

Energy Conservation: What are my choices? What can I save?

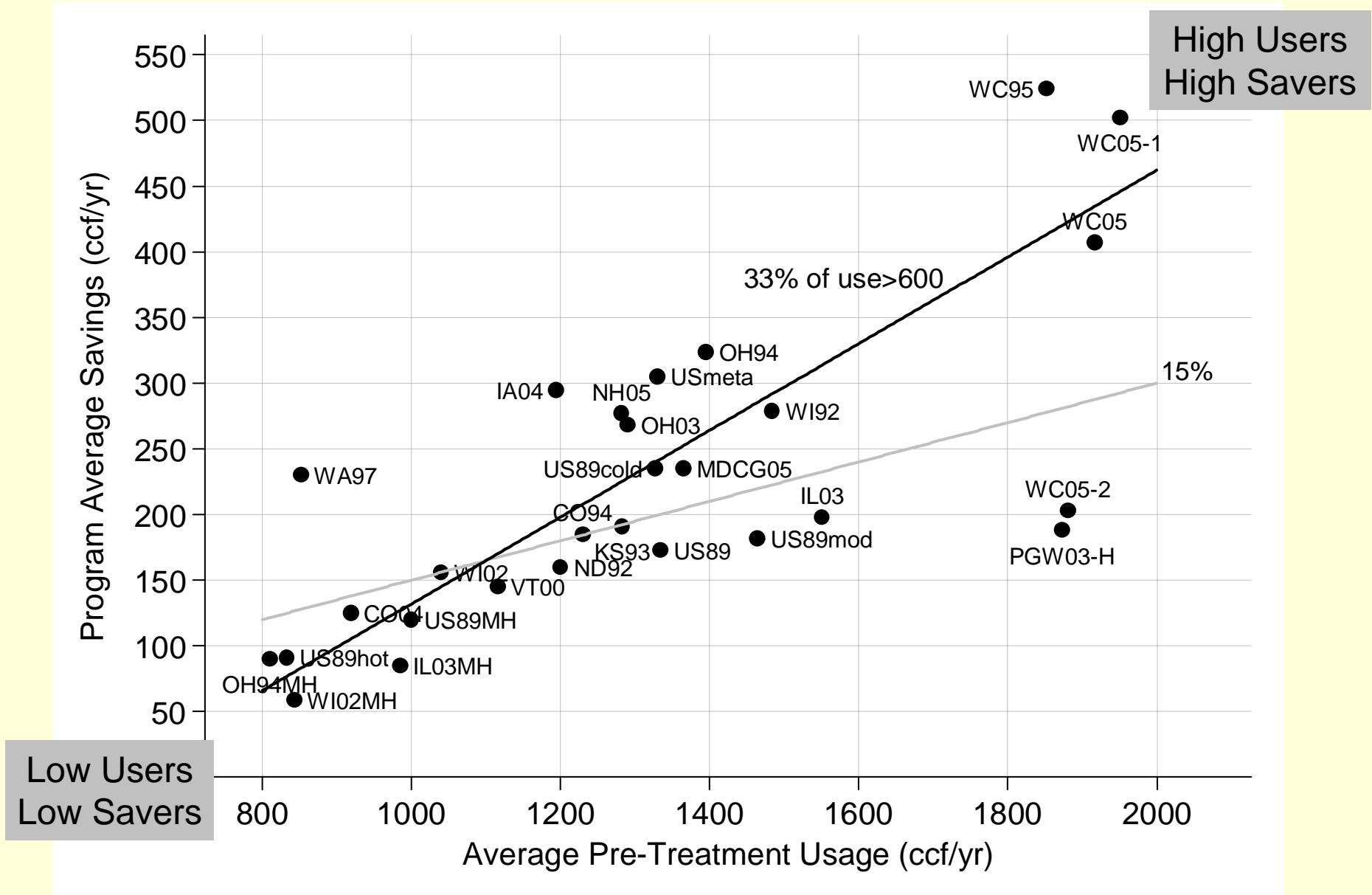
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How much do programs save?

- Evaluation Results
 - Many WAP evaluations find 10%-15% savings, 125 – 200 th/yr
 - Some save 25%, 300 therms
 - Utility program savings average from 50 to 500 therms
 - Electric baseload programs save 500 – 1,700 kWh
- Why do savings vary?
 - Savings come from stopping waste
 - High Usage = More waste = More savings
 - Low gas use <1000 therms/yr, High use >1400 therms/yr
 - Rule of thumb: highest winter bill ~ heating savings potential
 - Diagnostic approach identifies the real opportunities
 - Proven treatments capture the savings, if done right

Wx Program Gas Savings Results

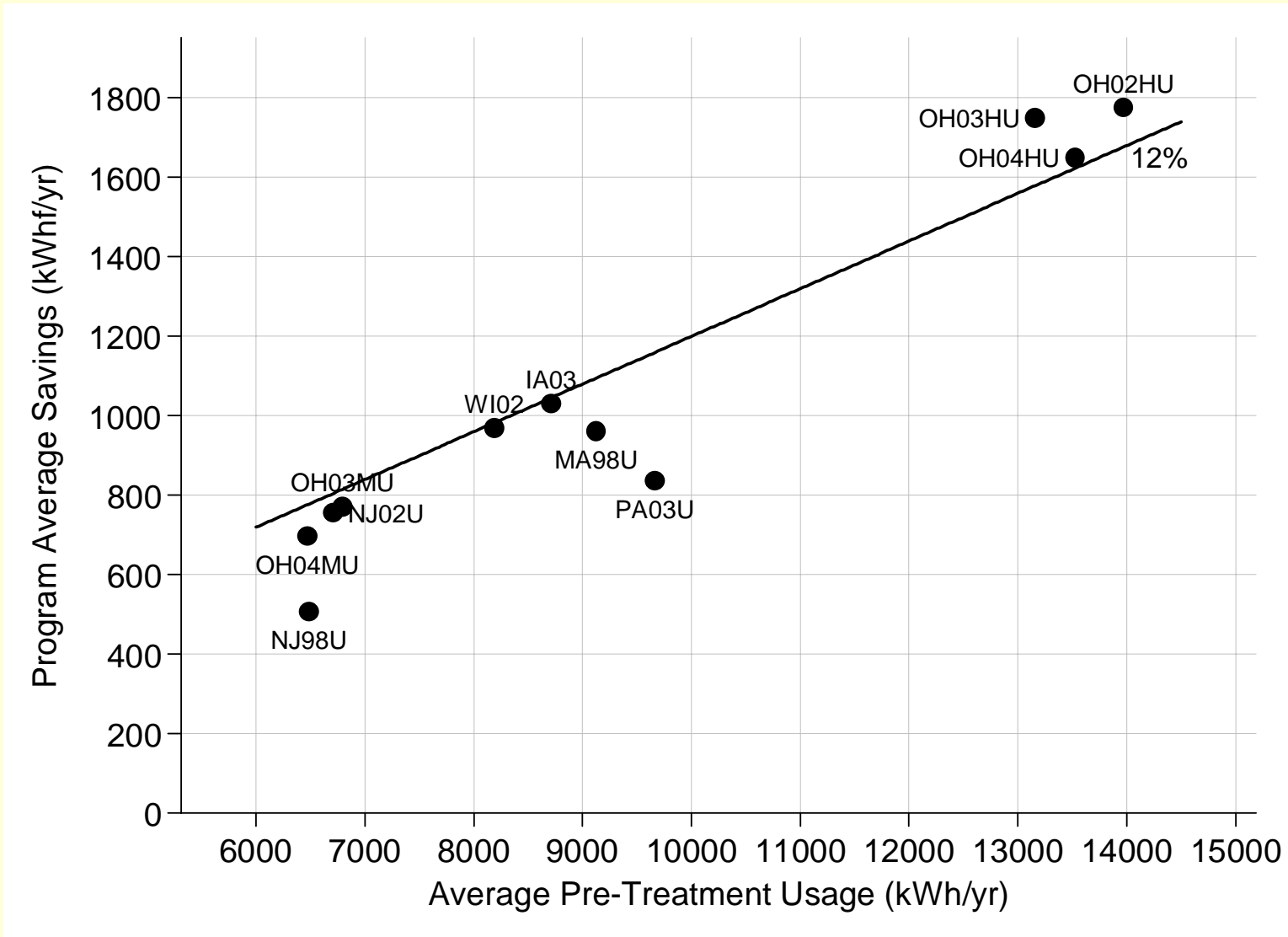


Wx Gas Savings Results

average therms/year/home

Study	Year	# Units	Pre_use	Savings	Save%	Cost \$/job
National: All	1989	3,873	1,334	173	13%	\$1,550
National: Cold	1989	1,040	1,327	235	18%	
National: Hot	1989	590	833	91	11%	
Nat'l Meta-eval	'93-'03	n/a	1,330	305	23%	\$2,913
Ohio	1994	2,209	1,395	324	23%	\$2,547
Iowa	2004	633	1,194	295	25%	\$5,682
New Hampshire	2005	27	1,282	277	22%	\$4,253
Ohio	2003	1,625	1,290	268	21%	\$4,800
Washington	1997	71	852	230	27%	\$3,132
Illinois	2003	2,056	1,551	198	13%	\$4,337
Kansas	1993	165	1,283	191	15%	
Colorado	1994	3,431	1,230	185	15%	
Wisconsin	'01-'03	8,252	1,040	156	15%	\$6,800
Vermont	'98-'00	25	1,116	145	13%	\$3,227
Colorado	2004	1,557	919	125	14%	\$2,850
Col Gas PA: Cont 1	2005	108	1951	502	26%	\$5,626
Phila Gas: Cont 2	2003	671	1873	188	10%	\$816

Electric Baseload Program Evaluation Results



Baseload Electric Savings

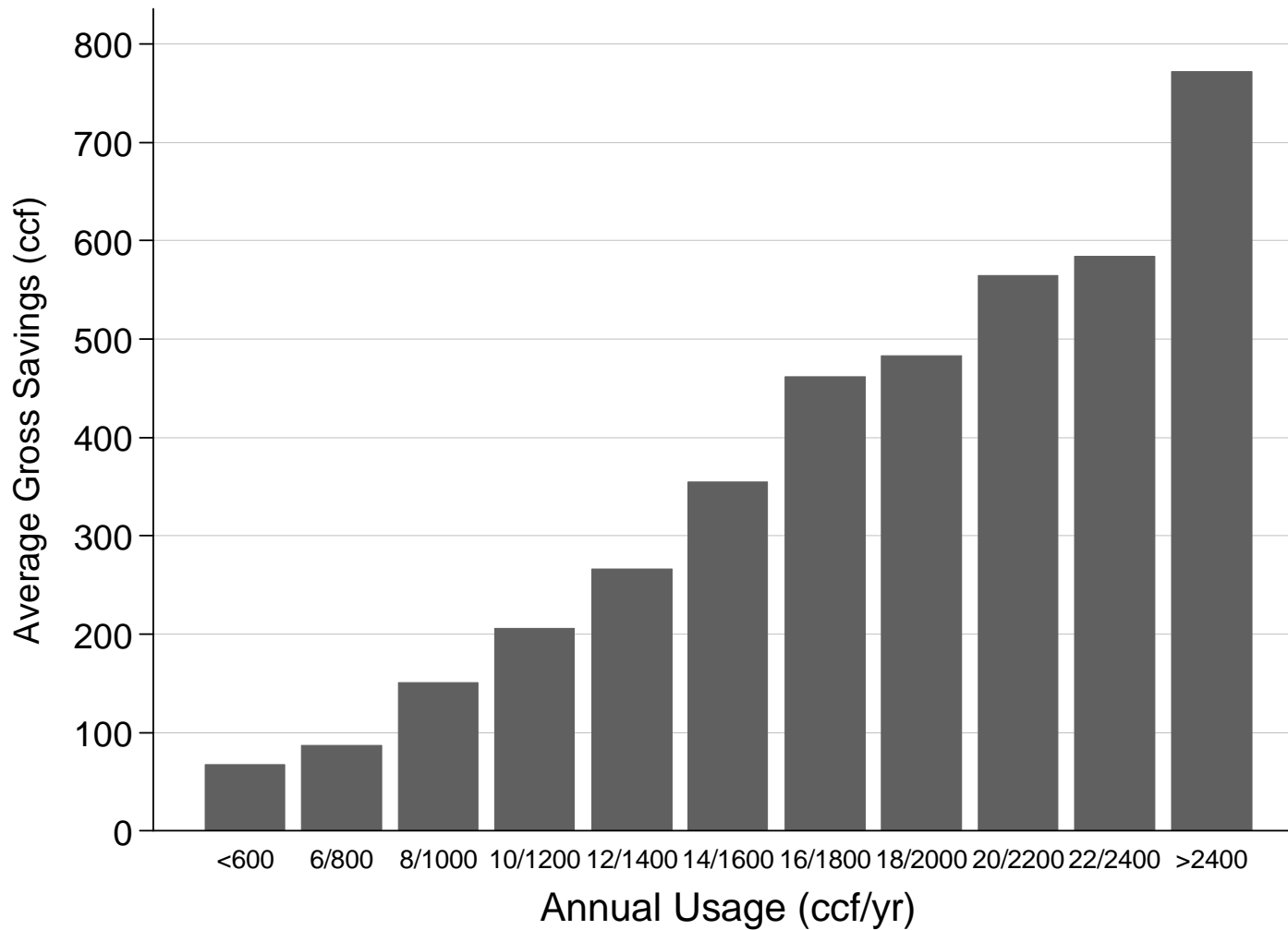
usage and savings in kWh/year/home

Study	Year	# Units	Pre-Use	Savings	Save%
Ohio HiUse	2004	4,789	13,525	1,650	12%
Ohio HiUse	2003	4,525	13,159	1,750	13%
Ohio HiUse	2002	2,194	13,975	1,775	13%
Ohio ModUse	2004	1,355	6,468	697	11%
Ohio ModUse	2003	2,585	6,791	772	11%
Iowa	2003	294	8,711	1,031	12%
Wisconsin	'01-'03	8,675	8,191	970	12%
MA utility	1998	~2,000	9,125	962	11%
NJ Utility	2002	756	6,705	756	11%
PA Utility	2003	659	9,661	836	9%

- Savings ~ 12%, but varies 772-1750 kWh depending on usage
- Payback generally quicker than most gas heating measures
- Refrigerators, lighting produce most of savings, except some hot water (and fuel switching in WI)

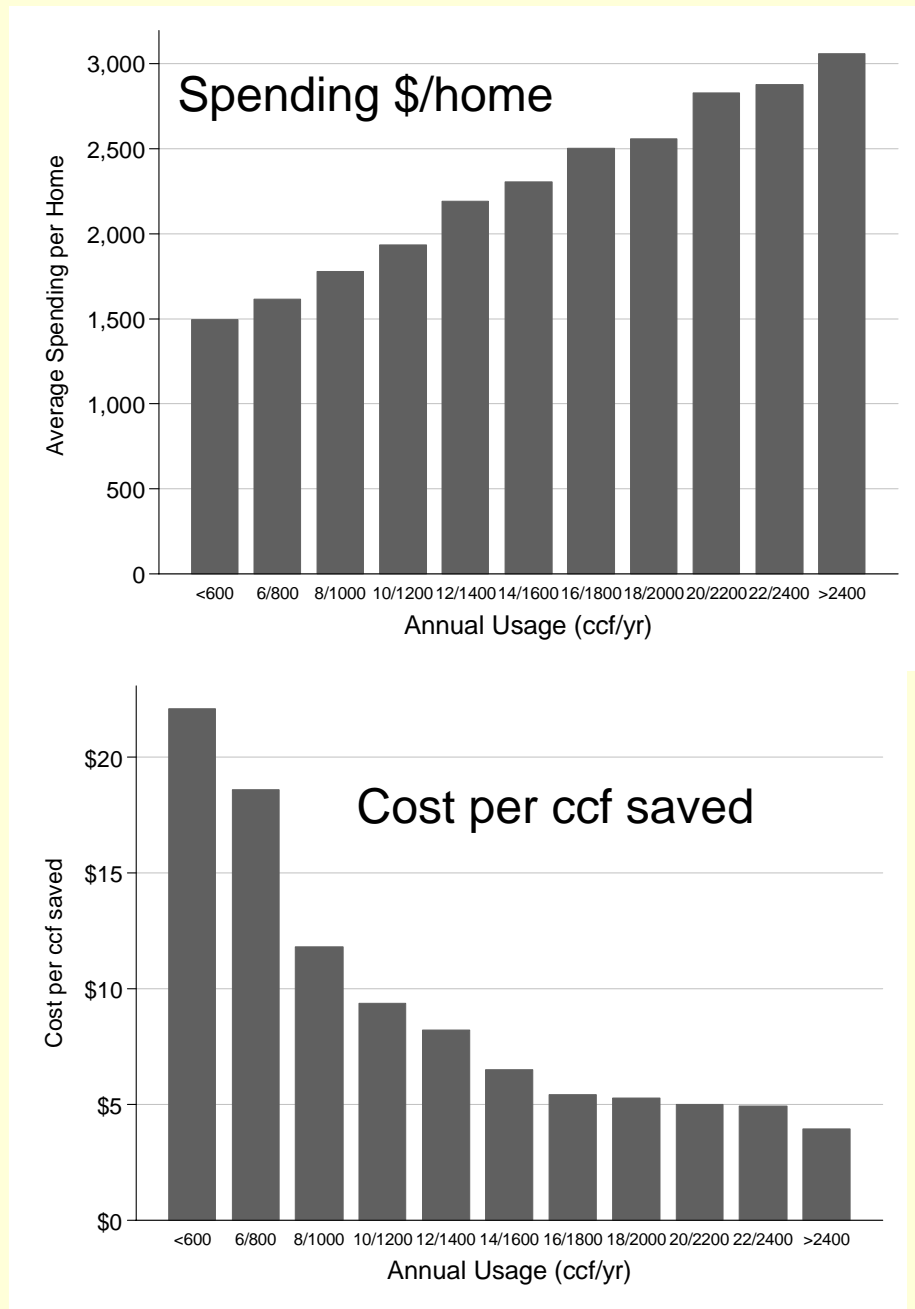
Wx Savings vs. Usage

Ohio WAP 94



Usage & Cost Effectiveness

- Spending increases sharply with usage in diagnostically driven programs
 - Graph shows doubling of spending from lowest to highest users
- High users much more cost effective
 - Graph shows Cost per ccf saved



Finding Energy Waste

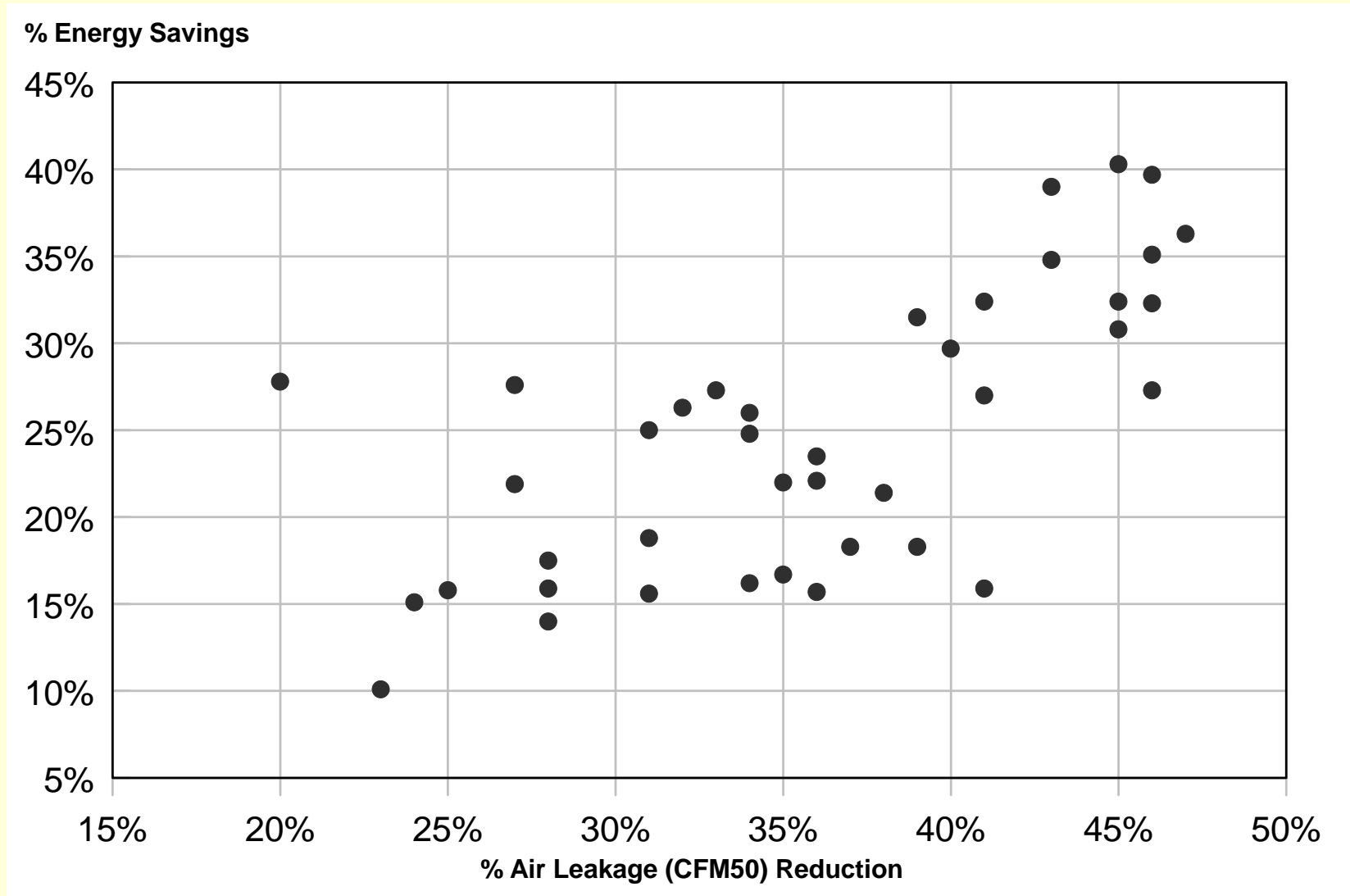
- #1 way to boost savings – target high users
 - If usage is high, find out why
 - Big house?
 - Lack of efficiency measures: install it
 - Uninsulated walls and attics
 - Inefficient stuff: replace or repair it?
 - Heating system, refrigerator
 - Hot water leak
 - Extra Stuff: unplug it / remove it?
 - 2nd fridge, freezer, dehumidifier, aquarium, grow lights
 - Thermal defects: fix it
 - High air leakage rate with lots of attic bypasses
 - Envelope integrity – split level, kneewall, porch, balloon framing
 - Behavior: educate
 - High heating thermostat setting
 - 24 hour/day mistakes: lights, computers, TVs, fans, furnace fan

Things that work: Thermal Envelope

- Wall Insulation
 - Big savings 120-200 th/yr (~0.2 th/ft²/yr)
 - Usually most cost-effective major measure
 - But saves only about half what most audit software predicts
 - Dense-packing approach & QC (with IR) help ensure savings
- Attic Insulation
 - Save 60-150 th/yr (0.1 – 0.2 th/ft²/yr)
 - Savings vary from 40%-100% projected due to existing conditions, higher R-value than assumed for uninsulated attic
 - Adding to existing insulation often only worthwhile if also fix bypass leakage problems
- Air sealing with blower door
 - Savings ~ 50-100 th/yr or 5-7 th/yr per 100CFM50
 - About 50%-70% of standard projected savings due to infiltration algorithm errors and interactions with conduction

Diagnostics & Savings

Agency savings vs. average CFM50 reduction



Things that work: Equipment

- Heating System Replacement
 - Save 100-200 th/yr (12%-20% of heating)
 - Condensing 92%+ AFUE to get 20%+ savings
 - Existing system efficiency better estimated at about 70%
 - Now cost-effective in high use homes due to high gas prices
- Duct Sealing & Insulating in attics, garages, crawlspaces
 - 7%-20% HVAC savings for reasonable cost
 - Consider radiant barriers in hot climate attics with A/C ducts
- Set-back Thermostats?
 - 4%-7% savings (70-100 th/yr) found in some programs
 - Do savings last?
- Hot Water (Showerheads, aerators, wraps, temp. turn down)
 - 45 th/yr for all measures found in Iowa 1992 (60% projected)
 - Other studies usually haven't found as much
 - Still worthwhile, but savings fall short because devices already have low flow, people overstate showering time, low flow devices may increase showering time and/or temperature, etc.

Things that work: Electric Baseload

Good option in low/mod heating usage homes

- Refrigerator replacement (& freezers & removals)
 - Replace based on rated usage or short term metering
 - Save ~600-900 kWh/yr. (more for 1970's side-by-side)
 - Savings often 80%-90% of projected based on 2 hour metering
- Lighting replacements: CFLs & fixtures
 - 25-50 kWh/yr/bulb, ½ projected due to hours, failure, removal
 - So inexpensive, should replace all feasible
- Fix hot water leaks – big savings when found & fixed
- Remove/unplug/shut-off unneeded end uses
 - Furnace fan set to “On” can often cost 3,000 kWh/yr !
 - Second fridges, freezers can use 400-2000 kWh/yr
 - Stuff that runs 24 hours/day
 - Computers, lights, TVs, fans, etc. can waste 100-300 kWh/yr each
 - Often the 24 hour use provides no real benefits – occupants misinformed

Things that work if diagnosed problem

- **Advanced air sealing / strategic dense packing**
 - Stuff that they teach at Affordable Comfort conference
 - Use blower door, zonal pressures, infra-red, etc.
 - Problems common in split levels, kneewalls, cantilevers, porch roofs, balloon framing, behind paneling and dropped ceilings, at key junctures and connections
- **Air conditioner commissioning / tune up**
 - 5%-15% A/C savings – best for hot climates / big cooling loads
 - Usually saves 0 if done by typical HVAC contractors
 - Need to properly test charge and air flow
- **Duct balancing / pressure relief**
 - Needed in some tighter newer homes, but limited savings data

Things that usually don't save much

- Window replacements
 - 3%-5% savings, 100+ year payback
 - One WAP study found negative correlation with savings
 - Existing window R-value & leakage is better than assumed
 - Some exceptions - Jalousie windows may be worth replacing or using an interior storm
- Routine Weatherstripping & Caulking
 - Air leakage is in attic, basement, crawlspace, and key junctures -- not windows, doors, outlets, baseboards
 - Routine caulking/weatherstripping good DIY project, not much savings
- Floor Insulation
 - Costly treatment with low/no savings
 - Nearly worthless over most basements
 - Over crawlspaces saves ~ .05 ccf/sq.ft. or less
 - but must fix ducts to get even these savings

Things that usually don't save much (2)

- Heating system tune-ups
 - Little savings, but may be needed for safety
 - Gas systems: 0%-2% savings? Worth it for some systems with problems
 - Oil systems more likely to benefit, but savings still questionable
- Basement duct sealing
 - Savings of 1%-3% in several studies
 - Maybe OK if basement is hottest room (disconnects)
 - Still seal large holes for comfort, returns for safety if dP problem
- Small behavior changes that don't save much
 - Change furnace filters monthly, lids on pots, close fridge quickly
 - “10 simple things you can do to save almost nothing...”
 - May divert attention from real opportunities for savings: thermostat settings, 24 hour stuff, unplugging stuff

Things probably not worthwhile, but maybe sometimes?

- Window air conditioner replacement
 - Must be targeted to high cooling use homes
 - Most window A/C don't use enough kWh to be worth replacing, but some probably do
 - One evaluation found savings of about 170 kWh/yr (20% of cooling load)– payback >20 years
- Major Hot Water Measures:
 - Water heater replacement
 - Conventional electric units: doesn't make sense to target high hot water loads since savings are all standby
 - Tankless – not sure if anyone has tried?
 - High efficiency clothes washer
 - May be worthwhile if targeted to homes with very large laundry loads (≥ 3 loads/day) , especially if electric water heating and high kWh price
 - Solar water heating
 - Most cost-effective in hotter climates (no freeze protection worries), especially if electric water heating and high electric rates
 - Need to consider potential maintenance issues for low income population

High Saving Programs

- Target high use homes
 - Most easily done with utility programs where you can set usage cut-offs
 - WAP serves all, but can prioritize, and can target spending
 - Develop low cost approach for low users, or focus on electric baseload?
- Employ diagnostic approach (blower doors, etc)
- Get extra funds from utilities or state gov't
- High heating saving WAP formula for 300+ th/yr
 - 50% dense-pack wall insulation ($50\% * 200 = 100$ th)
 - 50% heating system replace ($50\% * 180 = 90$ th)
 - Stop installing low efficiency furnaces – please!
 - 80% attic insulation ($80\% * 70 = 56$ th)
 - Blower door air sealing ($80\% * 70$ th = 56 th)
- Don't forget electric baseload
 - Refrigerators & lighting & education can often produce larger bill savings than Wx, especially in lower gas use homes

Low Savings Programs

- Treat many low use homes
 - Mild climate, newer housing stock put program at a disadvantage in terms of savings heating
- Don't target resources to problems
 - Don't spend much more on high users than low users, don't look at usage
 - Don't bother with electric baseload
- Allow contractors to block effective treatments
 - Blower door too difficult, time consuming
 - Diagnostics not worthwhile
 - Wall insulation too hard due to...
 - Condensing furnace installation problems
- View weatherization as a housing program
 - Windows, doors and repairs take up large fraction of budget

Don't forget...

It's not just energy savings

- Utility bill affordability
 - Improved payment behavior
 - Reduced shut-offs
- Environmental emission reductions
 - SO_x, NO_x, CO₂ (global warming), etc.
- Health & Safety improvements
 - Heating and water heating system repairs & replacements
 - Reduced shut-offs
 - Smoke & CO detectors
 - Fixing other home safety problems – electrical, etc.
- Affordable housing stock preservation
- Economic Impacts
 - Reduced fuel imports, local job creation