DESIGN VS REALITY: LESSONS LEARNED FROM OPERATIONAL NET ZERO ENERGY BUILDINGS

CASE STUDIES
**CASE STUDY: IBEW-NECA ZERO NET ENERGY CENTER (ZNEC)**

**BUILDING USE**
Electrical Apprenticeship

**BUILDING TYPE**
1981 Commercial Renovation

**AREA**
46,000 sq ft

**COST**
$288/sq ft

**Energy Use Intensity (EUI)**
15.3 kBTU/sf/yr

**LOCATION**
San Leandro, CA

**TEAM**
- IBEW-NECA | Owner
- FCGA | Architect
- Novo Construction | GC
- stok | Energy Modeler, LEED Consultant, Commissioning Agent

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**ACTIVE STRATEGIES**
- Lighting Controls
- Building Automation System
- Variable Refrigerant Flow

**PASSIVE STRATEGIES**
- Natural Light
- Natural Ventilation
- Thermal Mass
- White/Reflective Surfaces

**ACTIVE STRATEGIES**
- Modbus dashboard in Main Lobby

**PASSIVE STRATEGIES**
- Solar Tree Inverters
CASE STUDY: IBEW-NECA ZERO NET ENERGY CENTER (ZNEC)

- 12kW (3) turbines
- 166 kW PV arrays
- Solar light tubes
- Rooftop monitors

ANNUAL ELECTRICITY GENERATION (ACTUAL)
263,500 KWH DC

ANNUAL ELECTRICITY USE (ACTUAL)
227,500 KWH DC

% OF ENERGY ONSITE
116%

CASE STUDY: IBEW-NECA ZERO NET ENERGY CENTER (ZNEC)

- Daylighting, natural ventilation
- Natural ventilation (stack effect)
- Thermal mass wall
IBEW-NECA ZNEC CHALLENGES

- Design & Construction
  - Financing
  - Early project team onboarding
  - Integrated systems contractor in Design Phase

- Operations
  - Lighting control system
IBEW-NECA ZNEC LESSONS LEARNED

- Firm up financing sooner
- Engage integrated systems contractor early
- Define configurations for optimal performance
- Use same manufacturer for all lighting control components
- Install additional solar tubes
- Explore other heating options

CASE STUDY: THE EXPLORATORIUM

BUILDING USE
Science Museum

BUILDING TYPE
1914 Renovation

AREA
190,000 sq ft

COST
$700/sq ft

Energy Use Intensity (EUI)
44.8 kBTU/sfyr

LOCATION
San Francisco, CA

TEAM
The Exploratorium | Owner
EHDD | Architect
Nibbi Brothers | GC
stok | LEED Consultant
CASE STUDY: THE EXPLORATORIUM

ACTIVE STRATEGIES
- Radiant Heating & Cooling
- Dedicated Outside Air System (DOAS)
- Lighting Controls
- Renewables

PASSIVE STRATEGIES
- Natural Light
- Natural Ventilation

ANNUAL ELECTRICITY GENERATION (ACTUAL)
- 36.7 kBTu/ sq ft

ENERGY SAVINGS (ASHRAE 90.1-2007)
- 40% (93% with PV)

CASE STUDY: THE EXPLORATORIUM

1.4 MW PV arrays
CASE STUDY: THE EXPLORATORIUM

THE EXPLORATORIUM CHALLENGES

- Design & Construction
  - Projected solar performance
THE EXPLORATORIUM CHALLENGES

- Design & Construction
  - Projected solar performance
- Operations
  - Operating assumptions – more open hours, more staff, more attendance
  - Lighting controls
  - Actual solar performance
  - Staff engagement / education

THE EXPLORATORIUM LESSONS LEARNED

- Fully commission all systems
- Integrated / compatible Building Management Systems & Power Management Systems
- Properly calibrated meters
- Plan for storage & utilization of excess power production
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