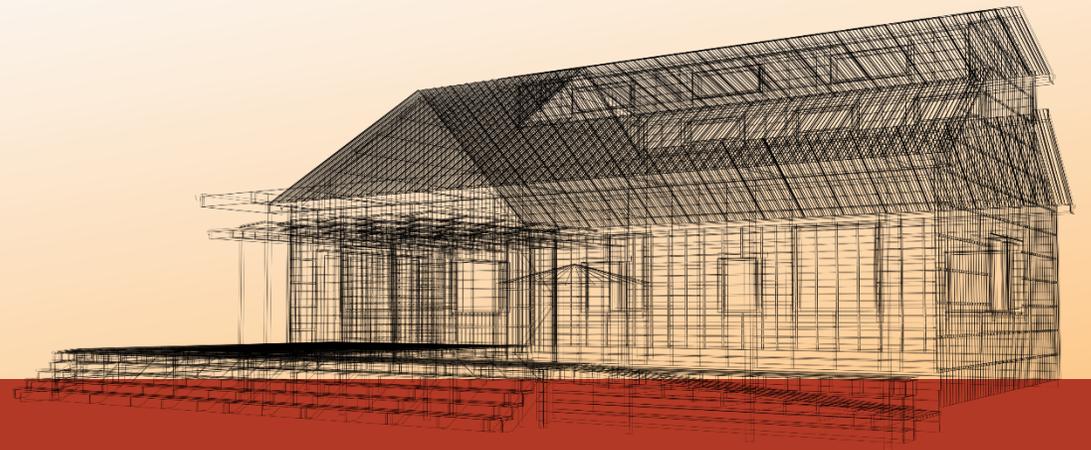


Sun Catcher Cottage



TEAM ILLINOIS

U.S. DEPARTMENT OF ENERGY RACE TO ZERO STUDENT DESIGN COMPETITION

TEAM INTRODUCTION

28 students



ILLINOIS
SOLAR
DECATHLON

8 majors

1 university



ILLINOIS
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

2007



2009



2011



2013



TEAM OBJECTIVES

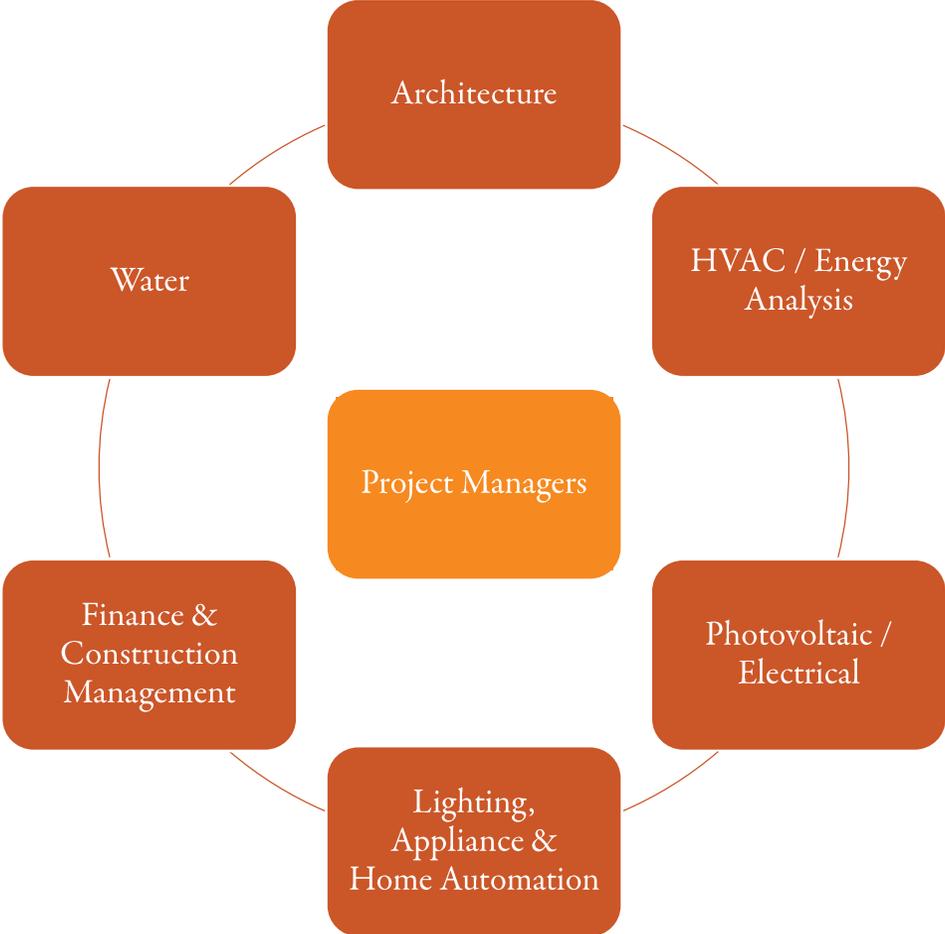
Team Education

Integrated Design

Scalable Solution



TEAM STRUCTURE



PROJECT SUMMARY

OVERVIEW

Deep energy retrofit

Existing farm cottage

Single-family home

Artist in Residency program

KEY FACTS

Area: 1718 SF

Bedrooms: 2

Baths: 2

HERS w/o PV: 30

HERS w/ PV: -7

Estimated Monthly Energy Cost: \$15.49

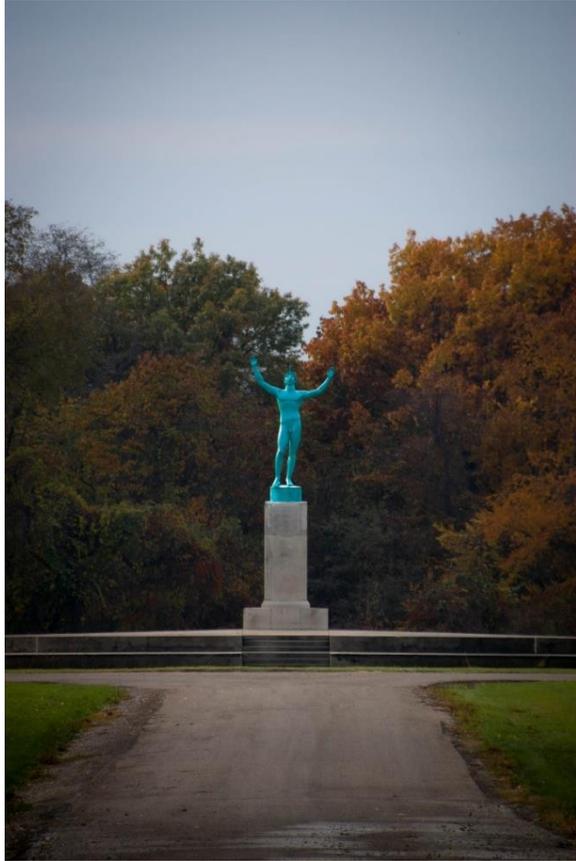
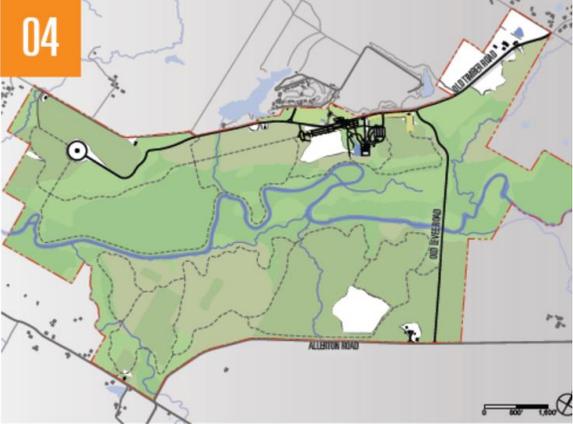


View from Northeast



View from Southeast

ALLERTON PARK & RETREAT CENTER



PROJECT LOCATION

Monticello, IL

Climate Zone: 5B



WHY RETROFIT?

83,392,000

single family homes in the US

**U.S. Department of Energy 2009 survey*

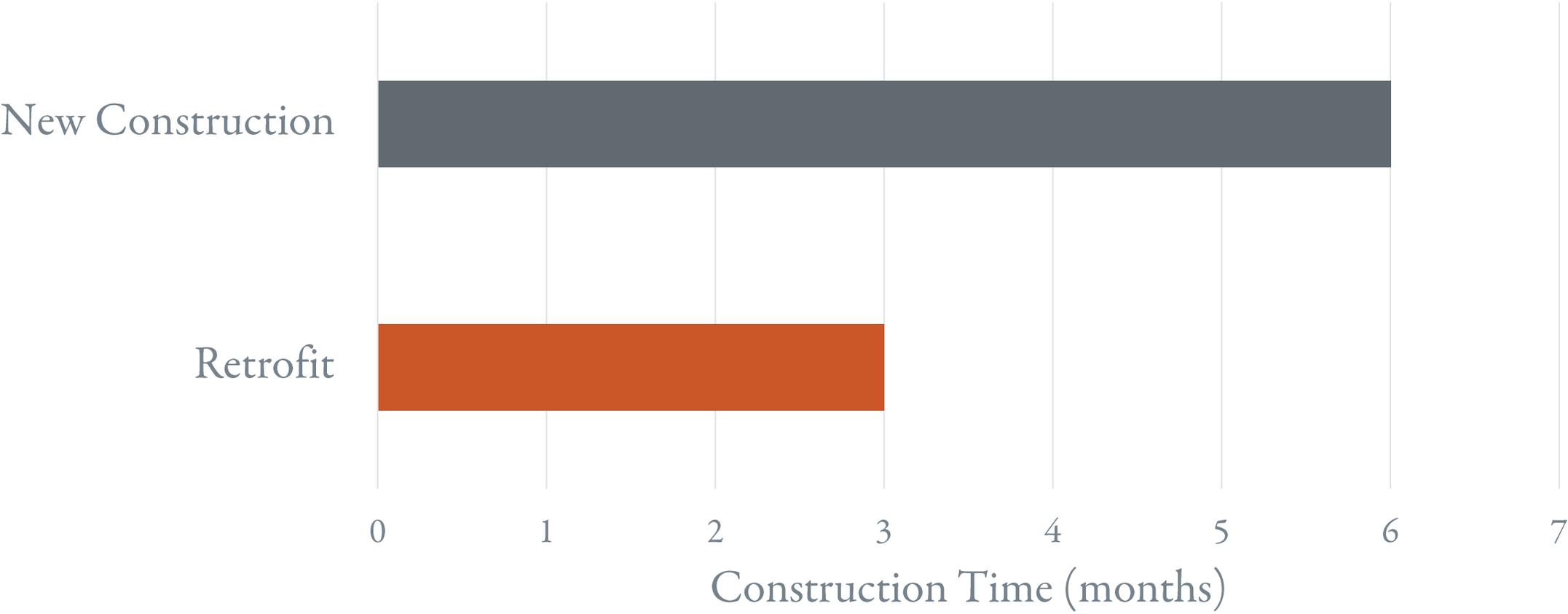
WHY RETROFIT?

35

median age of homes (years)

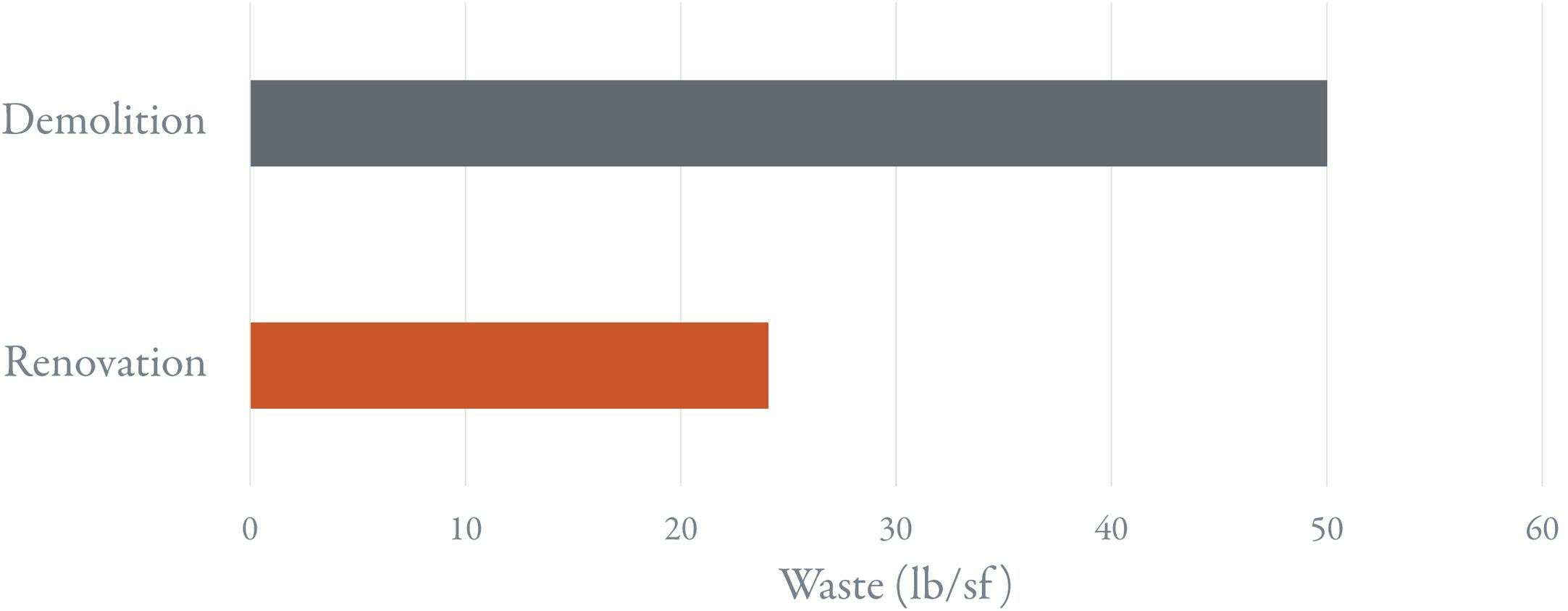
**U.S. Department of Energy 2009 survey*

WHY RETROFIT?



**Estimated for Sun Catcher Cottage Project*

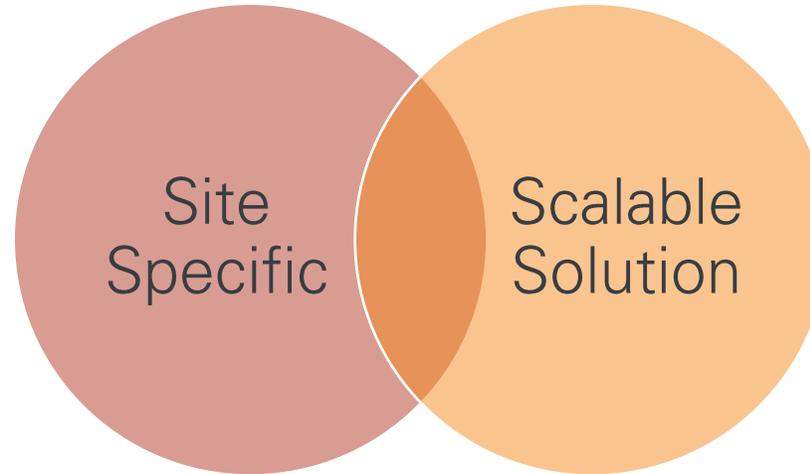
WHY RETROFIT?



**Environmental Protection Agency*

DESIGN GOALS

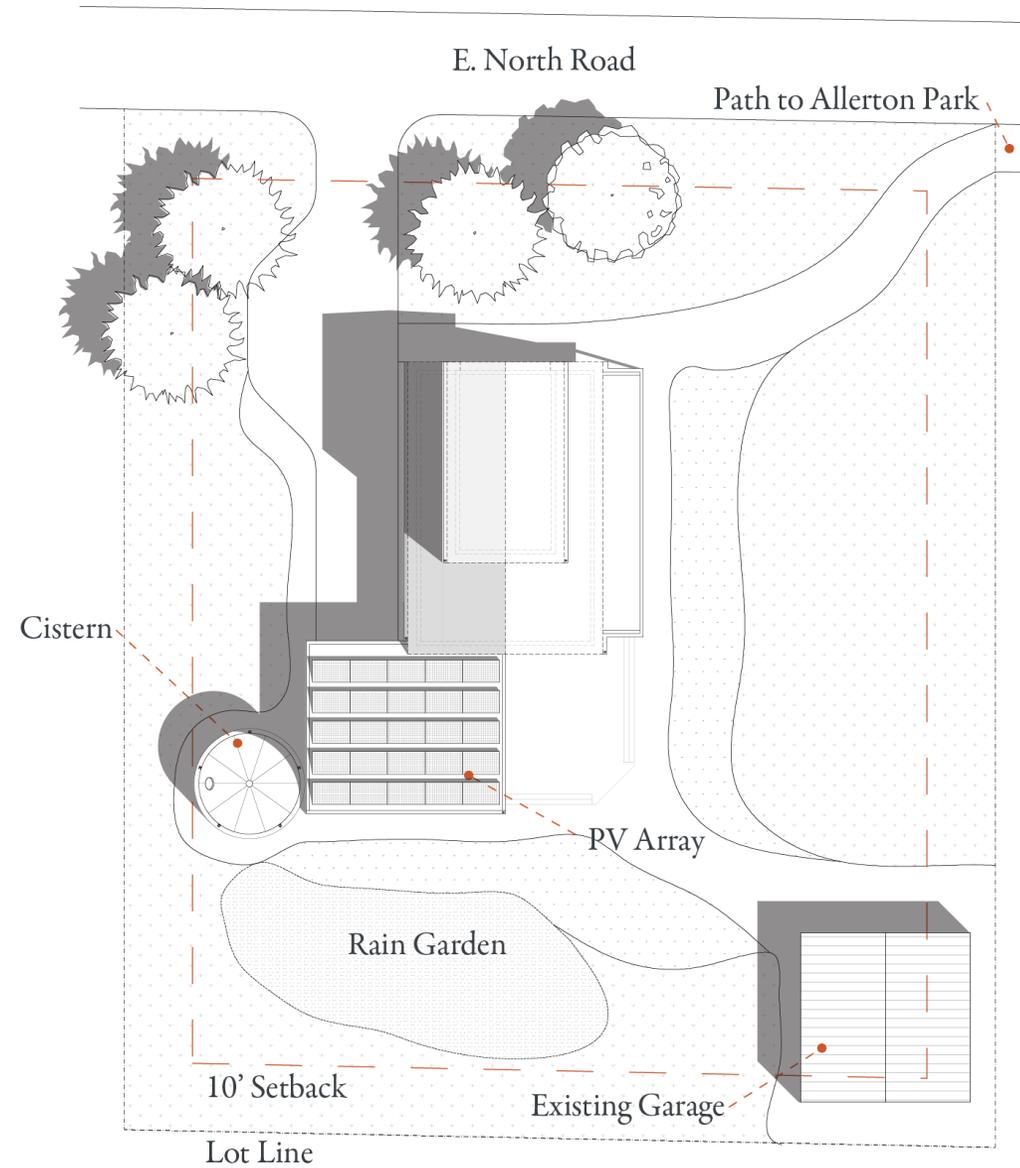
Artist in Residency program
Open floor plan
Connection to nature
Net-zero



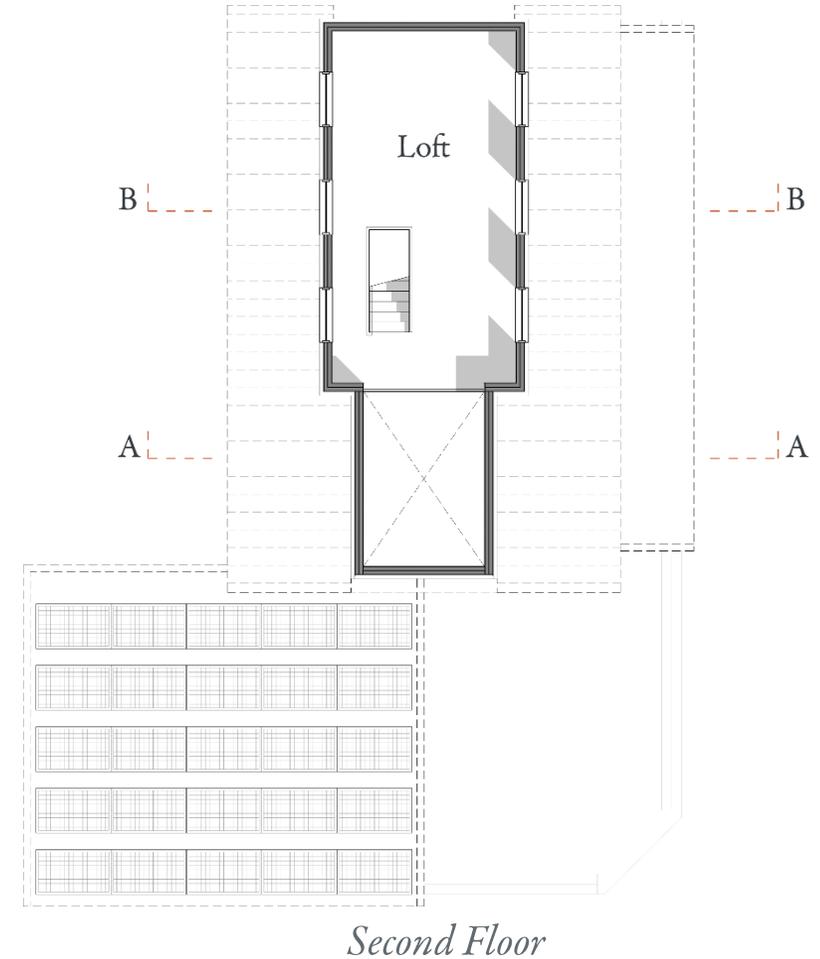
Repurpose existing materials
Improve envelope
Upgrade building systems



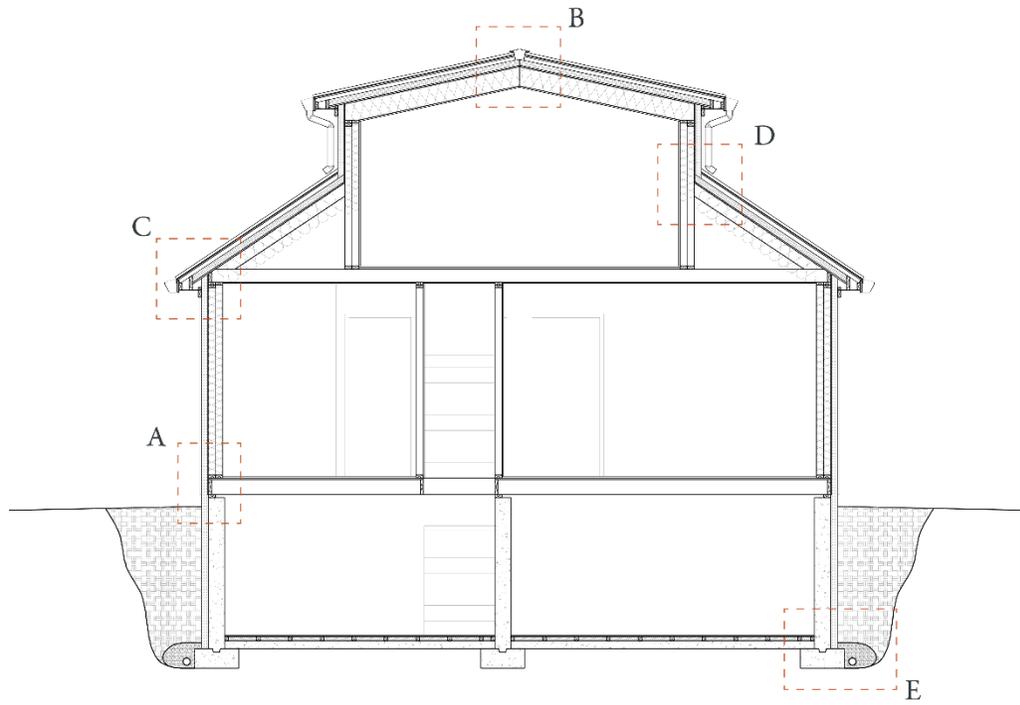
SITE PLAN



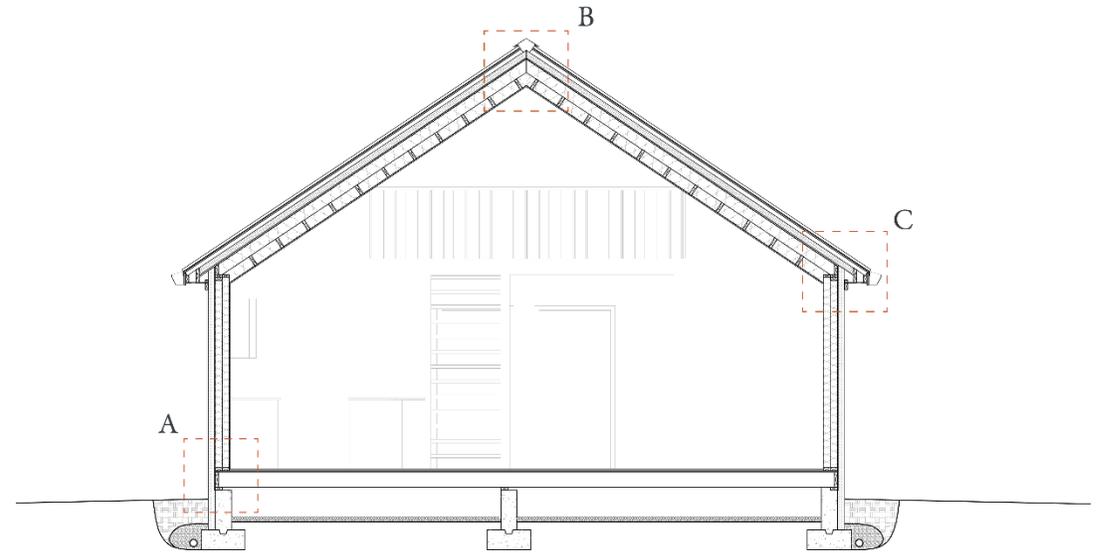
PLANS



SECTIONS

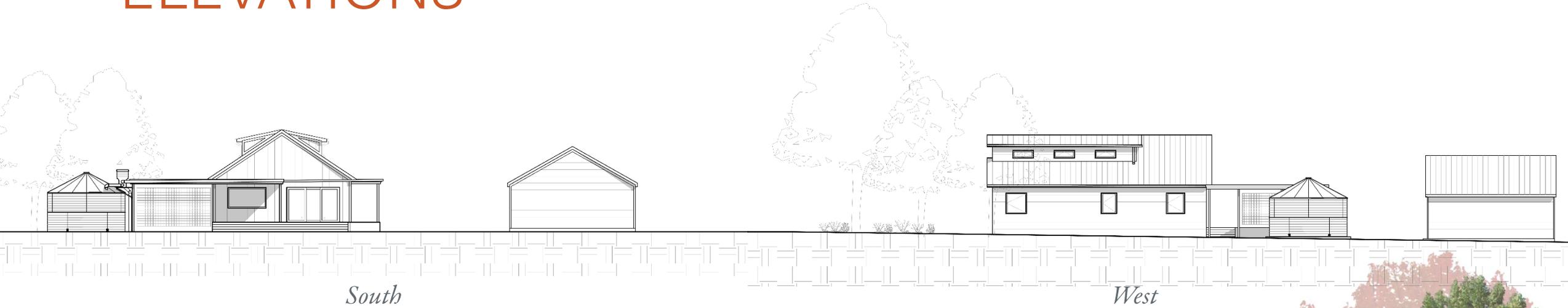


Section B-B

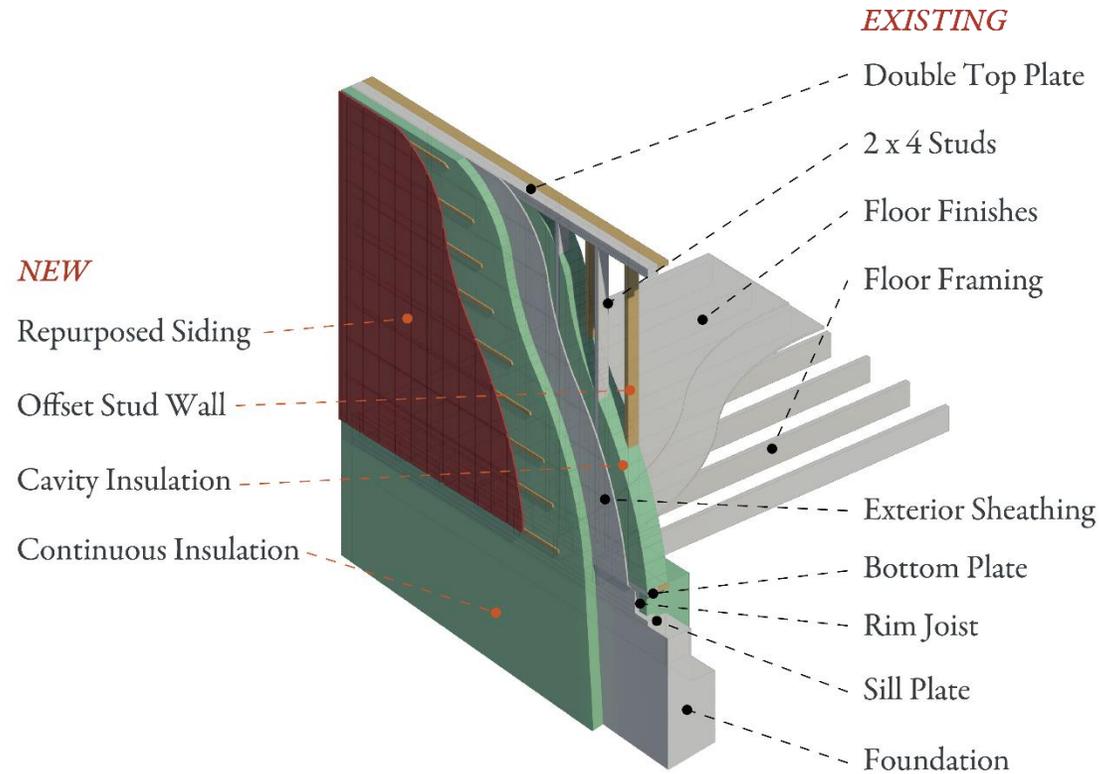


Section A-A

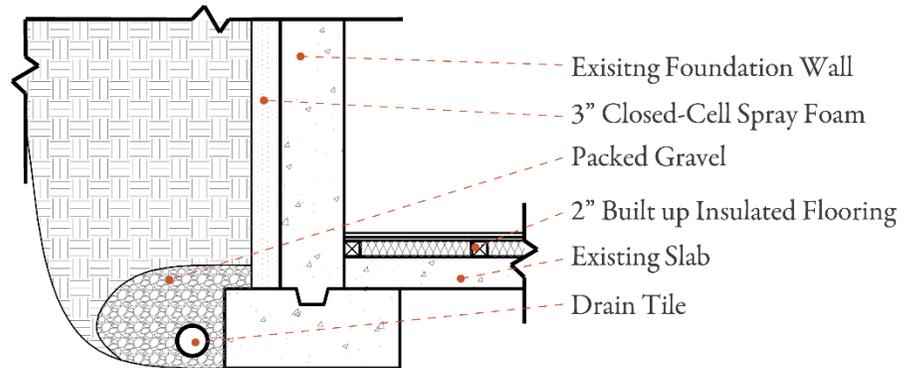
ELEVATIONS



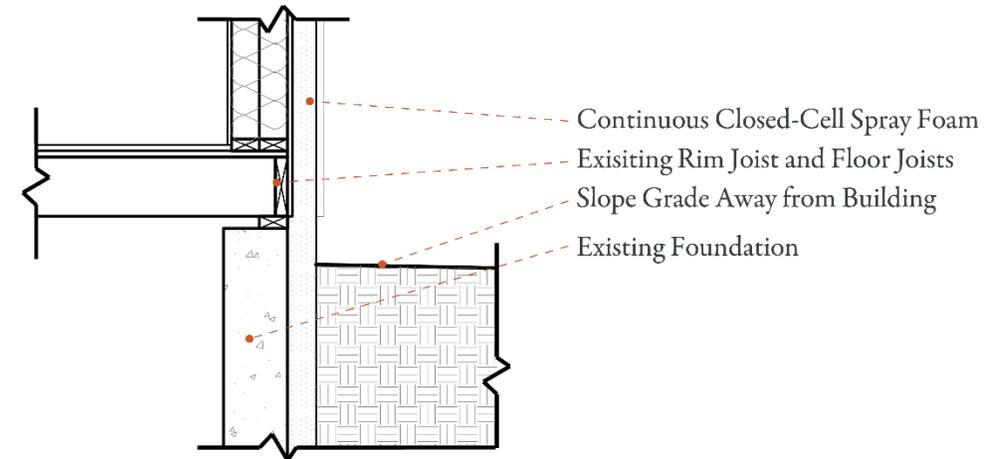
ENVELOPE CONSTRUCTION



ENVELOPE DETAILS

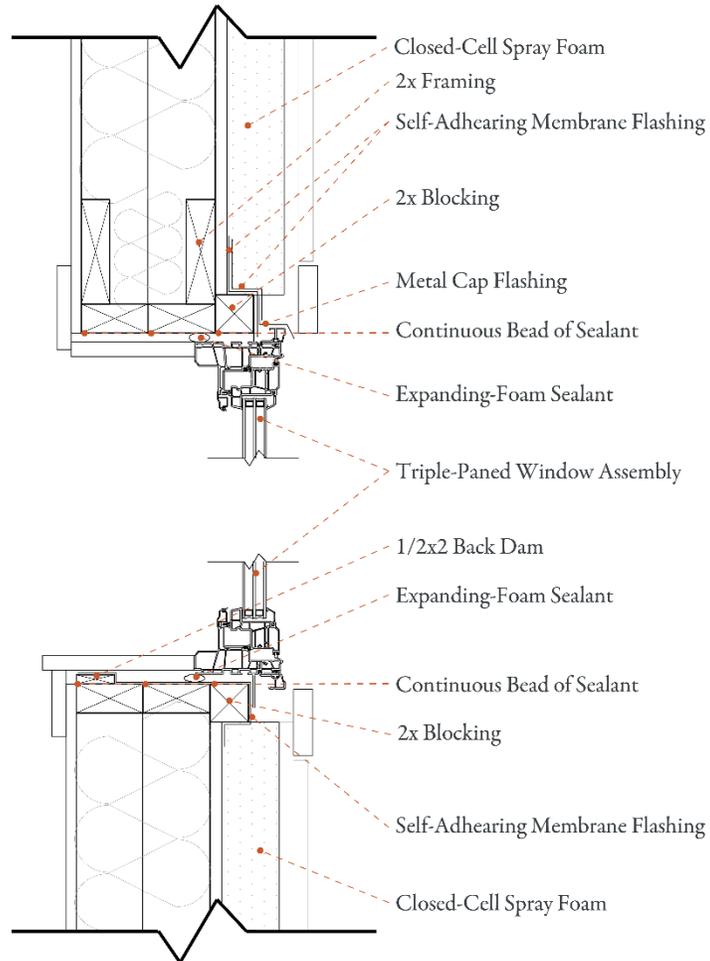


Foundation Detail

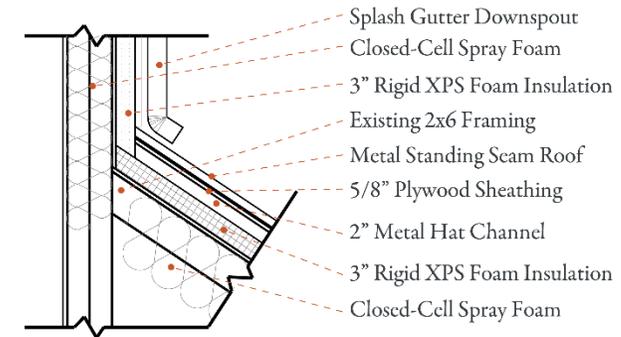


Rim Joist at Grade Detail

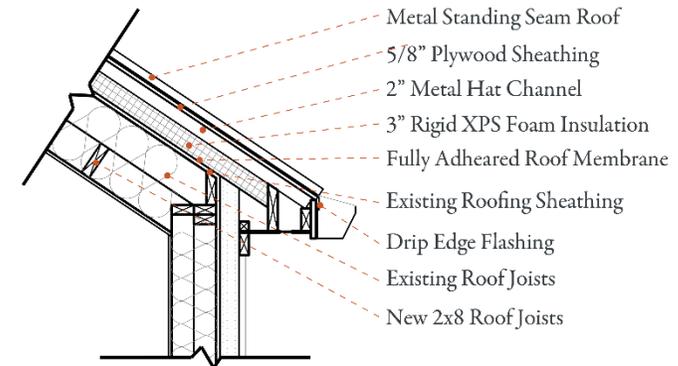
ENVELOPE DETAILS



Window Detail



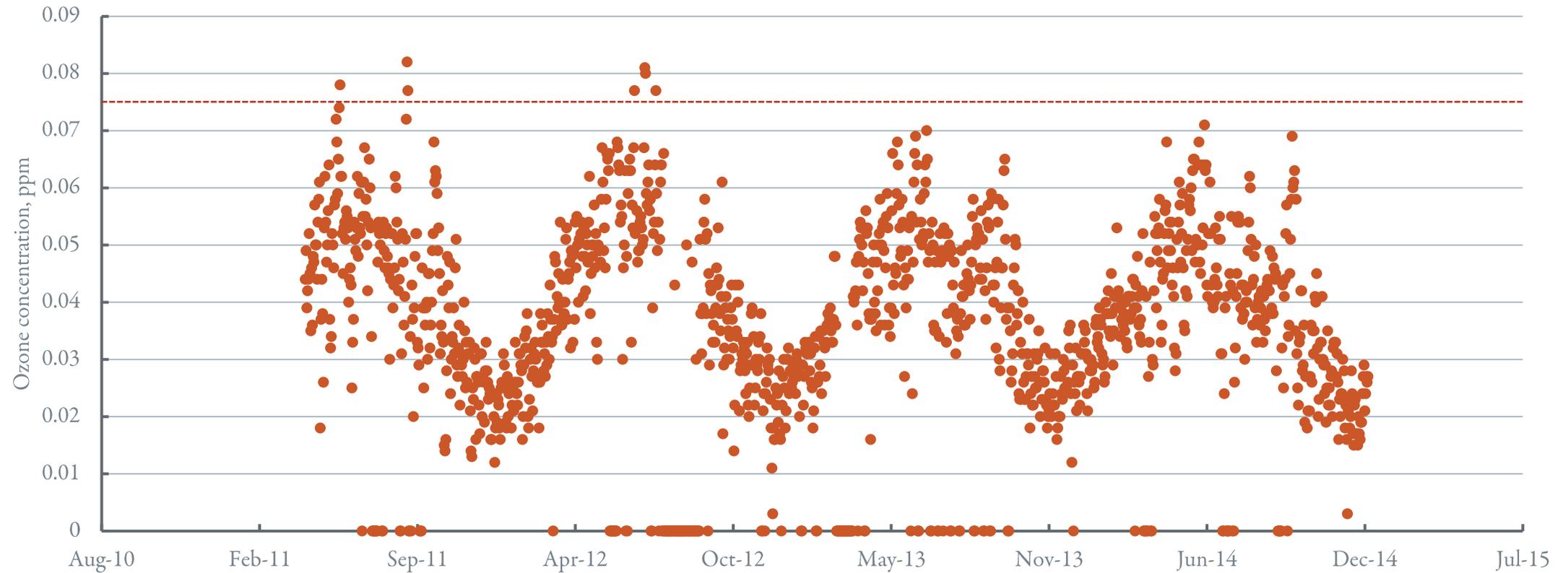
Flashing Detail



Eave Detail

OUTDOOR AIR QUALITY EVALUATION

Daily Max 8-hour Ozone Concentrations from 2011 to 2014



INDOOR AIR POLLUTION CONTROL

Lunos e2 HRV

Broan Local Exhaust Fans

Mitsubishi Mini Split

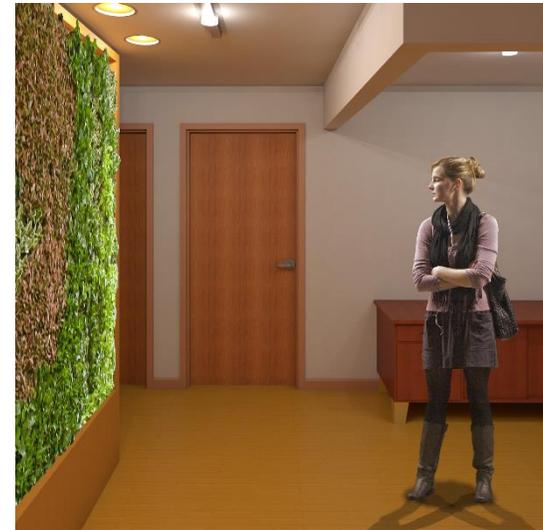
Eco-wall

Low Emissive Materials

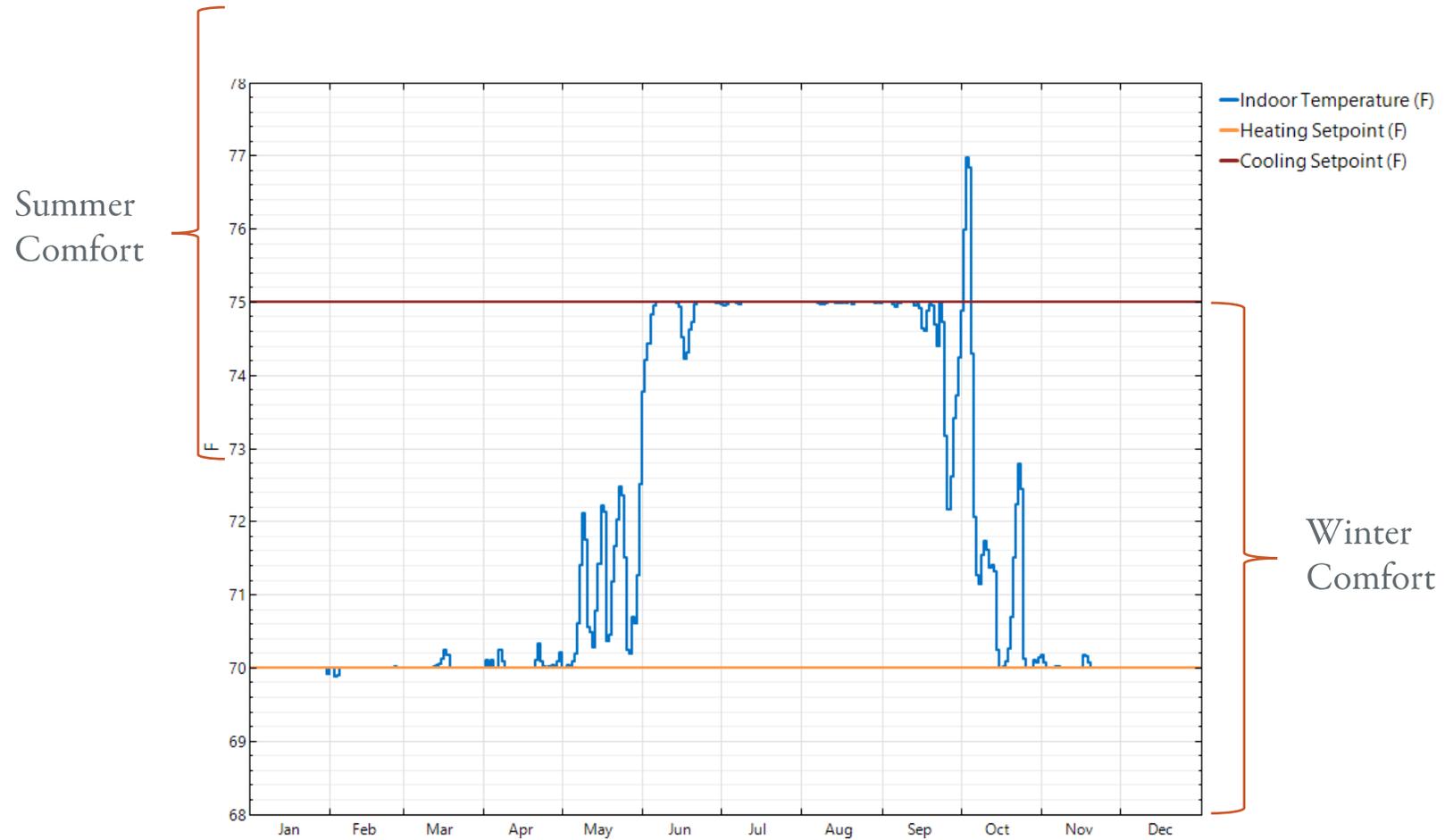
Moisture Control

Radon Control

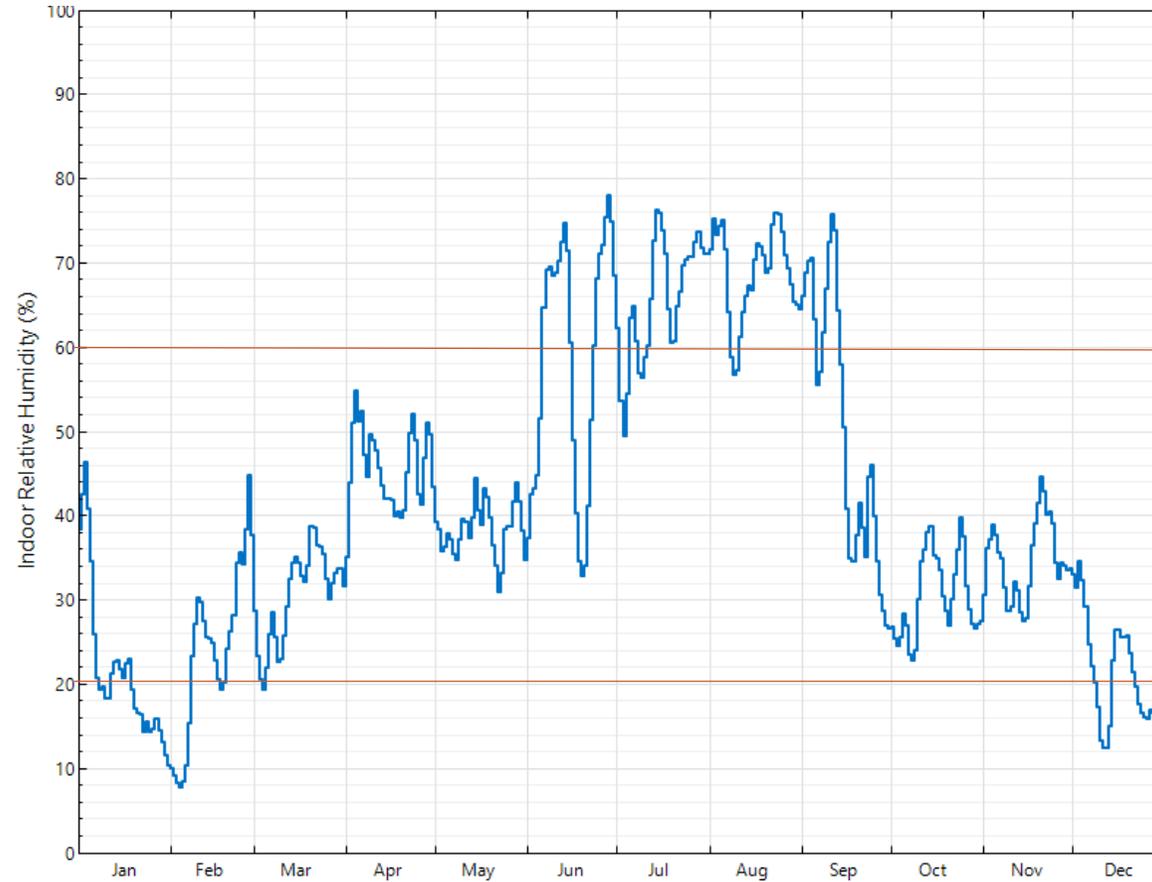
Commissioning & Operation



INDOOR AIR POLLUTION CONTROL



INDOOR AIR POLLUTION CONTROL



HVAC DESIGN PRINCIPLES

Occupant Comfort & Safety

- Decentralization
- Climate-oriented design

Energy Efficiency

- Heat pump technology
- Duct minimization

Scalability

- Flexible integration
- Low maintenance

HVAC DESIGN AND ANALYSIS

Sun Catcher Heating and Cooling Loads Summary

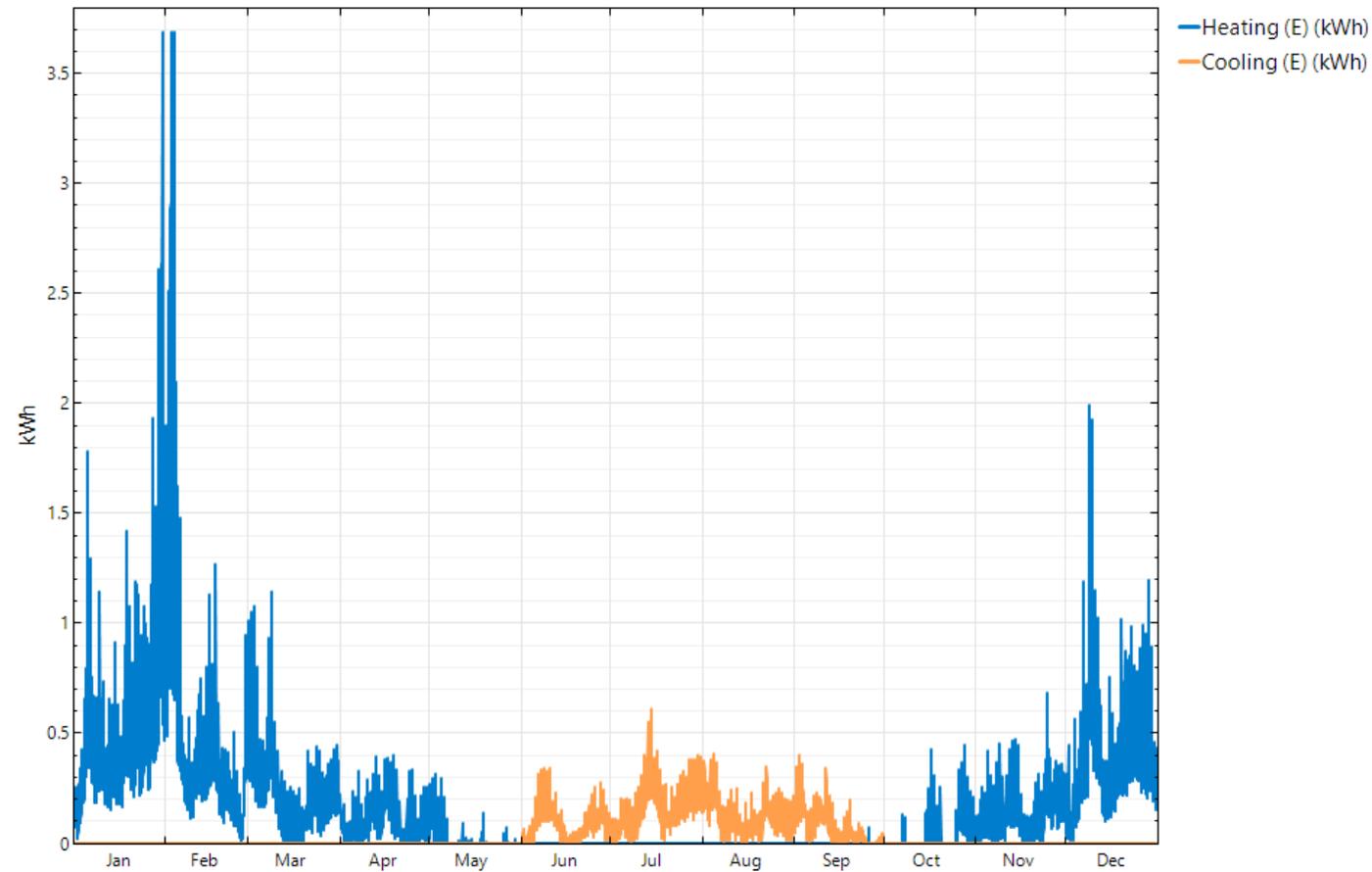
Item	Heating Load, Btu/h	Cooling Load, Btu/h
Total Sensible Loads	16,795	6,420
Total Latent Loads	1,302	1,354

Mini Split System Characteristics

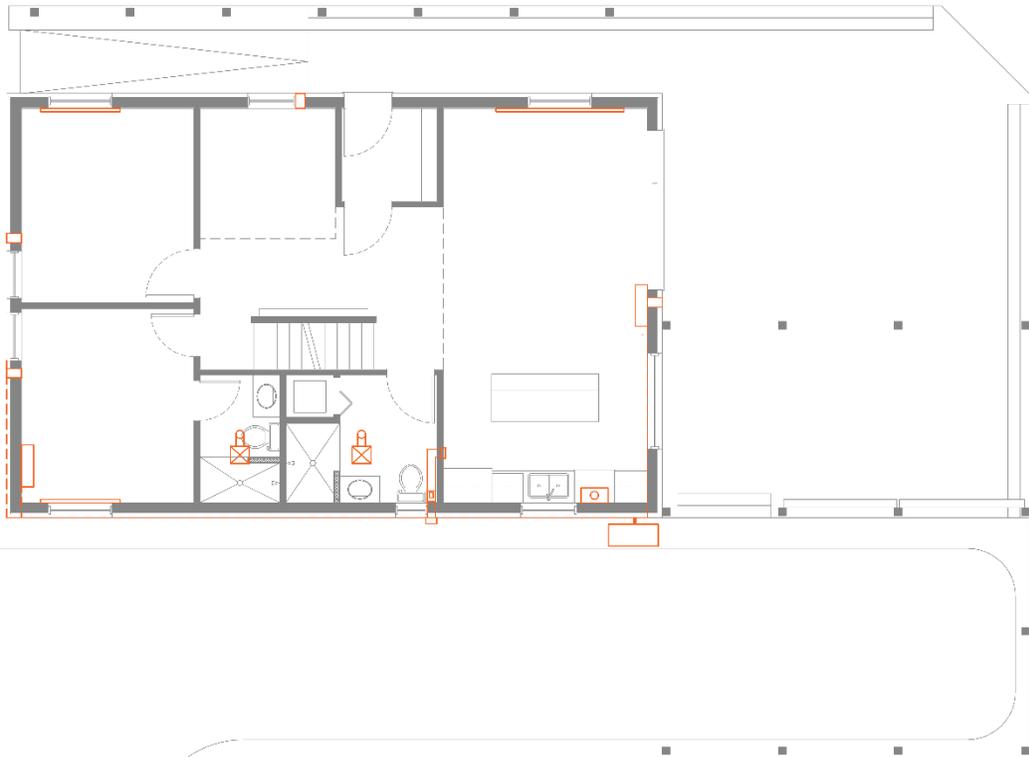
HSPF	10
SEER	19
Lowest operating outdoor temperature	-13 °F



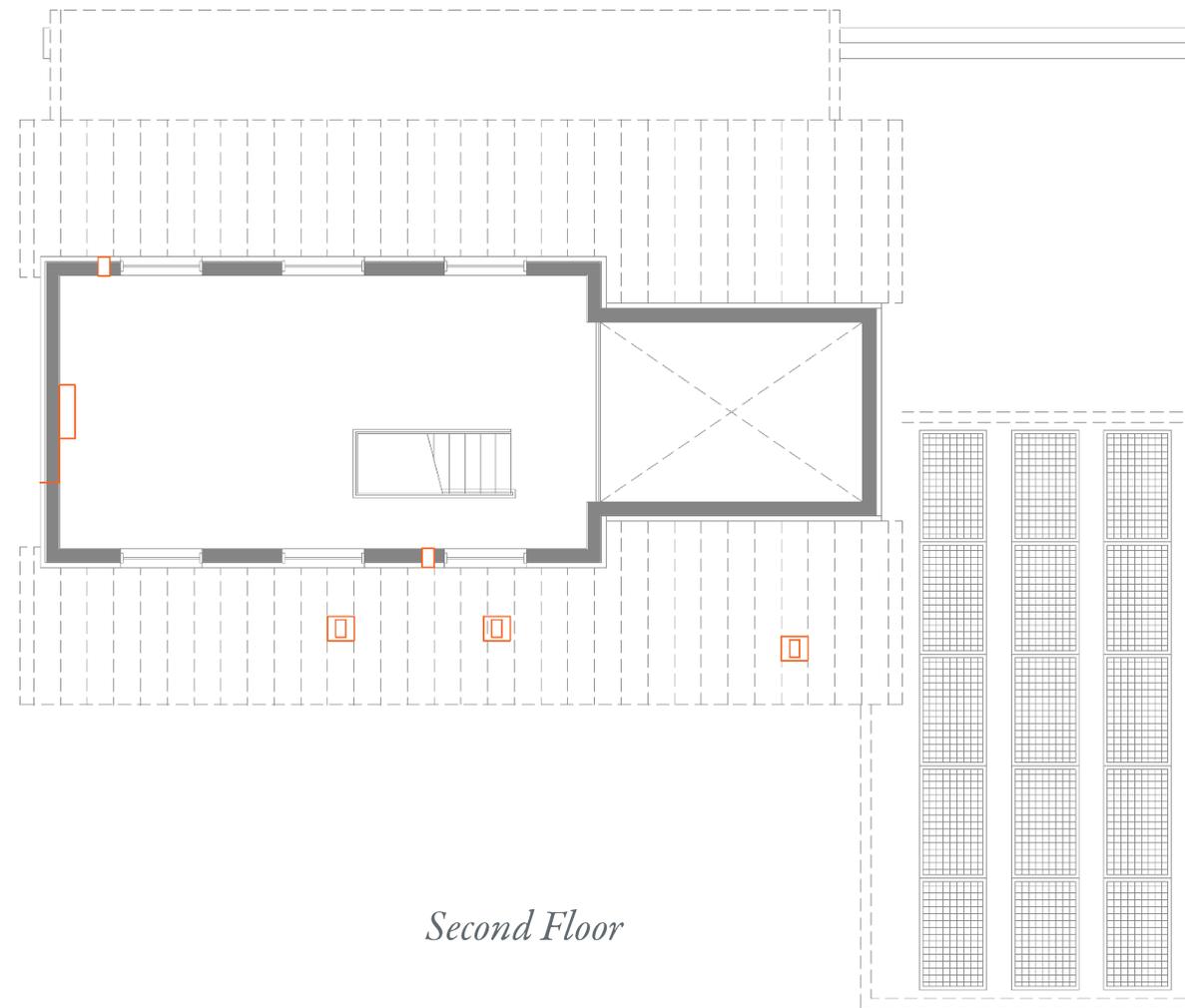
HOURLY HEATING AND COOLING PROFILE



HVAC PLAN



First Floor

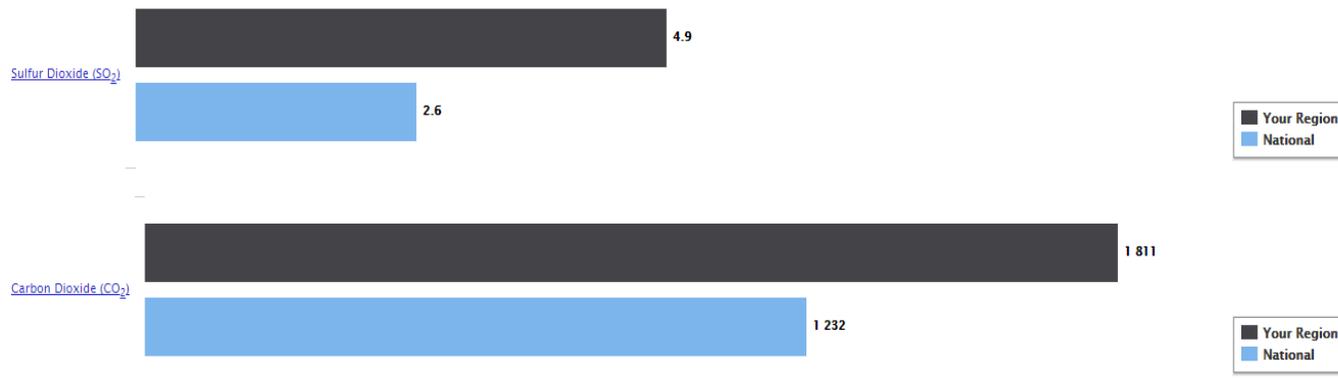
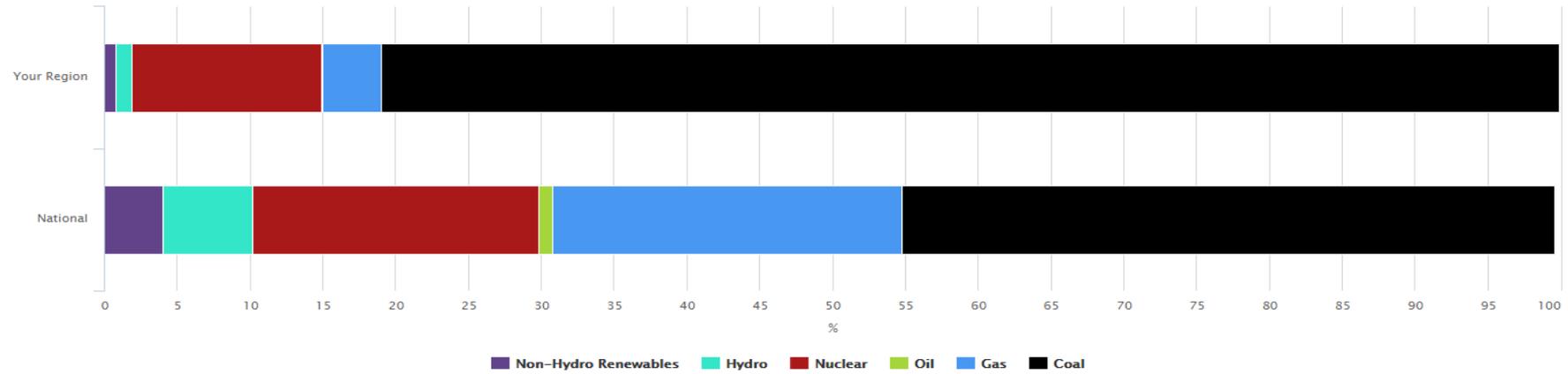


Second Floor

LOCAL ELECTRICITY PROFILE

Fuel Mix Comparison

This chart compares fuel mix (%) of sources used to generate electricity in your region to the fuel mix (%) for the entire United States.

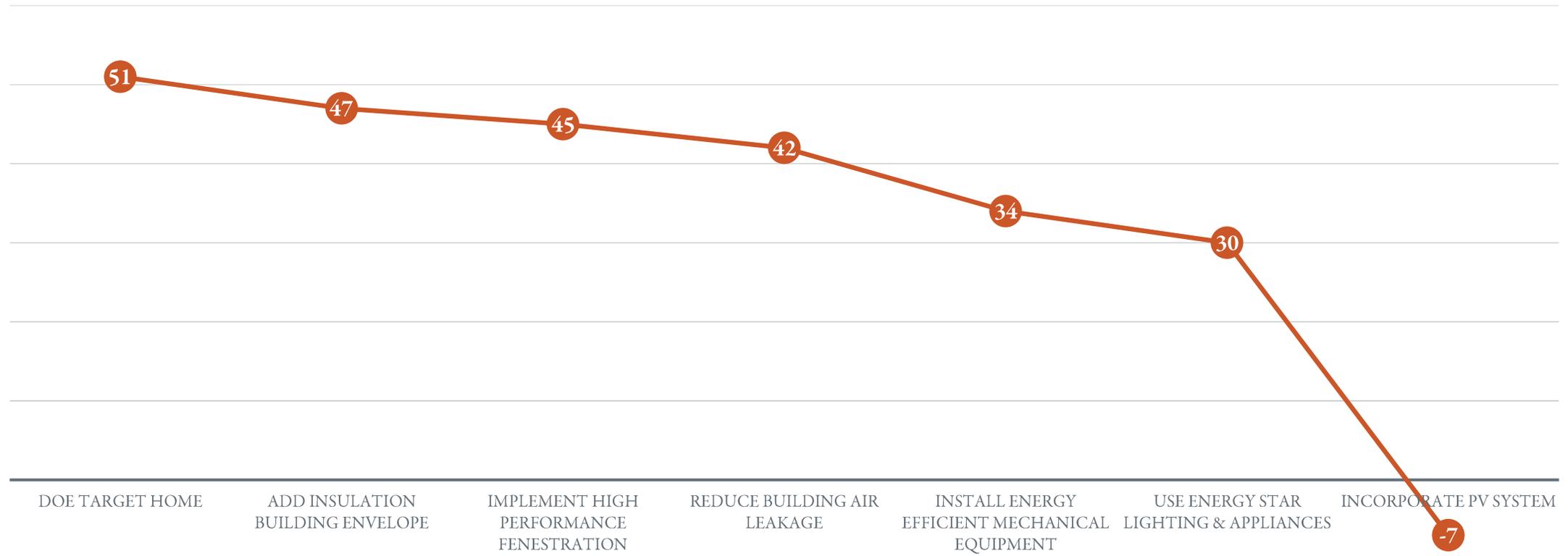


**Environmental Protection Agency Power Profiler*



ENERGY EFFICIENCY DESIGN PROCESS

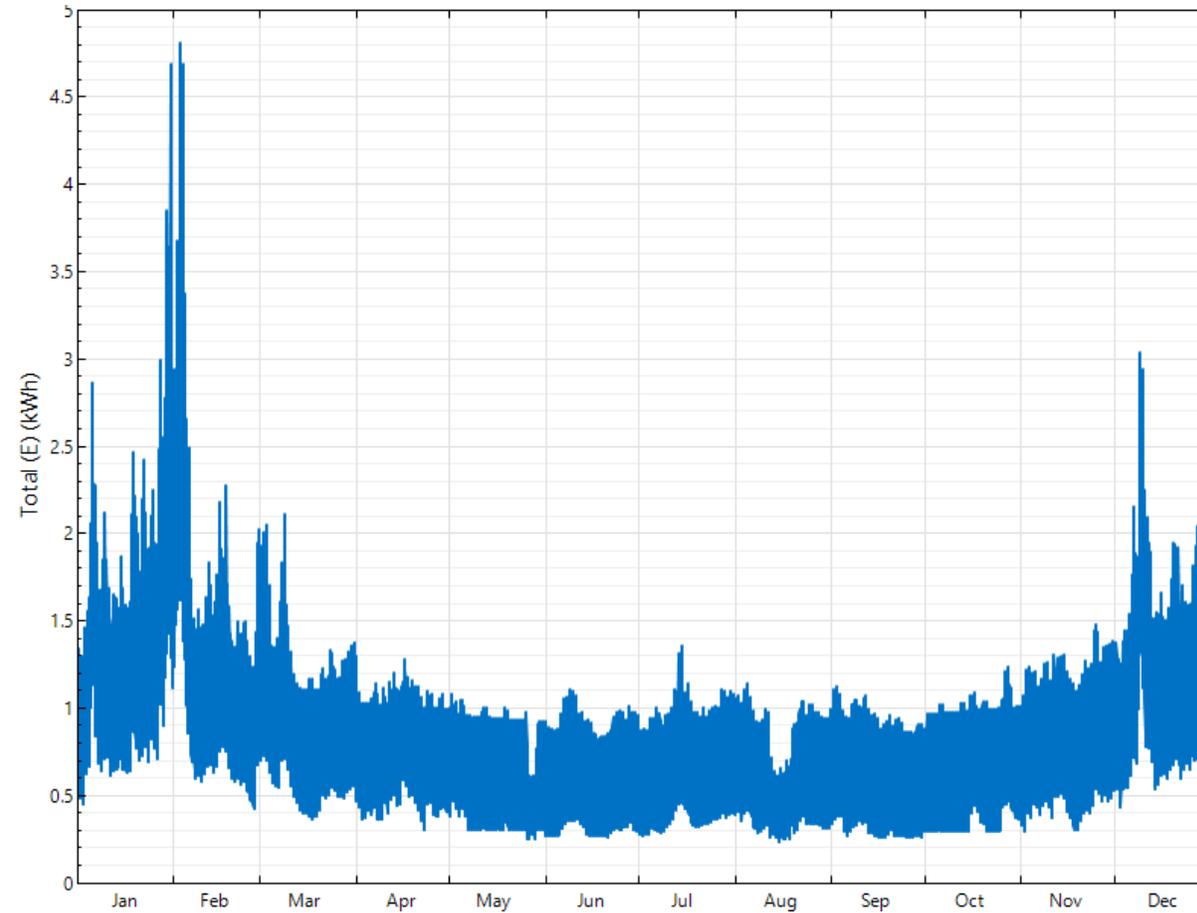
HERS Rating



WHOLE-HOUSE ENERGY SIMULATION RESULTS

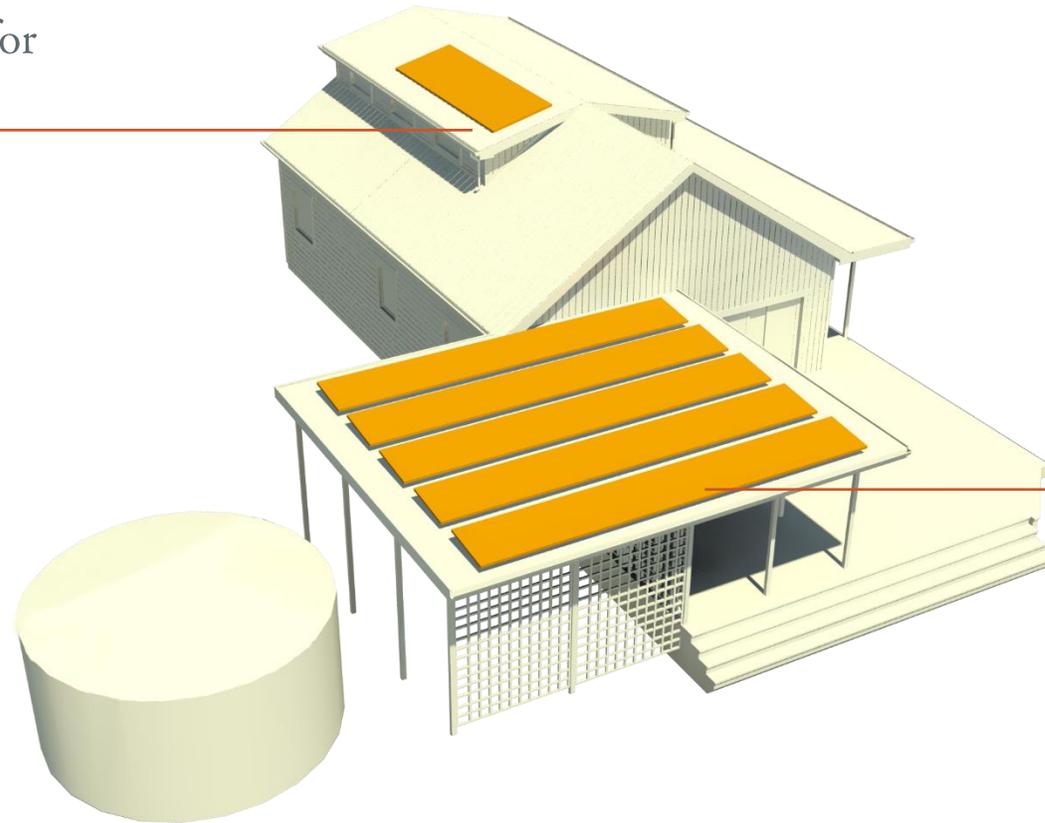
	REM/Rate Result	BEopt Result
Heating (kWh)	1795	1159
Cooling (kWh)	415	278
Hot Water (kWh)	1100	1415
Lighting & Appliances (kWh)	4388	4125
Annual Total (kWh)	7698	6977

HOURLY ENERGY SIMULATION RESULTS



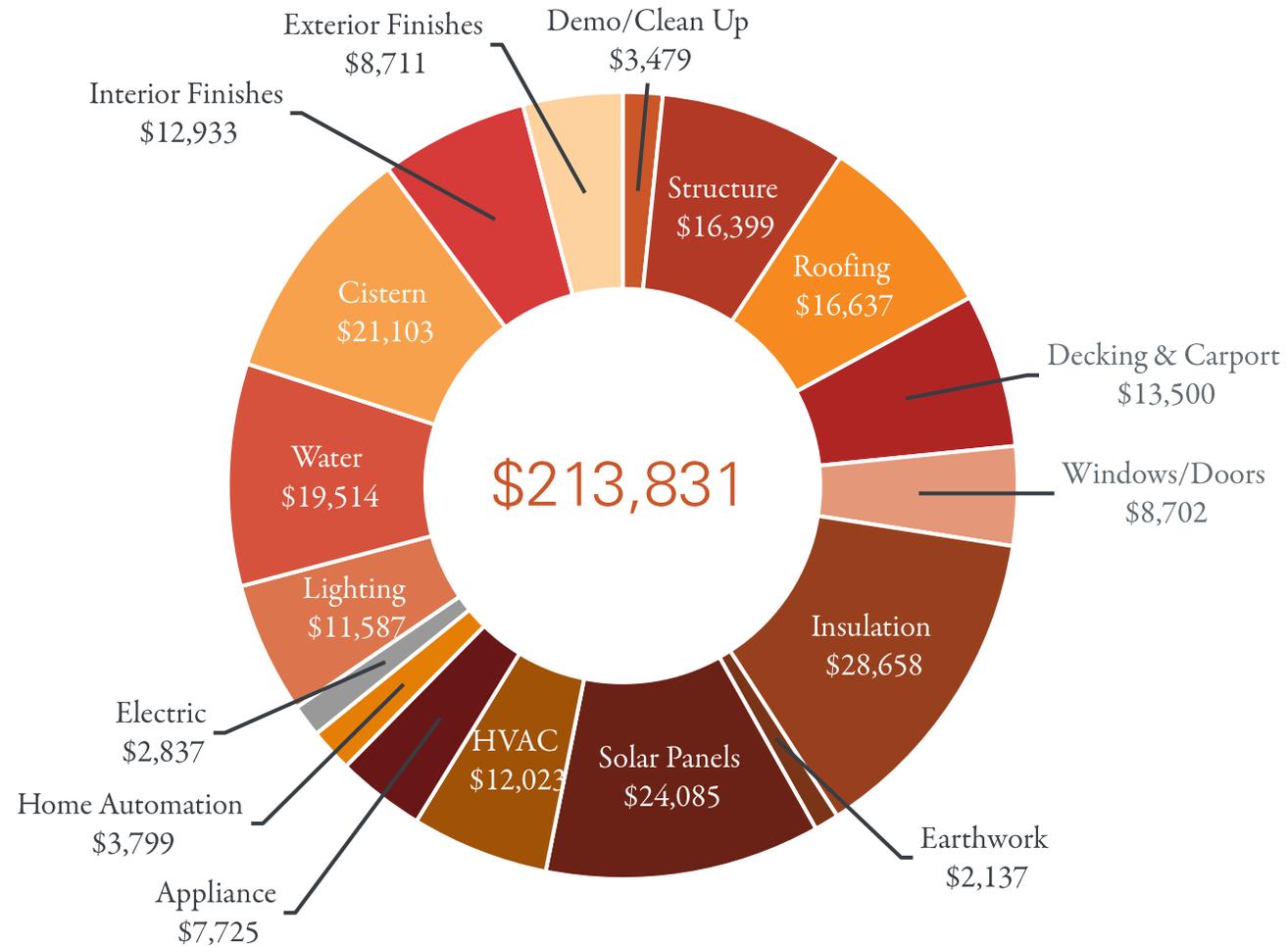
PHOTOVOLTAIC SYSTEM

Proposed location for
additional panels



5x5 Array
6,880 kW

CONSTRUCTION COSTS



FINANCIAL BREAKDOWN

Monthly Debt

Property Tax	\$649.97
Insurance	\$65.00
Household Debt	\$30.00
Utility Costs	\$15.49
Mortgage PMT	\$1,459.19
Debt to Income Ratio	37%

Monthly Debt with Incentives

After year 1	\$(283,342.09)
Subtract Incentives	\$16,344.22
PV	\$(266,997.87)
Payback Period	309.61
Payment if Refinanced	\$(1,375.02)
BE Ratio if Refinance	36%

Incentives

PV State	\$6,338.28
PV Federal	\$7,605.94
Utilities	\$2,400.00

DOMESTIC HOT WATER

Fixture	Diameter (in)	HW Run (ft)	Vol. in Pipe (gal)	Maximum Flow Rate (gpm)	Minimum Estimated Wait Time (s)	Supply Velocity (ft/s)
Single Basin Sink w/ Faucet	1/2	9.75	0.0899	1.5	3.60	3.59
Single Basin Sink w/ Faucet	1/2	10.25	0.0945	1.5	3.78	3.59
Shower Head	1/2	6.42	0.0592	2	1.79	3.27
Shower Head	1/2	5.00	0.0461	2	1.38	2.94
Double Basin Sink w/ Faucet	1/2	21.58	0.1990	2.2	5.58	2.94
Dish Washer	1/2	19.00	0.1752	-	-	-
Clothes Washer	1/2	11.50	0.1060	-	-	-

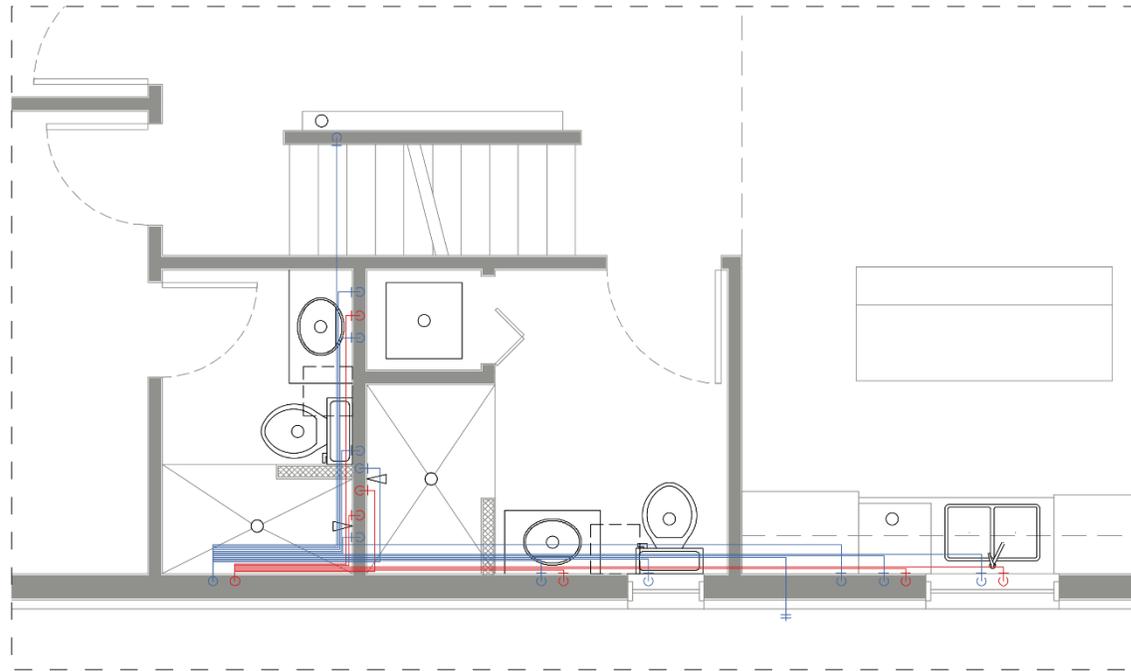
Energy Factor

Efficiency: 2.78

Hybrid: 2.75

Electric: 0.83

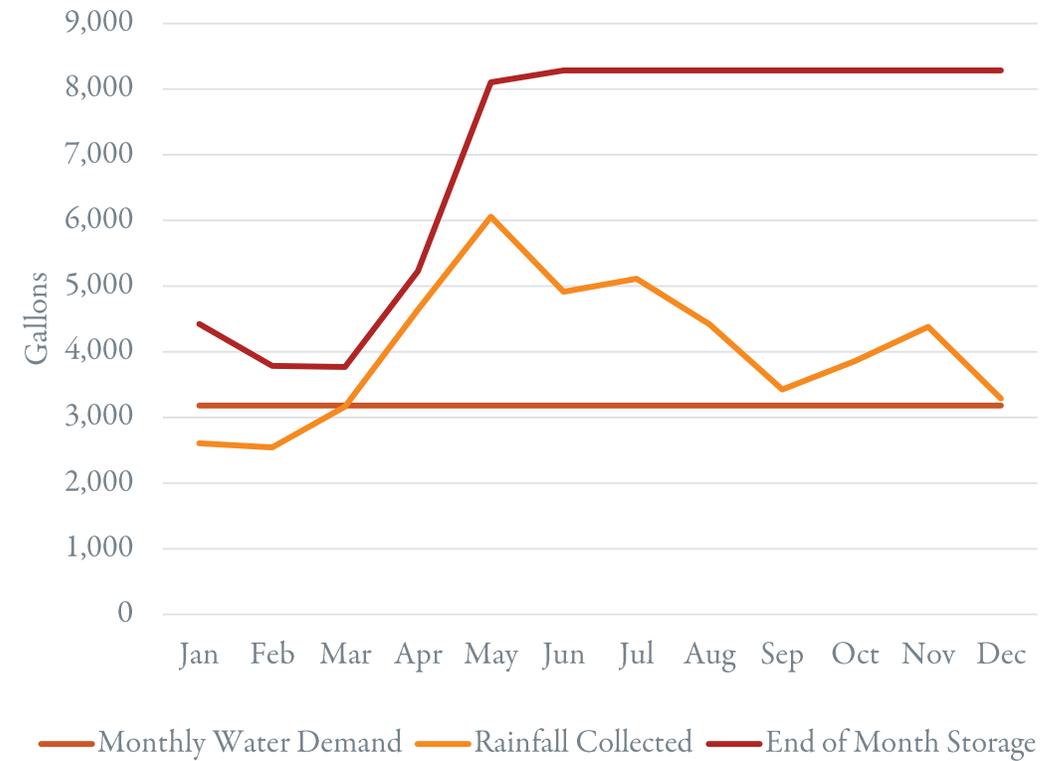
DOMESTIC HOT WATER PLAN



NET ZERO WATER



Annual Rainwater Collection



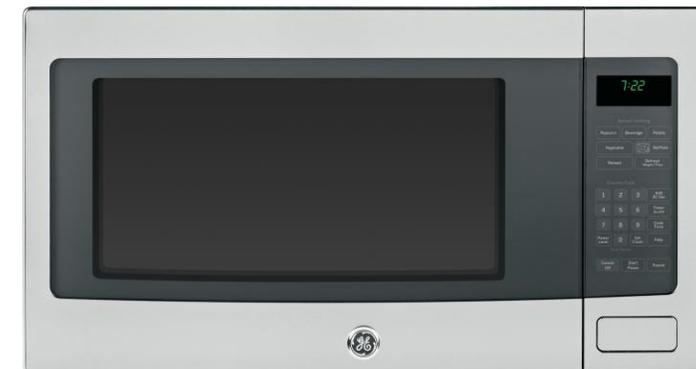
APPLIANCES

Whirlpool HybridCare Duet Dryer with Heat Pump Technology

Summit 12" induction cooktop

GE Profile Series

1,814 kWh total



LIGHTING

Consistent and Efficient

Agro Plant Light

Molex Transcend (VLM)

- Easily Customizable: Beam Spread, Intensity and Color
- Freedom of Sockets: Easily Relocated or Swapped Out



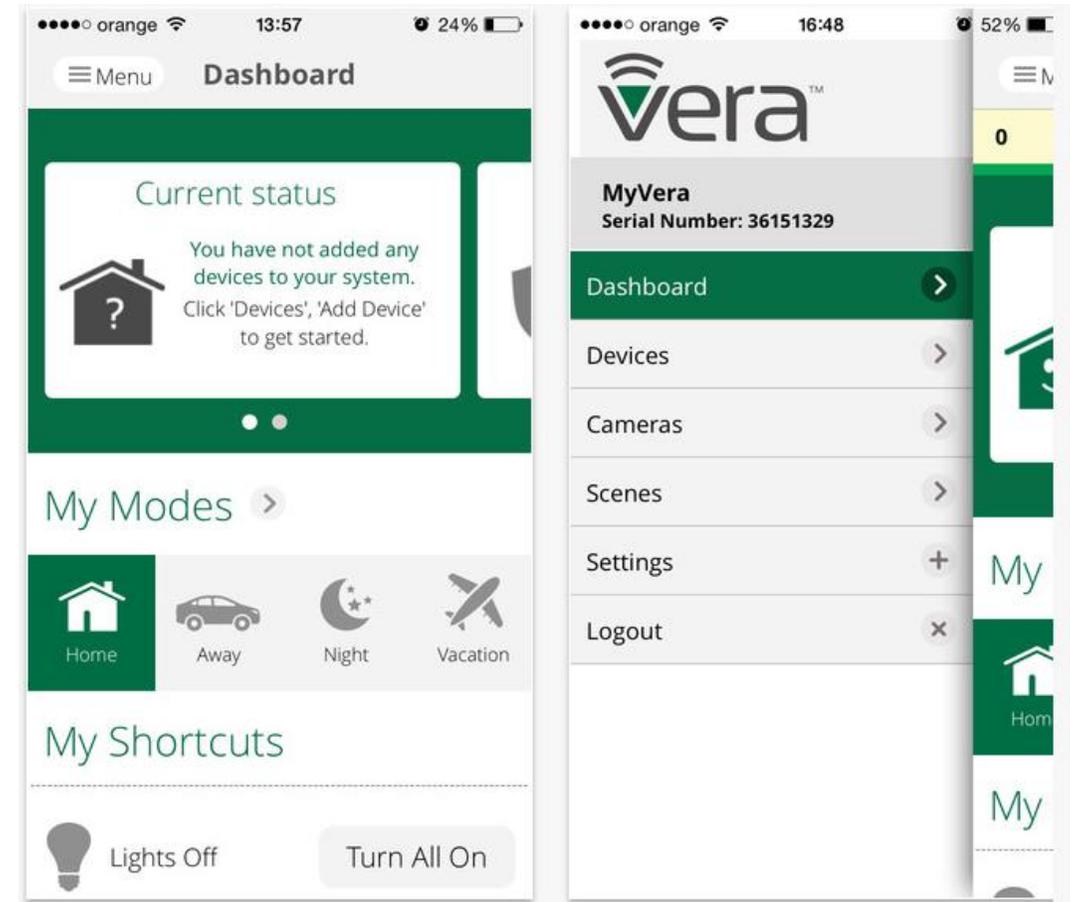
HOME AUTOMATION, CONTROLS & MONITORING

VeraEdge Home Automation

Programmable Thermostat

Sensor

Air Quality Monitor



INDUSTRY PARTNERS

SOM

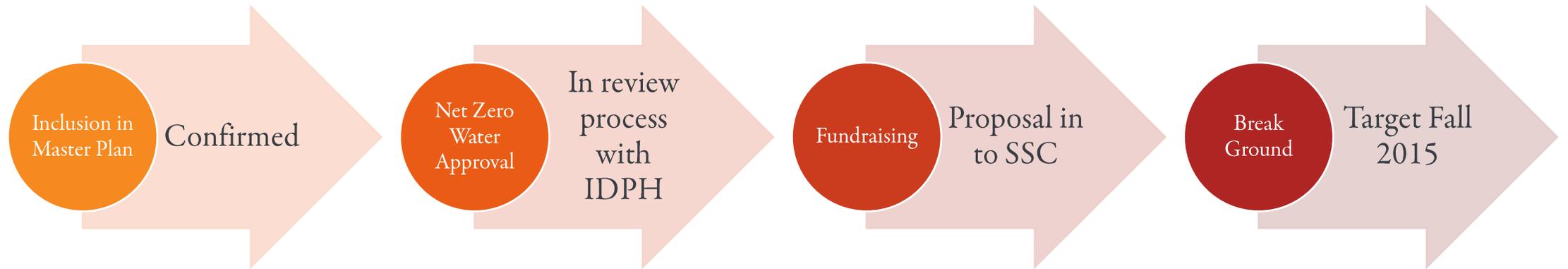


KENNEDY HUTSON ASSOCIATES



THANK YOU

NEXT STEPS





Thank You
Sun Catcher Cottage

TEAM ILLINOIS

U.S. DEPARTMENT OF ENERGY RACE TO ZERO STUDENT DESIGN COMPETITION