Teaching and **Research Winery**
and the **August A. Busch III Brewing**
and **Food Science Laboratory**

Flad Architects

"This new complex showcases UC Davis' commitment to environmental excellence. It embodies our vision to serve as a catalyst for sustainable economic development and social progress for California and beyond."

Neal Van Alfen, *UC Davis Dean of the College of Agricultural and Environmental Sciences*

Sustain-ability

insights

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WBF

A Model of Sustainable Possibilities

The first LEED Platinum certified building of its kind, the WBF serves as a role model for the wine, beer, and food industries. Its construction methods and operating systems incorporate sustainable features that can be tested, modified, and eventually implemented as best practices. As advances are made in environmentally conscious technology, the building can adapt to demonstrate those advances, due to its flexible design.

Key Objectives

- **Reduce and monitor usage of water and energy and reduce and reclaim waste output.**
- **Engage the landscape and respond to local climate.**
- **Mitigate freeway and railroad noise.**
- **Minimize distance to existing utility connections.**

Integrated Design

Design-build delivery was essential to achieve LEED Platinum certification within a lean construction budget. High net-to-gross efficiency in design (approximately 85 percent) aligned program needs, quality of materials, and budget. Accurate cost estimates reduced the need for contingency funds, and allowed more money to be allocated to sustainable elements. Close collaboration between the architect and builder ensured that all of the project goals, including extraordinary sustainability features, were met. An area of the site was designed to harvest rainwater for building use, the building envelope was thermally enhanced to reduce mechanical conditioning, and process areas were configured to assist natural ventilation.

Solutions

"The goal is for the facility to be not just carbon neutral, but carbon zero, in terms of emissions."

Roger Boulton, *UC Davis Stephen Sinclair Endowed Professor of Viticulture and Enology*

Site

The facility's architectural character respects earlier campus planning and reflects the common goals of the project — conserving energy and protecting the environment, enhancing the department's image and identity within the university, and maintaining site relationships.

The WBF is connected to established pathways and encourages activity in the central courtyard. This orientation and organization is beneficial for envelope performance. While portions of the building with greater lighting needs are exposed to daylight, these large glass areas are protected from direct solar exposure, but still provide a strong visual connection to the campus. The site is located near community services and high density residential districts, meeting basic LEED criteria for site selection, community connectivity, and transportation access.

Building Envelope

Given the site's poor soil conditions, a "geopier" system is used to provide a stable foundation. In this method, crushed rock, densely compacted into drilled cavities, acts as an alternate to concrete. An innovative wall assembly incorporates rigid insulation to prevent thermal bridging, achieving an R-26 value. Contextually compatible plaster is locally manufactured with low embodied energy. Low slope PVC roofing and steep slope metal roofing reflect the sun's rays, minimizing the heat island effect.

Daylight

Managing the light, using it to the building's advantage, is a major goal for the WBF. To that end, the dual-glazed aluminum storefront and windows accommodate daylight and views at eye-level. Large vision glass areas face north and east, appropriate for the hot, dry climate. Above, cellular polycarbonate panels with high thermal value (R-4) are shaded by deep roof overhangs, providing ambient light at clerestories. As a result of these design features, the building meets or exceeds all LEED daylight standards for occupied areas.

Energy

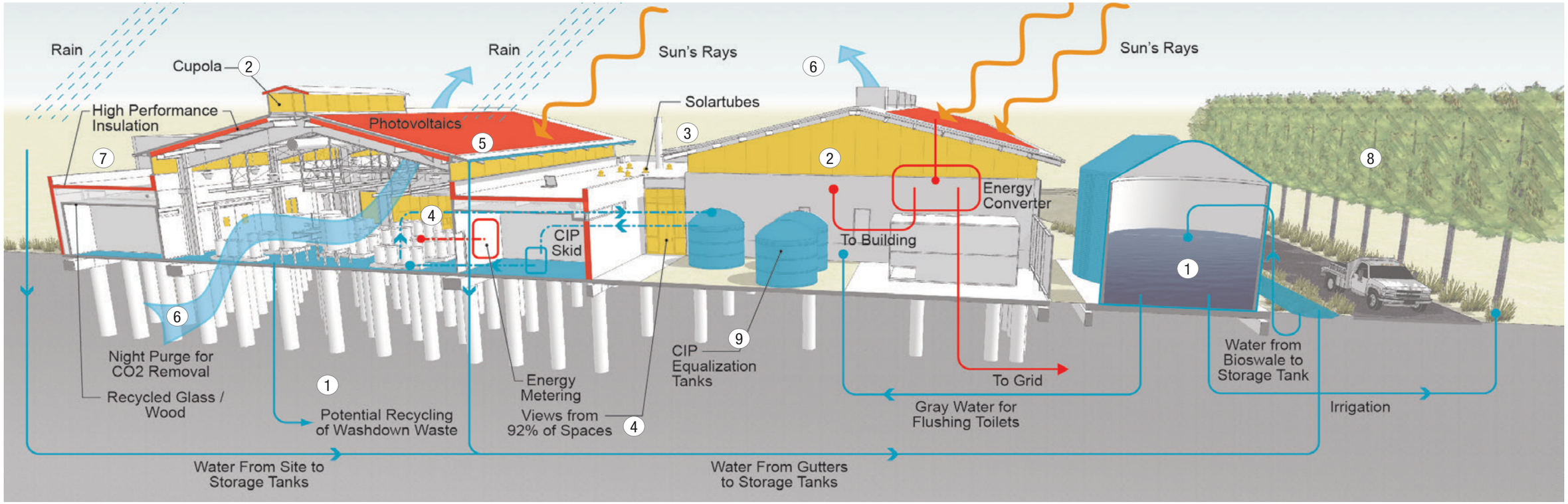
Energy conservation in the WBF is also paramount. On the most basic level, the campus central utility plant provides chilled water and steam. A variable volume air handling unit with hot water reheat is used to condition occupied spaces. Heat recovery within the air handler is accomplished through passive heat pipe technology. A closed loop, water-cooled system is used for process air conditioning equipment, while nighttime ventilation fans pre-cool process areas. Photovoltaic panels gather sunlight and provide 120,000 kWh per year – more than 17.5 percent of the building's electrical demands.

Indoor Environmental Quality (IEQ)

The WBF design allows for exceptional air quality within the building. Not only did the project achieve a perfect score in the LEED IEQ category, it exceeds ASHRAE standards by 38 percent.

Elements of the outstanding environmental quality review include:

- All products and finishes emit low VOC or none at all.
- Monitored "flush out" and air sampling is conducted before occupancy.
- Ductwork was protected during construction.
- High air filtration and entry mats minimize airborne pollutants.
- Building carbon dioxide levels are carefully monitored, with a fermenter capture system and night purge ventilation to ensure that excess carbon dioxide is removed from the building.



Sustainable Highlights

1. Captured rainwater is used for irrigation and gray water flushing, reducing the building's non-process water demand to net zero. The building's design will allow future users to capture process washdown in the fermentation hall.

2. Extensive use of windows, clerestories, and a cupola provides natural light to all perimeter program spaces, reducing the energy demand for artificial light and associated heat load.

3. Solar tubes, outfitted with dampers to control light levels, introduce daylight to interior rooms.

4. All regularly occupied program spaces have a visual connection to the outdoors, enhancing the quality of the research and teaching environment.

5. Photovoltaics on south-facing pitched roofs generate enough energy to satisfy the viticulture and enology department's peak power demand. (Any surplus power can be fed back to the power grid.)

6. Interior air quality control and carbon dioxide monitoring is provided by exterior air entrainment. It also doubles as a night purge system, pre-cooling interior spaces.

7. Enhanced exterior skin insulation (R26 on walls and roof) mitigates heat gain in the summer and heat loss in the winter, reducing the mechanical load and subsequent energy demand.

8. Drought-tolerant planting and strategically located shading minimize irrigation needs and heat island effects from hardscape surfaces.

9. Process equipment is cleaned by CIP, so 80 percent of waste water can be recycled.

Environmental Preservation

The global, multi-billion dollar business of beer, wine, and food production relies heavily on natural resources and energy-intensive processing to bring their products to market. Industry leaders acknowledge that their companies must find more sustainable methods in the future – to protect the environment, maximize efficiency, and produce less waste. To that end, the WBF opens its laboratories to private sector colleagues. In this state-of-the-art facility, corporate researchers can test their own theories, while leveraging the knowledge and expertise of the university's faculty and staff.

Heightened Performance

The WBF is the first LEED Platinum building on the UC Davis campus and the third in California's state educational system. Housing the world's first LEED Platinum certified winery, brewery, and food processing pilot plant, it is also the first process science building to receive this rating. The university initially planned to meet a lower energy efficiency standard on the project, but industry leaders, who would ultimately benefit from the most advanced facility, contributed additional funding to reach the Platinum goal.

While the WBF educates students about sustainable techniques for cultivation and production, it also serves as a "living model," demonstrating the effectiveness of energy efficient technologies and construction practices.

Features

Sustainable Operations

Specifically designed to address the demands of an arid climate, sustainable features of the WBF include:

- Capture and storage of 176,000 gallons of rainwater, satisfying annual irrigation requirements and all non-potable demands. This is the first large-scale rainwater harvesting system in the area to address both resource goals.
- A clean-in-place (CIP) system — similar to those used in pharmaceutical manufacture — collects, treats, and re-uses all cleaning water, reducing demand by 80 percent and demonstrating a model applicable to other businesses.
- Research fermenters are piped for carbon dioxide sequestration, allowing later conversion to solid state. This reduces the building's energy requirements for air quality and temperature control, and prevents the release of carbon dioxide into the environment, which contributes to global warming.
- All-bolted steel connections in the building allow for removal and re-assembly, if needed. This system substantially reduced field labor during construction, reducing the schedule by two weeks.
- Wall assembly was done by applying plaster over rigid insulation. Away from the weather resistive barrier, this required significant research, collaboration, and the development of custom components.
- Real-time data for all building systems is on display. Students are directly involved in the operation and monitoring of these systems, thus preparing future leaders for a more responsible, sustainable industry.

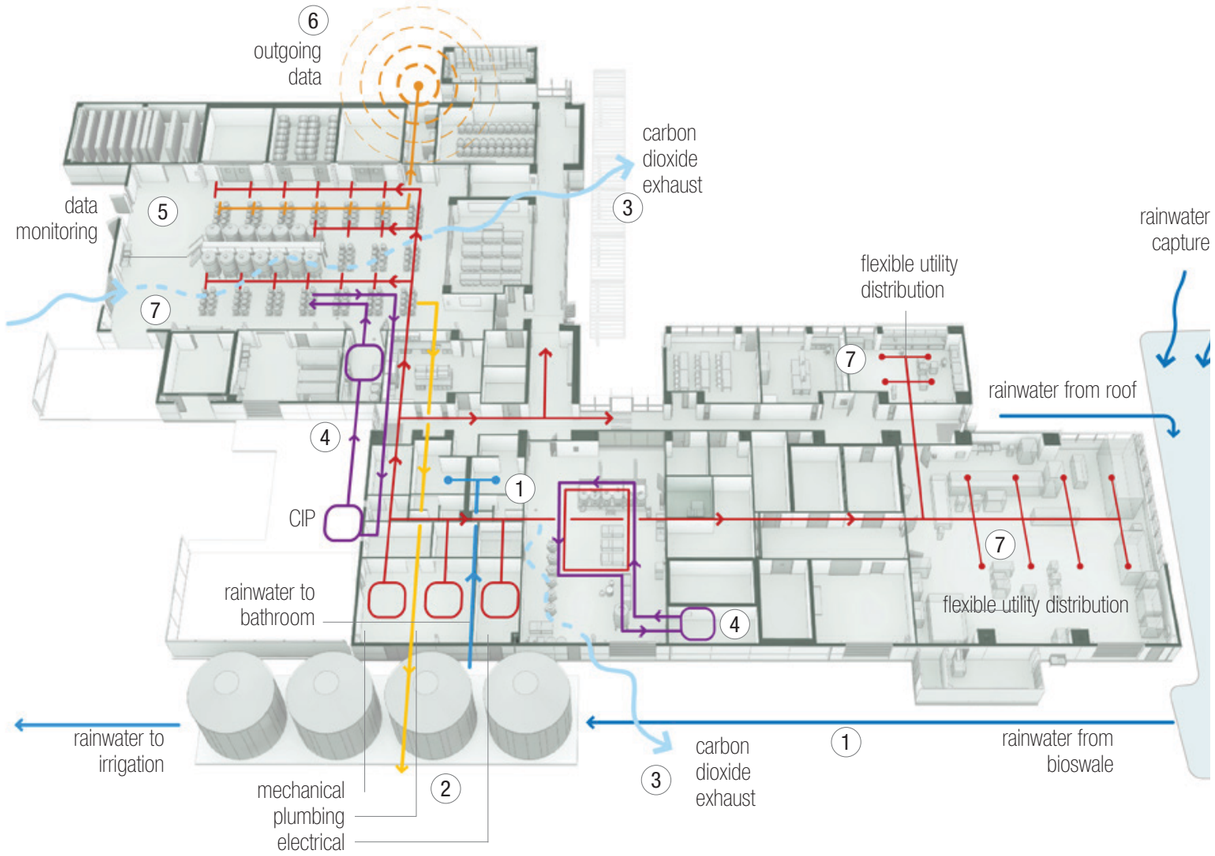
"When we first started talking about making this a highly sustainable facility, some people thought it was a harebrained idea. But we were fortunate to work with encouraging and supportive people who saw the potential for this building."

Roger Boulton, *UC Davis Stephen Sinclair Endowed Professor of Viticulture and Enology*

Cost Benefits

A base construction value of $400 per square foot is typical for university research buildings in California – and a significant achievement for a process science facility. Equally important, the investment in LEED Platinum design and technology fulfilled the donors' vision and will ultimately translate into reduced long-term operating costs.

The WBF's integrated envelope design, separate laboratory zones, and higher ambient temperatures for process facilities exceeds California Title 24 standards by 34 percent. All together, these features reduce the annual energy demand by 143,909 kWh of electricity and 439 therms of natural gas. Implemented for an additional cost of $167,835, these systems are expected to pay for themselves in 10 years.



Laboratory Flows

Dark Blue = Rainwater
Yellow = Carbon Dioxide Sequestering
Light Blue = Carbon Dioxide Exhaust
Purple = CIP
Orange = Data Monitor
Red = Flexible Utility Distribution

Utility Diagram

1. Irrigation and toilet flushing requires 176,000 gallons of water annually. The site receives approximately 17 inches of annual rainfall; 11 inches is required to satisfy this demand. Captured from roofs and landscape areas, rainwater is retained and filtered through a bioswale prior to processing in an ozone-filtration system. The rainwater is then stored in four, 44,000-gallon, above-ground water tanks.

2. Carbon dioxide produced during fermentation is sequestered through a calcium hydroxide scrubber to maintain concentration levels below 5,000 ppm for an average eight-hour day. Eventually the WBF plans to convert this carbon into a solid to augment and improve the soil.

3. A night purge ventilation system provides redundant carbon dioxide exhaust, as the facility is cooled using the night air.

4. Fermenters are maintained with a clean-in-place (CIP) system to reduce water, energy, and chemical use. Organic matter is removed from the captured water so that it can be recycled up to eight times.

5. A principal goal of the WBF is to monitor water and energy use, along with output from process waste. Inputs and outputs are measured through meters connected to electronic data collection and storage systems.

6. The fermentation process is monitored and recorded through wired connections to equipment. Research results can then be accessed remotely through web-based programs.

7. Overhead utility carriers deliver hot and cold water supply and return, power, gas, compressed air, and glycol cooling systems to the primary processing areas. These carriers are designed for flexibility, accommodating changing equipment needs and configurations.

Andrew Cunningham, RIBA, LEED AP, Principal, Flad Architects

Andrew Cunningham appreciates the built landscape. Growing up in Scotland, he studied the storied architecture of that country, from its historical monuments to the evolving contemporary architecture. Today he helps shape the landscape of his new home – California – preserving what is historically interesting and important, while planning for a dynamic, environmentally responsible future.

"I'm very proud that, through this LEED Platinum certified design, we've had such a positive impact on an entire commercial sector – it illustrates what can be done right now to improve processes, increase efficiency, and mitigate the environmental impact of food and wine production. Perhaps best of all, I know that the students who come through this program, who work and study and learn in this lab, will make even greater advances. With every new discovery, they will have a profound effect on the future of the industry."

Andrew Cunningham, *Flad Architects*

Mr. Cunningham has more than 25 years of experience with research and development projects for private and public sector clients. He has served as project manager for an array of building types, ranging from pharmaceutical/biotech research and manufacturing plants, to vivaria and specialized containment facilities, as well as academic, retail, hospitality, and office buildings. The Teaching and Research Winery and the August A. Busch III Brewing and Food Science Laboratory at the University of California, Davis, is his first foray into structures designed for cutting-edge viticulture and food processing.

Flad Architects