

Thank you for joining today's webinar.
We'll begin momentarily.



Approved
Continuing
Education

Zero for Lower Cost: Five Faster, Better, Cheaper Strategies

Presented By: Sam Rashkin



building.dupont.com/eduhub





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Presented By:

Sam Rashkin

Contact Info:

email:

sam@truhomefacts.com

Housing 2.0:

<https://www.greenbuildermedia.com/housing-2.0>

LinkedIn:

<https://www.linkedin.com/in/sam-rashkin-1684582/>



- **Zero** is the Future ... What We Know with Certainty
- **Zero** Building Blocks ... Adapt or be Left Behind
- **Zero** Innovations ... Faster, Better, Cheaper
- **Zero** Value Imperative ... Getting to Cheaper



Zero is the Future ...

What We Know with Certainty

Zero is the Future: What We Know with Certainty

1. Zero Has Left the Station
2. Zero Has to Manage Greater Risks
3. Zero Can't Ignore External Forces



Zero Has Left the Station: **HERS Metrics**

Cumulative HERS Ratings: **3.6 Million**

HERS Ratings in 2022: **337,962**

Avg. HERS Index in 2022: **58**

Avg. IECC Code Home HERS Index: **70-80**

Source: “Number of HERS Rated Homes in U.S. in 2022 Tops 330,000 Mark,” RESNET, Jan. 11, 2023

Zero Has Left the Station: National Code

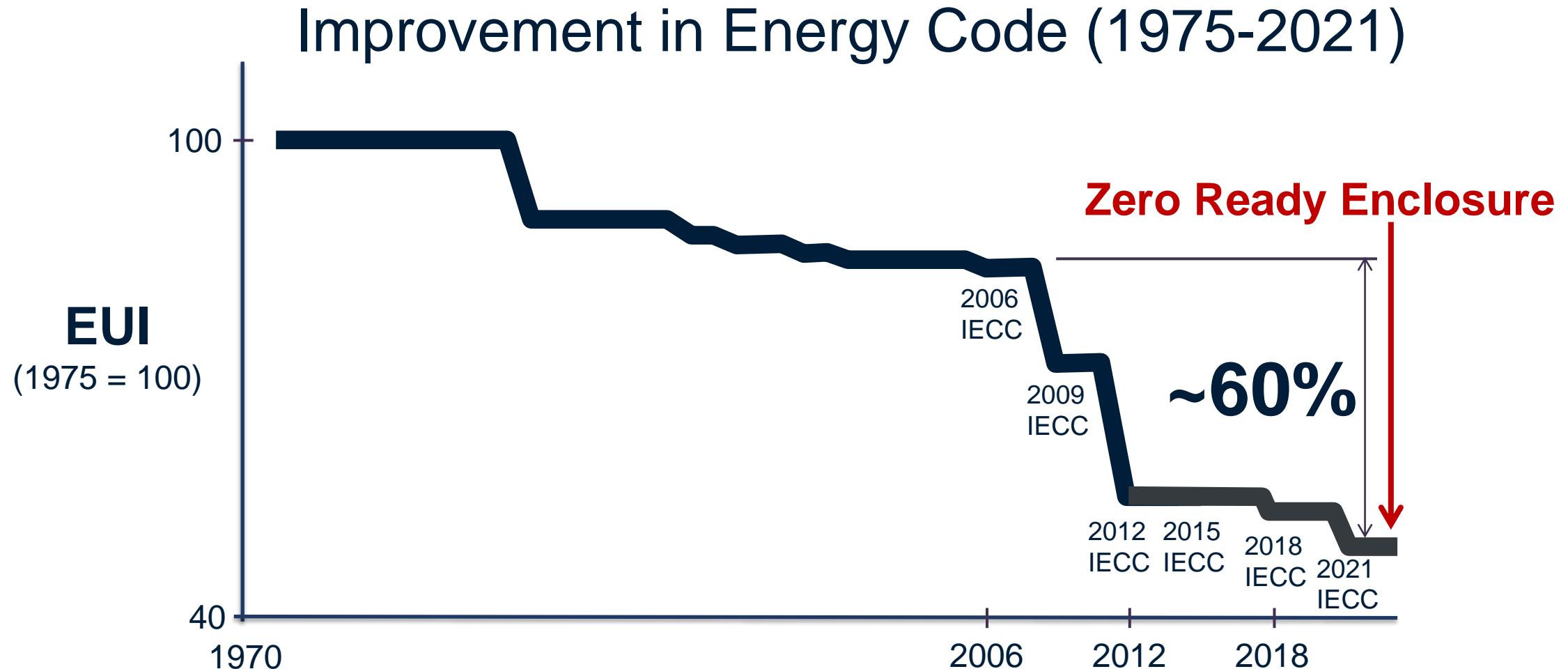


Image Basis: Building Energy Codes Program: National Benefits Assessment, 1992-2040



Zero Has Left the Station: **State Codes**

Building Code Targets Moving to Zero

California

Oregon

New Jersey

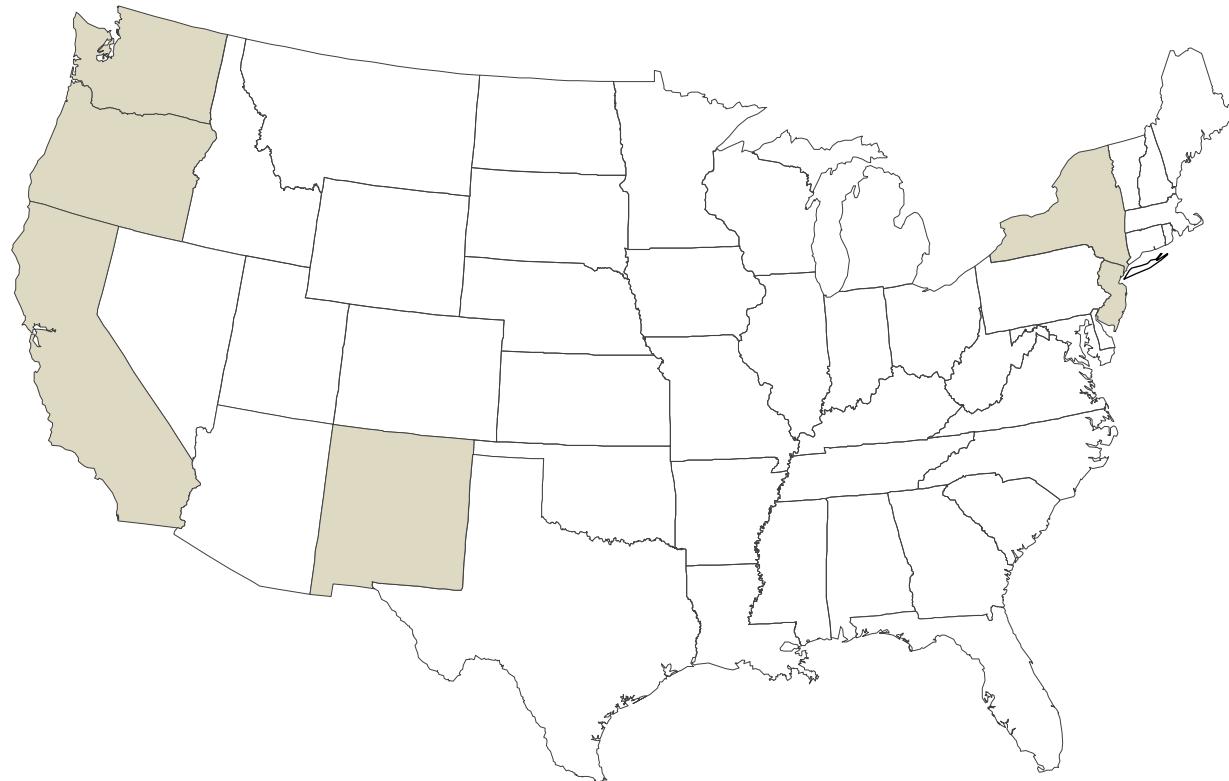
New Mexico

New York

Puerto Rico

Washington

2015 - 2021 IECC



Source: “How to Zero Out Emissions? More US States use Energy Efficiency,” Annie Gileo, ACEEE Blog Post, July 16, 2019

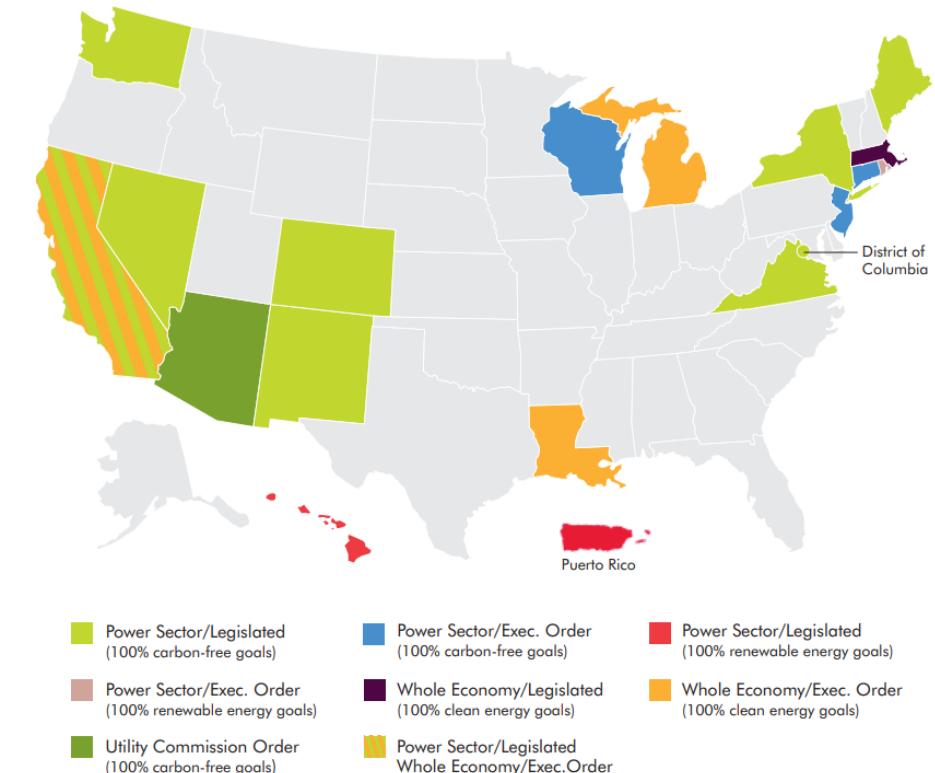


Zero Has Left the Station: State Policies

States with 100% Clean Energy or Renewable Energy Policies

Arizona
California
Colorado
Connecticut
District of Columbia
Hawaii
Louisiana
Maine
Massachusetts

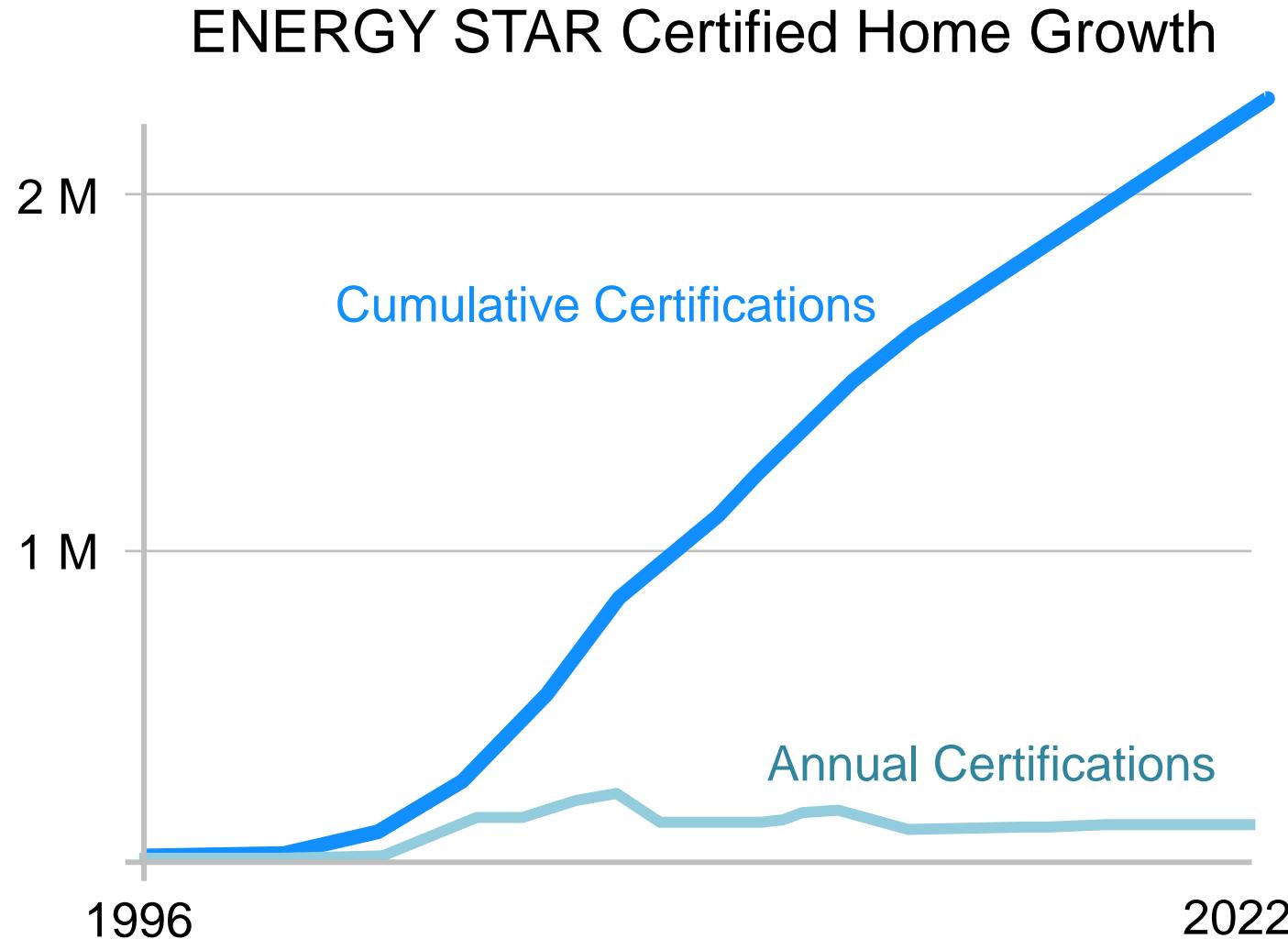
Michigan
Nevada
New Jersey
New Mexico
New York
Puerto Rico
Rhode Island
Virginia
Washington



Source: “Advancing Toward 100 Percent: State Policies, Programs, and Plans for Zero-Carbon Electricity,” Bentham Paulos, Clean Energy States Alliance, Updated April 2021



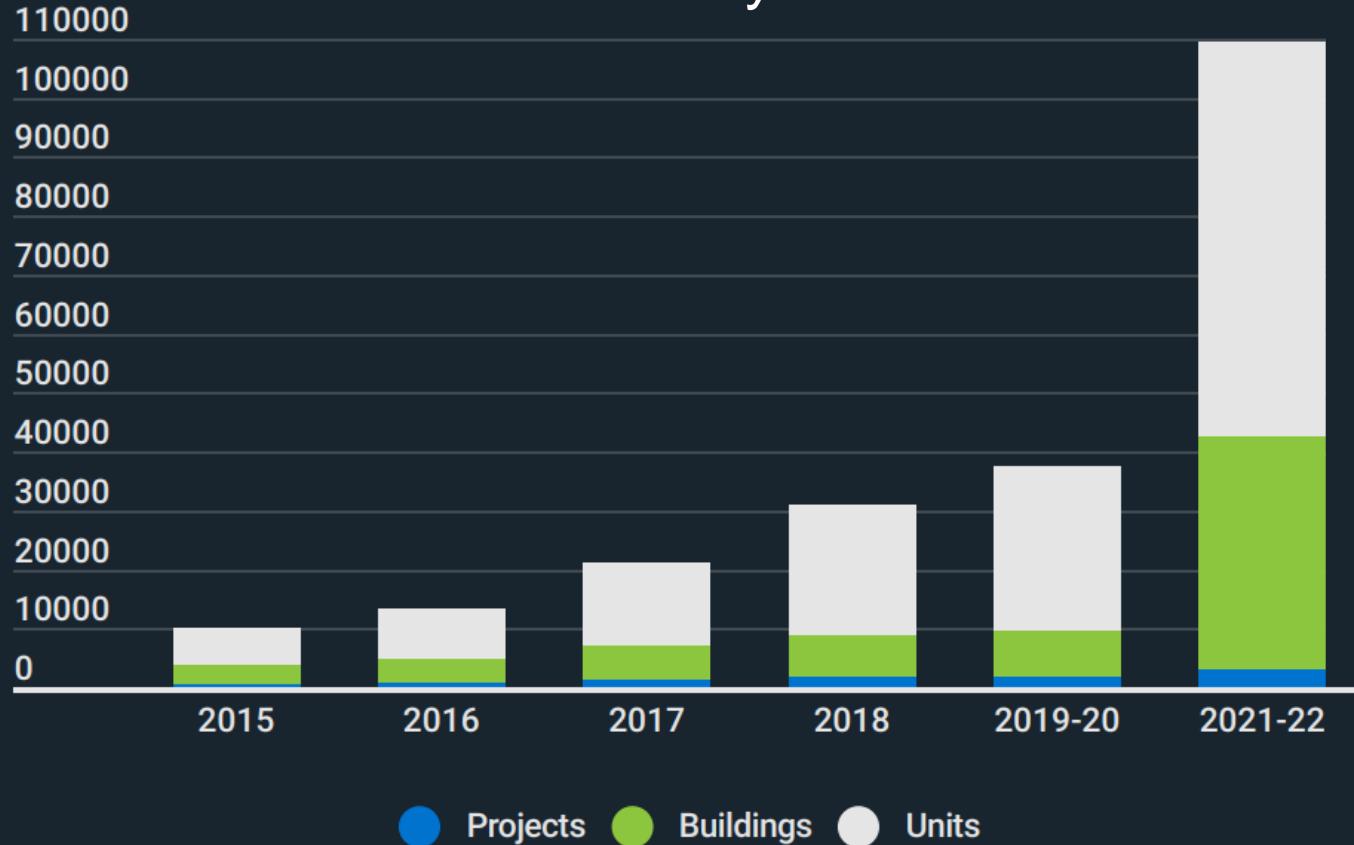
Zero Has Left the Station: Certifications



2.5+ Million
ENERGY STAR
Certified Homes

Zero Has Left the Station: Certifications

Zero / Zero Ready Home Growth



Since 2020:

190%

Growth in Total Projects

440%

Growth in SFH's

Source: "Inventory of Zero in the U.S. and Canada," Energy & Environmental Building Alliance 2022



Zero Has Left the Station: Tax Credit

45 L Credit:

- Single- & Multi-Family Prevailing Wage:
 - **\$2,500**/ENERGY STAR Certified Homes
 - **\$5,000**/DOE Zero Energy Ready Home
- Multi-Family Homes:
 - **\$500**/ENERGY STAR Certified Home
 - **\$1,000**/DOE Zero Energy Ready Home
- Manufactured Homes
 - **\$2,500**/ENERGY STAR HUD-Code Home

10-Year Lock

for builder tax credit
from 2023 to 2032



Zero Has Left the Station: ESG Movement

Environmental, Social and Governance:

- **Aligns w/Carbon Neutrality Objectives**
Included in Investment Strategies
- **Makes Financing Easier to Secure**
to Buy or Build Multi-Family
- **Creates “Impact Investing” Options**
for Affordable Housing
- **Top Builders Already Engaged**
preparing ESG Reports

60%

Of Global Investors
Surveyed Plan to
Adopt ESG Criteria

Source: “ESG: 2021 Trends and
Expectations for 2022,” Harvard Law
School Forum on Corporate
Governance, February 25, 2022



Zero Has Left the Station: Mainstream Builders

Clayton

Walk Through the Clayton Home



Clayton® Commits to Build All Residential Manufactured Homes To DOE Zero Energy Ready Home™ Specifications by End of 2023

OMAHA, NE., May 6, 2023 – Clayton, a builder of attainable housing, announced its move to build all new residential manufactured homes to Department of Energy (DOE) Zero Energy Ready Home specifications by January 1, 2024. These solar-ready homes, available to order in July 2023, will include enhanced energy efficiency features that significantly reduce energy costs for homeowners, while also supporting the company's broader sustainability goals. At the 2023 Berkshire Hathaway Shareholders Meeting, Clayton is showcasing a home built to the DOE Zero Energy Ready Home specifications.

"We are driven to make energy efficient homes an attainable option for home buyers across the country," said CEO Kevin Clayton. "Energy efficiency is crucial for lowering monthly utility costs and maintaining long-term affordability."

DOE Zero Energy Ready Homes are built inside a certified building facility and are designed with energy-efficient features that can offset up to 100 percent of the home's energy use when combined with a renewable energy system, such as solar panels. Every DOE Zero Energy Ready Home must meet rigorous efficiency requirements, making it less costly for homeowners if they choose to add solar in the future.

All Clayton DOE Zero Energy Ready Homes will be equipped with [enhanced energy-efficient features](#), such as a Rheem® hybrid heat pump water heater, low-E windows with argon gas, SmartComfort® by Carrier high efficiency heat pump or gas furnace, ENERGY STAR® certified appliances, LED lighting throughout, an ecobee® smart thermostat and additional insulation. To deliver additional value to the consumer, Clayton will reinvest the credits received for building the certified homes to offset the cost of materials.



\$148/Sq. Ft.

- 3 BR/2 Baths
- 1,549 Sq. Ft.
- \$230,000 before land/solar
- One 64-gallon Bin waste
- Compare to \$150/SF for minimum code home*

* *"How Much Does it Cost to Build a House in 2022"*,
Rachel Abraham, Forbes

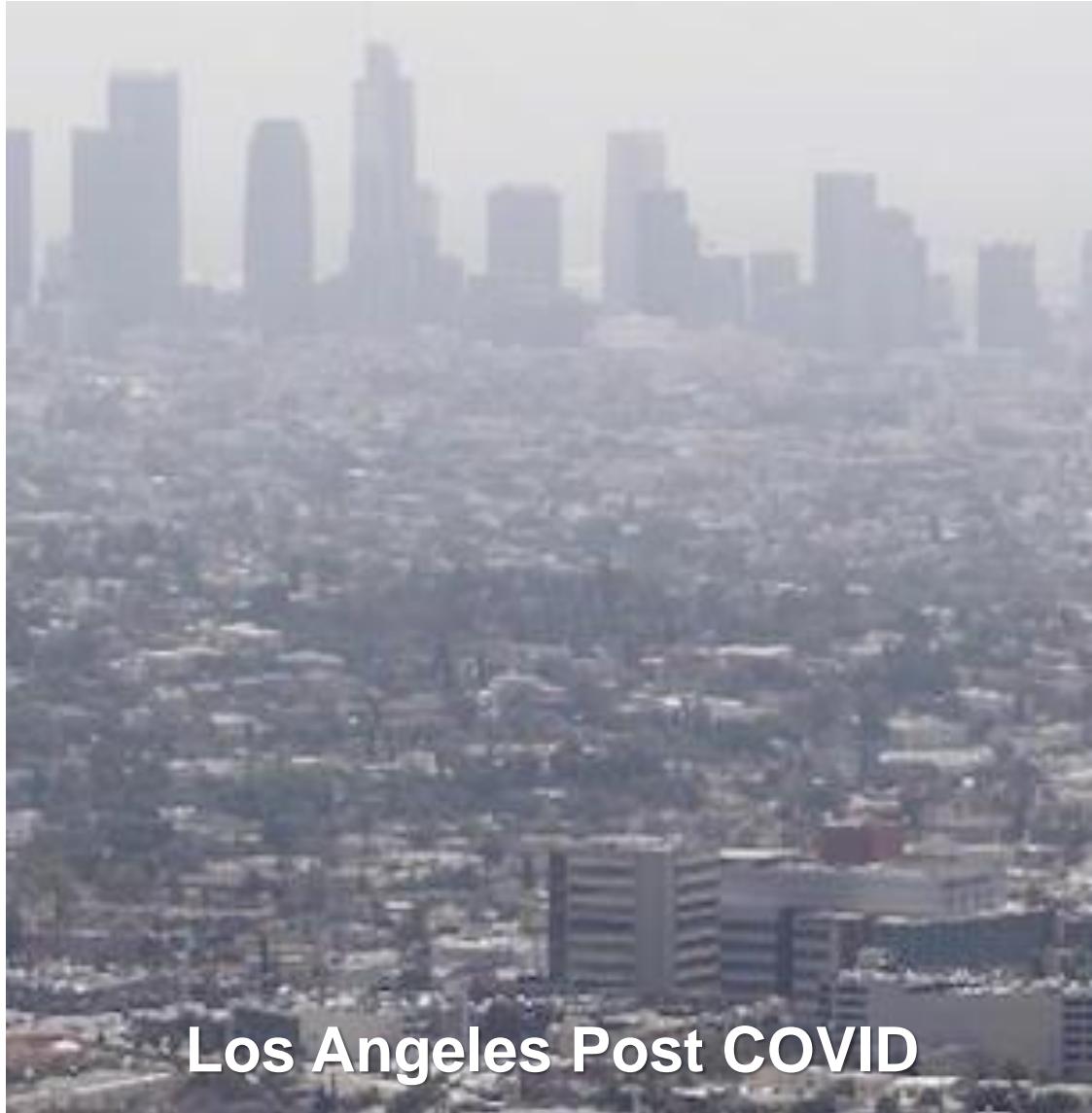
Zero Has Left the Station: Superior UX



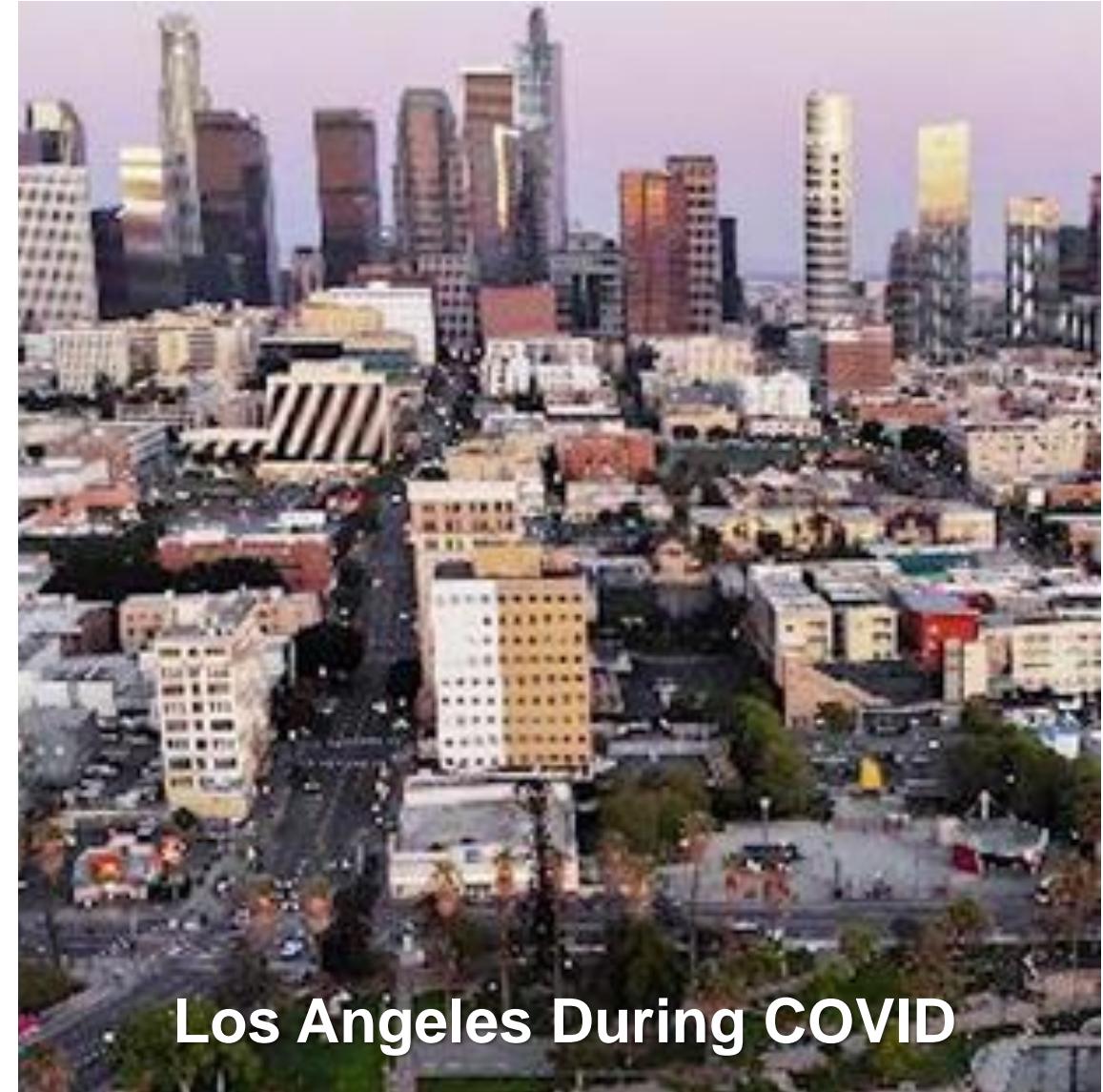
- Great Company
- Great Design
- No Gas Bills
- Comfort
- Convenience
- Ultra-Low Maintenance
- Safety
- Acceleration
- Handling
- Great Community
- Great Design
- No Energy Bills
- Comfort
- Convenience
- Ultra-Low Maintenance
- Safety
- Health
- Resilience



Zero Has Left the Station: Superior Planet

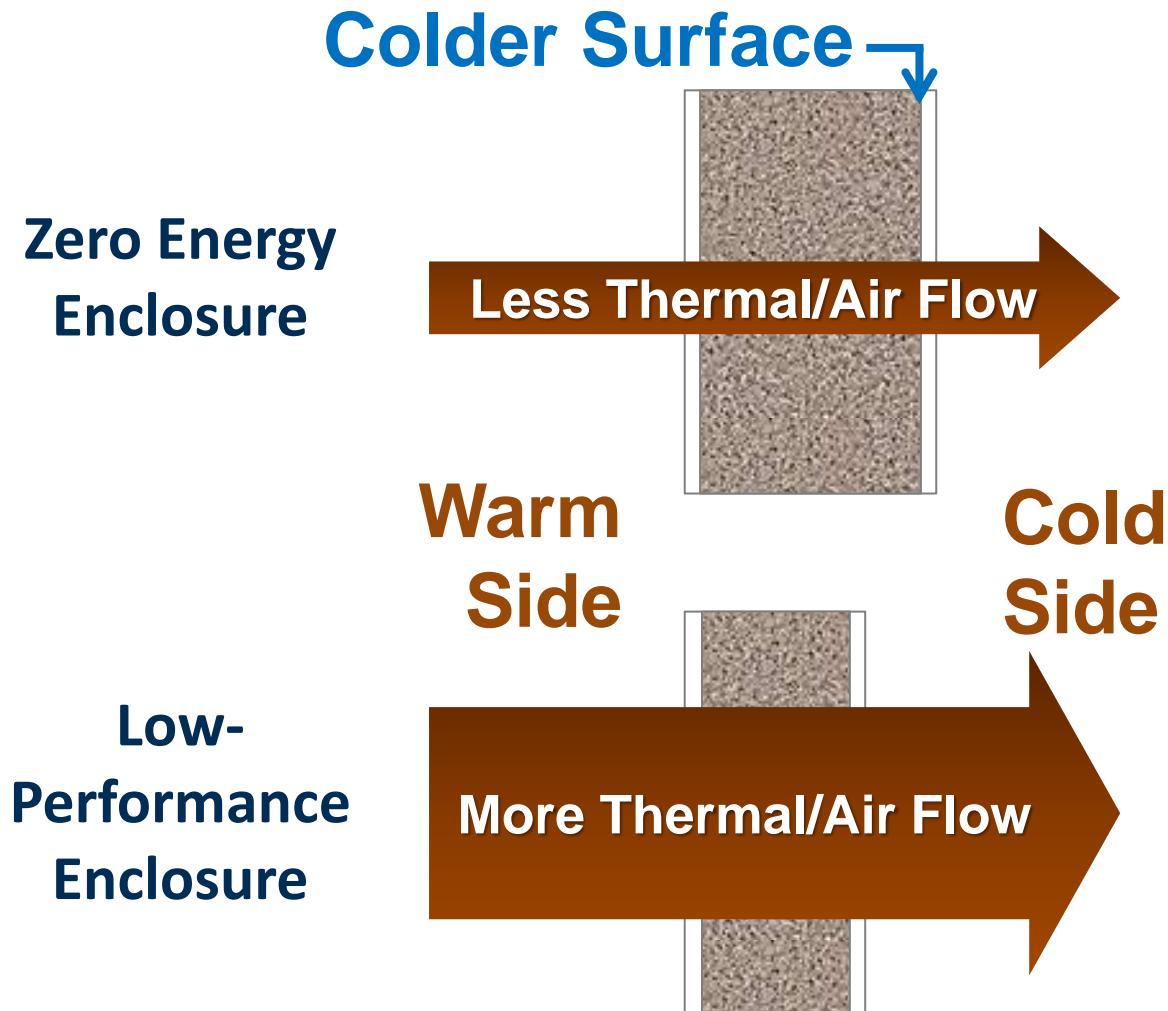


Los Angeles Post COVID



Los Angeles During COVID

Zero Has to Manage Greater Risks: Moisture



Resulting Moisture Risk:

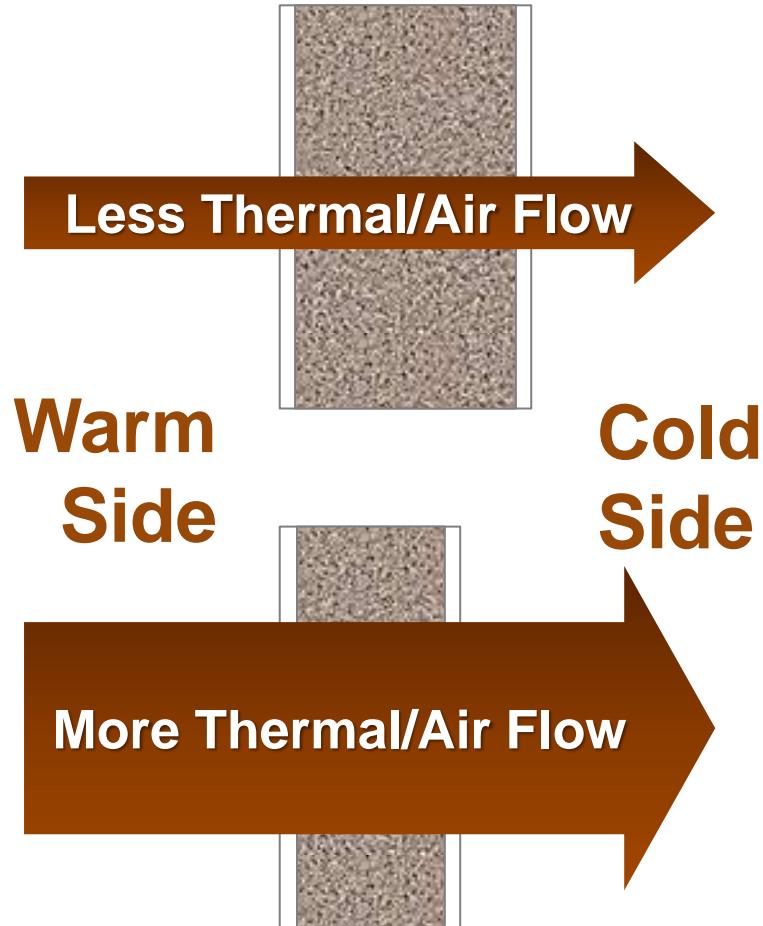
- More Wetting Potential
- Less Drying Potential

Moisture Solution:

- Air Flow Control Layer
- Bulk Moisture Control Layer
- Vapor Control Layer

Zero Has to Manage Greater Risks: **Comfort**

**Zero Energy
Enclosure**



**Low-
Performance
Enclosure**

Resulting Comfort Risk:

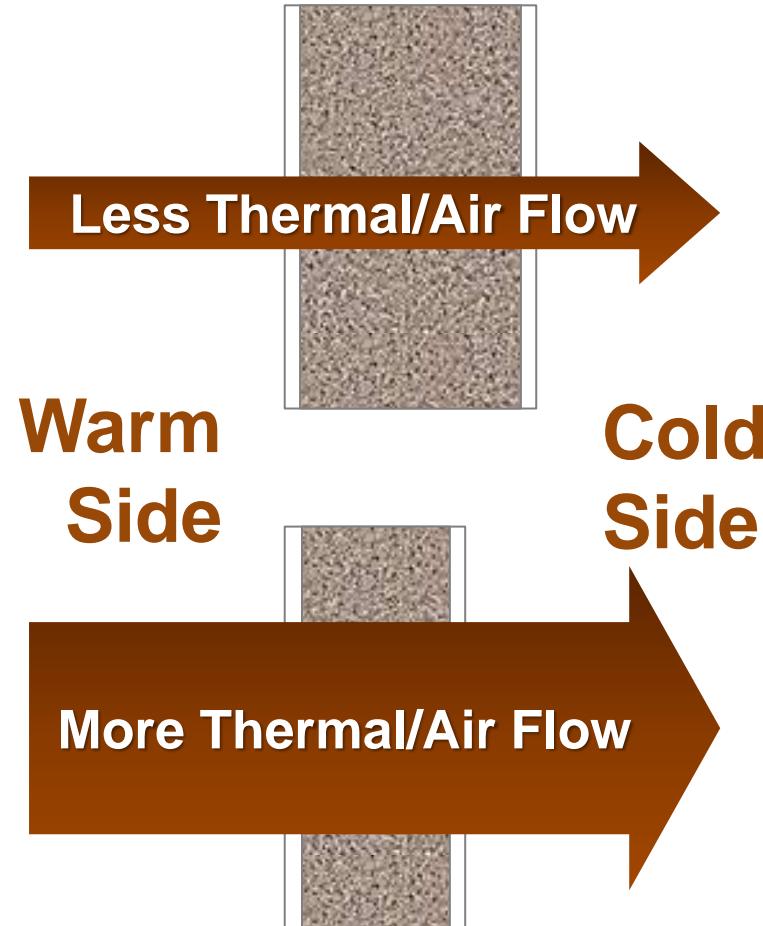
- Less Air Flow
- Shorter Cycles
- Longer Swing Seasons

Comfort Solution:

- HVAC Best Practices
 - Quality Installation
 - Dehumidification
- AFDD [future]

Zero Has to Manage Greater Risks: IAQ

**Zero Energy
Enclosure**



Resulting IAQ Risk:

- More Accumulated Contaminants

IAQ Solution

- High-Performance Home:
 - Bldg. Sci. Control Layers
 - HVAC Best Practices
- Comprehensive IAQ
 - Source Control
 - Dilution
 - Filtration

Zero Can't Ignore External Forces: Hard Trends



External Forces:

- More Disaster Risk
- More Water Shortages
- Electrification Transition

Future Ready Solution:

- Resilience
- Water Conservation
- Electric Ready Homes:
 - Appliances/Equipment
 - Solar
 - EVs
 - Batteries



**Zero Building Blocks ...
Adapt or Be Left Behind**



Zero Building Blocks

Why	Homes, Communities, Planet too Important to Fail			
What	Step One: Start with Efficiency	Step Two: Manage Risks	Step Three: Be Future Ready	Step Four: Get on Path to Zero
How	Efficient Enclosure	Water Protection	Resilience	Zero Energy Ready
	Efficient Equipment	Ensured Comfort	Water Efficiency	Net Zero Energy
	Efficient Components	Comprehensive IAQ System	Electric Ready	Net Zero Carbon



Zero Innovations: Faster, Better, Cheaper

Housing Can't Ignore Proven Innovations

Faster, Better, Cheaper Innovations

Replace Obsolete
100+ Year Old Platform

Load with Tech

Optimize UX

Mass-Customize

Own the Customer
for Life



Future Cars: EV's

EV Replaces
Internal Combustion Engine

Controls / Cameras / Sensors /
Smart Components / Batteries

Design / Performance / Quality

Curated Design Packages and
Building Blocks

Tech-Driven Transaction /
Ongoing Services & Revenue



Future Homes: ZEH's

Offsite Production Replaces
Field Construction

Controls / Cameras / Sensors /
Smart Components / Solar / Batteries

Design / Performance / Quality /
Community

Digitized Curated
Design Packages and Building Blocks

Tech-Driven Transaction /
Ongoing Services & Revenue



Zero Faster, Better, Cheaper: 5 Innovations

1. Advanced Enclosure
2. Ensured Comfort
3. Comprehensive IAQ
4. Future Ready
5. UX Optimization Business Model



Zero Innovations ... Faster, Better, Cheaper:
Advanced Enclosure



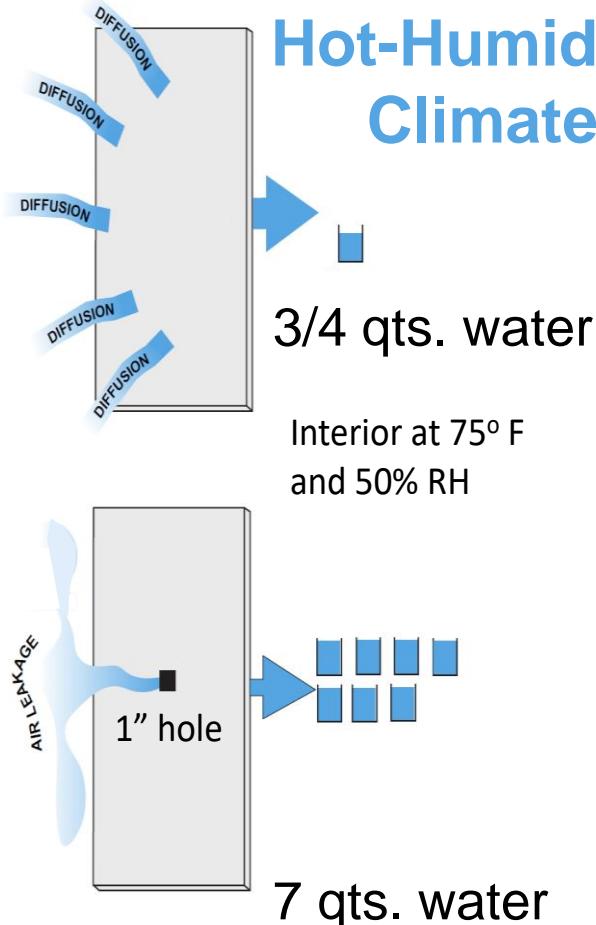
Advanced Enclosures: Complete Building Science

Driving Forces	Control Layers
Air Pressure	Air Flow
Heat	Thermal Flow
Moisture (Bulk)	Water Flow
Moisture (Vapor)	Vapor Flow

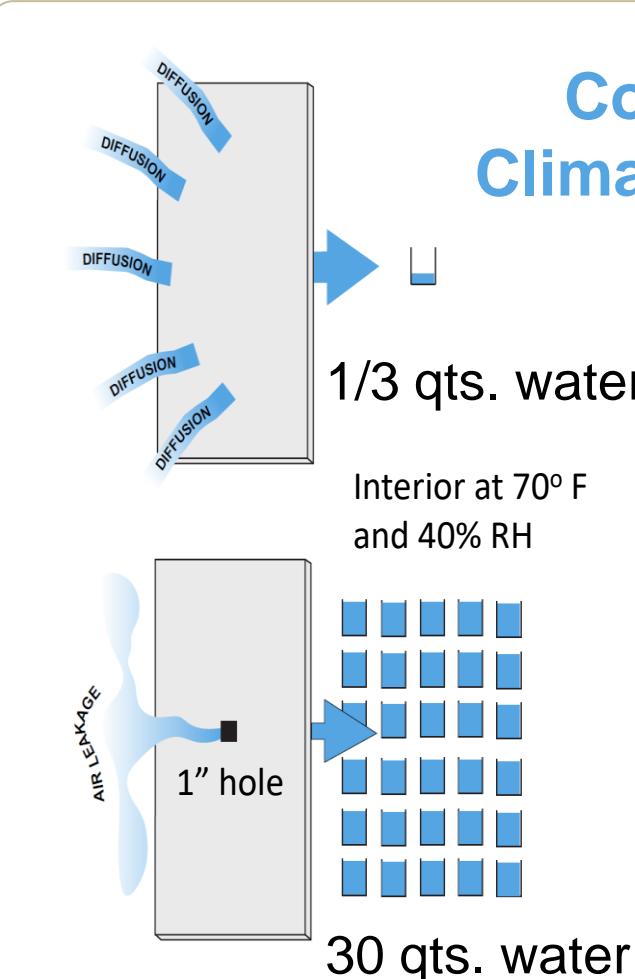
Straightforward
for New Homes

Complicated
for Existing Homes

Moisture Vapor Flow: Air Leakage vs. Diffusion



Moisture vapor flow over Spring, Summer, and Fall from the exterior to interior



Moisture vapor flow over Winter from the interior to exterior

Moisture flow due to air leakage vs. diffusion with 5 Pascal pressure difference:

~10X Greater
in Hot-Humid Climates

~100X Greater
in Cold Climates



Advanced Air Flow Control: Air Sealing Target

Climate Zones	ACH50 Requirements/Targets			
	Zero Energy Ready	ENERGY STAR V3	2012 - 2018 IECC	Passive House
1-2	3.0	6.0	5.0	0.6
3-4	2.5	5.0	3.0	0.6
5-7	2.0	4.0	3.0	0.6
8	1.5	3.0	3.0	0.6

Why 1.5 ACH50 Max Everywhere:

- Moisture Control
- Outdoor Contaminants
- Readily Achievable

Advanced Air and Moisture Vapor Control

Manual Air Sealing



Aerosol Air Sealing



Aerosol Air Sealing:

Faster:

- Reduced Cycle Time
- Faster Compliance

Better:

- Minimized Moisture Risk
- Digital Precision
- Guaranteed Air Seal Target
- Enhanced Durability

Cost Savings:

- Cycle Time
- Rework
- Single-Solution

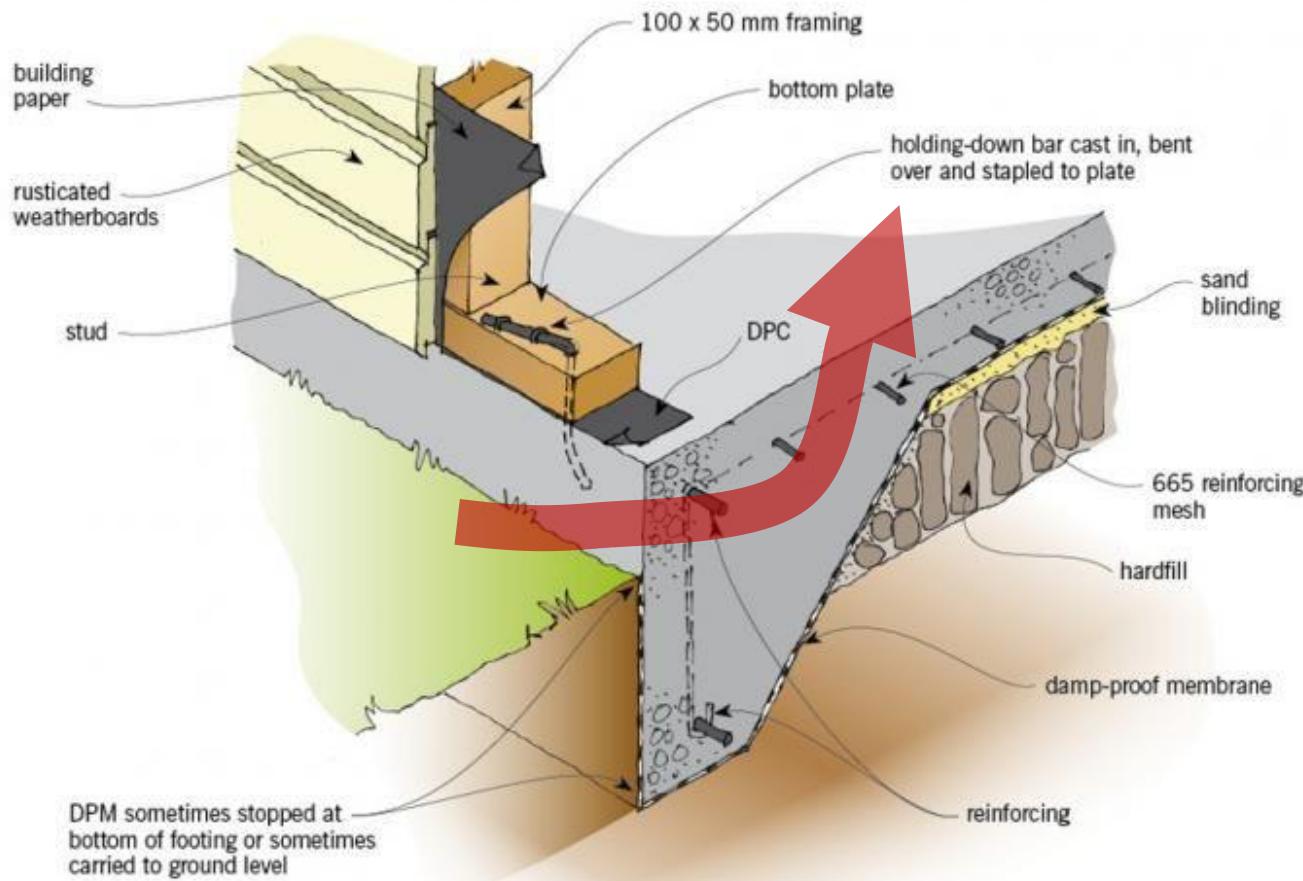


Advanced Enclosure: IECC Insulation R-Values

Climate Zone	Slab, Depth			Floor R-Value			Basement/Crawl Space			Ceiling			Wood Frame Wall		
	2015	2018	2021	2015	2018	2021	2015	2018	2021	2015	2018	2021	2015	2018	2021
1	0			13			0			30			13 or 0+10 for 2021		
2															
3	0			10 / 2ft.			19			5/13			38 49		
4 except Marine	10 / 2 ft.			10 / 4 ft.			19			10 / 13					
5 & Marine 4							30			15/19 or 13+5 for 2021			20 or 13+5 20+5 or 13+5		
6	10 / 4 ft			30			15/19 or 13+5 for 2021			49 60					
7 & 8							38			15/19 or 13+5 for 2021			30/ 20+5/ 13+10/ 0+20		

Advanced Foundations: Thermal Bridging

Slab Edge Problem



Advanced Foundations: Exterior Insulation



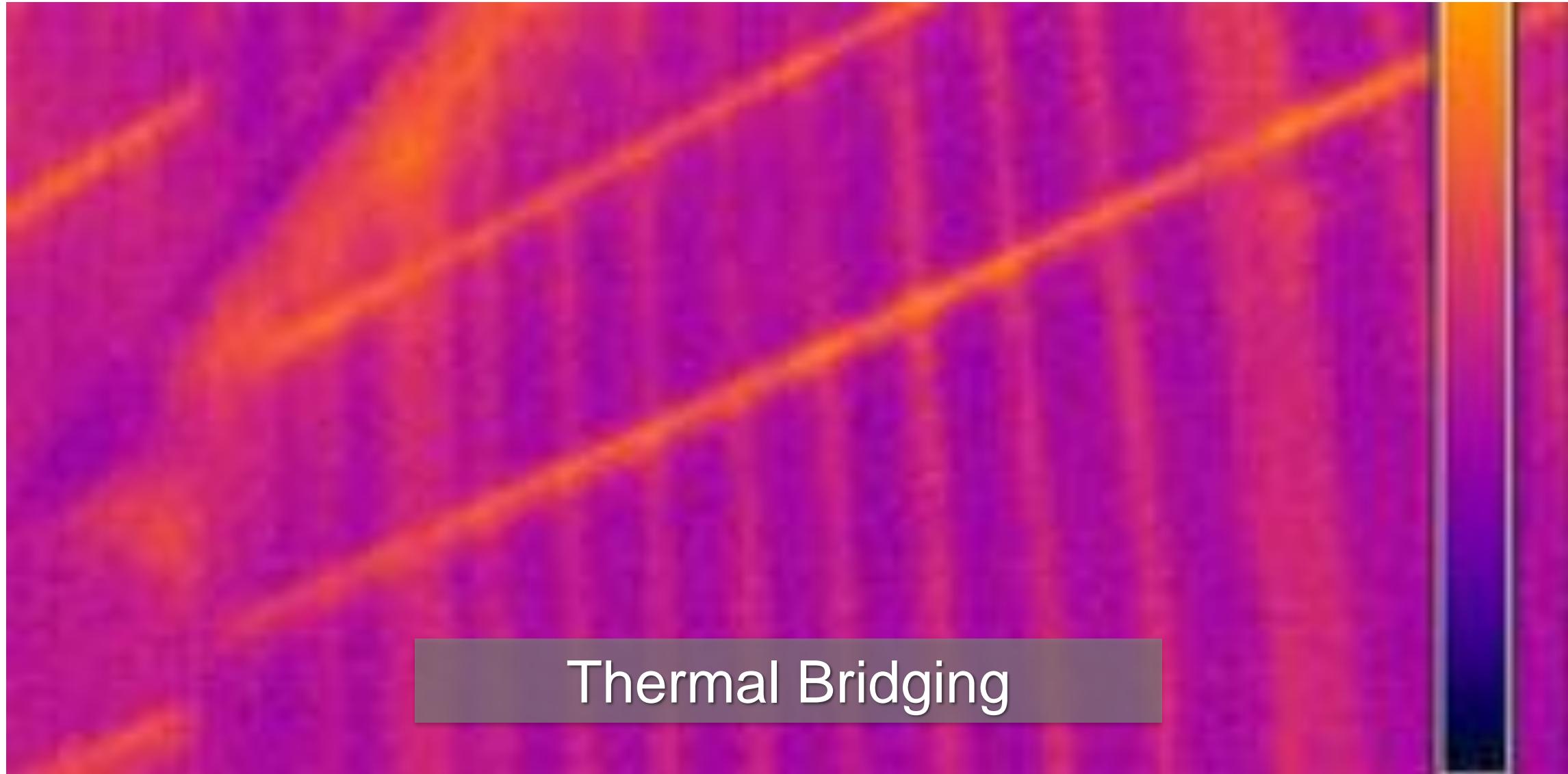


Advanced Walls: Insulation R-Value Killers





Advanced Walls: Insulation R-Value Killer

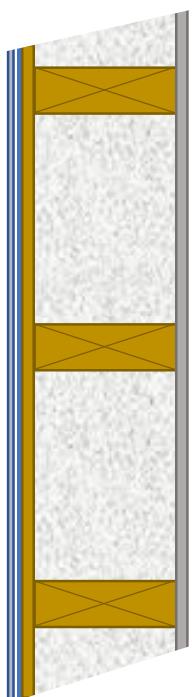


Advanced Walls: Ensured Effective R-Value

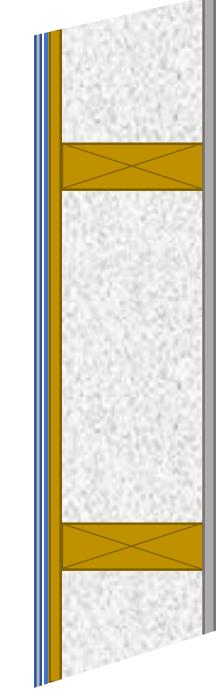
Maximum Quality Installed Insulation Risk

Maximum Moisture Control Risk

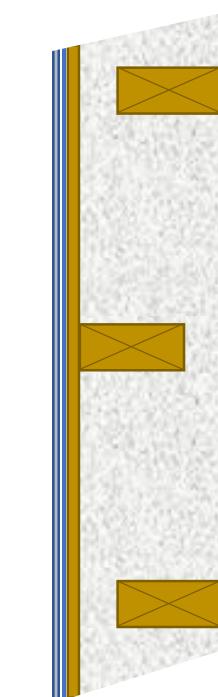
Excessive Thermal Bridging



Conventional
Framing
25-30% F.F.



Advanced
Framing
19% F.F.



Staggered Stud
Framing
12% F.F.

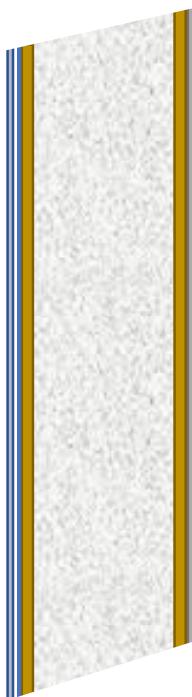


Double-Wall
Framing
10% F.F.

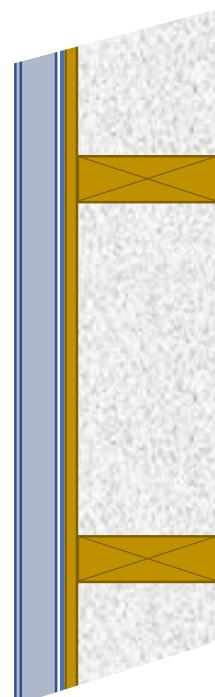
Ensured Quality Installed Insulation

Minimal Moisture Control Risk

Minimal Thermal Bridging



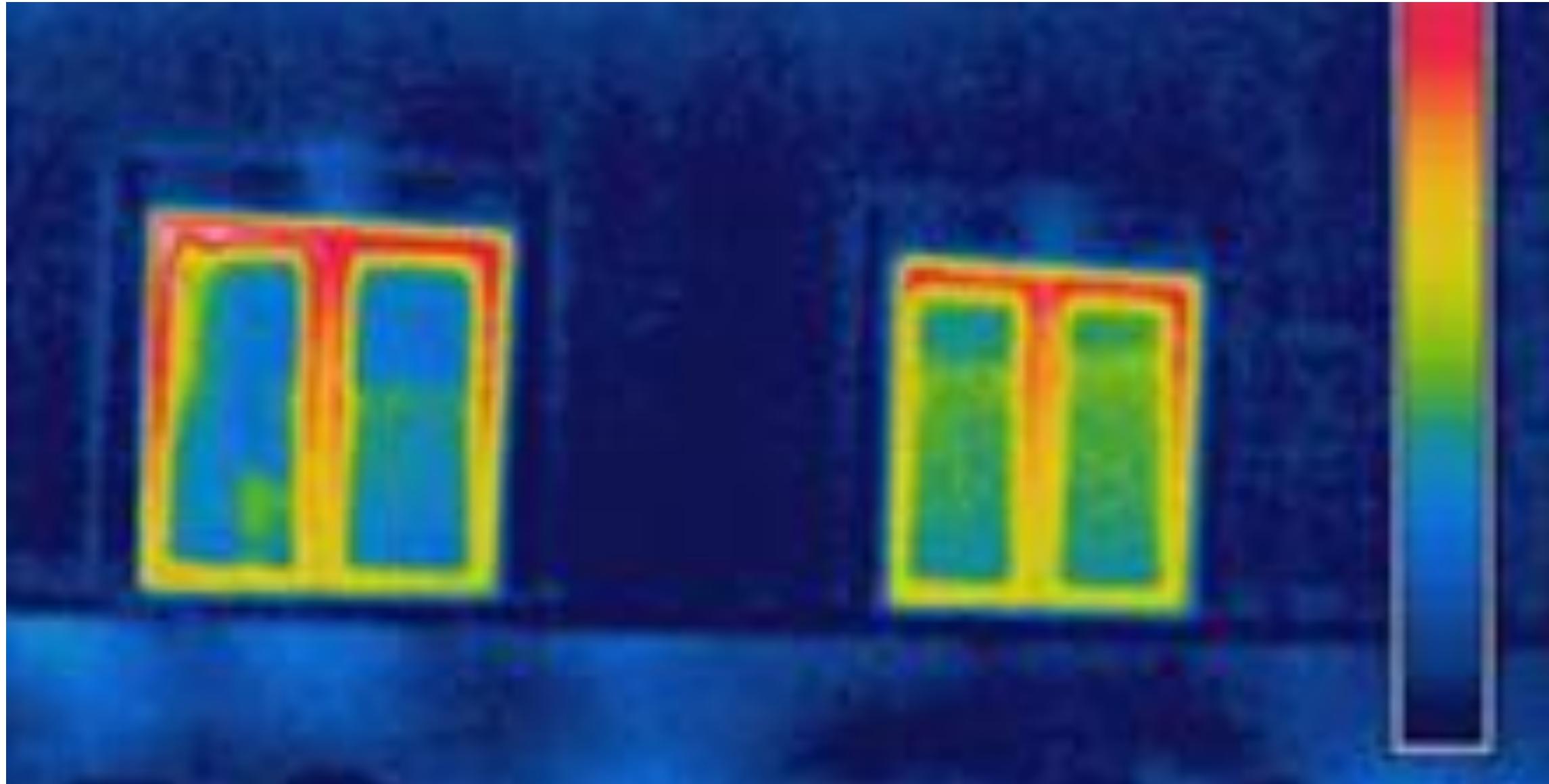
Structural
Insulated Panels
5% F.F.



Rigid Insul.
Sheathing
2% F.F.



Advanced Walls: Cold Climate R-Value Killer



Advanced Walls: Cold Climate R-Value Killer

Performance

Building Science

Efficient/Smart

IAQ

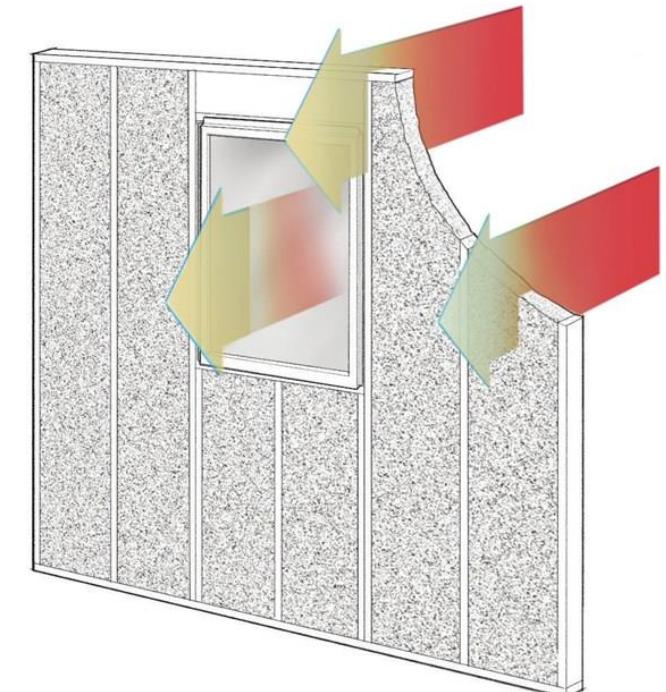
Water Efficient

Disaster Ready

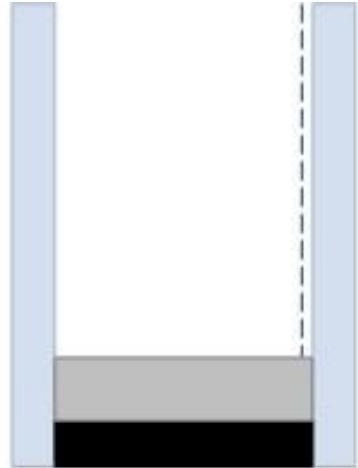
Path to Zero

Effective Wall R-Value /
% Reduction in Insulated Wall R-Value
[Cold-Climate Home with 15% Window to Wall Area]

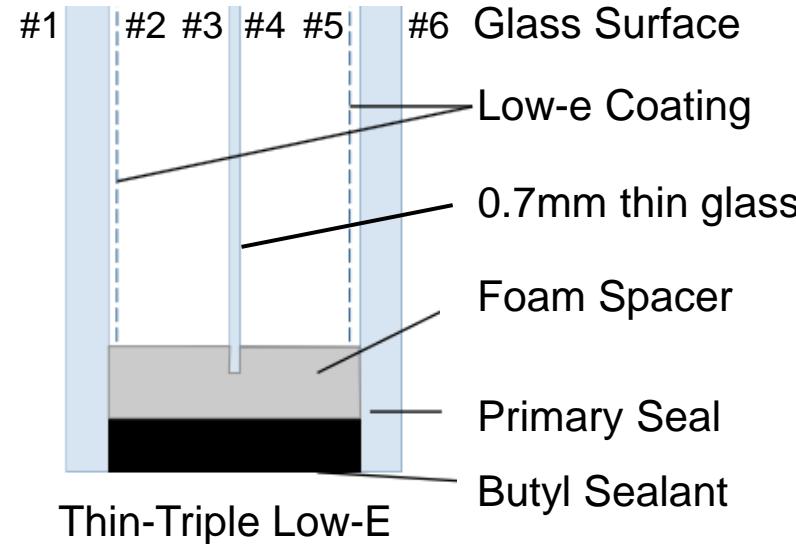
Window U-Value	Cavity Wall Insulation Rated R-Value		
	R-18	R-39	R-60
0.30	R-11 / ~40%	R-15 / ~60%	R-17 / ~70%
0.15	R-14.5 / ~20%	R-23 / ~40%	R-28 / ~50%



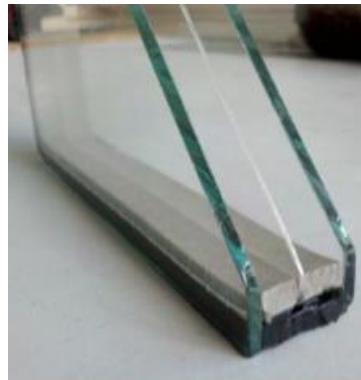
Advanced Windows: Thin-Triple Low-E



Typical Double Low-E



Thin-Triple Low-E



Faster:

- Lighter Weight Installation with Thin LED TV Float Glass

Better:

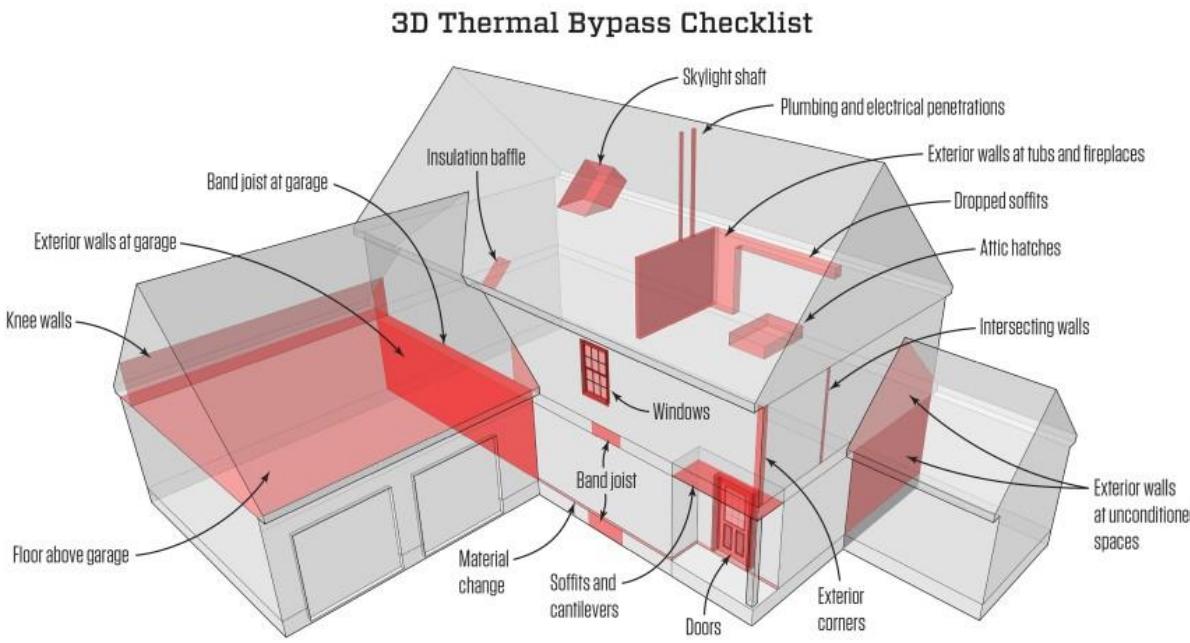
- Krypton Gas Fill
- 3 Layers Glass R-7 to R-10

Reduced Premium:

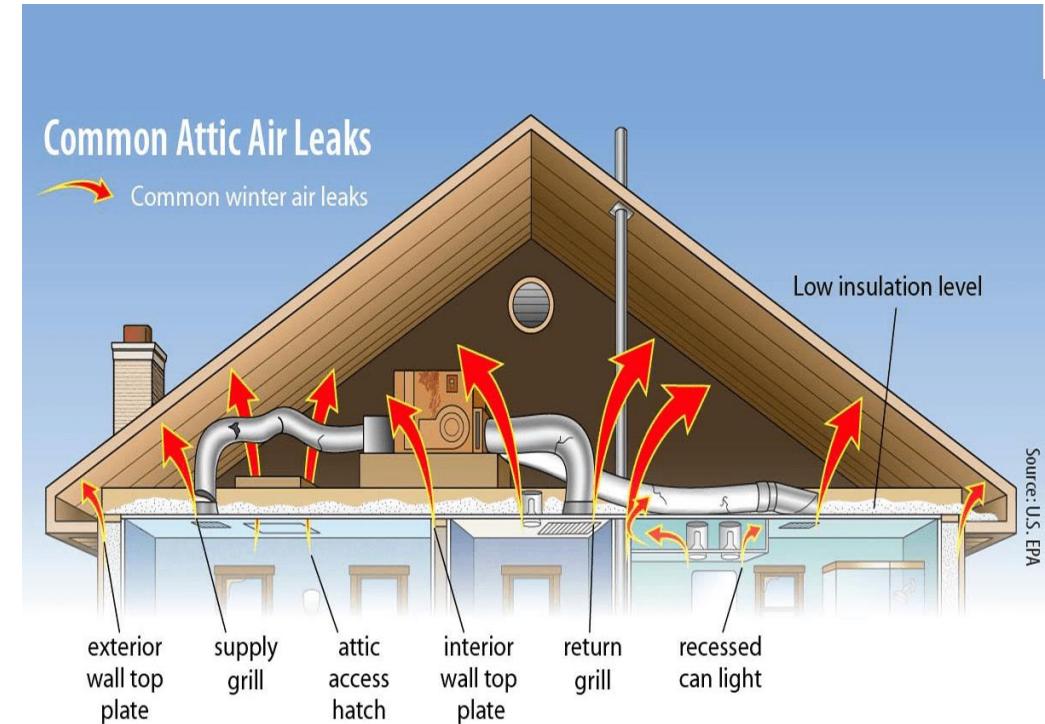
- Much Lower Cost than Conventional Triple Glass
- Manufacturer Plants Not Required to Fully Retool

Advanced Attic: Most Egregious Interface

Air Barriers



Air Sealing



Source: 'Air-Barrier Basics,' Steve Bazcek, The Journal of Light Construction, January 9, 2019

Advanced Attic: Unvented Attics

Performance

Building Science

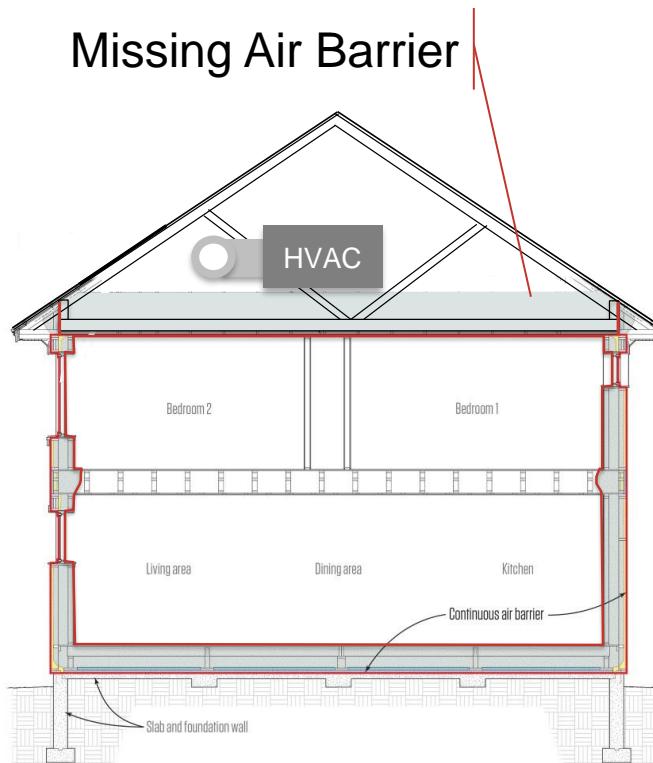
Efficient/Smart

IAQ

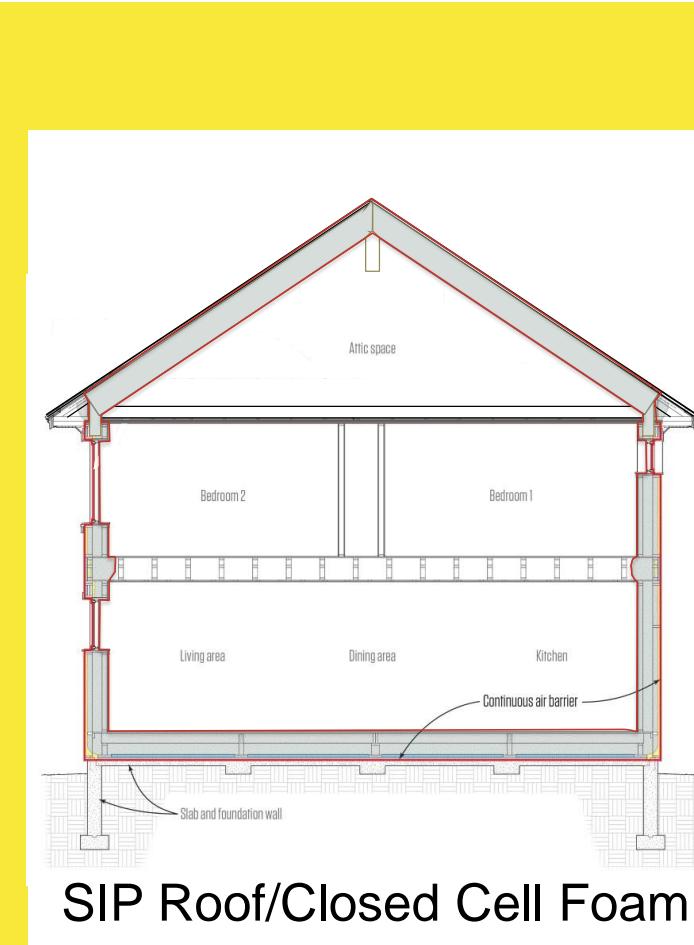
Water Efficient

Disaster Ready

Path to Zero



Conventional Framing



SIP Roof/Closed Cell Foam

Faster:

- Reduced Cycle Time

Better:

- More Conditioned Space
- More Efficient
- More Comfort
- More Strength
- More Resilient [Fire/Impact]

Cheaper:

- Less Rework
- Cost Savings
 - Vents (ridge, soffit, gable)
 - Air Barriers and Sealing
 - Operations (time)

Advanced Attic: Unvented Attic

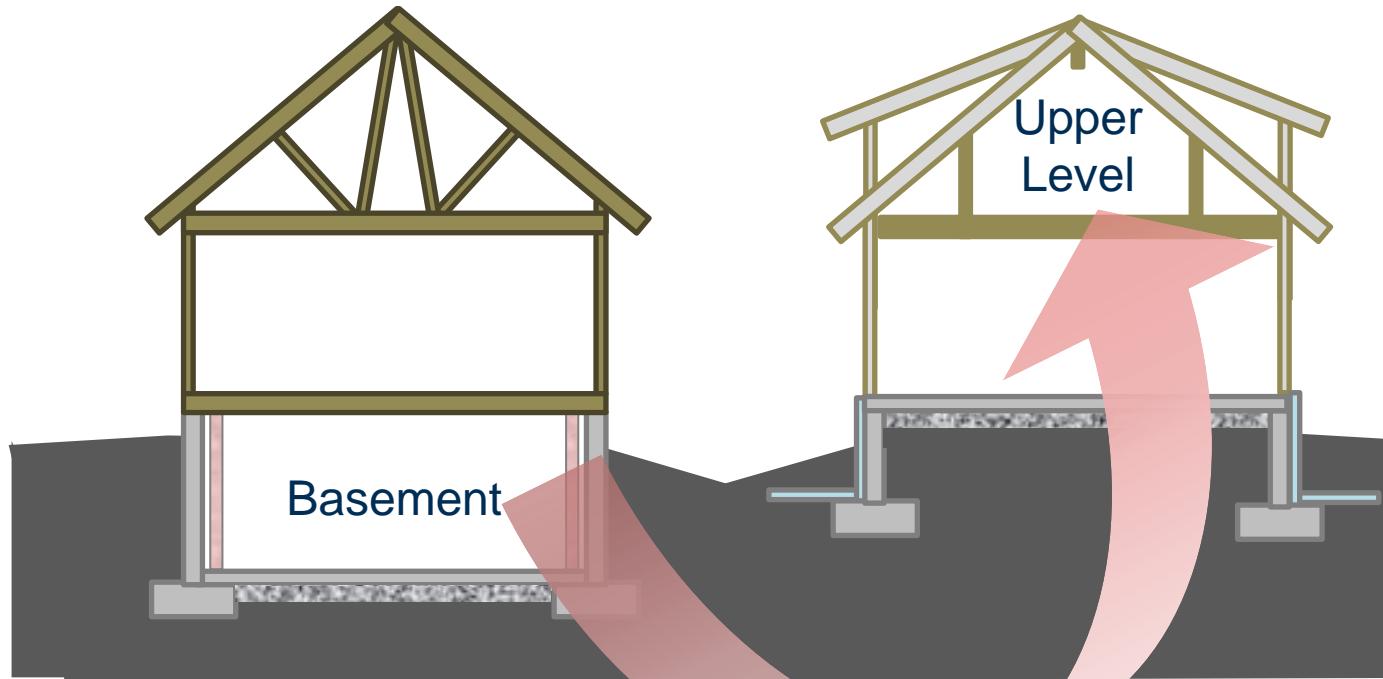


SIP Roof 100% Air Barrier



Ventilated Attic ~50% Air Barrier

Advanced Enclosure: System Integrated Design



Framed Roof

Basement with
Vented Attic

SIP Roof

Trade off Basement
for Upper Level

¹ "Frost-Protected Shallow Foundations, NAHB Research Center, 4/30/04

Cost Savings	
FSP Foundation ¹	up to \$6K
Wall Framing	\$1K - \$2K
Egress Windows	\$1K - \$2K
Air Sealing/Barriers	\$1K - \$2K
Attic Venting	\$1K - \$1.5K
Reduced Waste	\$1K - \$2K
Time (10 days)	\$5K - \$8K
Added Value	
2 nd Fl. vs. B'ment	\$40K - \$80K

Advanced Enclosure: Offsite Construction



Faster:

- Reduced Cycle Time
- Reduced Trades

Better:

- Improved Quality
- More Strength

Cheaper:*

- Operations Cost
- Reduced Rework
- Substantially Less Waste

* If Integrated Design and Turn-key Providers



Zero Innovations ... Faster, Better, Cheaper:
Ensured Comfort



Advanced Comfort: Quality Installation Problems

Fault Type	Testing High	Testing Low
Equipment Sizing	31 – 93%	0 – 9%
Refrigerant Charge	4 – 50%	29 – 78%
Duct Leakage	67 – 100%	N.A.
Air Flow	8 – 29%	50 – 93%

U.S. DOE study found
70 to 100%
of field measured HVAC
systems evidenced at
least one performance-
compromising fault

Source: U.S. DOE Summary Report on
Residential HVAC Installation:
www.osti.gov/servlets/purl/1470985

Advanced Comfort: HVAC Location Challenge



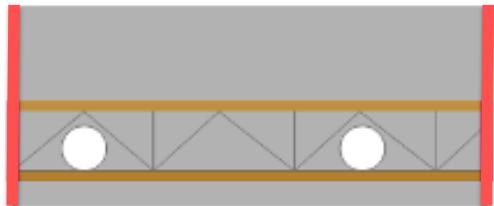
10-45% Added Thermal losses



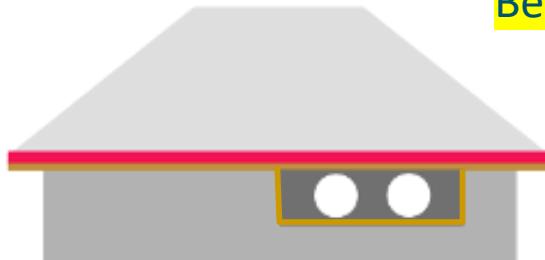
Dust and Moisture Contaminants

Advanced Comfort: Optimize HVAC Location

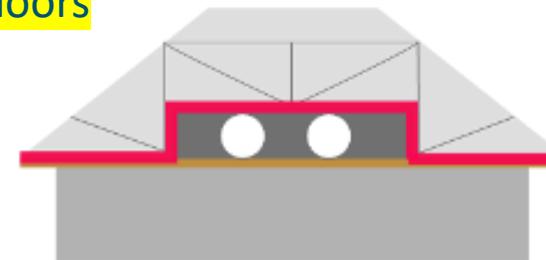
Ducts in Conditioned Space



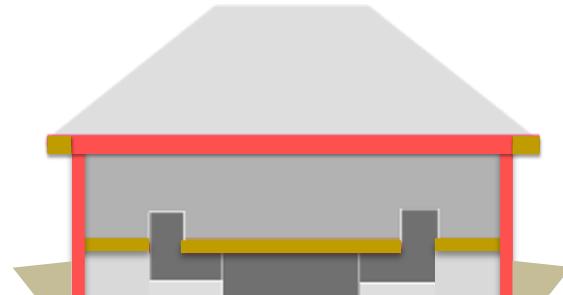
Between Floors



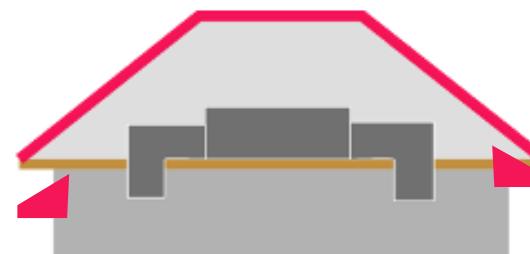
Dropped Ceiling



Modified Attic Truss

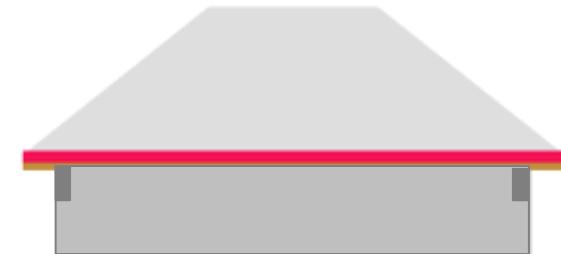


Unvented Crawl Space / Basement



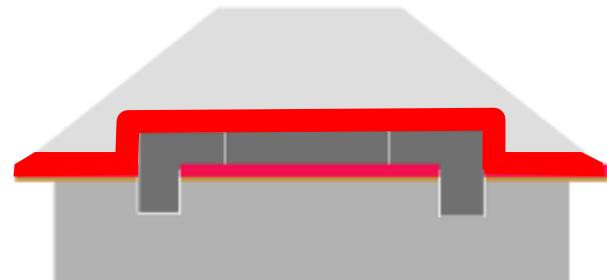
Unvented Attic

Ductless Systems



Mini-Split

Buried Ducts



Ducts in Vented Attic

Advanced Comfort: Plug-and-Play Ducts



- **Faster:**
 - Cycle Time [up to 50%]
 - Integrated Duct Sealing
 - One-Size Duct Runs
 - Snap-fit Connection System
 - App-Based Balancing
- **Better:**
 - Inherently Air-Tight
 - Inherently Better Mixing
 - Inherently Better Air Flow
 - Ducts in Conditioned Space
- **Cheaper:**
 - Cycle time[up to 50%]
 - Less Waste [up to 75%]

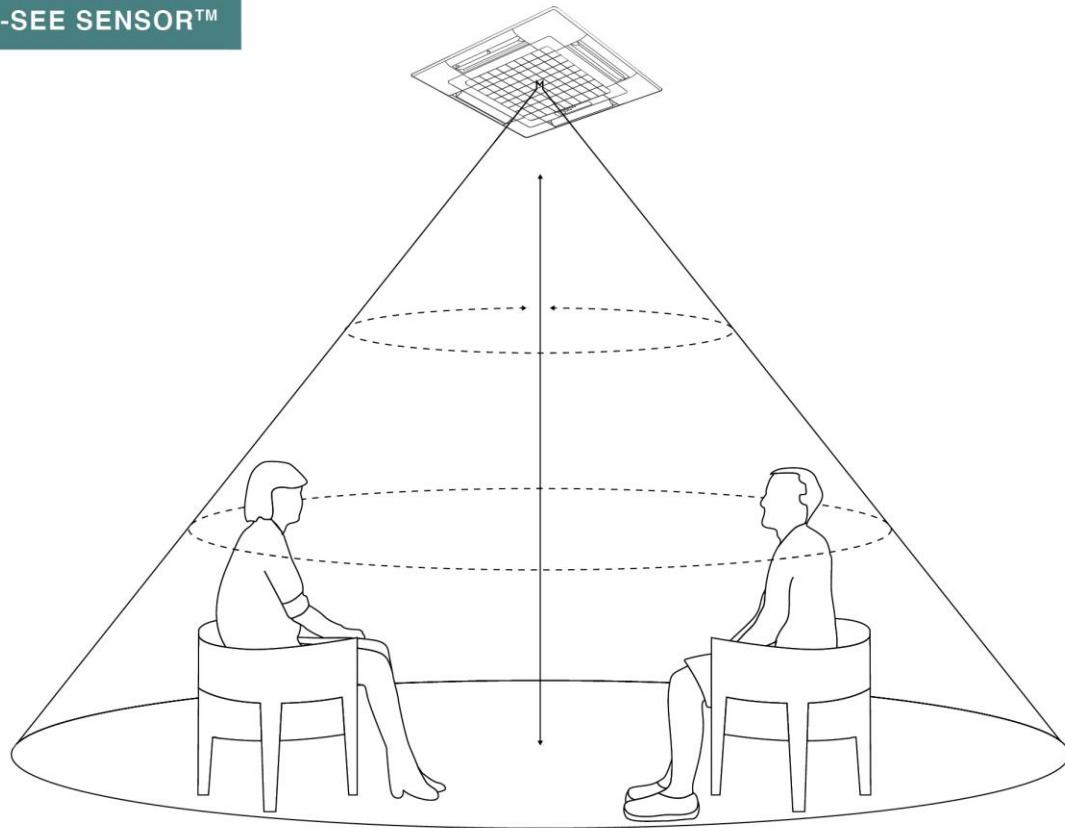
Advanced Comfort: Variable Speed Mini-Splits



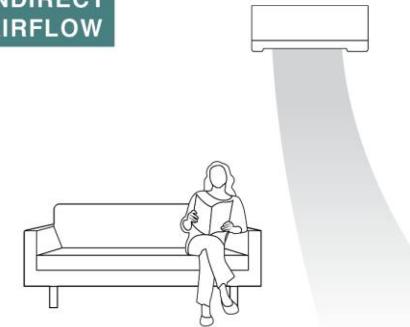
- **Faster:**
 - Cycle Time
 - Duct Installation
 - Quality Installation
- **Better:**
 - Efficiency
 - Quiet
 - Comfort (Mixing)
 - Smart
- **Cheaper:**
 - Cycle time
 - ~1-ton Size Reduction for Ducts in Conditioned Space
 - One size fits all for up ~2-ton Variation Due to Orientation

Advanced Comfort: Smart Duct Distribution/Mixing

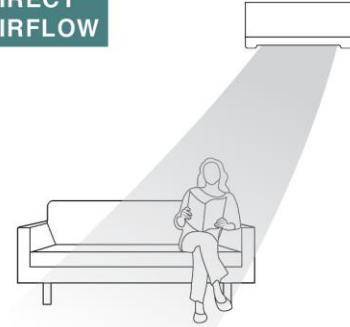
3D I-SEE SENSOR™



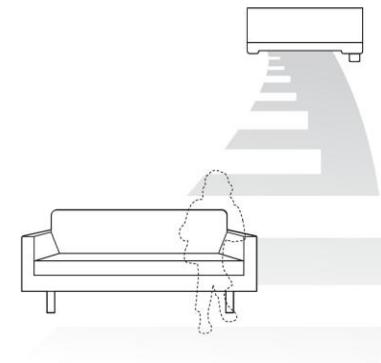
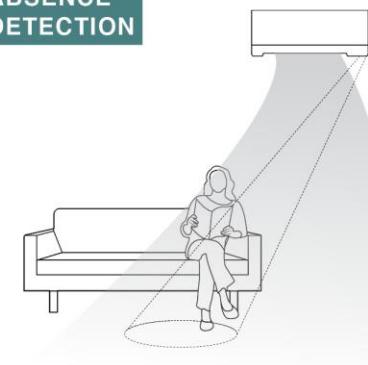
INDIRECT AIRFLOW



DIRECT AIRFLOW

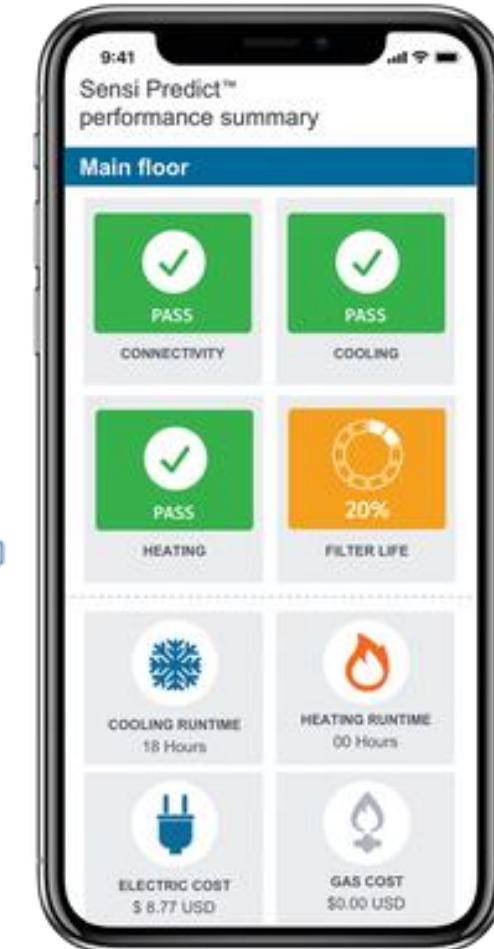
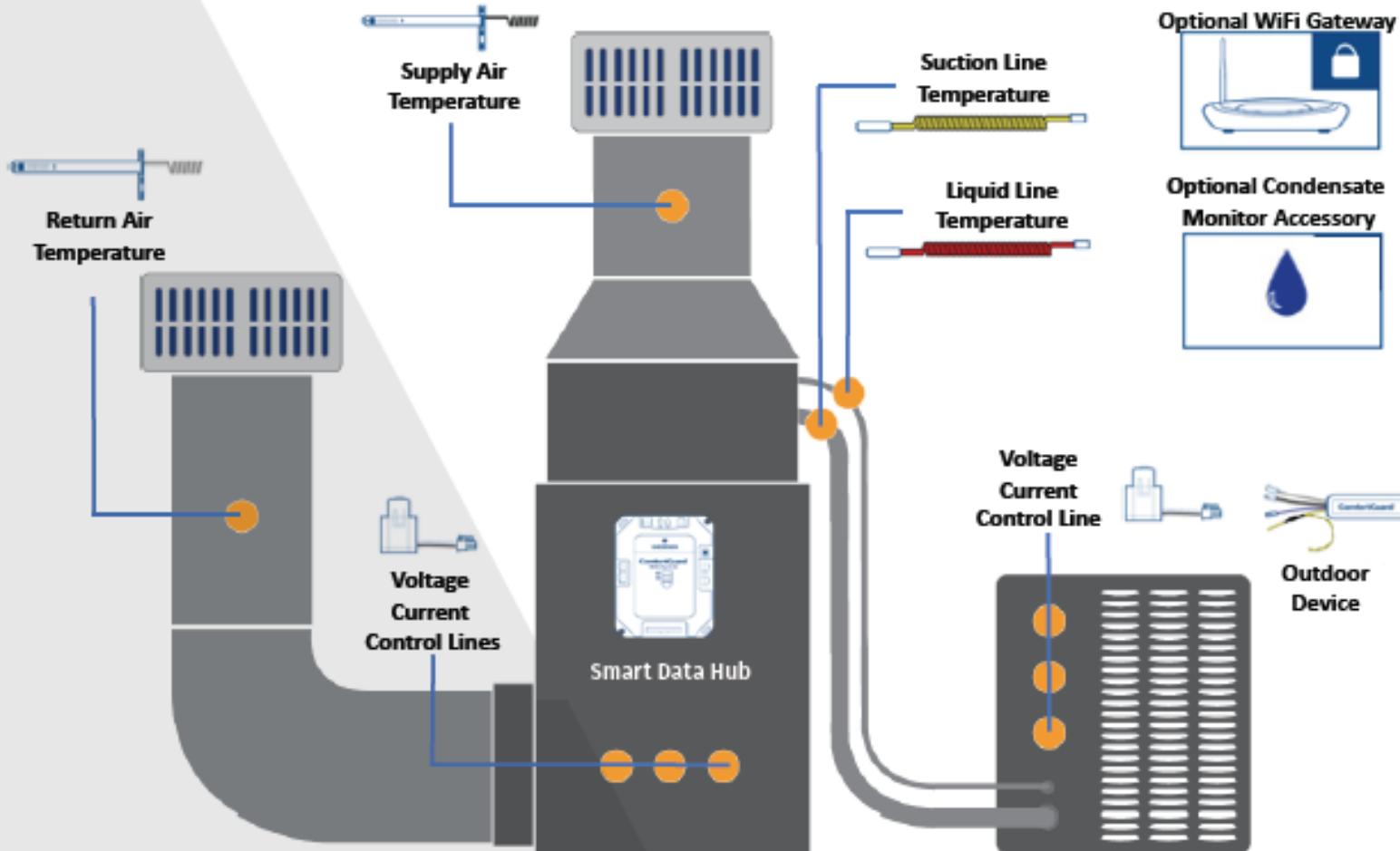


ABSENCE DETECTION



Advanced Comfort: AFDD QA Accountability

Emerson Sensi-Predict





Zero Innovations ... Faster, Better, Cheaper:
Comprehensive IAQ



Why IAQ: Exposure to Contaminants

Indoor vs. outdoor contaminants on average

2-5 times greater

While Americans Spend

70% of the day inside their homes

Source: EPA



Why IAQ: Evidence of Respiratory Illness

“If your child doesn’t use an inhaler,
consider yourself a lucky parent because,

**1 in 10 children in the U.S.
suffers from asthma.”**

Source: Remarks for Administrator McCarthy, Announcement of Clean
Power Plan, Washington, DC, June 2, 2014

At least 80%
of home buyers and
homeowners of all age
groups report they
would pay more for a
healthier home.

Source: "Green and Healthier Homes:
Encouraging Consumers of all Ages in Sustainable
Living," Dodge Data & Analytics, 2015



Why IAQ: Willingness to Pay



\$50 Billion/Yr.
1.5 - 3X

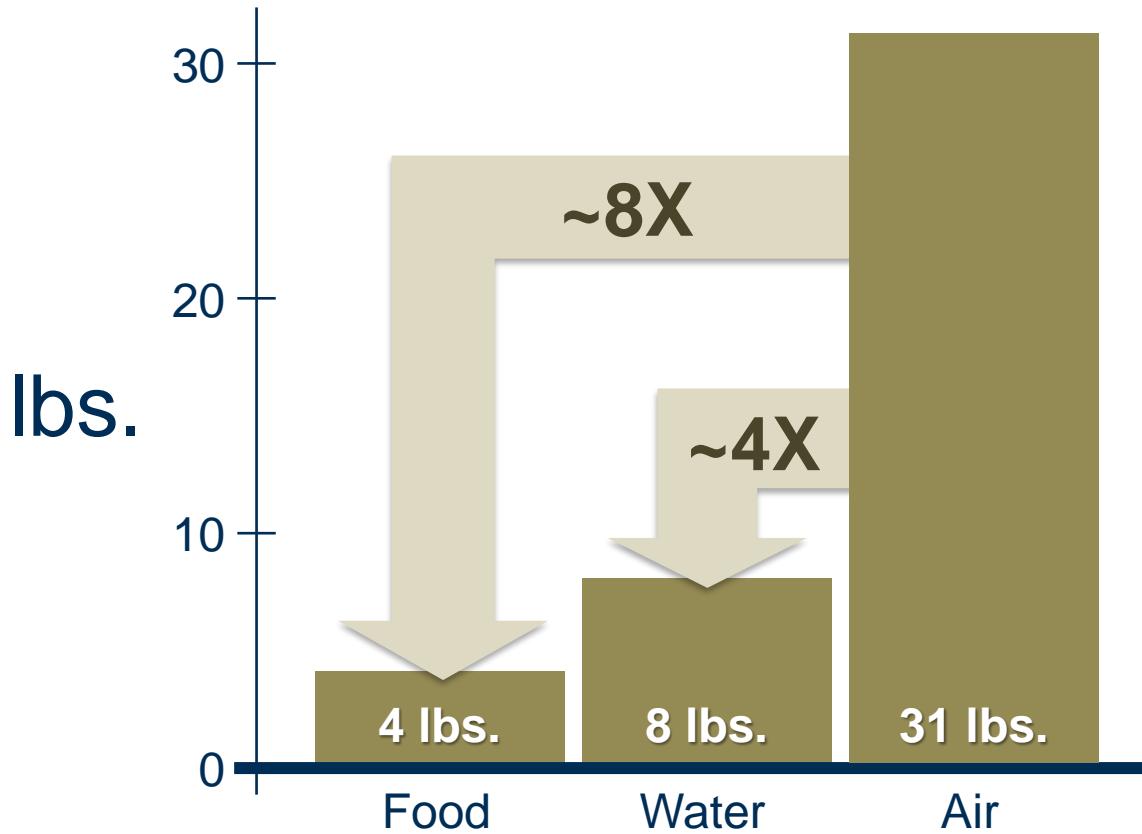


\$20 Billion/Yr.
300X

* If you keep it simple!!!

Communicating IAQ: Keeping it Simple

Amount of Food, Water, Air Ingested Daily



Contaminant Risks:

- Chemicals
 - VOCs
 - Formaldehyde
- Excessive Humidity
 - Mold
 - Mustiness
- Dust Particles
- Biological Triggers
 - Dust Mites
 - Pests
 - Pollen
- Combustion Gases
- Radon



Comprehensive IAQ: One-Stop Shop

Indoor Air Quality



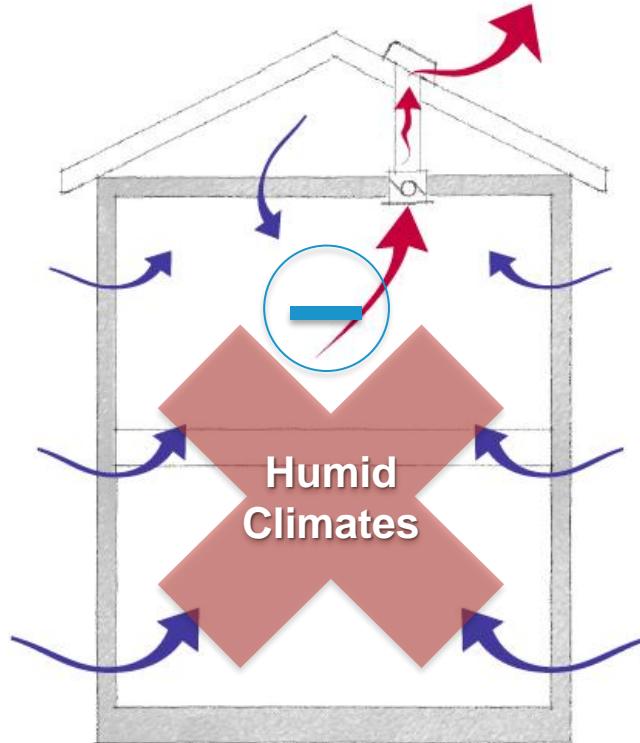
High-Capture Filtration

Fresh Air

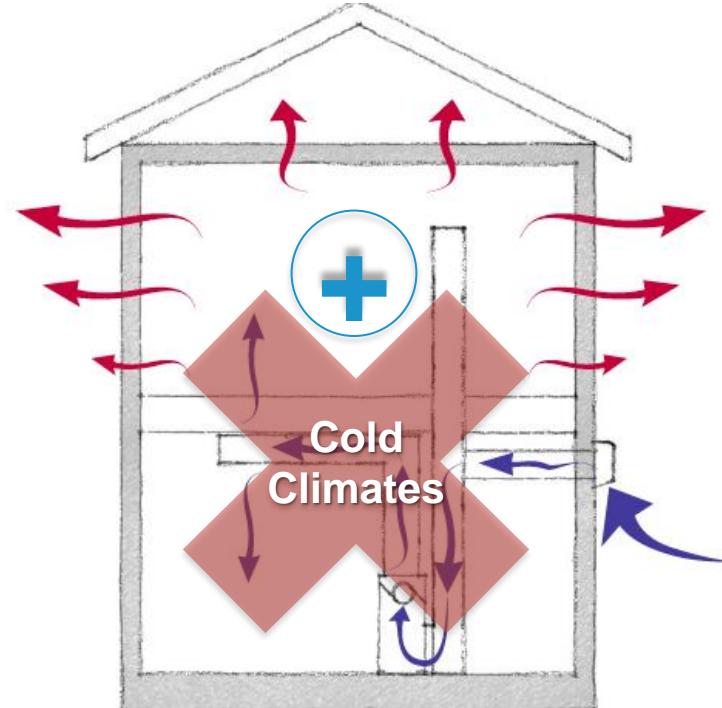
Source Control

- Building Science Control Layers
- Pest Screens
- Low- and No-Chemical Materials
- Whole-House Dehumidification
- Direct and Power-Vent Equipment
- Electric Appliances
- Radon Resistant Construction
- Whole-House Ventilation
- Spot Ventilation (Kitchen/Baths)
- HVAC High-MERV Air Filters
- Ventilation High-MERV Air Filters

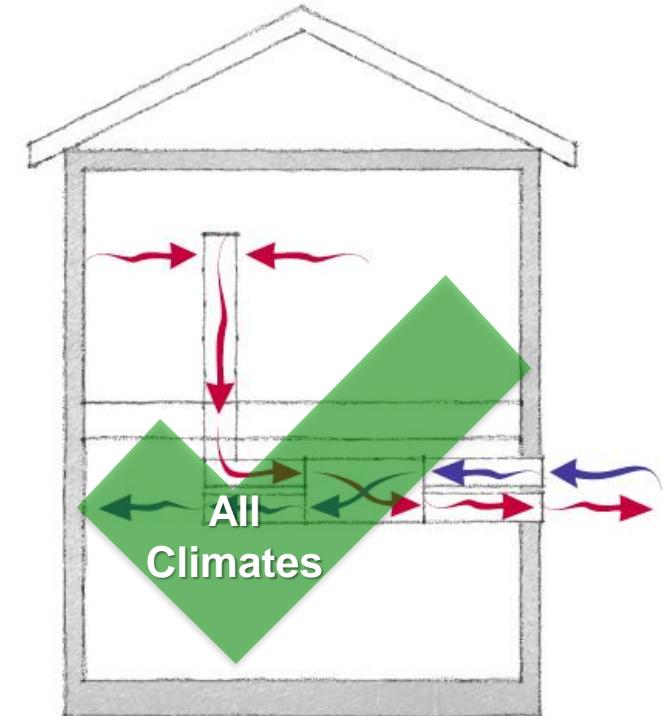
Fresh Air: Whole-House Ventilation Options



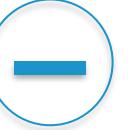
Exhaust-Only



Supply-Only



Balanced

Key:  = Negative Pressure

 = Positive Pressure

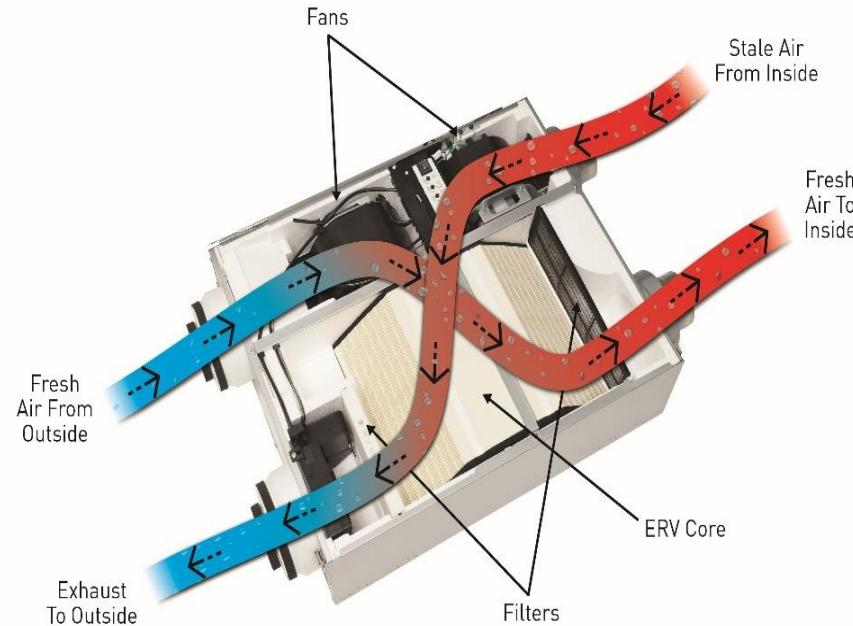
Fresh Air: Balanced WHV Options

Minimum WHV
in All Climates



Integrated Supply/Exhaust

Source: Panasonic



Dedicated HRV/ERV

Thru-Wall HRV/ERV

Source: Lunos

Increasing Cost



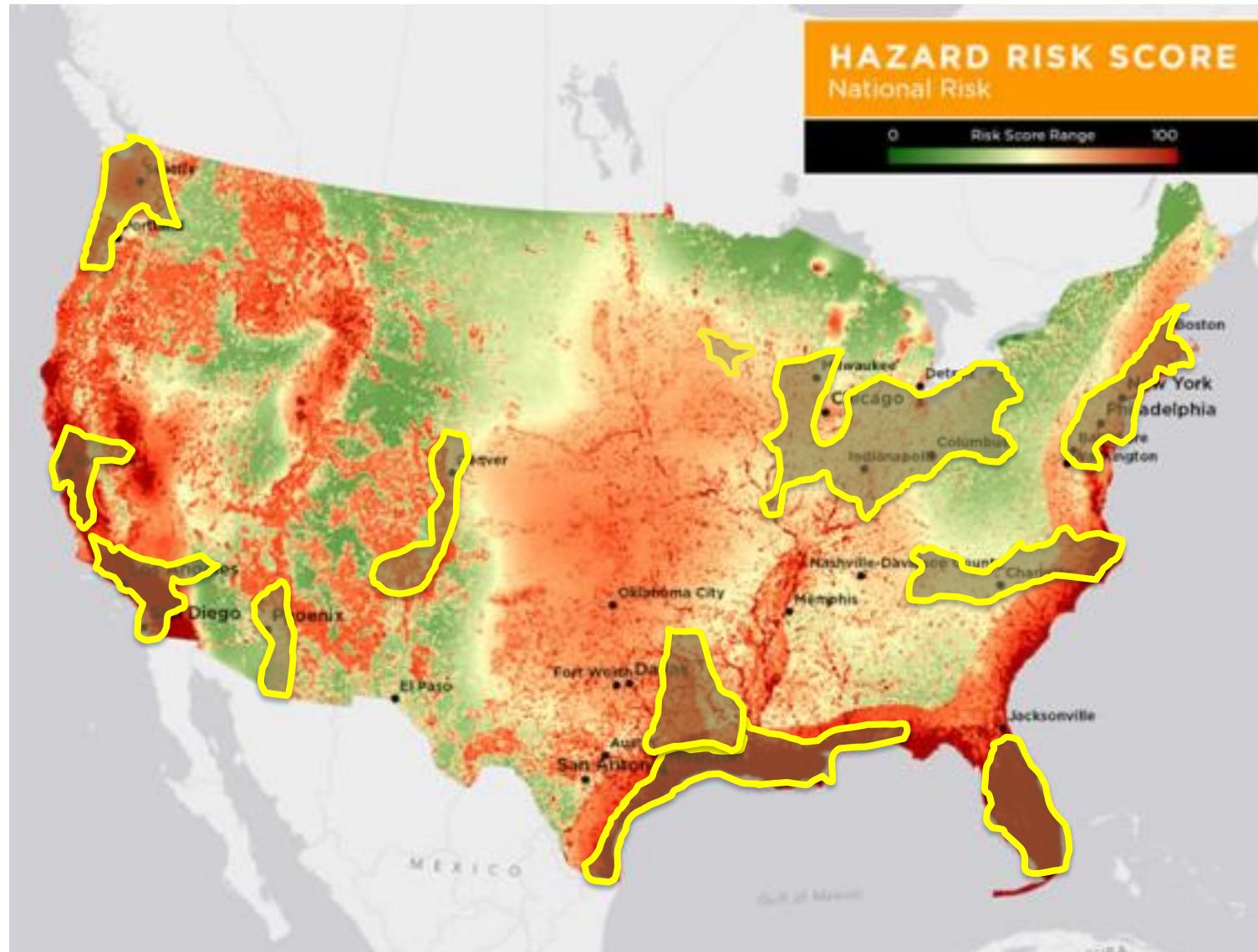
Zero Innovations ... Faster, Better, Cheaper:
Future Ready



Future Ready: Prepare for Hard Trends

Hard Trend	Solution
Greater Disaster Risk	Resilient Homes
More Severe Water Shortages	Water Efficient Homes
Electrification	Electric-Ready Homes

Why Disaster Ready: Huge Risk Exposure

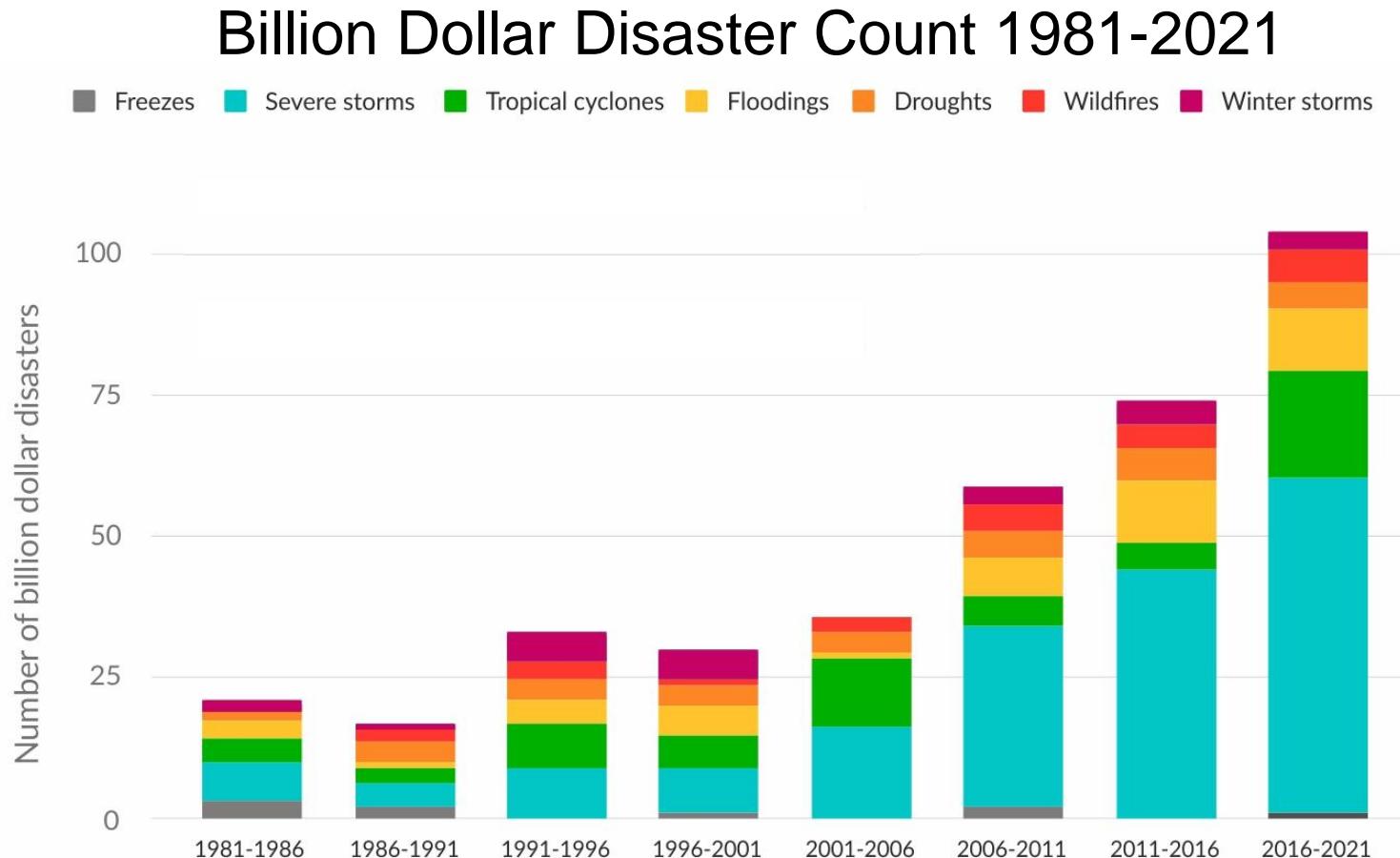


\$6.6 Trillion
estimated market
value of homes in
high natural disaster
risk locations ...
43% of U.S. Homes

Source: Realty Trac



Why Disaster Ready: Huge Cost Increase



\$152+ Billion
natural disaster cost 2021
68+%
cost increase 2011 to 2021

Source: "What Climate Change is Costing Homeowners," Charlotte Granville, FIXR, 11/14/22



Resilience: Best Practices

Resilience

Disaster Resistance

Post-Disaster Occupancy

Best Practices

Wildfire Resistance

Flood Resistance

Wind/Impact Resistance

Earthquake Resistance

Severe Winter Weather Resistance

High-Performance Home

Natural Comfort

Solar Electric

Solar Hot Water

Battery Storage



The Water Imperative



“We will all know
the value of water
when the well
runs dry.”

Ben Franklin



The Well Running Dry



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WEATHER AND NATURAL DISASTERS

Feds call for water cutbacks ‘to avoid a catastrophic collapse’ of Colorado River

PUBLISHED WED, AUG 17 2022 11:23 AM EDT | UPDATED WED, AUG 17 2022 12:52 PM EDT



Catherine Clifford
@IN/CATCLIFFORD/
@CATCLIFFORD

SHARE



KEY POINTS

- For the second year in a row, the federal government said Arizona, Nevada and Mexico will have to reduce their water consumption.
- A 23-year drought has been drying up the Colorado River and the effects of climate change, both in terms of extreme heat and low precipitation, are making that more severe.
- Arizona, Nevada and Mexico have been asked to make cuts starting in January. Arizona water officials balked at being asked to shoulder what they see as an unfair portion of the burden.

23-Year Drought

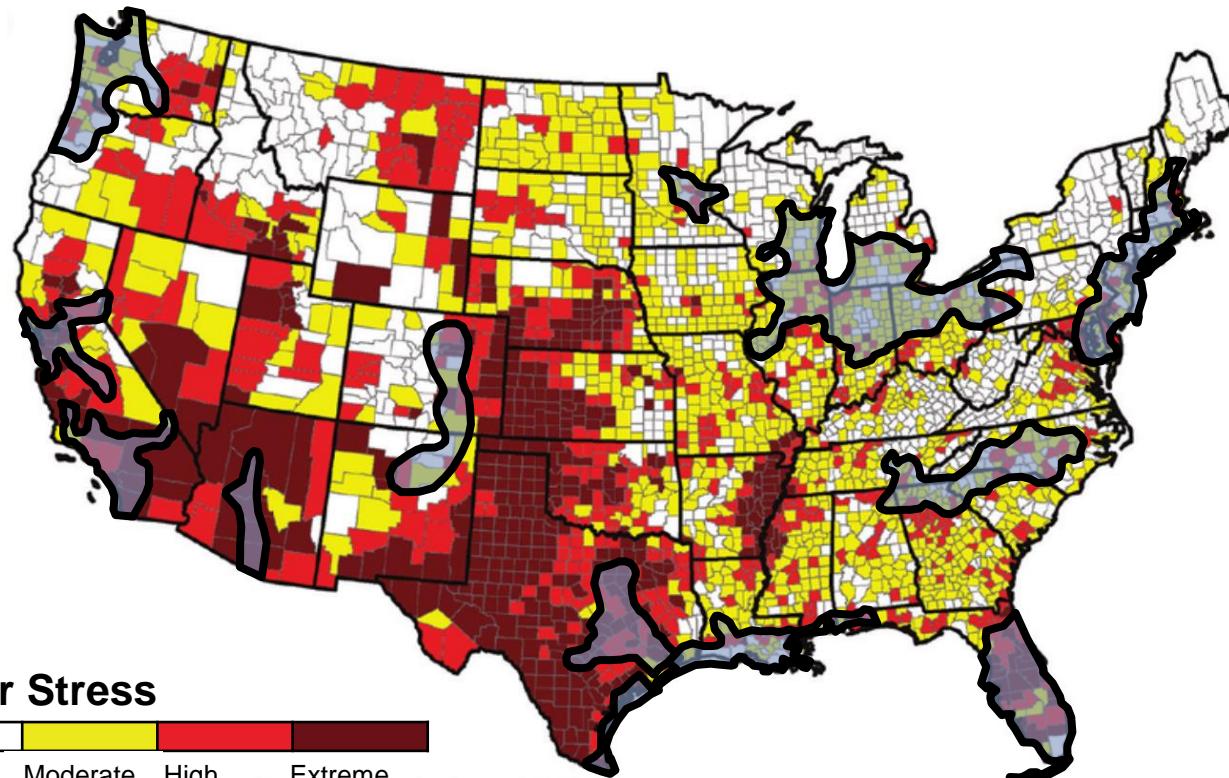
has been drying up the Colorado River.

Effects of climate change, extreme heat and low precipitation, are making it more severe.



The Well Running Dry

Water Supply Sustainability Risk Index 2050
Climate Change Effects



Source: 2014 National Climate Assessment. U.S. Global Change Research Program

**“\$40,000 a door
just to have the
right to water.”**

Craig Karn,
Landscape Architect in Colorado

Source: “Building Industry Experts Express Concern for the Future of Water,” Joe Bousquin, Builder Online, June 3, 2021



Water Efficient: Best Practices

**Water
Efficient**

Best Practices

**Efficient Indoor
Water Use**

Water Efficient Plumbing Fixtures

Water Efficient Appliances

Efficient Hot Water Distribution

**Efficient Outdoor
Water Use**

Efficient Irrigation

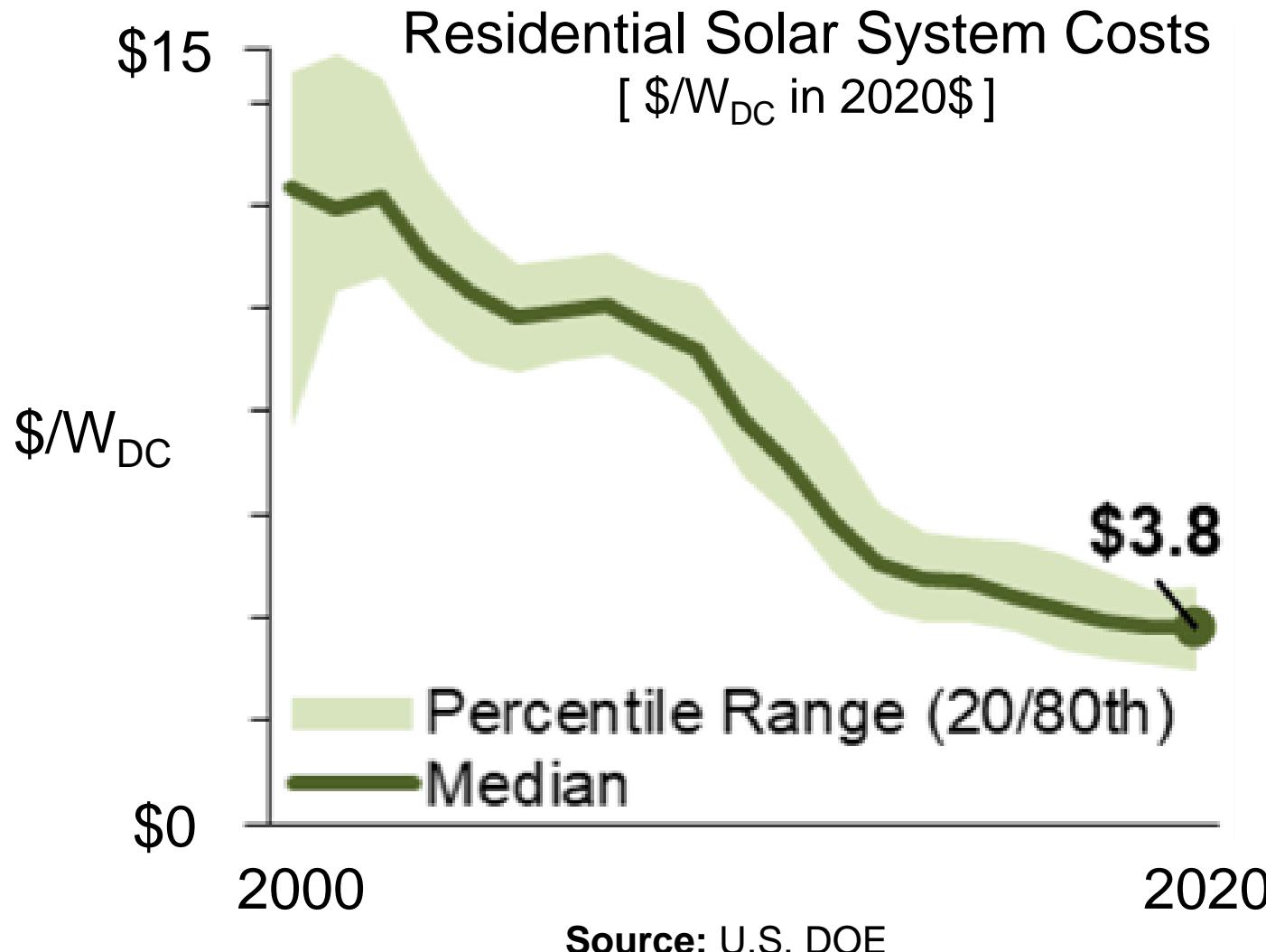
Irrigation Controls

Water Harvesting

Grey Water Recovery

Rainwater Harvesting

Electric Ready: Solar



~\$15K

average cost to install
6kW solar system on a
home before tax credit
(~\$10,000 after tax credit)

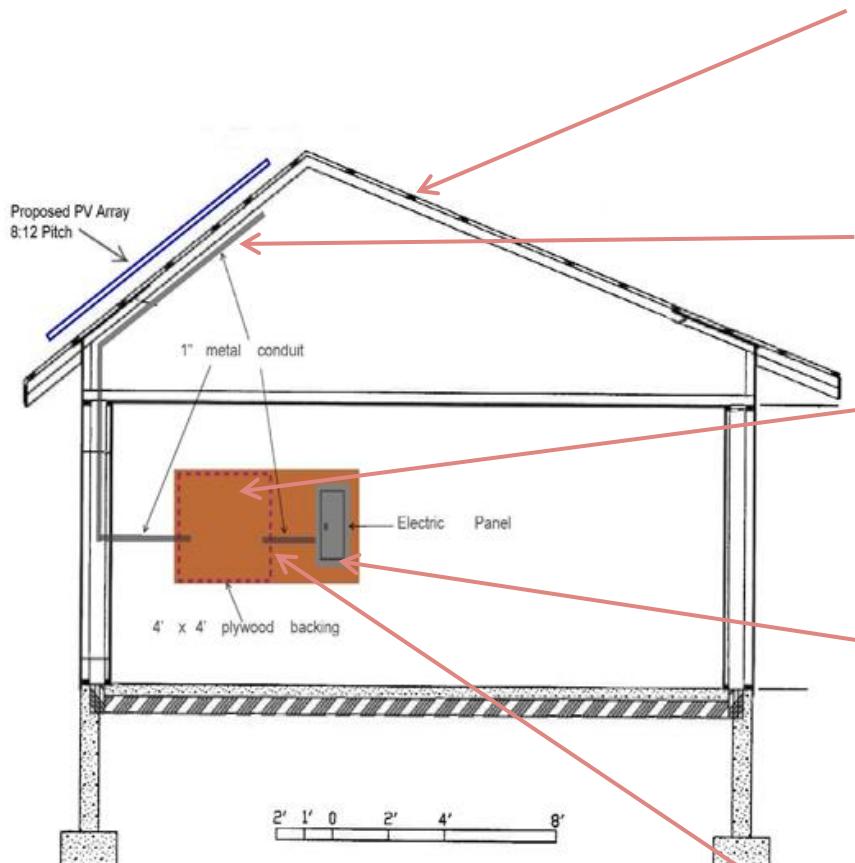
Source: *HomeGuide*

~\$20K - \$97K

average lifetime utility bill
savings

Source: *energysage*

Electric Ready: Solar Ready – Simple, Cheap



Documentation of the maximum allowable dead load and live load (DL.: 6 lbs./sf.)

Conduit to run DC wire from roof to inverter

Dedicated Area for installing inverter and balance of system

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

Conduit to run AC wire from inverter to electric panel

\$1,000's
cost savings installing solar in the future along with no disruption



Solar System Not Integrated in Design

Design

Fit to Site

Natural Comfort

Right-Sizing

Simple

Integrated Sys.





Solar System Integrated in Design

Design

Fit to Site

Natural Comfort

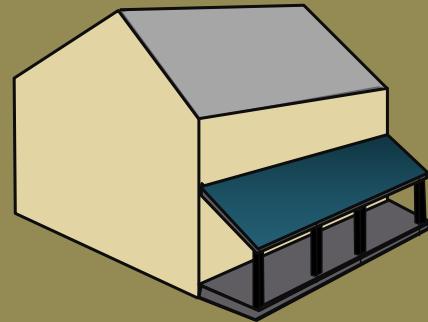
Right-Sizing

Simple

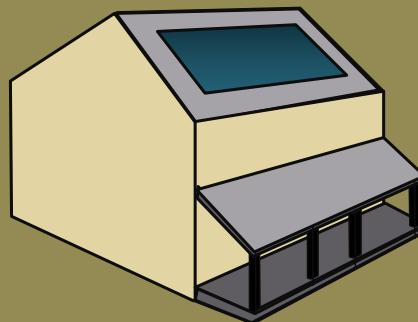
Integrated Sys.



Solar System Integration Faster, Better, Cheaper



**Solar Integrated
vs.
Solar Not Integrated**



**~\$3K Lower
1st Cost**

- No Sheathing
- No Underlayment
- No Roofing
- No Mounting Rack

**~\$6K Lower
Future Cost**

- Remove/Reinstall for New Roof

Better UX

- Better Appearance
- More Daylight
- More Electricity Production

Less Risk

- No Roof Penetrations



Electric Ready: Best Practices

Electric Ready

Best Practices	
Gas / Oil Devices	High-Amp Outlets [e.g., Cooktop, Oven, Clothes Dryer, Furnace, Water Heater]
Solar Ready	Conduit Engineer Roof Load Calcs for Solar Collectors Space for Balance of System
EV Ready	Pre-Install Conduit [208/240v, 40 amp] Level 2-Ready Outlet
Battery Ready	225-amp Busbar Back-up Power Circuits Transfer Switch to Hook up to Battery Storage Subpanel/Split-Bus Main Panel for Critical Loads

Future Electric Home: Solar + Battery + EV + Smart

Performance

Building Science

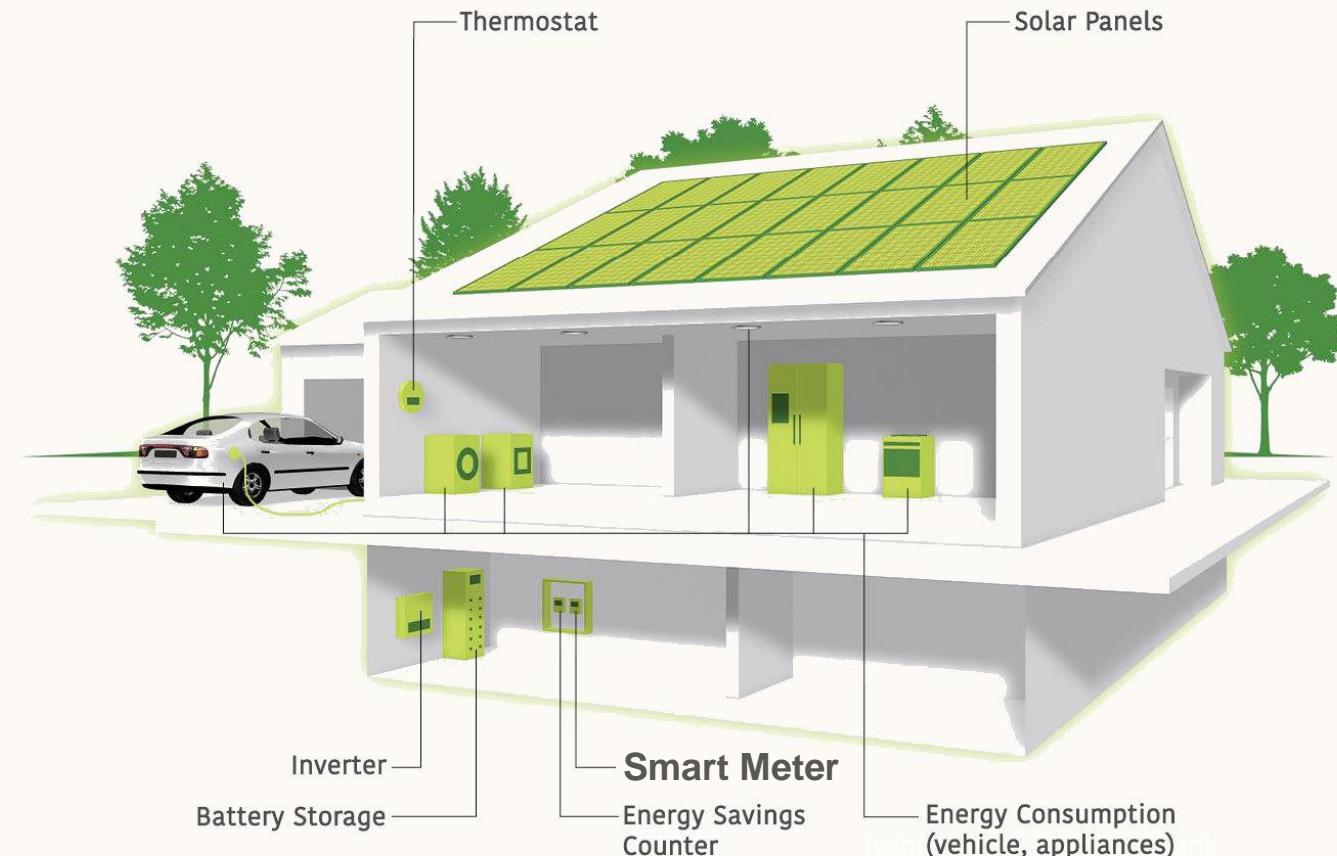
Efficient/Smart

IAQ

Water Efficient

Disaster Ready

Path to Zero



Source: 'In Germany, Consumers Embrace a Shift to Home Batteries,' Paul Hockenos, Yale Environment 360, March 18, 2019



Zero Innovations ... Faster, Better, Cheaper:

UX Optimization Business Model



Why UX Optimization Critical

Housing is the Ultimate Consumer Product

- Size
- Cost
- Emotion
- Impact
- Aspirations



Performance a Must-Have



Zero Energy



Health



Open Space



Daylight / Fresh Air



Outdoor Living



Storage



Smart



Work-at-Home

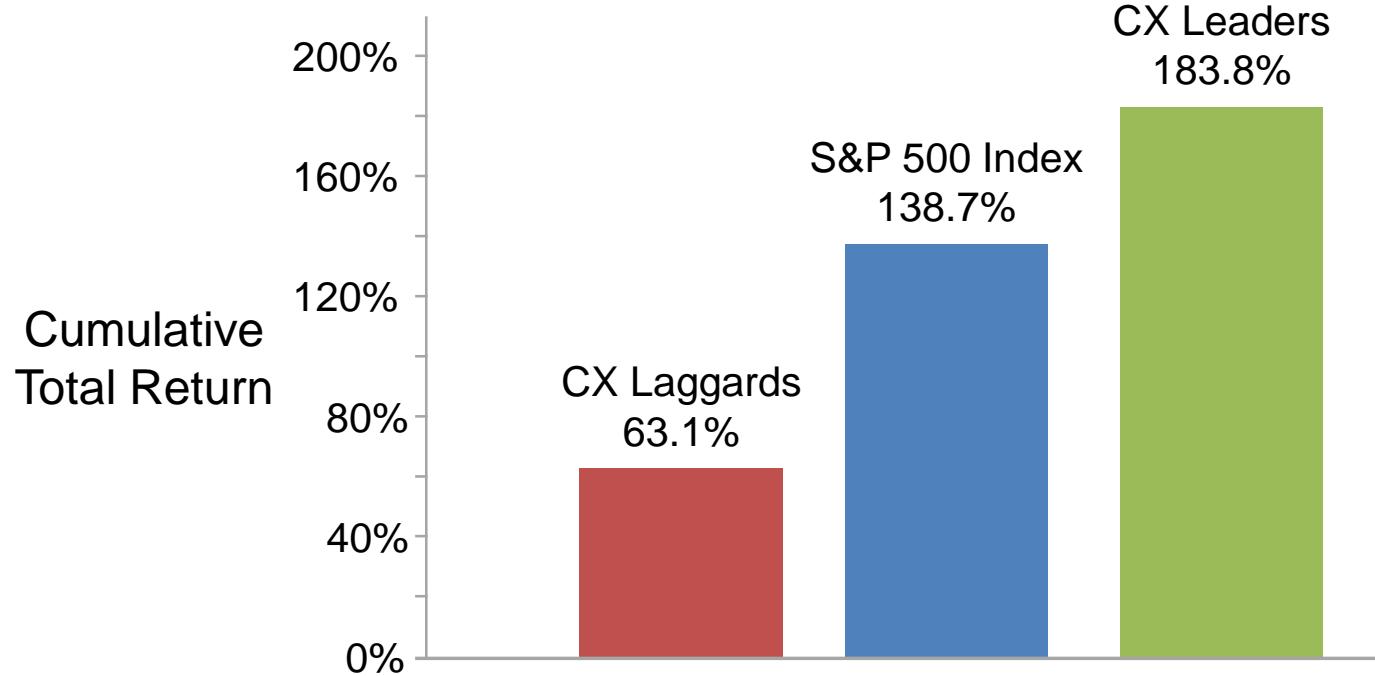


Advanced Lighting



Color

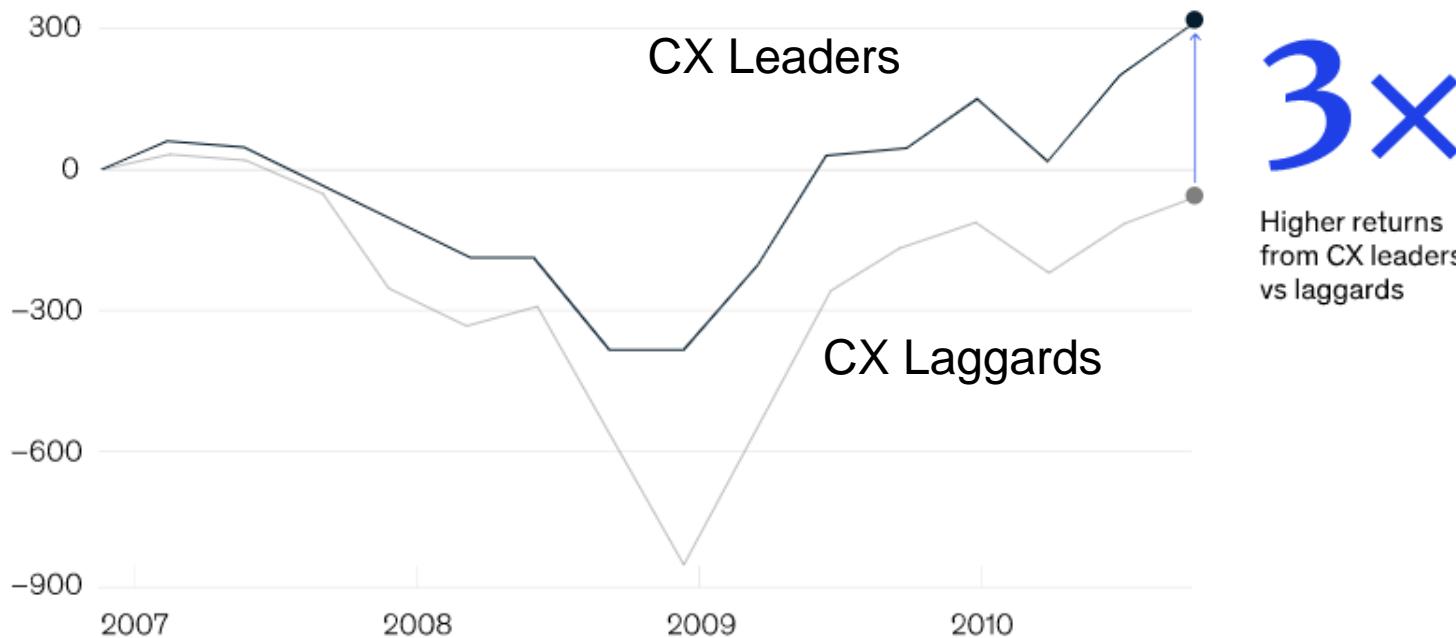
11-Year Stock Performance from 2007 - 2017



Source: Watermark Consulting

3X
Financial
performance
advantage
for CX leaders vs.
laggards

Financial Performance (total shareholder returns)

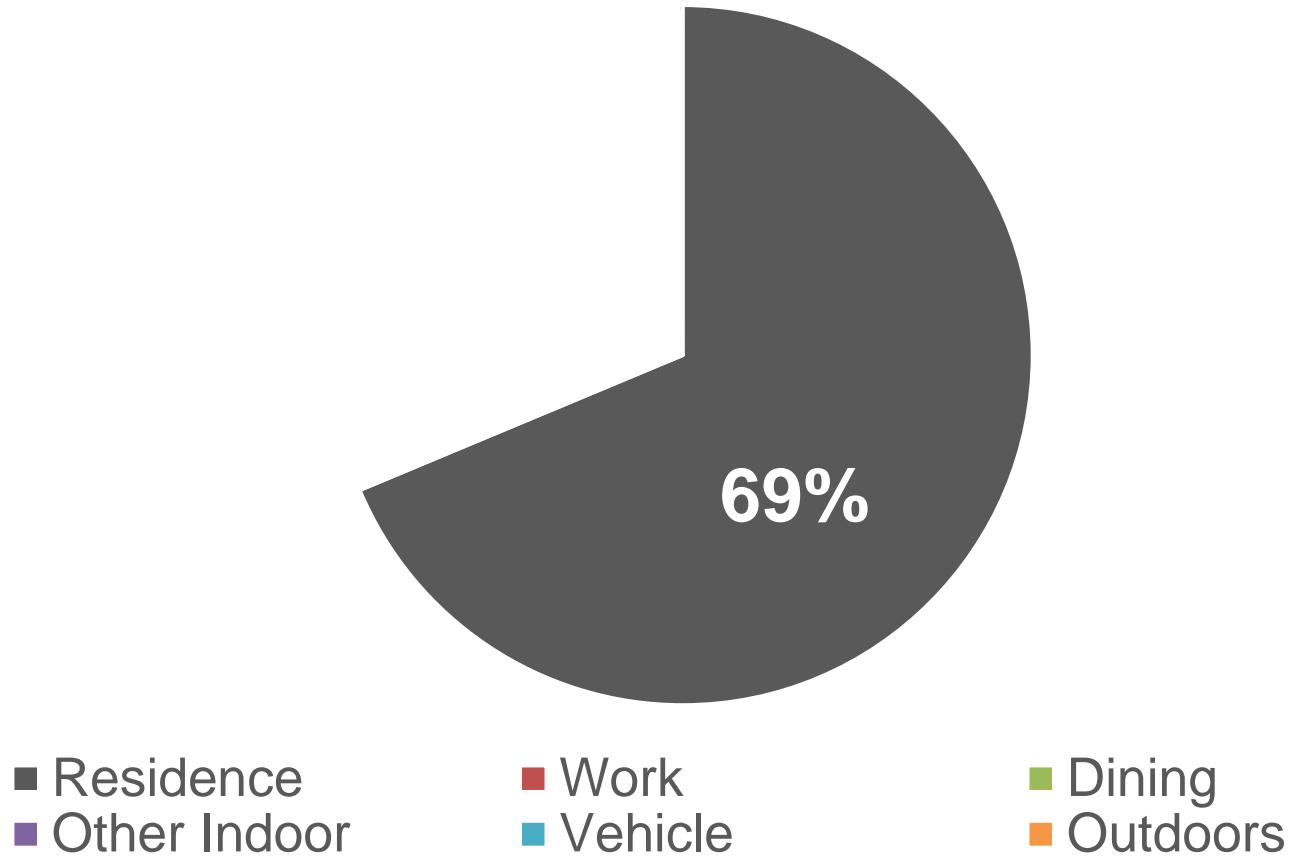


'Comparison of total shareholder returns for publicly traded companies ranking in the top ten of Forrester's CX Performance Index from 2007–09.
Source: Forrester Customer Experience Performance Index (2007–09)

Source: McKinsey & Company

3X Resilience Advantage for CX leaders vs. laggards during recessionary periods with shallower troughs and quicker recovery

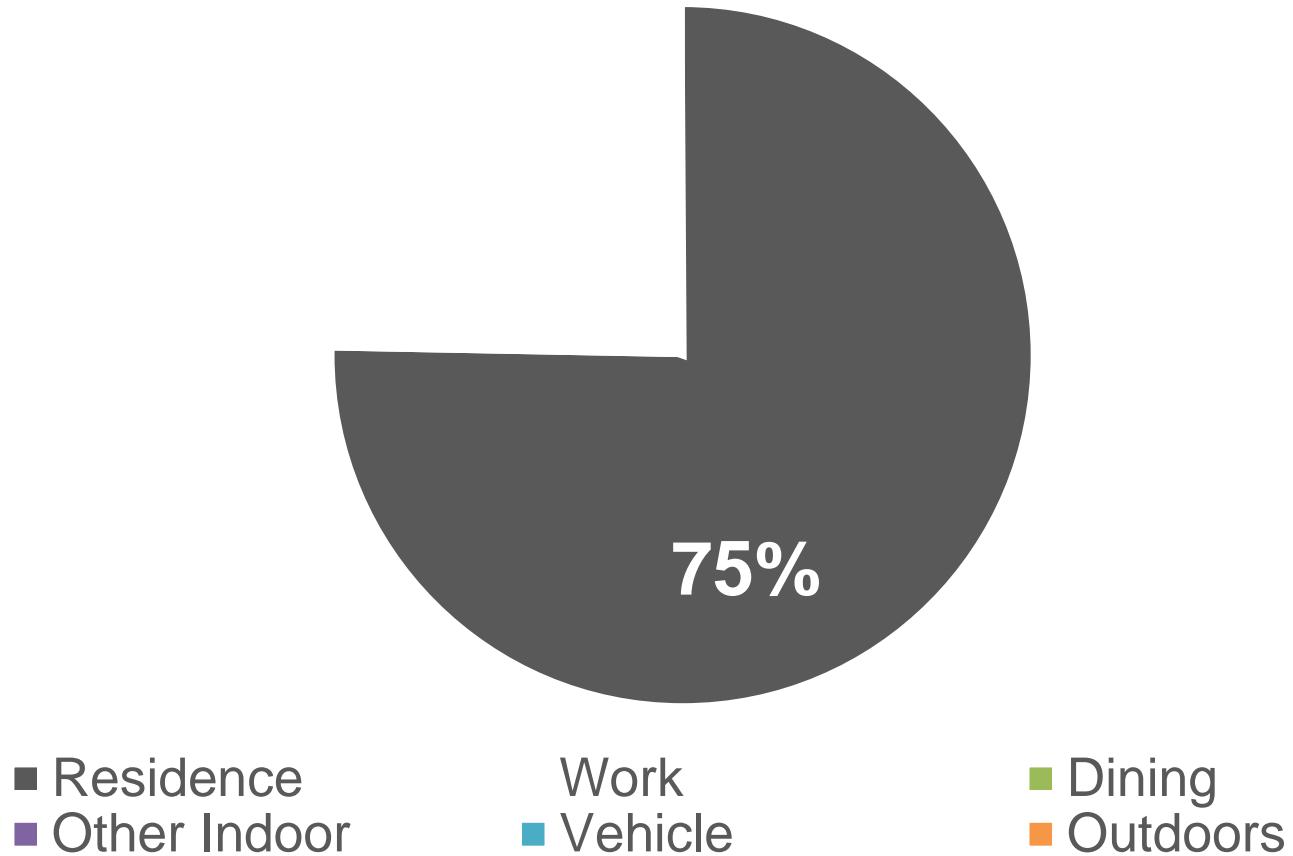
Why UX Imperative Applies to Housing



Source: National Human Activity Pattern Survey, LBNL, 2001

Home is where
life happens™

Why UX Imperative Applies to Housing

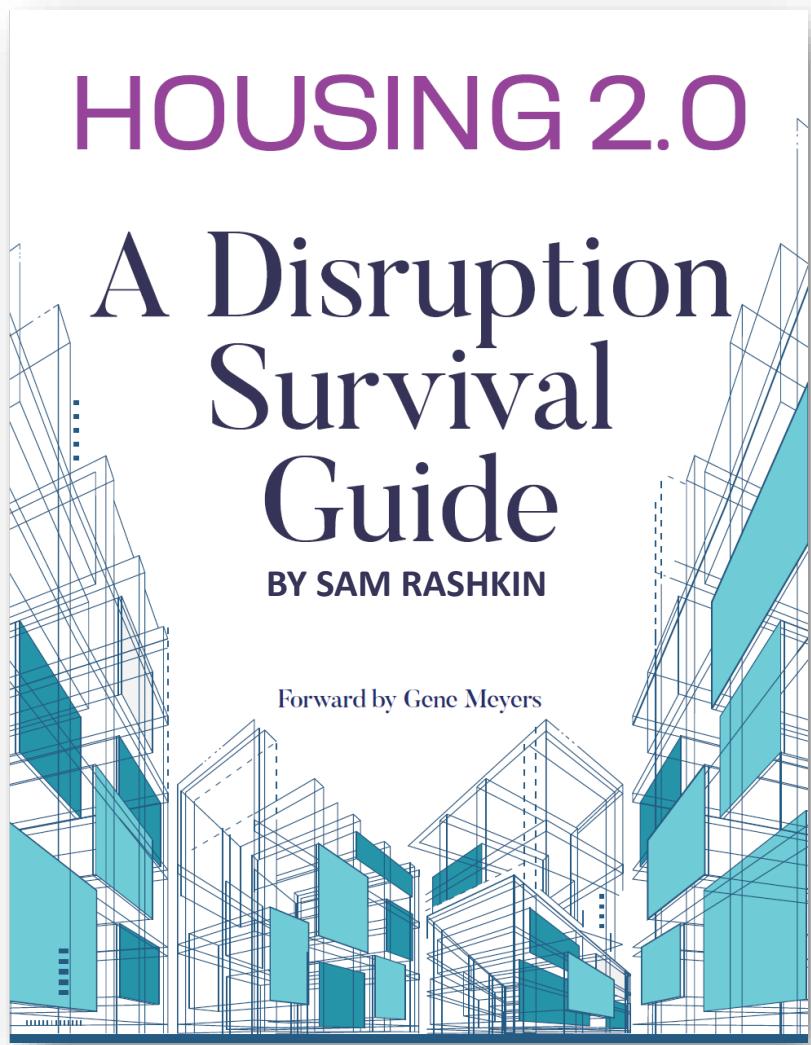


Source: National Human Activity Pattern Survey, LBNL, 2001

Home is where
life happens™



UX Optimization Guidance: Housing 2.0



Goal:

Make high-performance
builders UX leaders

Development:

5+ years vetting with 100's
of housing professionals:

- 420+ pages
- 100's graphics
- 360+ citations
- 7 guest expert essays

[https://www.greenbuildermedia.com/
housing-2.0](https://www.greenbuildermedia.com/housing-2.0)



Housing 2.0 UX Optimization: Why



Core Value:
Homes where life
happens better

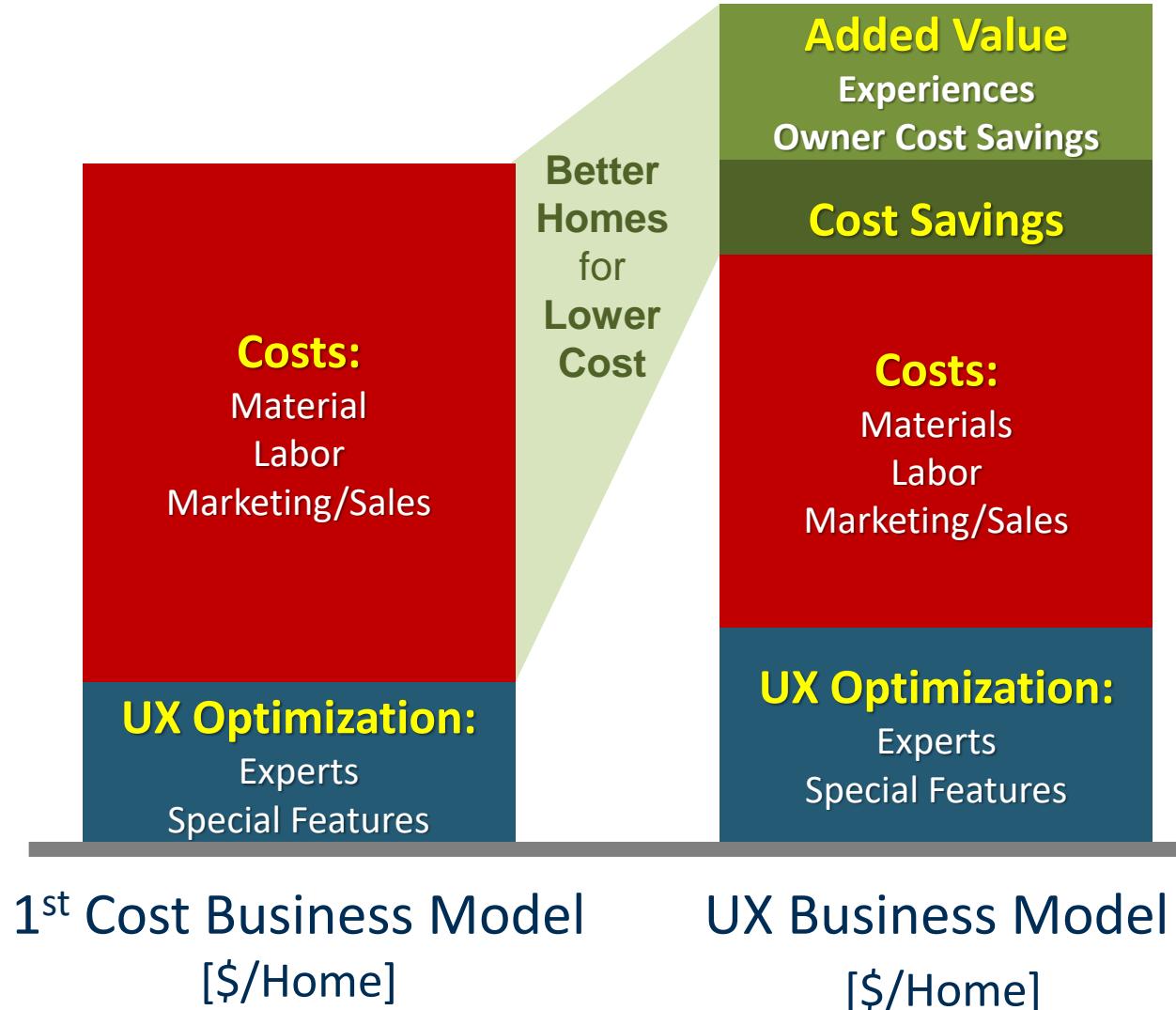
Housing 2.0 UX Optimization: What



Framework:

- 5 User Experiences
- 19 Strategies
- 150+ Best Practices

Housing 2.0 UX Optimization: “How”



Process:

1. Invest in experts and special features that transform UX
2. Extract cost savings:
 - Minimize waste
 - Minimize complexity
 - Maximize system integration
3. Sell better homes for lower cost



Zero Value Imperative ... Getting to Cheaper



Getting on Path to Zero Value Imperative

Zero Building Blocks	Benefit	Added Value
Efficient	Utility Cost Savings	\$20 - \$60K (30 yrs.)
	Smaller HVAC Equipment/Ducts	\$2 - \$3K
Manage Risks	Moisture Maintenance Cost Savings	\$1 - \$30K (30 yrs.)
	Superior Smart Comfort	\$10 - \$20K
Future Ready	Health Cost Savings	\$30 - \$40K (30 yrs.)
	Value of Less Sick Days	\$10 - \$15K (30 yrs.)
	Resilience Insurance Savings	\$10 -\$90K (10 yrs.)
	Water Bill Savings	\$8 - \$12K (30 yrs.)
	Future Upgrade Cost Savings	\$15 - \$30K
	Electric Ready Supply Disruption	\$17 - \$40K
Total	Solar Electric System Savings	\$20K - \$97K (lifetime)
	Optimize How Home Lives	\$100 - \$150K

50 - 60%
HERS



Housing 2.0 UX Optimization: Results

Optimized Experience	Cost Savings / Added Value Basis	Cost Savings/Added Value	
		\$400K Home	Typical Home %
Community	Superior communities Convert 'C' locations to 'A' locations	\$30 - \$200K	10 – 50%
Design	Significantly less square feet, waste, and complexity, (e.g., hard costs) in homes that live better	\$40 - \$70K	15 – 25%
Performance	Superior comfort, health, and durability w/positive cash-flow from utility savings	\$100 - \$150K	30 – 40%
Quality	Less cost for labor, materials, rework, waste removal, and customer service	\$40K - \$60K	10 – 15%
Sales	Lower costs for marketing and sales along with higher profit and growth	\$30K - \$50K	10 – 20%
Total	Optimized Homeowner Experience is Better Business	\$130 - \$280K	30 – 70%

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Tyvek®

DUPONT

Styrofoam™

GREAT STUFF PRO.

FROTH-PAK™

DuPont™ Tyvek® HomeWrap®

DuPont™ Tyvek® Tape

DuPont™ Flashing Tape

DuPont™ Styrofoam™ Brand XPS Insulation

DuPont™ Tyvek® Protec™

Great Stuff Pro™ Window & Door
Foam Sealant

DuPont™ FlexWrap™

Great Stuff Pro™ Gaps & Cracks
Foam Sealant

DuPont™ FlexWrap™ EZ

Froth-Pak™ Foam Sealant

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Brand

GREAT STUFF PRO

FROTH-PAK™



100%

of the electricity used to make our
products in our North American
operations comes from
renewable energy sources*

* We have purchased Renewable Energy Credits to offset our electricity usage since 2016 for select brands. Starting in 2020, we offset our full in-house manufacturing electricity usage for brands in North America.



Did You Know?

Home Builders may be eligible for
tax credits when using DuPont products.

- ∅ up to **\$2,500** per dwelling (meet or exceed ENERGY STAR® requirements)
- ∅ up to **\$5,000** per dwelling (meet or exceed DOE zero-energy ready)
(US only)

Find out more about the Inflation Reduction Act and Section 45L:





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