



EEBA 2015, DENVER CO: VALUE-DRIVEN PASSIVE HOUSE DESIGN STRATEGIES FOR MULTI-FAMILY BUILDINGS

US building impacts

72% electricity consumption

39% energy use

38% CO₂ emissions

40% raw materials

30% waste output

14% potable water use



MISSION:

The Greater Philadelphia Passive House Association
Is dedicated to making Passive House design and construction
a mainstream practice.

US building impacts

72% electricity consumption

39% energy use

38% CO₂ emissions

40% raw materials

30% waste output

14% potable water use

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.



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.

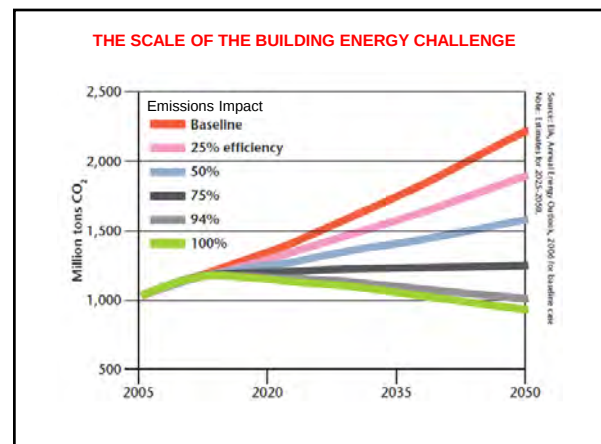
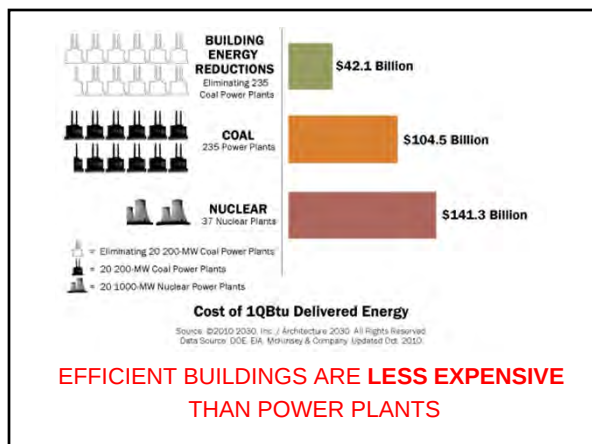
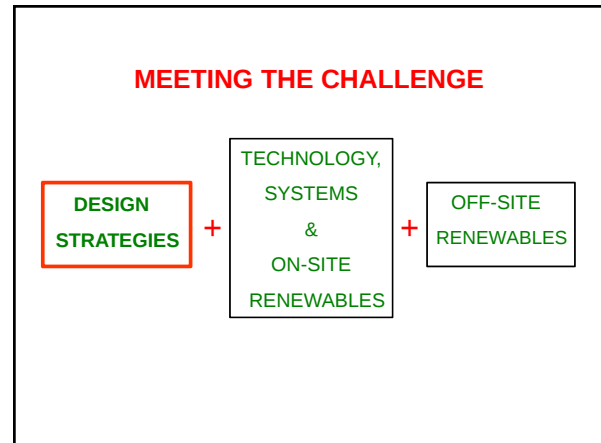
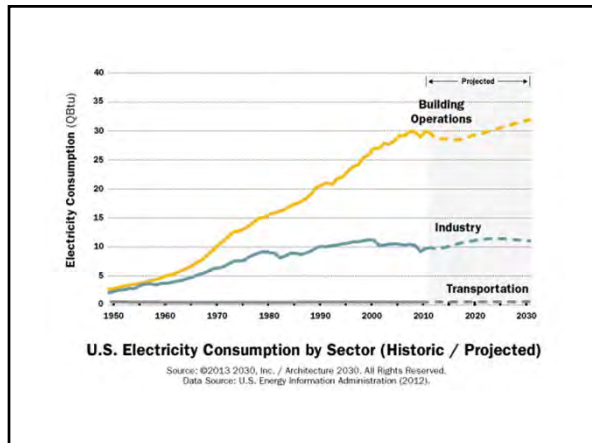
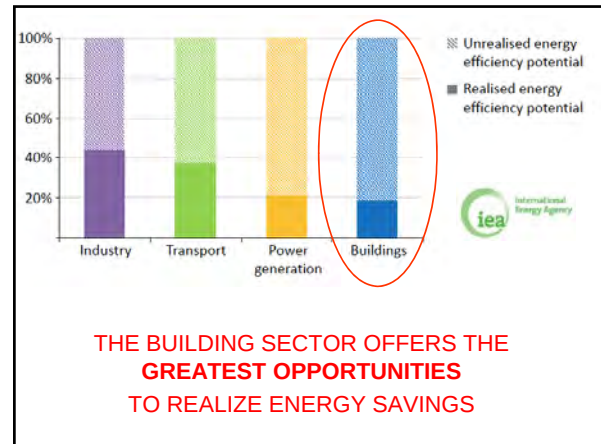
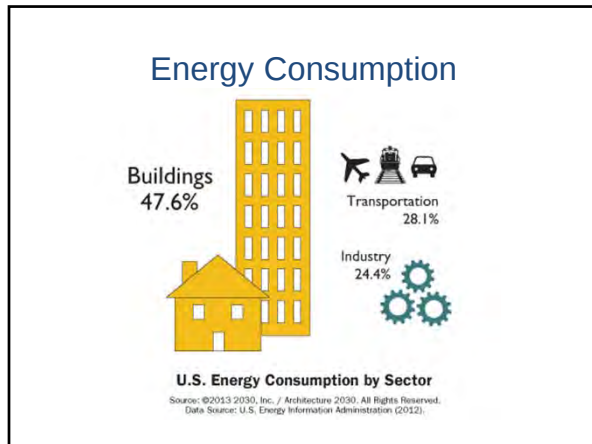
blupath.us



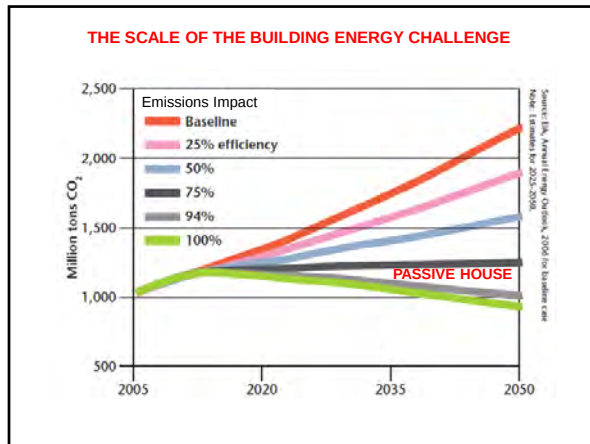
AGENDA

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.

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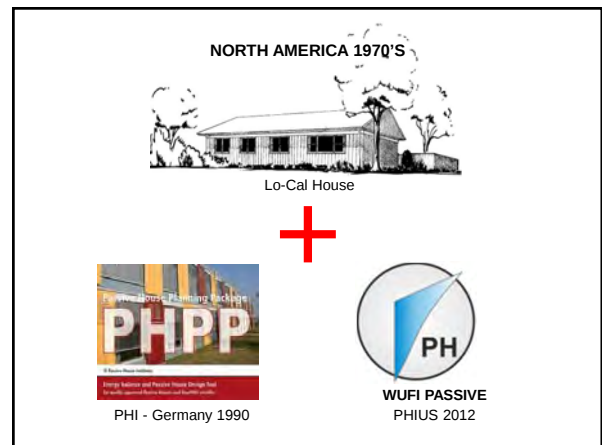


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Civic House Feasibility Study
University of Pennsylvania

What is Passive House? (PassivHaus)





NOT

Passive Solar
Used
15,600 kWh/yr



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



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Transformer Townhome





Coffee Analogy #1

Science based
Conservation focused
Better built
Cost effective
=

SMART DESIGN

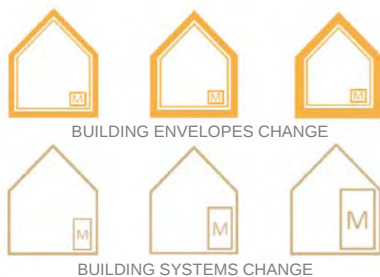
Efficient, comfortable, healthy
ZEC - Zero Energy Capable



Energy Star



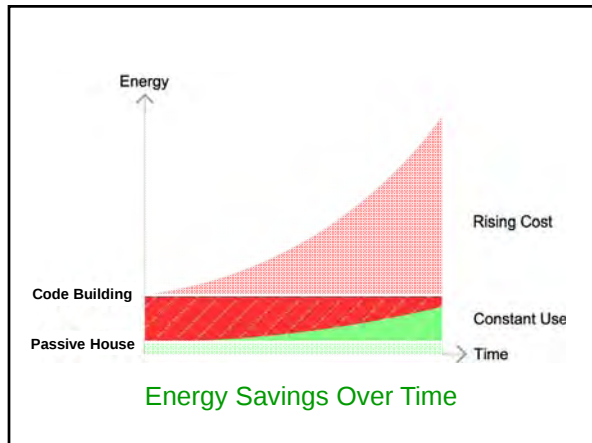
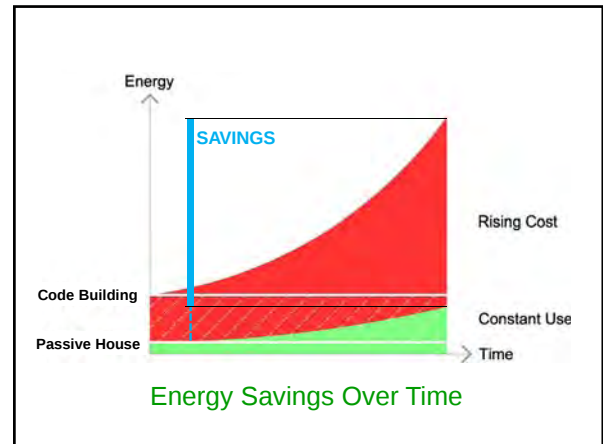
Passive House



Paradigm Shift

Coffee Analogy #2

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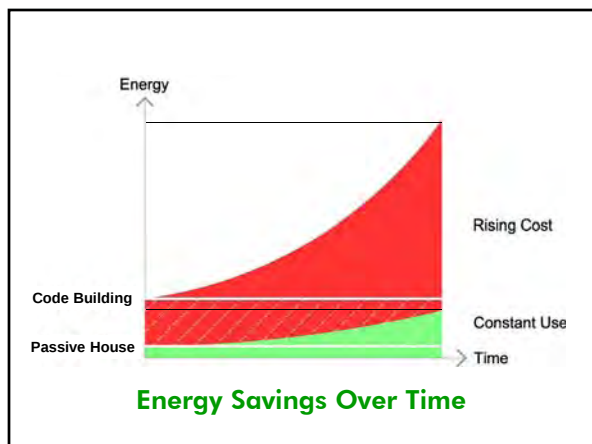


BENEFITS BEYOND ENERGY SAVINGS

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

'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***



BENEFITS BEYOND ENERGY SAVINGS

MORE FUTURE-PROOF – SURVIVABLE

Mitigates issues surrounding

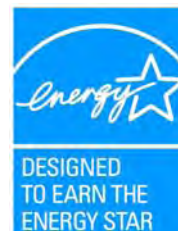
extreme weather

global energy

&

material

availability, cost and scarcity



x 5

PASSIVE HOUSE CONCEPTS



Continuous Ventilation



Super Insulated Air Tight Shell



Efficient Appliances



Optimized Solar Energy



Accurate and Proven Analysis

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Accurate and Proven Analysis



Typical building

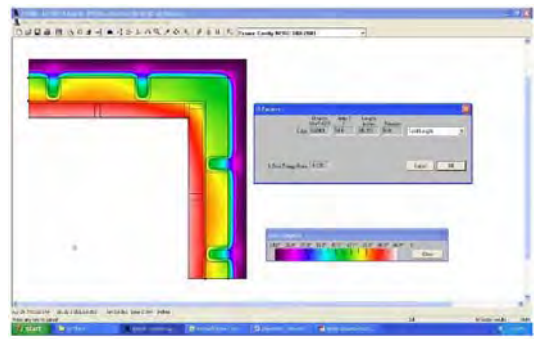
Passive House

EFFICIENT



Passive House + Solar Array* =
Net Zero Energy

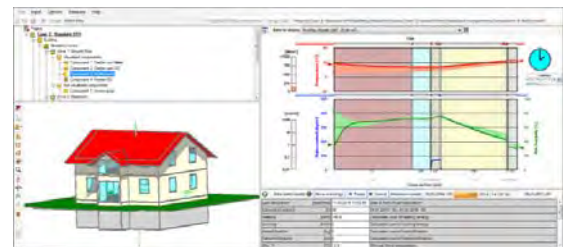
*PLUS, PREMIUM



THERMAL MODEL
Assembly



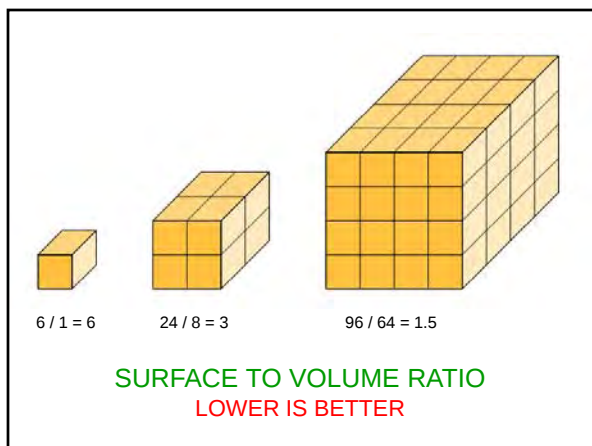
25 Years + 55,000 Units 2012
(ask us about Brussels 2015)



HYGROTHERMIC MODEL
Assembly

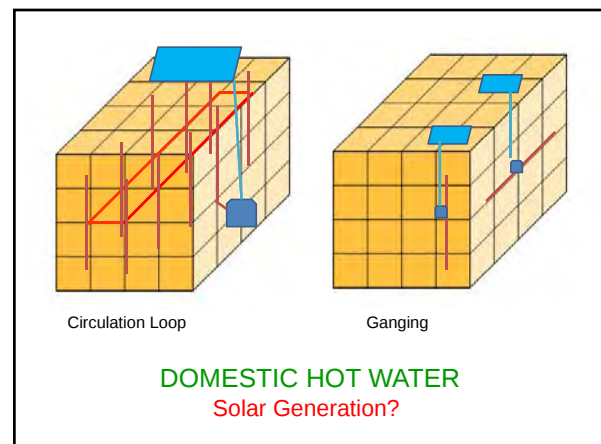
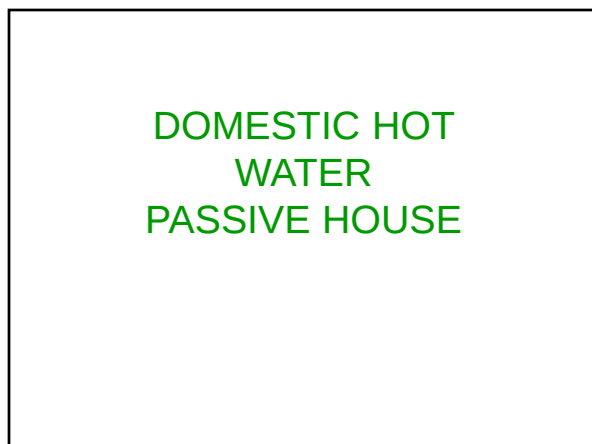
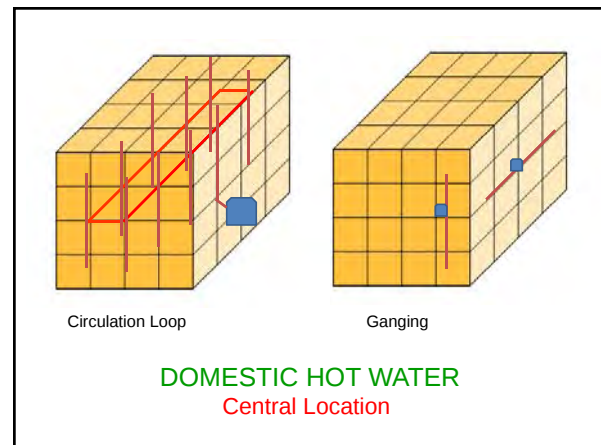
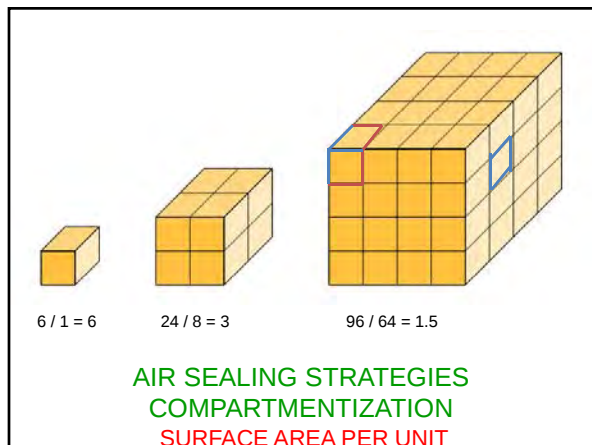
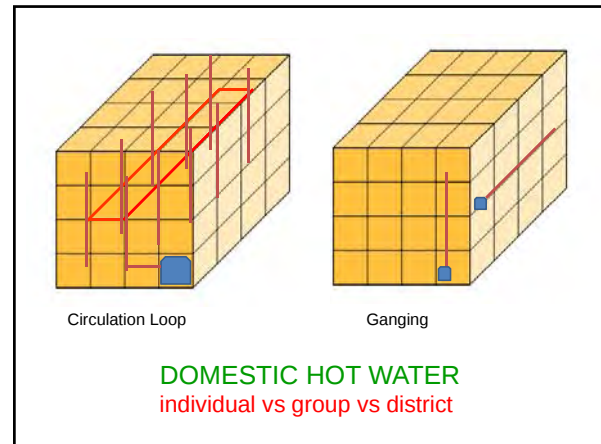
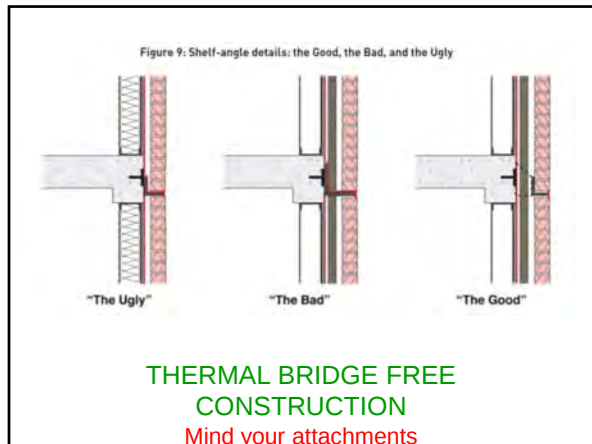
WHY IS PASSIVE HOUSE GOOD FOR BIGGER BUILDINGS?

THE PASSIVE HOUSE THERMAL ENVELOPE

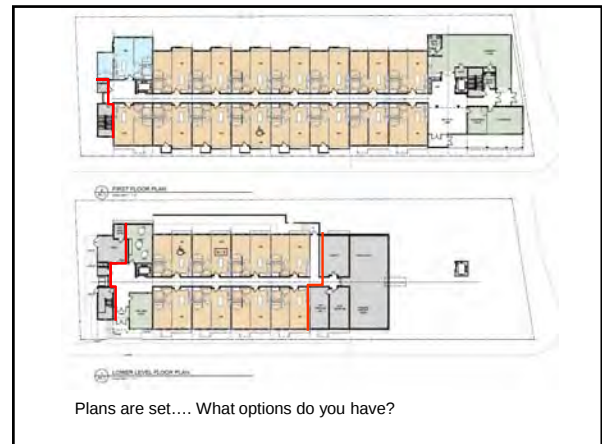


Hydrophobic	drains & dries
Lightweight	long attachments/ brackets
Non Combustible	fire resistant
Flexible	cuts to size cuts around objects layers easily

THERMAL BRIDGE FREE
CONSTRUCTION
Foam Free is Better



HEAT & A/C DUCTS PASSIVE HOUSE vs STANDARD CONSTRUCTION

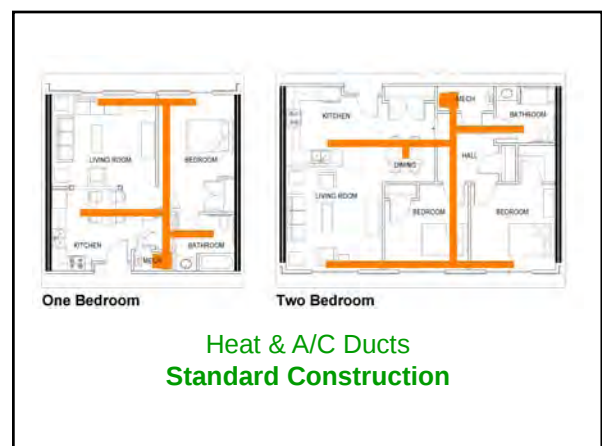


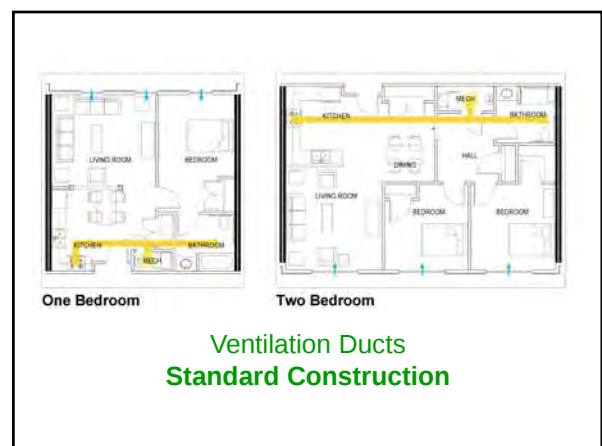
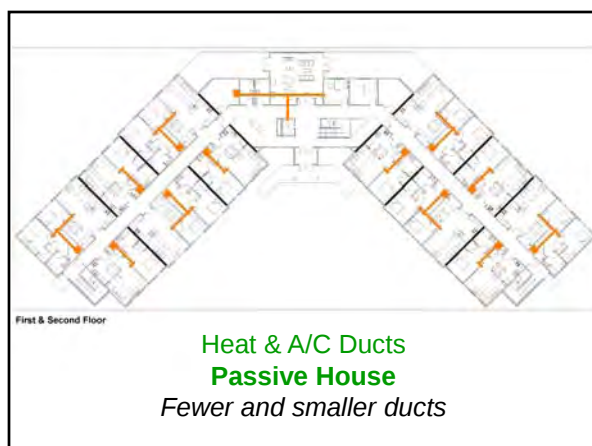
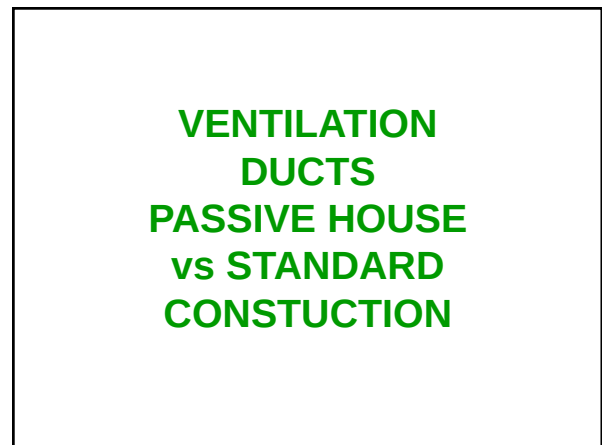
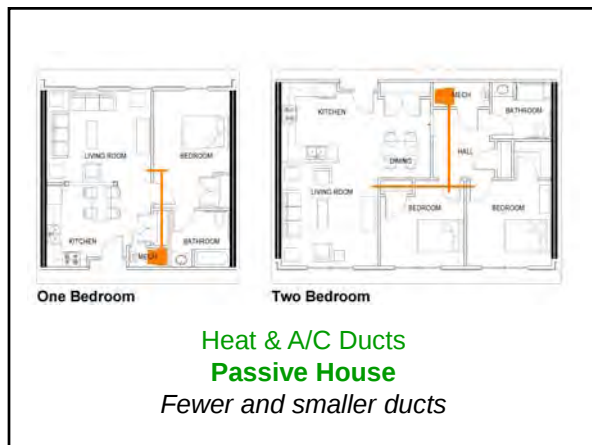
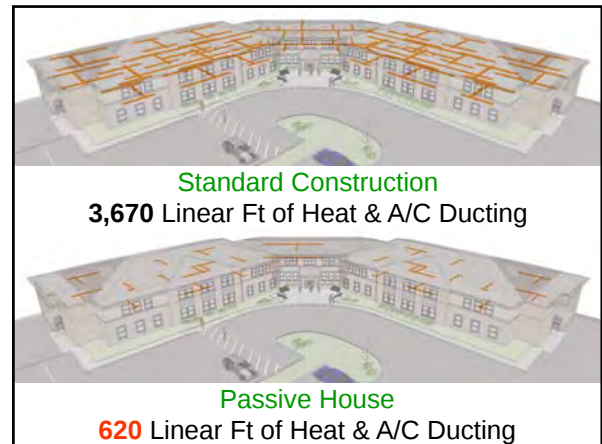
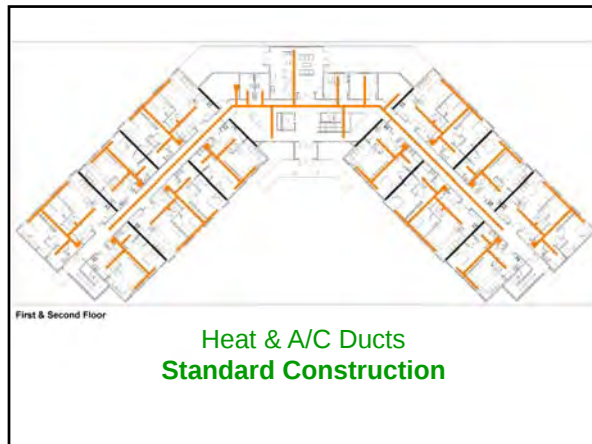
Passive House verification

Building	Golden Age Living Apartments		
Street Address	100 East Valley Road		
City, State, Zip	Hempstead, Pennsylvania 19138		
Country	Multi-family Senior Housing		
Building type	P.5. Residential		
Climate	1. Climate (Building Use, zone and mass) - 258		
Home owner / Client	Golden LLC		
Street Address	10000 Jackson Ave. 100		
City, State, Zip	Mount Laurel, New Jersey 08054		
Architect	Hedberg Rosenberg Architects LLC		
Street Address	10000 Jackson Ave.		
City, State, Zip	Hempstead, New Jersey 08033		
Mechanical system			
City, State, Zip			
Year of construction	2011	Interior temperature profile	19
No. of building units	11	Interior temperature for zone	19.0
No. of occupants	110.8	Interior heat capacity for zone	30.0 MJ/K
Yearly energy	7.7 kWh/m² per m² FTA	2016 energy	7.7 kWh/m² per m² FTA

Specific heat loads and reference to the latest EN 15601				
	Winter heat loss	Requirements	Compliant?	
Space heating	Overall space heating demand	2.53 kWh/m²/yr	4.15 kWh/yr	yes
	Heating coil	3.25 kWh/m²/yr	3.17 kWh/yr	yes
Space cooling	Overall specific cooling demand	3.81 kWh/m²/yr	5.11 kWh/yr	yes
	Cooling coil	2.40 kWh/m²/yr	-	-
Primary energy	Frequency of overheating (> 27.7°)	%	-	-
	Specific primary energy (including heat recovery)	31.7 kWh/m²/yr	38.0 kWh/yr	yes
Airtightness	Specific primary energy (excluding through-roof heat recovery)	7.9 kWh/m²/yr	-	-
	Pressurization test result q ₅₀	0.6 m³/m²/h	0.6 m³/m²/h	yes
Passive House?	yes			

* Heating coil: 300 mm diameter





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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 (ALFG)
- Comfortable and effective when located high
- Good practice for 4+ stories

One Bedroom

**Ventilation Ducts
Standard Construction**



One Bedroom



Two Bedroom

**Ventilation Ducts
Passive House**

≥75% Energy is recovered from ventilation

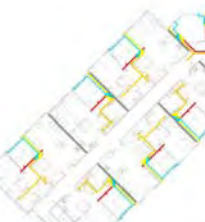


Exhaust-Driven Fresh Air Design

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

One Bedroom

**Ventilation Ducts
Standard Construction**



First & Second Floor

**Ventilation Ducts
Passive House**

≥75% Energy is recovered from ventilation



First & Second Floor

**Ventilation Ducts
Standard Construction**



Standard Construction

1,158 Linear Ft of Ventilation Ducting

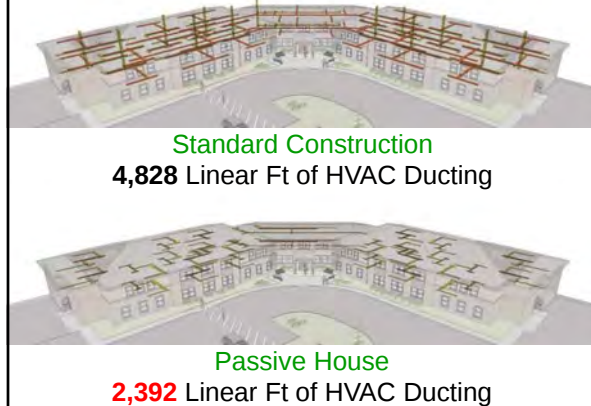


Passive House

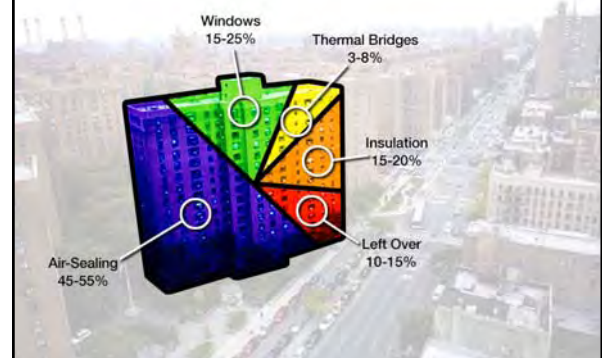
1,772 Linear Ft of Ventilation Ducting

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Combined Ventilation and Heat & AC Ducting



Thermal Components: Performance breakdown towards PH goal

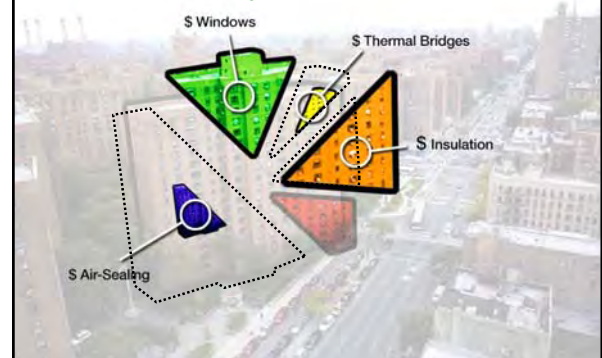


STANDARD	QTY	PASSIVE HOUSE	QTY
VRF Heat Pump Units	3	Air to Air Heat Pump Units	28
Vertical Air Handlers	28	Energy Recovery Ventilators	26
Local Exhaust Fans	56		
Roof Exhaust Fans	14		
Trickle Vents	128		




**HVAC Equipment
Standard Construction vs
Passive House**

Thermal Components: How much do they cost?



A skyline of work. One at a time.

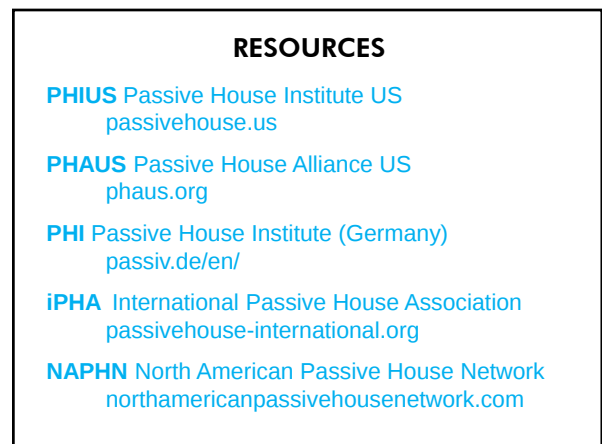
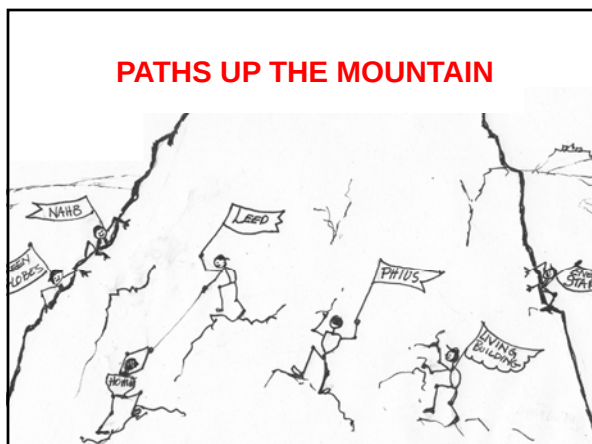
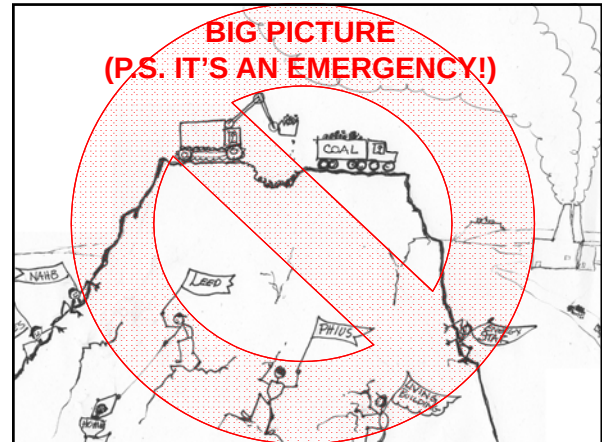


ANOTHER PERSPECTIVE ON ENERGY USE



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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

ECONOMICS OF PASSIVE HOUSE

RETURN ON INVESTMENT

LIFE CYCLE ANALYSIS

PRESENT VALUE ANALYSIS

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

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

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

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+B+C: Multifamily Midrise		
Project Checklist: PASSIVE HOUSE - POSSIBLE POINTS		
1	1.1	1.1.1 Integrated Design
1	2	2.1 Sustainable Sites
1	3	3.1 Water Efficiency
1	4	4.1 Energy & Atmosphere
1	5	5.1 Materials & Resources
1	6	6.1 Indoor Environmental Quality
1	7	7.1 Community & Local Economy
1	8	8.1 Regional Priority
1	9	9.1 Innovation
1	10	10.1 Leadership in Energy & Environmental Design
1	11	11.1 Regional Priority
1	12	12.1 Innovation
1	13	13.1 Leadership in Energy & Environmental Design
1	14	14.1 Regional Priority
1	15	15.1 Innovation
1	16	16.1 Leadership in Energy & Environmental Design
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1	157	157.1 Leadership in Energy & Environmental Design
1	158	158.1 Regional Priority
1	159	159.1 Innovation
1	160	160.1 Leadership in Energy & Environmental Design
1	161	161.1 Regional Priority
1	162	162.1 Innovation
1	163	163.1 Leadership in Energy & Environmental Design
1	164	164.1 Regional Priority
1	165	165.1 Innovation
1	166	166.1 Leadership in Energy & Environmental Design
1	167	167.1 Regional Priority
1	168	168.1 Innovation
1	169	169.1 Leadership in Energy & Environmental Design
1	170	170.1 Regional Priority
1	171	171.1 Innovation
1	172	172.1 Leadership in Energy & Environmental Design
1	173	173.1 Regional Priority
1	174	174.1 Innovation
1	175	175.1 Leadership in Energy & Environmental Design
1	176	176.1 Regional Priority
1	177	177.1 Innovation
1	178	178.1 Leadership in Energy & Environmental Design
1	179	179.1 Regional Priority
1	180	180.1 Innovation
1	181	181.1 Leadership in Energy & Environmental Design
1	182	182.1 Regional Priority
1	183	183.1 Innovation
1	184	184.1 Leadership in Energy & Environmental Design
1	185	185.1 Regional Priority
1	186	186.1 Innovation
1	187	187.1 Leadership in Energy & Environmental Design
1	188	188.1 Regional Priority
1	189	189.1 Innovation
1	190	190.1 Leadership in Energy & Environmental Design
1	191	191.1 Regional Priority
1	192	192.1 Innovation
1	193	193.1 Leadership in Energy & Environmental Design
1	194	194.1 Regional Priority
1	195	195.1 Innovation
1	196	196.1 Leadership in Energy & Environmental Design
1	197	197.1 Regional Priority
1	198	198.1 Innovation
1	199	199.1 Leadership in Energy & Environmental Design
1	200	200.1 Regional Priority

LEED v4 MULTI-FAMILY + Passive House

RESOURCES



A WINNING COMBINATION

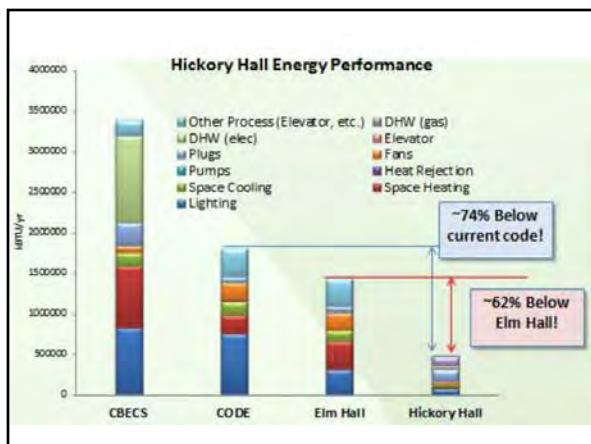
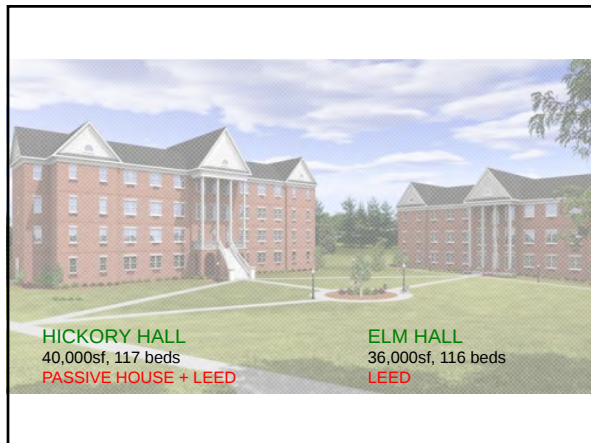
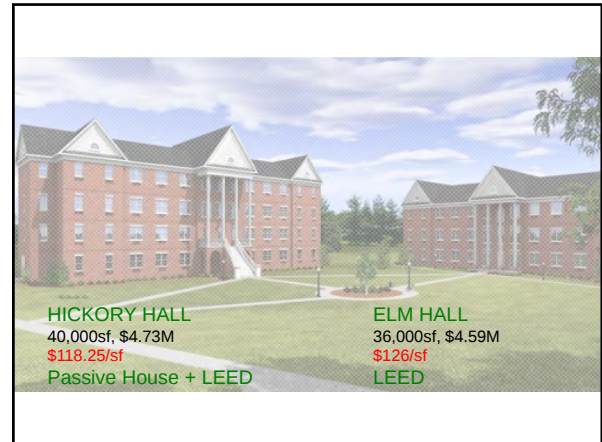
Passive House + LEED

+ LBC

+ DOE

+ ...

EEBA 2015, DENVER CO: VALUE-DRIVEN PASSIVE HOUSE DESIGN STRATEGIES FOR MULTI-FAMILY BUILDINGS



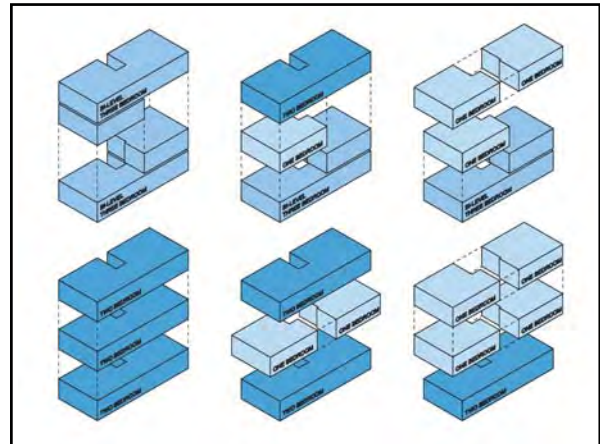
STABLE NEIGHBORHOODS

DIVERSE- RACE, CLASS, GENDER, TYPE, AGE
CULTURE IDENTIFY & HISTORY
DURABLE BUILDINGS
HEALTHY SPACES
LOCAL LABOR
LONG TERM VALUE
STABLE UTILITY COSTS
FUTURE PROOF

SYNERGYSITC MODELS

Studies show a need for housing that can-

- Adapt to the changing demographics
- Accessible and support aging-in-place
- Adapt as families grow and change
- Accommodate singles
- Allow for home offices



Transformer Townhome



Transformer Townhome

