

CODES AND STANDARDS ENHANCEMENT INITIATIVE (CASE)

Results Report – Residential High Performance Walls

Measure Number: 2016-RES-ENV2-F

Residential Envelope

2016 CALIFORNIA BUILDING ENERGY EFFICIENCY STANDARDS

California Utilities Statewide Codes and Standards Team

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1. PREFACE

The Codes and Standards Enhancement (CASE) initiative presents recommendations to support California Energy Commission’s (CEC) efforts to update California’s Building Energy Efficiency Standards (Title 24) to include new requirements or to upgrade existing requirements for various technologies. The four California Investor Owned Utilities (IOUs) – Pacific Gas and Electric Company (PG&E), San Diego Gas and Electric (SDG&E), Southern California Edison (SCE) and Southern California Gas Company (SoCalGas) – and Los Angeles Department of Water and Power (LADWP) sponsored this effort. The program goal is to prepare and submit proposals that will result in cost-effective enhancements to energy efficiency in buildings. This report and the code change proposal presented herein is a part of the effort to develop technical and cost-effectiveness information for proposed regulations on building energy efficient design practices and technologies. The code change proposals presented in this report are now included in the 2016 Building Energy Efficiency Standards.

2. EXECUTIVE SUMMARY

2.1 Measure Description

The residential high performance walls measure increases the performance of the residential envelope, reducing the amount of heat transfer through exterior walls and thus reducing heating, ventilation, and air conditioning (HVAC) loads. The Statewide CASE Team proposed changing the standards to lower prescriptive wall U-factor requirements via increased insulation and increased stud size.

This proposal results in modifications to Section 150.1(c)1 and Table 150.1-A of the Title 24 Building Energy Efficiency Standards. CEC adopted the 2016 Standards and Reference Appendices on June 10, 2015.

The compliance manuals and compliance forms will be updated to reflect the changes to the standards. This change also requires changes to the Alternative Calculation Manual (ACM) Reference Manuals and the compliance software.

2.2 Summary of Revisions that Occurred during CEC Pre-rulemaking and Rulemaking

The Statewide CASE Team solicited feedback from a variety of stakeholders when developing the version of the CASE Report that CEC used as a “document relied upon” in their rulemaking package (see Appendix A). In addition to personal outreach to individual key stakeholders, the Statewide CASE Team conducted a public stakeholder meeting to discuss the proposal on May 8, 2014. Feedback that stakeholders provided during the utility-sponsored stakeholder meeting is summarized in Section 2.4 of the report presented in Appendix A.

2.3 Energy Savings

The first year statewide savings impact of the adopted standard are 6.4 gigawatt-hours and 1.7 MMtherms per year of energy, and 8.4 megawatts of electrical demand. The methodology used to estimate energy savings is described in detail in Section 5.

Table 1: First year statewide energy impacts estimate

Measure	First Year Statewide Savings			First Year TDV Savings
	Electricity Savings (GWh)	Power Demand Reduction (MW)	Natural Gas Savings (MMtherms)	TDV Electricity and Natural Gas Savings (Million kBtu)
High Performance Walls	6.4	8.4	1.7	654

3. EVOLUTION OF REQUIREMENTS

The Statewide CASE Team solicited feedback from a variety of stakeholders when developing the version of the CASE Report that is presented in Appendix A. In addition to personal outreach to individual key stakeholders, the Statewide CASE Team conducted a public stakeholder meeting to discuss the proposal on May 8, 2014. Section 2.4 of the report presented in Appendix A summarizes issues that were addressed between the time the Statewide CASE Team commenced work on the project and the time the CASE Report was submitted to CEC. See Appendix B for a list of comments that are relevant to this measure that were submitted to CEC throughout the pre-rulemaking and rulemaking processes.

There were very few changes to the measure in the period between the most recent version of the CASE Report that was submitted to CEC and the adopted standard. The majority of changes occurred during pre-rulemaking, and while that is not the focus of this section, the changes are described briefly below.

3.1 Pre-rulemaking Changes

In the CASE Report submitted to CEC in September 2014, the CASE Team proposes an exterior wall U-factor of U-0.046 in all climate zones, and mandatory HERS verification of Quality Insulation Installation (QII) for projects that install batt, blanket, or loose-fill insulation. The U-0.046 proposal appears in CEC's initial draft language (prior to the 45-Day language). The latest docketed CASE Report and the adopted standards exclude the QII proposal, and increase the U-factor to U-0.051 in climate zones 1-5 and 8-16, and U-0.065 in climate zones 6 and 7, which make the standard less stringent (a U-factor of U-0.051 was not cost-effective in climate zones 6 and 7).

These changes occurred primarily as a result of several discussions between CEC, the Statewide CASE Team, and the California Building Industry Association (CBIA) in November and December of 2014 and January of 2015. The discussions concerned feasibility and cost assumptions through spreadsheet analysis, and were conducted in-person and over email.

4. ADOPTED STANDARDS

The adopted 15-Day Language and Reference Appendices are presented in the following sections. Additions released in the 45-Day Language Express Terms are underlined and deletions are struck with lines. Revisions included in the 15-Day Language are in red font and are double underlined if the language was added or struck with double lines if the language was deleted.

4.1 Building Energy Efficiency Standards Code Language

4.1.1 Section 150.1(c)1B

- B. ~~=Walls (including heated basements and crawl spaces) insulation shall be installed that has a shall be insulated such that the opaque wall has an assembly U-factor equal to or less than shown in Table 150.1-A, or walls shall be insulated between wood framing with an- R-value equal to or greater than shown in TABLE 150.1-A. shall be installed. The maximum U-factors shown are maximum U-factors for the opaque wall assembly. Alternatively, for mass walls above grade and for below grade walls with insulation installed on the interior, the or minimum opaque wall R-values shown are for the minimum R-values for insulation installed between wood-framing members; and for below grade walls with exterior insulation, the R-values shown are the minimum R-values for continuous insulation.~~
- A. C. ~~-Above grade mass walls and below grade walls shall have insulation installed resulting in a wall assembly U-factor equal to or less than shown in TABLE 150.1-A.~~

~~Walls less than a 2x6 framed wall shall meet the equivalent U-factor indicated in TABLE 150.1-A.~~

~~Walls greater than or equal to a 2x6 framed wall shall meet the equivalent U-factor indicated in TABLE 150.1-A.~~

4.2 Reference Appendices Code Language

The Statewide CASE Team did not propose changes to the Reference Appendices for the high performance walls standards.

4.3 Compliance Manual

In April of 2015, the Statewide CASE Team provided CEC with proposed revisions to the Residential Compliance Manual to describe how to comply with the code change outlined in this CASE Report. The revisions that the Statewide CASE Team provided served as the first draft of CEC's revisions to the Compliance Manual. At the time of writing CEC has released a version of the Compliance Manual for public review. The Compliance Manuals are scheduled to be approved during the November 2015 CEC Business Meeting. The Statewide CASE Team recommended revisions to the following sections of the Compliance Manual:

- Chapter 3 – Section 3.6.2.2 Walls
- Chapter 3 – Section 3.6.3.4 Advanced Assembly Systems

5. FINAL COST-EFFECTIVENESS RESULTS

5.1 Energy Savings Estimates

Energy savings were calculated by modeling single family residential prototype buildings with the increased wall U-factor, and measuring energy savings as compared with the prototypes compliant with the 2013 prescriptive requirements. The energy savings methodology and results are described further in Section 4 and Section 5, respectively, of the CASE Report presented in Appendix A. The methodology has not changed since docketing the CASE Report in February of 2015.

Table 2: Estimated first year energy savings by climate zone

Climate Zone	Per Unit First Year Savings ²			
	Electricity Savings ⁴ (kWh/yr)	Demand Savings (kW)	Natural Gas Savings (Therms/yr)	Total TDV Savings ⁵ (kBtu)
Climate Zone 1	31	0.00	36	6,636
Climate Zone 2	27	0.01	22	5,167
Climate Zone 3	17	0.00	18	3,707
Climate Zone 4	28	0.03	19	4,747
Climate Zone 5	16	0.00	19	3,571
Climate Zone 6	13	0.02	10	2,576
Climate Zone 7	7	0.01	5	1,439
Climate Zone 8	23	0.05	8	3,056
Climate Zone 9	43	0.09	11	4,927
Climate Zone 10	55	0.09	12	5,331
Climate Zone 11	101	0.11	22	9,313
Climate Zone 12	60	0.09	22	7,753
Climate Zone 13	107	0.14	20	9,437
Climate Zone 14	95	0.12	23	8,846
Climate Zone 15	234	0.19	4	9,913
Climate Zone 16	43	0.03	42	8,809

Statewide impacts from the adopted measure are presented in Table 3.

Table 3: Statewide estimated first year energy savings

Measure	First Year Statewide Savings			First Year TDV Savings
	Electricity Savings (GWh)	Power Demand Reduction (MW)	Natural Gas Savings (MMtherms)	TDV Electricity and Natural Gas Savings (Million kBtu)
High Performance Walls	6.4	8.4	1.7	654

5.2 Final Cost-effectiveness Estimates

As shown Table 4, the code change is cost-effective in all climate zones except climate zones 6 and 7. The cost-effectiveness estimates have not changed since submitting the CASE Report to CEC in February of 2015. The latest version of the CASE Report is included, in its entirety in Appendix A of this report.

Table 4: Cost-effectiveness summary for U-0.051¹

Climate Zone	Benefit: TDV Energy Cost Savings + Other Cost Savings ² (2016 PV\$)	Cost: Total Incremental Cost ³ (2016 PV\$)	Change in Lifecycle Cost ⁴ (2016 PV\$)	Benefit-to-Cost Ratio ⁵
Climate Zone 1	1,148	517	(631)	2.2
Climate Zone 2	894	517	(377)	1.7
Climate Zone 3	641	517	(124)	1.2
Climate Zone 4	821	517	(304)	1.6
Climate Zone 5	618	517	(101)	1.2
Climate Zone 6	446	517	71	0.9
Climate Zone 7	249	517	268	0.5
Climate Zone 8	529	517	(12)	1.0
Climate Zone 9	852	517	(335)	1.6
Climate Zone 10	922	517	(405)	1.8
Climate Zone 11	1,611	517	(1,094)	3.1
Climate Zone 12	1,341	517	(824)	2.6
Climate Zone 13	1,633	517	(1,116)	3.2
Climate Zone 14	1,530	517	(1,013)	3.0
Climate Zone 15	1,715	517	(1,198)	3.3
Climate Zone 16	1,524	517	(1,007)	2.9

1. Relative to existing conditions. All cost values presented in 2017 dollars.
2. Present value of TDV cost savings equals TDV electricity savings plus TDV natural gas savings; $\Delta TDV\$ = \Delta TDV\$\text{E} + \Delta TDV\$\text{G}$.
3. Total incremental cost equals incremental construction cost (post adoption) plus present value of incremental maintenance cost; $\Delta C = \Delta C_{I_{PA}} + \Delta CM$.
4. Negative values indicate the measure is cost-effective. Change in lifecycle cost equals cost premium minus TDV energy cost savings; $\Delta LCC = \Delta C - \Delta TDV\$$
5. The Benefit-to-Cost Ratio is the TDV energy costs savings divided by the total incremental costs; $B/C = \Delta TDV\$ \div \Delta C$. The measure is cost-effective if the B/C ratio is greater than 1.0.

6. ACKNOWLEDGMENTS

The Pacific Gas and Electric Company, Southern California Edison, Southern California Gas Company, San Diego Gas and Electric Company and Los Angeles Department of Water and Power sponsored this report as part of the CASE (Codes and Standards Enhancement) project for the 2016 Building Energy Efficiency Standards. Stuart Tartaglia of PG&E was the project manager for the 2016 Building Standards Advocacy Project on behalf of the utility team. Patrick Eilert is the program manager for the PG&E's CASE program; Stu Tartaglia, Marshall Hunt (PG&E) and Jon McHugh (McHugh Energy) supported this measure on behalf of PG&E. Randall Higa and Ishtiaq Chisti were the CASE program manager for the SCE; Bach Tsan, supported this measure on behalf of SCE. Sue Kristjansson, Martha Garcia, Dipo Olatunji and Phil Pratt were SoCalGas's CASE program managers; Lovell Willmore supported this measure on behalf of SoCalGas. Chip Fox was SDG&E's CASE program manager; Adrian Salas and John Barbour supported this measure on behalf of SDG&E. Jim Kemper was the CASE program manager on behalf of the LADWP.

Energy Solutions is the prime contractors and provided coordination for all CASE Reports. Farhad Farahmand and Joshua Rasin of TRC performed the analysis and reporting presented here. TRC and Energy Solutions provided technical and editorial review. Catherine Chappell provided technical oversight on this topic and coordination for all TRC CASE topics.

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APPENDIX A: DOCKETED VERSION OF CASE REPORT

APPENDIX B: DOCKETED COMMENTS LOG

CEC administered a public pre-rulemaking and rulemaking process to update the Title 24 Standards. The table below lists comments that were submitted to CEC through the pre-rulemaking and rulemaking process that are pertinent to this measure. The version of the CASE Report that is presented in Appendix A was developed taking comments that were submitted to CEC in response to the Scoping Workshops held April – August 2014 into account. See Section 3 of this report for a discussion of issues that stakeholders raised in comments that were submitted to CEC after the Statewide CASE Team submitted the CASE Report to CEC (comments submitted in response to the November 3, 2014 Scoping Workshop, the 45-Day Language, and the 15-Day Language).

Comment Letter #	Comment Letter ID	Link
Comments Submitted to CEC in Response to 45-Day Language and 45-day Hearings Held March 2-3, 2015		
1	Lowe Southwest (3)	Lowe Southwest Distribution-Charlie Snowden on Multiple Comments re 45-Day Response 2015-03-30 TN-75535.pdf