BIOMEDICAL SCIENCES AND ENGINEERING EDUCATION BUILDING

The Universities
AT SHADY GROVE

COOPER CARRY

LAKE | FLATO

Gilbane

AEI

INTRODUCTION AND PROCESS

The Universities at Shady Grove is a consortium of nine public universities of the University System of Maryland offering quality higher education on a single campus in Montgomery County, Maryland. Sustainability was integral to the design of the Biomedical Sciences and Engineering Education Building (BSE), defining the building and strengthening the vitality of the USG campus. The BSE is tracking LEED Platinum and will showcase environmental connectivity, energy efficiency, user health, and productivity through the experience of the building itself.

The Integrated Design Process is an approach that involves all of a building project's team members — including the owner, vested company members, landscape designers, architects, engineers, and building users — in developing and refining project goals, systems, and materials. A multi-disciplinary team met in July of 2014 to set performance goals for the BSE. Sustainable goals were developed to strengthen campus identity while creating a unique stand-alone destination.

DESIGN CHARRETTE GOALS

The building and site design will promote **ECOLOGICAL CONNECTIVITY & FUNCTION** across the campus, as well as cultural connectivity with the greater community.

The BSE will teach students and other users about **BUILDING PERFORMANCE** by showcasing building systems and learning opportunities.

The BSE will **SET AN EXAMPLE** for sustainable design—both in the Mid-Atlantic region and globally—for teaching lab program, design, construction, and operations.

The BSE will be a leader in **CONSERVING RESOURCES**, including water, energy, and materials.

BIOPHILIC DESIGN will enhance human health and happiness by celebrating our innate human attraction to natural systems and elements.

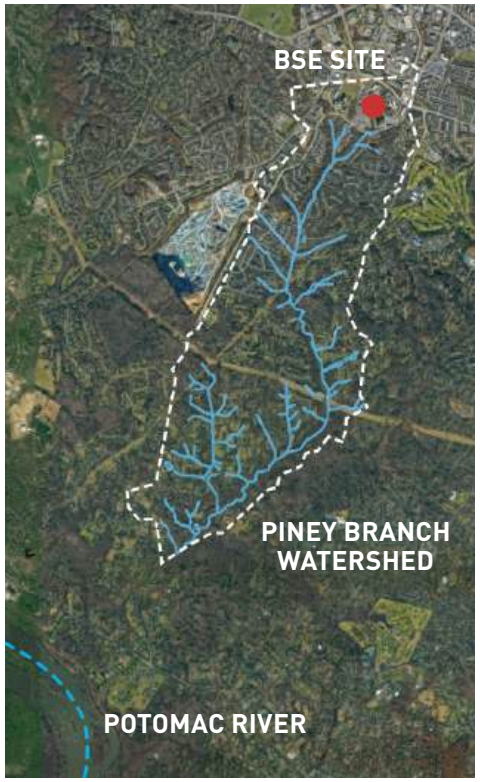
LEED© (Leadership in Energy and Environmental Design) is the most widely used green building rating system in the world. Available for virtually all building project types, from new construction to interior fit-outs, operations, and maintenance, LEED provides a framework that project teams can apply to create healthy, highly efficient, and cost-saving green buildings. LEED certification is a globally recognized symbol of sustainability achievement. The BSE is tracking LEED Platinum, highlighted by these performance categories:

LEED 2009 for New Construction and Major Renovations

Project Checklist

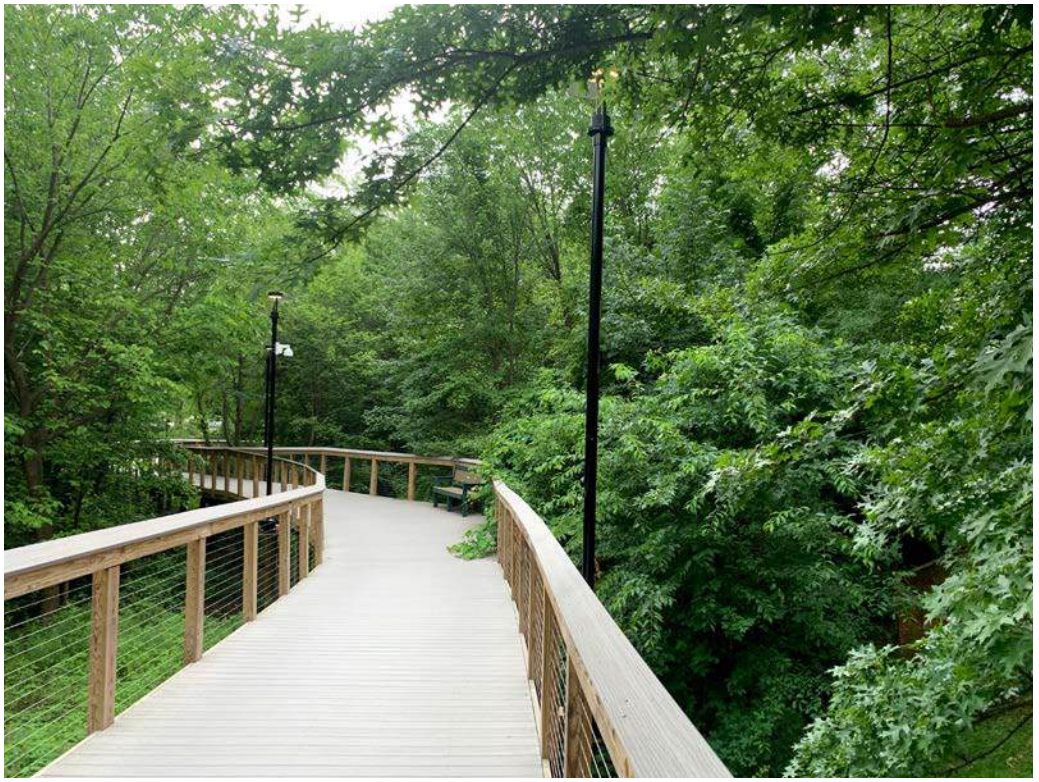
Y	?	N			
21	1	4		**Sustainable Sites**	**Possible Points: 26**
Y			Prereq 1	Construction Activity Pollution Prevention	
		1	Credit 1	Site Selection	1
5			Credit 2	Development Density and Community Connectivity	5
		1	Credit 3	Brownfield Redevelopment	1
6			Credit 4.1	Alternative Transportation—Public Transportation Access	6
	1		Credit 4.2	Alternative Transportation—Bicycle Storage and Changing Rooms	1
3			Credit 4.3	Alternative Transportation—Low-Emitting and Fuel-Efficient Vehicles	3
2			Credit 4.4	Alternative Transportation—Parking Capacity	2
		1	Credit 5.1	Site Development—Protect or Restore Habitat	1
1			Credit 5.2	Site Development—Maximize Open Space	1
1			Credit 6.1	Stormwater Design—Quantity Control	1
		1	Credit 6.2	Stormwater Design—Quality Control	1
1			Credit 7.1	Heat Island Effect—Non-roof	1
1			Credit 7.2	Heat Island Effect—Roof	1
1			Credit 8	Light Pollution Reduction	1
10				**Water Efficiency**	**Possible Points: 10**
Y			Prereq 1	Water Use Reduction—20% Reduction	
4			Credit 1	Water Efficient Landscaping	2 to 4
2			Credit 2	Innovative Wastewater Technologies	2
4			Credit 3	Water Use Reduction	2 to 4
27	2	6		**Energy and Atmosphere**	**Possible Points: 35**
Y			Prereq 1	Fundamental Commissioning of Building Energy Systems	
Y			Prereq 2	Minimum Energy Performance	
Y			Prereq 3	Fundamental Refrigerant Management	
13		6	Credit 1	Optimize Energy Performance	1 to 19
7			Credit 2	On-Site Renewable Energy	1 to 7
2			Credit 3	Enhanced Commissioning	2
2			Credit 4	Enhanced Refrigerant Management	2
3			Credit 5	Measurement and Verification	3
	2		Credit 6	Green Power	2
6		8		**Materials and Resources**	**Possible Points: 14**
Y			Prereq 1	Storage and Collection of Recyclables	
		3	Credit 1.1	Building Reuse—Maintain Existing Walls, Floors, and Roof	1 to 3
		1	Credit 1.2	Building Reuse—Maintain 50% of Interior Non-Structural Elements	1
2			Credit 2	Construction Waste Management	1 to 2
		2	Credit 3	Materials Reuse	1 to 2
2			Credit 4	Recycled Content	1 to 2
2			Credit 5	Regional Materials	1 to 2
		1	Credit 6	Rapidly Renewable Materials	1
		1	Credit 7	Certified Wood	1
12	1	2		**Indoor Environmental Quality**	**Possible Points: 15**
Y			Prereq 1	Minimum Indoor Air Quality Performance	
Y			Prereq 2	Environmental Tobacco Smoke (ETS) Control	
1			Credit 1	Outdoor Air Delivery Monitoring	1
1			Credit 2	Increased Ventilation	1
1			Credit 3.1	Construction IAQ Management Plan—During Construction	1
1			Credit 3.2	Construction IAQ Management Plan—Before Occupancy	1
1			Credit 4.1	Low-Emitting Materials—Adhesives and Sealants	1
1			Credit 4.2	Low-Emitting Materials—Paints and Coatings	1
1			Credit 4.3	Low-Emitting Materials—Flooring Systems	1
1			Credit 4.4	Low-Emitting Materials—Composite Wood and Agrifiber Products	1
1			Credit 5	Indoor Chemical and Pollutant Source Control	1
1			Credit 6.1	Controllability of Systems—Lighting	1
	1		Credit 6.2	Controllability of Systems—Thermal Comfort	1
1			Credit 7.1	Thermal Comfort—Design	1
1			Credit 7.2	Thermal Comfort—Verification	1
		1	Credit 8.1	Daylight and Views—Daylight	1
		1	Credit 8.2	Daylight and Views—Views	1
6				**Innovation and Design Process**	**Possible Points: 6**
1			Credit 1.1	Innovation in Design: Green Housekeeping	1
1			Credit 1.2	Innovation in Design: Integrated Pest Management	1
1			Credit 1.3	Innovation in Design: SSc5.2 - Exemplary Performance	1
1			Credit 1.4	Innovation in Design: WEc3 - Exemplary Performance	1
1			Credit 1.5	Innovation in Design: WEc2 - Exemplary Performance	1
1			Credit 2	LEED Accredited Professional	1
4				**Regional Priority Credits**	**Possible Points: 4**
1			Credit 1.1	Regional Priority: WEc3 (40%)	1
1			Credit 1.2	Regional Priority: MRc2 (50%)	1
1			Credit 1.3	Regional Priority: SSc6.1	1
1			Credit 1.4	Regional Priority: WEc2	1
86	4	20		**Total**	**Possible Points: 110**

Certified 40 to 49 points Silver 50 to 59 points Gold 60 to 79 points Platinum 80 to 110



The Piney Branch Watershed


Green Roof on the BSE


Campus Boardwalk over Wetlands

SITE ECOLOGY

Embracing the Wetlands

The BSE is located at the headwaters of the Piney Branch Watershed, a sub-watershed of the Watts Branch, which is a tributary of the Potomac River.

The project is dedicated to creating a strong connection to the local site ecology by minimizing impacts on the adjacent wetland. Native planting is emphasized along the wetland edge, and outdoor rooms of varying vegetation types are designed to passively respond to seasonal temperatures and comfort. The building also showcases and educates visitors about the impacts that development has on wetlands and watersheds.

Ecological Connectivity

The building and site design promotes ecological connectivity and function across the campus. The campus has an ecological spine as a centerpiece of design, which celebrates the wetlands, stream, and forest canopy through spatial and material relationships.

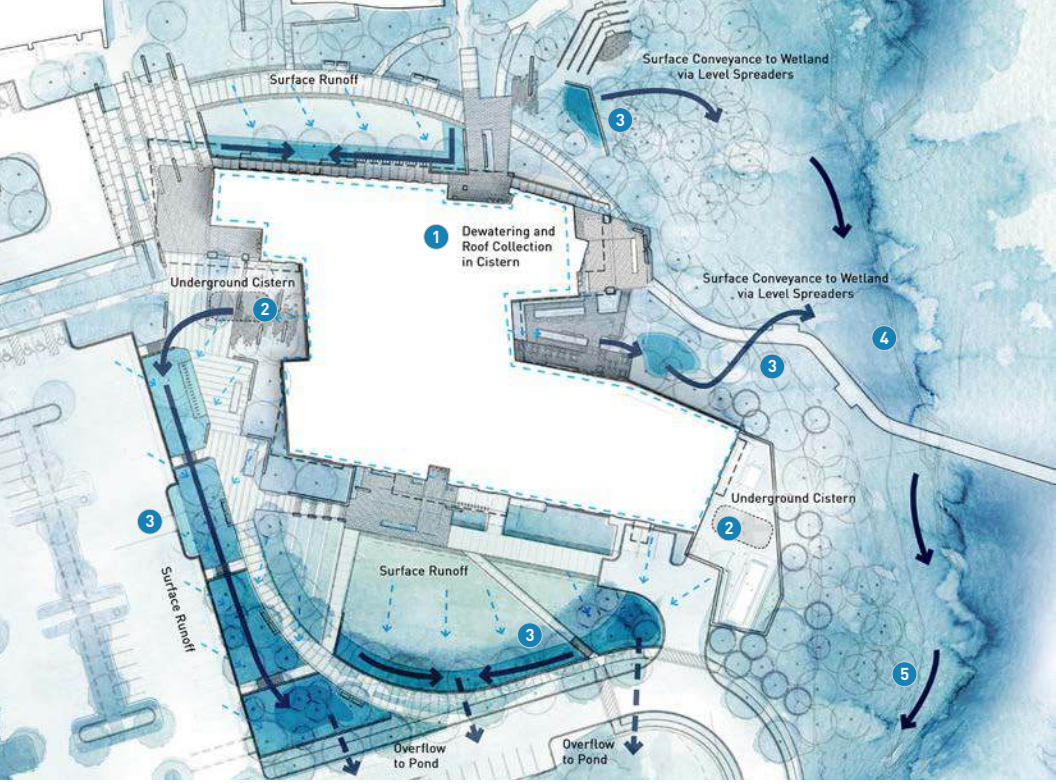
The project was built on a previously developed asphalt parking lot with existing infrastructure to protect greenfields and preserve habitat and natural resources. This project promotes biodiversity by providing open space that makes up **43%** of the total site area. It is now a Special Protection Area (SPA) that provides protected habitat for diverse wildlife.

Heat Island Effect

Paving materials that are able to effectively reject solar heat will be installed for **72%** of the site hardscape. Reflective roofing materials will also be installed. This will reduce heat islands to minimize impact on microclimate and human and wildlife habitat.

Light Pollution Reduction

Interior and exterior lighting will minimize light trespass from the building and site, reduce sky-glow to increase night sky access, improve nighttime visibility through glare reduction, and reduce development impact from lighting on nocturnal environments.



Stormwater run-off diagram

WATER EFFICIENCY

Collecting Stormwater

Particular focus has been placed on minimizing the impact that the newly constructed building and landscape will have on the watershed.

1. 100% of condensate and rainwater that falls on the roof is harvested.
2. Rainwater is first collected into a cistern that can be used for irrigation, toilet and urinal flushing, and chiller makeup.
3. A series of bioswales will naturally filter water and to allow it to infiltrate the adjacent soils.
4. The filtered water is then introduced into the adjacent wetlands.
5. Water filters through the wetlands and arrives at the pond to the south of the building site.

Quantity Control

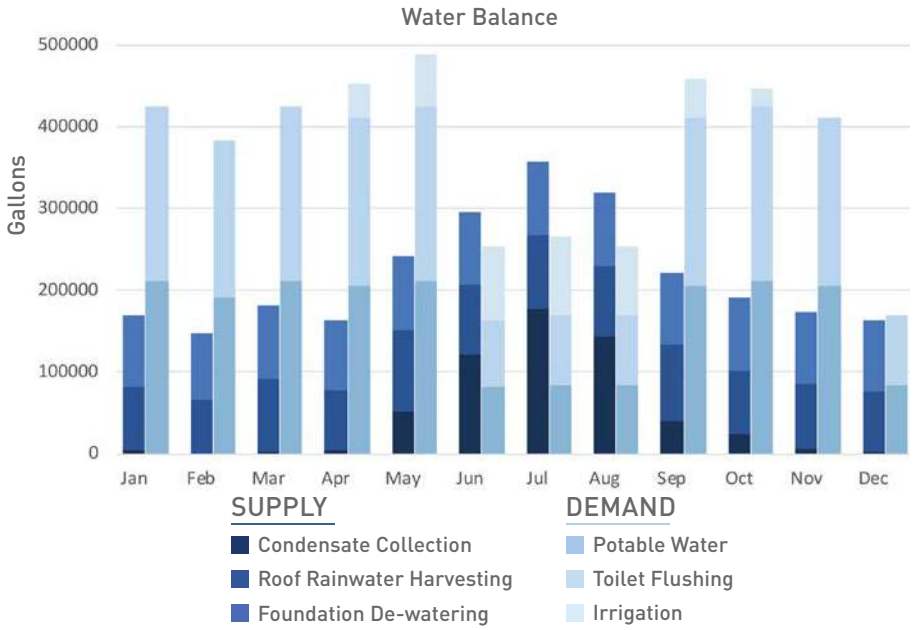
The majority of the previous site consisted of an impervious parking lot. This project limited disruption of the natural hydrology by reducing impervious cover and increasing on-site infiltration, reducing stormwater runoff volume by **28%**.

Innovative Wastewater Technology

The BSE collects non-potable water from the roof drainage system, condensation water from mechanical systems, from foundation drainage, and under-slab de-watering system. Reclaimed water goes through a large cascade filter before entering a 20,000 gallon cistern. This water is pumped on demand to a rainwater treatment skid, and is stored in a 2,000 gallon day tank. The skid has multiple treatment devices: high quality filters, chlorination injection, and UV lights to treat the water. This water is only used to flush urinals, water closets, and east courtyard water feature.

Water Use Reduction

The project team will employ strategies that, in aggregate, use **79%** less water than baseline predictions. Increased water efficiency within the building will reduce the burden on municipal water supply and wastewater systems. The BSE uses rainwater collected in cisterns rather than potable water resources to irrigate the native, drought-resistant landscape on the site. A water balance calculation was performed to evaluate opportunities to balance water supply. The BSE is expected to save over **1.3 million** gallons of water per year.



PINEY BRANCH WATER GARDEN

Water Garden

The Piney Branch Water Garden features commissioned public artwork by Michael Singer Studio. It is a sculptural work that functions as a connection and transition between the built realm and its ecological context. Suspended cast aluminum elements act as floating lanterns that visually connect the indoor atrium with the outdoor gardens. Abstracted patterns within the sculpture reference natural phenomena and scientific disciplines found in the building. Water emerges from a raised source at the western end of the garden, flowing east through a curved series of shallow pools and small copper spillways. The sound of the flowing water occurs at several points within the garden both near the entry and outdoor seating spaces. The water flows from the darkest recesses of the courtyard towards the wooded wetland to the east.

1. Interior living wall in the BSE atrium extends from the ground floor to the 1st floor
2. Elevated water basin with submerged sculpted panel, surrounded by sculpted cast aluminum and copper elements suspended from above
3. Sculpted elements integrated with evergreen ground covers
4. Lower basin with underwater and emergent sculptural details, submerged sculpted panels, and water lilies
5. Metal walkway bridge over lower water basin connecting outdoor deck to BSE entry and campus boardwalk
6. Water basin connects to bioswale and infiltration berm to the east; water returns for recirculation at the east end of the basin
7. Planted bioswale and infiltration berm connects to the existing forested wetland to the east (through infiltration only)
8. Interior cafe connects to outdoor seating areas
9. East entry to the BSE

Biophilic Design in the BSE

WELL-BEING AND BIOPHILIA

Biophilia is humankind's innate biological connection with nature. Biophilic design can reduce stress, enhance creativity and clarity of thought, improve our well-being, and expedite healing. As the world population continues to urbanize, these qualities are ever more important.

Natural Colors, Textures, and Shapes

The interior spaces of the BSE incorporate design strategies that reference the natural world. Green colored glass, natural wood siding, and living green walls mimic biological environments. The patterning near the vertical circulation of the building alludes to the vertical circulation of water and nutrients through trees. Colors and patterns on walls and carpets were chosen to add visual interest and evoke a sense of natural order and comfort.

1. Natural Daylight
2. Exterior Views
3. Wood Flooring
4. Living Green Wall
5. Green Glass
6. Wood Wall Drum
7. Natural Ventilation
8. Boardwalk
9. Reclaimed Wood Siding
10. Bluestone

INDOOR ENVIRONMENTAL QUALITY

Living Green Wall

A living wall connects the atrium to the boardwalk and wetlands to the east. This green wall creates healthy indoor air and increases comfort through passive humidification control.

Indoor Air Quality

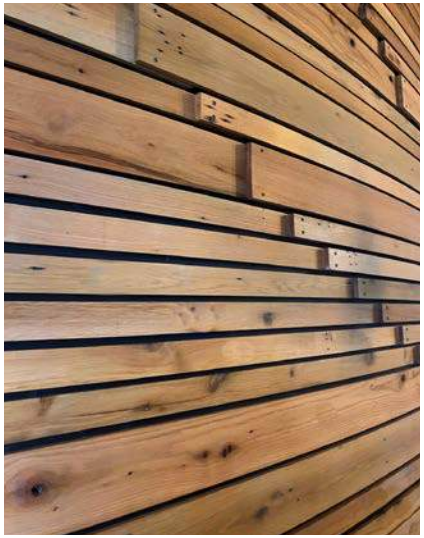
The project has been designed to increase ventilation and minimize pollutant entry into the building and cross-contamination of regularly occupied areas. MERV air filters and walk-off entry mats minimize exposure of building occupants to potentially hazardous particulates and chemical pollutants.

Daylight and Views

Interior spaces are connected to the exterior environment through views, daylight, and natural ventilation. **87%** of occupied spaces have views to the exterior of the building.

Low-Emitting Materials

Adhesives, sealants, coatings, flooring systems, and other products were carefully selected to reduce harmful or irritating indoor air contaminants. The design team eliminated high-VOC products and lab-finishes where possible and used low-emitting materials throughout the BSE.



Wood Wall Drum

Living Green Wall

MATERIAL LIFE CYCLE

Less is More

HVAC and structural systems were coordinated to become part of the building aesthetic, minimizing the need for finish materials. Concrete columns, ceiling slabs, and polished floors were left exposed to express their true materiality and durability. The slab was right-sized to use less cement, further reducing material volume (and cost). Optimizing the amount of material used not only decreased BSE's carbon intensity but improved the indoor environment for inhabitants.

Recyclables

The project will provide a easily-accessible dedicated areas for the collection of recycling throughout the entire building. This facilitates the reduction of waste generated by building occupants that is hauled to and disposed of in landfills.

Construction Waste Management

The construction team will recycle at least **95%** of construction waste. A construction waste management plan was developed and implemented that identifies the materials to be diverted from disposal.

Recycled Building Content

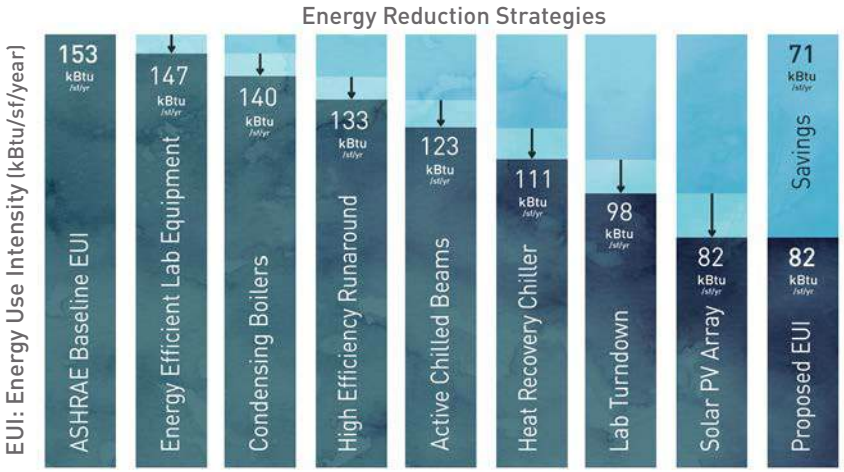
The building will use materials with recycled content, such that the sum of post-consumer recycled content plus one-half of the pre-consumer content constitutes at least **20%** of the total value of the materials in the project.

Regional Materials

Many building materials and products were extracted, harvested, or manufactured within 500 miles of the project site, including regional wood, brick, and bluestone.

Building Performance on Display

The BSE teaches visitors about building performance by showcasing functional systems with intuitive controls (engineering lab systems, sunshades, PV panels, and responsive lighting). The educational process is on display through outdoor classrooms, engineering lab porches, and labs visible through transparent glass walls.



Energy Reduction Strategies

ENERGY

EUI

Energy Use Intensity is a building's annual energy use per unit area. It is typically measured in kBTU per square foot per year. EUI is useful for comparing performance of buildings across sizes, types, and locations. EUI is used by programs like ENERGY STAR® and the 2030 Challenge, which have specific EUI goals for different building types. The BSE is expected to have an EUI of **98** (before including solar power), which is a **36%** reduction from a typical lab building.

Optimize Energy Performance

The main energy conservation measures that resulted in these savings are two-pipe active chilled beams, lab air handling unit energy recovery using glycol run-around loop, high-efficiency chillers, condensing hot water boilers, variable primary chilled water and heating hot water pumps, office unit air-side economizer, and LED light fixtures.

On-Site Renewable Energy

A solar photovoltaic array will be installed that will produce enough energy to offset **8%** of the project's annual energy costs. This is enough to offset the typical energy use of **17** houses every year.

Commissioning Energy Systems

A third-party commissioning authority has verified that the building's energy related systems are installed, calibrated, and perform according to design. This commissioning process started early in the design process and will continue after systems performance verification is completed.

Thermal Comfort and Control

Thermal controls are provided for **54%** of building occupants and **100%** of shared multi-occupant spaces. Providing these high levels of system control will promote the productivity, comfort, and well-being of building occupants.

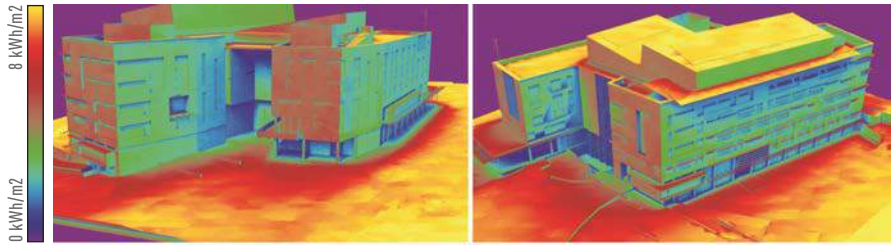
HVAC systems and the building envelope has been designed to meet the requirements of ASHRAE 55-1992. This provides a comfortable thermal environment that supports the productivity and well-being of building occupants. Building assessment will be performed with a survey that collects anonymous responses about thermal comfort in the building, including an assessment of overall satisfaction with thermal performance and identification of thermal comfort-related problems.

Solar Radiation

The images below show the daily cumulative solar radiation on building surfaces. Exterior shading is critical to control the incident solar radiation on the glazed facades under the permissible limits.

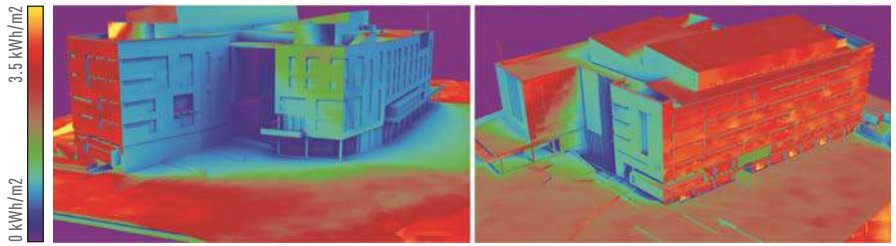
Vertical shade sails on the west elevation were designed to provide solar protection from direct solar radiation during summer months without compromising exterior views at eye level.

Solar Radiation on the BSE (kWh/m2)



June 21- Northeast Elevation

June 21- Southwest Elevation



December 21- Northeast Elevation

December 21- Southwest Elevation

OPERATIONS

Measurement & Verification

The project team will implement a measurement and verification plan to provide for the ongoing accountability of building energy consumption over time. This plan includes a process for corrective action if energy savings predicted by the energy model are not achieved.

Long-term engagement is critical to project performance. Performance will be measured, evaluated, and shared with building users via digital green screen located at the building entry. Intelligent controls and feedback systems will be designed to save energy and to enhance comfort in individual spaces as needs and occupants change.

Outdoor Air Delivery Monitoring

Permanent monitoring systems that provide feedback on ventilation system performance will be installed to ensure that ventilation systems maintain design minimum ventilation requirements. All monitoring equipment will be configured to generate an alarm when conditions vary by 10% or more from the set point.

Green Housekeeping

A green housekeeping policy is in place for the building and site to reduce the exposure of building occupants and maintenance personnel to potentially hazardous chemical, biological and particulate contaminants, which adversely affect air quality, human health, building finishes, building systems and the environment.

Integrated Pest Management

An environmentally sensitive management plan is in place for the site's natural components. Integrated pest management will manage indoor and outdoor pests in a way that protects human health and the surrounding environment from toxins.

Smoke Free Campus

The Universities at Shady Grove is a tobacco-free campus. These measures minimize exposure of building occupants, indoor surfaces, and ventilation air distribution systems to environmental tobacco smoke.

Green Screen Display

The building green screen provides real-time performance information to building users to encourage individuals to conserve energy. This powerful tool educates the community with a goal to reduce campus energy consumption, improve operational efficiency, and teach sustainability and well-being. The BSE teaches students and other users about the building by showcasing building systems and real-time building performance.