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Cellulose Insulation Manufacturers Association

California Energy Commission
Attn: Docket No. 12-BSTD-1
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Subject: Docket 12-BSTD-1

The Cellulose Insulation Manufacturers Association, a trade association representing 21 manufacturers of cellulose building insulation throughout the United States, submits the following comments on Title 24 Proposed Building Energy Efficiency Standards.

The concerns of CIMA and its members focus on proposed revisions to table 150.1A that increases the prescriptive requirement for wood frame cavity wall insulation from R13 to R15+4ci in California Climate Zones (CCZ) 2-10 and from R19 to R21+4ci in CCZ 1 and 11-16.

This change would eliminate many types of cost-effective, energy-efficient cavity insulations including standard density fiberglass, open-cell spray foams, and cellulose and other natural fiber insulations, such as cotton and wool, in wood-framed walls in many California climate zones. To achieve these modest increases in cavity R-value, the density of fibrous and open-cell spray polyurethane foam insulations must significantly increase, or closed-cell spray foam products must be used. This will not only significantly increase the cost to home owners, but may have the unintended consequence of restricting use of insulation materials that offer significant environmental benefits, such as high recycled content and/or low embodied energy.

Studies have shown that the proposed cavity R-value increases will have negligible effect on the overall energy usage of a building. The Spray Polyurethane Foam Institute has supplied the Commission with an authoritative analysis demonstrating that the payback period for the additional cost associated with the proposed R-values is at least 36 years in one of California's colder climates and could approach 100 years in some climate zones. When the fact that the proposed prescriptive requirements could restrict use of insulation with much less embodied energy and much higher recycled content is added to the assessment, the proposed changes do not appear to be a wise choice for California.

(Continued)

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CIMA does not believe it is necessary to restate information already presented by other commenters, we do, however, want to call the Commission's attention to an analysis commissioned by CIMA in 2005 when prescriptive requirements for R15 and R21 of cavity insulation were first proposed as changes to the International Energy Conservation Code. This analysis focused solely on the effect of an additional R2 of cavity insulation in walls. CIMA specified that the assessment be based on the highest reasonably anticipated marginal energy savings and the lowest reasonably anticipated incremental costs. A total of 20 cities in US climate zones 3 through 6 were assessed. Even under the very conservative constraints imposed on this analysis, predicted cost recovery periods ranged from 19 years to 70 years. This is consistent with the data reported by SPFI for cities in various climate zones within California. A copy of this study is included with this letter.

We urge the Commission to consider all the factors that affect the energy-efficiency and environmental impacts of insulation materials before imposing prescriptive requirements that may actually result in greater global energy consumption and have negative environmental impacts.

The Cellulose Insulation Manufacturers Association

By Daniel Lea
Secretary and Executive Director

Executive Summary

Economic Analysis of Proposed Wood-Frame Wall Cavity R-Value Increases

An analysis of the expected energy savings resulting from increases in the R-Values required for wood-frame wall cavities in residential structures in climate zones three through six shows that the energy savings do not justify the investment that will be required. The impact on the national energy use by the residential sector would be minimal, especially if insulations with high-embodied energy are used. Energy savings and the resulting reduction in utility cost have been calculated for cavity changes from R 13 to R 15 in climate zones 3 and 4 and R 19 to R 21 in climate zones 5 and 6. Energy savings were calculated for ten representative cities in the four climate zones and ten large metropolitan areas across the country for a typical 2100 ft^2 house. The savings due to both reduced heating loads and reduced cooling load are expressed in dollars using average energy costs. Simple pay back (investment divided by annual savings) have been computed for the twenty cities using $490 and $245 for the cost of increased insulation. Present Values of the energy savings in current dollars have been calculated for a fifteen-year period after occupancy using annual energy cost escalation rates up to 10%.

● **Increasing wall-cavity insulation from R 13 to R 15 in climate zones 3 and 4 and from R 19 to R 21 in climate zones 5 and 6 is not cost effective.** The average annual saving per house for the 20 cities in the analysis is $10.86. The range of calculated annual savings per house is $7.01 to $12.80 for an energy cost of $0.9 per therm and $0.0947 per kwh.

● **The simple pay back for an insulation investment of $490 ranges from 38 to 70 years.** The simple pay back for an initial investment that is one-half of the estimated value is 19 to 35 years. These pay back periods do not represent an attractive investment.

● **The Present Value in current dollars of the first 15 years of savings ranges from $89 to $148 for an annual energy cost rate of 5%.** This 15-year Present Value is less than either the $490 or $245 initial investment. These Present Values do not represent an attractive investment.

● **Energy savings for the first 15 years are not significant at the national level.** The accumulated saving for a construction rate of 500,000 houses per year in the four climate zones over a 15-year period is estimate to be 0.08 Quads or 0.025 % of the national use in the residential sector. If high-embodied energy insulation materials are used, then the savings are reduced to about 0.02%.

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R&D Services, Inc.
August 1, 2005

Economic Evaluation of Proposed Cavity Wall R-Value Increases

Abbreviated Conclusions

● The projected energy savings for wall cavity R-Values increased above the 2003 U.S. D.O.E. recommendations are not cost effective under any reasonable set of assumptions.

● The payback to the consumer is not adequate.

● The reduction in national energy use due to the increased wall R-Values is not significant. The accumulated savings for the first fifteen years is estimated to be 0.08 Quads.

Background

An analysis has been undertaken to evaluate the financial benefits to future home owners that result from proposed increases in wood frame wall thermal insulation requirements in the International Energy Conservation and International Residential Codes. The R-value requirements for wood frame walls in climate zones 3, 4, 5 and 6 were increased to values in excess of the 2003 U.S. D.O.E. recommendations. The issue being addressed is the savings that would result from increasing wall cavity insulation R-Values above R 13 and R 19. The wood frame wall R-Values being discussed are summarized in Table 1. These R-Values are related to IECC Table 402.1 (Supp.).

Table 1. Progression of Recommended R-Values for Wood Frame Walls

Climate Zone	Original DOE	Amended in Nashville	Proposed
3	13	15	13
4 (except marine)	13	15	13
5 (and marine 4)	19	21	19
6	19	21	19

The key issue is the home-owner’s savings for changes in wood frame wall insulation requirements from R 13 to R 15 in climate zones 3 and 4 and from R 19 to R 21 in climate zones 5 and 6.

Basis for the Economic Analysis

Energy savings due to heat flow across insulated wall cavities provide a basis for calculating reduced heating and cooling costs due to increased R-Values. The analysis focuses specifically on the fraction of the building envelope occupied by insulated wall cavities. The calculated savings are based on a 2,100 ft^2 house with 13% glazing and total wall area of 1600 ft^2. The cavity area used does not include the area of the framing since it will remain constant in thermal resistance. The insulated wall area is taken to be 1203 ft^2. Annual energy flows are calculated using HDD and CDD data published for U.S. cities (Zip Code Data Base-Owens/Corning Fiberglas Corporation and Manual J, Air Conditioning Contractors of America)). The calculated heat flows are translated to utility usage with a heating equipment efficiency of 0.9 and cooling equipment COP of 2. The projected savings will decrease if actual equipment efficiencies are greater than the nominal values selected for this analysis. No consideration has been given to the possibility of reduced capitol investment for heating or cooling equipment since the heating and cooling load changes are very small.

The dollar savings to be associated with the calculated heat flows are based on the DOE recommended values of $0.90 per therm and $0.0947 per kwh. These, of course, are current values that will likely increase with time. The initial annual dollar savings per house have been calculated using the above cost factors. The cost of upgrading from R 13 to R 15 has been estimated by the National Association of Home Builders to be $490 without consideration of any structural changes. The cost of increasing from R 19 to R 21 in regions 5 and 6 is conservatively taken to also be $490. Consideration of an initial investment of $245 is also considered in this analysis.

Using the basis outlined above it becomes possible to calculate the simple payback for an investment of $490 to provide increased cavity insulation. The present value for 15 years of projected savings have also been calculated for comparison with the initial investment required to increase the frame wall cavity insulation R-Values. Present values are given in current dollars using realistic interest rates and energy cost escalation rates. A present value that is less than the initial cost is not a good investment.

Calculated Reductions in Heat Flow

Table 2 contains calculated savings for reduced heat flow due to the indicated R-Value increases in Zones 3-6. Since heat flow involves all of the thermal resistances between the exterior and the interior air masses on both sides of a wall, a resistance corresponding to sheathing, siding, and air films has been added to the heat-flow path in every case. Representative cities have been selected for the climate zones in accordance with Briggs et al. (Climate Classification for Building Energy Codes and Standards)

Table 2. Annual Heating and Cooling Load Reductions for Representative Cities

Zone	City	Annual Savings-Heating	Annual Saving-Cooling	Total
R-13 to R 15		therms	kwh	$/yr
3	Memphis	7.089	44.96	10.64
3	El Paso	5.967	55.42	10.62
3	San Francisco	7.730	1.25	7.08
4	Baltimore	10.419	24.82	11.73
4	Albuquerque	9.918	33.67	12.11
4	Salem	10.336	8.81	10.14
R19 to R 21				
5	Chicago	7.748	11.77	8.09
5	Boise	7.233	11.43	7.59
6	Burlington	9.658	4.60	9.13
6	Helena	9.978	3.92	9.35

Average Annual Savings for Zones 3 and 4: $ 10.39
Average Annual Savings for Zones 5 and 6: $ 8.54

An estimated cost of $490 is proposed for the increase in wall insulation R-Value. This initial investment is compared to savings by three methods. The simple payback in years is calculated by dividing the initial cost by the annual savings. Table 3 contains simple paybacks for initial costs of $490 and $245. Simple payback does not take into account escalating energy prices, inflation, or the time-value of money. The Present Value of the investment, therefore, has been calculated for the savings shown in Table 2. The Present Value in this case is the total of all savings over a 15 year period. The Present Value of an investment must exceed the initial cost in order for the investment to be recommended. A 15-year Present Value has been computed using an inflation rate of 3% per year and an interest rate of 4% per year (PV-1) The Present Value, consequently, is stated in current dollars. Since the Present Value is sensitive to the future cost of energy, two cases are considered with increasing energy costs. The first calculation including energy cost escalation (PV-2) assumes energy increasing at an annual rate of 5% while the second case (PV-3) uses an annual increase in the cost of energy of 10%. The results of these financial factors are collected in Table 3 for the initial utility savings given in Table 2.

Table 3. Financial Factors Related to an Investment in Increased Wall R Values

Rep. City	Savings ($/yr)	Simple Pay Back (yrs.) Cost $490	Cost $245	PV-1($)	PV-2($)	PV-3($)
Memphis	10.64	46	23	99	134	186
El Paso	10.62	46	23	99	134	186
San Francisco	7.08	69	35	66	89	124
Baltimore	11.73	42	21	110	148	205
Albuquerque	12.11	40	20	113	153	212
Salem	10.41	47	23	95	128	178
Chicago	8.09	61	30	76	102	142
Boise	7.59	65	32	71	96	133
Burlington	9.13	54	27	85	115	160
Helena	9.35	52	26	87	118	164

The entries for Present Value in current dollars (PV-1, PV-2, and PV-3) are well below the projected initial cost of $490. The R-value upgrades are not a good investment when viewed from the home owners perspective. The most likely present value case is represented by PV-2 where the cost of energy is moving upward at a slightly greater rate than the general inflation rate. PV-3 is unlikely in that the cost of energy is increasing at more than three times the inflation rate. Fifteen year Present Values approaching the initial investment are achieved if the energy increase rate is about seven times the general inflation rate.

Table 4 contains calculated energy savings, simple payback, and Present Value (PV-2) for ten large metropolitan areas. The savings were calculated for the appropriate R-Value requirements in each city. This second set of ten cities is included to show that the projected savings for the set of "representative" cities can be extended to areas with large populations.

Table 4. Annual heating and Cooling Cost Reductions for Ten Large U.S. Cities

City	Savings ($/yr)	Payback of $490 (yrs)	PV (2) ($)
Boston	7.01	70	88
New York City	12.10	40	153
Washington, D.C.	11.64	42	147
Atlanta	8.99	54	113
Houston	8.17	60	103
St. Louis	12.80	38	162
Detroit	7.91	62	100
Milwaukee	8.51	57	107
Denver	7.77	63	98
Seattle	9.28	52	117
Average	**9.42**		

Further Consideration of the Investment Potential

The anticipated investment of $490 to achieve the R-Values increase under discussion can be justified if the escalation of the cost of energy is large enough to compensate for inflation and interest rates. The rate of energy cost escalation must be much greater than inflation rate and interest rate. Table 5 explores this point of view as follows. A multiplier for the initial annual savings is obtained such that the product of the multiplier and the initial annual savings equals the investment. The multiplier depends on three economic factors: inflation rate, interest rate, and the escalation rate for the cost of energy: and the number of years of accumulated savings. If the economic factors are selected then the number of years required to obtain a PV equal to the investment can be determined. The results for the years of accumulated savings to match the initial investment are shown in Table 5 for both the projected initial investment, $490, and approximately one half of the projected initial investment, $245.

Table 5. Years of Accumulated Savings Required to Achieve a Specified Present Value

Annual Savings ($)	Initial Cost ($)	PV Mult.	Energy Escalation Rate (% per year)		
			5%	10%	20%
7.01	490	69.90	excessive	41 years	20 years
12.80	490	38.28	80	28	16
7.01	245	34.95	66	26	15
12.80	245	19.14	25	17	11

The range of annual savings shown in Table 5. corresponds to the annual savings in Table 4 for selected cities. None of the results in Table 5 for the years of accumulated savings required to equal the initial cost is attractive for either the estimated initial cost of $490 or one-half of the estimated cost, $245.

Energy Savings at the National Level

The annual energy use by the U.S. residential sector is currently about 21 Quads. The annual energy savings projected for the proposed increases in mandated R-Values range up to about 10 therms per house. If 500,000 homes per year are built to the higher R-Values under discussion, then the savings during the first year after the houses are built would be about 0.0005 Quads. The total savings with 500,000 new houses each year for a 15 year period would be about 0.08 Quads against a total projected use during the 15 year period of more than 315 Quads.

The estimated 15-year cumulative energy savings of 0.08 Quads would be significantly reduced by the use of insulation materials with high embodied energy to achieve the increased R-Values. The energy required to produce around 350 pounds of insulation per house could require as much as 36 therms for some types of insulation. In this case three to four years of energy savings would be required to pay back the energy used to produce the insulation. The accumulated 15 year national energy savings in this case would be reduced by about 25% to a value of about 0.02 % of the total residential energy use.

Conclusions

- The projected energy savings for wall-cavity R-Values increased above the U.S. D.O.E. recommendations are not cost effective under any reasonable set of assumptions. Fifteen years of accumulated energy savings expressed in current dollars is far below the initial investment for energy cost escalation rates up to 10% per year for 15 years.

- The payback to the consumer is not adequate. The number of years required to achieve a Present Value equal to the initial investment is 28 years or more for an initial cost of $490 and 17 years or more for an initial cost of $245 for energy cost escalation rates up to 10% per year.

- The reduction in national energy use is not significant. The accumulated savings for the first fifteen years is estimated at 0.08 Quads. This energy savings is insignificant in comparison with the estimated energy use of around 315 Quads in the residential sector for the same 15-year period. The national energy savings is reduced by up to 25% if high embodied insulations are used to achieve the high wall cavity R-Values.

Note Concerning the Use of Foam Sheathing

The use of foam sheathing has been suggested as an alternative method of achieving wall cavity insulation levels of R 15 or R 21. The addition of R 2 sheathing would provide additional savings due to increased thermal resistance in the fraction of the wall occupied by framing. If R 2 foam sheathing replaces plywood or OSB, then the net added R is about R 1.2. If R 2 foam sheathing is in addition to the plywood or OSB sheathing, then there would be a net R 2 increase in the framing resistance. The following table contains calculated savings for the two options described above.

Table 6. Calculated Annual Savings for the Wall Framing Region
Due to Use of R 2 Foam Sheathing

City	Framing	Annual Savings $ (R 1.2)	Annual Savings $ (R 2)
Memphis	2x4	5.33	8.08
El Paso	2x4	5.33	8.06
San Francisco	2x4	3.55	5.37
Baltimore	2x4	5.88	8.90
Albuquerque	2x4	6.08	9.20
Salem	2x4	5.08	7.70
Chicago	2x6	4.40	6.80

Boise	2x6	4.13	6.38
Burlington	2x6	4.97	7.68
Helena	2x6	5.09	7.86

The annual savings in Table 6 are based on reduced heat flow through the framing. A total savings can be obtained by adding the savings for the cavity region with the saving for the framing region provided they are made on the same basis. The results in Table 2 include a resistance term for the sheathing so they should be added to the column headed R 2 in Table 6 to arrive at an overall savings. If foam sheathing replaces wood sheathing then the added resistance for the entries in Table 2 would be R 1.2 and the savings in the cavity region would be reduced.

The February 23, 2005 Executive Summary of the DOE study of this topic states: “There may be little or no cost increase if insulating sheathing is used to obtain the additional R-2 requirement, but many builders prefer not to use insulating sheathing for reasons other than cost.” This statement clearly indicates the idea of replacing wood sheathing with foam sheathing. This means than the added R is about 1.2 rather than 2 with a reduction in the cavity savings to be expected. The calculated heat loss or gain across a wall must take into account all of the materials in the wall. In the case that R 2 sheathing replaces wood sheathing, there is an increase of R 1.2 in the wall resistance rather than R 2. Table 7, therefore, contains calculated annual savings for R 1.2 added to both the cavity region and the framing region.

Table 7. Annual Savings Achieved by Replacing Wood Sheathing with Foam Sheathing

City	Cavity ($/yr)	Framing ($/yr)	Total ($/yr)
Memphis	6.68	5.33	12.01
El Paso	6.67	5.33	12.00
San Francisco	4.44	3.55	7.99
Baltimore	7.37	5.88	13.25
Albuquerque	7.61	6.08	13.69
Salem	6.37	5.08	11.45
Chicago	5.02	4.40	9.42
Boise	4.71	4.13	8.84
Burlington	5.67	4.97	10.64
Helena	5.81	5.09	10.90

Average Annual Savings for Zones 3 and 4: $11.73
Average Annual Savings for Zones 5 and 6: $ 9.95

The annual savings for foam sheathing replacing wood sheathing to achieve the R 15 or R 21 cavity insulation levels are $1.30 to $1.40 greater than the savings for R 2 added to the cavity. This option would result in a relatively small increase in the calculated PV values for this option. The economic evaluation of this option will require an analysis of the cost. A careful analysis of the structural consequences of replacing wood sheathing with foam sheathing is needed. Preliminary results indicate that a complete replacement of wood by foam would not result in structurally acceptable houses. A partial replacement of wood with foam reduces the savings that have been projected for this option.

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