In 2012, Phipps reached new heights with the opening of the Center for Sustainable Landscapes (CSL), which was the first and remains the only facility in the world to meet four of the highest green building standards: Living Building Challenge™, WELL Building Platinum, Four-Stars Sustainable SITES™ and LEED® Platinum.

**Sustainability Showcase**

**Living in Harmony with Nature**

**BY RICHARD V. PIACENTINI**

THE CENTER FOR SUSTAINABLE LANDSCAPES (CSL) is a 24,350-square-foot education, research and administration facility at Phipps Conservatory and Botanical Gardens in Pittsburgh. The design team’s challenge was to meet an unprecedented palette of the world’s highest green standards while creating a facility that would serve a multitude of functions and seamlessly integrate with the guest experience of Phipps—a 125-year-old institution that receives over 450,000 visitors annually.
The intent of the CSL is to demonstrate the beauty of humanity living in harmony with nature. The design—shaped by systems thinking—reveals the interconnection between all natural and human-made systems so that visitors and society at large may better understand how each of our actions influence all others, ultimately inspiring everyone to live more sustainably.

By using a facilitated integrated design process, Phipps clearly established the vision, goals and targets for the project in collaboration with all principal architects, engineers, community members and staff. The resulting series of 15 charrettes aligned around this purpose and goals allowed the team to collectively build a roadmap to success and create interdisciplinary opportunities that otherwise would have been missed. The decision to
use the Living Building Challenge as the project’s design standard—made at the outset of the process—guided Phipps and its partners toward a host of other certifications to define for themselves what the greenest building in the world should look like.

Designed to operate as efficiently and elegantly as a flower, the CSL challenges the perceived mutual exclusivity between built and natural environments, effectively blurring the line between the two. The sun, earth and wind are used to light, heat and cool the interior, plants clean wastewater for reuse and every occupied space affords views of nature. The stringent parameters required by the robust building certifications necessitated an integrative design process with well-defined goals shared by the entire design team and the owner. These “constraints” actually served as catalysts for creative and innovative solutions that define the forefront of sustainable design. The holistic approach used to bring this project to life and the exportable, behavior-changing education programs and original research being conducted within this space can be applied universally, creating communities that are healthier and more supportive of all life.

The CSL is the first facility in the world to meet four of the world’s highest green building standards: The Living Building Challenge™, awarded in March 2015; WELL Building Platinum, awarded in October 2014; Four-Stars Sustainable Sites Photo © Paul S. Wiegma

Onsite photovoltaic solar panels, positioned and oriented based on several sun-tracking studies, generate enough electricity to meet the Center for Sustainable Landscapes’ energy needs on an annual basis.

### ENERGY AT A GLANCE
- Annual Energy Use Intensity (EUI) (Site) 19 kBtu/ft²
- Electric Usage 129,876 kWh
- Electric Generated (On-Site Solar and Wind) 133,301 kWh
- Any excess energy produced is used elsewhere on the campus. No energy is exported to the grid.
- Annual Source (Primary) Energy 19 kBtu/ft²
- Annual Load Factor 42.36
- Energy Star 100

### WATER AT A GLANCE
- Annual Water Use Average of 50 gallon/day of potable water, which equals 18,000 gallons/year.

### KEY SUSTAINABLE FEATURES
- Water Conservation: Constructed wetland, lagoon, rain tank, ultra-low flow plumbing, waterless urinals, permeable asphalt, rain gardens, cisterns, green roof
- Recycled Materials: High recycled material content throughout, 96.74% of construction waste diverted from landfills
- Daylighting: 80% daylight autonomy achieved through high performance low-emissivity windows, light shelves, louvers, overhangs
- Individual Controls: Digital building management system with weather monitoring
- Carbon Reduction Strategies: No combustion. All energy generated through renewable resources on-site, materials sources within appropriate radius
- Transportation Mitigation Strategies: EV stations on-site

### BUILDING TEAM
- Building Owner/Representative: Phipps Conservatory and Botanical Gardens
- Architect: The Design Alliance Architects
- Mechanical Engineer: CJL Engineering
- Electrical Engineer: CJL Engineering
- Energy Modeler: 7group, LLC
- Structural Engineer: Atlantic Engineering Services
- Civil Engineer: Civil & Environmental Consultants
- Landscape Architect: Andropogon Associates
- LEED Consultant: evolveEA
- Commissioning Agent: Pitchford Diversified

### BUILDING AT A GLANCE
- Name: Center for Sustainable Landscapes
- Location: Pittsburgh
- Owner: Phipps Conservatory and Botanical Gardens
- Principal Use: Research, administration and education
- Employees/Occupants: 56
- Percent Occupied: 95%
- Gross Square Footage: 24,350
- Total Cost: $15,656,361
- Substantial Completion: December 2012
- Occupancy: January 2013

### BUILDING ENVELOPE
- Roof
  - Type: Insulated green roof on pedestals
  - Overall R-value: R-48
  - Reflectivity: 0.3
- Walls
  - Type: Rain Screen
  - Overall R-value: R-12 Continuous; R-25 Metal
- Basement/Foundation
  - Slab Edge Insulation R-value: R-8
  - Under-Slab Insulation R-value: R-8
- Windows
  - Effective U-factor for Assembly: 0.57
  - Visual Transmittance: 0.7
- Location
  - Latitude: 40°N
  - Orientation: 80°W

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Case Study Center for Sustainable Landscapes

Energy Efficiency: From the Outside In

Working from the Living Building Challenge’s net zero energy imperative, the CSL design team quickly realized that the best strategy would be to reduce operating demand as much as possible by starting with outside-in passive strategies first in exploring every opportunity to minimize the building’s energy loads. Everything from building envelope and orientation to lighting, heating, cooling and employee comfort levels were taken into consideration to discover how much energy was truly needed to power the building.

Efforts to maximize natural daylight, supplemented by occupancy sensors and daylight dimming controls, have resulted in a lighting power density of 0.57 W/ft² without adjustment for controls. Daylight autonomy in most spaces is approximately 80%; total projected energy savings to Standard 90.1-2004 baseline is 77%. These strategies couple with renewable energy generation and reuse of water to yield a total Energy Use Intensity (EUI) modeled at 19 kBtu/ft²-year post-occupancy. In its first operational year, the CSL achieved an actual total EUI of 18 kBtu/ft²-year with a net EUI of –3 kBtu/ft²-year producing more electricity onsite through photovoltaic and wind generation than the building used. This represents a 73.8% reduction (68.7 kBtu/ft²-year median EUI per EPA’s Target Finder vs. 18 kBtu/ft²-year for...
CSL EUI). Each year, the surplus from renewable energy resources has grown. Having a net zero building powered by onsite renewable energy eliminates fossil fuel use and the greenhouse gasses associated with carbon-intensive energy production. The CSL is net-positive energy, powered by a 125 kW photovoltaic array, which includes sun-tracking, rooftop and ground-mounted sets. An American-made 10 kW aluminum vertical axis wind turbine is also placed where it can take advantage of the most favorable wind conditions.

Water: Accounting for Every Drop
The 2.9-acre CSL site is net zero water, managing all rainfall and treating all sanitary waste on site. Meeting the net zero water challenge for the CSL meant designing an overall water-balanced approach, incorporating all three tiers of water that would need to enter and exit the building: potable water (suitable for drinking and hand-washing), graywater (roof runoff) and blackwater (contaminated by human waste). To
achieve this goal, the team explored comprehensive solutions that would yield net zero total usage for the entire site and fit the appropriate quality of water with its intended use. The CSL can manage a 10-year storm event within the site boundaries (3.3 in. of rain in 24 hours) through soil- and vegetation-based systems like green roofs, rain gardens, bioswales, lagoon, pervious asphalt and high performance native landscapes. No potable water was used for irrigation after the landscape’s establishment period. The CSL also harvests 0.5 acres of rooftop runoff from adjacent buildings outside the site boundary. Annually, approximately 500,000 gallons of rooftop runoff are harvested in an underground 80,000-gallon rain tank. The harvested water can be infiltrated or used on the lower campus. Ultimately, it will be used to offset daily irrigation demand in Phipps’ conservatory spaces, significantly reducing the campus’ need for municipal water supply and the energy required to treat and deliver it to Phipps. All of the building’s wastewater is treated on site using settling tanks, constructed wetlands, sand filters, and UV filters prior to reuse as flush water for the building’s restrooms.

**Materials: The Most Rigorous Challenge**

While many approach the Living Building Challenge expecting the net zero energy and water imperatives to be the most difficult to achieve, for Phipps, most arduous by far was the Challenge’s Materials Red List. The Red List contains 21 classes of chemicals (over 800 chemicals) that cannot be in any of the building materials or furnishings. It requires that manufacturers disclose in writing the presence or absence of Red List chemicals in their products. The Living Building Challenge is revolutionary and calls for the reform of the building product market itself, and represents a change of course that few were prepared for at the time of the CSL’s construction.

The Athena Impact Estimator for Buildings life-cycle assessment tool guided the design development, analyzing candidate materials for energy consumption, solid waste, air pollution index, GWP, and weighted...
resource use, thereby informing structural systems, exterior envelope and interior finish materials. To achieve net zero energy, a robust, efficient building envelope was necessary. The CSL exterior wall assembly has an R-value of 12, the roof assembly has an R-value of 48 and slab-on-grade floors have an R-value of 8. The project accounted for its total carbon footprint by purchasing 2600 metric tons of Green-e certified renewable carbon offsets. During construction, 96.74% of construction waste was diverted from disposal. Occupants are encouraged to use recycling and composting receptacles; each cubicle is provided with a 3 gallon recycling bin and smaller-than-typical 1 liter waste bin. Although at the time, the Living Building Challenge certification did not require it, Phipps also extended the Red List standard to all interior furnishings.

**Site and Biophilic Design: Connecting People to Nature**

As a building with a goal of focusing attention on the important intersection between the built and natural environments, biophilic design elements and attributes were absolutely critical to the design of the CSL. The place-based identity of the CSL comes through in its project site, where a once dilapidated brownfield now hosts 1.5 acres of green space with a variety of native plant communities inspired by local ecology. From a water management system based on natural lagoons and constructed wetlands to a wooden building skin reclaimed from dilapidated Pennsylvania barns, environmental features lend the building a natural, organic character while helping to achieve its net zero energy and water goals. A Virginia creeper vine climbing the atrium exterior makes the building a part of nature’s cycles of growth and efflorescence.

In the building’s atrium, natural patterns and processes are brought to vibrant life by a generative sound art installation which changes based on the seasons, weather and time of day. In the administration, research and education facility, natural light and a sense of spaciousness help contribute to occupant wellness. An on-site art program, the BETA Project (Biophilia Enhanced Through Art), brings natural shapes and forms into the building, including a spiral staircase which houses a weathering steel sculpture suspended in mid-air, a Dale Chihuly glass sculpture emphasizing oval and tubular forms, and a flock of glass birds to complement the live animals in the outdoor habitat.

From building to landscape, from architecture to art, the CSL uses biophilic design to blur the lines between the built and natural environments to engage in a seamless symbiosis, and to demonstrate that human and environmental health are inextricably connected.

**Inspiring the Public**

Through talks and presentations, docent-led tours and dynamic science education programs, the CSL reinforces the importance of human-environment interactions. As increasing numbers of people discover the visionary concepts at work at the CSL, as well as the potential for replication, they will be encouraged to mount similar projects at the home, business and community levels. Additionally, in the CSL’s dedicated indoor and outdoor classroom spaces, Phipps gives area children a chance to connect to nature, instilling a sense of wonder and fostering the growth of tomorrow’s environmental stewards. In these ways, the CSL will catalyze the kind of change that results in stronger, healthier and more equitable communities now and in the future.

**ABOUT THE AUTHOR**

Richard V. Piacentini is the president and CEO of Phipps Conservatory and past Chair of the International Living Future Institute™ (ILFI) and is a past president of the American Public Gardens Association (APGA).