

**DOCKET****12-BSTD-1**DATE APR 04 2012RECD. APR 05 2012efficiency research  
analysis  
policy

Wednesday, April 04, 2012

California Energy Commission  
Attention: Docket No. 12-BSTD-1  
Dockets Office  
1516 Ninth Street, MS-4  
Sacramento, CA 95814  
[ryasny@energy.ca.gov](mailto:ryasny@energy.ca.gov)

**Re: Docket No. 12-BSTD-1 Proposed Language for Title 24, part 11 Tier 3 (ZNE)**

Dear Commissioner Douglas,

This letter is in support of the proposed 15 day language for CALGreen (Title 24, part 11) presented at the 45 Day Language workshop for Title 24 buildings standards held the March 13, 2012. The language of interest is paraphrased in slide 63 of the CEC staff presentation as follows:<sup>1</sup>

*Tier 3: Zero Net Energy -ZNE Homes shall comply with all Tier 2 requirements and have a Home Energy Rating System (HERS) Design Rating of zero or less*

This language is similar to proposed language that I submitted in my written comments to HCD during the public comment period for the HCD Focus Group Meetings regarding proposals to the 2013 CALGreen Code. My written comments, submitted to Mr. Stoyan Bumbalov of HCD dated December 7, 2011 are attached which I wish to also be placed into the record as they are directly related to the concept of a ZNE energy tier.

The rationale for having a well defined Zero Net Energy Home tier are as follows:

- A ZNE tier provides an unambiguous definition of Zero Net Energy Home that results in clarity for the market and preserves the brand of a California Zero Net Energy Home.
- A Zero Net Energy home defined as a HERS design rating of 0 or less is very achievable and more likely to be considered as an actual goal for broad implementation by 2020 as compared to harder to achieve “aspirational” goals based on site energy.
- A clear ZNE tier based on a HERS design rating, helps develop the administrative tools and the feasibility issues associated with certifying a ZNE home for future code compliance

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<sup>1</sup> [http://www.energy.ca.gov/title24/2013standards/rulemaking/documents/2012-03-12-13\\_hearing/presentations/March\\_13\\_Hearing\\_Residential.pdf](http://www.energy.ca.gov/title24/2013standards/rulemaking/documents/2012-03-12-13_hearing/presentations/March_13_Hearing_Residential.pdf)



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Wednesday, December 07, 2011

Stoyan Bumbalov  
Division of Codes and Standards  
Department of Housing and Community Development  
[sbumbalov@hcd.ca.gov](mailto:sbumbalov@hcd.ca.gov)

**Re: 2013 CALGreen Proposed Express Terms Comments**

To Stoyan Bumbalov and Developers of the 2013 update to CALGreen (Title 24, part 11),  
These comments are in response to the California Energy Commission's proposed voluntary energy requirements in the 2013 update to CALGreen as presented at the November 14, 2011 HCD focus group meeting. My recommendations are summarized as follows, with the remainder of this letter describing in more detail these recommendations including proposed revisions to the code language:

- Overall we support the CEC proposal
- A Zero Net Energy (ZNE) tier should be added to the two other voluntary tiers for showing advanced energy performance
- The "all high efficiency lighting" prerequisite should allow an exception for low efficiency lighting when at least as many rated watts of photovoltaics are installed as the wattage of low efficacy lighting.
- Vacancy sensor requirements beyond those in Title 24 part 6 should be carefully considered as some of these spaces do not have many permanently installed luminaires or the luminaires are not on very many hours. .



- A clear definition of a ZNE certified home provides a vehicle for a consistent statewide target for government and utility energy efficiency programs.

## A ZNE Tier Protects the Zero Net Energy Home “Brand”

If there is not a clear definition of what is a zero net energy home, then there is not a level playing field for builders who would call their homes “zero net energy.” By having a well defined method of defining a home a zero net energy, builders are able to differentiate their superior product from another home that might look like it is ZNE (i.e. has a solar panel) but does not contain the other energy efficiency features that are essentially invisible to the untrained eye. I recommend that the California Energy Commission interview those builders of ultra-efficient homes to better understand the views of the likely beneficiaries of a state policy that clearly defines a Zero Net Energy Home.

## ZNE = HERS Rating of 0, an Achievable Goal

Current new buildings	PV kWh	PV kW	PV Cost \$/house
Site energy ZNE	17,501	11.7	\$52,502
Source energy ZNE	10,264	6.8	\$30,791
Societal Energy ZNE	8,056	5.4	\$24,168
(Elec) Grid neutral	6,645	4.4	\$19,935

48% reduction T-24 (4 cycles 15% reduction)	PV kWh	PV kW	PV Cost \$/house
Site energy ZNE	11,581	7.7	\$34,744
Source energy ZNE	7,324	4.9	\$21,972
Societal Energy ZNE	5,835	3.9	\$17,505
(Elec) Grid neutral	5,195	3.5	\$15,586

66% reduction all end-uses	PV kWh	PV kW	PV Cost \$/house
Site energy ZNE	5,834	3.9	\$17,501
Source energy ZNE	3,421	2.3	\$10,264
Societal Energy ZNE	2,685	1.8	\$8,056
(Elec) Grid neutral	2,215	1.5	\$6,645

Figure 1: PV Cost Implications of different ZNE definitions with low PV price estimate (\$4.50/W)

the societal cost (TDV) definition that is currently the basis of the California HERS rating, values photovoltaics more than the site or source energy definitions because photovoltaic generation is relatively coincident with peak electrical demand, a component of energy cost that is included in the societal costing (TDV) metric but is not included in site or source energy definitions that do not account for the time of day (or year) that solar energy is generated.

Figure 1 illustrates the costs of complying with various metrics of zero net energy: Site Energy (1 kWh electricity = 3,413 Btu), Source Energy (1 kWh electricity = 3 x 3,413 = 10,239 Btu), Societal Energy (trade-offs based on TDV, time dependent valuation of different energy sources including peak demand) and Grid Neutral (natural gas consumption is not included). The calculated kWh of photovoltaic (PV) generation is calculated for each metric and this is converted to the size of the photovoltaic system in terms of design PV kW. This PV cost per home is calculated by multiplying the PV kW by \$4,500/kW, the installed cost of photovoltaics in a fully commoditized photovoltaic market, such as is currently found in Germany.<sup>2</sup> The

<sup>2</sup> LBNL 2011. Barbose, et al.. *Tracking the Sun IV: A Historical Summary of the Installed Cost of Photovoltaics in the United States from 1998 to 2010*. <http://eetd.lbl.gov/ea/ems/reports/lbnl-5047e.pdf>



The grid neutral definition would require less photovoltaics than the societal energy definition but it does not include generating enough on-site renewable energy to offset both electricity and natural gas imports. As a result grid neutral would define a zero net electricity home not a zero net energy home.

This table shows that the costs of a renewable energy system required for achieving ZNE with a circa 2000 home using a site energy definition would require \$52,000 of photovoltaics. In contrast, a new home that reduces energy consumption of the Title 24 loads and appliance loads by 2/3's using a societal cost definition of ZNE would need \$8,000 worth of photovoltaics. Even though the low cost system is still expensive, this is relative to the California median home cost of \$300,000. For a 30 year fixed loan the cost of the photovoltaic system would result in an extra \$43/mo mortgage payment on the \$1,600/mo mortgage payment for a median cost California home.<sup>3</sup> However much of this additional PV mortgage cost would be offset by utility bill savings.

### ***A ZNE Tier Helps Develop 2020 Code Certification Tools***

One of the key statements from the 2008 CPUC Long Term Energy Efficiency Strategic Plan is “All new residential construction in California will be zero net energy by 2020.” This is in response to the AB 32 “Global Warming Solutions Act of 2006) “ and the ARB Climate Change Scoping Plan which calls for reducing Greenhouse Gas emissions to 1990 levels by 2020, even though the state’s population will have grown by 40% over this time period. If this policy is going to be implemented it implies that the goal for the 2019 Title 24 energy code is that all new homes will be Zero Net Energy or equivalent. This is a tremendous target and it will take some time to get all of pieces together to apply this new standard.

Creating a reliable framework for certifying that a home is zero net energy is one of the pieces to this puzzle. Taking steps to assure that this framework works in a voluntary setting, such as part of a voluntary utility incentive program, or as part of a voluntary ZNE rating is a low risk way to work out the bumps and hick-ups associated with certification. A delay in voluntary home certification has a significantly smaller impact than a delay of certificate of occupancy in a mandatory code situation.

There will likely be many unanticipated issues that will arise when certifying homes as ZNE. Delaying the process of voluntary ZNE certification by one code cycle is undesirable for the building industry, and the cities that ultimately will be enforcing a 2019 ZNE energy code two code cycles later.

### ***ZNE Certified Home Consistent Statewide Target***

Given the consistent policy statements by all levels of state government of the desirability of a transformed housing industry that manufactures energy-efficient, safe and comfortable energy efficient homes that reduces the consumers total cost of ownership (mortgage + utility payments), a variety of market transformation activities will likely be aimed at encouraging the growth of

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<sup>3</sup> 5% APR, 30 year fixed loan, for comparison 100% of the loan (not reduced by a down payment)



Zero Net Energy homes. With a single well defined definition, the market can do what it does best, find low cost methods of delivering the product. The economies of scale are diminished if the programs designed to promote zero net energy have different definitions of what ZNE is.

CALGreen was specifically design to have a “reach” or voluntary component which would exemplify the future of “Green Home” that really was designed and constructed to reduce toxic exposure, reduce environmental impact and increase energy autonomy. The purpose of CALGreen was to separate “green” from “greenwash.” I am asking the CEC and other cognizant State agencies to pursue the adoption of a ZNE tier in the 2013 CALGreen (Title 24, part 11) so that the stability, transparency and the validity of the market for Zero Net Energy homes is assured.

Sincerely,

A handwritten signature in green ink that reads "Jon McHugh". The signature is written in a cursive, flowing style.

Jon McHugh, PE

Cc: Mr. Stoyan Bumbalov, HCD  
Dana Papke, CARB  
Cathy Fogel, CPUC



McHugh Energy CALGreen Comments Dec.7, 2011

## Background

At the November 14<sup>th</sup> focus group meeting, Martha Brook of the California Energy Commission presented a proposal for CALGreen that can be summarized as follows:

- Energy measures are in the voluntary portion of CALGreen (Appendix A4)
- Prerequisites required for both tiers include:
  - Home Energy Rating System (HERS) Design Rating
  - Quality Insulation Inspection (QII)
  - All permanently installed lighting shall be high efficacy and have vacancy sensor controls
  - All permanently installed lighting mounted to the building shall be high efficacy and have photocontrol or time clock controls
  - All appliances provided by the builder shall be ENERGY STAR labeled if an ENERGY STAR specification is applicable
- Tier 1 performance standard
  - Energy Budget that is 85 percent or less than the Title 24, Part 6 Energy Budget
  - Maximum modeled imported electricity consumption no greater than 10,000 kWh per year
- Tier 2 performance standard
  - Energy Budget that is 70 percent or less than the Title 24, Part 6 Energy Budget
  - Maximum modeled imported electricity consumption no greater than 8,500 kWh per year

Overall I support the CEC proposal as it makes progress towards the goals in the CPUC Energy Efficiency Strategic Plan<sup>1</sup>, namely that, “All new residential construction in California will be zero net energy by 2020.” To achieve this goal, the California building codes must increasingly promote high levels of energy efficiency with on-site renewable energy systems. Though the tiers are nominally voluntary, the tiers provide a model code that cities can adopt as a standard or various beyond code incentive programs can adopt as a program criteria. Ideally the tiers act as a market signal that prepares the market for the increased levels of efficiency that will be required as California approaches its Zero Net Energy (ZNE) goal.

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<sup>1</sup> California Public Utilities Commission, California Long Term Energy Efficiency Strategic, September 2008. (CPUC 2008)



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If we consider that California has two more standards cycles (2016 and 2019) in advance of the 2020 ZNE goal, then it is desirable that we have a CALGreen tier that is representative of the 2016 T-24 energy code that has adopted all cost effective efficiency measures and 2019 T-24 energy code that is Zero Net Energy for all new homes. Thus it is desirable to have CALGreen tiers that reflect this trajectory to zero net energy as shown in Figure 1.

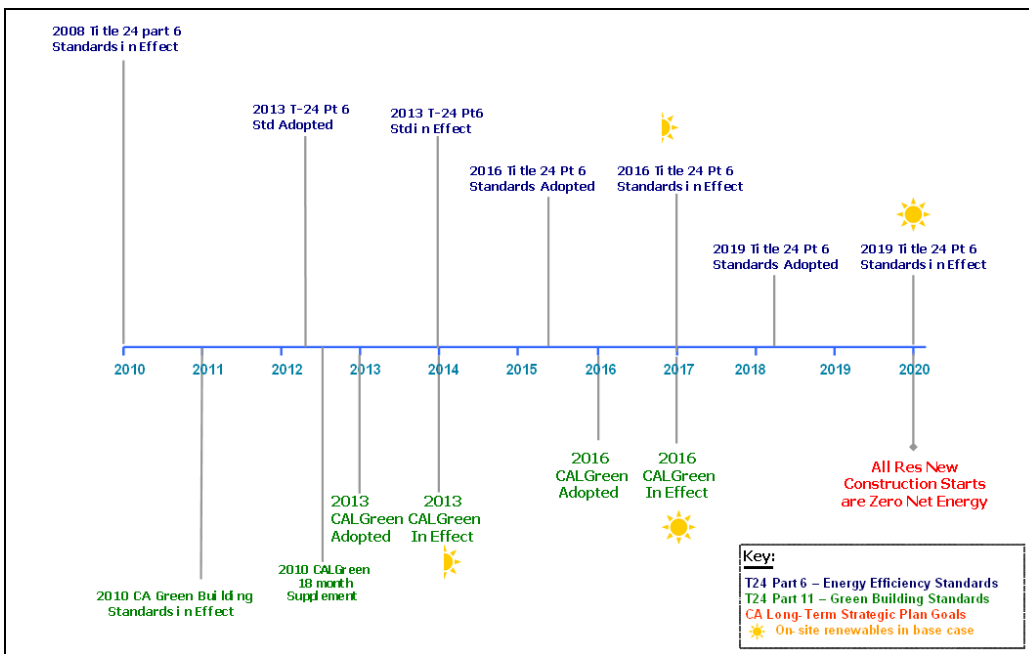


Figure 1: Building Standards Timeline to Net Zero Homes

For utility efficiency programs a reduction in energy consumption of at least 15% is considered the minimum threshold for receiving utility rebates. Thus the tier 1 levels of efficiency of 15% beyond code coordinates well with the IOU programs in terms of defining a minimum beyond code threshold.

During the Title 24 workshops, CEC staff presented an analysis of potential alternatives for the prescriptive envelope measures that would comprise “Package A” in the 2013 Title 24 part 6 standard. The package of envelope measures that would save the most energy and still be cost-effective would save 45% of energy simulated in the performance approach, however the CEC staff selected a package of measures that did not exceed a first cost threshold – this package as proposed would save around 30% of energy simulated in the performance approach. Thus considering just considering envelope measures that are cost-effective in 2011, the opportunity as compared to the 2013 standard is  $0.55 / 0.70 = 79\%$  or 21% beyond code before considering putting ducts inside conditioned spaces, and other measures that consider HVAC or water heating improvements. Thus Tier 2 is potentially a reasonable proxy for what the 2016 energy code might approach.



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What is missing is a proxy for what might be required two code cycles out. What is needed is a “ZNE Tier” that describes what the state of California considers a ZNE home and what might be the requirements of the energy code two code cycles out in 2019.. This ZNE tier would provide guidance and marketing support to cutting edge developers that want to differentiate their homes from other homes on the market (half of which were built before there was any energy code). A ZNE tier would differentiate ZNE homes from inefficient homes have solar panels. This ZNE tier provides the policy signals to the market and as a voluntary standard helps works out the mechanics of such a rating well in advance of mandatory energy code requirement. I support the addition of a ZNE tier that includes all of the requirements of tier 2 plus zero net energy requirements.

I also recommend the following modifications to the CEC proposal:

Space	Avg h/yr
Kitchen	1,241
Master Bathroom	730
Secondary Bathroom	730
Powder room	730
Closets	511
Master Bedrooms	511
Secondary Bedrooms	511
Utility Rooms	949
Hallways	438
Living Rooms	949
Dining Rooms	1,241

**Figure 2: Lighting hours per year by room, grayed spaces required to have a vacancy sensor under 2013 T-24, Pt 6**

- For the all high efficiency lighting prerequisite, allow low efficacy lighting if it is offset on a watt per watt basis with on-site renewable generation (photovoltaics). In most situations, the full load hours of PV generation (between 1,200 – 1,400 kWh/kW) will exceed the full load hours of energy consumption by low efficacy lighting (see Figure 2). This trade-off is simple and provides the flexibility to a tiny percentage of the market not satisfied with the broad range of high efficiency lighting products and results in a net energy savings. This simplicity meets all of the efficacy of the energy code without all of the exceptions and is likely a model for a future (and more simple) energy code.
- The proposed T-24 energy code would require occupancy sensors in garages, laundry rooms and utility rooms and all lighting in these spaces must be high efficacy. It also requires that bathrooms have an occupancy sensor or have all high efficiency lighting. All other lighting must be high efficacy or have a an occupancy sensor or a dimmer.

Thus we recommend dropping the requirements for vacancy sensors for most spaces not already required by Title 24 part 6. These other spaces include kitchens, bedrooms, hallways, living rooms and dining rooms. Kitchens have projections like cabinets that would thwart a simple passive infrared wall box sensor. Bedrooms are typically illuminated by electric light only 1.4 hours per day, thus the savings opportunity is small. Lights are typically on in hallways a little over an hour per day. Dining rooms and living rooms are occupied longer, savings are subject to how much lighting is permanently installed and how often lights are left on when unoccupied. The energy savings benefit of the occupancy sensor is reduced if the lighting is all high efficacy and there is less





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wattage to control. Thus removing added controls language keeps this proposed green code simple.

## **Proposed Changes**

The following are friendly amendments to the CEC staff proposal with stricken language with ~~strikeouts~~ and added language underlined.

### **APPENDIX A4 - RESIDENTIAL VOLUNTARY MEASURES**

#### **DIVISION A4.2 ENERGY EFFICIENCY**

Newly constructed low-rise residential buildings shall meet Sections 1 and 2:

1. **Prerequisites.** Each of the following efficiency measures is required:
  - A. **Home Energy Rating System (HERS) Design Rating.** A HERS design rating shall be computed by Compliance Software certified by the Commission for the Proposed Design Building and this rating shall be included in the Certificate of Compliance documentation;
  - B. **Quality Insulation Inspection (QII).** The QII procedures specified in Title 24, Part 6 shall be completed;
  - C. **High efficacy indoor lighting.** All permanently installed lighting shall be high efficacy as defined in Title 24, Part 6.

Exception: Low efficacy lighting shall be allowed when it is offset by an equal or more watts of on-site photovoltaic generation installed between 110 and 270 degrees as measured clockwise from due north when viewed in plan and installed with no significant shading obstruction. Significant shading obstructions include vent, chimney, architectural feature, roof mounted equipment that are closer than two times the height of the obstruction above the lowest part of the photovoltaic panels and south of any part of the photovoltaic panels.

~~and shall have vacancy sensor controls. Vacancy sensors in garages shall use ultrasonic, dual-technology, or other methods for occupant detection which do not rely solely on line of sight. Permanently installed lighting shall be installed in kitchens, bathrooms, utility rooms, and garages at a minimum. Every room which does not have permanently installed lighting shall have at least one switched receptacle installed. Each ceiling fan provided by the builder shall be installed with an ENERGY STAR light kit;~~

- D. **High efficacy exterior lighting.** All permanently installed lighting mounted to the building shall be high efficacy as defined in Title 24, Part 6 and shall have photocontrol or time clock controls; and
- E. **Appliance rating.** Each appliance provided by the builder shall be ENERGY STAR labeled if an ENERGY STAR specification is applicable for the appliance.



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2. **Performance Standard.** One of the following advanced efficiency levels shall be met:
- A. **Tier I:** Buildings complying with the first level of advanced energy efficiency shall have an Energy Budget that is 85 percent or less than the Title 24, Part 6 Energy Budget for the Proposed Design Building as calculated by Compliance Software certified by the Energy Commission. ~~There shall be a limit on calculated Total net building electricity consumption placed on of the Proposed Design Building as calculated by within the Compliance Software that is equivalent to shall be no greater than~~ 10,000 kWh per year. A Proposed Design Building calculated by the Compliance Software to consume more than this amount of grid supplied electricity shall use additional energy efficiency measures or an on-site solar electric system to reduce the Proposed Design Building calculated total net building electricity consumption to a level that is at or below 10,000 kWh per year; or
  - B. **Tier II:** Buildings complying with the second level of advanced energy efficiency shall have an Energy Budget that is 70 percent or less than the Title 24, Part 6 Energy Budget for the Proposed Design Building as calculated by Compliance Software certified by the Energy Commission. ~~There shall be a limit on calculated Total net building electricity consumption placed on of the Proposed Design Building as calculated by within the Compliance Software that is equivalent to shall be no greater than~~ 8,500 kWh per year. A Proposed Design Building calculated by the Compliance Software to consume more than this amount of grid supplied electricity shall use additional energy efficiency measures or an on-site solar electric system to reduce the Proposed Design Building calculated total net building electricity consumption to a level that is at or below 8,500 kWh per year.
  - C. **Zero Net Energy:** Zero Net Energy buildings shall comply with all of the tier II requirements and shall have a Home Energy Rating System (HERS) Design Rating of 0 or less.

Additions and alterations to low-rise residential buildings shall meet Sections 3 and 4:

3. **Prerequisites.** Each of the following efficiency measures is required if applicable to the addition or alteration building project:
- A. **Quality Insulation Inspection (QII).** The QII procedures specified in Title 24, Part 6 shall be completed;
  - C. **High efficacy indoor lighting.** All permanently installed lighting shall be high efficacy as defined in Title 24, Part 6 and shall have vacancy sensor controls.

**Exception:** Low efficacy lighting shall be allowed when it is offset by an equal or more watts of on-site photovoltaic generation installed between 110 and 270 degrees as measured clockwise from due north when viewed in plan and installed with no significant shading obstruction. Significant shading obstructions include vent, chimney, architectural feature, roof mounted equipment that are closer than two times the height of the obstruction above the lowest part of the photovoltaic panels and south of any part of the photovoltaic panels. ~~Vacancy sensors in garages shall use ultrasonic, dual technology, or other methods for occupant detection which do not rely solely on line of sight. Permanently installed lighting shall be installed in kitchens, bathrooms, utility rooms, and garages at a minimum. Every room which does not have permanently installed lighting shall have at least one switched receptacle installed. Each ceiling fan provided by the builder shall be installed with an ENERGY STAR light kit; and~~



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- D. **High efficacy exterior lighting.** All permanently installed lighting mounted to the building shall be high efficacy as defined in Title 24, Part 6 and shall have photocontrol or time clock controls.
- 4. **Performance Standard.** One of the following advanced efficiency levels shall be met:
  - A. **Tier I:** Buildings complying with the first level of advanced energy efficiency shall have an Energy Budget that is 95 percent or less than the Title 24, Part 6 Energy Budget for the Proposed Design Building as calculated by Compliance Software certified by the Energy Commission for each mechanical system altered. Mechanical systems include heating, space cooling, and water heating systems. If the addition or alteration changes the envelope with no change to mechanical systems, then no additional efficiency measures above Part 6 are required; or
  - B. **Tier II:** Buildings complying with the second level of advanced energy efficiency shall have an Energy Budget that is 90 percent or less than the Title 24, Part 6 Energy Budget for the Proposed Design Building as calculated by Compliance Software certified by the Energy Commission for each mechanical system altered. Mechanical systems include heating, space cooling, and water heating systems. If the addition or alteration changes the envelope with no change to mechanical systems, then no additional efficiency measures above Part 6 are required.
  - C. [Zero Net Energy:](#) Zero Net Energy buildings shall comply with all of the tier II requirements and shall have a Home Energy Rating System (HERS) Design Rating of 0 or less.

I look forward to your responses to these comments and I am available to answer any clarifying questions that you might have. I support the 2013 CALGreen development process to bring increasingly healthy and energy efficient homes to the California market. I will be providing additional input as modifications are made to the proposed standard.

Sincerely,

Jon McHugh, PE  
Principal, McHugh Energy Consultants Inc.  
P.O. Box 2878  
Fair Oaks, CA 95628

Cc: Shawn Huff ([shuff@hcd.ca.gov](mailto:shuff@hcd.ca.gov)), Doug Hensel ([dhensel@hcd.ca.gov](mailto:dhensel@hcd.ca.gov)), Martha Brook ([Mbrook@energy.state.ca.us](mailto:Mbrook@energy.state.ca.us))