

ZERO NET ENERGY VERIFIED CASE STUDY

GETTING TO
zero | San Diego



Borrego Springs Library | Borrego Springs, CA
Credit: Jeff Durkin, Bread Truck Films

Overview Facts

Building size: 13,165 sf

Location: Borrego Springs, CA

Construction Type:
New Construction

Building Type: Government
Building—Library

Construction Year:
October 2017

Occupied Date:
December 2018

ASHRAE Climate Zone: 3B

**Predicted Energy Use
Intensity (EUI):**
41.4 kBtu/sf-yr

Net EUI:
-0.1 kBtu/sf-yr

Borrego Springs Library

Anchored in the small desert community of Borrego Springs, the new public library responds to the community's deep appreciation for the distinctive ecosystem and ecology. The freestanding, one-story 13,500 square foot structure provides a library and community room. The sustainable structure not only withstands the harsh desert climate but also allows visitors to absorb and immerse themselves in the surrounding beauty. The zero net energy (ZNE) building features many energy-saving principles, including solar shading, significant daylight harvesting, an energy-efficient and durable building envelope, and on-site renewable power production.

The project was a three-part county plan: community library, public park, and a sheriff's office. All phases were completed simultaneously, which allowed the seamless implementation of the master plan. The Borrego Spring Library is intended to serve as the community's social and civic center, integrating the desert's unique ecosystem and ecology, the naturally dark sky, and extensive history of Borrego Springs' desert culture. An important aspect of the design is that everything about the site and the layout relates to astronomy.

“The County opened its third zero net energy library at Borrego Springs in December 2018 to provide the community with a valued facility asset to meet its needs. This beautiful building is also environmentally responsible, achieving LEED Gold certification and Zero Energy petal certification through ILFI.”

Susan Freed, Project Manager, Energy, and Sustainability Division at the County of San Diego



Exterior view from the park
Credit: Jeff Durkin, Bread Truck Films

Lessons Learned

1. Community involvement during design benefits County projects because it leads to better-designed projects and improves the match between community needs and the result.
2. Energy modeling is essential for optimizing sustainable design measures, but physical models can provide insights that digital models can't.
3. The master plan being completed simultaneously allowed for connection to the park and building to work seamlessly together.
4. Commissioning agents engaged early in the project can provide construction insights and offer system controls integration services that provide a smoother construction hand-off experience.

Planning and Design Approach

Borrego Springs residents strongly appreciate the desert's distinctive ecosystem and ecology. Adjacent to Anza-Borrego State Park, California's biggest state park, it was critical that the new library's design compliment the surrounding landscape. When the community needed a new library, the County of San Diego was clear about the sustainability goals: achieve LEED Gold library and participate in the County's zero net energy (ZNE) initiative.

The overall goal for the Borrego Springs community was that the new library is a community focal point and that it provides access to meeting spaces, opportunities to gather and engage in civic enrichment activities and technology. In addition, the project was intended to create a campus of learning that provides spaces for inspiration, imagination, and elements that organically translate into the overall design. The design team's goal was to create a fluid and comprehensive link between the library and desert environment while achieving ZNE. Roesling Nakamura Terada Architects (RNT) had the winning design-build plan for integrating a library into the community.

Project Team and Awards

Project Team Owner/s:
County of San Diego

Architect: Roesling Nakamura
Terada Architects

Contractor: BNBuilders

Energy Consultant: Stok

MEP Consultant: MA
Engineers

Civil Engineer: WSP

Commissioning Agent: 3Qc

Awards:

- LEED Gold
- 2019 AIA San Diego, Architectural Merit Award
- 2019 AIA San Diego, Energy Efficiency & Integration Award
- 2019 Orchids and Onions San Diego, Orchid Award
- 2019 American Society of Civil Engineers, San Diego Chapter, Project Award
- Living Building Challenge, Zero Energy Certified



Exterior view from the park
Credit: Jeff Durkin, Bread Truck Films

During the ten-month design phase, the design team worked with the community, encouraging participation and incorporating community input. Additionally, the design team played off the celestial skies as inspiration for the entire library and site. The entrance has been designated as a galaxy plaza and has a circular mosaic showing the visible constellations from Borrego Springs. The master site plan includes a large “star walk” connecting the park and Library. The team also created a Revit model, which allowed them to plan and track various stages in the building’s lifecycle. This led to the decision to include a second corten steel skin on the Southside, which turns rust red as it weathers, further blending into the landscape. The north side of the building is a light-colored, smooth stucco, providing a beautiful contrast.

Stakeholder Engagement

Stakeholder and community engagement played a vital role in the project’s outcome. The project had a high level of involvement with the community from the early design phase of the project. From the start, the community’s voice was heard during city meetings which allowed their opinions and ideas to be implemented in the early design stage.

The stakeholder and community engagement aspect during the project’s whole lifespan was important because the community of Borrego Springs takes immense pride in their community and the types of amenities offered. The community comprises a diverse population, seasonal and year-round residents living in semi-rural to rural lands. The County of San Diego connected with the Borrego Springs Community Sponsor Group who served as the information link between the County on planning and land use matters through community workshops, social media, and online surveys.

“Our team was honored to create a cultural center and learning campus for Borrego Springs. Playing off the celestial skies was a tremendous inspiration for the entire library and park site. The Galaxy Court, Cosmos Way, and Polaris Plaza educate with concrete markers indicating the planets’ relationships to earth and sun. Everything about the site has been thought through, with respect to recreation, dark skies astronomy, discovery, and places for imagination.”

Ralph Roesling, Principal at RNT Architects

Physical daylight model placed on site
Credit: Jeff Durkin, Bread Truck Films



Energy Modeling

RNT developed a physical model and two digital models to study different elements of the building. Early, iterative energy modeling studies helped maximize the project's goals and confirm that the design met the requirements to achieve ZNE. Throughout design and construction, the mechanical engineers and the County contracted energy consultant Stok. They were engaged in the design, providing energy efficiency solutions to achieve the project goals. A physical model was studied on-site close to the summer solstice in the late afternoon. The study showed RNT just how far the sun reached around the north side of the building, highlighting the need to reconsider façade shading treatments at the northwest corner curtain wall.

Energy Efficiency Strategies and Features

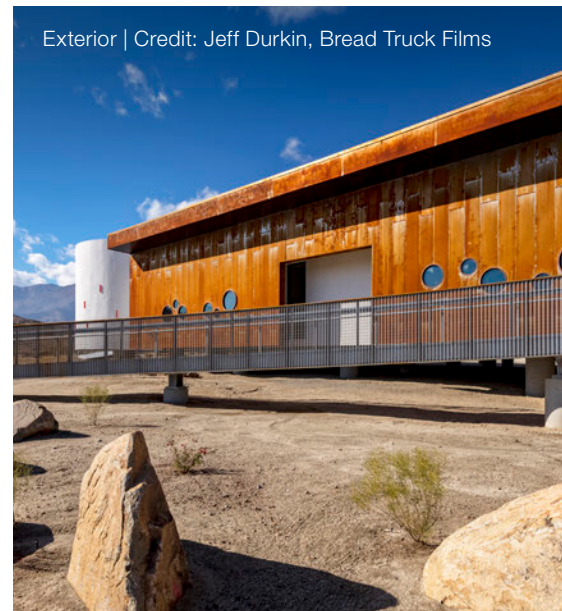
Building Envelope

Due to Borrego Springs' intense climate and fragile ecosystem, the building envelope played a significant role in the ZNE design. The community demanded that the building have nearly no impact on the natural landscape and surroundings. As a result, concrete piles and caissons elevate the structure, alluding that the earth-colored building rose horizontally with the natural sloping desert floor. Elevated two feet on the Southside and nearly eight feet on the Northside, this light-touch approach allows water to flow in its natural path during flood events. Limiting impervious surfaces, the simplistic water management plan allows much-needed stormwater to feed the aquifer. On occasion, wildlife takes refuge under the building to escape the heat.

“Our library is going to become the spot where we do life together”

Resident

Exterior | Credit: Jeff Durkin, Bread Truck Films



The amount of intense radiant sun that the building would endure daily was a major concern. The team designed the building in the optimum orientation, working with the sun rather than against it. A highly reflective cool roof deflects heat away from the structure. In addition, calculated overhangs prevent direct sunlight from striking the building's façade.

High-performance insulation encapsulated the entire structure. The curtain wall includes insulated glazing units to support a comfortable environment. A ventilated double-skinned system on the South façade dissipates heat from the most severe heat conditions. The weathered steel cladding panel is extended 1" from the rigid insulation and is vented on the top and bottom, allowing the natural chimney effect of heated air to exhaust at the top; A fortified front to address the harsh southern exposure.

Lighting and Daylighting

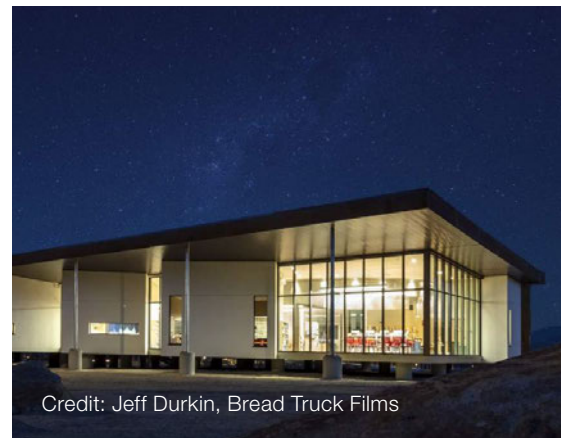
The building orientation was specifically designed to work with the sun to allow for daylighting and reduce the need for artificial lighting. The North façade is primarily glazed and shaded by the roof, providing indirect daylight deep into the interior spaces. The unobstructed windows provide views towards Indianhead Peak and the greater desert. The limited south façade windows direct occupants' attention to fun architectural details like circular windows; This design limits heat gain, increases thermal comfort and limits heating and cooling.

Where artificial lighting is needed, ambient LED lighting with occupancy lighting controls are provided.

Borrego Springs is a Dark Sky Community, meaning it is a city that has shown exceptional dedication to the preservation of the night sky through the implementation and enforcement of a quality outdoor lighting ordinance, dark sky education, and citizen support of dark skies. The design team worked hard to promote responsible lighting and Dark Sky Stewardship. All the external lights are aimed downwards but still effectively address safety measures.

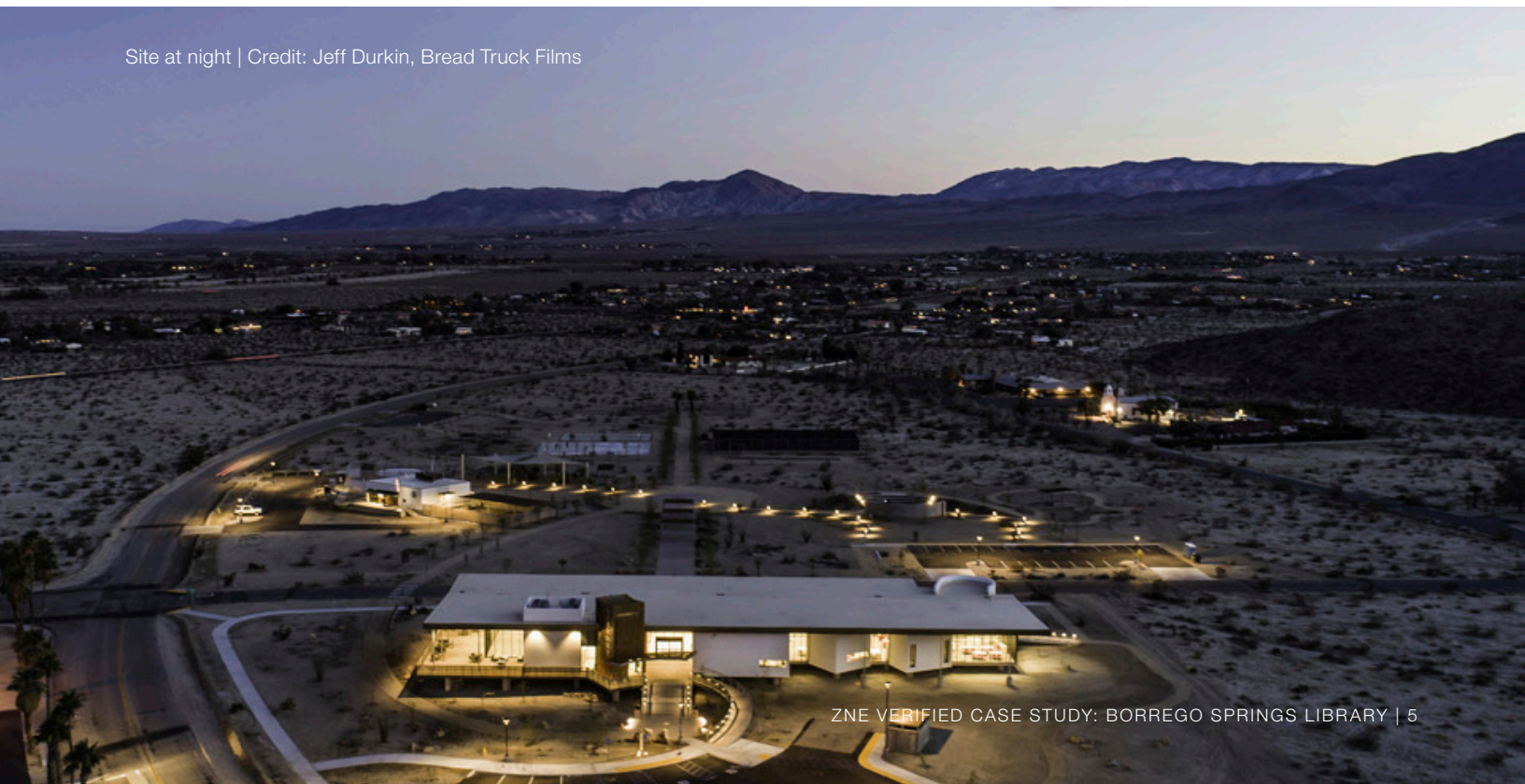
“The whole Borrego Valley is in a flood zone; it’s an alluvial fan. The best way to design for this was to lift the whole building upon piles and let the water flow through the site”

Brandon Martella, RNT Architects

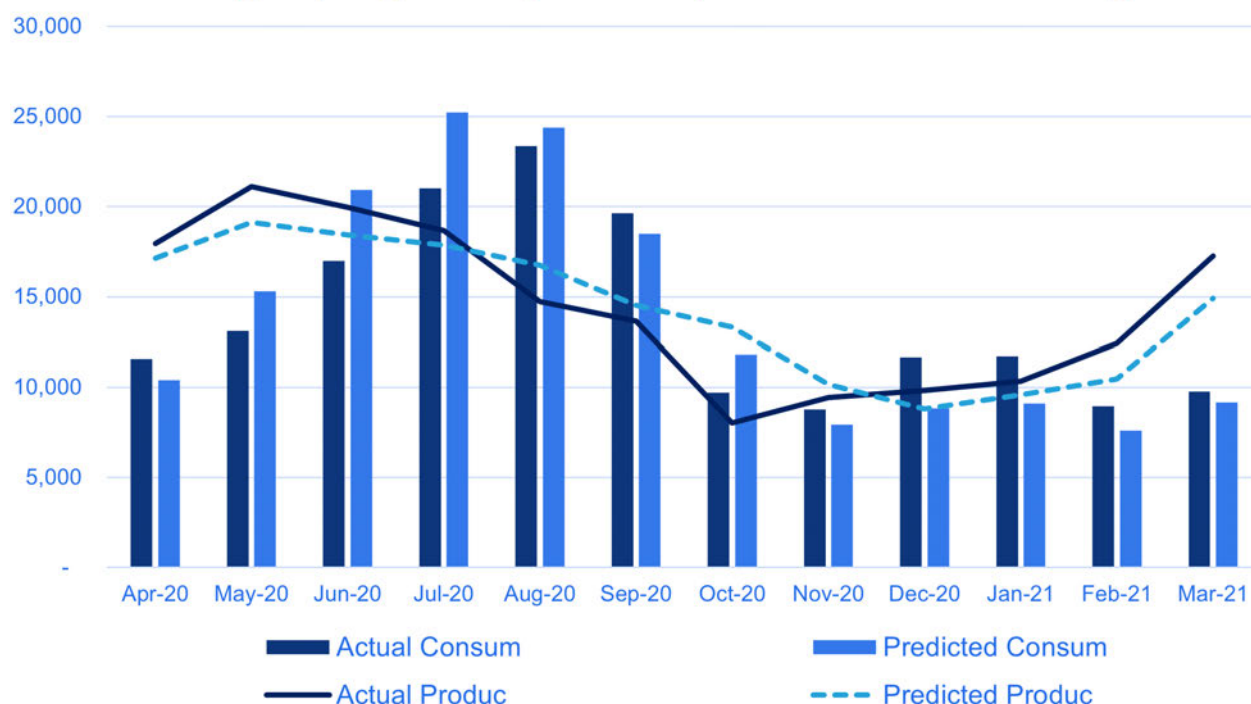


Credit: Jeff Durkin, Bread Truck Films

Site at night | Credit: Jeff Durkin, Bread Truck Films



Borrego Springs Library Consumption-Production Tracking



Heating, Ventilation, and Air Conditioning (HVAC)

The library also serves as an emergency cool zone. Therefore, the team sought an efficient and durable HVAC system to offer the community reliable heating, especially cooling. The variable refrigerant flow (VRF) HVAC system was selected. The system optimizes energy usage while providing multiple zones, allowing simultaneous heating and cooling, maintaining occupant comfort across the entire building. Condensing and heat recovery units are located behind a parapet adjacent to the tower. Distributing HVAC in the ceiling plenum provides unobstructed views that direct occupants to enjoy the architecture. Each room has a zone, allowing the rooms to be set to different temperatures, allowing for optimal efficiency with minimal energy loss. For example, if the library is closed, but the meeting room is occupied, only the meeting room zone needs to be conditioned to human thermal comfort ranges.

Monitoring and Controls

The HVAC, lighting, plug loads, and photovoltaic (PV) systems are submetered, allowing accurate, real-time energy monitoring to help better understand their energy profile performance, increase reliability, and realize potential energy savings. All systems are integrated into the County's central control server. This allows for equipment monitoring, building diagnostic information, and energy analytics to be accessed by staff at any time to diagnose issues if they arise.

To ensure the success of the integrated systems, the energy-using systems were fully commissioned by 3Qc. The ZNE audit occurred in 2020, and the building is now Zero Energy Certified by the International Living Building Institute.

Renewable Energy Generation and Storage

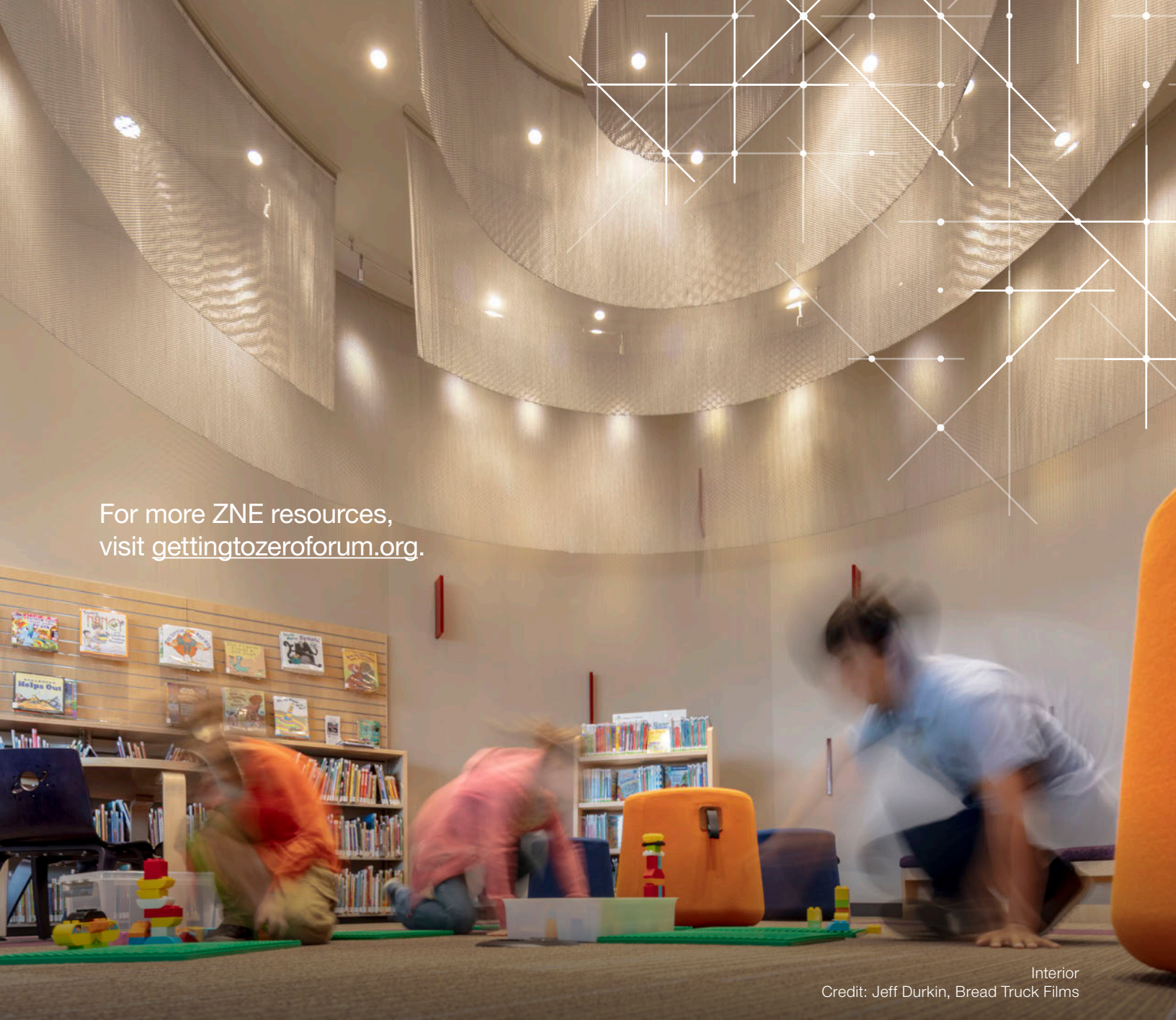
The County elected to install PV panels above the parking lot, which will offset all energy needed to operate the building by harvesting and storing electricity on-site. The PV inverter on-site has 103.95 kW of renewable capacity. The shading parking structures on which these PV panels were installed have many co-benefits. The availability of electric vehicle (EV) charging stations is becoming fundamentally more demanding in the market. The heat directly impairs a car's battery function, so parking under a shaded structure will allow EVs to maintain their charge better and be more effective and efficient in the long run. There are two EV chargers located on-site.

Occupant Engagement

The County facilities and library staff have been trained on the buildings' sustainability features. Digital displays at the entrance highlight many of the building's design elements and sustainability considerations that visitors should know. Additionally, outreach materials were produced and distributed to staff and visitors. These included a sustainability scavenger hunt, brochures, and posters that showcase how sustainable design supports the County of San Diego's conservation. The design team highlighted Borrego Springs' status as a stargazing-friendly Dark Sky Community, with creative educational displays including constellation mapping and connections to local history, making the ZNE building an educational, fun, and beautiful place to learn and connect with the community and the environment.



Interior | Credit: Jeff Durkin, Bread Truck Films



For more ZNE resources,
visit gettingtozeroforum.org.

Interior
Credit: Jeff Durkin, Bread Truck Films



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