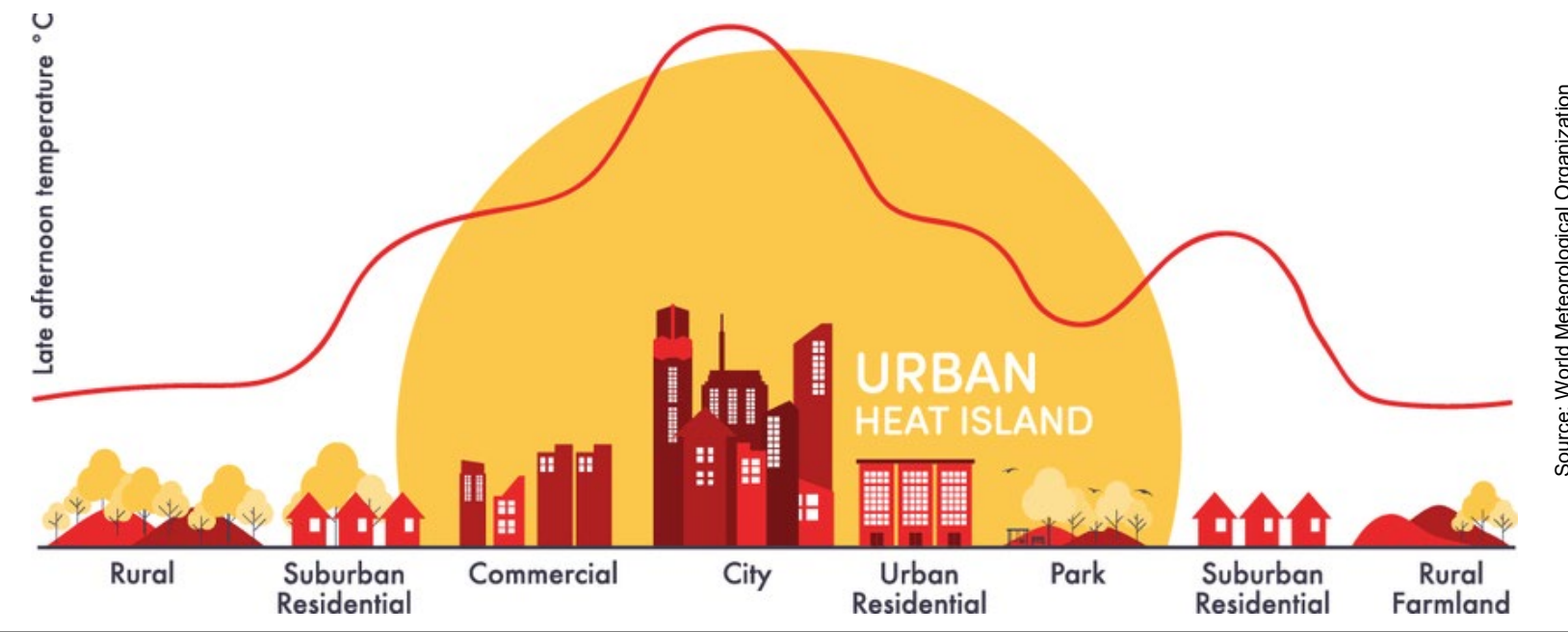


Project Background

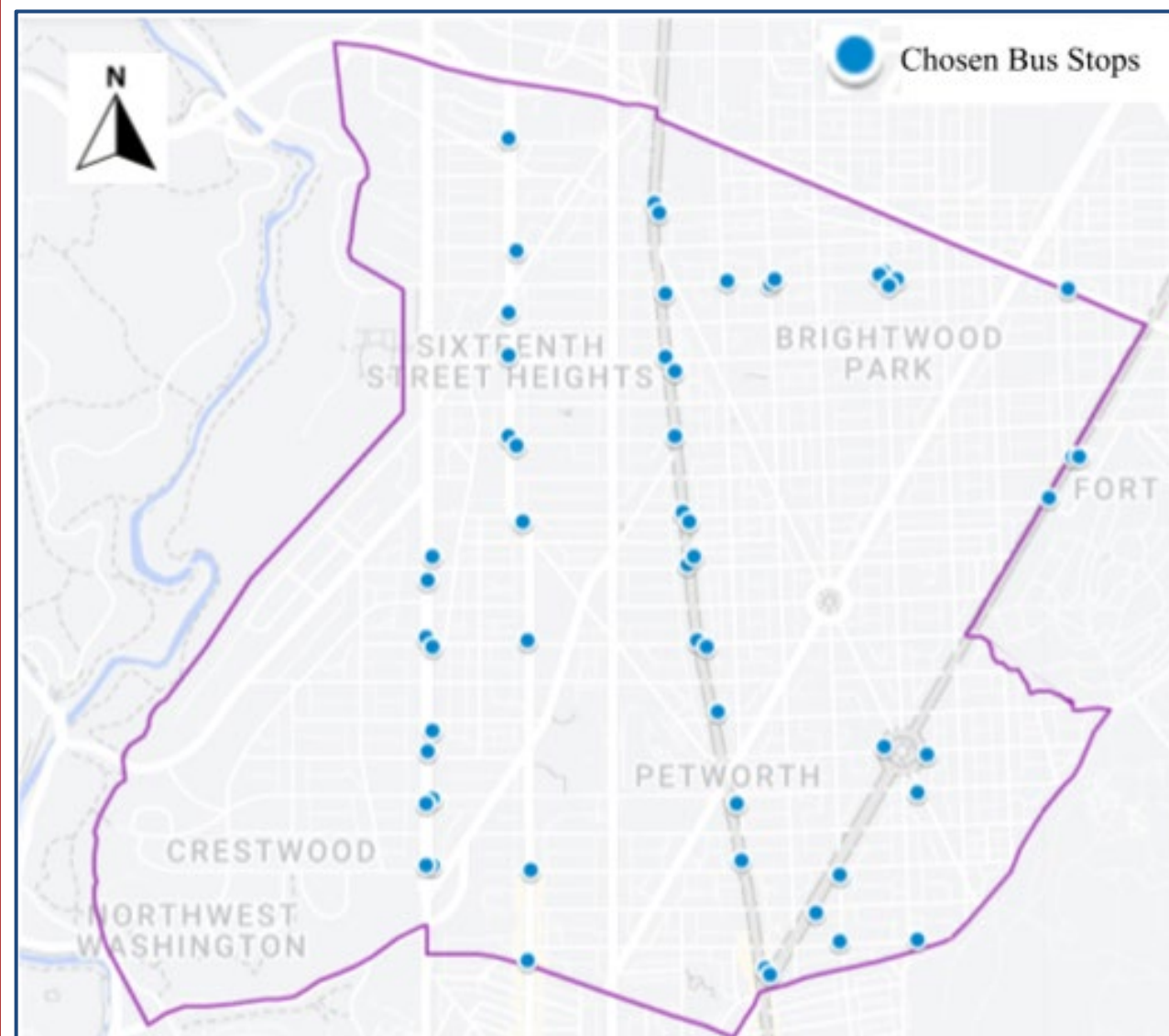


The **Urban Heat Island Effect** causes highly paved areas of cities lacking vegetation to have a **temperature higher than average**, which has been heightened by climate change (Urban Heat Hot Spots, 2023). The **elderly** are at a **higher risk of developing heat-related illnesses**, as well as worsening any preexisting conditions (Kenney, 2023).

Project Goals and Objectives

- Enhance transit rider experience by designing a bus shelter focused around heat mitigation, sustainability, and hazard resilience.
- Increase bus shelter design sustainability by ensuring that at least 50% of design materials are renewables.
- Increase the number of accessible bus shelters in areas of high elderly population to be at least 40% of all bus stops.
- Improve heat safety, accessibility, aesthetics, and equity design features using human-centered design principles.
- Maintain bus structure heat index temperature below 90 Fahrenheit during extreme heat events.

Region of Analysis



Cluster 18 in Washington, DC:

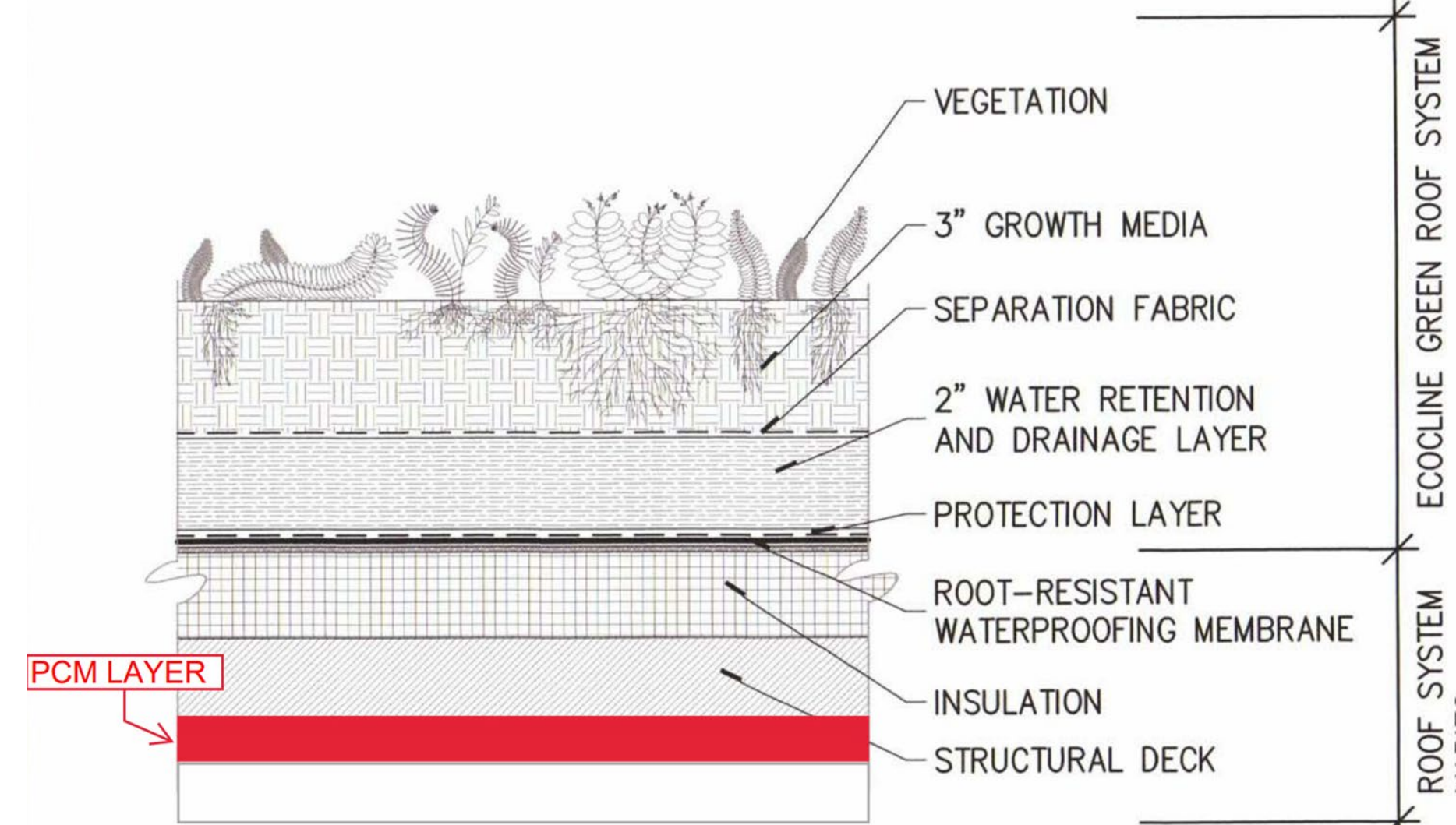
- High Projected Elderly Population
 - Low Socioeconomic Status
 - High Bus Ridership
- Chosen Bus Stops:**
- Routes with Highest Ridership
 - Stops Near:
 - Senior Living
 - Churches
 - Grocery Stores
 - Stops in Full Sun, or Without Bench Were Prioritized

Existing Bus Stops

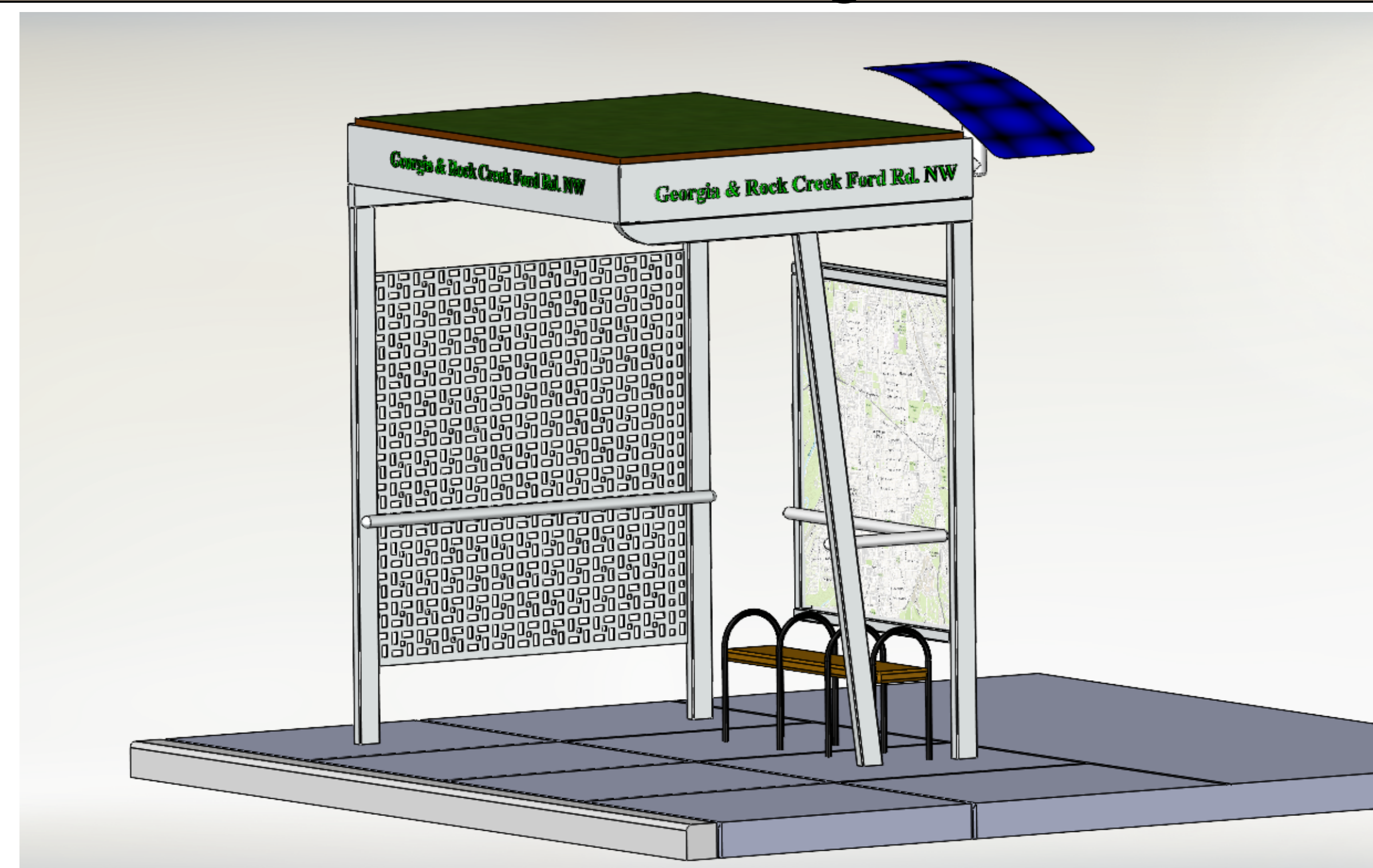


Many existing bus stops **had no bench** or **did not provide shade** to the bench. Additionally, **current bus stops** have the potential to **get hotter than the ambient temperature**.

Roof Cross Section



Our Design



Design Choices

01	Coated Frame	<ul style="list-style-type: none"> Stainless Steel Thermochromic Paint
02	Green Roof	<ul style="list-style-type: none"> Drought Resistant Sedums Native Plant Species
03	Layered Ceiling	<ul style="list-style-type: none"> 2" Rigid Insulation PCM Layer Architectural Wood
04	Open Siding	<ul style="list-style-type: none"> Increased Airflow Space for Hot Air to Escape
05	Accessibility	<ul style="list-style-type: none"> Non-Slip Recycled HDPE Bench 2.5' x 4' Open Bay Assistive Railing Tactile Labels Voice Announcements
06	Wayfinding & Advertising	<ul style="list-style-type: none"> Bus Route Map (Interior) Advertising Panel (Exterior)
07	Sustainable Power	<ul style="list-style-type: none"> Solar Panel Powered Lighting Charging Outlets

Impacts of Heat Mitigation Methods

Heat Mitigation Method	Effectiveness	Cost
Thermochromic Paint	<ul style="list-style-type: none"> Reflects 93% of solar energy at temp. above 65°F and reduces ambient temp. Absorbs solar radiation at temps. below 65°F increasing surface heating and suitable hours for human comfort. 	N/A
Green Roof	<ul style="list-style-type: none"> Decreases roof surface temp. by up to 40°F compared to conventional rooftops. Mitigates Urban Heat Island Effect contributing to decreased temp. of surrounding area. 	\$820 (7'x5'10")
Phase Change Materials	<ul style="list-style-type: none"> Absorbs and releases heat through phase change to cool or heat the space at different external temps. 	\$122.49
Perforated Siding	<ul style="list-style-type: none"> Provides shade while also increasing airflow into the shelter contributing to lower ambient temps. 	\$260
HDPE Bench	<ul style="list-style-type: none"> Stays cooler for longer due to less heat conductivity than typical benches. 	\$600
Insulation	<ul style="list-style-type: none"> Slows heat exchange keeping cool air in and hot air out. 	\$80

Implementation

The DC Bus Shelter Program is currently being implemented through a 20 years partnership between the District Department of Transportation (DDOT) and Clear Channel advertising. The funding for this project comes from \$100 million set aside from the district. DDOT is looking for bus stop designs that are preferable cost neutral that can combat the heat waves that have become frequent during the summer month.

The redesigned bus shelter will cost approximately \$13,500 in material costs. The bus stop will have minimal increase in maintenance costs when compared to existing bus shelter. Maintenance primarily includes the minimal work for the green roof.

References

Dr. W. Larry Kenney: Heat, humidity, and health. (2023, June 27). SciLine. <https://www.sciline.org/health-medicine/heat-humidity-health/>

Urban Heat Hot Spots. Urban Heat Hot Spots | Climate Central. (2023, July 26). <https://www.climatecentral.org/climate-matters/urban-heat-islands-2023>