ZERH & ENERGY STAR From a Production Builder's View – Lessons Learned

10.2.24

EEBA
Energy & Environmental Building Alliance

2024 HIGH PERFORMANCE HOME BUILDER SUMMIT

OCTOBER 1 - 3 | SALT LAKE CITY, UTAH

BUILDING OUR FUTURE

ENERGY STAR

ZERO ENERGY READY HOME
U.S. DEPARTMENT OF ENERGY

45L
$$

Agenda

- Review what we'll cover & speaker introductions
- Overview of FHA mandates, 45L incentives, ENERGY STAR, & ZERH
- How homebuilders can achieve ENERGY STAR & ZERH
- Lessons learned by homebuilders – panelists & audience
- Closing remarks

EEBA
Energy & Environmental Building Alliance

Today's Panel Speakers

Bill Shadid
Aeroseal
Strategic Marketing

Gord Cooke
Construction Instruction
Partner

Matthew Cooper
PEG
SVP & COO

Megan Cordes
Beazer Homes
Dir. Of Sust. & Bldg. Science

Philip Squires
Mattamy Homes
VP Sust. & Procurement

Bill Rectanus
Thrive Home Builders
COO

EEBA
Energy & Environmental Building Alliance

Overview of FHA Mandates, 45L Incentives, ENERGY STAR, & ZERH

Today's Goal:
Help to Make 45L $ More Achievable For You

ENERGY STAR **OR** ZERO ENERGY READY HOME U.S. DEPARTMENT OF ENERGY **=** **45L $$**

EEBA
Energy & Environmental Building Alliance

HUD and USDA Mortgages: 2021 IECC Update

HUD adopts IECC 2021 as minimum energy standard for all HUD- and USDA-Financed Housing

5/28/2024

5/28/2025

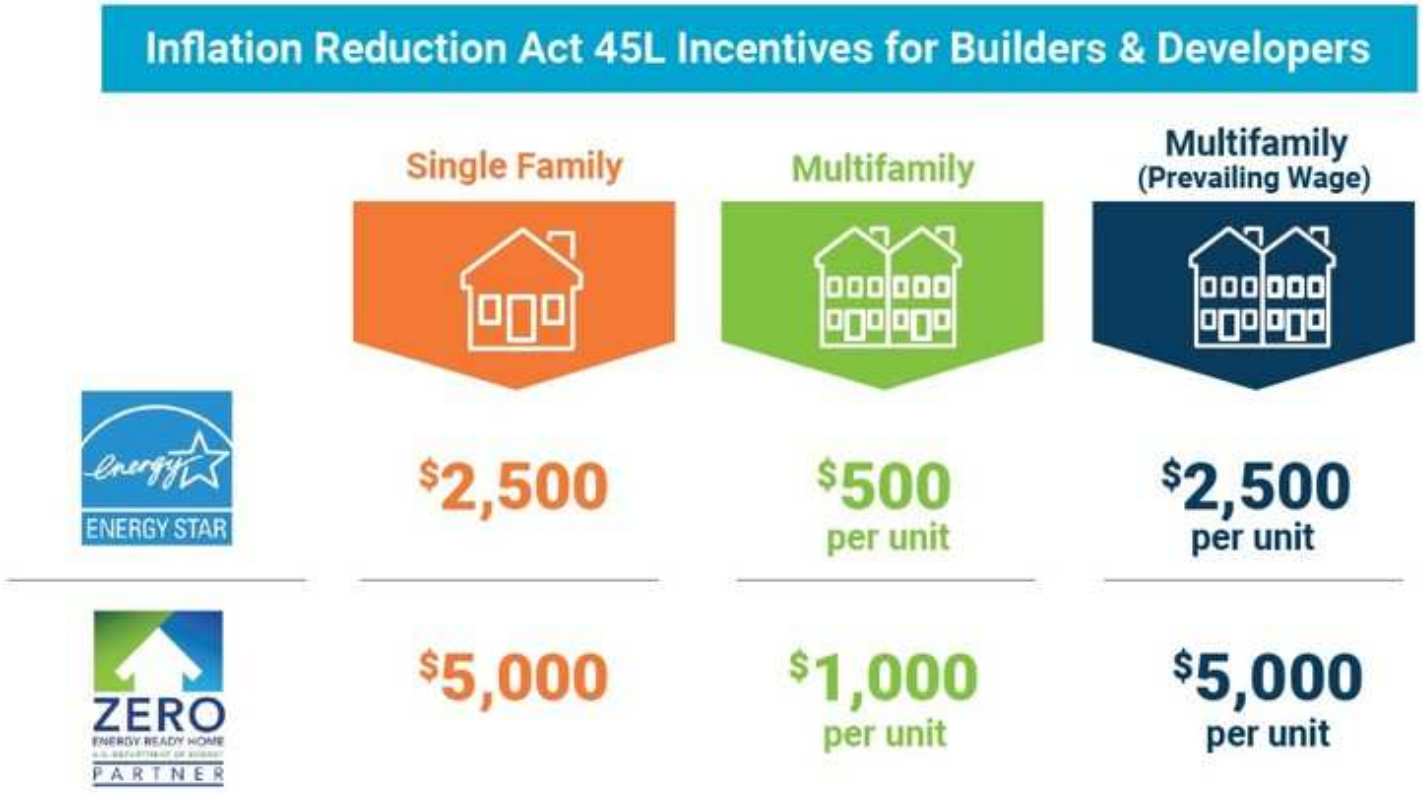
FHA-insured Multifamily: all pre-applications submitted to HUD after this date must meet IECC 2021

FHA-insured Single family: all building permit applications submitted after this date must meet IECC 2021

11/28/2025

EEBA
Energy & Environmental Building Alliance

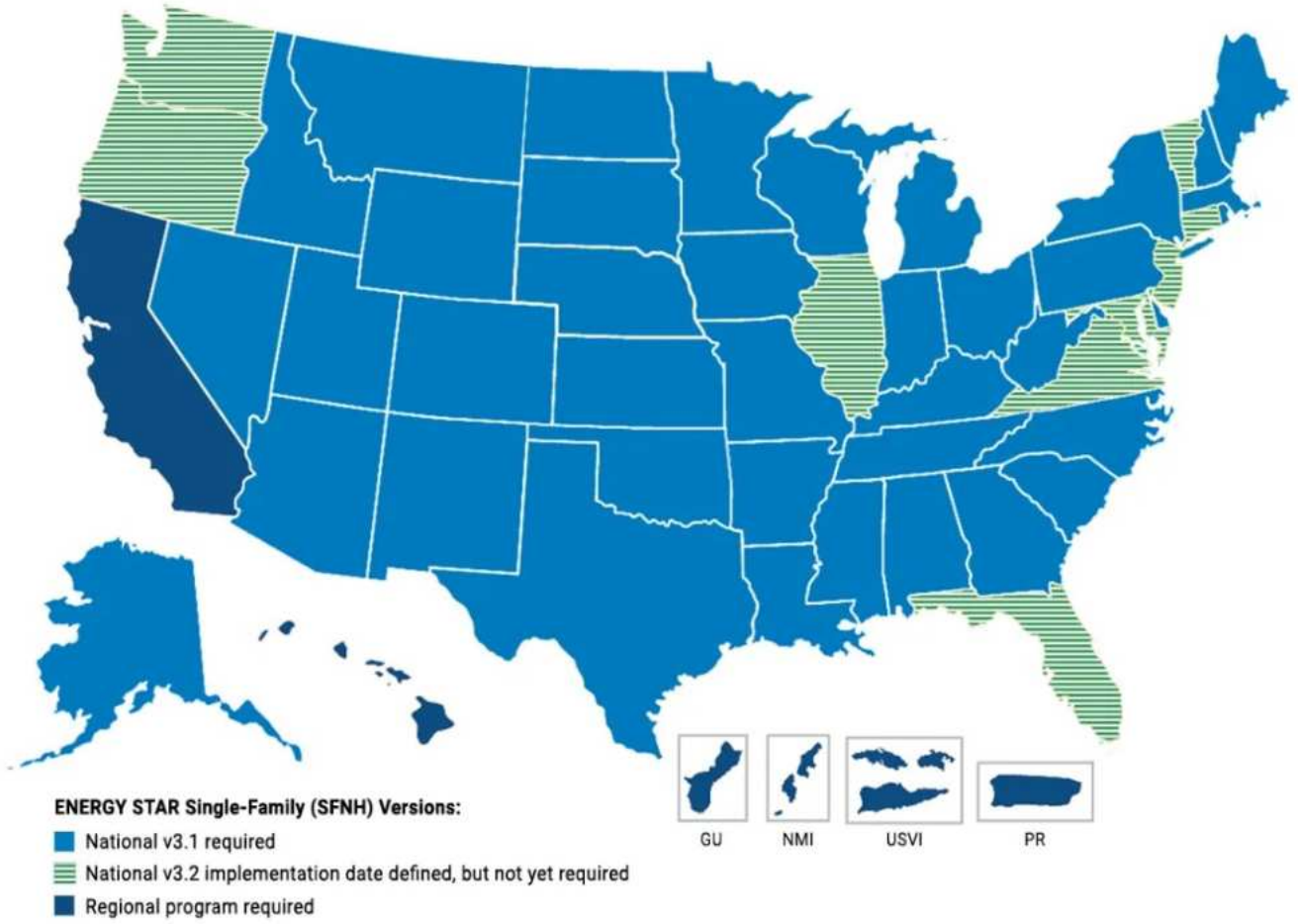
45L Incentives & the Inflation Reduction Act



Major Changes to 45L under IRA
Certainty and Timeline: Extended in the law for 10 years through 2032
Certification Requirements: Energy Star Certification (+ ZERH Certification) Mandatory Energy Star Checklist and approved energy model performance requirements Energy Star 3.1 allowed through Dec 31, 2024; Energy Star 3.2 required for homes acquired (sold) starting Jan 1, 2025

EEBA
Energy & Environmental Building Alliance

ENERGY STAR Overview



EEBA
Energy & Environmental Building Alliance

Major Changes Seen in ENERGY STAR 3.2 vs. 3.1

1. **Target HERS Score Reduced (performance – can use different mix of measures, reference home to right – one way to get there)**
   55-65 → 45-55
2. **Thermal Envelope Minimum Requirements**
   Mandatory thermal envelope minimums from 2021 IECC
3. **No new checklist items or prescriptive requirements**
   Duct leakage testing and limits required but have not increased from 3.1

Key efficiency features of National v3.2 Reference Design

Climate Zone	1	2	3	4	4C & 5	6	7	8
Thermal Enclosure								
Ceiling Insulation	R-30	R-49		R-60				
Ceiling Insulation Grade	I							
Wall Insulation	R-13 Cavity		R-20 Cavity + R-5 Continuous					
Wall Insulation Grade	I							
Frame Floor Insulation	Not present			R-19	R-30		R-38	
Floor Insulation Grade	Not present			I				
Slab Insulation & Depth	Uninsulated		R-10 2 ft	Not present				
Window U-factor / SHGC	0.40 / 0.25		0.30 / 0.40		0.27 / 0.40			
Door U-factor	0.17							
Infiltration and Mechanical Ventilation								
Infiltration (ACH50)	3				3			
Mech. Vent. Type & Efficiency (CFM / W)	Supply Fan / 2.9				Exhaust Fan / 2.8			
HVAC								
Furnace & AC Efficiency (AFUE / SEER)	80 / 16			90 / 16	95 / 14			
Heat Pump Efficiency (AFUE / SEER)	9.2 / 16							
HVAC Grade	Airflow Deviation: -20% / Watt Draw Efficiency: 0.52 W per CFM / Refrigerant Grade: III							
Thermostat Type	Programmable							
Duct Leakage to Outside (CFM / 100 ft^2 of CFA) & Insulation	0 CFM per 100 ft^2 of CFA / No Insulation (Not Applicable)							
Duct Location	100% Cond. Space							
DHW								
Efficiency & Capacity (EF / Gal.)	Gas: 0.90 / 0 (Instantaneous); Electric: 2.06 / 60							
Lighting & Appliances								
Lighting	100% Tier 2, Per ANSI / RESNET / ICC 301							
Refrigerator (kWh/yr)	450							
Dishwasher	ENERGY STAR Defaults, Per ANSI / RESNET / ICC 301							

Climate zones 1,2 reduced ACH from 4 to 3

Climate zones 3-8 stayed at ACH 3

EEBA
Energy & Environmental Building Alliance

Zero Energy Ready Home Overview

DOE ZERH

Program Version Effective Dates

National (except California)

Program Version and Revision Number	Required for Use, if Home's Permit Date is on/after this Date	Project Type
Version 1, Rev. 7	6/1/2019	Single family, multifamily up to 5 stories
Version 1, Rev. 8	1/1/2023	
Version 1, Rev. 9 [a]	1/1/2024	Multifamily, any height
Single Family Version 2, Rev. 1	1/1/2024	Single Family
Multifamily Version 2	1/1/2025	Multifamily, any height

[a] Multifamily buildings of any height certified under Version 1, Rev. 9 are deemed to meet the certification requirements for Version 1, Rev. 8 where that revision is required.

California Only

Program Version and Revision Number	Required for Use, if Home's Permit Date is on/after this Date	Project Type
CA Version 1, Rev. 7	10/1/2018 [b]	Single family, multifamily up to 5 stories
CA Version 1, Rev. 8	1/1/2023 [b]	
CA Single Family Version 2	1/1/2024	Single family
CA Multifamily Version 2 [c]	1/1/2024	Multifamily, any height

[b] If both plan approval ***and*** permit date are not on/after this date the prior revision may be used.
[c] Multifamily buildings of any height certified under CA Multifamily Version 2 are deemed to meet the certification requirements for CA Version 1, Rev. 8, where that version is required.

Manufactured Homes

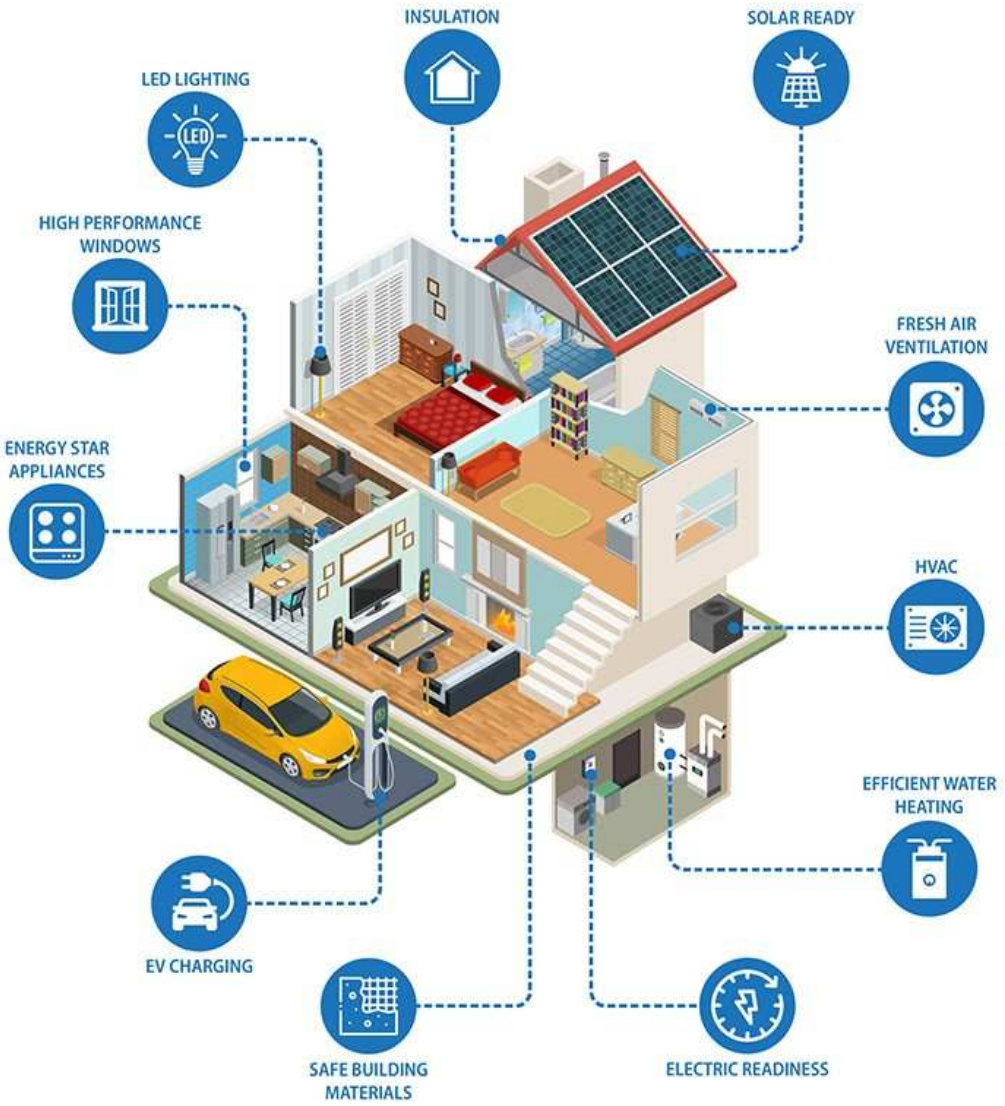
Program Version and Revision Number	Required for Use, if Home's Production Date is on/after this Date	Project Type
Manufactured Homes Version 1 (Pilot)	1/1/2023	Manufactured homes (specifications apply nationally, including California)

Exhibit 1: DOE Zero Energy Ready Home Mandatory Requirements

Component	Mandatory Requirements
1. ZERH V2 (Rev. 1) National Rater Checklist	1.1 Rater completes the DOE ZERH Single Family Homes Version 2 (Rev. 1) National Rater Checklist
2. ENERGY STAR Single Family New Homes Baseline	2.1 Certified under ENERGY STAR Single Family New Homes Version 3.2 [13]
3. Envelope	3.1 Ceiling, wall, floor, & slab insulation meet or exceed 2021 IECC UA [14,15,16] 3.2 Windows meet high performance requirements based on climate zone [17] *Advisory:* DOE is monitoring the implementation of ENERGY STAR product specifications for residential windows (V7.0), and plans to adopt these in a future program version update [18]
4. Duct System	4.1 All heating and cooling distribution ducts and heating and cooling air-handling equipment are located within the thermal and air barrier boundary. [19]
5. Water Heating Efficiency	5.1 Hot water delivery systems meet efficient design requirements. [20] ***or*** 5.2 Water heater and fixtures meet efficiency criteria. [21, 22] ***or*** 5.3 Home is certified under WaterSense Labeled Homes Version 2.0.
6. Lighting & Appliances [23]	6.1 All builder-supplied and -installed refrigerators, dishwashers, clothes washers, and clothes dryers are ENERGY STAR certified. [24, 25] 6.2 100% of builder-installed lighting fixtures and lamps (bulbs) provided are LEDs. [25,27] 6.3 All installed bathroom ventilation fans are ENERGY STAR certified. [28]
7. Indoor Air Quality	7.1 Certified under EPA Indoor airPLUS. [29] 7.2 Energy efficient balanced ventilation (HRV or ERV) is provided in Climate Zones 6-8. [30]
8. Renewable Ready	8.1 Provisions of the DOE Zero Energy Ready Home Single Family Homes Version 2 (Rev. 1) PV-Ready Checklist completed. [31]
9. Electric Vehicle Ready	9.1 One parking space is provided per dwelling unit that includes a powered 208/240V, 30A receptacle installed in dwelling unit's garage or within 6 feet of the dwelling unit's private driveway. The electric service panel identifies the branch circuit as "Electric Vehicle Charging." [32] For other parking configurations, see endnote. [33]
10. Heat Pump Water Heater Ready	10.1 Individual branch circuit outlet is installed, energized, and terminates within 3 feet of each installed fossil fuel water heater. [34] 10.2 A space is located within the home or garage that is at least 3' x 3' wide and 7' high surrounding or within 3 feet of the installed fossil fuel water heater, to facilitate future heat pump water heater installation. [35]
11. Heat Pump Space Heating Ready	11.1 Individual branch circuit outlet or conduit is installed to facilitate future wiring for a heat pump installation. Circuit or conduit labeled as "For future heat pump." [36]

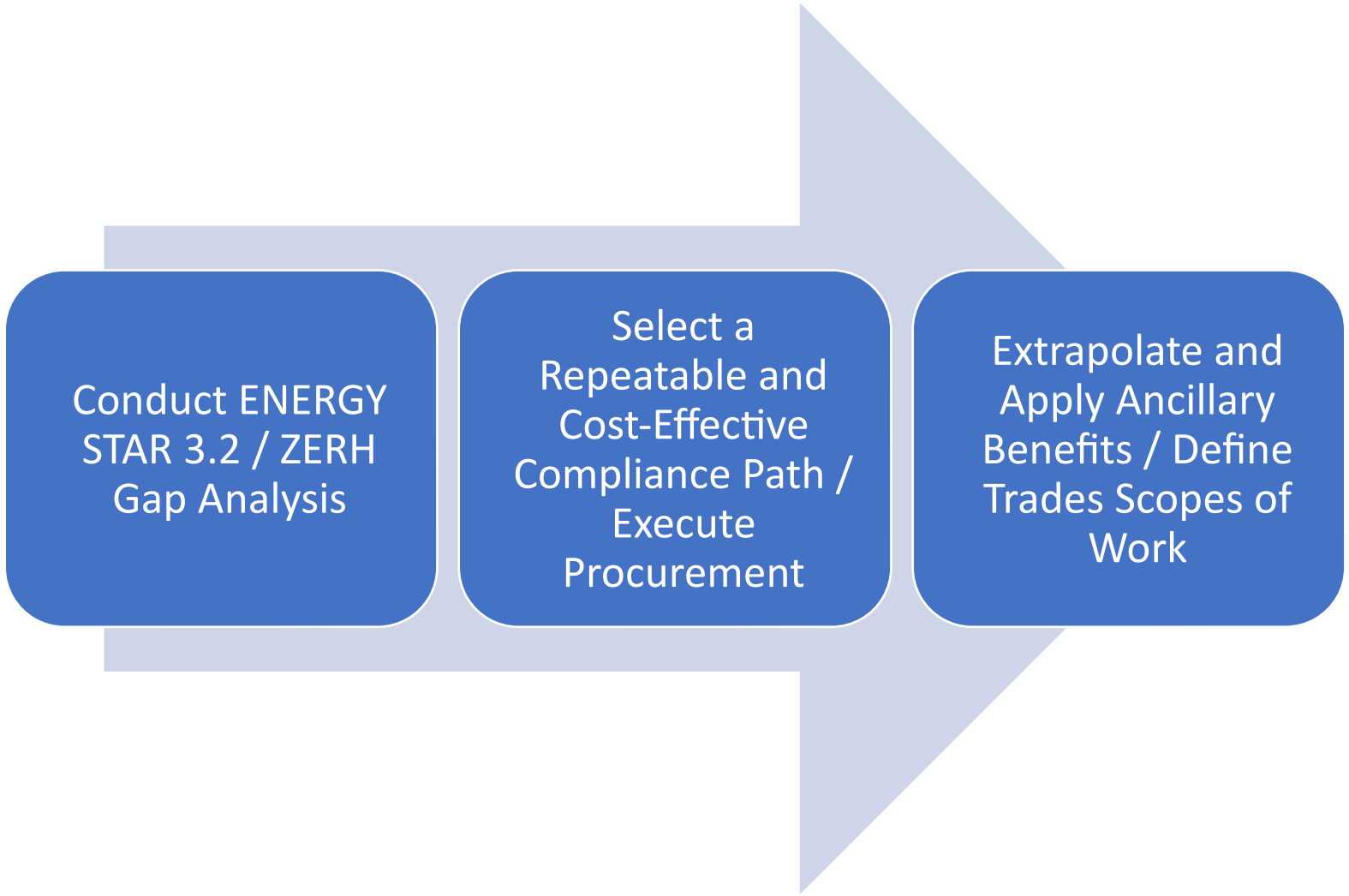
EEBA
Energy & Environmental Building Alliance

Zero Energy Ready Home Overview



EEBA
Energy & Environmental Building Alliance

Planning for ENERGY STAR 3.2 or ZERH



Planning for ENERGY STAR 3.2 or ZERH

Builder A TN Modeling

Projected Performance Modeling - EXAMPLE

*changes noted in Red

State	TN
Climate Zone	4
Ekotrope 4.1.1	

options: TH, End Unit, Attached garage, Conditioned Crawl, 2 Story, 4 BR, Worst Case Orientation - W

Building Specs - Model Crawl Space	Base Specs	RHEIA	Option 1	Option 2	Option 3	Option 4	Option 5
Slab (Below-Grade)	R-10 (Perimeter)	R-10 (Perimeter)	R-10 (2/4)	R-10 (Perimeter)	R-10 (Perimeter)	R-10 (2/4)	R-10 (2/4)
Foundation Walls	R-10 (Continuous)	R-10 (Continuous)	R-13 (Continuous)	R-13 (Continuous)	R-13 (Continuous)	R-13 (Continuous)	R-13 (Continuous)
Framed Floors	R-19	R-19	R-38	R-38	R-38	R-38	R-38
Rim Joist	R-19	R-19	R-21	R-21	R-21	R-19	R-21
Above Grade Walls	R-19	R-19	R-19	R-21	R-19	R-19	R-19
Ceiling	R-38	R-38	R-60	R-60	R-60	R-60	R-60
Windows (U/SHGC)	.30/.34	.30/.34	.30/.34	.30/.34	.28/.28	.28/.28	.30/.34
Glass Doors, Sliders (U/SHGC)	NA	NA	NA	NA	NA	NA	NA
Heating Zone 1	8.2 HSPF	8.2 HSPF	8.2 HSPF	8.2 HSPF	8.2 HSPF2	8.2 HSPF2	8.2 HSPF2
Cooling Zone 1	15 SEER	15 SEER	15 SEER	15 SEER	16 SEER2	16 SEER2	16 SEER2
Water Heating	50 gal .91 EF Elec	50 gal .91 EF Elec	50 gal. 3.42 EF HPWH	50 gal. 3.42 EF HPWH	50 gal. 3.42 EF HPWH	50 gal. 3.42 EF HPWH	50 gal .91 EF Elec
Clothes Washer / Dryer	High Efficiency	High Efficiency	High Efficiency	High Efficiency	High Efficiency	High Efficiency	High Efficiency
Whole House Mechanical Ventilation	Exhaust 50CFM	Exhaust 50CFM	ERV 84% 64CFM 28 Watts	ERV 84% 64CFM 28 Watts	ERV 84% 64CFM 28 Watts	ERV 84% 64CFM 28 Watts	ERV 84% 64CFM 28 Watts
Duct Leakage to Outside	4 CFM25 / 100 sqft.	0.25 CFM25 / 100 sqft.	0.25 CFM25 / 100 sqft.	0.25 CFM25 / 100 sqft.	0.25 CFM25 / 100 sqft.	0.25 CFM25 / 100 sqft.	0.25 CFM25 / 100 sqft.
Duct Location conditioned / unconditioned	40/60	100/0	100/0	100/0	100/0	100/0	100/0
Infiltration (ACH50)	5 ACH50	5 ACH50	4.7 ACH50	4.7 ACH50	5 ACH50	5 ACH50	2 ACH50 AEROSEAL
Design HERS Index (ENERGY STAR v3.1 Target HERS Index)	Fails 65 - Target 61	Pass 58 - Target 61	Pass 47 - Target 61	Pass 47 - Target 61	Pass 45 - Target 61	Pass 45 - Target 61	Pass 47 - Target 61
Design HERS Index (ENERGY STAR v3.2 Target HERS Index)	Fails 65 - Target 47	Fails 58 - Target 47	Pass 47 - Target 47	Pass 47 - Target 47	Pass 45 - Target 47	Pass 45 - Target 47	Pass 47 - Target 47
ES 3.2 Fail notes:	Specified envelope UA is 255 BTU / hF. This exceeds the 2021 maximum of 231 BTU / hF	Specified envelope UA is 255 BTU / hF. This exceeds the 2021 maximum of 231 BTU / hF					

EEBA
Energy & Environmental Building Alliance

How Builders Can Achieve ENERGY STAR & ZERH

The Technical Elements

Critical Elements	ENERGY STAR v3.2	DOE ZERH	Complexity
1. Insulation values to IECC 2021 - - Attics, walls, foundations	*YES*	*YES*	*?*
2. Ducts in Conditioned Space	*YES*	*YES*	*?*
3. Air tightness	*3.0 ACH*	*1.5 to 2.75 ACH*	*?*
4. Ventilation	*Supply or Exhaust*	*Balanced*	*?*
5. Heating & cooling Verification	*ACCA 310*	*ACCA 310*	*?*
6. Water heating efficiency	*UEF 0.9 to 2.2*	*UEF 0.95 to 2.57*	*?*
7. Indoor AirPlus	*NO*	*YES*	*?*
8. EV, PV, HPWH Ready	*NO*	*YES*	*?*

EEBA
Energy & Environmental Building Alliance

Look for Ways to Make the Process SIMPLER

Critical Elements	ENERGY STAR v3.2	DOE ZERH	Complexity
1. Insulation values to IECC 2021 - - Attics, walls, foundations	*YES*	*YES*	*High*
2. Ducts in Conditioned Space	*YES*	*YES*	*High*
3. Air tightness	*3.0 ACH*	*1.5 to 2.75 ACH*	*Low to Medium*
4. Ventilation	*Supply or Exhaust*	*Balanced*	*Medium*
5. Heating & cooling Verification	*ACCA 310*	*ACCA 310*	*Medium*
6. Water heating efficiency	*UEF 0.9 to 2.2*	*UEF 0.95 to 2.57*	*Low*
7. Indoor AirPlus	*NO*	*YES*	*Low*
8. EV, PV, HPWH Ready	*NO*	*YES*	*Low*

EEBA
Energy & Environmental Building Alliance

What Homebuilders Can Do

Enclosure Opportunities

Use energy modeling to help make informed choices

- Better attics
- Better windows
- Better foundations
- Better walls
- As tight as possible

….Then optimize HVAC

EEBA
Energy & Environmental Building Alliance

Enclosure Opportunities – Air Sealing

Air Sealing Considerations

- What is your primary air barrier?
  - Drywall, sheathing, WRB, poly?
- Which contractors are involved?
- What accessory materials are compatible?
  - Caulks, foams, tapes, gaskets, sealants
- How do you know you will “pass”?

Your goal should be 1.5 to 2.0 ACH

EEBA
Energy & Environmental Building Alliance

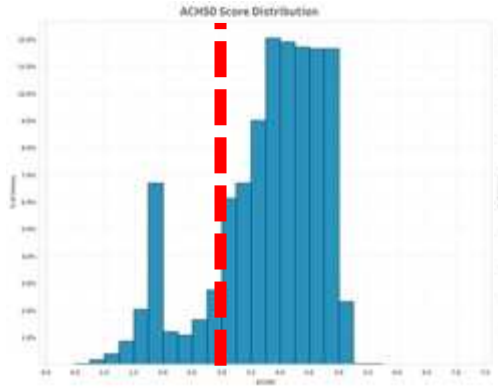
Enclosure Opportunities – Air Sealing

Air Sealing Advantages

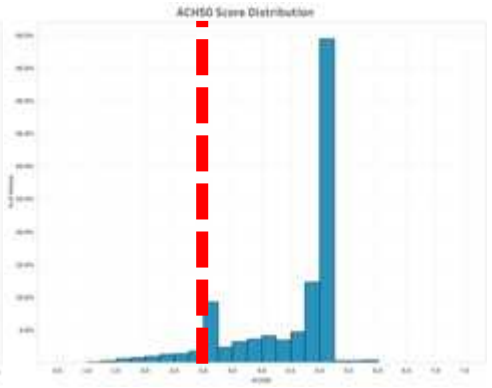
- Most cost effective energy reduction
- Manages moisture - summer and winter
- Reduces noise, dust, bugs
- More effective use of trade skills and technology
- “Blower door directed, automated” air sealing to confirm results

EEBA
Energy & Environmental Building Alliance

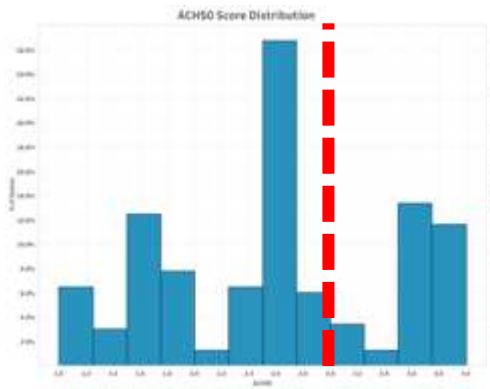
Where are We Today?
Envelope Air Tightness Comparison Across Markets



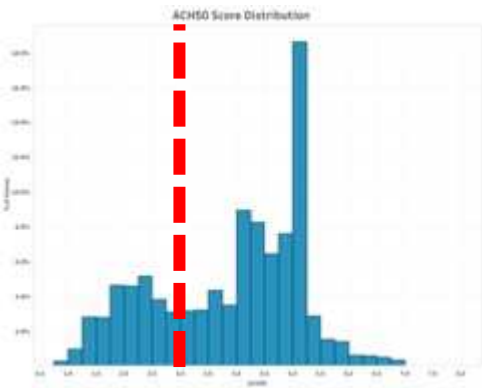
Houston



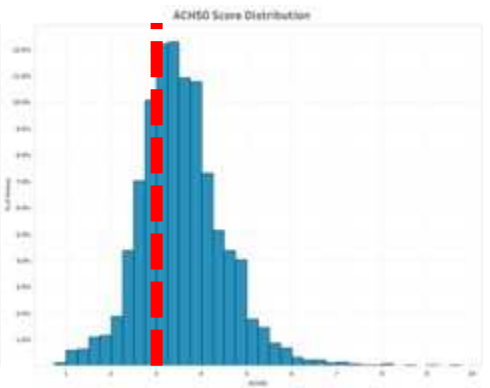
Phoenix



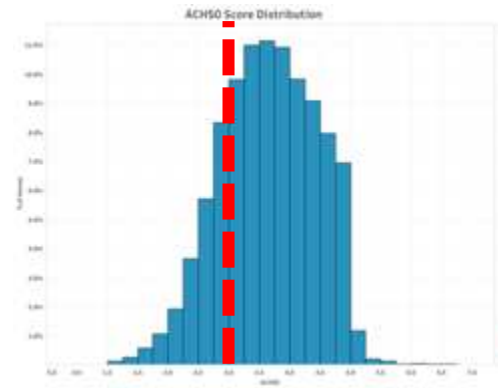
San Diego



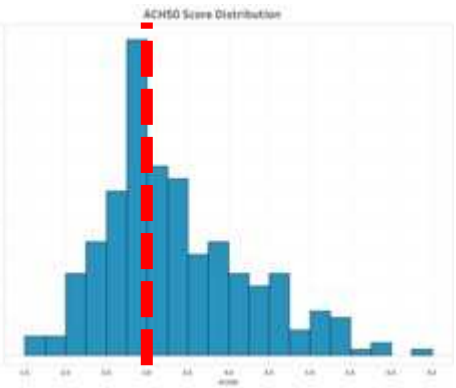
Atlanta



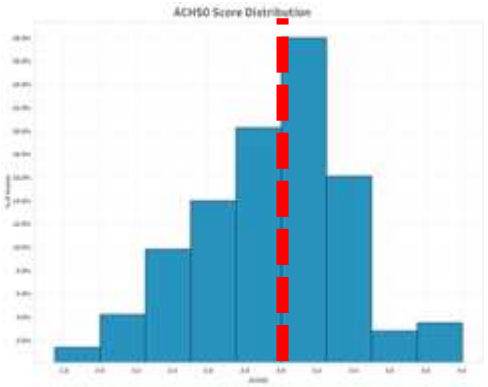
Raleigh



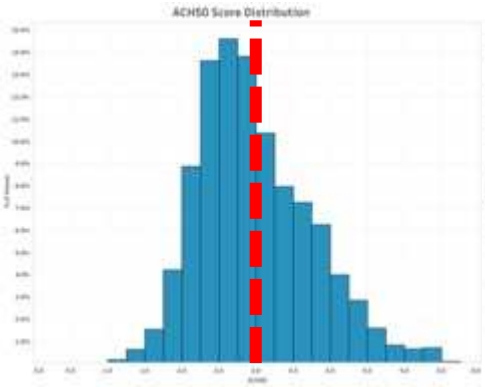
Indianapolis



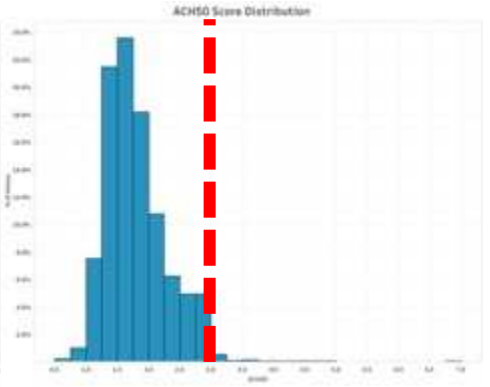
Seattle



Salt Lake City



Chicago



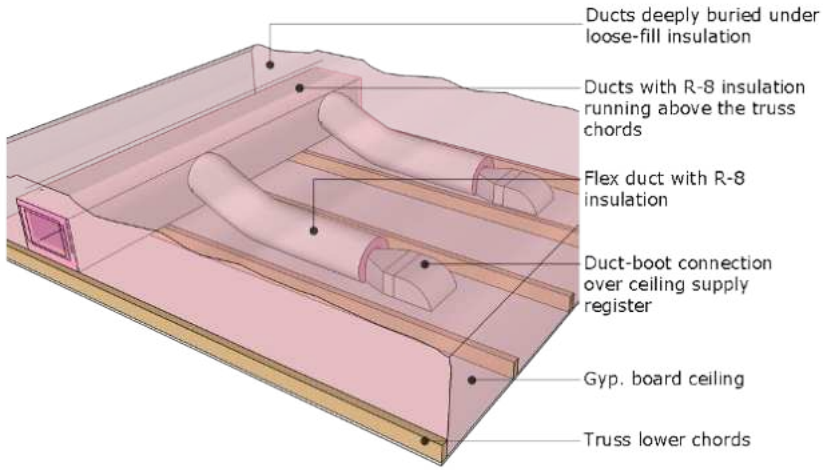
Minneapolis

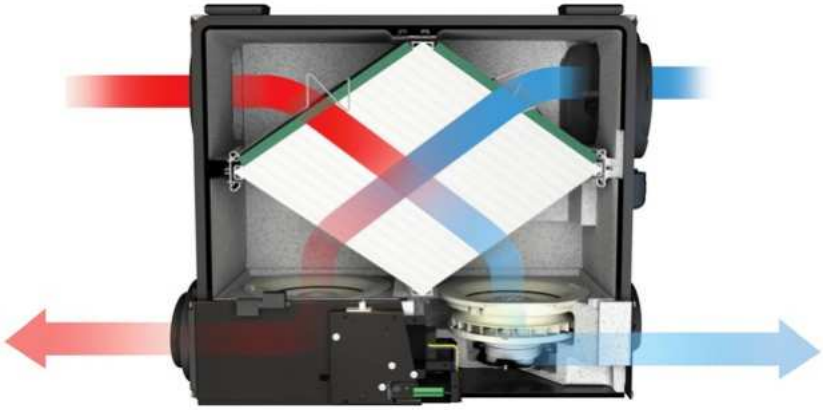
Single family detached homes, 9.10.22 – 9.9.23, Data provided by Ekotrope

= 3 ACH50

EEBA
Energy & Environmental Building Alliance

What Homebuilders Can Do





HVAC Opportunities

Use energy modeling to help make informed choices

- Location and conditioning – attic, inside house, under insulation, in attic boxes….
- Ventilation strategy – ERV or HRV or exhaust only?
- HVAC Grading vs. Contractor Commissioning
- Room by room air balancing
- Load center calculations and design
- EV & PV consideration
- Radon

EEBA
Energy & Environmental Building Alliance

Lessons Learned by Homebuilders: Panelists & Audience

Lessons Learned

- Trade relationships are important
- How to balance related product limits with need for ENERGY STAR & ZERH strategies
- Local inspectors sometimes hesitant about newer solutions
- Regional differences and their impact on meeting energy efficiency requirements – impact glass in Florida

Questions From the Audience

EEBA
Energy & Environmental Building Alliance

Closing Remarks

Thank you….
now go get those $ incentives!

Bill Shadid
Aeroseal
Strategic Marketing
bill.shadid@aeroseal.com

Gord Cooke
Construction Instruction
Partner
gord@constructioninstruction.com

Matthew Cooper
PEG
SVP & COO
mcooper@pegenv.com

Megan Cordes
Beazer Homes
Dir. Of Sust. & Bldg. Science
megan.cordes@beazer.com

Philip Squires
Mattamy Homes
VP Sust. & Procurement
philip.squires@mattamycorp.com

Bill Rectanus
Thrive Home Builders
COO
brectanus@thrivehomebuilders.com

EEBA
Energy & Environmental Building Alliance