MITSUBISHI ELECTRIC TRANE HVAC US

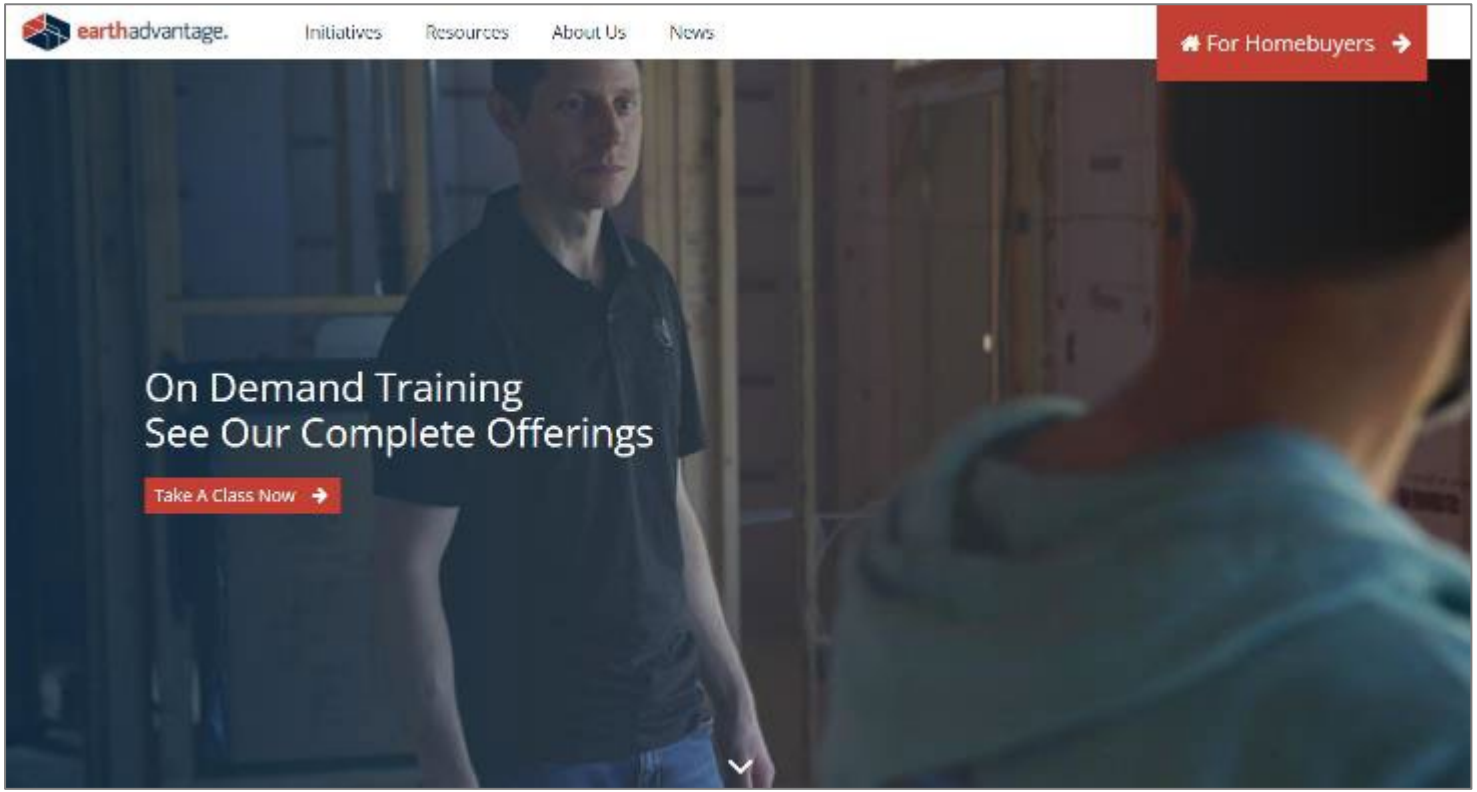
Oregon Residential Specialty Code 2021

Cost Effective Pathways for HVAC Compliance

Greg Davenport – Performance Construction Manager, Pacific NW

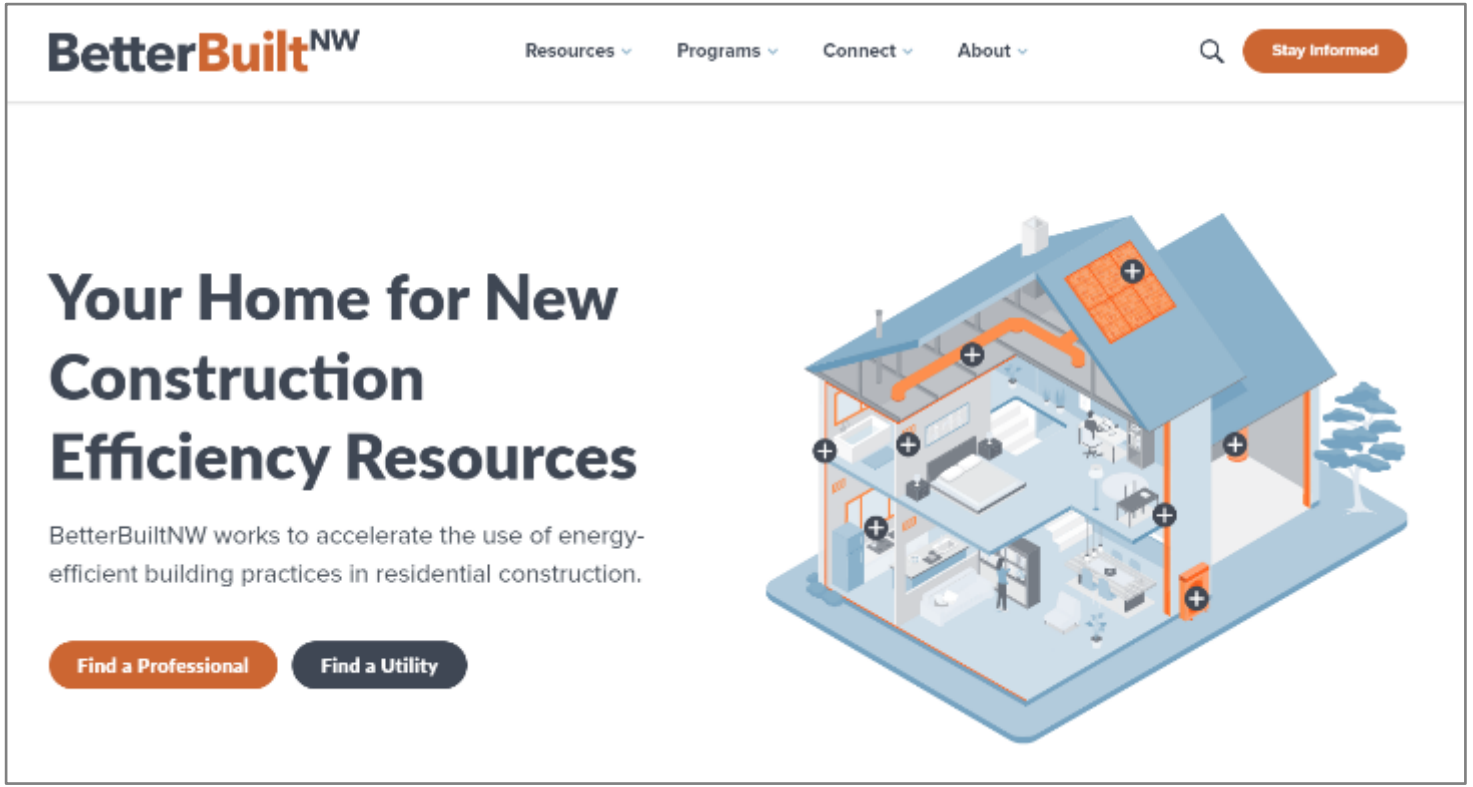
December 3, 2021

Earth Advantage Training



www.earthadvantage.org

Find Energy Raters & Incentive Programs



www.BetterBuiltNW.com

OR Energy Code – Additional Resources

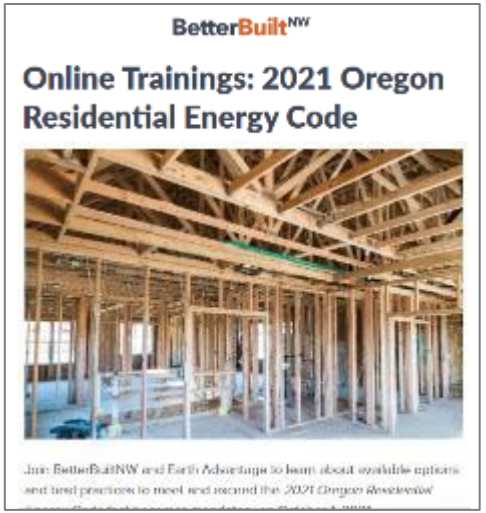
NEEA Fact Sheet:

Download here: www.earthadvantage.org/resources/publications.html

OR Energy Code – Additional Training

BetterBuiltNW
On-Demand Trainings (1-3 hours)

- *Top 10 Best Practices for Today's Homebuilder*
- *Building with Ducts Inside Conditioned Spaces*
- *On The Level Series*
  betterbuiltnw.com/resources/online-trainings-2021-oregon-residential-energy-code



Oregon Building Code Division
On-Demand Training Video (35 mins)

- *2021 ORSC Energy Code Update*
  https://www.youtube.com/watch?v=wPXewV2y-94

CE Credits available through Earth Advantage

- Oregon State CCB
- AIA LU/HSW
- ICC

A link to submit your request for CEs will be provided at end of the session.

GoToWebinar tracks attendance. In order to receive CE credit, attendees must attend the full hour presentation ending at 1PM.

Optional Q&A may extend beyond 1PM and isn't required in order to earn CEs.

MITSUBISHI ELECTRIC TRANE HVAC US

Greg Davenport

Performance Construction Manager, Pacific NW

Disclaimer

Greg Davenport and Mitsubishi Electric Trane HVAC US LLC assume no responsibility or liability for any errors, misrepresentations, misinterpretations or omissions in the content of this presentation. The information is provided with no guarantees of completeness, accuracy, usefulness or timeliness.

Attendees are encouraged to consult with state and local building and code officials and review the ORSC which can be found here:

https://www.oregon.gov/bcd/codes-stand/Pages/index.aspx

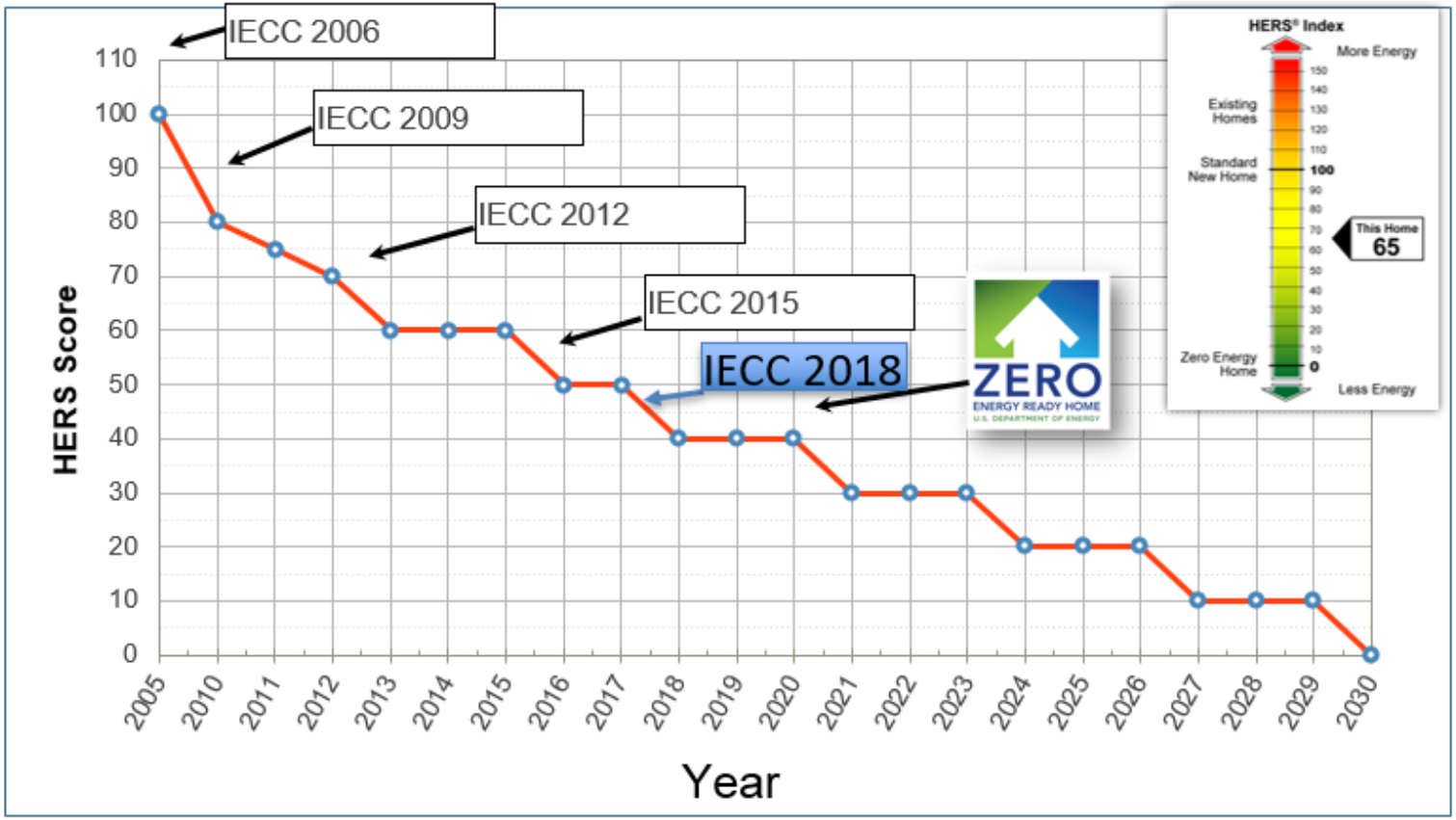
2021 Oregon Residential Specialty Code (ORSC)

Effective April 1, 2021

Based on the 2018 International Residential Code

Mandatory date for implementation: October 1, 2021

New 2021 ORSC Energy Use



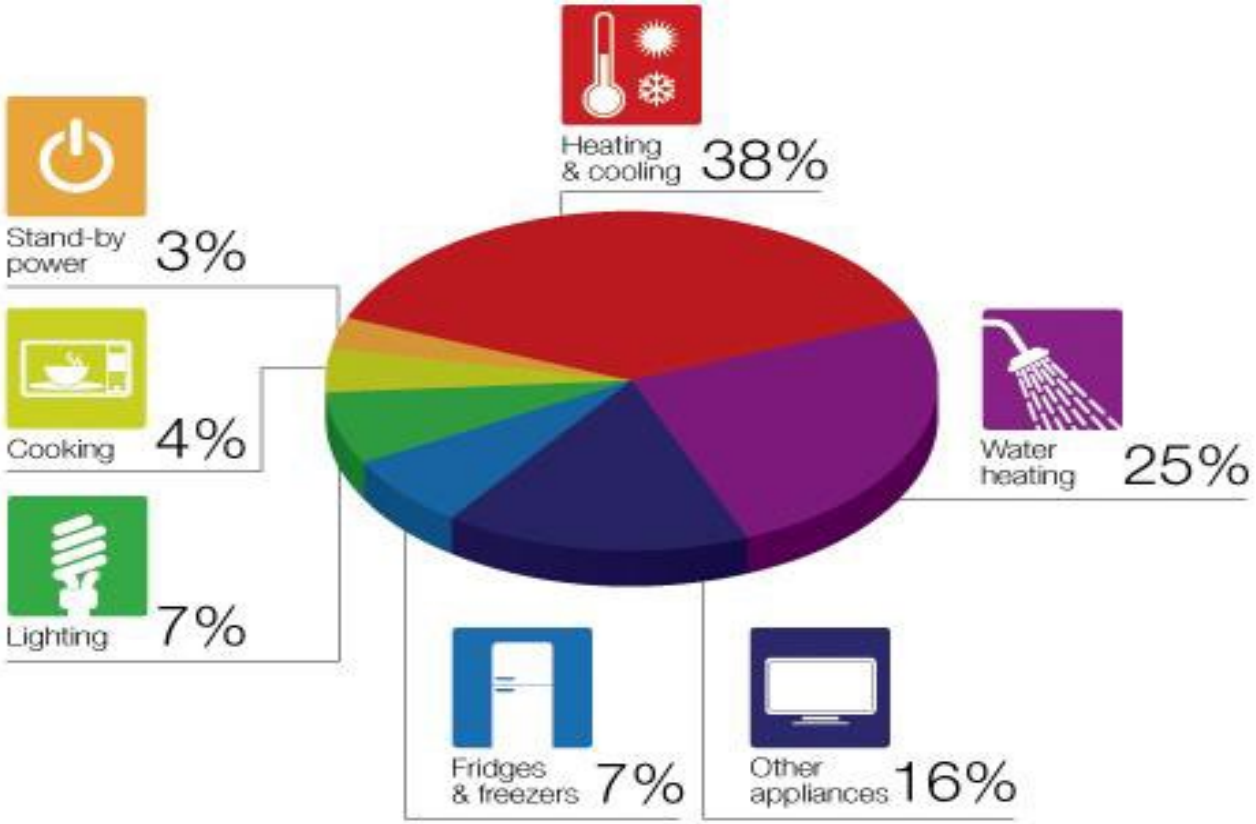
RNC Heating and Cooling Loads

Variable Capacity Heat Pumps (VCHP) offer energy efficient solutions for every home

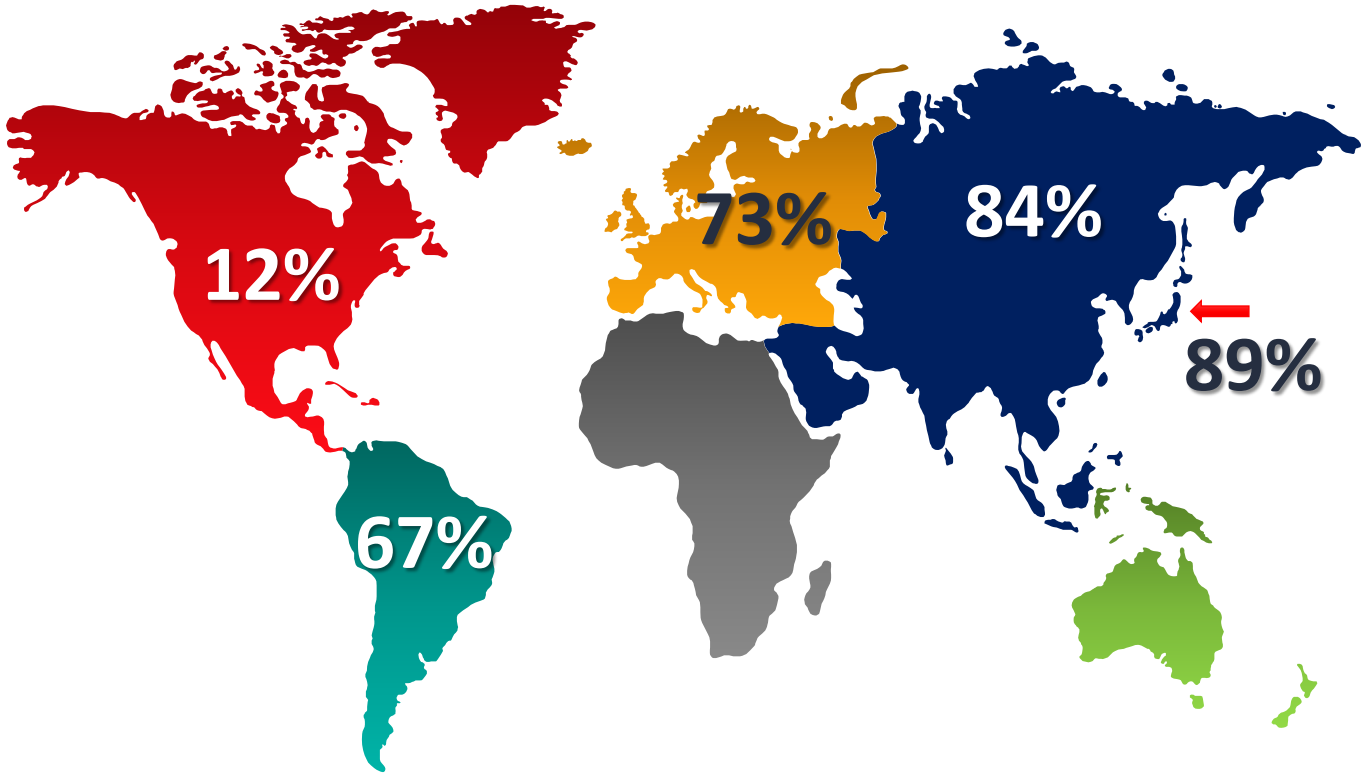
Home size (sq ft)	2006 IECC Heating (Btu)	2018 IECC Heating (Btu)	DOE Zero Energy Ready Heating (Btu)	Passive Heating (Btu)	Passive Cooling (Btu)
500	14,000	10,000	9,000	5,500	6,000
1,000	28,000	20,000	18,000	11,000	12,000
1,500	42,000	30,000	27,000	16,500	18,000
2,000	56,000	40,000	36,000	22,000	24,000
2,500	70,000	50,000	45,000	27,500	30,000

Approximate heating loads for 25F Winter (95F Summer)

Home Energy Use



Variable Capacity Heat Pump Adoption



Cold climate heat pumps can heat homes efficiently down to -15F design temp with little or no supplemental heat

Recent extreme weather events have made cooling essential for comfort and safety

VCRF … can eliminate ductwork when properly designed

2021 ORSC

TABLE N1101.1(2) – ADDITIONAL MEASURES		
☐	1	**HIGH-EFFICIENCY HVAC SYSTEM[a]** a. Gas-fired furnace or boiler AFUE 94 percent, or b. Air-source heat pump HSPF 10.0/14.0 SEER cooling, or c. Ground-source heat pump COP 3.5 or Energy Star rated
☐	2	**HIGH-EFFICIENCY WATER HEATING SYSTEM** a. Natural gas/propane water heater with minimum UEF 0.90, or b. Electric heat pump water heater with minimum 2.0 COP, or c. Natural gas/propane tankless/instantaneous heater with minimum 0.80 UEF and Drain Water Heat Recovery Unit installed on minimum of one shower/tub-shower
☐	3	**WALL INSULATION UPGRADE** Exterior walls—U-0.045/R-21 conventional framing with R-5.0 continuous insulation
☐	4	**ADVANCED ENVELOPE** Windows—U-0.21 (Area weighted average), and Flat ceiling[b]—U-0.017/R-60, and Framed floors—U-0.026/R-38 or slab edge insulation to F-0.48 or less (R-10 for 48"; R-15 for 36" or R-5 fully insulated slab)
☐	5	**DUCTLESS HEAT PUMP** For dwelling units with all-electric heat, provide: Ductless heat pump of minimum HSPF 10 in primary zone replaces zonal electric heat sources, and programmable thermostat for all heaters in bedrooms
☐	6	**HIGH EFFICIENCY THERMAL ENVELOPE UA[c]** Proposed UA is 8 percent lower than the code UA
☐	7	**GLAZING AREA** Glazing area, measured as the total of framed openings is less than 12 percent of conditioned floor area
☐	8	**3 ACH AIR LEAKAGE CONTROL AND EFFICIENT VENTILATION** Achieve a maximum of 3.0 ACH50 whole-house air leakage when third-party tested and provide a whole-house ventilation system including heat recovery with a minimum sensible heat recovery efficiency of not less than 66 percent.

Balanced Ventilation in Oregon

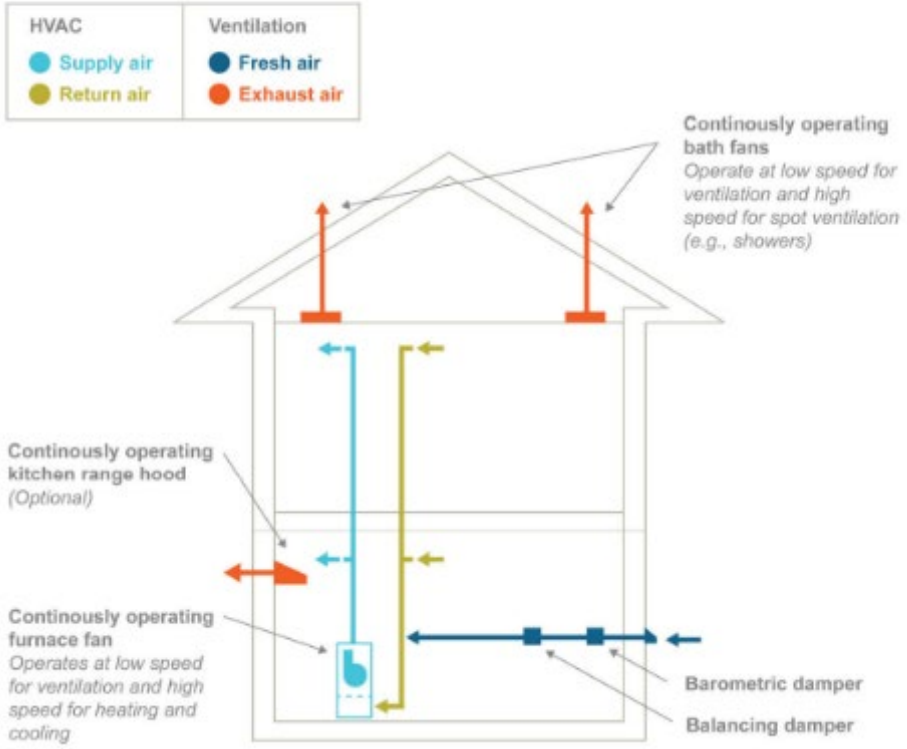
Supply fans and exhaust fans with interlocked controls

Spot HRV/ERV that meet ASHRAE 62.2 minimum fresh air requirements – may need >1 for large homes

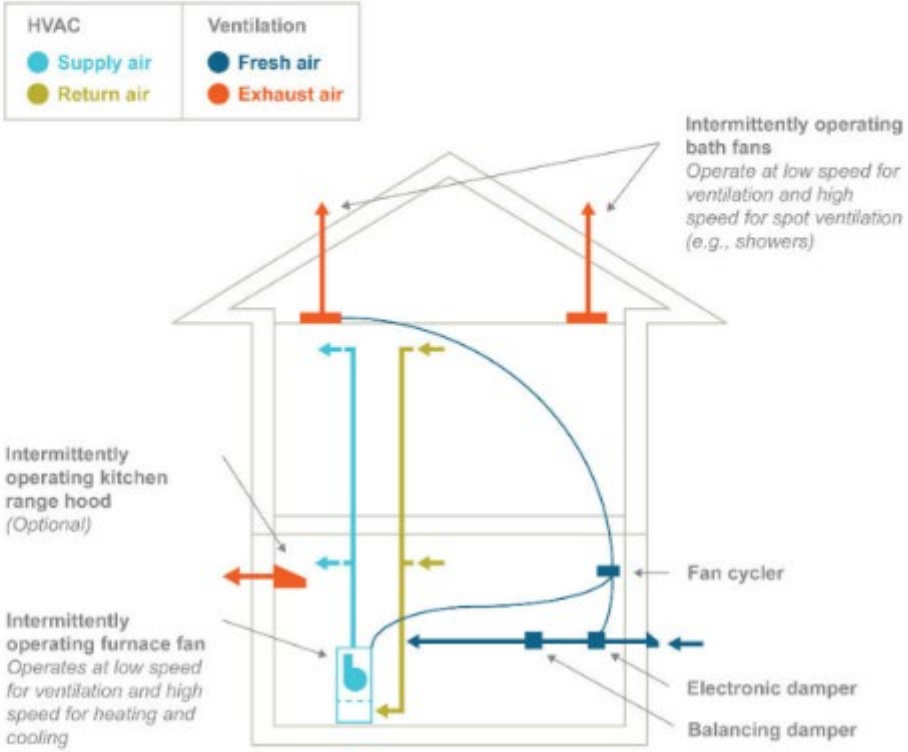
Ducted HRV/ERV combined with central air handler

Ducted HRV/ERV with separate ductwork

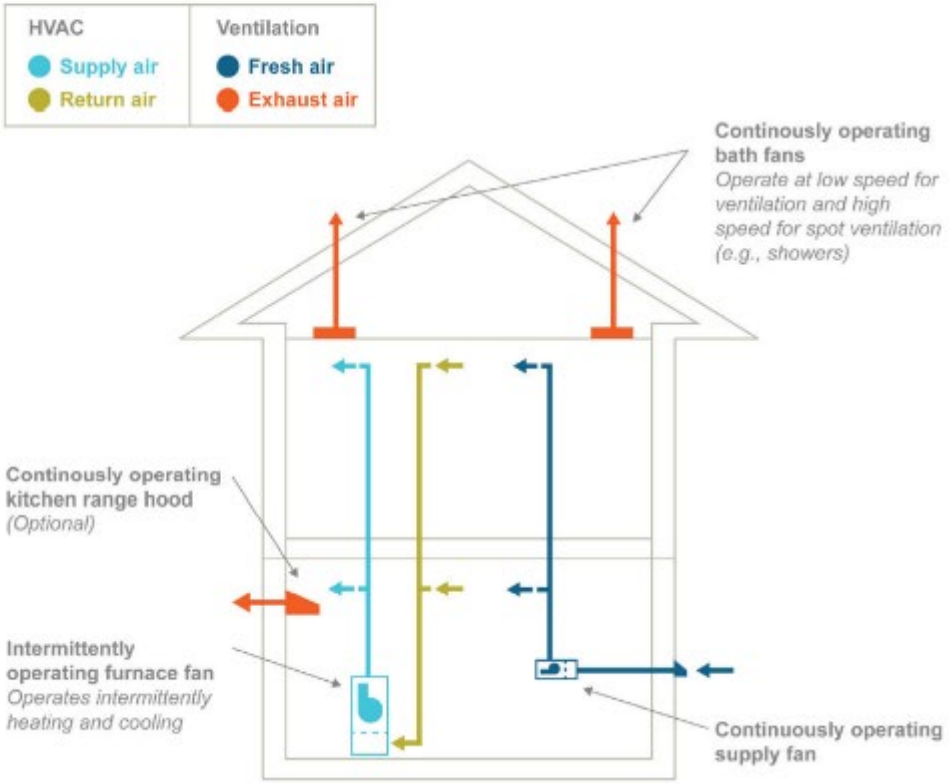
Traditional approach – Combine exhaust only with supply only



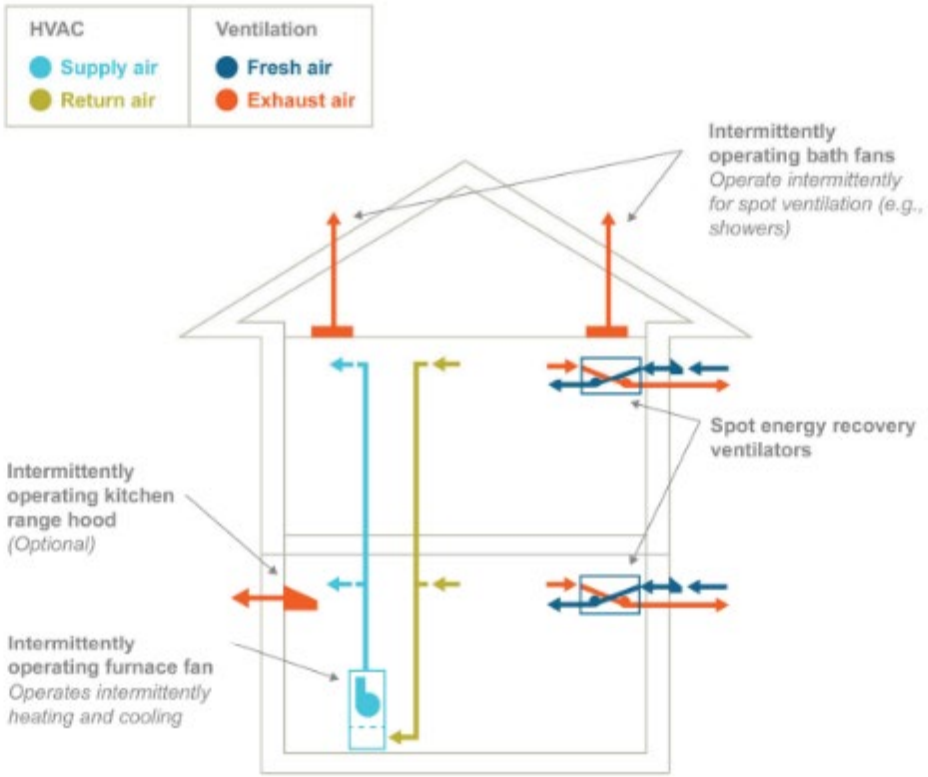
Traditional approach – Combine exhaust only with supply only (intermittent design)



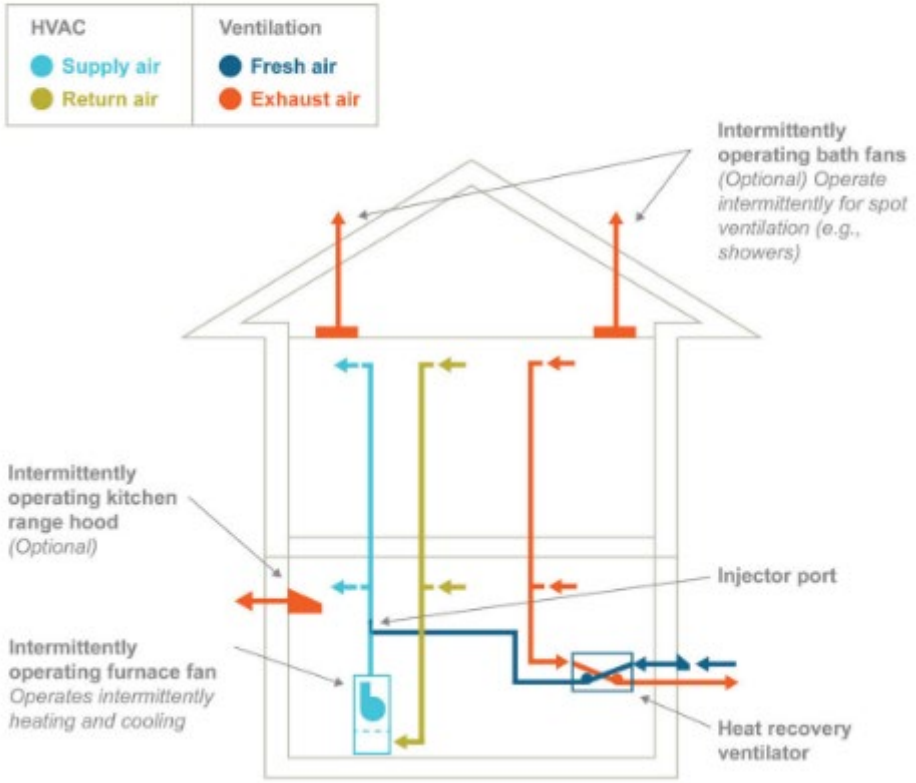
Two fan balanced strategy



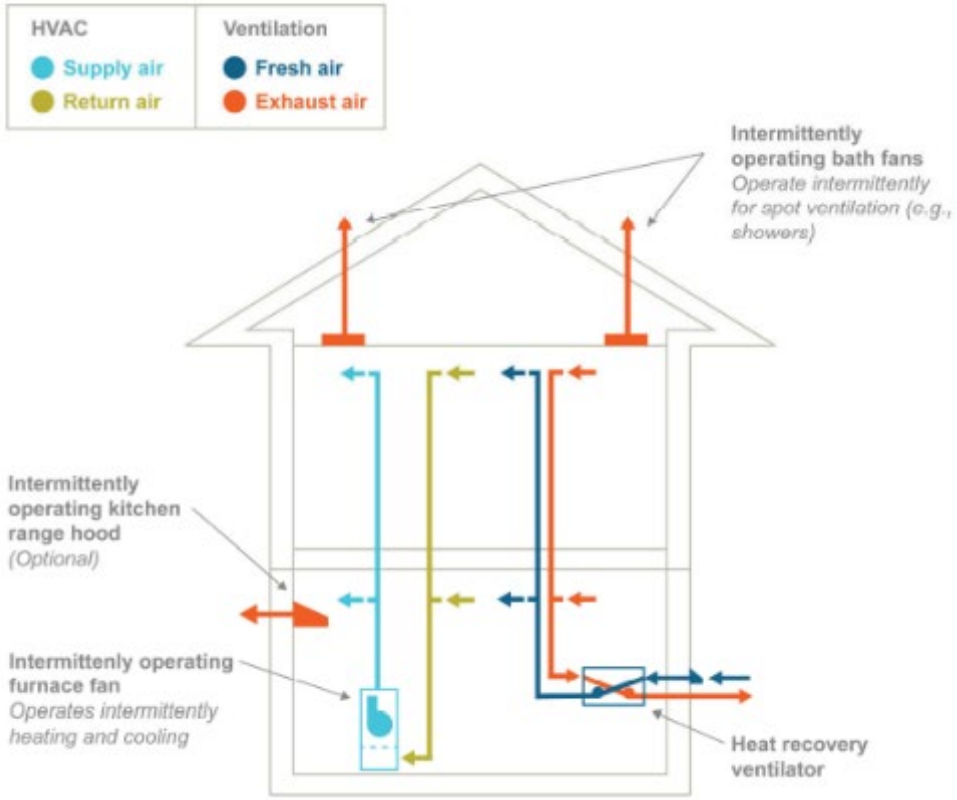
Spot ERVs – normally provide 100 CFM or less



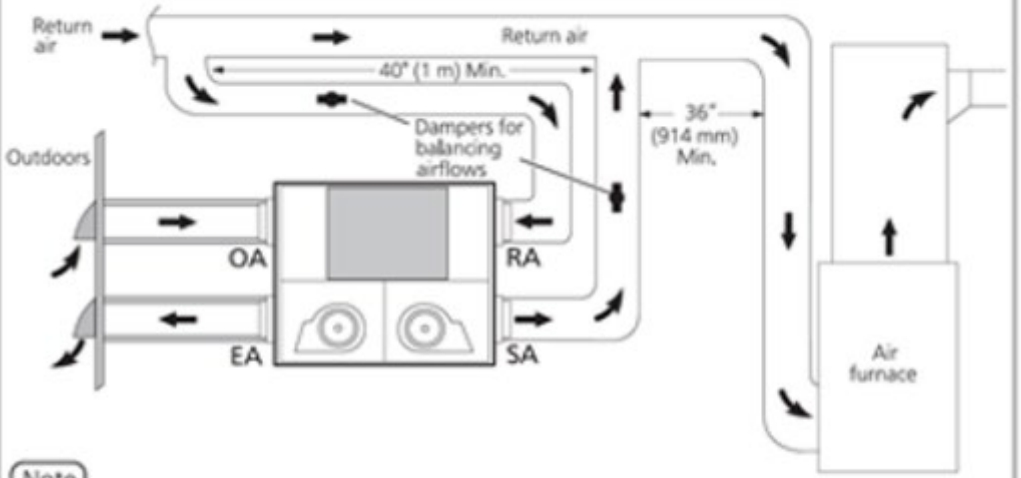
Balanced – Integrated heat recovery ventilator



Balanced – Standalone HRV



DUCTWORK



Note

(1)Recommended straight run before elbow is more than 2 ft (610 mm).
(2)Unit is normally balanced on high speed with the furnace blower on.
(3)A minimum separation of 40 inches (1 m) is recommended between the two direct connections.
(4)The exhaust air connection shall be upstream of the supply air connection to prevent exhausting any fresh air.
(5)The distance between two outdoor hoods please see P.12.
(6)The airflow must be confirmed on site using the balancing procedures found in P.14.

Fig.8

Heat Pump Hot Water Heaters

Pathway for extra energy credit under ORSC

Northwest Energy Efficiency Alliance (NEEA):
Domestic hot water equals ~18% of home energy use

60% energy savings over standard electric hot water system

NEEA: ~$350 savings per year and $3,500 lifetime compared to standard electric hot water system

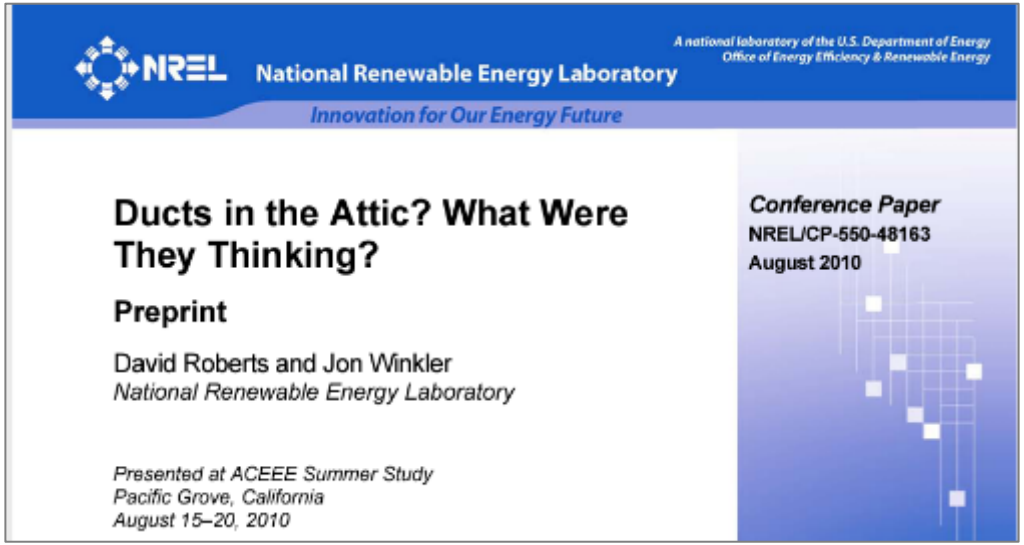
May need ducting kit if used in conditioned space

100% electric, may qualify for utility rebates

2021 ORSC

Ducts: inside conditioned space or deeply buried

Exceptions
- 5% of HVAC system can be outside conditioned space
- insulated/air-sealed mechanical room
- conditioned crawlspace or attic



NREL National Renewable Energy Laboratory

A national laboratory of the U.S. Department of Energy
Office of Energy Efficiency & Renewable Energy

Innovation for Our Energy Future

Ducts in the Attic? What Were They Thinking?

Preprint

David Roberts and Jon Winkler
National Renewable Energy Laboratory

Presented at ACEEE Summer Study
Pacific Grove, California
August 15–20, 2010

Conference Paper
NREL/CP-550-48163
August 2010

Table 3. Savings Due to Moving Ducts Inside Living Space

	Houston	Phoenix	Las Vegas
Reduction in Required A/C Capacity	24%	24%	23%
Reduction in Annual Cooling Electricity Usage	17%	16%	14%
Reduction in Peak Cooling Demand	22%	23%	22%

- Poorly insulated ducts can result in thermal losses of 10-45% of total space conditioning energy use
- US DOE Building America:
  properly installed buried ducts can reduce thermal losses to 3% or less

https://basc.pnnl.gov/case-studies/building-america-top-innovations-2013-profile-buried-and-encapsulated-ducts

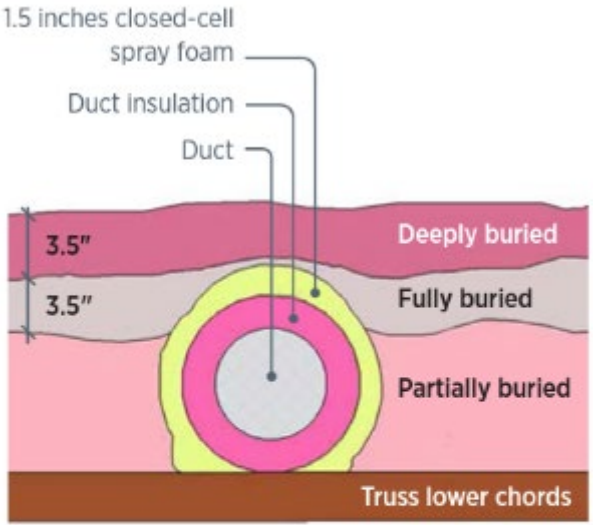
Ducts Inside Pros and Cons

Pros	Cons
Lowers heating/cooling loads ~10-20%	Many HVAC contractors not familiar with good ducts inside strategies
Lower loads may mean smaller, less expensive HVAC systems	May result in framing adjustments, such as open web trusses
May improve comfort	
Smaller, efficient ductwork easier/less expensive to install	
Lower energy bills for homeowner	

Ducts Inside Conditioned Space vs. Buried Ductwork

Inside Conditioned Space	Buried Ducts
~25% more efficient than buried ductwork	Simple transition for many builders/HVAC contractors
Lower risk of condensation issues	Risk of condensation on ductwork – varies by climate
May be more expensive/complex than buried ductwork	Work in attic has risk of damaging ductwork

Buried, unencapsulated ducts should not be installed in moist or marine climates because there is a risk of condensation on the surface of the ductwork; however, CARB research has shown encapsulating ductwork with an adequate amount of closed-cell spray foam prior to covering with blown insulation will prevent condensation.



Building America research shows encapsulating the ducts in spray foam before covering with loose-fill insulation provides adequate protection against condensation making this low-cost, high-performance method appropriate for every climate zone.

Insulation & Installation of Ducts

CHANGE SUMMARY: R-8 insulation required and “ducts inside” with exceptions.

N1105.2 Insulation of ducts. All new duct systems or new portions of duct systems exposed to unconditioned spaces, and buried ductwork within insulation that meets the exception to Section N1105.3, shall be insulated to minimum R-8.

Exceptions:

1. The replacement or addition of a furnace, air conditioner or heat pump shall not require existing ducts to be insulated to current code.
2. Exhaust and intake ductwork.

N1105.3 Installation of ducts. All new duct systems and air handling equipment and appliances shall be located fully within the building thermal envelope.

Exceptions:

1. Ventilation intake ductwork and exhaust ductwork.
2. Up to 5 percent of the length of an HVAC system ductwork shall be permitted to be located outside of the thermal envelope.
3. Ducts deeply buried in insulation in accordance all of the following:
   - 3.1. Insulation shall be installed to fill gaps and voids between the duct and the ceiling, and a minimum of R-19 insulation shall be installed above the duct between the duct and unconditioned attic.
   - 3.2. Insulation depth marker flags shall be installed on the ducts every 10 feet (3048 mm) or as *approved* by the *building official*.

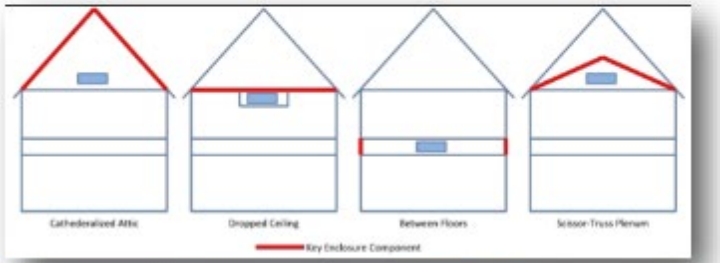
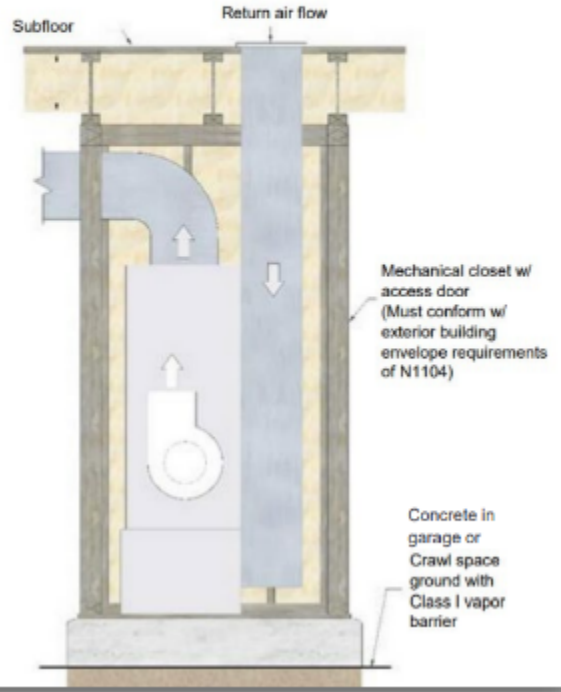


Image courtesy of Home Innovation Research Labs.

Insulation & Installation of Ducts (Thermal Envelope)

CHANGE SUMMARY: Air handler may be installed inside conditioned space via construction of a mechanical closet, whether in the garage, crawl space, or other location.

Figure 4: For buried ducts to be considered inside conditioned space, the air handler must be installed inside conditioned space. This practice typically requires constructing a mechanical closet below the floor plane.

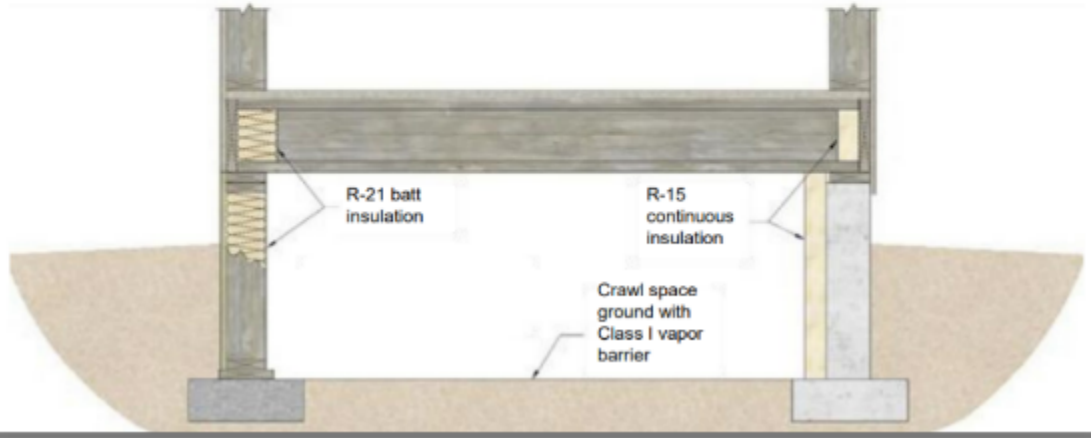


Insulation & Installation of Ducts (Thermal Envelope)

CHANGE SUMMARY: Under-floor (crawl) space can become part of the thermal envelope with either R-21 cavity or R-15 continuous insulation.

When installing ducts in an under-floor space, there are a few options to prescriptively meet the ductwork requirements including the deeply buried exception.

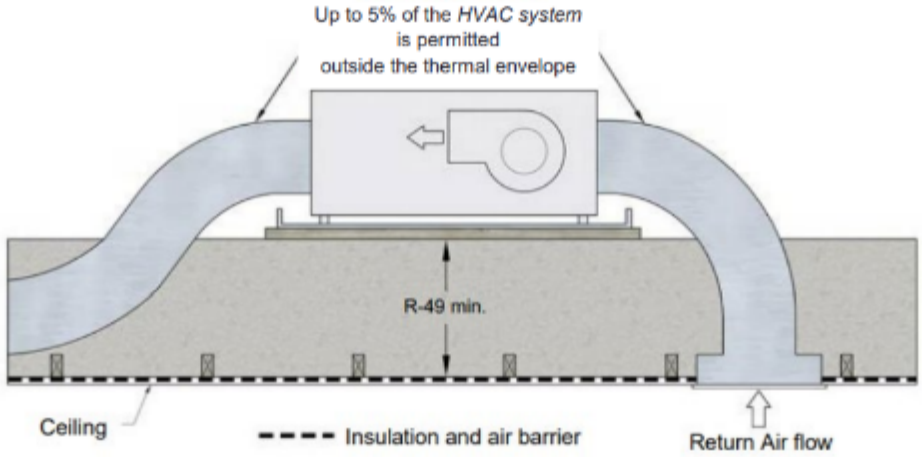
Figure 1: The most straightforward of these options is to make the under-floor space part of the thermal envelope.



Insulation & Installation of Ducts (Attic)

CHANGE SUMMARY: Up to 5% of the length of an HVAC system* shall be permitted to be located outside of the thermal envelope.

Figure 6: Up to 5% of the length of an HVAC system ductwork shall be permitted to be located *outside of the thermal envelope.*

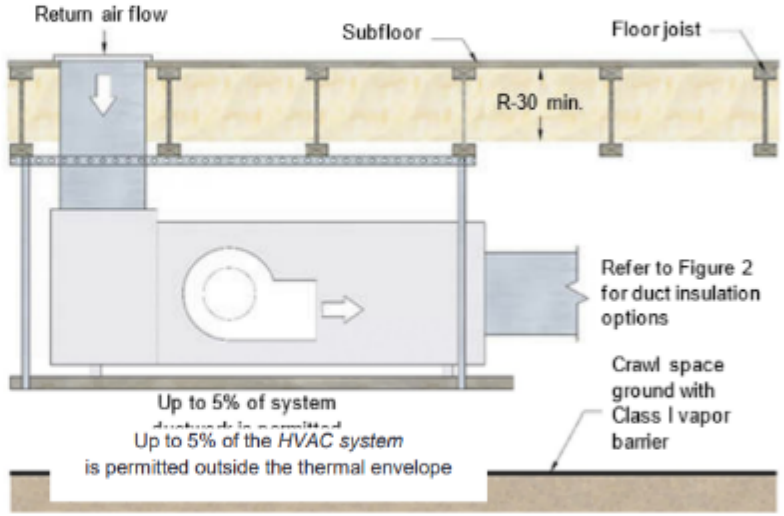


- **HVAC System:** Refers to the equipment, distribution network and terminals that provide either collectively or individually the processes of heating, ventilating and/or air-conditioning processes to a building. (*Errata forthcoming)

Insulation & Installation of Ducts (Crawl)

CHANGE SUMMARY: Up to 5% of the length of an HVAC system* shall be permitted to be located outside of the thermal envelope.

Figure 3: For air handlers installed in under-floor spaces, up to 5% of the total system length (inclusive of both the ducts and air handling equipment) may be outside the thermal envelope. Access for maintenance and proper function of the equipment must be available.

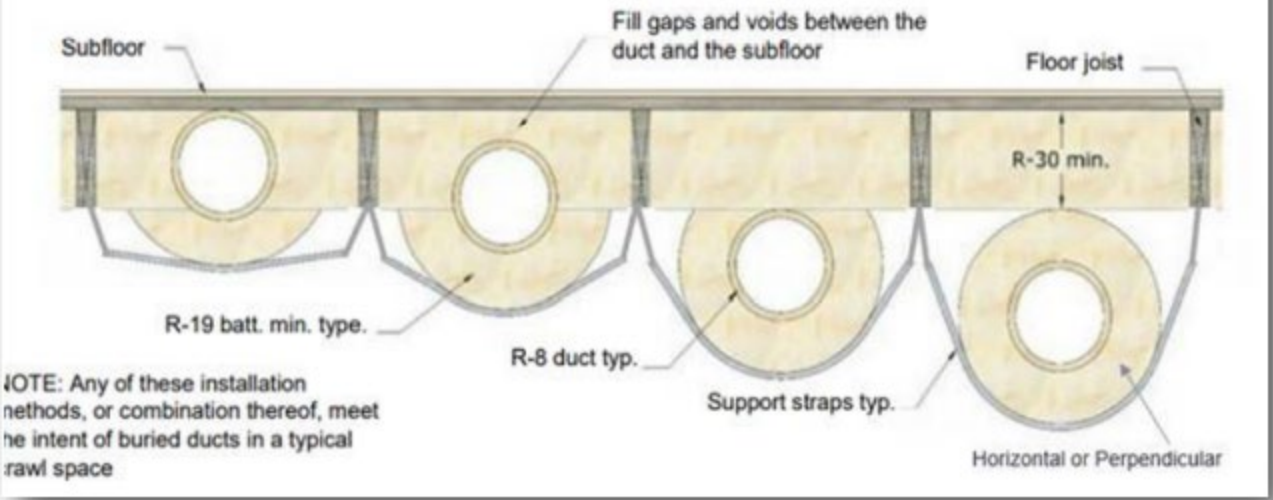


- **HVAC System:** Refers to the equipment, distribution network and terminals that provide either collectively or individually the processes of heating, ventilating and/or air-conditioning processes to a building. (*Errata forthcoming)

Insulation & Installation of Ducts (Crawl)

CHANGE SUMMARY: R-19 Batt insulation may be used around the R-8 to achieve the 'buried duct' requirement.

Figure 2: When in an under-floor space batt insulation may be used to achieve the R-19 insulation level around entire surface area of the duct not in contact with the required R-30 floor insulation. Floor insulation shall be installed to fill any gaps and voids between the duct and the floor. Depth marker flags are not required as long as the additional batt insulation is clearly marked as R-19 and there is little to no evident compression of the batt by support straps or other material.



Western OR market Winter design temps >25F		Eastern OR market Winter design temps 0-25F	
System	HSPF IV	System	HSPF IV
SUZ/SVZ 12 K BTU	12.1	SUZ/SVZ H2i 12 K BTU	10.2
SUZ/SVZ 18 K BTU	12.6	SUZ/SVZ H2i 18 K BTU	10.4
SUZ/SVZ 24 K BTU	10.4	SUZ/SVZ H2i 24 K BTU	9.2
SUZ/SVZ 30 K BTU	13.6	SUZ/SVZ H2i 30 K BTU	9
SUZ/SVZ 36 K BTU	11.7	SUZ/SVZ H2i 36 K BTU	9
SUZ/SVZ 42 K BTU	9.3	PUZ/PVA H2i 24 K BTU	10.4
PUMY/PVFY 48 K BTU *	11	PUZ/PVA H2i 30 K BTU	9.8
		PUZ/PVA H2i 36 K BTU	11.2
		PUZ/PVA H2i 42 K BTU	10
		PUMY/PVFY H2i 48 *	11

HSPF's accurate as of 8/13/2021. Equipment does change from time to time. Please confirm HSPFs on submittal documents.

* = not climate zone IV


OPEN HOUSE
NOYES
OPEN HOUSE

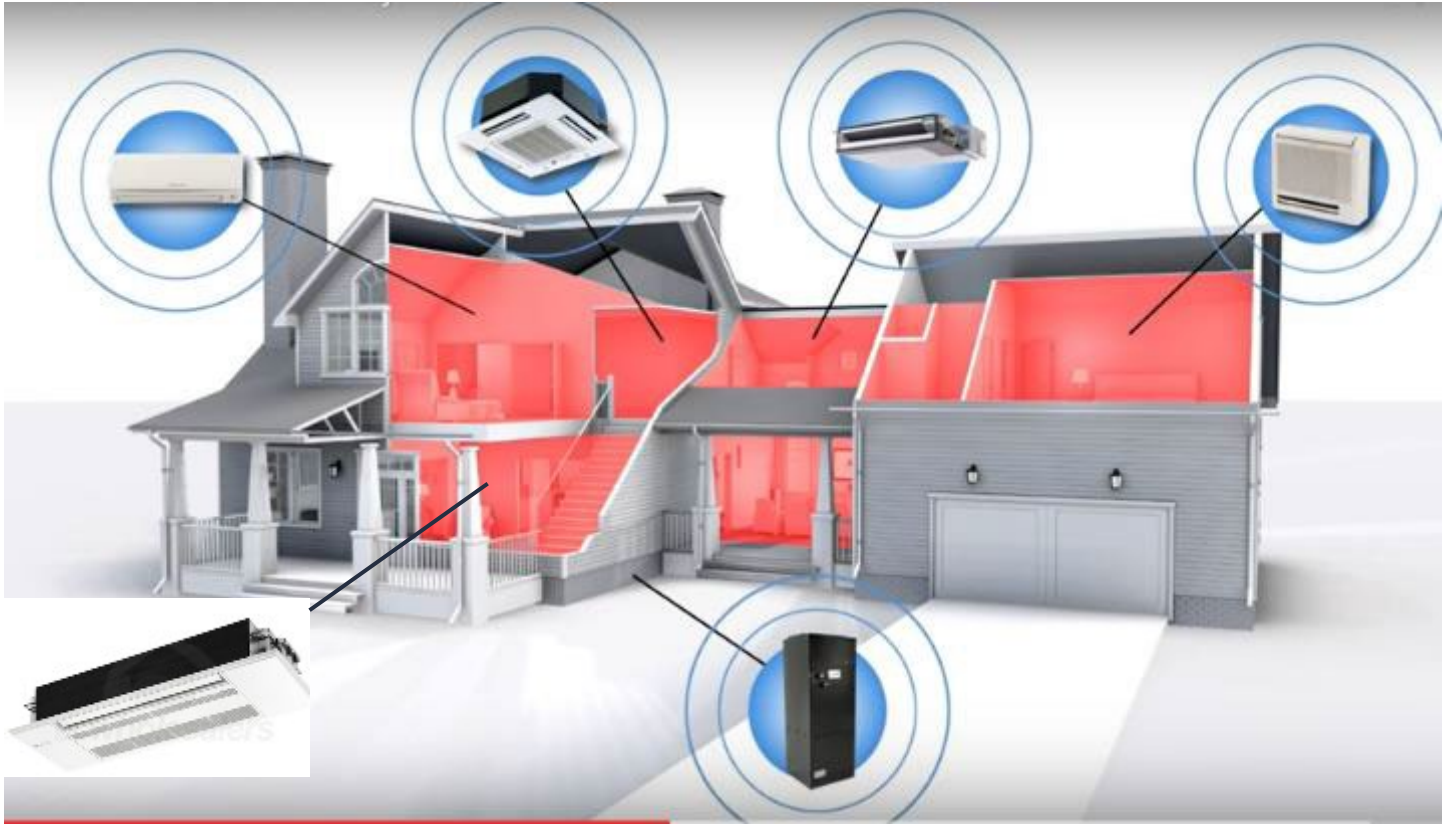
Provides all heating
and cooling

High-efficiency
variable capacity heat pump

Nearly all electric home
Nearly net zero


APA

Design Flexibility



	Standard			H2i		
	all ductless	**mixed**	**all ducted**	**all ductless**	**mixed**	**all ducted**
MXZ 2C20	10 HSPF	9.65 HSPF	9.3 HSPF	9.8 HSPF	9.65 HSPF	9.5 HSPF
MXZ 3C24	9.8 HSPF	9.5 HSPF	9.2 HSPF	10 HSPF	9.5 HSPF	9.0 HSPF
MXZ 3C30	10.6 HSPF	10.1 HSPF	9.2 HSPF	11 HSPF	10.4 HSPF	9.8 HSPF
MXZ 4C36	11 HSPF	10.4 HSPF	9.6 HSPF	11.3 HSPF	11.1 HSPF	11 HSPF
MXZ 5C42	10 .3 HSPF	9.7 HSPF	9.1 HSPF	11 HSPF	10.8 HSPF	10.6 HSPF
MXZ 8C48	11.5 HSPF	10.8 HSPF	10.1 HSPF	11.5 HSPF	10.8 HSPF	10.1 HSPF
MXZ 8C60	10.5 HSPF	10.25 HSPF	10 HSPF			

All HSPF numbers taken from current submittals. HSPF can change from time to time. Please verify all HSPF numbers with current submittals

Slim Duct Systems Reduce Ductwork

Size: 37 x 29 x 9 7/8 inches

Bottom return or rear return air – can add fresh air on return side

Variable speed fan – up to .6 static pressure

Capacity 9, 12, 15, 18, 24, 30, 36, and 42 K Btu (larger sizes have slightly larger dimensions)

Can be attached to single zone or multi-zone ODUs

Hybrid Ductless and Ducted VCHP Systems Reduce Ductwork and Make Ducts Inside C Space Much E

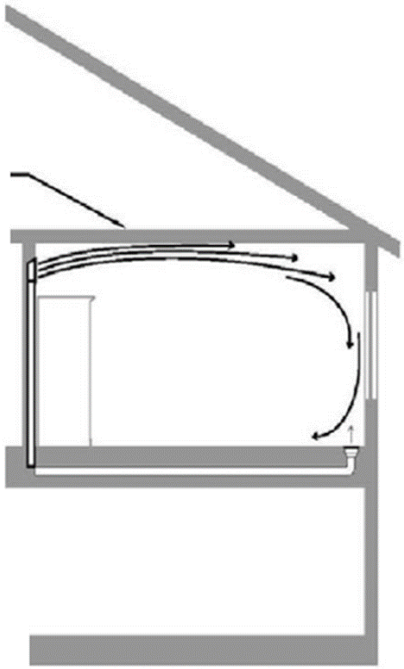
$?

Tacoma/Pierce County Habitat for Humanity®

Compact Duct Design

Compact duct design

compact register design directs airflow to hug the ceiling plane



compact

traditional

Habitat Tacoma Horizontal Ducted Version 2.0

Small trunk line in soffit ceiling with Unico small duct terminations

Habitat Tacoma Horizontal Ducted Version 3.0

Ducts inside conditioned space

Smart compact duct systems

Horizontal Ducted Systems with Smart Compact Duct Design

- Design temperatures 7/90
- Cold climate heat pump
- Supplemental heat not required

1,000sf 3-bed rambler

15k Btu cold climate heat pump

Ducts inside conditioned space

Smart duct system,
~45 feet total duct length

Horizontal ducted system
with bottom return

Horizontal Ducted in Truss Tunnel

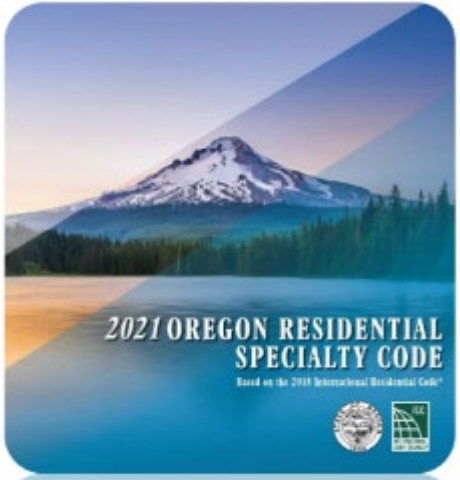
Design temps 9/92

Cold climate heat pump, supplemental heat not required

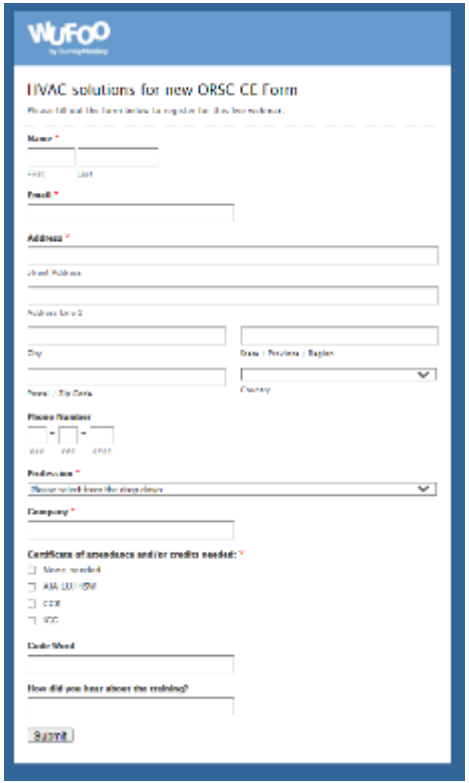
2021 ORSC

Additional Resources:

Division website - Oregon.gov/bcd
Technical questions - BCD.PTSPtech@oregon.gov
Program contacts - Oregon.gov/bcd/Pages/contact-us.aspx
Residential Structures Program - Oregon.gov/bcd/codes-stand/Pages/residential-structures.aspx



To receive Continuing Education (CE) credits, please submit the form at this link:



https://eai.wufoo.com/forms/hvac-solutions-for-new-orsc-ce-form/

Questions?

Greg Davenport
Performance Construction Team
gdavenport@hvac.mea.com
206-719-2448