

ARCHITECTURE AT ZERO

2021-22

A design competition for Decarbonization, Equity and Resilience in California



PUENTES VISALIA

PASSIVE HOUSE BB

SAN FRANCISCO, CA

Puentes Visalia is a story

of building connections: for migrant farmworkers to transition to stable, permanent housing; for the site to reconnect to both its oak chaparral past and more recent agricultural land use; and for our design team to explore the challenges of unifying multiple disciplines and systems in order to develop a truly sustainable ecosystem. We chose Puentes - bridges - as a literal and metaphorical design motif.

The literal connectors at Puentes Visalia are easily spotted: short walkways at outside decks connect buildings and neighbors, footpath bridges cross small bio-swales that connect to the rapidly depleting aquifer beneath this site; and on-site bike-share docking station and a bus stop connect our site to local transit and the larger city and region.

Our metaphorical bridges focus on the energy and emissions brief of this competition. We explored an energy model not included in the resources list. We did this to see if alternate models and frameworks could better connect design professionals and building owners to the outcomes of their efforts. We designed our buildings to optimize efficiency first by setting the international Passive House Standard as our design target. We chose to go beyond the energy targets set by the Passive House Standard and chose prefabricated straw wall panels as our building system, to enable Puentes Visalia to extend its reach to a zero carbon materials future.



Mechanical Systems

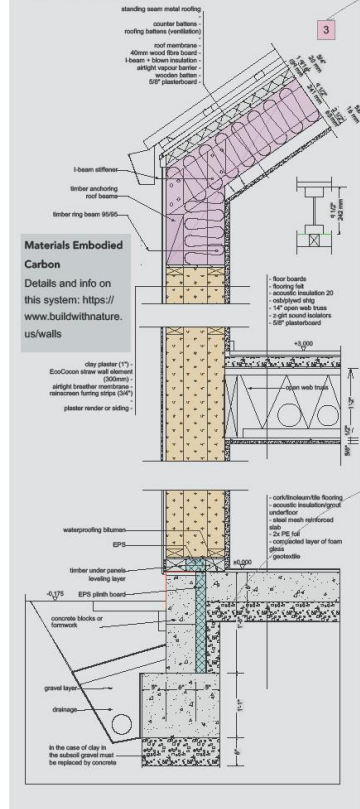
We selected readily available all-electric HVAC systems located and installed to optimized access from outside the building.
 Hot Water: 80g Rheem ProTera Hybrid Electric: <https://www.rheem.com/product/pro-terea-hybrid-electric-water-heater-pqh050-02-n375-15>
 Air Conditioning: Gibson HVAC 2.0: <https://www.gibson-hvac.com/wp-content/uploads/2020/01/Brochure.pdf>
 Ventilation: Zehnder ComfoAir 200: <https://zehnderamerica.com/wp-content/uploads/2014/02/Specifications-CA-200.pdf>

Generation & Storage

Our energy model assumes 11 - 300W PV panels. Our roof design shows room for 16 x 12 = 28 PV panels. Our model shows we are already a PLUS energy producer with only 11 (medium efficiency) PV panels. This means Puentes Visalia could EASILY become a local community power plant, especially if battery storage capacity was added.



Assemblies



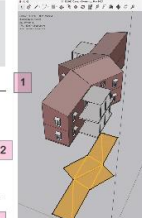
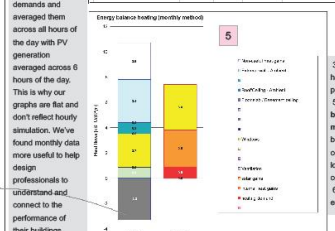
Our Energy Journey STARTED HERE:

1. We started by importing our building 3D model into DesignPH: the Passive House plugin for SketchUp.
2. We used climate data for Fresno as the closest major city with existing PHPP climate data.

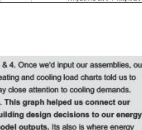
Hourly vs Monthly Data Discussion

We include these graphs to meet the level of this competition. However, the Passive House Planning Package (PHPP) model, which has proven extremely accurate

uses monthly analysis, rather than hourly PHPP's intent is to predict building performance and not grid impact. To comply with the brief's requirement, we've taken our total electric demands and averaged them across all hours of the day with PV generation averaged across 6 hours of the day. This is why our graphs are flat and don't reflect hourly simulation. We've found monthly data more useful to help design professionals to understand and connect to the performance of their buildings.



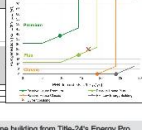
Month	Electric Demand (kWh)	PV Generation (kWh)	Net Demand (kWh)
Jan	1,200	1,500	300
Feb	1,100	1,600	500
Mar	1,000	1,700	700
Apr	900	1,800	900
May	800	1,900	1,100
Jun	700	2,000	1,300
Jul	600	2,100	1,500
Aug	500	2,200	1,700
Sep	600	2,100	1,500
Oct	700	2,000	1,300
Nov	800	1,900	1,100
Dec	1,100	1,600	500



3 & 4. Once we'd input our assemblies, our heating and cooling load charts led us to pay close attention to cooling demands.

5. This graph helped us connect our building design decisions to our energy model outputs. It's also where energy balancing got interesting: the slab connection to ground increased the heat load somewhat, but provided beneficial cooling.

6. Once code minimum PV was added, we easily offset the total electric demands.

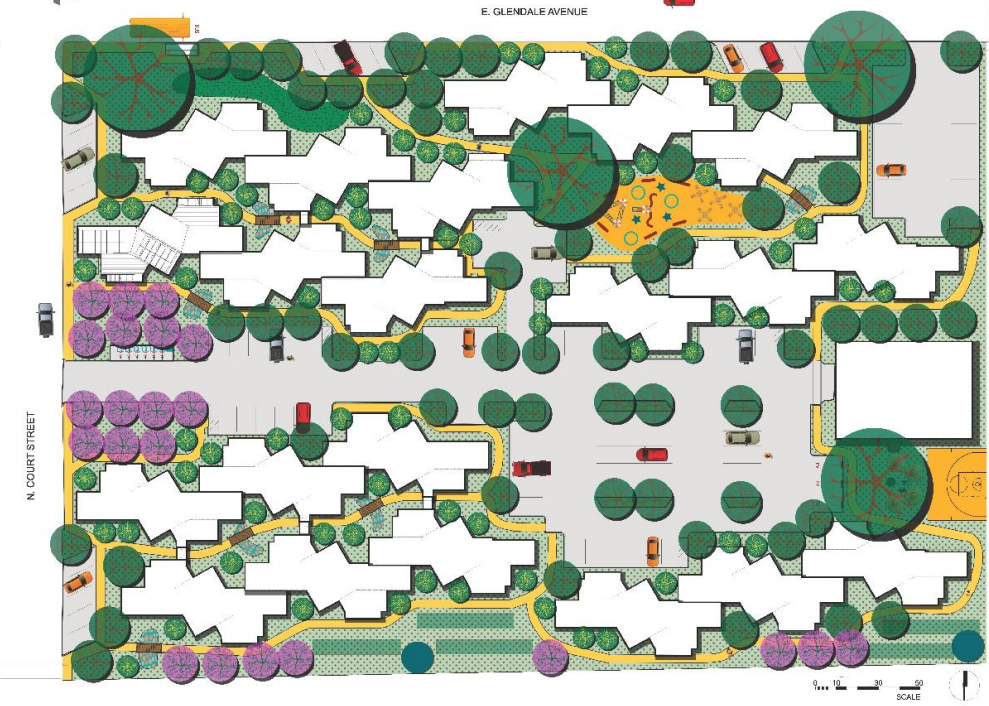


7. Comparisons: we graphed outputs for the same building from Title-24's Energy Pro software & PHPP to see how they stacked up. We included outputs for a prescriptive T-24 model of our building. Results showed Energy Pro significantly overestimates both cooling and heating loads compared to PHPP. Energy production outputs were similar, but net annual electrical demand outputs from PHPP showed our design to be a net negative emissions building.

Para Liegar: until we are able to measure the real demand from this design against these predictive models, we will not know if we have made meaningful design decisions. We must bridge that gap.

LEGEND

- VALLEY OAK
- STONE FRUIT TREE
- SHADE TREE
- CITRUS TREE
- LOW WATER PLANTINGS
- RAIN WATER COLLECTION TANK
- RAIN GARDEN AND BRIDGE
- BIOSWALE
- COMMUNITY GARDEN



1. Project Narrative

PUENTES VISALIA

Equidad y resiliencia | Equity and resiliency

¿Qué significa equidad? Equidad significa nunca asumir que el inglés es su primer idioma. La equidad significa no solo exigir una comunicación multilingüe, sino celebrarla.

What does equity mean? Equity means never assuming that English is your first language.

Equity means not only requiring multilingual communication, but celebrating it.

Acceso igual | Equal Access:

Equity means all ground floor homes on this property will be accessible for the elderly, for the disabled, for the temporarily injured, and for young families with push-chairs, push-bikes and push-carts. The site will integrate accessible design into all lower floor areas, not just the 'accessible units,' to provide universal access to all ground-floor spaces on this property.

Second and third-floor units may potentially be made accessible by adding vertical access lifts to the side of outside decks.

Calidad y Confort | Quality and Comfort:

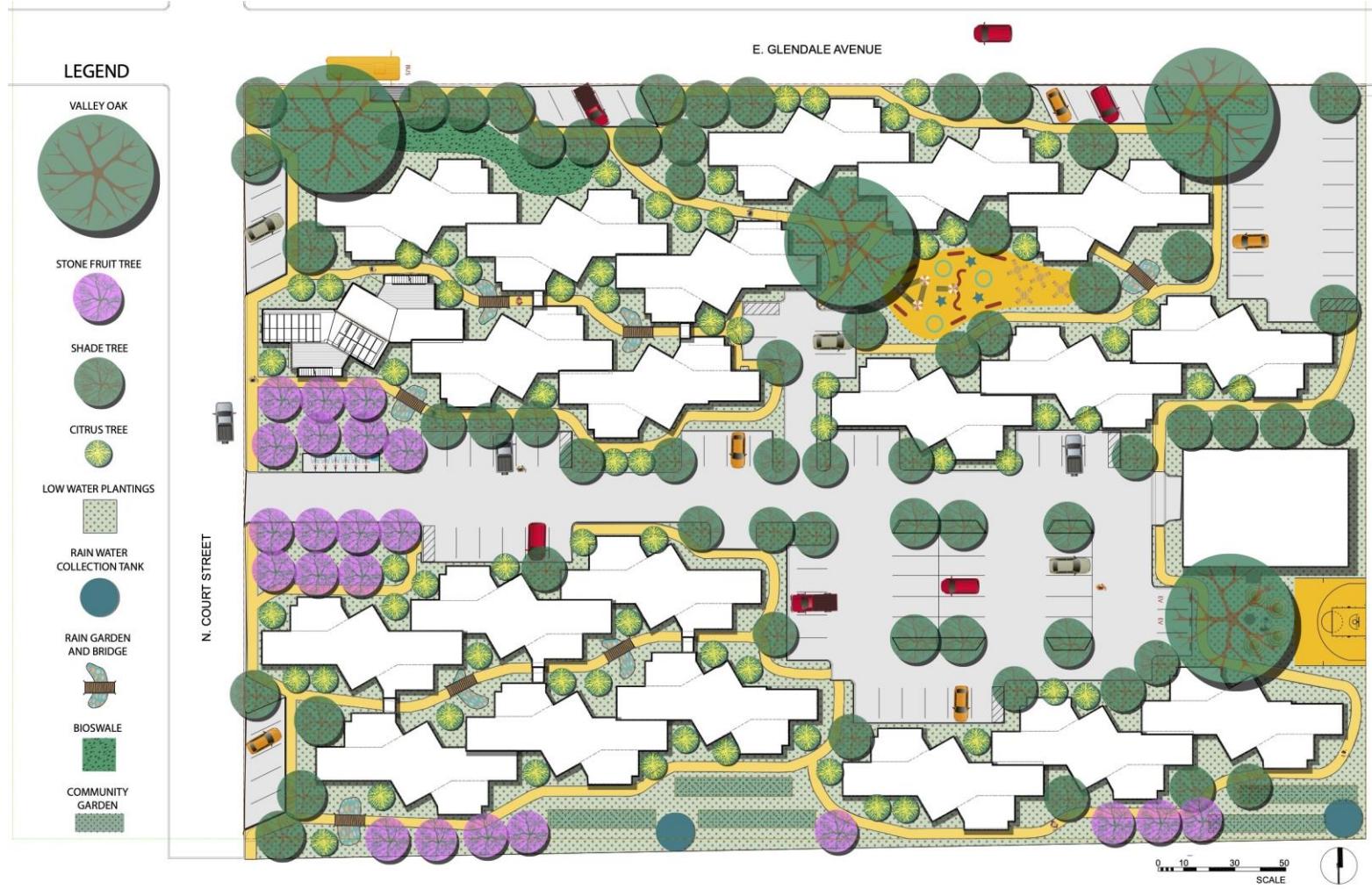
A common assumption is that quality and comfort are reserved for the wealthy. These simple homes are designed to specifically maintain an even indoor temperature throughout the year, using passive exterior shades, higher than standard wall and roof insulation, and balanced heat recovery ventilation. This means that residents simply *won't need a 'cooling center'* - they'll be sublimely comfortable inside their own apartments. We believe that equity means never needing to move out of your home when the temperature goes above 100F. This also means residents will remain comfortable inside their homes when there are power outages and smoke events from seasonal fires or bad air days - because resiliency is baked into the design of these buildings.

Tranquilidad | Tranquility

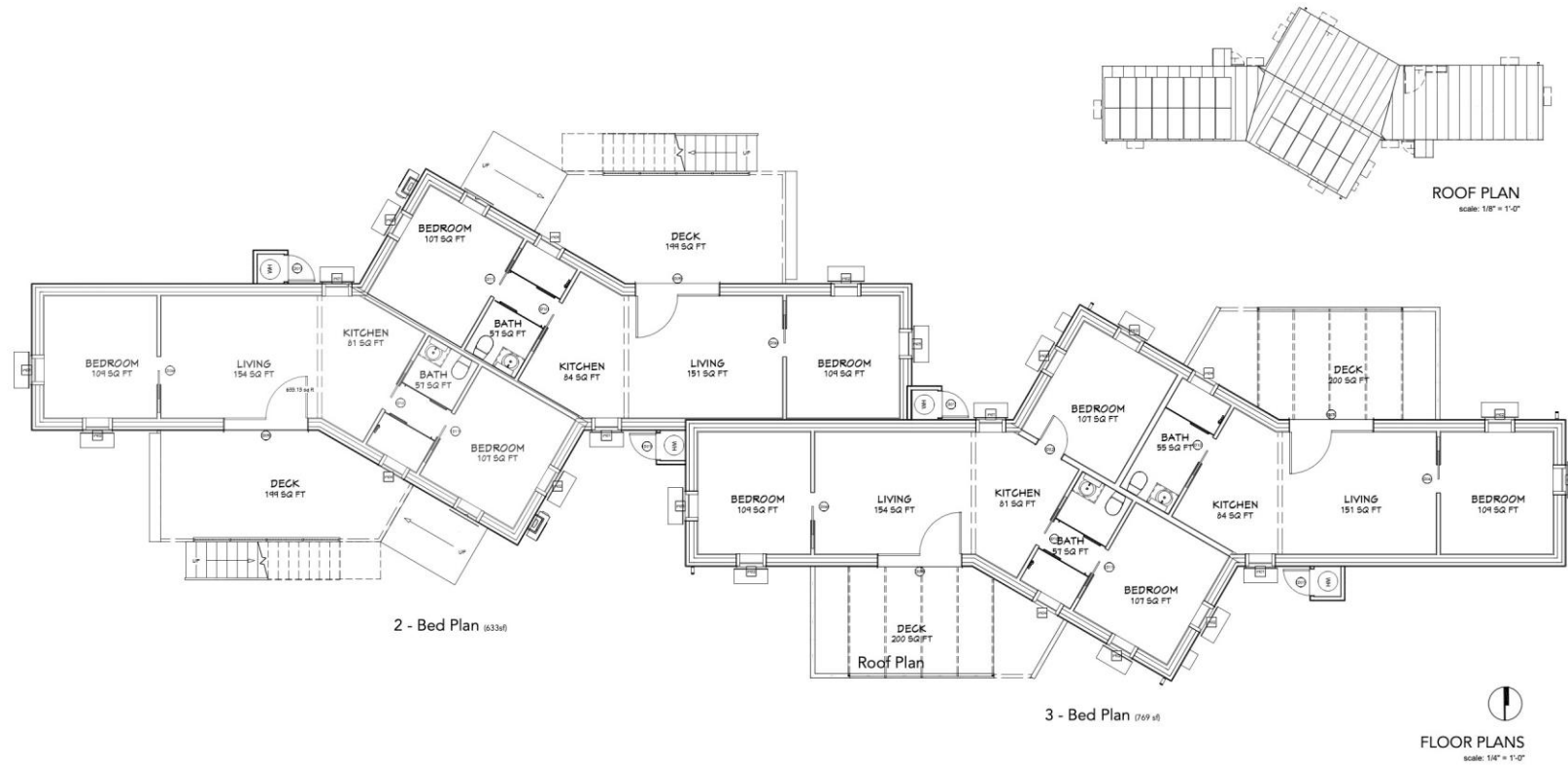
Sound quality is often neglected in apartment design, but adds immense quality of life to any urban, high density living space. We've designed these buildings with lovely thick walls, not just for the energy benefits, but for optimum acoustic separation. Similarly, all windows and doors are triple-paned because we believe the best neighbors are the ones you never hear. We've also fitted each unit with its own energy recovery ventilator to provide 100% filtered, outdoor air to every room, because great indoor air quality is an equity issue that everyone deserves. It also means that occupants can shut their doors and windows when it's noisy outside, but still breathe fresh air. It also means that when the next firestorm hits, their air supply is already being filtered. Running indoor air filtration devices won't be necessary. (Access to the HRV's will be from the outside of each unit to ensure filter changes can be easily managed by the building maintenance team. We believe that operations and maintenance are an equity issue - we've designed maintenance to be simple, so that occupants aren't burdened with additional work.

Privada al aire libre | Private Outdoors:

2. Site Plan



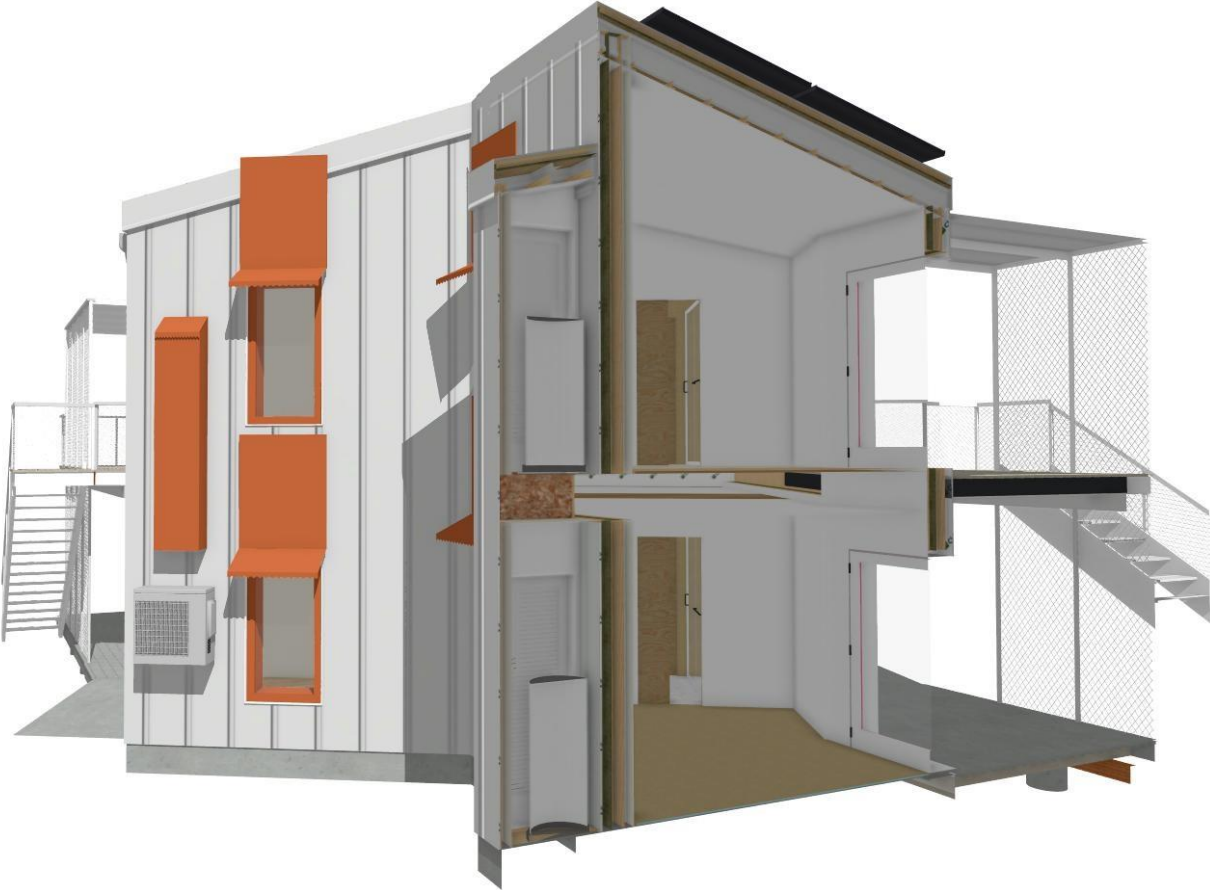
3. Floor Plans



4. Perspective Drawing



5. Illustrated Sections



6. Mechanical System Summary

Puentes Visalia

Mechanical Systems Summary

We selected readily available all-electric HVAC systems located and installed to optimize access from outside the building.

Hot Water: 80g Rheem ProTerra Hybrid Electric :

<https://www.rheem.com/product/professional-prestige-proterra-hybrid-electric-water-heater-proph50-t2-rh375-15>

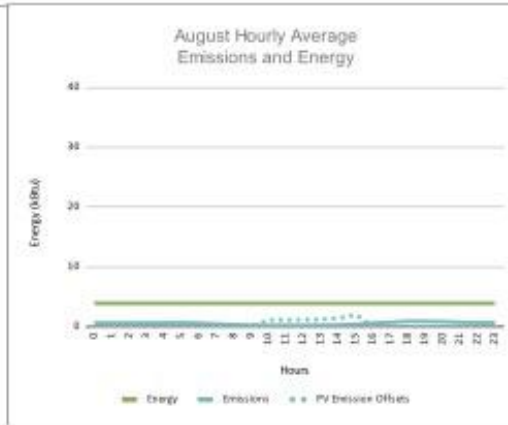
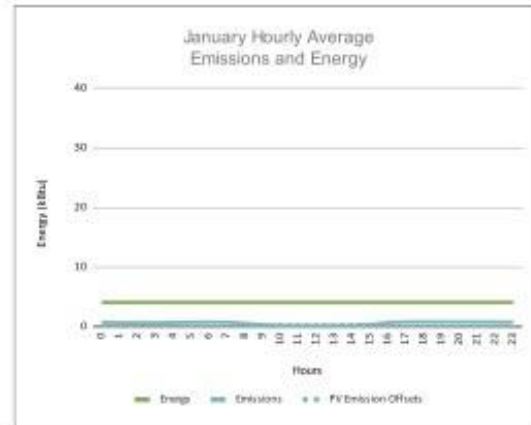
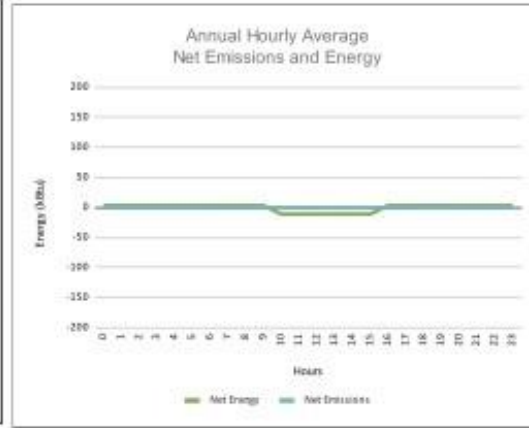
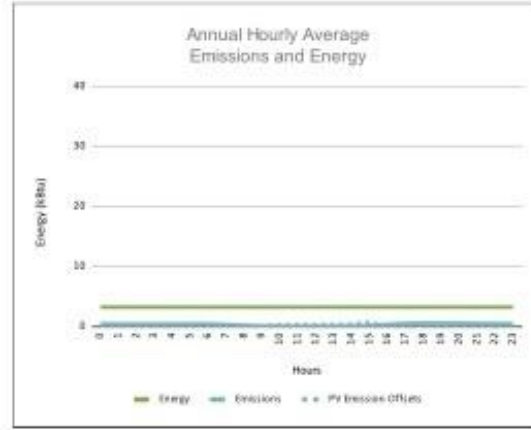
Air Conditioning: Ephoca HPAC 2.0-

<https://innova-usa.com/wp-content/uploads/2020/01/Brochure.pdf>

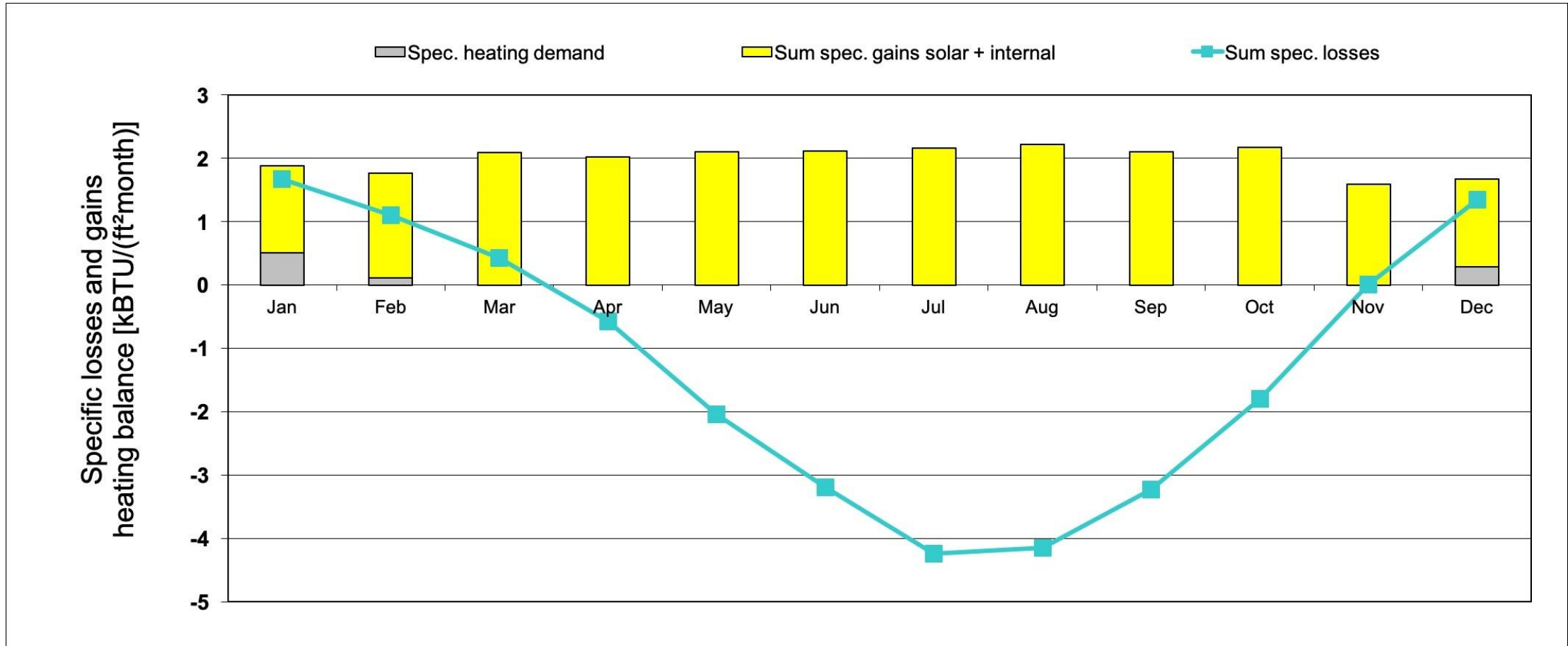
Ventilation: Zehnder ComfoAir 200 :

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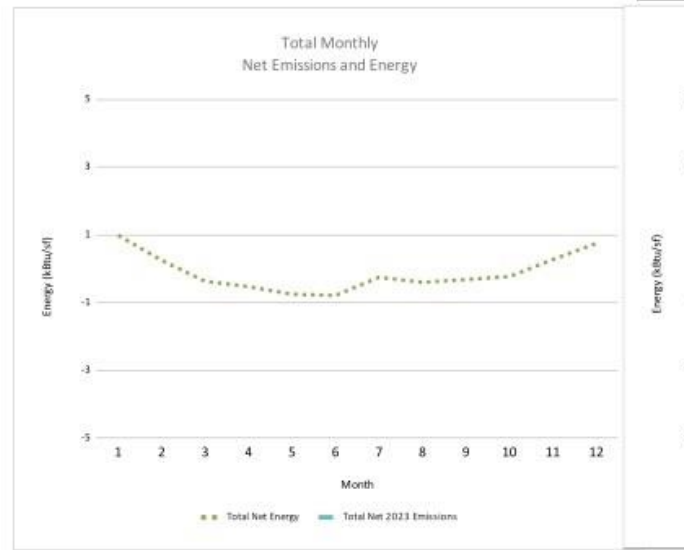
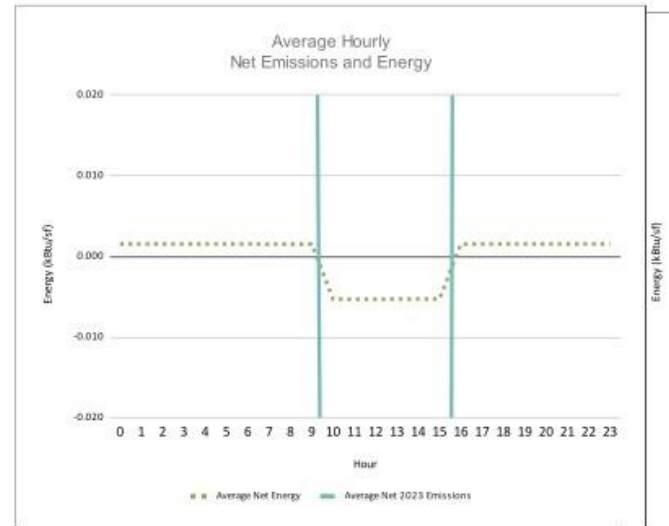
7. Annual End-Use Summary Table



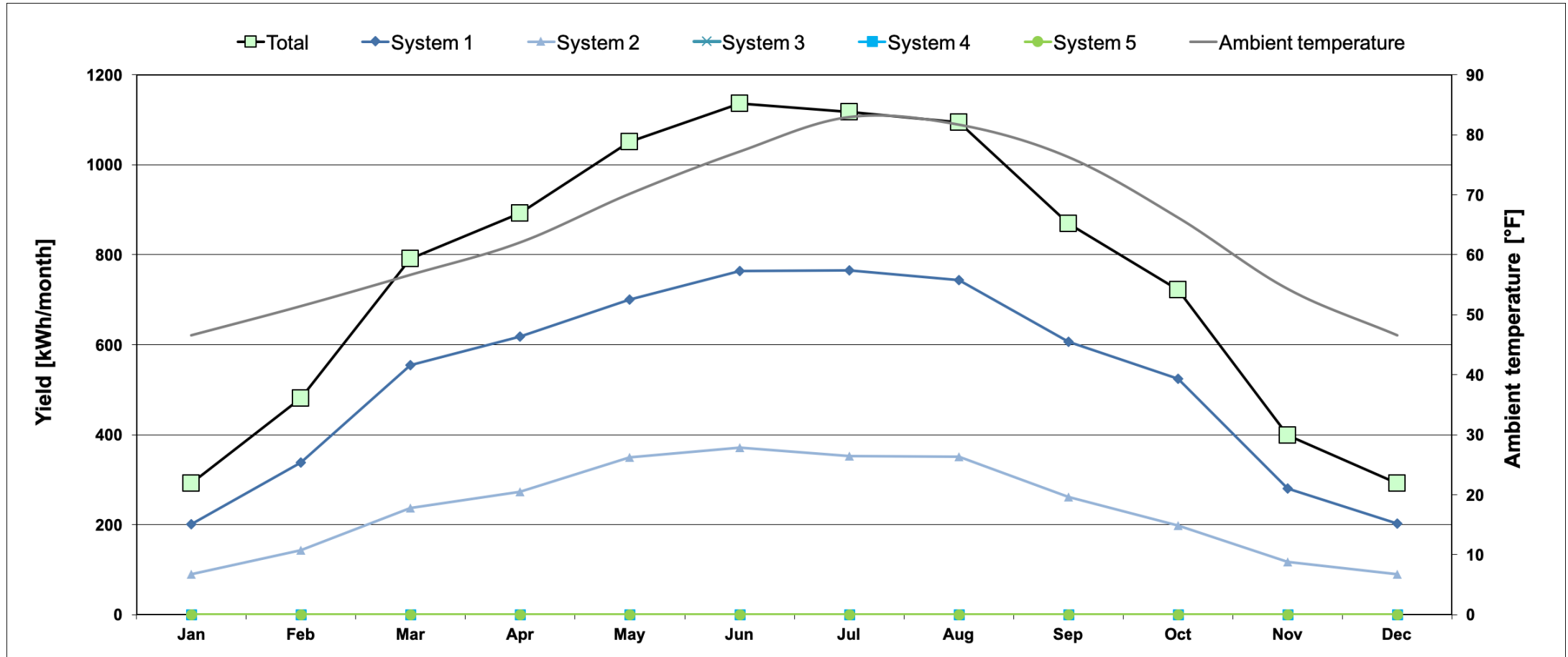
8. Monthly End Use Energy Consumption Bar Chart



9. Hourly load shapes for energy and emissions

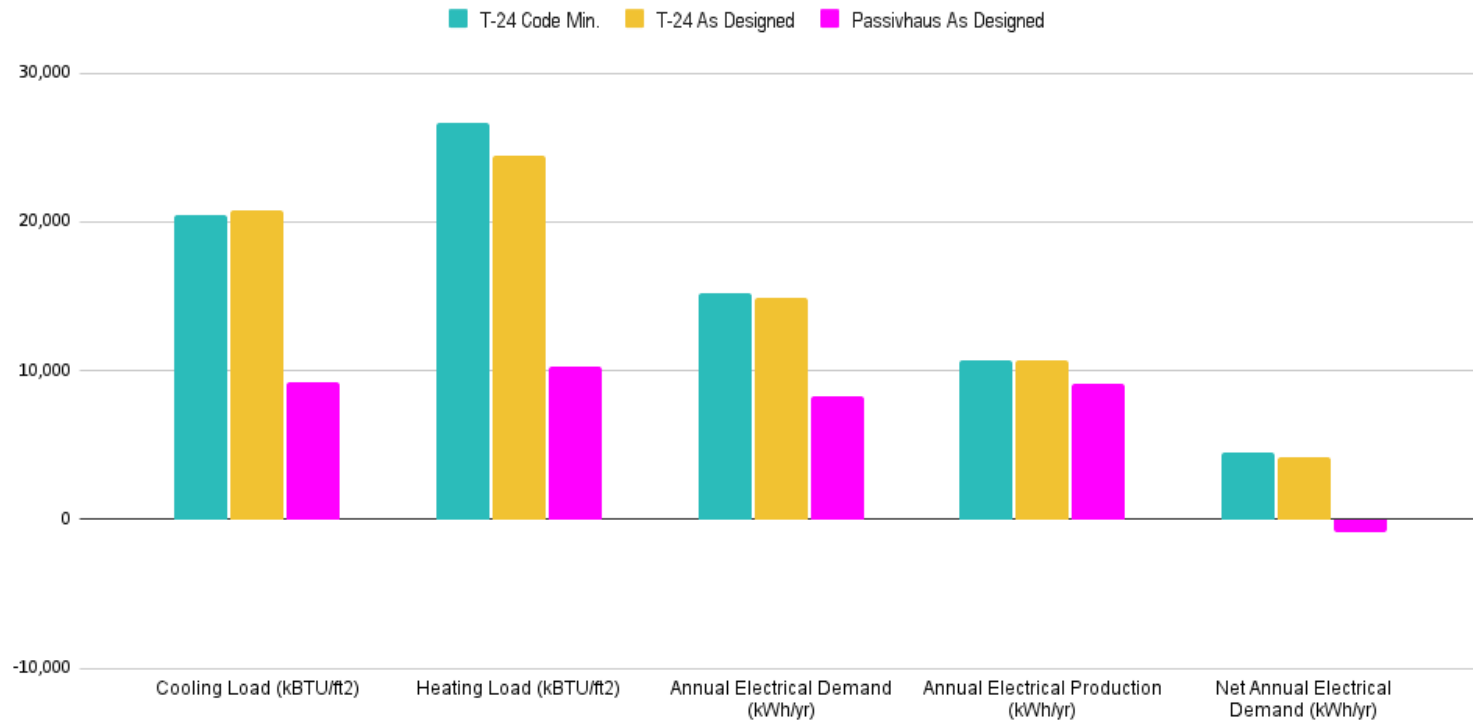


10. Details of renewable energy systems



11. Storage Systems

Model Output Comparisons:



Puente Visalia 4-Plex All Electric Building

B EQUITY Essay

C. Climate Adaptation Assessment Matrix

PROJECT NAME:	Puentes Visalia		
IMPACT	ADAPTIVE MEASURE	USING THIS MEASURE? (Y/N)	IF THE PROJECT IS EMPLOYING THIS MEASURE, BRIEFLY DESCRIBE TECHNICAL SPECIFICATIONS
HEAT	Is the project planting trees that will provide shade to buildings, homes, sidewalks, streets, or parking lots?	yes	The buildings provide additional shade to neighbors, with shade and fruit trees planted between them. Walls are planned to add additional shade and privacy around exterior decks.
	Is the project enhancing insulation of homes?	yes	Our walls exceed Passive House levels of insulation, using an 11.75" wall panel filled with straw insulation.
	Is the project installing cool roofs?	yes	Yes, Title 24 prescriptive requirements for the climate zone. SR = 0.85, Emittance = 0.75.
	Is the project reducing electrical grid demand and household costs associated with cooling?	yes	50% reduction over code built & Title 24 equivalents. Net positive with minimum 7.5kWp on-site PV array.
	Is the project providing a community cooling center?	no	Our design makes an additional cooling center obsolete as each unit is designed to remain cool and habitable. The community center may be used as a refuge and cooling center for surrounding communities.
	Is the project adding permeable land cover?	yes	Landscaping includes drainage swales and permeable paving.
	Is the project replacing agricultural lands (croplands, rangelands, or pastures) or natural land cover (trees, grasslands, shrublands, wetlands, or wetlands) with pavement or buildings? (Negative co-benefit.)	yes	This entire neighborhood is former farmland. We've done the best we can to keep the land productive for fruit and food crops by including vines, fruit trees and a community planting area in the design.
	Please add any additional measures employed to address this impact.		Our design incorporated passive exterior shading for all windows. Our energy model includes an assessment for overheating risk. We easily meet this target.
PRECIPITATION CHANGE (e.g. drought, extreme precipitation events)	Is the project setting up an ongoing mechanism to conserve water?	yes	Low water and CA Native plants and trees planted on site. Stormwater Collection tanks. Use Laundry Grey water for Shade Trees watering.
	Is the project promoting improved soil health, soil quality, or soil stability?	yes	Low water and CA Native plants and trees planted on the site require no chemical fertilizers or pesticides, they usually succeed in native soils without any additional resources. CA native low-draw fruits that stabilize the soil.
	Is the project restoring wetlands, watersheds, or riparian buffers?	yes	All stormwater is kept on site. Majority of it is collected into a bioswale and smaller rain gardens throughout the property. Rain water is collected and filtered through the plants in soil and it eventually percolates into the aquifer below or feeds nearby creeks.
	Is the project planting native, drought-tolerant vegetation?	yes	Native Valley Oaks, CA native grasses, annuals, perennials and shrubs are planted throughout the site.
	Is the project changing permeable surfaces to paved surfaces? (Negative co-benefit.)	yes	The site is currently undeveloped. We have to add some paved surfaces, but they are kept to a minimum.
	Is the project increasing water use? (Negative co-benefit.)	no	
	Please add any additional measures employed to address this impact.		All stormwater is collected into bioswales, rain gardens and rain water tanks. Laundry grey water is routed into landscaping.
WILDFIRE	Does the project involve fuels management work to maintain ecosystem health in a high priority landscape?	N/A	
	Does the project involve rehabilitation work in a high priority landscape impacted by wildfire?	no	Defensible space will need to be provided by the City of Visalia.
	Does the project involve the hazard prevention work to mitigate wildfire threats to communities?	yes	Roofing materials of all structures are Class A fire-rated. Senses are minimal and fire-escape protected to reduce the risk of embers penetrating the roof via the soffit vents.
	Is the project implementing other types of forest or other ecosystem management treatments to reduce wildfire intensity or reduce potential impacts of wildfires?	no	
	Is the project implementing other fire mitigation or prevention measures for non-forested habitats that may be impacted by wildfire?	no	
	Does the project involve new construction in a high priority landscape for reducing or preventing wildfire threats? (Negative co-benefit.)	yes	
	Does project include a backup power source (e.g., battery charged by renewable energy, generator) to operate housing development in case of emergency power shutoff?	yes	Community battery backup anticipated, not calculated into energy calculations.
Please add any additional measures employed to address this impact.		Each unit includes a mechanical ventilation system to allow residents to remain inside during smoke events and still be able to breathe filtered outside air.	

D. Optional Supplemental Energy Information