

As part of the State's effort to achieve a carbon-neutral economy, NYSERDA initiated the Buildings of Excellence (BOE) Competition in early 2019. The competition recognizes and rewards the design, construction, and operation of very low- or zero-carbon emitting multifamily buildings.

[nysersda.ny.gov/boe](https://nysersda.ny.gov/boe)



## Project Details

**Location:**

Geneva, New York

**Project Area:**

83,086 sq. ft

**Number of Buildings:**

4

**Number of Stories  
Per Building:**

3

**Number of Units:**

87

**Project Cost:**

\$15,841,215

**Cost per Gross Square Foot:**

\$191

**Market Sector:**

LMI

**Construction Type:**

New

**Construction Start Date:**

November 2022

**Completion Date:**

October 2023

**REDC Region:**

Finger Lakes

**Developer:**

The Solar Village Company

**Architect & Design Team Lead:**

Marc Rodriguez -The Solar Village Company, Sustainable Comfort, Inc.

**Technologies Used:**

Modular (Geneva), PV, ASHP to support space conditioning, ERV, ASHP DHW, induction cooktop, HP dryer, Smart buildings monitoring and controls.

## All-electric, net zero energy success in affordable multifamily housing

### Background

Geneva Solar Village is a four-building, 87-unit affordable multifamily rental development located in Geneva, NY. Each building is designed to achieve net zero energy performance, and includes on-site solar, solar storage, and electric vehicle (EV) charging. The project, which uses modular construction techniques, is one of the first developments in the northeast United States to integrate solar, storage, load management, and EV charging through energy management in service of low- to moderate-income (LMI) communities. The community also includes mixed-use spaces and a Farm Share. It is located within walking distance to Finger Lakes Health, Geneva High School, Middle School, Elementary, and the Geneva Community Center.

The project will have impacts beyond the Geneva Solar Village development, as the Solar Home Factory where the panels are manufactured is expanding to support additional modular developments in the region. The factory also has relationships with local community colleges and unions to recruit and train tradespeople to support advanced construction techniques.

### Key Project Features

The Geneva Solar Village project seeks to demonstrate that any increased cost from the integration of solar PV, air source heat pumps (ASHP), and air quality systems can be offset by labor savings from modular construction. Key project features include:

- ✓ **HVAC:** Minisplit—air source heat pump (ASHP), energy recovery ventilator (ERV)
- ✓ **Water Heating:** ASHP (A.O. HPTU 3.45EF)
- ✓ **Envelope:** Panelized R-9.6 ZipR
- ✓ **Lighting:** Light emitting diode (LED), daylighting.
- ✓ **Appliances:** Laundry: heat pump dryer, Cooking: induction range.
- ✓ **Renewables:** On-site solar PV.
- ✓ **Resilience Strategies:** Prolonged life of exterior materials, backup battery.

**Predicted Site Energy Use Intensity (EUI): 23.3 kBtu/SF/yr**

**Net Site Energy Use Intensity (EUI): 4.7 kBtu/SF/yr**

**Predicted Renewable Production Intensity (RPI): 12.1 kBtu/SF/yr**

**Energy Code Baseline: 2019 NYS Energy Conservation Construction Code (ECCC)**

**Performance Path: Energy Rating Index (ERI)**

**Certification: ENERGY STAR® Multifamily New Construction v1.1**

# Planning and Design Approach

## Project Goals

The Geneva Solar Village project will demonstrate that modular, net zero multifamily design has significant benefits to project development and long-term building operation, proving the viability of modular, net zero multifamily construction to other developers. The project team is using a panelized construction solution that is manufactured in the Geneva-based Solar Home Factory, which will be expanded to support additional projects and integrated into the region. The goal is to use the experience from this project to develop a modular construction solution in the factory, which will also be a net zero energy facility. This project will train and develop the local workforce and deploy additional similar projects in the region using this process. The Geneva Solar Village project will demonstrate a key aspect of the process: a single-design, lean-manufactured module that serves the one- to two-bedroom multifamily development market. This modular product will allow for easily replicable all-electric, net zero multifamily communities in locations across New York State. The project developers seek to achieve the following goals:

### Construction Efficiencies:

- Reduce overall construction time by 30% thereby reducing construction loan interest paid.
- Realize a 30% labor savings through modular construction.
- Apply a portion of labor savings to solar PV installation, achieving a cost-neutral integration.
- Reduce solar PV installation cost 35% by installing at the modular factory.

### Market demonstration:

- Design, manufacture, and construct a demonstration multifamily building 'package' that is pre-approved for underwriting for multifamily construction and permanent financing at preferred terms.
- Generate a tenant waitlist exceeding 100% of units prior to construction start through marketability of net zero living.
- Prove the marketability of a one-utility-bill lifestyle, net zero apartment.
- Increase living density and number of units for developer.

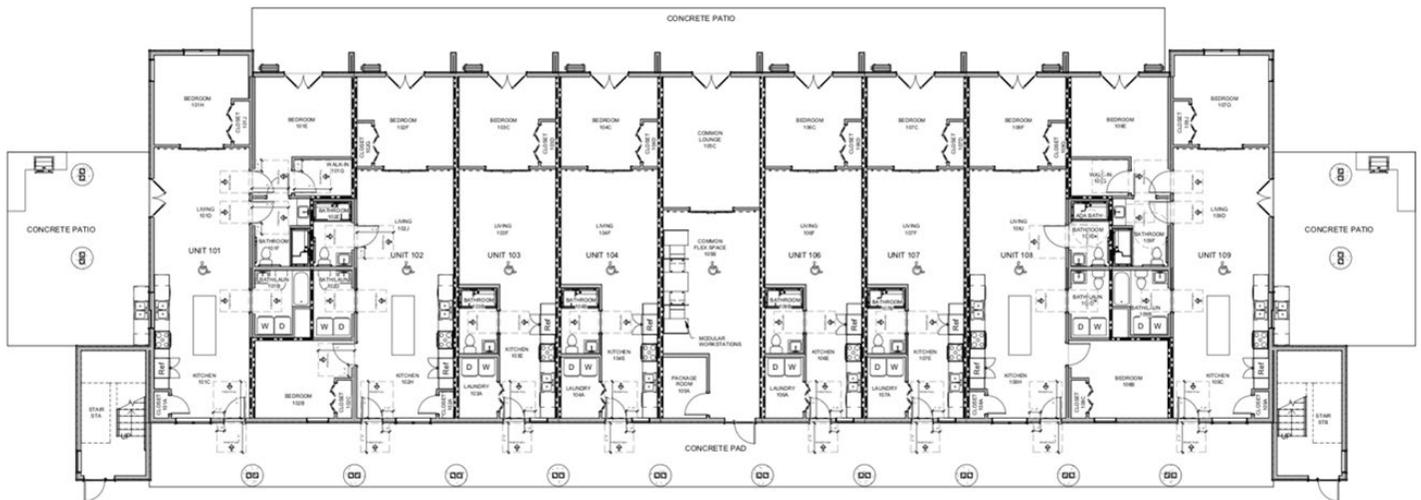
### Building performance and occupant experience:

- All-electric building with 100% on-site solar production for maximum carbon reduction.
- Prove viability of centralized air-source heat pump for domestic hot water systems.
- Improve multifamily livability through larger, higher quality common spaces.

## Project Team

The project developer and architect for Geneva Solar Village was the Solar Village Company, with Sustainable Comfort serving as the design team lead and primary energy consultant. The wall panels used in construction will be manufactured locally by the Solar Home Factory. The general contractor is Solar Village Company, and the project partnered with unions including Local 840 and Local 276.

## Building Design



Floorplan provided by project developer the Solar Village Company.

This project is a continuation of the net zero, high-performance modular buildings first constructed at Lake Tunnel Solar Village community in Geneva, NY. The goal of the project is to manufacture modules as a complete unit in the locally based Solar Home Factory.

The project will integrate solar PV, air-source heat pumps, and indoor quality systems—the cost of which can be offset by labor savings from modular construction. The buildings are insulated using Zip R-sheathing to maximize the amount of continuous insulation and limit thermal bridging. Additionally, the team has worked to optimize the building, roof, and site layout to meet the load of the building via PV panels on the roof. This will reduce the PV costs and not require an off-site solar system.

The proposed domestic hot water (DHW) system is a high-efficiency, air-to-water package system. Domestic hot water (DHW) will be supplied via the use of a tanked air-source heat pump. The cooling and heating will be supplied via ductless heat pumps. The LG Heat Pumps are highly efficient wall mounted units ideal for small spaces.

## Energy Modeling

The energy modeling tool used on this project was Ektrope V4.0.1, receiving certification from ENERGY STAR® Multifamily New Construction v1.1 and participating in the NYSERDA New Construction—Housing Program, meeting Tier 4 (Net Zero) performance. In addition, the project was awarded through round one of NYSERDA's Buildings of Excellence Competition.

A representative sample set of dwelling units were modeled, and their performance rated in accordance with the ANSI/RESNET/ICC 301-2019 standard to establish an Energy Rating Index (ERI). These units include the one-bedroom on the first, second, and third floor (exterior only), and the two-bedroom units on the first, second, and third floor (both interior and exterior). All dwelling units have pre-PV (ERI) in the low 40's, varying by number of beds and location in building, and a post-PV ERI that range from -1 to -7. [An ERI is often referred to as the Residential Energy Services Network (RESNET) Home Energy Rating System or HERS Rating]

Additional details of the features included in the energy model are as follows:

- Windows are modeled with a solar heat gain coefficient of 0.26 and U-value of 0.16.
- Wall assemblies are modeled with R-9.6 continuous insulation with R-20 cavity insulation for the panelized wall system.
- The ceiling is modeled as an unvented R-49 flat roof.
- Heat pump for heating and cooling is modeled as LG (12/kBTU/h) with a 3.1 coefficient of performance for heating and 10.5 energy efficiency ratio for cooling.
- The energy recovery ventilation (ERV) is modeled with an efficiency of 66% Apparent Sensible Effectiveness (ASE).
- Air leakage is modeled at 0.3 cubic feet per minute at 50 Pa (CFM50) per square foot of enclosure.
- The domestic hot water system, which is a tanked heat pump water heater (HPWH), was modeled with a 3.45EF.
- The model assumes an electric HP dryer, induction ranges, and ENERGY STAR® refrigerator, dishwasher, and clothes washer.

The two-bedroom units use between 14.8 to 15.3 MBtu/year and the studio units use between 10.3 to 11.0 MbtU/year.

## Energy Efficient, All-Electric Design

### High-Efficiency Lighting Fixtures and Appliances

This project is designed to incorporate LED light fixtures and daylighting strategies to reduce the energy load from lighting. Each apartment will be fit with heat pump clothes dryers, which are much more efficient than standard electric dryers. Additionally, each unit has temperature controls in each bedroom and major living space.

### Building Envelope

The buildings are insulated using a panelized wall system to maximize the amount of continuous insulation, limit thermal bridging and maximize structure and insulation. Below is a detailed description of the exterior envelope:

- **Roofs:** R-49
- **Foundation insulation:** The building will be built above an unvented crawl space with R-15 insulated concrete forms (ICF).
- **Exterior walls: Panelized Wall System:** R-9.6 continuous insulation with R-20 dense pack cellulose cavity insulation.
- **Windows/doors:** Kohltech Triple-pane Energlass Plus low-solar gain (LSG), and energy efficient doors.

The panelized wall system, triple-pane windows, and air-source heat pump serve to create a building envelope that is 35% better than code levels of insulation based on building UA Analysis.

### All-Electric Systems

The Geneva Solar Village will include all-electric systems with no on-site fossil fuel combustion. All heating and cooling systems will be served by high-efficiency, air-source heat pump systems. The hot water will be served by air-to-water tanked heat pump and the entire electrical load of all systems will be offset by solar panels located on the roof and site. In addition to these systems, the project features renewable energy generation and electric vehicle charging stations. There will be a 518-kilowatt (kW) modular-integrated solar PV system mounted on the roof and surrounding site to serve the electric needs of each building. Electric vehicle charging stations will be located on site in addition to the 10-vehicle fleet of electric vehicles available for checkout by residents.

## Renewable Energy

The project will include a 459-kW modular-integrated solar PV system. Panels will be mounted on the entire roof top as well as potential solar carports to serve the electric needs of each building. The design optimizes the building, roof, and site to meet the load of the building through the generation of these panels. This will reduce the PV costs and means that the project does not require an off-site solar system.

## Energy Consumption Feedback and Smart Building Technologies

Smart building technologies used in the Geneva Solar Village project include temperature controls, energy recovery ventilation, and electric vehicle charging stations.

Electric vehicle charging stations, still under consideration, will be located on site to encourage the use of electric vehicles that can be powered by an on-site solar generator. An EV car share program will be provided to residents allowing them to reserve and use shared community EVs.

The project is designed to include in-unit displays that show energy usage relative to other anonymized neighbors. This allows residents to understand how much energy they are using relative to their neighbors without disclosing any specific information about other residents. Providing this data in an easy-to-understand format helps residents to understand their energy usage in context and encourages them to reduce where possible.

## Building Operations

### Leasing Structure

The developer will seek to pre-lease over 60% of apartments prior to the start of construction, using the project's sustainable nature as a selling point. By pre-leasing this share of the project's occupancy, the developer will achieve the minimum Debt-Service Coverage Ratio (DCSR) required for multifamily housing by most lenders prior to construction start. Residents' leases include all utilities, internet, and TV.

### Cost Reduction

The Geneva Solar Village will show a cost per dwelling unit and per square foot that is comparable to traditional construction. This is due in large part to the cost savings achieved through modular construction, which reduces overall labor costs and material waste. The project will quantify these savings on a net zero multifamily project.

In addition, the highly efficient building envelope which includes the panelized wall construction, triple-pane windows, and air source heat pump systems will result in a 35% reduction in heating costs compared to the 2015 International Energy Conservation Code (IECC) and 63% reduction in heating costs compared to the 2015 IECC with federal minimum equipment standards.

## Additional Benefits

### Site Context

The Geneva Solar Village project is developed on a compact site footprint roughly three acres in size which achieves a density of 35 units per acre; this far exceeds the density of the surrounding areas. The existing density of downtown Geneva, NY is eight units per acre, and the area surrounding the site is 5.6 units per acre, according to the 2010 census tract data. The project is located within walking distance to Finger Lakes Health, Geneva High School, elementary and middle schools, and the Geneva Community Center.

This project will also create 90 additional, local, permanent full-time jobs for the manufacturing of modules at the Solar Homes Factory which is located in Geneva, NY. As a result of the Geneva Solar project, the factory is undergoing an expansion of over 100,000 square feet to support future modular construction projects and has several buildings in queue for development. The factory supports recruitment and training of local tradespeople through partnerships with local high schools, community colleges, and unions. Through the program, students and tradespeople become employees of the factory, joining the relevant union as a pre-apprentice, and go through apprenticeship in the factory. This is especially efficient for the advanced construction techniques needed in modular construction, as traditional union apprenticeships focus more broadly. Through this program, the factory is able to train talent in the trades and techniques most relevant for modular construction applications.

*The Geneva Solar Village will push the integration of renewable systems in the rapidly growing modular-multifamily construction segment. This will be done through refining modular constructability and cost savings, including solar PV to get to net zero operation, and tracking and sharing data related to construction cost, energy use during operation, and financial performance of the project.*

## Community Engagement

The project will develop and maintain a website to share data for the project, including comparisons of ongoing energy use from the Lake Tunnel Solar Village and Geneva Solar Village. The Solar Homes Factory has already been widely involved in presentations, case studies, and tours of the Lake Tunnel Solar Village to demonstrate the viability of this type of construction. Additionally, the Solar Village Company intends to distribute designs, schematics, and processes to the public as a means of fostering increased implementation and developer acceptance.

Through the Building of Excellence award, the project plans to scale this development to multifamily construction and provide a model for construction around the State and country.

## Occupant Health, Comfort, and Productivity

Interior surfaces will include commercial vinyl plank flooring with a 30-year wear layer warranty and laminate designer shower and bath surrounds. The project panel construction and triple-pane windows allow for superior exterior noise reduction.

Each apartment will include a temperature control in each bathroom and major living space. The indoor air quality will be greatly enhanced through use of energy recovery ventilation. Each apartment will include continuously operating fresh air ventilation through ERV which pulls stale air from bathrooms and kitchens and brings in fresh air to all rooms, while exchanging 66% of the energy.

## Resiliency

The exterior surfaces will include steel siding, polyvinyl chloride (PVC) trim, and triple-pane vinyl windows, all selected for maximum long-term durability. This emphasis on long-term durability will prolong the life of materials. In addition, the superior building envelope and air sealing designed into this project will provide enhanced thermal survivability in the event of a power disruption.

The project is designed to generate enough energy through solar PVs to supply its energy needs on an annual basis, reducing reliance on grid electricity. In addition, the development has battery backup storage to provide power during times of damage, disruption, or when the PVs are not producing.

## Lessons Learned

- Modular net zero multifamily design can be cost-comparable to traditional multifamily construction.
- Replicability is a key factor—using a repeatable and adaptive design allows the team to build on their experience and learn from previous projects.
- The project team is continuing to refine the mechanical system package for the modular construction pods. They have encountered technical challenges with off-the-shelf solutions, and are working with outside engineers, including NREL, to develop solutions at the appropriate scale for these applications.
- Designs that incorporate smaller individual living spaces with larger outdoor community spaces, along with community programming and shared resources are a marketable concept in the affordable multifamily market.
- Where incentives are available, project teams should tailor projects/products to be eligible for incentives and support to reduce costs for the customer.
- Incentive programs drive decision making through their design, not just the incentive itself. Well-designed incentive programs encourage quality control, and help to organize the team, data, and analysis around common goals.

## Ready to get started?

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