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HVI Comment - CEC Draft Express Terms

Additional submitted attachment is included below.

HOME VENTILATING INSTITUTE

9 April 2021

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

Re: Docket No. 19-BSTD-03, 2022 Energy Code Pre-Rulemaking, Draft Express Terms

Dear CEC Staff:

Thank you for the opportunity to present comments on CEC's Draft Express Terms (DET). It is encouraging to see CEC's prioritization of residential ventilation and indoor air quality initiatives within the DET. As California's Building Energy Efficiency Standards evolve, the Home Ventilating Institute (HVI) will continue to provide solutions that meet and exceed stakeholder demands. HVI supports CEC's objective to provide energy-efficient indoor air quality to additions, alterations, and new construction projects in California and welcomes further dialogue with CEC in this process.

The DET significantly expanded the scope of ventilation revisions from that previously communicated by CASE or CEC through prior workshops and reports. This letter summarizes comments by HVI in response to the DET revisions. HVI's comments are focused primarily on ventilation requirements for dwelling units, though they also address some exhaust ventilation requirements applicable to light-commercial buildings.

HVI is an ISO 17065 compliant 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.

I. Section 100: Definitions and Scope

1. **ANSI/AHRI 1060**: The definitions section introduces a new reference to ANSI/AHRI 1060, but this standard does not appear to be referenced anywhere. Please clarify where this standard will be referenced.

2. **Atmospherically vented:** HVI requests that CEC provides a definition for this term, which was introduced within the DET. Please see comment 17 within the Mandatory Provisions section of this letter.

3. **Fan efficacy:** HVI requests that CEC modify its use of this term to align with the industry convention of reporting efficacy in terms of useful output divided by power input (i.e., cfm/W in the case of fan efficacy). This change would make CEC consistent with ENERGY STAR, HVI, IECC,

and ASHRAE 90.1's use of this term. Further, using a cfm/W metric for fan efficacy would be internally consistent with the use of "efficacy" within Title 24 Part 6. For example, Section 100 of the DET defines the following efficacy terms using the convention of reporting useful output divided by power input:

> **Luminous Efficacy** is a measure of the luminous efficiency of a light source. It is the quotient of the total luminous flux emitted by the total light source power input, expressed in lm/W.
>
> **Photosynthetic photon efficacy (PPE)** is photosynthetic photon flux divided by input electric power in units of micromoles per second per watt, or micromoles per joule as defined by ANSI/ASABE S640.

Finally, the convention of defining efficacy in terms of the useful output divided by power input is the most rational for communicating the term's intention. For example, improving the effectiveness of lamp is naturally understood to increase its efficacy metric, because an improved lamp is more efficacious. Likewise, improving the effectiveness of a fan should increase its efficacy metric. If CEC does not wish to align with ASHRAE 90.1, the IECC, ENERGY STAR, and HVI, please consider using the term "specific fan power" for W/cfm instead of "fan efficacy."

4. **Makeup air:** HVI requests that CEC modifies the definition of this term. Please see comment 3 within the Mandatory Provisions section of this letter.

5. **VENTILATION SYSTEM, CENTRAL FAN INTEGRATED, or CFI** is a ventilation system where ventilation ductwork is connected to the duct system of a dwelling unit space conditioning system to enable distribution of ventilation air to the dwelling while the space conditioning system air handling unit is operating~~. a central fan forced air space conditioning system that also intends to bring outdoor air into buildings, causing indoor air to flow out of the building through ventilation relief outlets or normal leakage paths through the building envelope.~~

   HVI requests that CEC retain the prior definition of CFI, which is aligned with the industry use of this term. The proposed definition is too broad, in that it includes both traditional central fan integrated systems as well as discrete ventilation systems with dedicated fans that are integrated with the central duct work but whose operation need not be interlocked with the central air handling unit to provide filtered and distributed outdoor air. Please see the additional comments for Section 150.0(o)1B (comments 5 and 6 in the Mandatory Provisions section of this letter).

6. **Whole-Dwelling Unit Mechanical Ventilation**: ASHRAE 62.2 and Title 24-2019 use the term "dwelling unit mechanical ventilation" to describe the primary ventilation system used to provide outdoor air to a dwelling unit. If CEC is looking for a more user-friendly term, HVI recommends "fresh air system", which is supported by HVI's manufacturer members through a labeling program that is designed to comply with code and standard requirements for labeling of primary ventilation systems. See the following link for more information: https://www.hvi.org/resources/publications/fresh-air-system/.

7. **Indoor lighting**: Table 100.0-A (pdf pages 54-56 of the DET) shows that compliance with Section 130 is required for indoor lighting for low-rise residential as well as for non-residential and

hotels/motels. The DET notes that this table will be updated for the 15-day language, so perhaps it is outdated. Beyond this table, it is not clear that there is a Section 130 requirement for low-rise residential or multifamily dwelling units. Please clarify:

a. Within the DET, are Sections 130.0(c), 130.0(d), and 130.0(e) applicable to low-rise residential, multifamily dwelling units, or the functional areas that are listed in Section 130.0(b)?
b. Within the DET, are Sections 130.0(c), 130.0(d), and 130.0(e) relevant to lighting that is integrated with exhaust fans when located in areas of commercial buildings that are not within a multifamily dwelling unit and that are not within the functional areas listed in 130.0(b)?

II. Mandatory Provisions: Single Family (150.0) and Multifamily (160.2, 160.3, and 160.5)

1. **150.0(k)2F and 160.5(a)2F Lighting Dimming Controls**. The revisions to these sections would introduce requirements for dimming controls for all kitchen lighting. No exceptions are provided for kitchen range hood lighting or appliance lighting. Typically, kitchen range hood lighting is used for task lighting during cooking, when brightness is generally desired. Additionally, controls for range hood lighting are typically located on the device, limiting the ability to use after-market dimming controls. Kitchen range hood lighting should therefore be exempted from the requirement for dimming control.

2. **150.0(m)1E and 160.3(b)5v** These sections prohibit compression of ventilation ducts within cavities. Generally, this is good practice. However, some ventilation fans are designed for compressed ducts in wall cavities. For example, some wall-mount exhaust fans accommodate 4" ducting that is slightly compressed to form an oval; such ducting has a greater hydraulic diameter than 3" ducting which would otherwise need to be used in a wall cavity to avoid compression (see image below). In this case, use of 4" round duct that is slightly compressed to form an oval can reduce static pressure, fan energy consumption, and coincident noise during fan operation. For these reasons, please consider modifying these sections as follows:

   Ducts installed in cavities and support platforms shall not be compressed to cause reductions in the cross-sectional area of the ducts, except where approved by manufacturer installation instructions.

   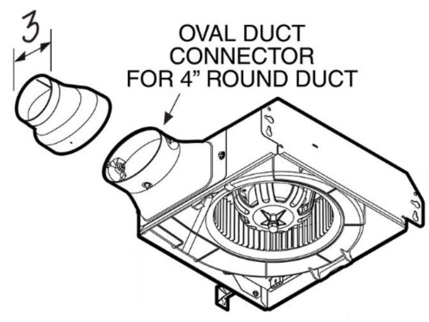

   Figure 1. Some ventilating fans are designed to deliver the targeted airflow when round ducts are slightly compressed to form an oval.

3. **150.0(m)12Aii and 160.2(b)1Aii Filter Makeup Air (MUA) with MERV 13**. These sections establish a new requirement to filter MUA with a MERV 13 filter.

Please clarify:

a. Whether this provision applies to MUA that is needed for the operation of whole-house fans, which can provide over 10 times the annual air changes of a kitchen range hood MUA system in a typical single-family dwelling unit,[1]
b. Whether this provision applies to passive inlets designed to provide MUA for the operation of a dwelling unit exhaust ventilation system, which can provide over 10 times the annual air changes of a kitchen range hood MUA system in a typical single-family dwelling unit,[2]
c. Whether an additional MERV 13 filter must be provided to pre-filter MUA within the MUA duct provided by the following system: a MUA duct that is integrated with the return trunk of a central air handler and whose operation is interlocked with the operation of the central air handler such that the makeup air passes through the central air handler's MERV 13 filter prior to crossing a mechanical cooling or mechanical heating heat exchanger, and
d. Whether an additional MERV 13 filter must be provided to pre-filter outdoor air within the outdoor air duct provided by the following system: a supply or balanced dwelling unit ventilation system with an outdoor air duct integrated with the return trunk of a central air handler and whose operation is interlocked with the operation of the central air handler such that the outdoor air passes through the central air handler's MERV 13 filter prior to crossing a mechanical cooling or mechanical heating heat exchanger.

HVI Recommendations:

i. Revise the definition of MUA. HVI supports requirements for filtration of outdoor air, and for that reason, proposes the following revision to the definition of makeup air to ensure that all outdoor air that is "intentionally conveyed by openings or ducts into the building from the outside" is filtered prior to delivery to the occupiable space:

   AIR, MAKEUP, or Compensating Outdoor Air is outdoor air that is intentionally conveyed by openings or ducts into the building from the outside; is supplied to <u>a space that freely communicates with</u> ~~the vicinity of~~ an exhaust <u>inlet</u> ~~hood~~; and replaces air, vapor and contaminants being exhausted by the exhaust <u>inlet</u> ~~hood~~. Makeup air is generally filtered and fan-forced, and it may be heated or cooled. Makeup air may be delivered through openings or ducts integral to <u>an</u> ~~the~~ exhaust ~~hood~~ system.

ii. Do not require double-filtration of outdoor air or double-filtration of MUA prior to introduction. Dwelling unit ventilation systems or makeup air systems that are integrated with the central duct system and whose operation is interlocked with the central fan such that the outdoor air or makeup air passes through the central air handler's MERV 13 filter prior to introduction to the occupiable space should not be required to have a separate MERV 13 filter or be required to provide gaskets/sealing for their filters.

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[1] Dwelling unit assumptions: 2000 ft2, single-family, 8.5 ft ceiling height. Whole-house fan assumptions: 2 hours run time for 60 days of the year at 3000 cfm (the minimum prescriptive whole-house fan airflow requirement for the reference dwelling unit per Section 150.1(c)12A). Range hood assumptions: 1 hour run time for 365 days of the year at 180 cfm (the proxy airflow for 70% RHCE, as proposed by CEC for range hood serving a gas cooking appliance in a dwelling unit > 1500 ft2).

[2] Dwelling unit assumptions: 2000 ft2, single-family, 8.5 ft ceiling height. Passive inlet assumptions: constantly open to serve continuous dwelling unit ventilation system. 50% of the Qtot ventilation rate provided through the passive inlets. Range hood assumptions: 1 hour run time for 365 days of the year at 180 cfm (the proxy airflow for 70% RHCE, as proposed by CEC for range hood serving a gas cooking appliance in a dwelling unit > 1500 ft2).

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iii. Provide alternative paths for compliance. HVI requests that CEC provide a compliance path for specification of ventilation systems that may not readily accommodate MERV 13 filtration, such as passive inlets and whole-house fans. Ventilation systems that introduce unfiltered or sub-filtered outdoor air could be paired with systems that filter the outdoor air after it is introduced into the indoor environment. For example, CEC could require that when a whole-house fan or passive inlets are provided that the central air handler with a MERV 13 filter be provided with controls that establish fan-only filtration cycles. The appropriate run time would likely need to be determined through models or simulations. This and potentially other strategies could result in achieving comparable average annual exposure for occupants across various ventilation system types.

4. **150.0(m)12Bv and 160.2(b)1Bv Air Filtration System Design and Installation**. This section introduces requirements for gasketing or sealing to reduce filter bypass. Presumably, the objective of this requirement is to ensure that the MERV 13 filter functions as designed to protect occupants from exposure to small airborne particles. Ancillary filters that are intended to protect equipment from coarse particulate matter and debris should not be subjected to the same sealing and gasketing requirements as the MERV 13 filter that is provided for occupant IAQ; further, manufacturers bear the responsibility for specifying the filtration level and any sealing necessary to protect the equipment that they provide. HVI requests the following exception be provided for such ancillary filters:

> Exception to Section 150.0(m)12Bv [160.2(b)1Bv]: Ancillary filtration provided to protect system components and not intended to comply with Section 150.0(m)12C [160.2(b)1C] requirements is exempt from requirements for gasketing or sealing.

Additionally, where MERV 13 filters are integral to mechanical ventilation systems, are provided to comply with the requirements of Section 150.0(m)12C [160.2(b)1C], and the filter installation location is labeled as requiring an OEM filter, manufacturers can ensure that there is a tight fit between the filter's frame and the filter rack/slot to limit bypass. This fit can be much tighter than would otherwise result from that achieved in separate, custom made metallic filter boxes / racks used in combination with ''of-the-shelf'', generic filters from local suppliers which could vary in dimension and create large gaps depending on the combination selected. To encourage integrated filter solutions with known dimensions and a tight fit, HVI requests that CEC provide the following exception:

> Exception to Section 150.0(m)12Bv [160.2(b)1Bv]: Filters that are integral to a mechanical ventilation system, provided to comply with the requirements of Section 150.0(m)12C [160.2(b)1C], labeled accordingly, and specified to be replaced with OEM filters are exempt from the requirements of Section 150.0(m)12C [160.2(b)1C].

Finally, please clarify whether the following scenarios would comply with the gasketing and sealing requirements of these sections:

a. Scenario A: A filter with a flat surface is held against another flat surface with pressure applied by a gasket or seal from the opposite surface. For example, a square cardboard filter squeezed against the bottom of an EPS insulated housing filter slot of a supply only ventilation device by a compressible sealing material on the opposite surface (e.g., within the access door).

b. Scenario B: A filter with a tight fit on at least 4 edges of the perimeter is installed against a hard, flat surface.

5. **150.0(o)1B and 160.2(b)2Aii Central Fan Integrated (CFI) Ventilation Systems, continuous operation**. Please explain why CEC introduced an exception to operate CFI systems continuously within multifamily dwelling units when this option has been prohibited in low-rise dwelling units in the past and continues to be prohibited for single-family dwelling units.

6. **150.0(o)1B Central Fan Integrated (CFI) Ventilation Systems, motorized dampers, and central air handler interlock.** When integrated with the central duct system, discrete ventilation systems can be designed to supply outdoor air to, and/or exhaust indoor air from multiple rooms in the home by using existing duct work. This configuration can improve the distribution of ventilation air while reducing installation costs and fan energy use. However, this modified definition coupled with the change proposed to Section 150.0(o)1B of the DET would increase both first costs (by requiring that controls be provided to interlock the operation of the central air handler and the ventilation system and that motorized dampers be provided for any ventilation ducts connected to the central duct system) and increase annual energy costs (by requiring that these systems operate the central fan in addition to the discrete fan during each ventilation cycle) of these systems.

   CEC staff have communicated that the primary reasons for introducing the requirement for motorized dampers and interlocked operation of the central fan are as follows:
   - Motorized dampers: specified to reduce unintended leakage through the integrated ventilation duct during calls for heating and cooling that do not coincide with calls for ventilation.
   - Central air handler interlock: specified to reduce the likelihood that ventilation air would flow backward through the central air handler's filter and re-entrain particulates into the indoor air. [Note to CEC staff: If this is a misinterpretation of CEC's communications, please let us know. Otherwise, please share the research that is used to support this position with respect to ventilation air introduced through large, central ducts at a velocity that is a fraction of that induced by the central air handler during its operation (i.e., far less likely to dislodge entrained particles).]

   Motorized Dampers – Clarifications
   Please clarify that a motorized damper that is integral to a ventilation system can meet the requirement for a motorized damper in Sections 150.0(o)1Biii. For such systems, there is no need to have an additional damper "installed on the connected ventilation duct(s)."

   Motorized Dampers - Recommended Exceptions
   Motorized dampers can effectively reduce leakage through outdoor air versus gravity dampers in certain situations, such as when the ventilation system is off and when the central air handler's induced pressure would cause the gravity damper to open during operation. However, there are cases when there is no added value associated with specifying a motorized damper, such as:
      a. Where the ventilation system's discrete fan is designed to operate continuously,
      b. Where a gravity damper is provided on an outdoor air duct connected to the central air handler's supply duct, or

c. Where a gravity damper is provided on an exhaust duct connected to the central air handler’s return duct.
d. Where a gravity damper is provided on an outdoor air duct connected to the central air handler’s return duct and such gravity damper is provided with a mechanism that prevents its opening under the design negative static pressure of the central air handler’s return duct. For example, some ventilation fan manufacturers provide integral gravity dampers with magnets that can be used for this purpose. Dampers held closed by such magnets open at static pressures that are expected to be beyond that which would be experienced during the run time of a typical central air handler’s connected duct. For example, a magnet providing a resistance to a static pressure of 0.75 in. of water is well above that which is likely to be experienced in a typical central air handler’s return trunk (e.g., 0.25 – 0.5 in. of water in practice).

For these situations, CEC should introduce an exception to the proposed motorized damper requirements.

Damper Control – Recommended Exception
Generally speaking, the requirements in Section 150.0(o)1B.iii to close dampers when the ventilation system is not operating and open dampers when the ventilation system is operating are good practice. However, this section (perhaps inadvertently) prohibits H/ERVs from using recirculation defrost when connected to a duct system serving a space conditioning system. Such a condition is not expected to occur frequently, especially for systems specified in California, and when there is a need to defrost an H/ERV, recirculation defrost will result in lower contributions to peak power than electric resistance defrost. To ensure that such recirculation defrost H/ERVs, which represent the vast majority of H/ERVs available in North America, can continue to be used and integrated with central air handler ducts in California, HVI offers the following options for CEC’s consideration:
a. Retain the previous definition of the VENTILATION SYSTEM, CENTRAL FAN INTEGRATED, or CFI within Section 100.0 to exclude discrete ventilation systems with dedicated fans from the definition,
b. Provide an interpretation to confirm that an ‘’outdoor air fan’’ is not considered an ‘’outdoor air fan’’ for an H/ERV during recirculation defrost, or
c. Change 150.0(o)1B.iii as follows: “…If the outdoor airflow supplied to the CFI system is powered by a discrete ventilation system with a dedicated fan, then the outdoor air fan shall not operate when the required motorized damper(s) on the outdoor air ventilation duct(s) is closed except during defrost cycle.”

Central Air Handler Interlock – Recommended Exceptions
Central air handler interlock with a ventilation system that uses a discrete fan to supply outdoor air to a central air handler’s duct system can provide an effective means for controlling the direction and distribution of outdoor airflow. However, interlocking the operation of the central air handler is not required to accomplish these ends in all cases. For example, the following configurations can provide effective means of accomplishing these ends while saving hundreds to thousands of kilowatt-hours of central fan energy consumption per dwelling unit:[3]

[3] Annual central air handler energy savings for a single-family detached home were estimated at 1016 kWh, based on the following assumptions: 2300 sqft, 2-story, 3-bedrooms, balanced ventilation, 0.47 weather and shielding factor; resulting in 99 cfm Qtot, 22 cfm Qinf, 77 cfm Qfan; variable ventilation Qfan rate at 1.5x continuous Qfan

a. Where an outdoor air supply duct is routed to the central air handler return duct, upstream of the central air handler filter; the instantaneous or design condition ventilation supply air temperature is no less than the minimum return temperature permitted by the manufacturer of any furnace connected to the central air handler return; and the H/ERV exhaust is not ducted to the central air handler return.
b. Where an outdoor air supply duct with an integral MERV 13 filter is routed to the central air handler return duct, downstream of the central air handler filter; the instantaneous or design condition ventilation supply air temperature is no less than the minimum return temperature permitted by the manufacturer of any furnace connected to the central air handler return; and the H/ERV exhaust is not ducted to the central air handler return.
c. Where an outdoor air supply duct is routed to the central air handler supply duct and the H/ERV exhaust is not ducted to the central air handler return.

For this situation, CEC should introduce an exception to the proposed interlock requirements. Also, where operation of the dwelling unit ventilation system is interlocked with the central air handler, HVI recommends limiting the central air handler's speed to a low-speed setting.

160.2(b)2Aii, Central Fan Integrated Ventilation Systems. Presumably, CEC intends to have the same CFI requirement for the multifamily path as for the single-family path. HVI recommends the same modifications in this case.

7. **150.0(o)1F Multifamily Requirements**: This section should be deleted as it addresses multifamily dwelling unit ventilation, which is outside the scope of Section 150.0.

8. **160.2(b)2Aivb Dwelling Unit Mechanical Ventilation, system type**: Please clarify the text within this section as follows to ensure that the "same ventilation system type" only pertains to the dwelling unit mechanical ventilation system. Otherwise, readers of this section may falsely assume that specifying exhaust ventilation for a bathroom would require all ventilation systems in the building to be exhaust: "…The <u>dwelling unit mechanical ventilation</u> system type installed throughout the building shall be only one of the following three types…"

9. **Dwelling unit mechanical ventilation fan efficacy, mandatory**
   a. **150.0(o)2C and 160.2(b)2Biii Heat Recovery Ventilation (HRV) and Energy Recovery Ventilation (ERV) System Fan Efficacy**. This section establishes maximum fan efficacy requirements for systems with heat or energy recovery as follows: "Systems with heat or

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ventilation rate (i.e., 116 cfm; 67% annual duty cycle for ventilation); 25% annual duty cycle for central air handler run time to provide heating/cooling (source: Rudd, A., I. Walker 2007. "Whole House Ventilation System Options – Phase 1 Simulation Study." ARTI Report No. 30090-01, Final Report, March. Air-Conditioning and Refrigeration Technology Institute, Arlington, VA); probability of coincidental operation of central air handler for heating/cooling and variable ventilation system for outdoor air: 67%*25%=17% (this is the % of "free" central air handler energy for distributing ventilation air); 0.58 W/cfm air handler fan efficacy (source: Section 150.1(c)10 prescriptive requirements for air handler efficacy that is not connected to a forced air furnace); 2-ton central cooling unit with airflow rate of 400 cfm/ton; air handler operates at design airflow rate when providing ventilation air (CEC's proposed language is silent on the operational speed of the central air handler, so the design rate is assumed to estimate an upper bound for coincidental energy use); result: 1016 kWh/yr consumed by central air handler for heating and cooling, 2032 kWh/yr consumed by central air handler for heating, cooling, and distributing ventilation air, 1016 kWh/yr savings potential when discrete ventilation fan is not interlocked with the central air handler.

energy recovery serving a single dwelling unit shall have a fan efficacy of ≤1.0 W/cfm as confirmed by HERS field verification in accordance with Reference Appendix RA3.7.4.4 (Note: 160.2(b)2Biii adds "or NA2.2.4.1.5 as applicable")."

b. **Section 160.2(b)2Aivb1: Balanced Ventilation.** …Systems with heat recovery or energy recovery that serve a single dwelling unit shall have a fan efficacy of ≤1.0 W/cfm;

In these sections and wherever Title 24 Part 6 establishes a prescriptive fan efficacy for unitized ventilation systems, HVI recommends that CEC:

i. Use the same convention for determining fan efficacy as is used by ASHRAE 90.1, the IECC, ENERGY STAR, and the industry at large: cfm/W. Please see the definitions section of this letter for more information.

ii. Establish the static pressure difference at which fan efficacy is to be determined to align with what is referenced by ASHRAE 90.1-2019 Addendum a as follows: "Fan efficacy for fully ducted HRV or ERV, balanced, and in-line fans shall be determined at a static pressure difference not less than 0.2 in. of water for each airstream. Fan efficacy for other ducted fan systems shall be determined at a static pressure difference not less than 0.1 in. of water."

iii. Clarify that the fan efficacy that is referenced shall be a rated value or shall be determined from rated values of airflow and power, with the option of interpolating between rated values. Approval of determining efficacy from rated values of airflow and power is necessary to ensure that available data from approved directories can be used to determine fan efficacy. Approval of interpolated values of rated airflow and power consumption when determining the efficacy at the design airflow rate encourages intelligent design to conserve energy (e.g., operating fans at lower speed where efficacy may be higher).

iv. When determining the mandatory fan efficacy of a balanced ventilation system, establish that the airflow used should be the following, or interpolated from such values:
   1. For heat or energy recovery ventilators: "net supply airflow". HVI 920 defines net supply airflow as, "the gross supply airflow reduced by measured cross leakage. This is the actual amount of outdoor air delivered by the supply system of the unit and is used for sizing the equipment for the required ventilation rate."
   2. For "integrated supply and exhaust ventilators" without heat or energy recovery: "net ventilation airflow." "Integrated supply and exhaust ventilator" is a product class that is recognized within HVI 920. Within HVI 920, "net ventilation airflow" is a rated parameter for "integrated supply and exhaust ventilators" that represents the "net quantity of outside airflow supplied."
   3. For all other balanced systems (e.g., those employing separate but coordinated exhaust and supply units): the rated supply or exhaust airflow, as applicable.

v. Clarify that when determining the fan efficacy of a heat or energy recovery ventilator or an "integrated supply and exhaust ventilator" without heat or energy recovery that the power consumed should be the total power consumption of the unit or interpolated from such values.

10. **Table 150.0-G and Table 160.2-G Kitchen Range Hood Airflow Rates (cfm) and ASTM E3087 Capture Efficiency (CE) Ratings According to Dwelling Unit Floor Area and Kitchen Range Fuel Type**: Conceptually, HVI supports CEC's proposed requirements to establish a minimum range hood capture efficiency (RHCE) with the option to comply using a proxy airflow during this cycle. However, CEC's RHCE targets were developed by LBNL assuming that the minimum RHCE should be determined based on the exposure for a person somewhere else in the home besides the

kitchen (i.e., assuming that the home is a well-mixed zone). This approach can significantly underestimate the exposure for those in proximity to cooking – especially the exposure for the cook. Within this cycle, to provide adequate protection for the cook across all dwelling units, it is prudent to establish a minimum RHCE/proxy airflow that is at the higher end of the range that LBNL recommended based on dwelling unit size. HVI requests that CEC use the following values for RHCE and proxy airflow within this cycle. Please see TN 235643, "Home Ventilating Institute Comments - Response to CEC's Nov 3 Proposal to Establish Minimum Capture Efficiency for Range Hoods" and TN 236371, "HVI Comments on 2022 Energy Code Pre-Rulemaking," for a detailed justification supporting this recommendation:

- Electric cooking: RHCE ≥ 65% or airflow ≥ 160 cfm
- Gas cooking: RHCE ≥ 80% or airflow ≥ 250 cfm

11. **Exception to 150.0(o)Giva:** For multifamily dwelling units, the manual ON-OFF control shall not be required to be accessible to the dwelling unit occupant. [Note: this exception can be deleted since multifamily dwelling units are not within the scope of Section 150.0.]

12. **150.0(o)1Gv and 160.2(b)2Avie Airflow Measurement of Local Mechanical Exhaust by The System Installer**:

    a. This section should be expanded to address airflow verification for range hoods that comply with Table 150.0-G or 160.2-G using an RHCE rating. The following modification is offered for this scenario:

    …The airflow required by Section 150.0(o)1G [160.2(b)2Avi] is the quantity of indoor air exhausted by the ventilation system as installed in the dwelling unit. For range hoods using a rated range hood capture efficiency to comply with Table 150.0-G, the airflow required is the rated airflow used to determine the specified range hood model's rated capture efficiency. …

    b. Section 150.0(o)1Gva and 160.2(b)2Avie1 are unnecessarily restrictive in that they only permit measurement of airflow rates at inlet and outlet terminals/grilles. In addition to these locations, ASHRAE 62.2 and ANSI/RESNET/ICC Standard 380 both permit airflow measurements performed in accordance with manufacturer instructions. For example, on-board diagnostic equipment that can be used to verify the ventilation system in-situ airflow rate is now provided by some manufacturers and should be approved for field verification of airflow where such equipment meets the minimum performance specifications required for airflow verification equipment in the Reference Residential Appendices. Such recognition would incentivize product innovation and encourage manufacturers to provide equipment that is capable of self-diagnosis, while potentially reducing costs and time required for builders and verifiers to demonstrate compliance with the energy code. The following modification is offered to Section 150.0(o)1Gva and Section 160.2(b)2Avie1 to accomplish this objective. A similar change is recommended for Section 160.2(b)2Avie1. Additionally, please see the correlating proposed modifications to Reference Residential Appendices RA 3.7 within Section IV of this letter.

    a. The system installer shall measure the airflow by using a flow hood, flow grid, or other airflow measuring device at the mechanical ventilation fan's inlet terminals/grilles, ~~or~~ outlet terminals/grilles, or at another location between the inlet and outlet terminals/grilles as specified by the manufacturer in accordance with the procedures in Reference Residential Appendix RA3.7.

c. These sections should be expanded to permit the use of manufacturer duct sizing tools when such tools are certified to the Energy Commission by the manufacturer to size the system in compliance with HVI 920. The following modification is offered to Section 150.0(o)1Gv for this scenario. A similar change is recommended for Section 160.2(b)2Avie1.

   [New subsection "c":] As an alternative to performing an airflow measurement of the system as installed in the dwelling unit, compliance may be demonstrated by installing an exhaust fan and duct system that conforms to manufacturer's sizing instructions. Manufacturer sizing instructions shall verify that the duct sizing uses the calculation methodology identified in HVI 920 Table AII1, with the exception that the field-installed duct length and number of elbows shall be used. Visual inspection shall verify the installed system conforms with the duct length, diameter, and number of elbows used within the manufacturer's sizing instructions and that the duct system has an exterior termination fitting with a hydraulic diameter greater than or equal to the minimum duct diameter.

13. **150.0(o)1Gvi Sound Ratings for Local Mechanical Exhaust.** This section should be modified to ensure that kitchen range hoods are rated for sound at any airflow that is no less than 100 cfm. The word "difference" is also inserted to clarify that the static pressure rating point is really a differential static pressure; use of the term "difference" is consistent with ASHRAE 90.1-2019 Addendum a. The following modification is offered to address these recommendations. This modification would align the Section 150.0(o)1Gvi exception with the Section 160.2(b)2Avif exception:

    EXCEPTION to Section 150.0(o)1Gvi: Kitchen range hoods may be rated for sound ~~at 100 cfm~~ at a static pressure difference determined at working speed as specified in HVI 916 section 7.2.

    Alternatively, if CEC desires to retain the reference to 100 cfm, please consider the following language to ensure that the working speed exception may be applied at airflows exceeding 100 cfm:

    EXCEPTION to Section 150.0(o)1Gvi: Kitchen range hoods may be rated for sound at no less than 100 cfm at a static pressure difference determined at working speed as specified in HVI 916 section 7.2.

14. **150.0(o)1H and 160.2(b)2Avii Airflow Measurement of Dwelling Unit Ventilation.** These sections are unnecessarily restrictive in that they only permit measurement of airflow rates at inlet and outlet terminals. In addition to these locations, ASHRAE 62.2 and ANSI/RESNET/ICC Standard 380 both permit airflow measurements performed in accordance with manufacturer instructions. For example, on-board diagnostic equipment that can be used to verify the ventilation system in-situ airflow rate is now provided by some manufacturers and should be approved for field verification of airflow where such equipment meets the minimum performance specifications required for airflow verification equipment in the Reference

Residential Appendices. Such recognition would incentivize product innovation and encourage manufacturers to provide equipment that is capable of self-diagnosis, while potentially reducing costs and time required for builders and verifiers to demonstrate compliance with the energy code. The following modification is offered to Section 150.0(o)1H to accomplish this objective. A similar change is recommended to Section 160.2(b)2Avii.

150.0(o)1H…The airflow required by sections 150.0(o)1C, 150.0(o)1E and 150.0(o)1F is the quantity of outdoor ventilation air supplied or indoor air exhausted by the mechanical ventilation system as installed and shall be measured by using a flow hood, flow grid, or other airflow measuring device at the mechanical ventilation fan's inlet terminals/grilles, ~~or~~ outlet terminals/grilles, or at another location between the inlet and outlet terminals/grilles as specified by the manufacturer in accordance with the procedures in Reference Residential Appendix RA3.7….

15. **150.0(o)1I Sound Ratings for Dwelling Unit Ventilation Systems.** This section requires dwelling unit ventilation systems to be rated for sound "at no less than the minimum airflow rate required by Sections 150.0(o)1C or 150.0(o)1E as applicable." However, there is no text in Section 150.0(o)1E. Please clarify what is meant by this reference.

16. **150.0(o)1J and 160.2(b)2Aix Label for Dwelling Unit Ventilation System On-Off Control.** The text for the dwelling unit ventilation system on-off control has been modified as follows: "This switch controls the indoor air quality ventilation for the home. Leave ~~it~~ switch in the "on" position at all times unless the outdoor air quality is very poor." HVI supports CEC's intention to clearly communicate the function and proper operation of the dwelling unit ventilation system control. However, HVI cautions that adding words to this already cumbersome label is likely to increase the chances that occupants will consider it an eyesore and will remove it. HVI questions whether the additional phrases "switch in the" and "position at all times" proposed by CEC will add sufficient clarity to justify the increased risk of removal by the occupant, especially when the same meaning can be derived from the current label without this additional text.

17. **150.0(o)1K and 160.2(b)2Ax Combustion Air and Compensating Outdoor Air or Makeup Air.** "Atmospherically vented" is not defined within Title 24 Chapter 6, ASHRAE 62.2, or the California Mechanical Code. Please consider defining "atmospherically vented" or using terms that are consistent with terms used in the California Mechanical Code for this appliance class.

18. **150.0(o)2A Dwelling Unit Ventilation Airflow Performance.** This section references Sections 150.0(o)1E and 150.0(o)1F. However, there is no text in Section 150.0(o)1E, and Section 150.0(o)1F should be deleted as it addresses multifamily dwelling unit ventilation, which is outside the scope of Section 150.0. Please clarify what is meant by these references.

19. **150.0(o)2B and 160.2(b)2Bii Kitchen Local Mechanical Exhaust - Vented Range Hoods**. This section establishes the field verification requirements for range hoods, including the requirement to verify the rated airflow where the airflow is used to comply with Section 150.0(o)1G (and 160.2(b)2Avi) requirements. This text should be modified to clarify that in certain cases, the airflow must be verified at a static pressure difference of 0.25 in. of water, depending on the Section 150.0(o)1Gv (and 160.2(b)2Avie) compliance method selected by the installer. The following modification is offered in this regard. A similar change is recommended for Section 160.2(b)2Bii.

150.0(o)2B … confirm the model is rated by HVI or AHAM to comply with the following requirements:
i. The minimum ventilation airflow rate as specified in by Section 150.0(o)1G, or alternatively the minimum capture efficiency as specified by Section 150.0(o)1G. If the prescriptive duct sizing method in 150.0(o)1Gvb is used by the installer to verify the airflow value, then the rated airflow value shall be verified using an approved directory at a static pressure difference of 0.25 in. of water. If the manufacturer's sizing instruction method in 150.0(o)1Gvc is used by the installer to verify the airflow value, then visual inspection shall be used to verify that the installed system conforms with the duct length, diameter, and number of elbows used within the manufacturer's sizing instructions, that the design condition is a point on an HVI-rated fan curve, and that the duct system has an exterior termination fitting with a hydraulic diameter greater than or equal to the minimum duct diameter.
[Note to CEC Staff: Please see HVI's comment 12c in Section II of this letter regarding the recommendation to permit manufacturer sizing. Additionally, similar language to what is proposed above would likely also be needed in the reference appendices.]

III. Prescriptive Requirements: Single Family (150.2) and Multifamily (170.2 and 180.2)

1. **150.2(b)1K and 180.2(b)4A Lighting.** These sections require altered luminaires to meet the requirements of Section 150.0(k) (160.5(a)) and Table 150.0-A (Table 160.5-A). However, Section 150.0(k)1A (160.5(a)1A) has been amended to provide exceptions for compliance with Table 150.0-A (Table 160.5-A) in certain cases, including exhaust fan lighting. For consistency, please extend the same exceptions to these sections.

2. **150.2(b)1L and 180.2(b)5A Mechanical Ventilation for Indoor Air Quality - Entirely New or Complete Replacement Ventilation Systems**. Please clarify these sections, as they seem to require that a ventilation system's ducting be completely replaced any time the ventilation fan is replaced, regardless of the condition and utility of the duct system. This can result in a waste of materials and an unnecessary expense for a dwelling unit owner, as ventilation systems are regularly replaced without the need to replace existing ducting – which is often in good condition. Introducing unnecessary costs for replacement of a duct system that does not need to be replaced can be a barrier to a homeowner replacing an energy-intensive or poorly functioning ventilation system. A common example is replacement of an exhaust fan, though the same logic could be applied to a dwelling unit ventilation system. If the existing duct system meets the ventilation system manufacturer's requirements and is still in good condition, replacement should not be required. Cleaning may be required if excessive amount of dust, debris or deposits reduce the cross-sectional area significantly. Please remove/modify these sections and leave the determination of whether ducting needs to be replaced or cleaned to the discretion of the owner and contractor. If CEC believes that additional prescriptive requirements are necessary to determine if existing ducts are adequate, then the following are offered for consideration as alternatives to replacement: cleaning (if necessary), sizing to meet manufacturer requirements, and/or testing to confirm leakage thresholds:

   ~~Entirely new or complete replacement ventilation systems shall comply with all applicable requirements in Section 150.0(o). Entirely new or complete replacement ventilation systems shall include a new ventilation fan component and an entirely new duct system. An entirely new~~

~~duct system shall be constructed of at least 75 percent new duct material, and up to 25 percent may consist of reused parts from the dwelling unit's existing duct system, including but not limited to registers, grilles, boots, air filtration devices, and duct material, if the reused parts are accessible and can be sealed to prevent leakage.~~

3. **170.2(c)3 Dwelling Unit Space Conditioning Systems.** Despite its title of "dwelling unit space conditioning systems", this section contains prescriptive requirements for dwelling unit ventilation systems. HVI recommends removing the ventilation system requirements from this section and placing them in a separate section that pertains to ventilation. As currently organized, the ventilation provisions would be easily overlooked.

4. **170.2(c)3A Heating System Type (prescriptive fan efficacy requirements)**. Despite its title of "heating system type", this section establishes prescriptive fan efficacy requirements for balanced ventilation systems. As noted previously, HVI recommends removing the ventilation system requirements from this section and placing them in a separate section that pertains to ventilation. As currently organized, the ventilation provisions would be easily overlooked. Additionally, it is not clear why there are prescriptive requirements for fan efficacy of balanced ventilation systems without heat recovery in some climates but not others. Because the climate zone does not affect the ventilation rate or run time of multifamily dwelling unit ventilation systems, the maximum prescriptive fan efficacy for these systems should be the same across all climate zones. With respect to establishing prescriptive fan efficacy requirements for balanced ventilation systems without heat or energy recovery, HVI recommends that CEC:

    a. Use the same convention for determining fan efficacy as is used by ASHRAE 90.1, the IECC, ENERGY STAR, and the industry at large: cfm/W. Please see the definitions section of this comment for more information.
    b. Establish the static pressure difference at which fan efficacy is to be determined to align with what is referenced by ASHRAE 90.1-2019 Addendum a as follows: "Fan efficacy for fully ducted HRV or ERV, balanced, and in-line fans shall be determined at a static pressure difference not less than 0.2 in. of water for each airstream. Fan efficacy for other ducted fan systems shall be determined at a static pressure difference not less than 0.1 in. of water."
    c. Establish the same prescriptive maximum fan efficacy for balanced ventilation systems without heat recovery across all climate zones.
    d. Establish the same prescriptive maximum fan efficacy for balanced ventilation systems without heat recovery regardless of the number of stories in the building.
    e. Clarify that the fan efficacy that is referenced shall be a rated value or shall be determined from rated values of airflow and power, with the option of interpolating between rated values. Approval of determining efficacy from rated values of airflow and power is necessary to ensure that available data from approved directories can be used to determine fan efficacy. Approval of interpolated values of rated airflow and power consumption when determining the efficacy at the design airflow rate encourages intelligent design to conserve energy (e.g., operating fans at lower speed where efficacy may be higher).
    f. Establish that when determining the fan efficacy of an "integrated supply and exhaust ventilator" without heat or energy recovery:
        1. The airflow used should be the rated "net ventilation airflow," or interpolated from such values. "Integrated supply and exhaust ventilator" is a product class

that is recognized within HVI 920. Within HVI 920, “net ventilation airflow” is a rated parameter for “integrated supply and exhaust ventilators” that represents the “net quantity of outside airflow supplied.”

2. The power used should be the rated total power consumption of the unit or interpolated from such values.

g. Establish that when determining the fan efficacy of a balanced system that does not incorporate heat or energy recovery and that is not an “integrated supply and exhaust ventilator”:
    1. The airflow used should be the rated supply or exhaust airflow, as applicable, or interpolated from such values.
    2. The power used should be the rated total power consumption of the individual supply or exhaust system, as applicable, or interpolated from such values.
    3. Each supply or exhaust fan that serves as a component of the balanced system shall comply with the fan efficacy requirement.

h. Use the same value for prescriptive fan efficacy of the individual components of a balanced ventilation system without heat or energy recovery that is adopted by ASHRAE 90.1-2019 Addendum A, ENERGY STAR, and by the 2021 IECC (shown in the table below). For balanced systems that have separate, distinct exhaust and supply fans, each fan would need to comply with the following table values individually. For example, a system using a separate supply fan and an exhaust fan, both with a design airflow of 50 cfm, would need to have a minimum supply fan efficacy of 3.8 cfm/W and a minimum exhaust fan efficacy of 2.8 cfm/W. Likewise, for a balanced system without heat recovery consisting of two fans in a box with a balanced airflow rate of 50 cfm, the system’s minimum efficacy should be determined by assigning a minimum of 3.8 cfm/W for the supply fan and a minimum of 2.8 cfm/W for the exhaust fan, resulting in a system efficacy of 1/[1/3.8+1/2.8] = 1.6 cfm/W, increasing to 1.8 cfm/W for systems with a design airflow between 90 and 200 cfm and to 1.9 cfm/W for systems with a design airflow greater than 200 cfm.

Table 6.5.3.7 Minimum Fan Efficacy for Low-Power Fans

System Type	Minimum Fan Efficacy[a, b], cfm/W
Transfer fans; in-line[e] supply or exhaust fan	3.8
Other exhaust fan, <90 cfm	2.8
Other exhaust fan, ≥90 cfm and ≤200 cfm	3.5
Other exhaust fan, >200 cfm	4.0

5. **170.2(c)3Bv ERV or HRV, section location and requirements.** The prescriptive requirements for ERVs and HRVs (H/ERVs) are miscategorized within the "Space Heating and Space Cooling" section. As noted previously, HVI recommends removing the ventilation system requirements from this section and placing them in a separate section that specifically addresses ventilation. As currently organized, the ventilation provisions would be easily overlooked.

   Additionally, HVI recommends that CEC expand the prescriptive path requirements for H/ERVs to all climate zones and multifamily building types where they were demonstrated by the CASE team to be cost effective. There were a 6 multifamily building prototypes and location combinations for which the specification of H/ERVs was determined to be cost effective but for which neither CASE nor CEC proposed to require H/ERVs within the prescriptive path. For example, the green highlighted cells below illustrate the climate zones where using H/ERVs in CASE's prototype multifamily buildings was determined by CASE to be cost effective (i.e., have a benefit-to-cost (BC) ratio exceeding 1).

Climate Zone	Low-Rise Garden Style	Low-Rise Loaded Corridor	Mid-Rise	High-Rise	Proposed HRV Requirement ?
1	4.5	3.6	3.1	1.8	Yes
2	2.9	2	1.9	1.5	Yes
3	1.5	0.8	1.2	0.7	No
4	1.6	1.2	1	0.9	No
5	1.3	0.7	0.6	0.8	No
6	0.1	-0.7	-0.2	0.3	No
7	-0.2	-1	-0.6	0.1	No
8	0	-0.7	-0.2	0.5	No
9	0.6	-0.4	0.3	0.7	No
10	1.2	0.2	0.6	1	No
11	3.1	2.5	2.5	1.9	Yes
12	2.5	1.8	1.8	1.6	Yes
13	2.7	2.3	2	1.7	Yes
14	3	2.5	2.2	2	Yes
15	1.6	1.2	1.2	1.6	Yes
16	4.3	4.1	3.1	2.7	Yes

   Figure 2. CASE's HRV BC ratios by climate zone and multifamily prototype, sourced from Tables 48-51 of CASE's 2022-MF-IAQ-F report. Green cells have a BC ratio exceeding 1. Climate zones bounded by purple lines are those for which CASE and CEC have proposed a prescriptive path requirement for H/ERVs.

   It is clear from this table that there are several scenarios where the BC ratio far exceeds one (CASE's criterion for cost-effectiveness), but an H/ERV is not required because CASE's criteria for this measure was that ALL prototypes within a climate zone must have a BC ratio > 1 for CASE to propose a requirement for ANY multifamily dwelling units within the climate zone. This blunt, macro-level approach is too coarse, as it unnecessarily leaves energy savings on the table simply because of the organizational approach chosen. For other system types, CEC has established a precedent of having more granular requirements where warranted (e.g., Section 170.2(c)3A has different requirements for multifamily space conditioning systems based on the number of stories in the multifamily building). In determining prescriptive path requirements for H/ERVs, more resolution would better characterize and capture the associated energy savings.

If CEC determines that it is not feasible to have separate requirements for each multifamily building type that is represented by these prototypes (i.e., the 6 green cells that pertain to low-rise and mid-rise buildings in climate zones 3, 4, 5, and 10), then HVI requests that CEC use the convention of applying weightings to each multifamily prototype to determine a blended BC ratio across each individual climate zone that is developed based on the market share represented by each prototype. Such an approach would demonstrate cost effectiveness and permit CEC to capture the savings that are expected for H/ERVs in additional climate zones 3 and 4.

Climate Zone	Multifamily Weighted Average Benefit-to-Cost Ratio	Proposed HRV Requirement ?
1	3.3	Yes
2	2.0	Yes
3	1.1	Yes
4	1.1	Yes
5	0.7	No
6	-0.3	No
7	-0.7	No
8	-0.3	No
9	0.1	No
10	0.5	No
11	2.5	Yes
12	1.8	Yes
13	2.1	Yes
14	2.3	Yes
15	1.2	Yes
16	3.5	Yes

Figure 3. H/ERV BC Ratios by climate zone, as determined by applying market weightings to BC ratios by prototype to develop a blended BC ratio for multifamily buildings in each climate zone.

The weightings used to derive these values were published by TRC in Figure 18 of their Multifamily Prototypes report (Figure 18 and adjacent text are also provided below for reference), which is cited in the CASE's final Multifamily IAQ report. The Multifamily Prototypes report noted that these weightings are intended for use in "calculating statewide energy savings and determining cost-effectiveness for 2022 Title 24, part 6 updates".

Figure 18 summarizes the weights by number of buildings and by square footage. The Statewide CASE Team will use these weights in calculating statewide energy savings and determining cost-effectiveness for 2022 Title 24, part 6 updates.

	Low-Rise Garden Style	Loaded Corridor	Mid-Rise Mixed-Use	High-Rise Mixed-Use
Weight by square footage	4%	33%	58%	5%

Figure 18: Table summary of statewide weight

Figure 4. Figure 18 extracted from TRC's Multifamily Prototypes report.

6. **170.2(c)3Bv ERV or HRV, verification when serving single dwelling units.** Bullet "a" of this section requires single dwelling unit H/ERVs to be field verified in accordance with NA2.6. However, there does not appear to be an NA2.6. Should this reference NA2.2.4.1.5 instead? Also, as noted previously within this comment, HVI recommends changing the fan efficacy metric to units of cfm/W to align with the common industry use of this term (California's metric of W/cfm is generally referred to as "specific fan power"). If CEC maintains its current metric, the HVI recommends change the fan efficacy requirement wording in this section to match 170.2(c)3Ai which is less confusing than the wording used in this Section:

    ''An ERV or HRV serving one individual dwelling unit shall be field verified in accordance with NA2.6 and confirm the model has a minimum sensible recovery efficiency of 67%, rated at 32° F (0°C), and a ~~minimum~~ fan efficacy of 0.6 W <u>or less</u> per cfm; or''

7. **170.2(c)3Bv ERV or HRV, verification when serving multiple dwelling units.** Bullet "b" of this section requires H/ERVs serving multiple dwelling units to have "fan power meeting the requirements of Section 170.2(c)." This section is very large, and its fan power requirements are dispersed across multiple subsections. For this reason, it would be helpful to reference the applicable subsections, as follows:

    …fan power meeting the requirements of ~~Section 170.2(c)~~:
    1. <u>Section 170.2(c)4Ai for each fan system that includes at least one fan or fan array with fan electrical input power ≥ 1 kW,</u>
    2. <u>Section 170.2(c)4Aiii for each fan motor that is less than 1 hp and 1/12 hp or greater, and</u>
    3. <u>Section 170.2(c)3Bva for fans having a fan nameplate electrical input power of less than 180 W or having a motor nameplate horsepower less than 62.1 W that are not within the scope of Section 170.2(c)4Aiii.</u>
       [Note for CEC staff: The phrase "having a fan nameplate electrical input power of less than 180 W or having a motor nameplate horsepower less than 62.1 W" is used in ASHRAE 90.1 to determine maximum power allowances for fans with motors less than 1/12 hp and is presumably aligned with CEC's intent for mapping fan power allowances to various fan sizes].

IV. Reference Appendices

1. **RA3.7 and NA2.2 Field Verification and Diagnostic Testing of Mechanical Ventilation Systems.** These sections are unnecessarily restrictive in that they only permit measurement of airflow rates at inlet and outlet terminals using portable measurement devices. In addition to these locations, ASHRAE 62.2 and ANSI/RESNET/ICC Standard 380 both permit airflow measurements

performed in accordance with manufacturer instructions. For example, integrated on-board diagnostic equipment that can be used to verify the ventilation system in-situ airflow rate is now provided by some manufacturers and should be approved for field verification of airflow where such equipment meets the minimum performance specifications required for airflow verification equipment in the Reference Appendices. Such recognition would incentivize product innovation and encourage manufacturers to provide equipment that is capable of self-diagnosis, while potentially reducing costs and time required for builders and verifiers to demonstrate compliance with the energy code. The following modifications are offered to Sections RA3.7.2 and RA3.7.3 to accomplish this objective. Similar changes are recommended for Sections NA2.2.2 and NA2.2.3:

RA3.7.2.2 Airflow Rate Measurements
All measurements of ventilation fan airflow rate shall be made with an airflow rate measurement apparatus (i.e., sensor plus data acquisition system) having an accuracy equal to or better than ± 10% of reading or 5 cfm, whichever is greater. The apparatus shall have an accuracy specification that is applicable to the airflow rates that must be verified utilizing the procedures in Section RA3.7.4. Airflows shall be measured at the mechanical ventilation fan's inlet terminals/grilles, ~~or~~ outlet terminals/grilles, or at another location between the inlet and outlet terminals/grilles as specified by the manufacturer.
[Note for CEC staff: specifying an accuracy of 10% of reading or 5 cfm, whichever is greater, would help ensure that measurement equipment can still comply with CEC's accuracy requirements at low airflow rates. For example, requiring that the equipment accuracy must be equal to or better than ± 10% of a continuous, 20 cfm bathroom exhaust rate in compliance with Table 150.0-F translates to an accuracy of ± 2 cfm, which may be beyond that which can be provided by typical diagnostic equipment. It is reasonable to place a lower bound of 5 cfm on instrument accuracy. The maximum 5 cfm error bound is also consistent with ANSI/RESNET/ICC 380-2019 Section 6.2.1.1.1.]

RA3.7.2.3 Calibration
All instrumentation used for mechanical ventilation system airflow rate diagnostic measurements shall be calibrated according to the manufacturer's calibration procedure to ensure the airflow measurement apparatus conforms to the accuracy requirement specified in Section RA3.7.2.2.
Exception: Onboard airflow measurement devices provided in accordance with RA3.7.3.4.

RA3.7.3 Diagnostic Apparatus for Measurement of Ventilation System Airflow
Ventilation system airflow rate shall be measured using one of the apparatuses listed in Section RA3.7.3. The apparatus shall produce airflow rate measurements that conform to the accuracy requirements specified in Section RA3.7.2 for measurements of residential mechanical ventilation system airflow at system inlet or outlet terminals, grilles, or registers for single or multiple branch ventilation duct systems.
The airflow rate measurement apparatus manufacturers shall publish in their product documentation, specifications for how their airflow measurement apparatuses are to be used for accurately measuring residential mechanical ventilation system airflow at system inlet ~~or outlet~~ terminals/~~,~~ grilles, outlet terminals/grilles, or at another location between the inlet and outlet terminals/grilles as specified by the manufacturer ~~or registers~~ of single or multiple branch ventilation systems.

The airflow measurement apparatus manufacturers shall certify to the Energy Commission that use of the apparatus in accordance with the specifications given in the manufacturer's product documentation will produce measurement results that are within the accuracy required by Section RA3.7.2.2.

For the airflow measurement apparatuses that are certified to the Commission as meeting the accuracy required by Section RA3.7.2.2, the following information shall be posted on the Energy Commission website, making the information available to all people involved in the airflow verification compliance process:

(a) The product manufacturers' model numbers for the airflow measurement apparatuses.

(b) The product manufacturers' product documentation that gives the specifications for use of the airflow measurement apparatuses to accurately measure residential mechanical ventilation system airflow at system inlet ~~or outlet~~ terminals/~~,~~ grilles, outlet terminals/grilles, or at another location between the inlet and outlet terminals/grilles as specified by the manufacturer ~~or registers~~ of single or multiple branch ventilation systems.

A manufacturer's certification to the Commission of the accuracy of the airflow measurement apparatus, and submittal to the Commission of the product documentation that specifies the proper use of the airflow measurement apparatus to produce accurate airflow rate measurements shall be prerequisites for allowing the manufacturer's airflow measurement apparatus to be used for conducting the system airflow verification procedures in Section RA3.7 for demonstrating compliance with Part 6.

RA3.7.3.4 Onboard Airflow Measurement Device.

An instrument that is provided by the ventilation fan manufacturer, integrated with the ventilation fan, and designed for measurement of residential ventilation exhaust or supply airflows that meets the applicable instrument accuracy specifications in RA3.7.2 may be used to measure the mechanical exhaust or supply ventilation airflow.

2. **RA3.7.4.3 and NA2.2.4.1.4 Kitchen Local Mechanical Exhaust - Vented Range Hood Verification.** Section 150.0(o)1Gv (and Section 160.2(b)2Avie) require the kitchen exhaust airflow to be verified by the installer using an in-situ airflow testing or a prescriptive duct sizing method. If using the prescriptive duct sizing method, the rated airflow at 0.25 in. of water must be used to comply. If the prescriptive duct sizing method is used for complying with Section 150.0(o)1Gv (or Section 160.2(b)2Avie), then the HERS Rater should also reference the kitchen range hood airflow at 0.25 in. of water when verifying the airflow within an approved directory. To ensure that this is the case, the following modification is offered. A similar modification is recommended for NA2.2.4.1.4:

   RA3.7.4.3… The verification procedure shall consist of visual inspection of the installed kitchen range hood to verify and record the following information:…

   (c) The rated airflow value or rated capture efficiency value listed in the HVI, AHAM, or other CEC-approved directory. If the prescriptive duct sizing method in 150.0(o)1Gvb is used by the installer to verify the airflow value, then the rated airflow value shall be verified using the approved directory at a static pressure difference of 0.25 in. of water.

3. **RA3.7.4.4 and NA2.2.4.1.5 Heat Recovery Ventilation (HRV) or Energy Recovery Ventilation (ERV) Rated Performance Verification.** This section details the H/ERV performance information that must be field verified, including verification of rated performance for fan efficacy or sensible recovery efficiency within HVI's directory or within another approved directory.

Because each H/ERV is likely to have several rated performance points within the HVI directory, HVI requests that CEC modify Section RA3.7.4.4 as follows to provide the verifier with the specificity needed to verify the desired performance parameter. A similar modification is recommended for NA2.2.4.1.5.

3. Look up and record the applicable rated performance for sensible recovery efficiency or fan efficacy at 32°F (0°C) for the installed model in the HVI, or other CEC-approved directory. Verification shall be at an airflow rate that is no less than the continuous dwelling unit ventilation airflow rate determined in accordance with Section 150.0(c). When the design airflow rate is between two listed airflow rates, interpolation of the sensible recovery efficiency and fan efficacy shall be permitted. If the manufacturer's sizing instruction method in 150.0(o)1Gvc is used by the installer to verify the airflow value, then visual inspection shall be used to verify that the installed system conforms with the duct length, diameter, and number of elbows used within the manufacturer's sizing instructions, that the design condition is a point on an HVI-rated fan curve, and that the duct system has an exterior termination fitting with a hydraulic diameter greater than or equal to the minimum duct diameter.
[Note to CEC Staff: Please see HVI's comment 12c in Section II of this letter regarding the recommendation to permit manufacturer sizing. Additionally, similar language to what is proposed above would likely also be needed in the reference appendices.]

If the value ~~given in~~ determined from the directory for sensible recovery efficiency or fan efficacy for the installed system meets or exceeds the performance required for compliance, then the system complies; otherwise, the system does not comply. If the system is not listed in the HVI or other CEC-approved directory, then the system does not comply.

4. **NA7.18.1.1.1 Dwelling Unit Ventilation Acceptance - Construction Inspection**. Bullet "a" requires the verifier to document that the dwelling unit ventilation system "is designed to provide a fixed minimum outside air when the unit is operating." This should be expanded to include variable dwelling unit ventilation systems that are permitted by CEC. The following modification is offered for this purpose: "…is designed to provide ~~a fixed minimum~~ outside air when the unit is operating."

Thank you for the opportunity to provide these comments in support of updating Title 24's ventilation requirements for dwelling units and light commercial buildings.

Sincerely,

Jacki Donner

Jacki Donner, CEO