DOCKETED

Docket Number:	17-BSTD-01
Project Title:	2019 Building Energy Efficiency Standards PreRulemaking
TN #:	217838
Document Title:	Presentation - Residential Quality Insulation Installation
Description:	Acrobat version of the Residential Quality Insulation Installation presentation by Michael Shewmaker made at the 6-1-17 Staff Workshop.
Filer:	Adrian Ownby
Organization:	California Energy Commission
Submitter Role:	Commission Staff
Submission Date:	6/5/2017 10:46:17 AM
Docketed Date:	6/5/2017

Residential Quality Insulation Installation

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2019 Pre-Rulemaking Workshop
Rosenfeld Hearing Room
June 1st, 2017

Acknowledgements

California Utilities Statewide Codes and Standards Team

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What is QII?

RA3.5 Quality Insulation Installation Procedures

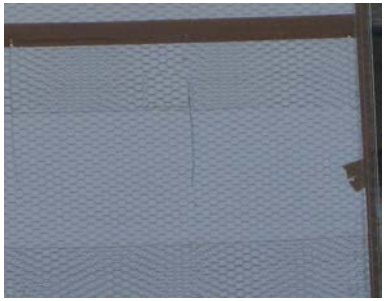
- A procedure for **verifying the quality of insulation installation** and air leakage control used in low-rise residential buildings. This procedure is to be followed by the insulation installer and a qualified Home Energy Rating System (HERS) rater must verify its conformance for meeting the requirements of §150.1(c) and §110.7 of the Standards.
- The procedure applies to wood and metal construction of framed and non-framed envelope assemblies. Framed assemblies include wall stud cavities, roof/ceiling assemblies, and floors.

QII Insulation Types

Batt & Blanket

Loose Fill

Rigid Board

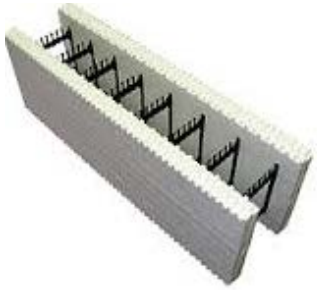


Below Deck Insulation

SPF

SIP

ICF



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Why We Have QII

Why We Have QII

What QII Should Look Like

Proposed Code Change Overview

What's being proposed for 2019?

- QII as a prescriptive measure for new construction and additions greater than 700 ft^2:
  - Single Family: All Climate Zones
  - Multifamily: CZs 1-6 & 8-16
- Will require HERS verification

Code Requirements

- **2005** – Introduced compliance credit for high quality insulation installation (QII)
- **2008** – No changes from 2005
- **2013** – QII verification procedures were revised to better align with ENERGY STAR's Thermal Bypass Checklist
  - Resulted in more stringent inspection procedures
- **2016** – QII was proposed as a mandatory measure, but ultimately removed from the CASE Report and left as a compliance credit
  - Removed to allow builders more time to adopt

Methodology for Savings Analysis

Methodology

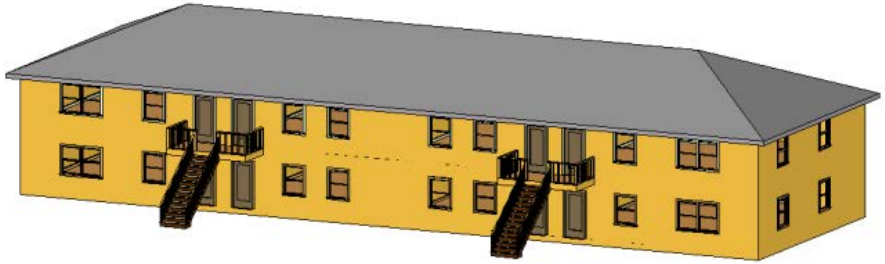
- CBECC-Res energy simulations
  - 2019 TDV values
  - 3 standard building prototypes:
    - Single Family:
      - 2,100 ft^2, 1-story
      - 2,700 ft^2, 2-story
    - Multifamily:
      - 6,960 ft^2, 8-unit, 2-story
  - ‘Standard’ vs. ‘Improved’ insulation construction quality

Building Prototypes

2,100 ft^2 Prototype

2,700 ft^2 Prototype

6,960 ft^2 Prototype



Incremental Cost Analysis

Incremental First Costs

- Estimates from detailed interviews with HERS raters and builders as well as previous research
- Cost estimates were made to reflect costs expected in the year 2020
- Incremental costs for QII include additional labor costs to install and air seal to QII Standards and HERS rater inspection costs
  - All incremental costs are based on labor only
  - No incremental material costs are assumed

Incremental Costs

Labor Costs

- Labor costs were based on a fully loaded labor rate from RSMeans of $44/hour after applying an average CA regional multiplier of 1.1
- Assumptions for labor:
  - 2 additional hours for single family
  - 1 additional hour, per dwelling unit, for multifamily

HERS Verification Costs

- HERS verification costs were obtained from interviews with raters and builders
- Includes assumptions for sampling:
  - 50% test rate (1-in-2) for single family
  - 25% test rate (1-in-4) for multifamily

HERS Rater Costs for QII

Single Family Assumptions

- 3 QII inspections per tested single family building with the third inspection completed at the time of other final HERS inspections and tests, and an average cost of $433 ($142/inspection)
- Costs for sampled units are based on the average cost for a single inspection of $183

HERS Verification	**Single Family**
	2,430 ft^2 Prototype
QII Tested	
QII only site visit ($/visit)	$183
Site visit combined w/ other measure ($/visit)	$67
Tested, Total Inspection Cost (3 visits)	$433
HERS Verification (Sampled)	$183
HERS Testing Rate	1-in-2
Avg. Cost per Home	$308

HERS Rater Costs for Multifamily QII

Multifamily Assumptions

- 4 site visits per building and a per visit cost for the 8-unit prototype building of $225 ($225 x 4 = $900)
- The assumption includes inspection of all units during the same visit

HERS Verification	**Multifamily**
	6,960 ft^2 8-Unit Bldg
QII - All units tested (4 site visits per building)	$900
HERS Verification (Sampled Cost/Building)	$400
HERS Testing Rate	1-in-4
Avg. HERS Cost per Building	$525

Cost Basis
(Average Installed Cost)

Component	Single Family (2,100 ft^2 & 2,700 ft^2 Prototypes)	Multifamily (6,960 ft^2, 8-unit Prototype)
Additional Installation Labor	$88	$352
HERS Verification (Tested)	$433	$900
HERS Verification (Sampled)	$183	$400
HERS Testing Rate	1-in-2	1-in-4
Avg. Cost per Building	**$396**	**$877**

Single Family – 2,100 ft^2 Prototype

Energy and Cost-Effectiveness Results

Per-Unit Energy Impacts

Single Family (2,100 ft^2 Prototype)

Climate Zone	Electricity Savings (kWh/yr)	Peak Electricity Demand Reductions (kW)	Natural Gas Savings (therms/yr)	TDV Energy Savings (TDV kBtu/yr)
1	46	0.00	53.91	12,516
2	28	0.03	29.66	8,211
3	23	0.00	27.11	6,552
4	25	0.04	20.99	7,077
5	23	0.00	27.67	6,573
6	18	0.02	15.98	4,767
7	9	0.02	9.58	2,583
8	35	0.11	9.45	6,132
9	60	0.13	12.17	7,665
10	70	0.12	14.49	7,644
11	134	0.13	27.66	13,188
12	63	0.15	26.04	11,340
13	149	0.15	22.87	13,020
14	123	0.14	27.81	13,041
15	273	0.21	4.41	13,230
16	54	0.04	47.25	12,054

TDV Energy Cost Savings

Single Family (2,100 ft^2 Prototype)

Climate Zone	30-Year TDV Electrical Cost Savings (2020 PV $)	30-Year TDV Natural Gas Cost Savings (2020 PV $)	Total 30-Year TDV Energy Cost Savings (2020 PV $)
1	$222	$1,944	$2,165
2	$302	$1,119	$1,421
3	$109	$1,025	$1,133
4	$425	$799	$1,224
5	$109	$1,028	$1,137
6	$211	$614	$825
7	$91	$356	$447
8	$694	$367	$1,061
9	$857	$469	$1,326
10	$767	$556	$1,322
11	$1,232	$1,050	$2,282
12	$970	$992	$1,962
13	$1,377	$876	$2,252
14	$1,188	$1,068	$2,256
15	$2,114	$174	$2,289
16	$320	$1,766	$2,085

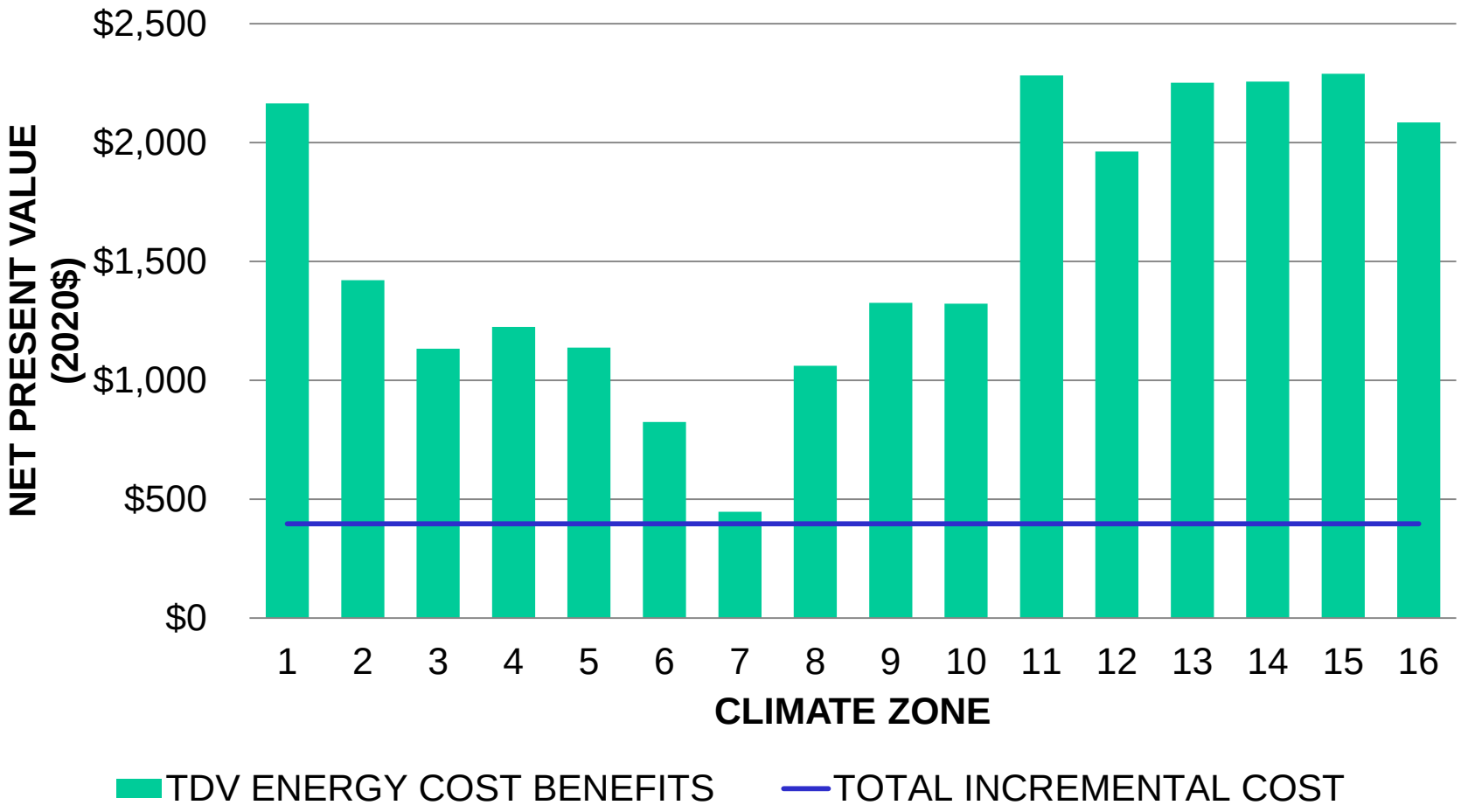
Lifecycle Cost-Effectiveness Summary

Single Family (2,100 ft^2 Prototype)

Climate Zone	Benefits TDV Energy Cost Savings + Other PV Savings (2020 PV $)	Costs Total Incremental Present Valued (PV) Costs (2020 PV $)	Benefit-to-Cost Ratio
1	$2,165	$396	5.47
2	$1,421	$396	3.59
3	$1,133	$396	2.86
4	$1,224	$396	3.09
5	$1,137	$396	2.87
6	$825	$396	2.08
7	$447	$396	1.13
8	$1,061	$396	2.68
9	$1,326	$396	3.35
10	$1,322	$396	3.34
11	$2,282	$396	5.76
12	$1,962	$396	4.95
13	$2,252	$396	5.69
14	$2,256	$396	5.70
15	$2,289	$396	5.78
16	$2,085	$396	5.26

Benefit-to-Cost Ratio

Single Family (2,100 ft^2 Prototype)



Single Family – 2,700 ft^2 Prototype

Energy and Cost-Effectiveness Results

Per-Unit Energy Impacts

Single Family (2,700 ft^2 Prototype)

Climate Zone	Electricity Savings (kWh/yr)	Peak Electricity Demand Reductions (kW)	Natural Gas Savings (therms/yr)	TDV Energy Savings (TDV kBtu/yr)
1	46	0.00	54.88	12,744
2	36	0.04	32.11	9,747
3	23	0.01	27.69	6,831
4	33	0.06	24.33	8,640
5	22	0.00	28.02	6,669
6	19	0.02	17.38	5,130
7	10	0.02	10.22	2,862
8	39	0.10	10.84	6,561
9	69	0.13	13.88	8,262
10	81	0.13	16.01	8,856
11	150	0.13	30.97	13,770
12	81	0.16	29.10	13,635
13	165	0.18	25.96	14,661
14	141	0.16	31.26	14,796
15	333	0.26	6.06	16,308
16	62	0.05	54.38	13,851

TDV Energy Cost Savings

Single Family (2,700 ft^2 Prototype)

Climate Zone	30-Year TDV Electricity Cost Savings (2020 PV $)	30-Year TDV Natural Gas Cost Savings (2020 PV $)	Total 30-Year TDV Energy Cost Savings (2020 PV $)
1	$229	$1,976	$2,205
2	$476	$1,210	$1,686
3	$131	$1,051	$1,182
4	$570	$925	$1,495
5	$107	$1,046	$1,154
6	$224	$663	$887
7	$117	$378	$495
8	$719	$416	$1,135
9	$897	$532	$1,429
10	$916	$617	$1,532
11	$1,210	$1,172	$2,382
12	$1,256	$1,102	$2,359
13	$1,546	$990	$2,536
14	$1,364	$1,196	$2,560
15	$2,588	$234	$2,821
16	$374	$2,023	$2,396

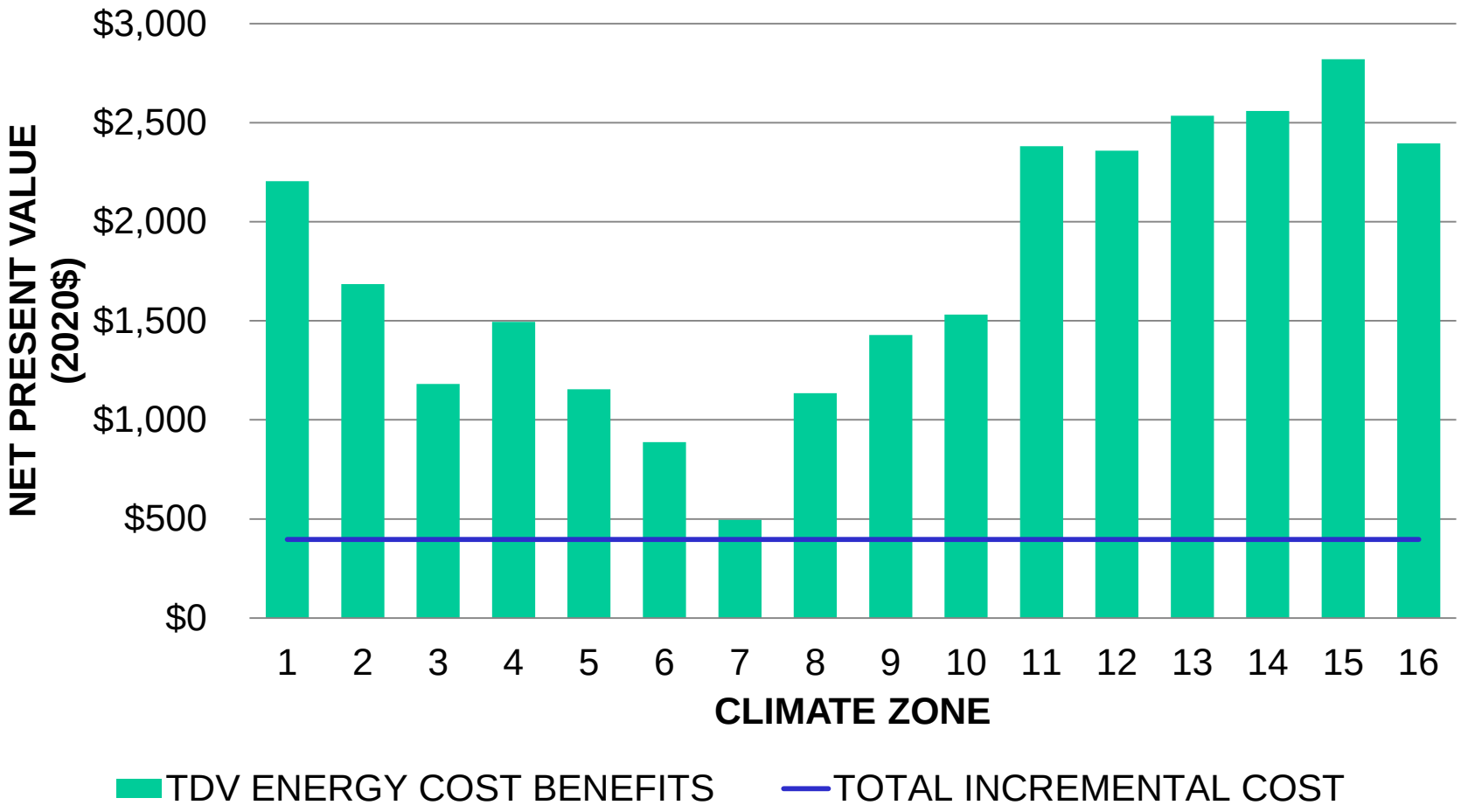
Lifecycle Cost-Effectiveness Summary

Single Family (2,700 ft^2 Prototype)

Climate Zone	Benefits TDV Energy Cost Savings + Other PV Savings (2020 PV $)	Costs Total Incremental Present Valued (PV) Costs (2020 PV $)	Benefit-to-Cost Ratio
1	$2,205	$396	5.57
2	$1,686	$396	4.26
3	$1,182	$396	2.98
4	$1,495	$396	3.77
5	$1,154	$396	2.91
6	$887	$396	2.24
7	$495	$396	1.25
8	$1,135	$396	2.87
9	$1,429	$396	3.61
10	$1,532	$396	3.87
11	$2,382	$396	6.01
12	$2,359	$396	5.96
13	$2,536	$396	6.40
14	$2,560	$396	6.46
15	$2,821	$396	7.12
16	$2,396	$396	6.05

Benefit-to-Cost Ratio

Single Family (2,700 ft^2 Prototype)



Multifamily – 6,960 ft^2 8-unit Prototype

Energy and Cost-Effectiveness Results

Per-Unit Energy Impacts

Multifamily (6,960 ft^2 8-unit Prototype)

Climate Zone	Electricity Savings (kWh/yr)	Peak Electricity Demand Reductions (kW)	Natural Gas Savings (therms/yr)	TDV Energy Savings (TDV kBtu/yr)
1	48	-0.02	91.84	21,228
2	58	0.05	57.88	16,495
3	-4	0.00	36.89	8,422
4	81	0.15	40.17	14,686
5	-36	-0.08	32.23	5,150
6	5	0.03	17.73	5,359
7	-16	0.03	1.89	1,114
8	81	0.14	8.66	8,770
9	126	0.24	15.52	13,363
10	124	0.20	19.85	13,015
11	250	0.26	54.04	26,239
12	159	0.21	52.45	22,411
13	277	0.29	46.24	25,404
14	232	0.24	54.28	24,778
15	518	0.42	2.44	24,778
16	130	0.08	107.37	27,840

TDV Energy Cost Savings

Multifamily (6,960 ft^2 8-unit Prototype)

Climate Zone	30-Year TDV Electricity Cost Savings (2020 PV $)	30-Year TDV Natural Gas Cost Savings (2020PV $)	Total 30-Year TDV Energy Cost Savings (2020PV $)
1	$301	$3,371	$3,672
2	$650	$2,203	$2,854
3	$48	$1,409	$1,457
4	$1,011	$1,529	$2,541
5	-$325	$1,216	$891
6	$241	$686	$927
7	$132	$60	$193
8	$1,180	$337	$1,517
9	$1,722	$590	$2,312
10	$1,481	$771	$2,252
11	$2,480	$2,059	$4,539
12	$1,878	$1,999	$3,877
13	$2,613	$1,782	$4,395
14	$2,203	$2,083	$4,287
15	$4,190	$96	$4,287
16	$807	$4,010	$4,816

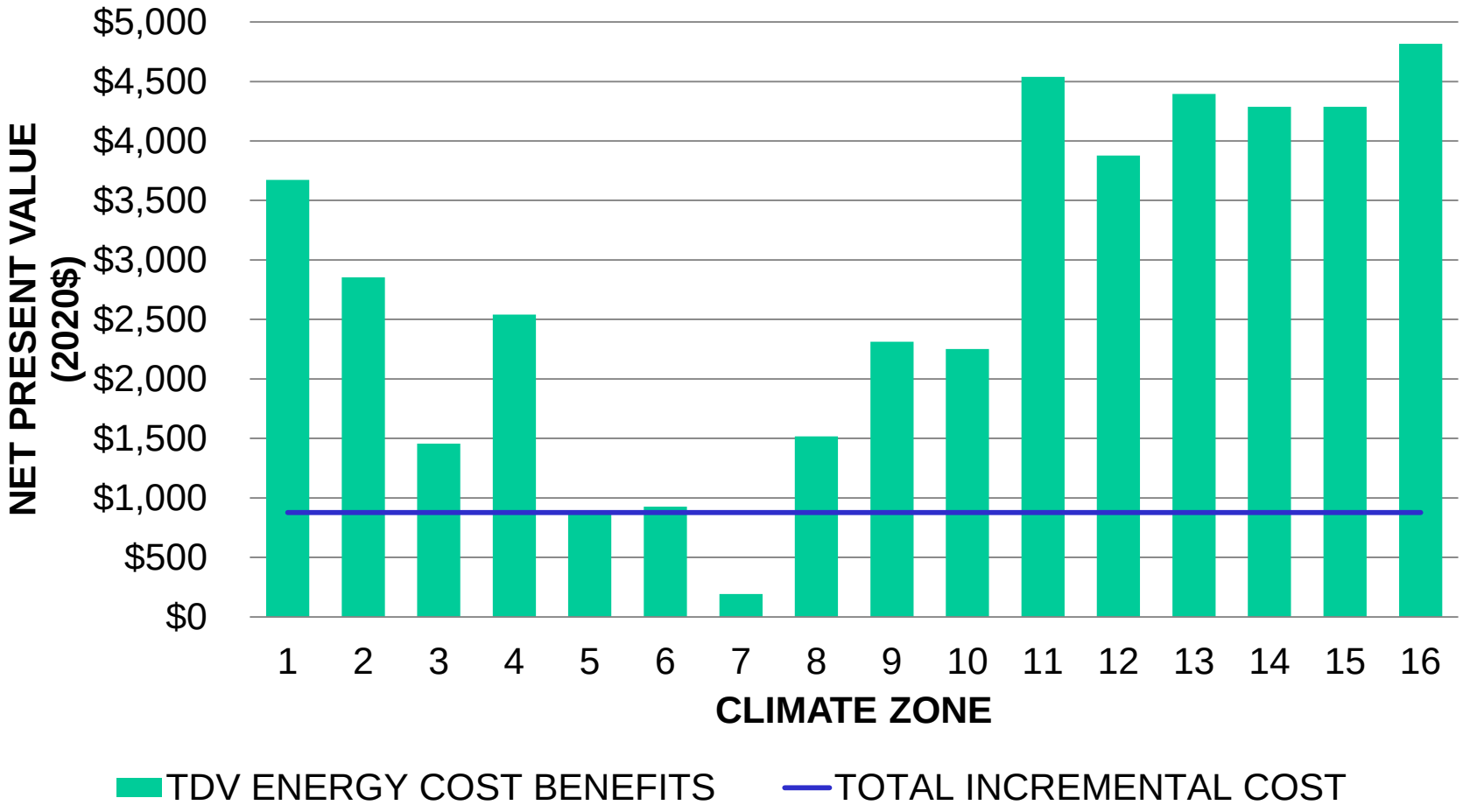
Lifecycle Cost-Effectiveness Summary

Multifamily (6,960 ft^2 8-unit Prototype)

Climate Zone	Benefits TDV Energy Cost Savings + Other PV Savings (2020 PV $)	Costs Total Incremental Present Valued (PV) Costs (2020 PV $)	Benefit-to-Cost Ratio
1	$3,672	$877	4.19
2	$2,854	$877	3.25
3	$1,457	$877	1.66
4	$2,541	$877	2.90
5	$891	$877	1.02
6	$927	$877	1.06
7	$193	$877	0.22
8	$1,517	$877	1.73
9	$2,312	$877	2.64
10	$2,252	$877	2.57
11	$4,539	$877	5.18
12	$3,877	$877	4.42
13	$4,395	$877	5.01
14	$4,287	$877	4.89
15	$4,287	$877	4.89
16	$4,816	$877	5.49

Benefit-to-Cost Ratio

Multifamily (6,960 ft² 8-unit Prototype)



Proposed Code Change Overview

What's being proposed for 2019?

- QII as a prescriptive measure for new construction and additions greater than 700 ft^2:
  - Single Family: All Climate Zones
  - Multifamily: CZs 1-6 & 8-16
- Will require HERS verification

Proposed Changes to Code Language

Building Energy Efficiency Standards

- Remove prescriptive option for storage water heaters
- Add row to Table 150.1-A

Reference Appendices

- Clean-up/clarification of verification procedures
- Add ‘Special Situation – Roof Deck Insulation’

Residential Compliance Manual

- Remove prescriptive option for storage water heaters
  - Option 2

Alternative Compliance Options

- Reduced building envelope leakage
- Cool roof (cooling dominated climate zones)
- High efficiency furnace
- High efficiency AC
- HVAC – zonal control
- Ducts located in directly conditioned space
  - Verified low-leakage ducts entirely in conditioned space
- High efficiency water heater
  - Condensing tankless water heater
- Drain water heat recovery

Key Web-Links/Resources

2019 Title 24 Utility-Sponsored Stakeholder Info

http://www.title24stakeholders.com/

Building Energy Efficiency Program

http://www.energy.ca.gov/title24/

Docket for Comments

https://efiling.energy.ca.gov/EComment/EComment.aspx?docketnumber=17-BSTD-01

Compliance Software

http://www.bwilcox.com/BEES/BEES.html

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Questions?