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HVI Comment - Docket No 19-BSTD-01 RACM and NACM Proposed Revisions to IAQ Ventilation System Simulations

Additional submitted attachment is included below.

HOME VENTILATING INSTITUTE

07 May 2021

Building Standards Office
California Energy Commission
1516 Ninth Street
Sacramento, California 95814

RE: HVI Comments on CEC's Draft RACM and NACM Proposed Revisions to IAQ Ventilation System Simulations
Docket # 19-BSTD-01

Dear CEC staff and Commissioners:

Founded in 1955, HVI is an ISO 17065 accredited certification body and a trade association representing over 100 manufacturers located in North America, South America, Asia, and Europe. Our manufacturer members provide the residential and light commercial ventilating products that deliver essential indoor air quality to California's homes and businesses. HVI's Certified Product Database contains listings for heat and energy recovery ventilators (H/ERVs), bath/utility room exhaust fans, kitchen exhaust fans, dryer exhaust duct power ventilators, in-line supply and exhaust fans, whole-house fans, duct termination fittings, and soffit vents, among other products.

CEC's proposed modifications to the 2019 Nonresidential and Residential Alternative Calculation Methods (ACMs) include significant changes to the simulation protocols for in-suite H/ERVs. Notably, CEC has proposed to levy a 15% penalty on H/ERV simulated energy performance due to concerns related to "lack of field verification of equipment efficiency" and concerns for the potential of "incorrect installation and incomplete or delayed routine maintenance." HVI expects the 15% penalty to shrink the EDR benefit of H/ERVs by over 50% -- significantly reducing the number of H/ERVs specified; impacting the business of manufacturers, distributors, contractors, and builders; and reducing homeowner and tenant access to balanced and energy efficient ventilation systems. Similar derating penalties are applied by CEC elsewhere in the ACM, such as those for whole-house fans, building air sealing and cavity insulation; however, in each case where CEC applies a derating, it also provides a path whereby such systems can avoid the derating penalty through field verification measures. No such path has been provided for H/ERVs in the draft language. CEC's proposal to derate H/ERVs unilaterally without providing an option to field-verify to avoid such a de-rating is a break with its convention and unduly punitive. For consistency, HVI requests that CEC provide the same opportunity for H/ERVs as it provides for other building systems with optional field verification.

HVI is eager to work with CEC to ensure that their concerns related to H/ERVs are thoroughly addressed, as demonstrated by HVI's proposal submitted to CEC staff on February 3, 2021. To proactively address CEC's concerns, HVI's proposal contained recommendations to improve HERV access, provide pathways to field verify energy performance, and introduce incentives for specifying fault indication devices to support maintenance and operation. Based on communications with CEC staff on April 23, 2021, HVI understands that CEC staff's heavy workload over the past couple of months did not permit time for a thorough review.

HVI requests that CEC staff be provided with more time to collaborate with industry to identify modifications that are workable to all parties before finalizing the proposed changes to the ACMs. We believe that we are very close to a solution. Included with this letter are specific comments on issues that are of concern and as well as proposed language and concepts that would resolve the industry's concerns. We appreciate your consideration in this regard and look forward to working together.

Sincerely,

Jacki Donner, CEO

Proposals and Rationale:

Proposal #1: Remove the proposed 5% penalty to watts, SRE, and ASRE when rated values are verified in accordance with the procedure proposed by CEC in the 2022 RACM Express Terms (Section RA3.7.4.4)

As CEC noted in its "CBECC Beta Software and ACM Notice of Availability" document, "The convention of the Residential ACM Reference Manual is to model proposed building components at an unverified, de-rated, state unless field verification is performed." However, where the ACM assumes a default performance for a system, it conventionally, and perhaps without exception, permits superior performance to be modeled for the proposed home, where such performance is field verified. HVI identified zero examples of systems that are derated or penalized without the opportunity to overwrite such defaults through field-verification. Examples of systems that are derated by CEC within the RACM except in the case of field-verification include:

1. Whole-house fans: simulated whole-house fan capacity must be reduced by 33% unless airflow and watts are verified, in which case, the whole-house fan is able to receive full credit (Section 2.4.10)
2. Wall insulation: the effective R-value of cavity wall insulation is reduced by 30% unless "quality insulation installation" is field verified, in which case, the wall insulation can receive full credit (Section 2.2.5)
3. Air leakage and infiltration: ACH50 for a proposed single-family home defaults to 5 unless field verified, in which case, full credit may be taken for air sealing below the 5 ACH50 threshold (2.2.4)

CEC has proposed a 5% penalty to watts, SRE, and ASRE "to account for the lack of field verification of equipment efficiency." Similar to other mechanical equipment, CEC should also afford H/ERVs the option to be simulated using rated performance parameters when field verified. Within the 2022 RACM Express Terms Section RA3.7.4.4, CEC has proposed that H/ERV rated watts and SRE be field verified through looking up the installed model's rated values within an approved directory. This method is like the field-verification required by the RACM in Section 2.4.5.4 to validate an air conditioner's EER.

This method could be coordinated in-step with CEC's proposal to introduce the 5% H/ERV derating into the ACM, to provide an alternative option to the derating and to provide equitable and conventional treatment for H/ERVs with respect to other building systems. Compliance with field verification measures that are aligned with 2022 RACM Express Terms RA3.7.4.4 should remove CEC's proposed 5% penalty to watts, SRE, and ASRE. Please see Table B, "Verified Measure, B" of this document for more information.

Proposal #2: Increase the maximum airflow rate without penalty to 125% of the ASHRAE 62.2 minimum.

ASHRAE 62.2 ventilation rates are recognized as the absolute <u>minimum</u> airflow rates that are legal for new construction in California. It is expected that members of the public seeking improved IAQ may elect to use higher rates to reduce pollutant concentration and support better performance and health outcomes. Studies that have shown better health outcomes for building occupants as a function of higher ventilation rates include:

1. Sundell[1]: Sick building syndrome declines as ventilation rate increases.
2. Milton[2]: Sick leave decreases as ventilation rate increases.
3. Bornehag[3]: Risk of asthma for children increases with decreasing ventilation rate in homes.
4. Seppänen[4]: Productivity decreases with decreasing ventilation rate.

While most of these studies were conducted in commercial buildings, LBNL's[5] analysis of residential studies concluded that, "Just over half of (residential) studies report one or more statistically significant health benefits of increased ventilation rates." LBNL noted that, "The findings of research on how ventilation rates in homes affect health are mixed," but that "overall… the number of reported statistically significant improvements in health with increased ventilation rates far exceeded the anticipated chance improvements in health."

In addition to noting the research that has associated higher ventilation rates with improved performance, reduced sick leave, and various improved health outcomes, it is informative to compare Title 24's ASHRAE 62.2 ventilation rates with international ventilation rates. As a point of reference, the ASHRAE 62.2 mechanical ventilation rate for a 1,000 ft^2, 2-bedroom apartment with 8-foot ceiling can be calculated as 0.40 air changes per hour. This rate is in the bottom quartile of typical European rates, as reported by Brelih and Seppänen[6] and is 26% lower than the mean of the European countries that they surveyed (see Table A).

Region	**Ventilation Rate (Air Changes Per Hour)**
Netherlands	0.98
Greece	0.7
Portugal	0.6
Hungary	0.6
Romania	0.54
Germany	0.51
Slovenia	0.5
Lithuania	0.5
Finland	0.5
Norway	0.48
Poland	0.44
UK	0.43

1 Sundell et al. 1994. Sick Building Syndrome (SBS) in Office Workers and Facial Skin Symptoms among VDT-Workers in Relation to Building and Room Characteristics: Two Case-Referent Studies. Indoor Air, 4: 83-94.
2 Milton et al. 2000. Risk of Sick Leave Associated with Outdoor Air Supply Rate, Humidification, and Occupant Complaints. Indoor Air, 10:212-221.
3 Bornehag, C & Sundell, Jan & Hägerhed, Linda. (2003). Asthma and allergy among children and the association to ventilation rate at home, a case control study. Epidemiology. 14. 10.1097/00001648-200309001-00224.
4 Seppänen, O. A., and W. Fisk. 2006. Some quantitative relations between indoor environmental quality and work performance or health. HVAC&R Research 12 (4):957–73. doi:10.1080/10789669.2006.10391446.
5 LBNL. Indoor Air Quality Scientific Findings Resource Bank. Building Ventilation. Accessed May 6, 2021. https://iaqscience.lbl.gov/vent-summary#:~:text=Just%20over%20half%20of%20studies,improve%20with%20increased%20ventilation%20rates.
6 Brelih, N. and Seppänen, O. 2011. Ventilation rates and IAQ in European standards and national regulations. Proceedings of the 32nd AIVC Conference and 1st TightVent Conference in Brussels, Belgium.

France	0.4
Italy	0.3
Czech Republic	0.3
Bulgaria	0.26
Mean	**0.50**
ASHRAE 62.2/Title 24	**0.40***

Table A. Comparison of European dwelling unit ventilation rates from Seppänen et al. to Title 24 ventilation rates. The representative dwelling unit used for the Seppänen study was a 969 ft^2, 2-bedroom multifamily dwelling unit. The ASHRAE 62.2/Title 24 ventilation rate is 26% less than the European mean.

In practice, ASHRAE 62.2/Title 24 whole house mechanical ventilation rates for new construction are determined based on the floor area and the number of bedrooms as a proxy for the expected number of occupants. Where the actual occupants exceed the number of bedrooms + 1, the design total ventilation rate will be lower than what the standard recommends for the case where the number of occupants are known (i.e., 7.5 cfm additional for each additional occupant). Designing to accommodate higher ventilation rates, especially for multifamily dwelling units, where occupants per room are higher and where conditioned floor area is lower than in single-family residences, is a reasonable design measure to accommodate variability in occupancy.

In summary, CEC software should continue to permit higher ventilation rates than the ASHRAE 62.2 minimum as such rates can accommodate higher occupant density than the standard's minimum assumptions and as such rates may be provided to support improvements in productivity, air quality, odor control, and health outcomes. Configuring energy models to permit at least a 25% increase from the 62.2 minimum without penalty would better align CBECC's rate cap with European rates (at least for multifamily dwelling units; for single-family dwelling units, a larger increase may be justifiable – as typical ASHRAE 62.2/Title 24 air change rates for single family dwelling units are more likely to be ~0.3 ACH50).

Proposal #3: Modify the accessibility table to provide exceptions for multifamily dwelling units outdoor air intakes and for single-family outdoor air intakes that are sized to reduce the accumulation of obstructions.

Based on a CHMC study by Hill[7] showing that outdoor air intakes can become clogged with debris, CEC has proposed outdoor air intake accessibility requirements in RACM Table 22. A closer look at this study shows that it has limited application for several reasons:

1. The study only included single-family homes where outdoor air intakes are closer to the ground (and more likely to be obstructed from debris that is generated near the ground) than in multifamily buildings; HVI is not aware of any studies demonstrating that screen obstructions are a problem in multifamily buildings.
2. For 74% of the homes studied, the intake screens were not obstructed.
3. Of the 26% of the homes whose screens were clogged, five homes had smaller screen diameters than permitted by the California's residential code and mechanical code, meaning that just 18% of all homes with code-compliant screen diameters had outdoor air intakes that were obstructed.

[7] Hill, D. (1998). Field Survey of Heat Recovery Ventilation Systems (Technical Series No. 96-215). Ottawa, Ontario: Canada Mortgage and Housing Corporation: Research Division.

4. The study noted that further research was needed to determine how the screen opening size, the height of the intake above the ground, and the pressure differential across the opening contribute to obstructions, and that changes to regulations (e.g., codes and standards) should only be made after conducting such research. Specifically, the study stated, "researchers should carry out a study to determine the best ways of resolving this problem. The research effort should address the relationship between the height of the grille and the rate of debris accumulation. It should also investigate the use of larger intake openings to be fitted with screening. A determination should be made of the opening size to air flow rate ratio at which various debris falls to the ground instead of being held against the screen face by suction. Based upon the results of this research, regulatory agencies should make changes to HRV intake and exhaust hood installation requirements to reduce this problem."

For a significant percentage of multifamily dwelling units, it is clear that CEC's proposed requirements are too restrictive to recognize any energy savings for in-suite H/ERVs. There are many cases when multifamily dwelling units may not have balconies, operable windows, or sufficient operable window opening area to comply with CEC's proposed accessibility determination in RACM Table 22 (i.e., location of the OA intake within 10 feet of a walking surface or grade or within 4 feet of a point on the perimeter of a window or door opening). This is especially true of affordable construction and where compliance with California Building Code requirements for window protection (Section 1015.8) limit the opening area that would be available to service outdoor air intakes safely and effectively from the inside of a dwelling unit. For such dwelling units, maintenance on outdoor air intakes would need to be addressed from the exterior (e.g., through suspended scaffolds, powered platforms, extension ladders, etc.) as part of a building's maintenance schedule in compliance with the requirements of the California Existing Building Code (CEBC). CEBC Section 101.8 requires multifamily dwelling units within the scope of the Department of Housing and Community Development (HCD) to maintain systems "in conformance with the code edition under which installed. The owner or the owner's agent shall be responsible for the maintenance of buildings and structures." Additionally, Section 10-103(b)3 of Title 24 Part 6 requires that maintenance information be provided "for all features, materials, components, and manufactured devices that require routine maintenance for efficient operation."

To ensure CEC's proposed requirements are in keeping with the underlying recommendations and limitations of the research and to ensure that in-suite H/ERVs can continue to be specified for multifamily dwelling units and recognized for their energy savings, HVI requests that CEC exempt wall-mounted multifamily outdoor air intakes and exempt wall-mounted outdoor air intakes with large screen/grille/louver openings from the accessibility requirements of RACM Table 22. No data have been presented on multifamily dwelling unit intakes; however, as demonstrated by the Hill study, single-family outdoor air intakes with undersized screen openings can quickly be obstructed by debris, so it is reasonable to address this problem at this time by requiring single-family outdoor air intake screen/grille/louver openings to be sized at the upper end of the permitted range if they are not easily accessible for service. The California Residential Code and Mechanical Code limit the outdoor air intake screen/grille/louver opening size to ½", so a range of 3/8" to ½" is recommended for the exemption, as shown below. Note that the phrase "with a louver, grille, or screen intake opening nominal size < ½ inch" can also be deleted from Table 22 because the California Mechanical Code (Section 402.4) and California Residential Code (R303.6) already require outdoor air intake openings to have a louver, grille, or screen intake opening nominal size ≤ ½ inch.

Table 22. Accessible determination for ventilation system components.

Dwelling Unit Ventilation System Component	Location	Accessible Determination
Outdoor Air Intake	Exterior wall ~~with a louver, grille, or screen intake opening nominal size < ½ inch~~	A point on the perimeter of the outdoor air intake shall be located within 10 feet of a walking surface or grade or within 4 feet of a point on the perimeter of a window or door opening.[1]
	Soffit	Complies
	Roof	Access shall be provided in accordance with California Mechanical Code Section 304.3.1 requirements for appliances

1. Outdoor air intakes located on an exterior wall are exempt from the accessible requirements of this table where such intakes serve multifamily dwelling units or where such intakes have a louver, grille, or screen intake opening nominal size > 3/8 inch.

Proposal #4: Modify the accessibility table to accommodate unconditioned basement, mechanical closet, and attic locations – all of which can be considered accessible by the Title 24 Part 6 and Title 24 Part 2; change the maximum height of the H/ERV access panel from 9.5 feet to 10 feet.

The anticipated replacement interval for H/ERV filters (quarterly) and anticipated cleaning interval for an H/ERV heat exchanger (annually) are greater than or equal to the anticipated replacement schedule for a heating or cooling system's central air handler filter (quarterly). As such, CEC should have similar determination of accessibility requirements for H/ERVs filters and central air handler filters and similar penalties for lack of accessibility for such components.

Title 24 Part 6 Access Requirements

Title 24 Part 6 Section 120.1(b)1Biii and Section 150.0(m)12Biii require central air handler filters and H/ERV filters to be "located and installed in such a manner as to be accessible for regular service by the system owner." Title 24 Part 6 Section 100 defines accessible as follows: ACCESSIBLE is having access thereto, but which first may require removal or opening of access panels, doors, or similar obstructions.

California Mechanical Code Attic Access Requirements

Section 304.4 of the California Mechanical Code has additional requirements for providing accessibility in attics, such as attic access opening size, passageway, platform, lighting, convenience outlet, etc. that apply to heating and cooling central air handlers and could also be extended to apply to H/ERVs in the RACM and NRACM.

Expanding the Conditioned Space Option

The Title 24 Part 6 definition of conditioned space is "an enclosed space within a building that is directly conditioned or indirectly conditioned." Such spaces do not include unconditioned basements or mechanical closets, which are easily reachable for access. These spaces are proposed for inclusion as acceptable locations.

Height of H/ERV Access Panel

Table 22 notes that outdoor air intakes are considered accessible when "within 10 feet of a walking surface." Ten feet is the maximum reach recommended by ladder manufacturers when using a 6-foot ladder. The same height and reference should be used when determining access for H/ERV access panels.

The following modifications are recommended to RACM Table 22 to provide more comparable accessibility requirements for central air handler filters and H/ERV filters and heat exchangers in accordance with the preceding rationale.

Table 22. Accessible determination for ventilation system components.

Dwelling Unit Ventilation System Component	Location	Accessible Determination
Filters and Heat Exchanger	Serviceable from conditioned space, unconditioned basements, or mechanical closets	The H/ERV or supply ventilation system access panel shall be located within ~~9.5~~ 10 feet of the ~~finished floor~~ walking surface.
	Attic	Access shall be provided in accordance with California Mechanical Code Section 304.4 requirements for appliances.
	Roof	Access shall be provided in accordance with California Mechanical Code Section 304.3.1 requirements for appliances.

Apply the Same Penalty to other HVAC Systems where Access is not Provided in Accordance with Table 22
Because the anticipated replacement interval for H/ERV filters (quarterly) and anticipated cleaning interval for an H/ERV heat exchanger (annually) are greater than or equal to the anticipated replacement schedule for a heating or cooling system's central air handler filter (quarterly), CEC should institute a similar penalty for lack of accessibility for heating and cooling system filters. For example, a change like the following should be instituted for all forced air heating or cooling systems in the RACM and NACM:

RACM 2.4.1.1. Verified Heating Seasonal Performance Factor (HSPF)
PROPOSED DESIGN
The software allows the user to specify the HSPF value for heat pump equipment. The HSPF of the proposed design shall be the same as the standard design where access to the heat pump's air handler filter does not comply with the accessibility requirements of Table 22.

Proposal #5: Reduce and remove the proposed 10% penalty to watts, SRE, and ASRE when Fault Indicator Displays (FID) are provided.
CEC staff has proposed a 10% penalty to watts, SRE, and ASRE for supply and H/ERV ventilation systems to account for expected performance reductions associated with assumptions that the system would be incorrectly installed or that maintenance would be delayed. Manufacturer literature typically requires maintenance for supply ventilation and H/ERVs on a similar schedule to that recommended for heating and cooling air handler systems (e.g., changing filters on a quarterly basis). Failure to maintain any mechanical system can be expected to result in reductions in performance over time, and CEC should address this issue equitably across all mechanical systems.

As demonstrated in the rationale for Proposal #1, CEC and the RACM have a strong history of not derating a system's performance within simulations unless CEC also provides an alternative path to claim the full value of the system's rated performance. In keeping with CEC's convention, HVI recommends that systems with a Fault Indicator Display (FID) be permitted to reduce or completely remove the proposed penalty, depending on the features that are incorporated in the FID. FIDs can be effective tools for communicating needed maintenance and faults and are the ideal solution to addressing maintenance concerns voiced by CEC. The recommendation to provide credits to systems with FIDs is aligned with CEC's RACM precedent to recognize FIDs for field validation of equipment performance and to substantiate simulating the full rated performance of equipment (e.g., RACM 2.4.5.1).

Table B provides a draft strawman for aligning CEC's derating proposal with its convention to provide an alternative field verification path to avoid derating. Within the table, Verified Measure A is already required by 2019 BEES. Accomplishing Verified Measure B would eliminate CEC's proposed 5% penalty associated with today's lack of field-verification of equipment performance. Verified Measure C builds on Measure B by adding a field-verification requirement that a "Level I" FID is provided, which is proposed to qualify for an additional 5% reduction from CEC's proposed penalty. Finally, Verified Measure D builds on Measure B by adding a field-verification requirement that a "Level II" FID be provided, which would qualify for an additional 5% reduction and complete the path to eliminate the proposed penalty through field-verification. The proposed Level II FID is more sophisticated than a Level I FID. Characteristics for Level I and Level II FID are provided following Table B.

Table B. Ventilation system performance derating proposal

Verified Measure	Field Verification Of…	Notes	Increase in Simulated Wattage and Decrease in ASRE and SRE
A	Airflow	Existing requirement: Field verify airflow in accordance with RA 3.7	15%
B	Airflow and Equipment Efficiency	1. Existing requirement: Field verify airflow in accordance with RA 3.7. 2. New: Field verify rated ASRE[1], SRE[1], and fan efficacy in accordance with same procedure proposed in 2022 CA BEES RA3.7.4.4.	10%
C	Airflow, Equipment Efficiency, and Level I FID	1. Existing requirement: Field verify airflow in accordance with RA 3.7. 2. New: Field verify rated ASRE[1] and SRE[1] in accordance with same procedure proposed in 2022 CA BEES RA3.7.4.4. 3. New: Field verify provision of Level I FID	5%
D	Airflow, Equipment Efficiency, and Level II FID[2]	1. Existing requirement: Field verify airflow in accordance with RA 3.7. 2. New: Field verify rated ASRE[1], SRE[1], and fan efficacy in accordance with same procedure proposed in 2022 CA BEES RA3.7.4.4. 3. New: Field verify provision of Level II FID[2]	0%

1. ASRE and SRE ratings are applicable to H/ERVs only. Values for these ratings shall be confirmed by the verifier at or above the field-verified airflow rate from values listed in accordance with HVI Publication 920 at zero degrees Celsius or shall be interpolated from such values.
2. Airflow, fan power, and fan efficacy values reported by a Level II FID are approved for use by a verifier when field-verifying these performance parameters.

Following are recommendations for the characteristics of Level I and Level II FIDs:

A Level I FID shall comply with the following:

1. Fault indication responding to the following categories:
    a. Filter check or maintenance, either based on performance sensing or a predetermined schedule
2. Fault indication using one or more of the following means:
    a. a visual display that is readily accessible to occupants of the dwelling unit and located on or within one foot of the H/ERV control,
    b. an electronic application, or
    c. an audible alarm accompanied by a visual display.
3. FID certified to CEC by the manufacturer as meeting Level I requirements

A Level II FID shall comply with the following:

1. Fault indication responding to the following categories:
    a. Filter check or maintenance, either based on performance sensing or a predetermined schedule
    b. Low supply airflow,
    c. Low exhaust airflow,
    d. Sensor failure for sensors that assist in monitoring or controlling for the following operations, where such operations are provided: airflow regulation, frost control, supply air tempering, and economizing.
2. Fault indication using one or more of the following means (same as Level I):
    a. a visual display that is readily accessible to occupants of the dwelling unit and located on or within one foot of the H/ERV control,
    b. an electronic application, or
    c. an audible alarm accompanied by a visual display.
3. Instrumentation and reporting of the following:
    a. Airflow with a maximum error of 10% or 5 cfm, whichever is greater, at the airflow setting reported.
    b. Fan watts draw with a maximum error of 10% or 8 watts, whichever is greater, at the airflow setting reported or in-situ fan power measurement
4. FID certified to CEC by the manufacturer as meeting Level II requirements

Thank you again for the opportunity to provide these comments. HVI looks forward to continuing the dialogue with CEC to identify solutions that can address CEC's concerns.