ENERGY DESIGN

conference & expo

STUDIO

CERTIFIED PASSIVE HOUSE DESIGNER

Residential New Construction Passive House

The Nordeast Nest

Case Study

Tim Eian, Dipl.-Ing., Certified Passive House Planner & Consultant

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 standard
- Residential Passive House design
- Strategies, materials and systems
- Challenges & Opportunities
- Performance

The
Passive House Standard

Passivhaus - Passive House

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

te STUDIO

Passive House in 90 Seconds

Video: Hans-Jörn Eich

Global Standard

Think globally, build locally.

te STUDIO

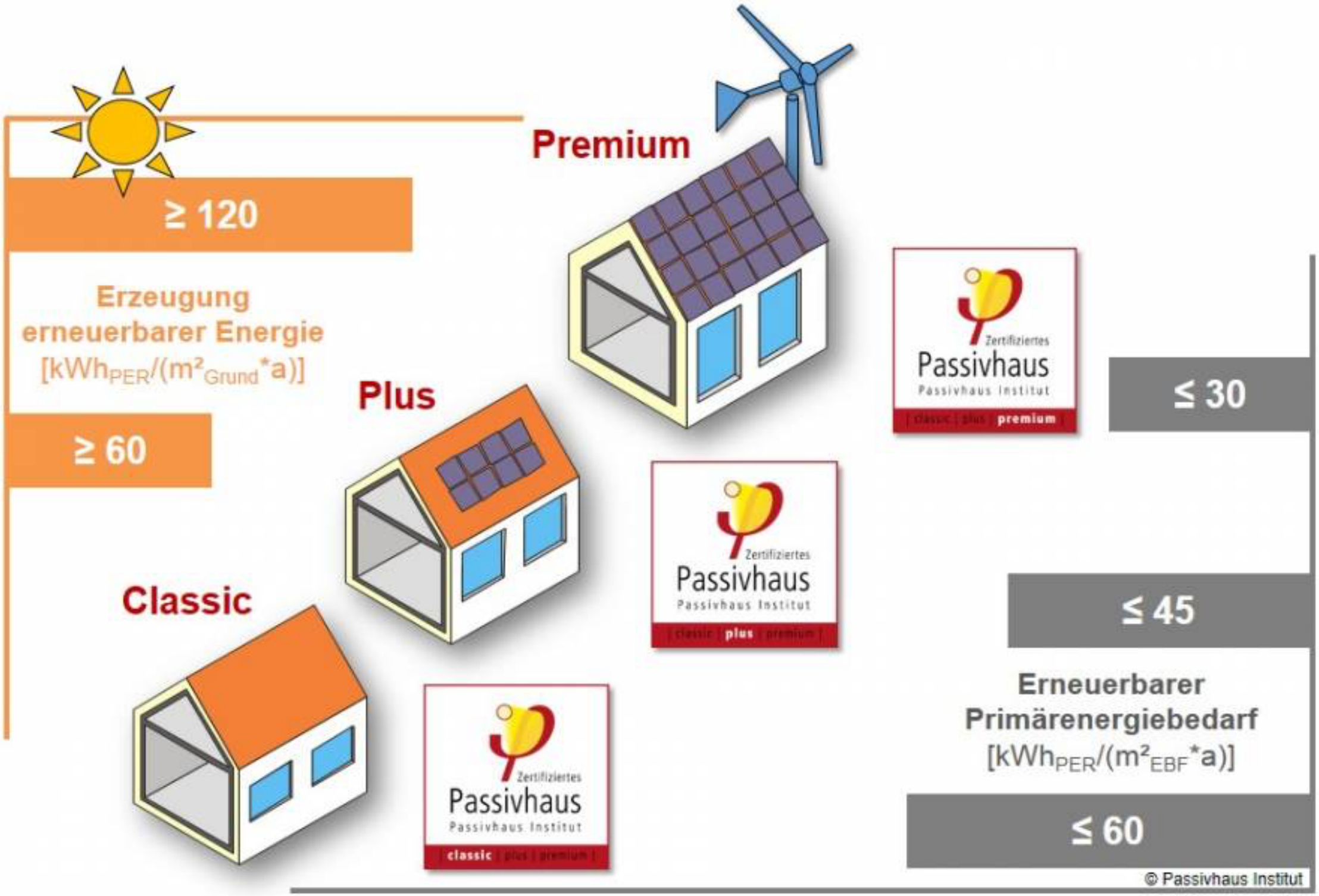
intep

Global Adoption

Third-Party Certified

Tool

The Path to Ultimate Sustainability



Global Climate Specificity

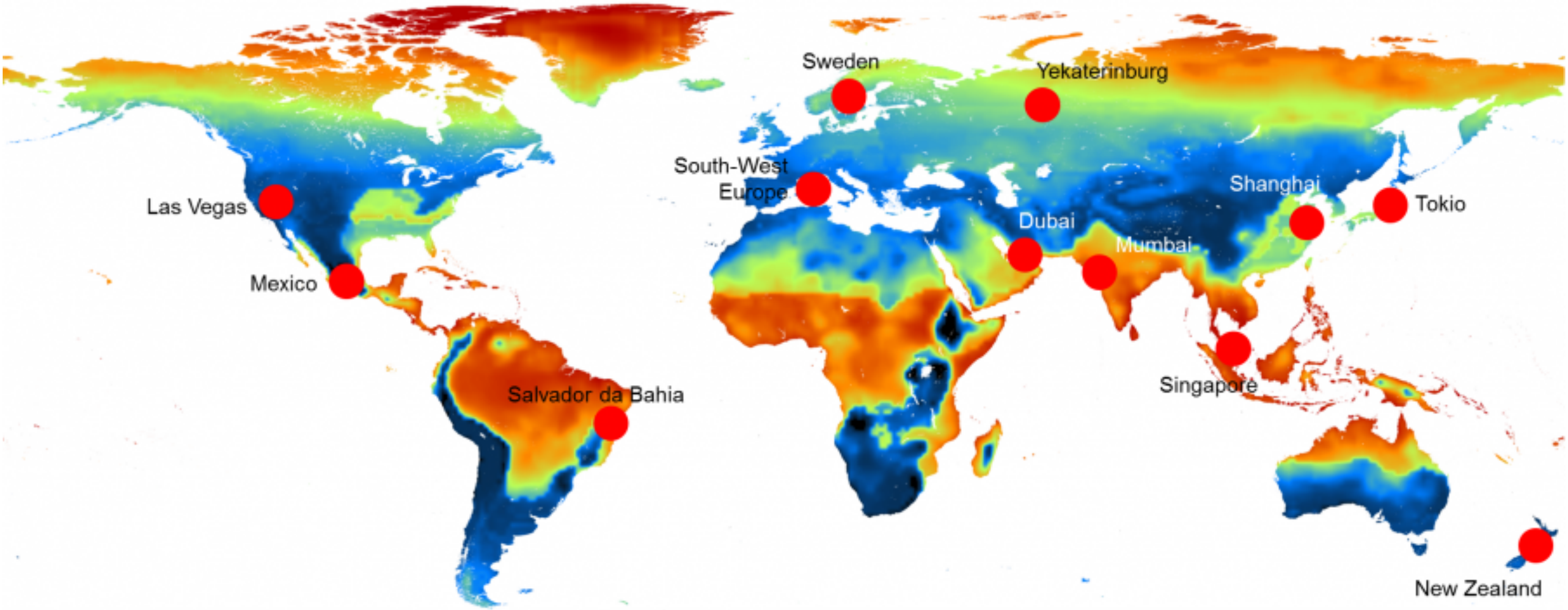


Illustration © Passive House Institute

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 ≤ 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)

Energy Modeling

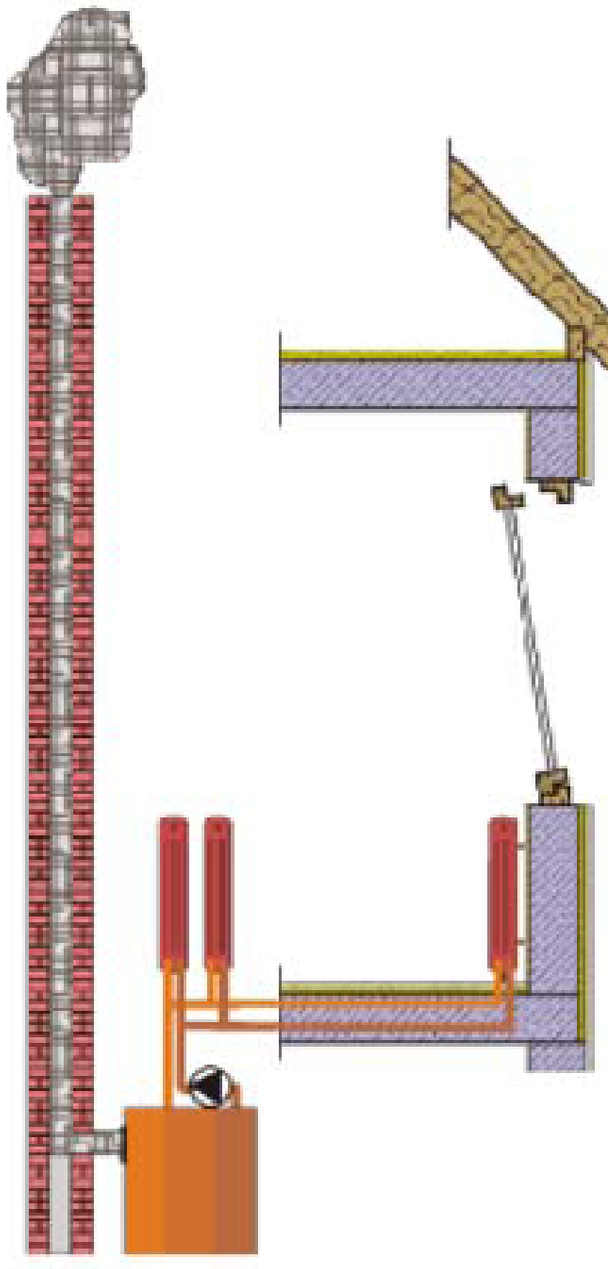
te STUDIO

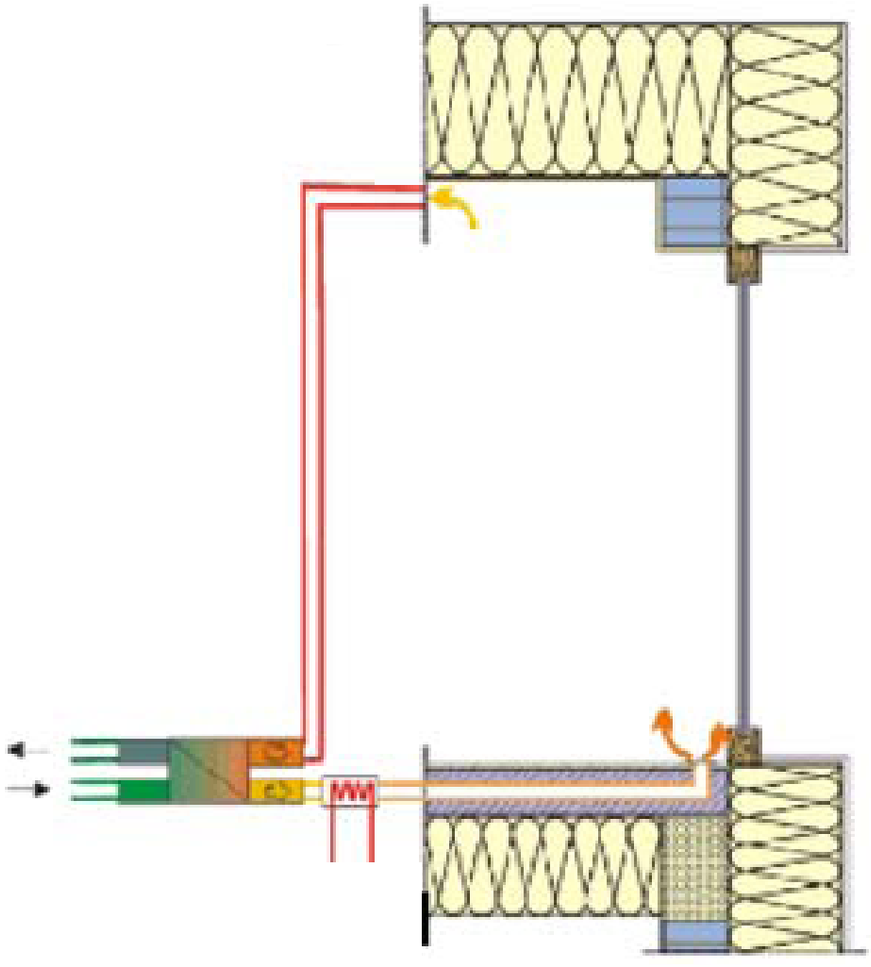
Conservation first

➡ Minimize losses

➡ Maximize (free) gains

Active vs. Passive





Active: 25-125 kBtu/(sf yr)

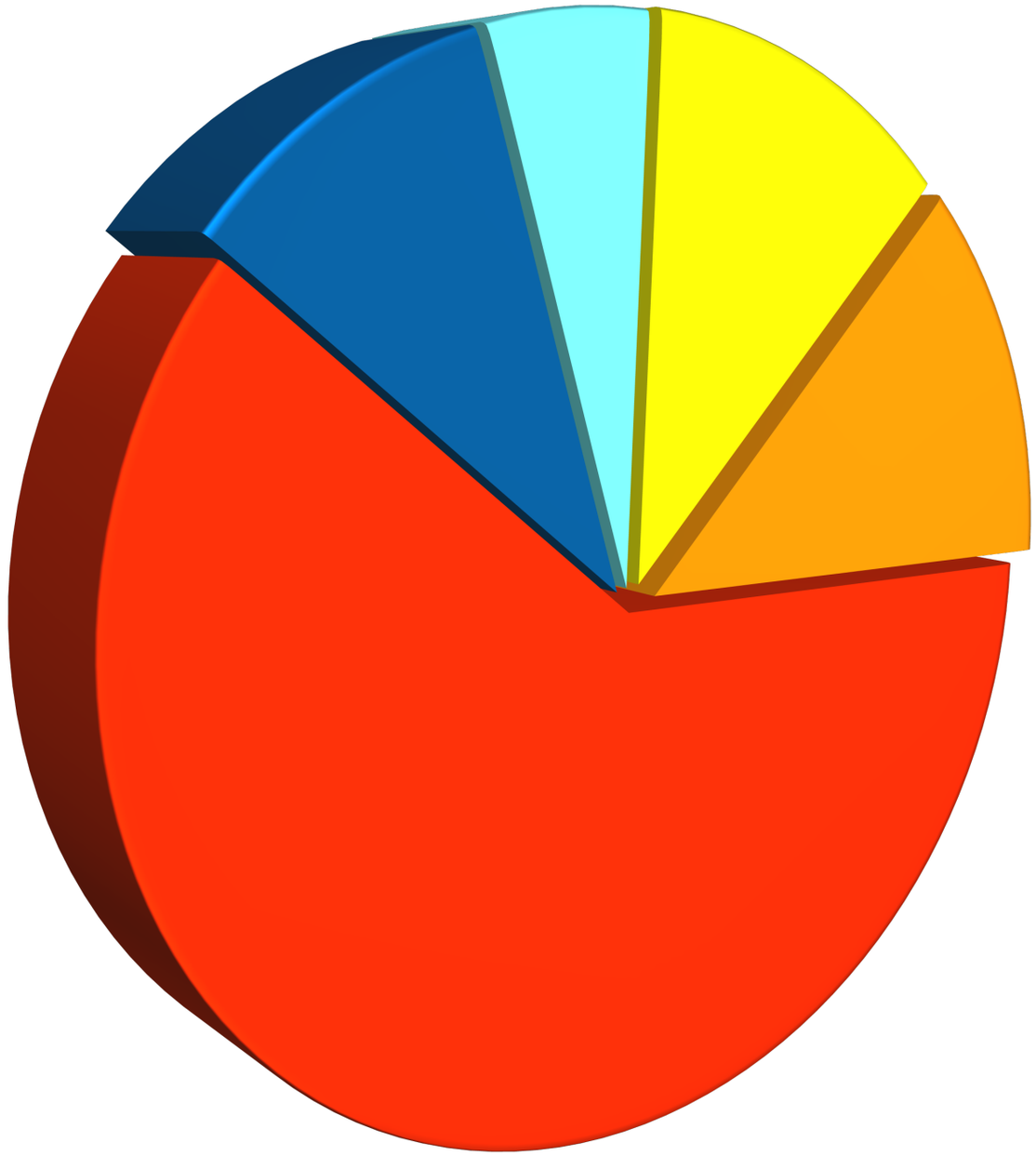
85 - 450 kWh/(m^2 a), typically found in the U.S.

Passive: 4.75 kBtu/(sf yr)

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

Source: Krapmeier & Drössler 2001

Energy Footprint



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

Code

Passive House

- ➡ 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/(m² a)

PHI Low Energy Building

≤ 9.5 kBtu/(sf yr)

≤ 30kWh/(m² a)

EnerPHit

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

≤ 7.9 kBtu/(sf yr)

≤ 25kWh/(m² a)

Total energy used to heat or cool a building.

te STUDIO

Source Energy Targets

PHI Low Energy Building

≤ 38 kBtu/(sf yr)

≤ 120kWh/(m² a)

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

varies

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

Total energy used to heat or cool a building.

te STUDIO

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}

≤1.0 ACH_{50}

Measured with a blower door in the field.

Component Targets

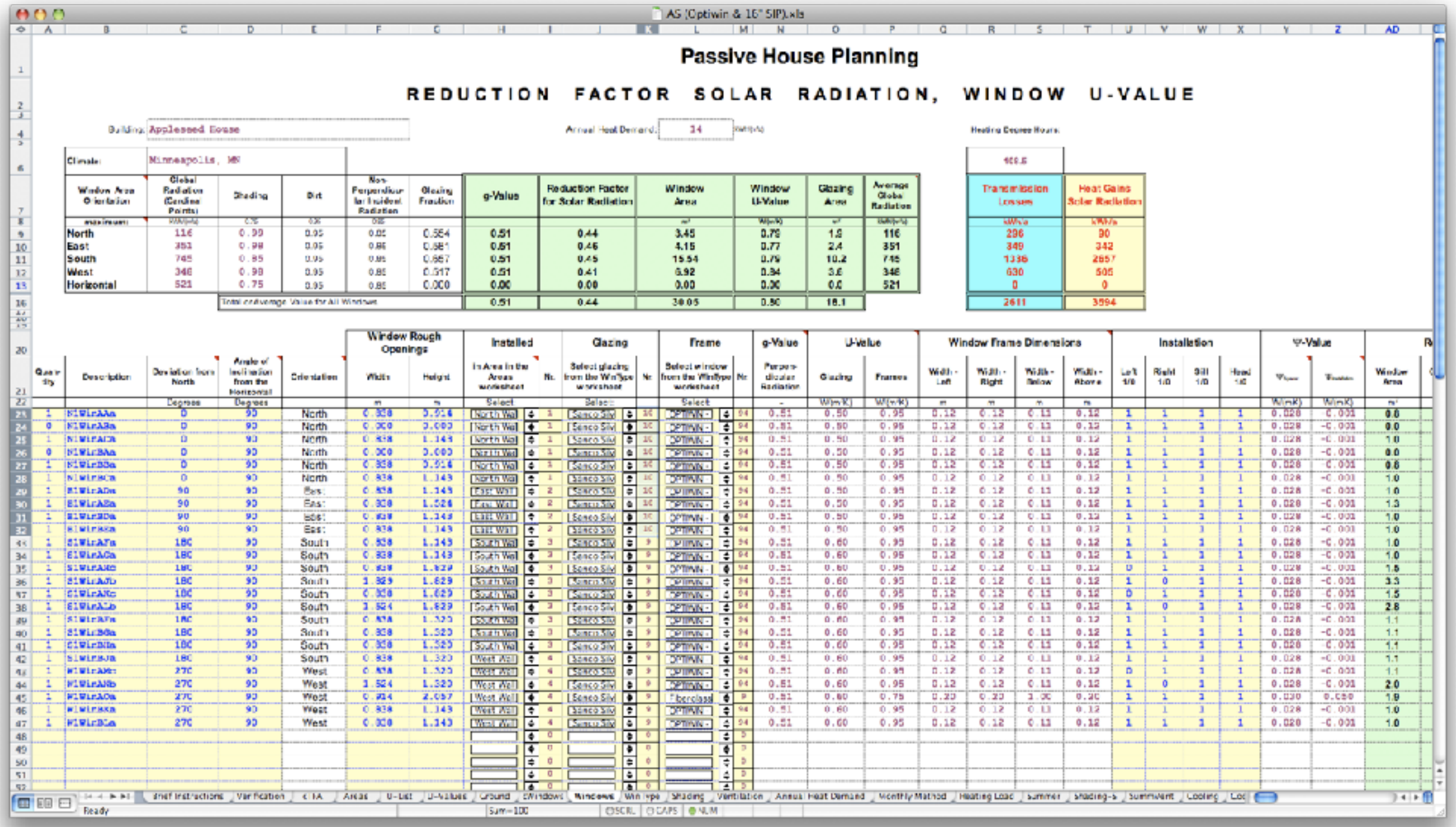
- Maximum U-values
- Minimum R-values
- SHGC requirements
- Minimum heat-recovery rates

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



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

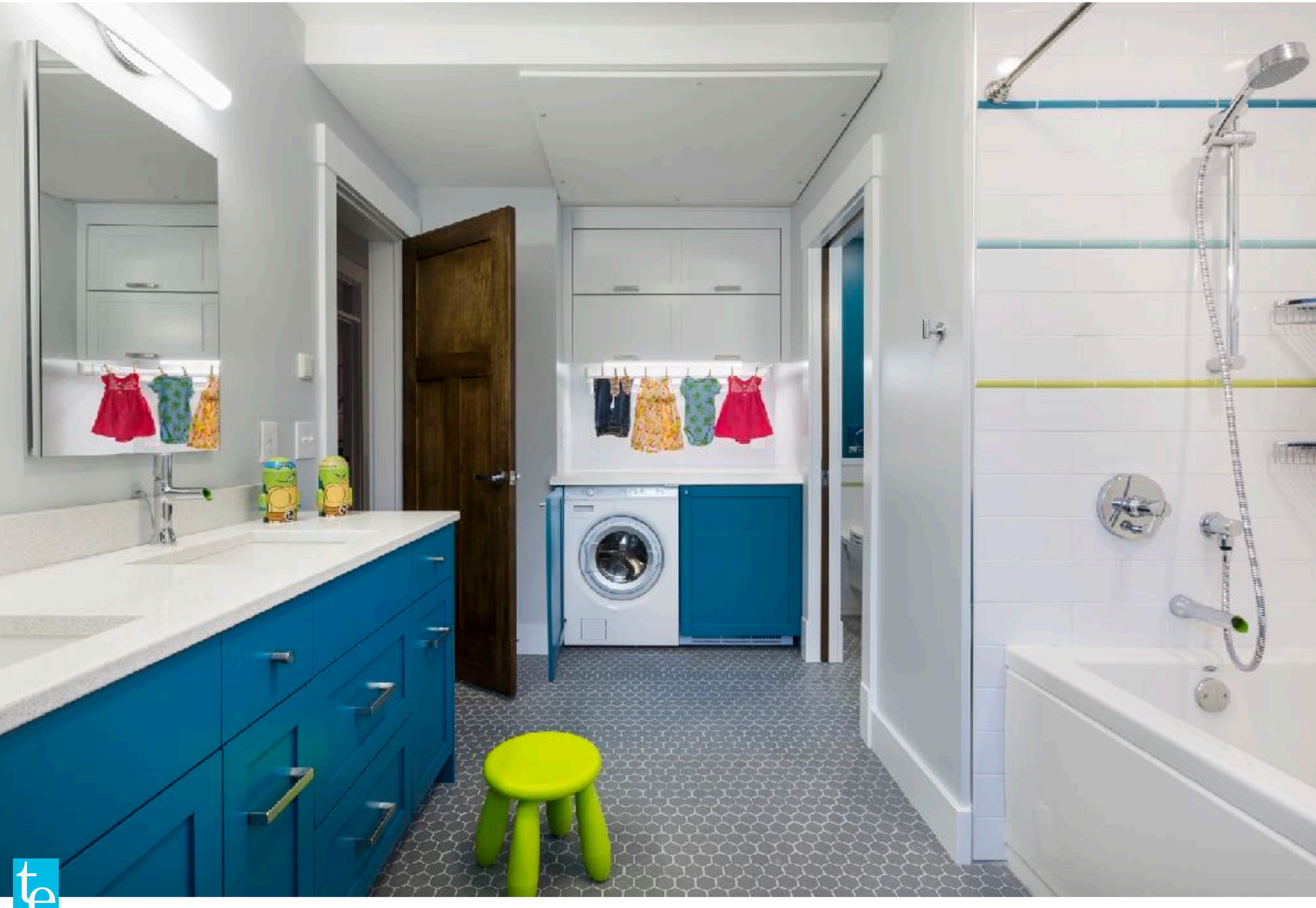
The Project

PHI Low Energy Building

Nordeast Nest

te STUDIO

te STUDIO



Home Energy Rating Certificate

2335 McKinley St NE
MPLS, MN 55418

BUILDING KNOWLEDGE

5 Stars Plus
Confirmed
HERS Index: 32
Efficient Home Comparison: 68% Better

Registry ID	**420377360**
Rating Number	**2014-1**
Certified Energy Rater	Patrick O'Malley
Rating Date	11/26/14
Rating Ordered For	Julie & Tarel Alkatout

General Information

Conditioned Area	2964 sq. ft.	House Type	Single-family detached
Conditioned Volume	26676 cubic ft.	Foundation	Conditioned basement
Bedrooms	3		

Mechanical Systems Features

Heating:	Fuel-fired air distribution, Natural gas, 90.0 AFUE.
Air-source heat pump:	Electric, Htg: 9.5 HSPF. Clg: 18.0 SEER.
Water Heating:	Instant water heater, Natural gas, 0.93 EF, 0.0 Gal.
Duct Leakage to Outside	RESNET/HERS default
Ventilation System	Balanced: ERV, 75 cfm, 120.0 watts.
Programmable Thermostat	Heat=Yes; Cool=Yes

Building Shell Features

Ceiling Flat	R-90.0	Slab	R-30.0 Edge, R-30.0 Under
Sealed Attic	NA	Exposed Floor	NA
Vaulted Ceiling	NA	Window Type	U-Value: 0.140, SHGC: 0.500
Above Grade Walls	R-60.0	Infiltration Rate	Htg: 133 Clg: 133 CFM50
Foundation Walls	R-25.0	Method	Blower door test

Lights and Appliance Features

Percent Interior Lighting	100.00	Range/Oven Fuel	Electric
Percent Garage Lighting	98.00	Clothes Dryer Fuel	Electric
Refrigerator (kWh/yr)	300.00	Clothes Dryer EF	3.01
Dishwasher Energy Factor	0.46	Ceiling Fan (cfm/Watt)	0.00

Estimated Annual Energy Cost

Use	MMBtu	Cost	Percent
Heating	12.3	$256	21%
Cooling	2.5	$80	6%
Hot Water	13.4	$104	8%
Lights/Appliances	24.4	$692	55%
Photovoltaics	-0.0	$-0	-0%
Service Charges		$116	9%
Total	52.7	$1249	100%

Criteria

This home meets or exceeds the minimum criteria for the following:
2006 International Energy Conservation Code
2009 International Energy Conservation Code
2012 International Energy Conservation Code

Building Knowledge, Inc.
PO Box 1376
Burnsville MN 55337
952-944-5605
www.buildingknowledge.com

te STUDIO

“Nordeast Nest”
Building Envelope Specifications

Window Frames
Optiwin, Alu2Wood
Timber window frame with insulation and exterior aluminum cladding
U_w-Value = 0.84 W/(m²K) [U_{IP} = 0.148 Btu/(h ft² F)]

Glazing
Glas Trösch
SILVERSTAR glaCE
EUROFLOAT
4:/18/4/18/:4
Argon filled
U_g-Value = 0.54 W/(m²K) [U_{IP} = 0.095 Btu/(h ft² F)]
g-Value (SHGC) = 53 %

Entry Doors
Doors of Distinction
Custom made entry door. Wood frame, wood finish, polyisocyanurate foam insulation core
Ud-Value = 0.79 W/(m²K) [U_{IP} = 0.139 Btu/(h ft² F)]

te STUDIO

Design Concept

Built Project

“Nordeast Nest”
Building Envelope Specifications

Exterior Walls

Below-grade exterior walls: U-value: 0,146 W/(m²K); R-39
- 5/8 "[16mm] drywall
- 11" [280mm] insulated concrete forms (ICF)
  [2.5" EPS (035) - 6" concrete - 2.5" EPS (035)]
- 4" [102mm] EPS insulation (035)
- Sto Flexyl

Above-grade exterior walls: U-value: 0,111 W/(m²K); R-51
- 5/8 "[16mm] drywall
- 2X6 Studs [140mm] with mineral wool batt insulation (040)
- 3/4" OSB [19mm] structural sheathing, air barrier, vapor retarder
- 12" I-Joist [305mm] with dense-pack cellulose insulation (039)
- 1/2" [12mm] wood fiberboard sheathing (068)
- Ventilated wood composite siding

te STUDIO

“Nordeast Nest”
Building Envelope Specifications

Slab

Insulated concrete slab (and footings): U-Value = 0.219 W/(m²K); R-26

- 4” [102 mm] concrete slab
- 6" [152 mm] EPS insulation (035)

Roof

Cold roof, insulated second floor ceiling: U-Value = 0.081 W/(m²K); R-70

- 5/8 "[16mm] drywall
- 2X6 [140mm] framing; service cavity (086)
- 3/4 "[19 mm] OSB air barrier, vapor retarder
- 20 "[508] loose-fill cellulose (042)
- Vented attic

te STUDIO

Construction Process

Before


CATERPILLAR


CATERPILLAR


BuildBlock


RJ
STEGORA INC
612-889-8277
PROJECT DESIGN BY
te
STUDIO
612-203-1629
TESTUDIO.COM
te
STUDIO


TIBONE
RJ
612-889-8237
te
STUDIO

Airtightness 0.36 ACH_{50}


RJ
612-899-8277
te
STUDIO


SIGA-Wigluv


WEATHER BLANKET


WEATHER BLANKET


Tyvek
STUDIO


DUPONT
Tyvek
HomeWrap
Arrow
BUILDING CENTER
ABC
Call 1-800-44-TYVEK
DUPONT The miracles of science

HVAC Systems

“Nordeast Nest”
HVAC Systems

Ventilation
Zehnder, ComfoAir 350 (84% efficiency)
Zehnder distribution system
Effective heat recovery efficiency = 76%

Heating, Cooling, Dehumidification
2 recirculating Fujitsu split air-to-air heat pump systems (first floor and second floor) with electric resistance backup post heater; system also provides cooling and dehumidification; sheet metal ductwork

Mantis gas fireplace; direct vent; modulating: can augment heating on coldest days of the year; will be used throughout the winter for enjoyment.

Electric resistance panel heaters (basement)

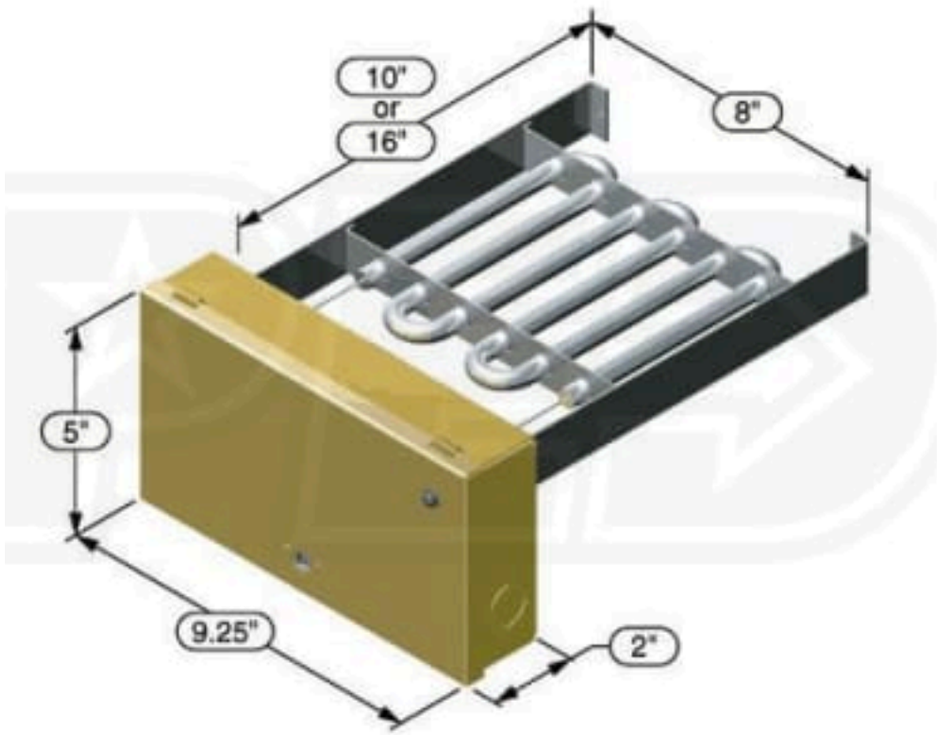
Domestic Hot Water
Boiler, IntelliHot i-200P tankless on-demand gas hot water heater with continuously insulated PEX tube distribution

te STUDIO

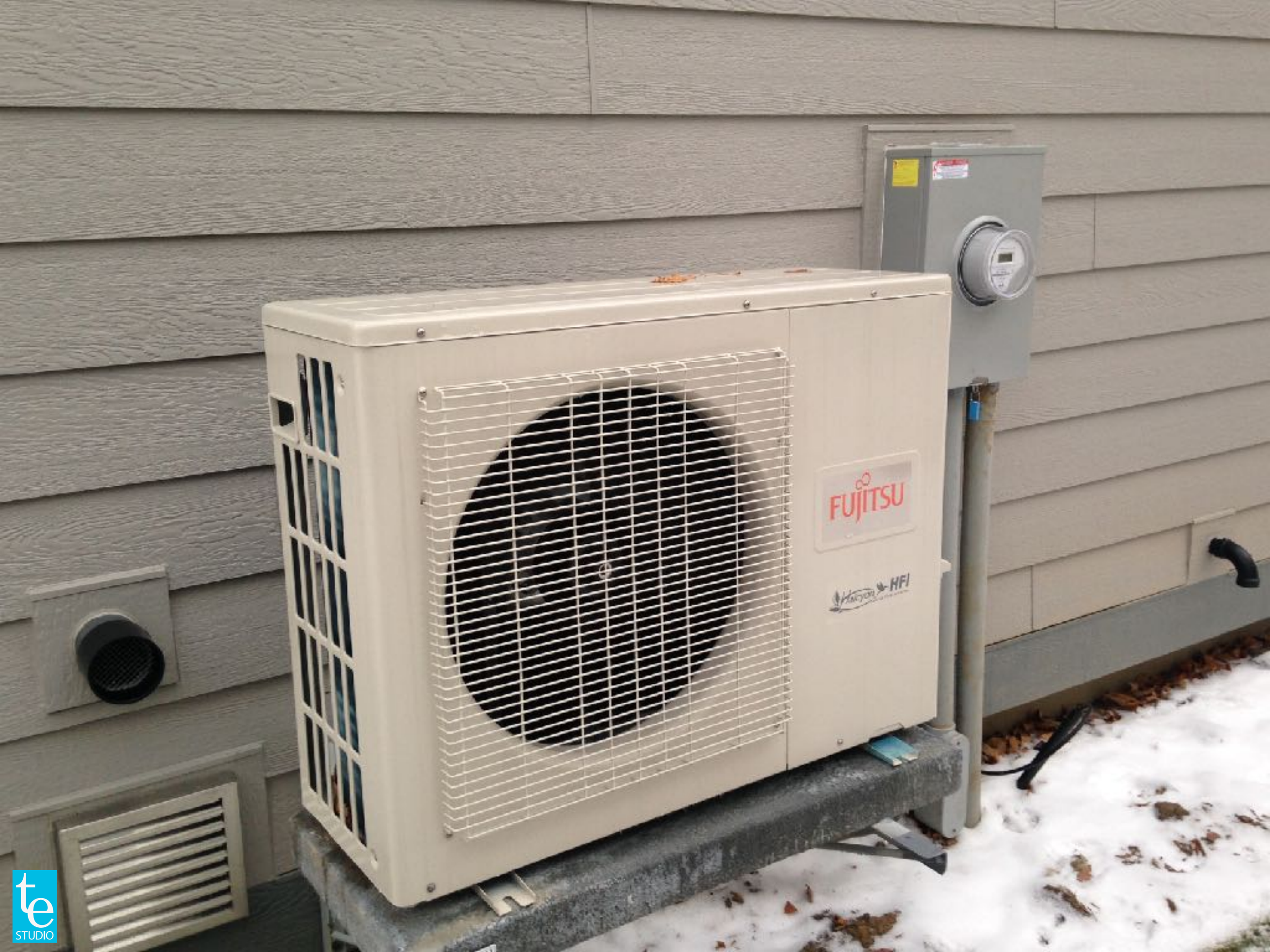
Energy Recovery Ventilation

Domestic Hot Water Heater

HAC Equipment



HVAC Distribution


FUJITSU
HFI

HVAC Distribution

Performance

“Nordeast Nest”
Modeled Performance

Annual Heating Demand
27 kWh /(m^2a) [8.5 kBTU/(sf yr)]

Heat Load
17 W/m^2 [5.4 Btu/h/ft^2]

Design Heat Load
3.8 KW [13.1 kBTU/h]

Source Energy Demand
104 kWh /(m^2a) [33 kBTU/ (sf yr)] for Heating, Domestic Hot Water, Auxiliary- and Plug Loads
Will be much less in reality as electricity is sourced from wind power.

Calculated with the PHPP

te STUDIO

Verification

PHI Low Energy Building Verification

Building:	"Nordeast Nest" - Alkatout Residence
Street:	2335 McKinley St. NE
Postcode/City:	55418 Minneapolis
Province/Country:	Minnesota US-United States of America
Building type:	
Climate data set:	US0040a-Minneapolis
Climate zone:	2: Cold — Altitude of location: 285.332424 m
Home owner / Client:	Julie and Tarek Alkatout
Street:	2335 McKinley St. NE
Postcode/City:	55418 Minneapolis
Province/Country:	Minnesota US-United States of America

Architecture:	TE Studio, Ltd.
Street:	901 23rd Ave NE
Postcode/City:	55418 Minneapolis
Province/Country:	Minnesota US-United States of America
Energy consultancy:	
Street:	
Postcode/City:	
Province/Country:	

Mechanical system:	TE Studio, Ltd.
Street:	901 23rd Ave NE
Postcode/City:	55418 Minneapolis
Province/Country:	Minnesota US-United States of America
Certification:	Passivhaus Institut
Street:	Rheinstr. 44/46
Postcode/City:	64283 Darmstadt
Province/Country:	DE-Germany

Year of construction:	2014	Interior temperature winter [°C]:	20.0	Interior temp. summer [°C]: 25.0
No. of dwelling units:	1	Internal heat gains (IHG) heating case [W/m²]:	2.3	IHG cooling case [W/m²]: 2.3
No. of occupants:	3.1	Specific capacity [Wh/K per m² TFA]:	84	Mechanical cooling: x

Specific building characteristics with reference to the treated floor area

					Criteria	Alternative criteria	Fullfilled?[2]
	Treated floor area	m²	226.4				
Space heating	Heating demand	kWh/(m²a)	27	≤	30	-	yes
	Heating load	W/m²	17	≤	-	-	
Space cooling	Cooling & dehum. demand	kWh/(m²a)	8	≤	30	-	yes
	Cooling load	W/m²	8	≤	-	-	
	Frequency of overheating (> 25 °C)	%	-	≤	-		-
	Frequency excessively high humidity (> 12 g/kg)	%	0	≤	10		yes
Airtightness	Pressurization test result n_{50}	1/h	0.4	≤	1.0		yes
Non-renewable Primary Energy (PE)	PE demand	kWh/(m²a)	104	≤	120		yes
Primary Energy Renewable (PER)	PER demand	kWh/(m²a)	62	≤	-	-	-
	Generation of renewable energy (in relation to projected building	kWh/(m²a)		≥	-	-	

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

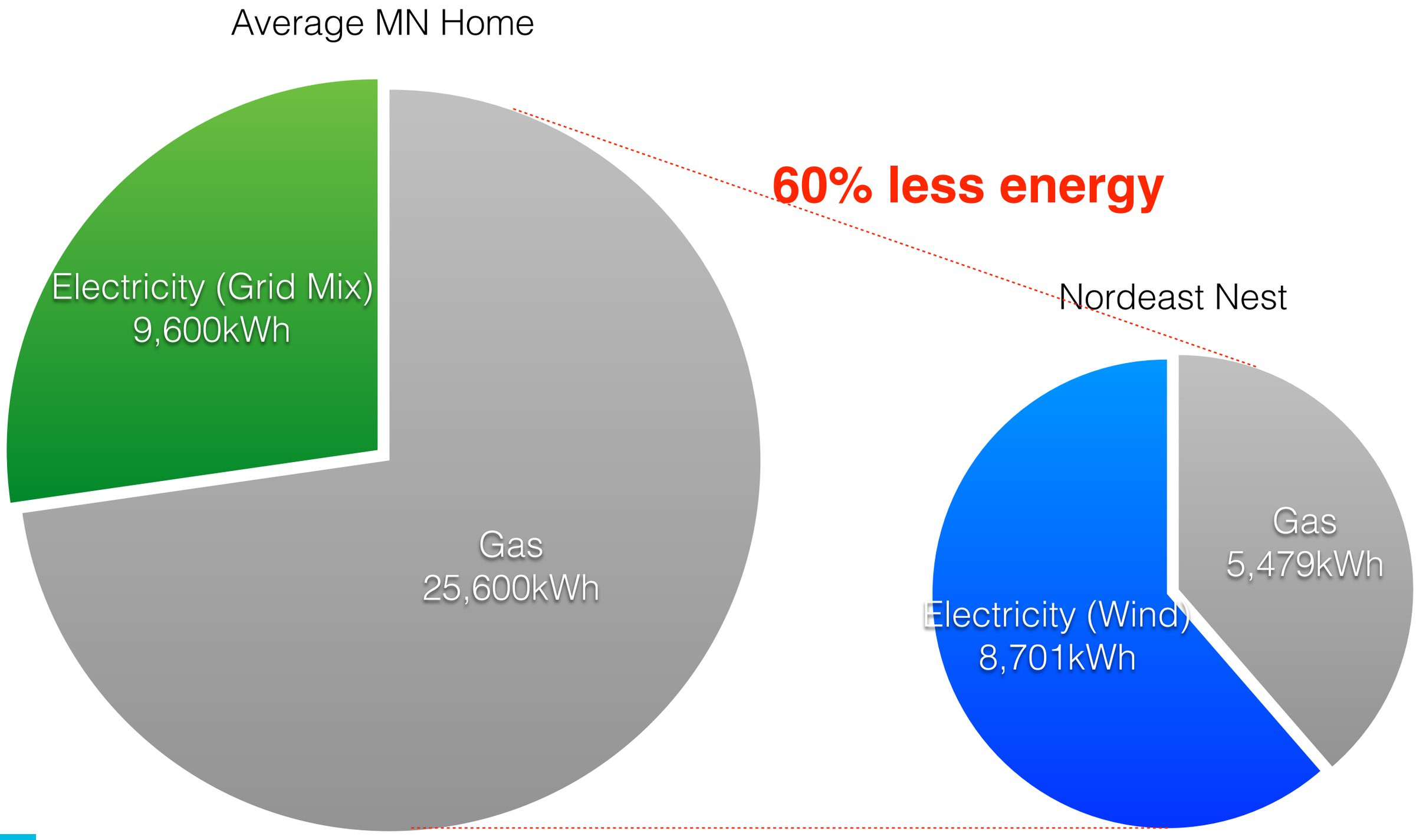
I confirm that the values given herein have been determined following the PHPP methodology and based on the characteristic values of the building. The PHPP calculations are attached to this verification.

PHI Low Energy Building? yes

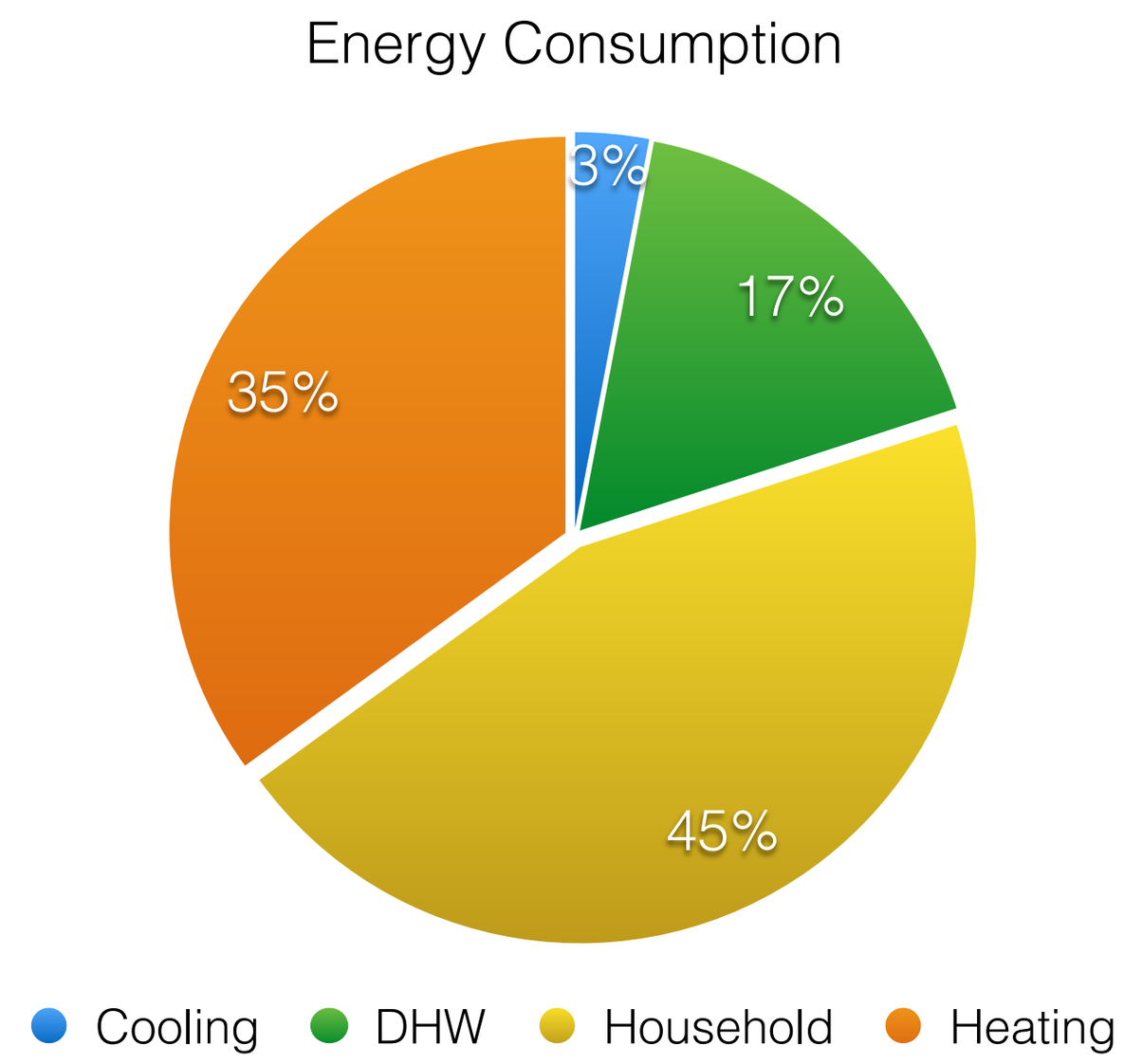
Task:	First name:	Surname:	Signature:
1-Designer	Tim	Eian	

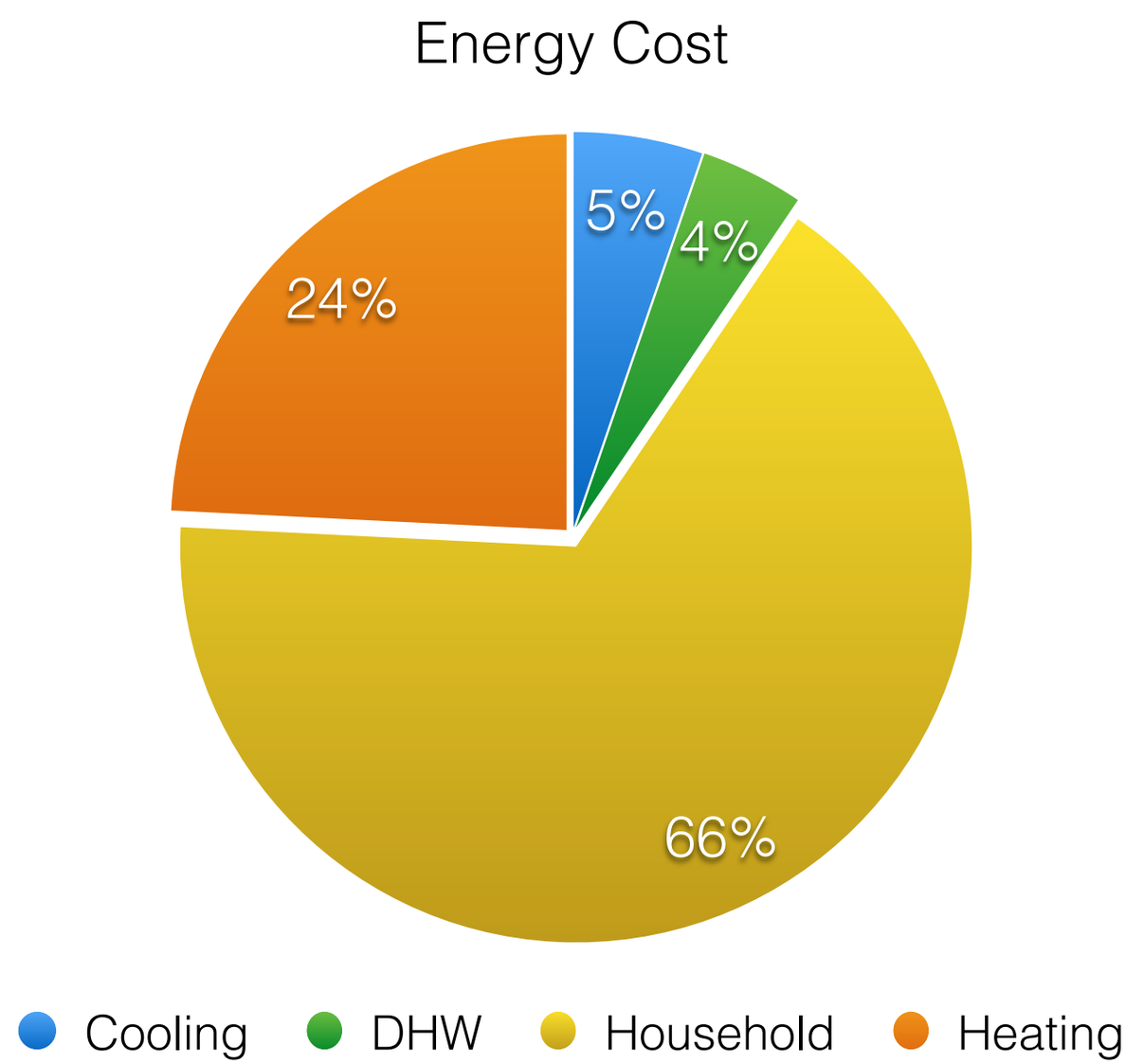
Issued on:	City:

Energy Footprint (Nordeast Nest)

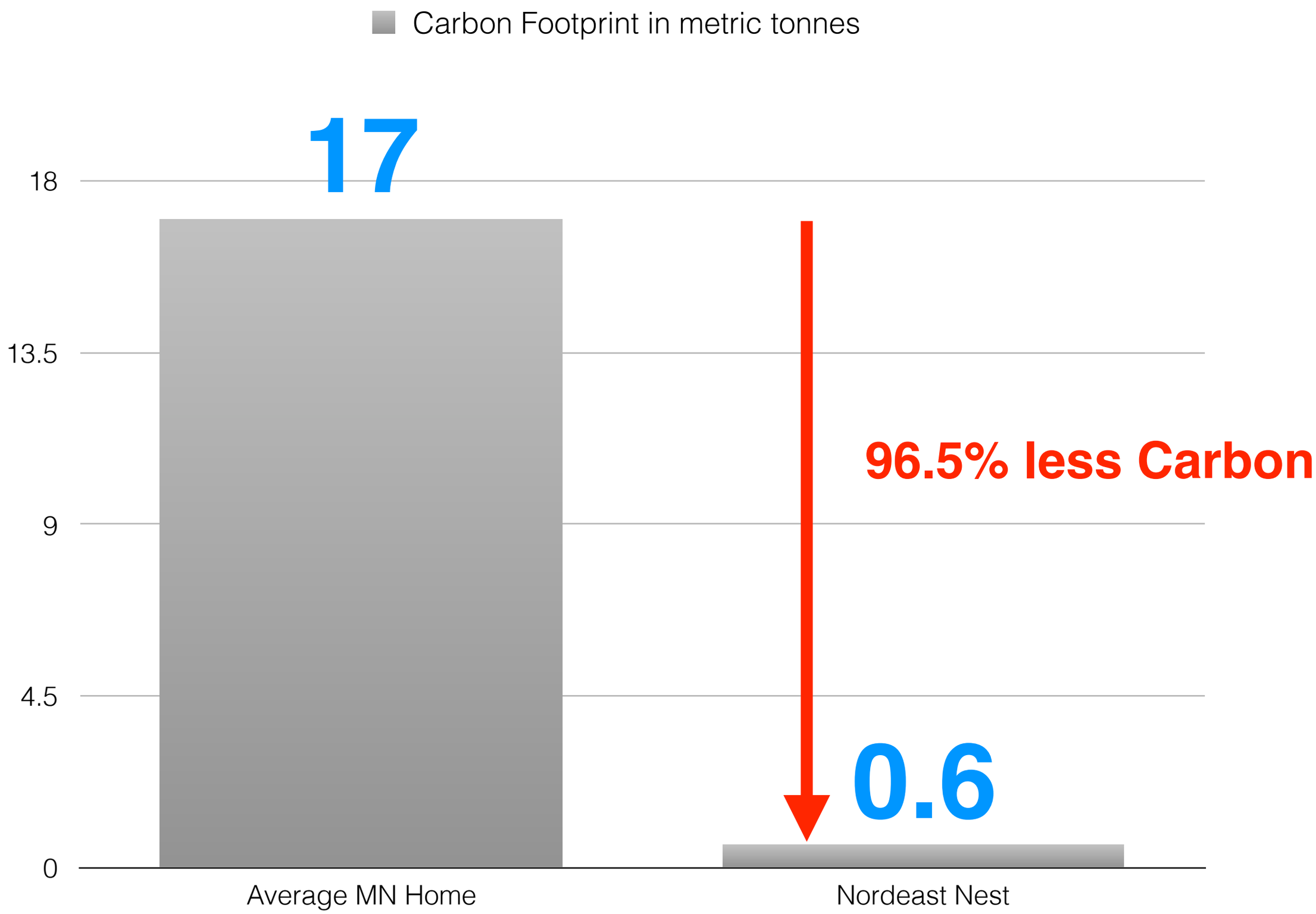


Energy Consumption and Cost





Carbon Footprint



Source: coolclimate.berkeley,edu

Transportation

nordeastnest.com

Resources

passivehouse.com

passipedia.org

passivehouse-international.org

Thank You!

High Performance Architecture

testudio.com