ARCHITECTURE AT ZERO 2021-22

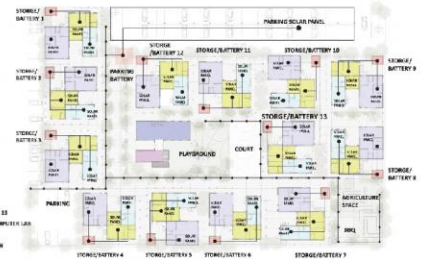
A design competition for Decarbonization, Equity and Resilience in California

EZB HOUSE

UNIVERSITY OF CARDIFF, CARDIFF, UK &

TEXAS A&M, COLLEGE STATION, TX

DIAGRAM SIDE VIEW



PROGRAM

- 1 BED ROOM X 11
- 2 BED ROOM X 37
- 3 BED ROOM X 37
- STORGES / BATTERY X 13
- MEETING SPACE/COMPUTER LAB
- LAUNDARY ROOM
- COMMUNITY KITCHEN
- BATHROOMS

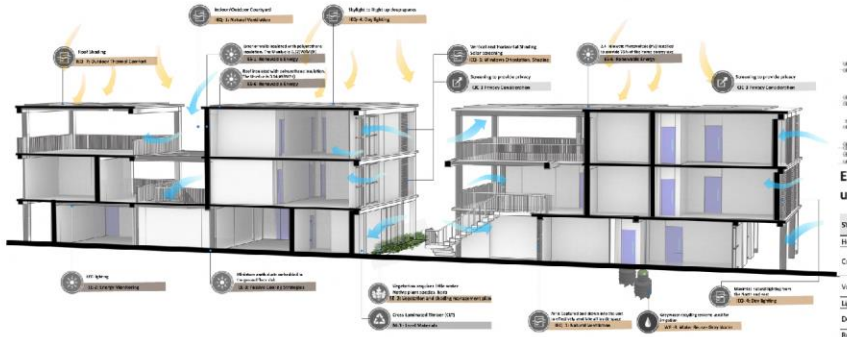
Project Narrative

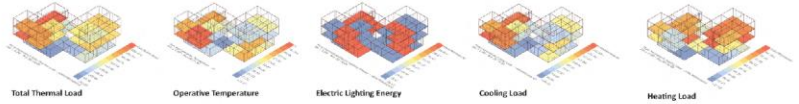
The Eco- Zero Bill Houses (EZB House) aims to design affordable family housing for farmworkers with high energy efficiency, renewable energy, and carbon reduction strategies. The design used selective technology and materials to reach a high level of eco-friendly housing. Several carbon reduction strategies were used, such as material recycling and ecosystem irrigation. Zero landscape concept implemented to reduce energy use, water consumption and maintenance. Our houses are designed with responsibly sourced timber frames or cross-laminated timber (CLT) to offset carbon emissions. Using such sustainability architectural material is a highly versatile structural timber panel used to form sustainable walls, roofs, and floors in a wide range of structures or, as we use it here. Central farmland was designed to provide agricultural products to the residents. Moreover, 13 Storage systems were distributed around the site to save spaces for the electronic battery and farmworker bikes.

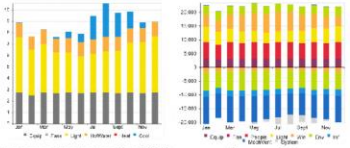
The EZB houses design results, a lower Energy Use Intensity (EUI) of 106.1 KWh PE /m2/y than the AIA 2030 challenging baseline of 137.8 KWh PE /m2/y. Around 1,000 Pv's panels were used to balance the EUI produced on the site. The cost of the energy bill is nothing, yet around 123,098.63 KWh per-years extra energy will preserve on the battery for the site energy consumption, and the extra will be sold to the energy and power provider. The budget that will be gained from extra energy can be used to maintain and improve the resident life quality.

The design was engaged several resilience strategies to respond to surroundings, such as poverty, air quality, climate change and extreme heat (refers to resilience strategies essay). The EZB House provides an equitable design, considering the social vulnerabilities and helping strengthen community engagement.

Floor PLan

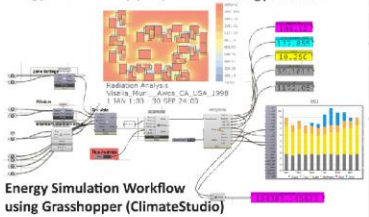






Energy Use Intensity (EUI)

Energy Balance



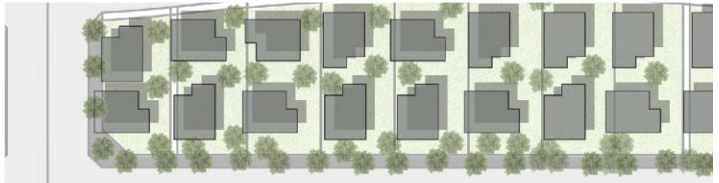
Energy Simulation Workflow using Grasshopper (ClimateStudio)

SYSTEM	SYSTEM DETAILS
Heating System	10 HSPF Air source heat pump.
Cooling System	SEER 22.High thermal mass with night flushing, automatically-operated windows and skylights, air source heat pump backup.
Ventilation System	Automatically-operated windows and skylights, outdoor air from the air source heat pumps.
Lighting System	100% LED (200lm/W) with vacancy control.
Domestic Hot Water System	50 gallon heat pump water heater per unit, with 2.35 energy factor.
Renewable/Generation System	40 kW (DC)PV on the roof and the parking area.

Mechanical System Summary

SYSTEM	Calculated Site Energy Use (KWh/m2/y)	
HVAC	80,680.67 (KWh/y)	
Lighting	569,573.9E (KWh/y)	
Appliances and Plug Loads	248,525.565 (KWh/y)	
Domestic Hot Water	115,211.95 (KWh/y)	
Gross EUI	Site EUI 808,490.41 KWh/y	106.12 KWh/m2/y which is better than the 2030 AIA Site EUI Baseline (137.850 KWh/m2/y)
Renewable Production	982,098.665 KWh/y for all the PV panels	
Net EUI	123,608.225 KWh/y extra will be preserved on battery for the site users and sold to the power electric services	

Annual End Use Summary Table



Site Plan

ECO- ZERO BILL HOUSES (EZB House) ARCHITECTURE AT ZERO 2021

Design Narrative

An Eco- Zero Bill Houses

The Eco- Zero Bill Houses (EZB House) aims to design affordable family housing for farmworkers with high energy efficiency, renewable energy, and carbon reduction strategies. The design used selective technology and materials to reach a high level of eco-friendly housing. Several carbon reduction strategies were used, such as material recycling and ecosystem irrigation. Zero landscape concept implemented to reduce energy use, water consumption and maintenance. Our houses are designed with responsibly sourced timber frames or cross-laminated timber (CLT) to offset carbon emissions. Using such sustainability architectural material is a highly versatile structural timber panel used to form sustainable walls, roofs, and floors in a wide range of structures or, as we use it here. Central farmland was designed to provide agricultural products to the residents. Moreover, 13 Storage systems were distributed around the site to save spaces for the electronic battery and farmworker bikes.

The EZB houses design results, a lower Energy Use Intensity (EUI) of 106.1 KWh PE /m2/y than the AIA 2030 challenging baseline of 137.8 KWh PE /m2/y. Around 1,000 Pv's panels were used to balance the EUI produced on the site. The cost of the energy bill is nothing, yet around 123,098.63 KWh per-years extra energy will preserve on the battery for the site energy consumption, and the extra will be sold to the energy and power provider. The budget that will be gained from extra energy can be used to maintain and improve the resident life quality.

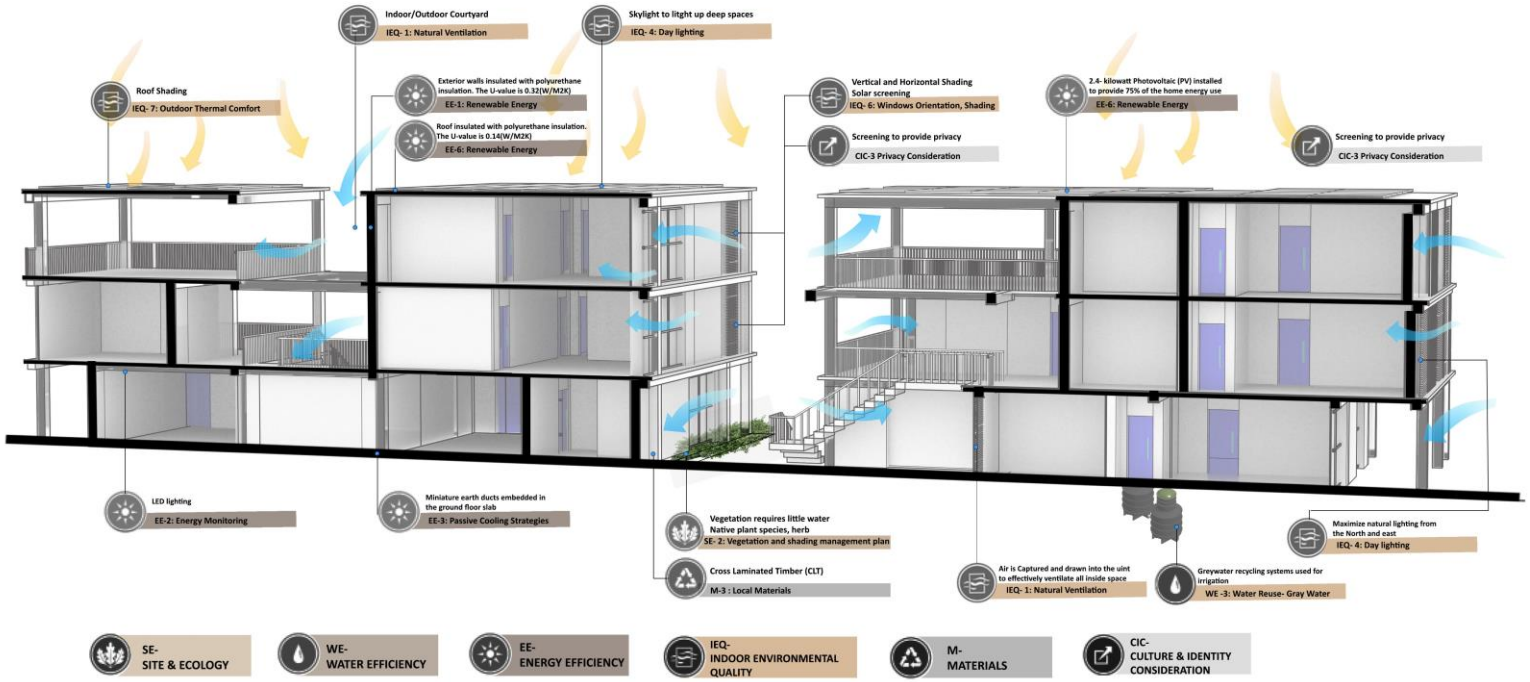
The design was engaged several resilience strategies to respond to surroundings, such as poverty, air quality, climate change and extreme heat (refers to resilience strategies essay). The EZB House provides an equitable design, considering the social vulnerabilities and helping strengthen community engagement.

2. Site Plan

3. Floor Plans

4. Perspective Drawing

5. Illustrated Sections



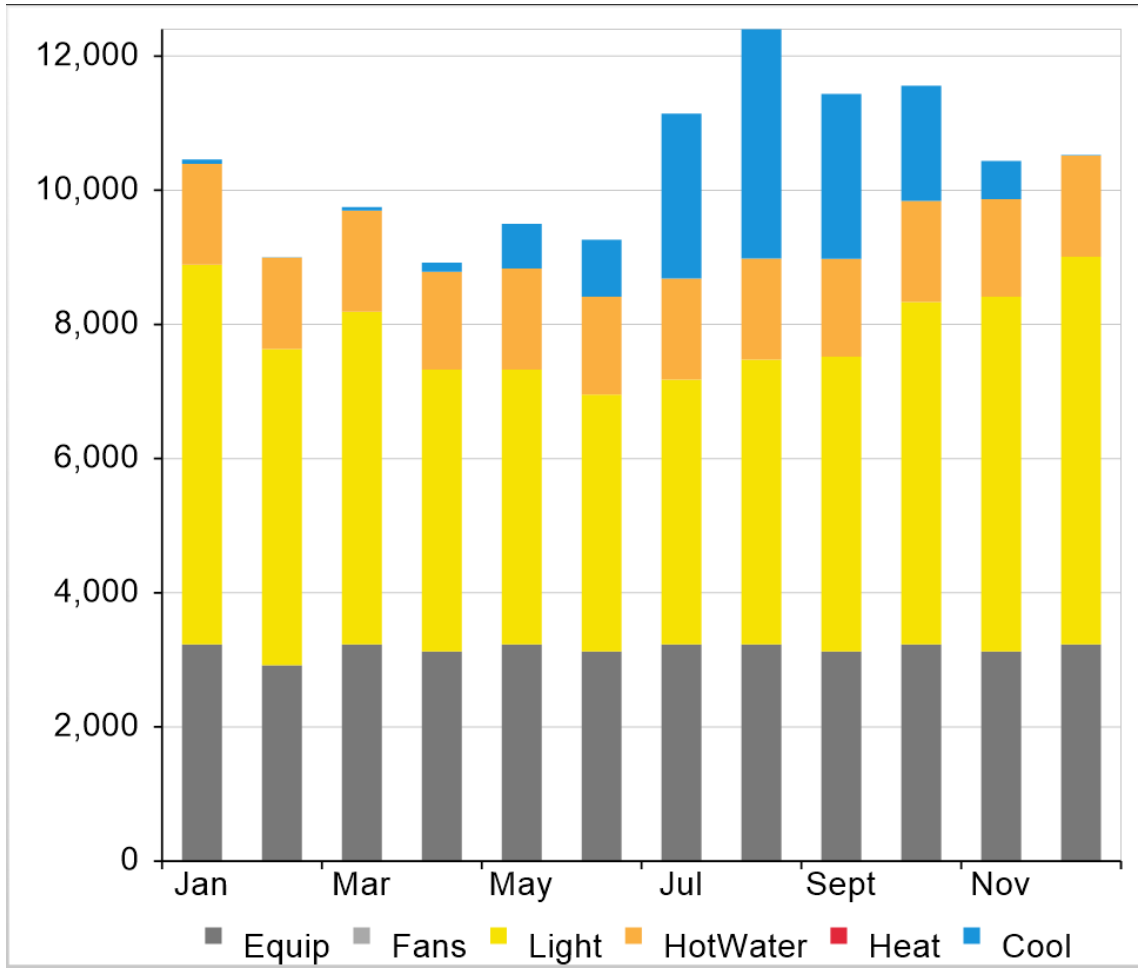
6. Mechanical System Summery

SYSTEM	SYSTEM DETAILS
Heating System	10 HSPF Air source heat pump.
Cooling System	SEER 22.High thermal mass with night flushing, automatically-operated windows and skylights, air source heat pump backup.
Ventilation System	Automatically-operated windows and skylights, outdoor air from the air source heat pump.
Lighting System	100% LED (200lm/W) with vacancy control.
Domestic Hot Water System	50 gallon heat pump water heater per unit, with 2.35 energy factor.
Renewable/Generation System	40 kW (DC)PV on the roof and the parking area.

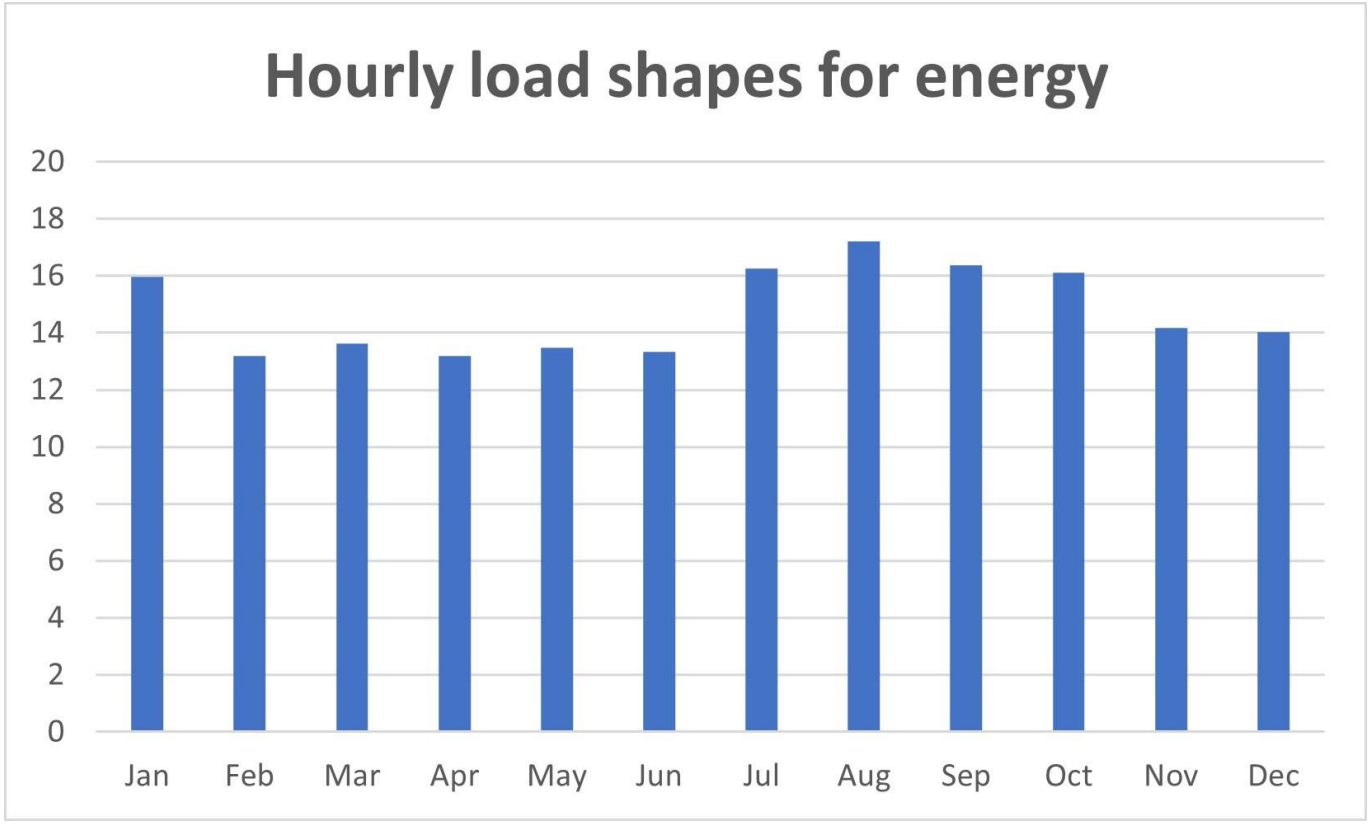
7. Annual End-Use Summery Table

SYSTEM	**Calculated site Energy Use (KWh/m2/y)**	
HVAC	80,605.07 (KWh/y)	
Lighting	365,373.06 (KWh/y)	
Appliances and Plug Loads	246,525.565 (KWh/y)	
Domestic Hot Water	115,311.95 (KWh/y)	
Gross EUI	**Site EUI 808,490.41 KWh/y**	**106.12 KWh/m2/y** which is batter than the **2030 AIA Site EUI Baseline (137.855 KWh/m2/y)**
Renewable Production	**932,098.635 KWh/y** for all the PV panels	
Net EUI	**123,608.225 KWh/y** extra will be preserved on battery for the site users and sold to the power electric services	

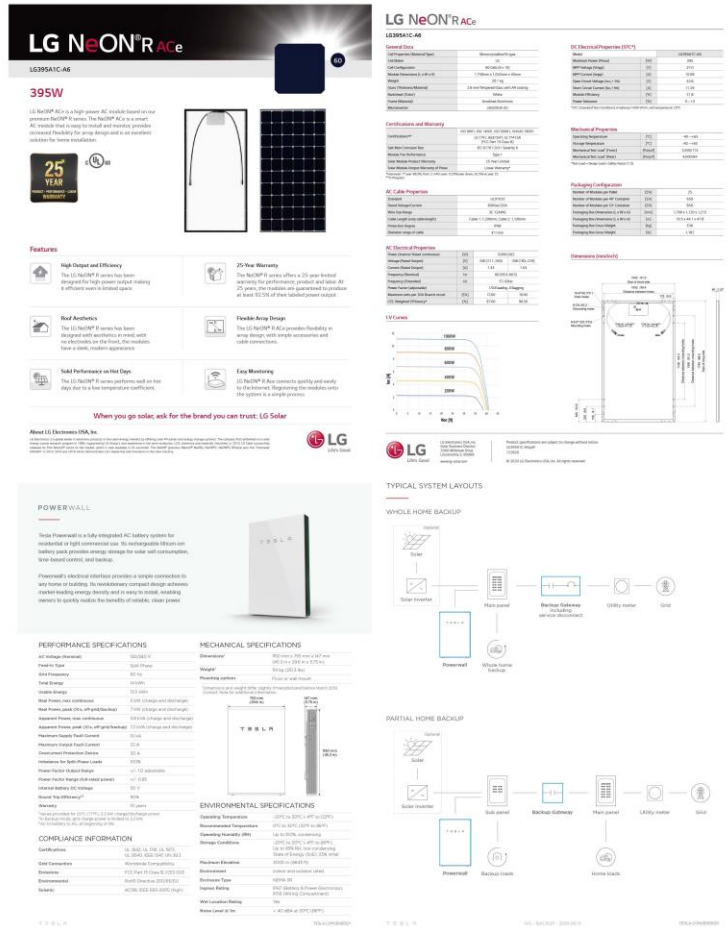
8. Monthly End Use Energy Consumption Bar Chart



9. Hourly load shapes for energy and emissions



10. Details of renewable energy systems



11. Storage Systems

B EQUITY Essay

Equity

Equity extends beyond architecture. In addition to designing for clients, architects must consider the communities that use those buildings or pass by them. The architect must plan for all potential users of a building. By incorporating equitable design qualities, The Eco- Zero Bill Houses include coordinated crossings, drop off/pick up points, parking lots where all other modes of transportation are linked, and resting areas and seating. The site also contains drinking fountains and additional space requirements for mobility equipment. As part of the community centre, there are all-gender toilets, cultural and religious spaces, such as prayer rooms, to accommodate faith-specific requirements for accessibility, as well as gentle gradients throughout the site. The design addressed access to green areas, education, sports, a community centre, and inclusive workspaces. For example, an equitably designed playground was planned for users to enter from all directions, including an adjacent sports field and parking lot. Access to all pieces of playground equipment is provided without the need for users of assistive devices to leave their instruments. The Eco- Zero Bill Houses provide extra energy sold to the Department of Water and Power. The money will be used to improve the farmworker family living by providing them with entertainment activities and poverty support.

The design team faces a wide range of challenges. Designing for families from different cultural and linguistic backgrounds was one of these challenges. The design team responds to this by designing a large community centre in the middle of the site and exposing and opening the community centre's interior space to ensure clear and polite communication and sharing knowledge with others. Adding a small library in the community centre will help the residents to learn about different cultures. Therefore, we believe this design strategy will overcome cultural and linguistic barriers.

Other trials are designing a house for farmworkers, mainly working with the natural environment, and having a low income. The design tame responds to this issue by designing space close to the surrounding environment by opening indoor to outdoor spaces. Also, the integration of visual connection between indoor and outdoor, such as courtyard spaces to provide/create an outdoor space and open spaces, increases the windows' size.

Our team is live in two different areas: Cardiff, UK and Texas, USA, and we have an original background in Saudi Arabia. We believe that we live in the era of globalisation, which affects the world and opens them to each other. So, the farmworkers community in Cardiff have the same or close challenges to the farmworker's community in Texas. However, the design's input parameters, such as environmental, claimant and context, need to reconsider for every different site.

C. Climate Adaptation Assessment Matrix

PROJECT NAME:	ECO- ZERO BILL HOUSES (EZB House)		
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?	Y	A 3 Meater tright Mountain Ash Rowan Tree
	Is the project enhancing insulation of homes?	Y	Exterior walls insulated with polyurethane insulation.
	Is the project installing cool roofs?	Y	Cool roof acrylic coating was used despite all roofs being covered with PV panels.
	Is the project reducing electrical grid demand and household costs associated with cooling?	Y	Orientation of the house and the vertical wood window shading panels helps with these issues
	Is the project providing a community cooling center?	N	
	Is the project adding permeable land cover?	Y	Crushed Stone/Gravel were used as permeable ground cover
	Is the project replacing agricultural lands (croplands, rangelands, or pasturelands) or natural land cover (trees, grasslands, shrublands, watersheds, or wetlands) with pavement or buildings? *(Negative co-benefit.)*	Y_N	Trying to not replace agricultural lands, however, the site is on good agricultural soil so we provide landscape spaces and agricultural centre to minimize the impact.
	Please add any additional measures employed to address this impact	Y	Courtyard between the house unit
PRECIPITATION CHANGE *(e.g. drought, extreme precipitation events)*	Is the project setting up an ongoing mechanism to conserve water?	Y	Site slope ,Rainwater harvestin,Better Irrigation practices. Grey water recycling,Pressure reducing valves, Water efficient bathroom accessories
	Is the project promoting improved soil health, soil quality, or soil stability?	N	
	Is the project restoring wetlands, watersheds, or riparian buffers?	Y	A tree buffer zoon was designed in the site edge.
	Is the project planting native, drought-tolerant vegetation?	Y	Mountain Ash Rowan, Point reyes meadowfoam, Woolly blue curls, Bush anemone,Island alumroot,Canyon snow iris, California bush sunflower, and more.
	Is the project changing permeable surfaces to paved surfaces? *(Negative co-benefit)*	N	
	Is the project increasing water use? Negative co-benefit.	N	Using Xeriscape design strategies such as a native plant that consumes less water and more hardscape design use than the softscape strategies.
	Please add any additional measures employed to address this impact		
WILDFIRE	Does the project involve fuels management work to maintain ecosystem health in a high priority landscape?	Y	The project used a zero-scape system to minimize the fire of any kind of plant material which can act as fuel.
	Does the project involve rehabilitation work in a high priority landscape impacted by wildfire?	N	
	Does the project involve fire hazard prevention work to mitigate wildfire threats to communities?	Y	The project will use a fire protector called Flame Stop® II to protect the buildings form the extrior and the Intrior. As well as the design implmeting the fire protection system.
	Is the project implementing other types of forest or other ecosystem management treatments to reduce wildfire intensity or reduce potential impacts of wildfires?	N	
	Is the project implementing other fire mitigation or prevention measures for non-forested habitats that may be impacted by wildfire?	Y	The project will use a fire protector called Flame Stop® II to protect the buildings form the extrior and the Intrior. As well as the design implmeting the fire protection system.
	Does the project involve new construction in a high priority landscape for reducing or preventing wildfire threats? *(Negative co-benefit.)*	N	
	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?	Y	Battery systems designed to collect extra energy from Pv to a backup power source and site lighting
	Please add any additional measures employed to address this impact		