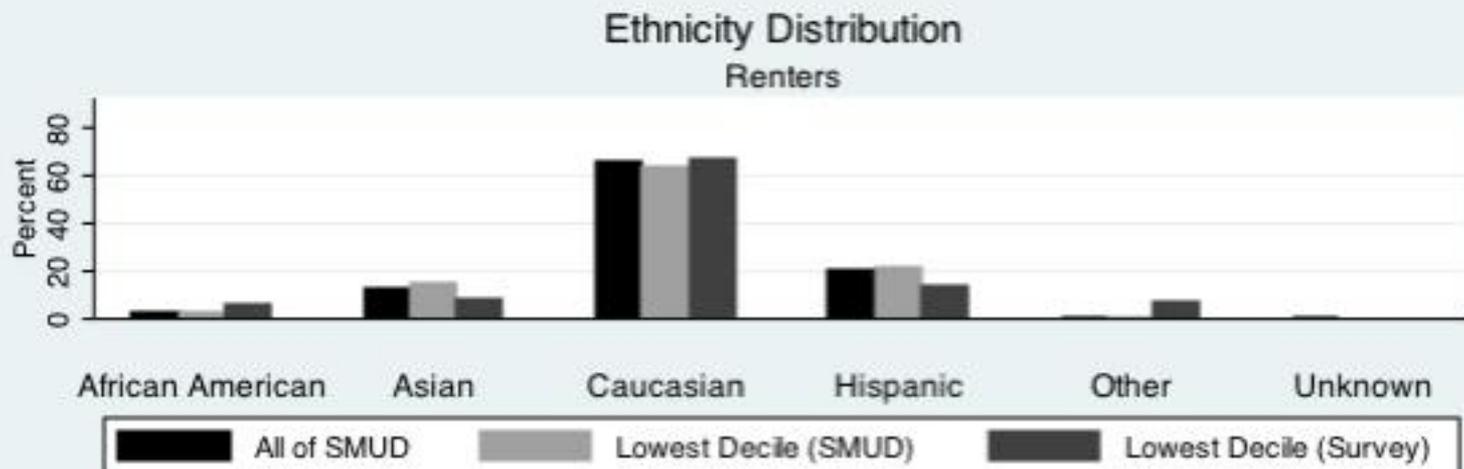
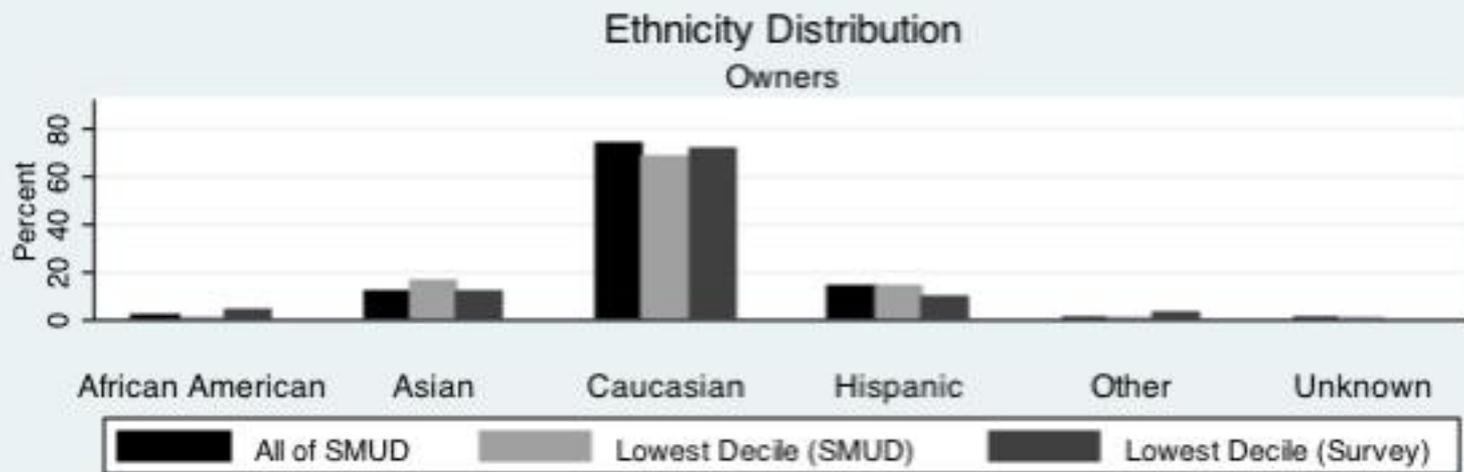
The End



Generating a survey sample – culling

- 1. Current address does not match the account address (3,934)**
- 2. Owners have been living in home for < 2.3 years (1,168)**
- 3. Summer peak loads less than 1/2 of winter peak loads (950)**
- 4. Average monthly usage is <30 kWh (184)**
- 5. Solar PV customers with net-metering (56)**

Demographics: Low users are 'normal' (education, age, race)



Energy consumed when 133 persons handwashed a set of dishes



**Recommendation:
Teach people how to
wash dishes frugally.**

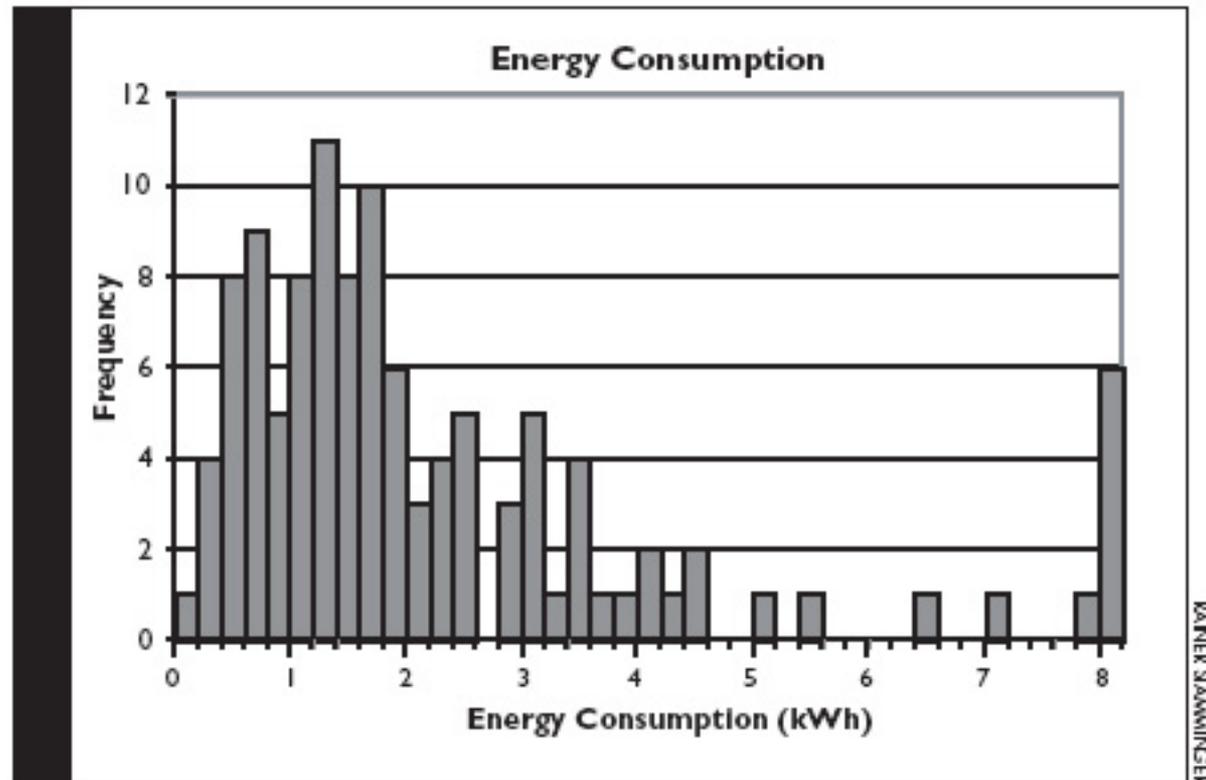


Figure 4. The highest energy consumption for hand washing was 16.6 kWh.

Source: Rainer Stamminger, "Is a Machine More Efficient Than the Hand?"
Home Energy Magazine, May/June 2004.

Next steps

- **What are next steps in this research?**
 - **Quantify prevalence of different types of low users identified**
 - **Ethnographic study of ultra-low users**
 - **Leverage diversity of low user population into program for encouraging emulation**

- **Do the results apply to all of California?**
 - **Large variation and low usage exist in all jurisdictions**
 - **Some of the particulars will differ (Delta breeze, A/C saturation), but basic findings relevant across the State**