Single-Family Passive House LA

Building Type & Use: New construction, single-family home (detached)

Location: Culver City, CA

Occupancy/Client: Developed by the owner/architect on their own land behind their existing home.

Highlights: Passive House certification, zero net energy, all-electric design, high-performance envelope

This case study is part of a series illustrating how building energy modeling is applied on real projects — showing the tools, decisions, and outcomes that define high-performance design in practice. CalBEM, a collaborative initiative sponsored by Southern California Edison, brings together California's building energy modeling (BEM) community to advance solutions for high-performance buildings.

Building Data

- **Gross Floor Area:** 2,038 gross square feet.
- **Occupancy/Units:** A single-family home unit with three bedrooms and three bathrooms.
- **Structure:** Wood-frame construction.

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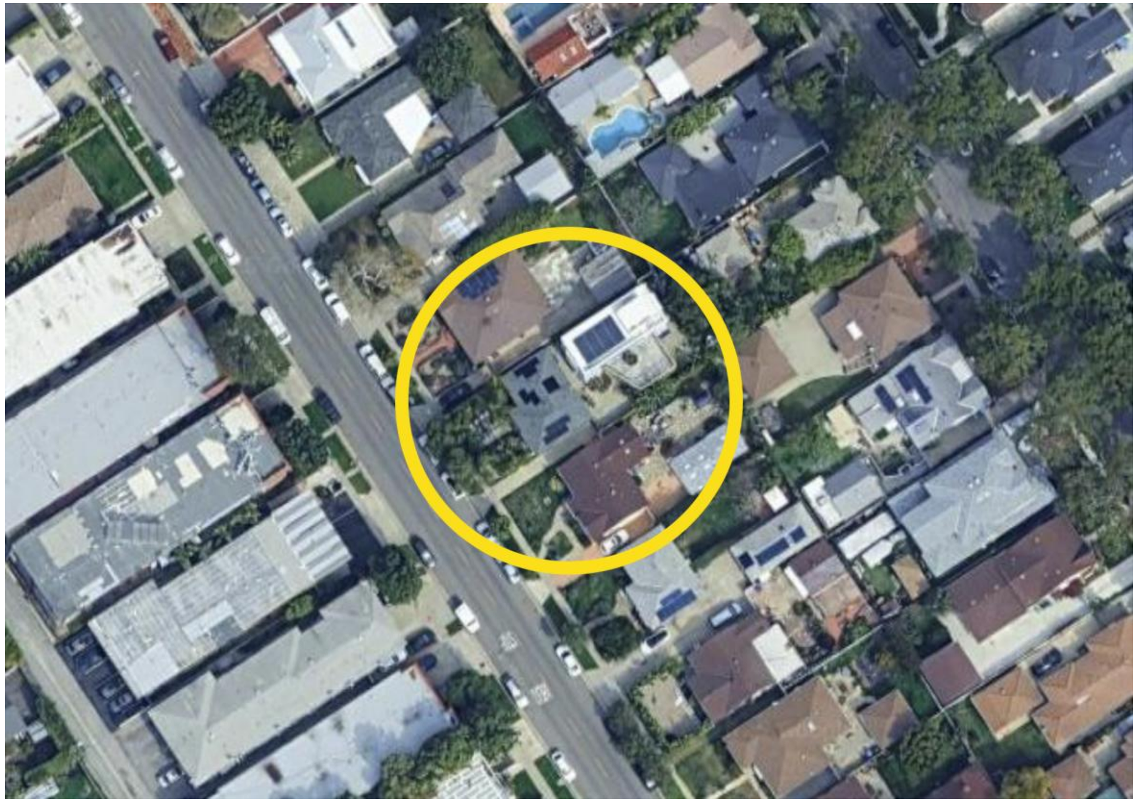
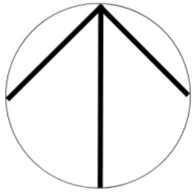


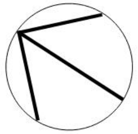
Passive House Los Angeles (PHLA+) - General Vicinity Plan

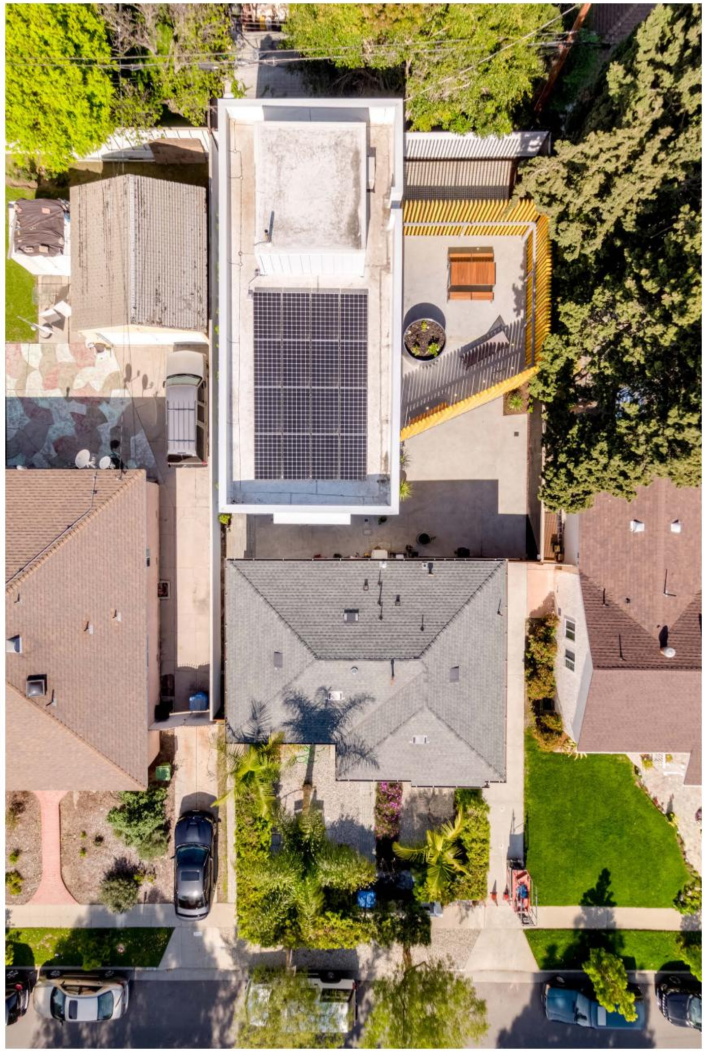


Site and Context

- Semi-urban duplex parcel in Culver City, CA.
- Includes existing post-war ranch-style house.
- Large cypress trees near the southern property line provide slightly obstructed solar access.

(Right) Aerial view of site and buildings. (Photo by Fraser Almeida)





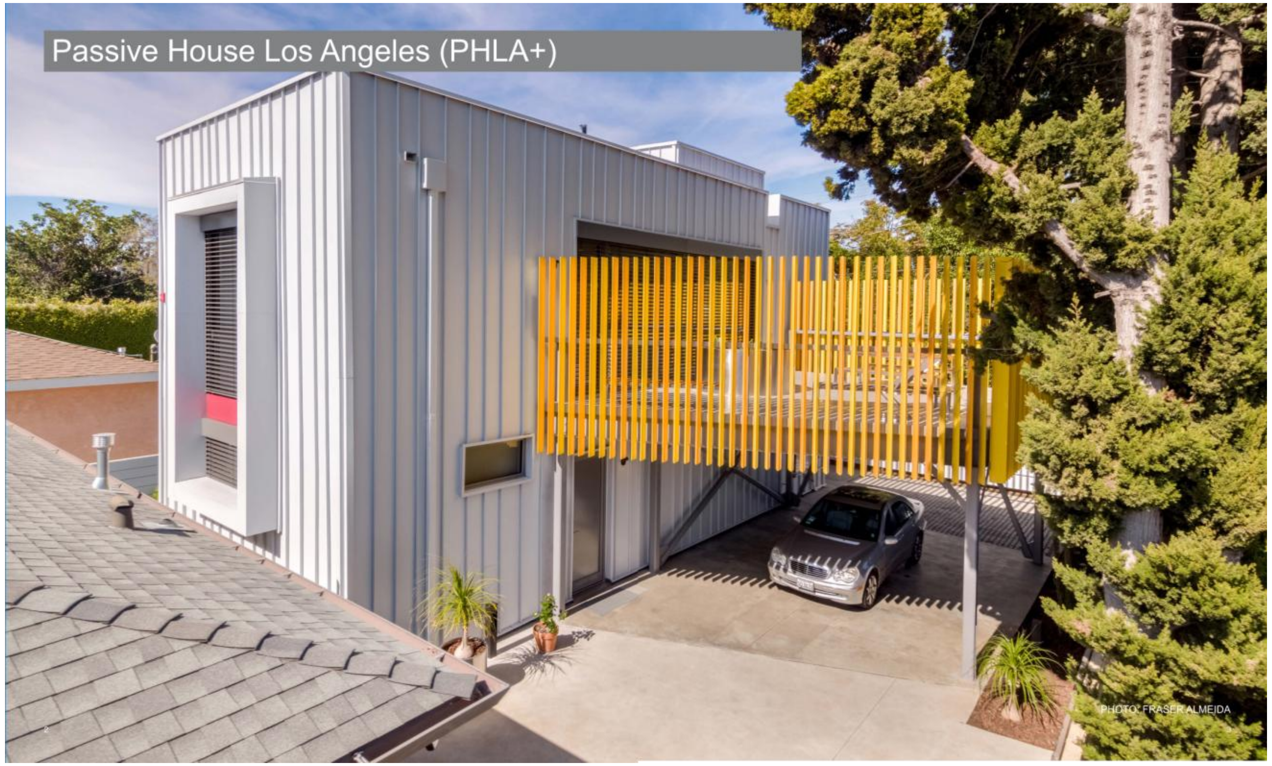
Mission and Goals

Three performance goals

1. Passive House Certification

2. Zero Net Energy

3. All-Electric Design

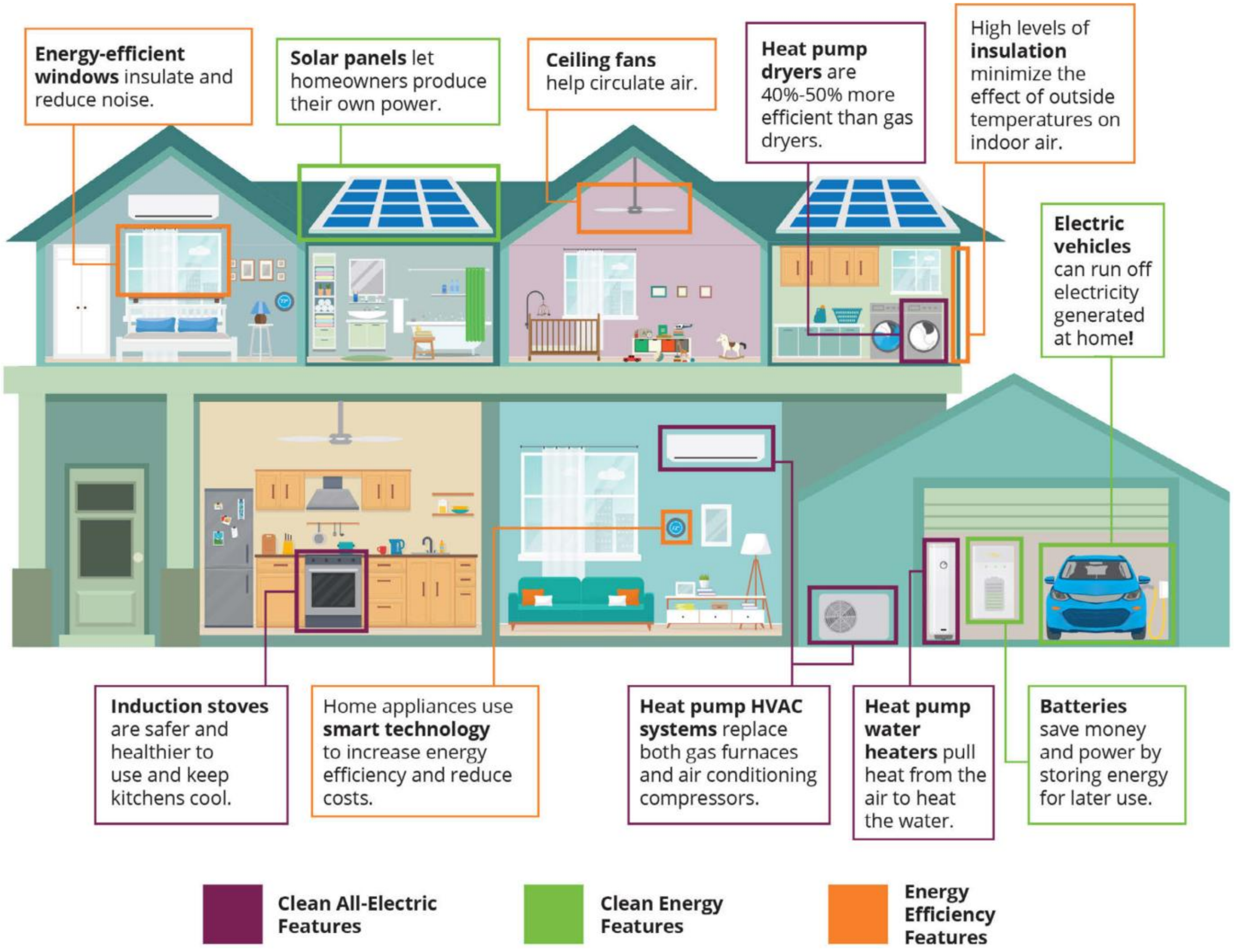


The Blueprint: Three Pillars of High-Performance Design

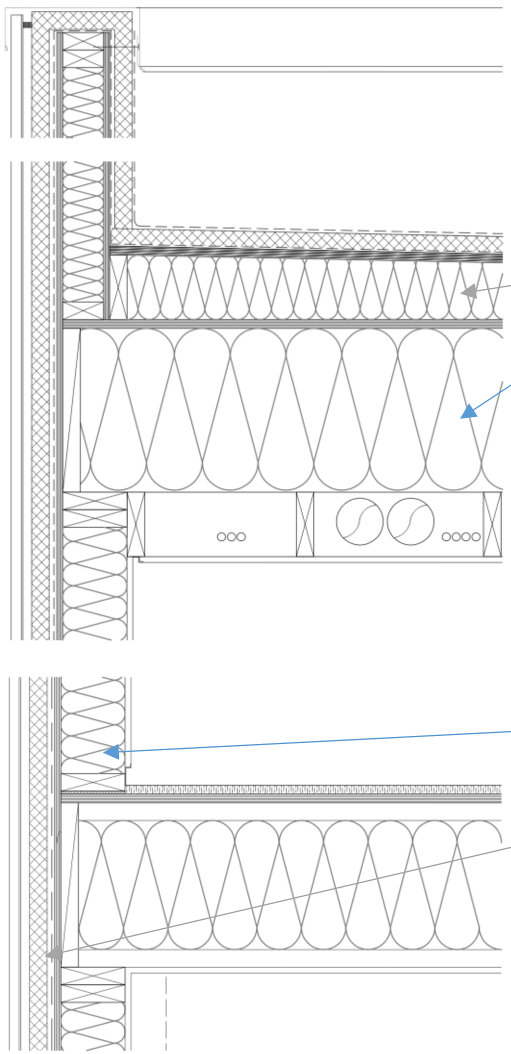
Pillar 1: Super-Insulated, Airtight Envelope

Pillar 2: Efficient HVAC Systems

Pillar 3: Renewables & Resiliency



Pillar 1: Building a Super-Insulated, Airtight Envelope



Roof (R-45)

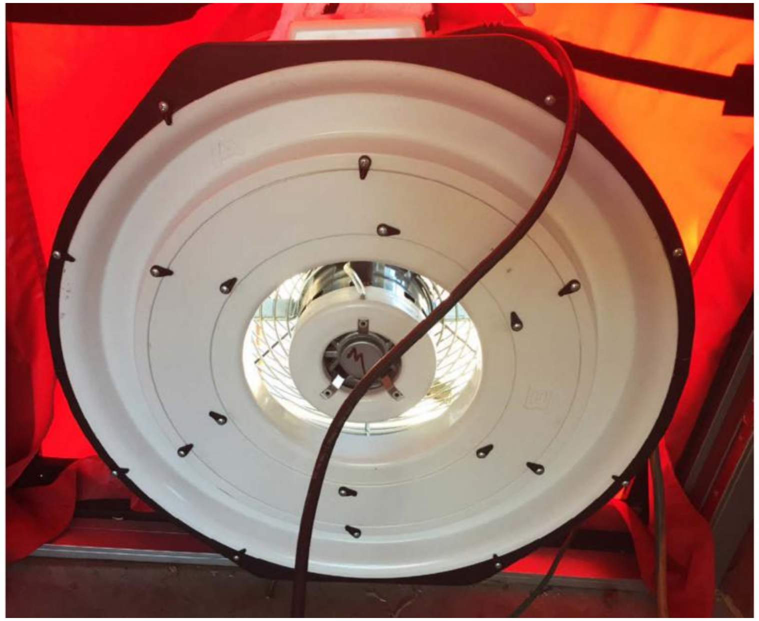
Blown mineral wool insulation between the roof joists and a rigid insulation board applied to the exterior (with a necessary slope for roof drainage)

Walls (R-31)

Mineral wool insulation between 2x6 framing with 1.5” continuous exterior rigid insulation board.

Continuous exterior insulation eliminating thermal bridging avoiding heat loss through more conductive details in the envelope.

Pillar 1: Building a Super-Insulated, Airtight Envelope



Airtightness:

Various sealants (expanding foam tape, gaskets, etc) applied to joints and gaps to ensure a tight air and vapor barrier. The home achieved 0.48 ACH50, surpassing the strict Passive House requirement of 0.6 ACH50.

[ACH50 = Air changes per hour at 50 pascals of pressure]

Pillar 1: Advanced Glazing and Smart Shading

Advanced Glazing:

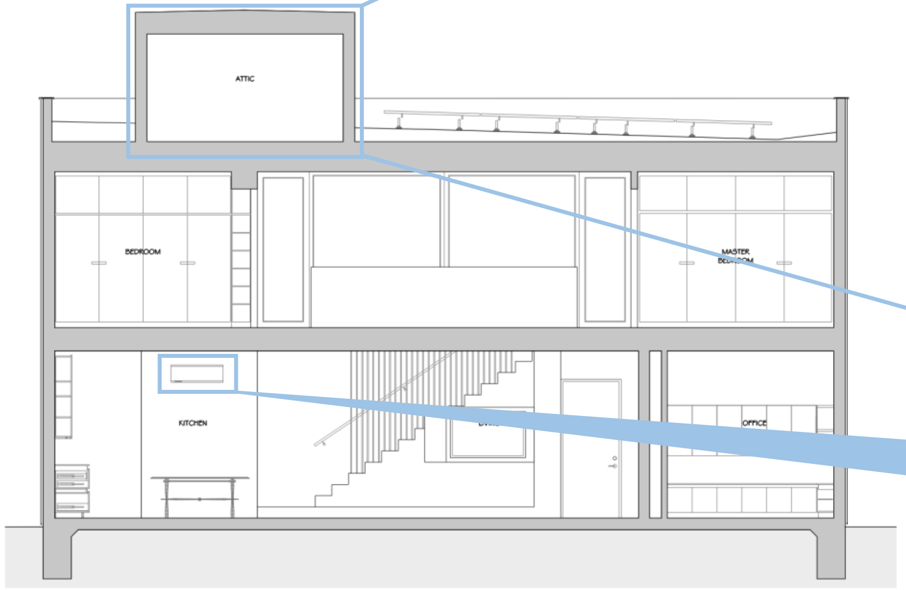
- The design features triple-glazed "tilt and turn" windows selected for both thermal performance and superior noise attenuation due to nearby flight paths.

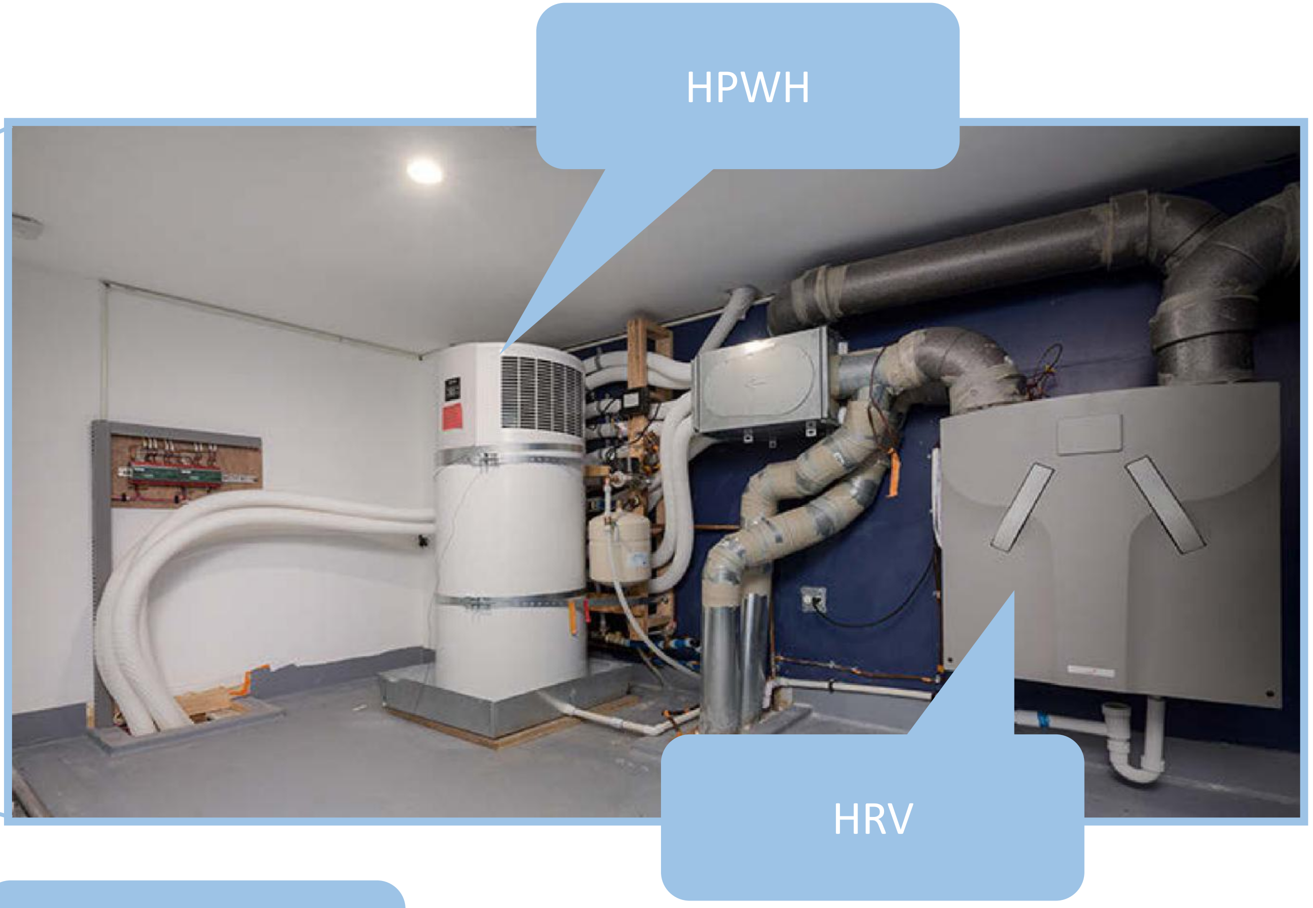
Smart Shading:

- An automated exterior blind system responds to the sun's position to maximize daylight while preventing direct solar heat gain.

Pillar 2: Efficient HVAC Systems

- **Heat & Cooling:** A single 0.9-ton ductless mini-split heat pump
- **Fresh Air:** Continuous, 24-hr fresh air from Heat Recovery Ventilator (HRV)
- **Appliances:** All-electric systems including a Heat Pump Water Heater (HPWH)





Pillar 3: On-Site Generation & Storage for Resiliency

After studying the large cypress tree impact of rooftop shading it was determined the impact would be minor on the PV array

System Specs:

- Solar PV Array: 5.36 kW system
- Battery Storage: 14 kWh

Battery enables load-shifting to avoid peak utility rates and provides uninterrupted power during grid outages

The Results: Prediction vs. Reality

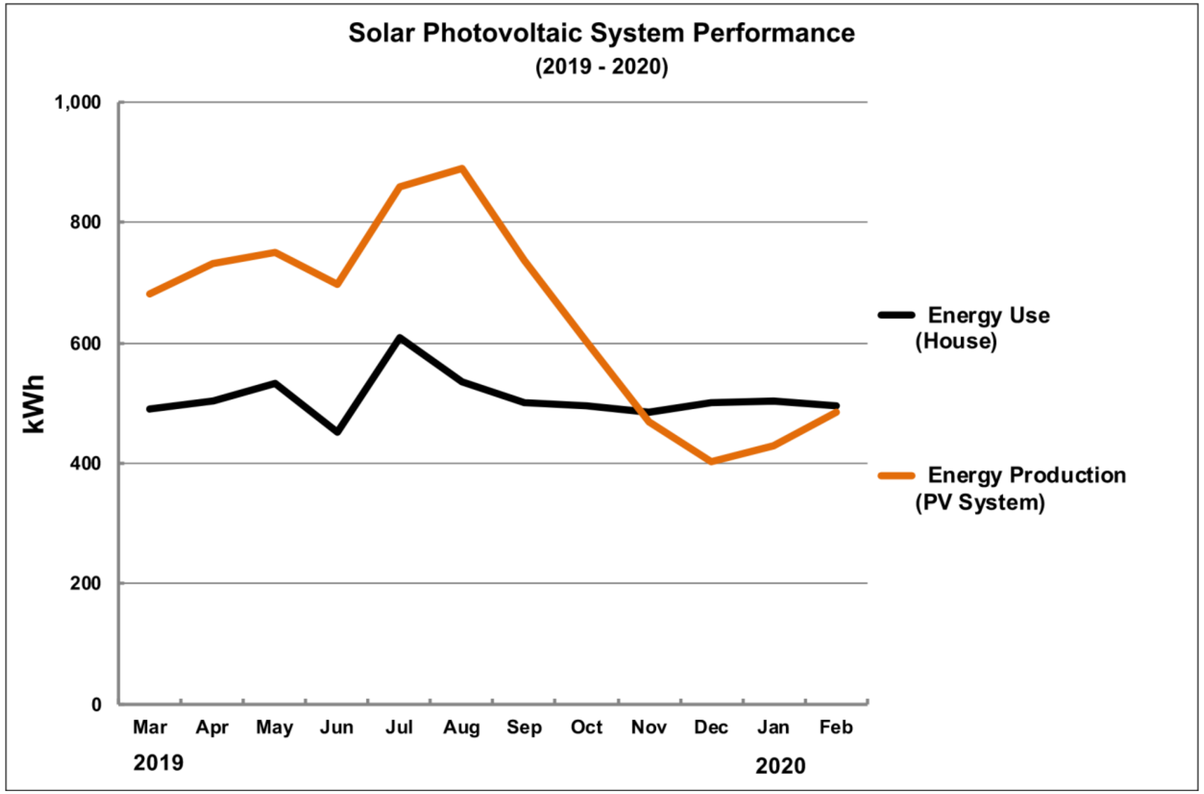
Passive House building simulation software (Passive House Planning Package, PHPP) was used to predict the energy use intensity (EUI) in kBtu/sq.ft of the home.

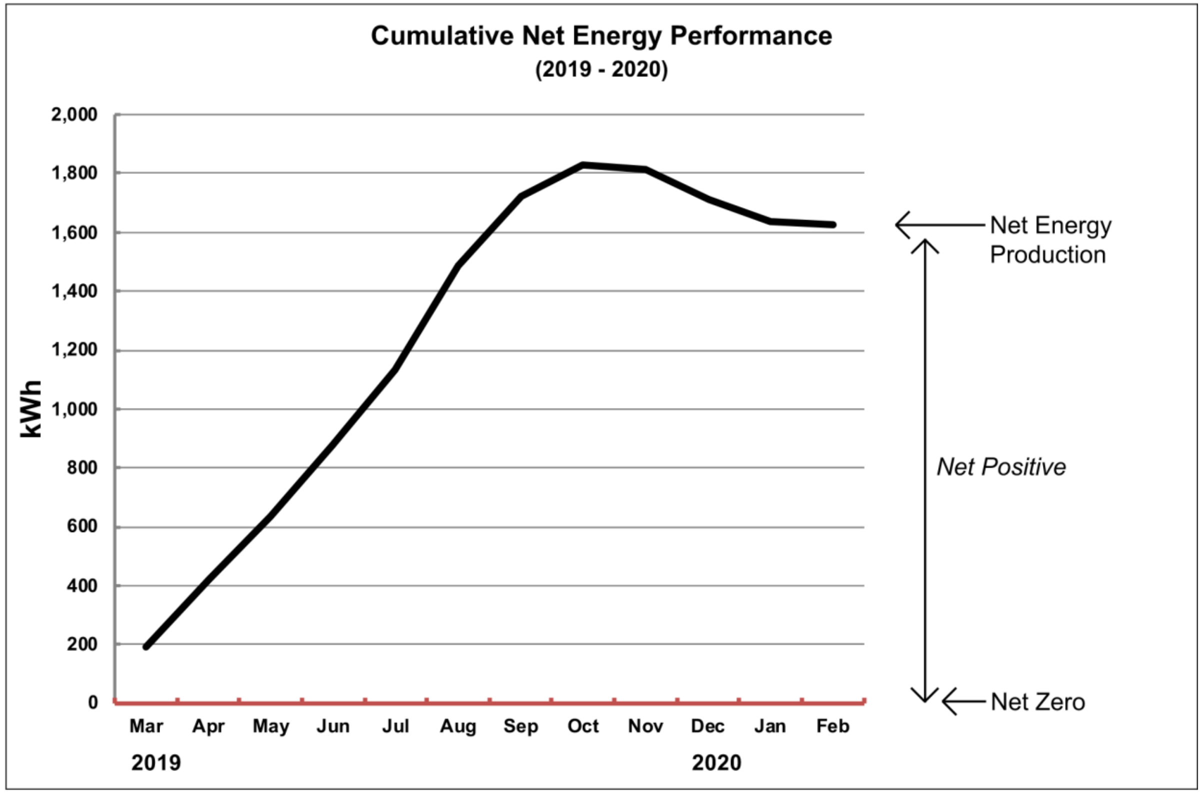
Metric	Modeled Performance (PHPP)	Measured Performance (Estimated Annualized)
Site EUI	7.0 kBtu/sq.ft. per year	10.2 kBtu/sq.ft. per year
Energy Use	4,170 kWh/year	6,190 kWh/year
ZNE Status	Modeled Net Positive	Net Positive by approx. 25%

- Analysis: While actual energy use was 45% higher than modeled (with the passive house model tool), the home still performed better than ZNE, generating more energy than it consumed.

Generating a 25% Energy Surplus

These charts show the Energy Use and Production (left), and the cumulative energy performance (right)





Key Take-aways

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- Glazing Trade-offs: While triple glazing provided excellent noise control, it was deemed unnecessary for ZNE performance in the mild Southern California climate and added significant cost.

- Kitchen Ventilation: The owner-architect noted that a direct exhaust fan might be preferable to the installed recirculation hood to better manage cooking by-products and odors.

- Construction Expertise: Achieving the required airtightness remains a challenge for trades unfamiliar with these standards, suggesting the need for specialized subcontractors or ongoing training.

Applying Passive House principles enabled the project to meet its ZNE home goals and achieved Passive House certification with a significant energy surplus. The project stands as a successful proof of concept for high-performance, all-electric urban infill.

PHOTO: FRASER ALMEIDA