CALIFORNIA ENERGY COMMISSION

2013 Building Energy Efficiency Standards Staff Workshop

Night-Ventilation Systems

May 31, 2011

Background

- Proposal sponsored by Sempra
- Proposal author Marc Hoeschele, Davis Energy Group
- Further analysis and modified proposal by CEC Staff and 2013 Project Team

Overview

- Summary of code change proposals
- Summary of current code requirements
- Typical practice
- Data/findings
- Analysis
- Code change details

Code Change Proposals

- Base Code Prescriptive Requirement for Whole House Fans where cost effective

- Compliance Option for three system types
  - WHFs
  - Fixed speed central fan system
  - Variable speed central fan system

Current Code Requirements

- Title 24 does not recognize ventilation cooling
  - Current ACM modeling rules do not reflect any benefit for nighttime ventilation cooling
- Title 20 requires whole house fans be listed for airflow and cfm/Watt

Whole House Fan Listing

<<previous Page: 2 of 73 next>> Records 11 - 20 of 729

Manufacturer Name	Brand Name	Model Number	Fan Type ▲	Air Flow CFM	Air FLow Efficiency (CFM/Watts)
Air Vent, Inc.	Grainger	WH302BD-HDX	Belt-Drive Single Whole House Fan	5381	11.622
Air Vent, Inc.	Grainger	WH362BD	Belt-Drive Single Whole House Fan	7438	14.103
Air Vent, Inc.	Grainger	WH362BD-HDX	Belt-Drive Single Whole House Fan	7881	13.424
LL Building Products, Inc. subsidiary of GAF Materials Corp.	Masterflow	30BWHFS	Belt-Drive Single Whole House Fan	3852	8.979
Marley Engineered Products	Marley Engineered Products	2438	Belt-Drive Single Whole House Fan	4430	7.433
Marley Engineered Products	Marley Engineered Products	3038R	Belt-Drive Single Whole House Fan	6097	9.946

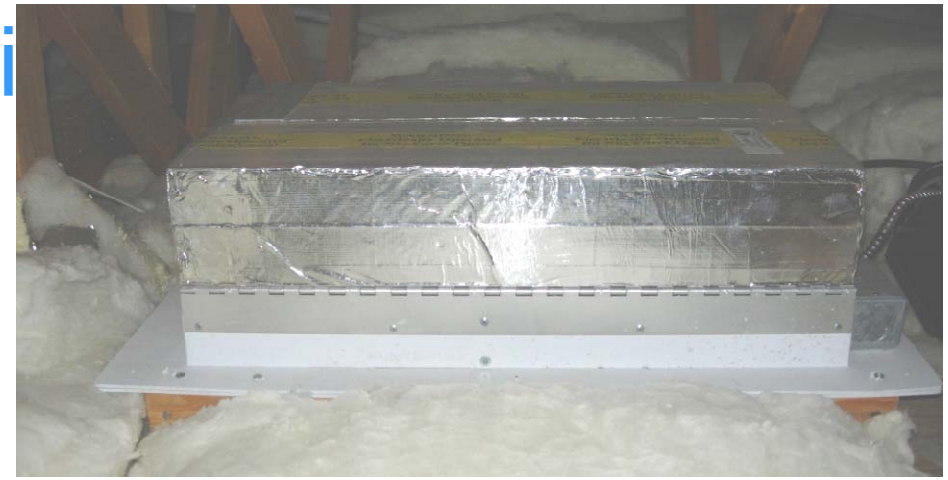
Typical Practice

Windows

- Operable windows provide limited night cooling.
  - LBNL 2006 mail survey: 20% never open windows at night; 50% hardly open windows
  - Closed interior doors and first floor windows (security) significantly reduces any benefit

Whole House Fans

- Rare in new construction; more common as a retrofit item (~6% PG&E saturation)
- Very efficient, but….
  - Manual control, open/close windows
  - Dust, noise, allergens, security, infiltration, thermal short to attic,…
  - Noise means some people use just as a “flush” device– evenings after it cools off, first thing in the AM. Does not pre-cool building mass

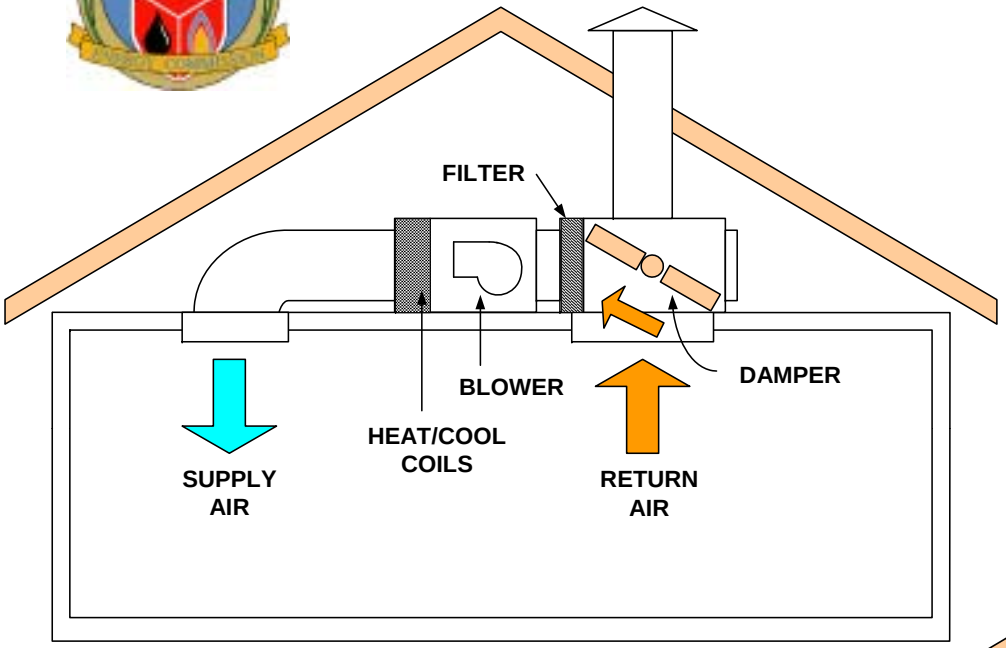


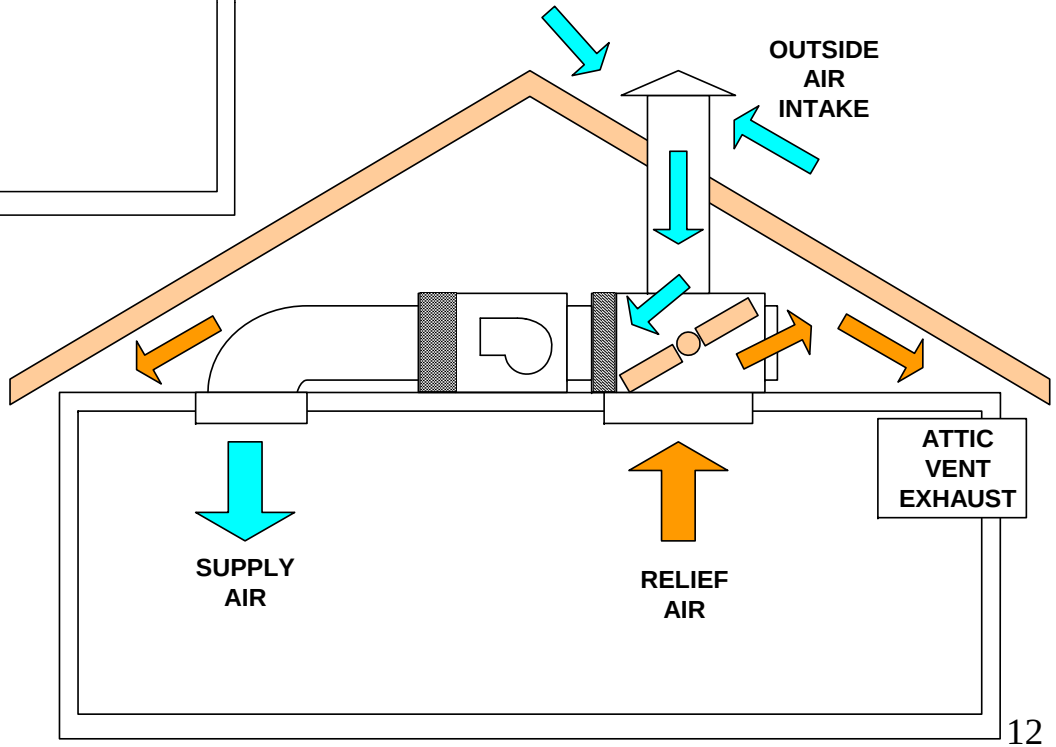
Integrated Central Fan Systems

- Characterize generally as fixed speed (SmartVent) and variable speed NightBreeze)
- Key Advantages-
  - Fully automated operation in response to outdoor temperature & ventilation setpoint;
  - security; filtered air
- Disadvantages-
  - More expensive
  - less efficient in terms of Watts/cfm

Integrated Central Fan Systems

- Common Features
  - Damper box
  - Outdoor air duct with air filter
  - Outdoor temperature sensor
- Differences
  - Ability to vary fan speed
  - Control strategy


FILTER
BLOWER
DAMPER
HEAT/COOL
COILS
SUPPLY
AIR
RETURN
AIR


OUTSIDE
AIR
INTAKE
ATTIC
VENT
EXHAUST
SUPPLY
AIR
RELIEF
AIR

Experience

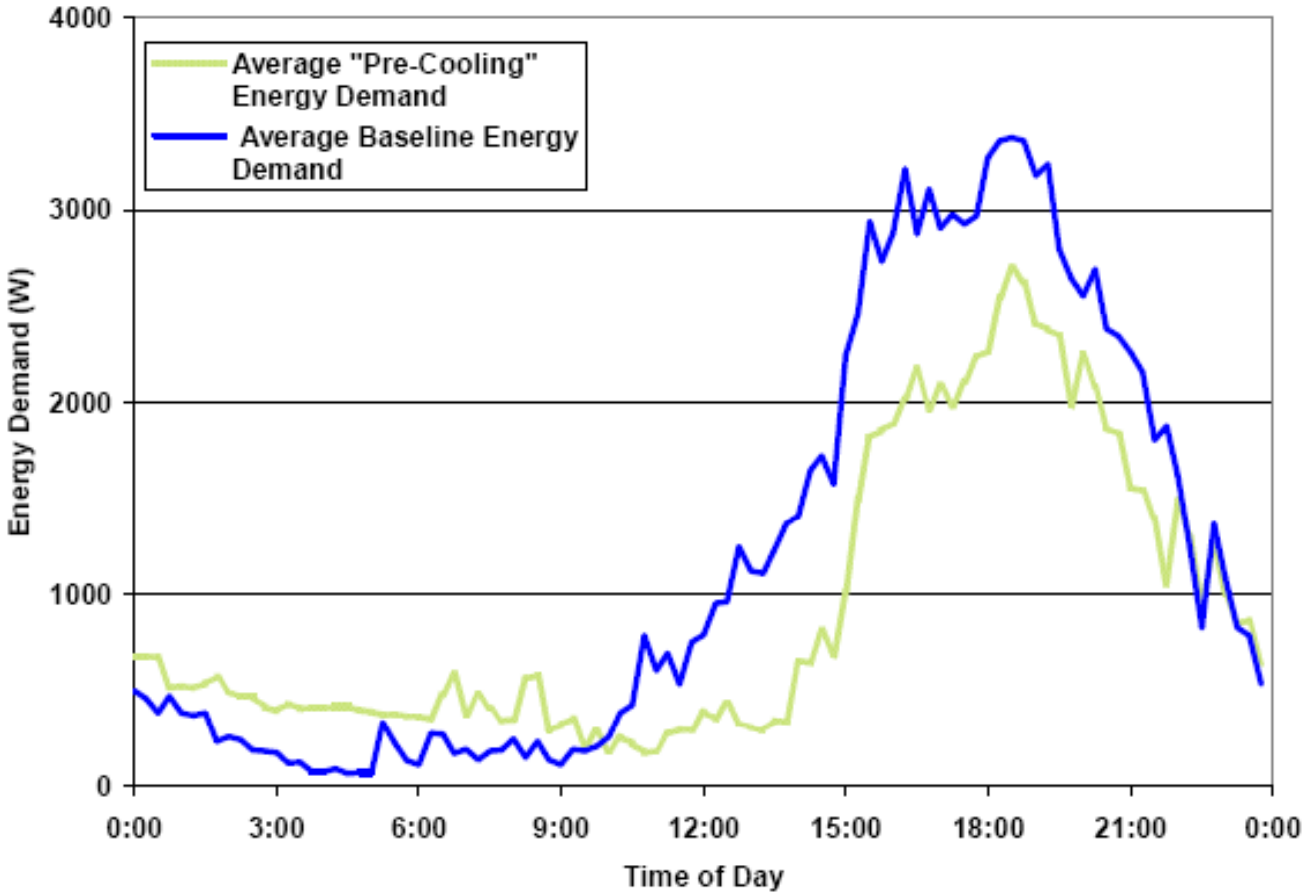
- WHFs largely installed as a retrofit product
- NightBreeze developed with CIEE and PIER funding (several 100 units installed since ~2003)
  - Monitored under Building America
- SmartVent introduced mid ‘90’s; more than 20,000 systems installed

PG&E monitored 6 Integrated Central Fan Systems

- (3 SV, 3 NB) near Sacramento in 2007 (Matrix)
- New (2005/2006) homes (2400-3150 ft2)
- 10% average duct leakage
- Projected annual savings vs. 17 SEER AC

  - 48-50% reduction in Noon to 6 PM kWh
  - Annual energy savings: -16% SV, 2% NB
  - Savings for days >92F: 14% SV, 30% NB

Central System Demand Reduction

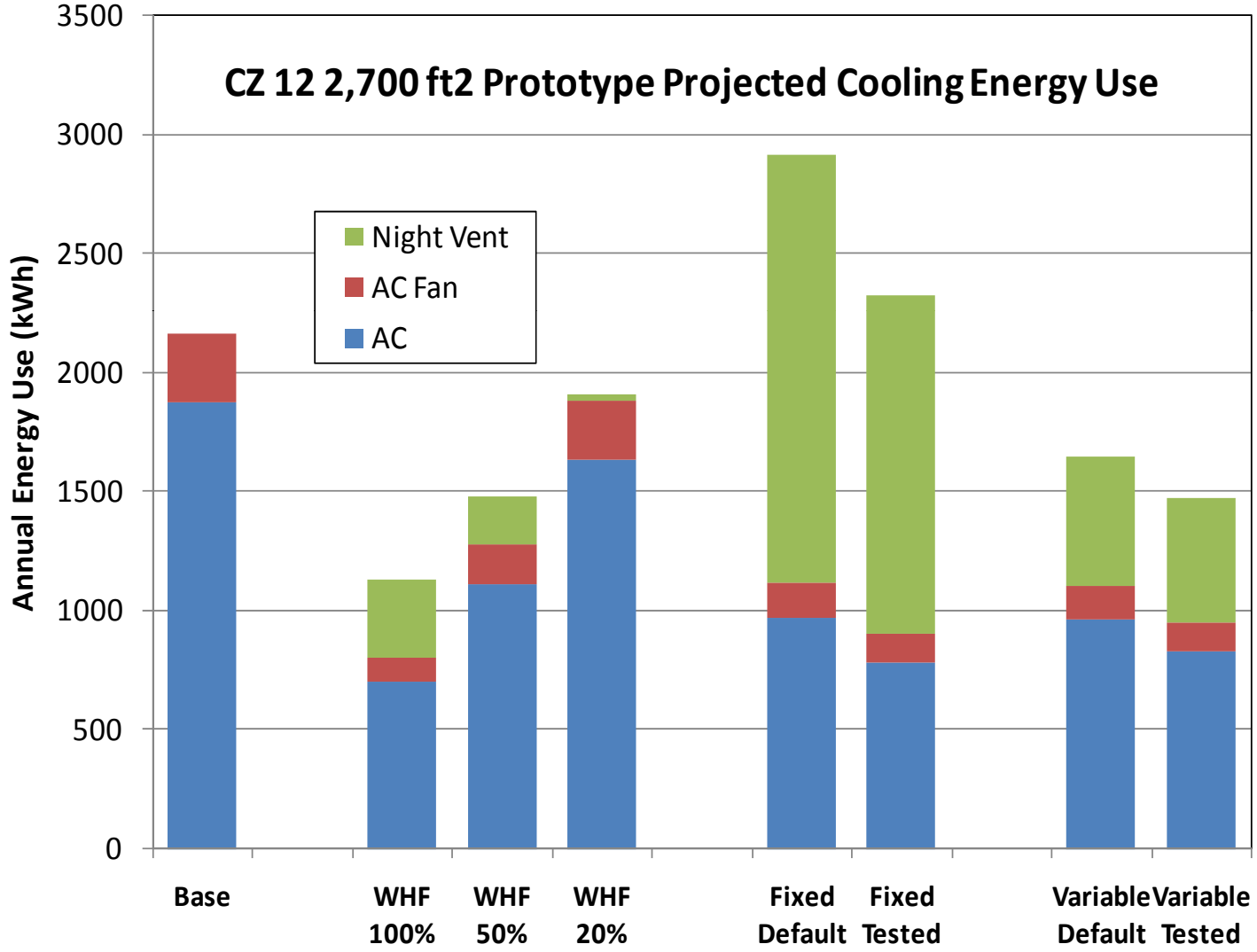


Average Demand for Days with 100-105F Peak Outdoor T

CSE Model Development

- Wilcox team revamped ACM model
  - Improved thermal modeling
  - Reduced natural ventilation impacts
  - More reasonable “floating” performance
- Whole house fans
  - Fixed airflow, W/cfm, and target temperature
- Integrated generic vent cooling model
  - Looks for indoor-to-outdoor delta T; fixed target T
  - Fixed speed: Static cfm & W/cfm
  - Variable speed: Daily varying cfm & W/cfm

CSE Model Results CZ12



Whole House Fan Life Cycle Cost

- Analyzed with 2013 Development Program
- Assumptions:
  - 2700 ft2 Prototype D with some 2013 measures
  - 5400 CFM (2 CFM/ft2) traditional Whole House Fan
  - 0.1 W/CFM (10 CFM/W) fan power
  - Cost to home buyer is $600 installed
  - Fan operates on window schedule (off 11 PM until dawn)
  - Occupant operates only to 25% of full potential

Whole House Fan Life Cycle Cost

Zone	LCC Savings $	Cost Effective
2	-270	
3	-1047	
4	173	Yes
6	-423	
8	1005	Yes
9	1025	Yes
10	1133	Yes
11	746	Yes
12	699	Yes
13	699	Yes
14	385	Yes
15	-651	
16	-238	

Whole House Fan Energy Impact

Zone	% of total TDV
4	4%
8	9%
9	6%
10	6%
11	3%
12	3%
13	3%
14	2%

Whole House Fan Requirement

- New prescriptive requirement in Section 151
  - (not mandatory)
- Single Family Homes in CTZs 4 and 8-14
- Shall have installed one or more whole house fans whose total Air Flow CFM as listed in the CEC Directory is at least 2 CFM/ft2 of conditioned floor area.

Whole House Fan Requirement

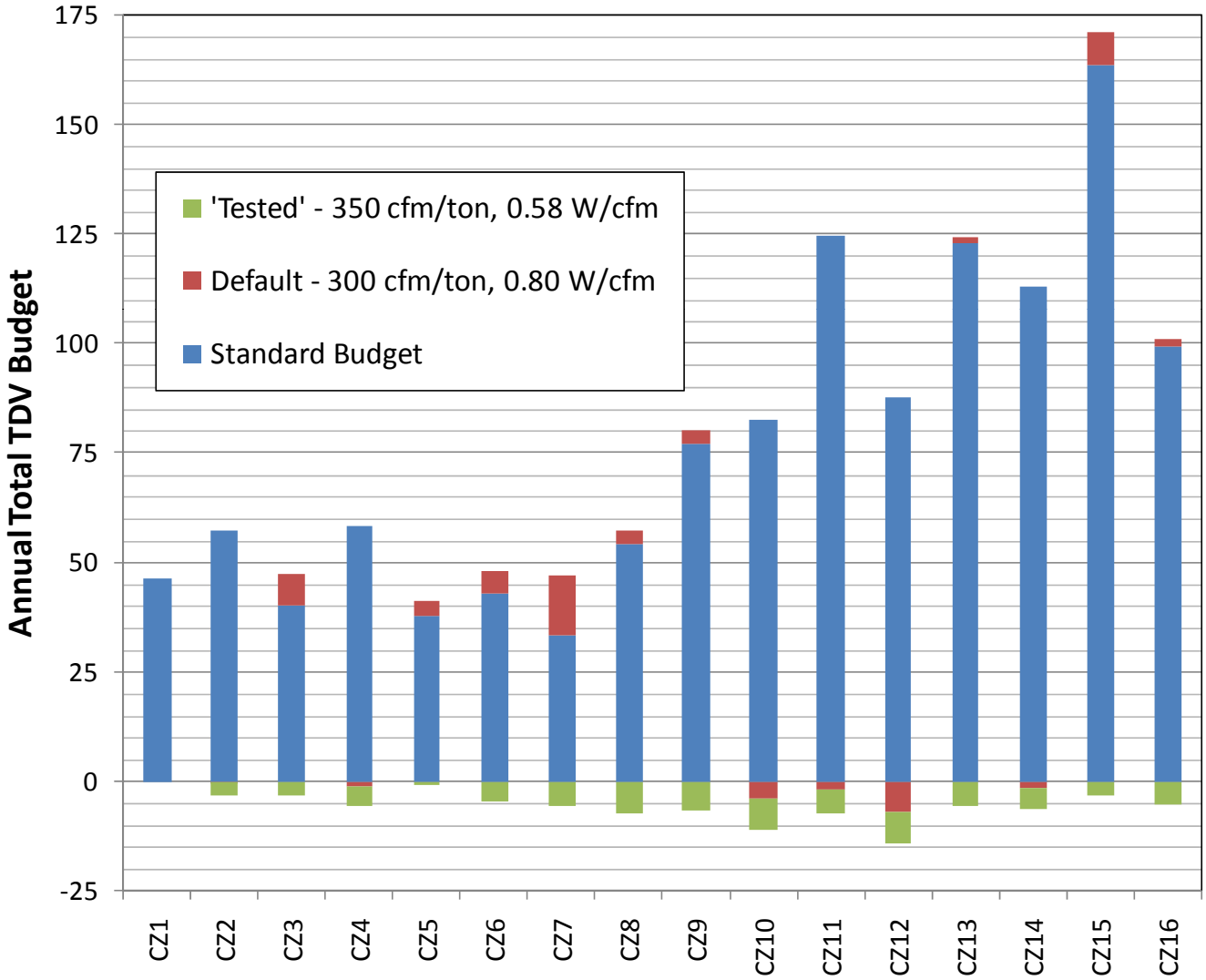
- Homes with Whole House Fans shall have at least 1 square foot of attic vent free area for each 375 CFM of rated whole house fan Air Flow CFM.

- Homeowners who have WHFs installed must be provided with a one page “How to operate your whole house fan” informational sheet.

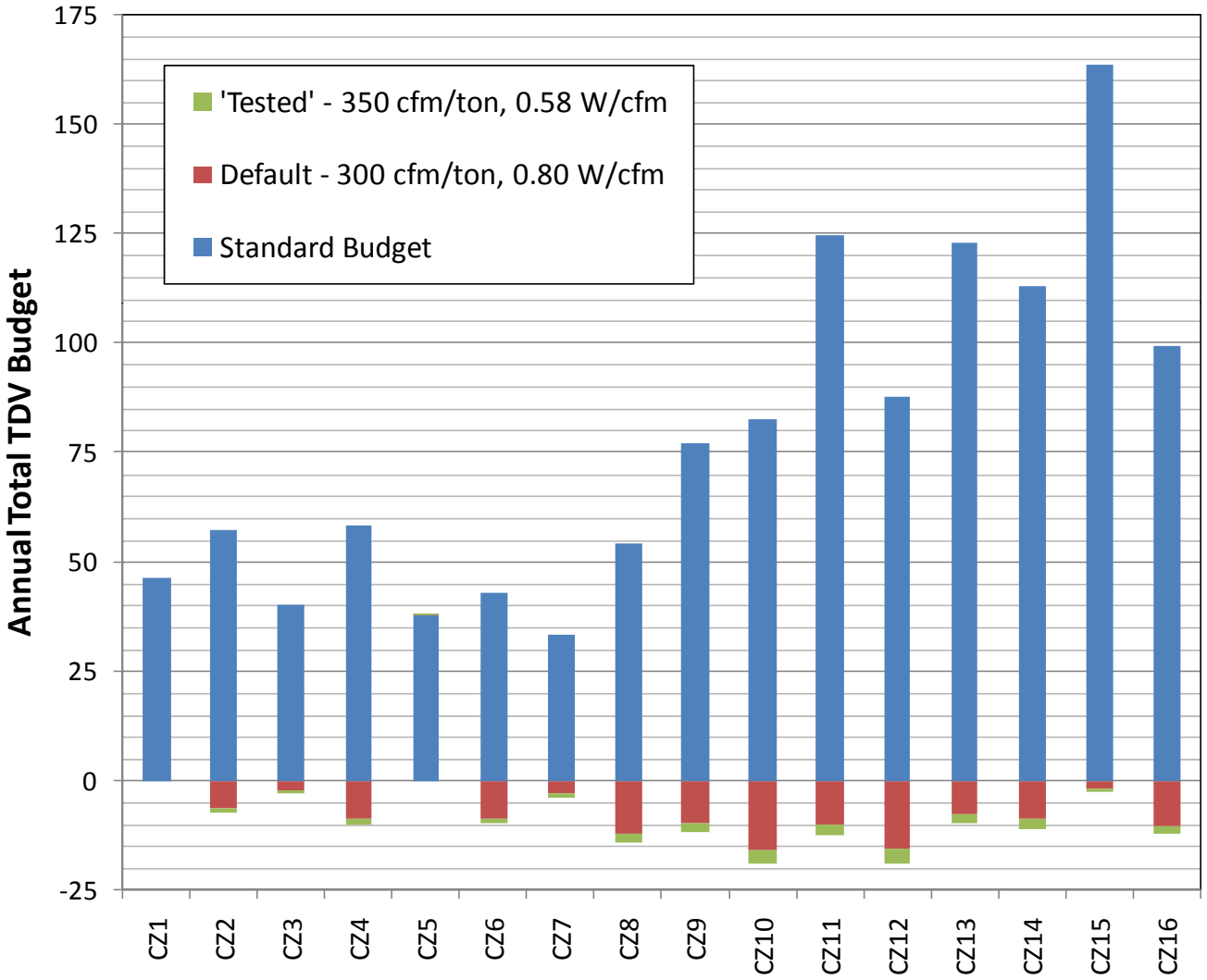
Whole House Fan RACM Changes

- Homes claiming credit for a Whole House Fan shall have a fan that operates in conjunction with the window ventilation model at an assumed flow rate of 0.25 times the CEC Directory CFM. The default fan power shall be 10 CFM/W.
- The CEC may define an improved Whole House Fan that would have a higher assumed flow rate because of insulated dampers, a lower sound level and/or room by room control capability.

"Fixed" Central System Credit



"Variable" Central System Credit



Central System RACM Changes

- Central Ventilation Systems shall be HERS verified to pass the duct leakage test with the dampers in air conditioning mode.

- Central Ventilation Systems shall be tested and HERS verified deliver the specified maximum ventilation CFM at the fan Watts specified.

Central System RACM Changes

- Central fan systems will be treated as “fixed speed” systems, unless the manufacturer provides documentation to the CEC that:
  - The fan motor is a variable speed motor
  - The motor is controlled in night ventilation mode to vary in a continuous range between full air flow (100%) and a minimum airflow of no more than 25% of full airflow.
  - the ventilation cooling rate calculation will occur at a time interval of 24 hours or less, to insure that the system responds in a timely manner to changes in weather patterns.

2013 Standards Update

Send related comments by June 30, 2011 to:

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