Beyond the Occupant Scapegoat

Part 1: Energy Performance of New Homes

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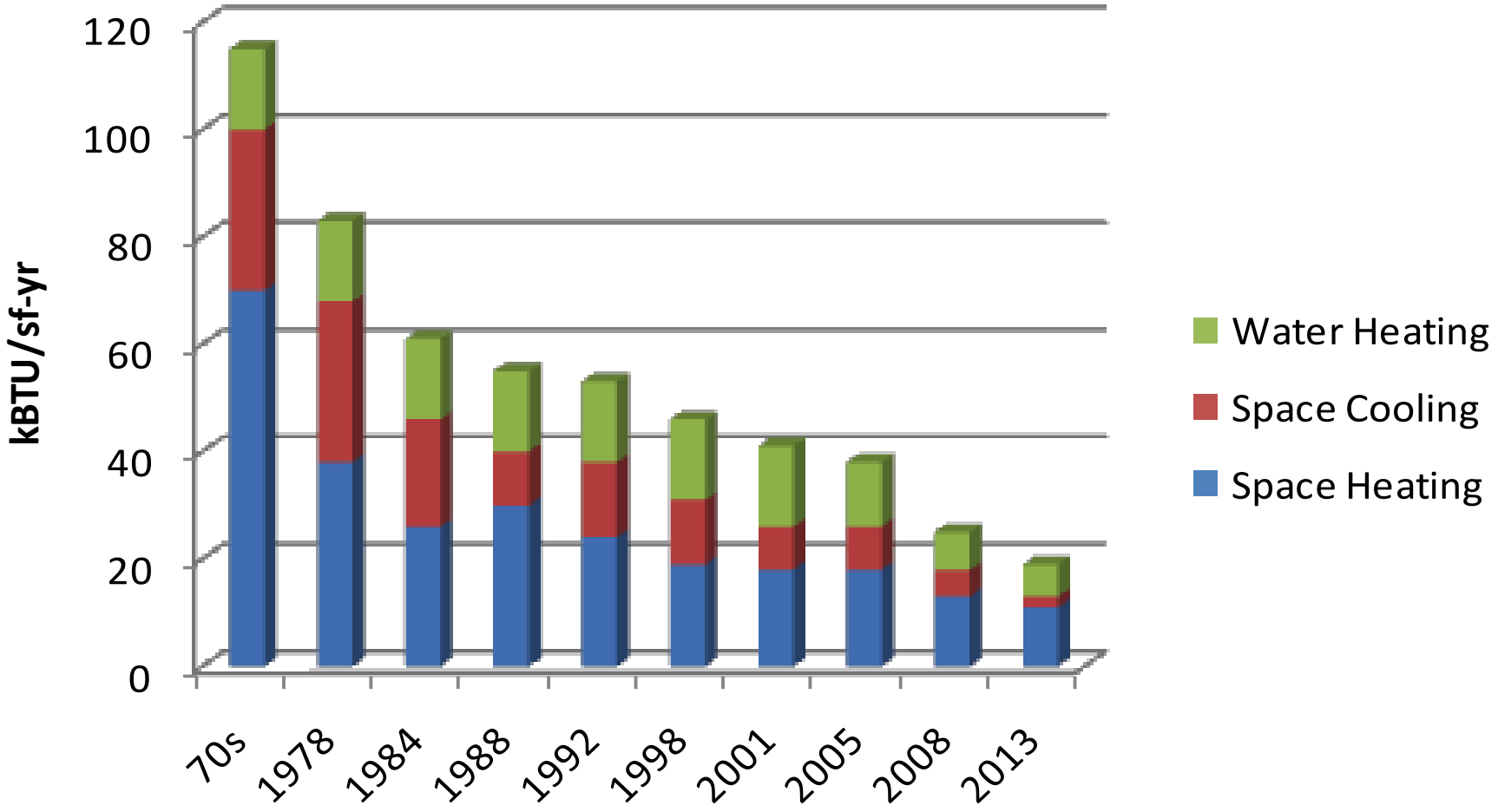
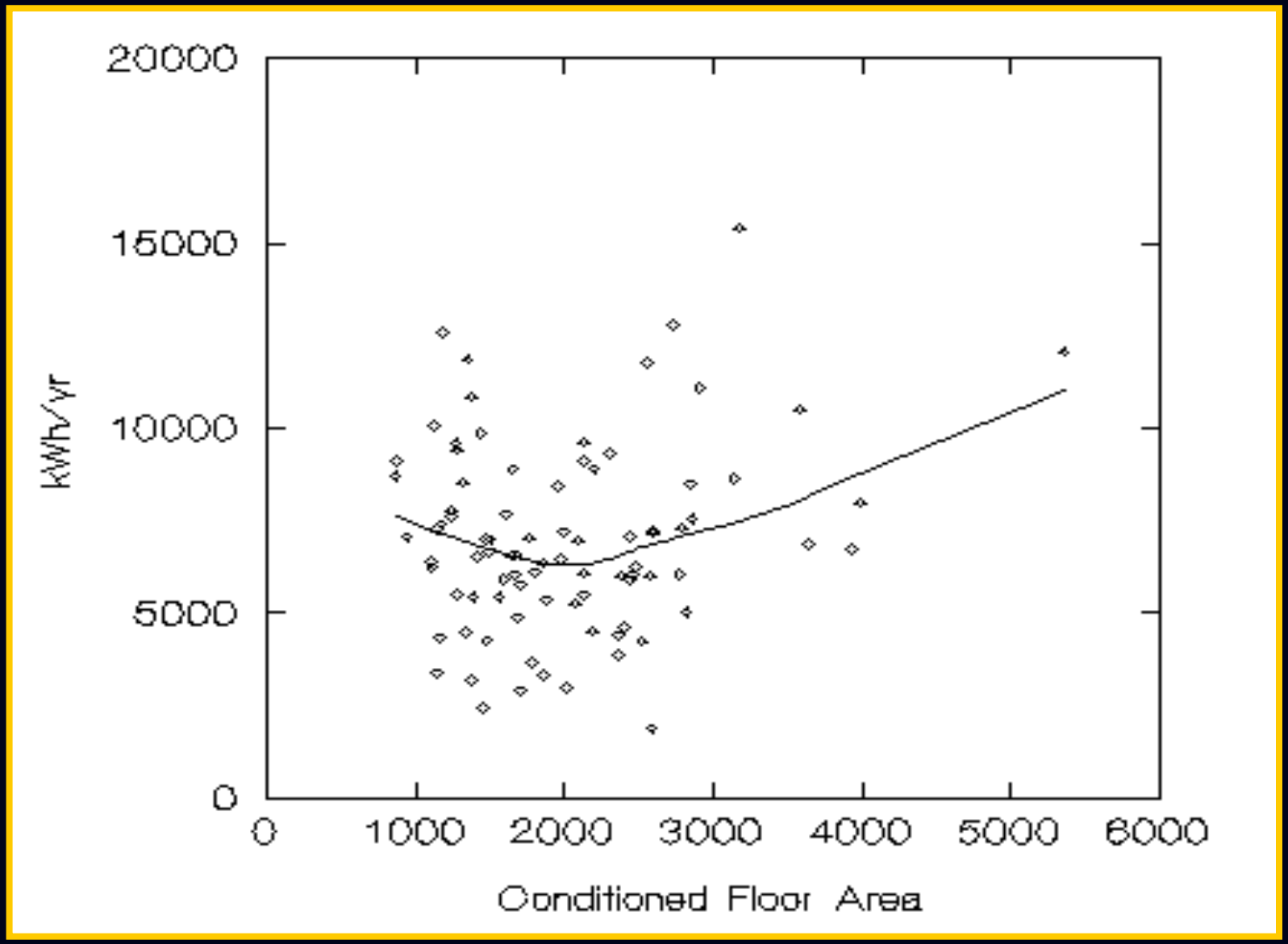
Modeled energy use for each Standards update Northern CA Inland Climate



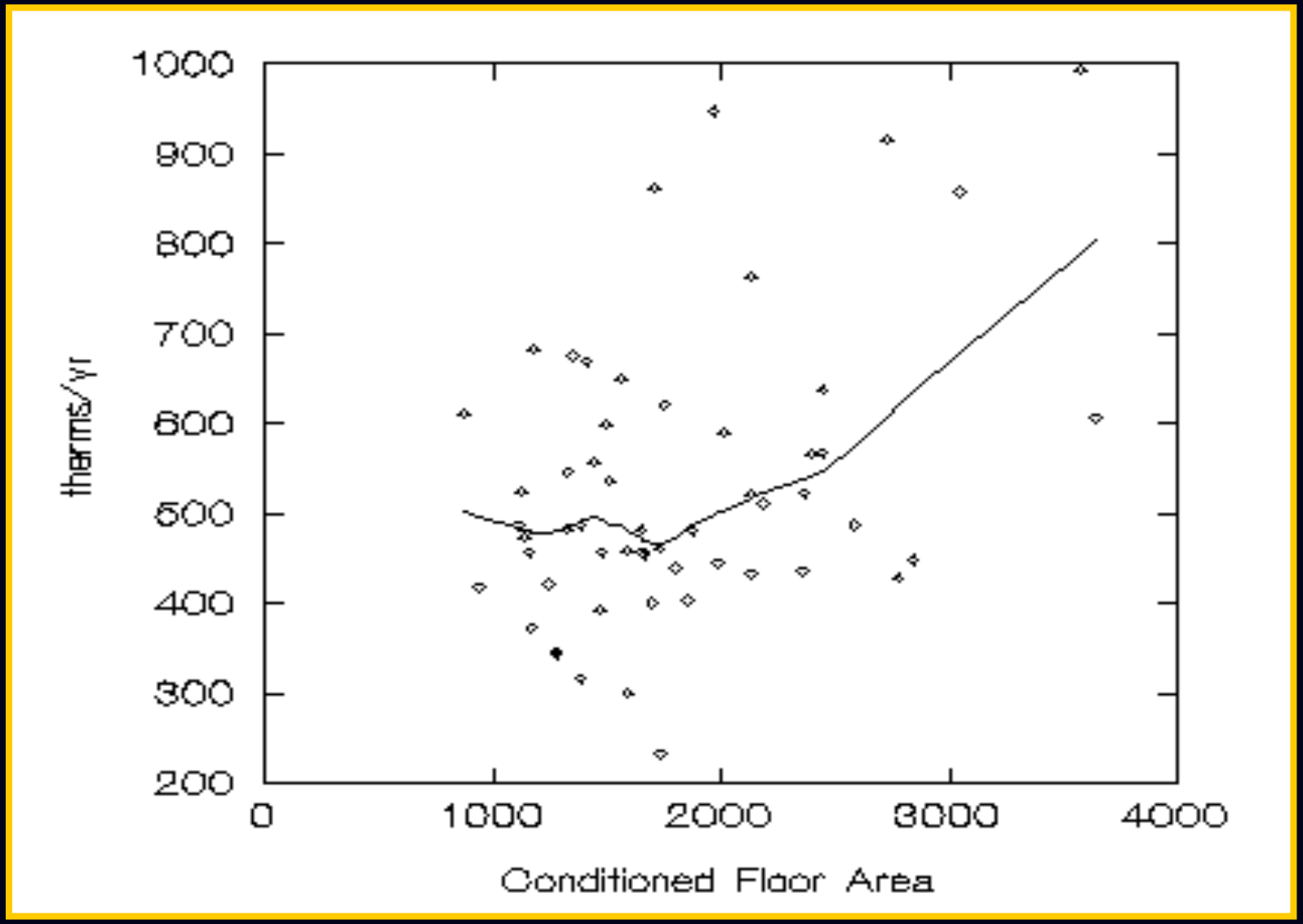
Source: California Energy Commission

How Much Electricity Does A New California Home Use?



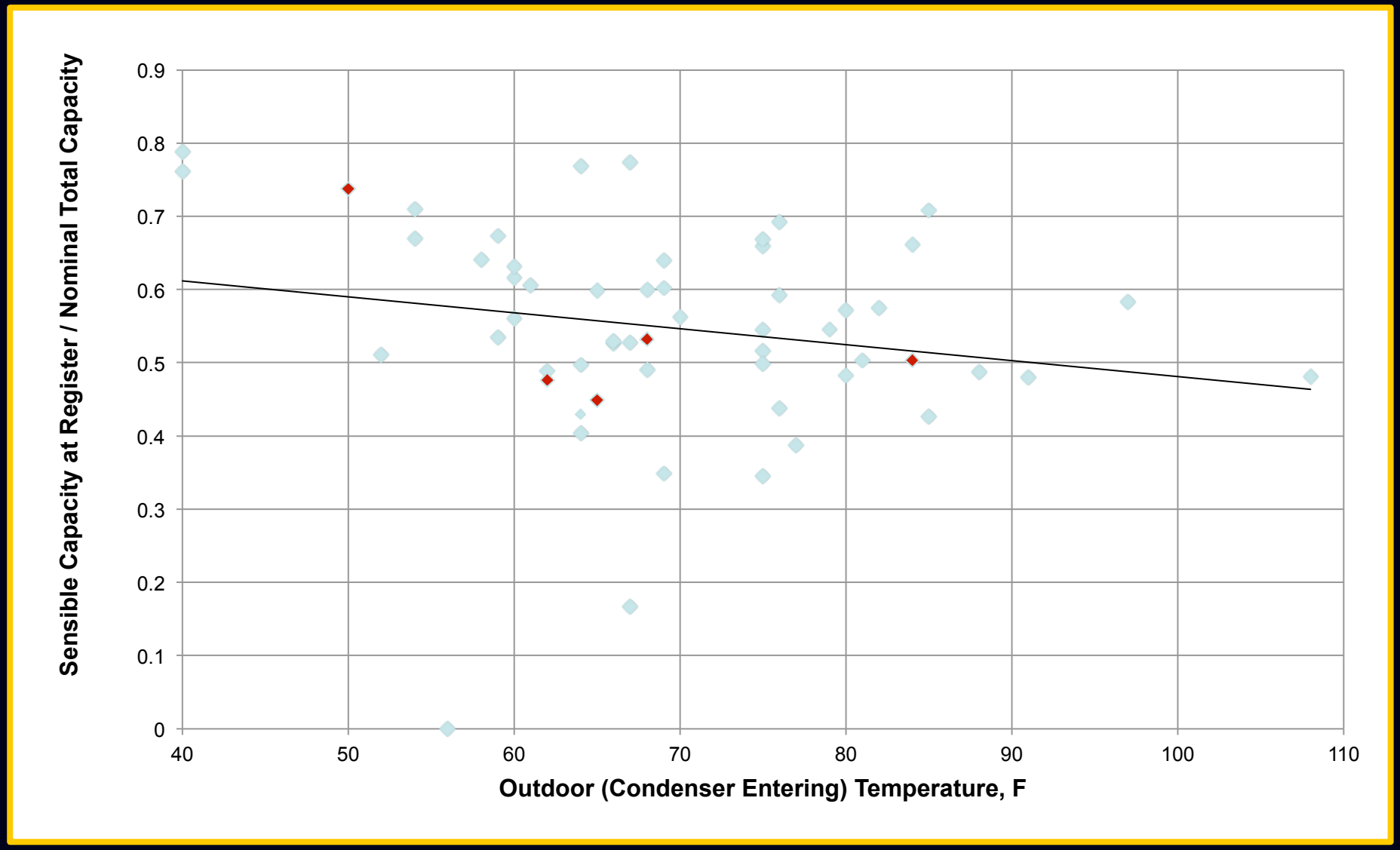
Source: California DSM Measurement Advisory Committee report

How Much Natural Gas Does A New California Home Use?



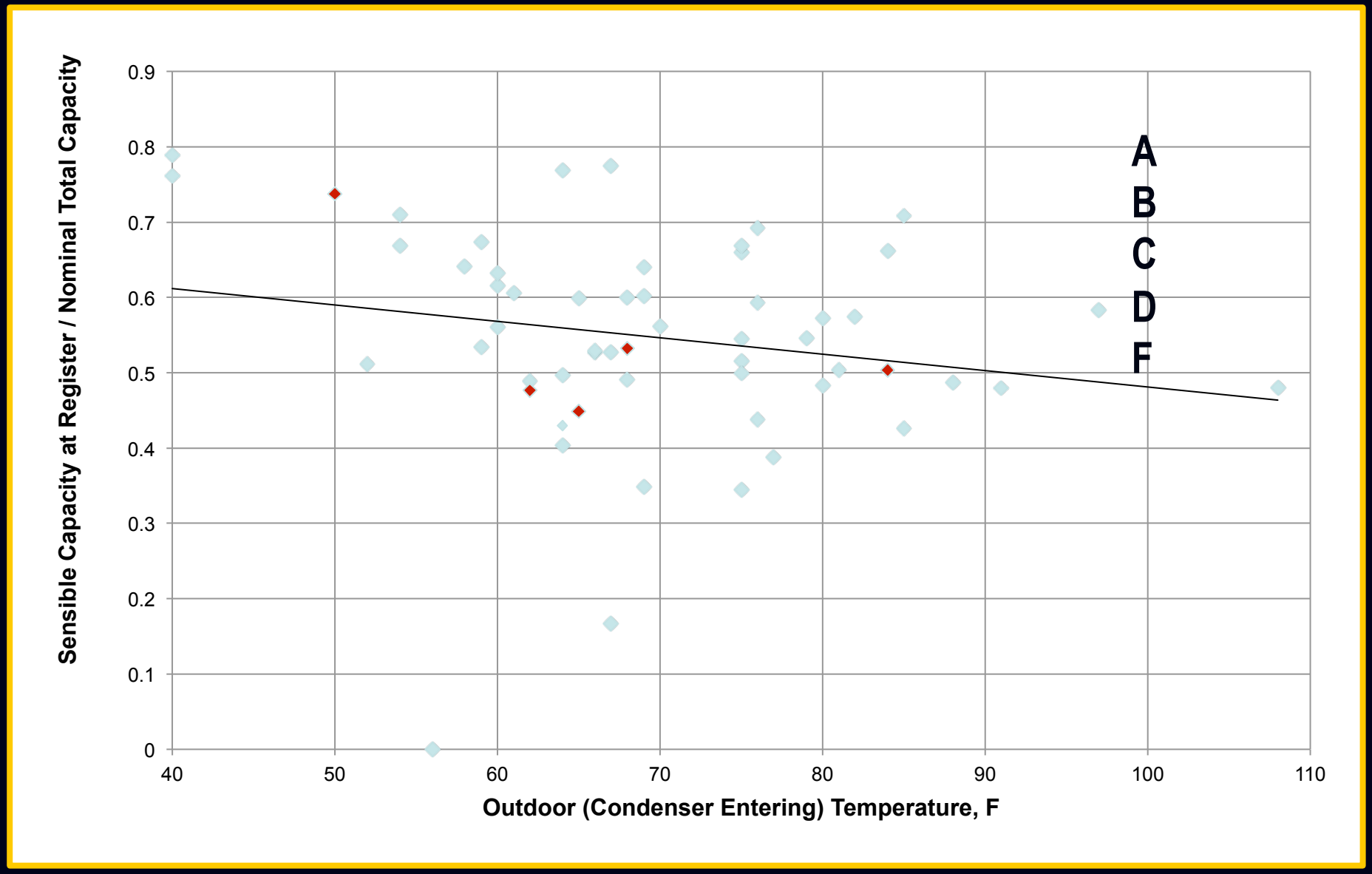
Source: California DSM Measurement Advisory Committee report

AC Sensible Capacity



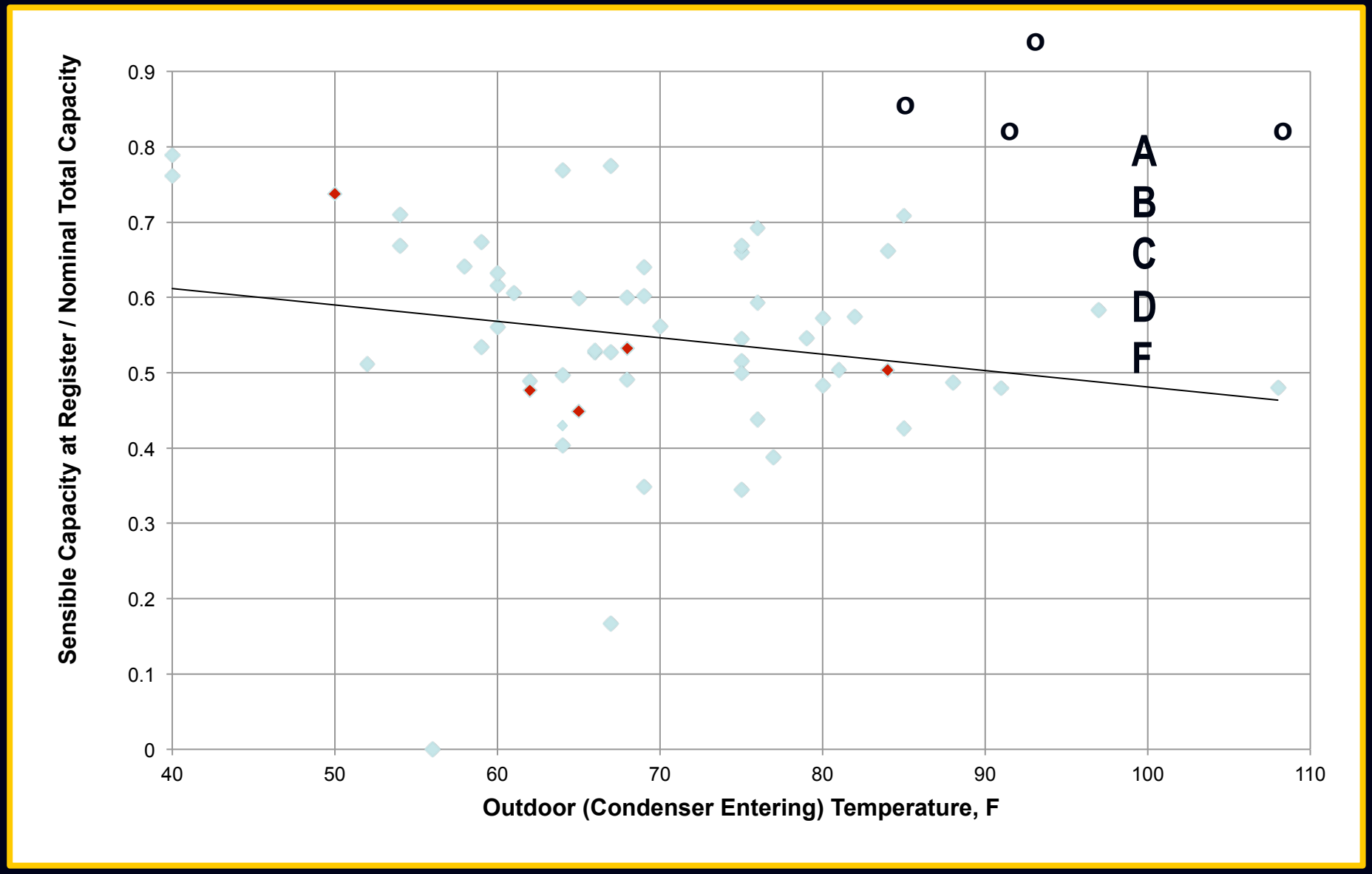
Source: California Energy Commission report 500-2012-062

AC Sensible Capacity



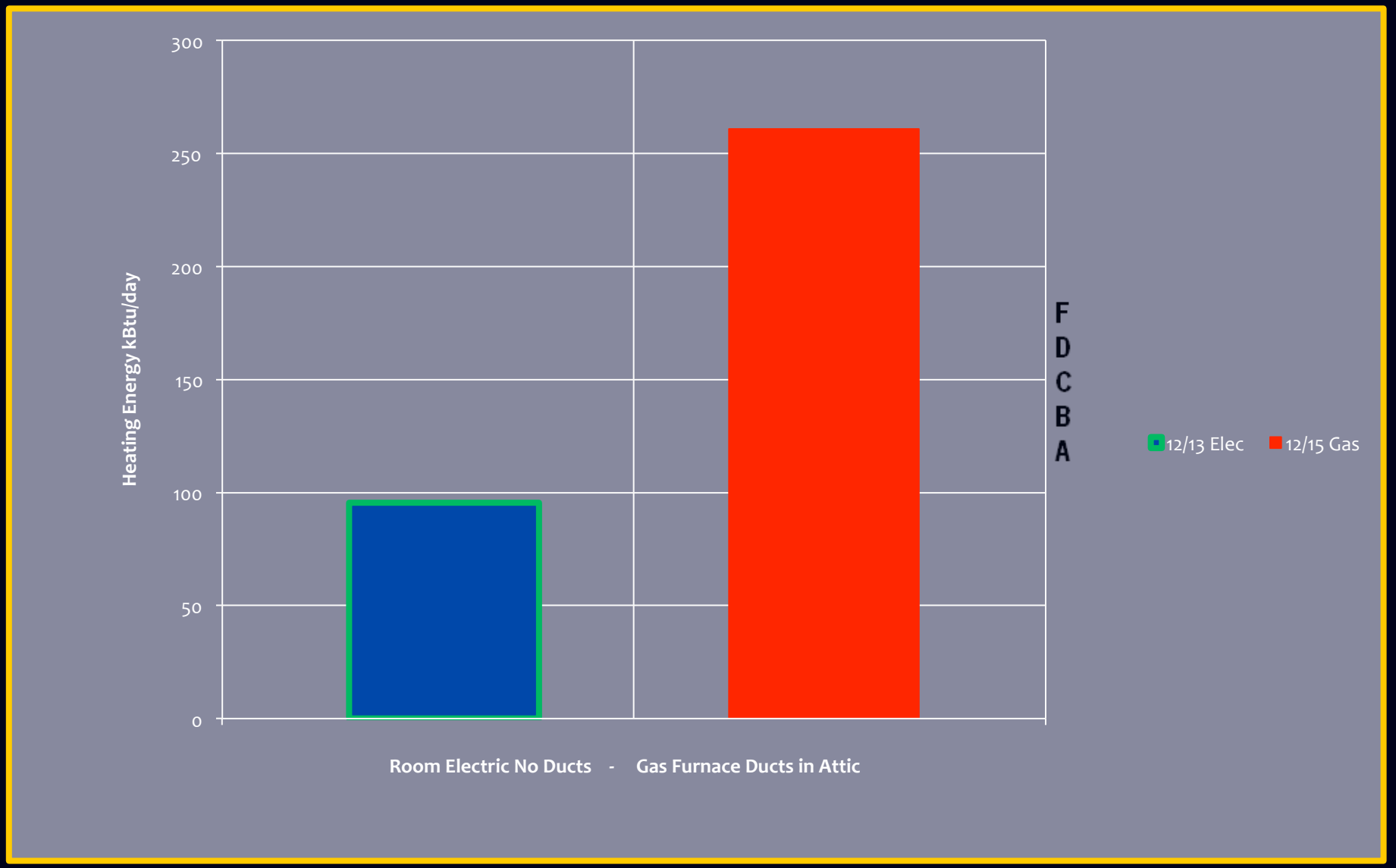
Source: California Energy Commission report 500-2012-062 and Rick Chitwood

AC Sensible Capacity



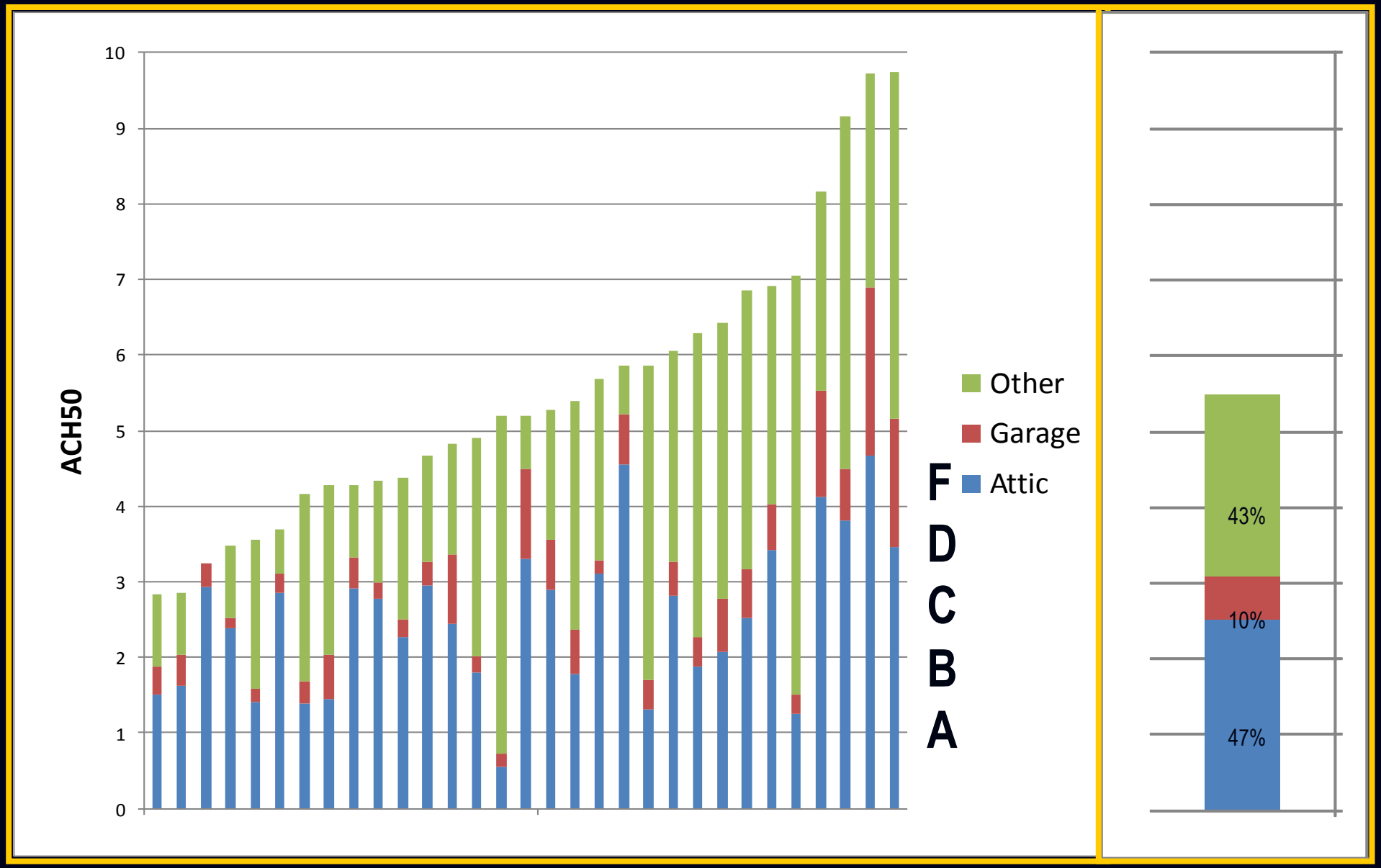
Source: California Energy Commission report 500-2012-062 , Rick Chitwood, and Energy Docs Home Performance

2005 Home – Heating Energy



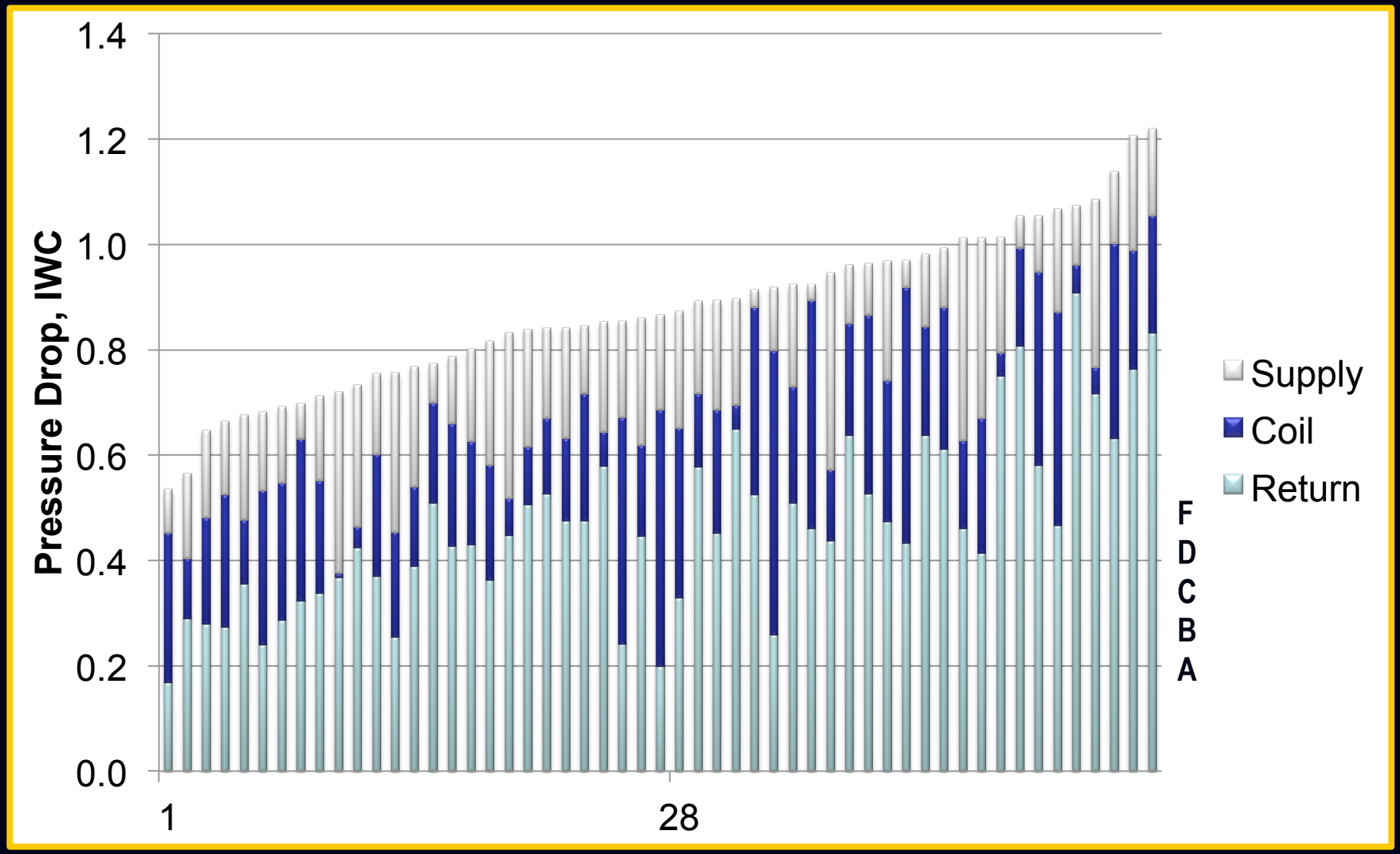
Source: California Energy Commission project Stockton Research Houses and Rick Chitwood

Air Leakage Rates and Path



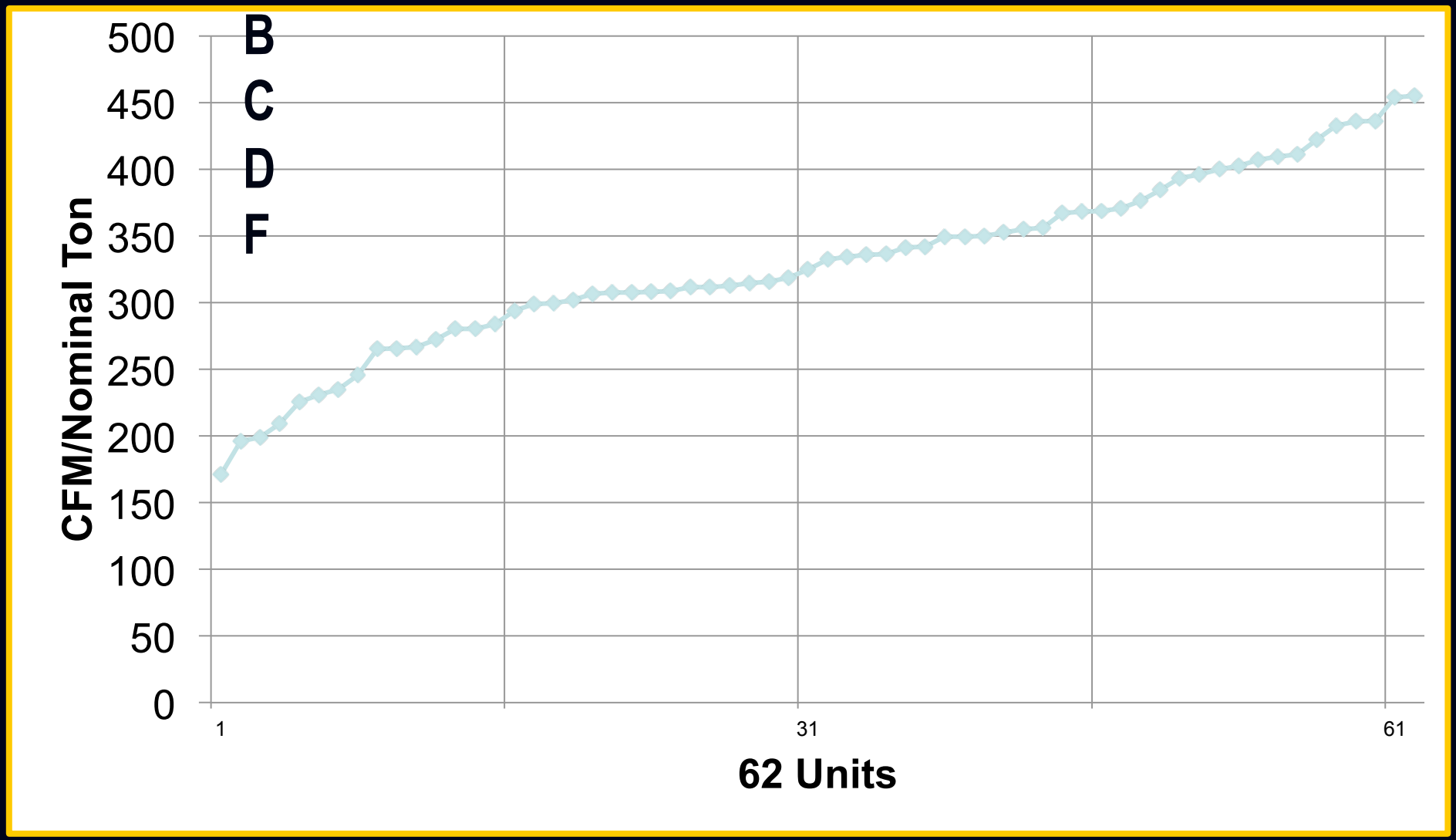
Source: California Energy Commission report 500-2012-062 and Rick Chitwood

Measured External Static Pressure



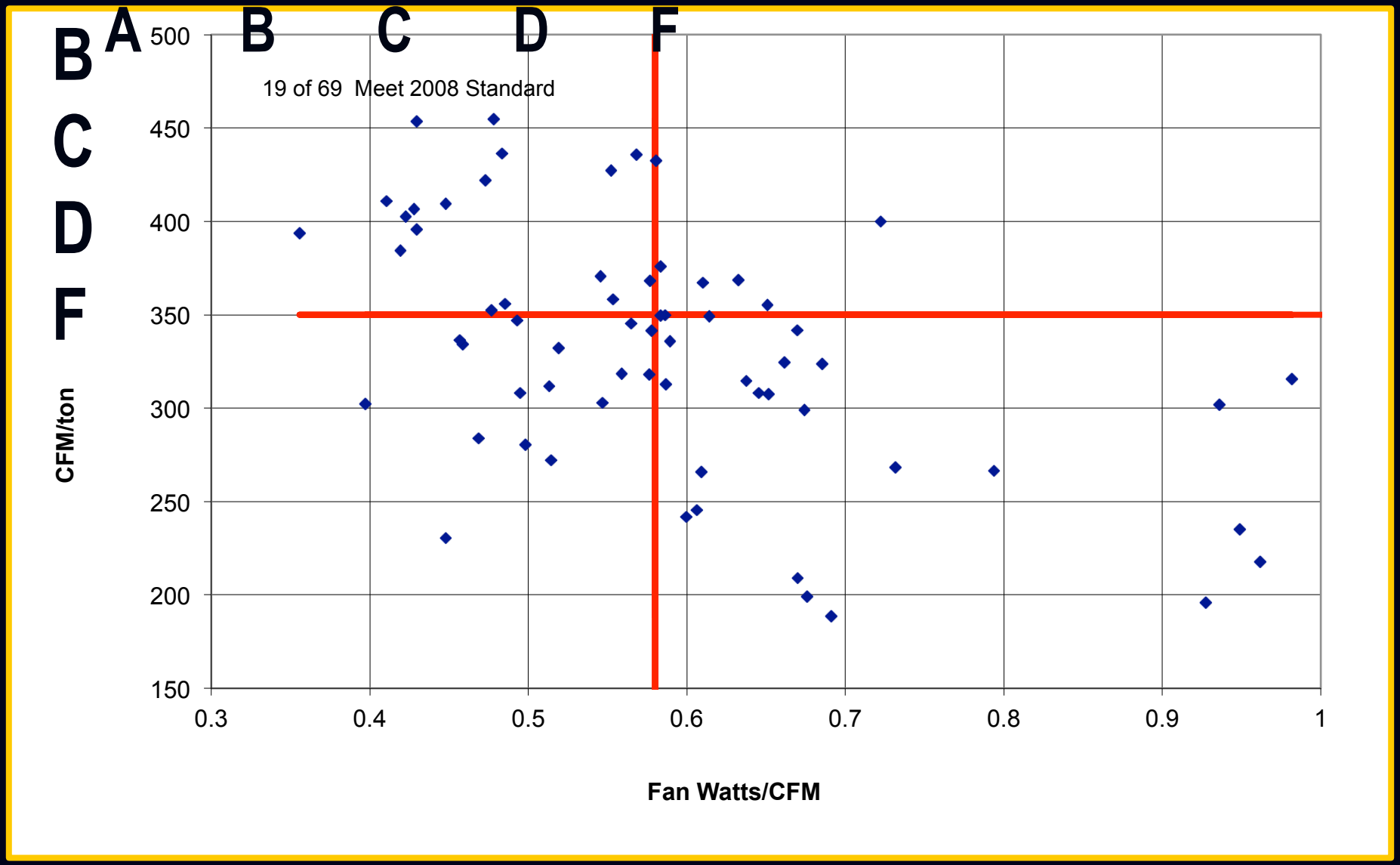
Source: California Energy Commission report 500-2012-062 and Rick Chitwood

Evaporator Coil Air Flow



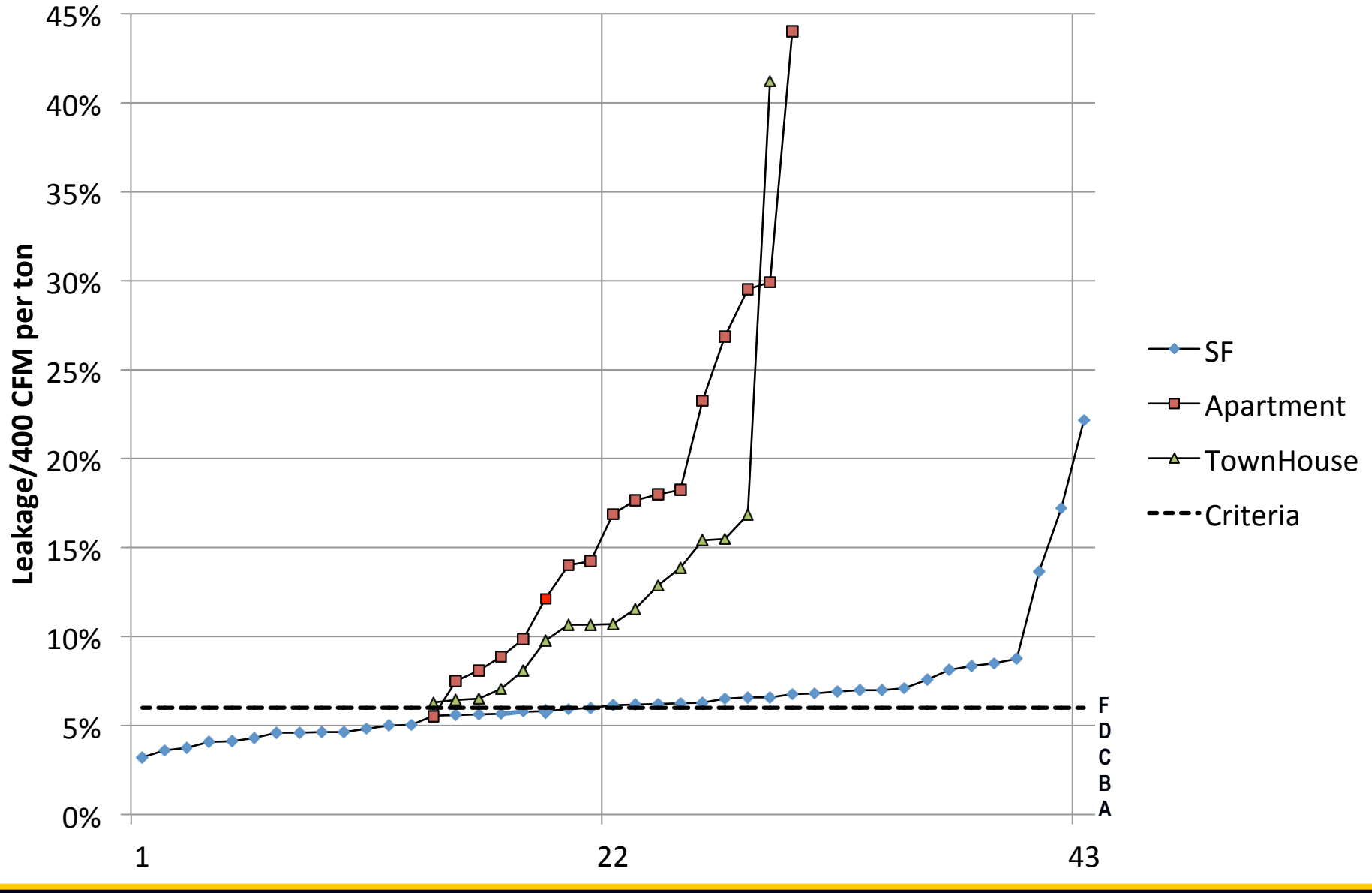
Source: California Energy Commission report 500-2012-062 and Rick Chitwood

Air Flow and Fan Watts



Source: California Energy Commission report 500-2012-062 and Rick Chitwood

Total Duct Leakage @ 25 Pa



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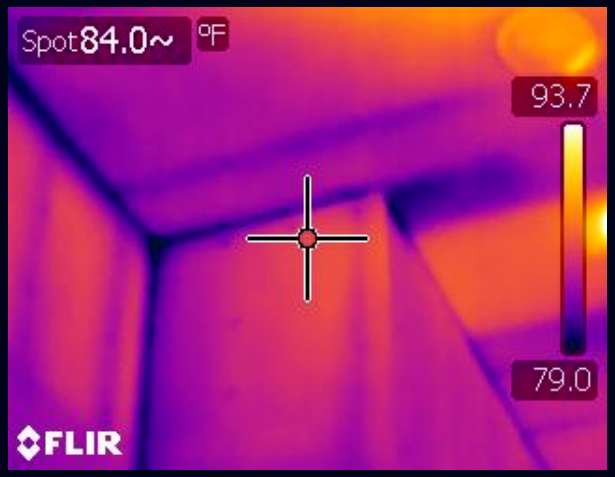
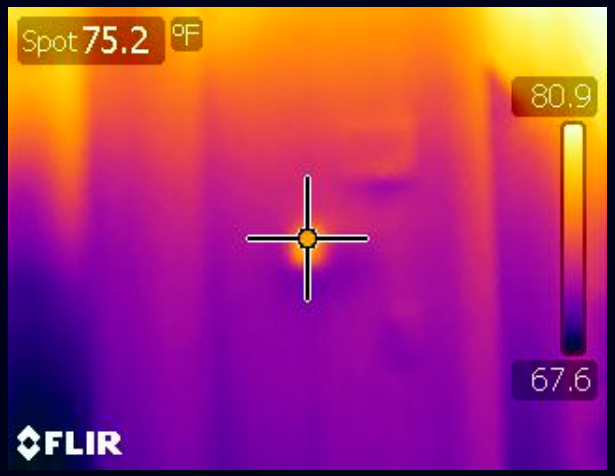




Comfort? … in a 2014 home

Source: PG&E ET Project field observation

Comfort? ... in a two story zoned home

Start Test: (Lower Floor Only Calling)

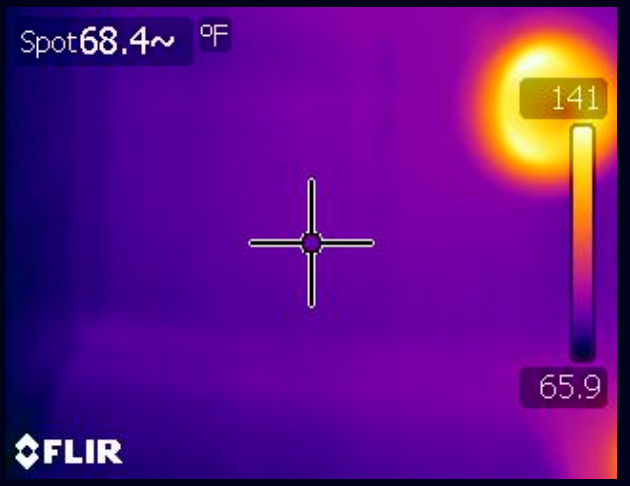
- Lower Floor Thermostat
- 68°F
- Upper Floor Thermostat
- 69°F
- Upper Floor Ceiling 68.4°F

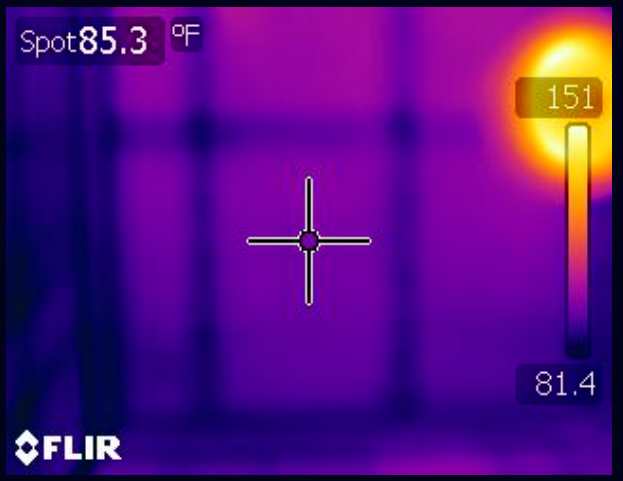
At 15 Minutes: (Lower Floor Only Calling)

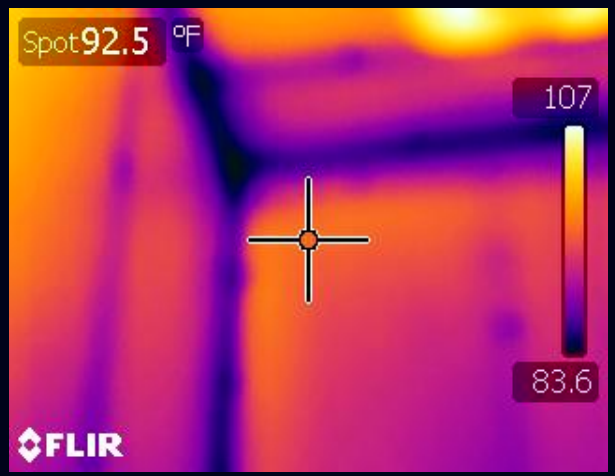
- Lower Floor Thermostat 68°F
- Upper Floor Thermostat 69°F
- Upper Floor Ceiling 85.3°F

Test Ended at 53 Minutes:

- Lower Floor Thermostat 72°F







Source: PG&E ET Project field observation

Current Residential HVAC Design and Installation

	Low	High	% difference
Fan: watts/square foot	**0.13 W/SF**	**0.92 W/SF**	**708%**
Heating: Btu/square foot	**9 Btu/SF**	**110 Btu/SF**	**1,222%**
Cooling: square feet/ton	**1,739 SF/ton**	**200 SF/ton**	**869%**
Air Infiltration: ACH	**0.12 ACH**	**1.92 ACH**	**1,600%**

Note: Average air infiltration is 0.25 ACH in new homes (2010 research, Wilcox, Proctor, Chitwood)

Source: California Energy Commission report 500-2012-062

Based on California Research

	Average Grade
Building Enclosure Tightness	F
Comfort Delivered	F
Air Handler Static Pressure	F
HVAC Air Flow	F
HVAC Fan Watts	F
HVAC Duct Leakage	F
Delivered Cooling Performance	F
Delivered Heating Performance	F

Beyond the Occupant Scapegoat

Part 2: Why Poor Performance (and how to fix it)

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Who's at Fault for this Poor Energy Performance?

- **Government** and their Energy Standards
- **Home Builders**
- Energy Feature **Subcontractors** and their Workers (especially HVAC subs)
- **Home Owners**

Who Do We Focus on to Improve Energy Performance?

- **Government** and their Energy Standards
- **Home Builders**
- Energy Feature **Subcontractors** and their Workers (especially HVAC subs)
- **Home Owners**

Government and their Energy Standards?

- Too much focus on: Licensing, bonding, certifications, HERS verification, and equipment efficiencies
- Standards are not performance based
- Standards are minimums – not goals
- Too many believe:
  - homes perform as modeled
  - the energy code is too strict and expensive now
  - all homes perform the same (so only shop price)
  - just add solar to get to ZNE

Home Builders?

- Shareholder focused corporate capitalism with no focus on the other stake holders:
  - workers
  - homeowners
  - the environment
- "Quality Control" not part of the construction process
- The lower the HVAC "bid" the more the shareholders profit

Energy Feature **Subcontractors** and their Workers (especially HVAC subs)**?**

- Directly responsible for **poor** HVAC system performance
- Doing **great** at what their employer asks them to do; being low bidder, and meeting code minimums
- Equipment manufacturers' control the "performance" narrative (no focus on installation quality – it is all about the "box)
- HVAC workforce skill in extremely low
- Worker training not in the low bid

Energy Feature **Subcontractors** and their Workers (especially HVAC subs)?

- "Quality Control" not part of the HVAC installation process
- Air conditioner efficiency losses add up:

Duct Leakage	7%	
Duct Conductive Losses		12%
Refrigerant Charge and Contamination	8%	
Low Air Flow (high latent removal)		14%
Equipment Oversizing	4%	
Room Air Delivery and Mixing	5%	
Total Loss	50%	

- The un-learning curve is hard to overcome

Homeowners?

- Homeowners have little impact on heating/cooling costs if the; energy standards, builders, and subcontractors do their job well.

To Move Forward and To Meet Our 2020 ZNE Goals We Must "Change the Paradigm"

1. Deliver (and verify) true performance in all energy feature categories (especially HVAC)
2. Incentivize homes and systems that really perform (but nothing else)

Energy Feature Subcontractors Must Incorporate True "Quality Control"

- Insulation Subcontractors
  - Blower Door test
  - IR Camera inspection
- HVAC Subcontractors
  - BTU's at the supply grilles compared performance tables
  - Record run time to confirm sizing
  - Duct leakage to outside less than 5 CFM_{25}
  - Fan watt draw less than 0.2 watts/CFM
  - Delivery velocities above 500 FPM

Certify/Verify all HVAC Systems that Deliver High Performance

1. First use certification program on **utility pilot programs**; ZNE, ET, & CAHP
2. Make Certification a **prescriptive measure** in the 2019 Standards
3. Certification a **mandatory measure** in 2022

Can we get technicians to do this job correctly 100% of the time? Yes! …but only with 100% QC testing