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Making Green Accessible

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PREFACE

The California Energy Commission's (CEC) Energy Research and Development Division supports energy research and development programs to spur innovation in energy efficiency, renewable energy and advanced clean generation, energy-related environmental protection, energy transmission, and distribution and transportation.

In 2012, the Electric Program Investment Charge (EPIC) was established by the California Public Utilities Commission to fund public investments in research to create and advance new energy solutions, foster regional innovation, and bring ideas from the lab to the marketplace. The EPIC Program is funded by California utility customers under the auspices of the California Public Utilities Commission. The CEC and the state's three largest investor-owned utilities—Pacific Gas and Electric Company, San Diego Gas and Electric Company, and Southern California Edison Company—were selected to administer the EPIC funds and advance novel technologies, tools, and strategies that provide benefits to their electric ratepayers.

The CEC is committed to ensuring public participation in its research and development programs that promote greater reliability, lower costs, and increase safety for the California electric ratepayer and include:

- Providing societal benefits.
- Reducing greenhouse gas emission in the electricity sector at the lowest possible cost.
- Supporting California's loading order to meet energy needs first with energy efficiency and demand response, next with renewable energy (distributed generation and utility scale), and finally with clean, conventional electricity supply.
- Supporting low-emission vehicles and transportation.
- Providing economic development.
- Using ratepayer funds efficiently.

For more information about the Energy Research and Development Division, please visit the CEC's research website (www.energy.ca.gov/research/) or contact the Energy Research and Development Division at ERDD@energy.ca.gov.

ABSTRACT

The Making Green Accessible project team participated in The Next EPIC Challenge: Reimagining Affordable Mixed-Use Development in a Carbon-Constrained Future, an Electric Program Investment Charge-funded design-build competition. This solicitation challenged multi-disciplinary project teams to design and build a mixed-use development—using cutting-edge energy technologies, tools, and construction practices—that is affordable, equitable, emissions-free, and resilient to climate change impacts and extreme weather events.

The design grant allowed the Making Green Accessible project team to incorporate proven and emerging green technologies into a ground-up development. Located on church-owned land, the project was designed to be a mixed-use affordable housing complex situated in Compton, California: one of the most notoriously underprivileged communities in the United States. The proposed development is composed of 73 affordable rental units, 10 for-sale affordable townhomes, 10 affordable accessory dwelling units, and a state-of-the-art 10,190-square-foot resilience hub. In times of extreme weather events or other catastrophic scenarios, the entire resilience hub is designed for short-term emergency response. Equipped with a grid-interactive microgrid, photovoltaic solar, and batteries, the community could achieve net zero energy and operational greenhouse gas emissions while being able to island from Southern California Edison's grid for up to 72 hours during power outages.

Furthermore, SoLa Impact's innovative Pathways to Homeownership Program breaks down barriers to acquiring intergenerational wealth by encouraging SoLa Impact's current residents to become homeowners through a five-year financial literacy, monthly saving, and down payment matching program. Once complete, these current SoLa Impact renters (future homeowners) will have saved $40,000 in one-third of the time it would have taken them otherwise while retaining the first right-of-refusal to purchase the for-sale townhomes built on this site.

Keywords: multifamily housing, affordable housing, disadvantaged communities, distributed energy resources, energy efficiency, decentralized energy, climate change, sustainability, renewable energy, grid-interactive buildings, building decarbonization

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Executive Summary

SoLa Impact is a family of social impact real estate funds focused on high-quality affordable housing, catalyzing economic development, and providing access to educational opportunities in low-income communities of color. The portfolio of projects houses more than 3,000 residents—88 percent of whom are formerly homeless, 95 percent of whom are from Black and brown communities, with an average annual resident income of $23,901.

The Making Green Accessible Project's purpose was to design a zero-carbon, affordable, replicable, grid-responsive, and equitable multifamily development in Compton, California. This project has 73 residential units, 10 for-sale affordable townhomes, 10 affordable accessory dwelling units, and a state-of-the-art 10,190-square-foot resilience hub. The design concept includes 400 kilowatts of battery storage and 450 kilowatts of solar photovoltaics on the roof of the building, along with peak demand curtailment to create an islandable project between 4:00 p.m. and 9:00 p.m. peak demand hours.

Background

Reducing greenhouse gas emissions drastically is necessary to lessen the predicted catastrophic effects of climate change. To meet California's aggressive zero-emission objectives and state and local government energy policies, building decarbonization must be implemented. Half of the households in California are unable to live in the area where they work due to the state's housing affordability crisis. To create an environmentally friendly neighborhood for residents, the project team designed an all-electric, mixed-use affordable housing development that is affordable for renters. The design also features state-of-the-art clean energy and energy-efficient solutions, flexible load management, and a showcase for emerging innovative clean energy technologies. This project is timely as it supports California's environmental justice goals and implements the project in Compton, a historically underinvested community where the impacts of climate change are likely to hit first and worst. The Making Green Accessible Project demonstrates how cutting-edge engineering and architecture can be integrated with regulatory knowledge to address a variety of mixed-use development-related issues while exploring innovative pathways for replicable designs throughout the state.

Project Purpose and Approach

As one of the design-phase awardees of "The Next EPIC Challenge: Reimagining Affordable Mixed-Use Development in a Carbon-Constrained Future," SoLa Impact sought to do exactly that—design innovative housing and climate solutions and demonstrate that both can be done in low-income Black and brown communities. By addressing the inadequacies of current affordable housing options and presenting an equitable and truly sustainable paradigm, the Making Green Accessible Project seeks to provide a replicable, alternative solution. The project aims to provide a financially viable, durable, and repeatable alternative for affordable housing developments in California and beyond. The goal of the Making Green Accessible affordable housing project was to develop a new paradigm for low-impact, zero-emission rental properties as well as affordable residences for low-income families. To minimize barriers to homeownership, facilitate intergenerational wealth building, and support neighborhood revitalization, the design combined energy efficiency, affordable rental units, affordable for-sale homes, built-in accessory dwelling units for additional revenue, supportive services, a community land trust, and a customized financing model. The design and innovative financing model offer a new way to reduce the wealth gap between races and create an ecosystem that can support both economic and energy security for Black, Indigenous, and People of Color communities across the country.

As California's largest privately funded affordable housing developer, SoLa Impact (SoLa) strives for cost-efficiency and speed to ultimately mitigate the homelessness crisis. SoLa does this by following the SoLa way: "Simplify, Standardize, and Repeat." SoLa builds the Honda Civics of affordable housing—without the bureaucratic bells and whistles that typical government-subsidized developers use. In Los Angeles County, for example, the average cost to build one unit of affordable housing is more than $650,000 per unit (Dillon and Poston, 2022); whereas SoLa's average cost to build is approximately $300,000 per unit. Incentivized to provide a return to SoLa mission-aligned investors, SoLa builds at half the cost and twice as fast as other affordable housing developers.

This design intended to serve the low end of the market, meaning low-income individuals and families that may, or may not, have been formerly homeless. For decades, low-income Black and brown communities have often been overlooked and underinvested in. As such, the main goal of this project was to prove that sustainable technologies can work and should be deployed in low-income communities so that residents can also benefit from the clean energy and climate resilience transition. Metrics used to demonstrate success include, but are not limited to, the information in Table ES-1.

Table ES-1: Project-specific Metrics, Benchmarks, and Final Design Performance

Environmental or Social Metric	Metric	Target Benchmark	Final Design Performance
Environmental	Site Energy Use Intensity in thousand British thermal units per hour per square foot (kBtu/h/sf)	29	27
Environmental	Total Solar Photovoltaic System Size in kilowatts direct current (kWdc)	450	450
Environmental	Battery Storage – Hours of Resiliency for Tier 1 & 2 Loads (hours)[1]	72	72
Environmental	Battery Storage – Total Daily Offset (Battery Size in kilowatt-hours [kWh])	400	400

[1] Tier 1 are critical loads that are life-sustaining and/or mission-critical that should be configured for 100 percent resilience. Tier 2 are priority loads should be maintained if doing so does not threaten the ability to maintain Tier 1 loads. Tier 3 are discretionary loads should be maintained only when doing so does not threaten the ability to maintain Tier 1 and Tier 2 loads.

Environmental or Social Metric	Metric	Target Benchmark	Final Design Performance
Environmental	Net zero operational greenhouse gas emissions in metric tons of greenhouse gas emissions	0	0
Social	Pathways to Homeownership Program participants (number)	10	12
Social	Pathways to Homeownership Workshops (number)	3	4
Social	Rental units designed (number)	50	83

Source: SoLa Impact

SoLa Impact pursued this innovative community design, driven by three goals: sustainability, resilience, and affordability. These goals were achieved and exceeded with a net carbon-negative energy design, unlimited Tier 1 critical and Tier 2 priority backup power to tenant units and common areas, and an average 50 percent reduction in tenant utility bill savings per year. In times of extreme weather events or other catastrophic scenarios, the entire resilience hub could be activated for short-term emergency response. Equipped with a grid-interactive microgrid, photovoltaic solar, and batteries, the community would have net zero energy and operational greenhouse gas emissions while still being able to island from Southern California Edison's grid for up to 72 hours during power outages.

Key Results

The development can restore limited operation in the event of a grid failure using a site-wide microgrid. Tier 1 load, or ten percent of peak demand, is restored instantly and perpetually. Services include concentrated services in the communal area, such as power for medical devices, Wi-Fi, a microwave, USB charging, and air conditioning, as well as site-wide safety elements like external lighting and fire alarms. Tier 2 load, or 25 percent of peak load, is accessible for 72 hours. This covers lighting within each unit, Wi-Fi, and refrigerators to keep food accessible, in addition to the Tier 1 load. The development also achieves a 25 percent reduction in embedded carbon versus the Self-Help Enterprises template design baseline.

The SoLa Impact project team believes that its innovative design can be used for a number of other use cases. For example, the design can be used to support the future development of net zero affordable housing—either as simple inspiration or a tactical step-by-step guide in SoLa's zero-emissions affordable housing roadmap. The Making Green Accessible Project design delivers a true pathway for zero-emission solutions that are technically and economically feasible, takes advantage of advanced building design and construction practices, and provides equitable access to safe, healthy, affordable, and desirable living environments.

Actions taken to share project information and foster adoption included the formation of a highly expert technical advisory committee that provided critical feedback on the design of this Electric Program Investment Charge project. Forming and meeting with the technical advisory committee regularly lent greater credibility to the design so that others may trust the project team’s judgment and take it to market. Five experts in fields ranging from renewables and storage to community and climate resilience provided more than 35 comments that were responded to and incorporated into future drafts by the team. Three out of five members were familiar with the Next EPIC Challenge and were able to facilitate changes in the design that aligned with the build phase scoring rubric. Other activities included presentations to, and meetings with, community leaders, prospective resident surveys, social media posts, and YouTube videos posted publicly.

Policy recommendations to facilitate broader adoption of the Making Green Accessible Project's affordable housing model include the following:

- Advise the California Public Utilities Commission to retain virtual net energy metering 1.0 or 2.0 tariffs for multifamily properties serving 100 percent low-to-moderate income households.
- Consider incentives to locate low-income multifamily projects near mass transit hubs that provide multiple modes of transportation. This will not only help meet the California Energy Commission’s goal to lower vehicle miles traveled but also acknowledges that most low-income households do not have access to credit (and have little, if any discretionary income available to make recurring electric vehicle car payments) required to purchase electric vehicles.
- Invest future Electric Program Investment Charge funds in research and development that will aid in policy solutions to overcome split incentives (transactions where the benefits do not accrue to the person who pays for the transaction) that cause landlords to underinvest in energy efficiency measures.

CHAPTER 1: Introduction

SoLa Impact (SoLa) partnered with Gensler and Buro Happold to develop the design for the Making Green Accessible (MGA) development, an innovative, buildable, and scalable solution for resilient, low-carbon affordable housing in Compton, California. This project team combines Buro Happold's energy consulting and engineering skills, Gensler's worldwide architectural experience, and SoLa's knowledge of affordable housing in California to investigate best practices in cutting-edge technology and design-build the suggested design. The group has created a replicable, all-electric, zero-net-energy design that lowers operating expenses for the occupants while enhancing the building's resilience and efficiency. The final objective is to build a scalable and adaptable prototype for future cost-efficient and low-carbon developments. The major energy and climate goals are specified within the California Energy Commission's (CEC's) minimum design requirements and project-specific goals. These requirements and goals consist of the following:

- All building end uses are all-electric.
- More than 20 percent of the site's peak load can be temporarily managed in response to grid conditions.
- The site achieves zero net energy between the hours of 4:00 p.m. and 9:00 p.m.
- All residential end uses must be controlled through a home energy management system that responds to real-time pricing signals.
- Microgrid controllers must be interoperable with distributed energy resource aggregators.
- Buildings must be able to island from the main grid during an outage and provide immediate, indefinite power to Tier 1 loads and immediate power to Tier 2 loads for 72 hours.
- Twenty percent of parking spaces must have building- or grid-interactive electric vehicle (EV) charging systems.
- Remaining parking must be EV-ready.

Projects often only succeed in achieving a small portion of these objectives. Market-rate or luxury housing projects, for instance, frequently meet ambitious sustainability targets, and affordable housing projects expand the supply of affordable housing. However, it is extremely uncommon for affordable housing projects to set and meet progressive sustainability targets because the technologies needed to do so are usually either prohibitively expensive, highly risky, or seen as such. MGA accomplished all of the set objectives by carefully and methodically analyzing both new and current technologies to see how well they fit into the affordable housing market in terms of upfront and ongoing costs as well as ease of use, maintenance, and installation. This project has 73 residential units, 10 for-sale affordable townhomes, 10 affordable accessory dwelling units (ADUs), and a state-of-the-art 10,190-square-foot resilience hub. The design concept includes 400 kilowatts (kW) of battery storage and 450 kW of solar photovoltaics (PV) on the roof of the building, along with peak demand curtailment to create an islandable project between 4:00 p.m. and 9:00 p.m. The total development components are outlined in Table 1.

Table 1: Total Development Components

Type	Count	SF	Total SF	Notes
1-BR Units	73	522 SF/unit	38,106 SF	3-story apartment complex on-grade with tuck-under parking. All units meet ADA and Federal Section 8 requirements. 30 EV stalls.
2B/2BA townhomes	10	1,710 SF/lot	17,100 SF	Townhomes with the ability to add a 3rd BR. 2 Outdoor terraces. 2 parking stalls/home (1 EV and 1 non-EV).
1-BR ADUs	10	544 SF/unit	5,440 SF	Single-family attached ADUs on the ground floor. All units meet ADA and Federal Section 8 requirements.
Total	83 rentals/10 homes	N/A	60,646 SF	Net rentable SF
Multi-purpose room	1	1,250 SF	1,250 SF	Part 1 of resilience hub. Church during normal operations and community gathering space during times of grid stress/outage.
Daycare	1	5,100 SF	5,100 SF	Part 2 of resilience hub. Area includes 3,200 SF of secured outdoor area and 1,900 SF of secured indoor space.
Community Center	1	3,840 SF	3,840 SF	Part 3 of resilience hub. Area includes a community kitchen, community room, tech/computer room, storage, and locker rooms.
Total Development	N/A	N/A	70,836 SF	82,458 SF lot (~2 acres)

Source: SoLa Impact

The project site is located on East Laurel Street in Compton, California. The conceptual approach to the design grows out of a vision of the project as the catalyst in the revitalization and stabilization of the surrounding neighborhood, which could presently be described as "transitional." The site is surrounded to the south and east by light industrial use, and to the north and west by low-density residential. The city of Compton's intent, and accordingly SoLa's own, is to see this project as a higher density model of moderately affordable residential living. Figure 1 shows an aerial photograph of the existing site, and Figure 2 shows the proposed site design in yellow.

Figure 1: Aerial Photograph of Existing Site

Source: SoLa Impact

Figure 2: Aerial Photograph of Proposed Site Design

Source: SoLa Impact

This project is timely because it supports California's environmental justice goals as well by implementing the project in Compton, a historically underinvested community where the impacts of climate change are likely to hit first and worst. Furthermore, the project adds to California's desperately needed affordable housing stock in a manner that is twice as cost- and time-efficient as traditional affordable housing developers. This project supports California's clean energy and climate goals by designing a scenario in which sustainable technologies are deployed in low-income multifamily communities ensuring that Black and brown renters share in the economic benefits provided by a just climate transition.

Compton's population of 92,000, of whom 27 percent are Black and 69 percent are Hispanic, is declining at a rate of 2 percent each year. The average annual household income in Compton is $58,000, and 20 percent of Compton residents live in poverty—double the nationwide average. According to the latest homelessness counts, there are 644 people sleeping on the streets every night; however, local housing assistance programs are at capacity. To address this, the city must accommodate more than 1,000 units of affordable housing by 2029 or else it will lose state funding. To make matters worse, Compton was ranked as the "Most Financially At-Risk City in California" in 2019 due to corruption and lack of leadership. Compton's troubled history of violence and crime still haunts the city with dangerous street takeovers and massive looting events increasing in recent years (Kurzweil, 2024).

SoLa has been investing in Compton, and communities like it, for over a decade making SoLa California's largest privately funded affordable housing developer, and Los Angeles County's largest Section 8 landlord. Compton is perhaps one of the most notorious cities in the United States. SoLa's main objective is to change the narrative of Compton from one of violence and economic blight to community resilience, sustainability, and intergenerational wealth. SoLa sought to demonstrate that partnering with faith-based organizations is an effective way to make use of underused land while ensuring an ongoing cooperative and equitable benefit to the wider community.

On October 20, 2023, the state Senate passed the Affordable Housing on Faith and Higher Education Lands Act (Senate Bill 4, Weiner, Chapter 771, Statutes of 2023) unlocking the potential development of 1.4 million units. Starting in 2024, Senate Bill 4 (SB 4) provides a streamlined approval process and development standards for affordable housing on lots owned by faith-based organizations. In Los Angeles County, there are over 4,300 developable acres, which could bring an additional 130,000 units of affordable housing (Wiley, 2022). SoLa's design is two acres (very close to the average church-owned lot size across the state) and serves as a replicable model for this new piece of legislation to address Los Angeles County's current shortfall of 500,000 units of affordable housing. Senate Bill 4, combined with an interest in unlocking faith-based land's "highest-and-best use," SoLa decided to partner with Logos Faith Development and the Immanuel Baptist Church. MGA sought to prove that unlocking the value of church-owned land, particularly in minority communities, could make a tremendous difference toward California's climate and housing goals.

Since the primary research product is largely information and analysis, the project addresses the following gaps: 1) a model for partnering with faith-based organizations to build sustainable and affordable housing, 2) an innovative financing model to unlock pathways to homeownership for low-income families, and 3) a cost-effective mixed-use affordable housing design that achieves net zero greenhouse gas (GHG) emissions on-site.

The main goal of MGA was to prove that sustainable technologies can work and should be deployed in low-income communities so that residents can also benefit from the clean energy and climate resilience transition. MGA sought to establish a replicable environmental, social, and governance financial strategy for affordable housing production that is self-sustaining and resilient, highlighted by the innovative green technologies included in the design. It represents a new financial model for deploying emerging technologies in affordable housing, bringing the benefits of a clean economy to those most at risk of climate impacts and spurring market transformation from the bottom-up.

Additionally, MGA sought to serve as a case study in advanced energy technology deployment by generating operational data that can be used to validate and improve performance. In this way, the project will be a model of both an energy-resilient building and a building that helps advance overall grid resilience. Metrics used to demonstrate success include but are not limited to those in Table 2.

Table 2: Project-specific Metrics, Benchmarks, and Final Design Performance

Environmental or Social Metric	Metric	Target Benchmark	Final Design
Environmental	Site Energy Use Intensity in thousand British thermal units per hour per square foot (kBtu/h/sf)	29	27
Environmental	Renewables Total in kilowatt-hours (kWh)	450	450
Environmental	Battery Storage – Hours of Resiliency for Tier 1 & 2 Loads (hours)	72	72
Environmental	Battery Storage – Total Daily Offset (Battery Size in kWh)	400	400
Environmental	Net Zero Operational GHG in metrics tons of GHG emissions	0	0
Social	Pathways to Homeownership Program participants (number)	10	12
Social	Pathways to Homeownership Workshops (number)	3	4
Social	Rental units designed (number)	50	83

Source: SoLa Impact and Buro Happold

The SoLa Impact project team believes that the potential audience and market for this research include the following:

- Local community-based organizations across California
- Affordable and market rate housing developers
- Solar microgrid system developers, including consultants, contractors, and utilities
- Government, including the California Department of Housing and Community Development

- California Building Standards Commission, including International Building Code consultants and the California Energy Commission
- Green building industry, including building contractors and consultants
- Low-income households, including advocates of low-income households
- Local governments, including economic development and planning/zoning consultants
- Mechanical, electrical, plumbing and structural engineers, including contractors
- Capital providers, including home mortgage industry, CalHome, Community Development Finance Institutions, construction lenders, and accountants
- Academia, including behavioral economists, housing think tanks and institutions, as well as sustainability-focused scholars and university departments

CHAPTER 2: Project Approach

SoLa approached zero-carbon design through a framework of "Now, New, and Next" technologies and strategies. The approach supports a process that considers all aspects of how architectural technology informs the zero-emissions operational target. "Now" represents technologies that are available in the market, with precedents for use in multifamily housing projects, but not necessarily commonly applied in affordable housing. "New" technologies are existing technologies that are commonly used in other building typologies but would be new to the affordable housing market. "Next" identifies emerging technologies that may be available, but not in all markets and with few precedents in built work, as well as technologies in late stages of development that may be relevant to the project for future applications but could be designed to support today's development.

Framing individual technologies through this lens, a quantitative model was used to assess them by standardized criteria. Following that model, the project team measured technologies for their carbon emissions reduction benefits as well as operational cost savings potential, market availability and experience, water savings, and other sustainability metrics. The framework identifies the metrics used to assess technologies as well as how emissions and energy conservation measures are cataloged. Each energy conservation measure or technology was assessed as a separate application and then combined into project design scenarios based on energy conservation measure bundles that perform best.

Initially, the project team assessed the performance of two fundamental site development options—the centralization of systems for cooling and heating as well as domestic hot water, compared to the more common approach of individual systems for each dwelling unit. These models—centralized versus decentralized—will inform the individual technologies in the Now, New, Next framework. There are significant emissions reductions to be achieved using a centralized system, but SoLa Impact recognized the barriers in terms of economics and operational and maintenance demands such systems can pose. SoLa's project offers a great demonstration of the benefits of centralization, but this will need to be proven through the design and analysis phases. Key technologies the project team assessed include the following:

- Passive design (orientation and massing)
- Rooftop canopies for solar control
- Automated air sealing of envelope
- Electrochromic glazing
- Phase-change material insulation
- Increased duct and pipe insulation
- Air-source heat pump
- Air-source heat pump with water heating

- Fan coil units (centralized heating/cooling systems)
- Solar PV systems
  - Conventional rooftop modules
  - Bifacial solar modules
  - Thin-film solar modules for building integration
  - Tracking solar modules
  - Combination solar thermal and PV systems
- Energy storage
  - Battery systems
  - Thermal systems, including phase-change material for centralized systems
- Site-wide microgrid system with islanding capability
- Integrated mobility strategies, EV charging tied to the site-wide microgrid
- Comprehensive building control management system
  - Dwelling unit metering and digital application interface

Many of these technologies will be visible across the site. For the centralized option, the project team planned for an Energy Center where all equipment will be located and accessible visibly to tell the zero-emissions story to residents and visitors. The Energy Center would incorporate the on-site generation technology infrastructure, such as inverters for solar PV as well as the heating and cooling systems, main electrical service equipment, and hot water supply, if centralized options are selected for the development.

Overall Design Approach and Strategies

The proposed building, based initially on Title 24 guidelines, uses building energy simulation software called Integrated Environmental Solutions Virtual Environment (IESVE) to assess energy performance. The massing was also parametrically analyzed for envelope performance using Honeybee and EnergyPlus software. The design incorporates the solar PV system and energy storage system to optimize energy efficiency and minimize environmental impact and operational costs. Process loads are approximated using real-world data or industry-standard load profiles for activities like lighting, plug loads, ventilation, and specialized processes as well as default 2022 California Building Energy Efficiency Standards assumptions for things such as appliance energy use. Control strategies for the solar and storage system focus on peak shaving, maximizing energy storage during off-peak periods, and intelligent load management to prioritize renewable energy consumption. By using these modeling solutions and assumptions, the proposed model aimed to achieve significant energy savings and contribute to a sustainable building design.

Through modeling optimization, the standard design is estimated to consume 45 kBtu/h/sf as compared to the proposed design, which is estimated to require 27 kBtu/h/sf. The standard design requires a 148-kW PV array, which covers about 25 percent of the annual energy demand. The proposed design has a maximized roof area for PV and is designed with a

415-kW PV array. This covers 100 percent of the overall predicted annual energy requirements on-site, including nonresidential and residential spaces. While the PV covers annual energy demands in the aggregate, there may be times during the winter when demand cannot be fully covered by PV production, and prosumer engagement will be required.

The design achieves this through a variety of passive and active strategies. The design ethos is to avoid heating and cooling loads through passive design opportunities such as operable windows, phase change materials in the wall and roof constructions, and limiting window-wall ratio to avoid high cooling loads in the climate imposed by high solar gain. The remaining load is then dealt with via a high-efficiency variable refrigerant flow system with an energy recovery ventilator for the outside air supply. Additionally, efficiency is achieved through demand response refrigerators and high-efficiency heat pump water heaters, exceeding the minimum code requirements wherever possible.

Architectural Designs, Aesthetics, and Functionality

SoLa's conceptual approach to the design grows out of a vision of the project as the catalyst in the revitalization and stabilization of the surrounding neighborhood, which could presently be described as "transitional"—surrounded to the south and east by light industrial use, and to the north and west by low-density residential. The city of Compton's intent, and accordingly SoLa's own, is to see this project as a higher-density model of moderately affordable residential living.

The design itself consists of an interplay between three architecturally distinct buildings, to achieve a scale more commensurate with the community. As seen in Figure 3, from left to right, they are: 1) a block of 10 affordable, for-sale townhomes facing South Willow Avenue, 2) an angular, iconic structure at the juncture of the other two blocks, containing a daycare center and community space (with three additional rental units above), and 3) a long, three-story structure along the east alley consisting of two stories of rental units over parking. Appropriate to the resilience hub's central role in the project, it can be accessed from the parking on the east, from the promenade along the rear of the for-sale housing, and from South Willow Avenue. Each structure employs a unique material cladding (stucco, cement panel, and metal panel, respectively), fenestration type, and patterning. Together they form three sides of a semi-public community space at the north end of the site that serves as the main pedestrian entry into the project from East Laurel Street: the only active and pedestrian street that bounds the property. A southwest view of the development can be seen in Figure 3.

Figure 3: Southwest View

Source: SoLa Impact

In addition to covered parking, the ground floor podium of the rental apartment structure bounding the east edge of the site is occupied by a multi-purpose space and—at the south end—"incubator garages" for local business start-ups. The units above are accessed by an open corridor, with operable windows at either end to afford natural cross-ventilation through the apartments. The east bank of units has operable polycarbonate "greenhouse porches" on their east ends; the units along the west also have operable shutters on their west face to control solar gain and privacy while allowing cross breezes. Between the worship space and the parking is located the "energy yard," designed to store and distribute power to the project with power during off-hours as well as emergencies such as power outages. In the latter case (due to heat waves or earthquakes etc.), the daycare center and community space in the center building combine to serve—together with the outdoor daycare yard, worship space, and covered parking area along the alley—as an interconnected Community Resilience Hub, equipped to provide shelter, supplies, food and first aid not only to tenants but surrounding neighbors. The three-story stacked rental units can best be seen in Figure 4.

Figure 4: Stacked Affordable Rental Units from Southeast View

Source: SoLa Impact

The three-story for-sale townhome bloc is organized into five pairs of homes flanking shared but separate two-story courtyards at the second level—the main living level of the homes. Above, on the third floor is the bedroom level, which is planned to allow flexibility regarding present and future use. It can either be partitioned into two bedrooms or left as a bedroom and open office/work area. This floor also offers a terrace, which can either be used as a covered outdoor patio or be built out into a third bedroom. Largely covered by PV panels, the courtyard provides shading to naturally cool the house and at the same time allow natural westerly breezes to cross through it, at both levels. On the ground floor, each townhome includes a covered tandem parking area, alongside an accessory dwelling unit for use as a separate apartment for extended family or as a sublet to provide additional income to assist with the mortgage. At the rear of each house, a polycarbonate greenhouse porch and backyard offers additional indoor-outdoor space for entertaining, gardening, or simply lounging—at the discretion of the homeowners, for either themselves or the renter. A view of the townhomes from the northeast view can be seen from Figure 5.

Figure 5: Northeast View

Source: SoLa Impact

Lastly, the project boasts over a third of an acre of public open space. This comprises the larger, more hardscaped north courtyard, which is abundantly planted with shade trees and includes a community garden. The other, smaller green space—softscape with drought-resistant planting—is located in the southwest portion of the site. Both spaces are proposed to accept, store, and reuse stormwater gathered both on-site as well as that from adjacent streets. A view from the northern entry courtyard featuring open space can be seen in Figure 6.

Figure 6: Northern Entry Courtyard

Source: SoLa Impact

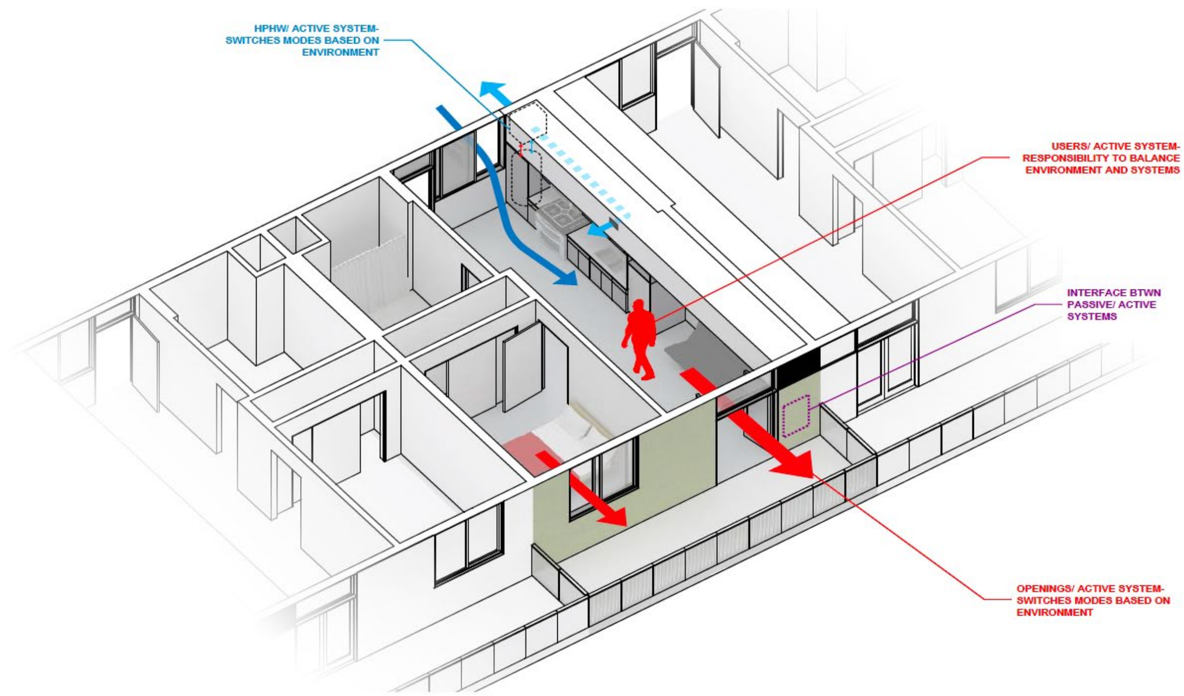
Design Strategies for Integrating Conventional and Emerging Energy Technologies

Load Flexibility, Grid interactions, and Resident Engagement

SoLa recently surveyed the cohort of future homeowners on their thoughts as they relate to the proposed load flexibility measures used in SoLa's design. Overall, the response was favorable with some interesting insights relating to implementing load flexibility technologies in low-income communities where residents are extremely price sensitive. All of the respondents agreed that they would be comfortable with their home using a smart thermostat and smart plugs to automatically reduce their energy usage if it saved them money on their monthly electricity bills and reduced the likelihood of power outages. However, only 83 percent said they would be open to email or text notifications from the microgrid with suggestions to reduce power usage during times of grid stress or power outages. To the project team, this means that SoLa's residents would prefer to "set it and forget it" with automated load scheduling as opposed to direct communication methods.

Phase change materials in the wall and roof construction and operable windows are the two main passive design features employed to avoid load within the building. Phase change materials add thermal mass effects to a lightweight structure without adding the significant embodied carbon of a thermally massive concrete structure. As seen in Figure 7, operable and casement windows are useful in the climate to help avoid load within the space by using cross and through ventilation. Avoided load reduces overall energy demand from heating, ventilation, and air conditioning (HVAC) systems, minimizing conditioning energy requirement. The resilience hub is the community pillar and is designed accordingly in a creative, eye-catching way. It is intended to serve as an anchor for the community and downtown Compton's neighborhood corridor.

Figure 7: Active and Passive Ventilation



HPWH = heat pump water heaters
Source: SoLa Impact

Microgrid Design Strategy

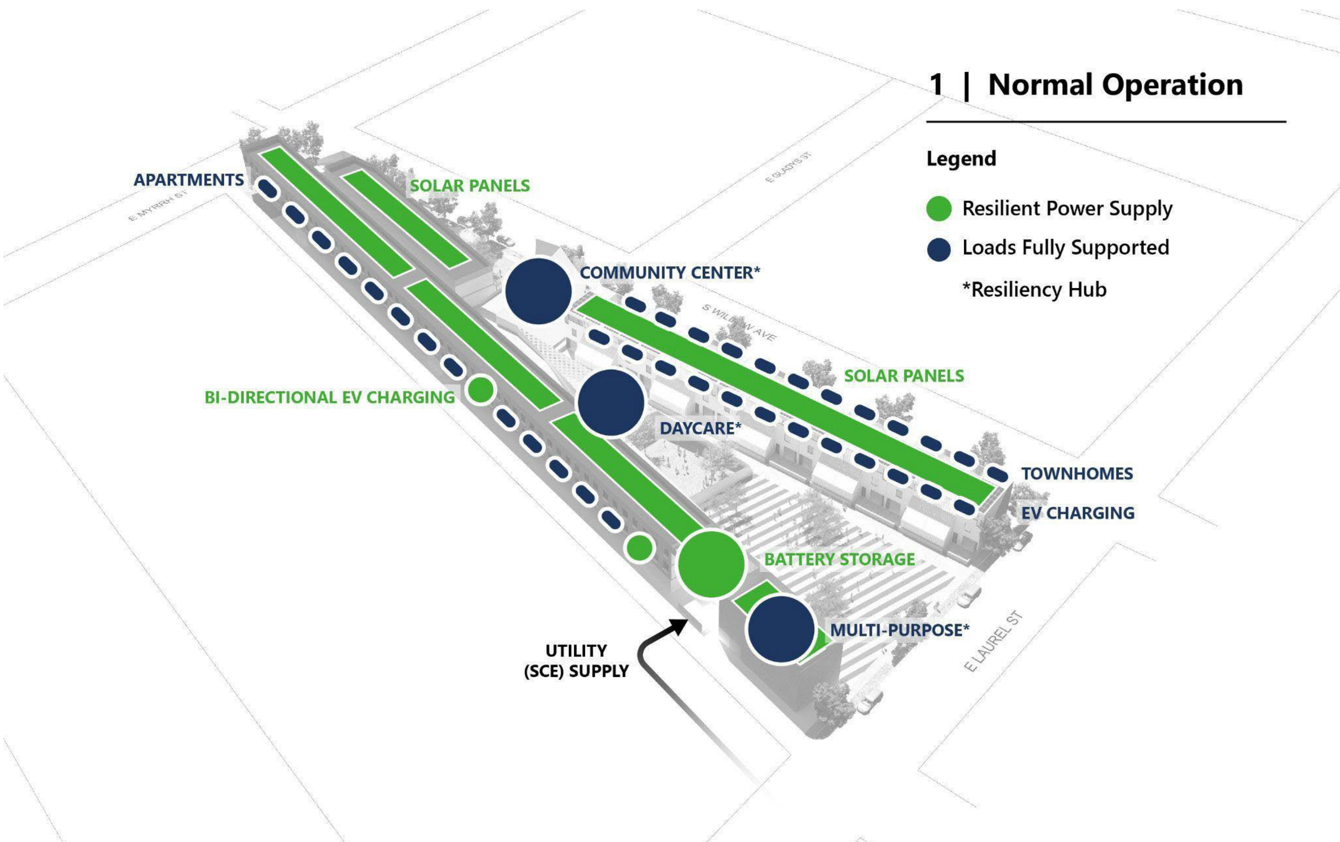
The ability to detach from the electrical grid and to dynamically manage and control energy producing systems is made possible by the microgrid. In addition to providing carbon-free energy during periods of grid energy production that are carbon-intensive, these systems provide resilience during power outages. It is anticipated that load systems with their own dedicated main controller, including lights and domestic water heating, will accept directives from the microgrid to operate in a certain mode and, in response to the signal received, will activate pre-programmed operational parameters. Motorized circuit breakers that are electrically driven and located at both the tenant and site levels complete the load shedding capabilities required for islanding operations. In addition to the California Energy Commission's microgrid design requirements, the following goals and operation strategies were added by the project design team:

1. Backup of resilience hub for a minimum of 72 hours during grid outage via on-site distributed energy resources (DERs) (PV, battery energy storage system, EV bi-directional chargers),
2. Implementation of two Level 3 bi-directional EV charging stations,
3. Virtual power plant and transactive energy including ability to sell excess power to the grid to lower site utility cost, and

4. Carbon footprint management for site and tenants to enable view their carbon dioxide footprint in real time.

For normal microgrid operation, the grid and DERs combine to serve loads. DERs would be used first with the remainder of load being supplied from the grid. Figure 8 shows the normal microgrid operation plan.

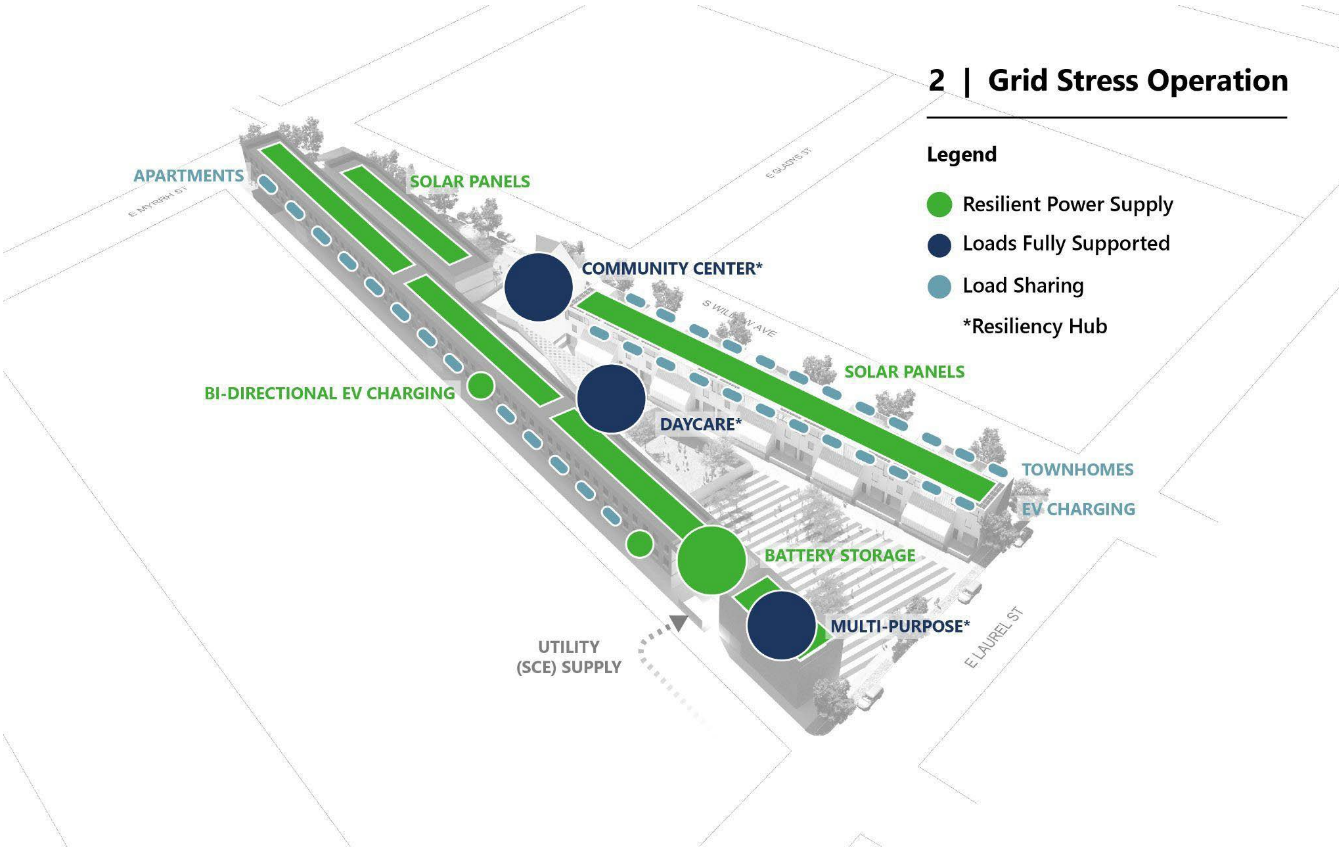
Figure 8: Microgrid—Normal Operation



SCE = Southern California Edison
Source: Buro Happold

For grid stress operation, the microgrid controller receives signals from the grid via the Itron smart distributed intelligence meters and disseminates communication to the predetermined non-critical tier 3 loads. Figure 9 shows the grid stress microgrid operation plan.

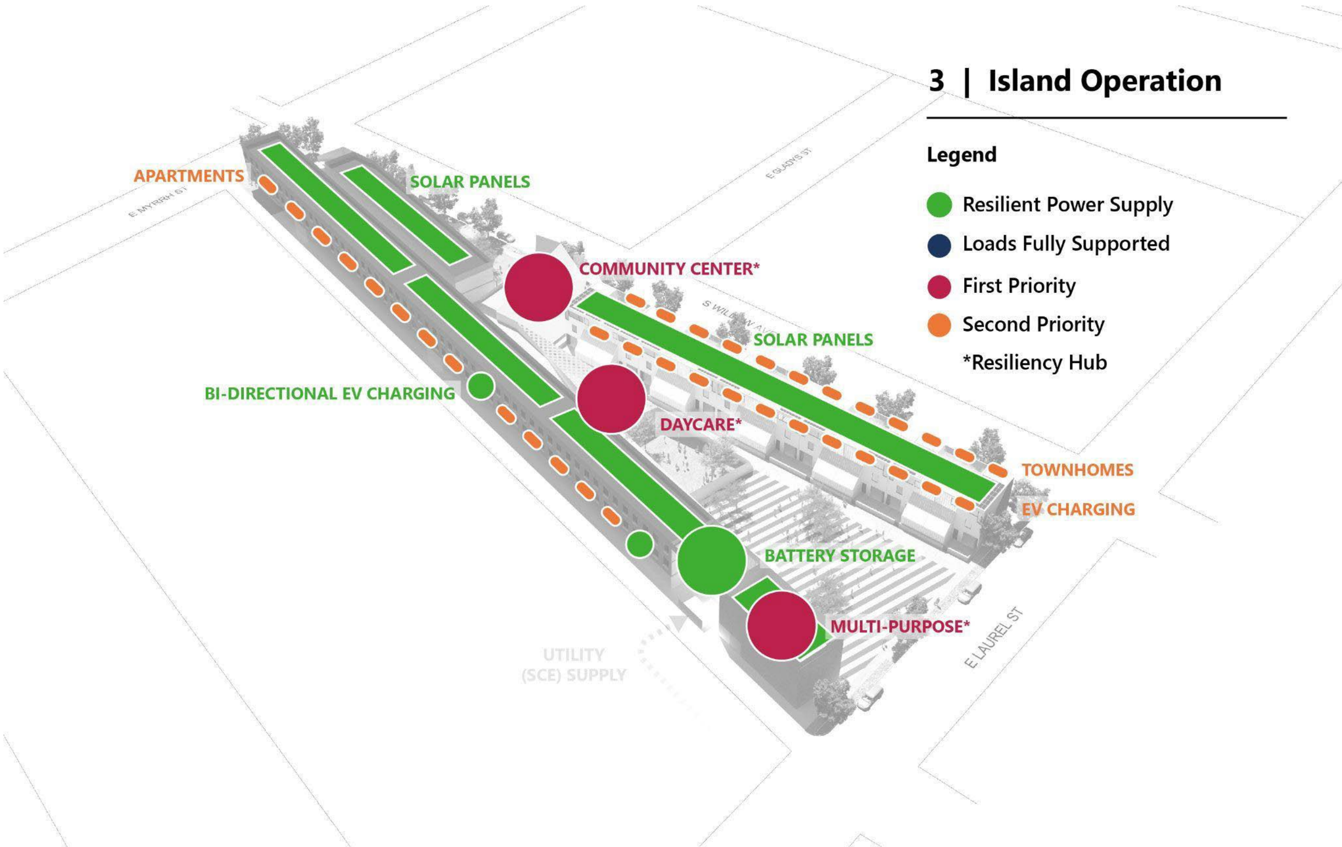
Figure 9: Microgrid—Grid Stress Operation



Source: Buro Happold

Lastly, island microgrid operation is set during the period before the recloser has restored grid power. The DERs will solely serve the site, first prioritizing tier 1 and 2 loads, and then if capacity is available adding on non-critical (tier 3) loads. Prioritizing of the loads is performed via the microgrid controller and building management system, which have connections to loads and end-use devices. For long-duration outages, once the outage exceeds a set duration of 30 minutes, the microgrid controller will prepare the site for meeting the 72-hour backup goal of the resilience hub by only prioritizing tier 1 and 2 loads. Tier 3 loads will remain offline. Figure 10 shows the islanding microgrid operation plan.

Figure 10: Microgrid—Island Operation



Source: Buro Happold

EV Charging and/or Electric Mobility Strategy, Vehicle-to-Building and/or Vehicle-to-Grid Capability

The design includes 10 Level 2 EV chargers and two Level 3 EV chargers, all of which can respond to grid and building signals through connection back to the microgrid controller. The design also includes a new innovative metering technology, the Itron smart distributed intelligence meter, which along with the Eaton microgrid controller can respond to grid signals and push appropriate actions to downstream devices such as EV chargers. The Itron smart distributed intelligence utility meters act as their virtual power plant aggregator, allowing for direct interaction with grid signals. The remaining 48 parking spaces are designed as EV-ready, meaning they will have all infrastructure upstream of the charger installed when the building is completed.

Advanced Construction Planning and Practices

The Electric Program Investment Charge (EPIC) grant has allowed the team the time and expertise to identify where systems can be reinvented to achieve new goals for higher performance, better integration, more efficiency, and ultimately less cost. SoLa Impact launched a separate operating entity, "Model/Z," a prefabricated modular housing manufacturer with a factory located only 15 minutes from the project site. The 73 rental apartments would be fully modular Model/Z units. Factory-built units would significantly boost time savings, cost savings, and sustainability over traditional on-site construction. A breakdown of the potential for construction time and cost savings of the advanced methods is shown below.

Greater than 25 percent cheaper:

- More productive labor hours and less material waste
- Pre-determined hard costs prevent project overruns and costly change orders.
- Model/Z units are three to five times less expensive than traditional government-funded Low-Income Housing Tax Credit projects.

Greater than 30 percent faster to build:

- Parallel (vs. serial) manufacturing and build process—pre-approved by the state
- "Plug-and-play" components due to standardization
- Fewer subcontractor scheduling conflicts and avoidance of weather delays
- Just-in-time arrival to site—installed in days, not months

The goal of Model/Z is to drive down construction hard costs by greater than 25 percent, improve completion times by greater than 30 percent, and reduce embodied carbon emissions by greater than 35 percent.

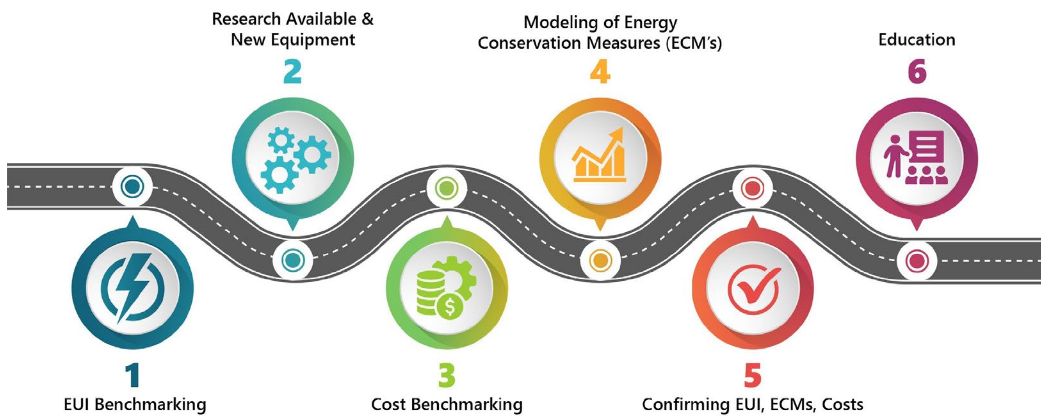
Furthermore, SoLa Impact would reduce emissions generated from construction activities (factory-built vs. traditional construction) as well as reduce transportation emissions due to a nearby factory.

Market Transformation

To enable broad scalability, the Making Green Accessible development has been thoughtfully developed with flexible replicability in mind. Future decarbonized mixed-use projects will revolve around the fundamental strategies of reducing demand, shifting load, and integrating DERs. Specific design criteria of different energy efficiency measures were influenced by localized climate circumstances. The project team produced a Zero-Emissions Affordable Housing Roadmap, which can best be illustrated by Figure 11. At its core, to promote the broader adoption of the emerging energy technologies and advanced architectural, design, and construction practices demonstrated by MGA, the project team suggests the following:

1. Benchmarking energy use intensity,
2. Researching available and new equipment,
3. Benchmarking cost,
4. Modeling energy conservation measures,
5. Confirming energy use intensity (EUI) and cost assumptions, and
6. Educating the public.

Figure 11: Net Zero Affordable Housing Roadmap



Source: SoLa Impact

A scalable model that builds wealth using faith-based property is a model that is highly replicable and scalable. Churches own sizable parcels of land, which could be put to higher and better use in many communities. While right-sizing the church sanctuary to today's smaller congregations, producing new affordable housing on the remaining land is mission-aligned and can become a source of income for the church if the land is put into the project as equity. Leasing these sizable parcels of land can also bring down each project's soft costs for rental and community supportive elements. In addition, churches and faith-based organizations are deeply embedded in their neighborhoods and communities, providing a natural and organic organizational structure for these developments.

Community Engagement

To ensure a beneficial project for the community of Compton, SoLa Impact's community engagement team conducted meaningful stakeholder and community outreach and engagement that has been incorporated into the project's final design. MGA aims to mitigate gentrification while aligning perfectly with the city of Compton's broader community priorities including the Downtown Compton Transit-Oriented Development Specific Plan adopted in 2022. Before speaking with Compton stakeholders and potential residents, SoLa's team established the following facts on the community of Compton:

Demographics:

- Compton is a majority Black and brown community (96 percent)—69 percent Hispanic, 27 percent Black.
- Compton is located in a California Environmental Protection Agency-designated disadvantaged community.
- The median household income is $58,000 per year, and the poverty rate is nearly 20 percent, which is double the national average.
- The site is located less than a 0.5 mile away from major public transit.

- This site is less than one mile away from the Metro A line, just a 15-minute walk for residents to travel from Glendora to Long Beach.

Housing and Homelessness:

- The city of Compton must accommodate an additional 1,000+ units of affordable housing by 2029. However, local housing assistance programs in Compton are at capacity. Compton's Transit-Oriented Specific Plan seeks to address this by upzoning considerable portions of the downtown area for housing one in five Compton residents living in poverty, which is double the nationwide average.
- According to the latest Los Angeles County point-in-time homelessness counts, there are 644 homeless people in Compton sleeping on the streets each night (LAHSA, 2022).

The project team held several meetings with key city stakeholders to introduce the project. These stakeholders included former Mayor of Compton Aja Brown, the City of Compton Planning Lead, Robert Delgadillo, City Manager, Assistant City Manager, and other city partners. The project team gathered feedback on the overall site design requirements, timeline, strategies, and cohesiveness of vital roles and services for the project. What the project team discovered through these meetings was the city of Compton must accommodate an additional 1,000+ units of affordable housing by 2029. Unfortunately, local housing assistance programs in Compton are at capacity.

To address this issue, SoLa developed the Pathways to Homeownership Program, which was launched in April 2023. Many Black and Latino families are living in communities—including Compton—where the increased cost of housing has far outpaced income growth. Rising home prices have made home ownership inaccessible to most families and continual rent increases make it difficult for families to save for down payments. For each year of participation in the program, a resident's total savings is matched with a contribution from various grantors and the SoLa Foundation. Within five years, they will have $40,000 in savings to put toward a down payment. Additionally, participants attend monthly financial literacy workshops and receive one-on-one coaching to ensure they are ready to purchase a home.

To ensure the project was in line with the needs of the church and Compton's economic development goals, the project team engaged with Dr. Lestean Johnson on multiple occasions. Dr. Johnson is both the Board Member Emeritus of the Immanuel Baptist Church as well as the President and CEO of Compton's Chamber of Commerce. Given Dr. Johnson's multiple hats, her insight provided the project team with a much better understanding of their vision for this underutilized piece of land. In particular, the project team learned that not only is having starter homes available to buy and affordable rental units important, but a place for working mothers and fathers to leave their kids while they go to work is equally as crucial to the fabric of the community. In general, the church elders and Compton officials feel this is a much-needed model that could be replicated throughout Los Angeles County and California at their other sister churches.

The project team also held multiple information sessions with residents and local community members where the project team shared information about SoLa's "Pathways to Homeownership" and "Attainable Homes" programs. Attendees were overjoyed to learn that by participating in SoLa's unique savings plan, their savings would be tripled, they would receive financial education, and have first right-of-refusal to purchase one of SoLa's "Attainable Townhomes," located on the EPIC project site. For those unable to attend the information sessions, the project team deployed a survey to the residents and the larger community, to ensure folks were aware of both programs.

When asked about the year-round programming and services, the most common response was that job training was the most important, followed by mental health services, and cultural events. As for emergency response, respondents said cooling centers and refrigeration were most important.

Minimizing Gentrification and Aligning with Community Needs

A driving development and investment philosophy of SoLa is to "uplift, not uproot, the communities in which SoLa invests." SoLa makes every effort to purchase and develop vacant or underutilized land to ensure residents are not uprooted and South Los Angeles is not gentrified. To that end, this project began with engaging a prominent community stakeholder in Immanuel Baptist Church. The church's leadership had previously and independently determined that its land should be used for housing and community resources. Thus, this project is in line with community development priorities because the vision for the project emanates from community leaders and stakeholders. Moreover, SoLa's goal is to rent 100 percent of the units to residents of Compton or greater South Los Angeles. This population also will be at or below 80 percent of the area median income and Section 8 housing voucher holders. The site's townhomes will be sold at-cost to residents as part of SoLa's innovative Pathways to Homeownership Program.

Workforce Development

It was anticipated that the Making Green Accessible initiative would benefit local job growth and workforce development. Affordable housing units are being built as part of the project, which will call for a mix of experienced and unskilled laborers to finish. This implies that employment prospects will arise for professionals engaged in the construction process, such as architects, engineers, and construction workers.

The building of affordable housing units will result in the creation of indirect jobs in addition to direct employment. The availability of more reasonably priced housing will draw in businesses and investors to the region. All things considered, it is anticipated that this development will have a major effect on the local economy by fostering economic growth and opening up job prospects.

Improving Access to PV and Electric Mobility

The project site is the perfect location to pilot an e-bike library and EV carshare expansion. The e-bike library would serve as a free or low-cost electric bicycle library that would provide community members with access to e-bikes for extended check-out times, including e-bikes for people with disabilities and cargo bikes. The EV carshare expansion is a partnership with the successful BlueLA Program, which provides an environmentally conscious alternative to ride sharing for disadvantaged communities. BlueLA seeks to bring at least 100 vehicles to underserved communities like Compton and South Los Angeles. The project team also intends to work with organizations like GRID Alternatives to install solar PV on the resilience hub and residential properties. GRID Alternatives is committed to creating accessible and inclusive job training opportunities for groups that are traditionally underrepresented in solar including women, people of color, and those impacted by the criminal justice system. Their job training programs and initiatives will also be included in SoLa's resilience hub programming.

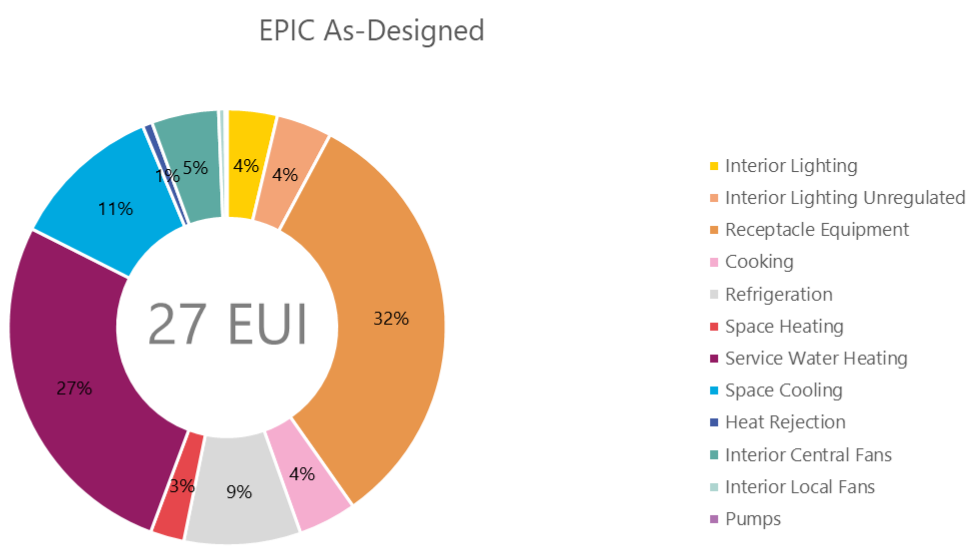
CHAPTER 3: Results

The key results of this project included identifying replicable solutions that developers of affordable multifamily housing can implement as one of the main outcomes. These covered business models, financing techniques, technology selection, and proper technology configuration. Achieving or surpassing targets for cost reduction, peak reduction, robustness, and efficiency informed the choice of technology and envelope features.

Energy Model Analysis

The design pushes further above-code requirements in areas that are well served with incentives. The standard design is estimated to consume 45 kBtu/h/sf as compared to the proposed design, which is estimated to require 27 kBtu/h/sf as seen in Figure 12.

Figure 12: Energy Distribution and Achieved EUI



Source: Buro Happold

The standard design requires a 148-kW PV array, which covers approximately 25 percent of the annual energy demand. The proposed design has maximized roof area for PV and is designed with a 450-kW PV array. This covers 100 percent of the overall predicted annual energy requirements on-site, including nonresidential and residential spaces. While the PV covers annual energy demands in aggregate, there may be times during the winter where demand cannot be fully covered by PV production and prosumer engagement will be required. Table 3 shows an analysis of the solar PV summary.

Table 3: PV Analysis Summary

Total Roof Area:	27,090	square feet (sf)
Maximum PV Area:	23,012	sf
PV Panel Power Density:	20.6	watts per square foot (W/sf)
Safety/Spacing Factor:	5	percent (%)
Roof PV Size:	450	kilowatt direct current (kWdc)
Roof PV Generation:	687	megawatt-hours (MWh)
Window Integrated PV Size:	0.415	kWdc
Window Integrated PV Generation:	430	kWh
Total PV System Size:	**450**	**kWdc**
Annual PV Generation	**687**	**MWh**
Site Annual Energy Consumption:	619	MWh
Site Annual Energy Consumption with EVs:	631	MWh

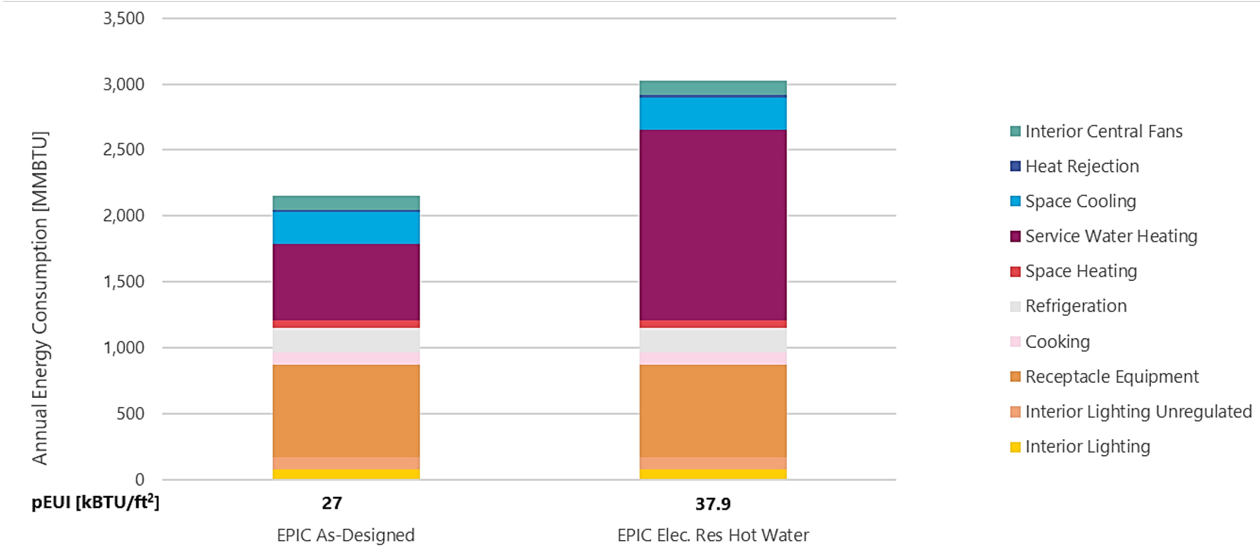
Source: Buro Happold

The design was calculated with a variety of passive and active strategies. The design ethos is to avoid heating and cooling loads through passive design opportunities such as operable windows, phase change materials in the wall and roof constructions, and limiting window-wall ratio to avoid high cooling loads in the climate imposed by high solar gain. The leftover load is then dealt with via a high-efficiency variable refrigerant flow system with an energy recovery ventilator for outside air supply. Additionally, efficiency is achieved through demand response refrigerators and high-efficiency HPWHs, exceeding the minimum code requirements wherever possible.

The implementation of virtual net metering for the building allowed the project to optimize the solar energy benefits and use DERs to bypass retail energy expenses while engaging in wholesale power grid sales. Utility bills for a code-compliant construction would have totaled close to a quarter of a million dollars. The yearly savings in this scenario above the baseline, amount to a 70 percent decrease in the price of all energy used on-site.

A major technology and research outcome from the MGA project is the inclusion of HPWHs throughout the development. HPWHs turned out to be a very significant energy saver—roughly 41 percent more efficient than the baseline design—and thus, were included as the project team's basis of design. The HPWH is assumed to have a 2.5 coefficient of performance with a 98 percent efficiency. The results can be seen in Figure 13.

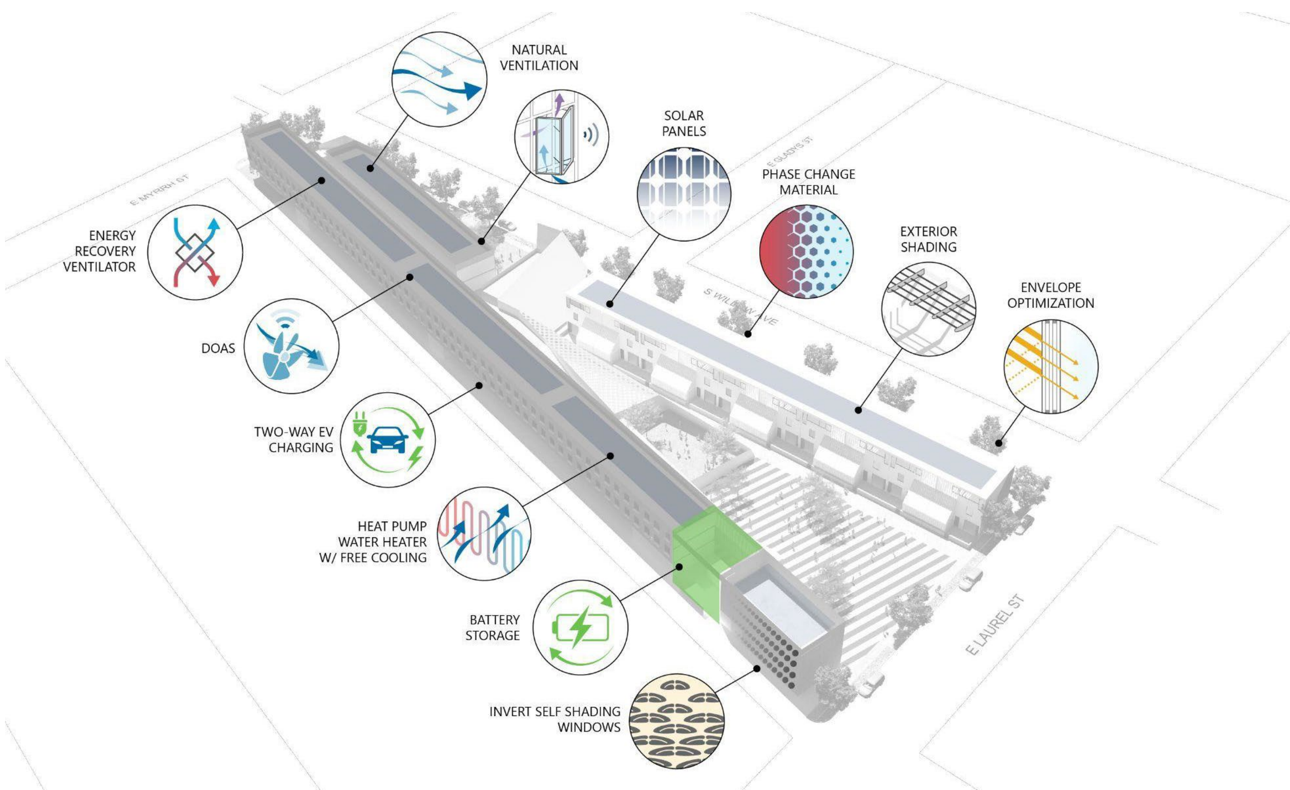
Figure 13: Heat Pump Water Heater Results



Source: Buro Happold

A full list of the emerging technologies successfully included in SoLa's final design can be seen in Figure 14. These emerging technologies enabled the project team to achieve net-zero energy with the reduction of the urban heat island effect and the increase of biophilic open space on-site.

Figure 14: Emerging Technologies Included in Final Design



Source: SoLa Impact

Design Challenges

Project Coordination

A key challenge for the design phase was aligning the timing of community outreach and Technical Advisory Committee (TAC) feedback with the correct timing of the team's work on the design. The TAC was heavily engaged throughout the design process and provided helpful feedback. However, feedback would often take weeks to come in while the design team needed to keep moving forward to ensure that timelines and deliverables were met.

Battery Energy Storage System

Another technical barrier and challenge during the design phase of the project included site coordination of battery energy storage systems to meet fire code requirements, which led to architectural design inefficiencies and higher cost. Moreover, the implementation of automatic load shedding controls operated by landlords in grid stress operations results in less autonomy for tenants/owners. These were both unavoidable design trade-offs.

Investor-Owned Utilities

For low-income homes, the virtual net energy metering (VNEM) program's transition from VNEM 2.0 to VNEM 3.0 is hampered by the influence of investor-owned utilities, such as Southern California Edison, where this project is located. Furthermore, measures to encourage energy-efficient behavior are hindered by California Public Utilities Commission laws that forbid multifamily properties from charging their residents for solar consumption on a $/kWh basis. Applying to be grandfathered would be crucial, as VNEM 2.0 leverages the creative Comprehensive Demand Reduction scheme to incentivize aligned end-user behavior.

Double-loaded Corridor Strategy

Double-loaded versus single-loaded corridors was a large topic of discussion centered around cost versus passive energy conservation design. To resolve this issue, the project team ended up compromising where one stack of rental units was double-loaded, and the other stack of rental units was single-loaded.

The outcome of the challenges and ensuing decisions was a cutting-edge design that pushes industry boundaries along a variety of design parameters, including envelope, HVAC efficiency, self-generation, EV charging, battery storage, and microgrid resilience. All technical barriers and challenges were overcome through collaborative team meetings with all MGA team members involved.

Energy and Emissions Performance

The proposed building, based initially on Title 24 guidelines, uses building energy simulation software IESVE to assess energy performance. The massing was also parametrically analyzed for envelope performance using Honeybee and EnergyPlus software. The design incorporates a solar PV system and energy storage system to optimize energy efficiency and minimize environmental impact and operational costs. Process loads are approximated using real-world data or industry-standard load profiles for activities like lighting, plug loads, ventilation, specialized processes, and default Title 24 Alternative Calculation Method assumptions such as appliance energy use. Control strategies for the solar and storage system focus on peak shaving, maximizing energy storage during off-peak periods, and intelligent load management to prioritize renewable energy consumption. The proposed model aims to achieve significant energy savings and contribute to a sustainable building design by considering these modeling solutions and assumptions.

As shown in Table 4, the proposed design decreases GHG emissions intensity by 40 percent. Similarly, as shown in the table below, the proposed design nearly tripled the amount of avoided GHG emissions by deploying 450 kWdc of solar.

Table 4: Baseline Versus Proposed Design Energy Use Intensity and GHG Emissions Intensity by End-Use

End-Use	Unregulated? Y/N	Site Energy Use Intensity (kBtu/sf/yr)			GHG Emissions Intensity (kg CO2/sf/yr)		
		Baseline	Proposed	% Improvement	Baseline	Proposed	% Improvement
Interior Lighting	N	1.00	1.00	0%	0.05	0.05	0%
Interior Lighting Unregulated	Y	1.11	1.11	0%	0.05	0.05	0%
Receptable Equipment	Y	12.08	11.89	2%	0.58	0.58	2%
Cooking	N	1.16	1.16	0%	0.06	0.06	0%
Refrigeration	N	2.53	1.59	37%	0.12	0.08	37%
Space Heating	N	0.33	0.68	-108%	0.02	0.03	-108%
Service Water Heating	N	5.84	4.23	28%	0.28	0.20	28%
Space Cooling	N	11.91	3.04	75%	0.58	0.15	75%
Heat Rejeciton	N	0.76	0.20	74%	0.04	0.01	74%
Interior Central Fans	N	7.31	1.34	82%	0.35	0.06	82%
Interior Local Fans	N	0.00	0.13	-	0.00	0.01	-
Exhaust Fans	N	0.00	0.00	-	0.00	0.00	-
Pumps	N	0.00	0.04	-	0.00	0.00	-
EV Charging	N	0.49	0.49	0%	0.02	0.02	0%
	Totals	44.5	26.9		2.16	1.30	
			-40%			-40%	

kBtu/sf/yr = thousand British thermal units per square foot per year
kg CO2/sf/yr = kilograms of carbon dioxide per square foot per year
Source: SoLa Impact

Costs and Benefits Performance

The budgeted overall cost of the proposed design is $34,740,000, including hard, soft, and administrative costs, as well as a roughly 10 percent premium for the sustainable technologies to be used. The total is comprised of four separate uses: apartments, ADUs, townhomes, and non-residential. The cost per unit for development of the one bedroom (1BR) apartment units is $285,000. With 73 proposed 1BR apartment units at $285,000 a unit, the total cost of the 1BR apartments is $20,805,000. There are ten 1BR ADUs with a cost per unit of $345,000, reflecting a total cost of $3,450,000. The ten 2BR/2 bath townhomes are projected to cost around $455,000 per unit with a total cost of $4,550,000. Finally, the three proposed nonresidential uses that together make up the “Resilience Hub” (multi-purpose room, daycare, and community center) will cost about $1,265,000 per unit, totaling an overall cost of $3,795,000. The assumed cost per units for each proposed design are the effect of market research, square footage, differentiation of design, and SoLa’s standard specifications and basis of design. As evidenced by the project team’s zero–emissions cost-benefit analysis, the project team expects the additional proposed sustainable technologies to add roughly $2.6 million to the overall project budget.

Technology Transfer Plan

SoLa Impact produced and widely released the final EPIC concept video on YouTube (CEC, 2023) and on Martin Muoto’s (SoLa Impact’s CEO and Founder) LinkedIn page. Additionally, the project team presented SoLa’s designs numerous times during multiple public outreach events, presentations, and homeownership workshops. The team will also share the lessons learned through a variety of potential opportunities. These include:

- Publishing the project final report on the CEC website,
- Sharing the collective knowledge gained through the project with the SoLa Impact staff to replicate in new and existing developments, and
- SoLa Impact staff further presenting the project design benefits at various conferences, industry organizations, and public-facing events as appropriate.

The intended audience includes:

- Internal SoLa Impact staff including management, project managers, and facilities teams,
- Fellow industry professionals, and
- City staff, community-based organizations, and other stakeholders impacted by the design strategies proposed in the project.

The information will be made available through:

- Speaking engagements,
- Visual presentations, and
- Written reports and/or briefs and memos.

CHAPTER 4: Conclusion

As a result of this work, a Phase II submission to the NEXT EPIC Challenge proving the technical and economic viability of an all-electric, mixed-use, low-income building was submitted. MGA supports California's clean energy and climate goals because the design submitted to the CEC's EPIC Program was fully net-zero equipped with a microgrid; thus, not only reducing GHG emissions and demand on Southern California Edison's electric grid, but also supplementing its strength with grid-interactive technologies. This project is timely because it supports California's environmental justice goals as well—delivering the project in Compton, a historically underinvested community where the impacts of climate change are likely to hit first and worst.

As one of the design-phase winners of "The Next EPIC Challenge: Reimagining Affordable Mixed-Use Development in a Carbon-Constrained Future" SoLa Impact sought to do exactly that—design innovative housing and climate solutions and apply for build-phase funding to demonstrate that both can be done in low-income Black and brown communities.

As California's largest privately funded affordable housing developer, SoLa Impact strives for cost-efficiency and speed to ultimately mitigate the homelessness crisis. SoLa does this by following the SoLa way: "Simplify, Standardize, and Repeat." SoLa builds the Honda Civics of affordable housing—without the bureaucratic bells and whistles that typical government-subsidized developers use. In Los Angeles County, for example, the average cost to build one unit of affordable housing is $650,000 per unit; whereas, SoLa's average cost to build is approximately $300,000 per unit. Incentivized to provide a return to SoLa's mission-aligned investors, SoLa builds at half the cost and twice as fast as other affordable housing developers.

The intention with this design was to serve the low-end of the market, meaning low-income individuals and families that may or may not have been formerly homeless. For decades, low-income Black and brown communities have often been overlooked and underinvested in. As such, the main goal of this project was to prove that sustainable technologies can work and should be deployed in low-income communities so that residents can also benefit from the clean energy and climate resilience transition.

The key implications of the MGA Project outcome for commercial markets and industry (that is, other real estate developers) is the innovative partnership model with faith-based institutions to unlock underutilized church land. MGA has produced an example for other private developers to partner with churches with declining congregation sizes.

The key implications of the MGA Project's outcome for utilities are the proof that grid harmonization can occur with microgrids. SoLa's deep collaboration with Southern California Edison showed that grid-interactive technologies such as vehicle-to-grid and battery storage can both be beneficial for the developer, resident, and the utility. The key implications of the MGA Project's outcome for policy in California is the affirmation that SB 4 and other bills like it can spur the production of sustainable and affordable housing. Furthermore, it supports more policy and action related to subsidizing grant competitions like EPIC.

GLOSSARY AND LIST OF ACRONYMS

Term	Definition
ADU	accessory dwelling unit
BR	bedroom
CEC	California Energy Commission
DER	distributed energy resources: technologies that can support local electrical generation, control, and storage
EPIC	Electric Program Investment Charge
EUI	energy use intensity
EV	electric vehicle
GHG	greenhouse gas
HPWH	heat pump water heater
HVAC	heating, ventilation, and air conditioning: the technology and systems used for controlling indoor climate, including temperature, humidity, and air quality in buildings and vehicles
IESVE	Integrated Environmental Solutions Virtual Environment (software)
kBtu/h/sf	thousand British thermal units per hour per square foot
kBtu/sf/yr	thousand British thermal units per square foot per year
kg CO2/sf/yr	kilograms of carbon dioxide per square foot per year
kW	kilowatt
kWdc	kilowatt direct current
kWh	kilowatt-hour
MGA	Making Green Accessible
MWh	megawatt-hour
PV	photovoltaic (solar panels)
SB	Senate Bill
SCE	Southern California Edison
sf	square foot (or square feet)
SoLa	SoLa Impact
TAC	Technical Advisory Committee
VNEM	virtual net energy metering
W	watt
W/sf	watts per square foot

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Project Deliverables

- Technology Review and Modeling of Performance Report
- Mechanical, Electrical, and Plumbing Systems Design
- Microgrid Design and Technical Report
- Zero Emissions Affordable Housing Roadmap and Guideline
- Building Plans
- Site Plans
- Stakeholder Outreach Recommendation Package
- Community Outreach Recommendation Package
- Conceptual Design and Engineering Report
- Energy and Emissions Performance Model Report
- Emerging Technologies and Strategies Report
- Zero-Emission Cost-Benefit Analysis Report
- Community Engagement Plan
- Concept Video
- Presentation Materials