ALPEN

HIGH PERFORMANCE PRODUCTS

What the Shell?

Leveraging the Historically Proven Principles of Passive House to Retrofit our Aging Built Environment

Learning Objectives

Our intent is to describe:

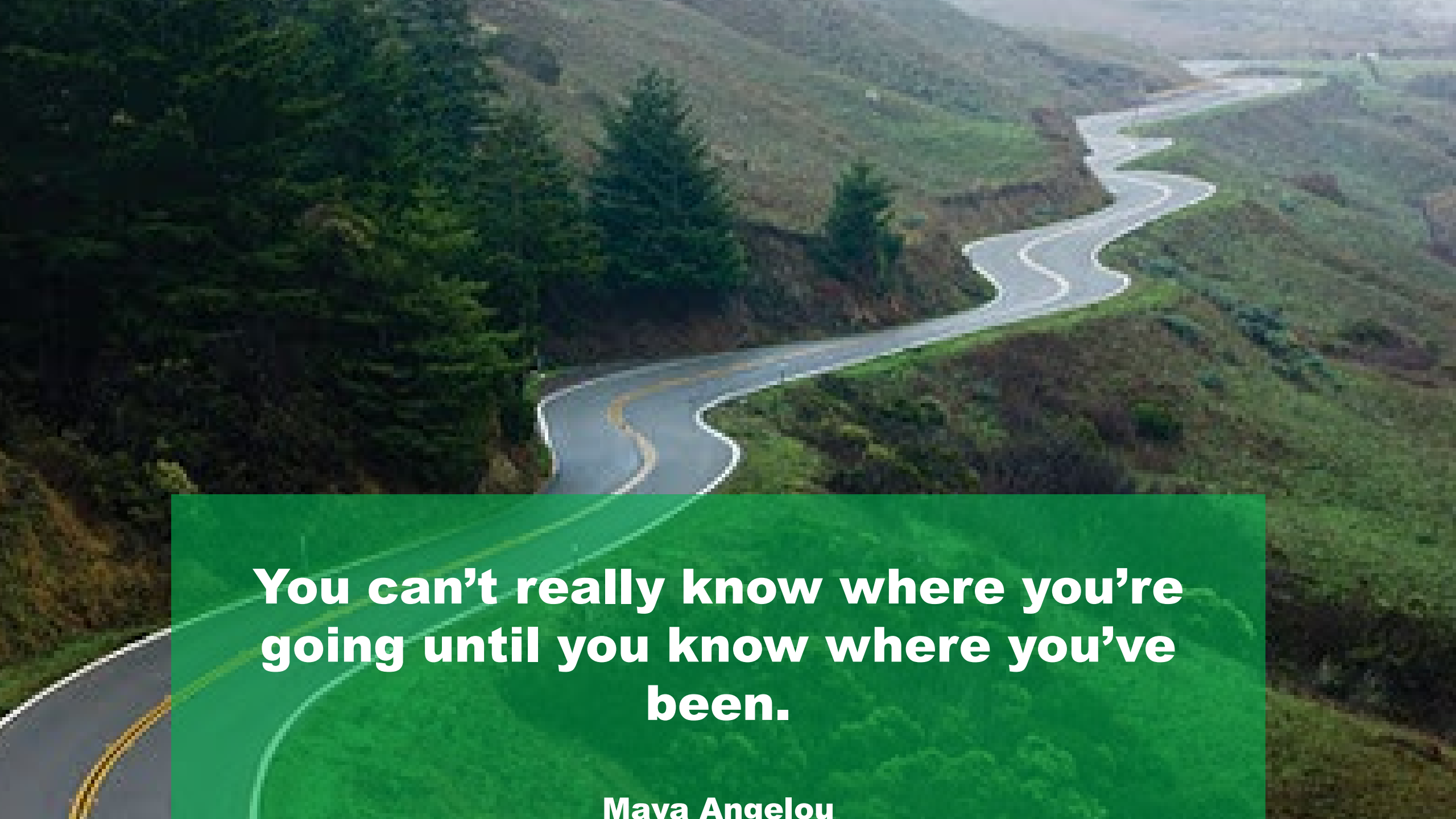
1. **How we got here:** the **origin and rapid evolution** of the North American passive house movement;

2. **Influence:** the **extraordinary broad influence of the passive house** movement--increasing our responsibilities as a community;

3. **A New Problem:** the opportunity and challenge of "**massive commercial built environment problem**" almost untouched by the passive house community;

4. **New Passive House Solutions:** examples of innovative and practical solutions either ***inspired by or consistent with passive house principles*** now being made available to address the "problem."

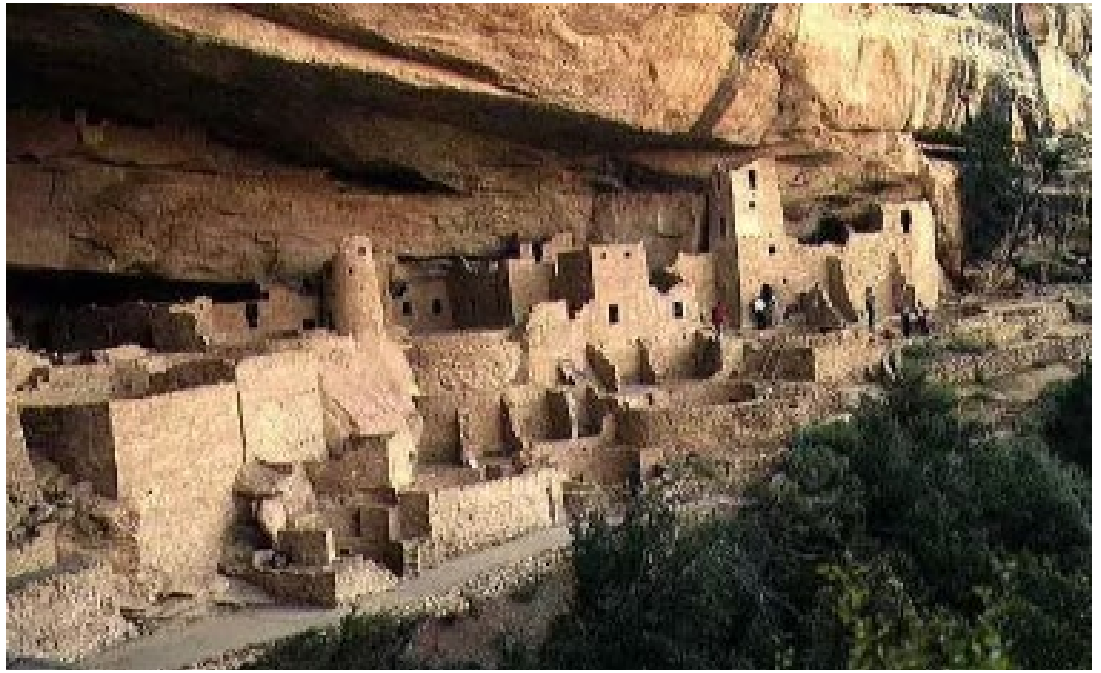
5. **Challenge:** a challenge the audience to "think big and outside the box" and consider how to drive "passive house adjacent solutions" to solve this ***big hairy critical problem.***


You can’t really know where you’re going until you know where you’ve been.
Maya Angelou

The Origins of “Passive House” Can Be Traced Back Thousands of Years

15th Century BC

The earliest known reference to use **solar energy** during reign Egyptian ruler Amenhotep the Great.

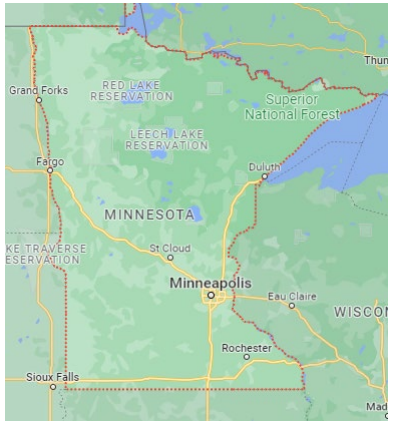


7th Century BC

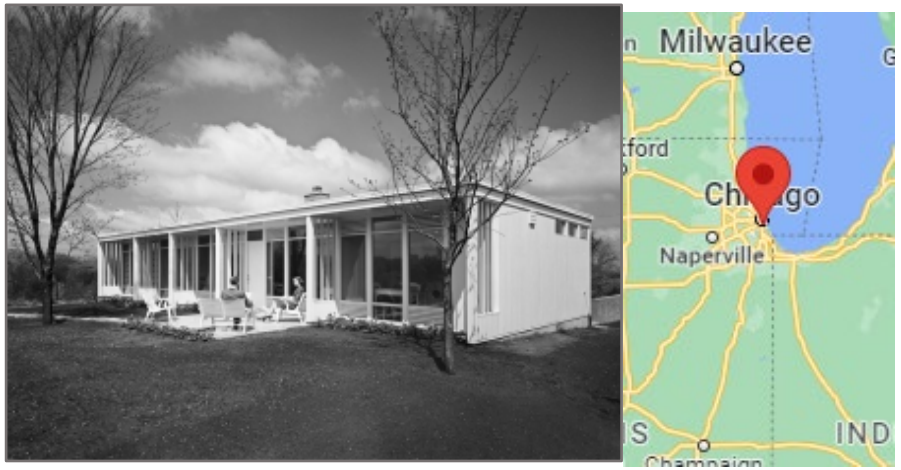
North American Anasazi Native Americans build into the south side of cliffs to consider **solar exposure**.

The Origins of "Passive House":
Let's *Fast Forward a Few Thousand Years*

The use of ***passive solar design*** begins to blossom in the United States:



The 1930s. Relatively modern designs of passive solar homes began to be built in the relatively colder climate of Minnesota.



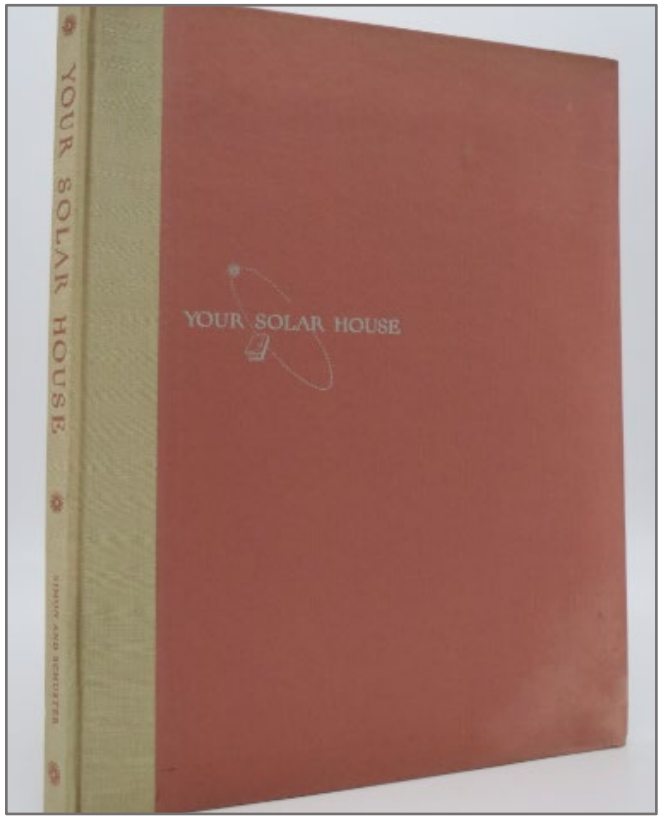
The 1940s The Keck brothers in Chicago built a prefab building with large, south-facing windows with overhangs to admit sunshine in the winter but block it in the summer months.

1880s The earliest version of solar heated homes appear in Salem, Massachusetts (Professor E.L. Morse)

The Origins of "Passive House":
Let's *Fast Forward a Few Thousand Years*

The use of ***passive solar design*** begins to blossom in the United States:

1941 Your Solar House is Published



- Funded by Libbey-Owens-Ford Glass Company (now Pilkington), and included 48 designs (***one for each state at the time***) of homes designed to utilize direct gain solar energy according to the unique geographic climate and building traditions of the time.
- Acknowledging wide climate diversity in North America, a precursor to a contributed to an issue central to the PHIUS and PHI split 60 years later.

Early solar homes (both passive and active)—were often complicated, ugly, expensive, and overglazed

So Where Did the Concept of the *Modern Passive House* Come From Anyway?

THE "**OVERNIGHT**" EXPLOSION OF PASSIVE HOUSE . . .
OVER THE LAST 50 YEARS!

History Can Firmly Point Its Finger at a Single Person as the First Mover of the Movement


NIXON '72
HUH? LET ME EXPLAIN.


SUEZ CANAL AREA
CAMPAIGN IN SINAI
Port Said
Ismailia
Suez
Cairo

1973 Yom Kippur War in the Middle East

Nixon Requests $2.2 Billion in Aid for Israel

The Arab World Responds with the Oil Embargo

Crisis = 危 机

危 = Danger

机 = Changing Point

And so it begins...

Oil Prices Skyrocket and Energy Conservation Takes Center Stage

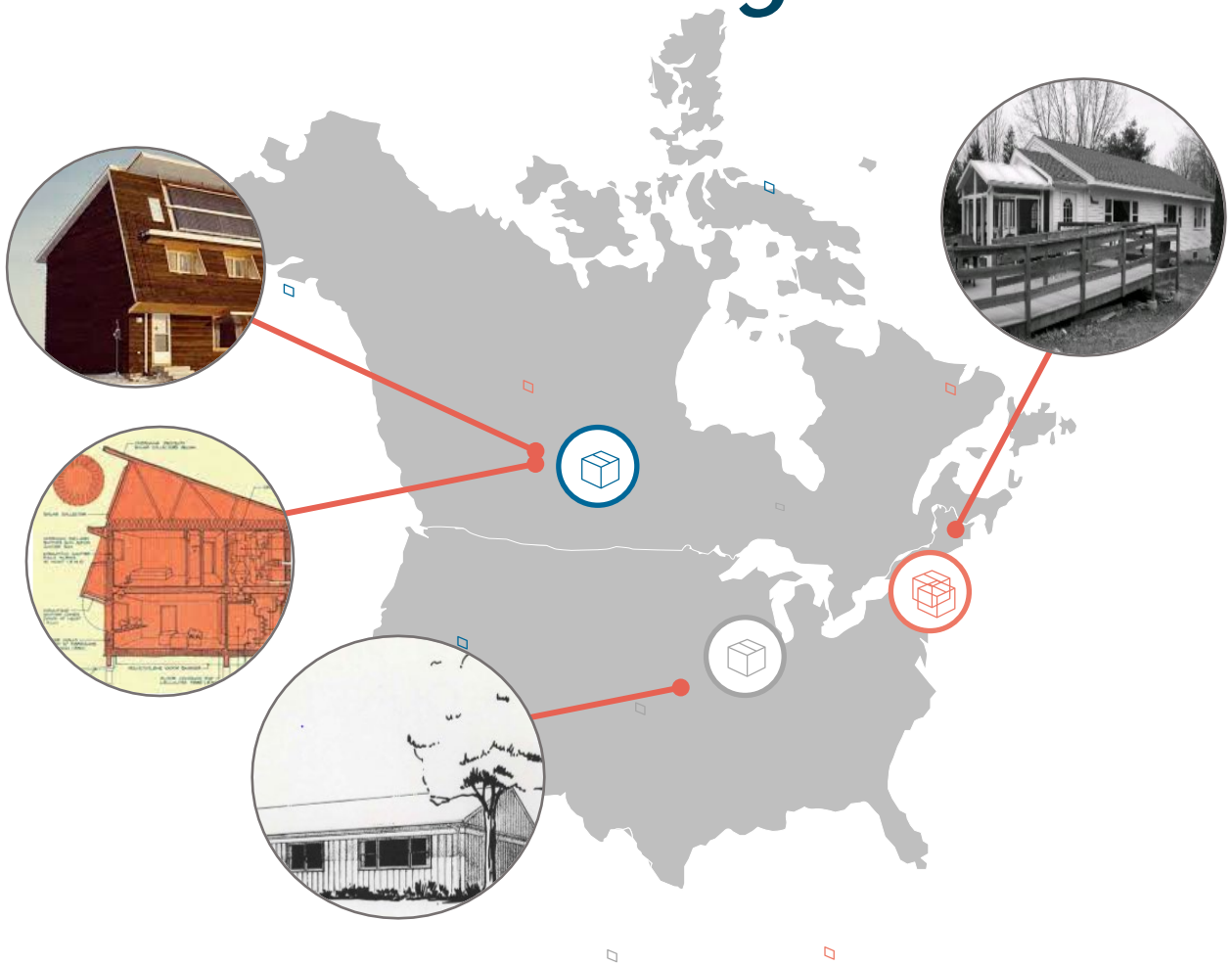
Price of Oil
(Adjusted for Inflation)

Carter Forms Department of Energy in 1977

Almost immediately begins funding research and deployment of new science of low-e glass

Pleads with Americans to Turn Down Thermostats

Three Influential *Super-insulated* Home Designs— the "*Original* Passive House" Designs?



1977 Ledger House
Pepperrel, Massachusetts

1977 Saskatchewan Conservation House
Regina, Saskatchewan

1976 Illinois Lo-Cal House
Urbana, Illinois

The Art of Communicating Complex and Abstract

Enter the Great Communicator

(Another) physicist William Shurcliff

Reading about other solar designers was "***infuriating***," he told the New York Times. "***Half the information was missing, and systems were vaguely described as 'ingenious' without explaining why they were ingenious or how well they worked. Sense had to be made of it.***"

Author of 100s or articles and dozens of books, he set about to explain the intersection of passive solar design and super-insulation.

Describing what he saw in these 3 *super-insulated and passively heated homes*, Shurcliff described . . . "passive house" for the first time:

He described a new category of a building that included:

1. Truly superb insulation;
2. Airtight envelopes;
3. No provision of extra thick thermal mass;
4. Non-oversized furnaces;
5. No conventional air movement;
6. No weird architecture;
7. No extra expense;
8. Modest passive heating;
9. Normal humidity around 50% year-round;
10. South windows are small enough to be shielded by eaves.

Great communicator but not so good at coining phrases, right?

What name should be given to this new system?

Super-insulated passive? Super-save passive? Mini-need passive? Micro-load passive? I lean toward 'micro-load passive.'

Whatever it is called, it has I predict a big future."

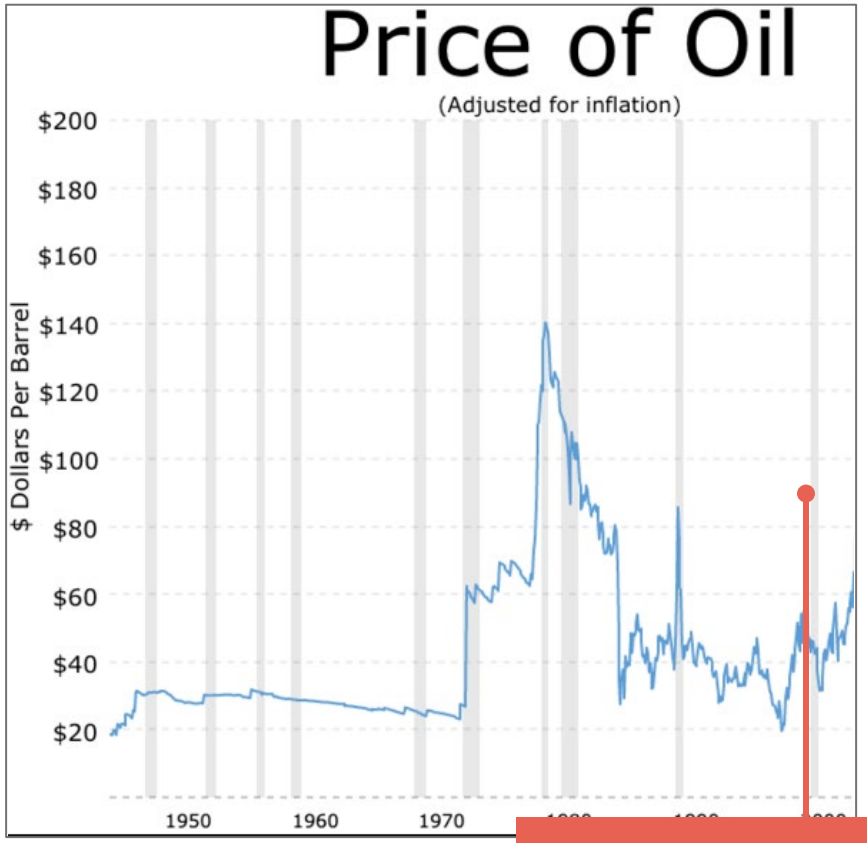
June 1979

Physicist William Shurcliff

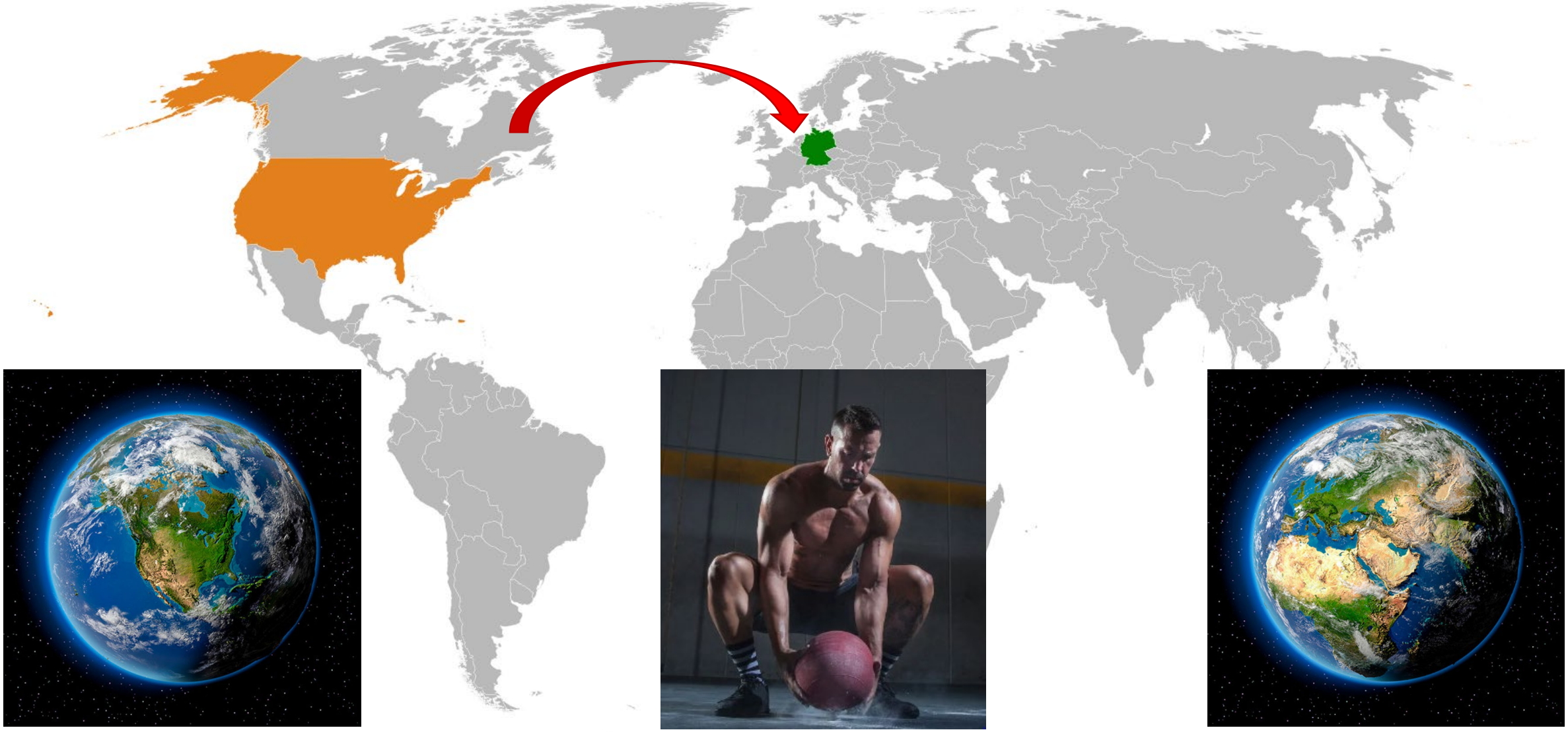
Then a funny thing happened in the United States

. . . if Only a Nation Could Take Ritalin

Oil Prices Plummeted . . . Interest Faded Fast



Oil Prices in the U.S. Dropped!



Picking up the Ball in Germany

A Rapid Explanation of Modern Day Passive House in North America

Passive House Goes Mainstream:

The Story of a **Wolf** and a ***Cat***

Passive House Passion Arrives

The story of

Provocative Marketing,

a ***Presentation on the Wrong Topic*** (sort of)

and

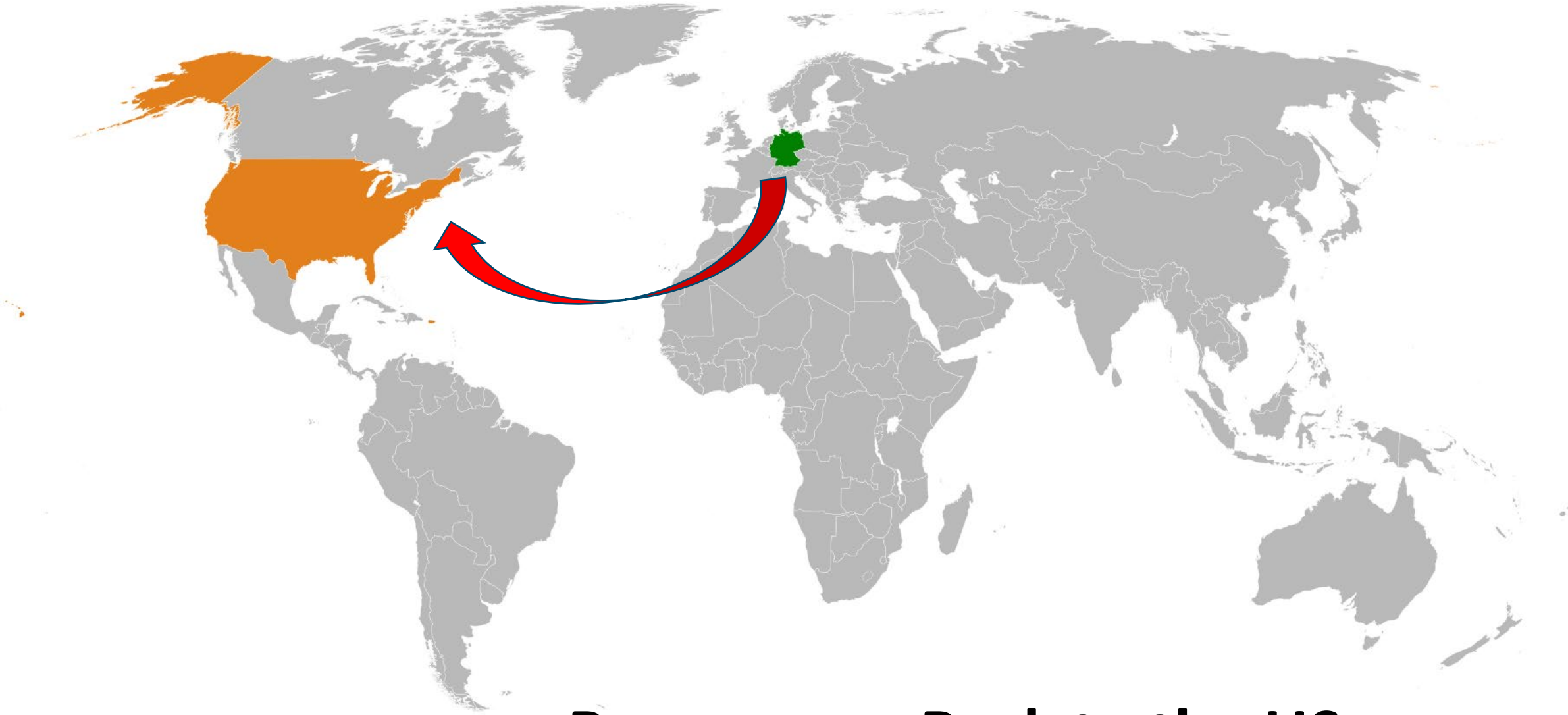
the ***Uncorking at Champaign***

The Wolf: Wolfgang Feist and the Passive House Institute

- Inspired by the writings of **Schurcliff** and fellow physicist **Amory Lovins**, among others, Feist picks up the ball

- Adding to this work, attached a comfort objective, creating performance standards and a defined process to achieve the standard, announces a **Passivhaus** system of building.

- He builds in Darmstadt, Germany, a prototype of the first Passive House in 1990, and established the Passive House Institute.



Boomerang Back to the US

The Cat: Katrin Klingenberg and PHIUS

- Katrin Klingenberg discovered passive house while studying architecture in Berlin and re-introduced the modified, passive house principles to the United States.
- In 2003, Klingenberg completed the first home in the United States built to PHI standards, and she later became the co-founder of Passive House Institute US (PHIUS).
- As the passive house movement gained new momentum, Klingenberg and others at PHIUS found that the single performance metric of PHI did not work for North America's extreme variations in climate.
- In 2015, PHIUS released the PHIUS+ standard, the only passive building standard to consider cost-effective and climate-specific performance criteria.

Passive House Explodes on the Scene

A US High Performance Window Manufacturer's Story

Norbert's "Provacative" Josko Brochure in 2007

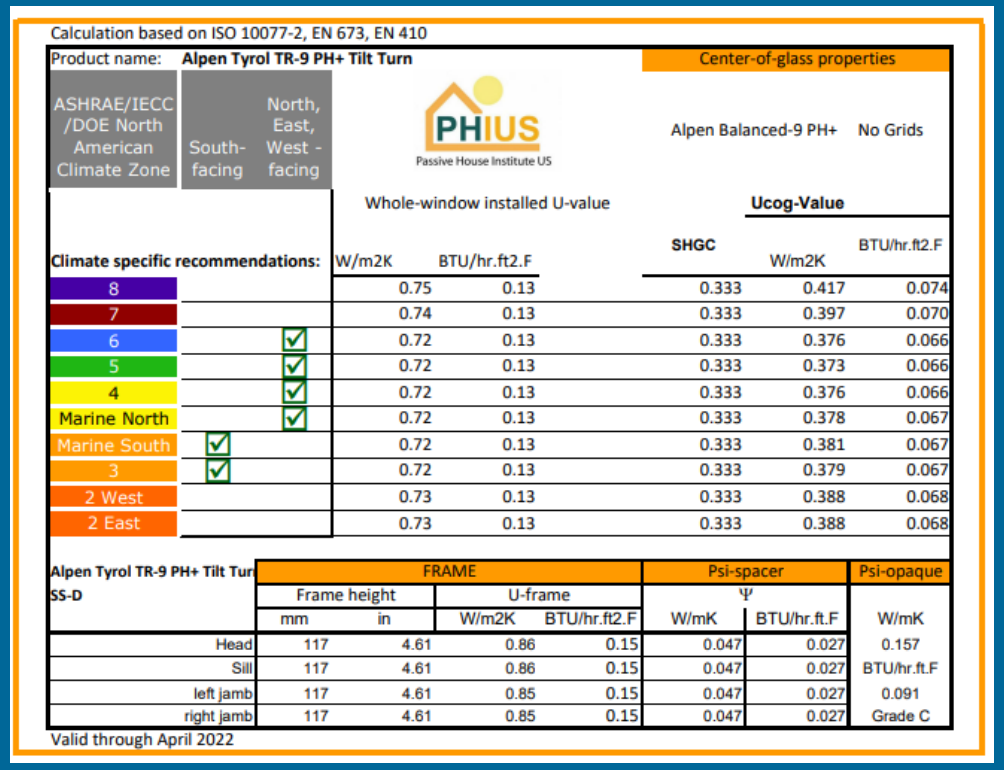
Robert Clarke's Accidental Presentation in PHIUS Conference Duluth in 2008

Passive House Explodes on the Scene

A US High-Performance Window Manufacturer's Story

PHIUS Conference at the University of Illinois

Urbana-Champaign in 2009



Calculation based on ISO 10077-2, EN 673, EN 410

Product name: **Alpen Tyrol TR-9 PH+ Tilt Turn**

PHIUS Passive House Institute US

ASHRAE/IECC /DOE North American Climate Zone	South-facing	North, East, West - facing	Whole-window installed U-value W/m2K	BTU/hr.ft2.F	Center-of-glass properties: Alpen Balanced-9 PH+ / No Grids — SHGC	Ucog-Value W/m2K	Ucog-Value BTU/hr.ft2.F
Climate specific recommendations:							
8			0.75	0.13	0.333	0.417	0.074
7			0.74	0.13	0.333	0.397	0.070
6		☑	0.72	0.13	0.333	0.376	0.066
5		☑	0.72	0.13	0.333	0.373	0.066
4		☑	0.72	0.13	0.333	0.376	0.066
Marine North		☑	0.72	0.13	0.333	0.378	0.067
Marine South	☑		0.72	0.13	0.333	0.381	0.067
3	☑		0.72	0.13	0.333	0.379	0.067
2 West			0.73	0.13	0.333	0.388	0.068
2 East			0.73	0.13	0.333	0.388	0.068

Alpen Tyrol TR-9 PH+ Tilt Tur SS-D	FRAME: Frame height mm	Frame height in	U-frame W/m2K	U-frame BTU/hr.ft2.F	Psi-spacer Ψ W/mK	Psi-spacer Ψ BTU/hr.ft.F	Psi-opaque W/mK
Head	117	4.61	0.86	0.15	0.047	0.027	0.157
Sill	117	4.61	0.86	0.15	0.047	0.027	BTU/hr.ft.F
left jamb	117	4.61	0.85	0.15	0.047	0.027	0.091
right jamb	117	4.61	0.85	0.15	0.047	0.027	Grade C

Valid through April 2022

How the Great Schism of 2011 between PHI and PHIUS Actually Accelerates Forward the Movement

- European-based PHI and the North American -based PHIUS groups formally split in 2011
- As a result, **passive house movement** in North America actually dramatically accelerates
- Why?

The “Two Christmases” Syndrome

- **More suppliers** enter the market (lower prices, more choice, less supply risk)
- **More consultants, architects, builders** enter the market—some attracted and to an extent loyal to one camp and others not;
- Twice the conferences and twice the associations
- **More friendly and appropriate North American standards** (critical for government adoption)
- Less rigidity, favoring European biases
- More competition, more conflict, more discussion

The Hidden Influence of Passive House

First residential and then commercial

Early PH-certified projects

Leads to large wave of non-certified projects

Leads to tsunami of "inspired projects"

The Accelerator of Local, State and now Federal Governments Code Explosions:
The Massive Tsunami behind the Tsunami

Amazing growth coming and influence!

Where Next?

The looming monster of the existing **commercial building stock** and the unique role the passive house community can play in taming it.

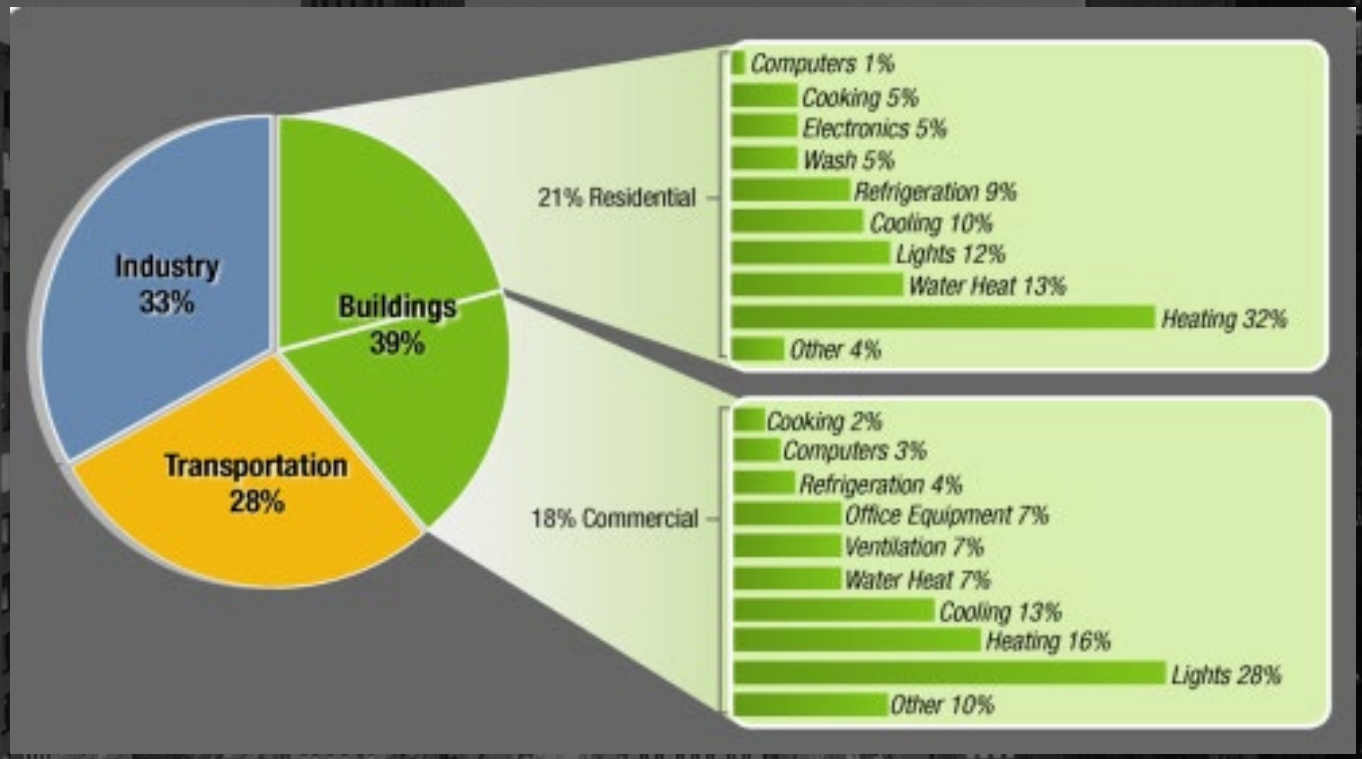
- "Efficient buildings" in world under 1%
- 80% of buildings we will use in 2050 are already built
- Almost 60% of residential windows go to replacement applications
- ***Less than 10% of all commercial building in all of the United States have ever replaced window! !!!***

- 5.5 million commercial buildings
- 30% single-pane (2.7B sq. ft.)
- 20% low-performing double-pane (1.8B sq. ft.)

What to Do?

Opportunities to Do More Than our Fair Share

Energy Use Problem in Commercial Real Estate



Comfort Problem in Commercial Real Estate

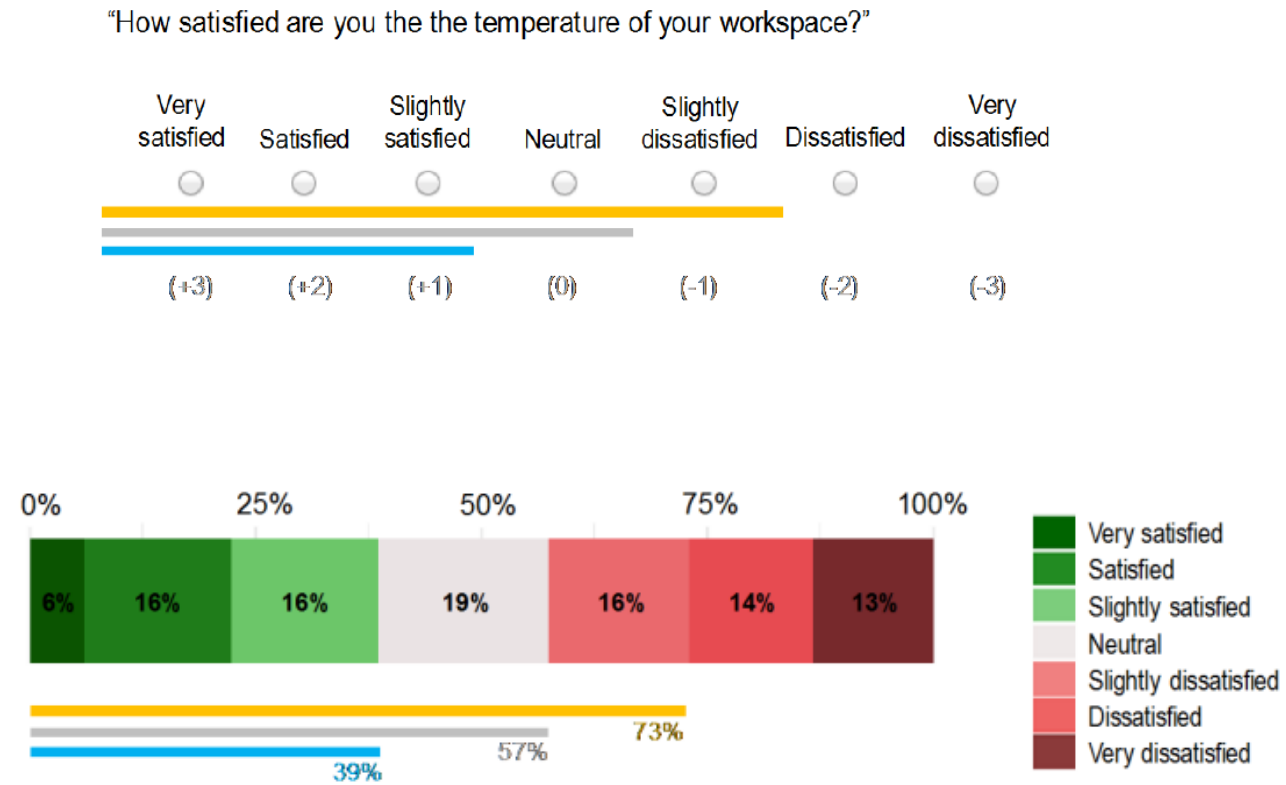
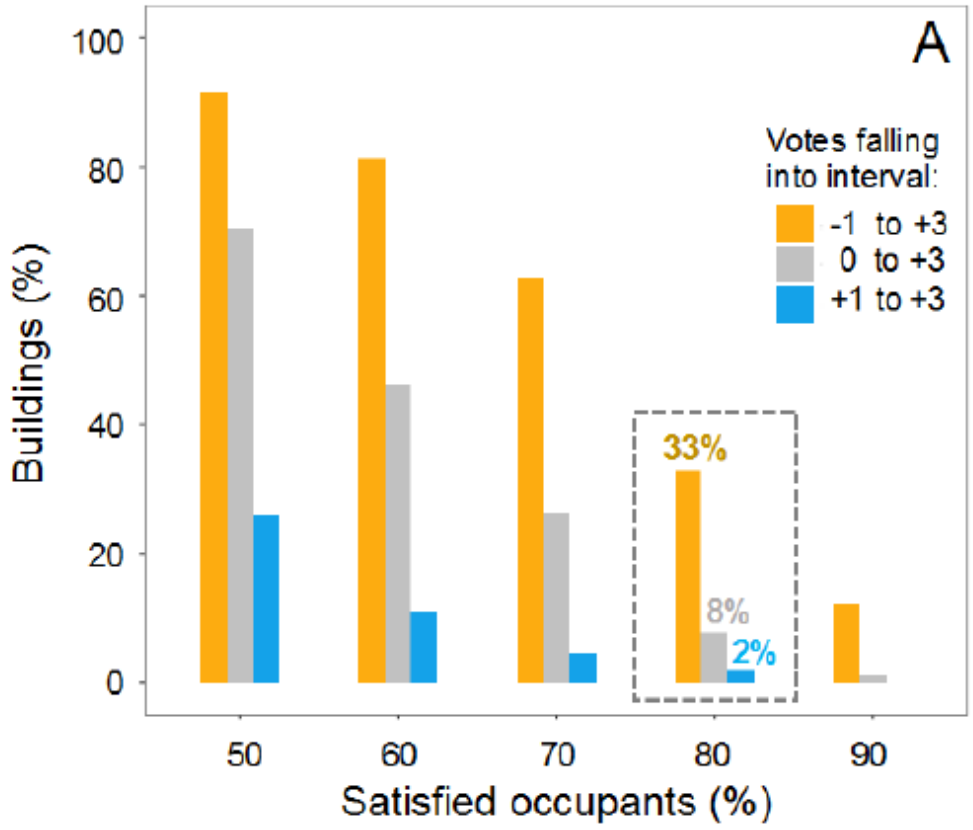


Figure 2: Bar chart showing the distribution of temperature satisfaction votes for 52,980 occupants (in 351 office buildings).



How do we get from the problem to the solution?

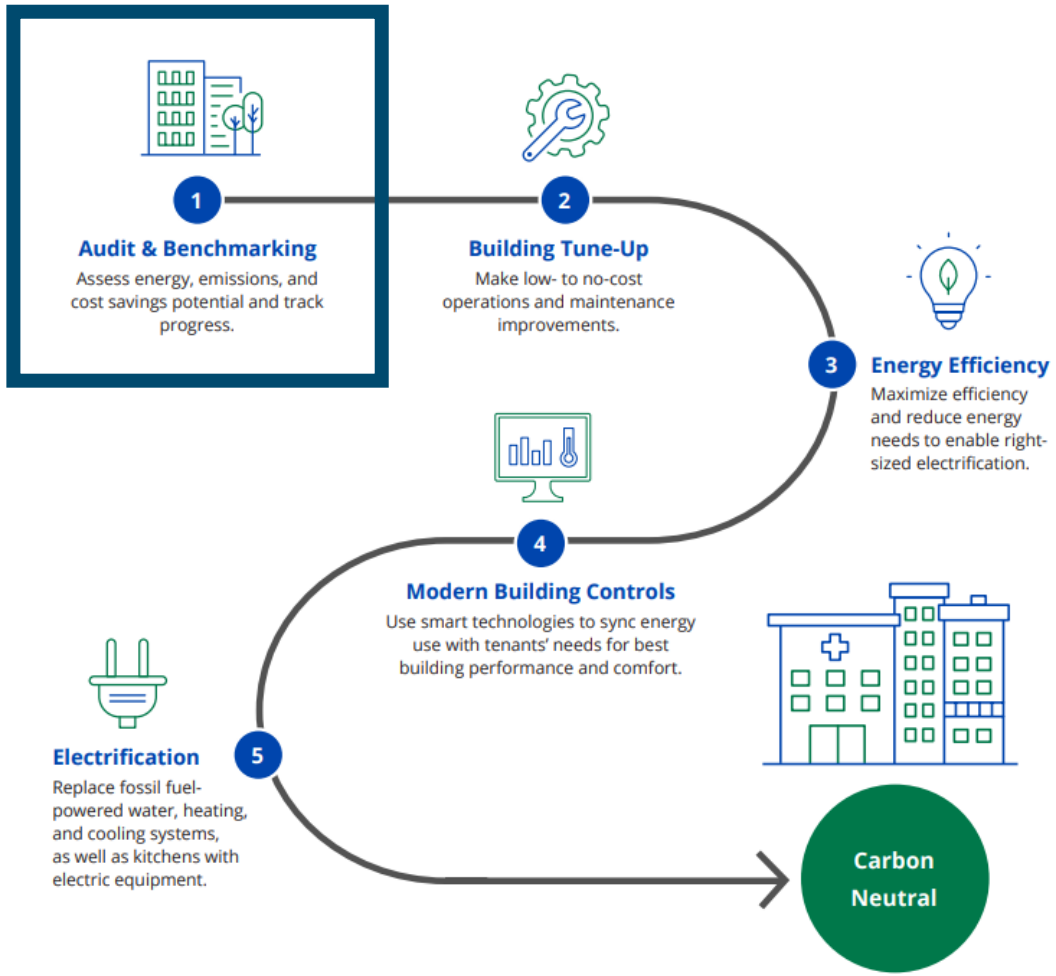


Diagram courtesy of Seattle Office of Sustainability and Environment

How do we get from the problem to the solution?

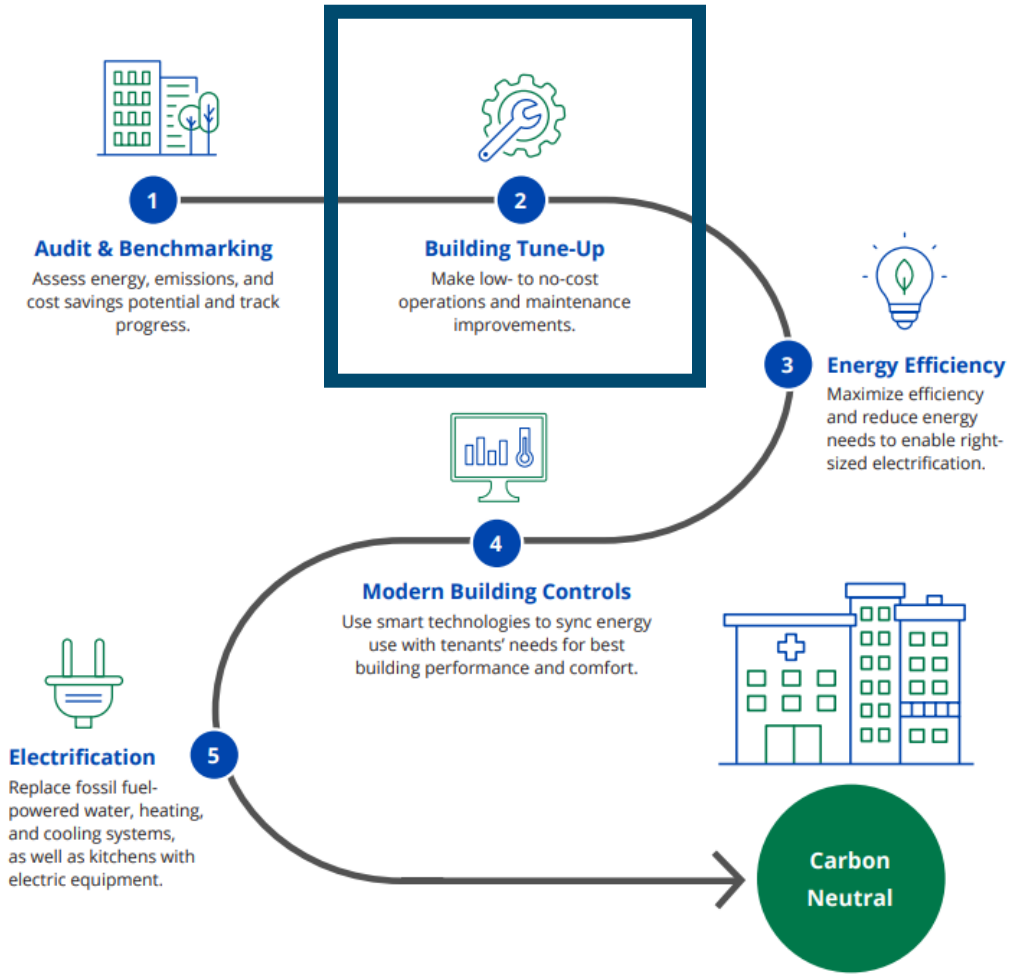
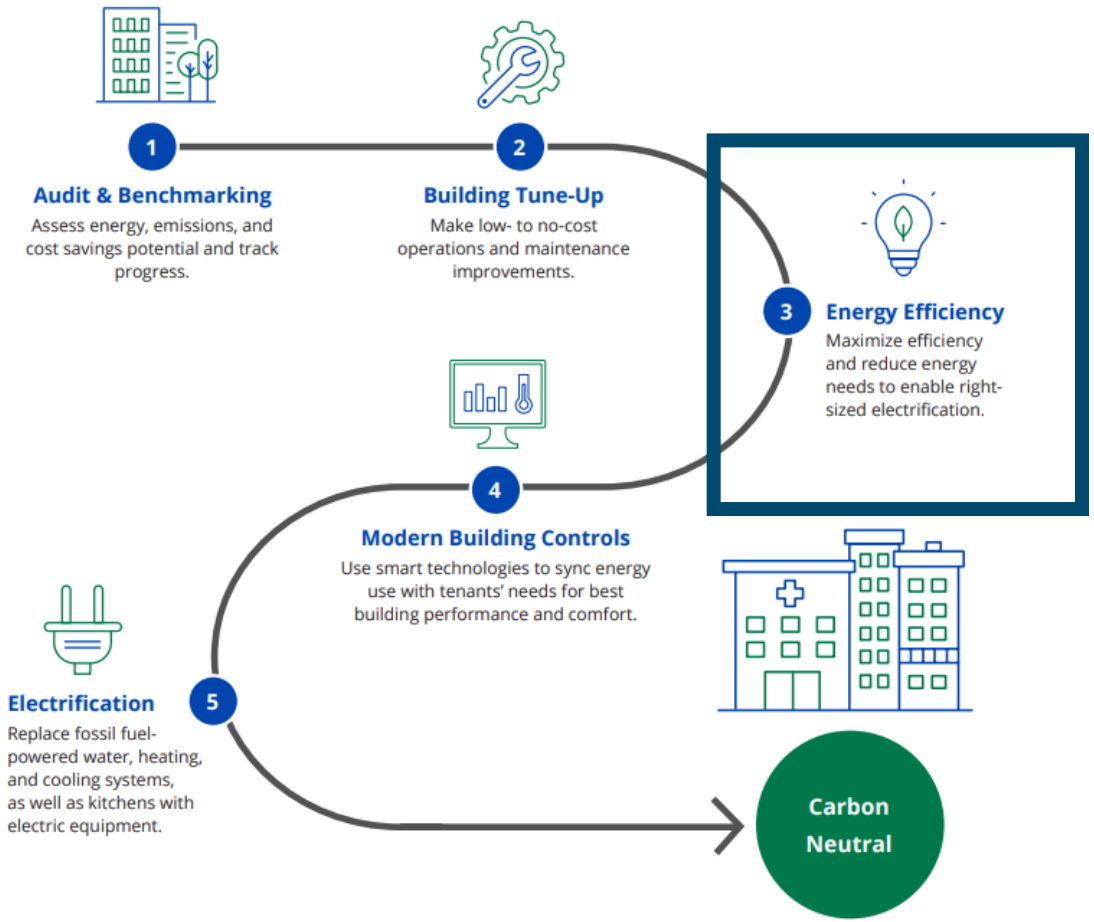


Diagram courtesy of Seattle Office of Sustainability and Environment

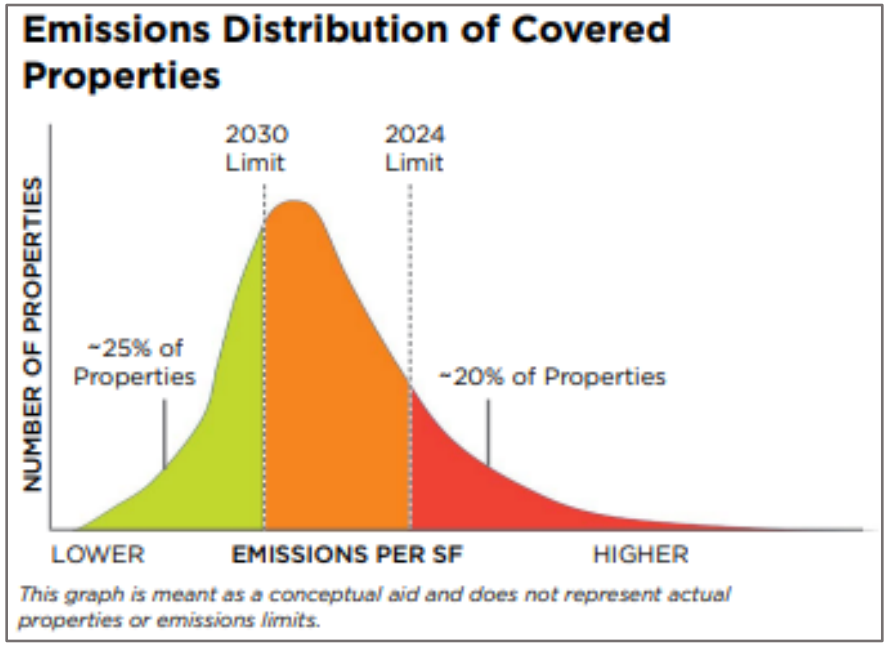
How do we get from the problem to the solution?



- Local Law 97
- Inflation Reduction Act
- Utility Incentives (ConEd, PG&E)

Diagram courtesy of Seattle Office of Sustainability and Environment

Local Law 97 - Penalties



- It affects nearly 60% of NYC building area.
- Requires 40% citywide emissions reduction by 2030.
- Many buildings are significantly above emissions limits and will require retrofits.

IRA 179D Tax Credits, Utility Incentives

PROVISION	NEW IRC SECTION 179D *EFFECTIVE FROM JAN. 1, 2023*	PREVIOUS IRC SECTION 179D *EFFECTIVE FROM JAN. 1,2006-DEC.31, 2022*
Eligibility	• Commercial building owners • Designers of buildings owned by: o Government entities o Not-for-profit organizations o Churches and other religious organizations o Tribal organizations o Not-for-profit schools and universities • REITs	• Commercial building owners • Designers of buildings owned by government entities
Tax deduction range	**Base deduction:** Sliding scale of 50 cents/sqft for energy savings of 25% and up to $1/sqft for energy savings of 50% or greater **Bonus deduction:** Sliding scale of $2.50/sqft for energy savings of 25% and up to $5/sqft for energy savings of 50% or greater	63 cents/sqft – $1.88/sqft per eligible system
Deduction cap	A three-year cap that allows IRC Section 179D to be claimed on buildings if the previous full deduction claim occurred more than three taxable years ago	Since 2006, there's been a lifetime cap of $1.80/sqft or $1.88/sqft with inflation adjustment
Technical requirements	ASHRAE standard in effect from four years prior to completion of construction	ASHRAE standard in effect from two years prior to start of construction
Bonus deduction	• Meet local prevailing wage • Meet apprenticeship percentage hours for up to 15% of labor hours	Not applicable

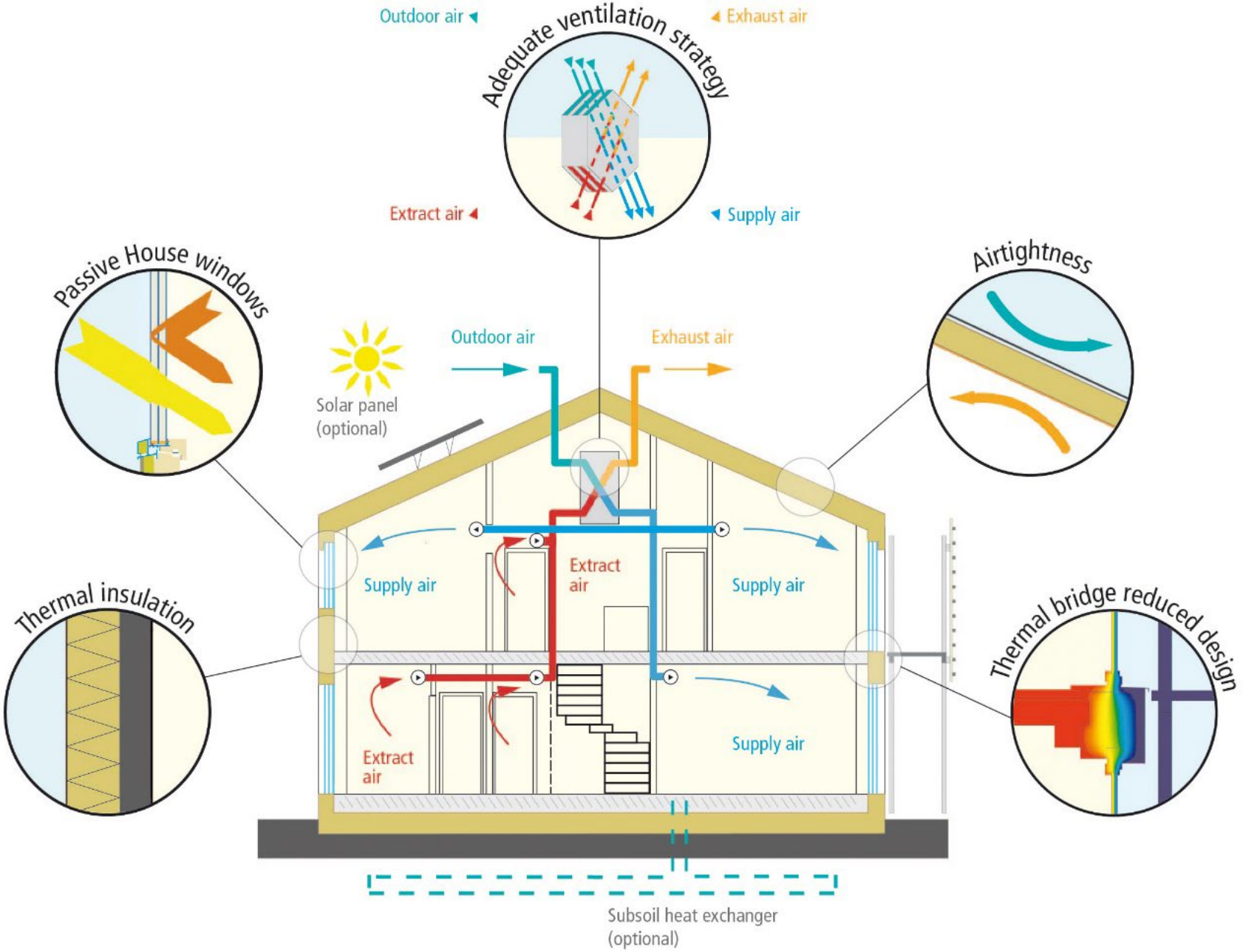
Utility Incentives

Ex: ConEd

Measure	Incentive	Unit
Single-Package Vertical Air Conditioner (SPVAC)[3]	$0.45 per kWh saved	
Single-Package Vertical Heat Pump (SPVHP)[2]		

Measure	Incentive	Unit
Window Film	$1	Square Foot
Cool Roof	$50	Thousand Square Feet
Other Envelope Measures	$0.68 per kWh $120 per Mlbs of Con Edison Steam[7] $20 per therm	

The Passive House Influence



System Integration

Part 1

TYPES OF SYSTEM RETROFITS

1 END-USE SYSTEM RETROFIT

Multiple components within a single end-use* system, e.g. heat pump with heat recovery and economizer controls

2 INTERACTIVE SYSTEM RETROFIT

Passive interactions between end-use systems or other components, e.g. window retrofit to increase daylight, reducing lighting energy use via daylight sensors

3 INTEGRATED SYSTEM RETROFIT

Active control between end-use systems, e.g. automated shades responding to utility price signals and optimized to either increase daylight, thereby reducing lighting energy, or decrease solar gain, thereby reducing air conditioning energy

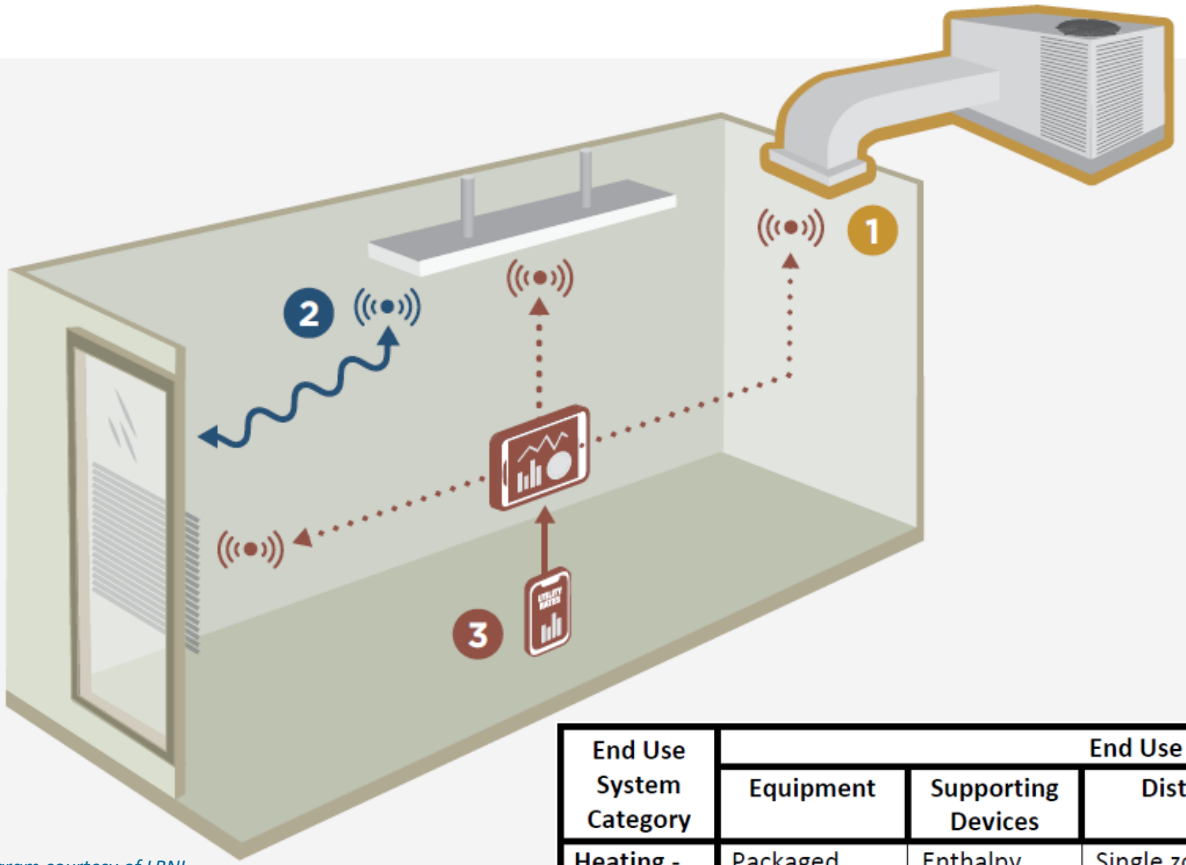


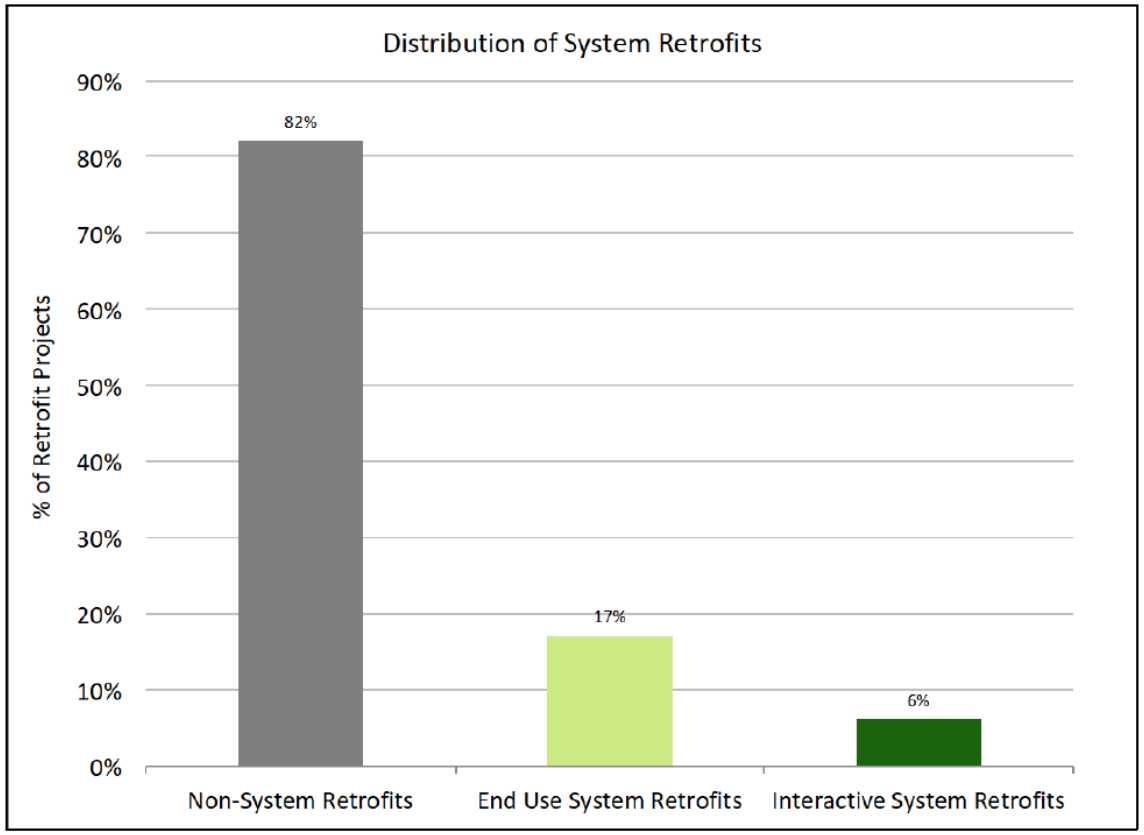
Diagram courtesy of LBNL

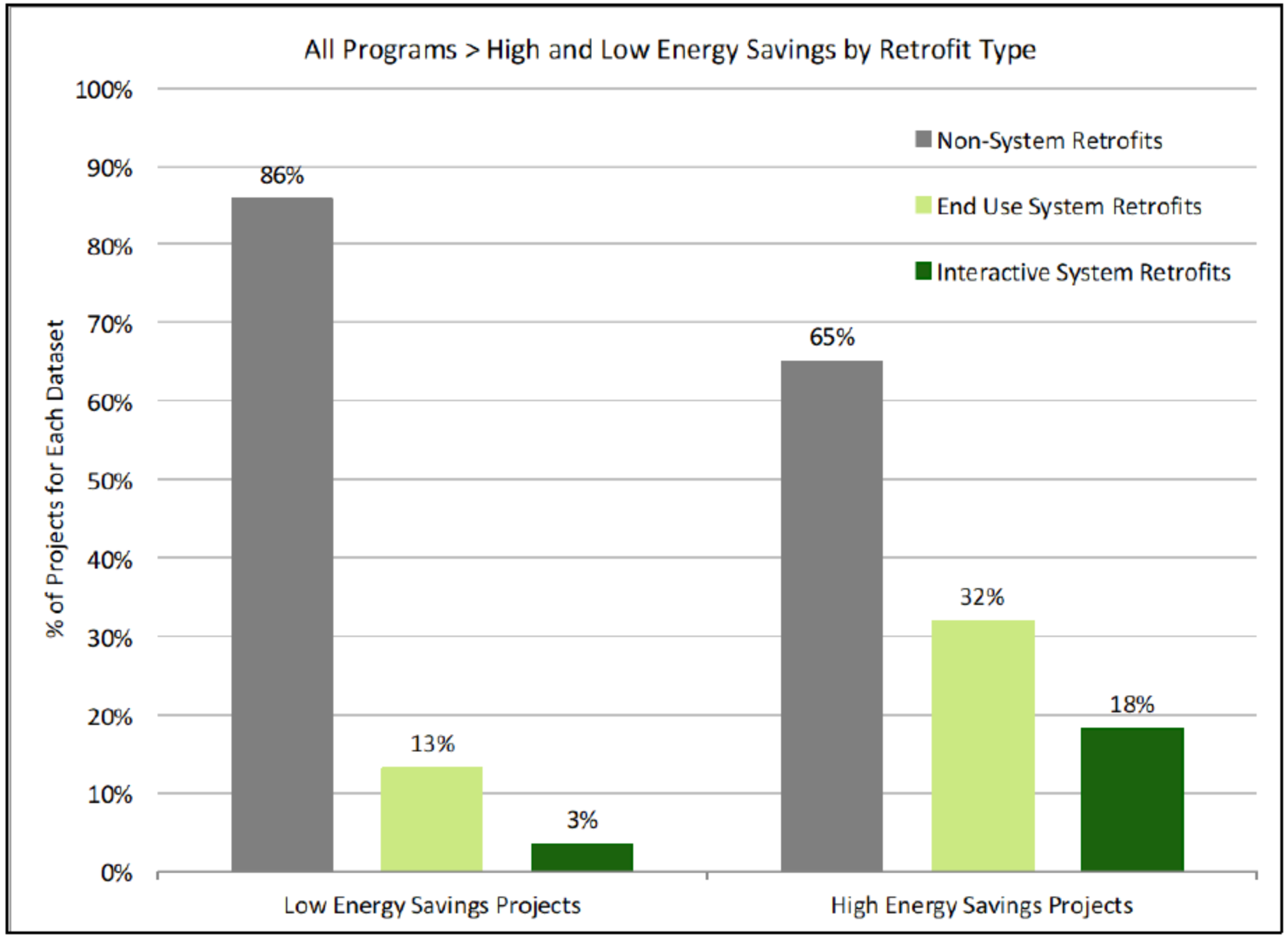
End Use System Category	End Use System Element				
	Equipment	Supporting Devices	Distribution	Termination	Sensors and Controls
Heating - Airside	Packaged heat pump rooftop unit	Enthalpy wheel for relief air heat recovery	Single zone, overhead ducting at standard pressure drop	Ceiling diffusers	Setback, scheduling, morning warm-up
Lighting	T5	—	Zonal	Direct/indirect overhead pendant	Occupancy, scheduling
	LED	Onboard electro-chemical battery	Workstation specific – one fixture per workstation	Overhead 2 x 4 troffer	Occupancy, daylight dimming
Ventilation	Dedicated outside air handler	Sensible heat recovery on relief air	Dedicated outside air ducting	Control dampers and ceiling diffusers	Demand controlled ventilation via CO_2 sensors

LBNL Study

Systems retrofits relatively uncommon

Buildings – Full Dataset	No. of Projects	No. of Buildings	Project Area 5th Percentile (sq. ft.)	Project Area Average (sq. ft.)	Project Area 95th Percentile (sq. ft.)
Totals	12,255	9,595	2,000	239,476	1,067,100

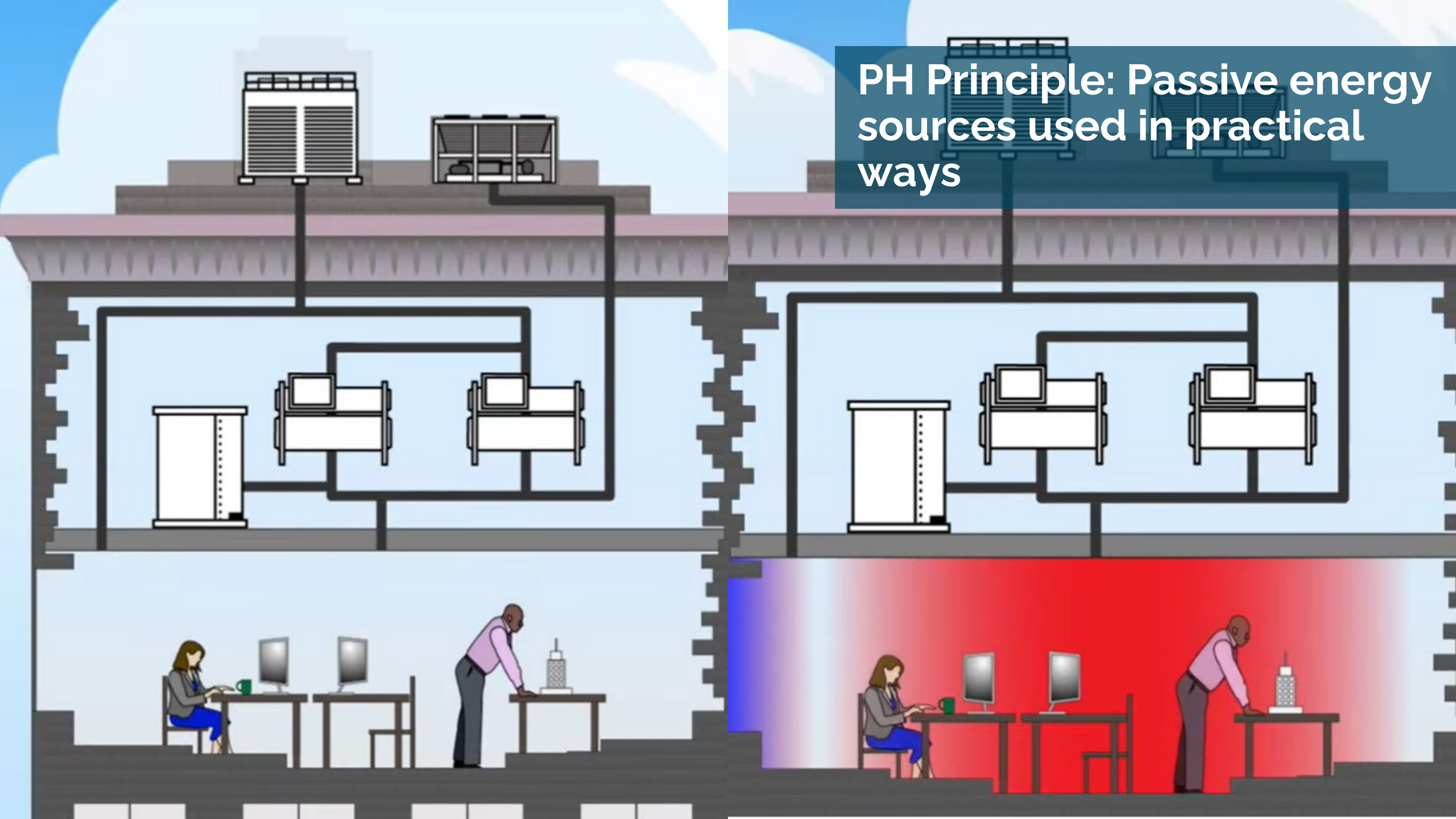



All Programs > High and Low Energy Savings by Retrofit Type
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
% of Projects for Each Dataset
Non-System Retrofits
End Use System Retrofits
Interactive System Retrofits
86%
13%
3%
65%
32%
18%
Low Energy Savings Projects
High Energy Savings Projects

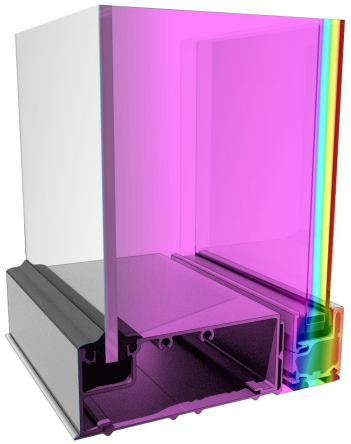
Practical Solutions

Part 2

PH Principle: Passive energy sources used in practical ways



PH Principle: Building Shell Optimization, Airtightness, Thermal Bridging



Innovative use of 'thin' glass with laminated performance films

High performance pultruded fiberglass frame

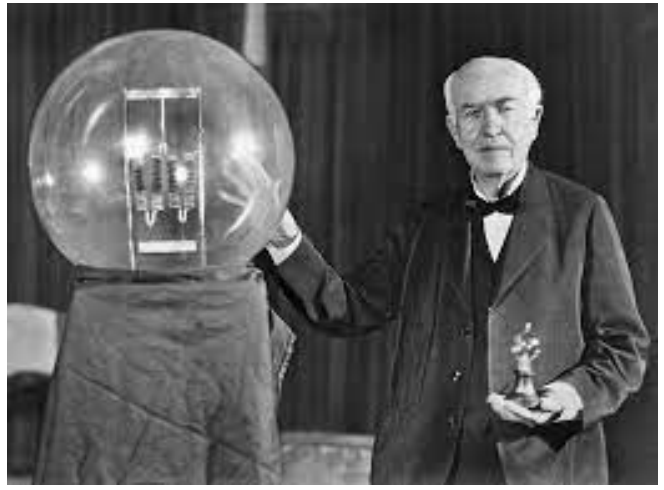
Super-insulated frame cavity

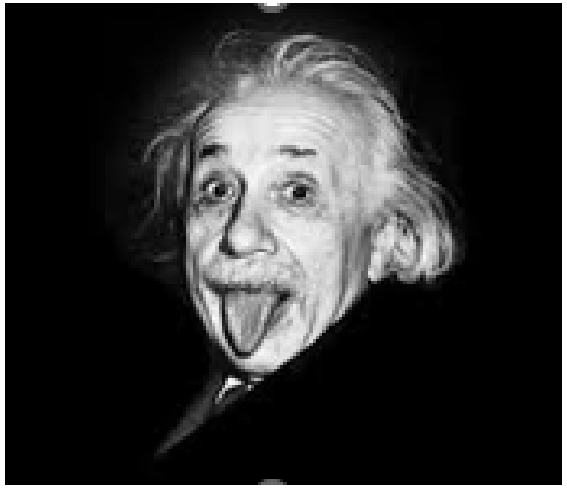
Customizable LoE coating configurations

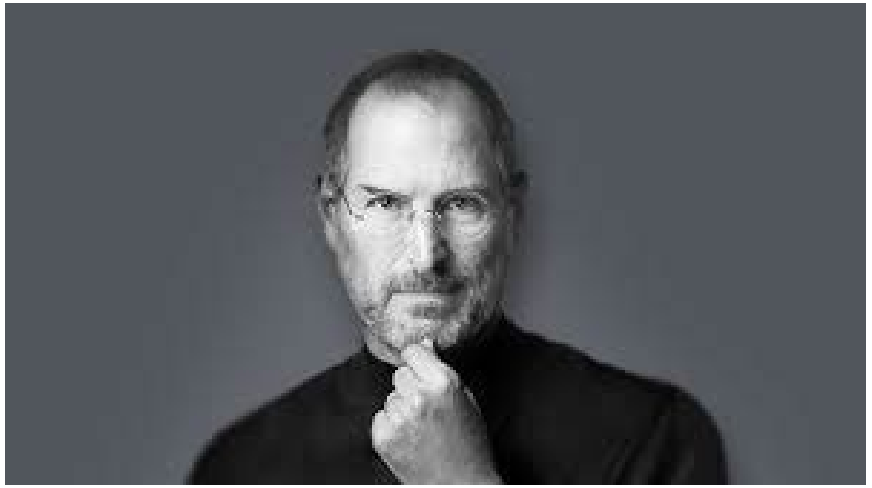
Inert gas fill

Warm-edge spacer

Gasket-edged, dual perimeter seal







History is written by the bold, creative and courageous who are not burdened by hesitation, doubt or a world telling them what problem they can't solve

ALPEN

HIGH PERFORMANCE PRODUCTS

Questions or Follow Up...

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Let's connect.

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