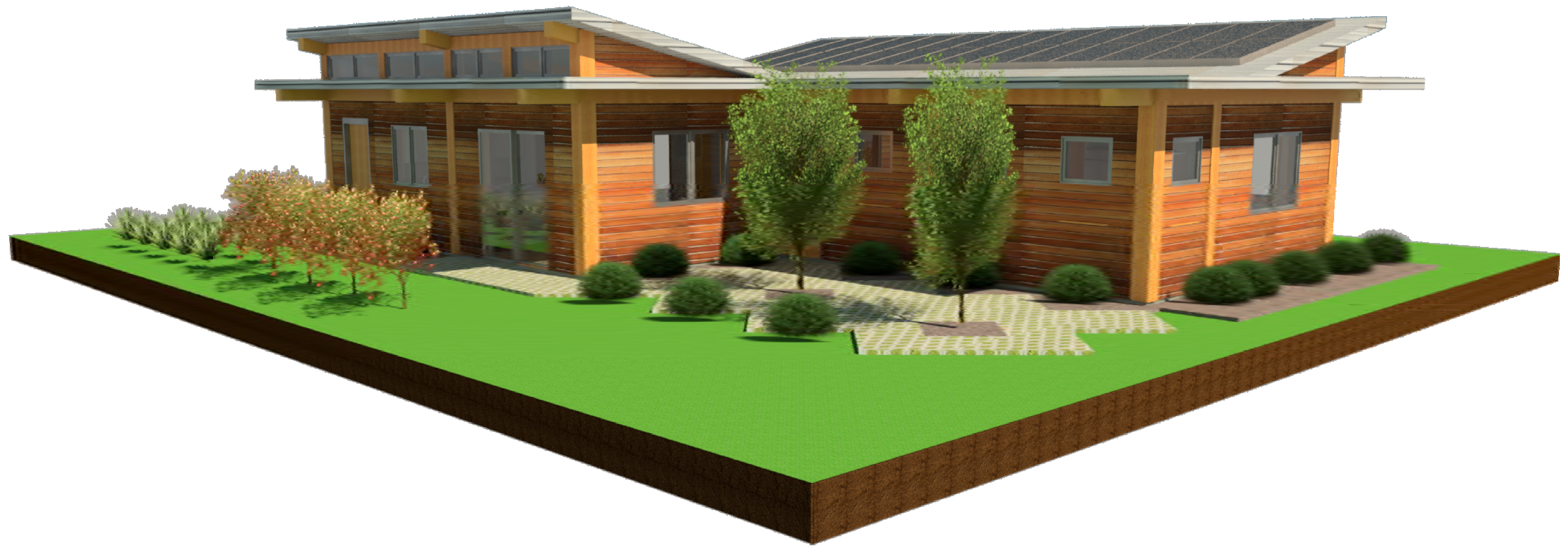
JUST BIG ENOUGH
GREEN HOUSING FOR ALL DESIGN COMPETITION

THE GATEWAY HOUSE

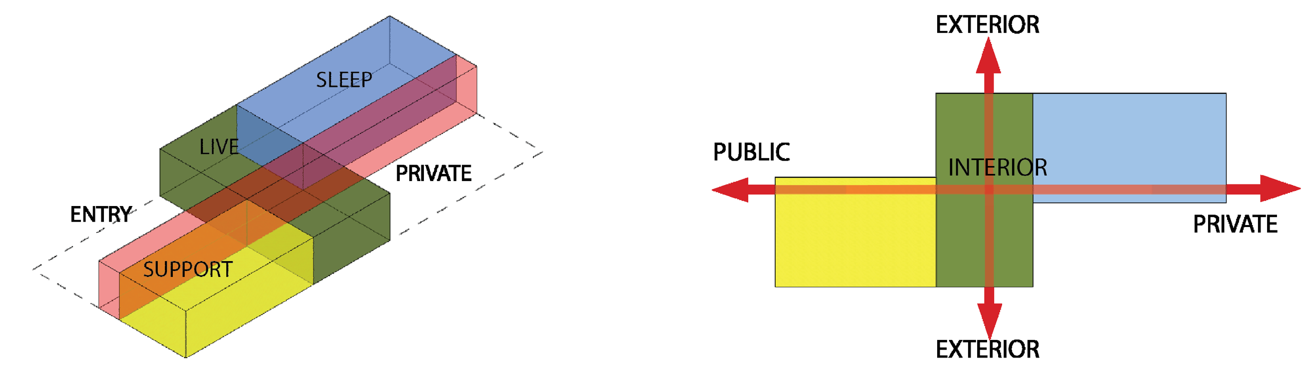
STEPHEN SCHREIBER, FAIA
RYAN RENDANO, LEED GA
WITH JANE THURBER (LANDSCAPE CONCEPT)

SOUTHEAST EXTERIOR PERSPECTIVE

(2 BEDROOM UNIT SHOWN)



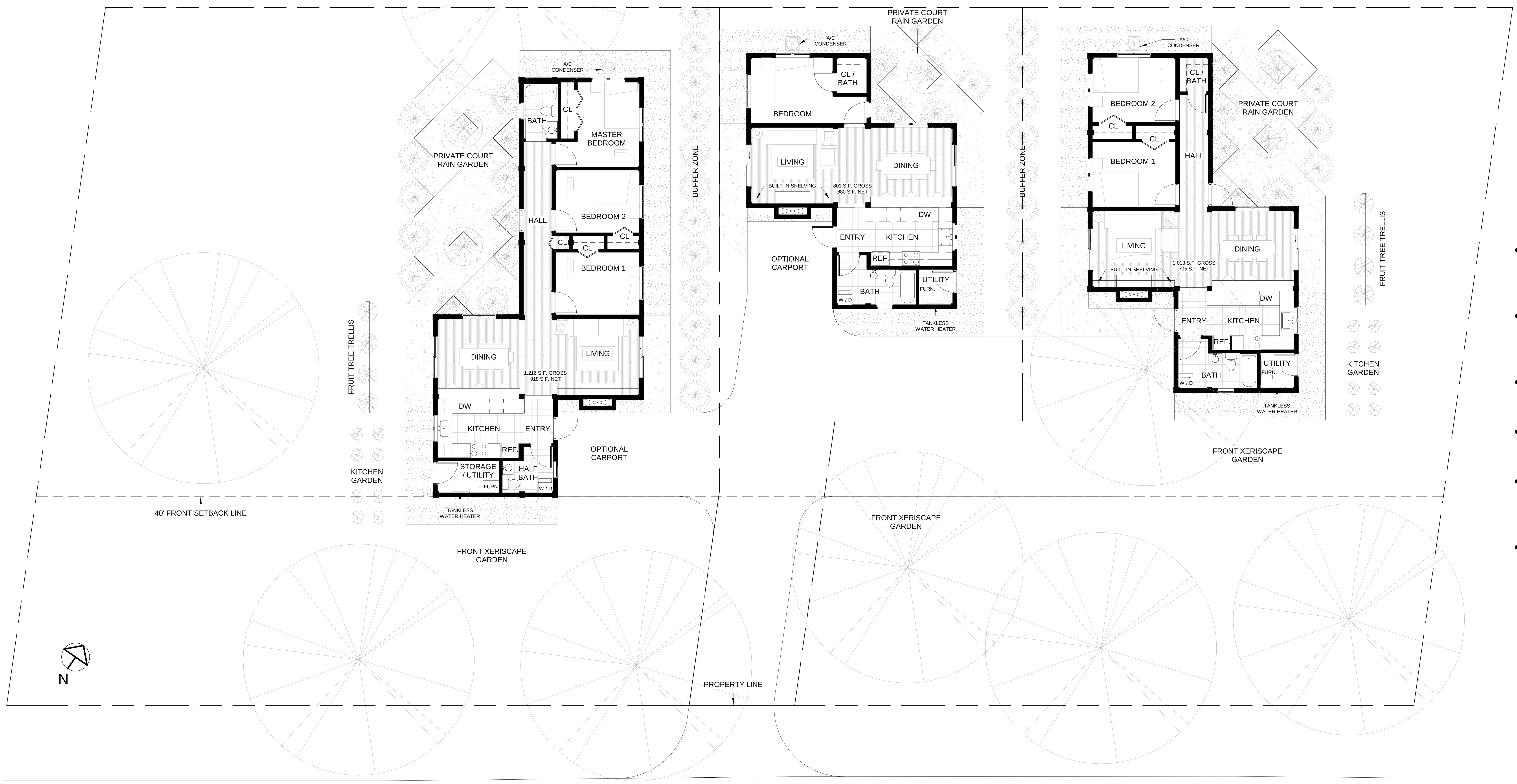
CONCEPT



OVERVIEW

The Gateway House consists of two connected modules, slipped along a central axis. The offset volumes create two major outdoor spaces; a xeriscape entry court facing the street, and private rain garden in the back.

Through its open plan layout and expansive cross-circulation patterns, the building emphasizes connection to the surrounding natural landscape, and challenges the notion of the home as a unit of isolation and containment. Rather, the Gateway House acts as a portal to nature--a suggestion to what lies beyond.



1 SITE PLAN
1/8" = 1'-0"

GOALS

- **Ease of Construction** - Modules can be stick-built or fabricated off-site. Timber frame structure sequesters carbon and has low embodied energy.
- **Passive Design** - Long and narrow volumes allow for passive ventilation, plentiful natural daylight, and generous outdoor spaces.
- **Visitable** - The home's compact, single-story plan is designed for ease of accessibility and allows for aging in place.
- **Affordable** - At just 918 net square feet for the three-bedroom unit, the Gateway House makes efficient use of resources.
- **Flexible** - Z-shaped plan can be easily flipped and rotated to accommodate a wide range of user needs and maximize efficiency based on site orientation.
- **Energy Efficient** - Anticipating a total energy use intensity of 29.1 kBTU/ft^2; an 80.25% reduction over the baseline energy model. Southern-facing, roof solar arrays are used to achieve net zero energy.

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ENERGY MODELING

(3 BEDROOM UNIT SHOWN)

The project team used eQUEST 3-65 energy modeling software to simulate the building's total annual energy use intensity (EUI). The projected energy savings of 80.25% are the result of an integrated package of passive and active design strategies, including:

- A high-performance building envelope with R-20 slab insulation, R-45 walls, R-60 roof system, and triple glazed low-e windows with a low window-to-wall ratio.
- Utilizing chilled water for cooling, and hot water for heating via a 4-pipe fan coil unit system with a heat pump and variable speed drive motors.
- Optimized building occupancy schedules and HVAC setpoint temperatures for heating and cooling.
- Exterior horizontal shading overhangs supplemented with interior shades and daylighting controls for artificial lighting.
- **Southern-facing, rooftop solar array generates an additional 30.67 kBTU/ft². This value offsets the total optimized EUI to achieve net zero energy.**

BASELINE DESIGN

Annual Electric Consumption
139,132 kBTU

Annual Gas Consumption
98,060 kBTU

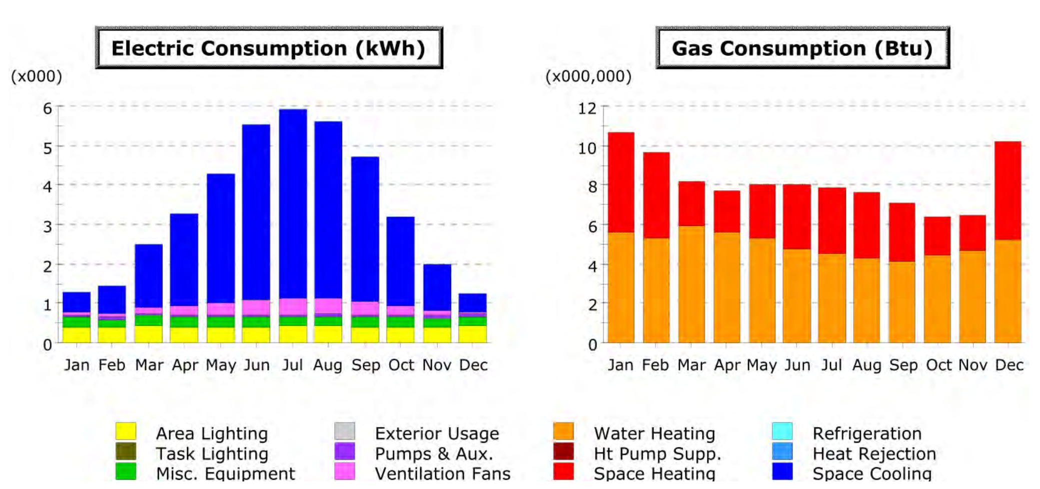
Total Energy Use Intensity (EUI)
147.3 kBTU/ft²

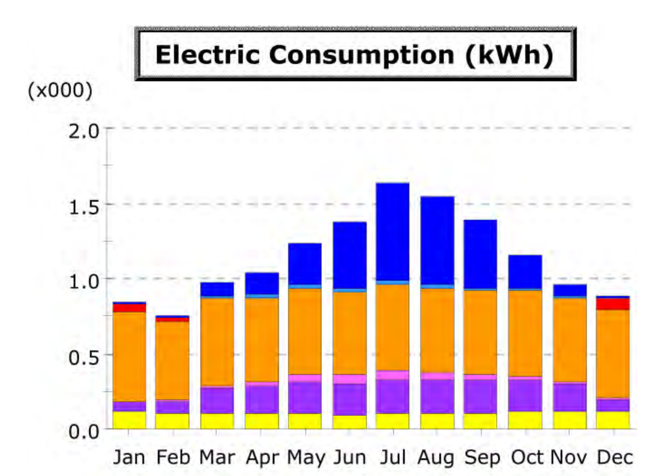
FINAL OPTIMIZED DESIGN

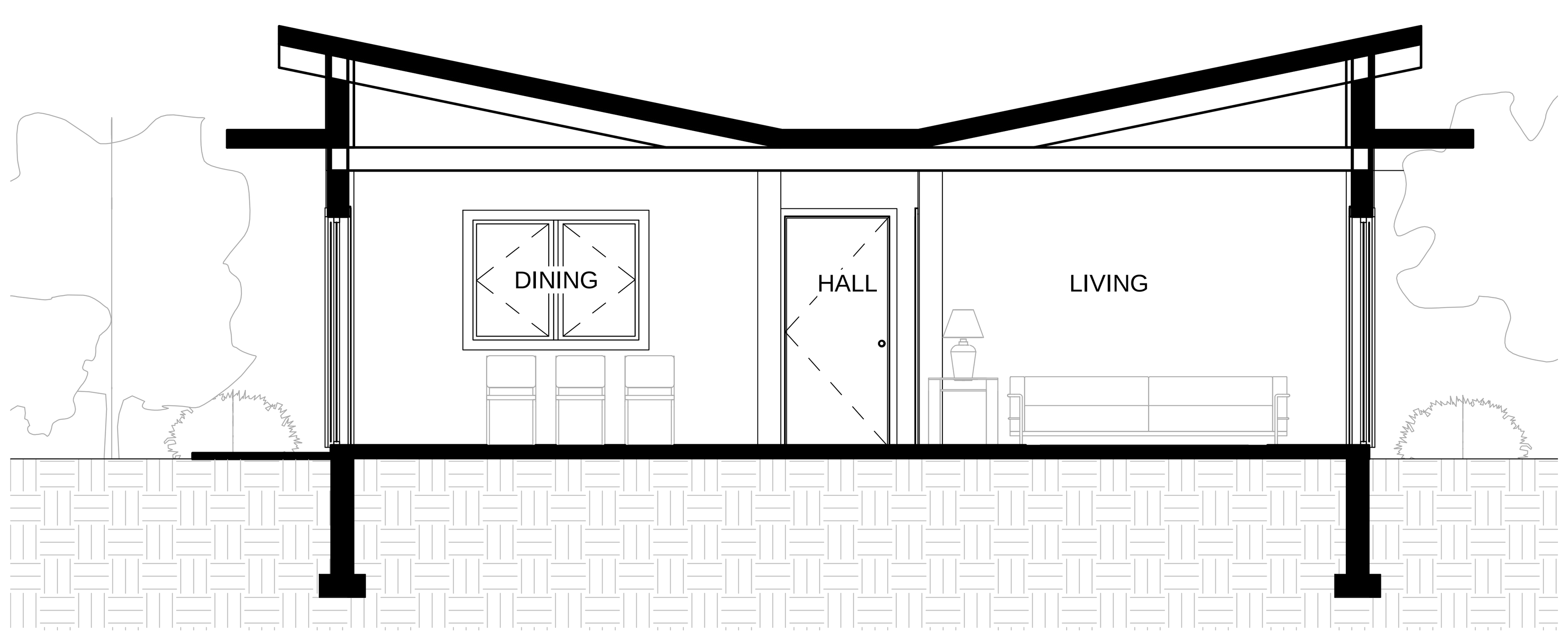
Annual Electric Consumption
47,088 kBTU

Total Energy Use Intensity (EUI)
29.1 kBTU/ft²

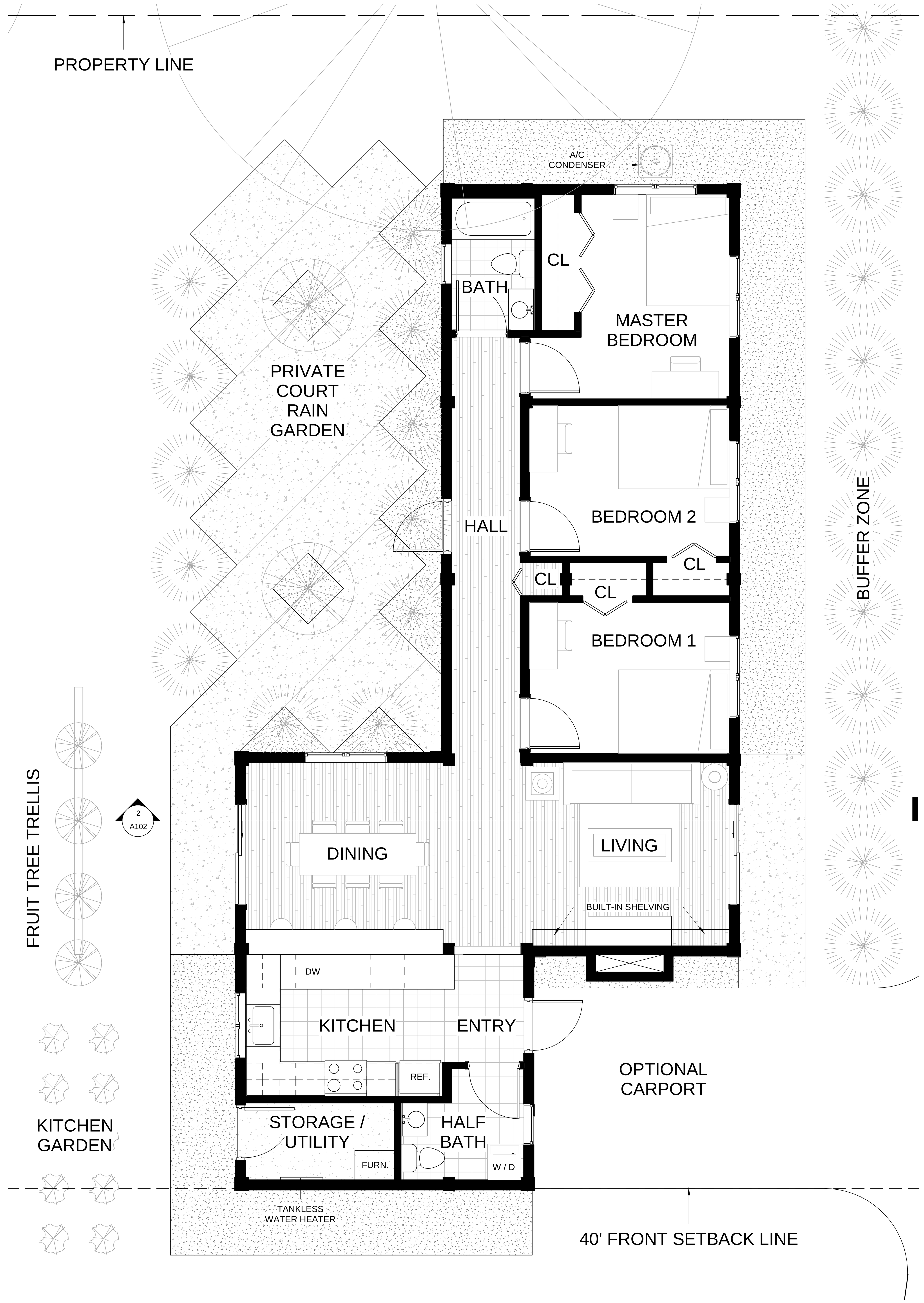
Total Energy Reduction from Baseline
80.25%



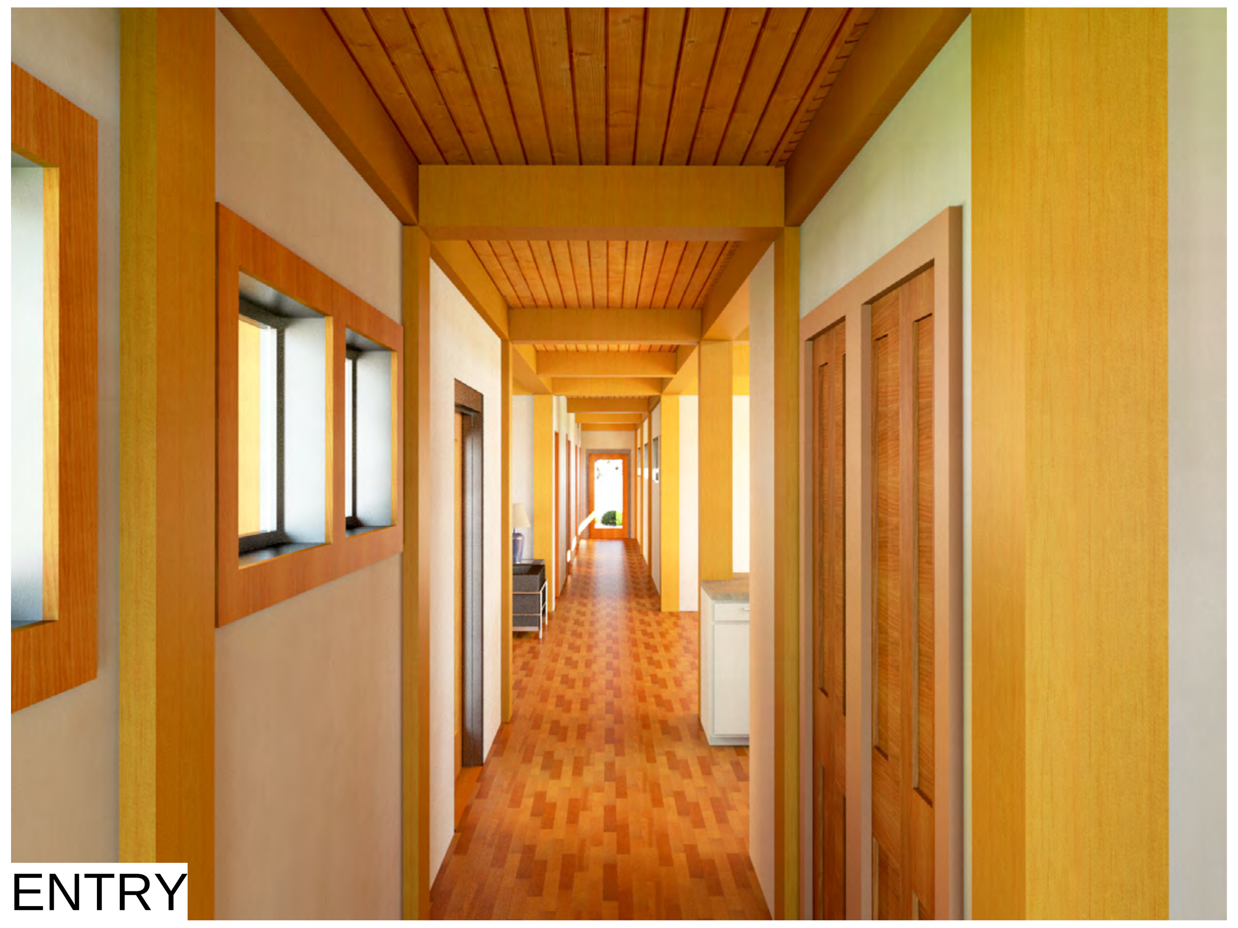




2 SECTION
1/4" = 1'-0"



1 FIRST FLOOR PLAN (3 BEDROOM UNIT SHOWN)
1/4" = 1'-0"



ENTRY

LIVING

DINING

Description	Material	Labor	Total
Direct			
Site Work	$3,244.00	$165.00	$3,409.00
Sewer, Water Gas	$2,148.00	$545.00	$2,693.00
Building Concrete	$8,767.00	$6,178.00	$14,945.00
Outside Concrete	$1,235.00	$2,318.00	$3,553.00
Rough Carpentry	$11,237.00	$6,655.00	$17,892.00
Cabinets	$6,570.00	$0.00	$6,570.00
Finish Carpentry	$1,552.00	$1,312.00	$2,864.00
Interior Doors	$1,520.00	$1,284.00	$2,804.00
Exterior Doors	$1,979.00	$94.00	$2,073.00
Insulation	$4,682.00	$1,019.00	$5,701.00
Exterior Siding	$12,462.00	$11,701.00	$24,163.00
Roofing	$3,620.00	$1,240.00	$4,860.00
Hardware	$201.00	$47.00	$248.00
Windows	$1,600.00	$372.00	$1,972.00
Drywall	$4,890.00	$6,411.00	$11,301.00
Painting	$1,583.00	$2,772.00	$4,355.00
Floor Covering	$3,799.00	$1,926.00	$5,725.00
Plumbing	$3,274.00	$4,730.00	$8,004.00
Tubs, Showers	$964.00	$621.00	$1,585.00
Bath Acces. & Mirrors	$334.00	$125.00	$459.00
Appliances	$3,142.00	$0.00	$3,142.00
HVAC System	$3,611.00	$2,228.00	$5,839.00
Fireplace	$1,532.00	$240.00	$1,772.00
Electrical	$1,857.00	$2,131.00	$3,988.00
Light Fixtures	$1,341.00	$271.00	$1,612.00
Direct Total	**$87,144.00**	**$54,385.00**	
Indirect			
Final Cleanup	$0.00	$775.00	$775.00
Building Permit	$4,743.00	$0.00	$4,743.00
Utility Connection Fees	$4,677.00	$0.00	$4,677.00
Add Category to Indirect			
Indirect Total	**$9,420.00**	**$775.00**	
Contractor Overhead & Profit	**$0.00**	**$14,153.00**	**$14,153.00**
Total	**$96,564.00**	**$69,313.00**	**$165,877.00**

Overview

The project team used eQUEST 3-65 energy modeling software to simulate the building's total annual energy use intensity (EUI). Through the integrated package of passive and active design strategies outlined below, the Architects reduced the annual EUI from a baseline of 147.2 kBTU/ft^2, to an optimized design of 29.1 kBTU/ft^2-- an 80.25% reduction over the baseline energy model. A southern-facing, rooftop solar array generates an additional 30.67 kBTU/ft^2. This value offsets the total optimized EUI to achieve net zero energy.

Baseline Design Results
Annual Electric Consumption = 139,132 kBTU
Annual Gas Consumption = 98,060 kBTU
Total Energy Use Intensity = 147.3 kBTU/ft^2

Optimized Design Results
Annual Electric Consumption = 47,088 kBTU
Total Energy Use Intensity = 29.1 kBTU/ft^2
Total Energy Reduction from Baseline = 80.25%

1. Passive Design Strategies

The building's compact footprint maximizes surrounding open green space. Long and narrow massing allows for natural ventilation, while clerestory windows provide plentiful natural daylighting throughout. All windows are triple glazed insulated units and shaded using exterior horizontal overhangs supplemented by opaque interior shades. The optimized window-to-wall ratio mitigates solar heat gains and energy losses, while providing generous views to the exterior. The building's timber frame structure is a renewable resource with low embodied energy, and naturally sequesters carbon. Rainwater is captured onsite via the roof system, treated, and used to irrigate the landscape.

2. Building Envelope

The building's floor system uses a slab on grade construction, with full under slab rigid board insulation to achieve R-20. Insulation is continuous between the slab and wall system to prevent thermal breaks. Walls use advanced wood frame stud construction, made possible by the timber post and beam structural system. The R-45 wall system is comprised of interior gypsum board, 2x6 framing insulated with dense pack cellulose insulation, plywood sheathing, a vapor barrier, and 3" of rigid foam board insulation. 1x4 batten boards are used to create a rain screen between the waterproofing and exterior siding. The low maintenance, standing seam metal roof uses a combination of cellulose and rigid insulation to achieve R-60, while its high solar reflectance index reduces solar heat gains during the cooling season.

3. Heating, Ventilation, and Cooling (HVAC) Systems

Building occupancy schedules are modified to reflect typical daily use patterns. Thermostat set point temperatures were adjusted from their default values to maximize heating and cooling savings, while still providing adequate thermal comfort for occupants. The HVAC system utilizes chilled water for cooling, and hot water for heating, delivered via a 4-pipe fan coil unit (FCU) system with a heat pump and optimized variable speed drive motors.

4. Lighting

High efficiency LED light fixtures with dimming control help to reduce annual electric bills.

* For a detailed summary of all energy modeling inputs and results, please see the full eQUEST reports available below.

Baseline Design - https://udrive.oit.umass.edu/xythoswfs/webview/_xy-10098705_1

Optimized Design - https://udrive.oit.umass.edu/xythoswfs/webview/_xy-10098703_1
https://udrive.oit.umass.edu/xythoswfs/webview/_xy-10098704_1

Overview

The Gateway House consists of two connected modules, slipped along a central axis. The offset volumes create two major outdoor spaces—a xeriscape entry court facing the street, and private rain garden in the back. Through its open plan layout and expansive cross-circulation patterns, the building emphasizes connection to the surrounding natural landscape, and challenges the notion of the home as a unit of isolation and containment. Rather, the Gateway House acts as a portal to nature--a suggestion to what lies beyond. Goals include:

1. **Energy performance**

At a maximum of just 918 net square feet for the three-bedroom configuration, the Gateway House makes efficient use of space. The design team used eQUEST 3-65 energy modeling software to perform whole building energy analysis. Through an integrated package of passive and active design strategies, the architects reduced the annual EUI from a baseline of 147.3 kBTU/square foot, to an optimized 29.1 kBTU--an 80.25% reduction over the baseline energy model. A southern-facing, rooftop solar array generates an additional 30.67 kBTU/square foot. This value offsets the total optimized EUI to achieve net zero energy.

2. **Sustainability**

The Gateway House has a simple footprint, with maximum spans of 14 feet. The house can easily be built using conventional lumber, or with nail laminated timber made from recycled materials. Long and narrow massing with clerestory windows allows for passive ventilation and provides plentiful natural daylight throughout. The compact, single-story plan is designed for ease of accessibility, and allows for aging in place.

The building's exterior envelope is comprised of R-45 walls, which could be either factory panelized SIPS (structurally insulated panels), or site built wood framed stud walls with dense pack cellulose and rigid foam board insulation. Battens are used to create a rain screen between the waterproofing and cementitious or wood siding. Thermal bridging is avoided. Windows are inset or pulled out within the thick walls depending on site orientation.

Windows are shaded by exterior brise soleil. Owners can opt for dual or triple glazed argon gas windows for greater efficiency. The recommended roofing material is a low-maintenance standing seam metal roof, with dense pack cellulose and rigid foam insulation. Each roof drains to its own filtration system to mitigate stormwater runoff. Roofs deposit rainwater into a cistern that nourishes the surrounding gardens.

Two mini-split ductless units provide heating and cooling. High efficiency LED light fixtures reduce annual energy bills. The building is designed to accommodate roof photovoltaic panels and solar hot water.

3. **Affordability**

The architects estimate that the house can be built for approximately $100 per square foot. The simple structure enables the house to be constructed on site by homeowners and conventional builders, or in a factory and trucked to the site. The strategic framing plan enables an efficient use of conventional lumber.

4. **Replicability**

The basic components of the Gateway House are flexible and can be resized, mirrored, and/or rotated to respond to changes in location, size requirements, and lot orientation. The house can be built to the setback line in two corners to allow for generous outdoor spaces.

Caution: Photovoltaic system performance predictions calculated by PVWatts® include many inherent assumptions and uncertainties and do not reflect variations between PV technologies nor site-specific characteristics except as represented by PVWatts® inputs. For example, PV modules with better performance are not differentiated within PVWatts® from lesser performing modules. Both NREL and private companies provide more sophisticated PV modeling tools (such as the System Advisor Model at http://sam.nrel.gov) that allow for more precise and complex modeling of PV systems.

The expected range is based on 30 years of actual weather data at the given location and is intended to provide an indication of the variation you might see. For more information, please refer to this NREL report: The Error Report.

The energy output range is based on analysis of 30 years of historical weather data for nearby , and is intended to provide an indication of the possible interannual variability in generation for a Fixed (open rack) PV system at this location.

RESULTS

9,193 kWh/Year*

System output may range from 8,995 to 9,616kWh per year near this location.

Month	Solar Radiation (kWh / m^2 / day)	AC Energy (kWh)	Energy Value ($)
January	2.24	467	61
February	3.10	582	76
March	3.88	798	105
April	4.93	943	124
May	5.36	1,032	136
June	6.00	1,094	144
July	5.83	1,090	143
August	5.22	980	129
September	4.29	800	105
October	3.15	621	82
November	2.10	409	54
December	1.83	377	50
Annual	3.99	9,193	$ 1,209

Location and Station Identification

Requested Location	burt's pit road
Weather Data Source	(TMY2) HARTFORD, CT 26 mi
Latitude	41.93° N
Longitude	72.68° W

PV System Specifications (Residential)

DC System Size	7.52 kW
Module Type	Premium
Array Type	Fixed (roof mount)
Array Tilt	12°
Array Azimuth	225°
System Losses	10%
Inverter Efficiency	96%
DC to AC Size Ratio	1.1

Economics

Average Cost of Electricity Purchased from Utility	0.13 $/kWh

Performance Metrics

Capacity Factor	14.0%