ENERGY DESIGN

conference & expo

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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** 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

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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


before


after
5605
Photos: Corey Gaffer

before

after

Photos: Corey Gaffer

Minneapolis
+ EnerPHit
= MinnePHit

The Passive House Standard

Passive House in 90 Seconds

Video: Hans-Jörn Eich

Passivhaus - Passive House

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

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Global Standard

Think globally, build locally.

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Global Adoption











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Third-Party Certified

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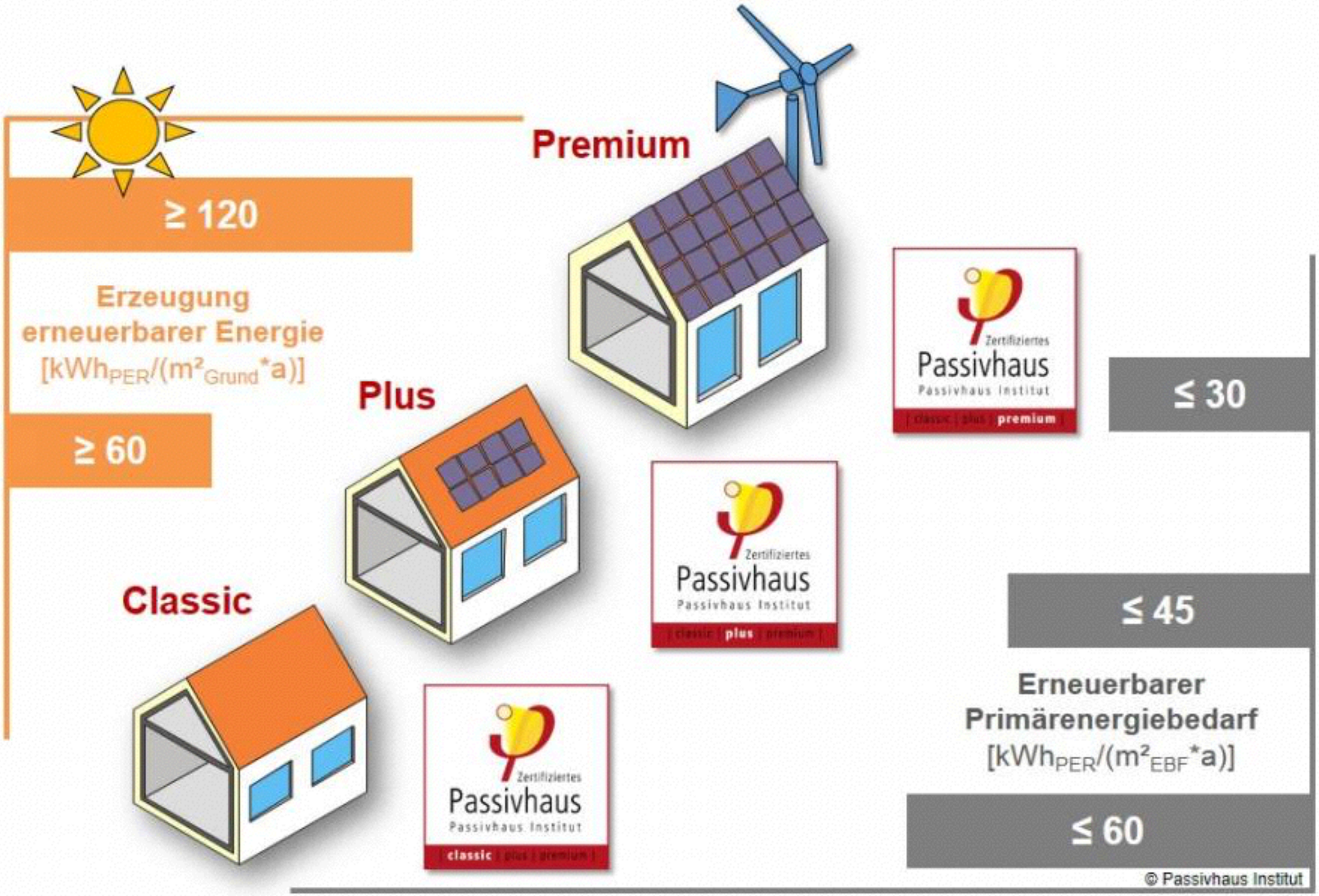
Tool

The Path to Ultimate Sustainability



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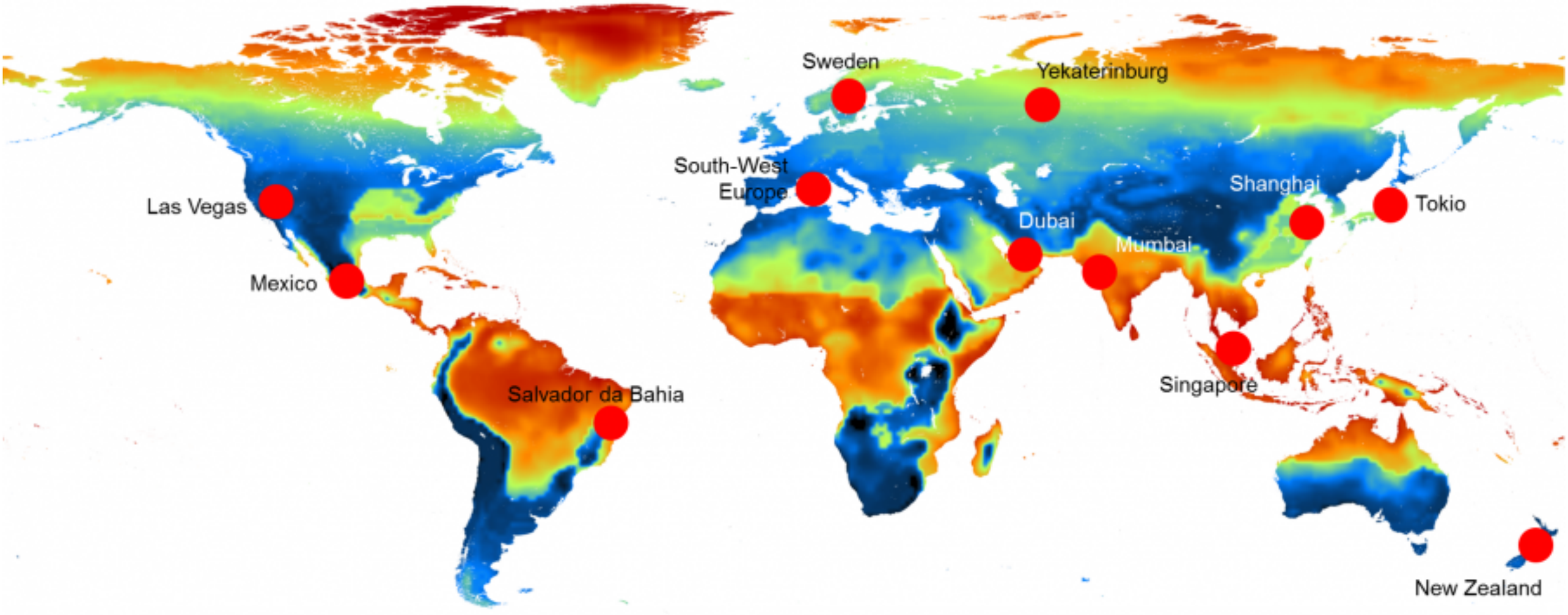
Global Climate Specificity



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Climate-Specific Requirements

Climate zone according to PHPP	Opaque envelope[1] against...				Windows (including exterior doors)					Ventilation	
	...ground	...ambient air			Overall[4]			Glazing[5]	Solar load[6]		
	Insulation	Exterior insulation	Interior insulation[2]	Exterior paint[3]	Max. heat transfer coefficient ($U_{D/W,installed}$)			Solar heat gain coefficient (g-value)	Max. specific solar load during cooling period	Min. heat recovery rate[7]	Min. humidity recovery rate[8]
	Max. heat transfer coefficient (U-value)			Cool colours							
	[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 ≤ 0	100	80%	-
Cold		0.12	0.30	-	0.65	0.70	0.80	U_g - g*1.0 ≤ 0		80%	-
Cool-temperate		0.15	0.35	-	0.85	1.00	1.10	U_g - g*1.6 ≤ 0		75%	-
Warm-temperate		0.30	0.50	-	1.05	1.10	1.20	U_g - g*2.8 ≤ -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)

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Energy Modeling

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PHIUS+

United States

Passive House Institute U.S., Chicago, Il
Local raters and tie-in with other certifications
New sovereign standard for the U.S.

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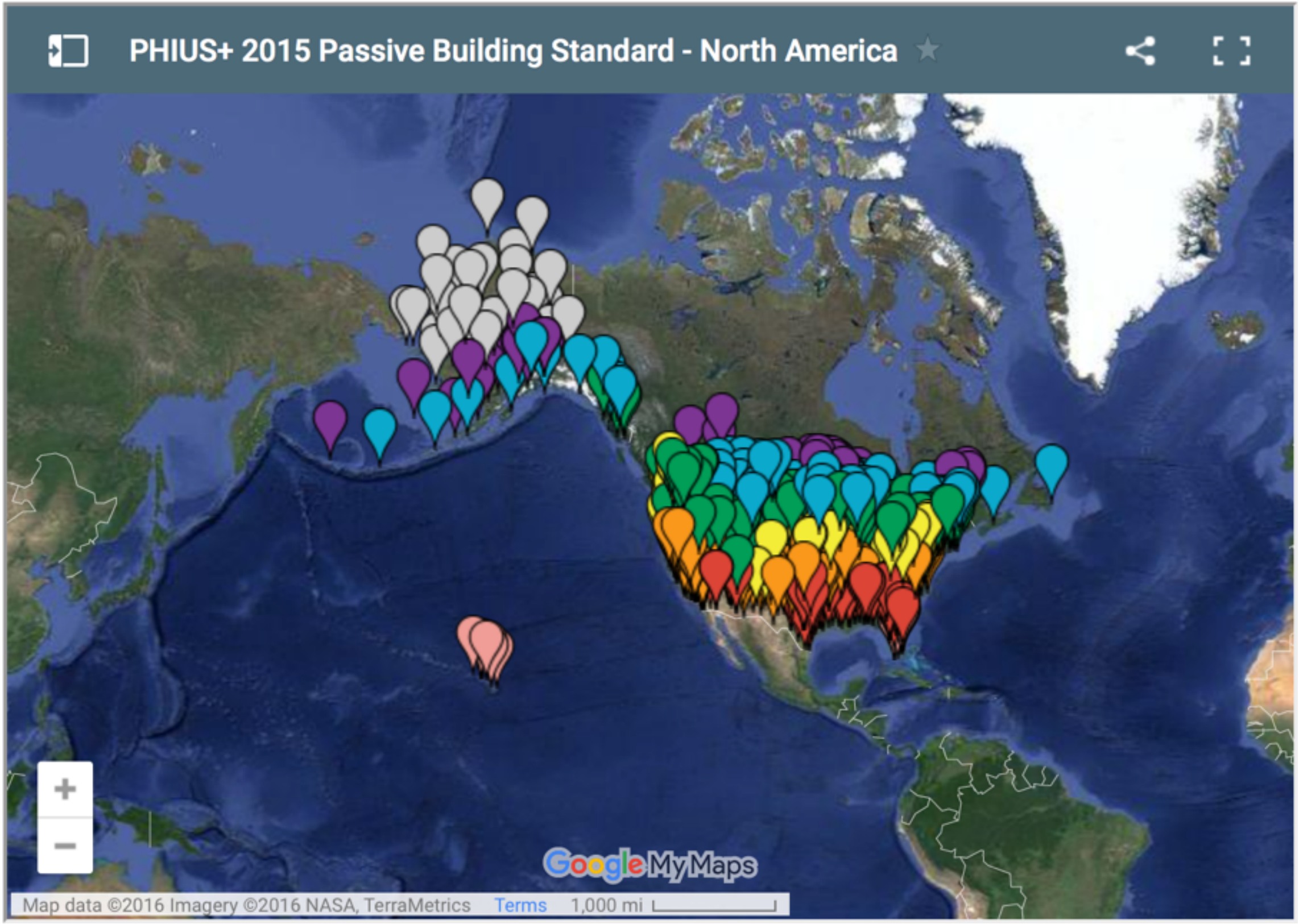
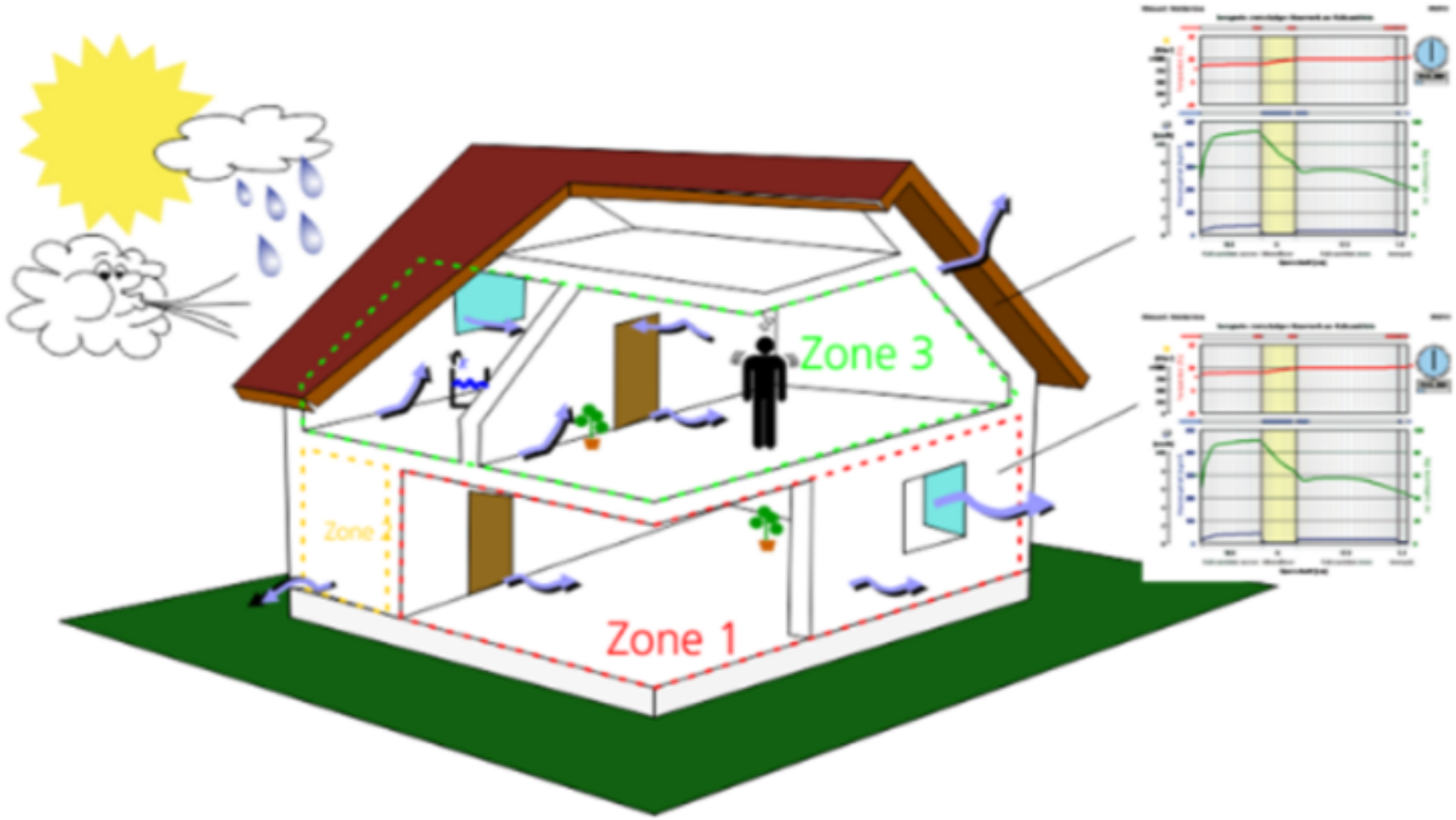
U.S. Climate Specificity



Energy & Hygrothermal Modeling

WUFI® Passive



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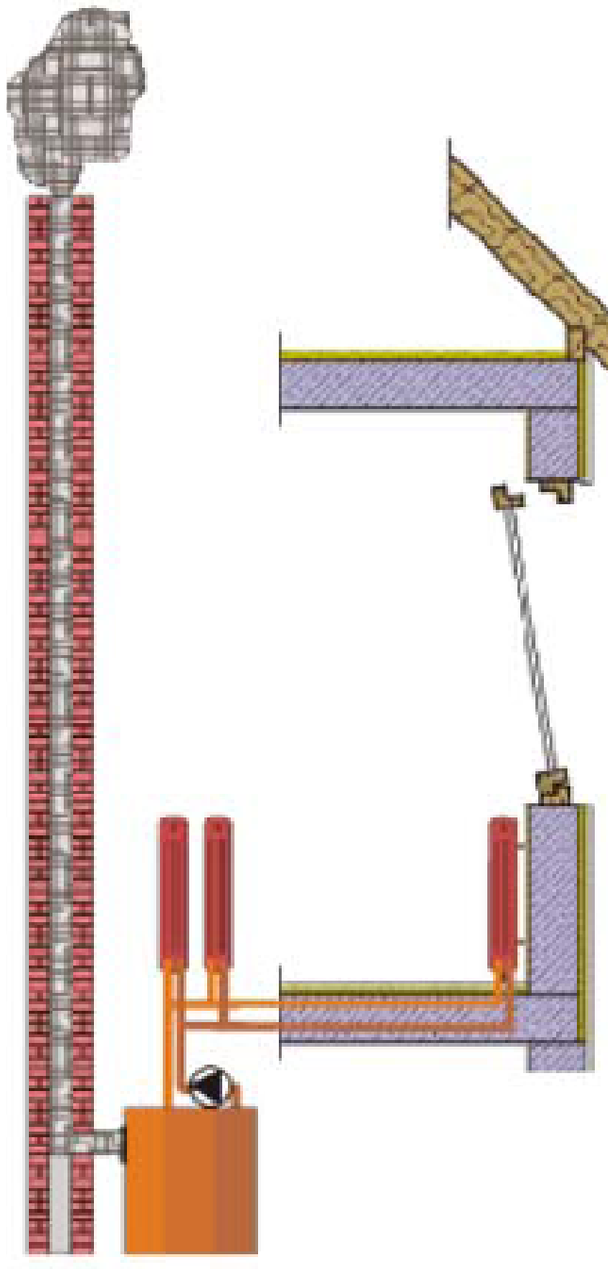
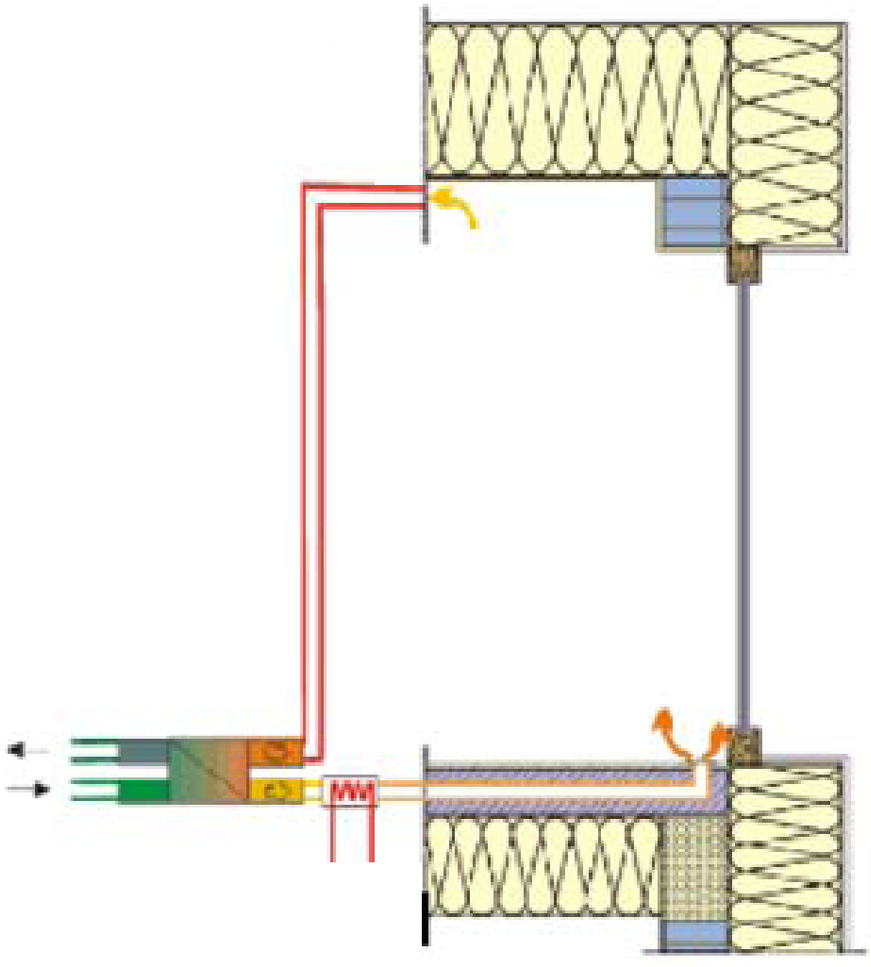
Conservation first

- ➡ Minimize losses
- ➡ Maximize (free) gains

Active vs. Passive





Active: 25-125 kBtu/(sf yr)

85 - 450 kWh/(m^2 a), typically found in the U.S.

Passive: 4.75 kBtu/(sf yr)

15kWh/(m^2 a), maximum target

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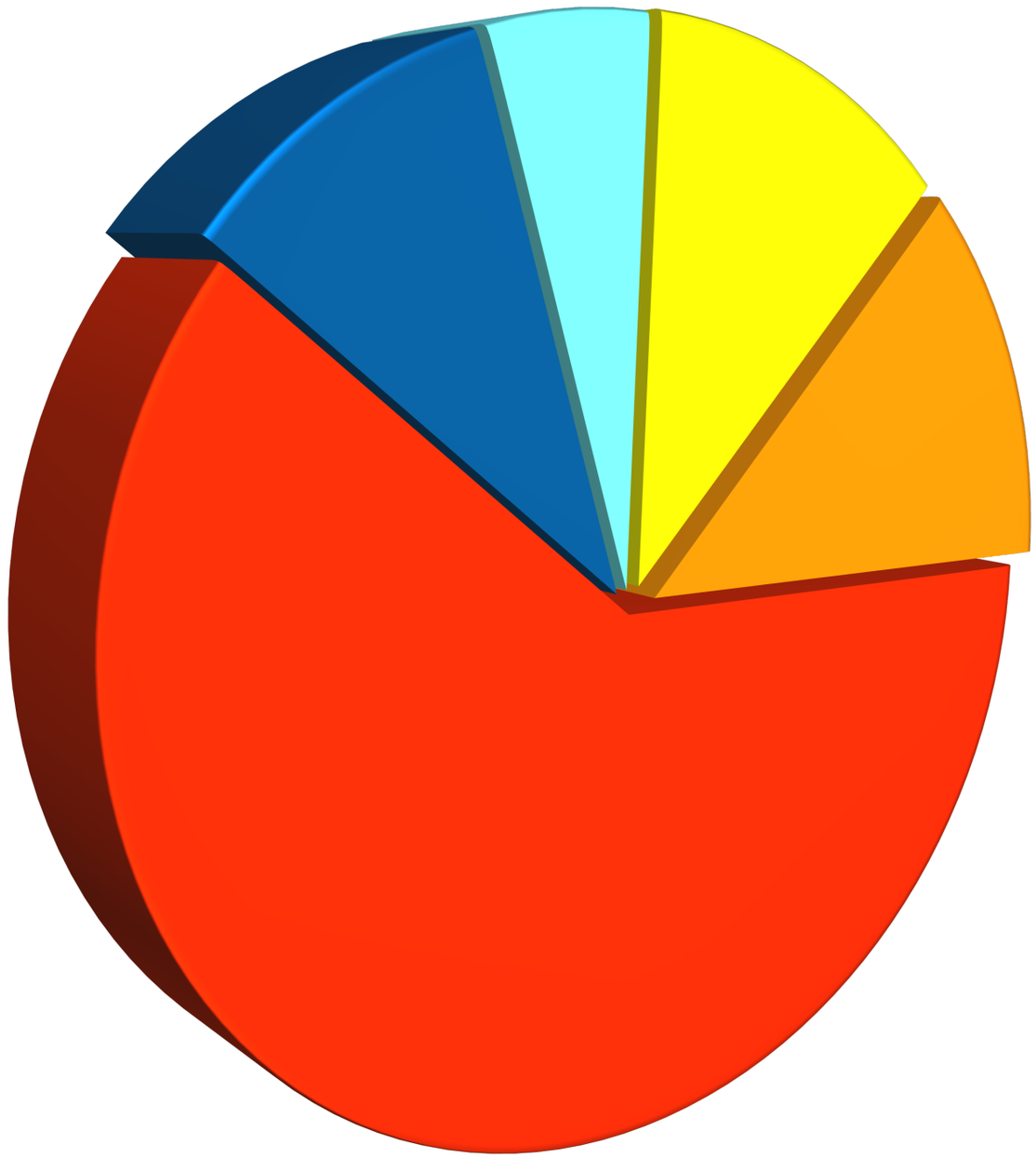
Source: Krapmeier & Drössler 2001

Energy Footprint



- Heating (active)
- Hot water (active)
- Cooling (active)
- Household Electricity
- Heat & hot water (passive)

Code

Passive House

- ➡ up to 90% less heating energy
- ➡ 50 to 75% less total energy

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Metrics

Energy per Square Foot and Year

Gas mileage for buildings.

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Space Conditioning Energy Targets

≤ 4.75 kBtu/(sf yr)

≤ 15kWh/(m² a)

≤ 7.9 kBtu/(sf yr)

≤ 25kWh/(m² a)

Total energy used to heat or cool a building.

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Source Energy Targets

≤ 38 kBtu/(sf yr)

≤ 120kWh/(m² a)

varies

≤ 120 kWh/(m² a) + ((QH - 15 kWh/(m² a)) * 1.2)

Total energy used to heat or cool a building.

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Heating Load Target (suggested)

≤ 3.17 Btu/(h sf)

≤ 10W/m^2

Heating energy can be supplied through ventilation system.

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Airtightness Targets

≤0.6 ACH_{50}

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Dr. Wolfgang Feist

≤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.

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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	-

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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

	Quantity	Description	Deviation from North	Angle of Inclination from the Horizontal	Orientation	Window Rough Openings Width	Window Rough Openings Height	Installed in Area in the Areas worksheet	Nr.	Glazing Select glazing from the WinType worksheet	Nr.	Frame Select window from the WinType worksheet	Nr.	g-Value Perpendicular Radiation	U-Value Glazing	U-Value Frames	Window Frame Dimensions Width - Left	Width - Right	Width - Below	Width - Above	Installation Left 1/0	Installation Right 1/0	Installation Sill 1/0	Installation Head 1/0	Ψ-Value		Window Area
			Degrees	Degrees		m	m	Select		Select		Select		-	W/(m²K)	W/(m²K)	m	m	m	m					W/(mK)	W/(mK)	m²
23	1	N1WinAAa	0	90	North	0.838	0.914	North Wal	1	Sanco Silv	10	OPTIWIN -	94	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	N1WinABa	0	90	North	0.000	0.000	North Wal	1	Sanco Silv	10	OPTIWIN -	94	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	1	N1WinACa	0	90	North	0.838	1.143	North Wal	1	Sanco Silv	10	OPTIWIN -	94	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	N1WinBAa	0	90	North	0.000	0.000	North Wal	1	Sanco Silv	10	OPTIWIN -	94	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	1	N1WinBBa	0	90	North	0.838	0.914	North Wal	1	Sanco Silv	10	OPTIWIN -	94	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	1	N1WinBCa	0	90	North	0.838	1.143	North Wal	1	Sanco Silv	10	OPTIWIN -	94	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	1	E1WinADa	90	90	East	0.838	1.143	East Wall	2	Sanco Silv	10	OPTIWIN -	94	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	1	E1WinAEa	90	90	East	0.838	1.524	East Wall	2	Sanco Silv	10	OPTIWIN -	94	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	1	E1WinBDa	90	90	East	0.838	1.143	East Wall	2	Sanco Silv	10	OPTIWIN -	94	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	1	E1WinBEa	90	90	East	0.838	1.143	East Wall	2	Sanco Silv	10	OPTIWIN -	94	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	1	S1WinAFa	180	90	South	0.838	1.143	South Wa	3	Sanco Silv	9	OPTIWIN -	94	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	1	S1WinAGa	180	90	South	0.838	1.143	South Wa	3	Sanco Silv	9	OPTIWIN -	94	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	1	S1WinAKc	180	90	South	0.838	1.829	South Wa	3	Sanco Silv	9	OPTIWIN -	94	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	1	S1WinAJb	180	90	South	1.829	1.829	South Wa	3	Sanco Silv	9	OPTIWIN -	94	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	1	S1WinAKc	180	90	South	0.838	1.829	South Wa	3	Sanco Silv	9	OPTIWIN -	94	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	1	S1WinALb	180	90	South	1.524	1.829	South Wa	3	Sanco Silv	9	OPTIWIN -	94	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	1	S1WinBFa	180	90	South	0.838	1.320	South Wa	3	Sanco Silv	9	OPTIWIN -	94	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	1	S1WinBGa	180	90	South	0.838	1.320	South Wa	3	Sanco Silv	9	OPTIWIN -	94	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	1	S1WinBKa	180	90	South	0.838	1.320	South Wa	3	Sanco Silv	9	OPTIWIN -	94	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	1	S1WinBJa	180	90	South	0.838	1.320	West Wall	4	Sanco Silv	9	OPTIWIN -	94	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	1	W1WinAMc	270	90	West	0.838	1.320	West Wall	4	Sanco Silv	9	OPTIWIN -	94	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	1	W1WinANb	270	90	West	1.524	1.320	West Wall	4	Sanco Silv	9	OPTIWIN -	94	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	1	W1WinAOa	270	90	West	0.914	2.057	West Wall	4	Sanco Silv	9	Fiberglass	9	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	1	W1WinBKa	270	90	West	0.838	1.143	West Wall	4	Sanco Silv	9	OPTIWIN -	94	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	1	W1WinBLa	270	90	West	0.838	1.143	West Wall	4	Sanco Silv	9	OPTIWIN -	94	0.51	0.60	0.95	0.12	0.12	0.11	0.12	1	1	1	1	0.028	-0.001	1.0
48									0		0		0														
49									0		0		0														
50									0		0		0														
51									0		0		0														
52									0		0		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

Ready | Sum=100 | SCRL | CAPS | NUM

Passive House Planning Package - PHPP

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Key Benefits

Comfort

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Indoor Environmental Quality

Ecology and Resource Efficiency

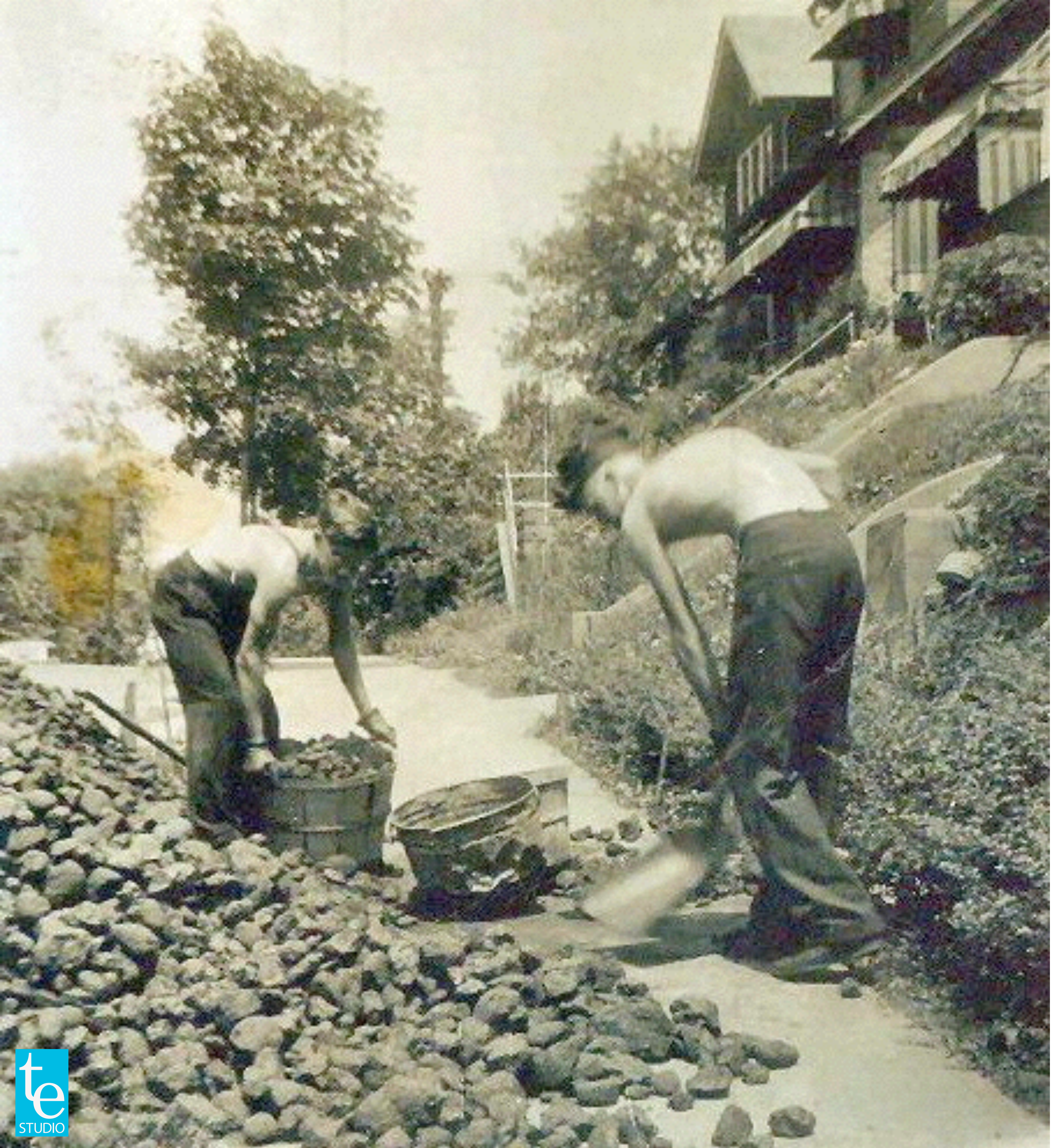
Image Source: dreamstime.com

The MinnePHit Project

Where are we?

what we got

Image Source: carlustblog.org



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