2024
Solar Decathlon
Design Challenge

258 Andrew J. Hairston

Presented by
Georgia Tech Solar
Decathlon Team
Faculty Advisor, Professor of the Practice, Licensed GC
Frank Wickstead

3rd Year - Civil Engineering
Jackie Zong

3rd Year - Civil Engineering
Arya Desai

3rd Year - Building Construction
Charles Morris

Masters - Architecture
Rachel Witherspoon

Masters - Building Construction
Aidan Risey

4th Year - Architecture
Yona (Yuhan) Wang

Masters – Business Administration and Environmental Engineering
Wyatt Williams

3rd Year - Architecture
Julie Chen

4th Year - Architecture
Anushka Kibria

1st Year - Architecture
Kiki (Jingqi) Ruan

4th Year - Building Construction
Nader Osman

3rd Year - Building Construction
Joel Jimenez

1st Year - Building Construction
Mahlon Sale

3rd Year - Building Construction
Carlos Hernandez

PhD - Civil Engineering
Arjun Thangaraj

Ramshankar

MEET THE TEAM

2 |
COMMUNITY
Historic Underinvestment | Yes
Low Income | 93rd Percentile
Energy Cost | 91st percentile
Housing Cost | 95th percentile
Molly and Joe and their two children
$68,000, <80% AMI
• Existing house was built in **1930**
• Deemed **unsafe to enter**
• New home will have **same footprint** as existing house
• Engaged local residents about the project
LOCAL CLIMATE

Spring | Average: 8.6 mph
Summer | Average: 7 mph
Fall    | Average: 8.3 mph
Winter  | Average: 10.6 mph

Precipitation | Average: 4.2"
Temperature    | Average Low: 51.2°F  Average High: 69.6°F
Humidity      | Average: 69%
Cloud Coverage | Average: 37%
DAYLIGHTING

SDA - 51.8%

ASE - 4.5%

Glare - 9.3%

Illuminance - 620 avg lux
MATERIAL SELECTION CRITERIA

- Occupant Health
- Low Embodied Carbon
- Affordable
- Locally Sourced
- Reclaimed
Roof: Standing Seam Metal

Insulation: Cellulose

Siding: Pine with Drainage Plane

Reclaimed Materials: Lighting Fixtures, Doors
Cabinet: Reclaimed Furniture
Paint: No-VOC
Appliances: Energy Star
Flooring: Bamboo and Carpet
ENGINEERING
- Advanced framing
- Dense pack cellulose
- 2x6 at 24” on center + R-6 ZIP Sheathing
- **R-25 in total**
- Engineered I-Joist
- Closed Cell Spray Foam w/ HFO
- **R-19 in total**
- Ventilation baffles
- Loose fill cellulose
- R-49 in total
Air Source Heat Pump
SEER 19, HSPF 10.2

Energy Recovery Ventilator (ERV)
MERV 13 Filter

Heat Pump Water Heater
50 gal, UEF = 3.7
- Daylight LED lighting
- Outlet switches
The excess energy will offset the energy bill through Georgia Power's RNR-Instantaneous Netting Program.
Site Energy Use (MBtu/yr) - B10 Benchmark vs. New Design

Total Consumption: 61.3

B10 Benchmark:
- Hot Water: 14.6 MBtu/yr
- Heating (G): 22.0 MBtu/yr
- Cooling: 5.7 MBtu/yr
- PV Production: 24.6 MBtu/yr
- Vent Fan: 4.1 MBtu/yr
- Lg. Appl.: 5.4 MBtu/yr
- Misc.: 7.0 MBtu/yr

New Design:
- Hot Water: 4.7 MBtu/yr
- Heating (E): 5.5 MBtu/yr
- Cooling: 4.1 MBtu/yr
- PV Production: 24.6 MBtu/yr
- Vent Fan: 5.4 MBtu/yr
- Lg. Appl.: 7.0 MBtu/yr
- Misc.: 5.7 MBtu/yr

Total Consumption: 19.6 MBtu/yr
<table>
<thead>
<tr>
<th>A1 - A3 PRODUCTION STAGE</th>
<th>A4 - A5 CONSTRUCTION STAGE</th>
<th>B1 - B7 USE STAGE</th>
<th>C1 - C4 END OF LIFE STAGE</th>
<th>D OPTIONAL INFORMATION STAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1</td>
<td>Transport to site</td>
<td>Use</td>
<td>B1</td>
<td>Use</td>
</tr>
<tr>
<td>A2</td>
<td>Transport to factory</td>
<td>Maintenance (+production, transport &amp; disposal of necessary materials)</td>
<td>B2</td>
<td>Maintenance (+production, transport &amp; disposal of necessary materials)</td>
</tr>
<tr>
<td>A3</td>
<td>Manufacturing</td>
<td>Repair (production, transport &amp; disposal of necessary materials)</td>
<td>B3</td>
<td>Repair (production, transport &amp; disposal of necessary materials)</td>
</tr>
<tr>
<td>A4</td>
<td>Installation</td>
<td>Replacement (+production, transport &amp; disposal of necessary materials)</td>
<td>B4</td>
<td>Replacement (+production, transport &amp; disposal of necessary materials)</td>
</tr>
<tr>
<td>A5</td>
<td>Operational energy use</td>
<td>Refurbishment (+production, transport &amp; disposal of necessary materials)</td>
<td>B5</td>
<td>Refurbishment (+production, transport &amp; disposal of necessary materials)</td>
</tr>
<tr>
<td>B6</td>
<td>Operational energy use</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B7</td>
<td>Operational water use</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Included in Emission Factors**

- Operational Energy Use

**Included in End-of-Life Emission Factors**

- Potential net benefits from reuse, recycling, carbon offsets, renewable energy, and/or energy recovery beyond the system boundary.
Cumulative Emissions (kg CO$_2$e)

- 1,466 kg CO$_2$e
- 11,025 kg CO$_2$e
- 17,538 kg CO$_2$e
- 30,029 kg CO$_2$e

75 Year Building Lifespan

Cumulative Emissions
- Embodied Emissions
- Operational Emissions
- End of Life Emissions
### Grid Intensity Scenario

<table>
<thead>
<tr>
<th>Scenario</th>
<th>258 Andrew J. Hairston Building Design (kg CO₂e)</th>
<th>B10 Benchmark (kg CO₂e)</th>
<th>Difference (kg CO₂e)</th>
<th>Acres of North American Forest</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conservative</td>
<td>11,025</td>
<td>450,675</td>
<td>439,650</td>
<td>513</td>
</tr>
<tr>
<td>95% by 2050</td>
<td>13,950</td>
<td>327,825</td>
<td>313,875</td>
<td>366</td>
</tr>
<tr>
<td>95% by 2035</td>
<td>12,150</td>
<td>273,150</td>
<td>271,000</td>
<td>305</td>
</tr>
</tbody>
</table>

**Georgia Power Energy Mix as of 2022**

- **Gas / Oil**: 48%
- **Coal**: 15%
- **Hydro**: 2%
- **Renewables**: 7%
- **Nuclear**: 5%
- **Null**: 5%

**Operational Carbon Output**
258 Andrew J. Hairston

= \frac{1}{15}

Average North American Single-Family House
Home Energy Rating Certificate
Projected Report
Based on Plans

HERS® Index Score: 38
Your home's HERS score is a relative performance score. The lower the number, the more energy efficient the home. To learn more, visit www.hersindex.com

Annual Savings: $1,785
*Relative to an average U.S. home

Home: 258 Andrew J Hairston
Atlanta, GA 30314
Builder:

Your Home's Estimated Energy Use:

<table>
<thead>
<tr>
<th>Use [MBtu]</th>
<th>Annual Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating</td>
<td>4.7</td>
</tr>
<tr>
<td>Cooling</td>
<td>1.8</td>
</tr>
<tr>
<td>Hot Water</td>
<td>1.5</td>
</tr>
<tr>
<td>Lights/Applicances</td>
<td>14.6</td>
</tr>
<tr>
<td>Service Charges</td>
<td>0</td>
</tr>
<tr>
<td>Generation (e.g. Solar)</td>
<td>0</td>
</tr>
<tr>
<td>Total:</td>
<td>22.7</td>
</tr>
</tbody>
</table>

This home meets or exceeds the criteria of the following:
2015 International Energy Conservation Code

Home Feature Summary:
- Home Type: Single family detached
- Model: N/A
- Community: N/A
- Conditioned Floor Area: 1,260 sq ft
- Number of Bedrooms: 3
- Primary Heating System: Air Source Heat Pump • Electric • 10.2 HSPF
- Primary Cooling System: Air Source Heat Pump • Electric • 19 SEER
- Primary Water Heating: Residential Water Heater • Electric • 3.8 UEF
- House Tightness: 2 ACH50
- Ventilation: 70 CFM • 70 Watts (Dehum) • ERV
- Duct Leakage to Outside: Unvented Forced Air
- Above Grade Walls: R-20
- Ceiling: Attic: R-50
- Window Type: U-Value: 0.17, SHGC: 0.22
- Foundation Walls: R-19
- Framed Floor: N/A

Rating Completed by:
- Energy Rater: Jackie Zong
- RESNET ID: 2JoahpWL
- Rating Company: Solar Decathlon at Georgia Tech
- Rating Provider:

Jackie Zong, Certified Energy Rater
Date: 2/13/24 at 11:34 AM

Ekotrope RATER: Version 4.1.3337
The Energy Rating Disclosure for this home is available from the Approved Rating Provider. This report does not constitute any warranty or guarantee.
## Home Energy Rating Certificate

**Projected Report**

Based on Plans

<table>
<thead>
<tr>
<th>HERS® Index Score:</th>
<th>Annual Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>-2</td>
<td>$2,695</td>
</tr>
</tbody>
</table>

Your home’s HERS score is a relative performance score. The lower the number, the more energy efficient the home. To learn more, visit www.hersindex.com

### Home: 258 Andrew J Hairston

**Atlanta, GA 30314**

**Builder:**

<table>
<thead>
<tr>
<th>Your Home’s Estimated Energy Use:</th>
<th>Annual Cost</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating</td>
<td>4.7</td>
<td>$189</td>
</tr>
<tr>
<td>Cooling</td>
<td>1.8</td>
<td>$72</td>
</tr>
<tr>
<td>Hot Water</td>
<td>1.5</td>
<td>$61</td>
</tr>
<tr>
<td>Lights/Appliances</td>
<td>14.6</td>
<td>$589</td>
</tr>
<tr>
<td>Service Charges</td>
<td></td>
<td>$0</td>
</tr>
<tr>
<td>Generation (e.g. Solar)</td>
<td>23.6</td>
<td>-$911</td>
</tr>
<tr>
<td>Total</td>
<td>22.7</td>
<td>$0</td>
</tr>
</tbody>
</table>

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- **Above Grade Walls:** R-20
- **Ceiling:** Attic, R-50
- **Window Type:** U-Value 0.17, SHGC 0.22
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**Rating Provider:**

Jackie Zong, Certified Energy Rater

(Date: 2/13/24 at 11:36 AM)

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Ekotrope - Version 1.2.1137

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<table>
<thead>
<tr>
<th>Item</th>
<th>Cost</th>
</tr>
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<tbody>
<tr>
<td>Land Cost</td>
<td>$100,000</td>
</tr>
<tr>
<td>Interior Finishes</td>
<td>$47,000.00</td>
</tr>
<tr>
<td>Exterior Finishes</td>
<td>$31,000.00</td>
</tr>
<tr>
<td>Demolition</td>
<td>$10,000.00</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>$11,000.00</td>
</tr>
<tr>
<td>Plumbing</td>
<td>$12,000.00</td>
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<tr>
<td>PV</td>
<td>$15,000.00</td>
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<tr>
<td>Design Fees</td>
<td>$15,000.00</td>
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<tr>
<td>HVAC</td>
<td>$16,000.00</td>
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<tr>
<td>Contingency</td>
<td>$25,000.00</td>
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<tr>
<td>Insulation</td>
<td>$8,000.00</td>
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<tr>
<td>Electrical</td>
<td>$7,000.00</td>
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<tr>
<td>Foundation Repair</td>
<td>$6,000.00</td>
</tr>
<tr>
<td>Framing</td>
<td>$47,000.00</td>
</tr>
<tr>
<td>Total Cost</td>
<td>$350,000</td>
</tr>
</tbody>
</table>
$100,000 Downpayment Assistance

Mortgage P&I (30 YR Fixed at 6.59%) = ($1595)

Molly and Joe and their two children
$68,000, <80% AMI

MONTHLY ENERGY SAVINGS: $225

- 2 Weeks of Groceries
- 4-Month Supply of Insulin
- Monthly Car Insurance Payment
- 2 Monthly Public Transit Passes
Replicability
• Maintaining Neighborhood Character
• Westside Future Land Use Framework Plan
• Local Reuse Centers

Sustainability
• Low Embodied Carbon
• Envelope Efficiency
• Net Zero with PV

Affordability
• Passive Design
• Energy Savings
• Downpayment Assistance
THANKS TO OUR SUPPORTERS
ENVELOPE DETAILS

ZIP TAPE OVER MTL FLASHER @ HEADER
PRE-FINISHED METAL FLASHING
1/2" RIGID INSULATION
WOOD TRIM
DRIPL CAP
5/4 X 4 WOOD TRIM
ZIP TAPE
BACKING ROD & SEALANT OR LOW EXPANSION FOAM
WD FRAME
INSULATED FIBERGLASS DOOR
DOOR SWEEP
WD THRESHOLD

EXTERIOR

INTERIOR

ZIP TAPE OVER MTL FLASHER @ HEADER
PRE-FINISHED METAL FLASHING
1/2" RIGID INSULATION
WOOD TRIM
DRIPL CAP
5/4 X 4 WOOD TRIM
ZIP TAPE
BACKING ROD & SEALANT OR LOW EXPANSION FOAM
INSULATED FIBERGLASS WINDOW; SEE PRODUCT INSTALLATION GUIDE
WD STOOL
WD APRON
WOOD SILL
CAULK @ KERF OF LAP SIDING
ZIP TAPE
BACKING ROD & SEALANT OR LOW EXPANSION FOAM

EXTERIOR

INTERIOR