

2024

Solar Decathlon  
Design Challenge

# 258 Andrew J. Hairston

Presented by  
**Georgia Tech Solar  
Decathlon Team**



SOLAR DECATHLON



Faculty Advisor,  
Professor of the  
Practice, Licensed GC  
**Frank Wickstead**



3<sup>rd</sup> Year - Civil  
Engineering  
**Jackie Zong**



3<sup>rd</sup> Year - Civil  
Engineering  
**Arya Desai**



3<sup>rd</sup> Year - Building  
Construction  
**Charles Morris**



Masters -  
Architecture  
**Rachel  
Witherspoon**



Masters - Building  
Construction  
**Aidan Risey**



4<sup>th</sup> Year -  
Architecture  
**Yona (Yuhan)  
Wang**



Masters - Business  
Administration and  
Environmental  
Engineering  
**Wyatt Williams**



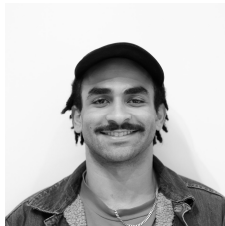
3<sup>rd</sup> Year -  
Architecture  
**Julie Chen**



4<sup>th</sup> Year -  
Architecture  
**Anushka Kibria**



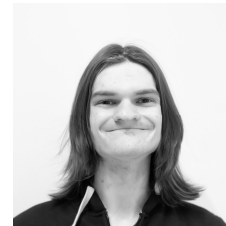
1<sup>st</sup> Year -  
Architecture  
**Kiki (Jingqi)  
Ruan**



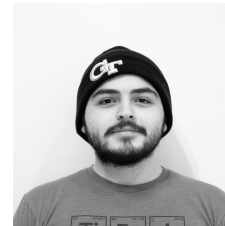
4<sup>th</sup> Year - Building  
Construction  
**Nader Osman**



3<sup>rd</sup> Year - Building  
Construction  
**Joel Jimenez**



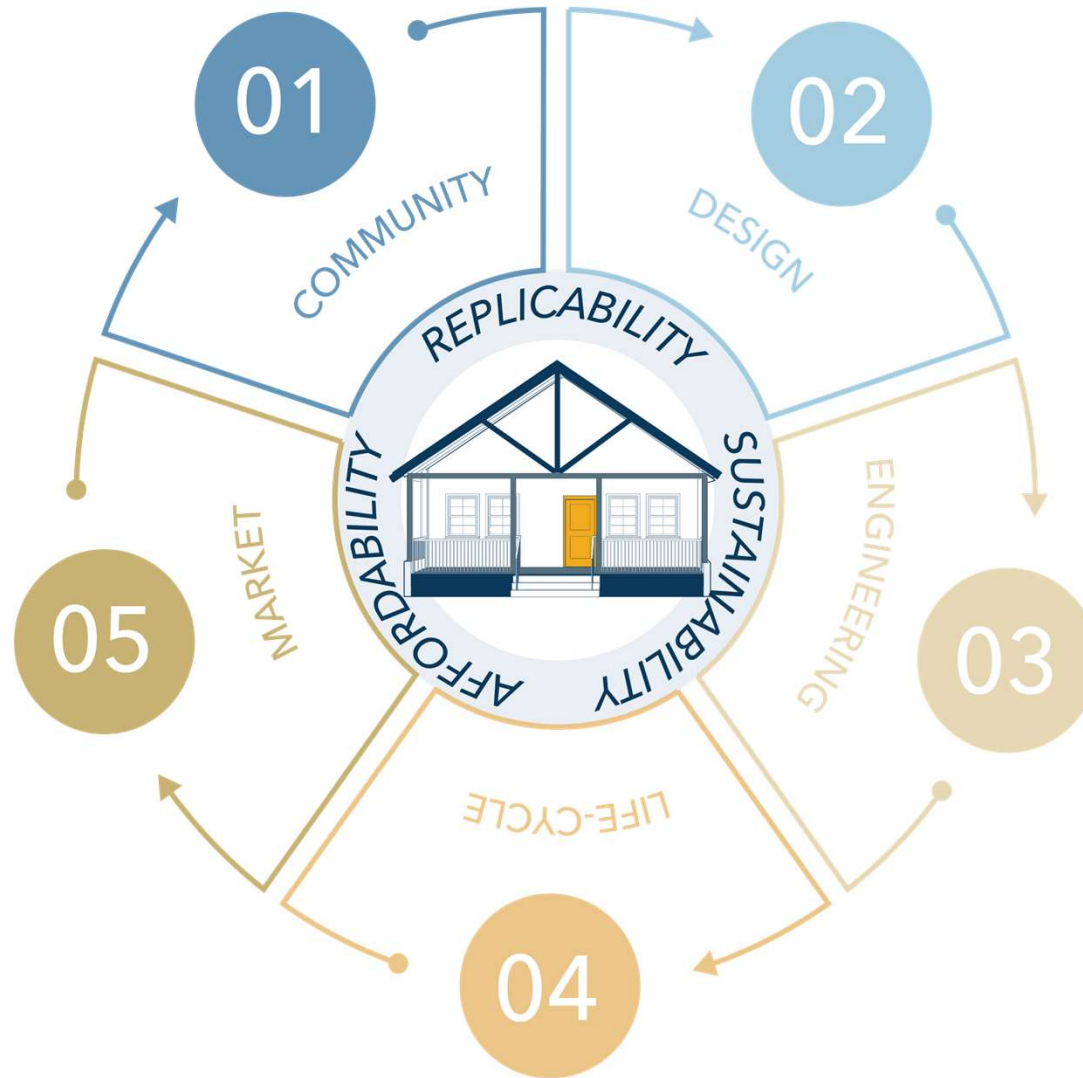
1<sup>st</sup> Year - Building  
Construction  
**Mahlon Sale**



3<sup>rd</sup> Year - Building  
Construction  
**Carlos  
Hernandez**

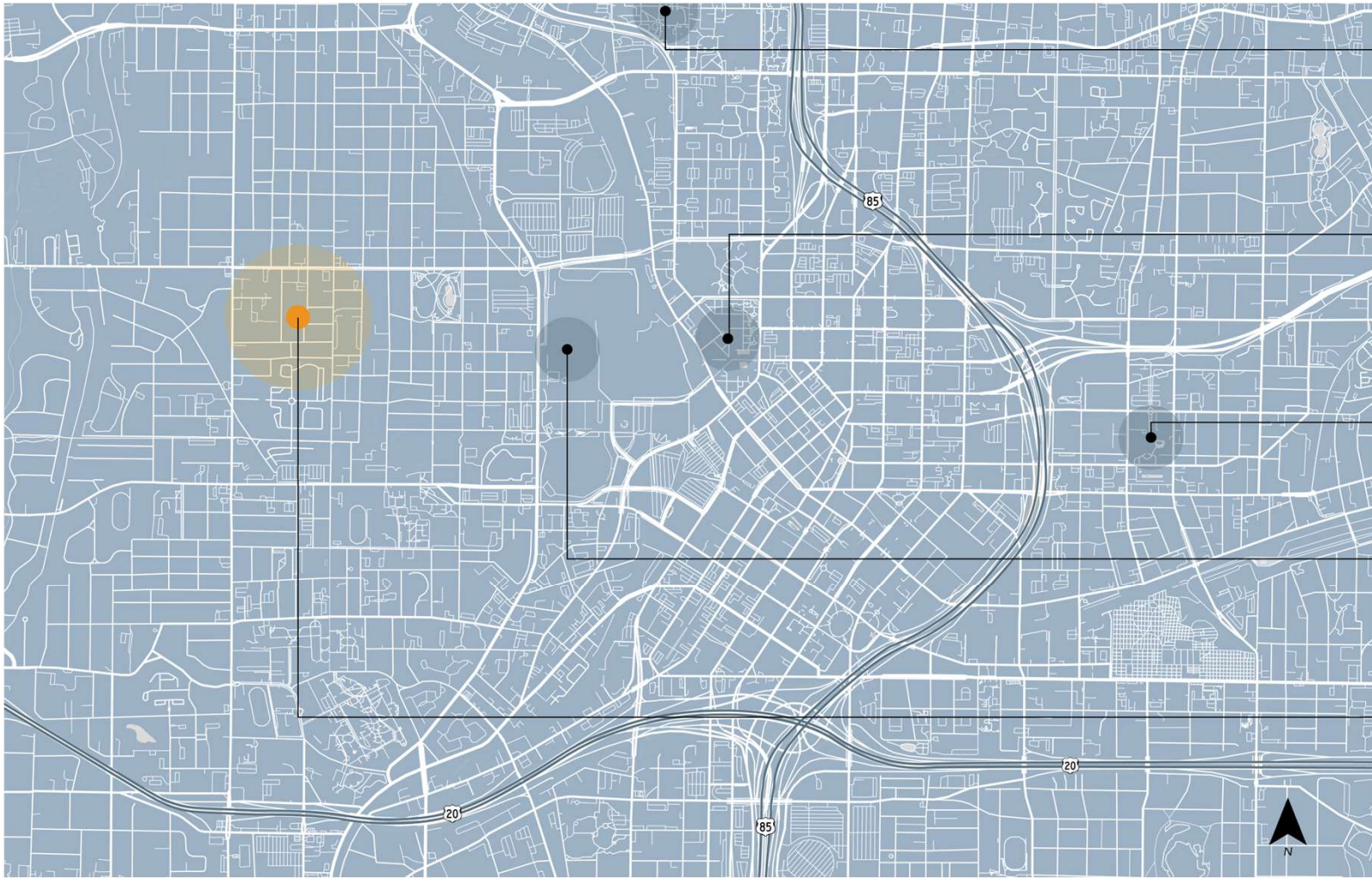


PhD - Civil  
Engineering  
**Arjun Thangaraj  
Ramshankar**



# 01 COMMUNITY





*Georgia Tech*



*Centennial Olympic*



*Martin Luther King National Park*

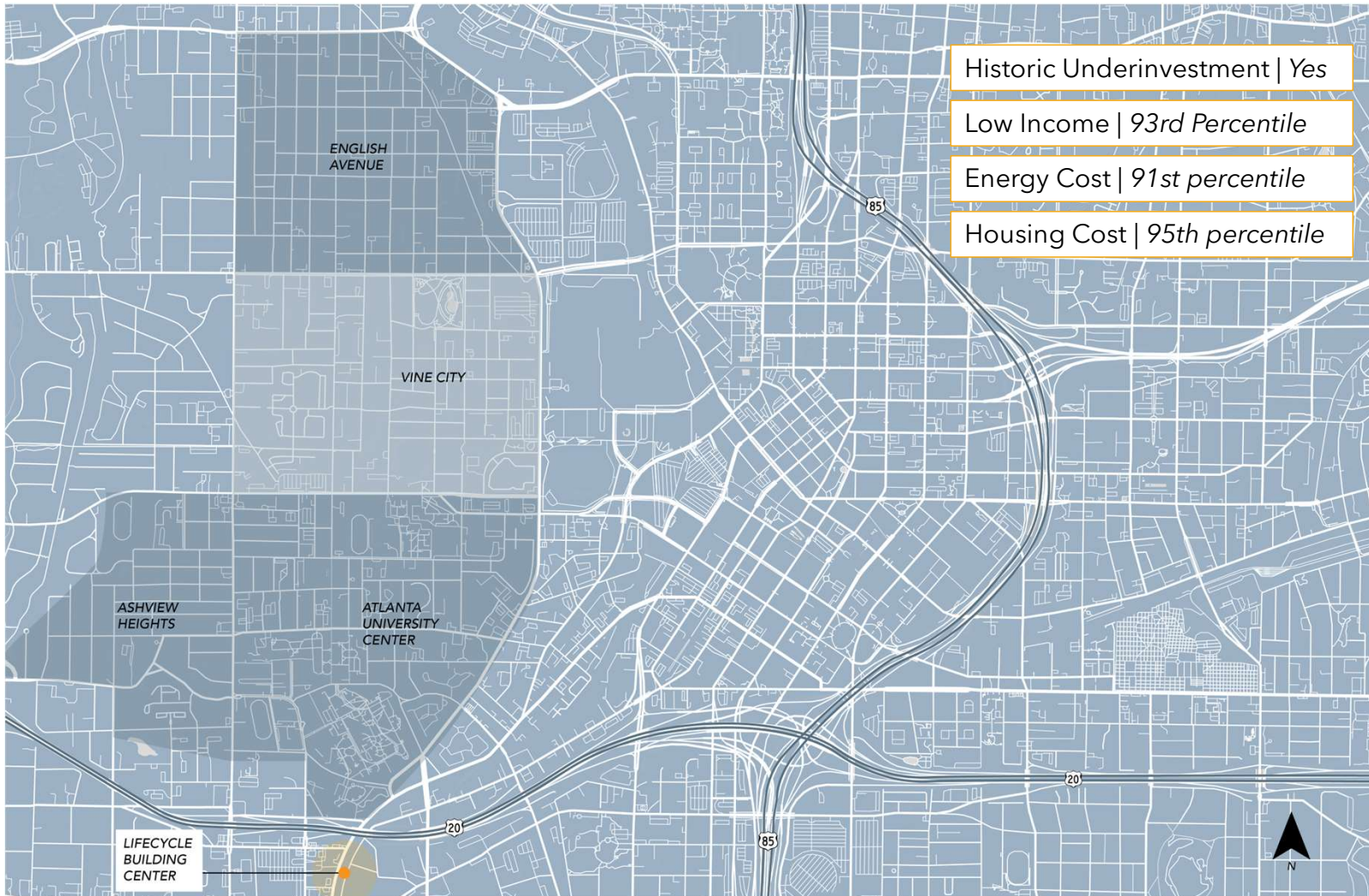


*Mercedes Benz Stadium*



*258 Andrew J Hairston*





- Historic Underinvestment | Yes
- Low Income | 93rd Percentile
- Energy Cost | 91st percentile
- Housing Cost | 95th percentile





258 ANDREW J  
HAIRSTON



MARTIN LUTHER KING JR.  
PRIOR RESIDENCE

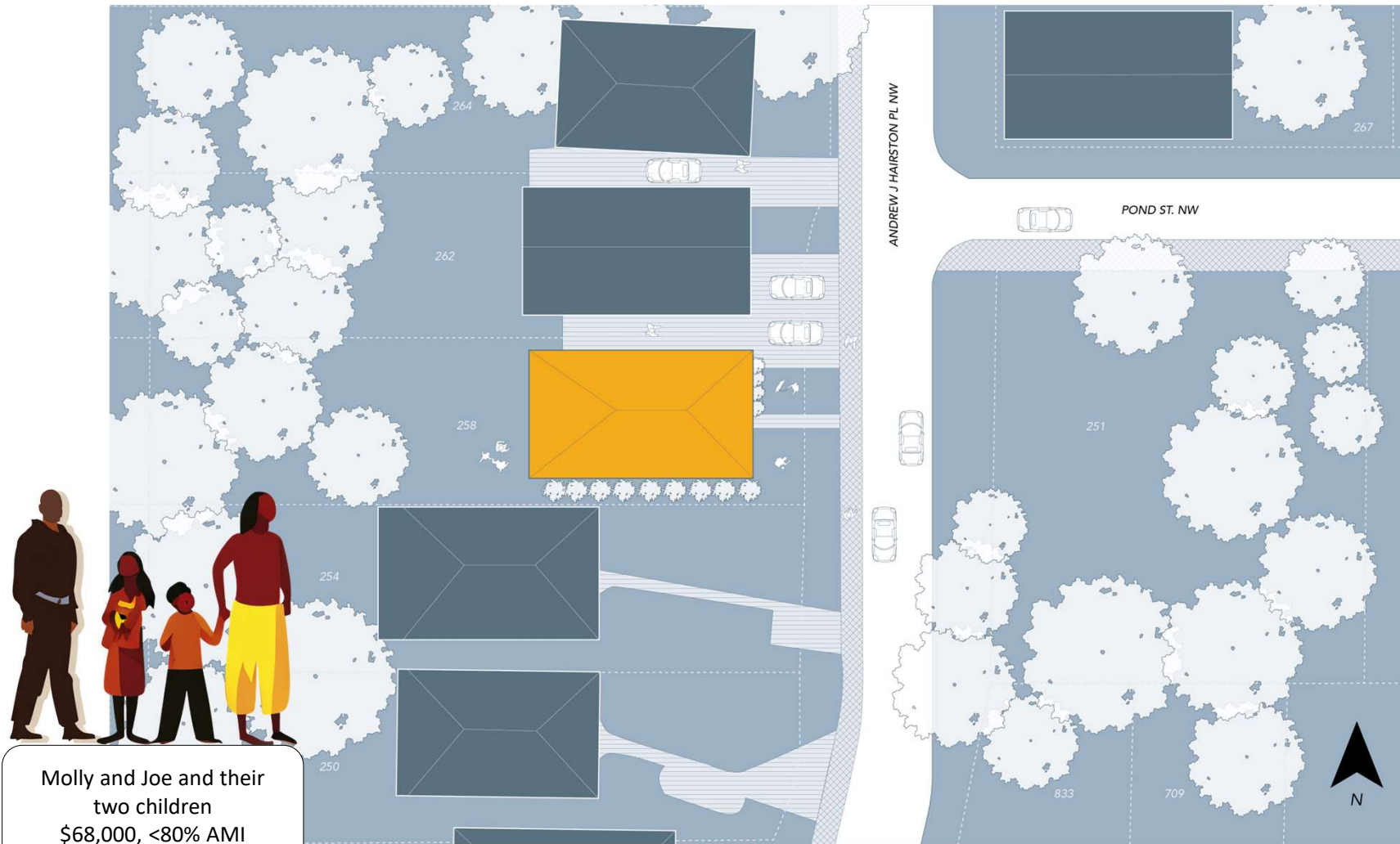


ALONZO HERNDON  
STADIUM



HERNDON HOME





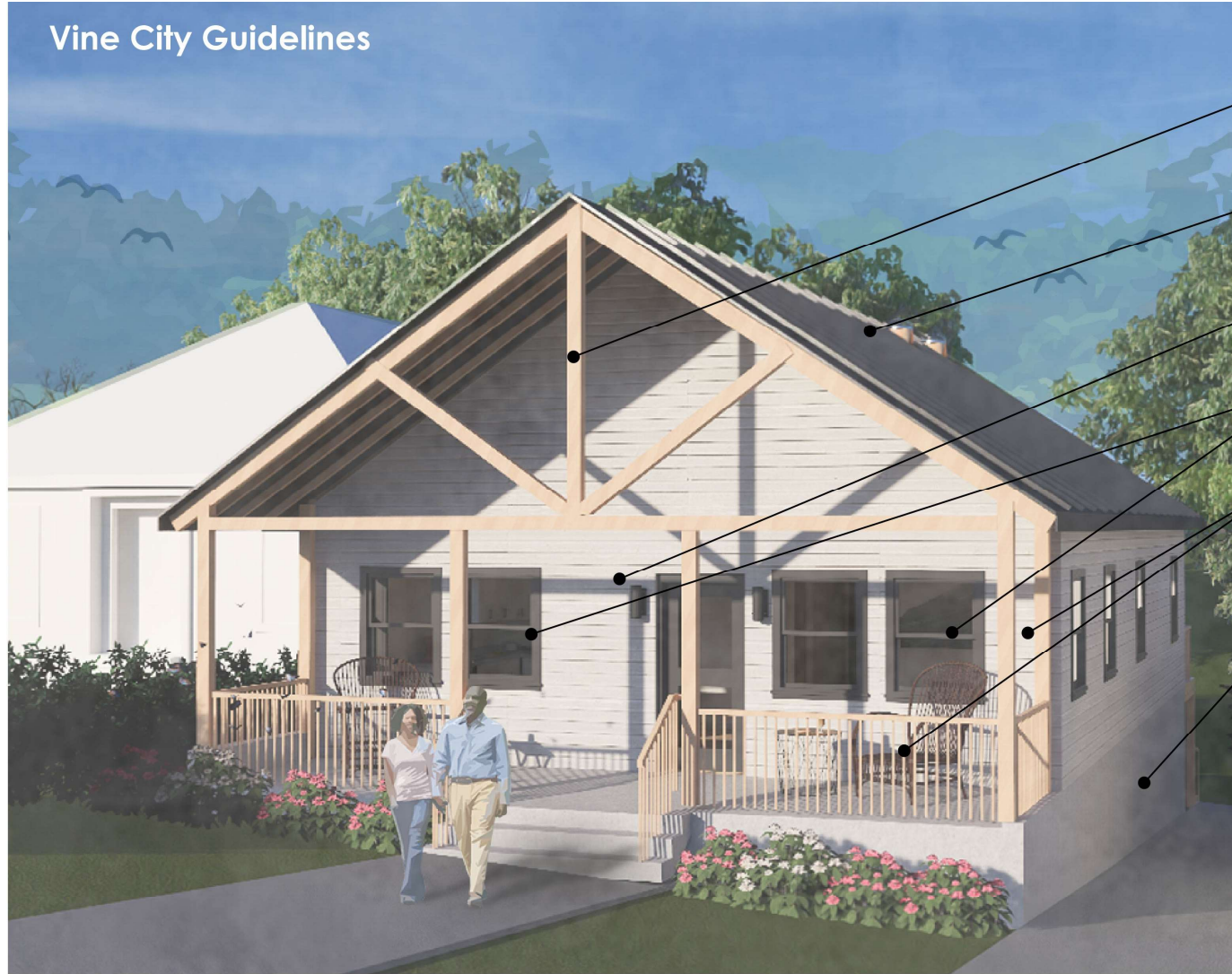


- Existing house was built in **1930**
- Deemed **unsafe to enter**
- New home will have **same footprint** as existing house
- Engaged local residents about the project





# Vine City Guidelines



Exterior Materials

Roof Height

Front Porch Width

Fenestration

Street-Facing Facade

Foundation Materials



2018 IRC with Georgia Amendments



EarthCraft certification from Southface Institute



DOE Zero Energy Ready Home

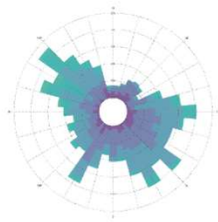


# DESIGN

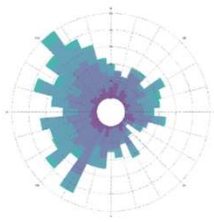
# 02



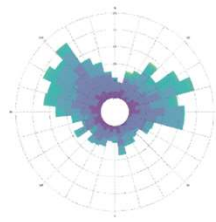
SOLAR DECATHLON



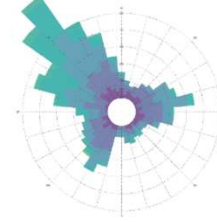
Spring | Average: 8.6 mph



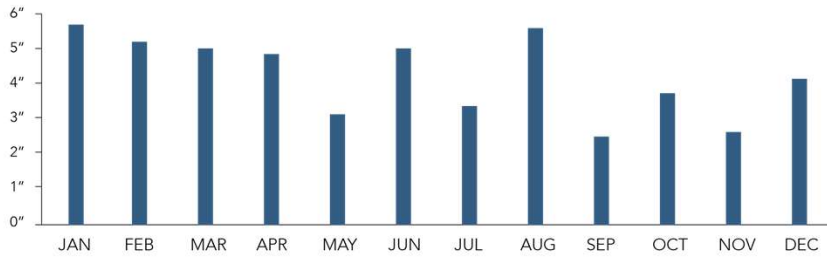
Summer | Average: 7 mph



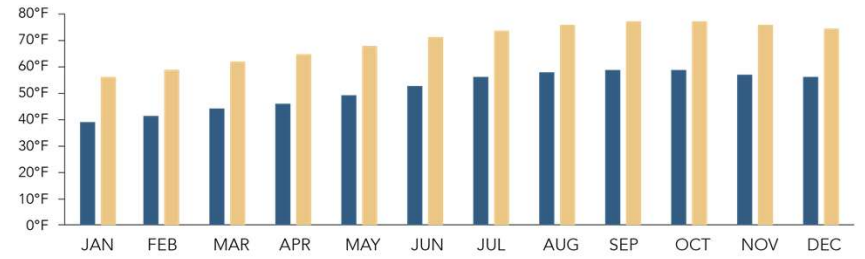
Fall | Average: 8.3 mph



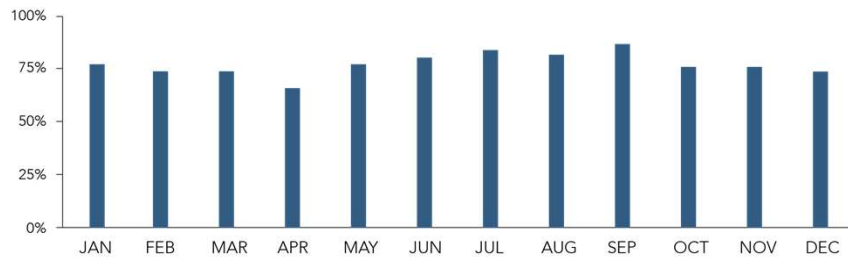
Winter | Average: 10.6 mph



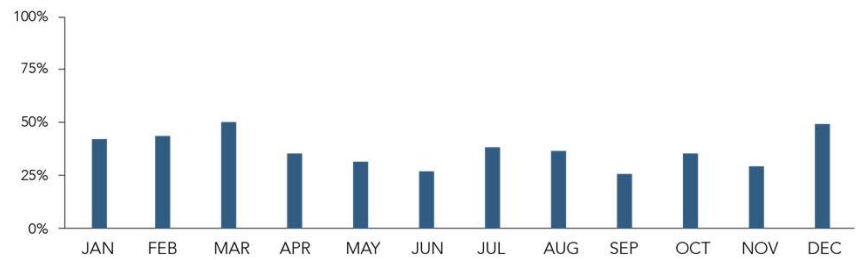
Precipitation | Average: 4.2"



Temperature | Average Low: 51.2°F | Average High: 69.6°F

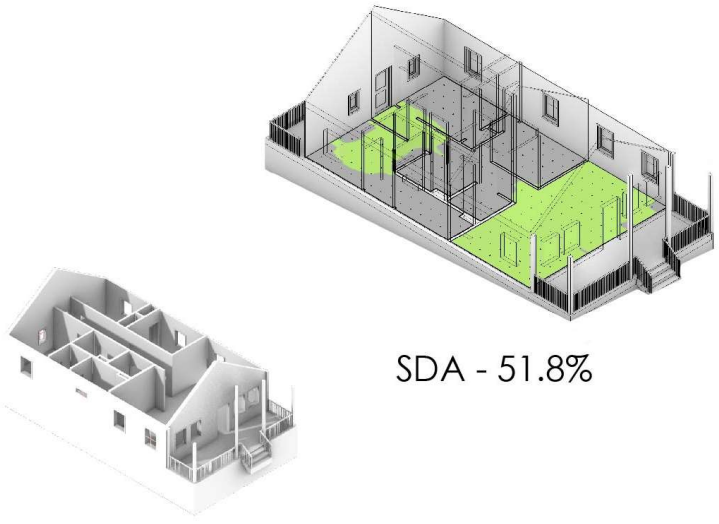


Humidity | Average: 69%

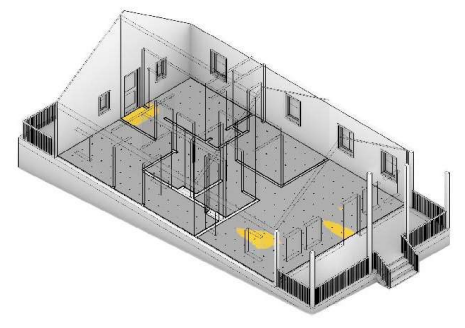


Cloud Coverage | Average: 37%

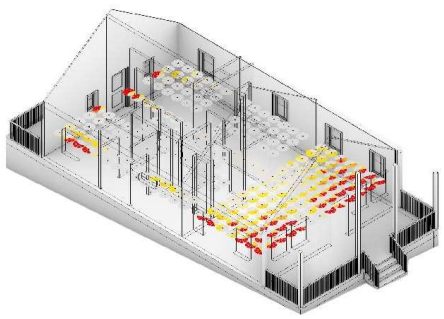
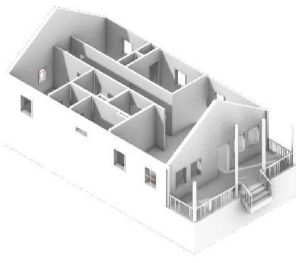




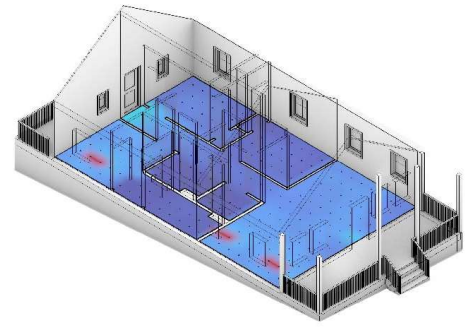
SDA - 51.8%



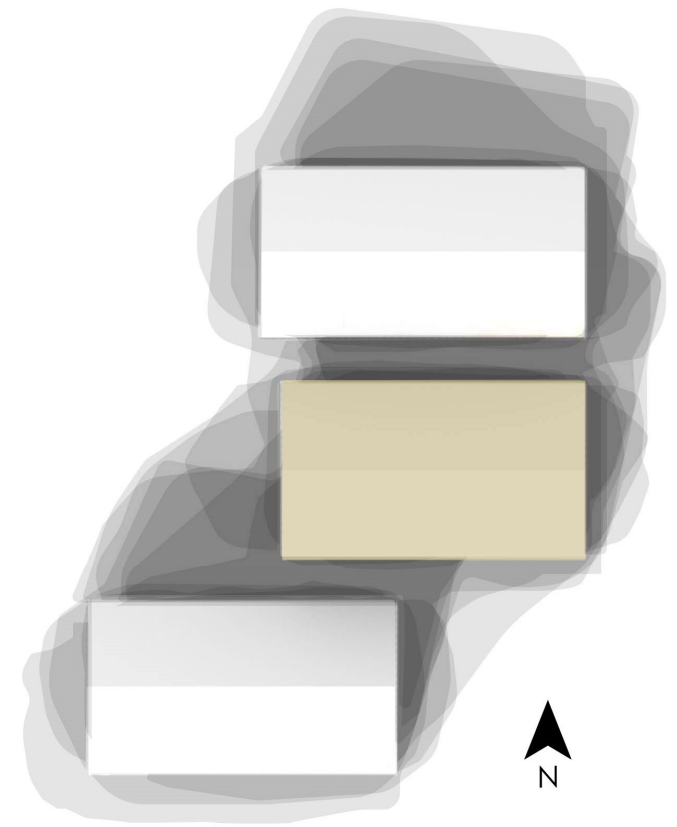
ASE- 4.5%



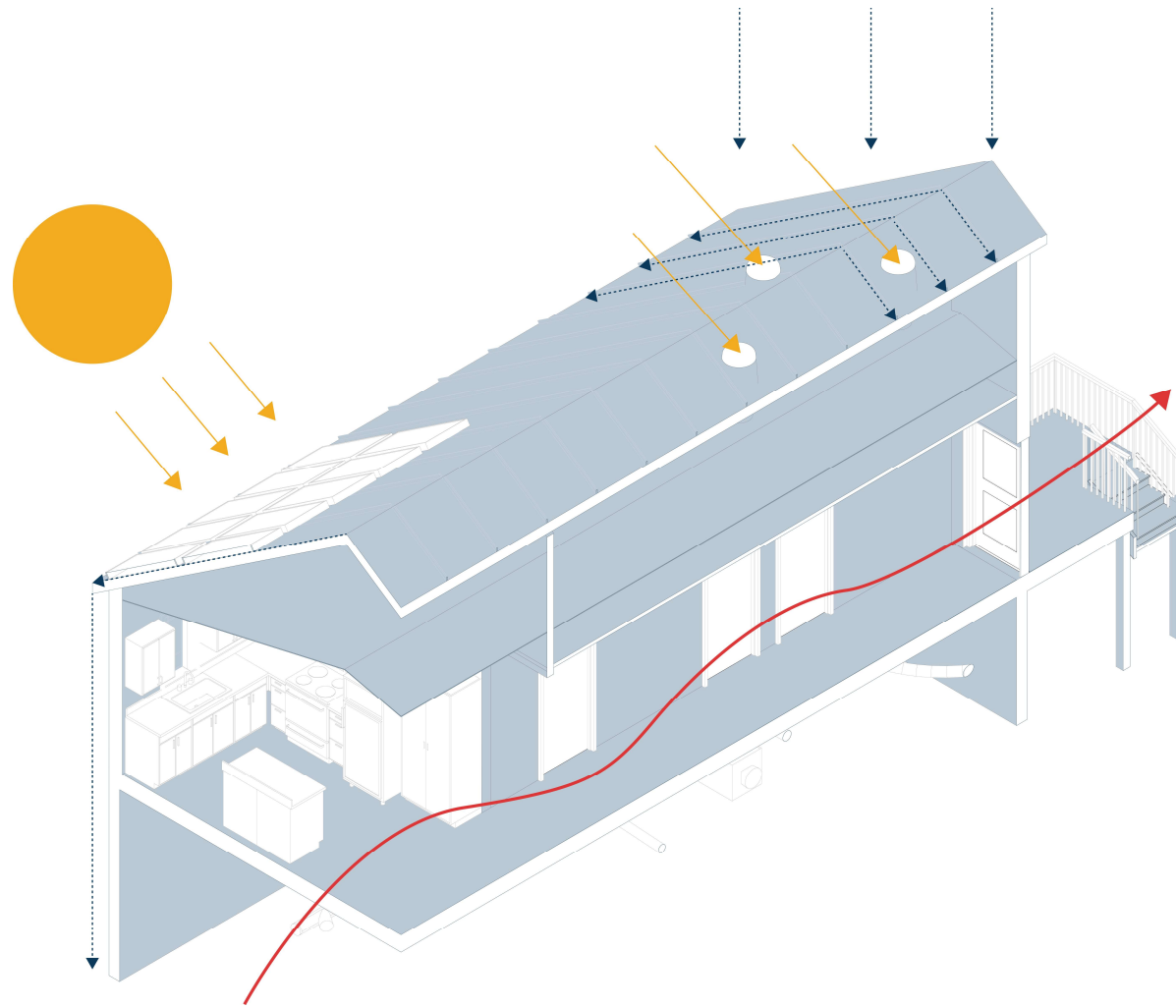
Glare - 9.3%



Illuminance - 620  
avg lux





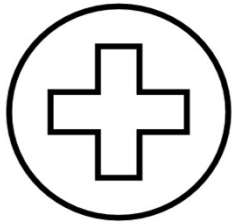




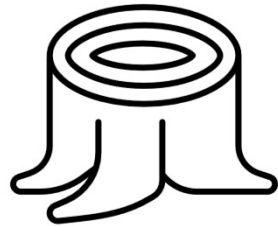




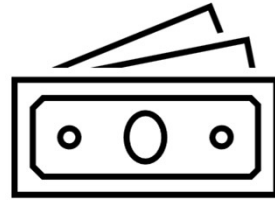




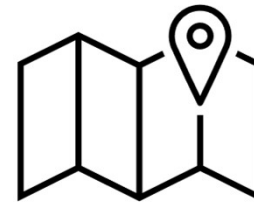
**Occupant  
Health**



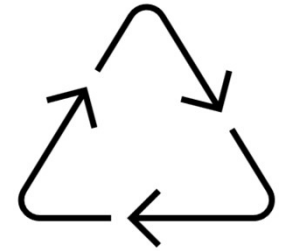
**Low Embodied  
Carbon**



**Affordable**

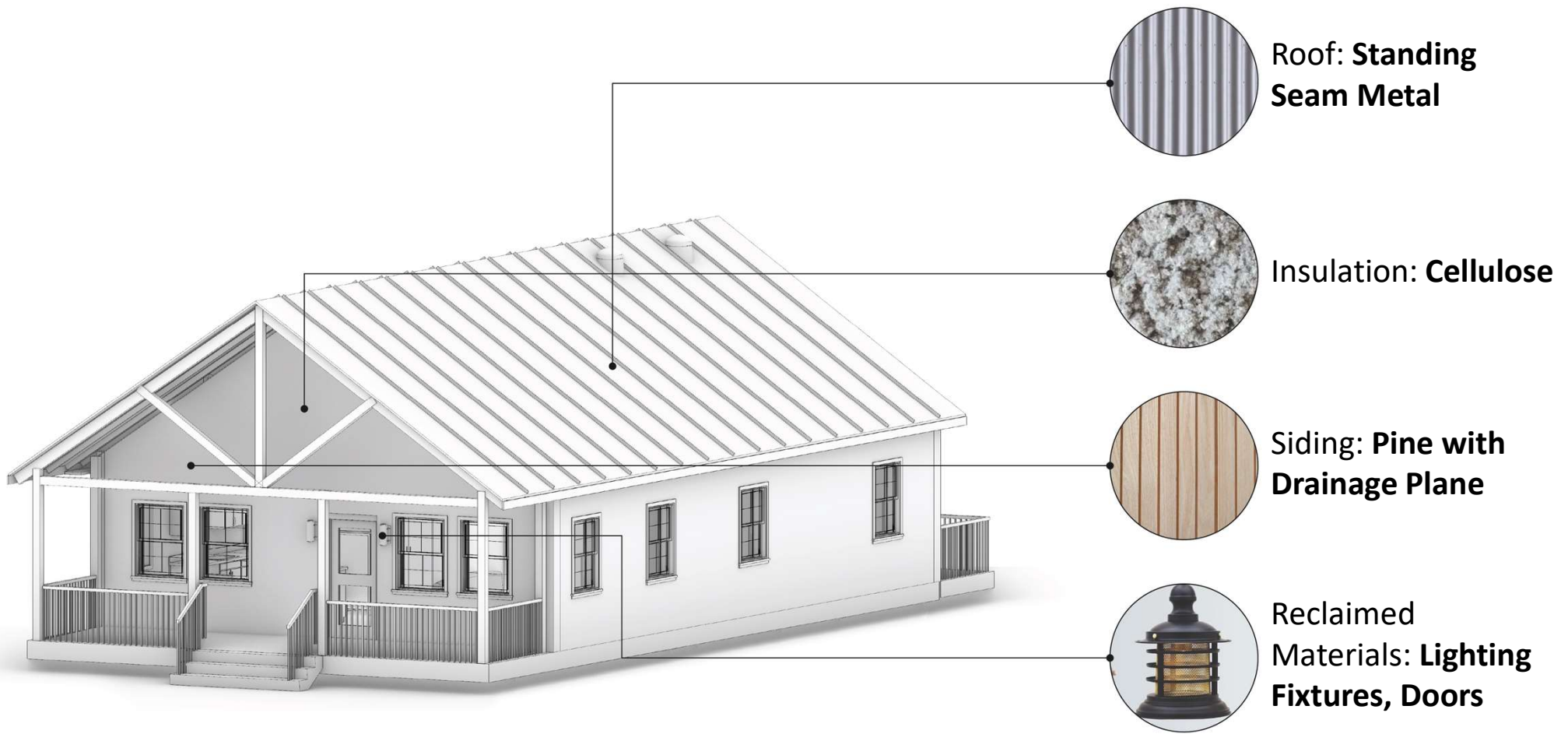


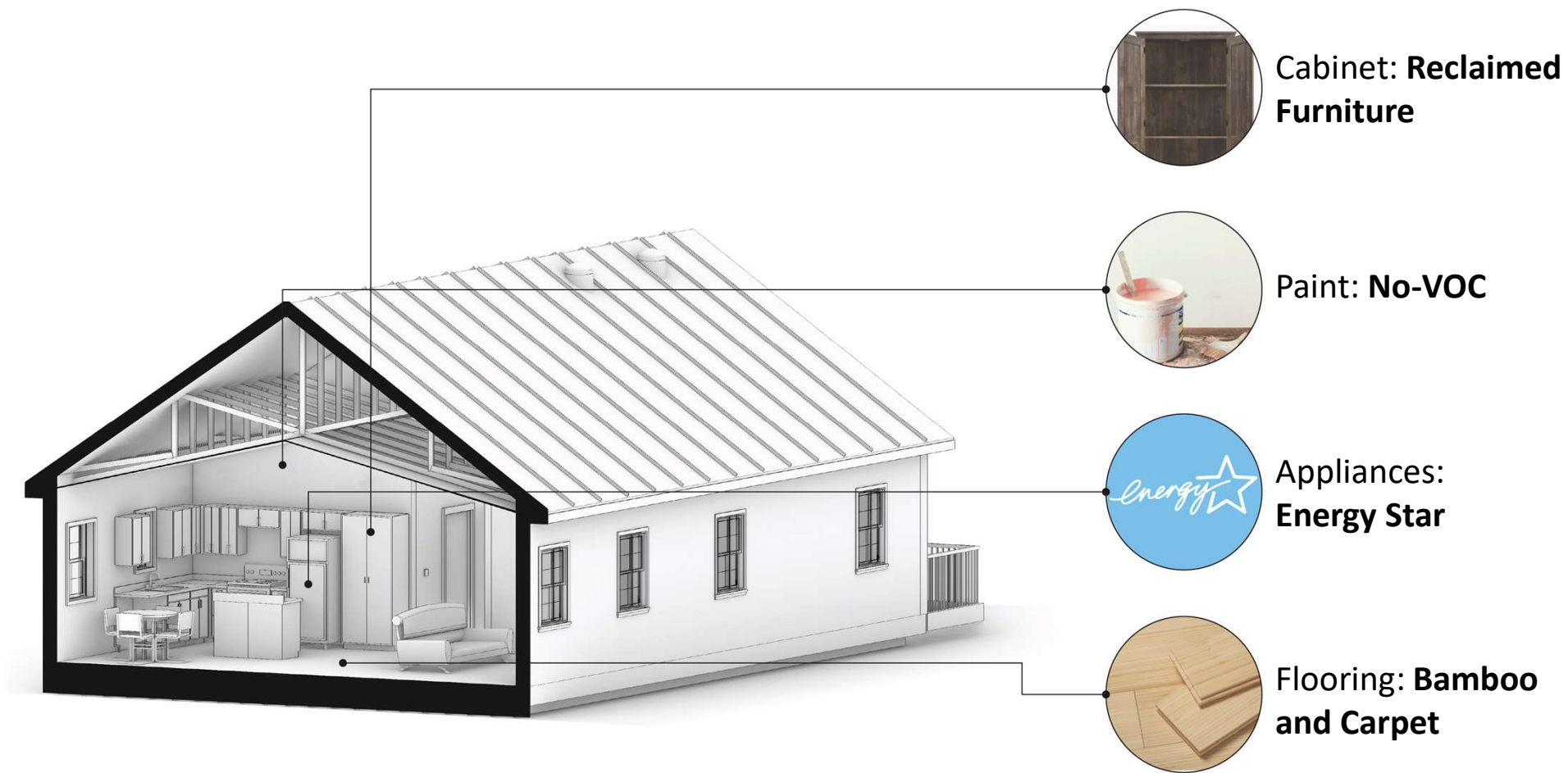
**Locally  
Sourced**



**Reclaimed**





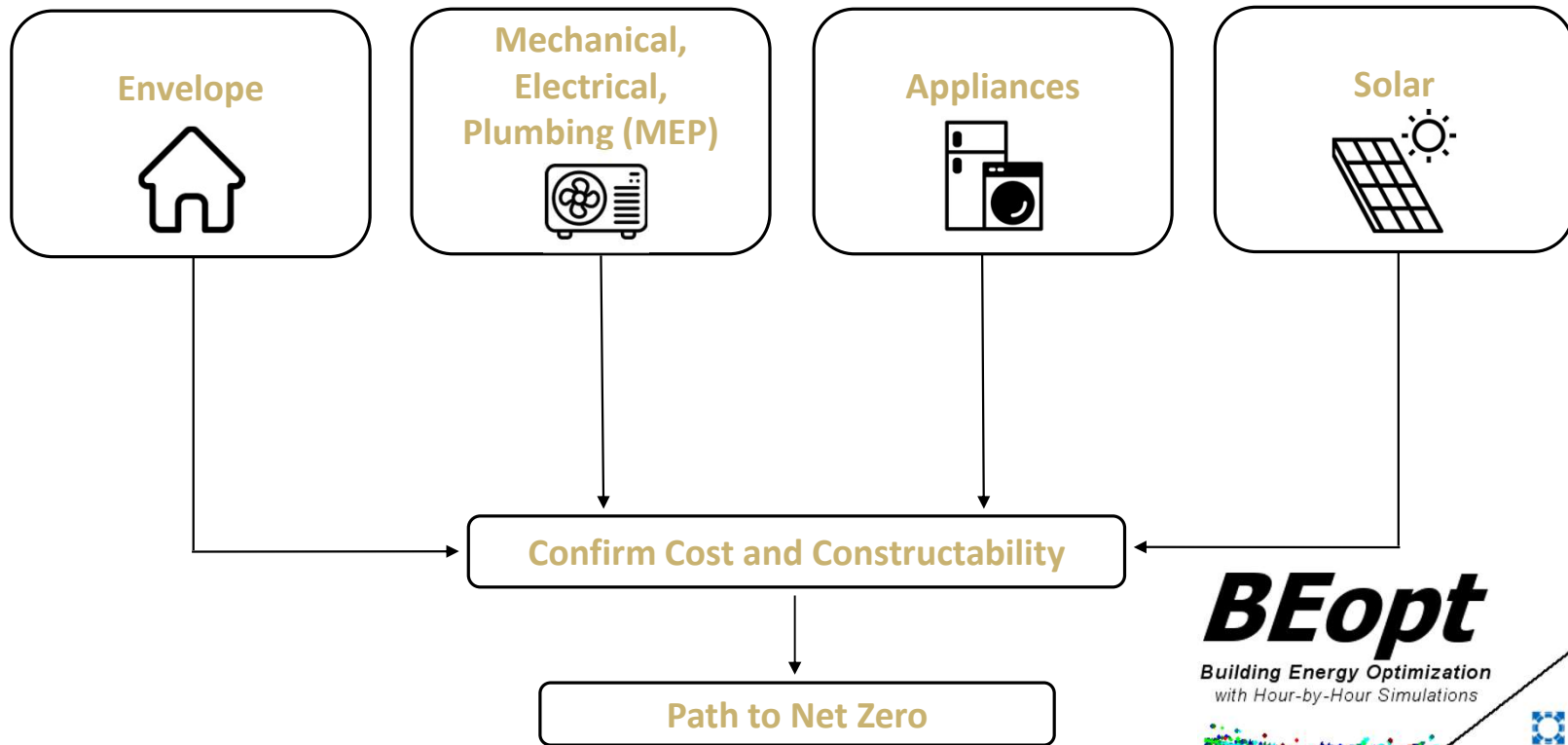


# ENGINEERING

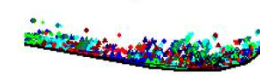
03



SOLAR DECATHLON



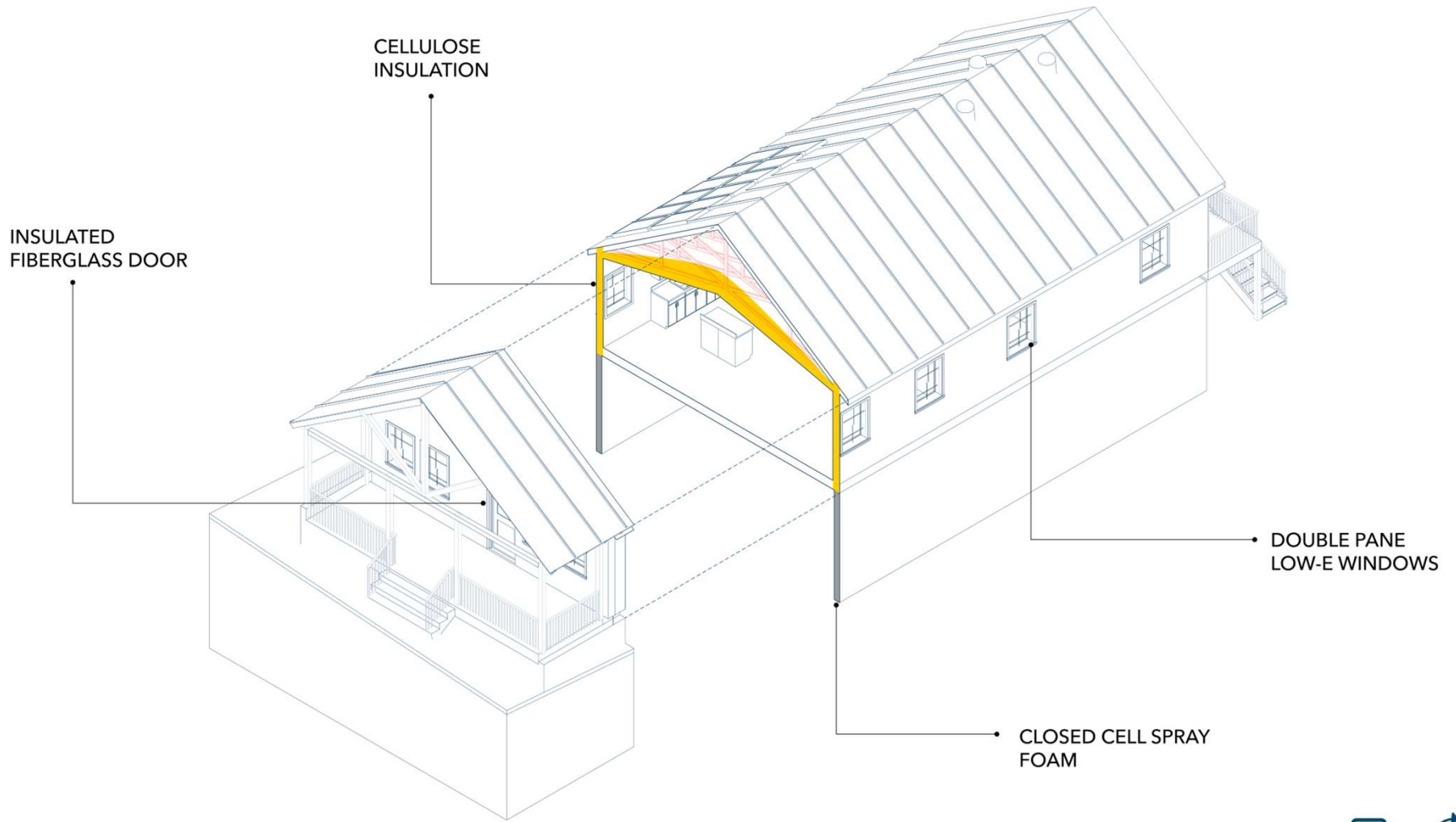
**BEopt**  
 Building Energy Optimization  
 with Hour-by-Hour Simulations

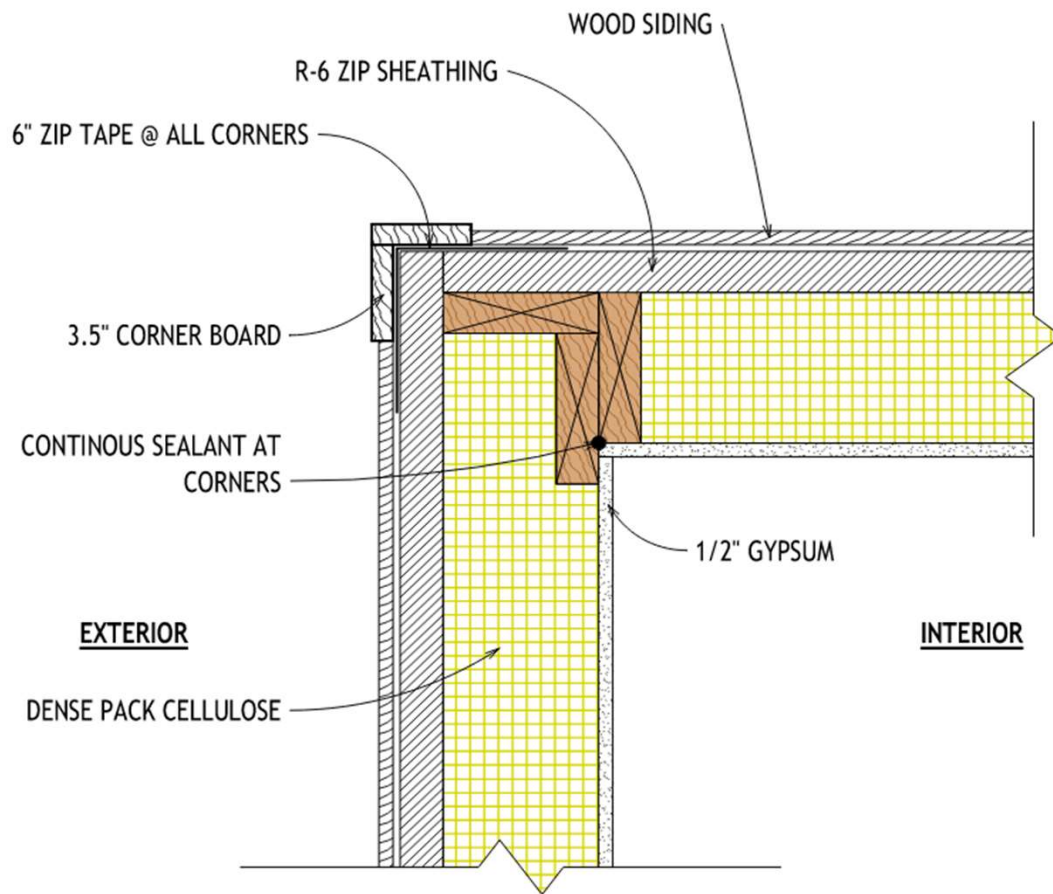


National Renewable Energy Laboratory  
 15013 Denver West Parkway  
 Golden, CO 80401  
[www.nrel.gov](http://www.nrel.gov)



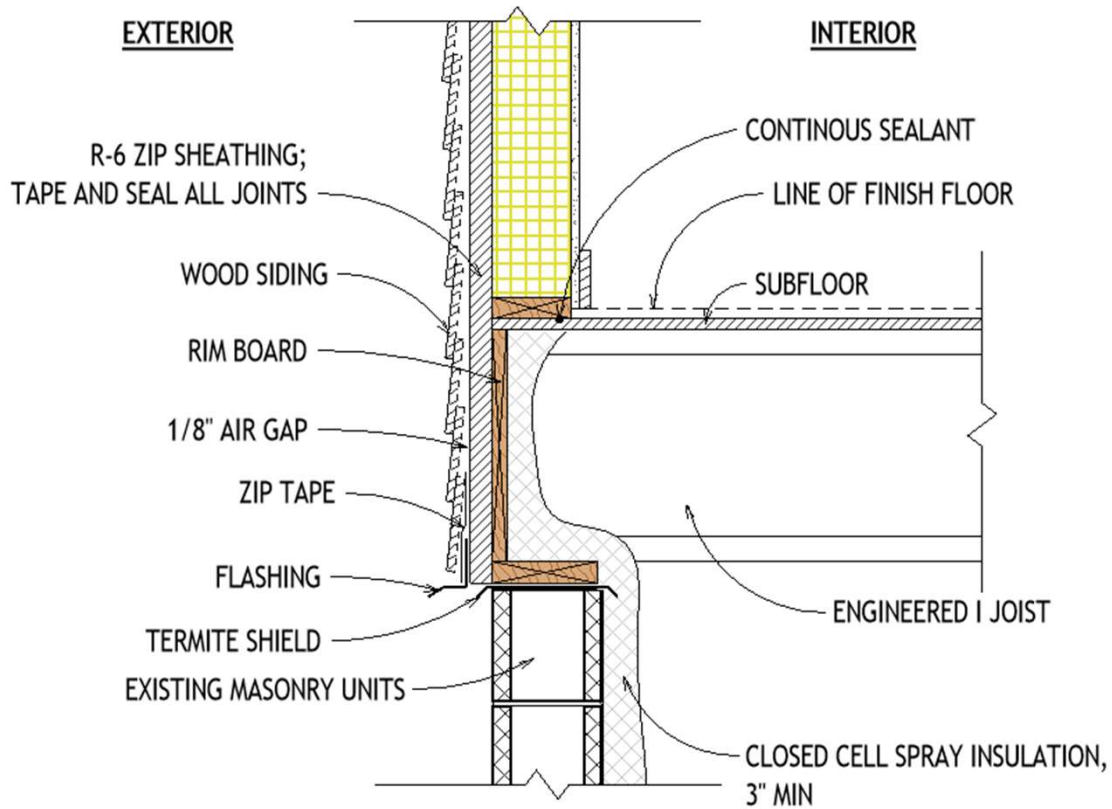






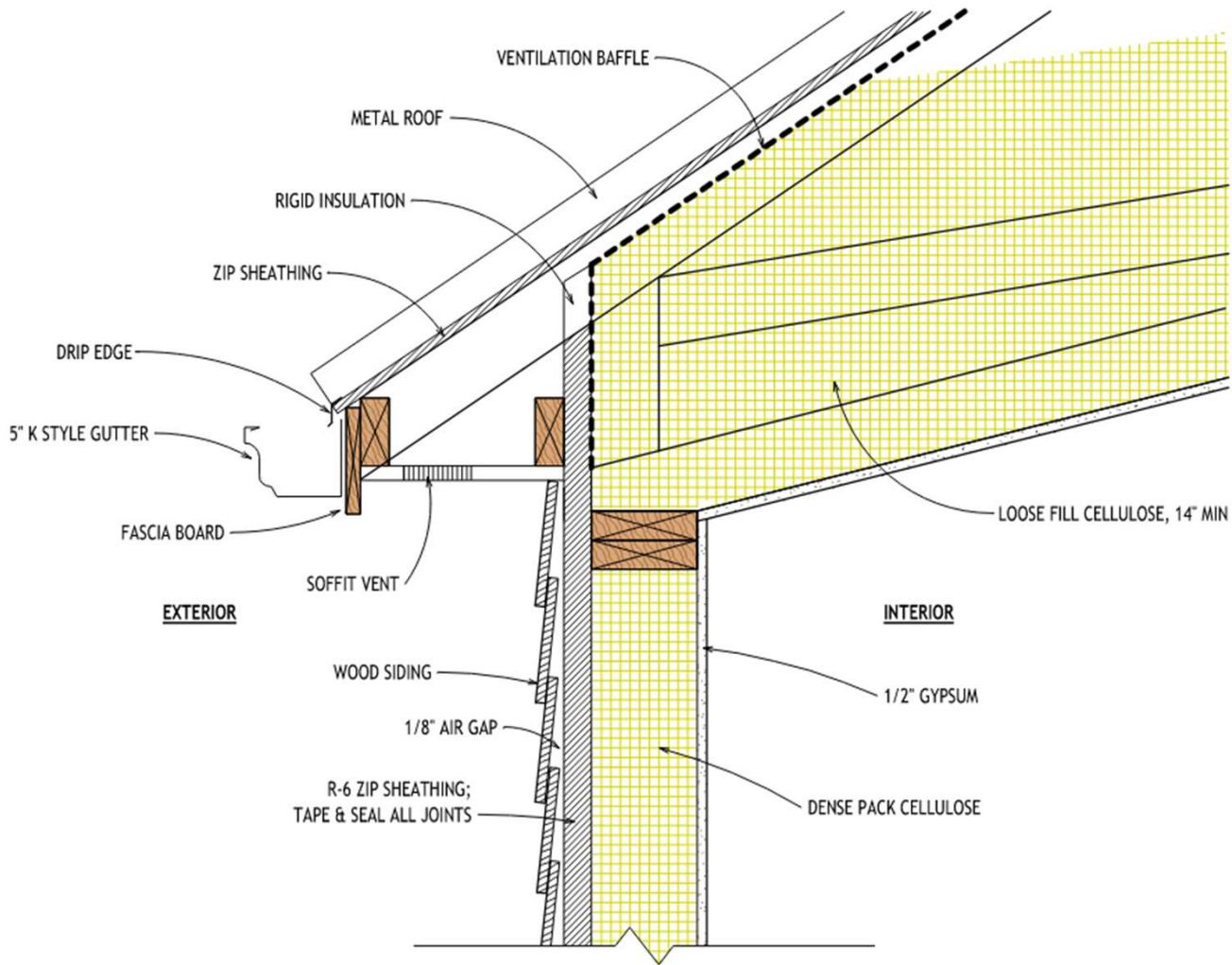
- Advanced framing
- Dense pack cellulose
- 2x6 at 24" on center + R-6 ZIP Sheathing
- **R-25 in total**





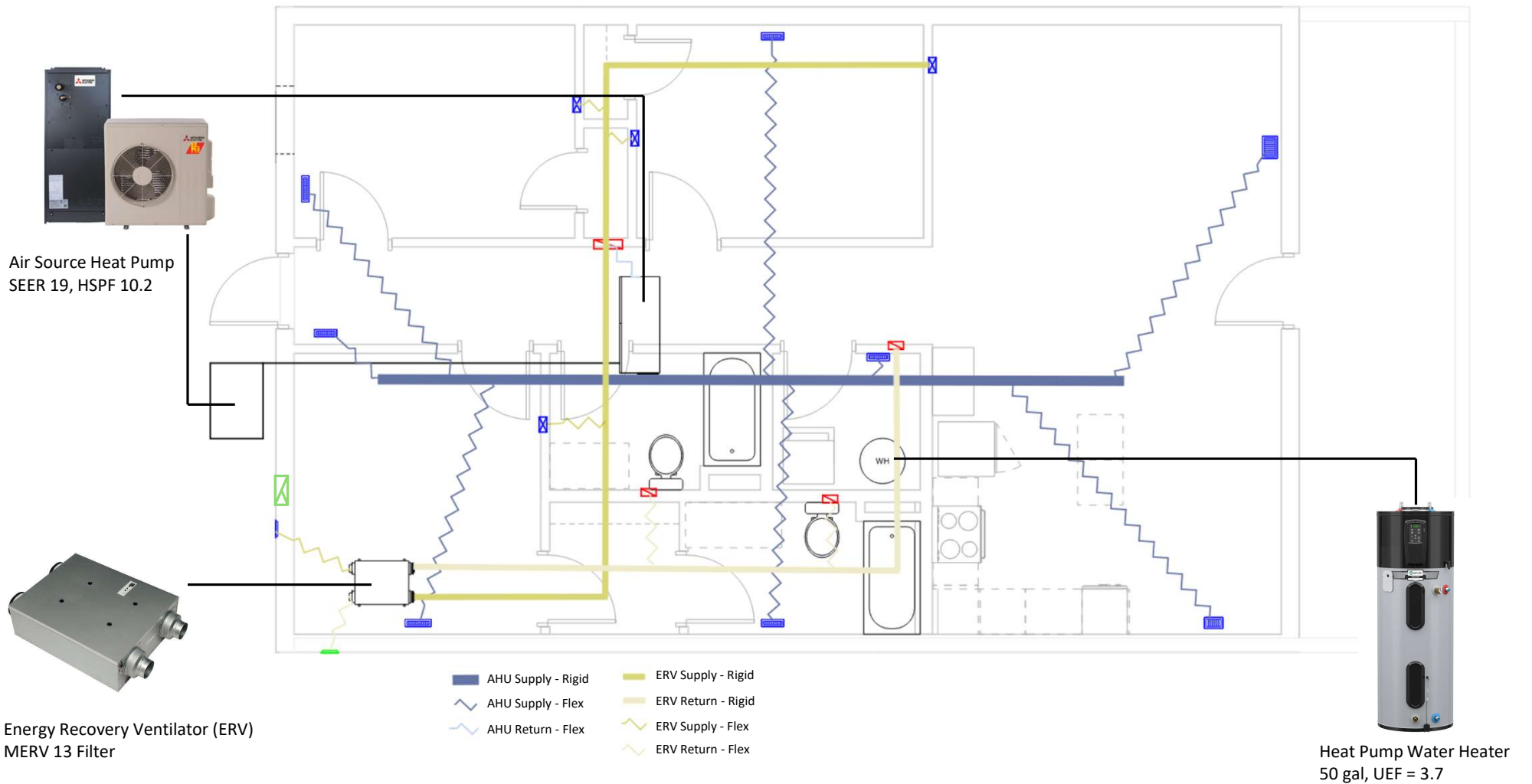
- Engineered I-Joist
- Closed Cell Spray Foam w/ HFO
- **R-19 in total**

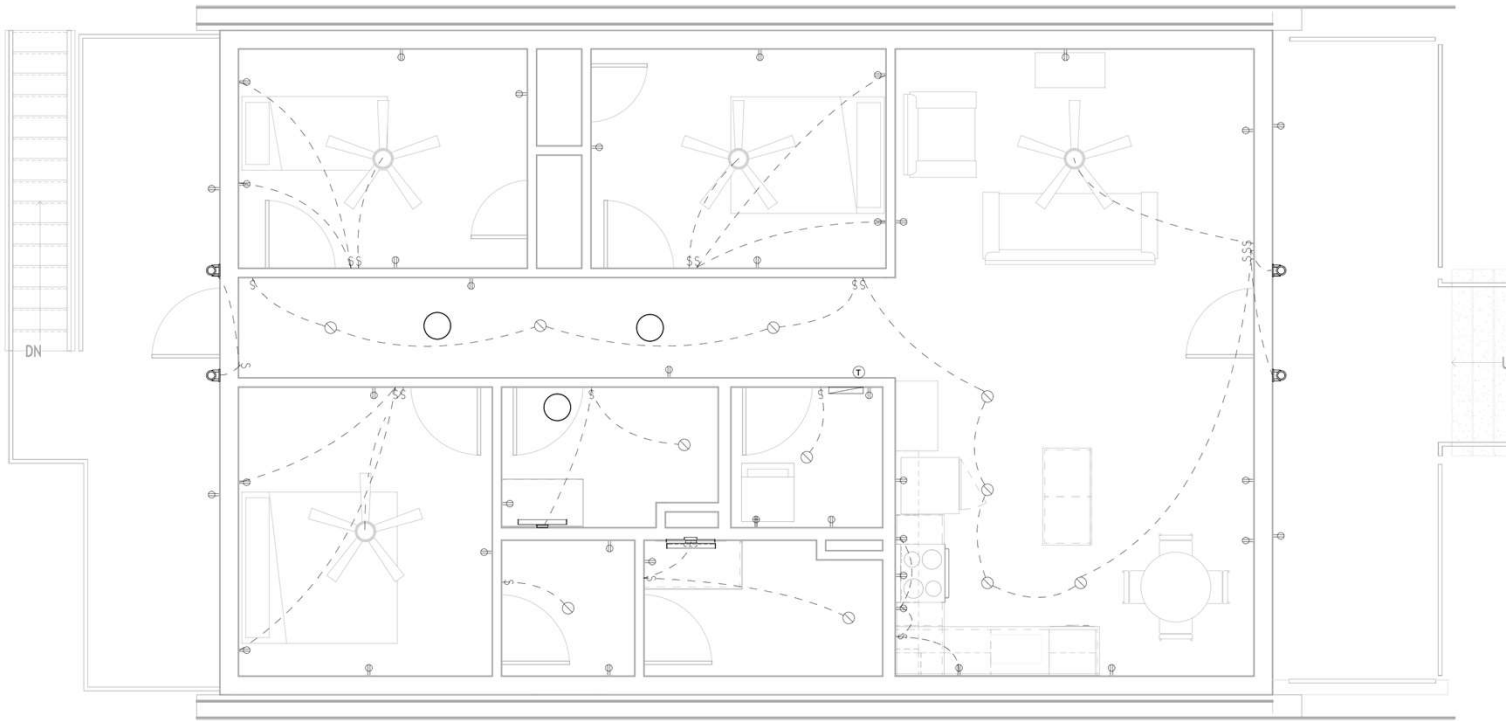




- Ventilation baffles
- Loose fill cellulose
- **R-49 in total**

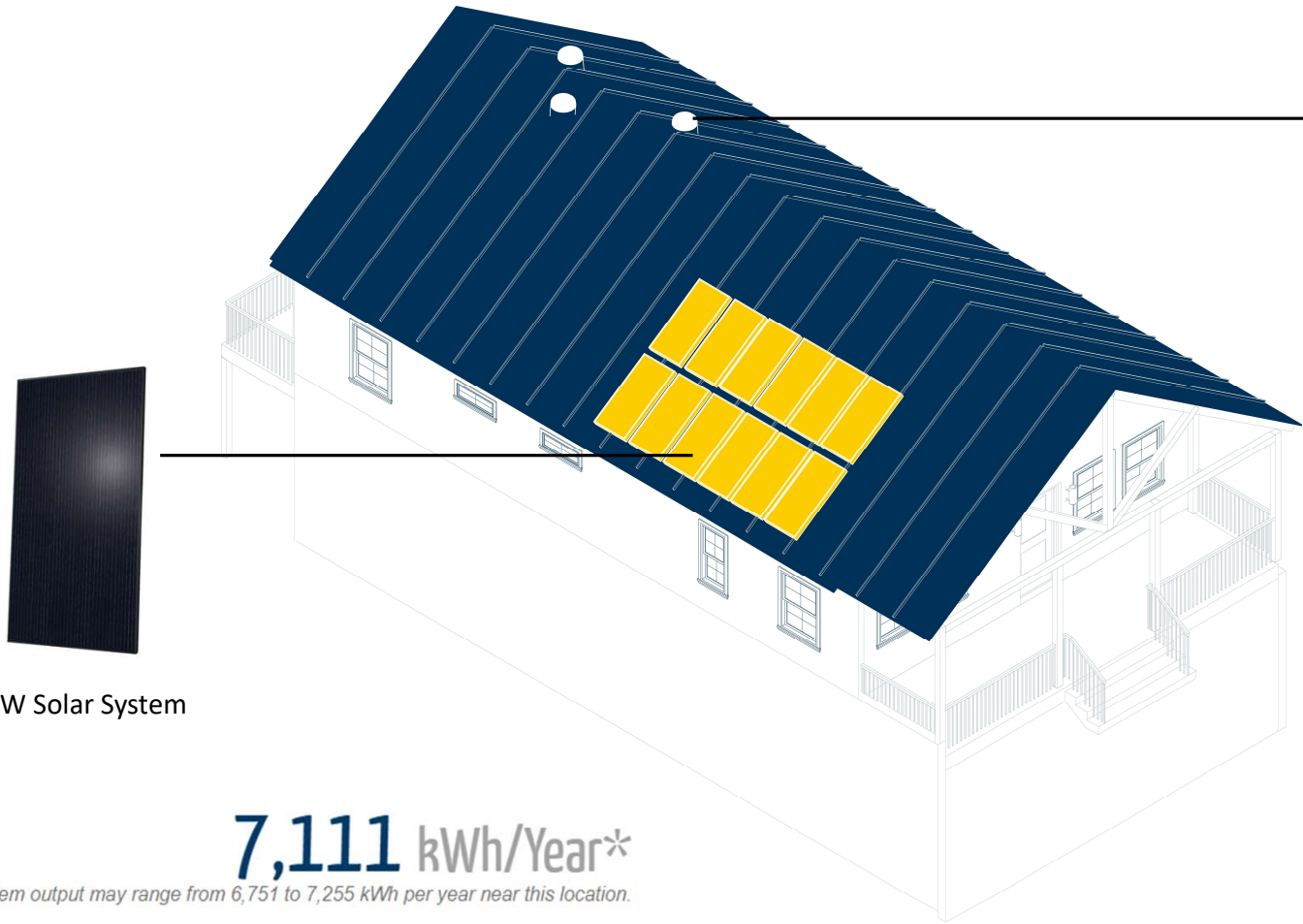






- Daylight LED lighting
- Outlet switches





Solar Tube Skylight

5 kW Solar System

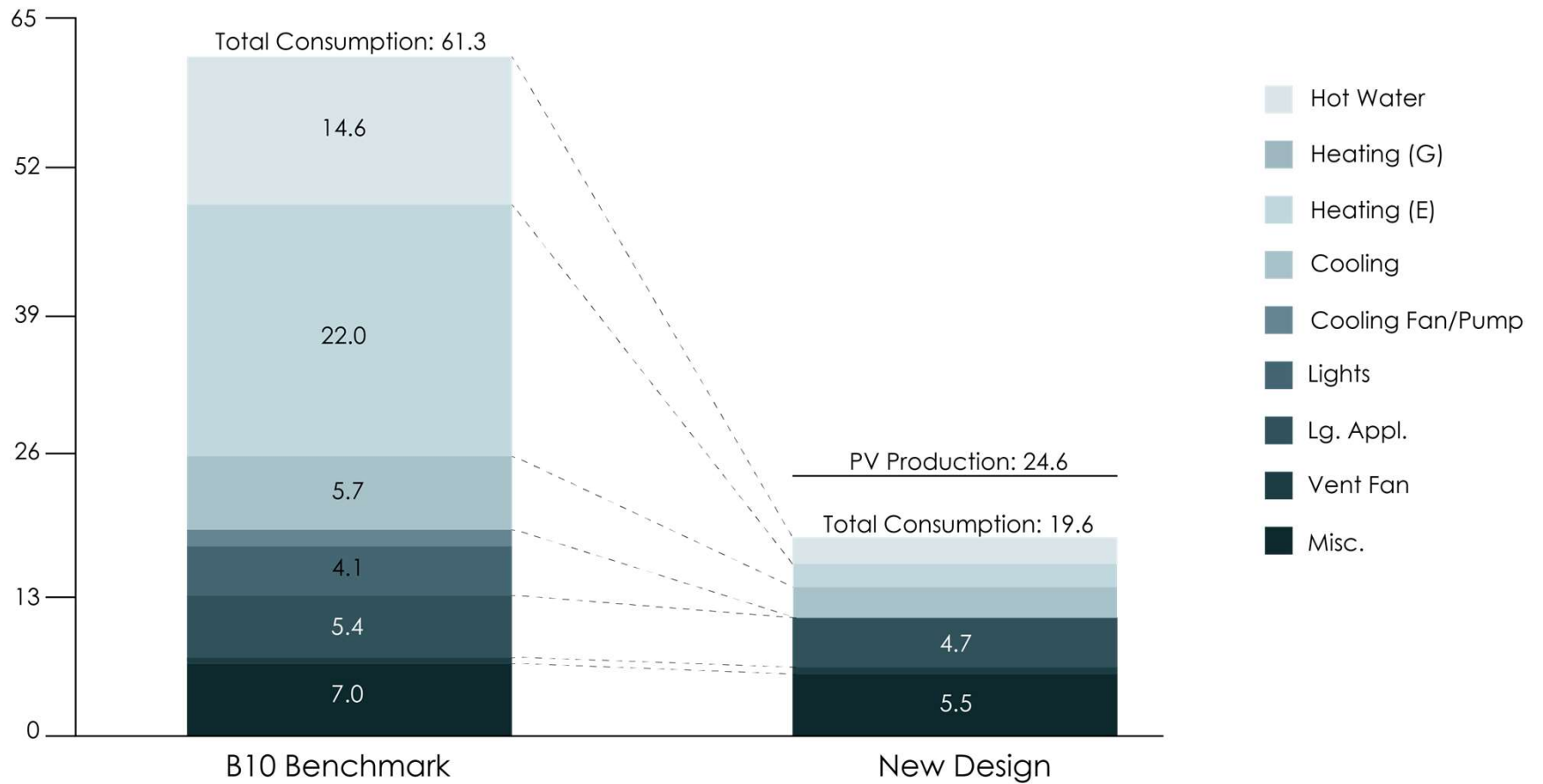
**7,111 kWh/Year\***

*System output may range from 6,751 to 7,255 kWh per year near this location.*

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





# LIFE CYCLE

# 04



SOLAR DECATHLON

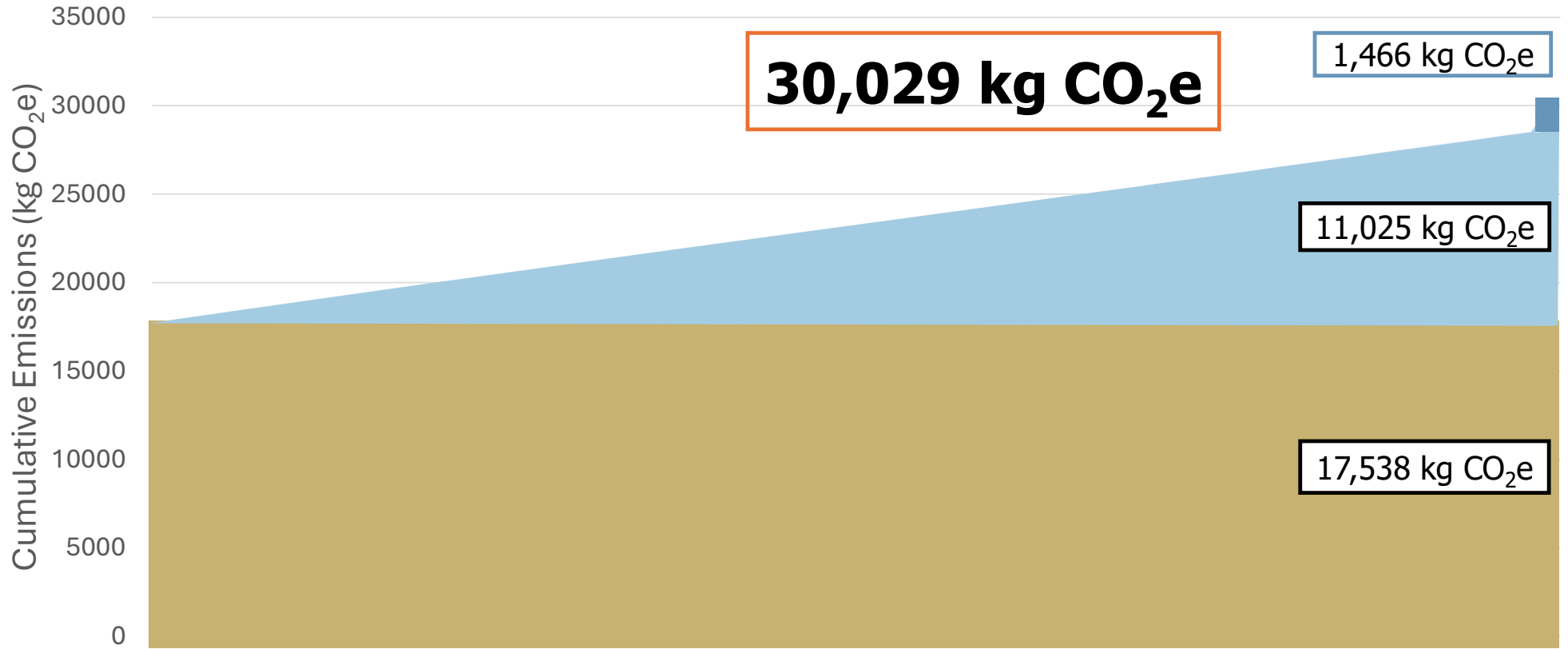
A1 - A3 PRODUCTION STAGE			A4 - A5 CONSTRUCTION STAGE		B1 - B7 USE STAGE					C1 - C4 END OF LIFE STAGE				D OPTIONAL INFORMATION STAGE
A1 Extraction and upstream production	A2 Transport to factory	A3 Manufacturing	A4 Transport to site	A5 Installation	B1 Use	B2 Maintenance (+production, transport & disposal of necessary materials)	B3 Repair (+production, transport & disposal of necessary materials)	B4 Replacement (+production, transport & disposal of necessary materials)	B5 Refurbishment (+production, transport & disposal of necessary materials)	C1 De-construction / Demolition	C2 Transport to waste processing or disposal	C3 Waste processing	C4 Disposal of waste	D Potential net benefits from reuse, recycling, carbon offsets, renewable energy, and/or energy recovery beyond the system boundary
					B6 Operational energy use									
					B7 Operational water use									

Included in Emission  
Factors

Operational Energy Use

Included in End-of-Life  
Emission Factors





75 Year Building Lifespan

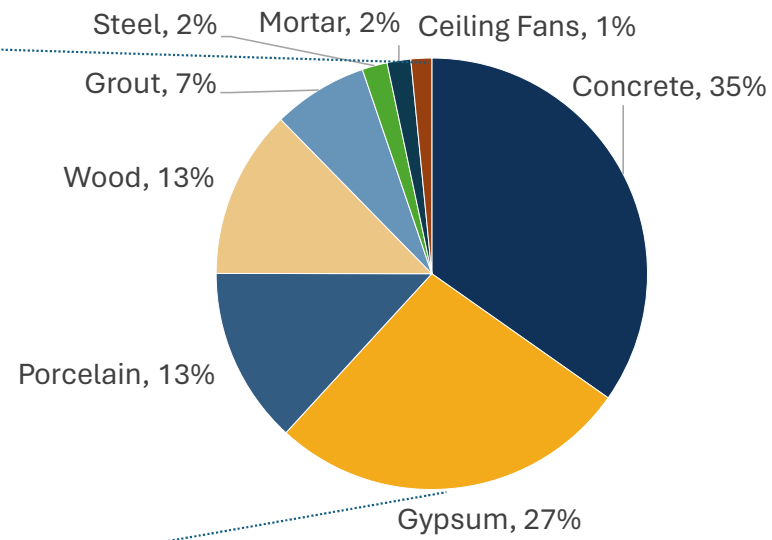
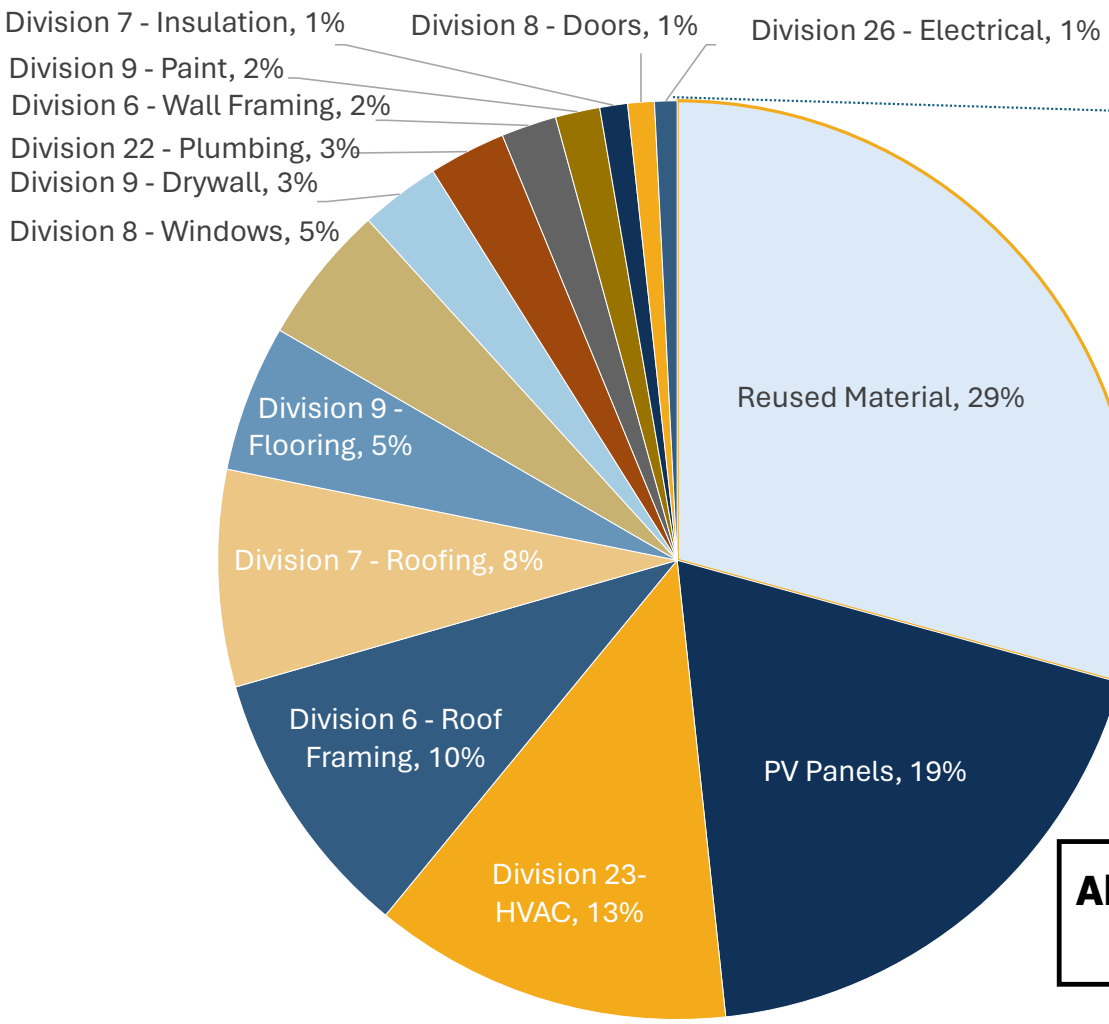
Cumulative Emissions

Embodied Emissions

Operational Emissions

End of Life Emissions

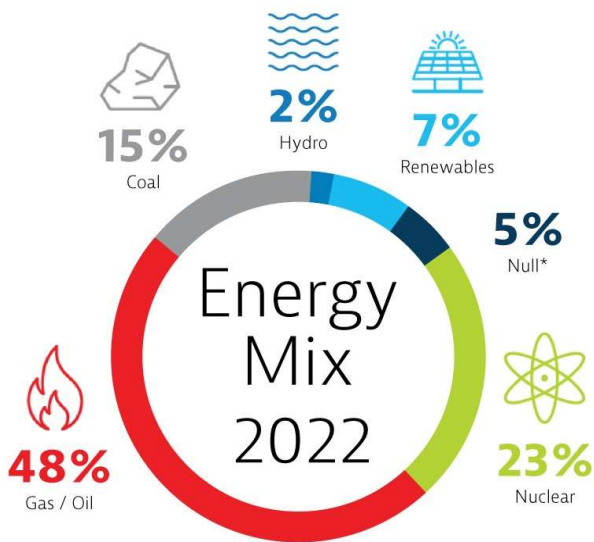




**All Materials**  
**24,802**

**Reused Materials**  
**7,263**





Georgia Power Energy Mix as of 2022

Grid Intensity Scenario	258 Andrew J. Hairston Building Design (kg CO <sub>2</sub> e)	B10 Benchmark (kg CO <sub>2</sub> e)	Difference (kg CO <sub>2</sub> e)	Acres of North American Forest
Conservative	11,025	450,675	<b>439,650</b>	513
95% by 2050	13,950	327,825	<b>313,875</b>	366
95% by 2035	12,150	273,150	<b>271,000</b>	305





258 Andrew J.  
Hairston

$$= \frac{1}{15}$$



Average North American  
Single-Family House



**MARKET**

05



SOLAR DECATHLON

# Home Energy Rating Certificate

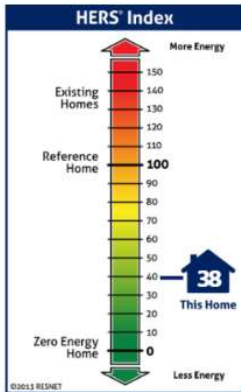
Projected Report  
Based on Plans

Rating Date:  
Registry ID:  
Ekotrope ID: 2Joa3pWL

<p><b>HERS® Index Score:</b></p> <p style="font-size: 2em; font-weight: bold;">38</p> <p>Your home's HERS score is a relative performance score. The lower the number, the more energy efficient the home. To learn more, visit <a href="http://www.hersindex.com">www.hersindex.com</a></p>	<p><b>Annual Savings</b></p> <p style="font-size: 2em; font-weight: bold;">\$1,785</p> <p><small>*Relative to an average U.S. home</small></p>	<p><b>Home:</b> 258 Andrew J Hairston Atlanta, GA 30314</p> <p><b>Builder:</b></p>
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## Your Home's Estimated Energy Use:

	Use [MBtu]	Annual Cost
Heating	4.7	\$189
Cooling	1.8	\$72
Hot Water	1.5	\$61
Lights/Appliances	14.6	\$589
Service Charges		\$0
Generation (e.g. Solar)	0.0	\$0
<b>Total:</b>	<b>22.7</b>	<b>\$911</b>



## Home Feature Summary:

Home Type:	Single family detached
Model:	N/A
Community:	N/A
Conditioned Floor Area:	1,260 ft <sup>2</sup>
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 (Default) • ERV
Duct Leakage to Outside:	Untested 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

## This home meets or exceeds the criteria of the following:

2015 International Energy Conservation Code

## Rating Completed by:

**Energy Rater:** Jackie Zong  
RESNET ID:

**Rating Company:** Solar Decathlon at Georgia Tech

## Rating Provider:



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

<p><b>Ekotrope</b></p> <p>Energy savings calculated without modifications to the energy model. (As Modeled)</p>	<p>Ekotrope RATER - Version:4.2.1.3337</p> <p>The Energy Rating Disclosure for this home is available from the Approved Rating Provider. This report does not constitute any warranty or guarantee.</p>
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# Home Energy Rating Certificate

Projected Report  
Based on Plans

Rating Date:  
Registry ID:  
Ekotrope ID: 2Joa3pWL

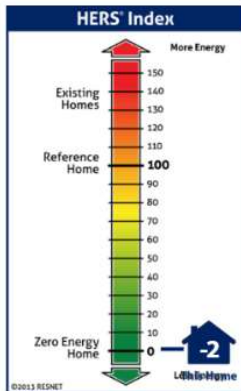
<p><b>HERS® Index Score:</b></p> <p><b>-2</b></p> <p>Your home's HERS score is a relative performance score. The lower the number, the more energy efficient the home. To learn more, visit <a href="http://www.hersindex.com">www.hersindex.com</a></p>	<p><b>Annual Savings</b></p> <p><b>\$2,695</b></p> <p><small>*Relative to an average U.S. home</small></p>	<p><b>Home:</b> 258 Andrew J Hairston Atlanta, GA 30314</p> <p><b>Builder:</b></p>
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## Your Home's Estimated Energy Use:

	Use [MBtu]	Annual Cost
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<b>Total:</b>	<b>22.7</b>	<b>\$0</b>

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## Home Feature Summary:

- Home Type: Single family detached
- Model: N/A
- Community: N/A
- Conditioned Floor Area: 1,260 ft<sup>2</sup>
- 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 (Default) • ERV
- Duct Leakage to Outside: Untested 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:  
**Rating Company:** Solar Decathlon at Georgia Tech

## Rating Provider:



Jackie Zong, Certified Energy Rater  
Date: 2/13/24 at 11:36 AM

<p>Energy savings calculated without modifications to the energy model. (As Modeled)</p>	<p>Ekotrope RATER - Version:4.2.1.3337</p> <p>The Energy Rating Disclosure for this home is available from the Approved Rating Provider. This report does not constitute any warranty or guarantee.</p>
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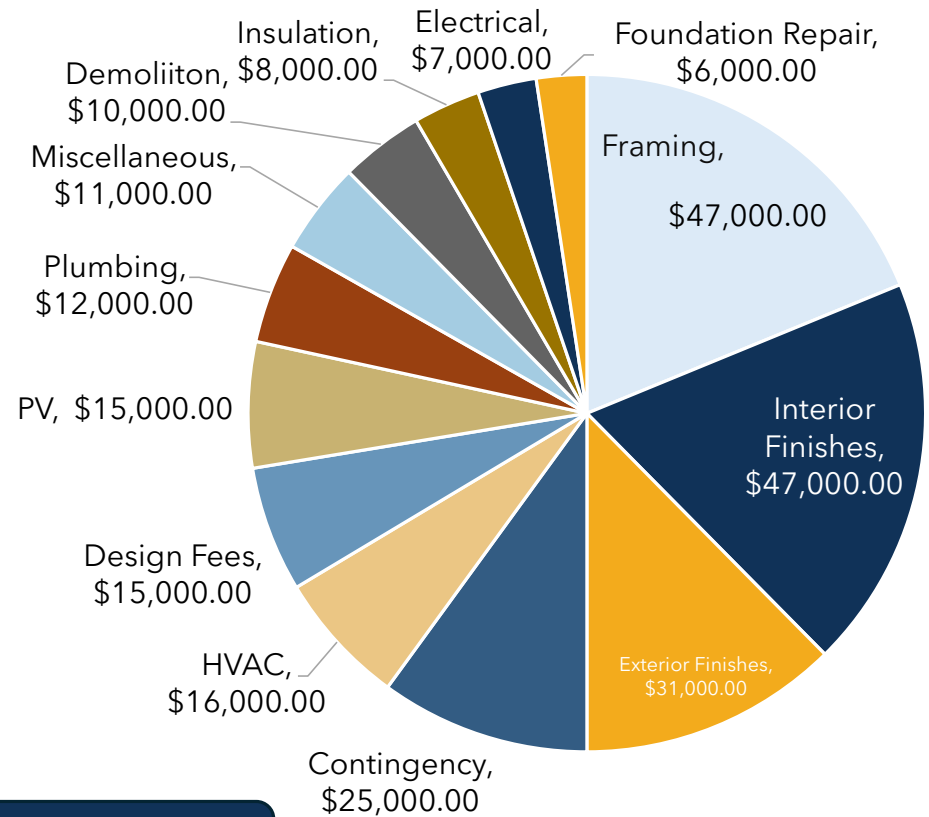




Land Cost: \$100,000



Construction Cost  
\$250,000



Total Cost: \$350,000





\$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

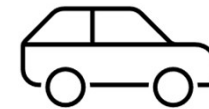
**MONTHLY ENERGY  
SAVINGS: \$225**



2 Weeks of  
Groceries



4-Month  
Supply of  
Insulin



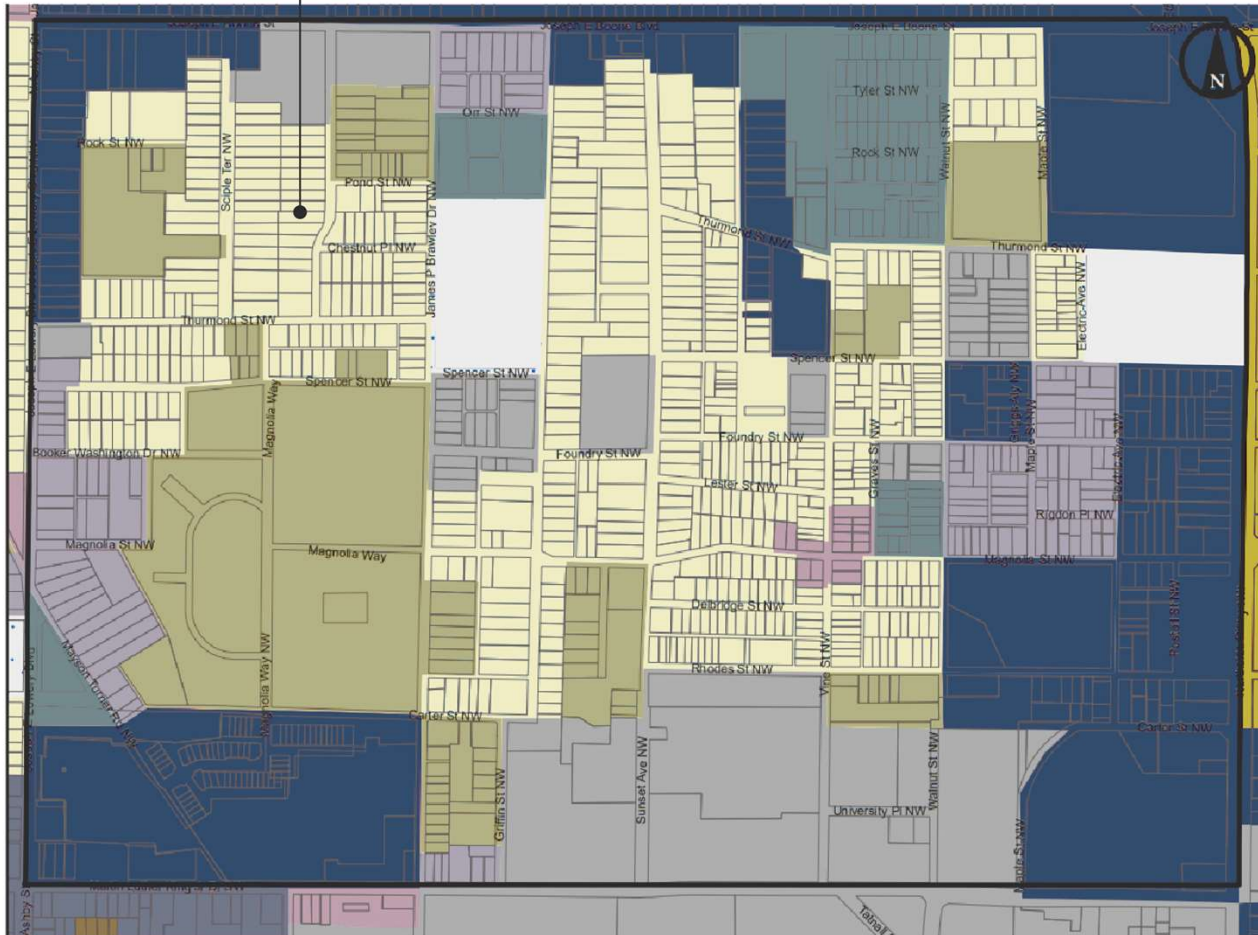
Monthly Car  
Insurance  
Payment



2 Monthly Public  
Transit Passes



258 Andrew J  
Hairston



- Community Facility
- Single Family Residential
- Low Density Residential
- Medium Density Residential
- Low Density Commercial
- High Density Commercial
- Office/Institution
- Open Space
- Mixed Use
- Low Density Mixed Use





## Replicability

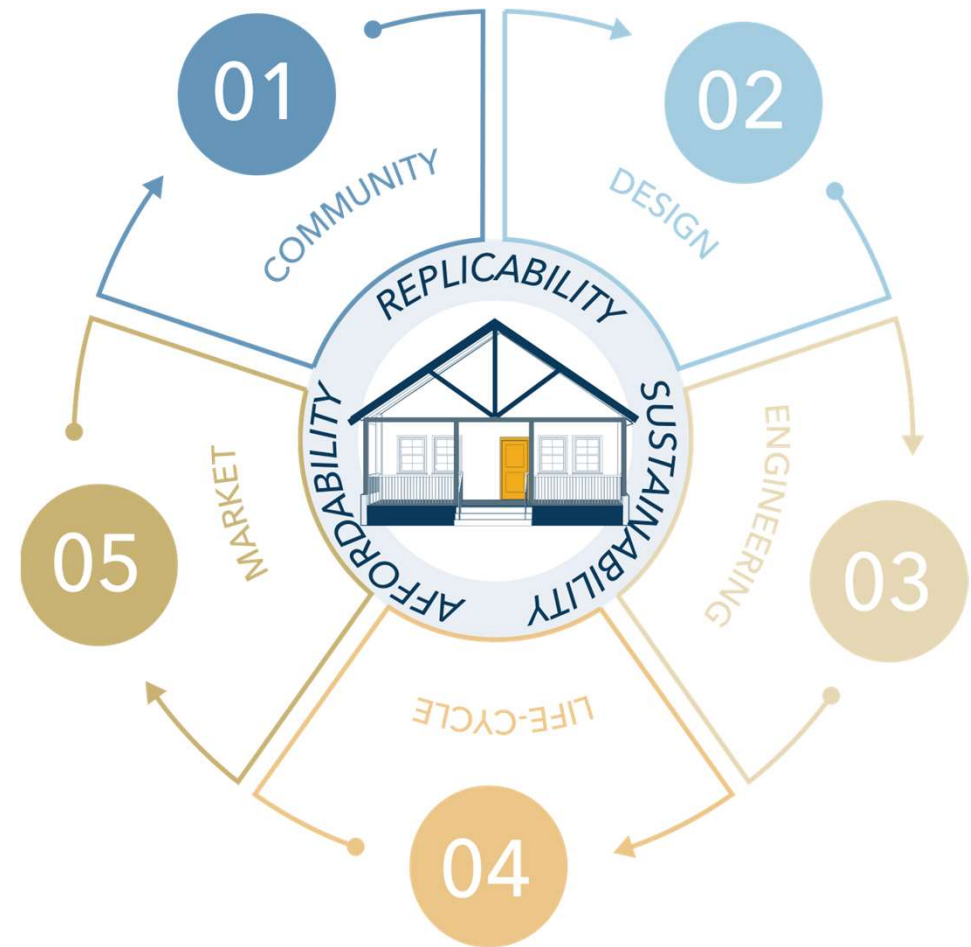
- Maintaining Neighborhood Character
- Westside Future Land Use Framework Plan
- Local Reuse Centers

## Sustainability

- Low Embodied Carbon
- Envelope Efficiency
- Net Zero with PV

## Affordability

- Passive Design
- Energy Savings
- Downpayment Assistance





**Honeywell**



Georgia  
Power



AMERICAN  
**MADE**  
CHALLENGES  
U.S. DEPARTMENT OF ENERGY



**SOLAR DECATHLON**



A L A I R  
HOMES

**SKANSKA**





