P2S INC

Case Study

Design Practices for Net-Zero Energy Facilities

MEP DESIGN SERVICES
PROVIDED BY P2S INC.

California State University Long Beach | Net-Zero Energy Building

College of Professional and International Education (CPIE)

The California State University (CSU or Cal State) is the largest four-year public university system in the United States. With 23 campuses and over 500,000 students and faculty, the CSU system has experienced over a decade of consistent growth. CSU Long Beach is one of the largest schools within the CSU system, and continues to set the standard for green building initiatives. Although Cal State policy requires that all new buildings adhere to a LEED Silver standard, CSU Long Beach pursues the principles of net-zero energy for all new facilities and construction. Home to the College of Professional and International Education (CPIE), CSU Long Beach intended to centralize CPIE activity, by building a new 35,000 SF facility for students and faculty.

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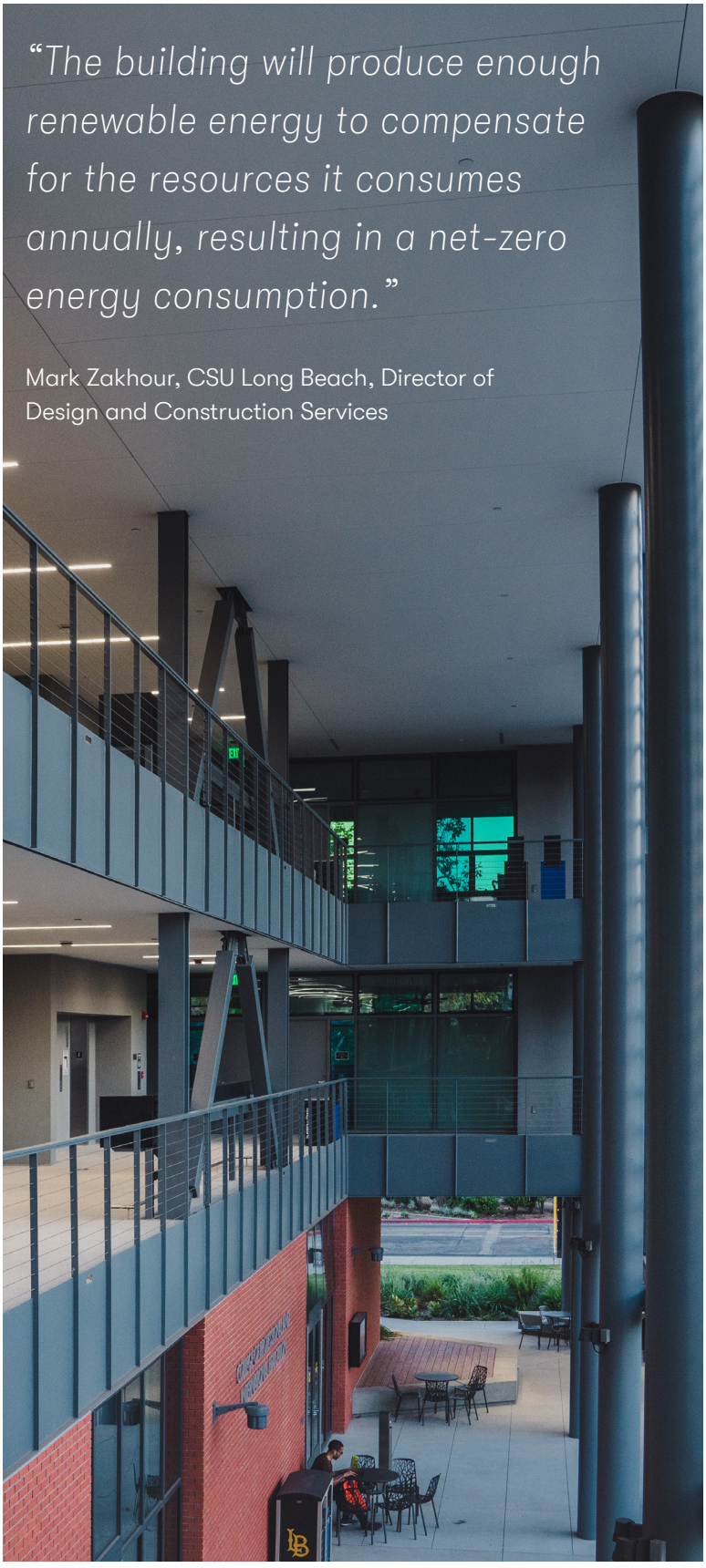


CLIENT OBJECTIVES

1. Achieve Net-Zero Energy Building Standards
2. Minimize Natural Resource Consumption
3. Reduce Operational & Maintenance Costs
4. Aesthetic Appeal & Ease of Operation
5. LEED Platinum® Certification
6. Centralize CPIE Student Activity

AT A GLANCE

- **Building Location:** Long Beach, CA
- **Project Size:** 35,000 SF
- **Market Sector:** Higher Education (Public)
- **Building Type:** Classroom/Conference
- **Delivery Method:** Collaborative Design-Build
- **Construction Cost:** $32 million
- **Project Completion:** Fall 2018

NET-ZERO ENERGY BUILDING DEFINITION

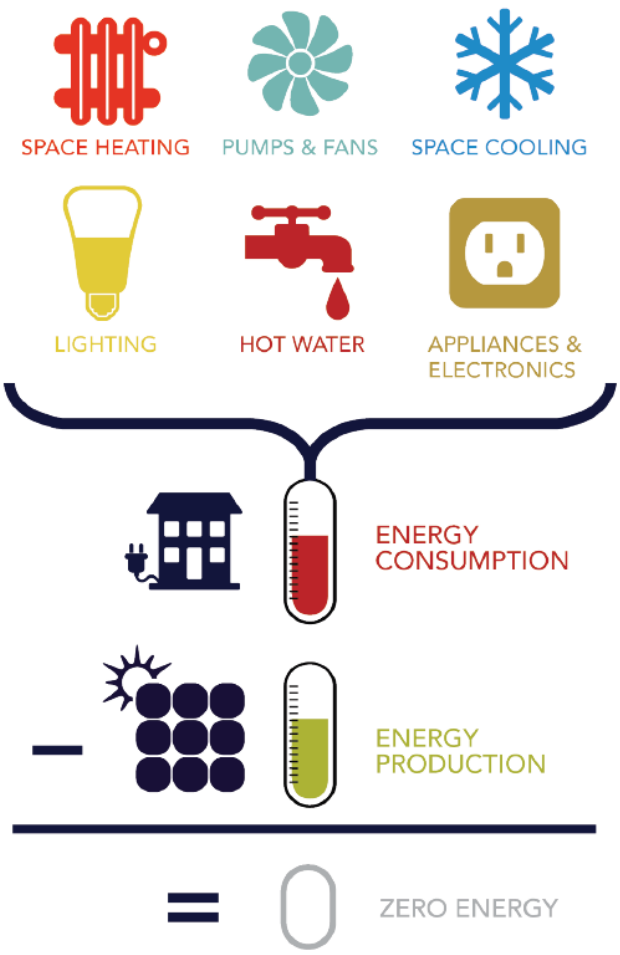
"An energy-efficient building where, on a source energy basis, the actual annual delivered energy is less than or equal to the on-site renewable exported energy."

BUILDING CO_2 EMISSIONS AND CONSUMPTION

Nearly 40% of US greenhouse gas emissions are attributed to the design, construction, and operation of buildings. Although sustainable practices are being adopted, buildings continue to consume 70% of the electricity load in the US. Net-zero energy facilities can reduce greenhouse gas emissions, by limiting the building's dependence on fossil fuels.

ENERGY INDEPENDENCE THROUGH NET-ZERO

To qualify as a net-zero energy building, the total amount of energy used on an annual basis must be less than or equal to the amount of renewable energy created on-site. Zero energy buildings use all cost-effective measures to reduce energy usage and include renewable systems that produce enough energy to meet remaining needs. As part of the CSU Long Beach Climate Action Plan to eliminate greenhouse gas emissions by 2030, the CPIE net-zero energy building would be the first of its kind in the California State University system.



NET-ZERO DESIGN METHODOLOGY

Striking a balance between aesthetics and functionality, net-zero design requires extensive collaboration between owners, architects, engineers, and contractors. Our integrated design approach is based on four major considerations.

Loads Reduction

System Efficiency

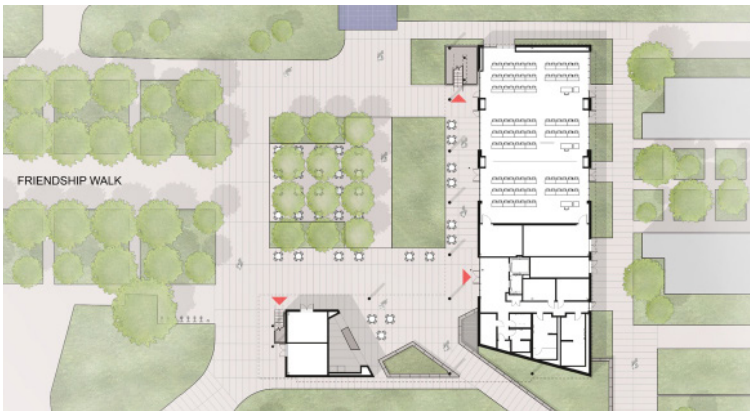
Regenerative Systems

Renewable Energy

LOADS REDUCTION

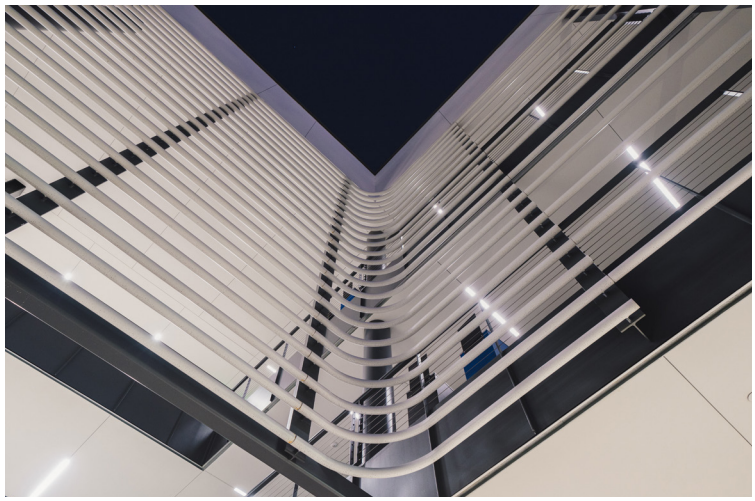
Building Orientation

Building orientation is critical to the overall energy performance of a facility. The CPIE facility orientation was carefully selected to not only maximize natural daylighting but also limit internal and external loads. The orientation also promotes passive cooling via natural ventilation and passive heating by harvesting the low sun during the winter months through carefully designed overhangs on the south side of the facility.



Envelope Design

As the barrier between the indoor and outdoor environments, design of building envelope is critical to energy performance of a facility. The CPIE's envelope design was optimized by conducting an energy model early on and various options of roof, wall, fenestrations and exterior insulation combinations were evaluated to maximize energy efficiency. The envelope and overhangs were then carefully selected and designed to limit external loads and promote the use of passive energy during winter and summer months.



Window Placement

Strategic overhang size selection maximizes passive technologies, for example, solar heat gain on the south side of the building. This design captures solar heat in winter when the sun is low and shields the facility in summer when the sun is high. Window placement directs this natural light into the interior center space, minimizing daytime electric lighting requirements.

SYSTEM EFFICIENCY

Primary HVAC and Ceiling Fans

Heating and air conditioning needs are accomplished through a radiant slab heating and cooling system that serves all three floors. Ventilation throughout the CPIE building is supplied by two DOAS systems, and monitored with CO_2 sensors. Supplementary to the building's cooling system, the ceiling fans increase thermal comfort and minimize HVAC energy costs. Ceiling fans are controlled via occupancy sensors and shut off upon non-occupancy.

Mixed Mode Ventilation

The CPIE buildings natural ventilation or "Economizer" mode provides EMS alerts that specify when windows should be opened or closed. A red and green light on the control panel indicates whether outside air is capable of supporting natural ventilation, based on outside air temperatures and humidity levels.

Plug Load and Lighting Controls

Occupancy based power outlets and lighting systems are integrated throughout the facility and controlled via sensor. LED lighting shuts off automatically during non-occupancy hours, and automatic dimming controls with light-level photo sensors are placed in day-lit areas to harvest daylight savings.

REGENERATIVE SYSTEMS

Regenerative drive technology increases energy savings by capturing power that is generated but unused and transferring it back into the building's electric grid. An elevator can account for 2–10% of a building's total energy consumption. When the cab goes up with a light load and down with a heavy load, the system generates more power than it uses. The use of regenerative drives within the CPIE elevator system converts excess energy into electricity that can be reused elsewhere in the building.

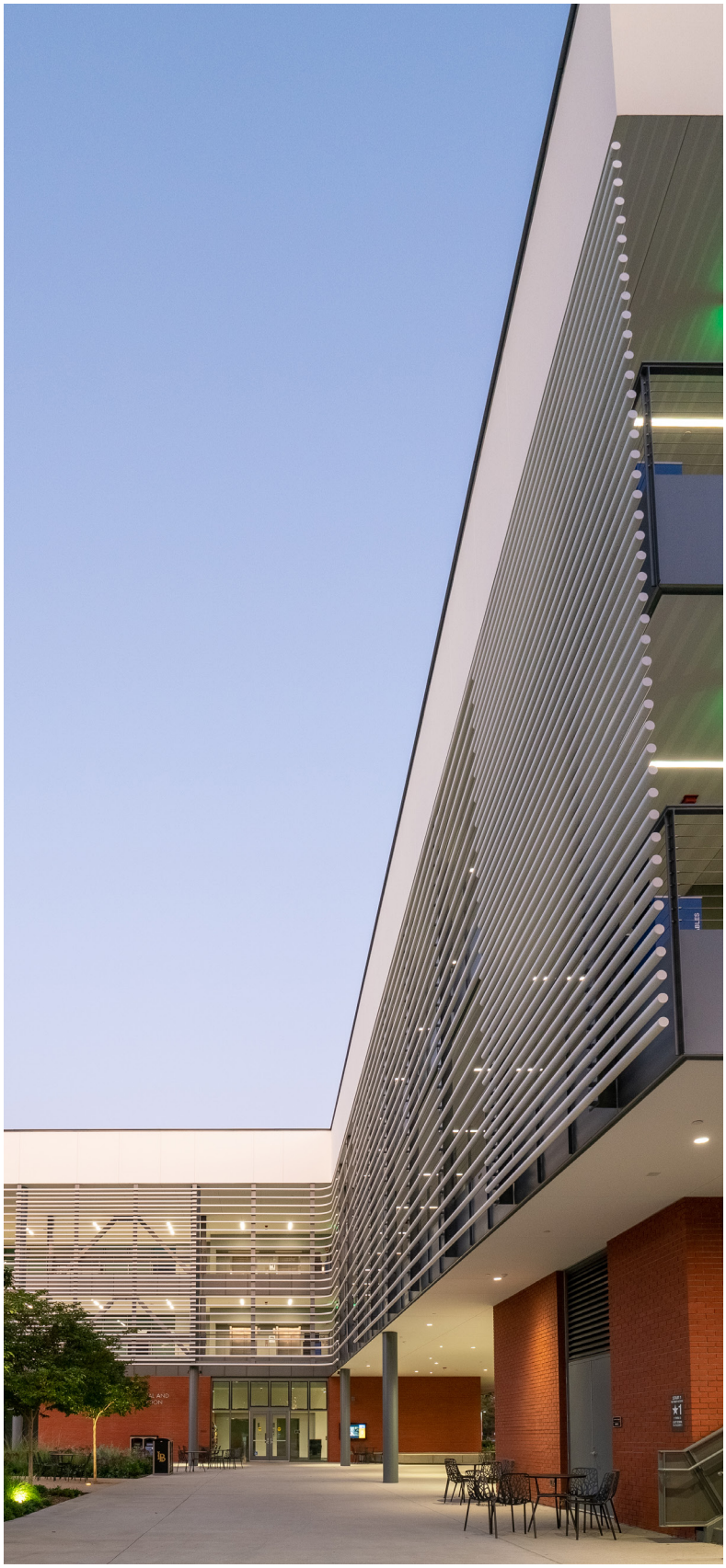
RENEWABLE ENERGY

Water Conservation Strategies and Photovoltaic Systems

Water consumption is minimized by utilizing efficient fixtures, aerators, xeriscaping and effective irrigation control. Complementary to buildings orientation, envelope, load reduction, and system optimization, renewable energy sources in the form of photovoltaics were used to offset the overall energy usage of the CPIE building.

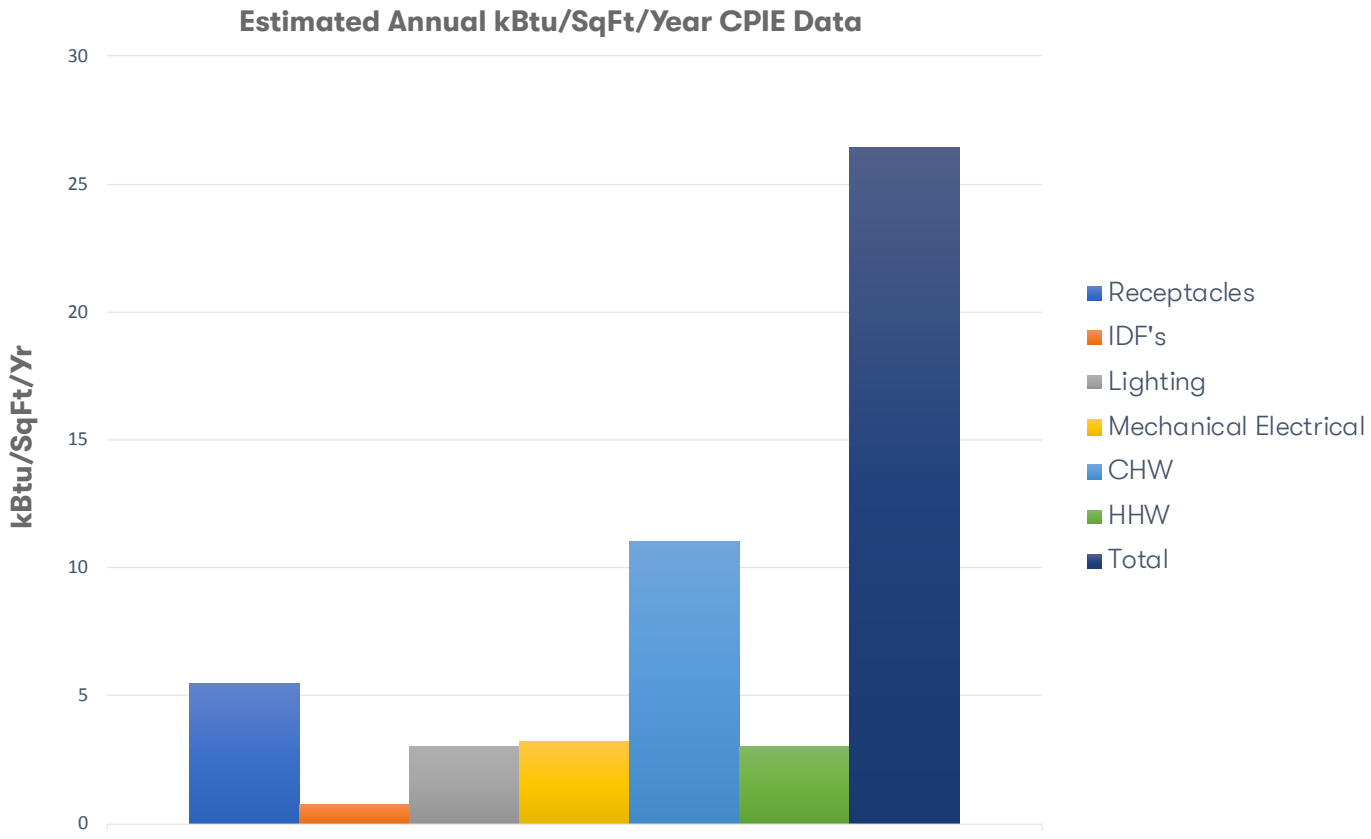
NZE PROCESS CONSIDERATIONS

- Minimize internal and external loads
- Conduct energy modeling early and monitor throughout the design process
- Identify efficient MEP systems and get concurrence from owner
- Identify control strategies to limit hours of operation of each system
- Identify type of renewable energy generated and space requirements



THE RESULTS

LEED Platinum® certified and the first net-zero energy building on the campus, the CPIE building sets new standards of sustainability for future development. Campus photovoltaic arrays are used to generate solar power and offset energy usage. In addition, building orientation was carefully considered to maximize natural lighting and ventilation. As a result, 95% of spaces are daylit, while ceiling fans and operable windows on both sides of each classroom provide a constant flow of fresh air, creating a healthy, comfortable, and productive learning environment that simultaneously minimizes the campus carbon footprint. The estimated energy use intensity (EUI) of the CPIE facility is 27 kBtu/ft2-year, and was 55% below the Title 24 2013 baseline.



AWARDS AND CERTIFICATION

Engineering News Record California, Best Green Project

AIA Long Beach South Bay Chapter, Honor Award

CHESC, Overall Sustainable Design Award

USGBC, LEED Platinum Certified

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