2013 Building Energy Efficiency Standards Staff Workshop

Residential Windows

May 31, 2011

Background

- Proposal sponsored by the California Statewide Utilities Codes and Standards Program as a Codes and Standards Enhancement (CASE) study

- CASE study authors
  - Ryan Schmidt, Heschong Mahone Group, Inc.
  - Ken Nittler, Enercomp, Inc.

Residential Windows

- Context
- Data collection
- Typical practice
- Analysis
- Code Change

Current Title 24 Requirements

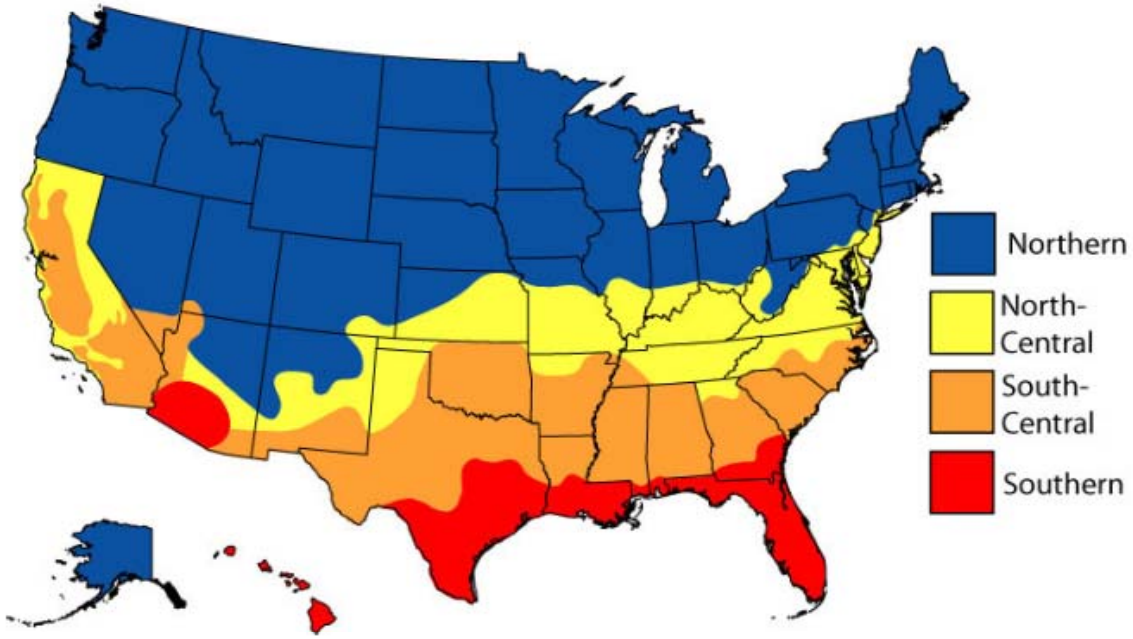
Standards Table 151-C, Component Package D (prescriptive)

- U-factor, all climate zones
  - 0.40
- SHGC
  - 0.35 in climate zone 15; 0.40 otherwise
  - No requirement (NR) in climate zones 1, 3, 16

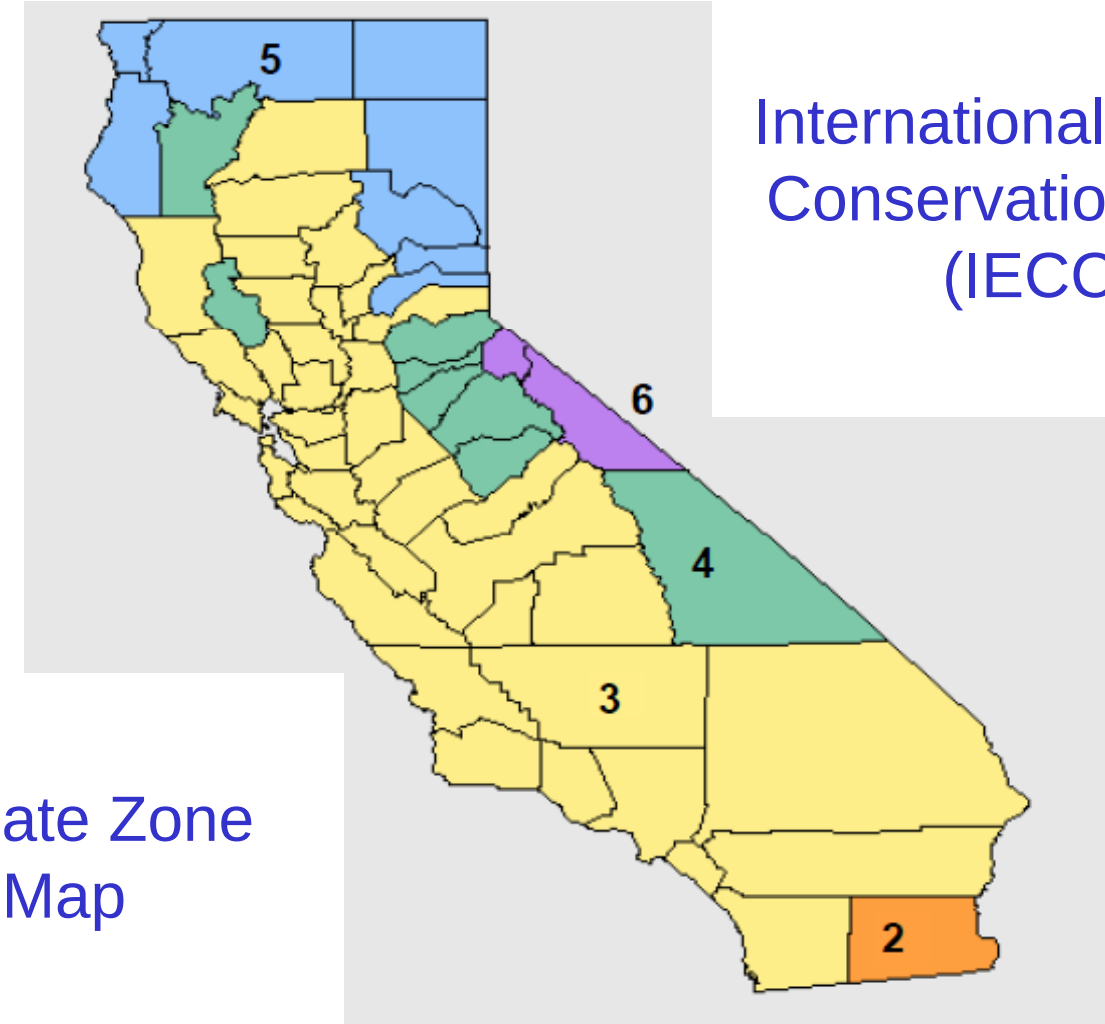
Related Codes / Standards

- Federal tax credits for consumer energy efficiency (nationwide)
  - 2010
    - U-factor = 0.30
    - SHGC = 0.30
  - 2011
    - Energy Star performance levels

- Energy Star Climate Zone Map



- **North Central** region: U-factor = 0.32, SHGC = 0.40
- **South Central** region: U-factor = 0.35, SHGC = 0.30



International Energy Conservation Code (IECC)

Climate Zone Map

- International Energy Conservation Code (IECC) 2012

	Climate Zone				
	2	**3**	4	5, Marine 4	6
U-factor	0.40	**0.35**	0.35	0.32	0.32
SHGC	0.25	**0.25**	0.40	NR	NR

Code Change Scope

- Update window prescriptive performance requirements
  - U-factor
  - SHGC
- Update window mandatory minimums

Data Collection

- Market research process
  - Supplier phone / online surveys
    - Window manufacturers
    - Window dealers / distributors
  - Retail site visits
    - Window showrooms
    - Home improvement stores
  - Compliance research calls / survey
    - Energy consultants
    - Building departments

Typical Window Practice

- Installed type
  - Vinyl frame
  - Double-pane, air or argon-filled, low-e glass
- Installed performance
  - Better than current Title 24 prescriptive requirements
    - U-factor: 0.30 – 0.35
    - Solar Heat Gain Coefficient (SHGC): 0.23 – 0.35
- Incremental costs
  - Minimal across typical SHGC values

Analysis – Goals/Parameters

- High statewide TDV savings (optimized energy / demand savings)
- High NPV (optimized cost-effectiveness)
- Minimized impact on heating TDV increases
- Consistency of requirements across climate zones
- Achievable performance values across typical window operator types

Analysis

- Building simulations
  - CALRES 2013: parametric simulation analysis to estimate new construction savings

    (alteration, addition, and retrofit savings TBD)
- Cost-effectiveness, by climate zone
  - Statewide TDV savings impacts, weighted by construction starts by climate zone
  - 30-year life cycle costs, $ NPV

Simulated Prototype Buildings

- Residential ACM Prototypes D and E
  - 2700 sf, 2-story (detached single-family)
  - 6960 sf, 2-story (8-unit multi-family)

- Equal glazing distribution on four orientations
  - Per standard design in Title 24

Measure Life Cycle Cost Comparison

	Description
Base	U-factor 0.40 SHGC per Package D (No overhang)
Proposed	ELSLE in CZ 2, 4, 6-16 (U-factor 0.32, SHGC 0.25) HSLE in CZ1,3,5 (U-factor 0.32, SHGC 0.50)

Single Family Results Summary

TDV and Net Present Value for 2700 ft2, Two Story, Single-Family Prototype										
	Proposed Design	Difference (Proposed - Standard)			Percent Difference (Proposed - Standard / Standard)			Net Present Value		
Climate Zone	Window Spec	Heating kTDV/ft2	Cooling kTDV/ft2	Total kTDV/ft2	Heating	Cooling	Total	Savings $	Cost $	NPV $
01	HSLE	-2.6	0.0	-2.6	-8%	0%	-5%	$1,216	($383)	$832
02	ELSLE	1.4	-5.9	-4.5	5%	-47%	-8%	$2,090	($383)	$1,707
03	HSLE	-1.4	-0.7	-2.1	-8%	-16%	-5%	$982	($383)	$599
04	ELSLE	1.6	-9.4	-7.8	8%	-46%	-13%	$3,624	($383)	$3,241
05	HSLE	-5.8	0.4	-5.4	-28%	0%	-14%	$2,525	($383)	$2,142
06	ELSLE	1.5	-8.3	-6.8	19%	-45%	-16%	$3,184	($383)	$2,801
07	ELSLE	1.0	-6.3	-5.3	46%	-42%	-16%	$2,488	($383)	$2,104
08	ELSLE	1.1	-10.0	-8.9	19%	-32%	-17%	$4,162	($383)	$3,778
09	ELSLE	1.2	-12.9	-11.8	13%	-25%	-15%	$5,494	($383)	$5,111
10	ELSLE	1.3	-13.9	-12.7	13%	-25%	-15%	$5,920	($383)	$5,537
11	ELSLE	1.0	-18.9	-17.9	5%	-22%	-14%	$8,380	($383)	$7,996
12	ELSLE	0.8	-13.4	-12.6	4%	-28%	-14%	$5,887	($383)	$5,504
13	ELSLE	0.5	-19.1	-18.6	3%	-22%	-15%	$8,698	($383)	$8,314
14	ELSLE	1.9	-15.3	-13.5	9%	-20%	-12%	$6,294	($383)	$5,911
15	ELSLE	0.0	-14.1	-14.1	-2%	-10%	-9%	$6,607	($383)	$6,224
16	ELSLE	6.7	-20.5	-13.9	15%	-65%	-15%	$6,486	($383)	$6,102
Statewide		**0.9**	**-11.0**	**-10.0**	**12%**	**n/a**	**-14.1%**	**$4,690**	**($383)**	**$4,307**
Average		0.6	-10.5	-9.9	7%	-32%	-13%	$4,627	($383)	$4,244
Min		-5.8	-20.5	-18.6	-28%	-65%	-17%	$982	($383)	$599
Max		6.7	0.4	-2.1	46%	-10%	-5%	$8,698	($383)	$8,314

Multi-Family Results Summary

TDV and Net Present Value for 6960 ft2, Two Story, 8-Unit Multi-Family Prototype										
	Proposed Design	Difference (Proposed - Standard)			Percent Difference (Proposed - Standard / Standard)			Net Present Value		
Climate Zone	Window Spec	Heating kTDV/ft2	Cooling kTDV/ft2	Total kTDV/ft2	Heating	Cooling	Total	Savings $	Cost $	NPV $
01	HSLE	-1.8	0.0	-1.8	-11%	0%	-3%	$2,170	($741)	$1,428
02	ELSLE	0.6	-5.9	-5.4	4%	-34%	-8%	$6,461	($741)	$5,720
03	HSLE	-1.0	-0.6	-1.6	-13%	-9%	-3%	$1,880	($741)	$1,139
04	ELSLE	0.6	-7.9	-7.3	7%	-28%	-10%	$8,751	($741)	$8,010
05	HSLE	-3.0	1.7	-1.3	-37%	271%	-3%	$1,507	($741)	$765
06	ELSLE	0.3	-6.9	-6.6	20%	-25%	-11%	$7,980	($741)	$7,238
07	ELSLE	0.0	-5.9	-5.8	100%	-26%	-10%	$7,039	($741)	$6,298
08	ELSLE	0.2	-7.4	-7.3	16%	-19%	-10%	$8,739	($741)	$7,998
09	ELSLE	0.3	-9.4	-9.1	14%	-15%	-9%	$10,921	($741)	$10,180
10	ELSLE	0.4	-9.6	-9.2	14%	-16%	-9%	$11,065	($741)	$10,324
11	ELSLE	0.2	-11.5	-11.3	2%	-13%	-9%	$13,609	($741)	$12,868
12	ELSLE	0.1	-9.7	-9.6	1%	-18%	-10%	$11,608	($741)	$10,867
13	ELSLE	0.0	-11.1	-11.1	0%	-13%	-9%	$13,428	($741)	$12,687
14	ELSLE	0.9	-10.8	-9.9	9%	-14%	-8%	$11,982	($741)	$11,240
15	ELSLE	0.0	-9.7	-9.7	0%	-7%	-5%	$11,644	($741)	$10,903
16	ELSLE	3.7	-16.7	-13.0	13%	-48%	-13%	$15,622	($741)	$14,881
Statewide		**0.2**	**-8.0**	**-7.8**	**n/a**	**n/a**	**-9.1%**	**$9,427**	**($741)**	**$8,686**
Average		0.1	-7.6	-7.5	9%	-1%	-8%	$9,025	($741)	$8,284
Min		-3.0	-16.7	-13.0	-37%	-48%	-13%	$1,507	($741)	$765
Max		3.7	1.7	-1.3	100%	271%	-3%	$15,622	($741)	$14,881

Proposed Prescriptive window requirements

- Package D
  - Climate Zones 2, 4, 6-16: U-factor = 0.32, SHGC = 0.25
  - Climate Zones 1, 3, 5: U-factor = 0.32, SHGC = NR
- Package C
  - Update once 2013 Package D components are finalized
- Package E
  - Remove from Standards

- Code language revisions to Package D (Table 151-C)

(Package D)	CLIMATE ZONE															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Maximum U-factor	~~0.40~~ 0.32	~~0.40~~ 0.32	~~0.40~~ 0.32	~~0.40~~ 0.32	~~0.40~~ 0.32	~~0.40~~ 0.32	~~0.40~~ 0.32	~~0.40~~ 0.32	~~0.40~~ 0.32	~~0.40~~ 0.32	~~0.40~~ 0.32	~~0.40~~ 0.32	~~0.40~~ 0.32	~~0.40~~ 0.32	~~0.40~~ 0.32	~~0.40~~ 0.32
Maximum SHGC	NR	~~0.40~~ 0.25	NR	~~0.40~~ 0.25	~~0.40~~ NR	~~0.40~~ 0.25	~~0.40~~ 0.25	~~0.40~~ 0.25	~~0.40~~ 0.25	~~0.40~~ 0.25	~~0.40~~ 0.25	~~0.40~~ 0.25	~~0.40~~ 0.25	~~0.40~~ 0.25	~~0.35~~ 0.25	~~NR~~ 0.25

Revised Mandatory Minimum in Section 150

(q) Fenestration Products separating conditioned space from unconditioned space shall meet the requirements of either Item 1 or 2 below:

1. Fenestration maximum U-factor of 0.57.

2. The weighted average U-factor of all fenestration products shall not exceed the U-factor that would result from installing 0.57 U-factor fenestration products throughout the conditioned space of the building.

EXCEPTION to Section 150(q)1: Up to eight square feet of fenestration area.

2013 Standards Update

Send related comments by June 30, 2011 to:

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