Testimony Regarding Montgomery County Department of Permitting Services Proposal to Adopt the 2012 International Residential and Energy Conservation Codes

The Montgomery County Energy and Air Quality Advisory Committee intends to submit a detailed testimony before the record of this hearing closes. Today we submit a summary of that testimony.

Executive Summary

I am testifying on behalf of the Montgomery County Energy and Air Quality Committee (EAQAC.) We are 15 county residents who have professional knowledge and experience (in many disciplines) and with both topics under our ordinance.

Our testimony is about a glaring pair of interrelated problems which **will have the unintended and counterproductive effects of: (1) not providing sufficient fresh air to protect human health and (2) causing an increase in energy demand**. These problems would be unintended consequences of the adoption of the new versions of the International Residential Code (IRC) and the International Energy Conservation Code (IECC) which specify aspects of the design of new homes.

The 2012 IECC would impose a new tightness standard for building enclosures which reduces air infiltration and was intended to save energy. The 2012 IRC would, for the first time, require tight homes to be supplied with outside air via mechanical ventilation. Taken together, these two codes would **not provide sufficient air to protect human health**. As well, these two codes **will have the unintended and counterproductive effect of causing an increase in energy demand**, as compared to the existing 2009 codes.

The inadequate ventilation proposed in the IRC results from errors in the underlying calculations. Energy costs increase because the energy savings from a "tighter" house are more than offset by the energy costs from mechanical ventilation. Today we propose amendments to the proposed codes that would resolve most of the problems that we have found.

The Two Problems

1. Energy Demand Regarding Outside Air

With respect to the problem of air infiltration, the two codes, taken together, actually increase energy demand (relative to the 2009 codes). This is not an intended consequence, but it is true.[1] The 2012 IECC does indeed tighten the building enclosure from 7 ach@50PA (in the 2009 IECC) to 3 ach@50PA. This is approximately equivalent to reducing annual average air infiltration from 0.35 air exchanges per hour to 0.15 air exchanges per hour. By itself, this change would decrease heating and cooling energy demand.

But, the building tightness specified in the IECC is so tight that the amount of outside air that would reach homeowners would be quite insufficient. So, the IRC for the first time requires single family homes to be mechanically ventilated. Mechanical ventilation requires electricity. A fair accounting of increasing building tightness must include this mechanical ventilation energy. Simple analysis shows that the amount of electricity used to provide mechanical air to a house is greater than the savings from tightening the building enclosure.

[1] The new IECC may well reduce overall energy demand in a compliant house. But, that reduction will be less than expected when one properly accounts for the cost of moving the right amount of mechanical air.

A detailed chart is shown in the appendix. Our basic conclusion is that **there is no net energy savings from tightening the building envelope to below 5@50PA .**

2. Air Quality

The second problem is that the amount of fresh outside air to be supplied to houses built to the **proposed 2012 IRC is insufficient for human health**. Fresh air entering these homes includes some mechanical ventilation air required by the 2012 IRC. (We re-print this table in the appendix.) and some infiltration of outside air (albeit reduced in these "tight" home). But, the total amount of mechanical air and the residual infiltration (which involves a formula not shown here) will be insufficient for human health purposes.

We have analyzed this issue using assumptions, standards, and related methods that are mainstream. For instance we used the ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) definition of sufficient outside air. The inadequate ventilation specified by the IRC results from their incomplete their understanding of natural ventilation in very tight homes with mechanical ventilation. The result of this analysis is **that homes built to the two new standards would be under-supplied, on the average by 20-25%**, depending on house size. To rectify this part of the problem, the amount, and therefore the cost, of mechanical ventilation air would have **to be increased by 60%** in the "tightest" homes**.**

3. Problems Taken Together

If we adopt the codes as written, there will still be an energy penalty and insufficient amounts of fresh air. If required mechanical airflow is increased to meet human health needs, the energy penalty discussed in the preceding section be further increased.
Thus, the requirement for mechanical ventilation air either:

- Leaves homeowners with insufficient fresh air for their family to breathe or
- If the fresh air problem is rectified mechanically, drives us further from the overall energy goal of saving energy.

The root of the problem is the requirement for whole-house mechanical ventilation and the specific ventilation rates in the IRC, in combination with the requirement for very tight building shells in the IECC.

In the next section our committee, EAQAC proposes specific language changes in both the 2012 IRC and 2012 IECC proposed codes to largely solve the twin and coupled problems of lower air quality and higher energy demand they would cause (if adopted without change)

Proposed Solutions to the Two Problems (see diagram on next page for an overview)
It is essential be provide builders with options for housing shells having different tightness. Since the tightness must be assessed after the house is built, builders must have options so that they can meet code even if the measured tightness differs somewhat from the tightness they proposed at the design stage. We propose that builders be allowed three options, which differ with respect to "tightness" of the homes they build.

1) "No mechanical air" option – This is our preferred option because it achieves adequate ventilation at the lowest cost (and greatest energy savings)

> This option would apply to houses in the tightness range 5.0-5.25 ach@50Pa. This option would allow a builder not to have to install mechanical ventilation equipment and for the homeowner not to have to pay an increased operating cost for the electricity to run such equipment. This option would provide the house with sufficient outside air for human health purposes. It would be allowed by amending the IECC and IRC requirements to allow homes with tightness up to 5.25 ach@50 Pa.

2) "Small mechanical air" option - The option is the closest to the current proposed codes

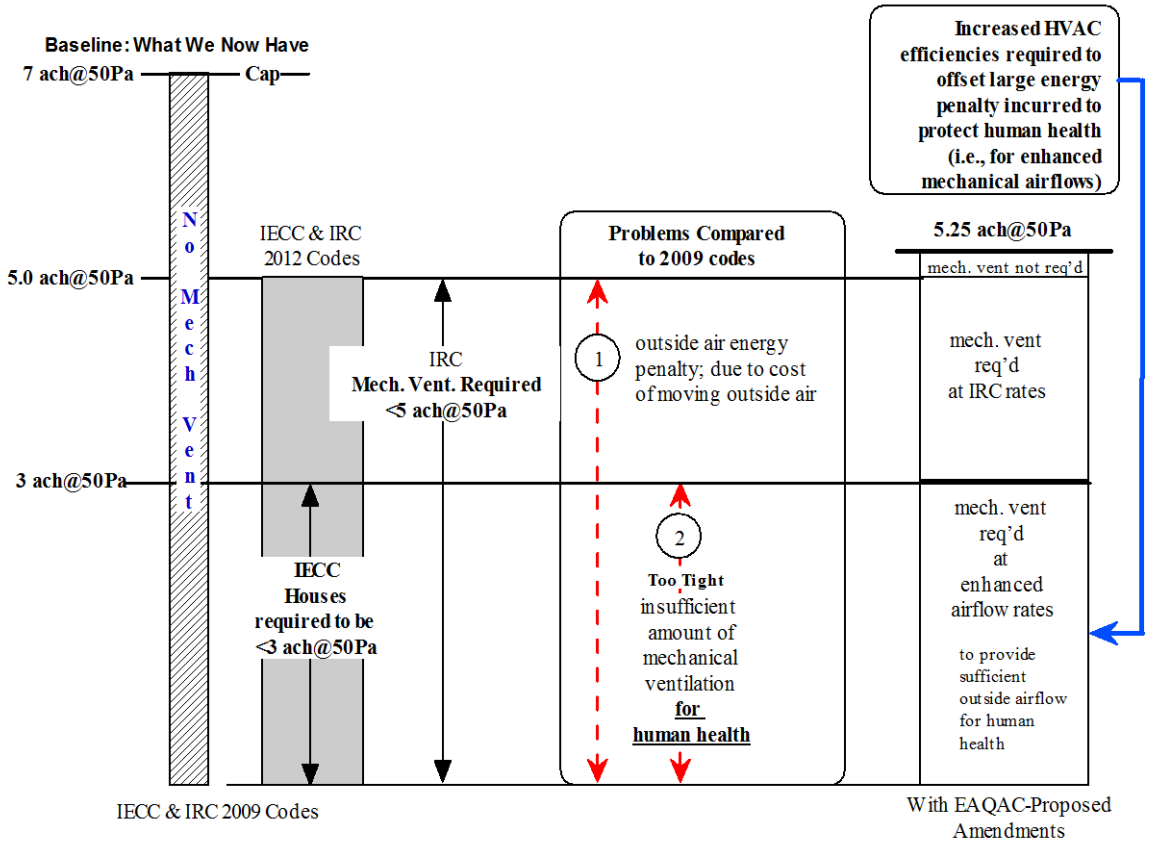
> This option would apply to houses in the tightness range 3.0-5.0 ach@50Pa. In this option, houses would have to have whole-house mechanical air and the amount of mechanical air would be as specified in the IRC-2012 Table M1507.3.3 (1). In this range of building tightness, there would be sufficient total mechanical and infiltrated air to provide for human health. This option entails a net energy penalty (relative to option 1) for using electricity to run a mechanical ventilation system. This option would require amendments to the IRC and to the IECC.

3) "Big mechanical air" option – This option achieves the "tightest" house but with the biggest energy penalty. This large energy penalty needs to be offset and we propose how to do this. It requires additional mechanical ventilation beyond that specified in 2012 IRC.

> This option would apply to houses in with tightness < 3.0 ach@50 Pa. The amount of mechanical air called for in IRC-2012 Table M1507.3.3 (1) is too small by 23-36%, depending on the tightness of the building. For such houses a modified form of Table M1507.3.3 is needed to meet human health needs. Insofar as the net energy penalty for using a larger airflow mechanical ventilation system would be larger, this option would require an additional energy demand action to offset this net energy penalty. We propose that the county amend the IECC to explicitly permit builders to install heating and cooling equipment that exceeds prevailing federal minimum efficiencies. We propose changes to both the Prescriptive and Performance options found in the IECC-2012 to accomplish this purpose.

In the following pages we present the formal amendments needed to implement our proposed solution. Please keep in mind that **"The root of the problem is the requirement for whole-house mechanical ventilation and the specific ventilation rates in the IRC, in combination with the requirement for very tight building shells in the IECC."**

Mo. Co. Energy & Air Quality Advisory Committee Proposed Amendments to 2012 IRC and IECC Codes



Proposed Amendments to the 2012 International Residential Code (IRC)

Amendment 1:
Adopt the following amendment to Table M1507.3.3 (1) found in Chapter 15 of the IRC. The amendment would retain the existing Table M1507.3.3(1) [Relabeled Table M1507.3.3(1-1)] for air exchange rates between 3 and 5 ach@50 Pa and would add a Table M1507.3.3(1-2) for use in those houses built to air exchange rates of less than 3 ach@50 Pa.

Amendment: Delete words as shown; add words as shown

Chapter 15 M1507.3.3 Mechanical ventilation rate

~~The whole-house mechanical ventilation system shall provide outdoor air at a continuous rate of not less than that determined in accordance with Table M1507.3.3(1).~~

Add
The whole-house mechanical ventilation system shall provide outdoor air at a continuous rate of not less than that determined in accordance with Table M1507.3.3(1-1) for houses whose air exchange rate, measured by a blower door test performed in accordance with Section R402.4.1.2 the 2012 International Energy Conservation Code, is greater than 3 and less than 5 ach at 0 .2 inches w.g.(50 Pa).

For houses whose air exchange rate, measured in the same manner, is less than or equal to 3 ach@0.2 inches w.g. (50 Pa), the whole-house mechanical ventilation system shall provide outdoor air at a continuous rate of not less than that determined in accordance with Table M1507.3.3(1-2).

Exception: The whole-house mechanical ventilation system is permitted to operate intermittently where the system has controls that enable operation for not less than 25-percent of each 4-hour segment and the ventilation rate prescribed in Tables M1507.3.3(1-1) or Table M1507.3.3(1-2) is multiplied by the factor determined in accordance with Table M1507.3.3(2).

Add New Table M1507.3.3 (1-2)

Table M1507.3.3 (1-2)

FLOOR AREA (square feet)	**NUMBER OF BEDROOMS**				
	0-1	2 – 3	4 – 5	6 – 7	> 7
	Airflow in CFM				
< 1,500	50	70	95	120	145
1,501 – 3,000	70	95	120	145	165
3,001 – 4,500	95	120	145	165	190
4,501 – 6,000	120	145	165	190	215
6,001 – 7,500	145	165	190	215	240
> 7,500	165	190	215	240	265

Amendments to 2012 International Energy Conservation Code (IECC)

Amendment 1
In the Prescriptive Option, we propose adopting an amendment that would delete the strike-through language and substitute the following language.

R402.4.1.2 Testing
~~The building or dwelling unit shall be tested and verified as having an air leakage rate of not exceeding 5 air changes per hour in Climate Zones 1 and 2, and 3 air changes per hour in Climate Zones 3 through 8.~~ Testing shall be conducted with a blower door at a pressure of 0.2 inches w.g. (50 Pascals). Where required by the *code official,* testing shall be conducted by an *approved* third party. A written report of the results of the test shall be signed by the party conducting the test and provided to the *code official.* Testing shall be performed at any time after creation of all penetrations of the *building thermal envelope*

Rather than the current language
Substitute Language
The building or dwelling unit shall be tested and verified as having an air leakage rate of not exceeding 5.25 air changes per hour.

Amendment 2
In the Performance Option, we propose adopting an amendment that would modify Table R405.5.2 (1) in this manner.

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
air leakage rate	Air leakage rate of 5 air changes per hour at a pressure of 0.2 inches w.g. (50Pa) If air leakage rate as tested is less than 3 air changes per hour as a pressure of 0.2 inches w.g. (50 Pa), then the mechanical airflow rates shall be no less than: $0.015 \times CFA + 11.25 \times (N_b + 1)$ where: CFA = conditioned floor area N_b = number of bedrooms Energy recovery shall not be assumed for mechanical ventilation.	For residences that are not tested the same air leakage rate as the standard reference design. For tested residences, the measured air exchange rate[c] The mechanical ventilation rate shall be in addition to the air leakage rate and shall be as proposed

We also propose amending footnote g to Table R405.5(1) as follows:

As written
Heating systems[f, g] As proposed for other than electric heating without a heat pump. Where the proposed design utilizes electric heating without a heat pump the standard reference design shall be an air source heat pump meeting the requirements of Section R403 of the IECC—Commercial Provisions. Capacity: sized in accordance with Section R403.6 As proposed.

Add this language
Exception: In that case, the design requires a higher efficiency heating system to offset the increased energy demand of the higher mechanical air ventilation rate.

g. For a proposed design without a proposed heating system, a heating system with the prevailing federal minimum efficiency shall be assumed for both the standard reference design and proposed design.

Proposed amendment
g. For a proposed design without a proposed heating system, a heating system with the prevailing federal minimum efficiency shall be assumed for both the standard reference design and proposed design unless increased energy demand incurred by use of an air exchange rate of 3 ach@50 Pa or less and the installation of whole-house mechanical ventilation equipment to satisfy the requirements of the Table M1507.3.3(1-2) is installed. In that case, the design requires a higher efficiency heating system to offset the increased energy demand of the higher mechanical air ventilation rate.

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Appendix

Results of Energy Impact Study

The following table reports the findings of an energy study regarding a model house that was subjected to rigorous analysis under two sets of codes:

IRC-2009 and IECC-2009
IRC-2012 and IECC-2012

The study methodology was to compute airflow and energy demands using:

- IRC and IECC requirements and building physics for air flows
- Weather for the past four years from a local Gaithersburg weather station
- IECC-2012 formulas for electrical energy use for mechanical air
- Current natural gas and electricity marginal costs
- A model house consisting of 3,000 sf of occupied space, 9 ft high ceilings, 4 bedrooms, and a gas/forced air furnace and air conditioning equipment that meets prevailing federal government requirements

The premise of the changes to the IECC regarding air infiltration is that tighter houses would necessarily lead to reduced energy demand, because there would be less air to heat and cool. The premise is not true because there is a significant, and not offset, energy penalty to bring outside air inside mechanically to "compensate" (at least partially) for the loss of natural infiltration.

The following table presents results from four cases:

Case 1: Comparison between model code years 2009 and 2012 for model house with the 2012 mechanical air system being run 100% of the time

Case 2: Same as Case 1 except ventilation system run only 50% of the time

Case 3: Same as Case 1 except mechanical airflow boosted in such a manner that the total outside airflow provides the full amount of outside air to meet ASHRAE's statement regarding sufficiency for homes.

Case 4: Same as Case 3 except ventilation system run only 50% of the time

Energy Analysis Results

Case No.	Description of Case	Total Costs	Costs to Condition	Costs to Move Mech. Vent. Air
Case 1				
2009	IRC & IECC as written	$340	$340	NA
2012	Codes as written; MV[a]-100%	$482	$216	$266
Difference		**($142)**		
	Savings?	NO		
Case 2				
2009	IRC & IECC as written	$340	$340	NA
2012	Codes as written; MV[a]-50%	$402	$180	$222
Difference		**($62)**		
	Savings?	NO		
Case 3				
2009	IRC & IECC as written	$340	$340	NA
2012	Enhanced MV: MV-100%	$612	$258	$354
Difference		**($272)**		
	Savings?	NO		
Case 4				
2009	IRC & IECC as written	$340	$340	NA
2012	Enhanced MC:MV-50%	$479	$202	$277
Difference		**($139)**		
	Savings?	NO		

Note: Non-linearites in this table are a consequence of the underlying building physics

[a] MV = mechanical ventilation air