



# Zero Energy Ready Home It All Begins with the Enclosure

**SAM RASHKIN**

Chief Architect,  
DOE Building Technologies Office

- Zero Business Case
- Zero all Begins with the Enclosure
- Zero Common Agenda
- Zero Ready for More Informed Consumer
- Zero Selling Simple vs. Complex

## 2025 Projected Impacts:<sup>\*</sup>

- **~\$350 Billion** Utility Bill Savings
- **~120,000** Persistent New Jobs
- **~3 Million** Job-Years of Work
- **~2,800 MMTCe** <Carbon Emissions



\* Impacts based on internal DOE analysis assuming 30% high-performance new homes by 2025

## Come to 5:00 p.m. Workshop

### **Supply System:**

Workforce  
Competent  
in Building  
Science

### **Product on Shelf:**

Better  
Buildings  
> Comfort  
> Health  
> Safety  
> Durability

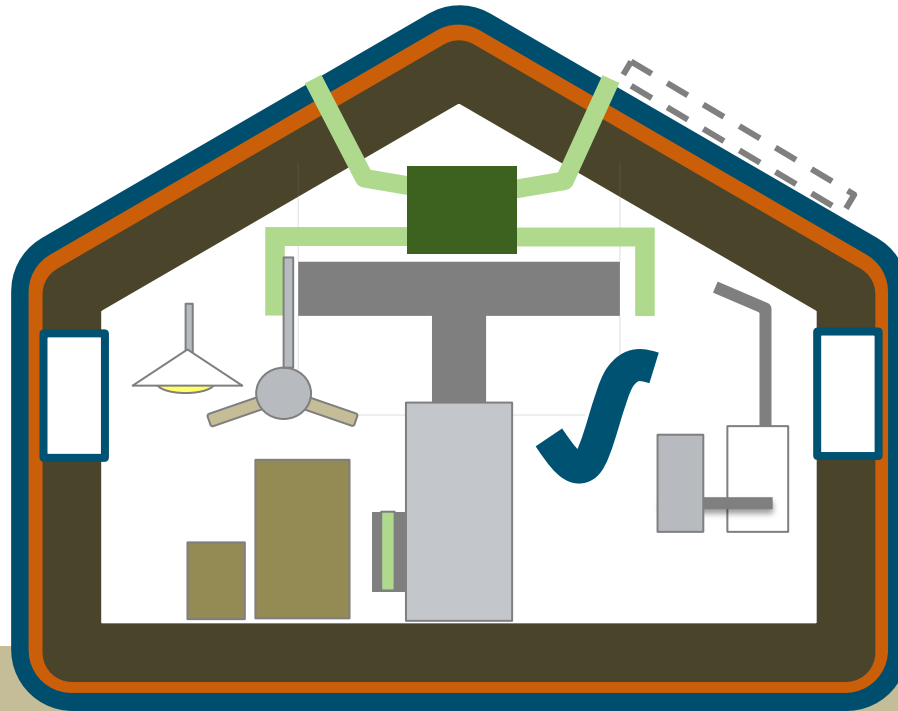
### **Market Demand:**

Consumers  
and  
Transaction  
Process  
That Value  
Better  
Buildings

### **Better Buildings Big Prize:**

- Savings
- Jobs
- Clean Air
- Security

# Zero Starts with the Enclosure



Optimized Enclosure System	Water Protection System	Optimized Comfort System	Complete IAQ System	Efficient Comps System	Solar Ready System
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- Zero Name
- Zero Threshold
- Zero Definition
- Zero Message
- Zero Call to Action
- Zero Progress

Lose the  
**‘Net’:**

- Confusing
- No Real Estate

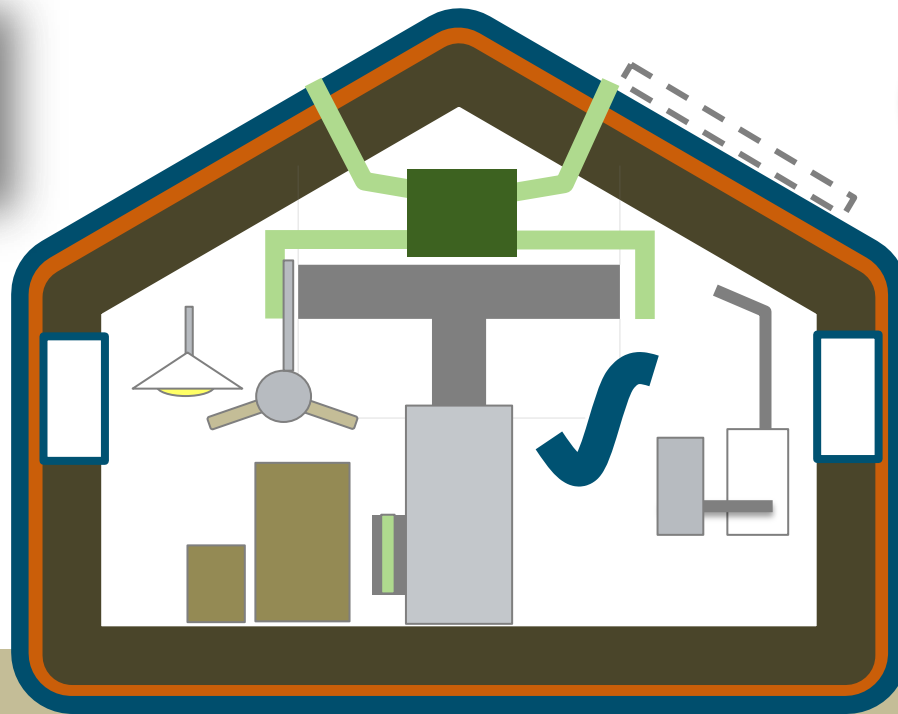


Add

**‘Ready’:**

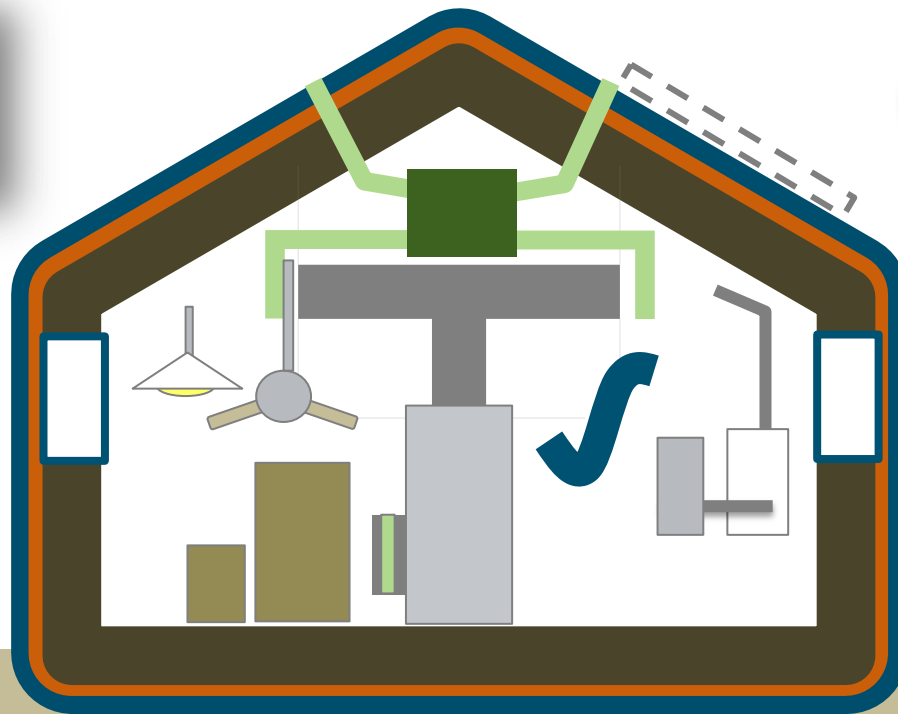
- Less Liability
- Inclusive vs. Exclusive

# Zero Threshold



Optimized Enclosure System	Water Protection System	Optimized Comfort System	Complete IAQ System	Efficient Comps System	Solar Ready System
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**High-performance home, so energy efficient,**  
all or most annual energy consumption  
can be offset by renewable energy.



## Zero Energy Ready Home: **The Experts' Choice**

Making the Largest Purchase of a Lifetime  
Just Got Easier

# Zero Call to Action

**ENERGY.GOV**  
Office of Energy Efficiency & Renewable Energy

Search Energy.gov

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Home » Residential Buildings » Zero Energy Ready Home

## ZERO ENERGY READY HOME

- Buildings Home
- About
- Emerging Technologies
- Residential Buildings
  - Building America
  - Home Energy Score
  - Home Performance with ENERGY STAR
  - Better Buildings Residential Network
  - Home Improvement Catalyst
- Zero Energy Ready Home**
- Partner Log In
- Become a Partner
  - Program Requirements
  - Partner Locator
- Zero Energy Home Tour
- Student Competition
- Housing Innovation Awards
- Resources
- Events
- Guidelines for Home Energy Professionals

Tour of Zero

Resources

Partner Locator

Become a Partner

### TOUR OF ZERO

Are you ready for a home that lives, works, and lasts better? The home of the future -- a better home -- is available today. Take a **virtual tour** of the award-winning homes independently certified to meet DOE Zero Energy Ready Home.

### SUCCESS STORIES

OCTOBER 6, 2015  
**DOE Zero Energy Ready Home Case Study: Mantell-Hecathorn Builders, Shenandoah Circle, Durango, CO**

**ENERGY.GOV**  
Office of Energy Efficiency & Renewable Energy

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Home » DOE Tour of Zero Gordon Estates by Mandalay Homes

## DOE TOUR OF ZERO: GORDON ESTATES BY MANDALAY HOMES

"WHEN I SAW MY FIRST BILL AND I COMPARED IT TO MY LAST HOME'S BILL, I WAS SO IMPRESSED."

**Mandalay Homes**  
Gordon Estates  
Phoenix, AZ  
mandalayhomes.com

"We love our home. We have enjoyed being here so much... When I saw my first bill and I compared it to my last home's bill, I was so impressed. This is such a wonderful home."  
- Mandalay homeowner

U.S. DEPARTMENT OF ENERGY

**KEY FEATURES**

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

Read more.

[Meet the Builder](#)

**1,915 ft<sup>2</sup>**  
3 bedroom, 2 bath  
A home making climate \$297,400 less per year

**HERS -1**  
0 is a net zero energy home  
100 is a better than code home  
130 is average existing home

**-\$94** Average monthly energy bill\*  
\$2,077 saved per year  
\$12,584 saved over 10 years\* (mortgage)  
\*Based on energy audit and DOE Home Energy Saver. Homeowner's energy audit for Gordon Estates. Homeowner's energy audit for Gordon Estates. Homeowner's energy audit for Gordon Estates.



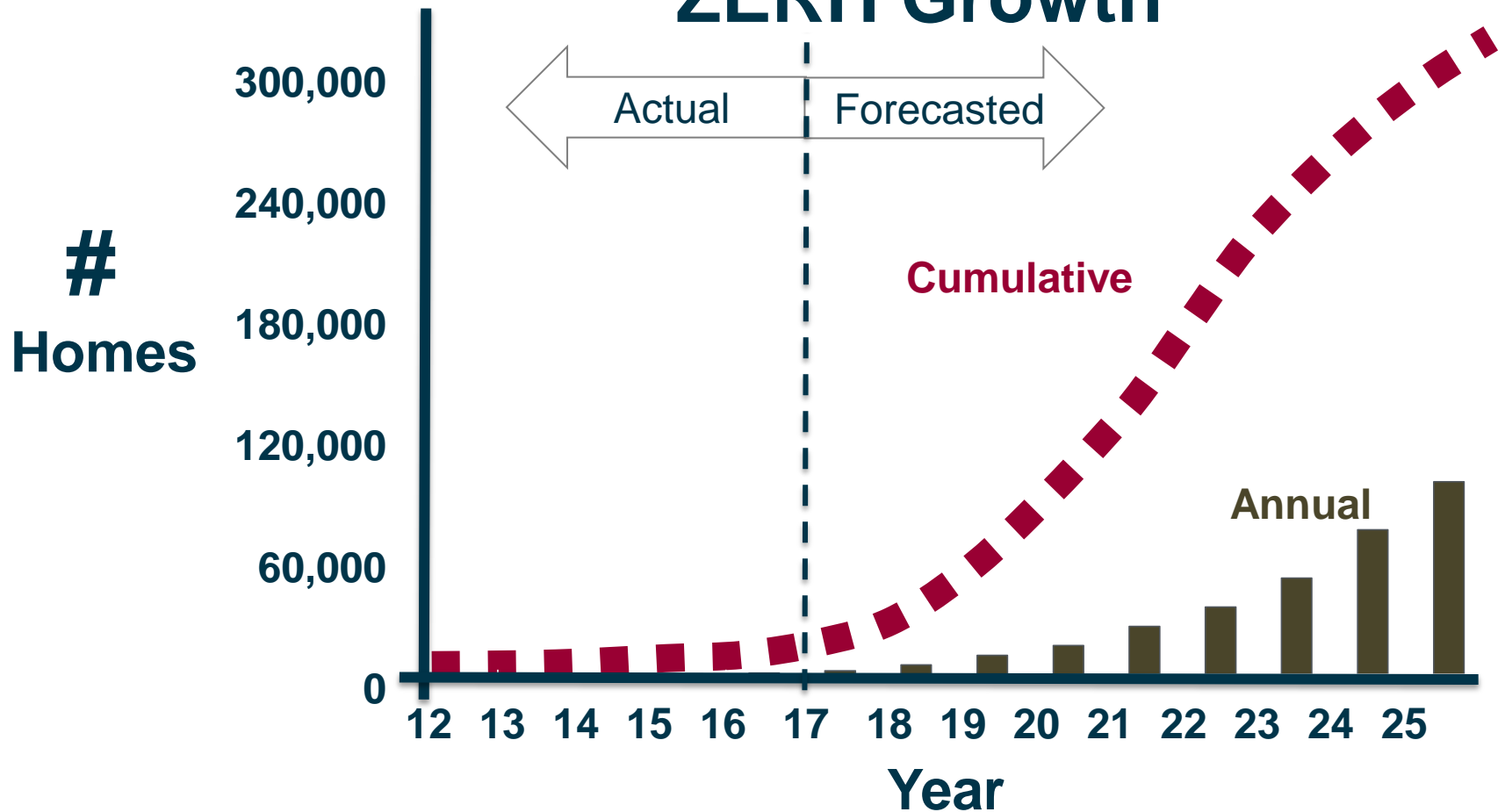
- Vetted Technical Requirements
- Strong Marketing Resources
- 50+ Trainings Seminars
- Foundation for Growth:

FY 2015 (Actual)	324
FY 2016 (Actual)	750
FY 2017 Projected	2,000
FY 2018 Projected	4,000
FY 2019 Projected	10,000
FY 2020 Projected	25,000

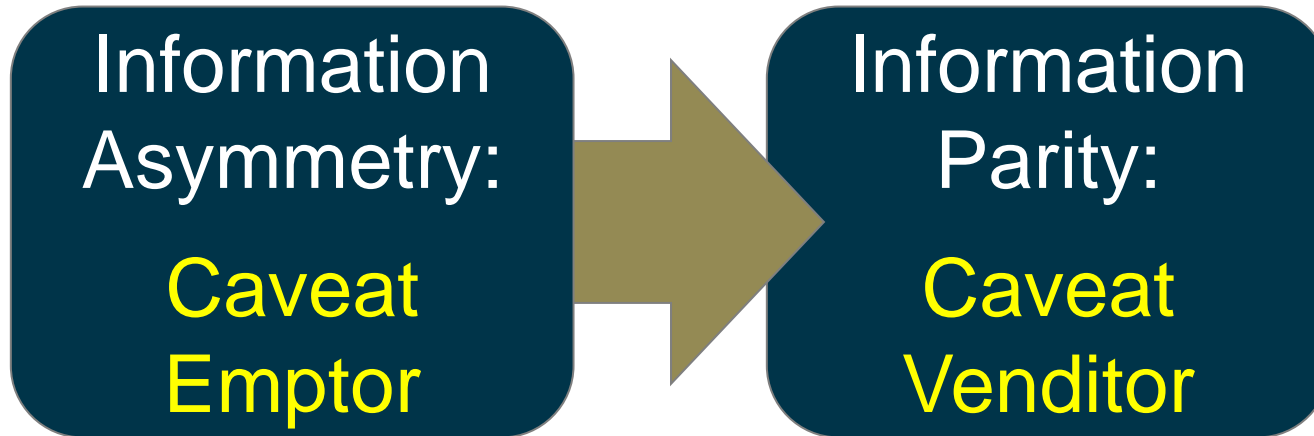


Pushing a  
Very Heavy Zero  
Up a Very Steep Hill

## ZERH Growth



# Zero Ready for More Informed Buyers





# Buyers will Know Thermal Defects



# Buyers will Know Thermal Defects



# Buyers will Know Thermal Defects

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**ENERGY**


Energy Efficiency &  
Renewable Energy



# Buyers will Know Thermal Defects



# Buyers will Know Thermal Defects

A thermal image of a building facade showing heat loss patterns. The image is color-coded, with warmer areas in yellow and orange, and cooler areas in blue and purple. Three callout boxes with white text and black backgrounds are overlaid on the image, pointing to specific areas of heat loss. The first box points to a dark, irregular shape on the left side. The second box points to a large, dark, irregular shape in the center. The third box points to a dark, irregular shape on the right side.

Un-heated  
vacant housing

Poorly insulated housing  
with varying  
degrees of heat loss

Well insulated occupied  
housing with heat loss visible  
through the chimney flues

# Buyers will Know Thermal Defects

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Renewable Energy



# LEED Silver Building

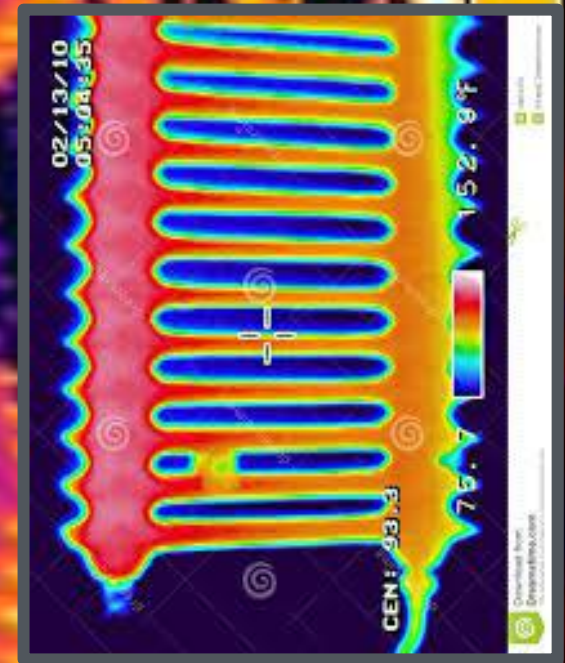
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Renewable Energy



**Aqua in Chicago**

# Buyers will Know Thermal Defects



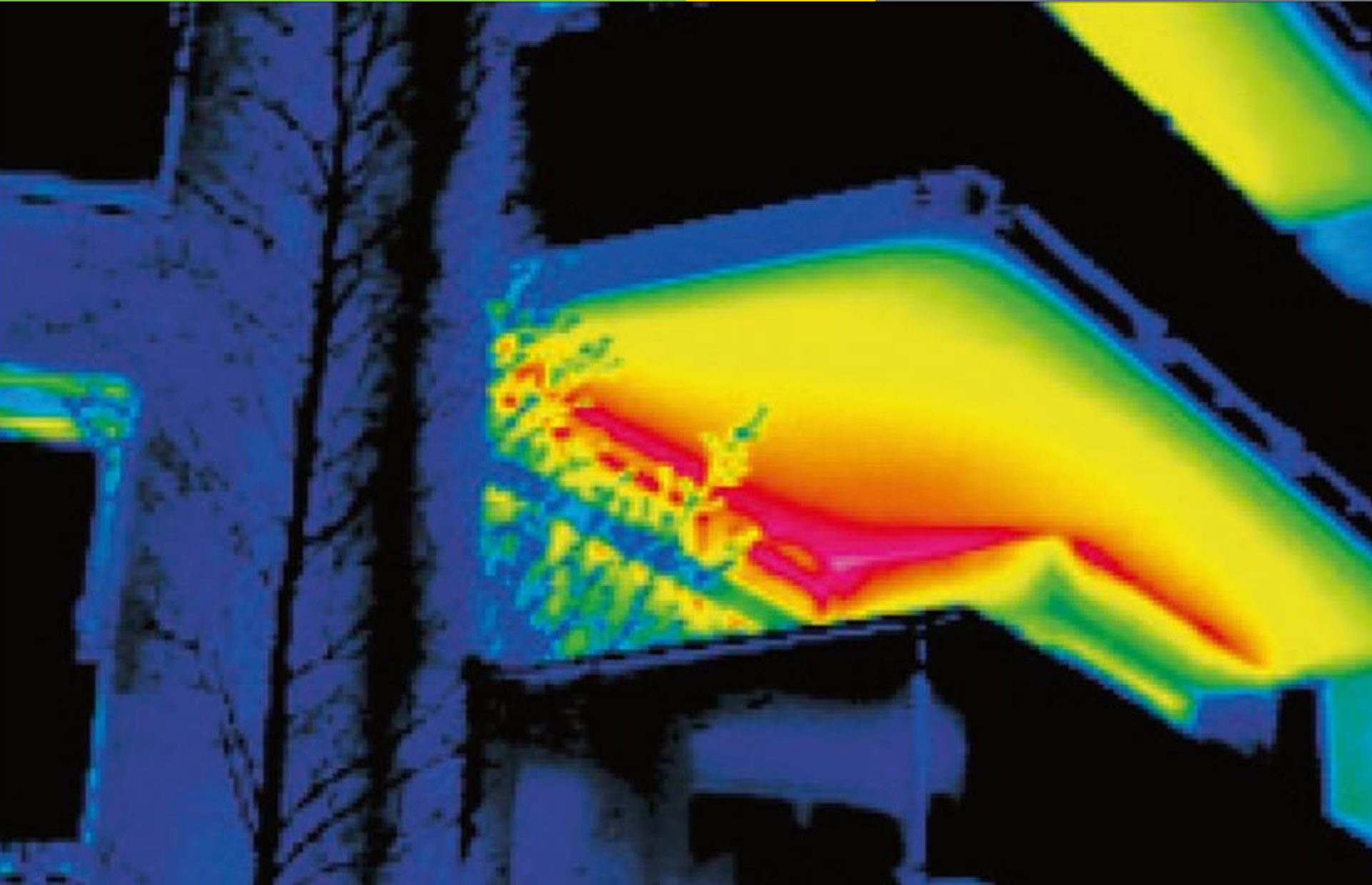
Aqua in Chicago



# Buyers will Know Thermal Defects

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Renewable Energy



# Buyers will Know Thermal Defects

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# Buyers will Know Poor Windows

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# Buyers will Know Moisture Problems

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**ENERGY**

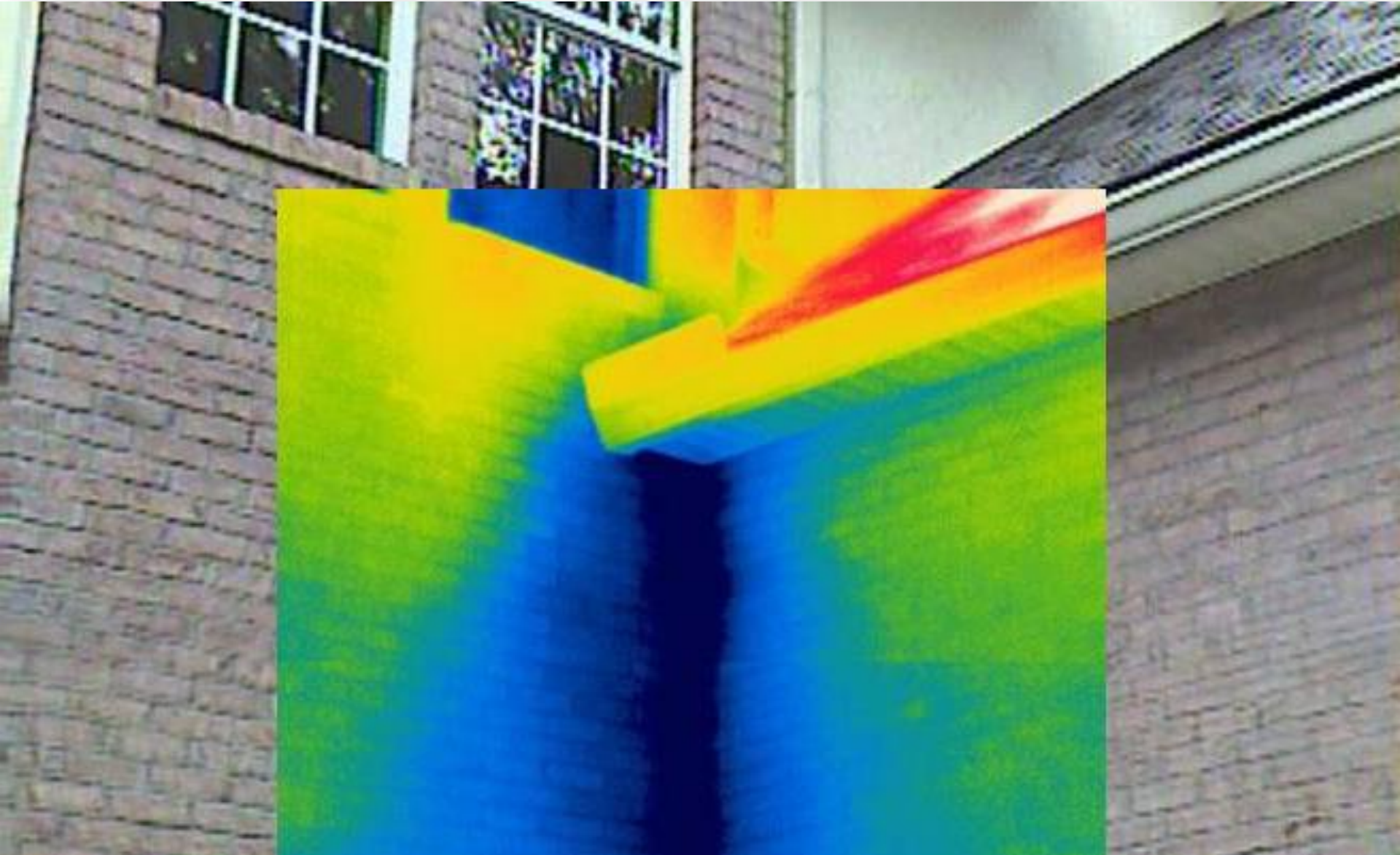
Energy Efficiency &  
Renewable Energy



# Buyers will Know Moisture Problems

U.S. DEPARTMENT OF  
**ENERGY**


Energy Efficiency &  
Renewable Energy




# Buyers will Know Indoor Air Quality




# Buyers will Know Indoor Air Quality

 Air Mentor 2015-02-05 10:10:53

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 Air Mentor



## 22

AIQ

Particulate Matter Good

### <5

Temperature Good

### 20.4 °C

✓

Gas Pollution Moderate

### 511

▲

Humidity Good

### 53 %

✓

PM2.5 Good

## <5


Current status:

The last hour average value is 5 ug/m3.


Recommendation Actions:


### African Violet

African Violet will bloom throughout the year, and it has strong ability to reduce carbon dioxide and hold dust. It reduces carbon dioxide concentrations i...



Effects

PM 

CO2 

## Diagnostic System:

- Outdoor Condensing Unit Sensors:
  - 3 Thermal
  - 2 Voltage
  - 1 Current
- <15 minutes install
- \$50 Hardware



### Current RMS Configuration

AP & ED Total Cost \$95



End Device (ED)



Access Point (AP)



New Configuration: Direct Internet Connection – Total Cost < \$50



## **Diagnostic Capability:**

- Low Charge
- Failed Start or Run Capacitor
- Reduced Condenser or Evaporator Flow
- Abnormal Operation
- Degraded Perf. (COP)

# Buyers will Know HVAC Quality



# Buyers will Know HVAC Quality



# Buyers will Know 'Good' Reviews



**Gary Lanthrum** reviewed **Estes Builders** — 5★

March 22 at 1:56pm · 🌐

This is the third house I've had built. Working with Estes was by far the best experience of all these construction projects. All new home construction projects will experience unexpected problems and challenges along the way. What really set Estes apart was the efficient and equitable way they help us work through those inevitable problems as they arose. Add to that the craftsmanship of the subs they used and we're all smiles with our new home.



Like



Comment



Share



Buffer



Estes Builders

## Home Builders - DO NOT BUILD WITH THIS COMPANY!!!

Jun 30 [redacted] Home Construction and Repair [redacted] Unprofessional Builder 428  
REVIEW RATING 5/5

If you are thinking about building with this company, I beg you not to. We signed a contract a year ago and were told that we would have a home in January. Well, January has come and gone and we just now have a completed home as of last week... Except when you walk inside you see missing trim, broken windows, the vinyl siding is warped, the porch steps are about to split apart, the paint looks... [Read more >](#)

Was this review helpful? 6 ↑ 1 ↓

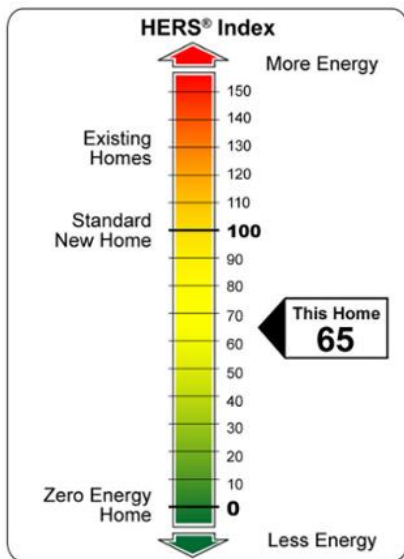
## Home Builders - Horrible Experience

May 31 [redacted] Home Construction and Repair [redacted] Home Construction 391 REVIEW RATING 5/5

First off I cant even describe how frustrating this was for me and my family. This company is just full of excuses. A 4 month home build turned into a year and a half. This company uses the bottom of the barrel subcontractors. I can write a book about how crapy the builder and the company is. They string you along the whole time thinking your an \*\*\*. The regional manager [redacted] ... [Read more >](#)

Was this review helpful? 7 ↑ 0 ↓

# Buyers will Know Performance



# Buyers will Know Performance



## ...for Transformational Experiences:

### Daily Break



# 2-3X

### Health



# 2X

### Tech + Design

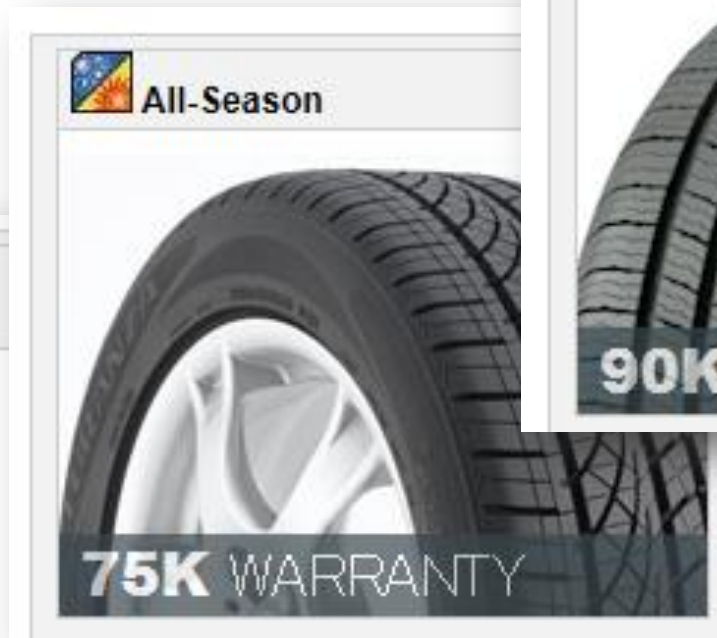
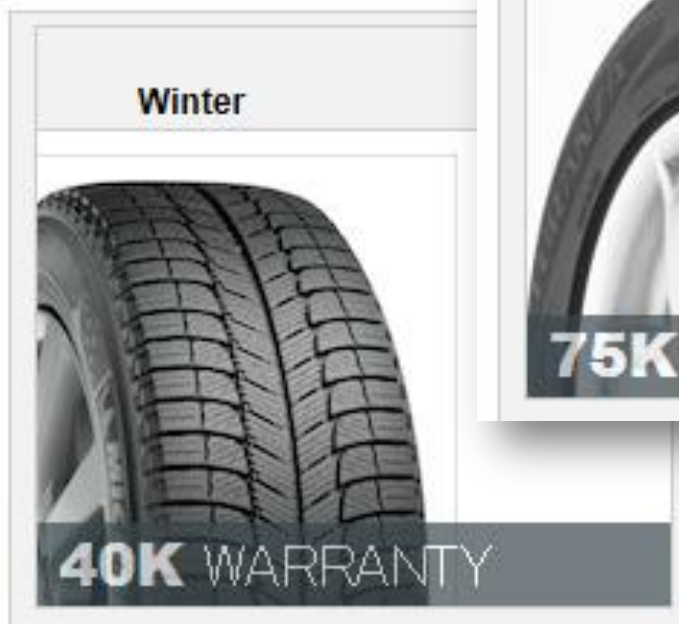


# 10X





# Zero Selling From Complex to Simple

# Consumer Choice Made Simple



# Consumer Choice Made Complex

 National Fenestration Rating Council® <b>CERTIFIED</b>		<b>World's Best Window Co.</b>  Millennium 2000+ Vinyl-Clad Wood Frame Double Glazing • Argon Fill • Low E Product Type: <b>Vertical Slider</b>	
<b>ENERGY PERFORMANCE RATINGS</b>			
U-Factor (U.S./I-P)	Solar Heat Gain Coefficient		
<b>0.35</b>	<b>0.32</b>		
<b>ADDITIONAL PERFORMANCE RATINGS</b>			
Visible Transmittance	Air Leakage (U.S./I-P)		
<b>0.51</b>	<b>0.2</b>		
Condensation Resistance			
<b>51</b>	<b>—</b>		
<small>Manufacturer stipulates that these ratings conform to applicable NFRC procedures for determining whole product performance. NFRC ratings are determined for a fixed set of environmental conditions and a specific product size. NFRC does not recommend any product and does not warrant the suitability of any product for any specific use. Consult manufacturer's literature for other product performance information.  <a href="http://www.nfrc.org">www.nfrc.org</a></small>			

 National Fenestration Rating Council <b>CERTIFIED</b>		<b>Restorations Windows</b> Vinyl Extruded, UltraCore Frame, Triple Glazed, Krypton90, Low-E Product Type: <b>Vertical Slider</b>	
<b>ENERGY PERFORMANCE RATINGS</b>			
U-Factor (U.S./I-P)	Solar Heat Gain Coefficient		
<b>0.18</b>	<b>0.22</b>		
<b>ADDITIONAL PERFORMANCE RATINGS</b>			
Visible Transmittance	Air Leakage (U.S./I-P)		
<b>0.42</b>	<b>0.1</b>		
Condensation Resistance			
<b>70</b>			
<small>Manufacturer stipulates that these ratings conform to applicable NFRC procedures for determining whole product performance. NFRC ratings are determined for a fixed set of environmental conditions and a specific product size. Consult manufacturer's literature for other product performance information.  <a href="http://www.nfrc.org">www.nfrc.org</a></small>			

# Consumer Choice Made Simple



National Fenestration  
Rating Council®  
**CERTIFIED**

## World's Best Window Co.

Millennium 2000+  
Vinyl-Clad Wood Frame  
Double Glazing • Argon Fill • Low E  
Product Type: **Vertical Slider**

Thermal Protection	<div style="width: 30%;"></div>
Sun Protection	<div style="width: 30%;"></div>
Natural Light	<div style="width: 40%;"></div>
Draft Protection	<div style="width: 30%;"></div>
Condensation Control	<div style="width: 30%;"></div>

# 10-Year Window

Manufacturer stipulates that these ratings conform to applicable NFRC procedures for determining whole product performance. NFRC ratings are determined for a fixed set of environmental conditions and a specific product size. NFRC does not recommend any product and does not warrant the suitability of any product for any specific use. Consult manufacturer's literature for other product performance information.  
[www.nfrc.org](http://www.nfrc.org)



National Fenestration  
Rating Council  
**CERTIFIED**

## Restorations Windows

Vinyl Extruded, UltraCore Frame,  
Triple Glazed,  
Krypton90, Low-E  
Product Type: **Vertical Slider**

Thermal Protection	<div style="width: 80%;"></div>
Sun Protection	<div style="width: 90%;"></div>
Natural Light	<div style="width: 40%;"></div>
Draft Protection	<div style="width: 90%;"></div>
Condensation Control	<div style="width: 80%;"></div>

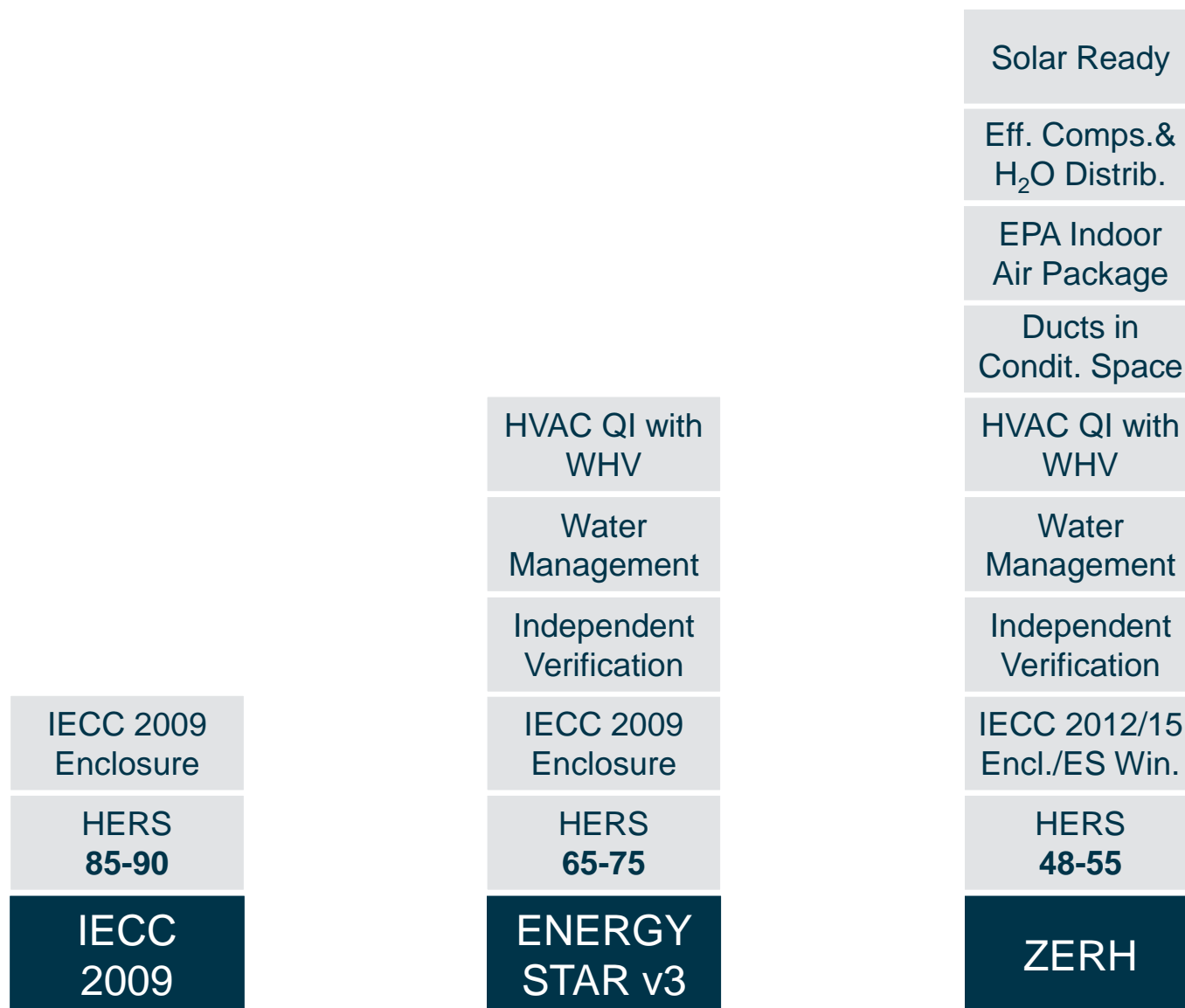
# 50-Year Window

Manufacturer stipulates that these ratings conform to applicable NFRC procedures for determining whole product performance. NFRC ratings are determined for a fixed set of environmental conditions and a specific product size. Consult manufacturer's literature for other product performance information.  
[www.nfrc.org](http://www.nfrc.org)

# Consumer Home Options

				Solar Ready	Solar Ready
				Eff. Comps.& H <sub>2</sub> O Distrib.	Eff. Comps.& H <sub>2</sub> O Distrib.
				EPA Indoor Air Package	EPA Indoor Air Package
				Ducts in Condit. Space	Ducts in Condit. Space
		HVAC QI with WHV	HVAC QI with WHV	HVAC QI with WHV	HVAC QI + HRV
		Water Management	Water Management	Water Management	Water Management
		Independent Verification	Independent Verification	Independent Verification	Independent Verification
IECC 2009 Enclosure	IECC 2012 Enclosure	IECC 2009 Enclosure	IECC 2012 Enclosure	IECC 2012/15 Encl./ES Win.	Ultra-Efficient Enclosure
HERS 85-90	HERS 70-80	HERS 65-75	HERS 55-65	HERS 48-55	HERS 35-45
<b>IECC 2009</b>	<b>IECC 2012</b>	<b>ENERGY STAR v3</b>	<b>ENERGY STAR v3.1</b>	<b>ZERH</b>	<b>PHIUS+</b>

# Consumer Home Options



# Consumer Choice Made Complex



# Consumer Choice Made Simple



IECC  
INTERNATIONAL ENERGY CONSERVATION CODE

**2009**

**5-Year Enclosure**



*Energy Star*

**10-Year Enclosure**



**ZERO**

ENERGY READY HOME

**50-Year Enclosure**



**PHIUS**

Passive House Institute US


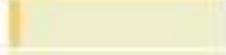
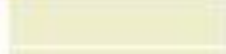
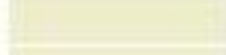
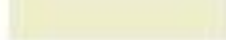
**100-Year Enclosure**




If High-Performance = Better Experience,  
Building Science Community Should Promote...

## Customer Reviews

35 Reviews

<u>5 star:</u>		(33)
<u>4 star:</u>		(2)
3 star:		(0)
2 star:		(0)
1 star:		(0)

**Average Customer Review**

 (35 customer reviews)

# Thank You



**For More Information:**

[www.buildings.energy.gov/zero/](http://www.buildings.energy.gov/zero/)