



SOLAR DECATHLON DESIGN CHALLENGE 2022



Georgia Institute of Technology
Retrofit Housing I 2022-04-05

English Avenue Yellow Jackets



Project Summary

Georgia Institute of Technology's team is a collaboration of 12 students from diverse educational, professional, and geographic backgrounds. Together, our goal is to create a replicable model for renovating the many vacant and derelict houses in the English Avenue neighborhood into affordable, healthy, and energy-efficient homes. In doing so, we envision contributing to a neighborhood that is not just a vibrant place to live but also is a platform for the upward mobility and prosperity of its residents.

With 60.53% of the residents in this census tract being housing burdened, spending more than 30% of their incomes toward rent or mortgages, and 44% of the adjacent lands being blighted, this retrofit housing project is set amidst a once-vibrant, thriving working-class neighborhood. The 'Westside Land Use Framework Plan' (2017) was formulated to advocate for the desires and needs of the community and to promote new opportunities for its revitalization. Our solution to the single-family residential retrofit typology aims to transform the performance of existing housing and help make a place that is simultaneously more sustainable and more equitable.

Design Strategy

Our design builds upon pillars that support replicability, historic preservation, climate-specific interventions, thermal comfort, cost-effectiveness, water conservation techniques (e.g., rainwater harvesting and greywater reuse), and a net-zero energy footprint. Our design for the renovation of the existing, 102-year-old-home at 588 James P. Brawley in English Avenue demonstrates a viable, replicable model for transforming derelict properties on the Westside of Atlanta into net-positive energy homes that are affordable to homeowners at 60% of Area Median Income (AMI).



Project Data

- **Location:** The English Avenue, Atlanta, GA
- **Climate Zone:** 3A
- **Building size:** 946 sq ft
- **Occupancy:** 2-4 people
- **Construction cost:** \$218 - \$243 / sqft
- **EUI:** 12.09 kBtu/ft²
- **Average utility cost:** \$537 annually
- **Annual carbon emission:** -0.2

Technical Specifications

Thermal performance:

Exterior Wall: R-25	Attic: R-60
Foundation Wall: R-6	Windows: U - 0.27
	SHGC - 0.21

HVAC: Ducted Mini-Split Heat Pump
18 SEER, 11 HSPF

On-Site PV: 6kW

Partners

Design Partner: Westside Future Fund

Industrial Partner: Perkins & Will

Project Highlights

1. Architecture: In order to seamlessly integrate this net-positive energy home into the existing community, our architectural design approach balances the preservation of the historic character of the 102-year-old house with subtle modifications to improve performance aspects such as PV exposure and daylighting. Our proposed solutions intend to renovate building envelopes and redesign spaces that foster multi-generational living by renovating features like porches, allowing for greater socialization while enhancing performance and energy efficiency.

2. Engineering: The engineering of the project focuses on reducing energy and water consumption with a view toward reducing the utility burden on the homeowner. By super-insulating the building envelope and taking care to greatly reduce air leakage, heating and cooling loads are greatly reduced. This allows for smaller mechanical units, which take the form of a series of efficient mini-split systems supplemented by controlled ventilation provided through an ERV. Additionally, rainwater harvesting and greywater recycling systems eliminate the use of potable water for irrigation and flush fixtures.

3. Market Analysis: Building upon the affordability programs championed by local non-profits Westside Future Fund and Atlanta Land Trust and repositioning their existing subsidy streams, our team has developed a strategy to offer this home at 60% of Area Median Income (AMI) while still providing an ample budget of \$243/sf to meet its performance goals. All told, the energy and water conservation strategies of this project reduce annual utility bills by over \$1,350 (72% reduction). When combined with the equity sharing, property tax reduction, and maintenance cost-reducing benefits of a community land trust model, we estimate the homeowner will be able to accrue benefits of almost \$71,096 in present value over the course of an average six-year period of ownership.

4. Durability and Resilience: Selection of materials, assemblies, and systems emphasize ease of maintenance and durability. Resilient siding and flooring materials reduce wear and tear on the home while mechanical systems, controls, and fixtures prioritize ease of use for the homeowner. Additionally, as an Atlanta Land Trust home, the house is enrolled in the non-profit's stewardship program, which assumes the costs of major annual maintenance.

5. Embodied Environmental Impact: The selection of building materials balances the project's primary emphasis on energy performance with the ecological impacts of those material selections. For example, our team has chosen to use mineral wool and blown-in cellulose products for much of the thermal barrier in lieu of spray foam products with higher global warming impacts. Additionally, an emphasis on wood and bio-based materials tested through our Environmental Life Cycle Assessment produces a project that boasts 10,010 kg of biogenic carbon storage.

6. Integrated Performance: The team's integrated approach to design and performance is exemplified in the home's roof, which inspired the logo of our competition submission. The traditional gabled roof form has been retained because of its importance to the identity of the English Avenue neighborhood, but with almost imperceptible modifications that improve PV exposure and the thermal barrier performance. The roof also supports the collection of rainwater as part of a conservation approach that completely eliminates potable water use for irrigation and flush fixtures.

7. Occupant Experience: The simple approach of the architectural and engineering design of the home makes its technologies accessible to the homeowner. Smart thermostats and controls systems for PV and other systems allow for easily digestible feedback and ease of use. Combined with the flexible and functional layout of the home, the house becomes a comfortable setting for families to live, work, and relax.

8. Comfort and Environmental Quality: The primary component addressed in this domain includes improving indoor comfort through measures that enhance IAQ levels and light quality. Introducing natural daylighting, non-toxic paint application, and adequate air and water filtration systems will address occupant comfort and health in the long run through flexible and responsive design.

9. Energy Performance: The end result of our design methodology is a modeled pre-PV HERS score of 44 with an EUI of 12.09 kBtu/sf. The project is completed with a 6kW photovoltaic system that offsets the projected energy consumption in order to make it a net-positive energy home.