

U.S. DEPARTMENT OF
ENERGY

Office of
**ENERGY EFFICIENCY &
RENEWABLE ENERGY**

63 and Me: What Have We Learned From the Field Studies in the Northwest Region?

National Energy Codes Conference Seminar Series

Building Technologies Office

Fall 2020



NECC Seminar Series Lineup

Catch the entire lineup of sessions weekly—Thursdays @ 1p ET:

- 10/01: Kickoff to the Series
- 10/08: Electronic Permitting
- 10/15: HVAC for Low-Load Homes
- 10/22: Performance-Based Compliance
- 10/29: 2021 IECC Commercial
- 11/05: Remote and Virtual Inspections
- 11/12: New for ASHRAE Standard 90.1
- 11/19: 2021 IECC Residential
- 11/24: Energy Codes Around the World
- 12/03: Advanced Technology and Codes
- 12/10: Policies for EE + Resilience
- 12/17: Field Studies in the NW Region

> **Learn more:** energycodes.gov/2020-building-energy-code-webinar-series

63 and Me: What Have We Learned From the Field Studies in the Northwest Region?



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Cornerstone Integrated Industries



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TRC



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CLEAResult

DOE Field Studies

For more information on DOE Energy Efficiency Field Studies, visit:

<https://www.energycodes.gov/compliance/energy-code-field-studies>

The screenshot shows the DOE Building Energy Codes Program website. The header includes the U.S. Department of Energy logo and navigation links for EERE Home, Programs & Offices, and Consumer Information. The main navigation bar features 'HOME', 'EVENTS', and 'ABOUT'. A search bar for 'Building Energy Codes' is present. The breadcrumb trail reads 'DOE » EERE » BTO » BECP » Compliance'. The left sidebar lists categories: DEVELOPMENT, ADOPTION, COMPLIANCE (with sub-items: BASICS, FIELD STUDIES, SOFTWARE & WEB TOOLS), and RESOURCE CENTER. The main content area is titled 'Energy Efficiency Field Studies' and includes a description of the program's research methods. Below this, there are tabs for 'Residential' and 'Commercial'. The 'Residential' tab is active, showing a section for 'Single-family Residential Buildings' with a list of study highlights.

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

EERE Home | Programs & Offices | Consumer Information

Building Energy Codes Program

Building Energy Codes

HOME | EVENTS | ABOUT

DOE » EERE » BTO » BECP » Compliance

Site Map | Printable Version | SHARE

Energy Efficiency Field Studies

The U.S. Department of Energy (DOE) Building Energy Codes Program has developed research methods to support states in studying the impacts of their building energy codes. The objectives of the studies is to document typical design and construction practices, target areas for improvement through workforce education & training initiatives, and quantify energy efficiency and environmental impacts in buildings. States are encouraged to conduct these types of studies every 3-5 years to validate impacts of codes and other energy-efficiency programs, as well as to benchmark technology trends in residential and commercial construction.

Residential | Commercial

Single-family Residential Buildings

Study highlights include:

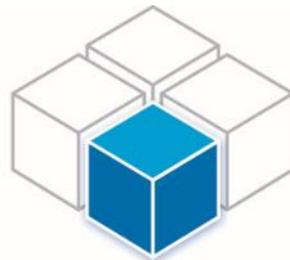
- Results based on an **energy metric** and reported at the **state-level**
- Focuses on **individual code requirements** within **new single-family** homes
- **Data confidentiality** — no personal data shared
- Designed around a **single site-visit** prioritizing **key items**
- Designed with **statistically significant** results in mind

The table below summarizes states who have recently conducted a field study based on the DOE methodology (study results are available where linked):

Team CII & NEEA Partnership

Data Collection Studies

12.15.2020



Cornerstone Integrated Industries

Collaborate. Innovate. Integrate.

Field Data Collection Recruitment Strategies

 WinTech Window Technology, Inc. 70 Series 2-7/8" Vinyl Horz Slider - LOWE IG 3/4 CPD# WNT-K-1-00148-00001 DS 55/27 AIR DS CL - 75IG	
ENERGY PERFORMANCE RATINGS	
U-Factor (U.S./I-P)	Solar Heat Gain Coefficient
0.31	0.23
ADDITIONAL PERFORMANCE RATINGS	
Visible Transmittance	Condensation Resistance
0.46	60
<small>Manufacturer stipulates that these ratings conform to applicable NFRC procedures for determining whole product energy performance. NFRC ratings are determined for a fixed set of environmental conditions and specific product size. NFRC does not recommend any product and does not warrant the suitability of any product for any specific use. www.nfrc.org. Consult manufacturer's literature for other performance information.</small>	



Sample Plan Examples

IDAHO

	Option 5	
	Location	Count
1	Meridian, Ada County	7
2	Boise City, Ada County	3
3	Caldwell, Canyon County	2
4	Eagle, Ada County	5
5	Ada County Unincorporated Area, Ada County	5
6	Nampa, Canyon County	4
7	Kootenai County Unincorporated Area, Kootenai County	4
8	Coeur d'Alene, Kootenai County	3
9	Bonneville County Unincorporated Area, Bonneville County	1
10	Post Falls, Kootenai County	4
11	Kuna, Ada County	2
12	Twin Falls, Twin Falls County	1

MONTANA

	Option 6	
	Location	Count
	Yellowstone County Unincorporated Area, Yellowstone County	14
	Billings, Yellowstone County	10
	Gallatin County Unincorporated Area, Gallatin County	12
	Bozeman, Gallatin County	8
	Missoula, Missoula County	5
	Missoula County Unincorporated Area, Missoula County	1
	Cascade County Unincorporated Area, Cascade County	1
	Belgrade, Gallatin County	2
	Kalispell, Flathead County	3
	Whitefish, Flathead County	3
	Helena, Lewis and Clark County	2
	Great Falls, Cascade County	2
	Total	63

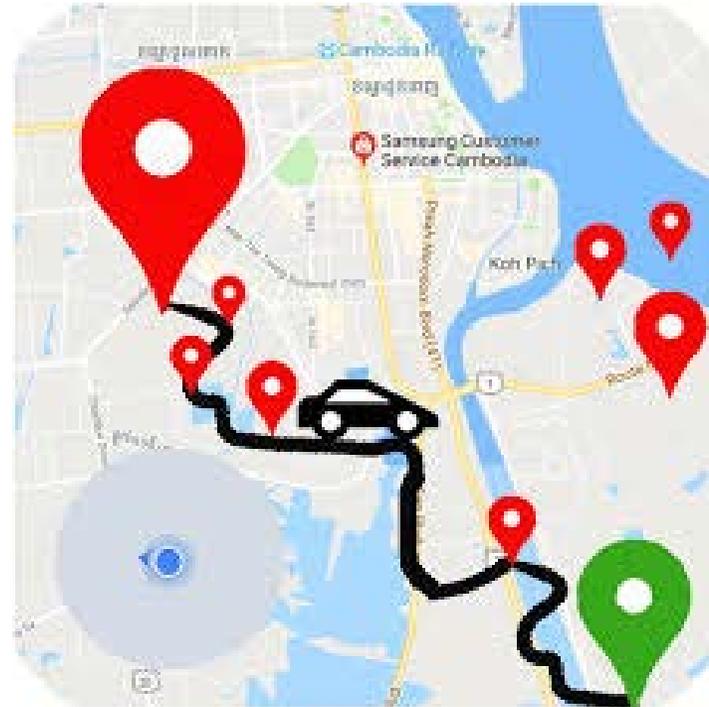
Recruitment

- ▶ Follow DOE protocols
- ▶ Efficient travel plans
- ▶ Initial contact
- ▶ Image
- ▶ Conversations
- ▶ Follow up



Travel Plans

- ▶ Route efficiently
- ▶ Schedule with builders in same area
- ▶ Leave openings for random homes/ leads
- ▶ Ship/store test equipment
- ▶ Travel trailers/motorhomes
- ▶ Apartments
- ▶ 10-14 day trips



Initial Contact Conversation

- ▶ Make small talk
- ▶ Find a connection
- ▶ Power of persuasion
- ▶ Ease into reason for visit
- ▶ Do not overwhelm with technical talk
- ▶ Minimize testing
- ▶ Stress no contact with building dept.
- ▶ Insure anonymity



Image!

- ▶ DO NOT overdress
- ▶ What are you driving?
- ▶ License plate?



Personal Protective Equipment (PPE)

- ▶ Pants
- ▶ Steel toe boots
- ▶ Hard hat
- ▶ Eye protection
- ▶ High visibility vest
- ▶ Some contractor require all of it



Follow Up

- ▶ Offer feedback to builder
- ▶ Test results
- ▶ Ask if you can provide any other information
- ▶ Provide contact information
- ▶ Provide study overview information



My Contact Information

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Oregon: 63 and Me

NEEA 2019 Oregon Residential New Construction Field Study

December 17, 2020

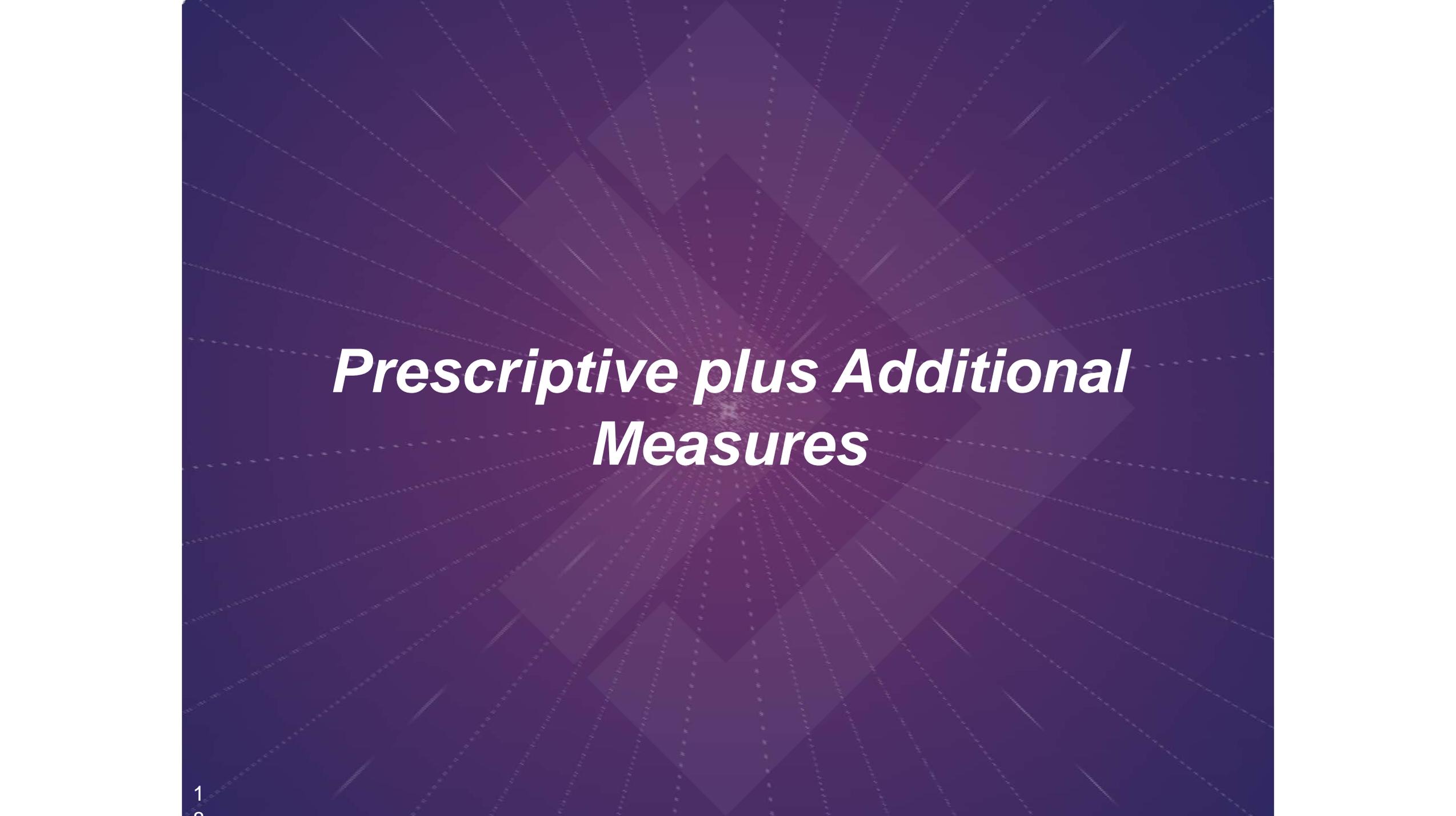
INTEGRATED
[RESILIENT]

SUSTAINABLE

AGENDA



- Oregon's Energy Code
 - Prescriptive vs Additional Measures
- Building Trends & Observations
 - Above Code
 - Water Heating
 - Envelope
 - Ducts
 - Infiltration



***Prescriptive plus Additional
Measures***

Prescriptive Requirements

TABLE N1101.1(1)
PRESCRIPTIVE ENVELOPE REQUIREMENTS^a

BUILDING COMPONENT	STANDARD BASE CASE		LOG HOMES ONLY	
	Required Performance	Equiv. Value ^b	Required Performance	Equiv. Value ^b
Wall insulation—above grade	U-0.059 ^c	R-21 Intermediate ^c	Note d	Note d
Wall insulation—below grade ^e	C-0.063	R-15/R-21	C-0.063	R-15/R-21
Flat ceilings ^f	U-0.021	R-49	U-0.020	R-49 A ^h
Vaulted ceilings ^g	U-0.033	R-30 Rafter or R-30A ^{g,h} Scissor Truss	U-0.027	R-38A ^h
Underfloors	U-0.033	R-30	U-0.033	R-30
Slab edge perimeter	F-0.520	R-15	F-0.520	R-15
Heated slab interior ^j	n/a	R-10	n/a	R-10
Windows ^l	U-0.30	U-0.30	U-0.30	U-0.30
Window area limitation ^{l, k}	n/a	n/a	n/a	n/a
Skylights ^l	U-0.50	U-0.50	U-0.50	U-0.50
Exterior doors ^m	U-0.20	U-0.20	U-0.54	U-0.54
Exterior doors with > 2.5 ft ² glazing ⁿ	U-0.40	U-0.40	U-0.40	U-0.40
Forced air duct insulation	n/a	R-8	n/a	R-8

Additional Measures

TABLE N1101.1(2)
ADDITIONAL MEASURES

Envelope Enhancement Measures (Select One)	1	High efficiency walls Exterior walls—U-0.045/R-21 cavity insulation + R-5 continuous
	2	Upgraded features Exterior walls—U-0.057/R-23 intermediate or R-21 advanced, Framed floors—U-0.026/R-38, and Windows—U-0.28 (average UA)
		Upgraded features Exterior walls—U-0.055/R-23 intermediate or R-21 advanced, Flat ceiling ^c —U-0.017/R-60, and Framed floors—U-0.026/R-38
	4	Super Insulated Windows and Attic OR Framed Floors Windows—U-0.22 (Triple Pane Low-e), and Flat ceiling ^c —U-0.017/R-60 or Framed floors—U-0.026/R-38
	5	Air sealing home and ducts Mandatory air sealing of all wall coverings at top plate and air sealing checklist ^f , and Mechanical whole-building ventilation system with rates meeting M1503 or ASHRAE 62.2, and All ducts and air handlers contained within building envelope ^d or All ducts sealed with mastic ^b
	6	High efficiency thermal envelope UA^g Proposed UA is 8% lower than the code UA
Conservation Measure (Select One)	A	High efficiency HVAC system^a Gas-fired furnace or boiler AFUE 94%, or Air source heat pump HSPF 9.5/15.0 SEER cooling, or Ground source heat pump COP 3.5 or Energy Star rated
	B	Ducted HVAC systems within conditioned space All ducts and air handlers contained within building envelope ^d <i>Cannot be combined with Measure 5</i>
	C	Ductless heat pump Ductless heat pump HSPF 10.0 in primary zone of dwelling
	D	High efficiency water heater^c Natural gas/propane water heater with UEF 0.85 OR Electric heat pump water heater Tier 1 Northern Climate Specification Product

Additional Measures

5A

HYAC DUCTS R-8

PRESCRIPTIVE GLAZING

WINDOWS AND SLIDING DOORS U=.30
FRONT ENTRY DOORS U.54
GARAGE TO HOUSE DOOR U.20

ADDITIONAL MEASURES

ENVELOPE ENHANCED MEASURE 5
MANDATORY SEALING OF WALL COVERINGS AT TOP PLATES
CONTINUOUS AIR BARRIER AT AREAS SUCH AS BEHIND TUBS
ALL DUCTS SEALED WITH MASTIC

CONSERVATION MEASURE A
GAS FIRED FURNACE AFUE 94%

OTHER ENERGY CODE REQUIREMENTS

ALL PERMANENTLY INSTALL LIGHT FIXTURES TO HAVE HIGH EFFIC LAMPS. SCREW IN COMPACT FLUORESCENT AND LED COMPLY

DOMESTIC HOT WATER PIPING OUTSIDE BUILDING ENVELOPE SHAL BE INSULATED TO R-3

WATER CLOSETS SHALL BE EPA WATERSENSE LABELED WITH FLU VOLUME NOT EXCEEDING 1.28 GALLONS PER FLUSH

SHOWER HEADS SHALL BE EPA WATERSENSE LABELED WITH MA FLOW RATE OF 2.0 GALLONS PER MINUTE

Additional Measures

6A & 2A

**TABLE N1101.1(2)
ADDITIONAL MEASURES**

Envelope Enhancement Measures (Select One)	1	High efficiency walls Exterior walls—U-0.045/R-21 cavity insulation + R-5 continuous
		Upgraded features
	2	Exterior walls—U-0.057/R-23 intermediate or R-21 advanced, Framed floors—U-0.026/R-38, and Windows—U-0.28 (average UA)
		Upgraded features
	3	Exterior walls—U-0.055/R-23 intermediate or R-21 advanced, Flat ceiling ^a —U-0.017/R-60, and Framed floors—U-0.026/R-38
		Super Insulated Windows and Attic OR Framed Floors
4	Windows—U-0.22 (Triple Pane Low-e), and Flat ceiling ^a —U-0.017/R-60 or Framed floors—U-0.026/R-38	
	Air sealing home and ducts	
5	Mandatory air sealing of all wall coverings at top plate and air sealing checklist ¹ , and Mechanical whole-building ventilation system with rates meeting M1503 or ASHRAE 62.2, and All ducts and air handlers contained within building envelope ⁴ or All ducts sealed with mastic ⁵	
	High efficiency thermal envelope UA⁶	
6	Proposed UA is 8% lower than the code UA	
Conservation Measure (Select One)		High efficiency HVAC system⁸
	A	Gas-fired furnace or boiler AFUE 94%, or Air source heat pump HSPF 9.5/15.0 SEER cooling, or Ground source heat pump COP 3.5 or Energy Star rated
		Ducted HVAC systems within conditioned space
	B	All ducts and air handlers contained within building envelope ⁴ Cannot be combined with Measure 5
		Ductless heat pump
	C	Ductless heat pump HSPF 10.0 in primary zone of dwelling
	High efficiency water heater⁹	
D	Natural gas/propane water heater with UEF 0.85 OR Electric heat pump water heater Tier 1 Northern Climate Specification Product	

For SI: 1 square foot = 0.093 m², 1 watt per square foot = 10.8 W/m².

a. Appliances located within the building thermal envelope shall have sealed combustion air installed. Combustion air shall be ducted directly from the outdoors.

b. All duct joints and seams sealed with listed mastic; tape is only allowed at appliance or equipment connections (for service air only) as specified in the Performance Tested Comfort Systems program administered by the Bonneville Power Administration (BPA).

c. Residential water heaters less than 55 gallon storage volume.

d. A total of 5 percent of an HVAC system's ductwork shall be permitted to be located outside of the conditioned space. Ducts in unconditioned space shall have insulation installed as required in this code.

e. The maximum vaulted ceiling surface area shall not be greater than 50 percent of the total heated space floor area unless vaulted ceiling area has a U-factor no greater than U-0.026.

f. Continuous air barrier. Additional requirement for sealing of all interior vertical wall covering to top plate framing. Sealing with approved sealant listed for sealing wall covering material to structural material (example: gypsum board to wood stud framing).

g. Table N1104.1(1) Standard base case design, Code UA shall be at least 8 percent less than the Proposed UA. Buildings with fenestration of the total vertical wall area may adjust the Code UA to have 15 percent of the wall area as fenestration.

**TABLE N1101.1 (2)
ADDITIONAL MEASURES**

Envelope Enhancement Measures (SELECT ONE BY PLACING MARK TO LEFT OF OPT)	1	HIGH EFFICIENCY WALLS EXTERIOR WALLS - U-0.045 / R-21 CAVITY INSULATION + R-5 CONTINUOUS
		UPGRADED FEATURES
	2	EXTERIOR WALLS - U-0.057 / R-23 INTERMEDIATE FRAMED FLOORS - U-0.026 / R-38 AND WINDOWS - U-0.28 (AVERAGE UA)
		UPGRADED FEATURES
	3	EXTERIOR WALLS - U-0.057 / R-23 INTERMEDIATE FLAT CEILINGS - U-0.017 / R-60 AND FRAMED FLOORS - U-0.026 / R-38
		SUPER INSULATED WINDOWS AND ATTIC OR FRAMED FLOORS
4	WINDOWS - U-0.22 (TRIPLE PANE LOW-E), AND FLAT CEILINGS ¹ U-0.017 / R-60 OR FRAMED FLOORS - U-0.026 / R-38	
	AIR SEALING HOME AND DUCTS	
5	MANDATORY AIR SEALING OF ALL WALL COVERINGS AT TOP PLATE AND AIR SEALING CHECKLIST ¹ AND MECHANICAL WHOLE-BUILDING VENTILATION SYSTEM WITH RATES MEETING M1503 OR ASHRAE 62.2, AND ALL DUCTS AND AIR HANDLERS CONTAINED WITHIN BUILDING ENVELOPE ⁴ OR ALL DUCTS SEALED WITH MASTIC ⁵	
	HIGH EFFICIENCY THERMAL ENVELOPE UA	
6	PROPOSED UA IS 8% LOWER THAN THE CODE UA	
CONSERVATION MEASURE (SELECT ONE BY PLACING MARK TO LEFT OF OPT)		HIGH EFFICIENCY HVAC SYSTEM⁸
	A	GAS-FIRED FURNACE OR BOILER AFUE 94% OR AIR-SOURCE HEAT PUMP HSPF 9.5/15.0 SEER COOLING, OR GROUND SOURCE HEAT PUMP COP 3.5 OR ENERGY STAR RATED
		DUCTED HVAC SYSTEMS WITHIN CONDITIONED SPACE
	B	ALL DUCTS AND AIR HANDLERS CONTAINED WITHIN BUILDING ENVELOPE ⁴ CANNOT BE COMBINED WITH MEASURE 5
		DUCTLESS HEAT PUMP
	C	DUCTLESS HEAT PUMP HSPF 10.0 IN PRIMARY ZONE OF DWELLING.
	HIGH EFFICIENCY WATER HEATER⁹	
D	NATURAL GAS / PROPANE WATER HEATER WITH UEF 0.85 OR ELECTRIC HEAT PUMP WATER HEATER TIER 1 NORTHERN CLIMATE SPEC. PRODUCT	

⁸ REQUIRES ADDITIONAL ANALYSIS AND POSSIBLE ALTERATIONS TO DESIGN, STRUCTURE AND/OR EXTERIOR DETAILS (CONTACT OUR OFFICES FOR ADDITIONAL INFORMATION)

a. Appliances located within the building thermal envelope shall have a sealed combustion air installed. Combustion air shall be ducted directly from the outdoors.

b. All duct joints and seams with listed mastic; tape only allowed at appliance or equipment connections.

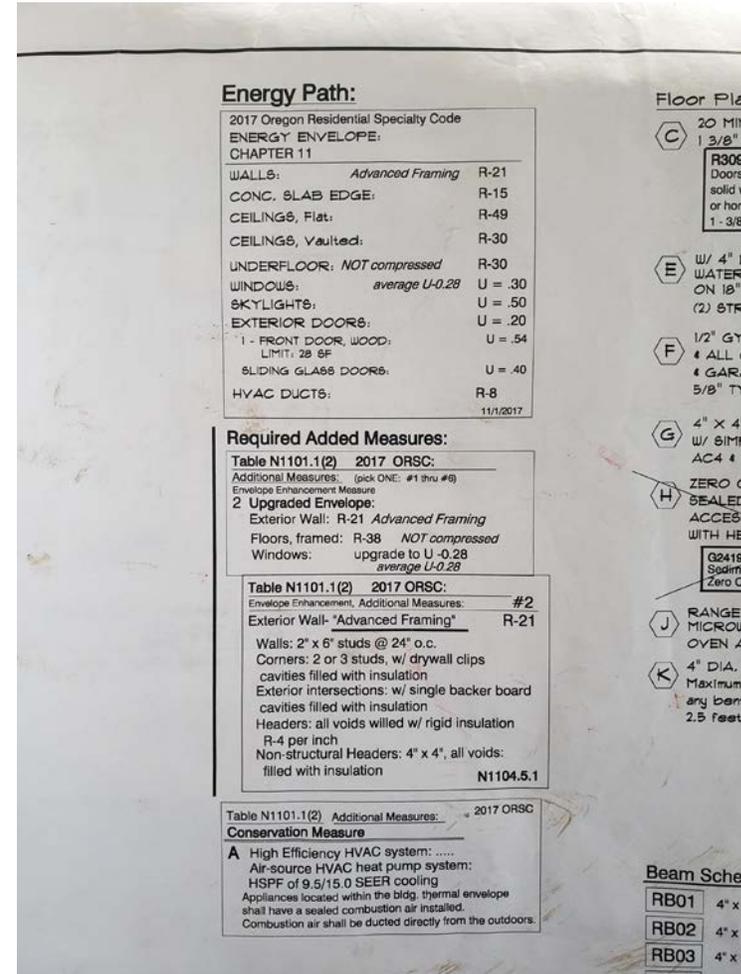
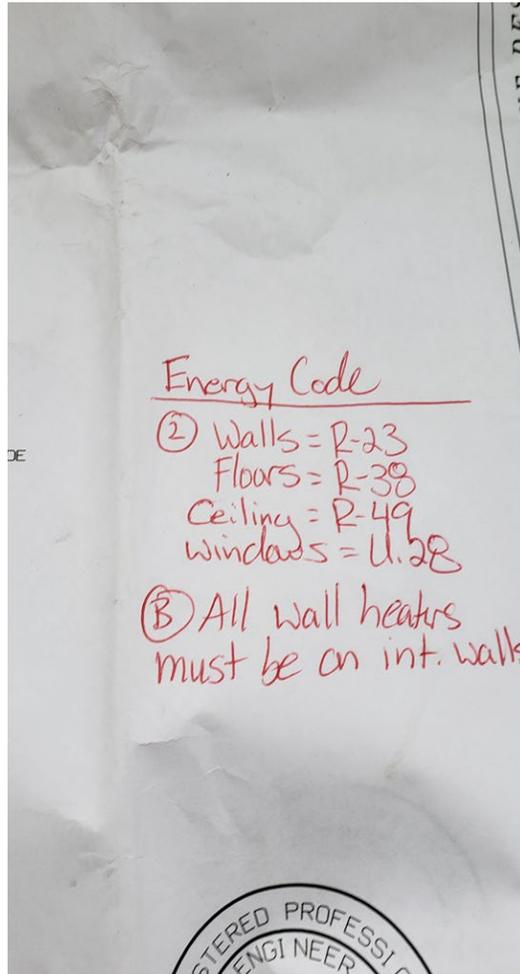
c. Residential water heaters less than 55 gallon storage.

d. A total of 5% of an HVAC system's ductwork shall be permitted to be located outside of the conditioned space floor area unless vaulted area has a U-factor no greater than U-0.26.

e. The Maximum vaulted ceiling surface area shall not be greater than 50 percent of the total heated space floor area unless vaulted area has a U-factor no greater than U-0.026.

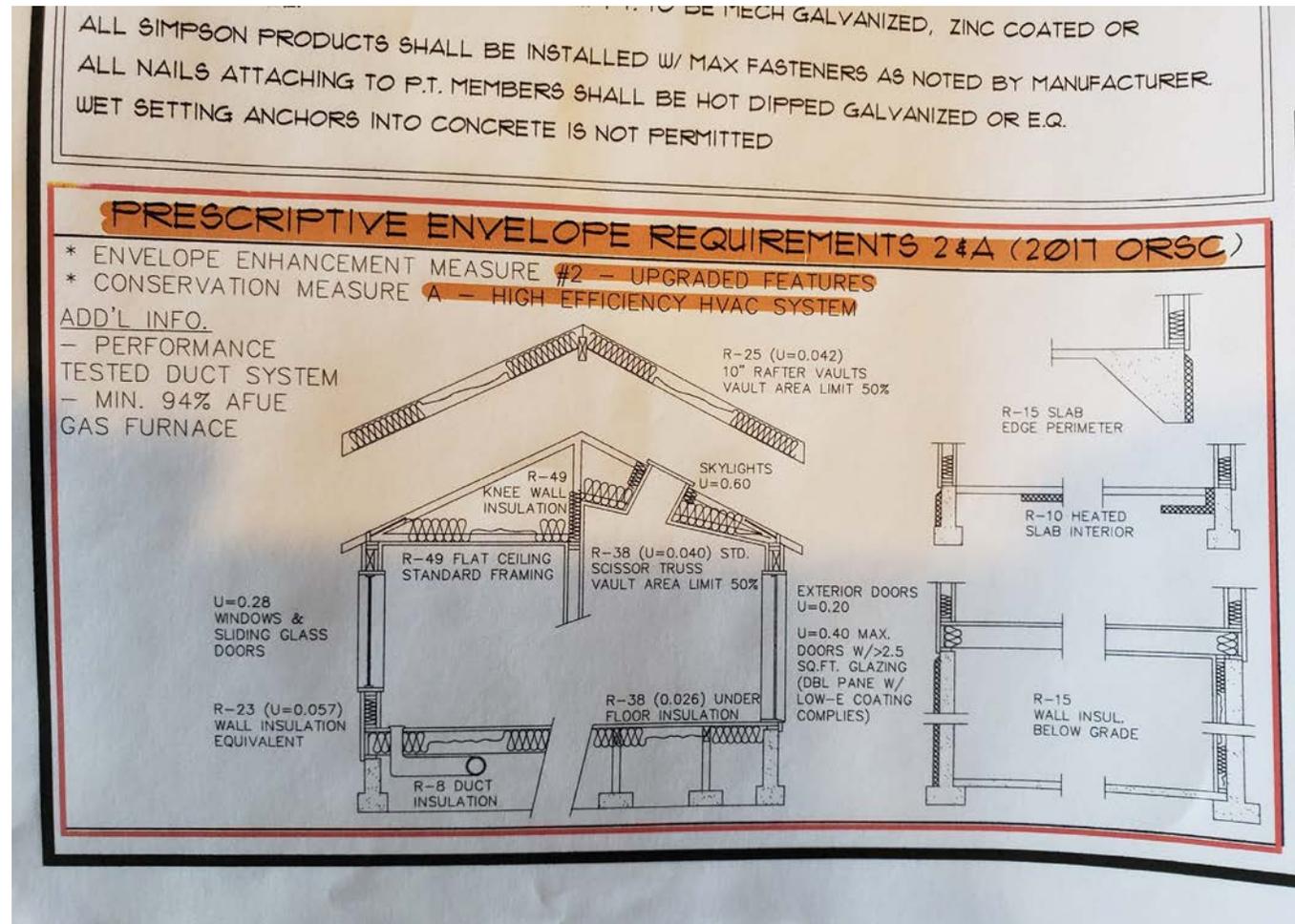
f. Continuous air barrier. Additional requirements for sealing of all interior vertical wall covering to top plate framing. Sealing with approved sealant listed for sealing wall covering material to structural material (example: gypsum board to wood stud framing).

Additional Measures 2B & 2A



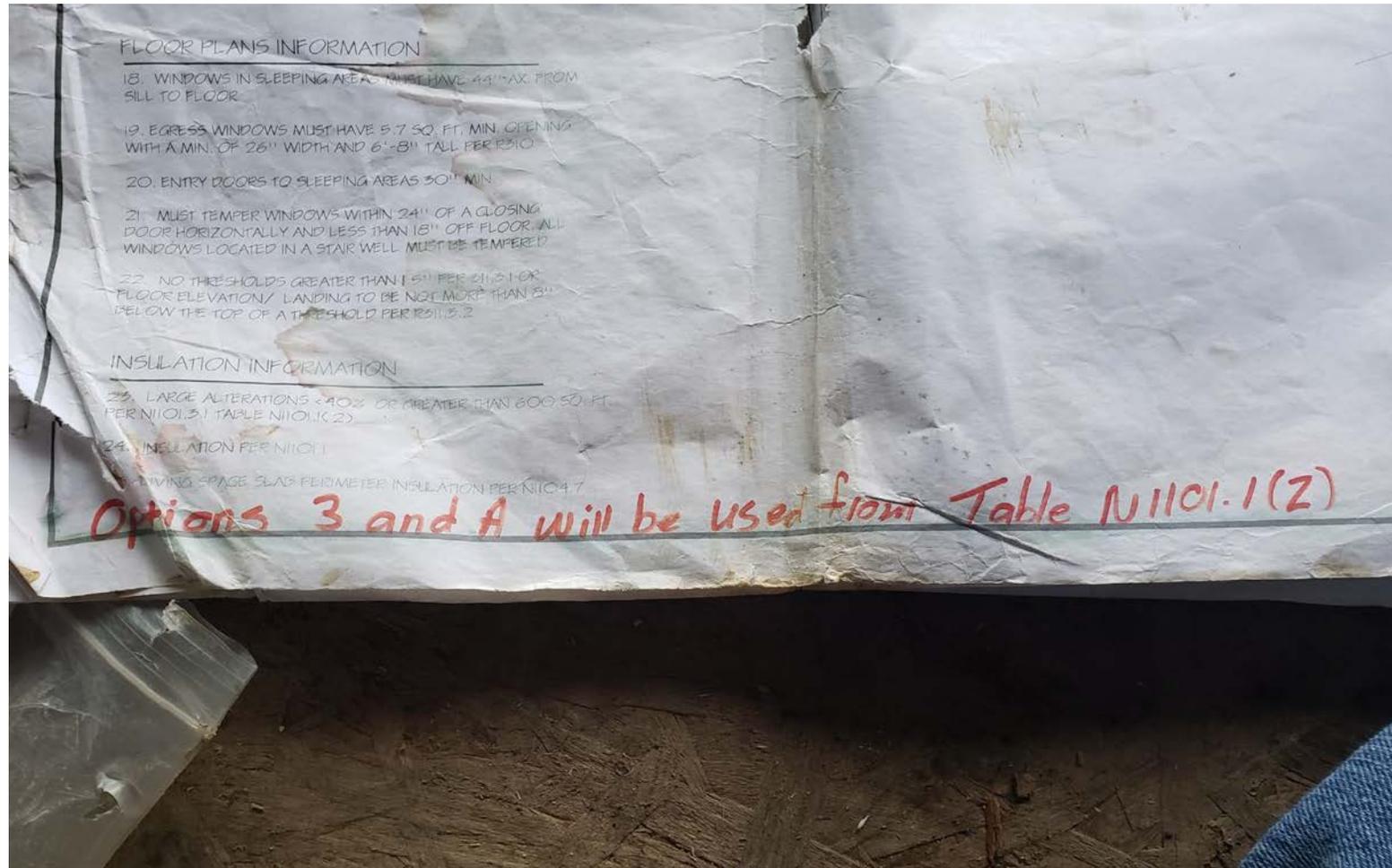
Additional Measures

2A



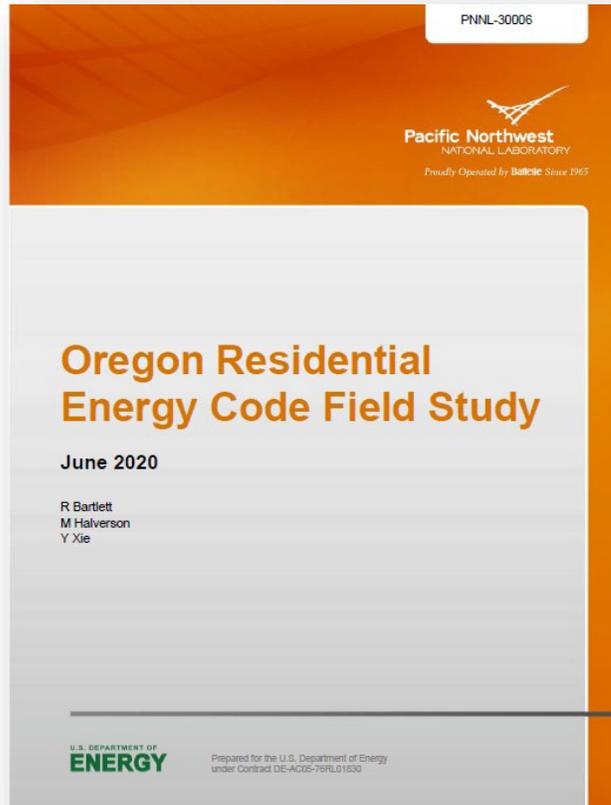
Additional Measures

3A



1

2019 Oregon Residential Energy Code Field Study



2

Building Trends & Observations



NEEA CODE STUDY: BUILDING TRENDS
2019

Foundation Type

All Data Points		
Foundation Type	Count	% Share
Crawlspace	139	87%
Slab On-Grade	19	12%
Heated Basement	2	1%
Total	160	100%

Builder Type				
Foundation Type	Production	% Share	Small	% Share
Crawlspace	45	98%	71	82%
Slab On-Grade	0	0%	16	18%
Heated Basement	1	2%	0	0%
Total	46	100%	87	100%

Above Code Program Participant				
Foundation Type	Above Code	% Share	Code	% Share
Crawlspace	30	73%	91	92%
Slab On-Grade	11	27%	7	7%
Heated Basement	0	0%	1	1%
Total	41	100%	99	100%

Climate Zone				
Foundation Type	4C	% Share	5B	% Share
Crawlspace	109	84%	30	100%
Slab On-Grade	19	15%	0	0%
Heated Basement	2	2%	0	0%
Total	130	100%	30	100%

Home Type

All Data Points		
Home Type	Count	% Share
Single Family Detached	144	89%
Townhome	17	11%
Total	161	100%

Builder Type				
Home Type	Production	% Share	Small	% Share
Single Family Detached	42	93%	78	88%
Townhome	3	7%	11	12%
Total	45	100%	89	100%

Above Code Program Participant				
Home Type	Above Code	% Share	Code	% Share
Single Family Detached	31	76%	94	93%
Townhome	10	24%	7	7%
Total	41	100%	101	100%

Climate Zone				
Home Type	4C	% Share	5B	% Share
Single Family Detached	114	87%	30	100%
Townhome	17	13%	0	0%
Total	131	100%	30	100%

User Guide | **Building Trends** | Heating & Cooling | Water Heating | HVAC Trends | Envelope

https://www.energycodes.gov/sites/default/files/documents/Oregon_Residential_Field_Study.pdf

Definitions of Line 15

- **Above Code Program Participant:** Home was certified or incentivized as an above code home through EPS for New Construction, Earth Advantage, or LEED



Water Heating

Water Heating

Tankless Gas Water Heater



Water Heating

Gas Storage Water Heater



Water Heating

Electric Storage Water Heater



Water Heating

Heat Pump Water Heater



Water Heating

Above Code Participation

Above Code Program Participant

Device	Above Code	% Share	Code	% Share
Electric Storage	0	0%	8	21%
HPWH	9	35%	3	8%
Gas Storage	1	4%	22	56%
Gas Tankless	16	62%	6	15%
Total	26	100%	39	100%



KEY INSIGHT

Builders who participated in an above code program chose the two most efficient options, gas tankless and HPWH, in far higher numbers than builders who did not participate in an above code program.

Water Heating

2014 vs. 2019

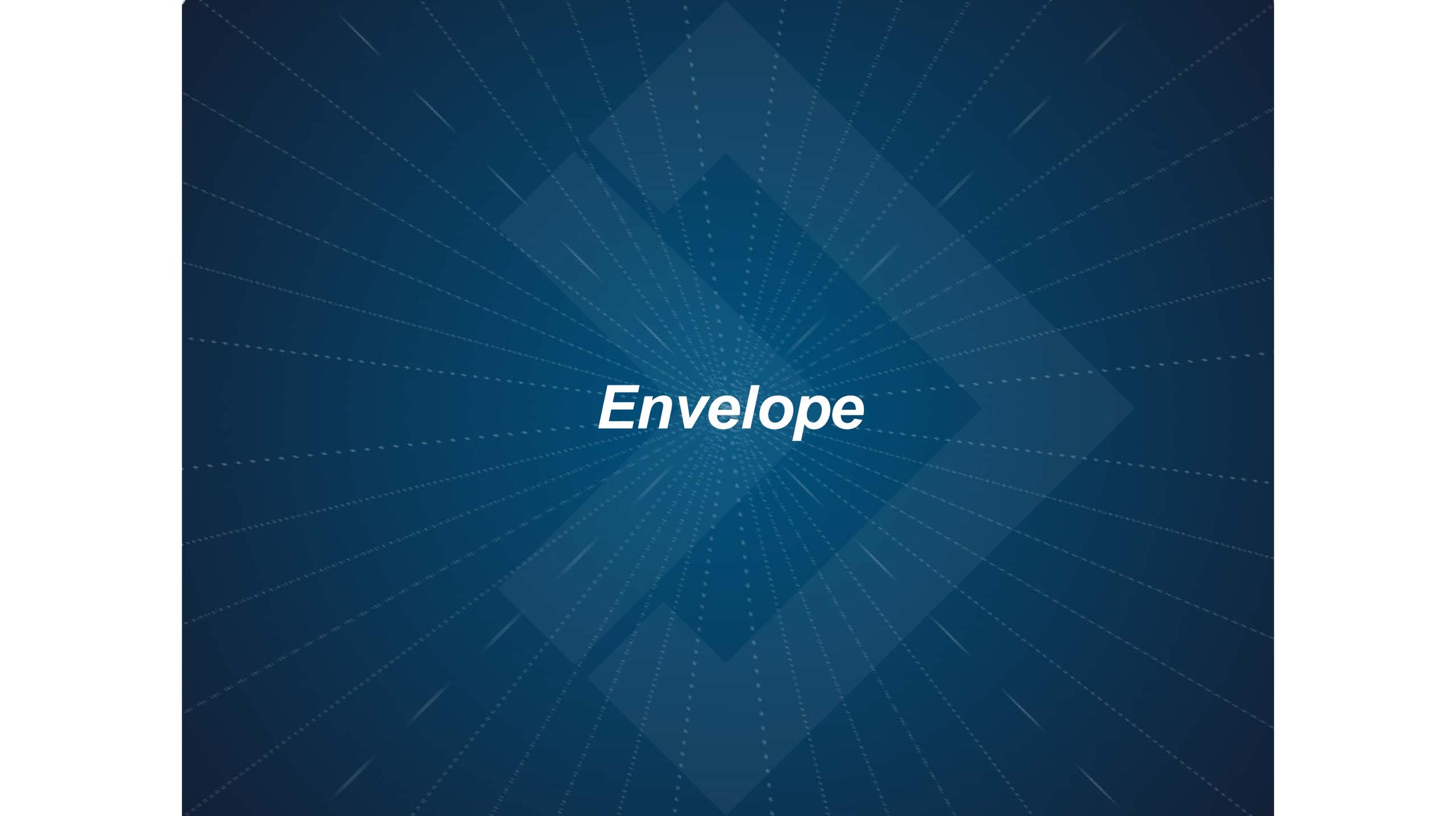
Code Study Comparison

Equipment	2014	% Share	2019	% Share
Electric Storage	25	28%	11	18%
HPWH	-	-	15	25%
Gas Storage	55	61%	13	21%
Gas Tankless	10	11%	22	36%
Total	90	100%	61	100%



KEY INSIGHT

The 2014 Oregon code field study found no heat pump water heaters, despite their market availability. The 2019 code study found heat pump water heaters comprised 25% of all water heating systems.

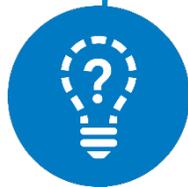
The background is a dark blue gradient with a central diamond shape. From the center of the diamond, numerous thin, light blue lines radiate outwards, creating a starburst or sunburst effect. The lines are spaced evenly and extend to the edges of the frame. The overall aesthetic is clean, modern, and technical.

Envelope

Hatch Insulation

All Data Points

Compliance	Count	% Share
Complies	20	53%
Does Not Comply	18	47%
Total	38	100%



KEY INSIGHT

Nearly half of homes with hatch insulation did not meet surrounding R-value.

Hatch Insulation

Poorly Insulated



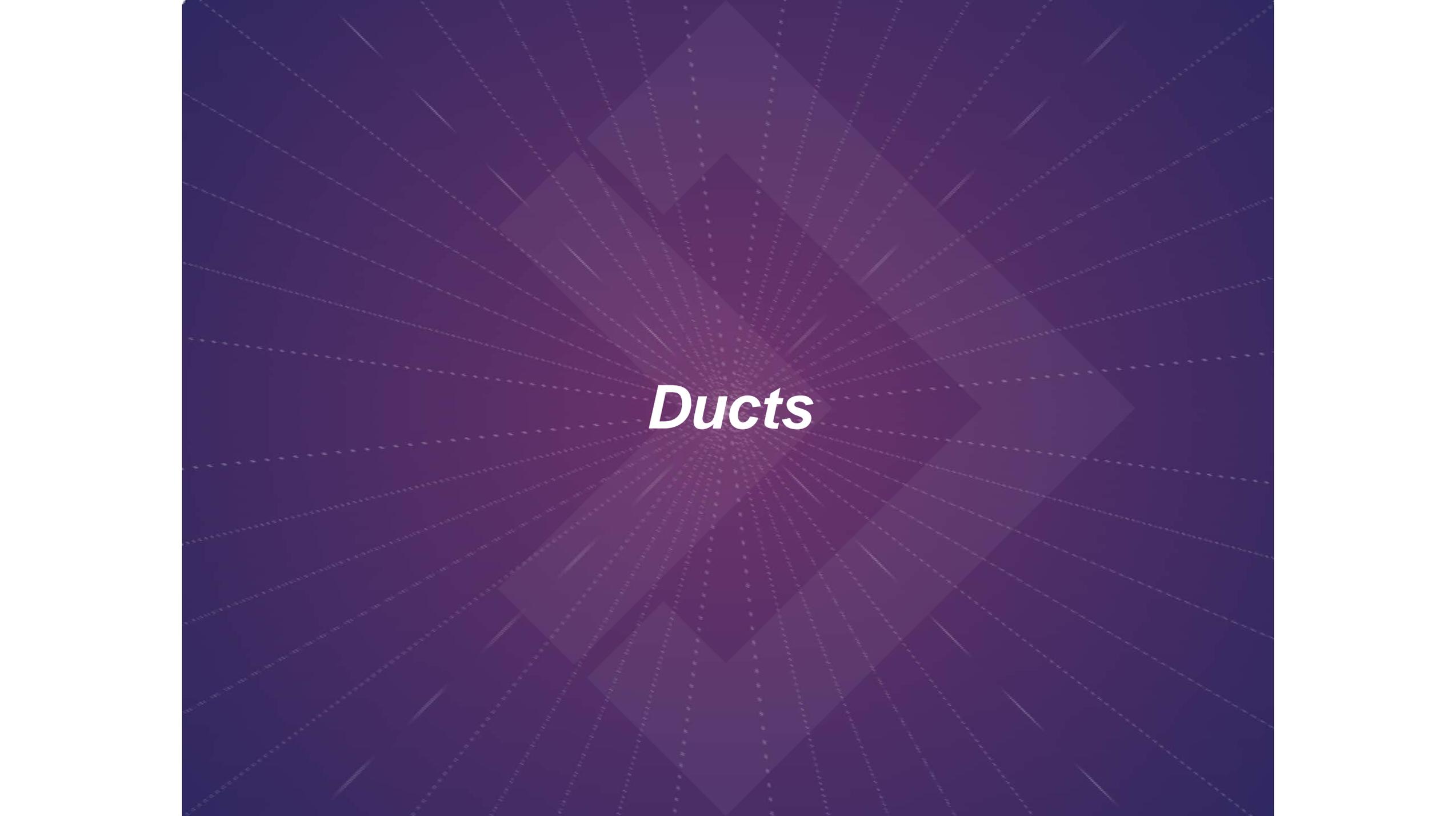
Hatch Insulation Not Insulated



Wall Insulation

Grade 3

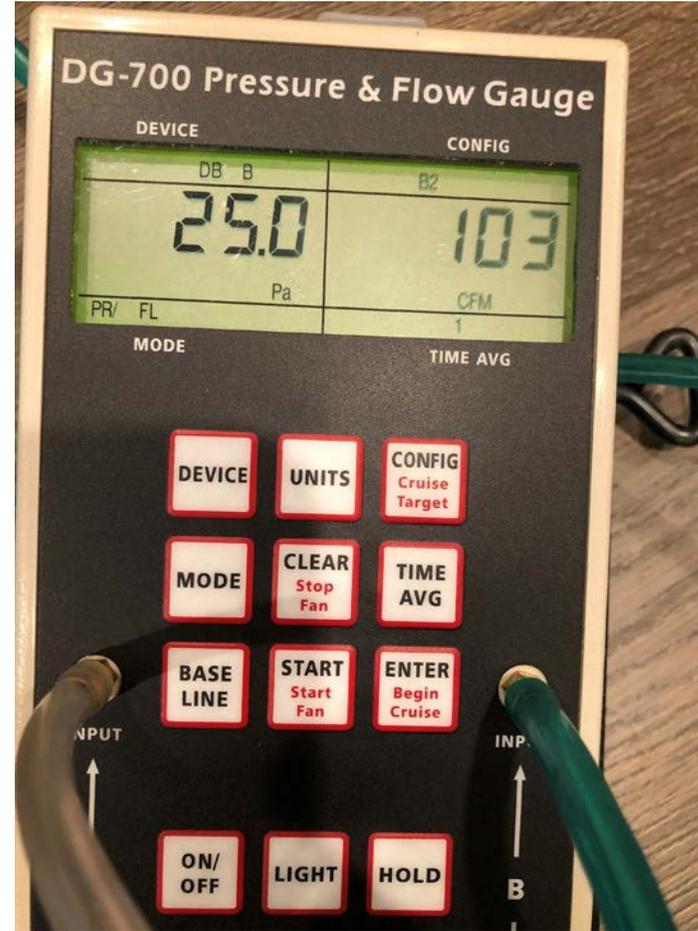




Ducts

Ducts

Duct Leakage Test



Ducts

Good Duct Sealing



Ducts

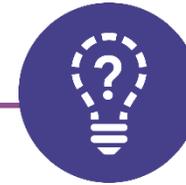
Duct Leakage

All Data Points

CFM	Value
Average	6.1

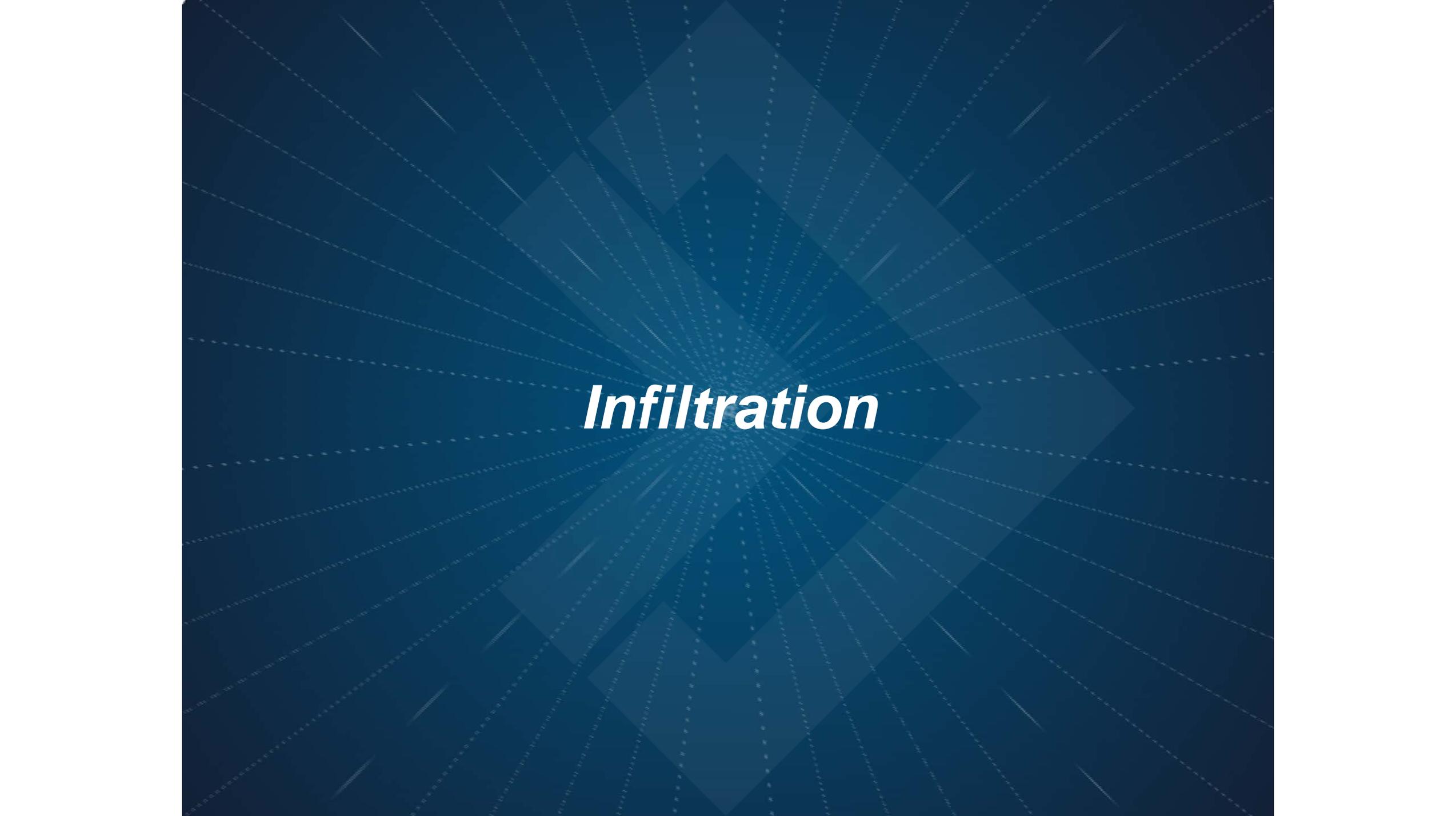
Above Code Program Participant

CFM	Above Code	Code
Average	4.9	6.8



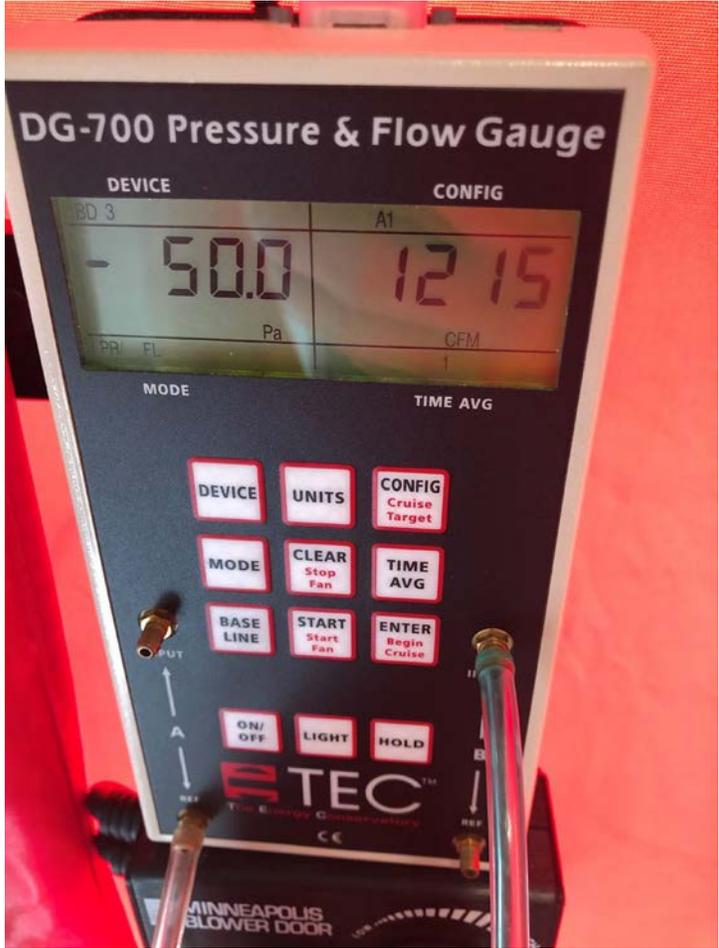
KEY INSIGHT

Above code program participants lowered the duct leakage rate to an average of 4.9 CFM/100 square feet. Conversely, homes built to code had a higher than average leakage rate of 6.8 CFM/100 square feet.

The background is a dark blue gradient with a central diamond-shaped pattern of lighter blue diamonds. Radiating from the center are numerous thin, light blue lines that create a starburst or sunburst effect. The overall aesthetic is modern and technical.

Infiltration

Blower Door



Envelope Infiltration

Above Code Program Participant

ACH50	Above Code	Code
Min	1.7	2.9
Average	3.4	4.6
Max	5.3	8.1



KEY INSIGHT

Reducing the air leakage from a home's envelope requires a concerted effort on the part of the builder. Homes built by above code program participants had an average ACH50 of 3.4, compared to 4.6 for homes built by non-participants.

Air Sealing Examples



Good Air Sealing Examples



Air Sealing Missed Opportunities



Thank You

Greg Lasher

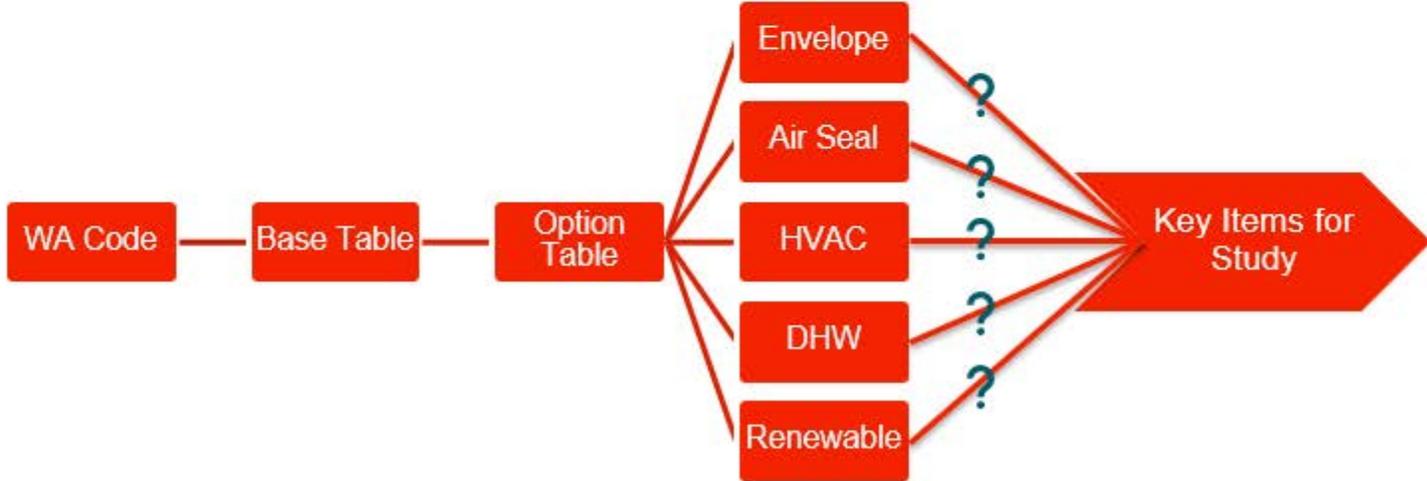
TRC

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63 And Me, or A Field Person's View of Code Compliance



WA Code vs Other State Codes





Two-Stage Approach

- **Phase 1:** What combination of options are being used to meet code?
 - Review plans from sample of Jurisdictions
 - Use results to build prototypes and prototype weights in final analysis
- **Phase 2:** Field data collection of components
 - Similar to standard data collection, but with more end points because of the mechanical pathways that can be used to meet code

Findings

- Phase 1
 - 92% homes built with just 6 combinations of options
 - HVAC and DHW options always selected in these 6 common combinations
 - Then either select the first level of envelope or air sealing options
 - Data collected from 342 homes plans from 13 jurisdictions (small, medium, and large size jurisdictions represented)
- Phase 2
 - 184 homes to get 63 observations of 11 key items (7 from DOE protocol + 4 from WA compliance pathways identified in Phase 1)
 - Annual Statewide potential:

Measure	Total Energy Savings (MMBtu/year)	Total Energy Cost Savings (\$/year)
Wall Insulation	25,672	328,142
Air Sealing	7,019	91,558
Duct Tightness	6,218	75,733
Low-Flow Fixtures	5,816	73,124
DHW	3,653	63,694
Ceiling Insulation	2,438	31,202
Foundation Insulation	1,116	14,028
Total	51,932	677,480



How We Found The
Homes and Convinced
Builders to Let us in



Start With The
Local
Jurisdiction

Responses From Code Officials



Here is a list of open projects



Here is a list of builders with open projects



No response



We don't have time



It's an unfunded mandate
\$\$\$\$\$



Follow The
Flags



Track The Truck



Scan For The Can



Zero In With
Zillow



CHELAN COUNTY

Utilize the
Utilities

Reel in the
Real Estate
Agents (They
work
Sundays too)

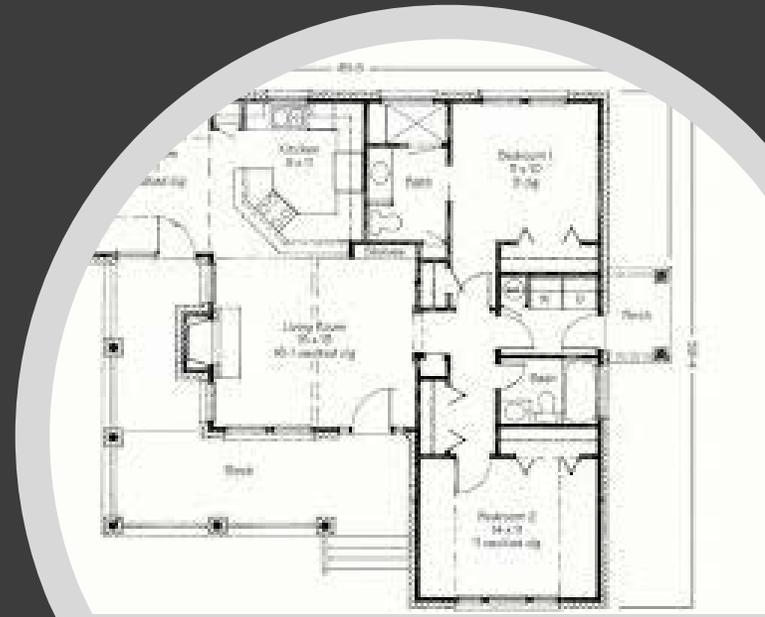




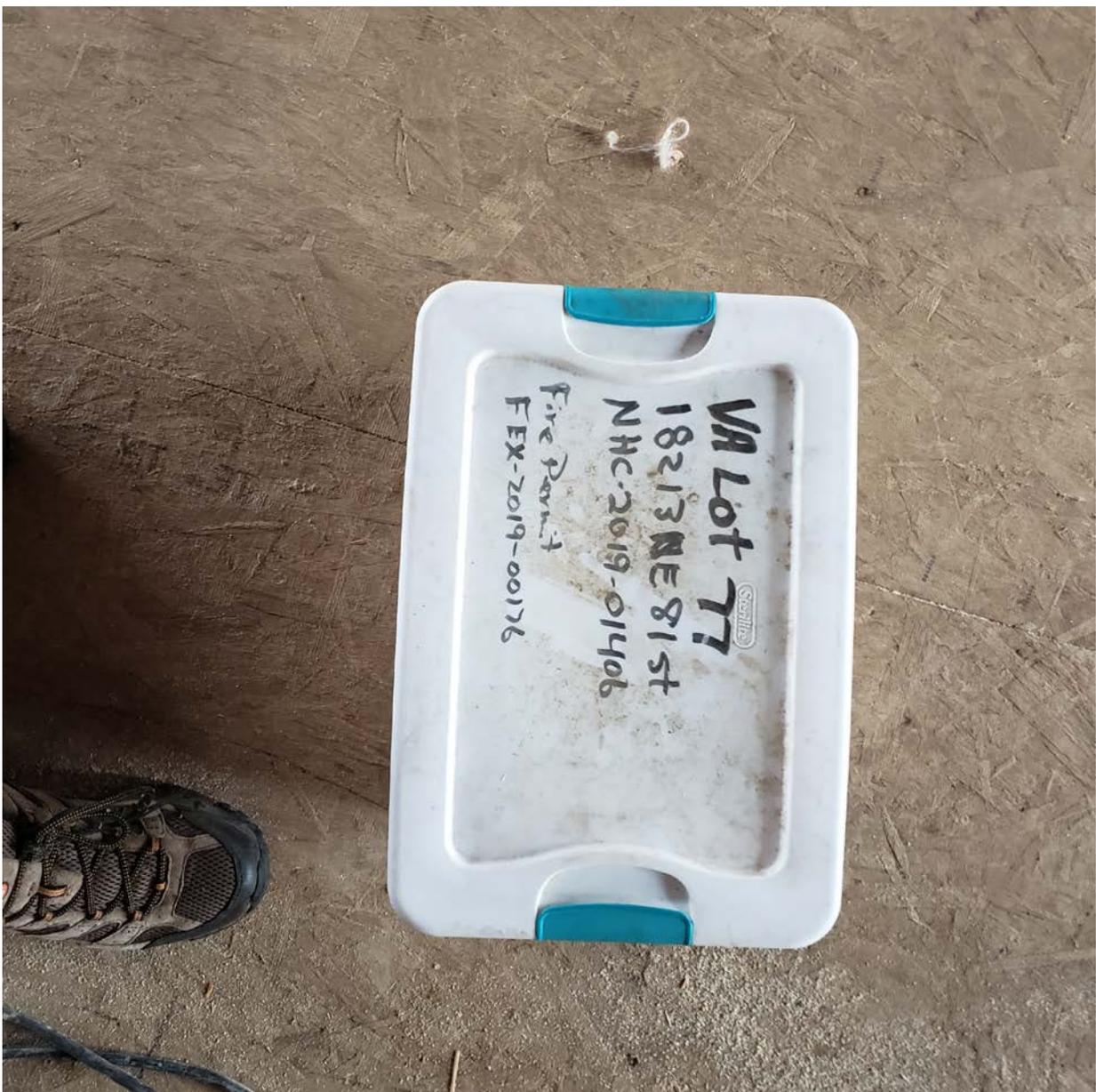
Search For The Shack

Finding The Plans

- At the house (think Easter egg hunt)
- Back to the building department
- The site shack



The Ideal





Dumpster Diving

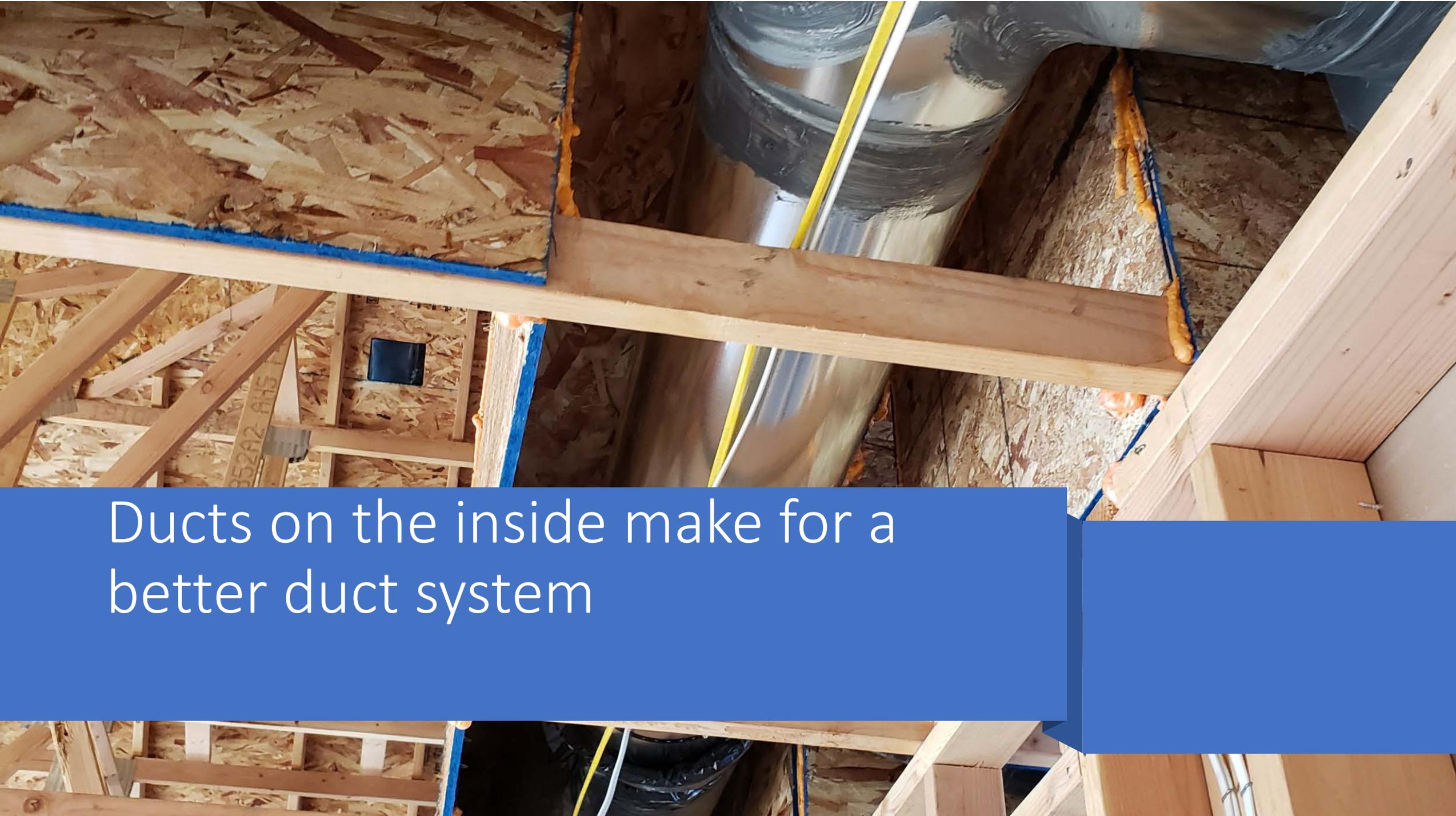


Revisit Local Jurisdiction



Other
Findings And
Trends





Ducts on the inside make for a better duct system

Ducts have
migrated from the
crawl to the attic



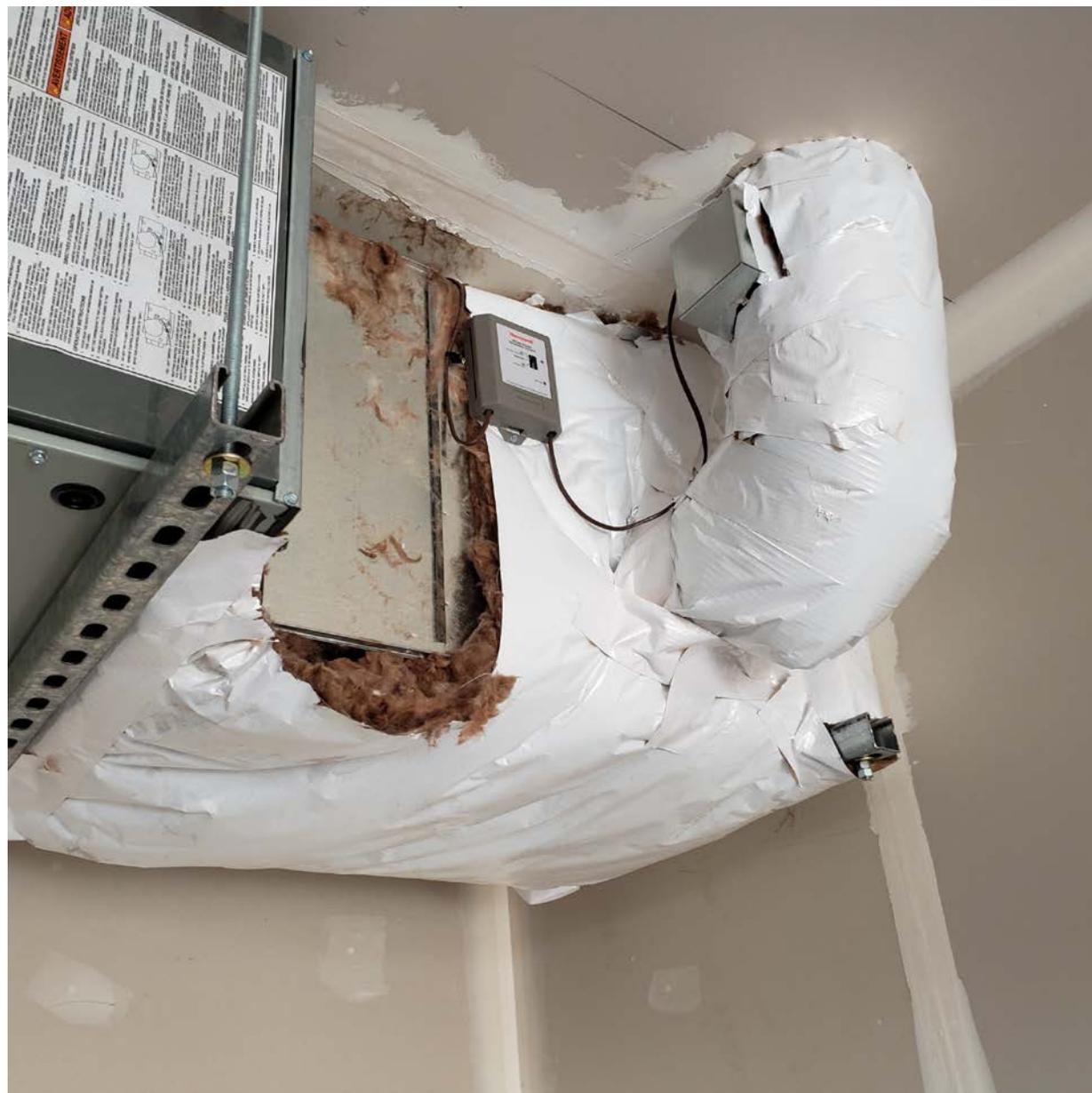


Web Trusses
Used as
Garage
Ceilings: Hard
Not to Have
Gaps

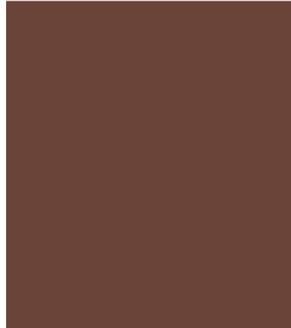


10 foot walls

Controllers Control What?



Ventilation System Controllers not set

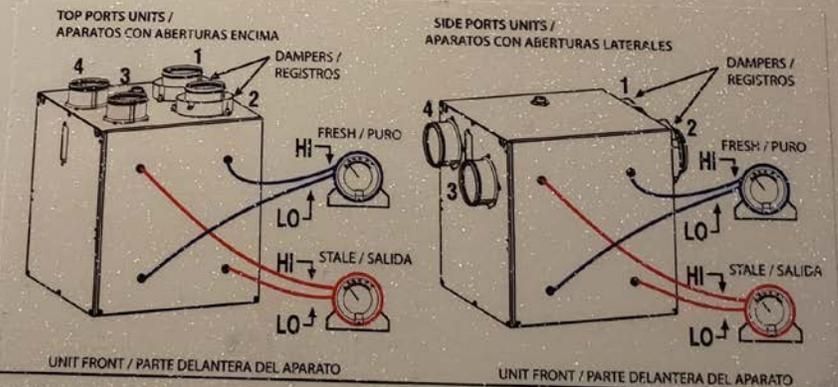


Ventilation
Timers
Usually Not
Set



HRVS Not Balanced, Or Results Posted are Wrong

BROAN®



1: EXHAUST AIR TO OUTSIDE / AIRE DE SALIDA HACIA EL EXTERIOR 2: FRESH AIR FROM OUTSIDE / AIRE FRESCO DESDE EL EXTERIOR
3: EXHAUST AIR FROM BUILDING / AIRE DE SALIDA DESDE EL INTERIOR 4: FRESH AIR TO BUILDING / AIRE FRESCO HACIA EL INTERIOR

⚠ WARNING

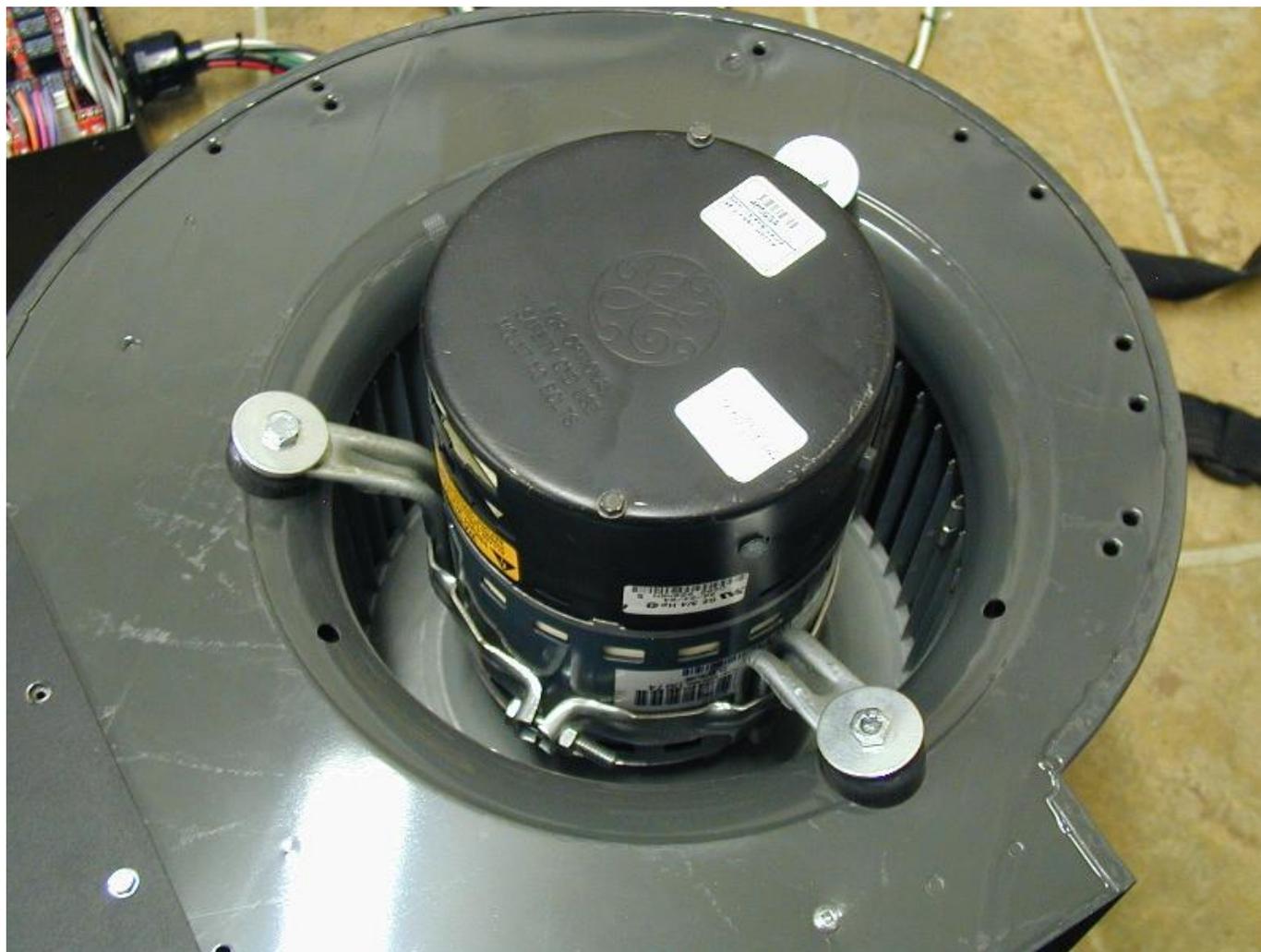
Risk of electric shock: Can cause injuries or death. Read manual and disconnect unit from power source before performing any maintenance or servicing.



⚠ ADVERTENCIA

Riesgo eléctrico: Puede causar lesiones o muerte. Lea el manual y desconecte la unidad de la corriente eléctrica antes de llevar a cabo cualquier reparación o operación de mantenimiento.

ECMS Not Used
on Air handlers
Used With
Ventilation
Systems.



HVAC Sizing Project

- Heat pump balance points were in the mid 20's
- HVAC sizing calculations were seldom located
- Gas furnaces are oversized





Heat Pump
Controllers
Not Set up

NOTICE: READ BEFORE INSTALLING
 IMPROPER INSTALLATION AND CARE MAY VOID WARRANTY. MANUFACTURER ASSUMES NO RESPONSIBILITY FOR FAILURE, DAMAGE OR INJURY FROM IMPROPER INSTALLATION, CARE, OR USE IN APPLICATIONS THAT EXCEED PRODUCT RATING. IT IS THE RESPONSIBILITY OF THE OWNER, ARCHITECT, OR BUILDER TO SELECT AND INSTALL PRODUCTS IN COMPLIANCE WITH APPLICABLE LAW AND BUILDING CODES.

GENERAL CONDITIONS:

- Store and use in dry, shaded areas and do not lay and flat.
- Do not let wet by the heater.
- Protect vinyl and glass from plaster, mortar, concrete, and paint. Remove such materials before they dry by washing with clean water.
- DO NOT BLOCK WEEP HOLES.
- Avoid using tools that could scratch glass or vinyl.
- Do not use solvents or cleaning fluids containing petroleum products, concentrated acids, or caustic materials. Limiting glass seals can be damaged by these products.

WINDOW AND DOOR INSTALLATION INSTRUCTIONS:
 CONTACT PLY GEM FOR INSTRUCTIONS FOR INSTALLING WINDOWS WHEN NOT IN NEAL-FIXES.

1. Verify rough opening (R.O.) dimensions. The gap between R.O. and window frame must be at least 1/4" and not more than 1/2".
2. Close and lock window sash during installation.
3. Apply a continuous 1/4" bead of caulk to the backside of the nailing fin.
4. Install window plumb, square and level, using shims as needed. Provide complete support to the interior sill. Windows over 4' in width require minimum 1" of support to the exterior.
5. Adjust frame to provide a uniform margin around the sash.
6. Nail with 6d or larger galvanized fasteners 8 to 18 inches apart using the holes provided in the nailing fin. Do not nail within 8 inches of frame corners. Drilling holes through the frame of the window could cause a leakage problem which would not be covered by the warranty.

MAINTENANCE

1. Sills, roller tracks, and weep holes should be cleared of construction debris before opening sash and periodically thereafter to prevent damage to rollers and to allow drainage.
2. Use only warm water and mild detergent with a clean cloth to clean glass and vinyl. Rinse with clean water and squeeze glass dry. Avoid use of razor blades, sharp tools, or dirty cloths, which may scratch the glass. Do not use acids, alkalis, or concentrated solutions of vinegar or ammonia, which can damage glass seals.
3. Maintenance and replacement parts may be ordered through your dealer.

ENERGY STAR® Qualified in Highlighted Regions

NERC
 National Fenestration Rating Council®

CPDF: PWG-M-123-01796-00001
 Vinyl Frame
 Double Glazing
 Low-E
 No Grids
 Argon Fill
 Picture

ENERGY PERFORMANCE RATINGS

U-Factor (U S / Ft² · °F)	1.31 (Metric/SI)	Solar Heat Gain Coefficient	0.33
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ADDITIONAL PERFORMANCE RATINGS

Visible Transmittance	0.60	Air Infiltration	≤ 0.3
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Tested in accordance with AAMA/WORQCSA 101/18.2/AA48-80.11
 Class CS-PG45 1829 x 1524 (72 x 60) - FW
 Design Pressure +2160W - 2160 Pa (+45J - 45 psf)

Rated in accordance with ASTM E90/E1330 for acoustical performance
 STC Rating: **UNRATED**

Ply Gem WINDOWS

2353792.6 37-3 5511768/RevC/MS/0418

New Subdivisions may have non utility fuel sources

WARNING
 This product can expose you to chemicals, including Titanium Dioxide, which are known to the State of California to cause cancer, birth defects or other reproductive harm. For more information go to www.P65warnings.ca.gov

170274000/MS/0818

(INT) COLOR COAT/AUBURN
 07-02-19 OUR TRUCK 370
 P.O. # 714-101858 MARK # GARAGE (SOFT: S.SS)
 400-1

2353792.6.99.1 H ***23

Local Code
Officials
Sometimes
Require Strange
Things



Looking Ahead
to the Next
Code: Where
we Think
Additional
Training and
Assistance is
Needed

- Getting Ducts inside
- Ventilation commissioning
- HRV design, installation and commissioning
- Heat Pump commissioning
- Advanced air sealing techniques

Thank you for your time!

QUESTIONS?

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Neil Grigsby ngrigsby@neea.org

Thank You!

Building Energy Codes Program

www.energycodes.gov/training

BECP help desk

<https://www.energycodes.gov/HelpDesk>

