DOE Zero Energy Ready Home



Energy Efficiency & Renewable Energy



Zero Energy Ready Made Simple Part I: Technical Specifications

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Zero Energy Ready Home:

- Zero Made Easy
- Zero Value Translated
- Zero Builders in Action
- Zero Specifications
 - I: Specs Explained
 - II: Rating & Verifying
- Zero Recognition





Energy Efficiency & **Renewable Energy**



Zero Energy Ready Home **Zero Specifications**





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1. DOE ZERH Specs =

- complete systems
- readily achievable
- cost-effective today



2. Reaching DOE ZERH not a big jump

- modest step up from ENERGY STAR



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Risk Man: Low-Loads Less Drying Less Fresh Air

Future Ready Health Ready Advanced Tech Zero Ready

Optimized Optimized Enclosure Comfort System System

d Water Protection System Complete IAQ System

Efficient Comps System

Solar Ready System

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Optimized Enclosure System







2012 / 2015 IECC Envelope Insulation Levels





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Optimized Comfort System







Optimized Duct Location

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Water Protection System









sump pumps

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- flooring materials
- sub-slab aggregate
- RH control in hot/humid



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- Radon
- Low emission materials
- Combustion safety
- Better filtration



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Efficient Comps System







- Appliances
 - Exhaust Fans
 - Ceiling Fans
 - Water Heating (target)

- High efficient lighting
- Efficient hot water distribution



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DOE ZERH PV-Ready Checklist

DOE ZERH Framework



	Area of Improvement	Mandatory Requirement	ts		
	1. ENERGY STAR for Homes Baseline	Certified under ENERGY STAR Qualified Homes Version 3 or 3.1 9, 10			
	2. Envelope ¹¹	Fenestration shall meet or Ceiling wall floor and slat			
Mandatory	Duct System	 Duct distribution systems lo optimized to achieve comm 	Must		
Reats.	. Water Efficiency	 Hot water delivery systems 	Comply		
	5. Lighting & Appliances ¹⁸	 All installed refrigerators, d 80% of lighting fixtures are minimum 80% of sockets All installed bathroom venti 	Compry		
	6. Indoor Air Quality	Certified under EPA Indoor	airPLUS 10		
	7. Renewable Ready Hot Water Ready provisions are encouraged but not required) ¹⁹			y Checklist are Completed; (Solar ed) ¹⁹	
	Ext HVAC Equipment ²¹	nibit 2: DOE Zero Energy	Ready Home Target Hom	e ^{7, 20}	
		Hot Climates (2012 IECC Zones 1,2) ²²	Mixed Climates (2012 IECC Zones 3, 4 except Marine)	Cold Climates (2012 IECC Zones 4 Marine 5,6,7,8)	
	AFUE	80%	90%	94%	
	SEER	18	15	13	
'larget	Geothermal Heat Pump	8.2	9 VERGY STAR FER and COP Cri	10 ²³	
Home'	SHRAE 62.2 Whole-House hanical Ventilation System	1.4 cfm/W; no heat exchange no heat exchange		1.2 cfm/W; heat exchange with 60% SRE	Trade-Off
nomo	sulation and Infiltration				Elovibility
Specs	Insulation levels shall mee Infiltration ²¹ (ACH50): Windows ^{22, 23, 24}	t the 2012 IECC and achieve Grav 3 in CZ's 1-2 2.5 in CZ	ie 1 Installation, per RESNET star s 3-4 2 in CZ's 5-7 1.5 in	ndards. I CZ 8	
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Specs	Insulation levels shall mee Infiltration ²¹ (ACH50): Windows ^{22, 23, 24 SHG U-Valu Homes qualifying through 1 U-values or SHGCS.²⁸ Water Heater ENERGY STAR minimum; for Effective for Homes Permitted Starting d/1/2012}	the 2012 IECC and achieve Gra 3 in C2's 1-2 2.5 in C2' Hot Climates (2012 IECC Zones 1,2,) C 0.25 ie 0.4 the Prescriptive Path with a tot rheating oil water heaters use EF Revised 07 Exhibit 3: Benc	e 1 Installation, per RESNET star s 3-4 2 In CZ's 5-7 1.5 In Mixed Cilmates (2012 IECC Zones 3, 4 except Marine) 0.27 0.3 al window-to-floor area greater - 0.50 /01/2012 hmark Home Size ²⁶	Cold Climates (2012 IECC Zones 4 Marine 5,6,7,8) 0.27 than 15% shall have adjusted Page 2 of 8	Identical to
Specs Size Adjust.	Insulation levels shall mee Infiltration ²¹ (ACH50): Windows ^{22, 23, 24} SHG U-Valu Homes qualifying through U-values or SHGCs. ²⁶ Water Heater ENERGY STAR minimum; for Effective for Homes Bermitted Searcing 4/1/2012 Redrooms in Home to be	t the 2012 IECC and achieve Gra 3 in CZ's 1-2 2.5 in CZ Hot Climates (2012 IECC Zones 1,2,) C 0.25 e 0.4 the Prescriptive Path with a tot rheating oil water heaters use EF Revised 07 Exhibit 3: Benc Built 1	le 1 Installation, per RESNET star s 3-4 2 in CZS 5-7 1.5 in Mixed Cilmates (2012 IECC Zones 3, 4 except Marine) 0.27 0.3 al window-to-floor area greater - 0.60 //01/2012 hmark Home Size ²⁶ 2 3 4 1 600 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Cold Climates (2012 IECC Zones 4 Marine 5,6,7,8) any 0.27 than 15% shall have adjusted Page 2 of 8 5 6 7 8	Identical to

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Target Home Avg. HERS Scores

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Based on 1800, 2400, and 3600 ft² prototypes on climate-appropriate foundations.

HERS Threshold for ZERH - *Relative* to a Target Home



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- Evaluation of the HERS Score for DOE ZERH compliance is relative to the Target Home
 - Not a fixed HERS Score

DOE Zero Energy Ready Home Projected Rating: Based on Plans - Field Confirmation Required.

 Alleviates impacts from software changes & updates

Energy Performance			
House Type	DOE Zero Energy Ready Home Builder Partner ID#		
Single-famil y detached	1		
Year built	Square footage of Conditioned Space including Basement		
2015	3600.0		
Number of Bedrooms	Square footage of Conditioned Space without Basement		
4	2400.0		
Site address (if not available, list the site Lot #)	Registered Builder		
	Certified Rater		
он.			
HERS Index without On-site Generation	Date of Rating		
50			
HERS Index with On-site Generation	Rating Software		
50	REM/Rate 1 v14.6		
HERS Index of the Target Home using size adjustment factor	Estimated annual energy costs(\$)		
52	1648		
Estimated annual energy use	Estimated annual energy savings		
Electric: 10041 kWh \ Natural Gas: 525 Thems	Electric: 3785 kWh \ Natural gas: 732 Therms		
Energy cost rates	Estimated annual emissions reductions		
Electric: 0.08 \$/kWh \-Natural Gas: 1.20 \$/Therms	CO2: 7.8 tons / SO2: 34.5 lbs / NOx: 16.6 lbs		



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Zero Energy Ready Home Zero Specifications: **Optimized Enclosure System**



A well-insulated and air-sealed home, with good windows and doors, reduces the amount of energy needed to keep the home comfortable.

Thermal Holes Are a Big Deal



1, 000 sq. ft. R-38 Attic U = .026

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Drop-Down Stair = R-1 R-1, U = 1.0 10 sq. ft. = 1% of area

What Percent Loss in Attic R-Value?

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Thermal Holes Are a Big Deal



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1% Hole Results in 27% Loss of R-Value

Optimized Enclosure System



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Air-Tight Construction

Complete Air Barriers

- Thermal Bypass
- Wind Intrusion

Insulation System

- Next Code Quantity
- Proper Installation
- Minimum Thermal Bridging

Advanced Windows

Air and Thermal Flow Control





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Zero Specifications – Optimized Enclosure System Air-Tight Construction



- 16 to 50% of HVAC Loads
- Moisture Problems
- Comfort Problems
- Indoor Air Quality

Target Home Air-Tightness



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	ACH50 Requirements/Targets				
Climate Zones	Zero Energy Ready Home Target - Detached	Zero Energy Ready Home Target – Attached*	ENERGY STAR V3	2012 & 2015 IECC	Passive House
1-2	3.0	3.0	6.0	5.0	0.6
3-4	2.5	3.0	5.0	3.0	0.6
5-7	2.0	3.0	4.0	3.0	0.6
8	1.5	3.0	3.0	3.0	0.6

* Built into REM/Rate v15.1 & EnergyGauge EGUSA5 update (expected mid-March 2016)

What We're Trying to Avoid



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Attic air infiltration into the wall

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ENERGY STAR Rater Field Checklist - Drywall Sealed at Top Plates (Item 4.5)



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Default: Spray Foam



Alternative: Sill sealer



Alternative: Constr. Adhesive





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Zero Specifications – Optimum Enclosure System Complete Air Barriers



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

Air Barrier Example: Garage Rim Joist



No air barrier is present between garage and conditioned space.



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Air barrier is present between garage and conditioned space.

Air Barrier Example: Wall Adjoining Porch Roof

Air barrier is installed prior to porch attic framing.



No air barrier between porch

attic and conditioned space.









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Zero Energy Ready Home Zero Specifications – Optimized Enclosure System Insulation System

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- Compliance with next generation code
- Three Options:
 - ✓ Prescriptive
 - ✓ Alternative equivalent U-factor
 - ✓ Total UA calculation
 - allows window to be included
- Allowances for ceilings without attic spaces

Insulation System for States with Advanced Codes



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- For homes meeting DOE Zero Energy Ready Home:
 - Achieving Version 3.1 compliance imposes little/no additional builder burden
 - HERS Target for DOE ZERH is already low enough such that homes will achieve Version 3.1 compliance by default in most/all cases
- Easy to assess compliance with Version 3.1 using Quick Compliance tool



What are Differences in 2012 and 2015 IECC Insulation Requirements?



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Changes Between the 2012 IECC and 2015 IECC

		Change		No Change			
					Changes Between the 20	12 IECC and 2 Change	No Change
	Prescriptive R-Value				Prescriptive R-Value		X
					U-Value Alternative	 Image: A second s	
					Total UA Alternative	 Image: A second s	
		Changes Between the 201	2 IECC and 2	015 IECC			
			Change	No Change			
	U-Value Alternative	Prescriptive R-Value		X			
		U-Value Alternative	~				
		Total UA Alternative	✓				
	Total UA Alternative	Changes Between the 2012 IECC and 2015 IECC					
			Change	No Change			
_		Prescriptive R-Value		X			
		U-Value Alternative	✓				
		Total UA Alternative	\checkmark				

ONLY Change in U-Value is for Above-Grade Framed Walls

No Changes to Prescriptive R-Value Requirements

Impacts of Meeting 2015 IECC UA Levels **ENERGY**

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- No additional burden for most designs
- In Climate Zones 1 5, meeting 2015 IECC via a wholebuilding UA tradeoff will be very slightly less stringent
 - Required Frame Wall U-Factor is 2 to 5% less stringent
 - Frame Walls might comprise ~ 20% 40% of total shell area...

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	CZ 2	CZ 3		
Walls	R-13 (rec. R13+5)	R-20 or R-13+5 (rec. R-13+5)		
Ceiling	R-38			
Floor	R-13	R-19		
Basement	R-0	R-5/13		
Crawl Space	R-0	R-5-13		
Slab	R-0 (rec. R-5 slab edge)			
Insulation Proper Installation

Void



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Compression

Misalignment

Insulation Thermal Bridging



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Zero Energy Ready Home Zero Specifications – Optimized Enclosure System Insulation System: High-R Walls



- Advanced Framing with Thicker Wall
- Rigid Insulation Exterior Sheathing
 - Continuous Rigid Insulation w/Sheathing
 - Continuous Rigid Insulation w/o Sheathing
 - Continuous Rigid Insulation w/Recessed Studs
- Structural Insulated Panels (SIPs)
- Insulated Concrete Forms (ICFs)
- Double Wall

Adv. Framing w/Thicker Walls

- R-17 R-21 (U 0.052-0.060)
- Higher Framing Factor (~12-15%)
- Blanket Insulation Issues:
 - R-19 is 6" thick; results in R-17 compressed in 2x6 wall
 - R-21 is 5.5" thick; results in R-21 in 2x6 Wall
- Blown-In Insulation Issues:
 - Settling
 - Proper Density (Bag Count)
- Spray Foam Issues:
 - Cost impact
 - Closed cell enhances structural
 - Need to ensure quality installation



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Rigid Insulation w/Sheathing

- R-18 Wall (U 0.054)
- Complete Thermal Break
- Exterior Condensation Surface
- Can Combine Sheathing w/ Weather Resistant Barrier
- Cladding Installation Issues
 - Fastening follow man. specs
 - Furring follow man. specs



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Rigid Insulation w/o Sheathing

- 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



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Rigid Insulation w/Recessed Studs ENERGY

- R-18 Wall "Extended Plate" Design
- 2x4 Studs with 2x6 Plates
- Sheathing Attached to Plates and Studs (longer nails)
- Complete Thermal Break Except for Top and Bottom Plates
- Condensation Surface Inside
 Assembly, so Must Control Air Flow
- Cladding Attachment simplified if permissible to nail into WSP



Structural Insulated Panels (SIPs)

- R-26 Walls (6") (U 0.034)
- Substantial Thermal Break (3 – 8% Framing Factor)
- Special Construction Practices Required
- Foundation has to be Perfectly Level
- Significantly Reduced Time-of-Construction
- Reduced Dimensional Variation
 Corrections
- "Killer Applications"





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~R-24 Walls (U 0.038)

- Complete Thermal Break
- Useful Thermal Mass
- Foundation has to be Perfectly Level
- Longer Time-of-Construction
- Maximum Disaster Resist.
- Termite Resistant
- Reduced Dimensional Variation Corrections
- Much More Costly



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Insulated Concrete Forms (ICFs)

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Double-Wall



- R-26 Walls (U ~ 0.034)
- Studs Offset or Separated to Ensure Complete Thermal Break
- Coldest Outside Sheathing Surface Suggests Plywood Rather Than OSB to Ensure Drying
 - Vapor-open designs use higherperm sheathing such as gypsum
 - Modeling needed to assure moisture control



 Uses Exact Same Framing Techniques Already Understood by Trade Partners





Zero Energy Ready Home Zero Specifications – Optimum Enclosure System Insulation System: High-R Roofs

High-R Roof Insulation at Flat



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High-R Roof Insulation at Slope



5.1 AIR-IMPERMEABLE: In direct contact with the underside of the sheathing



Minimum R-value of Impermeable Insulation

Climate Zone	Minimum Impermeable Insulation R-Value*	2012 IECC Ceiling R-Values
2B and 3B Tile Roof	None Required	30
1, 2A, 2B, 3A, 3B, 3C	R-5	38
4C	R-10	38
4A, 4B	R-15	49
5	R-20	49
6	R-25	49
7	R-30	49
8	R-35	49

*contributes but doesn't supersede 2012 IECC insulation requirements

Rigid + Air Permeable Insulation

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



Rigid foam (Impermeable) ABOVE THE ROOF SHEATHING

Roof Sheathing

Rafter

Cavity Insulation (Can be Air-Permeable)

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Zero Energy Ready Home Zero Specifications – Optimized Enclosure System

Advanced Windows

ENERGY STAR Windows

- Assures beyond-code window performance
- Fenestration used for passive solar design are exempt from the U-factor and SHGC requirements
- Area-weighted averages for U-factor, SHGC permitted





- Updated Specs



Window Specs to Apply to DOE Zero Energy Ready	Hot Climates IECC CZ 1-2		Mixed Climates IECC CZ 3-4 except Marine		Cold Climates IECC CZ 5-8 and 4 Marine	
Home Projects	U-Value	SHGC	U-value	SHGC	U-Value	SHGC
Projects permitted up to 8/31/2016	0.40	0.25	[3] 0.30 [4] 0.30	[3] 0.25 [4] 0.40	0.30 0.31 0.32	Any ≥0.35 ≥0.40
Projects permitted <i>after</i> 8/31/2016*					0.27* 0.28* 0.29*	Any* ≥0.32* ≥0.37*
*For Cold Climate Zones, the revised space are applicable to DOE Zero Energy Ready Homes permitted						

*For Cold Climate Zones, the revised specs are applicable to DOE Zero Energy Ready Homes permitted after 8/31/2016

Note that DOE Zero Energy Ready Home offers multiple compliance paths. See the National Program Requirements, Exhibit 1 with footnotes, for details.

Windows Are a Big Deal



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V	Window 15% of Vall Area	Wall R-Value with Windows w/Varied Wall Insulation Levels				
	J-Value	R-0	R-18	R-39	R-60	
	0.30	R-5	R-11	R-15	R-17	
	0.20	R-5	R-13	R-19	R-23	
	0.15	R-5	R-14.5	R-23	R-28	
	0.10	R-5.5	R-16	R-27	R-34	

Sources:

"Holes in the Wall: To Improve the Energy Performance of Walls, Look at the Total R-Value," Journal of Light Construction, February 2014; Multi-Assembly R-Value / U-Value Calculator – Cascadia Windows and Doors; Michael Blasnik Presentation, 2014 ACI Conference



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Zero Energy Ready Home Zero Specifications: **Optimized Comfort System**

Optimized Comfort System



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Quality HVAC Installation:

- High efficiency
- Properly designed and installed
- Combined with a duct system that's insulated, sealed, and balanced
- ... Maintain comfort with less energy.

Optimized Duct Systems



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Zero Energy Ready Home Zero Specifications – Optimized Comfort System Quality HVAC Installation



1. Air follows the path of least resistance.



What We Are Trying to Avoid



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Verify that the ducts are balanced, insulated, tight, and installed without major defects.



Design:

- 1. Calculate Heating/Cooling Loads
- 2. Select Equipment that Meets Loads
- 3. Design Duct System that Gets Air from Equipment to Rooms and Back

Commission:

- A. Check Airflow at Air Handler
- B. Check Refrigerant Charge
- C. Measure Airflow at Registers/Exhaust (recommended)

HVAC Designer Report <u>Rater Design</u> Review

Checklist

HVAC Commissioning Checklist



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Zero Energy Ready Home Zero Specifications – Optimized Comfort System **Optimized Duct Systems**

- Significant Thermal Losses:
 - Thermal losses triple for ducts in unconditioned vs. conditioned space

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- Total thermal losses can range from 10-45%
- Extensive unconditioned space penetrations
- Significant Performance Impacts:
 - IAQ
 - Comfort
 - Durability

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Short Duct Run

up to 10' of total length is permitted to be outside of the home's thermal and air barrier boundary.

Jump Ducts

may be located in attics if all joints, including boot-todrywall, are fully air sealed with mastic

Ductless HVAC system



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- Conditioned Floor Space [3 options] within the thermal boundary
- Unvented Crawl Space/Basement
 which is within the home's thermal boundary
- Unvented Attic

regardless of whether conditioned with a supply register

• Vented Attic [dry & humid option] equivalent option where other locations in conditioned space are impractical, expensive, don't work well in specific climates, or increase envelope loads

Ducts in Conditioned Floor Space Option 1: Dropped Ceiling





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





Ducts in Conditioned Floor Space Option 2: Modified Attic Truss





Ducts in modified truss in attic



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



Ducts in Conditioned Floor Space Option 3: Ducts Between Floors



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





Unvented Crawl Space/Basement



Ducts Outside Picture Source: Construction Instruction

Ducts Inside

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



Ducts in Unvented Attic





Ducts in unvented attic

- No Class I VR on attic floor
- Design for code-compliant thermal & ignition barriers on the SPF




Ducts in Vented Attic: Dry CZs

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Ducts in Vented Attic: Humid CZs

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Buried Encapsulated Ducts (BEDs)





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Zero Energy Ready Home Zero Specifications: Water Protection System

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Bulk Moisture

- weather resistant barriers
- flashing
- capillary breaks

Water Management Checklist



Moisture Vapor (Air Flow)

- Air Sealing
- Air Barriers
- Vapor Barriers/Retarders
- HVAC Quality Installation
- Whole-House Ventilation
- Spot Ventilation

Thermal Enclosure Checklist

HVAC Quality Installation Checklist

Basic Concept

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What We're Trying to Avoid



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Missing step & kick-out flashing

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Step and Kick-Out Flashing (3.1)

- 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.





Step & Kick-Out Flashing



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Zero Energy Ready Home Zero Specifications: Efficient Component System



Components and MEL's are increasingly larger part of total energy use in low-Load homes (~50%).



Zero Energy Ready Home requires:

- ENERGY STAR Certified Appliances:* refrigerators, dishwashers, clothes washers
- ENERGY STAR Certified Fans*: bathroom ventilation, ceiling fans
- ENERGY STAR Certified Lighting: Min. 80% of fixtures or lamps (CFL or LED)
- WaterSense Hot Water Distribution

*Only where installed by builder

Water Efficient System Context

ENERGY Energy Efficiency & Renewable Energy

Indoor Fixtures

- Plumbing Fixtures
- Appliances and Other Equipment

Distribution

- Service Pressure
- Metering (for Multi-Family Homes)
- Leak Prevention
- Hot Water Distribution
- Outdoor
 - Landscape Design
 - Irrigation (if installed)



- "Must Have" for zero net-energy ready homes
- Based on EPA WaterSense Specifications:
 - ≤ 0.5 gallons of water in any piping/manifold between hot water source and any hot water fixture.
 - ≤ 0.6 gallons of water shall be collected from the hot water fixture before hot water delivered.
 - Recirc. Systems based **ONLY** on a timer or a temp sensor not permitted

Built for when water was free and energy was cheap!

Copper L piping:

- 1" = 5.53 ounces/ft
- $\frac{3}{4}$ = 3.22 ounces/ft
- $\frac{1}{2}$ " = 1.55 ounces/ft

Fixture Fixture **Stored Volume must** Fixture Estoned: Volume: be ≤ 0.5 gallons 30'. Ggallons 10' branch 5 Wait Time: 1 – 1.5 2 9 with sowerhead Hot Water Heater Fixture



Fixture

Fixture

- Core Plumbing Layout (wet wall)
- Manifold System
- Demand Pumping System

See Jonah Schein

U.S. DEPARTMENT OF

ENERGY

EPA WaterSense

....Hot Water Distribution & Design Details that Work....

March 2 @ 3:30 pm

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Zero Energy Ready Home Zero Specifications: Comprehensive IAQ System



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ENERGY STAR + Indoor airPLUS



Why IAQ is NOT A La Carte?

- 2000 SF Home
- 8.5' Ceilings
- 3 ACH50 Air Tightness
- 200 cfm Exhaust (e.g. dryer, range hood)

- 5 Pa depressurization





Indoor Air Quality as a System



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Source Control

Practices & Product Selection That Limit Moisture, Radon, Chemicals, Combustion By-Products, Biological Contaminants

Dilution

• Filtration

HVAC Quality Installation System

Source Control: Radon Radon Zones in U.S.



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Source Control: Radon Radon Resistant Construction



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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)

Radon Test Kits Not Required

Source Control: Biological Contaminants Screened Openings for Pests



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

Source Control: Combustion By-Products Power/Direct Vent Equipment



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Power Vented Water Heater



Direct-Vent Furnace

Source Control: Combustion By-Products Certified Fireplaces & Stoves



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

Source Control: Combustion By-Products Certified CO Alarms



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CO Alarm in each bedroom area



CO Alarm



Combined CO & Smoke Alarm



Enforceable policy in Multi-family buildings



Source Control: Combustion By-Products Attached Garage Isolation

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Exhaust Fan Optional



Buildings.Energy.gov



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No Air Handler in the Garage



Picture Source: Construction Instruction

Source Control: Chemicals Low Formaldehyde Pressed Wood



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Source Control: Chemicals Low Formaldehyde Cabinets



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- Visit <u>www.kcma.org</u>
- Follow Industry Professional link to Environmental Stewardship Program

WNOBIAN AL STEWARDSHID GRA KCMA TM This cabinet is certified under the Kitchen **Cabinet Manufacturers** Association (KCMA) Environmental Stewardship Program. The program recognizes companies that demonstrate an ongoing commitment to environmental practices and sustainability.

Source Control: Chemicals Low VOC Paints

Interior paints and finishes, including 90% or more of such products applied to interior surfaces of homes, shall be certified low-VOC or no-VOC by one of the following:

- Green Seal Standard GS-11, OR
- Greenguard Certification for Paints and Coatings, OR
- Scientific Certification Systems (SCS) Standard EC-10.2-2007, Indoor Advantage Gold, OR
- Master Painters Institute (MPI) Green Performance Standards GPS-1 or GPS-2, OR
- A third-party low-emitting product list based on CA Section 01350, e.g., the CHPS List at chps.net/manual/lem_table.htm.





Source Control: Chemicals U.S. DEPARTMENT OF ENERG Low VOC Carpet, Padding, Adhesives

Carpets and carpet adhesives shall be labeled with, or **otherwise** documented as meeting, the Carpet & Rug Institute (CRI) Green Label Plus or Green Label testing program criteria. Carpet cushion (i.e., padding) shall similarly be certified to meet the CRI Green Label testing program criteria.





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Identifying Low-Emission Solutions...



 Low emission materials and products are rapidly evolving, gaining market share & recognition

- Standards, labels, certification agencies can be challenging to navigate
- To help partners identify sources and spec products, a new IAP resources 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 packaging, and/or spec sheets. For a list of KCMA certified manufacturers that produce compliant cabinets, visit: <u>http://www.kcma.org/Members/ ESP_Certified_Manufacturers</u> 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.	Sink bases), product



Three Options:

- Exhaust-Only
- Supply-Only
- Balanced

ASHRAE 62.2 2010 Continuous Ventilation Rate: [7.5 cfm * (# bedrooms + 1)] + [.01 x Sq. Ft.] 2,000 sq. ft., 3 Bedroom Home Example: [7.5 * (3+1)] + [.01 * 2,000] = [30 + 20] = 50 cfm

Meeting WHMV Requirements



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- WHMV Fan Efficiency
 - For an example home of 4 BR and 2500 SF in CZ5:
 - Qfan = 0.01*Afloor + 7.5(Nbr + 1)
 - = $0.01^{*}(2500) + 7.5^{*}(5) = 63$ cfm

CZ 1-2	CZ 3, 4 (except Marine)	CZ 4 Marine, 5-8
2.8 cfm/W	2.8 cfm/W	1.2 cfm/W
No heat exchange	No heat exchange	HX with 60% SRE

63 cfm / (1.2 cfm/W) = 53 Watts BALANCED w/ 60% SRE

Dilution: Whole-House Ventilation



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Dilution: Spot Ventilation

- Kitchen:
 - 100 CFM Intermittent
 - 5 ACH Continuous
- Bathrooms:
 - 50 CFM Intermittent
 - 20 CFM Continuous





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Filtration: High-MERV HVAC Filter



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8 MERV Filter Minimum

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Zero Energy Ready Home Zero Specifications: Solar Ready System

Zero Cost-Effectiveness

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Source: SEIA / GTM Research



More than half of all U.S. homebuilders

are expected to offer solar PV energy systems as an option in new single-family homes by 2016, up from just 12 percent in 2013.

Source:

Green Multifamily and Singe Family Homes: Growth in a Recovering Market, McGraw Hill, NAHB, 2014

RERH Applicability



Average Daily Solar Radiation Per Month



Screen for RERH Applicability



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Renewable Energy Ready Checklists

- Determine applicability by zip code
- <u>http://gisatnrel.nrel.gov/PVWatts_Viewer/index.html</u>
- In this Mid-Atlantic example, solar resources = 4.8 kWh/m²/day



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Not required in areas lacking access to significant solar resources:

- Tree Shading
- Tall Buildings
- Available South Facing Roof



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



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Zero Energy Ready Home Zero Specifications: **Summary**

Technical Specifications...

- How Heavy is the Lift?



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• ENERGY STAR Certified Homes v3

- Advanced Windows
- Air-Tight Construction
- 2012/15 IECC Insulation
- Energy Efficient Components
- Efficient Hot Water Distribution
- Optimized Duct System
- Indoor Air Quality (passive radon mitigation)
- Renewable Ready Construction (PV-Ready ONLY)
- Efficiency Threshold (HERS Index)



Thank You



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See Tech Specs Made Simple – Part 2

Robby Schwarz, Energy Logic

March 2 @ 1:30 pm



Resources:

www.buildings.energy.gov/zero/

- Specs
- Tech Training Webinars
- Marketing Toolkit
- DOE Tour of Zero

Contact: zero@newportpartnersllc.com

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