

HOW TO GET TO ZERO: A MULTI-STATE COMPARISON OF ZERO ENERGY READY HOMES

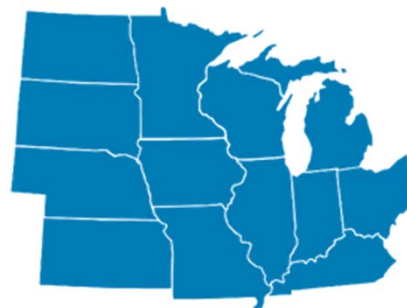
Ian Blanding, Midwest Energy Efficiency Alliance
Will Bryan, Southeast Energy Efficiency Alliance

About MEEA

We are a nonprofit membership organization with 160+ members, including:

- Utilities
- Research institutions
- State and local governments
- Energy efficiency-related businesses

As the key resource and champion for energy efficiency in the Midwest, MEEA helps a diverse range of stakeholders understand and implement cost-effective energy efficiency strategies that provide economic and environmental benefits.



The Southeast Efficient Energy Alliance (SEEA) promotes energy efficiency as a catalyst for economic growth, workforce development and energy security across 11 southeastern states including Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee and Virginia.

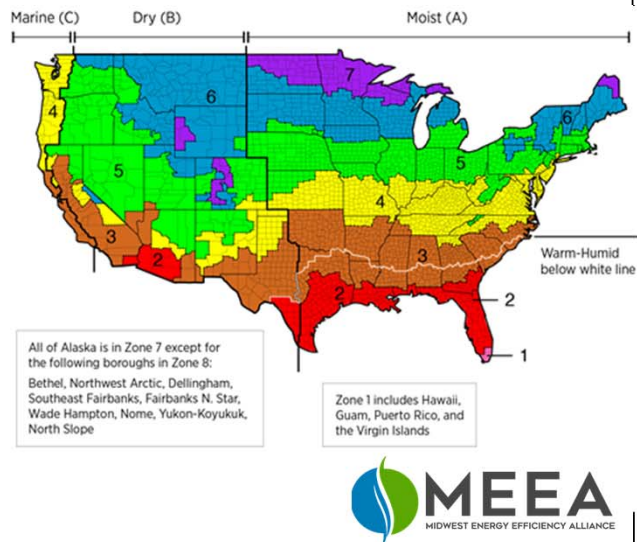
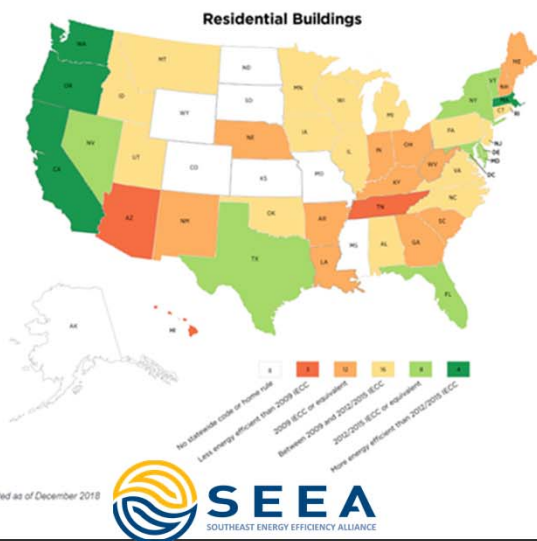


Agenda

- Energy Codes and Climate Zones
- RESNET HERS Data
- National Overview of Zero Energy Ready Homes
- ASHRAE 90.2
- Component-Level Strategies by Climate Zone
- Policy Implications and Next Steps



Energy Codes & Climate Zones



RESNET HERS Data

- Energy Raters collect more than seventy unique data points for each home to calculate a HERS Index score—a measure of the overall energy performance of the building.
- The HERS Index is measured on a scale from 0 to 100. The lower the score the more efficient the home. *(A score of 100 is designed to represent the energy performance of a standard home of like size and type complying with the 2006 IECC).*
- As of 2017, RESNET has audited more than two million homes in the United States
- Our dataset is based on all HERS-rated homes in the United States with a rating ≤ 48 from 2017 – present.



Zero Energy Ready Home

General Home Characteristics:

- Conditioned Area
- Onsite Power Generation
- Energy Use Intensity (EUI)

Building Envelope:

- Foundation Insulation
- Above Grade Wall Insulation
- Ceiling Insulation
- Window U-Factor and SHGC

- Air Leakage

HVAC:

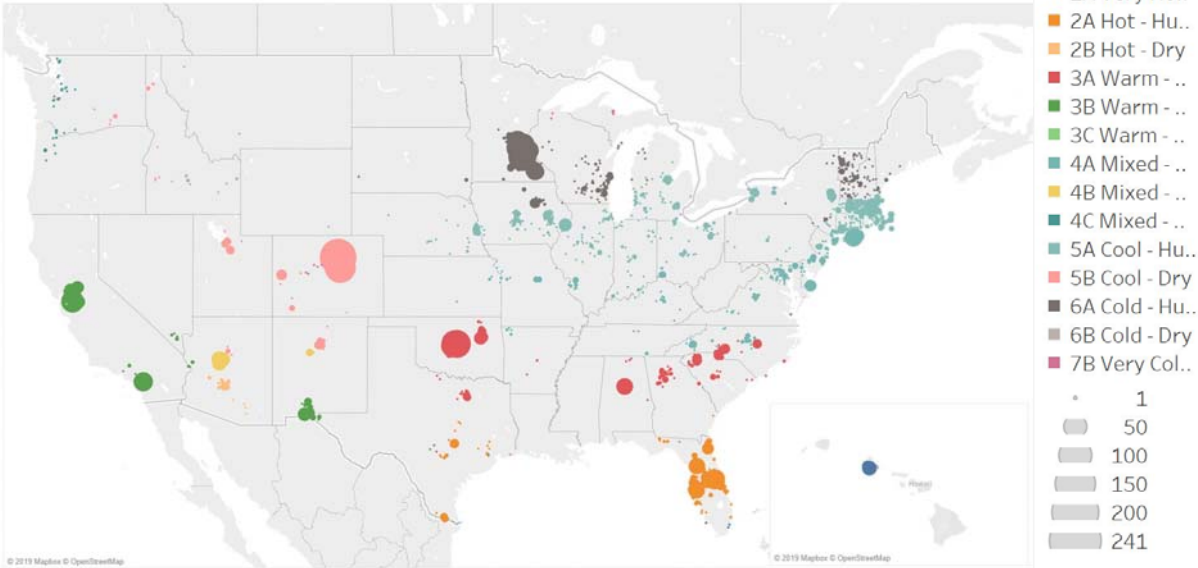
- Heating/ Cooling Efficiency
- % of Ducts Conditioned
- Duct Leakage

Other Key Components:

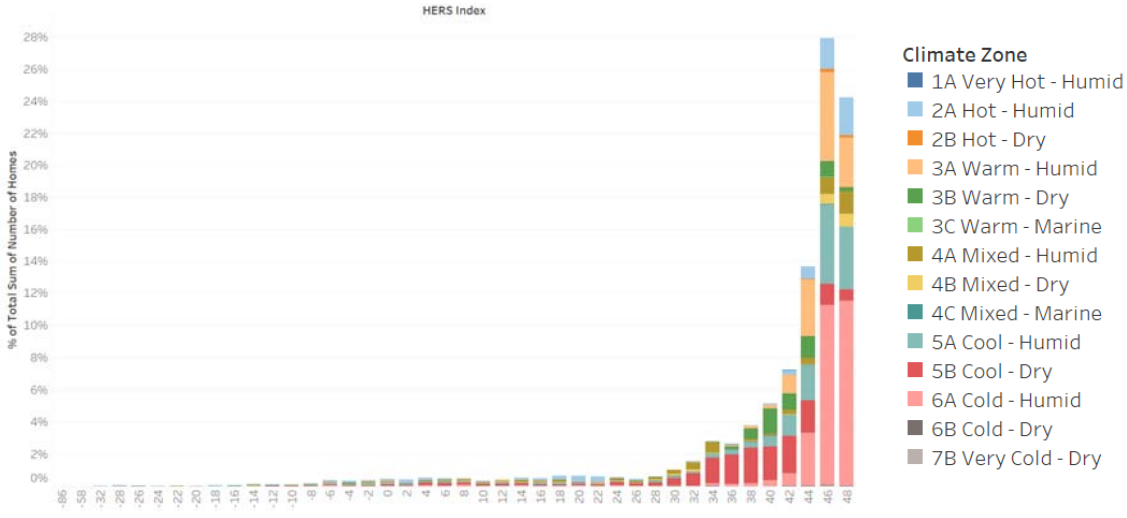
- % of High-Efficacy Lighting
- Ventilation Type



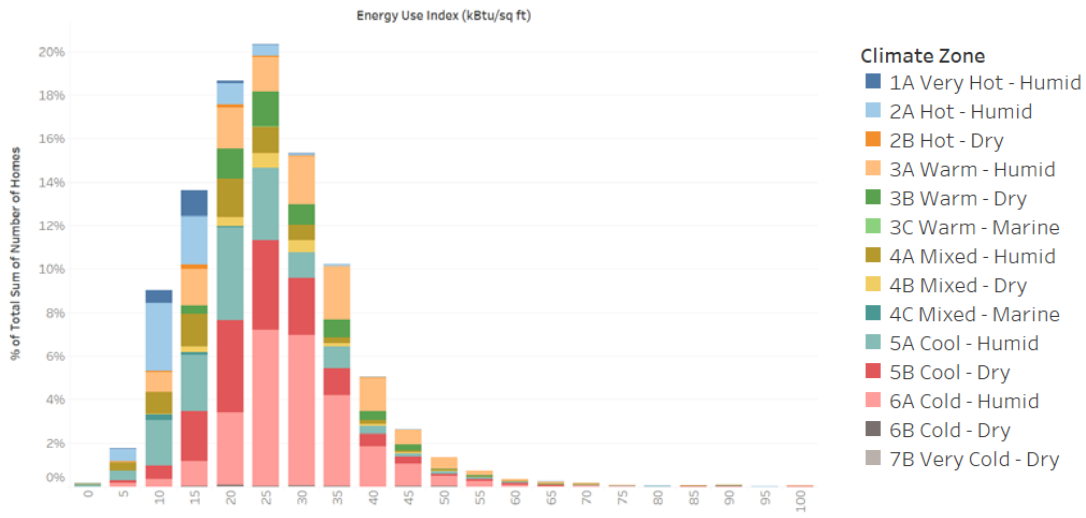
Where are Zero Energy Ready Homes Located?



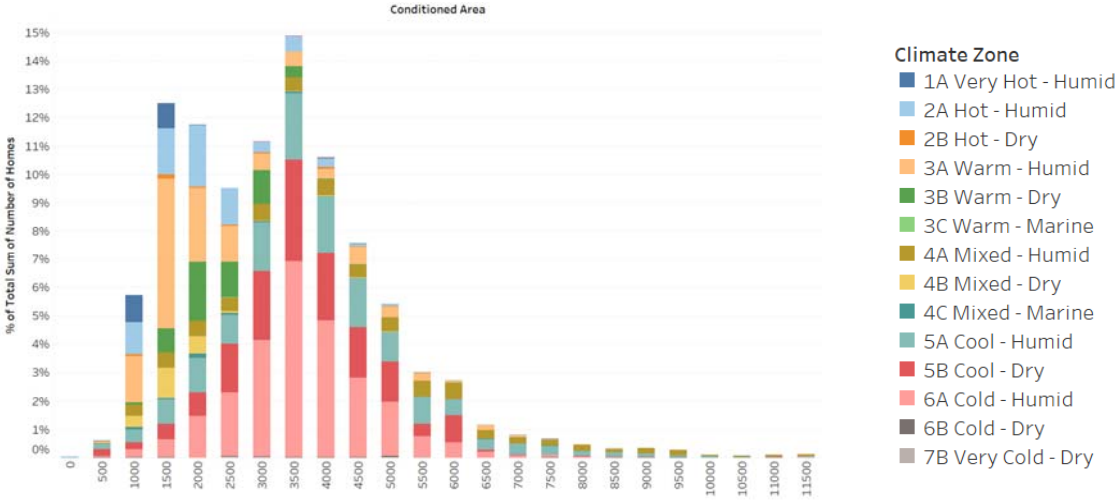
HERS Rating by Climate Zone



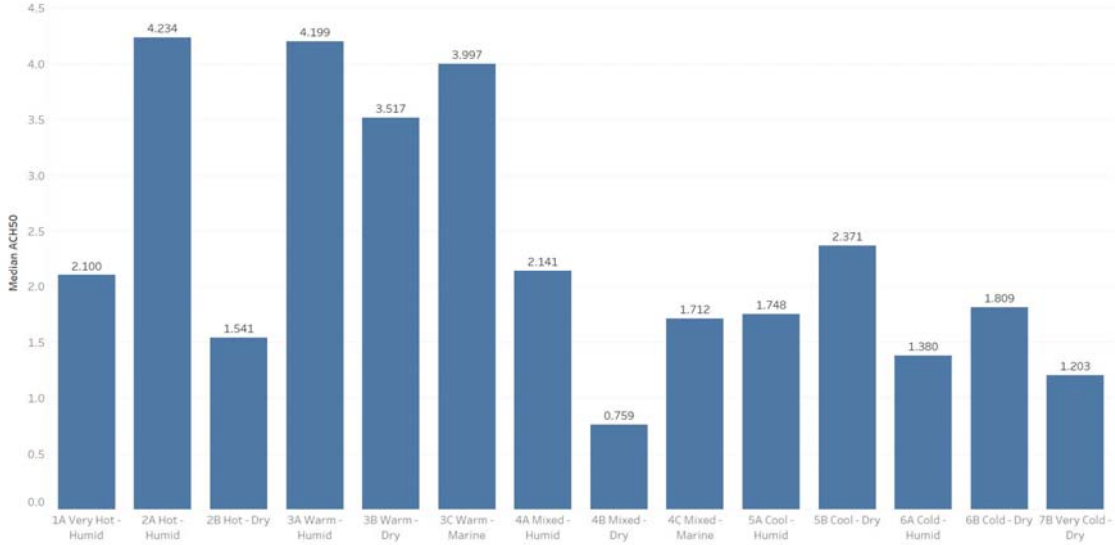
Energy Use by Climate Zone



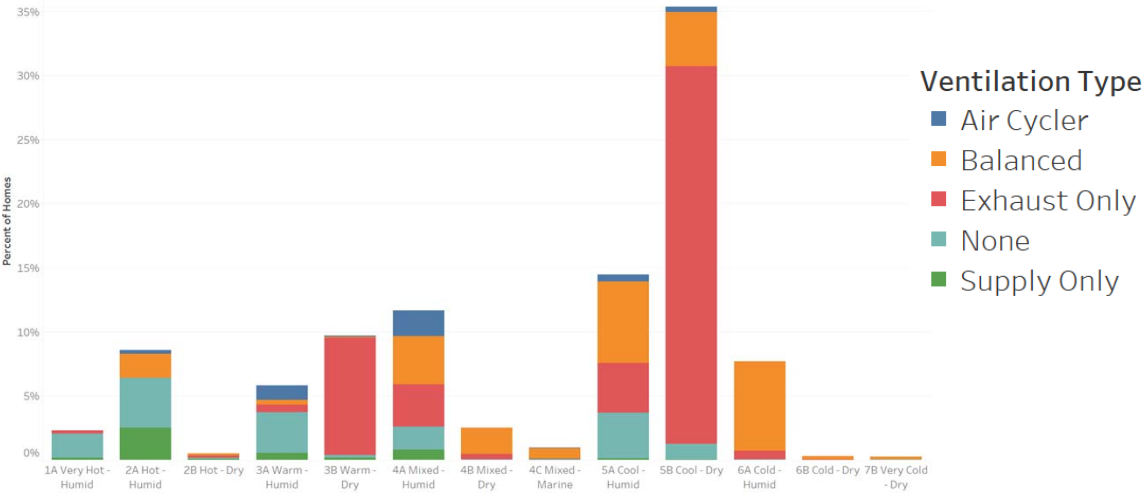
Conditioned Area by Climate Zone



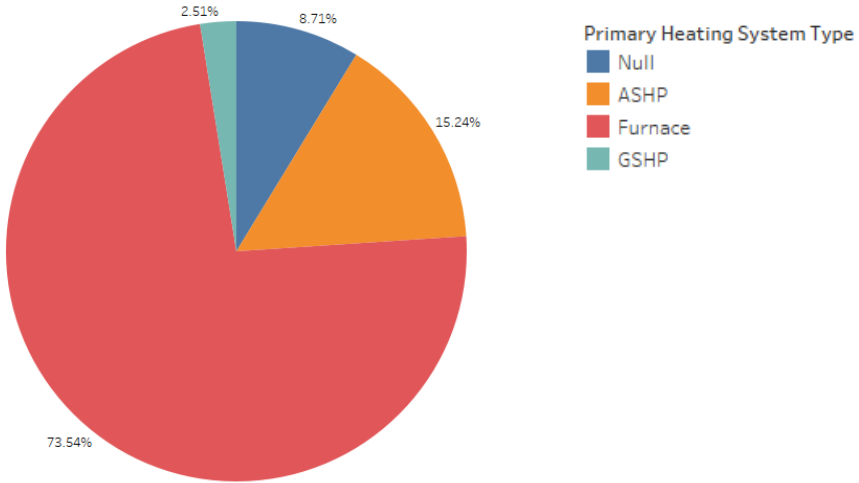
Air Leakage by Climate Zone



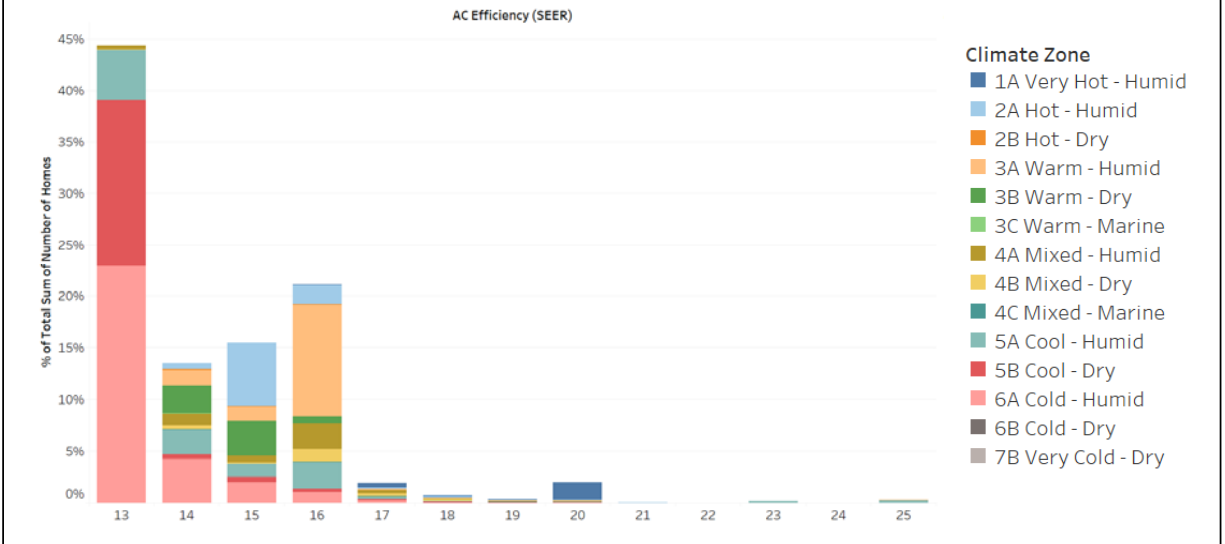
Ventilation Type by Climate Zone



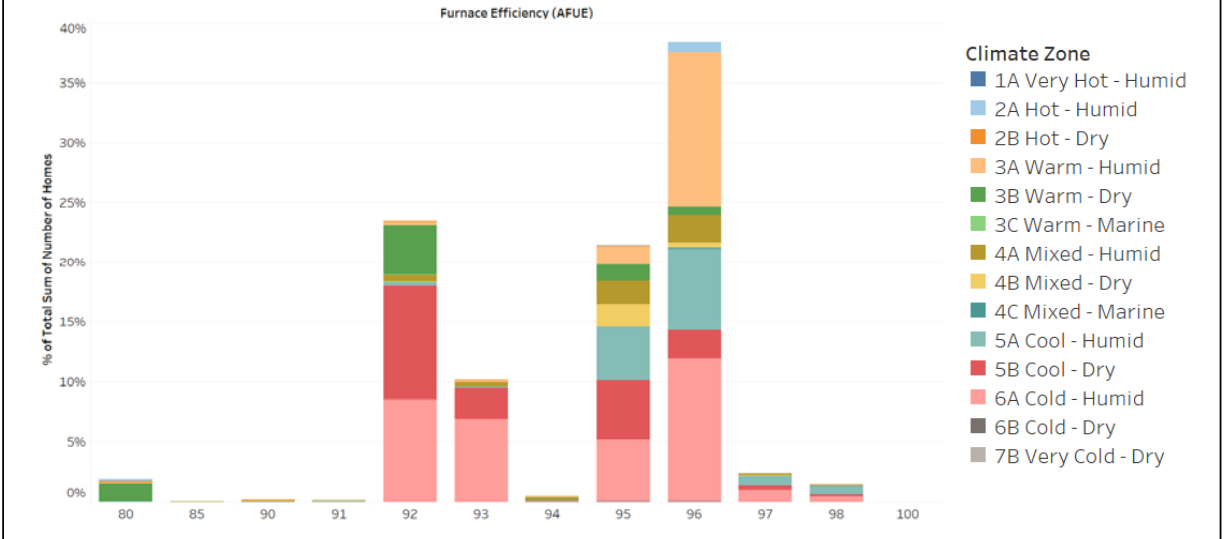
Primary Heating Type



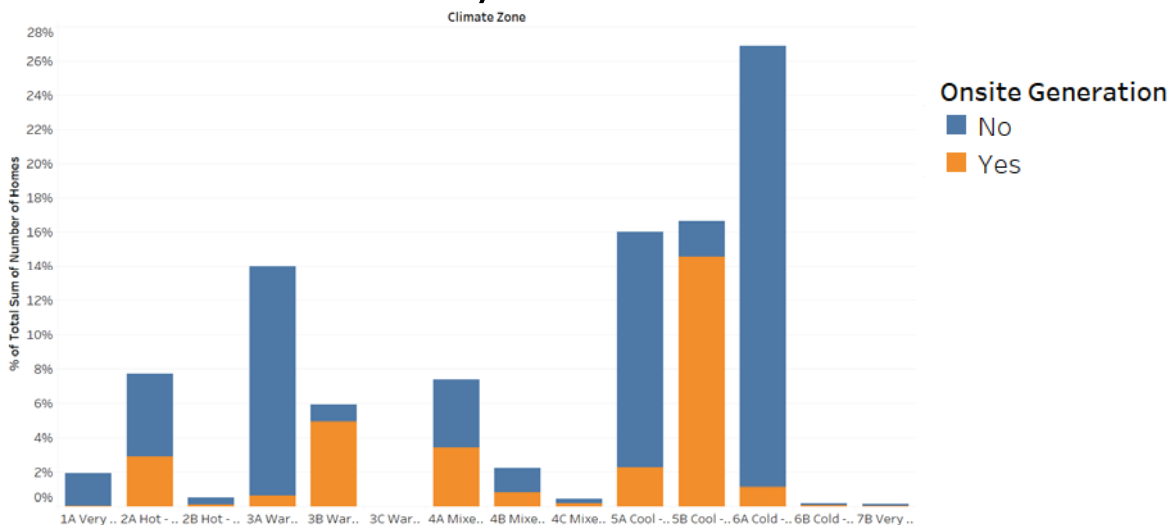
AC Efficiency by Climate Zone



Furnace Efficiency by Climate Zone



Solar Penetration by Climate Zone



ASHRAE 90.2 – Zero Energy Ready

Standards Advisory Panel Recommendations

- International leadership standard
- On the path of supporting the ASHRAE Board of Directors vision for net zero or near zero energy buildings (NZEB) by 2030 (current revision 50% improvement relative to a 2006 IECC baseline)
- Address the energy aspects related to indoor environmental quality including comfort, moisture control, and indoor air quality
- Should not generally address the broad subject of sustainability
- Consider the energy aspects of meeting residential water needs
- Incorporate requirements that use cost effectiveness as a significant criterion
- Incorporate appropriate field performance metrics to measure compliance during construction
- Easy to use and easy to enforce
- Evaluate the use of renewable energy alternatives
- Fenestration backstops w/ PV



Source: Theresa Weston, Dupont Performance Building Solutions



ASHRAE 90.2 – Zero Energy Ready

ERI Target

Climate Zone*	90.2 Max ERI	2018 IECC Max ERI
1	43	57
2	45	57
3	47	57
4	47	62
5	47	61
6	46	61
7	46	58

*Climate zones 0 & 8 not listed

Other Key Requirements

- Maximum U-Factor/SHGC Table
- Air Leakage – Max 5 ACH50
- Duct Leakage – 4cfm25/100 sq. ft.
- HVAC Equipment Sizing
- Hot water pipe insulation
- Maximum Fixture Flow Rates
- High Efficiency Lights
- Air Leakage, Insulation, Fenestration backstops w/ PV





HERS/ERI ≤ 43			
Measure	Median Value	Measure	Median Value
EUI (kBtu/sq. ft.)	17.3	Duct Conditioned (%)	100
Conditioned Area (sq. ft)	1,627	Duct Leakage Outside (%)	5.3
Foundation (R-Value)	N/A	Duct Leakage Total (%)	15.7
AG Wall (R-Value)	8 + 1	Ventilation Type	None
Window (U-Factor)	.34	Efficient Lighting (%)	N/A
Window (SHGC)	.22	Heating Efficiency	ASHP
Ceiling (R-Value)	N/A	Cooling Efficiency (SEER)	21
Air Leakage (ACH50)	2.0	Onsite Power	3%

Climate Zone
1: ASHRAE
90.2





HERS/ERI ≤ 5*			
Measure	Median Value	Measure	Median Value
EUI (kBtu/sq. ft.)	9.9	Ducts Conditioned (%)	100
Conditioned Area (sq. ft)	4,367	Duct Leakage Outside (%)	N/A
Foundation (R-Value)	N/A	Duct Leakage Total (%)	N/A
AG Wall (R-Value)	21 + 1	Ventilation Type	Exhaust Only
Window (U-Factor)	.31	Efficient Lighting (%)	N/A
Window (SHGC)	.28	Heating Efficiency	ASHP
Ceiling (R-Value)	N/A	Cooling Efficiency (SEER)	ASHP
Air Leakage (ACH50)	1.4	Onsite Power	100%

Climate Zone
1: Zero Energy



HERS/ERI ≤ 45			
Measure	Median Value	Measure	Median Value
EUI (kBtu/sq. ft.)	15.9	Duct Conditioned (%)	100
Conditioned Area (sq. ft)	2,239	Duct Leakage Outside (%)	1.9
Foundation (R-Value)	N/A	Duct Leakage Total (%)	6.5
AG Wall (R-Value)	8	Ventilation Type	None
Window (U-Factor)	.34	Efficient Lighting (%)	N/A
Window (SHGC)	.23	Heating Efficiency	ASHP
Ceiling (R-Value)	30	Cooling Efficiency (SEER)	16
Air Leakage (ACH50)	4.2	Onsite Power	64%

Climate Zone
2: ASHRAE
90.2



HERS/ERI ≤ 5			
Measure	Median Value	Measure	Median Value
EUI (kBtu/sq. ft.)	14.4	Ducts Conditioned (%)	100
Conditioned Area (sq. ft)	2,385	Duct Leakage Outside (%)	1.7
Foundation (R-Value)	N/A	Duct Leakage Total (%)	6.4
AG Wall (R-Value)	8	Ventilation Type	None
Window (U-Factor)	.36	Efficient Lighting (%)	N/A
Window (SHGC)	.23	Heating Efficiency	ASHP
Ceiling (R-Value)	30	Cooling Efficiency (SEER)	16
Air Leakage (ACH50)	4.3	Onsite Power	79%

Climate Zone
2: Zero Energy



HERS/ERI ≤ 47			
Measure	Median Value	Measure	Median Value
EUI (kBtu/sq. ft.)	17.7	Duct Conditioned (%)	50
Conditioned Area (sq. ft)	4,067	Duct Leakage Outside (%)	1.8
Foundation (R-Value)	N/A	Duct Leakage Total (%)	3.7
AG Wall (R-Value)	13 + 1	Ventilation Type	None
Window (U-Factor)	.30	Efficient Lighting (%)	82.5
Window (SHGC)	.21	Heating Efficiency (AFUE)	96
Ceiling (R-Value)	22	Cooling Efficiency (SEER)	15
Air Leakage (ACH50)	2.7	Onsite Power	9.4%

Climate Zone
3: ASHRAE
90.2



HERS/ERI ≤ 5			
Measure	Median Value	Measure	Median Value
EUI (kBtu/sq. ft.)	18.9	Duct Conditioned (%)	100
Conditioned Area (sq. ft)	2,568	Duct Leakage Outside (%)	2.4
Foundation (R-Value)	N/A	Duct Leakage Total (%)	4.8
AG Wall (R-Value)	22	Ventilation Type	Exhaust Only
Window (U-Factor)	.29	Efficient Lighting (%)	100
Window (SHGC)	.21	Heating Efficiency	ASHP
Ceiling (R-Value)	34	Cooling Efficiency (SEER)	ASHP
Air Leakage (ACH50)	2.7	Onsite Power	100%

Climate Zone
3: Zero Energy



HERS/ERI ≤ 47			
Measure	Median Value	Measure	Median Value
EUI (kBtu/sq. ft.)	18	Duct Conditioned (%)	100
Conditioned Area (sq. ft)	3500	Duct Leakage Outside (%)	1.3
Foundation (R-Value)	0 + 10	Duct Leakage Total (%)	4.0
AG Wall (R-Value)	19 + 1	Ventilation Type	Balanced
Window (U-Factor)	.29	Efficient Lighting (%)	90
Window (SHGC)	.27	Heating Efficiency (AFUE)	95.5
Ceiling (R-Value)	38	Cooling Efficiency (SEER)	15
Air Leakage (ACH50)	2.0	Onsite Power	56%

Climate Zone
4: ASHRAE
90.2



HERS/ERI ≤ 5			
Measure	Median Value	Measure	Median Value
EUI (kBtu/sq. ft.)	15	Duct Conditioned (%)	100
Conditioned Area (sq. ft)	2400	Duct Leakage Outside (%)	.90
Foundation (R-Value)	0 + 11	Duct Leakage Total (%)	3.5
AG Wall (R-Value)	19 + 1	Ventilation Type	Balanced
Window (U-Factor)	.29	Efficient Lighting (%)	90
Window (SHGC)	.26	Heating Efficiency	ASHP
Ceiling (R-Value)	30	Cooling Efficiency	ASHP
Air Leakage (ACH50)	1.9	Onsite Power	85%

Climate Zone
4: Zero Energy



HERS/ERI ≤ 47			
Measure	Median Value	Measure	Median Value
EUI (kBtu/sq. ft.)	22	Duct Conditioned (%)	100
Conditioned Area (sq. ft)	4000	Duct Leakage Outside (%)	.70
Foundation (R-Value)	0 + 10	Duct Leakage Total (%)	5.5
AG Wall (R-Value)	20 + 1	Ventilation Type	Balanced
Window (U-Factor)	.28	Efficient Lighting (%)	90
Window (SHGC)	.26	Heating Efficiency (AFUE)	96
Ceiling (R-Value)	49	Cooling Efficiency (SEER)	15
Air Leakage (ACH50)	1.9	Onsite Power	1%

Climate Zone
5: ASHRAE
90.2



HERS/ERI ≤ 5			
Measure	Median Value	Measure	Median Value
EUI (kBtu/sq. ft.)	19	Duct Conditioned (%)	100
Conditioned Area (sq. ft)	3500	Duct Leakage Outside (%)	.78
Foundation (R-Value)	2 + 7	Duct Leakage Total (%)	NA
AG Wall (R-Value)	22+ 1	Ventilation Type	Balanced
Window (U-Factor)	.27	Efficient Lighting (%)	100
Window (SHGC)	.30	Heating Efficiency	ASHP
Ceiling (R-Value)	54	Cooling Efficiency	ASHP
Air Leakage (ACH50)	1.6	Onsite Power	83%

Climate Zone
5: Zero Energy



HERS/ERI ≤ 47			
Measure	Median Value	Measure	Median Value
EUI (kBtu/sq. ft.)	30	Duct Conditioned (%)	100
Conditioned Area (sq. ft)	3900	Duct Leakage Outside (%)	.80
Foundation (R-Value)	4.5+ 4	Duct Leakage Total (%)	2.0
AG Wall (R-Value)	20 + 1	Ventilation Type	Balanced
Window (U-Factor)	.29	Efficient Lighting (%)	50
Window (SHGC)	.30	Heating Efficiency (AFUE)	96
Ceiling (R-Value)	49	Cooling Efficiency (SEER)	13
Air Leakage (ACH50)	1.4	Onsite Power	4%

Climate Zone
6 & 7 :
ASHRAE 90.2

HERS/ERI ≤ 5			
Measure	Median Value	Measure	Median Value
EUI (kBtu/sq. ft.)	28	Duct Conditioned (%)	100
Conditioned Area (sq. ft)	3000	Duct Leakage Outside (%)	.80
Foundation (R-Value)	7 + 3	Duct Leakage Total (%)	NA
AG Wall (R-Value)	20 + 6	Ventilation Type	Balanced
Window (U-Factor)	.23	Efficient Lighting (%)	100
Window (SHGC)	.33	Heating Efficiency (AFUE)	96
Ceiling (R-Value)	53	Cooling Efficiency (SEER)	13
Air Leakage (ACH50)	1.5	Onsite Power	50%

Climate Zone
6 & 7 : Zero
Energy

Key Takeaways

- Varied pathways to get to Zero Energy
- Climate zone has a big influence on what measures are installed
- Zero Energy homes often rely on on-site power generation
- ASHRAE 90.2 levels is essentially ZER
 - To get to ZE, builders add slight envelope improvements, advanced equipment and on-site generation



Use of Data/Policy Implications

- Which component-level approaches are widely-implemented and have significant market share in ZER homes?
- How do we leverage building energy codes (or other policies) to encourage ZER practices to be more widely adopted in new construction in a cost-effective manner?
- How effective are these practices in building truly zero energy homes?



Next Steps/ Further Analysis

- Expand to all 50 states
- Determine most cost-effective approach by Climate Zone
- Consult with RESNET and local energy raters
- Develop report for states and jurisdictions considering ZER or ZE Codes



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