Intro to ZNE (and Beyond): Design for Residential Buildings

Bronwyn Barry, CPHD

Passive House California

North American Passive House Network

What you'll learn today: (CEU's)

- Understand the five essential building science design principles needed for optimal building comfort and lowest energy use
- Identify locally-specific R-values for walls, roof and floor assemblies already being used in Palo Alto residential buildings to meet Net Zero and Passive House performance targets
- How to effectively work with an energy consultant to optimize performance at the early design stages
- How to integrate new tools for high performance design into your work process



Today's Agenda

1.00pm	10	Welcome & Introductions
	45	New Goals, New Thinking, A New Way of Design
	35	Intro to PH/NZE Fundamentals
2.30pm	15	**Break**
	35	What Does ZNE Look like in Palo Alto?
	25	Easier energy modeling - demo of new tools
	45	Technical Panel - Getting to Zero
	10	Next Steps - Resources & Closing
4.40pm	20	**Networking**



New Goals

New THINKING

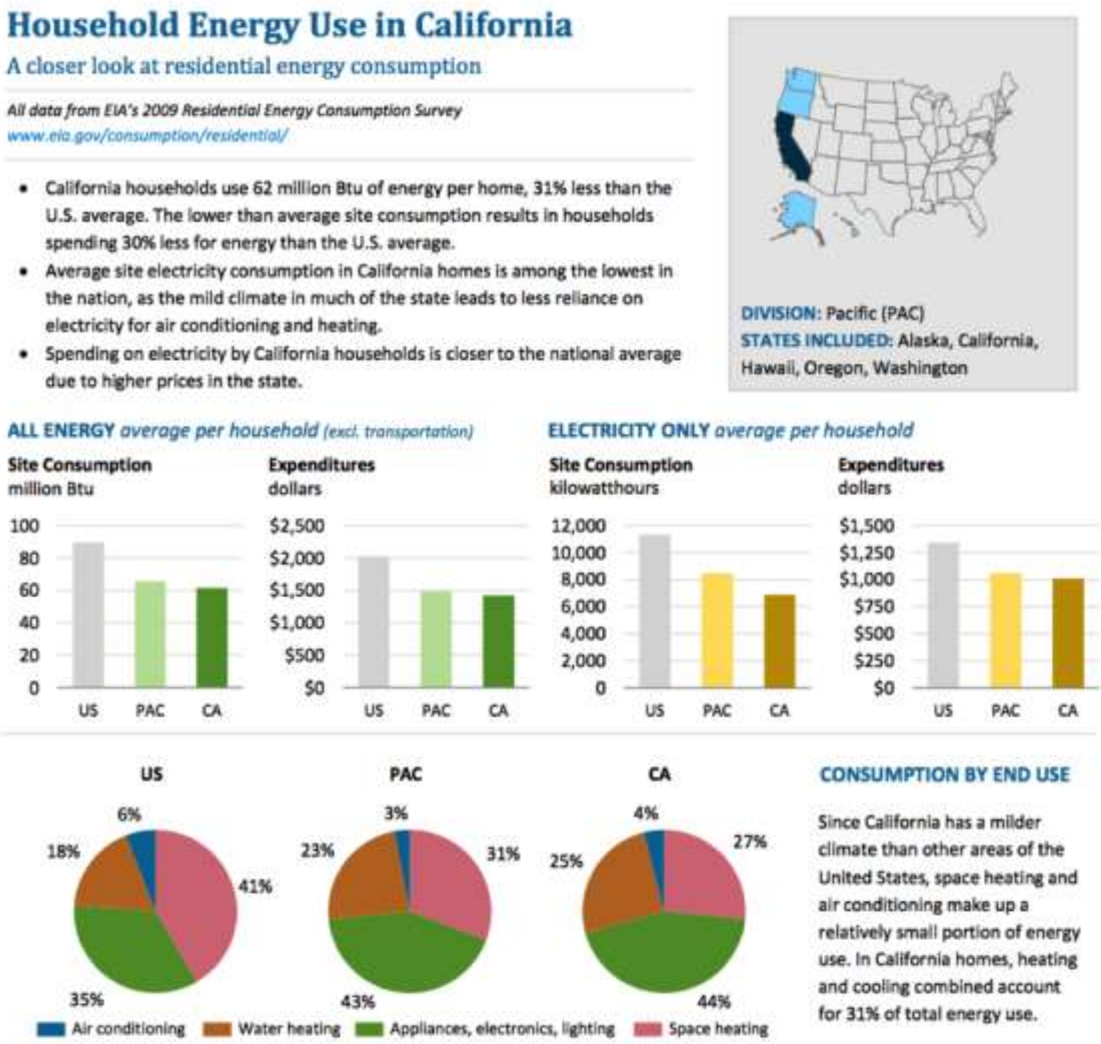
A New Way to Design

What California needs now

1. Stable Peak Load predictions for both summer and winter…
2. Absolute energy targets with reliable predictably reliable results
3. Utilities delivering all renewable energy

IMAGE credit: Chie Kawahara's Twitter feed – Sept.1st, 2017

California's current reality



Household Energy Use in California

A closer look at residential energy consumption

All data from EIA's 2009 Residential Energy Consumption Survey
www.eia.gov/consumption/residential/

- California households use 62 million Btu of energy per home, 31% less than the U.S. average. The lower than average site consumption results in households spending 30% less for energy than the U.S. average.
- Average site electricity consumption in California homes is among the lowest in the nation, as the mild climate in much of the state leads to less reliance on electricity for air conditioning and heating.
- Spending on electricity by California households is closer to the national average due to higher prices in the state.

DIVISION: Pacific (PAC)
STATES INCLUDED: Alaska, California, Hawaii, Oregon, Washington

CONSUMPTION BY END USE

Since California has a milder climate than other areas of the United States, space heating and air conditioning make up a relatively small portion of energy use. In California homes, heating and cooling combined account for 31% of total energy use.

- CA homes use 31% less than the U.S. average
- Expenditure for energy about the same as U.S. average
- 62M BTU energy use per home = 18,170 kWh
- Average size = 1,525 SF
- 60% Single Family Homes

Source: www.eia.gov/consumpion/residential

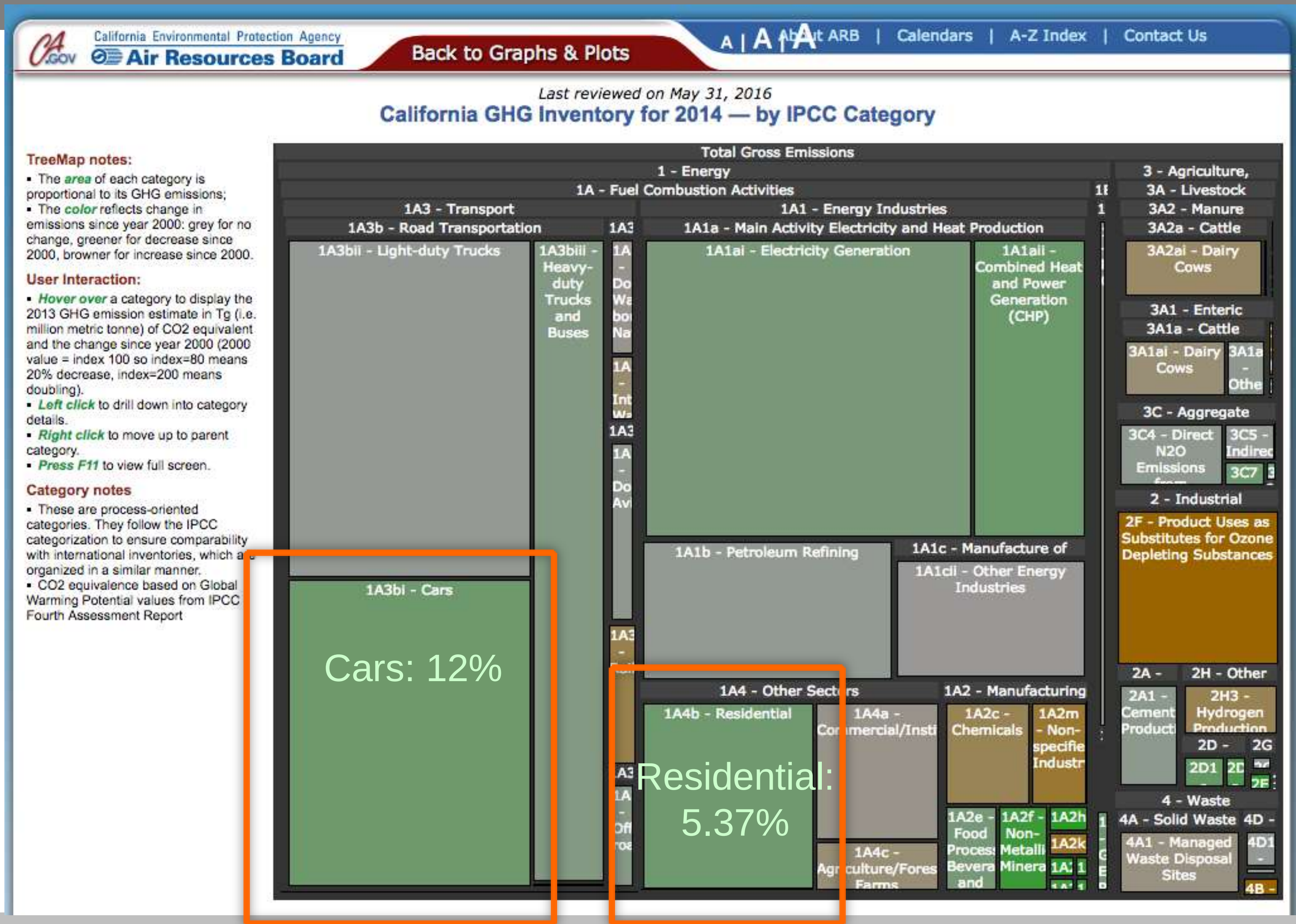
What that means in PV

Min. Required Roof Area = 780 SF
(Assuming 17.3 SF/panel)

Energy use: 18,170 kWh/yr

- Assume: 400 kWh/panel
- 12 kW PV Array
- = 45 panels!

California Carbon Emissions



LEAD BY EXAMPLE (A COUPLE OF MY OWN DESIGNS)

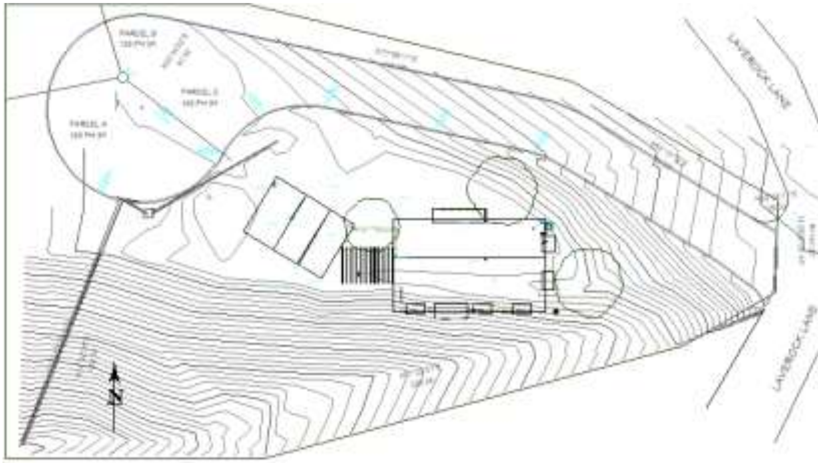
SOURCE: One Sky Homes

ALL ELECTRIC (INDUCTION COOKTOP & LED'S)

NOMINALY THIS IS A PLUS ENERGY HOME…

PROJECT STATS

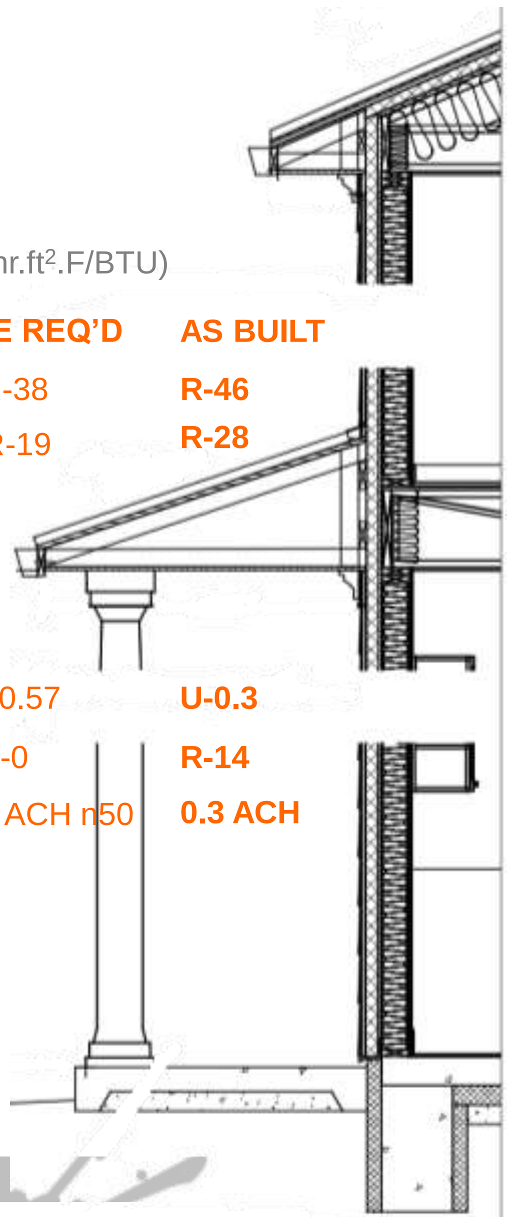
Alamo - CA Climate Zone 12		
HDD & CDD	2602	1578
Area & TFA	2968 SF	2342 SF
Net Annual Energy Use & Production	10,707 kWh	12,767 kWh
PV	7.5 kW	
Gas/Electric Split	All Electric	
Mech systems	Heat Pump, HRV	Heat Pump WH



COMPARED TO 2016 T-24 CODE REQUIREMENTS

ASSEMBLIES (hr.ft^2.F/BTU)

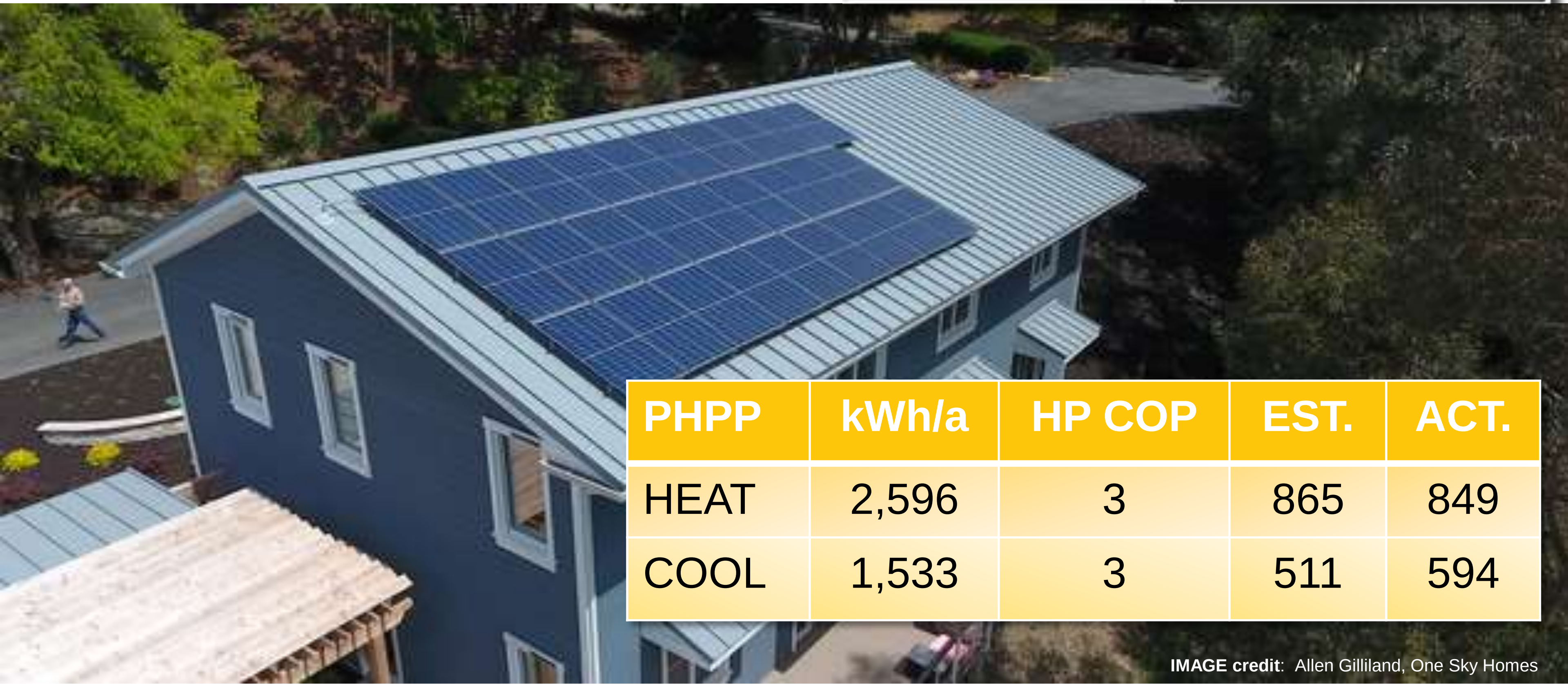
	CODE REQ'D	AS BUILT
ROOF/CLG:	R-38	**R-46**
WALLS:	R-19	**R-28**
WINDOWS:	U-0.57	**U-0.3**
FLOOR/SLAB:	R-0	**R-14**
AIR TIGHTNESS:	3 ACH n50	**0.3 ACH**



MY PHPP MODEL IS INSANELY ACCURATE!

NO PERFORMANCE GAP!

Treated floor area	217.6	m²
Heating demand	12	kWh/(m²a)
Heating load	10	W/m²
ecif. space cooling demand	7	kWh/(m²a)
Cooling load	7	W/m²
g (> 23.3333333333333 °C)		%



PHPP	kWh/a	HP COP	EST.	ACT.
HEAT	2,596	3	865	849
COOL	1,533	3	511	594

IMAGE credit: Allen Gilliland, One Sky Homes

WITH NET METERING MY NUMBERS LOOK GREAT!

BUT PRACTICALLY THIS HOME STILL NEEDS A UTILITY!

Passive House verification

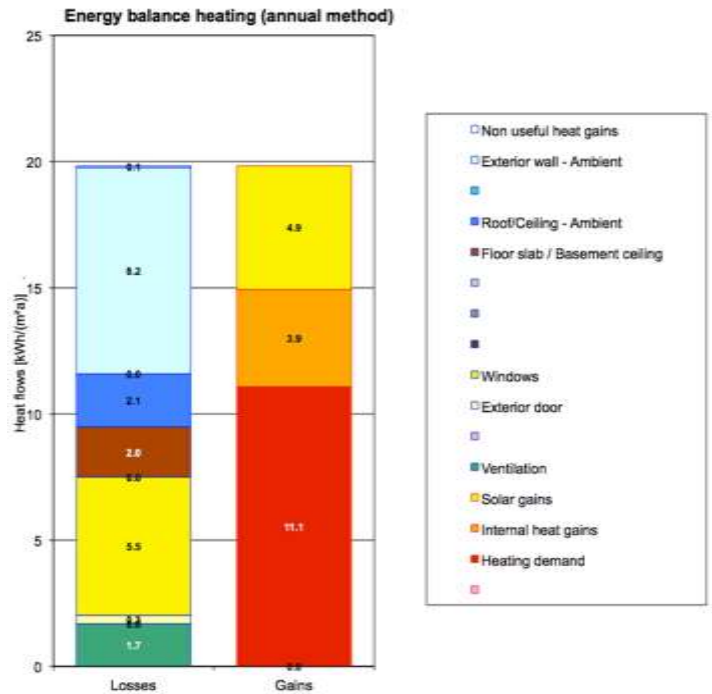
Building:	Alamo Haus le Fangsi				
Street:	xxxx Laverock Lane				
Postcode / City:	Alamo, CA				
Country:	USA				
Building type:	Single Family Residence				
Climate:	CA, San Jose				
Home owner / Client:	Dennis Huang and Lynn Ito				
Street:					
Postcode/City:					
Architecture:	One Sky Homes - Bronwyn Barry				
Street:	Glenkirk Avenue				
Postcode / City:	San Jose, CA				
Mechanical system:	One Sky Homes - Allen Gilliland				
Street:	Glenkirk Avenue				
Postcode / City:	San Jose, CA				
Year of construction:	2015	Interior temperature winter:	21.1 °C	Enclosed volume V_e m³	1055.0
No. of dwelling units:	1	Interior temperature summer:	23.3 °C	Mechanical cooling:	x
No. of occupants:	6.2	Internal heat sources winter:	2.1 W/m²		
Spec. capacity:	60 Wh/K per m² TFA	Ditto summer:	4.0 W/m²		

Specific building demands with reference to the treated floor area

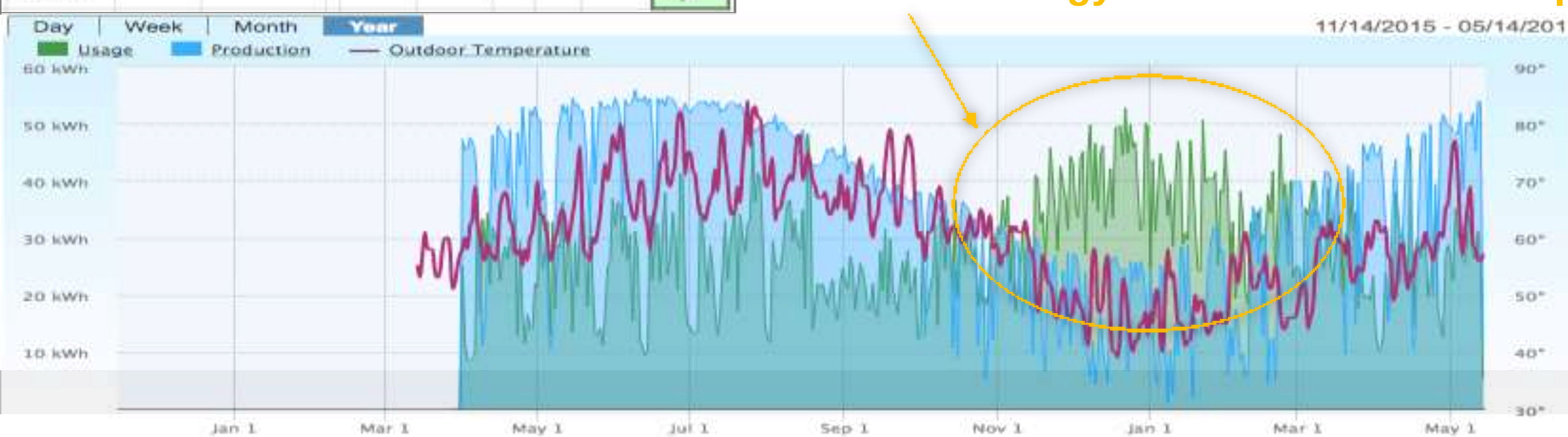
			Requirements	Fulfilled?*
	Treated floor area	217.4 m²		
Space heating	Heating demand	12 kWh/(m²a)	15 kWh/(m²a)	yes
	Heating load	10 W/m²	10 W/m²	yes
Space cooling	Overall specif. space cooling demand	7 kWh/(m²a)	15 kWh/(m²a)	yes
	Cooling load	7 W/m²	-	-
	Frequency of overheating (> 23.3333333333333 °C)	%	-	-
Primary energy	Heating, cooling, dehumidification, DHW, auxiliary electricity, lighting, electrical appliances	74 kWh/(m²a)	120 kWh/(m²a)	yes
	DHW, space heating and auxiliary electricity	19 kWh/(m²a)	-	-
	Specific primary energy reduction through solar electricity	kWh/(m²a)	-	-
Airtightness	Pressurization test result n_{50}	0.3 1/h	0.6 1/h	yes

* empty field: data missing; '-': no requirement

Passive House?	yes



Annual Energy Use vs Generation Gap

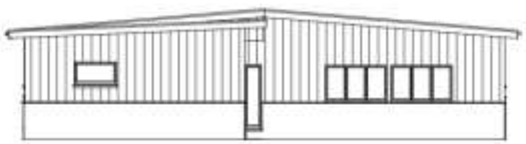


What About Retrofits?

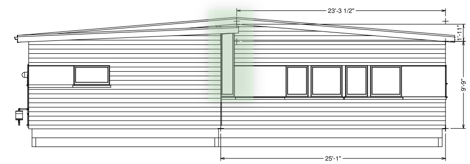

SUNNYVALE

Where we started

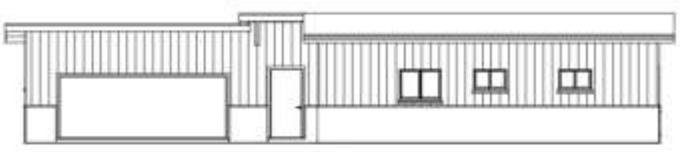
Elevations



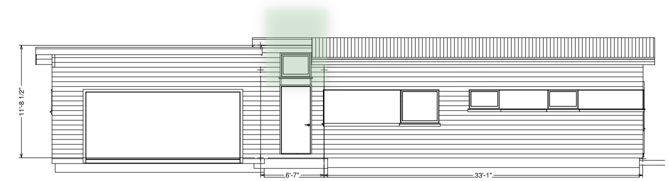
FRONT ELEVATION (SE)



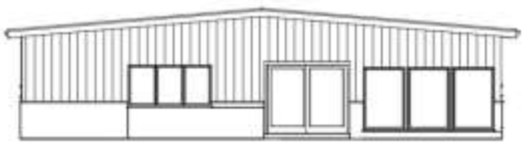
FRONT - SOUTH EAST



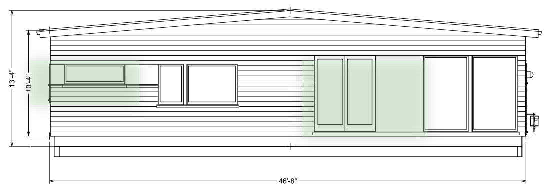
SIDE ELEVATION (NE)



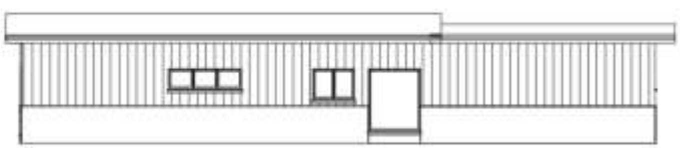
SIDE - SOUTH EAST



REAR ELEVATION (NW)



REAR - SOUTH WEST



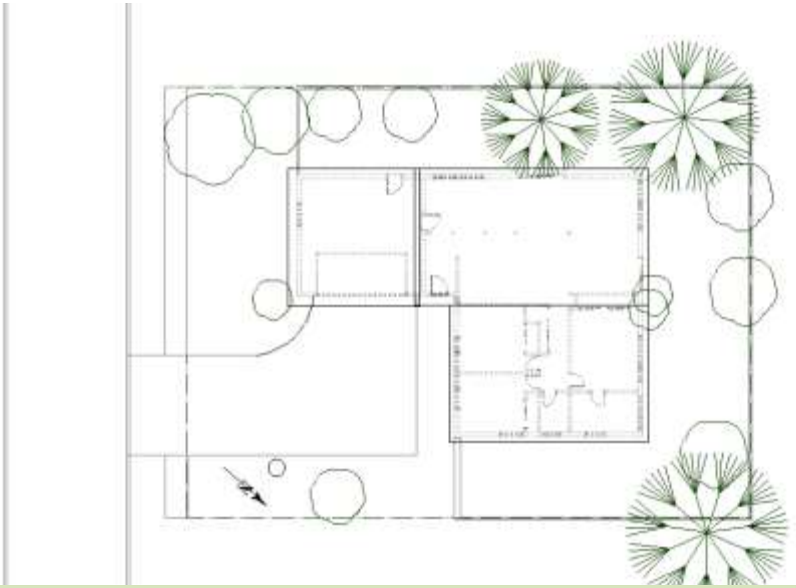
SIDE ELEVATION (SW)

SIDE - SOUTH WEST

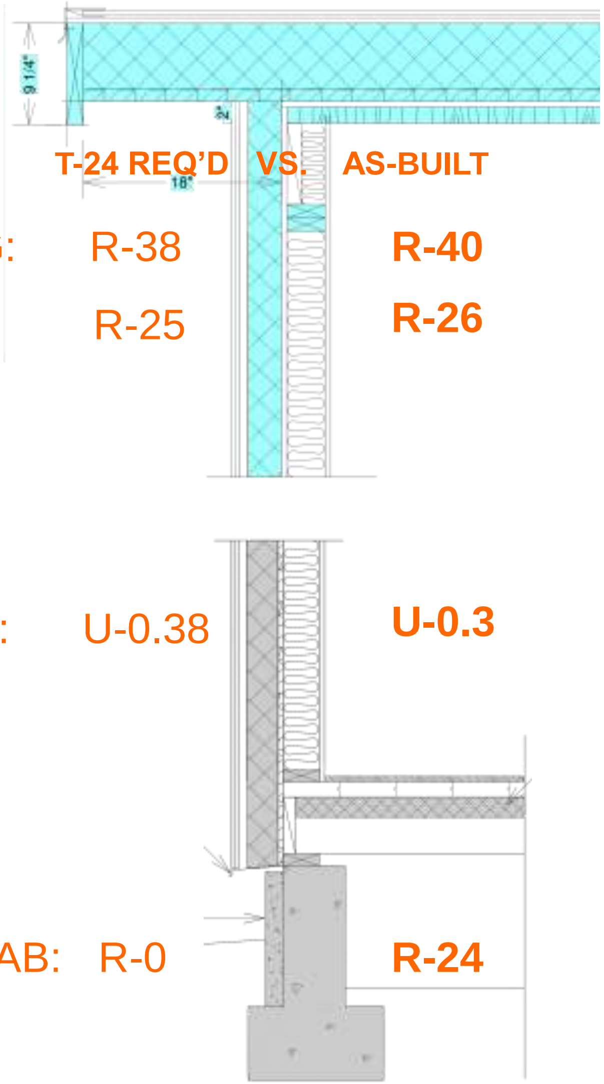
BEFORE AFTER

PROJECT STATS

Sunnyvale - CA Climate Zone 3		
HDD/CDD	2643	220
Area/TFA	2000 SF	1560 SF
Net Annual Energy Use & Production	5,765 kWh/yr	none
Gas/Electric Split	Gas Cooking, DHW	
HVAC systems	1 ton Fujitsu HP & Panasonic Bath Fans, HRV	



ASSEMBLIES (hr.ft^2.F/BTU)



	T-24 REQ'D	VS. AS-BUILT
ROOF/CLG:	R-38	**R-40**
WALLS:	R-25	**R-26**
WINDOWS:	U-0.38	**U-0.3**
FLOOR/SLAB:	R-0	**R-24**

MEASURED SAVINGS:

- $499 per year energy cost
- 40% Source Energy

	Pre Retrofit	Post Retrofit	Annual Savings
Electricity			
Space Heating (kWh/yr)	510	718	-208
Space Cooling (kWh/yr)	0	90	-90
Total Electricity (kWh/yr)	5,636	5,765	-129
Natural Gas			
Space Heating (therms)	510	0	510
Total Natural Gas (therms)	654	150	504
Source Energy (MMBtu/yr)[1]	132	78	54
Utility Cost[2]	$1,473	$974	$499

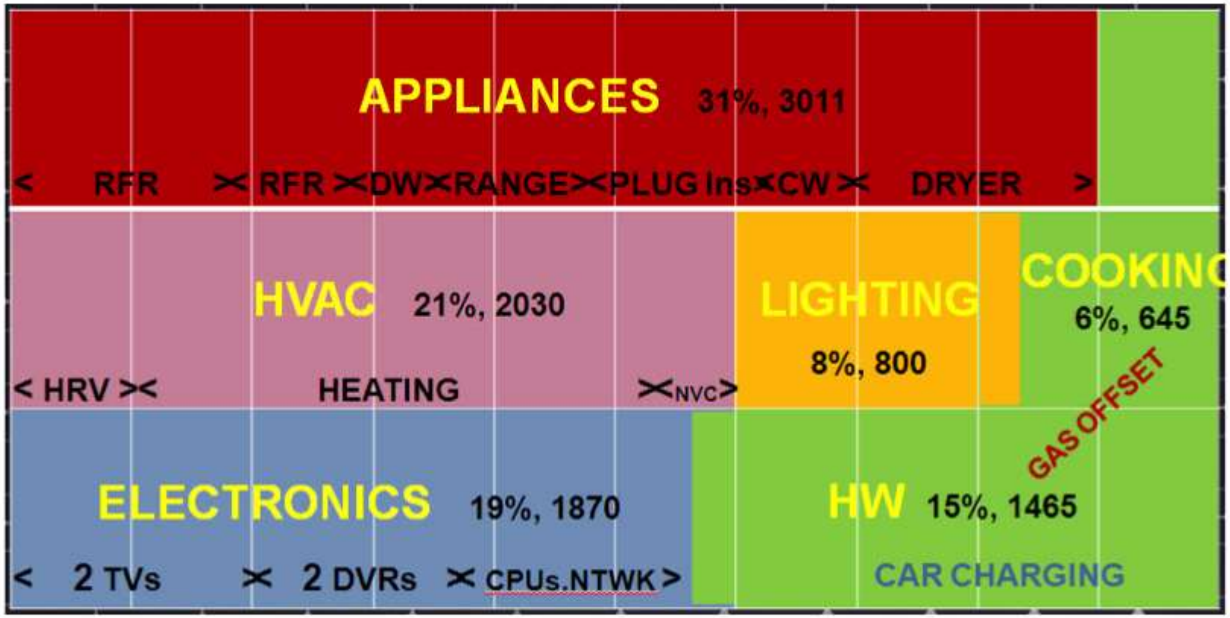
[1]Source multipliers of 3.15 for electricity and 1.09 for natural gas based on BEopt v2.2

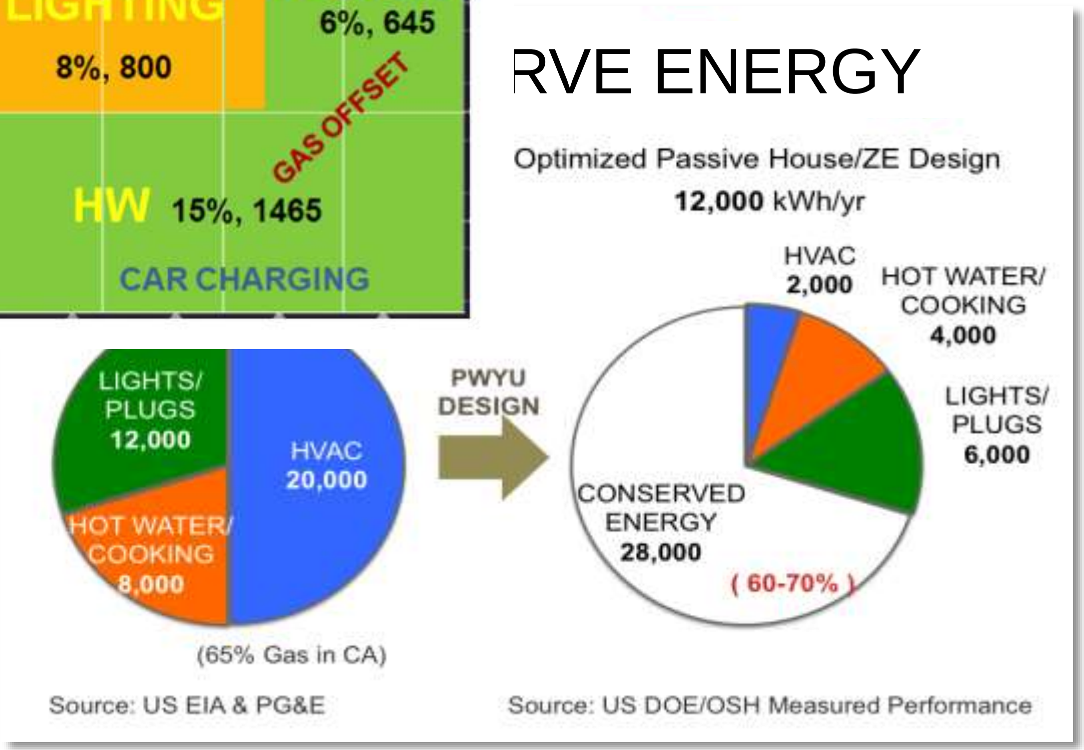
[2]Utility rates for PG&E rate based on averages from actual utility bills of 1.03/Therm and 0.14 /kWh.

Table 9: Annual Site and Source Energy Savings Normalize to TMY3
Source: http://www.nrel.gov/docs/fy15osti/63085.pdf


COTTLE

Breaking Down Net Zero

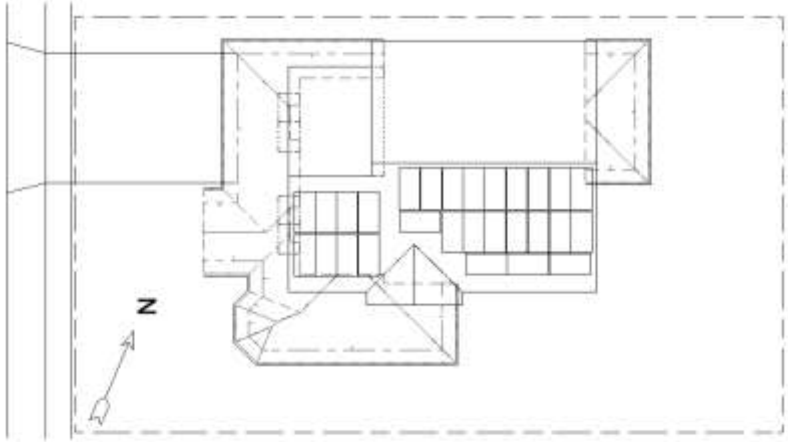




- 3,200 SF home (family of 5)
- 28 PV Panels (6.2 kW)
- 11,100 kWh production

PROJECT STATS

Cottle - CA Climate Zone 3		
HDD/CDD	2335	574
Area/TFA	3200 SF	2776 SF
Net Annual Energy Use & Production	9356 kWh	11,100 kWh
PV		6.2 kW
Gas/Electric Split	Gas Cooking, Solar Hot Water with backup	
	Heat Pump, NightBreeze Cooling, Solar Thermal Hot	



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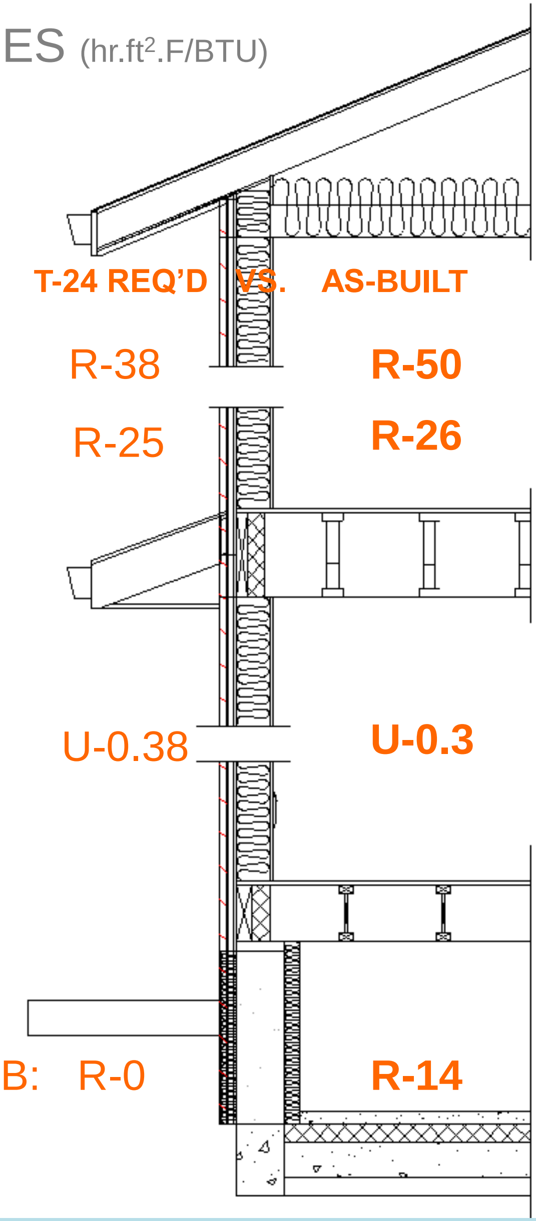
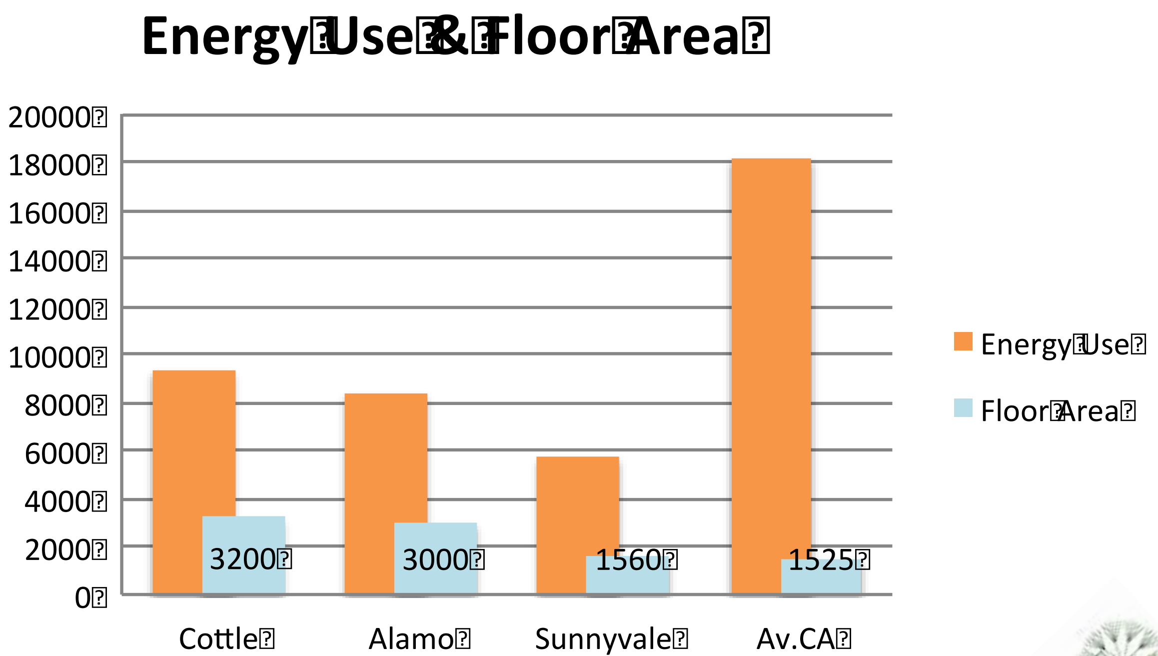
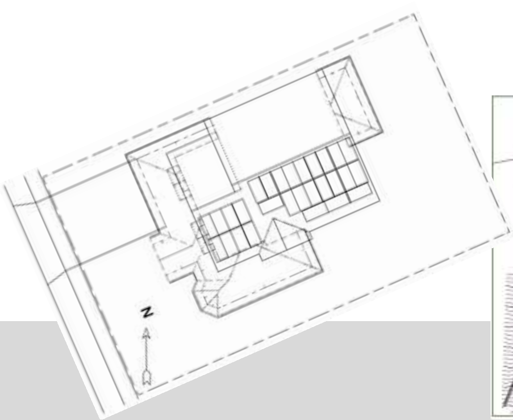
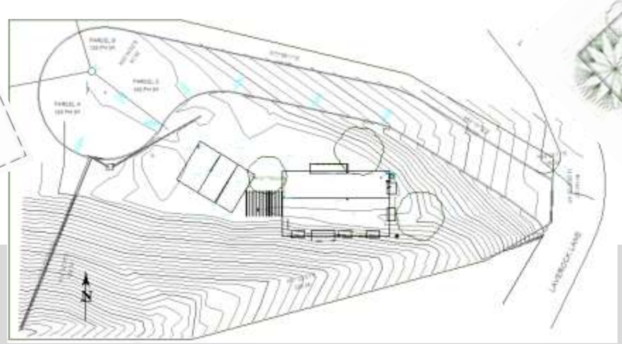


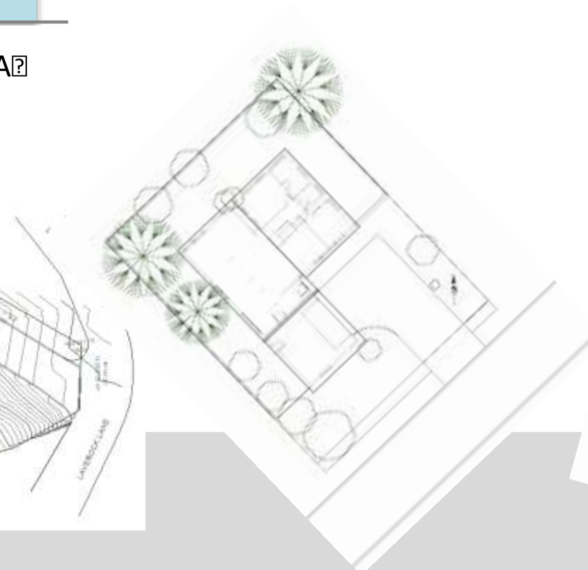
	T-24 REQ'D	VS.	AS-BUILT
ROOF/CLG:	R-38		**R-50**
WALLS:	R-25		**R-26**
WINDOWS:	U-0.38		**U-0.3**
FLOOR/SLAB:	R-0		**R-14**

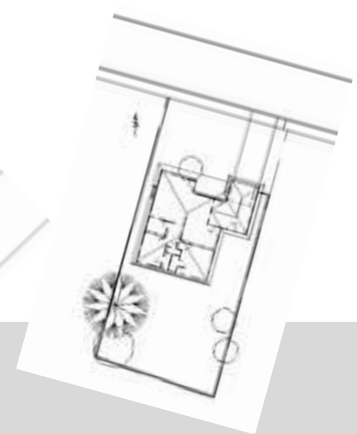
Comparing these homes





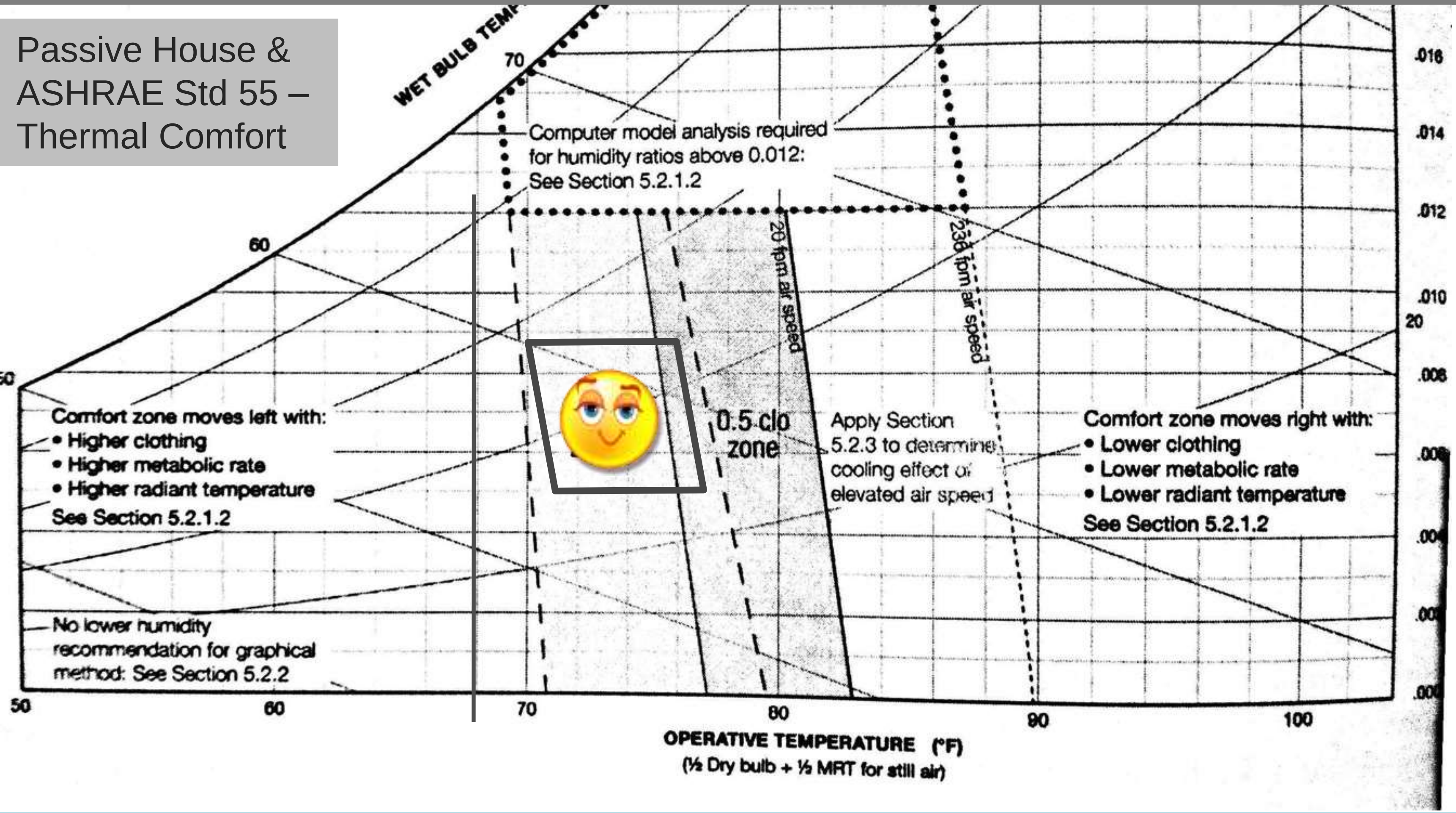






Target COMFORT (not energy)

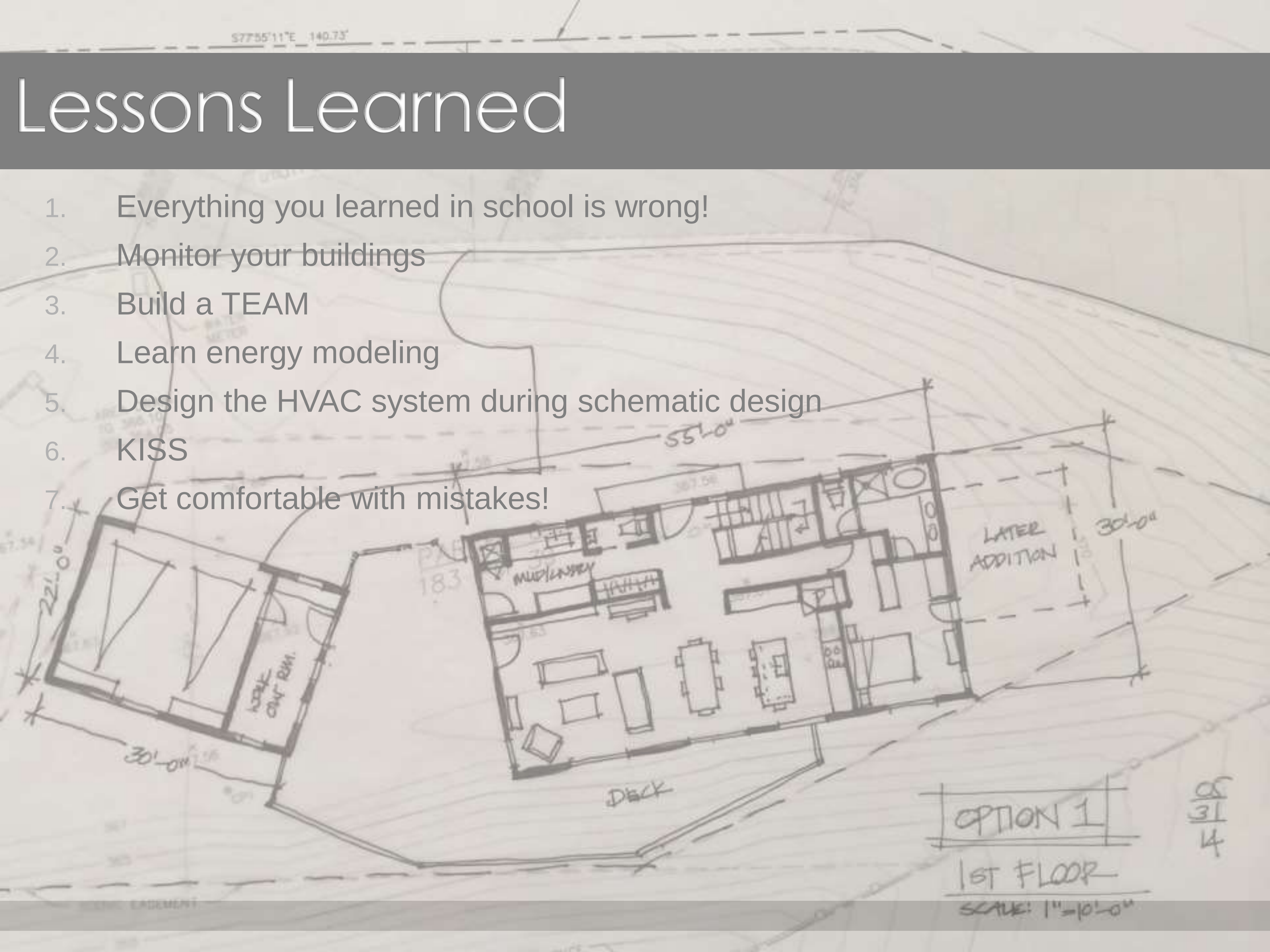
Passive House & ASHRAE Std 55 – Thermal Comfort



NONE of our clients have asked us to lower their energy bills.
ALL have asked for better comfort or to eliminate mold.

Lessons Learned

1. Everything you learned in school is wrong!
2. Monitor your buildings
3. Build a TEAM
4. Learn energy modeling
5. Design the HVAC system during schematic design
6. KISS
7. Get comfortable with mistakes!



Lessons Learned

- Windows (+ Shading) Matter
- Air sealing gets you half way there
- Roof Design and Form factor are HUGE
- Drive your own energy model!

THANK YOU!

Bronwyn Barry, CPHD

Passive House BB

PH CA naphn North American Passive House Network

www.passivehousecal.org

www.naphnetwork.org

Regional Groups Working in Cooperation

NAPHN: A Continental Network

Passive House Northwest PHnw

PASSIVEHOUSE CANADA

maison passive québec

passivhaus MAINE

PH CA PASSIVE HOUSE CALIFORNIA

phmn PASSIVE HOUSE MINNESOTA

NYPH NEW YORK PASSIVE HOUSE

vermont passive house

PHRM PASSIVE HOUSE ROCKY MOUNTAINS

NORTH AMERICAN CERTIFIERS CIRCLE PASSIVE HOUSE CERTIFIER

PHWPA PASSIVE HOUSE WESTERN PA

GPPHA GREATER PHILADELPHIA PASSIVE HOUSE ASSOCIATION

in support of professionals working with the
international Passive House Standard

Passive House Institute

International PASSIVE HOUSE Association iPHA

2017 NAPHN CONFERENCE & EXPO

Attend the Conference

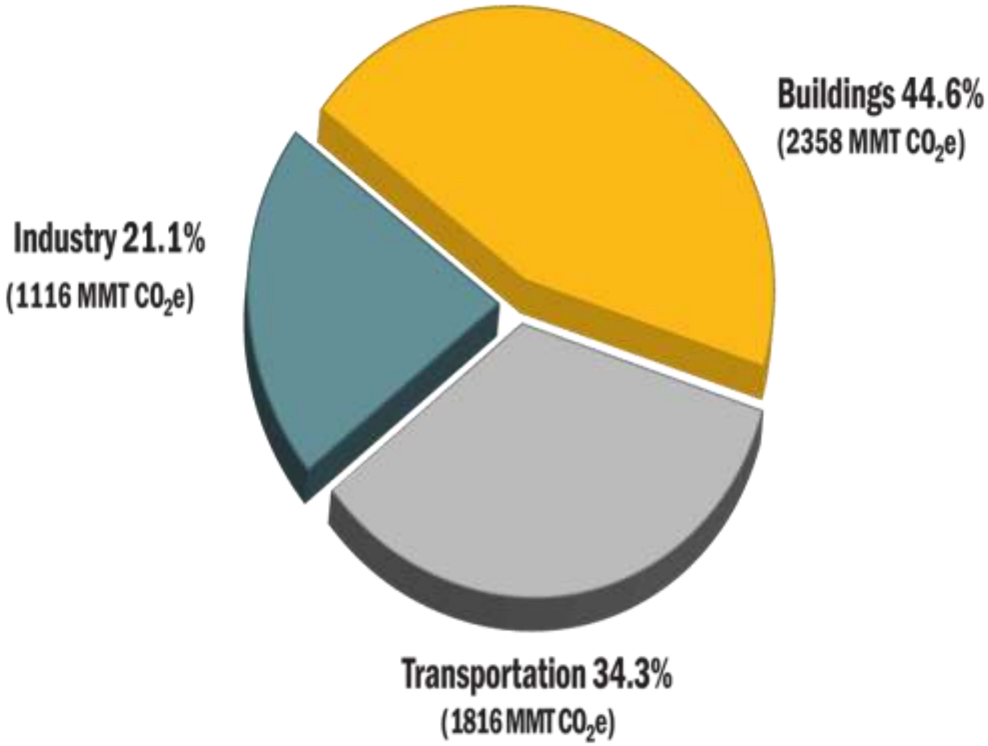
naphn 17 North American Passive House Network

PASSIVE+ RENEWABLES

OCT. 4-8, 2017
OAKLAND, CALIFORNIA

www.naphnconference.com

US CO2 Emissions



U.S. CO_2 Emissions by Sector

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

California's State Mandate

"The state and nation must be aggressive about setting goals, such as having zero-net-energy residential buildings by 2020 and commercial buildings by 2030."

-Gov. Jerry Brown

2012

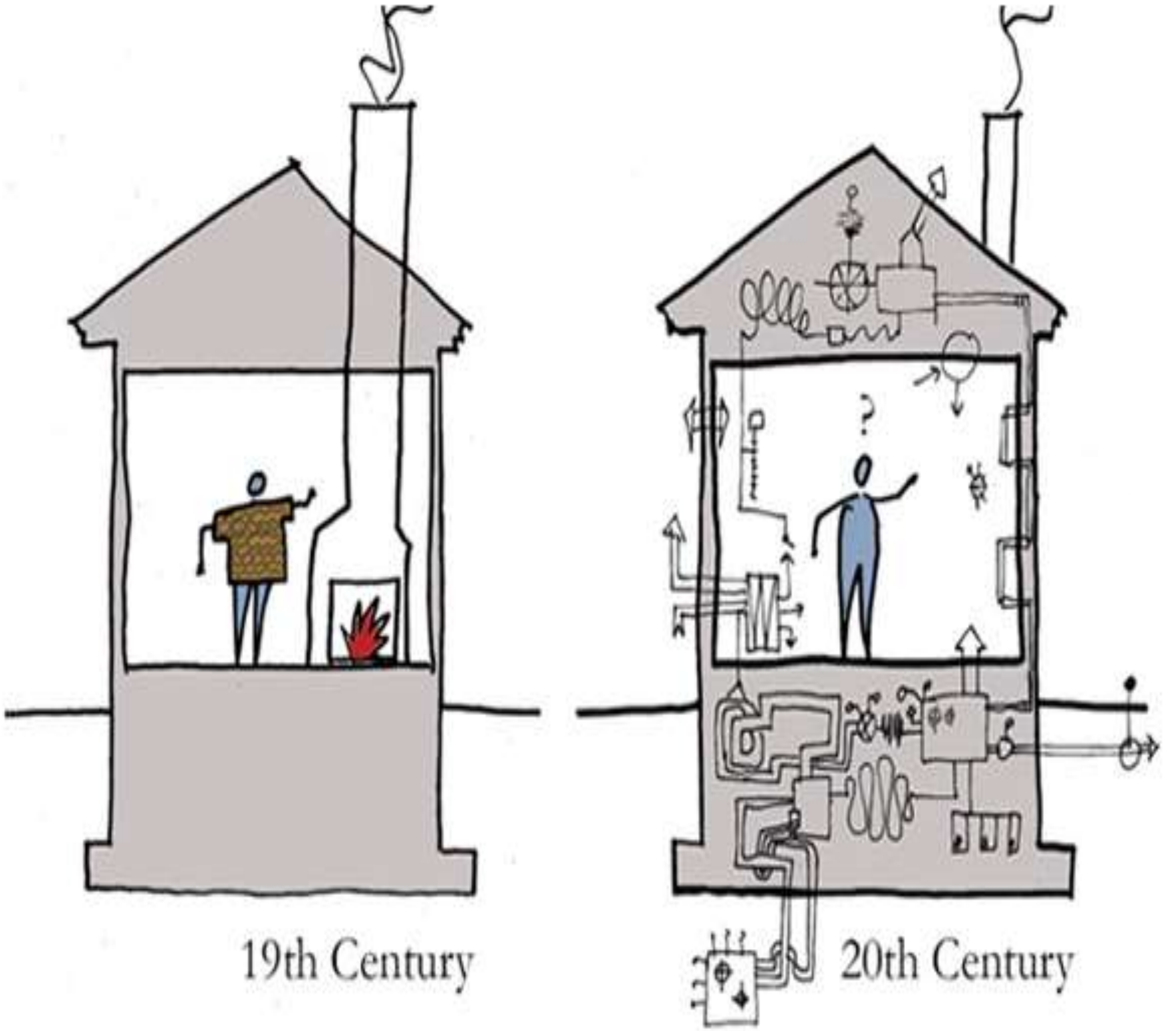
“Big Bold” goals for ZNE in California

2020	100% ZNE residential new construction
2030	100% ZNE commercial new construction
	50% ZNE retrofits of existing buildings

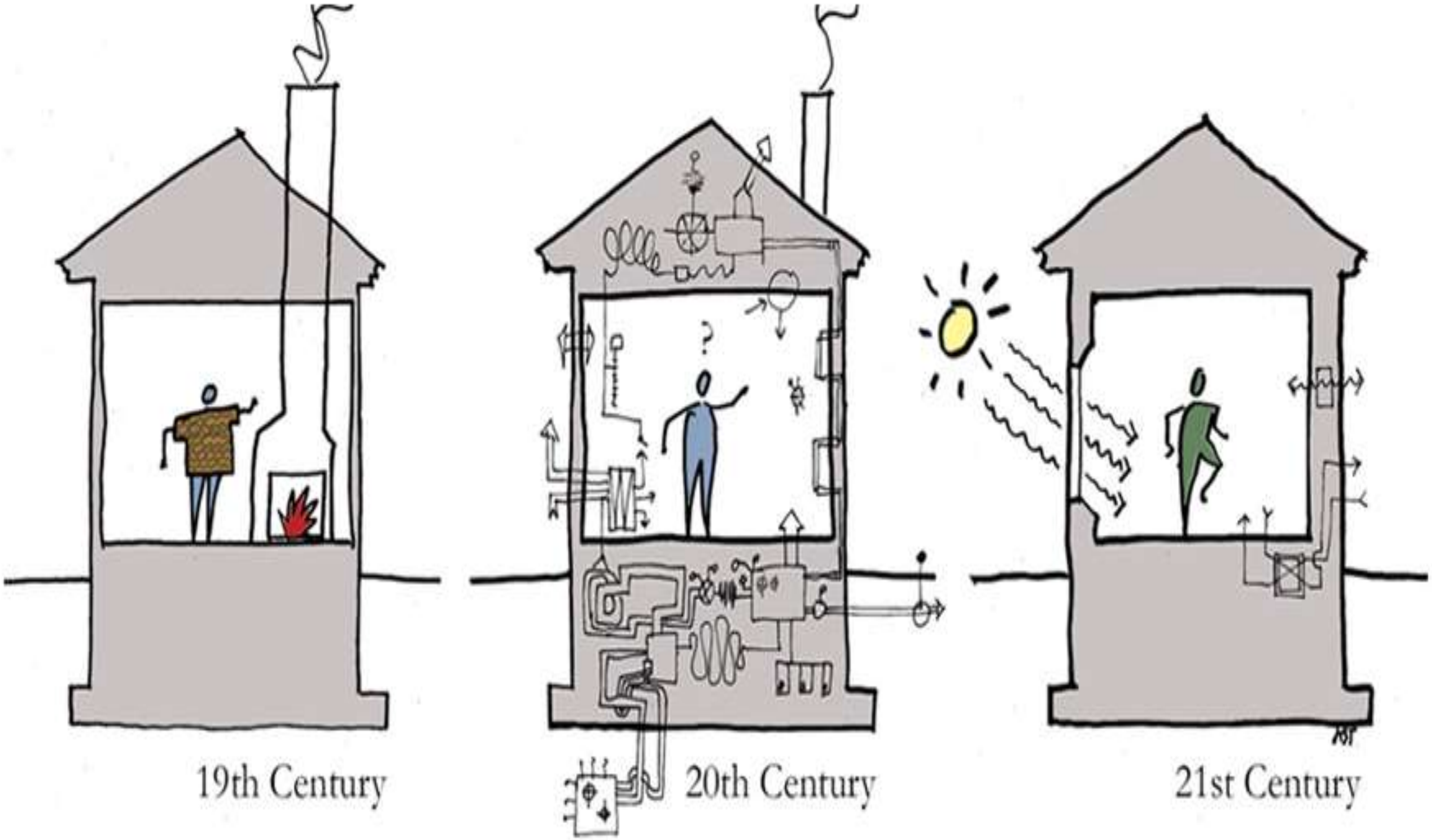
Passive House 101

Passive House 101

19th Century



Albert, Righter & Titman Architects



Albert, Righter & Titman Architects

Passive House in 90 seconds

Click to open video

Passive House Myths

- It's only for single-family homes.
- Airtight buildings have bad air quality.
- You can't open the windows in a PH building.
- PH buildings are blocky and ugly.
- You don't need mechanical systems in PH buildings.
- CA energy code is so strict! We don't need PH.
- PH is overkill for mild California climate.

Passive House Myths

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FALSE

Passive House is the path to **Net Zero**.

What Do We Want From Our Buildings?

use **less energy**

be **more comfortable**

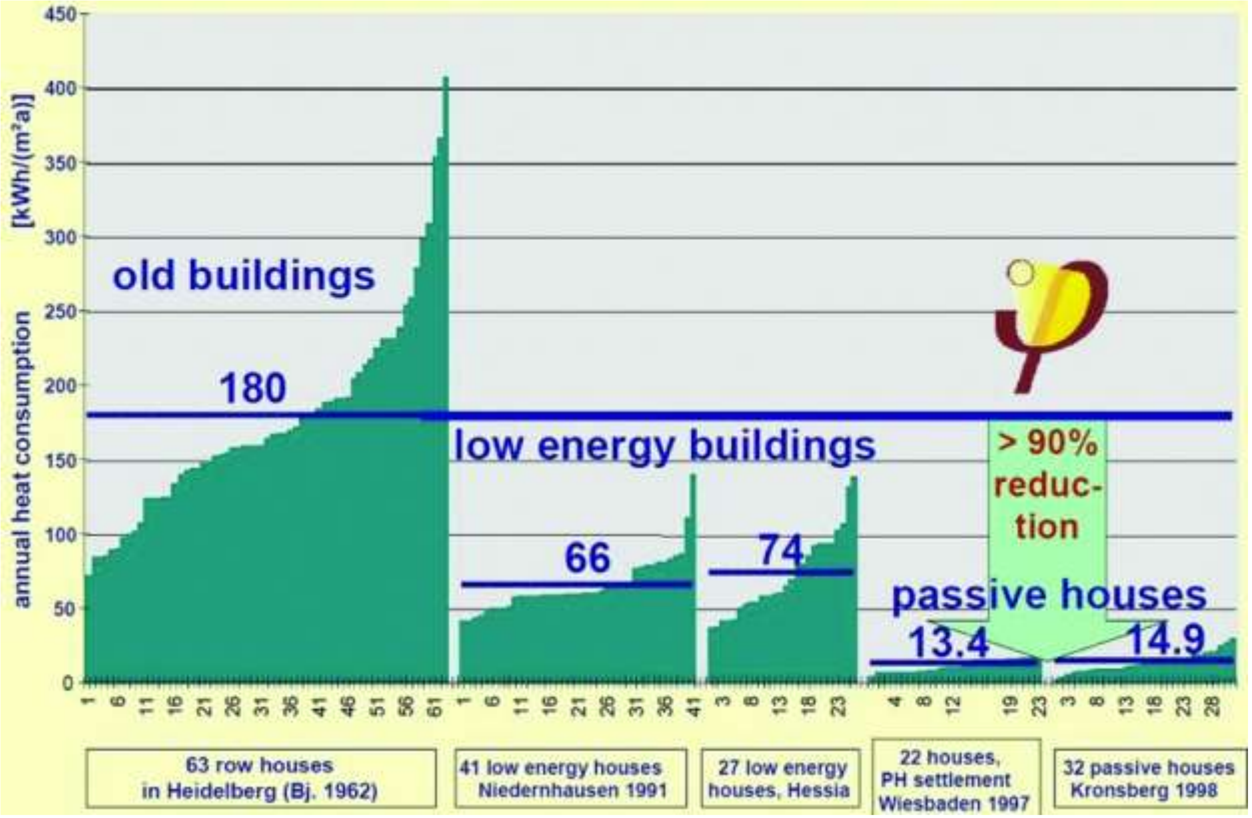
be **healthier**

be **more resilient**

Use Less Energy

Approx **90%** reduction in heating & cooling

Up to **75%** reduction in total energy usage.



Be More Comfortable

More comfortable with steady surface temperature on all surfaces and no drafts

Quiet even in a noisy city

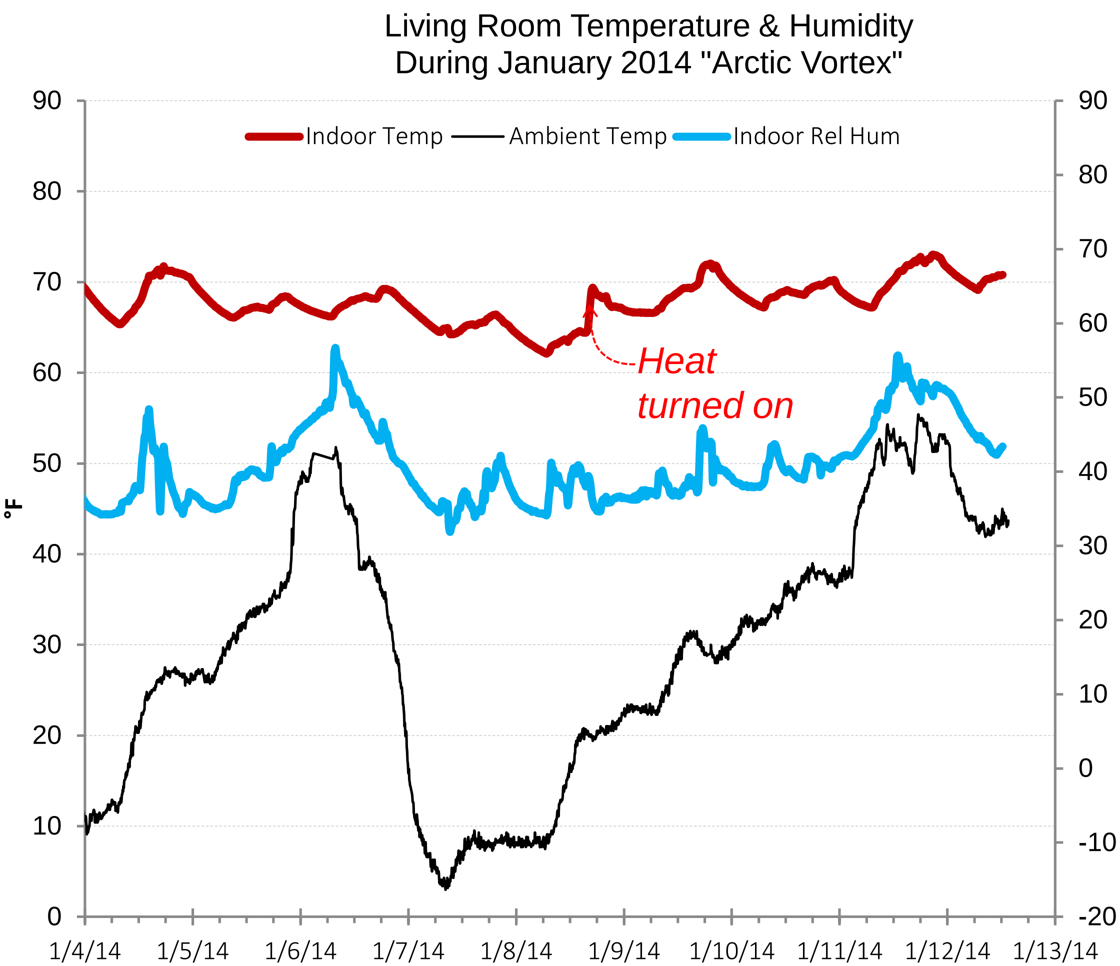
Be Healthier

Cleaner and fresher air. Inside air is completely exchanged with filtered outside.

No mold or moisture problems thanks to reduced thermal bridging and superior ventilation.

Healthier homes, healthier people with fewer respiratory illnesses and relief for asthma sufferers.

Be More Resilient



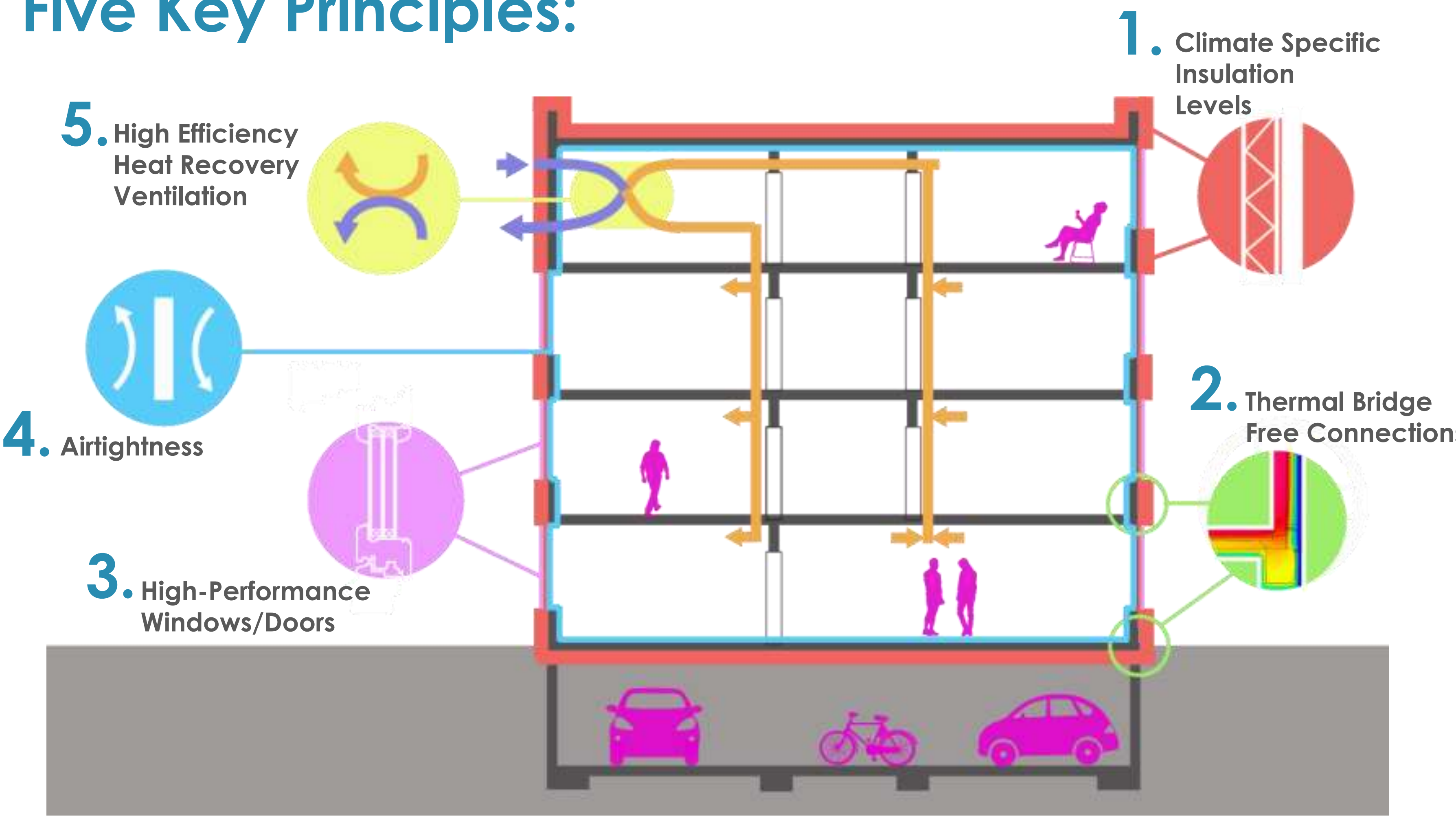
Cramer Silkworth, Baukraft Engineering, Brooklyn, NY

SUPPORTS RENEWABLES TRANSITION

- **Path to Net-Zero Buildings & more.**
- Allows switching to all electric buildings.
- More even utility demand profile.
- Primary Energy Renewable (PER) Calculation optimizes building energy use for 100% renewable grid.

INTEGRATED METHODOLOGY

Five Key Principles:



1. CONTINUOUS INSULATION

Insulation levels are climate dependent.

(Think of temperature rated sleeping bags.)

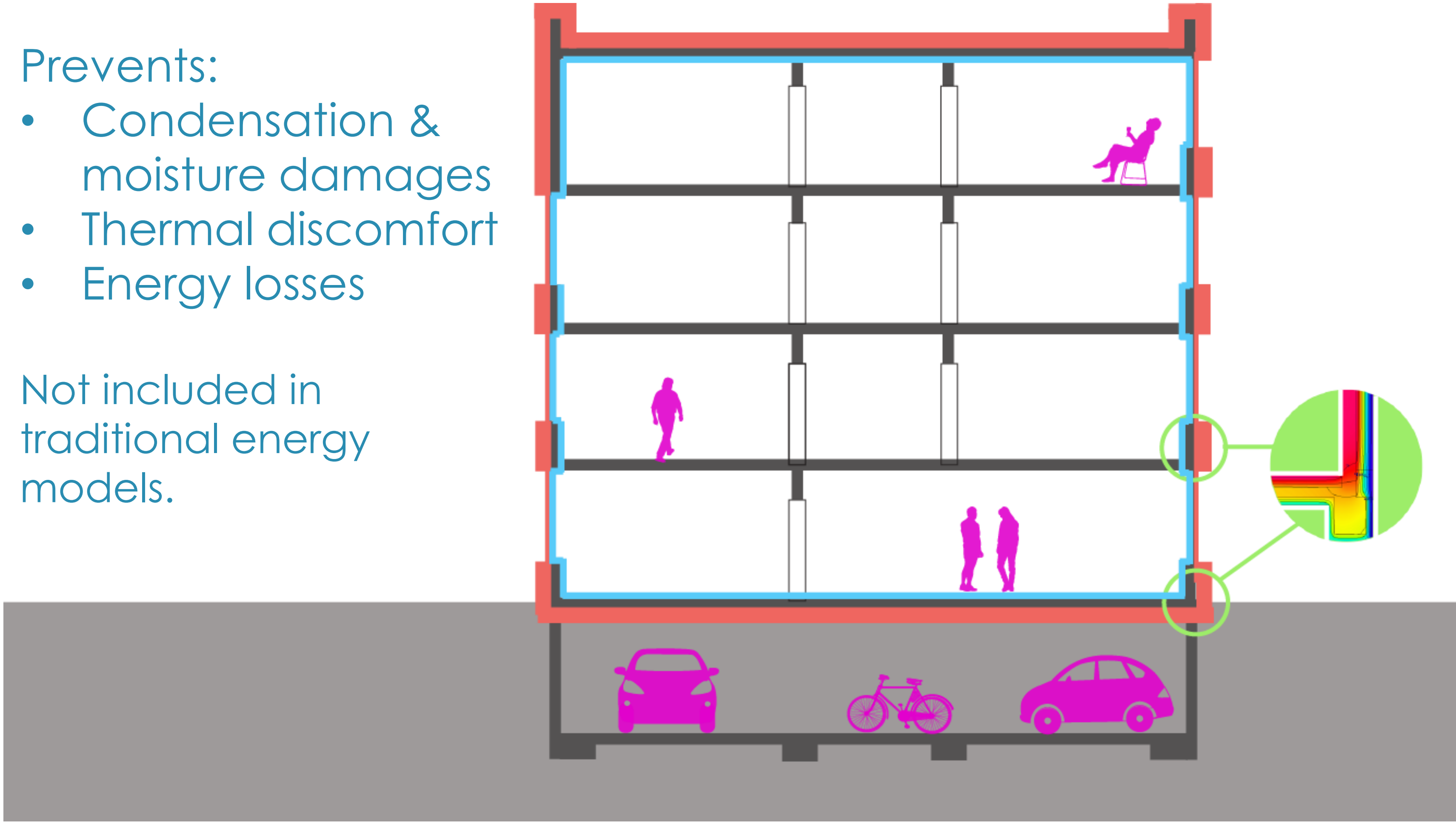
Surrounding enclosed space like a parka.

2. NO THERMAL BRIDGES

Prevents:

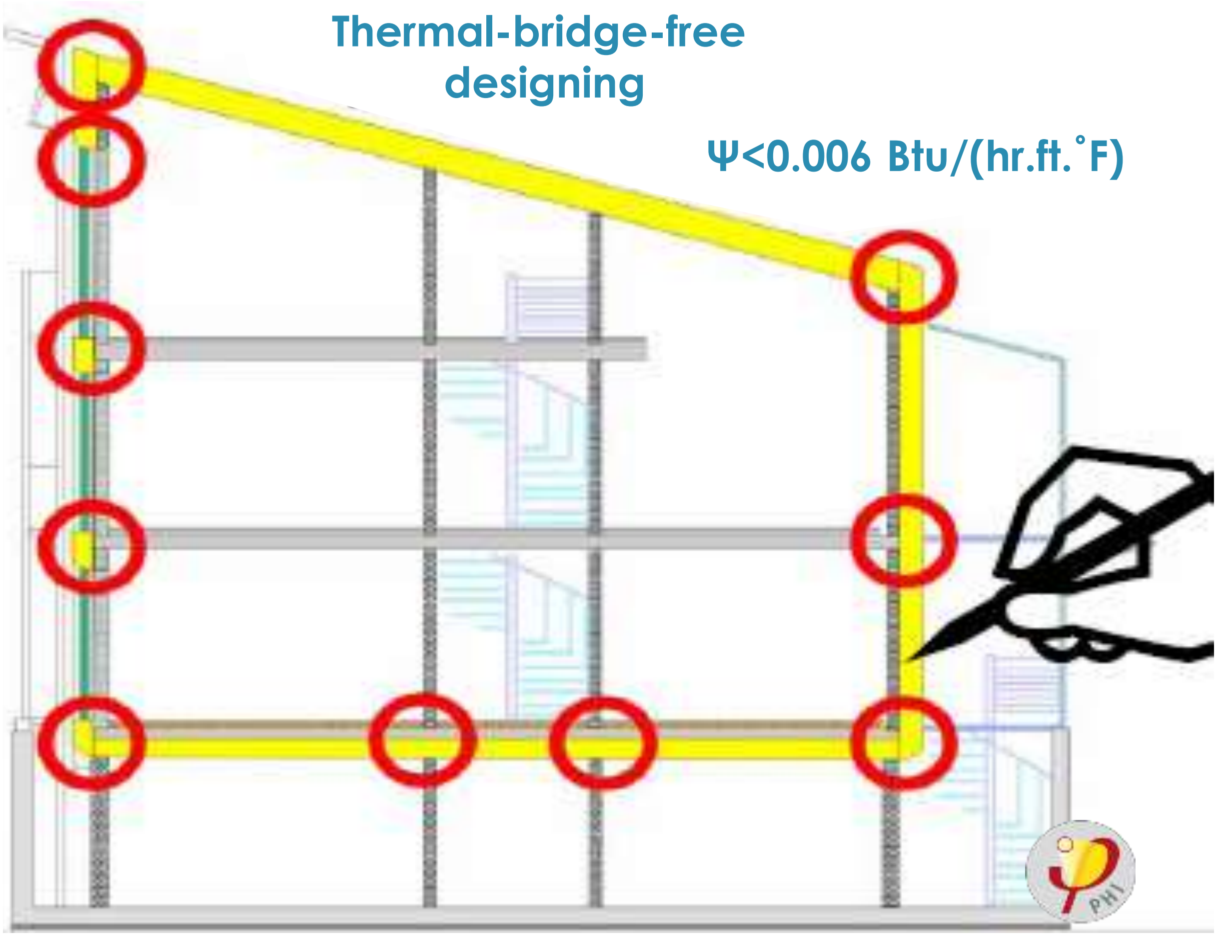
- Condensation & moisture damages
- Thermal discomfort
- Energy losses

Not included in traditional energy models.



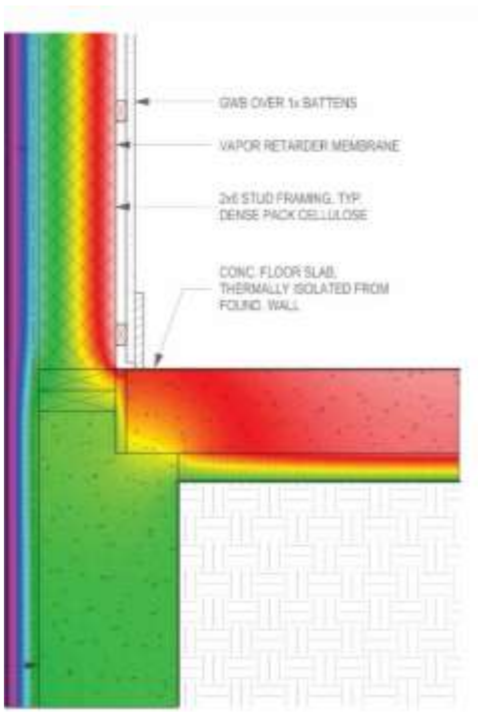
Eliminate and calculate: lowers risks and increases predictability.

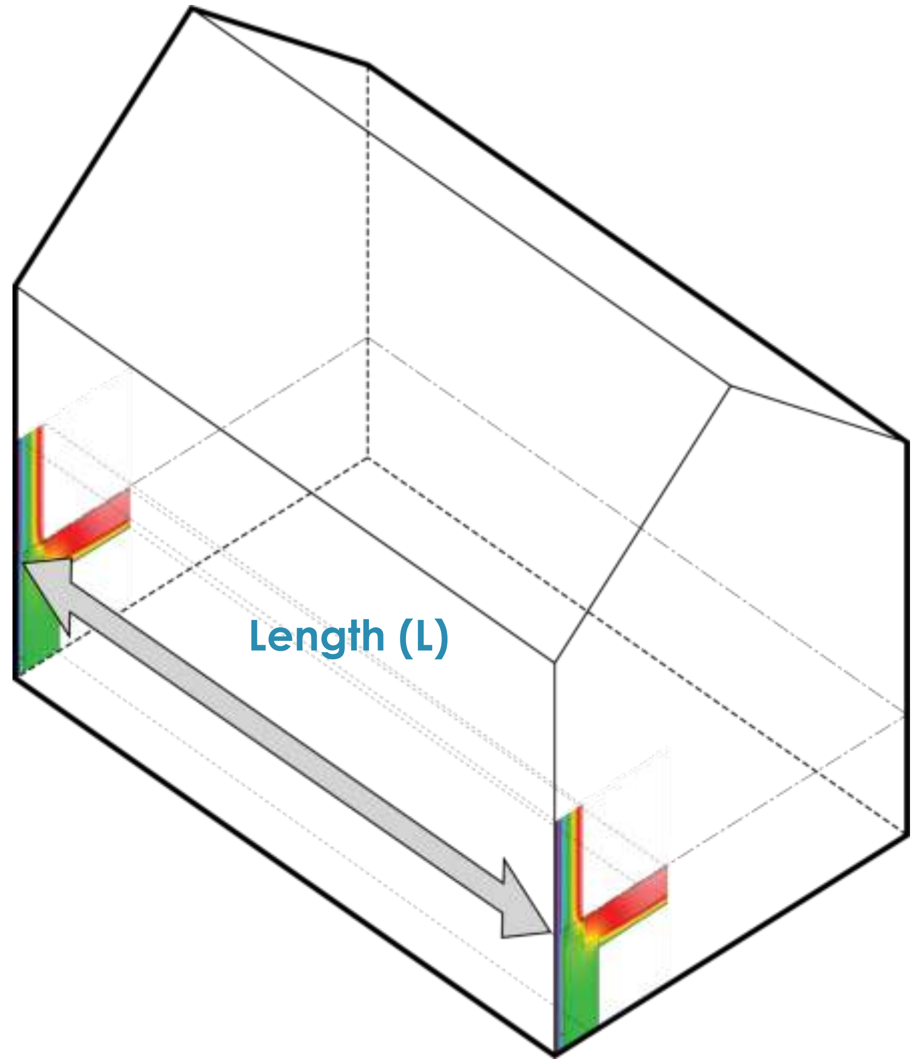
The Pencil Rule



Source: PHI, Author: JS

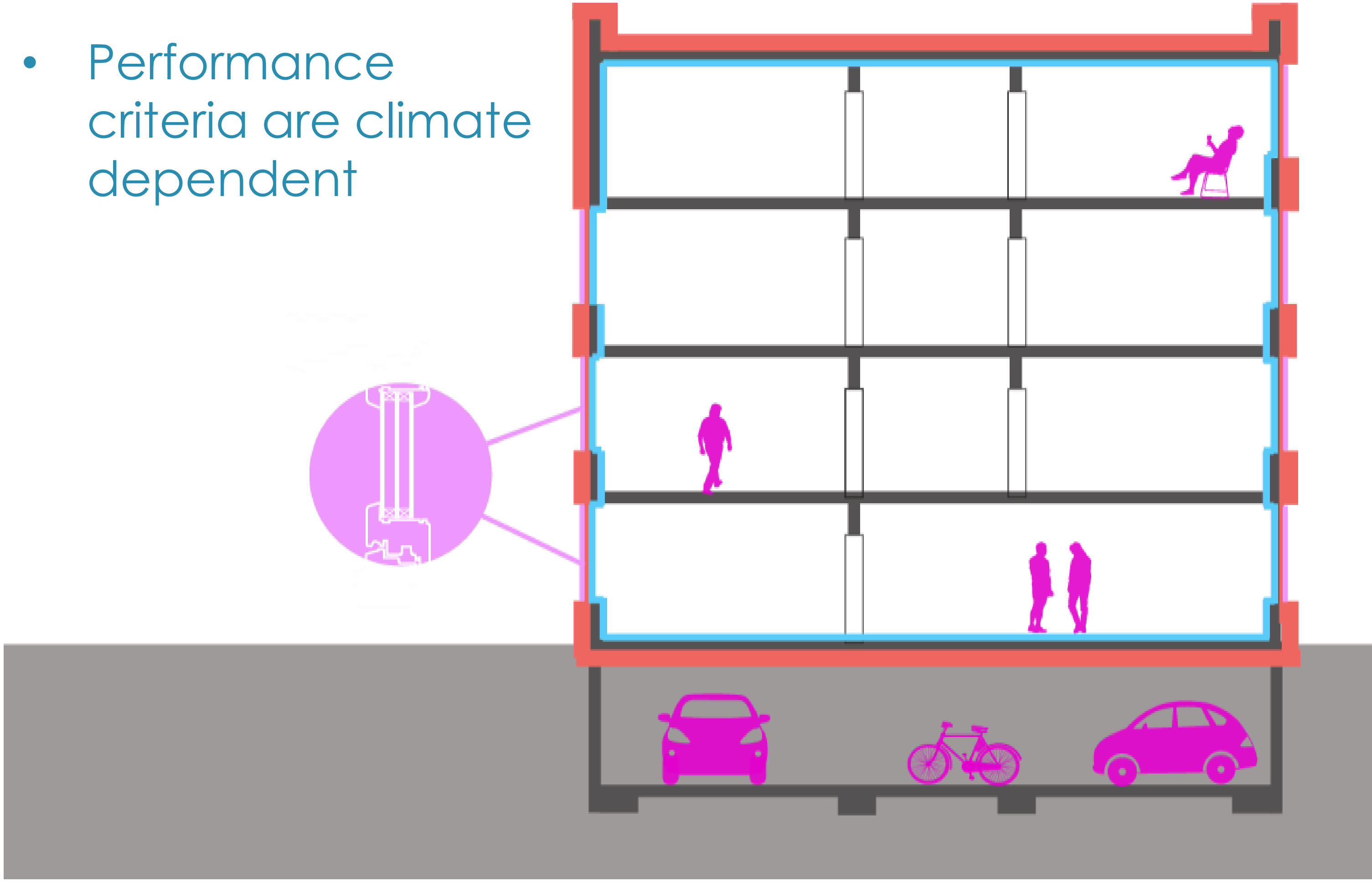
LINEAR THERMAL BRIDGES (PSI VALUE)

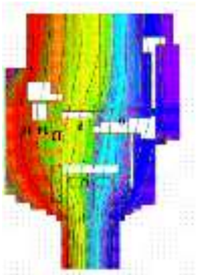


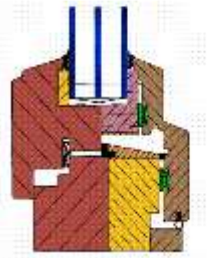


3. INTEGRATED WINDOWS & DOORS

- Performance criteria are climate dependent

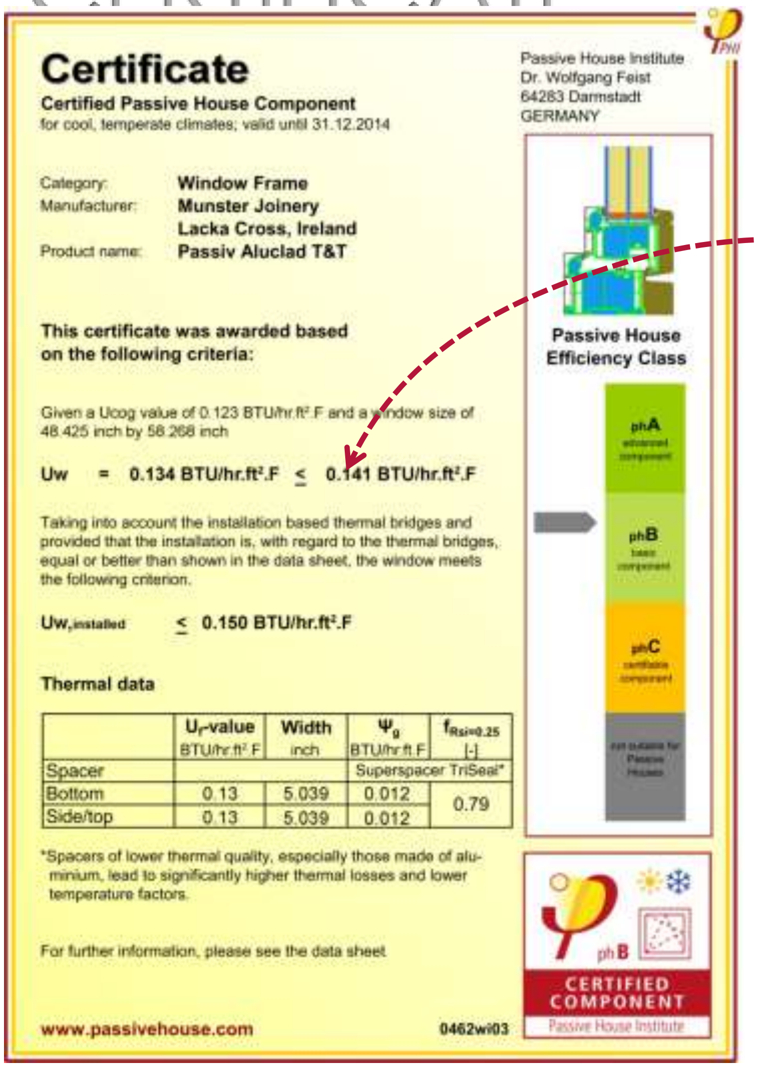






Must maintain enclosure continuity of airtightness and insulation.

SAMPLE PHI WINDOW FRAME CERTIFICATE



Certificate

Certified Passive House Component

for cool, temperate climates; valid until 31.12.2014

Passive House Institute
Dr. Wolfgang Feist
64283 Darmstadt
GERMANY

Category:	**Window Frame**
Manufacturer:	**Munster Joinery**
	Lacka Cross, Ireland
Product name:	**Passiv Aluclad T&T**

This certificate was awarded based on the following criteria:

Given a Ucog value of 0.123 BTU/hr.ft².F and a window size of 48.425 inch by 58.268 inch

Uw = 0.134 BTU/hr.ft².F ≤ 0.141 BTU/hr.ft².F

Taking into account the installation based thermal bridges and provided that the installation is, with regard to the thermal bridges, equal or better than shown in the data sheet, the window meets the following criterion.

$U_{w,installed}$ ≤ 0.150 BTU/hr.ft².F

Thermal data

	U_f-value BTU/hr.ft².F	Width inch	Ψ_g BTU/hr.ft.F	$f_{Rsi=0.25}$ [-]
Spacer			Superspacer TriSeal*	
Bottom	0.13	5.039	0.012	0.79
Side/top	0.13	5.039	0.012	

*Spacers of lower thermal quality, especially those made of aluminium, lead to significantly higher thermal losses and lower temperature factors.

For further information, please see the data sheet

Passive House Efficiency Class

phA advanced component

phB basic component

phC certifiable component

not suitable for Passive Houses

phB

CERTIFIED COMPONENT

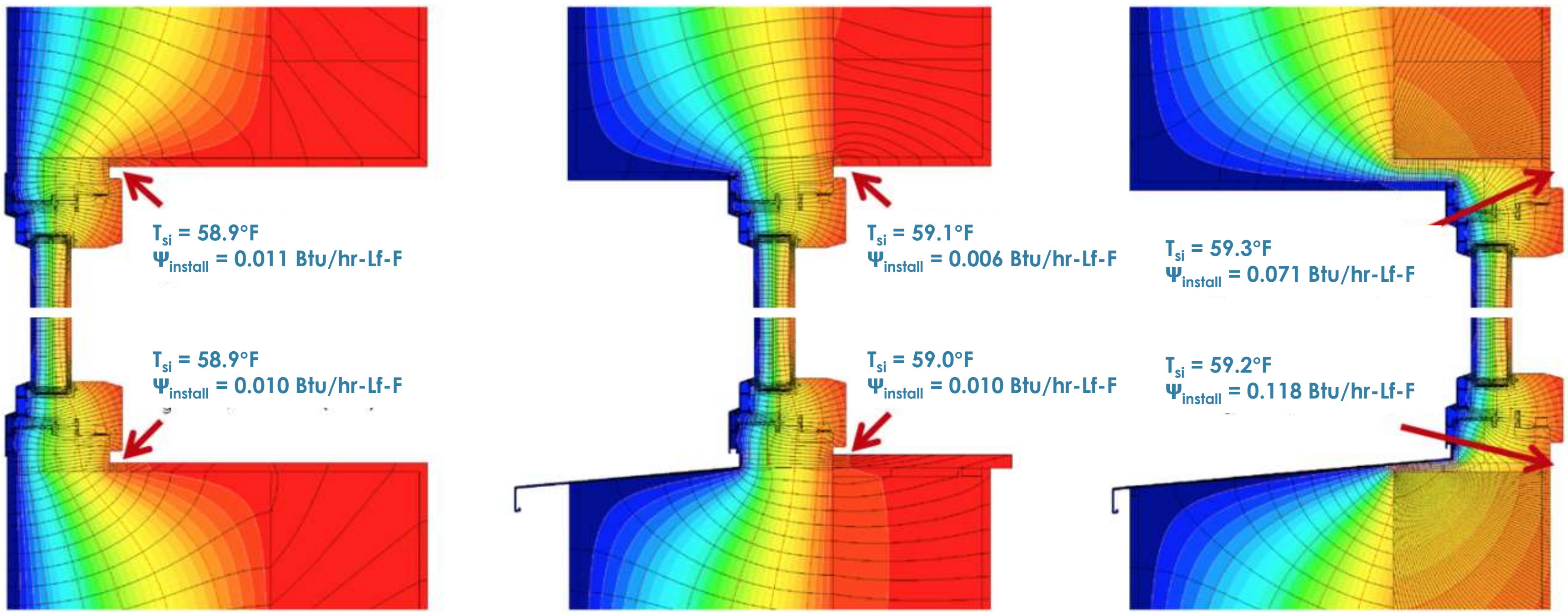
Passive House Institute

www.passivehouse.com **0462wi03**

This Passive House Institute certificate is based on a U-value for glass of 0.12 Btu/hr·ft^2·F

It is possible to get glass with an even lower U-value – for example **0.10 Btu/hr ft^2 F**, which would further improve the rating of this window

WINDOW INSTALL POSITION



$U_{w\text{-}installed}$ = 0.151 Btu/hr-ft^2-F
($R_{w\text{-}installed}$ = 6.62 hr-ft^2-F/Btu)

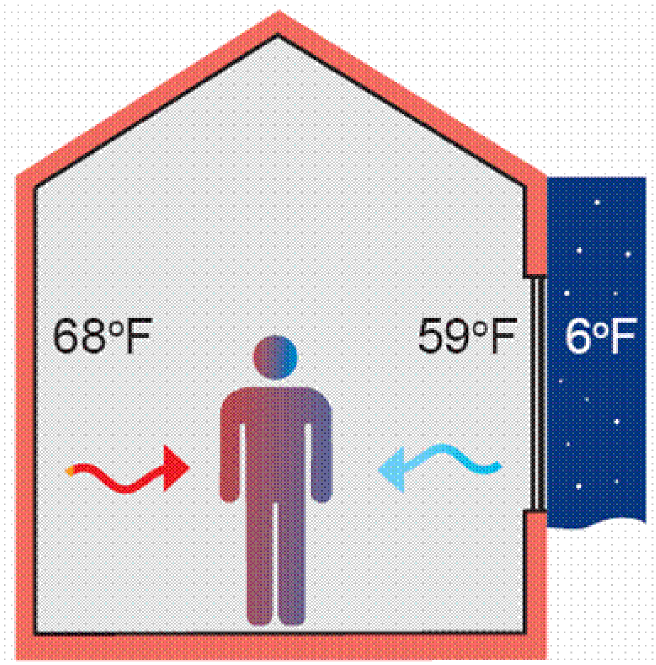
$U_{w\text{-}installed}$ = 0.148 Btu/hr-ft^2-F
($R_{w\text{-}installed}$ = 6.76 hr-ft^2-F/Btu)

$U_{w\text{-}installed}$ = 0.215 Btu/hr-ft^2-F
($R_{w\text{-}installed}$ = 4.65 hr-ft^2-F/Btu)

To determine the final energy balance impact of moving the installed position, the shading effect of the setback and the resultant solar gains must also be taken into account

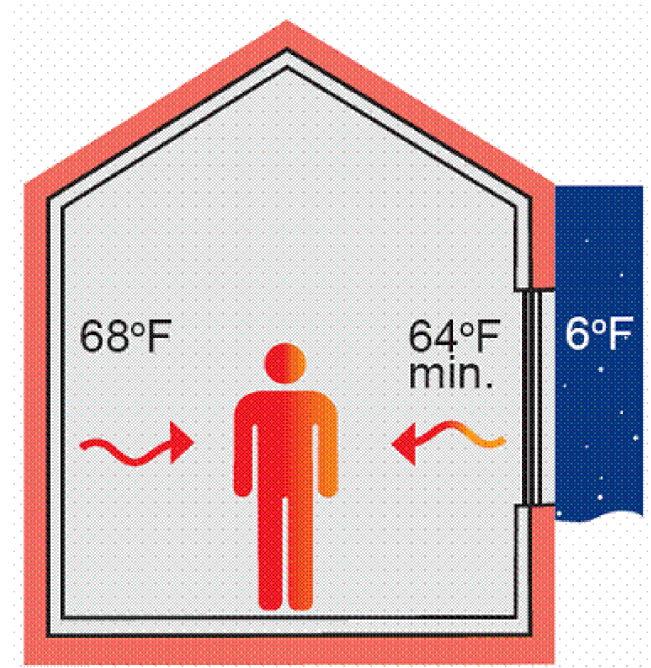
THERMAL CONTINUITY = COMFORT

Typical: Double-Glazing



Discomfort

Passive House: Triple-Glazing



Comfort

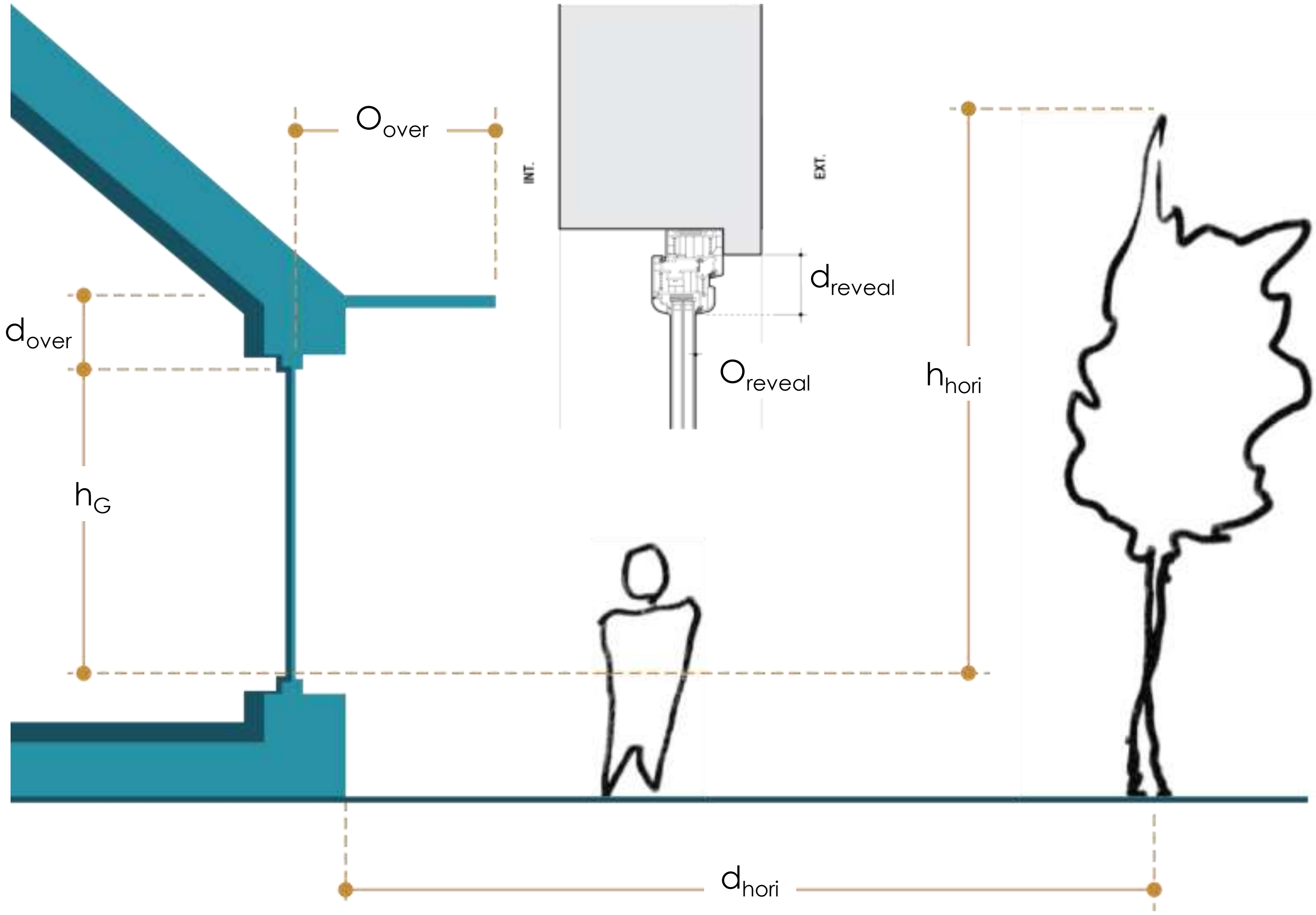
Even temperatures allows removal of perimeter mechanical systems.

BUILDING ON PASSIVE ELEMENTS

Exterior Shading: Critical for minimizing cooling loads

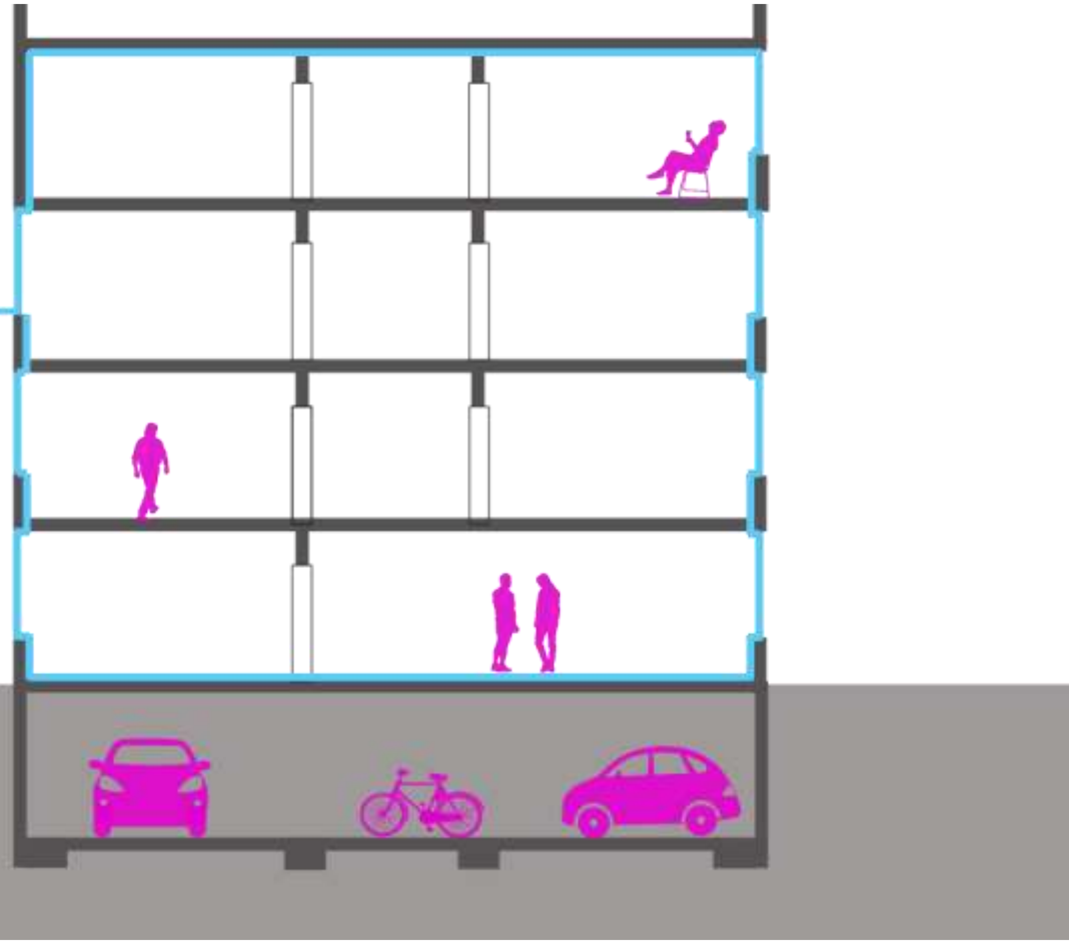
Compactness: Allows for more even glazing and lower insulation levels.

SHADING (PER WINDOW)



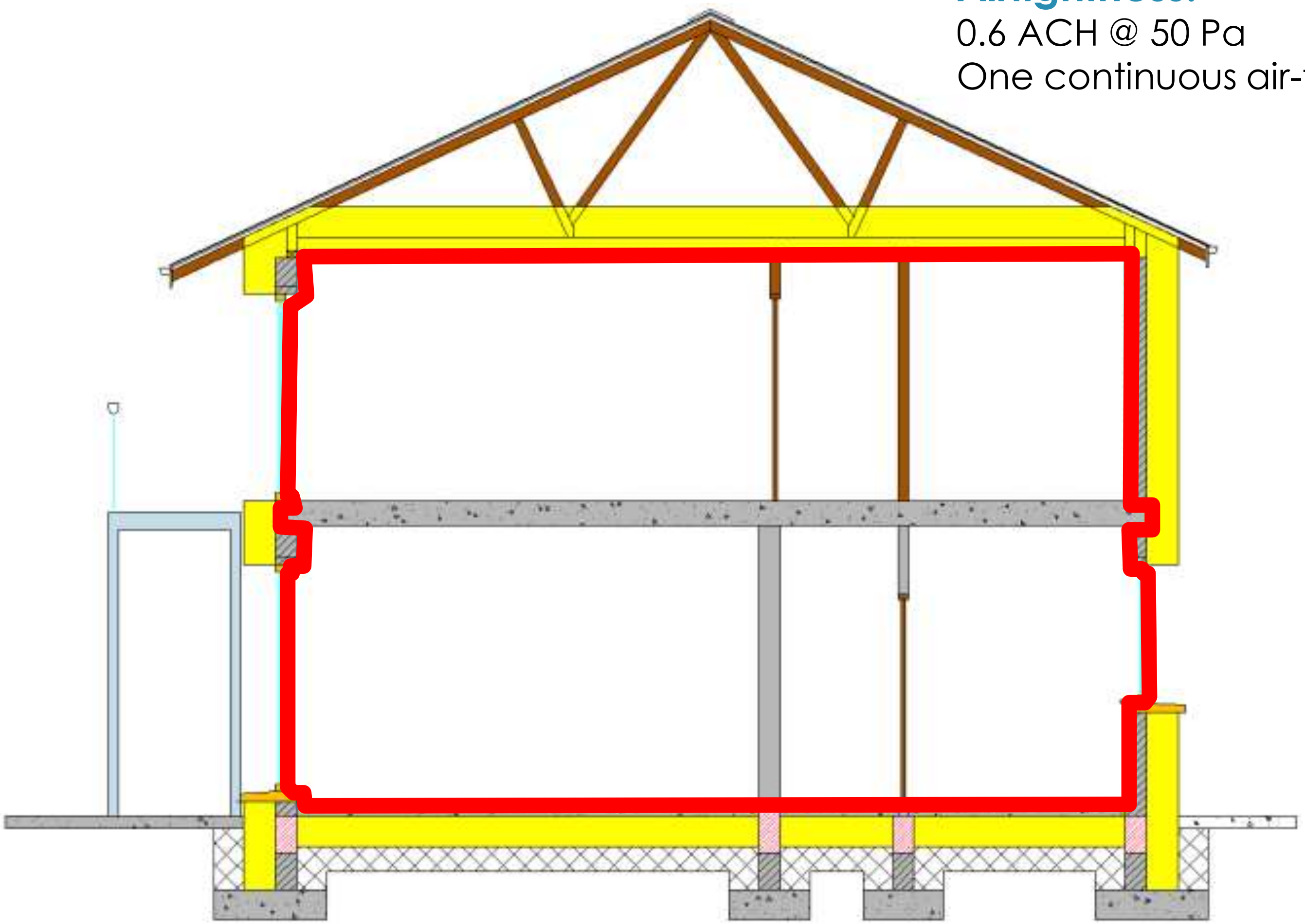
4. CONTINUOUS AIRTIGHTNESS

Tested airtightness
limit of 0.6 ACH50



Airtightness is a driving force of performance.

THE "RED LINE" TEST

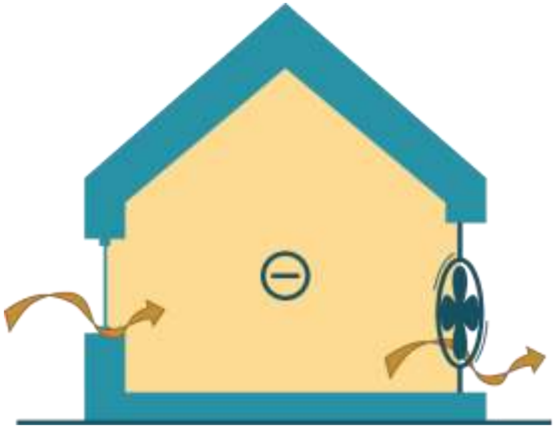


Airtightness:

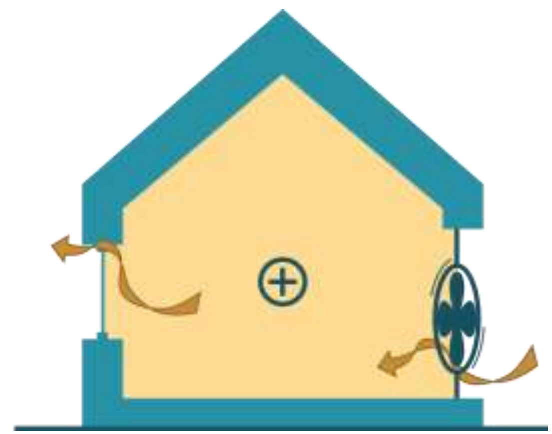
0.6 ACH @ 50 Pa

One continuous air-tight layer:

VERIFICATION: AIRTIGHTNESS TESTING



Negative Pressure Test

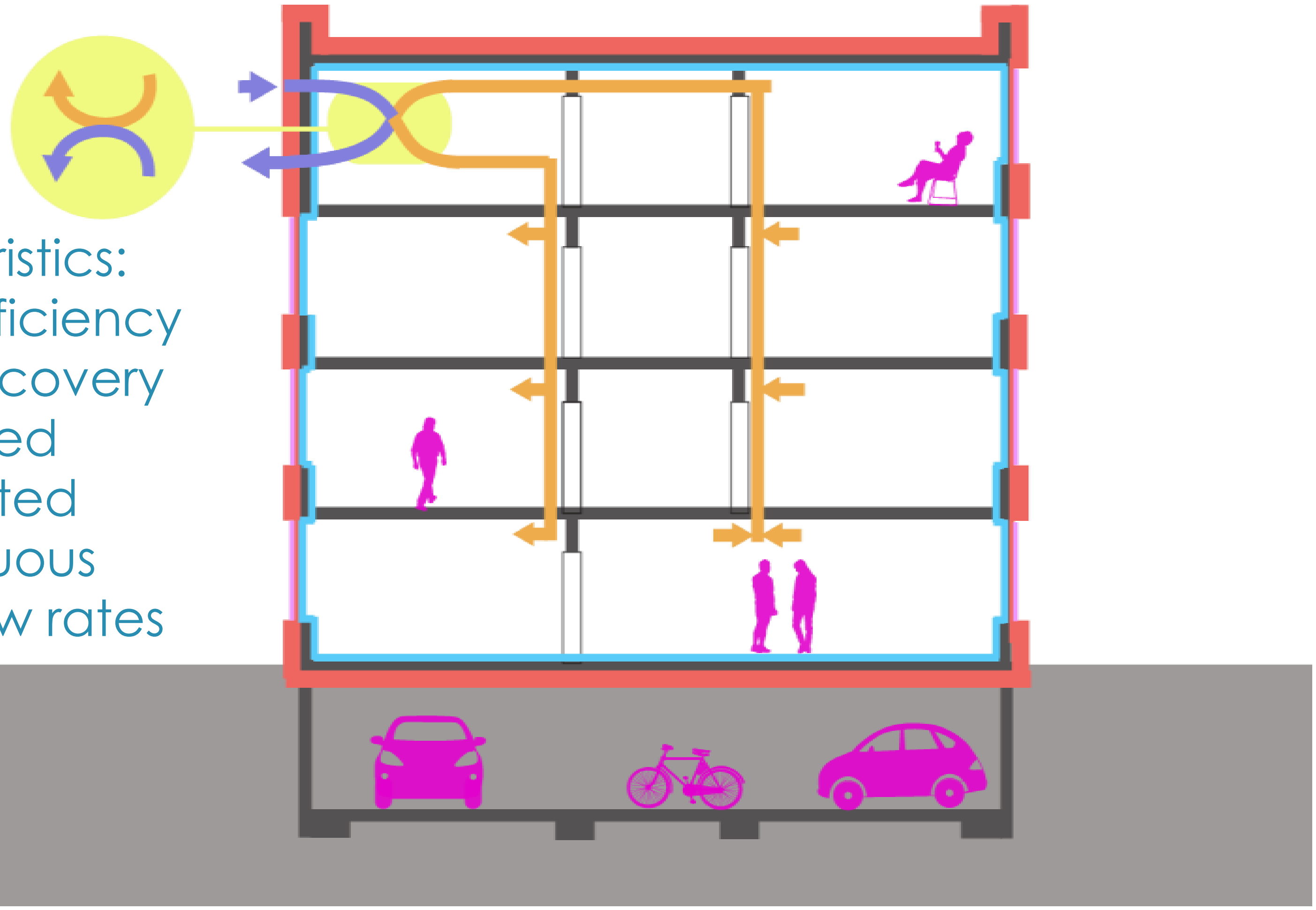


Positive Pressure Test

WHY DO WE BUILD AIRTIGHT?

- Prevention of condensation in the construction
- Prevention of drafts
- Prevention of cold floors in the ground floor
- Preventing air pollution of the room air
- Securing the sound insulation of building components
- Securing the operation and effectiveness of the ventilation system
- Securing the insulation effect of the external building components
- Reduction of ventilation heat losses

5. VENTILATION



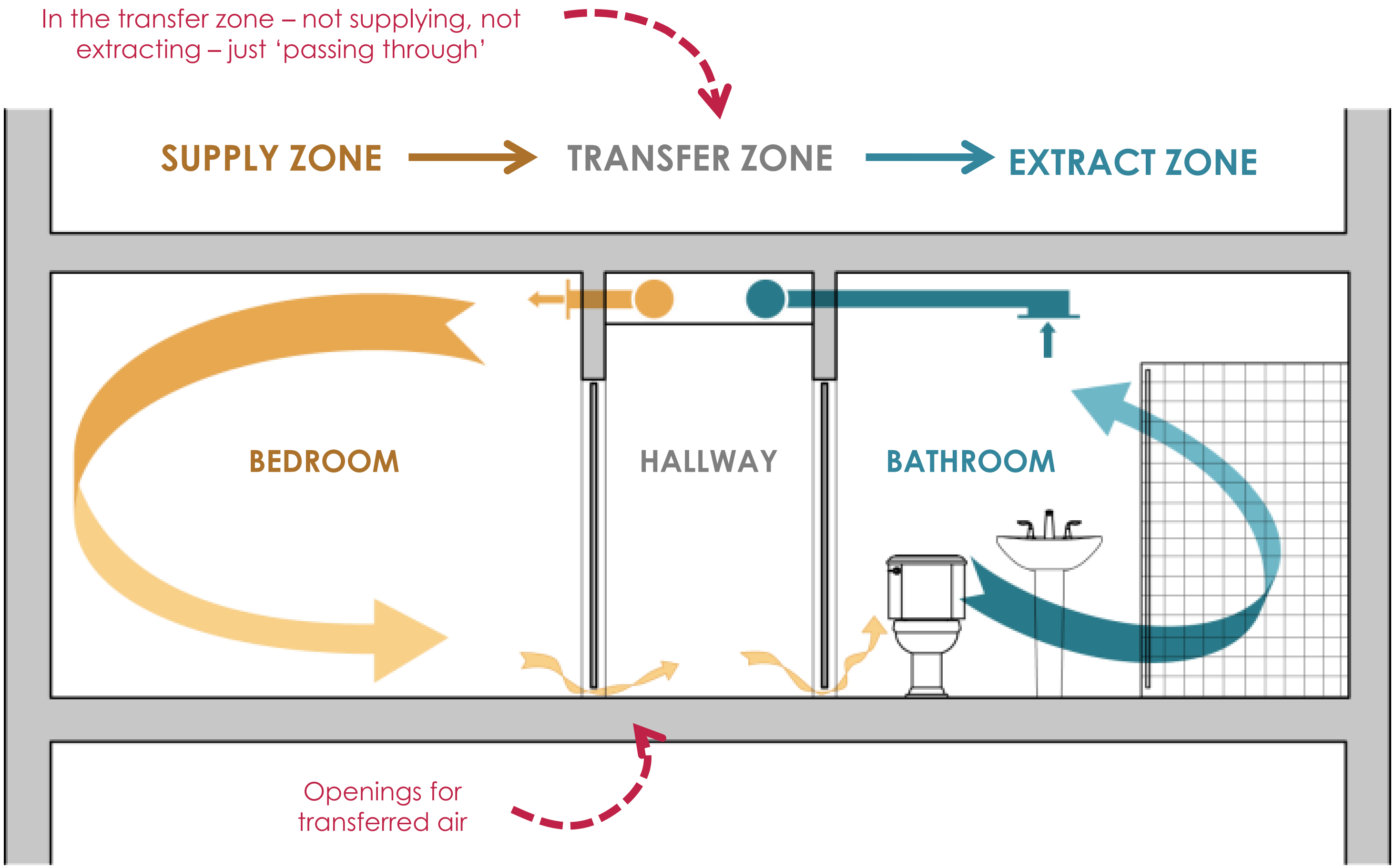
Characteristics:

- High efficiency heat recovery
- Balanced
- Distributed
- Continuous
- Low flow rates

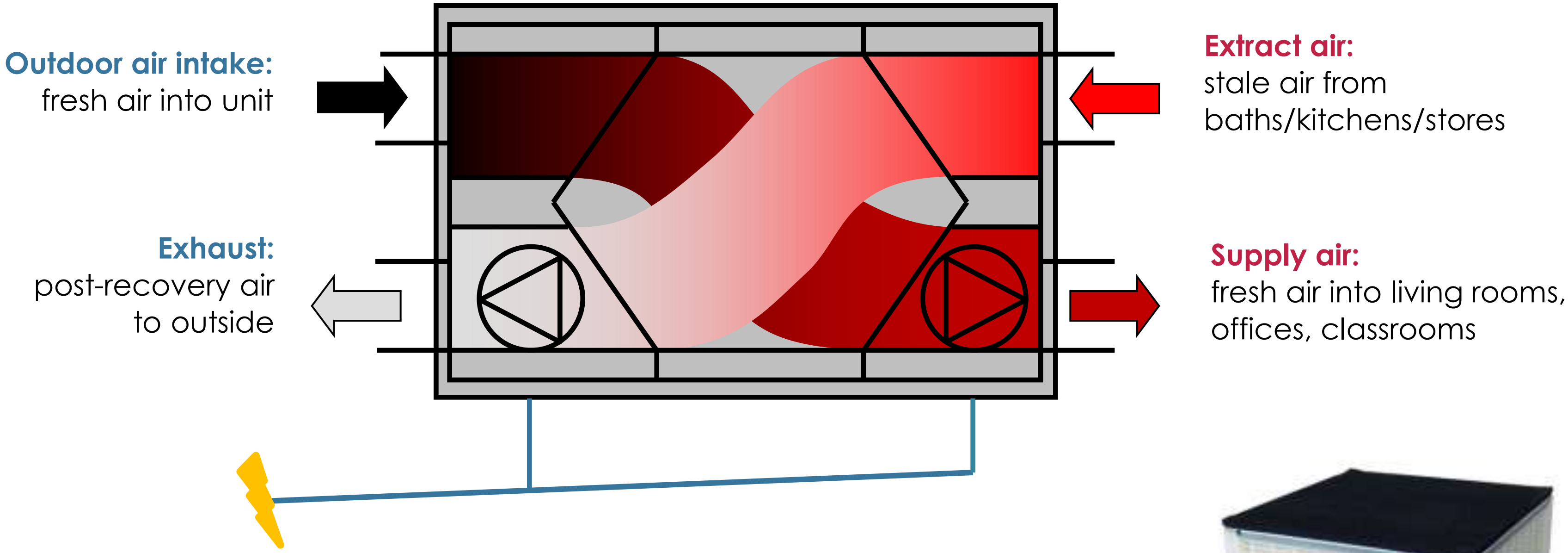
Controlled high indoor air quality possible using very little energy.

BALANCED VENTILATION: SUPPLY & EXTRACT ZONES

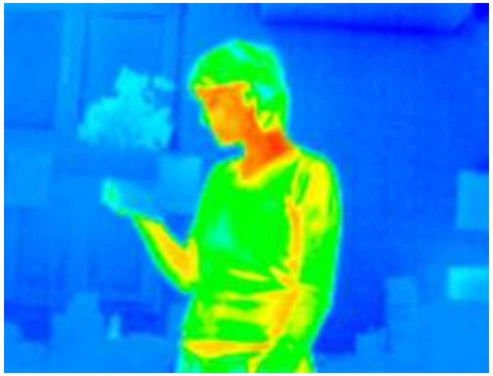
The distribution of ventilation (fresh air supply and stale air extraction) should **use as little ductwork as possible** but still provide air flow through the entire building:



H/ERV


Outdoor air intake:
fresh air into unit
Exhaust:
post-recovery air
to outside
Extract air:
stale air from
baths/kitchens/stores
Supply air:
fresh air into living rooms,
offices, classrooms

& OPTIMIZE PASSIVE HEAT GAINS



People

Appliances & Equipment

Daylight

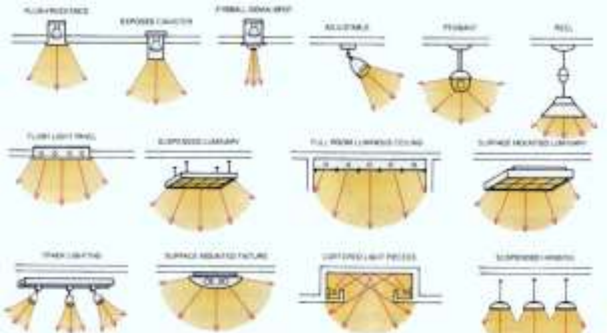
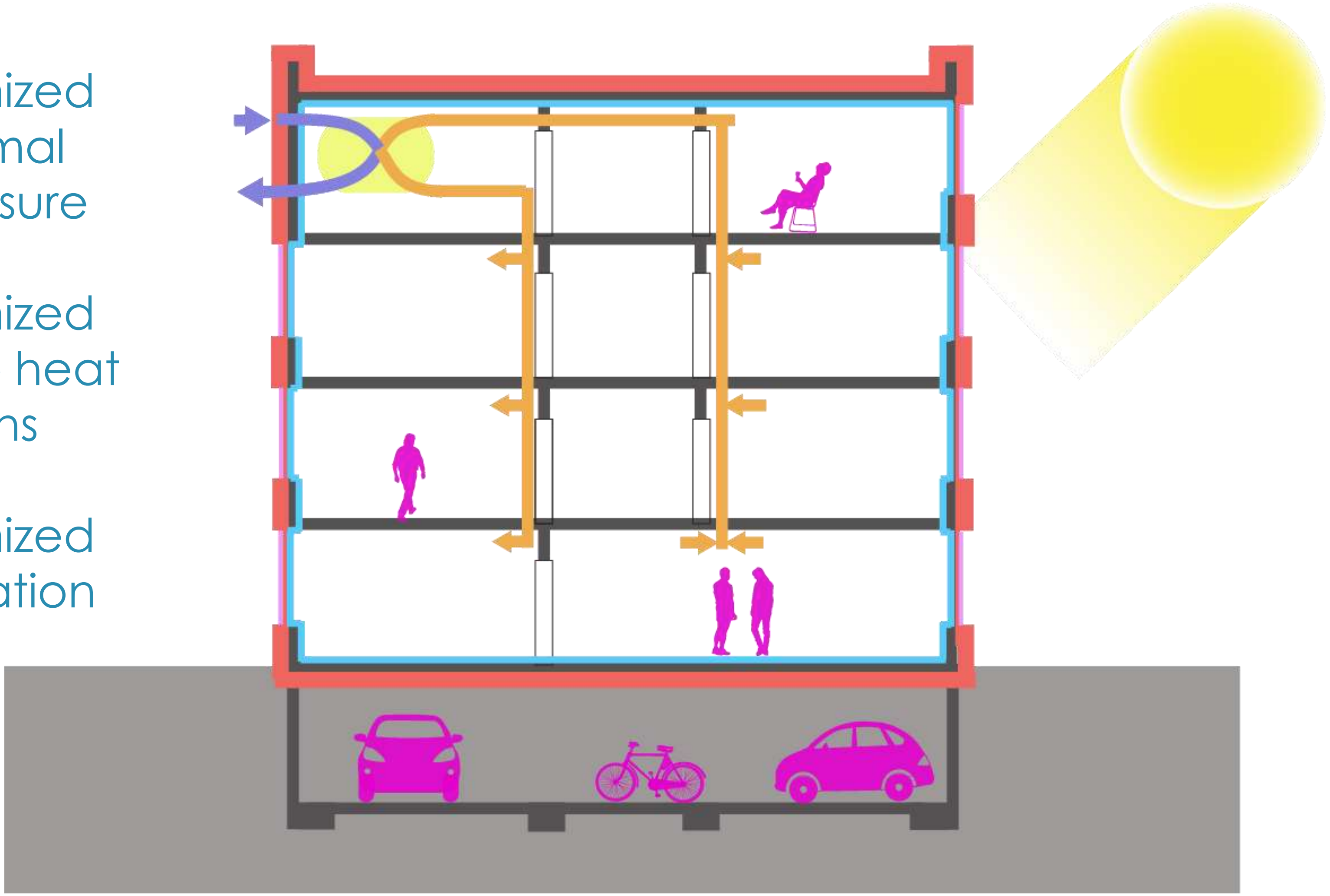


Fig. 31-16 ■ Examples of types of ceiling fixtures.

Lighting & Mechanical Systems

NEAR PASSIVE BALANCE…..

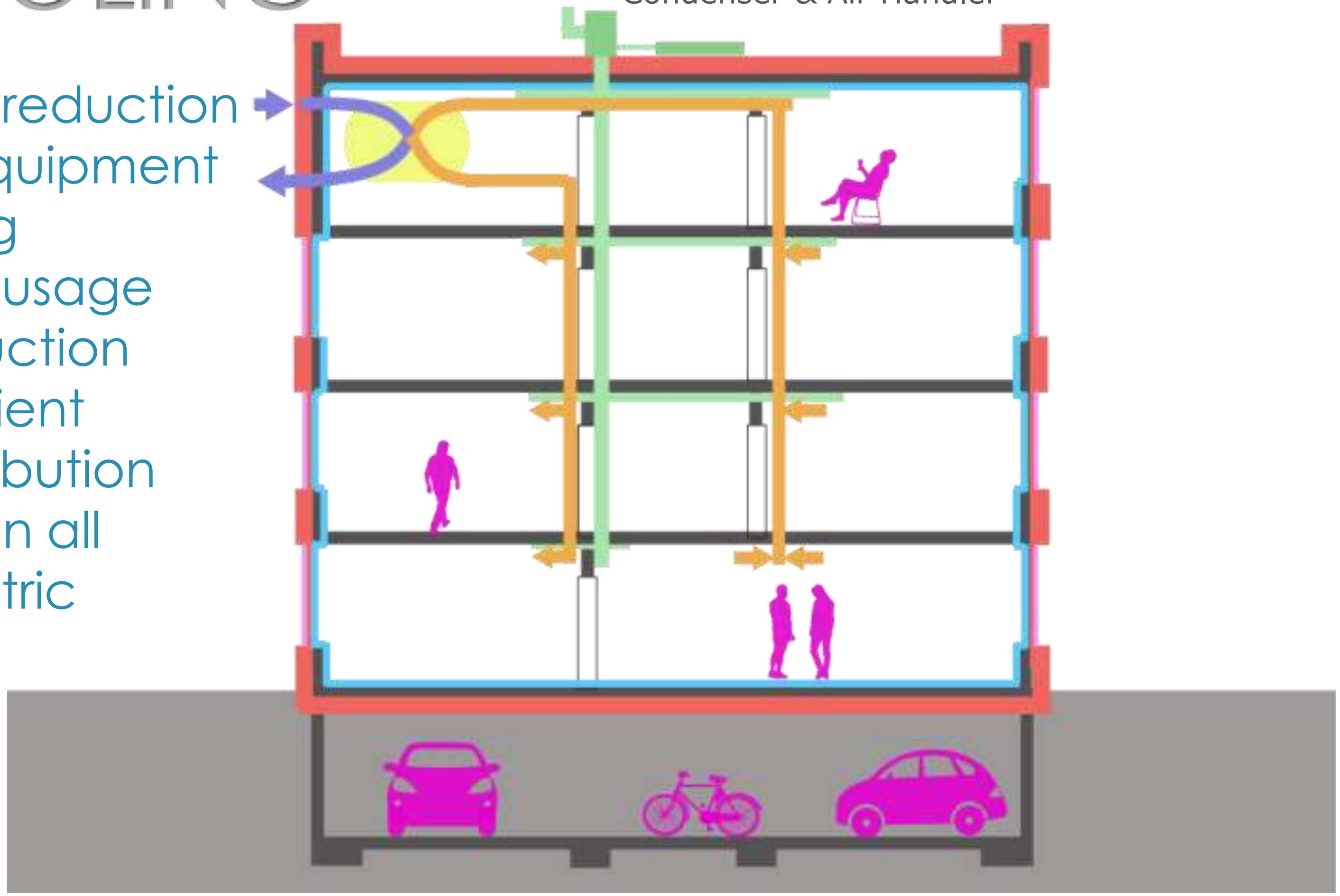
Optimized thermal enclosure
+
Optimized passive heat gains
+
Optimized ventilation



We still typically need active space conditioning systems…just much smaller systems.

THEN ADD HEATING & COOLING

- 75% reduction in equipment sizing
- 90% usage reduction
- Efficient distribution
- Often all electric



Typical to pull distribution to core of building.

HEATING DISTRIBUTION STRATEGIES

VENTILATION AIR

RECIRCULATING AIR

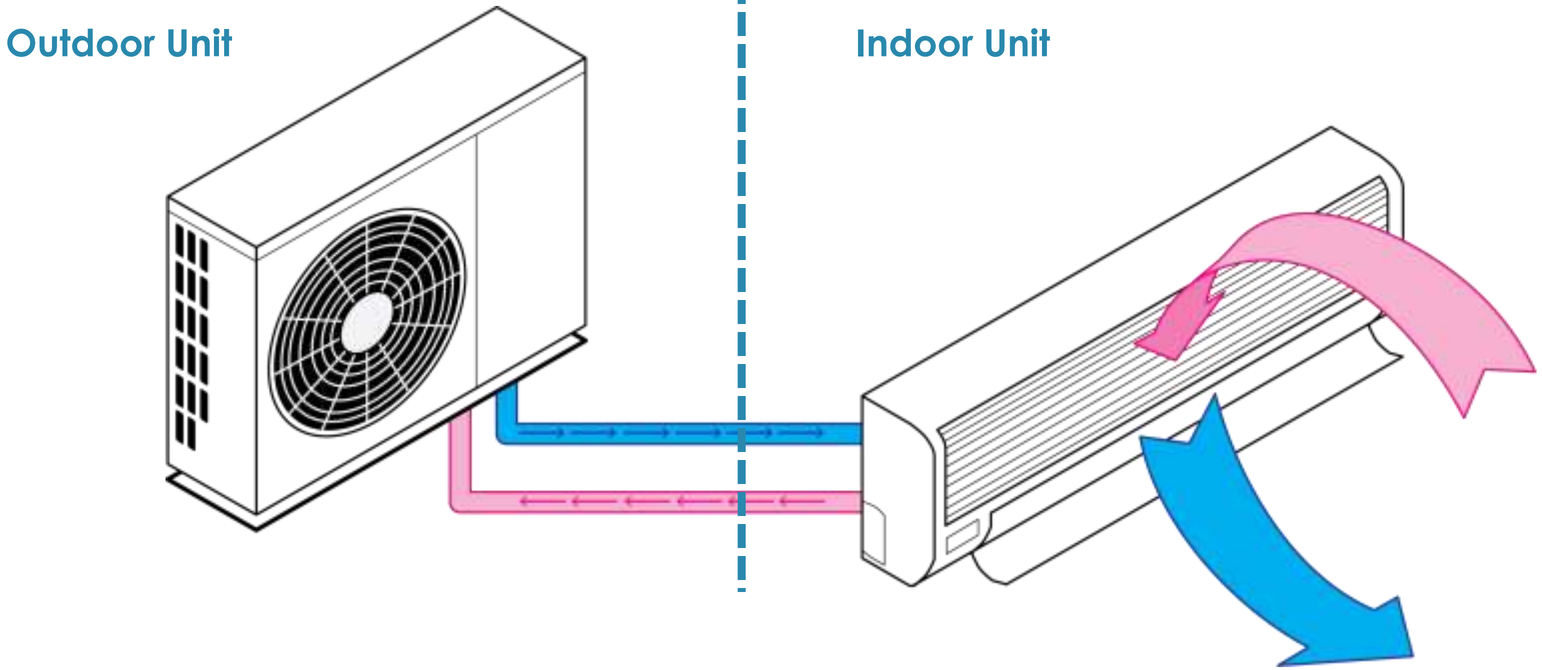
HYDRONIC RADIATOR

ELECTRIC RESISTANCE
(Will probably exceed Primary Energy threshold)

HEAT PUMP HEATING + COOLING

Can be used for **heating and cooling**, for many types of buildings. They do not GENERATE heat, but instead use the refrigeration cycle to MOVE (pump) heat.

- Very efficient
- Multiple /Variable capacities
- Single and multi-zone
- Can dehumidify
- Usually run on electricity



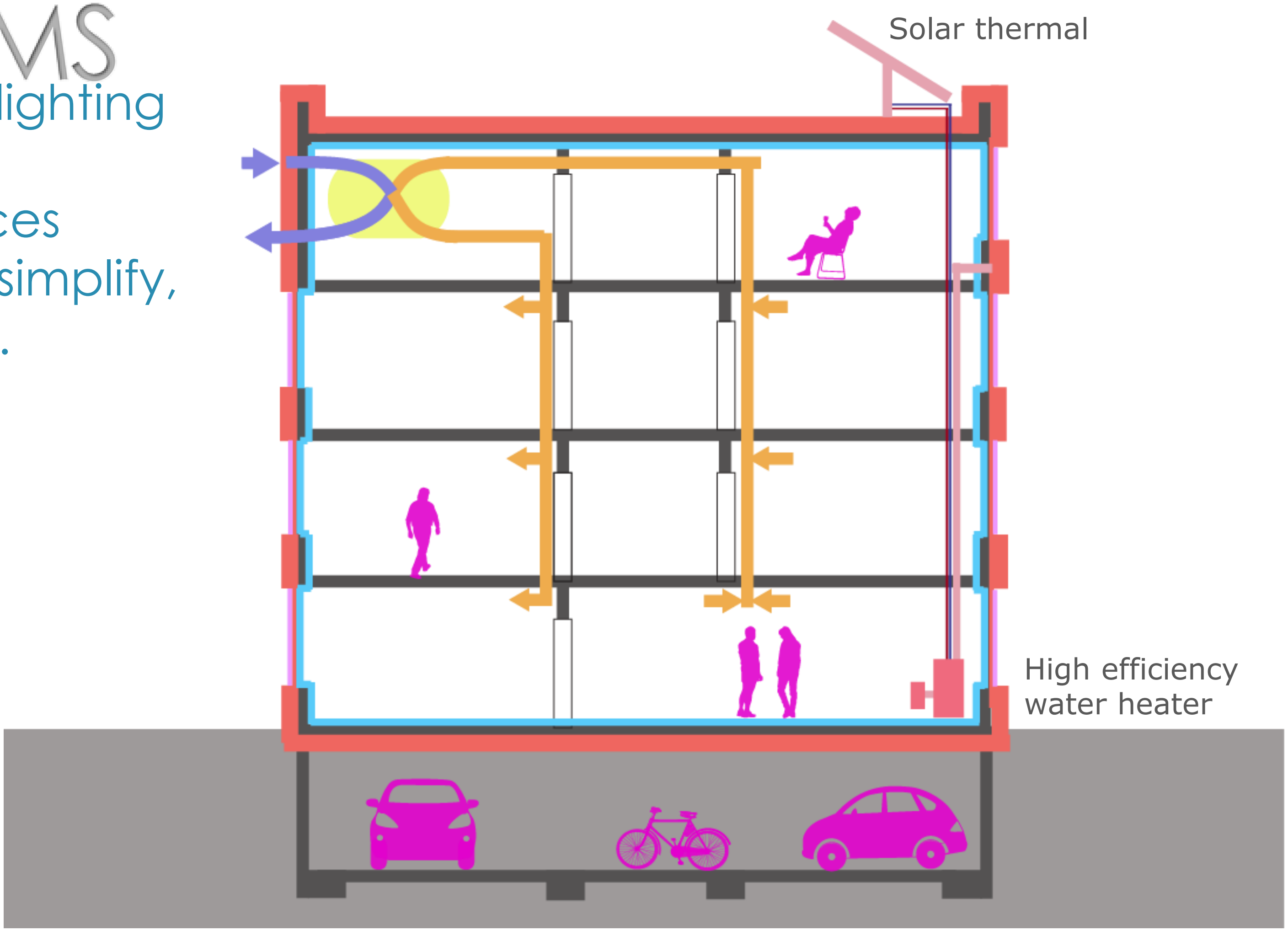
DUCTED MINI-SPLIT

Aesthetically more integrated, however more expensive and slightly less efficient

- Ceiling mounted air handler for heating and cooling system
- Note flow and return connections to external compressor
- Condensate drain also required
- Ducted system for distributing heated or cold air
- **Don't confuse this with an HRV/ERV- this air handler simply re-circulates indoor air**

EFFICIENT SYSTEMS & SMART SYSTEMS

- Efficient lighting
- Efficient appliances
- Simplify, simplify, simplify…



Smart systems should enhance performance, not compensate for poor performance.

INSULATION OF FITTINGS

Not like this: uninsulated pumps

Not like this: uninsulated storage tank connections

Fittings covered by insulating mouldings.
Prefabricated insulating mouldings are available by now.

QUALITY ASSURANCE

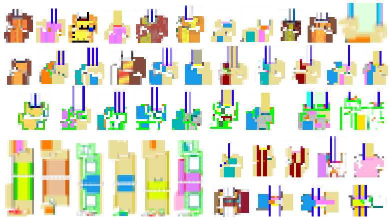
Tools enabling predictability:

Certified Professionals:

CONSULTANT
CERTIFIED PASSIVE HOUSE TRADESPERSON
CERTIFIED PASSIVE HOUSE CONSULTANT
TRADESPERSON

Energy Model Design Tool & Manual:

Certified Components:



Certified Buildings:

Reference Materials:

Passipedia
PASSIPEDIA
The Passive House Resource

Global Research:

Passive House Institute

www.passivehouse.com

NACC: 9 CERTIFIERS AND GROWING

NORTH AMERICAN CERTIFIERS CIRCLE

PASSIVE HOUSE CERTIFIER

Passive House Institute accredited

CertiPHIers COOPERATIVE

Herz & Lang

MEAD

MIZU PASSIVE HOUSE CONSULTING

Passive House Institute

iPHA Passive House Academy

PEEL PASSIVE HOUSE

RDH BUILDING SCIENCE

ZEPHIR PASSIVHAUS ITALIA Affiliato iPHA

LOCAL PROJECT EXAMPLES

HOTELS

OFFICE BUILDINGS

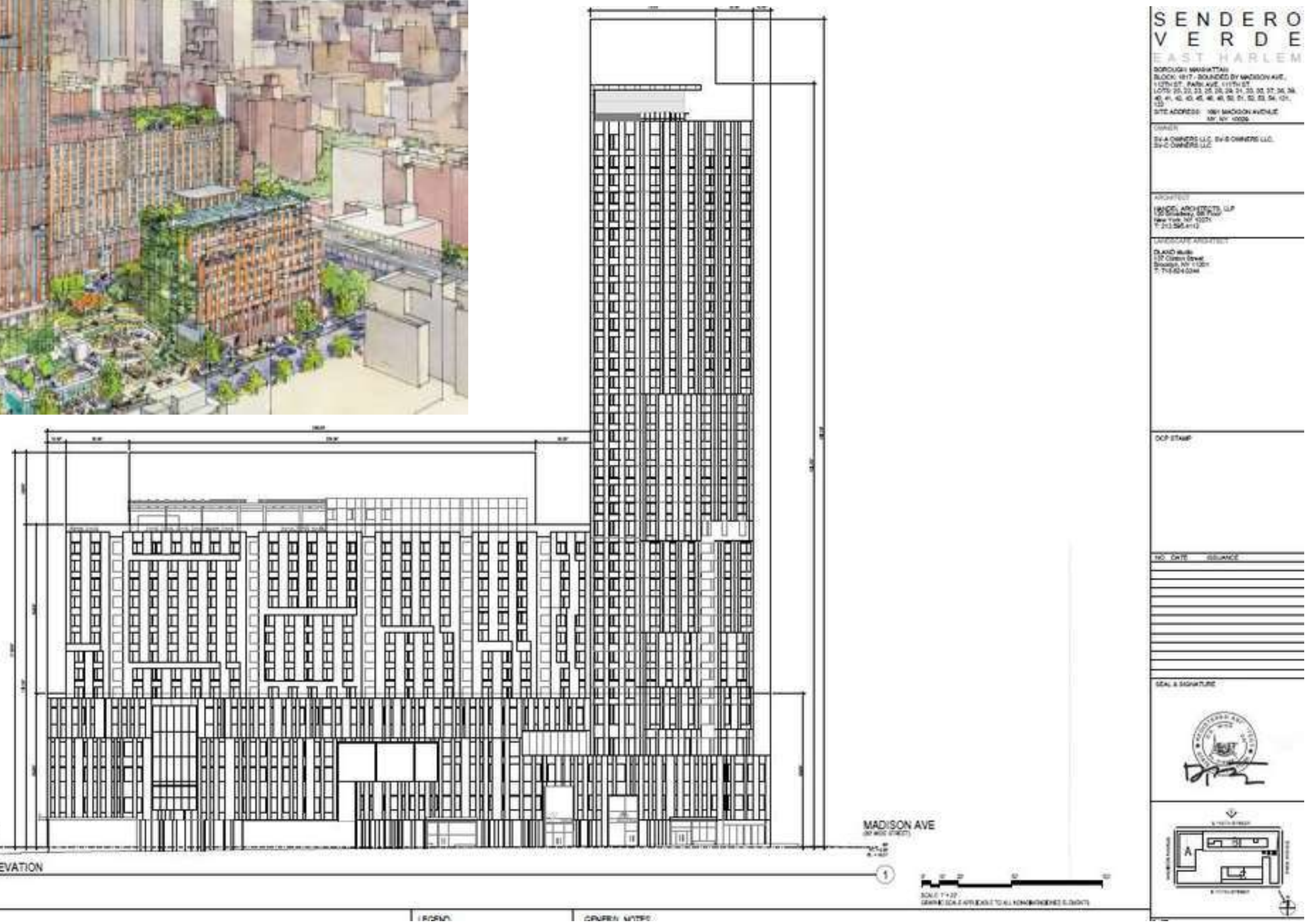
HISTORIC RESTORATION

COURTHOUSE & PRISON

UNIVERSITY LABORATORY

DORMITORIES

MIXED-USE


SENDERO
VERDE
EAST HARLEM
PARK AVE
MADISON AVE
NORTH ELEVATION

SO START MAKING PASSIVE HOUSE BUILDINGS

It's just the beginning.

Find out more: www.naphnetwork.org

Register for conference: www.naphconference.com

Register for training: www.naphnetwork.org/training/

Contact Us at NAPHN:
Phone: 929-376-8537
Email: info@naphnetwork.org
Address:
NAPHN, 450 Lexington Avenue,
#3717, New York, NY 10163-3717

Contact Us at LOCAL ORG:
Phone: 123-456-7891
Email: info@localorg.org
Address:
ACRONYM, Street, Room, City, ST
12345-1234

Thank you.



Is there a Passive House ‘Vernacular’ in Palo Alto?

Bronwyn Barry

Intro to Zero Net Energy (and Beyond)
City of Palo Alto
September 2017

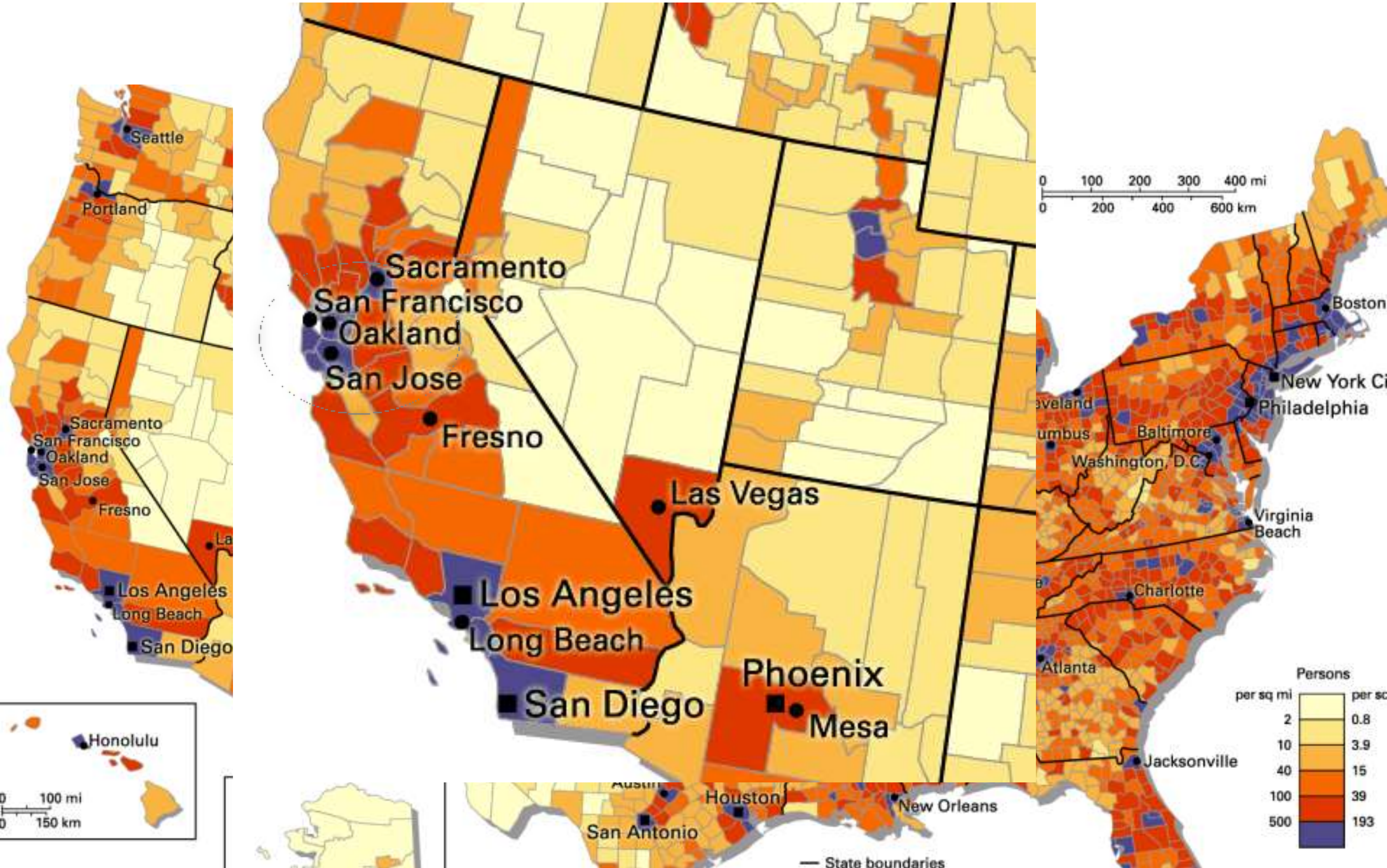
The 3 gables,

Warm Climates: The Palo Alto Cluster

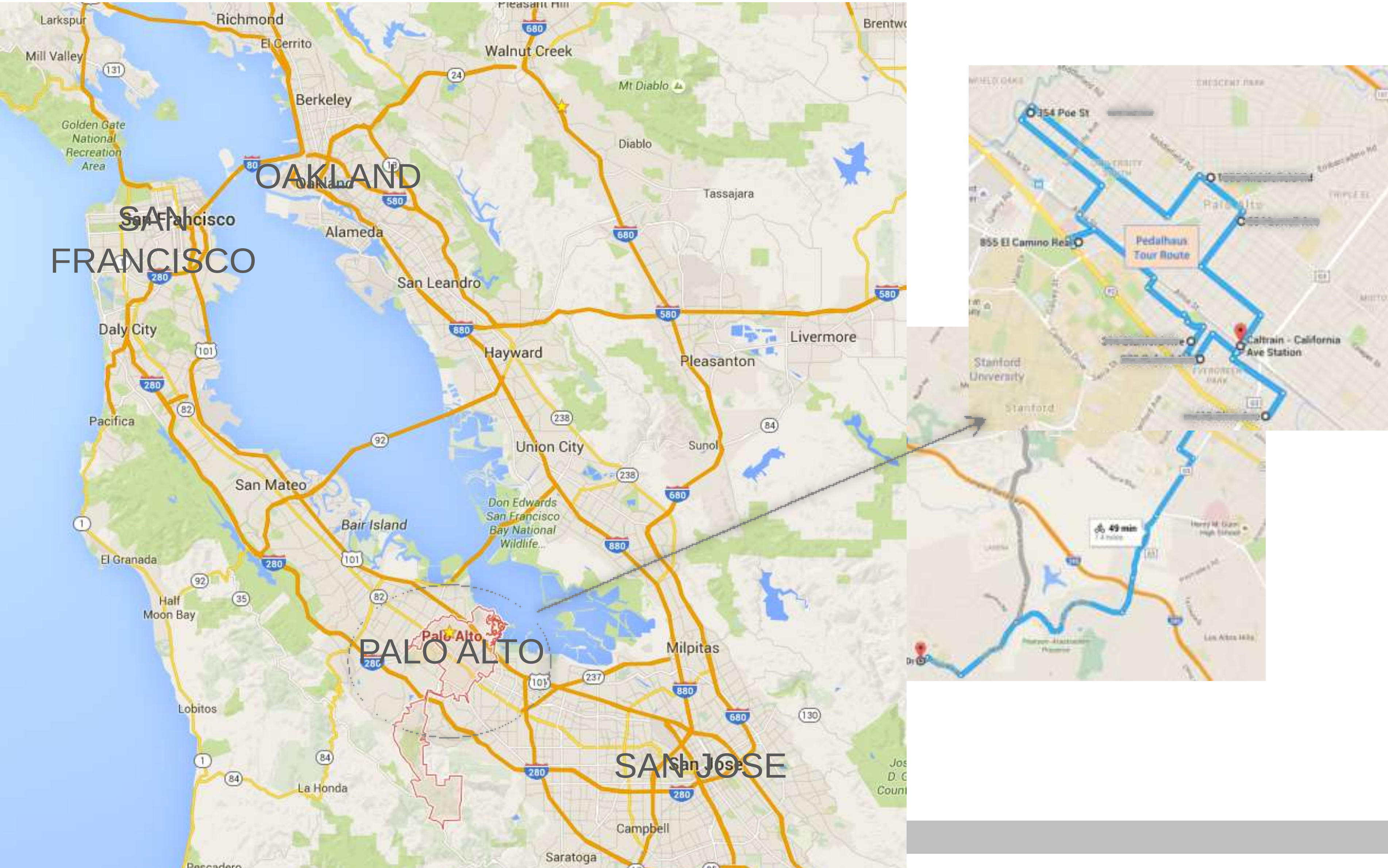
the 3 larger buildings

and a tiny house.

Site & Population Density



Site Geographic Location:

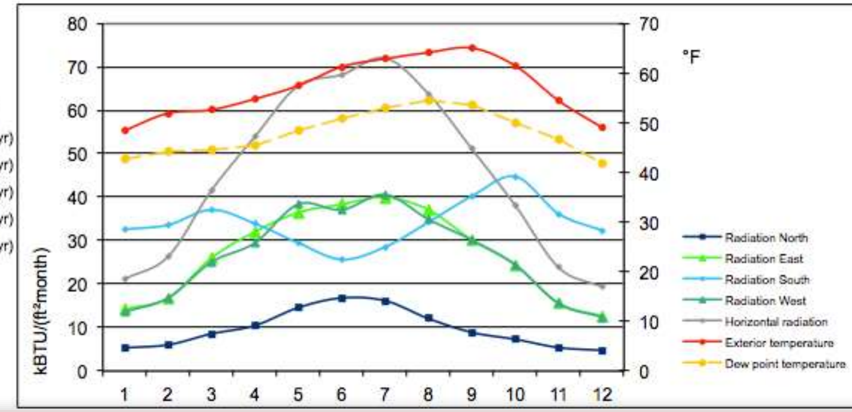


Climate Data Comparison

SAN FRANCISCO

2493 F.day/yr

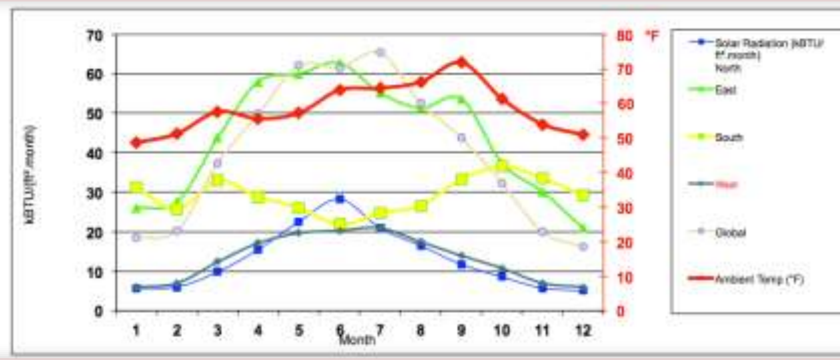
	Data for heating Annual method	Data from monthly balance Heating	Cooling	
Heating / cooling period	128	90	365	day/yr
Heating / cooling degree hours	2493	1830	-8058	°F.day/yr
Radiation North	24	17	121	kBTU/(ft²yr)
Radiation East	68	59	354	kBTU/(ft²yr)
Radiation South	125	92	404	kBTU/(ft²yr)
Radiation West	66	43	318	kBTU/(ft²yr)
Horizontal radiation	107	67	545	kBTU/(ft²yr)



MOFFAT FIELD (PALO ALTO)

H_t	143	day/yr
G_t (Heating Degree Days)	2306	°F.day/yr
North	34	kBTU/(ft²yr)
East	147	kBTU/(ft²yr)
South	136	kBTU/(ft²yr)
West	40	kBTU/(ft²yr)
Horizontal	117	kBTU/(ft²yr)

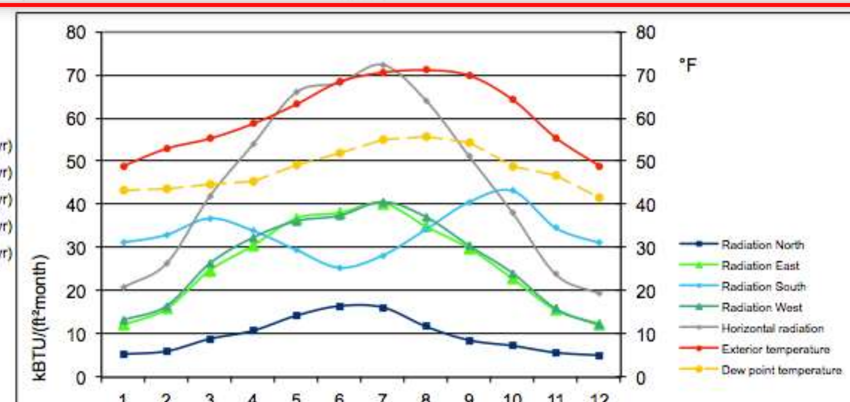
2306 F.day/yr



SAN JOSE

2006 F.day/yr

	Data for heating Annual method	Data from monthly balance Heating	Cooling	
Heating / cooling period	104	62	365	day/yr
Heating / cooling degree hours	2006	1304	-6770	°F.day/yr
Radiation North	18	11	121	kBTU/(ft²yr)
Radiation East	46	35	344	kBTU/(ft²yr)
Radiation South	100	58	398	kBTU/(ft²yr)
Radiation West	48	25	322	kBTU/(ft²yr)
Horizontal radiation	76	40	546	kBTU/(ft²yr)



Stanford Street

TEAM:
Owners: Kate Kramer & Sven Thesen
Design: Arkin Tilt Architects
PH Consultant: Dan Johnson
Contractor: Quantum Builders

Oxford Street

TEAM:
Owners: Magic Learning Community
Design: (A Long List of Collaborators)
PH Consultant: Allen Gilliland, Pearl Renaker, Luke Morton
Contractor: Dan Fulga Construction

Field Chiarello Retrofit

TEAM:
Owners: Chris Field & Nona Chiarello
Design: Scott Shell, EHDD Architects
PH Consultant: Graham Irwin
Contractor: By owners

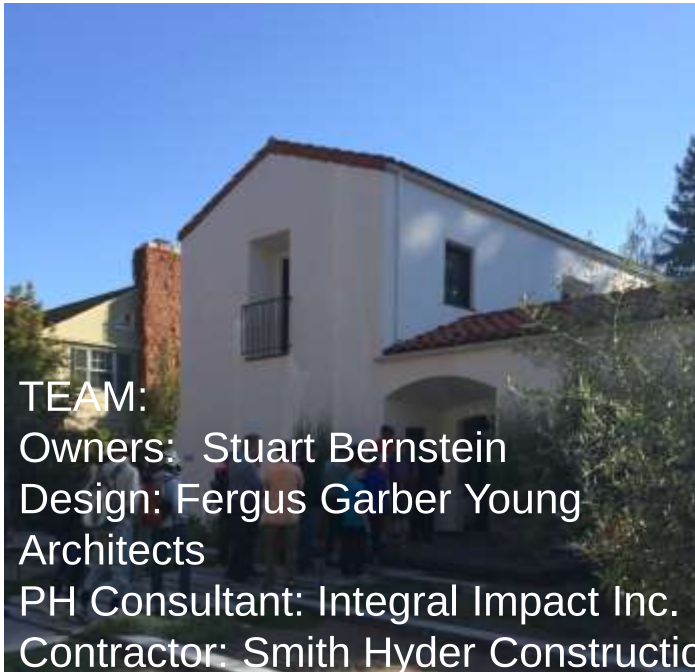
Poe Street

TEAM:
Owners: Sally-Ann Rudd & Ronjon Nag
Design: Fergus Garber Young
PH Consultant: Pearl Renaker
Contractor: Pete Moffat Construction

Mighty House

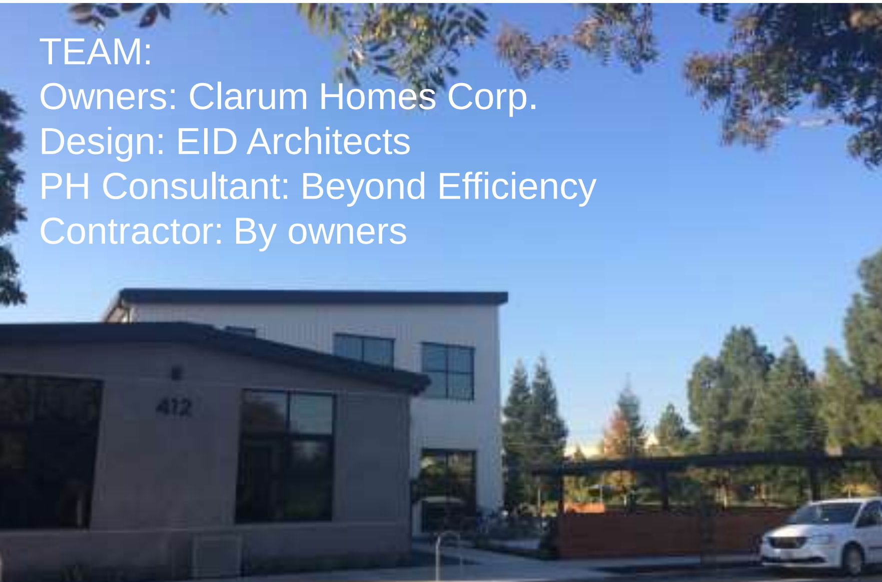
TEAM:
Owners: Siena Shaw & Brian Rubin
Design & Construction: Dimension Style
PH Consultant: owners

Bernstein Residence



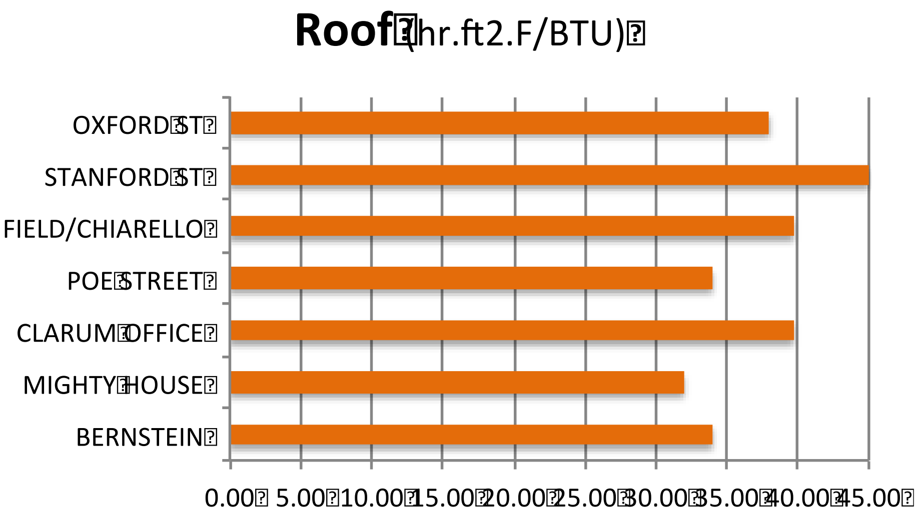
TEAM:
Owners: Stuart Bernstein
Design: Fergus Garber Young Architects
PH Consultant: Integral Impact Inc.
Contractor: Smith Hyder Construction

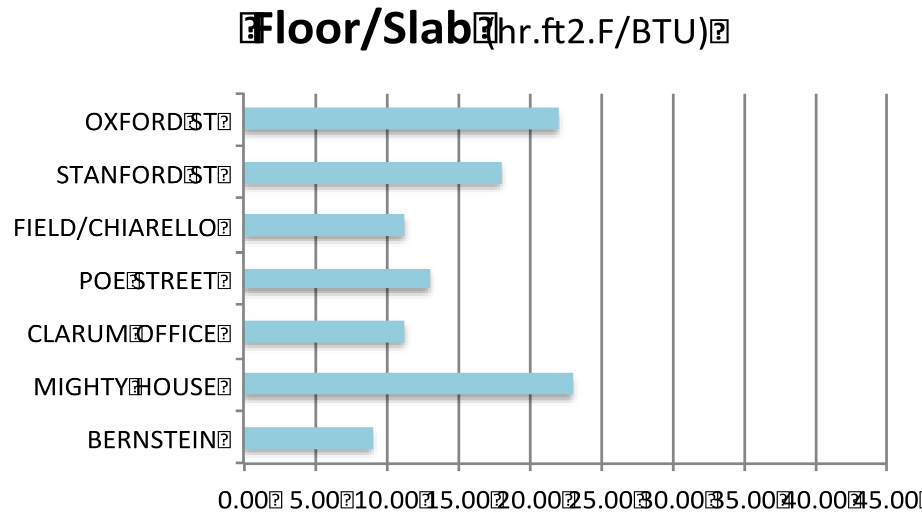
Clarum Homes Office Building

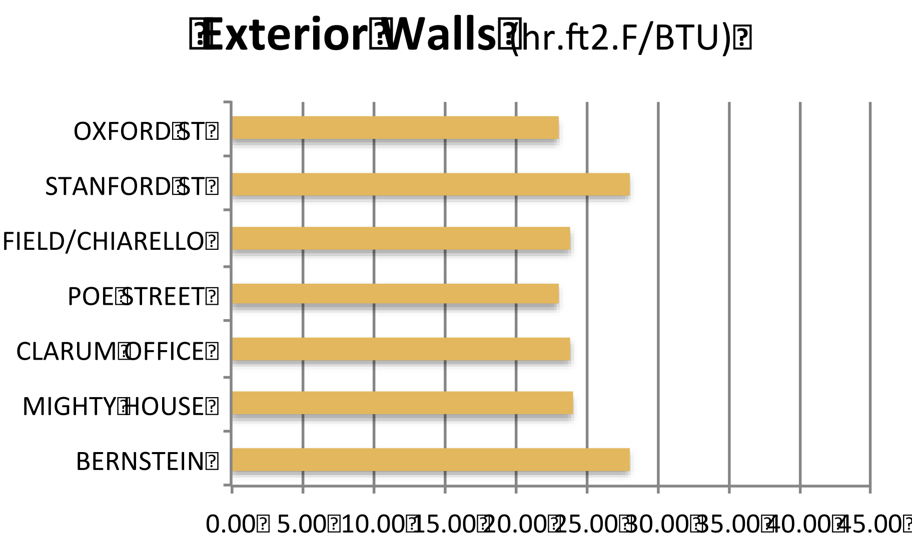


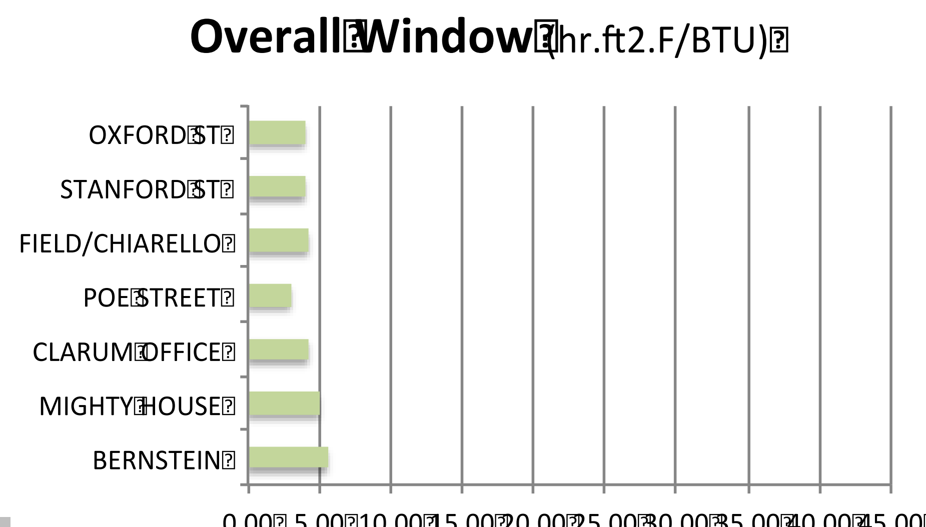
TEAM:
Owners: Clarum Homes Corp.
Design: EID Architects
PH Consultant: Beyond Efficiency
Contractor: By owners

Assemblies (IP units)

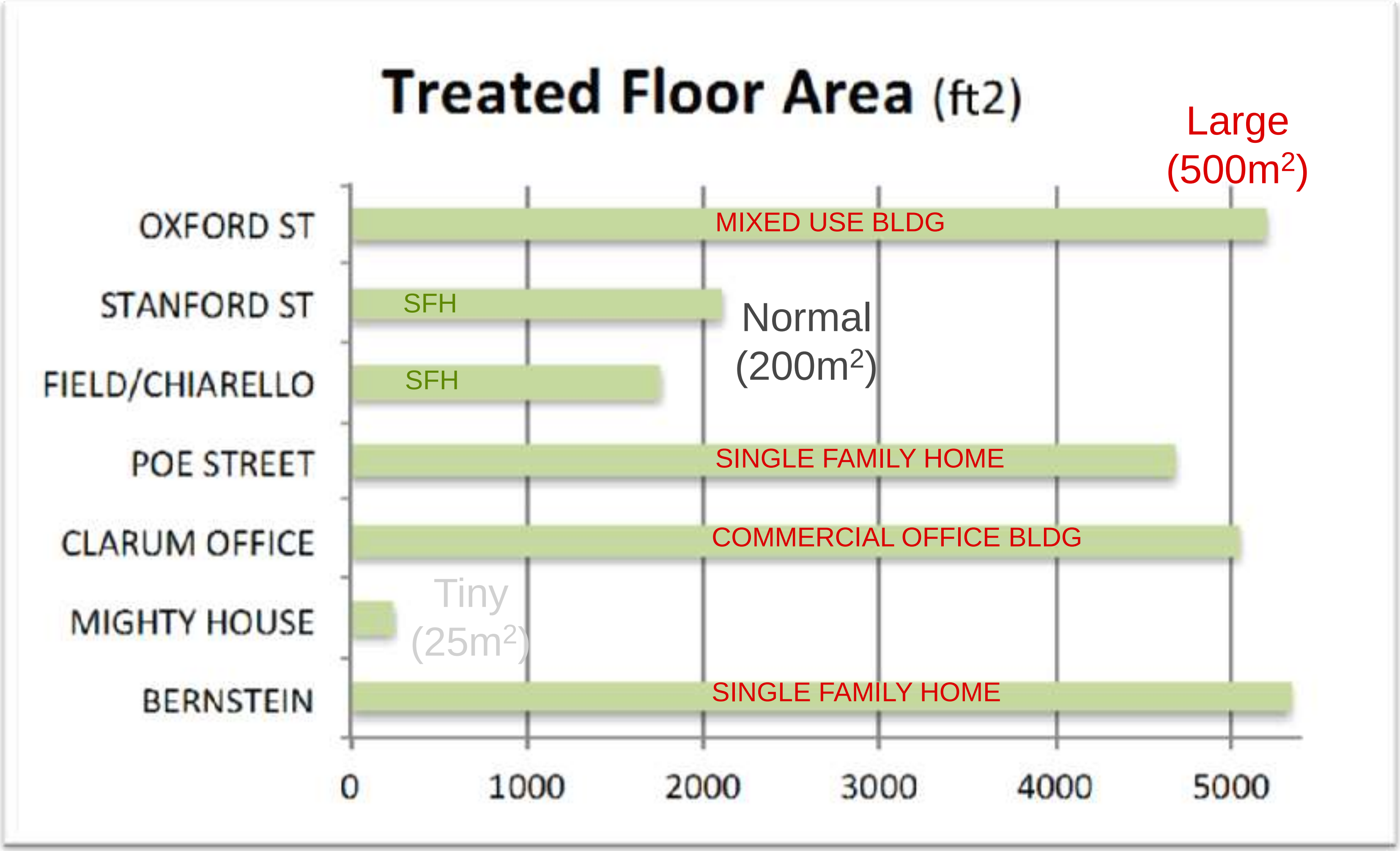




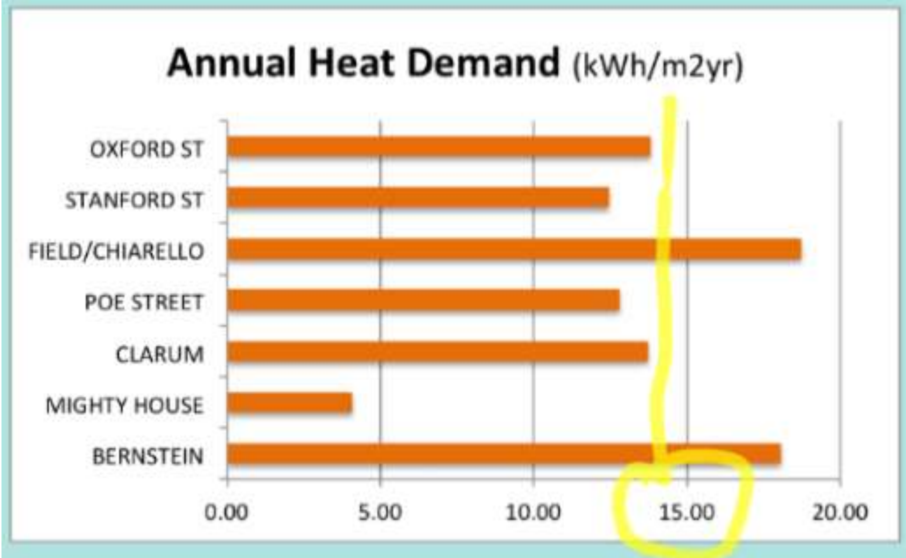


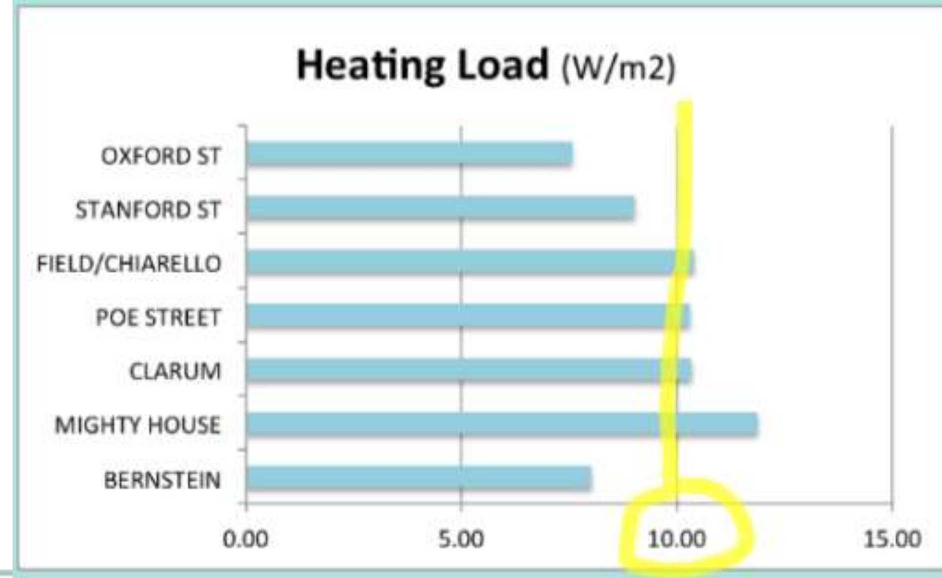


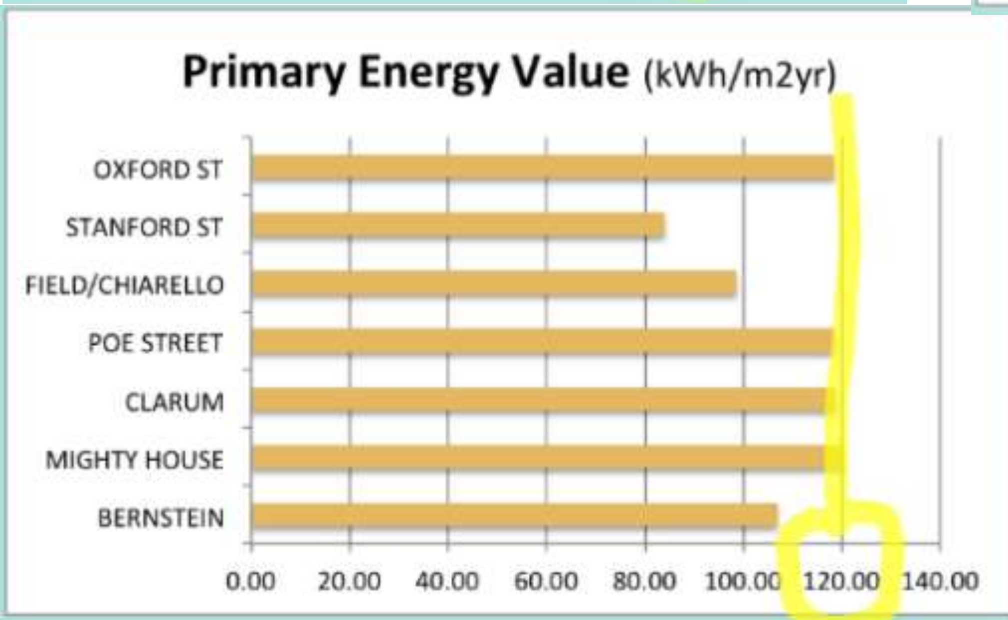
The Size Factor?



Certification Metrics







Warm Climate Summary

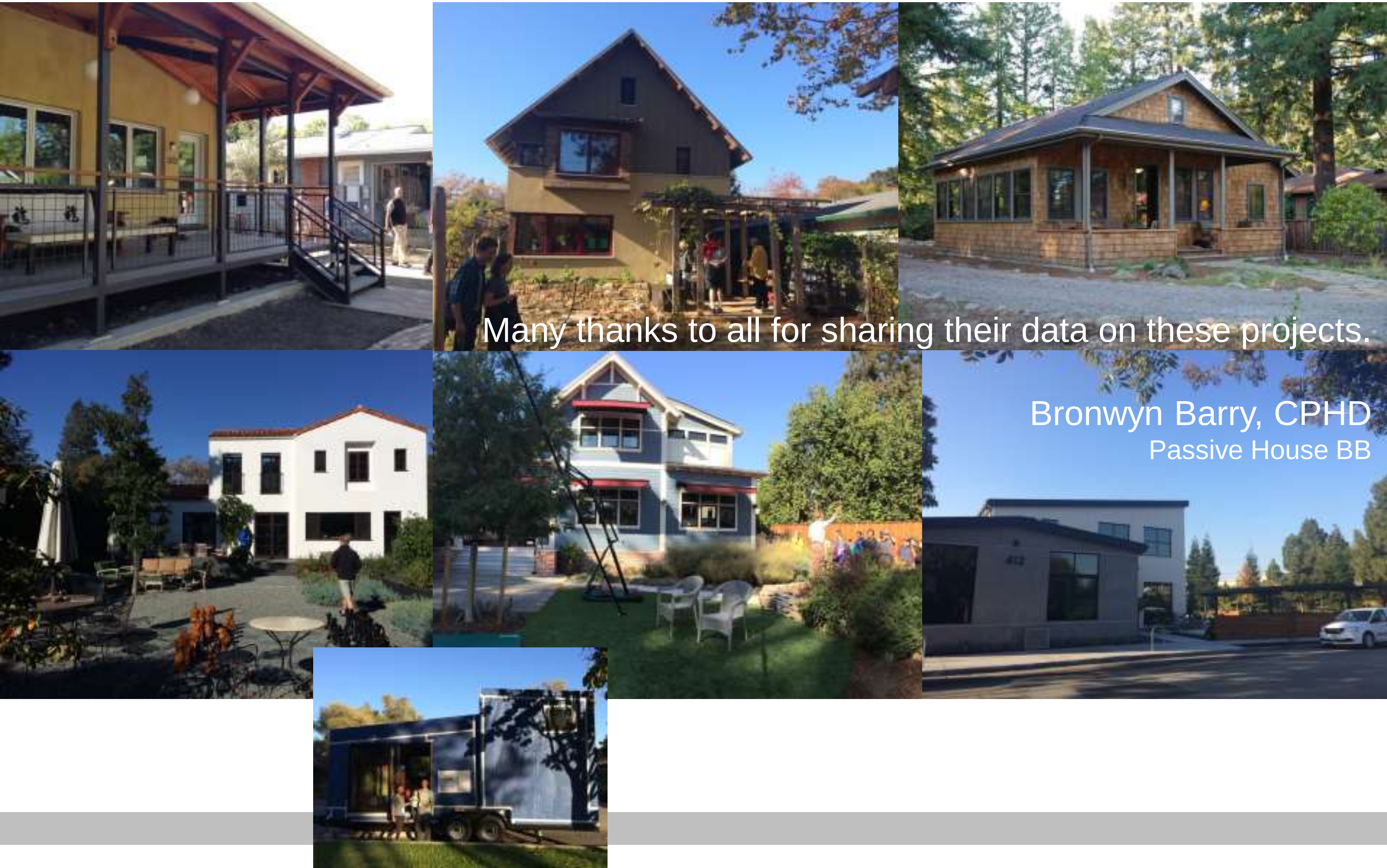
PH-related observations:

- Assemblies for all these projects had very similar U-values, despite size variation
- 2 certified via Heat Load criteria (surprising!)
- Showed PH allowed remarkable design & modeling flexibility

Non PH-related observations:

- None of these projects have an attached garage

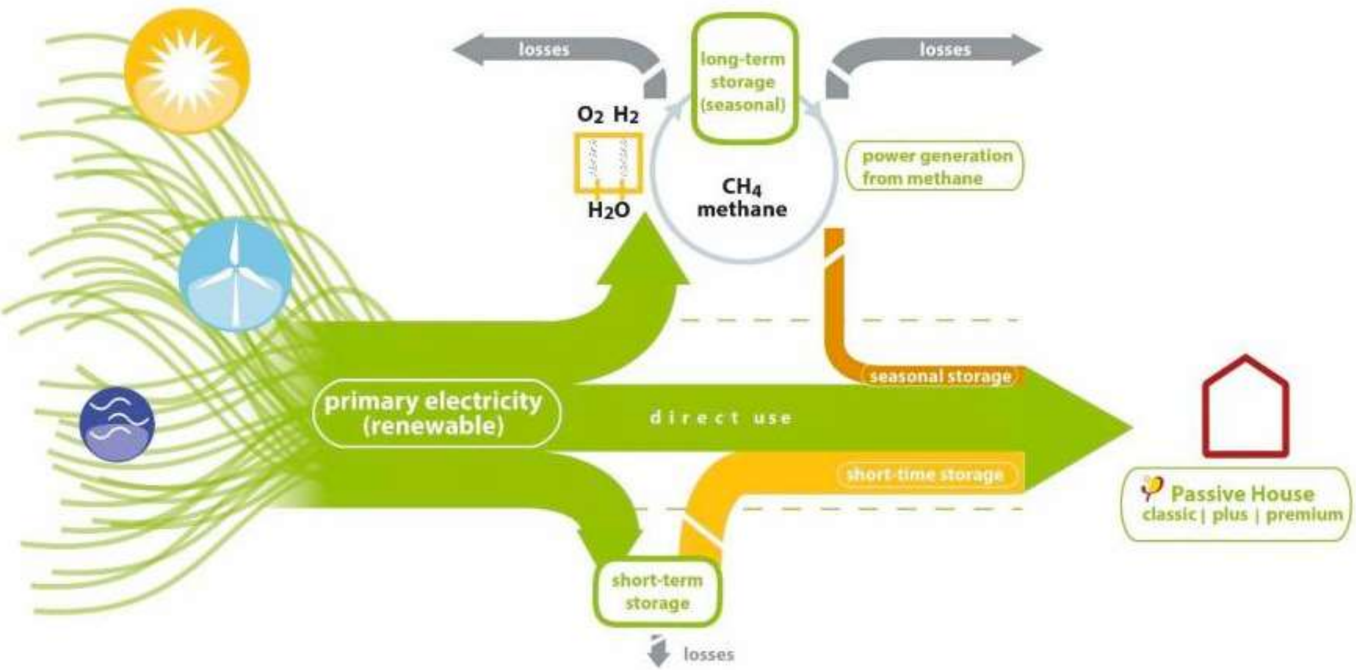
Thanks!



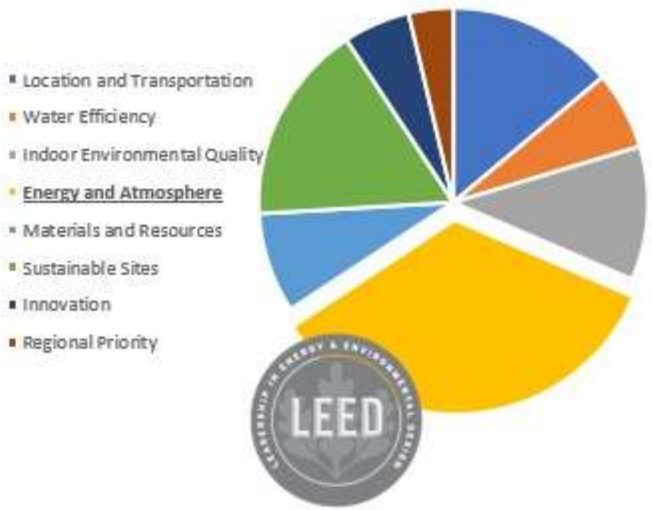
Many thanks to all for sharing their data on these projects.

Bronwyn Barry, CPHD
Passive House BB

PASSIVE HOUSE TOOLS & TARGETS



PASSIVE HOUSE ENERGY LEADERSHIP



PASSIVE HOUSE TARGETS

Heating/Cooling Demand: $15\ kWh/m^2yr$

or $4.75\ kBTU/hr.ft^2$

or

Peak Heat Load: $10\ W/m^2$

or $3.2\ BTU/hr.ft^2$

Air-tightness: $n_{50} < 0.6$ ACH

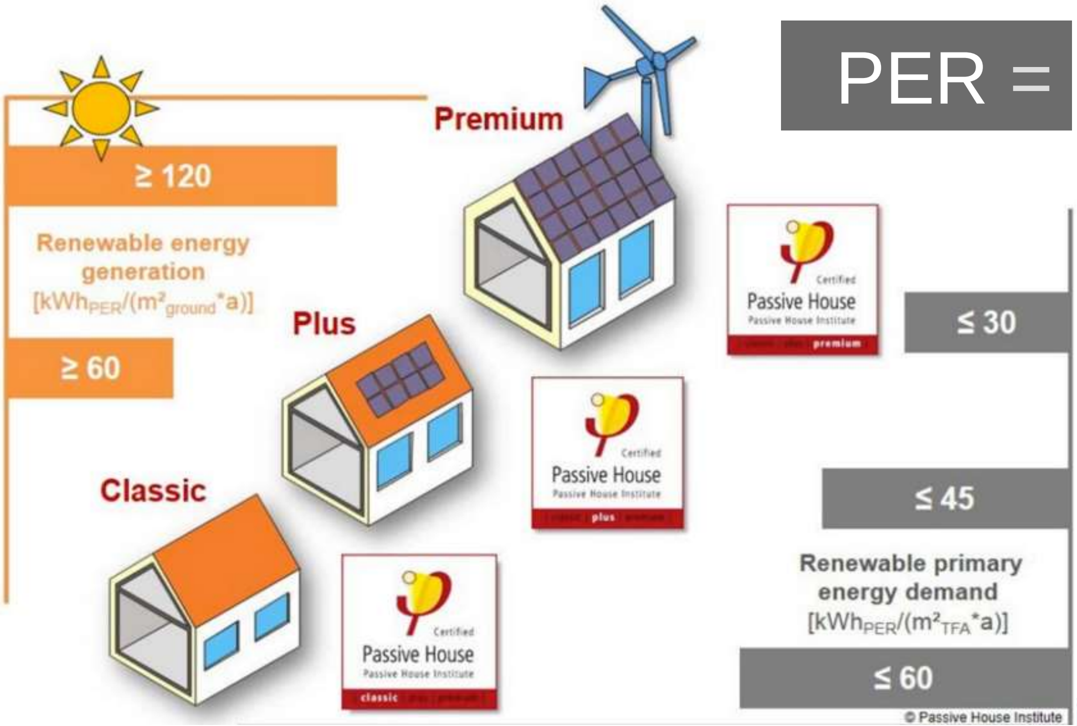
Total Primary Energy: (PER SLIDING SCALE)

Passive House Institute

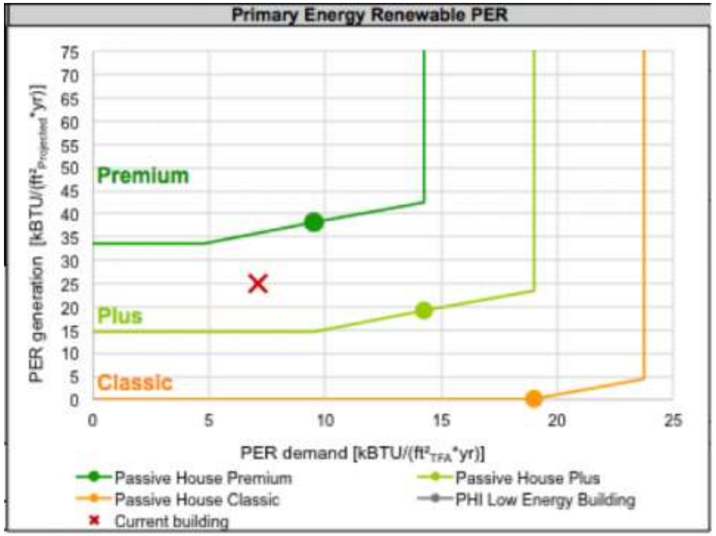
Cooling Limits adjusted for Humid Climates:

City	kBTU/ft2.yr
Madrid	4.75
Melbourne	4.75
New York	5.38
Beijing	6.02
Seaoul	6.02
Austin	6.97
Shanghai	7.6
Miami	16.5

THREE CERTIFICATION LEVELS



PER = Energy Supply from Renewable Resources / Final Energy Demand at the Building

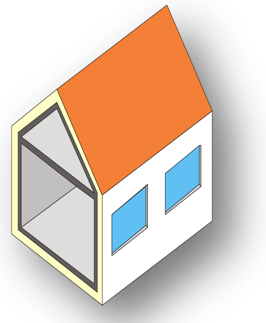


INCENTIVIZES:

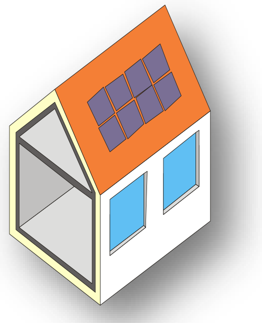
1. Total Demand Reduction & Peak Load Shifting
2. Fuel switching to all-electric with heat pumps
3. Regional renewable grid efficiencies
4. Allows local and off-site renewable credits
5. Seasonal storage of renewables at utility scale
6. Urban density & equitable renewable credit for all buildings

SOURCE: https://passipedia.org/certification/passive_house_categories/per#the_per_sustainability_assessment

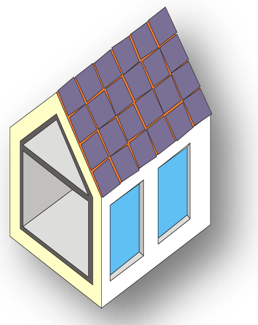
Certified Passive House Buildings



Certified Passive House
Passive House Institute
classic | plus | premium



Certified Passive House
Passive House Institute
classic | plus | premium



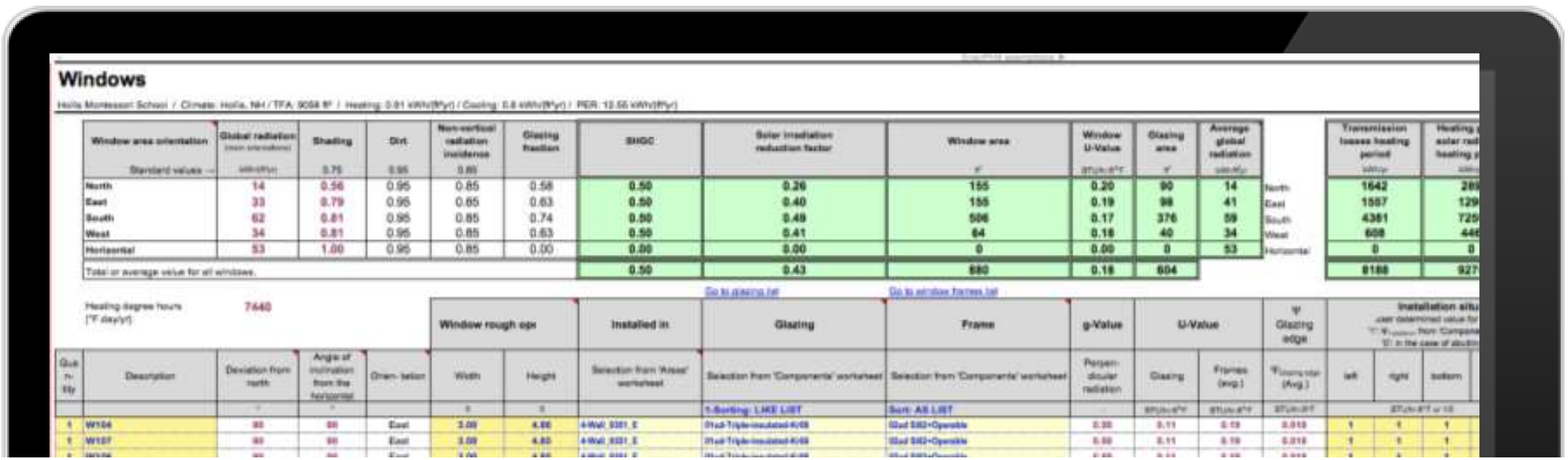
Certified Passive House
Passive House Institute
classic | plus | premium

Increased Efficiency + Renewable Generation on Site or Nearby

THE ENERGY MODEL: PHPP

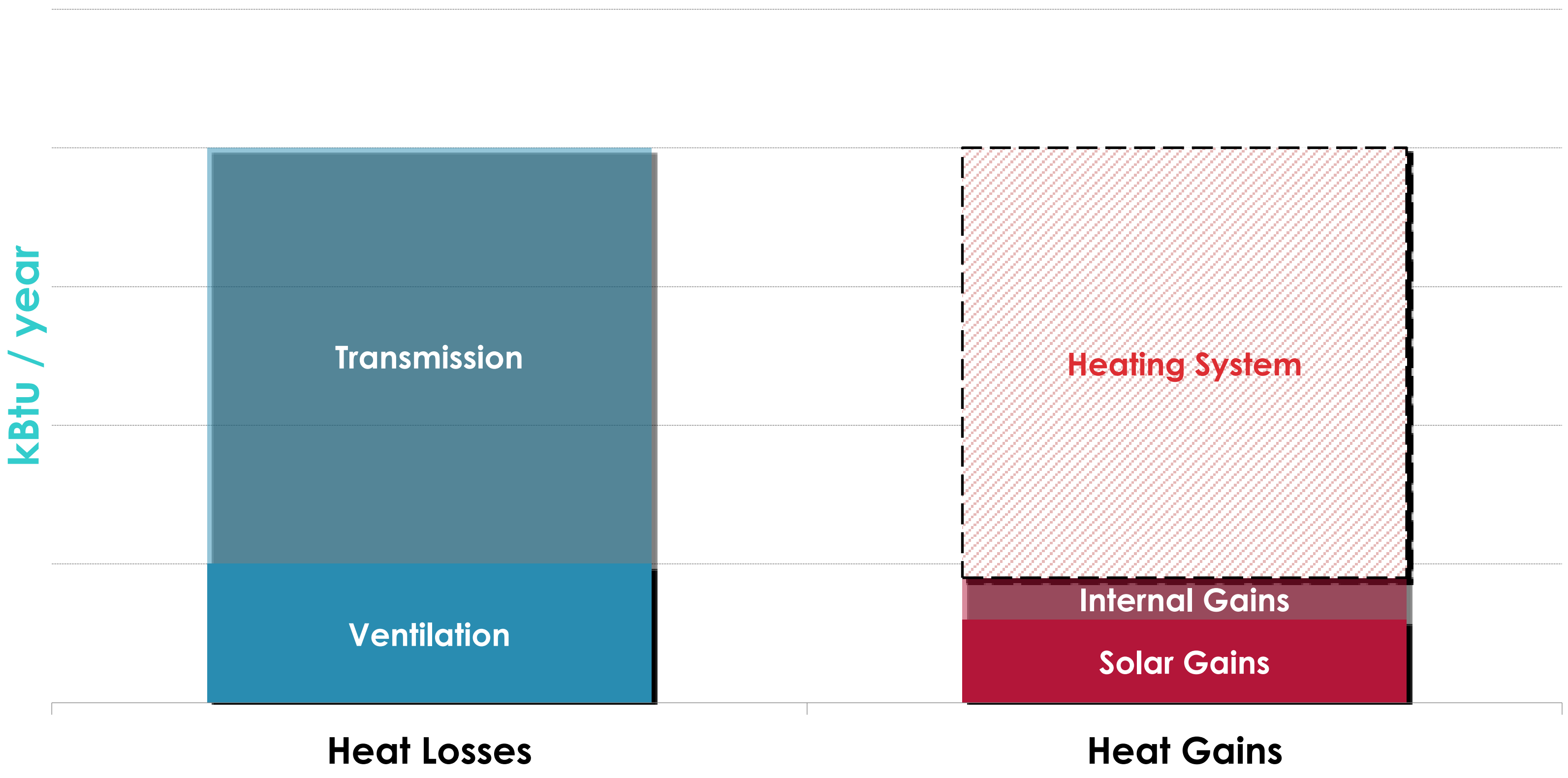
What is PHPP?

- A numerical steady-state energy modeling spreadsheet
- Uses monthly climate data to quickly calculate detailed gains and losses for low-energy buildings
- Purpose built for low-energy buildings and Passive-House style buildings
- Excel spreadsheet based and low-cost

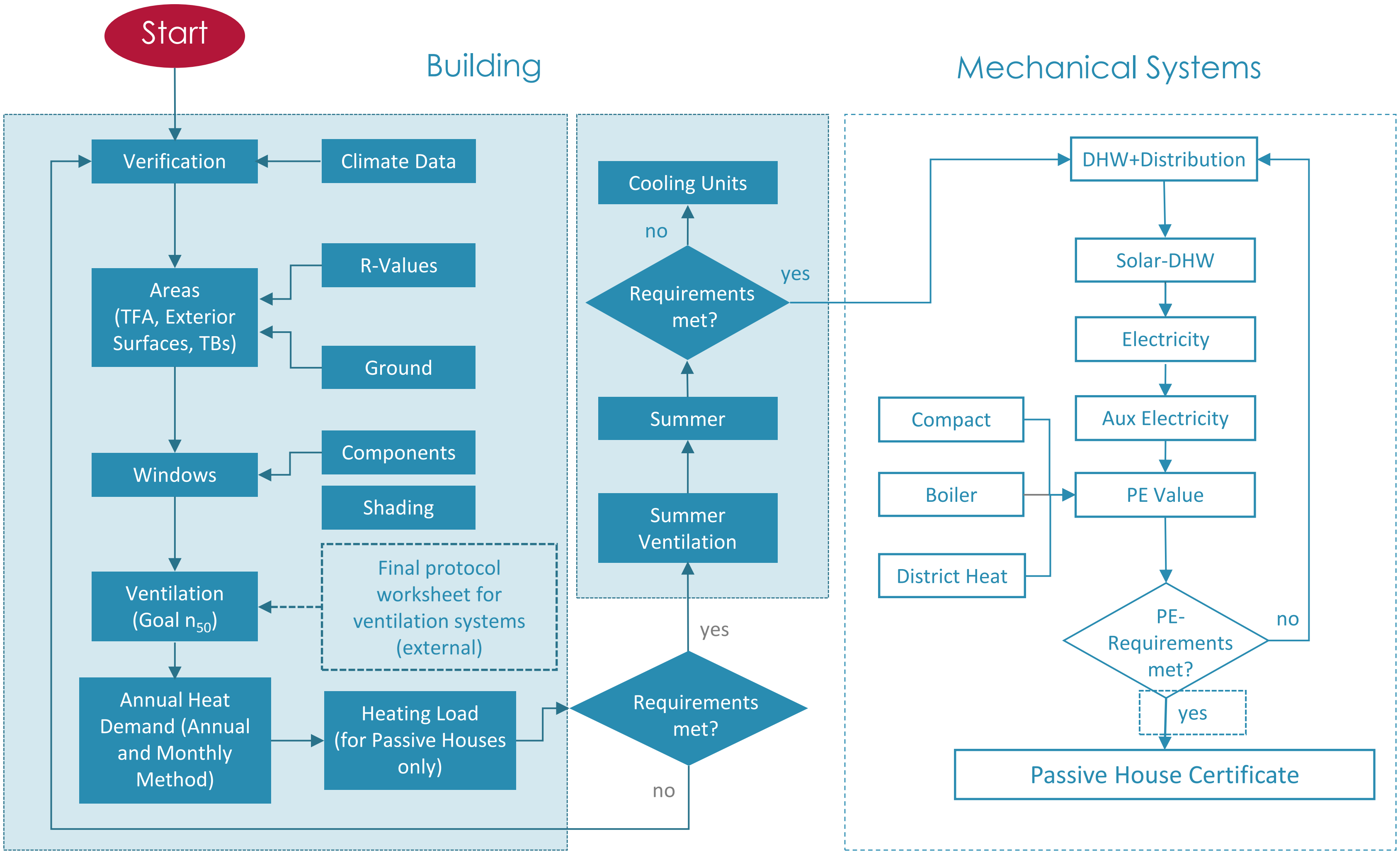


ENERGY BALANCE

$$Q_H = Q_T + Q_V - [\eta \times (Q_S + Q_I)]$$

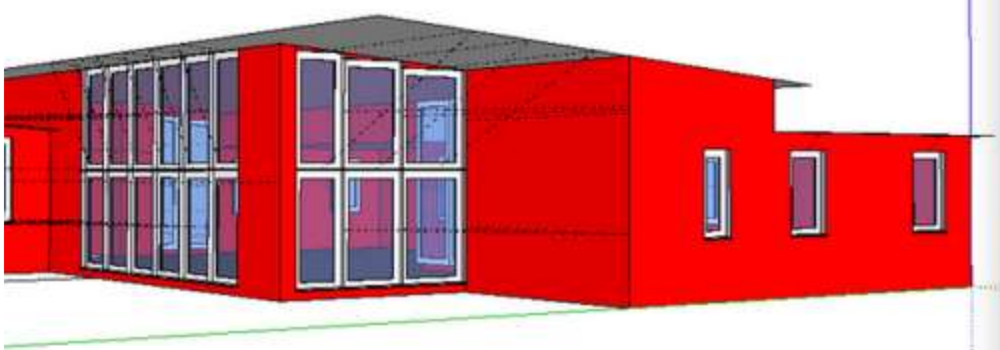


PHPP ROADMAP



GEOMETRY INPUT WITH DESIGNPH (SKETCHUP)

Climate: NY,New York
Qh 25 kWh/m²yr
TFA 250 m² (user-defined)
FHLF 3.33



Source: Building-Type LLC, Passive House Consultants. Howie House. 2015

designPH main

designPH 1.0, registered to: edwinmay [Unregister]

Update window options | Redraw windows

Heat Balance | Areas | U-value editor | Assemblies | Components | Climate

Annual Heat Demand

▼ Annual Heat Demand

Total heat losses (kWh/a)	Total free heat gains (kWh/a)	Utilisation factor	Treated Floor Area (m²)	Ann. Heat Demand (kWh/a)	Specific Ann. Heat Demand, Q_h (kWh/m²a)
12753.67	6634.95	0.98	250.48	6242.48	24.92

▼ Transmission heat losses

Total Heat Loss Area (m²)	Area Weighted U-value (W/m²K)	Av. Temp. Factor	Ann. Htg. Degree Hours (kKh)	Transmission Heat Loss (kWh/a)	Q_t (kWh/m²a)
833.41	0.20	0.88	70.10	10754.61	42.94

▼ Ventilation heat loss

Treated Floor Area (m²)	Ventilation volume (m³)	Eff. air exchange rate	Heat capacity of air	Ann. Htg. Degree Hours (kKh)	Ventilation heat loss (kWh/a)	Q_v (kWh/m²a)
250.48	626.20	0.14	0.33	70.10	1999.06	7.98

▼ Solar heat gains

Group nr.	Area Group	Win. area (m²)	Glazing area (m²)	g-value	Reduction factor	Radiation, G_s	Solar heat gain (kWh/a)	Q_s (kWh/m²a)
2	North Windows	30.68	20.44	0.50	0.40	106.70	660.46	2.64
3	East Windows	9.62	5.31	0.50	0.33	279.40	449.64	1.80
4	South Windows	17.79	11.60	0.50	0.39	557.60	1958.43	7.82
5	West Windows	23.65	14.93	0.50	0.38	290.90	1315.51	5.25
6	Horizontal Windows	0.00	0.00				0.00	0.00
		81.75	52.29				4384.05	17.50

▼ Internal heat gain

Treated Floor Area (m²)	Internal heat gain rate (W/m²)	Heating period (days/a)	Heating period (kh/a)	Internal heat gain (kWh/a)	Q_i (kWh/m²a)
250.48	2.10	178.30	4.28	2250.90	8.99

ONLINE GUIDE TO CERTIFICATION

Free to download!
http://passiv.de/downloads/03_building_certification_guide.pdf

DETAILS ON HOW TO CERTIFY

Example plans

Site plan

Neighbouring buildings including their height and distance to the proposed building must be represented on the site plan if they shade the building. Show topography if possible.

Angle of deviation from North

Neighbouring vegetation or / and any other elements which shade the building, including height and type of vegetation (e.g. coniferous or deciduous)

Graphic identification of the building envelope intended for certification

See page 26 for acceptable file formats and general requirements

Scale:
1:200
Angle of de
from North
206°

Elevation

Show outside and outgoing air vents, grid types, distance from ground

Make sure to show clearly and to name any non-heated adjacent rooms accordingly

Show the different type of surfaces

Make sure to name all surfaces and windows using the same coding both on the drawings and in the PHPP

Correct representation of walls, windows, and doors

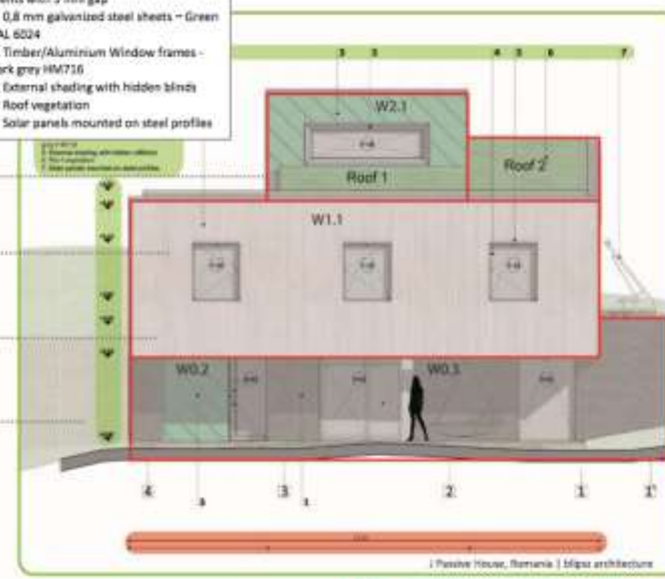
Make sure to show clearly the wall surfaces in contact with the ground as well as the ground line for semi-buried walls

Dimensions

Scale:
1:50
or
1:100

See page 26 for acceptable file formats and general requirements

1. Facade cladding panel – dark grey NU073
2. 22x40 mm wood panel façade elements with 5 mm gap
3. 0,8 mm galvanized steel sheets – Green RAL 6024
4. Timber/Aluminium Window frames - dark grey HM716
5. External shading with hidden blinds
6. Roof vegetation
7. Solar panels mounted on steel profiles



Graphic identification and external dimensions of the thermal envelope

CLOSE OUT DOCUMENTS

- HVAC & electrical penetrations
- Airtightness test results
- Thermography – If conducted
- Photographs taken during sequence inspections – walls, air sealing, insulation,
- HVAC Data sheets w/ efficiency % and H/ERV commissioning
- Signed Passive House Declaration on PHPP
- Building user manual

Specific building characteristics with reference to the treated floor area — The PHPP has not been filled completely; it is not valid as verification

					Criteria	Alternative criteria	Fulfilled?[2]
	Treated floor area	ft²	2160				
Space heating	Heating demand	kBTU/(ft²yr)	1.87	≤	4.75	-	yes
	Heating load	BTU/(hr.ft²)	3.29	≤	-	3.17	
Space cooling	Cooling & dehum. demand	kBTU/(ft²yr)	4.22	≤	5.39	5.39	yes
	Cooling load	BTU/(hr.ft²)	3.44	≤	-	3.25	
	Frequency of overheating (> 77 °F)	%	-	≤	-		-
	Frequency excessively high humidity (> 0.012 lb/lb)	%	1.4	≤	10		yes
Airtightness	Pressurization test result n_{50}	1/hr	0.6	≤	0.6		yes
Non-renewable Primary Energy (PE)	PE demand	kBTU/(ft²yr)	14.54	≤	38.04		yes
Primary Energy Renewable (PER)	PER demand	kBTU/(ft²yr)	7.14	≤	-	-	-
	Generation of renewable energy (in relation to projected building footprint area)	kBTU/(ft²yr)	0.00	≥	-	-	

[2] Empty field: Data missing; '-': No requirement

…onfirm that the values given herein have been determined following the PHPP methodology and based on the characteristic values of the building. The PHPP calculations are attached to this verification.

Passive House Classic? yes

Task: | First name: | Surname: | Signature:

Issued on: | City:

CONGRATULATIONS!

With the methodology you have made a Passive House.

….but it's important to remember,

Define your Target!

Anything is Possible.