DOCKETED

Docket Number:	17-BSTD-01
Project Title:	2019 Building Energy Efficiency Standards PreRulemaking
TN #:	221583
Document Title:	Brummitt Energy Associates Comments
Description:	N/A
Filer:	System
Organization:	Tim Hreha
Submitter Role:	Public
Submission Date:	10/20/2017 4:56:39 PM
Docketed Date:	10/20/2017

Comment Received From: Tim Hreha
Submitted On: 10/20/2017
Docket Number: 17-BSTD-01

Brummitt Energy Associates Comments

Additional submitted attachment is included below.

BRUMMITT ENERGY
ASSOCIATES INC

777 S. Highway 101, Suite 203
Solana Beach, CA 92075
Ph 619.531.1126
www.brummitt.com

October 20, 2017

California Energy Commission
1516 Ninth Street
Sacramento, CA

RE: Docket 17-BSTD-01 – 2019 Building Energy Efficiency Standards Pre-Rulemaking

Thank you for the opportunity to participate in this process.

Although the comments included herein are detail oriented, it is important to keep the big picture in mind; What is the purpose of the 2019 Building Energy Efficiency Standards? As they are currently written, do they achieve this purpose? Could they be rewritten to achieve their purpose in a more cost-effective and timely manner?

What if all the time, expertise, and money was focused on creating an actual energy budget for each project and verifying whether or not it ultimately operates within that budget, rather than creating specialized software for calculating hourly Time Dependent Valuations of energy use based upon fixed operational inputs with limited relevance to the project's actual intended use in an attempt to indirectly affect the overall load on the grid?

Currently the 2019 Building Energy Efficiency Standards favor natural gas usage over electricity due to the difference in their Time Dependent Valuations (TDV), as discussed in detail in the remainder of this document. If the purpose of the 2019 Building Energy Efficiency Standards is to reduce emissions, then this preference for natural gas usage in buildings is counterproductive to that goal.

This is because data from Pacific Gas & Electric shows that the emissions associated with their electricity generation are lower than the emissions from onsite natural gas use (per Btu). California's 2030 Climate Commitment of deriving 50% of the state's electricity from renewable sources will continue to reduce emissions from electricity generation even further. Buildings are constructed with design life spans of at least 50 years and HVAC systems with life spans of at least 25 years, meaning the 2019 Building Energy Efficiency Standards will continue to affect California's emissions well beyond 2030. It is shortsighted to enact regulations that favor natural gas over electricity; Emissions free electricity generation can, and likely will, be achieved in the near future, while burning natural gas on site will never be emissions free.

Acknowledging that dramatic changes are unlikely, we also believe that implementing the following incremental changes would improve the 2019 Building Energy Efficiency Standards will help California to meet its 2030 Climate Commitment and the commitments that are sure to follow.

1) The Standard Design Building should return to being in alignment whether using the Prescriptive or Performance Approach to compliance.

According to Section 140.1(a), "the energy budget for the Standard Design Building is determined by applying the mandatory and prescriptive requirements to the Proposed Design Building." Since the 2013 Building Energy Efficiency Standards, the Alternative Calculation Method (ACM) has directly violated this fundamental requirement of the Performance Approach. Some examples of how the Performance Standard Design Building has diverged from the Prescriptive requirements are listed below:

a) Envelope:
The Performance Standard Design Building envelope requirements used to match the Prescriptive requirements by construction type. However, since the 2013 Building Energy Efficiency Standards, the envelope has been fixed to specific construction types. As an example, projects with mass walls may find that it is much easier to comply using the Prescriptive Approach, which has specific requirements for mass walls, rather than using the Performance Approach because it will be compared to Prescriptive metal framed walls in the Standard Design Building.

i) ACM Section 5.5.3 Roofs, Roof Type, Standard Design:
All roofs in the baseline building are modeled as "Wood-framed and other"

ii) ACM Section 5.5.4 Exterior Walls, Wall Type, Standard Design:
All walls in the standard design building are modeled as "metal framed"

iii) ACM Section 5.5.5 Exterior Floors, Floor Type, Standard Design:
The standard design building floors shall be of type "other"

b) Service Hot Water:
The Performance Standard Design Building service water heating fuel source used to match the proposed design, but since the 2013 Building Energy Efficiency Standards it has changed to always use gas. If the proposed design uses an electric water heater, even a very efficient heat pump water heater, it may still be penalized in the Performance Approach due to the different Time Dependent Valuations of the different fuel sources (see Attachment A: Service Water Heating Details for more information).

i) ACM Section 5.9.1.2 Water Heaters, Water Heater Type and Size, Standard Design:
Gas storage water heater for non-residential buildings; gas instantaneous water heaters for residential living spaces of high-rise residential buildings and hotel/motel guestrooms; gas storage water heater for common spaces of high-rise residential buildings and hotel/motel buildings.

c) HVAC systems:
The Performance Standard Design Building HVAC systems differ dramatically from the Prescriptive requirements, but this is mostly by design. The many issues caused by this change require their own section (see the remainder of this document).

2) The Standard Design Building HVAC system mapping needs clarification and correction.

a) The HVAC system map and the system descriptions contradict each other & need clarification: Because the Standard Design Building is determined by the compliance software, it is critical that the HVAC System Map be extremely clear such that its rules can be incorporated into the software. Unfortunately, this is not currently the case; the ACM includes many inconsistencies, some of which are highlighted in Attachment B: HVAC System Map Details. These inconsistencies should be addressed with one or more of the following strategies:

i) At minimum, they should be addressed directly such that there are no contradictions within the ACM.

ii) Alternatively, the compliance software should enable the user to directly influence how the Proposed Design Building HVAC systems are mapped to the Standard Design Building HVAC systems i.e. mark any thermal zone as a "Covered Process".

b) The HVAC system map overemphasizes variable volume systems and needs correction: The Standard Design Building HVAC systems are almost always variable volume. Only buildings that are both single-story and less than 10,000 ft^2 utilize constant volume systems in the Standard Building Design per ACM Section 5.1.2 HVAC System Map, Table 5 (see below). As a result, most projects are compared to variable volume systems and this forces any design utilizing constant volume systems to use the Prescriptive Approach to compliance for their mechanical design because using the Performance Approach results in an insurmountable fan energy penalty.

Table 5 – Nonresidential Spaces (Not Including Covered Processes)

Building Area	Floors	Standard Design	Description
≤ 10,000 ft^2	1 floor	PSZ	Packaged Single Zone
	>1 floor	PVAV	Packaged VAV Unit
10,000 ft2 – 150,000 ft2	Any	PVAV	Packaged VAV Unit
>150,000 ft2	1 floor	SZVAV	Single-zone VAV Unit
	>1 floor	VAVS	Built-up VAV Unit

Although these projects are still able to achieve compliance, this highlights how the Prescriptive Approach has become far more lenient than the Performance Approach; the Prescriptive Approach has no such variable volume requirements. For example, a 5-story 160,000 ft^2 office building using only constant volume heat-pumps without economizers could comply using the Prescriptive Approach. This same design would never be able to comply using the Performance approach because it would be compared to a Standard Design Building utilizing variable volume systems and a high-efficiency central plant.

The Performance Approach was added to the Building Energy Efficiency Standards to empower design teams to find the most efficient *whole building* design and, even if only one feature of a project is treated more leniently under the Prescriptive Approach, this power is taken away; whole building energy models are no longer used, interactions between building features are no longer captured, and projects are designed with even less attention to how they will ultimately operate in reality. The Prescriptive requirements *become the design* and we can only hope that they have be written to result in an energy efficient building regardless of where it will be located and what its intended use is. As long as the two approaches to compliance remain inherently inequitable, this scenario is a very real risk. Potential strategies for avoiding this risk include the following:

i) At minimum, the HVAC System Map should be modified such that more projects are compared to constant volume systems in the Standard Design Building. For example, the HVAC System Map used by ASHRAE Standard 90.1-2013 Appendix G (see below) only uses variable volume systems as the baseline when a project is either more than four stories tall (not one story) or more than 25,000 ft^2 in size (not 10,000 ft^2).

TABLE G3.1.1-3 Baseline HVAC System Types

Building Type	Climate Zones 3b, 3c, and 4–8	Climate Zones 1–3a
Residential	System 1—PTAC	System 2—PTHP
Public assembly <120,000 ft^2	System 3—PSZ-AC	System 4—PSZ-HP
Public assembly ≥120,000 ft^2	System 12—SZ-CV-HW	System 13—SZ-CV-ER
Nonresidential and 3 floors or fewer and <25,000 ft^2	System 3—PSZ-AC	System 4—PSZ-HP
Nonresidential and 4 or 5 Floors and <25,000 ft^2 or 5 floors or fewer and 25,000 ft^2 to 150,000 ft^2	System 5—Packaged VAV with reheat	System 6—Packaged VAV with PFP boxes
Nonresidential and more than 5 floors or >150,000 ft^2	System 7—VAV with reheat	System 8—VAV with PFP boxes
Heated-only storage	System 9—Heating and ventilation	System 10—Heating and ventilation
Retail and 2 floors or fewer	System 3—PSZ-AC	System 4—PSZ-HP

ii) Ideally, the HVAC System Map would return to being in alignment with the Prescriptive Approach requirements i.e. the Performance Approach's Standard Design Building HVAC systems should be assigned on a system-by-system basis using system type and fuel source (see below), not on a building basis using the building area and number of floors. Otherwise, the issues caused by differing fuel sources (discussed in Attachment A: Service Water Heating Details) will also affect HVAC system design, perverting which systems are due to different fuel sources being subject to different Time Dependent Valuations.

2008 Nonresidential ACM Manual *2-61*

Table N2-13 – Standard Design HVAC System Selection

Building Type	System Type	Proposed Design Heating Source	System
Low-Rise Nonresidential (three or fewer stories above grade)	Single Zone	Fossil	System 1 – Packaged Single Zone, Gas/Electric
		Electric	System 2 – Packaged Single Zone, Heat Pump
	Multiple Zone	Any	System 3 – Packaged VAV, Gas Boiler with Reheat
High Rise Nonresidential (four or more stories)	Single Zone	Any	System 5 – Built-up Single Zone System with Central Plant
	Multiple Zone	Any	System 4 – Central VAV, Gas Boiler with Reheat
All Residential including Hotel/Motel Guest Room	Hydronic	Any	System 5 – Four Pipe Fan Coil System with Central Plant
	Other	Fossil	System 1 (No economizer) – Packaged Single Zone, Gas/Electric
		Electric	System 2 (No economizer) – Packaged Single Zone, Heat Pump

iii) Alternatively, the Prescriptive Approach should be modified such that it is subject to the same constraints as the Performance Approach i.e. constant volume systems should not be allowed to use the Prescriptive Approach to compliance on projects that are taller than one story or greater than 10,000 ft^2 in size. This would rectify the current scenario in which the Prescriptive Approach is far more lenient than the Performance Approach.

c) How the HVAC system map handles Covered Processes needs correction:
In addition, more "Covered Processes" space types are needed. ACM Section 5.1.2 HVAC System Map, Table 4 (see below) currently treats "Warehouse and light manufacturing space types (per the Appendix 5.4A Schedule column) that do not include cooling in the proposed design" and "Covered Processes" separately from the nonresidential "Building Type". ACM Section 5.1.2 HVAC System Map, Table 6 (also shown below) clarifies which spaces are considered "Covered Processes", but this list is not an accurate reflection of spaces that are provided with dedicated HVAC systems in typical mechanical designs. One potential solution is the following:

i) This could be remedied in a manner similar to ASHRAE Standard 90.1 Appendix G Exception 2 to Section 3.1.1, which requires separate single-zone systems "for any spaces that have occupancy or process loads or schedules that differ significantly (differ is defined) from the rest of the building."

Table 4 – HVAC System Map

Building Type	Standard Design
Residential or hotel/motel guestrooms in a building with 3 or fewer floors	System 1 - PTAC
Residential or Hotel/motel Guestrooms in a building with 4 or more floors	System 2 - FPFC
Warehouse and light manufacturing space types (per the Appendix 5.4A Schedule column) that do not include cooling in the proposed design	System 9 - HEATVENT
Covered Process	See **Table 6 – System Map for Covered Processes**
All other space types	See **Table 5 – Nonresidential Spaces (Not Including Covered Processes)**

Table 6 – System Map for Covered Processes

Building Type or Space Type	Floors	Baseline System
Total computer room design cooling load is over 3,000,000 Btu/h Note: if the user chooses computer room for the space type and enters a receptacle load less than 20 W/ft^2 then the proposed and baseline shall use a receptacle load of 20 W/ft^2.	Any	System 10 – CRAH Unit
Computer rooms that do not meet the conditions for System 10, CRAH	Any	System 11 – CRAC Unit
Laboratory Space	Any	System 12 – LAB
Restaurant Kitchen	Any	System 13 – KITCH

3) The treatment of Computer Rooms and Data Centers requires revision.

a) The default load applied to these occupancies is unreasonably high:
According to ACM Section 5.1.2 HVAC System Map, Table 6 (shown previously), "if the user chooses computer room for the space type and enters a receptacle load less than 20 W/ft^2 then the proposed and baseline shall use a receptacle load of 20 W/ft^2." There is no justification provided for this minimum receptacle load, which seems extraordinarily high for a minimum value, nor is it listed as a separate "Energy Component" in the NRCC-PRF-01-E form such that its relative weight in the overall building performance can be evaluated.

This should be addressed with the following changes:

i) Rather than set a minimum receptacle load, set a minimum process load such that the computer room load is reported under the "Process" line item in the NRCC-PRF-01-E so that its role can be evaluated separately from the building's receptacle loads.

ii) In addition, either:

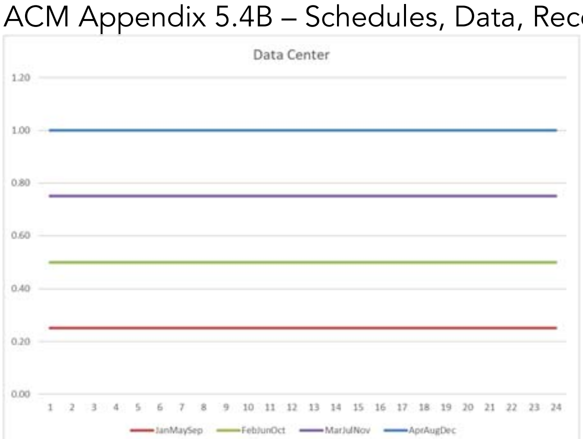
(1) reduce the minimum load applied to these space types by at least half, or…

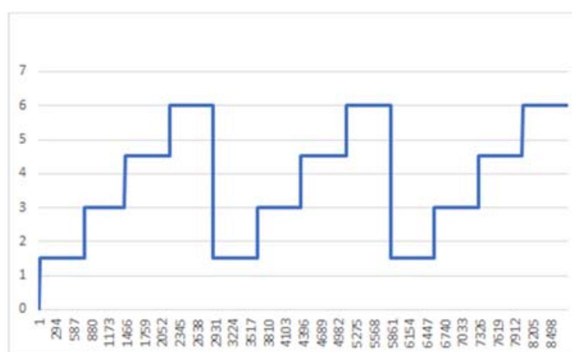
(2) require an additional user input based on the maximum kW load that the space has been designed for.

b) The default schedule applied to these occupancies is unrealistic:
According to ACM Appendix 5.4B – Schedules, Data tab, the Receptacle schedule (see the hourly profile below) that is applied to the minimum receptacle load in computer room space types is 24/ 7 and rotates from month to month through 25%, 50%, 75%, and 100% of the load. This is obviously unrealistic, as illustrated by the resulting annual profile of the computer room load (also shown below).

Although this unrealistic load and schedule applies to both the Proposed Design Building and Standard Design Building, it can still skew the results of the Performance Approach by inflating either the credit or penalty associated with the HVAC systems serving the computer room because the system must meet this large and variable load throughout the annual simulation. Combined with the Time Dependent Valuations, this monthly step-function can have an outsized impact on the Performance Approach.

ACM Appendix 5.4B – Schedules, Data, Receptacle, Hourly Profile & Resulting Annual Profile





This unrealistic schedule should be replaced with either:

(1) a constant, 24/7 schedule that does not change from month to month, or…

(2) the receptacle schedule that is associated with the main building space type, or…

(3) a schedule that is based on loads measured in actual computer rooms in operation.

Conclusion

We believe that the best projects are those that use the Performance Approach because no undue burden is placed on any one aspect of the design (i.e. Envelope, HVAC, Lighting, or Plumbing). The 2019 Building Energy Efficiency Standards should favor integrated, whole building energy analyses, but currently they do the opposite. We hope our suggestions will be implemented and that the Building Energy Efficiency Standards will begin to focus more on how buildings are actually operating in the real world, not according to rigid and overly complex rules.

Thank you for your time and consideration, we appreciate your attention to these critical issues. Please do not hesitate to contact us should you have any questions or need clarification of any of our concerns.

Sincerely,

BRUMMITT ENERGY ASSOCIATES, INC.

10/20/17

Charles Christenson, PE, BEMP, LEED AP
Vice President

Co-signed:

10/20/17

Hans Marsman, LEED AP, CEA
Associate Principal

10/20/17

Tim Hreha, CEA, LEED Green Associate
Building Performance Specialist

Attachment A: Service Water Heating Details
Attachment B: HVAC System Map Details

Attachment A: Service Water Heating Details

The penalty for using an electric water heater, even for projects that will have very low hot water usage once in operation, often cannot be overcome by increasing envelope, lighting, or mechanical efficiency. This unreasonable result is due to a combination of factors:

- CBECC-Com uses default occupancy numbers and default gallons per person, which cannot be overwritten.
- The Standard Design Building always uses natural gas for water heating, which has low Time Dependent Valuation (TDV) multipliers, as shown in the table below.
- The TDV multipliers for electricity are up to 120 times higher, as shown in the table below.

	15-year TDV data					**30-year TDV data**				
	Elec Non-Res		**Gas Non-Res**		**Comparison**	**Elec Non-Res**		**Gas Non-Res**		**Comparison**
Units:	kBtu/kWh	kBtu/kBtu	kBtu/therm	kBtu/kBtu	kBtu/kBtu	kBtu/kWh	kBtu/kBtu	kBtu/therm	kBtu/kBtu	kBtu/kBtu
Max	973.76	285.38	235.36	2.35	12125%	917.41	268.87	256.37	2.56	10488%
Min	19.07	5.59	173.02	1.73	323%	18.58	5.44	194.39	1.94	280%
Avg	27.47	8.05	198.47	1.98	406%	27.46	8.05	219.80	2.20	366%

For projects with a small hot water load, it is often too costly to pipe natural gas to the site or to provide gas piping throughout the building, so the use of electric water heaters is the only practical solution.

For compliance purposes, one strategy is to exclude water heating from the Performance Method report and instead submit a separate Prescriptive Method report just for water heating (this path allows electric water heaters). Although this is a viable route to compliance, it represents a workaround that is contradictory to the intent of Title 24 in general and the Performance Method in particular.

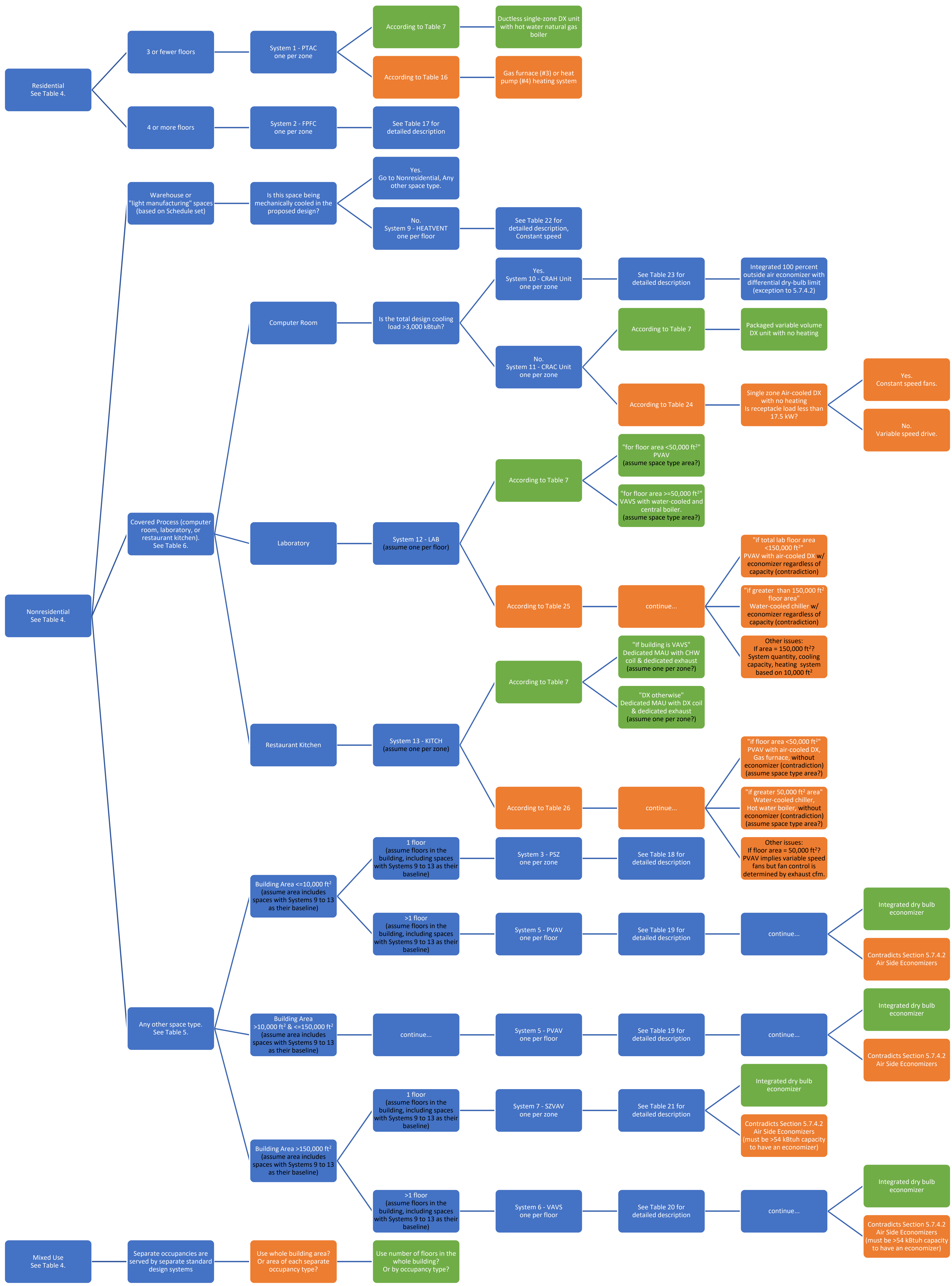
Furthermore, green building rating systems such as LEED, CHPS, Savings By Design, and even project or client specific efficiency requirements often require that all energy uses are included in the analysis. One small electric water heater prevents a project from complying with many of these programs or forces a drastically different modeling strategy.

To address this issue, we recommend that the CEC make the following revisions to the ACM:

- The Standard Design Building should use natural gas for service water heating only when there is a large hot water load (e.g. hotels, high rise residential).
- For occupancy types with a low hot water load, the Standard Design Building's water heating fuel source should match the Proposed Design Building's water heating fuel source.

Attachment B: HVAC System Map Details

See the flow chart on the following page.



Residential
See Table 4.
3 or fewer floors
System 1 - PTAC
one per zone
According to Table 7
Ductless single-zone DX unit with hot water natural gas boiler
According to Table 16
Gas furnace (#3) or heat pump (#4) heating system
4 or more floors
System 2 - FPFC
one per zone
See Table 17 for detailed description
Nonresidential
See Table 4.
Warehouse or "light manufacturing" spaces (based on Schedule set)
Is this space being mechanically cooled in the proposed design?
Yes.
Go to Nonresidential, Any other space type.
No.
System 9 - HEATVENT
one per floor
See Table 22 for detailed description, Constant speed
Covered Process (computer room, laboratory, or restaurant kitchen).
See Table 6.
Computer Room
Is the total design cooling load >3,000 kBtuh?
Yes.
System 10 - CRAH Unit
one per zone
See Table 23 for detailed description
Integrated 100 percent outside air economizer with differential dry-bulb limit (exception to 5.7.4.2)
No.
System 11 - CRAC Unit
one per zone
According to Table 7
Packaged variable volume DX unit with no heating
According to Table 24
Single zone Air-cooled DX with no heating
Is receptacle load less than 17.5 kW?
Yes.
Constant speed fans.
No.
Variable speed drive.
Laboratory
System 12 - LAB
(assume one per floor)
According to Table 7
"for floor area <50,000 ft²"
PVAV
(assume space type area?)
"for floor area >=50,000 ft²"
VAVS with water-cooled and central boiler.
(assume space type area?)
According to Table 25
continue...
"if total lab floor area <150,000 ft²"
PVAV with air-cooled DX w/ economizer regardless of capacity (contradiction)
"if greater than 150,000 ft² floor area"
Water-cooled chiller w/ economizer regardless of capacity (contradiction)
Other issues:
If area = 150,000 ft²?
System quantity, cooling capacity, heating system based on 10,000 ft²
Restaurant Kitchen
System 13 - KITCH
(assume one per zone)
According to Table 7
"If building is VAVS"
Dedicated MAU with CHW coil & dedicated exhaust
(assume one per zone?)
"DX otherwise"
Dedicated MAU with DX coil & dedicated exhaust
(assume one per zone?)
According to Table 26
continue...
"if floor area <50,000 ft²"
PVAV with air-cooled DX, Gas furnace, without economizer (contradiction)
(assume space type area?)
"if greater 50,000 ft² area"
Water-cooled chiller, Hot water boiler, without economizer (contradiction)
(assume space type area?)
Other issues:
If floor area = 50,000 ft²?
PVAV implies variable speed fans but fan control is determined by exhaust cfm.
Any other space type.
See Table 5.
Building Area <=10,000 ft²
(assume area includes spaces with Systems 9 to 13 as their baseline)
1 floor
(assume floors in the building, including spaces with Systems 9 to 13 as their baseline)
System 3 - PSZ
one per zone
See Table 18 for detailed description
>1 floor
(assume floors in the building, including spaces with Systems 9 to 13 as their baseline)
System 5 - PVAV
one per floor
See Table 19 for detailed description
continue...
Integrated dry bulb economizer
Contradicts Section 5.7.4.2 Air Side Economizers
Building Area >10,000 ft² & <=150,000 ft²
(assume area includes spaces with Systems 9 to 13 as their baseline)
continue...
System 5 - PVAV
one per floor
See Table 19 for detailed description
continue...
Integrated dry bulb economizer
Contradicts Section 5.7.4.2 Air Side Economizers
Building Area >150,000 ft²
(assume area includes spaces with Systems 9 to 13 as their baseline)
1 floor
(assume floors in the building, including spaces with Systems 9 to 13 as their baseline)
System 7 - SZVAV
one per zone
See Table 21 for detailed description
Integrated dry bulb economizer
Contradicts Section 5.7.4.2 Air Side Economizers (must be >54 kBtuh capacity to have an economizer)
>1 floor
(assume floors in the building, including spaces with Systems 9 to 13 as their baseline)
System 6 - VAVS
one per floor
See Table 20 for detailed description
continue...
Integrated dry bulb economizer
Contradicts Section 5.7.4.2 Air Side Economizers (must be >54 kBtuh capacity to have an economizer)
Mixed Use
See Table 4.
Separate occupancies are served by separate standard design systems
Use whole building area? Or area of each separate occupancy type?
Use number of floors in the whole building? Or by occupancy type?