DOCKETED	
Docket Number:	21-BSTD-01
Project Title:	2022 Energy Code Update Rulemaking
TN #:	238341
Document Title:	QC Manufacturing, Inc. Comments - on Decarbonization and Improper Whole House Fan Airflow Software Derating
Description:	N/A
Filer:	System
Organization:	QC Manufacturing, Inc.
Submitter Role:	Public
Submission Date:	6/21/2021 1:54:39 PM
Docketed Date:	6/21/2021

Comment Received From: QC Manufacturing, Inc.
Submitted On: 6/21/2021
Docket Number: 21-BSTD-01

on Decarbonization and Improper Whole House Fan Airflow Software Derating

Additional submitted attachment is included below.

June 20, 2021

California Energy Commission
Docket Unit, MS-4
1516 Ninth Street
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docket@energy.ca.gov

Re: Docket 21-BTSTD-01 Decarbonization and Improper Whole House Fan Airflow Software Derating

Submitted by: Andy Llora / Richard Fayad

QC Manufacturing, Inc.

The following comments are submitted in order to voice our comments and concerns regarding the set of airflow deratings applied in whole house fan models in CBECC res software, some of which has been in effect since before 2019 code, but the cumulative effects created drastic impacts on the whole house measure when 2019 code became effective due to the addition of the WHF HERS verification. These matters must be addressed if Decarbonization efforts are to be taken seriously.

Prior to 2019 code HERS verifications, the following airflow derating s are being applied to the WHF models prior to the cfm/watts being sent to the physics engine:

- Airflow Degraded by +67% based on the assumption that only 1/3 of homeowners will open windows for cooling purposes.

In addition to the above software degradations applied to WHF airflow, the addition of 2019 code HERS resulted in a 3rd degradation of airflow:

- Airflow degraded by 67% if no HERS verification is applied to the performance model.

Using the above computations, a model for a 2000 sq ft home, with a proposed WHF of 3000cfm, will be derated as follows:

1st Derating: 3000 * .33 = 990 CFM
2nd Derating 990 * .33 = 327 CFM

The resulting airflow CFM of 327 cfm is 5-ton sent to the physics engine for computations to evaluate the cooling AC offsets of the whole house fan. This mathematically implies to the physics engine that if no HERS test is performed, the home will be receiving only 1/10th of the airflow rate and cooling power of the whole house fan, and this is mathematically not correct, resulting in little to no compliance losses/gains for the addition/removal of a whole house fan system.

When we inquired in 2019 about the first derating, the CEC stated they used the 2006 LBNL report Ventilation Behavior and Household Characteristics in New California Houses, from which they determined that only 1/3 of occupants would open their windows for cooling purposes.

We inquired with LBNL as to whether their report in fact claims this, and they stated it does not. They directed me to these tables:

Table 5A: Reasons for Opening Windows: Statewide Probability Sample

Reasons to open windows (Percent, adjusted by sampling weight) Sacramento Area, Southern California, Rest of State, **Total**	Very Important	Somewhat Important	Slightly Important	Not at all important	Never open for this reason
Cool the house	55,62,57,**59**	21,25,22,**23**	11,8,10,**10**	4,1,3,**3**	7,4,6,**6**

Using the sum of the two left columns, the statewide probability that a homeowner will open up their windows for cooling purposes is 59 + 23 = **82% are likely to open their windows for cooling purposes.**

Table 5B: Reasons for Opening Windows: Builders' Sample

Reasons to open windows (Percent, adjusted by sampling weight) Sacramento Area, Southern California, Rest of State, **Total**	Very Important	Somewhat Important	Slightly Important	Not at all important	Never open for this reason
Cool the house	52,53,46,**50**	27,11,25,**21**	0,16,14,**11**	0,5,7,**5**	20,16,7,**13**

Using the sum of the two left columns, the statewide probability that a homeowner will open up their windows for cooling purposes is 50+21 = **71% are likely to open their windows for cooling purposes.**

In light of this corrected information, the initial derating of homeowner usage should be changed from 67% to 33%, to properly reflect that 2/3 of homeowners are willing to open their windows for home cooling, not 1/3 as what is currently being used.

As for the second derating, the derate is already baked into the algorithm, and the software applying it in again at runtime. This is a crucial point. The original WHF/Cool Vent field-tests prior to 2013 code that formed the basis of the WHF credit took nominal air-fan speed, and tested real-install (after static pressure losses) performance to correlate the performance credit as per the nominal fan speed. Now in addition, removal of the HERS verification derates from nominal to something lower (to account for static pressure losses), while still applying the same algorithm that already has the static-pressure loss baked in. They didn't test in the field what happens when you have 3,000 cfm flowing through the home from a nominal 3,000 CFM fan that has no static pressure. They tested what happens when a nominal 3,000 CFM fan is installed but only pushes out 2,000 or so because the attic blocks flow.

This change of WHF sizing from 2013/2016 to 2019 code now has drastic impacts on causing WHF to be oversized just for a very small amount of EDR compliance, because the software model which was built years ago, is expecting higher CFMs of fans with no live static pressures, so a field verified cfm value that is modelled simply produces little compliance gains.

These two deratings of the WHF, is causing following conditions to be in effect for this measure which need to be addressed:

1. **Compliance gains for multiple stories are improperly computed**
   In 2013 and 2016 code, 3 story > 2 story > 1 story compliance for WHF.
   In 2019 Code 1 story > 2 story > 3 story, the computations are erroneous and backwards in relation to cooling savings based on stories.
   Due to heat rising, and a WHF being mounted on the highest floor, it is well understood than whole house fans work better in homes with more stories, and serve a better overall task of creating a balanced air temp across the entire home.

2. **WHF must now be oversized, and this violates the concepts of right-sized equipment practices of Manual J, D, S.**
   2013/2016 sizing was based on lab certified CFM of WHF to sq footage of home.
   2019 sizing must now be based on field verified CFM (much lower) of WHF to ratio of home.
   This results in larger fans, or multiple fans being required just to get 0.5-2 EDR
   This has made the measure cost prohibitive to builders previously very satisfied with the measure costs.
   Additional fans are not proven to be more effective, and homeowner simply does not need that much CFM or venting.

3. **More EDR gains are allocated to the WHF, than the prescriptive WHF measure and equipment installation**
   0.5 EDR is allocated for a default WHF with no HERS.
   Specified WHF + HERS yields 1-3 EDR in climate zones 8/10/12
   It is illogical and mathematically incorrect for the software to imply that a verified WHF yields better cooling offsets than the same fan specs, with no HERS test.
   It is the only measure where the HERS test is greater than the installation of the measure itself.

4. **Removal of the WHF prescriptive measure, does not result in a proper deficit**
   Removal of the WHF prescriptive measure, does not result in an EDR deficit in CZ 9, 11,13-14.
   Only removal in CZ 8/10/12 receive a deficit.
   If prescriptively required in CZ 8-14, a deficit should be applied in software when it is removed from the model in CZ 8-14.

Decarbonization Considerations:

- Per American Journal of Engineering (AJER) 2013 Study
- The carbon component emitted by the use of a **2-ton A/C** per day emission of carbon is 5344 g.
- For 5 summer months, that totals 800kg for a single home, or 8,000,000kg for 10,000 homes
- Installation of a WHF reduces AC usage by 50-90%. This is the only measure able to claim such vast amounts of cooling offsets.

Estimations of Decarbonization Results

- In 2020 QuietCool was installed in over 20,000 new homes in CA new construction alone
- Reducing the carbon footprint of CA new homes by 8,000,000 kg assuming only 50% of A/C usage was reduced.
- That is very conservative, considering CA homes have a 5-ton system on average, and homeowners experience more than 50% A/C usage reduction.
- That is 8 million metric tons of decarbonization that can be attributed to whole house fans in new homes built to 2016 code.

This measure is being removed from many projects in 2019 code due to the errors listed above, and the result will be increased loads on the grids during peak hours, and an increase in carbon footprint of new homes in CA across the state.

If the Commissioner, the CEC, and the statewide sustainable design agencies truly wish to make significant efforts in the decarbonization of residential new homes, they must start by repairing the improper calculations on whole house fans in CBECC res software, which is allowing this highly beneficial, prescriptive measure to be removed with no consequences to the computations of compliance.

Sincerely,

Andy Llora

New Construction Sales Manager

QC Manufacturing, Inc.