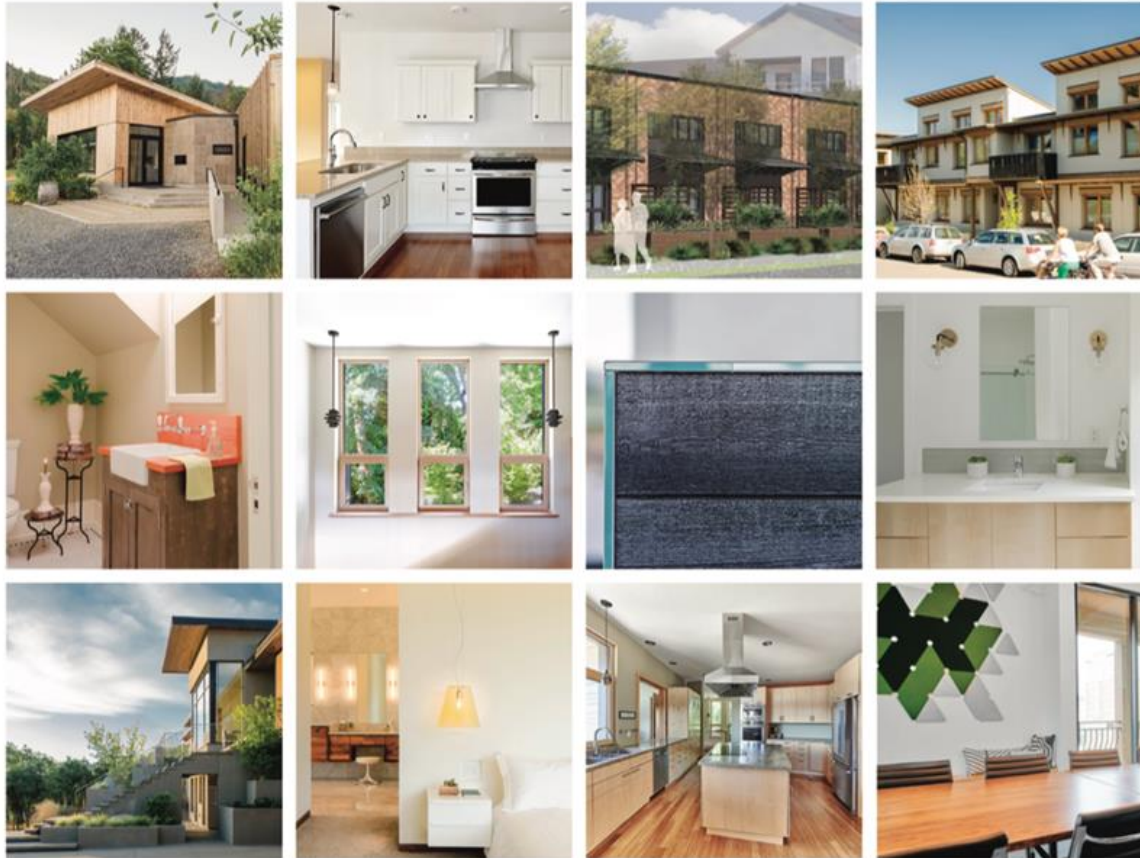


Energy Trust of Oregon

NET ZERO EMERGING LEADERS INTERNSHIP

Green Hammer | Emily Nelson

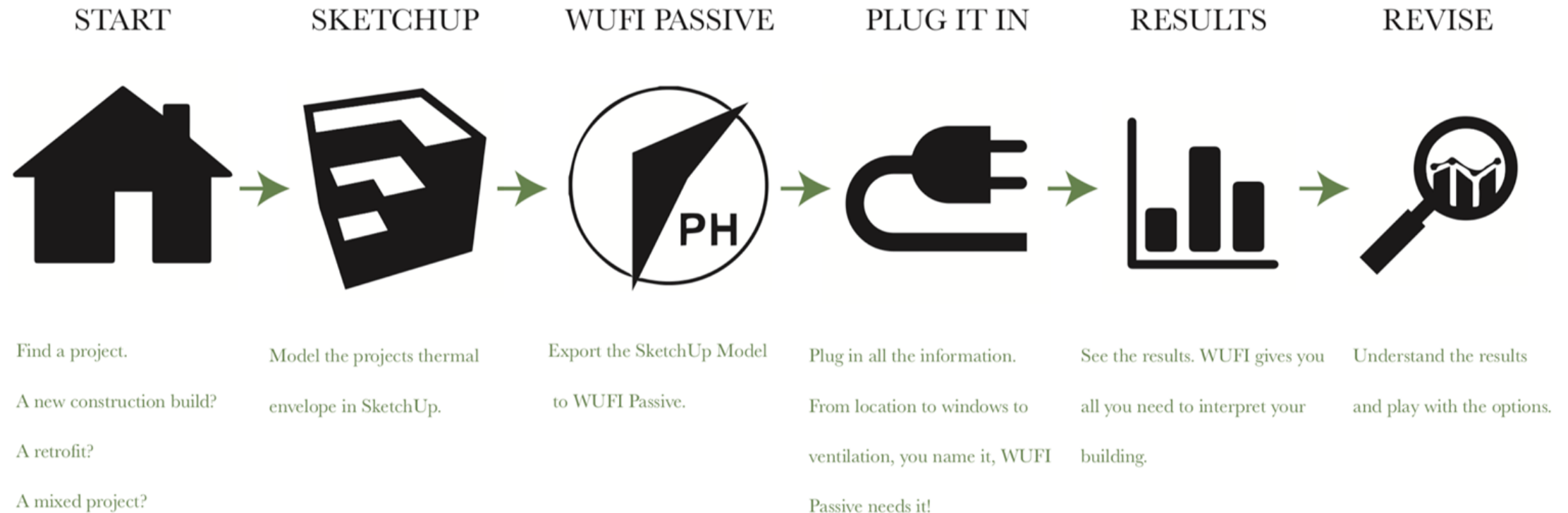


Green Hammer is committed to the AIA 2030 commitment towards 70% or greater predicted energy use intensity (pEUI) savings across their building portfolio each year.

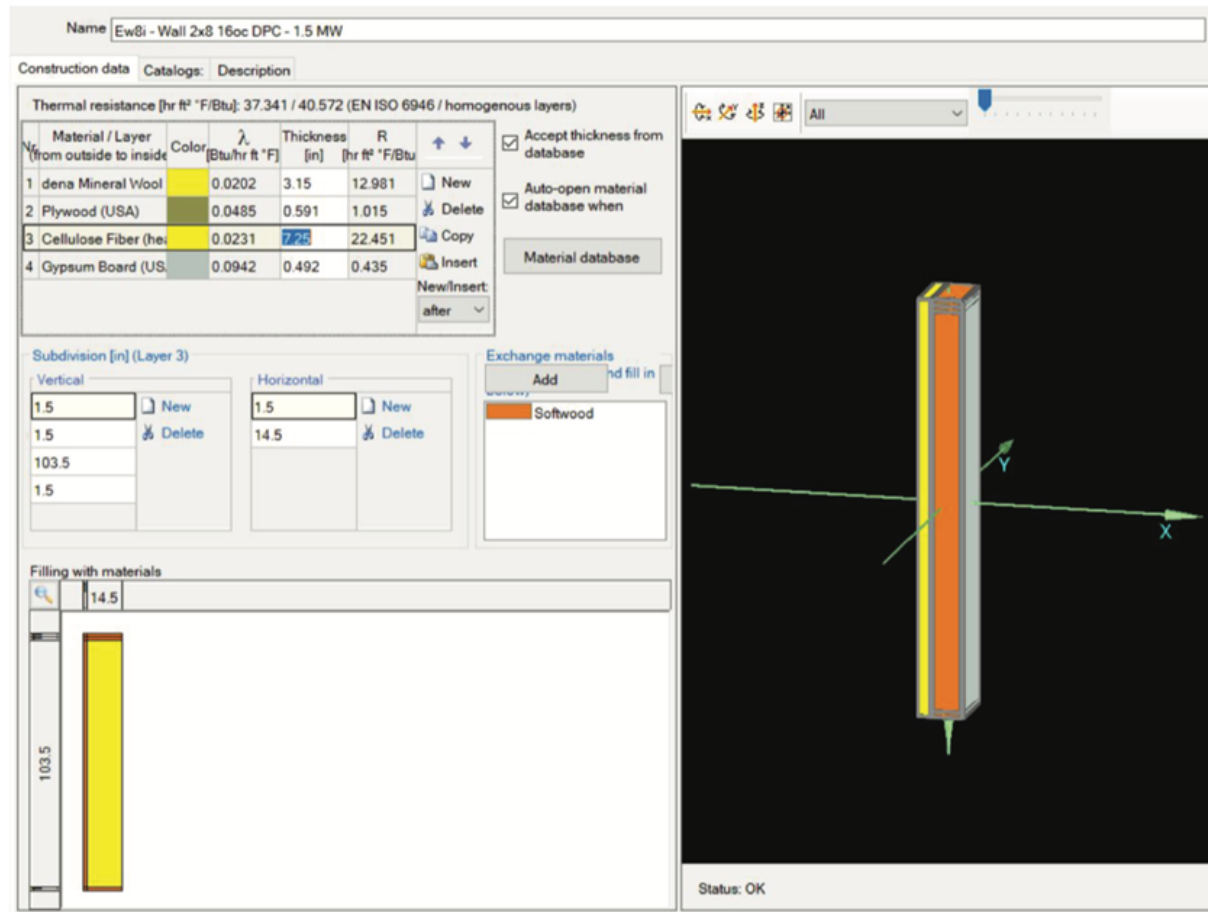
The Internship Agenda and Goals

- Expand Upon Integrating Energy Modeling into the Workflow
- Simplify the Energy Modeling Process
- Create User-Friendly Guidelines
- Create Easy-to-Use Comprehensive Databases
- Encourage Use of the Systems and Softwares
- Share Gained Knowledge
- Understand the Results

The WUFI Passive Way



The Assembly Database



Creating a custom database that works for all of Green Hammers' needs:

- Walls
 - Including Green Hammer standards and existing finds
 - Various sizes, insulation types, barrier options, exc.
- Floors
 - Including slab on grade, suspended, basement, exc.
 - Various insulation types, thicknesses, and finishes.
- Roofs
 - Including sloped, flat, ventilated, non ventilated, exc.
 - Various insulation types, structures, barrier options, exc.

The Window Database

Database: Window (Edit)

Name:

Window data | Catalogs | Description

☒ Uw/Frame factor detailed calculation (obligatory for passive house verification)

Parameters

Uw -mounted [Btu/hr ft² °F]	0.13
Frame factor [-]	0.7527
Glass U-value [Btu/hr ft² °F]	0.09
Solar energy transmittance hemispherical [-]	0.4
SHGC/Solar energy transmittance (perpendicular) [-]	0.4
Long wave radiation emissivity (mean glazing/frame) [-]	0.8

SHGC detailed

Incident angle [°]	SHGC [-]
0	0

New
Delete
Copy
Insert
New/Insert
after

Frame parameters (optional for WUFIplus, required for passive house verification)

Setting	Left	Right	Top	Bottom
Frame width [in]	3.5	3.5	3.5	3.5
Frame U-value [Btu/hr ft² °F]	0.14	0.14	0.14	0.14
Glazing-to-frame psi-value [Btu/hr ft² °F]	0.012	0.012	0.012	0.012
Frame-to-Wall psi-value [Btu/hr ft² °F]	0.02	0.02	0.02	0.02

Shown Uw factor is related to standard window geometry. It will be calculated with component dimensions.

Help OK Cancel

Creating a custom database that works for all of Green Hammers' needs:

- Commonly Found Windows
- Different Manufacturers
- Various Materials
- Various R - Values
- Various SHGC
- Exc.

Window Data: Fixed to Operable



Zola - uVPC - Thermo - Triple Pane

Fixed: R - 7

Uw-Mounted	0.15
Frame Factor	0.7553
Glass U-Value	0.09
Solar Energy Transmittance Hemispherical	0.37
SHGC (Perpendicular)	0.37
Long Wave Radiation Emissivity	0.8
Frame Width	3.46
Frame U-Value	0.144
Glazing-to-Frame Psi-Value	0.040
Frame-to-Wall Psi-Value	0.02

Operable: R - 6

Uw-Mounted	0.17
Frame Factor	0.7553
Glass U-Value	0.09
Solar Energy Transmittance Hemispherical	0.31
SHGC (Perpendicular)	0.31
Long Wave Radiation Emissivity	0.8
Frame Width	3.46
Frame U-Value	0.144
Glazing-to-Frame Psi-Value	0.060
Frame-to-Wall Psi-Value	0.02

Fixed to Operable in Action

Fixed: R - 7	
Heating Demand	5.22
Cooling Demand	4.55
Heating Load	3.41
Cooling Load	3.01
Source Energy	9,184
Site Energy	13.9

Operable: R - 6	
Heating Demand	6.39
Cooling Demand	3.27
Heating Load	3.77
Cooling Load	2.53
Source Energy	9089
Site Energy	13.76

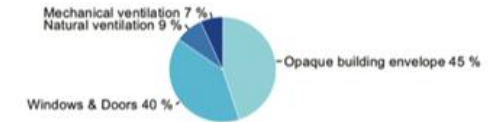
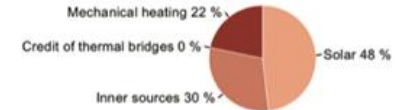
HEAT FLOW - HEATING PERIOD

Heat gains

Solar:	12,746 kBtu/yr
Inner sources:	7,963 kBtu/yr
Credit of thermal bridges:	0 kBtu/yr
Mechanical heating:	8,397 kBtu/yr

Heat losses

Opaque building envelope:	12,386 kBtu/yr
Windows & Doors:	10,951 kBtu/yr
Natural ventilation:	2,343 kBtu/yr
Mechanical ventilation:	1,855 kBtu/yr



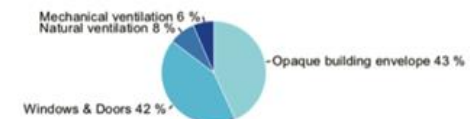
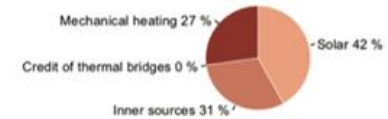
HEAT FLOW - HEATING PERIOD

Heat gains

Solar:	11,588 kBtu/yr
Inner sources:	8,505 kBtu/yr
Credit of thermal bridges:	0 kBtu/yr
Mechanical heating:	10,285 kBtu/yr

Heat losses

Opaque building envelope:	12,442 kBtu/yr
Windows & Doors:	12,181 kBtu/yr
Natural ventilation:	2,338 kBtu/yr
Mechanical ventilation:	1,851 kBtu/yr



Window Data: Double to Triple

Double Pane

Zola - uVPC - Classic Clad



Fixed: R - 4

Uw-Mounted	0.25
Frame Factor	0.7553
Glass U-Value	0.09
Solar Energy Transmittance Hemispherical	0.44
SHGC (Perpendicular)	0.44
Long Wave Radiation Emissivity	0.8
Frame Width	3.46
Frame U-Value	0.60
Glazing-to-Frame Psi-Value	0.023
Frame-to-Wall Psi-Value	0.02

Operable: R - 3.8

Uw-Mounted	0.26
Frame Factor	0.7553
Glass U-Value	0.09
Solar Energy Transmittance Hemispherical	0.37
SHGC (Perpendicular)	0.37
Long Wave Radiation Emissivity	0.8
Frame Width	3.46
Frame U-Value	0.64
Glazing-to-Frame Psi-Value	0.023
Frame-to-Wall Psi-Value	0.02

Triple Pane

Zola - uVPC - Thermo Clad



Fixed: R - 7

Uw-Mounted	0.15
Frame Factor	0.7553
Glass U-Value	0.09
Solar Energy Transmittance Hemispherical	0.41
SHGC (Perpendicular)	0.41
Long Wave Radiation Emissivity	0.8
Frame Width	3.46
Frame U-Value	0.25
Glazing-to-Frame Psi-Value	0.007
Frame-to-Wall Psi-Value	0.02

Operable: R - 6

Uw-Mounted	0.17
Frame Factor	0.7553
Glass U-Value	0.09
Solar Energy Transmittance Hemispherical	0.34
SHGC (Perpendicular)	0.34
Long Wave Radiation Emissivity	0.8
Frame Width	3.46
Frame U-Value	0.32
Glazing-to-Frame Psi-Value	0.007
Frame-to-Wall Psi-Value	0.02

Double to Triple in Action

Double Pane	
Heating Demand	9.06
Cooling Demand	3.98
Heating Load	4.71
Cooling Load	2.98
Source Energy	9,699
Site Energy	14.68

Triple Pane	
Heating Demand	5.85
Cooling Demand	4.17
Heating Load	3.63
Cooling Load	2.9
Source Energy	9,205
Site Energy	13.93

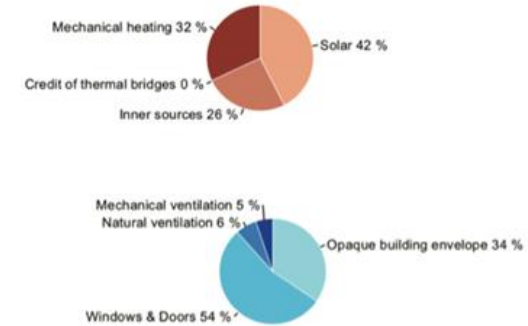
HEAT FLOW - HEATING PERIOD

Heat gains

Solar:	14,230 kBtu/yr
Inner sources:	8,548 kBtu/yr
Credit of thermal bridges:	0 kBtu/yr
Mechanical heating:	14,580 kBtu/yr

Heat losses

Opaque building envelope:	12,351 kBtu/yr
Windows & Doors:	19,314 kBtu/yr
Natural ventilation:	2,313 kBtu/yr
Mechanical ventilation:	1,831 kBtu/yr



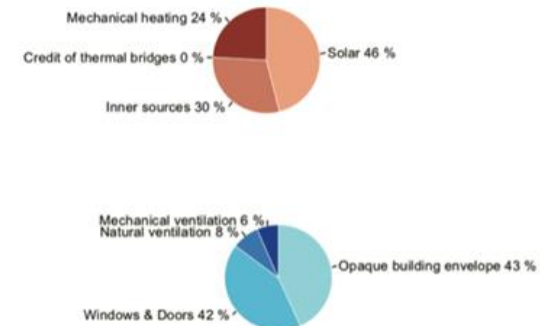
HEAT FLOW - HEATING PERIOD

Heat gains

Solar:	12,587 kBtu/yr
Inner sources:	8,143 kBtu/yr
Credit of thermal bridges:	0 kBtu/yr
Mechanical heating:	9,418 kBtu/yr

Heat losses

Opaque building envelope:	12,367 kBtu/yr
Windows & Doors:	12,024 kBtu/yr
Natural ventilation:	2,338 kBtu/yr
Mechanical ventilation:	1,851 kBtu/yr



Window Data: Unilux: Wood to EcoWindows: Vinyl

Unilux

Unilux - Wood - Meister - Triple Pane



Window Data	Fixed: R - 6.5	Operable: R - 6
Uw-Mounted	0.16	.17
Frame Factor	0.8544	.8544
Glass U-Value	0.09	.09
Solar Energy Transmittance Hemispherical	0.44	.44
SHGC (Perpendicular)	0.44	.44
Long Wave Radiation Emissivity	0.8	.8
Frame Width	2	2
Frame U-Value	0.4	.43
Glazing-to-Frame Psi-Value	0.0082	.0098
Frame-to-Wall Psi-Value	0.02	.02

EcoWindows

EcoWindows - Vinyl - Iglo Energy
Classic - Triple Pane



Window Data	Fixed: R - 6.5	Operable: R - 6
Uw-Mounted	0.16	0.17
Frame Factor	0.7692	0.7692
Glass U-Value	0.09	0.09
Solar Energy Transmittance Hemispherical	0.17	0.21
SHGC (Perpendicular)	0.17	0.21
Long Wave Radiation Emissivity	0.8	0.8
Frame Width	3.25	3.25
Frame U-Value	0.23	0.245
Glazing-to-Frame Psi-Value	0.025	0.035
Frame-to-Wall Psi-Value	0.02	0.02

Wood to Vinyl in Action

Wood	
Heating Demand	4.41
Cooling Demand	7.64
Heating Load	3.32
Cooling Load	4.12
Source Energy	9,751
Site Energy	14.76

Vinyl	
Heating Demand	7.68
Cooling Demand	1.65
Heating Load	4.06
Cooling Load	1.72
Source Energy	8,931
Site Energy	13.52

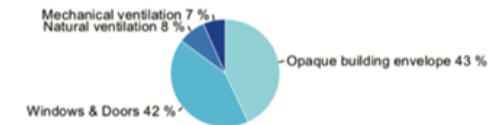
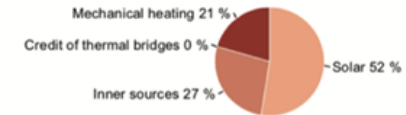
HEAT FLOW - HEATING PERIOD

Heat gains

Solar:	13,660 kBtu/yr
Inner sources:	7,027 kBtu/yr
Credit of thermal bridges:	0 kBtu/yr
Mechanical heating:	7,099 kBtu/yr

Heat losses

Opaque building envelope:	11,334 kBtu/yr
Windows & Doors:	11,102 kBtu/yr
Natural ventilation:	2,174 kBtu/yr
Mechanical ventilation:	1,721 kBtu/yr



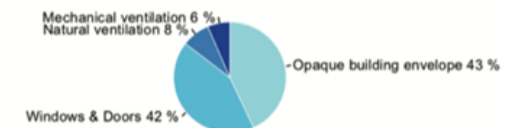
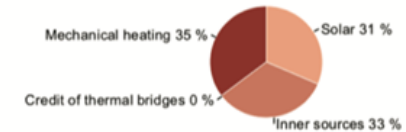
HEAT FLOW - HEATING PERIOD

Heat gains

Solar:	8,802 kBtu/yr
Inner sources:	9,279 kBtu/yr
Credit of thermal bridges:	0 kBtu/yr
Mechanical heating:	12,369 kBtu/yr

Heat losses

Opaque building envelope:	12,441 kBtu/yr
Windows & Doors:	12,255 kBtu/yr
Natural ventilation:	2,337 kBtu/yr
Mechanical ventilation:	1,851 kBtu/yr



A Retrofit: After the Remodel

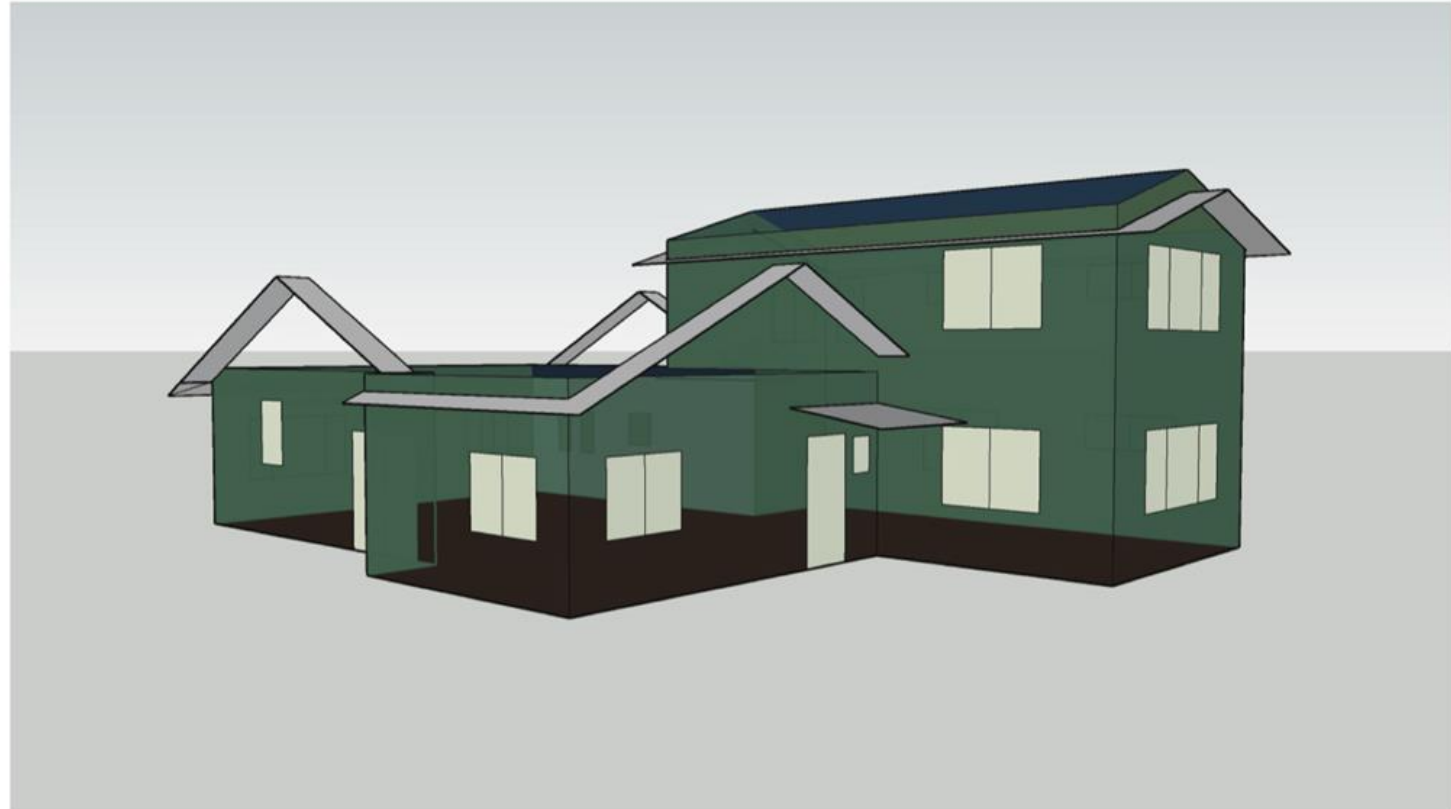
Type: Residential

Status: Under Construction

Net - Volume: 13,522.3 ft³

Floor Area: 1847.2 ft²

Envelope Area: 2.866 ft²



The Results

Data Type	Original Data	Updated Windows	Updated Walls	Updated Roof	Windows, Walls, & Roof	Windows, Walls, Roof, & Systems
Heating Demand	33.86	20.87	31.41	32.92	17.63	9.76
Cooling Demand	0.69	1.49	0.66	0.66	1.51	2.15
Heating Load	15.09	11.77	14.43	14.85	10.88	4.66
Cooling Load	0.85	1.77	0.88	0.83	1.77	1.99
Source Energy	12,288	10,243	11,171	12,124	9,702	7,311
Site Energy	54.19	40.44	51.51	53.15	36.93	19.29

A Retrofit: Before the Remodel

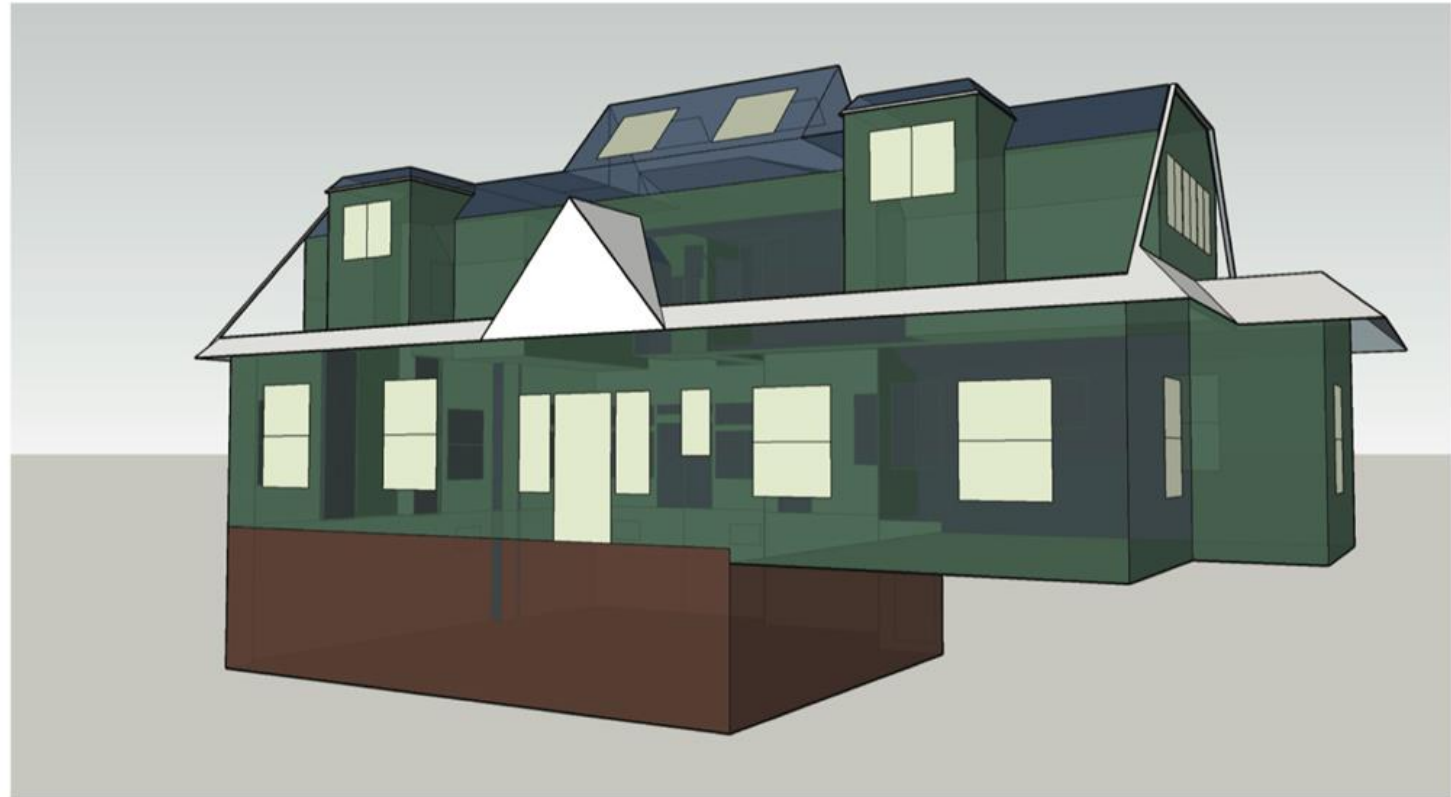
Type: Residential

Status: In Planning

Net - Volume: 25,870.4 ft³

Floor Area: 3,822.5 ft²

Envelope Area: 2.103 ft²



The Results

Data Type	Original Data	Updated Windows	Updated Walls	Updated Roof	Windows, Walls, & Roof	Windows, Walls, Roof, & Systems
Heating Demand	74.59	66.52	58.29	58.46	34.28	17.9
Cooling Demand	1.02	0.85	0.72	0.63	0.27	2.35
Heating Load	27.57	25.37	23.22	23.32	16.76	5.76
Cooling Load	0	0	0	0	0	0.27
Source Energy	60,130	55,006	49,778	49,887	34,527	18,634
Site Energy	87.09	78.77	70.29	70.46	45.54	11.88

Understanding the Results

- Explore Energy Modeling as a Team
- Utilize the Tools Available
- Share Gained Knowledge
- Continue to Revise

Thank You!