FLORIDA SOLAR ENERGY CENTER®

Creating Energy Independence

Oh No! Inconsistency in Calculating RESNET/ICC Energy Rating Index for 2018 IECC Compliance

RESNET Building Performance Conference

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2018 IECC R406.3 Specification

R406.3 Energy Rating Index. The Energy Rating Index (ERI) shall be determined in accordance with RESNET/ICC 301 except for buildings covered by the *International Residential Code*, the ERI Reference Design Ventilation rate shall be in accordance with Equation 4-1.

Ventilation rate, CFM = (0.01 × total square foot area of house) + [7.5 × (number of bedrooms + 1)]

(Equation 4-1)

The Principle Issue

- Section R406.3 of 2018 IECC reduces the Reference Ventilation rate (i.e. Air Exchange Rate) significantly below the Standard 301 Reference Air Exchange rate
- 2018 IECC definition:

  VENTILATION. The natural or mechanical process of supplying conditioned or unconditioned air to, or removing such air from, any space.

Reference Air Exchange Rates

- ANSI/RESNET/ICC 301:

  Qtot (cfm) = 0.03 * CFA + 7.5 * (Nbr+1)

- 2018 IECC R406.3 specification:

  Qtot (cfm) = 0.01 * CFA + 7.5 * (Nbr+1)

- For 2,000 ft^2, 3-bedroom, 1-story home:
  - ANSI/RESNET/ICC 301: Qtot = 90 cfm
  - 2018 IECC Sec. R406.3: Qtot = 50 cfm
  - Difference = 40 cfm or 44% reduction

Why This Matters

- Reduction of the outdoor air exchange rate in the Reference Home:
  - Reduces the total building load for the Reference Home (TRL = Total Reference Load)
- All other things equal, this causes the ERI/HERS Index to increase because TRL is the denominator of the "scoring fraction"

$$ERI = PEfrac * (TnML / TRL)$$

RESNET Study Design

- Two home compliance configurations
  - With photovoltaics (2015 IECC backstops)
  - Without photovoltaics (2009 IECC backstops)
- Sixteen different TMY cities encompassing all IECC climate zones
- Two different simulation sets:
  - Standard 301 ERI/HERS Index
  - 2018 IECC Compliance Index

Climate Impacts

- Temperature difference between indoors and outdoors is greater in colder climates
- Outdoor air exchange results in larger load and larger energy consumption implications in colder climates
- Expect impacts of the 2018 IECC Reference Home ventilation specification to be larger in cold climates than warm climates.

Climate Characteristics

LOCATION	IECC CZ	HDD_{65}	2018 IECC Index
Miami, FL	1A	150	57
Orlando, FL	2A	1,439	57
Houston, TX	2A	526	57
Phoenix, AZ	2B	997	57
Charleston, SC	3A	2,051	57
Charlotte, NC	3A	3,153	57
Ok. City, OK	3A	3,993	57
Las Vegas, NV	3B	2,301	57
Baltimore, MD	4A	4,631	62
Kansas City, MO	4A	5,434	62
Chicago, IL	5A	6,399	61
Denver, CO	5B	5,655	61
Minneapolis, MN	6A	7,783	61
Billings, MT	6B	6,732	61
Fargo, ND	7A	9,211	58
Fairbanks, AK	8	13,072	58

2/3rd Rule

- Air Exchange Rates (ANSI/RESNET/ICC 301)
  - Table 4.2.2(1) Note (f) requires that ANSI/ASHRAE Standard 62.2 Equation 4.6 be applied in both the Rated Home and Reference Home cases
  - ASHRAE 62.2 Equation 4.6:

    Qfan = Qtot – Qinf

    where:

    Qinf = infiltration rate which may be no greater than 2/3rd *Qtot*

High-Efficiency Homes

LOCATION	Outdoor Air Exchange Rates				
	ach50	wsf	Qinf	Qfan	Qtot
Miami, FL	7	0.41	46.6	43.4	90.0
Orlando, FL	7	0.42	47.7	42.3	90.0
Houston, TX	7	0.39	44.3	45.7	90.0
Phoenix, AZ	7	0.43	48.8	41.2	90.0
Charleston, SC	7	0.43	48.8	41.2	90.0
Charlotte, NC	7	0.43	48.8	41.2	90.0
Ok. City, OK	7	0.61	69.3	30.0	99.3
Las Vegas, NV	7	0.55	62.5	30.0	92.5
Baltimore, MD	7	0.50	56.8	33.2	90.0
Kansas City, MO	7	0.60	68.2	30.0	98.2
Chicago, IL	7	0.60	68.2	30.0	98.2
Denver, CO	7	0.63	67.0	30.0	97.0
Minneapolis, MN	7	0.63	71.6	30.0	101.6
Billings, MT	7	0.66	75.0	30.0	105.0
Fargo, ND	7	0.69	78.4	30.0	108.4
Fairbanks, AK	7	0.70	79.5	30.0	109.5

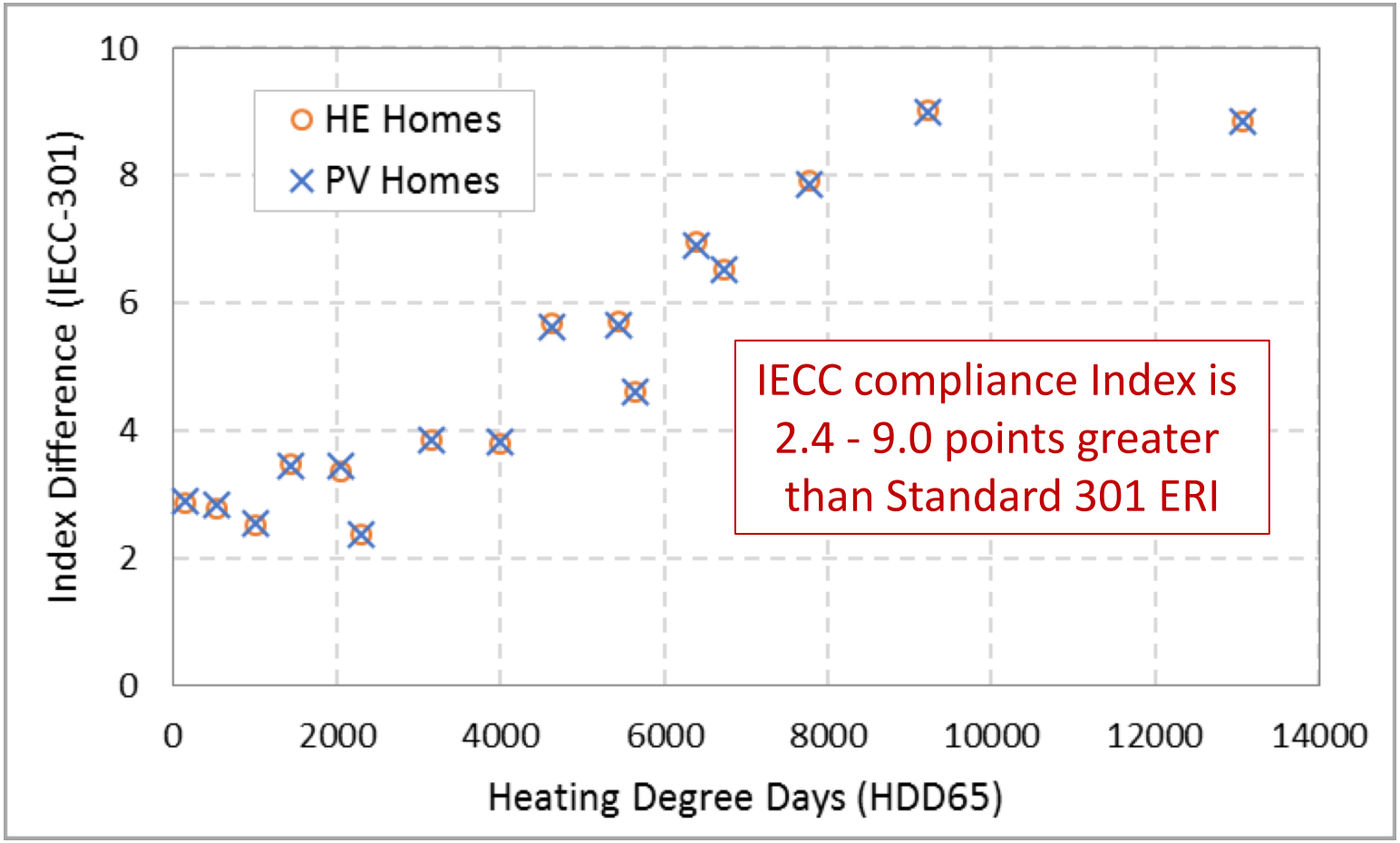
PV Homes

LOCATION	PV Watts	Outdoor Air Exchange Rates				
		ach50	wsf	Qinf	Qfan	Qtot
Miami, FL	1,275	5	0.41	33.3	56.7	90.0
Orlando, FL	1,350	5	0.42	34.1	55.9	90.0
Houston, TX	1,125	5	0.39	34.1	55.9	90.0
Phoenix, AZ	750	5	0.43	34.9	55.1	90.0
Charleston, SC	750	3	0.43	20.9	69.1	90.0
Charlotte, NC	750	3	0.43	20.9	69.1	90.0
Ok. City, OK	675	3	0.61	29.7	60.3	90.0
Las Vegas, NV	375	3	0.55	26.8	63.2	90.0
Baltimore, MD	1,275	3	0.50	24.3	65.7	90.0
Kansas City, MO	1,275	3	0.60	29.2	60.8	90.0
Chicago, IL	2,625	3	0.60	29.2	60.8	90.0
Denver, CO	1,950	3	0.63	28.7	61.3	90.0
Minneapolis, MN	2,550	3	0.63	30.7	59.3	90.0
Billings, MT	2,175	3	0.66	32.1	57.9	90.0
Fargo, ND	3,300	3	0.69	33.6	56.4	90.0
Fairbanks, AK	6,600	3	0.70	34.1	55.9	90.0

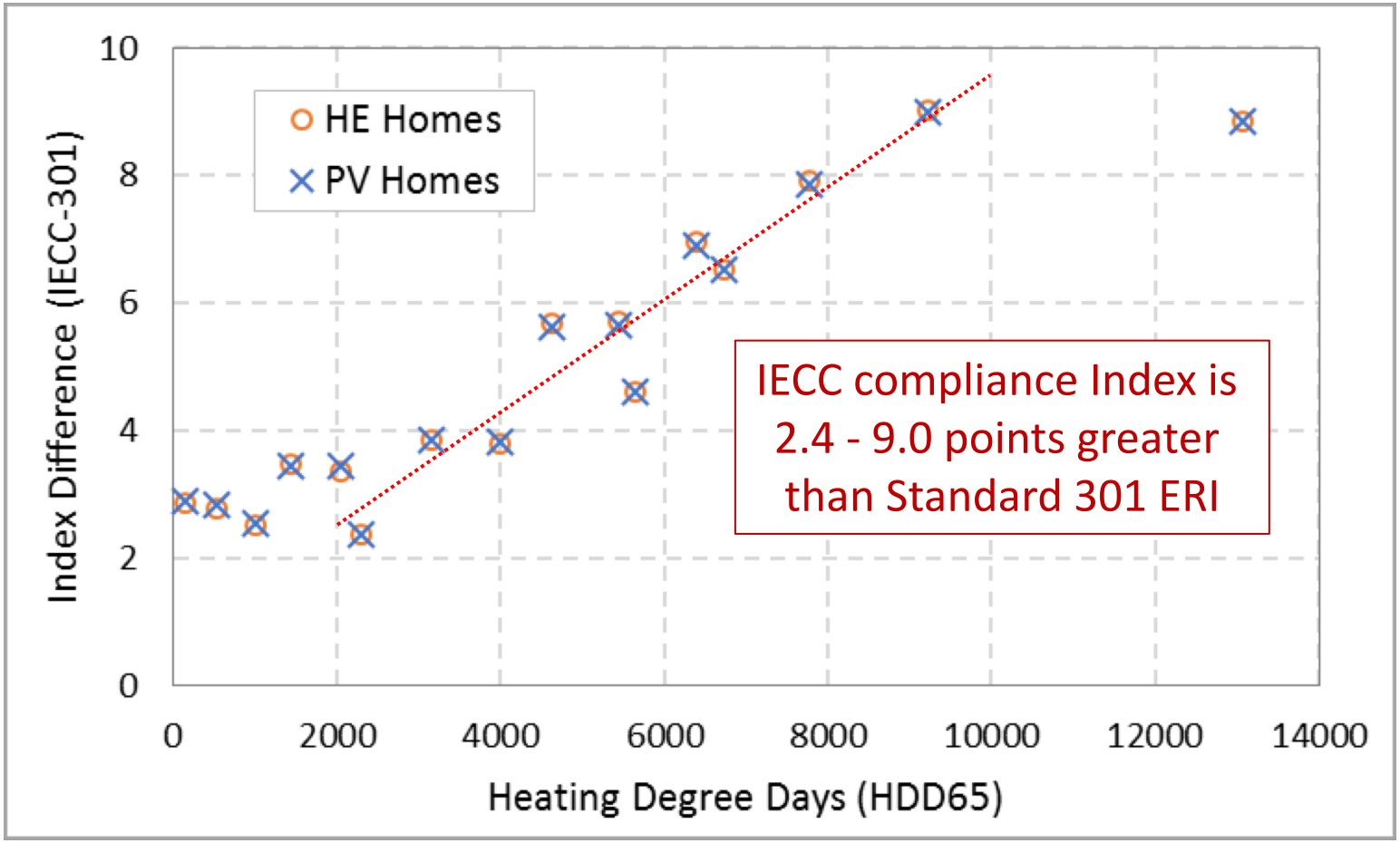
Other Home Characteristics

- PV Homes have 75% high-efficiency lighting, minimum standard HVAC and hot water systems and standard appliances
- HE Homes have 100% high-efficiency lighting, ENERGY STAR refrigerators, clothes washers, dryers and dishwashers and high efficiency HVAC and hot water systems
- All homes configured to meet minimum ERI requirements of their respective climate zones.

Rated Home Index Increases



Rated Home Index Increases



PV Home: Total Energy Consumption

City	Reference Homes			Rated Homes		
	301 HERS	2018 IECC	Delta MBtu	301 HERS	2018 IECC	Delta MBtu
Miami	54.2	52.5	-1.7	39.1	39.1	0.0
Houston	53.4	51.2	-2.2	38.5	38.5	0.0
Orlando	48.7	47.3	-1.4	35.1	35.1	0.0
Phoenix	60.2	58.3	-1.9	41.3	41.3	0.0
Charleston	57.0	54.6	-2.4	39.2	39.2	0.0
Charlotte	93.6	85.7	-7.9	62.1	62.1	0.0
Oklahoma City	115.7	106.5	-9.2	75.5	75.5	0.0
Las Vegas	83.7	79.2	-4.5	55.3	55.3	0.0
Baltimore	105.7	94.1	-11.6	78.7	78.7	0.0
Kansas City	120.3	107.5	-12.8	89.5	89.5	0.0
Chicago	125.1	109.9	-15.2	101.0	101.0	0.0
Denver	104.1	94.9	-9.3	86.0	86.0	0.0
Minneapolis	142.9	123.8	-19.1	111.8	111.8	0.0
Billings	123.5	109.1	-14.4	97.7	97.7	0.0
Fargo	165.3	140.1	-25.2	127.9	127.9	0.0
Fairbanks	225.5	193.0	-32.5	177.3	177.3	0.0

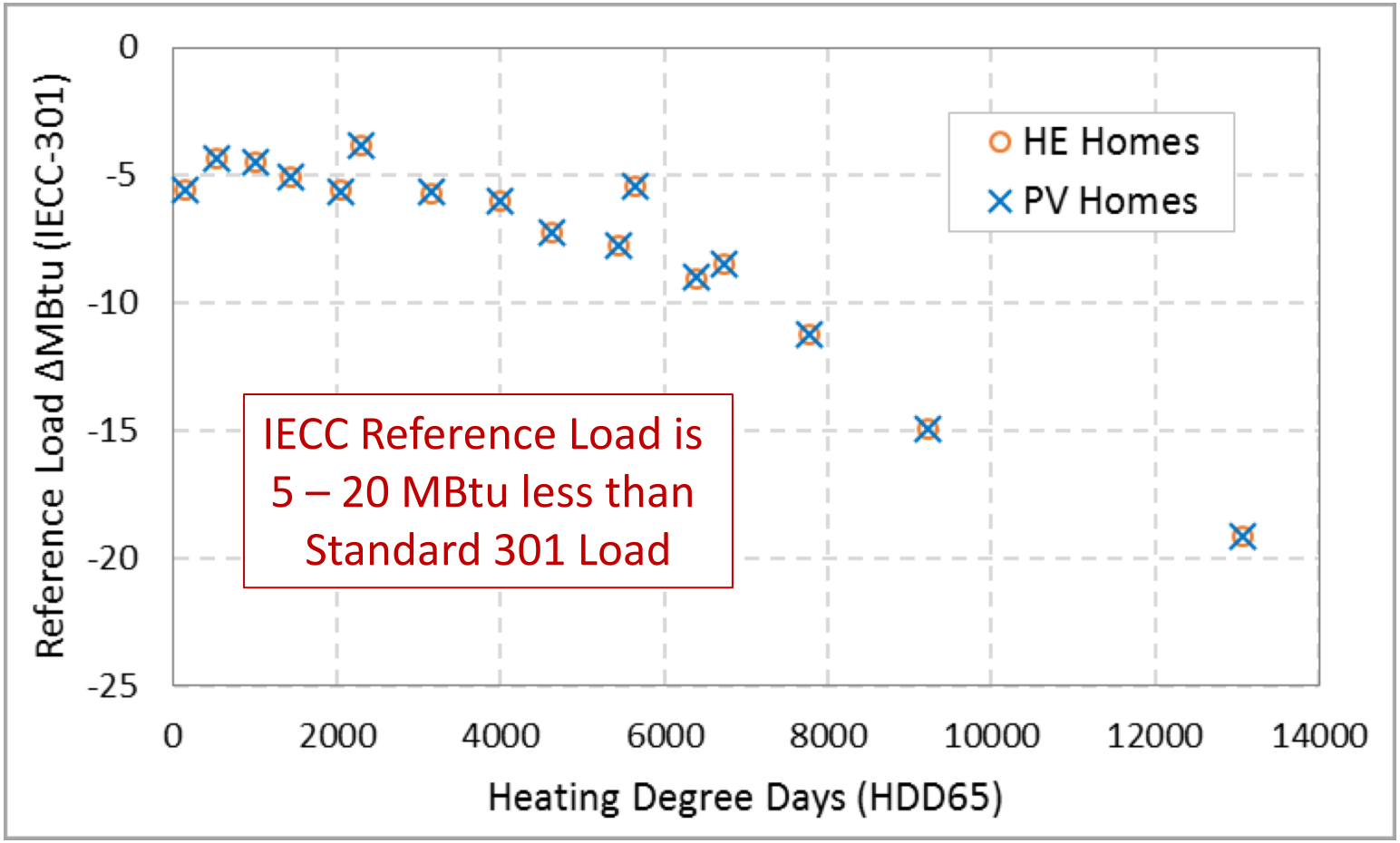
HE Home: Total Energy Consumption

City	Reference Homes			Rated Homes		
	301 HERS	2018 IECC	Delta MBtu	301 HERS	2018 IECC	Delta MBtu
Miami	54.1	52.5	-1.7	31.9	31.9	0.0
Houston	53.3	51.2	-2.2	31.4	31.4	0.0
Orlando	48.7	47.3	-1.4	28.6	28.6	0.0
Phoenix	60.1	58.3	-1.9	35.2	35.2	0.0
Charleston	56.7	54.3	-2.4	33.2	33.2	0.0
Charlotte	93.1	85.2	-7.9	57.4	57.4	0.0
Oklahoma City	115.2	105.9	-9.2	70.8	70.8	0.0
Las Vegas	83.0	78.5	-4.5	50.6	50.6	0.0
Baltimore	105.2	93.6	-11.6	70.1	70.1	0.0
Kansas City	119.7	106.9	-12.8	78.8	78.8	0.0
Chicago	124.6	109.4	-15.2	84.1	84.1	0.0
Denver	103.6	94.4	-9.3	69.6	69.6	0.0
Minneapolis	142.5	123.4	-19.1	95.7	95.7	0.0
Billings	123.1	108.8	-14.4	82.5	82.5	0.0
Fargo	164.9	139.7	-25.2	105.7	105.7	0.0
Fairbanks	225.2	192.7	-32.5	144.2	144.2	0.0

Findings

- Reference Home total energy consumption is substantially decreased by 2018 IECC ventilation specification
- Rated Home total energy consumption is unchanged by 2018 IECC ventilation specification
- Increase in Rated Home index is due entirely to Reference Home ventilation specification.

Reference Home Load Change

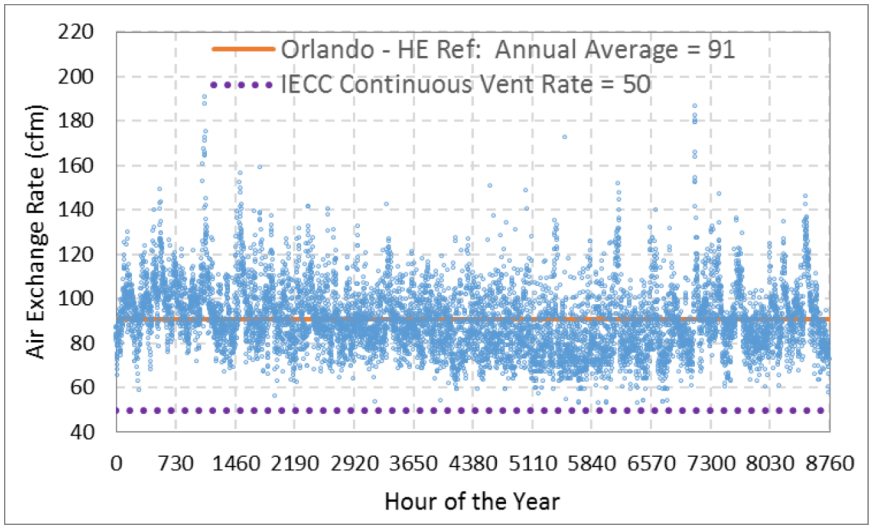


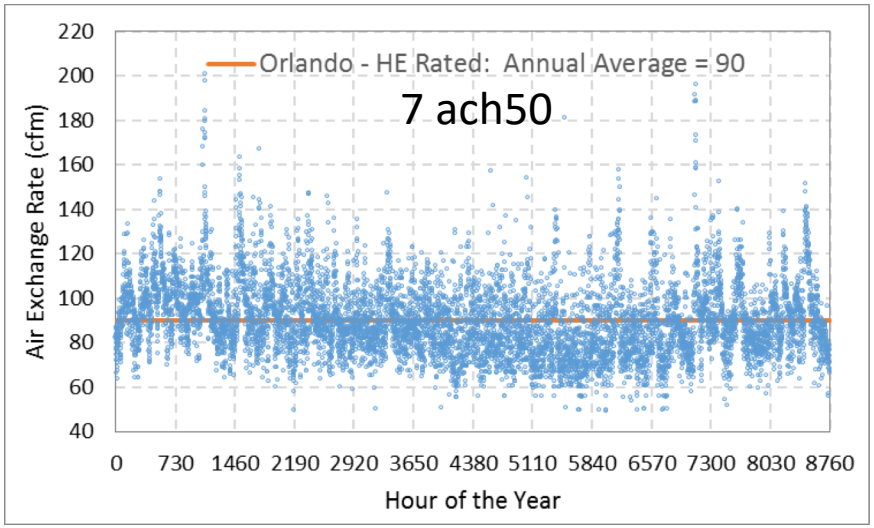
Total Reference Loads (TRL)

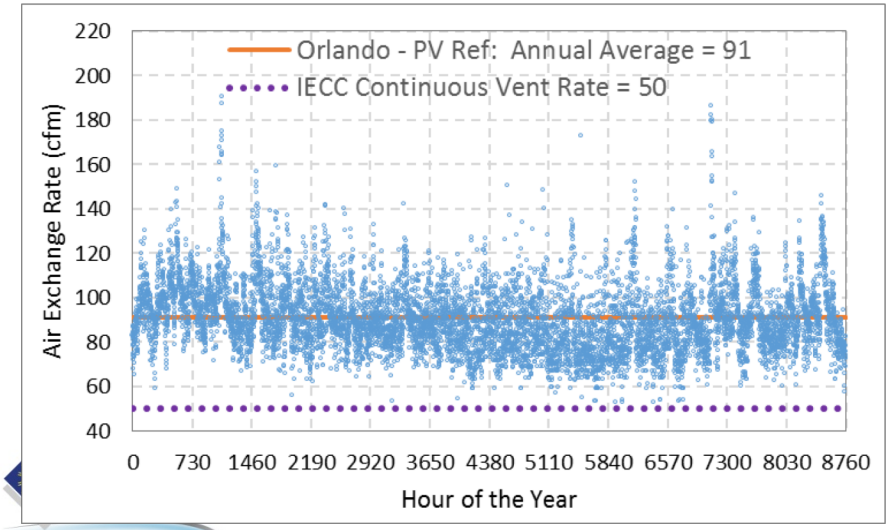
- Total Reference Home Loads (TRL) are reduced by 2018 IECC ventilation specification
- Entire load reduction stems from change in outdoor air exchange rate (~90 cfm > 50 cfm)
- Reductions in TRL can significantly increase calculated Index (TRL is denominator of "scoring fraction")

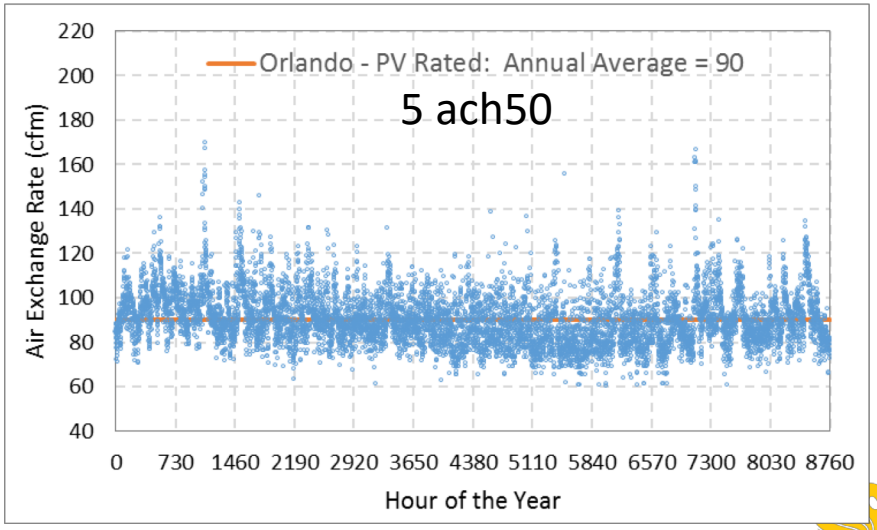
$$ERI = PEfrac * (TnML / TRL)$$

Air Exchange Rates: Orlando, FL

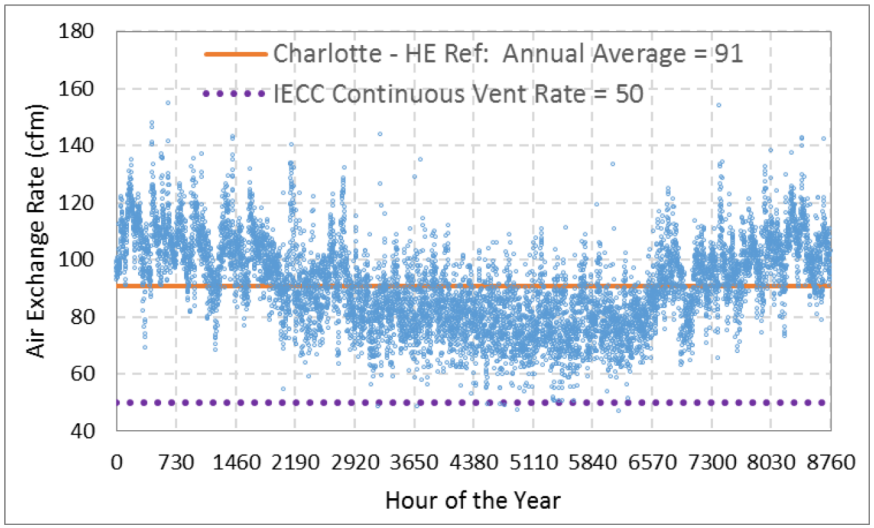


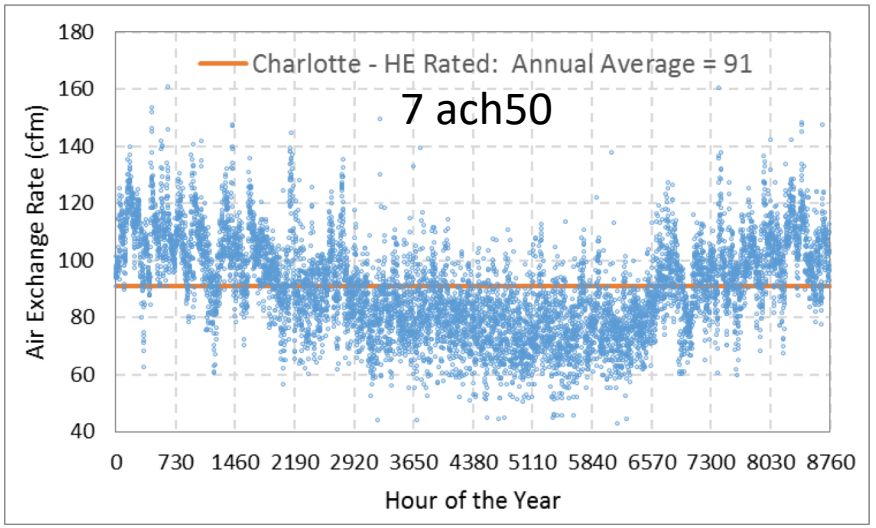


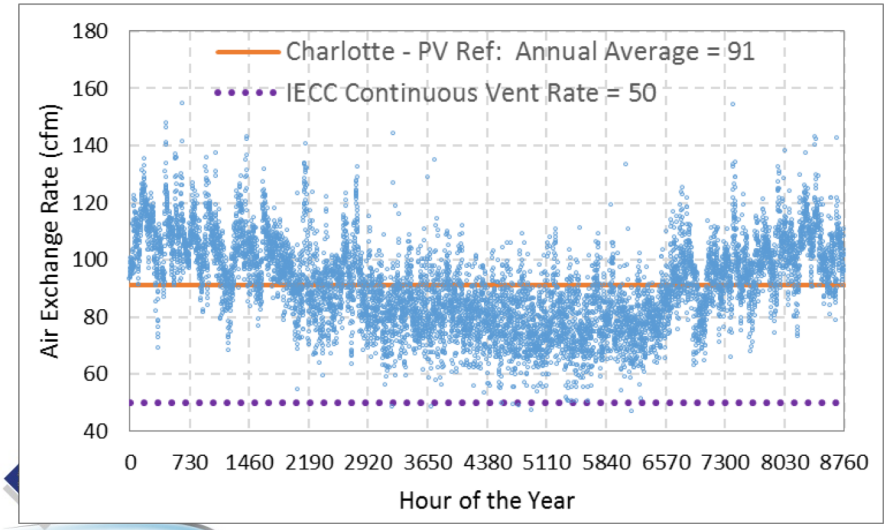


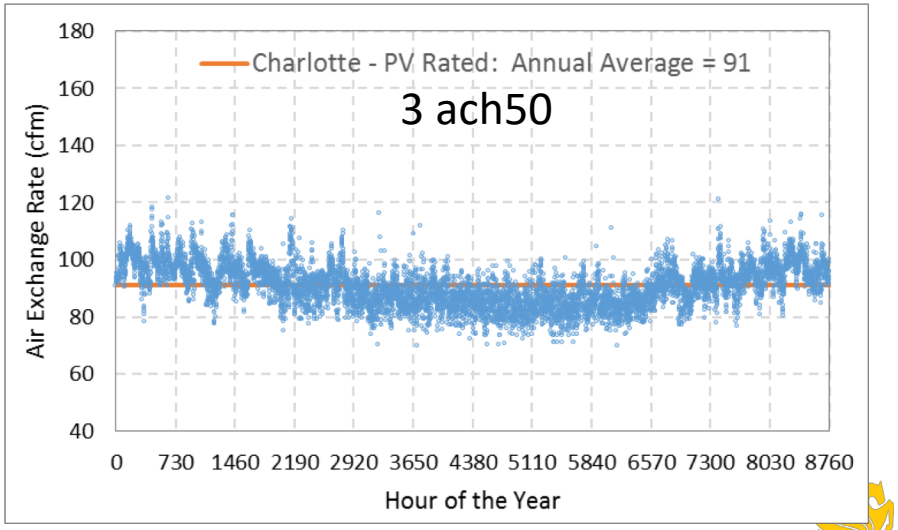


Air Exchange Rates: Charlotte, NC

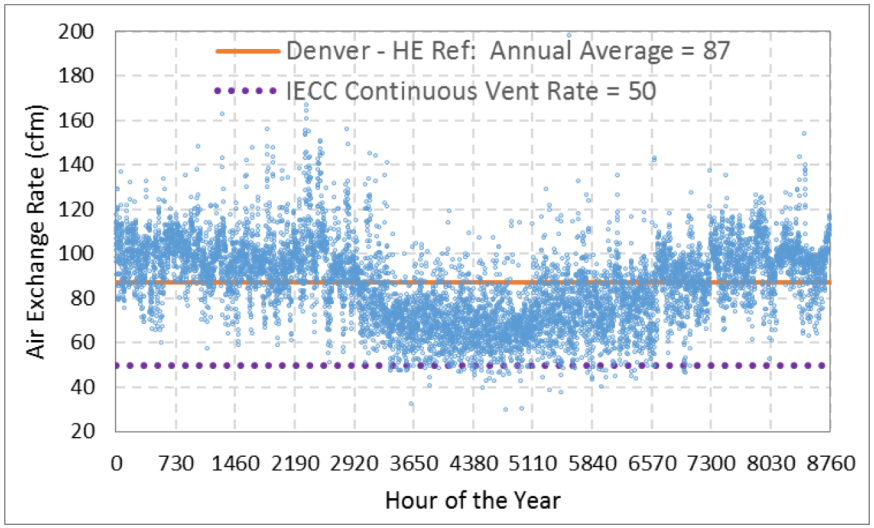


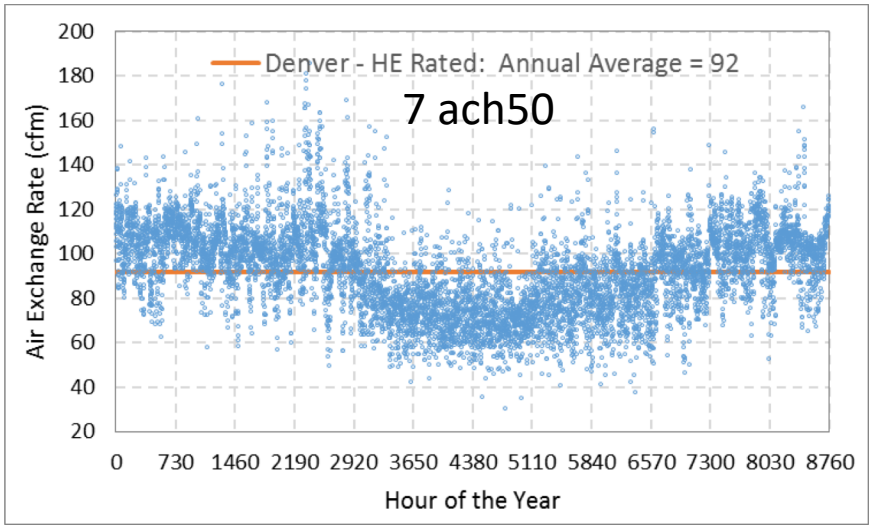


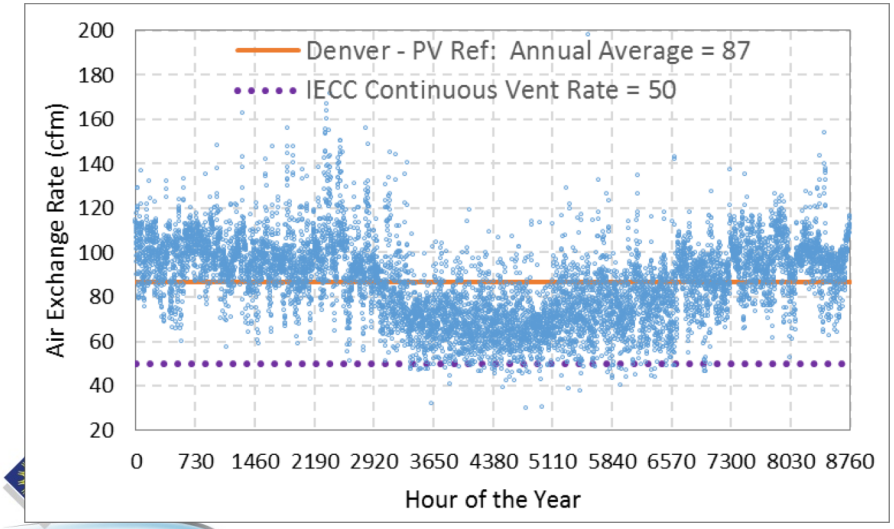


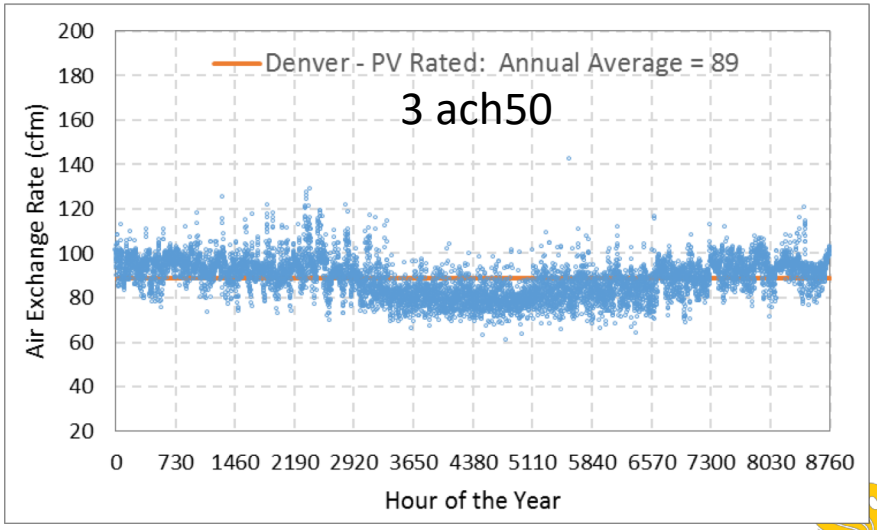


Air Exchange Rates: Denver, CO

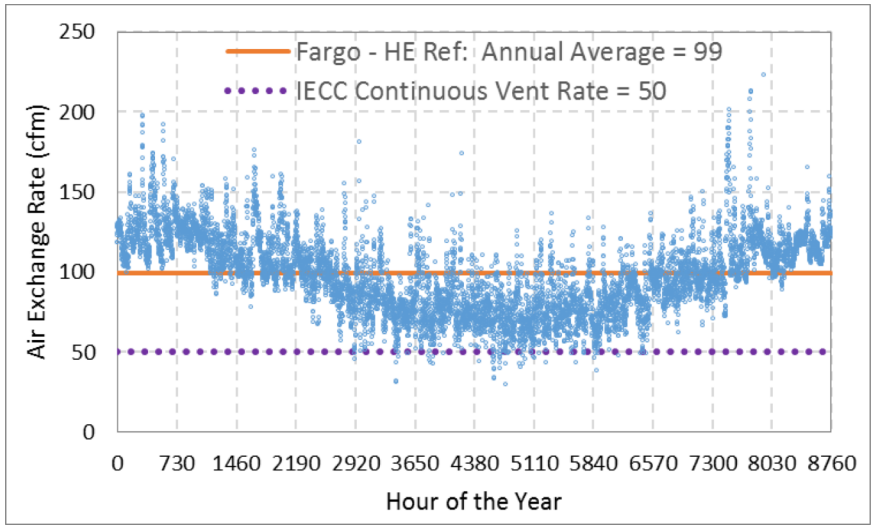


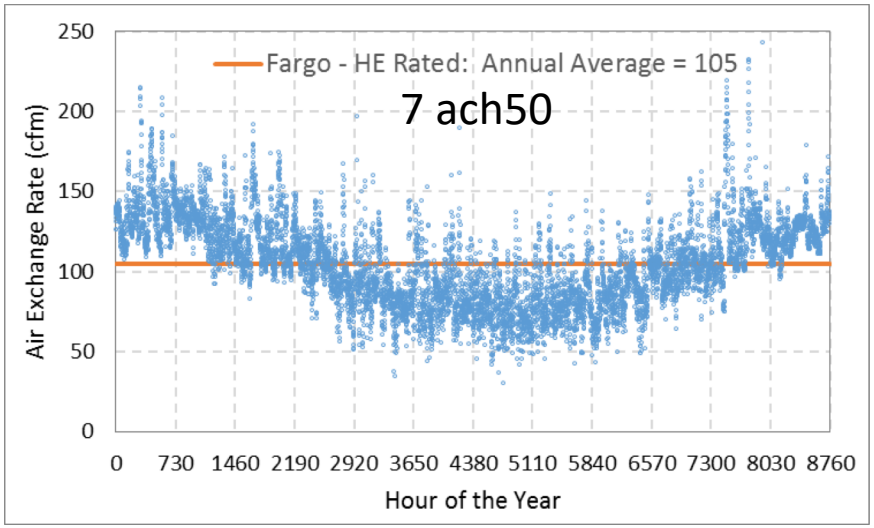


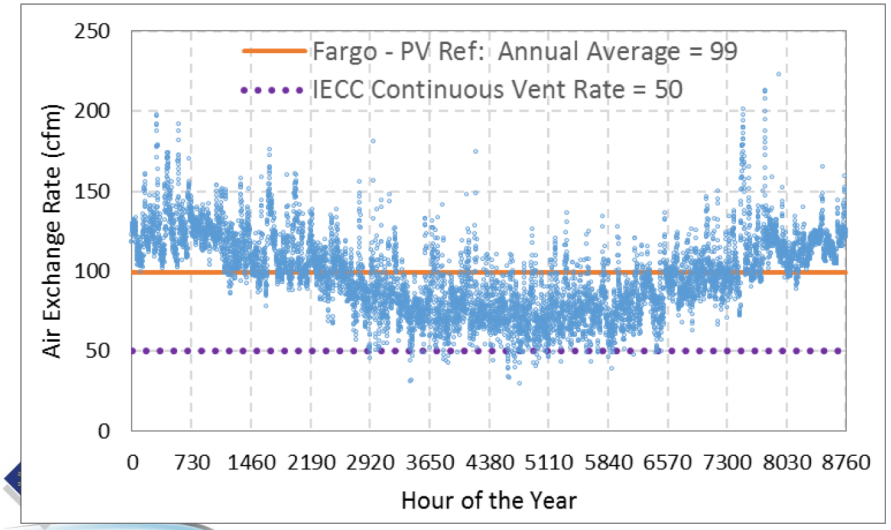


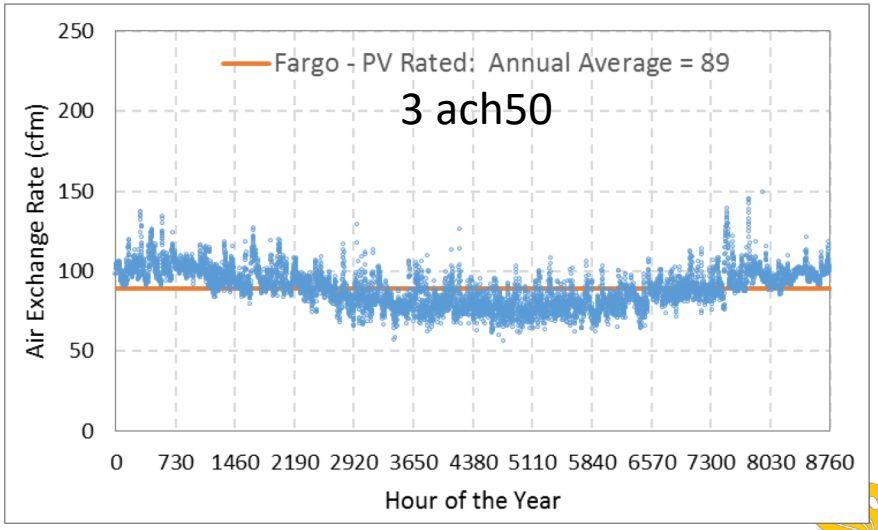


Air Exchange Rates: Fargo, ND









Conclusions

- Annual average hourly air exchange rates for Rated Homes effectively meet ASHRAE 62.2 Indoor Air Quality Standards
- Use of the 2018 IECC R406.3 ventilation specification in the Reference Home will likely result in a 2 to 10 point increase in the Rated Home index score
- Differences in envelope backstops (2009 IECC minimums versus 2015 IECC minimums) do not appear to affect the index score increase.

Questions?