mountZED
CARBON NEUTRAL ECOVILLAGE

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CALIFORNIA ENERGY COMMISSION

$1M DESIGN AWARDEE

FINAL CASE STUDY REPORT

C4GS-ZEDlife

C4GS-ZEDlife™
ZERO FOSSIL ENERGY DEVELOPMENTS

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INTRODUCTION

San Diego’s current energy landscape can be characterized by recent market trends, environmental imperatives, and evolving energy policies. In response to the California Energy Commission's 2022 call for an Epic Challenge, the C4GS-ZEDlife team took up the opportunity and with the help of a CEC Epic Challenge grant, the “mountZED Ecovillage" project emerged with innovative and proactive solutions to reduce CO2 emissions during construction.

The C4GS-ZEDlife project design solves for on-premise renewable and shareable energy systems, crafts a new model for mobility solutions and proposes a viable approach to educating and housing a new green building workforce. The multi-pronged strategy takes into account construction material fluctuations, supply chain challenges, and economic issues prevalent in the market. It also sets the stage for disruption to business as usual construction practices by introducing a Kit of Parts™ Building System.

The Kit of Parts ™ solution offers a DIY solution to affordable home building by reducing demand on material needs and on the demand to continue carbon-producing material distribution practices. With the potential for DIY building, the Kit of Parts ™ building system comes with education and employment opportunities that will feed the Mt Hope Community and the growing green building economy.

This case study provides an in-depth analysis of the C4GS-ZEDlife mountZED Ecovillage project, exploring its goals, strategies, and outcomes in detail. The case study further outlines how the mountZED Ecovillage development demonstrates strong alignment with San Diego's Climate Action Plan by addressing various strategies and measures related to decarbonization, renewable energy, mobility, circular economy, resilient infrastructure, and emerging climate action, with a focus on inclusivity and sustainability. The project offers dual policy suggestions that can benefit all California stakeholders seeking change in the housing and energy markets.

The Proposed Project

The C4GS-ZEDlife mountZED Ecovillage project development initiative calls for a focus on pressing challenges facing Mt Hope and other communities in San Diego and throughout California. The project zeros in on three challenges that we believe are systemically intertwined, namely, affordability, environmental sustainability, and equitable economic development. The CEC Epic Challenge called for an affordable housing project design prepared to meet the challenges of living in a carbon-constrained future. The mountZED Ecovillage Project plan met these challenges head-on by taking a ZED – Zero Energy Development – approach to designing for a multi-level, housing and transport built environment fueled by the sun and aided by a state of the art data management system. The solar housing system is to be engineered using a proprietary PowerClad Solar Canopy ™ and data collecting system, situated on top of a residential development constructed out of a duplicatable Kit of Parts ™ Building System. Both will be further discussed in this case study. (See Building Innovations)

Scope of Project: Design Concept

The Scope of the project is expansive, encompassing the creation of a ZERO Energy Development (ZED) built environment. This environment is not just a physical space; it offers a defined cultural space to appeal to the local Mount Hope community, while harnessing the power of the sun and utilizing state-of-the-art data management systems. As we will make clear in this case study, the innovative C4GS-ZEDLife Kit of Parts™ building system serves as the engineering backbone, stabilizing the construction of duplicatable and sustainable urban living. The Microgrid System serves as the “nervous system” of the development, sourcing and distributing energy throughout the built environment and calculating the energy data used. The design concept addresses the challenge to educate the next generation of green buildings and demystifies the building process for communities that wish to engage more fully in building development. It also outlines a plan for energy efficiency by integrating plug-and-play energy solutions to overcome existing technical challenges.

WORKING ASSUMPTIONS:

C4GS-ZEDLife approached this project by first conducting preliminary research and asking ourselves a number of “what if” questions: “What if... we demystify green building industry practices, while solving for affordable mixed-use housing development? What if ... we reduce the carbon footprint of car emissions in multi-family housing, while assisting historically marginalized communities in making the leap to EV transportation? What if... emerging technology and clean energy home features reduce residential ratepayers' energy and financial burdens? Additionally, what if... we could train the future generation of clean energy professionals on our project; and what are the barriers of entry to entering clean energy professions?”

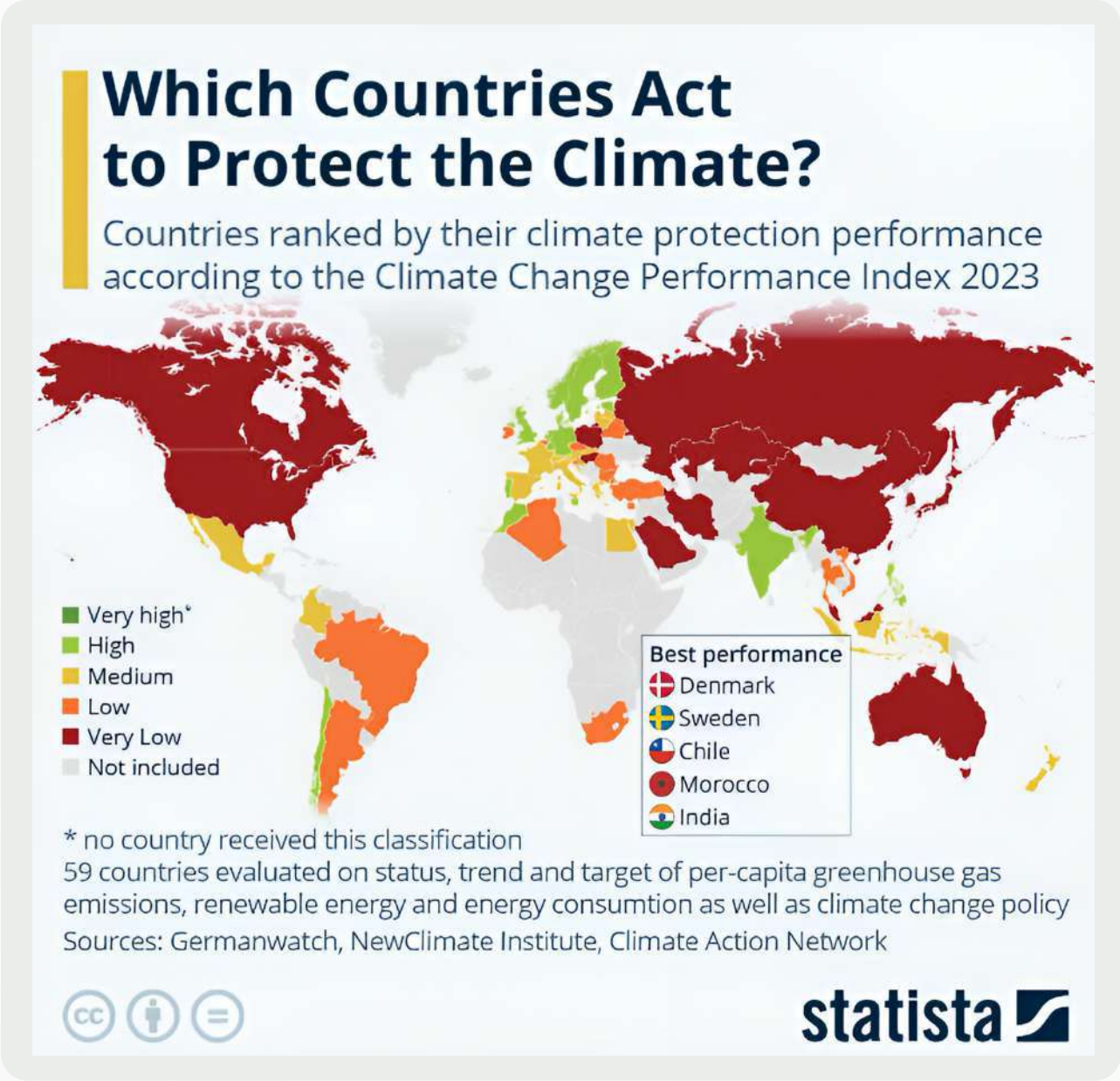
Red Herring or White Elephant? Research Unveils the relation between the housing and energy crisis

Our questions and research were based on a strong ‘White Elephant in the Room ‘ hunch regarding the disconnect between opportunities available for upgrading homes with solar charging and traditionally marginalized community awareness of opportunities. We approached research just as the cost of fossil-fueled energy rates hit all California residents, severely impacting those with less means and the EV sales market started to drop. We also collectively walked into the project with personal experience stories documenting systemic challenges encountered in growing a real estate development company and in buying and renting within San Diego.

We are all too aware of the deeply disheartening prospect of gradually being priced out of the very community that has nurtured us. As a “delightfully melanated team,” we are no stranger to the history of institutional red-lining and segregation from the economic and political systems. Both have been left unchecked with little accountability of policies written to divide not unite. Given the weighty impact of redlining history on communities like Mt Hope, we recognize there is no one way to untangle a complex web woven over centuries of self-interested urban planning and predatory real estate practices. However, after conducting research we arrived at a working hypothesis that takes into consideration barriers of entry to green careers and to affordable housing.

Precedent Study

The project design started with exploring insights from other nations through knowledge exchange initiatives.



PRECEDENT STUDY

Bill Dunster MultiFamily Passive House Early Innovation BedZED, UK 2002

BedZED (UK)

In 2018, C4GS founders met Bill Dunster, co-author of The ZEDlife and one of the Godfathers of Sustainable Architecture. With the help of his team at ZEDfactory, Bill designed and assisted in the first community-built, all-clean energy multi-family community, the world-famous BedZED, named for the town Beddington at its Zero Energy Development status. BedZED - the UK's first major sustainable community – boasts major energy savings and lower bills, abundant green space, a friendly community, and continued above-market sale prices.

The iconic BedZED village in South London remains an inspiration for zero-carbon homes worldwide and is the precedent project on which we based the proposed mountZed Ecovillage in San Diego. It is Bill Dunster's lifelong commitment to Sustainable Development and the C4GS team's willingness to push boundaries that will take the mountZED Ecovillage from a design concept to a built environment.

PROJECT GOALS

“Solar is Power *for* the People”

With systemic challenges top of mind and galvanized by our precedent study, the C4GS-ZEDlife design team established four fundamental energy pillars on which to base foundational goals of the design concept:

1. Reduce Energy Burdens for tenants by providing access to solar generation and energy efficiency
2. Create resilience through clean transportation and a focus on health and wellness for all community members
3. Reduce embodied carbon through the usage of low or no-carbon materials and the use of local supply chains
4. Ensure equity through shared energy and communal EV Rideshare programs

The success of the mountZED EcoVillage project will be gauged by reaching measurable outcomes that result from a multifaceted approach. The measurable outcomes goals include:

- Decreasing energy consumption using advanced architectural modeling and data collection tools.
- Reducing the cost to build and maintain the development over the lifetime of the building.
- Reducing pollution by using low embodied carbon materials and an operational approach to reducing
- carbon footprint.
- Time efficiency in construction through onsite, community-led modular building construction.
- Solving for Ratepayer benefits, including greater electricity reliability and lower costs

PROJECT MISSION : REIMAGINE

The mission of the project is to reimagine affordable mixed-use development in a carbon-constrained future. The mountZED project Design Charter outlines the mission by articulating a positive vision of community, sustainability, energy efficiency, and the integration of cultural identity with environmental responsibility. It names steps to take to participate fully in a sustainable and resilient circular clean energy economy that is human and culture-centered.

PROJECT OWNERS

C4GS-ZEDlife is a young, US-based, company joint venture formed by Communities for Global Sustainability (C4GS, LLC.), a delightfully "melanated" group of community leaders, builders, innovators and investors in green technology and ZedPower, LLC, an internationally recognized expert in the field of sustainable zero-carbon housing.

At C4GS-ZEDlife, our purpose is to design ZERO carbon/ZERO waste lifestyles and infrastructure through, zero-energy real estate developments, eco-villages, and sustainable communities. C4GS-ZEDlife is a catalyst for change, focusing on innovation, education, and empowerment towards sustainable living.

Embarking on a journey toward a Carbon ZERO, ZERO waste lifestyle and infrastructure. Our commitment manifests through meticulously designed zero (fossil) energy developments, single and multi-family housing, workforce housing, sustainable ecovillages, and innovative mixed-use communities that generate energy and maintain a carbon-negative footprint, resulting in ZERO energy bills.

Our ZEDlife Studio program allows us to fulfill our purpose to impact the next 7 generations - through our immersive Pre-Apprentice training studios which inspire participants to commit to sustainable living.

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Principal & COO

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Principal & Environmental Architect

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Key Project Data

Project Summary:

City of: San Diego, CA
County of: San Diego, CA
Number or Stories: 6 Building
Occupancy:
R-2, B, M, F2, S IIIA
Construction Type: IA & VA
Flood Zone: NO
Fire sprinklers:
Yes (Deferred Submittal)

Project Space

Total Lot Sizes: 91,880
Built Area: 55,490
Courtyards: 21,590
Green Space: 39%

Project Space Details:

New Construction of a 6-Story Apartment Complex
(Affordable Housing)

- 102 Units

(Single, Duplex, Student Housing)

- Leasing/Office Area
- ZEDcafe and Ghost Kitchen
- Farmers Market
- Rooftop Gardens
- ZEDlabz
- Wellness Center
- Onsite Daycare
- After School Care

Project Purpose

The purpose of the project is to reimagine affordable mixed-use development in a carbon-constrained future, guided by the mountZED project Design Charter. This charter articulates a positive vision of community, sustainability, energy efficiency, and the integration of cultural identity with environmental responsibility. It names steps to take to participate fully in a sustainable and resilient circular clean energy economy that is human and culture-centered.

Three design initiatives focus the C4GS-ZEDlife design team's effort in developing a concept for the Mount Hope EcoVillage project. We regard the initiatives as interdependent in the weight they have throughout the design process:

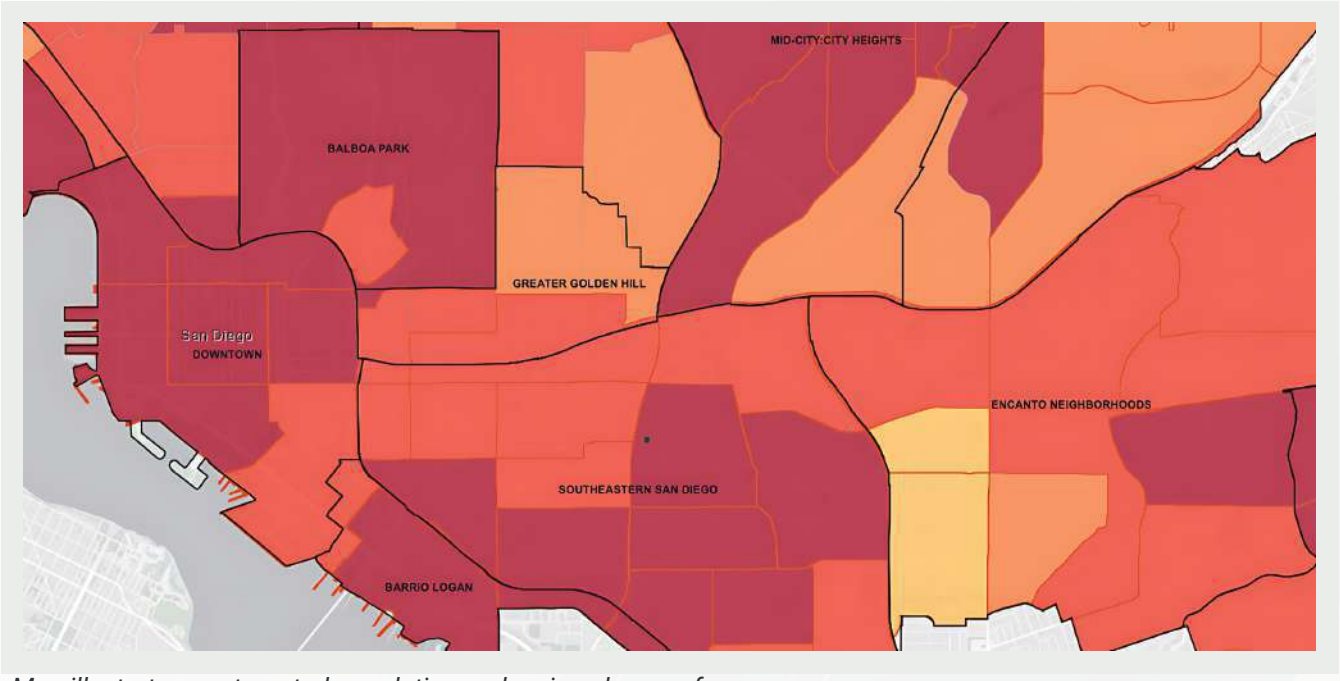
1. A community-centered design
2. A cutting-edge solar canopy with a virtual data and energy load management system
3. A Kit of Parts™ —a replicable carbon-reducing building system.

The design concept solves for addressing the challenge to educate the next generation of green buildings and demystifying the building process for communities that wish to engage more fully in building development. The design concept also solves for energy efficiency by integrating plug-and-play energy solutions to overcome existing technical challenges.

The Site in Question:
Challenges of the Site; Pre-existing Conditions

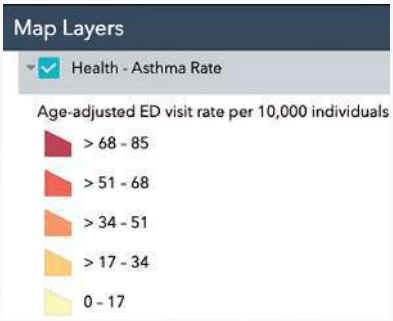
Mount Hope is a historically underserved community in San Diego, characterized by aging infrastructure, limited economic opportunities, and environmental challenges. Located between Francis St and the 36th Street bridge in San Diego, CA. Residents of The mountZED Ecovillage will be conveniently located less than one mile from Interstates 5, 15 and 94, allowing for immediate access to major biotech and telecom job centers in less than a 25-minute commute. 32.70691 -117.11879

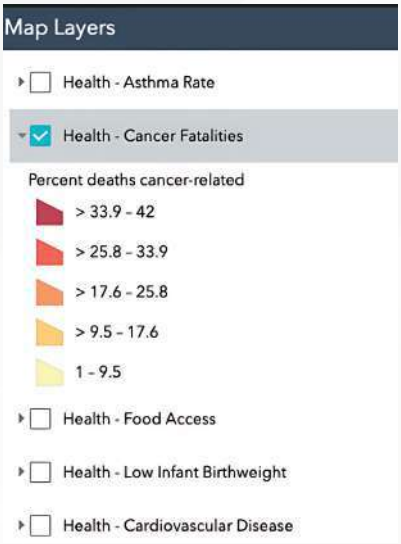
The mountZED Ecovillage is also located approx. 6 miles from the San Diego International Airport, makng its location an attractive convenience for those who travel. Additionally, the property is located within walking distance from the Metro and San Diego Trolley transportation hub, providing service to the San Diego Coaster and Amtrak. Given its proximity to mass transit corridors, Mount Hope is located in a climate zone designated as an area targeted for toxic and polluting substances publicly recognized as injurious to human health. Data from the San Diego Climate Equity



Map illustrates our targeted population and various layers of concern.

Index indicates the following conditions: Asthma, Cancer and Cardiovascular risks

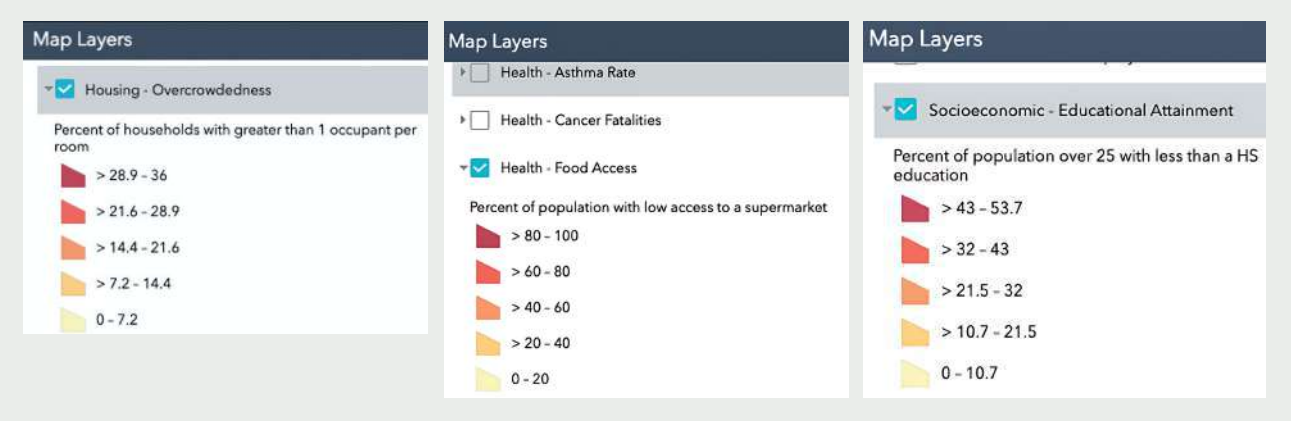




Data collection underscored alarming environmental hazards, a stark deficiency in green spaces, limited access to higher education, and the prevailing issue of food deserts. These factors serve as pivotal indicators, emphasizing the urgent need for the development of The mountZED Ecovillage. Positioned as a beacon of hope, this initiative aims to serve as a best practice demonstration project, not only for San Diego, but also for global communities grappling with similar challenges.

Mount Hope's Challenges: Energy, Housing, Environment, and Education

Through our community-first approach, we meticulously examined the energy, environmental, housing, and education vulnerabilities within Mount Hope. Our research phase leveraged three robust data tools: CalEnviroScreen 4.0, the City of San Diego's Climate Equity Index, and the Department of Energy's Community Leap energy burden guidelines. These tools, rooted in scientific methodologies, meticulously assessed the impacts of climate change, environmental stressors, energy consumption, housing conditions, and educational access at the census-tract level.



According to the DOE Communities LEAP, the State of California has an average energy burden of 2%, while the average energy burden in California stands at 2%, Mount Hope's energy burden is 3X higher as indicated on the chart below:

Energy Burden Assessment Based on Increased In Energy Bills

California	Promise Zone	Mount Hope
Energy Burden 2-3 %	Energy Burden 5.3 %	**Energy Burden 6.7 %**
Average Annual Energy Cost $ 1,960 ($163.33/mo.)	Average Annual Energy Cost $ 3430 (Est. 75% increase since 2020, $285.83/mo)	**Average Annual Energy Cost $ 3430 (Est. 75% increase since 2020, $285.83/mo)**
Num Households 13,103,373	Num Households 26,603	**Num Households 1,087**
Income $115,504	Income $64,272	**Income $ 50,568**

With preliminary community research in hand and with the picture of pollution top of mind, the next step called for direct community engagement.

COMMUNITY DEVELOPMENT INITIATIVE

A Community-Led Approach

The C4GS-ZEDlife mountZED project team embarked on a broad, collaborative path to follow the Design Charter Initiatives and achieve its value-based community principles. Three best practice principles guided our efforts:

1. Community First - A Call To Engage

The *Community First* principle is a call to action for people to choose between maintaining the status quo or becoming part of the solution: Let your neighborhood ecology decay and remain unserved by new sustainable opportunities, or organize and take advantage of eco-action opportunities available to communities at large. We view the community and the people who reside within each neighborhood as a critical sector of community stewardship For example: At the outset of actual concept design, the project team actively engaged with local residents, community organizations, and stakeholders to solicit input and gather feedback. The project reflects the needs and priorities of the community. Community contribution sets the stage for community stewardship.

The Community and Stewardship sectors represent the two most critical aspects of creating a zero-carbon lifestyle. Community buy-in allows for sustainable, low-embodied carbon housing developments to become part of the neighborhood landscape. Early neighborhood engagement is first and foremost the most critical step to community stewardship. Taking this step sets in motion community dialogue and action to prevent gentrification and redlining. The Community First principle is one of the vital lessons C4GS-ZEDlife brings to future developers.

Evidence of this principle at work became readily apparent with I Am Green, our community outreach and engagement experts, leading the way. I AM Green leadership – Sister Maria and Brother David Muhammed – demonstrated a robust commitment to soliciting community input and integrating community feedback into the project's design, including the purpose of non-residential space. This ranged from boots on the ground surveys and Pop-Up community event surveys to organizing special community gathering events like Everyday is Earth Day and online town hall Zoom meetings with community members from Mt Hope neighborhood. The outreach resulted in local community, residents, business owners and leaders coming together to form a mountZED Ecovillage Focus Group.

Lesson Learned:

We learned that Mt. Hope community and its residents have endured a long history of being ignored, marked by empty promises, systemic barriers, and disenfranchisement. I Am Green prioritized active and empathetic listening to address this historical neglect. Before discussing design, zero-energy development, or anything else, we knew we had to create a safe space to make room for the decades of frustrations that had built up amongst many Mt Hope community members. In addition to organizing community town halls and listening sessions, I AM Green participated in Mt. Hope Neighborhood meetings and remained attuned to local concerns and desires, all of which were shared with the C4GS design team. Members of the C4GS team participated in all community meetups.

2. Eco Chamber - All Hands on Deck!

The "Eco-Chamber" is a play on words to emphasize an "all hands on deck" approach to advocating for low-carbon living and a low-carbon society. Collaboration extends beyond the local community to include the broader decision-making sector of government, elected officials, and community leaders. Collaboration secures a network of relations necessary to modify, change, or create sustainable housing development policies and regulations within the local San Diego area. The Eco-Chamber and Community-First messages resonate with leaders who recognize it as more than just a strategy; they hear it as the sound of people driven by common interests, working together to implement policy change.

For example, during the design of the mountZED Ecovillage, we introduced our "EcoDistrict" initiative to the San Diego City Council President. This presented C4GS-ZEDlife with an opportunity to engage with supportive NGOs, Non-profits, and sustainability advocate organizations with the city's support. The reverberation was created by C4GS-ZEDlife collaborating with the community, the San Diego Housing Commission, the County of San Diego, and Educational Institutions like the University of California San Diego and the San Diego County Board of Education. The collaboration gave birth to the "Environmental League of Justice," an eco-advocacy coalition initiative mounted to bring together Mt Hope Community, C4GS and government and affiliated agencies.

Lesson Learned:

We learned that new and genuine collaborative efforts are needed to influence how builders, architects, and developers enter a neighborhood or community.

3. Build for Seven Generations and Complete Communities

A 7 Generations initiative calls for designing in a sustainable way, a way that ensures buildings and property values last across generational divides. By following a ZED energy, circular economy model of green building, we design and build for 7 generations with the goal of leaving room for future generations to encounter and inherit the ZED living values.

BONUS: Complete Community Initiatives Alignment

Our commitment to the City of San Diego's Complete Communities Initiative underscores our dedication to inclusive planning and thriving communities. We leverage the initiative's principles to guide our project's design

- **Housing Solutions** - The project creates additional density in an area where there is currently a majority of homes over 50 years old.
- **Mobility Choices** - Considers mobility throughout the design including accessible public transportation
- **Play Everywhere** - Integrates pocket parks and public green spaces
- **Community Stewardship** - The scope of work plan for the build phase includes outreach to develop a Community Land Trust, a Mt. Hope Community Cooperative, and a CDC for shared community governance.

BUILDING INNOVATION
IDEAS / STRATEGIES / CONSTRAINTS

There were multiple design constraints throughout the project. We self-imposed an innovative and integrated pavilion approach to the site design allowing for substantial views and green communal space between them. This tangentially created and allowed space for vehicle circulation (horizontal and vertical). With proposed EV chargers outside every unit we wanted to provide renewable energy for the project entirely. Enclosing each pavilion over the Southern Side was our proposal to amass beautiful solar canopies that would provide aesthetics, performance, and shade for community residents. Through use of voids, translucent panels and lightwells we are able to shelter light to lower levels without obstruction.

Other key design constraints that gave the project its authority and rigidity was the concept of modular building within the pavilions. Each Unit is to be composed of CNC cut panels that are easily accessible and assemblable by the public and its youth. Outside of the fixed unit footprint it can become a plug and play kind of build. The Solar Canopies provide energy generation for lighting, appliances, receptacles, EV chargers and internal battery storage. The end result is that they speak to each other effortlessly.

mountZED
CARBON NEUTRAL ECOVILLAGE

Other carbon neutral principles that were employed consist of greywater reuse, irrigation systems in courtyard, locally sourcing materials keeping transportation emissions low, Low VOCs and omitting harmful materials. The Units themselves have an airtight envelope with multiple layers of continuous insulation assuring thermal comfort for occupants and reduced energy bills - thus directly relating to a potential surplus of energy streamlined through the solar canopy. The entire Master Plan Pavillion Concept was an integrated approach to radically re-shape and re-think what an urban block could be.

With radical rethinking comes meeting head on time-worn conventions that are presumed by industry leaders and policy makers alike. Yet climate change has opened the door to questioning conventions. This is a time to dispense with the default appeal to conventional wisdom. With a carbon-neutral call to action, the C4GS design team questioned conventions and treated them simply as constraints to overcome through inventive design. Three are worth mentioning:

BUILDING INNOVATION CONSTRAINTS

Building Typology Constraints:

The initial constraints which limited options in building typologies suitable for the site, were the ramping system, the removal of a costly below building parking garage, and sustainable mixed-use developments. To overcome the typology constraints , the team conducted thorough research into existing building typologies and explored innovative approaches to meet the project's sustainability goals. The effort resulted in developing a new typology, tailored to the project's requirements, which includes both fire-protected steel and wood (IA & VA.)

Battery Technology Constraints:

Given the project's emphasis on energy storage and management, battery technology fireproofing challenges became all too apparent. Overcoming this involved evaluating various battery options, considering factors like energy density, lifespan, and safety. The decision to utilize lithium-titanate (LTO) batteries, known for their enhanced safety and longevity, addressed the constraint imposed by solving for battery storage and management.

Construction Constraints:

The Kit of Parts ™ Building System presents a carbon reducing building solution that comes with the added cost benefit of simplifying building for the general public. The simplicity of the KIT of Parts ™ system is that it sources local material for prefab delivery and omits the carbon producing step of delivery of factory made prefab models. The team designed the system for elegant integration with a powerclad solar canopy and a host of carbon reducing in home practices. Steps are reduced. Money is saved.

In the next section we speak more specifically to each innovation that resulted from the facing constraints as opportunities to design.

Design Methods:
Problem Solving for Maximal Impact

We designed the project as a microgrid with the goal of operating as an ‘island all the time’ not just when the grid has an outage.

1. Firstly, we designed the project as a microgrid with the goal to 'island all the time' not just when the grid has an outage. We felt it was critical to the carbon-neutral goals of the community to provide resilience and self-reliance at the core of the design. Controlling our DERs as a microgrid maximizes the impact this project can have on affordable housing because we can improve the air quality in historically marginalized communities and provide the largest financial benefit by maximizing the usage of onsite energy which would avoid the costs associated with purchasing energy from the grid.

2. Secondly, we focused on integrating an Ecosystem of Distributed Energy Resources (DERs) rather than designing them as individual components. It was critical to not only understand how each DER would be used individually but rather how all of our DERs interact together to build a lifestyle that fits seamlessly into the community.

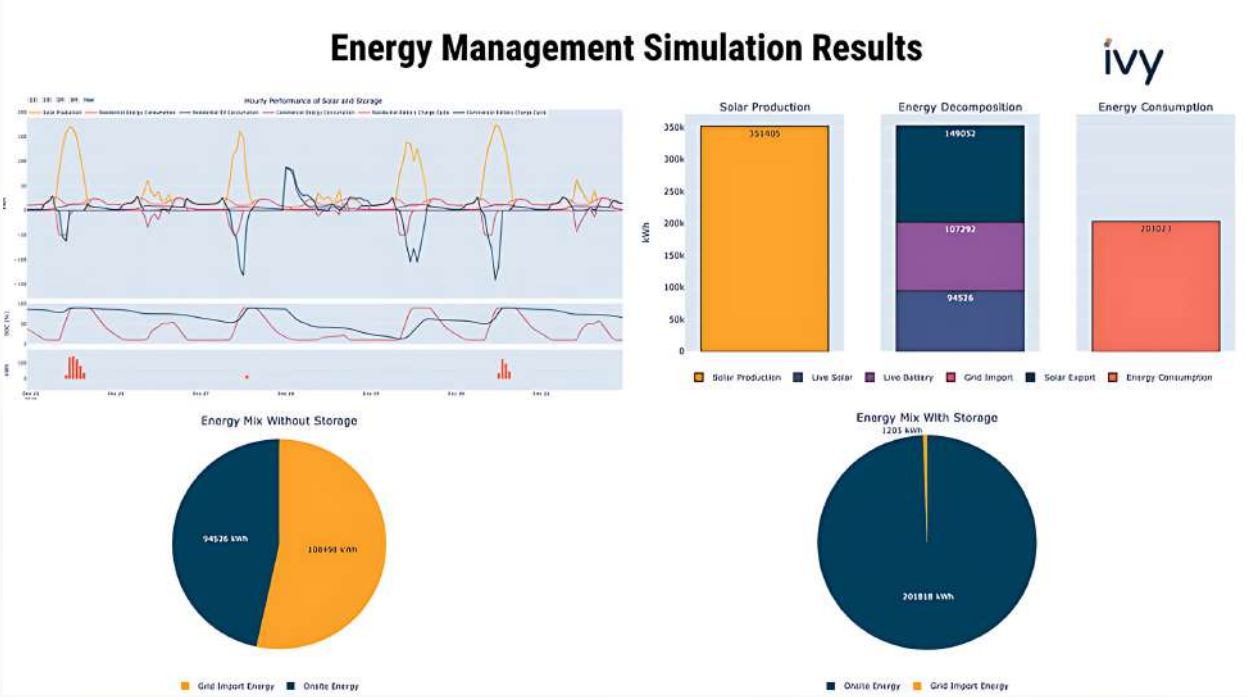
3. Thirdly, we performed integrated energy modeling throughout every step in the design. Each design choice, whether it was electrification measures, hardware decisions, or solar array configuration has an impact on the entire energy design for the community. Our approach was simple, as changes and updates occur in any aspect of the design, using the toolkit we can simulate the performance of all of the DERs together to understand the community-wide impact of the decision.

4. Lastly, we wanted to build our Customized Renewable Energy Management Model as a reusable toolkit for the energy design of future communities. Therefore we built our first version, the Mount Hope Energy Simulations app which is an energy management and control tool. This tool can ingest energy consumption and solar production time-series forecasts from commercial building engineering softwares as well as simulate various energy management control algorithms. Furthermore, it can simulate the energy use of the various DERs in the design and impact of the design and the control schema has on the energy utilization.

Some outputs of the toolkit are optimal system sizing for battery storage, simulations of the energy performance of the DERs at the individual and community level, and a breakdown of how the onsite resources vs the utility grid serve the community's needs. This data is vital to design an ecosystem of DERs to maximize community use and resulting benefits as well as inform the carbon accounting that would be offset by onsite renewable energy.

Next using the Ivy Energy customized Data management system

The graph below represents a few snapshots of the results from a simulation for a single pavilion. The graph on the top right shows how well we utilized onsite solar production to serve energy consumption based on when solar was consumed live or when the battery was discharging to serve the community's needs. The bottom two pie charts show the energy mix of the community with only solar and with solar and storage controlled as a microgrid. The results are forecasting a 99% reduction in grid-imported energy and a minimal grid reliance.



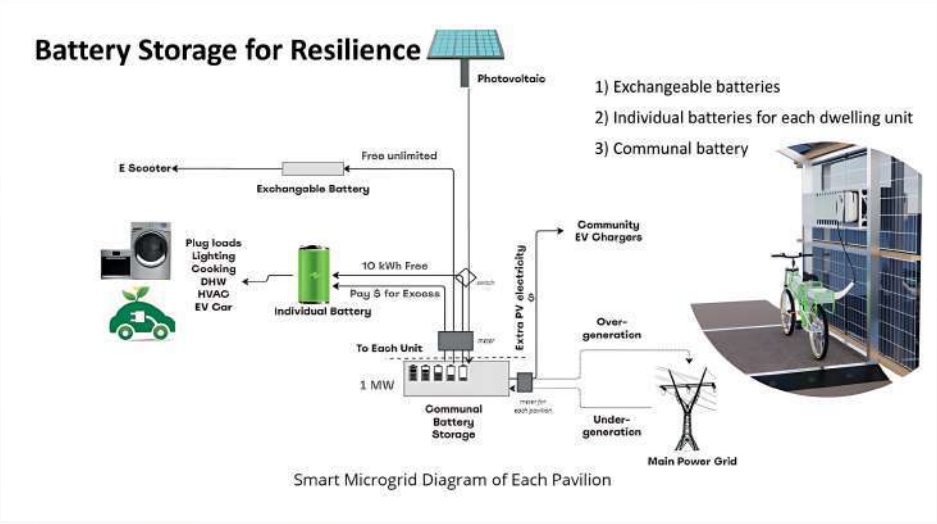
Renewable Energy Management Model: Design Philosophy

- Microgrid based Design and Control - "Island all the time"
- Ecosystem of DERs for Energy Lifestyle
- Integrated energy modeling through every step in the design
- Reusable Toolkit for Solar and Battery Sizing Optimization and Control Logic Performance Simulations

Our goal throughout the energy management design was to leverage solar, storage, and electric vehicles for an individual's future eco-friendly lifestyle, putting how users can engage and interact with these systems at the forefront of how we want to design and operate them. Our second priority was to create an architecture and control scheme that provides resilience, maximizes the use of onsite resources, and minimizes the community's impacts on the electrical grid.

MicroGrid System

In the photo below we have a logic diagram of the various distributed energy resources that will be utilized in the community. There are exchangeable batteries that can be freely charged to power personal electric transports like an e-scooter. Individual 10 kWh batteries in each dwelling unit that can be charged full for free daily, and large scale 1 MWh batteries that will serve the commercial loads. All of the DERs within the community are controlled by an energy management system specifically designed to optimize the performance of the community as a whole.



Smart Microgrid Diagram of Each Pavilion

The Microgrid System is made up of four integrated component systems:

- Customized The Solar 'PowerClad' System™ - patent pending
- C4GS ZEDlife Exchangeable Battery™ System
- Customized Renewal Energy System™
- Customized Data Management System

The Powerclad Solar Canopy™

Instead of attaching conventional solar panels to a metal roof, we've opted for a cutting-edge Translucent Bi-facial BIPV (Building-Integrated Photovoltaic) system. This innovative choice both harnesses sunlight efficiently and creates a harmonious play of light and shade. Importantly, it reduces the need for additional materials typically required for solar panel installation.

The system addresses the inefficiency of rooftop solar installations, offering an innovative solution for harvesting and distributing solar power. The mountZED 1,121-kW Powerclad Solar Canopy™ generates enough energy to provide 10kW of free energy per unit through a virtual microgrid, while allowing storage of excess production and conservation to power additional homes in the neighborhood.

Leveraging Renewable Energy:
Empowering Eco-Friendly Lifestyles

In our pursuit of sustainable energy solutions, we have developed a comprehensive approach centered around customized control of renewable energy systems tailored to individual lifestyles. At the heart of our design philosophy lies the concept of a microgrid, coined as "Island all the Time." We use this to point out rather than island the community during emergency events, the microgrid always operates independently when resources allow, ensuring resilience and self-reliance everyday, even in the absence of grid outages.

Emphasizing the integration of various Distributed Energy Resources (DERs) into a cohesive community ecosystem, our energy management algorithms prioritize both their individual functionalities and also their collective contribution to a community's energy needs. Through meticulous energy modeling at every stage of the design process, we strive to optimize energy efficiency, understand design tradeoffs on energy performance, and minimize environmental impact.

Moreover, our endeavor extends beyond a singular project: We aimed to establish a reusable toolkit for future energy management endeavors. Our customized Renewable Energy Management Toolkit is designed to be reused for all future projects, able to ingest specific production and consumption forecasting for new projects and simulate various control algorithms to determine the performance of the DERs.

The toolkit is intended to facilitate informed decision-making and foster sustainable practices in the design of communities to come. This introduction encapsulates our commitment to leveraging solar, storage, and electric vehicles to forge a greener, more resilient energy landscape while emphasizing user engagement and long-term viability.

The Power for Life™ Exchangeable Battery

The Power for Life™ exchangeable battery system introduces a novel concept to use the same batteries for both homes and electric vehicles. The system promotes a holistic approach to energy consumption. The exchangeable batteries last ten times longer than standard LiFePo4 lithium batteries and can recharge in 20 mins. The system makes possible the ability to swap out individual battery packs for maintenance and efficiency renewal without replacing the entire system.

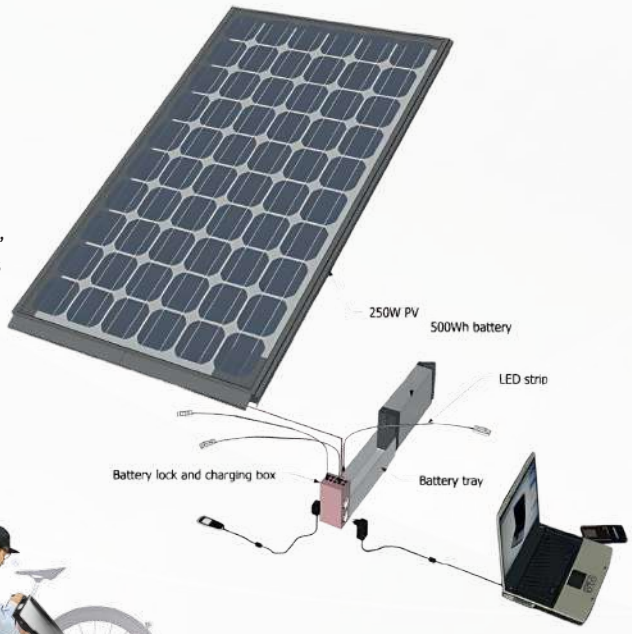
The lithium-titanate (LTO) battery chemistry offers enhanced safety, longer lifespan, and reduced risk of peak lithium. LTO batteries are lighter and more suitable for urban applications compared to standard LifePo4 batteries. Their stability and longevity make them a valuable choice, particularly for building-integrated electrical storage systems in urban areas facing climate change challenges.

Exchangeable Battery System

Through the integration of the Power for Life™ exchangeable batteries, we are able to expand the capacity of the microgrid to solve for a community micro grid. As a community micro grid, each household battery storage and bi-directional EV car charging systems are integrated into a shared grid system. This is important for storing power in the event of an emergency disruption of grid power.

ALWAYS CONNECTED!

One standard solar panel produces a maximum of 250W, which can easily charge one of these batteries in a day in most climates. However, if it doesn't, the battery can automatically be topped up from the mains using off-peak nighttime electricity in the early hours.



Kit of Parts™ Building System

The C4GS-ZEDlife Kit of Parts™ is an on-site prefab, 12-step construction process that enables building a mountZED maisonette in one week. The maisonette can be assembled efficiently and safely as a 12-step building process, culminating in community celebration of achievement. Workshops will involve skilled contractors, ZEDLife Pre-Apprenticeship Certificate Fellows and community residents. Workshops employ a “learn by doing” approach to training and building.

Demystifying the Process:
How to Build a Home in 12 Easy Lessons

As many can attest, building residential in California is no easy venture. It takes time, money and patience to move through the stages of design, accessing permits, material delivery and building to city code. Projects can be delayed by any number of details impacting conventional construction approaches. To make good on our design charter initiatives, the C4GS design team masterminded a building system that demystifies the simple act of building.

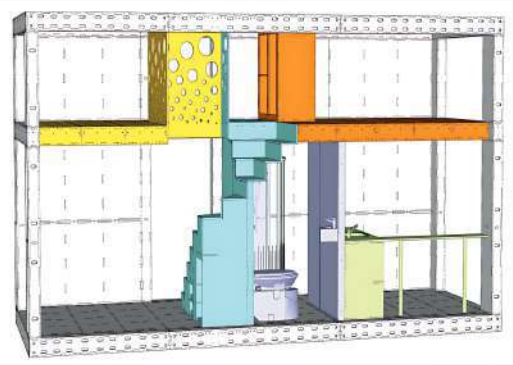
Bedroom Interiors

Kitchen and Dining Space Interiors

Using a specialized modeling system, the C4GS-ZEDlife Architects design the spaces using SketchUp models and pre-designated design guidelines. With our proprietary color-coded system, each design team expert works together through our integrated design process to produce a final set of highly engineered plans which include: Building Physics, Electrical and Plumbing, Structural Engineering, Interior and Exterior Finishing Options, Solar Power Systems & Virtual Power Management.

Prefabricated construction is less hazardous to workers and residents than conventional construction sites because there is far less potential for accidents and disruptions. Each panel takes about twenty minutes to build. It takes about a week to finish a single-family house.

The process of prefabricated construction can create jobs for communities as most people can be trained to build these strong structural panels. As the world's demand for sustainable construction continues to increase (evidenced by recently released tax incentives for energy-efficient projects, so too will the demand for local eco-friendly housing options. The prefabricated construction building process offers a powerful path to eco-friendly new builds meeting the demand for housing at local, national and global levels.



To deploy the C4GS-ZEDlife Kit of Parts™ building system, we use 3D wood panel structures produced with precision using Computer Numerical Control (CNC) machines. The images demonstrate the detailed design process behind prefabricated constructions.

The Design Process:
Kit of Parts 12 Step System

The unique design integrates electric vehicles into the design and achieves maximum use of space. Our development project was informed by evidence-based, comprehensive density studies. These studies influenced the sustainable housing design approach we took to develop a new typology, one that optimizes space utilization by integrating electric vehicles. In addition, the development provides direct access to the MTS trolley and buses.

Demystifying the Process:

1. Design Workshop

Design workshops with future residents allow customization of internal layouts for maximum convenience. Residents can choose furniture like partitions, shelving, and wardrobes within their allocated shell.

2. Cut Materials

A local community team is set up to cut the individual ply and cement board components for each maisonette kit of parts.

Kit of Parts 12 Step System

3. Insulation Station

In a workshop, teams use tools like rubber mallets and electric torque drivers to build structural insulated panels filled with non-combustible rock fiber, which are then transported to building sites using electric forklifts.

4. Putting it Together

Assembly teams install panels on-site, including staircases and partitions. Windows and doors are installed after the exterior membrane. A two-inch frame projection is crucial for airtightness, with timber strips used to minimize adhesive seal use.

5. Prep for Plumbing & Electric

An internal finishing team spray the interiors ready for first fix plumbing and electrical work

6. Safety Fireproofing

A community team fits prefabricated bathrooms and kitchens from CNC cut flameproof plywood or showerproof waterproof boards. Fireproof cement board battery safes are installed with fireproofed access doors in each home.

7. Test and Certify

A team completes second fix plumbing and electrical work – with each house then tested and certified by a professional plumber and electrician.

8. Cladding Corner

A cladding team fits the roll over epdm roof membrane and cementitious fire proof Hardiplank maisonette wall siding. Each home should if possible be a different colour.

9. Art is Life

A collective of artisans shall craft vibrant murals in the heart of public spaces.

10. Putting it Together

A decking team will install fireproof decking on all external surfaces.

11. Roof Gardens

Roofgarden team to create rot-proof planters with irrigation systems connected to rainwater storage tanks. Topsoil added to steep bank retaining walls. Roofgardens, lawns filled with topsoil, planted with irrigation systems. Full-size trees planted in communal green open spaces.

12. Prep for Plumbing & Electric

The communal rooms are fitted out by the first maisonette teams to finish their own pavilion


mountZED
CARBON NEUTRAL ECOVILLAGE

KNOWLEDGE TRANSFER

Design Standards Blueprint: C4GS-ZEDlife is creating a blueprint for future mixed-use developments by developing a library of standardized architectural designs that prioritize sustainability. These designs are adaptable to different locations and can be customized to meet specific requirements while maintaining core sustainability principles.

Modular Building Components: C4GS-ZEDlife employs modular construction methods, allowing for standardized, repeatable, and scalable building components. These modules can be pre-fabricated in controlled environments, enhancing quality control and efficiency.

Cost Predictability: C4GS-ZEDlife can offer accurate cost predictions for their projects, through rigorous cost analysis and optimization. This predictability attracts investors and financing partners, making sustainable mixed-use development a financially viable and appealing option.

Collaborative Ecosystem: C4GS-ZEDlife fosters collaboration within the industry, encouraging developers, architects, and construction companies to adopt our practices. We offer training programs and consulting services to help transition others to the standardized, repeatable, and scalable model.

Community Engagement: At C4GS-ZEDlife we recognize the importance of community buy-in for widespread adoption. We actively involve local communities in the development process, seeking input and feedback to create developments that align with community needs and values.

Knowledge Transfer:
Housing People, Not Cars

TRANSITIONING TO A STANDARDIZED MIXED-USE DEVELOPMENT MODEL: ZEDlife's ambition extends beyond a single groundbreaking project; we aim to revolutionize the mixed-use development industry as a whole. Our approach to this transformation called for taking steps to activate the following key strategies.

The mountZED EcoVillage Pilot Project and overarching goals align closely with the ambitious goals and strategies in the City's Climate Action Plan. The table below identifies ways that the EcoVillage pilot project helps the City of San Diego implement specific strategies and measures within the CAP.

CAP Strategy	
Strategy 1: Decarbonization of the Built Environment	• Project exemplifies all-electric new construction in a COC and how a developer can successfully utilize "less GHG intensive materials and practices" (in this case, a carbon neutral build). • Project provides an example of decarbonized housing to neighboring homes, strengthening buy-in for existing building retrofits. C4GS engages with the community in an ongoing effort to incorporate their input and foster an inclusive development process. With City programming support, adjacent homes can access Inflation Reduction Act (IRA) funds to retrofit their homes in alignment with 1.1 and access benefits of decarbonization also provided by the pilot project.
Measure 1.1: Decarbonize Existing Buildings	
Measure 1.2: Decarbonize New Building Development	

Strategy 2: Access to Clean and Renewable Energy	• Project contributes to Measure 2.1 by expanding local generation of renewable energy sources through the inclusion of an integrated PV facade that provides a significant onsite energy source. This will reduce energy costs for residents and reduce the need to draw power from the grid. The project also includes solar-powered battery storage, exemplifying a comprehensive local Distributed Energy Resource (DER) project. This aligns with the "deployment of building scale renewables and mandates the use of renewables through building codes, while engaging residents and other stakeholders in the process."
Measure 2.1: Citywide Renewable Energy Generation	
Measure 2.3: Increase Electric Vehicle Adoption	• Project includes electric bicycle & micro-mobility charging stations, as well as EV charging, open to the public which aligns directly with the City's goal. • Project provides shared electric mobility options, as listed above and including EVs, supporting "the citywide electric vehicle strategy to accelerate EV adoption within COC's".
Strategy 3: Mobility and Land Use	
Measure 3.2: Increase Safe, Convenient, and Enjoyable Transit Use	• Project includes strategies to reduce VMT and GHG emissions from the transportation sector, through the provision of several micro-mobility options, which is the greatest source of emissions in the region • Project provides low-cost upgrade features, such as shading and benches to the existing transit stop which aligns with Measure 3.2. • Project offers a residential 3 year live/work program for green professional trades and entrepreneurs (ZEDworkshops & ZEDhub). The program aligns with the CAPs telecommute efforts, as well as the CAP's green economy & just transition section. • On every level, each unit will have a parking spot with a charging station directly parallel to the home. This "will optimize use of curb space including the management of on-street parking" for others living in the community which aligns with Measure 3.6.
Measure 3.3: Work from Anywhere	
Measure 3.6: Vehicle Management	
Strategy 4: Circular Economy and Clean Communities	• Project will include onsite composting in order to divert organic waste, including food scraps, from the landfill. Compost will be utilized in onsite gardens and landscaping.
Measure 4.4: Zero Waste to Landfill	

Strategy 5: Resilient Infrastructureand Healthy Ecosystems Measure 5.2: Tree Canopy	Project includes living art murals, a garden, and shade trees that capture stormwater. This aligns with CAP actions to "increase tree planting in Communities of Concern."
Strategy 6: Emerging Climate Action	• Project is a proof of concept for deploying technologies and practices that reduce GHG emissions from buildings and transportation in an inclusive and equitable process. • C4GS, as an innovative, mission-driven developer, supports the City's goal to "build programs and partnerships to recognize and incentivize business practices that align and implement the CAP strategies and measures." • C4GS will support the City in "identifying opportunities to improve city processes to facilitate faster deployment of technologies and practices in San Diego." The project will inform areas of improvement between the City and developers looking to construct carbon neutral developments.

Avoided Carbon Emissions per Year

Whole Complex

Annual Electric Energy Consumption		BASELINE	PROPOSED
All Residential	[kWh]	1,592,060	5,164
Commercial Space and Site Lighting	[kWh]	156,647	864
Annual Total Electricity Consumption	[kWh]	1,751,037	6,027
Avoided Energy Consumption per year	**[kWh]**		**1,745,009**
Operational Carbon Emissions			
CA Electric Grid CO2 Emissions in 2024 (mid case scenario)	*[kg CO2/mWh]*	*156.64*	*156.64*
Carbon Emissions per year 2024	[TON CO2]	274.3	0.2
Avoided Carbon per year	**[TON CO2]**		**274**

AVOIDED **CARBON** 274 metric tons of CO2

Benefits of Building the Knowledge Base

The project knowledge base extends beyond technological advancements. It promotes tenant engagement, incentivizes energy efficiency, and utilizes the ZEDPower-platform™ for emissions-free transportation. With proof of energy efficiency in hand, the Mount Hope community is empowered to accelerate the community's transition to sustainable living. Research findings will be shared with the public through publications.

Achievements and Implications

Recognizing the need for transformative development in the area, the mountZED project team embarked on a mission to reimagine affordable mixed-use development while prioritizing environmental sustainability and community empowerment. The project builds upon the principles of environmental justice, aiming to address systemic inequalities and create a more equitable future for residents of Mount Hope. The mountZED Ecovillage project design reached conclusions with implications for stakeholders;

- **Design for affordable housing units:** The mountZED EcoVillage project team successfully developed a plan for a mix of affordable housing options, including permanent supportive housing units, live/work units for students, and market-rate apartments.

IMPLICATION: Implementing Community First and Complete Communities initiatives will guarantee a process of early community development discussion between the developer and the community, to time to learn about community needs and desires.

- **Solving for carbon reduction within an affording housing development:** As a primary design initiative, we set out to demystify the building process. With the epic challenge calling for solutions to energy saving development, we recognized the opportunity to take a systemic approach to demystifying the building process to ensure we designed and engineered for efficiency and longevity.

IMPLICATION: The ZEDlife LTO batteries— is an integral part of the building equation. Their reduced embodied carbon and extended lifespan enables a continuous surplus of renewable energy generation, gradually balancing out the initial carbon debt incurred during construction. This surplus isn't merely a bonus—it's a game-changer.

- **Putting All Government Land to Good Use:** The mountZED Ecovillage development encroaches on three dead-end streets owned by the city. These spaces will be put to good use through the increased affordable housing units and public accessible green spaces.

IMPLICATION: The design team worked to meet and integrate city codes into the ZEDhousing and transportation development plan.

Kit of Parts Building System:
Creating a new supply chain

The C4GS-ZEDLife Kit of Parts™ introduces new construction components that do not currently appear to exist on the Californian supply chain:

- An earthquake resistant two story between slabs fireproofed steel ‘slimflor’ car park structure enabling multiple two-story homes to be stacked vertically while providing ramped electric vehicle access for both cars and micro personal EVs. This enables every home to have off street EV charging and access to EV’s without requiring carbon intensive basement parking structures.
- A rockfibre, insulated, CNC cut, flame-proofed plywood-stressed skin, two story maisonette structure that can be cut and assembled on site by local unskilled labor.
- A water cylinder with integrated heat pump
- A reversible air source heat pump with heat / cool recovery integrated and ducted hot / cold air distribution.
- A 10 kWh LTO individual household integrated battery storage unit with half fixed static batteries and half exchangeable LTO batteries.
- A 1 MWH LTO community scale battery storage unit in a 40 foot shipping container for every 20 households
- A building integrated mono-crystalline glass / glass laminate photovoltaic rainscreen roofing and vertical walling system with variable translucency.
- Personal electric vehicles of all sizes powered by exchangeable 48volt non-combustible LTO batteries that do not add fire load

IMPLICATIONS: These innovative elements together revolutionize urban living, moving away from the ubiquitous, mundane grid of stacked cubes on vast asphalt parking lots to creating a vibrant medium-density mixed-use housing and EV- transportation solution. The C4GS-ZEDlife Kit of Parts™ redefines suburbia, empowering communities with limited public transit access to embrace sustainable growth. More over As renewable energy replaces fossil fuels on the national grid, the C4GS-ZEDlife Kit of Parts™ becomes a beacon of sustainability, effectively neutralizing its impact on greenhouse gas emissions.

Integration of green building practices

The project incorporates green building features such as solar panels, energy-efficient appliances, and sustainable materials to minimize energy consumption and reduce carbon emissions.

IMPLICATION: In urban core communities such as Mount Hope, green development has the greatest long-term potential of reducing energy burdens, increasing health and wellness and ensuring long-term investment in the green building industry.

Community engagement and empowerment

The project has fostered a sense of community ownership and pride through ongoing engagement with residents, community events, and collaborative decision-making processes.

IMPLICATION: Green developers can assist in the further development of projects like the mountZED Ecovillage and the overall sustainability if they prioritize community development as a first, rather than last step in concept design.

Job creation and economic development

The project solves for generating over 100 local jobs during the construction phase and continues to support workforce development initiatives aimed at building a skilled and diverse workforce in the green building sector.

IMPLICATION: Green developers can assist in supporting workforce development if they design Workforce Training into community development and into the actual real estate development package.

Making a Positive Impact on Mount Hope

The C4GS-ZEDLife mountZED Ecovillage is more than just a development; it's a transformative force for the local community. Our commitment to sustainability, innovation, and Community First engagement sets us apart from developers who approach real estate development only in terms of geography.

When considering the positive impacts on Mt Hope's community as a whole, we developed and implemented the I Am Green outreach campaign. I AM Green recognized the community's expertise in effectively engaging their neighbors using a Community Outreach Framework to ensure inclusivity and document community response.

IMPLICATIONS: Three important features of our *Community First* initiative grew directly from robust community outreach efforts:

The importance of forming a community-based Environmental League of Justice (ELJ), a collaboration involving community residents, business owners, educational leadership, board members, and green-building coalition members. The early ELJ adopters are committed to working for Environmental and Social Justice in Mt Hope and the greater San Diego community. The ELJ collaboration extends to partnering with key policy advocates such as the Climate Action Campaign, San Diego Green Building Council, and San Diego Building Electrification Coalition. The ELJ alliance aims to effect policy change for housing and environmental justice, by aligning our project with San Diego city initiatives.

Making a top priority to to minimize gentrification: An important feature of the C4GS-ZEDlife Community First approach to community development is to significantly reduce the likelihood of gentrifying the state-of-the-art mountZEDEcovillage. With this top of mind, our effort to control for gentrification aligns with San Diego's complete communities initiative as well as San Diego's Climate Action Campaign.

Our Community First real estate development approach is further aligned with the CEC's concerns and with the city of San Diego's new housing initiative. San Diego's initiative aims to create more new homes near transit, provide protections to existing residents and increase the supply of land available for new homes. Equally important, the city initiative incentivizes new home opportunities in all communities that San Diegans of all income levels can afford. The initiative is focused on protecting the city's most vulnerable community members, which include students, seniors and those in areas with very low, low and moderate access to opportunity.

Strategy for creating Affordable Housing in Today's Market

The Mount Hope project team is committed to keeping the community affordable and preventing gentrification by taking a proactive, community-driven approach. Our ZEDlife approach prioritizes community – developer collaboration, acting inclusively, and with an unwavering commitment to sustainable building; together all three actions work to undue red-lining, harmful zoning laws, and limited resources. We aim to address urgent community needs and maintain a strong neighborhood presence, avoiding economic pitfalls that could displace residents. Furthermore, the mountZED multifamily housing project prioritized affordability in response to the dynamic housing market.

IMPLICATION: To align with the community's specific needs, a significant portion of the housing units, spanning from 30% to 60% of the Area Median Income (AMI), should be earmarked for residents within this income range. The projects have been thoughtfully segmented into two categories: permanent supportive housing (PSH) and live + learn (LLH) units, exclusively reserved for households within the 30% to 60% AMI bracket. This tailored approach ensures that the housing project accommodates the financial diversity within the Mount Hope community.

Market rates, striking a balance between affordability and sustainability. This not only generates revenue to support the project's long-term viability but also provides an opportunity for residents outside the specified income range to become part of the vibrant Mount Hope community.
In essence, this comprehensive strategy caters to both the specific affordability needs of the community and the project's overall sustainability.

Addressing College Student Home Insecurity

We included the ZEDlife Lab based on early research assessments of the barriers to entering green careers. We found there are many including the lack of reinforcement within current education systems. In turn, preparation for green careers is slowed down by the need for re-schooling or continued education especially when communities and individuals lack housing and sufficient financial resources to participate in career advancement programs. Complicating the matter further is the availability of community resources dedicated to cultivating green building internships and apprenticeships for youth and adults.

We came to the conclusion that if we were going to design and build a state of the art electrified eco - village, we must include a solution that caters to training up the next generation of green builders. Knowing the building industry offers journeymen apprenticeships, we designed for a “Live and Learn” pipeline that moves youth and industry professionals from learning to working in the green building industry. The mountZED Ecovillage concept design necessarily includes a ‘live and learn’ initiative to train future leaders in the green building industry with the option of living on-site.

As a result, we designed for and developed collaboration partnerships to make manifest a viable future for student housing and a green workforce:

- 27 out of 102 units are dedicated to live/work student housing
- On-site Green Building Training in partnership with UCSD’s extended studies
- Over 100 local jobs will be provided to community members during construction.

IMPLICATION: Design for mixed-use public centers like ZEDLife Lab™ for skill development, green talent pool creation and community empowerment

Environmental Impact:

The project solves for reducing energy consumption, increased access to renewable energy sources, and improved air quality in the community.

IMPLICATION: Reducing energy consumption impacts the environment and the health of the Mt Hope community in a net positive way.

Challenges and Lessons Learned

Despite its many successes, The mountZED Ecovillage project faced several challenges along the way. Most pressing was coming up against California's now outdated housing and energy policies.

1. Human-centered / Community-centered focus: LEED's certified Architecture today must envision a solution that is centered on people and the planet.

Lesson learned: Design for changing lifestyle. Best practice design now calls for equating wellness with carbon reduction.

2. While historically influential when first established, energy policies can benefit from updates to align with the global trend toward clean energy.

Lesson learned: To address the challenge of working with outdated energy policies and the constraints it places on innovation, the C4GS mountZed Ecovillage project presents a proactive solution that speaks to reducing the carbon footprint for affordability, namely: Adopt new construction strategies, new materials and the widespread adoption of electric vehicles for transportation.

3. Proposing and getting a new, integrated building typology passed across the city council calls for moving through a long gauntlet of city offices and protocols.

Lesson learned: Thorough Testing is Crucial: Our experience underscores the importance of comprehensive testing when introducing new modular systems. From structural integrity to fire resistance, each component must undergo rigorous evaluation to ensure compliance with safety standards and building codes.

4. Introducing new modular systems and materials for testing in the US (ASTM, fire & structural testing) requires time and focus on translating the system into a current policy language that communicates the best methods of testing.

Tips for Testing New Modular Systems

Utilize Accredited Testing Facilities: Partner with accredited testing facilities that specialize in modular construction. These facilities have the expertise and resources to conduct comprehensive testing in accordance with industry standards, providing reliable data for informed decision-making. We partnered with the University of California San Diego's Powell Laboratory and Department of Structural Engineering to conduct our testing.

Collaboration with Regulatory Bodies: Engaging with regulatory agencies early in the testing process is essential. By fostering open communication and transparency, developers can navigate regulatory hurdles more effectively and expedite the approval process for innovative modular systems.

Simulate Real-World Conditions: Replicate real-world conditions as closely as possible during testing. This may involve subjecting modular components to varying environmental factors, such as temperature fluctuations, moisture exposure, and seismic activity, to assess their resilience and longevity.

Document Test Results Thoroughly: Maintain detailed records of test procedures, observations, and outcomes for future reference. Documenting test results ensures traceability and facilitates knowledge transfer within the development team, enabling informed decision-making and continuous improvement efforts.

Seek Feedback from Stakeholders: Solicit feedback from stakeholders, including designers, engineers, and end-users, throughout the testing process. Incorporating diverse perspectives can uncover potential issues and opportunities for optimization, ultimately leading to more robust and user-centric modular systems.

5. In addition to policy constraints, the project team faces financial constraints:

Securing funding and financing for affordable housing projects can be challenging, especially for historically excluded communities with limited access to capital.

Lesson Learned: Key policy updates to address financial constraints could involve implementing measures such as loan guarantees, interest rate subsidies, and revolving loan funds to facilitate financing for carbon-neutral affordable housing developments. These updates could serve as alternatives to standard affordable housing subsidies, while also supporting housing projects that incorporate a mix of affordable, “Missing Middle” student and luxury housing within the same development project. Planning for mixed housing types can foster equitable thinking around sustainable, cross-class and multi-generational lifestyles in a carbon-constrained future.

To ensure the provision of sufficient long-term affordable and “Missing Middle Housing,” strict qualifications should be established for these programs. Additionally, capacity-building support could be provided to help lenders and developers gain a deeper understanding of alternative financing options for affordable and Missing Middle housing projects.

To that end, we suggest CEC support assist emerging developers in gaining a deeper understanding of how to navigate the financing landscape for affordable mixed housing development. In addition to sharing links to government funding sites, a resource that walks developers through the entrepreneurial steps to gain access to capital would open doors to young developers bringing innovations to market. Moreover, streamlined application processes and dedicated support staff could be implemented to simplify the funding application process and address any city or cultural barriers faced by emerging developers.

6. Regulatory Hurdles

Navigating complex regulatory frameworks and zoning requirements can delay project timelines and increase costs, requiring careful planning and coordination with local authorities.

Lesson Learned: Collaborate with local jurisdictions to outline a carbon-neutral development regulatory pilot program that a) streamlines and reduces the cost of permitting and b) provides regulatory flexibility for innovative building types, materials, construction techniques and energy systems. With climate change impacting city infrastructure, a regulatory pilot program tailored to carbon-neutral development will be the proverbial carrot offered to those companies that comply with safety and environmental standards. A carbon-neutral regulatory program requires enhanced inter-agency coordination to minimize duplicative requirements. A program focused on green building can and should provide clear guidance and define holistic sustainability outcomes to developers participating in pilot projects.

7. Community Resistance

Some residents may be resistant to change or skeptical of new development projects, requiring proactive outreach and engagement strategies to build trust and consensus.

Lesson Learned: Community resistance can be addressed through early and enhanced community engagement efforts by walking in with a strategic plan that prioritizes inclusive community planning processes, stipended stakeholder consultations, and public forums to address concerns and gather feedback from local residents.

Developers have an opportunity to foster community-developer trust by first modeling and prompting transparency and accountability before asking the community to advocate for net-zero carbon development. Public agencies and developers should consider the strength of their community engagement plan before entering a community and build in collaboration and community-ownership-building opportunities. Rather than be blindsided by community attacks, developers must work to avoid placating and tokenizing historically excluded communities.

8. The mountZED EcoVillage project's holistic carbon reducing systems approach to green building surpasses the 30% carbon reduction currently adopted by leading architectural companies. It also addresses LEED certification rubrics by surpassing them both in terms of reducing carbon footprint and designing for wellness. In each case, the EcoVillage project sets a high bar for the green building and architectural design industry.

Lesson Learned:

We recognize architectural designers and contracting companies will change if new funding sources can be identified to fund new carbon-reducing projects.

9. We solve for Workforce Development by including a pre- apprenticeship plan for training and housing future green builders.

Lesson Learned:

Barriers to entering the green building industry must come into awareness before a company can embark on a work development plan. By committing to examination of our conformational bias with research, we were ready to "worldbuild" a plan and envision a building industry changing due to new generations of youth rising up from training in ZED building values and practices. We plan for all of our projects to include ZED building training for communities, contractors and students.

In the future, we plan to include local AIA and NOMA chapters and in our Echo chamber to strategize ways to implement the AIA, NOMA and ZEDLife Zero Carbon training in K-12 and university systems. AIA has adopted a zero carbon initiative that calls for an AIA member commitment as well as completing a CE requirement in carbon reduction practices. We call on AIA to adopt a workforce development initiative that mirrors the commitment call for training in reducing carbon.

CONCLUSION

We are living at a time of disruption in technology, economy and building development. Climate change, the most powerful disruptor, waits for no one.

The C4GS-ZEDlife mountZed Ecovillage pictures how disruption leads to transformation of green building values and practices that can and will reshape the industry and set a new standard for mixed-use development. C4GS-ZEDlife is at the forefront of this revolution. We are a company committed to harnessing the potential of modular construction methods and cutting-edge energy technologies.

In keeping with this commitment, The mountZed Ecovillage solves for new residences with a groundbreaking promise, namely, an annual net-zero energy consumption for both living spaces and personal transit. It's a bold step toward minimizing our environmental impact and reducing the carbon footprint associated with traditional housing models. In other words, the C4GS-ZEDLife mountZED Ecovillage is more than just a development; it's a transformative force for the local community. Our commitment to sustainability, innovation, and Community First engagement sets us apart from developers who approach real estate development only in terms of geography.

To redefine the way we build and live. We are ZEDlife By Design

Reflecting on the lessons learned and their relevance for stakeholders, particularly real estate developers and government policymakers, C4GS-ZEDlife understands the pivotal role our project plays in reshaping industry standards and policy initiatives. Our design journey with the mountZED Ecovillage project has illuminated key insights that can drive meaningful change:

For real estate developers, our project underscores the imperative of prioritizing community collaboration and sustainable design principles from the outset. By embracing a Community First approach and integrating green building practices, developers can both meet regulatory requirements and advocate for resilient, inclusive communities that thrive in the face of climate challenges.

Similarly, government policymakers must recognize the urgency of updating outdated regulations and zoning policies to support carbon-neutral development. Our experience highlights the importance of streamlining permitting processes, providing financial incentives, and promoting workforce development initiatives to catalyze the transition toward sustainable urban development.

In conclusion, our project sets a new benchmark for the industry by demonstrating the feasibility and benefits of carbon-neutral mixed-use development. By embracing the lessons learned and collaborating with stakeholders, both real estate developers and government policymakers can together pave the way for a more sustainable and equitable future.

ACKNOWLEDGEMENTS

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First and foremost, a sincere thank you to our Epic team members, whose genius has been instrumental in turning ideas into impactful reality. The individuals who offered technical insights, program management prowess, and exemplary leadership have been the pillars upon which our project stands tall. From the late-night brainstorming sessions to the moments of triumph and challenges faced together, this project has been a shared adventure. The project outcomes and outputs exceeded our expectations. We also produced a number of documents, such as reports, papers, presentations, and videos, to disseminate our findings and recommendations to a wider audience.

We hope that our project will inspire and inform other researchers, practitioners, and policymakers who are interested in pursuing similar goals and initiatives. We also hope that our project will benefit the people and communities of California, who deserve to live in comfortable, healthy, and resilient neighborhoods that are powered by clean and renewable energy.... by design. To everyone who made this journey unforgettable, thank you for being a part of our story and for helping us script a future powered by innovation and sustainability.

Project Partners:

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Urban Alchemy 360
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Center for Community Energy - Jose Torre-Buneo
National Black Contractors Association
Saltwater-Strategies - Elayne Fowler
San Diego Association of Governments - Planning Department
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KEY PROJECT DELIVERABLES

The C4GS-ZEDLife mountZED Ecovillage design project delivered significant contributions to Affordable Mixed Use Housing in a Carbon Constrained Future:

- C4GS-ZEDLife **Kit of Parts™ Manual** - The manual is a step-by-step guide to organizing a design workshop to ensure the Kit of Parts™ can be assembled efficiently and safely as a 12-step process, culminating in a community celebration of achievement. Workshops will involve skilled contractors, ZEDLife Certificate Fellows and community residents.

- C4GS-ZEDLife **Reimagine Our Community Guide** (Also known as a "Green Charrette Guide)

- **Virtual Power Grid Management System** and **Microgrid Reusable Toolkit**

- All Electric Transportation Integration

- Hands-on Workforce Development and Training Model - **ZEDlife Studios™**

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