DOCKETED	
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Project Title:	2022 Energy Code Pre-Rulemaking
TN #:	235453
Document Title:	Presentation-October 27, 2020 Energy Code on Pre-Rule Making Workshop
Description:	Staff Presentation on Steam Trap Monitoring and Controlled Environmental Horticulture by: Payam Bozorgchami on October 27, 2020 on Energy Code on Pre-Rule Making Workshop
Filer:	Tajanee Ford-Whelan
Organization:	Efficiency Division
Submitter Role:	Public Agency
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2022 Pre-Rulemaking for Building Energy Efficiency Standards

Payam Bozorgchami, P.E.

October 27, 2020

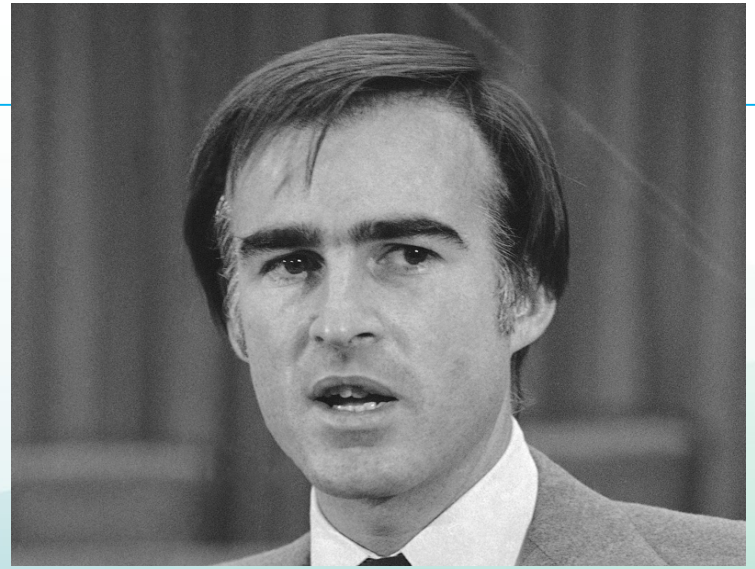
Start Time: 9:00 AM

What We Will Cover Today

- **Some Basic Background**
- **How Title 24, Part 6 is Developed**
- **Haile Bucaneg**
  - Steam Trap Monitoring
    - Steam Tram Fault Detection
    - Steam Trap Strainer and Blow-off Valve assembly
- **Thao Chau**
  - Controlled Environmental Horticulture
    - Lighting minimum Efficacy
    - Dehumidification Requirements
    - Envelope Requirement for Greenhouses

Authority & Process

- **Public Resources Code (PRC 25402):** Reduction of wasteful, uneconomic, inefficient, or unnecessary consumption of energy
  - (a)(1) Prescribe, by regulation, lighting, insulation, climate control system, and other building design and construction standards that increase the efficiency in the use of energy and water…
  - Warren Alquist Act Signed into law in 1974 by Governor Ronald Reagan and launched by Governor Jerry Brown in 1975 which mandates updates Building Efficiency Standards and requires the building departments to enforce them through the permit process.



Goals of the California Energy Code

1. Increase building energy efficiency cost-effectively
2. Contribute to the state's GHG reduction goals
3. Enable pathways for all-electric buildings
4. Reduce residential building impacts on the electricity grid
5. Promote demand flexibility and self-utilization of PV generation
6. Provide tools for local government reach codes

Process Used to Updated Energy Codes

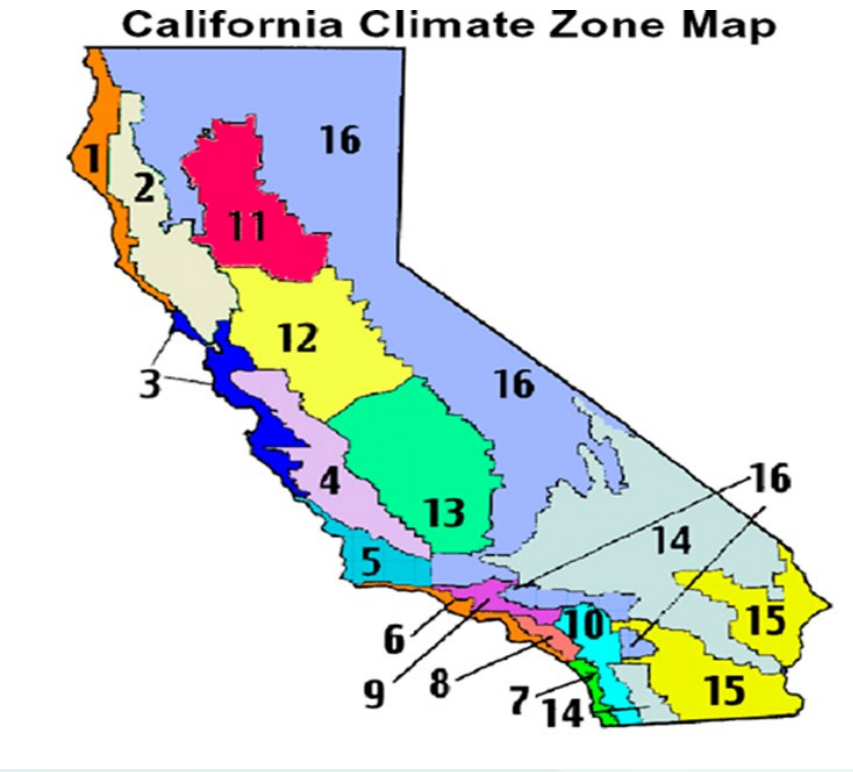
CEC staff, with input from utility partners and industry stakeholders, develop the triennial standards update

Opportunities for participation

- Utility-Sponsored Stakeholder Meetings
- CEC-Sponsored Workshops

Standards must be cost-effective

- Life-Cycle Costing Methodology
- Time Dependent Valuation (TDV)



2022 Standards Process

2022 STANDARDS UPDATE SCHEDULE	
DATE	**MILESTONES**
November 2018 - November 2019	Updated Weather Files
November 2018-December 2019	Metric Development
November 2018-July 2019	Measures Identified and approval
August 2019 to October 2020	Stakeholder meeting/workshop & final staff workshop
August 2020-October 2020	CASE Reports submitted to the CEC
February 2021	45-day Language Hearings
July 2021	Adoption of 2022 Standards at a Business Meeting
July 2021 to November 2021	Staff work on Software, Compliance Manuals, Electronic Documents Available to Industry
December of 2021	Approval of the Manuals
January 2022	Software, Compliance Manuals, Electronic Documents Available to Industry
January 1, 2023	Effective Date

Tentative Pre-Rulemaking Schedule

- **September 1**
  - Energy Savings and Process Improvements for Alterations and Additions
    - Roof deck insulation for low-slope roofs
    - Prescriptive attic insulation for alterations
    - Prescriptive duct sealing
    - Electric resistance water heating
    - Electric resistance space heating
    - 40-ft trigger for prescriptive duct requirements
    - Cool roof for steep-slope roofs
    - Cool roof for low-slope roof
- **September 9**
  - Nonresidential Grid Integration
  - Controlled Receptacle, CEA Proposal
- **September 10**
  - Verification Testing
- **September 22**
  - Outdoor lighting
  - Daylighting
- **September 23**
  - Computer Room Efficiencies
  - Pipe Sizing and Leak Testing for Compressed Air Systems
  - Refrigeration System Operation

Tentative Pre-Rulemaking Schedule (Cont.)

- **September 30**
  - Indoor Air Quality Roundtable discussion with the outside world
- **October 6 and November 19**
  - Solar Photo Voltaic and Electrification
  - Multifamily All Electric
- **October 7**
  - Nonresidential Indoor Lighting
  - Air Distribution
  - Nonresidential HVAC Controls
- **October 13**
  - Multifamily Domestic Hot Water
  - Multifamily Restructuring
- **October 20**
  - Nonresidential High Performance Envelope
- **October 27**
  - Control Environmental Horticulture
  - New Construction Steam Trap
- **November 3 ~~October 29~~ (Commissioner roundtable discussion on September 30 on IAQ)**
  - Indoor Air Quality Roundtable discussion with the outside world
  - Nonresidential Reduced Infiltration

Key Web-Links

2022 Title 24 Utility-Sponsored Stakeholder
http://title24stakeholders.com/

Building Energy Efficiency Program
http://www.energy.ca.gov/title24/

Comments to be submitted to:
https://efiling.energy.ca.gov/EComment/EComment.aspx?docketnumber=19-BSTD-03

NOTE: For this workshop comments To Be Submitted By November 10, 2020

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Comments For Todays Workshop

Due Date: November 10, 2020 By 5:00 PM

Comments to be submitted to:
https://efiling.energy.ca.gov/EComment/EComment.aspx?docketnumber=19-BSTD-03

Questions ?

Thank You!

Steam Trap Monitoring for 2022

Staff Pre-Rulemaking Workshop

Presenter: Haile Bucaneg, Senior Mechanical Engineer

Date: October 27, 2020

Proposal Summary

Submeasures pertaining to Steam Trap Monitoring:

- Automatic steam trap fault detection and diagnostics.
- Steam trap strainer and blow-off valve assembly.

2022 Code Update Sections Affected

Building Energy Efficiency Standards for Residential and Nonresidential Buildings:

- Section 100.1(b) – Definitions.
- Section 120.6(j) – Mandatory Requirements for Steam Traps.

Reference Appendices:

- NA7.21 Steam Trap Fault Detection Acceptance Tests.

Automatic Steam Trap Fault Detection and Diagnostics (FDD)

Automatic Steam Trap FDD

Steam Trap FDD Requirements Apply to the Following:

- New industrial facilities and steam traps serving new industrial process equipment in existing industrial facilities.
- Operating pressure is greater than 15 psig and,
- Total combined connected boiler input rating is greater than 5 million Btu/hr

Automatic Steam Trap FDD

Steam Trap Fault Detection:

- Steam traps shall be equipped with automatic fault detection sensors.

Central Steam Trap FDD Monitoring System:

- Provide a status update of all steam trap FDD sensors at no greater than 8-hour intervals.
- Automatically transmits an alarm to the facility operator that identifies which steam trap has a fault once the system has detected a fault.

Automatic Steam Trap FDD

Acceptance testing:

- Construction inspection.
- Functional testing.
  - 7 steam traps or less will require each device be tested.
  - More than 7 steam traps sampling can be used.

Automatic Steam Trap FDD

Cost Element	Cost (2023 PV)
Sensor	$955.47
Sensor Installation Labor	$95.55
Gateway ($2,500 per 25 sensors)	$100.00
Gateway Installation Labor ($200 per 25 sensors	$8.00
Building Permit (permit per sensor)	$95.55
Manual Trap Assessment Savings (per trap)	$(19.42)
Central Monitoring Platform (per sensor)	$19.42
Total Incremental First Cost	**$1,254.57**

Automatic Steam Trap FDD

Cost Element	Cost (2023 PV)	Year Cost is Incurred
Sensor	$710.96	10
Sensor Installation Labor	$71.10	10
Gateway ($2,500 per 25 sensors)	$74.41	10
Gateway Installation Labor ($200 per 25 sensors)	$5.95	10
Building Permit (permit per sensor)	$71.10	10
Manual Trap Assessment Savings (per trap)	$(227.73)	1-15
Central Monitoring Platform (per sensor)	$227.73	1-15
Battery	$323.11	3, 6, 9, 12, 15
Total Incremental Maintenance and Equipment Cost	**$1,256.62**	

Automatic Steam Trap FDD

Table 13: Orifice Diameter (inches) by Gauge Pressure (psig)

	Orifice1	Orifice2	Orifice3	Orifice4	Orifice5	Orifice6	Orifice7	Orifice8	Orifice9
15	3/16	1/4	5/16	3/8	1/2	9/16	7/8		
30	1/8	5/32	3/16	1/4	9/32	5/16	3/8	7/16	3/4
45	1/8	5/32	3/16	1/4	5/16	3/8	7/16	5/8	
60	1/8	5/32	3/16	7/32	9/32	11/32	3/8	1/2	
80	7/64	1/8	5/32	3/16	1/4	9/32	5/16	11/32	1/2
100	7/64	1/8	5/32	3/16	1/4	9/32	5/16	11/32	1/2
125	7/64	1/8	5/32	3/16	1/4	9/32	5/16	11/32	7/16
150	7/64	1/8	5/32	3/16	1/4	9/32	5/16	11/32	7/16
200	7/64	1/8	5/32	3/16	1/4	9/32	5/16	11/32	3/8
250	5/64	7/64	1/8	5/32	3/16	1/4	9/32	5/16	11/32
300	5/64	7/64	1/8	5/32	7/32	1/4	9/32	5/16	11/32
400	5/64	1/8	5/32	3/16	7/32	9/32	5/16		
500	5/64	7/64	1/8	5/32	3/16	7/32	1/4	9/32	
600	5/64	3/32	1/8	5/32	3/16	7/32	1/4		

Automatic Steam Trap FDD

Table 18: Steam trap FDD –Energy Savings Per Steam Trap

Gauge Pressure (psig)	Typical Orifice Diameter (inch)	Market Share	Open Trap Steam Loss [W] (lb/hr-trap)	Specific Enthalpy Change Fluid to Gas [hfg] (Btu/lb)	Annual Open Trap Energy Loss [Eloss] (Btu/hr-trap)	Annual Energy Savings [ES] (therms/yr-trap)
15	3/16	9.8%	73.79	945.7	69,781	224
30	3/16	10.7%	69.60	929.1	64,667	208
45	5/32	20.3%	83.50	915.9	76,475	246
60	5/32	8.6%	88.64	904.9	80,206	258
80	5/32	7.8%	102.83	892.2	91,744	295
100	5/32	8.6%	124.55	881.0	109,725	352
125	1/8	17.1%	136.99	868.7	119,003	382
150	1/8	7.7%	161.50	857.6	138,506	445
200	7/64	4.9%	192.00	838.0	160,896	517
250	7/64	0.9%	184.32	820.7	151,274	486
300	7/64	0.7%	231.44	805.0	186,308	598
400	5/64	0.5%	235.84	777.0	183,244	588
500	5/64	1.2%	246.83	751.9	185,594	596
600	3/32	1.1%	266.60	728.8	194,296	624
Weighted Average Values:				**891.7**	**99,664**	**320**

Automatic Steam Trap FDD

	Stem Trap FDD Energy Cost Savings over 15-Year Period of Analysis (PV/ trap)	Steam Trap FDD Incremental Cost Over 15-year Period of Analysis (2023 PV/trap)	Steam Trap FDD B/C Ratio
Weighted Average Values	**$6,576**	**$2,511**	**2.62**

Automatic Steam Trap FDD

Electricity Savings (GWh/yr)	Reduced GHG Emissions from Electricity Savings (Metric Tons CO2e)	Natural Gas Savings (Million therms/yr)	Reduced GHG Emissions from Natural Gas Savings (Metric Tons CO2e)	Total Reduced CO2e Emissions (Metric Tons CO2e)
0.064	15.344	3.156	17,211.9	17,227.3

- 1.8% expected growth – Federal Reserve industrial production index.
- 2% reduction based on systems less than 5 million Btu/hr.
- 5% steam leakage from failed traps.
- 9,860 steam traps statewide (3,200 industrial boilers statewide).

Automatic Steam Trap FDD

Technical Feasibility

- Various steam trap monitoring devices available.
  - Wired.
  - Wireless.
- Various system pressures analyzed.

Cost Effectiveness

- Applicable in all climate zones.

Proposed Code: Steam Trap FDD

120.6(j) Mandatory Requirements for Steam Traps. Steam traps in new industrial facilities and steam traps serving new industrial process equipment in existing industrial facilities where the installed steam trap operating pressure is greater than 15 psig and the total combined connected boiler input rating is greater than 5 Million Btu/hr, the steam traps shall conform to the following:

1. Central Steam Trap FDD Monitoring. Steam trap systems shall be equipped with a central steam trap monitoring system that:

A. Provides a status update of all steam trap fault detection sensors at no greater than 8-hour intervals.

B. Automatically transmits an alarm to the facility operator that identifies which steam trap has fault once the system has detected a fault.

2. Steam Trap Fault Detection. Steam traps shall be equipped with automatic fault detection sensors that shall communicate their operational state to the central steam trap monitoring system as described in item 120.6(j)2 of this section.

Staff Questions

Automatic steam trap FDD:

- Q1: is the statewide savings methodology used in the report clear?
- Q2: are the steam trap failure assumption typical in the industry?
  - 6 months between failure and finding the failure.
  - 66% steam trap failures assumed to fail open.
- Q3: is proposed standard language clear?

QUESTION?

Steam Trap Strainer and Blow-Off Valve Assembly

Steam Trap Strainer and Blow-Off Valve Assembly

Steam Trap Strainer and Blow-Off Valve Assembly Requirements Apply to the Following:

- New industrial facilities and steam traps serving new industrial process equipment in existing industrial facilities.
- Operating press is greater than 15 psig and,
- Total combined connected boiler input rating is greater than 5 million Btu/hr

Steam Trap Strainer and Blow-Off Valve Assembly

Steam Trap Strainer and Blow Off Valve Assembly Installation:

- Steam trap must be installed downstream within 3 feet of a strainer and blow-off valve, or
- Integral steam trap strainer and blow-off valve assembly.

Steam Trap Strainer and Blow-Off Valve Assembly

Acceptance testing:

- Construction inspection.

Steam Trap Strainer and Blow-Off Valve Assembly

Cost Element	Cost (2023 PV)
Strainer (weighted average)	$410.74
• Standalone Strainer Incremental Cost (75% market presence)	$505.52
• Integral Strainer Incremental Cost (25% market presence)	$126.38
Installation Labor	$75.00
Total Incremental First Cost	**$485.74**

Steam Trap Strainer and Blow-Off Valve Assembly

Cost Element	Cost (2023 PV)	Year Cost is Incurred
Strainer	$333.97	7
Strainer Installation Labor	$60.98	7
Steam Trap Replacement (4 year interval)	$(894.42)	4, 8, 12
Steam Trap Replacement Labor (4 year interval)	$(178.45)	4, 8, 12
Steam Trap Replacement (6 year interval)	$578.49	6, 12
Steam Trap Replacement Labor (6 year interval)	$115.41	6, 12
Maintenance	$97.34	1-15
Total Incremental Maintenance and Equipment Cost	**$113.33**	

Steam Trap Strainer and Blow-Off Valve Assembly

Table 19: Steam Trap Strainer Installation –Energy Savings Per Strainer

Gauge Pressure (psig)	Orifice Diameter (inch)	Market Share	Open Trap Steam Loss [W] (lb/hr-trap)	Specific Enthalpy Change Fluid to Gas [hfg] (Btu/lb)	Open Trap Energy Loss [Eloss] (Btu/hr-trap)	Annual Energy Savings [ES] (therms/yr-strainer)
15	3/16	9.8%	73.79	945.7	69,781	75
30	3/16	10.7%	69.60	929.1	64,667	69
45	5/32	20.3%	83.50	915.9	76,475	82
60	5/32	8.6%	88.64	904.9	80,206	86
80	5/32	7.8%	102.83	892.2	91,744	98
100	5/32	8.6%	124.55	881.0	109,725	117
125	1/8	17.1%	136.99	868.7	119,003	127
150	1/8	7.7%	161.50	857.6	138,506	148
200	7/64	4.9%	192.00	838.0	160,896	172
250	7/64	0.9%	184.32	820.7	151,274	162
300	7/64	0.7%	231.44	805.0	186,308	199
400	5/64	0.5%	235.84	777.0	183,244	196
500	5/64	1.2%	246.83	751.9	185,594	199
600	3/32	1.1%	266.60	728.8	194,296	208
Weighted Average Values:				**891.7**	**99,664**	**107**

Steam Trap Strainer and Blow-Off Valve Assembly

	Strainer Energy Cost Savings over 15-Year Period of Analysis (2023 PV/ strainer)	Strainer Incremental Cost Over 15-year Period of Analysis (2023 PV/strainer)	Strainer B/C Ratio
Weighted Average Values	**$2,192**	**$599**	**3.66**

Steam Trap Strainer and Blow-Off Valve Assembly

Electricity Savings (GWh/yr)	Reduced GHG Emissions from Electricity Savings (Metric Tons CO2e)	Natural Gas Savings (Million therms/yr)	Reduced GHG Emissions from Natural Gas Savings (Metric Tons CO2e)	Total Reduced CO2e Emissions (Metric Tons CO2e)
0.004	1.023	0.210	1,147.5	1,148.5

- 20% of traps will require strainers and blow-off valve assembly.
- 1,972 steam traps statewide.

Steam Trap Strainer and Blow-Off Valve Assembly

Technical Feasibility

- Standardize best practice.

Cost Effectiveness

- Applicable in all climate zones.

Proposed Code: Strainer

120.6(j) Mandatory Requirements for Steam Traps. Steam traps in new industrial facilities and steam traps serving new industrial process equipment in existing industrial facilities where the installed steam trap operating pressure is greater than 15 psig and the total combined connected boiler input rating is greater than 5 Million Btu/hr, the steam traps shall conform to the following:

...

3. Steam Trap Strainer Installation. Steam traps shall either:

A. Be equipped with an integral strainer and blow-off valve; or

B. Be installed downstream within 3 feet of a strainer and blow-off valve.

Staff Questions

Steam trap strainer and blow-off valve assembly:

- Q1: is the statewide savings methodology used in the report clear?
- Q2: are the steam trap failure assumption typical in the industry?
  - 4 year life for baseline steam traps and 6 year life for steam traps with strainer and blow-off valves.
- Q3: is proposed standard language clear?

QUESTION?

Comments for Todays Workshop

Due Date: November 10, 2020 By 5:00 PM

Comments to be submitted to:
https://efiling.energy.ca.gov/EComment/EComment.aspx?docketnumber=19-BSTD-03

Contact Information

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Payam Bozorgchami, P.E. 2022 BEES Project Manager

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Thank You!

Controlled Environmental Horticulture Proposal for 2022

Staff Pre-Rulemaking Workshop

Presenter: Thao Chau, Electrical Engineer

Date: 10/27/2020

Proposal Summary

- Horticultural lighting requirements
- Dehumidification requirements
- Envelope updates for conditioned greenhouses

Sections Affected

Submeasure Name	Type of Requirement	Modified Section(s) of Title 24, Part 6
Horticultural Lighting Minimum Efficacy	Mandatory	100.1, 120.6, 141.1
Horticultural Lighting Minimum Efficacy	Prescriptive	140.6
Efficient Dehumidification	Mandatory	100.1, 120.6, 141.1
Efficient Dehumidification	Prescriptive	140.4
Greenhouse Envelope	Mandatory	100.1, 120.6, 141.1
Greenhouse Envelope	Prescriptive	140.3

Horticultural Lighting Requirements

Horticultural Lighting Efficacy

Proposed new **mandatory** requirements for newly constructed buildings

- Indoor grow facilities with 40 kW of horticultural lighting load
  - Photosynthetic Photon Efficacy (PPE) ≥ 2.1 μmol/J
- Greenhouses with 40 kW of horticultural lighting load
  - Photosynthetic Photon Efficacy (PPE) ≥ 1.7 μmol/J
- Time switch controls and multi-level controls are also required for both indoor grow facilities and greenhouses types of all sizes.

Horticultural Lighting Efficacy

Proposed new **mandatory** requirements for additions and alterations

- Adding or altering the existing lighting systems
  - cause **increase** in lighting wattage, *and*
  - ≥ 10% of the existing luminaires
- Must meet all new horticultural lighting requirements.
- Exception: alterations limited to adding lighting controls and replacing lamps, ballasts, or drivers.

Implementation Cost – Lighting

Building Type	Incremental Equipment Cost	Incremental Maintenance Cost	Total Incremental Cost
Indoor Facility	$109.96	($37.35)	$72.61
Greenhouse	$4.32	$13.49	$17.81

Energy and Energy Cost Impacts – Lighting

Construction Type	First-Year Electricity Savings (GWh)	First-Year Peak Electrical Demand Reduction (MW)	First -Year Natural Gas Savings (MMtherms)	15-Year Present Valued Energy Cost Savings (PV$ million)
New Construction	238.5	16.2	N/A	$545.01
Additions and Alterations	86.5	6.6	N/A	$197.66
TOTAL	**325.0**	**22.9**	**N/A**	**$742.67**

Greenhouse Gas Emission Impact – Lighting

Electricity Savings (GWH/yr)	Reduced GHG Emissions from Electricity Savings (MT CO_2e)	Natural Gas Savings (Million Therm/yr)	Reduced GHG Emissions form Natural Gas Savings (MT CO_2e)	Total Reduced CO2e Emissions (MT CO_2e)
324.97	78,109	N/A	N/A	78,109

TDV Energy Cost Savings Per Square Foot of Canopy – Indoor Facilities Lighting

Climate Zone	15-Year TDV Electricity Cost Savings (2023 PV$)	15-Year TDV Natural Gas Cost Savings (2023 PV$)	Total 15-Year TDV Energy Cost Savings (2023 PV$)
1	$384	$0	$384
2	$435	$0	$435
3	$413	$0	$413
4	$446	$0	$446
5	$401	$0	$401
6	$431	$0	$431
7	$410	$0	$410
8	$464	$0	$464
9	$464	$0	$464
10	$447	$0	$447
11	$441	$0	$441
12	$434	$0	$434
13	$440	$0	$440
14	$458	$0	$458
15	$454	$0	$454
16	$391	$0	$391

TDV Energy Cost Savings Per Square Foot of Canopy – Greenhouse Lighting

Climate Zone	15-Year TDV Electricity Cost Savings (2023 PV$)	15-Year TDV Natural Gas Cost Savings (2023 PV$)	Total 15-Year TDV Energy Cost Savings (2023 PV$)
1	$53	$0	$53
2	$42	$0	$42
3	$43	$0	$43
4	$40	$0	$40
5	$37	$0	$37
6	$38	$0	$38
7	$35	$0	$35
8	$39	$0	$39
9	$37	$0	$37
10	$35	$0	$35
11	$42	$0	$42
12	$41	$0	$41
13	$41	$0	$41
14	$29	$0	$29
15	$31	$0	$31
16	$40	$0	$40

First-Year Energy Impacts Per Square Foot of Canopy – Indoor

Climate Zone	Electricity Savings (kWh/yr)	Peak Electricity Demand Reductions (kW)	Natural Gas Savings (therms/yr)	TDV Energy Savings (TDV kBtu/yr)
1	189.5	0.012	0.0	4,318.4
2	192.4	0.012	0.0	4,886.1
3	191.2	0.012	0.0	4,636.7
4	193.1	0.012	0.0	5,011.9
5	191.8	0.012	0.0	4,501.0
6	193.2	0.012	0.0	4,842.6
7	192.8	0.012	0.0	4,611.1
8	194.4	0.012	0.0	5,213.4
9	194.3	0.012	0.0	5,210.2
10	195.0	0.012	0.0	5,020.3
11	194.8	0.012	0.0	4,956.6
12	193.7	0.012	0.0	4,881.8
13	195.1	0.012	0.0	4,948.7
14	195.1	0.012	0.0	5,146.7
15	199.0	0.012	0.0	5,100.7
16	191.2	0.012	0.0	4,394.2

First-Year Energy Impacts Per Square Foot of Canopy – Greenhouse

Climate Zone	Electricity Savings (kWh/yr)	Peak Electricity Demand Reductions (kW)	Natural Gas Savings (therms/yr)	TDV Energy Savings (TDV kBtu/yr)
1	23.2	0.003	0.0	597.3
2	18.5	0.002	0.0	473.2
3	18.7	0.002	0.0	478.7
4	17.6	0.002	0.0	447.7
5	16.0	0.002	0.0	417.8
6	16.4	0.002	0.0	429.0
7	15.5	0.002	0.0	390.3
8	16.3	0.002	0.0	443.0
9	15.9	0.002	0.0	414.9
10	15.6	0.002	0.0	398.2
11	18.7	0.003	0.0	468.8
12	18.6	0.002	0.0	464.9
13	18.2	0.002	0.0	457.5
14	13.5	0.002	0.0	331.4
15	14.1	0.002	0.0	343.8
16	17.5	0.002	0.0	452.2

Technical Feasibility

Technology	Average PPE (μmol/J)	Meets minimum 1.7μmol/J PPE greenhouse	Meets minimum 2.1μmol/J PPE indoor
Single-ended 400-W high pressure sodium lamp with magnetic ballast	0.9	No	No
Double-ended 1,000-W high pressure sodium lamp with electronic ballast	1.7–1.9	Yes	No
Single-ended high pressure sodium luminaire	1.0	No	No
Metal halide luminaire	0.8	No	No
Ceramic metal halide luminaire	1.5	No	No
Fluorescent lighting luminaire	0.84 – 0.95	No	No
LED lighting luminaire	1.1–3.0	Yes	Yes

Lighting Analysis Assumptions

Parameter	Cannabis - Flower	Cannabis - Vegetative	Cannabis - Clone	Leafy Greens	Tomatoes
Canopy Area per Luminaire (ft^2)	20	24	10	58	56
Photoperiod (hours per day)	12	18	24	18	12
Indoor Grow PPFD (µmol/m2/s)	1,000	600	200	200	350
Greenhouse PPFD (µmol/m2/s)	600	400	200	200	350

15-Year Cost-Effectiveness Per Square Foot of Canopy – Indoor Lighting

Climate Zone	Benefits TDV Energy Cost Savings + Other PV Savings (2023 PV$)	Costs Total Incremental PV Costs (2023 PV$)	Benefit-to-Cost Ratio
1	$384.34	$72.61	**5.3**
2	$434.87	$72.61	**6.0**
3	$412.66	$72.61	**5.7**
4	$446.06	$72.61	**6.1**
5	$400.59	$72.61	**5.5**
6	$430.99	$72.61	**5.9**
7	$410.39	$72.61	**5.6**
8	$463.99	$72.61	**6.4**
9	$463.71	$72.61	**6.4**
10	$446.80	$72.61	**6.2**
11	$441.14	$72.61	**6.1**
12	$434.48	$72.61	**6.0**
13	$440.43	$72.61	**6.1**
14	$458.05	$72.61	**6.3**
15	$453.96	$72.61	**6.3**
16	$391.09	$72.61	**5.4**

15-Year Cost-Effectiveness Per Square Foot of Canopy – Greenhouse Lighting

Climate Zone	Benefits TDV Energy Cost Savings + Other PV Savings (2023 PV$)	Costs Total Incremental PV Costs (2023 PV$)	Benefit-to-Cost Ratio
1	$53.16	$14.50	**3.7**
2	$42.12	$14.50	**2.9**
3	$42.60	$14.50	**2.9**
4	$39.85	$14.50	**2.7**
5	$37.18	$14.50	**2.6**
6	$38.18	$14.50	**2.6**
7	$34.74	$14.50	**2.4**
8	$39.43	$14.50	**2.7**
9	$36.93	$14.50	**2.5**
10	$35.44	$14.50	**2.4**
11	$41.72	$14.50	**2.9**
12	$41.37	$14.50	**2.8**
13	$40.72	$14.50	**2.8**
14	$29.49	$14.50	**2.0**
15	$30.60	$14.50	**2.1**
16	$40.25	$14.50	**2.8**

Staff Questions

1. Is 40 kW of horticultural lighting load a reasonable threshold?

2. Is 10% of connected horticultural lighting a good threshold for alterations?

QUESTIONS?

Horticultural Dehumidification Requirements

Dehumidification Requirements

- Stand-alone dehumidifiers
  - Volumes ≤ 8.0 cubic feet: min integrated energy factor of 1.77 L/kWh
  - Volumes > 8.0 cubic feet: min integrated energy factor of 2.41 L/kWh
- Integrated HVAC system with on-site heat recovery to fulfill ≥ 75 percent of the annual energy for dehumidification reheat;
- Chilled water system with on-site heat recovery to fulfill ≥ 75 percent of the annual energy for dehumidification reheat; or
- Solid or liquid desiccant dehumidification system for system designs ≤ 50°F dewpoint.

Implementation Cost – Dehumidification

Building Type	Incremental Equipment Cost	Incremental Maintenance Cost	Total Incremental Cost
Indoor – per Square Foot of Canopy	$8.11	0.00	$8.11

Energy and Energy Cost Impacts – Dehumidification

Construction Type	First-Year Electricity Savings (GWh)	First-Year Peak Electrical Demand Reduction (MW)	First -Year Natural Gas Savings (MMtherms)	15-Year Present Valued Energy Cost Savings (PV$ million)
New Construction	(0.1)	0.0	0.9	$256.00
Additions and Alterations	(0.2)	0.0	0.3	$76.30
TOTAL	**(0.3)**	**0.0**	**1.2**	**$332.20**

Greenhouse Gas Emission Impact – Dehumidification

Electricity Savings (GWH/yr)	Reduced GHG Emissions from Electricity Savings (MT CO_2e)	Natural Gas Savings (Million Therm/yr)	Reduced GHG Emissions form Natural Gas Savings (MT CO_2e)	Total Reduced CO2e Emissions (MT CO_2e)
(0.27)	(66)	1.18	6,427	6,361

TDV Energy Cost Savings Per Square Foot of Canopy – Dehumidification

Climate Zone	15-Year TDV Electricity Cost Savings (2023 PV$)	15-Year TDV Natural Gas Cost Savings (2023 PV$)	Total 15-Year TDV Energy Cost Savings (2023 PV$)
1	$1.18	$21.55	$22.74
2	$0.31	$21.55	$21.86
3	$0.71	$21.56	$22.27
4	$0.04	$21.56	$21.59
5	$0.62	$21.55	$22.17
6	$0.54	$21.79	$22.33
7	$0.53	$21.91	$22.44
8	$0.00	$21.79	$21.79
9	($0.26)	$21.79	$21.53
10	($0.40)	$21.79	$21.39
11	($1.03)	$21.56	$20.52
12	($0.23)	$21.56	$21.32
13	($1.13)	$21.56	$20.43
14	($1.00)	$21.79	$20.79
15	($2.92)	$21.79	$18.87
16	$0.45	$21.79	$22.24

First-Year Energy Impacts Per Square Foot of Canopy – Dehumidification

Climate Zone	Electricity Savings (kWh/yr)	Peak Electricity Demand Reductions (kW)	Natural Gas Savings (therms/yr)	TDV Energy Savings (TDV kBtu/yr)
1	0.5	0.06	0.8	255
2	0.2	0.02	0.8	246
3	0.3	0.03	0.8	250
4	0.0	(0.01)	0.8	243
5	0.3	0.04	0.8	249
6	0.2	0.02	0.8	251
7	0.2	0.02	0.8	252
8	(0.1)	0.00	0.8	245
9	(0.2)	(0.03)	0.8	242
10	(0.2)	(0.03)	0.8	240
11	(0.4)	(0.05)	0.8	231
12	(0.1)	(0.01)	0.8	240
13	(0.4)	(0.05)	0.8	230
14	(0.5)	(0.04)	0.8	234
15	(1.2)	(0.11)	0.8	212
16	0.1	(0.01)	0.8	250

15-Year Cost-Effectiveness Per Square Foot of Canopy – Dehumidification

Climate Zone	Benefits TDV Energy Cost Savings + Other PV Savings (2023 PV$)	Costs Total Incremental PV Costs (2023 PV$)	Benefit-to-Cost Ratio
1	$22.74	$8.110	**2.80**
2	$21.86	$8.110	**2.70**
3	$22.27	$8.110	**2.75**
4	$21.59	$8.110	**2.66**
5	$22.17	$8.110	**2.73**
6	$22.33	$8.110	**2.75**
7	$22.44	$8.110	**2.77**
8	$21.79	$8.110	**2.69**
9	$21.53	$8.110	**2.65**
10	$21.39	$8.110	**2.64**
11	$20.52	$8.110	**2.53**
12	$21.32	$8.110	**2.63**
13	$20.43	$8.110	**2.52**
14	$20.79	$8.110	**2.56**
15	$18.87	$8.110	**2.33**
16	$22.24	$8.110	**2.74**

Staff Questions

1. Given that different plants have different optimal water levels, are there any concerns about the proposed dehumidification requirements?

2. Are there any other types of dehumidifiers should be considered?

QUESTIONS?

Conditioned Greenhouse Envelope Requirements

Conditioned Greenhouse Envelopes

Max Weighted U-Factors	Walls	Roofs
Non-Opaque	0.7	0.7
Opaque	Sections 120.7 and 140.3(a)	Sections 120.7 and 140.3(a)

Comments for Today's Workshop

Due Date Nov 10, 2020 By 5:00 PM

Comments to be submitted to:
https://efiling.energy.ca.gov/EComment/EComment.aspx?docketnumber=19-BSTD-03

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Thank You!