28th Street/Little Portugal Station

Design Development Framework (DDF)
Sustainability Memo

Final
August 2025

Introba

Issue	Description	Date (MM.DD.YY)	Prepared By	Signed Off
V1		05.30.23	PJC, MA	
V2		06.16.23	PJC, DNK	
V2b		07.03.23	PJC, DNK	
V2c		09.28.23	PJC, DNK	
V2d		10.12.23	PJC, MA, DNK	
V3		16.01.24	PJC, DNK	
V4		8.5.25	PJC	

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V4

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1 Introduction

The purpose of Santa Clara Valley Transportation Authority's (VTA) Design Development Framework (DDF) is to provide a concept vision and guiding principles for real estate development at the 28th Street/Little Portugal Transit Center (the "Station") in San José, California. VTA and stakeholders will use the DDF to guide and evaluate developers' future proposals and designs for Transit-Oriented Development (TOD) on approximately 12 acres of VTA-owned property by the Station. The Station is being constructed as part of the BART Silicon Valley Phase II (BSVII) Extension Project (www.vtabart.org).

1.1 Memo Purpose

This memo focuses on helping VTA gain a comprehensive understanding of the sustainability issues and considerations for the TOD.

The memo identifies climate considerations, best practices, passive and active strategies, and key actions that have been identified to achieve the sustainability goals identified by VTA. It should be noted that these are current at time of writing, but technology adapts and advice may need to be updated, especially considering the long-term buildout of this site.

The diagrams and figures provided in this DDF document are conceptual and subject to change. They reference BART Silicon Valley Phase II Extension Project (BSVII) plan sets updated through April 2025. This content is for preliminary planning purposes only; it is not a formal planning application nor a regulatory document. Unless otherwise noted, all figures in this document were created by Introba for VTA.

1.2 Memo Organization

The memo begins with an executive summary consolidating key findings. The following three sections explain the sustainability considerations, including:

- Section 3 – Energy and Carbon Management: Analysis of Net Zero Energy goals, the options available through site wide utilities, and embodied carbon.
- Section 4 – Materials, Resources, and Waste: Identify goals in material use to further sustainability progress
- Section 5 – Resilience and Adaptation: Target key elements to protect both the location and users from climate change impacts, and plan for resilience.

2 Executive Summary

The key goal of this memorandum is to provide a framework that VTA can use to encourage sustainable building design as they evaluate developer proposals for Transit-Oriented Development (TOD) on VTA-owned property. This framework is intended to align with the 2020 VTA Sustainability Plan, VTA's overarching goals, and to provide a benchmark that can be used to assess proposals and designs.

In striving to meet their commitment to continual improvement, VTA recognizes that aggressive actions are necessary to halt, reverse, restore, mitigate, and prepare for the consequences of climate change[1]. As long-term landowners, VTA wishes to fully realize their role as environmental and community stewards—elevating the development at this site beyond code requirements.

Sustainability guidelines for the development include: a target of net zero energy; encouragement of centralized utilities; consideration for how these buildings can impact the health of both the occupants and the broader community; and how the buildings might operate in an emergency or in future environmental conditions.

Through thoughtful planning and design, it is possible for the VTA site to generate more renewable energy than is consumed, release less carbon, reduce water demands, divert construction materials from the waste stream, promote healthy indoor environments through design and material selection, and create resilient buildings.

Analysis was undertaken on the location, climate, and various massing and orientation options in order to help guide the planning and goal setting.

As a result of these VTA and site-specific considerations, three principal focus areas have been identified. They are:

- Energy & Carbon Management
    - → The conscientious handling of resources involved in the development of a **net zero energy** establishment, with acknowledgment for the **embodied carbon** impact of material and systems selection.
- Materials, Resources, & Waste
    - → The selection of healthy **materials** while planning for a robust **water resource** management and **waste** handling building approach.
- Resilience & Adaptation
    - → An analysis of the methods of project **resilience**, both of the site and of the building itself, which can be adopted to improve overall systems performance and long-term survivability/**adaptation**.

Key Actions have been identified for the three focus areas and precede the detailed narrative in each section of this memorandum.

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[1] Santa Clara Valley Transportation Authority Sustainability Plan 2020

3 Energy & Carbon Management

3.1 Key Actions

This section highlights the Key Actions which arise from the detailed analysis of Section 3: Energy & Carbon Management.

Goal: Net Zero Energy

- Minimize fossil fuel use on site during construction, using electric site equipment to the greatest extent possible
- Utilize programmatic electrification of all systems through the selection of only electric equipment (e.g., heating and cooling systems for water, kitchen appliances, and backup generators). I.e., utilize zero fossil fuels during operations.
- Engage in envelope optimization using a highly insulative envelope and by selecting overall design of apertures & materials to allow for passive heating/cooling and natural ventilation. At minimum, achieve the following design thresholds:
  - → Infiltration – 0.08cfm/ft2 façade at 75Pa at most
  - → Typical Window Assembly U value 0.3Btu/hr.sf.°F, SHGC 0.3 – additional assessment based on orientation etc.
  - → Wall Assembly R30, Roof Assembly R58
  - → Refer to PHIUS prescriptive climate zone requirements: https://www.phius.org/phius-core-prescriptive-2021-climate-zone-table
- Optimize lighting systems through the use of maximized, appropriately shaded daylit spaces, and highly efficient LED lights in non-daylit areas.
- HVAC optimization & refrigerant minimization through the use of heat pumps and passive design for heating, cooling, humidity control, and ventilation.
- Implement cool roof/wall strategies using planted, low-maintenance green roofs where space allows, high SRI roofs where there is no space, and vertical growing walls.
- Building systems optimization through the use of live controls, feedback systems, and error identification.
- Set EUI target prior to renewables integration.
- Onsite and offsite renewable energy integration in the form of not only solar but wind and water-generated power where feasible—requiring the use of wind mapping and identification of local hydropower sources.
- Engagement with building occupants by providing signage and incentives for informed decision making with regard to proper space and resource usage.
- Establish electric vehicle (EV) and carpooling parking spots for occupant and visitor use and provide carpooling and public transit incentives to minimize emissions impact associated with commute.

Goal: Carbon Neutral (as per Climate Smart San José) & 40% Net GHG Reduction

- Design the project to be lightweight and efficient, with a whole building life cycle assessment (WBLCA) used to optimize all building components.
- Utilize modular and adaptable design elements in office/institutional spaces to enable future reconfiguration, deconstruction, and reuse. This includes the use of modular interior products (e.g., ceiling & carpet tiles, movable partitions) and the inclusion of a building tag.
- Maximize the number and type of product (structural, interior, & envelope) being sourced from local sources (extraction & manufacture), most particularly from local material and product reclamation and reuse sites.
- Select necessary new product types (e.g., concrete) from manufacturers with high performing EPDs (low global warming impact categories) and a high quantity of recycled content.

3.2 Overview

In the US, buildings are responsible for approximately 40% of carbon emissions, annually. Energy and carbon management is crucial for reducing these emissions, combating climate change, and achieving regional sustainability goals.

By reducing energy demand, buildings can contribute to overall resource conservation and reduce the environmental impact associated with energy generation. Implementing efficient technologies, adopting renewable energy sources, and promoting energy-conscious behaviors, can allow buildings to play a significant role in transitioning to a low-carbon future. Beyond electrification, this involves designing to minimize energy consumption and improve building performance; energy monitoring to track trends and strategies; the use of low impact construction techniques; the integration of circularity principles (continuous reuse) in building design; and the selection of low carbon materials for construction.

Successful implementation will require a collaborative effort between the design and construction teams from the start of the design process through to construction & operations. This collaborative process will allow the project to capture the most cost-effective and performance-driven solutions.

It is noted here that by 2030—the year the 28th Street/Little Portugal TOD is projected to commence—the CA Energy Efficiency Strategic Plan is expected to have mandated all new residential and office/institutional construction to be Net Zero Energy (NZE).

There exist additional local goals and requirements set by the City of San José which are of import to the project. The San José Reach Code[2] requires all new buildings to be all electric, to provide electric vehicle charging, and to be solar ready since 2021. Climate Smart San José—adopted in 2018—sets goal for the City to achieve carbon neutrality by 2030[3].

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[2] Climate Smart San José - San Hose's Natural Gas Infrastructure Prohibition and Reach Code Ordinances

[3] Climate Smart San José - Pathway to Carbon Neutrality by 2030

With these regional considerations in mind, it is important that the VTA site's design reflect not only current requirements but also preparations for an ever-improving, ever-evolving set of regional sustainability requirements.

3.3 Net Zero Energy

3.3.1 Background

The vision for this site is to reach Net Zero Energy. An NZE building, as defined by the US Department of Energy (DOE), produces enough renewable energy to meet its own annual energy usage, thereby reducing the use of non-renewable energy in the building sector[4].

Achieving NZE requires integrated design, designing buildings for reduced energy consumption & optimized energy production, and collaboration with building users and operators. Together, these strategies ensure that the intended building performance can be achieved.

The path to NZE can be envisioned as a pyramid, as shown in Figure 1. Starting from the lowest tier (1. Programming), the implementation measures needed to achieve NZE are mainly economic and programmatic in nature. As the tiers progress, the implementation measures become more technical in nature and include the utilization of: a high-performing building envelope; efficient lighting systems; optimized heating, ventilation, and air-conditioning (HVAC) systems; building controls to both reduce energy use and maintain reduced energy use; and renewables integration.

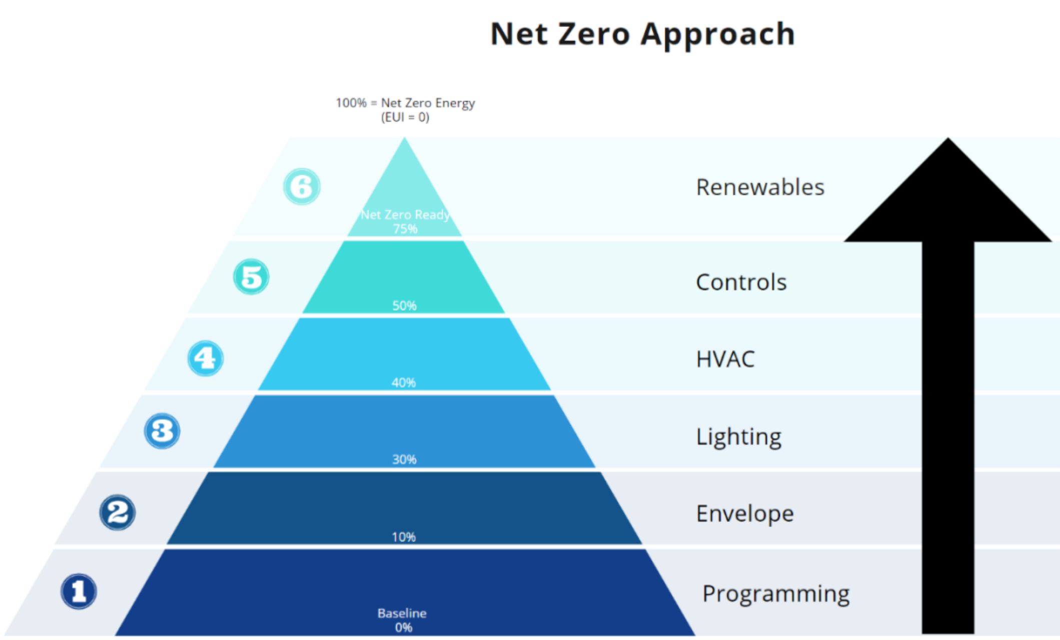


Figure 1. Net Zero Energy Pyramid

[4] U.S. Department of Energy – A Common Definition for Zero Energy Buildings

In order to achieve an NZE building, ASHRAE[5] recommends that the site energy use intensity (EUI) for this climate zone (3C) not exceed the values highlighted in Table 1.

Building Type	**Net Zero Ready Target EUI (kBTU/sf-yr)**
Office/Institutional	17
Multifamily	19
Combined	**18**

Table 1. Target Energy Use Intensities

Figure 2 illustrates how a Net Zero Ready building performs significantly better than the operational performance of a typical 2013 building and when compared to current target set by the Architecture 2030 program. This substantially improved performance requires targeted design approach in which consideration is given to every element of the design, construction, and operation of a building.

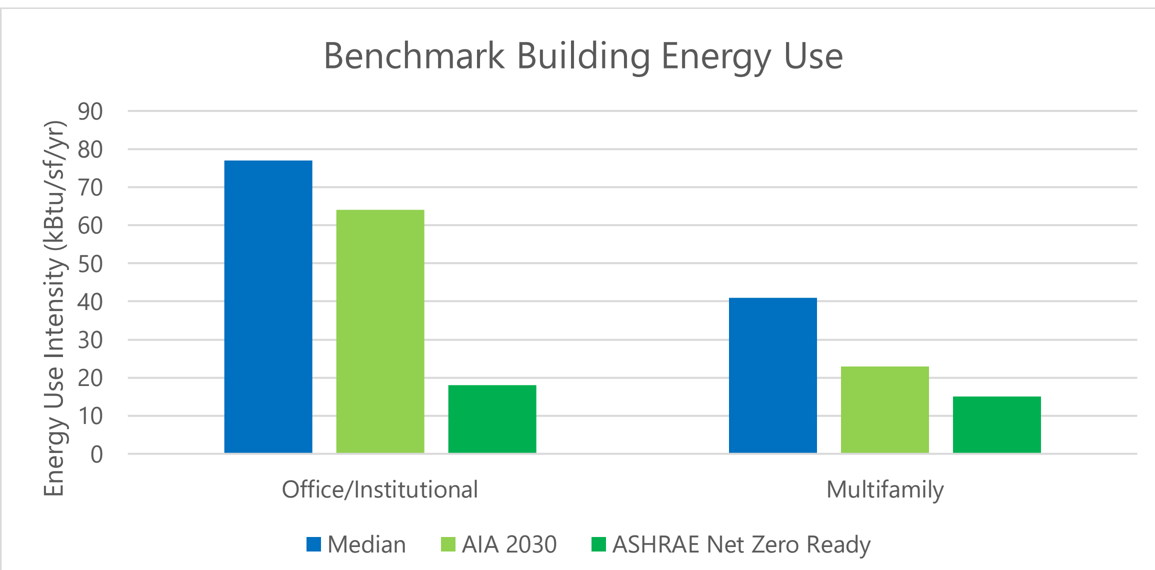


Figure 2. Benchmark and Target Energy Use Intensities

Electrification is a central step to decarbonization and is required by the San José Reach Code. No fossil fuels will be used during operation at the site in order to reduce carbon emissions and to reduce local pollution that may impact users.

[5] ASHRAE - Advanced Energy Design Guide for Multifamily Buildings - Achieving Zero Energy, 2022
ASHRAE - Advanced Energy Design Guide for Small to Medium Office Buildings - Achieving Zero Energy, 2019

Use of fossil fuels on site during construction should also be minimized, by the use of electric equipment and power supplies.

A heat pump system is recommended to provide heating and cooling efficiently without the use of fossil fuels. Consideration will need to be given to how to provide an alternate backup power system to a traditional fossil fuel generator. All cooking should be electric.

3.3.2 Passive Systems

Passive systems are those which enable a project to achieve its indoor climate (viz., thermal comfort, ventilation, and humidity), lighting, and/or energy requirements through consideration of the local climate and carefully selected materials, apertures, massing, orientation, daylighting, and natural ventilation. Buildings which make use of passive design inherently put a lesser load on the building's energy systems. For this reason, it is critical to establish the physical design of a building to maximize passive strategies before addressing the building's mechanical, electrical, and plumbing (MEP) systems selection and operation. In order to achieve some/all of the principles of passive design, the following must be considered:

The envelope of the building should be highly insulated and focus on the elimination of thermal bridging and producing an airtight envelope, which will minimize heat loss in winter and heat gain in summer and reduce energy use for both cooling and heating.

The massing and orientation suggestions — contained within the Design Development Framework (DDF) and Appendix B: TOD Framework Memo — account for a high-level analysis of siting (impacted by climate as well as by other buildings and site features).

Daylighting: While programming a building, consider what space types might benefit from direct sun, and what space types should avoid this and could utilize indirect light on the north façade. Control of solar gain to prevent overheating must be considered, and the challenges this poses on different facades. Figure 3 demonstrates the amount of solar insolation by orientation in first the summer and then the winter. Southwest sun in the summer will lead to significant overheating, while southeast sun in the winter could be used for passive heating as long as the shading is designed to block it in the summer, by accounting for the sun altitude.

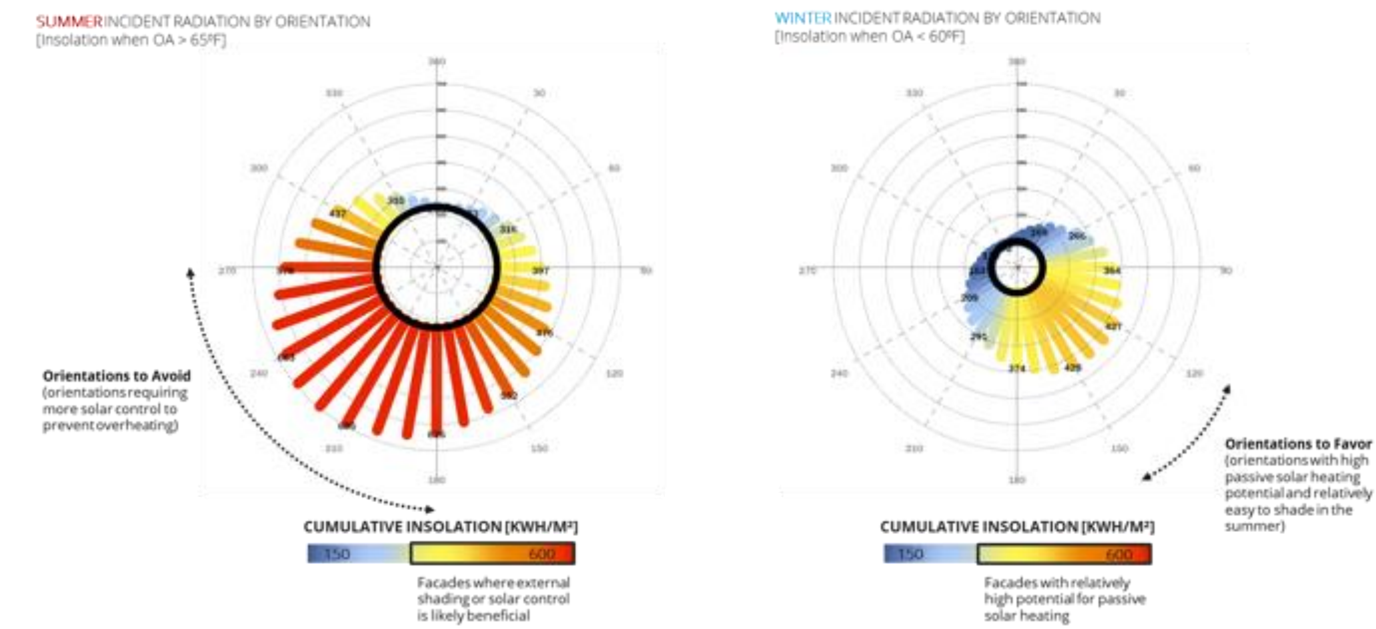


Figure 3. Seasonal Solar Availability

The climate of San José lends itself to the provision of well daylit spaces. Daylight is shown to improve human health and wellness, while also reducing the need for artificial lighting. Designs should optimize the balance between provision of daylight and reducing unwanted solar heat gain that will increase energy use. Strategies will differ between building types, some that are universal are shallower massing to improve light penetration, programming that ensures non-regularly occupied spaces are in the darkest areas, exterior shading that is not entirely solid to block direct sun but still allow light, either louvres or translucent products.

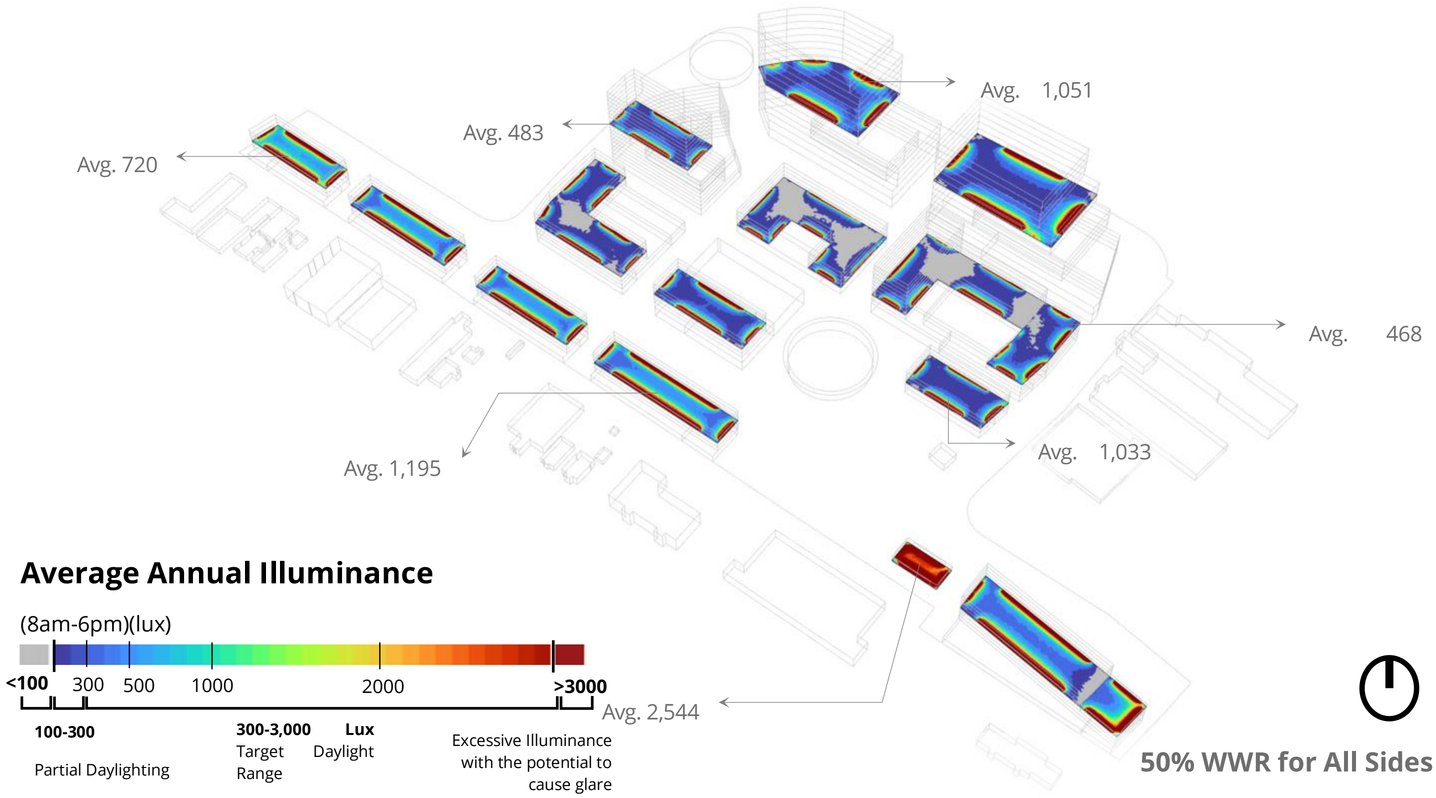


Figure 4. Average Annual Daylight Illuminance for conceptual massing scenario

Office/institutional buildings could consider utilizing operable shading, internal or external, to block direct sun but automatically open to allow daylight when direct sun is gone, a central daylit atrium providing light to surrounding spaces, or in spaces that are difficult to daylight using circadian rhythm lighting to prevent people from losing the passage of time. Residential buildings could design balconies to block or allow sun at different times of the day and year.

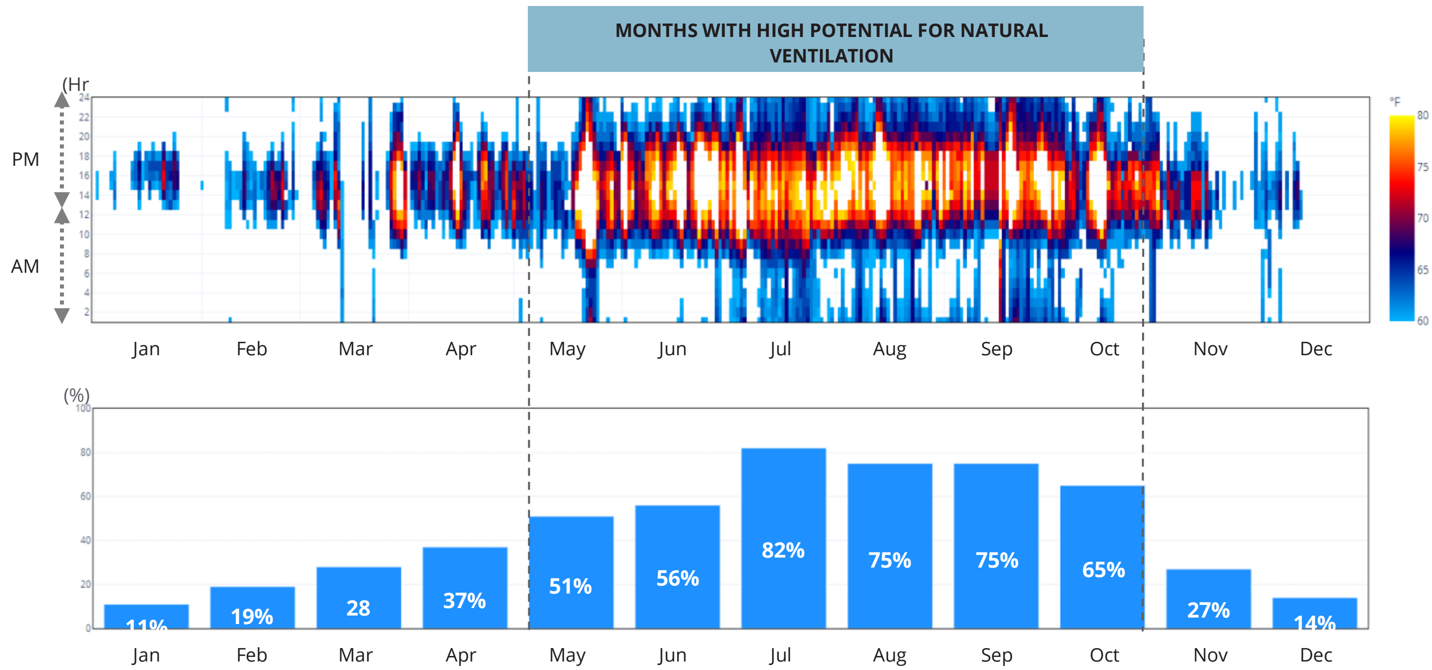
Views: Views connect occupants to the outdoors and should be considered during programming. As a result of the low-rise nature of the existing neighborhoods, there are views to the east of the hills and towards downtown San José. Above the second floor, the buildings will look out onto the mountains of the Diablo Range. Higher stories may get views to the north of the San Francisco Bay. However, even simple views of plantings, activity, or the sky can provide human wellbeing benefits in the form of productivity, respite, and improved sleep.

Natural Ventilation: The climate of San José lends itself to the use of natural ventilation, especially in the summer, as shown in Figure 4. The year-round mild to warm temperatures create an excellent opportunity to bring in outside air and reduce reliance on HVAC systems. Natural ventilation potential is determined by plotting the number of hours when the outdoor temperature is above 60°F and below 80°F. Natural ventilation is possible below this temperature, but mechanical ventilation with heat recovery would be more appropriate to maintain comfort in that range.

Historically 59% of daytime hours, and 41% of total hours, have been in the 60°F-80°F range. The majority of hours outside that range are cooler currently.

With climate change it is expected that 62% of daytime hours will be in the 60°F-80°F range by 2050.

By 2080, 21% of daytime hours will be warmer than 80°F, four times as many hours as are seen currently. Approaches should consider future operation as well.



* *Betti G., Tartarini F., Nguyen C., Schiavon S. (2022). CBE Climate Tool: a free and open-source web application for climate analysis tailored to sustainable building*

Figure 5. Seasonal Natural Ventilation Potential by Temperature

Natural and Mixed Mode Ventilation strategies should be evaluated in an effort to maximize passive design strategies and to take advantage of times conditions are favorable for the use of outside air. Consideration should include impact of outdoor pollution.

Strategies can be applied as a mixed mode system to both residential and office/institutional buildings, with careful implementation of control systems on exterior openings to prevent energy waste. Different natural ventilation strategies should be explored to improve air circulation and efficiency of natural ventilation. Residential buildings would lend themselves to single sided or cross-ventilation using traditional windows and doors, while office/institutional buildings should consider stack effect and automated openings. Significant diurnal swings are seen so night flushing opportunities should also be assessed.

Natural ventilation potential needs to consider resilience against the impacts of climate change, both in predicted temperature rise, and the air quality impacts of increasing wildfires and local pollution sources, as well as the potential resilience benefits that can be realized as discussed in Section 4.2.1 Passive Survivability.

The predominant summer and winter winds come from different orientations. This allows a design strategy that embraces the summer winds, to assist with cooling and adaptive thermal comfort, while blocking winter winds which may cause discomfort.

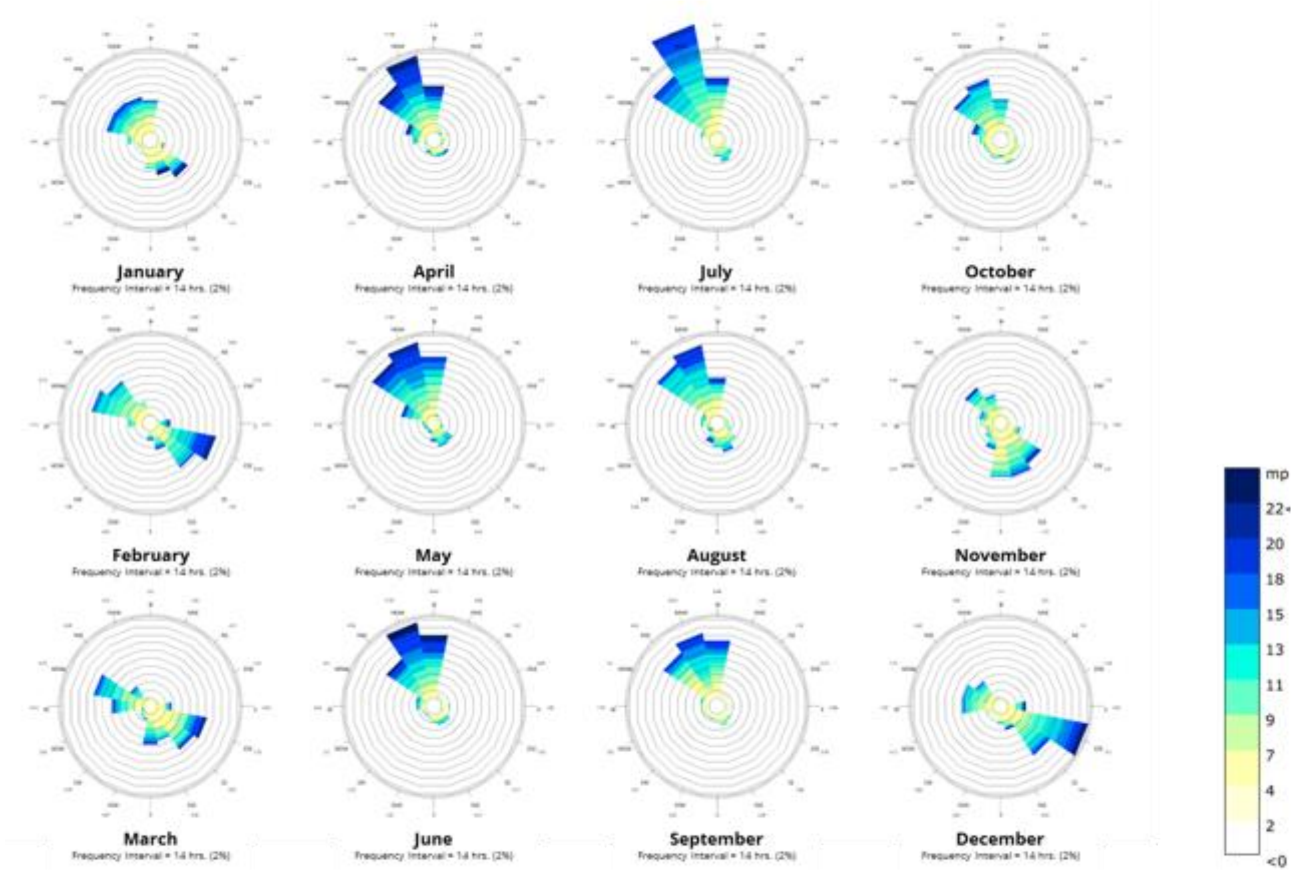


Figure 6. Annual Wind Analysis

Shading: The San José region has a moderate climate with mild temperatures throughout the year. Shading is a significant factor in creating comfortable outdoor spaces, while wind movement does not provide as much benefit. Shading can increase the comfortable hours of the year from 65% to 88% according to the Universal Thermal Climate Index (UTCI) indicator.

Outdoor spaces can be oriented to take advantage of the wind patterns shown in Figure 5, utilizing a breeze in the summer, while blocking cold winter winds. Figure 6 emphasizes that shading will be more important to outdoor comfort, and with the expectation that outdoor temperatures will increase in the future shading will become even more important in the future.

The site should address potential urban heat island effects from solar gain, which can increase cooling needs in the surrounding buildings in addition to creating uncomfortable outdoor spaces. Landscaping and vegetation, as well as artificial shading, can reduce heat island impact, in addition to the specification of high albedo hardscape and roof materials.

Noise Pollution: Noise pollution may be an issue, particularly in residential buildings. The site experiences high levels of noise pollution from the highway (75-79dBA), and acoustic stress can have health impacts. Ensure that designs consider noise transfer from outside the building, and between spaces inside the building. Consider the use of sound walls, planting buffers, and acoustic treatment on windows. Plantings can also be used to buffer air pollution from the highway.

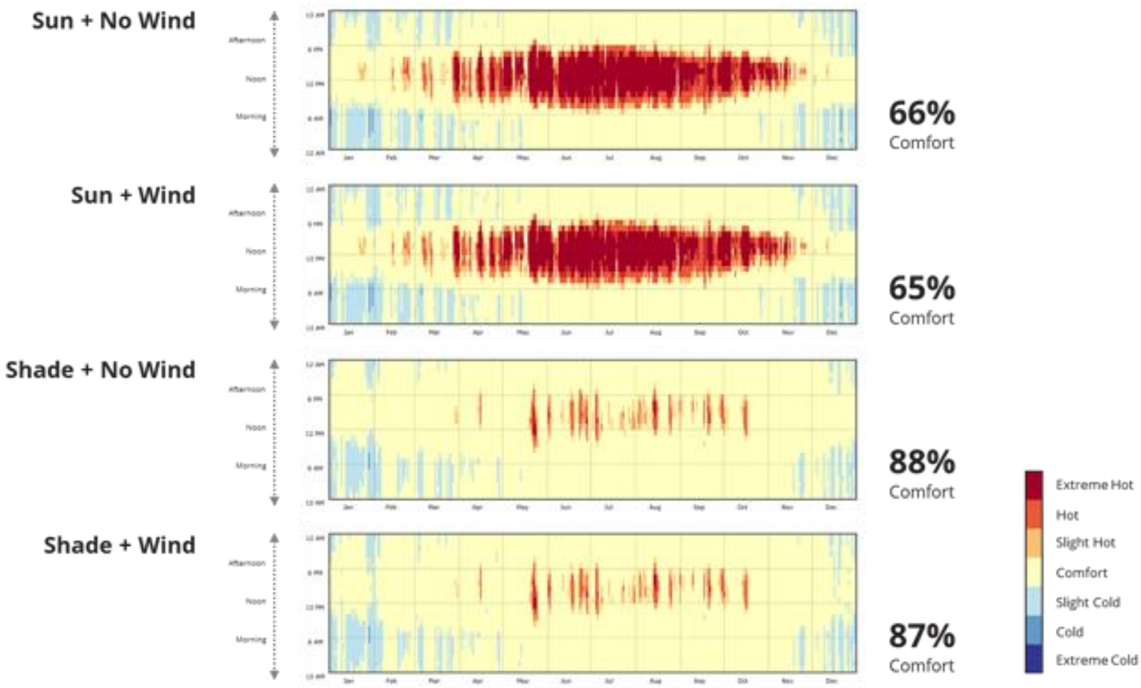


Figure 7. Outdoor Comfort – UTCI

3.3.3 Systems

Improving the energy efficiency of systems is a fundamental aspect of building energy and carbon management. This includes using energy-efficient HVAC, lighting systems, and appliances.

The requirement for no fossil fuel use will drive the use of heat pump systems to provide heating and cooling for the development. Different types of heat pumps–air-source, water-source, ground-source – should be analyzed to determine the preferred system that will meet the net zero goal. Energy recovery ventilation will improve performance further.

Building management systems are essential to determine that the operation is tracking the net zero goal, and to allow items to be caught before they become issues. Developers should consider installing building management systems that enable real-time monitoring and ongoing commissioning of systems.

Engaging building occupants in energy conservation practices is essential for effective energy management, educating occupants about energy-efficient behaviors and providing feedback on energy usage can encourage responsible energy consumption and promote a culture of sustainability within the buildings.

Consider the location of the building relative to pollution sources such as the freeway when analyzing natural ventilation, and when selecting filtration for mechanical systems.

3.3.4 Site Level Opportunities

As the site is planned to be developed concurrently, it is possible to achieve NZE across the site rather than building by building. This enables trade-offs between building types. Developers should consider site infrastructure systems that can balance energy and water uses, and costs, between users, and energy conservation strategies that benefit from economies of scale.

As an example of this concept: A district energy system for the site which is using ground source heat pump technologies can be utilized to increase the efficiency of HVAC and DHW systems. These systems may not make economic sense in small-scale applications, and the site size may be challenging, but the savings associated over the life cycle of the block should be considered. Energy needs can be balanced across the block and developing a single plant for the whole development will reduce maintenance costs and the footprint; each building will not need a separate plant, only heat exchangers and pumps.

It should be noted that these systems are becoming common on college campuses as they decarbonize and replace traditional chiller and boiler central plants.

The central utility plant would need to be located somewhere on site, while sub-metering would allow the costs to be passed on to the appropriate user. This approach will be best achieved with a master developer, as coordination of the design and connections of the system between multiple parties can be challenging. Additionally, a party will need to remain to act as the utility as this may be outside of the purview of VTA.

A centralized development-level PV system management will allow the collection, storage, and distribution of energy across buildings as their energy demands vary, contributing to the Net Zero Energy goal. Centralizing management of the battery storage will also allow load shifting. This may be achieved with multiple developers but will require a party to be responsible for the system on an ongoing basis.

Case Studies: The concept of centralized energy management is not without precedent. The following illustrates brief examples of this concept being utilized, both in the US and globally:

- A gas utility under the name "Networked Geothermal" (for a neighborhood in Framingham, MA[6]), and the City of West Union, IA installed a central ground source system in 2012[7]
- A study undertaken by the Rocky Mountain Institute and the National Renewable Energy Laboratory in 2020[8] reviewed different types of "connected communities" and how centralized energy management has been utilized, with a number of sites across the US being identified
- European utilities, which are increasingly = seeing this as a new business model[9], with systems installed from the UK to Hungary

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[6] https://www.eversource.com/content/residential/save-money-energy/clean-energy-options/geothermal-energy
[7] https://greenupwestunion.com/about-green-up-west-union/
[8] https://www.nrel.gov/docs/fy20osti/75528.pdf
[9] https://www.euractiv.com/section/energy/news/sun-beneath-our-feet-the-european-cities-turning-to-geothermal/

3.3.5 Renewables

Achieving NZE for the VTA 28th Street/Little Portugal TOD poses a challenge given the site area, the vertical nature of the development and the density of use. While the climate is ideal for the use of photovoltaic (PV) systems to generate energy, it is estimated that the whole development would require approximately 5.4MW of PV to reach NZE, if the EUIs specified in Table 1 of Section 2.1 are achieved.

PV Estimate to achieve NZE
5.4MW
325,000 ft^2 or
7.5 acres

This extent of photovoltaics (PV) would require a significant footprint, estimated as 325,000sf or 7.5 acres, and will not fit entirely on the project site. The development is 12 acres, with 7.1 acres of that considered buildable. Within that area will be outdoor courtyard spaces, and roof spaces used for mechanical and other equipment.

NZE is achievable by using passive design best practices, site-wide strategies, Building Integrated PV (BIPV) and off-site renewables. PV located on building roofs, ground mounted as shading elements or parking cover, and/or as building shades will be the lowest cost and highest production. Building-integrated photovoltaics (BIPV) can be incorporated as glazing elements, as part of a cladding system, but it should be noted that these newer and considerably more expensive technologies. Off-site solar on other VTA sites may be possible but needs to be evaluated in comparison with VTA's own plans to decarbonize transit energy uses.

If other off-site renewables are considered, this should be through a vehicle such as an off-site power purchase agreement (PPA), not simply the purchase of RECs (renewable energy certificates), and must be truly new and additive, not buying existing resources.

Battery storage should be analyzed to allow as much of the energy generated to be used on site as possible, to improve resilience, and to ensure that any electricity drawn from the grid is taken when the grid is at its cleanest, not during periods of overloading and use of older utility plant. This could be done at either a building or a site level, but at a site level different energy use time profiles between building types can allow for tradeoffs.

3.4 Embodied Carbon

3.4.1 Background

The focus of decarbonization in the built environment has largely been on energy efficiency, electrification, renewable energy, and the overall reduction of operational carbon. An often-overlooked element of decarbonization is embodied carbon, which accounts for 11% of global annual emissions and is connected to issues of public health and equity. Embodied carbon is the total amount of greenhouse gas emissions released during a product's lifecycle, which includes extraction, manufacturing, transport, construction, and disposal. It is reported as global warming potential (GWP) and is measured in kilograms carbon dioxide equivalent (kgCO2e). The graphic below details the lifecycle stages of a building from cradle to grave.

Addressing embodied carbon now is imperative to mitigating the impacts of our climate change trajectory. Most of the building's total embodied carbon is released upfront in the product stage (A1 through A3 as depicted in the graphic above), which means most of the impact is in the beginning of a building's life, during the development process. The figure below conveys the importance of addressing carbon in the path to carbon neutrality and emphasizes the magnitude of embodied emissions as buildings become more energy efficient and the grid becomes cleaner.

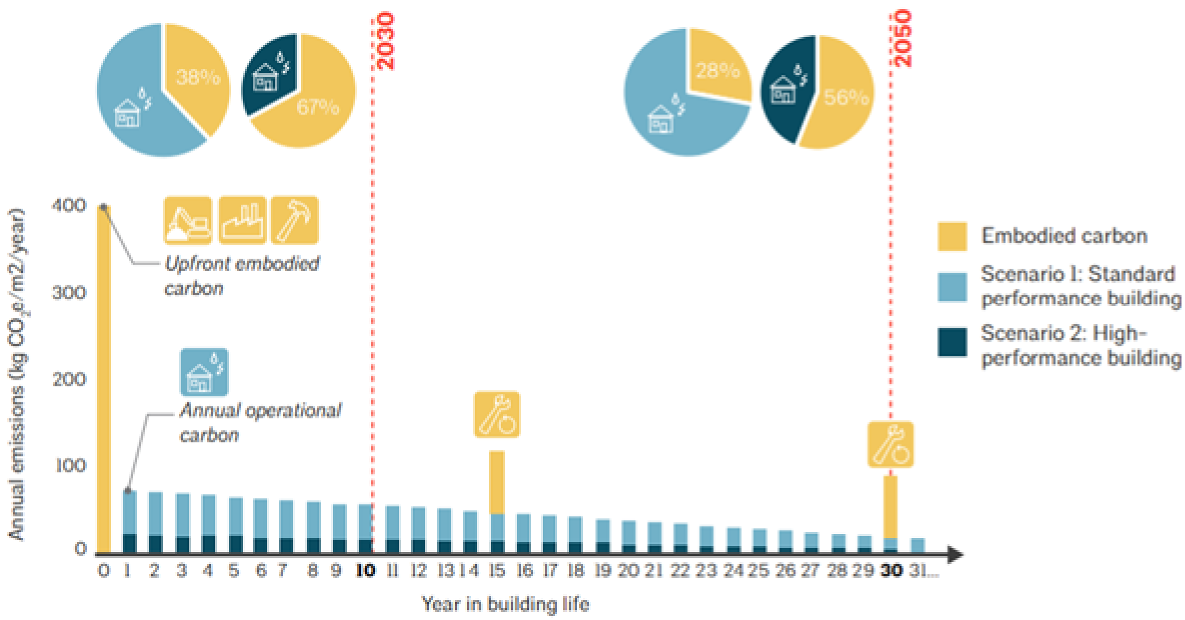

Figure 8. Carbon Impact Across Building Life

Reference: AIA-CLF Embodied Carbon Toolkit

Embodied carbon is particularly impactful in new development, due to the high quantity of newly created products and materials. As embodied carbon uniquely accounts for the greenhouse gas emissions associated with creating (and disposing of) brand new items, ensuring that the embodied carbon for a new building remains low is essential to meeting not only VTA's sustainability goals, but also those of the greater state of California.

In 2017, the Buy Clean California Act was enacted, which requires projects on state infrastructure to provide transparency into the emissions associated with certain products. Namely, products which tend to have very high embodied carbon: structural steel, concrete reinforcing steel, mineral wool board insulation, and flat glass. This Act also stated the maximum allowable GWP (in kg CO2e) for these four 'high impact' material types.

In 2022, Assembly Bill No. 2446 (AB 2446) was passed and signed into law, furthering the state's push for environmental action in the built environment. AB 2446 requires that the California Air Resources Board (CARB) develop and enact a plan for the reduction of building emissions. This framework mandates that the entire state's building sector achieve a 20% net reduction in greenhouse gas emissions by 2030, and a 40% net reduction in the same by the year 2035. These greenhouse gas emissions goals are comprehensive, that is, it accounts for both low and high impact material categories.

With increasingly ambitious global warming reduction goals being set by the state of California, it is vital for all California projects to keep in mind the likelihood that greenhouse gas emissions from both embodied and operational carbon will need to be drastically reduced in order to meet the current and forthcoming state legislation.

3.4.2 Strategic Approach

There are a number of approaches which may be utilized when seeking to minimize a project's embodied carbon. While the embodied carbon of a new construction project can never truly be zero (this would require absolutely no new materials or products to have been utilized in the creation of the project), there are many highly effective strategies which may be employed.

Below are recommended strategies for reducing embodied carbon that were developed by American Institute of Architects (AIA) and the Carbon Leadership Forum (CLF). For additional information on these strategies, refer to the AIA-CLF Embodied Carbon Toolkit.

Design Strategies: Design lightweight, efficient structures, and use a Whole Building Life Cycle Assessment (WBLCA) to optimize the envelope design. Designing for adaptability is preferred to accommodate future aesthetic and functional space changes. The use of modular interior products, such as carpet and ceiling tiles, movable partitions, and minimal custom logos/color selections aids in ensuring the flexibility of the project. Building tags—which detail the make, strength characteristics, and use of individual structural and decorative building elements—allow for circularity to be better incorporated into the project's fundamental design. The combined use of building tags, informed product selection, and flexible spatial arrangements are desirable in order to prepare the space for future disassembly and reuse.

Material and System Selection: Select carbon-storing materials (such as mass timber, laminated bamboo, wool, and cork). MEP systems should be selected with low-carbon refrigerants, while insulative materials with low- to zero toxicity should be chosen (e.g., avoid rigid polyurethane spray foam containing hydrofluorocarbons (HFCs). It is likewise desirable for focus to be placed on the end of life of the building by preferentially selecting materials with high recycling potential and local extraction/harvesting availability. The extraction and/or harvest of the building's structural and aesthetic materials should be noted for purposes of community learning. In cases where local procurement is infeasible, particular note should be given as to the origins and environmental impacts of importing resources from global suppliers and any potential cultural implications this may have (both locally and globally).

Specification and Procurement Strategies: Integrate Environmental Product Declarations (EPDs) and GWP limits into project specifications and use EPDs to identify lower-carbon facilities and products. EPDs consist of documentation into a product's global warming impact and contain data ranging from emissions (typically in kgCO2e) to other impact categories including eutrophication, acidification, and ozone depletion potential. Lower-carbon facilities are based on the energy source (grid mix) of the plant. Lower carbon products can be based on the weight/density of the product and/or the ingredient sourcing like recycled and local ingredients. Source sustainable wood, specifically by using reclaimed/salvaged wood or FSC certified wood. Optimize concrete specification and mix design. Concrete is one of the largest contributors to embodied carbon in the built environment, so minimizing the volume of Portland cement by replacing it with Type 1L cement, fly ash, slag, and other supplementary cementitious materials can ensure a lower embodied carbon project.

Process Strategies: Identify embodied carbon as a priority and set a project reduction target. This will enable the project to better identify embodied carbon strategies early in the project, which in turn will enable greater reductions. Using a whole-building life cycle assessment (WBLCA) will help the project evaluate design options and system/materials selection and quantify the associated reductions. Embodied carbon is more difficult to measure and track than operational carbon as emissions information from manufacturers is needed to ascertain the actual embodied carbon of a product. As referenced in the recommended strategies, the use of EPDs is crucial to understanding the project's embodied carbon. EPDs are reports which are produced by manufacturers and which define the global warming impact of the product itself. Not all products have environmental product declarations, and the existence of an EPD does not guarantee that the product itself has a good environmental profile. However, EPDs allow for that environmental profile to be recorded and evaluated in comparison with other product types. In this way, a project is seen as the sum of all the individual products that go into its creation. These products can then be selected by comparing EPDs and selecting those with the smallest global warming impact.

There are several databases that streamline the EPD selection and comparison process. Databases like Ecomedes and Transparency Catalog are user-friendly platforms that allow filtering of products based on whether they have an associated EPD. Beyond just finding EPDs they can also set filters on rating system requirements (such as LEED) and types of disclosure (product-specific EPDs v industry-average EPDs). While these databases can help identify EPDs and compare individual products, tools like LCA and Tally can be used to calculate a specific building's embodied carbon impact. These can help guide reduction strategies throughout design and quantify the actual whole building embodied carbon which can be used for credit under several different rating systems (such as LEED and Living Building Challenge).

By maximizing the recommended strategies outlined above, VTA can establish a significantly reduced embodied carbon as compared to a business-as-usual building. This supports a lower carbon future and aligns with the various commitments set forth by the State of California.

4 Materials, Resources, & Waste

4.1 Key Actions

This section highlights the Key Actions which arise from the detailed analysis of Section 4: Materials, Resources, & Waste

Goal: Ethical Resource Utilization

- Select necessary new product types (e.g., paint) from local manufacturers with high performing HPDs or equivalent (minimal human health impact) and a high quantity of recycled content.
- Select necessary new product types (e.g., structural timber) from local manufacturers with environmental stewardship certifications (e.g., Forest Stewardship Council) and certified supply chain tracking from extraction point(s).
- Achieve diversion of 90%+ of project's construction waste to certified recycling facilities (construction waste diversion).
- Track and implement strategies to minimize operational waste of all waste stream types (landfill, recyclables, organics, and inorganics). This requires set waste receptacles, user education, oversight, and audits in addition to a plan that covers purchasing requirements (no disposable plastics in kitchen equipment, minimal to no disposable plastics in cleaning equipment). Involvement with local recycling and composting facilities is needed.
- Collect and store both rainwater and project graywater (sink, shower, and laundry water) for reuse for non-potable purposes.
- Implement and provide oversight & auditing on outdoor water use, with no potable water permitted for outdoor use and bans placed on pavement washing.
- Plant native, adaptive, drought-resistant species to replace all turf and to establish green roof/walls.
- Utilize low flush and flow fixtures and educational signage on water resource consumption.

4.2 Overview

The manner in which VTA handles its resources, both purchased and generated, is essential in establishing the project's environmental and human-centric impact. Much of the content of this section addresses the need for VTA to consider the policies of purchasing and handling of resources (materials, water, and waste), not just the operations.

4.3 Healthy Materials

Construction material plays a significant role in creating a healthier built environment and enhancing the health and well-being of building users. In addition to the carbon impact of materials discussed previously, prioritizing products and design strategies to preserve and positively impact the environment and human health is essential towards achieving VTA's sustainability goals and vision.

VTA encourages the use of building materials, furniture, fixtures, and equipment that encompass the best sustainability attributes available on the market today. This in turn reduces exposure to toxic and harmful materials, lowering the overall Greenhouse Gas (GHG) emissions, and push the industry forward through shedding a light on materials circularity and high-risk materials.

When it comes to the need for 'healthy' building materials, it is important to recognize that the concept of a healthy material is broken down into three principal facets:

- **Human Health of Occupants** – There are a growing number of buildings materials that are known to or suspected to be hazardous to human health. Avoiding certain chemicals and choosing products with transparent chemical ingredients lists can support a healthier environment for occupants and push the industry forward in disclosing this information.
- **Environmental Health** – Building materials used in construction have significant environmental health impacts. As discussed in the Embodied Carbon section of this memorandum, these emissions associated with the "footprint" of a material, or a product are known as embodied carbon emissions.
- **Human Health of Laborers** – Many products utilized in the building industry, such as brick, timber, glass, steel, iron, minerals (e.g., mica, gypsum, silica), and stone, are considered high-risk materials for modern-day slavery. As a result, these high-risk materials must be closely monitored to determine not only precise extraction/harvest origins but also the practices of the companies responsible for their fundamental procurement.

At its core, VTA values a wholistic approach to sustainability in all its leased and owned assets. To this end, it is strongly recommended that development on VTA parcels operate to the highest standard in terms of human health and wellbeing. Utilizing the strategic approaches outlined in this memorandum will enable project teams to minimize reputational risk associated with poor ethical and sustainable material and system selections, while maximizing both confidence in design and public acceptance.

Generally, project teams should look for opportunities to use less materials, where possible, leverage ingredient transparency disclosures, such as Health Product Declarations (HPDs)[10] and Declare Labels[11], and utilize fair labor certifications, such as Cradle to Cradle[12] and Living Product Challenge[13]. Below are recommended strategies for creating a project that acknowledges and mitigates the health impacts of the building materials.

- **Design optimization:** Strategies can include evaluating a more efficient and optimized structural design to reduce the materials needed and eliminate excess waste through careful design coordination between disciplines using insights from Building Information Models (BIM). Other design optimization strategies include a materials substitution approach to find entirely different structural design options. The smaller the quantity of materials used is, the less the impact is on environmental and human health. For this reason, highly emissive/toxic

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[10] https://www.hpd-collaborative.org/
[11] https://declare.living-future.org/
[12] https://c2ccertified.org/get-certified
[13] https://living-future.org/lpc/

materials should be minimized from all necessary-applications and healthy-material compliant alternatives selected. From interior/aesthetic applications, these riskier products may be eliminated altogether.

- **Product Selection:**
  - → **Building Occupant Health:** Use products that reduce toxicity potential of high-touch surfaces at risk for the most exposure in an effort to protect the health of building occupants. There are many tools available to aid designers in selecting healthy, low-VOC materials and avoiding chemicals with known or suspected human health impacts. Leveraging the materials requirements in certifications like LEED, WELL, and Living Building Challenge (LBC) can be a helpful starting point even if a project is not targeting these, as these are commonly implemented across new construction projects. In comparing these different 'green' standards, it is important to note that LBC has typically much more stringent and ambitious requirements than LEED across the different environmental categories. WELL, in contrast, focuses predominantly on human physical and mental wellbeing and so can be utilized for projects which prioritize wellbeing.
    Additionally, utilize resources including Healthy Building Network's Product Guidance and Green Science Policy Institute's Six Classes of Chemicals when specifying, selecting, and procuring materials. In managing the process of incorporating heathier materials and to ensure teams are advancing desired outcomes, creating a Healthier Materials Plan can help support the goal across the project. Information on developing a Healthier Materials Plan is detailed in the AIA Healthier Materials Protocol.
  - → **Laborers Health:** The Design for Freedom (DF) movement has curated a toolkit which allows developers and designers to both understand how the current building industry is operating off the 'slavery discount', and how to best approach requiring suppliers to provide complete transparency into product procurement and make informed material sourcing choices. Additionally, there are several certifications and standards that address fair labor in the toolkit which include material specific and general supplier product certifications, labels, & standards.

By maximizing the recommended strategies outlined above, VTA can support healthier and more just spaces for occupants to thrive.

4.4 Water

Water is one of our most valuable resources, both for ecologically and for the sake of human health.

The state of California has been experiencing ongoing droughts for an extended period of time. Conditions in Southern California have improved this year (2023) due to record snowfalls. However, Southern California typically experiences a severe state of drought and water shortages are of significant concern, with conditions expected to worsen in the long term. Proper water management is essential in order to reduce water consumption and the strain on local water resources.

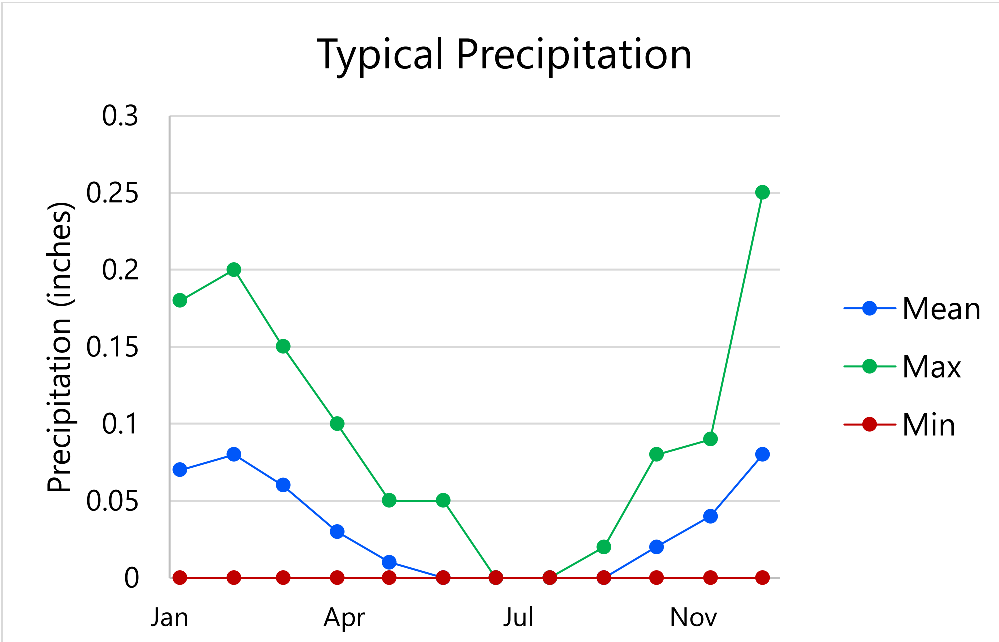


Figure 9. Annual Precipitation in San José, 2020

Design should consider water use reductions and water reuse options. The use of potable, i.e., drinkable, water for non-potable uses is wasteful, particularly in drought conditions.

Water use reduction should include implementing water-saving fixtures such as low-flow toilets and faucets, and WaterSense appliances, and educating occupants on the impacts of their water use.

Site landscaping should be designed to have low or no irrigation requirement, and where irrigation is needed recycled water should be considered. The San José municipal purple pipe system is located within a mile of the site, developers should work with the San José Water Company to investigate connecting with this.

Greywater collection and filtration systems collect polluted water, typically from handwashing sinks, laundry, and showers, and filter it, along with rainwater, for reuse in non-potable uses. Non-potable uses are typically toilet flushing and irrigation. Residential buildings produce a large amount of greywater due to showering and laundry, so are more compatible with collection and reuse.

Rainwater and greywater reuse systems can also help reduce the amount of water that leaves the site, reducing loads on the utility, and potentially utility charges. Site-wide systems should be considered as they may make this more economic. Green roofs may necessarily conflict with the roof area needed for PV. However, rainwater capture off of the PV systems and vertical growing spaces allow for rainfall to be effectively captured, reused, and/or store for slow release.

4.5 Waste

Implementing strategies to reduce construction and operational waste is essential for resource management. This includes practices like waste segregation, on-site sorting, and establishing recycling programs to divert materials from landfill. Recovering and recycling construction and demolition waste, such as concrete, metal, wood, and plastics, can help conserve resources and minimize environmental impact. Key action items in addressing material waste are highlighted below:

- All materials and products installed on site should be selected with a view to longevity and reuse, to reduce waste creation.
- The buildings should each have waste, recycling, and composting collection points, in addition to a centralized hazardous waste (batteries and electronics) collection point. San José currently sorts the compost from the garbage manually at a waste sorting facility, however, dedicated compost is available and is more efficient.
- Construction waste should be sorted on site to the extent this is possible, and at least 75% of construction waste should be diverted from the landfill.

5 Resilience & Adaptation

5.1 Key Actions

This section highlights the Key Actions which arise from the detailed analysis of Section 5: Resilience & Adaptation

Goal: Protect Locality from Climate Change Effects

- Protect all existing flora (both native and naturalized). Any flora which must be removed from site should be relocated. Ensure no flora is killed without certified indication of illness from plant pathologist; arborist certification is insufficient due to monetary conflict of interest.
- Maximize rooftop, vertical, and landscape planting of native, adaptive, drought-resistant flora.
- Implement and provide regular oversight & audits of outdoor cleaning agents, pest management, and a pesticide ban.
- Engage in community urban reforestation efforts.
- Participate in a demand response program for any power obtained from energy grid (municipality) to minimize risk of overload on peak days & times and consequent fire risk.
- Establish ecology plan encompassing protection of existing and future plantings, prevent against flora removal without plant pathologist confirmation (arborist not suitable due to conflict of interest), as well as banning seasonal substitutions of plantings (e.g., aesthetic flower/foliage replacement).

Goal: Protect Occupants from Climate Change Effects

- Conduct a climate risk analysis for the site and identify the site's universal thermal climate index (UTCI). Implement planting and shading measures on areas of high UTCI risk.
- Maximize passive heating, cooling, and natural ventilation strategies to ensure project robustness during times of energy scarcity and/or conservation. Natural ventilation should include a manual/automatic shut-off during wildfire instances in vicinity.
- Maximize natural daylighting through shaded windows and skylight systems to prevent interruptions of occupant comfort and maximize visual safety during times of energy scarcity and/or conservation.
- Implement system redundancies and battery storage for onsite renewables.
- Minimize impervious hardscape through the use of planted pavers on all pedestrian walkways and low-traffic byways & parking lots.

5.2 Overview

The built environment plays a critical role in shaping our lives, and as we face increasing challenges such as climate change, natural disasters, and population growth, the resilience and adaptation of the built environment has emerged as a key consideration in creating sustainable infrastructure.

To plan for the impacts of natural disasters or disturbances, as well as address issues that impact long-term building performance such as changing climate conditions, the developer should complete a hazard assessment and climate related risk plan during pre-design. Complete a vulnerability assessment of impacts associated with climate change over the long-term service life of the project in order to ensure reliable performance of the project's mission and operations in changing conditions.

The developer should prioritize mitigation actions based on cost, difficulty, and risk reduction, and should consider ancillary and cascading risks to infrastructure and communities that rely on that infrastructure.

5.3 Site Resilience

The concept of site resilience is both overlooked and highly essential in ensuring the long-term resilience of the project. Creating outdoor spaces that provide comfort, including in the face of a changing climate, is an important element of creating resilience outside the walls of the building.

Site resilience encompasses both an understanding of the regional climate risks which the site is prone to, as well as the mitigation efforts which the site can implement. These mitigation efforts aim to reduce the actual cause of the climate risks rather than to only address their outcomes.

With the increasing extremity and variability of rainfall events, effective site resilience measures include protecting any pre-existing nature/adaptive flora on site during construction, as well as substantially increasing the site's overall green growing potential once built. Integrating such measures allows for the site to better support individual native species, pollinators, and the regional biodiversity while making the actual project site more resilient to the flooding and runoff effects associated with heavy rainfall events. As well, the reduction in exposed hardscape will cause a corresponding reduction in the Urban Heat Island Effect, making passive survivability within a building in the summer more achievable.

Critical to the successful implementation of site resiliency is an understanding of the trickle-down effects which the project design can have not only on its physical footprint but on the region in which it is located. This level of consideration not only benefits the development in the long-term, but also helps to ensure that community climate concerns are being included when finalizing the project's design.

While only a relatively small amount of ground-level growable space is available for this project, marginal implementation of native plantings can still have significant cumulative effects. In cases where flooding from surrounding impervious development is a concern, the use of narrow bioswales may allow for the site to be more resilient to extreme storm events. Planted area of this type requires borders to prevent passerby from crushing flora and/or compacting bioswale gradated systems.

5.3.1 Site Analysis

The Universal Thermal Climate Index (UTCI) considers what the temperature "feels like" to individuals in outdoor environments, incorporating solar radiation, relative humidity, and wind speed to estimate the level of heat or cold stress that individuals might experience. It is seen in studies that temperatures between 48°F and 79°F indicate no thermal stress. This is the thermal comfort band that has been analyzed.

Analysis of UTCI for this site before interventions is mapped in Figure 9 and shows that 53% of the site was between those comfort bands for more than 60% of the year.

This analysis has been undertaken using current weather files. Analysis of specific design options should also consider future climate scenarios, and how a warmer climate might make outdoor spaces less comfortable.

Areas in green are generally comfortable more than 60% of the year, and generally are those provided with shade by the buildings. Areas in red may benefit from additional design solutions within the public realm such as plantings, shading, and consideration of hardscape materials (e.g., planted pavers).

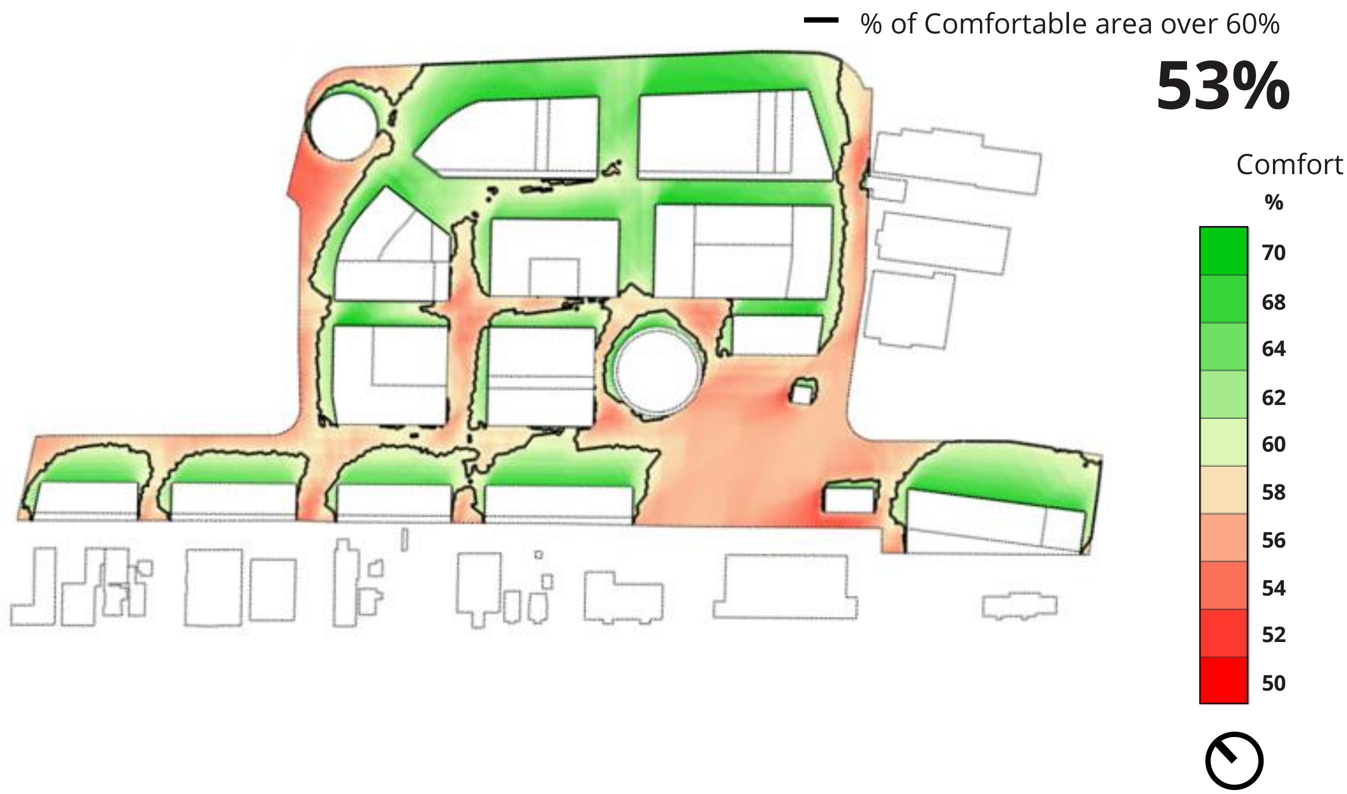


Figure 10. Conceptual Site UTCI achievement before interventions

5.4 Building Resilience

The concept of building resilience has gained significant attention in recent years as the frequency and intensity of natural disasters and other emergencies have increased. Resilient buildings can help protect lives and facilitate a quicker recovery following adverse events. They are designed, constructed, and equipped to enhance their durability, adaptability, and responsiveness in the face of adverse events.

Building resilience is not limited to the resilience of the building itself, but also involves the place of buildings within their community and how a building can contribute to the resilience of the community. Resilient buildings can provide safe havens, services, and infrastructure that can be utilized during and after disasters.

Due to the high solar radiation effect on the façade, glare and heat gain mitigation strategies, such as reducing the window-to-wall ratio, wall thickness (increasing shading of the window), or reducing SHGC are recommended.

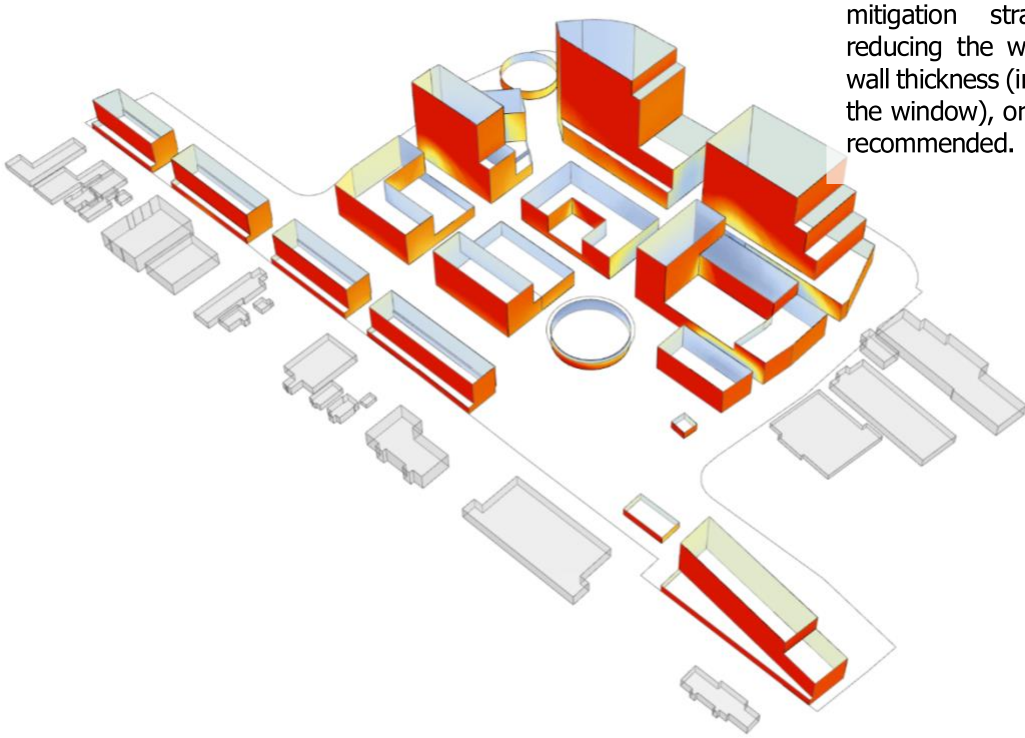
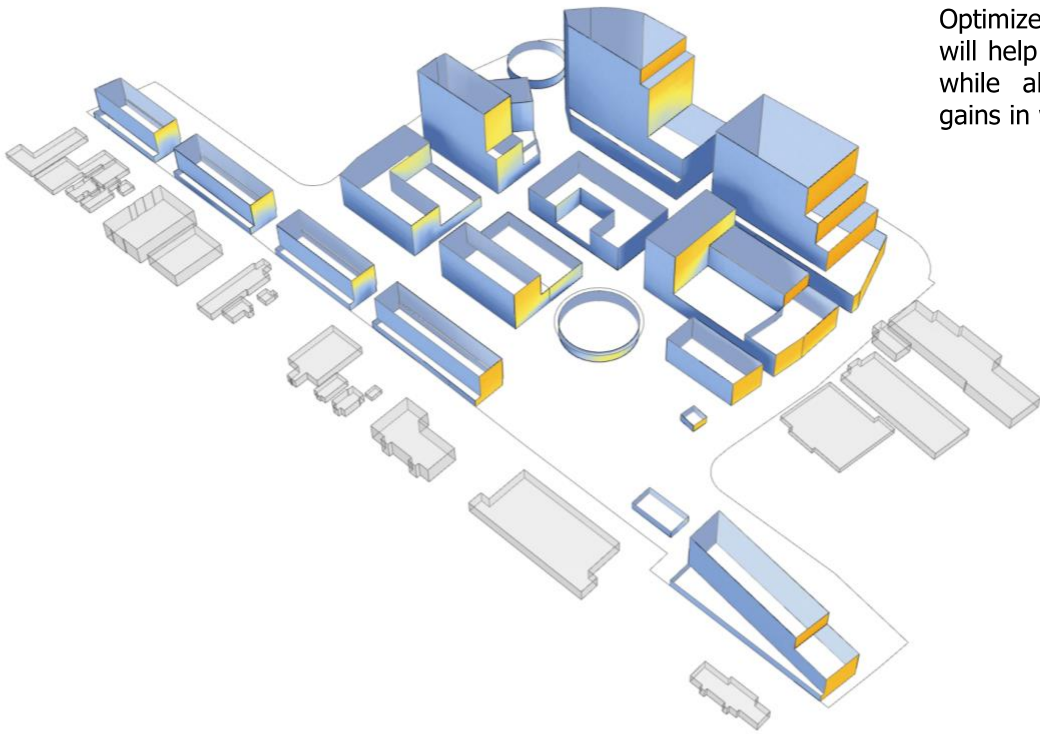


Figure 11. Conceptual Massing Façade Incident Solar Radiation when OA > 65°F



Optimized shading strategies will help blocking summer sun while allowing passive heat gains in winter.

Figure 12. Conceptual Massing Façade Incident Solar Radiation when OA < 60°F

5.4.1 Passive Survivability

Passive survivability refers to the ability of a building to maintain livable conditions in the event of an extended loss of power, interrupting services to the building including lighting, cooling, heating, and ventilation.

This does not mean that the building needs to operate as normal, but it should be able to maintain safe indoor temperatures, breathable air, and visual safety. Visual safety can be described as the level of light needed to safely move around the building, while thermal safety can be measured by the predicted Heat Index and whether it falls within a safe range.

Thermal safety is the ability to maintain indoor conditions within safe temperature boundaries without the use of heating and cooling systems. A highly insulated envelope is a key contributor to this, as well as natural ventilation in summer, and passive solar heating in winter. This thermal safety could be provided in specific safety zones if for example it is not considered appropriate to provide operable windows throughout the building.

Thermal safety can be measured using either the Standard Effective Temperature (SET), or the more commonly known Heat Index. Heat Index is a measure of how hot it really feels when relative humidity is factored in with the actual air temperature. Modelling should be undertaken to analyze how a building design will perform in a disaster scenario, under both historic and future weather conditions, to ensure that the designated safe areas stay in appropriate Heat Index ranges. Calculations and ranges are provided by the National Weather Service[14].

Natural ventilation increases passive survivability in many scenarios, but may decrease it in some scenarios, such as wildfires where pollution would prevent the use of windows.

Provision of adequate daylight is important so that occupants can move around in the daytime without artificial lighting. Easily accessible staircases allow movement in the event that the elevators are disabled.

5.4.2 Redundancy

Certain elements of resilience will necessarily require solutions that are not passive. For example, during the provision of a consistent potable water supply or during instances when direct fresh air intake must be halted in the case of a nearby pollution event (industrial off-gassing, wildfire occurrence).

During these cases, redundancies may be built into the system through the use of the renewable energy system and battery array in order to provide further resilience. The buildings should then be designed such that power can be automatically limited to only a small number of uses in emergency operation.

The value of this redundancy is becoming increasingly recognized as severe weather events become more common, and the monetary losses seen during a power outage can be quantified.

[14] National Weather Service https://www.weather.gov/ama/heatindex