ENERGY DESIGN

conference & expo

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CERTIFIED PASSIVE HOUSE DESIGNER

Residential Passive House Retrofit (EnerPHit)

The MinnePHit House

Case Study about the first cold-climate EnerPHit project in the World

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In accordance with the Department of Labor and Industry's statute 326.0981, Subd. 11,

"This educational offering is recognized by the Minnesota Department of Labor and Industry as satisfying **1.5 hours** of credit toward **Building Officials and Residential Contractors code/ energy** continuing education requirements."

For additional continuing education approvals, please see your credit tracking card.

Learning Objectives

- The Passive House building energy standards
- Residential Passive House retrofit design
- Strategies, materials and systems
- Challenges & Opportunities
- Certification

Introduction

EnerPHit
Quality-Approved
Energy Retrofit with
Passive House Components
Dr. Wolfgang Feist

The MinnePHit House
Minneapolis, MN

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Photos: Corey Gaffer

before

after

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before


after
5605
Photos: Corey Gaffer

before

after

Photos: Corey Gaffer

Minneapolis
+ EnerPHit

= MinnePHit

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The
Passive House Standard

Passivhaus - Passive House

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PHI
Low Energy
Building

"A rigorous, voluntary building energy standard focusing on highest energy efficiency and quality of life at low operating cost."

Passive House in 90 Seconds

Video: Hans-Jörn Eich

Global Standard

Think globally, build locally.

Global Adoption











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Third-Party Certified

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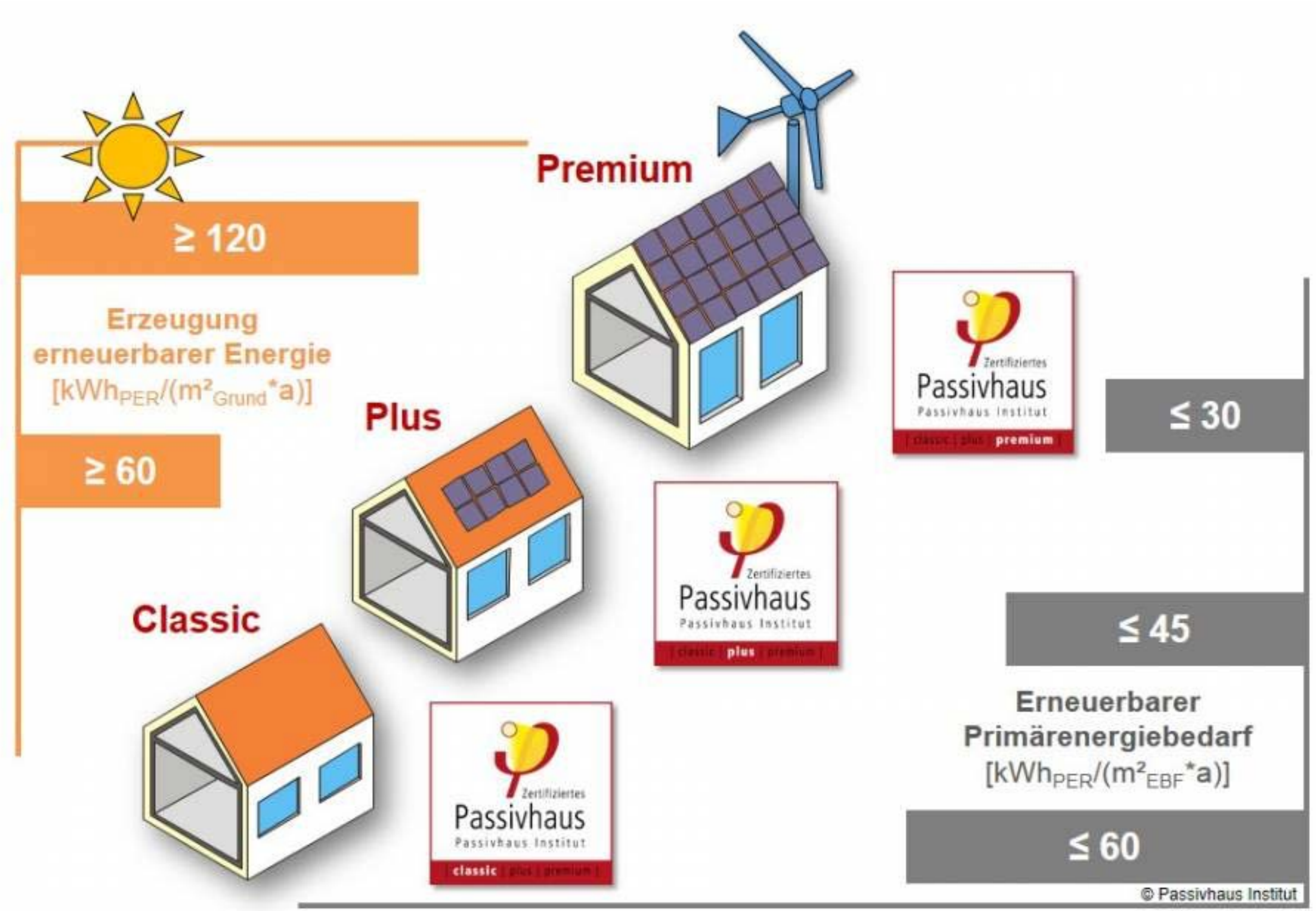
Tool

The Path to Ultimate Sustainability



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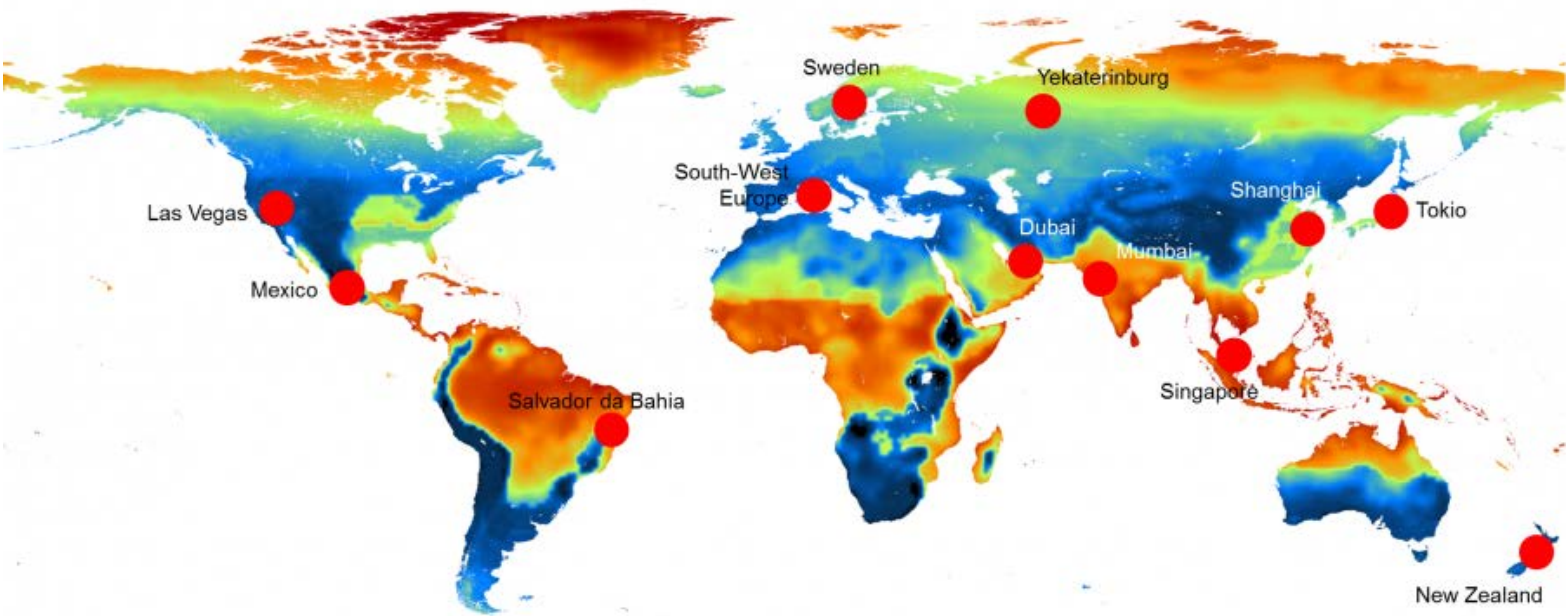
Global Climate Specificity



Climate-Specific Requirements

Climate zone according to PHPP	Opaque envelope[1] against... ...ground: Insulation	...ambient air: Exterior insulation	...ambient air: Interior insulation[2]	...ambient air: Exterior paint[3]	Windows (including exterior doors): Overall[4]			Glazing[5]	Solar load[6]	Ventilation: Min. heat recovery rate[7]	Ventilation: Min. humidity recovery rate[8]
	Max. heat transfer coefficient (U-value)			Cool colours	Max. heat transfer coefficient ($U_{D/W,installed}$)			Solar heat gain coefficient (g-value)	Max. specific solar load during cooling period		
	[W/(m²K)]			-	[W/(m²K)]			-	[kWh/m²a]	%	
Arctic	Determined in PHPP from project specific heating and cooling degree days against ground.	0.09	0.25	-	0.45	0.50	0.60	$U_g - g*0.7 \leq 0$	100	80%	-
Cold		0.12	0.30	-	0.65	0.70	0.80	$U_g - g*1.0 \leq 0$		80%	-
Cool-temperate		0.15	0.35	-	0.85	1.00	1.10	$U_g - g*1.6 \leq 0$		75%	-
Warm-temperate		0.30	0.50	-	1.05	1.10	1.20	$U_g - g*2.8 \leq -1$		75%	-
Warm		0.50	0.75	-	1.25	1.30	1.40	-		-	-
Hot		0.50	0.75	Yes	1.25	1.30	1.40	-		-	60 % (humid climate)
Very hot		0.25	0.45	Yes	1.05	1.10	1.20	-		-	60 % (humid climate)

Energy Modeling

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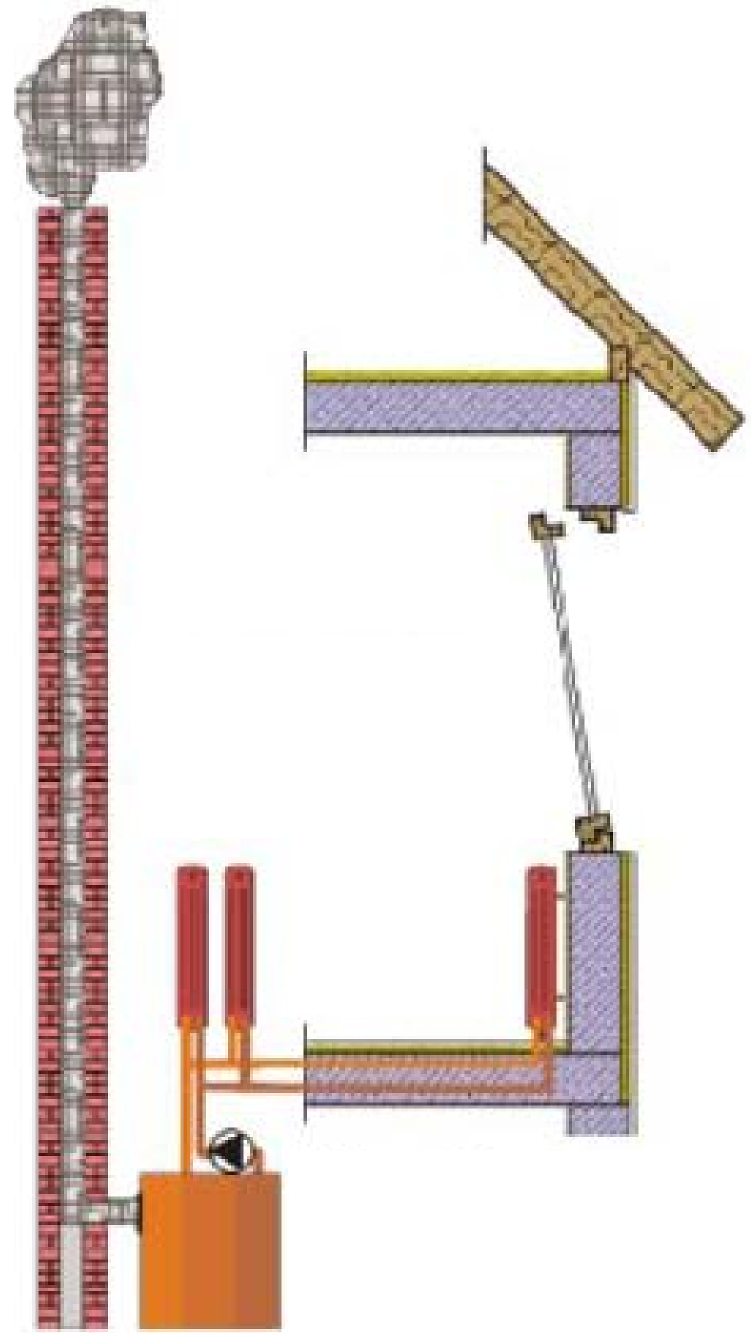
Basic Concept

Conservation first

➡ Minimize losses

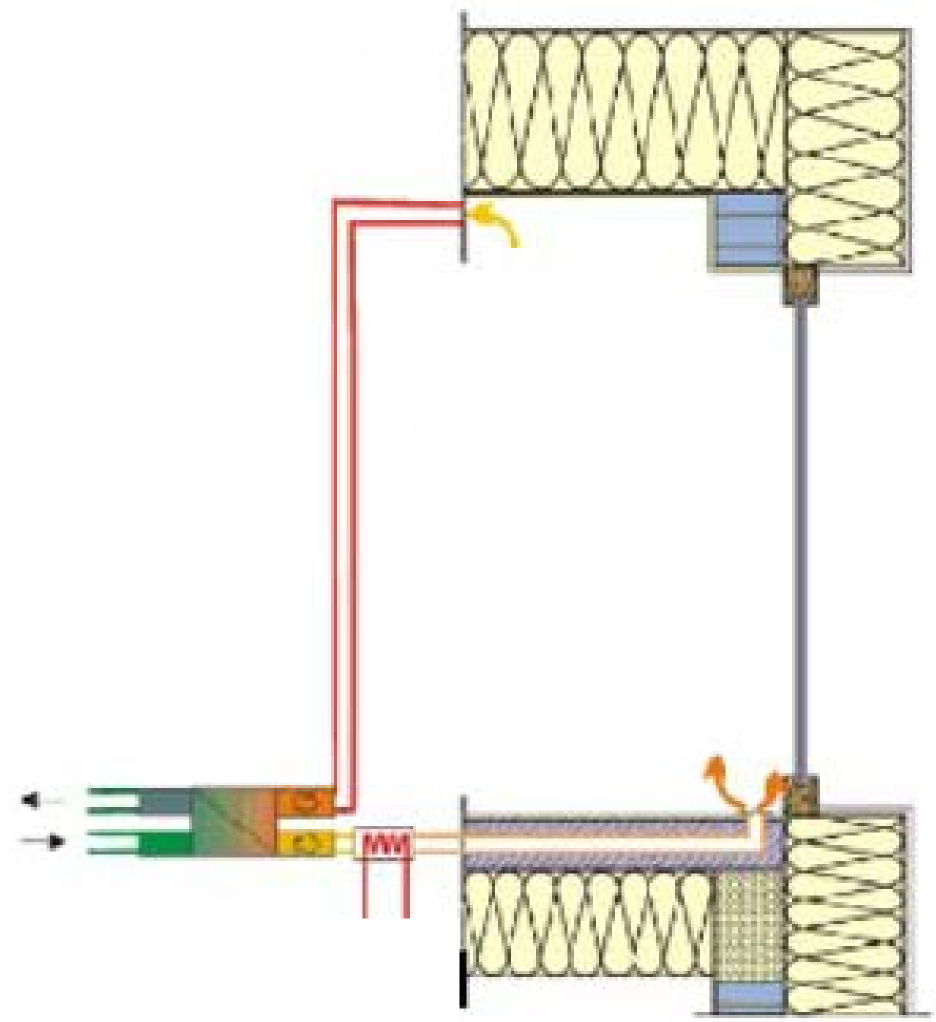
➡ Maximize (free) gains

Active vs. Passive



Active: 25-125 kBtu/(sf yr)

85 - 450 kWh/(m² a), typically found in the U.S.



Passive: 4.75 kBtu/(sf yr)

15kWh/(m² a), maximum target

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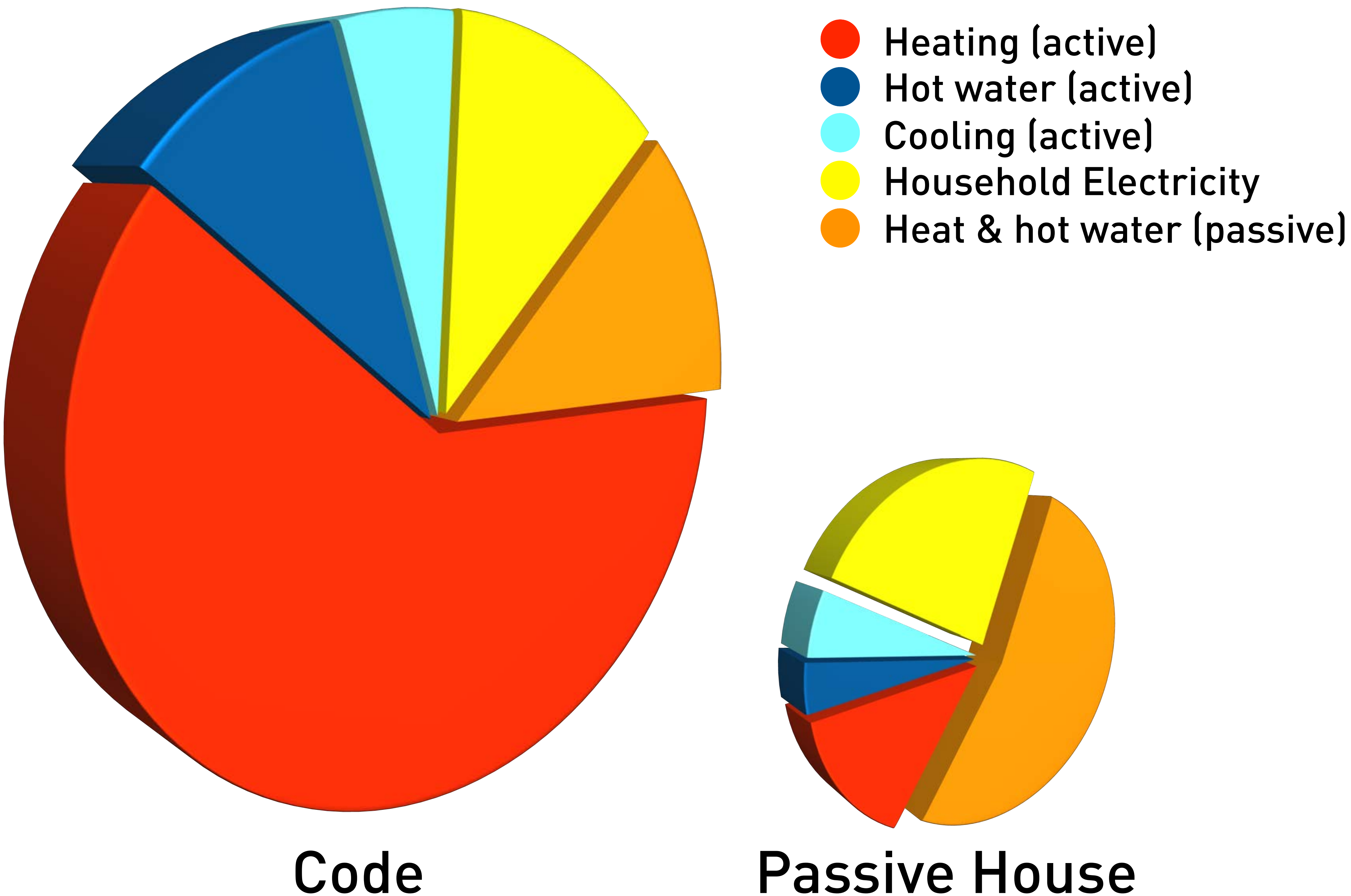
Source: Krapmeier & Drössler 2001

Energy Footprint



➡ up to 95% less heating energy

➡ 50 to 75% less total energy

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Metrics

Energy per Square Foot and Year

Gas mileage for buildings.

Space Conditioning Energy Targets

≤ 4.75 kBtu/(sf yr)

≤ 15kWh/(m² a)

PHI Low Energy Building

≤ 9.5 kBtu/(sf yr)

≤ 30kWh/(m² a)

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≤ 7.9 kBtu/(sf yr)

≤ 25kWh/(m² a)

Total energy used to heat or cool a building.

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Source Energy Targets

PHI Low Energy Building

≤ 38 kBtu/(sf yr)

≤ 120kWh/(m^2 a)

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varies

≤ 120 kWh/(m^2 a) + ((QH - 15 kWh/(m^2 a)) * 1.2)

Total energy used to heat or cool a building.

Heating Load Target (suggested)

$\leq$ 3.17 Btu/(h sf)

$\leq 10 W/m^2$

Heating energy can be supplied through ventilation system.

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Airtightness Targets

≤ 0.6 ACH$_{50}$

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≤ 1.0 ACH$_{50}$

Measured with a blower door in the field.

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Component Targets

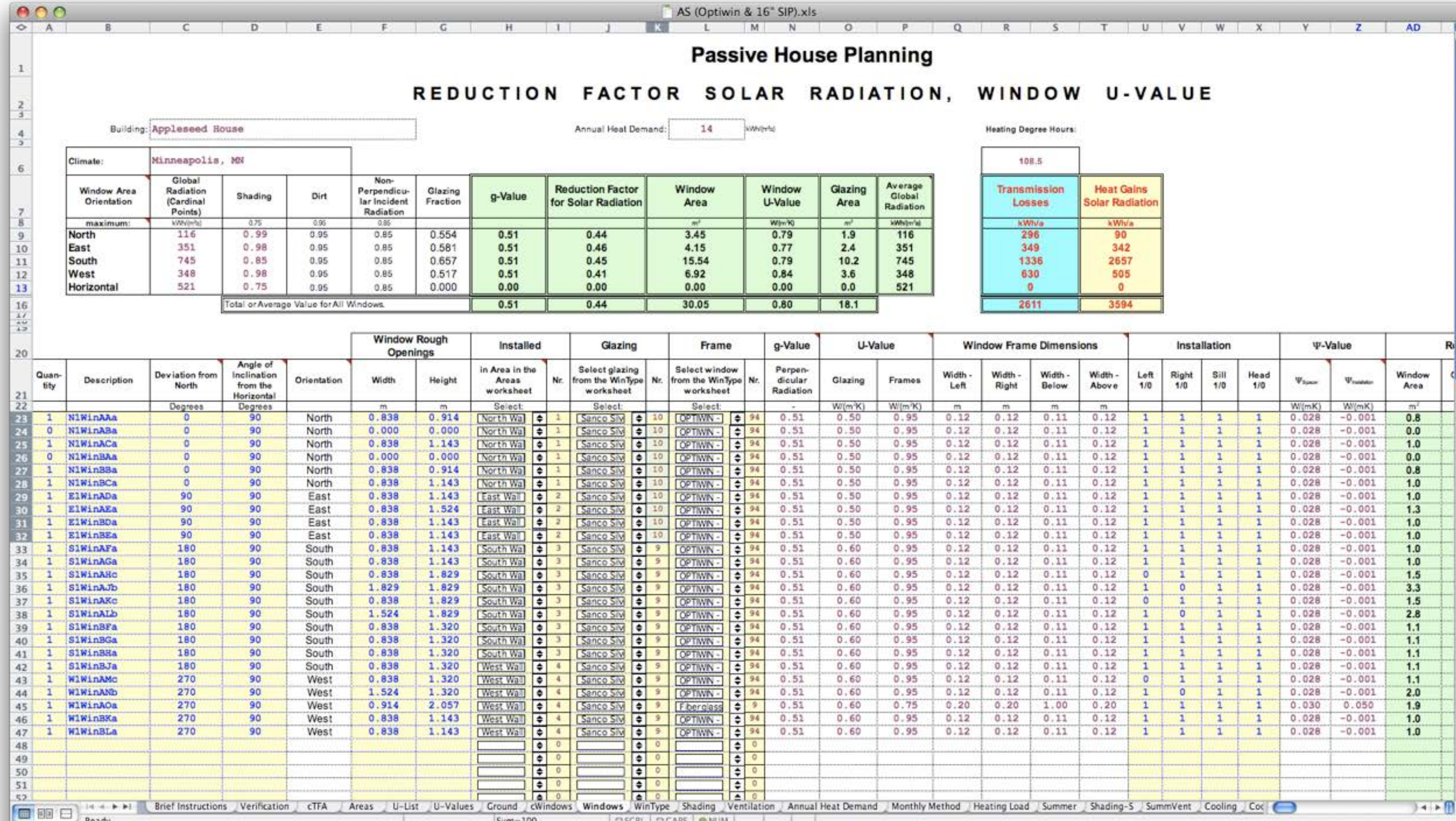
- Maximum U-values
- Minimum R-values
- SHGC requirements
- Minimum heat-recovery rates

EnerPHit offers a Component Track.

Component Targets

Climate zone	Hygiene[1]	Comfort[2]			
	Min. temperature factor	Max. thermal transfer coefficient			
	$f_{Rsi=0.25\ m^2K/W}$	U-value			
	[]	[W/(m²K)]			
					
Arctic	0.80	0.45	0.50	0.60	0.35
Cold	0.75	0.65	0.70	0.80	0.50
Cool-temperate	0.70	0.85	1.00	1.10	0.65
Warm-temperate	0.60	1.10	1.15	1.25	0.85
Warm	0.55	-	1.30	1.40	-
Hot	-	-	1.30	1.40	-
Very hot	-	-	1.10	1.20	-

Predictable Outcome & Measurable Results



AS (Optiwin & 16" SIP).xls

Passive House Planning

REDUCTION FACTOR SOLAR RADIATION, WINDOW U-VALUE

Building: Appleseed House

Annual Heat Demand: 14 kWh/(m²a)

Heating Degree Hours: 108.5

Climate: Minneapolis, MN

Window Area Orientation	Global Radiation (Cardinal Points)	Shading	Dirt	Non-Perpendicular Incident Radiation	Glazing Fraction	g-Value	Reduction Factor for Solar Radiation	Window Area	Window U-Value	Glazing Area	Average Global Radiation	Transmission Losses	Heat Gains Solar Radiation
maximum:	kWh/(m²a)	0.75	0.95	0.85				m²	W/(m²K)	m²	kWh/(m²a)	kWh/a	kWh/a
North	116	0.99	0.95	0.85	0.554	0.51	0.44	3.45	0.79	1.9	116	296	90
East	351	0.98	0.95	0.85	0.581	0.51	0.46	4.15	0.77	2.4	351	349	342
South	745	0.85	0.95	0.85	0.657	0.51	0.45	15.54	0.79	10.2	745	1336	2657
West	348	0.98	0.95	0.85	0.517	0.51	0.41	6.92	0.84	3.6	348	630	505
Horizontal	521	0.75	0.95	0.85	0.000	0.00	0.00	0.00	0.00	0.0	521	0	0
	Total or Average Value for All Windows.					0.51	0.44	30.05	0.80	18.1		2611	3594

Row	Quantity	Description	Deviation from North (Degrees)	Angle of Inclination from the Horizontal (Degrees)	Orientation	Window Rough Openings: Width (m)	Window Rough Openings: Height (m)	Installed: in Area in the Areas worksheet (Select:)	Nr.	Glazing: Select glazing from the WinType worksheet (Select:)	Nr.	Frame: Select window from the WinType worksheet (Select:)	Nr.
23	1	N1WinAAa	0	90	North	0.838	0.914	North Wa	1	Sanco Silv	10	OPTIWIN -	94
24	0	N1WinABa	0	90	North	0.000	0.000	North Wa	1	Sanco Silv	10	OPTIWIN -	94
25	1	N1WinACa	0	90	North	0.838	1.143	North Wa	1	Sanco Silv	10	OPTIWIN -	94
26	0	N1WinBAa	0	90	North	0.000	0.000	North Wa	1	Sanco Silv	10	OPTIWIN -	94
27	1	N1WinBBa	0	90	North	0.838	0.914	North Wa	1	Sanco Silv	10	OPTIWIN -	94
28	1	N1WinBCa	0	90	North	0.838	1.143	North Wa	1	Sanco Silv	10	OPTIWIN -	94
29	1	E1WinADa	90	90	East	0.838	1.143	East Wall	2	Sanco Silv	10	OPTIWIN -	94
30	1	E1WinAEa	90	90	East	0.838	1.524	East Wall	2	Sanco Silv	10	OPTIWIN -	94
31	1	E1WinBDa	90	90	East	0.838	1.143	East Wall	2	Sanco Silv	10	OPTIWIN -	94
32	1	E1WinBEa	90	90	East	0.838	1.143	East Wall	2	Sanco Silv	10	OPTIWIN -	94
33	1	S1WinAFa	180	90	South	0.838	1.143	South Wa	3	Sanco Silv	9	OPTIWIN -	94
34	1	S1WinAGa	180	90	South	0.838	1.143	South Wa	3	Sanco Silv	9	OPTIWIN -	94
35	1	S1WinAHc	180	90	South	0.838	1.829	South Wa	3	Sanco Silv	9	OPTIWIN -	94
36	1	S1WinAJb	180	90	South	1.829	1.829	South Wa	3	Sanco Silv	9	OPTIWIN -	94
37	1	S1WinAKc	180	90	South	0.838	1.829	South Wa	3	Sanco Silv	9	OPTIWIN -	94
38	1	S1WinALb	180	90	South	1.524	1.829	South Wa	3	Sanco Silv	9	OPTIWIN -	94
39	1	S1WinBFa	180	90	South	0.838	1.320	South Wa	3	Sanco Silv	9	OPTIWIN -	94
40	1	S1WinBGa	180	90	South	0.838	1.320	South Wa	3	Sanco Silv	9	OPTIWIN -	94
41	1	S1WinBHa	180	90	South	0.838	1.320	South Wa	3	Sanco Silv	9	OPTIWIN -	94
42	1	S1WinBJa	180	90	South	0.838	1.320	West Wall	4	Sanco Silv	9	OPTIWIN -	94
43	1	W1WinAMc	270	90	West	0.838	1.320	West Wall	4	Sanco Silv	9	OPTIWIN -	94
44	1	W1WinANb	270	90	West	1.524	1.320	West Wall	4	Sanco Silv	9	OPTIWIN -	94
45	1	W1WinAOa	270	90	West	0.914	2.057	West Wall	4	Sanco Silv	9	Fiberglass	9
46	1	W1WinBKa	270	90	West	0.838	1.143	West Wall	4	Sanco Silv	9	OPTIWIN -	94
47	1	W1WinBLa	270	90	West	0.838	1.143	West Wall	4	Sanco Silv	9	OPTIWIN -	94
48									0		0		0
49									0		0		0
50									0		0		0
51									0		0		0

Row	g-Value: Perpendicular Radiation (-)	U-Value: Glazing W/(m²K)	U-Value: Frames W/(m²K)	Window Frame Dimensions: Width - Left (m)	Width - Right (m)	Width - Below (m)	Width - Above (m)	Installation: Left 1/0	Right 1/0	Sill 1/0	Head 1/0	Ψ-Value: Ψ_{Spacer} W/(mK)	$\Psi_{Installation}$ W/(mK)	Window Area m²
23	0.51	0.50	0.95	0.12	0.12	0.11	0.12	1	1	1	1	0.028	-0.001	0.8
24	0.51	0.50	0.95	0.12	0.12	0.11	0.12	1	1	1	1	0.028	-0.001	0.0
25	0.51	0.50	0.95	0.12	0.12	0.11	0.12	1	1	1	1	0.028	-0.001	1.0
26	0.51	0.50	0.95	0.12	0.12	0.11	0.12	1	1	1	1	0.028	-0.001	0.0
27	0.51	0.50	0.95	0.12	0.12	0.11	0.12	1	1	1	1	0.028	-0.001	0.8
28	0.51	0.50	0.95	0.12	0.12	0.11	0.12	1	1	1	1	0.028	-0.001	1.0
29	0.51	0.50	0.95	0.12	0.12	0.11	0.12	1	1	1	1	0.028	-0.001	1.0
30	0.51	0.50	0.95	0.12	0.12	0.11	0.12	1	1	1	1	0.028	-0.001	1.3
31	0.51	0.50	0.95	0.12	0.12	0.11	0.12	1	1	1	1	0.028	-0.001	1.0
32	0.51	0.50	0.95	0.12	0.12	0.11	0.12	1	1	1	1	0.028	-0.001	1.0
33	0.51	0.60	0.95	0.12	0.12	0.11	0.12	1	1	1	1	0.028	-0.001	1.0
34	0.51	0.60	0.95	0.12	0.12	0.11	0.12	1	1	1	1	0.028	-0.001	1.0
35	0.51	0.60	0.95	0.12	0.12	0.11	0.12	0	1	1	1	0.028	-0.001	1.5
36	0.51	0.60	0.95	0.12	0.12	0.11	0.12	1	0	1	1	0.028	-0.001	3.3
37	0.51	0.60	0.95	0.12	0.12	0.11	0.12	0	1	1	1	0.028	-0.001	1.5
38	0.51	0.60	0.95	0.12	0.12	0.11	0.12	1	0	1	1	0.028	-0.001	2.8
39	0.51	0.60	0.95	0.12	0.12	0.11	0.12	1	1	1	1	0.028	-0.001	1.1
40	0.51	0.60	0.95	0.12	0.12	0.11	0.12	1	1	1	1	0.028	-0.001	1.1
41	0.51	0.60	0.95	0.12	0.12	0.11	0.12	1	1	1	1	0.028	-0.001	1.1
42	0.51	0.60	0.95	0.12	0.12	0.11	0.12	1	1	1	1	0.028	-0.001	1.1
43	0.51	0.60	0.95	0.12	0.12	0.11	0.12	0	1	1	1	0.028	-0.001	1.1
44	0.51	0.60	0.95	0.12	0.12	0.11	0.12	1	0	1	1	0.028	-0.001	2.0
45	0.51	0.60	0.75	0.20	0.20	1.00	0.20	1	1	1	1	0.030	0.050	1.9
46	0.51	0.60	0.95	0.12	0.12	0.11	0.12	1	1	1	1	0.028	-0.001	1.0
47	0.51	0.60	0.95	0.12	0.12	0.11	0.12	1	1	1	1	0.028	-0.001	1.0

Brief Instructions | Verification | cTFA | Areas | U-List | U-Values | Ground | cWindows | Windows | WinType | Shading | Ventilation | Annual Heat Demand | Monthly Method | Heating Load | Summer | Shading-S | SummVent | Cooling | Coo

Ready Sum=100 SCRL CAPS NUM

Passive House Planning Package - PHPP

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Key Benefits

Highest Comfort

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Superior Indoor Environmental Quality

Ecology and Resource Efficiency

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Image Source: dreamstime.com

Cheapest Life Cycle Cost

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Image Source: dreamstime.com

The
MinnePHit Project

Where are we?

what we got

Image Source: carlustblog.org

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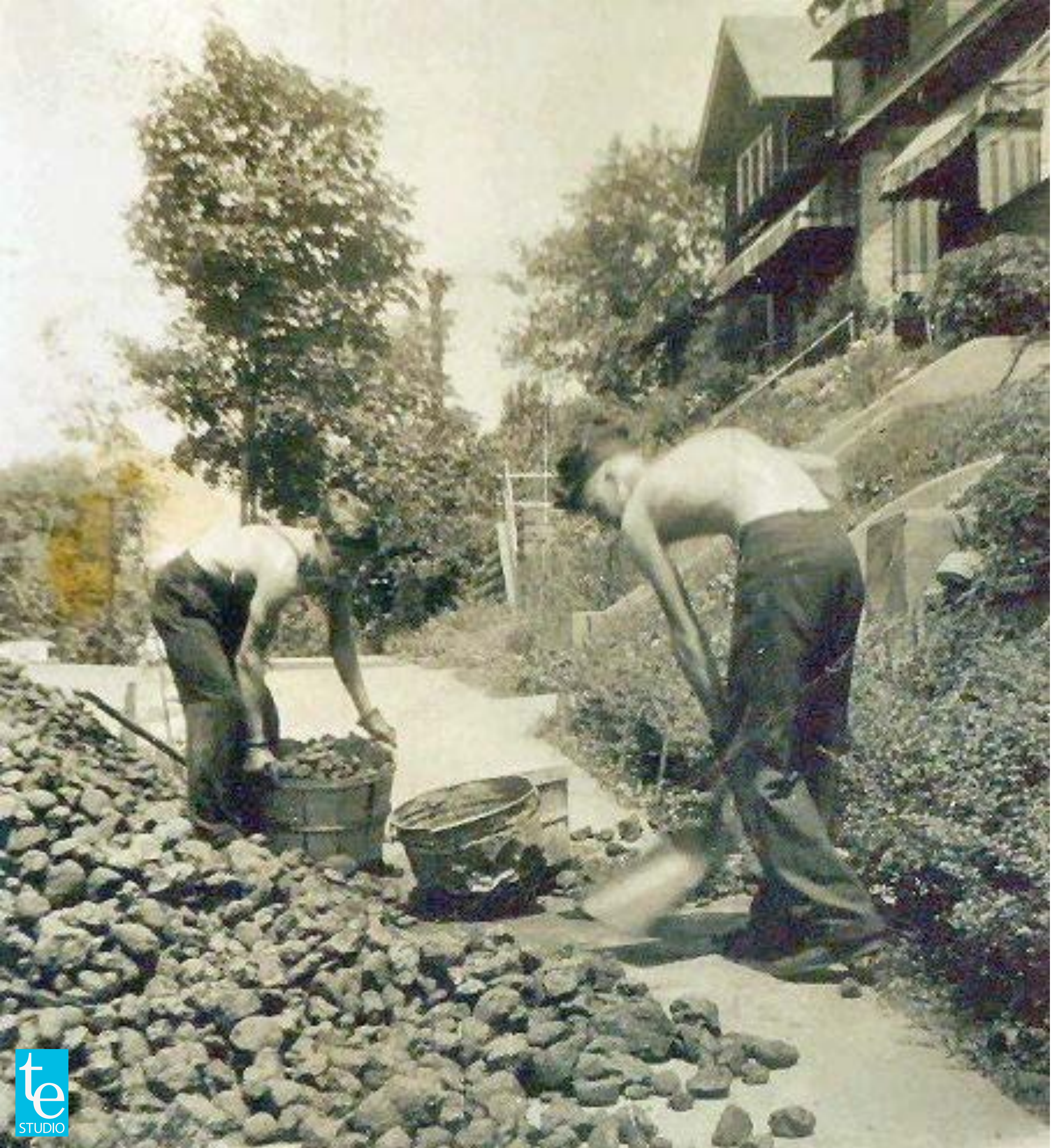

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