



**CALIFORNIA
ENERGY**
CODES & STANDARDS

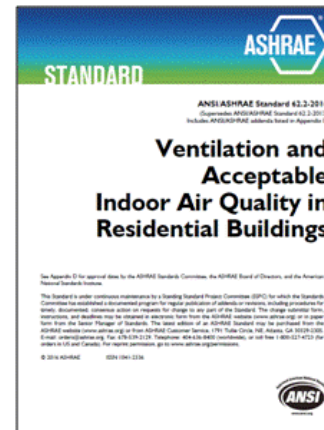
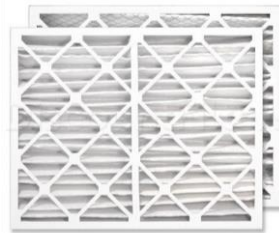
A STATEWIDE UTILITY PROGRAM

2019 Title 24 Codes & Standards Enhancement (CASE) Proposal

Residential IAQ Measures:

- Adoption of ASHRAE 62.2-2016
- Increased HVAC Filter MERV
- Kitchen Hood Verification

September 27, 2016



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Proposed Code Change Overview

- Types of building impacted
 - Single family, low rise & high-rise multi-family residential
- Building systems impacted
 - Ventilation for indoor air quality
 - HVAC filtration
 - Kitchen hoods
- Anticipated type of change
 - Update to reference indoor air quality code (ASHRAE 62.2)
 - Possible increase of HVAC filter efficiency
 - Enforcement of kitchen hood compliance with current code
- Description of change
 - Adoption of ASHRAE 62.2-2016, with modification, expanding scope to mid/high rise
 - Increase minimum HVAC filter efficiency from MERV 6 to MERV 11
 - Require HVI labeling of kitchen hoods & verify to ensure compliance with 62.2
 - ~~Require hoods to be externally vented? (Not required by 62.2 if 300 cfm fan kitchen fan provided)~~

Proposed Code Change History

- Why are we proposing this measure?
 - Basic ventilation rate has not changed for single family residences since the 2008 Title 24 standards adopted ASHRAE 62.2-2007*
 - 2013 & 2016 Title 24 standards adopted 62.2-2010
 - Desire to update to the current standard
 - Kitchen hood 100 cfm and 3 some requirements included in 62.2 have not been enforced**
 - Higher filter efficiency is justified by the risk of PM 2.5 exposure

*They changed for multi-family in 2013 with the adoption of 62.2-2010

**62.2-2010 alternatively allows a separate fan delivering 5 ACH continuously

Current Code Requirements Title 24 Part 6: Whole Building Ventilation - Single Family

- Existing Title 24 Requirements – Single Family
 - Compliance with ASHRAE 62.2-2010*
 - Mandatory for new homes and additions > 1000 ft² (Section 150.0(o))
 - $Q_{fan} = 0.01*(CFA) + 7.5*(\#BR+1)$ - includes 0.02 cfm/ft² infiltration credit

Conditioned Floor Area (ft ²)	Bedrooms				
	0-1	2-3	4-5	6-7	>7
≤1500	30	45	60	75	90
1501-3000	45	60	75	90	105
3001-4500	60	75	90	105	120
4501-6000	75	90	105	120	135
6001-7500	90	105	120	135	150
>7500	105	120	135	150	165

- Intermittent ventilation systems allowed in accordance with lookup table (62.2-2010 Table 4.2)

*California version that includes Addenda b, c, e, g, h, i, j, n

** Roughly equivalent to 5 ACH50 leakage rate

Current Code Requirements Title 24 Part 6: Whole Building Ventilation - Multi-family

- Existing Title 24 Requirements – Low rise Multifamily
 - Compliance with ASHRAE 62.2-2010* which only applies to low rise
 - Same as SF except...
 - $Q_{fan} = 0.03*(CFA) + 7.5*(\#BR+1)$ - no infiltration credit except townhomes**
 - 62.2-2010 target leakage = 0.2 cfm/ft² of envelope surface area at 50 Pa (to minimize leakage from adjacent units)
- Existing Title 24 Requirements – High rise Multifamily
 - Regulated by Title 24 Part 6, airflow rate given in the California Mechanical Code
 - $Q_{fan} = 0.06*(CFA) + 5*(\#BR+1)$
 - Natural ventilation allowed if conditions met

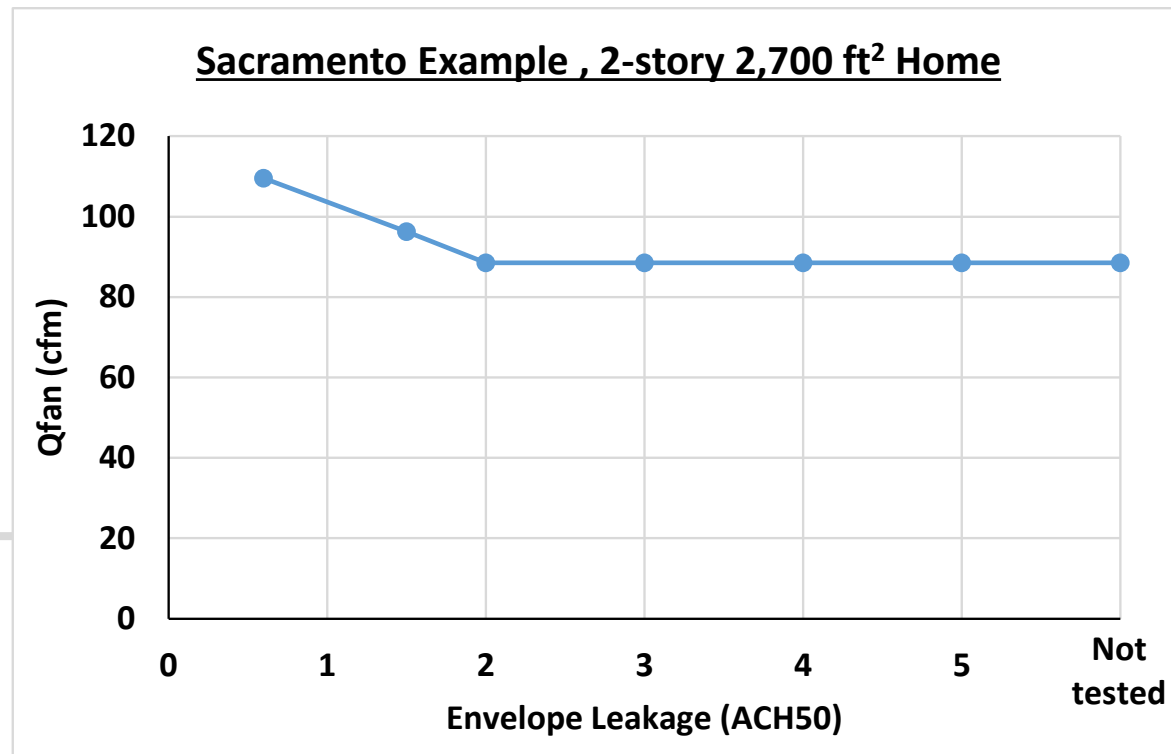
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ASHRAE 62.2-2016 Key Changes: Whole Building Ventilation

- Single Family
 - Eliminate “default infiltration credit” of 0.02 cfm/ft²
 - Install fans to deliver $Q_{total} = 0.03(CFA) + 7.5*(\#BR+1)$ **OR**
 - Complete blower door test & calculate Q_{infil}
 - $Q_{fan} = Q_{total} - Q_{infil}$
 - Smart Ventilation: Intermittent tables replaced with variable ventilation, the 3-hr average of which is $\geq Q_{fan}$, or other methods that require calculation of relative exposure
- Multi-family (low-rise & high-rise)
 - 62.2-2016 applies to all multi-family occupancies
 - Target leakage increased from 0.2 to 0.3 cfm₅₀/sf-enclosure

Proposed Title-24 Implementation of ASHRAE 62.2-2016 : Whole Building Ventilation

- Adopt 62.2-2016* across all single family & multifamily occupancies
 - Natural ventilation no longer allowed for high-rise
- Assumed infiltration for Qfan calculation
 - Qinf calculated using default value of 2 ACH50 (tight home)
 - Qinf varies by climate zone & house geometry
 - $Q_{fan} = Q_{total} - Q_{infil}$
- If blower door test done (single family only)
 - If <2 ACH50, Qinf calculated based on value from test



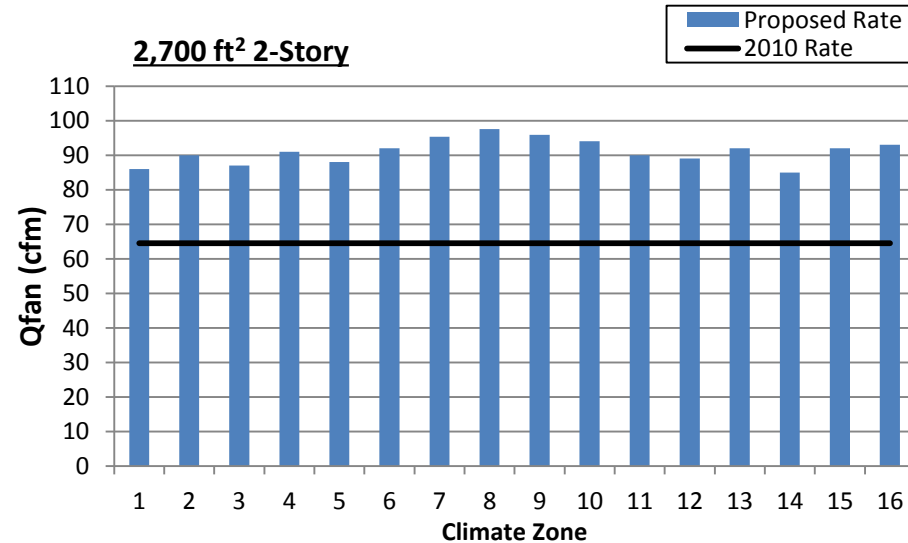
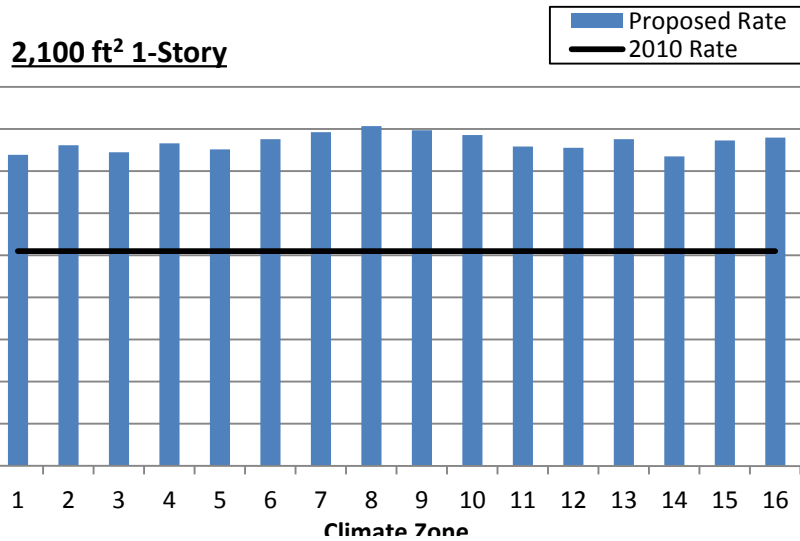
*California version

Proposed Title-24 Implementation of ASHRAE 62.2-2016: Whole Building Ventilation (cont.)

- Ventilation/infiltration airflow simulation in CBECC-Res
 - Envelope leakage
 - Decoupled from Qfan calculation unless < 2 ACH50
 - No changes to default assumption
 - 5 ACH50 single family
 - 7 ACH50 low-rise multifamily*
 - If blower test performed apply results in model (single family only)
 - Mechanical Ventilation airflow
 - Based on Qfan calculation
- Other
 - Implement variable ventilation provisions of Section 4, with Commission acceptance and certification of devices/controls
 - Remain compliance neutral. Standard = Proposed

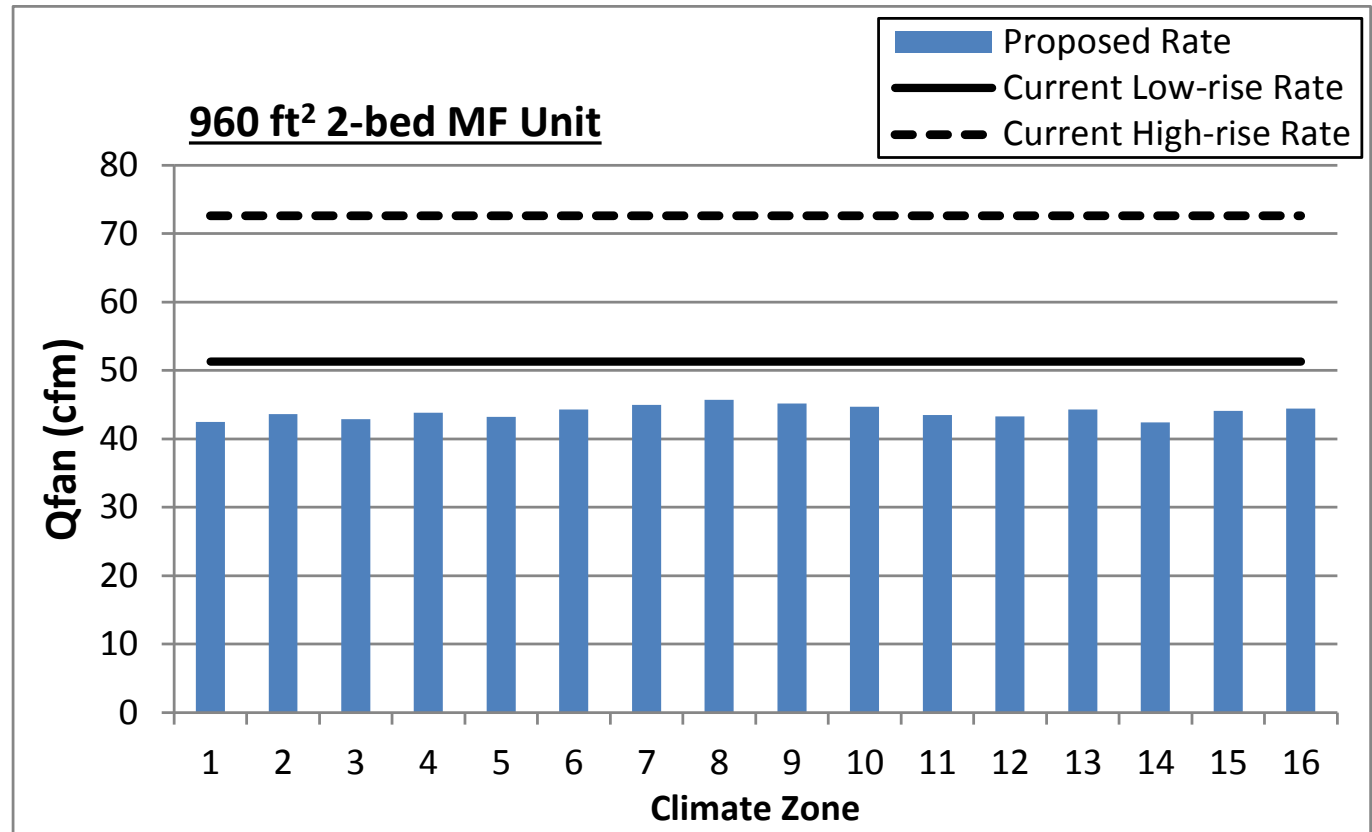
*High rise handled per CBECC-Com and non-residential ACM rules.

Changes in Q_{fan} for 2 ACH50, 62.2-2016: Whole Building Ventilation – Single Family



~45% higher
ventilation rates

Changes in Q_{fan} for 2 ACH50, 62.2-2016: Whole Building Ventilation – Multifamily



~15% lower airflow
for low-rise
~40% lower airflow
for high-rise

Typical Practices: Whole Building Ventilation

- Current practices
 - Most builders provide continuously operating exhaust fans to meet 62.2-2010 ventilation rate
 - Balanced ventilation systems (ERV, HRV) rarely used
 - Less than 10% of builders complete blower door tests and take credit for tight construction
 - Blower door testing rarely done in multifamily
- Trends
 - Few builders go beyond QII for sealing to reduce leakage below the default 5 ACH50, but a fair number of homes are <5

Market Impact: Whole Building Ventilation

- Current Market
 - Adjustable-speed fans widely available - can dial in Q_{fan} vent rates
 - There are no utility or other incentives that encourage compliance with the ASHRAE ventilation standards
- Market impacts and barriers
 - Higher ventilation rates may increase ventilation system cost slightly

Current Code Requirements Title 24 Parts 6 & 11: Filtration/Local Exhaust

- Existing Title 24, Part 6 Requirements
 - MERV 6 filters as required by 62.2-2010*
 - Kitchen hoods meet 62.2-2010* performance rating of ≥ 100 cfm, ≤ 3 sones
 - No HERS verification
 - 62.2 alternative to vented hood: 5 ACH continuous fan
- Existing CALGreen Requirements
 - Establishes mandatory limits for VOC emissions in adhesives, paints, sealants, carpet & pads, and carpet pad adhesives
 - Bathroom exhaust fans shall be ENERGY STAR compliant, ducted to terminate outside the building, and include humidity control
 - Not enforced

*California version that includes Addenda b, c, e, g, h, i, j, n

Current Code Requirements: Unvented Gas Appliances

- ASHRAE 62.2-2016
 - Unvented gas appliances not specifically disallowed currently
- California Health and Safety Code
 - Generally prohibits unvented heaters, including unvented decorative fireplaces
 - Allows unvented decorative fireplaces if numerous conditions, including development of standards by HCD, are met
- Chapter 9, CMC (Section 924.1 & 924.1.1)
 - Unvented fuel-burning room heaters prohibited in Group R occupancies

Proposed Title-24 Implementation: Filtration / Local Exhaust / Heater Venting

- Increase HVAC filter MERV requirement to 11
- Mandatory HERS verification of HVI label on kitchen hood
 - Confirm that airflow & some ratings comply with 62.2-2016



Home Ventilating Institute (HVI)
3317 E. Bell Rd., Ste. 101122
Phoenix, AZ 85032 USA
Ph. 855.HVI.VENT
www.hvi.org

- Unvented space heaters not allowed to be installed within conditioned space



Typical Practices: Filtration/Local Exhaust/Heater Venting

- Current Practices

- Some recirculating kitchen hoods may still be in use
- ASHRAE 62.2-2010 kitchen exhaust requirements not being verified
- MERV 6 or better filters installed

Air Filter Performance Requirement		Maintenance Instructions
Airflow (CFM)	Initial Resistance (inch WC)	USE ONLY REPLACEMENT FILTERS WITH AN INITIAL RESISTANCE LESS THAN 0.032 AT 400 CFM AIRFLOW RATE
400	0.03	

Source: California Energy Commission

AHRI 680 Standard Rating						
Airflow Rate (CFM)	Initial Resistance (in H ₂ O)	Final Resistance** (in H ₂ O)	Dust Holding Capacity** (g)	Particle Size Efficiency** (0.30 - 1.0 µm)%	Particle Size Efficiency** (1.0 - 3.0 µm)%	Particle Size Efficiency** (3.0 - 10 µm)%
400	0.05					
800	0.10					
1200	0.17					
1600	0.25					
2000*	0.32					
		0.50	45	17	53	87

* Maximum Rated Airflow Rate as published by the manufacturer.
 ** Standard Rating requires that these shall be tested at Maximum Rated Airflow Rate as published by the manufacturer.

Source: AHRI 2010

Market Impact: Filtration/Local Exhaust/Heater Venting

- Current Market
 - Many production builders use combination microwave-kitchen hoods
 - Most retailers offer high MERV filters and many buyers purchase them
 - Vented and non-vented decorative fireplaces are manufactured and sold in California, but no data on their use
- Market impacts and barriers
 - Increasing filter MERV from 6 to 11 may double the cost
 - Most microwave/hood combinations are not likely to meet 62.2 volume/sound standards

Incremental Cost Estimation: All Measures

- How we collected costs of base case technology and proposed technology
 - Assumed no cost impact for higher ventilation rate fans since most meet the standard when operated at higher speeds
 - Internet survey used to estimate the incremental cost of MERV 11 vs. MERV 6 filters (depends on filter size)
 - \$6-\$12 for 18"x30"
- What components of costs did we leave out?
 - Builder survey needed to identify cost and market impacts of eliminating microwave-hood combination products
 - Are there costs associated with installing higher MERV filters?
- *Do you find these costs to be reasonable?*

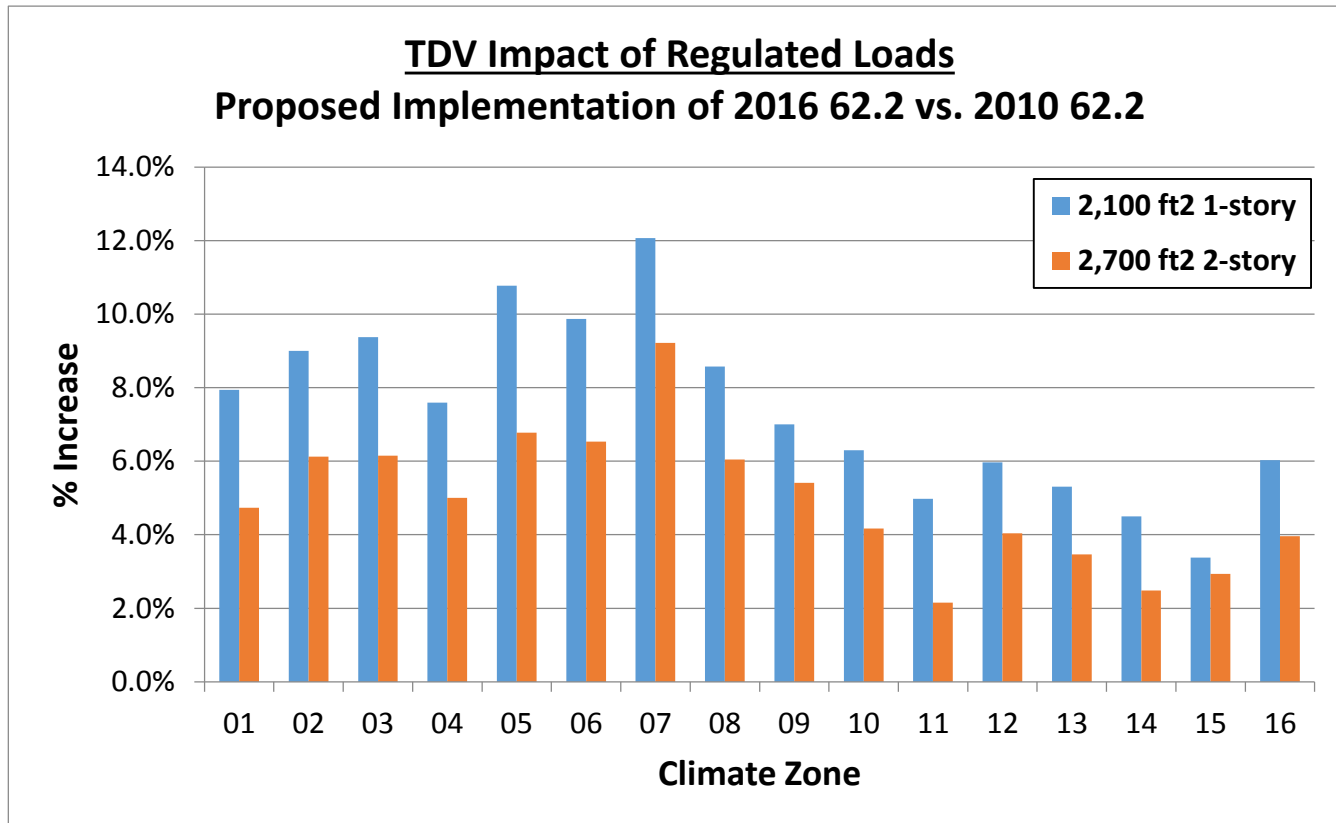
Methodology for Savings Analysis: All Measures

- Methodology for energy and demand Impacts (negative)
 - CBECC used to estimate site energy and demand impacts for increased ventilation rates
 - Single family: Weighted 45% 2100ft² single story and 55% 2700ft² two story prototype buildings
 - Multifamily: 6,960ft² 8-unit apartment
 - Designed to 2016 prescriptive standards; 2019 TDV
 - Intermittent fan control technologies still emerging - no effort was made to estimate impacts of smart ventilation controls
 - Spreadsheet analysis and prior test data used to estimate fan energy consumption for MERV 6 vs. MERV 11 filters; also LBNL data

Assumptions for Energy Impacts Analysis

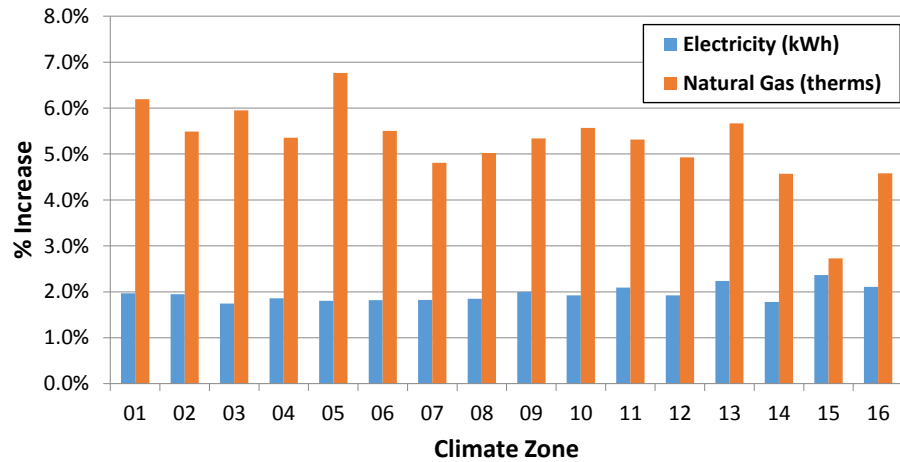
- Key assumptions and data sources
 - For ventilation:
 - Data from CBECC analysis
 - General assumptions from the ACM, including fan efficacy
 - Calculated and compared Q_{fan} values in all climate zones
 - Assumed 100% compliance
 - For MERV 11 filters:
 - Filters sized in accordance with 2013 standards
 - Airflow based on 800 ft² per ton, 400 cfm/ton
 - Filter static pressure loss from laboratory tests completed for Building America study and LBNL research
 - Assume regulated cfm variable speed fan motor
- Additional data needs
 - Energy impacts of HRVs given higher ventilation rates

Preliminary Energy Impacts - TDV

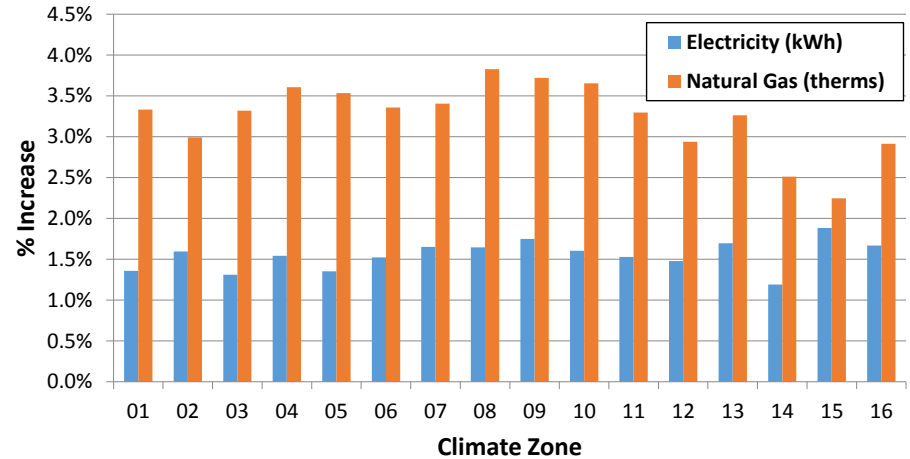


Preliminary Energy Impacts – Site Energy

Energy Impact of Regulated Loads - 2,100 ft²
Proposed Implementation of 2016 62.2 vs. 2010 62.2



Energy Impact of Regulated Loads - 2,700 ft²
Proposed Implementation of 2016 62.2 vs. 2010 62.2



Compliance and Enforcement- Market Actors

- Who would be involved in implementing these measures?
 - T24 Consultant / CEA
 - Builder
 - Manufacturers
 - Mechanical contractor
 - HERS Rater
 - Plans Examiner / Building Inspector
 - Building Owners
- Others?

Compliance and Enforcement—Tasks

Market Actor	Task(s)	Success Criteria
Title 24 Consultant	<ul style="list-style-type: none"> - Completes compliance documents - Ensure builder is aware requirements - Convey ventilation rate information (CF1R) 	<ul style="list-style-type: none"> - Correct fan(s) specified - HVI listed kitchen hood specified
Builder	<ul style="list-style-type: none"> - Provides specifications for ventilation fans, kitchen hood, filter to HVAC contractor - Provides ventilation system operating instructions and filter information to owner 	<ul style="list-style-type: none"> - Correct ventilation fans & hood procured - Information clearly & efficiently communicated - Owner fully informed
Mechanical Contractor	<ul style="list-style-type: none"> - Installs ventilation fans and controls - Installs properly vented kitchen hood - Supplies MERV 11 filter and properly sized filter grille and labeling 	<ul style="list-style-type: none"> - Correct equipment installed - Kitchen hood properly vented - Ventilation fans set to correct speed - Correctly sized filter & return air grille
Manufacturer/ Distributor	<ul style="list-style-type: none"> - Provides equipment meeting standards and specifications, installation information, and technical support 	<ul style="list-style-type: none"> - Correct products supplied, subcontractors well informed on installation practice

Compliance and Enforcement—Tasks

Market Actor	Task(s)	Success Criteria
Plans Examiner	<ul style="list-style-type: none"> - Verifies that CF-1R is consistent with building plans and meets compliance criteria 	<ul style="list-style-type: none"> - Minimize paperwork - Quick review and processing
Building Inspector	<ul style="list-style-type: none"> - Verifies that required HERS inspections listed on CF-1R have CF-2R and CF-3R paperwork - Verifies that CF forms are signed off and certified - Sign certificate of occupancy 	<ul style="list-style-type: none"> - Minimize paperwork - Quick review and processing
Mechanical Contractor	<ul style="list-style-type: none"> - Installs ventilation fans and controls - Installs properly vented kitchen hood - Supplies MERV 11 filter 	<ul style="list-style-type: none"> - Does this without needing additional training
HERS Rater	<ul style="list-style-type: none"> - Reviews CF-2Rs - Measures and verifies ventilation fan cfm - Verifies filter MERV and kitchen hood HVI label - Informs builder of deficiencies as needed 	<ul style="list-style-type: none"> - Minimal or no re-inspections

Compliance and Enforcement—Resources

Market Actor	Resource(s)
Title 24 Consultant	<ul style="list-style-type: none"> - CBECC-Res / EnergyPro compliance software - EnergyCodeAce tools - Title 24 Compliance manuals
Builder / General Contractor	<ul style="list-style-type: none"> - Building officials at jurisdiction - Title 24 Consultant - HERS Rater - Mechanical contractor
Mechanical Contractor and Other Subs	<ul style="list-style-type: none"> - EnergyCodeAce tools - Utility-sponsored training classes? - HERS Rater
HERS Rater	<ul style="list-style-type: none"> - EnergyCodeAce tools - CalCERTS / CHEERS Trainings - Utility-sponsored training classes?
Plans Examiner / Building Inspector	<ul style="list-style-type: none"> - EnergyCodeAce tools - CalCERTS / CHEERS Trainings - Utility-sponsored training classes?

Strawman Code Change Language

- Title 24 Standards
 - Update Sections 120.1(b) and 120.1(c) to reference ASHRAE 62.2-2016 for high-rise residential
 - Change the Table 120.1-A reference from CBC to ASHRAE 62.2 or reference appropriate parts of Section 150 for High Rise
 - Section 150(e): Add gas space heaters to scope, prohibit unvented fireplaces and space heaters unless they comply with Health & Safety Code Section 19881-19882
 - Section 150(m)12.B: Change MERV 6 to MERV 11
 - Section 150(o):
 - Add HVI labeling requirement for kitchen hoods;
 - Add language that describes California approach to ASHRAE 62.2 adoption (or reference specific California version)
- Joint Appendices
 - Update Glossary to reference ASHRAE 62.2-2016
 - Add new HERS protocol for verification of HVI kitchen hood label
- Alternative Compliance Method (ACM) Technical Manual
 - Add calculation method for Q_{total} , Q_{inf} , and Q_{fan} with provision to provide Q_{fan} as a CF-1R output

Feedback Request from Stakeholders

- *We would like your input ...*
 - Potential energy savings
 - Potential costs
- To respond:
 - Call or email CASE author
 - Email info@title24Stakeholders.com

Thank you.

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