US building impacts

72% electricity consumption

39% energy use

38% CO_2 emissions

40% raw materials

30% waste output

14% potable water use

US building impacts

72% electricity consumption

39% energy use

38% CO_2 emissions

40% raw materials

30% waste output

14% potable water use

BLUPATH

INSPIRING DESIGN
FOR PLACES TO THRIVE

LAURA BLAU AIA, LEED BD&C® AP
CPHC (Certified Passive House Consultant)
CPHB (Certified Passive House Builder)
CPHD (Certified Passive House Designer-pending)
Principal-in-Charge

Woman-owned, award winning architecture and design firm focusing on high-performance building design.

blupath.us

Certified WBENC Women's Business Enterprise

MISSION:

The Greater Philadelphia Passive House Association

Is dedicated to making Passive House design and construction

a mainstream practice.

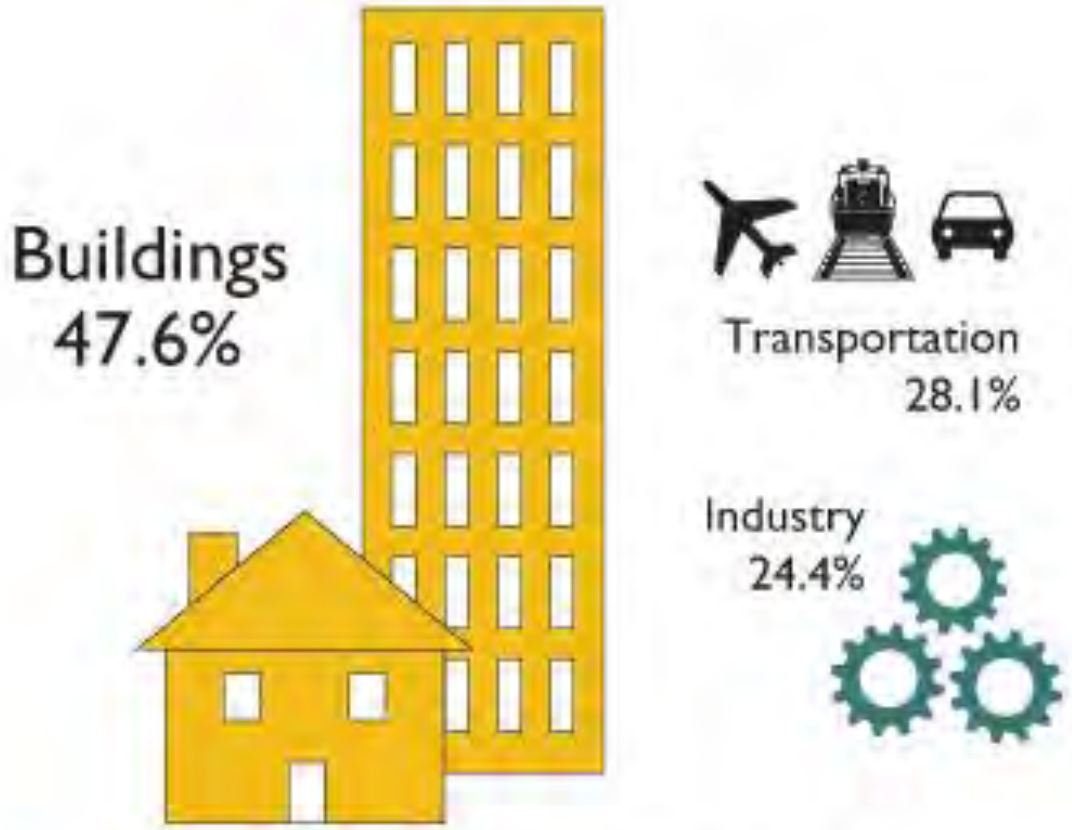
LEARNING OBJECTIVES

1. Learn how passive technologies and the ‘whole-building’ approach can be implemented to achieve high performance buildings.
1. Discover the financial advantages of conservation-driven design over traditional efficiency approaches, particularly for fixed income constituents.
2. Understand the advantages of Passive House Certification and how it can be applied or used in combination with other green building certifications.
3. Appreciate the health, acoustic and comfort advantages of Passive House designed projects.

AGENDA

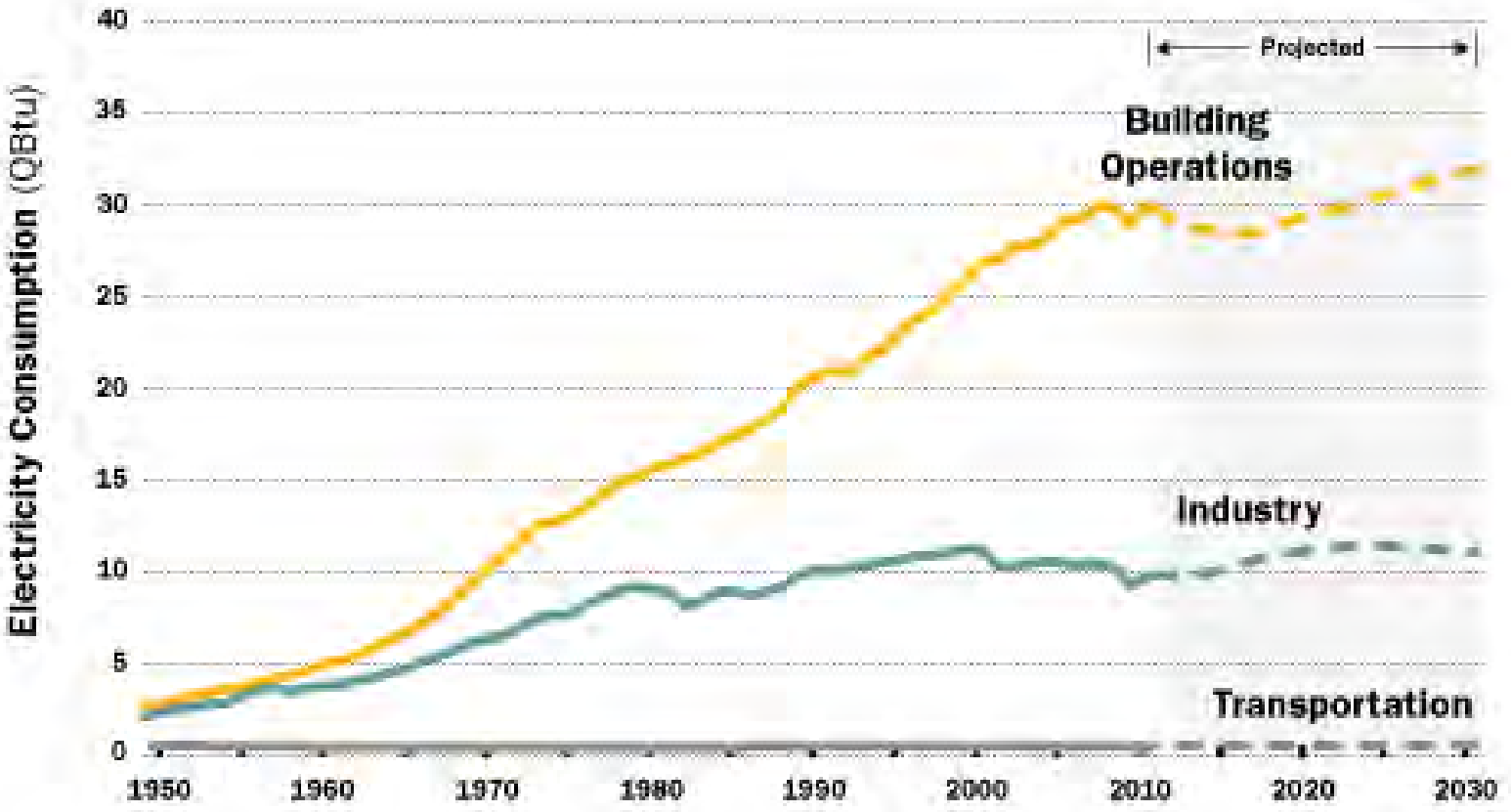
1. Set the stage: Building's global role.
2. Bust some Passive House myths.
3. Explain the Passive House Standard.
4. Understand how to implement and optimize energy savings in Multi-family projects.
5. Remind us of the big picture.
6. Discussion and Q & A.

Energy Consumption



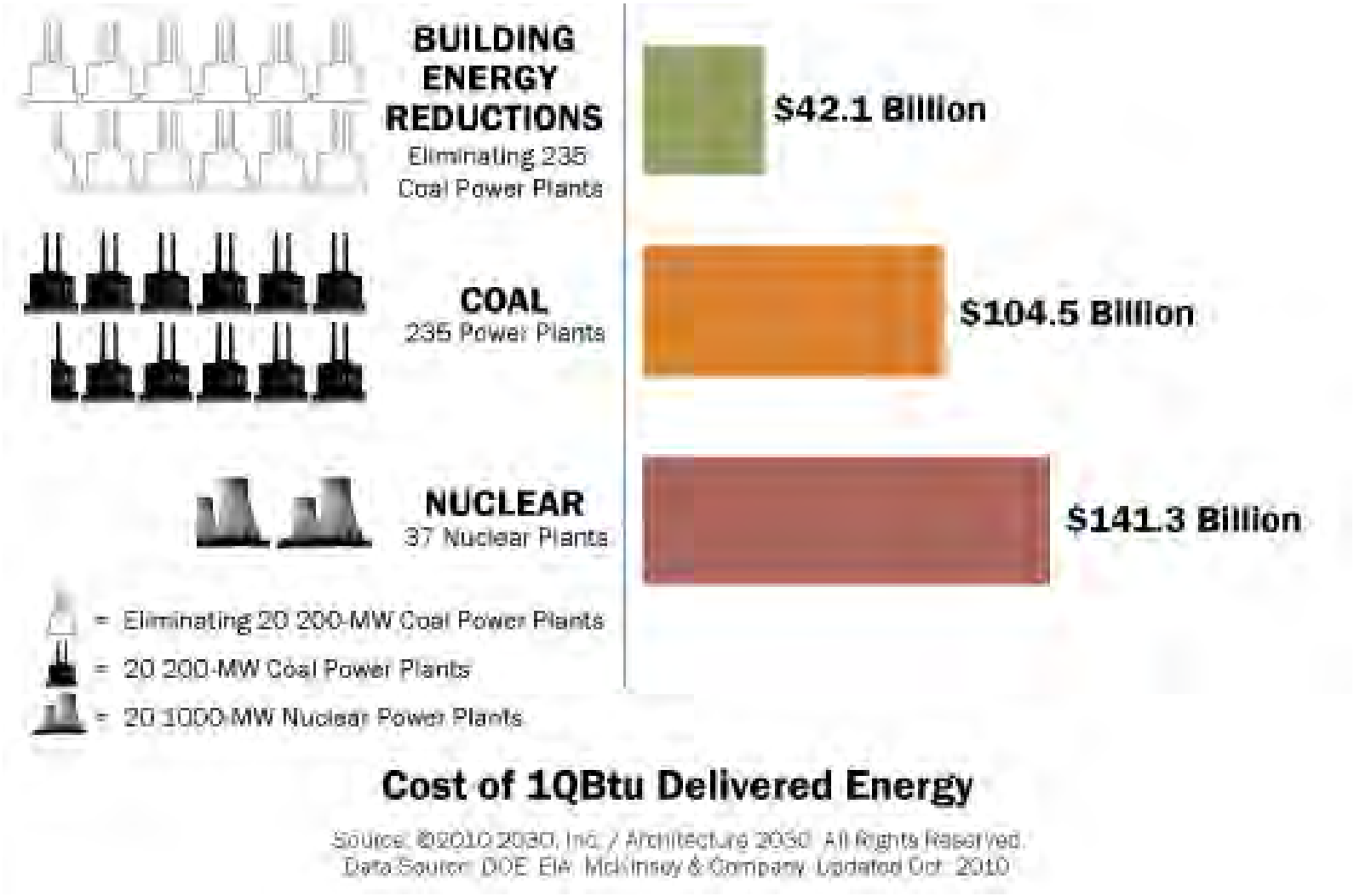
U.S. Energy Consumption by Sector

Data Source: U.S. Energy Information Administration (2012).

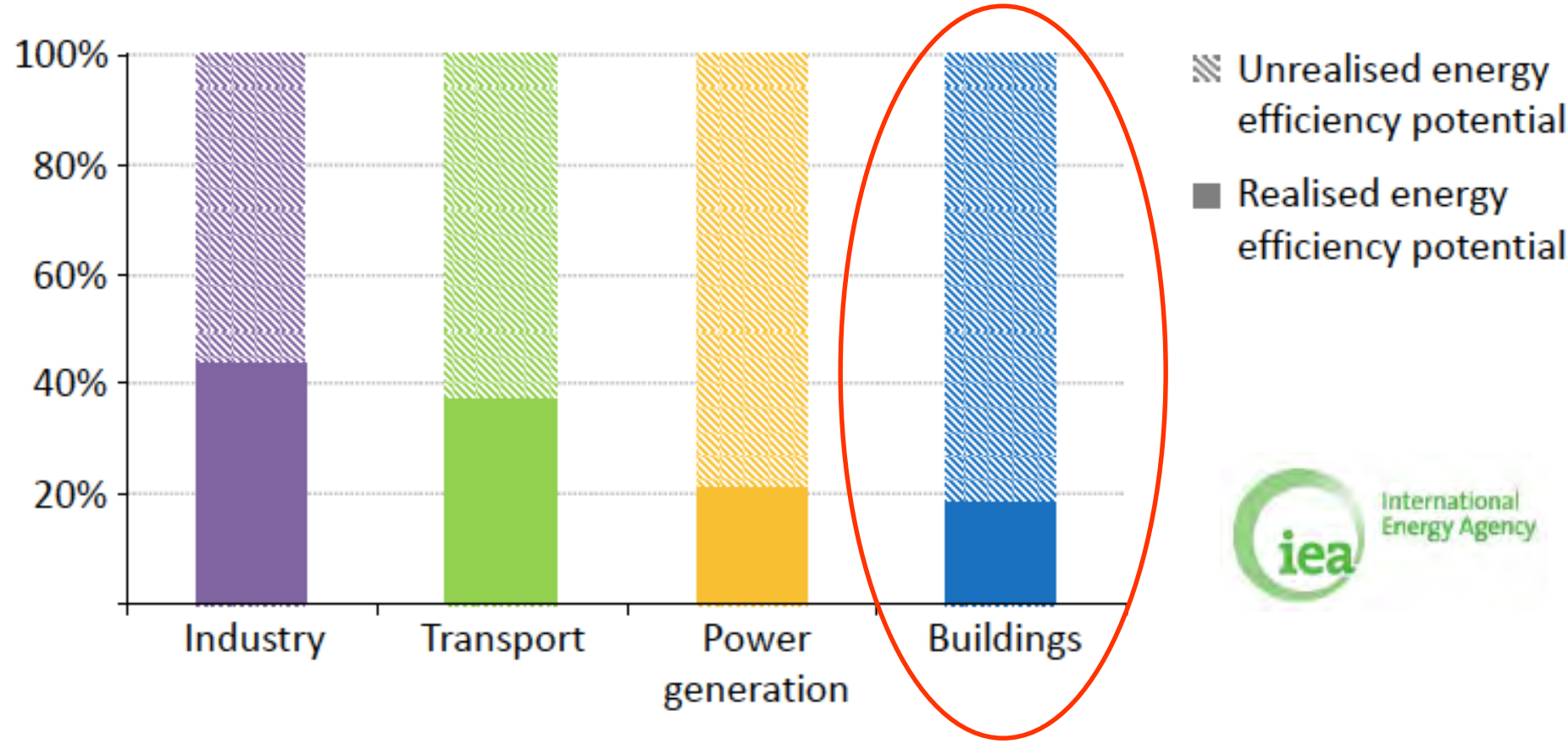


U.S. Electricity Consumption by Sector (Historic / Projected)

Data Source: U.S. Energy Information Administration (2012).

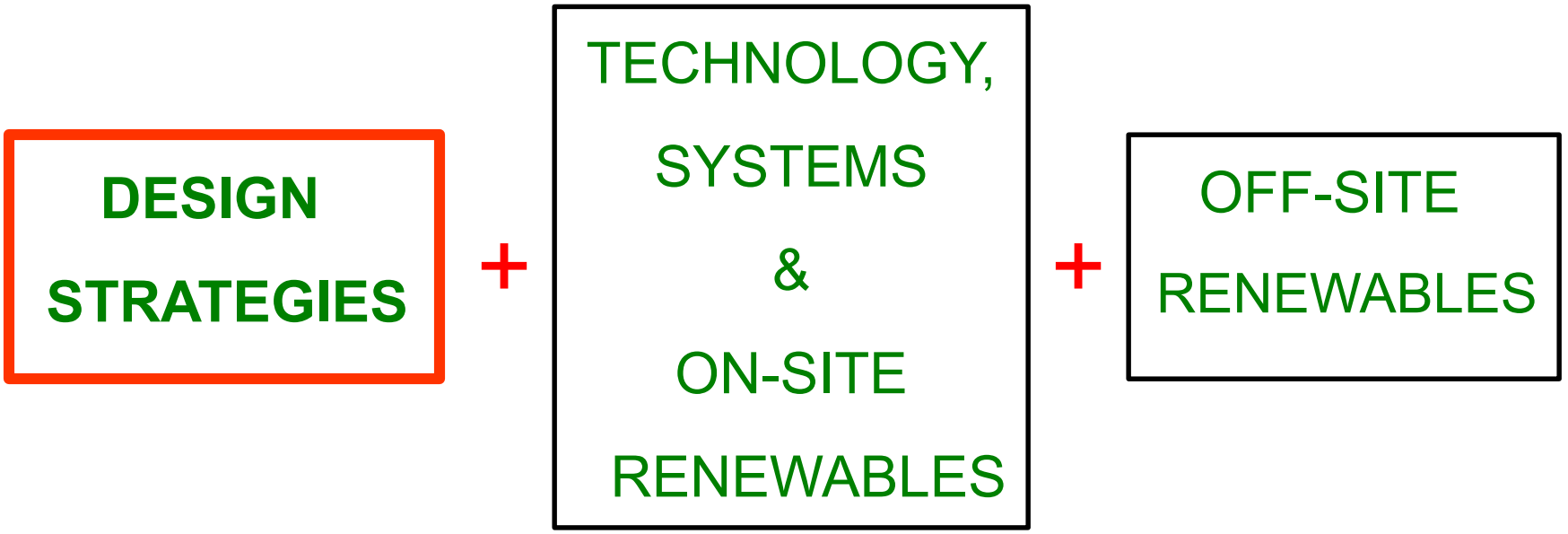


EFFICIENT BUILDINGS ARE **LESS EXPENSIVE** THAN POWER PLANTS

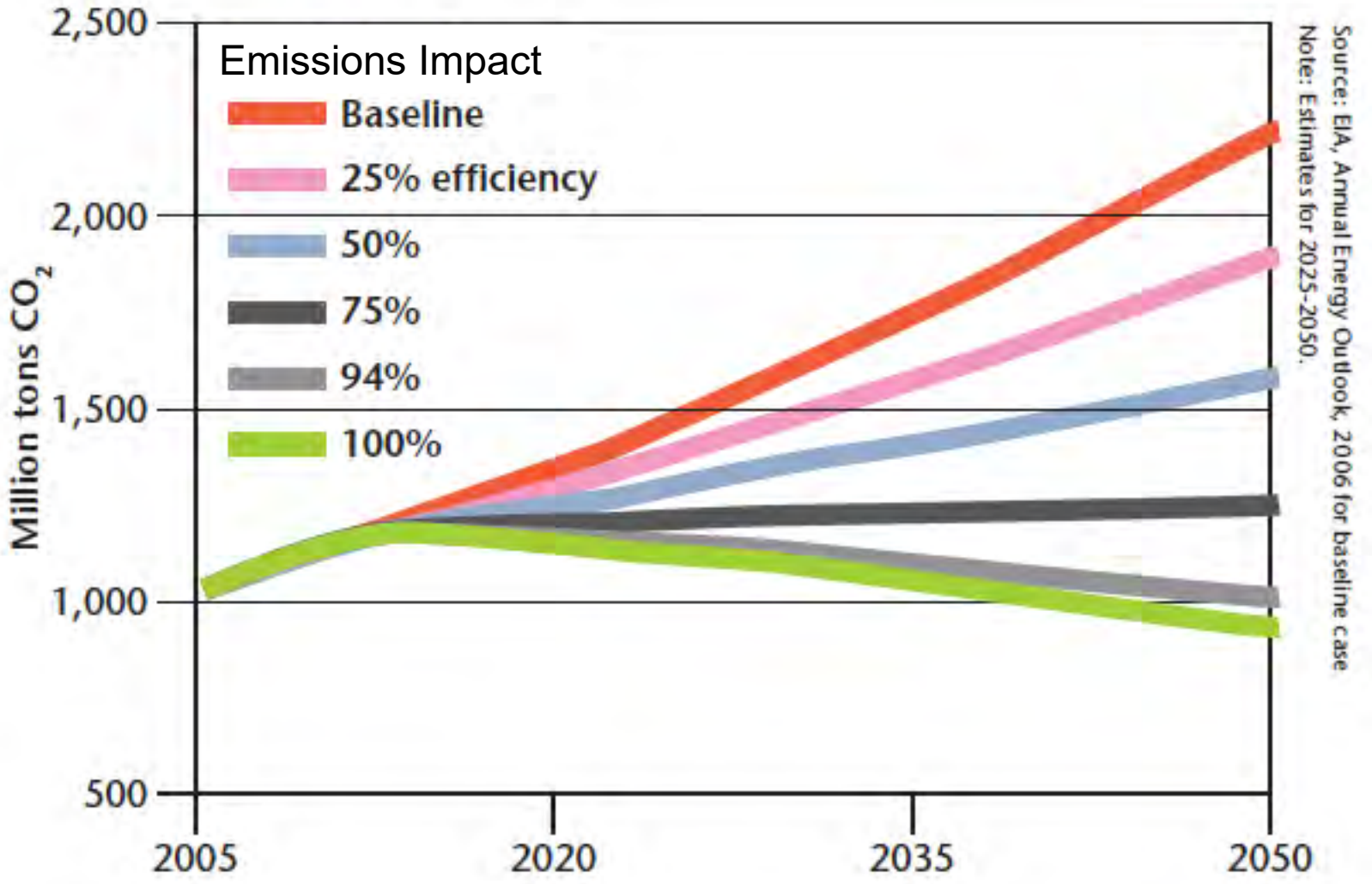


THE BUILDING SECTOR OFFERS THE
GREATEST OPPORTUNITIES
TO REALIZE ENERGY SAVINGS

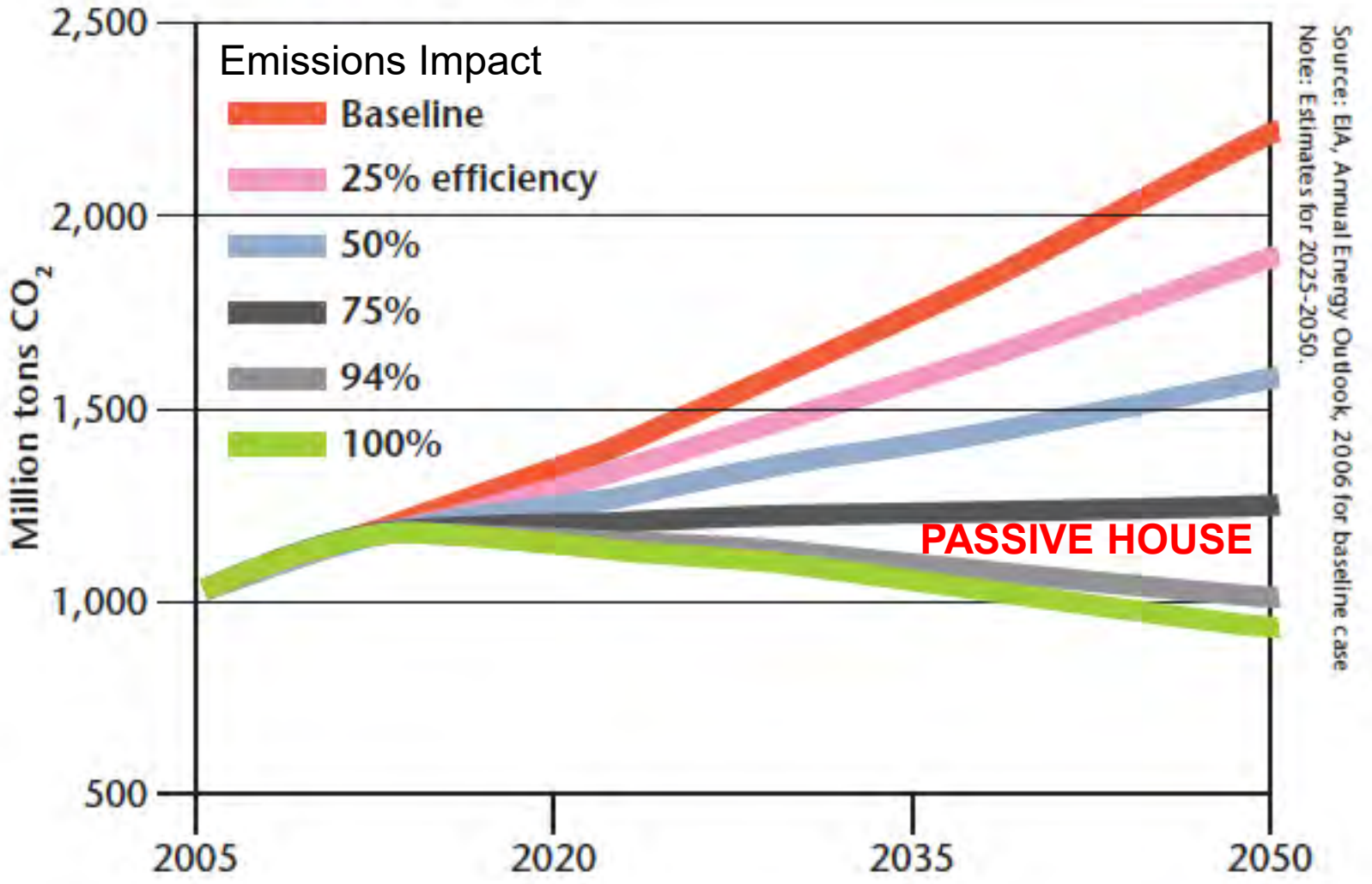
MEETING THE CHALLENGE



THE SCALE OF THE BUILDING ENERGY CHALLENGE



THE SCALE OF THE BUILDING ENERGY CHALLENGE



What is Passive House?

(PassivHaus)

Passive Solar
Used
15,600 kWH/yr

Passive House
Used
116 kWH/yr
99% less for heating
84% less for cooling

Civic House Feasibility Study

University of Pennsylvania

NORTH AMERICA 1970'S

Lo-Cal House

+

PHI - Germany 1990

WUFI PASSIVE

PHIUS 2012


BROWNSTONE RENOVATION
Brooklyn, NY
Prospect Architecture, Architect

Transformer Townhome

MULTI-FAMILY & SENIOR HOUSING
Philadelphia, PA
BluPath, Architect


MULTI-FAMILY MIXED USE
Philadelphia, PA
Onion Flats, Architect


MULTI-FAMILY SENIOR RESIDENCES
Brooklyn, NY
Chris Benedict, Architect


TERRAHAUS STUDENT RESIDENCE
Unity College, Unity ME
GO Logic, Architect

MCKEESPORT YMCA, ACTION-HOUSING
Pittsburgh, PA
Thoughtful Balance, Architect


FUTURE HOUSE MULTIFAMILY PROJECT
Changzhou, China
Ludwig Rongen, Architect


MIXED USE HIGH RISE
Nantong China
Ludwig Rongen, Architect

Science based

Conservation focused

Better built

Cost effective

=

SMART DESIGN

Efficient, comfortable, healthy

ZEC - Zero Energy Capable

BUILDING ENVELOPES CHANGE

BUILDING SYSTEMS CHANGE

Paradigm Shift

Coffee Analogy #1

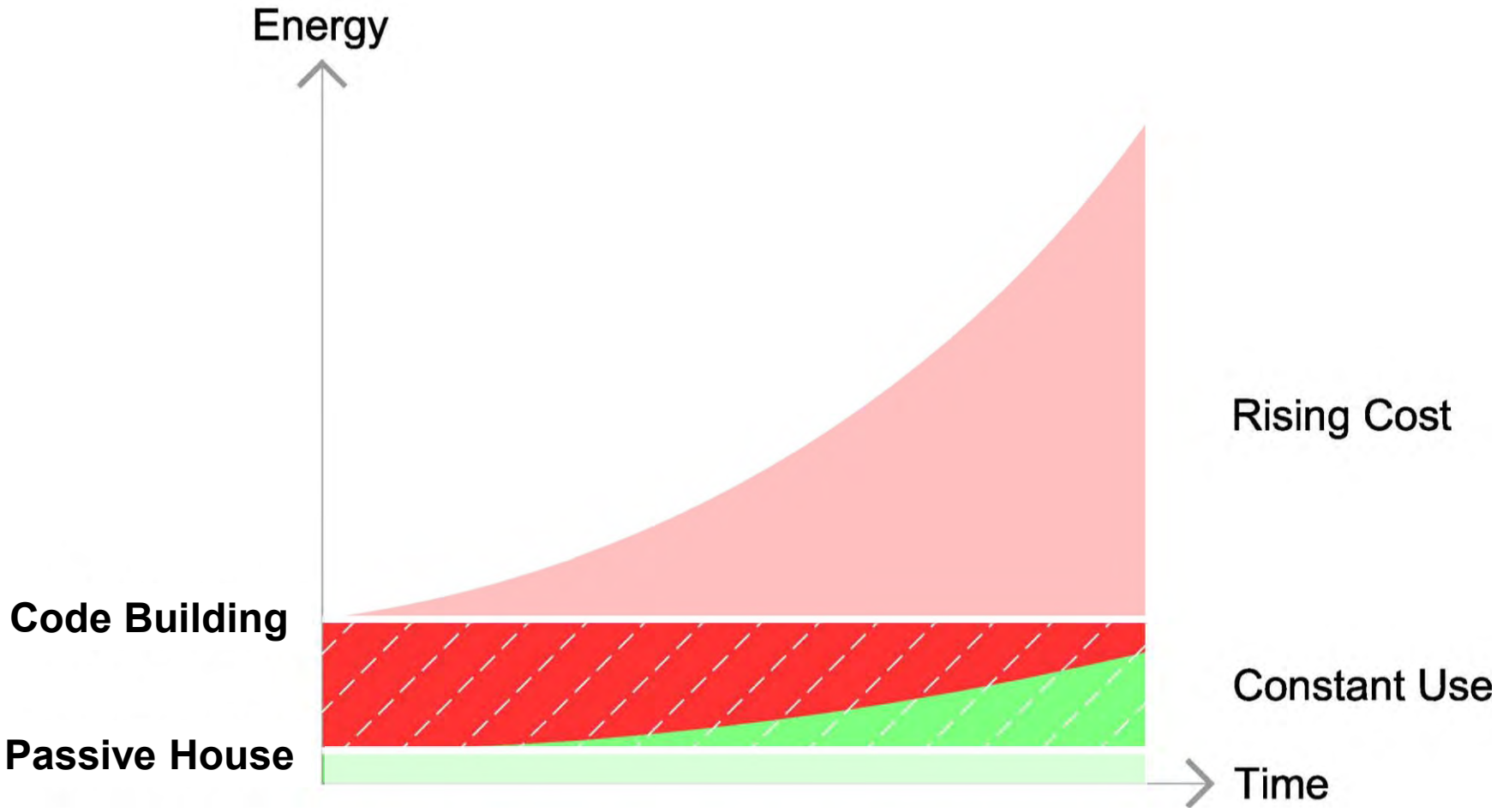
Energy Star

Passive House

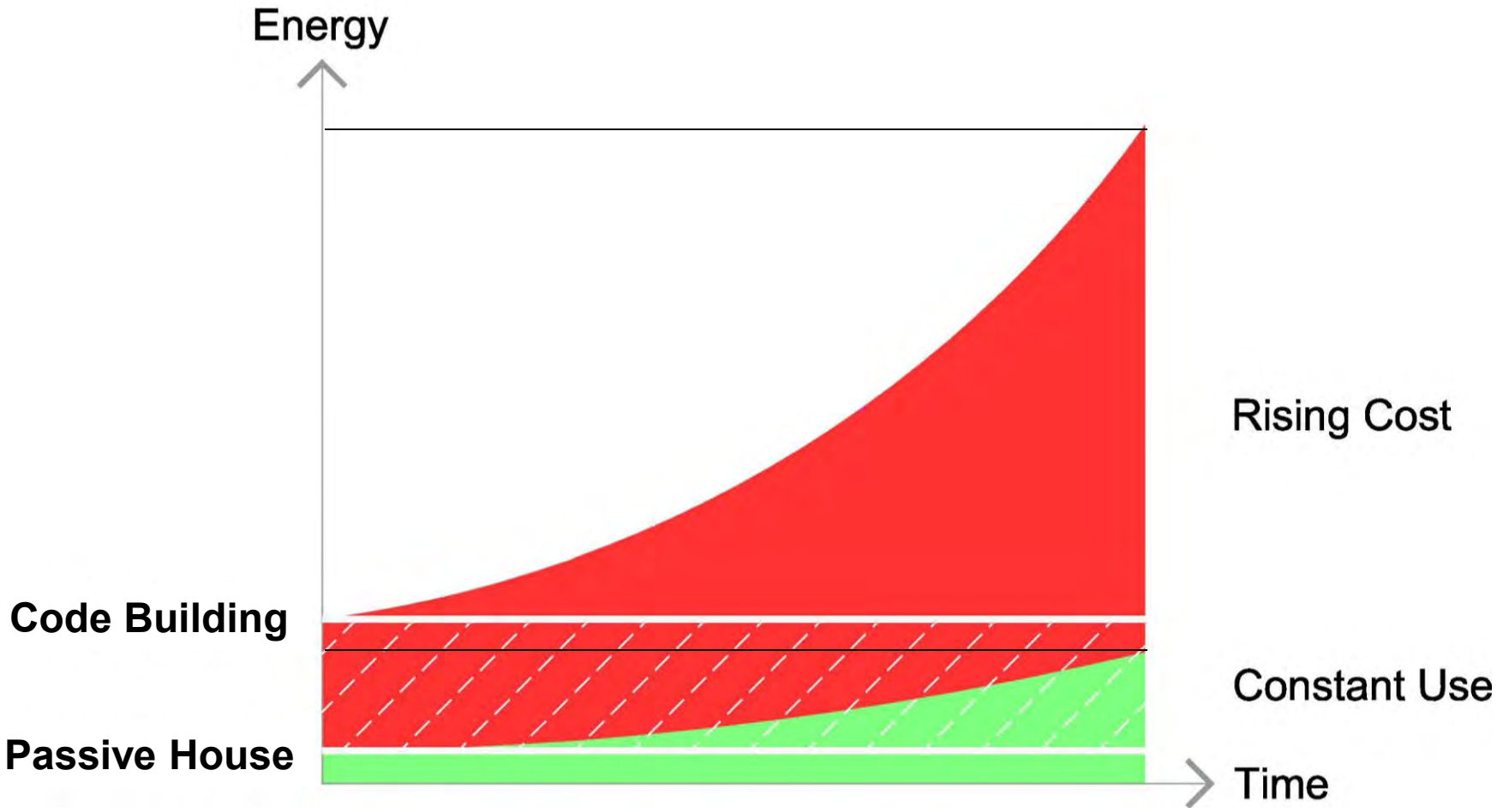
Coffee Analogy #2

Standard

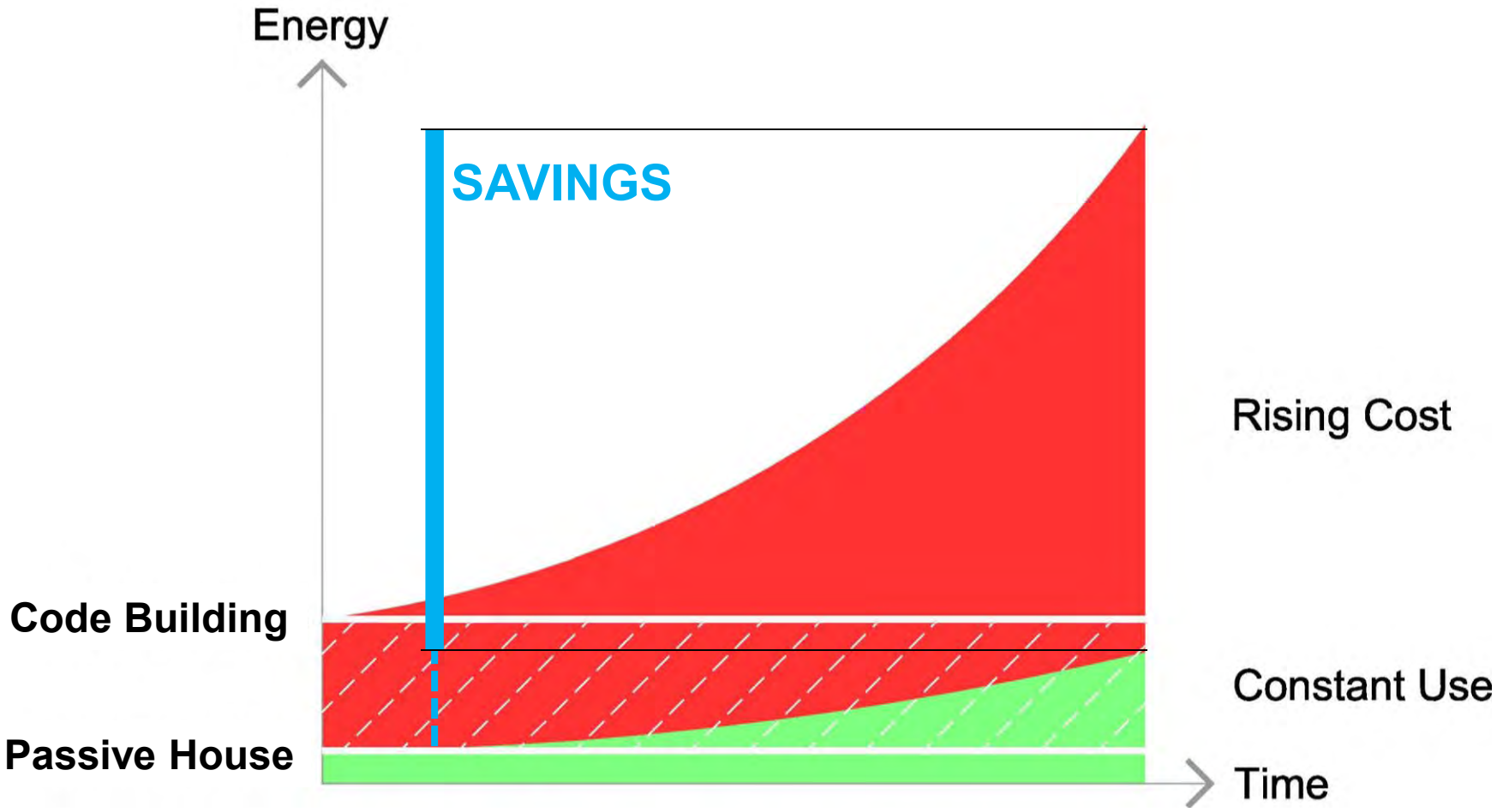
Passive House



Energy Savings Over Time



Energy Savings Over Time



Energy Savings Over Time

BENEFITS BEYOND ENERGY SAVINGS

LABOR IS LOCAL

PEOPLE POWER IS A RENEWABLE RESOURCE

Contributes to the local economy

BENEFITS BEYOND ENERGY SAVINGS

LONG TERM VALUE

ENVELOPE IS PERMANENT TO THE BUILDING

Less or smaller mechanical equipment

Lower O&M costs

BENEFITS BEYOND ENERGY SAVINGS

LOWER RISK – MORE DURABLE

Studies show
most envelope failures
are from air leakage and
thermal bridging

BENEFITS BEYOND ENERGY SAVINGS

HIGHER PRODUCTIVITY

More comfortable,
healthier indoor air quality
higher user satisfaction

BENEFITS BEYOND ENERGY SAVINGS

MORE FUTURE-PROOF – SURVIVABLE

Mitigates issues surrounding

extreme weather

global energy

&

material

availability, cost and scarcity


Passivhaus
Institut


PHIUS
Passive House Institute US


EnerPHit
Certified
Retrofit
Passive House Institute
CERTIFIED
COMPONENT
Passive House Institute
CERTIFIED
PASSIVE HOUSE
TRADESPERSON
TRADESPERSON


PH
PH
CERTIFIED
BUILDER
PH
PHIUS+
RATER

‘Gas Mileage Standard’

for a building

Passive House certification- CLASSIC

Meets rigorous performance standards

Specific heat and cooling demand

<4.75 kBtu/sq ft/ year*

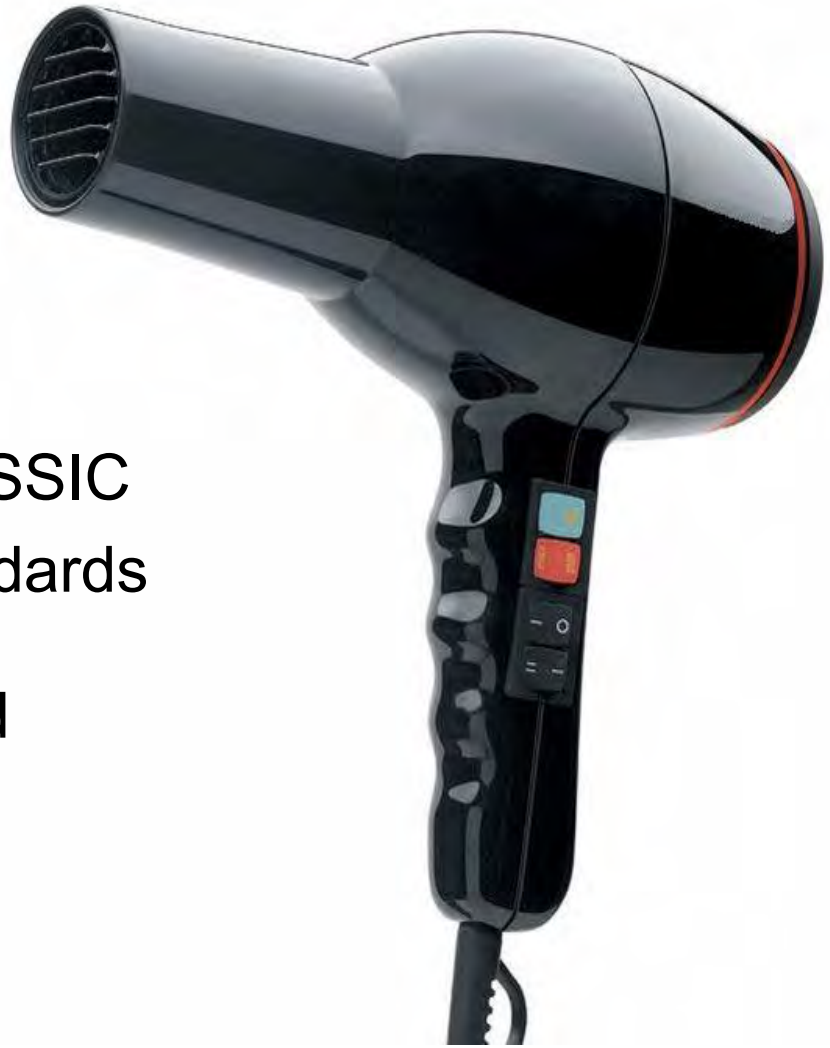
Air tightness

<0.6 ACH @ 50 Pa**

Specific primary energy demand

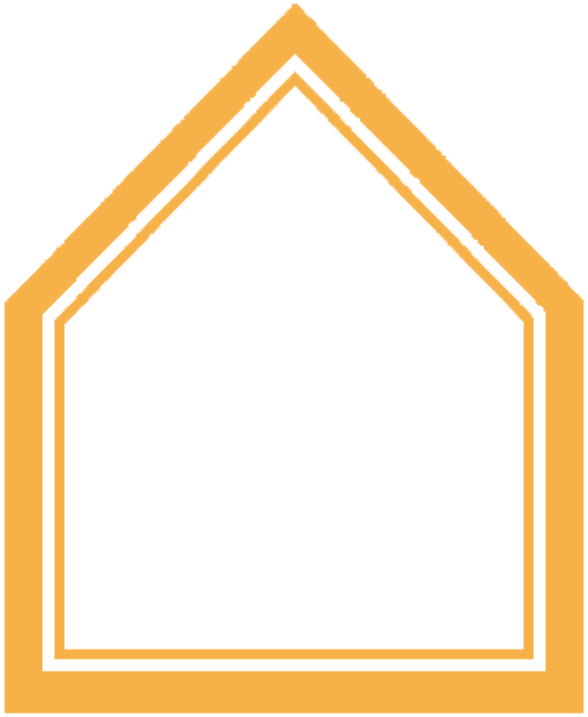
<38.1 kBtu/sq ft/ year***

NEW!: PHIUS+* ** *** PLUS*** PREMIUM***



x 5

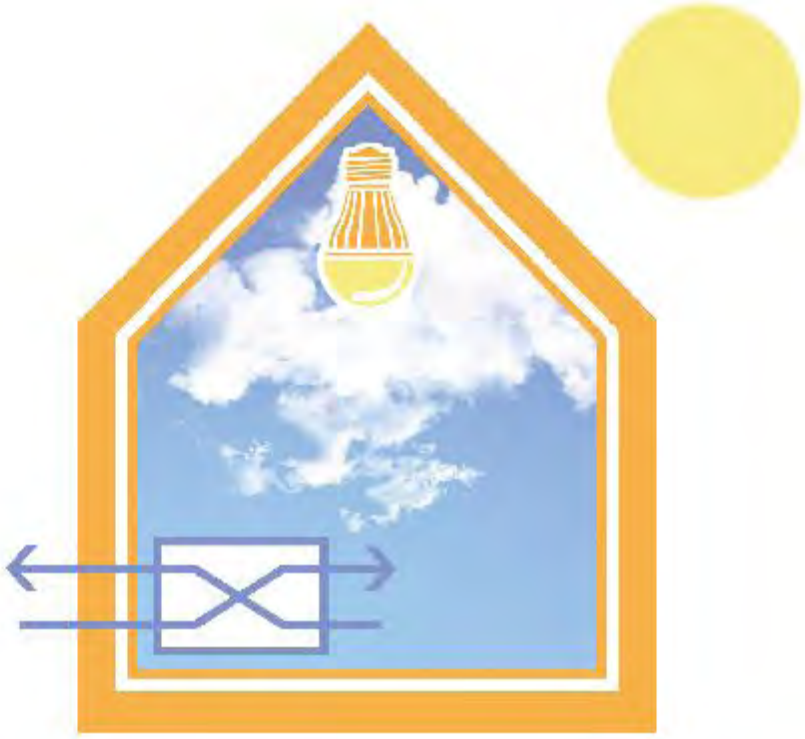
PASSIVE HOUSE CONCEPTS



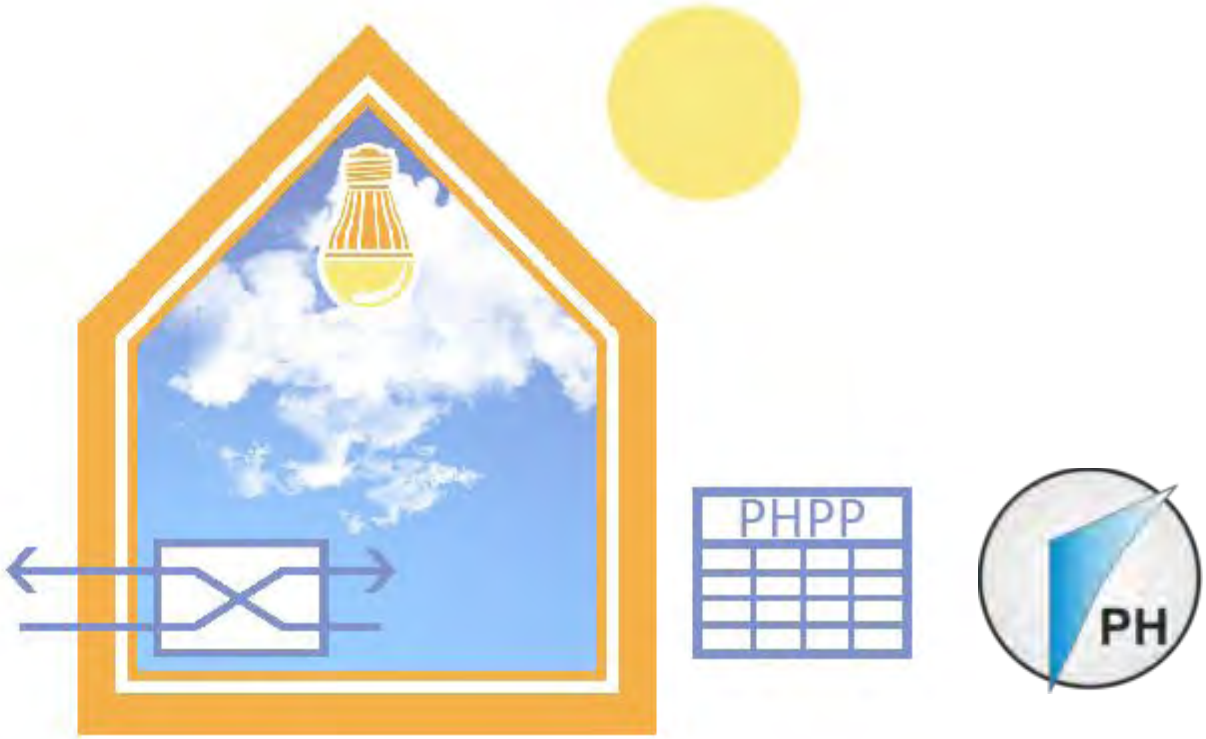
Super Insulated Air Tight Shell

Optimized Solar Energy

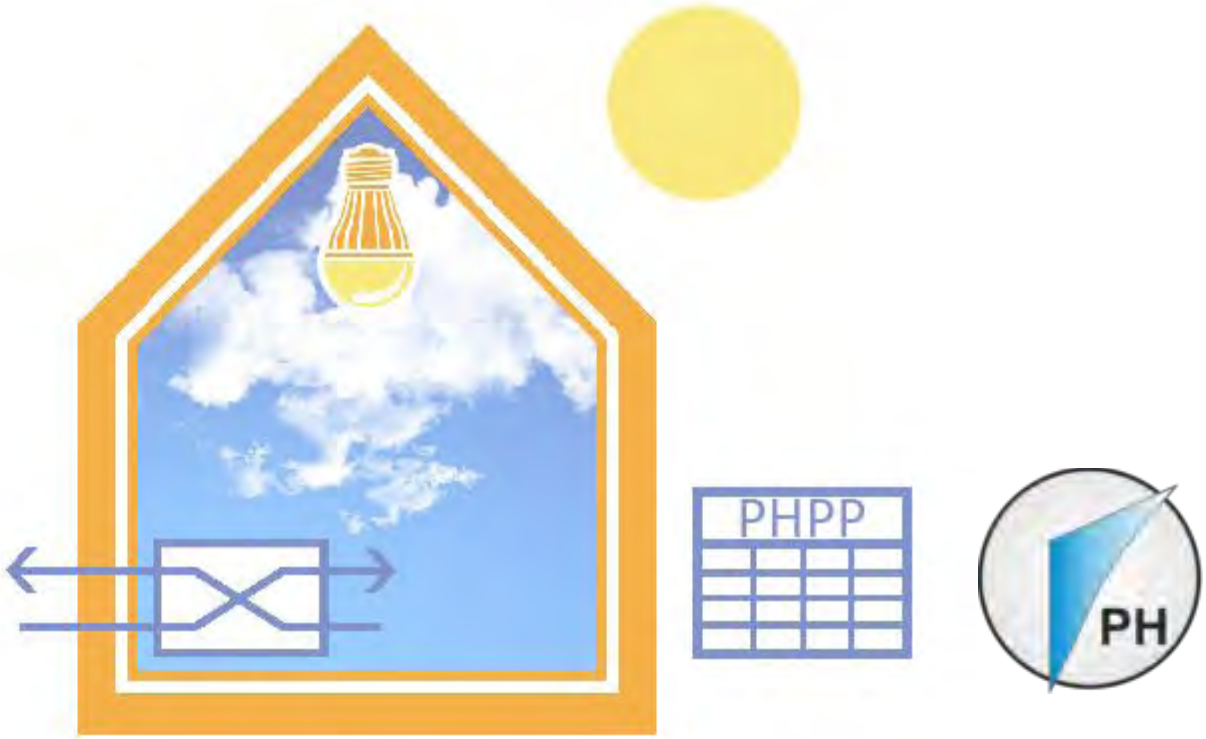
Continuous Ventilation



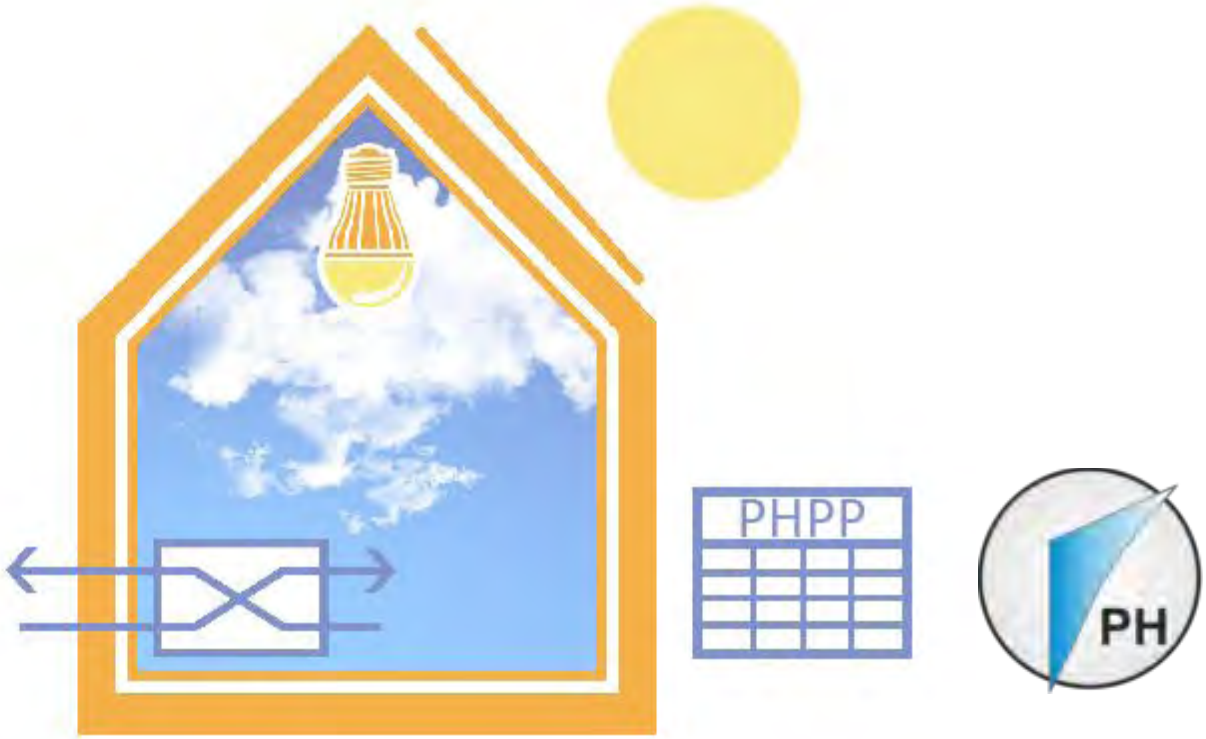
Efficient Appliances



Accurate and Proven Analysis

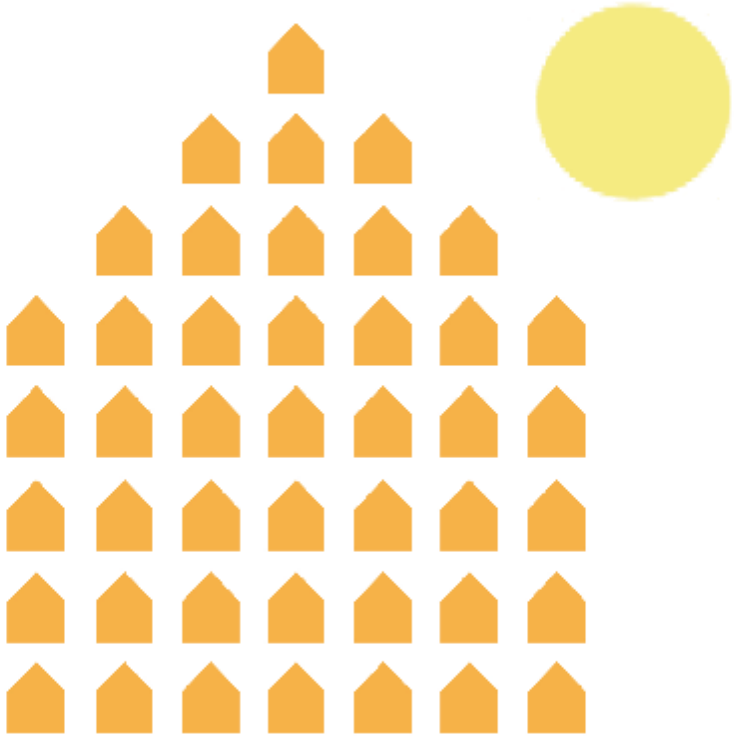


Accurate and Proven Analysis



Passive House + Solar Array* = Net Zero Energy

*PLUS, PREMIUM



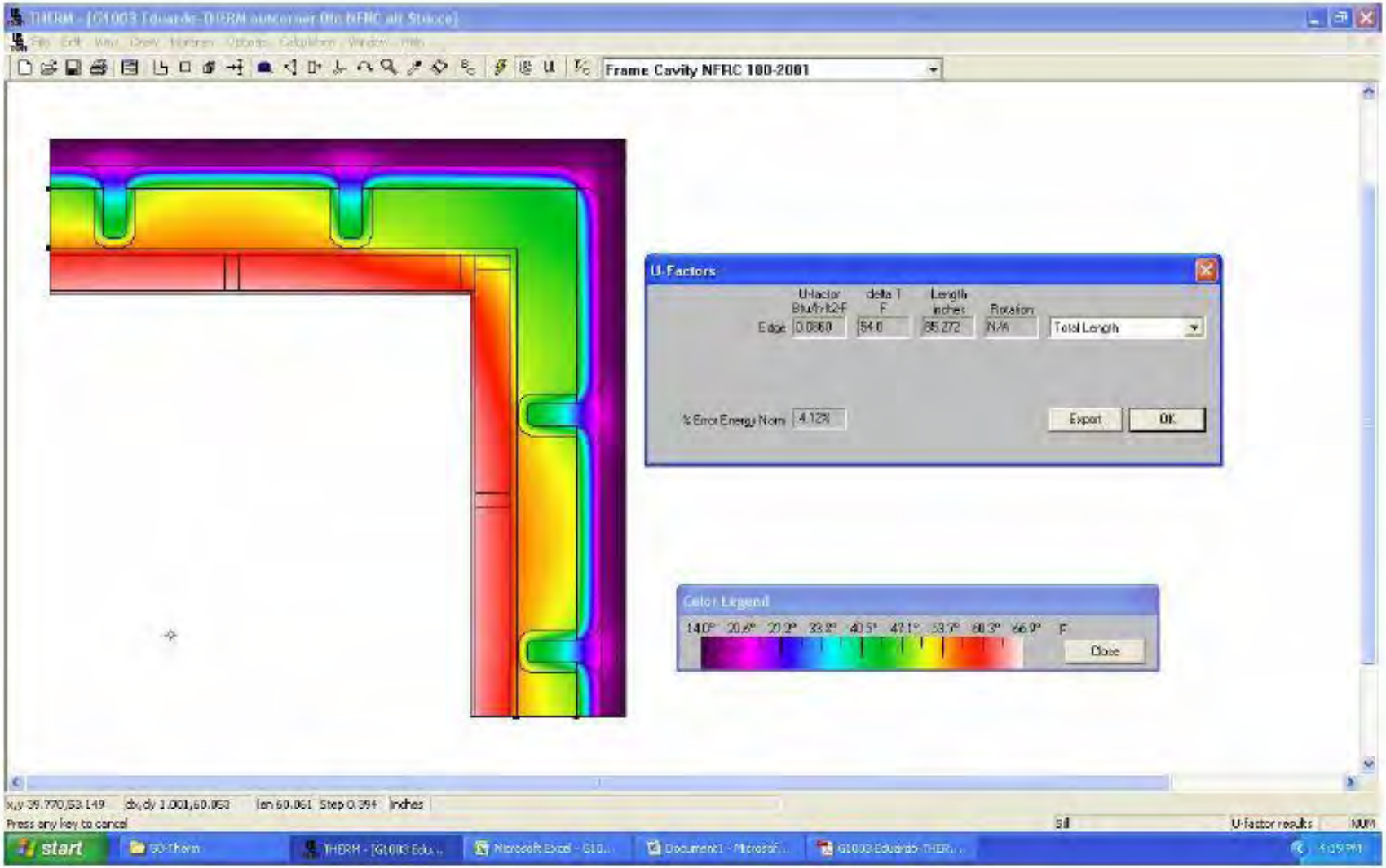
25 Years + ~~55,000~~ Units 2012

(ask us about Brussels 2015)

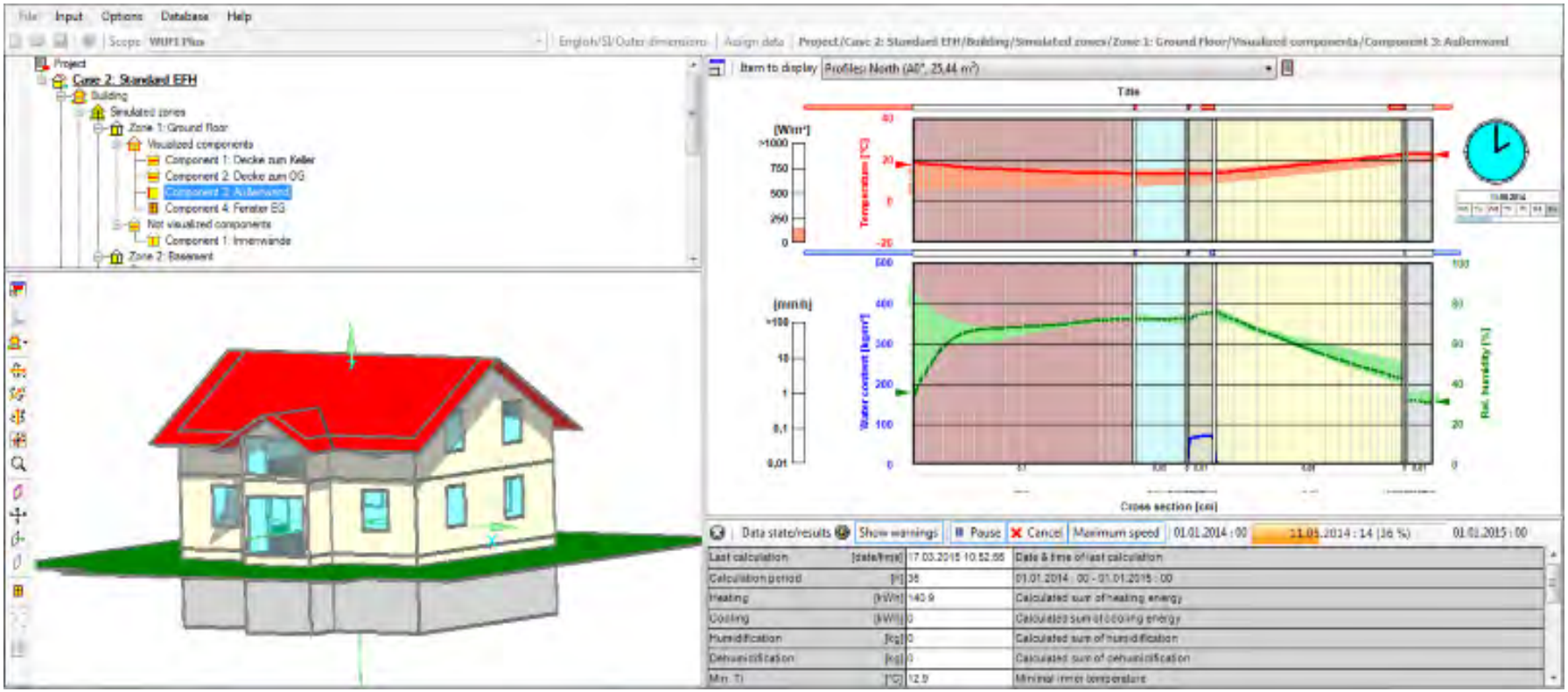
Typical building

Passive House

EFFICIENT



THERMAL MODEL
Assembly

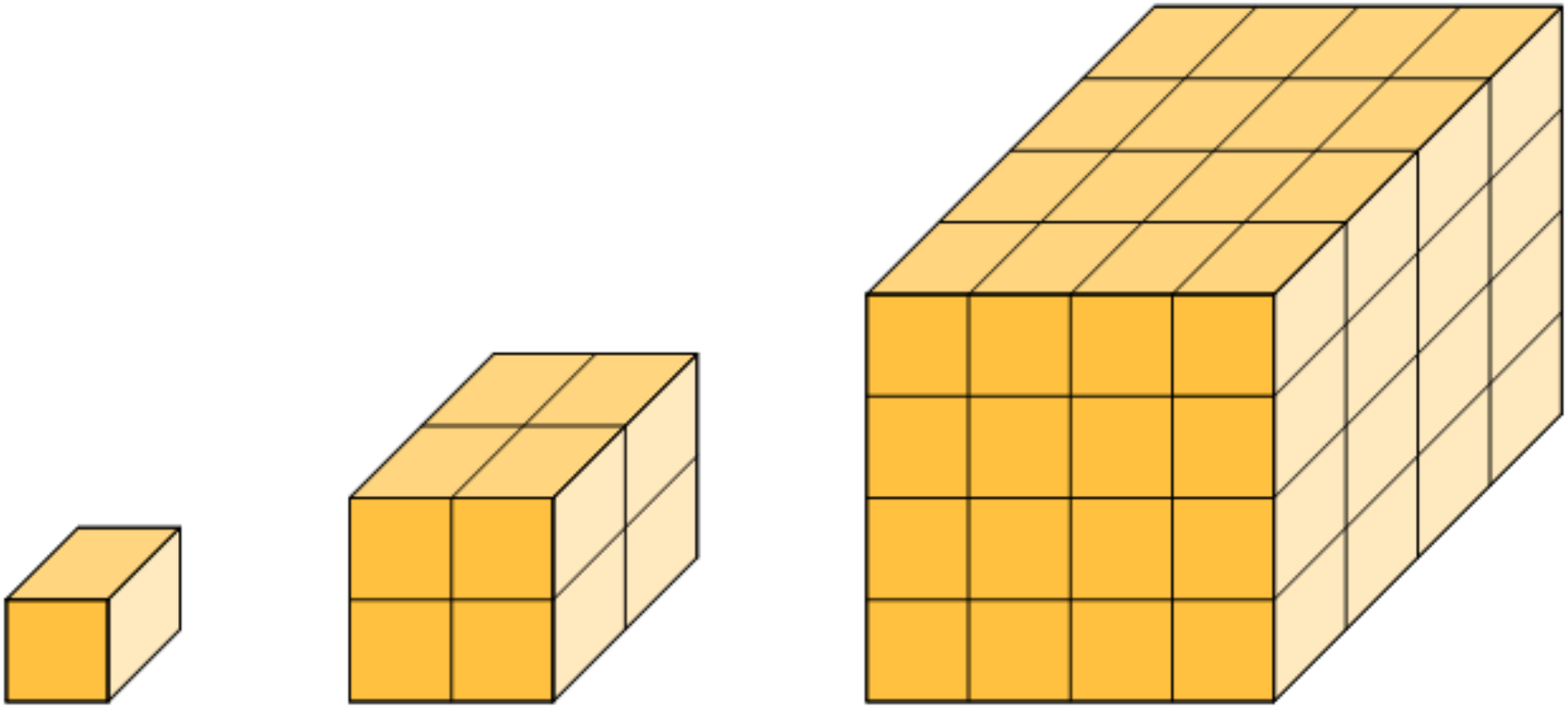


HYGROTHERMIC MODEL

Assembly

WHY IS PASSIVE HOUSE GOOD FOR BIGGER BUILDINGS?

SURFACE TO VOLUME RATIO



6 / 1 = 6

24 / 8 = 3

96 / 64 = 1.5

SURFACE TO VOLUME RATIO

LOWER IS BETTER

THE PASSIVE HOUSE THERMAL ENVELOPE

THERMAL BRIDGE FREE CONSTRUCTION

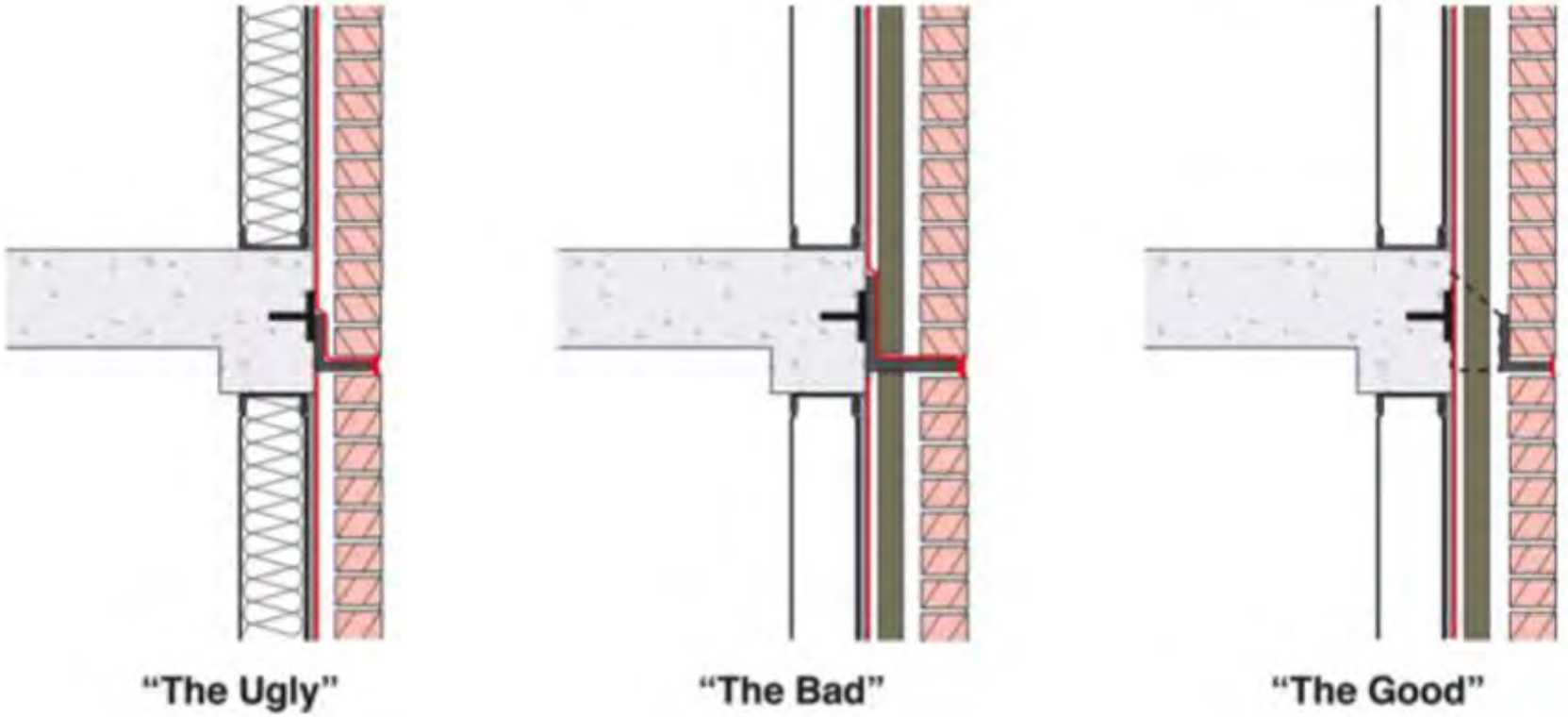
Foam Free is Better

Hydrophobic	drains & dries
Lightweight	long attachments/ brackets
Non Combustible	fire resistant
Flexible	cuts to size cuts around objects layers easily

THERMAL BRIDGE FREE CONSTRUCTION

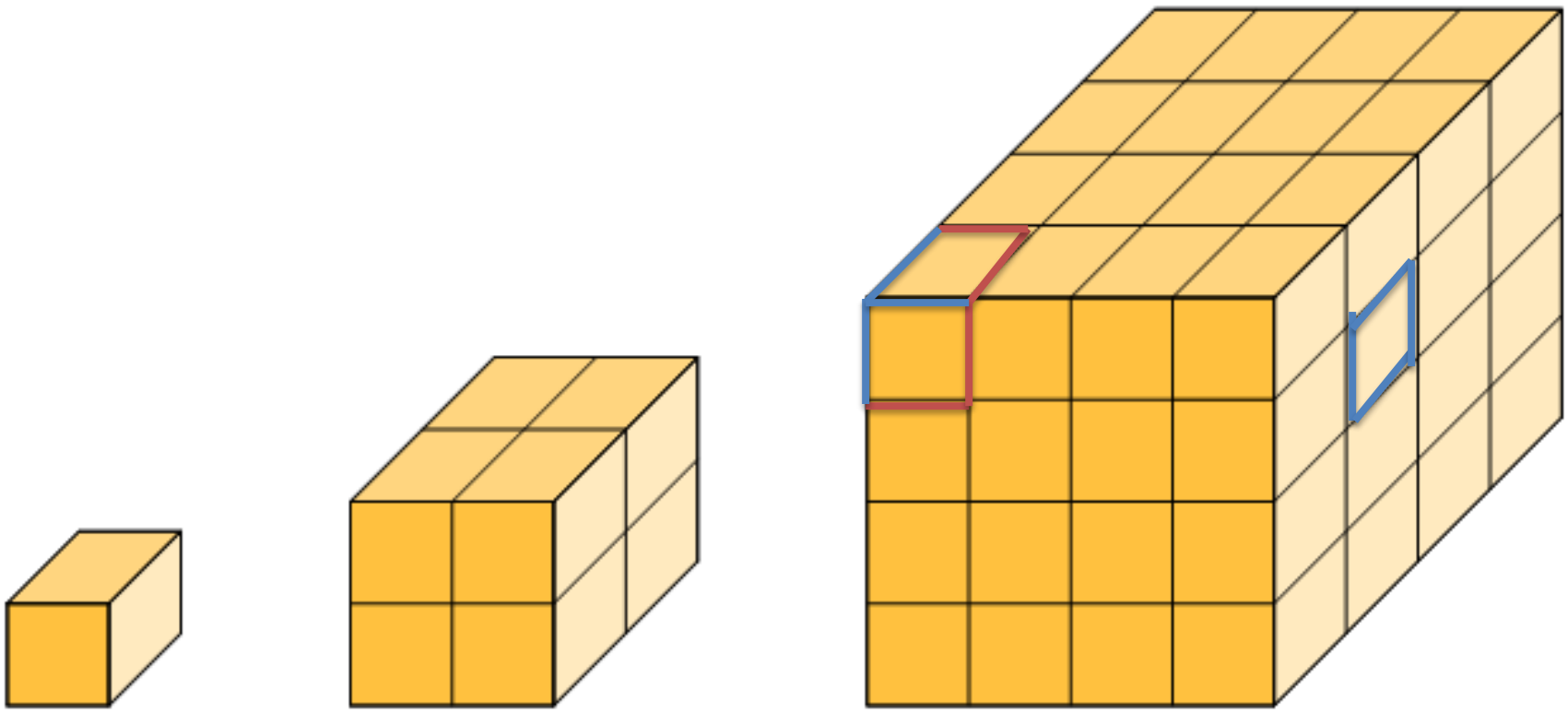
Foam Free is Better

Figure 9: Shelf-angle details: the Good, the Bad, and the Ugly



THERMAL BRIDGE FREE CONSTRUCTION

Mind your attachments



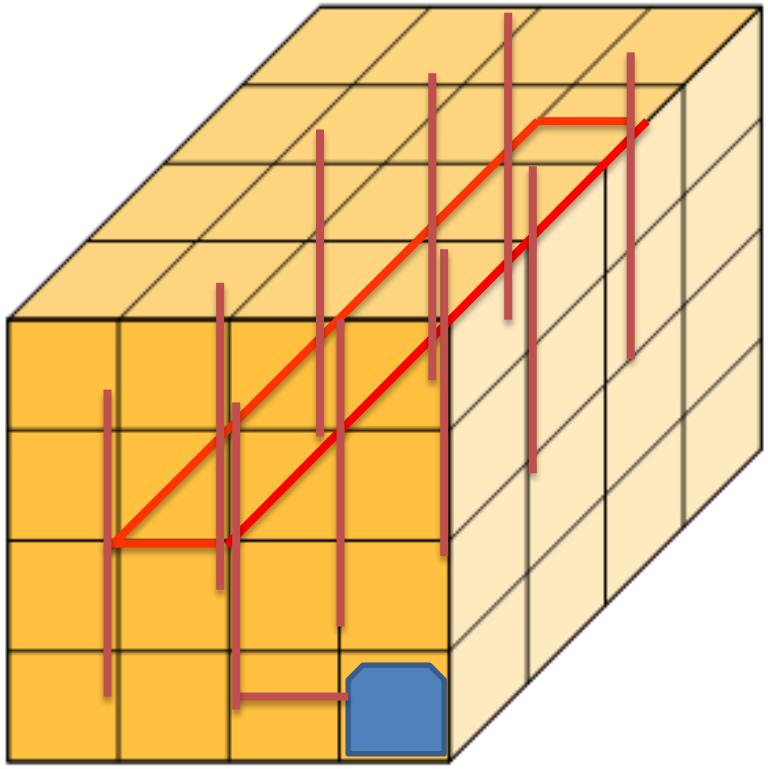
6 / 1 = 6

24 / 8 = 3

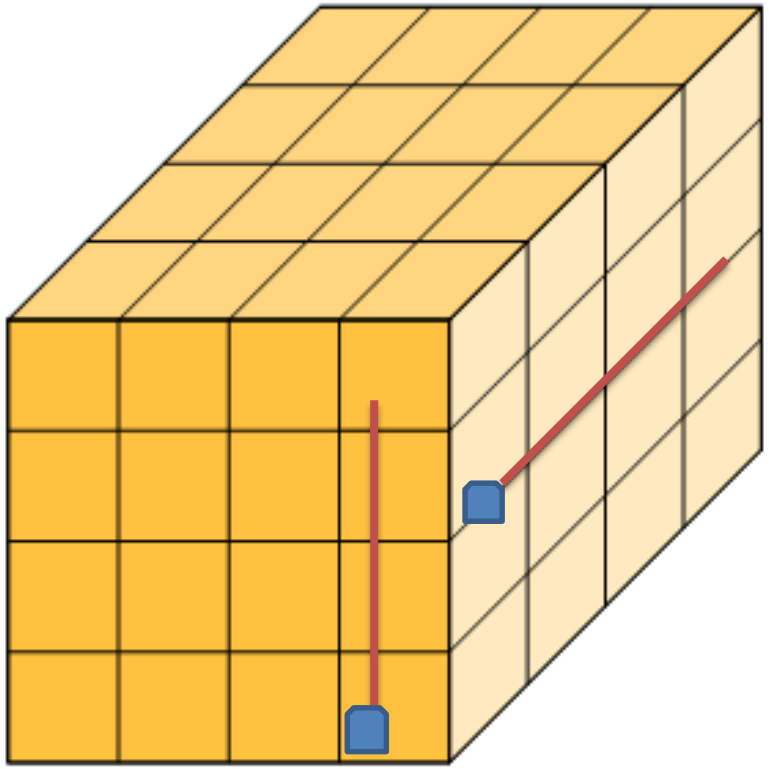
96 / 64 = 1.5

AIR SEALING STRATEGIES
COMPARTMENTIZATION
SURFACE AREA PER UNIT

DOMESTIC HOT WATER PASSIVE HOUSE



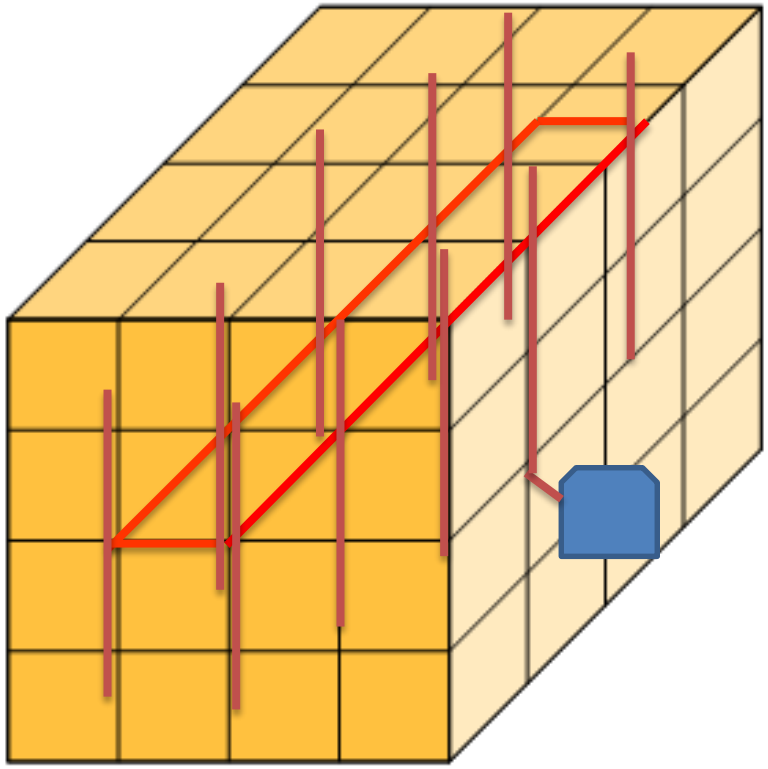
Circulation Loop



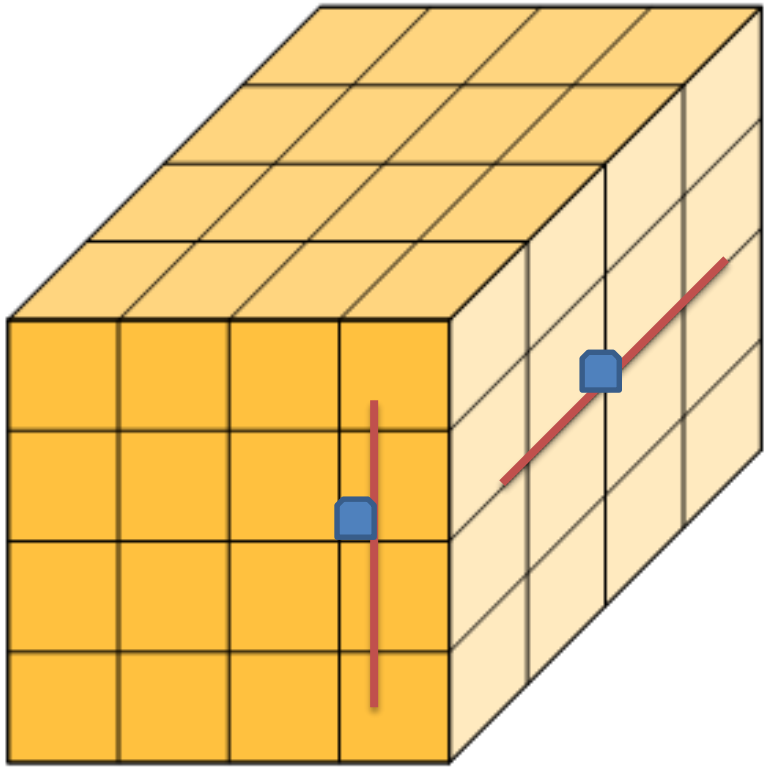
Ganging

DOMESTIC HOT WATER

individual vs group vs district



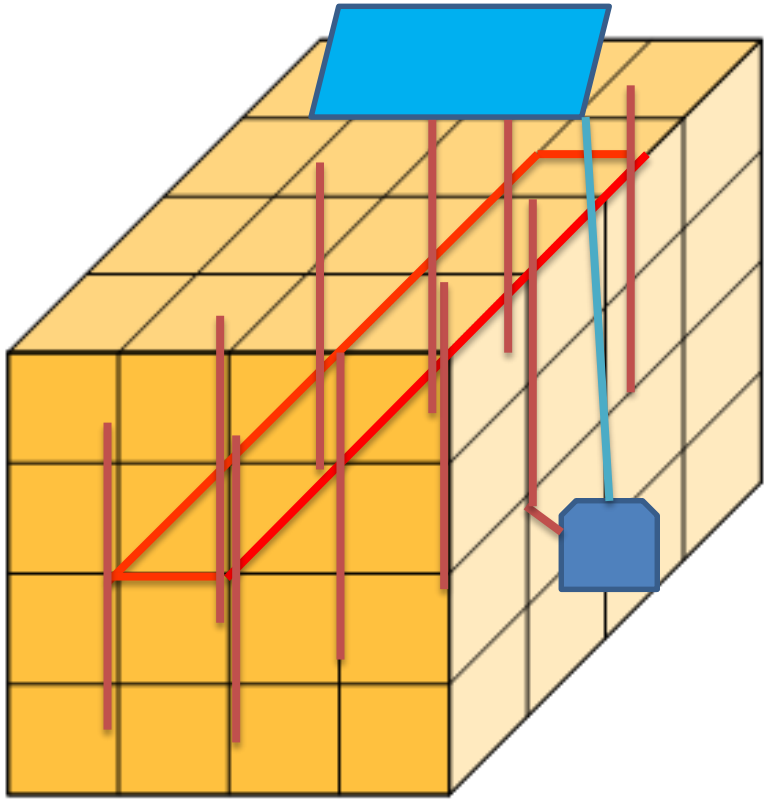
Circulation Loop



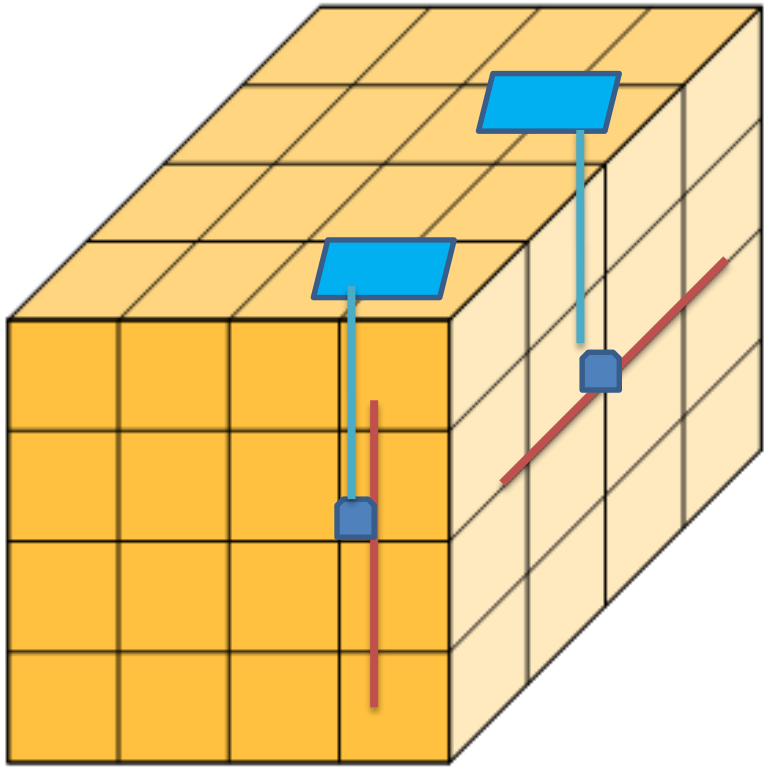
Ganging

DOMESTIC HOT WATER

Central Location



Circulation Loop



Ganging

DOMESTIC HOT WATER

Solar Generation?

HEAT & A/C
DUCTS
PASSIVE HOUSE
vs STANDARD
CONSTUCTION

GALA Senior Residence
Philadelphia PA
Haley Donovan Architects
Conifer Developers

Passive House verification

Building:	Golden Age Living Accomodations
Street Address:	2030 East Haines Street
City, State, Zip:	Philadelphia, Pennsylvania 19138
Country:	USA
Building type:	Multifamily Senior Housing
Climate:	PA, Philadelphia
Altitude of building site [feet above sea level]:	248
Home owner / Client:	Conifer LLC
Street Address:	20000 Horizon Way, Ste 180
City, State, Zip:	Mount Laurel, New Jersey 08054
Architecture:	Haley Donavan Architecture LLC
Street Address:	106 Kings Highway
City, State, Zip:	Haddonfield, New Jersey 08033
Mechanical system:	
Street Address:	
City, State, Zip:	

Year of construction:	2015		Interior temperature winter:	68.0	°F	Enclosed volume V_e ft³:	481184
No. of dwelling units:	70		Interior temperature summer:	77.0	°F	Mechanical cooling:	x
No. of occupants:	119.8		Internal heat sources winter:	1.30	BTU/h ft²		
Spec. capacity:	11	BTU/F per ft² TFA	Dito summer:	1.30	BTU/h ft²		

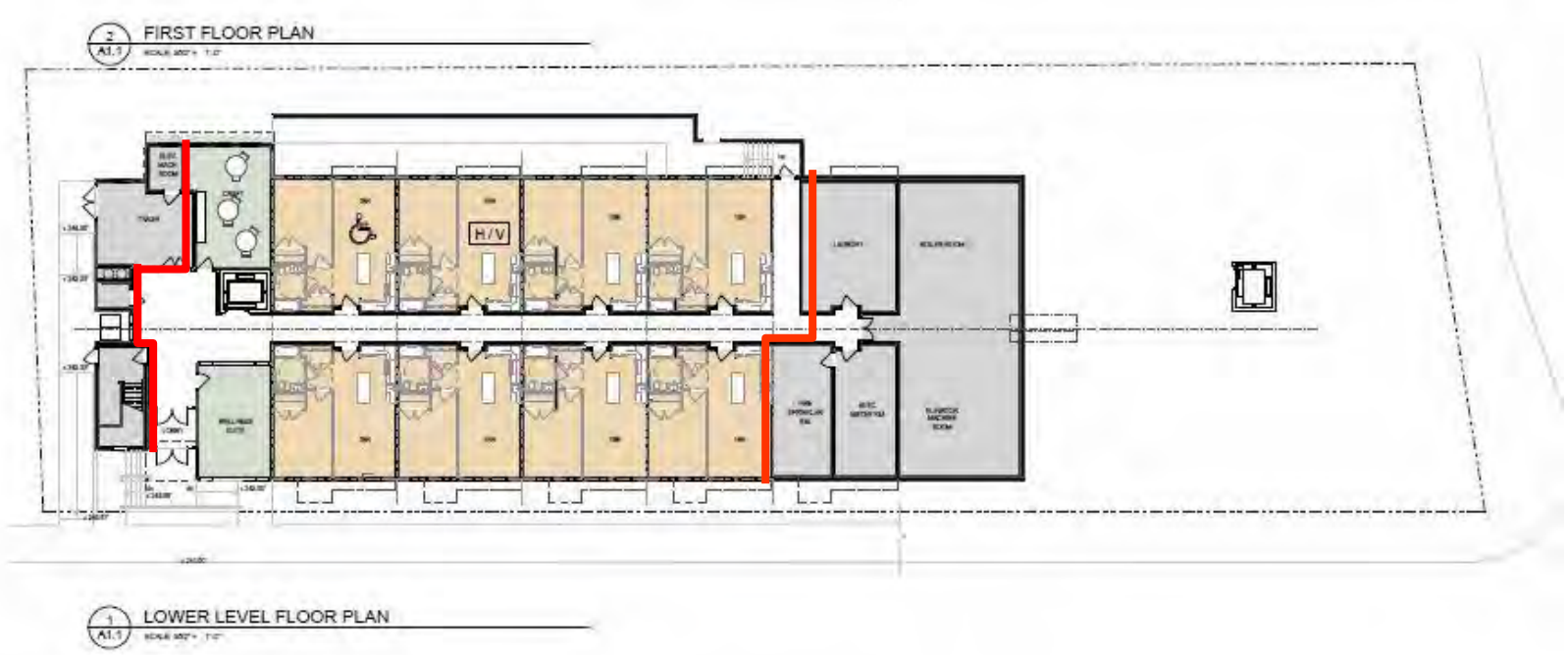
Specific building demands with reference to the treated floor area

						Requirements		Fulfilled?*
	Treated floor area		45139	ft²				
Space heating	Heating demand		2.53	kBTU/(ft²yr)	53% of	4.75 kBTU/(ft²yr)		yes
	Heating load		3.25	BTU/(hr.ft²)	103% of	3.17 BTU/(hr.ft²)		yes
Space cooling	Overall specif. space cooling demand		3.81	kBTU/(ft²yr)	67% of	5.71 kBTU/(ft²yr)		yes
	Cooling load		2.40	BTU/(hr.ft²)		-		-
	Frequency of overheating (> 77 °F)			%		-		-
Primary energy		Heating, cooling, auxiliary electricity	dehumidification, DHW, lighting, electrical appliances	31.7	kBTU/(ft²yr)	83% of	38.0 kBTU/(ft²yr)	yes
	DHW, space heating and auxiliary electricity			7.9	kBTU/(ft²yr)		-	-
	Specific primary energy reduction through solar electricity				kBTU/(ft²yr)		-	-
Airtightness	Pressurization test result n_{50}			0.6	1/h		0.6 1/h	yes

* empty field: data missing; -: no requirement

Passive House?	yes

2 A1.1 FIRST FLOOR PLAN



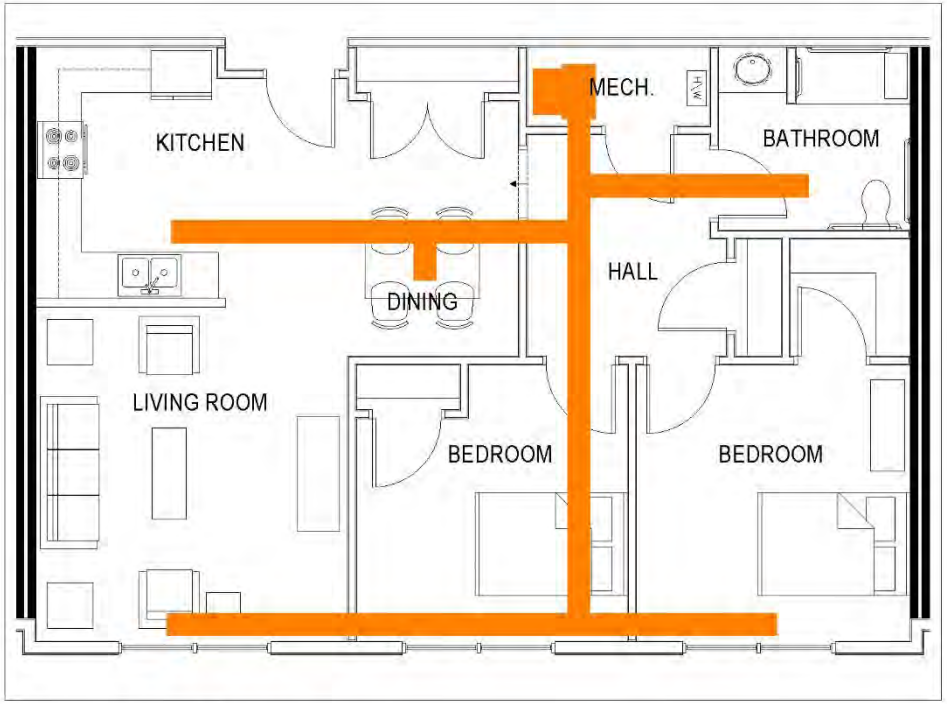
1 A1.1 LOWER LEVEL FLOOR PLAN

Plans are set…. What options do you have?

Case Study:
HVAC Ducting
24-Unit Senior Affordable Housing

Fayette County Community Action Corporation
Fairchance, PA
Sleighter Engineering and Architecture, Architect

One Bedroom



Two Bedroom

Heat & A/C Ducts

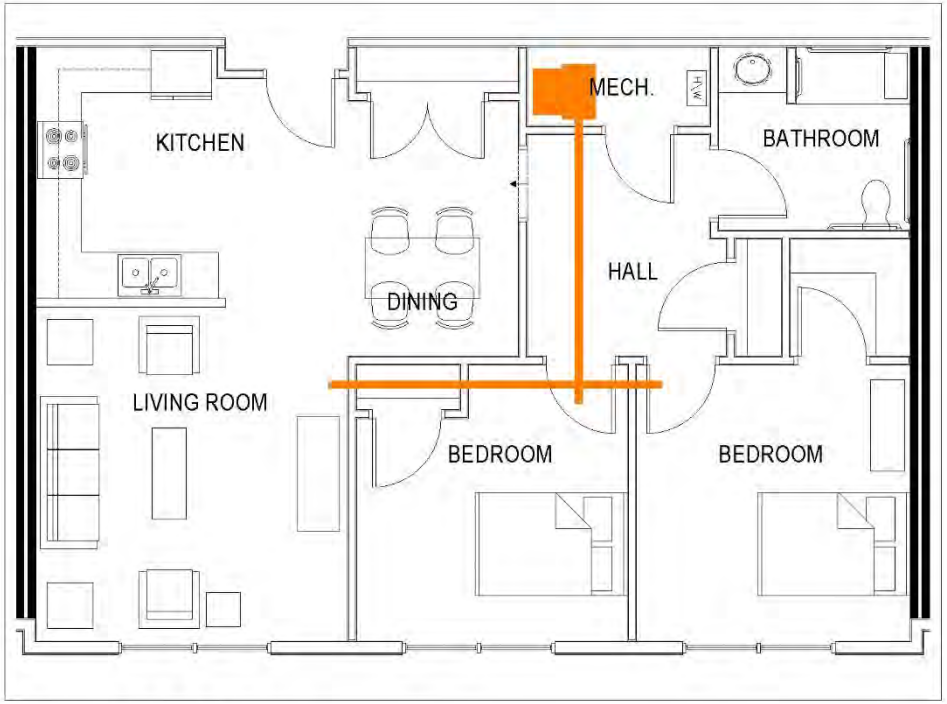
Standard Construction

First & Second Floor

Heat & A/C Ducts

Standard Construction

One Bedroom



Two Bedroom

Heat & A/C Ducts

Passive House

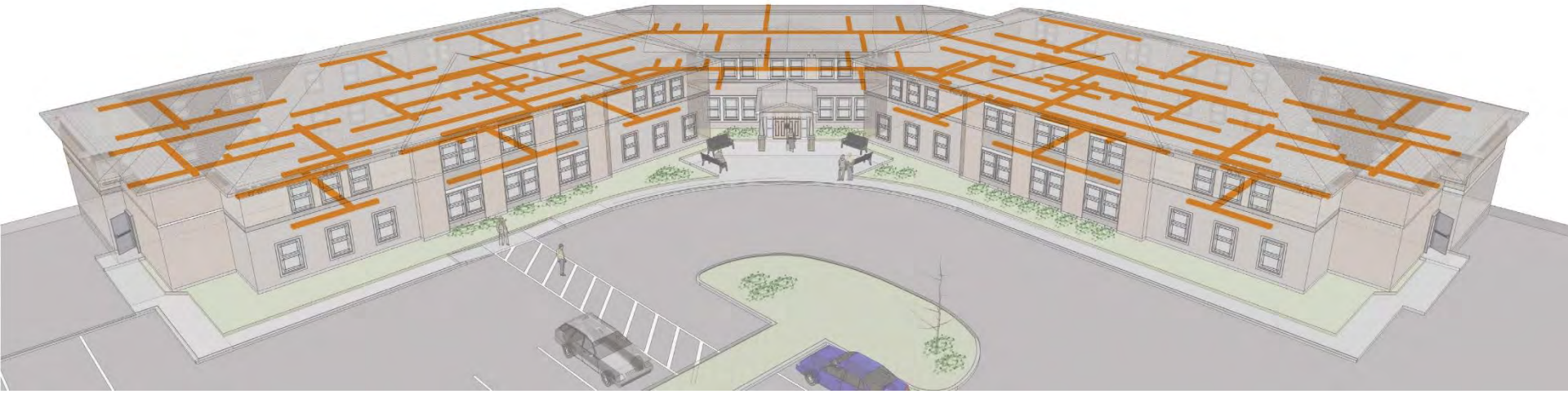
Fewer and smaller ducts

First & Second Floor

Heat & A/C Ducts

Passive House

Fewer and smaller ducts



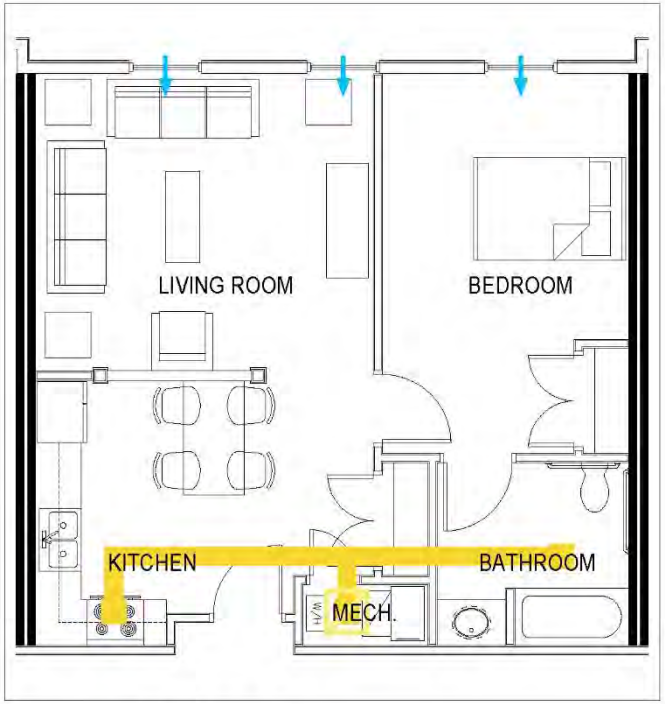
Standard Construction

3,670 Linear Ft of Heat & A/C Ducting

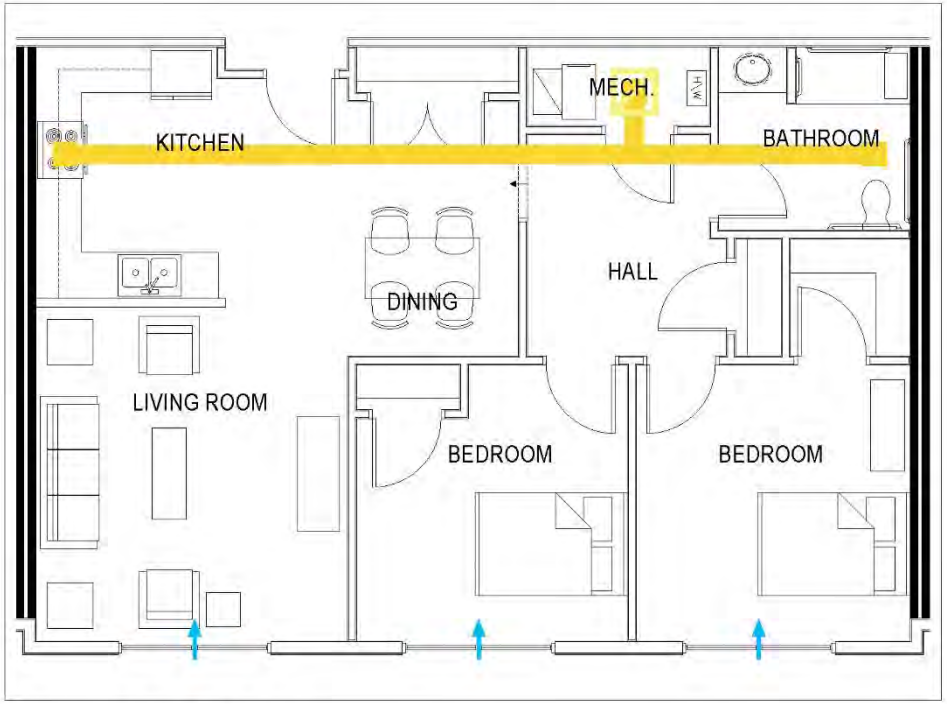
Passive House

620 Linear Ft of Heat & A/C Ducting

VENTILATION DUCTS PASSIVE HOUSE vs STANDARD CONSTUCTION

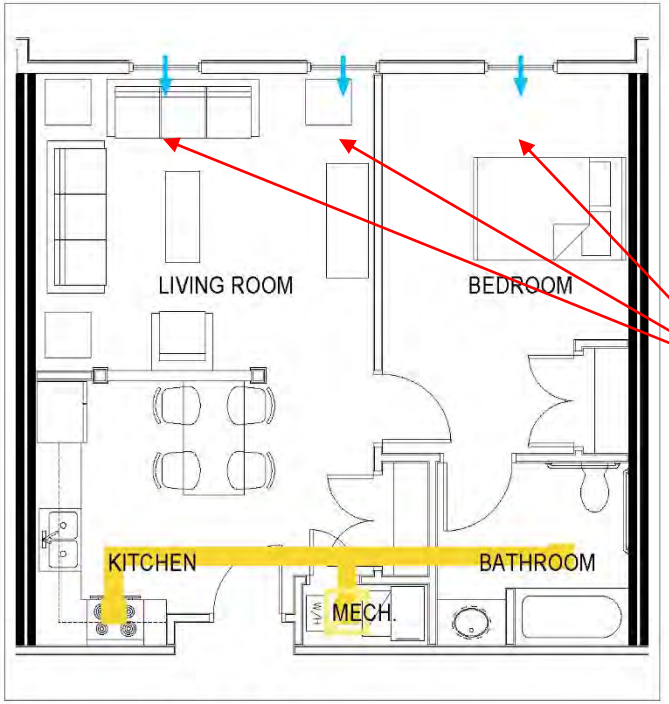


One Bedroom



Two Bedroom

Ventilation Ducts
Standard Construction



One Bedroom

Designed Inlets for Exhaust-Driven

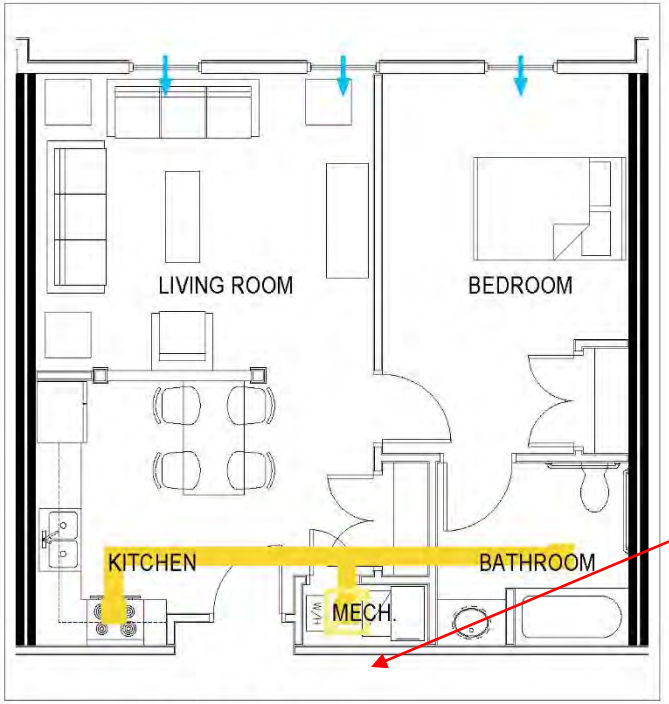
- Intentional openings in building envelope that allow a trickle of air into buildings in response to pressure differential
- Trickle Vents often built into window frames (AL,FG)
- Comfortable and effective when located high
- Good practice for 4+ stories

Steven Winter Associates, Inc.
Improving the Built Environment Since 1972

Building America
U.S. Department of Energy

CARB
Consortium for Advanced Residential Buildings

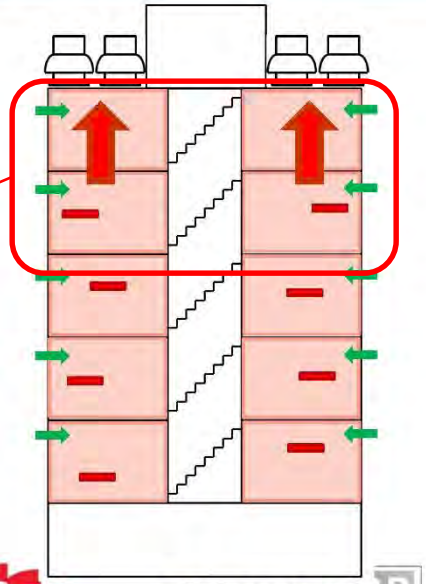
Ventilation Ducts
Standard Construction



One Bedroom

Exhaust-Driven Fresh Air Design

- Exhaust slightly depressurizes the units
- Outside air enters through leaks, cracks, or planned inlets (trickle vent, not undercut)
- Widely used in the North



Steven Winter Associates, Inc.
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Building America
U.S. Department of Energy

CARB
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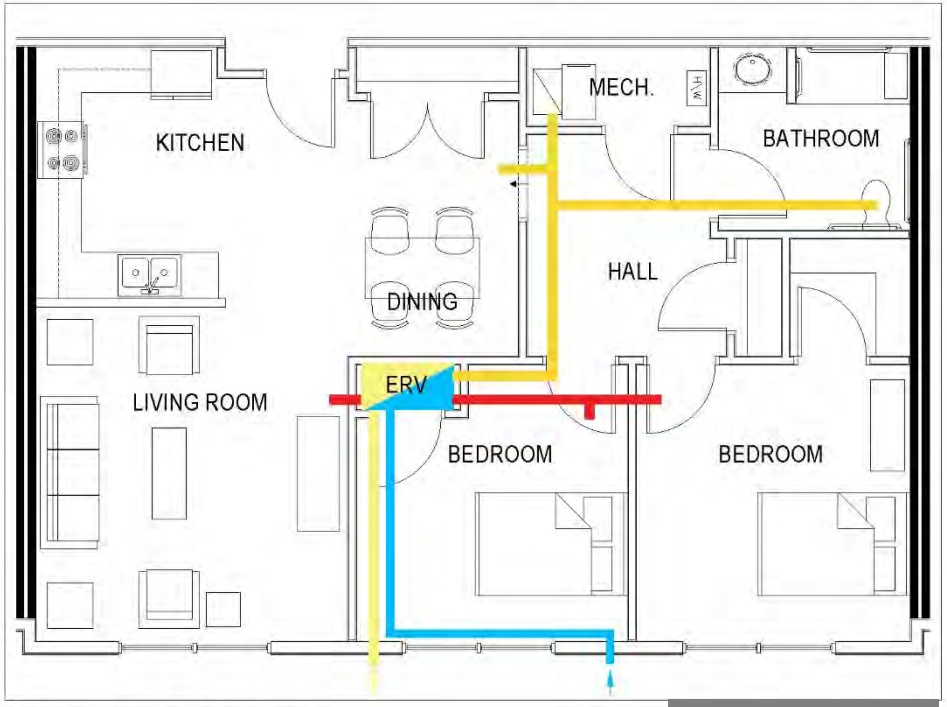
Ventilation Ducts
Standard Construction

First & Second Floor

Ventilation Ducts
Standard Construction

One Bedroom



Two Bedroom

Intake Air
Exhaust Air
Supply Air
Return Air

Ventilation Ducts

Passive House

≥75% Energy is recovered from ventilation

First & Second Floor

Ventilation Ducts

Passive House

≥75% Energy is recovered from ventilation

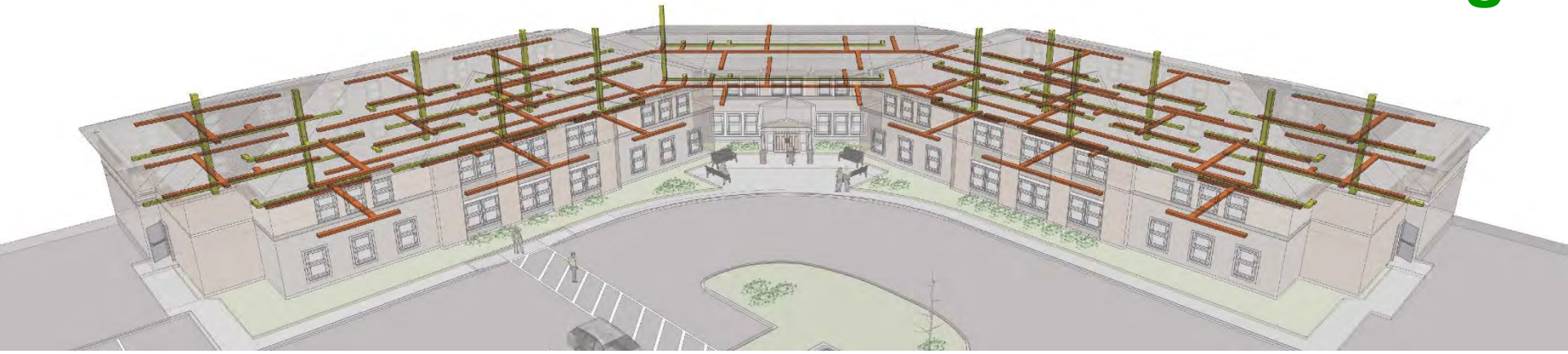
Standard Construction

1,158 Linear Ft of Ventilation Ducting

Passive House

1,772 Linear Ft of Ventilation Ducting

Combined Ventilation and Heat & AC Ducting



Standard Construction

4,828 Linear Ft of HVAC Ducting

Passive House

2,392 Linear Ft of HVAC Ducting

STANDARD	QTY	PASSIVE HOUSE	QTY
VRF Heat Pump Units	*3*	Air to Air Heat Pump Units	*28*
Vertical Air Handlers	*28*	Energy Recovery Ventilators	*26*
Local Exhaust Fans	*56*		
Roof Exhaust Fans	14		
Trickle Vents	*128*		







HVAC Equipment
Standard Construction vs Passive House

ANOTHER PERSPECTIVE ON ENERGY USE


-90%


-90%

62Msf or 65,000 NYC apts. renovated to PASSIVE HOUSE

=

A single 1.2MW Coal power plant

62Msf or 65,000 NYC apts. renovated to PASSIVE HOUSE

=

A single 1.2MW $2B Coal power plant

Wean Philadelphia
off of fossil fuels
neighborhood by neighborhood

Wean Philadelphia
off of fossil fuels
neighborhood by neighborhood

60 % OF THE WORLD'S BUILDINGS

WILL BE REBUILT

IN THE NEXT TWO DECADES.

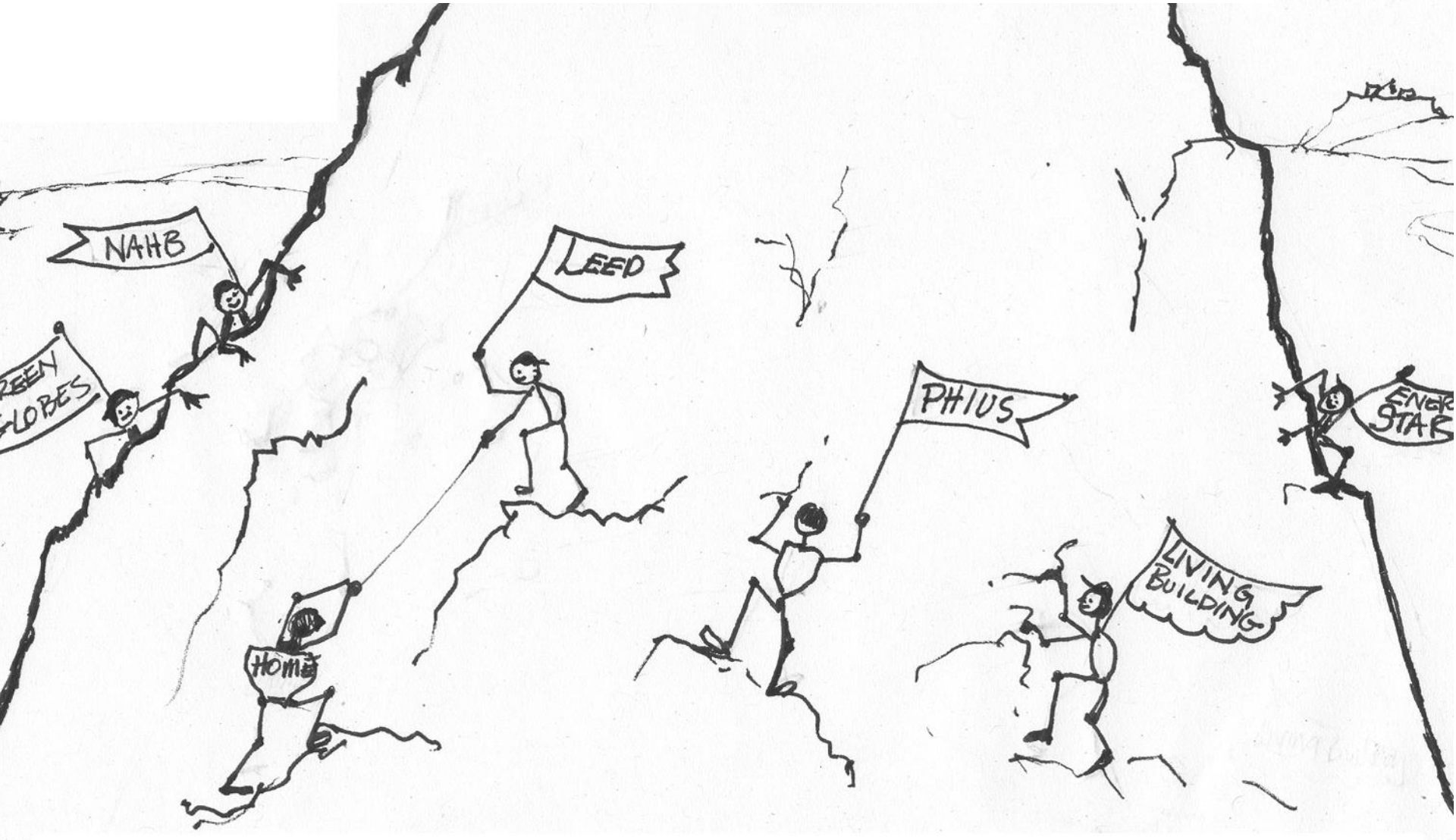
"That is a **huge opportunity** if we **do it right."**

– Ed Mazria, Architecture 2030

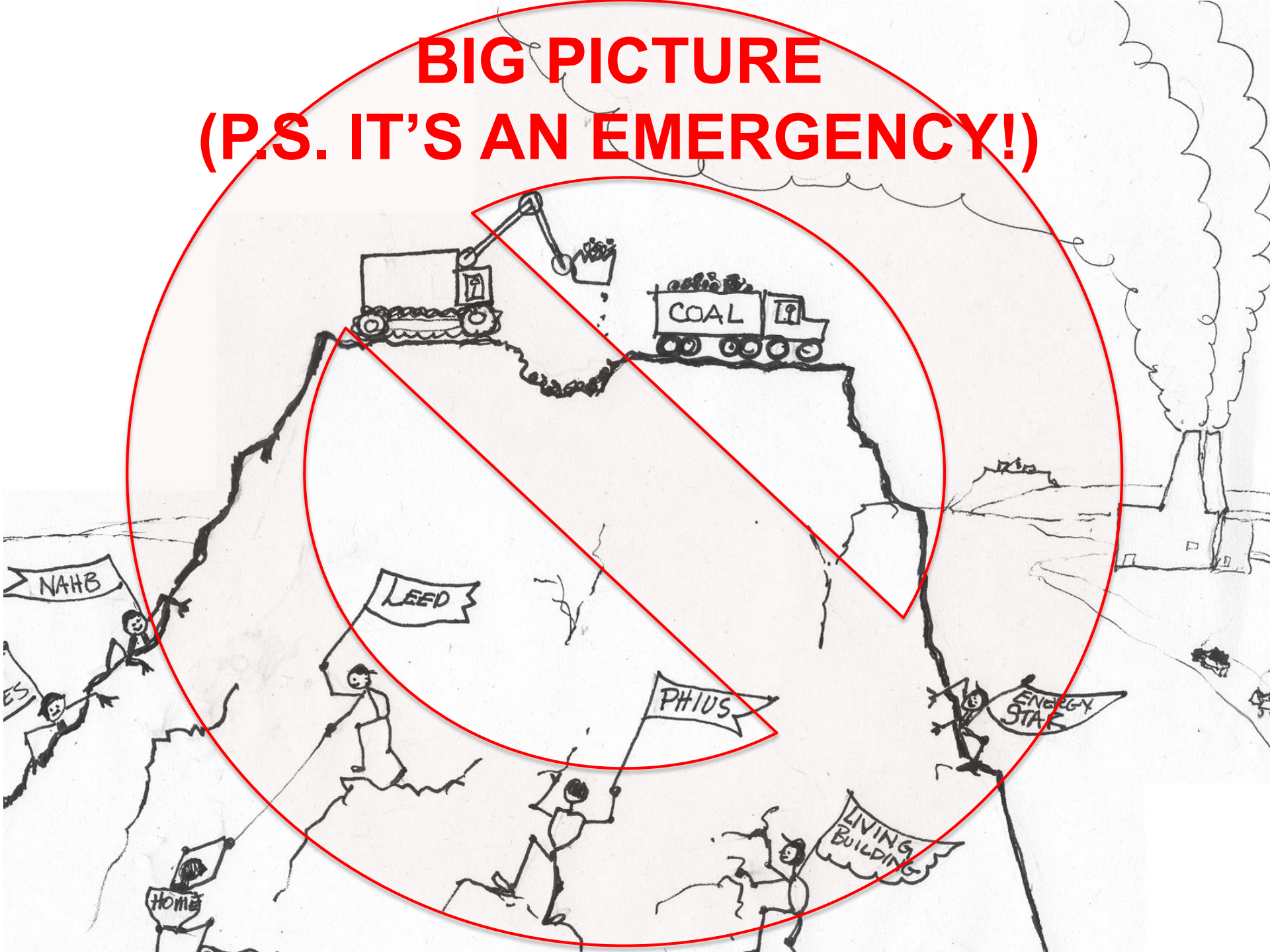
25-75 years
between renovations

WASTED $$
MISSED opportunities

PATHS UP THE MOUNTAIN



BIG PICTURE
(P.S. IT'S AN EMERGENCY!)



RESOURCES

PHIUS Passive House Institute US
passivehouse.us

PHAUS Passive House Alliance US
phaus.org

PHI Passive House Institute (Germany)
passiv.de/en/

iPHA International Passive House Association
passivehouse-international.org

NAPHN North American Passive House Network
northamericanpassivehousenetwork.com

RESOURCES

ENERGY STAR Building rating system - energy
energystar.gov

LEED Building rating system
new.usgbc.org/leed

GREEN GLOBES Building rating system
greenglobes.com

2000 WATT SOCIETY Global energy effects
novatlantis.ch/en/2000-watt-society

GREEN LEASES Landlord tenant relationships
greenleaselibrary.com

RESOURCES

SG BUILD Construction methods consultants
sgbuild.com

FOURSEVENFIVE High performance building supply, foursevenfive.com

STRUCTURESdb Design-build
structuresdb.com

THE CLIMATE TRUST Climate solutions for government, utilities and large businesses
climatetrust.org

RESOURCES

ECONOMICS OF PASSIVE HOUSE

RETURN ON INVESTMENT

LIFE CYCLE ANALYSIS

PRESENT VALUE ANALYSIS

$$\text{Price of Saved Energy} = \frac{(a_{loan} * (I_{add} - R) + Z)}{E_{saved}}$$

$$\text{Net Present Value (NPV)} = K_0 * \frac{1 - (1+p)^{-n}}{p}$$

3 Prerequisites

47 Credits

3 ‘Synergy’ Prerequisites

31 ‘Synergy’ Credits

40-49 Certified

50-59 Silver

60-79 Gold

80-110 Platinum

110 Possible Points

47-78 PASSIVE HOUSE POINTS

LEED v4 for B D & C: Multifamily Midrise

Project Checklist PASSIVE HOUSE- POSSIBLE POINTS

Y	?	N			
	2		Credit 1	Integrative Process	2
			Sustainable Sites	Possible Points:	7
	2		Credit 1	Heat Island Reduction	2
			Water Efficiency	Possible Points:	12
			PERFORMANCE PATH		
	9		Credit 1	Total Water Use	12
			PRESCRIPTIVE PATH		
	4		Credit 2	Indoor Water Use	6
			Energy and Atmosphere	Possible Points:	37
30			Credit 1	Annual Energy Use	30
5			Credit 2	Efficieng Hot Water Distribution	5
	2		Credit 3	Advanced Utility Tracking	2
			Materials and Resources	Possible Points:	9
	1		Credit 1	Durability Management Verification	1
	2		Credit 2	Environmentally Preferable Products	5
			Indoor Environmental Quality	Possible Points:	18
3			Credit 1	Enhanced Ventilation	3
	2		Credit 2	Contaminant Control	2
3			Credit 3	Balancing of Heating and Cooling Distribution Systems	3
3			Credit 4	Enhanced Compartmentalization	3
2			Credit 5	Combustion Venting	2
1			Credit 6	Enhanced Garage Pollutant Protection	1
	3		Credit 7	Low Emitting Products	3
			Innovation	Possible Points:	6
	2		Credit 1	Innovation	5
	1		Credit 2	LEED AP Homes	1
			Regional Priority	Possible Points:	4
	1		Credit 1	Regional Priority: Specific Credit	1
47	31		**Total**	Possible Points PH/LEED 78	110

Certified 40 to 49 points Silver 50 to 59 points Gold 60 to 79 points Platinum 80 to 110

LEED v4 MULTI-FAMILY + Passive House

A WINNING COMBINATION

Passive House + LEED

+ LBC

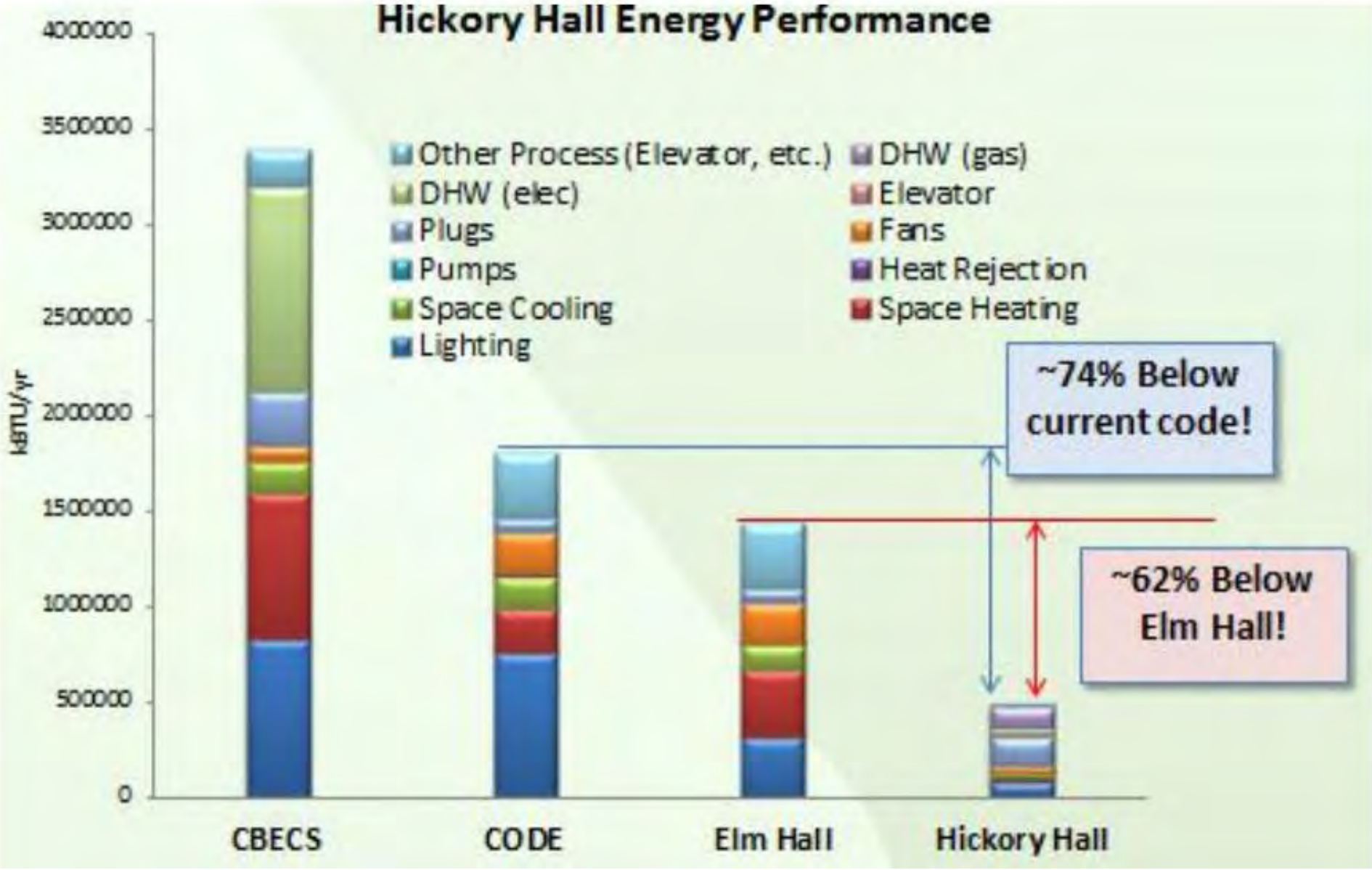
+ DOE

+ ...


HICKORY HALL
Emory and Henry College
Emory, Virginia
Adam Cohen, CPHC

HICKORY HALL
40,000sf, 117 beds
PASSIVE HOUSE + LEED

ELM HALL
36,000sf, 116 beds
LEED


Hickory Hall Energy Performance
4000000
3500000
3000000
2500000
2000000
1500000
1000000
500000
0
kBTU/yr
Other Process (Elevator, etc.)
DHW (elec)
Plugs
Pumps
Space Cooling
Lighting
DHW (gas)
Elevator
Fans
Heat Rejection
Space Heating
~74% Below current code!
~62% Below Elm Hall!
CBECS
CODE
Elm Hall
Hickory Hall

HICKORY HALL
40,000sf, $4.73M
$118.25/sf
Passive House + LEED

ELM HALL
36,000sf, $4.59M
$126/sf
LEED


Hickory Hall
2012
71 Points Attempted
7 denied
LEED GOLD PENDING
+
PASSIVE HOUSE
(EA 26 Points)
ELM Hall
2010
51 Points Awarded
LEED SILVER
(EA 12 Points)