DESIGN FOR POSITIVE CHANGE
Mithun Ranks No. 12 overall and No. 2 in Sustainability by Architect Magazine, 2018
6 AIA COTE TOP TEN GREEN AWARDS

10+ NET ZERO BUILDINGS

AIA 2030 COMMITMENT

SUSTAINABLE R&D INVESTMENT 15,000+ HOURS

150+ GREEN STORMWATER PROJECTS

15+ PROJECTS WITH GREEN DISTRICT SCALE SYSTEMS

500+ SUSTAINABLE DESIGN PRESENTATIONS

CARBON NEUTRAL OPERATIONS SINCE 2004

40+ LEED CERTIFIED PROJECTS
ZNE-ready Affordable Housing is not only possible, but is being designed and built.

Construction is Cost-Neutral at a minimum, with potential for Lower Utility Bills.

Co-Benefits are Plentiful (and potentially Beautiful).

It's really about Zero Net Carbon (not Energy).
Electrifying Multifamily Affordable Housing—
Resilience
---
thrive in the face of climate change

Health & Wellbeing
---
enhance the human condition

Carbon
---
achieve carbon positivity

Artificial Intelligence
---
empower designers & enable superior decision-making

Construction Technology
---
transform building delivery for positive change
2030 Challenge Reporting

![Bar chart showing % reduction from 2009 to 2020]
**Zero Net Carbon**
- Comprehensive Model Analysis of all Systems
- Actual EUI
- Source Energy
- Carbon (embodied and operational)

**Title 24 CEC**
- Politically Weighted
- Excludes certain loads, systems & equipment
- Includes only:
  - Space Conditioning, Mechanical Ventilation and Water Heating
  - TDV energy use
  - Cost basis

**Benchmarking**
- Separately metered Units, Common Areas, and Whole Building
- Actual Energy Use, Utility Costs, and ROI
- Resident Behavior
Research & Development
Zero Net Energy for CA
Multifamily Residential Design

Low, Mid and High Rise
Several Construction Types
All-Electric San Francisco Affordable Housing Projects—

with ambitious EUI targets

- Casa Adelante Housing (2060 Folsom)
- Florida Family Apartments (Mission neighborhood)
- Maceo May Veterans Apts (Treasure Island)
- Balboa Upper Yard (Outer Mission)
- Blocks 52 & 54 (Hunters Point Shipyard)
PV Production for Net Zero Energy—
The Shift from ZNE to All-Electric
Clean Energy Sources are Outpacing Targets—

Low income and communities of color bear a disproportionate burden of pollution from fossil fuels and are more cost-burdened with utility bills.

Auke Hoekstra, PhD
Electrification is Pathway to Zero Carbon in CA—

Including Gas or Propane in a building is a guaranteed Carbon footprint in perpetuity.

Rapidly greening grid means and All-Electric Buildings have a path to Zero Carbon Emissions.

NRDC Analysis. Climate Zone 13 (Fresno) with rooftop solar, including methane leakage.
Berkeley Says No to New Gas Connections

Hillary Noll, a Mithun senior associate in San Francisco, says heat pumps are providing savings for five all-electric multifamily housing projects the firm has underway in the city. She says this is primarily due to federal tax credits for affordable housing tied to energy efficiency targets. Those require the addition of solar water heaters when gas burners are used, helping trim gas consumption. Without gas, additional savings come from avoided equipment such as gas piping, meters, and combustion venting, as well as simplified fire code compliance.

"There’s a trickle-down effect," says Noll, who estimates about $150,000 in savings per project.

Noll says Mithun’s clients favor all-electric design primarily as a response to heightened awareness of climate change. But they also feel they are getting a better building. In most of Mithun’s all-electric projects, these savings are being used to upgrade air filtration systems to protect residents from soot from the region’s increasingly frequent wildfires. Owners also recognize that eliminating gas today will future-proof the structures against expensive retrofits. "When you design for natural gas in a building, you’re designing for obsolescence," says Noll.

Many California cities plan to ban gas only from new municipal buildings, while pushing private developers to go electric by mandating higher efficiency for gas-equipped buildings. Bartholomay says Los Angeles is following another model pioneered in Vancouver, British Columbia: phasing in limits on carbon emissions that will ratchet down over time.

Whatever model jurisdictions use, Bartholomay says, they will have to stop the installation of new gas equipment—which can last 15–20 years—in all buildings by 2030 to have any hope of meeting their mid-century carbon targets.

Although San Francisco has yet to institute a gas ban similar to the one recently enacted across the bay, in Berkeley, several residential projects there anticipate such restrictions, including Mithun’s Marcus May Apartments, a 105-unit building for formerly homeless veterans and their families slated for completion in 2021.

Image courtesy Mithun
Reach Codes—

City Reach Codes - Building Electrification

- No reach code
- Electric readiness (no increased efficiency)
- Mixed fuel option with an increase in efficiency compliance margin above Code
- Mixed fuel option with high efficiency compliance margin above Code
- Electric requirement for specific appliances
- Gas Ban (select building sectors)

San Luis Obispo
Menlo Park

San Diego
San Francisco
Mountain View
Oakland
Berkeley

Note: All information in this chart is tentative, based on information obtained to date.
Low income and communities of color bear a disproportionate burden of pollution from fossil fuels and are more cost-burdened with utility bills on average.
How Equitable Electrification is Achievable—

Equitable Building Electrification: A Framework for Powering Resilient Communities

provides decision makers with a step by step guide to achieve GHG goals while ensuring every person, regardless of race and income, can benefit from the clean energy transition.
Decarbonization and Resilience
Project Case Studies—
All-Electric San Francisco Affordable Housing Projects

with ambitious EUI targets and all-electric systems

Casa Adelante Housing (2060 Folsom)
Florida Family Apartments (Mission neighborhood)
Maceo May Veterans Apts (Treasure Island)
Balboa Upper Yard (Outer Mission)
Blocks 52 & 54 (Hunters Point Shipyard)
Casa Adelante - 2060 Folsom Mission Neighborhood
San Francisco, CA

Size: 127 Units and 169,995 GSF
2030 Goal: 23.6 kBtu/sf/yr
Construction Cost: $68,175,234
Hard Cost / sq ft: $401/ sq ft
Parkside Porch for the People

2060 Folsom
San Francisco, California

**Client:** Mission Economic Development Agency, Christ Church Community Development Center

**Overview:** Affordable housing development overlooking new neighborhood park in the Mission District. 51 affordable units, community room, garden courtyard, youth lounge, childcare center, parking for 150 cars.

**Size:** \( 150,000 \) sf

** Metrics:** Green Point Rated, LEED Gold Targeted

**Services:** Architecture, Interior Design and Landscape Architecture

**Collaborators:** J.A. Studio, Associate Architects

**Affordable Housing and Critical Services**

2060 Folsom creates in-demand affordable homes and an active community hub, inspired by the Mission District’s unique blend of civic participation and working-class heritage. Maximizing density, the nine-story building houses families and transitional-age youth, and offers programs critical to the future of the district.

**Maximizing Views and Connection**

The building is conceived as a ‘front porch’ overlooking the new neighborhood park at the corner of Folsom and 17th streets. A spacious courtyard draws sunlight and park views into the building. A community room and common spaces clustered around the courtyard create a ‘town square’ for indoor-outdoor events.

**Activated Streetfronts**

A transparent ground floor holds a diverse array of active programs. Wide sidewalks, bike lanes, retail and art murals activate streetfronts and encourage public interaction. Public services including a childcare center and offices for local organizations are housed on the first two floors, and an incubator space on the prominent southeast corner supports local entrepreneurship.
Case Adelante – 681 Florida Mission Neighborhood
San Francisco, CA

Size: 130 Units and 142,100 GSF
2030 Goal: 23.6 kBtu/sf/yr
Construction Cost: $64,687,461
Hard Cost / sq ft: $455/ sq ft
Mission Possible
Family Housing

681 Florida
San Francisco, California

Client: Tenderloin Neighborhood Development Corporation (TNDC) and Mission Economic Development Agency (MEDA), Joint Venture
Overview: 158 Units with amenities/services and 10,000 SF of Production, Distribution and Repair (PDR) space reserved for local arts organizations.
Program: Residential, Business, Assembly
Size: 450,000 square feet, 344 homes
Metrics: Meets AIA/USGBC 2030 Challenge
Services: Architecture, Interior Design, Landscape Architecture
Collaborators: List here
Completion: May 2021
Cost: $80,000,000

Family-Friendly Mixed Use
This new, mixed-use development provides amenity-rich, family-friendly urban living. A ground floor, double-height facade spanning the entire block maximizes flexibility and visibility for diverse communities; and durable materials, highly coordinated systems design, careful cost analysis, and an RFI meet the AIA/USGBC 2030 challenge; all helping to ensure the Mission remains a backbone of San Francisco culture.

Serving a Need
Responding to need, the development supports displaced and low-income families with 30% of units reserved for formerly homeless residents with income 15-30% AMI; and the remainder of units available to residents 40-60% AMI. The project also provides spaces for a variety of programs and services, from job placement and tax preparation, to urban rooftop farming and healthy cooking classes.

Honoring the Mission’s Art Culture
Honoring the arts culture of the Mission, the ground-floor space is dedicated for an arts organization use and designed to maximize visibility—pedestrians will be able to see through from one sidewalk across the block to the next. A forecourt with a large art gate at the main entrance welcomes events as well as curious passers-by.
Maceo May Veterans Apts
Treasure Island
San Francisco, CA

Size: 105 Units and 114,836 GSF
2030 Goal: 22.6 kBtu/sf/yr
Construction Cost: $52,280,034
Hard Cost / sq ft: $455/ sq ft
Healthy Homes for Veterans

Maceo May Apartments
San Francisco, California

Client: Swords to Plowshares and Chinatown Community Development Center

Overview: Six-story building on Treasure Island in San Francisco housing formerly homeless Veterans and their families

Program: 106 multi-family units (studios, 1- and 2-bed), on-site residential services, property management office, community room, laundry, parking, bicycle storage, outdoor common areas including pet area, culinary gardens, forested healing garden, playground, 1560 sq ft rooftop deck

Size: 194,530 sq ft, 0.79 acres

Metrics: LEED Certification and Green Point Rated

Services: Architecture, Landscape Architecture

Completion: 2007

Creating Community
Home to a diversity of residents, from families with young children to Veterans recently experiencing homelessness, Maceo May Apartments will provide a range of common areas from gathering spaces to healing gardens. Its community-centered design—access to views for all, active ground floor uses, and place-based wayfinding—will integrate residents into their new neighborhood.

Infrastructure for Health Inside and Out
Pursuing LEED certification, the design emphasizes social cohesion and wellness, including features tailored to support those with a history of chronic illnesses and mental health challenges. Active design principles within the building connect residents to each other and the natural environment via the adjacent shared public way, community park and island trail network.

Building for a Resilient Future
The design uses net-zero energy strategies to achieve an EUI of 18.2, incorporates several resilient design elements guarding against disaster and climate change impacts, and prioritizes healthy and durable materials throughout. Modular construction parameters have influenced the unit design and will reduce construction cost and duration—speeding the delivery of much needed housing.
Hunters Point Shipyard
Blocks 52 & 54
San Francisco, CA

Size: 112 Units and 169,4746 GSF
2030 Goal: 20.2 kBtu/sf/yr
Construction Cost: $ 69,281,046
Hard Cost / sq ft: $ 408/ sq ft
Shipyard Multifamily

HPS 52 + 54 Case Study

San Francisco, California

- Co-Sponsors: Mosser Housing Development Corporation and the Related Companies
- Architect: Mithun
- Lot Area: 26,000 sf
- Project Size: 125,000 sf
- Zoning: 85 feet height limit, zero setbacks, no parking required, 7,000 sf of open space required
- Funding: 4% California Tax credits and San Francisco Mayor’s Office of Housing and Community Development (MOHCD), AHFC
- Metrics: Green Point or LEED certified
- Transit: BART regional transit. Multiple MUNI bus lines. Bike share a block away.

Project Description:
- Safe, stable affordable housing for low income families (60% AMI, 40% neighborhood priority)
- Located immediately adjacent to Balboa Park BART station
- 300 feet from 280 Freeway
- Highly impacted by traffic at busy intersection

Project and Community Goals:
- Affordable units for families
- Active ground floor for the community
- A vibrant new BART Plaza
- Safe streets for pedestrians and cars
- Protected open space for residents

Program:
- Residential 100% affordable units with a mix of 3br, 2br, 1br and studios, community room, garden courtyard, rooftop garden, bike parking, and supportive services offices
- Child Development Center 6,000 sf
- Neighborhood Retail
- Non-Profit Office Space 6,500 sf
EUI 20.6—

Balboa Upper Yard Family Apts
San Francisco, CA

2030 Goal: 23.6 kBtu/sf/yr
LEED Baseline 80.9 kBtu/sf/yr
39% savings
Promoting Health through Community Development

Balboa Park Housing Case Study
San Francisco, California

Co-Sponsors: Mission Housing Development Corporation and the Related Companies
Architect: Mithun
Lot Area: 20,000 sf
Project Size: 150,000 sf
Parking: 155 unit parking, area setbacks, no parking required, 5,000 sf open space required
Funding: 4% California Tax credits and San Francisco’s Mayor Office of Housing and Community Development (MOHCD), SFHC
Timeline: Fall 2016, Development team selected
Spring, Summer 2017, Community outreach, 2017-2019, Design, Permits, and Financing
2018 or early 2019, Construction to start
2020, Residences move-in

Features:
- Green Point or LEED rated
- BART regional transit
- Multiple MUNI bus lines
- Bike lanes 2+ blocks away

Project Description:
- Safe, stable affordable housing for low income families (60% AMI, 40% neighborhood priority)
- Located immediately adjacent to Balboa Park BART station
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- Highly impacted by traffic at busy intersection

Project and Community Goals:
- Affordable units for families
- Active ground floor for the community
- A vibrant new BART Plaza
- Safe streets for pedestrians and cars
- Protected open space for residents

Program:
- Residential 100+ affordable units with a mix of 1br, 2br, for and studios, community rooms, garden courtyard, rooftop garden, bike parking, and supportive services offices
- Child Development Center 6,000 sf
- Neighborhood Retail
- Non-Profit Office Space 6,500 sf

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Energy Efficiency Measures—
Typical Loads in Multifamily Housing

- Space Heating gas
- Space Cooling
- Indoor Fans
- Pumps & Misc.
- Domestic Hot Water gas
- Indoor Lighting
- Receptacle electricity
- Receptacle gas
- Other Ltg
- Process Motors
Passive Design Strategies

WATER SMART

The building's extensive courtyards and planting areas capture and store rainwater in large stormwater tanks, reducing flood damage to the structure and the surrounding neighborhood while cutting down on overall water consumption.

BRINGING IN THE GREEN

The building is designed to take full advantage of its proximity to park and the Foxxom Street "green boulevard." A deep, south-facing, landscaped courtyard draws sunlight and views into the building, intervening building and park inside and outside. The planting then wraps into a five-story "green wall" with drought-tolerant plantings along the south-facing sides of the connecting bridges. The concept is a continuous green bridge that connects the streets, the park, and the building to the broader neighborhood.

THE SUNNY MISSION

The building is designed to capture the sun and bring it deep into all common, circulation, and play spaces. The roof is lined with a solar hot-water system to cut down on energy usage. The street-level double-height ground floor utilizes the building overhang as well as horizontal shading to control temperatures while bringing the complex down to an intimate scale at the sidewalk. A combination of racial shadow and building massing controls the sun in residential units as well as adding articulation and interest to the primary façade.
Building Systems

Envelope/ Wall Assemblies: Type 1B/Type III with 2” C. I.
Window to Wall Ratios: 22%
Glazing:
Building Orientation: E-W axis
Passive Strategies: External Shading, Operable Windows
Domestic Hot Water: Air Source Heat Pump
Heating & Cooling, Units:
Heating & Cooling, Other(?): Electric Resistance & None
Ventilation: DOAS HRVs in each Unit
Daylight Sensors/Lighting Controls: Occupancy Sensors, Daylight Dimming
On-Site Renewables: Solar PV (house load) & Solar Thermal Preheat
**Air Source Heat Pump**

- Operate by moving heat from one place to another, rather than generating heat directly.
- Think of a refrigerator operating in reverse.
- Can be stand alone or integrated with tanks.
- 3 to 5 times more efficient than resistance.
- Can retrofit an existing hot water system.
<table>
<thead>
<tr>
<th>Systems</th>
<th>Model Number</th>
<th>System Photo</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electric Resistant Heat (MECH)</td>
<td>DAIKIN DPS004A</td>
<td><img src="image" alt="Utility Room" /></td>
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<tr>
<td>Air Source Heat Pump (VRV) (MECH)</td>
<td>MITSUBISHI PURY P288TSLMU-A</td>
<td><img src="image" alt="Community Room" /></td>
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<td>Air Source Heat Pump (ASHP) (PLUMB)</td>
<td>COLMAC HPA15-PDAC PLC</td>
<td><img src="image" alt="Water Heater" /></td>
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<tr>
<td>Energy Recovery Ventilator (ERV) (MECH)</td>
<td>RENEAIRE HE4XINH</td>
<td><img src="image" alt="Community Room" /></td>
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# MEP Equipment Cont.

<table>
<thead>
<tr>
<th>Systems</th>
<th>Model Number</th>
<th>System Photo</th>
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<tbody>
<tr>
<td>Ceiling Fan</td>
<td>BIG ASS FAN- ESSENCE</td>
<td>8'</td>
</tr>
<tr>
<td>Electric Radiant Heat (MECH)</td>
<td>KING KCV1202</td>
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<tr>
<td>Heat Recovery Ventilator (HRV) (MECH)</td>
<td>ZENDER 350-R</td>
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<tr>
<td>Generator (ELEC)</td>
<td>MTU 6R0120 DS 180</td>
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</table>
# Menu of System Options

<table>
<thead>
<tr>
<th>System Options</th>
<th>Folsom</th>
<th>Florida</th>
<th>Maceo May</th>
</tr>
</thead>
<tbody>
<tr>
<td>Photovoltaic (PV)</td>
<td>⬜️</td>
<td></td>
<td>⬜️</td>
</tr>
<tr>
<td>Solar Thermal (ST)</td>
<td>⬜️</td>
<td></td>
<td>⬜️</td>
</tr>
<tr>
<td>Air Source Heat Pump (ASHP) Domestic Hot Water</td>
<td>⬜️</td>
<td>⬜️</td>
<td>⬜️</td>
</tr>
<tr>
<td>Variable Refrigerant Volume (VRV) Common Areas</td>
<td>⬜️</td>
<td>⬜️</td>
<td>⬜️</td>
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<tr>
<td>Energy Recovery Ventilator (ERV)</td>
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<tr>
<td>Heat Recovery Ventilator (HRV)</td>
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<tr>
<td>Electric Radiant Heat</td>
<td>⬜️</td>
<td>⬜️</td>
<td>⬜️</td>
</tr>
<tr>
<td>Ceiling Fans (Units)</td>
<td></td>
<td></td>
<td>⬜️</td>
</tr>
<tr>
<td>Ceiling Fans (Common areas)</td>
<td>⬜️</td>
<td></td>
<td>⬜️</td>
</tr>
<tr>
<td>Backup Generator</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Battery Backup</td>
<td></td>
<td></td>
<td>⬜️</td>
</tr>
<tr>
<td>Z-Duct and Fan</td>
<td></td>
<td></td>
<td>⬜️</td>
</tr>
</tbody>
</table>

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Anticipated Carbon and Energy Savings—
Projected Energy Savings—

kBTU/sf/year reduction averaging 32%

EUI = Energy Use Intensity
Casa Adelante Housing—

Energy Use Breakdown

- Space Heating gas
- Space Cooling
- Indoor Fans
- Pumps & Misc.
- Domestic Hot Water gas
- Indoor Lighting
- Receptacle electricity
- Receptacle gas
- Other Ltg
- Process Motors

T24 Standard

Design

- Space Heating electric
- Space Cooling
- Indoor Fans
- Pumps & Misc.
- Domestic Hot Water electric
- Indoor Lighting
- Receptacle electricity
- Other Ltg
- Process Motors
EUI Comparison—

18.8 EUI savings

- Space Heating electric
- Space Heating gas
- Space Cooling
- Indoor Fans
- Pumps & Misc.
- Domestic Hot Water electric
- Domestic Hot Water gas
- Indoor Lighting
- Receptacle electricity
- Receptacle gas
- Other Ltg
- Process Motors

U.S. National Average: 78.8
Title 24 Baseline: 39.0
Design: 18.2
Net Zero: 9.9

2030 Challenge 70%
Carbon Emissions

kBTU/sf/year reduction averaging 32%
Carbon tons/year reduction averaging 77% !!!
Carbon Emissions Avoided—
via annual operational energy use between design and T24 standard
Cost Analysis—
MEP First Costs

Normalized by Gross Building Area
### Co-Benefits Story:

Eliminating the solar hot water system saved $215,000 in first cost. And was a simplification of systems and O&M costs over time.

$215,000 Savings Solar Thermal

Allowed for addition of improved Ventilation, adding ERVs in every unit.

ERV cost premium over Z-ducts was Appx ~$1,200/unit

105 units = $133,000 = $82,000 savings

### Cost Analysis—

#### Maceo May Apts: Systems Cost Comparison

<table>
<thead>
<tr>
<th></th>
<th>All Electric</th>
<th>Natural Gas</th>
<th>Summaries</th>
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<tbody>
<tr>
<td>DHW</td>
<td>$106,820</td>
<td>$30,580</td>
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</tr>
<tr>
<td>Tanks</td>
<td>$29,131</td>
<td>$14,900</td>
<td></td>
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<tr>
<td>Add Labor/HR</td>
<td>$14,104</td>
<td></td>
<td></td>
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<tr>
<td>Electric DHW</td>
<td></td>
<td>$150,055</td>
<td></td>
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<tr>
<td>Gas DHW</td>
<td>$45,480</td>
<td>$104,675</td>
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<tr>
<td>Solar HW</td>
<td>None</td>
<td>$219,000</td>
<td></td>
</tr>
<tr>
<td>RecCh: same</td>
<td>$-</td>
<td>$-</td>
<td></td>
</tr>
<tr>
<td>Bldg Gen.</td>
<td>NA</td>
<td></td>
<td>$168,387</td>
</tr>
<tr>
<td>NA</td>
<td>$-</td>
<td>Gas Trench, backfill, pipe, stubout inside</td>
<td>$25,000</td>
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<tr>
<td>NA</td>
<td>$-</td>
<td>Field joints</td>
<td>$10,000</td>
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<td>NA</td>
<td>$-</td>
<td>Gas Meter Room</td>
<td>$28,550</td>
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<td>NA</td>
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<td>Gas piping to Boiler Room</td>
<td>$11,904</td>
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<td>NA</td>
<td>$-</td>
<td>Insulated copper pipe to Solar Thermal to Tanks</td>
<td>$25,000</td>
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<tr>
<td>NA</td>
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<td>Gas to Laundry</td>
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<td>Gas Ventilation</td>
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<td>Utility Connection</td>
<td>Gas Connection</td>
<td>$-</td>
<td>$15,000</td>
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<td></td>
<td></td>
<td></td>
<td>GasBldg Costs</td>
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<tr>
<td><strong>TOTAL</strong></td>
<td>$150,055</td>
<td>$392,867</td>
<td>Total Diff: $242,812</td>
</tr>
</tbody>
</table>

**Solar PV**

- Array: 123,000kW
  - $443,566 assume half: $221,250

**TOTAL w PV**

- $593,621 assume half: $654,117
  - Total Diff: $160,754
Annual Utility Cost Savings

Total Annual Utility Cost (Projected)
Annual Utility Cost Savings—

Normalized by Gross Building Area
PV area required for NZE—

Approximate area required to achieve source NZE with design EUI of 17.8

Existing PV = 123 kW + 16,500 SF
Net Zero House Loads—

- 17.8 EUI savings

Design

- Space Heating electric
- Space Heating gas
- Space Cooling
- Indoor Fans
- Pumps & Misc.
- Domestic Hot Water electric
- Domestic Hot Water gas
- Indoor Lighting
- Receptacle electricity
- Receptacle gas
- Other Ltg
- Process Motors

Chart showing energy consumption with 2030 Challenge 70% goal.

- U.S. National Average: 78.8
- Title 24 Baseline: 37.0
- Design: 17.8
- Net Zero: 11.9
Net Zero House Loads—

A benefit of the all-electric design is that the PV system can be directly linked to the biggest common area electric loads.

- HPS Bldg 54 has \(~155,300\text{kWh/year}\) common area electricity consumption.

- If premium efficiency panels are installed on the maximum available roof area, the PV system should be able to offset 97% of the estimated electricity demand (\(~150,700\text{kWh/yr}\))

- If standard efficiency panels are installed on the maximum available roof area, the PV system should be able to offset 76% of the estimated electricity demand (\(~117,700\text{kWh/yr}\))
Conclusions
- ZNE-ready Affordable Housing is not only possible, but is being designed and built.
- Construction is Cost-Neutral at a minimum, with potential for Lower Utility Bills.
- Co-Benefits are Plentiful (and potentially Beautiful).
- It’s really about Zero Net Carbon (not Energy).
Keys to Success—

What **Not** to Do:
- Switch to all-electric late in design
- Evaluate Systems in Isolation
- Solicit Minimal Bids

What **to Do:**
- Bring in Innovative Consultants
- Select Innovative GC and Subs
- Both Compliance & Performance
- Energy Models
- Set Clear Goals and get Buy In from All
- Evaluate On Site Renewables Options
- Commissioning – do it
Decision Making Drivers—

Cost: First and Operational

- Consensus is that it can be cost-neutral or cost-saving to go all-electric for this building type in CA market.

- Natural Gas $/therm is still heavily subsidized and cheaper than Electricity (depending on Tier Rate), but our study and others demonstrate that

ROI

- Master-metered vs tenant meters; sizing on site renewable (PV) appropriately to cover owner’s house loads but not over-produce

- Solar PV as “Insurance” for Operating Budgets
Decision Making Drivers—

Simplification of Building Systems

- During Construction: Reduced construction and connection coordination, saves time and money
- During Operations: One less bill to pay, PV tied to HPHW has no moving parts

Property Management and O&M

- Building Management sees benefit in elimination of the natural gas utility
- Need to build Familiarity with Training for new systems
- Can avoid proprietary maintenance contracts or sophisticated technical expertise
Decision Making Drivers—

Resilience & Future-Proofing

• Mitigate impacts to building occupants and emergency workers during Seismic Disaster events
• Potentially Vulnerable during Rolling Grid Blackouts and Public Safety Power Shutoffs
• Avoid future costly retrofits to remove natural gas systems ($850,000+/- for this building type)
• “Net Zero Ready” and “Fossil-Fuel-Free Ready” building
• Ability to expand Battery Systems for TOU and future smart grid technology
Next Steps + Studies

- **CEC Title 24**: Ability to accurately model HPWH, Adding an All-Electric Baseline
- **On-Site Renewables**: Solar Thermal vs PV with heat pump technology
- **Benchmarking**: ROI and Operational Energy will be key to track in coming years—both aggregated resident meters and common area house loads from building owners
- **Density and Land Use**: Building Decarbonization needs to expand scope to include land use patterns, density, transit implications
- **Battery Storage & EV Charging**: Optimizing Battery Storage for various uses: TOU, Peak Shaving, Resiliency/Off-Grid Islanding, Critical discussion about EV Charging requirements, future EV infrastructure capacity