HVAC Loads in High-Performance Homes

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Changing AC Loads – Why?

- Improved Enclosure
  - Airtight – negligible infiltration but poorer drying potential
  - Increased Insulation
  - Climate-appropriate moisture management
  - Advanced Framing
  - High performance windows
- EnergyStar Appliances
- Energy-Efficient Lighting
- Window Shading for location, orientation
- Improved air distribution, ventilation

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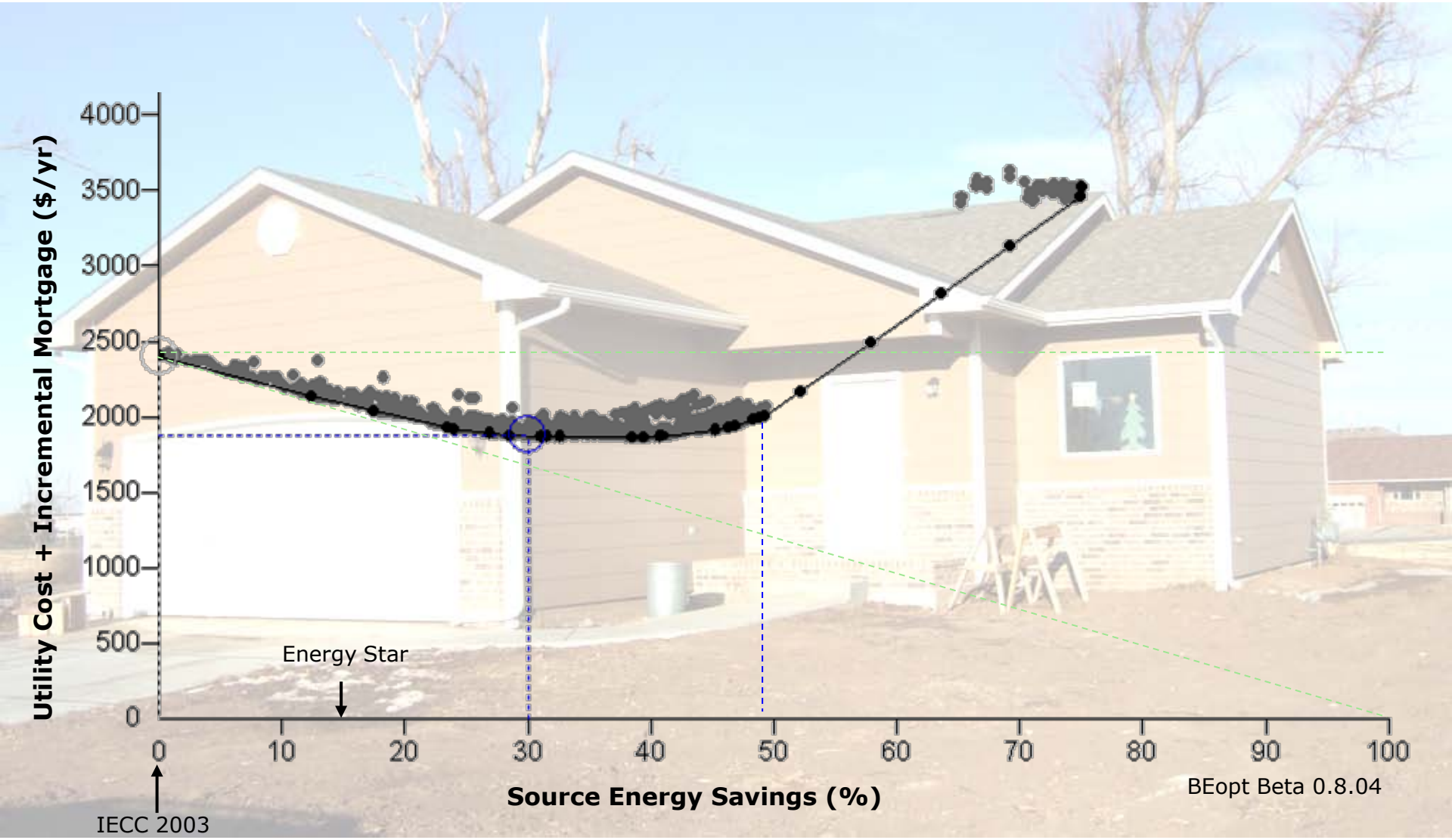

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HVAC Specification so far…

- Sizing
  - Manual J / Design Day
  - ASHRAE Residential Heat Balance
  - ~~Rules of Thumb~~
- High Performance duct systems
  - Ducts within conditioned space – NOT IN ATTICS
  - Low duct leakage
  - Reduced static pressure
- Ventilation System
  - ERV / HRV
  - Rate? ASHRAE 62.2?
- Dehumidification equipment

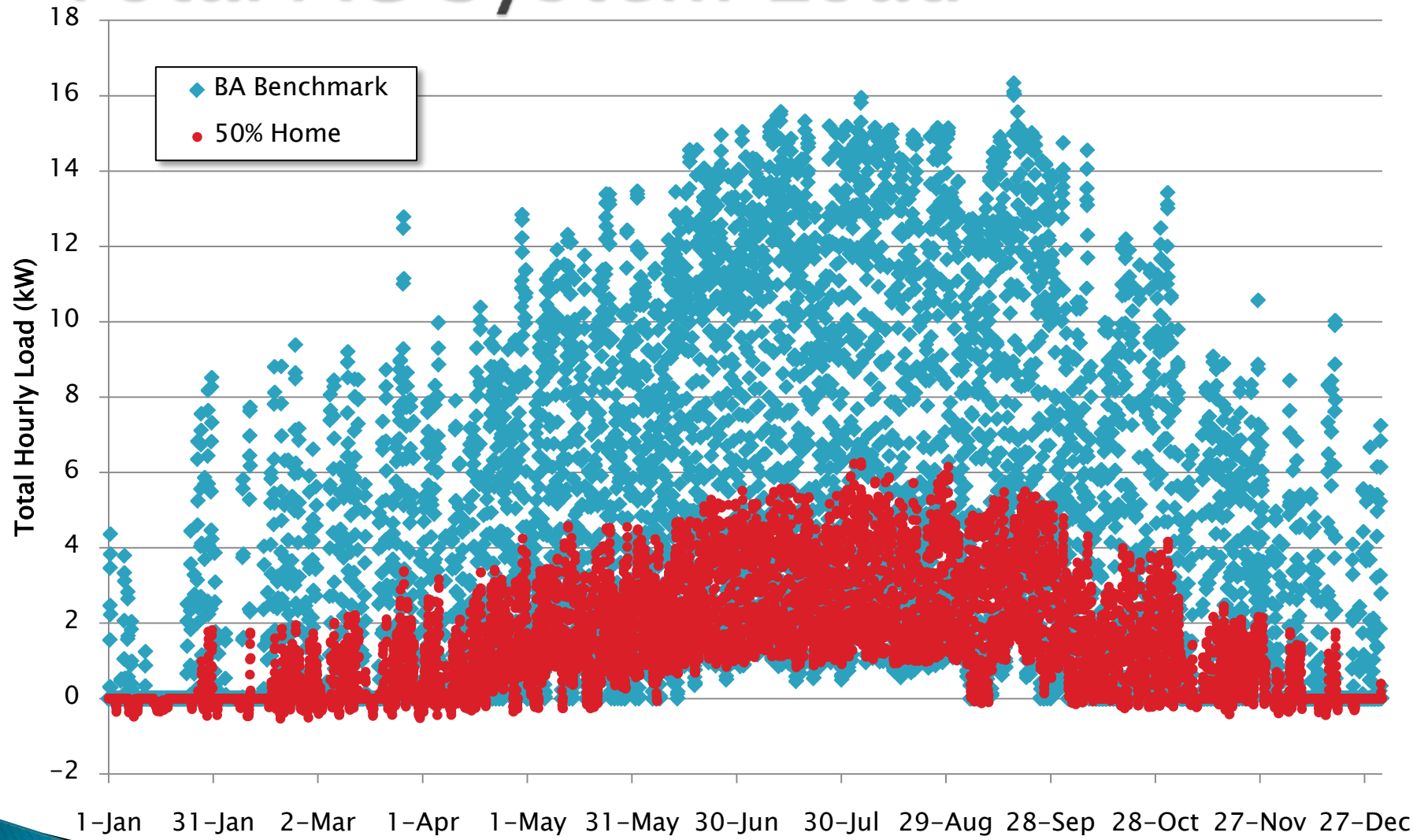
Comparison of Loads – Houston, TX

- Representing early '90's construction practice
- SEER 10 AC
- 2x4 construction, wall U-value per IECC 2003
- Ducts in attic
- 15% Fluorescent Lighting
- Standard Efficiency Appliances
- No Dehumidifier
- Moderate infiltration (0.00057 SLA)
- Spot Ventilation

- Representing high-performance homes
- SEER 15+ AC
- 2x6 construction, R-19 cavity insulation
- Ducts in conditioned space
- 90% CFL Lighting
- EnergyStar Appliances
- EnergyStar DX Dehumidifier
- Tight (.00015 SLA or less)
- (ERV Ventilation)

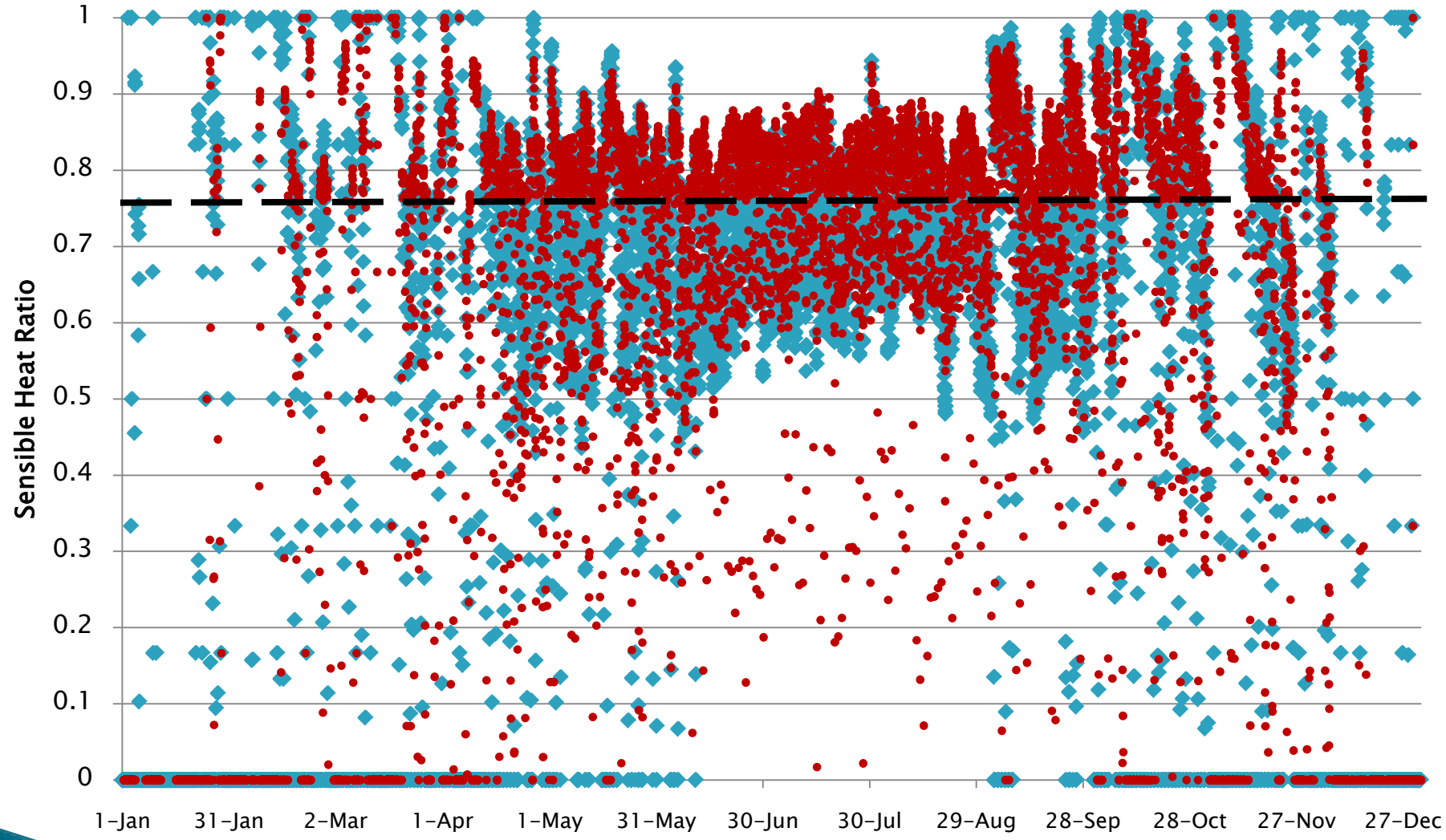
BA Benchmark	50% Home

Total AC System Load



Houston, TX – Hot, Humid Climate

AC System Sensible Heat Ratio



BA Benchmark

50% Home

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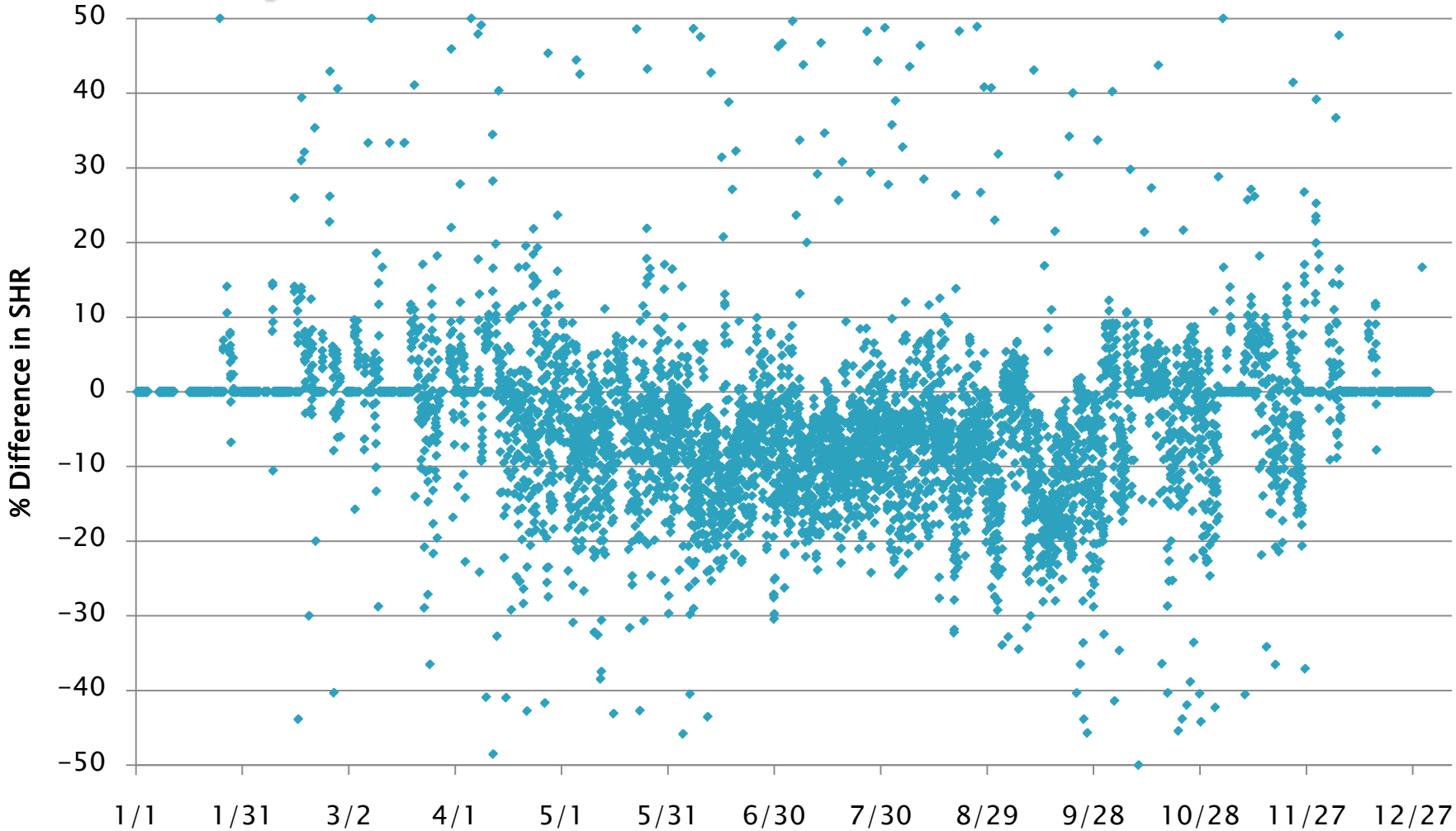

$$\frac{SHR_{Benchmark} - SHR_{50\%}}{SHR_{Benchmark}}$$

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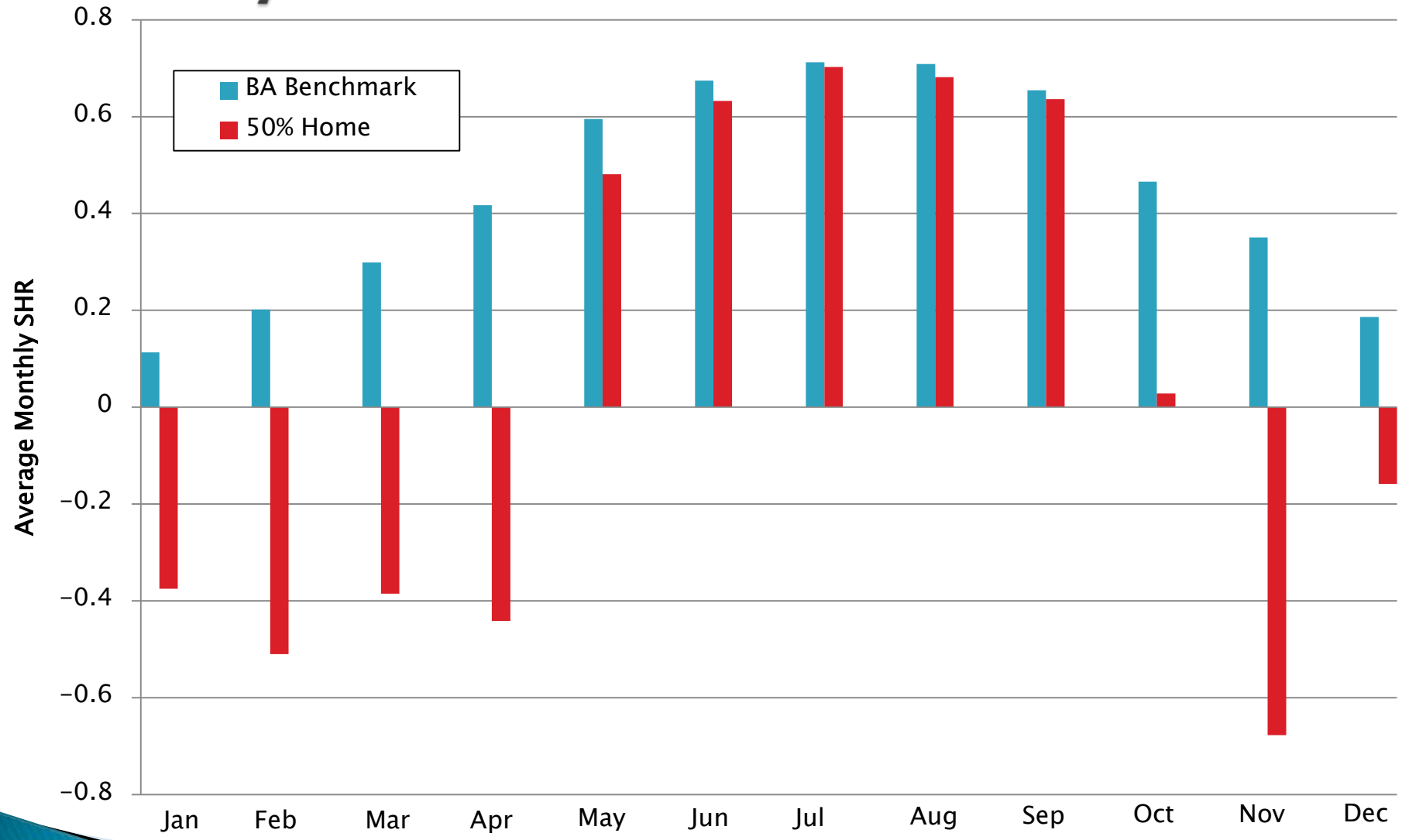

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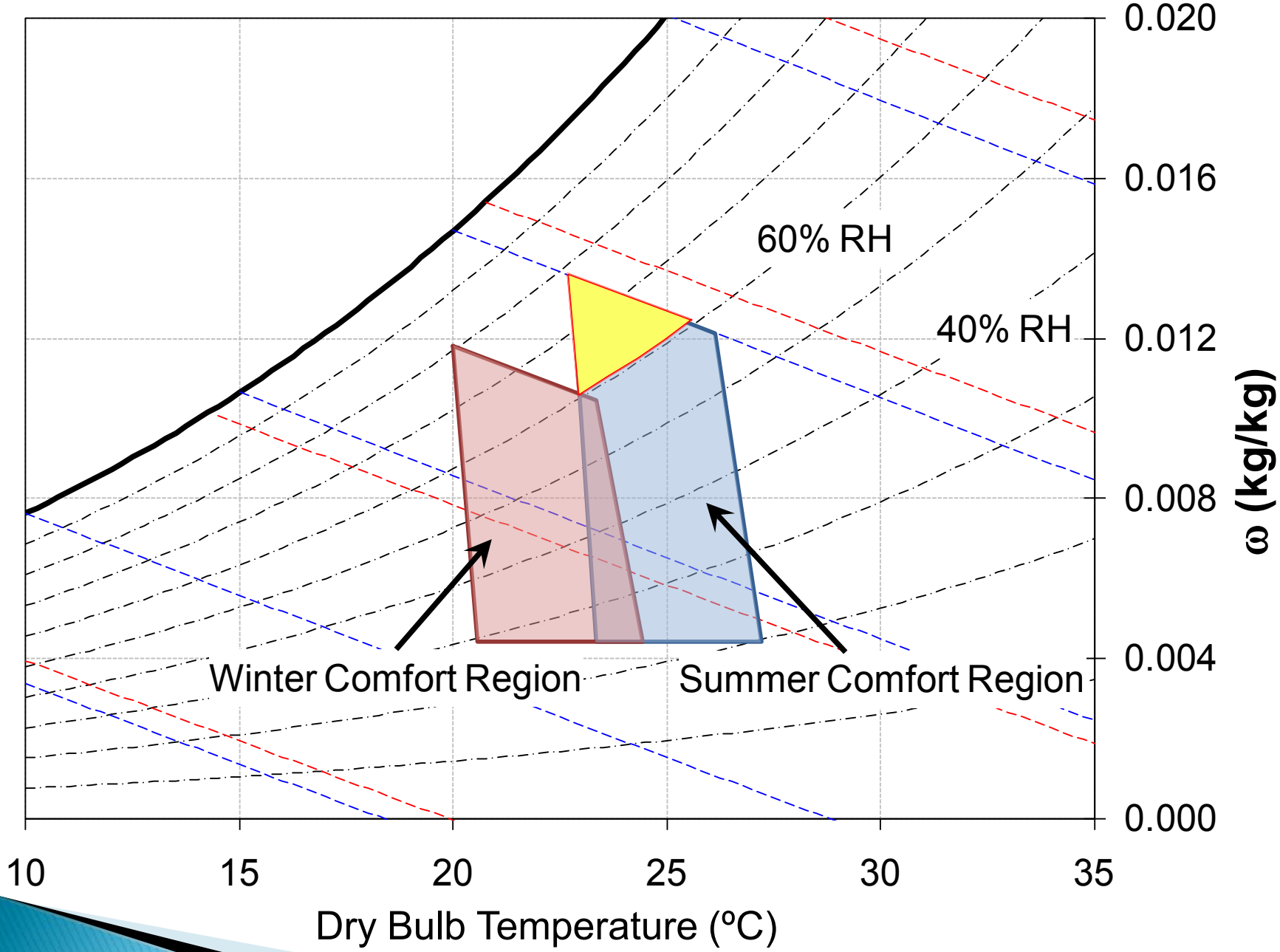
0.020
0.016
0.012
0.008
0.004
0.000
ω (kg/kg)
60% RH
40% RH
Winter Comfort Region
Summer Comfort Region
10
15
20
25
30
35
Dry Bulb Temperature (ºC)

Humidity Control Strategies: Hot-Humid Climate

Cases Modeled: 50% Home with…

0. AC Only
1. AC & Thermostat Reset
2. AC & ERV
3. Heat-Exchanger Assisted AC
4. AC with Condenser Reheat
5. AC with Desiccant Wheel
6. AC with High-Efficiency DX Dehumidifier
7. AC with Standard Eff. DX Dehumidifier
8. AC, ERV, High-Eff. DX Dehumidifier
9. AC, ERV, Standard Eff. DX Dehumidifier

Humidistat Setpoint: 55%

Humidity Excursions above 70% RH

	BA Benchmark	2006 IECC Home	High-performance Home Cases		
			0	1	6 *
Hrs. Above 70% RH	1,014	1,304	968	956	0
Number of Excursions	175	225	191	192	0
Avg. Exc. Length (hrs)	5.8	5.8	5.1	5.0	0
Max. Exc. Length (hrs)	20	32	35	35	0

*Humidistat Setpoint: 55%

Humidity Excursions above 60% RH

	BA Benchmark	2006 IECC Home	High-performance Home Cases		
			0	1	6 *
Hrs. Above 60% RH	3,056	3,495	3,141	3,110	0
Number of Excursions	302	263	247	249	0
Avg. Exc. Length (hrs)	10.1	13.3	12.7	12.5	0
Max. Exc. Length (hrs)	70	87	86	75	0

* Humidistat Setpoint: 55%

Conclusions

- Humidity Control is needed for High-Performance Homes
- HVAC Loads in high-performance homes have greater variability
- Advanced strategies, equipment needed to address smaller, more variable loads

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Questions?

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