## Nebraska's New Residential Energy Code

#### **Requirements and Best Practices**

Nebraska Energy Code Training Program Instructor: Matt Belcher May 5, 2021: 3:30 pm – 5:30 pm CST







## Housekeeping

- Attendees are muted upon entry
- Questions? Enter them in the chat box
- Webinar is being recorded slides and recording will be sent to attendees
- CEU's will be available upon request (ICC)
  - Course: 28218, CEUs: 0.20
- Email <u>nwestfall@mwalliance.org</u> with questions







### About MEEA

- MEEA is a nonprofit membership organization with 160+ members, including:
  - Utilities
  - Research institutions
  - State and local governments
  - Energy efficiency-related businesses
- MEEA helps stakeholders understand and implement costeffective energy efficiency strategies









## About the Nebraska Training Program

- Goal: prepare the Nebraska workforce for upcoming changes in construction best practices
  - Residential and Commercial Energy Code
  - Building Science
  - Practical Solutions
- Focused on providing training to builders, code officials, design professionals, public officials and students
- For more information, visit: https://www.mwalliance.org/nebraska-energy-codestraining-program







### **About Verdatek Solutions**



#### **Matt Belcher**





NEBRASKA CODE OFFICIALS ASSOCIATION



## Introduction Poll #1

- What is your profession?
  - Code Official
  - Home Builder
  - State/local government
  - Energy Rater/Consultant
  - Architect/Engineer
  - Non-profit
  - Academic
  - Utility
  - Other (type in chat)







### Introduction Poll #2

- How long have you been in the construction industry?
  - 0-5 years
  - 5-10 years
  - 11-15 years
  - 16-20 years
  - 21+ years







### Introduction Poll #3

- How familiar are you with the residential provisions in the 2018 IECC?
  - Extremely Familiar
  - Somewhat Familiar
  - Somewhat Unfamiliar
  - Not familiar at all







## **Training Objectives**

- What is the 2018 Energy Code?
- Inside the Energy Code:
  - Building Envelope
  - Interior Comfort/Health
  - Remodeling
- Marketing Energy Efficient/High Performance Buildings









## Today's Agenda

- Code Requirements in the 2018 IECC
- Moisture Management
- Air Movement
- Heat Transfer
- Performance Testing
- HVAC System
- Key Takeaways







# What is the 2018 IECC?

(Nothing scary, really!)







### Model Energy Code Efficiency



## Nebraska Residential Field Study

- Conducted in 2017 by **Nebraska Department of Environment** and Energy. 2009 IECC was the baseline.
- Collected and analyzed several data points for new homes, including:
  - Envelope air leakage
  - Efficacy in lighting
  - Duct leakage
  - Ceiling & exterior wall insulation
  - Basement & slab insulation
  - Windows

#### For More Information and Data:

https://www.energycodes.gov/sites/default/files/documents/ Nebraska\_Residential\_Compliance\_Evaluation\_final.pdf







### Nebraska Residential Field Study -Results

- Overall, not too bad! But room to improve.
  - Envelope Air Leakage: Better than code(7 ACH50)
    - Not all would meet 2018 IECC
  - Efficacy in Lighting: Average; some good, some not
  - Duct Leakage: Ugh!
    - Needs significant improvement to meet 2018 IECC
  - Ceiling Insulation:
    - Amount: Good+ (Average: R-42.5)
    - Install: Not as good. Reduces compliance (R-factor)









### Nebraska Residential Field Study -Results Frame Wall R-Value (Cavity)

- Frame Wall Insulation: Most common installation was below code
  - Even continuous insulation < Code
  - Quality of Installation an issue
- Basement Insulation: Meets code(average), but room to improve
- Slab insulation: Meets or exceeds code
- Windows: Meets code but will need to upgrade to meet 2018 IECC









### So, What's Changed since 2009?



#### 2018 IECC / IRC Section 11

- Creates a Residential Energy Code separate from the Commercial Energy Code
- Adds testing and verification requirements
- Promotes Innovation through Energy Ratings Index (ERI)
  - Uses a HERS-type index as an "equivalent" for residential applications
  - Mandatory requirements still apply







#### **Energy Certificate**

 Energy Certificate located on circuit breaker box includes key energy efficiency measures and is signed by the builder

#### **Air Sealing**

- All holes between floors and through exterior walls/ceilings have been sealed in **accordance with table R402.4.1.1**
- Building or dwelling unit is tested to verify air leakage rate of ≤ 3 Air Changes per Hour (ACH)
- Building or dwelling unit must have continuous air barrier installed







#### Ducts

- All ducts are sealed with approved materials (e.g. mastic or UL 181 tape) duct tape is not acceptable
- All ducts outside conditioned space are tested to verify duct leakage with a total duct leakage or leakage to the outside test
- Supply & return ducts in attic insulated to  $\geq$  R-6 when ducts are outside conditioned space and  $\geq$  R-8 when ducts are outside the building thermal envelope

#### **Building Cavities**

 Building framing cavities shall not be used as supply ducts or plenums







#### Heating and Cooling

- Controls: Programmable thermostat installed
- Equipment sized per ACCA Manuals S & J

#### Lighting

- Minimum of **90% high-efficacy lamps** installed
- Recessed lighting in thermal envelope IC-rated and airtight

#### **Mechanical Ventilation**

- Installed according to requirements in the International Mechanical Code
- Required for all homes ≤ 5 ACH per Section M303.4 (3 ACH is a 2018 IECC mandatory requirement)







#### Other requirements

- Wood-burning fireplaces have tight flue dampers or doors, and outdoor combustion air
- Mechanical system piping insulated to min R-3 for fluids >105° F or <55° F

• Circulating hot water systems shall be insulated to at least R-2. Systems shall include an automatic, or readily accessible, off-switch.







## **Energy Code Compliance Pathways**

#### Prescriptive Method Requirements

• All mandatory and prescriptive requirements must be met

#### **Total UA Method Requirements**

- All mandatory and prescriptive requirements (other than Table R402.1.2) must be met
- Include documentation to demonstrate compliance with the UA Trade-off method. Compliance software submittal must include completed compliance form, inspection checklist and certificate demonstrating compliance with 2018 IECC levels







## **Energy Code Compliance Pathways**

#### Simulated Performance Requirements (Section R405)

- All mandatory requirements must be met
- Submit an energy cost analysis report which demonstrates that the proposed design (as built) home is more efficient than the standard reference design home

#### Energy Rating Index Requirements (Section R406)

- All Mandatory requirements met. Meet or exceed 2009 IECC prescriptive envelope requirements
- ERI score of 61 or lower. Submit report demonstrating compliance







Indicates Change

23

Table R402.1.2 Insulation Requirements By Component

Requirement	2009 IECC	2018 IECC
Ceiling R-value	R-38	R-49
Wall R-value	R-20 or R-13+5	R-20 or R-13+5
Floors over unconditioned space	R-30	R-30
<b>Basement R-value</b>	10/13	15/19
Slab R-value and depth	10, 2 ft.	10, 2 ft. * <b>R-5 insulation shall be provided</b> under the full area of a heated slab
Crawl space wall R-value	10/13	15/19

Indicates Change

Table R402.1.2 Fenestration Requirements By Component

Requirement	2009 IECC	2018 IECC
Fenestration U-factor (windows, glass, opaque and swinging doors with <50% glazing)	.35	0.30
Skylight U-factor	.60	0.55







Indicates Change

	Requirement	2009 IECC	2018 IECC
	Eave Baffle	NO REQUIREMENT	For air permeable insulations in vented attics, <b>a baffle shall be installed adjacent to</b> <b>soffit and eave vents</b> . Baffles shall maintain an opening equal or greater size than the vent. The baffle shall extend over the top of the attic insulation. The baffle shall be permitted to be any solid material. (402.2.3)
	Hot water pipe insulation	NO REQUIREMENT	<b>Insulated to R-3</b> , <sup>3</sup> / <sub>4</sub> or larger pipes with exceptions (403.5.3)
-	1		





Good Life. Great Resources.



Indicates Change

Requirement	2009 IECC	2018 IECC
Duct Insulation	Supply ducts in attics shall be insulated to a minimum of R-4. <u>Exception</u> : Ducts or portions thereof in conditioned space (403.2.1)	Supply and Return ducts in attics shall be insulated to a <b>minimum of R-6 or R-8</b> , depending on diameter. All other ducts shall be insulated to a <b>minimum of R-6 or R-4</b> . <u>Exception</u> : Ducts or portions in conditioned space (403.3.1)
Duct Testing	<u>Post construction</u> : Leakage to Outdoors: 8 cfm/100 sq. ft. Total Leakage: 12 cfm/100 sq. ft. <u>Rough-in</u> : Total Leakage: 6 cfm/100 sq. ft. Exception: Duct tightness test not required if most ducts located entirely within building envelope. (403.2.2)	Ducts tested to the following leakage rates: <u>Post construction</u> : Total Leakage: <b>4 cfm/100 sq. ft.</b> <u>Rough-in</u> : Total Leakage: <b>4 cfm/100 sq. ft.</b> Exception: Duct tightness test not required if all ducts located entirely within building envelope. (403.3.4)

## Other changes in the 2018 IECC

Indicates Change

Requirement	2009 IECC	2018 IECC
Thermally Isolated sunroom U-factor	Maximum fenestration U-factor shall be 0.50 and maximum skylight U-factor shall be 0.75. (402.3.5)	Maximum fenestration <b>U-factor shall be 0.45</b> and maximum skylight U-factor shall be 0.70. (402.3.5)
Buried Ducts in Attic	Not referenced	Ducts tested to have a maximum leakage rate of 1.5 cfm25/100 sq. ft. to the outside, are insulated with ≥ R-8 insulation, and have at least R-19 insulation above and to the sides of the ducts, <b>count as being in conditioned space</b> . (403.3.6)







# **Performance Testing**

#### A Great Benefit (and a new code requirement)







- Blower door test documents a home's air leakage performance
- Required by code
- Third party verification (some areas; performed by Inspectors)
- Provides solid data for final equipment adjustment and energy use/cost forecast
- Great liability protection for all involved





	AIR LEAKAGE REPORT			
Date:	May 02, 2012	Rating No.:	8016891 - 097	
Building Name:	802EastMcCartyStreet	Rating Org.:	ASERusa	
Owner's Name:	River City Habitat for Humanit	Phone No.:	314-894-2300	
Property:	802 East McCarty Street	Rater's Name:	Gary Fries	
Address:	Jefferson City, MO 65101	Rater's No.:	8016891	
Builder's Name:	River City Habitat for Humanit			
Weather Site:	Columbia, MO	Rating Type:	Confirmed	
File Name:	8016891 - 097 - eSTAR 2.0, TC, NR - 802 East M	Rating Date:	12/01/11	

		Blower door test	
se Infiltration		Heating	Cooling
	NaturalACH:	0.23	0.16
	ACH @ 50 Pascals:	3.78	3.78
	CFM @ 25 Pascals:	427	427
	CFM @ 50 Pascals:	670	670
	Eff. Leakage Area: [sq.in]	36.8	36.8
	Specific Leakage Area:	0.00018	0.00018
	ELA/100 sf shell: [sq.in]	0.96	0.96

Whole Ho

Duct Leal

Ven

ige	Leakage to Outside Units	Ductwork
	CFM @ 25 Pascals:	25
	CFM25 / CFMfan:	0.0214
	CFM25/CFA:	0.0181
	CFM per Std 152:	N/A
	CFM per Std 152 / CFA:	N/A
	CFM @ 50 Pascals:	39
	Eff. Leakage Area: [sq.in]	2.15
	Thermal Efficiency:	N/A
	Total Duct Leakage Units	CFM25/CFA
	Total Duct Leakage:	0.0181

ilation	Mechanical:	Air Cycler
	Sensible Recovery Eff. (%):	0.0
	Total Recovery Eff. (%):	0.0
	Rate (cfm):	50
	Hours/Day:	24.0
	Fan Watts:	150.0
	Cooling Ventilation:	Natural Ventilation

#### ASHRAE 62.2 - 2010 Ventilation Requirements

For this home to comply with ASHRAE Standard 62.2 - 2010 Ventilation and Acceptable Indoor Air Quality in Low-Rise Residential Buildings, a minimum of 44 cfm of mechanical ventilation must be provided continuously, 24 hours per day. Alternatively, an intermittently operating mechanical ventilation system may be used if the ventilation rate is adjusted accordingly. For example, a 88 cfm mechanical ventilation system would need to operate 12 hours per day, as long as the system operates to provide required average ventilation once each hour.

#### REM/Rate - Residential Energy Analysis and Rating Software v12.98



Date:	May 02, 2012
Building Name:	123 Main Street
Owners Name:	Jane Smith
Property Address:	123 Main Street Omaha, NE 68007
Builder's Name:	ABC Construction
Weather Site:	Omaha, NE
File Name:	101682391-097 eSTAR

Rating No.:81158891-901Rating Org.:Raters USAPhone:555-55555Rater's<br/>Name:John WilliamsRater's No:1234567Rating Type:ConfirmedRating Date:12/01/20

Date:	May 02, 2012	Rating No.:	8016891 - 097
Building Name:	802EastMcCartyStreet	Rating Org.:	ASERusa
Owner's Name:	River City Habitat for Humanit	Phone No.:	314-894-2300
Property:	802 East McCarty Street	Rater's Name:	Gary Fries
Address:	Jefferson City, MO 65101	Rater's No.:	8016891
Builder's Name:	River City Habitat for Humanit		
Weather Site:	Columbia, MO	Rating Type:	Confirmed
File Name:	8016891 - 097 - eSTAR 2.0, TC, NR - 802 East M	Rating Date:	12/01/11

AIR LEAKAGE REPORT

	Blower	door test
	Heating	Cooling
NaturalACH:	0.23	0.16
ACH @ 50 Pascals:	3.78	3.78
CEM @ 25 Pascals:	427	427
CFM @ 50 Pascals:	670	670
Eff. Leakage Area: [sq.in]	36.8	36.8
Specific Leakage Area:	0.00018	0.00018
ELA/100 sf shell: [sq.in]	0.96	0.96
	NaturalACH: ACH @ 50 Pascals: CFM @ 25 Pascals: CFM @ 50 Pascals: Eff. Leakage Area: [sq.in] Specific Leakage Area: ELA/100 sf shell: [sq.in]	Heating   NaturalACH: 0.23   ACH @ 50 Pascals: 3.78   CEM @ 25 Pascals: 427   CFM @ 50 Pascals: 670   Eff. Leakage Area: 0.00018   ELA/100 sf shell: [sq.in] 0.96

Duct Leakage	Leakage to Outside Units	Ductwork
	CFM @ 25 Pascals:	25
	CFM25 / CFMfan:	0.0214
	CFM25/CFA:	0.0181
	CFM per Std 152:	N/A
	CFM per Std 152 / CFA:	N/A
	CFM @ 50 Pascals:	39
	Eff. Leakage Area: [sq.in]	2.15
	Thermal Efficiency:	N/A
	Total Duct Leakage Units	CFM25/CFA
	Total Duct Leakage:	0.0181

Ventilation	Mechanical:	Air Cycler
	Sensible Recovery Eff. (%):	0.0
	Total Recovery Eff. (%):	0.0
	Rate (cfm):	50
	Hours/Day:	24.0
	Fan Watts:	150.0
	Cooling Ventilation:	Natural Ventilation

#### ASHRAE 62.2 - 2010 Ventilation Requirements

For this home to comply with ASHRAE Standard 62.2 - 2010 Ventilation and Acceptable Indoor Air Quality in Low-Rise Residential Buildings, a minimum of 44 cfm of mechanical ventilation must be provided continuously, 24 hours per day. Alternatively, an intermittently operating mechanical ventilation system may be used if the ventilation rate is adjusted accordingly. For example, a 88 cfm mechanical ventilation system would need to operate 12 hours per day, as long as the system operates to provide required average ventilation once each hour.

#### REM/Rate - Residential Energy Analysis and Rating Software v12.98







#### Whole House Infiltration

	Blower Door Test	
	Heating	Cooling
Natural ACH:	0.23	0.16
ACH @ 50 Pascals:	3.78	3.78
CFM @ 25 Pascals:	427	427
CFM @ 50 Pascals:	670	670
Eff. Leakage Area (sq. in)	36.8	36.8
Specific Leakage Area:	0.00018	0.00018
ELA/100 sf shell (sq. in)	0.96	0.96

AIR LEAKAGE REPORT			
)ate:	May 02, 2012	Rating No.:	8016891 - 097
uilding Name:	802EastMcCartyStreet	Rating Org.:	ASERusa
)wner's Name:	River City Habitat for Humanit	Phone No.:	314-894-2300
roperty:	802 East McCarty Street	Rater's Name:	Gary Fries
ddress:	Jefferson City, MO 65101	Rater's No.:	8016891
uilder's Name:	River City Habitat for Humanit		
Veather Site:	Columbia, MO	Rating Type:	Confirmed
ile Name:	8016891 - 097 - eSTAR 2.0, TC, NR - 802 East M	Rating Date:	12/01/11

		Blower	Blower door test	
ole House Infiltration		Heating	Cooling	
	NaturalACH:	0.23	0.16	
	ACH @ 50 Pascals:	3.78	3.78	
	CFM @ 25 Pascals:	427	427	
	CFM @ 50 Pascals:	670	670	
	Eff. Leakage Area: [sq.in]	36.8	36.8	
	Specific Leakage Area:	0.00018	0.00018	
	ELA/100 sf shell: [sq.in]	0.96	0.96	

Duct Leakage	Leakage to Outside Units	Ductwork
	CFM @ 25 Pascals:	25
	CFM25 / CFMfan:	0.0214
	CFM25/CFA:	0.0181
CFM per Std 152:		N/A
	CFM per Std 152 / CFA:	N/A
	CFM @ 50 Pascals:	39
	Eff. Leakage Area: [sq.in]	2.15
	Thermal Efficiency:	N/A
	Total Duct Leakage Units	CFM25/CFA
	Total Duct Leakage:	0.0181

Ventilation	Mechanical:	Air Cycler
	Sensible Recovery Eff. (%):	0.0
	Total Recovery Eff. (%):	0.0
	Rate (cfm):	50
	Hours/Day:	24.0
	Fan Watts:	150.0
	Cooling Ventilation:	Natural Ventilation

#### ASHRAE 62.2 - 2010 Ventilation Requirements

For this home to comply with ASHRAE Standard 62.2 - 2010 Ventilation and Acceptable Indoor Air Quality in Low-Rise Residential Buildings, a minimum of 44 cfm of mechanical ventilation must be provided continuously. 24 hours per day. Alternatively, an intermittently operating mechanical ventilation system may be used if the ventilation rate is adjusted accordingly. For example, a 88 cfm mechanical ventilation system would need to operate 12 hours per day, as long as the system operates to provide required average ventilation once each hour.

#### REM/Rate - Residential Energy Analysis and Rating Software v12.98







#### **Duct Leakage**

Leakage to Outside Units	Ductwork
CFM @ 25 Pascals:	25
CFM25/CFM fan:	0.0214
CFM25/CFA:	0.0181
CFM per Std 152:	N/A
CFM per Std 152/CFA:	N/A
CFM @ 50 Pascals:	39
Eff. Leakage Area (sq. in.)	2.15
Thermal Efficiency:	N/A
Total Duct Leakage Units:	CFM25/CFA
Total Duct Leakage:	0.0181

AIR LEAKAGE REPORT			
ate:	May 02, 2012	Rating No.:	8016891 - 097
uilding Name:	802EastMcCartyStreet	Rating Org.:	ASERusa
wner's Name:	River City Habitat for Humanit	Phone No.:	314-894-2300
roperty:	802 East McCarty Street	Rater's Name:	Gary Fries
ddress:	Jefferson City, MO 65101	Rater's No.:	8016891
uilder's Name:	River City Habitat for Humanit		
Veather Site:	Columbia, MO	Rating Type:	Confirmed
ile Name:	8016891 - 097 - eSTAR 2.0, TC, NR - 802 East M	Rating Date:	12/01/11

		Blower door test	
louse Infiltration		Heating	Cooling
	NaturalACH:	0.23	0.16
	ACH @ 50 Pascals:	3.78	3.78
	CFM @ 25 Pascals:	427	427
	CFM @ 50 Pascals:	670	670
	Eff. Leakage Area: [sq.in]	36.8	36.8
	Specific Leakage Area:	0.00018	0.00018
	ELA/100 sf shell: [sq.in]	0.96	0.96

Whole H

Duct Leakage	Leakage to Outside Units	Ductwork
	CFM @ 25 Pascals:	25
	CFM25 / CFMfan:	0.0214
	CFM25/CFA:	0.0181
	CFM per Std 152:	N/A
	CFM per Std 152 / CFA:	N/A
	CFM @ 50 Pascals:	39
	Eff. Leakage Area: [sq.in]	2.15
	Thermal Efficiency:	N/A
	Total Duct Leakage Units	CFM25/CFA
	Total Duct Leakage:	0.0181

Ventilation	Mechanical:	Air Cycler
	Sensible Recovery Eff. (%):	0.0
	Total Recovery Eff. (%):	0.0
	Rate (cfm):	50
	Hours/Day:	24.0
	Fan Watts:	150.0
	Cooling Ventilation:	Natural Ventilation

#### ASHRAE 62.2 - 2010 Ventilation Requirements

For this home to comply with ASHRAE Standard 62.2 - 2010 Ventilation and Acceptable Indoor Air Quality in Low-Rise Residential Buildings, a minimum of 44 cfm of mechanical ventilation must be provided continuously, 24 hours per day. Alternatively, an intermittently operating mechanical ventilation system may be used if the ventilation rate is adjusted accordingly. For example, a 88 cfm mechanical ventilation system would need to operate 12 hours per day, as long as the system operates to provide required average ventilation once each hour.

#### REM/Rate - Residential Energy Analysis and Rating Software v12.98







#### Ventilation

Mechanical:	Air Cycler	
Sensible Recovery Eff (%):	0.0	
Total Recovery Eff (%):	0.0	
Rate (cfm):	50	
Hours/Day:	24	
Fan Watts:	150.0	
Cooling Ventilation:	Natural Ventilation	

Date:	May 02, 2012	Rating No.:	8016891 - 097
Building Name:	802EastMcCartyStreet	Rating Org.:	ASERusa
Owner's Name:	River City Habitat for Humanit	Phone No.:	314-894-2300
Property:	802 East McCarty Street	Rater's Name:	Gary Fries
Address:	Jefferson City, MO 65101	Rater's No .:	8016891
Builder's Name:	River City Habitat for Humanit		
Weather Site:	Columbia, MO	Rating Type:	Confirmed
File Name:	8016891 - 097 - eSTAR 2.0, TC, NR - 802 East M	Rating Date:	12/01/11

AID I EAKAGE DEDODT

		Blower door test	
Whole House Infiltration		Heating Cooling	
	NaturalACH:	0.23	0.16
	ACH @ 50 Pascals:	3.78	3.78
	CFM @ 25 Pascals:	427	427
	CFM @ 50 Pascals:	670	670
	Eff. Leakage Area: [sq.in]	36.8	36.8
	Specific Leakage Area:	0.00018	0.00018
	ELA/100 sf shell: [sq.in]	0.96	0.96

Duct Leakage	Leakage to Outside Units	Ductwork
	CFM @ 25 Pascals:	25
	CFM25 / CFMfan:	0.0214
	CFM25/CFA:	0.0181
	CFM per Std 152:	N/A
	CFM per Std 152 / CFA:	N/A
	CFM @ 50 Pascals:	39
	Eff. Leakage Area: [sq.in]	2.15
	Thermal Efficiency:	N/A
	Total Duct Leakage Units	CFM25/CFA
	Total Duct Leakage:	0.0181

Ventilation	Mechanical:	Air Cycler	
	Sensible Recovery Eff. (%):	0.0	
	Total Recovery Eff. (%):	0.0	
	Rate (cfm):	50	
	Hours/Day:	24.0	
	Fan Watts:	150.0	
	Cooling Ventilation:	Natural Ventilation	

ASHRAE 62.2 - 2010 Ventilation Requirements

For this home to comply with ASHRAE Standard 62.2 - 2010 Ventilation and Acceptable Indoor Air Quality in Low-Rise Residential Buildings, a minimum of 44 cfm of mechanical ventilation must be provided continuously, 24 hours per day. Alternatively, an intermittently operating mechanical ventilation system may be used if the ventilation rate is adjusted accordingly. For example, a 88 cfm mechanical ventilation system would need to operate 12 hours per day, as long as the system operates to provide required average ventilation once each hour.

#### REM/Rate - Residential Energy Analysis and Rating Software v12.98







### Ventilation and I.A.Q.



Building Envelope + Air Sealing Package + HVAC Design, Equipment & Installation + ERV/HRV + Water Heating Design

= Occupant Comfort







# Any questions?







# Moisture Management

#### It Connects EVERYTHING!






### The Major "Damage Functions"

- Liquid water (bulk and capillary)
- Air-borne water
- Vapor
- Radiation (UV degradation)
- Pests
- People















### **Prioritizing Moisture Movement**

#1 – Bulk Water
#2 – Capillary Water
#3 – Air-Transported Moisture
#4 – Diffusive Moisture Movement









#### Bulk Water Management – Priority #1





## The key is proper drainage!







### **Always Allow For Drying**

**Exterior Conditions** Temperature: 80° F Relative Humidity: 75% Vapor Pressure: 2.49 kPa Conditions Within Cavity

Temperature: 120° F Relative Humidity: 100% Vapor Pressure: 11.74 kPa



#### **Interior Conditions**

Temperature: 75° F Relative Humidity: 60% Vapor Pressure: 1.82 kPa

Vapor is driven both inward and outward by a high vapor pressure differential between the brick and interior and the brick and exterior

### **Properly Lap Flashing**

• The mason's flashing (black) was installed after and in front of the house wrap (green). This is reverse flashing that will trap any drain water that gets past the brick veneer.









#### **Direct Water Away From Corners**











### Capillary Moisture Flows - Priority #2



Capillary suction draws water into porous material and tiny cracks Cavity acts as capillary break and receptor for capillary water interrupting flow

Image courtesy of Building Science Corp.



**NEBRASKA** Good Life. Great Resources.



#### **Foundation Moisture Management**



45

#### Sill Plates Need Capillary Breaks











### Air Transport of Moisture – Priority #3

- Air carries a **lot** of water
- Air leakage
  - Moisture flow
    - 4X8 Drywall
    - 70 F
    - 40% RH
    - 1 square inch hole
- Flow quantity30 Quarts of water!!



Image courtesy of Building Science Corp.



**NEBRASKA** Good Life. Great Resources.





Image courtesy of Building Science Corp.





- Migration of moisture by means of vapor pressure differential
- Occurs in either direction based on climate conditions and exterior/interior levels of humidity
- Different building materials have different permeability



## Air Movement

#### Air Movement Seeks Balance







#### How Does Air Get Around?

#### Air In = Air Out

For air movement you need:

- A hole
- A driving force
- Another hole









#### **Internally Generated Air Pressure**



#### Expansion of Conditioned Space

- Conditioned space boundaries moving towards exterior surfaces of building
- Garage isolated from house by air barrier/pressure boundary
- Garage ventilated and conditioned independently of rest of conditioned spaces







#### **Batt Insulation Grading**

## **Code Compliant** Not Acceptable Grade III: 2% - 5% Grade I: Almost no gaps Grade II: Up to 2% RESNET protocol for the effect of missing insulation on installation grade

Diagrams from the HERS Standards







## Heat Transfer

A Triple Threat







#### Heat Transfers in 3 Ways

- Convection Through fluids (liquid or gas)
- Conduction Through solids
- **Radiation** Mostly windows









### **Practical Application - Windows**

- Heat always moves from hot to cold
- Always a mix of transfers
- Different rates of transfer can be important









### **Condensing Surface Temperatures**

- Dewpoint of interior air =  $37^{\circ}F$
- Where will condensation occur? Inside surface of exterior sheathing
- One Solution? Interior vapor retarder, but what type and at what "cost?"









#### Major Building Envelope Protection Systems

- Water Barrier
- Air Barrier
- Thermal Barrier
- Vapor Profile (not just the designated vapor retarder)
- Maintenance documents







#### "You don't get what you expect, you get what you inspect!"









## **HVAC System**

Don't Forget the **"V"** 







### **HVAC Design and Loads**

#### **Oversized systems**:

- Less comfort
- Less efficient
- Poorly handles moisture
- Premature equipment failure

#### **<u>Right-sized systems</u>**:

- Better operating efficiencies
- Greater comfort
- Healthier indoor environments
- Better moisture control







### **HVAC Design and Loads**

- Properly designed HVAC systems rely on scientific criteria and a systematic method to match the loads required for health and comfort:
  - ACCA Manual J Residential Load Calculation
  - ACCA Manual S Residential Equipment Selection
  - ACCA Manual D Residential Duct Systems
- Reports should be submitted with permit application









## $\textbf{H}\underline{\textbf{V}}\textbf{AC} \text{ Design and Loads}$

Today's homes risk health problems for occupants because:

- They are not properly ventilated:
  - < 3 ACH
- More chemicals and products are used in and around a house:
  - Concentration levels are often 2 to 100 times higher than outside.







#### **Balanced Ventilation**

- Blows air into and out of the house
- Is cost effective by reclaiming energy from exhaust and supply airflows (60%-80%!)
- Balances exhaust and supply flows (minimizes pressure differential)
- Maintains the Minimum Ventilation Guideline automatically with proper set-up







## Appraisals and Resale Value





ooda Elie. Oreat Resources



#### **Green Appraisers**

- Unlike granite countertops, energy efficiency investments are not always visible at a glance
- Utilize certifications, labels, ratings, and scores
- Make sure appraisers are accurately valuing sustainable properties
  - Residential Green and Energy Efficient Addendum - Assists appraisers in analyzing residential "Green" features and properties.













#### Residential Green and Energy Efficient Addendum!

- Resources for realtors and appraisers on properly valuing energy efficiency/green features
  - Educational materials
  - List of designated appraisers
  - Trainings
- For more information: http://www.appraisalinstitute.or g/education/green\_energy\_ad dendum.aspx





	-		100	100			
.1	Residential Green and Energy Efficient Addendum						
	Clier	nt.	20.08.030.0040700				100000
AI Reports	Subj	ect Property	F				
Form 820.06*	City	5		s	ate:	Zip:	
Additional	resources to	aid in the w	aluation of green prope	rties and the co	mpletion of thi	s form can be f	bund at
The annraiser hore	http://	www.appra	isalinstitute.org/educa	bonygreen_ene	ngy_addendum	Làtipx	
<ul> <li>has been co</li> </ul>	insidered in th	he appraise	's development of the	opraisal of the s	ubject property	y anly far the cl	ient and
intended us	er(s) identifie	ad in the app	oraisal report and only f	or the intended	use stated in th	e report.	thorn ident
by the appr	aiser as the cl	lient or inte	nded user(s) in the repo	rt.	ee open by pa	Thes outer than	Church Interna
<ul> <li>is the result</li> </ul>	of the appra	iser's routin	e inspection of and ing	iries about the :	ubject property	s green and er	nergy efficie
the appraise	er's opinions	or conclusio	Data provided herein i ns.	s assumed to be	accurate and it	found to be in	empricould.
<ul> <li>is not made</li> </ul>	as a represen	ntation or a	a warranty as to the el	ficiency, quality	function, open	ability, reliabilit	y or cost say
assessment	s.	of the subje	ct property in general,	and this addendi	an should not a	te relied upon t	or such
Green Building: The	practice of o	reating stru	ctures and using proces	ses that are envi	ronmentally re	sponsible and H	isource-effi
practice expands and	g s Hecycle fr ś complemen	to the classi	c building design conce	peration, maint ins of economy.	enance, renova utility, durabilit	tran, and decor y, and comfort	(US EPA), H
Performance building	g and green b	building are	often used interchange	abiy.			
Co Elements of Gene	a Building (	I onton hulling	first has attached as that	Part laste they also	discoute of succ	the building know	and in 197 cit
water, (3) energy, (4	materials, (5	5) indoor en	vironmental quality, an	d (6) maintanan	e and operatio	n. The energy a	nd water
elements are the mo	st measurabl	e elements	of green or high perform	nance housing.	Appraisans need	savings amour	its to develo
income approach to	support energ	gy efficient	contributory value.				
THIRD-PARTY VE	RIFICATION	S (See two	es defined in plassa	rvì.:	_		
The following verifie	d items are co	onsidered w	ithin the appraisal anal	rsis of the subject	t property:		
							The second s
Seaso Castification	Environmen	ntal Protecti	on Agency (EPA):	🗆 tn	door airPLUS D	1 WaterSense	ENERGY:
Green Certification	Environmen Energy Dep	ntal Protecti artment (D)	on Agency (EPA): DE):		door airPLUS D ro Energy Read	1 WaterSense ly Home (ZERH)	C ENERGY:
Green Certification Certifications attest that the home meets	Environmer Energy Dep Home Innor Home Innor	ntal Protecti artment (Di vation Reservation Reservation Reservation	on Agency (EPA): DE): arch Labs NGBS Home R arch Labs NGBS New Ho	emodel: me: D8/	toor airPLUS C ro Energy Read once OSh	I WaterSense ly Home (ZERH) er □ Gold	ENERGY:
Green Certification Certifications attest that the home meets certain minimum	Environmen Energy Dep Home Inno Home Inno Living Build	ntal Protecti artment (D) vation Reservation Reservation fing Challene	on Agency (EPA): DE): arch Labs NGBS Home R arch Labs NGBS New Ho re (LBC):	emodel: me: 08	toor airPLUS C ro Energy Read once Shy ing Building Ce	WaterSense ly Home (ZERH) er Gold rtifked G P	ENERGY:
Green Certification Certifications attest that the home meets certain minimum thresholds.	Environmen Energy Dep Home Inno Home Inno Living Build Passivhaus Passive Hos	ntal Protecti artment (D) vation Reservation Reservation Reservation Standard: 256 Institute	on Agency (EPA): DE): arch Labs NGBS Home R arch Labs NGBS New Ho te (LBC): -US:	emodel: me: Dav Dv Dv Dv	toor airPLUS C ro Energy Read once Sky ing Building Ce 9 Love Energy HUS+ 2015	WaterSense ly Home (2ERH) er Gold ntified DP D EnerPhit	ENERGY Em vtal Cartific Passive H
Green Cartification Cartifications attest that the home meets cartian minimum thresholds.	Environmen Energy Dep Home Inno Home Inno Living Build Passivhaus Passive Hou USGBC LEE	ntal Protecti artment (D) vation Reseivation Reseivation Reseivation standant: standant: standant: sta Institute D:	on Agency (EPA): DE): arch Labs NGBS Home R arch Labs NGBS New Ho te (LBC): US:	emodel: me: Dia Dia Dia Dia Dia Dia Dia Dia Dia Dia	toor airPLUS C ro Energy Read once Shi ing Building Ce 8 Low Energy HUS- 2015 rolfed DS	WaterSense ly Home (2ERH) er Gold rtified P EnerPhit her Gold	ENERGY Ens vtal Cartifics Passive H
Green Cartification Cartifications attest that the home meets cartier minimum thresholds.	Environmen Energy Dep Home Inno Home Inno Lising Build Passivhaus Passive Hou USGBC LEB Other:	ntal Protecti artment (D0 vation Rese vation Rese ing Challeng Standard zie Institute D:	on Agency (EPA): DE): arch Labs NGBS Home R arch Labs NGBS New Ho se (LBC): cUS: cUS:	emodel: me: Dis Dis Dis Dis Dis Dis Dis Dis Dis Dis	toor airPLUS E ro Energy Read onse Shi ing Building Ce 8 Low Energy HUS+ 2015 rolfed S	WaterSense y Home (258H) er Gold rtified DP EnerPhit Iver Gold	DENERGY DEm Vtal Cartific DPassive H DPassive H
Green Certification Certifications attent dist the home meets certain minimum thresholds.	Environmen Energy Dep Home Inno Home Inno Using Build Passivhaus Passive Hot USGBC LEFU Other: Date Verified:	ntal Protecti artment (D) vation Rese vation Rese ing Challeng Standard zie Institute D: Green C Organiz	on Agency (EPA): DE): arch Labs NGBS Home R arch Labs NGBS New Ho te (LBC): US: artification Version: ation URL:	emodel: me: 08 09 09	toor airPLUS E ro Energy Read onze Shi ing Building Ce 1 Low Energy HUS+ 2015 mifed S ABOVI II Ver	Wate/Sense by Home (2014) er Gold rtified 2 P EnerPhit hver Gold E VALID ONLY II fication review	ENERGY
Green Certification Certifications attent that the home meths certain minimum thresholds.	Environmen Energy Dep Home Inno Home Inno Using Build Passivhaus, Passive Hos USGBC LEE Other: Date Verified: / /	ntal Protecti artment (D) vation Reservation Reservation Reservation Standard: standard: use Institute D: Green C Organiz	on Agency (EPA): 2012: 2014: Anth Labs NGBS Nome II 2014: Anth Labs NGBS New Ho ter (LBC): 2015: 2015: 2015: 2016: 201	emodel: me: 8 00 09 04 04	toor airPLUS E ro Energy Read once Skhone Skhone Skhone NUS>2015 rhlfed SS ABOVI Ver Ver	UkaterSense by Home (ZERH) rtified D P EnerPhit her Gold Evalution Concern fication review fication review	ENERGY Estimate Passive H Ration CHECKED: ed on site ed to this re
Green Certification Certifications attest that the borne meets certain minimum thresholds.	Environment Energy Dep Home Inno Uving Build Passive Hou USGRC LEFL Other: Date Verified: J / RESNET's H Rating ID to	ntal Protecti artment (D) vation Reseauration Reseauration Reseauration Standard sie Institute D: Green C Criganiz ERS	on Agency (EPA): 201): arch Labs NGBS Home II arch Labs NGBS New Ho te (LBC): 405: 4	in in 22 armodel: me: 8 armodel: 0 br 0 br 0 br 0 ca	toor airPLUS E ro Energy Read once Ski ing Building Ce B Low Energy HUS> 2015 rnified SK Read Read Read Read Read Read Read Read	UkaterSense y Home (253H) er Gold Cliffed D P EnerPhit hver Gold E VALID ONLY I fication review fication review fication review	ENERGY     Ensore     Ensore     Ensore     Creteckee     Creteckee     don site     d to this reg     dated_/_
Green Cartification Cartifications attent that the home meets cartain misciname thresholds.	Environment Energy Dep Home Inno Using Build Passive Hou USGRC LEFI Other: Date Verified: J / RESNET's H Rating (0 to D Sampling	ntal Protecti artment (Di vation Rese ing Challeng Stanstant se Institute D: Green C Organis ERS (150): Rating	on Agency (EPA): DE: arch Labs NGBS Home A arch Labs NGBS New Ho e (LBC): US: US: US: ES: Estimated energy La Entry Somiss inclu- Score bolves 100 ind	in 23 emodel: me: 8 9 9 9 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	teor airPLUS C ro Energy Read onas Shifting C ing Building C I Low Energy ruli5x 2015 rulifed S Ver Ver res: 5 /vea resting & Coolin c5 are expected	United Series Withome (25214) er Gold Cliffed D P ExertPhit Wer Gold EventPhit Fication review Fication review Fication review CLWh rate P	ENERGY     Ensity     Ensity     Ensity     Cartific     Passive H     Passive H     Passive H     CHECKED: ed on site ed to this rep e dated _/_ in dwerope I
Green Certification Certifications attent that the borne meets contain minimum thresholds.	Environmen Energy Deg Home Inno Home Inno Issing Build Passive Hos USGBC LEEI Other: Date Venflied: J J RESNET's H Rating (D to Sampling Projecter	Ital Protecti artment (DC vation Reservation Reservation Reservation Reservation Reservation Standard: Lise Institute D: Green C Organiz (Rating d Rating	on Agency (EPA): DE: arch Labs NGBS Home R arch Labs NGBS New Ho se (LBC): US: ustification Version: ustification Version: Estimated energy sa Score below 100 ind code home per squa	in in 22 senodat: ma: 8 0 U 9 0 P 0 C 4 C 4	teor airPLUS C ro Energy Read onae Ski ing Building Ce ILOW Exergy HUS> 2015 rnified Ski Ver Ver Nets S Nearesting & Coolin ts are expected to a Report estim	WitterSansa Hy Home (2530H) er Gold rtifled P EnarMhit hver Gold Kotter Kullen OnLy in fication review Ecation attachCkWh rab 0 fo be kower th notes energy co	DEREGY      DEREGY
Green Certification Certifications attact that the home meets orderin minimum thresholds.	Environmen Energy Deg Home Inno Home Inno Living Build Passive Hou USGBC LEEF Other: Date Verified: J / J RESNET's H Racing (D to Samping) Projecter Conferes Opersument	etal Protecti eartment (Di varion Reservation Reservation Reservation Standard: see Institute D: Green C Organia ERS 150): g Rating d Rating d Rating d Rating e Forerv	on Agency (EPA): 2012 with Labs MGBS Nome R Labs MGBS Nome He et IBC: uts: Ectimated energy ta Ectimated energy ta Ectimated energy ta Ectimated energy ta Ectimated energy ta Ectimated energy ta Ectimated energy ta Score below 100 mB.	in 19 19 19 19 19 19 19 19 19 19 19 19 19	teor airPLUS C ro Energy Read once Shi ing Building Ce RUSS 2015 rtified Si RUSS 2015 rtified We Use net S_Alear teoring & Coolin to are expected tex Areport estim "confirmed ra	WaterSense     WiterSense     WiterSense     Ver □ Gold     Cold	DENERGY
Green Certification Certifications attest that the borne series confare neinstra- tionsholds.	Environmer Environmer Home Inno Home Inno Home Inno Passhhau Passhhau Passhhau Passhhau Passhhau Passhhau Passhhau Passhhau Dother AESNET's H Score DOE's Hom Score	etal Protecti eartment (Di vation Reservation Reservation Reservation Reservation Reservation Standard: size Institute D: Green C Organiz ERS 1501: g Rating d Rating d Rating e Energy	on Agency (EPA): DE: with Labs NGBS frome in with Labs NGBS frome in with Labs NGBS frome in en ILBCI: USS: Exempt Sounds and Course below 100 indi- code home por space Score below 100 indi- code home por space Exempt Sounds and Extinuation of Sedetoam Extinuation of Sedetoam	in in it is in the second seco	teorainPLUS C ro Energy Read once Shine Ce on Bullow Energy rUS> 2015 rUS> 2015 rU	WaterSense     Vriew (228H)     wer □ Gold     Cold	DNERGY:     DNERGY:     DEFINITION     DEFINITION     DEFINITION     DNERGY      DN
Green Certification Certification status that the hore meets outlan minimum threeholds. Energy Label Labels disclose the state file hore's energy asets.	Environmer Energy Dep Home Inno Home Inno Home Inno Home Inno Passiheau Passiheau Passiheau Passiheau Passiheau Passiheau Dother: AESNET's H Score Score (1 to Dothers	tal Protecti artment (D) vation Reservation Reservation Reservation Reservation Reservation Reservation Reservation Reservation Standard: Standard: Crigarita Crigorita Crigarita Crigarit	on Agency (EPA): DE ExtrA Lab NGES Home M ter (Lab NGES Home He e (LAG): et al. (LAG): et	In in it is horder to be a second of the sec	toor and ULS C ro Energy Read once Sharpy Read once Sharpy Read Blow Exercise 105 2015 reliable Store We We We We We We We We We We We We We	2 WaterSense y Home (ZERH) wr □ Gold CRAID ONLY 1 Control Contro	DNERGY     DEMON     DEMON     DEMON     DEMON     Passbee     Passbee     Passbee     Reat     CHECKED-     do as the     dated/_     the demonstrate     dated/_     in average 1
Green Certification Certifications attest dut the hone meets online minimum thresholds. Energy Label Label dackse the attest the know's amegy assets.	Environmer Energy Deg Homa Inno Homa	tal Protects artment (D) vation Reseavation Reseavation Reseavation Reseavation Reseavation Standard: ase Institute D: Green C Organia ERS 150]: g Rating d Rating e Energy 10]: core a Score	on Agency (EPA): DE: with Labs NGES Home // Home // Labs NGES Home // In Labs NGES Home // In Labs NGES Home // In Labs NGES Home // Score Home // Home // H	int in a second	too airtus c ro Energy Read onue Shing Building C I too Energy rifled S 2015 Refer S S August We Ve We Ve We C We C We C We C We C We C We C We	UNITATIONAL W Home (ZEIH) W Home (ZEIH) W Home (ZEIH) W Look (Color Color	DNERGY     DEMON     DEMON     DEMON     DEMON     Passbae     Passbae     Passbae     Rati     CHEDRED     de on state     datad     _/_     an average l     datad     _/_     an average l
Green Certification Certifications attest dut the home meets certain minimum thresholds. Energy Libel Label attaches the attest the home's energy such.	Environmen Environmen Environ Europe Homai Inno Living Build Passive Hou Juscelle Build Passive Hou Juscelle Commen- Base Verificat Confirmed Conf	tal Protecti artment (Di vation Rese, vation Rese, vation Rese, vation Rese, vation Rese, vation Rese, reg Challen Di ERS Cogania ERS Cogania ERS Cogania di Rating di Score: di	on Agency (IRPA): DEI arch Labs NGES Home # Kernet Labs NGES Home # In 1865: New Ho In 1865: New Ho In 1865: New Home antification Version: Entimetated analysis Entimetated analysis Entimetated analysis Estimated analysis Score below 120 and Control Score Score 200 Control Score 200 Control Score Score 200 Control Score Score 200 Control Score Score 200 Control Score 200 Contro	intermediation in the second s	toor airPULS E ro Energy Read once □ Shi ing Building ⊂ Shi it lose Exerpt rilfed □ S Refer □ Shi Ver □ Ver □ Ver □ Ver □ Ver □ Ver 0 Confirmed ra of Cooline or Confirmed ra of Cooline of Cooline o	U WaterSenze y Home (ZEBH) with the second secon	ENLENCY:     Enveroperation
Green Certification Cardification attack the hore meets orbit observes thresholds.	Environment Enangy Deg Homa Inno Homa Inno Homa Inno Homa Inno Using Laber Passive Hos Using Laber Other: Date Verified: Projecter Score I Score I Score I Other Ener Range I Range I	tal Protects artment (Di variment (Di variment (Di variment (Di variment (Di variment (Di variment) see institute Di ERS	on Agetroy (EPA): DE EVACL Lab NGES Home Ho Home NGES Home Ho Home Home Home Home Home Home Home Home Estimated analysis and Score Bobies 100 Am Home Array Soundary In Score Bobies 100 Am Home, Home Sneegy Estimated Analysis Score Bobies Home Analysis Estimated Analysis Score Bobies Home Analysis Estimated Ana	Interpretation     Interpre	too airVLS ⊆ ro Energy Read on a □ Silv ing Building ⊂ I too Energy rilifed □ S ⊆ □ Year Silve ⊂ Silve U Year U Y	UNDERFECTION V Hame (ZEEH) V Hame (ZEEH) Construction	DRERGY:     DRERGY:     DEFINITION     DEFINITION     DEFINITION     Resting H     Resting H
Green Certification Certification states that the hore water certain ministra- thresholds. Energy Label Labels disclose the state for hore's energy water.	Environment Environment Franzo Dego Homai Inno Homai Inno Living Build Passible Hos Jassible Hos Usfaffielt Jassible Hos Other: Date Verifielt Jassible Hos Confirmit Date Verifielt Projecte Confirmit Confir	tal Protecti artment (Dr varion Rese varion Rese ing Challeng Standard: are institute Dr ERS 150]: g Rating d Score g Score to 	on Agency (IRA): OE Exerch Labs NGBS Never Ho IRA (Labs NGBS Never H	intervent of the second secon	toor air/U.S. E ro Energy, Read- ing Building Ca J Lone Sengre, HUS-2015 riffled □ S I Lone Sengre, HUS-2015 riffled □ S I Lone Sengre, U Lone Sengre, Sengre	U Waterdonna yy Home (2284) w ☐ Gold Charles A Control	Envenion     Envenion     Envenion     Envenion     Envenion     Ratific     Passive H     Ratific     Ratific     Retrict     Envenion     Envenion     Envenion     Stic test.     dated      In average A     rage energy
Green Certification Certification states (out the horn methods) orbit ministrum threshold).	Environmer Environmer Homs Inno Homs Inno Living Baill Passible Hos Passible Hos Differ Date Verified: Confirmit Score Score Score (1 to Confirminal DDE's Hom Score (1 to Confirminal Confirminal DDE's Hom Score	tal Protects attrement (DV vation Reservation Reservatio Reservation Reservation Reservati	on Agency (IRA): DE Exclusion NGES Home # NGES Home # Influences and the Second Base and Second Base Exclusion URL: Enterpresent and the Second Base Enterpresent and the Second Base Exclusion URL: Enterpresent and the Second Base Exclusion and the Second Base Second Base Exclusion and the Second Base Second Base Exclusion and the Second Describe energy Lab Rating Version: Tables Area Second Base Rating Version: Texture Second Base Rating Version: Texture Second Base Second Base Secon	In        In        In        In        In        In        In        In        In         In         In         In         In          In          In	too air/U.S € Teneny Read or Energy Read one Data Energy inte Building Ce B Low Energy Hilled S 10 P Confined Nergy & Confin Vergy & Confin Vergy & Confin Vergy & Confin Vergy & Confin S are expected energy cost be to r _ C kWh ratio Read Confined Confined P Confined Confined Confined Confined P Confined Confined Confined Confined Confined P Confined Conf	UNDERGENERATION OF A CONTRACT	ENLENCY:     Enversore     Enversore     Enversore     Control Control     Control     Control     Control     Control     Control     Control     Control      Control
Green Certification Certification state that the home sets certain ministrum thresholds. Energy Label Labels durings the sate the home's anargy assets.	Environment Environment Hanne Innon Hanne Innon Hanne Innon Baster Hanne Hanne Innon Hanne Innon Hanne Innon Other: Date Handing (10 Other Date Handing (10 Other Date Hanging (10 Other Score I to Other Enrich Score I to Other Enrich Score I to Date Hange I Date Hange I Hange I H	tal Protect: artmant (DV vation Rese: vation Rese: vation Rese: artmat (DV Standard: ae Institute D: Green C Organia e EnS 150): g Rating d Rating d Rating d Rating d Rating d Score gy Score: to ): Score or Organia Score or Organia	on Agency (IEA): DE EUC: Lab NGES Near H; encl Lab NGES Near H; Encry Sources inclu- Encry Sources in	In the second seco	ABOV aPULS E or Server, Standard Server, Standard Server, Standard Server, Standard Server, Standard Server, Standard Server, Server, Standard Server, Server, Server, Standard Server, Server, Server, Standard Server, Serve	Votard Zender     Votard	ENLENCY:     Environment
Green Certification Certification states furth the hore methods order noisesant thresholds.	Envirgumer Envirgumer Home Inco Uning Build Pasishraus, Pasishraus	tal Protects attement (DV vation Reseavation Reseavatio Reseavation Reseavation Reseavatii	on Agency (IEA): OE Excito Labo MGES Home He include MGES New He In 1820: Sector Labo MGES New He In 1820: Sector Labo MGES New He Inflication Version: Extended New 200 mG code home per super Score below 200 mG code home per super Extended new go as Energy Society and the home Describe new go Labo Describe new go	In      In	toor airPLLS C toor airPLLS C onceSh ing Building C Sh Ing Building C Sh Ing Building C Sh Ing Building C  Very Very Very Very Very Very Very Very	Votard Series     Votard	Encency     E
Green Certification Carditations attack the horn methods order neining thresholds.	Envirgument Envirgument Home Innop Home Innop Jaines Parallel Passiberhaus Passiberhaus Juscope Lisse Other Date Verified Sorre (Lisse Other Envirg Range (Lisse Other Envirg Range (Lisse Other Envirg Range (Lisse Other Envirg Range (Lisse Other Envirg Range (Lisse Other Envirg Range (Lisse Other Envirg	tal Protect: artment (DV vation Reseauring Challeng Standard: ase institute DI Green C Organia ERS C Rating d Rating d Rating d Rating d Score gy Score: Score of Organia Score of Organia Score of Organia	on Agency (IRA): DE Exercic Labs NGES Home & Introduction NGES Home & Introduction NGES Home & Introduction Version:	In      In	boox airPULS_C     boox airPULS_C     crearsy Read     crearsy Read     file	Votard Ziesen     Votard     Vo	ENLENCY:     Employ:
Green Certification Certification strate dut the home strate certain ministra- thresholds. Energy Label Laber Jackson (Ma Laber Jackson (M	Environment Environment Home Innov Home Inno	tal Protect: artement (DV vation Reseauce) Standard: artematic (DV Standard: artematic (DV Standard:	on Agency (IEA): DEI Euror Labo NGES more A ench Labo NGES more A ench Labo NGES more the ench Labo NGES more the Estimated energy tab home . Home Energy Labo Describe energy Labo Reting Versions	int       int      int        int         int         int        int         int         int         int          int           int	boox airPLLS C or Serving Acade     once C Serving Read Serving Acade     once C Serving Read Serving Acade     once C Serving Academy C Serving     once C Serving Academy C Serving     once C Serving Academy C Serving     once Serving     once C Ser	Votational     V	ENERGY      ENERGY      ENERGY       ENERGY
Green Certification Certification states for the hore methods or full in hore methods or full in hore the state for hore 's among a soft. Netfield Energy In provements Only include	Environment Environment Environment Home Innov Home Innov Home Innov Passinhaux, Passinhau	tal Protection actives that Protection actives to the second seco	on Agency (IRA): OE Exarch Labo NGES Home H Exarch Labo NGES Home H In 1825 Construction of the Construction and the Construction of the Construction of the Construction of the Construction of the Construction of the Construction of the Construction of the Construction of the Construction of the Construct	In	there are provided in the second	Votational     V	ENERGY     Energy
Green Certification Carditations attack the horn methods orbit the horn methods orbit neininum threshold.	Envirgument Envirgument Envirgument Home Linno Home Linno Home Linno Passibhase. Passibhase. Passibhase. Passibhase. Passibhase. Passibhase. Passibhase. Passibhase. Passibhase. Passibhase. Passibhase. Passibhase. Passibhase. Passibhase. Passibhase. Date Verification. Explain ene Confirmed Date Verification. Explain ene Cast of imp Date	Hall Protects and Annual (D)	on Agency (IEA). DE Exct Lab NGES How his has NGES How his entitication Nession	and the second sec	ABOW     ABOW     ABOW	VALID CONLY II	DRERGY      DREGY      DRERGY
Green Certification Certification states for the hore states orbit the hore states orbit neistant thresholds. Energy Label Labels disclose the state the hore's energy seeks warpy seeks. Verified Energy improvements. Crity robude improvements.	Envirgumes	hal Protects atoment (D) diversified and the second ing Challmon faces ing Challmon faces	on Agency (EPA): DE DE texts Lab NGBS New He in Lab NGBS New He and text Lab NGBS New He and text Lab NGBS New He refification Version: Estimated energy is Energy Sounds(c) Estimated energy is Estimated energy is Estimated and participation Score below 200 nd cade home per space Estimated energy is Score below 200 nd Common and the home Estimated energy is Describe energy Lab Nating Version: Thomeseurprotect age re- tion URL 10 dbmer texts and the home re- station NRL: 10 per and the second age homesents: S	In      In	book and VLSS. Experiments     once and the second se	Vietner (2586)     Vietner	Duelkoy     Duelkoy     Dentkoy     D



## Marketing High Performance homes







#### **High Performance Homes**

- High-performing homes cost less to heat and cool, are more comfortable, and are healthier for their occupants.
- 69% of real estate agents said promoting energy efficiency in listings was very or somewhat valuable
- Immediate benefits energy savings, comfort, and health
- Long term-benefits higher selling price







#### Energy Efficiency is a Must-Have for Home Buyers

- A survey done by the NAHB in 2018 showed 46% of builders reported that marketing green homes was easier than marketing non-green homes
- Energy efficient homes also keep residents in their homes longer and sell more quickly than non-energy efficient homes.
- Green certified homes have a higher market value than less efficient homes
- The odds of mortgage default are also one-third less for ENERGY STAR rated homes











## Key Takeaways

- 2018 IECC has new requirements for:
  - Air sealing
  - Duct sealing
  - U-Factor
  - R-Values
  - Performance Testing
- Controlling moisture is critical
  - Proper air sealing is key
  - Right-sizing HVAC is required
  - Mechanical ventilation must be installed and takes on new importance







# Thank you!

Questions? Matt Belcher, Verdatek Solutions <u>matt@verda-solutions.com</u>

Nicole Westfall, Midwest Energy Efficiency Alliance <u>nwestfall@mwalliance.org</u>





DEPT. OF ENVIRONMENT AND ENERGY

NEBRASKA CODE OFFICIAIS ASSOCIATION
## Nebraska Energy Code Stakeholder Survey

- Goal: to better understand how different stakeholders interact with the energy code and energy efficient technologies
- 15-minute survey
- Results will also help identify topics to include in the trainings
- Attendees of this training will receive a link to take this survey (in addition to this training evaluation) – your participation is greatly appreciated!







