



A STATEWIDE UTILITY PROGRAM

# 2019 Title 24 Codes & Standards Enhancement (CASE) Proposal Quality Insulation Installation (QII)

September 14, 2016

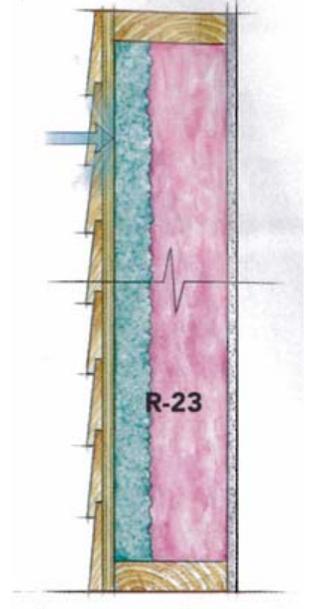


Bill Dakin  
Davis Energy Group  
[bldakin@davisenergy.com](mailto:bldakin@davisenergy.com)



## Proposed Code Change Overview

- **Types of building impacted**
  - Single family and low-rise multifamily residential
- **Building system impacted**
  - Impacts building shell: walls, attic/roof, framed floors
- **Anticipated type of change**
  - Prescriptive Requirement
- **Description of change**
  - Propose changing QII HERS inspection from compliance credit to prescriptive measure
  - Already a prerequisite for 2016 CALGreen tiers
  - Expand QII inspection protocols to properly address new products / insulation methods
    - Hybrid installations (spray foam + batt)
    - Box netting and  $\geq$  R-19 batt insulation under roof deck w/ wire attachments



---

## Proposed Code Change History

- Why are we proposing this measure?
  - Support CA climate action goals and move towards ZNE buildings
  - Support cost-effective envelope improvement opportunities prior to introducing PV
    - Optimally performing building envelope is the starting point for ZNE ready homes
  - QII already prerequisite for 2016 CALGreen.
  - Included in prescriptive package to trade tankless with storage water heater
  - Significant savings opportunity
    - (5.5 – 11.4% projected savings based on CBECC runs)

## Current Code Requirements

- Existing Title 24 Requirements
  - Performance Compliance Option
  - Current ACM models cavity insulation values at 70% of the R-value of the installed insulation with attic defects assumed as well unless QII credit is taken
- Existing Model Code Requirements (2015 IECC)
  - Includes some components of QII
    - Continuous air barrier
    - Cavity insulation in contact w/ air barrier
- Other Programs
  - ENERGY STAR Thermal Bypass Checklist
    - LEED, DOE's ZERH
  - RESNET Home Energy Rating Standards (Insulation Grade Standards)

---

## Typical Practices

- Current practices
  - CalCERTS registry data (Jan 2015- April 2016)
    - 24% of registered SF homes include QII
    - 13% MF buildings took QII credit
  - Implementation not consistent
  - Projects not taking QII tend to have reduced insulation quality and building envelope performance
- Trends
  - May become more common in next code cycle in order to meet increasing code requirements
- Do you agree with this description?

## Market Overview and Analysis

- Current Market
  - Well established but implementation not widespread or consistent
  - 90% of new homes constructed using batt insulation in walls
  - QII is a common credit taken for builders participating in utility incentive programs (CAHP, CMHNNH)
- Market barriers
  - Challenges meeting QII standards, especially with batt insulation.
  - Lack of trained installers with understanding of the QII requirements
- Other market information sources we should know about?

## Incremental Cost Estimation (Preliminary)

- How we are collecting costs
  - 2016 Reach Code studies
  - Update with interviews with contractors, builders, HERS raters, and program implementers
  - Costs include additional builder and HERS rating costs
  - Leverage CalCERTS data to identify amount of sampling used with QII

- Incremental Costs

	<u>Single Family</u> (Assumes 1 of 3 sampling)	<u>Multifamily</u> (Based on 8-unit bldg.)
Installation Labor	\$89	\$354
HERS Rater	\$277	\$708
Average per Bldg	\$366	\$1,062

- Anticipate further cost reductions in this measure as implementation increases

- ***Do you find these costs to be reasonable?***

---

## Methodology for Savings Analysis

- Methodology for energy and demand Impacts
  - CBECC-Res Title 24 compliance software using 2019 TDV values
  - Prototype Buildings
    - Buildings used in Title 24 development activities
    - SF: 2,100 ft<sup>2</sup> single story and 2,700 ft<sup>2</sup> two story
      - Assumes 45% 2,100 & 55% 2,700
    - MF: 6,960 ft<sup>2</sup> , 8 unit, 2 story building
  - Based on 2016 prescriptive requirements

## Incremental Cost Savings

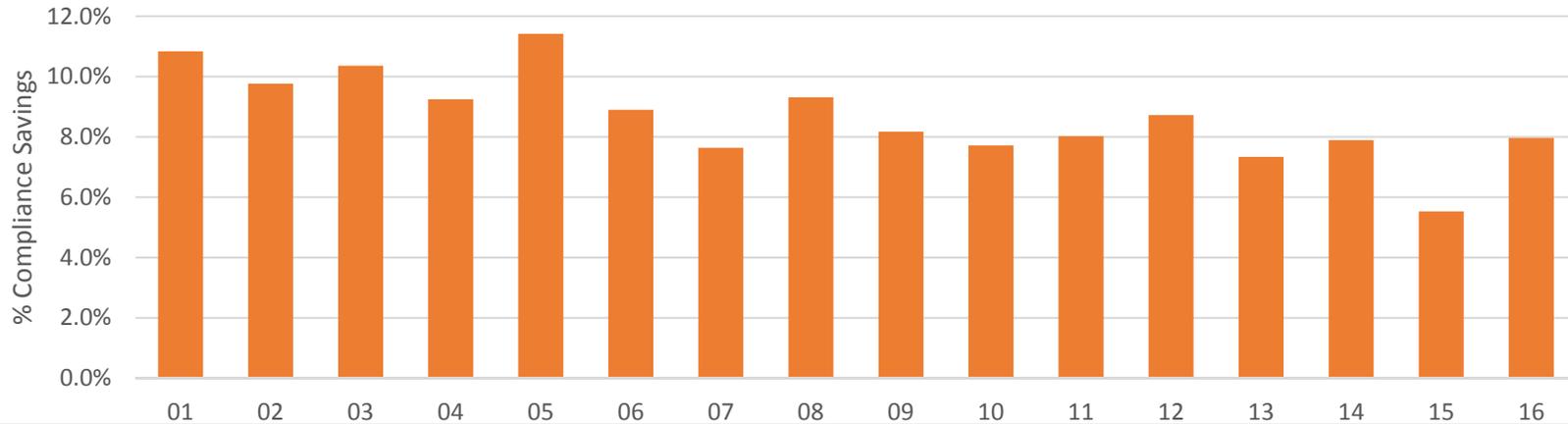
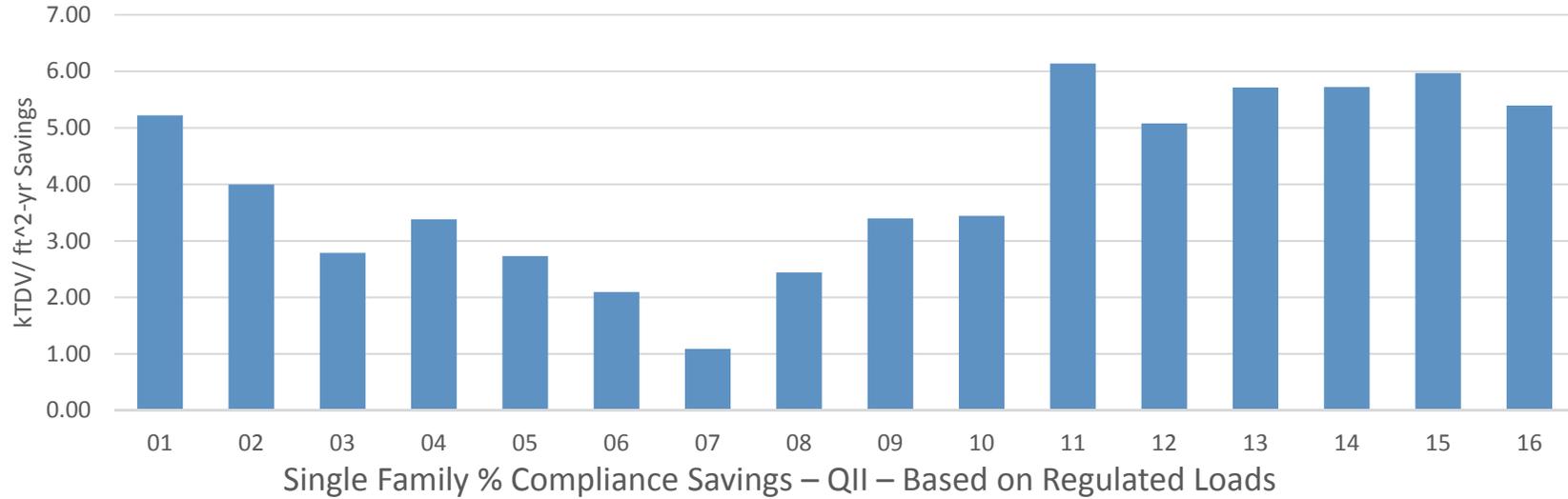
- Approach
  - Incremental cost savings are calculated based on TDV cost savings associated with energy savings over the entire period of analysis.
  - Net Present Value of savings based on 2019 TDV cost multiplier of \$0.1732/TDV kBTU saved.
  - Benefit to Cost Ratio = NPV TDV cost savings / lifecycle cost
    - No replacement or maintenance costs associate with this measure

## Initial Findings on QII Implementation

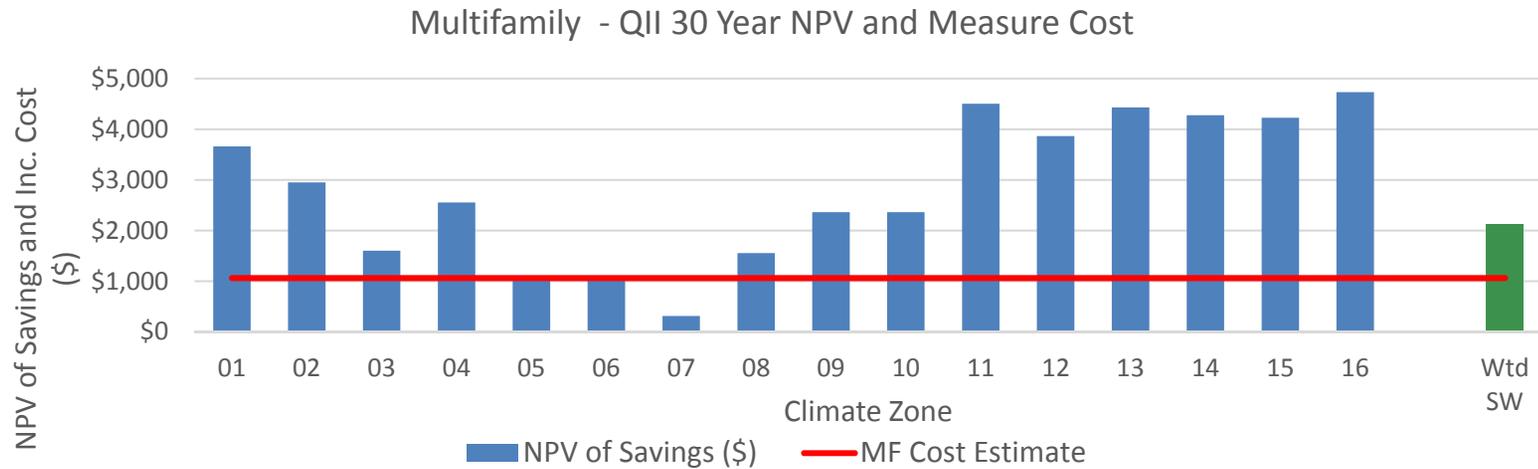
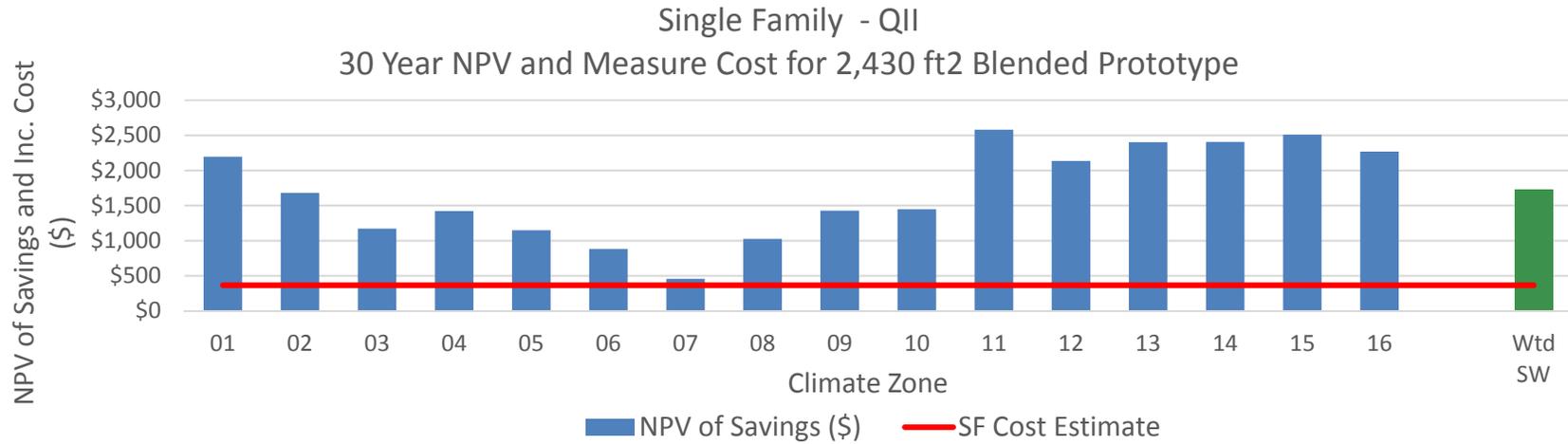
- Preliminary results from HERS rater survey
  - Builders still struggle with QII compliance
  - Lack of Installer training and worker turnover cited as the biggest reasons
  - Mixed responses on whether QII credit has increased or decreased since 2013 code
  - 70% taking QII only when necessary
  - Most failures during wall insulation inspection phase
  - Most common failures include voids, trimming around pipes & wires, air sealing and air barriers
  - Average 1-3 additional site visits are required due to inspection failures
  - Failing QIIs has led to lost HERS rater work

# CBECC-Res Preliminary TDV Impacts (2019 TDV)

## Single Family 2430 ft<sup>2</sup> TDV Savings - QII



# CBECC Preliminary Benefit and Cost Results (2019 TDV)



## Preliminary Cost Effectiveness Estimates By Climate Zone

Climate Zone	Single Family Prototype		Multifamily Prototype	
	NPV of Savings (\$)	TDV Benefit Cost Ratio @ \$366 Inc. Cost	NPV of Savings (\$)	TDV Benefit Cost Ratio @ \$133 Inc. Cost
01	\$2,195	6.00	\$3,660	3.45
02	\$1,680	4.60	\$2,950	2.78
03	\$1,171	3.20	\$1,601	1.51
04	\$1,420	3.88	\$2,553	2.40
05	\$1,148	3.14	\$1,072	1.01
06	\$881	2.41	\$1,023	0.96
07	\$458	1.25	\$313	0.29
08	\$1,026	2.81	\$1,553	1.46
09	\$1,428	3.91	\$2,360	2.22
10	\$1,447	3.96	\$2,360	2.22
11	\$2,580	7.05	\$4,503	4.24
12	\$2,135	5.84	\$3,865	3.64
13	\$2,402	6.57	\$4,431	4.17
14	\$2,405	6.58	\$4,274	4.02
15	\$2,509	6.86	\$4,226	3.98
16	\$2,268	6.20	\$4,732	4.46
<b>Weighted Statewide</b>	<b>\$1,730</b>	<b>4.73</b>	<b>\$2,124</b>	<b>16.00</b>

QII is cost effective in most climate zones

## Preliminary Energy Impacts – Statewide Weighted

Preliminary Energy Savings Estimate					
Bldg Type	Annual per Unit Electricity Savings* (kWh/unit-yr)	Annual per Unit Natural Gas Savings* (Therms/unit-yr)	First Year Statewide Electricity Savings** (GWh/yr)	First Year Statewide Natural Gas Savings** (Million Therms/yr)	Confidence Level (high, medium, low)
<b>SF</b>	80.4	21.5	8.7	2.3	High
<b>MF</b>	11.8	3.1	0.3	0.1	High

\* Per unit kWh & Therm savings based on weighted statewide values

\*\* Statewide values based on 2016 assumptions for housing starts

---

## Potential QII Changes

- QII Prescriptively Required
- Move from current Pass/Fail to a 2-Tier level of compliance?
  - Provide a “partial credit” QII in recognition of projects having trouble meeting current QII
  - Full QII still prescriptively required and assumed in Standard using performance method
  - Does this make compliance more difficult and time consuming?
- ***Thoughts or Comments?***

## Potential Revised Degradation Assumptions for Partial Credit QII Installations

### “Partial credit” QII

- No change to air barrier and air sealing requirements
  - Would allow for some gaps and compression
  - Would assume some performance degradation
    - Similar to 2008 criteria?
    - Need clear direction for HERS raters to evaluate
  - Leverage data from Residential Construction Quality Project used to develop original QII cavity degradation
    - Determine degradation assumptions
    - Determine effective wall U-value
  - Pros: Easier for builders to comply; recognizes field challenges
  - Cons: Add complexity to HERS inspections. HERS costs would not be affected
- 
- ***Other Thoughts or Comments?***

# SSNiF Worksheet (for CASE Author Reference Only)

Stakeholder	Situation	Need	Feature/ solution
<p>What market actors are involved in implementing this measure?</p>	<ul style="list-style-type: none"> <li>- What level of subject matter expertise do they have?</li> <li>- What level of technology expertise?</li> <li>- What is their workflow/ tasks?</li> <li>- Where do they perform their work?</li> </ul>	<ul style="list-style-type: none"> <li>- What is their work product in relation to this measure?</li> <li>- Do they need to coordinate with other market actors?</li> <li>- What does success look like to the user?</li> </ul>	<ul style="list-style-type: none"> <li>- What solution could meet the specific need identified?</li> </ul>

---

## Compliance and Enforcement- Market Actors

- Who would be involved in implementing this measure?
  - T24 Consultant / CEA
  - Builder
  - Insulation Contractor
  - Other Subs (framer, HVAC, Electrician, Plumber)
  - HERS Rater
  - Plans Examiner / Building Inspector
  - Building Owners
  
- ***Others?***

## Compliance and Enforcement – Tasks

Market Actor	Task(s)	Success Criteria
T-24 Consultant	<ul style="list-style-type: none"> <li>- Ensure builder is aware of the requirements</li> <li>- If Mandatory Measure, not much else needed.</li> <li>- If not, ensures that QII is included in CF-1R</li> </ul>	<ul style="list-style-type: none"> <li>- Builder and construction team are aware of requirements and there are no surprises.</li> </ul>
Builder / General Contractor	<ul style="list-style-type: none"> <li>- Coordinate w/ insulation contractor and other subs to ensure everyone understands requirements and installation quality is met</li> <li>- Ensure building is properly air sealed and continuous air barrier is maintained</li> <li>- Coordinate w/ and schedule HERS Rater and Building Inspector for inspections</li> <li>- Completes CF-2R for air sealing procedures of QII</li> </ul>	<ul style="list-style-type: none"> <li>- Work is completed within budget and on schedule</li> <li>- Ensure inspections due not cause schedule delays</li> <li>- Minimize / eliminate inspection failures / callbacks</li> <li>- Minimize paperwork required</li> </ul>

## Compliance and Enforcement – Tasks

Market Actor	Task(s)	Success Criteria
Insulation Contractor	<ul style="list-style-type: none"> <li>- Install insulation according to QII criteria</li> <li>- Ensure work is not compromised by other subs.</li> <li>- Make sure field crews are aware of requirements needed to meet QII</li> <li>- Complete CF-2R for QII and registers the forms with the HERS Provider on the project site</li> </ul>	<ul style="list-style-type: none"> <li>- Meet builder's schedules</li> <li>- Complete installs w/o budget overruns</li> <li>- Minimize time spent installing insulation on site</li> <li>- Minimize training needed for field crews</li> <li>- Minimize paperwork needed to complete</li> </ul>
Other Subs (HVAC, Plumbing, Electrical)	<ul style="list-style-type: none"> <li>- Ensure any work they are responsible for does not affect insulation or air barrier integrity</li> </ul>	<ul style="list-style-type: none"> <li>- Work trades are responsible for is not compromised by QII requirements</li> <li>- Minimize additional level of effort</li> </ul>
Plans Examiner	<ul style="list-style-type: none"> <li>- Verify that CF-1R is consistent with building plans and meets compliance criteria for local jurisdiction</li> </ul>	<ul style="list-style-type: none"> <li>- Minimize amount of paperwork needed to review</li> </ul>

## Compliance and Enforcement – Tasks

Market Actor	Task(s)	Success Criteria
Building Inspector	<ul style="list-style-type: none"> <li>- Verify that all required HERS inspections listed on CF-1R have CF-2R and CF-3R paperwork</li> <li>- Verify that all paperwork is in order and CF-2R and CF-3Rs are signed off and certified</li> <li>- Sign off permit</li> </ul>	<ul style="list-style-type: none"> <li>- Minimize amount of paperwork needed to complete process</li> </ul>
HERS Rater	<ul style="list-style-type: none"> <li>- Review CF-2Rs and documents materials used on site</li> <li>- Inspect both air sealing and insulation components (min 2 – 3 site visits)</li> <li>- Verify QII requirements are being met</li> <li>- Makes sure all parties are aware of responsibilities and expectations</li> <li>- If project does not pass, communicate issues with responsible parties and require re-inspection</li> <li>- Complete and submit CF-3Rs to HERS Registry</li> </ul>	<ul style="list-style-type: none"> <li>- All projects meet QII criteria and pass without issues</li> <li>- Minimize the amount of inspection failures and callbacks</li> <li>- Complete inspections quickly and under budget</li> <li>- Maintain healthy working relationships with other market actors</li> </ul>
Building Owner	<ul style="list-style-type: none"> <li>- Little direct involvement unless spec builder</li> <li>- Develop project goals including programming, schedules, &amp; budget</li> </ul>	<ul style="list-style-type: none"> <li>- Coordination with project team,</li> <li>- Minimize amount of paperwork needed to complete process</li> <li>- Project completed to expected standards and within budget</li> </ul>

## Compliance and Enforcement – Resources

Market Actor	Resource(s)
T-24 Consultant	<ul style="list-style-type: none"> <li>- CBEEC-Res / EnergyPro compliance software</li> <li>- EnergyCodeAce tools</li> <li>- T-24 Compliance manuals</li> </ul>
Builder / General Contractor	<ul style="list-style-type: none"> <li>- Building officials at jurisdiction</li> <li>- T-24 Consultant</li> <li>- HERS Rater</li> <li>- Insulation Contractor</li> </ul>
Insulation Contractor and Other Subs	<ul style="list-style-type: none"> <li>- EnergyCodeAce tools</li> <li>- Utility-sponsored training classes?</li> <li>- HERS Rater</li> </ul>
HERS Rater	<ul style="list-style-type: none"> <li>- EnergyCodeAce tools</li> <li>- CalCERTS / CHEERS Trainings</li> <li>- Utility-sponsored training classes?</li> </ul>
Plans Examiner / Building Inspector	<ul style="list-style-type: none"> <li>- EnergyCodeAce tools</li> <li>- CalCERTS / CHEERS Trainings</li> <li>- Utility-sponsored training classes?</li> </ul>

## Strawman Code Change Language

- Title 24 Standards
  - Update Table 150.1-A Component Package A to include QII in prescriptive packages
- Residential Appendices
  - Sections RA2.2 (including Table RA2-1), & RA3.5
- Residential Alternative Compliance Method (ACM) Reference Manual
  - Section 2.2.6 – Insulation Construction Quality, including Table 4
- Applies to new construction
  - Additions greater than certain size (??? Sqft)

---

## Feedback Request from Stakeholders

- *We would like your input....*
- Input on proposals included in presentation
  - QII as prescriptive requirement
  - “Partial-credit” QII compliance criteria
  - HERS rater costs
- Please provide input at [Title24Stakeholders.com](http://Title24Stakeholders.com)

---

# Thank you.

Bill Dakin

Davis Energy Group

[bldakin@davisenergy.com](mailto:bldakin@davisenergy.com)

