CALIFORNIA ENERGY CODES & STANDARDS

A STATEWIDE UTILITY PROGRAM

Second Stakeholder Meeting for High Performance Attics

March 14, 2017

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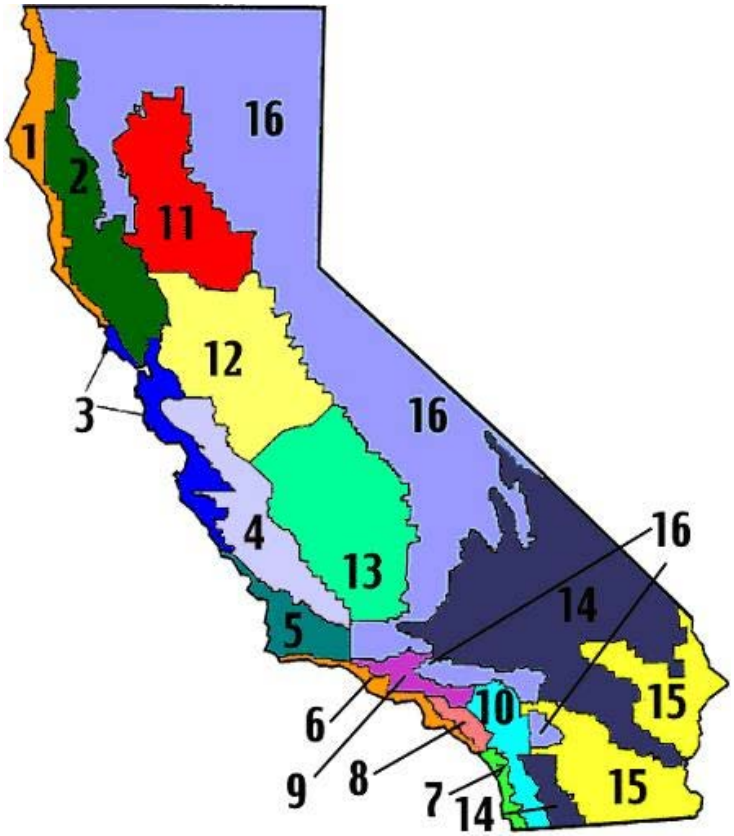
Agenda

1. Background
2. Proposed Code Changes
3. Technical and Market Barriers
4. Compliance and Enforcement
5. Cost Effectiveness and Energy Impacts
6. Next Steps

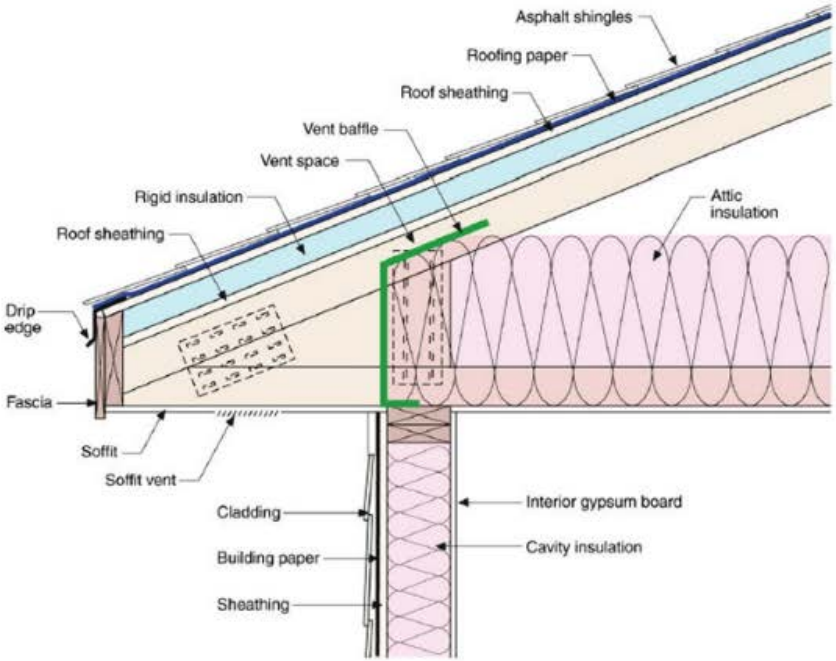


1. Background

Introduction to Building System

- High Performance Attic (HPA) = Insulation at roof deck OR ducts in conditioned space to reduce loads and increase duct system efficiency
  - Standard vented attic
  - Conventional ceiling and duct insulation levels
  - Duct leakage testing (<5%)
- Alternative high performance strategies
  - Unvented (semi-conditioned) sealed attics

Option A (Above Deck)



Option B (Below Deck)

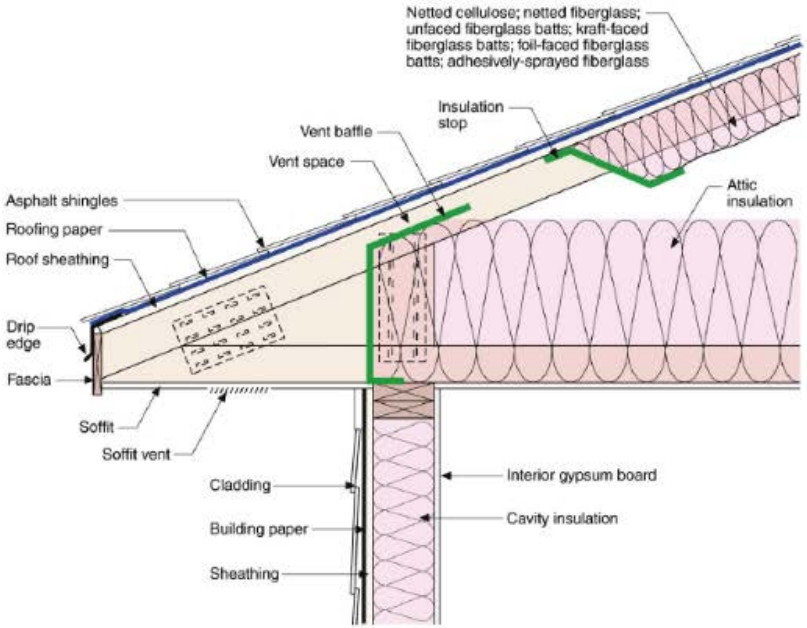
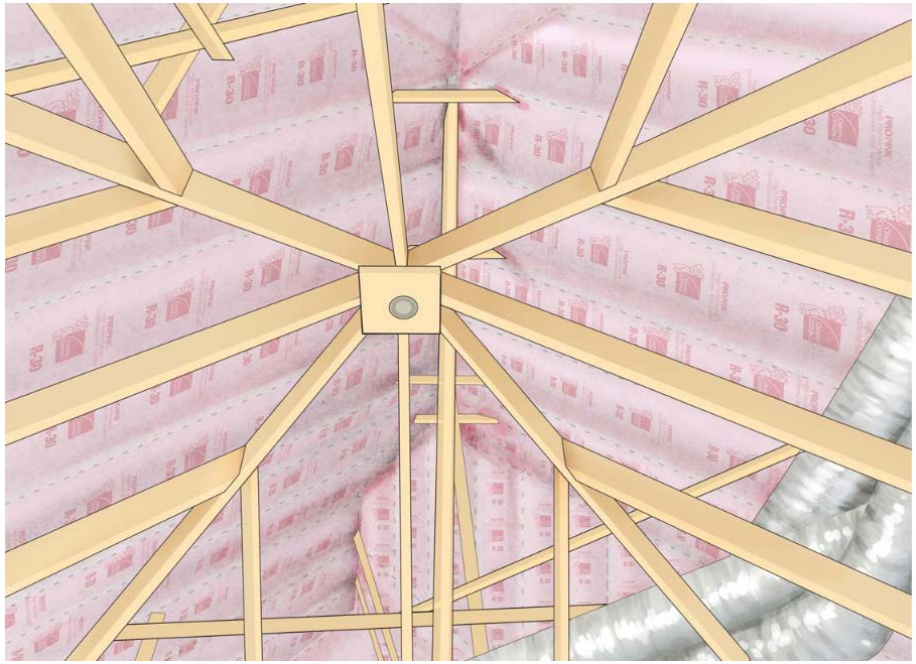


Figure 1: Venting Details for Modified Conventional Vented Attic

Source: Building Science Corporation

Alternative Options: Sealed Attics

Box netted strategy



Source: Owens Corning

Spray foam

Implementation to Date

- Incented under 2013 code cycle California Advanced Home Program
  - To support market transformation for 2016 code
  - ~ 10% of CAHP homes installed HPA or sealed attic*
- Limited uptake under 2016 code to date (first 1.5 months of code cycle)
- Solar PV Tradeoff in place for 2016 code cycle **ONLY**
  - Will sunset for 2019 code cycle

** Source: PG&E CAHP participants permitted under the 2013 Title 24 standards.*

Relevant Code History

- Existing prescriptive requirements in 2016 Title 24, Part 6
  - Option A (Above deck)
  - Option B (Below deck)
  - Option C (ducts in conditioned space)
  - Note: Not required in all climate zones

			Climate Zone									
			4	8	9	10	11	12	13	14	15	16
Option A (above deck)	**Roofing Type**	No Air Space	R8	R8	R8	R8	R8	R8	R8	R8	R8	R8
		With Air Space	R6	R6	R6	R6	R6	R6	R6	R6	R6	R6
Option B (below deck)	**Roofing Type**	No Air Space	R18	R18	R18	R18	R18	R18	R18	R18	R18	R18
		With Air Space	R13	R13	R13	R13	R13	R13	R13	R13	R13	R13

Other Relevant Codes/Requirements

- 2015 IECC
  - R-8 ducts, leakage < 4 cfm25 /100 ft^2
  - R-38 ceiling insulation
  - Low leakage air handler
- 2018 IECC
  - Buried duct provision
- DOE Zero Energy Ready Home
  - “Duct distribution systems located within the home’s thermal and air barrier boundary or optimized to achieve comparable performance”

2. Proposed Code Changes

Proposed Code Change

- High-level description of the proposed code change include:
  - Prescriptive measure where cost effective
  - From R-13 to R-19 underdeck batt (for roof “with air space”)
    - 1.4% TDV impact on a statewide basis
  - Revision to existing prescriptive requirement
  - Impacts low-rise residential buildings
    - Cost effective for single family in 7 climate zones
    - Cost effective for multi-family in 3 climate zones
  - Applies to additions > 700 ft^2

- *Draft language is provided in the resources section of Adobe Connect and on Title24Stakeholders.com.*

Proposed Code Change Details

Required for both SF and MF			Climate Zone									
Required for only SF			4	8	9	10	11	12	13	14	15	16
Option A (above deck)	**Roofing Type**	No Air Space	R8	R8	~~R8~~ R9	R8	~~R8~~ R9	~~R8~~ R9	~~R8~~ R9	~~R8~~ R9	~~R8~~ R9	~~R8~~ R9
		With Air Space	R6	R6	~~R6~~ R7	R6	~~R6~~ R7	~~R6~~ R7	~~R6~~ R7	~~R6~~ R7	~~R6~~ R7	~~R6~~ R7
Option B (below deck) Box Net	**Roofing Type**	No Air Space	R18	R18	~~R18~~ R22	R18	~~R18~~ R22	~~R18~~ R22	~~R18~~ R22	~~R18~~ R22	~~R18~~ R22	~~R18~~ R22
		With Air Space	R13	R13	~~R13~~ R16	R13	~~R13~~ R16	~~R13~~ R16	~~R13~~ R16	~~R13~~ R16	~~R13~~ R16	~~R13~~ R16
Option B (below deck) Batt	**Roofing Type**	No Air Space	R18	R18	~~R18~~ R27	R18	~~R18~~ R27	~~R18~~ R27	~~R18~~ R27	~~R18~~ R27	~~R18~~ R27	~~R18~~ R27
		With Air Space	R13	R13	~~R13~~ R19	R13	~~R13~~ R19	~~R13~~ R19	~~R13~~ R19	~~R13~~ R19	~~R13~~ R19	~~R13~~ R19

Why Are We Proposing This Code Change

- Support California ZNE and climate action goals
- Contributes to reduced PV sizing
- Advance HPA where cost-effective
- Leverage current market transformation activities related to 2016 code
- Prescriptive measures allow for builder flexibility

Feedback

3. Technical and Market Barriers

Technical and Market Barriers

- Builder comfort level with HPA
  - Which HPA approach?
  - Are there alternative compliance strategies?

- Resolution
  - Builder training (WISE)
  - TRC Master Builder program
  - CAHP
  - Energy Code ACE
  - Energy Commission research projects

WISE
Workforce Instructions for Standards and Efficiency

california advanced homes™

Energy Code Ace™
HELPING YOU PLAY YOUR CARDS RIGHT

Technical and Market Barriers

- Solar PV Tradeoff may slow HPA uptake
  - HPA is a new prescriptive requirement as of January 2017
  - Energy Commission states solar PV tradeoff will be gone for 2019 cycle

- Resolution
  - Market will be exploring options and moving towards HPA
  - Insulation industry and other resources supporting builders/contractors

Feedback

4. Compliance and Enforcement

Compliance Process

Design Phase

- What happens during design phase?
  - Builder/Energy consultant recommends measures & ensures team is aware of requirements
  - Architects/designers develop details for drawings
  - No change in practice if builder already doing HPA

Compliance Process

Permit Application Phase

- What happens in permit application phase?
  - Plans reviewer verifies drawings match Title-24, part 6 report

Compliance Process

Construction Phase

- What happens in construction phase?
  - Builder coordinates with subcontractors
  - HPA scheduling (Option A, B, C)
  - May need to account for additional installation time
  - Builder ensures that measure is implemented properly

Compliance Process

Inspection Phase

- What happens in permitting phase?
  - If QII applied, HERS rater inspects deck insulation
    - New protocols being drafted
  - Building inspector conducts final field inspections

Compliance and Enforcement Barriers

- Training
  - Many builders/installers not yet familiar or comfortable with HPA
  - Possible resolutions include
    - Continue market transformation efforts
    - Continued manufacturer engagement with industry
    - New HPA solutions become available

WISE
Workforce Instructions for Standards and Efficiency

Feedback

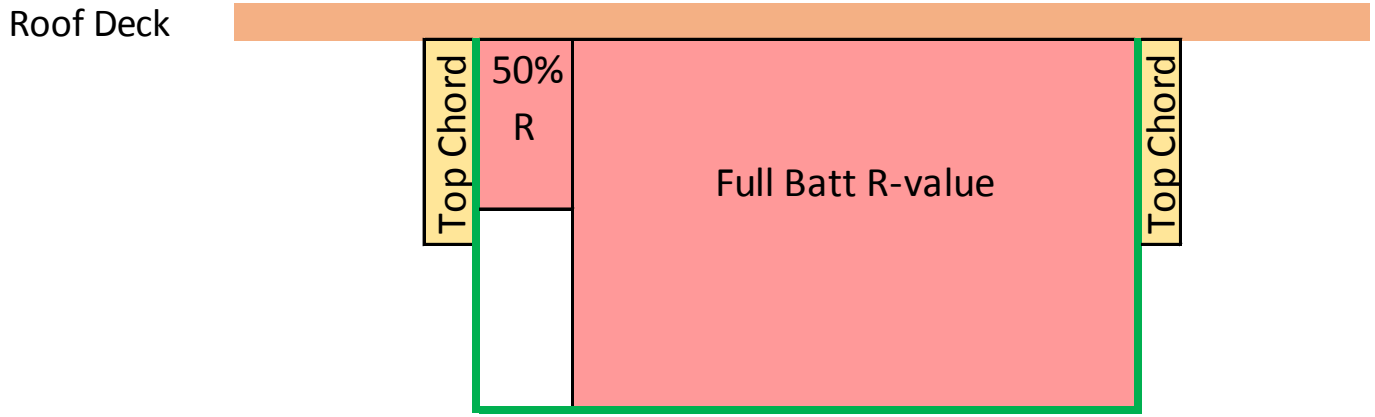
5. Cost Effectiveness and Energy Impacts

Definition of Baseline and Proposed Conditions

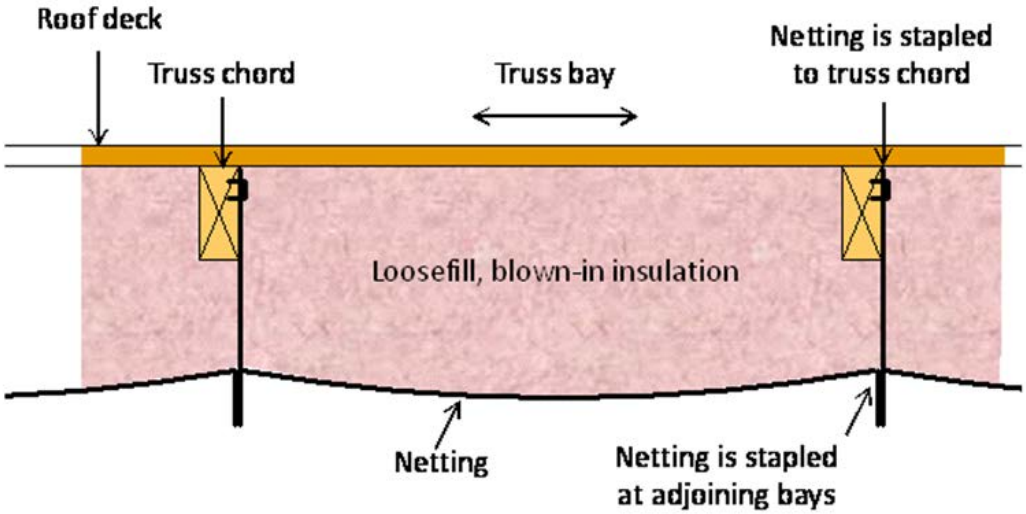
- **Baseline Conditions**
  - Minimally compliant with 2016 Standards
    - R-13 underdeck, (Option B, with air space)
  - 2,100 & 2700 ft^2 single family prototypes
    - Results for 2,430 ft^2 blended prototype
  - 6,960 ft^2, 8-unit multifamily prototype
  - 2019 TDV
  - Ventilation loads adjusted for 2016 ASHRAE 62.2 ventilation rates
  - All climates zones evaluated using CBECC-Res

- **Proposed Conditions**
  - All non-HPA assumptions consistent with baseline
  - R-19 underdeck (with air space)
  - Additional cases for other scenarios
    - Above deck
    - No air space

Interim Modeling Method- U-factor Equivalence



- Compliance software currently models only “box net” configuration
  - Software fix planned for later in 2017 allowing for batt
  - U-factor equivalence table in JA4 (Joint Appendices)



Cost Effectiveness Analysis – Incremental Costs

- Focus on lowest cost implementation option: Underdeck batt insulation
  - R-13 fills 2x4 underdeck top chord cavity
  - >R-13 extends beyond top chord framing
- PG&E Code Readiness project (real world costs)
  - Builder and insulation contractor had HPA experience (30 homes)
  - Installed R-19 on PG&E Code Readiness home completed Feb 2017
  - Incremental cost to builder \$.093/ft^2 roof deck area + 1 hr incremental labor/1050 ft^2
  - Materials: added insulation cost, added baling wire

- **Total Incremental Maintenance Cost = (\$0)** Single and Multi-family

- **Total Single-Family Incremental First Cost = \$283 (2,430 ft^2 blended prototype)**
- **Total Multi-Family Incremental First Cost = \$565 (8 unit prototype)**

Cost Effectiveness Analysis

Incremental Cost Savings (Benefits)

- Energy Cost Savings over 30-year period of analysis
  - **SF: Total Energy Cost Savings = range of $287 to $677, varies with climate zone**
  - **MF: Total Energy Cost Savings = range of $578 to $722, varies with climate zone**
  - *Energy cost savings explained in more detail in Appendix slides.*

- **Total Incremental Cost Savings (Benefit) over 30-year period of analysis = $17,620,700**

Single-Family Benefit-to-Cost Ratio: R-19 Batt, Option B, roofing w/air space

Climate Zone	Benefit to Cost
1	*n/a*
2	*n/a*
3	*n/a*
4	*0.86*
5	*n/a*
6	*n/a*
7	*n/a*
8	0.78
9	**1.02**
10	0.90
11	**1.56**
12	**1.62**
13	**1.80**
14	**1.41**
15	**2.39**
16	**1.04**

Equivalent Performance:

With air space:

- R-7 above deck
- R-16 box net below deck

Without air space:

- R-9 above deck
- R-22 box net below deck
- R-27 batt below deck

Option C: no change from 2016

Cost Effective in Seven Climate Zones

If Benefit-to-Cost Ratio is over 1, measure is cost effective.

Multi-Family Benefit-to-Cost Ratio: R-19 Batt, Option B, roofing w/air space

Climate Zone	Benefit to Cost
1	*n/a*
2	*n/a*
3	*n/a*
4	*0.43*
5	*n/a*
6	*n/a*
7	*n/a*
8	*0.66*
9	*n/a*
10	*0.51*
11	**1.02**
12	*0.81*
13	**1.24**
14	*0.83*
15	**1.28**
16	*0.60*

Equivalent Performance:

With air space:

- R-7 above deck
- R-16 box net below deck

Without air space:

- R-9 above deck
- R-22 box net below deck
- R-28 batt below deck

Option C: no change from 2016

Cost Effective in Three Climate Zones

If Benefit-to-Cost Ratio is over 1, measure is cost effective.

6. Next Steps

Next Steps

- Please send any additional feedback to:
  - CASE Author (see contact info at end of this presentation)
  - Info@title24stakeholders.com

- Keep an eye on Title24Stakeholders.com for:
  - Presentations from today's meeting
  - Draft Code Change Language
  - Notes from today's meeting
  - Draft CASE Report (will be posted in April)

Thank you.

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Appendix

References

- Title24Stakeholders.com
- EnergyCodeAce.com
  - See Reference Ace for 2016 Standards, Appendices, and Compliance Manuals
- California Energy Commission 2019 Standards Webpage
- Draft language is provided in the resources section of Adobe Connect and on Title24Stakeholders.com.

Annual Energy Savings Per Dwelling Unit (2,430 ft^2 Single Family)

Climate Zone	TDV Energy Savings (TDV kBtu/yr)	30 Year TDV Energy Cost Savings ($2020)
1	n/a	n/a
2	n/a	n/a
3	n/a	n/a
4	n/a	n/a
5	n/a	n/a
6	n/a	n/a
7	n/a	n/a
8	n/a	n/a
9	1,710	$287
10	n/a	n/a
11	2,722	$440
12	2,664	$457
13	2,997	$508
14	2,377	$400
15	4,013	$677
16	1,737	$293

Annual Energy Savings Per 8 Unit Multi-family Prototype (6,960 ft^2)

Climate Zone	TDV Energy Savings (TDV kBtu/yr)	30 Year TDV Energy Cost Savings ($2020)
1	n/a	n/a
2	n/a	n/a
3	n/a	n/a
4	n/a	n/a
5	n/a	n/a
6	n/a	n/a
7	n/a	n/a
8	n/a	n/a
9	n/a	n/a
10	n/a	n/a
11	3,341	$578
12	n/a	n/a
13	4,037	$698
14	n/a	n/a
15	4,176	$722
16	n/a	n/a

Annual Energy Savings Per Dwelling Unit (2,430 ft^2 Single Family)

Climate Zone	Annual Electricity Savings (kWh/yr)	Annual Natural Gas Savings (therms/yr)	Peak Electric Demand Reduction (kW)
1	n/a	n/a	n/a
2	n/a	n/a	n/a
3	n/a	n/a	n/a
4	n/a	n/a	n/a
5	n/a	n/a	n/a
6	n/a	n/a	n/a
7	n/a	n/a	n/a
8	n/a	n/a	n/a
9	18	1	0.04
10	n/a	n/a	n/a
11	35	3	0.04
12	16	3	0.04
13	43	3	0.04
14	31	3	0.03
15	85	0	0.07
16	10	6	0.01

Annual Energy Savings Per 8 Unit Multi-family Prototype (6,960 ft^2)

Climate Zone	Annual Electricity Savings (kWh/yr)	Annual Natural Gas Savings (therms/yr)	Peak Electric Demand Reduction (kW)
1	n/a	n/a	n/a
2	n/a	n/a	n/a
3	n/a	n/a	n/a
4	n/a	n/a	n/a
5	n/a	n/a	n/a
6	n/a	n/a	n/a
7	n/a	n/a	n/a
8	n/a	n/a	n/a
9	46	1	0.05
10	n/a	n/a	n/a
11	54	3	0.04
12	40	3	0.04
13	69	3	0.06
14	45	3	0.04
15	106	0	0.06
16	24	5	0.02