

# Zero Place and the Necessary Future of Buildings

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# Overview

- Bio
- Inspiration
- Need for a transformation in building technology
- Exemplar: Zero Place
- Policy prescriptions for decarbonizing buildings

# Bio

- Founder of Zero Place
- COO of Elemental Cognition, an AI R&D company
- Formerly the Program Director of the Smarter Energy Research Institute at IBM
- Owner of a net-zero energy home
- Passionate about energy efficiency and climate change solutions
- Background in technology
- Graduate of the U.S. Air Force Academy, the RAND Graduate School, and University of Maryland School of Public Affairs





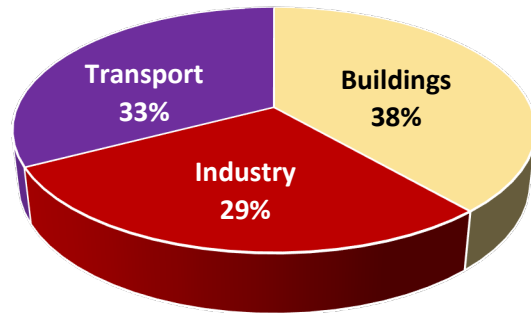
Inspiration

# What do buildings have to do with climate change?

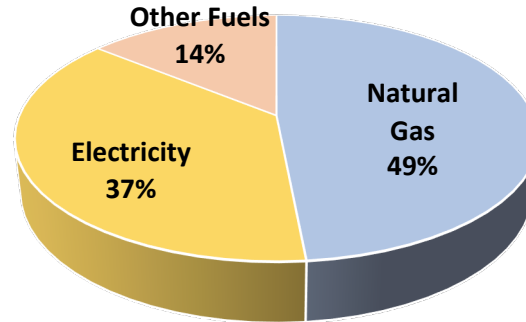
- Buildings - highest CO2 emissions

- Heating of homes in the U.S.

**CO2 Emissions from Fossil Fuels (USGBC, 2015)**

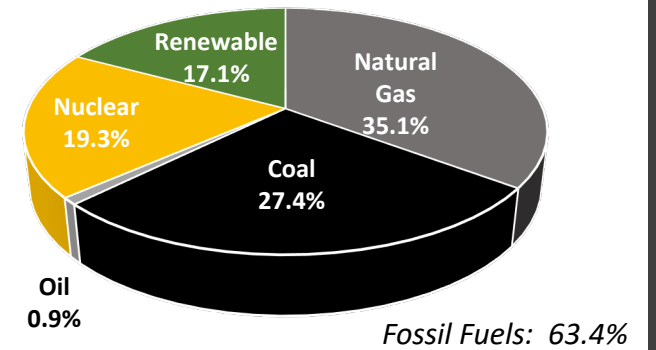


**U.S. Fuels for Home Heating (2014)**

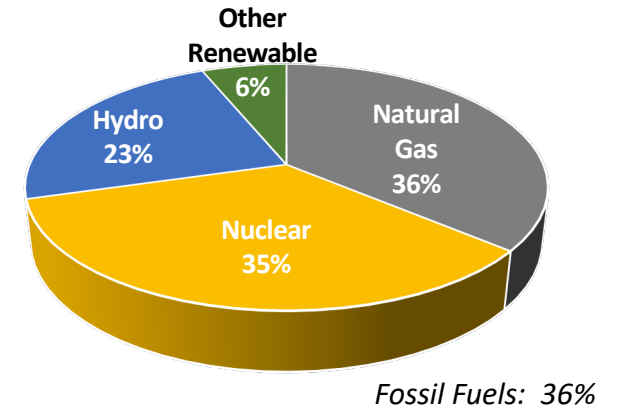


- Electricity Generation

**U.S. Electricity Generation by Source (EIA, 2018)**



**NY Electricity Generation by Source (EIA, 2019)**

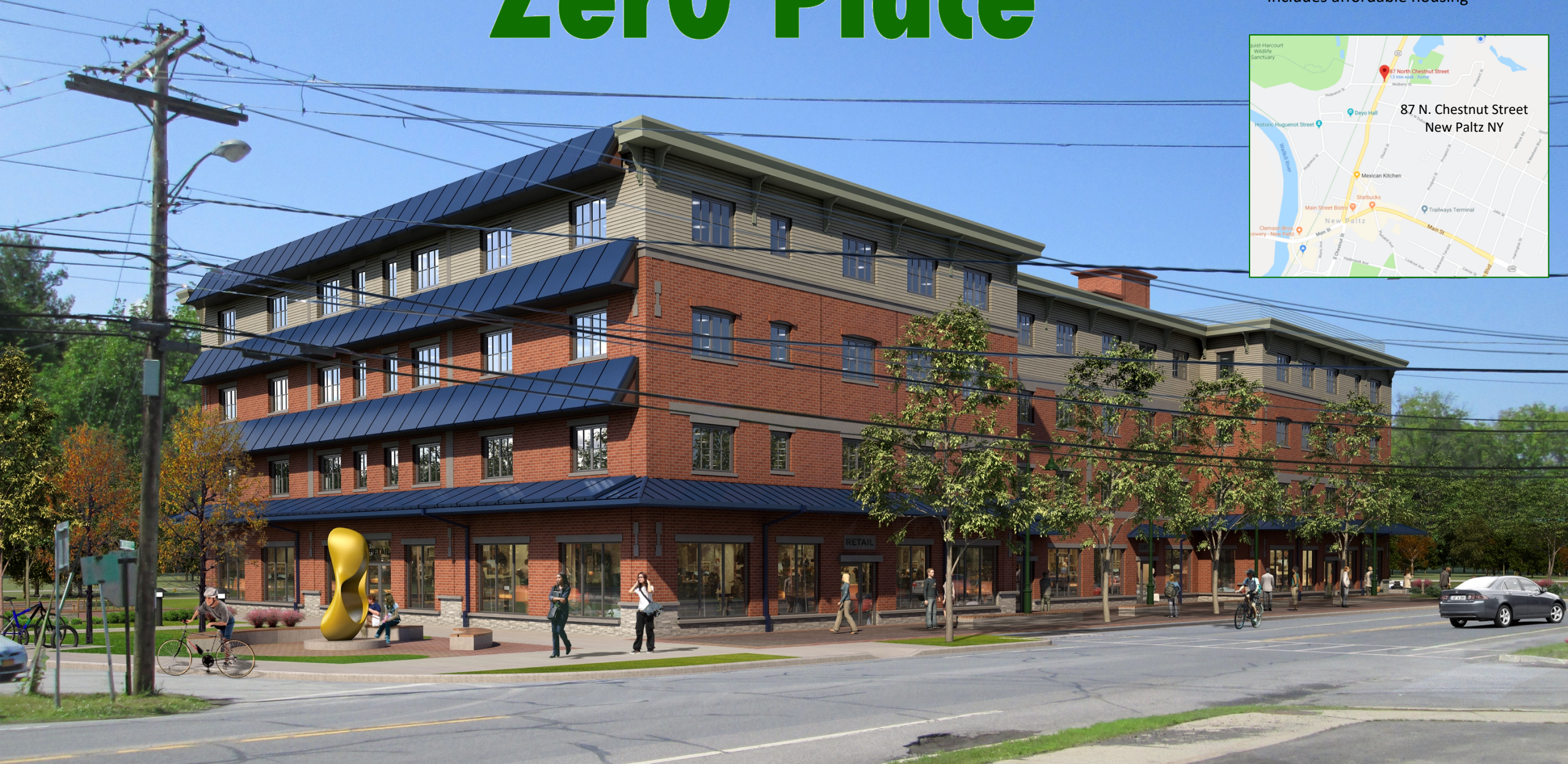


# Moving to a zero emissions building

- Electrification of all systems (eliminates oil/gas)
- Making the building efficient
  - Envelope: walls, floor, roof, windows
  - HVAC
  - Solar: Offset electric demand
  - Operations: energy monitoring, tenant behavior
- Decarbonizing the production of electricity

# Zer0 Place

- Mixed use, net-zero energy building
- 100% privately financed with NY- and federal incentives
- Owner developed and operated
- Includes affordable housing





# Envelope

## Features

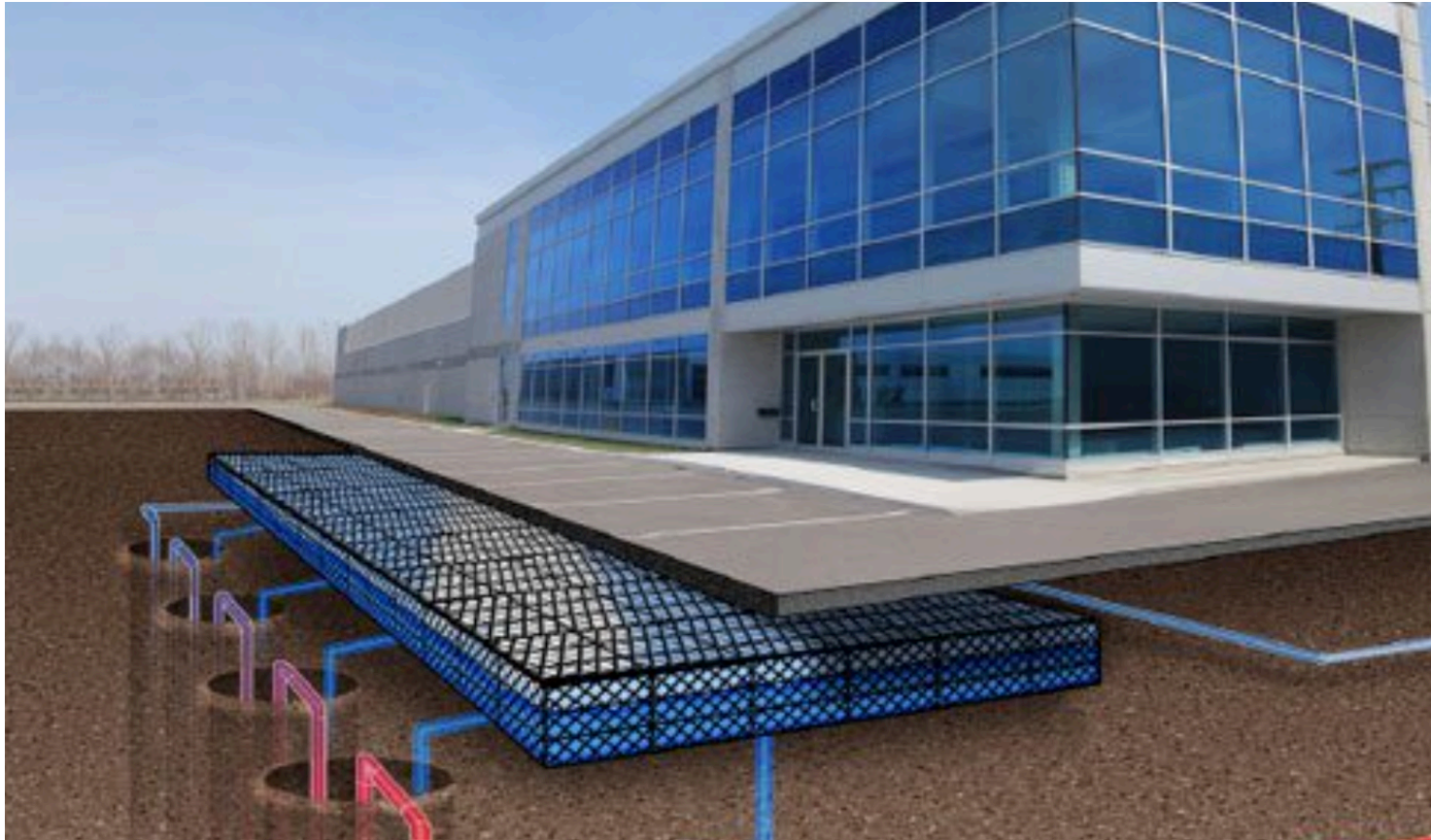
- Insulated-concrete form (ICF) walls
- Triple-paned fenestration
- High-R slab and roof assemblies
- Air-tight construction strategy
- Thermal bridging reduction

## Performance

- 37% better than code
- 65% tighter than NYS ECCC
- Saves 169,488 kWh/yr of energy



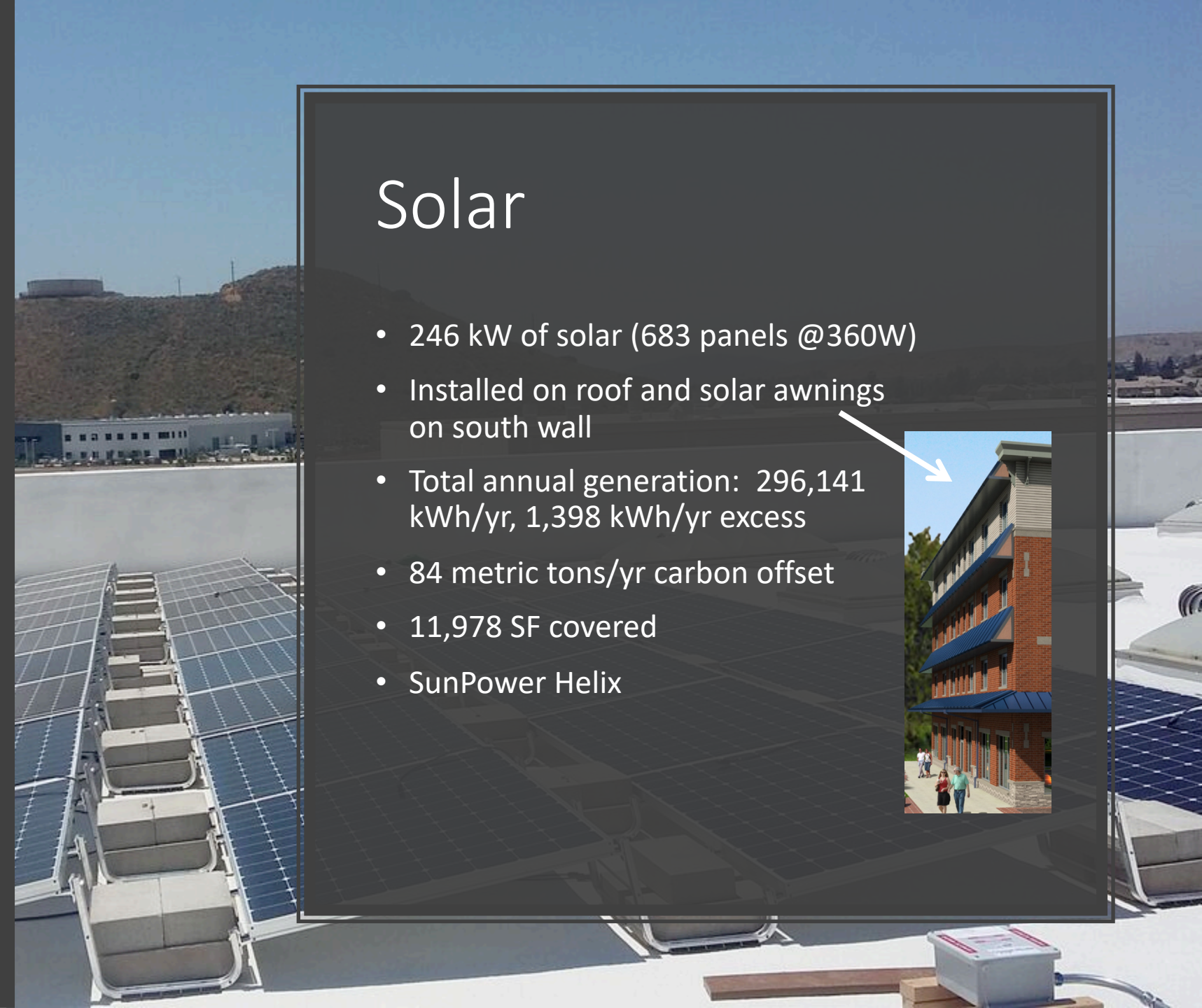
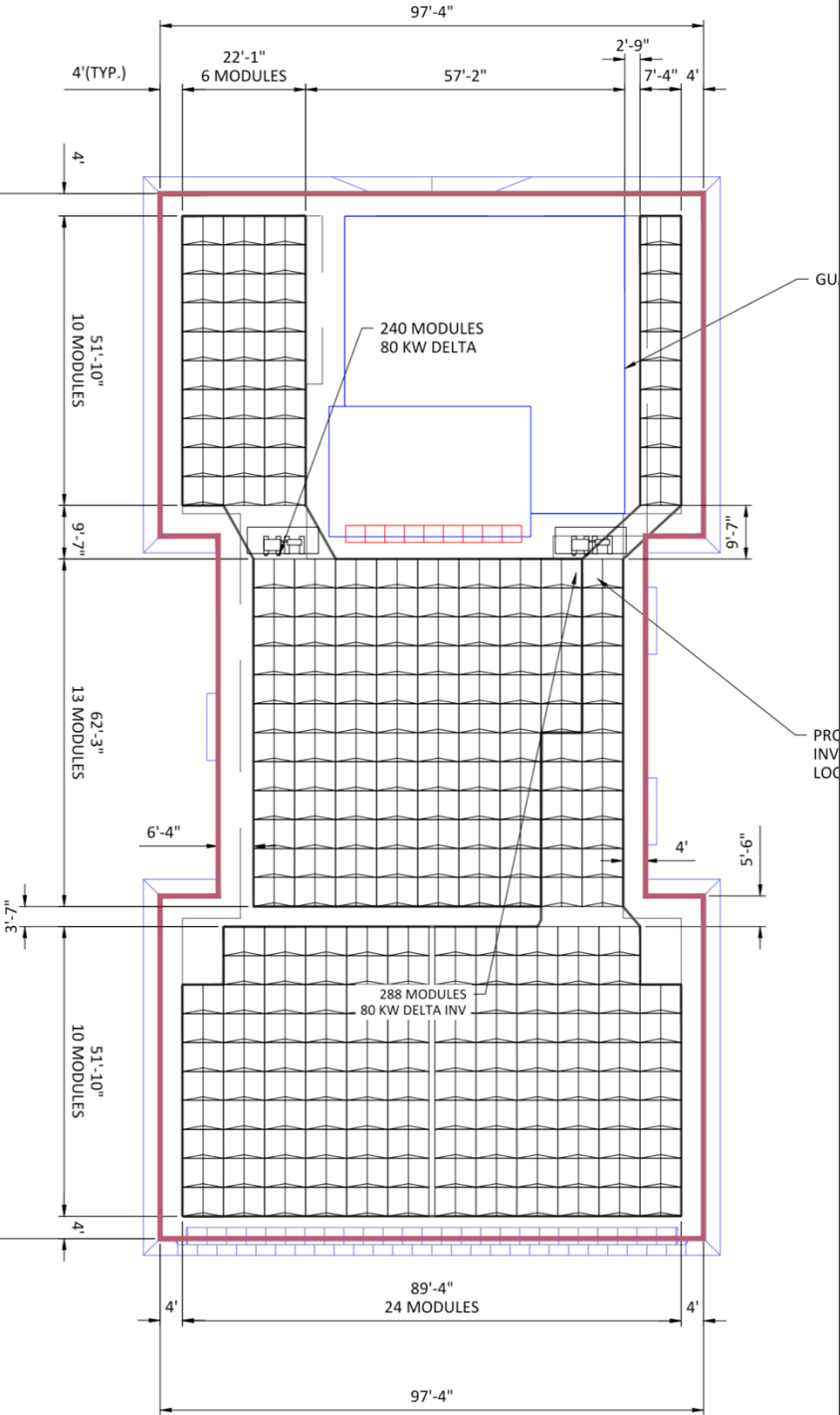




## HVAC and DHW

Ground-source Heat Pump (GSHP) provides 100% heating, cooling, and hot water

- 15x, 400-ft wells, all within building footprint
- Integrating DHW with building heating/cooling saved 15% system cost and achieves higher efficiency through balancing
- Variable speed pump, and all ducting / distribution within building envelope
- Unitary ERV systems for each unit with controls for CO<sub>2</sub>, oven use, and tenant control



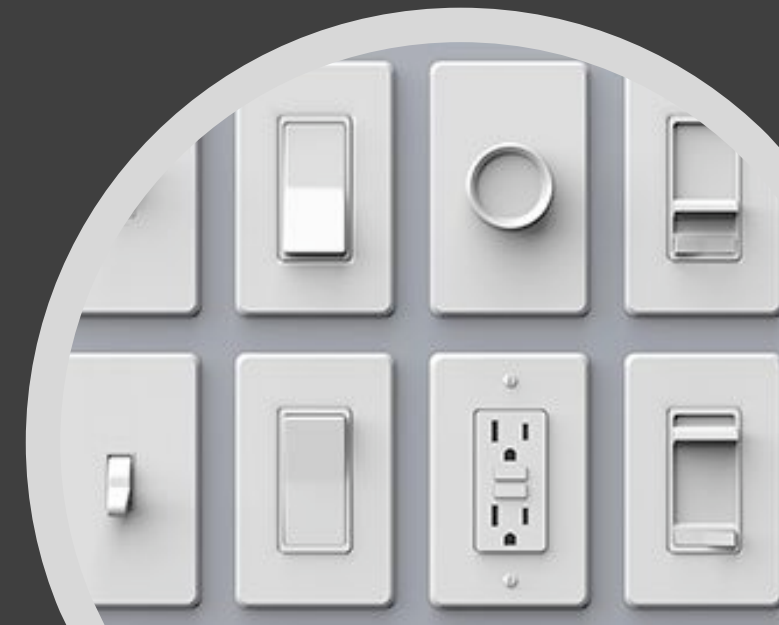
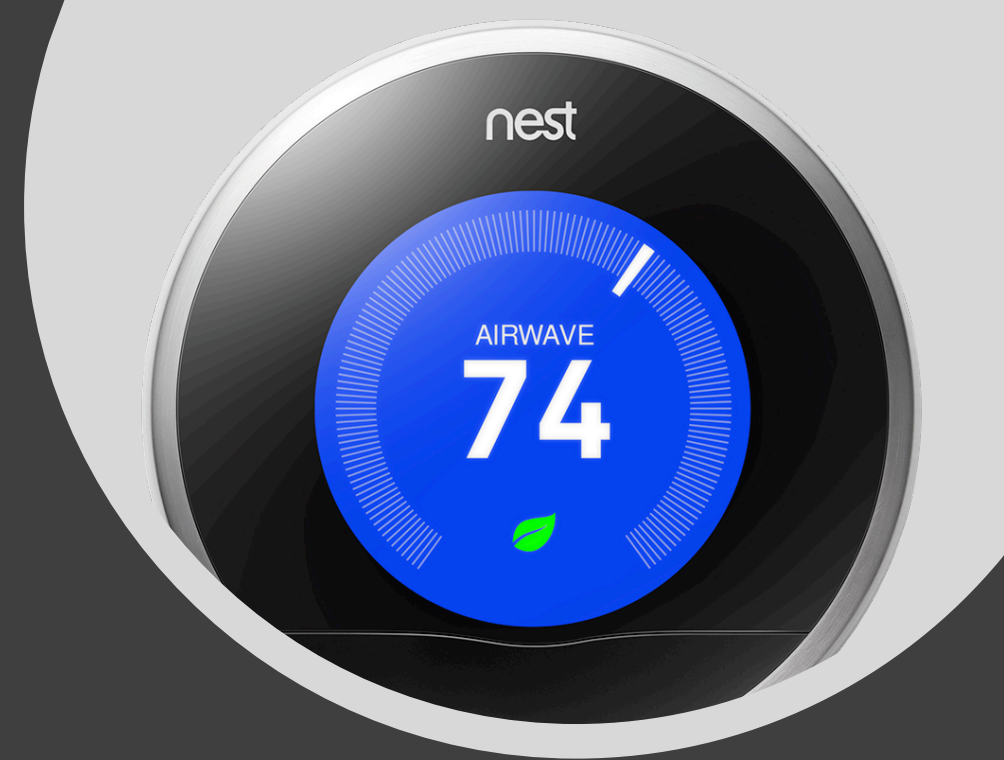
# Solar

- 246 kW of solar (683 panels @360W)
- Installed on roof and solar awnings on south wall
- Total annual generation: 296,141 kWh/yr, 1,398 kWh/yr excess
- 84 metric tons/yr carbon offset
- 11,978 SF covered
- SunPower Helix



# Operations

- Incentivizing tenants
  - Zero Place bundles power and water with rent
  - Building should largely run on its own, but tenants must not waste energy
- Monitoring infrastructure installed
  - Electric sub-metering of HVAC and plug load
  - Water sub-metering for individual hot and cold
- Social incentives
  - Gamification
  - Posting a "leader board" and average consumption
- Lease agreement limits – payments for exceeding a threshold
- Tenant selection – select tenants to participate in the ethic of the building



# Other Features

- 10 EV charging stations (with electric bike ports)
- 50 bicycle racks on the property
- Adjacent to Empire Trail
- Bus stop onsite
- $\frac{3}{4}$  mi from village center
- Bike lanes along street frontage
- Adherence to “complete streets” principles
- Seeking LEED Platinum and LEED pilot credit of Passive Survivability (maintains 50% F off grid)



# Modeled Building Performance

- HERS Index Score
  - -13 with solar (net-zero energy)
  - 35 before solar
- Produces 1,398 kWh/yr extra
- Reduce annual carbon emissions by 132 metric tons of CO<sub>2</sub>e
- More carbon saved through Complete Street principles

# Cost Analysis

- Estimate a 20% - 25% premium over NY ECC-code compliant building
- Estimate 8-10 year payback

Feature	Increase over reference	Benefits
ICF Walls	\$275,000	<ul style="list-style-type: none"><li>• Superior air barrier and insulation</li><li>• Extended life-cycle and reduced mnx</li></ul>
Solar PV	\$450,000	<ul style="list-style-type: none"><li>• Direct payback of 8.3 years, 12% IRR</li></ul>
GSHP	\$500,000	<ul style="list-style-type: none"><li>• 5-7 year payback due to doubling efficiency of ASHP</li><li>• Also ensures savings from peak demand charges</li></ul>
Eco-car Elevator	\$20,000	<ul style="list-style-type: none"><li>• 50%-80% less energy than conventional, regenerative drive</li><li>• Savings on rooftop machining</li></ul>



- Zero Place lot historically used for auto-related businesses.
- Burned down in Feb 2015



TRAIL  
X-ING



WALTON  
ROAD  
LEFT

CAUTION

CAUTION

CAUTION

CAUTION

CAUTION

CAUTION

CAUTION

CAUTION

CAUTION











AHEAD

# Policy ideas for decarbonizing buildings

- New buildings
  - Construct only low- and zero-carbon buildings
- Old buildings:
  - retrofit for energy efficiency (insulation, windows)
  - eliminate fossil fuel systems (HVAC primarily)

## Electrification

- Electrify all aspects of buildings (HVAC, appliances)
- Decarbonize electric production (wind, solar, hydro, nuclear)

## Finance

- Green loans for energy efficiency
- Accounting for energy efficiency in building values

## Incentives

- Aligning incentives of builders, owners, and tenants
- Cost of carbon

## Analytics and IT

- Install building monitoring systems
- Use analytics to optimize building efficiency

## Government Buildings

- Aggressively begin by transforming all federal, state, and local buildings