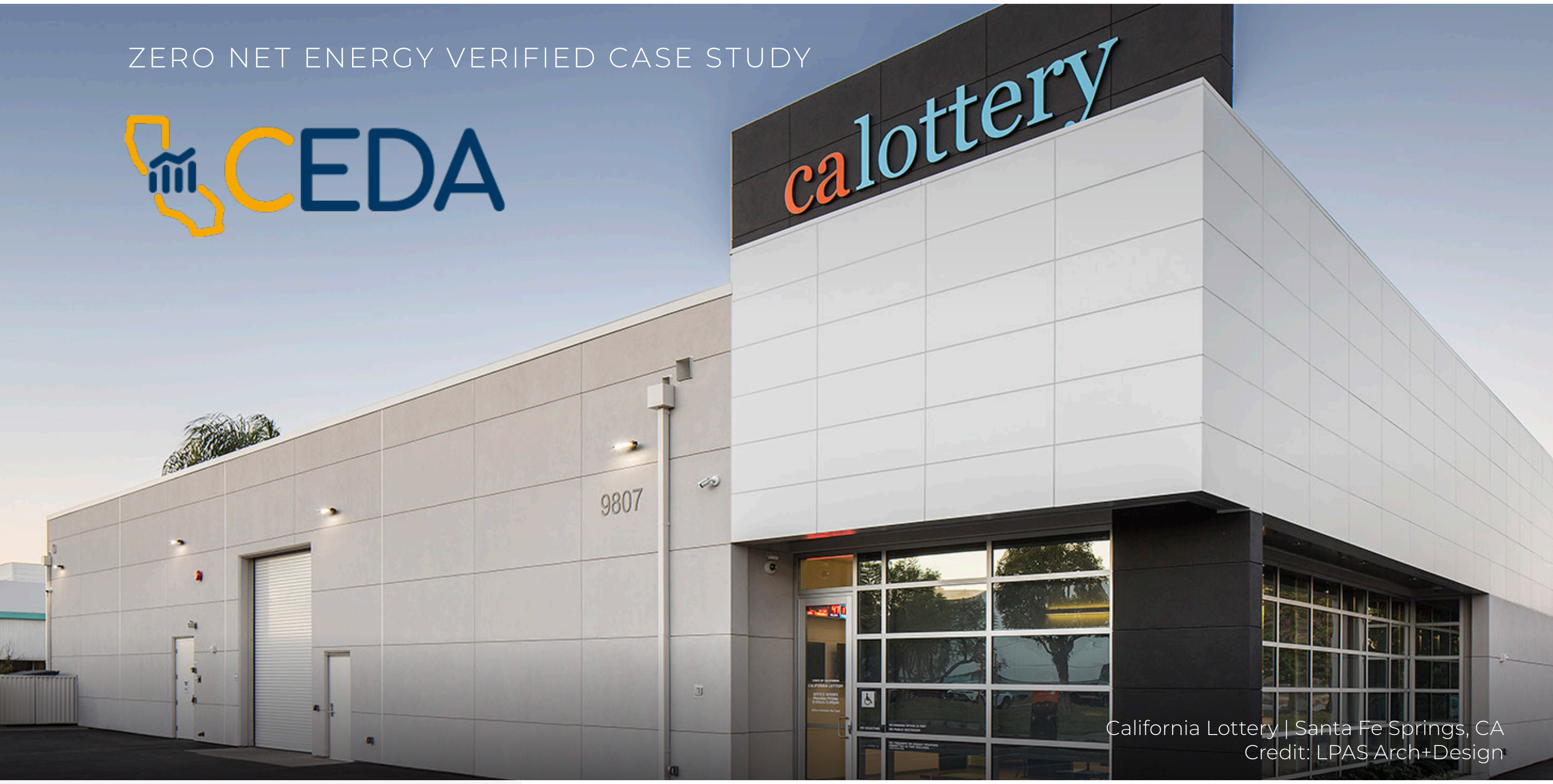
ZERO NET ENERGY VERIFIED CASE STUDY

CEDA



California Lottery | Santa Fe Springs, CA
Credit: LPAS Arch+Design

OVERVIEW FACTS

Building size: 12,840 sf

Location:
Santa Fe Springs, CA

Construction Type: Retrofit

Building Type: Office

Completion Date: 2015

California Climate Zone: 9

Measured Site Energy Use Intensity (EUI):
41.4 kBtu/sf-yr

Net EUI:
-0.1 kBtu/sf-yr

Total Building Cost:
$5,744,000

Cost/sf: $447

Hard costs: $5,016,000

Soft costs: $728,000

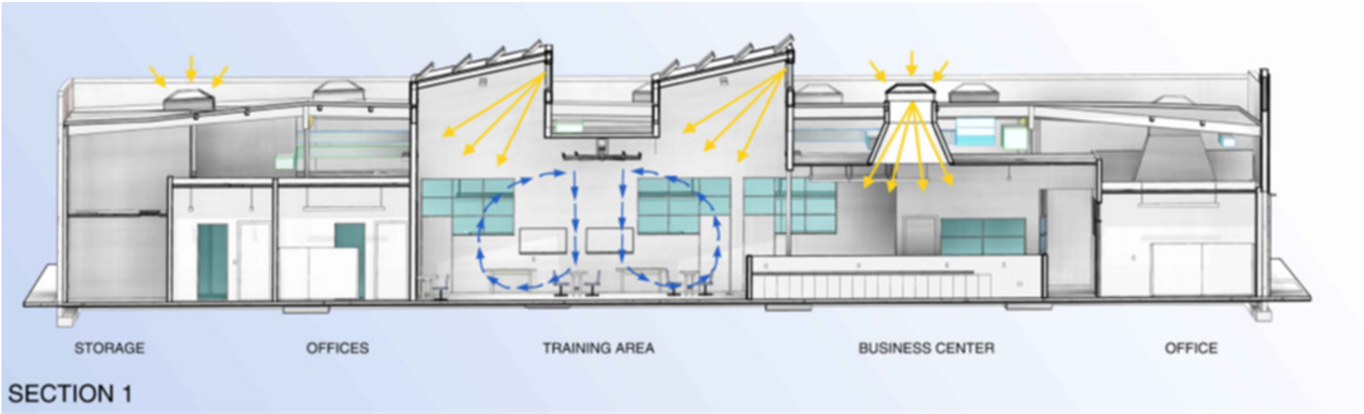
California State Lottery Santa Fe Springs District Office

The California State Lottery District Office in Santa Fe Springs is a deep energy major renovation of an existing 12,840-square-foot warehouse.

The Lottery partnered with LPAS Architecture + Design to retrofit the building using passive design strategies including daylighting and an energy-efficient envelope, as well as a rooftop photovoltaic (PV) system to achieve an ultra-high-performance, fully zero net energy, all-electric public building.

Planning and Design Approach

Due to constraints on the move-in date for the facility, as well as a desire to reduce the cost of the project, the Lottery chose to renovate an existing structure with an uninsulated roof and walls, rather than construct a new building. The team to focused on deep energy savings, allowing them to achieve their zero net energy goal with a much smaller PV system.



North-South Section Diagram: toplighting by skylight, solar tube, and light monitors; air circulation by high-efficiency fan. Diagram credit: LPAS Architecture + Design

Energy Modeling

A daylight model helped to significantly reduce the necessary lighting power density. During the energy modeling process, the team added a 15% buffer to the calculated renewable production which ultimately allowed for the late addition of electric vehicle charging stations. An early plug load study identified areas for potential improvements and established a baseline for occupant power usage. That estimated consumption along with climate data and baseline design energy assumptions, were used to calculate how much power would need to be generated by PV panels. Thorough daylight modeling predicted the ideal combination of top lighting and interior glass walls to properly illuminate the space. The design team also worked with the construction firm and equipment managers early on to understand the mechanical systems' needs and prepare the existing structure for retrofit.

Operating Costs

When the building was renovated in 2015, the team estimated an operating cost savings of approximately $10,000 annually (5% less than the previous operating cost) for a facility that is 44% larger. In 2020, the building spent $14,123 on electricity and $3,703 on water (including the fire line). The total 2020 utility cost was $1.39/sf, which is far lower than the national average of $2.14/sf[1] and is particularly impressive given California's relatively high utility costs.

PROJECT TEAM

Architect: LPAS Architecture + Design

Contractor: DPR

Structural Engineer: KPFF

MEP Engineer: Interface Engineering

Building Performance Engineer: Integral Group

Builder: DPR Construction

AWARDS

LEED Gold certification: 2009

ENERGY STAR Certified, Score of 100: 2018

1 According to the Building Owners and Managers Association. See **https://www.boma.org/BOMA/Research-Resources/3-BOMA-Spaces/Newsroom/PR91818.aspx**

Efficiency Strategies and Features

ENVELOPE

A highly efficient envelope helps reduce heating and cooling loads in the building, which allowed for downsizing the HVAC system. Interior batt insulation and 3" rigid insulation yielded an R-value of 38, a level twice as efficient as that required by California's energy code in effect at the time of construction. Roof insulation, with 1" wool in addition to the batt and rigid insulation of the walls, offers a 30% improvement above code with an R-value of 40. The amount of top lighting and PVs necessary for the project resulted in a substantial increase in the roof load, which required an upgrade in structure. These improvements may have been more cost effective if an entirely new roof had been constructed, rather than reusing the existing roof structure. All windows use glazing units that exceed code for solar heat gain coefficient (SHGC), with the curtain wall offering a U-value of 0.35 and an SHGC of 0.5.

MEASURED ENERGY STATS*

12.4 kBtu/sf-yr – 20.2 kBtu/sf-yr

Building's Total EUI – Renewable Production (RPI)

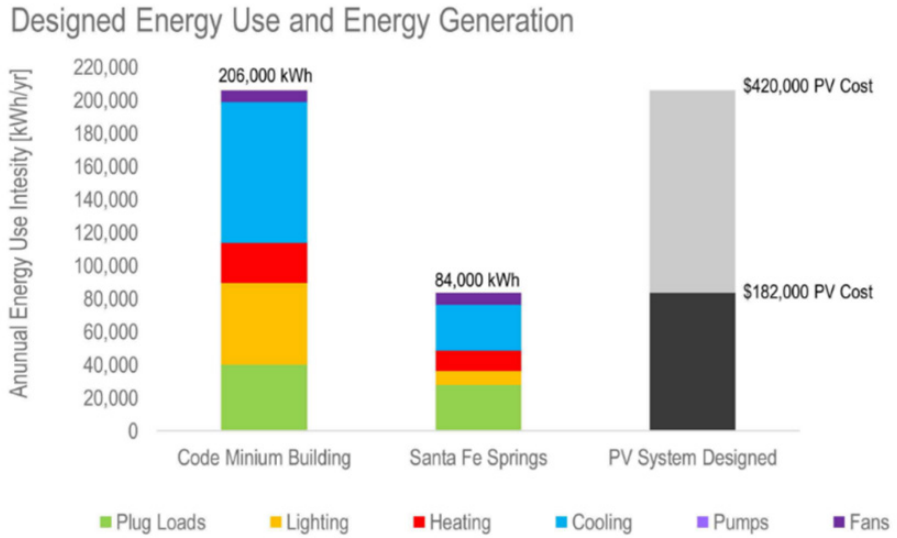
Net EUI: -7.8 kBtu/sf-yr

EV Charging: 3.5 EUI

Site Energy Use Index (EUI): kBtu/SF/yr

The Energy Equation: the building energy use minus the renewables production equals the net energy of the building. If renewable production exceeds energy use its net EUI is below zero (negative) and it is creating surplus energy.

*2020 data, may differ from typical occupancy due to COVID-19



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LIGHTING AND DAYLIGHTING

Even though the existing warehouse contained few windows, and only two façades offered daylight, daylighting is now the primary source of illumination. The design team optimized the roof to enhance daylighting opportunities by including 22 prismatic lens skylights, four solar tubes, and two north-facing light monitors to strategically illuminate workspaces and circulation paths. Interior glass walls (known as relights) distribute this light throughout the office and work to provide even light levels. Exterior glass curtain walls bring diffuse daylight into the lobby from the north and east. High-efficiency LED lights supplement these daylighting strategies when the natural light levels decrease below an acceptable value.

HEATING, VENTILATION, AND AIR CONDITIONING (HVAC)

After addressing lighting, the reduction in cooling loads offered the most dramatic savings. The design team was unable to incorporate natural ventilation because security concerns for the Lottery prohibited additional openings in some rooms. The HVAC system needs to run year-round so efficiency of the system was crucial. Three large, high-volume, low-speed fans circulate air more evenly keeping occupants comfortable in both summer and winter. An intelligent HVAC system uses an efficient, single zone, variable air volume (VAV) system. Controls sense room temperature and automatically adjust the frequency and volume of air released as needed. The system prevents overheating and overcooling which typically account for a high percentage of energy use in buildings built to code.

In reviewing lessons learned, the project manager noted that solar tubes are more economical than skylights.

Everyone was surprised by how much power printers consumed: about one-third of the total.

California Lottery | Santa Fe Springs, CA
Credit: LPAS Arch+Design

PLUG LOADS

The design team began with a plug load analysis based on previous office plug load energy use. Analysts tracked energy use in the Lottery's previous office in 12 types of spaces. The data revealed that the building's off-hours plug load accounted for 36% (6,020 kWh) of its total plug load. The analysis revealed that turning off lottery machines and printers during nights and weekends could save 65% of this unnecessary energy consumption. Shutting down computers and monitors could further reduce the off-hours plug load to nearly zero. To help manage this energy use in the new office, the design approach integrated smart plugs at each workstation which allows workers to customize the shutoff times to their office hours, so systems are turned off when not in use.

MONITORING AND CONTROLS

Many of the building's systems are designed to increase ease of operation for the occupants. Lights operate with motion sensors to reduce unnecessary lighting energy use, and photocells automatically adjust the lighting to the amount of daylight in the space. The HVAC system requires minimal user attention to function efficiently. A thermal sensor detects the room temperature, which allows diffusers to run only when necessary and release an appropriate amount of air. A building management system incorporates the HVAC, lighting, plugs, and PV energy system.

CEDA

California Energy Design Assistance (CEDA) Program

Public buildings like this office, as well as private-sector projects, are eligible for design assistance through the CEDA program. CEDA provides complimentary custom energy modeling to analyze energy efficiency options and potential energy savings for new construction and major alteration projects. Based on these projected energy savings, projects can qualify for financial incentives to offset the costs of energy-saving measures.

Email **CEDA@willdan.com** or call 855-502-3914 for more information.

PG&E Pacific Gas and Electric Company®

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