CALIFORNIA ENERGY CODES & STANDARDS
A STATEWIDE UTILITY PROGRAM

Notes from 2019 Title 24 Part 6 Code Development Cycle Utility-Sponsored Stakeholder Meeting for Residential and Nonresidential Indoor Air Quality

Posted July 12, 2017

Meeting Information

Meeting Date: March 16, 2017

Topics Discussed: Residential and Nonresidential Indoor Air Quality

Meeting Time: 9:00am – 12:00pm

Meeting Host: California Statewide Utility Codes and Standards Team

Attendees

First Name	Last Name	Contact	Organization
Statewide Utility Codes and Standards Team			
Utility Staff			
Kelly	Cunningham	KACV@pge.com	Pacific Gas and Electric Company (PG&E)
Marshall	Hunt	mbh9@pge.com	Pacific Gas and Electric Company (PG&E)
John	Barbour	JBarbour@semprautilities.com	San Diego Gas & Electric (SDG&E)
Daniela	Garcia	dgarcia3@semprautilities.com	SoCalGas
Randall	Higa	Randall.Higa@sce.com	Southern California Edison (SCE)
Chris	Kuch	christopher.kuch@sce.com	Southern California Edison (SCE)
Bach	Tsan	Bach.tsan@sce.com	Southern California Edison (SCE)
Codes and Standards Enhancement (CASE) Team Members			
Alea	German	agerman@davisenergy.com	Davis Energy Group
Marc	Hoeschele	mhoesch@davisenergy.com	Davis Energy Group
David	Springer	dspringer@davisenergy.com	Davis Energy Group
Heidi	Hauenstein	hhauenstein@energy-solution.com	Energy Solutions
Vanessa	Morelan	vmorelan@energy-solution.com	Energy Solutions
Anna	Brannon	abrannon@integralgroup.com	Integral Group
Matt	Dehgani	mdehghani@integralgroup.com	Integral Group
Ryan	Sit	rsit@integralgroup.com	Integral Group
Stefan	Gracik	sgracik@integralgroup.com	Integral Group
Jon	McHugh	jon@mchughenergy.com	McHugh Energy Consultants
Marian	Goebes	mgoebes@trcsolutions.com	TRC Energy Services
California Energy Commission Participants			
Mark	Alatorre		California Energy Commission (CEC)
Joe	Loyer	joe.loyer@energy.ca.gov	California Energy Commission (CEC)
Veronica	Martinez	Veronica.Martinez@energy.ca.gov	California Energy Commission (CEC)
Adrian	Ownby	adrian.ownby@energy.ca.gov	California Energy Commission (CEC)
Alex	Pineda	alex.pineda@energy.ca.gov	California Energy Commission (CEC)

Other Participants			
Eric	Adair		Adair Concepts & Solutions LLC
Laura	Petrillo-Groh		AHRI
Roy	Eads		Benningfield Group
Russ	King		Benningfield Group
Dan	Johnson		Beyond Efficiency
Bruce	Wilcox		Bruce A Wilcox, P. E.
Peter	Simmons		Building and Systems Analytics
Shelby	Gatlin		CalCERTS, Inc.
Mark	Wiese		CalCERTS, Inc.
Ryan	Ware		CalCERTS, Inc.
Michel	Fourcroy		CalCERTS, Inc.
Peggy	Jenkins		California Air Rescouces Board (CARB)
Zoe	Zhang		California Air Rescouces Board (CARB)
Robert	Raymer		California Building Industry Association
Barry	Taheri		California Consultants
Mike	Hodgson		ConSol
Tony	Martinez		ConSol
George	Nesbitt		Environmental Design / Build
Gina	Rodda		Gabel Energy
Aniruddh	Roy		Goodman
Jason	Lorcher		Green Dinosaur, Inc.
Dan	O'Donnell		Honeywell International
Julie	Eagle		Ingersoll Rand
Soodabeh	khalifeh		Khalifeh & Associates, Inc.
Rengie	Chan		Lawrence Berkeley National Lab (LBNL)
Brett	Singer		Lawrence Berkeley National Lab (LBNL)
Brennan	Less		Lawrence Berkeley National Lab (LBNL)
Luis	Garcia		LDI Mechanical
Glenn	Savage		LG Electronics
Mike	Milliken		micrometl
Vincent	Lee		Mitsubishi Electric
Douglas	Tucker		Mitsubishi Electric
Alex	Hillbrand		National Resources Defense Council
Mark	Lyles		NBI
Bohdan	Fedyk		NEBB
Bo	White		NegaWatt Consulting
Roger	Hedrick		NORESCO
Kyra	Weinkle		NORESCO
Daniel	Arnold		Nortek Global HVAC
Neil	Hettler		Owens Corning
Gourgen	Abnousian		Precise Air Systems Inc.
Abram	Conant		Proctor Engineering Group, Ltd.
Andy	Llora		QC Manufacturing, Inc.
Karen	Meyers		Rheem
Dave	Dias		Sheet Metal Worker's Local 104
Chris	Walker		SMACNA (CAL)

Linda	Jennings		SMACNA (of San Diego)
Joe	Cortese		Stanton Engineering
Nehemiah	Stone		Stone Energy Associates
Peter	McKinney		StrionAir/ United Technologies
Huey	Cao		Tad Consulting
Steven	Taylor		Taylor Engineering LLC
Beth	Braddy		Trane
Roger	LeBrun		VELUX America LLC
Marcos	Hernandez		Villara Building Systems
Rick	Wylie		Villara Building Systems

Meeting Agenda

Time	Topic	Presenter
9:00 – 9:20	Introduction	Kelly Cunningham (PG&E)
9:20 – 10:35	Residential Indoor Air Quality (IAQ)	David Springer (Davis Energy Group)
10:35 – 11:50	Nonresidential Indoor Air Quality (IAQ)	Ryan Sit (Integral Group)
11:50 – 12:00	Review and wrap-up, next steps	Kelly Cunningham (PG&E)
9:00 – 9:20	Introduction	Kelly Cunningham (PG&E)

Key Takeaways and Action Items

1. **Overview**
    a. No key takeaways or action items.
2. **Residential Indoor Air Quality**
    a. There is significant industry push-back on the proposed requirement for MERV 13 filters for recirculating HVAC systems. Concerns are based on cost, installation challenges, and fan efficacy impacts. Further study is planned to evaluate the impact of using thicker (2”) filters on return grille and filter size, and fan efficacy.
    b. There is industry support for only requiring MERV 13 filters on balanced and supply ventilation systems for units that are close to busy roadways in high-rise multifamily units, as proposed in the draft CASE Report. The CASE Team is not proposing any changes to the report on this subject.
    c. Data from an LBNL study showed that, for exhaust ventilation, a single family building envelope can provide similar filtration as a MERV 13 filter. CARB disagreed that the building shell can filter for very fine particulates. Requiring tighter construction and filtered makeup air on all building types would likely meet with strong opposition. The CASE Team is not proposing any changes to the report on this subject.
    d. For multifamily (MF) exhaust systems using filtered makeup air, provisions should be made to limit interior negative pressures.
    e. Costs for air sealing MF units and ventilation shafts were felt to be too low. The CASE Team will revisit these costs.
3. **Nonresidential Indoor Air Quality**
    a. The CASE Author should consider having the proposed code change language reference Part 4 in cases where Part 4 already has the relevant ASHRAE 62.1 requirements.

   b. The CASE Author should consider proposing MERV 13 filtration for outside air treatment instead of MERV 11.

4. **Review and wrap-up, next steps**

Meeting Notes

Overview of 2019 Title 24, Part 6 Development

- Kelly Cunningham (PG&E) and John Barbour (SDG&E) presented.
- Presentation available here.

Comments and Feedback

- No comments or questions received.

Residential Indoor Air Quality

- David Springer (Davis Energy Group, Utility CASE Team) presented.
- Presentation available here.

Comments and Feedback

1. Gina Rodda (Gabel Energy): Credit for balanced systems would be great!
2. Brennan Less (LBNL): The CASE Team is proposing a balanced ventilation credit for low-rise multifamily, which would lower the required Qfan by 15 percent. Balanced ventilation is much more valuable in multifamily buildings to minimize intra-unit air exchange. Credit for infiltration is only allowed for single family. For multifamily, it is assumed that Q infiltration (Qinf) is zero, because we do not know where infiltration air is coming from. Since there are energy penalties for using HRVs or ERVs no credit is proposed for single family. The relative exposure calculations in Appendix C of ASHRAE 62.2-2016 provide a credit for balanced systems that use time-varying ventilation, but the CASE Team does not recommend including them in the ACM, because of the level of complexity. This would not preclude using an engineering approach to take credit for balanced systems in all building types, but compliance would be challenging.
3. Dan Johnson (Beyond Efficiency): The compliance software for low-rise residential gives the Standard Design a Heat Recovery Ventilator (HRV) if the Proposed Design has a HRV. Therefore, there is no compliance credit for HRV. Can we change the compliance software to get credit for HRV? This would increase adoption.
   a. David Springer (Davis Energy Group, Utility CASE Team): The 2016 ACM Manual states “In many cases, this energy [energy impact of ventilation] is substantially compliance neutral, because the standard design is typically set equal to the proposed design.” However, CBECC analysis shows significantly lower energy use in the Standard case with exhaust ventilation than the Standard case when an HRV or ERV is included in the proposed design. It is likely that in the exhaust ventilation case, the building envelope is treated as an air-to-air heat exchanger, while in the HRV/ERV case, the ventilation system is modeled as an HRV/ERV with zero heat recovery. This indicates a need to update the ACM to correctly model energy use of ERV and HRV systems.
4. Brennan Less (LBNL): Meaningful capture of PM2.5 starts around MERV 13.
5. Zoe Zhang (CARB): The MERV 13 requirement applies to all filters in the HVAC system. Some systems may have more than one filter: one in supply and one in the return. Some systems only have one filter.

   a. David Springer (Davis Energy Group, Utility CASE Team): The CASE Team is unaware of any residential systems that include filters in both the supply and return air paths. The vast majority of HVAC systems have filters located in the return grille (filter grille). A few use filters located in racks at the furnace or air handler. As proposed in the draft CASE Report, MERV 13 filters would be applied to all recirculating HVAC systems. Although air passes through recirculation filters only about 6 to 15 percent of the time, these filters would remove both outdoor and indoor PM2.5 when do they operate. The CASE Report also recommends MERV 13 filters for outdoor air in balanced or supply-only IAQ ventilation systems that are proximate to busy roadways; MERV 8 filters would be required for outside air in other locations, so as not to discourage balanced systems (i.e., encourage exhaust only strategies).

6. Aniruddh Roy (Goodman): When this measure was presented in September 2016, the proposed requirements was to move from MERV 6 to MERV 11. What prompted the revision to MERV 13?
   a. David Springer (Davis Energy Group, Utility CASE Team): CARB requested that MERV 13 be required, and the Energy Commission supports the request. MERV 13 does have higher capture efficiency for particulates in PM2.5 range. However, there are no data to support the argument that MERV 13 filters in recirculating HVAC systems reduce indoor PM 2.5 concentrations.
7. Aniruddh Roy (Goodman): Section 150 of the standard requires 350/cfm/ton for fan efficacy. Have you studied impact that MERV 13 will have on the fan efficacy requirements (which are changing as a result of the federal standards)?
   a. David Springer (Davis Energy Group, Utility CASE Team): Yes, we studied the impact of MERV 13 filters on pressure drop as well as efficacy. The HVAC CASE Report is proposing a reduction in fan efficacy from 0.58 to 0.45 watts/cfm to synchronize with the 2019 DOE standard, which will effectively require that furnace manufacturers use ECMs or other high efficiency fan motors. Calculations show that if the conservative filter sizing in Table 150-B is applied to a typical MERV 13 filter, the pressure drop will be less than 0.1 inch w.c., and this will have little or no impact on efficacy. Further analysis showed that if a MERV 8 filter is sized for a pressure drop of 0.15 inches, the face area of the filter would have to be increased by a factor of three to maintain the same 0.15 inches pressure drop with a MERV 13 filter, so larger and/or thicker filters and larger grilles will be required. This analysis shows the importance of correct sizing (using ACCA Manual D), and that properly sized MERV 13 filters will not affect efficacy under either the existing or proposed scenarios.
8. Aniruddh Roy (Goodman): The ASHRAE 62.2 committee discussed the possibility of updating the ASHRAE to require MERV 11 as opposed to MERV 6 during the recent winter conference. The committee did not reach consensus on the recommendation to move to MERV 11. If the objective is to harmonize with ASHRAE 62.2-2016, recommending MERV 11 or 13 is not a harmonization with ASHRAE.
9. Peggy Jenkins (CARB): CARB supports the increase to MERV 13 to help minimize exposure to PM 2.5. California has elevated PM levels, particularly urban areas near highways. There are density requirements for new development, which has an impact on PM levels. Many of the new planned developments are in close proximity to busy roadways. The health impact of PM exposure are striking We are in agreement that increasing MERV ratings should be coupled with other system-level design recommendations to ensure the entire mechanical systems continue to function well with MERV 13 filters. For example, there may be a need to consider requiring

deeper filter grills. We appreciate the California Energy Commission supporting this effort to address indoor air quality.

a. David Springer (Davis Energy Group, Utility CASE Team): Filter pressure drop can be reduced by using deeper pleated filters, but larger filter areas will also be required. Data on the reduction of PM 2.5 resulting from the use of MERV 13 filters in recirculating HVAC systems would help support this proposed code change, but data from the HENGH study and other sources may not be available until after CASE Reports are finalized.

10. Dan Johnson (Beyond Efficiency): Why is the requirement structured to require MERV 13 on forced air returns? Does this assume an exhaust-only system? I thought the building shell was filtering the outdoor air equivalent to MERV 13
    a. David Springer (Davis Energy Group, Utility CASE Team): The CASE Team is following the CARB and Energy Commission recommendations, which are to apply MERV 13 filters on forced air returns in houses that use any fresh air ventilation system type. The CASE Team acknowledges the questionable value of MERV 13 filters for return air, given short equipment runtimes, improved source control from verified kitchen hoods, and proposed use of MERV 13 filters with IAQ ventilation systems in locations that are close to busy roadways. This decision is in the hands of the Energy Commission. To clarify, the Commission has proposed MERV 13 filtration for both outdoor air (which would affect only supply-only and balanced ventilation systems) and for recirculated air (which is independent of the ventilation strategy).
11. Dan Johnson (Beyond Efficiency): Why not look at limiting PM2.5 emissions, and why is there an increase in PM2.5 emissions (outdoors) lately?
    a. Marian Goebes (Davis Energy Group, Utility CASE Team): Many regulations have helped reduce PM2.5 emissions, particularly from diesel trucks. There are still PM2.5 emissions from breaking and tire wear.
    a. Chris Walker (CAL SMACNA): Tires are big source of PM. Just addressing emissions from internal combustion engines will not be enough to contain PM emissions.
    b. Zoe Zhang (CARB): PM2.5 has been regulated for years, and statewide there is a great reduction. Our concerns are especially in near-roadway environments. Due to the proximity to traffic emissions, PM in houses near roadways could be high compared to houses that are far away from traffic.
    b. Rick Wylie (Villara Building Systems): If busy roadways are the concern, then let's address them, not all homes.

        Marian Goebes (Davis Energy Group, Utility CASE Team): The CASE Report had recommended that the requirement for MERV 13 filtration of outside air be limited to residential units within 500 feet of a busy roadway: specifically – within 500 feet of a road with average annual daily traffic greater than 100,000, based on California Department of Transportation data. However, the Commission had concerns that it would be challenging for design teams to identify these areas and for building officials to verify whether a building was within this zone.

    c. Peter Simmons (Building and Systems Analytics): How do we know the PM 2.5 levels of outside air?
        i. Zoe Zhang (CARB): Check here for PM2.5 reading: https://www.arb.ca.gov/aqmis2/aqdselect.php.

ii. Bo White (NegaWatt Consulting): In the CASE Report, can you provide maps or references indicating the location of non-attainment areas and of the mentioned freeways/roadways?

d. Peggy Jenkins (CARB): The health impacts seen along busy roadways are not allergies and asthma, but rather cardiovascular and respiratory hospital admissions and deaths.

12. Brett Singer (LBNL): Savings in health costs for Californians will likely be much higher than any costs for filters!
    a. Gina Rodda (Gabel Energy): I agree.
    b. Marian Goebes (Davis Energy Group, Utility CASE Team): The CASE Report includes a descriptions of studies that estimate the financial benefits from reducing PM2.5.
13. Chris Walker (CAL SMACNA): Is MERV 13 or greater required for automobile cabin filtration?
    a. Zoe Zhang (CARB): No requirement for automobiles now, but CARB funded a study looking at cabin filters and HEPA filters that are much better at removing particles than filters installed by car makers.
14. Peter Simmons (Building and Systems Analytics): Has anyone looked at PM levels over the height of the high-rise buildings?
    a. Zoe Zhang (CARB): There were some studies in Asia for vertical distribution of PM2.5 in high-rise building. I am not aware of any studies in the United States (U.S.). There was one study in Los Angeles for vertical distribution near freeways, but they are evaluating ambient air, not indoor air.
    b. Peter Simmons (Building and Systems Analytics): I have some data as I am regularly involved in high-rise design, both here in the U.S. and in Asia.
15. Brett Singer (LBNL): I have a question about the consideration of filtration on supply ventilation systems. We recently completed a study with CARB where we looked at different types of filtration systems. We found that exhaust ventilation systems in buildings with tight envelopes and without any filter look similar to supply-side ventilation systems with MERV 13 filters. The exhaust ventilation systems actually look a little better in terms of protection from outdoor particles. In other words, if you are aiming to achieve comparable performance to an exhaust ventilation system using a supply-side ventilation system, you need to filter incoming air with at least MERV 13. Was there any consideration of requiring filtration on supply ventilation systems? The study report is available on CARB's website at https://www.arb.ca.gov/research/apr/past/11-311.pdf.
    a. David Springer (Davis Energy Group, Utility CASE Team): We are only recommending applying supply-side filtration for high-rise multifamily buildings close to busy roadways.
    b. Brett Singer (LBNL): You are not recommending for single family buildings close to freeways?
    c. David Springer (Davis Energy Group, Utility CASE Team): Not for balanced, only for supply-only. Perhaps we should consider this, but we are assuming that most single family buildings and low-rise multifamily units are going to use the least expensive ventilation system, which is exhaust. A study LBNL completed for CARB shows that for houses with exhaust ventilation, the building envelope is at least as effective as a MERV 13 filter. Also, there is a very limited number of balanced systems that can accommodate MERV 13 filters. The concern with high-rise multifamily is that many use a ventilation approach of exhaust only with a passive vent, which provides no filtration. For high-rise multifamily units close to busy roadways, the passive vent would allow considerable PM2.5 to enter the unit. Consequently, the Utility CASE Team proposed that high-rise

multifamily units close to busy roadways (defined in CASE Report) would be required to provide mechanically-driven supply air with MERV 13 filtration.

d. Peggy Jenkins (CARB): CARB does not consider the building shell to provide adequate removal of the very fine PM that is most responsible for health impacts. Brett was just pointing out that if a supply system is used, at least a MERV 13 filter would be needed to reach reasonable equivalence to the BA exhaust situation, but the two are not really equal.

e. Dan Johnson (Beyond Efficiency): So, supply or balanced ventilation with forced air could use MERV 6 on returns, because outdoor air is filtered separately?

16. Dan Johnson (Beyond Efficiency): MERV 13 on outdoor air only, or on recirculated air?
    a. David Springer (Davis Energy Group, Utility CASE Team): The CASE Team proposal is to require MERV 13 on:
        i. recirculated air in all dwelling units,
        ii. supply-only ventilation systems in all dwelling units proximate to busy roadways, and
        iii. balanced ventilation systems in high-rise units proximate to busy roadways.
17. George Nesbitt (Environmental Design/Build): Are you allowing ventilation to be reduced when doing a blow door test?
    a. David Springer (Davis Energy Group, Utility CASE Team): The ASHRAE 62.2 standard is designed to provide the same ventilation regardless of the tightness of the house, through a combination of infiltration (as measured by a blower door test) and mechanical ventilation. Applying this standard, a tighter house will require more mechanical ventilation. Compliance credit will still be allowed if blower door testing is used to verify a leakage rate of less than 5 ACH50. If no blower door test is conducted, the CASE Team has proposed that 2 ACH50 be assumed as the infiltration rate. This compliance credit is decoupled from the calculation of the mechanical ventilation rate. Note that for multifamily units, ventilation through infiltration is assumed to be zero, so all ventilation must be provided mechanically.
    a. George (Environmental Design/Build): Typically, the blow door test is not completed until the house is mostly done and the equipment is already installed and hard to get to. It is hard to change ventilation rate at the end.
18. George Nesbitt (Environmental Design/Build): There is evidence that tighter houses are better, even if more fan energy is required to achieve ventilation rates. We should be careful in how these requirements are structured so we continue to encourage tight houses, and we do not create a disincentive to do so by requiring a more expensive ventilation system.
19. Marian Goebes (Davis Energy Group, Utility CASE Team): (Slide 20) We will likely change the requirements for high-rise residential so the MERV 13 filter threshold is based on proximity to roadways as opposed to location in non-attainment area. This approach parallels the approach San Francisco has pursued for their local ordinance.
20. Dan Johnson (Beyond Efficiency): Regarding passive vents (slide 21), Steven Winter Associates (SWA) has excellent studies showing that a small fraction of exhaust makeup air actually comes through passive vents.
    a. Luis Garcia (LDI Mechanical): Passive air inlets are not effective for mitigating site acoustic concerns.
    a. Brett Singer (LBNL): Can one use passive vents in buildings close to freeways?

i. David Springer (Davis Energy Group, Utility CASE Team): The Utility CASE Team recommends that for high-rise multifamily units, passive vents can't be used – ventilation must be provided as mechanically driven with MERV 13 filtration. The CASE Team did not propose requirements for low-rise units near freeways, since most use an exhaust only approach (without passive vents).

b. Luis Garcia (LDI Mechanical): Additional research and case studies need to be conducted with passive air inlets under Option 1.

c. Dan Johnson (Beyond Efficiency): Passive inlets usually do not work: https://www1.eere.energy.gov/buildings/publications/pdfs/building_america/ventilation_multifamily_buildings.pdf.

d. Marian Goebes (Utility CASE Team): Passive vents may not be an optimal strategy for IAQ, but the incremental cost of mechanically-provided supply air (like balanced systems) is much higher. We are only requiring MERV 13 filters on passive vents in areas with high PM2.5 exposure (i.e., close to busy roadways) for high-rise multifamily.

e. Peter Simmons (Building and Systems Analytics): What about the neutral pressure plane in high-rise buildings with passive vents?

21. Peter Simmons (Building and Systems Analytics): Have these costs been verified?
    a. David Springer (Davis Energy Group, Utility CASE Team): We are looking for feedback on cost estimates today, or you can provide input in the coming months. It is helpful if you can provide data to support recommended revisions to cost estimates.
22. Luis Garcia (LDI Mechanical): Larger return grilles/filters should be included in cost estimates.
23. Nehemiah Stone (Stone Energy Associates): Maintenance cost would increase since the filters have to be replaced, and MERV 13 filters cost more, right? That is, the incremental cost of the MERV 13 filter is not just a first-cost issue.
    a. Chris Walker (CAL SMACNA): Agree with Nehemiah. Need to include a higher frequency change rate for MERV 13 filters relative to MERV 6 filters.
        i. David Springer (Utility CASE Team): Because of their larger surface area, high MERV filters may not require replacement any more frequently.
24. Dan Johnson (Beyond Efficiency): The incremental cost of design and verification paperwork are not included in the cost effectiveness analysis.
    a. David Springer (Davis Energy Group, Utility CASE Team): ACCA Manual D calculations are currently required under Title 24, Part 11, though not well enforced. Costs estimates for larger grilles and filters and sealing for compartmentalization will be updated.
25. Brett Singer (LBNL): You should note that the costs shown in the presentation are for packs of filter. The slides included a cost per filter, but that text was a lot smaller. So, it is $120 per pack of filters.
    a. David Springer (Utility CASE Team): That is correct.
26. Dan Johnson (Beyond Efficiency): Filter cost may be trivial compared to system design increase.
27. Participant: Where was energy savings data presented?
    a. David Springer (Utility CASE Team): There are no energy savings, expect for the slide showing single family impacts. For low-rise multifamily, there will be no change in energy use. There may be a slight reduction in energy use for high-rise multifamily.
28. Brett Singer (LBNL): When we calculate the benefits of improved filtration, the benefits are always higher than the costs. Although the Energy Commission is not required to calculate

monetary value of health benefits, we have high confidence that the health benefits far outweigh the costs of the measure.

29. Rick Wylie (Villara Building Systems): Beyond the cost of MERV 13 relative to MERV 6, you have to consider the cost of larger return air grills and/or added grills, along with the cost of higher efficiency blowers. I believe this will drive the cost increase beyond "cost-effective".
    a. Robert Raymer (CBIA): I am not sure a "larger" return grill is going to be an easy solution as grill size with current standards has been very problematic. Return grill size has been a significant issue with the 2013 and 2016 requirements. Increasing that size for 2019 may not be a design option, or it will pose huge design and cost issue.
    b. Andy Llora (QC Manufacturing, Inc.): Impacts to return grill or duct sizing would not be needed if fan efficacy is changed from 0.58 watts/cfm.
        i. David Springer (Davis Energy Group, Utility CASE Team): The improved efficiency of furnace fans required by DOE will tend to have a neutral impact on compliance since the measured watts/cfm will be lower, but so will the efficacy limit (proposed to be reduced from 0.58 to 0.45 W/cfm). Larger grilles and filters will be required for higher MERV filters regardless of the fan efficacy.
30. Peggy Jenkins (CARB): Why is the incremental cost of higher MERV filters so low?
    a. David Springer (Davis Energy Group, Utility CASE Team): We did a web survey to derive our cost estimate. I can share that information.
    b. Peggy Jenkins (CARB): That would be great.
31. Nehemiah Stone (Stone Energy Associates): If the MERV 13 filters cost more, why is there an assumption of zero incremental maintenance cost?
    a. David Springer (Davis Energy Group, Utility CASE Team): Good point. The cost of changing the filter will not change, but the replacement filter itself will be more expensive. Costs in the draft CASE Report will be updated.
32. Peter Simmons (Building and Systems Analytics): It appears that to comply with these ventilation rates, only all air systems can be considered, what about radiant systems?
    a. Chris Walker (CAL SMACNA): Question for CARB, is there any evidence that radiant systems can increase problematic off-gas emissions from flooring materials?
33. Peter Simmons (Building and Systems Analytics): Will the single family ventilation rates be applicable for naturally ventilated residences?
    a. David Springer (Davis Energy Group, Utility CASE Team): Yes. Natural ventilation is no longer recognized by ASHRAE 62.2.
34. Nehemiah Stone (Stone Energy Associates): Does the proposal call for revisions to the California Mechanical Code too?
    a. Bo White (NegaWatt Consulting): Are there discrepancies between the proposed Part 6 ventilation requirements and the requirements in the Mechanical Code (Part 4 or Title 24)?
    b. David Springer (Davis Energy Group, Utility CASE Team): Yes. Proposed changes include references from Title 24, Parts 2 and 4, to Part 6 for IAQ ventilation requirements. ASHRAE Standard 62.2-2007 was adopted with the 2008 Title 24 standards and the Offerman study was published in 2009.
35. Nehemiah Stone (Stone Energy Associates): Could you please cover any exceptions that might apply to additions/alterations for any of the requirements that pertain to high-rise multifamily?
    a. Marian Goebes (Davis Energy Group, Utility CASE Team): This is a good question. The CASE Team needs to discuss exceptions a bit more then get back to the stakeholder team.

36. Mike Hodgson (ConSol): The Offerman study triggered the requirement for ventilation per ASHRAE 62.2 in residential new construction. Are there any studies that demonstrate the current ASHRAE 62.2 requirement alleviates the IAQ concerns in residential new construction?
    a. Brett Singer (LBNL): Responding to Mike Hodgson's question, the Offerman study (available from https://www.arb.ca.gov/research/apr/past/04-310.pdf).
    b. Marian Goebes (Davis Energy Group, Utility CASE Team): Although a study of new construction homes is not available, a study of 81 weatherized homes found higher ventilation rates, lower concentrations of VOCs, formaldehyde and carbon dioxide, and improvements in health (e.g., children had fewer headaches, eczema, and skin allergies; and adults had improvements in psychological distress) after homes met the 62.2 standard. Approximately half the homes were improved to meet the 62.2-1989 standard, and half to meet the 62.2-2010, and there were greater improvements for homes that met the 2010 standard. The abstract of that study is available here: http://onlinelibrary.wiley.com/doi/10.1111/ina.12325/abstract.
        i. Also, DOE Building America program is initiating a national study.
37. Luis Garcia (LDI Mechanical): What about intermittent exhaust fans as identified in ASHRAE 62.2?
    a. Brennan Less (LBNL): Agree with Luis's comment. Are the requirements in Normative Appendix C of 62.2-2016, which allows for real-time smart ventilation control, allowed in the Title 24, Part 6?
    b. Marian Goebes (Davis Energy Group, Utility CASE Team): Intermittent ventilation as outlined in Table 4.2 in ASHRAE 62.2-2010 (CA) was eliminated in 62.2-2016 and replaced by a "relative exposure" calculation described in Normative Appendix C. This calculation requires numerous inputs and equations, and there are no plans to include it in compliance methods. However, Section 4 of the 2016 standard allows variable rate ventilation systems if they provide an average dwelling-unit ventilation rate over any three-hour period that is greater than or equal to Qfan.
38. Gina Rodda (Gabel Energy): Are air sealing requirements prescriptive or mandatory?
    a. David Springer (Utility CASE Team): Air sealing for compartmentalization is proposed to be a mandatory option for multifamily units (with balanced ventilation provided as the other option).
39. Dan Johnson (Beyond Efficiency): How is compartmentalization verified or enforced?
    a. David Springer (Utility CASE Team): The Energy Commission is advocating blower door tests be used to verify that leakage is not greater than 0.3 cfm per square foot of enclosure surface area (walls, ceiling, and floor). The CASE Team is recommending that sampling be allowed in accordance with Reference Residential Appendix Section RA2.6.
40. Dan Johnson (Beyond Efficiency): Do studies show that remote kitchen exhaust is equally effective removing cooking-generated PM2.5 as exhausted range hood?
    a. Brennan Less (LBNL): No. Range hoods that cover the cooking surface are more effective and at lower airflows.
41. Brennan Less (LBNL): At what fan speed does a kitchen exhaust need to meet the flow, noise specs? Low, Medium, High, any speed?
    a. David Springer (Utility CASE Team): ASHRAE 62.2-2016 requires that kitchen exhaust fans used to comply with Section 5.2 of the standard shall be rated for sound at a maximum of 3 sone at one or more airflow settings greater than or equal to 100 cfm. Fans with a minimum airflow setting exceeding 400 cfm are exempt.

42. Brett Singer (LBNL): Any comments on microwave exhaust hoods that do not meet HVI sound certification requirements?
43. Brennan Less (LBNL): Verifying kitchen exhaust airflow is highly non-trivial.
44. Dan Johnson (Beyond Efficiency): From slide 18, HVAC fan run time is only 6 to 15percent of the year. How is filtration provided for exhaust-only systems for the remainder of the year?
    a. David Springer (Davis Energy Group, Utility CASE Team): The predominant indoor source of PM 2.5 is cooking. The proposed verification of kitchen hoods is intended to reduce this source. The secondary source is outdoor air, and in one study filtration of air by the building enclosure was found to be as effective at limiting PM2.5 as a MERV 13 filter used in a supply ventilation system.
45. Gina Rodda (Gabel Energy): Is there a test method available to test these potentially large ventilation systems are sealed to 6 percent of total ventilation rate?
    a. Chris Walker (CAL SMACNA): SMACNA has a leakage test standard for ductwork. It does not use a percent of design flow as that is not correct per our research. It does use a cfm per square foot of surface, much like a building envelope.
    b. Gina Rodda (Gabel Energy): Thank you Chris, that would make this lean more towards a test performed by an Acceptance Test Technician then, I would think.
    c. Chris Walker (CAL SMACNA): I would suggest using SMACNA's standard, which is already the basis of compliance for commercial buildings. The original standard is from 1985.
    d. David Springer (Utility CASE Team): The Team will coordinate with the Commission to recommend a test standard or protocol, and will review the SMACNA leakage test standard as part of this research.
46. Peter Simmonds (Building and Systems Analytics): In high-rise residential, the ventilation system is to be tested for leakage, but who tests the facade?
    a. Dan Johnson (Beyond Efficiency): According to SWA studies, the key performance variable for multifamily was compartmentalization above all else. Who tests the facade and parting walls?
    b. David Springer (Davis Energy Group, Utility CASE Team): Whether the testing is completed by a HERS Rater, an ATT, or either, will be determined by the Commission.
47. Nehemiah Stone (Stone Energy Associates): At the start of the presentation, you said that it applies to renovations over a certain conditioned floor area. Venting directly to the exterior in existing high-rise multifamily, is not always possible. What exception is available?
    a. David Springer (Davis Energy Group, Utility CASE Team): The Team will discuss applicability to additions and alterations with the Commission. It is expected that only major alterations would trigger requirements for compartmentalization and ASHRAE 62.2 compliance.
48. Rick Wylie (Villara Building Systems): Bottom line, the HVAC industry is still struggling with current airflow/fan watt requirements without the addition of MERV 13. We are also facing new federal furnace efficiency requirements that will further challenge airflow and static capacity. We strongly oppose the increase to MERV 13. The cost impacts are not justified, considering that most people do not have health issues with the current systems' design. For those allergy/asthma sufferers, the cost of their individual solutions are much less than this all-home solution.
    a. Dan Johnson (Beyond Efficiency): Are you suggesting using a separate outdoor air filter instead of exhaust-only, keep return air filter at MERV 6?

   b. David Springer (Davis Energy Group, Utility CASE Team): The Energy Commission's proposal is to require MERV 13 at both the recirculation filter (which is independent of the ventilation strategy), and at the outside air filter (which would only apply to balanced or supply-only ventilation strategies). Exhaust-only ventilation would still be permitted, and would not be affected by the proposed MERV 13 requirement.
   c. Luis Garcia (LDI Mechanical): Agree with Rick. We should adhere to ASHRAE 62.2 for all residential occupancies without revisions to MERV requirements.

49. Dan Johnson (Beyond Efficiency): Has CBECC been demonstrated to accurately predict measured data?
50. Peggy Jenkins (CARB): For industry folks, is there a reason that using a 2-inch filter slot would not address the airflow issues?
   d. Luis Garcia (LDI Mechanical): Still need to enlarge size of return filter grille for multifamily to reduce pressure drop in conjunction with going to 2-inch filter on multifamily.
51. Gina Rodda (Gabel Energy): for multifamily high-rise, there was a proposal that a builder could pursue sealing between parting walls and exteriors and air infiltration verification. Is it a mandatory or prescriptive requirement? How would infiltration be verified, by a HERS Rater?
   e. Marian Goebes (Utility CASE Team): It would be a mandatory requirement requiring either compartmentalization or balanced ventilation in multifamily units, and the Commission is still weighing whether it would be verified by a HERS Rater, an Acceptance Test Technician, or either.

Nonresidential Indoor Air Quality

- Ryan Sit (Integral Group, Utility CASE Team) presented
- Presentation available here.

Comments and Feedback

1. Brett Singer (LBNL): Are there existing requirements for bathroom exhaust?
   a. Mark Alatorre (Energy Commission): The California Mechanical Code (CMC or Title 24, Part 4) includes requirements for bathroom exhaust. There are no requirements in Title 24, Part 6.
2. Jeff Miller (Energy Commission): High-rise residential dwelling units would not be covered by ASHRAE 62.1.
3. Brett Singer (LBNL): Worth noting that the increased ventilation should improve productivity as well as health.
   a. Peter Simmons (Building and Systems Analytics): How does increased ventilation improve productivity?
4. Steve Taylor (Taylor Engineering): Given Part 4 (based on the Uniform Mechanical Code) already has all the ASHRE 62.1 requirements, why not just leave the ASHRAE 62.1 requirements in Part 4 as opposed to duplicating the requirements in Part 6? Instead of presenting the requirements in Part 4 and Part 6, you could just say the ventilation rates in Part 6 are 30 percent higher than the requirements presented in Part 4. It would be much easier and less confusing if the ventilation tables were only presented in one location.
   a. Peter Simmons (Building and Systems Analytics): I agree with Steve.
   b. Mark Alatorre (Energy Commission): The idea is to move all ventilation requirements into Part 6 to address this issue.

   c. Steve Taylor (Taylor Engineering): If you are going to move all requirements to Part 6, can you please work with the Building Standards Commission to ensure that they do not adopt the ventilation rates when they adopt the mechanical code. It is very confusing to have similar, but sometimes slightly different requirements in various parts of the standards.
   d. Mark Alatorre (Energy Commission): Understand. We are working on a proposal that clarifies the scope of Part 4 so that it is clear that ventilation requirements are in Part 6.

5. Steve Taylor (Taylor Engineering): On the proposal to recommend 130 percent of ASHRAE ventilation rates, during the last stakeholder meeting there was discussion of applying these higher rates for systems that do not have outside air economizers. If you have an outside air economizer, you are effectively achieving the higher ventilation rate (higher rates) year round, but you just aren't achieving on peak.
   a. Mark Alatorre (Energy Commission): That was my understanding as well.
   b. Jon McHugh (McHugh Energy Consultants): You can have months at a time where it is too hot or too cold to use the economizers. Do economizers always increase outdoor air rates?
   c. Steve Taylor (Taylor Engineering): Average outdoor rate is much higher with an economizer than if there is no economizer. When you look at statewide averages, economizers are more beneficial to the state. Bill Fisk has completed studies on this. It seems like encouraging the use of economizers is aligned with the states' interests, even though you may not get the peak savings.
   d. Joe Cortese (Stanton Engineering): Steve is correct on the impact of economizers.
   e. Utility CASE Team: The study that Steve referenced is available here: https://eetd.lbl.gov/sites/all/files/publications/lbnl-54475.pdf.
6. Dan Johnson (Beyond Efficiency): Will 130 percent of the ASHRAE 62.1 ventilation rates require a dedicated outdoor air system (DOAS) if new outdoor air fraction exceeds the maximum percent allowed on furnace/air handler?
   a. Utility CASE Team: Minimum ventilation rates must be provided to the space. It is the responsibility of the mechanical designer to specify equipment that can do so.
7. Bo White (NegaWatt Consulting): You are recommending ventilation rates that are 130 percent of the requirements in ASHRAE 62.1, which is more stringent that aligning with ASHRAE 62.1.
   a. Ryan Sit (Utility CASE Team): Correct.
8. Chris Walker (CAL SMACNA): How do the proposed natural ventilation requirement square with health concerns of PM in outside air? The natural ventilation requirements seem to be in direct conflict with the discussion we had on residential IAQ to minimize exposure to PM.
9. Bo White (NegaWatt Consulting): This measure will result in additional energy usage not energy savings.
10. Steve Taylor (Taylor Engineering): ASHRAE 62.1-2016 requires areas that are naturally ventilated to also have mechanical ventilation, with a few exceptions. The rationale is that windows get when the weather isn't nice and you don't get any ventilation when windows are closed. California has so far not aligned ASHRAE 62.1 on the requirement for mechanical ventilation and allows natural ventilation without mechanical ventilation. What is going to happen for this round? Is mechanical ventilation going to be mandatory?
   a. Utility CASE Team: We are proposing to align with the exceptions in ASHRAE 62.1, so mechanical ventilation would not be required when the openings are permanent.

   b. Steve Taylor (Taylor Engineering): The repercussions are that dorms and other buildings will have to have mechanical ventilation where they are not currently required to have mechanical ventilation.

11. Dan Johnson (Beyond Efficiency): Current code does not require nonresidential outside air to be distributed to each space, only into building as a whole. Will this change?
    a. Utility CASE Team: The proposed code change may have different minimum ventilation rates depending on space type. It is the responsibility of the mechanical designer to provide sufficient ventilation for each space.
12. Steve Taylor (Taylor Engineering): California adopts international building code section on ventilation, which has a section on natural ventilation that does not align with the mechanical code (Part 4) or the energy code (Part 6). This is very confusing and should be addressed.
    a. Anna Brannon (Utility CASE Team): You mentioned this during the first stakeholder meeting. We have completed a review where there are potential overlaps with other parts of Title 24, and have shared this information with the Energy Commission. The Energy Commission has been working with the Building Standards Commission to discuss the overlaps and identify potential solutions to help simplify and eliminate areas of confusion.
13. Steve Taylor (Taylor Engineering): There are many other requirements in ASHRAE 62.1 apart from the ventilation requirements. Are you considering pulling requirements other than ventilation rates into Title 24, Part 6? Be very careful about which requirements are included in each part of Title 24 to avoid confusion.
    a. Peter Simmons (Building and Systems Analytics): Why not simply refer to ASHRAE 62.1
    b. Bach Tsan (SCE): If it is not an energy savings, why should we move the information from Part 4 to Part 6?
    c. Brett Singer (LBNL): I agree with Steve Taylor's suggestion. If you want to align with 62.1, best to just refer to it.
    d. Utility CASE Team: The Statewide Utility CASE Team is considering having the proposed code change language reference Part 4 in cases where Part 4 already has the relevant ASHRAE 62.1 requirements.
14. Chris Walker (CAL SMACNA): If capture of PM2.5 begins at MERV 13, why use MERV 11 for nonresidential buildings given the earlier discussion? Students and teachers should benefit from same filtration rates as being proposed for multifamily residential.
15. Peter Simmons (Building and Systems Analytics): If the air is contaminated, then increasing the ventilation rate will increase contamination.
    a. Bohdan Fedyk (NEBB): If there is contaminated air, you are required to exhaust completely.
16. Dan Johnson (Beyond Efficiency): Most projects do not use a design engineer to calculate ventilation. Most project just have a design-build contractor.
    a. Gina Rodda (Gabel Energy): I find that most projects are using mechanical engineers, unless it is a simple packaged system.
    b. Dan Johnson (Beyond Efficiency): Aren’t most nonresidential projects using simple packaged systems? I work in schools, so perhaps its different for other building types.
    c. Gina Rodda (Gabel Energy): Not in my experience (though schools do typically use constant volume packaged for classrooms, though not larger classrooms buildings).

   d. Bach Tsan: How about Test and Balance Agencies (TABs)? The contractors have to hire them to balance the systems.
   e. Chris Walker (CAL SMACNA): TAB contractors would be most appropriate to perform calculations.
   f. Peter Simmons (Building and Systems Analytics): These calculations are standard calculations for most design engineers.

17. Kyra Weinkle (NORESCO): Would the Plans Examiner be qualified to confirm the calculations are done correctly?
    a. Gina Rodda (Gabel Energy): The calculations would typically be reviewed by the mechanical plan checker.
    b. Joe Loyer (Energy Commission): Do most of the 560 building departments have on-staff mechanical engineers that plan check, or do most building departments contract out for those services?
    c. Gina Rodda (Gabel Energy): Only the larger building departments have mechanical engineers on staff. I do find that building departments will use outside plan check for more complicated buildings that may be outside their scope of understanding. This is very common.
18. Steve Taylor (Taylor Engineering): How did you determine minimum airflow setpoints on variable air volume (VAV) boxes using the multiple space equitation? This a very complex.
    a. Ryan Sit (Utility CASE Team): We used a spreadsheet tool that is typically used for LEED analyses to determine minimum outdoor air flowrates. These results were then input into the energy model that accounts for energy use for all hours of the year (8760 model).
19. Dan Johnson (Beyond Efficiency): Energy Code is driving down loads but increasing flow, school air handlers are greater than 30 percent outdoor air, this gets problematic, yes?
    a. Utility CASE Team: Ventilation rates will increase for classroom space types.
20. Steve Taylor (Taylor Engineering): ASHRAE 62.1 ventilation rates are lower than Title 24 ventilation rate in all building types except schools. Since you are revising the ventilation rates, you could choose to leave the rates for schools untouched and still higher than the ASHRAE 62.1 rate.
21. Chris Walker (CAL SMACNA): Increased ventilation without mechanical filtration of outdoor air goes backward on IAQ for schools. What triggers exist in the proposal for mechanical filtration?
22. Peter Simmons (Building and Systems Analytics): Have the proposed changes been substantiated with calculations? Are the proposals for buoyance or wind driven natural ventilation (slide 48)?
23. Dan Johnson (Beyond Efficiency): Do the current Title 24, Part 6 requirements for window switch interlock with zone HVAC apply to every window on the facade? Just one window?
    a. Gina Rodda (Gabel Energy): All operable openings in the space in which the thermostat resides. This is prescriptive and can be "traded" away via the performance approach.
    b. Dan Johnson (Beyond Efficiency): This is not implemented in compliance software.
24. Peter Simmons (Building and Systems Analytics): The ASHRAE 62.1 committee is working on new calculations for naturally ventilated spaces.
25. Glenn Savage (LG Electronics): Packaged unit efficiency are tested at 0.4 inches water gauge (W.G). There may not be good understanding of how much the additional static pressure impacts efficiency.

26. Steve Taylor (Taylor Engineering): The calculations for the multiple-space equation (MSE) with VAV are way more complex than single-space VAV systems. There is a proposed addendum to ASHRAE 62.1 for a MSE that provides pre-calculated rates. The proposed addendum should be part of the Title 24, Part 6 proposal. We also find that designers are way more conservative than they need to be, in part, because the calculations are quite complex. The simplified approach can help address the tendency for engineers to be overly conservative.
    a. Anna Brannon (Utility CASE Team): This would be an alternate approach?
    b. Steve Taylor (Taylor Engineering): Yes.
27. Mike Hodgson (ConSol): The Warren Alquist Act only mentions IAQ in Section 25402.1(d). The Warren Alquist Act only requires the Energy Commission to conduct a pilot project to calibrate and identify changes to modeling assumptions to evaluate the impact of the Standards on energy savings, cost effectiveness and the effect on IAQ. It is difficult to understand from the Warren Alquist Act that the Energy Commission has a mandate to control IAQ. Has the Warren Alquist Act been updated to require the Energy Commission to regulate IAQ?
    a. Jeff Miller (Energy Commission): We have worked with our attorneys to develop a full written accounting of the Energy Commissions' responsibility and authority to regulate indoor air quality. We can share this write-up with stakeholders. There are a variety of considerations apart from Warren Alquist that factor in to our authority and responsibility to regulate indoor air quality.
        i. Utility CASE Team: The Energy Commission's memo is available for review here: http://title24stakeholders.com/wp-content/uploads/2017/04/IndoorAirQualityRegulationCaliforniaTitle24EnergyCommissionAuthorityResp....pdf
    b. Mike Hodgson (ConSol): I am not arguing that the Energy Commission has authority, but it is not appropriate to reference Warren Alquist as the justification.
    c. Dan Johnson (Beyond Efficiency): Doesn't the California Building Code (CBC), Section 1203 already regulate IAQ?
        i. Mark Alatorre (Energy Commission): That section of the CBC references the mechanical code (Part 4). The mechanical code then references Part 6. We do have a plan to try to make this less confusing.