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MEUS Comments 45-day 2019 BEES language

Additional submitted attachment is included below.

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May 5, 2018

Commissioner Andrew McAllister and Energy Commission Staff
Docket Unit, MS-4
California Energy Commission
1516 Ninth Street
Sacramento, CA 95814-5512

Re: MEUS Comments - 45-Day Language Express Terms for Title 24 2019 Building Energy Efficiency Standards (Docket No. 17-BSTD-02)

Dear Commissioner McAllister and Energy Commission Staff,

Mitsubishi Electric Cooling & Heating, a division of Mitsubishi Electric US, Inc. ("MEUS"), a manufacturer of Variable-speed Mini-splits and Multi-splits (VSMS) and Variable Refrigerant Flow (VRF) heating and cooling systems, appreciates the opportunity to submit comments in response to the California Energy Commission's proposed changes to the Building Energy Efficiency Standards contained in the California Code of Regulations (CCR), Title 24, Part 6, and associated administrative regulations in Chapter 10 of Part 1 as published in the Express Terms (45-Day Language) on January 19, 2018.

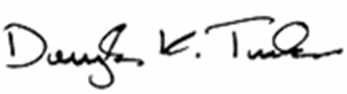
The MEUS comments are both an expression of our commitment to health and safety (IAQ) as well as a commitment to increasing HVAC efficiencies over time to the benefit of residents, building occupants and the general public. Our company slogan: "Changes for the Better" expresses our commitment to the greater good. To this end, it is our belief that VSMS and VRF systems can greatly improve both efficiency and safety (IAQ) in both residential and commercial applications, and our development teams are committed to this mission. MEUS and our industry trade association, AHRI (Air-conditioning, Heating and Refrigeration Institute), have worked closely with CEC staff over the past several years toward proper recognition of the benefits of VSMS and VRF technologies. However, it is our perception that the 2016 Code and the 2016 Residential Compliance Manual specifically avoid discussion or mention of "mini-split" or "multi-split" systems by name in numerous locations where these technologies are not only an appropriate solution, they have consumer and efficiency benefits that far outweigh the alternatives. MEUS wishes to clearly state our whole-hearted commitment to rectifying these issues in time for these technologies to be properly tested, rated and certified by CEC-approved agencies before the 2019 Code takes effect. We have the necessary resources including a talented and technically astute staff, as well as the most sophisticated test facility in North America, ready to make these objectives happen.

The following comments reference specific sections of the code followed by some general comments on specific ways that the code could be tailored to reduce heating and cooling loads to make smaller HVAC systems a more cost-effective solution. It should be noted that this low-load HVAC strategy can also cut the size of rooftop solar on ZNE homes by 30%-40% helping all-electric ZNE designs achieve cost as well as efficiency parity with gas alternatives and the current code requirements. These ZNE strategies also address grid supply and demand concerns as they relate to renewables by reducing heating loads at night. We offer these suggestions despite also being a manufacturer of innovative solar products as a show of good faith and commitment to helping the state of California reach its ZNE objectives without imposing additional cost premiums that would negatively impact the market and may promote “push-back” from developers and the NAHB.

We are your partners and will look for every opportunity to facilitate the affordable implementation of all-electric ZNE homes in an effort to meet the requirements of AB32 as well as other corollary mandates. To this end, we have added a comment on the use and definition of TDV as a metric in modeling compliance through CBECC, and the manner in which the algorithms that determine TDV do not appear to give full credit to HP systems whose loads are directly offset by rooftop solar and appear to penalize them as if there are 70% grid losses still factored into the equation for this scenario. We urgently request dialogue on this issue and commit to doing our part to provide technical support on these issues. We believe these objectives are in the best interest of occupant safety as well as facilitating CEC objectives to make homes truly zero energy.

MEUS appreciates the opportunity of the Commission to allow for comments to be provided. Thank you very much and we look forward to the completion of the future Title 24 standard.

Best regards,



Douglas K. Tucker
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Comment #1

110.2 Appliance Efficiency Charts a-k (pages 94-107 of pdf)

These charts show great variety in systems from commercial capacities to VRF multi-splits, but none of the capacities and none of the descriptions specifically correlate with mini-splits with typical capacities of 6000 to 12,000 BTU. The chart includes PTAC units but those are categorically different. Is this an oversight?

Comment #2

110.10(b)2.A: Mandatory requirements for solar ready:

> "**Single Family Residences.** The solar zone shall be located on the roof or overhang of the building and have a total area no less than 250 square feet or 50 percent of the potential solar zone area, whichever is smaller."

Given probable loads in most climate zones this square footage given perfect proportions would accommodate a 3.5kW array which is less than half of what a typical 1600s.f. home will require to reach net zero energy. Is this realistic? Are we misleading designers into thinking that low-load homes will need such a small array? Given that a 1600s.f. home has about 2000sf. of roof, the allocation of 250s.f of roof area seems inadequate. In multi-family scenarios, more lenient rules could apply. There are numerous exceptions that allow less solar area. Some allow compensatory measures such as OCST thermostats and energy star appliances. These exceptions seem too lenient if you are trying to actually go zero energy.

Section 110.10 makes no allowances for other types of renewable energy. The CEC should make it clear that they would they be allowed if developed. It seems that other renewable technologies should be given fair hearing and they may in fact help solve or level the grid demand and supply matching issues.

Comment #3

120.1(b)1.4 & 2.A IAQ Fan Requirements

> 2. **Attached dwelling units.** All dwelling units shall meet the requirements of ASHRAE Standard 62.2, Ventilation and Acceptable Indoor Air Quality in Residential Buildings subject to the amendments specified in subsection A below. All dwelling units shall comply with subsection B below.
> A. Amendments to ASHRAE 62.2 requirements.
> i. Window operation is not a permissible method of providing the Whole-Building Ventilation airflow required in Section 4 of ASHRAE Standard 62.2.
> ii. Continuous operation of central forced air system air handlers used in central fan integrated ventilation systems is not a permissible method of providing the

whole-building ventilation airflow required in Section 4 of ASHRAE Standard 62.2.

MEUS strongly supports ASHRAE Standard 62.2 guidelines. Although economizer features of commercial systems can save energy, we feel that CFI (central fan integrated) systems are inherently inefficient in residential applications due to: 1) the size of central fans relative to actual 62.2 requirements; 2) inevitable inefficiencies; 3) higher filter requirements in "nonattainment areas"; 4) the negative impact of MERV 13 filters on static pressure and flow; 5) potential failure modes due to reduced flow; 6) and the probability that periods of cooling and heating loads will not coincide with the intermittent IAQ requirements of ASHRAE Standard 62.2. We strongly recommend making IAQ fan systems separate from central air handlers because their lower air flow rates are conducive to higher filtration rates without a serious impact on efficiency. We also recommend anticipating technological innovation in controls that will allow dedicated IAQ fans to operate more like economizers, bringing in fresh air at optimal times to cool conditioned space at night during periods of high cooling loads. Smart controls with RF communication can track cfm rates of multiple exhaust fans in the home so that a minimum of conditioned air is displaced, enhancing system efficiencies while meeting ASHRAE Standard 62.2 requirements. For example, a balanced ERV, operating in a living room can adjust its airflow relative to the length of time a bath exhaust fan is left on, etc. Compliance credit could be offered for such innovation, helping to drive demand for such innovation.

Comment #4

120.1(b)1.4 & 2.A IAQ Fan Requirements

iv. Air filtration for mechanical systems shall conform to the specifications in Section 120.1(b)1.
v. Multifamily attached dwelling units shall have mechanical ventilation airflow provided at rates in accordance with ASHRAE 62.2 section 4.1.1, and comply with one of the following subsections ai or bii below.
a. A balanced mechanical ventilation system shall provide the required dwelling-unit ventilation airflow.
b. A continuously operating supply ventilation system or a continuous operating exhaust ventilation system shall be allowed to be used to provide the required dwelling unit ventilation airflow when the following condition is satisfied:
I. Dwelling-unit envelope leakage shall be less than or equal to 0.3 cfm/ft^2 of envelope surface area as confirmed by field verification and diagnostic testing in accordance with the procedures specified in Reference Nonresidential Appendix NA2.3.

This section places balanced ventilation on an equal footing with continuously operating supply or exhausts fans and ties the use of the supply-exhaust only fans to tighter envelopes. There are several concerns with this section: 1) Balanced ventilators are inherently more efficient and should be recommended over scenarios where bathroom fans are allowed to run continuously. 2) Typical supply-only or exhaust-only fans operating continuously can displace all the air in a small bathroom in three hours. Its predictable that people will close that door in cold climates which risks temperatures dropping significantly in that room, condensation of vapor drive in walls, and heat loss through all the adjoining interior walls. 3) Tying the use of supply and exhaust-only fans to tighter building envelopes does not also include a provision for make-up air. The tighter the building gets, the greater the potential for depressurization and back-drafting of appliances. There are often exhaust fans and dryers in the same small space with a water heater and a closable door. Although the code says to avoid back-drafting elsewhere, it does not make the issues with this scenario clear and they are common problems with significant health and safety concerns.

We strongly recommend requiring dedicated ERV or HRV fans with high filtration rates located specifically in areas away from vapor sources.

We do not feel that high filtration requirements are necessary on dedicated IAQ fans except in nonattainment areas.

We also strongly recommend against allowing continuously operating supply or exhaust only fans. Supply only scenarios will facilitate vapor drive which is a health concern as it pertains to potential condensation in wall assemblies. Exhaust only, as we have noted is not a good solution. There are very affordable products that provide balance ventilation on the market.

Comment #5

120.1(b)2.Aiii IAQ Fan Requirements

> iii. Horizontally attached single family dwelling units shall have mechanical ventilation airflow provided at rates in accordance with ASHRAE 62.2 section 4.1.2 using a default value for leakage rate at 50 Pa that corresponds to a dwelling unit envelope leakage of 2 ACH50 for the infiltration credit calculation.
>
> I. Dwelling-unit envelope leakage shall be less than or equal to 0.3 cfm/ft^2 of envelope surface area as confirmed by field verification and diagnostic testing in accordance with the procedures specified in Reference Nonresidential Appendix NA2.3.

These two references under this section appear on the same page but make reference to two different standards for verifying building leakage. The first is consistent with HERS practices; the second is a convention used by NFRC to verify window leakage and does not normally apply to envelopes. They should be consistent. We encourage the 2ACH50 standard as it is reasonably achievable and significantly reduces cooling and heating loads. We support incentives to create low load homes.

<u>Comment #6</u>

<u>120.1(b) IAQ Fan Requirements</u>

> vi. Multifamily building central ventilation systems that serve multiple dwelling-units shall be balanced to provide ventilation airflow to each dwelling-unit served at a rate equal to or greater than the rate specified by ASHRAE 62.2 section 4.1.1, but not more than ten percent greater than the specified rate. These systems shall utilize means such as constant air regulation devices, orifice plates, and variable speed central fans to ensure the dwelling-unit airflows can be adjusted to meet this balancing requirement.

The requirements of this paragraph seem unnecessarily stringent compared to the leniency of other paragraphs in this section. Given the airflow complexity of a 10-unit central IAQ system, it would be very difficult to balance the flows to all the units that precisely, especially if they are different sizes. For example, the complex consists of small 800sf. 2 bedroom units; they will need about 40cfm each. A ten percent margin of error is only 4cfm. It would be extremely difficult to balance the flows of 10 units to within 4cfm to each, especially if they are different sizes and length of duct runs vary, etc. This requirement seems entirely impractical. It is better to limit the size of central IAQ units to 4 units and require that they be approximately the same cfm requirement in the first place, and then loosen the requirement to within 10cfm rather than a percentage. The amount of potential heat loss here relative to the headaches for the contractor and the HERS rater don't compare to the gross heat loss caused by continuously operating exhaust fans as allowed above.

<u>Comment #7</u>

<u>120.1(b)2.Bii IAQ Fan Requirements</u>

> ii. Kitchen Range Hoods. The installed kitchen range hood shall be field verified in accordance with the procedures in Reference Nonresidential Appendix NA2.2.4.3 to confirm the model is rated by HVI to comply with the following requirements:
> a. The minimum ventilation airflow rate specified in Section 5 of ASHRAE 62.2.
> b. The maximum sound rating specified in section 7.2.2 of ASHRAE 62.2.

This regulation does not go far enough. In the context of tighter low-load homes, it is or can be detrimental to install oversized kitchen hoods. Many residences install expensive commercial grade fans with 800-1200 cfm which poses significant depressurization issues. This category of product needs to have maximum cfm requirements to prevent particulate infiltration and potential back-drafting of combustion appliances. This is an important health and safety issue.

Comment #8

120.1(b)2.B IAQ Requirements

> **Design Requirements for Minimum Quantities of Outdoor Air.** Every space in a building shall be designed to have outdoor air ventilation according to Item 1 or 2 below:
> 1. **Natural ventilation.**
> A. Naturally ventilated spaces shall be permanently open to and within 20 feet of operable wall or roof openings to the outdoors, the openable area of which is not less than 5 percent of the conditioned floor area of the naturally ventilated space. Where openings are covered with louvers or otherwise obstructed, openable area shall be based on the free unobstructed area through the opening.

Although the above section has been deleted, we would like to go on record for including it. In low and high-rise buildings having operable windows greatly facilitates the health and safety of the occupants and this should be required in all categories of habitable structures. Operable windows should not supersede ASHRAE Standard 62.2 IAQ requirements. However, the other struck provision that follows this paragraph, which requires IAQ fans in each room, far exceeds requirements. We support measures to promote healthy buildings.

Comment #9

120.1 (c) 1. IAQ Filtration in Non-Residential and Hotel Buildings

> **Nonresidential and Hotel/Motel Buildings.** All occupiable spaces shall meet the requirements of subsection 1 and either 2 or 3:
> 1. **Outdoor Air Treatment.** The system shall be provided with air filters to clean the outdoor air at any location prior to its introduction into occupied spaces in accordance with subsection A and B.
> A. The filters shall have a designated efficiency equal to or greater than MERV 13 when tested in accordance with ASHRAE Standard 52.2, or a particle size efficiency rating equal to or greater than 50 percent in the 0.30-1.0 μm range, and equal to or greater than 85 percent in the 1.0-3.0 μm range when tested in accordance with AHRI Standard 680; and
> B. Systems shall be equipped with air filters that are two or more inches in depth.

MEUS supports limiting the requirement for MERV 13 for outdoor air filtration only to areas that have high ambient PM2.5 (i.e., ear busy roadways); and, for economizers which bring in outdoor air in commercial applications. In addition, the language should provide for the use of one inch filters.

Comment #10

120.1 (d) IAQ Ventilation in Non-Residential and Hotel Buildings
(d) **Operation and Control Requirements for Minimum Quantities of Outdoor Air.**
1. **Times of occupancy.** The minimum rate of outdoor air required by Section 120.1(bc)2 shall be supplied to each space at all times when the space is usually occupied.
EXCEPTION 1 to Section 120.1(cd)1: Demand control ventilation. In intermittently occupied spaces that do not have processes or operations that generate dusts, fumes, mists, vapors or gasses and are not provided with local exhaust ventilation (such as indoor operation of internal combustion engines or areas designated for unvented food service preparation), the rate of outdoor air may be reduced if the ventilation system serving the space is controlled by a demand control ventilation device complying with Section 20.1(cd)4 or by an occupant sensor ventilation control device complying with Section 120.1(cd)5.
EXCEPTION 2 to Section 120.1(cd)1: Temporary reduction. The rate of outdoor air provided to a space may be reduced below the level required by Section 120.1(bc)2 for up to 30 minutes at a time if the average rate for each hour is equal to or greater than the required ventilation rate.
2. **Pre-occupancy.** The lesser of the minimum rate of outdoor air required by Section 120.1(bc)2 or three complete air changes shall be supplied to the entire building during the 1-hour period immediately before the building is normally occupied.

Requiring outdoor air "be supplied to each space at all times space is usually occupied" will unnecessarily waste a great deal of energy. Smart T-stats can identify occupancy patterns. Some buildings require occupancy sensors. This "usually" needs clarification. What is required here to meet this criterion? The building is either occupied or it is not. Fresh air should be supplied when it is needed.

Requiring three air changes to an "entire building" in the hour before occupancy is unreasonable and should be struck from the text. Section 120.1(bc)2 are adequate.

Comment #11

General Notes on HVAC, IAQ and Health and Safety:

MEUS strongly supports provisions that accommodate the all-electric ZNE home. It is our perception that the 2019 Code and CBECC modeling do not go far enough to give adequate and equitable compliance credit to advanced HVAC technologies such as variable capacity heat pumps (VCHP) and variable refrigerant flow (VRF), that are so critical to making all-electric ZNE homes affordable. We commit to the CEC to provide whatever resources necessary to remedy this problem and request dialogue at every level of the CEC in regard to resolving this compliance credit issue quickly. ME US is dedicated to continuous improvement of our product lines and aims to be at the forefront of innovation as we partner with the CEC to meet ZNE objectives in both commercial and residential applications.

We are also of the opinion that heat pump HVAC systems and sealed combustion furnaces are inherently safer than open combustion appliances that are prone to greater CO hazards under certain install conditions. Heat pump systems can now operate effectively in all climate zones, and there is no reason to compromise safety and efficiency.

We strongly recommend that the 2019 code require sealed-combustion (condensing) appliances with a minimum efficiency of .90 AFUE for all residential and commercial applications. The safety and efficiency issues associated with open combustion gravity-type units are an unnecessary compromise, especially with the trend toward tighter building envelopes. Cold pipe condensing flues are inherently safer and more conducive to deep insulation in HPA attics, allowing ducts to be deeply buried without the expense or fire safety concerns associated with building insulation dams around hot flues. Perhaps the greatest safety concern is the location of gravity-vent water heaters in laundry rooms or small spaces that have exhaust fans, a scenario which poses significant back-drafting hazards and which should be strictly prohibited.

Comment #12

General Note on “UV Scrubbers” and IAQ:

It has come to our attention that there are a great deal of UV filtration devices sometimes referred to as “UV scrubbers” on the market nationwide. More HVAC contractors than not try to sell such devices as an upgrade to their HVAC system installation. In theory, these devices use bursts of UV light to kill bio-toxins in the airstream that passes them and thereby “filter” of clean the air. Independent lab research as well as studies conducted by the California EPA and the California Air Resources Board (CARB) have concluded that the UV light emitted from these devices falls far short of levels required to kill toxins but are sufficient to form “free radicals” chemical compounds that kind combine with other particles to produce toxic compounds that are correlated with cancer and other serious illnesses. There are publications online confirming CARB and Cal EPA condemnation of UV scrubbers, but they are apparently powerless to outlaw them. In the interest of public health, we request that your staff interface with the appropriate regulatory agency to restrict use of these devices in California and include education about their harmful effects in your IAQ classes at the Energy Centers. (See separate files containing CARB and Cal EPA information on UV scrubbers uploaded to the docket separately following these comments.)

<u>Comment #13</u>

MEUS agrees that is it in the best interest to consolidate all information related to Demand Response in one section as is being proposed. This allows for a comprehensive overview of the requirements and allows future reference to §110.12 only.

Section 110.12.a.1 states: "All demand responsive controls shall be ~~capable of functioning as~~ an OpenADR 2.0a or OpenADR 2.0b Virtual End Node (VEN), as specified under Clause 11, Conformance, in the applicable OpenADR 2.0 Specification."

By requiring OpenADR as the base communication protocol, MEUS believes that this will reduce the ability for manufacturers to provide a comprehensive solution for Demand Response events issued by many Utilities. Although there is some overlap, most Utilities have a preferred method of initiating and terminating Demand Response events which do not necessarily use OpenADR. Since every customer does not live in an area with the same infrastructure, terrain, population density, etc., different communication protocols can provide various degrees of solutions to be able to reach those customers. Various Utilities have stated that in certain locations, they have had greater results with one protocol over another and even have had great success with legacy communications. With more than 150 million customers nation-wide, this can become a serious issue. [1.]

Since there is not one agreed upon communication standard between all Utilities nationwide at this time, this requirement will put strain on manufacturers to develop multiple products which are to be used for the same application. The result of these multiple products will result in high development costs that can cause significant market disruption. Although Mitsubishi Electric shares the vision of a national demand response protocol, the current absence of consensus regarding protocols will require a significant time investment to resolve. Affording the industry time to form working groups to resolve protocol issues will greatly enhance the design, testing, and implementation process with a lower risk of market disruption and lost resources.

This requirement may cause unintended effects to customers. New products which involve IOT connectivity is expected to grow significantly in the next few years.[2.] Customers have already begun the process of replacing many products within their home with smart devices. Some of these devices allow for Utilities to connect in order to initiate shed events. These devices typically require a sizable cost investment on part of the customer and removing some of the functionality of these products can cause the trust customers have with various manufacturers to decline.

By requiring OpenADR, this also causes future innovation to be stifled. Within the tech industry, new computer languages were created in order to reduce the difficulty to implement new ideas.[3.] There is a possibility that in the near future a new communication protocol could be released which would help in the development of this industry. If communication between devices were limited, it could cause the industry to slow. All communication protocols have their pros and cons depending on the application. Without the ability to choose, it is not possible to keep pace with trends and this can cause competition to be reduced.

Recommendation: MEUS proposes that section 110.12.a.1 be amended to allow for a non-proprietary open protocol to be used with or in place of OpenADR. The following changes are requested in *red*:

> **(a) Demand responsive controls.**
> 1. Section 110.12.a.1 states: "All demand responsive controls shall be ~~capable of functioning as~~ an OpenADR 2.0a or OpenADR 2.0b Virtual End Node (VEN), as specified under Clause 11, Conformance, in the applicable OpenADR 2.0 Specification *or by using an open protocol or both*."

It is strongly recommended that the Commission expand the requirement of OpenADR (to allow protocols and interface technologies to mature). In order to assist with future developments, MEUS could help with facilitating future talks between the CEC and other interested parties in order to come to a consensus on this requirement.

Sources

1. "Electric power sales, revenue, and energy efficiency form EIA-861 (2016)". *US Energy Information Administration*. Nov. 3rd 2017. https://www.eia.gov/electricity/data/eia861/
2. Columbus, Louis. "2017 Roundup of Internet of Things Forecasts". *Forbes.* Dec. 12th, 2017. https://www.forbes.com/sites/louiscolumbus/2017/12/10/2017-roundup-of-internet-of-things-forecasts/#5dcc496e1480
3. Sherman, Matt. "Why are there so many programming languages?". *Stack Overflow*. July 29th, 2015. https://stackoverflow.blog/2015/07/29/why-are-there-so-many-programming-languages/

Comment #14

120.4 Air Distribution Ducts and Plenums:

> (a) **CMC Compliance.** All air distribution system ducts and plenums, including, but not limited to, building cavities, mechanical closets, air-handler boxes and support platforms used as ducts or plenums, shall be installed, sealed and insulated to meet the requirements of the CMC Sections 601.0, 602.0, 603.0, 604.0, 605.0, and ANSI/SMACNA-006-2006 HVAC Duct Construction Standards Metal and Flexible 3rd Edition, incorporated herein by reference. Connections of metal ducts and the inner core of flexible ducts shall be mechanically fastened. Openings shall be sealed with mastic, tape, aerosol sealant, or other duct-closure system that meets the applicable requirements of UL 181, UL 181A, or UL 181B. If mastic or tape is used to seal openings greater than 1/4 inch, the combination of mastic and either mesh or tape shall be used.

The phrase "as ducts and plenums" in this context leaves the meaning of this paragraph open to interpretation. The above paragraph does not clarify whether or not building cavities may be used as ducts or plenums without sealed metal liners or custom square duct inserts. Although the CMC sections may clarify this point, we feel the text prior to this reference should unambiguously prohibit the use of chases, soffits or wood framed cavities to be used as ducts or plenums. As far as we understand, such use of wall cavities and wood plenums has been prohibited since the early 1990s. It also calls for a bit more detail about how the various UL181 tapes may be used. We recommend requiring that plenums be sealed only with mastic due to high pressure differentials at this point in the system. There is no mention of the prohibition against using traditional cloth backed tapes on ducting. Although there is a question about jurisdictional authority, this section would be a good place to insert a requirement that manufacturers of non-compliant "duct tape" be required to call it by a different name such as "multi-purpose tape" with a mandatory warning: "not to be used as duct tape". This would prevent suppliers from putting these products on the shelf next to all the ducting supplies, as is now the case in all major consumer outlets.

Comment #15

General Comment on Furnace Replacement Requirements:

Although the code requires HERS testing on new construction, the incidence of furnace replacement violations is extremely high in the state of California. The CSLB estimates that only 1 in 20 furnace replacements is properly permitted and HERS tested. The most common violations are use of non-compliant tapes, high leakage rates, under-ducted, oversized systems (potential heat exchanger failures), condensate pumps and pans inside of open stud return plenums, and non-compliant flues. Anecdotal evidence from the field supports this. The CSLB enforcement division has far too few resources to stop these widespread violations that greatly affect both safety and efficiency. MEUS has perhaps the most comprehensive training program in the state for its installers and commits to trying to rectify these health and safety concerns. But far more is needed to achieve statewide goals to promote safety and efficiency from regulatory agencies (CEC, CSLB, EPA) that need to work in a concerted effort to:

1) Require NCI or NATE certification training of all HVAC contractors statewide by 2021.
2) Alternatively, require all "CEC-certified" by attendance of training statewide energy training centers operated by IOUs.
3) Promote use of proper duct sealing measures.
4) Prohibit the use of duct-board products (fiberglass is a probable carcinogen)
5) Prohibit the use of non-conforming tapes or use of conforming tapes in the wrong application.

6) Strictly prohibit the installation of replacement FAU's on top of existing unsealed stud-framed plenums or in duct systems that use unsealed wall cavities in any portion of the duct system.
7) Strictly prohibit the installation of residential FAUs in homes or multi-family buildings with asbestos ducts. This will require the creation of an upgrade fund for low-income families and landlords that can be funded through a ratepayer fee or tax similar to Cal's Energy Upgrade Program.
8) Because so many replacement furnaces are "upgraded" to a larger size capacity without verifying duct flow, this scenario poses a serious risk to public health (heat exchanger failures), and there is anecdotal evidence that it is extremely common (As much as half of the furnace replacements in the state). We strongly recommend duct testing by HVAC contractors be mandatory prior to swapping furnaces, coils or condensers to verify ducts are not too small for FAU capacity.
9) Impose significant penalties if contractors hook up systems that are more than 10% oversized relative to duct size and flow requirements because of potential heat exchanger and CO hazards .
10) Strictly prohibit suppliers including box stores like Lowes and Home Depot from selling non-conforming tapes in their HVAC sections (you can't currently buy conforming tapes in these stores or Ace Hardware stores.)
11) Create more stringent enforcement rules for HVAC installers that would threaten them with suspension of license for up to one year if they are caught either: a) installing furnaces without permits or, b) installing them without replacing asbestos ducting, and/or penalties of up to $10,000.
12) Crack down own widespread fraud among HVAC contractors that is well documented by CSLB wherein "false red-tags" are used to induce sale of new systems when in fact there are no existing CO dangers.
13) Phase-in requirements that require sealed combustion furnaces and instantaneous water heaters in the near term (next 5 years) as well as create incentives for phasing-in heat pump systems in the long term.

Comment #16

Other General Comments on Ducting Requirements:

1) Multi-family duct leakage allowed (12%) is ridiculously high compared to single family standards.
2) Duct board is a terribly inferior product to other duct types and should have been regulated out of existence years ago. It is a compromise to public safety (fiberglass a

suspected carcinogen) and cannot be reliably installed to meet leakage requirements with durability over time. The code should explicitly prohibit its use.

3) Cloth backed UL181 tapes are inadequate for general use. The code allows them to be used with mastic and ties, but not on plenums. They are inferior and this standard is too confusing to be accurately followed by installers and inspectors in the field. It relies too heavily on small HVAC contractors to train their staff. Many do not.

Comment #17

Recommendations on Duct Design as it Pertains to Fan Efficiency and HERS Verification:

In a collaborative effort to meet CEC goals and make ZNE homes affordable in this code cycle, ME US recommends that low-cost building measures that save more energy than more costly technical solutions be implemented before or simultaneous to costly mechanical system requirements. This cost prioritization of measures is consistent with the stated goals of the CEC but does not appear to be emphasized in the structure of the Code. A calculation method for kWh and BTUs/dollar should be factored into to the prioritization of new code requirements. Otherwise, manufacturers may be required to spend enormous amounts of R&D requirements to meet arbitrary and aggressive implementation schedules, resulting in market disruption and higher product cost as well as higher customer dissatisfaction – only to have those R&D investments invalidated by building system inefficiencies related to the site-specific installation and design process, over which manufacturers have no significant control. For this reason, we are recommending a rethinking of these priorities so as to offer adequate development schedule lead-times for manufacturers as well as time to institute statewide trainings and new "CEC-certifications" (or NCI, BPI, NATE, etc.) for subcontractors and general contractors on building science principles. CSLB mandated "tailgate meetings" should be expanded to cover documented QC topics (signed by attendees) so that construction workers in the field are well versed on relevant issues of building science and "new-school" thinking that the CEC is trying to promote. Quality control starts with the assembly line worker and the construction worker alike, and more QC is needed in the field than can be provided by CEA analysts and HERS raters.

On that introductory note the following HVAC and ducting related points are made:

The 2019 code seems to be focused on rapid increases in FAU fan efficiency and it appears that fan watt-draw measurements in the field are used as an indication of motor efficiency. However, this is far from the case. The only accurate measure of fan efficiency is either: 1) lab testing where all variables are controlled; or 2) field testing where static pressure is also measured and verified to be within range. If static pressures are out of range, field-measured watt draw says virtually nothing about motor efficiency. Although overall airflow is measured by HERS raters, and there is a high correlation between total airflow and static pressure, these measurements are not an accurate determination of static pressure. There are several reasons for this, but chief among them is the fact that most HERS raters use flow hood devices that are not always large enough to accommodate all grill sizes and the results can provide only “soft” numbers. Flow grid devices take considerably more time and money to use and most HERS raters do not use them. Since HERS raters are not required to measure static pressure as an isolated variable in the field, virtually all of the field measured watt-draw readings are invalid indicators of motor efficiency.

Static pressure and how it is impacted by duct diameter and length, elbows, plenum and damper configuration is actually the issue that causes fan watt draw to vary from one installation to the next. It is far more accurate and probably no more difficult for a HERS rater to measure static pressure instead of flow with a flow hood. Although fan motor efficiency is also a variable in field-measured watt-draw, motor efficiency as measured at the factory or in the lab is far more accurate and will not vary by more than +/- 1% in a lab test over thousands of products coming off the assembly line. All manufacturers implement statistical process control measures (SPC) which monitors such variation and it is implicit in our QC programs that measures are implemented at the factory to bring variation within range. Any manufacturer would be able to offer you similar reassurance of motor efficiency meeting rating requirements in a consistent manner over time. Our SPC books can be opened to you to put any question of these quality control measures to rest. For these reasons we propose altering the current standard for using fan field measured watt-draw as a standard metric for motor efficiency.

MEUS remains committed to “continuous improvement” which is infused in our corporate culture from top to bottom and especially in our product development teams. We are already on a path to continuously improve motor efficiency. However, unilaterally requiring near term improvements in motor efficiency to meet the .45watt/cfm requirement across all product categories could result in “panic mode” development schedules that are extremely disruptive to our business model and which may be impossible to achieve given other upgrades currently proposed in the 2019 code such as MERV13 filtration requirements. Significantly increasing filtration rates at the same time that watt-draw is to improve by 25% introduces two new criteria that are known to be in direct opposition to each other. Under all normal design circumstances, and given the basic physics involved, higher filtration rates inherently increase static pressure and watt-draw. Such oppositional variables will require serious rethinking and redesign of entire product lines across the entire industry with less than a year of development time remaining and with even tighter tooling and manufacture engineering schedules. Imposing such stringent and oppositional regulatory requirements simultaneously, and with inadequate forewarning and lead times will inevitably lead to crisis management scenarios for manufacturers, increased product failures, higher costs to consumers, and market disruption.

Furthermore, such motor efficiency improvements are only beneficial if combined with intelligent “new-school” duct design which should be mandatory in the 2019 code (but is conspicuously absent or only recommended practice) as it can improve system efficiencies by 30% to 50% *at a lower cost* than conventional duct system design (fewer ducts, shorter runs, less install labor, buried ducts, bar type grills, central damper control, oversized plenums and returns to facilitate better flow and filtration, etc.).

The cost to integrate ECM motors that are 20% to 25% more efficient, but which improve overall system efficiency by only 5% to 12% (here estimated, considering condenser kW usage) may be an ineffective strategy, or quickly invalidated by poor systems integration on the part of Wrightsoft designers and installers.

MEUS will be very agreeable and is already instituting reasonable improvements to motor efficiency through an iterative product development and testing process that is data driven and in a manner that is not going to disrupt manufacturing continuities and markets.

Another critical variable is site-specific duct design which requires well trained system designers and the use of proper design tools that result in drawings that detail every duct, plenum, boot and grill dimension. Although, we appreciate the fact that CBECC is a capable program for running heat load calculations, but it is not a duct design program and is adequate for specifying duct sizes compared to more developed duct design programs such as Wrightsoft. We are not suggesting mandating use of Wrightsoft specifically. Any similar program would do, but we are suggesting that the interface between CBECC and Wrightsoft be improved to facilitate responsible and efficient duct design without the redundancy of having to re-enter data. The CEC should require duct layouts and calculations using Wrightsoft or a new competing program, provided that it has sufficient detail: a punch-list of system details and notes such as return grill area, duct diameters and the new-school design details such as bar-type damperless grills at most of the supplies and longer supply plenums to accommodate centralized dampered control of the larger habitable spaces. Widespread training programs such as the **CEC's statewide trainings at energy centers**, (or NATE, NCI) **should be mandatory** for all licensed HVAC contractors and all system designers whether certified or not (low-rise residential does not require license or certs). Wrightsoft, duct-blasters, manometers, static pressure (pitot) tubes, refrigerant charge gauges, etc. should be mandatory installation equipment. The end of eyeball engineering needs to come to an end.

It summary, it is probable that manufacturers can guarantee a specific air handler watt draw will not exceed .58watts/cfm based on a system not exceeding a specific design static pressure. But these system efficiencies are far more easily achieved at a lower installed price if the CEC would mandate "new-school" approaches to system design (i.e. Chitwood School of Thought). Combined with deeply buried ducting, simple heat load calculations reveal that you can save 1-1/2 to 2-tons of cooling capacity in your average high cooling load house by employing this strategy, and it cuts the cost of the duct system by 33%. Given the lack of control of design variables in the field, it does not seem reasonable that manufacturers are being asked to cut watt draw arbitrarily by 25% across many system categories within about a year. The proposal appears to be based on a few sample tests in narrow product categories and it is not the most feasible or cost-effective strategy.

MEUS agrees with CEC requirements for manufacturer installed measurement access hole (MAH) and our member companies universally offer installation training and technical support. We agree that static pressure should be measured by a HERS rater or installer without risking damage to equipment and heat exchangers by drilling MAHs in the field.

Comment #18

Section 150.0 Filtration Requirements & Challenges of Meeting IAQ Requirements with CFI systems

To meet the CEC's higher IAQ filtration requirements while avoiding numerous product engineering challenges that may not be met in such a short development cycle, MEUS recommends eliminating CFI systems (central fan-integrated IAQ) from central FAUs for the following reasons: a) they do not efficiently meet ASHRAE Standard 62.2 because central fans require so much more power than dedicated HRVs and ERVs and are inappropriately sized for this application; b) The continuous or intermittent operating schedules for the optimized HRV or ERV systems will often not coincide with the schedule of heating and cooling demands during off seasons in extreme climates and much of the year in mild climates; c) If CEC now requires higher MERV 13 filtration the resulting higher static pressures can cause premature equipment failure modes such as heat exchanger and coil failures; d) In at least some of these cases, heat exchanger failures will be catastrophic enough to pose serious health and safety concerns; e) Higher MERV filters and the resulting static pressure increases make it difficult to meet the lower .45 watt/cfm requirement for many FAU models and will make it impossible for others. In conclusion, MERV 6 filtration is adequate to protect the equipment, and although we are supportive of MERV 13 standard on dedicated IAQ fans, the requirement imposed on central FAUs and CFI systems, will inevitably result in reduced airflow, higher static pressures, higher watt draw, higher stress on both coils and heat exchangers, with higher initial and maintenance costs as well as safety and liability concerns. In the interest of efficiency and safety, it becomes necessary to separate IAQ functions from central air handlers. CFI is simply not a good technical solution in single family and low-rise residential applications.

Comment #19

General Comment on Zoning Plenums combined with Gas Furnaces

Similarly, HVAC zoning plenums on any type of combustion furnace should be prohibited due the high likelihood of reduced airflow scenarios that can cause significant inefficiencies, but more importantly, can lead to premature failure and catastrophic failure of heat exchangers, greatly increasing CO poisoning hazards. This is a considerable safety concern. Although the CEC has described in great detail how these systems should be designed and tested, most HVAC contractors will give you testimony that it is almost impossible to achieve proper airflows through them to meet flow, watt-draw and SP requirements and they are prone to failure modes and failure, with fairly low perceived comfort and low customer satisfaction. Zoning plenum failure is highly likely to trigger other system failures: namely prolonged reduced flows through the heat exchanger, premature heat exchanger failure and potential CO poisoning hazards. Given the move toward efficiency and safety, more stringent flow and watt-draw requirements, and the engineering failure modes of these systems, they should be prohibited in 2019.

When room by room zoning is desired, multi-split systems are the technology of choice, and yet these are not even mentioned under the zoned controls of the CECs 2016 Residential Compliance Manual. Even if we were not focused on these technologies, we would argue for their inclusion in the Compliance Manuals. It is a matter of public safety and the greater good.

On that note, it is important to point out that the 2016 Residential Compliance Manual seems to go out of the way to avoid mention of mini-split and multi-split systems discussion of mini-splits and in numerous parts of the text where their advantages are in fact significant in avoiding other construction costs while providing other benefits and increasing efficiency. They are not mentioned in the section on zoning, and they are also conspicuously absent from any discussion of compliance credit for eliminating ducts in the attic.

Mitsubishi Electric US would like to promote direct and ongoing discussion with CEC staff regarding these omissions, and commit the resources necessary to comply with all equipment certification requirements and can do so immediately and within the next 6 months so as to facilitate proper rating of equipment with both the CEC and AHRI.

<u>Comment #20</u>

<u>General Comment on Apparent Bias for In-Slab Hydronic Heating Systems:</u>

Ironically, the code gives credit to hydronic heating generally because it eliminates ducts in attic, but does not require specification of whether wall radiators or in-slab radiant heat is used. Under 2% of the market uses wall panels, so the majority of these hydronic systems are installed in-slab and there are no requirements for full under slab insulation in any climate zone, resulting in higher BTU losses to ground than would be the case if there were a forced air system with ducts in the attic. Here at Mitsubishi Electric, we can only advocate for control of all variables and a level playing field for all technologies so that such unseen, tacit biases in the code do not dictate extraordinary inefficiencies in one category only to impose cost prohibitive requirements in another that lead to unfair competition and market disruption.

To clarify, MEUS believes that efficiency and insulation measures should be applied evenly and fairly in how the algorithms give compliance credit to various measures. It is clear, give a few simple “back of the napkin” heat load calculations that all in-slab hydronic systems should have full slab insulation and even if they had it, would probably not qualify for DCS credit given heat loss through either R-7 or R-10 slab insulation. The states CBECC compliance software must provide for modeling the difference between having slab insulation and not having it. The fact that there is no way to model this option greatly inhibits the ability of designers to evaluate these cost and efficiency trade-offs.

Comment #21

General Comment on FAU Cabinet Leakage, Remediation Measures and Safety Issues:

Given the tighter duct leakage requirements, MEUS recognizes that air handler leakage is a more significant issue and that tighter cabinet requirements are appropriate in this category. We have heard reports of some manufacturers having high FAU cabinet leakage and invalidating warranties if HERS raters or contractors try to remedy the problem in the field. This is a catch-22 situation for installers and needs to be remedied in the following manner:

1) Require high cabinet sealing requirements: .5cfm at 50pa leakage or better
2) Require that all manufacturers provide in-field cabinet sealing measures and recommendations that do not void warranties. This may include high-temp caulking that meets fire requirements and that will not introduce contaminants into the conditioned air.

Comment #22

In the interest of in-field system optimization, and customer satisfaction, MEUS recommends that refrigerant charge verification method for VSMS systems recommended to CEC by AHRI be adopted in all climate zones.

Comment #23

General Comment on Whole House Fans:

To avoid product and cost redundancy as well as system efficiency compromises, we suggest that the CEC reconsider its 1.5cfm/sf requirement for whole house fan minimum capacity. It is conceivable that this standard may be appropriate for very hot climates (CZs 14 & 15?) and perhaps not for more moderate climates. Although, 1.5cfm/sf is already a reduction from earlier standards, it is still a high enough rate of flow to achieve a full air change in just 5 to 6 minutes. A .5cfm/sf standard would work in most other climates, be more efficient and achieve a full air-change in just 16 minutes. Anecdotal evidence indicates that this capacity is adequate for temperate climates with the added benefit of lower pressurization of attics and much quieter systems.

Longer runtimes also open opportunities for WHFs having Wi-Fi RF interface with IAQ fans and both shutting them off during WHF operation as well as logging cfm ventilation to optimize compliance with ASHRAE Standard 62.2 with minimum unwanted heat loss or

gain. UC Davis has experimented with such systems. Manufacturers would be encouraged to enter the field if code was flexible enough to accommodate such innovation and offered compliance credit for its implementation. Although controllers for such systems do not as yet exist, the code's one size fits all approach discourages innovation in this category.
We advocate for requiring analog timers and eventually phasing-in differential controllers to turn whole house fans off while residents are sleeping with sensors to detect delta-T between indoor and outdoor temperatures. Provisions should also be made to integrate these systems into unvented attics and require dedicated make-up air sources so WHFs can be programmed to cool the house even if residents are not home. This is another reason to scale down the cfm requirements.

Comment #24

General Comment on HPA Design and Serviceability of Ducts in Conditioned Space:

Given the new HPA requirements in the code and the obvious advantages of HPA measures under the various options offered, we strongly support these measures as they promote much lower HVAC load conditions generally, and are likely to have high efficiency to cost ratios. However, given the importance of duct leakage, and the prevalence of flex ducting in the industry, we feel it is a mistake to conceal ducts in chases and soffits without provision for their serviceability. In a best case, flex ducts and joints in the system will begin to fail after 25 years, and buildings, especially green buildings, are designed to last 100 years. Concealing ducts or equipment inside attic "plenums" (CEC term for framed chase, soffit or attic compartment that is sealed with drywall or plywood) may reduce the heat loss of ducts to unconditioned attic air, but it sets up conditions that will make duct replacement or repair extremely expensive and invasive of the living space when problems eventually develop. The probable and predictable consequence of promoting the ducts in conditioned space (DCS) option is that homeowners and residence will prolong needed duct replacement when it is in fact needed, resulting in significant loss of performance and efficiency. One may argue that leakage to conditioned space is not so bad as leakage to outside, and that is true. However, the model homes that have incorporated DCS for test purposes often have multiple ducts within one plenum, with the obvious eventual result that when ducts fail, there will be no way to balance flows to provide comfort to all zones. Even if DCS "plenums" did not leak to outside, there would be significant performance and efficiency compromises. Since we also produce many models of ducted heat pumps, this is an issue that concerns us.

It should also be obvious that the term "plenum" which the CEC has chosen to refer to sealed compartments that house HVAC systems including their ducts, air handlers and supply and return plenums, is inherently confusing. It will not be uncommon to have HVAC return and supply plenums inside this "plenum" (sealed plywood compartment). We humbly suggest changing this confusing term everywhere it may appear in the Standards and the Compliance Manuals.

Proposal to Add HPA Option "D":

It is abundantly clear to us that mini-split and multi-split systems offer significant energy savings by eliminating ducts in conditioned space without the needed expense of roof deck insulation (HPA options A&B). If refrigerant lines are insulated in addition to being deeply buried under R-38 to R-60 blown cellulose or blown fiberglass insulation, the losses would be far less than either options A or B and would have less than a tenth the distribution losses of the in-slab hydronic system that you are already giving this credit to. Whereas above or below deck insulation will cost a minimum of $1/sf., the cost of increasing blown ceiling insulation from R-38 to R-60 is less than $0.45/s.f.. For this reason we would argue for an HPA option "D" (corresponds to ductless), that would allow the HPA attic savings to help offset any differences in system installation costs. We advocate for R-60 blown insulation so that total insulation levels (ceiling+deck) are comparable to the other HPA options. Given the system advantages and efficiencies achievable with multi-split systems, we feel the addition of this option would create a more level playing field with the competing options that you have already implemented.

Comment #25

VRF and VCHP Test Criteria and Protocols:

MEUS recognizes the implicit challenges of rating variable capacity systems that generally have more complex controllers and algorithms that track more variables to respond continuously to changing demand conditions. Rating capacity at one temperature on VRF and VSMS systems is like taking a snap shot of an ice-skating competition to rate the performance. We recognize that it would be optimal if VRF and VSMS systems had test protocols that might verify capacity and performance along a range of temperatures and conditions to fully recognize their efficiencies and ability to meet building load requirements. The current AHRI certification process is best use for test lab comparisons between different system types tested using the same standard. For this reason, MEUSS would like to take the lead to form a working group with the CEC and other Industry Stakeholders to develop and installation performance criteria and installations protocols for these systems. The current state of the art relative to AHRI and international standards have not yet caught up to this technology, and we now recognize that this is a major factor that has led to past errors in efficiency ratings. Some models and precedents for the new protocols exist, but there must be a rapid and steady effort to produce consensus in the industry and among regulatory agencies. We will also continue to work with AHRI and industry members to revise the industry accepted test protocols to provide better representations of VRF and VSMS system efficiency and capacity.

MEUS is committed to this effort and desires open and ongoing discussions with CEC staff to facilitate rapid development of these protocols. In a spirit of collaboration, we would appreciate ongoing communication with CEC staff to resolve these test protocol issues.

<u>Comment #26</u>

<u>General Comment on TDV Calculations and Apparent Bias Against All-Electric ZNE Structures:</u>

Whether intended or not it is the CEC's intent, it appears that it is much harder for all-electric homes to qualify for compliance credit through CBECC or Energy Pro for both residential and commercial projects. It is clear from the engineers that man our West Business Unit in Cypress, CA, that architects and designers statewide are experiencing this problem and it is obvious to just about every designer in the state that there is some kind of problem. There may be a range of variables that play into this, and we humbly admit that we were not aware of how significant this problem was until the crisis snuck up on us. So we are at least in part to blame for not anticipating factors like the difficulty reaching consensus on VRF and VCHP systems. However, we are committed to solving all the problems that are in "our court" and working with you to resolve those that are not. One possible factor is the source energy factors that give a three to one favor to gas appliances over electric appliances due to a 70% distribution loss when appliances are powered through the grid. However, many ZNE homes are powered by solar which mitigates against grid efficiency losses during the day. The nature of time dependent valuation of energy is such that nighttime usage is inherently inexpensive, so TDV should only be increased for these appliances in the new peak hours: the hour before and after dust and dawn when demand is still high and solar production is lower.

MEUS will continue to press for all-electric prescriptive options that will achieve actual TDV parity with .80 AFUE alternatives that are currently allowed. This includes allowances for high-efficiency heat pump HVAC systems (ducted and ductless) as well as HP water heating technologies with integrated or outdoor condensers that meet TDV equivalence. We believe these technologies present numerous product advantages for home owners and the general public and they deserve a level playing field.

We also encourage discussion between the CEC, the PUC and the IOUs regarding time of use metering and rate payer education so that people are not running their dishwashers during these peak periods. We presume there are already working groups discussing these grid management issues. We further support DR controls, improved VRF controls, EMS technologies to alleviate these power management concerns, which will also improve TDV calculations and compliance credit ratings of all electric ZNE homes.

In conclusion, we ask that you please have your staff respond to these fundamental concerns about TDV and the creation of a level playing field for all-electric ZNE homes in the near future. We are desirous of ongoing discussions with the CEC until to resolve all of these issues in time for the release of the 2019 versions of CBECC and are committed to furthering the discussions and continuous improvement of our product lines until we have achieved TDV parity for the all-electric ZNE scenario.