ENERGY DESIGN
conference & expo

The American Dream Renewed: Passive House for Everyone

Tim Delhey Eian
TE Studio & Intep
Passive House Minnesota

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.

The
Passive House Standard

Passivhaus - Passive House

EnerPHit ✓

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

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

Third-Party Certified

Certification Documentation

This building has been awarded the Certified Passiv
by the Passive House Institute.

This certification is based solely on the design data and sp
House Institute by the client for the purpose of certificatio
checked and approved the building's energy balances ac

This certification does not cover quality assurance c
implementation. The Passive House Institute hereby ta
the above.

Certificate-ID: 9689_PHI_PH_20141017_AM

Passive House Institute
Dr. Wolfgang Feist
Rheinstr. 44/46
64283 Darmstadt
Germany

Certificate

The Passive House Institute awards the seal "Certified Passive House"
to the following building

24th Street Passive House #1, 749 24th St. North, La Crosse, WI 54601, USA

Client: Western Technical Collage
400 7th St. North, La Crosse, WI 54602, USA

Architect: Integrated Planning LLC
901 23rd Ave NE, Minneapolis, MN 55418, USA

Building Services: Integrated Planning LLC
901 23rd Ave NE, Minneapolis, MN 55418, USA

This building was designed to meet Passive House criteria as defined by the Passive House Institute. With appropriate on-site implementation, this building will have the following characteristics:

- Excellent thermal insulation and optimised connection details with respect to building … The heating demand or heating load will be limited to
  15 kWh per m² of living area and year or a heating load of 10 W/m², respectively
- When outdoor temperatures are high, thermal comfort can be ensured with pas… minimal energy demand for cooling and dehumidification according to the location-… requirements.
- A highly airtight building envelope, which eliminates draughts and reduces the h… The air change rate through the envelope at a 50 Pascal pressure difference, as ve… ISO 9972, is less than
  0.6 air changes per hour with respect to the building's volume
- A controlled ventilation system with high quality filters, highly efficient heat re… consumption, ensuring excellent indoor air quality with low energy consumption
- A total primary energy demand for heating, domestic hot water, ventilation and … during normal use of less than
  120 kWh per m² of living area and year

This certificate is to be used only in combination with the associated certificatio… the exact characteristics of the building.

Passive Houses offer high comfort throughout the year and can be heated … example, by heating/cooling the supply air. Even in times of cold outdoor tem… of a Passive House is evenly warm on the inside and the internal surface temp… air temperatures. Due to the highly airtight envelope, draughts are elim… ventilation system constantly provides fresh air of excellent quality. Energy c… comfort in a Passive House are very low. Thanks to this, Passive Houses off… and future rises in energy prices. Moreover, the climate impact of Passive H… use, thereby resulting in the emission of comparatively low levels of carbo…

issued:
Darmstadt, 17.10.2014

Wolfgang Feist

Dr. Wolfgang Feist

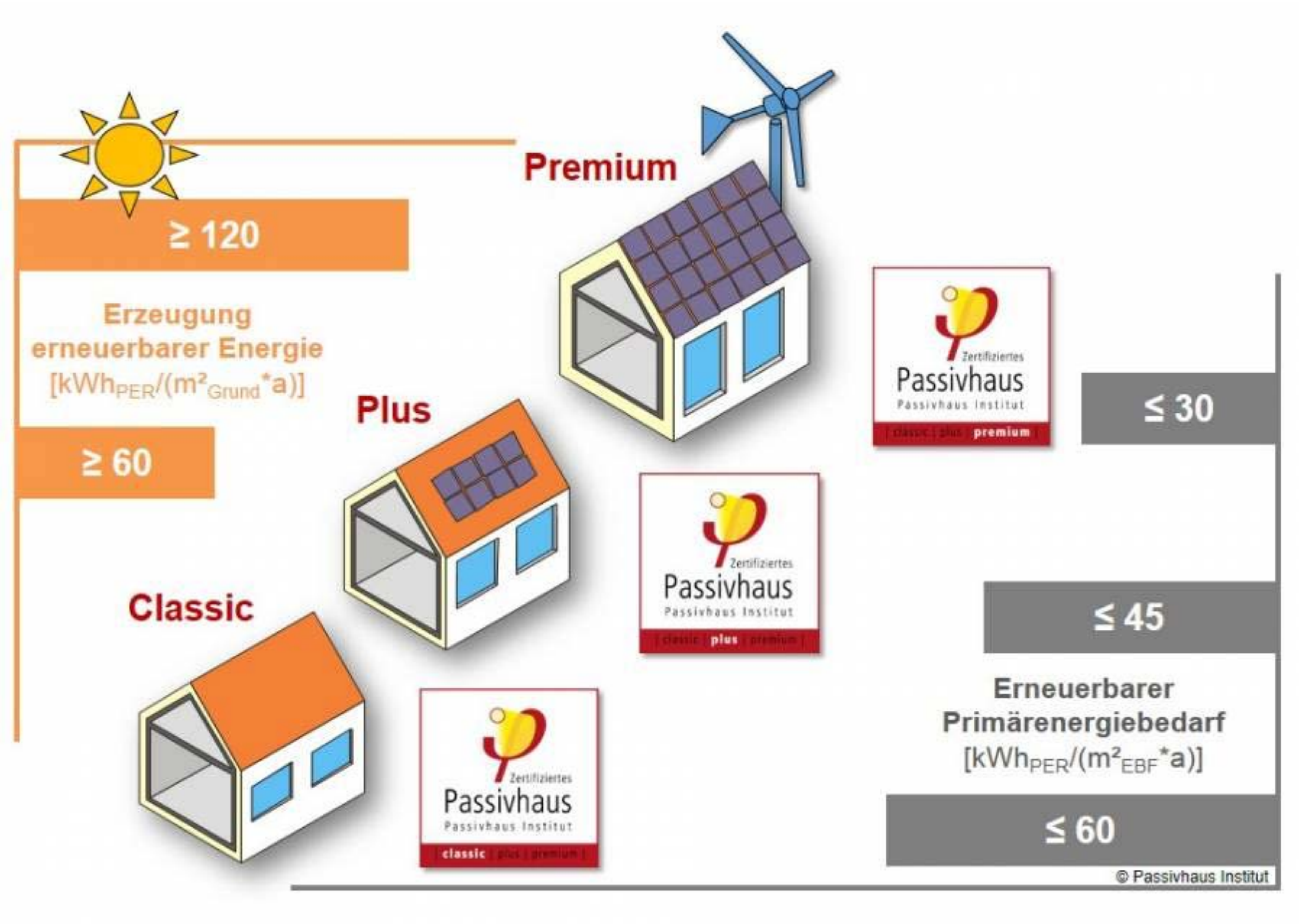
Certificate-ID: 9689_PHI_PH_20141017_AM

Certified
Passive House

Passive House Institute

Tool

The Path to Ultimate Sustainability



© Passivhaus Institut

Global Climate Specificity

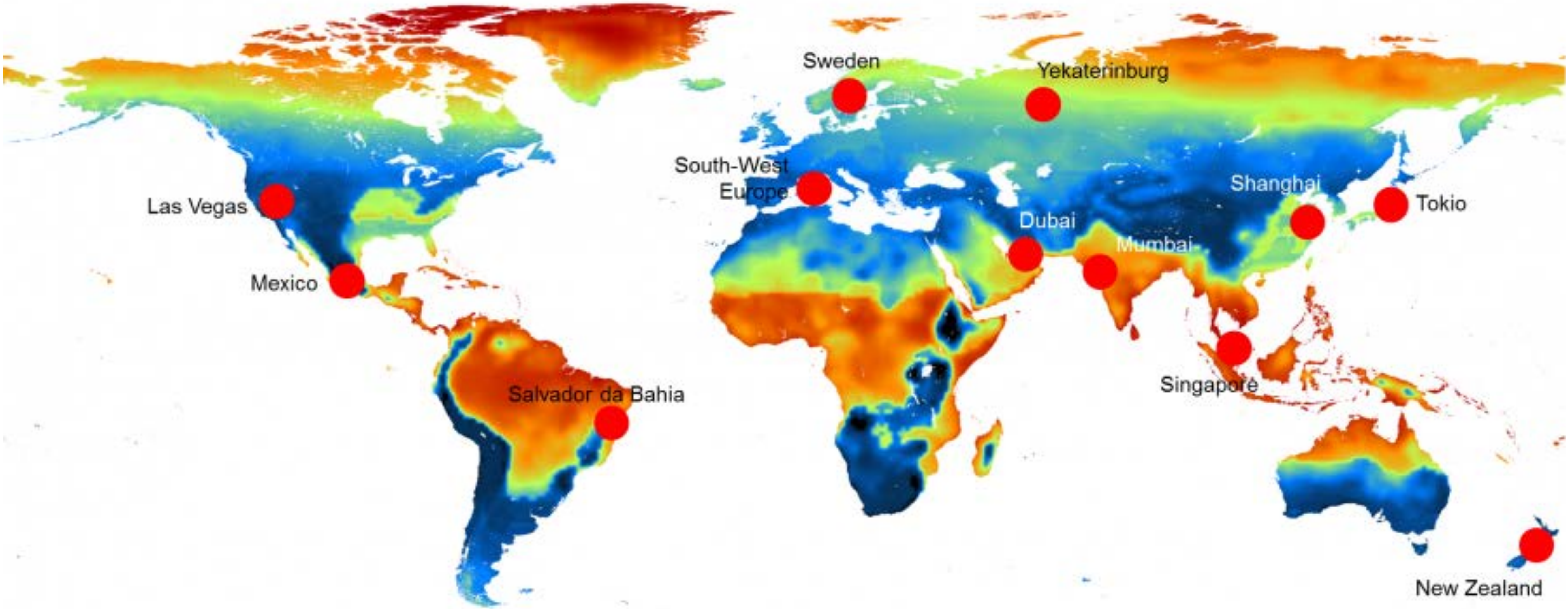
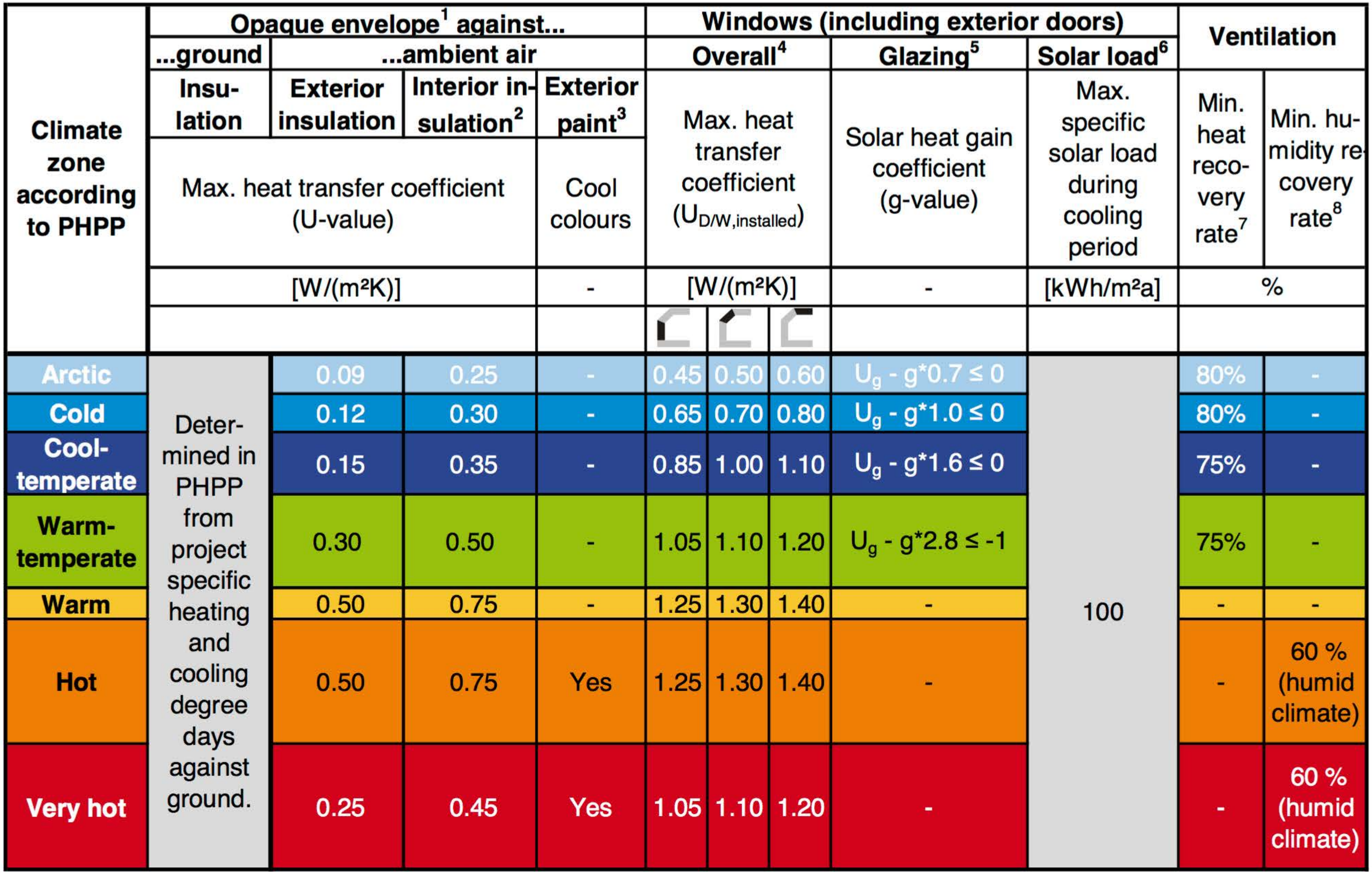


Illustration © Passive House Institute

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	$U_g - g*0.7 \le 0$	100	80%	-
Cold		0.12	0.30	-	0.65	0.70	0.80	$U_g - g*1.0 \le 0$		80%	-
Cool-temperate		0.15	0.35	-	0.85	1.00	1.10	$U_g - g*1.6 \le 0$		75%	-
Warm-temperate		0.30	0.50	-	1.05	1.10	1.20	$U_g - g*2.8 \le -1$		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

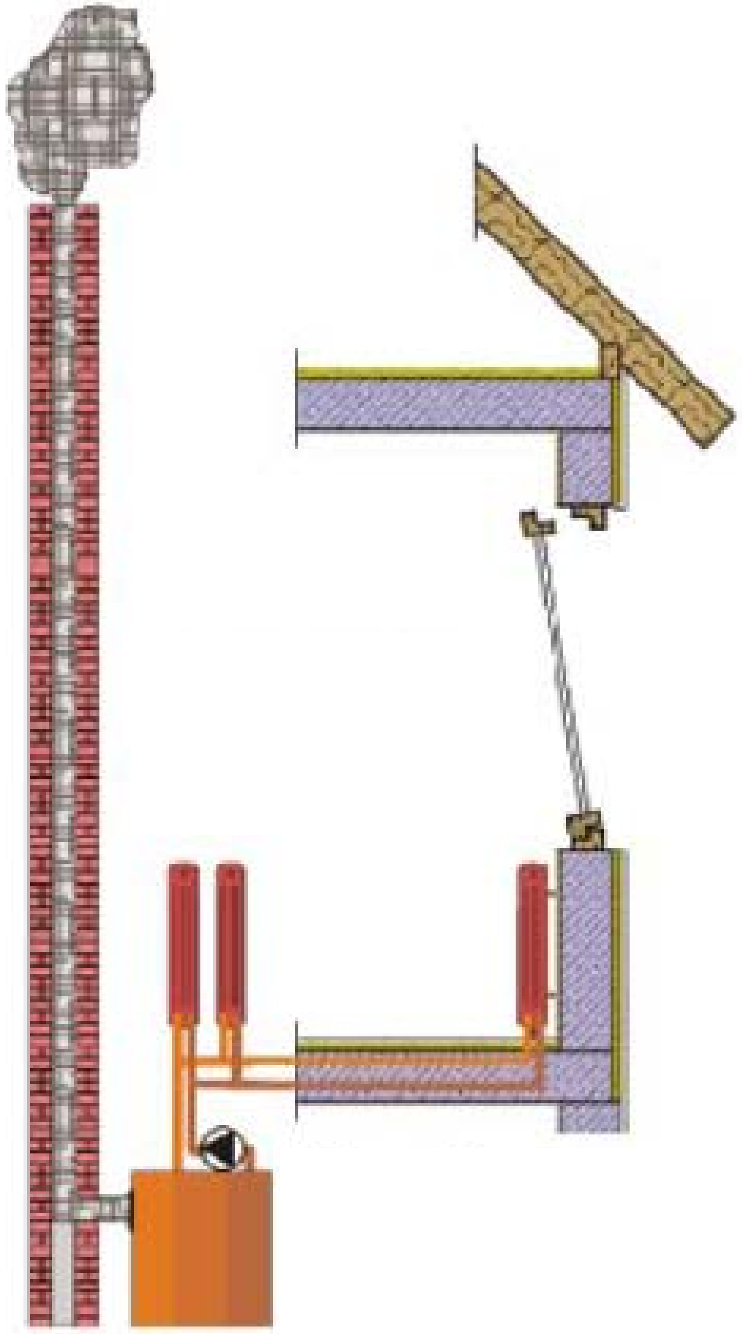
Basic Concept

Conservation first

➡ Minimize losses

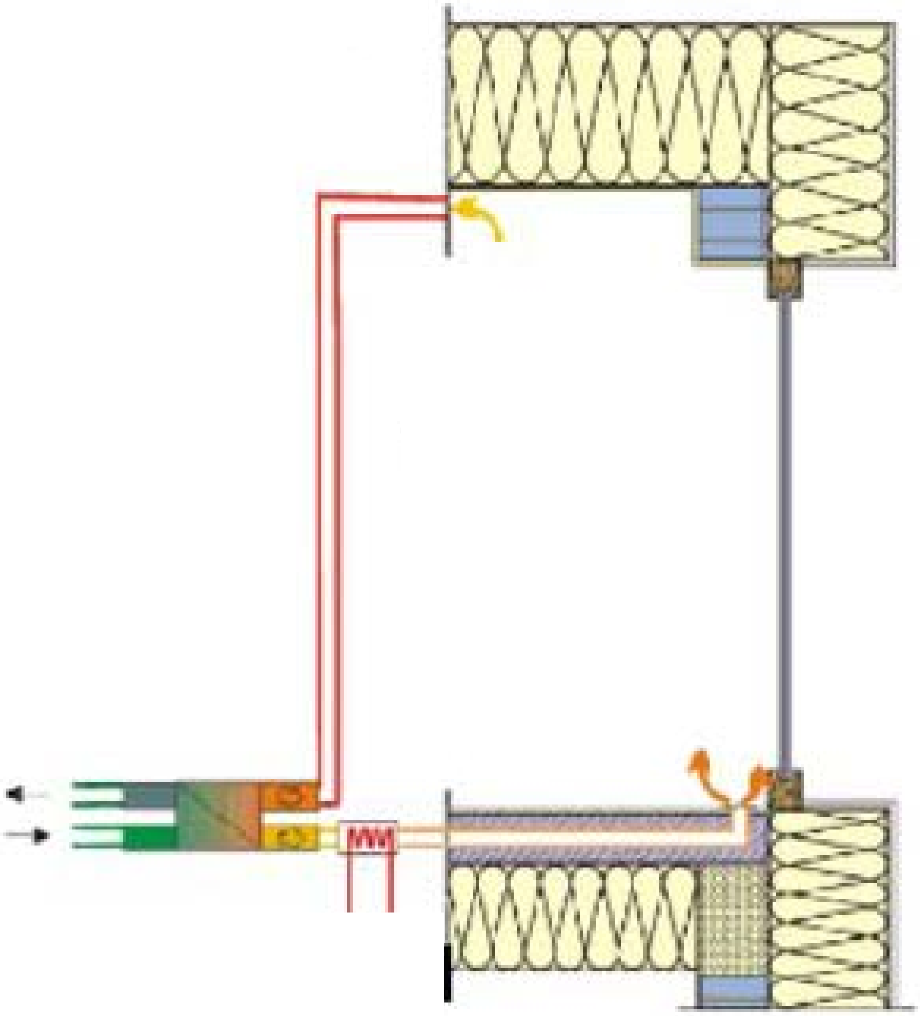
➡ Maximize (free) gains

Active vs. Passive



Active: 25-125 kBtu/(sf yr)

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

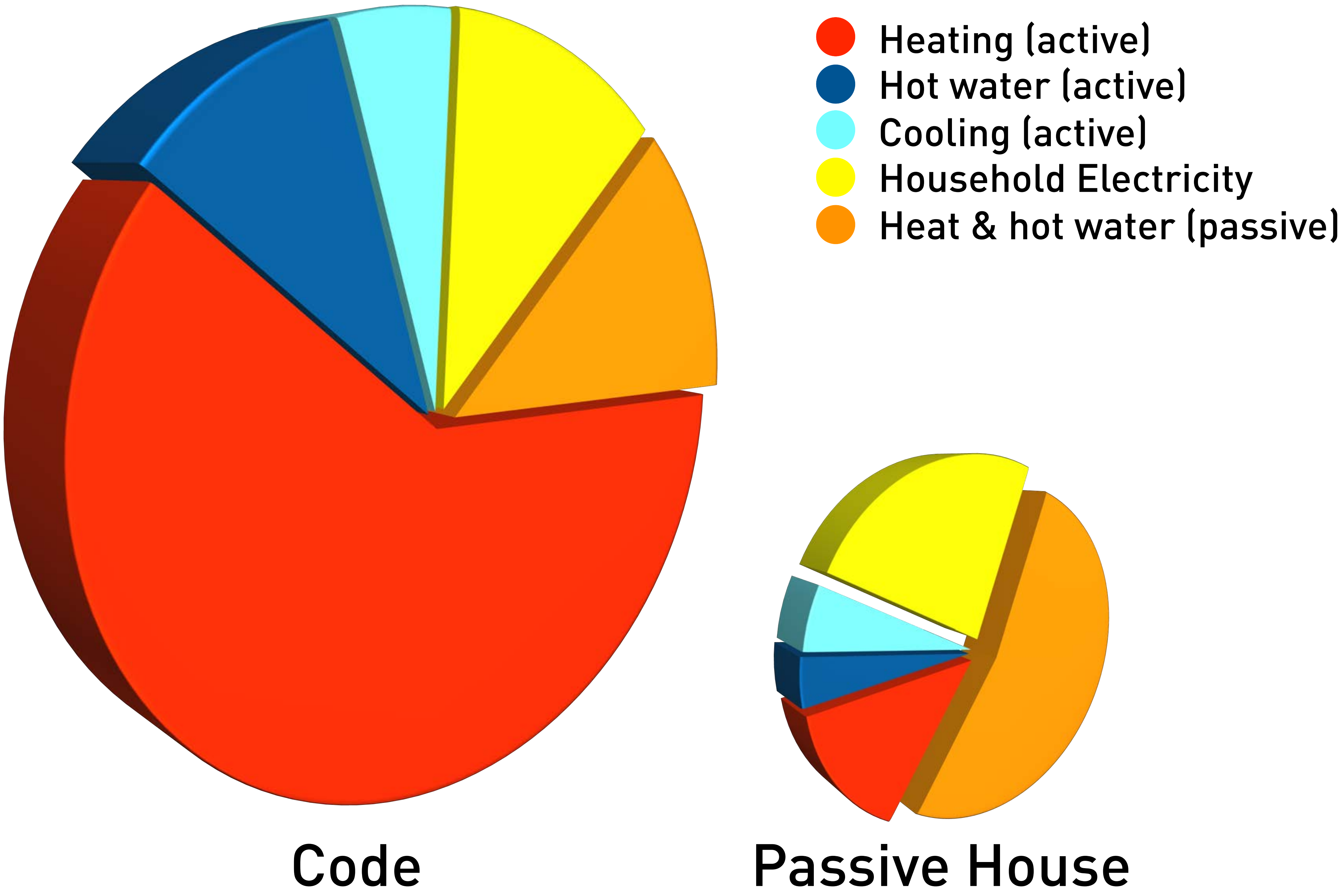


Passive: 4.75 kBtu/(sf yr)

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

Source: Krapmeier & Drössler 2001

Energy Footprint



- ➡ up to 95% less heating energy
- ➡ 50 to 75% less total energy

Metrics

Energy per Square Foot and Year

Gas mileage for buildings.

Space Conditioning Energy Targets

≤ 4.75 kBtu/(sf yr)

≤ 15kWh/(m^2 a)

PHI **Low Energy** Building

≤ 9.5 kBtu/(sf yr)

≤ 30kWh/(m^2 a)

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Passive House Components
Dr. Wolfgang Feist

≤ 7.9 kBtu/(sf yr)

≤ 25kWh/(m^2 a)

Total energy used to heat or cool a building.

Source Energy Targets

PHI **Low Energy** Building

$\leq$ 38 kBtu/(sf yr)

$\leq 120\text{kWh}/(\text{m}^2\ \text{a})$

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varies

$\leq 120\ \text{kWh}/(\text{m}^2\ \text{a}) + ((\text{QH} - 15\ \text{kWh}/(\text{m}^2\ \text{a})) * 1.2)$

Total energy used to heat or cool a building.

Heating Load Target (suggested)

≤ 3.17 Btu/(h sf)

≤ 10W/m^2

Heating energy can be supplied through ventilation system.

Airtightness Targets

≤0.6 ACH$_{50}$

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≤1.0 ACH$_{50}$

Measured with a blower door in the field.

Component Targets

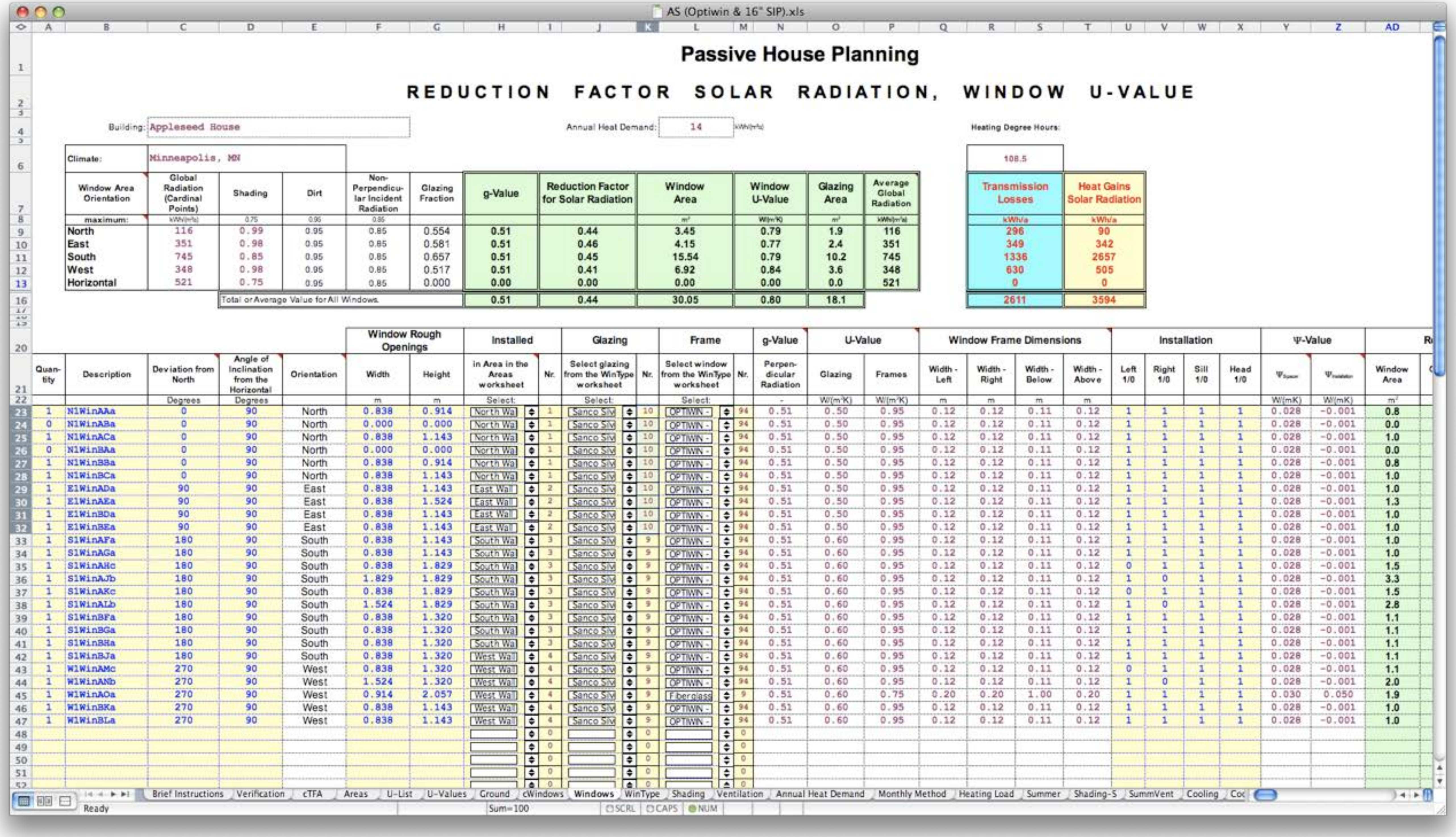
- Maximum U-values
- Minimum R-values
- SHGC requirements
- Minimum heat-recovery rates

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

					Window Rough Openings		Installed		Glazing		Frame		g-Value	U-Value		Window Frame Dimensions				Installation				Ψ-Value		R
Quantity	Description	Deviation from North	Angle of Inclination from the Horizontal	Orientation	Width	Height	in Area in the Areas worksheet	Nr.	Select glazing from the WinType worksheet	Nr.	Select window from the WinType worksheet	Nr.	Perpendicular Radiation	Glazing	Frames	Width - Left	Width - Right	Width - Below	Width - Above	Left 1/0	Right 1/0	Sill 1/0	Head 1/0	Ψ_{Spacer}	$\Psi_{Installation}$	Window Area
		Degrees	Degrees		m	m	Select:		Select:		Select:		-	W/(m²K)	W/(m²K)	m	m	m	m					W/(mK)	W/(mK)	m²
1	N1WinAAa	0	90	North	0.838	0.914	North Wa	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
0	N1WinABa	0	90	North	0.000	0.000	North Wa	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
1	N1WinACa	0	90	North	0.838	1.143	North Wa	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
0	N1WinBAa	0	90	North	0.000	0.000	North Wa	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
1	N1WinBBa	0	90	North	0.838	0.914	North Wa	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
1	N1WinBCa	0	90	North	0.838	1.143	North Wa	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
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
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
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
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
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
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
1	S1WinAHc	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
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
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
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
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
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
1	S1WinBHa	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
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
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
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
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
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
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
								0		0		0														
								0		0		0														
								0		0		0														
								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 | Coo

Ready | Sum=100 | SCRL | CAPS | NUM

Passive House Planning Package - PHPP

Key Benefits

Highest Comfort

Superior Indoor Environmental Quality

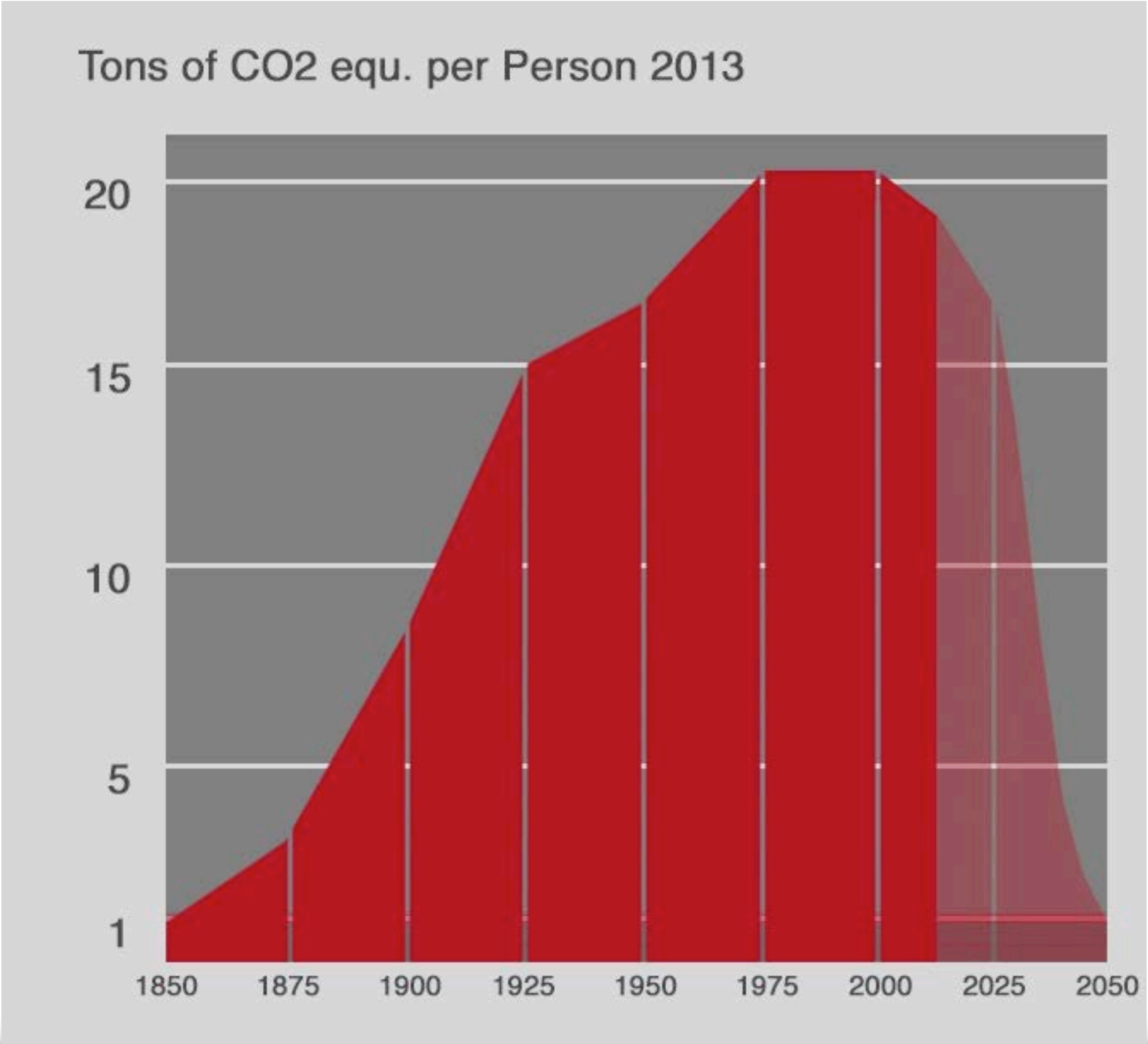
Ecology and Resource Efficiency

Image Source: dreamstime.com

Cheapest Life Cycle Cost

Image Source: wikimedia.org

American Dream in the 21st Century?



Affordable, efficient, comfortable and sustainable housing, which is not a burden on resources and does not produce greenhouse gases.

Why?

Climate Change

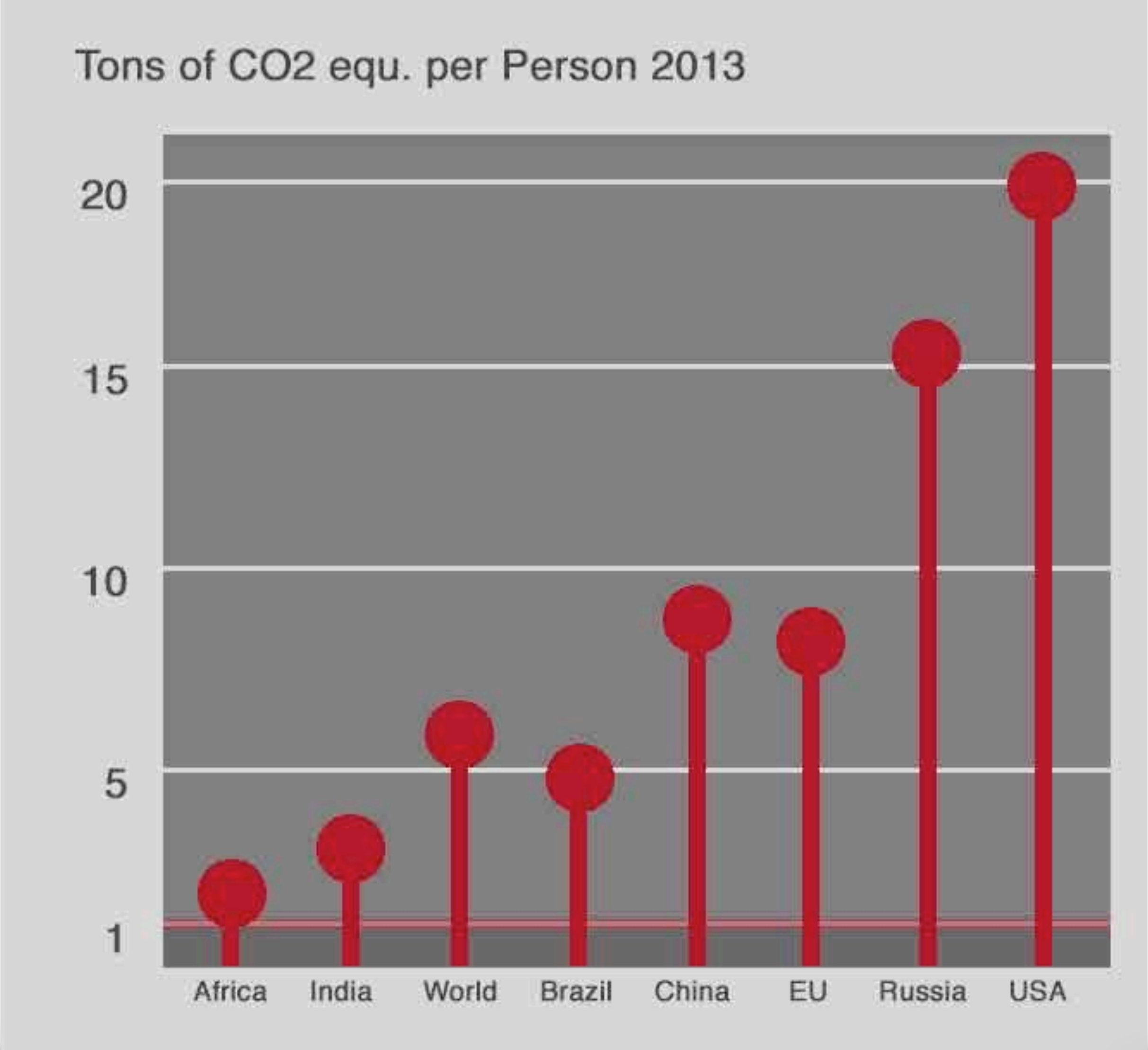
What is sustainable?

One Sustainable Target for Spaceship Earth

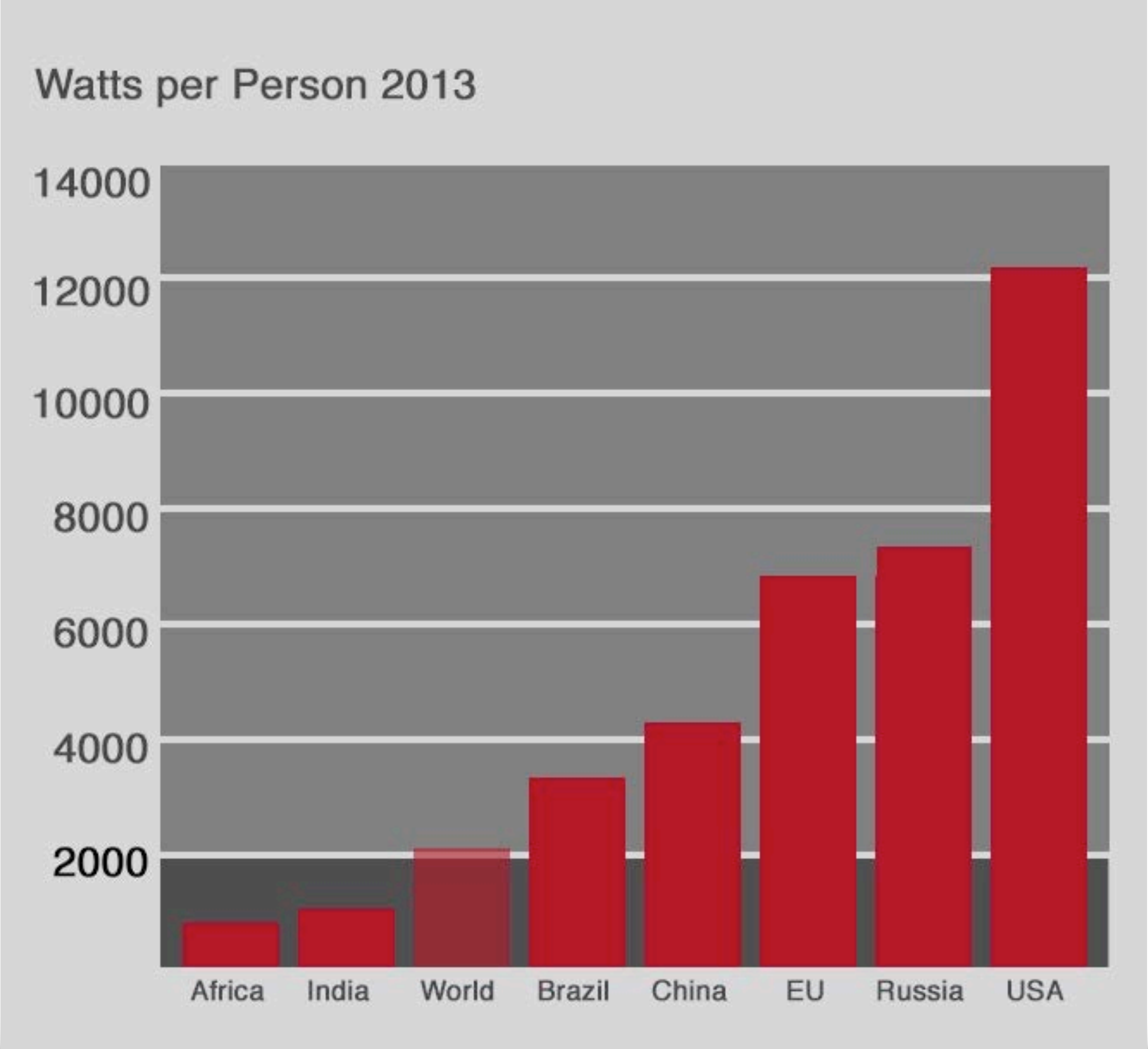
Continuous Energy Consumption per Capita
1,500 Watts (renewable)
\+ 500 Watts (non-renewable)
= 2,000 Watts

Carbon Footprint per Capita and Year
1 ton CO_2

What is the status quo?

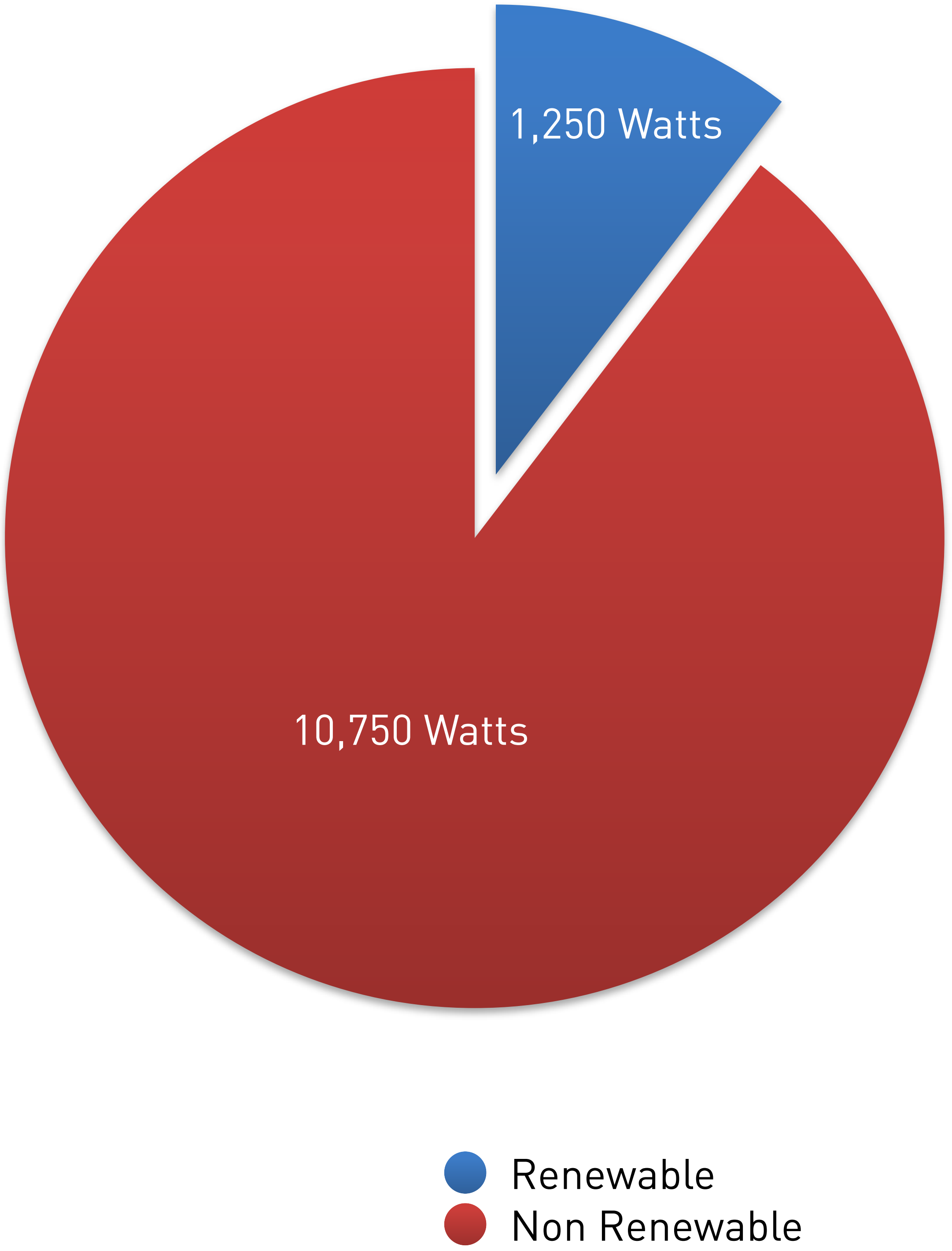


Tons of CO2 equ. per Person 2013



Watts per Person 2013

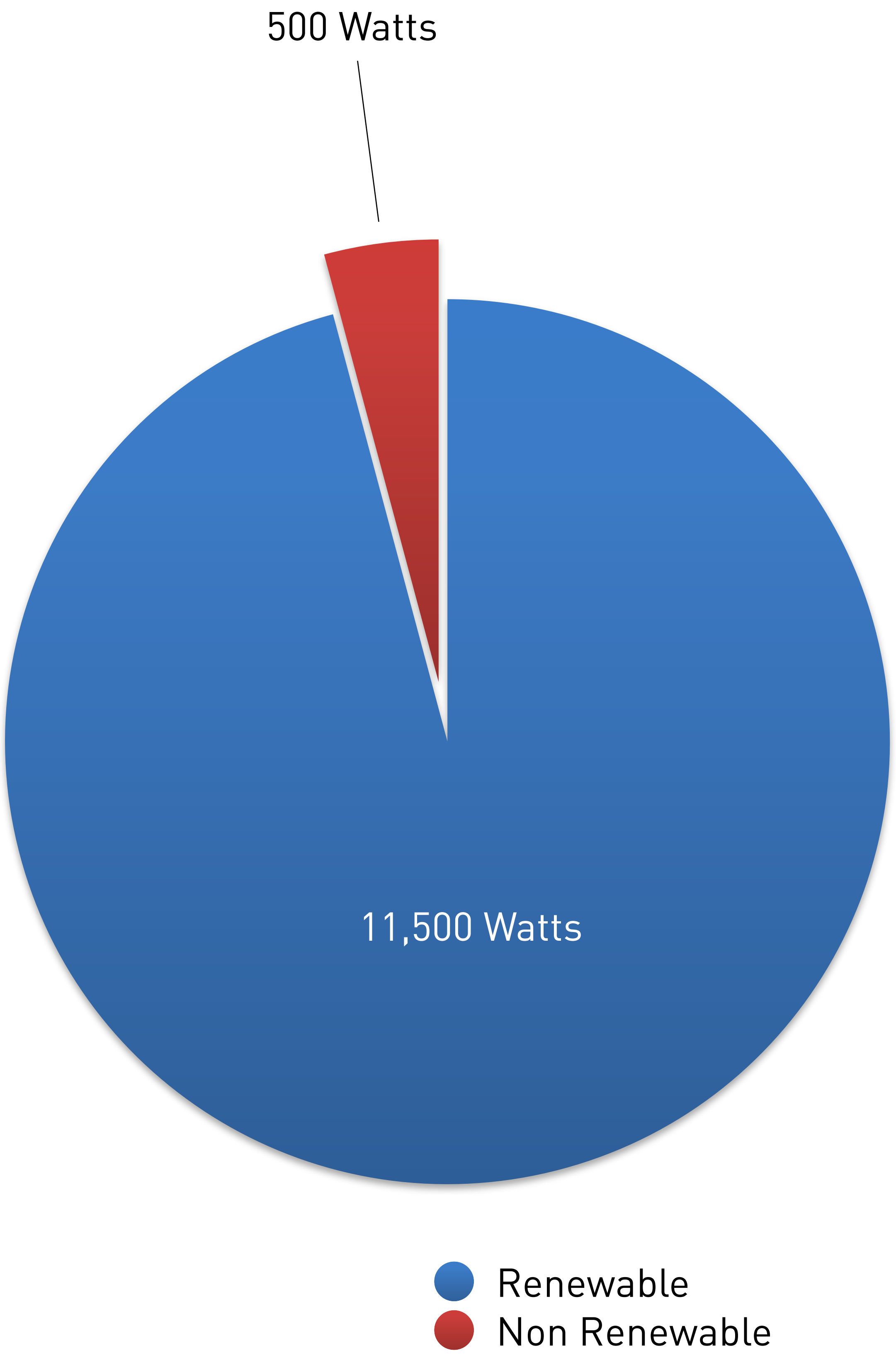
12,000 Watts/ Person and 20 tons CO_2/ Person/ Year

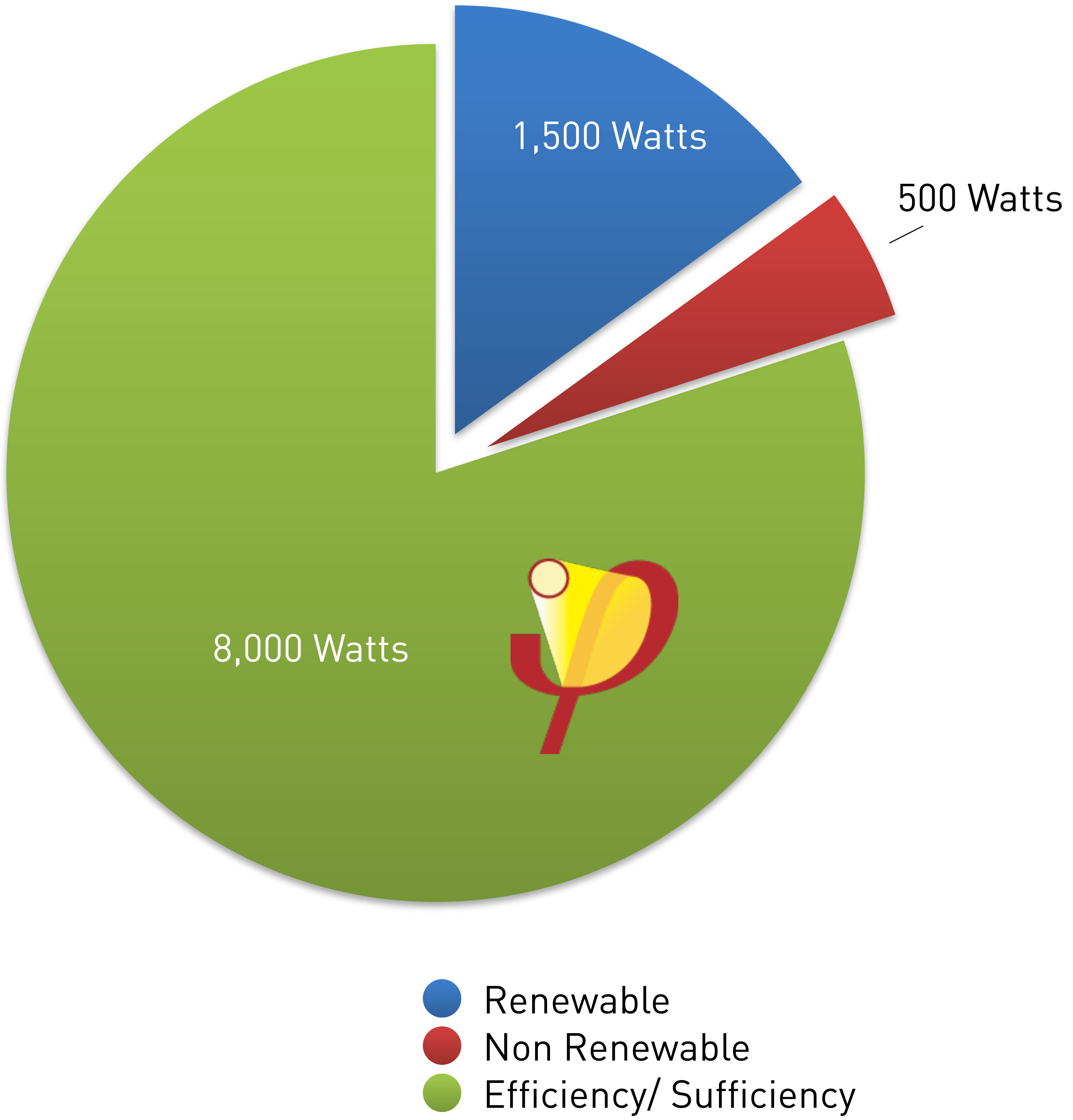


**(Goal:
2,000 Watts
1 ton CO2)**

Well, how do we do that?

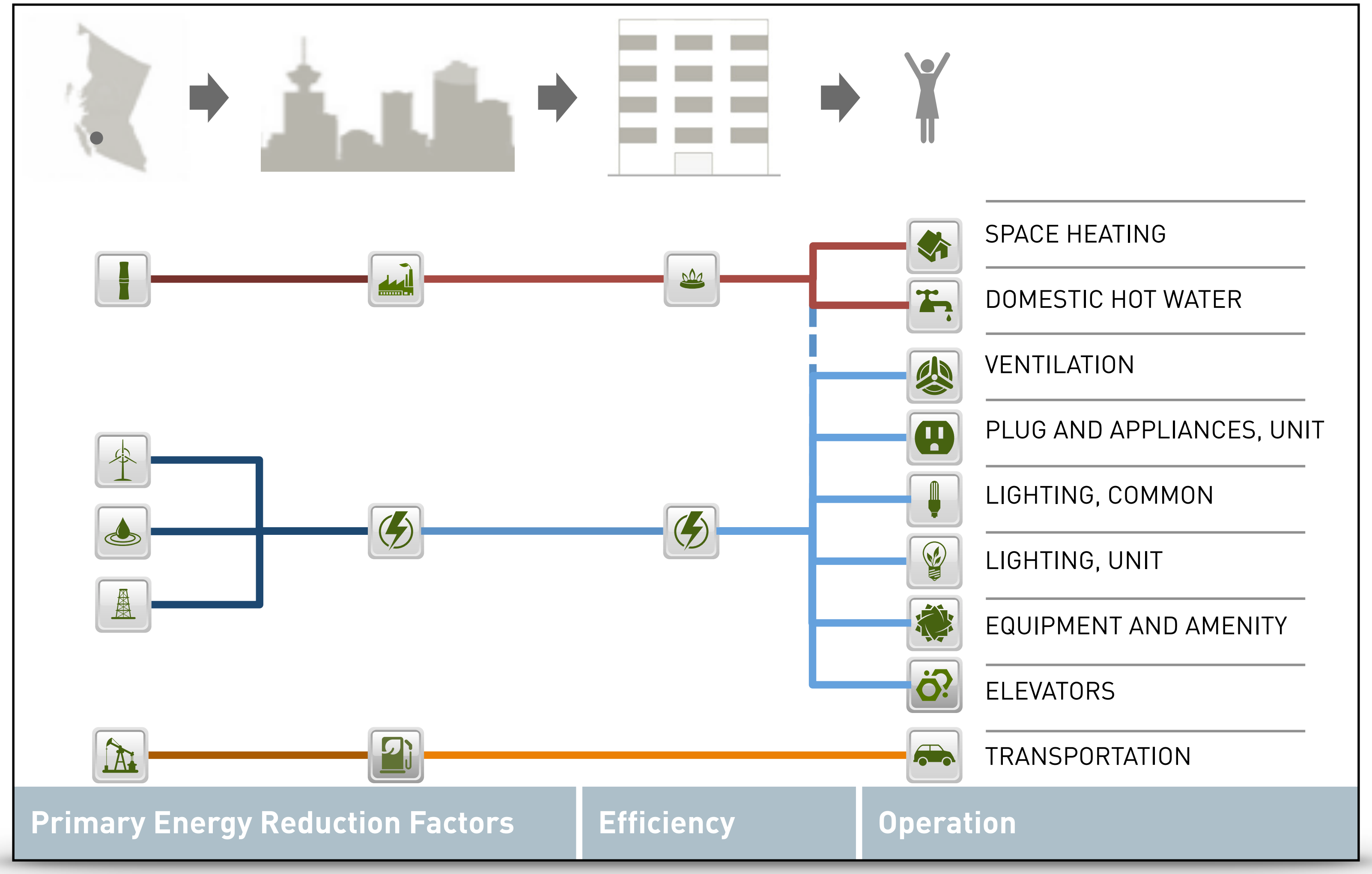
Substitution, or Sufficiency + Efficiency?





Changes on a Macro Level

Current Setup



SPACE HEATING

DOMESTIC HOT WATER

VENTILATION

PLUG AND APPLIANCES, UNIT

LIGHTING, COMMON

LIGHTING, UNIT

EQUIPMENT AND AMENITY

ELEVATORS

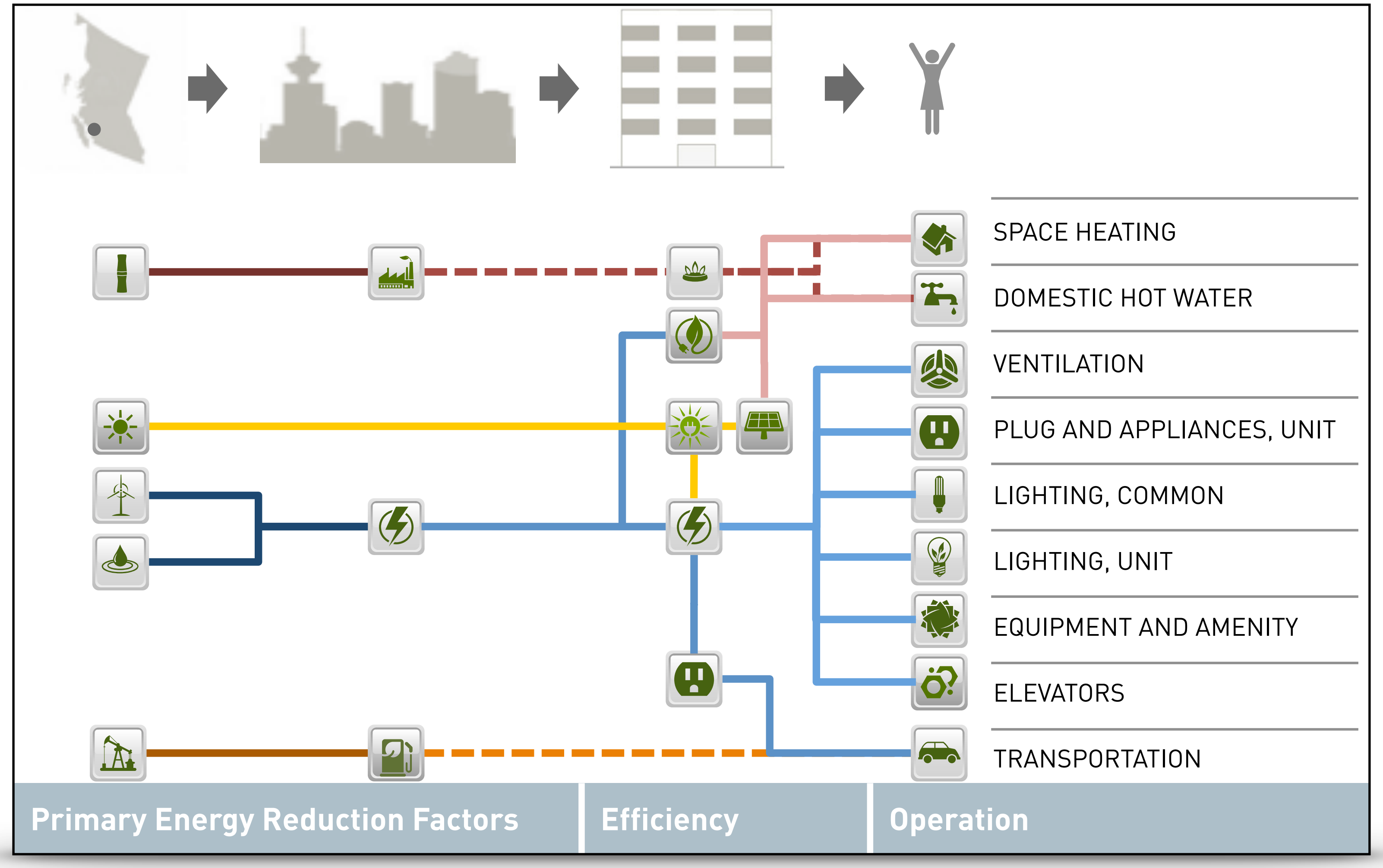
TRANSPORTATION

Primary Energy Reduction Factors

Efficiency

Operation

Tomorrow's Setup



Changes on a Micro Level

Conventional Wisdom:
Full on-site offset

“Plus Energy” before there was Passive House Plus and Premium