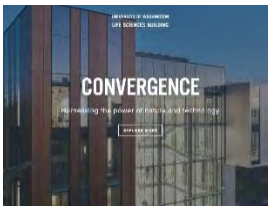
UW Life Sciences Building
Sustainable Design Approach and Performance Metrics

Links to Websites

AIA COTE Website



Project Website

University of Washington Article

Links to Animated Diagrams

Energy and Water Systems Animation

https://drive.google.com/file/d/1_rjiL8j6SFZEncjv0op3Zc2Z-viCP50c/view?usp=sharing

Natural Ventilation Cooling Animation

https://drive.google.com/file/d/1ZSTyTqTkaINQM4wyE1zDi1Dj0B2w5kOm/view?usp=sharing

2030 Challenge

- *Modeled Projected Energy Use Intensity (EUI):* 152.7 kBtu/ft2.yr
- *Baseline EUI:* 370 kBtu/ft2.yr*
- *Percent Reduction: 58.7%*
- *Additional Percent Reduction from onsite energy: 1.5%*
- *Additional Percent Reduction from offsite energy: 20%*
- ***Total percent reduction: 80.2%*****

*Based on National Average EUI for Laboratory Building as per 2030 Reporting Tool

**Also meets the more aggressive 2030 Challenge for the years 2020-2025

Modeled vs. Actual Performance

Actual Measured EUI: 137 kBtu/ft2.yr (decrease by 15.7)

Modeled renewable energy: 2,883,290 kWh/yr

Actual renewable energy: 2,964,451 kWh/yr (increase 100,000 kWh than modeled)

Energy Conservation

- 58.7% energy reduction from baseline (national average for lab buildings per 2030 Reporting Tool)
- Heating and cooling using energy efficient radiant systems:
    - chilled beams (lab ceilings),
    - chilled waves (office and public ceilings)

      Chilled waves and chilled beams: A more efficient system than the traditional VAV approach also with an eye on fan energy savings long-term over the complete lifecycle of the building.
    - radiant floor heating and cooling (office and public zones)

      Radiant floor: a passive, more efficient hydronic heating/cooling strategy to maintain occupant comfort while reducing fan energy.
- Operable windows
    - Natural ventilation in public zones including main open stair
- High performance envelope
    - Two low E coatings for glazing
- Exhaust Heat Recovery & Single heating/cooling coil

  This project implemented an innovative solution to combine the single heat recovery coil into a multiple function heating, cooling, and heat recovery hydronic loop. We calculated a net energy and first cost savings. This system does not capture all of the potential heat recovery hours during the winter months but provides significant fan energy savings year around for a net operational savings along with a first cost savings through a reduction in piping and AHU equipment cost savings.

Energy Saving Strategies and Statistics

- Building Integrated Photovoltaics
    - Building Integrated Photovoltaics on the exterior shades (include details and diagrams)
        - Generate electricity
        - Reduce solar heat gain
        - Maintain maximum views and daylight
    - The BIPV fins generate 12,260 kWH of electricity which equals the amount of energy required for lighting all 12,400 square feet of the open and private offices along the perimeter of levels 2-5.
    - Manufacturer is Onyx Solar
    - Total SF of fins : 6,411.67
        - Every 2 fins create a module
        - Fins are 30" deep spaced 5' apart
    - The fins use an amorphous silicon PV glass
        - It produces more power than a crystalline silicon solution in a diffuse light conditions (overcast areas)
        - Provides a clean appearance
        - Can provide various levels of transparency: 10%, 20%, 30%
        - LSB is 10% transparency
        - PV glass is encapsulated between 2 pieces of tempered glass

- Energy generation
    - BIPV fins = 12,260 kWH
    - Rooftop solar panels = 110,000 kWH
    - **Total modeled energy generation = 122,260 kWH**

- Radiant Floor
    - Provides a passive, more efficient hydronic heating/cooling strategy to maintain occupant comfort while reducing fan energy.

- Chilled Waves/Beams
    - A more efficient system than the traditional VAV approach also with an eye on fan energy savings long-term over the complete lifecycle of the building.

- Natural Ventilation Cooling Strategy
    - Operable windows provide cooling in public zones, offices, and the large open stair
    - Windows in office have manual operation so users have control over their own comfort
    - Windows in public zones are controlled by the building automation system for optimized building performance
    - The open stair, cooled by building automated windows, uses a natural stack effect to increase ventilation
    - When using this passive cooling strategy the building's cooling system powers down saving energy

- High Performance Building Envelope
    - Thermally broken curtainwall system with a U-value of .26 to reduce heat loss through glazing
    - Rainscreen system with continuous exterior insulation and fiberglass clips to reduce heat loss through walls

- Exhaust Heat Recovery & Single Heating/Cooling Coil

- An innovative solution to combine the single heat recovery coil into a multiple function heating, cooling, and heat recovery hydronic loop. This system provides significant fan energy savings year around for a net operational savings along with a first cost savings through a reduction in piping and AHU equipment cost savings

Sustainable Education

- Touchscreen educational dashboard at building entry with real-time measurements of energy and water use

Water Collection and Re-use

- 40% Water Use Reduction
  - Water Use Intensity (WUI) of 4.2 gal/sf/year
  - Based on interior fixtures (toilets, urinals, faucets, showers, kitchen sinks)
  - Based on methodology for LEED calculation
  - Predicted water use of approximately 771,000 gal/year
  - Predicted water use savings of approximately 521,000 gal/year

- 28% Waste Water Reused
  - Collect reject lab water from reverse osmosis system, store in cistern and re-use for greenhouse irrigation
  - Predicted water savings from RO reuse is 293,750 gal/year
  - Approximately 20% of water used to create reverse osmosis purified water is wasted – and typically dumped down the drain. LSB's RO Reclaim system captures that otherwise wasted water and re-treats and re-purposes it to irrigate the greenhouse plants.

- 1.8% Precipitation managed on site
  - For 72,0345-SF of building (42,570-sf) and new paving(29,465-sf) created on the site, we manage 31,166-gal per year from existing trees saved, and new green roof.
  - Given 37-in average annual rain, over the surfaces, we get 1,661,483-gal of rain per year.

Water Collection and Re-use narrative

The reverse osmosis reject water from the labs is stored in a cistern in the basement and reused for irrigating the research and teaching plants in the greenhouse. This innovative water re-use strategy is unique and tailored to the specific program uses of the Life Sciences Building. Unlike rainwater, which varies seasonally, the lab water is constant throughout the year so the cistern can be relatively small, located within the building, and easier to maintain than a typical large vault within the ground. Unlike exterior irrigation, which varies seasonally and has higher irrigation needs for the first several years for plants to get established, the greenhouse irrigation is used throughout the year and is a public display of the research being conducted within the building.

The aim of the project at hand is to lessen the use of Seattle City water supplied to the greenhouse for single pass irrigation purposes. You can imagine that watering plants in the existing 14,000 sq ft greenhouse uses a lot of water. The idea is to redirect the reject water from the lab bldg RO/DI system to use in the greenhouse plant irrigation system. The RO/DI reject water would otherwise pass directly to

drain (about 20% of the supply water to this system). We have tested the RO/DI system reject water and it proves acceptable for irrigation of the greenhouse plants so why just put it down the drain when it could be useful for a second function and also decrease demand elsewhere. This is a new idea for UW and although the demands for greenhouse watering are few at UW, there are quite a number of lab bldgs with similar RO/DI systems which could have the reject water redirected for other purposes. In addition, the greenhouse hosts 1000s of K-12 students and their teachers annually for tours of the plants. Similarly, 40% of all UW incoming students pass through Biology courses and most of these tour the greenhouse as part of their course work. Our intent is to include the water saving feature here as part of the tour to illustrate and encourage others to think in terms of water conservation via multiple use approaches. The media wall on the 1st floor lobby will also include illustrations and information on the sustainability features of the new bldg, and student input to toward making the most impactful presentation will be very helpful.

Water Strategies and Statistics

- RO Reclaim System
    - Approximately 20% of water used to create reverse osmosis purified water is wasted – and typically dumped down the drain. LSB's RO Reclaim system captures that otherwise wasted water and re-treats and re-purposes it to irrigate the greenhouse plants.

- Low flow fixtures
    - Toilets, faucets, and showers use low flow fixtures to reduce the amount of potable water used by the building.

- *Percent Reduction:* ***32%***

Materials

- 86% of construction waste is diverted from landfill
- 10% recycled content for building materials
- 10% of materials are locally sourced within the region
- To improve indoor air quality all adhesives, sealants, paints, flooring and composite wood have low or no VOC (volatile organic compounds)
- Specific material selections for recycled content include:
    - Structural steel with over 90% recycled content
    - GreenGirt fiberglass clips replace metal clip for exterior cladding providing a thermal break and have 32% recycled content
    - mineral wool insulation, a healthy natural material, is used in lieu of fiberglass batt insulation and rigid insulation whenever feasible and provided 16% recycled content
    - Interface carpet with 80% recycled content
    - McKeon overhead coiling doors were selected with 90% recycled content
- Specific material selections for regional sourcing include:
    - DensGlass exterior sheathing is 100% regional with manufacturing 24 miles away and harvesting 85 miles away from the project site
    - General Technologies post tensioning steel is 98% regional with manufacturing and harvesting 29 miles away
    - Beumont reinforcing steel is 99% regional with manufacturing and harvesting 29 miles away from the project site

Habitat Cavities in Landscape

- Concrete site walls have runnel along top for water that spills over into vertical slots in the concrete called habitat cavities
- The vertical slots are bush hammered concrete to create a heavily textured surface for moss to build up
- The moss attracts birds and insects creating ecological microclimates for the plants and animals to thrive.

Biophillic Design

- Core of building clad with wood– experience of trees as once stood in Olympic Peninsula (touch and experience the wood)
- Views from roof deck down to greenhouse
- Views from Burke-Gilman Trail into greenhouse
- Experience of Level 1 as below tree canopy (extension of Deodar Cedars on north with wood slat ceiling inside at same level.)

Building Intro and Design Concept

The Department of Biology at the University of Washington (UW) sees over one third of all students enrolled at UW and is the largest STEM program in the state. In order to meet their growing demand, the 207,000 square foot Life Sciences Building (LSB) embodies three core concepts—**Science is a Gateway, Connections, and Engagement**—enhancing the building's relation to the campus, students, faculty, and environment. With these core values in mind, we designed a flexible, collaborative and highly sustainable building.

Science is a Gateway: Living Lab

A primary project goal was to make the building a living lab by placing science and sustainability on display. The greenhouse research and renowned plant collection are steps away from the pedestrian trail, while unique plants from the Biology courses integrated into the cascading landscape near the west entrance. The species selected create a "plant timeline" starting with Bryophytes (mosses) from 500 million years ago up through Angiosperms (flowers) which began 160 million years ago.

Building integrated "solar fins" on the southwest façade are a billboard for sustainable innovation—feeding real-time data to touchscreen dashboards in the entry lobby where students can compare energy generated by standard solar panels on the roof with energy generated by the thin film solar technology in the solar fins.

Connections: Ecotone

This next-level science facility creates an "eco-tone"—the region of transition between two biological communities—in both program and design where the technology behind the science intersects with the study of the natural world. The southern exterior is comprised of metal, glass, and energy producing solar fins to represent technology, while the northern exterior boasts natural wood to represent nature and visually connect the building to the treasured Deodar Cedar tree canopy lining this woodland path on

campus. The ecotone converges at a six-story, 1,000 square-foot glass-box atrium that connects the south and north ends of the building.

Suspended inside the glass-box atrium is the feature stair connecting the 6 floors of research with oversized landings that encourage chance-encounters between scientists and students—fostering collaboration and providing natural ventilation cooling for public spaces. The high-tech glass system around the staircase seems to disappear as one looks out to the public courtyard, a primary thoroughfare through campus with reclaimed wood benches tucked into the landscape as areas of respite for both students and passerby.

Engagement: Programming & Planning

The building houses 40 principal investigators and their teams where research labs, teaching labs, an active learning classroom, café, animal care suites, growth chambers and greenhouses holistically integrate their approach to life sciences in a space designed around creating a healthy collaborative environment.

The project's core concepts drove us to design technical teaching and research spaces that are open, flexible, and efficient, while allowing for additional informal collaboration and interaction spaces for students and faculty throughout the building. Flexible planning allowed for 18 more Principal Investigators than originally planned, while enabling endless views and ample natural light through the labs, offices, conference rooms and break spaces.

Design – Unique Features of the Building

PV FINS

The building generates energy using solar panels integrated into the south façade. Referred to as “building integrated photovoltaics”, or BIPVs for short, this is the first of its kind installation: solar cells manufactured using thin film technology are laminated within vertical glass fins that are integrated into to a custom exterior curtainwall. This solar innovation achieves multiple sustainable design goals including reducing unwanted solar heat gain in the offices, providing expansive views from within the offices, reflecting daylight, and producing enough electricity to light all four floors of private and open offices along the perimeter of the building throughout the year.

The design criteria for the BIPV fins were to be fully supported by the curtainwall system, have all of the electrical wiring concealed with the mullion, and provide access to the wiring from the inside for future maintenance. This required designing a custom aluminum extrusion for the mullion which was deeper than their other extrusions and allowed the inside cap to snap off. In addition, this was a new material assembly so it required applying for an Underwriters Laboratories (UL) listing and getting approval from the local electrical inspector who would be the first authority having jurisdiction to approve it. In response to the inspector’s requirements a longer electrical whip was required than the solar manufacturer had available so this also had to be custom. We’ve grown to realize that innovations of this magnitude require not only our best ideas but also our best communication and teaming skills to turn an aspirational vision into a reality.

The successful design and installation of this innovative design feature required extensive collaboration between the architect (Perkins+Will), electrical engineer (AEI), contractor (Skanska), sub-contractor (VECA), curtainwall manufacturer (Mission Glass), and solar manufacturer (Onyx Solar).

STAIR

2. Adjacent to the main entry is a 1000 square-foot glass-box atrium, six stories high, which connects the south and north ends of the building. Suspended within the point-supported glass box is a communicating

stair offering oversized landings to encourage communication between researchers, one of the top priorities for the Biology Department. The stair also visually connects the researchers inside the building with an exterior public courtyard along a major campus axis. This courtyard, referred to as “the porch”, is designed both for quick access and respite with cascading stairs, reclaimed wood bench seating, and ”habitat walls” with vertical slot cavities designed to collect moss and fauna and restore the ecology of the site.

WOOD



3. The main elevator core, on display from the exterior courtyard through the glass atrium, is wrapped in three-inch thick live-edge wood slabs from 200-footDouglas Fir old-growth trees, a donation from the Leopold Foundation as part of the conservation organization’s forest preservation efforts. The wider base of the trees are located on the lower floor with progressively narrower slabs on the floors above corresponding with the original trees. On overcast days and when the sun is down the nine tapering trees are seen in silhouette mounted in front of backlit frosted glass.

DECK


4. A south facing roof deck partially covered for rain protection provides outdoor seating for the café and views down into the greenhouses with plant collections ranging from a desert climate zone to cool and warm tropics.

GRANTS

5. For the Life Sciences Building the Perkins+Will design team partnered with students from UW Solar and the UW Urban Infrastructure Lab to present the solar design opportunities to the client team. Following the design team's presentation of specific solar options for the building the students presented case studies from their research of solar installations. We ended with a combined presentation of solar grant funding opportunities to offset the project costs. As a result of this partnered presentation with the students the client team decided to proceed with one of the proposed solar options. The students remained involved during design and construction—they solidified two grants with the Campus Sustainability Fund (CSF) and continue to engage in how to communicate the sustainability story on the interactive touchscreen in the public lobby. With the student organizations engaging during design and construction they developed a vested interest that we hope will extend long after project completion as they continue to celebrate the aspirational design features they helped create. It becomes their building and their story.

EDUCATION ON DISPLAY

6.The public lobby displays a touchscreen educational dashboard to learn about the latest research discoveries and interact real-time with the building's energy and water use.