ARCHITECTURE AT ZERO 2021-22

A design competition for Decarbonization, Equity and Resilience in California

DE LA TIERRA

PAUL HALAJIAN ARCHITECTS

CLOVIS, CA

▲1/2 TOWER
3-story | 22 & 23 homes for each
below grade automated stacked parking
[45 total]

de la tierra

At the intersection of agriculture in America, socially responsible architecture and sustainable design exists the need to reinvent housing for farmworkers. This project combines the real-world perspectives of San Joaquin Valley farmworkers with an architecturally sensitive, technically sound response to the pressing reality of climate change.

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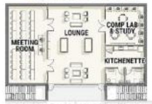
Excavated soil from the lower court area is used to construct Rammed Earth Mass Walls. Cross Laminated Timber panels are used for floor construction. Solar hot water collectors with storage tanks are provided on each stack of homes. Power generation is provided by maximum surface coverage of photovoltaic panels at south and west-facing roof surfaces. Additional panels occur above the central Promenade.

▼COMMUNITY ROOMS



NEIGHBORHOOD
3-Story
15 Homes Each
Private Garages & Entrances
[63 total]

MUD ROOMS ▶
provide area for decontamination prior to entering home. Includes restroom with shower, laundry, and storage for dirty shoes & clothes. Area is directly accessed from the garage entrance and can be separated from the rest of the home with a sliding door.

Private direct staircase to garage unit below and ground floor public courtyard

Staircase serves as buffer between units

3 BEDROOM UNIT ▲
Above Grade Level

Private direct staircase to ground floor public courtyard

Staircase & garage serve as buffer between units

1 BEDROOM UNIT ▲
At Grade Level

Staircase serves as buffer between units

Private direct staircase to private garage unit below

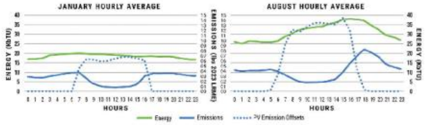
3 BEDROOM UNIT ▲
Below Grade Level

A - **Roof Mounted PV Panels**
B - **Self Shading Windows** due to wall thickness w/ high efficiency glazing
C - **Rammed Earth Wall Construction** provides R-33 value
D - **Battery Storage** provides 3 days of emergency power back-up
E - **Permeable Pavers** provides water recharging for water table below
F - **Operable Courtyard Ceiling** provides passive ventilation
G - **PV Shade Structure** provides shading for Promenade and primary drive aisle
H - **Solar Hot Water Heating System** w/ Electric Tank Storage
I - **Ceiling Mounted Fan Coils** for optimal user control
J - **Water Source Variable Refrigerant Flow** w/ DOAS connected to GSHP and hydronic lines 300' below grade
K - **Earth Sheltering** provides natural envelope insulation

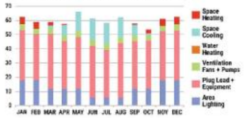
MECHANICAL SYSTEMS SUMMARY

Electrical power will be supplied by way of roof mounted photovoltaic panels that will offset the energy demand. Generated power will be stored on site in a network of batteries with a storage capacity of 715 kwh. A Water Source Variable Refrigerant Flow with Dedicated Outdoor Air System will use ground source heat pumps and hydronic lines to pre-temper the water supplied to the ceiling mounted fan coils in each home. Operable windows and ceiling fans will minimize use of the mechanical system and reduce demand. Drilling for the buried loop can be done efficiently because this operation can occur with excavation of the sunken courtyards. LED lighting will incorporate vacancy sensors and be integrated with daylight controls that will automatically adjust the artificial light levels based on incoming natural light. A solar hot water heating systems with backup electric tank storage incorporates collectors on south and west facing roofs, with tanks in attic spaces.

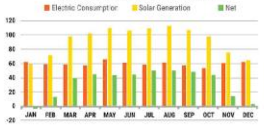
EMISSIONS + ENERGY



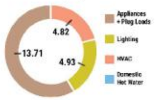
ELECTRIC CONSUMPTION (KWH X000)



ENERGY COMPARISON (KWH X 000)

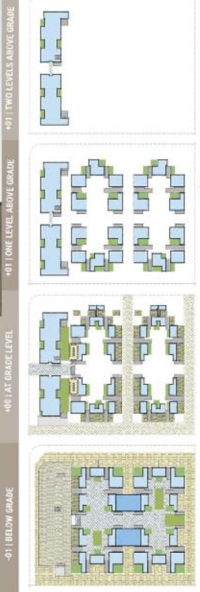


ENERGY CONSUMPTION (EUI)



ANNUAL END USE SUMMARY

HVAC	4.82
Lighting	4.93
Appliances + Plug Loads	13.71
Domestic Hot Water	0.00
Gross EUI	23.46
Renewable Production	-23.70
Net EUI	-0.24



EARTH
VEHICULAR CIRCULATION
PEDESTRIAN CIRCULATION / COMMUNITY COPEN SPACE
INDOOR COMMUNITY SPACES (COMPUTERS, GYM, KITCHEN, ETC)
UNIT AREA
PRIVATE GARAGE
SHARED PARKING
CIRCULATION / VERTICAL CIRCULATION
COMMUNITY OUTDOOR / GREEN SPACE
PRIVATE OUTDOOR / GREEN SPACE
RAMP TO UNDERGROUND PARKING
ON-SITE SOLAR BATTERY BACKUP SYSTEM [3 DAYS]
MONUMENTAL OUTDOOR STAIRS

(A) TOWER
Both Towers total 45 Units
1 Bedroom = 19 | 2 Bedroom = 17 | 3 Bedroom = 9
Conditioned Space = 7,405 sq. ft.
Parking = Underground 88 spaces w/ 2 EV

(B) NEIGHBORHOOD
Total 60 Units
1 Bedroom = 12 | 2 Bedroom = 20 | 3 Bedroom = 28
Conditioned Space = 52,288 sq. ft.
Parking = Private Garages = 60

(C) PROMENADE
Community Space = 5,188 sq. ft.

(D) UNDERGROUND SHARED PARKING

de la tierra

ARCHITECTURE AT ZERO

NARRATIVE

At the intersection of agriculture in America, socially responsible architecture and sustainable design exists the need to reinvent housing for farmworkers. This project combines the real-world perspectives of San Joaquin Valley farmworkers with an architecturally sensitive, technically sound response to the pressing reality of climate change.

From interviews with farmworkers and advocate organizations, we learned that “farmworker housing” is stigmatizing, often inhumane and unsustainable. The fundamental goal of this project is to demonstrate how housing can accommodate the day-to-day lives of farmworkers and support the social patterns that exist, while using building systems and technologies that will realize a decarbonized living environment.

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Excavated soil from the lower court area is used to construct Rammed Earth Mass Walls. Cross Laminated Timber panels are used for floor construction. Solar hot water collectors with storage tanks are provided on each stack of homes. Power generation is provided by maximum surface coverage of photovoltaic panels at south and west-facing roof surfaces. Additional panels occur above the central Promenade.

2. Site Plan

+01 | TWO LEVELS ABOVE GRADE
+01 | ONE LEVEL ABOVE GRADE
+00 | AT GRADE LEVEL
-01 | BELOW GRADE
section
A
B
C
D
hw
pv
EARTH
VEHICULAR CIRCULATION
PEDESTRIAN CIRCULATION / COMMUNITY COPEN SPACE
INDOOR COMMUNITY SPACES (COMPUTERS, GYM, KITCHEN, ETC)
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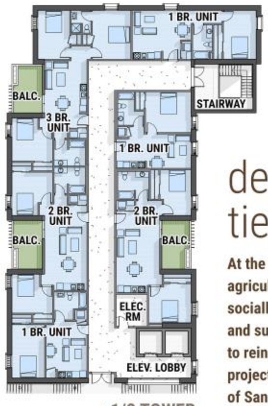
C PROMENADE
Community Space = 5,188 sq. ft.
D UNDERGROUND SHARED PARKING

3. Floor Plans



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Above Grade Level

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Below Grade Level

4. Perspective Drawing

5. Illustrated Sections

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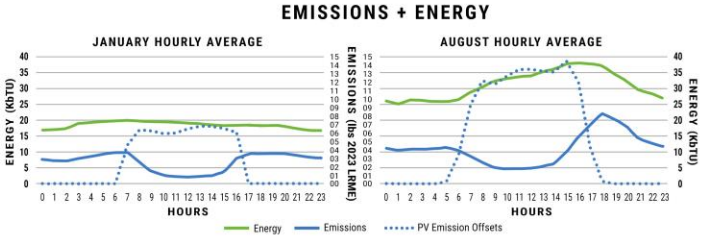

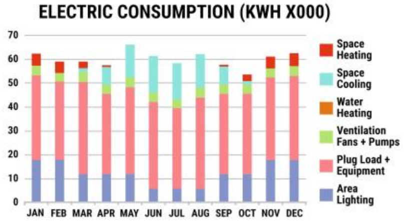

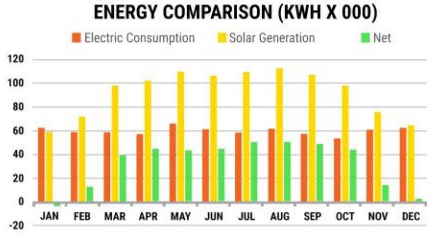

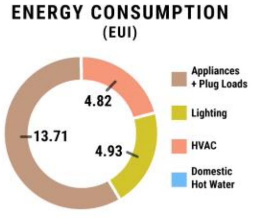

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Lighting	4.93
Appliances + Plug Loads	13.71
Domestic Hot Water	0.00
Gross EUI	23.46
Renewable Production	-23.70
Net EUI	-0.24

6. Mechanical System Summery

MECHANICAL SYSTEMS SUMMARY

Electrical power will be supplied by way of roof mounted photovoltaic panels that will offset the energy demand. Generated power will be stored on site in a network of batteries with a storage capacity of 3,954 kwh. A Water Source Variable Refrigerant Flow with Dedicated Outdoor Air System will use ground source heat pumps and hydronic lines to pre-temper the water supplied to the ceiling mounted fan coils in each home. Operable windows and ceiling fans will minimize use of the mechanical system and reduce demand. Drilling for the buried loop can be done efficiently because this operation can occur with excavation of the sunken courtyards. LED lighting will incorporate vacancy sensors and be integrated with daylight controls that will automatically adjust the artificial light levels based on incoming natural light. A solar hot water heating systems with backup electric tank storage incorporates collectors on south and west facing roofs, with tanks in attic spaces.

7. Annual End-Use Summery Table

ANNUAL END USE
SUMMARY

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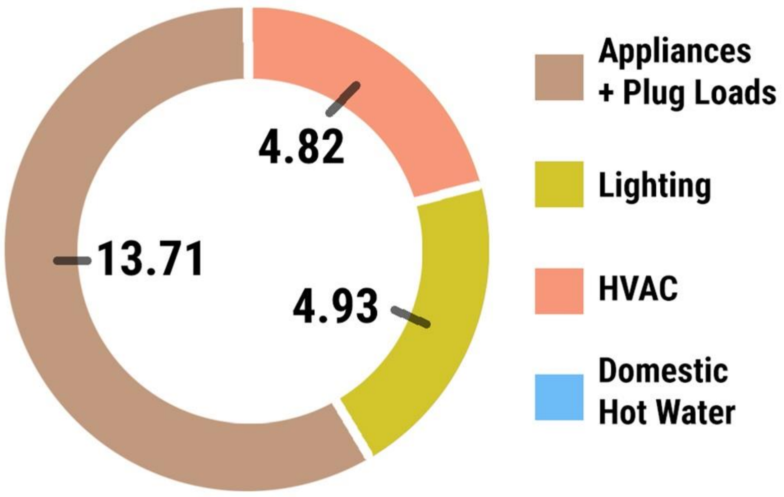
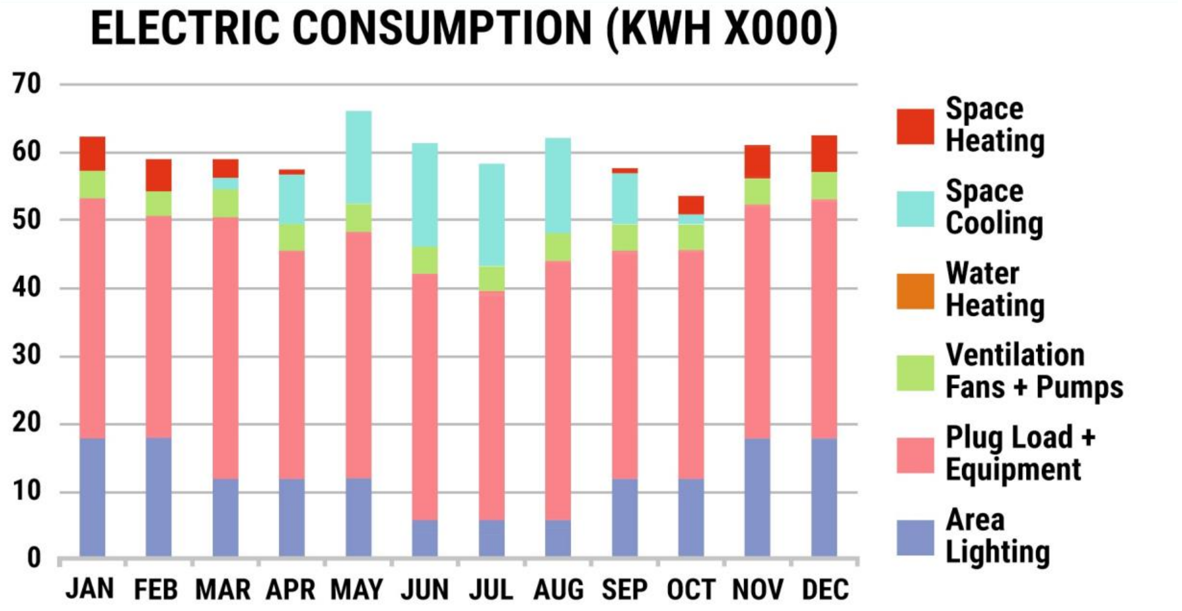
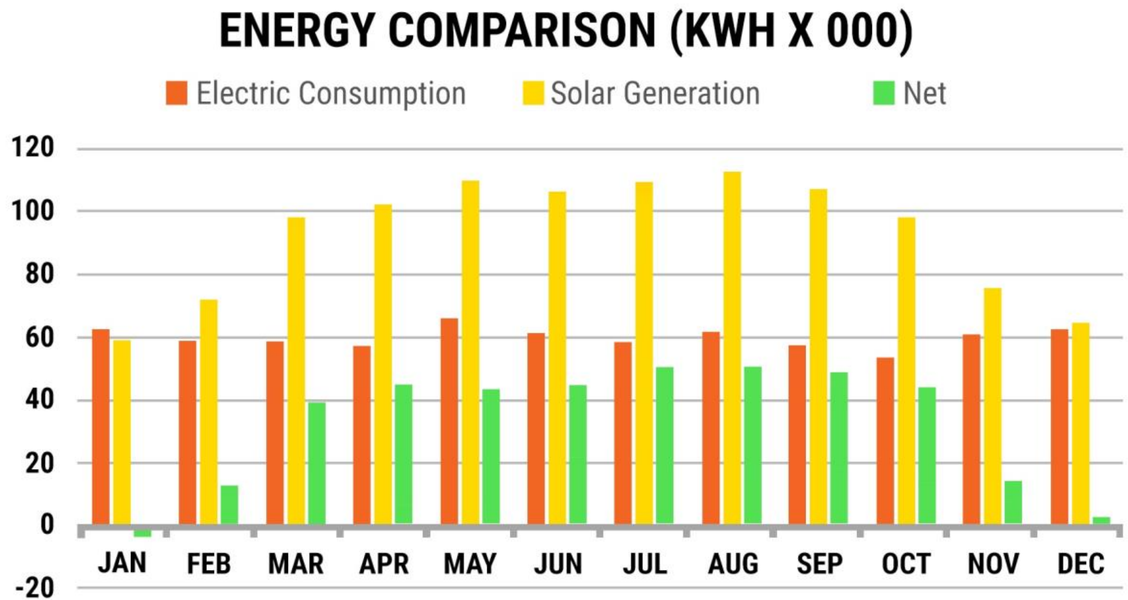
ENERGY CONSUMPTION
(EUI)

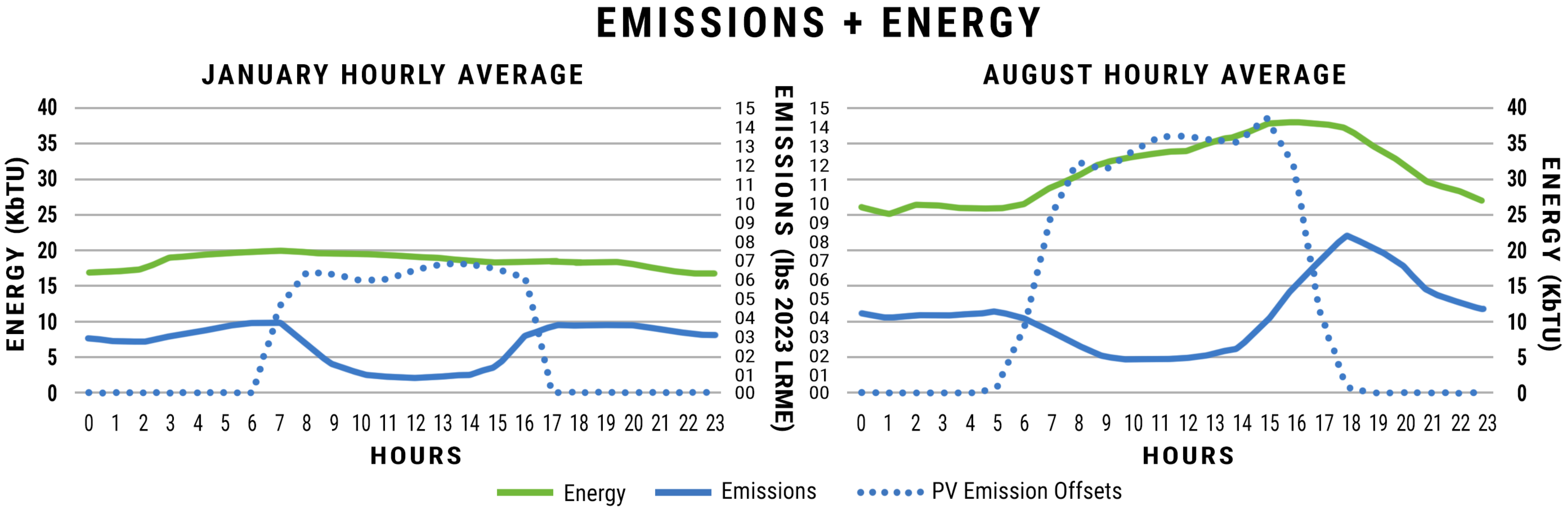


8. Monthly End Use Energy Consumption Bar Chart





9. Hourly load shapes for energy and emissions



10. Details of renewable energy systems

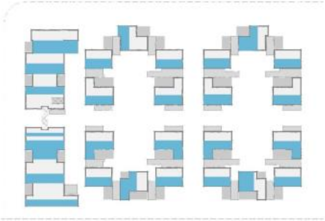
RENEWABLE ENERGY SYSTEM DETAILS

SIZING PV SYSTEM

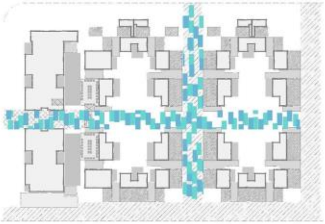
We sized our PV system based on Covetool's energy generation software –starting by reducing the demand as much as possible by choosing high-efficiency systems, then made up the remainder with on-site PV to bring the EUI down to zero. That gave us a required PV array of 27,300 sf.

27,300 sf PV required = 1,552 panels @ approx. 17.6 sf per panel

1,552 panels * 425 Watts per panel = **659 kw system size**



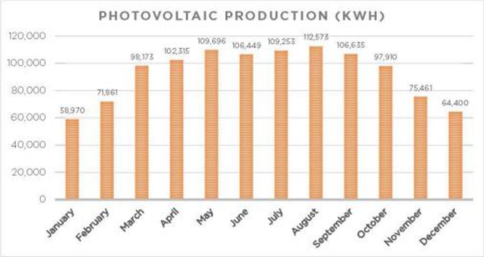
Opaque Solar Panels on all South and West Facing Roofs = 13,362 sf

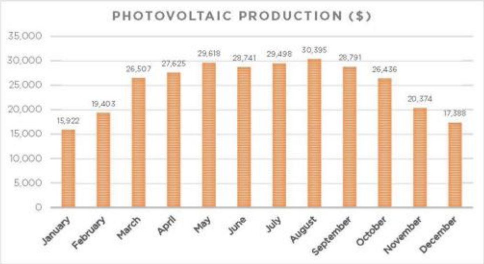


Mix of Opaque Panels and Transparent Colored Glass Panels above Promenade/Drive Aisle = 13,938 sf

Using the NREL (National Renewable Energy Laboratory) online software, we calculated the performance of this proposed system, which gave us estimated monthly PV production values as well as the cost savings associated with that production.

Using premium modules at proper tilt angle for our latitude allows for maximum efficiency.





1,113,696 KWH ANNUAL GENERATION with $300,698 ANNUAL ENERGY SAVINGS

Any photovoltaic production not funneled into site electric demand charges the on-site lithium-ion battery bank, then goes back to the grid to offset embodied carbon in building materials.

11. Storage Systems

STORAGE SYSTEMS SUMMARY

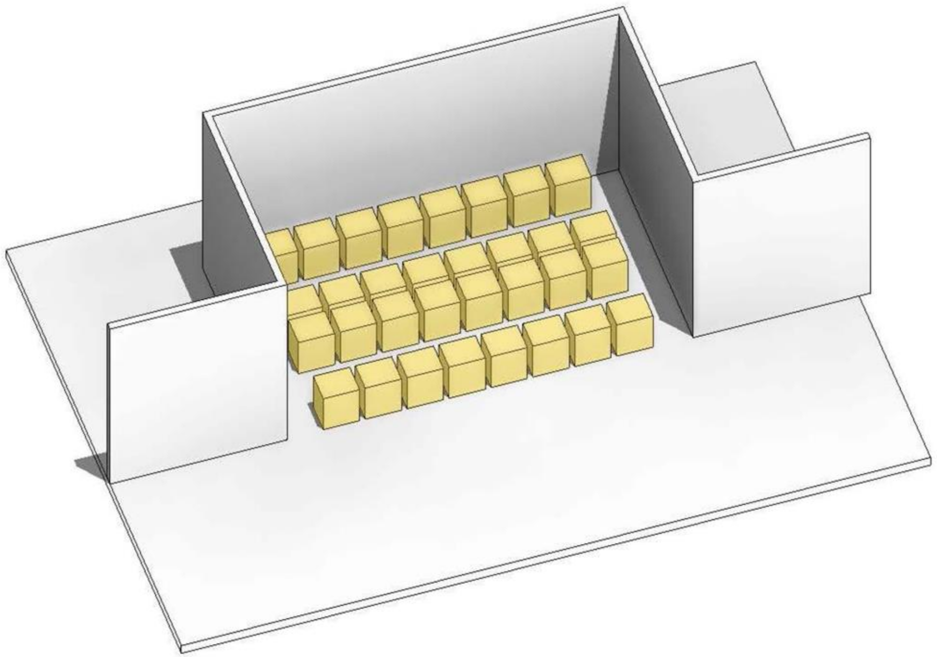
BATTERY BANK SIZING

On-site, the design includes two yards for lithium-ion battery banks to supply power during emergency events and when the solar array doesn't generate as much as the buildings' demand load.

Two yards at 740 sf each are provided = 1,480 sf total

Given that our daily demand is 659 kwh, we assume 3 days of backup for resiliency and a 2x factor (to accommodate 50% depth of discharge on batteries) = 3,954 kwh of battery storage is required.

Converting these numbers into ampere-hours totals approximately 83 batteries with 1,000 AH each. Using standard battery sizes (39" x 32" x 48"), we can assume that 8.7 sf per battery is sufficient for location within the yards. This leaves plenty of room for air circulation and maintenance access when needed.



Example of battery yard at ground level (Fencing removed for clarity)

With a battery bank and PV array of this size, we can safely estimate that the project will be easily self-sustaining and will even push power back to the grid to help offset embodied carbon from building materials.

B EQUITY Essay

EQUITY ESSAY

Equity begins with sincerity. Equity places others before self. Equity is not a formula, but a world view. This project, designed by architects from the San Joaquin Valley who are familiar with the context of the site, climate, socioeconomic, and political issues surrounding farm work attempts to apply "design thinking" to a complex problem where architecture can be a significant component of the solution. As local architects, we understand the often-inequitable reality of farm work.

From interviews in Spanish and English we learned that "farmworker housing" is stigmatizing. What farmworkers really want is a single-story, single-family residence on land they own with a front yard, a back yard and 2-car garage. Our greatest challenge was to balance these needs with the specified sustainability and density benchmarks. We accomplished this by providing private circulation from each garage to the residential unit, giving a more single-family character to an otherwise dense project.

Community rooms provide space for on-site services such as financial education, how to use energy efficiently, life skills, ESL, and computer basics. Passive survivability infrastructure such as a battery bank to facilitate on-site services instead of moving to an off-site cooling center or clinic is provided. This protects the residents' vulnerabilities by reducing dependence on outside organizations during emergencies. The generous promenade can accommodate farmer's markets and mobile health clinics with programs for the uninsured to encourage healthy habits. Additional program such as a gym and on-site daycare could possibly be open to others as well for income generation.

Non-documented residents are often afraid of seeking support. The uninsured lack access to healthcare, affordable childcare, and experience language barriers in everyday life. This design provides space at the intersection of the Promenade and the Neighborhoods for support services and education to be provided on site. Interviews gave us valuable insight like ridesharing and 40-minute commutes are common and work hours vary depending on season and weather. Most have large families and often return "home" annually. We took these specific characteristics into account when crafting this project.

The site design provides access to natural light and views, drought-tolerant planting, private space as well as community gathering/education space, and floor plans that accommodate farmworker's specific needs. HVAC systems are designed with individual controls instead of building-wide systems to prevent large scale shutdown and rammed earth mass walls reduce maintenance over time.

All homes are provided with a decontamination zone off the resident's garage with access to laundry, a bathroom, and privacy for changing immediately so that manure, pesticides, and soils can be removed before fully entering the home. Additionally, 2 bathrooms in each 2- and 3-bedroom home are provided so that several family members on the same work schedule can simultaneously use the bathroom. All homes have access to private outdoor space via balconies, private yards, or courtyards.

C. Climate Adaptation Assessment Matrix

PROJECT NAME:	de la tierra		
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	Native trees are planted throughout courtyard to provide shade for outdoor gathering areas. In addition, the Tower building on the west side will self-shade the rest of the site during the afternoon and the Neighborhood clusters create smaller courtyards that are shaded and recessed into the earth.
	Is the project enhancing insulation of homes?	YES	Project is using rammed earth mass walls (with earth from on-site excavations for sunken courtyard). This nearly doubles the R-value of a traditional wall assembly. At lower levels, earth sheltering helps lower ambient air temperatures within units.
	Is the project installing cool roofs?	YES	Standing seam metal roof functions as a cool roof to meet and exceed CA Title 24 requirements.
	Is the project reducing electrical grid demand and household costs associated with cooling?	YES	See Decarbonization Supplemental Document for more information. Project includes windows recessed in thick rammed earth walls to provide self-shading, increased insulation values, and a ground source heat pump HVAC system to reduce electrical grid demand during peak summer hours.
	Is the project providing a community cooling center?	YES	Community spaces on lower Promenade level are on backup battery power supply for residents' use during emergencies or utility shutoffs. This resilience room is complete with restrooms, a small food bank, kitchen and lounge area. In addition, the passive design of the buildings allows for more residents to stay put in their own units during crises, without leaving the site or relying on governmental agencies.
	Is the project adding permeable land cover?	YES	While the existing site is completely agricultural use, we are reducing the impact of development by providing permable pavers in the lower courtyard level.
	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.)*	YES	We recognize the importance of the impact development has on the overall project, therefore we have made extra efforts to reduce that impact by adding permeable pavers, using renewable resources for building materials and providing abundant photovoltaic offset to not only eliminate the project's grid demand load, but provide extra power back to the grid to offset the embodied carbon footprint of the building materials. Developing on this site in particular has additional benefits like being close to existing infrastructure like city water and sewer systems, as well as physcial assets like the Visalia River Way Sports Park and adjacent shopping center for grocery and convenience of the residents.
	Please add any additional measures employed to address this impact.	-	The mechanical system was chosen very carefully for this project, as these systems tend to dominate the electric load of projects in the Central Valley. By using a ground source heat pump system, with VRF fan coils and DOAS (direct outside air supply) we can greatly reduce the energy demand of these systems. Traditionally, multi-family mechanical systems are larger, building-wide units but this project proposes a series of smaller units to give residents individual control and eliminate building-wide outages for maintenance or utility shutoffs. Should these occur on rare occasion, fewer residents will be removed from service than if a whole building or complex went down. In addition, using highly efficent building materials allows us to create passively resilient dwellings that give residents the opportunity to thrive during daily life and survive during emergency events – all without leaving the comfort of their homes.
PRECIPITATION CHANGE *(e.g. drought, extreme precipitation events)*	Is the project setting up an ongoing mechanism to conserve water?	YES	CA Title 24 requirements are already fairly prescriptive as far as providing water systems that reduce the demand on our shrinking groundwater supply. Low flow fixtures are provided throughout the project, and drought-tolerant, native species landscaping is provided throughout the site. These native, drought-tolerant species help reduce maintenance time and costs. In addition, permable pavers are provided in the lower sunken courtyard areas to reduce stormwater runoff and recharge the groundwater aquifer.
	Is the project promoting improved soil health, soil quality, or soil stability?	YES	Project uses permeable pavers to help renew soil and water quality, and rammed earth mass walls reuse the excavated soil to avoid off-site transportation.
	Is the project restoring wetlands, watersheds, or riparian buffers?	n/a	Project site is not within the listed categories.
	Is the project planting native, drought-tolerant vegetation?	YES	CA Title 24 requirements are already fairly prescriptive as far as providing drought-tolerant, native species within the landscape. The use of these species also promote resilience in extreme climates and reduce long term maintenance.
	Is the project changing permeable surfaces to paved surfaces? *(Negative co-benefit.)*	YES	Project site used to be vacant agricultural land, so while developing it and adding paved surfaces reduced the permability, project is offsetting this with the use of permeable pavers and planted areas.
	Is the project increasing water use? Negative co-benefit.	YES	Compared to the previous agricultural use, which is typically a very high water use, the building demand is probably less. We are additionally offsetting the building demand with low flow fixtures and planted areas to keep runoff on-site to recharge the groundwater below.

RESILIENCE ESSAY

The notion of "Resilience" in the context of the built environment mandates that we design not just for the typical or current climates but also that we consider future climate changes and incorporate the ability to prepare and plan for, absorb, recover from, and more successfully adapt to adverse events.

In the San Joaquin Valley, resiliency is an overarching issue relevant to all aspects of life. Resiliency is locally vital given prolonged drought, poor air quality, routine occurrence of wildfires and other natural and human caused disasters. As a local design team, we understand firsthand the extremes of the climate and were able to connect with farmworkers to conduct interviews to tailor the project to their specific needs.

Throughout our research, it was clear that there are three main components of resiliency as outlined below:

Emotional - Trauma, adverse health outcomes, and food insecurity

- The design addresses this by providing spaces that foster mental health and a sense of community with ample access to natural daylight and views from the inside and emphasis on connections to outdoor space. This is essential in a post-pandemic culture. The Promenade can be opened to the public to act as a farmers market to supply residents with food or income.

Financial - Generational poverty and language barriers in everyday life

- The design addresses this by providing a variety of unit types to allow for a lower barrier to entry. Educational classes on financial education, how to use less energy, life skills, ESL, and computer basics in the community room can be offered.

Ecological - Air quality, climate change and extreme heat

- The design addresses air quality caused by smog and wildfire smoke, pesticide drift by providing adequate indoor spaces for use during extreme weather/poor air quality, and filtered outdoor air within indoor spaces so we're not relying on operable windows and pollutants entering the living areas.

- The design addresses drought, reduced groundwater and higher contamination concentration by recessing the first floor to provide earth sheltering, planting drought tolerant and native species around the site, adding pervious materials in the courtyard to filter rainwater on-site before entering the water table and reducing runoff.

- The design addresses extreme heat which often results in blackouts and utility shutoffs by providing earth sheltering and thick mass walls to improve occupant comfort, providing PV generation and battery backup, and providing one outlet in each unit on a house panel fed by battery backup to reduce energy insecurity.

The project provides several resilient features:

- Battery backup/load shifting

- Thermal mass rammed earth walls and CLT floor systems

- Operable windows/ceiling fans
- Broad overhangs and shaded windows
- Operable vertical louvers for occupant control
- Individualized HVAC units per home instead of building-wide systems to minimize large-scale shutdowns.
- Community room at lower courtyard level also functions as a resilience room with battery backup for power, a small food bank/storage, restrooms, and climate control for gathering during heat waves/utility shutdowns.

DECARBONIZATION NARRATIVE

DECARBONIZATION STRATEGIES

The design includes realistic strategies that incorporate energy efficiency measures and renewables to achieve decarbonization. Some of the strategies incorporated include:

- Reduced energy demand
  - Thick rammed earth mass walls constructed from the spoils of the lower-level courtyard excavation
    - Provides R-33 wall value, compared to traditional wall assemblies that on average provide R-21.
  - Earth sheltering will insulate lower-level homes
    - Provides a more comfortable ambient temperature with 65-degree dirt adjacent to one or two sides instead of dry air at up to 110 degrees Fahrenheit.
  - High efficiency windows
    - Dual glazed with Low-E protective coating providing SHGC of 0.25 and U-value of 0.28, compared to traditional windows meeting baseline Title 24 values at SHGC of 0.25 and U-value of 0.30.
  - Extra insulation at roof level, plus reflective metal cool roof
    - Provides R-60 roof assembly value, compared to traditional roof assemblies that on average provide R-38.
  - Efficient appliances and systems
    - EnergyStar rated appliances
    - Solar hot water generation
    - Ground source heat pump to feed VRF system
  - Education for residents to learn about energy and water use reduction
    - Space for classes in the community center near the center of the Promenade
  - Broad overhangs and operable vertical fins
    - Overhangs at upper stories shade windows, while thick wall massing provides depth to self-shade all windows. Operable vertical fins exist on west-facing Tower façade to allow for views when desired, but occupant control of shading during harsh afternoon sun.
  - Sunken courtyard and outdoor space to avoid wind/dust pollution
  - West Tower shades the rest of the site in the harsh afternoon sun

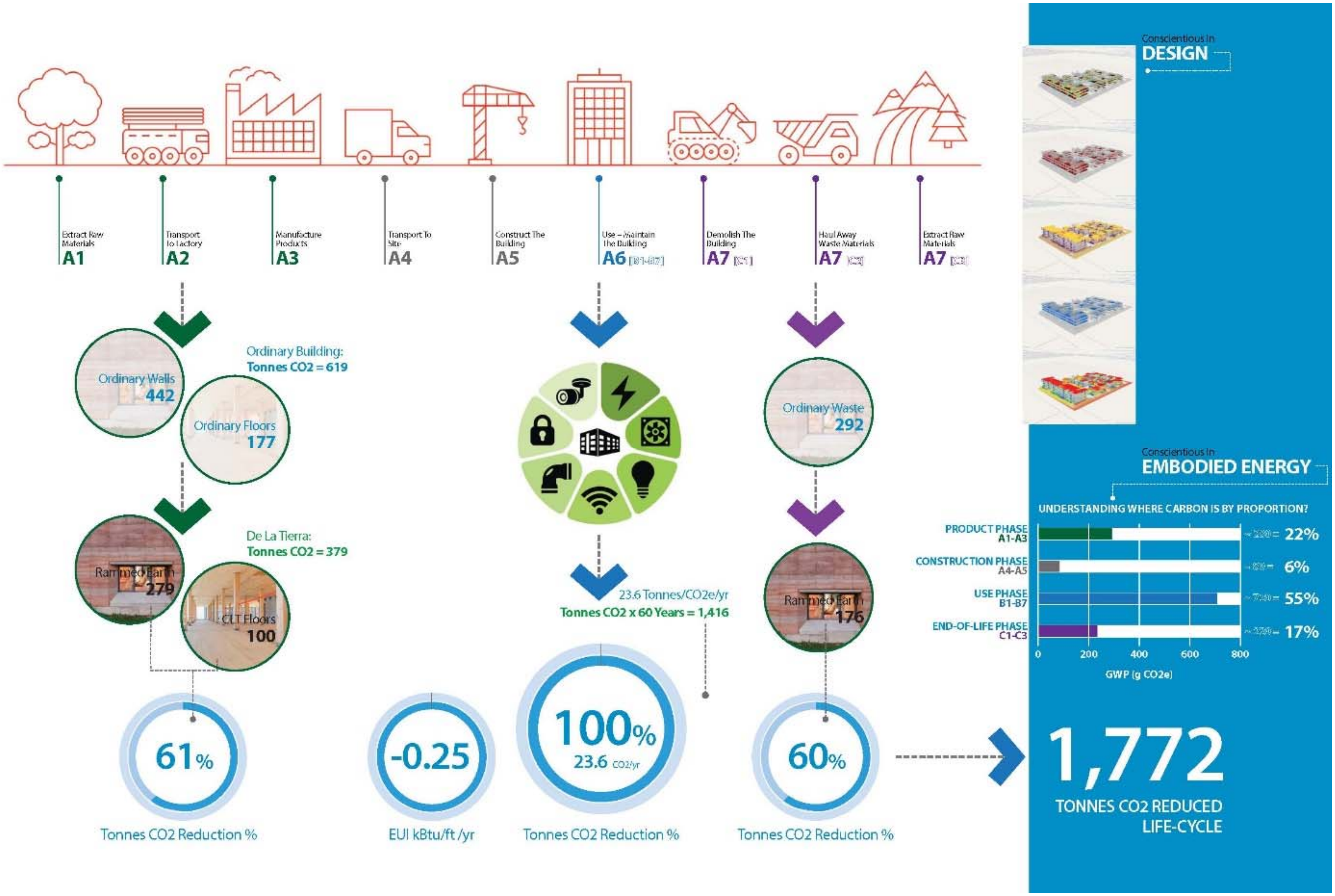
- Renewables
  - PV panels
    - Include a mix of solid, high-efficiency panels with colored glass translucent panels achieve visual variety while adding to energy offset and provide shade below Promenade and primary drive aisle.

- On-site Battery backup storage facilitates distribution of battery power to each home enabling residents to stay on site during emergencies and utility shutdowns instead of traveling to off-site cooling centers. Battery bank also powers the community spaces to provide “resilience rooms” for the community.
- Solar hot water heating can be funded by up to 10% tax credits to help with initial cost. Backup electric tank water heaters are provided, but are not anticipated to be used often due to our extremely sunny climate.
- Ground source heat pump system includes +/- 300 feet of vertical piping in the earth gets to 55 degrees to pre-chill or pre-heat air seasonally to feed the buildings’ mechanical system. These pumps provide 4x the heating capacity vs. traditional gas-fired furnaces for the same energy draw. Water-sourced VRF fan coils in each unit provide occupant control, and DOAS (direct outside air supply) systems provide filtered outside air, to avoid reliance on operable windows during poor air quality days.

- Embodied Carbon to achieve zero carbon goals
  - Spoils from excavated site are used for rammed earth walls above after amendments added for strength and durability.
  - Cross-laminated timber panels will be used for floor assembly reduces dependence on steel/concrete, and is a more renewable resource. It provides ample STC and IIC protection between dwelling units as well as provides a finished ceiling surface for the units below, eliminating the need for an additional dropped ceiling typically made from metal studs and drywall.

- How design achieves Zero Carbon performance goals
  - Design generates a net EUI of negative 0.24.

LIFE CYCLE EMBODIED CARBON



SUPPLEMENTAL ENERGY INFORMATION

Generated from CoveTool (a Revit Plug-In) is shown on following pages.

ANALYSIS SUMMARY

Location

12750 Ave 336, Visalia, CA 93291, USA

1

Walk Score®

Car-Dependent

25

Bike Score®

Somewhat Bikeable

Building Type

Apartments

0

Overall Energy

The current model is done using Commercial - California Title 24 2019 energy code assumptions. The current design is better than the national average and can be significantly improved by higher performance of envelope, HVAC and more. The building load is driven by Equipment and Lighting.

BENCHMARKS

WHERE DO WE NEED TO BE?

Energy

41	8	55%	10%
National Average	2030 Target	Daylight	Glare

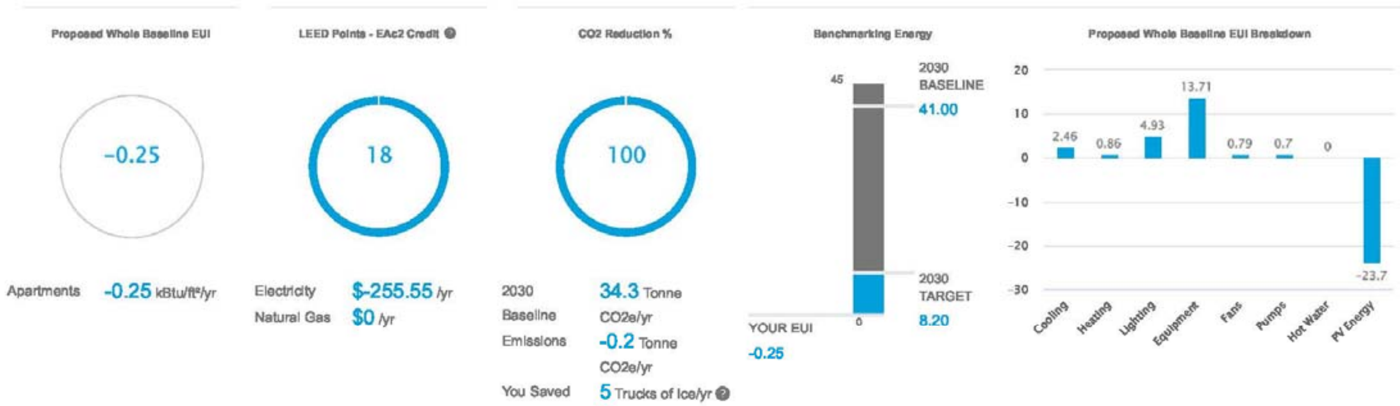
EUI is expressed as energy per square foot per year. It is calculated by dividing the total energy consumed by the building in one year (measured in kBtu) by the total floor area of the building. The most common unit for EUI is kBtu/ft²/year.

Spatial Daylight Autonomy (sDA) describes the percentage of floor area that receives at least 300 lux for at least 50% of the annual occupied hours.

Annual Solar Exposure (ASE) refers to the percentage of space that receives too much direct sunlight (1000 Lux or more for at least 250 occupied hours per year), which can cause glare or increased cooling loads.

ENERGY ANALYSIS

Baseline Energy



Cooling

Your cooling load is not dominating your energy use. This is because your HDD are higher than your CDD days.

Heating

Your heating load is not dominating your energy use. This makes sense - although your HDD days are higher than your CDD, the Equipment load is dominating the calculation. Look under the Usage and Schedules tab in the Engineering Inputs.

Lighting

Your lighting load contributes to 21.02% of the total EUI. You can reduce your lighting load by reducing your lighting power density and having daylight and occupancy sensors in the Engineering Inputs.

Equipment

Your equipment load is dominating your energy use. You can reduce your equipment load by reducing your appliance power density.

Hot Water

Your hot water load contributes to 0.0% of the total EUI. You can reduce your hot water load by reducing your domestic hot water demand and using a more efficient hot water generation system in Engineering Inputs.

Fans

Your fan load contributes to 3.37% of the total EUI. You can reduce your fan energy by switching your fan flow control accordingly in the Engineering Inputs.

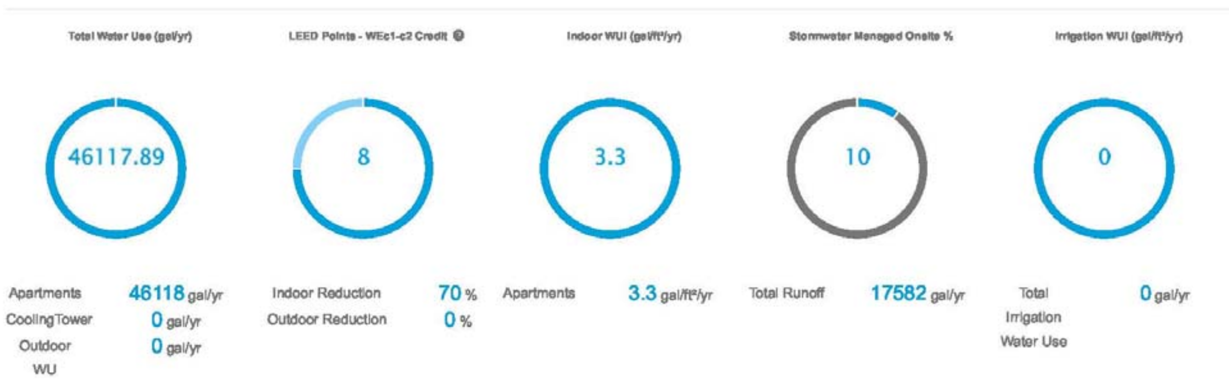
Pumps

Your pump load contributes to 2.99% of the total EUI. You can reduce your pump energy by adjusting pump control for cooling/heating in the Engineering Inputs.

PV Energy

The current Photovoltaic panels offset -23.7 EUI off the building.

Water Use


Total Water Use (gal/yr)
46117.89
Apartments 46118 gal/yr
CoolingTower 0 gal/yr
Outdoor WU 0 gal/yr
LEED Points - WEc1-c2 Credit
8
Indoor Reduction 70 %
Outdoor Reduction 0 %
Indoor WUI (gal/ft²/yr)
3.3
Apartments 3.3 gal/ft²/yr
Stormwater Managed Onsite %
10
Total Runoff 17582 gal/yr
Irrigation WUI (gal/ft²/yr)
0
Total Irrigation Water Use 0 gal/yr

2030 PALETTE

The strategies below are applicable to your building and location


Building Facade


Cool Roof


Cross Ventilation


Daylight from Multiple Sides


Direct Gain: Glazing


Double Roof


Earth Sheltering

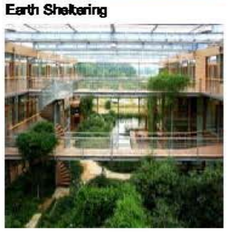

East/West Shading


Form For Cooling


Form For Daylighting


Form For Heating


Green Roof


Indirect Gain: Sunspace


Intermediate Light Shelves


Night Vent Cooling


Shading Devices


Side Daylighting


Solar Greenhouse


Stack Ventilation

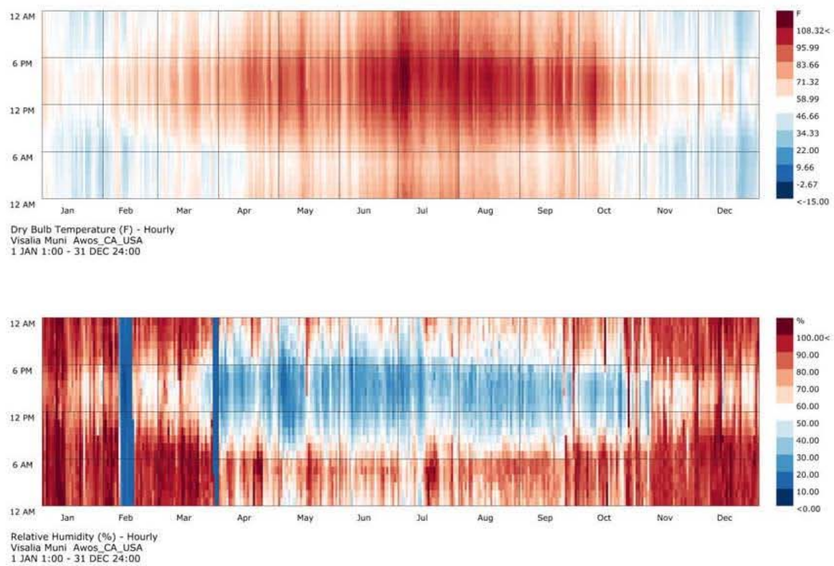

Thermal Storage Wall


Top Daylighting

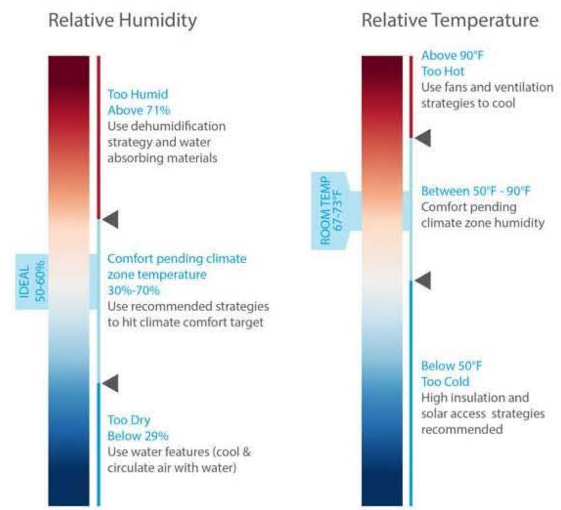

Top Daylighting Controls

CLIMATE ANALYSIS

RELATIVE TEMPERATURE & HUMIDITY

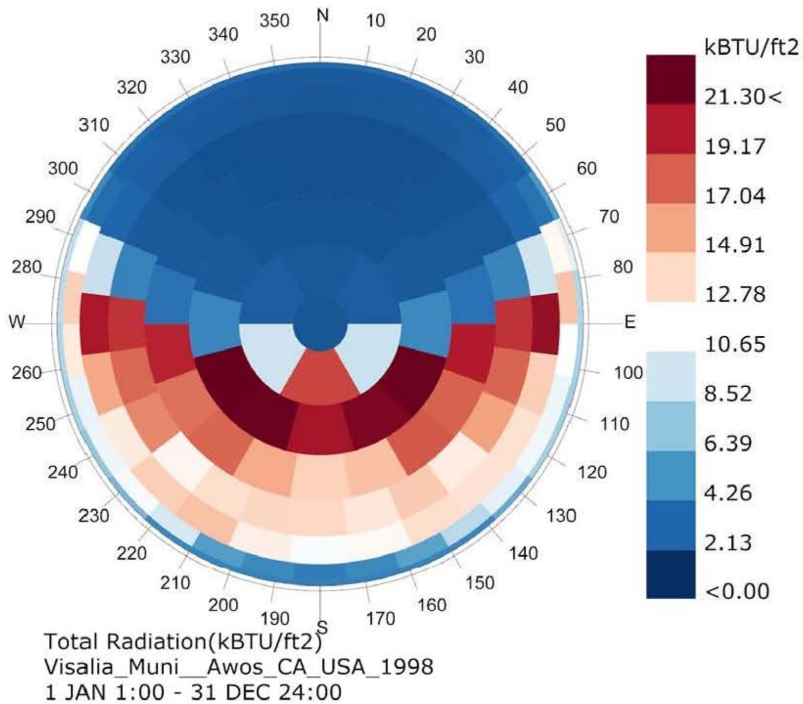


This graph shows the outdoor comfort in Visalia using the yearly range of temperatures and humidities.

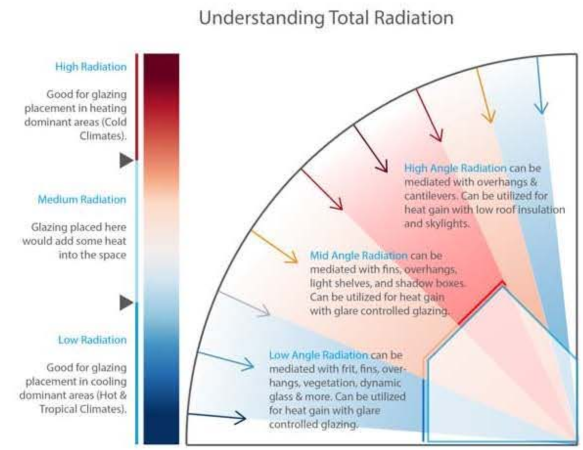


CLIMATE ANALYSIS

RADIATION BY SKY SEGMENT



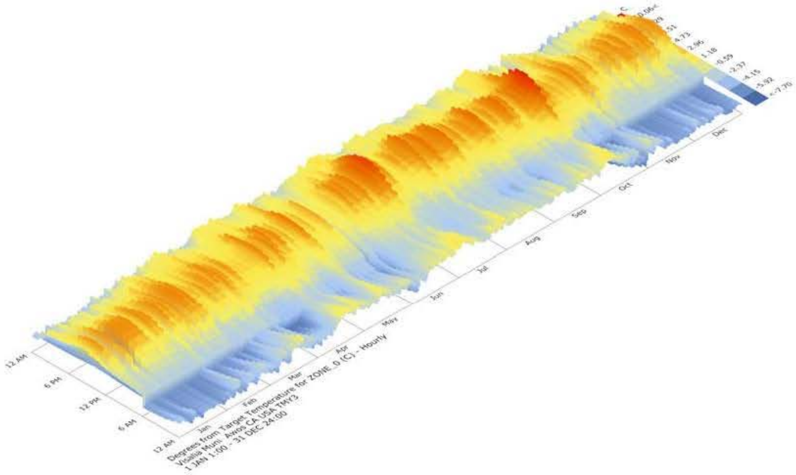
This graph maps the radiation onto a sky dome to show the Intensity of the direction and Intensity of solar radiation on a yearly basis around the cardinal points for Visalia.



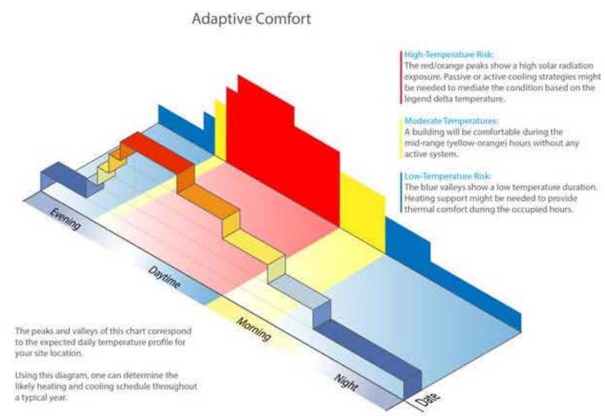
This diagram shows a radiation map projected onto a dome which is used to determine the best placement for glazing and possible radiation mediation strategies. Use the color, angle, and direction of radiation to identify what strategy you can use to optimize thermal comfort and ideal placement.

CLIMATE ANALYSIS

ADAPTIVE COMFORT

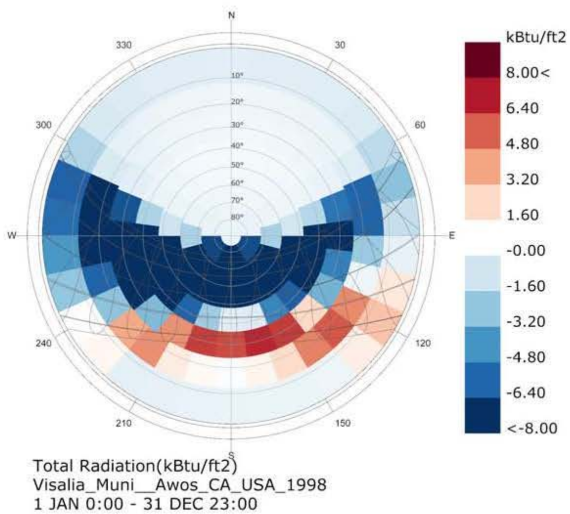


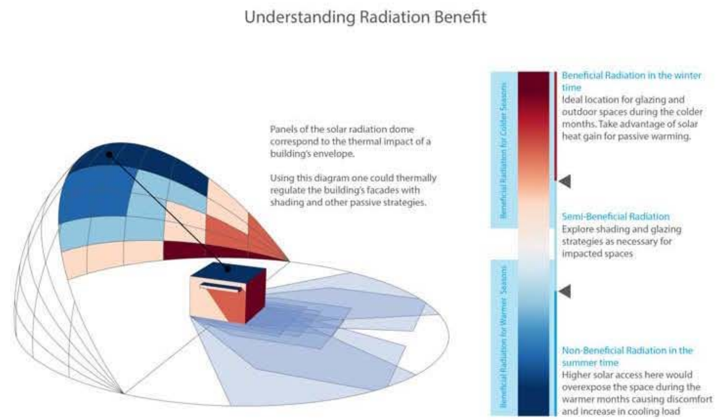
Adaptive Comfort chart showing the time of day and time of year with the greatest human comfort for your location.



CLIMATE ANALYSIS

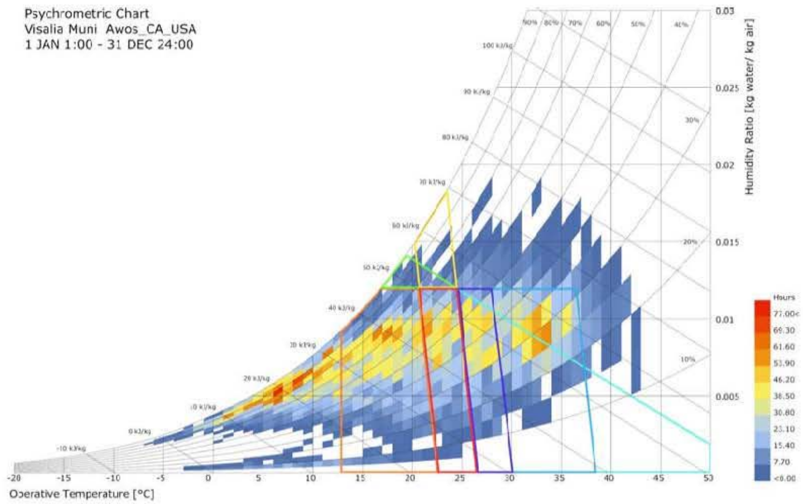
RADIATION BENEFIT





CLIMATE ANALYSIS

PSYCHROMETRIC CHART



10.48 % COMFORT - NO PASSIVE STRATEGIES

Impact of Design Strategies
% of additional comfort - higher is better

11.94 % EVAPORATIVE COOLING

10.09 % THERMAL MASS + NIGHT VENTILATION

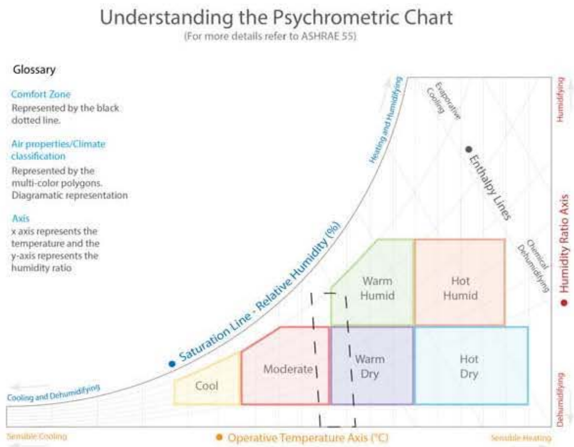
7.32 % OCCUPANT USE OF FANS

29.68 % INTERNAL HEAT GAIN

0.50 % DESICCANT DEHUMIDIFICATION

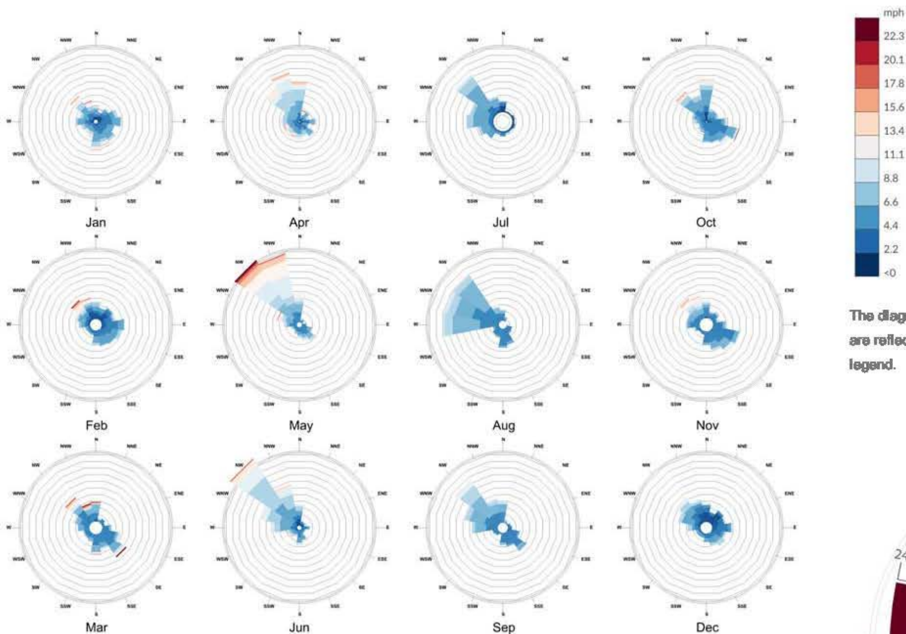
0.48 % DEHUMIDIFICATION

This chart shows the relationship between dry bulb, humidity ratio, and enthalpy. The polygons overlaid on the chart represent different strategies to increase comfort. Based on ASHRAE 55-2013 under standard conditions.


Understanding the Psychrometric Chart
(For more details refer to ASHRAE 55)
Glossary
Comfort Zone
Represented by the black dotted line.
Air properties/Climate classification
Represented by the multi-color polygons. Diagramatic representation
Axis
x axis represents the temperature and the y-axis represents the humidity ratio
Heating and Humidifying
Evaporative Cooling
Enthalpy Lines
Saturation Line - Relative Humidity (%)
Chemical Dehumidifying
Humidity Ratio Axis
Humidifying
Dehumidifying
Warm Humid
Hot Humid
Cool
Moderate
Warm Dry
Hot Dry
Cooling and Dehumidifying
Sensible Cooling
Operative Temperature Axis (°C)
Sensible Heating

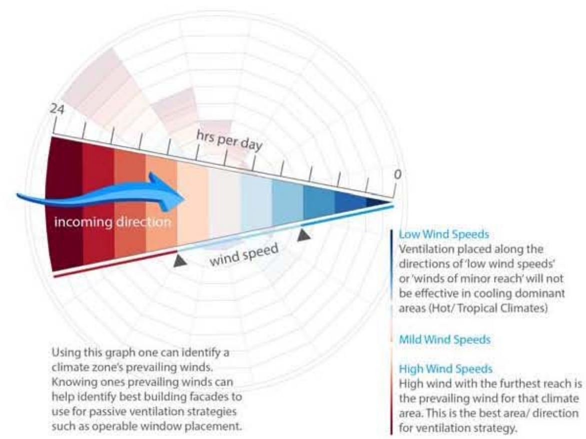
CLIMATE ANALYSIS

WIND

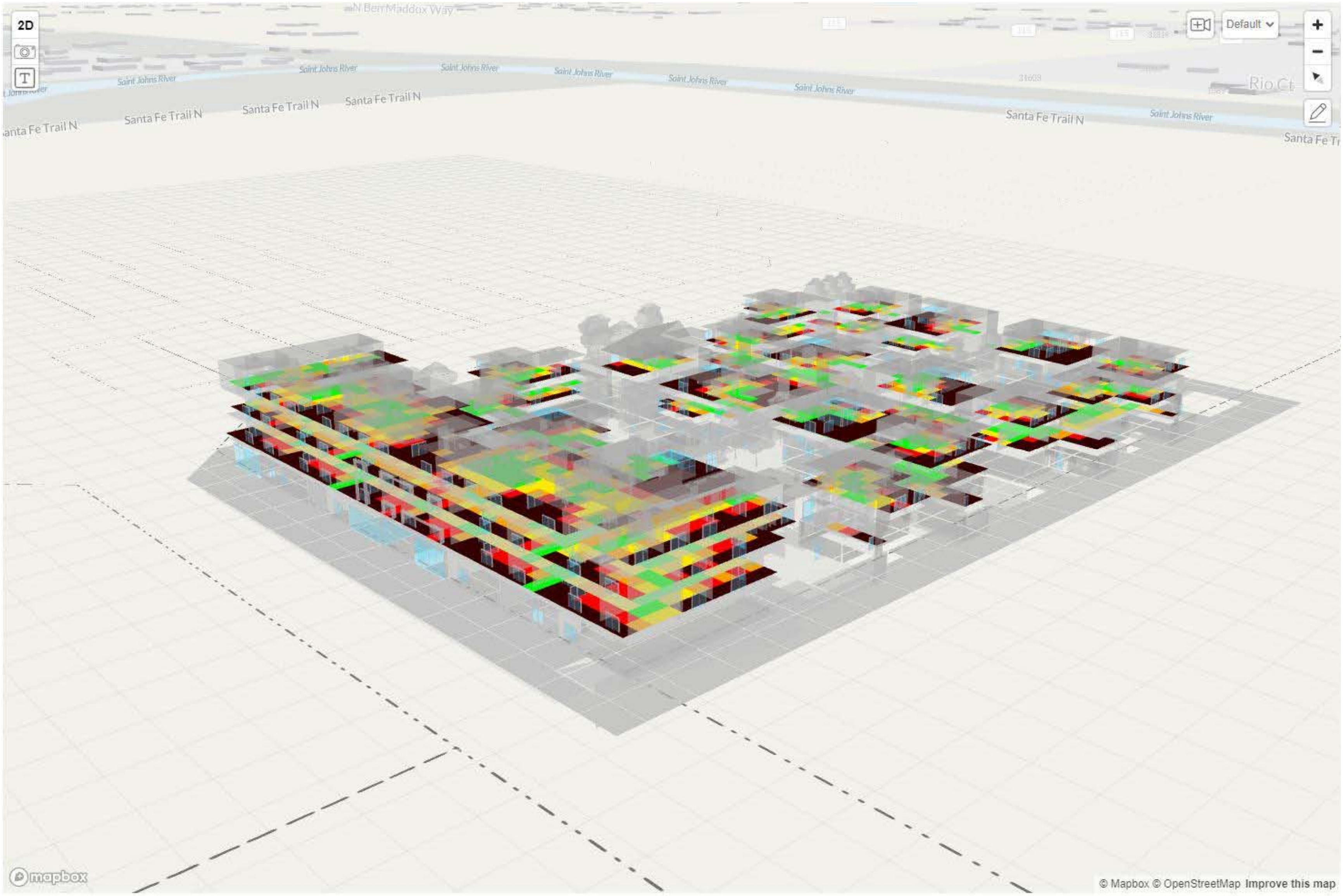


The diagrams show the wind direction and intensity coming to the site. The number of hours are reflected by the size of the rose, and the intensity is expressed in colors as shown in the legend.

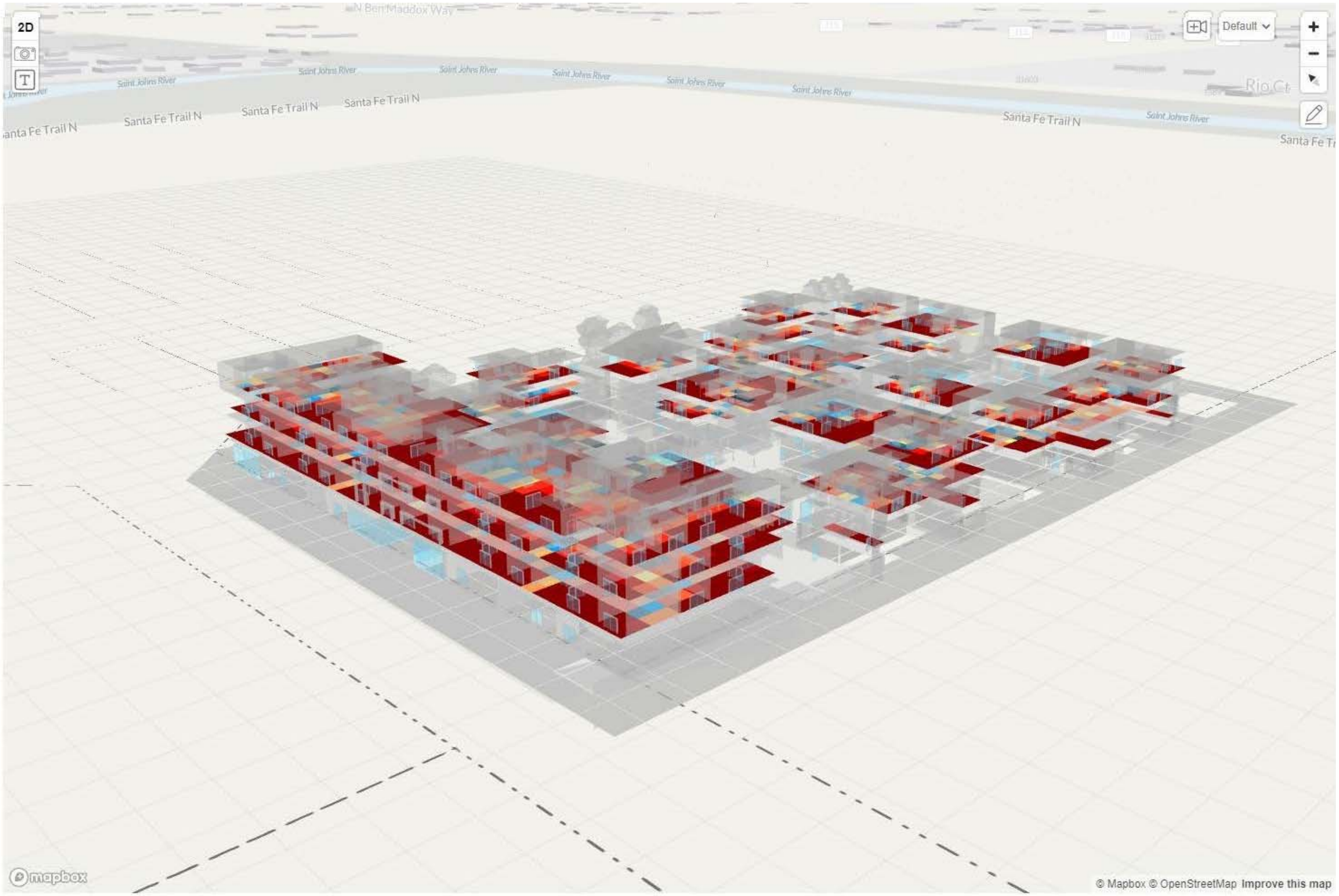
Understanding the Wind Diagram



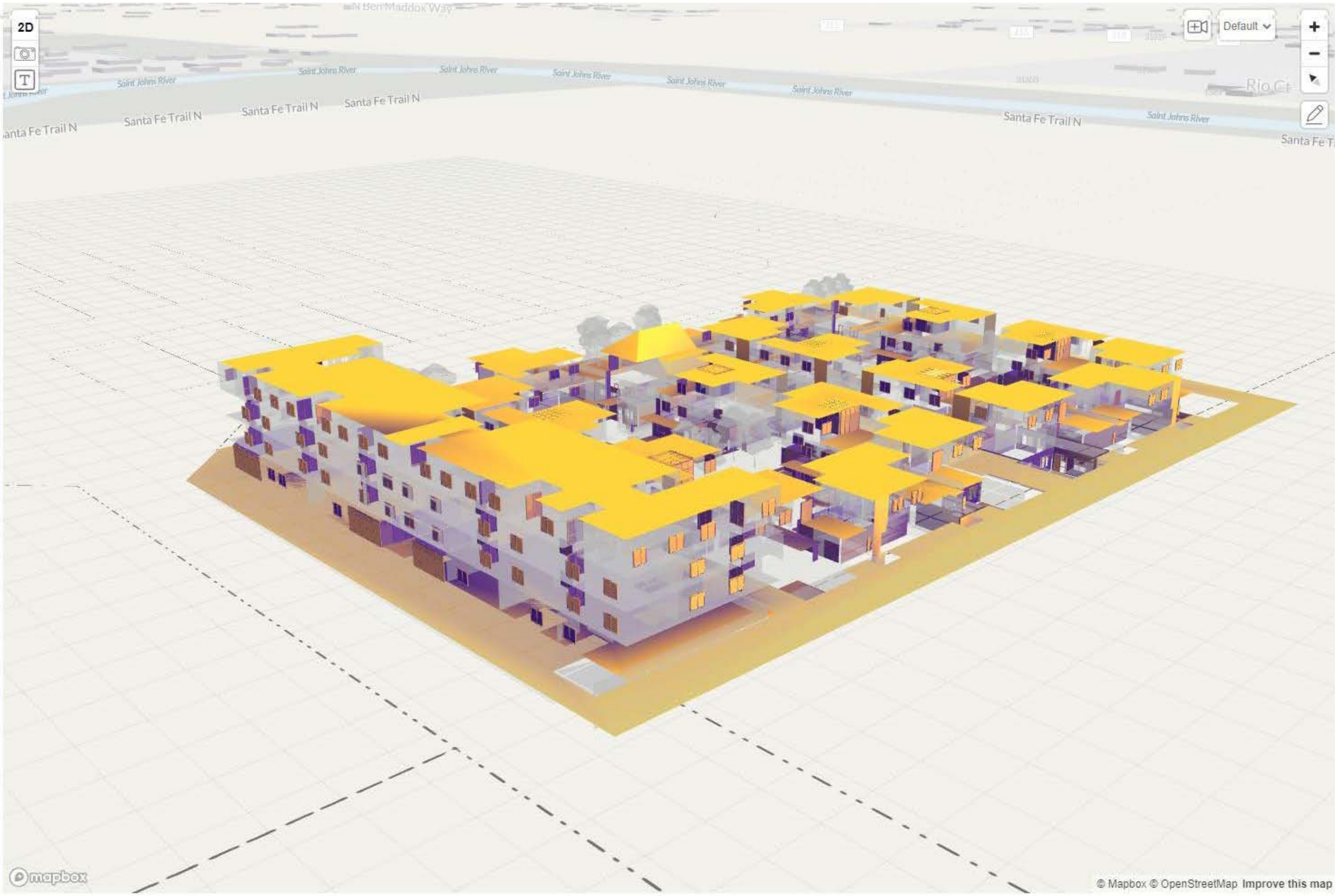
Glare + Annual Sunlight Exposure



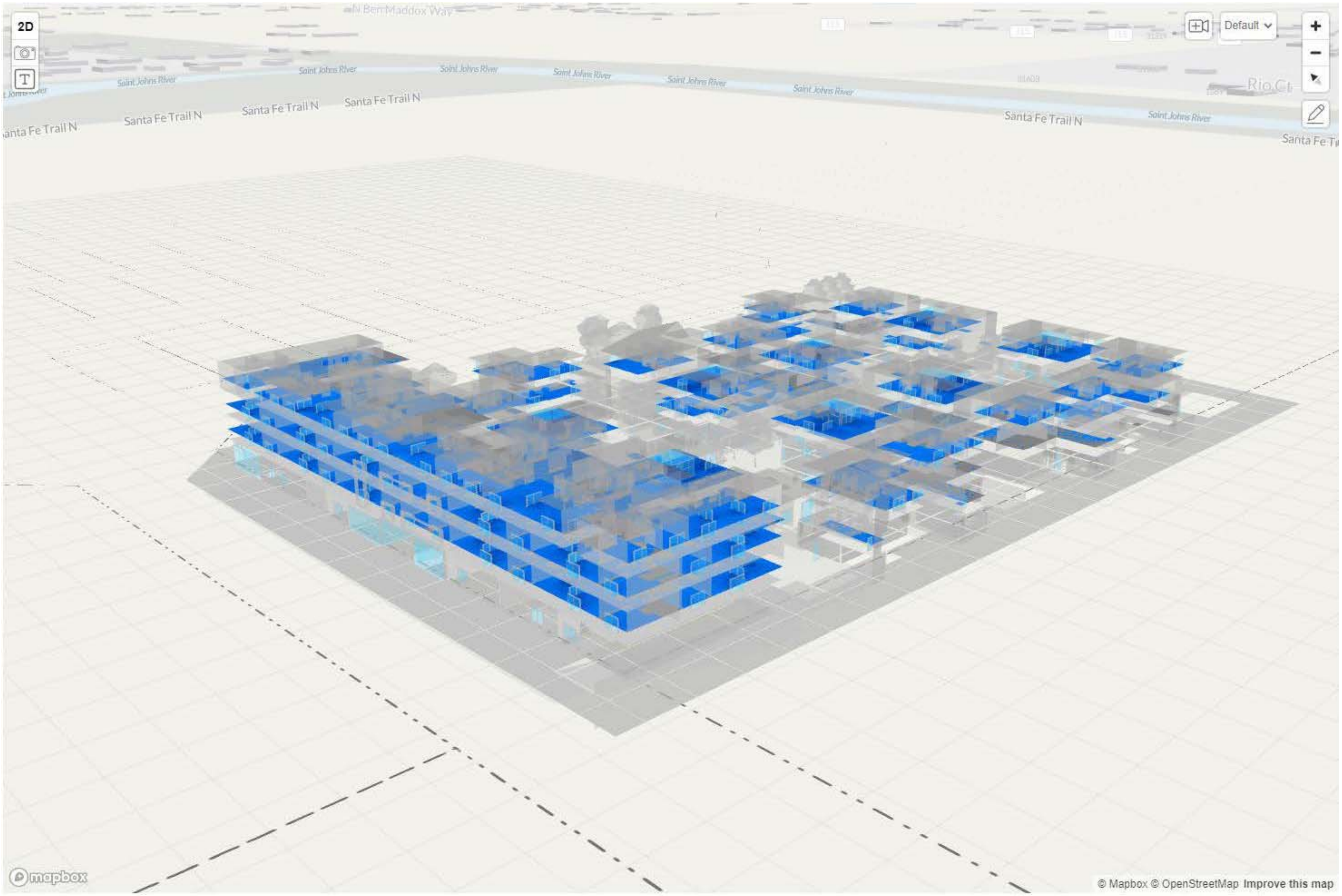
Daylighting



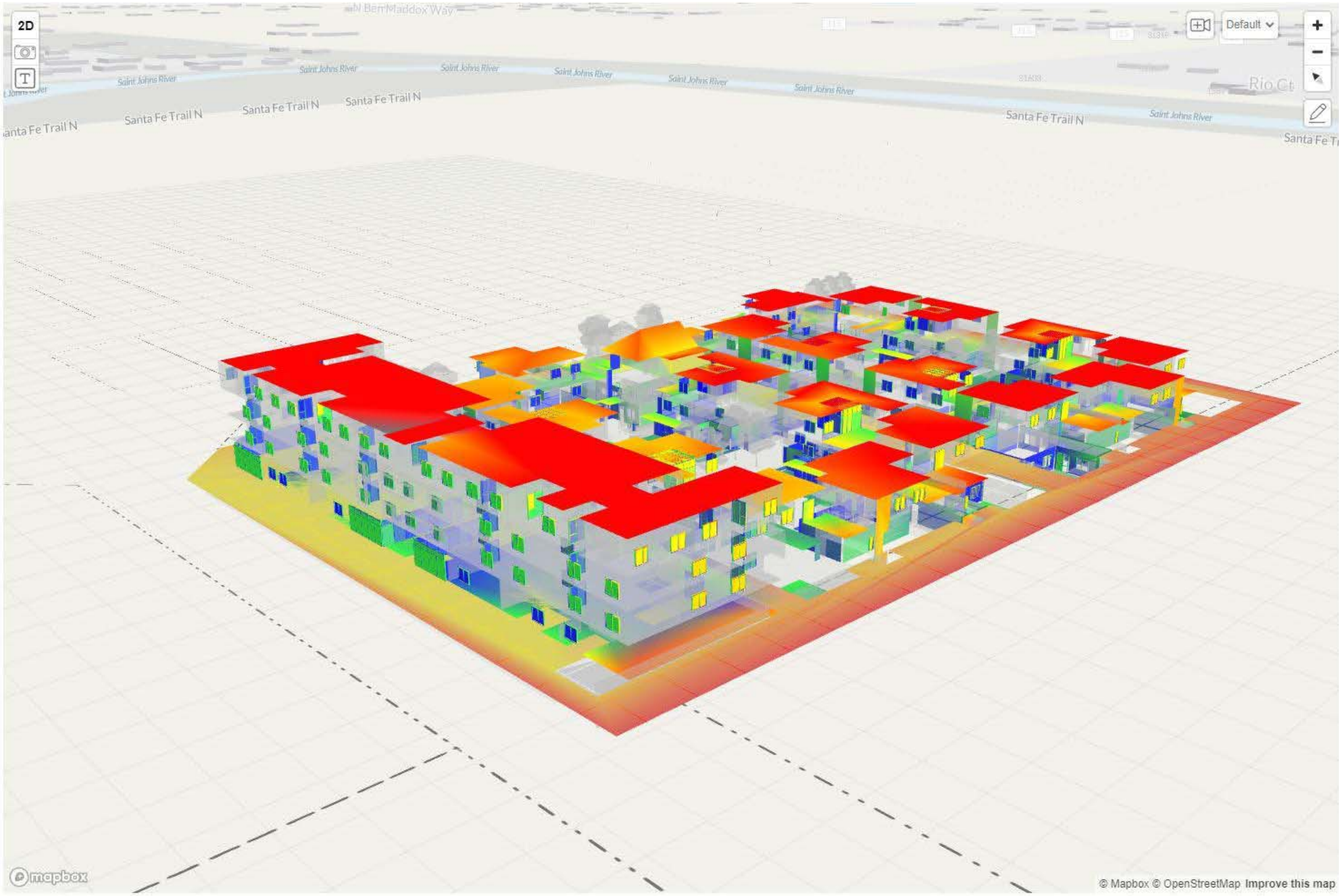
Solar Radiation



Quality Views



Sun Hours


2D
Default
Saint Johns River
Santa Fe Trail N
Rio Ct
© Mapbox © OpenStreetMap Improve this map