



What's Next in Zero Energy: Multifamily, Residential, and Other Trends

Wednesday, July 10

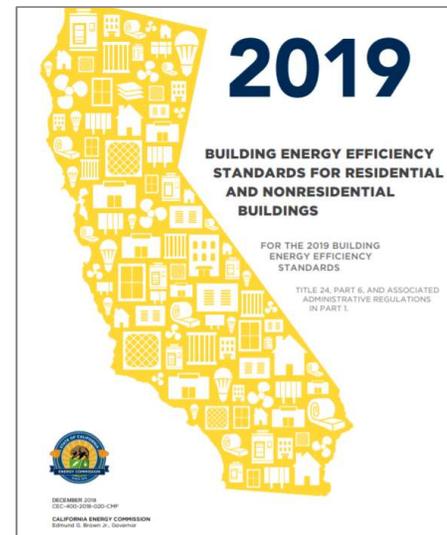
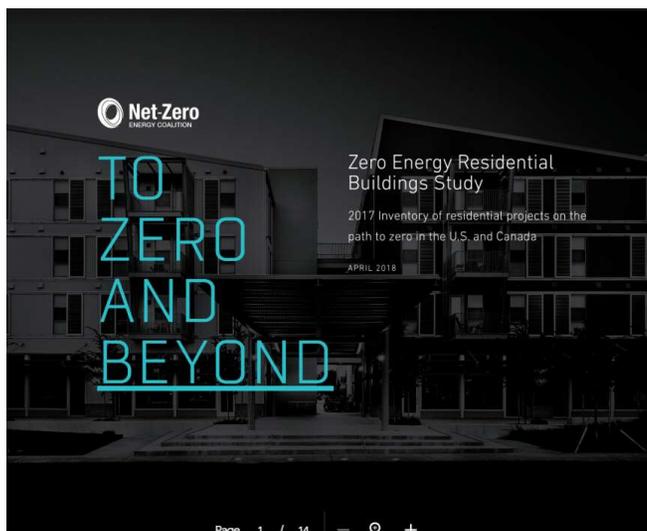
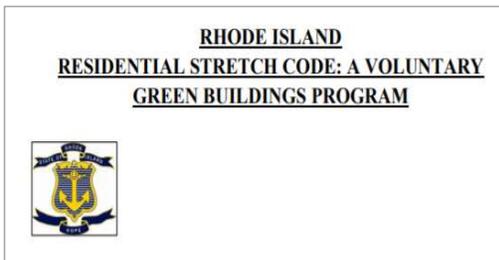
3:30 PM – 5:00 PM



Speakers

- **Jamie Lyons**, Newport Partners
- **Martha Campbell**, Rocky Mountain Institute (RMI)
- Moderator: Eric Werling, DOE

Introduction: A Growing Movement to Zero Energy



Study Finds Green Home Building Continues to Gain Traction

Introduction: Single & Multifamily; New & Existing



Resources: Building America Solution Center

U.S. DEPARTMENT OF
ENERGY

Energy Efficiency &
Renewable Energy

... at Your Finger Tips

2,700,000 Served!

>350,000 users



- Best Practices
- Case Studies
- Program Checklists
- Research Reports
- **Building Science Advisor**
- **Home Improvement Expert**
- Sales Tool
- Mobile Field Kit



Jamie Lyons

Newport Partners

U.S. DEPARTMENT OF
ENERGY

Zero Energy Ready Home Training

July 10, 2019

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



**What's Next for Zero Energy
Better Buildings 2019 Summit**

James Lyons, P.E.
Newport Partners

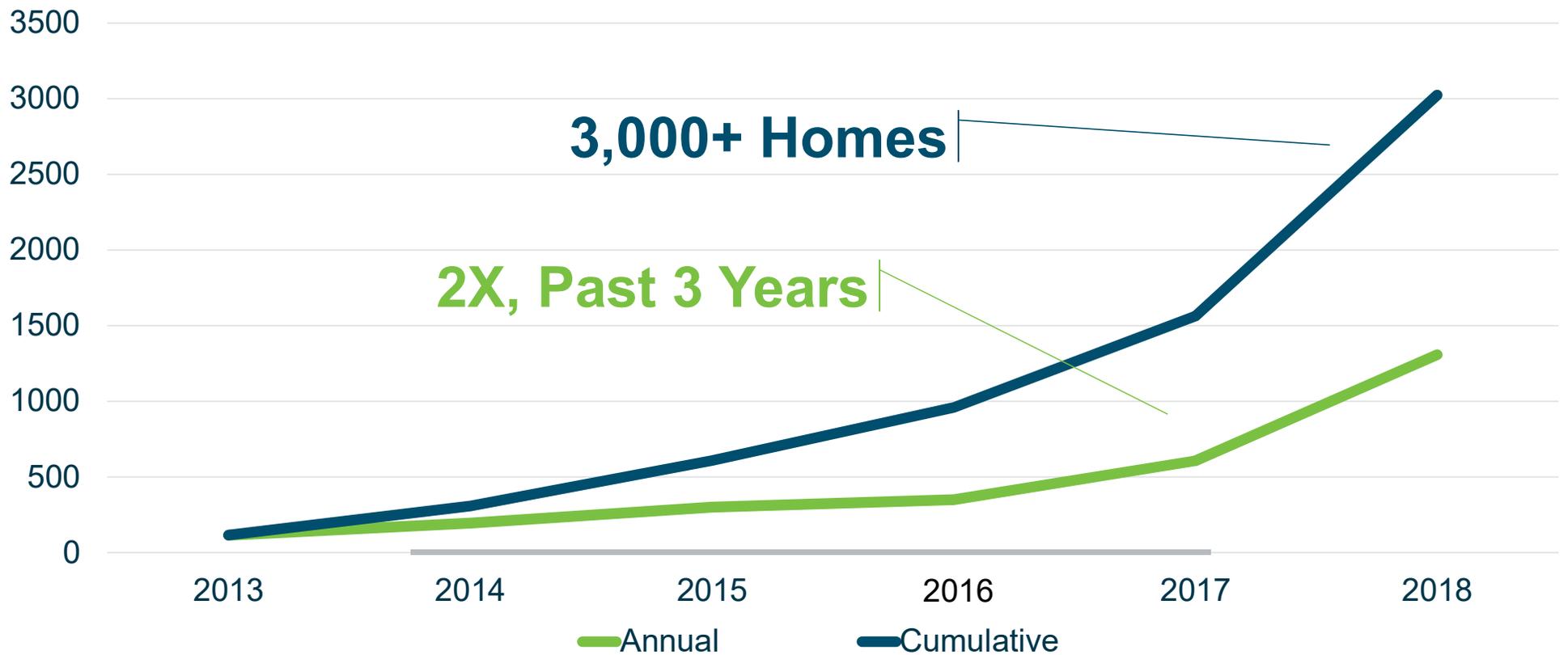
What's Next for Zero Energy & Zero Energy Ready - Overview

1. All Signs Point to Zero
2. What is Zero
3. Why Zero
4. How to Build Zero
5. Resources

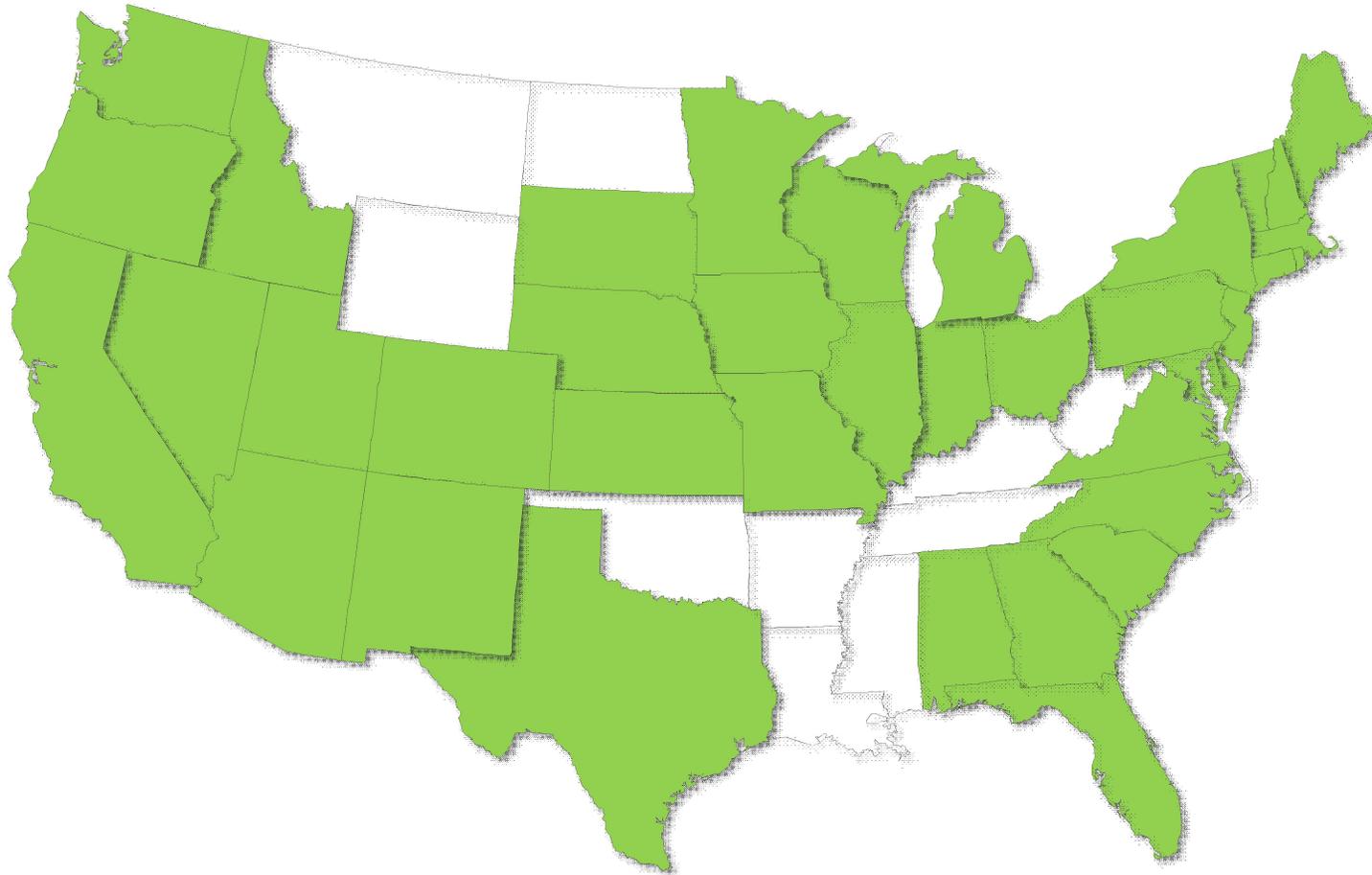


Zero Energy Ready Home
All Signs Point to Zero

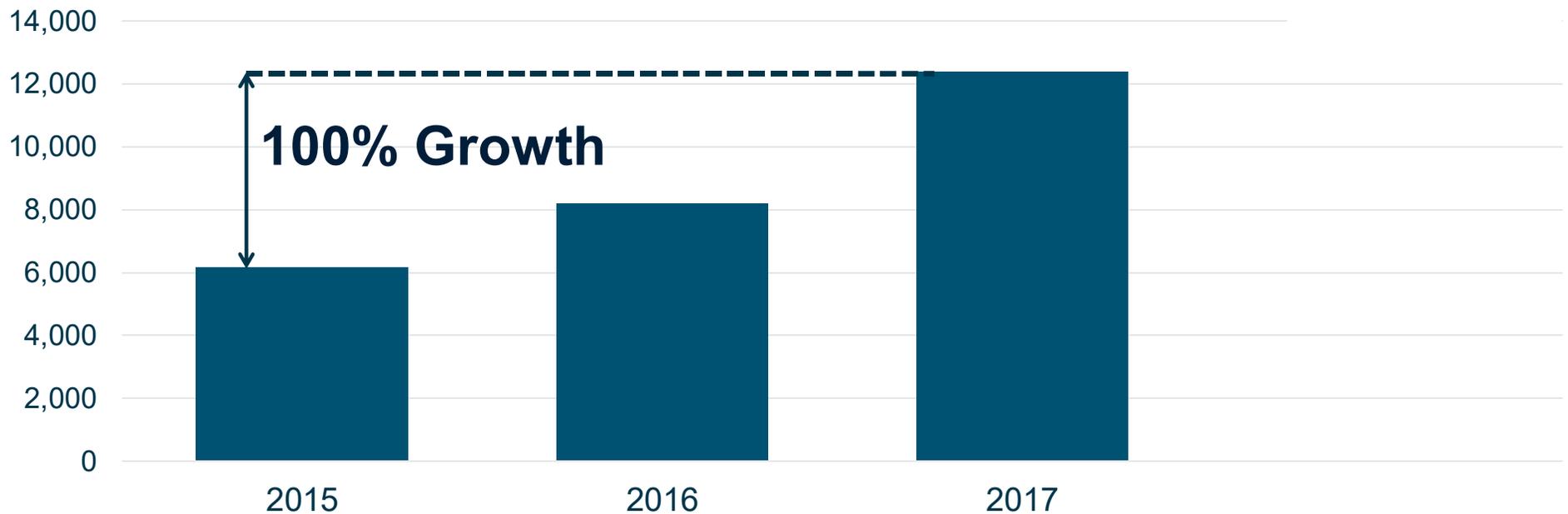
ZERH Certifications



States with ZERH



Zero Residential Units



Source: "To Zero and Beyond, Zero Energy Residential Buildings Study, 2016 Inventory of residential projects on the path to zero in the U.S. and Canada, Net Zero Energy Coalition, June 2017, call with Shipa Sankaran, February 16, 2018

Zero Builder Commitment



Built or Plan to Build a Net Zero,
Near Net Zero, or Net Zero Ready Home

Source: Dodge Data & Analytics, October 2017

Energy Efficiency, GHG Emissions, Regulation • August 28, 2018

19 Mayors Sign Net Zero Carbon Pledge

OCTOBER 10, 2017 / Zero Net Energy / Energy Codes



Mayors from 19 cities around the world signed a pledge to enact regulations and/or planning policy to ensure new buildings operate at net zero carbon by 2030 and all buildings by 2050.

Source: Smart Energy Decisions

States Implementing/Planning Zero Codes:

- California
- Oregon
- Puerto Rico
- Washington
- New York

States Leveraging DOE Zero Energy Ready Home in Low Income Housing Tax Credit Plans:

- Delaware
- Georgia
- New Jersey
- Pennsylvania
- Washington DC

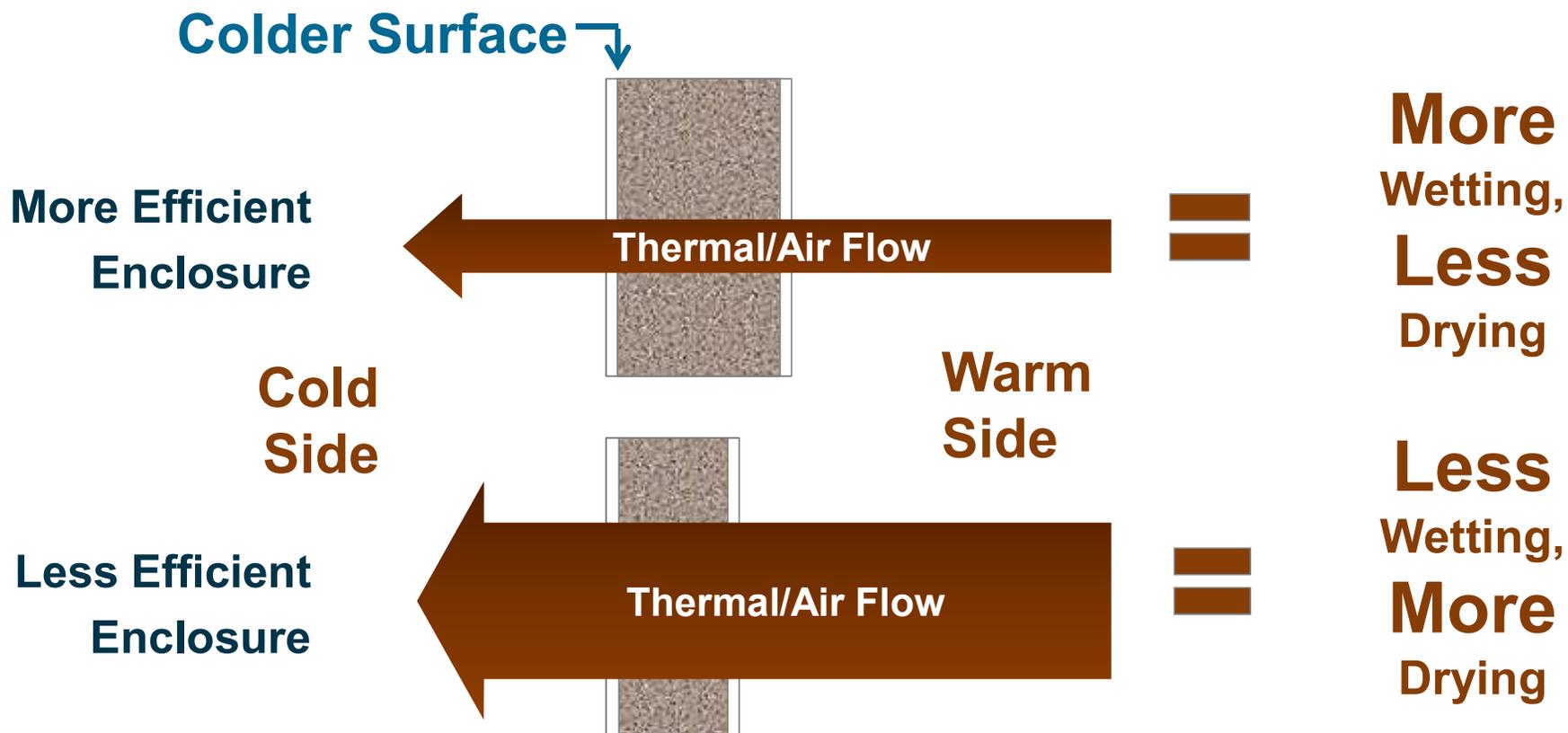


Zero Energy Ready Home

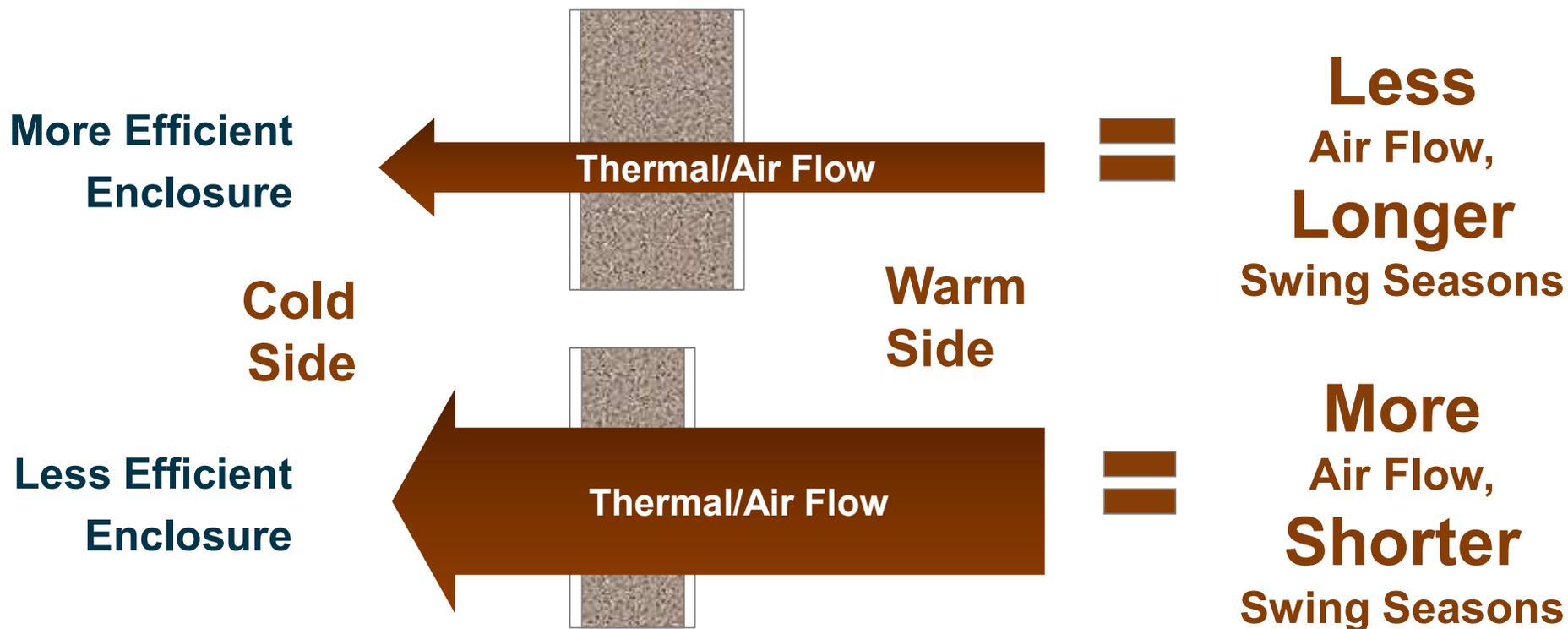
What is Zero

1. Moisture Damage
2. Ensured Comfort
3. Ensured Indoor Air Quality

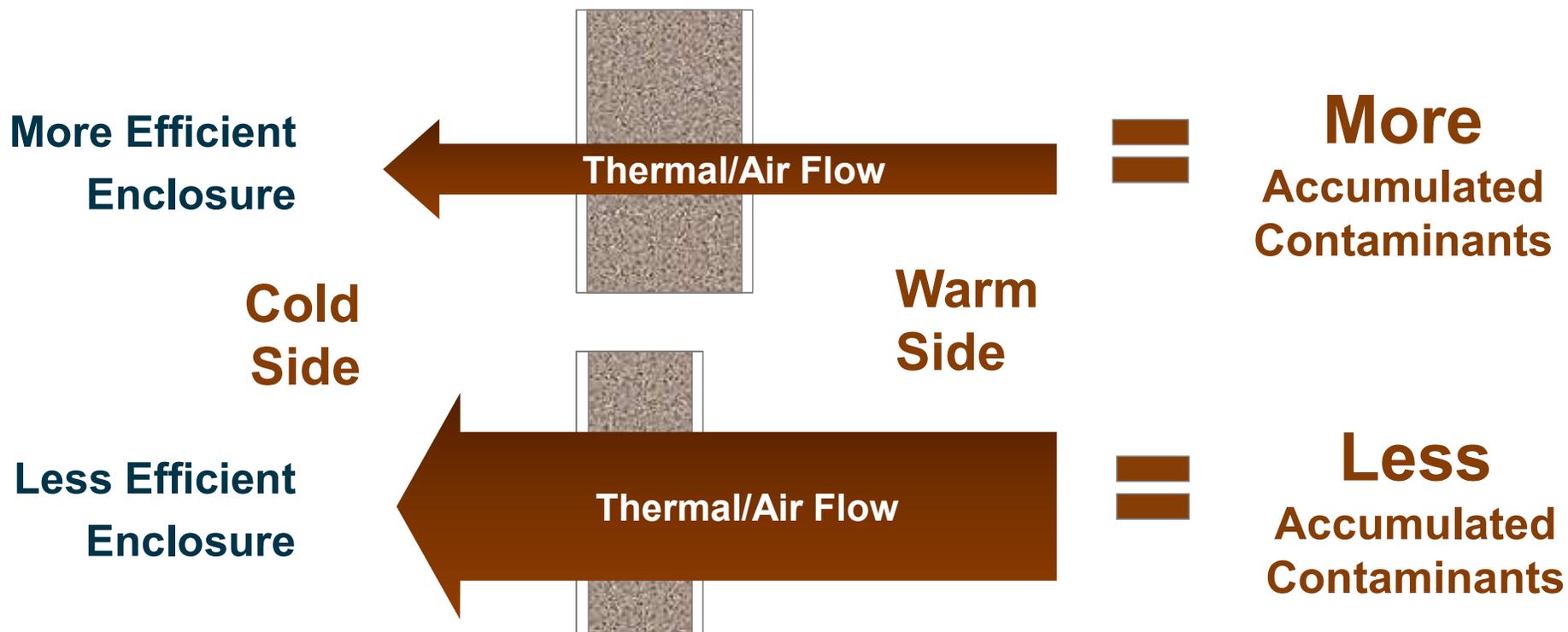
Risk #1: Moisture Damage



Risk #2: Ensured Comfort



Risk #3: Ensured IAQ



Zero = Comprehensive Strategy

Step One: **Optimize Efficiency**

Energy Efficient
Enclosure

Energy Efficient Components

Step Two: **Do No Harm**

Comprehensive
Water Protection

Ensured
Comfort System

Comprehensive Indoor Air Quality

Step Three: **Ensure Zero Ready**

Solar Ready Construction





Zero Energy Ready Home Orientation

Why Zero

Zero Lives Better



-  \$10,000's Savings
-  Cozy Indoors
-  Total Comfort
-  Healthy Living
-  Peace-of-Mind
-  Quality Assurance
-  Future Ready

Why ZERH: Cost Effective

ZER Incremental Cost	Houston (CZ2)	Atlanta (CZ3)	Baltimore (CZ4)	Chicago (CZ5)
	\$2,065	\$6,094	\$5,993	\$5,368
Mortgage Threshold (30 Years) 	\$10,980	\$15,563	\$25,305	\$20,619
Resale Threshold (12 Years) 	\$5,576	\$7,903	\$11,835	\$10,472
Consumer WTP (4%) 	\$9,139	\$9,690	\$10,130	\$13,874
First Cost Threshold (0%) 	\$0	\$0	\$0	\$0
	✓	✓	✓	✓
	✓	✓	✓	✓
	✓	✓	✓	✓
	✗	✗	✗	✗
ZE Incremental Cost	Houston (CZ2)	Atlanta (CZ3)	Baltimore (CZ4)	Chicago (CZ5)
	\$15,488	\$20,069	\$18,674	\$23,125
Mortgage Threshold (30 Years) 	\$26,715	\$35,927	\$49,118	\$45,414
Resale Threshold (12 Years) 	\$13,567	\$18,245	\$24,945	\$23,063
Consumer WTP (4%) 	\$9,139	\$9,690	\$10,130	\$13,874
First Cost Threshold (0%) 	\$0	\$0	\$0	\$0
	✓	✓	✓	✓
	✗	✗	✓	✓
	✗	✗	✗	✗
	✗	✗	✗	✗

Source: 'The Economics of Zero Energy Homes: Single Family Insights,' Rocky Mountain Institute, 10/18



- **Less Liability**
 - Customer Satisfaction
 - Customer Service Costs
 - Risk Management (3rd-party verification)
- **Market Differentiation**
 - Key Competition (Existing, Code, ENERGY STAR)
 - New Sales Force (Homebuyers)



2030 Projected Impacts:*

- **~\$150 Billion** Utility Bill Savings
- **~1 Million** Job-Years of Work
- **~1,100 MMTCe** <Carbon Emissions

* Impacts based on internal DOE analysis assuming 30% high-performance new homes by 2030

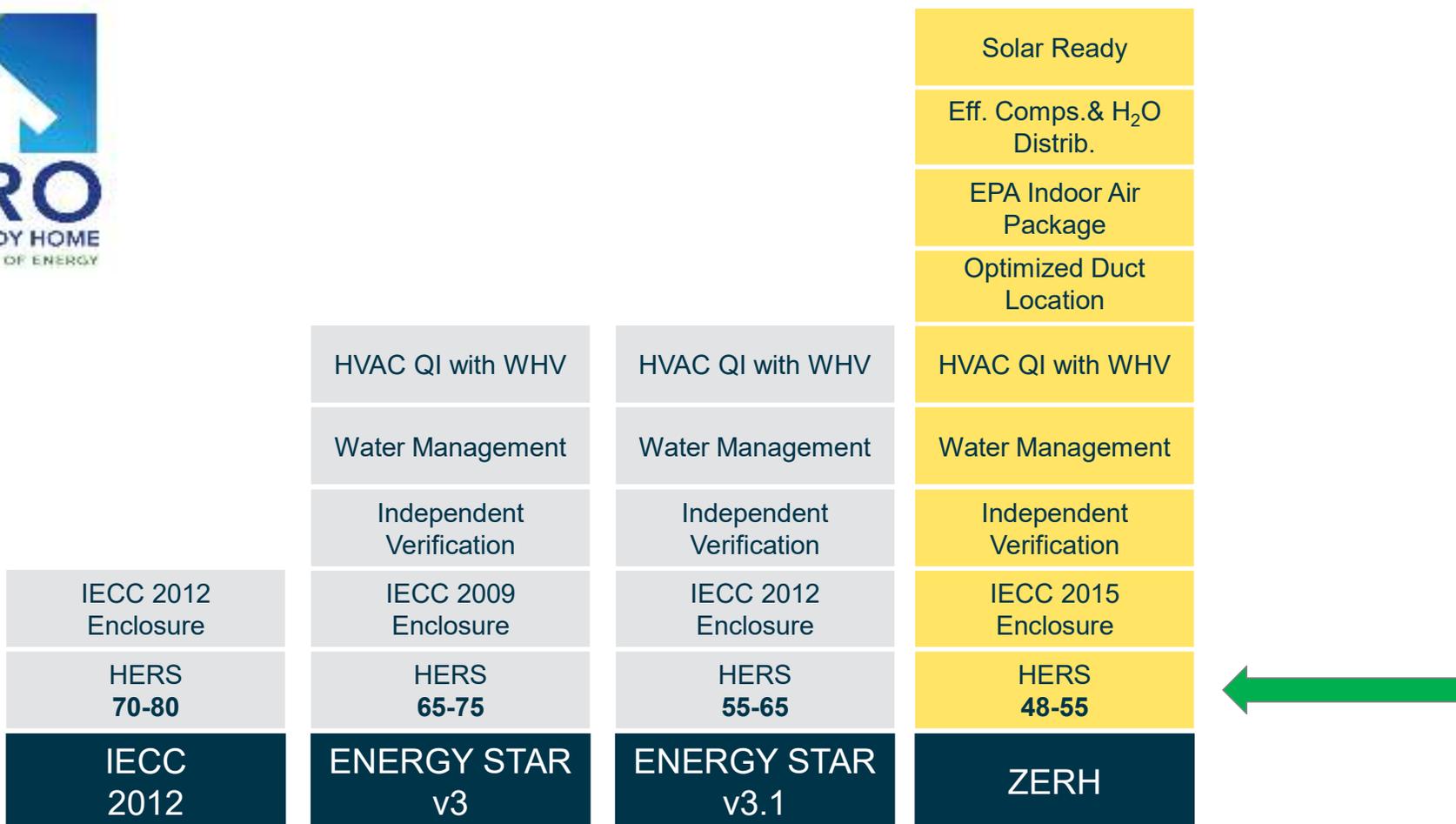


Zero Energy Ready Home

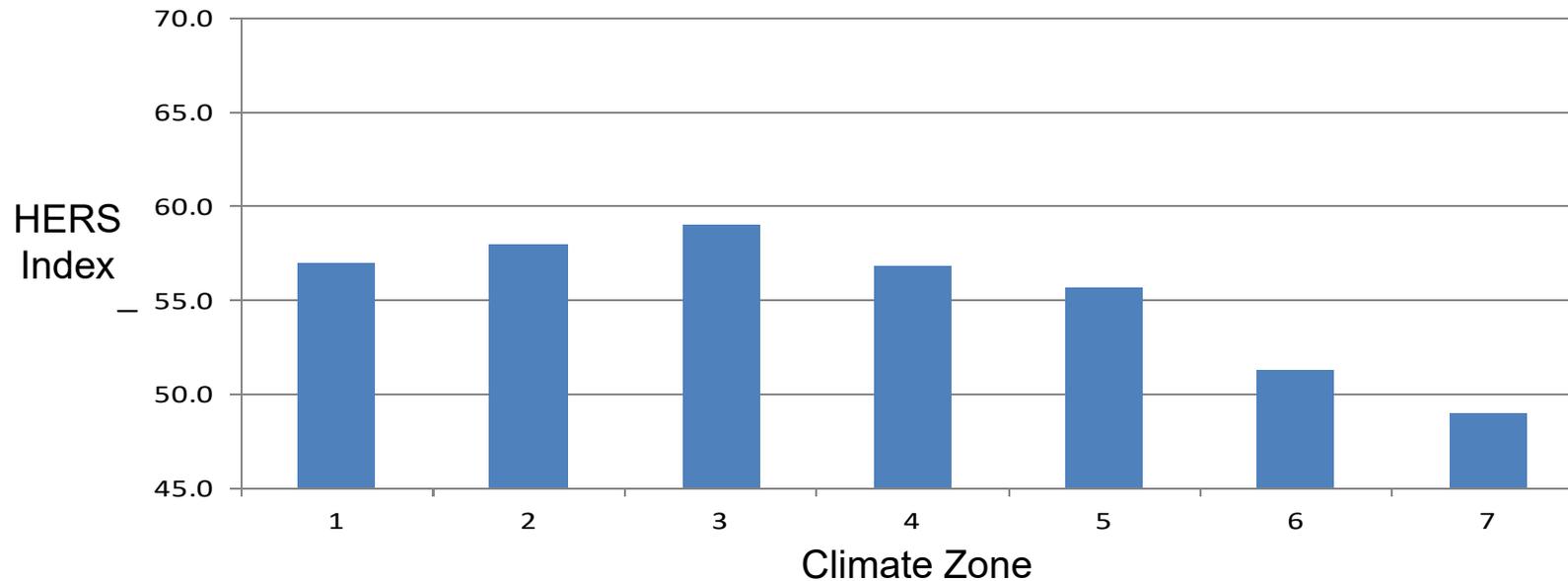
How to Build Zero

The East Lift from ENERGY STAR to Zero

The Easy Lift to ZERH...



Typical DOE ZERH-Compliant HERS Index by Climate Zone



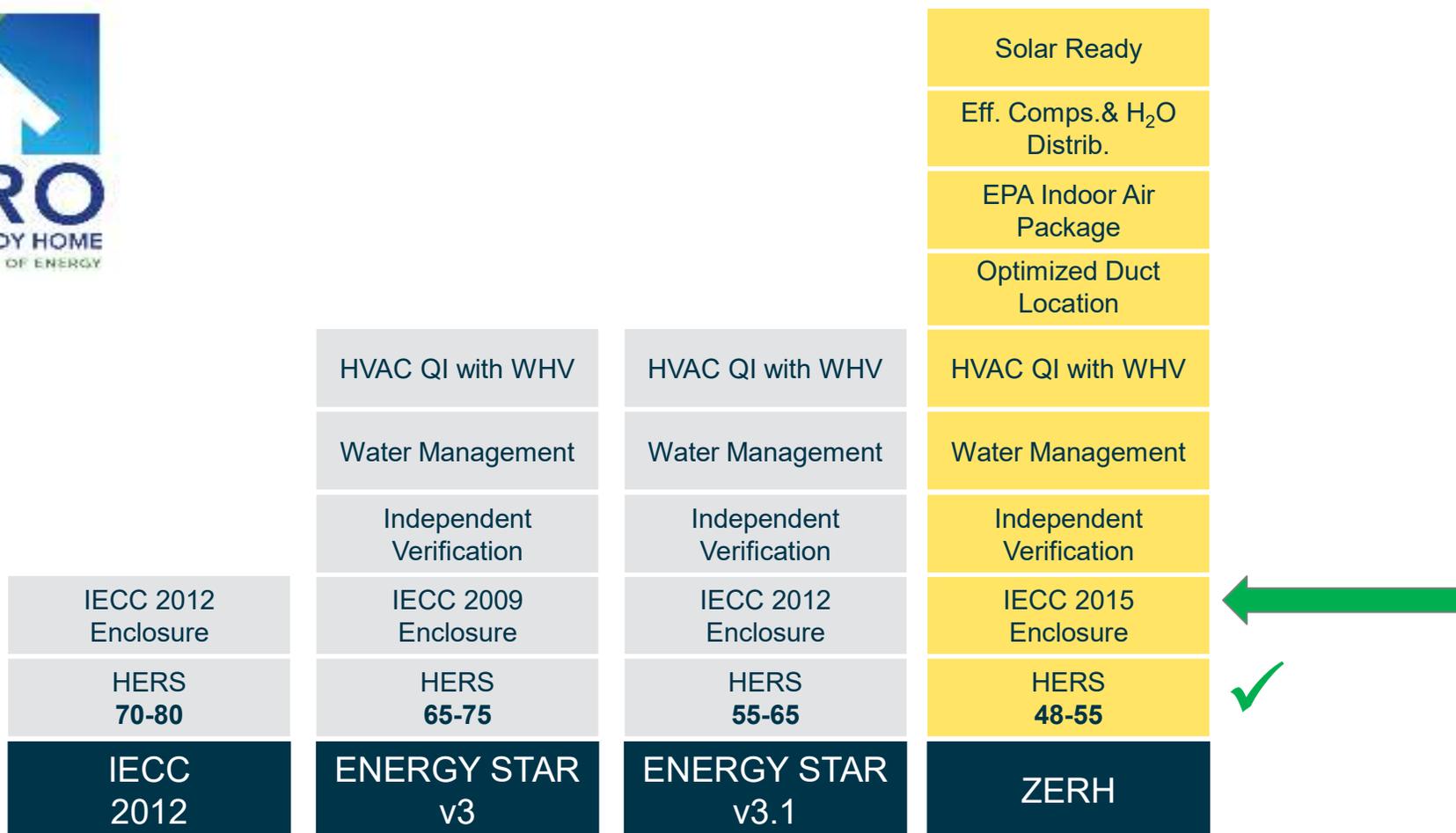
Based on 1800, 2400, and 3600 ft² prototypes on climate-appropriate foundations.

- **236,000+** HERS Ratings
- **61** Avg. HERS Index
- **~85,000** Homes Ready for ZERH



Source: *“Demand for HERS Continues to Grow: Over 236,000 Homes HERS Rated in 2018,”* RESNET blog, January 17, 2019

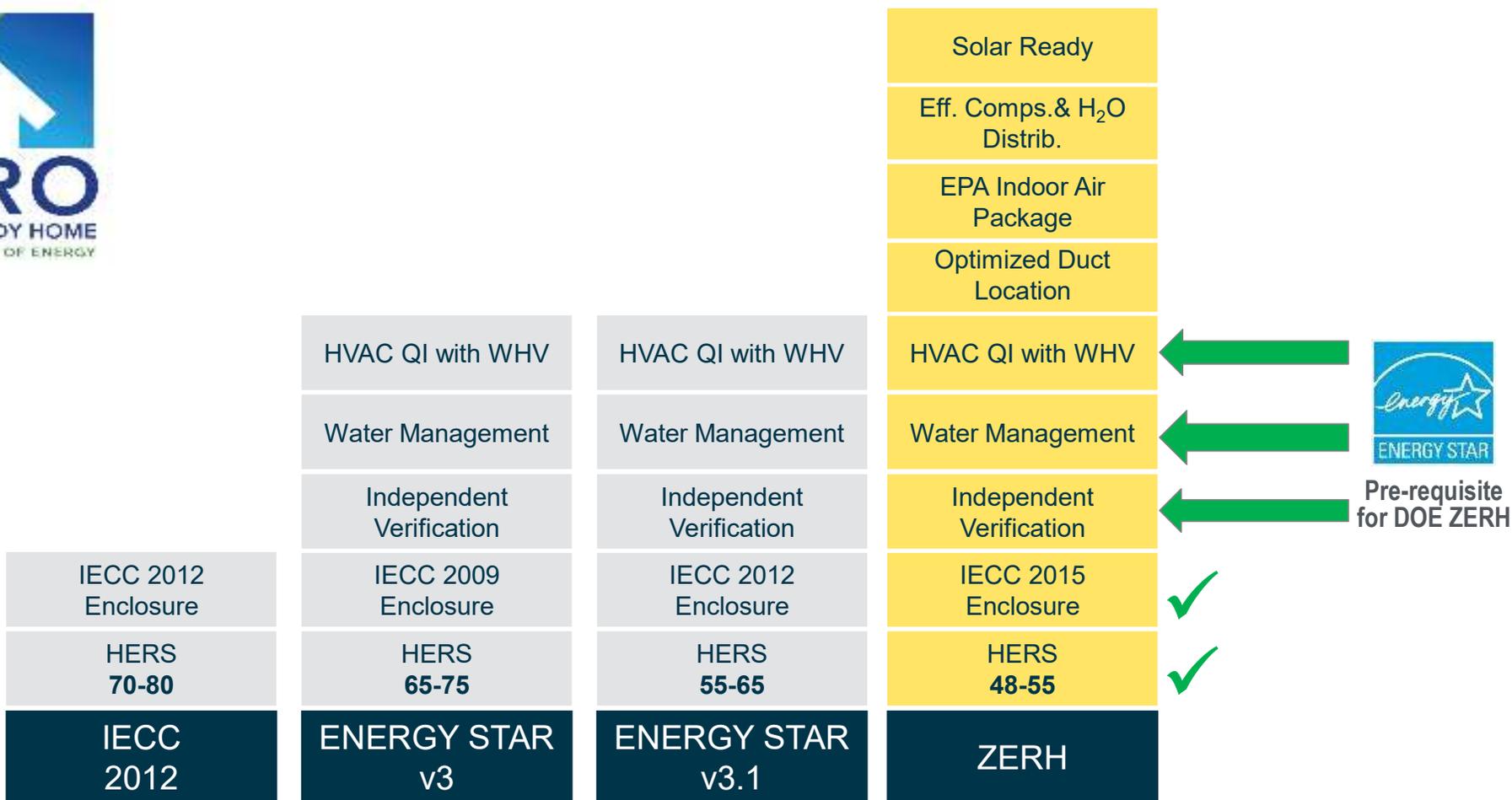
The Easy Lift to ZERH...



2015 IECC Prescriptive Requirements

Climate Zone	Fenestration		Slab R-Value & Depth	Basemt Wall R-Value	Floor R-Value	Ceiling R-Value	Wood Frame Wall R-Value
	U-factor	SHGC					
					13	30	13
					19	38	20 or 13+5
4 ex. M		0.40			30	49	20+5 or 13+10

The Easy Lift to ZERH...

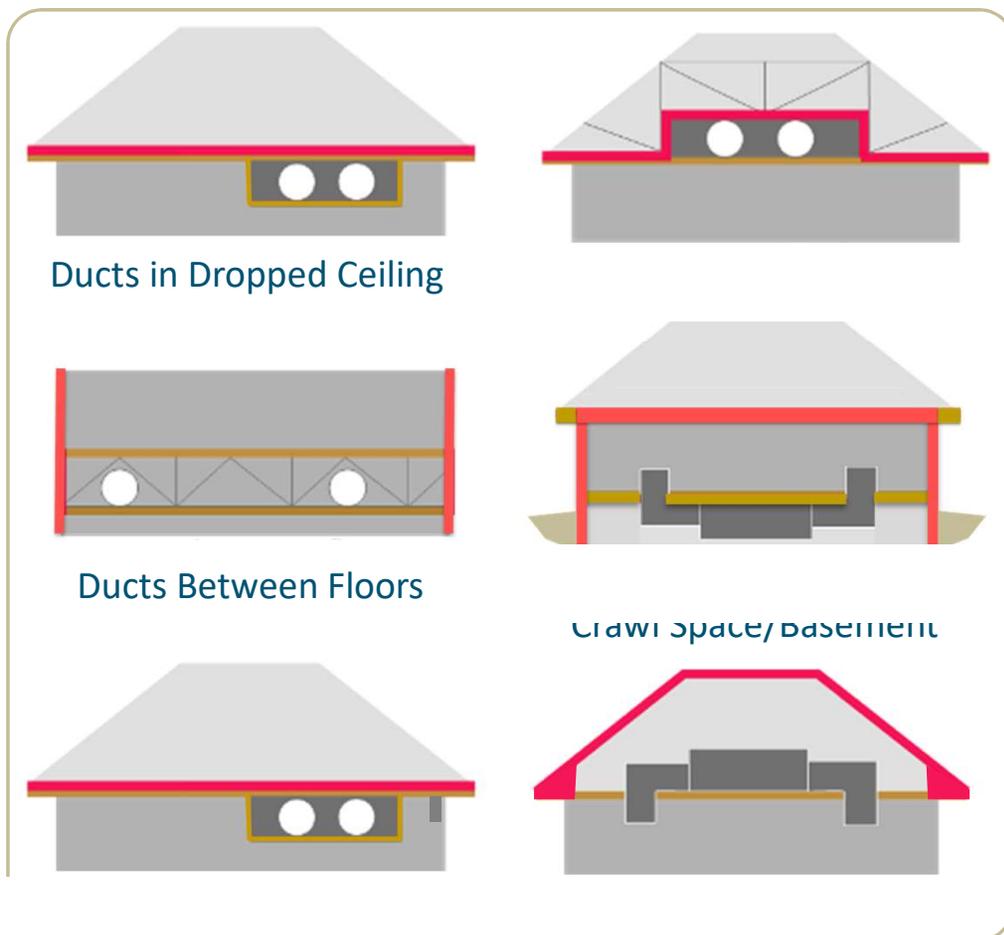


The Easy Lift to ZERH...



			Solar Ready	
			Eff. Comps. & H ₂ O Distrib.	
			EPA Indoor Air Package	
			Optimized Duct Location	←
	HVAC QI with WHV	HVAC QI with WHV	HVAC QI with WHV	✓
	Water Management	Water Management	Water Management	✓
	Independent Verification	Independent Verification	Independent Verification	✓
IECC 2012 Enclosure	IECC 2009 Enclosure	IECC 2012 Enclosure	IECC 2015 Enclosure	✓
HERS 70-80	HERS 65-75	HERS 55-65	HERS 48-55	✓
IECC 2012	ENERGY STAR v3	ENERGY STAR v3.1	ZERH	

Options for Optimized Duct Location



Ducts in Conditioned Space

Buried Ducts

A cross-sectional diagram of a house showing a duct (grey) buried within the ceiling structure (grey). The duct is highlighted with a red outline, and the surrounding ceiling material is also highlighted in red, indicating it is encapsulated with spray polyurethane foam (SPF).

- Buried & SPF encapsulated (Humid Climates)
- Buried (Dry Climates)
- Buried (2018 IECC)

The Easy Lift to ZERH...

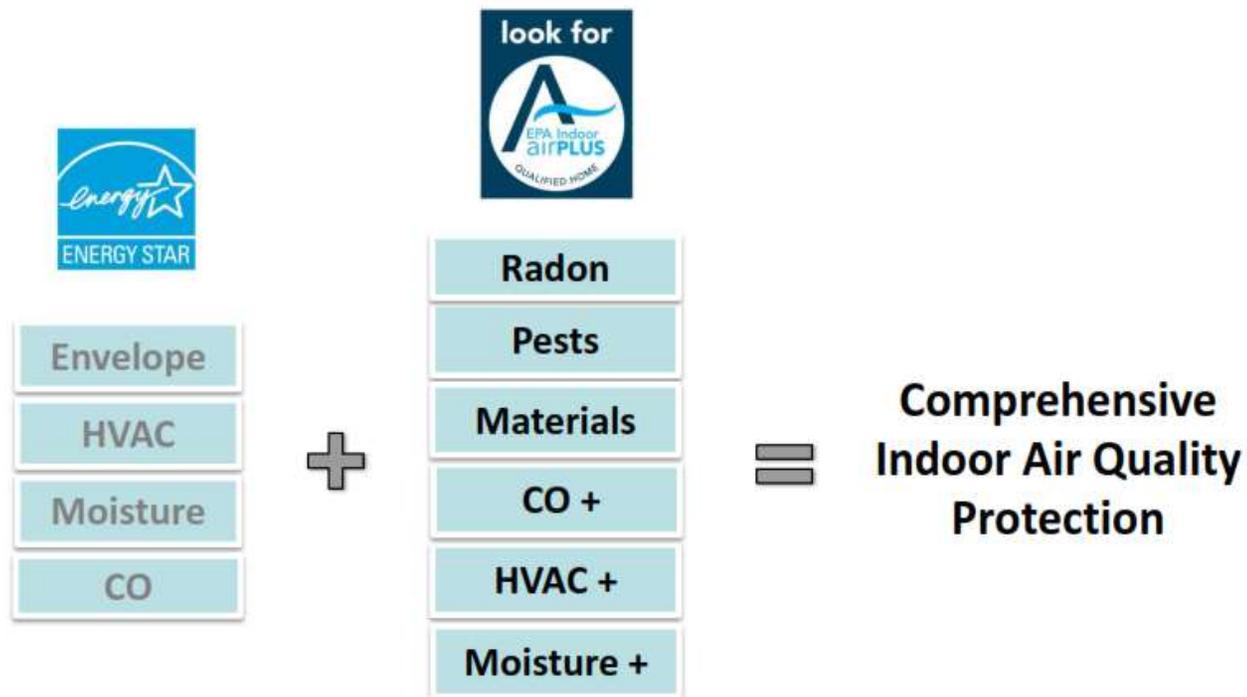


			Solar Ready	
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			Optimized Duct Location	✓
	HVAC QI with WHV	HVAC QI with WHV	HVAC QI with WHV	✓
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Pre-requisite for DOE ZERH

ENERGY STAR + Indoor airPLUS

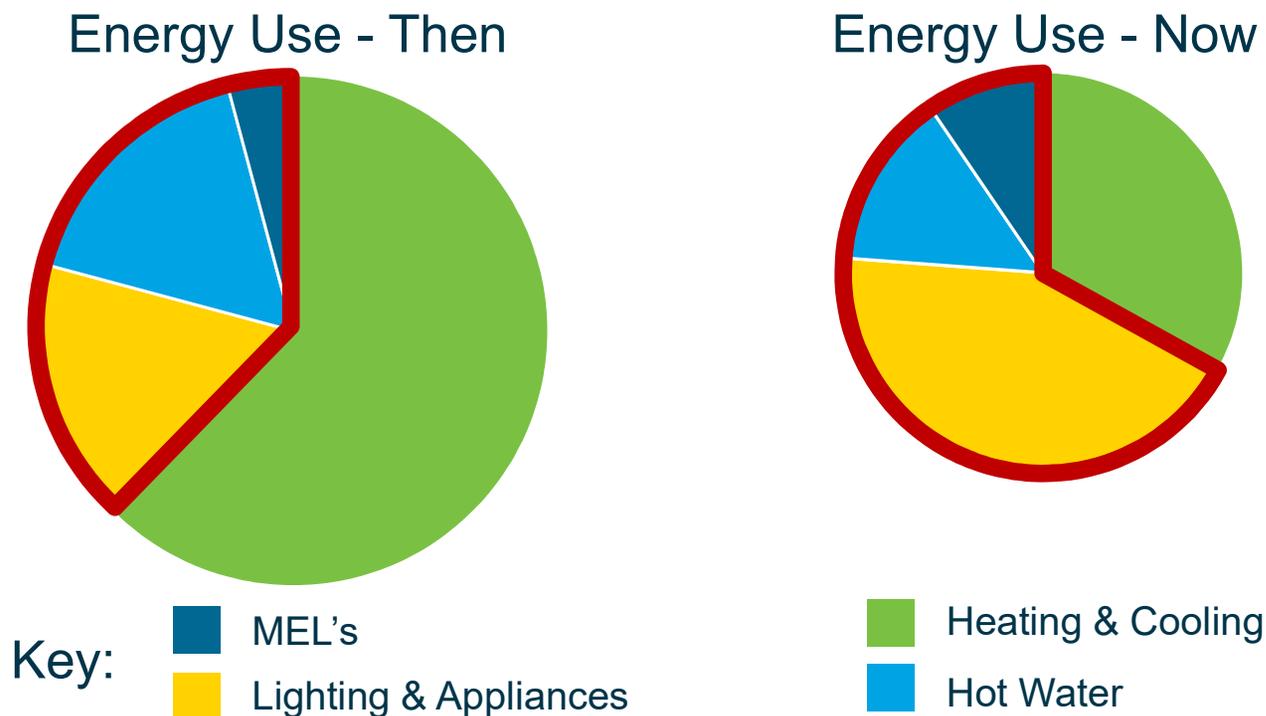


The Easy Lift to ZERH...



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IECC 2012	ENERGY STAR v3	ENERGY STAR v3.1	ZERH	

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



The Easy Lift to ZERH...



			Solar Ready	←
			Eff. Comps. & H ₂ O Distrib.	✓
			EPA Indoor Air Package	✓
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Documentation of the maximum allowable dead load and live load ratings of the existing roof (Rec DL.: +6 lbs./sq. ft.)

Conduit to run DC wire from roof to inverter

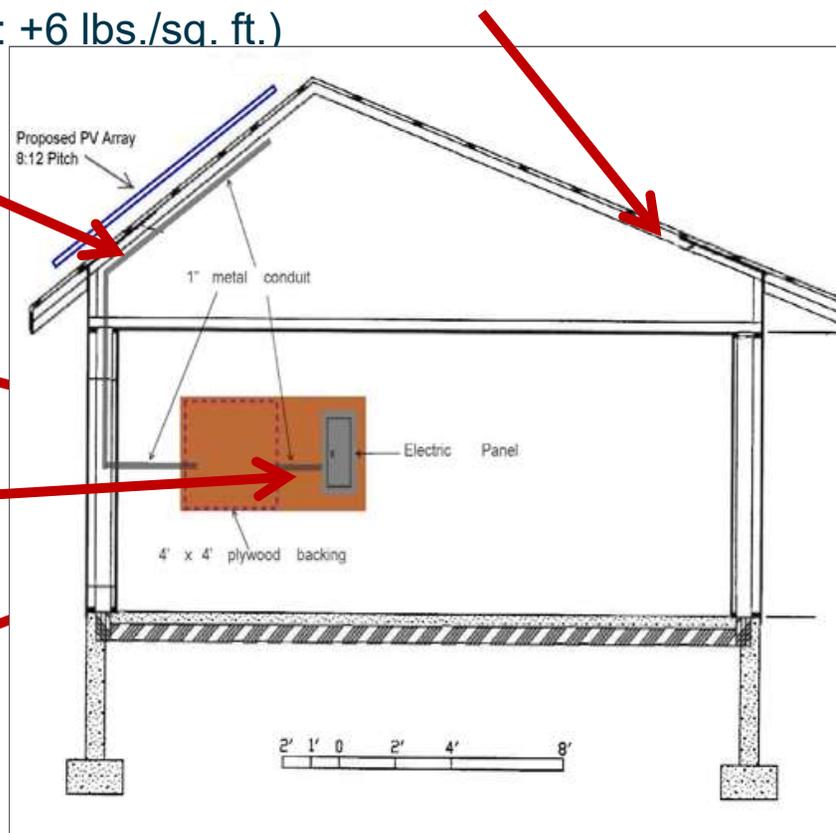
Dedicated Area

for installing inverter and balance of system

Conduit to run AC wire from inverter location to electric panel

Circuit Breaker

designated and/or installed for use by the PV system in the electric panel





Zero Energy Ready Home

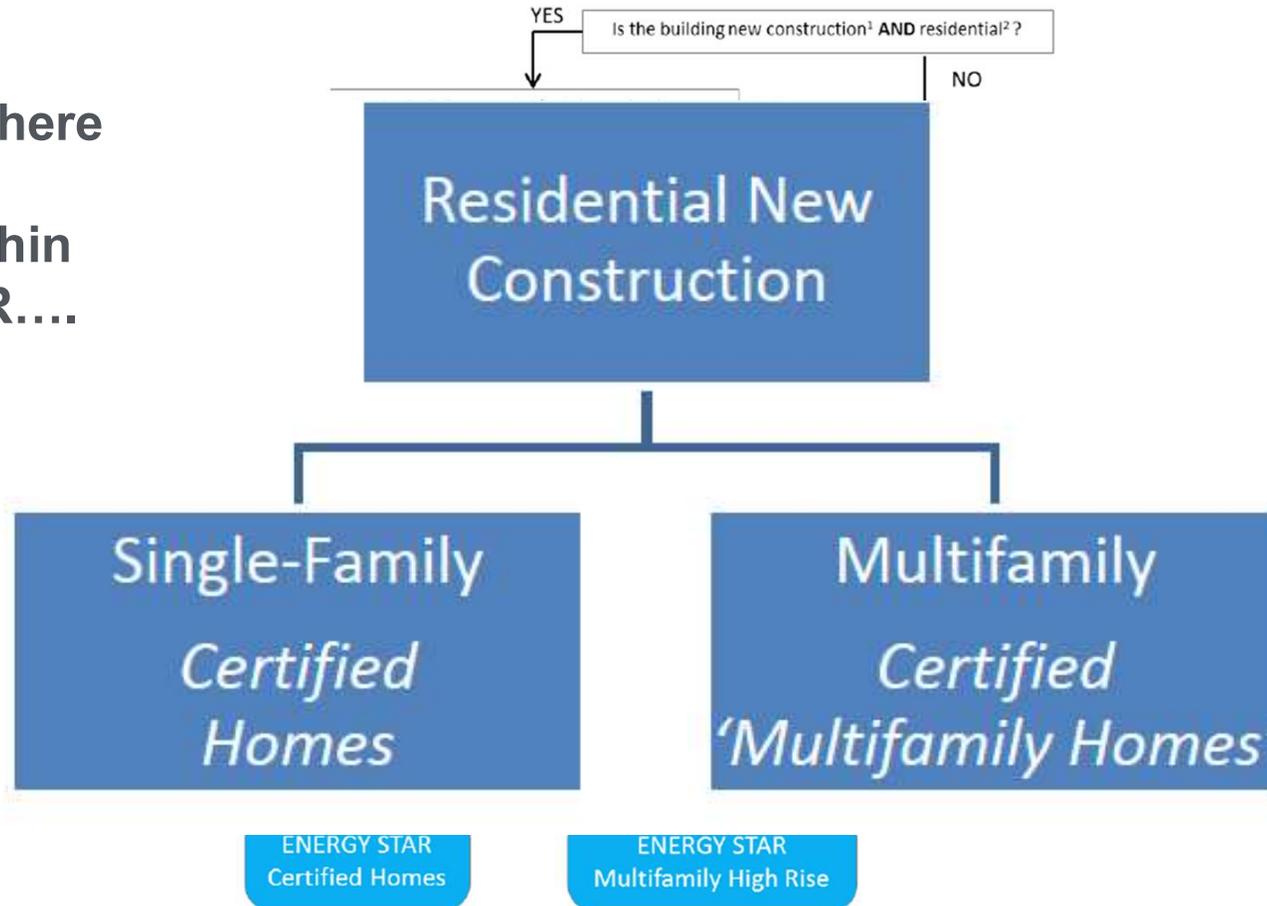
Multifamily Provisions

ENERGY STAR Multifamily New Construction

Process for determining where a Multifamily project fits within ENERGY STAR....

Then....

Now....



Integration with ENERGY STAR Multifamily New Construction

Program	Eligible Building Types	Performance Basis	Addresses Common Spaces	Implementation Dates
ENERGY STAR Multifamily New Construction (V1, 1.1, 1.2)	Dwellings in any size MF building In mixed use buildings, dwellings + common space must be > 50% of total square footage	ERI Prescriptive ASHRAE	Yes	Available for use currently Required for permit dates on/after 1/1/2021
DOE Zero Energy Ready Home – Multifamily	Same as ESMFNC, with a limit of 5 stories or less	ERI Prescriptive	Yes	Will be available for use Spring 2020



Zero Energy Ready Home Resources

- DOE Zero Energy Ready Home Program Requirements
- 20+ Tech Training Webinars
 - Getting Enclosures Right, Joe Lstiburek, BSC
 - Low Load HVAC, Greg Cobb, Energy Inspectors
- Fact Sheets
 - How to Find Low Emission Products
 - ZERH Savings & Cost Estimate
- Building America Solution Center
- 100+ ZERH Project Case Studies



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.](#)

Recognition Resources

- Zero Energy Ready Home Logo
- Customizable Resources
 - Dare to Compare Brochure
 - Dare to Compare Fact Sheet
 - Superior Experience Fact Sheets
 - Homeowner Manual
 - Drop-in Messaging
 - Drop-in Homebuyer Testimonials
- Housing Innovation Awards
- Tour of Zero
- Partner Locator



**“No more trips to
the hospital!!!”**

Homeowner



For More Information

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



Web Site:

www.buildings.energy.gov/zero/

e-mail Contact:

zero@newportpartnersllc.com

Martha Campbell

Rocky Mountain Institute

U.S. DEPARTMENT OF
ENERGY



REALIZE

Industrialized Retrofits for Multifamily Buildings

Martha Campbell | Better Buildings Summit
2019



Transforming global energy use to create a clean, prosperous, and secure low carbon future.



AGENDA

- **REALIZE OVERVIEW**
- **RETROFIT MODEL**
 - **ENVELOPE SYSTEMS**
 - **MECHANICAL SYSTEMS**
 - **BUSINESS MODEL**
- **DOE PILOT**



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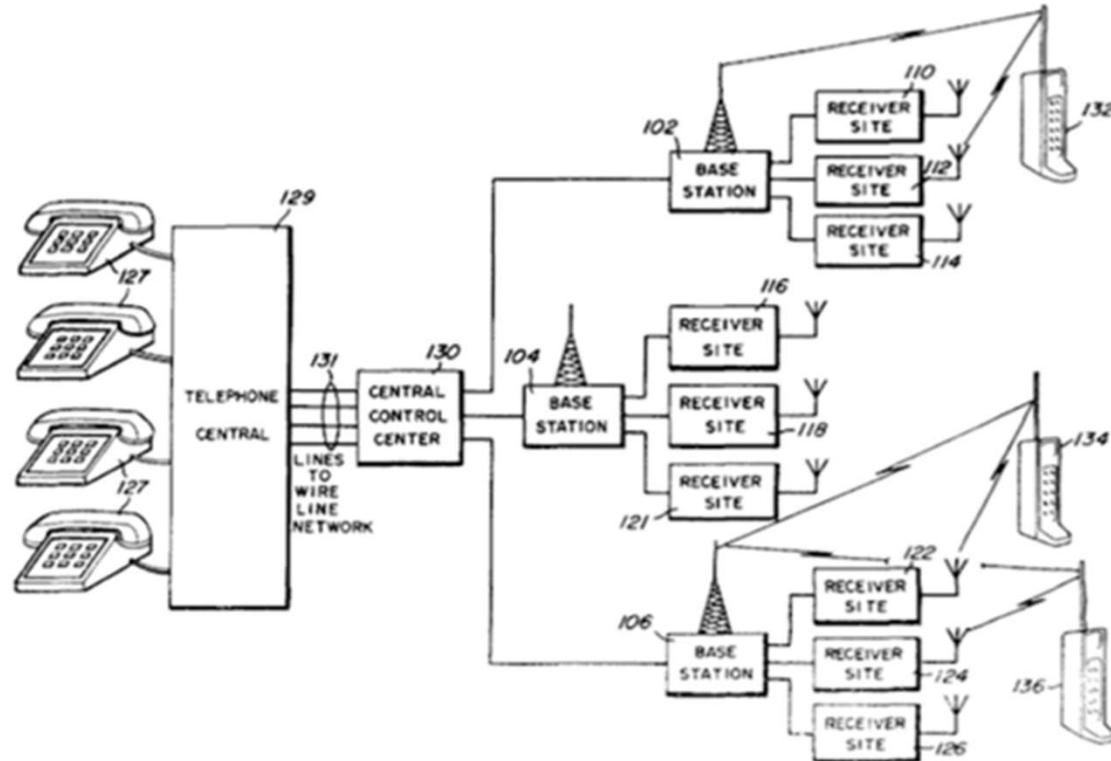


THE PROBLEM

A “MODERN” DAY RENOVATION



A SERVICE ANALOGY





THE SOLUTION

ENERGIESPRONG



ENERGIESPRONG: A MODEL OF INSPIRATION

Core offering: A net zero carbon retrofit bundle that is 1) affordable, 2) attractive, 3) ensures energy performance, and 4) can be delivered in less than two weeks



QUALITY

*Net-zero energy homes
with long performance
warranties*



NON-INTRUSIVE

*Refurbishment within a
week to 10 days*



AFFORDABLE

*Financeable through
energy cost savings*



LOOK & FEEL

*Attractive and
comfortable homes*



MARKET ENABLEMENT MODEL



REALIZE: GOAL AND MISSION

REALIZE seeks to create a business model inspired by Energiesprong to catalyze industry to develop readily available, cost-effective, deep energy retrofits for the US residential market



SOME OF OUR PARTNERS





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- REALIZE OVERVIEW
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ENVELOPE SYSTEMS

FACADE PANELS: A VARIETY OF SOLUTIONS



RC PANELS FACTORY PRODUCTION

Panel Description:

- SIP panels made with fiberglass, OSB, graphite-infused foam, and waterproofing sealant material.
- Cut to meet 3D imaging model specifications by CNC machine
- Windows and doors installed into panel
- Exterior claddings applied to panel: stucco and STO brick veneer



FACADE INSTALLATION SITE PRE-WORK



RENOLUTION PROJECT





AGENDA

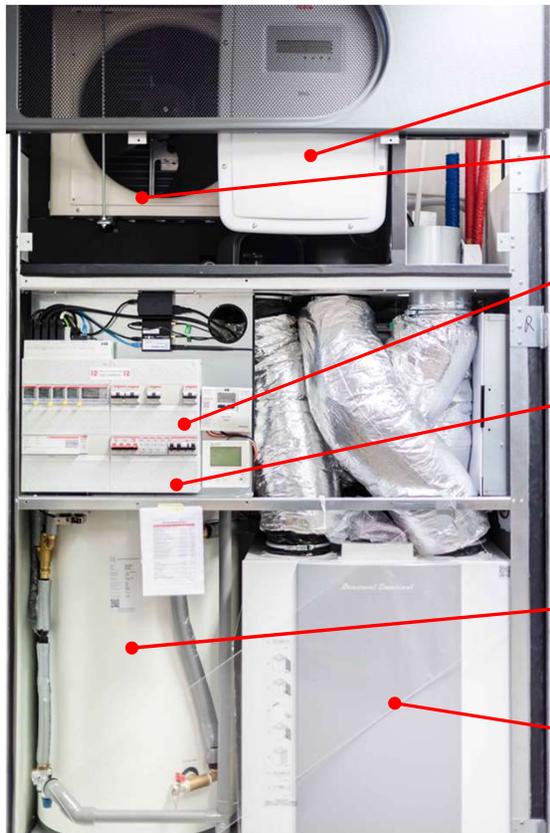
- REALIZE OVERVIEW
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ENERGIESPRONG MECHANICAL SYSTEMS

- Retrofits are always **all-electric**
- The mechanical systems typically consists of:
 - heat pump (space heating and DHW)
 - ERV
 - solar panels & inverter
 - printed circuit board controls
- Systems are either **distributed or centralized** into one closet/unit
- The **market was late to innovate** on the mechanical side and more progress has been made on the facade systems



FACTORY ZERO INTEGRATED CLIMATE ENERGY MODULE (iCEM)



PV Inverter

Heat Pump (for DHW and space heating)

Control Board and Thermostat

Plumbing (behind control board and ducting)

DHW Tank

ERV

- Parts sourced from various OEMs and assembled on site
- Approximately 8 units assembled per week
- Working with Denzo to get standardized parts for next model



FACTORY ZERO PROJECT EXAMPLES





AGENDA

- REALIZE OVERVIEW
- NETHERLANDS FIELD TRIP
 - ENVELOPE SYSTEMS
 - MECHANICAL SYSTEMS
 - BUSINESS MODEL
- DOE PILOT



FINANCING

COMPONENTS OF THE FINANCING CHALLENGE

#1 Revenue Challenges (Source)

- Project economics for deeper performance improvements don't pencil out due to an inability for owners to capture more rent through adjustments in the utility allowance
- A handful of lenders underwrite to 75%-80% of the savings, none underwrite up to 100%

#2 Transaction Complexity (Source)

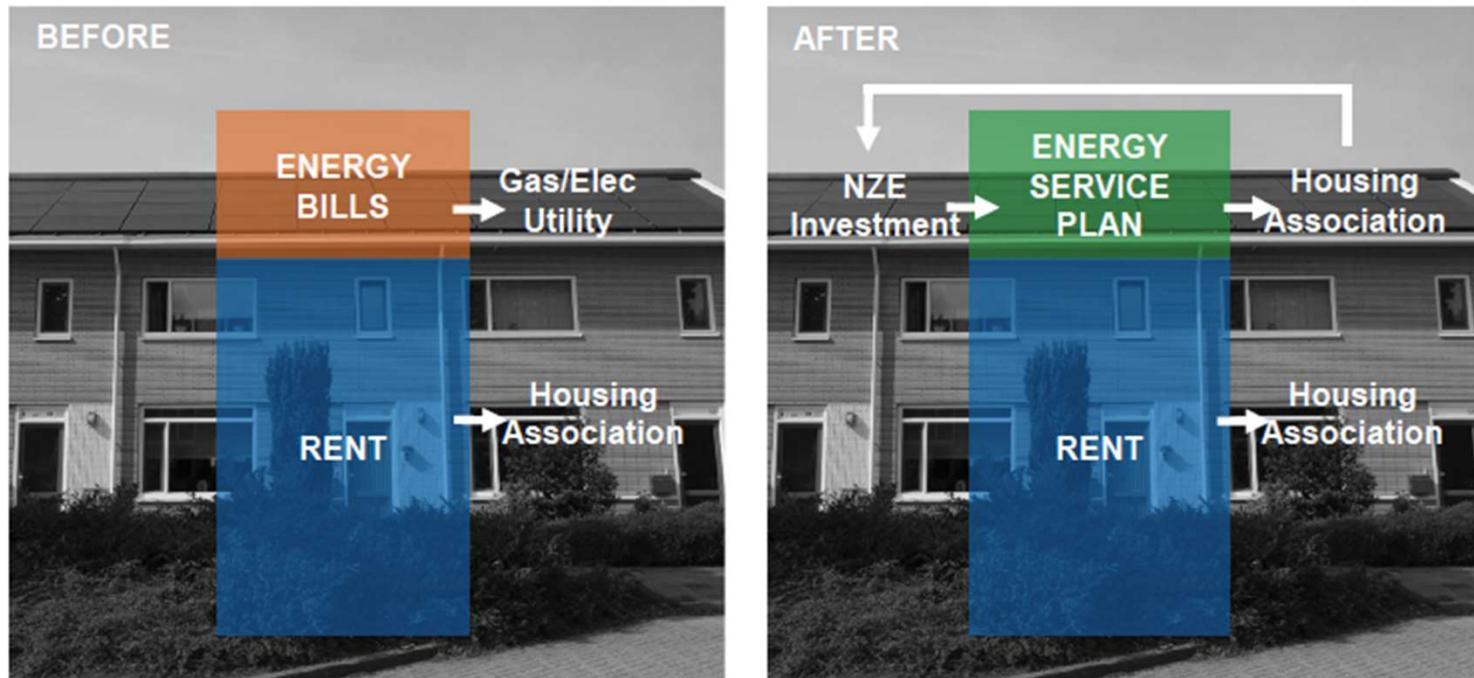
- Affordable housing capital stack is complex with many conflicting strings and interests attached
- Poor policy alignment or coordination amongst government agencies disincentive stated government carbon reduction goals
- Utility incentive programs are disaggregated and can have limiting cost-effectiveness requirements

#3 Cost Issues (Uses)

- Suppliers need sight to a pipeline to commit R&D investment
- Large volumes of organized demand needed to negotiate and drive down costs
- Greater organization along the value chain, helps reduce cost and mark-ups

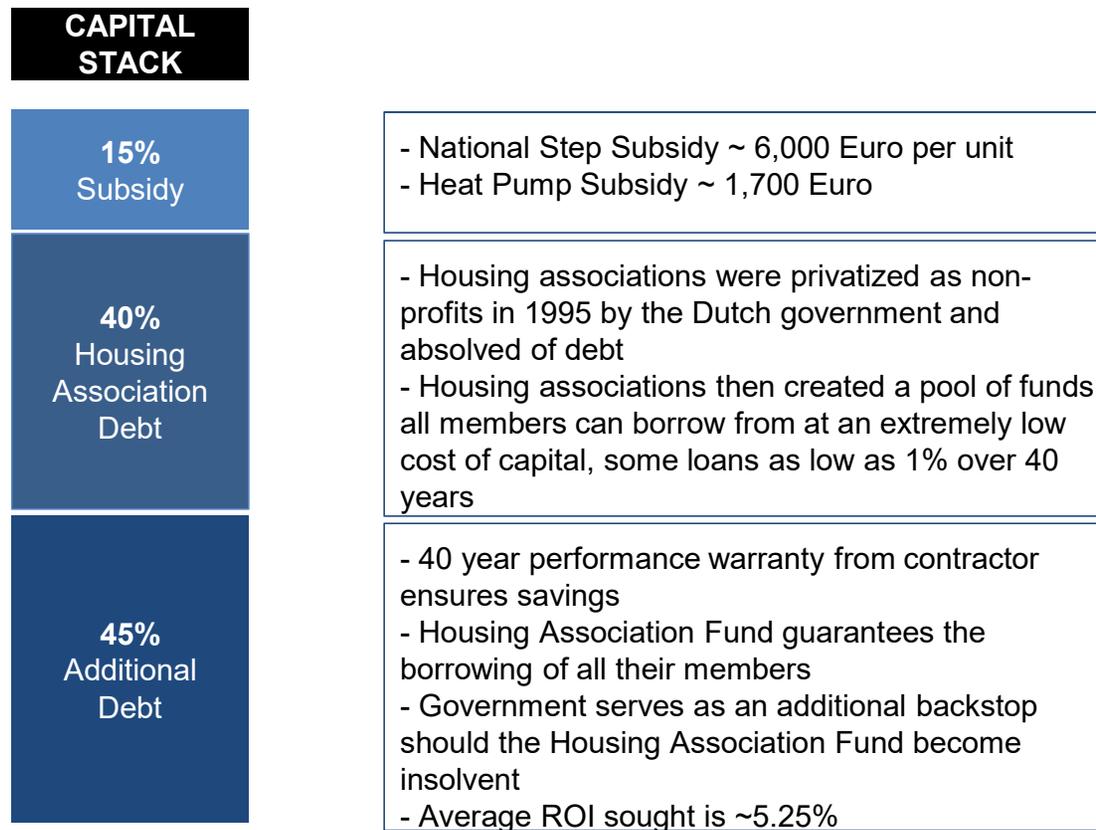
DUTCH SOLUTION FOR CHALLENGE #1: REVENUE

CONVERT UTILITY BILLS INTO A REVENUE STREAM FOR BUILDING OWNERS



DUTCH SOLUTION FOR CHALLENGE #2: COMPLEXITY

THREE LAYER CAPITAL STACK WITH A 40 YEAR INVESTMENT HORIZON



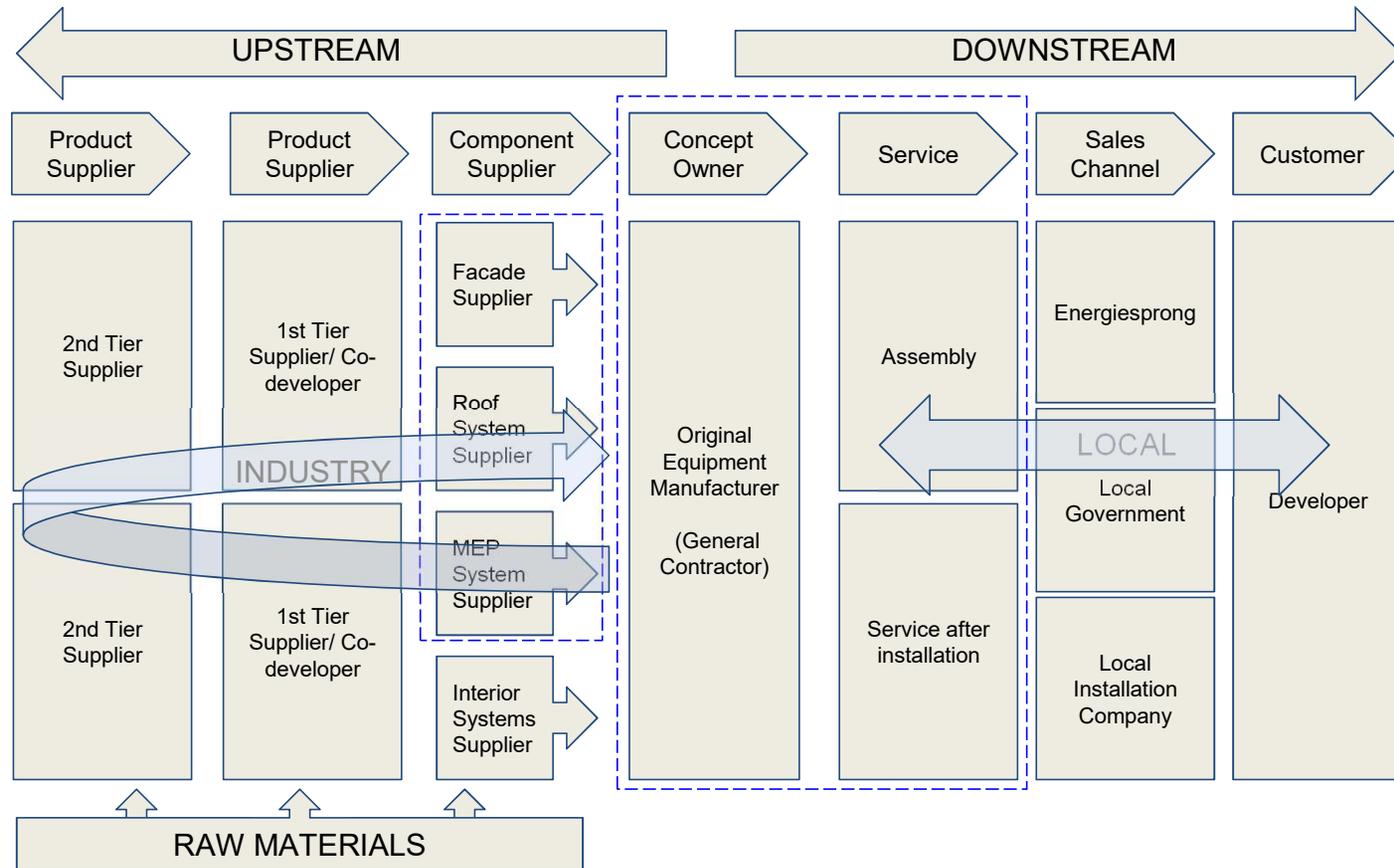
DUTCH SOLUTION FOR CHALLENGE #3: COSTS

AGGREGATE LARGE VOLUMES OF DEMAND TO NEGOTIATE PRICES



DUTCH SOLUTION FOR CHALLENGE #3: COSTS

GCs ORGANIZE A COMPLEX VALUE CHAIN TO PRODUCTIZE THEIR OFFERING





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DOE PROJECT OVERVIEW

US DEPARTMENT OF ENERGY BUILDING AMERICA PROGRAM FOA-0001630

Major Partners: Passive House Institute US, Net Zero Energy Coalition, Re:Vision Architecture, The Levy Partnership, Staengl Engineering, Energiesprong, Centria, Bunting Architectural Metals, Mitsubishi, Goodman Manufacturing, RenewAire, and PowerWise

Desired Project Outcome:

Develop a standardizable, transferable, climate zone specific net zero energy ready retrofit system, designed with at least a 50% lower energy use intensity relative to the measured baseline energy performance



DOE TEAM SELECTION PROCESS

<https://www.rmi.org/our-work/buildings/realize/rfps/>

REQUEST FOR PROPOSALS

BUILDING OWNERS AND DEVELOPERS

PANEL SYSTEM MANUFACTURERS

MECHANICAL SYSTEM MANUFACTURERS



REALIZE 
A Rocky Mountain Institute Initiative

PILOT BUILDING SELECTED

440 TREMONT STREET, BOSTON, MA - WINN COMPANIES



PILOT BUILDING NEXT STEPS

- Develop panel and mechanical system designs
- Conduct costing exercise including energy savings
- Finalize pilot building designs to include panel and mechanical system products
- Kick off construction in Q1 2022

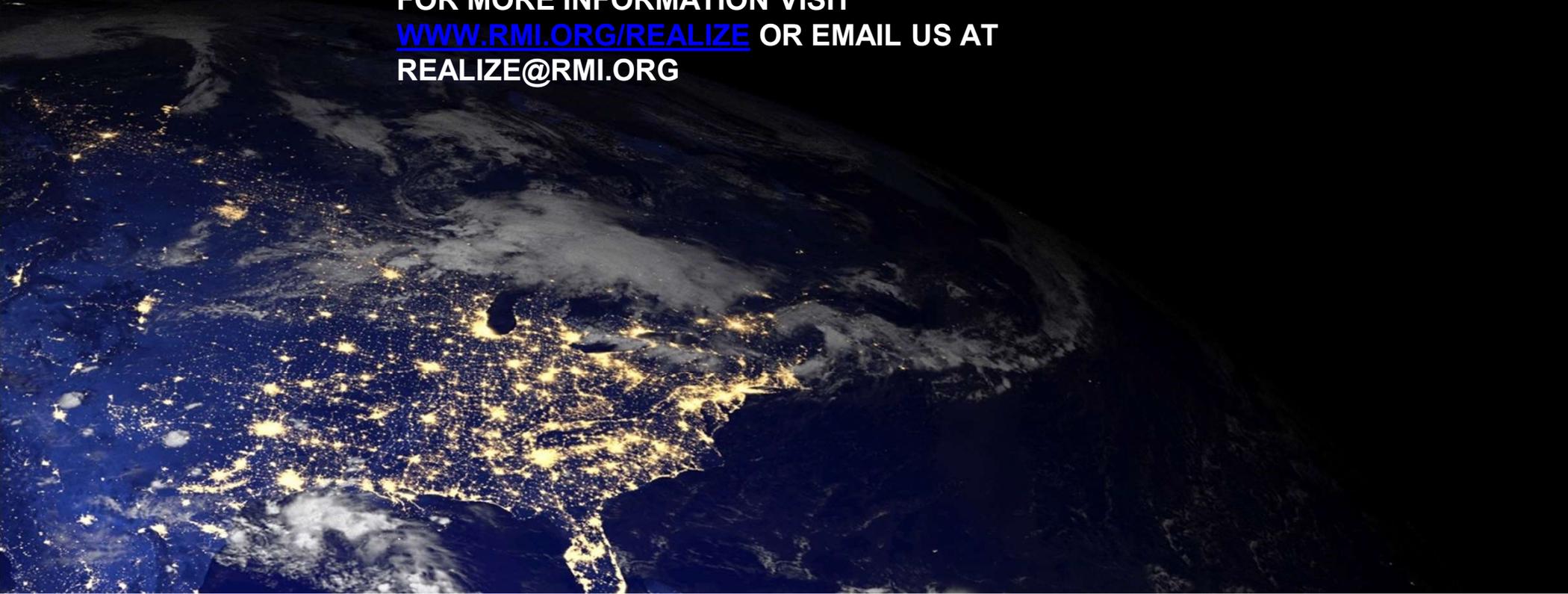


Centria panel examples



THANK YOU

FOR MORE INFORMATION VISIT
WWW.RMI.ORG/REALIZE OR EMAIL US AT
REALIZE@RMI.ORG



Thank You

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