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Energy Efficient Buildings

Passive House Buildings – Mitigating Climate Change

Implementing the Passive House Building Standard to minimize the energy intensity and CO_2 emissions in buildings

House Committee on
Natural Resources
Act 250 & Climate Change

www.vtph.org

January 23, 2020

Presenters Credentials

Peg Elmer Hough

- 40+ Years Veteran Planner
- Town Planner/Zoning Administrator in Chittenden County
- Trained in details of A250 working for the Environmental Board, then ANR (managed "Act 250 Club" across state agencies and staffed Gov Kunin's Commission on VT's Future)
- VNRC Land Use Program Director, then Planning Director at Commerce Agency (incl'd first State Hazard Mitigation Plan) guiding emerging smart growth initiatives
- Prof. of land use law and policy at VLS, appointed to "smart growth seat" on Downtown Board

Enrique Bueno

- Chemical Engineer
- 40 Years experience in basic industries – Cement, Aluminum and Steel production
- 9 Years specialized in Building Science and Passive House Buildings
- Founding member of the VT Passive House NPO 5013C
- Board Chair of the VT Passive House organization
- Certified Passive House Consultant

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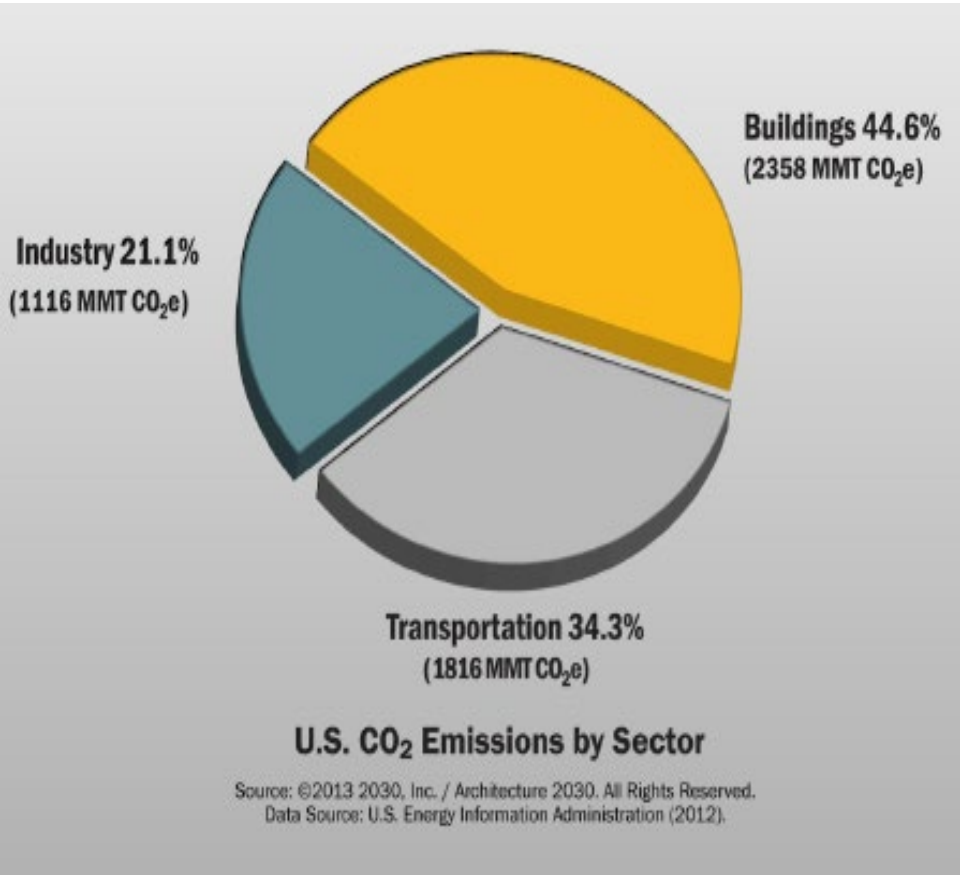
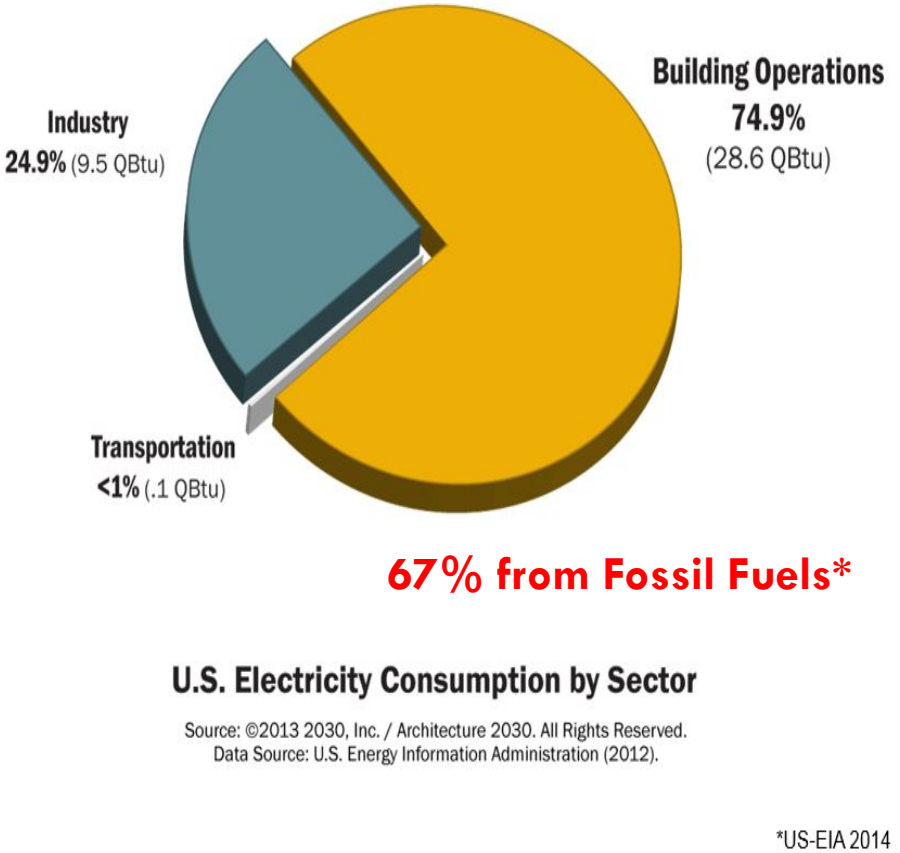
The Problem

Building Operations and Materials have a mayor impact on CO_2 emissions

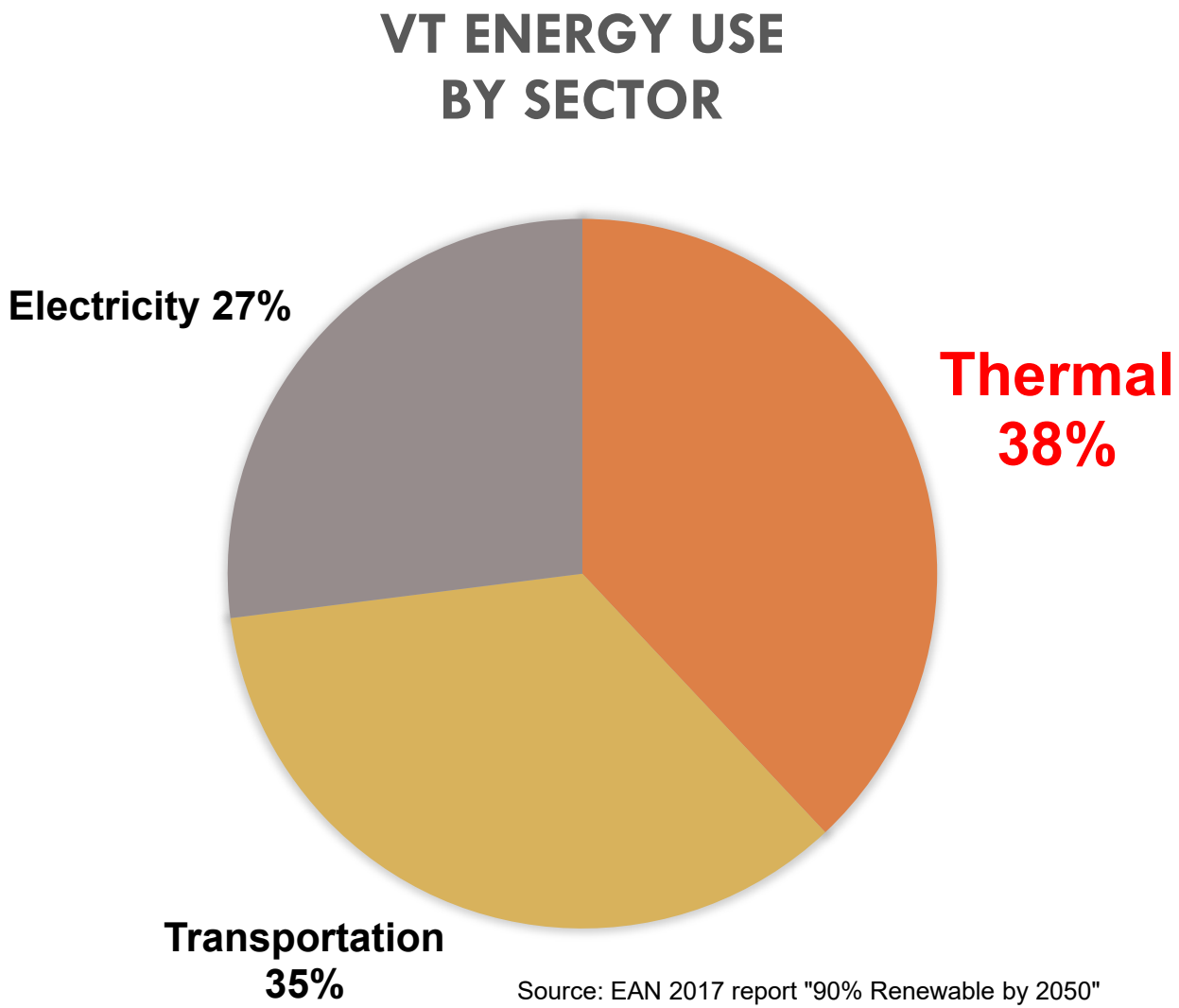


*US-EIA 2014



The Problem in VT

76% of Thermal comes from Fossil Fuels



Source: EAN 2017 report "90% Renewable by 2050"

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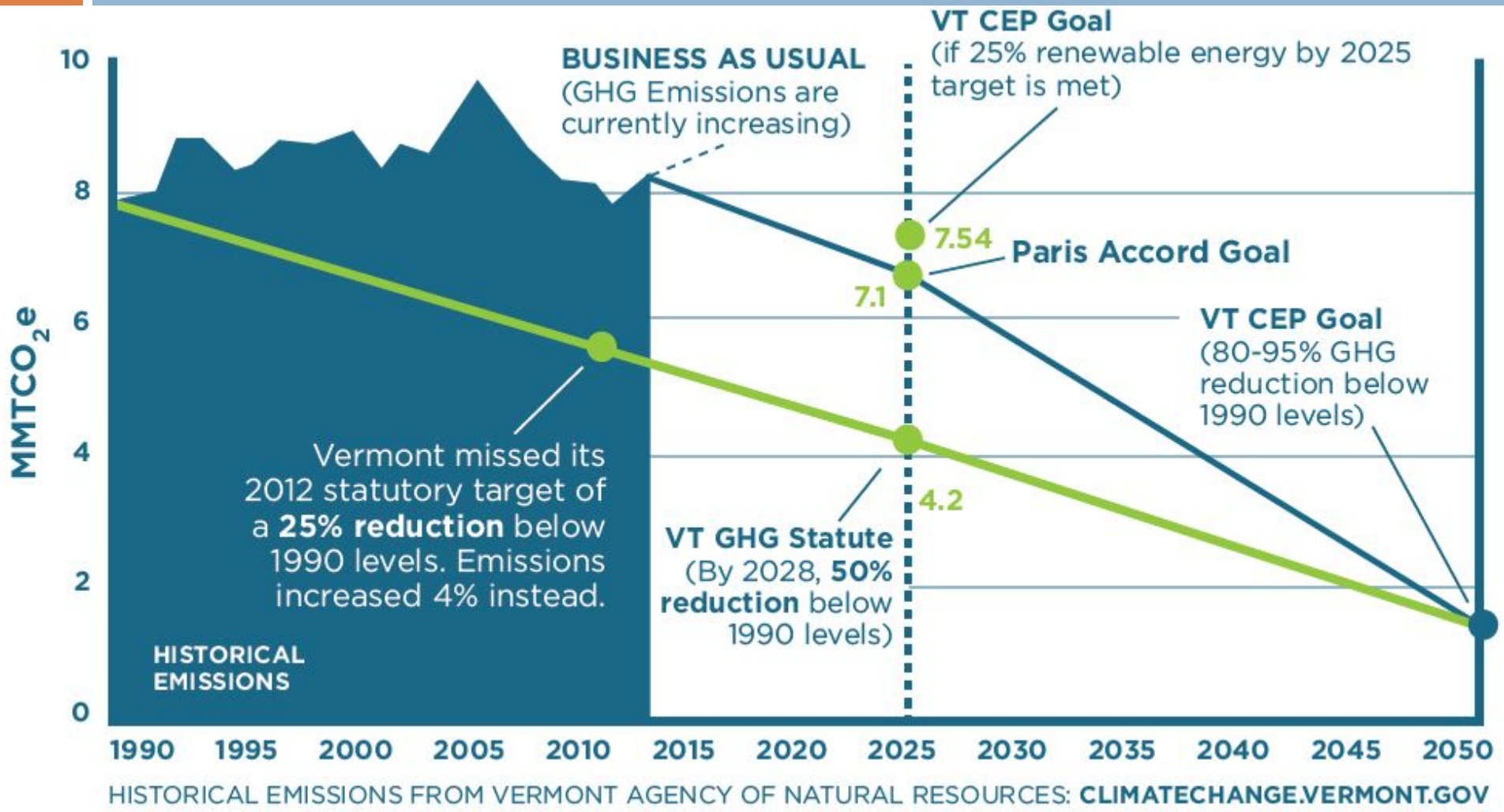
The Problem in VT

VT's CO2 emissions increased by 11% from 2012 to 2015

by 2015 we were 55% above the goal



Source: EAN 2017 report "90% Renewable by 2015"

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What are we proposing to contribute to the Solution?

Adoption of the Passive House Standard as RBES

ZERH Staircase

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

ZERO ENERGY READY HOME
U.S. DEPARTMENT OF ENERGY

				Solar Ready	Solar Ready
				Eff. Comps.& H_2O	Eff. Comps.& H_2O
				EPA Indoor Air Package	EPA Indoor Air Package
				Optimized Duct Location	Optimized Duct Location
		HVAC QI with WHV	HVAC QI with WHV	HVAC QI with WHV	HVAC QI plus HRV
		Water Management	Water Management	Water Management	Water Management
Independent HERS Verif.	Independent HERS Verif.	Independent HERS Verif.	Independent HERS Verif.	Independent HERS Verif.	Independent PHIUS Verif.
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**
IECC 2009	**IECC 2012**	**ENERGY STAR v3**	**ENERGY STAR v3.1**	**ZERH**	**PHIUS+**

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Act 250 - Criterion 9 (F)

F) Energy conservation. A permit will be granted when it has been demonstrated by the applicant that, in addition to all other applicable criteria, the planning and design of the subdivision or development **reflect the principles of energy conservation, including reduction of greenhouse gas emissions from the use of energy, and incorporate the best available technology for efficient use or recovery of energy.** An applicant seeking an affirmative finding under this criterion shall provide evidence that the subdivision or development complies with the applicable building energy standards under 30 V.S.A. § 51 or 53, **including the stretch code** for residential buildings adopted pursuant to 30 V.S.A. §51(d).

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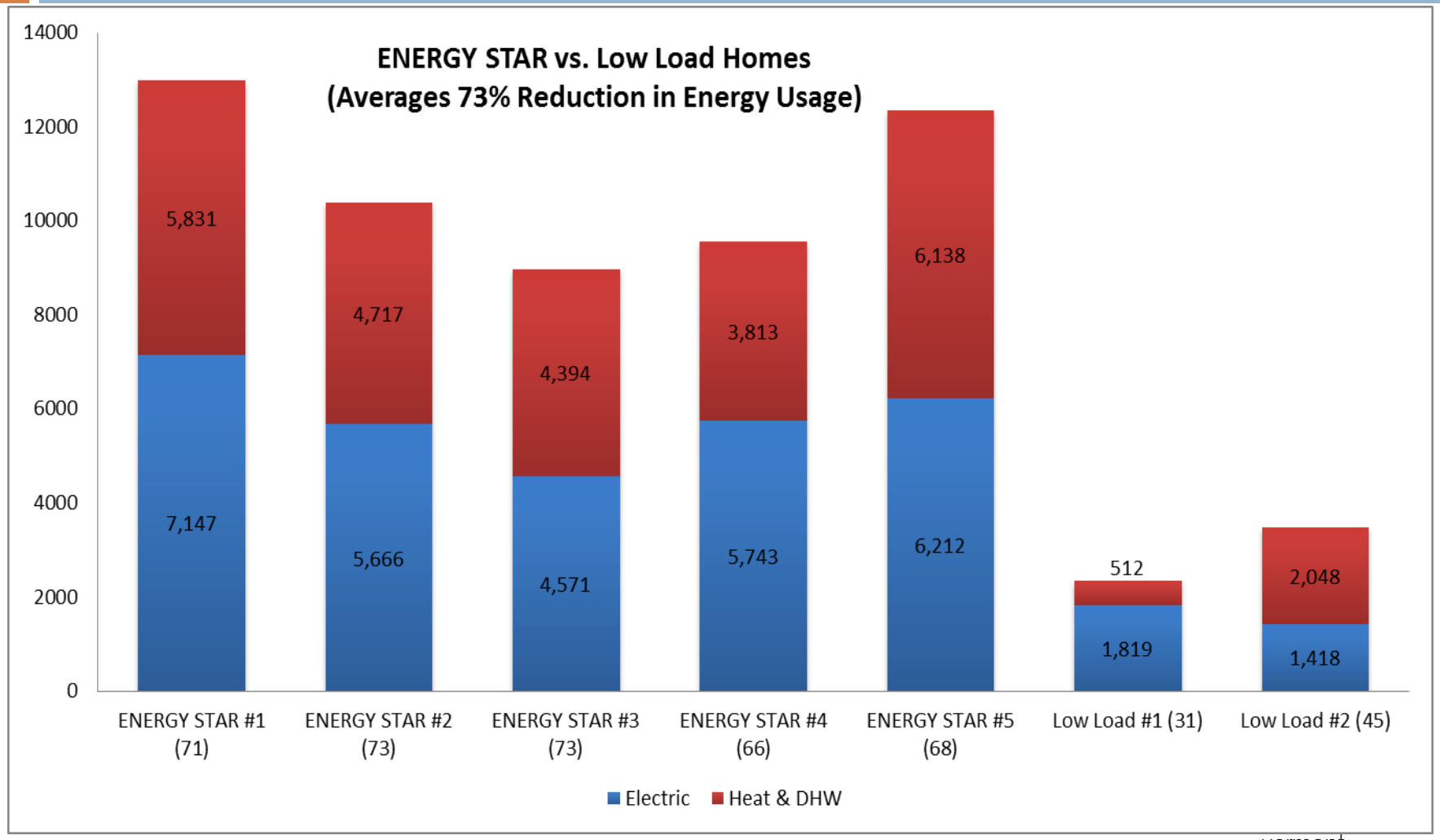
Actual Energy Consumption Comparison of five Energy Star Homes, one Passive House and one Low Load



Source: Efficiency VT 2012

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RBES Stretch Code is stuck !

ZERH Staircase

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ZERO ENERGY READY HOME
U.S. DEPARTMENT OF ENERGY

here

				Solar Ready	Solar Ready
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				EPA Indoor Air Package	EPA Indoor Air Package
				Optimized Duct Location	Optimized Duct Location
		HVAC QI with WHV	HVAC QI with WHV	HVAC QI with WHV	HVAC QI plus HRV
		Water Management	Water Management	Water Management	Water Management
Independent HERS Verif.	Independent HERS Verif.	Independent HERS Verif.	Independent HERS Verif.	Independent HERS Verif.	Independent PHIUS Verif.
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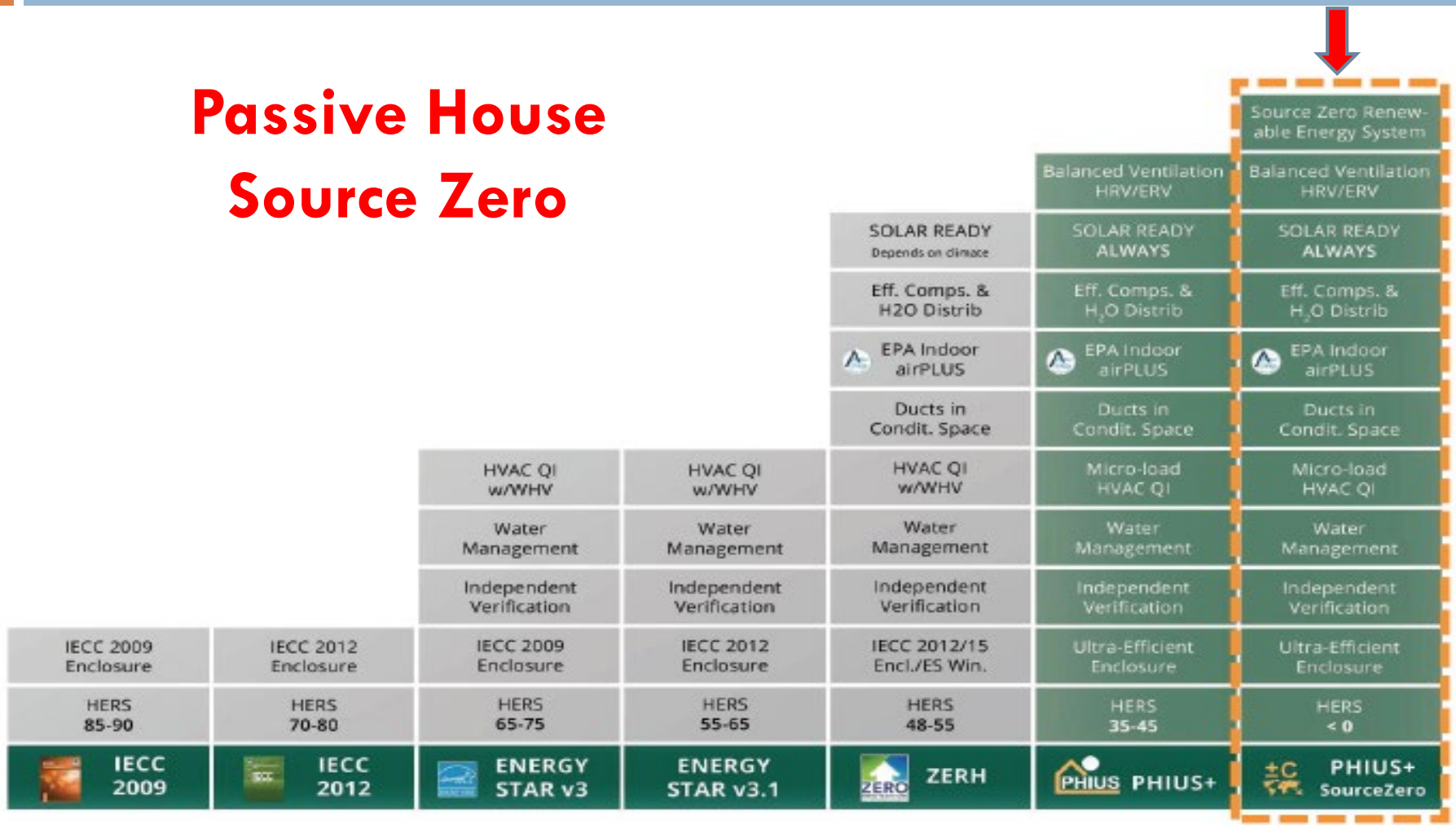
RBES should be here !

Passive House

Source Zero



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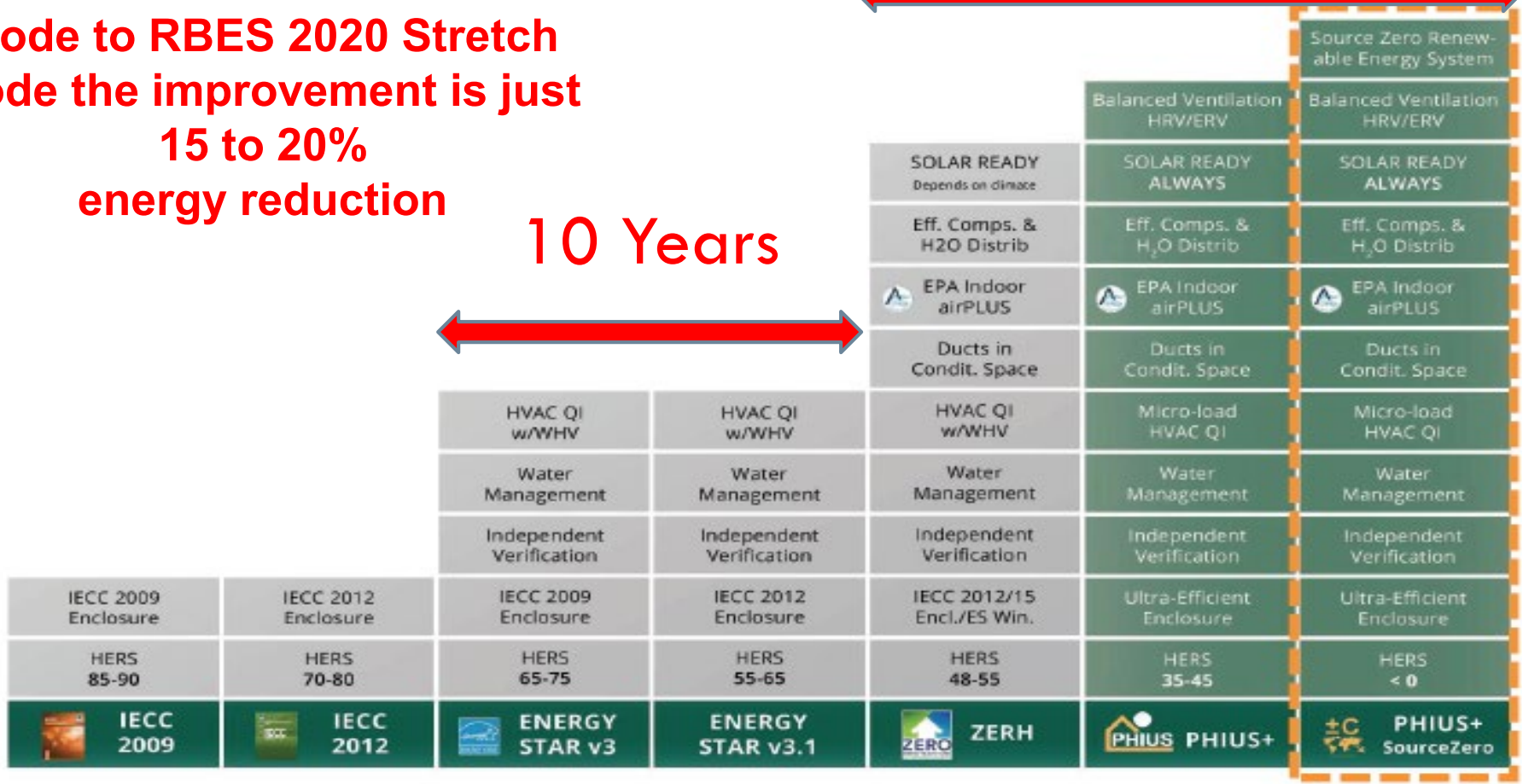
How long is it taking ?

From RBES 2015 Stretch Code to RBES 2020 Stretch Code the improvement is just 15 to 20% energy reduction

???

10 Years



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Where does a Zero Energy Ready Building Start According to the DOE ?

Zero Starts with the Enclosure

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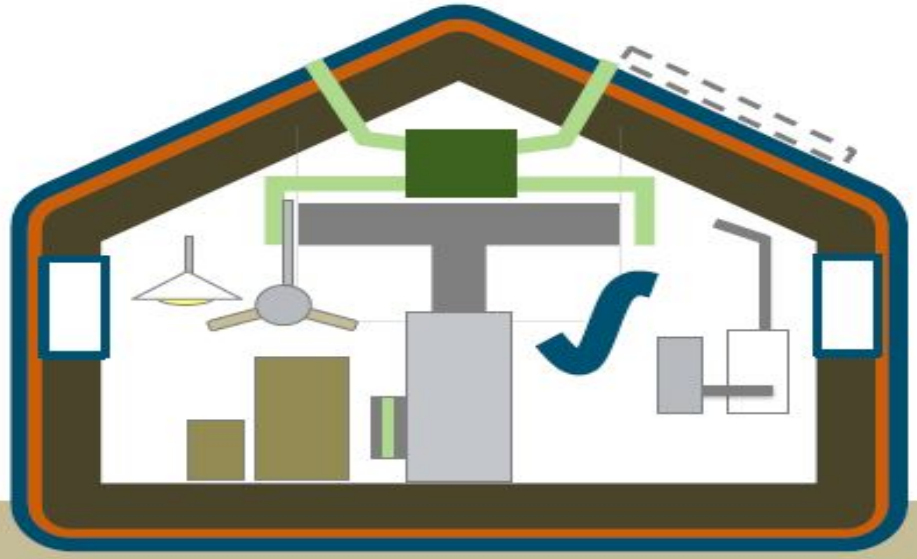

Optimized Enclosure System	Water Protection System	Optimized Comfort System	Complete IAQ System	Efficient Comps System	Solar Ready System

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DOE's Recognition of the Passive House Standard

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Efficiency VT's Multifamily Incentives for the Passive House Standard

Incentives	Energy modeling for building	50% of modeling cost (up to $5,000) if conducted early in support of integrated design process; must include EVT Energy Consultant in process.
	Thermal Shell commissioning	50% of commissioning cost (up to $5,000) if air leakage target is 0.10 cfm50/sq. ft. exterior building shell area or less
	Passive House	Additional $300 per unit incentive for successful Passive House certification.

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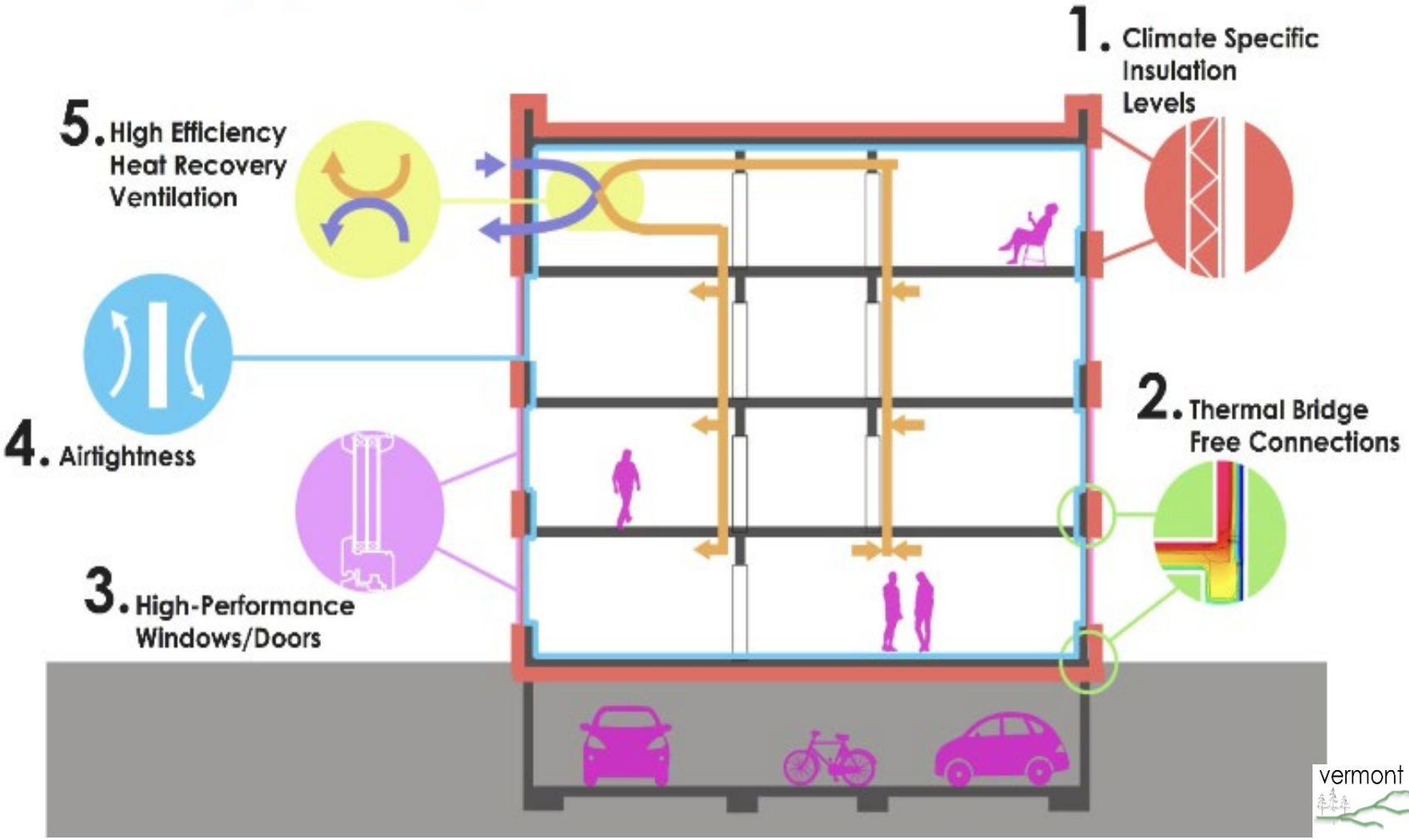
PASSIVE BUILDING PRINCIPLES

Five key principles:



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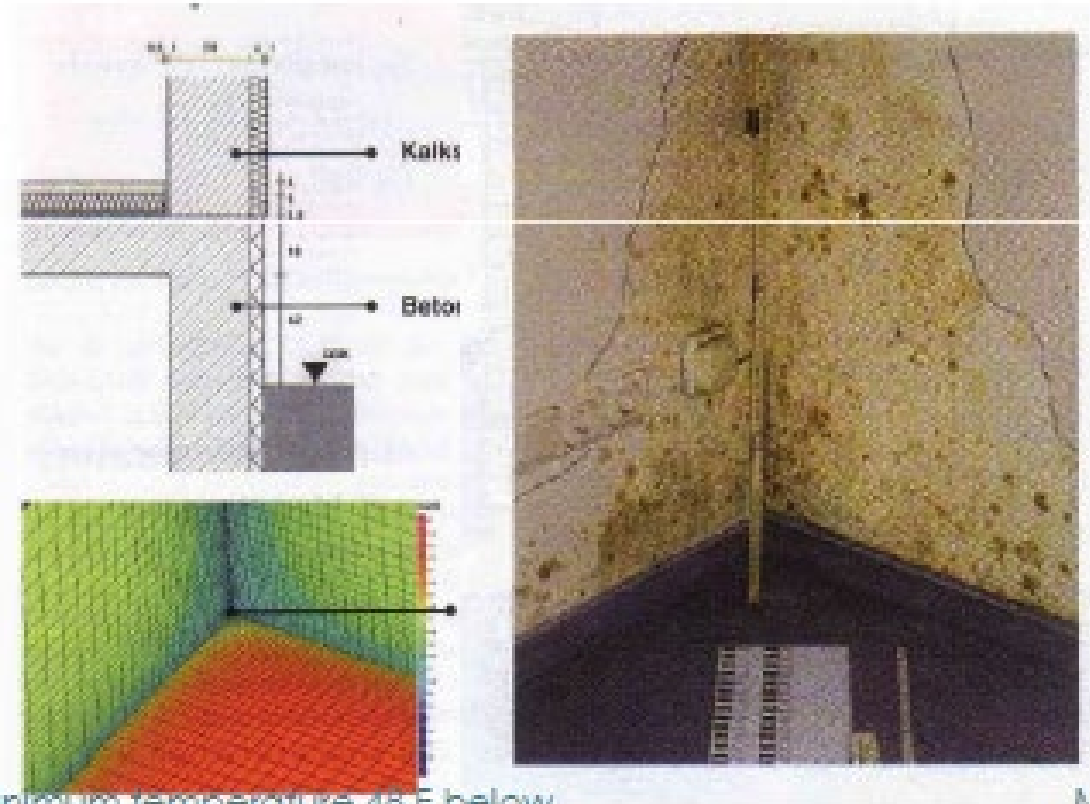
MINIMIZE LOSS:

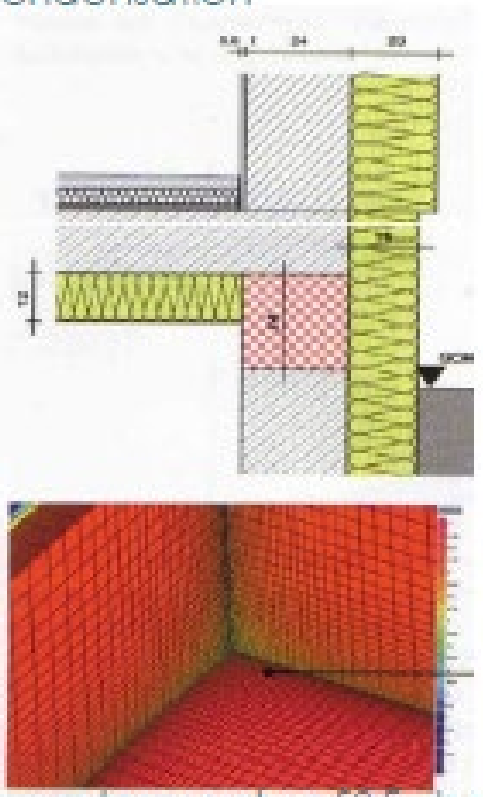
ELIMINATING THE THERMAL BRIDGE MINIMIZES HEAT LOSS CONDENSATION/BUILDING DETERIORATION

BAD = high heat loss + risk of condensation



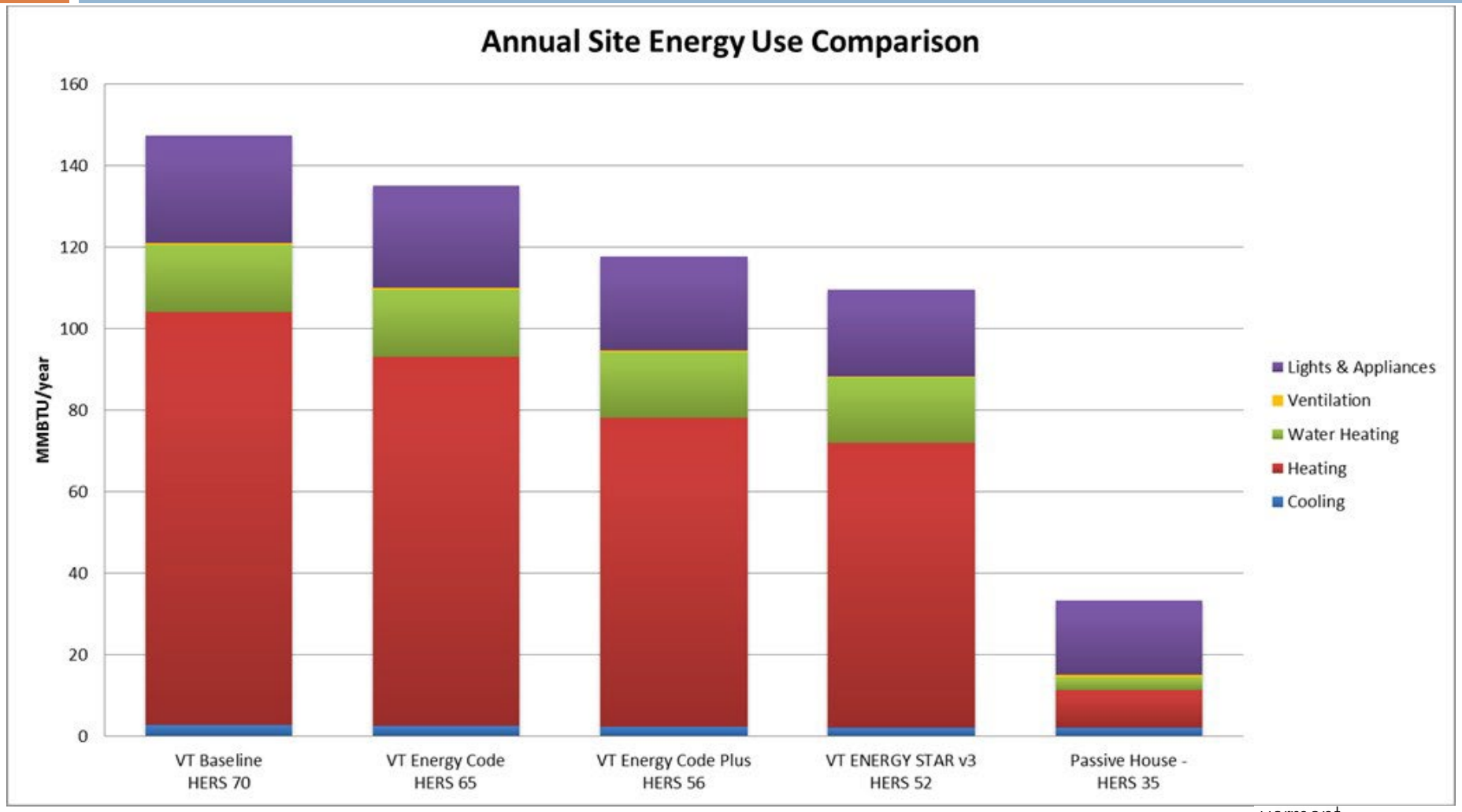
Minimum temperature 46 F below dew-point, risk of condensation

GOOD = low heat loss, warm interior surface + no condensation



Minimum temperature 58 F above dew-point, no risk of condensation

Energy Usage Comparison



Source: Efficiency VT - 2012

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How does it relate to other programs?

Energy Efficient Housing Concepts in the US:

- Vermont Energy Code (RBES): required for all new construction **but not enforced**
- Energy Star 3.0: DoE Program (30% more efficient than Code)
- Building America: DoE super energy savings Program (15% better than EStar)
- Passive House: **90% more efficient than VT RBES Code**
- 70% more efficient than Energy Star
- 55% more efficient than Building America

Can be cost equivalent to conventional building for single family and equal or less for multifamily and commercial construction.

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Passive House Projects
North East USA

High Rise – Cornell-Tech - NYC

School
Portland ME

Affordable Senior Housing
Milton VT

Affordable Housing
Brewer - ME

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East Harlem - NYC
East 111th Street development

Rendering Courtesy of Handel Architects

Mixed-use, 655 affordable apartments complex including

- Seniors' housing
- Harlem RBI/Dream Charter School
- YMCA facility
- Mount Sinai Health Center
- Urban Market & Retail Space
- Public gardens

Income from $19,050 to $106,080

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Village Center Apartments
Brewer, ME

48 Affordable Housing Units
51,778 SqFt Interior Floor Area
1,2 & 3 Bedroom units
3 common areas
1 dog washing room

$135/sqft construction cost

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Village Center Apartments
Brewer, ME

Conventional Double Stud-Wall filled with cellulose that any builder can build

Not Rocket Science

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Gilford Village Knolls III
New Hampshire

Multifamily
Affordable
Senior Housing
24 Units
20,571 ft²

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Twin Pines Housing –West Lebanon NH
Maclay Architects – Waitsfield VT

Tracy Street - Twin Pines Housing

AREA: 27,000 sf
Net Positive Energy
ILFI Net Zero Energy
PHIUS+ 2015

ENERGY INTENSITY: 25 kBTU/sf-yr (modeled)
Air Infiltration: 0.044 cfm50/sf (actual)
Solar PV array size: 180 kW

COMPLETION: 2019

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Passive House Projects Vermont

ELM PLACE - Best Overall Passive Building Winner

Multifamily project category Winner
Affordable project category Honorable Mention

2017 PHIUS Passive House Projects Competition

83% less energy for heating/cooling than a conventional building

@ only 2% more cost

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Elm Place Senior Housing, Milton-VT
Passive House vs. Stretch Code 2020

Space heating	Heating demand	5.38	kBTU/(ft2yr)
	Heating load	4.91	BTU/(hr.ft2)
Primary energy	dehumidification, DHW, lighting, electrical appliances	59	kBTU/(ft2yr)
Airtightness		0.7	ACH50

Passive House
68% better than
Stretch Code

Space heating	Heating demand	17.06	kBTU/(ft2yr)
	Heating load	11.90	BTU/(hr.ft2)
Primary energy	dehumidification, DHW, lighting, electrical appliances	75	kBTU/(ft2yr)
Airtightness		3	ACH50

Stretch Code
217% More
Heating Demand
27% More Primary
Energy

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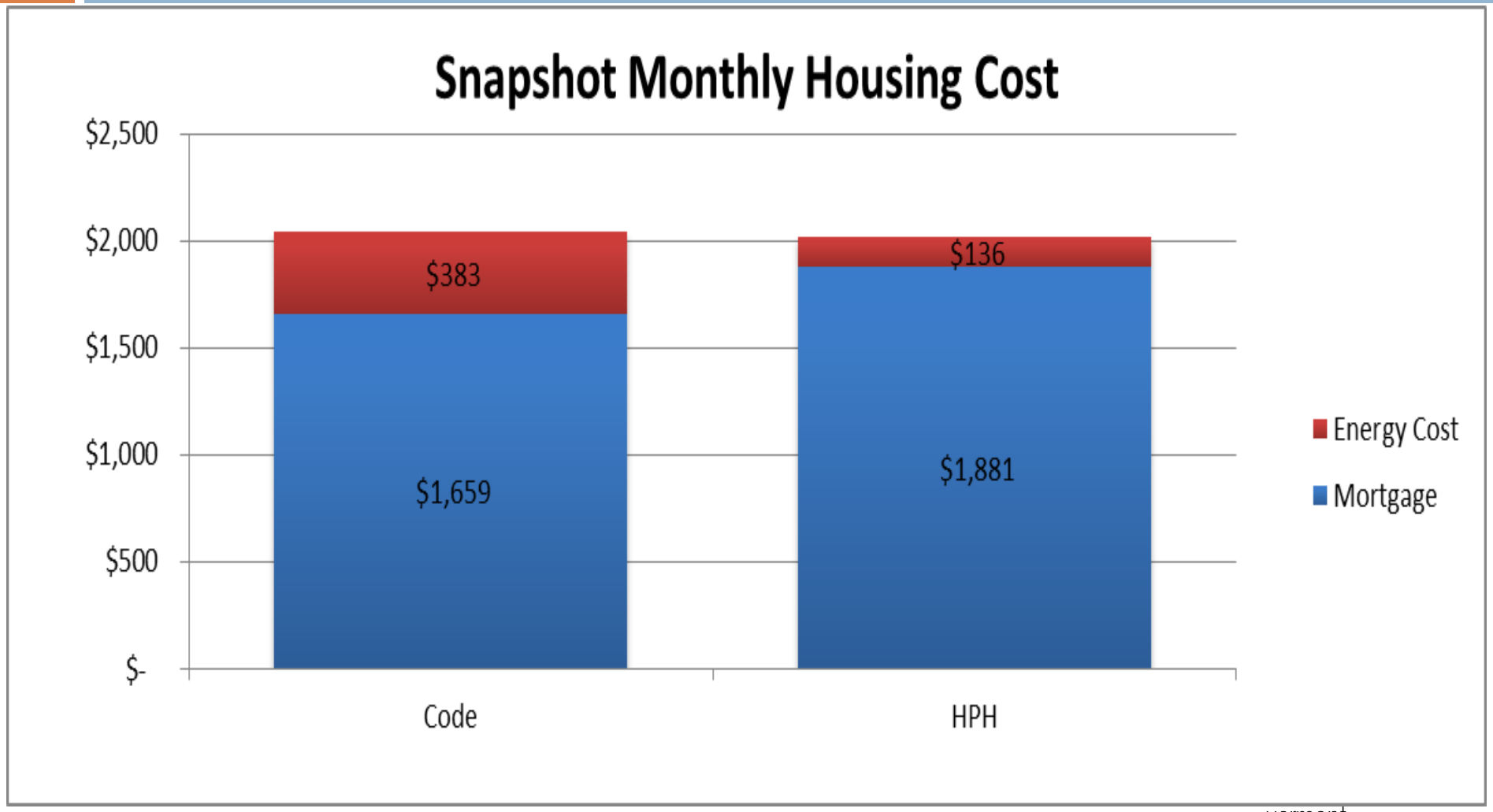
Cost Analysis for High Performance Single Family Home



Source: Efficiency VT

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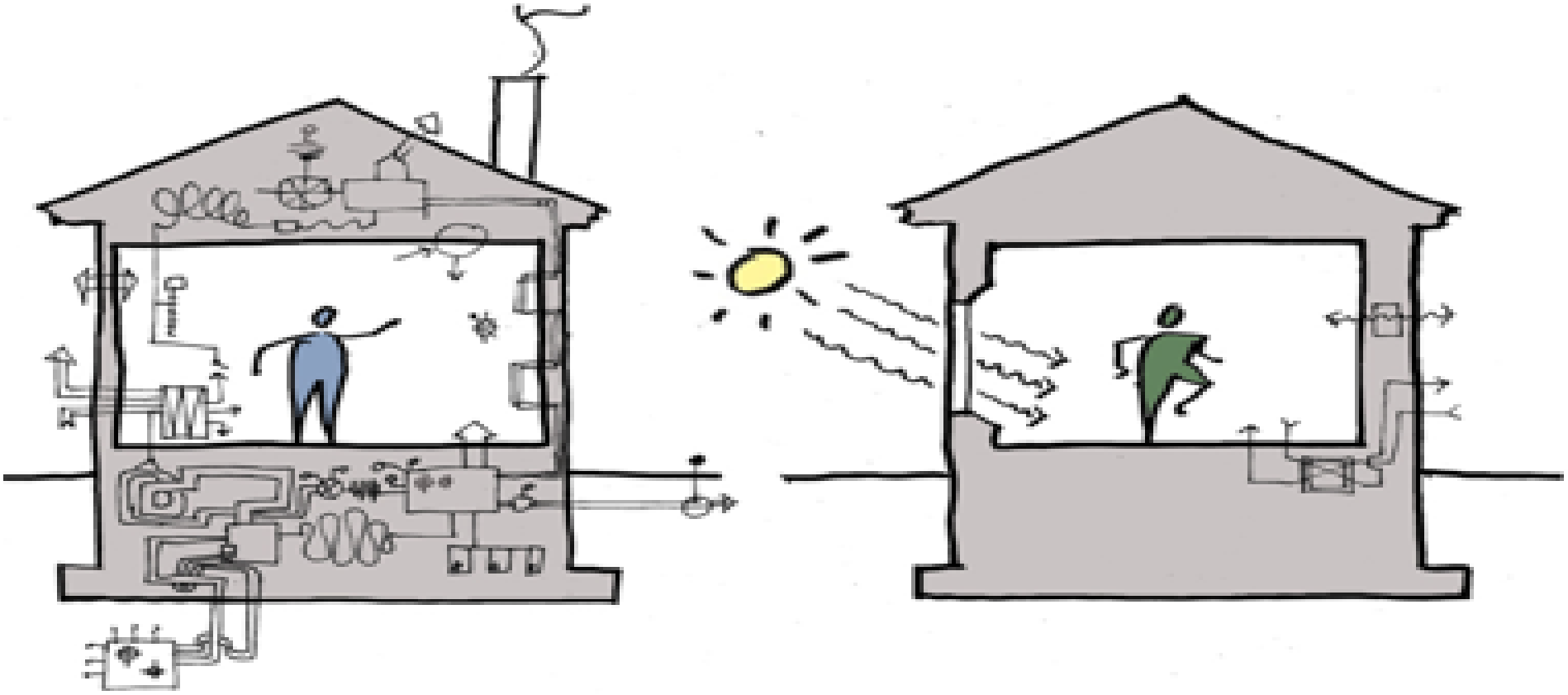
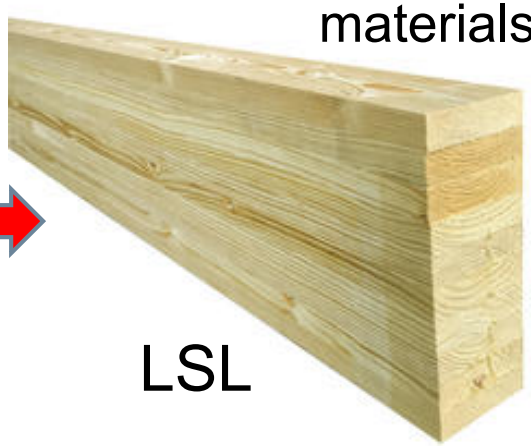
Passive House Moves Toward Simplicity



Economic Opportunities for VT

Bio Mass and Bio Fuels are not the Answer

We could turn our forest into carbon sequestration materials



LSL

Wood Fiber insulation Boards

Instead of

Pellets

=

$+CO_2$

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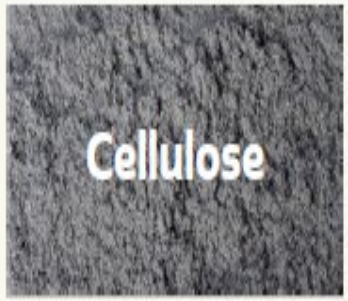
There are lots of plant-based carbon-storing building materials



Materials with negative embodied energy that can have a serious impact in reducing GHG emissions

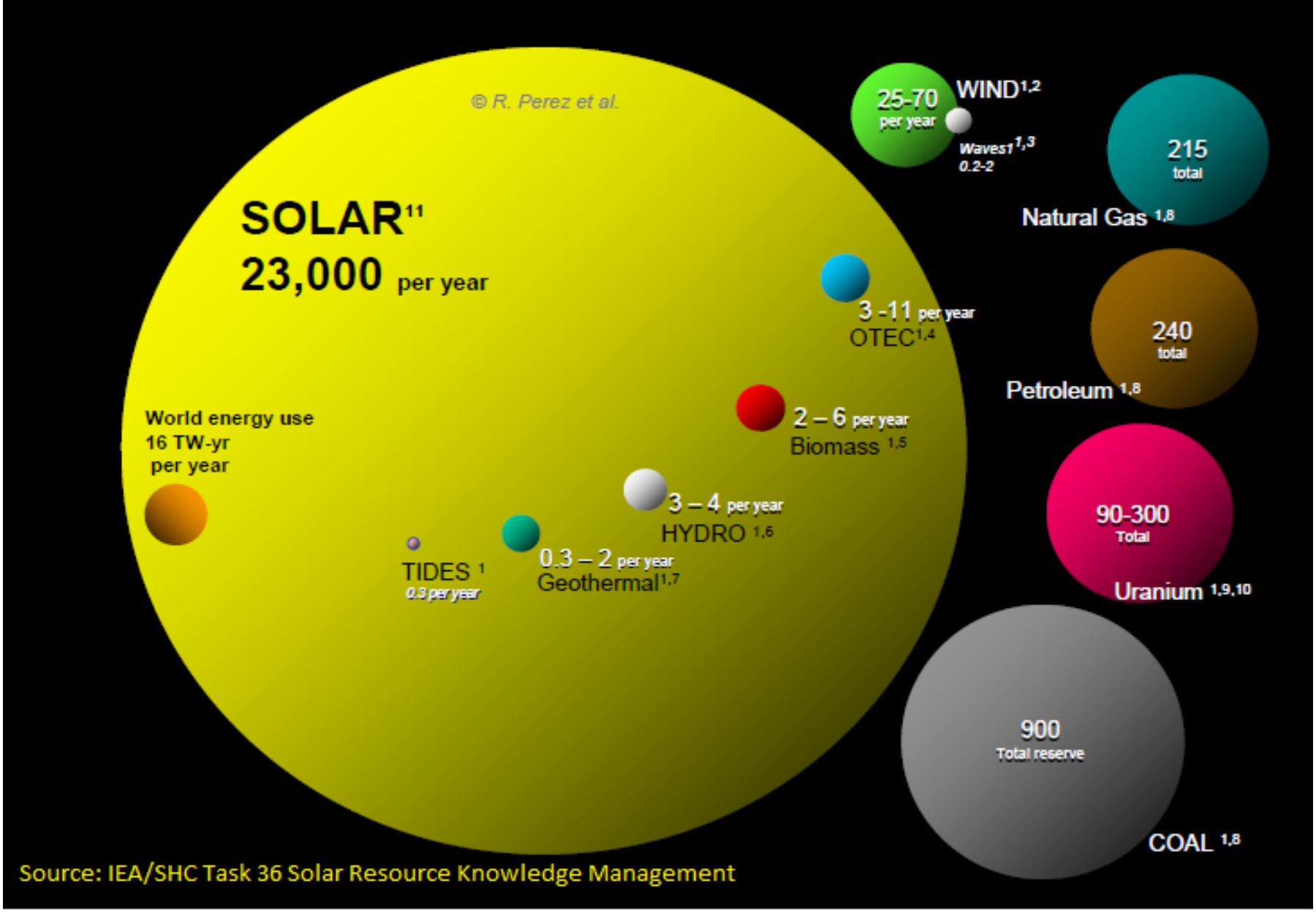


Figure 1: Comparing finite and renewable planetary energy reserves (Terawatt-years). Total recoverable reserves are shown for the finite resources. Yearly potential is shown for the renewables.

What We Have and What We Lack

- We have the science

- We have the craftmanship

- We have of shelf materials and components

- **We lack legislation !**

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VT Legislature's URGENT MISSION

VT Legislature must act now to reduce the energy waste and CO2 emissions related to buildings by:

1) Enacting legislation to require builders and contractors' registration

2) Requiring builders and contractors' certification

3) Boldly and immediately upgrading the VT building code RBES to Passive House levels of energy and carbon reductions

4) Designate an authority to enforce the newly adopted building code

5) Designate an authority for work verification

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Recommendation: Edit 9 (F)

F) … the planning and design of the subdivision or development reflect the principles of energy conservation, including reduction of greenhouse gas emissions from the use of energy **and high embodied energy building materials…**
…An applicant seeking an affirmative finding under this criterion shall provide evidence that the subdivision or development complies with the applicable building energy standards **of Passive House or DOE ZERH programs, which supersede the stretch code for residential buildings.**

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Hazard Mitigation and Climate Adaptation

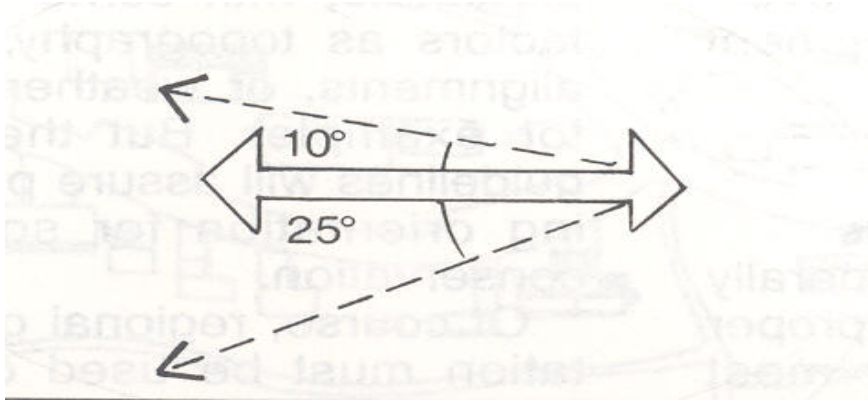
- VT's most common impact of extended power outages, from our summer and winter storms
- VT Dept of Health info on mortality increasing with extreme heat events
- *Combine those two bullets, with the thought of several days without power*
- We need comfortable buildings, providing for passive heating and cooling!

Encourage landscaping as a tool to maximize energy efficient heating and cooling

Street layout to maximize solar access

- In Vermont, the best street orientation, to maximize southern exposure for building design, is east-west

- This may have the greatest influence on -- sets the framework for -- lot and building layout.



Recommendation: Edit 9(M)

(M) Climate adaptation. The development or subdivision will employ building orientation, site and landscape design, and building design to maximize passive heating and cooling ~~and that are~~ sufficient to enable the improvements to be sited and constructed, including buildings, roads, and other infrastructure, to withstand and adapt to the effects of climate change, including extreme temperature events, wind, and precipitation reasonably projected at the time of application.

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Thank you

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Because we care about you saving money and living healthy, and care about the environment, our legacy and our future, we design and build

energy efficient buildings.

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Enrique Bueno - ebueno@eplusbuildings.com

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