

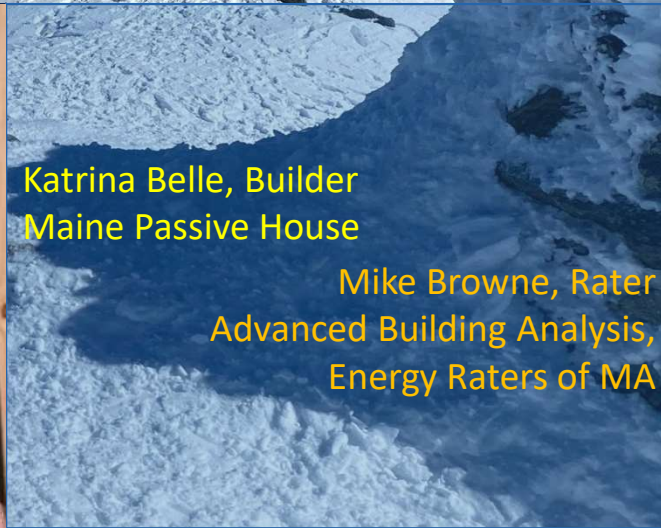
Extreme HERS Rating



MT WASHINGTON STATE PARK
MT WASHINGTON
SUMMIT 1.917M
6.288FT



Katrina Belle, Builder
Maine Passive House



Mike Browne, Rater
Advanced Building Analysis,
Energy Raters of MA



Presentation Outline

- Review of the Design and Construction - Katrina
- Review of the Rating - Mike



Gorham Passive House

Gorham, NH
Construction: 11/22-11/23

The Team



Hans Breaux, Project
CO+OP, Architect

Architect & CPHC

Katrina Belle, COO,
Maine Passive House

Builder, CPHC

Mike Bratina & Rachel
Rennard

Motivated & Passionate
client, Tech extraordinaire

Mike Browne

Energy Rater

Client objectives:

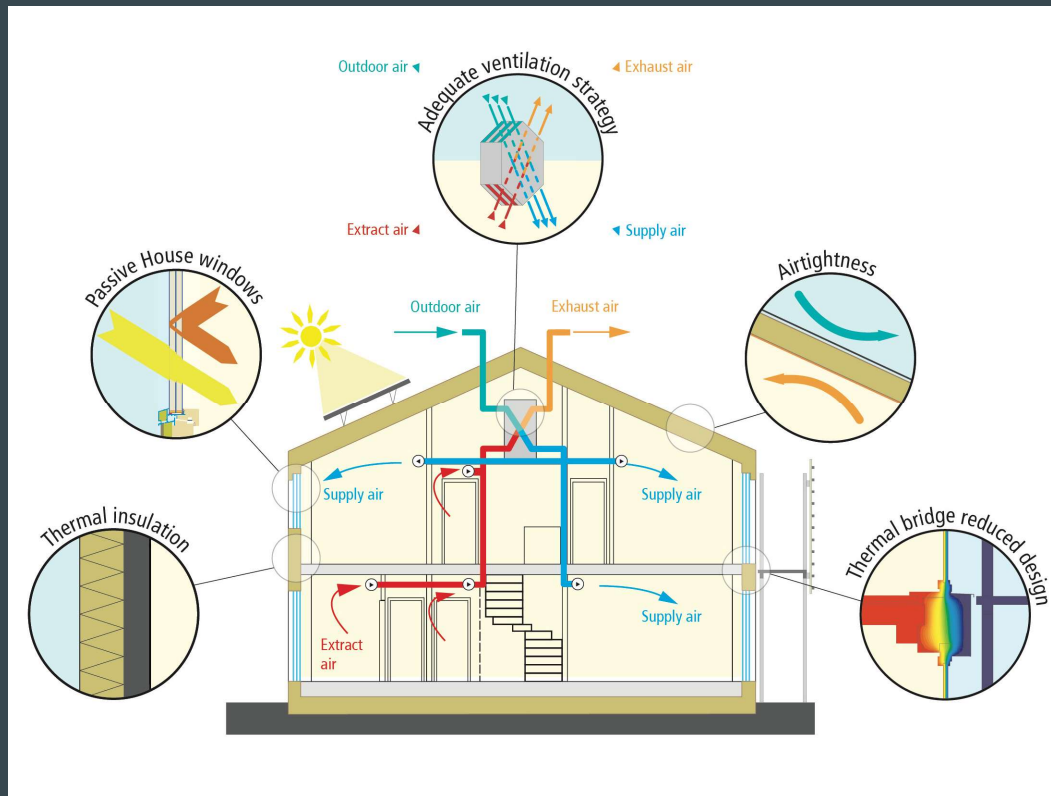
- Passive
- Net zero; net positive
- Sustainable and environmentally friendly
- Built with local resources (people and materials) when possible
- Non reliant on fossil fuels
- Built to withstand changing climate
- Chemical free and high air quality
- Modest and unassuming
- Fit in Gorham NH (size, style, color)
- Smart home/home automation
- Built to leverage new technologies (future proofing)
- Connected to nature
- Sunny and light
- Accommodate aging in place
- Welcoming, comfortable, built to entertain
- Contemporary farmhouse or mountain house
- Pet friendly
- Take advantage of views of Presidential Range (Mt. Madison & Mt. Washington)

Site Positioning & House Layout





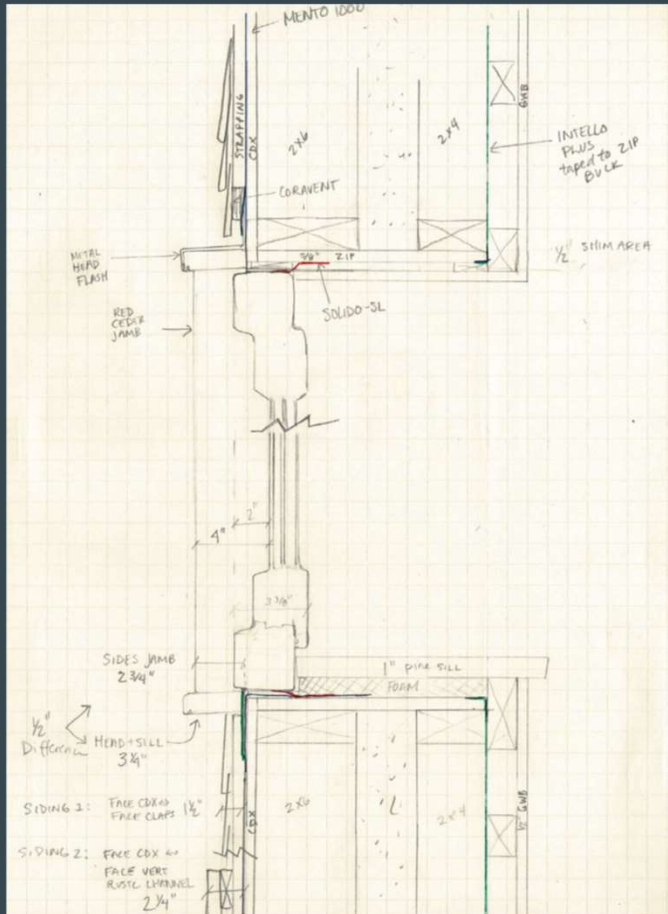
Construction Strategies - Performance



Passive House Principles

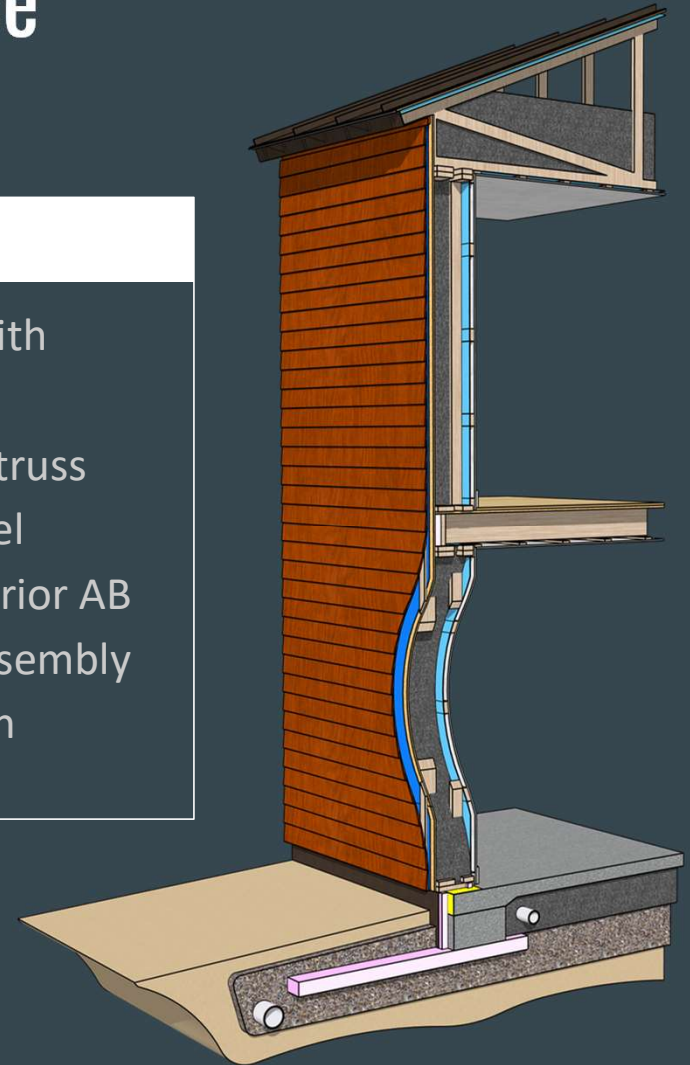
- Very good insulation
- Triple Pane/high performance windows
- ERV
- Air barrier
- Minimize thermal bridging

Construction Strategies - Performance

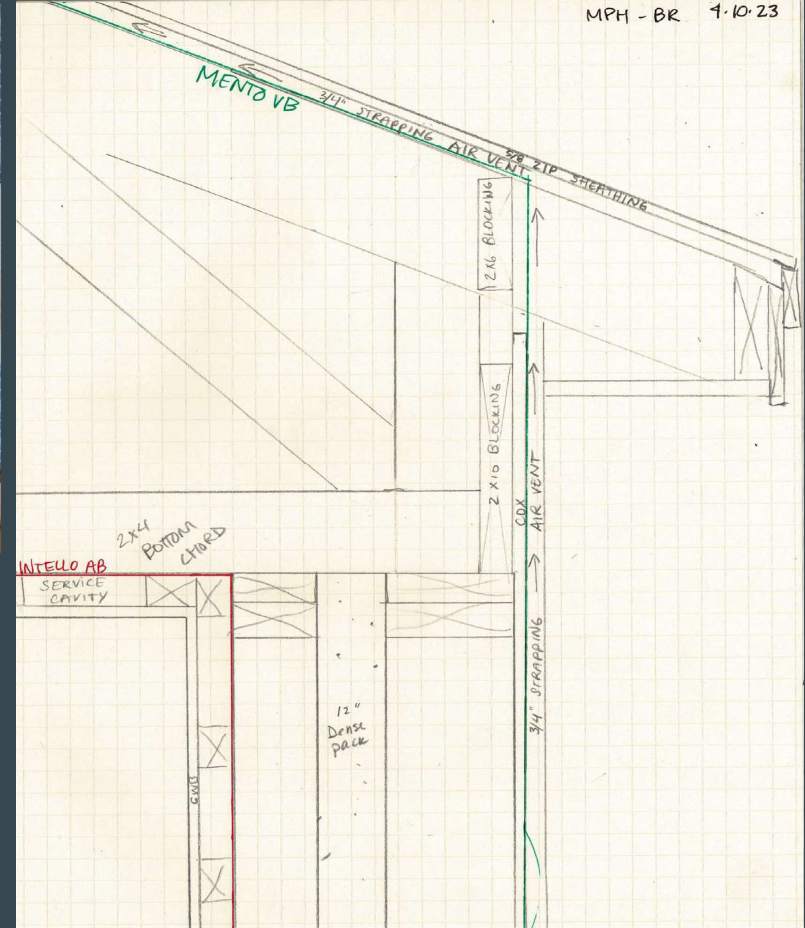
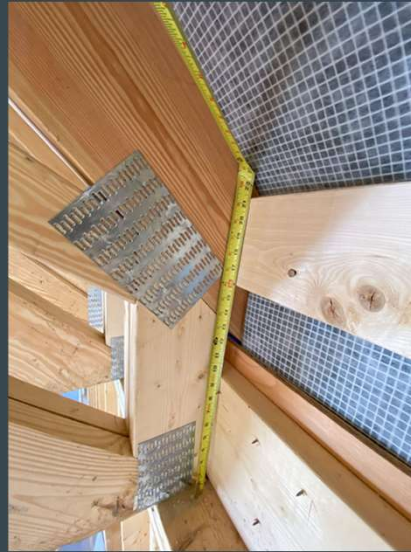
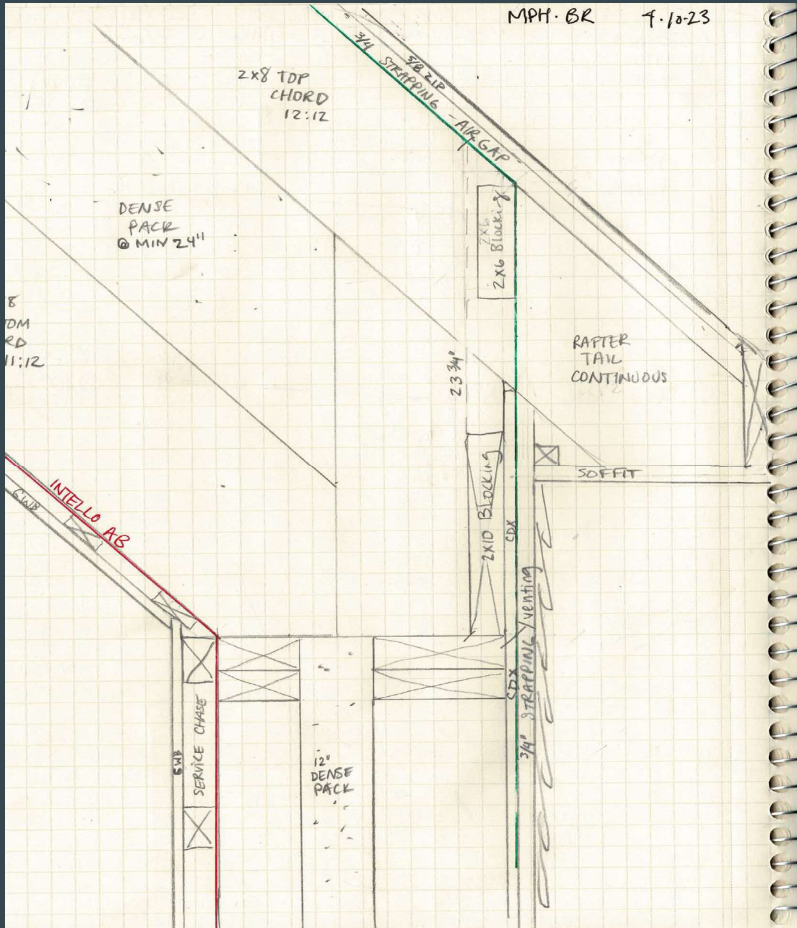


Wall Construction

- Double stud with service chase
- Parallel chord truss with raised heel
- Interior & exterior AB
- Vapor open assembly with rainscreen



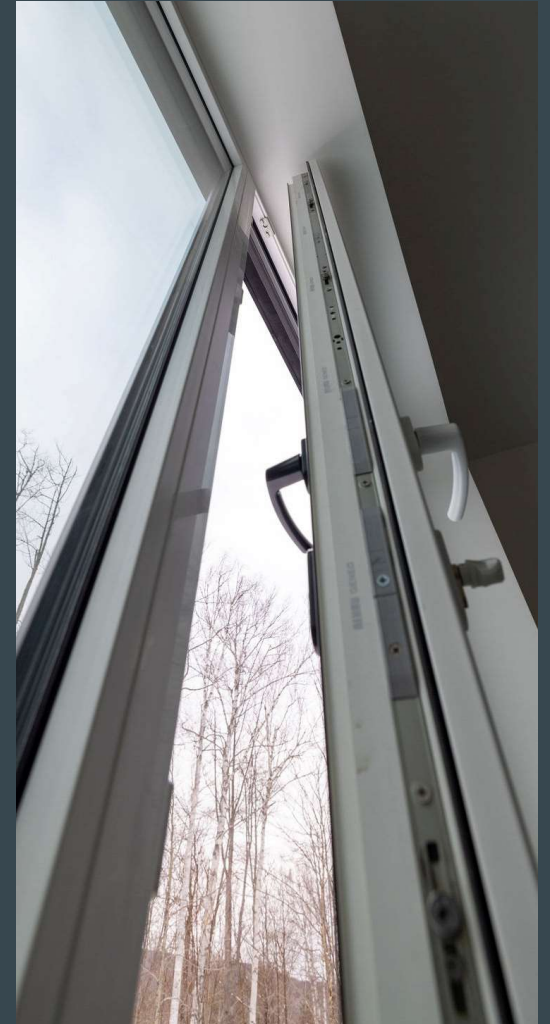
Construction Details – Wall Assembly



PH products used



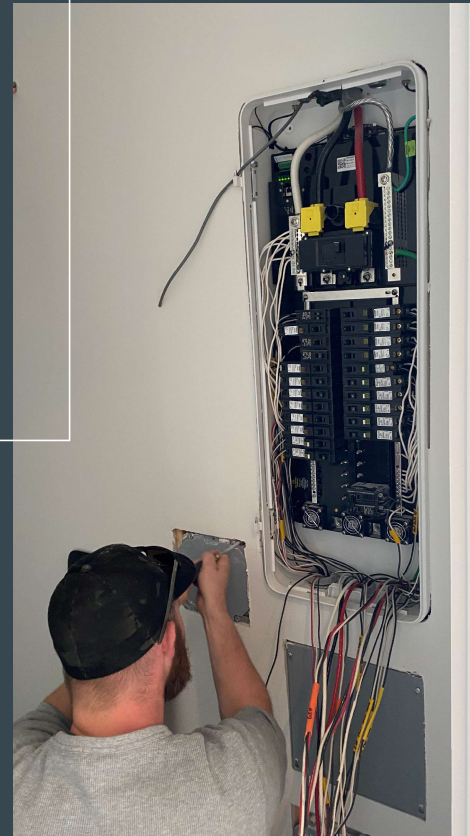
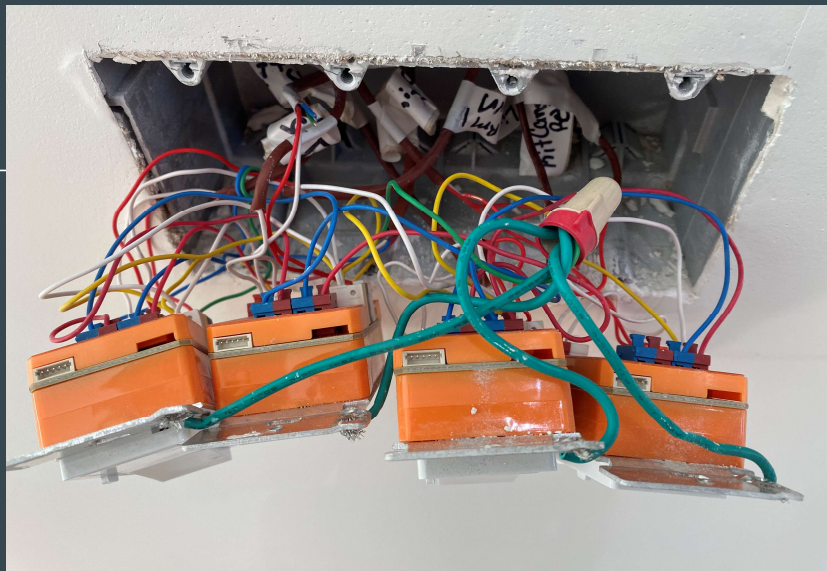
Zhender ERV 350
Logic Windows
475 air sealing products



Construction Strategies – Performance & monitoring

SPAN Panel & DC Lighting

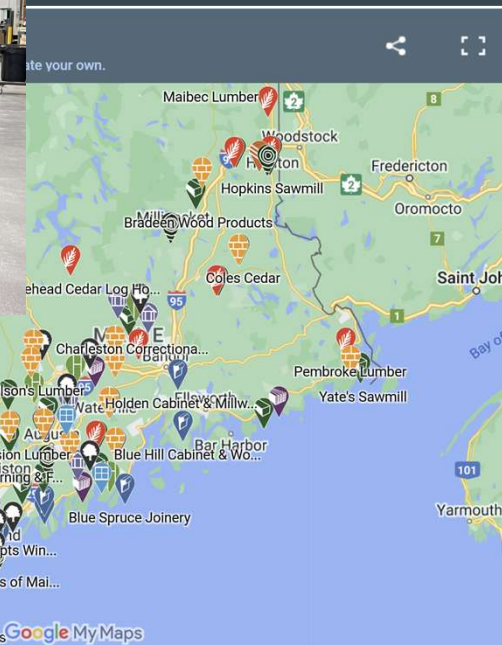
- Low voltage wires
- Less energy
- Ability to control & program all lighting
- Smart automation of all building systems



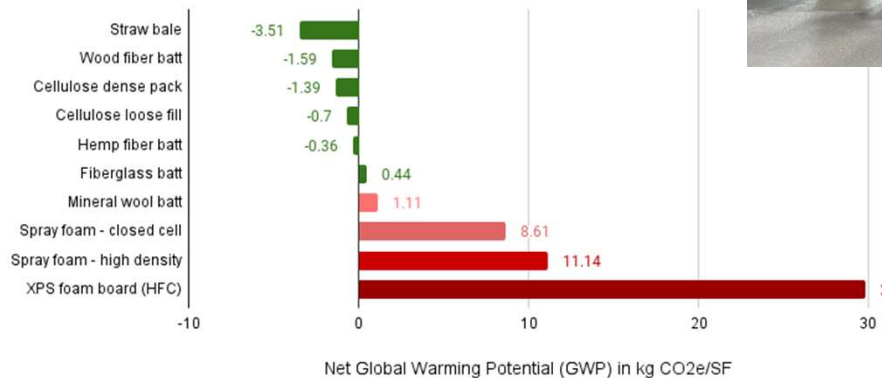
Construction Strategies - Embodied Carbon

Approach: Cost & Carbon – that which reduces carbon, often reduces cost

1. Supply chain & Location source
Call you Supplier
2. Resource regeneration rate
Not necessarily FSC
3. Carbon sequestration
Recycled?
Made with renewable energy?



Embodied Carbon of Common Insulation Types



Local products, less processed

- Local green hemlock
- Locally milled siding
- Locally milled flooring
- Recycled cellulose insulation

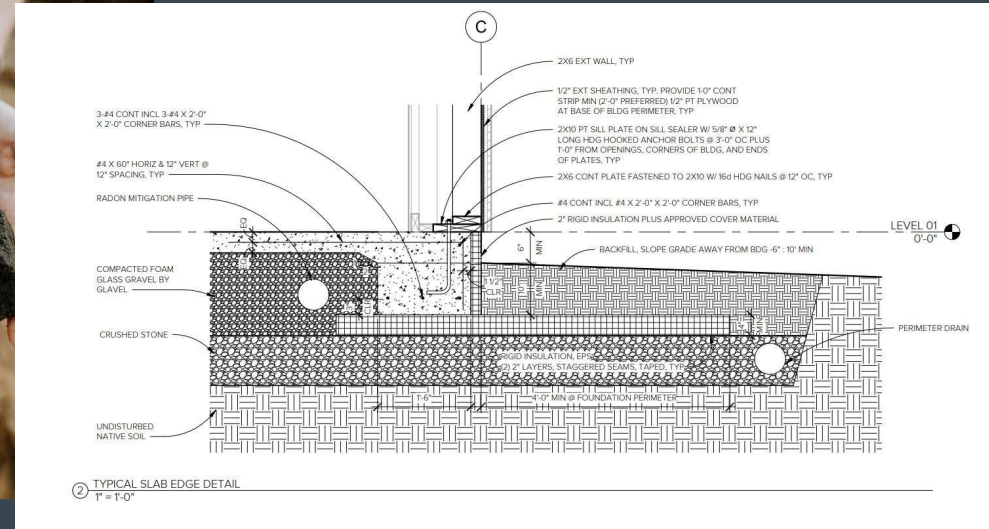
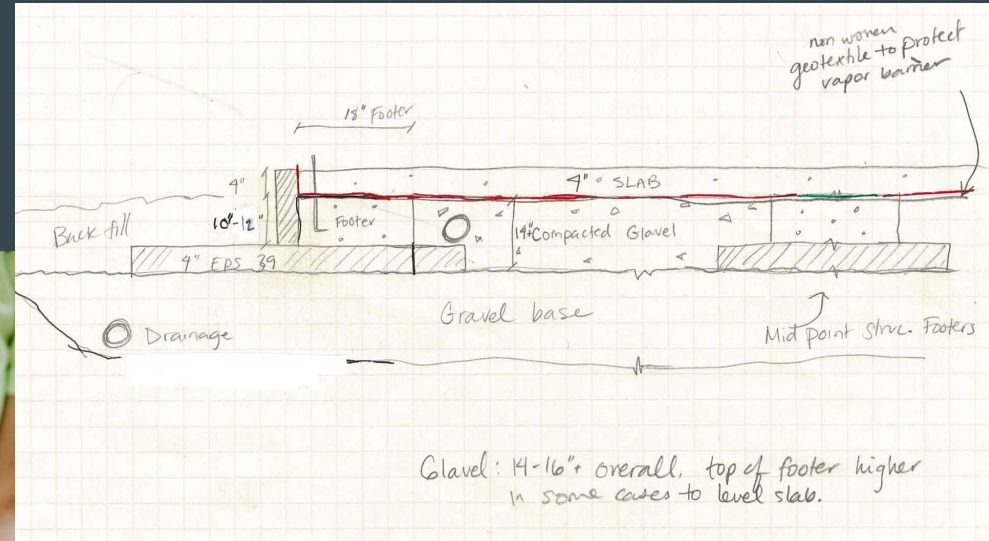


Construction Strategies

Sub slab Embodied Carbon

Glavel

- Recycled foam glass insulative aggregate
- Made in an electric kiln powered by renewables
- Trucked from Vermont to NH (135 mi away)
- R 1.7/compacted inch
- Replaces sub slab gravel/fill



Glavel - Installation



GLAVEL
FOAM GLASS GRAVEL



Glavel: Beam Analysis & Cost comparison

We came in **\$265.81** under the estimate number we had prepared for an all-foam sub slab. This number includes labor and materials.

We saved **2.6 metric tons of CO₂e** by switching to Glavel. This number doesn't take into account Vermont's renewably produced product or it's proximity to the site.

Step 2 - View results

2.6 Metric Tons of Carbon Dioxide (CO₂) equivalent

This is equivalent to greenhouse gas emissions from:

0.563 gasoline-powered passenger vehicles driven for one year ? 

6,488 miles driven by an average gasoline-powered passenger vehicle ? 

This is equivalent to CO₂ emissions from:

294 gallons of gasoline consumed ? 

257 gallons of diesel consumed ? 

2,892 pounds of coal burned ? 

0.035 tanker trucks' worth of gasoline ? 

0.329 homes' energy use for one year ? 

0.509 homes' electricity use for one year ? 

The Rating



Home Energy Rating Certificate

Final Report

Rating Date: 2024-01-19
 Registry ID: 464005061
 Ekotrope ID: dWPqIAEv



HERS® Index Score:

18

Your home's HERS score is a relative performance score. The lower the number, the more energy efficient the home. To learn more, visit www.hersindex.com

Annual Savings

\$18,160

*Relative to an average U.S. home

Home:
 13 Clay Brook Rd
 Gorham, NH 03581

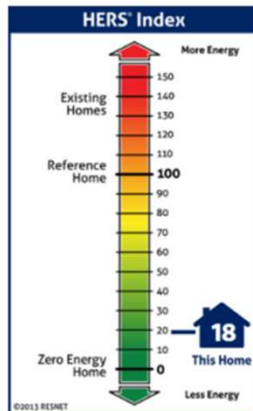
Builder:
 Maine Passive House

Your Home's Estimated Energy Use:

	Use [MBtu]	Annual Cost
Heating	19.1	\$1,485
Cooling	0.0	\$0
Hot Water	2.7	\$213
Lights/Appliances	16.8	\$1,308
Service Charges		\$227
Generation (e.g. Solar)	0.0	\$0
Total:	38.7	\$3,234

This home meets or exceeds the criteria of the following:

- ENERGY STAR v3.2
- ENERGY STAR v3.1
- ENERGY STAR v3
- 2021 International Energy Conservation Code



Home Feature Summary:

- Home Type: Single family detached
- Model: N/A
- Community: N/A
- Conditioned Floor Area: 2,159 ft²
- Number of Bedrooms: 3
- Primary Heating System: Air Source Heat Pump • Electric • 10.9 HSPF2
- Primary Cooling System: Air Source Heat Pump • Electric • 29.8 SEER2
- Primary Water Heating: Residential Water Heater • Electric • 3.8 Energy Factor
- House Tightness: 4.2 ELA
- Ventilation: 125.1 CFM • 37 Watts • ERV
- Duct Leakage to Outside: Forced Air Ductless
- Above Grade Walls: R-43
- Ceiling: Vaulted Roof, R-83
- Window Type: U-Value: 0.15, SHGC: 0.26
- Foundation Walls: N/A
- Framed Floor: N/A

Rating Completed by:

- Energy Rater:** Michael A Browne
RESNET ID: 3992602
- Rating Company:** Advanced Building Analysis, LLC
2 Woodlawn St, Amesbury, MA 01913
(978) 270-3911
- Rating Provider:** Energy Raters of Massachusetts
2 Woodlawn Street Amesbury, MA 01913
978-270-3911



Michael A Browne

Michael A Browne, Certified Energy Rater
 Digitally signed: 1/28/25 at 9:25 AM



Ekotrope RATER - Version:4.2.1.3557

The Energy Rating Disclosure for this home is available from the Approved Rating Provider. This report does not constitute any warranty or guarantee.

HERS Index = Rated Home / Reference Home

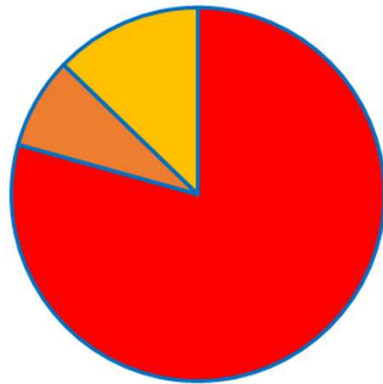
- Table 4.2.2(1) Specifications for the Energy Rating Reference and Rated Homes in RESNET 301-2019 ... and the footnotes!



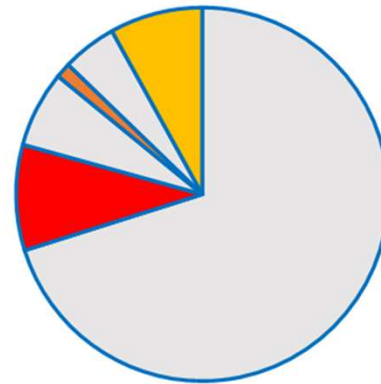
Ekotrope Fuel Summary Comparison

Annual End-Use Consumption	HERS Ref.	Rated Home	Savings	% Saved
Heating [Electric kWh]	48,563.4	5,605.5	42,958.0	88.5%
Hot Water [Electric kWh]	4,847.6	804.0	4,043.6	83.4%
Lights & Appliances [Electric kWh]	7,832.7	4,935.7	2,897.0	37%
Total [Electric kWh]	61,243.7	11,345.2	49,898.5	81.5%
Total Onsite Generation kWh	0.0	0.0	0.0	0%

Reference Home, Gorham, NH

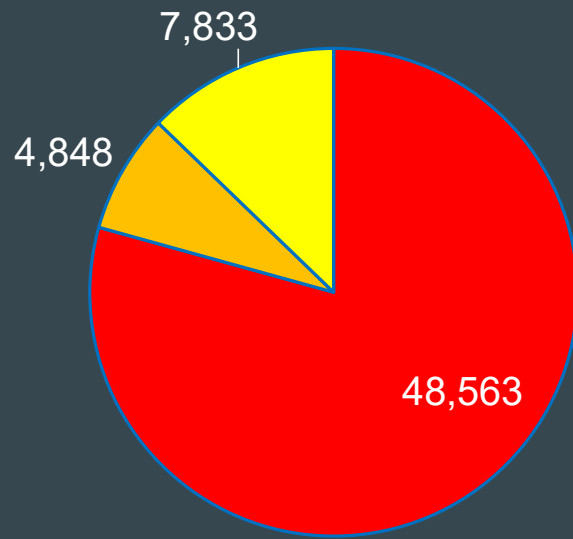


Rated Home, Gorham, NH

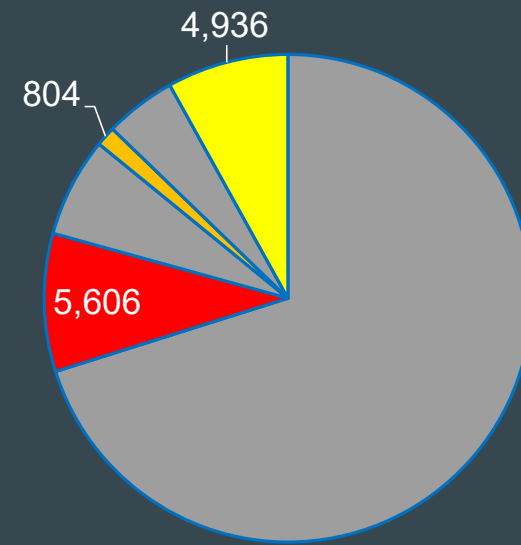


Annual Consumption in kWh -- Thinner slices

Reference Home, Gorham,
NH

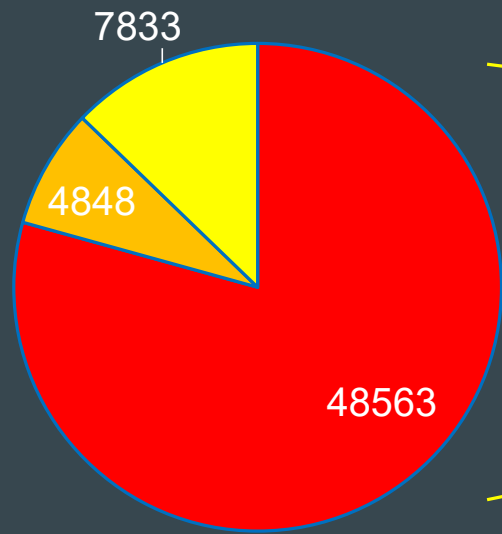


Rated Home, Gorham,
NH

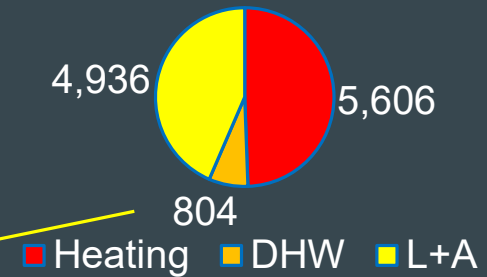


Annual Consumption in kWh – Smaller Pie

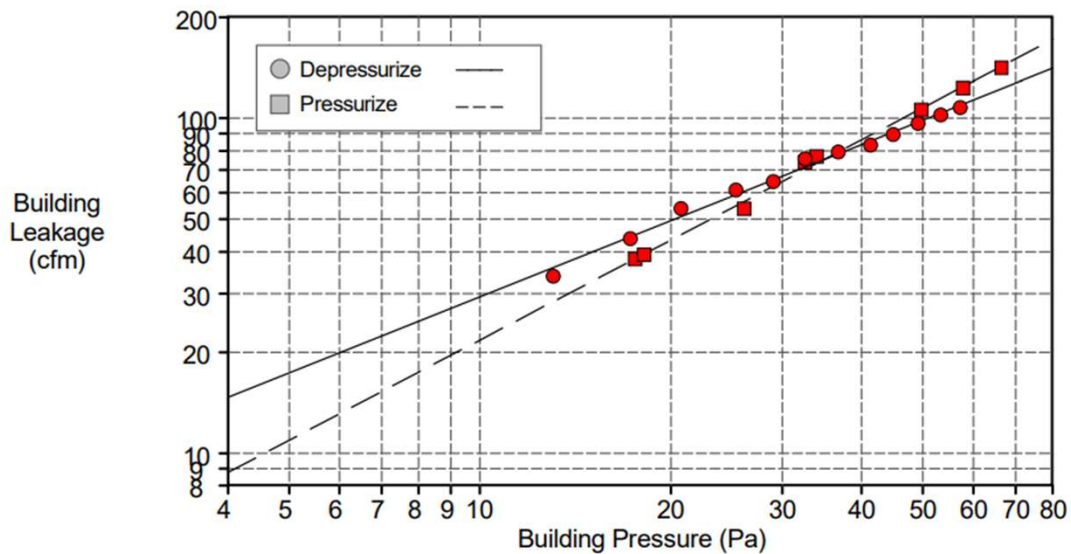
Reference Home, Gorham, NH



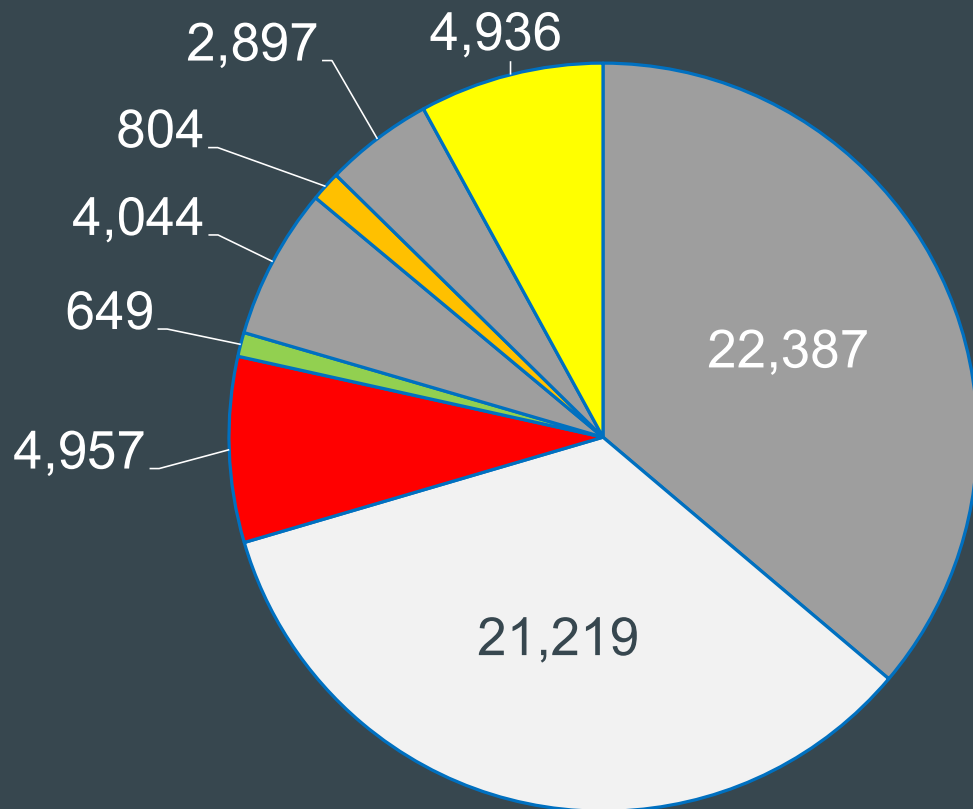
Rated Home, Gorham, NH



Test Results at 50 Pascals:	<u>Depressurization</u>	<u>Pressurization</u>	<u>Average</u>
cfm (Airflow)	99 (+/- 3.3 %)	108 (+/- 4.0 %)	103 (+/- 2.6 %)
ACH50	0.26	0.29	0.27
cfm/ft ² (Floor Area)	0.0457	0.0498	0.0478
cfm/ft ² (Surface Area)	0.0180	0.0196	0.0188
Leakage Areas:			
Canadian EqLA @ 10 Pa (in ²)	8.6 (+/- 6.6 %)	6.4 (+/- 8.7 %)	7.5 (+/- 5.3 %)
in ² /ft ² Surface Area	0.0016	0.0012	0.0014
LBL ELA @ 4 Pa (in ²)	4.2 (+/- 11.2 %)	2.5 (+/- 14.5 %)	3.3 (+/- 8.9 %)
in ² /ft ² Surface Area	0.0008	0.0005	0.0006
Building Leakage Curve:			
Flow Coefficient (C)	5.2 (+/- 18.4 %)	2.2 (+/- 23.6 %)	3.7 (+/- 14.7 %)
Exponent (n)	0.754 (+/- 0.053)	0.993 (+/- 0.066)	0.873 (+/- 0.042)
Correlation Coefficient	0.99513	0.99777	
Test Standard:	E779-10		
Test Mode:	Depressurization and Pressurization		



Rated Home, Gorham, NH



Air tightness was worth 30 HERS Index points as compared to the reference home per RESNET with SLA: 0 .00036. In effect, the Reference home for this rating has an infiltration of 2040 CFM50, so in this Rating, we are seeing a 95% savings in infiltration. The annual savings in infiltration for this home are more than half of the overall difference in heating energy use between the Reference home and the Rated home!

- Other Heating delta
- Infiltration Delta
- Other heating
- Infiltration
- DHW delta
- DHW
- L+A Delta
- L+A

Ekotrope Fuel Summary Comparison

Gorham, NH Location

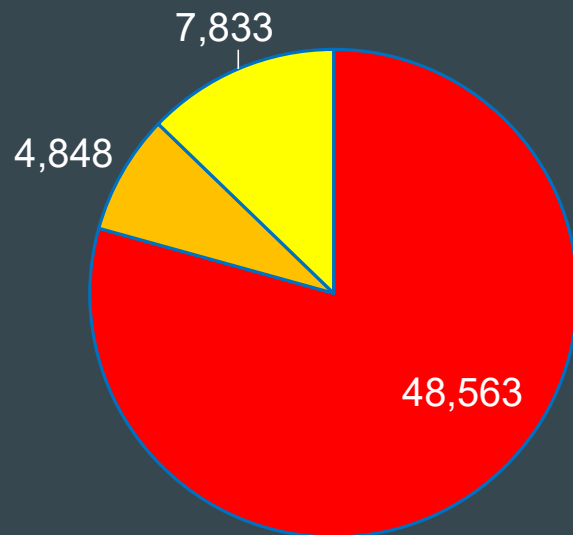
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Hot Water [Electric kWh]	4,847.6	804.0	4,043.6	83.4%
Lights & Appliances [Electric kWh]	7,832.7	4,935.7	2,897.0	37%
Total [Electric kWh]	61,243.7	11,345.2	49,898.5	81.5%

Amesbury, MA Location

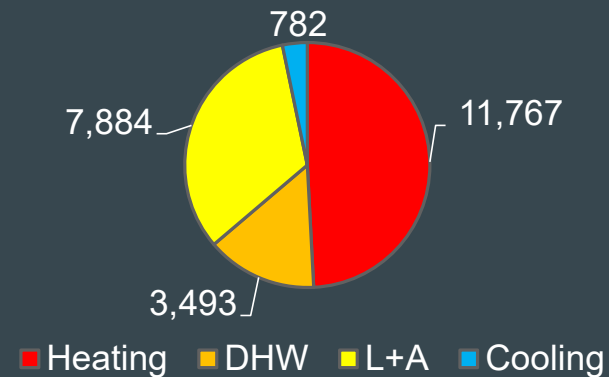
Annual End-Use Consumption	HERS Ref.	Rated Home	Savings	% Saved
Heating [Electric kWh]	11,767.3	1,655.2	10,112.2	85.9%
Cooling [Electric kWh]	782.4	224.7	557.7	71.3%
Hot Water [Electric kWh]	3,493.1	526.6	2,966.6	84.9%
Lights & Appliances [Electric kWh]	7,884.1	4,935.7	2,948.4	37.4%
Total [Electric kWh]	23,927.0	7,342.2	16,584.8	69.3%

Annual Consumption in kWh – Reference Homes different locations

Reference Home, Gorham, NH

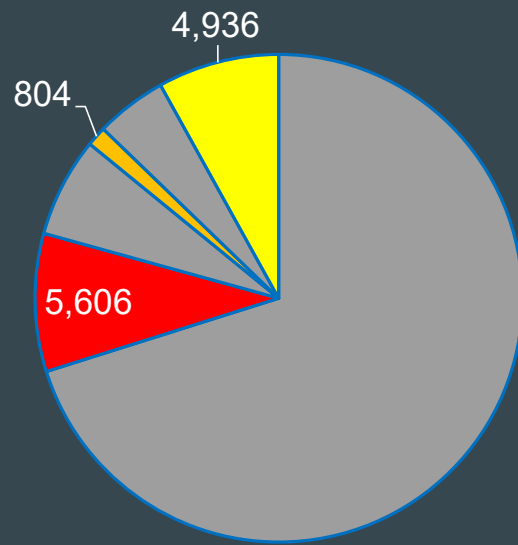


Reference Home, Amesbury, MA

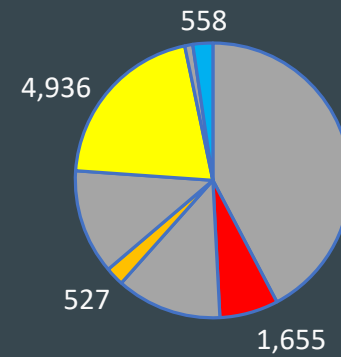


Annual Consumption in kWh – Rated Home by Location

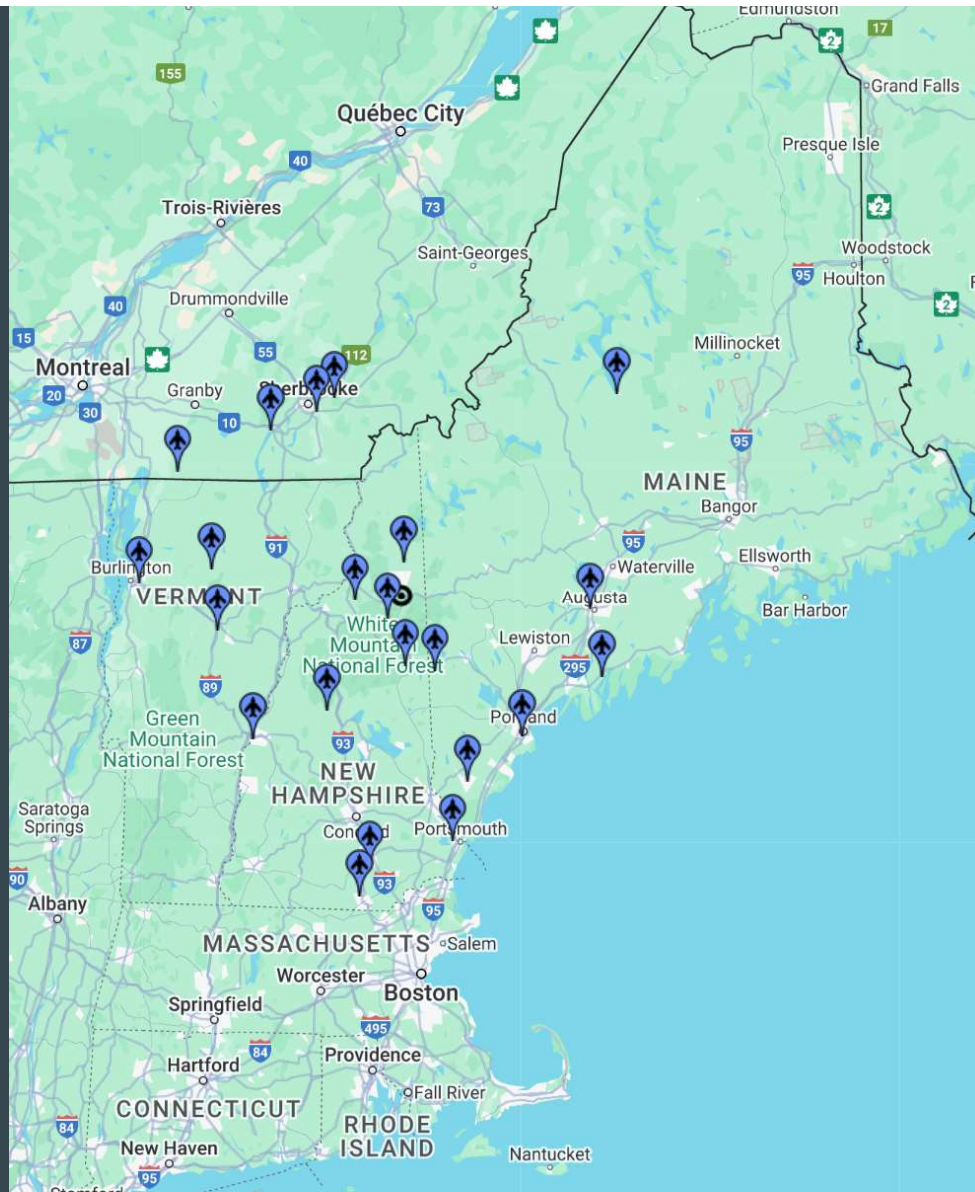
Rated Home, Gorham, NH



Rated Home, Amesbury, MA



Coos County? Wx Location?



<https://ashrae-meteo.info/v2.0/>

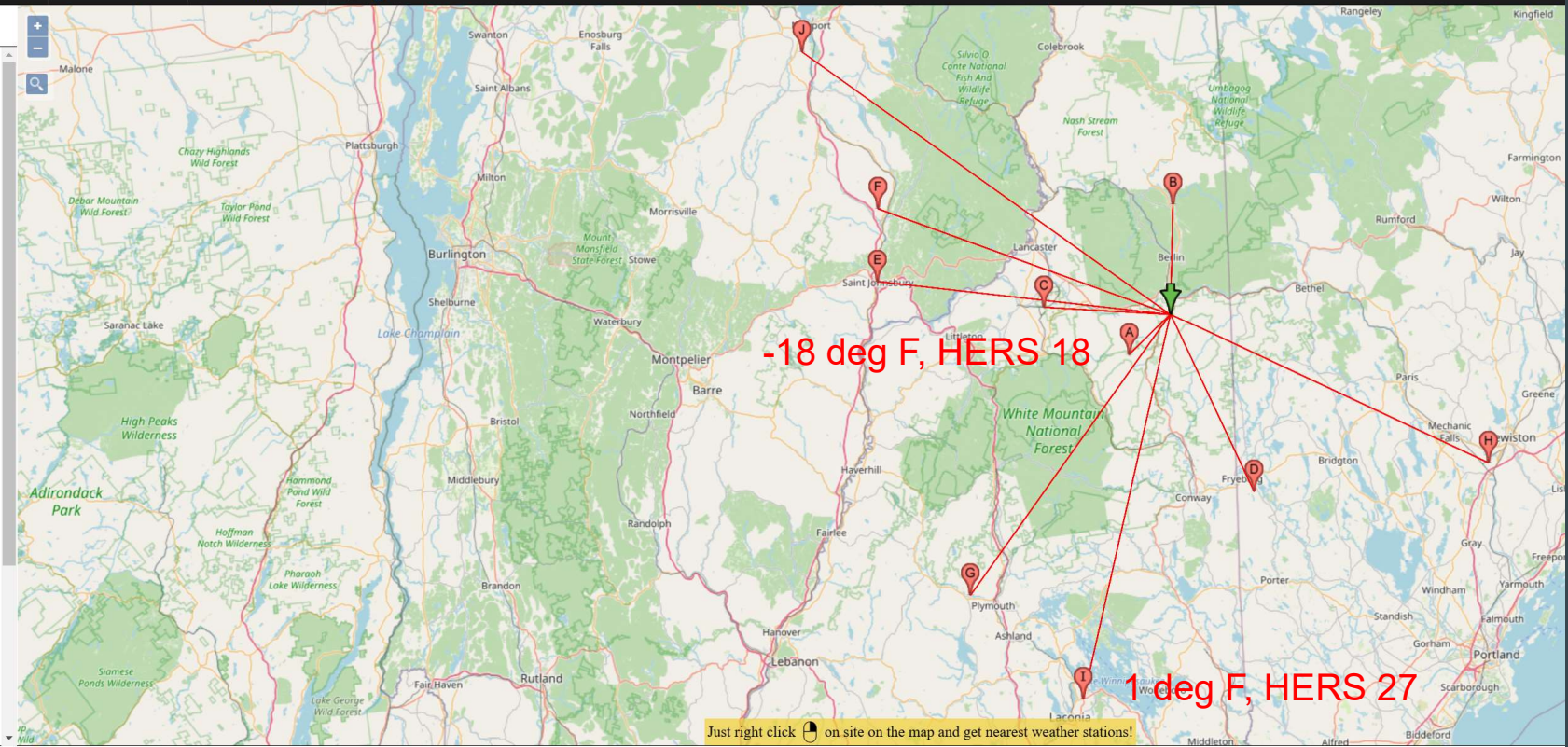
ASHRAE CLIMATIC DESIGN CONDITIONS 2009/2013/2017/2021

2009 2013 2017 2021

MAP STATIONS STANDARDS PSYCHROMETRIC CALCULATOR SI IP Show all station

Lat&lon (xx.xx,yy.yy) or WMO

- A MT WASHINGTON SUMMIT, NH, USA distance 8 miles
- B BERLIN, NH, USA distance 16 miles
- C MT WASHINGTON REGIONAL, NH, USA distance 18 miles
- D FRYEBURG EASTERN SLOPE, ME, USA distance 28 miles
- E ST JOHNSBURY, VT, USA distance 41 miles
- F CALEDONIA COUNTY AP, VT, USA distance 44 miles
- G PLYMOUTH, NH, USA distance 48 miles
- H AUBURN-LEWISTON, VT, USA distance 52 miles





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Dashboard

Devices

Alerts

Account

Weather Map

Filter

January 21, 2025 - January 23, 2025



Summary: December 1, 2024 - January 29, 2025

	Outdoor Temperature	Feels Like	Dew Point	Wind Speed	Wind Gust	Max Daily Gust	Wind Direction
Average	20.5°F	9.9°	5.4°	1.9 mph	2.8 mph	14.0 mph	SSE
High	51.4°F 12/17/24 11:05 am	16.7° 1/29/25 10:51 am	10.9° 1/29/25 10:48 am	28.2 mph 1/27/25 9:44 pm	38.7 mph 1/27/25 9:44 pm	40.0 mph 1/28/25 12:00 am	--
Low	-11.9°F 1/22/25 4:13 am	3.2° 1/29/25 4:57 am	-1.4° 1/29/25 12:02 am	0.0 mph 1/29/25 12:00 am	0.0 mph 1/29/25 12:00 am	0.0 mph 1/29/25 12:00 am	--

Carbon Rating & HERS® Certificate

Final Report

Rating Date: 2024-01-19
 Registry ID: 464005061
 Ekotrope ID: dWPqIAEv



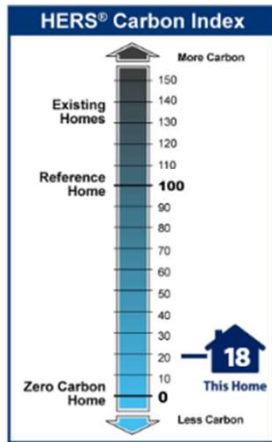
Carbon Index	HERS® Index	About these ratings: Both ratings are relative performance scores. A lower Carbon Rating Index means fewer carbon emissions for a home. The lower the HERS Rating, the more energy efficient the home. For more info: www.resnet.us/about/resnet-carbon-rating-index www.hers.com	Home: 13 Clay Brook Rd Gorham, NH 03581 Builder: Maine Passive House
18	18		

	CO ₂ e Emissions [tons/yr]	Annual Cost
Heating	1.5	\$1,485
Cooling	0.0	\$0
Hot Water	0.2	\$213
Lights/Appliances	1.3	\$1,308
Service Charges		\$227
Generation (e.g. Solar)	0.0	\$0
Total:	3.0	\$3,234

Annual Savings*
18.4 Tons CO₂e
\$18,160
 *Relative to an average U.S. home

This home meets or exceeds the criteria of the following:

- ENERGY STAR v3.2
- ENERGY STAR v3.1
- ENERGY STAR v3
- 2021 International Energy Conservation Code



Home Feature Summary:

- Home Type: Single family detached
- Model: N/A
- Community: N/A
- Conditioned Floor Area: 2,159 ft²
- Number of Bedrooms: 3
- Primary Heating System: Air Source Heat Pump • Electric • 10.9 HSPF2
- Primary Cooling System: Air Source Heat Pump • Electric • 29.8 SEER2
- Primary Water Heating: Residential Water Heater • Electric • 3.8 Energy Factor
- House Tightness: 4.2 ELA
- Ventilation: 125.1 CFM • 37 Watts • ERV
- Duct Leakage to Outside: Forced Air Ductless
- Above Grade Walls: R-43
- Ceiling: Vaulted Roof, R-83
- Window Type: U-Value: 0.15, SHGC: 0.26
- Foundation Walls: N/A
- Framed Floor: N/A

Rating Completed by:

Energy Rater: Michael A Browne
 RESNET ID: 3992602
Rating Company: Advanced Building Analysis, LLC
 2 Woodlawn St, Amesbury, MA 01913
 (978) 270-3911
Rating Provider: Energy Raters of Massachusetts
 2 Woodlawn Street Amesbury, MA 01913
 978-270-3911



Michael A Browne

Michael A Browne, Certified Energy Rater
 Digitally signed: 1/28/25 at 9:25 AM



Ekotrope RATER - Version:4.2.1.3557

The Energy Rating Disclosure for this home is available from the Approved Rating Provider. This report does not constitute any warranty or guarantee.



**BUILDING EMISSIONS
ACCOUNTING**
FOR MATERIALS



Input Legend 🖱️

Required for saving projects
Required for project calculations
Non-essential
Read-only, do not edit

Input Units 🖱️

Imperial

Project Information 🖱️

Project Name	Clay Brook Passive House
Scenario	Baseline
Beam Version	V1.1
Designer	Project CO+OP
Engineer	L&L Structural
Builder / Developer	Maine Passive House
Development Project	
Address	5 Evergreen/13 Clay Brook
City	Gorham
Country	United States
Province / State (Can./US only)	New Hampshire
Building Type	Single Detached House
Construction Type	New Construction
Project Development Stage	Construction Complete


Construction Year	2024	
Number of Bedrooms	2	
Stories Above Grade	2	
Total Floor Area	2841	ft ²
Above Grade Conditioned Area	2217	ft ²
Below Grade Conditioned Area	0	ft ²

Filter Concrete 🖱️

Building Dimension Inputs (Excluding Garage) 🖱️

DIMENSION NAME	QTY	UNIT	DESCRIPTION								
CONTINUOUS FOOTINGS VOLUME	9.1	yd ³	<table border="1" style="display: inline-table; margin-right: 10px;"> <tr> <td>Length (ft)</td> <td>164.00</td> <td>X</td> <td>Height (in.)</td> <td>12.00</td> <td>X</td> <td>Width (in.)</td> <td>18.00</td> </tr> </table> Exclude: garage	Length (ft)	164.00	X	Height (in.)	12.00	X	Width (in.)	18.00
Length (ft)	164.00	X	Height (in.)	12.00	X	Width (in.)	18.00				
COLUMNS/PIERS & PADS VOLUME	1.9	yd ³	Total volume of discontinuous foundation elements Includes: pads/footings, columns/piers/piles Excludes: garage								
FOUNDATION WALL AREA	0.0	ft ²	Total foundation wall surface area (centerline length x height) Includes: basement, party walls. Excludes: openings, garage foundation								
FOUNDATION SLAB/FLOOR AREA	1456.0	ft ²	Total foundation slab surface area Excludes: garage slab								
EXTERIOR WALL AREA	2545.0	ft ²	Surface area of exterior walls. Includes: gable ends. Excludes: window & door openings, party walls, garage walls								
WINDOW AREA	369.0	ft ²	Area of window frames (preferable) or rough openings Includes: full glazing area, skylights. Excludes: garage windows								
PARTY WALL AREA	0.0	ft ²	Wall area that partitions this unit from others Typical for townhouses & apartment units								
INTERIOR WALL AREA	1950.0	ft ²	One side only (i.e. centerline) of all interior walls. Includes: interior door area. Excludes: exterior, garage partition and party walls								
FRAMED FLOOR AREA	761.0	ft ²	Above grade flooring area Excludes: basement floor slab, and floor openings								
FINISHED CEILING AREA	2050.4	ft ²	Total finished ceiling area Includes: basement ceilings. Excludes: garage ceilings								
ROOF CAVITY INSULATION AREA	1687.6	ft ²	Total area of roof insulation								
ROOF SURFACE AREA	1792.7	ft ²	Total roof surface area. Includes: overhangs								
TIMBER FRAMING VOLUME	0.2	yd ³	Total volume of wood in heavy timber posts & beams Separate inputs for steel found in Structural Elements section								

Garage Dimension Inputs

DIMENSION NAME	QTY	UNIT	DESCRIPTION										
GARAGE PARTITION WALL AREA	0.0	ft ²	Wall area that partitions the main building from the garage. Excludes: openings and exterior garage walls										
GARAGE CONTINUOUS FOOTINGS VOLUME	5.6	yd ³	<table border="1" style="margin-left: 20px;"> <tr> <td style="text-align: center;">Length (ft)</td> <td></td> <td style="text-align: center;">Height (in.)</td> <td></td> <td style="text-align: center;">Width (in.)</td> </tr> <tr> <td style="text-align: center;">100.00</td> <td style="text-align: center;">X</td> <td style="text-align: center;">12.00</td> <td style="text-align: center;">X</td> <td style="text-align: center;">18.0</td> </tr> </table>	Length (ft)		Height (in.)		Width (in.)	100.00	X	12.00	X	18.0
Length (ft)		Height (in.)		Width (in.)									
100.00	X	12.00	X	18.0									
GARAGE COLUMNS/PIERS & PADS VOLUME	0.0	yd ³	Total volume of discontinuous foundation elements Includes: pads/footings, columns/piers/piles										
GARAGE FOUNDATION WALL AREA	0.0	ft ²	Foundation wall surface area										
GARAGE SLAB AREA	624.0	ft ²	Slab surface area										
FLOOR AREA ABOVE GARAGE	0.0	ft ²	Floor area of interior space directly above the garage.										
GARAGE FOUNDATION ATTRIBUTION % 	100%	=	<table border="1" style="margin-left: 20px;"> <tr> <td style="text-align: center;">624.0</td> <td></td> </tr> <tr> <td style="text-align: center;">624.0</td> <td></td> </tr> </table> Portion of garage foundation attributed to the garage. The rest is attributed to the main building.	624.0		624.0							
624.0													
624.0													
GARAGE EXTERIOR WALL AREA	1267.9	ft ²	Surface area of exterior garage walls Includes: gable ends. Excludes: window & door openings, partition walls										
GARAGE WINDOW AREA	55.0	ft ²	Area of window frames (preferable) or rough openings Includes: full glazing area, skylights.										
GARAGE FINISHED CEILING AREA	575.0	ft ²	Garage ceiling area covered by materials										
GARAGE ROOF SURFACE AREA	1291.6	ft ²	Garage roof surface area. Calculated with roof pitch Includes: overhangs										
GARAGE TIMBER FRAMING VOLUME	0.0	yd ³	Volume of wood for heavy timber structures in garage										



PROJECT NAME: Clay Brook Passive House
 SCENARIO: Baseline
 BEAM VERSION: V1.1

SELECTED PROJECT MATERIALS REVIEW

18,345	34,113	11,527	4,240
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SECTION	CATEGORY	MATERIAL	NET EMISSIONS kg CO ₂ e	GROSS EMISSIONS kg CO ₂ e	STORAGE Short Cycle kg CO ₂	STORAGE Long Cycle kg CO ₂	QTY
Footings & Slabs	CONTINUOUS CONCRETE FOOTINGS	Concrete - 3001-4000 psi, Standard mix / NRMCA [Industry Avg US & CA]	2,672	2,672	0	0	9.1 yd ³
Footings & Slabs	CONCRETE COLUMN PADS & PIERS	Concrete - 3001-4000 psi, Standard mix / NRMCA [Industry Avg US & CA]	561	561	0	0	1.9 yd ³
Footings & Slabs	CONCRETE SLABS	Concrete - 3001-4000 psi, Standard mix / NRMCA [Industry Avg US & CA]	0	0	0	0	1456.0 ft ²
Footings & Slabs	REBAR FOR COLUMN FOOTINGS, PADS & PIERS	Rebar / Concrete Reinforcing Steel Institute / 98% recycled, EAF / [Industry Avg N.America] / #3	81	81	0	0	552.0 ft
Footings & Slabs	REINFORCING MESH FOR SLAB	Welded wire reinforcement / Insteel Industries / 6" x 6" x 6/6g [US & CA]	480	480	0	0	1456.0 ft ²
Footings & Slabs	SUB-SLAB INSULATION	EPS foam board / Type II / R 4.0-inch, 15 psi / EPS Industry Alliance [Industry Avg US & CA]	1,606	1,606	0	0	1202.1 ft ²
Footings & Slabs	SUB-SLAB INSULATION	Foam glass aggregate / Hasopor / R 1.7-inch, 10-60 mm [EU]	282	282	0	0	1164.8 ft ²
Footings & Slabs	BASEMENT FLOORING	Engineered Wood Flooring / NWFA and Decorative Hardwoods Association / 3/8" to 3/4" [Industry Avg US & CA]	82	82	0	0	128.5 ft ²
Footings & Slabs	AGGREGATE BASE	Aggregate / NRMCA / US Average [Industry Avg]	660	660	0	0	1456.0 ft ²
Footings & Slabs	ADDITIONAL MATERIALS	Sheet barrier Non-Permeable / [BEAM Avg]	79	79	0	0	1456.0 ft ²
Structural Elements	STRUCTURAL TIMBER	Laminated veneer lumber (LVL) / AWC & CWC [Industry Avg US & CA]	65	65	0	0	0.2 yd ³
Exterior Walls	LIGHT WOOD FRAME WALLS	Wood / SPF / 2x6 Lumber / AWC & CWC [Industry Avg US & CA]	459	459	0	0	2545.0 ft ²
Exterior Walls	LIGHT WOOD FRAME WALLS	Wood / SPF / 2x4 Lumber / AWC & CWC [Industry Avg US & CA]	292	292	0	0	2545.0 ft ²
Exterior Walls	STRUCTURAL SHEATHING	Plywood / 1/2" / AWC & CWC [Industry Avg US & CA]	659	659	0	0	2545.0 ft ²
Exterior Walls	BARRIERS AND MEMBRANES	Sheet Barrier Permeable / [BEAM Avg]	171	171	0	0	2545.0 ft ²
Exterior Walls	BARRIERS AND MEMBRANES	Int. Wall & Ceiling Barrier, sheet / SIGA / Majrex 200 / Moisture-variable / EU	286	286	0	0	2545.0 ft ²
Exterior Walls	CAVITY INSULATION	Cellulose / dense pack / CIMA / R 3.7-inch / [Industry Avg US & CA]	-3,662	2,068	5,730	0	2545.0 ft ²
Cladding	EXTERIOR WALL CLADDING	Wood / SPF / 3/4" boards / AWC & CWC [Industry Avg US & CA]	284	284	0	0	2545.0 ft ²
Cladding	STRAPPING / FURRING	Wood / SPF / 1x3 Lumber / AWC & CWC [Industry Avg US & CA]	30	30	0	0	2545.0 ft ²
Cladding	INTERIOR CLADDING FOR EXTERIOR WALLS	Drywall 1/2" [BEAM Avg US & CA]	730	730	0	0	2545.0 ft ²
Windows	WINDOWS - TRIPLE-GLAZED	Window - triple pane / Vinyl frame / BICA Study [US & CA]	3,394	3,394	0	0	369.0 ft ²
Interior Walls	LIGHT WOOD FRAME INTERIOR WALLS	Wood / SPF / 2x4 Lumber / AWC & CWC [Industry Avg US & CA]	254	254	0	0	1950.0 ft ²
Interior Walls	CLADDING FOR INTERIOR WALLS	Drywall 1/2" [BEAM Avg US & CA]	1,119	1,119	0	0	1950.0 ft ²
Interior Walls	CAVITY INSULATION	Cellulose / dense pack / CIMA / R 3.7-inch / [Industry Avg US & CA]	0	0	0	0	292.5 ft ²

Floors	LIGHT WOOD FLOOR FRAMING	Wood joist / TJI 230/360 / 11-7/8" Depth / AWC & CWC [Industry Avg US & CA]	377	377	0	0	761.0 ft²
Floors	SUB FLOORING	OSB subflooring / Huber / AdvanTech / 19/32" Subflooring	633	633	0	0	961.3 ft²
Floors	FLOORING	Hardwood flooring / NWFA and Decorative Hardwoods Association / Solid Wood Flooring / 3/4" [Industry Avg US & CA]	651	651	0	0	715.3 ft²
Floors	FLOORING	Ceramic tile / Tile Council of North America/ 18.8 kg/m2 / [Industry Avg US & CA]	45	45	0	0	34.2 ft²
Ceilings	CEILING FINISHES	Drywall 1/2" [BEAM Avg US & CA]	588	588	0	0	2050.4 ft²
Ceilings	CEILING STRAPPING	Wood / SPF / 1x3 Lumber / AWC & CWC [Industry Avg US & CA]	36	36	0	0	2050.4 ft²
Roof	WOOD ROOF FRAMING	Wood roof truss / Gable Roof, Double Howe, 2x6 Chords, 2x4 Webs, 4:12 Pitch / QWEB [Industry Avg CA]	1,036	1,036	0	0	1792.7 ft²
Roof	ROOF DECKING	OSB sheathing & barrier / Huber ZIP System / Roof and Wall Sheathing / 5/8"	1,006	1,006	0	0	1792.7 ft²
Roof	ROOF STRAPPING	Wood / SPF / 1x3 Lumber / AWC & CWC [Industry Avg US & CA]	0	0	0	0	1792.7 ft²
Roof	ROOFING	Metal Panels - Steel / Metal Building Manufacturers Assn / 24 gauge [Industry Avg US]	2,054	2,054	0	0	1792.7 ft²
Roof	ROOF CAVITY INSULATION	Cellulose / dense pack / CIMA / R 3.7-inch / [Industry Avg US & CA]	-2,817	1,591	4,407	0	978.8 ft²
Roof	ROOF CAVITY INSULATION	Cellulose / loose fill / CIMA / R 3.7-inch / [Industry Avg US & CA]	-888	502	1,390	0	708.8 ft²
Roof	BARRIERS AND MEMBRANES	Roof Deck Sheet Barrier / [BEAM Avg]	131	131	0	0	1792.7 ft²
Garage	CONTINUOUS CONCRETE FOOTINGS	Concrete - 3001-4000 psi, Standard mix / NRMCA [Industry Avg US & CA]	1,629	1,629	0	0	5.6 yd³
Garage	REBAR FOR CONTINUOUS FOOTINGS	Rebar / Concrete Reinforcing Steel Institute / 98% recycled, EAF / [Industry Avg N.America] / #3	56	56	0	0	385.5 ft
Garage	GARAGE AGGREGATE BASE	Aggregate / NRMCA / US Average [Industry Avg]	283	283	0	0	624.0 ft²
Garage	GARAGE CONCRETE SLAB	Concrete - 3001-4000 psi, Standard mix / NRMCA [Industry Avg US & CA]	3,389	3,389	0	0	624.0 ft²
Garage	REINFORCING MESH FOR GARAGE SLAB	Welded wire reinforcement / Insteel Industries / 6" x 6" x 6/6g [US & CA]	206	206	0	0	624.0 ft²
Garage	LIGHT WOOD FRAME EXTERIOR WALLS	Wood / SPF / 2x6 Lumber / AWC & CWC [Industry Avg US & CA]	-2,866	260	0	3,125	1267.9 ft²
Garage	EXTERIOR WALL CLADDING	Wood / SPF / 3/4" boards / AWC & CWC [Industry Avg US & CA]	188	188	0	0	1686.3 ft²
Garage	WINDOWS – DOUBLE-GLAZED	Window - double-glazed / Vinyl frame / BfCA Study [US & CA]	439	439	0	0	55.0 ft²
Garage	WOOD ROOF FRAMING	Wood roof truss / Gable Roof, Double Howe, 2x6 Chords, 2x4 Webs, 4:12 Pitch / QWEB [Industry Avg CA]	-617	498	0	1,115	1291.6 ft²
Garage	ROOF DECKING	OSB sheathing & barrier / Huber ZIP System / Roof and Wall Sheathing / 5/8"	725	725	0	0	1291.6 ft²
Garage	ROOFING	Metal Panels - Steel / Metal Building Manufacturers Assn / 24 gauge [Industry Avg US]	1,480	1,480	0	0	1291.6 ft²

MATERIAL CARBON EMISSIONS BY SECTION

Footings & Slabs	6,502 kg CO₂e	
Foundation Walls	0 kg CO₂e	
Structural Elements	65 kg CO₂e	
Exterior Walls	-1,795 kg CO₂e	
Party Walls	0 kg CO₂e	
Cladding	1,044 kg CO₂e	
Windows	3,394 kg CO₂e	
Interior Walls	1,373 kg CO₂e	
Floors	1,705 kg CO₂e	
Ceilings	624 kg CO₂e	
Roof	521 kg CO₂e	
Garage	4,913 kg CO₂e	
NET TOTAL	18,345 kg CO₂e	MCE (kg CO₂e)

BEAM RESULTS

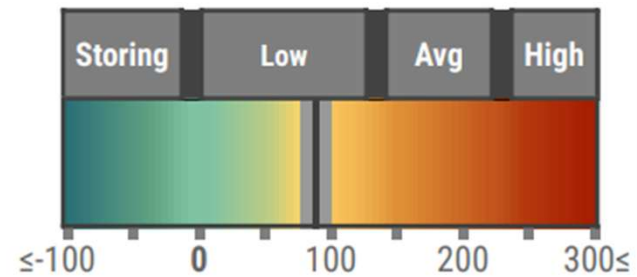


PROJECT EMISSIONS (MCE)

NET EMISSIONS kg CO ₂ e	GROSS EMISSIONS kg CO ₂ e	STORAGE SHORT CYCLE kg CO ₂	STORAGE LONG CYCLE kg CO ₂
18,345	34,113	11,527	4,240

PROJECT EMISSIONS INTENSITY (MCI)

	Metric kg CO ₂ e/m ²	Imperial lb CO ₂ e/ft ²
MCI Conditioned Floor Area	89	18
MCI Total Floor Area	70	14
MCI Per Bedroom	9,173	20,222



HIGHEST EMITTING MATERIALS

SECTION	kg CO ₂ e	MATERIAL
Windows	3,394	Window - triple pane / Vinyl frame / BfCA Study [
Garage	3,389	Concrete - 3001-4000 psi, Standard mix / NRMCA
Footings & Slabs	2,672	Concrete - 3001-4000 psi, Standard mix / NRMCA
Roof	2,054	Metal Panels - Steel / Metal Building Manufactur
Garage	1,629	Concrete - 3001-4000 psi, Standard mix / NRMCA
Footings & Slabs	1,606	EPS foam board / Type II / R 4.0-inch, 15 psi / EF
Garage	1,480	Metal Panels - Steel / Metal Building Manufactur
Interior Walls	1,119	Drywall 1/2" [BEAM Avg US & CA]
Roof	1,036	Wood roof truss / Gable Roof, Double Howe, 2x6
Roof	1,006	OSB sheathing & barrier / Huber ZIP System / Ro

HIGHEST CARBON-STORING MATERIALS

SECTION	kg CO ₂ e	MATERIAL
Exterior Walls	-3,662	Cellulose / dense pack / CIMA / R 3.7-inch / [Ind
Garage	-2,866	Wood / SPF / 2x6 Lumber / AWC & CWC [Industr
Roof	-2,817	Cellulose / dense pack / CIMA / R 3.7-inch / [Ind

Integrated Carbon Emmissions

- Operational Carbon Annual Emissions of 3 tonnes per year
- Embodied Carbon Emissions of 18 tonnes
- How to compare the relative impact?
- Integrate tonnes of emissions over time
- Result is tonnes * years over a period of time

Integrated Carbon Emissions – an idea...

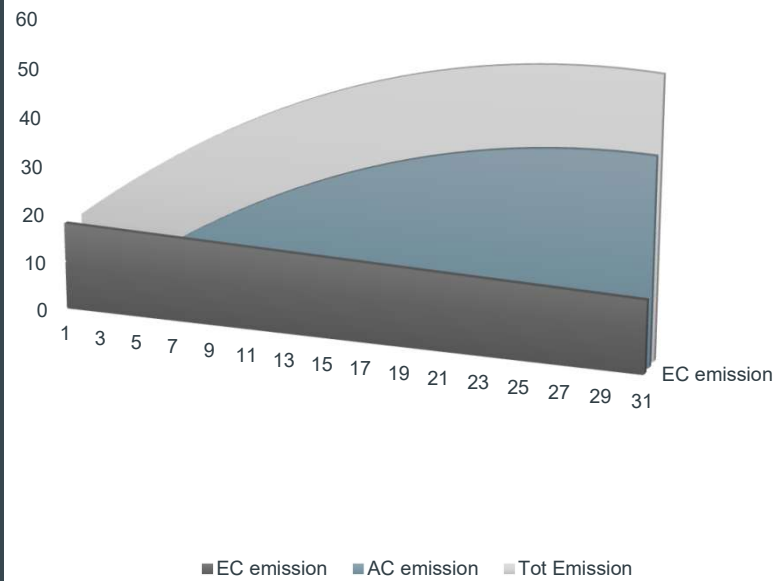
$$\text{Annual Carbon Index} = \frac{\text{Rated Home AC}}{\text{Reference Home EC}}$$

$$\text{Embodied Carbon Index} = \frac{\text{Rate Home EC}}{\text{Reference Home EC}}$$

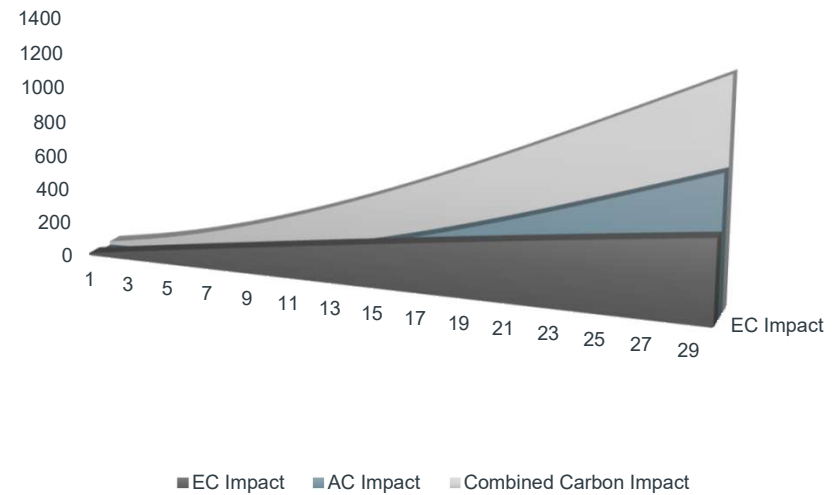
$$\text{Combined Carbon Damage} = EC * (\text{years} + 1) + \frac{1}{2} AC * (\text{years})^2$$

$$\text{Total Carbon Index} = \frac{\text{Rated Home CCD}}{\text{Reference Home CCD}}$$

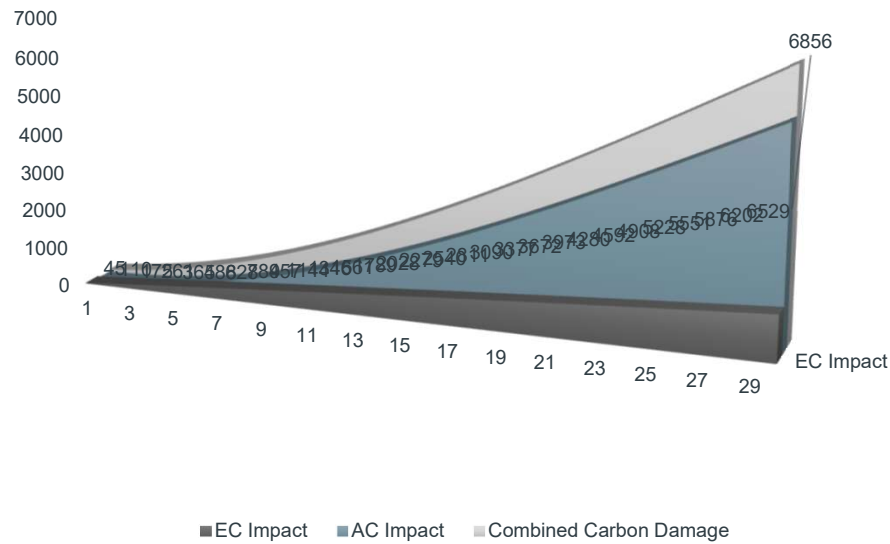
Combined emissions as a function of time – total tonnes



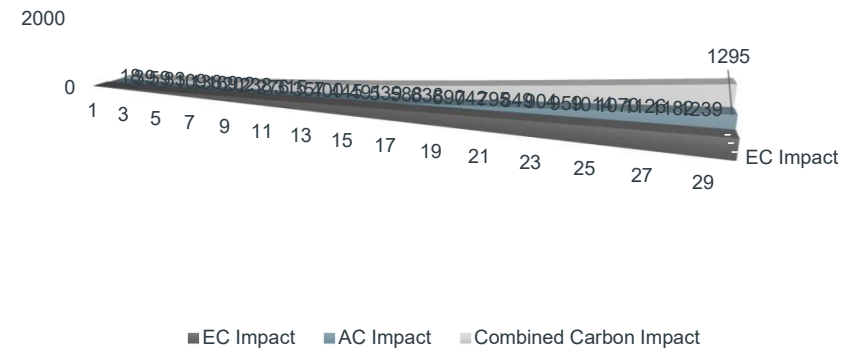
Impact from Emissions over time (ton*years) shown as embodied emissions, operation emissions and total emissions



**Damage from Emissions over time
(ton*years)
shown as embodied emissions,
operation emissions and total
emissions**



**Impact from Emissions over time
(ton*years)
shown as embodied emissions,
operation emissions and total
emissions**



How to communicate about carbon emissions

- What is the global warming impact of 1 tonne of CO₂ released into the atmosphere today?

