Solar Decathlon Design Challenge 2024

Georgia Institute of Technology
Residential Division - Single-Family Housing

Project Summary

The 2024 Solar Decathlon team from Georgia Tech consists of 15 student members with diverse academic and professional experiences. The team connects the institution's academic resources and industry network to collaborate with underserved communities in Westside Atlanta using the Asset-Based Community Development approach.

Atlanta ranks 4th in the nation in median energy burden levels and 3rd among low-income households. Many communities in Westside Atlanta face energy burdens, equity theft, and displacement. The team's collective vision is to make broad and long-lasting impacts in the region to address its energy and housing challenges, support the transition to a clean energy economy, and develop a green workforce.

Design Strategies

As an integration into a historic neighborhood, the new construction on the existing foundation of 258 Andrew J Hairston in Vine City aims to fit flawlessly into the existing context while providing new homeowners with a simple and efficient system for energy conservation. This 3-bedroom, 2-bathroom house follows all design guidelines established by the Vine City neighborhood to ensure that the design can be easily replicable throughout this neighborhood and other similar communities to make sustainability more accessible. The team seeks to design entirely with off-the-shelf products to ensure maintenance is simple for the homeowner while keeping the system interfaces easy to understand and operate. These changes will make it effortless for a legacy resident to take on homeownership for the first time.

Project Data

- Location: Vine City, Atlanta, GA
- Climate Zone: 3A
- Building Size: 1260 sqft
- Occupancy: 3-5 people
- Construction Cost: $198/sqft
- Source EUI: 16.8 kBtu/sqft
- HERS: 38/-2 (without/with solar energy)
- Average Utility Cost: $48/month
- Annual Carbon Emission: 0.58 lbs/sqft/yr

Technical Specifications

Thermal Performance

Exterior Wall: R-20 Attic: R-49
Foundation Wall: R-19 Windows:U-0.17
SHGC: 0.22

HVAC: Air Source Heat Pump
SEER: 19 HSPF: 10.2
Rooftop Solar: 5 kW

Design Partners: Westside Future Fund, Lifecycle Building Center
Industry Partners: Lord Aeck Sargent, Skanska, Southface Institute

Project Highlights

Architecture: The floor plan is inspired by traditional southern design techniques, which maximize natural ventilation and strategic shading. The exterior design, including the gable roof, front porch, and the façade, matches the neighborhood vernacular and local design guidelines. Many passive design techniques work together to minimize mechanical loads and are the first step towards the net zero energy goal.

Engineering: With a well-insulated envelope, the house utilizes a one-ton air source heat pump to meet the cooling and heating loads. In addition, an ERV supplies clean and fresh air to each room of the house. All ductwork runs in the conditioned crawlspace. A heat pump water heater is installed in a central location to provide hot water efficiently through insulated pipes.

Envelope: The house's exterior 2x6 walls and ceiling feature cellulose insulation. Additionally, the ZIP insulated sheathing system is employed to enhance continuous insulation and function as a vapor barrier. Closed-cell spray foam insulates the crawlspace walls, bolstering structural integrity and keeping the space unharmed from moisture and water.

Efficiency: The Building Energy Optimization Tool (BEopt) is used for design selections to optimize energy performance. Energy Star appliances and systems are chosen for energy efficiency and minimal maintenance to simplify long-term living. A 5 kW solar system is installed to meet the net-zero energy goal and reduce energy burden.

Grid-Interactivity: Enrolling the home in Georgia Power's Instantaneous Net-Metering Program allows for the homeowner to offset their electricity bill. Energy management systems are implemented to shift equipment schedules to reduce peak-hour electricity load from the grid while saving costs as well.

Life-Cycle: The design incorporates reclaimed materials from a local reuse center, Lifecycle Building Center, and other low-carbon, nontoxic, virgin materials in the market to lower the embodied carbon. EC3 emission factor database, Tallycat, and EPA Waste Reduction Model (WARM) are used to perform a cradle-to-grave life cycle assessment with an analysis of lifecycle greenhouse gas emissions.

Health: The house design prioritizes accessibility with a one-floor layout for ease of movement and maximum space. Outlets, storage, and working surfaces are strategically placed for clear visibility and easy access. Home systems, including thermal comfort, lighting, and security, are controllable through a user-friendly physical panel.

Market: By leveraging local non-profit initiatives and reconfiguring subsidy streams, our team enables affordable housing at 80% of the Area Median Income with a budget of $198/square foot for construction costs. The project incorporates energy conservation, resulting in savings of over $2,695 annually. By reducing the energy burden, the homeowner can better afford the home, allowing for long-term living and a path toward generational wealth.

Community: The project team collaborates closely with community-based organizations in the area to build trust with the residents and ensure the project is replicable, affordable, and sustainable. During construction, workforce training and workshops will be implemented to empower community members through access to green-economy career pathways and entrepreneurship.