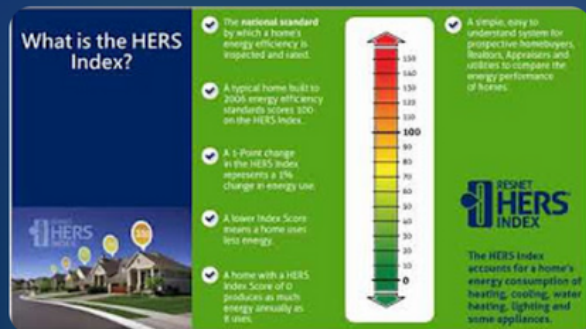




Armando Cobo





DOE Zero Energy Ready

GreenHome Institute

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▶ Play all

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≡ Sort



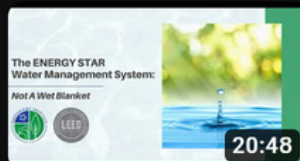
Understanding RESNET's Home Energy Rating System HERS Index

GreenHome Institute • 2.3K views • 4 years ago



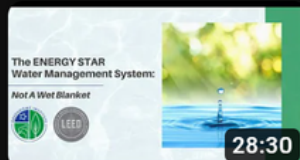
Residential ENERGY STAR Certification: Revision 11 Overview

GreenHome Institute • 396 views • 2 years ago



The ENERGY STAR Water Management System: Not A Wet Blanket | Part 1 of 3

GreenHome Institute • 209 views • 3 years ago



The ENERGY STAR Water Management System: Not A Wet Blanket | Part 2 of 3

GreenHome Institute • 128 views • 3 years ago

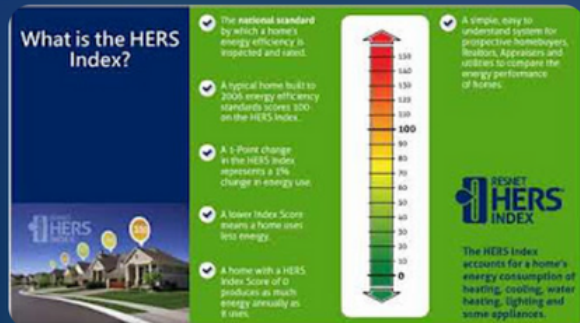


The ENERGY STAR Water Management System: Not A Wet Blanket | Part 3 of 3

GreenHome Institute • 94 views • 3 years ago

Watch the DOE Zero Energy Ready Homes Playlist

<https://greenhomeinstitute.org/zeroenergyreadyplaylist>



DOE Zero Energy Ready

GreenHome Institute

Public

10 videos 34 views Last updated on Mar 1, 2023



▶ Play all

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No description



Achieving Indoor airPLUS on residential buildings Part 1 - Introduction

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Achieving Indoor airPLUS on residential buildings Part 3 Program Requirements

GreenHome Institute • 60 views • 4 years ago



Achieving Indoor airPLUS on residential buildings Part 4 Marketing - Q&A - Conclusion

GreenHome Institute • 50 views • 4 years ago



Real Time Energy Model to meet, beat code and get IRA 45L

GreenHome Institute • 206 views • 1 month ago

Watch the DOE Zero Energy Ready Homes Playlist

<https://greenhomeinstitute.org/zeroenergyreadyplaylist>

Under the proposed Indoor airPLUS Version 2:



The new “Indoor airPLUS Certification” specifications focus on fundamental strategies to improve indoor air quality without a prerequisite of ENERGY STAR certification.



The new “Indoor airPLUS Gold” specifications include more advanced protections for improved indoor air quality in conjunction with ENERGY STAR certification as a prerequisite.

Comment Deadline April 3rd <https://www.epa.gov/indoorairplus/indoor-airplus-version-2>

Indoor airPLUS Version 2, 2023 Public Comment Documents

Comments on the following documents may be submitted through April 24, 2023.

Executive Summary and Highlights

- [Draft Indoor airPLUS Version 2 Executive Summary_\(pdf\)](#) (110.46 KB, February 2023)
- [Draft Indoor airPLUS Version 2 Highlights Summary of Proposed Updates - 2nd Public Comment_\(pdf\)](#) (234.92 KB, February 2023)

Program Requirements and Specifications

Home Certification Organizations (HCOs)

Home Certification Organizations (HCOs) are independent organizations recognized by EPA to implement an ENERGY STAR certification program based on the ENERGY STAR Residential New Construction program requirements for site-built [single-family](#) and [multifamily](#) homes and apartments when an Energy Rating Index (ERI) or dwelling unit modeling compliance path is used. Energy Rating Companies (e.g., rater companies and Providers) providing third-party verification for these compliance paths are required to operate under an HCO.

EPA has recognized the following organizations as Home Certification Organizations (HCOs):

HOME CERTIFICATION ORGANIZATIONS (HCOs)	
National ¹	
Residential Energy Services Network (RESNET)	EXIT →
Building Science Institute (BSI)	EXIT →
California ²	
Residential Energy Services Network (RESNET)	EXIT → in partnership with CalCerts
CHEERS	EXIT → in partnership with the National Energy Registry

ID#10431

Credit Name	EAc1 - Annual energy use
Credit Category	Energy & atmosphere
International Applicable	No
Campus Applicable	No



Rating System

LEED BD+C: Homes

Rating System Version

v4 - LEED v4

Inquiry

According to the US DOE "Zero Energy Ready Homes are at least 40%-50% more energy efficient than a typical new home. This generally corresponds to a Home Energy Rating System (HERS) Index Score in the low- to mid-50s, depending on the size of the home and region in which it is built." \n\n

Interpretation 10398 states that projects that receive ENERGY STAR for Homes v3 certification may automatically earn a HERS 70.

Can projects that earn the DOE Zero Energy Ready Home label also receive a HERS equivalency?

Ruling

Projects that earn the DOE Zero Energy Ready Home certificate may automatically earn a 15 points in EA credit Annual Energy Use.

In addition, projects that earn the DOE Zero Energy Ready Home certificate meet the following credits and prerequisites:

EA prerequisite Minimum energy performance (Required)

EA prerequisite Education of homeowner, tenant, or building manager (Required)

EA credit Efficient hot water distribution system Option 2. Performance test (3 points)

EA credit Active solar-ready design (1 point)

EA credit HVAC Start-up credentialing (1 point)

EA credit Annual energy use (15 points)

IN credit Innovation ZERH (1 point)



Projects also meet the requirements of all credits and prerequisites deemed equivalent to the EPA Indoor airPLUS program.

<https://www.usgbc.org/leedaddenda/10431>



Annual energy use

Energy and Atmosphere

Possible 29 Points

[Language](#)[Guide](#)[Addenda](#)[Resources and tips](#)[Course](#)

Intent

To improve the home's overall energy performance and reduce its g

Requirements

Projects with *major energy users not included in the HERS Index*, in
or other major energy users not included in the HERS index must use



58	15
56	16
54	17
52	18
50	19
45	20
40	21
35	22
30	23
25	24
20	25
15	26
10	27
5	28
0	29

12	0	0	Indoor Environmental Quality		18
Y			Prereq	Ventilation	Required
Y			Prereq	Combustion Venting	Required
Y			Prereq	Garage Pollutant Protection	Required
Y			Prereq	Radon-Resistant Construction	Required
Y			Prereq	Air Filtration	Required
Y			Prereq	Environmental Tobacco Smoke	Required
Y			Prereq	Compartmentalization	Required
			Credit	Enhanced Ventilation	3
2			Credit	Contaminant Control	2
3			Credit	Balancing of Heating and Cooling Distribution Systems	3
			Credit	Enhanced Compartmentalization	3
2			Credit	Enhanced Combustion Venting	2
1			Credit	Enhanced Garage Pollutant Protection	1
3			Credit	Low Emitting Products	3
1			Credit	No Environmental Tobacco Smoke	1



<https://www.usgbc.org/credits?>

Version=%22v4%22&Rating+System=%22Homes%22&Category=%22Indoor+environmental+quality%22

23 - 29 points in LEED Out
of 40 required
For Zero Energy Ready

5.2b

Optional | 15 points maximum | Automatic Qualification for Enterprise Green Communities Plus
Moving to Zero Energy: Near Zero Certification

Projects located in Climate Zone 1A, 2A, 3A or 4A following this criterion must also comply with Criterion 7.8.

5.2a

Optional | 5 to 12 points

Moving to Zero Energy: Additional Reductions in Energy Use

Projects located in Climate Zone 1A, 2A, 3A, or 4A following this criterion must also comply with Criterion 7.8.

**CATEGORY 5
OPERATING ENERGY**

Select construction and location type:

New
Construction

Substantial
Rehab

Moderate
Rehab

Rural / Tribal / Small Towns

Urban / Suburban

First 20 Cohort

▼ 2020 Criteria

Introduction

✓ Checklist

27 points of the 40 needed on new construction or
35 major rehab
Good for 3 Michigan Low Income Tax Credit Points

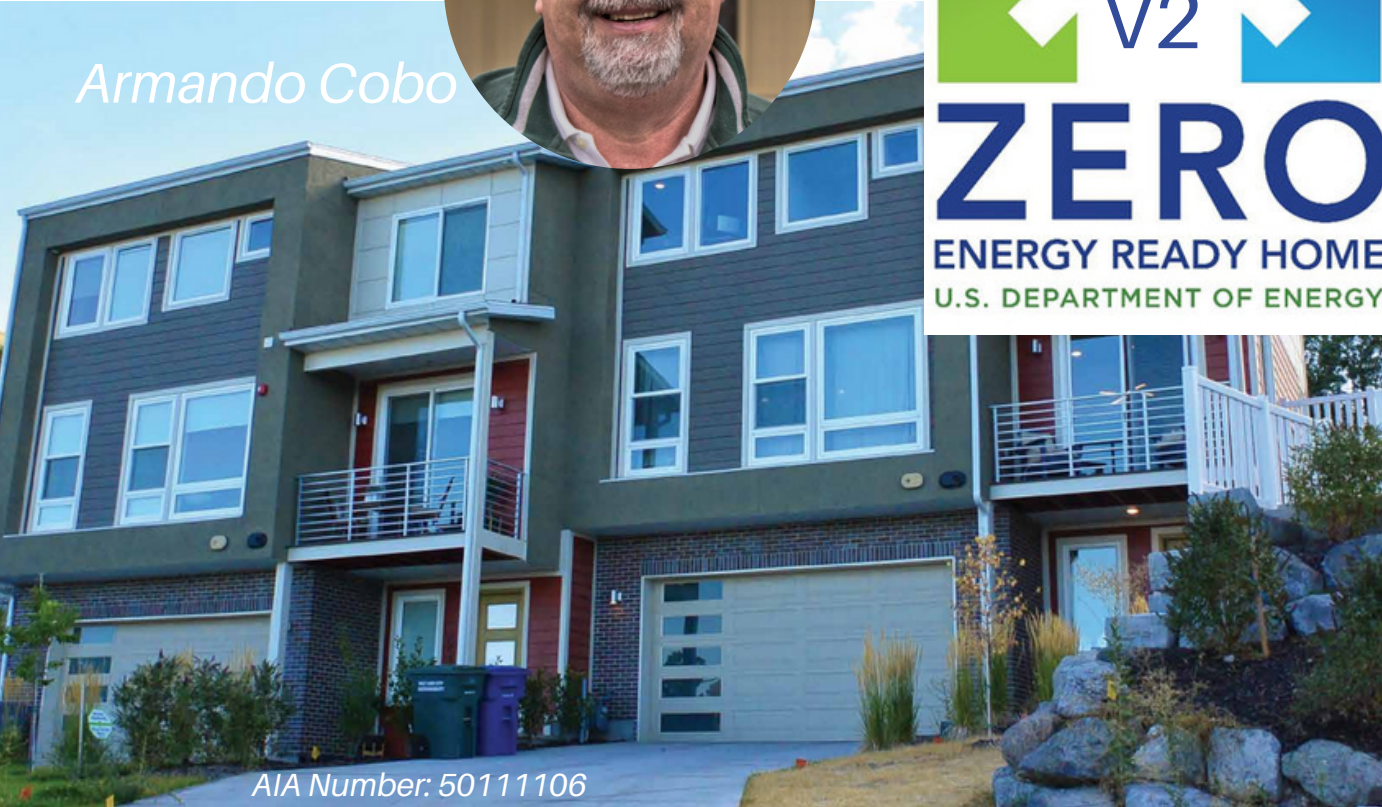
	Measures	Level Renovations	DOE ZERO Energy Ready Equilivant
Achieving?			
Yes	Home Energy Cost Rating and Performance Testing Opportunities	Certified	Yes
Yes	Moisture and wall water leak assessment + repair	Certified	Yes
Yes	Properly exhausting bath fans in each bathroom	Certified	Yes
Yes	Electric stove OR Range Hood is tested to vent at 100 CFM outdoors	Certified	Yes
Yes	Test combustion based appliances for CO leaks and replace or repair if found	Certified	Yes
Yes	Carbon Monoxide detectors are installed on all floors and near	Certified	Yes
Yes	Use at least MERV 8 Rated Filters on Ducted Systems	Certified	Yes
Yes	Use steel braided hoses or drainpans under clothes washers	Certified	Yes
Yes	Drains under tank water heater in or above living space	Certified	Yes
Yes	Gutter system draining away from home or well-draining sandy soils	Certified	Yes
Yes	A majority of lighting should be LED or CFL	Certified	Yes
Yes	Attached Housing Only - Reduce air leaks between units	Certified	Yes
Yes	If fireplace exists ensure occupants are not exposed to bad air quality	Certified	Yes
No	Determine the project's future climate risks	Certified	
No	No gas leaks found from inspection	Certified	
Maybe	No radon detected above PCL 4 when tested or sytem installed	Certified	Zone 1 yes
No	Shower head(s) are under 2.2 Gallons Per Minute (Average) Or Home Water Score of 2	Certified	
No	Bathroom Aerators are under 2.0 Gallons Per Minute (Average) Or Home Water Score 2	Certified	
No	Toilets are under 1.6 Gallons per Flush (average) Or Home Water Score of 2	Certified	
No	Plumbing leak and pressure test shows no leaks	Certified	



<https://greenhomeinstitute.org/greenstar-homes-certification-manual-2/>



Armando Cobo



Zero Energy Ready Home Program Version 2



GreenHome Institute
Armando Cobo
ZERH Program Instructor
3/29/2023

Armando Cobo, Designer

CoboDesigner.com

972-781-8724

What is the DOE ZERH Program?

A nationally-recognized voluntary certification program focused on:



- Energy efficiency
- GHG reductions
- Indoor air quality
- Comfort
- Moisture management
- Renewable readiness
- Electric readiness (V2)

What does the ZERH program do?

- Recognizes “high performance” new homes that meet rigorous criteria
- Certification system for 45L tax credit
- Encourages adoption of energy efficiency technology innovations
- Provides participating builders and programs with resources to promote benefits of high performance, low emission homes to homebuyers



A Symbol of Excellence

HEALTHFUL ENVIRONMENT



COMFORT PLUS



ADVANCED TECHNOLOGY



ULTRA EFFICIENT



QUALITY BUILT



DURABILITY

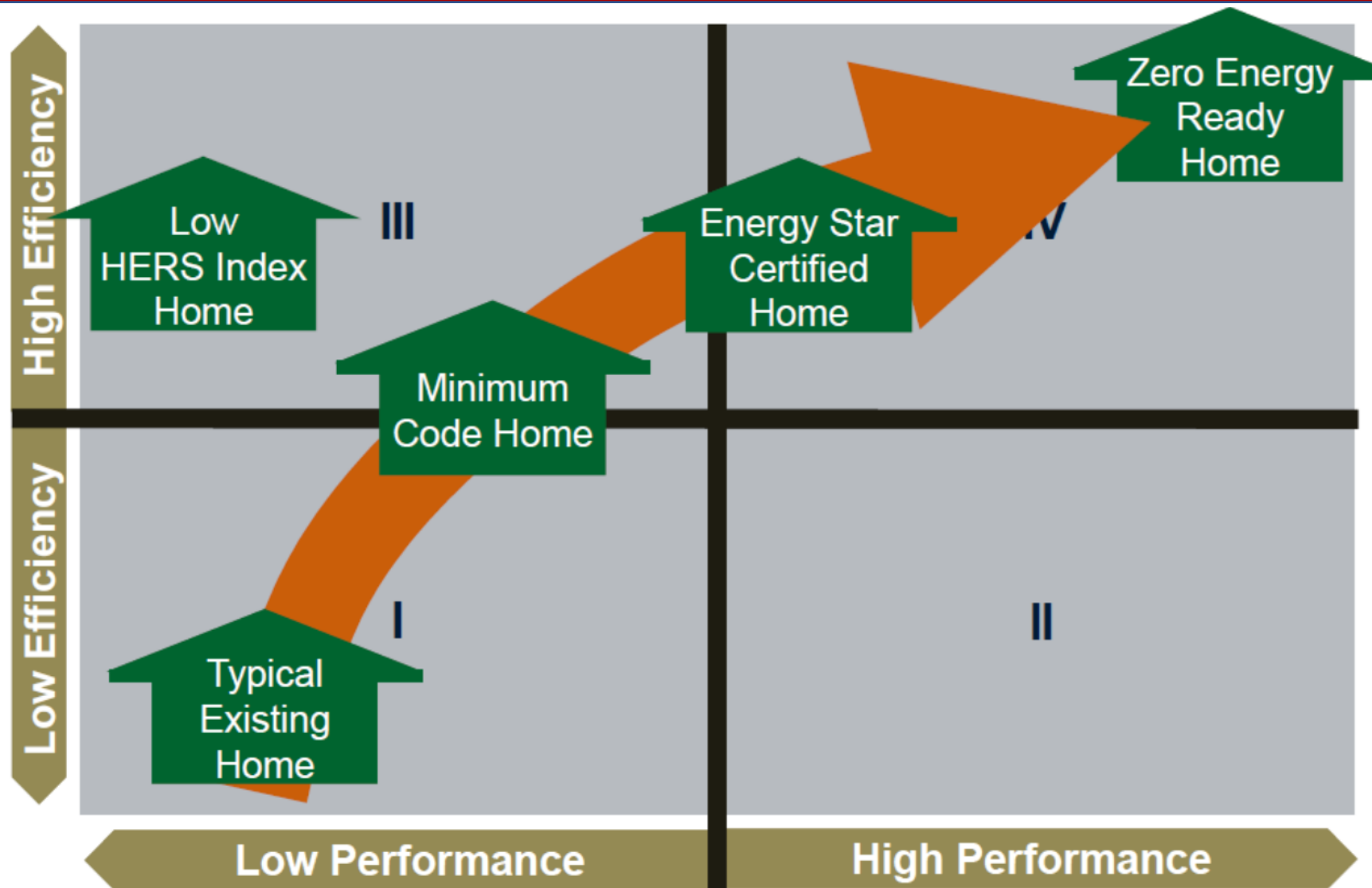


KEY

- DOE Zero Energy ReadyHome
- ENERGY STAR Certified Home
- Existing Home

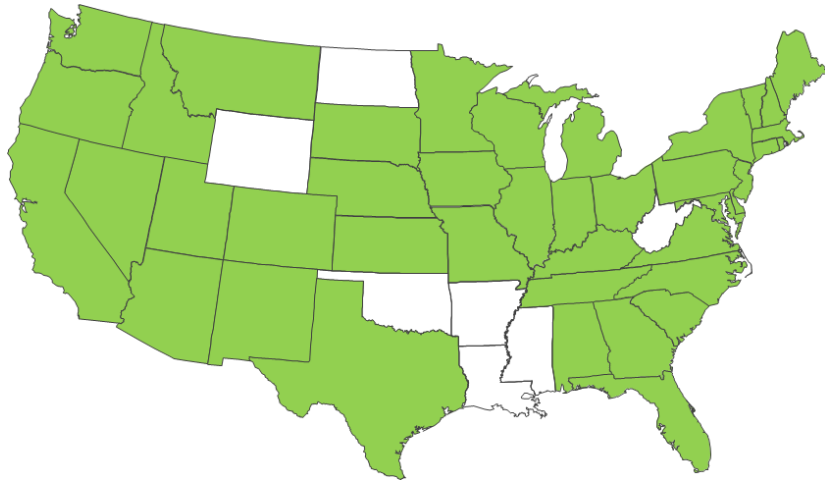
This label indicates relative performance of this DOE Zero Energy Ready Home to existing homes (built between 1990 and 2010) and ENERGY STAR Certified Homes. Actual performance may vary.





Time is now

Zero Energy Ready Home Program Version 2



**12,000+ Certified to
DOE Zero Energy Ready Home.**

- **RESNET IN 2022**
- **RESNET ~ 335,000/yr**
- **58 is Average HERS score – v2: 40s**



Single Family



Townhomes



Duplexes



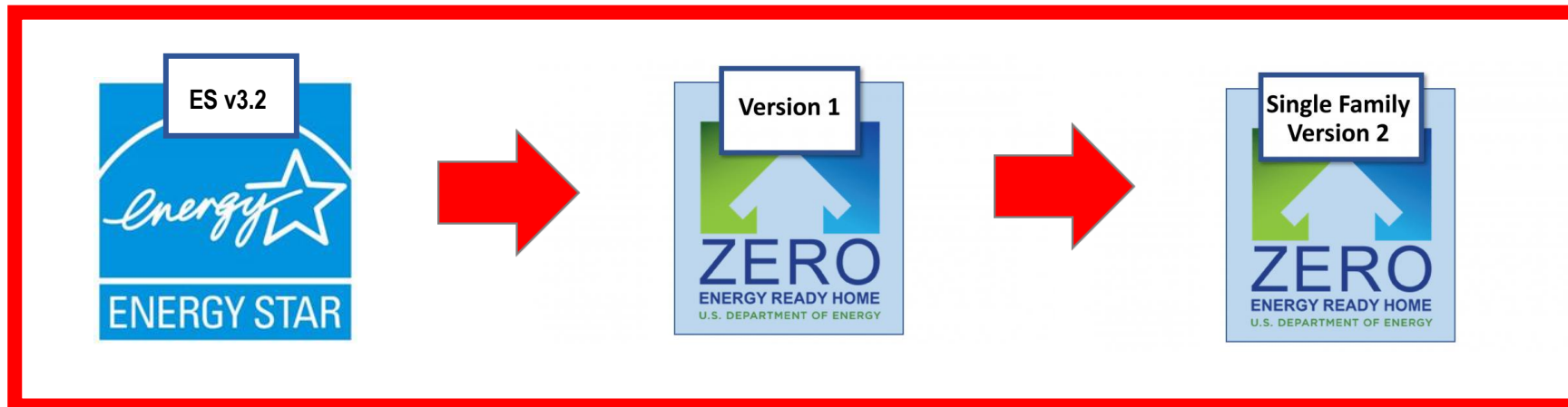
Manufactured Housing



Multifamily (up to 5 stories)

Builders - Must be certified by DOE - Recognized ZERH Certification Organizations – 1/01/2023

Verifiers - Must be certified by DOE - Recognized ZERH Certification Organizations – 1/01/2023



Pilot Program Development



Specifications under development by DOE.



Important: The table below provides program version eligibility dates for ZERH certification by building sector, based on permit date. However, beginning January 1, 2023, the 45L tax credit for ZERH certification is based on the date a home is acquired. To ensure 45L eligibility, please refer to [45L Tax Credits for Zero Energy Ready Homes](#).

DOE ZERH • Program Versions and Implementation Timelines

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. 06	7/20/2017	Single family, multifamily up to 5 stories
Version 1, Rev. 07	6/1/2019	
Version 1, Rev. 08	1/1/2023	
Single Family Version 2	1/1/2024	Single Family
Multifamily Version 2	TBD (may be optionally used after publication)	Multifamily, any height

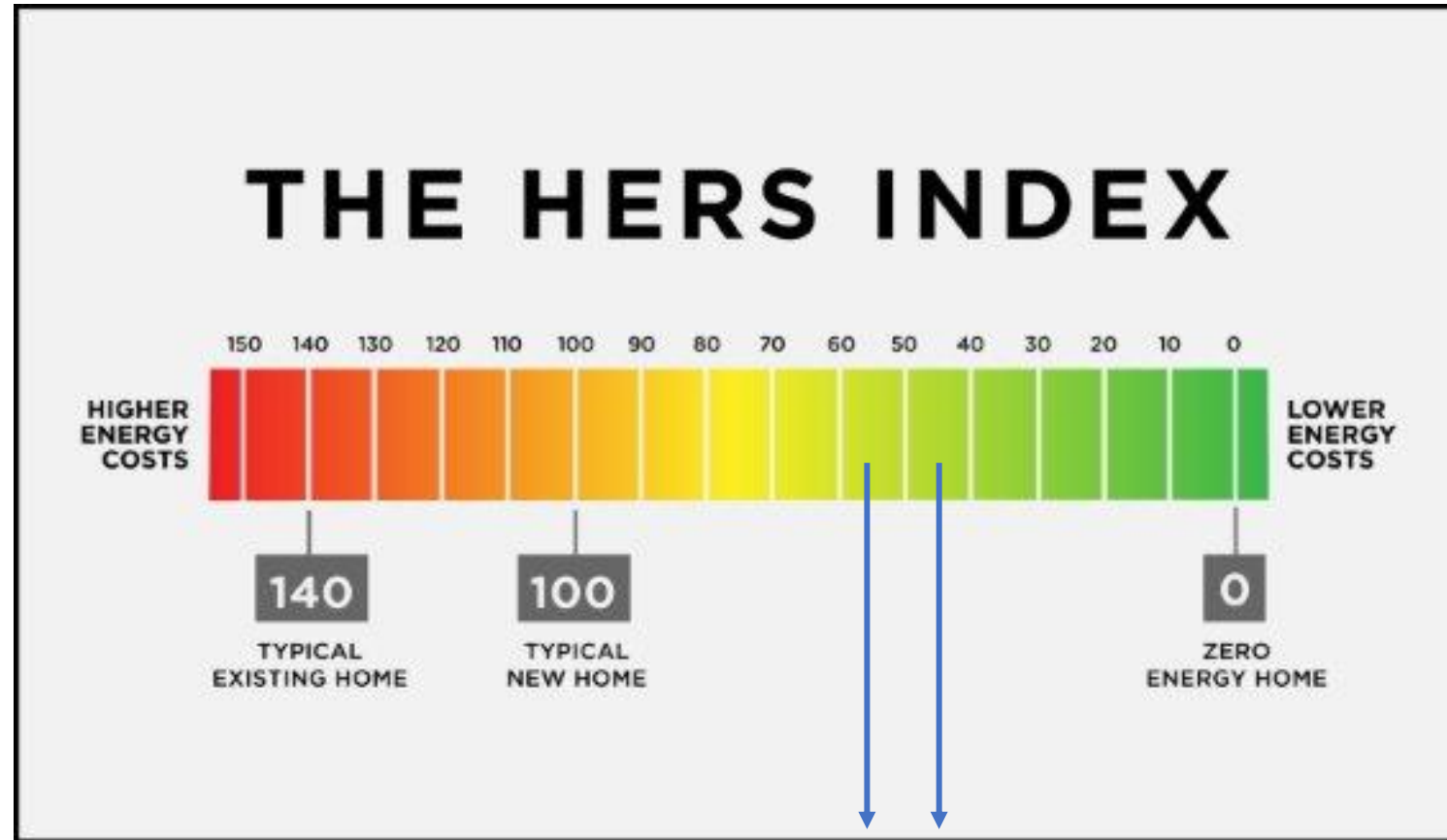
California Only

Program Version and Revision Number	Required for Use, if Home's Permit/Plan Approval Date is on/after this Date	Project Type
CA Version 1, Rev.07	10/1/2018	Single family, multifamily up to 5 stories
CA Version 1, Rev.08	1/1/2023	
CA Single Family Version 2	TBD (may be optionally used after publication)	Single family
CA Multifamily Version 2		Multifamily, any number of stories

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)
Manufactured Homes Version 2	TBD (may be optionally used after publication)	





The Inflation Reduction Act of 2022 Tax Credit – Section 45L

Zero Energy Ready Home
Program Version 2



2022: the old version of 45L was sunset on December 31, 2022. Energy savings requirement was 50% reduction in heating/cooling energy relative to reference home (2006 IECC). It will probably haunt us for a while, but it's no longer available for new homes.

2023: 45L **extended** to 2032 (10 years)!

Unprecedented stability; previously tax credit needed to be extended every year or so.

2023–2032: energy savings requirements are based on **Certification** under the ENERGY STAR Residential New Construction Program (lower tier) and the DOE Zero Energy Ready Home Program (upper tier).



Available to Homebuilders

<https://www.energy.gov/eere/buildings/45l-tax-credits-zero-energy-ready-homes>

Tiers of 45L Tax Credits, 2023-2032

Home Type	Efficiency Standard	Base Credit	Bonus Credit (prevailing wage)
Single-family	Energy Star Single-Family New Homes Program	\$2,500	
	DOE Zero Energy Ready Home Program	\$5,000	
Manufactured	Energy Star Manufactured Homes National Program	\$2,500	
	DOE Zero Energy Ready Home Program	\$5,000	
Multi-family	Energy Star Manufactured National and Regional Program	\$500/unit	\$2,500/unit
	DOE Zero Energy Ready Home Program	\$1,000/unit	\$5,000/unit



How to Get to Zero

DOE ZERH Mandatory Requirements

Zero Energy Ready Home Program Version 2



Component	Mandatory Requirements
1. ZERH V2 National Rater Field Checklist	<input type="checkbox"/> Rater completes the DOE ZERH – Single Family Homes Version 2 National Rater Field Checklist
2. ENERGY STAR Single Family	<input type="checkbox"/> Certified under ENERGY STAR Single Family New Homes Version 3.2 ¹¹
New Homes Baseline	
3. Envelope	<input type="checkbox"/> Ceiling, wall, floor, & slab insulation meet or exceed 2021 IECC UA ^{12,13,14} <input type="checkbox"/> Windows meet high performance requirements based on climate zone ¹⁵ <i>Advisory:</i> 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 ¹⁶
4. Duct System	<input type="checkbox"/> All heating and cooling distribution ducts and heating and cooling air-handling equipment are located within the thermal and air barrier boundary ¹⁷
5. Water Heating Efficiency	<input type="checkbox"/> Hot water delivery systems meet efficient design requirements ¹⁸ <i>or</i> <input type="checkbox"/> Water heater and fixtures meet efficiency criteria ¹⁹
6. Lighting & Appliances	<input type="checkbox"/> All builder-supplied and -installed refrigerators, dishwashers, clothes washers, and clothes dryers are ENERGY STAR qualified ^{20, 21} <input type="checkbox"/> 100% of builder-installed lighting fixtures and lamps (bulbs) provided are LEDs ²² . <input type="checkbox"/> All installed bathroom ventilation and ceiling fans are ENERGY STAR qualified ²³
7. Indoor Air Quality	<input type="checkbox"/> Certified under EPA Indoor airPLUS ²⁴ <input type="checkbox"/> Energy efficient balanced ventilation (HRV or ERV) is provided in Climate Zones 6-8 ²⁵

DOE ZERH Mandatory Requirements

Zero Energy Ready Home Program Version 2



8. Renewable Ready	<input type="checkbox"/> Provisions of the DOE Zero Energy Ready Home PV-Ready Checklist Version 2 are Completed ²⁶
9. Electric Vehicle Ready	<input type="checkbox"/> One parking space is provided per dwelling unit that includes a powered 208/240V, 40A receptacle installed in garage or within 3 feet of driveway or dedicated parking space. The electric service panel identifies the branch circuit as "Electric Vehicle Charging." ²⁷
10. Heat Pump Water Heater Ready	<input type="checkbox"/> Individual branch circuit outlet is installed, energized, and terminates within 3 feet of each installed fossil fuel water heater, and a space located within the home or garage that is at least 3' x 3' wide and 7' high shall be available surrounding or within 3 feet of the installed fossil fuel water heater, to facilitate future heat pump water heater installation. ²⁸
11. Heat Pump Space Heating Ready	<input type="checkbox"/> Individual branch circuit outlet is installed or conduit is installed to facilitate future wiring for a heat pump installation. Circuit or conduit labeled as "For future heat pump." ²⁹

HVAC Equipment ³¹ DOE Zero Energy Ready Home Target Home			
	Very Hot & Hot Climates (2021 IECC Climate Zones 1,2)	Warm & Mixed Climates (2021 IECC Climate Zones 3, 4A, 4B)	Cold & Very Cold Climates (2021 IECC Climate Zones 4C, 5,6,7,8)
Furnace AFUE	80%	CZ3: 92%; CZ4: 95%	95%
SEER	18	16	16 (ASHP); 14 (A/C)
HSPF	9.2	9.2	9.5
Boiler AFUE	80%	CZ3: 92%; CZ4: 95%	95%
Whole-House Mechanical Ventilation System Efficiency	2.9 cfm/W no heat exchange	2.9 cfm/W no heat exchange	1.2 cfm/W; balanced with heat exchange, 65% ASRE

DOE ZERH Mandatory Requirements

Zero Energy Ready Home Program Version 2



HVAC Grading					
• Airflow Deviation: Grade I, -7.5%		• Watt Draw Efficiency: Grade I, 0.45 cfm/W		• Refrigerant Grade (as applicable): Grade III	
Insulation and Infiltration					
• Insulation levels modeled to 2021 IECC Prescriptive values and achieve Grade 1 installation, per ANSI / RESNET / ICC Standard 301					
• Infiltration – SF Detached Dwelling units ³² (ACH50): CZs 1-2: 2.75 CZ 3,4A, 4B: 2.25 CZs 4C, 5-7: 2.0 CZ 8: 1.5					
• Infiltration – SF Attached Dwelling units (duplexes, townhouses) (ACH50): 3.0 (all Climate Zones)					
Windows					
2021 IECC Climate Zone	1 – 2	3	4A, 4B	4C, 5	6 – 8
U-Value	0.40	0.30	0.30	0.27	0.25
SHGC	0.23	0.25	0.40	Any	Any
Doors					
Door Type	Opaque	≤ ½-Lite	> ½-Lite		
Climate Zone	All	All	1 – 3	4 - 8	
Door U-Value	0.17	0.25	0.30	0.30	
Door SHGC	Any	0.25	0.25	0.40	
Water Heater					
DHW equipment modeled at the following applicable efficiency levels based on Uniform Energy Factor (UEF):					
• Electric Systems: UEF = 2.57					
• Gas / Propane Systems: UEF = 0.95					

Ducts and Thermostat³³

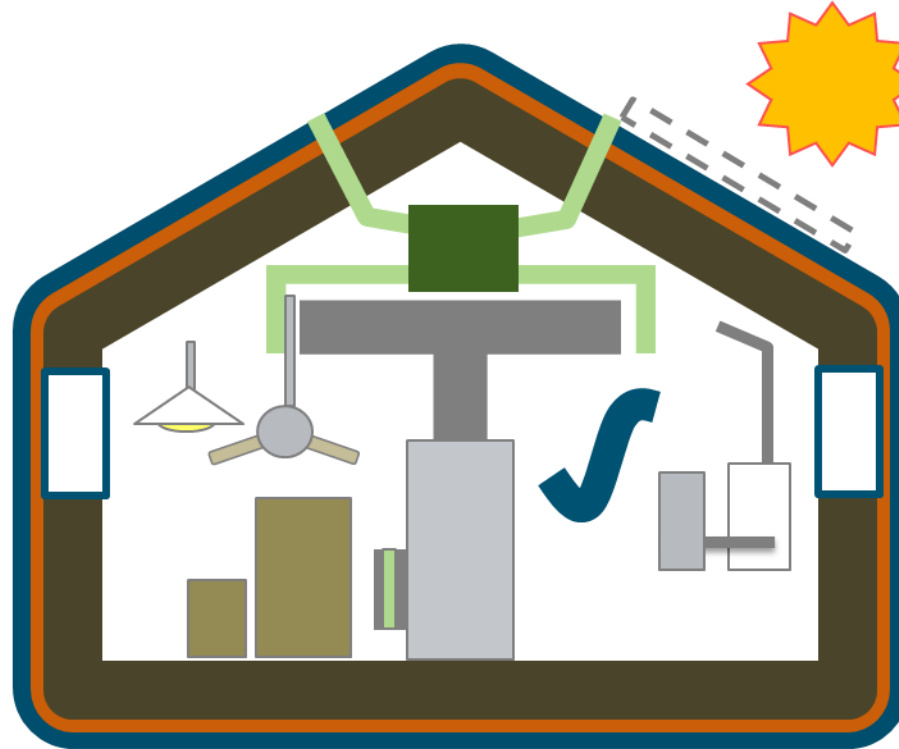
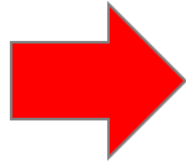
- All ducts and air handlers modeled within conditioned space, uninsulated, with no leakage to the outside
- Programmable thermostat

Lighting & Appliances

- For purposes of calculating the DOE ZERH Target Home ERI, homes shall be modeled with an ENERGY STAR dishwasher, ENERGY STAR refrigerator; ENERGY STAR ceiling fans (if used), and ENERGY STAR lamps (bulbs) or fixtures in 100% of Qualifying Light Fixture Locations as defined by ANSI / RESNET / ICC Standard 301-2019.



ES v. 3.2



ZERH v2

Optimized
Enclosure
System

Water
Protection
System

Optimized
Comfort
System

Complete
IAQ
System

Efficient
Comps
System

Solar
Ready
System

Optimized
Enclosure
System

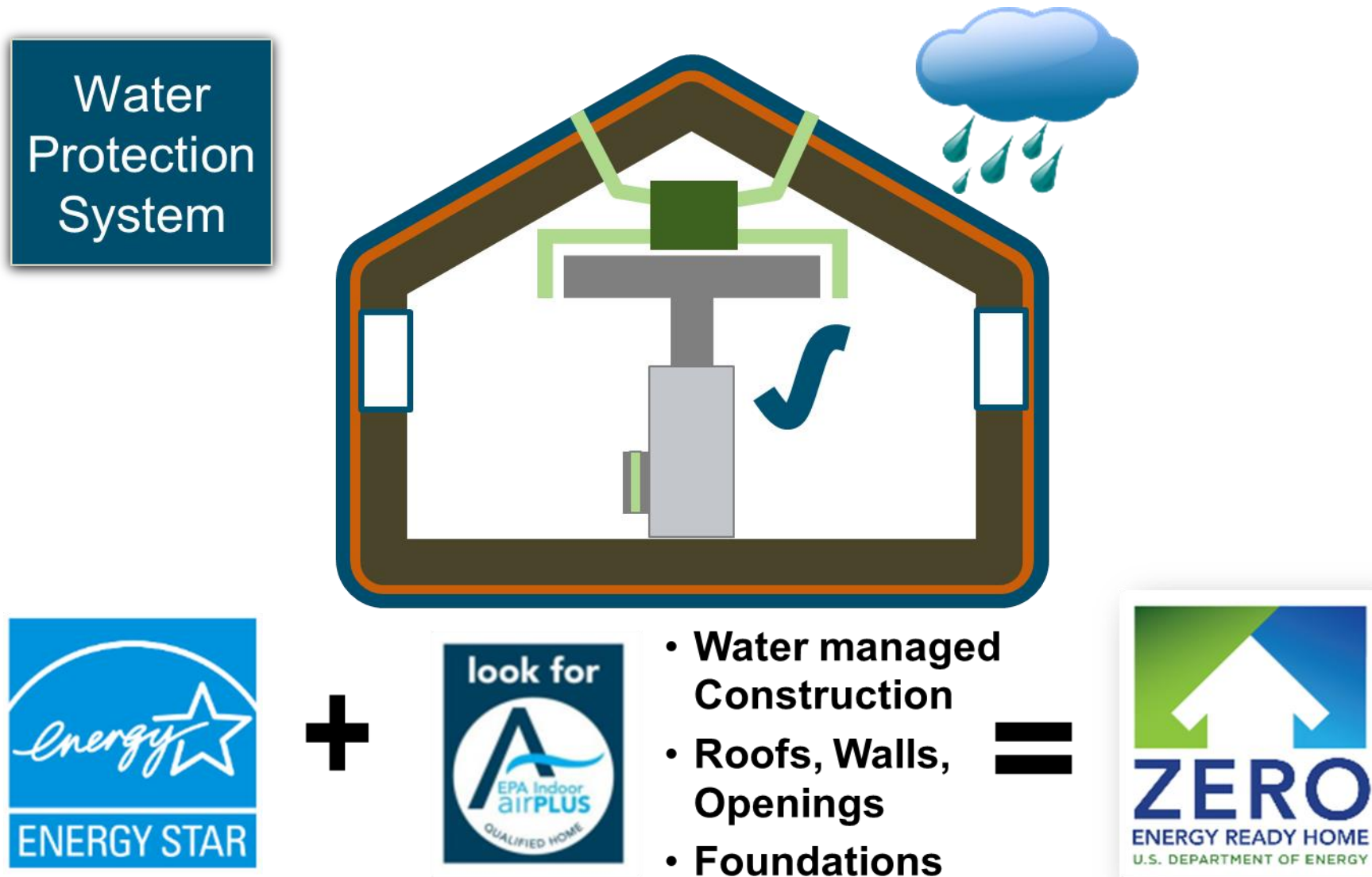


2021 IECC Envelope
Insulation

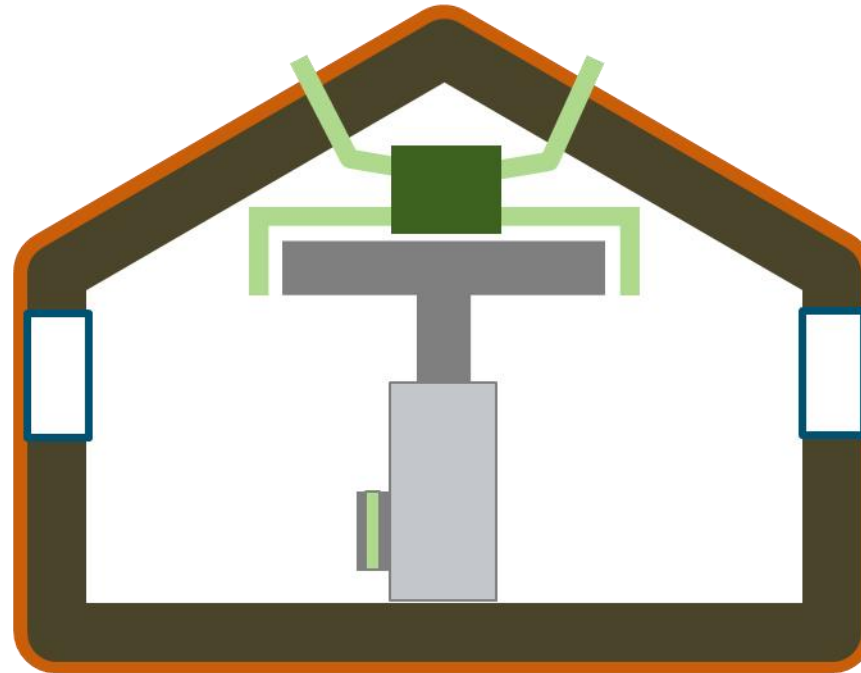
+ **TIGHT CONSTRUCTION** **=**

Performance Windows





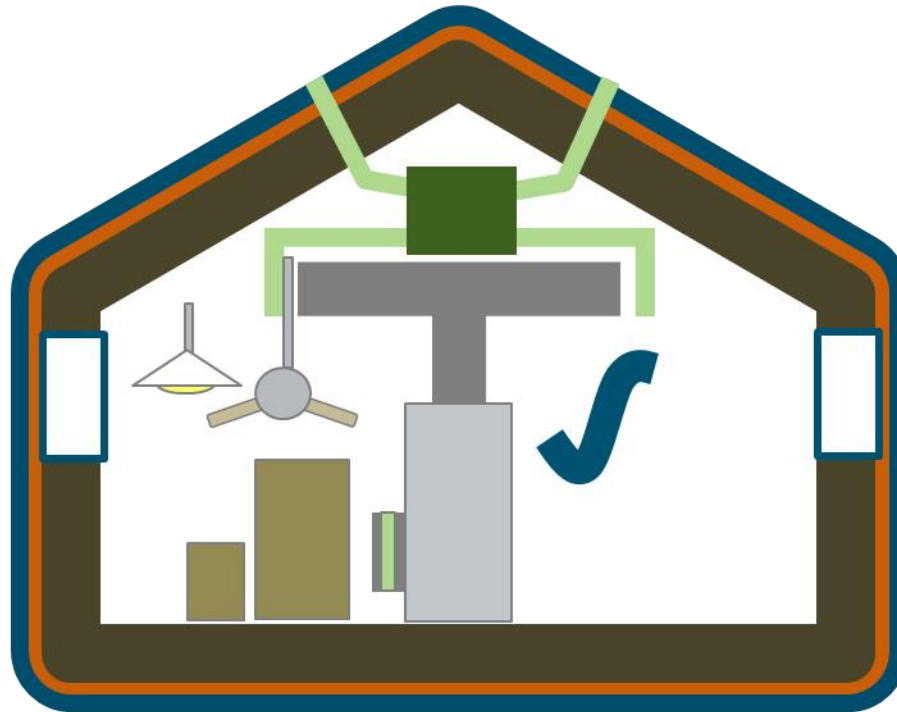
Complete
IAQ
System



- Radon
- Low Emission Materials
- Combustion Safety
- High MERV Filter



Efficient
Components
System



* Target only



ENERGY STAR:

- Appliances
- Exhaust Fans
- Ceiling Fans
- Water Heating*

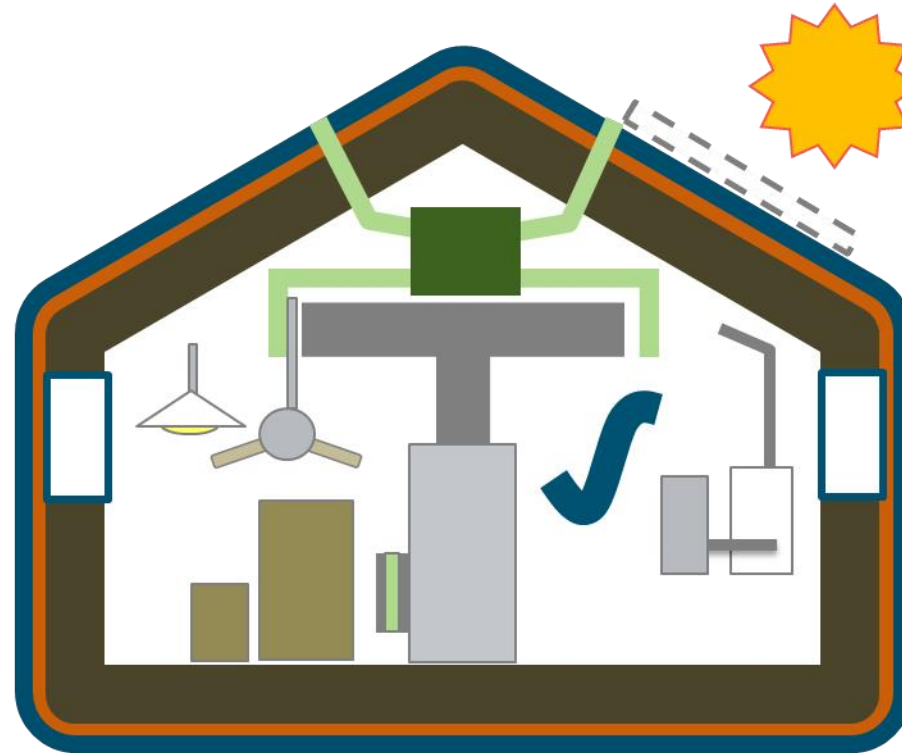


Efficient:

- Lighting
- Hot Water Distribution
- Equipment*



Solar
Ready
System

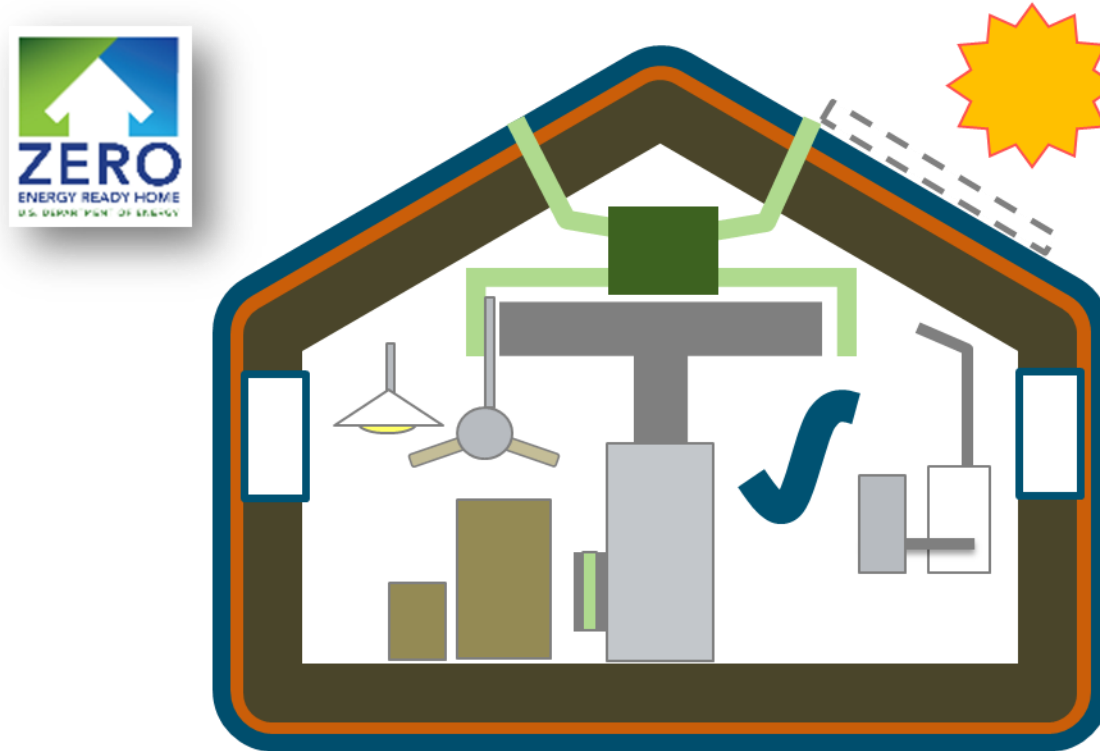


+

DOE ZERH
PV-Ready Checklist

=





High-performance home, so energy efficient,
all or most annual energy consumption
can be offset by renewable energy.

Moving to ZERH

Zero Energy Ready Home Program Version 2



		Solar Ready	HPWH Ready	PV Ready Checklist	Solar Ready
		Eff. Comps.& H ₂ O Distrib.	H ₂ O Distrib.	1 EV Ready Minimum	Eff. Comps.& H ₂ O Distrib.
		EPA Indoor Air Package	EPA Indoor Air Package	High Eff. Lighting	EPA Indoor Air Package
		Ducts in Condit. Space	Ducts in Condit. Space	100% High Eff. Lighting	Ducts in Condit. Space
HVAC QI with WHV	HVAC QI with WHV	HVAC QI with WHV	HVAC QI with WHV	HP Space Ready	HVAC QI + HRV
Water Management	Water Management	Water Management	Water Management	Certify IAP v1	Water Management
Independent Verification	Independent Verification	Independent Verification	Independent Verification	ES Builder Appliances	Independent Verification
IECC 2009 Enclosure	IECC 2021 Enclosure	IECC 2015 Enclosure	IECC 21 Enclosure	High-Performance Windows	Ultra-Efficient Enclosure
HERS 65-75	HERS 50s	HERS 48-55	HERS 40s	No SAF	HERS 35-45
ENERGY STAR v3	ENERGY STAR v3.2	ZERH v1	ZERH v2		PHIUS+

Envelope Airtightness

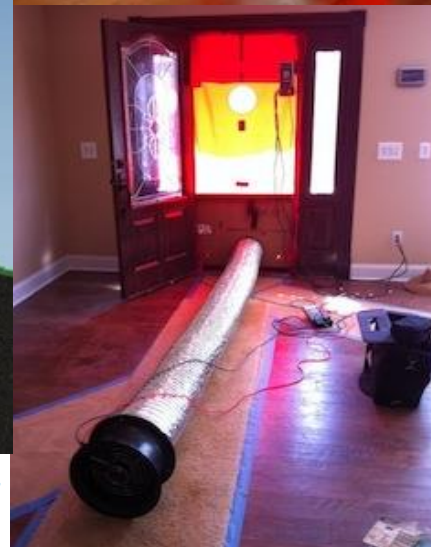
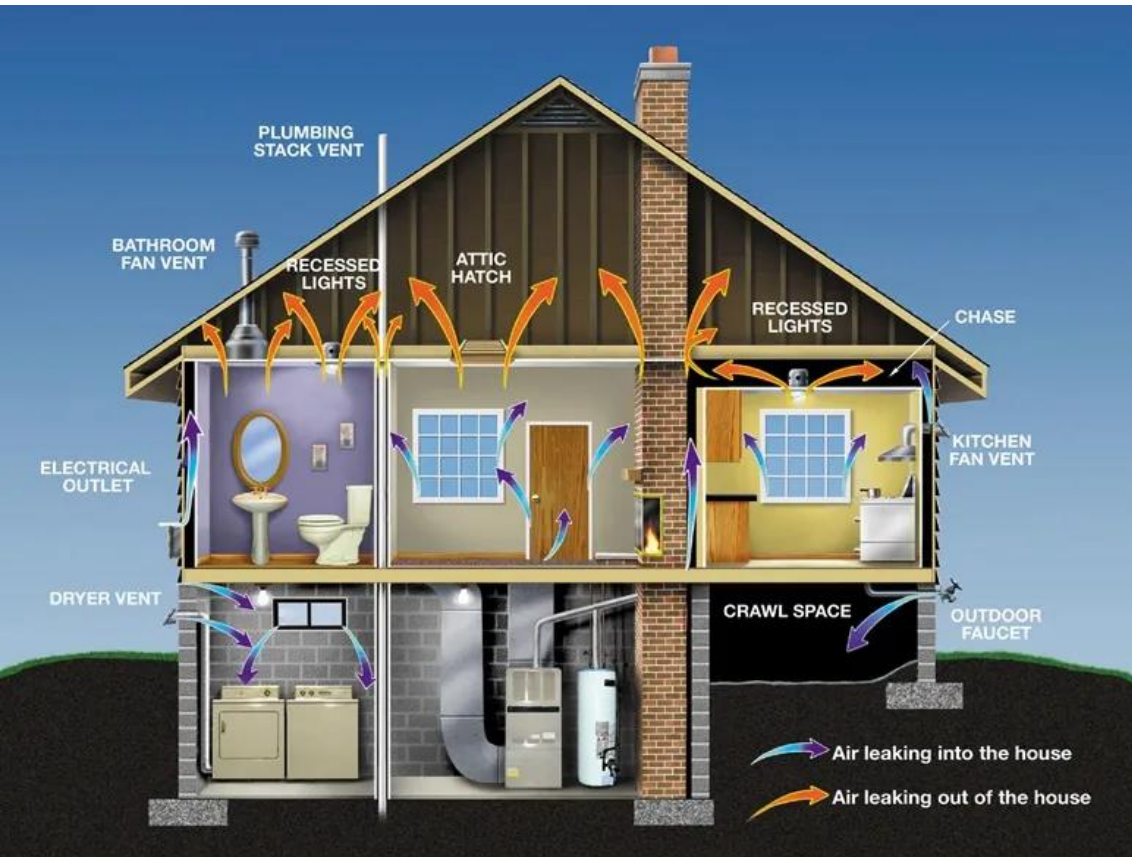
The resistance to inward or outward air leakage through unintentional leakage points or areas in the building envelope.

Trust But Verify

Zero Energy Ready Home Program Version 2



Blower Door, Duct Testing & Infrared Leakage



Armando Cobo, Designer

CoboDesigner.com

972-781-8724

High-Performance Walls and Roofs Options

Specific wall technologies will depend on climate, costs, construction type, and other design considerations for each builder. They are just examples of systems that could be considered.

Advanced Framing with Thicker Wall

- 2x4 & 2x6 @ 24" o.c. with rigid insulation
- Staggered studs (2x4) with 2x6 or 2x8 plates

Rigid Insulation Exterior Sheathing

- Continuous Rigid Insulation w/Sheathing
- Continuous Rigid Insulation w/o Sheathing

Structural Insulated Panels (SIPs)

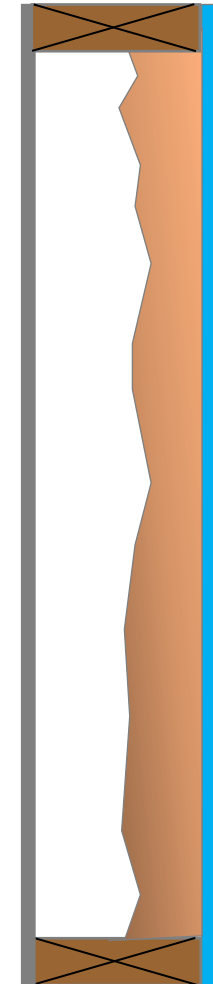
Insulated Concrete Forms (ICFs)

Double Wall

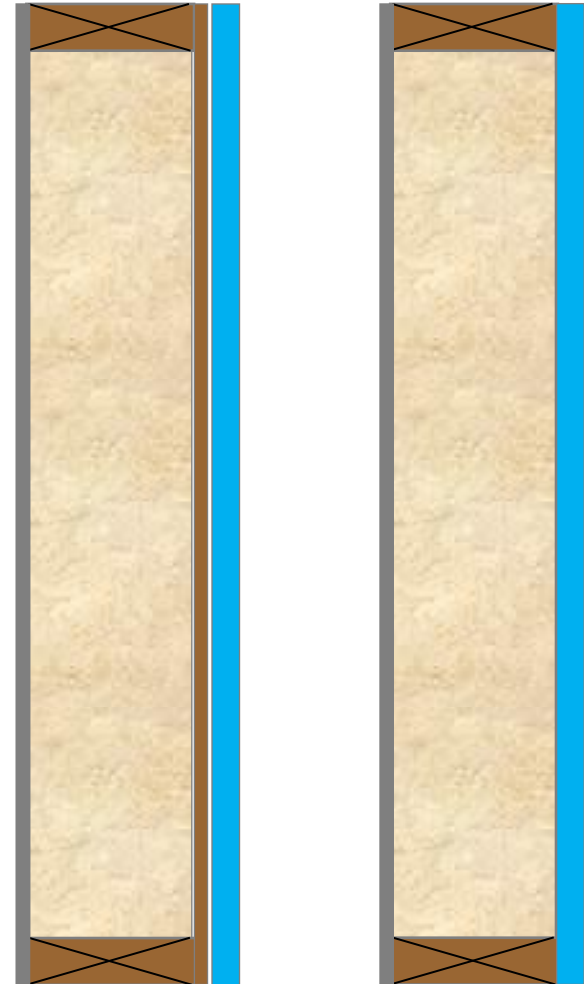
- R-17 – R-21 (U 0.052-0.060)
- Higher Framing Factor (~12-15%)
- Multiple insulation options



- R-17-R-28 Wall
- Complete Thermal Break
- Enhanced Racking Strength and Impact Resistance with ccSPF Enables No Sheathing
- Rigid Insulation Sheathing can serve as WRB w/Liquid Membrane at Joints and Pan Flashing
- Substantially Reduced Framing including Single Plates
- Engineered, stamped system



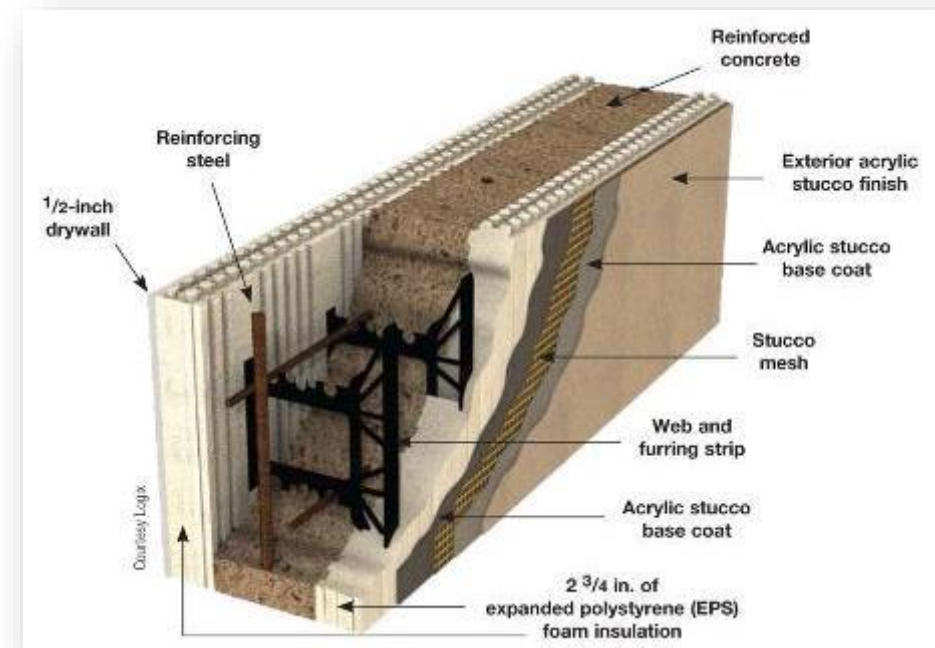
- R-18 Wall (U 0.054)
- Complete Thermal Break
- WSP should be kept above T_{DP}
- Can Combine Sheathing w/ Weather Resistant Barrier
- Cladding Installation Issues
 - Fastening – follow man. specs
 - Furring – follow man. specs



- R-26 Walls (6") (U 0.034)
- Substantial Thermal Break (3 – 8% Framing Factor)
- Special Construction Practices Required
- Significantly Reduced Time-of-Construction
- Reduced Dimensional Variation Corrections



- ~R-24 Walls (U 0.038)
- Complete Thermal Break
- Useful Thermal Mass
- Foundation has to be Perfectly Level
- Panel option
- Disaster Resistant
- Termite Resistant



- R-26 Walls ($U \sim 0.034$)
- Studs offset for thermal break
- Condensation management at outside sheathing surface:
 - Modeling needed to assure moisture control
 - Vapor-open designs use higher-perm sheathing such as gypsum may be used



- Uses same material and techniques already understood by trade partners

Walls

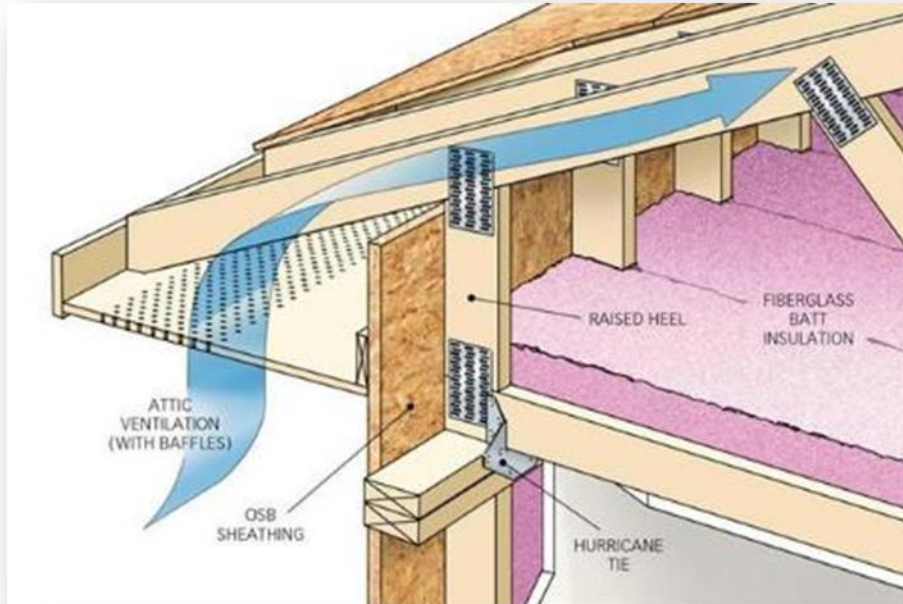
- ☐ Showers and Tubs
- ☐ Fireplaces
- ☐ Attic Knee Walls
- ☐ Skylight Shaft Walls
- ☐ Adjoining Porch Roof
- ☐ Staircase Exterior Walls
- ☐ Double Walls
- ☐ Rim/Band Joists
- ☐ Other Exterior Walls

Floors

- ☐ Floors Above Garage
- ☐ Cantilevered Floor
- ☐ Unconditioned Floor (Basement/Crawl Space)

Ceilings

- ☐ Dropped Ceiling/
Soffit at
Unconditioned Attic
- ☐ Other Ceilings



Heeled Framing Required

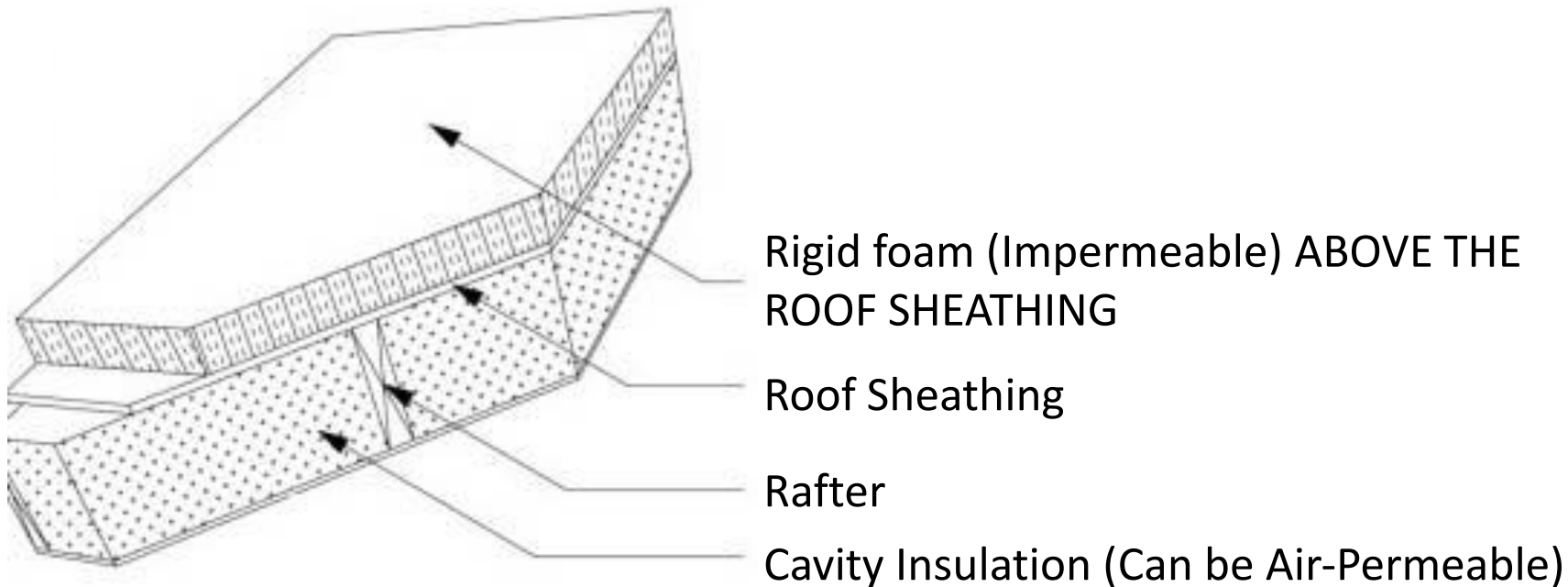
Allows to install
continuous R49/R60
Insulation in the attic per
2021 IECC CZs



Minimum R-value of Impermeable Insulation

Climate Zone	Minimum Impermeable Insulation R-Value*	2021 IECC Ceiling R-Values
2B, 3B tile roof only	None Required	49
1, 2A, 2B, 3A, 3B, 3C	R-5	49
4C	R-10	60
4A, 4B	R-15	60
5	R-20	60
6	R-25	60
7	R-30	60
8	R-35	60

5.2 Rigid Insulation Board above structural roof sheathing + air-permeable insulation in direct contact with the underside of the sheathing

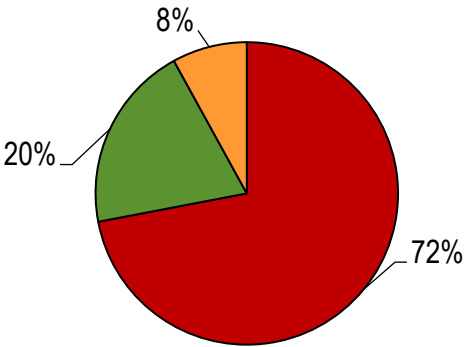
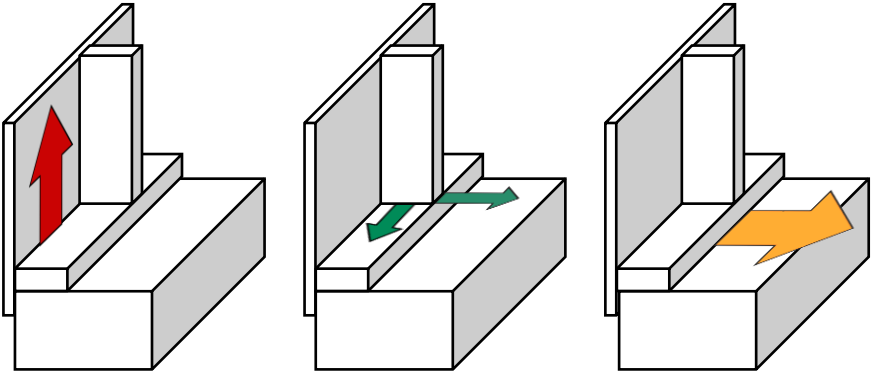
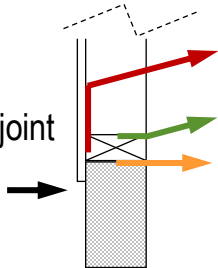


Building Science Corporation



Exterior air barrier

Sheathing / foundation joint
1.1 cfm/ft @ 50 Pa



- Sheathing / bot plate
- Stud / bot plate
- Bot plate / floor

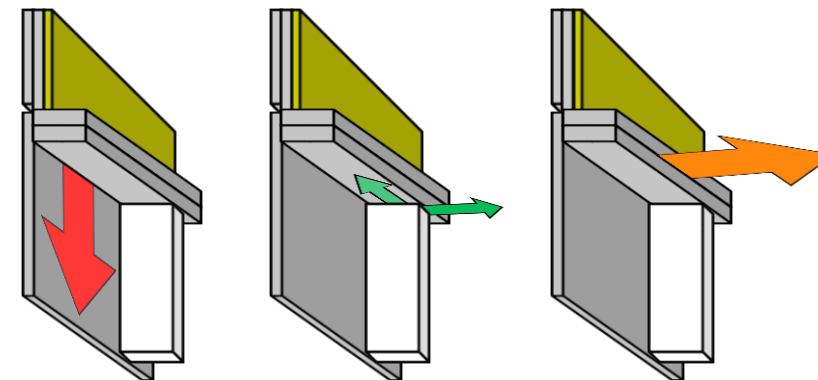
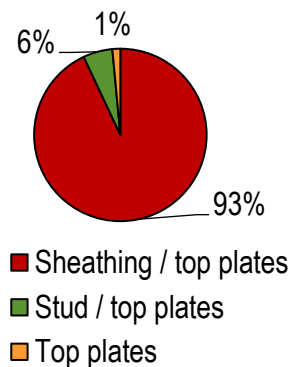
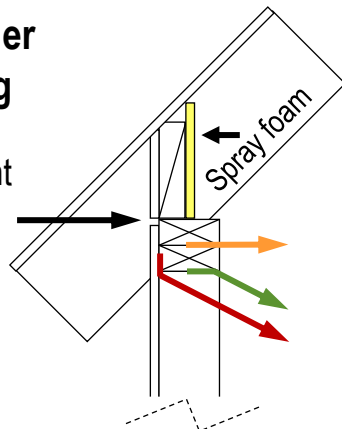
2-Story house (Floor area = 2,000 ft²)
Sheathing / foundation joint unsealed \cong 0.5 ACH₅₀

Zones	DOE ZERH Home		IECC 2021	
	Requirement	Contribution to requirement (%)	Requirement	Contribution to requirement (%)
1 – 2	2.75	17	5	10
3 – 4	2.25	20	3	17
4C, 5-7	2	25	3	17
8	1.5	33	3	17

	ACH50 Requirements/Targets					
Climate Zones	Zero Energy Ready Home Target - Detached	Zero Energy Ready Home Target – Attached*	ENERGY STAR V3.0	ENERGY STAR V3.1	2012 & 2015 IECC	Passive House
1-2	2.75	3.0	6.0	4.0	5.0	0.6
3-4	2.25	3.0	5.0	3.0	3.0	0.6
4C, 5-7	2.0	3.0	4.0	3.0	3.0	0.6
8	1.5	3.0	3.0	3.0	3.0	0.6

Exterior air barrier Cathedral ceiling

Sheathing / roof joint
1.1 cfm/ft @ 50 Pa



2-Story house (Floor area = 2,000 ft²)
Sheathing / roof joint unsealed $\cong 0.5 \text{ ACH}_{50}$

Zones	DOE ZERH Home		IECC 2021	
	Requirement	Contribution to requirement (%)	Requirement	Contribution to requirement (%)
1 – 2	2.75	17	5	10
3 – 4	2.25	20	3	17
4C, 5 – 7	2	25	3	17
8	1.5	33	3	17

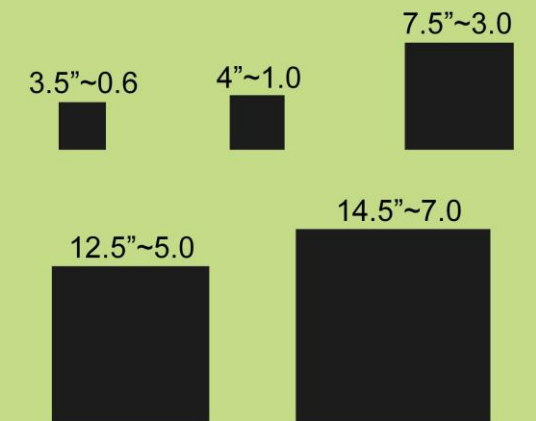
Seal, Seal and Seal

Zero Energy Ready Home Program Version 2



BLOWER DOOR TEST

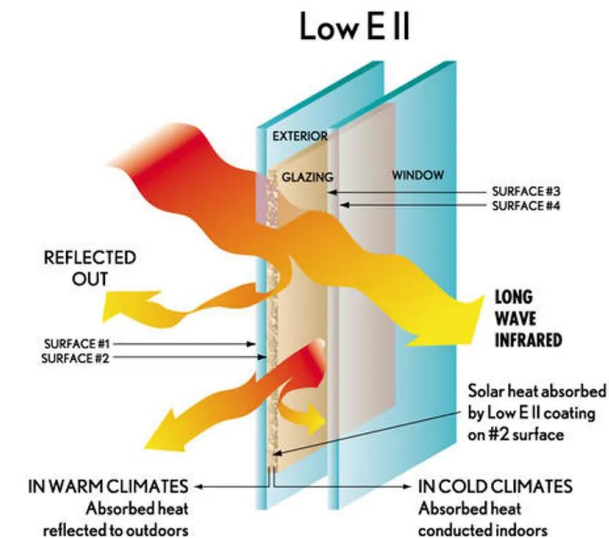
2,500 SQ. FT. HOUSE
in² ~ ACH50



ACD2023

High Performance Windows

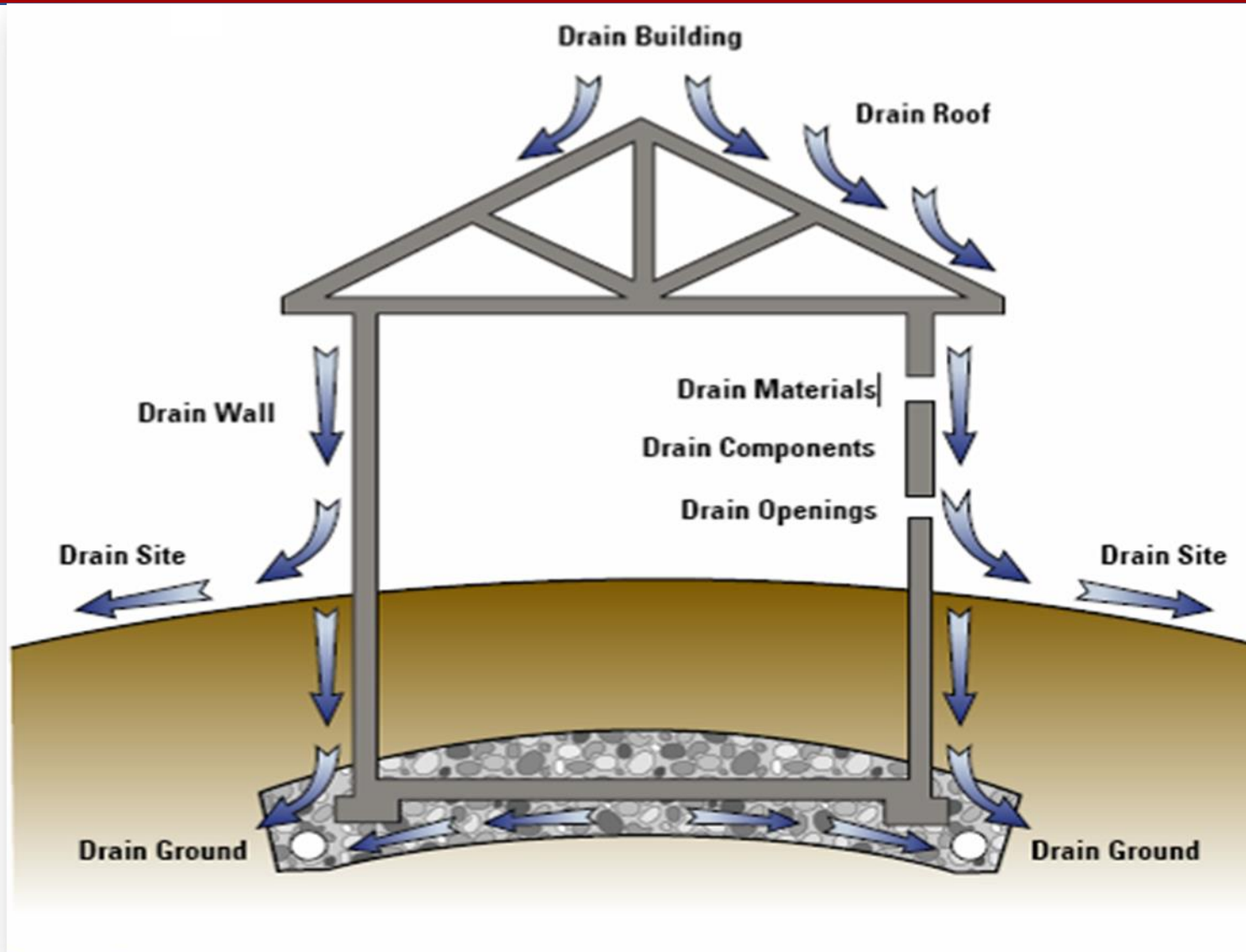
Window Specs Required for DOE ZERH Projects	IECC CZ 1-2		IECC CZ 3,4A, 4B		IECC CZ 4C, 5 (SHGC values listed below may be paired with the U-value in the same row)		IECC CZ 6-8	
	U-Value	SHGC	U-value	SHGC	U-Value	SHGC	U-Value	SHGC
	≤ 0.40	≤ 0.23	[CZ 3] ≤ 0.30 [CZ 4] ≤ 0.30	[CZ 3] ≤ 0.25 [CZ 4] ≤ 0.40	≤ 0.27 = 0.28 = 0.29 = 0.30	Any ≥ 0.32 ≥ 0.37 ≥ 0.42	≤ 0.25	Any

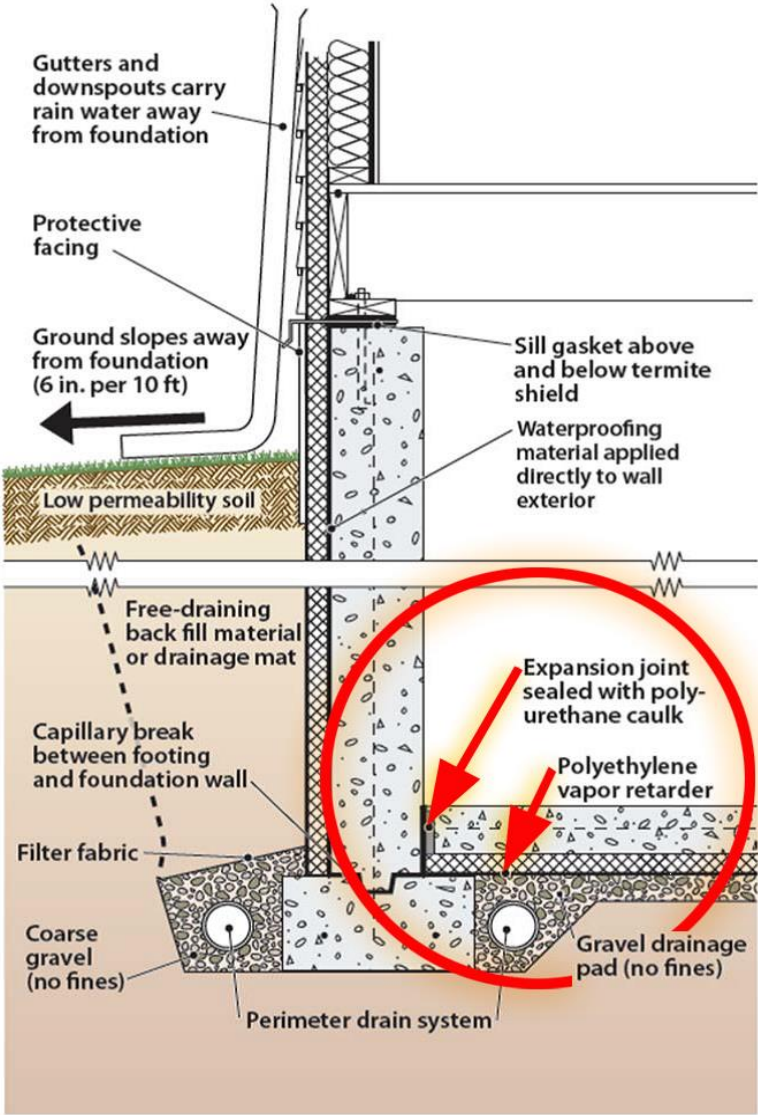


Marvin Windows

1. DOE Zero Energy Ready Home offers multiple compliance paths including area weighting and allowances for passive solar design. See the National Program Requirements, Exhibit 1 with footnotes, for details.

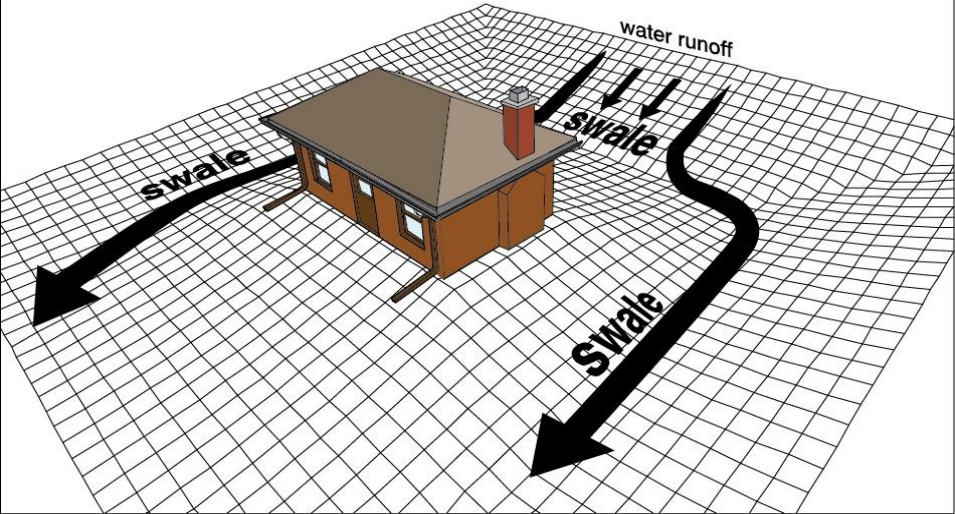
Water Protection System





Swales

when the overall lot drainage is toward the house, swales can be used to direct surface water away from the foundation



Step and Kick-out Flashing

Zero Energy Ready Home
Program Version 2



- Step and kick-out flashing at all roof-wall intersections, extending $\geq 4"$ on wall surface about roof deck and integrated with drainage plane above.
- Step flashing goes behind water barrier on wall and under shingles on the roof.

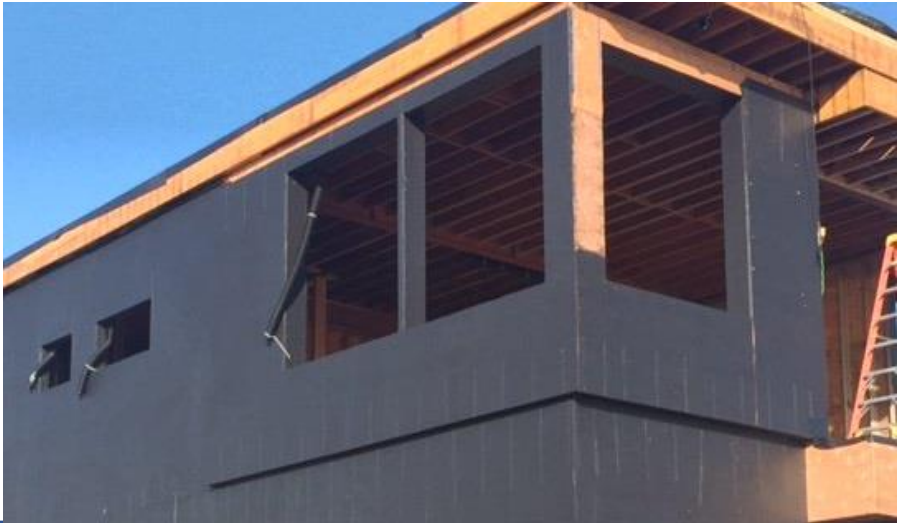
Flashing
extends up
wall

Diverting
water away
From wall



Rainscreens and WRBs

Zero Energy Ready Home
Program Version 2



Armando Cobo, Designer

CoboDesigner.com

972-781-8724

Optimized Duct System

We Are Trying to Avoid

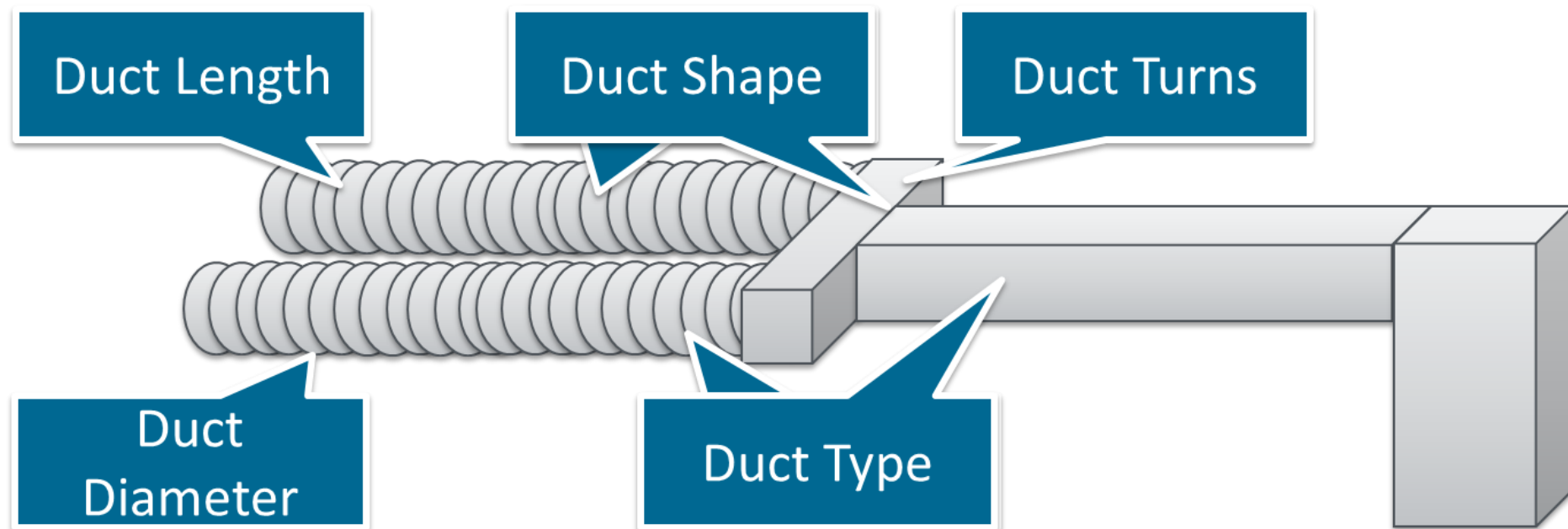
Zero Energy Ready Home Program Version 2

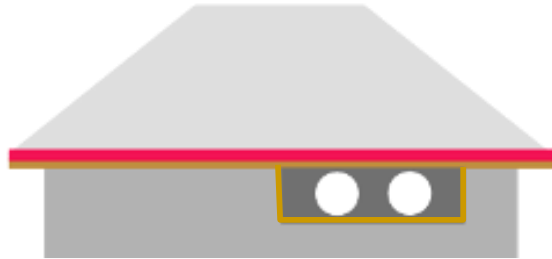


Ductopus!!!

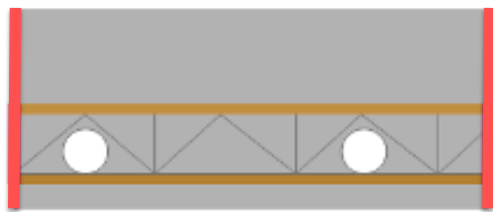
Factors that influence the airflow of the ducts:

- Duct Type
- Duct Turns
- Other Components
- Duct Length
- Duct Size
- Duct Shape

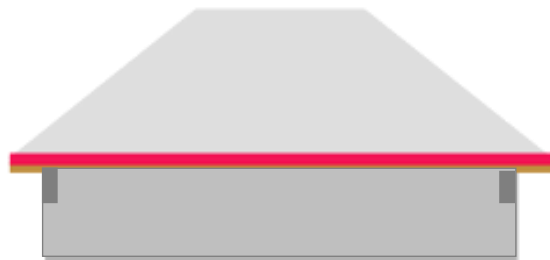




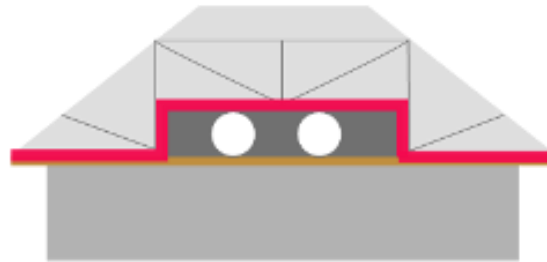
Ducts in Dropped Ceiling



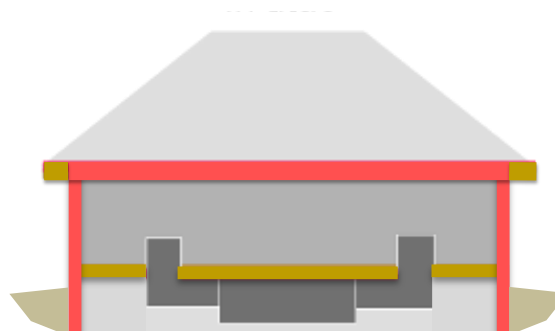
Ducts Between Floors



Ductless Systems



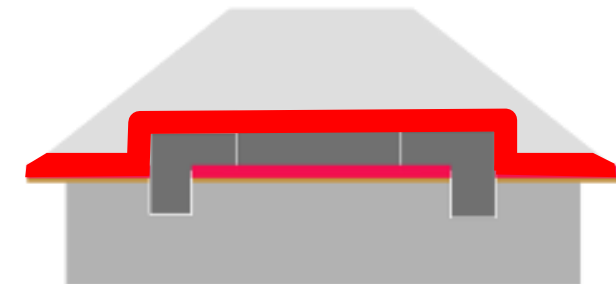
Ducts in Modified Attic Truss



Ducts in Unvented
Crawl Space/Basement

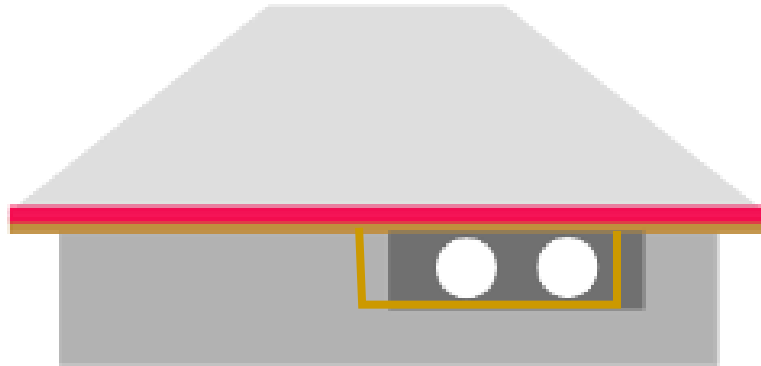


Ducts in Unvented Attic



Ducts in *Vented* Attic

- Buried & SPF encapsulated (Humid Climates)
- Buried (Dry Climates)
- Buried (2021 IECC)

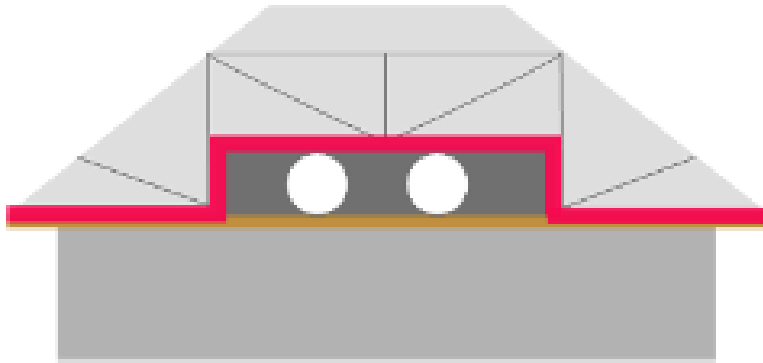


Ducts in Dropped Ceilings

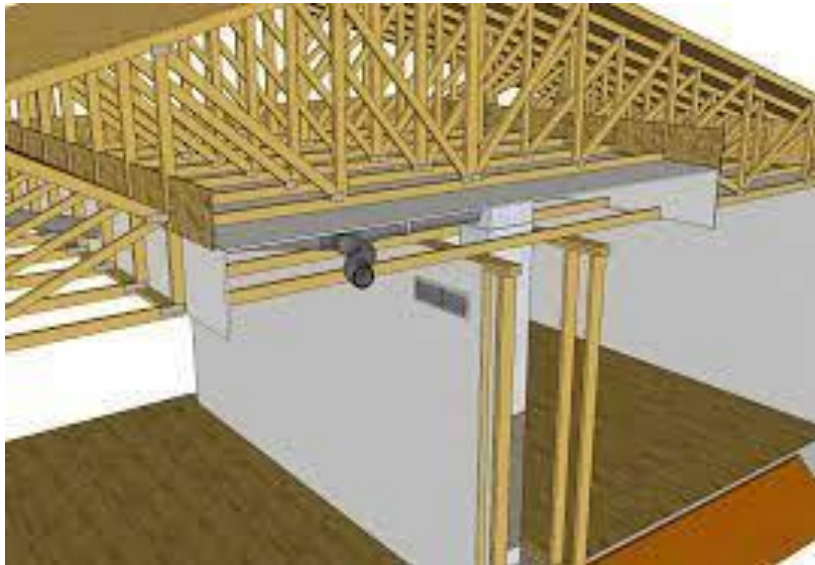
Issues:

- Architectural Integration
- Good Fit w/Simple Plans
- Longer Throws (ACCA Man T)





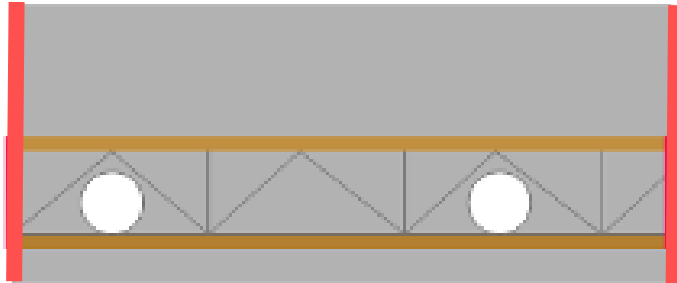
Modified Attic Truss in Attic



Issues:

- Design Integration
- Good Fit w/Narrow Plans
- Sealed Air Barrier Critical





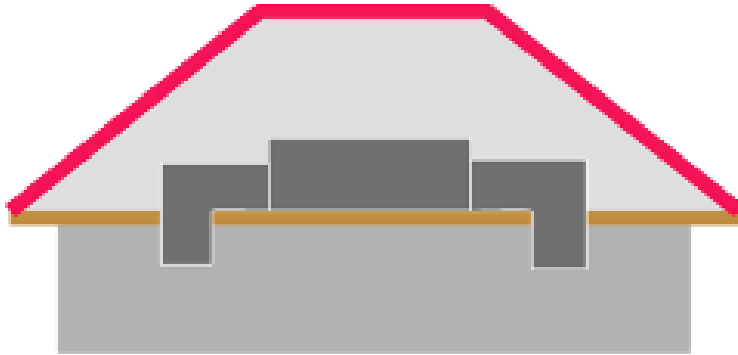
Ducts Between Floors



Issues:

- Simple Installation
- Design Flexibility
- Cost-Effective
- Takes advantage of lower design loads & smaller ducts
- Floor Registers Likely

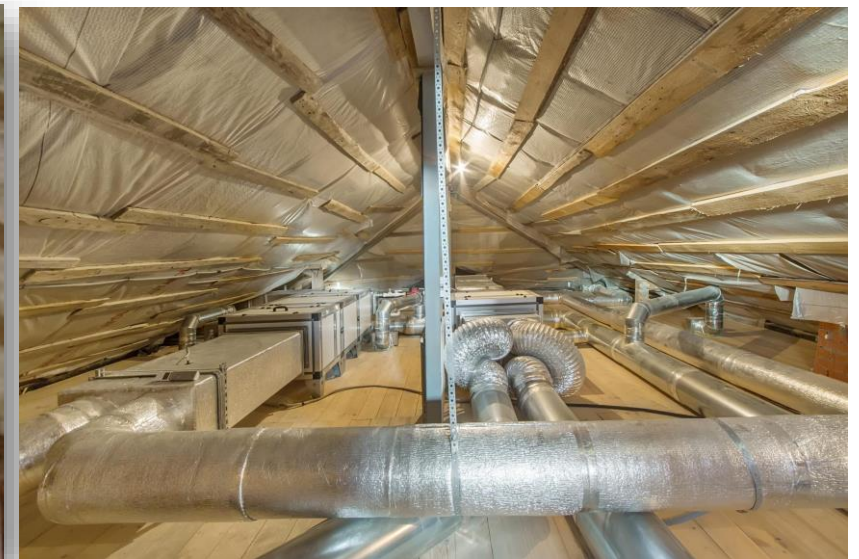


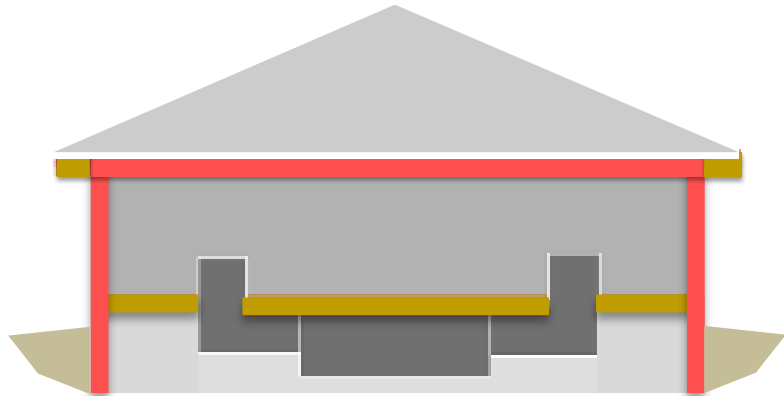


Ducts in unvented attic

Issues:

- Design for code-compliant thermal & ignition barriers on the SPF
- Need to consider added heating/cooling load





Ducts in unvented crawl space
or basement

Issues:

- Simple Installation
- Design Flexibility
- Cost-Effective
- Floor Registers Likely

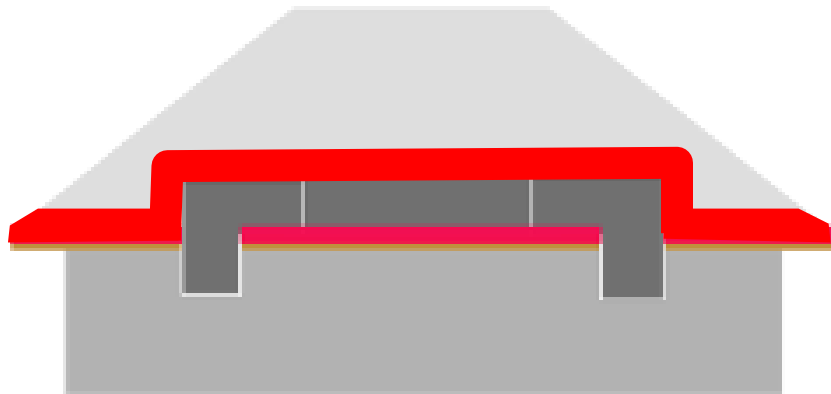


NO VENTED CRAWL SPACE ALLOWED

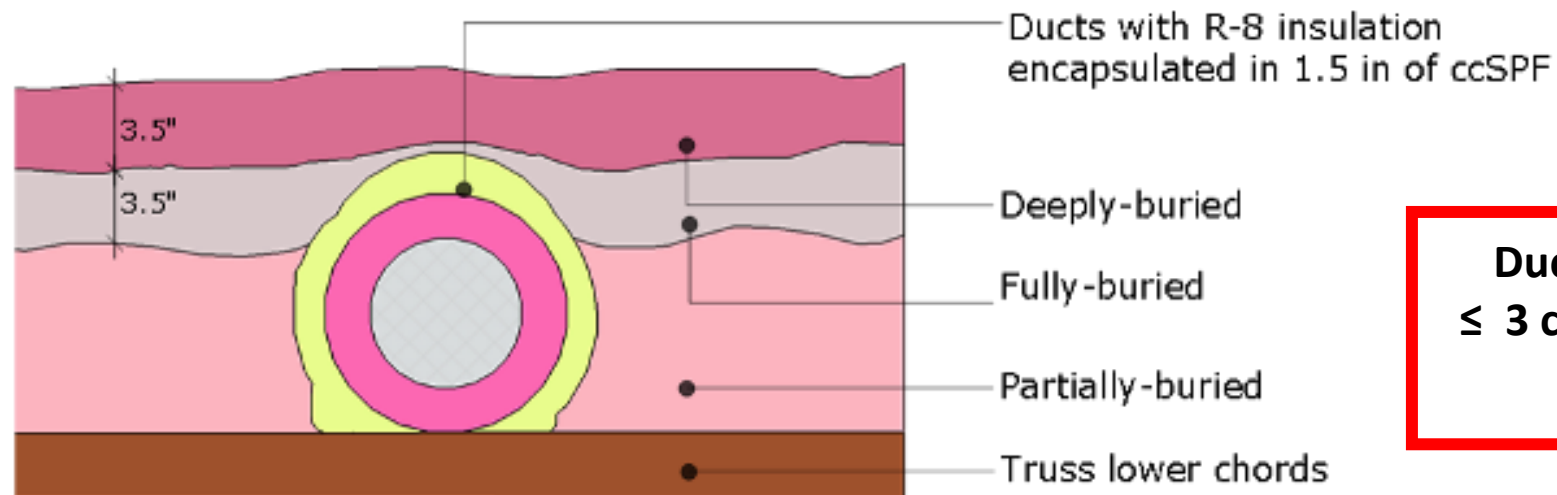
Exceptions:

- 100-year flood zone
- Marine Climate
- Dry Climate
- Raised Pier Foundation w/ no Walls
- Sealed w/ Capillary Break and Dehumidification

Buried Encapsulated Ducts (BEDs)

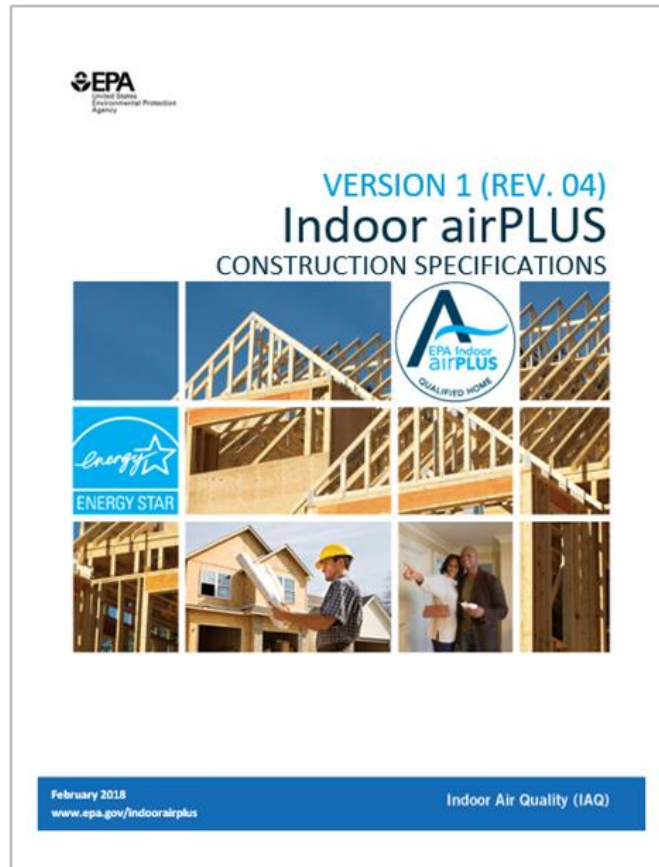


Ducts in vented attic

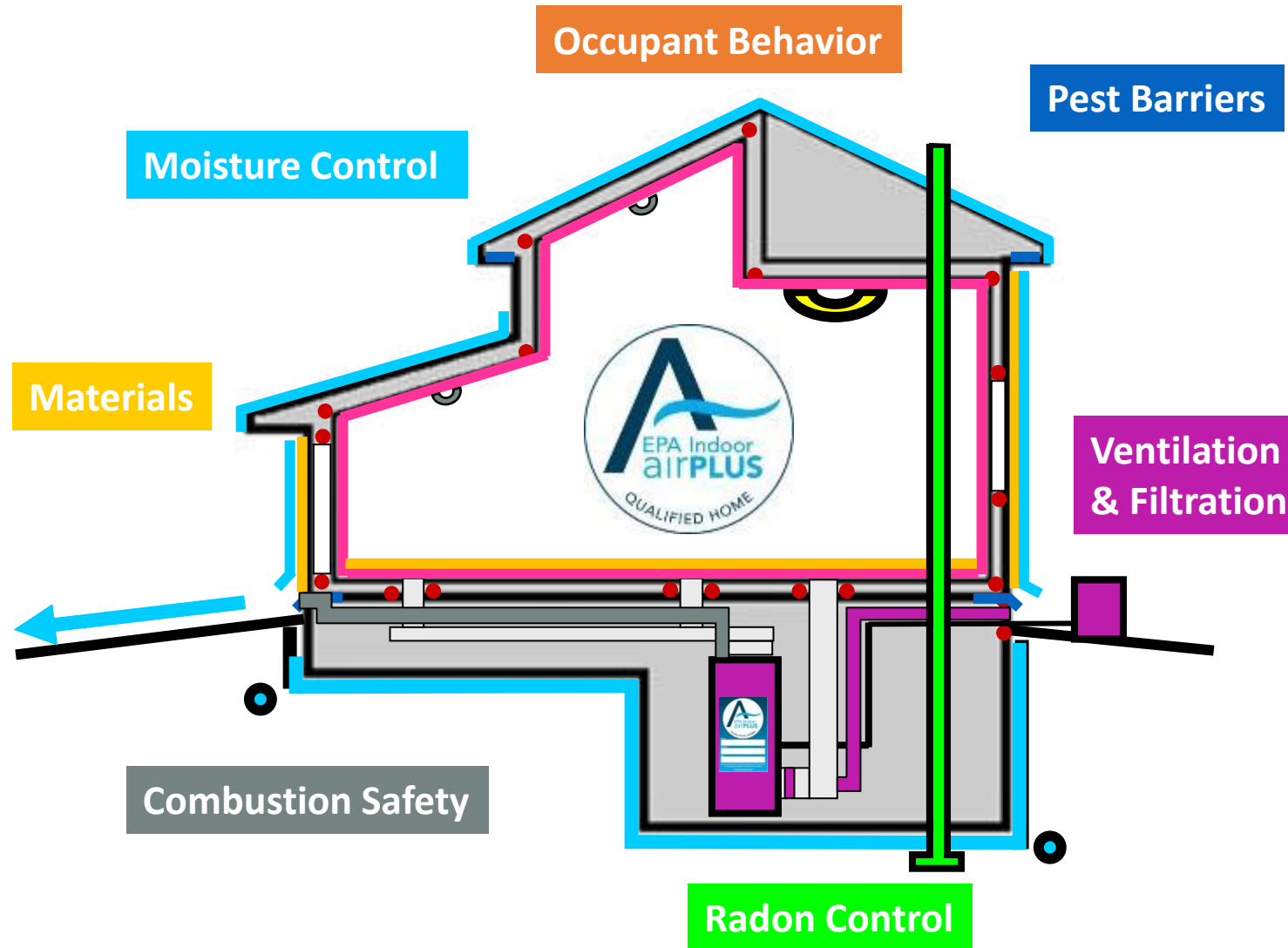


**Duct sealed to
 ≤ 3 cfm25/100 SF
CFA LTO**

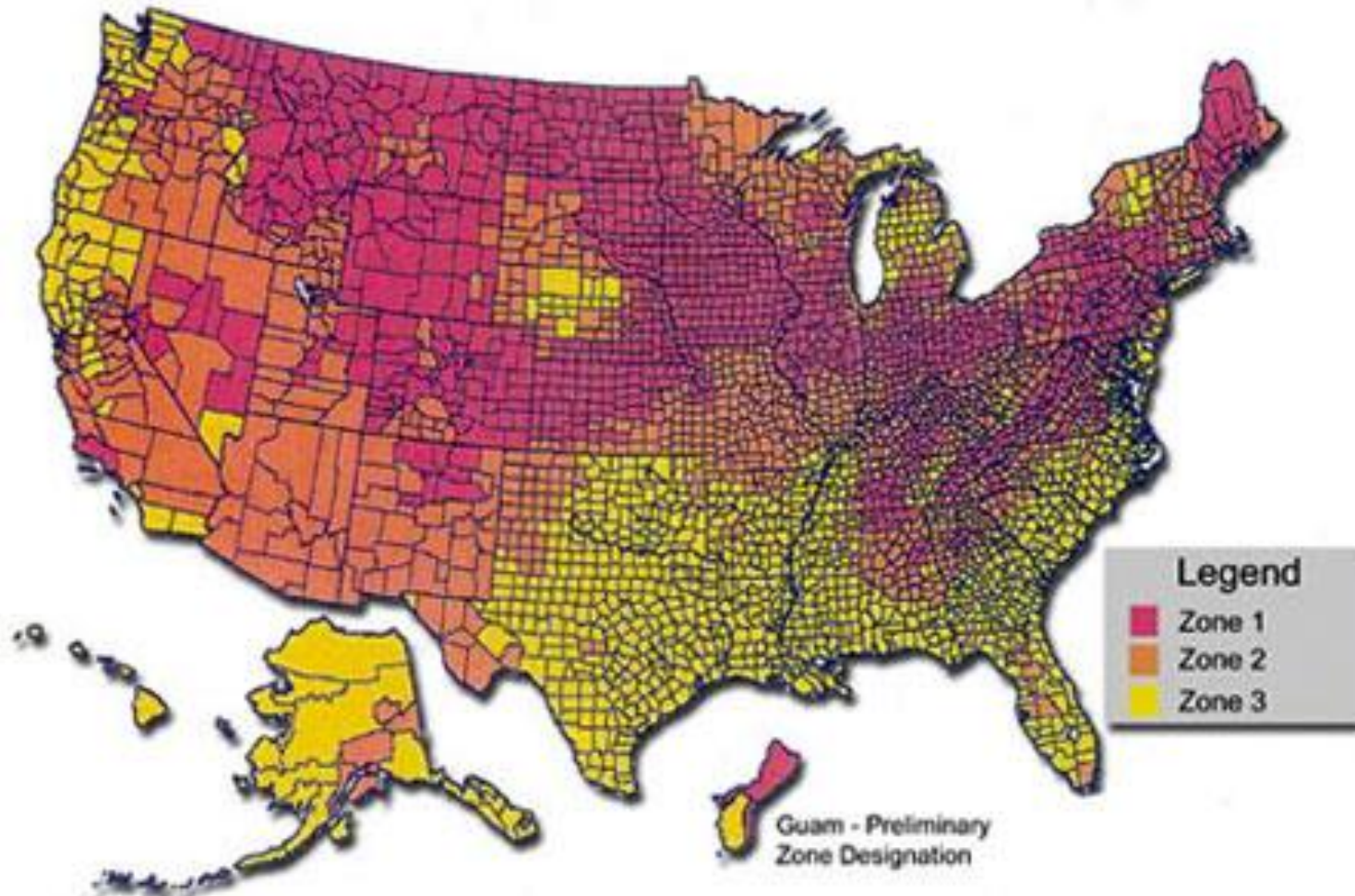
Indoor Air Quality



- Non-regulatory home label; currently for new homes.
- Assists home builders, trade contractors & renovators
- Concrete way for builders to sell health benefits to customers
- Independent, 3rd-party verification
- Construction Specs, technical support, marketing resources

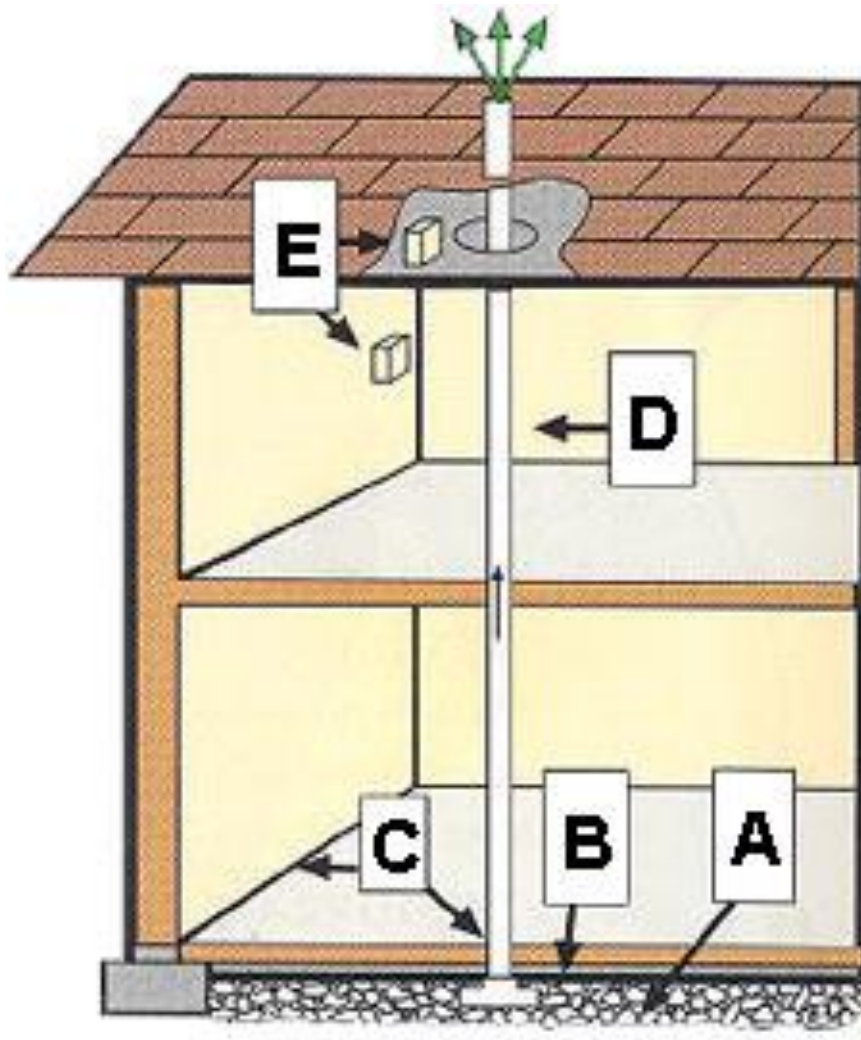


EPA Map of Radon Zones



Note: these maps indicate average risk by county. However, High levels of Radon can be found in any home.

Surgeon General's Warning:
Radon Causes Lung Cancer



Required for Moisture Control:

A. Gas Permeable Layer
(min. 4" clean gravel)

B. Plastic Sheeting
(under slab)

C. Sealing and Caulking
(all openings in concrete floor)

D. Vent Pipe
(3 or 4 inch PVC pipe)


E. Junction Box
(if fan needed later)



Corrosion-proof rodent/bird screens for openings
(e.g., copper or stainless steel mesh)
Exception: clothes dryer vent

- Low emission materials and products are rapidly evolving
- Labels & certifications can be challenging to navigate
- To help partners identify sources and spec products, a new IAP resource is available:


How to Find Indoor airPLUS Compliant Low-Emission Products



How to Find Indoor airPLUS Compliant Low-Emission Products

Cabinetry

Requirement: Use Cabinetry made with component materials (plywood, particleboard, MDF) that are certified to comply with the appropriate standards above; OR registered brands or products produced in plants certified under the Kitchen Cabinet Manufacturers Association's (KCMA) Environmental Stewardship Certification Program (ESP 05-12); OR GREENGUARD or GREENGUARD Gold Certification for Cabinetry.




Meet at least one standard below	How to find compliant products
----------------------------------	--------------------------------

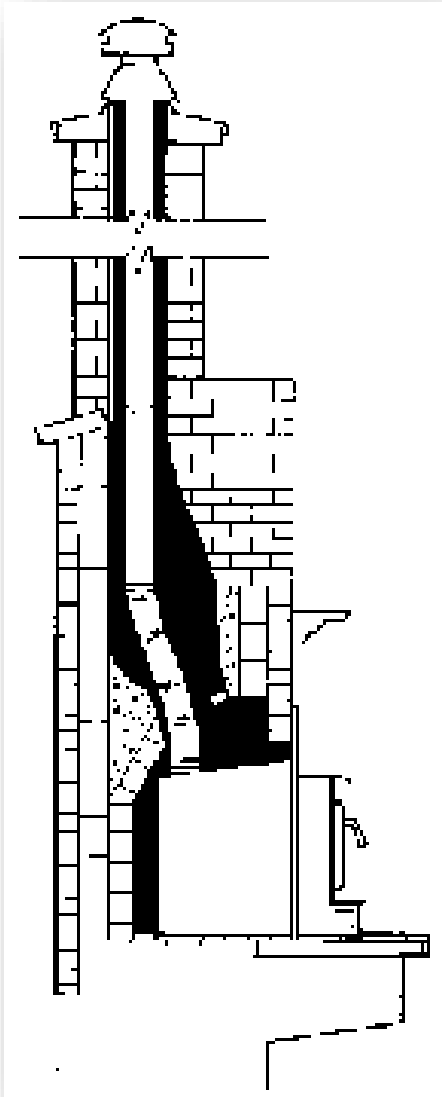
KCMA's Environmental Stewardship Program (ESP 05-12)

Look for the KCMA-ESP label on cabinets (often sink bases), product packaging, and/or spec sheets.

For a list of KCMA certified manufacturers that produce compliant cabinets, visit:
http://www.kcma.org/Members/ESP_Certified_Manufacturers

Note: Manufacturers listed in the link above can be used as a resource, but partners should request confirmation from the manufacturer or supplier that the product lines they are using are indeed compliant.





- Vented to outdoors
- Adequate Combustion and Ventilation Air
- Gas fireplace power or direct vented
- Meet Specified Standards

CO Alarm in each bedroom area



CO Alarm

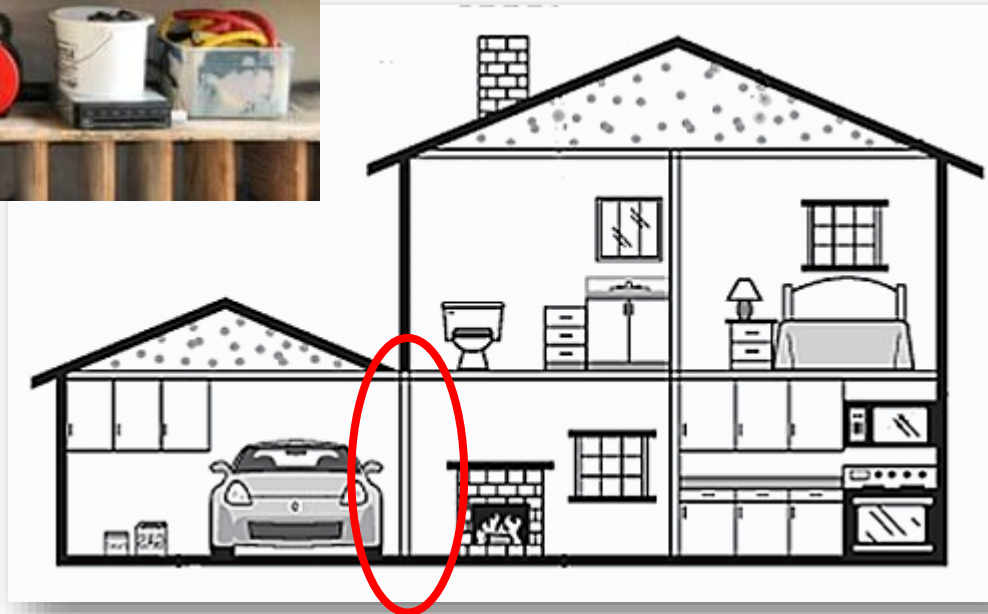


Combined CO
& Smoke Alarm



Environmental tobacco smoke (ETS)

Enforceable policy in
Multi-family buildings



Air Sealing & Gasketed Door

Exhaust Fan
Optional



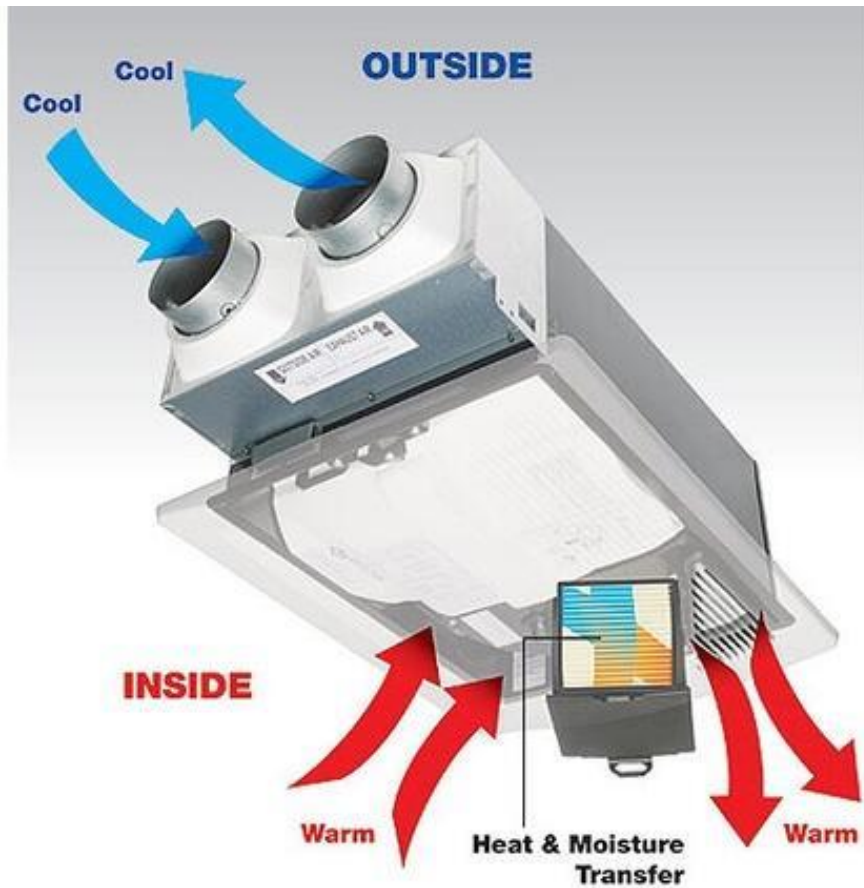
No Air Handler in the Garage



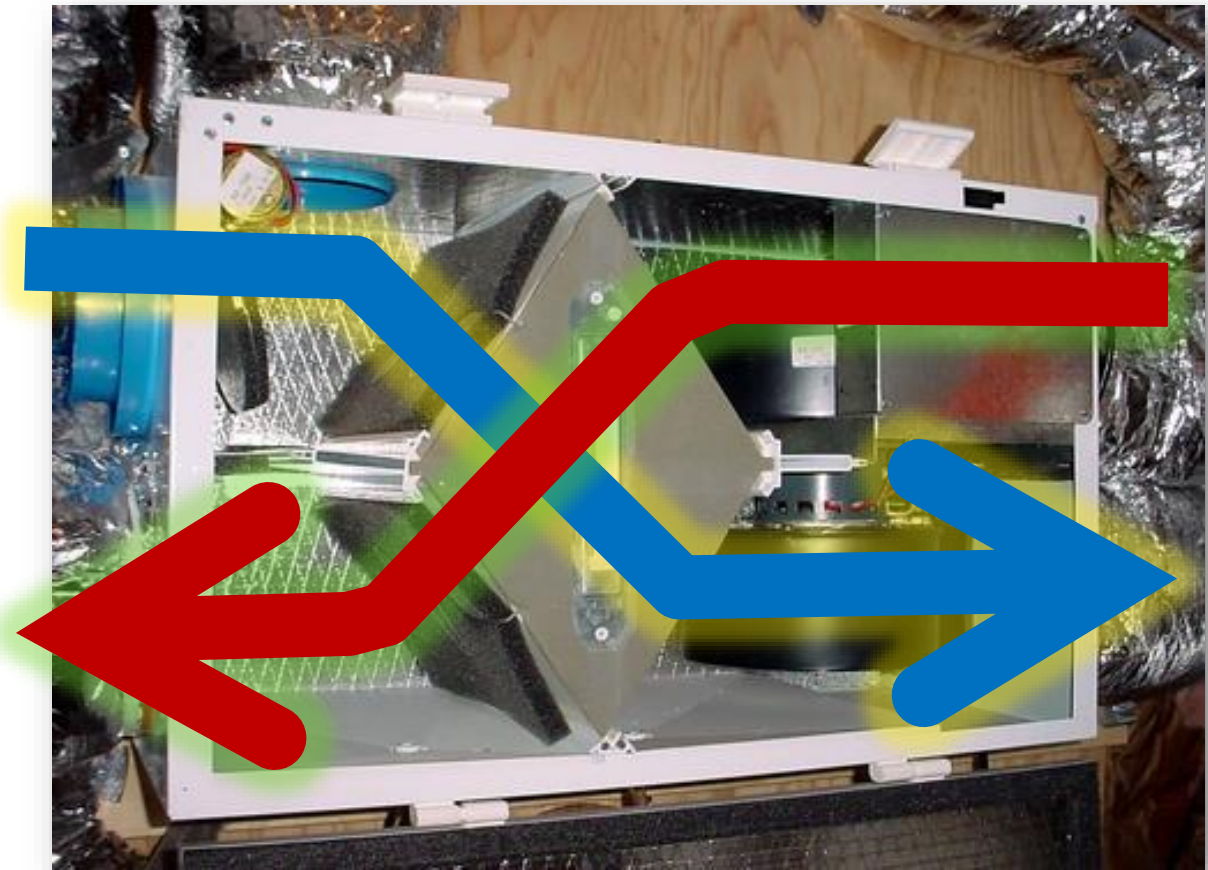


- Filters come multiple sizes.
- Filters are typically 1", 2" or 4" in depth.
- In years past the primary purpose for filtration was to protect the HVAC system not IAQ.
- 11-13 MERV Filter – IAP, soon to be
- 16 MERV Filter Recommended



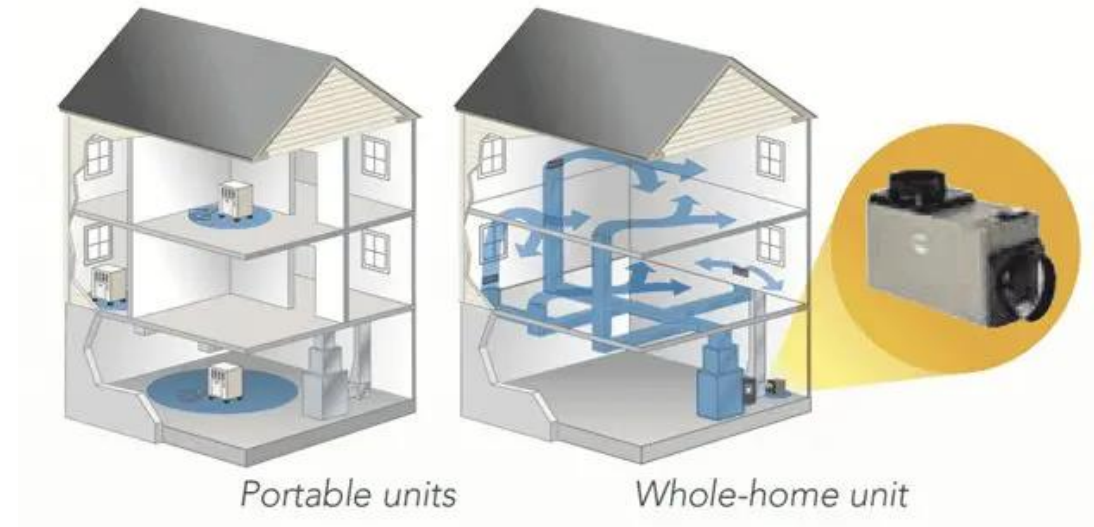


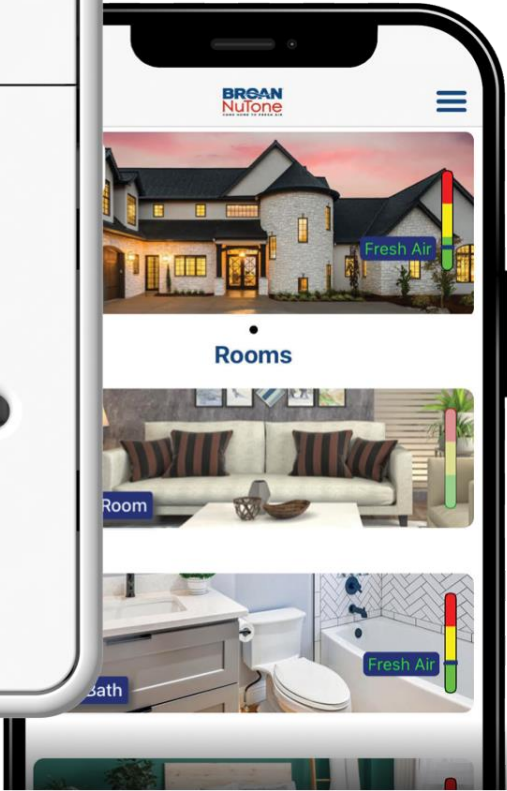
Spot ERV or HRV



ERV or HRV Core

Install equipment with
sufficient latent capacity to
maintain indoor $RH \leq 60\%$...
Best at 50%





Efficient Equipment and Water Distribution

Zero Energy Ready Home requires:

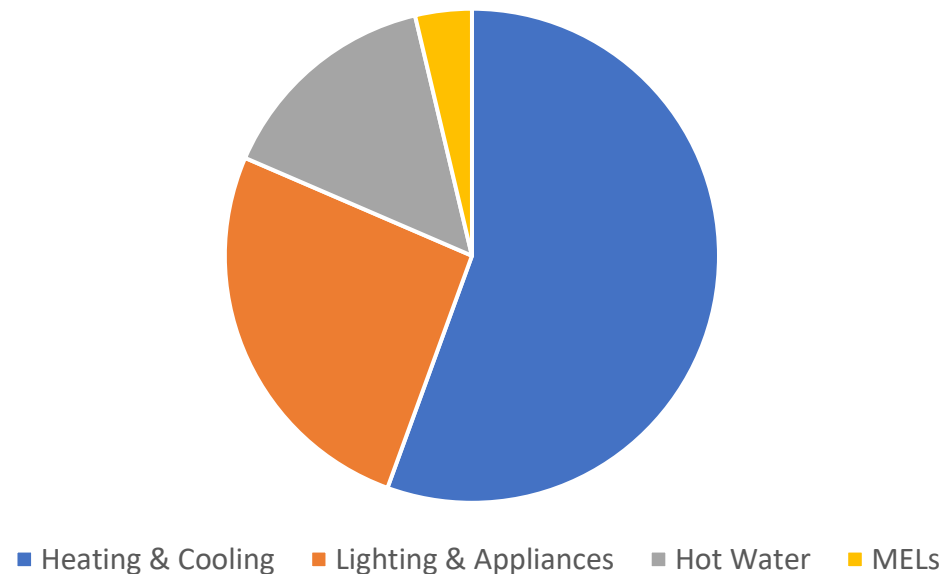
- **ENERGY STAR Certified Appliances*:**
refrigerators, dishwashers, clothes washers
- **ENERGY STAR Certified Lighting*:**
100% of fixtures or lamps LEDs
- **ENERGY STAR Certified Fans:**
bathroom ventilation, ceiling fans
- **WaterSense Hot Water Distribution**
or WH and fixtures meet efficiency criteria
- **HPWH Ready**
- **Heat Pump Space Heating Ready**

*Only where supplied and installed by builder

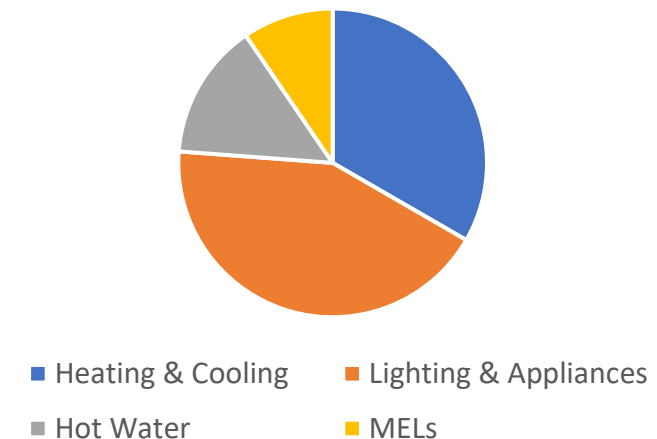


Components and Electric Loads are increasingly larger part of total energy use in low-load homes (~50%).

Energy Use - Then



Energy Use - Now



Smart electrical panels offer these two key advantages:

- Remote Energy Management. Smart panels include a mobile app for real-time monitoring and control over circuit loads. ...
- Optimal Energy Usage in Emergencies. Power essential loads by switching between circuits to use standby power sources.





**Flushing
Urinals**



**Lavatory
Faucets**



**Irrigation
Controllers**



**Tank-Type
Toilets**



Showerheads



**Pre-Rinse
Spray
Valves**



**More than
10,000 Labeled
Product
Models**



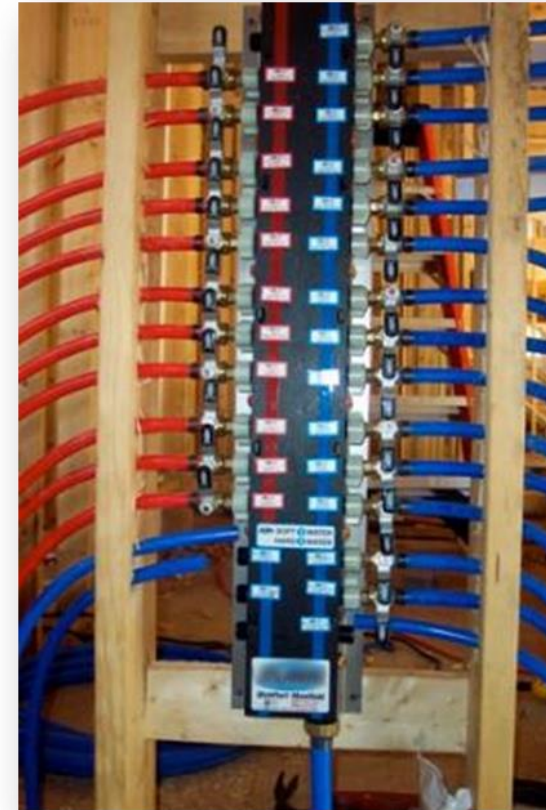
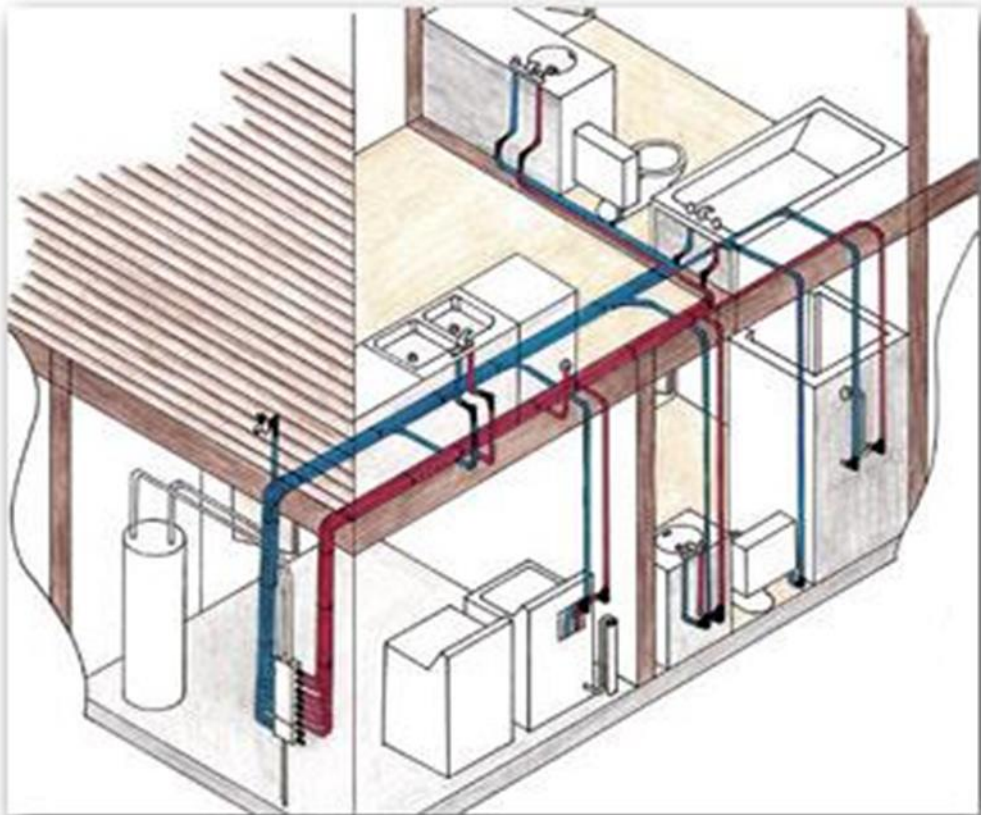
**And a label for
the entire home.**

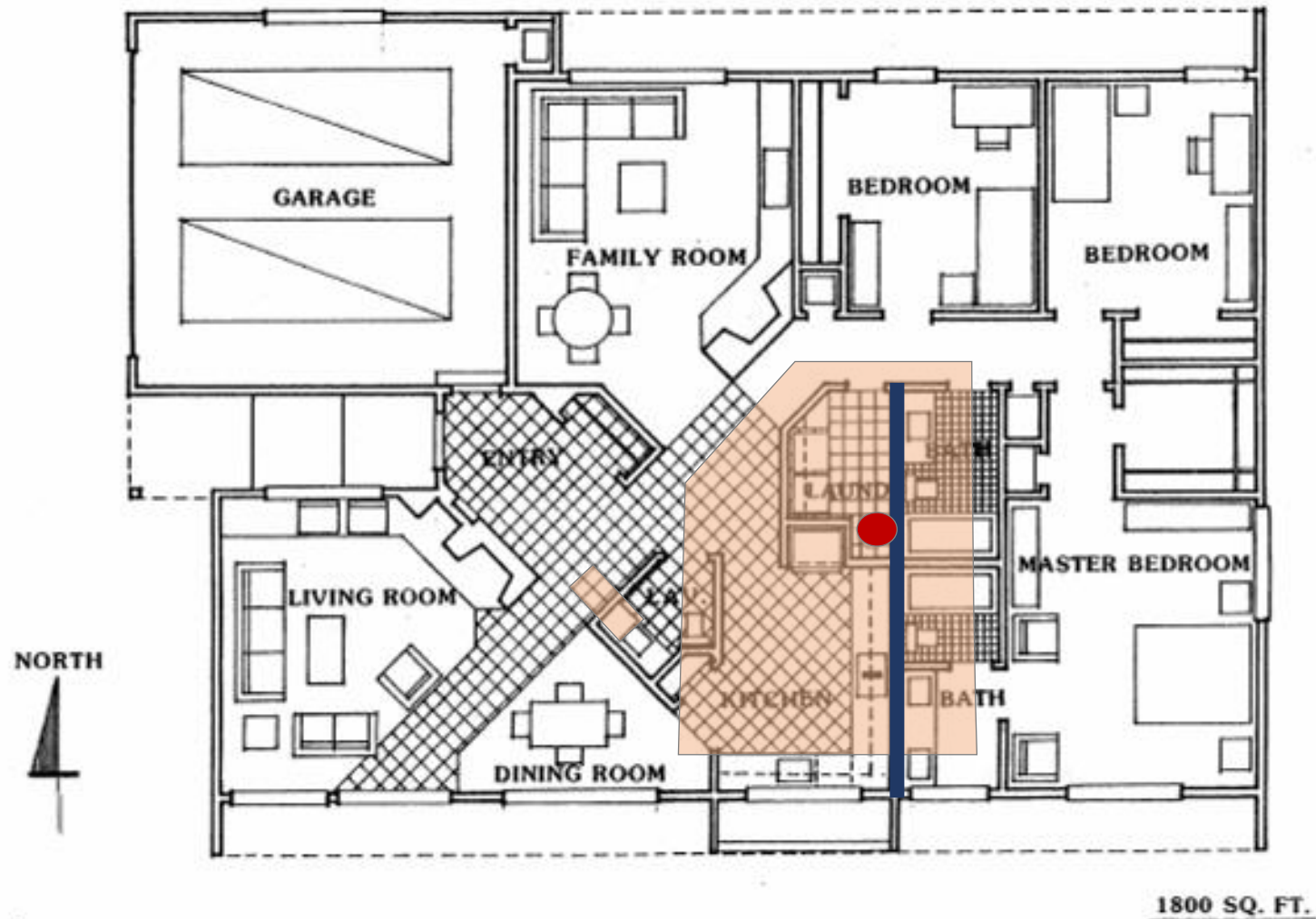
Option A: Distribution

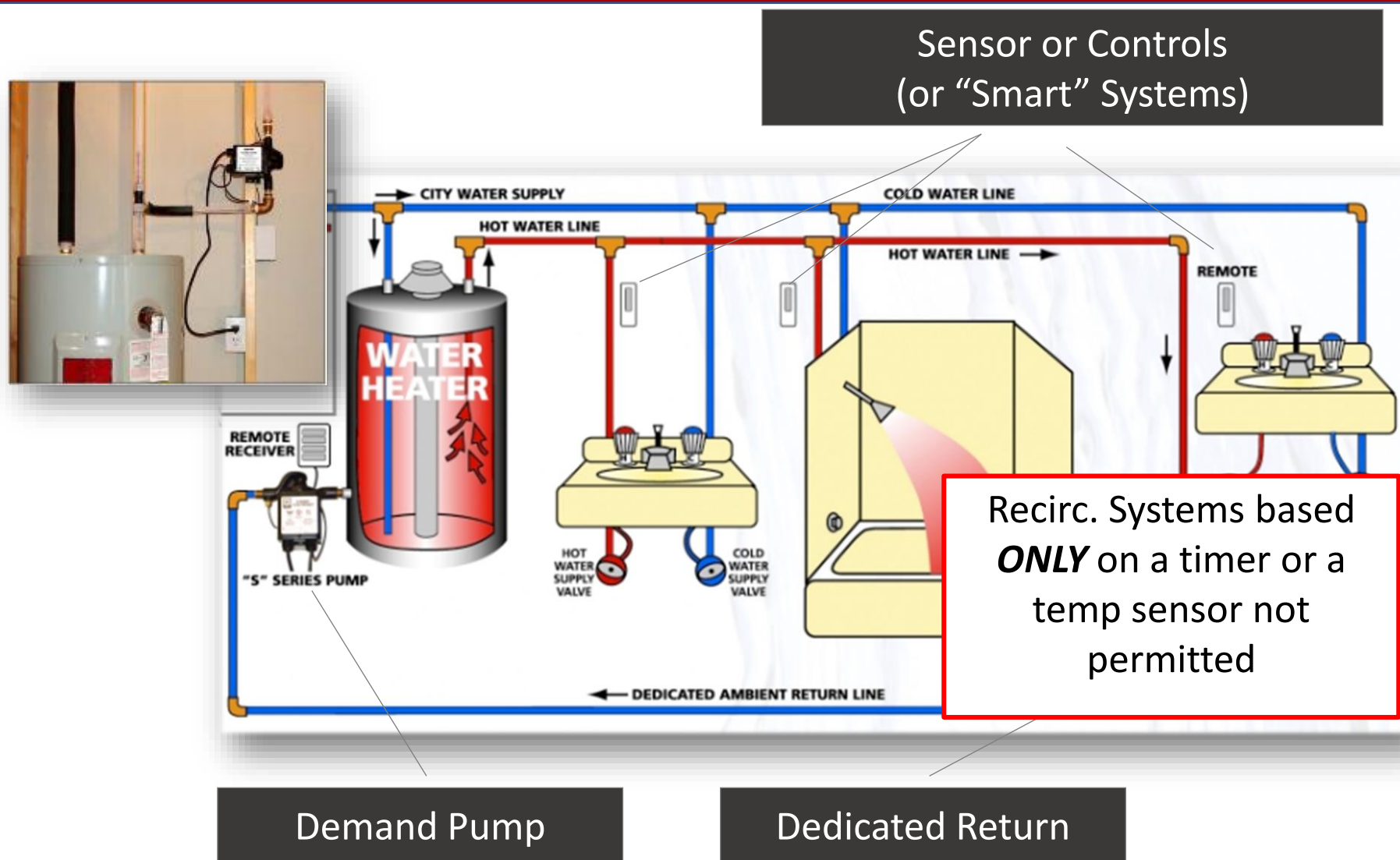
- Based on EPA WaterSense Specifications:
 - ≤ 0.5 gallons of water in any piping/manifold between hot water source and any hot water fixture.
 - By the time the flow at the furthest fixture has + 10F temp increase, no more than 0.6 gallons of water has been delivered

Manifold Plumbing System

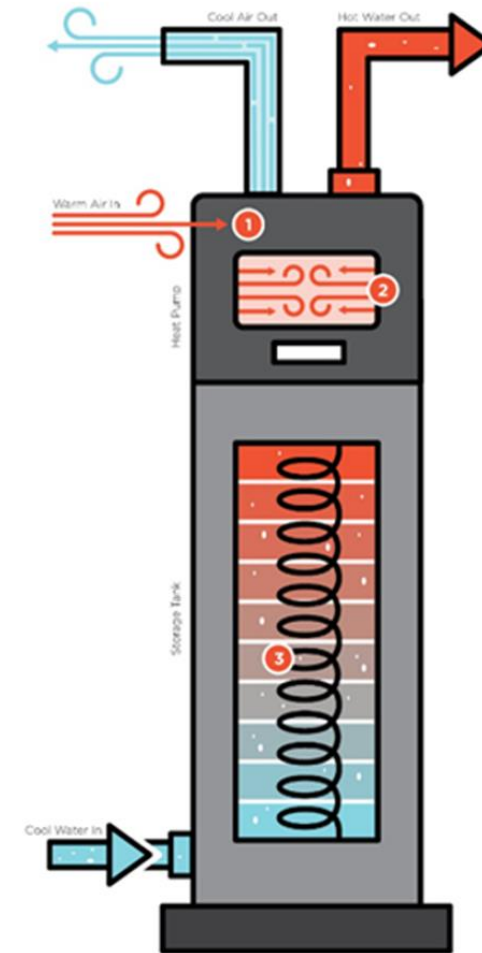
Zero Energy Ready Home
Program Version 2







1. Heat pump water heaters pulls warmth from the air.
2. Warm air is compressed, increasing its temperature.
3. Condenser coils transfer heat to the water.
4. Location must maintain 40° -90° F range year-round.
5. Provide at least 1,000 cubic feet of air space.
6. Air passing over the evaporator can be exhausted to the room or outdoors.



Rheem, A.O. Smith, GE, others are coming out with 120 volt-15 amp plug-in models in 2022 or later.

Heat Pump Water Heater Ready

Individual branch circuit outlet is installed, energized, and terminates within 3 feet of each installed fossil fuel water heater, and a space located within the home or garage that is at least 3' x 3' wide and 7' high shall be available surrounding or within 3 feet of the installed fossil fuel water heater, to facilitate future heat pump water heater installation.



Exception: If already using electric appliances.

Heat Pump Space Heating Ready

Individual branch circuit outlet is installed or conduit is installed to facilitate future wiring for a heat pump installation. Circuit or conduit labeled as “For future heat pump.”



Option B: Distribution

High Efficiency Water Heater

- Gas WH: $EF \geq 0.90$ or a $UEF \geq 0.87$
- Electric WH: $EF \geq 2.2$ or a $UEF \geq 2.2$
- Hybrid/Electric HPWH: $EF \ 3.0 - 4.0$

WaterSense Labeled

- Showerheads
- Bathroom sink faucets

Stored Hot Water Volume

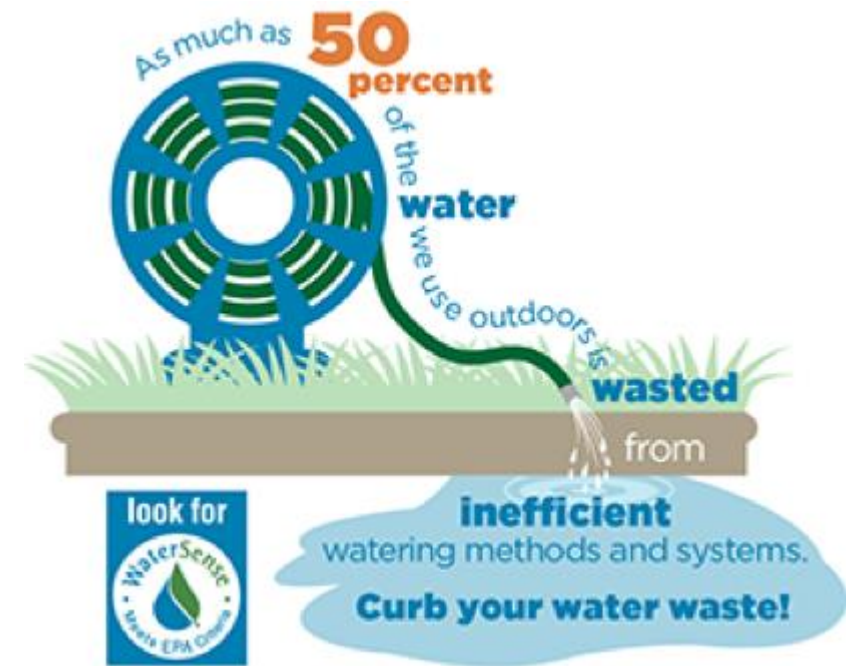
- Hot water distribution system stores ≤ 1.2 gallons between the hot water source and the furthest fixture

The WaterSense Water Budget Tool is:

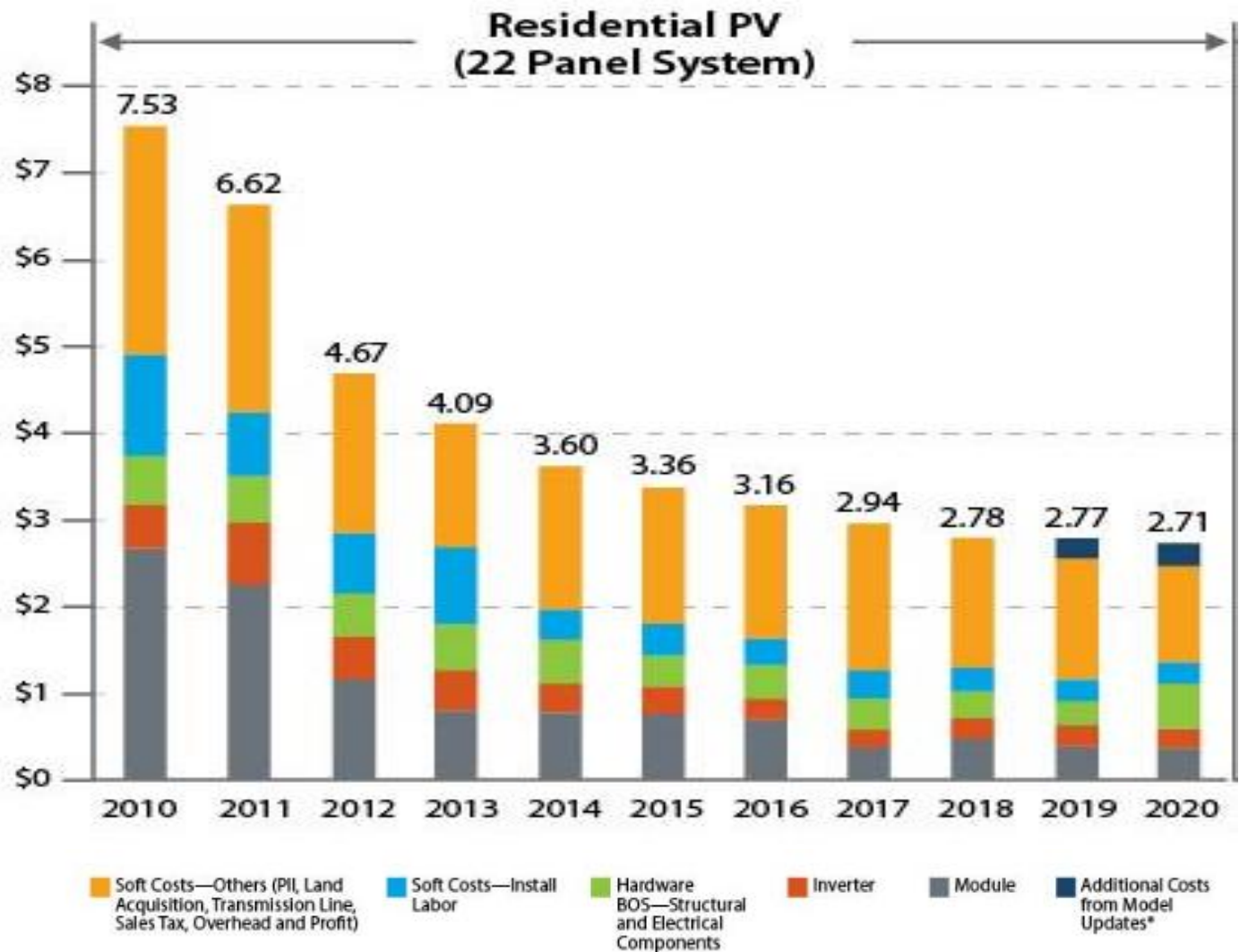
- A pass/fail measure of whether a home's landscape meets the WaterSense requirements for efficiency
- A simple way to establish a relative measure of efficiency in a landscape
- An effective way to help builders consider landscape and irrigation design
- A tool that rewards decisions that will translate to measurable water savings for home owners

The WaterSense Water Budget Tool is NOT:

- A full feature landscape design tool
- A predictive model (i.e. it is not intended to predict how much water a landscape will use)



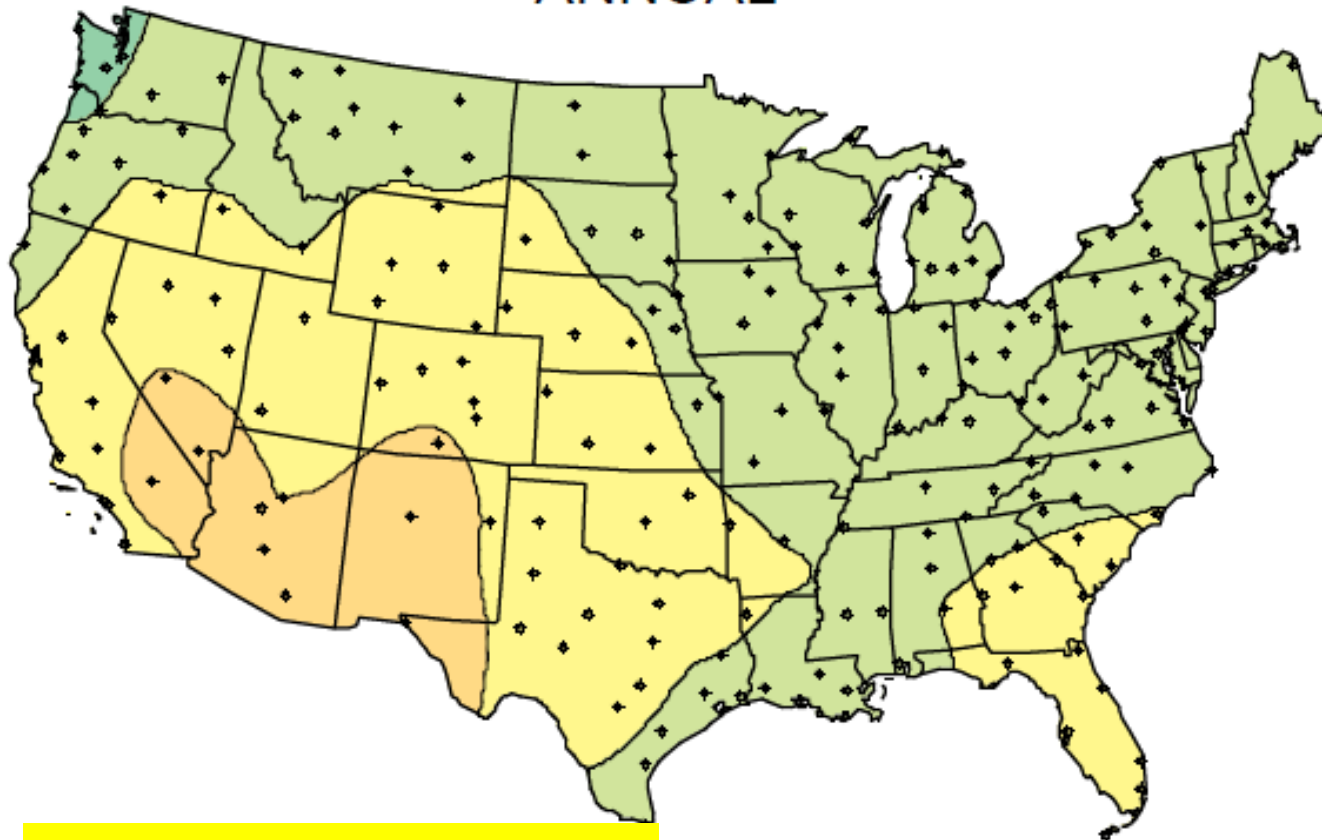
Solar Ready



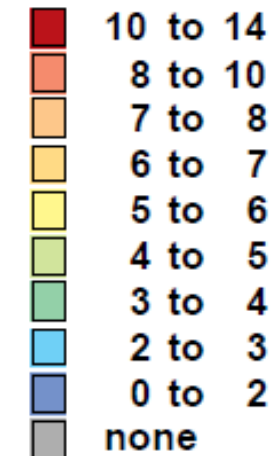
Source: [NREL Documenting a Decade of Cost Decline for PV Systems](#), 2021.

Average Daily Solar Radiation Per Month

ANNUAL



kWh/m²/day



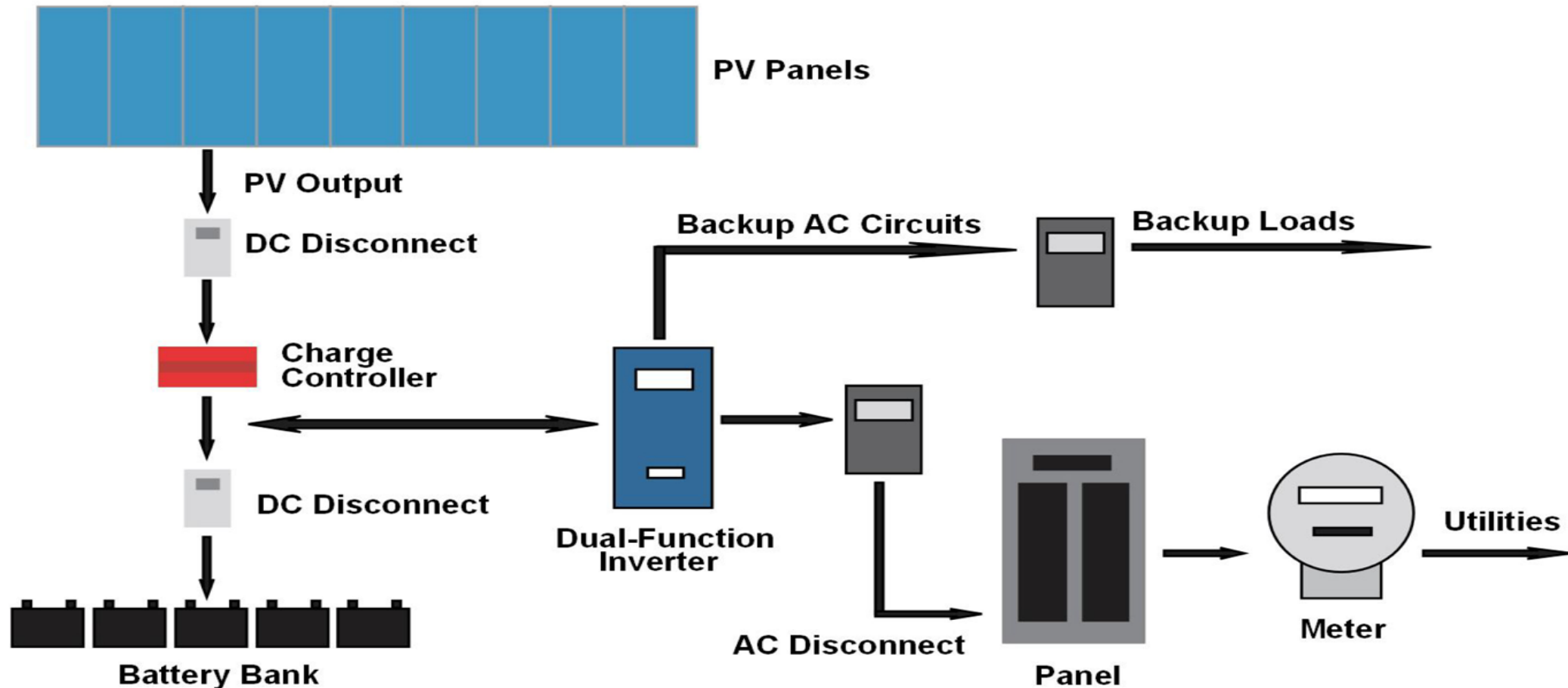
Solar Ready Required

PV-Ready v2 Checklist must be completed.

Exceptions:

- Home already has an on-site PV system
- Connected to community solar system
- Location has significant natural shading
- If ≤ 600 sf of roof area oriented between 110°-270° of true north.

GRID-TIED PV SYSTEM



Documentation of the maximum allowable dead load and live load ratings of the existing roof (Rec DL.: 6 lbs./sq. ft.)

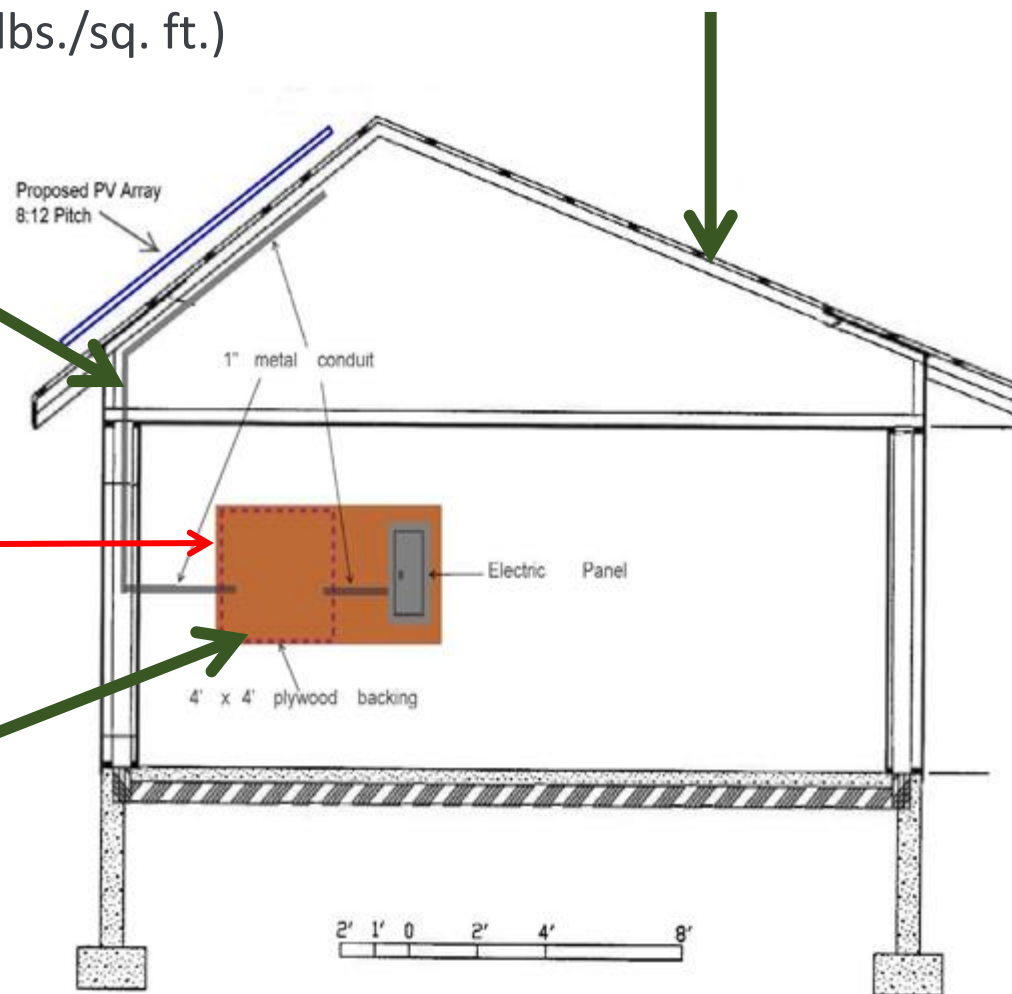
Conduit to run DC wire from roof to inverter

Dedicated Area for installing inverter and balance of system

Conduit to run AC wire from inverter location to electric panel

Circuit Breaker
designated and/or installed for use by the PV system in the electric panel

Inline
or
Micro-
Inverter
system





Zero Ready for Smarter Builders



REPORT/PAPER - 2019

The Economics of Zero-Energy Homes

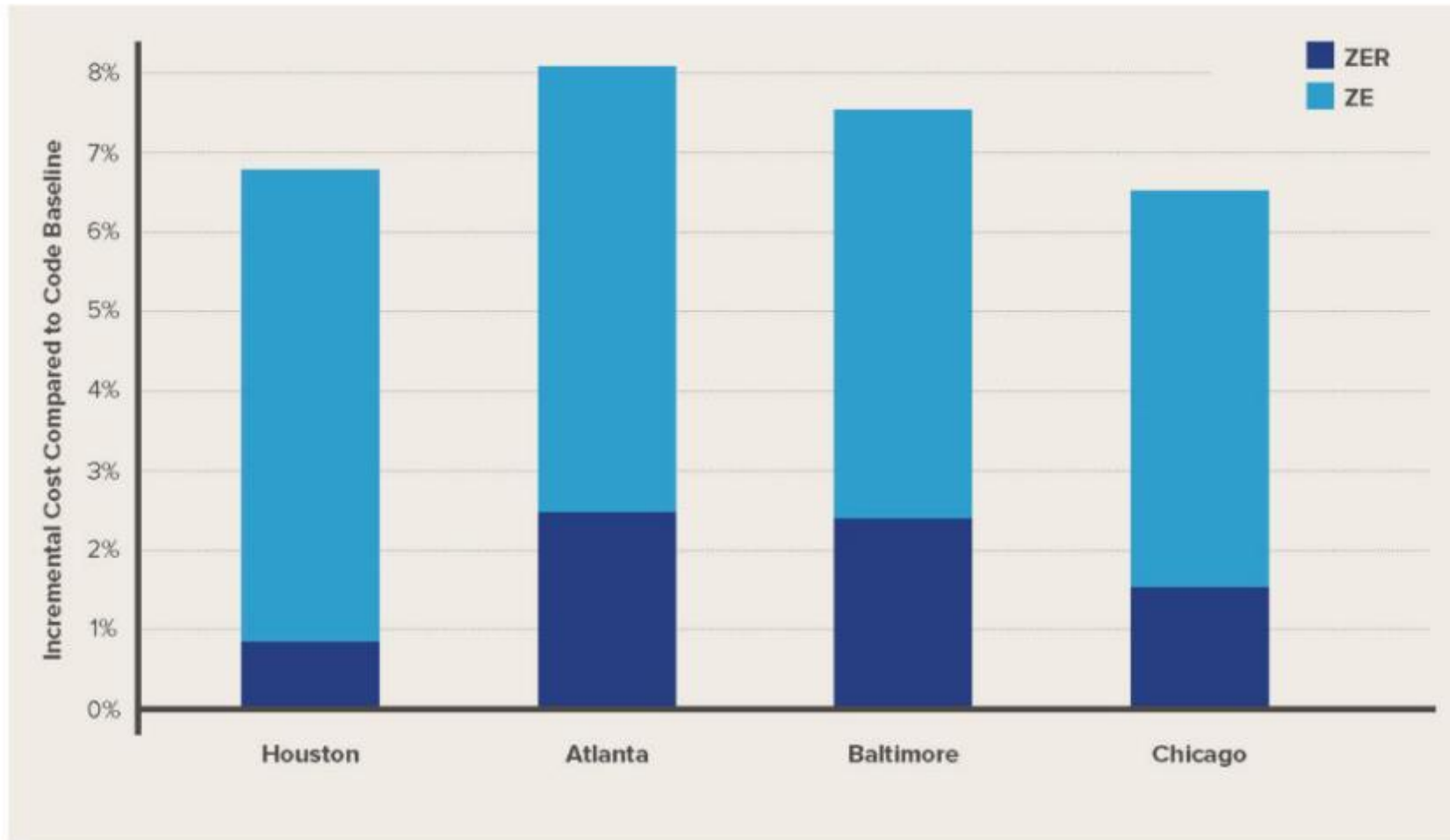
By Jacob Corvidae, Michael Gartman and Alisa Petersen

<https://www.rmi.org/insight/economics-of-zero-energy-homes/>

<https://www.youtube.com/watch?v=ROFoiZOW7NU>

- ZE and ZER homes currently make up less than 1.5% of residential new construction, largely due to outdated or overstated cost assumptions.
- Contrary to popular belief, ZER homes fall under a 3% incremental cost in most parts of the country, with that cost dropping under $\leq 2.5\%$ in select locations such as Baltimore, MD.

Figure 1: Incremental Costs for ZE and ZER Homes



Cities are close to achieving cost parity for ZER and ZE homes

Next Steps

www.buildings.energy.gov/zero/

- Become a Partner
- Program Specs
- DOE Tour of Zero
- 24+ Recorded Webinars
- Marketing Took Kit



Review

- Technical Guidelines
- Partnership Agreement Terms

Register

- Electronically Sign Agreement

Choose Optional Commitments:



- 100% of homes meet DOE Zero Energy Ready Home Guidelines



- Homes meet EPA's WaterSense Guidelines



- Homes meet IBHS's Fortified Home Guidelines



- Meet DOE ZERH Home Quality Management Program

- **Take Orientation Training**
after registering and renew training every year
- **Provide Certificate**
for DOE Zero Energy Ready Home to each home owner
- **Adhere to Brand Identity Guidelines**
for proper use of the DOE Zero Energy Ready Home name and logo
- **Build/Verify at Least One Home/Year**
to maintain active partnership

To view the full Agreement terms and disclaimers, visit:

<http://www1.eere.energy.gov/buildings/zero/>

Process:

- Become a Builder or Rater partner (online)
- No need to pre-register projects; no program fees
- Recommend integrated design process (MEPs)
- Rater: plan review & site inspections
- Project Certification
 - Rater sends compliance report (generated by modeling software) to DOE or RESNET Registry
- Builder credited with certified home on DOE website

ENERGY STAR & DOE ZERH

- Same rater network
- Same modeling software (at least 3 different options)
- Same plan review & site inspection protocol



Available in your Marketing Toolkit...

- Zero Energy Ready Home Logos
- Branded Consumer Brochure
- Branded Point-of-Sale Fact Sheet
- Drop-In Messaging
- Take the Tour Web Button
- Branded Tour of Zero Web Button
- Consumer Video

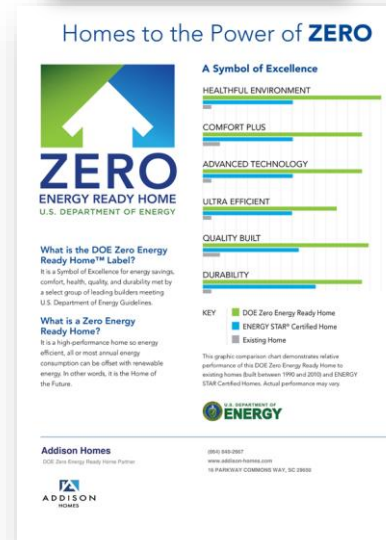
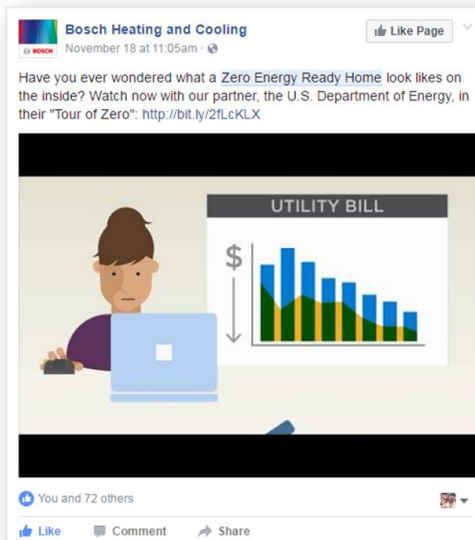


***Brand yourself
as a leader!***

Promote the ZERH Advantage!

Where to use:

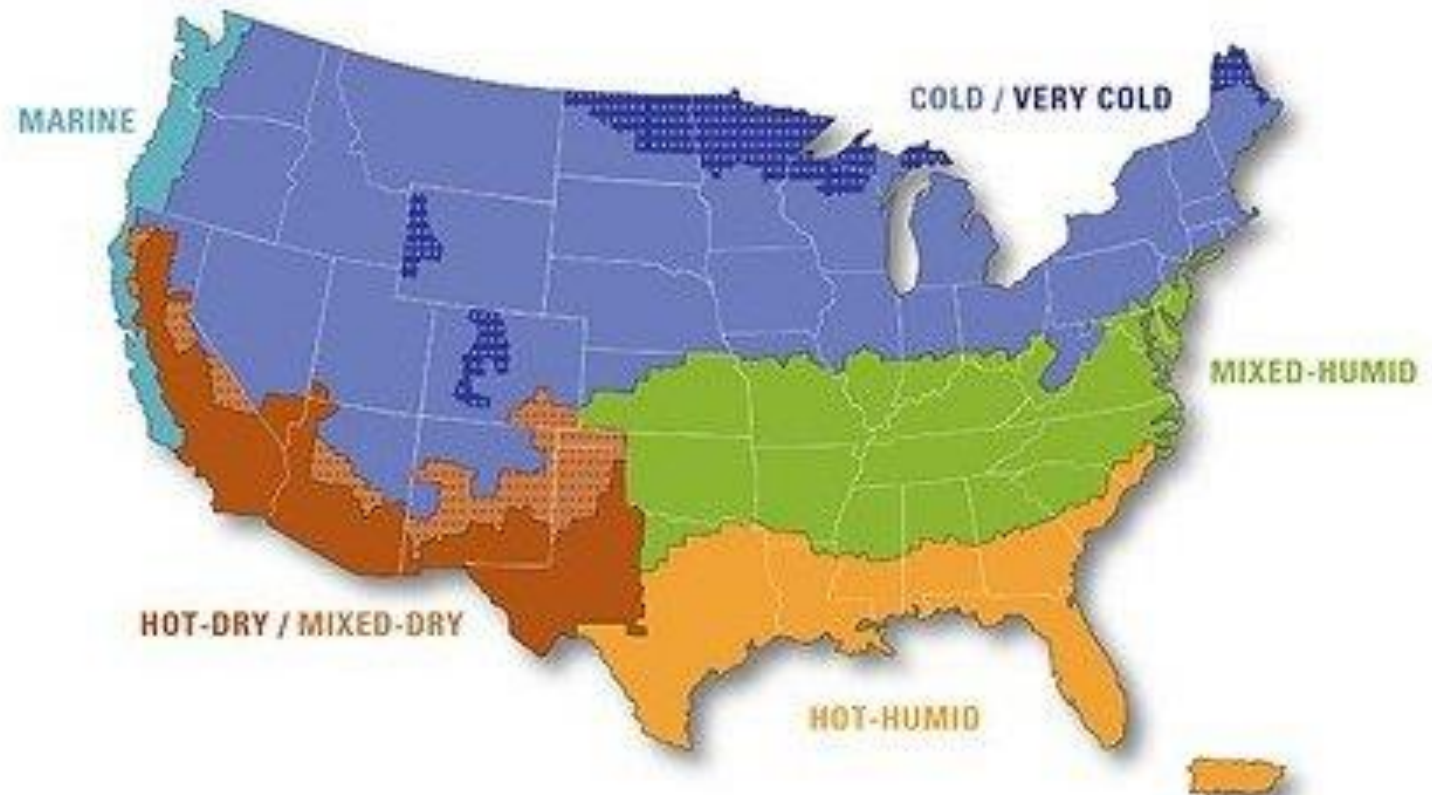
- Promotional Events
- Home Tours
- Sales Materials



Be a Part of the National Tour of Zero!

Where to use:

- Website
- Social Media
- Press Releases



www.energy.gov/eere/buildings/maps/doe-tour-zero



ENERGY.GOV
Office of Energy Efficiency & Renewable Energy

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DOE TOUR OF ZERO

Buildings Home

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Appliance & Equipment Standards

Building Energy Codes

Success Stories

Resource Center

Funding Opportunities

Are you ready for a home that lives, works, and lasts better? The home of the future - a better home - is available today. Take a virtual tour of homes that are so energy efficient a renewable energy system can offset all or most of their annual energy consumption. These award-winning homes are independently certified to meet DOE Zero Energy Ready Home guidelines and constructed by a select group of top builders. Zero Energy Ready Home is part of the U.S. Department of Energy's Better Buildings initiative. Better Buildings aims to make commercial, industrial, public, and residential buildings 20 percent more energy efficient over the next decade.

NAHMI

COLD / VERY COLD

MIXED-HUMID

HOT-DRY / VERY DRY

HOT-HUMID

Click on a climate zone to see homes in that region.

Search:

Search

Reset

Showing 1 to 25 of 77 entries

TOUR THESE HOMES

BUILDER

LOCATION

HIA WINNER

CLIMATE ZONE

Cobbler Lane	Addison Homes	Greer, SC	2015	MIXED-HUMID
Fishers Circle	Amaris Homes	Maplewood, MN	2015	COLD / VERY COLD
Johns Island Custom	Amerisips Homes, LLC	Charleston, SC	2014	HOT-HUMID
Eco Village Ithaca	AquaZephyr	Ithaca, NY	2014	COLD / VERY COLD
ZED 2	Boulder ZED Design Build	Boulder, CO		COLD / VERY COLD

The Home of the Future Today

0:00 / 3:41

The Home of the Future Today Video (Text Version)

Tour

Video

Armando Cobo, Designer

CoboDesigner.com

972-781-8724



U.S. DEPARTMENT OF ENERGY

Energy Efficiency & Renewable Energy

DOE Home | Programs & Offices | Consumer Information

Building Technologies Office

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Building Energy Codes

DOE Zero Energy Ready Home: Partner Profile

New Town Builders

NEW TOWN BUILDERS

DOE Zero Energy Ready Home

Partner ID: 619

Organization Type: Builder

Main Contact: Bill Rotunus

Address: 1653 PLATTE STREET
DENVER, CO 80002

Primary Phone Number: (303) 707-4400

41

Certified DOE Zero Energy Ready Homes (2012 - Present): 0

Certified Builders Challenge Homes (2009 - 2012): 0

Website: www.newtownbuilders.com

All Places of Business

Comments

DOE Zero Energy Ready Home version 4.5.1

Created on: 2/16/2014 10:15 AM | U.S. Department of Energy | USDOE.gov

Content last updated: 1-27-2014

"WHAT I LOVE ABOUT THIS HOME IS JUST HOW COMFORTABLE IT IS."

New Town Builders

The ArtIZEN Plan
Denver, CO
newtownbuilders.com

"What I love about this home is just how comfortable it is. The temperature is always perfect. I never have to think about it or worry about it regardless of where I am in the house. It just feels very cozy and warm. Our home is also very quiet ... like a sanctuary ... we're right by a busy road and you don't hear the noise"

- Homeowner



KEY FEATURES

- High-performance insulation system for enhanced quiet and comfort
- Comprehensive draft protection
- Fresh air system for cleaner, healthier indoor air
- High-efficiency comfort system
- High-efficiency appliances and advanced lighting technology for energy and water savings

[Read more.](#)



[More ...](#)

[Meet the Builder](#)



2,115 ft²

3 bedrm, 2.5 bath
2 floors
cold climate
\$450,000 w/land

HERS-3

This home's score w/PV

0 = a net zero energy home
100 = typical new code home
130 = average existing home

~\$0

Average monthly energy bill*

\$1,902 saved per year*
\$80,892 saved over 30-yr mortgage**
*calculated; **calculated with fuel escalation rate per 2014 EIA Annual Energy Outlook

Congratulations to the 2022 Housing Innovation Award Winners!



<https://www.energy.gov/eere/buildings/housing-innovation-awards>



Housing Innovation
Award

World-Class Expert Guidance...

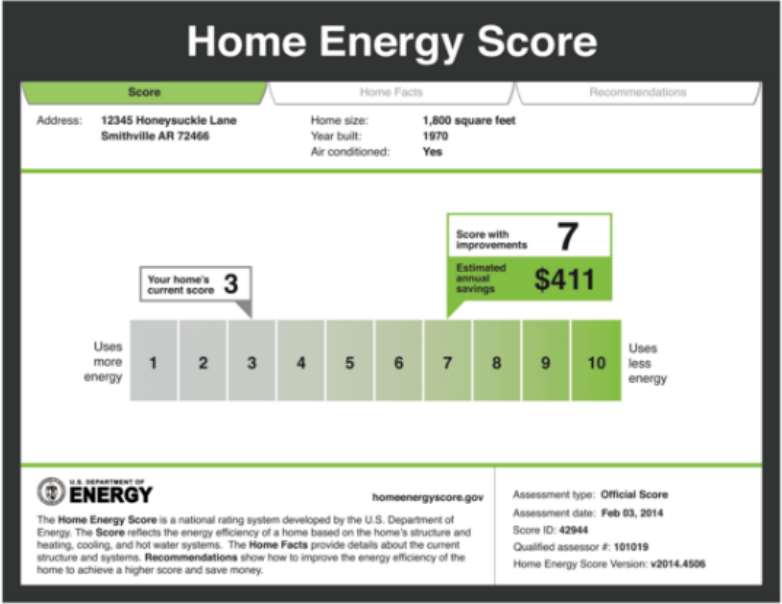
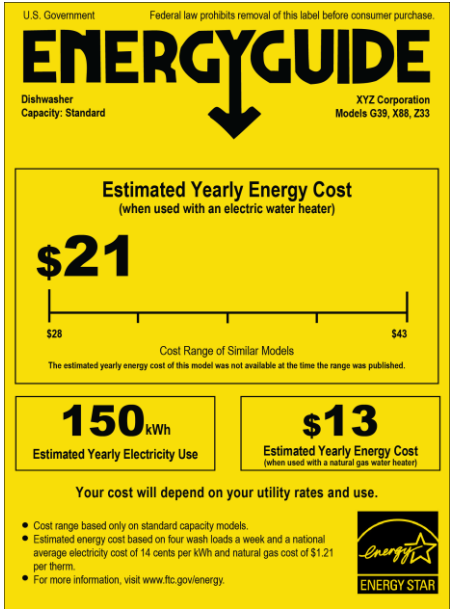
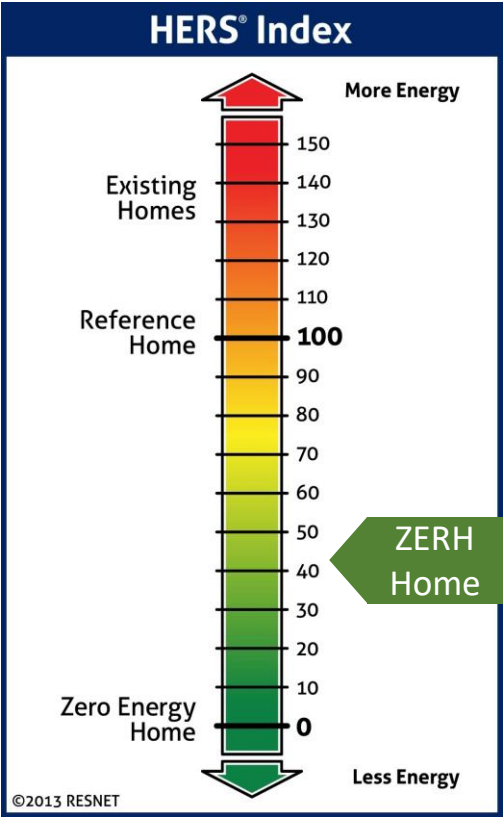
Building America Solution Center
BASC.energy.gov



...At Your Fingertips



Zero Ready for Smarter Buyers



As more MLS listings add HERS scores to all listings, this measurement will be equally critical for existing housing stock. By providing a HERS score as part of the building process, contractors can help homeowners understand how the design and product specifications will deliver energy savings in the near-term and improve a home’s measurable value over the long-term. Ask for **AI Report Form 820.06**

Buyers Know Reduced Energy

Zero Energy Ready Home Program Version 2



Credit: The Zero Energy Project

- **Design**

- Appearance
- Size
- Function

- **Performance**

- Energy Efficiency (HERS)
- Comfort
- Health

- **Cost**

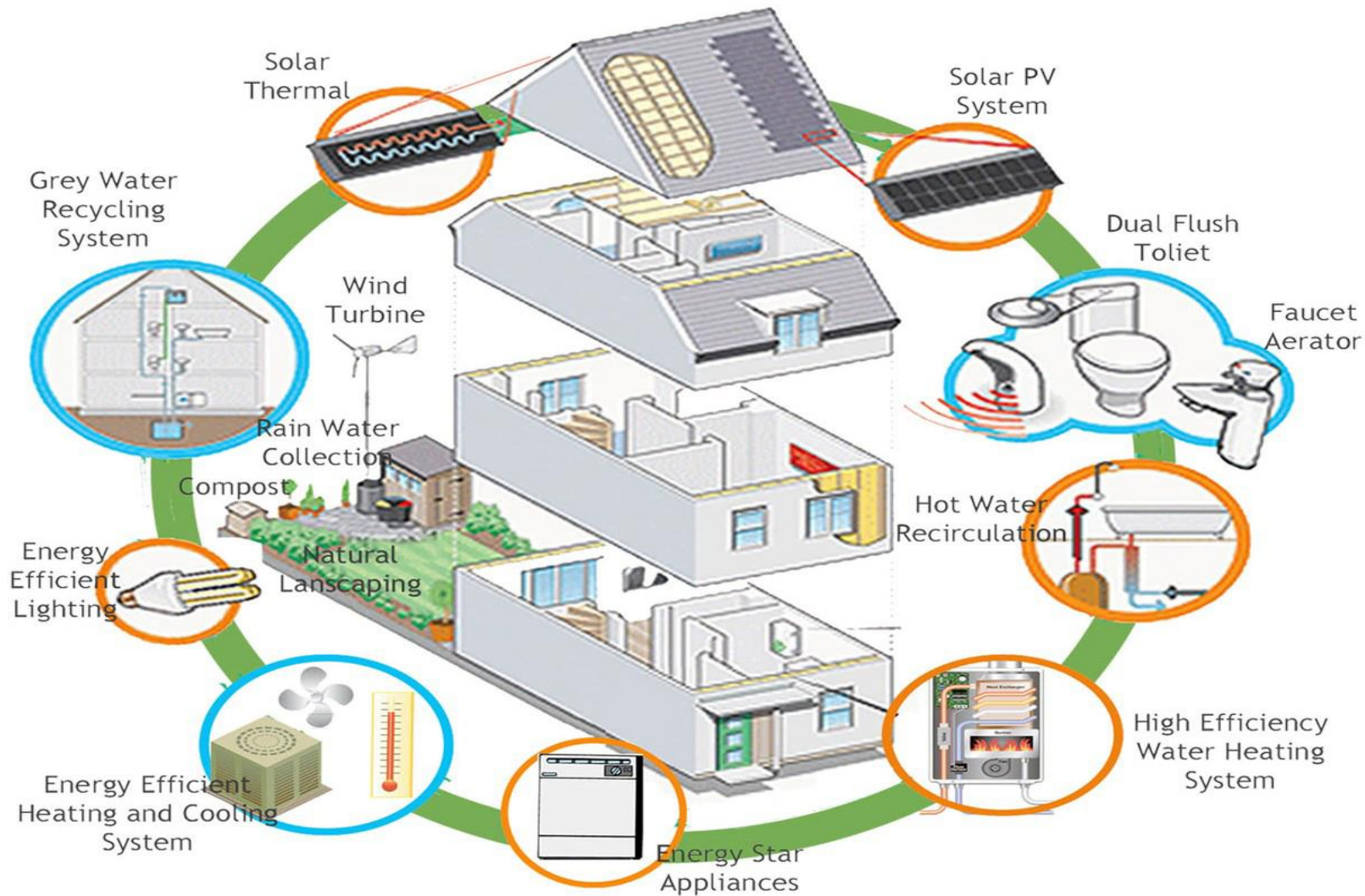
- Sticker Price
- Ownership Cost (PITI + E)
- Resale Value
- Maintenance Cost

- **Durability**

- Repair Record
- Disaster Resistance
- Warranty

- **Value**

- Awards/Special Recognition
- Professional Reviews
- Owner Reviews





Zero Ready for Bragging Rights

Lots of Recognition Choices...

Zero Energy Ready Home
Program Version 2





ACD ZERH SPECIFICATIONS

≤ 1 ACH50

(Seal, Tape, Insulation & Outsulation)

HERS ≤ 45

(Low H&C Loads, ES Specs)

135 mph EF2 Wind Design Load or Higher

1 AC Ton per 1,000-1,500 sf.

(Correctly performed Design, Inside Conditioned Space,
Metal Trunk and Flex Supply Duct System, ERV, Humidity
Control Fans, Dehumidifier, Smart Monitoring)

ASHRAE 62.2-2013

2-2.5 kW /sq. ft.



- ▶ 5,000 s.f., 10 kW SunPower327 system, 2 EV Chargers, 0.95ACH50, 2 & 3 ton AC, 2-96%AFUE, 2 TWH, All ES Lighting and Appliances, 2 Bars, a Theater, 70' Pool & Hot Spa.
- ▶ In first 4 PV-months, system covered 99-80% electric bills...
\$1.89 - \$44.00 (92% per 1st year)

See Owners enjoying their savings... in Cancun!






ACCOUNT INFORMATION

ACCOUNT #:
INVOICE #:
CUSTOMER NAME:
SERVICE ADDRESS: ★ 10507 EASTLAWN DR
DALLAS TX 75229-5311
ESI ID:

YOUR ENVIRONMENTAL IMPACT

kWh Electricity Used	536
CO ₂ Emissions Avoided (pounds) ¹	595
Which is like the annual CO ₂ absorbed by this many young trees 	62

CARD PAYMENT

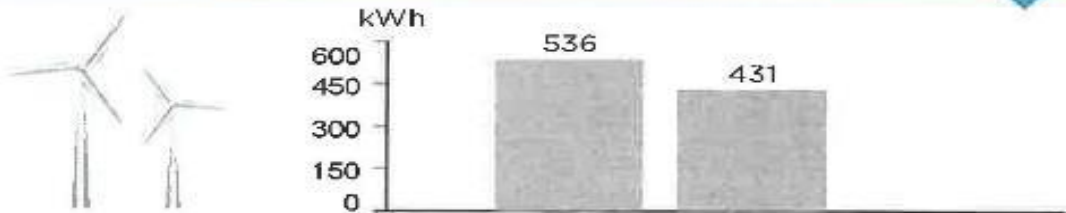
AUTOPAY DATE	AUTOPAY AMOUNT
	\$1.89

BILLING SUMMARY

Product	Renewable Rewards [®] 24
Previous Amount Due	\$187.08
Payments	-187.08
Current Electricity Charges	1.89
Amount Due	\$1.89



ELECTRICITY USAGE SUMMARY



Billing Period	Current	Previous	
Billing Days	31	30	
Average High Temperature	67 ° F	62 ° F	
Average Daily Usage (kWh)	17	14	

Log in to My Account to see detailed usage history.

26 U.S. Code § 25D - Residential Clean Energy Credit

Inflation Reduction Act of 2022 (P.L. 117-169)

- **Available to homeowners**
 - **Effective 2022-2032**
 - 30% tax credit (no bonus tax credits)
 - (retroactive to January 1, 2022)
 - 26% in 2033
 - 22% in 2034
- **Now available for:**
 - Stand-alone storage (at least 3kWh)
 - Fuel cells (capped at \$500/0.5kW capacity)
- Customer must have tax “appetite” to take advantage of credit in current year or following year (1-year carryforward) – not eligible for direct pay or transfer.

- Design zero energy homes wisely
- **EVERYTHING** starts with a complete set of plans and specifications...
Details, details, details!
- Work with educated contractors
- Choose the right systems and materials
- Engage approved and certified Appraisers – 9.7% premium on ZER homes
- **Residential Green and Energy Efficient Addendum – Form 820.06**
- Request lenders that offer energy efficient mortgages, EEM
- Work with zero energy savvy Sales Professionals

Thank You

For More Information:

<https://www.energy.gov/eere/buildings/zero-energy-ready-home-program>



Email Contact:

acobo100@Hotmail.com

CoboDesigner.com

Cell: **972-781-8724**



Thank You

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U.S. DOE Zero Energy Ready Home for Single Family Homes ERI Target Procedure for National Program Requirements, Version 2 Revised January 2023

This document provides detailed instructions for determining the DOE Zero Energy Ready Home Version 2 Energy Rating Index (ERI) Target, the highest ERI value that a home can achieve and qualify under the Zero Energy Ready Home program. Note, however, that regardless of the measures selected, the Mandatory Requirements in Exhibit 1 of the DOE Zero Energy Ready Home Version 2 National Program Requirements shall be met.

A DOE-recognized Home Certification Organization for Zero Energy Ready Home certifications (HCO for ZERH) approved software rating tool shall automatically determine the ZERH Version 2 - ERI Target for each rated home (referred to as the "ZERH V2 ERI Target" within this document). This shall be done by configuring the DOE ZERH Target Home Design in accordance with the building characteristics defined in Exhibit 1. The approved software rating tool shall not rely on a user-configured DOE ZERH Target Home Design. The approved software rating tool shall calculate the ERI value of the DOE ZERH Target Home Design. This ERI value shall be calculated using ANSI / RESNET / ICC Standard 301 including all Addenda and Normative Appendices, with new versions and Addenda implemented according to the schedule defined by the HCO for ZERH that the home is being certified under. This value, rounded to the nearest whole number, shall equal the ZERH V2 ERI Target.

Exhibit 1: Expanded DOE Zero Energy Ready Home Version 2 Target Home Design Definition

Building Component	Expanded DOE Zero Energy Ready Home Version 2 Target Home Design Definition ¹								
Foundations	Construction Type & Structural Mass: Same as Rated Home, except:								
	<ul style="list-style-type: none"> For masonry floor slabs, modeled with 80% of floor area covered by carpet and 20% of floor directly exposed to room air 								
	Conditioning Type: Same as Rated Home, except:								
	<ul style="list-style-type: none"> Crawlspaces shall be modeled as vented, with uninsulated walls, with net free vent aperture = 1sq. ft. per 150 sq. ft. of crawlspace floor area. This vented crawl shall be insulated at the floor level at a U value based on the section "Floors over Unconditioned Spaces" below. 								
	Gross Area: Same as Rated Home								
	Insulation ^{2, 3} : Choose appropriate insulation level below:								
	<ul style="list-style-type: none"> Basement Wall Assembly U-factor only applies to conditioned basements; if applicable, insulation shall be located on interior side of walls Floor assemblies above crawlspace foundations shall be configured to meet the applicable floor assembly U-factor listed in the building component section for Floors Over Unconditioned Spaces Slab floors with a floor surface less than 12" below grade shall be insulated to the Slab Insulation R-value. The insulation shall extend downward from the top of the slab on the outside of the foundation wall and then vertically below-grade to the Slab Insulation Depth 								
	Climate Zone per 2021 IECC ⁴	CZ 1	CZ 2	CZ 3	CZ 4	CZ 4C & 5	CZ 6	CZ 7	CZ 8
	Slab Insulation R-Value ⁵	0	0	10	10	10	10	10	10
	Slab Insulation Depth (ft)	0	0	2	4	4	4	4	4
	Basement Wall Assembly U-Factor	0.360	0.360	0.091	0.059	0.050	0.050	0.050	0.050
	Construction Type: Wood frame								



U.S. DOE Zero Energy Ready Home for Single Family Homes ERI Target Procedure for National Program Requirements, Version 2 Revised January 2023

Floors Over Unconditioned Spaces	Gross Area: Same as Rated Home								
	Insulation:								
	Climate Zone	CZ 1	CZ 2	CZ 3	CZ 4	CZ 4C & 5	CZ 6	CZ 7	CZ 8
	Floor Assembly U-Factor	0.064	0.064	0.047	0.047	0.033	0.033	0.028	0.028
Above-Grade Walls	Interior & Exterior Construction Type: Wood frame								
	Gross Area: Same as Rated Home								
	Solar Absorptance = 0.75								
	Emittance: 0.90								
	Insulation:								
	Climate Zone	CZ 1	CZ 2	CZ 3	CZ 4	CZ 4C & 5	CZ 6	CZ 7	CZ 8
	Wall Assembly U-Factor	0.084	0.084	0.060	0.045	0.045	0.045	0.045	0.045
Thermally Isolated Sunrooms	None								
Doors ⁶	Area: same as Rated home								
	Orientation: same as Rated home								
	U-Values and SHGCs, based on ENERGY STAR doors								
	Door Type		Opaque		≤1/2-Lite		>1/2-Lite CZ1-3		>1/2-Lite CZ4-8
	U-Value		0.17		0.25		0.30		0.30
	SHGC		N/A		0.25		0.25		0.40
Glazing	Total Area: (except in homes with conditioned basements and attached homes ⁷) • Same as Rated Home, where Rated Home glazing area is less than 15% of conditioned floor area; OR • 15% of the conditioned floor area, where the Rated Home glazing area is 15% or more of the conditioned floor area								
	Orientation: Equally distributed to North, East, South, and West								
	Interior Shade Coefficient: Same as Energy Rating Reference Home, as defined by ANSI / RESNET / ICC Std. 301								
	External Shading: none								
	U-Values and SHGCs, as defined below:								
	Climate Zone	CZ 1	CZ 2	CZ 3	CZ 4	CZ 4C & 5	CZ 6	CZ 7	CZ 8
	U-Value	0.40	0.40	0.30	0.30	0.27	0.25	0.25	0.25
	SHGC	0.23	0.23	0.25	0.40	0.40	0.40	0.40	0.40
Skylights	None								
Ceilings	Construction Type: Wood frame								
	Gross Area: Same as Rated Home								
	Insulation:								
	Climate Zone	CZ 1	CZ 2	CZ 3	CZ 4	CZ 4C & 5	CZ 6	CZ 7	CZ 8



U.S. DOE Zero Energy Ready Home for Single Family Homes ERI Target Procedure for National Program Requirements, Version 2 Revised January 2023

	Ceiling Assembly U-Factor	0.035	0.026	0.026	0.024	0.024	0.024	0.024	0.024
Attics	Construction Type: Vented with aperture = 1sq. ft. per 300 sq. ft. ceiling area								
	Radiant Barrier: none								
Roofs	Construction Type: Composition shingle on wood sheathing								
	Gross Area: Same as Rated Home								
	Solar Absorptance = 0.92								
	Emittance = 0.90								
Internal Mass	Same as Energy Rating Reference Home, as defined by ANSI / RESNET / ICC Std. 301 Additional mass specifically designed as a Thermal Storage Element for the Rated Home shall be excluded.								
On-site Energy Storage Systems	None.								
On-site Power Production	None.								
Lighting, Appliances, & Internal Gains	Lighting: Fraction of qualifying Tier II fixtures to all fixtures in qualifying light fixture locations: 100% for interior, exterior, and garage								
	Refrigerator: 450 kWh per year								
	Dishwasher: Capacity Same as Rated Home, or Standard capacity if no dishwasher in the Rated Home For Standard capacity: LER = 270, GHWC = \$22.23, Elec\$ = \$0.12, Gas\$ = \$1.09, LCY = 208 For Compact capacity: LER = 203, GHWC = \$14.20, Elec\$ = \$0.12, Gas\$ = \$1.09, LCY = 208								
	Ceiling Fan: 122 CFM per Watt; Quantity = Number of bedrooms + 1 when ceiling fans present in Rated home; Otherwise, Quantity = 0								
	Clothes Washer: Efficiency equal to "Std 2018-Present" Standard Clothes Washer Model if clothes washer present in the Rated Home; otherwise, same as Energy Rating Reference Home, as defined by ANSI / RESNET / ICC Std. 301.								
	Clothes Dryer: Same as Energy Rating Reference Home, as defined by ANSI / RESNET / ICC Std. 301.								
	Internal Gains: Same as Energy Rating Reference Home, as defined by ANSI / RESNET / ICC Std. 301, except for adjustments for the lighting, refrigerator, dishwasher, and ceiling fans specified in this Section.								
Heating Systems	Heating capacity shall be selected in accordance with ACCA Manual S based on building heating and cooling loads calculated in accordance with ACCA Manual J, Eighth Edition, ASHRAE Handbook of Fundamentals, or an equivalent computation procedure. For forced-air HVAC systems, degraded capacity from other than Grade I installation shall be accounted for using same methodology applied to Energy Rating Reference Home.								
	Fuel Type: Same as Rated Home, except Target Home Design shall be configured with gas where Rated Home has non-electric equipment ⁸								
	Installation Quality: For forced-air HVAC systems, Grade I (-7.5%) blower fan airflow deviation; Grade I (0.45 CFM/Watt); and for air-source heat pumps, Grade III refrigerant undercharge.								
	System Type: Same as Rated Home, except Target Home Design shall be configured with air-source heat pump where Rated Home has air-source or ground-source heat pump, electric strip heat, or electric baseboard heat; efficiency selected from below ⁹								
	Climate Zone	CZ 1	CZ 2	CZ 3	CZ 4	CZ 4C & 5	CZ 6	CZ 7	CZ 8
	Gas Furnace AFUE	80	80	92	95	95	95	95	95



U.S. DOE Zero Energy Ready Home for Single Family Homes

ERI Target Procedure for National Program Requirements, Version 2

Revised January 2023

	Gas Boiler, AFUE	80	80	92	95	95	95	95	95
	Air-Source HP, HSPF	9.2	9.2	9.2	9.2	9.5	9.5	9.5	9.5
	ASHP Backup	electric	electric	electric	electric	electric	electric	electric	electric
	For non-electric warm furnaces and non-electric boilers, the Electric Auxiliary Energy shall be determined in accordance with the methodology for the Energy Rating Reference Home in ANSI / RESNET / ICC Std. 301.								
Cooling Systems	Cooling capacity shall be selected in accordance with ACCA Manual S based on building heating and cooling loads calculated in accordance with ACCA Manual J, Eighth Edition, ASHRAE Handbook of Fundamentals, or an equivalent computation procedure. For forced-air HVAC systems, degraded capacity from other-than-Grade I installation shall be accounted for using same methodology applied to Energy Rating Reference Home.								
	Fuel Type: Same as Rated Home, except Target Home Design shall be configured with gas where Rated Home has non-electric equipment ⁸								
	Installation Quality: For forced-air HVAC systems, Grade I (-7.5%) blower fan airflow deviation; Grade I (0.45 CFM/Watt); and for AC's and air-source heat pumps, Grade III refrigerant undercharge.								
	System Type: Same as Rated Home, except Target Home Design shall be configured with air-source heat pump where Rated Home has air-source or ground-source heat pump, electric strip heat, or electric baseboard heat; efficiency selected from below ¹⁰								
	Climate Zone	CZ 1	CZ 2	CZ 3	CZ 4	CZ 4C & 5	CZ 6	CZ 7	CZ 8
	AC SEER	18	18	16	16	14	14	14	14
	Air-Source Heat Pump SEER	18	18	16	16	16	16	16	16
Service Water Heating Systems	Use (Gallons per Day): Same as Energy Rating Reference Home, as defined by ANSI / RESNET / ICC Std. 301, except for reduced usage resulting from the dishwasher specified in the Lighting, Appliances, & Internal Gains Section. ¹¹								
	Tank Temperature: Same as Energy Rating Reference Home, as defined by ANSI / RESNET / ICC Std. 301.								
	Fuel Type: Same as Rated Home, except Reference Design shall be configured with gas where Rated Home has non-electric equipment ⁸								
	System Type: Where Rated Home has non-electric water heater, Target Home Design shall be configured with a tankless gas water heater with 0.95 Uniform Energy Factor (UEF). Where Rated Home has electric water heater, Target Home Design shall be configured with an electric heat pump water heater with 2.57 UEF and tank size equal to that of Rated Home, or 60-gallon tank size if Rated Home uses tankless electric water heater.								
Thermal Distribution Systems	Duct Leakage to Outside: 0 CFM25 per 100 sq. ft. of conditioned floor area								
	Duct Insulation: None								
	Duct Surface Area: Same as Rated Home								
	Supply and Return Duct Locations shall be 100% in conditioned space.								
Thermostat	Type: Programmable								
	Temperature Setpoints: Same as Energy Rating Reference Home, but with offsets for a programmable thermostat, as defined by ANSI / RESNET / ICC Std. 301								
Dehumidifiers	Type, capacity, efficacy, and dehumidistat setpoint same as Energy Rating Reference Home, as defined by ANSI/RESNT/ECC 301, when dehumidification system is present in Rated home; otherwise none.								
	Infiltration Rates (ACH50)								



U.S. DOE Zero Energy Ready Home for Single Family Homes ERI Target Procedure for National Program Requirements, Version 2 Revised January 2023

Infiltration	Climate Zone	CZ 1	CZ 2	CZ 3	CZ 4	CZ 4C & 5	CZ 6	CZ 7	CZ 8
	Single Family Detached	2.75	2.75	2.25	2.25	2.0	2.0	2.0	1.5
	Single Family Attached	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Whole-House Mechanical Ventilation	Rate: $CFM = 0.01 * CFA + 7.5 * (Nbr + 1)$, where CFA = Conditioned Floor Area and Nbr = Number of Bedrooms; Runtime: 24 Hours / Day								
	Fan Watts: determined by dividing the airflow rate (cfm) as calculated based on prior row, by the fan efficacy values (cfm/Watt) shown below								
	System Type: determined from table entries below								
	Climate Zone	CZ 1	CZ 2	CZ 3	CZ 4	CZ 4C & 5	CZ 6	CZ 7	CZ 8
	System Type ¹²	supply	supply	supply	supply	balanced	balanced	balanced	balanced
	Fan Efficacy (cfm/W)	2.9	2.9	2.9	2.9	1.2	1.2	1.2	1.2
	Heat Exchange	No	No	No	No	Yes; 65% ASRE	Yes; 65% ASRE	Yes; 65% ASRE	Yes; 65% ASRE

Footnotes:

- ¹ Any parameter not specified in this exhibit shall be identical to the value entered for the Rated Home.
- ² Slab insulation R-values represent nominal insulation levels; and assembly U-factors for foundations, floors, walls, and ceilings represent the overall assembly, inclusive of sheathing materials, cavity insulation, installation quality, framing, and interior finishes.
- ³ If software allows the user to specify the thermal boundary location independent of the conditioned space boundary in the basement of the rated home, then the thermal boundary of the ZERH Target Home Design shall be aligned with this boundary. For example, if the thermal boundary is located at the walls, then the wall insulation shall be configured as if it was a conditioned basement. If the thermal boundary is located at the floor above the basement, then the floor insulation shall be configured as if it was a floor over an unconditioned space.
- ⁴ Climate Zones as defined by the 2021 IECC may be viewed online: <https://codes.iccsafe.org/content/IECC2021P1/chapter-3-re-general-requirements>. Note that some locations have shifted to a different climate zone in the 2021 IECC as compared to prior versions of the IECC. Compliance with DOE ZERH program requirements is based on climate zones as defined in the 2021 IECC.
- ⁵ Rating software incorporating DOE ZERH Version 2 compliance should include an input that indicates if a code official in the project's jurisdiction has designated the jurisdiction as having a Very Heavy Termite infestation. If this input is selected, then for the purpose of an envelope UA analysis, the code reference home's slab edge insulation level shall be set to the same R-value and depth as the Rated Home. The intent is that the Rated Home would not be penalized (in terms of envelope UA compliance) if it is unable to install slab edge insulation due to termite-related risks. However, for



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the determination of the ZERH V2 ERI Target value, the slab edge insulation R-value and depth shall be as listed in Exhibit 1, regardless of whether the input for Very Heavy Termite infestation is selected.

⁶ Note that the U-factor requirement applies to all fenestration while the SHGC only applies to the glazed portion.

⁷ When determining the ZERH ERI Target for homes with conditioned basements and for attached homes, the following formula shall be used to determine total window area of the ZERH Target Design:

$$AG = 0.15 \times CFA \times FA \times F$$

Where:

- AG = Total glazing area
- CFA = Total conditioned floor area
- FA = (Gross above-grade thermal boundary wall area) / (Gross above-grade thermal boundary wall area + 0.5 x Gross below-grade thermal boundary wall area)
- F = 1 - 0.44 x (Gross common wall area) / (Gross above-grade thermal boundary wall area + Gross common wall area)

And where:

- Thermal boundary wall is any wall that separates Conditioned Space from Unconditioned Space, outdoor environment, or the surrounding soil;
- Above-grade thermal boundary wall is any portion of a thermal boundary wall not in contact with soil;
- Below-grade thermal boundary wall is any portion of a thermal boundary wall in soil contact; and
- Common wall is the total wall area of walls adjacent to another conditioned living unit, not including foundation walls.

⁸ Fuel type(s) shall be same as Rated Home, including any dual-fuel equipment where applicable. For a Rated Home with multiple heating, cooling, or water heating systems using different fuel types, the applicable system capacities and fuel types shall be weighted in accordance with the loads distribution (as calculated by accepted engineering practice for that equipment and fuel type) of the multiple systems.

⁹ For a Rated Home without a heating system, the ZERH Target Home Design shall be configured with a 78% AFUE gas furnace system, unless the Rated home has no access to natural gas or fossil fuel delivery. In such cases, the ZERH Target Home Design shall be configured with a 7.7 HSPF air-source heat pump.

¹⁰ For a Rated Home without a cooling system, the ZERH Target Home Design shall be configured with a 13 SEER electric air conditioner.

¹¹ ZERH Target Home Design should reflect standard-flow plumbing fixtures, reference or "Std 2018-Present" Standard Clothes Washer Model gallons per day, standard distribution system water use effectiveness, a hot water piping ratio of 1.0, no pipe insulation, and no drainwater heater recovery.

¹² Ventilation Type is identified here for clarity in programming the Target Home Design only. Numerous factors such as energy performance, induced sensible and latent loads, IAQ, and moisture management should be considered in selecting an appropriate ventilation system type.



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The following homes are eligible for qualification under the DOE Zero Energy Ready Home (ZERH) Single Family program: Dwellings¹ (e.g., single-family homes, duplexes) and Townhomes.² These homes may be site-built or modular construction.³

To determine the required version and revision of DOE ZERH program requirements to use based on a project's location, building type, and permit date⁴, partners must reference the DOE ZERH implementation timelines information posted on the [DOE ZERH program requirements website](#). Partners are advised to check the DOE ZERH website and IRS Guidance on the 45L tax credit for further information about tax credit eligibility. Also note 45L tax credit eligibility is based on a project's Acquisition Date.

To qualify for the DOE ZERH Single Family program, an eligible home shall meet the minimum requirements specified below, be verified and field-tested by an approved Rater⁵, and meet all applicable codes.⁶ Note that compliance with these guidelines does not imply compliance with all local code requirements that may be applicable to the home to be built. In cases where local codes overlap with and/or exceed the ZERH program requirements, these local requirements shall be met. **In any jurisdiction where 2021 IECC Appendix RC Zero Energy Residential Building Provisions have been adopted as a code requirement, homes must comply with both the Energy Rating Index (ERI) requirements of Appendix RC and meet the DOE ZERH Target Home ERI requirements described below, to achieve DOE ZERH certification.** The builder and the Rater must both have signed a DOE ZERH partner agreement for a home to be certified.

DOE Zero Energy Ready Home Certification Process

1. Projects must meet the Mandatory requirements listed in Exhibit 1.
2. Projects conduct energy modeling using an approved software rating tool from a DOE-recognized Home Certification Organization for ZERH Certifications (HCO for ZERH) to establish the home's Energy Rating Index (ERI) value. The home's ERI value must be equal to or lower than the ERI of the DOE ZERH Target Home as defined in Exhibit 2. The ERI value for the Target Home shall be automatically generated by the approved software rating tool.⁷
3. Construct the home using the measures specified in the design that result in an ERI value at or below the DOE ZERH ERI Target, calculated above, **and** incorporate the mandatory requirements listed in Exhibit 1. On-site power generation may not be used to meet the Target ERI.
4. Use a Rater operating under a DOE-recognized HCO for ZERH to verify that all requirements have been met in accordance with the Mandatory Requirements and with the inspection procedures for minimum rated features in ANSI / RESNET / ICC Standard 301-2019, Appendix B.^{8,9} Rater must review all items in the ZERH Single Family V2 Rater Checklist.¹⁰ For modular homes, a Rater must verify in the plant any requirement that is not readily verifiable on-site. Submit the home to the HCO for ZERH for final certification and follow the HCO for ZERH's certification and oversight procedures, including those for quality assurance, recordkeeping, and reporting. The Rater is required to keep electronic or hard copies of completed checklists required for the DOE ZERH certification, including those required for prerequisite certifications.
5. The submission of qualifying DOE ZERH projects to DOE occurs through the HCO for ZERH.

Exhibit 1: DOE Zero Energy Ready Home Mandatory Requirements

Component	Mandatory Requirements
1. ZERH V2 National Rater Field Checklist	<input type="checkbox"/> Rater completes the DOE ZERH – Single Family Homes Version 2 National Rater Field Checklist
2. ENERGY STAR Single Family	<input type="checkbox"/> Certified under ENERGY STAR Single Family New Homes Version 3.2 ¹¹



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New Homes Baseline	
3. Envelope	<input type="checkbox"/> Ceiling, wall, floor, & slab insulation meet or exceed 2021 IECC UA ^{12,13,14} <input type="checkbox"/> Windows meet high performance requirements based on climate zone ¹⁵ <i>Advisory:</i> 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 ¹⁶
4. Duct System	<input type="checkbox"/> All heating and cooling distribution ducts and heating and cooling air-handling equipment are located within the thermal and air barrier boundary ¹⁷
5. Water Heating Efficiency	<input type="checkbox"/> Hot water delivery systems meet efficient design requirements ¹⁸ or <input type="checkbox"/> Water heater and fixtures meet efficiency criteria ¹⁹
6. Lighting & Appliances	<input type="checkbox"/> All builder-supplied and -installed refrigerators, dishwashers, clothes washers, and clothes dryers are ENERGY STAR qualified ^{20, 21} <input type="checkbox"/> 100% of builder-installed lighting fixtures and lamps (bulbs) provided are LEDs ²² . <input type="checkbox"/> All installed bathroom ventilation and ceiling fans are ENERGY STAR qualified ²³
7. Indoor Air Quality	<input type="checkbox"/> Certified under EPA Indoor airPLUS ²⁴ <input type="checkbox"/> Energy efficient balanced ventilation (HRV or ERV) is provided in Climate Zones 6-8 ²⁵
8. Renewable Ready	<input type="checkbox"/> Provisions of the DOE Zero Energy Ready Home PV-Ready Checklist Version 2 are Completed ²⁶
9. Electric Vehicle Ready	<input type="checkbox"/> One parking space is provided per dwelling unit that includes a powered 208/240V, 40A receptacle installed in garage or within 3 feet of driveway or dedicated parking space. The electric service panel identifies the branch circuit as "Electric Vehicle Charging." ²⁷
10. Heat Pump Water Heater Ready	<input type="checkbox"/> Individual branch circuit outlet is installed, energized, and terminates within 3 feet of each installed fossil fuel water heater, and a space located within the home or garage that is at least 3' x 3' wide and 7' high shall be available surrounding or within 3 feet of the installed fossil fuel water heater, to facilitate future heat pump water heater installation. ²⁸
11. Heat Pump Space Heating Ready	<input type="checkbox"/> Individual branch circuit outlet is installed or conduit is installed to facilitate future wiring for a heat pump installation. Circuit or conduit labeled as "For future heat pump." ²⁹

Exhibit 2: DOE Zero Energy Ready Home Target Home ³⁰

HVAC Equipment ³¹			
	Very Hot & Hot Climates (2021 IECC Climate Zones 1,2)	Warm & Mixed Climates (2021 IECC Climate Zones 3, 4A, 4B)	Cold & Very Cold Climates (2021 IECC Climate Zones 4C, 5,6,7,8)
Furnace AFUE	80%	CZ3: 92%; CZ4: 95%	95%
SEER	18	16	16 (ASHP); 14 (A/C)
HSPF	9.2	9.2	9.5
Boiler AFUE	80%	CZ3: 92%; CZ4: 95%	95%
Whole-House Mechanical Ventilation System Efficiency	2.9 cfm/W no heat exchange	2.9 cfm/W no heat exchange	1.2 cfm/W; balanced with heat exchange, 65% ASRE
HVAC Grading			



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• Airflow Deviation: Grade I, -7.5%		• Watt Draw Efficiency: Grade I, 0.45 cfm/W		• Refrigerant Grade (as applicable): Grade III	
Insulation and Infiltration					
<ul style="list-style-type: none">Insulation levels modeled to 2021 IECC Prescriptive values and achieve Grade 1 installation, per ANSI / RESNET / ICC Standard 301Infiltration – SF Detached Dwelling units³² (ACH50): CZs 1-2: 2.75 CZ 3,4A, 4B: 2.25 CZs 4C, 5-7: 2.0 CZ 8: 1.5Infiltration – SF Attached Dwelling units (duplexes, townhouses) (ACH50): 3.0 (all Climate Zones)					
Windows					
2021 IECC Climate Zone	1 – 2	3	4A, 4B	4C, 5	6 – 8
U-Value	0.40	0.30	0.30	0.27	0.25
SHGC	0.23	0.25	0.40	Any	Any
Doors					
Door Type	Opaque	≤ ½-Lite	> ½-Lite		
Climate Zone	All	All	1 – 3	4 - 8	
Door U-Value	0.17	0.25	0.30	0.30	
Door SHGC	Any	0.25	0.25	0.40	
Water Heater					
DHW equipment modeled at the following applicable efficiency levels based on Uniform Energy Factor (UEF): <ul style="list-style-type: none">Electric Systems: UEF = 2.57Gas / Propane Systems: UEF = 0.95					
Ducts and Thermostat ³³					
<ul style="list-style-type: none">All ducts and air handlers modeled within conditioned space, uninsulated, with no leakage to the outsideProgrammable thermostat					
Lighting & Appliances					
<ul style="list-style-type: none">For purposes of calculating the DOE ZERH Target Home ERI, homes shall be modeled with an ENERGY STAR dishwasher, ENERGY STAR refrigerator; ENERGY STAR ceiling fans (if used), and ENERGY STAR lamps (bulbs) or fixtures in 100% of Qualifying Light Fixture Locations as defined by ANSI / RESNET / ICC Standard 301-2019.					

Endnotes:

¹ A dwelling, as defined by ANSI/RESNET/ICC 301, is any building that contains one or two dwelling units used, intended, or designed to be built, used, rented, lease, let, or hired out to be occupied, or that are occupied for living purposes. A dwelling unit, as defined by ANSI/RESNET/ICC 301 is a single unit providing complete independent living facilities for one or more persons, including permanent provisions for living, sleeping, eating, cooking, and sanitation.

² A Townhouse, as defined by ANSI/RESNET/ICC 301, is defined as a single-family dwelling unit constructed in a group of three or more attached units in which each unit extends from the foundation to roof and with open space on at least two sides. Townhomes are also eligible to participate in the DOE Zero Energy Ready Home Multifamily Version 2 program.



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³ A modular home is a prefabricated home that is made of modules or sections that are manufactured and substantially assembled in a manufacturing plant. These pre-built sections are transported to the building site and constructed by a builder to meet all applicable building codes for site-built homes.

⁴ The Rater may define the 'permit date' as either the date that the permit was issued or the date of the contract on the home. In cases where permit or contract dates are not available, Providers have discretion to estimate permit dates based on other construction schedule factors. These assumptions should be both defensible and documented.

⁵ The Rater is defined as the person(s) completing the third-party verification required for certification. The person(s) shall: a) be a Certified Rater or Approved Inspector, as defined by ANSI / RESNET / ICC Standard 301, or an equivalent designation as determined by a DOE-recognized Home Certification Organization for ZERH (HCO for ZERH). All Raters for DOE ZERH projects must successfully complete a DOE ZERH orientation course. The Rater shall also have a signed partnership agreement in place with the DOE ZERH program.

⁶ Where requirements of the local codes, covenants, manufacturers' installation instructions, or engineering documents overlap with the requirements of these guidelines, DOE offers the following guidance:

- a. In cases where the overlapping requirements exceed the DOE ZERH Single Family guidelines, these overlapping requirements shall be met;
- b. In cases where overlapping requirements conflict with a requirement of these DOE ZERH Single Family program requirements, then the home is exempt from the conflicting requirement within these guidelines. However, certification shall only be allowed if the Rater has determined that no equivalent option is available that could meet the intent of the conflicting requirement of these guidelines. Note that a home must still meet the Target Home Energy Rating Index Target. Therefore, other efficiency measures may be needed to compensate for the omission of the conflicting requirement.

⁷ The software program shall automatically determine, without relying on a user-configured Target Home, the ERI target for each rated home by following the DOE Zero Energy Ready Home Target Home Procedure, Version 2.

⁸ In the event that a Rater is not able to determine whether an item is consistent with the intent of a provision, (e.g., an alternative method of meeting a checklist requirement has been proposed), then the Rater shall consult their Provider. The term 'Provider' refers to an Approved Rating Provider, as defined by ANSI / RESNET / ICC Standard 301-2019, that is approved by a DOE-recognized HCO for ZERH. If the Provider also cannot make this determination, then the Rater or Provider shall report the issue to DOE prior to project completion at: zerh@doe.gov and will receive an initial response within 5 business days. If DOE believes the current program guidelines are sufficiently clear to determine whether the intent has been met, then this guidance will be provided to the Partner and enforced beginning with the house in question. However, if DOE believes the program guidelines require revisions to make the intent clear, then this guidance will be provided to the Partner but only enforced for homes permitted after a specified transition period following the release of the revised guidelines, typically 60 days in length. This process will allow DOE to make formal policy decisions as Partner questions arise and to disseminate these policy decisions through the ZERH Policy Record and the periodic release of revised program documents to ensure consistent application of the program guidelines.

⁹ Sampling of those requirements for ENERGY STAR Single Family New Homes (ESSFNH) and Indoor airPLUS qualification is allowed to the extent permitted by their respective program requirements and allowances for sampling. Rater-only sampling of features specific to the DOE ZERH Single Family Home qualification may be conducted in accordance with an HCO for ZERH-approved Sampling Protocol.

¹⁰ Raters are expected to use their experience and discretion to verify that the overall intent of each checklist item has been met (i.e., identifying major defects that undermine the intent of the checklist item versus identifying minor defects that the Rater may deem acceptable).



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¹¹ In some states, an earlier version of ENERGY STAR Single Family New Homes such as Version 3.1 may be required by the ENERGY STAR Residential New Construction program. However, compliance with DOE Zero Energy Ready Home V2 requires compliance with ESSFNH V3.2.

¹² Building envelope assemblies, including exterior walls and unvented attic assemblies (where used), shall comply with the relevant vapor retarder provisions of the 2021 International Residential Code (IRC).

¹³ The total building envelope UA shall be less than or equal to the UA value that results from multiplying the U factors in the 2021 International Energy Conservation Code (IECC) – Table R402.1.2 by the same assembly areas as the home being certified. The UA calculation shall be done using a method consistent with the ASHRAE Handbook of Fundamentals and shall include the thermal bridging effects of framing materials. The calculation for a steel-frame envelope assembly shall use the ASHRAE zone method or a method providing equivalent results, and not a series-parallel path calculation method. The performance of components (i.e., fenestration, ceilings, walls, floors, slabs) can be traded off using the UA approach. However, note that the DOE ZERH Mandatory window provisions (Exhibit 1) and Items 3.1 through 3.3 of the ESSFNH National Rater Field Checklist must be met regardless of the UA tradeoffs calculated.

For jurisdictions designated by a code official as having Very Heavy Termite Infestation, the slab edge insulation value and depth shall be adjusted in the UA calculation. The code-required insulation level and depth shall be set to the insulation level and depth found in the Rated Home for the purpose of determining compliance with this ZERH requirement.

¹⁴ Slab edge insulation allowances permitted by the most recent version and revision of the ENERGY STAR Single Family New Homes program are permitted. A list of currently exempted details is available at www.energystar.gov/slabeledge. Note that projects using these exempted details must still achieve the Target ERI and the total building envelope UA requirement, which assume the use of slab edge insulation per the 2021 IECC prescriptive values.

¹⁵ Windows shall meet the performance criteria below based on climate zone:

Window Specs Required for DOE ZERH Projects	IECC CZ 1-2		IECC CZ 3,4A, 4B		IECC CZ 4C, 5 (SHGC values listed below may be paired with the U-value in the same row)		IECC CZ 6-8	
	U-Value	SHGC	U-value	SHGC	U-Value	SHGC	U-Value	SHGC
	≤ 0.40	≤ 0.23	[CZ 3] ≤ 0.30 [CZ 4] ≤ 0.30	[CZ 3] ≤ 0.25 [CZ 4] ≤ 0.40	≤ 0.27 = 0.28 = 0.29 = 0.30	Any ≥ 0.32 ≥ 0.37 ≥ 0.42	≤ 0.25	Any

The following exceptions apply:

- An area-weighted average of fenestration products shall be permitted to satisfy the U-factor requirements;
- An area-weighted average of fenestration products ≥ 50% glazed shall be permitted to satisfy the SHGC requirements;
- 15 square feet of glazed fenestration per dwelling unit shall be exempt from the U-factor and SHGC requirements, and shall be excluded from area-weighted averages calculated using a) and b), above;



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- d. One side-hinged opaque door assembly up to 24 square feet in area shall be exempt from the U-factor requirements and shall be excluded from area-weighted averages calculated using a) and b), above;
- e. Fenestration utilized as part of a passive solar design shall be exempt from the U-factor and SHGC requirements and shall be excluded from area-weighted averages calculated using a) and b), above. Exempt windows shall be facing within 45 degrees of true South and directly coupled to thermal storage mass that has a heat capacity $> 20 \text{ btu} / \text{ft}^3 \times \text{F}$ and provided in a ratio of at least 3 sq. ft. per sq. ft. of South facing fenestration. Generally, thermal mass materials will be at least 2 in. thick.
- f. For project sites located at an elevation $\geq 5,000$ feet above sea level and located in Climate Zones 5 – 8, windows with a maximum U factor of 0.30 (with any SHGC) may be used to satisfy this program requirement. For project sites located at an elevation $\geq 8,000$ feet above sea level and located in Climate Zones 5 – 8, windows with a maximum U factor of 0.32 (with any SHGC) may be used to satisfy this program requirement.

If no NFRC rating is noted on the window or in product literature (e.g., for site-built fenestration), select the U factor and SHGC value from Tables 4 and 10, respectively, in 2013 ASHRAE Fundamentals, Chapter 15. Select the highest U-factor and SHGC value among the values listed for the known window characteristics (e.g., frame type, number of panes, glass color, and presence of low-e coating).

¹⁶ More information on the ENERGY STAR V7.0 residential window specification may be found here: https://www.energystar.gov/products/res_windows_doors_skylights/partners DOE may initially consider phase in of the ENERGY STAR V7.0 window specifications prioritizing Climate Zones 7 and 8, due to the significant benefit of advanced windows in these very cold climate zones.

¹⁷ Exceptions:

- a. Up to 10 ft. of total duct length is permitted to be outside of the home/unit's thermal and air barrier boundary.
- b. Ducts (but not air handlers) may be located in a vented attic if minimum R-8 duct insulation is used, duct leakage to outdoors is measured $\leq 3 \text{ CFM}_{25}$ per 100 ft^2 of conditioned floor area, and:
 - o In Moist (A) climate zones (per 2021 IECC Figure R301.1), an additional 1.5 in. (min.) of closed-cell spray foam encapsulates the ducts and ductwork is buried under 2 in. (min.) of blown-in insulation; OR
 - o In Dry (B) and Marine (C) climate zones (per 2021 IECC Figure R301.1), ductwork is buried under at least 3.5 in. of blown-in insulation.
- c. Systems which meet the criteria for "Ducts Located in Conditioned Space" as defined by 2021 IECC Section R403.3.2.
- d. Jump ducts which do not directly deliver conditioned air from the heating/cooling equipment may be located in attics if all joints, including boot-to-drywall, are air sealed and the jump duct is fully buried under the attic insulation
- e. Ducts and air-handling equipment may be located within an uninsulated and unvented crawl space or basement when the applicable dehumidification requirements of the Indoor airPLUS program (Version 1) are met
- f. Ducts and air-handling equipment associated with rooftop make-up air units or dedicated outdoor air systems (DOAS) that provide ventilation, and may also provide supplemental heating and cooling, are permitted to be outside of the building's thermal and air barrier boundary.

This provision does not apply to equipment or ductwork that only provides ventilation.



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Ducts located in unvented attic assemblies meeting the requirements of Section 806.5 of the 2021 IRC satisfy this provision.

¹⁸ Hot water delivery systems meet the following efficiency requirements:

To minimize water wasted while waiting for hot water, the hot water distribution system shall store no more than 0.5 gallons (1.9 liters) of water in any piping/manifold between the hot water source and any hot water fixture. System options include manifold-fed systems; structured plumbing systems; core plumbing layouts, and on-demand recirculation systems. The following requirements apply to recirculation systems:

- a. Recirculation systems must be based on an occupant-controlled switch or an occupancy sensor, installed in each bathroom which is located beyond a 0.5 gallon stored-volume range from the water heater.
- b. Recirculation systems which operate based on “adaptive” scheduling, meaning that they “learn” the hot water demand profile in the home and adapt their operation to anticipate this profile, are permitted at this time, and do not require the use of occupant-controlled switches or occupancy sensors.
- c. Recirculation systems that are activated based **solely** on a timer and/or temperature sensor are not eligible.

To verify that the system stores no more than 0.5 gallons (1.9 liters), verifiers shall either use the Calculation method or the Field Verification method. In the Calculation method, the verifier shall calculate the stored volume between the hot water source and the furthest fixture using the piping or tubing inside diameter and the length of the piping/tubing. In the case of on-demand recirculation systems, the 0.5-gallon (1.9 liter) storage limit shall be measured from the point where the branch feeding the furthest fixture branches off the recirculation loop, to the fixture itself. An Excel-based tool is available on the DOE ZERH website for this calculation.

Using the Field Verification method, no more than 0.6 gallons (2.3 liters) of water shall be collected from the hot water fixture before hot water is delivered. Only the fixture with the greatest stored volume between the fixture and the hot water source (or recirculation loop) needs to be tested. To field-verify that the system meets the 0.6-gallon (2.3 liter) limit, verifiers shall first initiate operation of on-demand recirculation systems, if present, and let such systems run for at least 40 seconds. Next, a bucket or flow measuring bag (pre-marked for 0.6 gallons) shall be placed under the hot water fixture. The hot water shall be turned on completely and a digital temperature sensor used to record the initial temperature of the water flow. Once the water reaches the pre-marked line at 0.6 gallons (approximately 24 seconds for a lavatory faucet), the water shall be turned off and the ending temperature of the water flow (not the collection bucket) shall be recorded. The temperature of the water flow must increase by ≥ 10 °F in comparing the final to the initial temperature reading. Under the DOE ZERH Single Family program, the approved verifier must confirm compliance with these requirements.

For production builders with house plans that offer an optional bathroom that does not include a shower or tub, the hot water distribution to this bathroom, when included, is not required to be evaluated under this requirement.

¹⁹ Water heaters and fixtures meet the following efficiency criteria:

- a. Gas water heaters, if present, shall have a Uniform Energy Factor ≥ 0.87
- b. Electric water heaters, if present, shall have a Uniform Energy Factor ≥ 2.2
- c. All showerheads and bathroom sink faucets and aerators shall be WaterSense labeled.
- d. The hot water distribution system shall store no more than 1.2 gallons between the hot water source and the furthest fixture. In the case of on-demand recirculation systems, the hot water source is



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considered as the point at which the branch feeding the fixture branches off the recirculation loop. This storage limit shall be verified by either 1) a calculation using the piping or tubing interior diameter and the system length based on plans, or 2) by a field verification test, using the protocol described in the prior endnote, which demonstrates a minimum temperature rise of 10 °F by the time 1.4 gallons of water is delivered to the furthest hot water fixture.

Projects using this compliance option are not permitted to use hot water recirculation systems which operate continuously or operate based solely on a timer or temperature sensor.

²⁰ For products in categories which are not covered by ENERGY STAR product criteria, such as combination all-in-one clothes washer-dryers, these products are exempt.

²¹ Due to industry supply chain challenges, DOE is temporarily allowing the use of non-ENERGY STAR certified refrigerators. Any project utilizing this temporary alternative must account for the non-ENERGY STAR certified refrigerator in the energy model and achieve an ERI value equal to or lower than the ERI of the DOE ZERH Target Home. DOE advises partners that this alternative may be rescinded in a future program update.

²² Up to 5% of lighting, for task or decorative lighting, may be exempt from this provision. The Target Home specification for lighting will remain at 100% regardless of whether this exemption is used (Exhibit 2).

²³ This provision does not apply to H/ERVs that are used to provide exhaust ventilation for bathrooms.

²⁴ Homes permitted on or before 12/31/2023 must certify under the Indoor airPLUS Version 1 program requirements. For homes permitted after 12/31/2023, DOE may consider a revision to these program requirements that specifies if an updated version of Indoor airPLUS must be used. See the Indoor airPLUS program site for information on program updates: <https://www.epa.gov/indoorairplus/indoor-airplus-program-documents>

²⁵ An HRV or ERV is required to provide whole-house mechanical ventilation for homes in Climate Zones 6 – 8 and must meet or exceed the following specifications: $\geq 65\%$ SRE (@ 32 °F) and ≥ 1.2 CFM/Watt.

²⁶ The DOE ZERH Single Family program requires that the provisions of the PV-Ready Version 2 Checklist are completed, unless one or more of the exceptions below applies in which case the PV-Ready features in the Checklist are not required. The exceptions are:

- a. The home already includes an on-site PV system.
- b. The home receives renewable energy from a community solar system, and there is a legally binding agreement in place for the provision of this energy to the home with a duration ≥ 15 years and written to survive a full or partial transfer of ownership of the property.
- c. The location has significant natural shading (e.g., trees, tall buildings impacting the south-facing roof).
- d. The home as designed does not have at least 600 square feet of roof area oriented in between 110 degrees to 270 degrees of true north.

The Rater shall document which, if any, exceptions apply.

²⁷ If the addition of the 40-amp Electric Vehicle Charging branch circuit increases the electrical service to the next nominal size (i.e., from 200-amp to 400-amp service), connecting the circuit to the electrical panel is not required. The conductor shall be labeled as “electrical vehicle charging.” The Rater shall retain a copy of the electrical sizing calculations or statement from the electrical designer for their records but need not evaluate the documentation.



U.S. DOE Zero Energy Ready Home Single Family Homes National Program Requirements Version 2

Homes without a private driveway or garage are exempt from this requirement.

²⁸ The individual branch circuit shall have a rating not less than 240V/30A or 120V/20A. The 3' x 3' x 7' volume may contain the existing water heater. An exception to the requirement for the 3' x 3' x 7' space is provided when the installed water heater is an electric tankless system or a fossil fuel tankless water heater.

Homes utilizing an electric water heater are exempt from this requirement.

²⁹ If a branch circuit outlet is installed, it shall be in compliance with 2021 IRC Section E3702.11 based on heat pump space heating equipment sized in accordance with 2021 IECC R403.7, and shall terminate within three feet of each fossil fuel space heater. Alternatively, code-compliant wiring conduit to facilitate future wiring for a heat pump installation may be installed and shall terminate within three feet of each fossil fuel space heater.

Homes utilizing electric heating systems as the primary heating for the home are exempt from this requirement.

³⁰ Compliance with DOE ZERH Version 2 program requirements is based on climate zones as defined in the 2021 IECC. Climate Zones as defined by the 2021 IECC may be viewed online: <https://codes.iccsafe.org/content/IECC2021P1/chapter-3-re-general-requirements>. Note that some locations have shifted to a different climate zone in the 2021 IECC as compared to prior versions of the IECC.

³¹ HVAC System Type for the Target Home shall be the same as the Rated Home, with the following exceptions. The Target Home is configured with an air-source heat pump when the Rated Home has an air-source or ground-source heat pump, electric strip heat, or baseboard heat. Applicable efficiency levels are based on Exhibit 2.

³² Envelope leakage shall be determined by using Standard ANSI/RESNET/ICC 380-2019.

³³ In homes with heat pumps with electric resistance back-up heating, programmable thermostats shall have "Adaptive Recovery" technology to prevent the excessive use of electric back-up heating.



U.S. DOE Zero Energy Ready Home Single Family Homes National Rater Field Checklist – Version 2

DOE Zero Energy Ready Home – Single Family Homes Version 2 National Rater Field Checklist			
Home Address:	City:	State:	Permit Date:
1. Partnership Status	Must Correct	Rater ¹ Verified	Exception or Alternate Used ² (Enter End Note #)
1.1 Rater has verified that builder is a registered DOE ZERH Builder Partner and identified the builder's Partner ID ³			
2. ENERGY STAR Single Family New Homes Baseline			
2.1 Home is certified under ENERGY STAR Single Family New Homes Version 3.2 ⁴			
3. Building Envelope			
3.1 Ceiling, wall, floor, & slab insulation meet or exceed 2021 IECC UA levels ⁵			
3.2 Windows meet high performance requirements based on climate zone ⁶			
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 ⁷			
5. Water Heating Efficiency (comply with 5.1 or 5.2; mark the other line N/A)			
5.1 Hot water delivery systems meet efficient design requirements ⁸			
5.2 Water heater and fixtures meet efficiency criteria ⁹			
6. Lighting & Appliances			
6.1 All builder-supplied and -installed refrigerators, dishwashers, clothes washers, and clothes dryers are ENERGY STAR qualified. ^{10, 11}			
6.2 100% of builder-installed lighting fixtures and lamps (bulbs) provided are LEDs. ¹²			
6.3 All installed bathroom ventilation and ceiling fans are ENERGY STAR qualified ¹³			
7. Indoor Air Quality			
7.1 Certified under EPA Indoor airPLUS ¹⁴			
7.2 Energy efficient balanced ventilation (HRV or ERV) is provided in Climate Zones 6 - 8 ¹⁵			
8. Renewable Ready			
8.1 Provisions of the DOE Zero Energy Ready Home PV-Ready Checklist Version 2 are completed ¹⁶			
9. Electric Vehicle Ready			
9.1 One parking space is provided per dwelling unit that includes a powered 208/240V, 40A receptacle installed in garage or within 3 feet of driveway or dedicated parking space. The electric service panel identifies the branch circuit as "Electric Vehicle Charging." ¹⁷			



U.S. DOE Zero Energy Ready Home Single Family Homes National Rater Field Checklist – Version 2

10. Heat Pump Water Heater Ready			
10.1 Individual branch circuit outlet is installed and energized, and terminates within 3 feet of each installed fossil fuel water heater and a space located within the home or garage that is at least 3' x 3' wide and 7' high must be available surrounding or within 3 feet of the installed fossil fuel water heater, to facilitate future heat pump water heater installation. ¹⁸			
11. Heat Pump Space Heating Ready			
11.1 Individual branch circuit outlet is installed or conduit is installed to facilitate future wiring for a heat pump installation. Circuit or conduit labeled as "For future heat pump." ¹⁹			
12. Energy Efficiency Threshold			
12.1 Home's ERI value \leq DOE ZERH Target Home ERI			
Rater Name: _____ Date of Review: _____			
Rater Signature: _____ Rater Company Name: _____			

Endnotes:

The following endnotes are intended to relate the same exemptions and clarifications as noted in the National Program Requirements. However, if there are any inconsistencies the endnotes in the National Program Requirements shall take precedence.

¹ The Rater is defined as the person(s) completing the third-party verification required for certification. The person(s) shall: a) be a Certified Rater or Approved Inspector, as defined by ANSI / RESNET / ICC Standard 301, or an equivalent designation as determined by a DOE-recognized Home Certification Organization for ZERH (HCO for ZERH). All Raters for DOE ZERH projects must successfully complete a DOE ZERH orientation course. The Rater shall also have a signed partnership agreement in place with the DOE ZERH program.

² If an exception for a program requirement or an alternate compliance method is used, enter the number of the corresponding End Note from this document that lists the exception or alternate.

³ The DOE ZERH Partner ID number for the builder is required within the energy rating software for ZERH certification.

⁴ In some states, an earlier version of ENERGY STAR Single Family New Homes (ESSFNH), such as Version 3.1, may be required by the ENERGY STAR Residential New Construction program. However, compliance with DOE Zero Energy Ready Home V2 requires compliance with ESSFNH V3.2.

⁵ Building envelope assemblies, including exterior walls and unvented attic assemblies (where used), shall comply with the relevant vapor retarder provisions of the 2021 International Residential Code (IRC).

The total building envelope UA shall be less than or equal to the UA value that results from multiplying the U factors in the 2021 International Energy Conservation Code (IECC) – Table R402.1.2 by the same assembly areas as the home being certified. The UA calculation shall be done using a method consistent with the ASHRAE Handbook of Fundamentals and shall include the thermal bridging effects of framing materials. The calculation for a steel-frame envelope assembly shall use the ASHRAE zone method or a method providing equivalent results, and not a series-parallel path calculation method. The performance of components (i.e., fenestration, ceilings, walls, floors, slabs) can be traded off using the UA approach. However, note that the DOE ZERH Mandatory window provisions (Exhibit 1) and Items 3.1 through 3.3 of the ESSFNH National Rater Field Checklist must be met regardless of the UA tradeoffs calculated.



U.S. DOE Zero Energy Ready Home Single Family Homes National Rater Field Checklist – Version 2

For jurisdictions designated by a code official as having Very Heavy Termite Infestation, the slab edge insulation value and depth shall be adjusted in the UA calculation. The code-required insulation level and depth shall be set to the insulation level and depth found in the Rated Home for the purpose of determining compliance with this ZERH requirement.

Any slab edge insulation allowances permitted by the most recent version and revision of the ENERGY STAR Single Family New Construction program are permitted. A list of currently exempted details is available at www.energystar.gov/slabeledge. Note that projects using these exempted details must still achieve the Target ERI and the total building envelope UA requirement, which assume the use of slab edge insulation per the 2021 IECC prescriptive values.

⁶ Windows shall meet the performance criteria below based on climate zone:

Window Specs Required for DOE Zero Energy Ready Home Projects	IECC CZ 1-2		IECC CZ 3,4A, 4B		IECC CZ 4C, 5 (SHGC values listed below may be paired with the U-value in the same row)		IECC CZ 6-8	
	U-Value	SHGC	U-value	SHGC	U-Value	SHGC	U-Value	SHGC
	≤ 0.40	≤ 0.23	[CZ 3] ≤ 0.30 [CZ 4] ≤ 0.30	[CZ 3] ≤ 0.25 [CZ 4] ≤ 0.40	≤ 0.27 = 0.28 = 0.29 = 0.30	Any ≥ 0.32 ≥ 0.37 ≥ 0.42	≤ 0.25	Any

The following exceptions apply:

- An area-weighted average of fenestration products shall be permitted to satisfy the U-factor requirements;
- An area-weighted average of fenestration products ≥ 50% glazed shall be permitted to satisfy the SHGC requirements;
- 15 square feet of glazed fenestration per dwelling unit shall be exempt from the U-factor and SHGC requirements, and shall be excluded from area-weighted averages calculated using a) and b), above;
- One side-hinged opaque door assembly up to 24 square feet in area shall be exempt from the U-factor requirements and shall be excluded from area-weighted averages calculated using a) and b), above;
- Fenestration utilized as part of a passive solar design shall be exempt from the U-factor and SHGC requirements and shall be excluded from area-weighted averages calculated using a) and b), above; Exempt windows shall be facing within 45 degrees of true South and directly coupled to thermal storage mass that has a heat capacity > 20 btu / ft³×°F and provided in a ratio of at least 3 sq. ft. per sq. ft. of South facing fenestration. Generally, thermal mass materials will be at least 2 in. thick.
- For project sites located at an elevation ≥ 5,000 feet above sea level and located in Climate Zones 5 – 8, windows with a maximum U factor of 0.30 (with any SHGC) may be used to satisfy this program requirement. For project sites located at an elevation ≥ 8,000 feet above sea level and located in Climate Zones 5 – 8, windows with a maximum U factor of 0.32 (with any SHGC) may be used to satisfy this program requirement.

If no NFRC rating is noted on the window or in product literature (e.g., for site-built fenestration), select the U factor and SHGC value from Tables 4 and 10, respectively, in 2013 ASHRAE Fundamentals, Chapter 15. Select the highest U-factor and SHGC value among the values listed for the known window characteristics (e.g., frame type, number of panes, glass color, and presence of low-e coating).

More information on the ENERGY STAR V7.0 residential window specification may be found here:

https://www.energystar.gov/products/res_windows_doors_skylights/partners DOE may initially consider phase in of the ENERGY STAR V7.0 window specifications prioritizing Climate Zones 7 and 8, due to the significant benefit of advanced windows in these very cold climate zones.



U.S. DOE Zero Energy Ready Home Single Family Homes National Rater Field Checklist – Version 2

⁷ Exceptions:

- a. Up to 10 ft. of total duct length is permitted to be outside of the home/unit's thermal and air barrier boundary.
- b. Ducts (but not air handlers) may be located in a vented attic if minimum R-8 duct insulation is used, duct leakage to outdoors is measured ≤ 3 CFM25 per 100 ft² of conditioned floor area, and:
 - o In Moist (A) climate zones (per 2021 IECC Figure R301.1), an additional 1.5 in. (min.) of closed-cell spray foam encapsulates the ducts and ductwork is buried under 2 in. (min.) of blown-in insulation; OR
 - o In Dry (B) and Marine (C) climate zones (per 2021 IECC Figure R301.1), ductwork is buried under at least 3.5 in. of blown-in insulation.
- c. Systems which meet the criteria for "Ducts Located in Conditioned Space" as defined by 2021 IECC Section R403.3.2.
- d. Jump ducts which do not directly deliver conditioned air from the heating/cooling equipment may be located in attics if all joints, including boot-to-drywall, are air sealed and the jump duct is fully buried under the attic insulation
- e. Ducts and air-handling equipment may be located within an uninsulated and unvented crawl space or basement when the applicable dehumidification requirements of the Indoor airPLUS program (Version 1) are met.
- f. Ducts and air-handling equipment associated with rooftop make-up air units or dedicated outdoor air systems (DOAS) that provide ventilation, and may also provide supplemental heating and cooling, are permitted to be outside of the building's thermal and air barrier boundary.

This provision does not apply to equipment or ductwork that only provides ventilation.

Ducts located in unvented attic assemblies meeting the requirements of Section 806.5 of the 2021 IRC satisfy this provision.

⁸ Hot water delivery systems meet the following efficiency requirements:

To minimize water wasted while waiting for hot water, the hot water distribution system shall store no more than 0.5 gallons (1.9 liters) of water in any piping/manifold between the hot water source and any hot water fixture. System options include manifold-fed systems; structured plumbing systems; core plumbing layouts, and on-demand recirculation systems. The following requirements apply to recirculation systems:

- a. Recirculation systems must be based on an occupant-controlled switch or an occupancy sensor, installed in each bathroom which is located beyond a 0.5 gallon stored-volume range from the water heater.
- b. Recirculation systems which operate based on "adaptive" scheduling, meaning that they "learn" the hot water demand profile in the home and adapt their operation to anticipate this profile, are permitted at this time, and do not require the use of occupant-controlled switches or occupancy sensors.
- c. Recirculation systems that are activated based **solely** on a timer and/or temperature sensor are not eligible.

To verify that the system stores no more than 0.5 gallons (1.9 liters), verifiers shall either use the Calculation method or the Field Verification method. In the Calculation method, the verifier shall calculate the stored volume between the hot water source and the furthest fixture using the piping or tubing inside diameter and the length of the piping/tubing. In the case of on-demand recirculation systems, the 0.5-gallon (1.9 liter) storage limit shall be measured from the point where the branch feeding the furthest fixture branches off the recirculation loop, to the fixture itself. An Excel-based tool is available on the DOE ZERH website for this calculation.



U.S. DOE Zero Energy Ready Home Single Family Homes National Rater Field Checklist – Version 2

Using the Field Verification method, no more than 0.6 gallons (2.3 liters) of water shall be collected from the hot water fixture before hot water is delivered. Only the fixture with the greatest stored volume between the fixture and the hot water source (or recirculation loop) needs to be tested. To field-verify that the system meets the 0.6-gallon (2.3 liter) limit, verifiers shall first initiate operation of on-demand recirculation systems, if present, and let such systems run for at least 40 seconds. Next, a bucket or flow measuring bag (pre-marked for 0.6 gallons) shall be placed under the hot water fixture. The hot water shall be turned on completely and a digital temperature sensor used to record the initial temperature of the water flow. Once the water reaches the pre-marked line at 0.6 gallons (approximately 24 seconds for a lavatory faucet), the water shall be turned off and the ending temperature of the water flow (not the collection bucket) shall be recorded. The temperature of the water flow must increase by ≥ 10 °F in comparing the final to the initial temperature reading. Under the DOE ZERH Single Family program, the approved verifier must confirm compliance with these requirements.

For production builders with house plans that offer an optional bathroom that does not include a shower or tub, the hot water distribution to this bathroom, when included, is not required to be evaluated under this requirement.

⁹ Water heaters and fixtures meet the following efficiency criteria:

- a. Gas water heaters, if present, shall have a Uniform Energy Factor ≥ 0.87
- b. Electric water heaters, if present, shall have a Uniform Energy Factor ≥ 2.2
- c. All showerheads and bathroom sink faucets and aerators shall be WaterSense labeled.
- d. The hot water distribution system shall store no more than 1.2 gallons between the hot water source and the furthest fixture. In the case of on-demand recirculation systems, the hot water source is considered as the point at which the branch feeding the fixture branches off the recirculation loop. This storage limit shall be verified by either 1) a calculation using the piping or tubing interior diameter and the system length based on plans, or 2) by a field verification test, using the protocol described in the prior endnote, which demonstrates a minimum temperature rise of 10 °F by the time 1.4 gallons of water is delivered to the furthest hot water fixture.

Projects using this compliance option are not permitted to use hot water recirculation systems which operate continuously or operate based solely on a timer or temperature sensor.

¹⁰ For products in categories which are not covered by ENERGY STAR product criteria, such as combination all-in-one clothes washer-dryers, these products are exempt.

¹¹ Due to industry supply chain challenges, DOE is temporarily allowing the use of non-ENERGY STAR certified refrigerators. Any project utilizing this temporary alternative must account for the non-ENERGY STAR certified refrigerator in the energy model and achieve an ERI value equal to or lower than the ERI of the DOE ZERH Target Home. DOE advises partners that this alternative may be rescinded in a future program update.

¹² Up to 5% of lighting, for task or decorative lighting, may be exempt from this provision. The Target Home specification for lighting will remain at 100% regardless of whether this exemption is used.

¹³ This provision does not apply to H/ERVs that are used to provide exhaust ventilation for bathrooms.

¹⁴ Homes permitted on or before 12/31/2023 must certify under the Indoor airPLUS Version 1 program requirements. For homes permitted after 12/31/2023, DOE may consider a revision to these program requirements that specifies if an updated version of Indoor airPLUS must be used. See the Indoor airPLUS program site for information on program updates: <https://www.epa.gov/indoorairplus/indoor-airplus-program-documents>



U.S. DOE Zero Energy Ready Home Single Family Homes National Rater Field Checklist – Version 2

¹⁵ An HRV or ERV is required to provide whole-house mechanical ventilation for homes in Climate Zones 6 – 8 and must meet or exceed the following specifications: $\geq 65\%$ SRE (@ 32 °F) and ≥ 1.2 CFM/Watt.

¹⁶ The DOE ZERH Single Family program requires that the provisions of the PV-Ready Version 2 Checklist are completed, unless one or more of the exceptions below applies in which case the PV-Ready features in the Checklist are not required. The exceptions are:

- a. The home already includes an on-site PV system.
- b. The home receives renewable energy from a community solar system, and there is a legally binding agreement in place for the provision of this energy to the home with a duration ≥ 15 years and written to survive a full or partial transfer of ownership of the property.
- c. The location has significant natural shading (e.g., trees, tall buildings impacting the south-facing roof).
- d. The home as designed does not have at least 600 square feet of roof area oriented in between 110 degrees to 270 degrees of true north.

The Rater shall document which, if any, exceptions apply.

¹⁷ If the addition of the 40-amp Electric Vehicle Charging branch circuit increases the electrical service to the next nominal size (i.e., from 200-amp to 400-amp service), connecting the circuit to the electrical panel is not required. The conductor shall be labeled as “electrical vehicle charging.” The Rater shall retain a copy of the electrical sizing calculations or statement from the electrical designer for their records but need not evaluate the documentation.

Homes without a private driveway or garage are exempt from this requirement.

¹⁸ The individual branch circuit shall have a rating not less 240V/30A or 120V/20A. The 3' x 3' x 7' volume may contain the existing water heater. An exception to the requirement for the 3' x 3' x 7' space is provided when the installed water heater is an electric tankless system or a fossil fuel tankless water heater.

Homes utilizing an electric water heater are exempt from this requirement.

¹⁹ If a branch circuit outlet is installed, it shall be in compliance with 2021 IRC Section E3702.11 based on heat pump space heating equipment sized in accordance with 2021 IECC R403.7 and shall terminate within three feet of each fossil fuel space heater. Alternatively, code-compliant wiring conduit to facilitate future wiring for a heat pump installation may be installed and shall terminate within three feet of each fossil fuel space heater.

Homes utilizing electric heating systems as the primary heating for the home are exempt from this requirement.

U.S. DOE Zero Energy Ready Home

Single Family Homes National Program Requirements – Version 2

Summary of Major Changes from Version 1

Program Component	Version 1	Version 2	Rationale
Built-In Best Practices (Mandatory Requirements)			
Building Envelope Insulation Levels	2015 IECC insulation requirements for opaque areas	2021 IECC insulation requirements for opaque areas.	Delivers most robust code-based building envelope. All ZERHs take advantage of the one chance to build a very high-performance envelope.
Window U/SHGC Values	Based on ENERGY STAR V6.0 specs, except for Cold Climates which are based on V5.0 specs	Based on ENERGY STAR V6.0 specs, except for Very Cold Climates (6-8) which are more rigorous at U 0.25.	Updates the window requirements to higher performance levels. Even higher performance windows may be used by partners as part of the overall envelope compliance strategy.
High Efficiency Lighting	80% requirement	100% requirement, with an exception for up to 5% for task or decorative lighting.	Recognizes the cost-effectiveness of LEDs and increases ZERH efficiency, while offering minor flexibility. Note that the ZERH Target Homes assumes 100% high efficiency lighting, so the Energy Rating Index (ERI) Target for V2 is based on 100% LEDs.
Energy Efficient Appliances	All builder-installed refrigerators, dishwashers, and clothes washers are ENERGY STAR qualified	All builder-supplied and installed refrigerators, dishwashers, clothes washers, <u>and clothes dryers</u> are ENERGY STAR qualified	Recognizes ENERGY STAR labeling of clothes dryers and increases ZERH efficiency.
Indoor Air Quality	Certify under Indoor airPLUS (IAP) V1	Certify under IAP V1. Advises that DOE may consider updated IAP provisions as they are developed. H/ERVs in Very Cold Climates (6-8)	Maintains requirement to certify under the IAP Version 1 program through at least 2023. Adds energy efficient whole-house ventilation in very cold climates.
Photovoltaic (PV) Ready	Implement the ZERH PV-Ready Checklist	Similar to V1. Eliminates the exception for sites with lower annual solar resources. Also adopts same roof area provisions as found in Appendix RB of the 2021 IECC.	Increases PV readiness in ZERH homes and recognizes the major increases in PV cost effectiveness.
Electric Vehicle Ready	No requirement	One parking space per dwelling unit includes an electric vehicle charging receptacle.	Lays the groundwork for the transition to electric vehicles in the near future. Many partners already incorporate this feature.
Heat Pump Water Heater Ready	No requirement	Dedicated circuit is installed and energized for each installed fossil fuel water heater. Space is reserved for a future electric (heat pump) water heater.	Lays the groundwork for the future installation of a HPWH and reduces retrofit cost and complexity.

U.S. DOE Zero Energy Ready Home

Single Family Homes National Program Requirements – Version 2

Summary of Major Changes from Version 1

Program Component	Version 1	Version 2	Rationale
Heat Pump Space Heater Ready	No requirement	A dedicated circuit outlet or conduit is installed to facilitate a future heat pump installation.	Lays the groundwork for the future installation of a heat pump for space heating and reduces retrofit cost and complexity.
Efficiency Threshold			
Minimum Required Energy Efficiency Threshold	Energy Rating Index (ERI) scores to qualify for ZERH in the 50s.	Updated ZERH Target Home achieves increased energy savings. Resulting ERI Targets to qualify for ZERH in the 40s.	Numerous innovations have entered the industry since the development of V1 and are reflected in the updated ZERH efficiency threshold.
Program Compliance & Administration			
Prescriptive Compliance Pathway	Allows a non-modeling compliance path. This path was rarely used.	Sunsets the Prescriptive compliance pathway for single family homes.	Removes this element of program infrastructure for single family homes because of extremely limited usage.
Certification of Multifamily buildings	Allows multifamily up to 5 stories, like ENERGY STAR Homes program had permitted.	Multifamily buildings will be certified under ZERH Multifamily V2 (under development) and not under ZERH Single Family V2. A transition period will allow MF buildings to continue to certify under the ZERH V1 single family program.	Multifamily buildings warrant a sector-specific program design. ZERH-MF will provide partners with the same framework found in ENERGY STAR Multifamily New Construction, with higher efficiency and performance specs.
Certification Oversight	EPA-approved Home Certification Organizations (HCOs) required to provide oversight.	DOE-approved HCOs for ZERH required to provide oversight and quality assurance for raters and ZERH certifications.	DOE-recognized HCOs for ZERH assure minimum oversight and quality assurance provisions for ZERH certifications.
Size Adjustment Factor (SAF)	SAF makes the ERI Target lower for homes larger than the benchmark. It does not apply to most ZERHs because they are not larger than the benchmark.	SAF is sunset. ENERGY STAR Homes V3.1 and V3.2 have both eliminated SAF as well.	Homes under ZERH V2 will be very efficient regardless of SAF. Removing SAF simplifies program requirements.

VERSION 1 (REV. 04)

Indoor airPLUS

CONSTRUCTION SPECIFICATIONS





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About the Indoor airPLUS Construction Specifications

These specifications were developed by the U.S. Environmental Protection Agency (EPA) to recognize new homes equipped with a comprehensive set of indoor air quality (IAQ) features. They were developed with significant input from stakeholders, based on best available science and information about risks associated with IAQ problems, and balanced with practical issues of cost, builder production process compatibility, and verifiability.

The Indoor airPLUS Program fully integrates ENERGY STAR Certified Home requirements as a prerequisite. In addition, both the ENERGY STAR Certified Home label and the Indoor airPLUS label are prerequisites for the Department of Energy's Zero Energy Ready Home Program and the PHIUS+ certification by Passive House Institute US, both of which are additional certification options in building high performance, sustainable homes.

In addition to these Construction Specifications, the Indoor airPLUS Program periodically publishes a Policy Record document. The Policy Record is used to provide updates on the resolution of issues, including clarifications, refinements, and/or changes to program requirements. Policy Record updates may be made more frequently than revisions to the Construction Specifications. As such, the Policy Record should be referenced alongside the Construction Specifications for the most current program requirements and interpretations.

The Construction Specifications, Policy Record, and other program documents can be found at www.epa.gov/indoorairplus/indoor-airplus-program-documents.

NOTE: Although these measures are designed to help improve IAQ in new homes compared with homes built to minimum code, they alone cannot prevent all IAQ problems. For example, occupant behavior, such as smoking indoors, and system maintenance are also important.

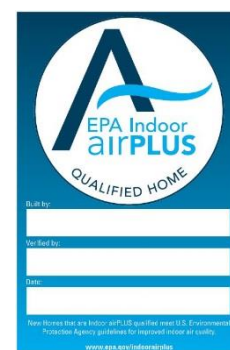
What's New in Version 1 (Rev. 04)?

Indoor airPLUS V1 (Rev. 04) revises the Construction Specifications to incorporate Policy Record updates recorded since the release of Revision 03 in October 2015. Although Indoor airPLUS Revision 4 does not increase program stringency from previous revisions, it adds clarification and/or refinement to some requirements. Additionally, this revision updates or eliminates various referenced standards as the industry continues to make improvements on consensus-based best practices in high performance construction techniques.

Homes permitted starting 05/01/2018 are required to use Revision 4 of the Construction Specifications for qualification. For homes permitted before 05/01/2018, partners can use either Revision 3 or Revision 4 if desired. The Rater may define "permit date" as either the date that the permit was issued or the date of the contract on the home.

Eligibility and Verification Requirements

For a home to earn the Indoor airPLUS label, it must also earn the ENERGY STAR Certified Homes label. Requirements for both programs can be verified and homes can be reported simultaneously. Verification can be completed during the ENERGY STAR inspection process and must be conducted by a certified Home Energy Rater, Rating Field Inspector, or an equivalent designation as determined by a Verification Oversight Organization, such as the Residential Energy Services Network (RESNET). The home must also comply with all applicable state and local codes and standards. Instructions for Indoor airPLUS verification are listed below in the Verification Checklist.



Qualified homes earn the Indoor airPLUS label. Place it next to the ENERGY STAR label.

Terms Used in This Document

- **EXCEPTIONS** to the requirements described in these construction specifications are noted as appropriate. For climate exceptions, refer to the 2015 International Energy Conservation Code (IECC) Climate Zone map (Figure 301.1). Climate Zone names may include a number for the temperature zone and a letter for the moisture zone (e.g., Zone 3C refers to coastal California only).
- **NOTES** provide additional information to clarify specification requirements.
- **ADVISORIES** provide additional guidance to be considered, but are not specification requirements.
- **ENERGY STAR Certified Homes**— Complete Mandatory Measures Checklists:

Rater – D [Rater Design Review Checklist](#)

Rater – F [Rater Field Checklist](#)

Builder – W [Water Management System Builder Requirements](#)

HVAC – D [HVAC Design Report](#)

HVAC – C [HVAC Commissioning Checklist](#)

Indoor airPLUS Version 1 (Rev. 04)

Verification Checklist



Home Address:		City:		State:		Zip:	
Climate Zone (1-6):		Radon Zone (1-3):					
Section	Requirements (Refer to full Indoor airPLUS Construction Specifications for details)		Must Correct	Builder Verified	Rater Verified	N/A	
ENERGY STAR V3	Note: The Rev. 04 checklist reflects only the additional Indoor airPLUS requirements and their corresponding section numbers that must be met after completing the ENERGY STAR requirements. ENERGY STAR remains a prerequisite for Indoor airPLUS qualification.						
	ENERGY STAR Version 3 (or 3.1, 3.2) Program Requirements must be followed and the home shall be ENERGY STAR certified in conjunction with Indoor airPLUS qualification.		<input type="checkbox"/>		<input type="checkbox"/>		
Moisture Control	1.1	Drain or sump pump installed in basements and crawlspaces. In EPA Radon Zone 1, check valve also installed. Exception Applied: <input type="checkbox"/> Slab-on-grade foundation <input type="checkbox"/> Free-draining soils	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
	1.2	Layer of aggregate or sand (4 in.) with geotextile matting installed below slabs AND radon techniques used in EPA Radon Zone 1. Exception Applied: <input type="checkbox"/> Slab-on-grade foundation <input type="checkbox"/> Free-draining soils <input type="checkbox"/> Dry climate	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
	1.4	Basements/crawlspaces insulated, sealed and conditioned. Exception Applied: <input type="checkbox"/> 100-year flood zone <input type="checkbox"/> Marine climate <input type="checkbox"/> Dry climate <input type="checkbox"/> Crawlspaced sealed with capillary break and active dehumidification <input type="checkbox"/> Raised pier foundation with no walls	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
	1.7	Protection from water splash damage if no gutters. Exception Applied: <input type="checkbox"/> Rainwater harvesting system <input type="checkbox"/> Dry climates	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
	1.11	Supply piping in exterior walls insulated with pipe wrap. Exception Applied: <input type="checkbox"/> Dry climate AND climate zone 1-3 <input type="checkbox"/> Air barrier insulation in wall cavity	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
	1.14	Hard-surface flooring in kitchens, baths, entry, laundry, and utility rooms.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
	2.1	Radon-resistant features installed in Radon Zone 1 homes in accordance with Construction Specification 2.1. Exception Applied: <input type="checkbox"/> Perimeter pipe loop in lieu of full aggregate (dry climate) <input type="checkbox"/> Manufactured home with raised pier foundation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
	3.2	Corrosion-proof rodent/bird screens installed at all openings that cannot be fully sealed. (Not required for clothes dryer vents.)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
HVAC Systems	4.1	Equipment selected to keep relative humidity < 60% in "Warm-Humid" climates. Exception Applied: <input type="checkbox"/> Climate zones 4-8, 3B, 3C and portions of 3A and 2B	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	
	4.2	Duct systems protected from construction debris AND no building cavities used as air supplies or returns.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
	4.3	No air-handling equipment or ductwork installed in garage.	<input type="checkbox"/>		<input type="checkbox"/>		
	4.6	Clothes dryers vented to the outdoors or plumbed to a drain according to manufacturer's instructions.	<input type="checkbox"/>		<input type="checkbox"/>		
	4.7	Central forced-air HVAC system(s) have minimum MERV 8 filter AND no ozone generators in home. Temporary filter installed to protect unit from construction dust.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Combustion Pollutants	5.1	Emissions standards met for fuel-burning and space-heating appliances. Identify appliance type: <input type="checkbox"/> Masonry heater <input type="checkbox"/> Factory-built wood-burning fireplace <input type="checkbox"/> Wood stove <input type="checkbox"/> Pellet stove <input type="checkbox"/> Natural gas/propane fireplace Appliance model name/number: _____	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	
	5.2	CO alarms installed in each sleeping zone (e.g., common hallway) according to NFPA 720.	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	
	5.3	Multifamily buildings: Smoking restrictions implemented AND ETS transfer pathways minimized.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
	5.4	Attached garages: Door closer installed on all connecting doors.	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	
	5.4	Attached garages: In homes with exhaust-only whole-house ventilation EITHER <input type="checkbox"/> 70 cfm exhaust fan installed in garage OR <input type="checkbox"/> Pressure test conducted to verify the effectiveness of the garage-to-house air barrier.	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	

Materials	6.1	All composite wood products certified low-emission. See spec.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
	6.2	Interior paints and finishes certified low-emission. See spec.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
	6.3	Carpet, carpet adhesives, and carpet cushion certified low-emission. See spec.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Final	7.1	HVAC system and ductwork verified to be dry and clean AND new filter installed.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
	7.2	Home ventilated before occupancy.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
	7.3	Equipment manuals, Indoor airPLUS label, and certificate provided for owner/occupant.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Rater Company: _____ Rater Employee: _____ Rater Signature: _____ Date: _____			Builder Company: _____ Builder Employee: _____ Builder Signature: _____ Date: _____			

Guidance for Completing the Indoor airPLUS Verification Checklist:

- Only ENERGY STAR certified homes verified to comply with these specifications can earn the Indoor airPLUS label. See Indoor airPLUS Construction Specifications for full descriptions of the requirements, terms, exceptions, abbreviations, references and climate map used in this checklist. Verification is not complete until this checklist is completed in full and signed.

Note: ENERGY STAR footnotes and exceptions will always be utilized unless otherwise noted in the Indoor airPLUS Construction Specifications. In some cases, Indoor airPLUS modifies or excludes certain ENERGY STAR exceptions or alternate pathways.

- Check one box per line. Check "N/A" for specifications that do not apply for specific conditions (e.g., climate) according to the exceptions described in the Indoor airPLUS Construction Specifications. Check either "Builder Verified" or "Rater Verified" for all other items to indicate who verified each item. Items may be verified visually on site during construction, by reviewing photographs taken during construction, by checking documentation, or through equivalent methods as appropriate.
- The Rater who conducted the verification, or a responsible party from the Rater's company, must sign the completed verification checklist. The builder must also sign the checklist if any items in the "Builder Verified" column are checked, and by so doing accepts full responsibility for verifying that those items meet Indoor airPLUS requirements.
- The Rater shall retain the rating documentation, all required ENERGY STAR Certified Homes documentation, and the Indoor airPLUS Verification Checklist for the home for a minimum of 2 years from final verification. The Rater shall coordinate with the Provider and/or builder to provide an Indoor airPLUS label and certificate for each qualified home.
- Raters who operate under a Sampling Provider are permitted to use a RESNET-approved sampling protocol for Indoor airPLUS homes located outside California, and a sampling protocol approved by the California Energy Commission for homes located in California, to verify any item designated "Rater Verified." For example, if the approved sampling protocol requires rating one in seven homes, then the checklist will be completed for the one home that was rated. Only Raters are permitted to use sampling. All items verified by the builder shall be verified for each qualified home or unit within a multifamily building. For example, if a Rater verifies 10 items on the Indoor airPLUS Checklist and the builder verifies the remaining checklist items, then an approved sampling protocol is permitted to be used only on the 10 Rater-verified items.

However, the builder may provide the Rater with a single signed copy of the checklist for an entire building or group of units with builder-verified items under the condition that all units within the building or group utilize: 1) the same HVAC system type (i.e. ductless mini-split, forced air, hydronic); 2) the same combustion appliances and combustion pollutant controls; and 3) the same low-emission materials certification/standard for all products (within their respective categories) verified in Section 6 of the Indoor airPLUS Construction Specifications. If there are no builder-verified items, the Rater may also utilize one checklist per group of units if the above criteria are met. Groups of units with any of the following conditions will require a separate and unique checklist to be completed and signed by the Rater and builder:

- Any units with differing HVAC system type (i.e., ductless mini-split, forced air, hydronic);
- Any units with differing combustion appliance types (e.g., masonry heater, pellet stove, wood-burning fireplace) stove, factory-built, etc.) or combustion pollutant controls; or Any units/groups with low-emission materials or finishes addressed in Section 6 that are compliant based on different certifications/standards within their product category.
- Exception: Builders and Raters may use a single checklist for units utilizing low-emission materials certified to different labels or standards, provided that documentation of the certifications for those materials are retained by the builder and available for inspection upon request.

For further information on the Indoor airPLUS program, visit www.epa.gov/indoorairplus.



All Indoor airPLUS qualified homes meet strict guidelines for energy efficiency set by ENERGY STAR, the nationally-recognized symbol for energy efficiency.

Indoor airPLUS Construction Specifications

Version 1 (Rev. 04)



ENERGY STAR certification is a pre-requisite for a home to achieve Indoor airPLUS qualification. ENERGY STAR checklist items that satisfy Indoor airPLUS requirements are only summarized below. Please refer to the [ENERGY STAR National Program Requirements](#) and the checklists under *Complete Mandatory Measures* for more information and the full description of the requirement. Depending on your state, newer versions of the ENERGY STAR Program Requirements may be in effect (e.g. V3.1, V3.2). States under newer versions of the ENERGY STAR Program Requirements can be found listed with other individual [Regional Specifications](#).

1. Moisture Control

1.1 Site and Foundation Drainage

NOTE: Completion of the ENERGY STAR requirements satisfies the following Indoor airPLUS requirements:

- ✓ Slope patio slabs, walks and driveway; tamp back-fill to prevent settling; AND slope the final grade away from the foundation (Builder-W 1.1 and 1.2).
- ✓ Swales or drains designed to carry water away from the foundation are permitted to be provided as an alternative to the slope requirements for any home, and shall be provided for a home where setbacks limit space to less than 10 ft. (Builder-W 1.1 and 1.2).
- ✓ Install protected drain tile at the footings of basement and crawlspace walls. Surround each drain tile pipe with washed or clean gravel wrapped with fabric cloth, or install an approved Composite Foundation Drainage System (CFDS) (Builder-W 1.8).

Additional Indoor airPLUS Requirements:

- Install a drain or sump pump in basement and crawlspace floors, discharging to daylight at least 10 ft. outside the foundation or into an approved sewer system.

Exceptions:

- Slab-on-grade foundations.
- In areas of free-draining soils — identified as Group 1 (Table R405.1, 2015 IRC) by a certified hydrologist, soil scientist, or engineer through a site visit — installation of a drain or sump pump is not required.
- In EPA Radon Zone 1, if a drain tile discharges to daylight install a backwater valve (check valve) at the drain tile outfall (see Specification 2.1 for additional radon measures).

1.2 Capillary Break Installation

NOTE: Completion of the ENERGY STAR requirements satisfies the following Indoor airPLUS requirements:

- ✓ Install polyethylene sheeting or extruded polystyrene (XPS) insulation beneath concrete slabs, including basement floors. Ensure sheeting is in direct contact with the concrete slab above (Builder-W 1.3).
- ✓ Install a capillary break at all crawlspace floors using ≥ 6 mil polyethylene sheeting, lapped 6 to 12 in. (Builder-W 1.4).

Additional Indoor airPLUS Requirements:

- Under the polyethylene sheeting or extruded polystyrene (XPS), insulation installed to meet ENERGY STAR Water Management System Builder Checklist Item 1.3:
 - Install a 4 in. layer of 1/2 in. diameter or greater clean aggregate; **OR**

- Install a 4 in. uniform layer of sand, overlain with either a layer of geotextile drainage matting throughout or strips of geotextile drainage matting along the perimeter installed according to the manufacturer's instructions.

Exceptions to the aggregate OR sand requirement: (Not applicable in EPA Radon Zone 1)

- Dry climates, as defined by 2015 IECC Figure 301.1.
- Areas with free-draining soils — identified as Group 1 (Table R405.1, 2015 IRC) by a certified hydrologist, soil scientist, or engineer through a site visit.
- Slab-on-grade foundations.

Alternative path for gut-rehabs:

- For an existing slab in a home undergoing a gut rehabilitation in Radon Zones 2 and 3, the alternate slab treatment in the ENERGY STAR Water Management System Builder Checklist, footnote 5, shall apply as an alternative to polyethylene and aggregate or sand under the slab. Homes undergoing gut rehabilitation in Radon Zone 1 must also install an active radon system utilizing sub-slab depressurization, and radon levels shall be verified upon final inspection to be below the EPA action level (4pCi/l) to receive qualification.

Note: In EPA Radon Zone 1 (see Specification 2.1):

- Polyethylene sheeting must be installed and overlapped by 6 to 12 in. at the seams.
- ENERGY STAR staking method for poly sheeting may not be used in crawlspaces with no slab.
- ENERGY STAR exceptions for capillary break (polyethylene) under slabs do not apply. Poly is required in Radon Zone 1.

Advisory: 10 mil polyethylene is recommended if crawlspace floors are not covered with a concrete slab.

1.3 Damp-Proofing and Waterproofing Below-Grade Exterior Walls

NOTE: Completion of the ENERGY STAR requirements satisfies the following Indoor airPLUS requirements:

- ✓ Finish all masonry and concrete walls (e.g., poured concrete, concrete masonry, insulated concrete forms) with a damp-proof coating (Builder-W 1.5).
- ✓ Finish all wood-framed walls with polyethylene and adhesive or other equivalent waterproofing (Builder-W 1.5).

No additional Indoor airPLUS Requirements

1.4 Basement and Crawlpace Insulation and Conditioned Air

Indoor airPLUS Requirements:

- Seal crawlspace and basement perimeter walls to prevent outside air infiltration.
- Insulate crawlspace and basement perimeter walls according to the prescriptive values determined by local code or R-5, whichever is greater.
- Provide conditioned air at a rate not less than 1 cfm per 50 sq. ft. of horizontal floor area. This can be achieved by a dedicated supply (2015 IRC section R408.3.2.2) or through crawl-space exhaust (2015 IRC section R408.3.2.1). However, if radon-resistant features are required (see Specification 2.1), do not use the crawlspace exhaust method.

Exceptions:

- Homes built in areas designated as 100-year flood zones. (Conditioned crawlspaces are not recommended for use in flood zones. For more information on designated 100-year flood zones, see FEMA's definition of Special Flood Hazard Areas: <https://www.fema.gov/flood-zones>).
- Raised pier foundations with no walls.
- Dry climates, as defined by 2015 IECC Figure 301.1.
- Marine climates, as defined by 2015 IECC Figure 301.1, if no air handler or return ducts are installed in the crawlspace.

Additional Exceptions:

- In lieu of perimeter wall insulation and conditioned air, crawlspaces that utilize a capillary break on the floor and that are well-sealed to prevent outside air infiltration are permitted to utilize active dehumidification with sufficient latent capacity to maintain relative humidity (RH) at or below 60 percent. The dehumidifier shall be drained to the outside or to a sump pump. With this exception, ENERGY STAR Certified Homes Water Management System Builder Requirements Item 1.4.3 staking method for poly sheeting may not be used in crawlspaces with no slab.

1.5 Drainage Plane and Drainage System

NOTE: Completion of the ENERGY STAR requirements satisfies the following Indoor airPLUS requirements:

- ✓ Install a continuous drainage plane behind exterior wall cladding that overlaps flashing and is fully sealed at all penetrations (Builder-W 2.2).
- ✓ Install flashing or an equivalent drainage system at the bottom of exterior walls to direct water away from the drainage plane and foundation (Builder-W 2.1).

No additional Indoor airPLUS Requirements

1.6 Window and Door Openings

NOTE: Completion of the ENERGY STAR requirements satisfies the following Indoor airPLUS requirement:

- ✓ Fully flash all window and door openings, including pan flashing over the rough sill framing, side flashing that extends over pan flashing and top flashing that extends over side flashing (Builder-W 2.3).

No additional Indoor airPLUS Requirements

1.7 Gutters, Downspouts and Site Drainage

NOTE: Completion of the ENERGY STAR requirements satisfies the following Indoor airPLUS requirements:

- ✓ Direct roof water away from the house using gutters and downspouts that empty into lateral piping on a sloping finish grade (Builder-W 3.2); OR
- ✓ Direct roof water to an underground catchment system not connected to the foundation drain system that discharges water ≥ 10 ft. from foundation (Builder-W 3.2).

Additional Indoor airPLUS Requirements:

- Provide extra protection for water splash damage on homes meeting one of the following ENERGY STAR exceptions for gutters and downspouts: slab on grade homes, homes that deposit rainwater to a grade-level rock bed with a waterproof liner and drain pipe, or homes that use a continuous rubber membrane system. Protection for water splash damage shall be met by one of the following:
 - Extend the foundation walls at least 16 in. above final grade; OR
 - Provide a drip line at eaves that is horizontally 16 in. away from the edge of the foundation wall; OR
 - Use cladding materials that are decay and rot resistant and can tolerate regular wetting extending at least 16 in. above final grade and install a well-sealed, continuous drainage plane per manufacturer's instructions.

Advisory: The use of self-adhering moisture membranes directly on exterior sheathing should be limited in these applications to encourage drying potential of moisture vapor through the wall assembly. A moisture resistant, non-perforated, and vapor permeable housewrap is preferred. (However, this may not be true for all wall assemblies where 50% or more of the insulation is outboard the structural assembly.)

Exceptions:

- Dry climates, as defined by 2015 IECC Figure 301.1.
- Homes with rainwater harvesting systems that are designed to properly drain overflow, meeting discharge-distance requirements outlined in ENERGY STAR Builder-W Item number 3.2.

1.8 Roof to Wall Intersections and Roof Penetrations

NOTE: Completion of the ENERGY STAR requirements satisfies the following Indoor airPLUS requirements:

- ✓ Fully flash all roof-to-wall intersections and all roof penetrations using step flashing for conventional roofs or continuous flashing for metal and rubber membrane roofs (Builder-W 3.1).
- ✓ Install "kick-out" flashing at the low end of roof-to-wall intersections (Builder-W 3.1).

No additional Indoor airPLUS Requirements

1.9 Roof Valleys and Decking

NOTE: Completion of the ENERGY STAR requirements satisfies the following Indoor airPLUS requirement:

- ✓ Install a self-sealing bituminous membrane or the equivalent at all valleys and roof decking penetrations for durability at potential failure points (Builder-W 3.3).

No additional Indoor airPLUS Requirements

1.10 Roof Eaves

NOTE: Completion of the ENERGY STAR requirements satisfies the following Indoor airPLUS requirement:

- ✓ Install ice flashing over the sheathing at eaves to provide protection from ice dams in climate zones 5 and higher (Builder-W 3.4).
- ✓ Extend a self-sealing bituminous membrane or the equivalent ("ice flashing") from the edge of the roof line to > 2 ft. up roof deck from the interior plane of the exterior wall (Builder-W 3.4).

No additional Indoor airPLUS Requirements

1.11 Moisture-Protective Systems

NOTE: Completion of the ENERGY STAR requirements satisfies the following Indoor airPLUS requirements:

- ✓ Install moisture-resistant backing material behind tub and shower enclosures (Builder-W 4.2).
- ✓ Install a corrosion-resistant drain pan properly draining to a conspicuous point of disposal (Builder-W 4.6).

Additional Indoor airPLUS Requirements:

- Insulate water supply pipes in exterior walls with pipe wrap.

Exceptions:

- Climate zones 1-3 located in dry climates, as defined by 2015 IECC Figure 301.1.
- When insulation in the wall cavity qualifies as an air barrier and pipes are located within the interior 50% of the wall cavity.

Advisory: Pipes should be installed as close as possible to conditioned space while maintaining Grade 1 insulation installation to reduce risk of freezing and/or condensation.

1.12 Class 1 Vapor Retarders

NOTE: Completion of the ENERGY STAR requirements satisfies the following Indoor airPLUS requirement:

- ✓ Do not install Class 1 vapor retarders on the interior side of vapor permeable insulation in below-grade exterior walls or in any exterior walls in Warm-Humid climates (Builder-W 1.6 and 4.3). Footnote: Class 1 vapor retarders, such as mirrors, may be used if mounted with clips or other spacers that allow air to circulate behind them.

No additional Indoor airPLUS Requirements

1.13 Materials with Signs of Water Damage or Mold

NOTE: Completion of the ENERGY STAR requirements satisfies the following Indoor airPLUS requirements:

- ✓ Building materials with visible signs of water damage or mold not installed or allowed to remain. If mold is present, effort should be made to remove all visible signs of mold (e.g., by damp wipe with water and detergent). If removal methods are not effective, then the material shall be replaced. However, stains that remain after damp wipe are acceptable. Lumber with "sap stain fungi" is exempt from this item as long as the lumber is structurally intact. (Builder-W 4.4).
- ✓ Do not enclose (e.g., with drywall) framing members and insulation products having high moisture content. (Note: Lumber should not exceed 18 percent moisture) (Builder-W 4.5).
- ✓ For wet-applied insulation, follow the manufacturer's drying recommendations (Builder-W 4.5).

No additional Indoor airPLUS Requirements

1.14 Moisture-Resistant Materials

Indoor airPLUS Requirements:

- Install only water-resistant hard-surface flooring in kitchens, bathrooms, entryways, laundry areas and utility rooms.

Note: Wood flooring, either pre-finished or site-finished, can be utilized in these areas, as long as any composite wood material or site-applied finish comply with Items 6.1 and 6.2, respectively.

2. Radon

2.1 Radon-Resistant Construction

NOTE: Completion of the [ENERGY STAR requirements](#) satisfies the following Indoor airPLUS requirement:

- ✓ Air seal all sump covers (Builder-W 1.7).

Additional Indoor airPLUS Requirements:

- Construct homes in EPA Radon Zone 1 (see www.epa.gov/radon/zonemap.html) with radon-resistant features (a passive system at minimum). EPA recommends that radon-resistant features are installed according to ANSI/AARST CCAH for 1-2 family dwellings and townhouses (max. total foundation area of 2500 sq. ft.) OR ANSI/AARST CC-1000 for larger foundations.

Visually verify the following requirements:

- Capillary break installed according to Specification 1.2, irrespective of climate zone.

Exception: In dry climates as defined by 2015 IECC Figure 301.1, a "pipe loop" in a trench of clean aggregate along the entire inside perimeter of the foundation (installed according to ANSI/AARST CCAH 403.1.1) can be used in lieu of a uniform layer of aggregate under the entire slab.

- A 3 or 4 in. diameter gas-tight vertical vent pipe, clearly labeled as a component of a radon reduction system. The vent pipe shall be connected to an open T-fitting in the aggregate layer (or connected to geotextile drainage matting according to the manufacturer's instructions) beneath the polyethylene sheeting, extending up through the conditioned spaces and terminating a minimum of 12 in. above the roof opening. At least 10 ft. of horizontal perforated drain tile is to be attached to the T-fitting beneath the polyethylene sheeting placed over earthen crawlspaces and below concrete slabs. Note: suction points are not permitted on sump lids.
- Radon fan (i.e., an active system) OR an electrical receptacle installed in an accessible attic location near the radon vent pipe (i.e., a passive system) to facilitate future fan installation if needed. A space surrounding the radon pipe, having a vertical height of not less than 48 inches and a diameter of not less than 21 inches, shall be provided in the attic area where the radon fan can be installed, if required.
- Homes with no accessible attic location for a fan must utilize another exterior location or a garage that is not below conditioned space per ANSI/AARST CCAH. The branch circuit supply shall be labeled at the electrical panel indicating its intended use.
- Foundation air sealing with polyurethane caulk or the equivalent at all slab openings, penetrations and control or expansion joints.

Exception to Item 2.1: Manufactured homes with raised-pier foundations (i.e. no solid perimeter foundation wall).

Alternative path for gut-rehabs:

- For homes with an existing slab undergoing gut rehabilitation in Radon Zone 1, an active radon system utilizing sub-slab depressurization must be installed, and radon levels shall be verified upon final inspection to be below the EPA action level (4pCi/l) to receive qualification. The alternate slab treatment in the ENERGY STAR Water Management System Builder Checklist, footnote 5, shall apply as an alternative to polyethylene and aggregate or sand under the slab.

Note: Larger buildings and multifamily properties may share mitigation systems across multiple units or may require multiple soil gas vent systems to accommodate large building footprints. See ANSI/AARST CC-1000 for electric metering requirements in shared (collateral) mitigation systems, as well as for maximum nominal sizes of soil gas collection plenums and corresponding pipe sizes.

Note: Consult local building codes to determine whether additional radon requirements apply. Also consult EPA's "Building Radon Out" (EPA 402-K-01-002) for general guidance on installing radon-resistant features.

Advisories:

1. Elevated levels of radon have been found in homes built in all three zones on EPA's Map of Radon Zones. Consult your state radon program for current information about radon in your area. Go to www.epa.gov/radon/whereyoulive.html and click on your state for contact information.
2. EPA recommends, but does not require, that all homes built with radon-resistant features in EPA Radon Zone 1 include a radon vent fan. EPA also recommends radon-resistant features for homes built in EPA Radon Zones 2 and 3, and that all homes with or without radon-resistant features be tested for radon prior to occupancy. A radon vent fan should be installed when the test result is 4 pCi/L (the EPA action level) or more.
3. Provide buyers with EPA's Citizen's Guide to Radon, encourage them to test for radon and refer them to www.epa.gov/radon for more information.
4. If soil or groundwater contamination is suspected on or near the building site (e.g., former industrial sites), volatile chemical contaminants from soil gas or vapor intrusion into a building may pose an IAQ risk. In such cases, EPA recommends radon-resistant features consistent with Specification 2.1, which can minimize or prevent the vapor intrusion into a house. See the EPA Vapor Intrusion Primer or ASTM E2600 for more information. You should also consult your state, tribal, or local environmental regulatory agency for information on the location of contaminated sites, including those subject to Superfund (CERCLA), Resource Conservation and Recovery Act (RCRA) cleanup requirements, or the Brownfields program. Visit EPA's "Where You Live" for more information.

3. Pest Barriers

3.1 Minimize Pathways for Pest Entry

NOTE: Completion of the ENERGY STAR requirements satisfies the following Indoor airPLUS requirements:

- ✓ Seal all penetrations and joints between the foundation and exterior wall assemblies (Rater-F 4.1 and 4.3).
- ✓ Air seal all sump covers (Builder-W 1.7).

No additional Indoor airPLUS Requirements

Advisories:

1. When sealing larger gaps that provide potential points of entry for rodents, copper or stainless steel wool is recommended in addition to sealant.
2. Additional precautions should be taken in areas classified as "Moderate to Heavy" termite infestation probability (as identified by 2015 IRC Figure R301.2 [6]):
 - Foundation walls should be solid concrete or masonry with a top course of solid block, bond beam, or concrete-filled block.
 - Interior concrete slabs should be constructed with 6 x 6 in. welded wire fabric, or the equivalent, and concrete walls should be constructed with reinforcing rods to reduce cracking.
 - Sill plates should be made of metal or preservative-treated wood.
3. Additional precautions should be taken in areas classified as "Very Heavy" termite infestation probability (as identified by 2015 IRC Figure R301.2[6]) i.e., Alabama, Florida, Georgia, Louisiana, Mississippi, South Carolina and parts of California and Texas:
 - Foam plastic insulation should not be installed on the exterior face of below-grade foundation walls or under slabs.
 - Foam plastic insulation installed on the exterior of above-grade foundation walls should be kept a minimum of 6 in. above the final grade and any landscape bedding materials and should be covered with moisture-resistant, pest-proof material (e.g., fiber cement board or galvanized insect screen at the bottom-edge of openings).
 - Foam plastic insulation applied to the interior side of conditioned crawlspace walls should be kept a minimum of 3 in. below the sill plate.

3.2 Rodent/Bird Screens for Building Openings

Indoor airPLUS Requirements:

- Provide corrosion-proof rodent/bird screens (e.g., copper or stainless steel mesh) for all building openings that cannot be fully sealed and caulked (e.g., ventilation system intake/exhaust outlets and attic vent openings).

Exception: This requirement does not apply to clothes dryer vents.

4. HVAC Systems

4.1 HVAC Sizing and Design

NOTE: Completion of the ENERGY STAR requirements satisfies the following Indoor airPLUS requirements:

- ✓ Calculate room-by-room heating and cooling design loads using Unabridged ACCA Manual J, 2013 ASHRAE Fundamentals, or other methodology per the Authority Having Jurisdiction (HVAC-D 3).
- ✓ Select all heating and cooling equipment to accommodate the calculated heating and cooling design loads using ACCA Manual S and ENERGY STAR allowances, inclusive of the pressure drop from all specified filters (HVAC-D 4).

Additional Indoor airPLUS Requirements:

- In "Warm-Humid" climates as defined by Section 301 of the 2015 IECC (i.e., Climate Zone 1 and portions of Zones 2 and 3A below the white line), equipment shall be installed with sufficient latent capacity to maintain indoor relative humidity (RH) at or below 60 percent. This requirement shall be met by either:
 - Additional dehumidification system(s), **OR**
 - A central HVAC system equipped with additional controls to operate in dehumidification mode.

Exception: Climate Zones 4-8, 3B, 3C and the portions of 3A and 2B above the white line as shown by 2015 IECC Figure 301.1.

Advisory: Although not required to meet this specification, independent dehumidification is recommended in Climate Zones 4A and 3A above the white line as shown in 2015 IECC Figure 301.1.

4.2 Duct System Design and Installation

NOTE: Completion of the ENERGY STAR requirements satisfies the following Indoor airPLUS requirements:

- ✓ Design all duct systems according to ACCA Manual D (HVAC-D 5).
- ✓ Ensure that all duct systems are installed to be substantially airtight (Rater-F 6.4 and 6.2).

Additional Indoor airPLUS Requirements:

- Do not use building cavities as part of the forced air supply or return systems.
- Either cover duct openings throughout construction to protect from construction debris or vacuum out ducts thoroughly prior to installing registers, grilles and diffusers (see Specification 7.1).

Advisory: Seams in the HVAC cabinet, plenum and adjacent ductwork should be sealed with mastic systems, tape that meets the applicable requirements of UL 181a or UL 181b, or gasket systems.

4.3 Location of Air-Handling Equipment and Ductwork

Indoor airPLUS Requirement:

- Do not locate air-handling equipment or ductwork in garages.

Note: Ducts and equipment may be located in framing spaces or building cavities adjacent to garage walls or ceilings if they are separated from the garage space with a continuous air barrier.

4.4 Room Pressure Differentials

NOTE: Completion of the ENERGY STAR requirements satisfies the following Indoor airPLUS requirement:

- ✓ Minimize room pressure differentials for any bedroom (as defined by RESNET's Mortgage Industry National Home Energy Rating Systems Standards (the RESNET Standard) that does not have a dedicated return (Rater-F 6.2).

No additional Indoor airPLUS Requirements

4.5 Mechanical Whole-Dwelling Ventilation

NOTE: Completion of the ENERGY STAR requirements satisfies the following Indoor airPLUS requirements:

- ✓ Provide mechanical whole-dwelling ventilation meeting all requirements of ASHRAE 62.2-2010 or later (HVAC-D 2).
- ✓ Test airflows to ensure they meet ASHRAE 62.2-2010 or later minimum requirements (Rater-F 7.1).
- ✓ Visually verify the following requirements:
 - Transfer air is not used to meet ventilation requirements (Rater-F 7.7.1).
 - Outdoor air inlets are located a minimum of 10 ft. from contaminant sources (Rater-F 7.7.2).

No additional Indoor airPLUS Requirements

Advisory: Outdoor air ducts connected to the return side of an air handler should be used as supply ventilation only if the manufacturers' requirements for return air temperature are met (e.g., most manufacturers recommend a minimum of 60 degrees Fahrenheit air flow across furnace heat exchangers). EPA also recommends filtering air inlets with a filter rated at MERV 13 or higher to minimize outdoor particles entering the home.

4.6 Local Exhaust for Known Pollutant Sources

NOTE: Completion of the ENERGY STAR requirements satisfies the following Indoor airPLUS requirements:

- ✓ Provide local mechanical exhaust ventilation to the outdoors in each bathroom and kitchen, meeting ASHRAE 62.2-2010 Section 5 requirements (Rater-F 8.1 and 8.2).

Additional Indoor airPLUS Requirements:

- Conventional clothes dryers shall be vented to the outdoors. Electric condensing dryers shall be plumbed to a drain according to manufacturer's instructions.

4.7 Filtration for Central Forced-Air HVAC Systems

NOTE: Completion of the ENERGY STAR requirements satisfies the following Indoor airPLUS requirement:

- ✓ Equip all filter access panels with gasket material or comparable sealing mechanism and ensure access panels fit snugly against the exposed edge of the installed filter when closed to prevent bypass (Rater-F 9.3).

Additional Indoor airPLUS Requirements:

- Install only HVAC filters that are rated MERV 8 or higher according to ASHRAE 52.2-2007 (at approximately 295 fpm).

Advisory: EPA recommends, but does not require, filters rated at MERV 13 or higher to reduce exposure to fine particles. Filters perform best when the filter rack design includes the following features, which are also included in some manufacturers' filter media boxes:

- Flexible, air-tight (e.g., closed-cell foam) gasket material on the surface that contacts the air-leaving (downstream) side of the filter.
- Friction fit or spring clips installed on the upstream side of the filter to hold it firmly in place.

- Upon installation of the air handling unit, include a filter for the remainder of construction activity to protect the unit and/or coil from construction debris and dust. Filter should be clean upon final inspection following construction (see Specification 7.1).

Advisory: To reduce the likelihood of construction dust contaminating the ducts and air handler, limit use of the HVAC system during activities with increased dust (e.g. drywall sanding, floor sanding).

- Do not install any air-cleaning equipment designed to produce ozone (i.e., ozone generators).

5. Combustion Pollutant Control

5.1 Combustion Equipment Located in Conditioned Spaces

NOTE: Completion of the ENERGY STAR requirements satisfies the following Indoor airPLUS requirements:

- ✓ Mechanically draft or direct vent all gas- and oil-fired furnaces, boilers and water heaters located in conditioned spaces. Naturally drafted equipment is allowed in Climate Zones 1-3 if the Rater has followed the combustion safety test procedures in Section 805 of the RESNET Standard. (Rater-F 10.1).
- ✓ Fireplaces that are not mechanically drafted or direct-vented to the outdoors must meet maximum allowed exhaust flow (Rater-F 10.2).

Additional Indoor airPLUS Requirements:

- Do not install any unvented combustion space-heating or decorative appliances within conditioned space.
- Ensure that all fireplaces and other fuel-burning and space-heating appliances located in conditioned spaces are vented to the outdoors and supplied with adequate combustion and ventilation air according to the manufacturers' installation instructions.
- Meet the following energy efficiency and emissions standards and restrictions for all fireplaces and other fuel-burning and space-heating appliances located in conditioned spaces:
 - Traditional masonry fireplaces designed for open fires are not permitted, with the exception of "masonry heaters" as defined by ASTM E1602 and section 2112.1 of the 2012 International Building Code (i.e., fireplaces engineered to store and release substantial portions of heat generated from a rapid burn).
 - Factory-built wood-burning fireplaces shall meet the certification requirements of UL 127 and shall have tight-fitting, gasketed glass doors and a dedicated outside air supply.

Advisory: Factory-built wood burning fireplaces qualified under EPA's wood-burning fireplace program are recommended. See: www.epa.gov/burnwise/fireplacelist.html
 - Wood stove and fireplace inserts as defined in section 3.8 of UL 1482 shall meet the certification requirements of that standard, **AND** they shall meet the emission requirements of the EPA's New Source Performance Standards for new residential wood heaters. See: www.epa.gov/residential-wood-heaters/final-new-source-performance-standards-residential-wood-heaters.

- Pellet stoves shall meet the requirements of ASTM E1509 **AND** they shall meet the emission requirements of the EPA New Source Performance Standards for new residential wood heaters.
- Natural gas and propane fireplaces shall have a permanently affixed glass front or gasketed door, and be power vented or direct vented in accordance with ANSI Z21.88/CSA 2.33. Decorative gas logs as defined in ANSI Z21.84/CSA 2.33 are not permitted.

Note: Unfinished basements and crawlspaces (except raised pier foundations with no walls) and attached garages that are air-sealed to the outside and intended for use as work or living space, are considered "conditioned spaces" for the purpose of this requirement.

5.2 Carbon Monoxide Alarms

Indoor airPLUS Requirement:

- All homes equipped with combustion appliance(s) or an attached garage shall have a carbon monoxide (CO) alarm installed in a central location in the immediate vicinity of each separate sleeping zone (e.g., in a hallway adjacent to bedrooms.) The alarm(s) shall be hard-wired with a battery back-up function and placed according to NFPA 720. The alarms shall be certified by either CSA 6.19-01 or UL 2034.

5.3 Multi-Family Environmental Tobacco Smoke Protections

Indoor airPLUS Requirements:

- Reduce exposure to environmental tobacco smoke (ETS) in multi-family buildings by:
 - Prohibiting smoking in indoor common areas, specified explicitly in building rental/lease agreements or condo/co-op association covenants and restrictions.
 - Locating designated outdoor smoking areas a minimum of 25 ft. from entries, outdoor air intakes and operable windows.
 - Minimizing uncontrolled pathways for ETS transfer between individual dwelling units by sealing penetrations in the walls, ceilings and floors of dwelling units; sealing vertical chases adjacent to dwelling units; and applying weather stripping to all doors in dwelling units leading to common hallways.

Advisory: To ensure that air sealing will effectively prevent migration of ETS, other air pollutants and odors between units in multifamily structures, conduct air-tightness testing of each unit in accordance with Section 802 of the RESNET Standard. The maximum air leakage rate should not exceed 0.3 CFM per square foot of the dwelling unit's enclosure area, at an induced pressure difference of 50 Pa, where the enclosure area includes the floor area, the ceiling area, and the demising and exterior wall areas.

5.4 Attached Garages

NOTE: Completion of the ENERGY STAR requirements satisfies the following Indoor airPLUS requirement:

- ✓ Isolate attached garages from conditioned spaces as follows:
 - Air-seal common walls and ceilings between attached garages and living spaces before installing insulation (Rater-F 2.4, 2.6, and 4.7).

- Use weather stripping or equivalent gasket to ensure all doors between living spaces and attached garages are substantially airtight (Rater-F 4.9).

Additional Indoor airPLUS Requirements:

- Install an automatic door closer on all connecting doors between living spaces and attached garages, **AND**
- In homes with exhaust-only whole house ventilation meet one of the following two requirements:
 - Equip the attached garage with an exhaust fan with a minimum installed capacity of 70 cfm that is vented directly outdoors. The fan shall be wired for continuous operation or with automatic fan controls (e.g., a motion detector) that activate the fan whenever the garage is occupied and operate for at least 1 hour after the garage has been vacated. If a ducted fan (not through-the-wall) is used, test and verify minimum capacity of 70 cfm, **OR**
 - Verify that the garage-to-house air barrier can maintain a pressure difference of greater than 45 Pa while the home maintains a 50 Pascal pressure difference with respect to the outdoors. All operable garage openings shall be closed during this test.

Advisories:

1. EPA recommends installing a garage exhaust fan if the homebuyer is expected to occupy the garage for work or recreational activities over extended periods of time.
2. ENERGY STAR certified fans are highly recommended.
3. Provide occupants with information in the Buyer Information Kit on the importance of, and methods for, ensuring adequate ventilation in the garage while occupied for extended periods of time.

6. Low-Emission Materials

Download [How to Find Indoor airPLUS Compliant Low Emission Products](#), which provides guidance on identifying compliant products including industry databases and examples of product labeling.

Note: The evaluation, certification and labeling of products for indoor emissions of volatile organic compounds (VOCs) is complex and evolving. EPA has not established threshold levels for indoor VOC emissions from any of the product categories addressed in these specifications. The third-party programs referenced in these specifications include U.S. programs that are designed to reduce human exposure indoors to individual VOCs of potential concern for human health effects, compared to similar products not certified as low-VOC or no-VOC. EPA will consider modifying these specifications to include additional third-party programs as appropriate.

6.1 Composite Wood

NOTE: The following requirements pertain to ALL composite wood products installed in the home during construction. Examples include but are not limited to: structural panels, cabinetry, shelving, trim, doors, stair treads, flooring, etc. See exceptions.

Indoor airPLUS Requirements:

- Structural plywood and oriented strand board (OSB): Use only products certified compliant with:

- PS1 or PS2, as appropriate, and made with moisture-resistant adhesives as indicated by “Exposure 1” or “Exterior” on the American Plywood Association (APA) trademark.

- Hardwood plywood: Use only products certified compliant with:
 - Formaldehyde emissions requirements of ANSI/HPVA HP-1-2016; **OR**
 - California Air Resources Board (CARB) Airborne Toxics Control Measure (ATCM) Phase II to Reduce Formaldehyde Emissions from Composite Wood Products; **OR**
 - EPA Toxic Substances Control Act (TSCA) Title VI certified.
- Particleboard and MDF products: Use only products certified compliant with:
 - CARB ATCM Phase II to Reduce Formaldehyde Emissions from Composite Wood Products; **OR**
 - EPA Toxic Substances Control Act (TSCA) Title VI certified; **OR**
 - Formaldehyde emissions requirements of ANSI A208.1 (particleboard) and A208.2 (MDF); **OR**
 - ECC Sustainability Standard by the Composite Panel Association; **OR**
 - GREENGUARD or GREENGUARD GOLD Certification.
- Cabinetry: Made with component materials (plywood, particleboard, MDF) that are certified to comply with:
 - The appropriate standards above; **OR**
 - Registered brands or products produced in plants certified under the Kitchen Cabinet Manufacturers Association’s (KCMA) Environmental Stewardship Certification Program (ESP 05-12); **OR**
 - GREENGUARD or GREENGUARD GOLD Certification for Cabinetry.

Exceptions to Item 6.1 per the CA ATCM and EPA’s TSCA Title VI:

- Windows that contain composite wood products are exempt from the requirements of this section if the window product contains less than five percent by volume of HWPW, PB, or MDF combined in relation to the total volume of the finished window product.
- Exterior doors and garage doors that contain composite wood products are exempt from the requirements of this section if either: (A) the doors are made from composite wood products manufactured with no added formaldehyde based resins or ULEF resins; or (B) the doors contain less than three percent by volume of HWPW, PB, or MDF combined in relation to the total volume of the finished exterior door or garage door.

Note: “No added formaldehyde” (NAF) or “Ultra-low emitting formaldehyde” (ULEF) products that are specifically manufactured under a limited exemption from the CARB ATCM to Reduce Formaldehyde Emissions from Composite Wood Products or EPA’s TSCA Title VI rule are compliant with Indoor airPLUS.

6.2 Interior Paints and Finishes

Indoor airPLUS Requirements:

- At least 90 percent of the interior surface area covered by site-applied paints and coatings shall use low-VOC or no-VOC products certified by one of the following third-party standards or certifications:
 - GREENGUARD or GREENGUARD GOLD Certification for Paints and Coatings, **OR**
 - Scientific Certification Systems (SCS) Standard EC-10.3-2014, Indoor Advantage Gold, **OR**
 - A third-party low-emitting product list based on CA Section 01350 (CDPH Standard Method V1.2-2017), **OR**
 - Green Seal Standard GS-11, **OR**
 - Green Wise and Green Wise Gold products, **OR**
 - Master Painters Institute (MPI) Green Performance Standards X-Green, GPS-1 or GPS-2.

6.3 Carpets and Carpet Adhesives

Indoor airPLUS Requirements:

- At least 90 percent of the interior surface area covered by carpet and carpet adhesives must use products labeled with, or otherwise documented as meeting, the Carpet and Rug Institute (CRI) Green Label Plus testing program criteria.
- For carpet cushion (i.e., padding), use only products certified to meet the CRI Green Label Plus testing program criteria.

6.4 Adhesives and Sealants

Advisory: While not currently required by Indoor airPLUS, EPA recommends that at least 90 percent of site-applied interior adhesives and sealants be low-VOC or no-VOC products certified by one of the following third-party standards or certifications:

- A third-party low-emitting product list based on CA Section 01350 (CDPH Standard Method V1.2-2010), **OR**
- Green Seal GS-36, **OR**
- GREENGUARD or GREENGUARD GOLD certification for adhesives and sealants.

6.5 Hard Surface Flooring

Advisory: While not currently required by Indoor airPLUS, EPA recommends that at least 90 percent of the interior hard surface flooring materials, adhesives, and underlayments be low-VOC or no-VOC emitting as certified by one of the following third-party standards or certifications:

- FloorScore ®; **OR**
- GREENGUARD or GREENGUARD Gold; **OR**
- SCS Indoor Advantage Gold; **OR**
- A third party low-emitting product list based on CA Section 01350 (CDPH Standard Method v1.2-2017); **OR**
- CRI Green Label Plus (adhesives)

7. Home Commissioning

7.1 HVAC and Ductwork Verification

Indoor airPLUS Requirements:

- Inspect ductwork before installing registers, grilles and diffusers to verify it is dry and substantially free of dust or debris. If duct openings were not covered during construction, thoroughly vacuum out each opening prior to installing registers, grilles and diffusers.
- After all dust-producing construction activities are complete (e.g., drywall, trim carpentry, floor sanding), verify HVAC filters are new, clean, and meet specified MERV rating (see Specification 4.7).

Advisory: Air balancing of supply registers and return grilles is highly recommended to improve the performance of the HVAC system and comfort of the occupants, but is not required at this time for Indoor airPLUS qualification.

7.2 Ventilation after Material Installation

Indoor airPLUS Requirements:

- Ventilate the home with outside air at the highest rate and duration practical, meeting ventilation requirements for outdoor air flow and humidity control (see Item 4.5):
 - During and shortly after installing products that are known sources of contaminants (e.g., cabinets, carpet padding and painting), **AND**
 - During the period between finishing and occupancy.

Advisory: If whole house ventilation cannot be scheduled prior to occupancy, advise the buyer to operate the ventilation system at the highest rate it can provide during the first few months of occupancy, meeting the above requirements.

7.3 Owner and Resident Information Kit

Indoor airPLUS Requirements:

- Provide resident(s), property manager, and/or building owner with information and documentation of the home's IAQ protections, including:
 - An Indoor airPLUS label and certificate.
 - Operations and maintenance instruction manuals for all installed equipment and systems addressed by Indoor airPLUS and ENERGY STAR requirements, including HVAC systems and accessories, dehumidifiers, combustion appliances and any radon system.

Advisory: Provide the homebuyer with information that addresses the importance of ensuring that manually controlled ventilation options (e.g., bathroom, garage (if applicable), kitchen exhaust fans; operable windows, and doors, etc.) are used when strong pollutant sources are present, such as when using common household products (e.g., cleaning products, pesticides) and when using the garage for hobbies or other pollutant generating activities.

Abbreviations

CFDS	Composite Foundation Drainage System
cfm	cubic feet per minute
ETS	Environmental Tobacco Smoke
fpm	feet per minute
ft.	feet
HVAC	heating, ventilating and air-conditioning
IAQ	indoor air quality
in.	inches
mil	common term to describe plastic sheeting thickness; 1 mil equals 0.001 inches
min.	minimum

MDF	medium density fiberboard
MERV	Minimum Efficiency Reporting Value; defined in ASHRAE 52.2-2007
OSB	oriented strand board
Pa	Pascal
pCi/L	picocuries per liter
Rev.	Revision
sq. ft.	square foot
spec	specification
VOC	Volatile Organic Compound
w.c.	water column

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ANSI Z21.88/CSA 2.33: ANSI Standard Z21.88-2014/CSA Standard 2.33-2014: Vented Gas Fireplace Heaters. 2014. American National Standards Institute/Canadian Standards Association.

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IRC: International Residential Code for One- and Two-Family Dwellings. 2015. International Code Council, Inc.

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Climate Zones of the Continental United States

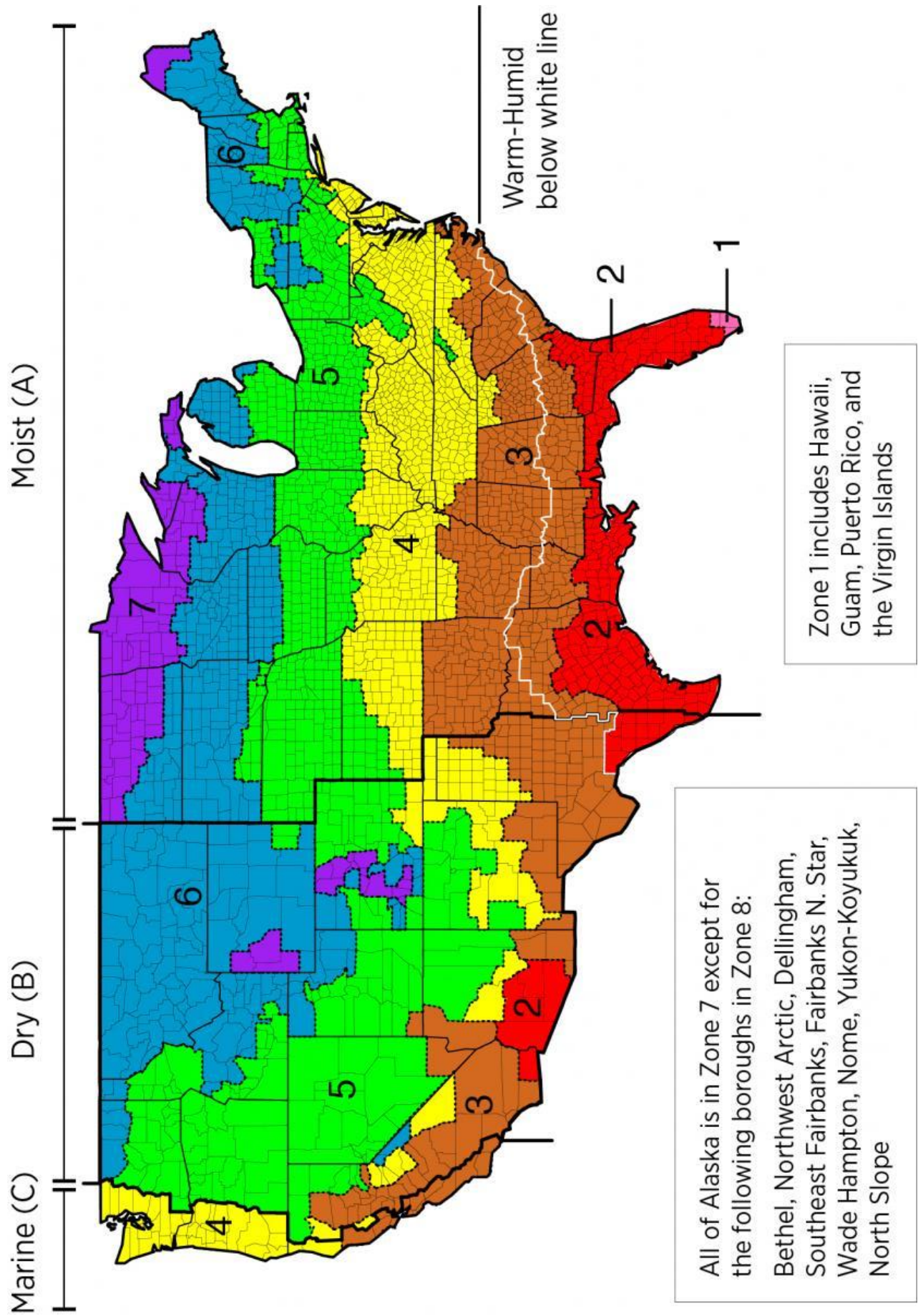


Figure 301.1 Climate Zones of the Continental United States. International Energy Conservation Code



Office of Air and Radiation (6609J)

EPA-402-K-13/001 | Revised February 2018



Homes with the Indoor airPLUS label are designed for improved indoor air quality compared to homes built to minimum code.

www.epa.gov/indoorairplus

DOE Zero Energy Ready Home PV-Ready Checklist



DOE Zero Energy Ready Home National Program Requirements Mandatory Requirement 7 (Renewable Ready) shall be met by any home certified under the DOE Zero Energy Ready Home program, only where **all three conditions** of the following conditions are met. If any of these three conditions is not met, the home is exempt from requirements contained in the PV-Ready checklist.

1. Location, based on zip code has at least 5 kWh/m²/day average daily solar radiation based on annual solar insolation using PVWatts online tool:
http://gisatnrel.nrel.gov/PVWatts_View/index.html **AND**;
2. Location does not have significant natural shading (e.g., trees, tall buildings on the south-facing roof, **AND**;
3. Home as designed has adequate free roof area within +/-45° of true south as noted in the table below.

<u>Conditioned Floor Area of the House (sq. ft.)</u>	<u>Minimum Roof Area within +/- 45° of True South for PV-Ready Checklist to Apply (ft²)</u>
≤ 2000	110
≤ 4000	220
≤ 6000	330
> 6000	440

Note:

- If a solar photovoltaic system is included with the home, then compliance with the Consolidated RERH checklist is not required.

These requirements were adapted from the EPA's Renewable Energy Ready Home Solar Photovoltaic Specification Guide (RERHPV Guide). For further guidance on any of the above items, this checklist notes the section of the guide. This guide can be accessed on the DOE Zero Energy Home program website at http://www1.eere.energy.gov/buildings/residential/pdfs/rerh_pv_guide.pdf

Designate a proposed array location and square footage on architectural diagram: PV _____ sq.ft. (<i>RERHPV Guide 1.1</i>)	<input type="checkbox"/>
Identify orientation (Azimuth) of proposed array location: PV _____ degrees. (<i>RERHPV Guide 1.2</i>)	<input type="checkbox"/>
Identify Inclination of proposed array location: PV _____ degrees. (<i>RERHPV Guide 1.3</i>)	<input type="checkbox"/>
Provide code-compliant documentation of the maximum allowable dead load and live load ratings of the existing roof; recommended: allowable dead load rating can support an additional 6 lbs/sq. ft. for future solar system. (<i>RERHPV Guide 2.1</i>)	<input type="checkbox"/>
Provide architectural drawing of solar PV system components. (<i>RERHPV Guide 3.5</i>) Alternative: Provide home buyer with the following information: <ul style="list-style-type: none"> ➤ List of renewable-ready features ➤ Available free roof area within +/- 45° of true south ➤ Location of panel or blocking for future mounting of PV system components ➤ Location of Breaker or slot for future breaker in electrical service panel ➤ Copy of the PV-Ready Checklist ➤ A copy of the RERH Solar PV Specification Guide 	<input type="checkbox"/>
Install a 1" metal conduit for the DC wire run from the designated array location to the designated inverter location (cap and label both ends). (<i>RERHPV Guide 3.2</i>)	<input type="checkbox"/>
Install a 1" metal conduit from designated inverter location to electrical service panel (cap and label both ends). (<i>RERHPV Guide 3.3</i>)	<input type="checkbox"/>
Install and label a 4' x 4' plywood panel area for mounting an inverter and balance of system components. (<i>RERHPV Guide 3.1</i>) Alternative: Blocking is permitted to be used as an alternative to the 4' x 4' panel. The area designated for the future panel to mount PV components shall be clearly noted in the system documentation.	<input type="checkbox"/>
Install a 70-amp dual pole circuit breaker in the electrical service panel for use by the PV system (label the service panel) (<i>RERHPV Guide 3.4</i>) Alternative: Provide a labeled slot for a double-pole breaker in the electrical service.	<input type="checkbox"/>