NREL Parking Garage Performance Review:
Achieving 90% Energy Savings in a Parking Structure

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Design Solution—Metrics for Performance

• **Parking Spaces**
  o 1,806 total spaces
  o 90 preferred spaces for carpooling and vanpooling, 90 preferred spaces for low-emitting vehicles, 36 electric vehicle charging stations

• **Renewable Energy Ready**
  o 1.13 MW PV (net zero energy for RSF complex)

• **Energy Performance**
  o 158 kBtu/space/yr, designed
  o 90% energy reduction versus ASHRAE Standard 90.1-2007

• **Lighting and Daylighting are the key strategies to ensure successful performance**
Design Solution—Structure

Elevation:
Aluminum perforated panels optimized by daylight model
• 40% openness
• North, east, and west positioning

Top floor PV roof, Jennifer Scheib, NREL
Design Solution—Structure

Interiors:

• Light concrete but no paint on ceiling or columns
• Slab and beam versus flat slab
Design Solution—Structure

**Interiors:** Atrium staircase leading to bus shelter

Atrium and bus shelter, Dennis Schroeder, NREL
Design Solution—Systems

- **0.05 W/ft² LPD**
  
  CBEA specification was used for reference when reviewing lighting fixture submittals

- **Lights are only on when needed**
  - Occupancy sensors (OS)
  - Photocells (PS)
Design Solution—Systems

Light well images, Dennis Schroeder, NREL
Design Solution—Systems

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Energy Performance

Predicted versus Measured, Summer 2012

**Predicted Energy Use (kBtu/space/yr, %) by End Use**
- Miscellaneous, 41.2, 26%
- Elevators, 24.5, 16%
- Security, 46.3, 29%
- Lighting, 46, 29%

**Actual Energy Use (%) by End Use**
- Miscellaneous, 37%
- Elevators, 24.5, 16%
- Security/Elevator, 37%
Lighting Energy Performance Last 48 Hours
EVCS Energy Performance Last 48 Hours
Getting it all to work

• Ensure photocells are placed appropriately
  o Hard to control to 1 FC...
  o A single global photocell with local zone configuration is now our preferred method

• Be prepared to fine tune occupancy controls
  o 30 seconds to 50%, 2 minutes to off works well
  o Do occupancy sensors sense the right things?
    – Full coverage?
    – Sensor shields to minimize false ON
Discussion About Innovation and Replication

• **Process innovation**
  - Use performance-based procurement (energy goal with performance incentives)
  - Require integrated design with energy modeling, starting in the predesign phase, to maximize efficiency feature early

• **Design innovation**
  - Focus on structure first (structure type, perimeter configuration to maximize high daylight, bay width, structure depth, finishes, colors, percent fly ash)
  - Achieve a low LPD with good nighttime cutoff
  - Implement a lighting control scheme that improves occupant experience in terms of aesthetics and safety
  - Reduce need or time of use for elevators, heat trace, ventilation, miscellaneous loads

• **Result:** Cost-competitive, energy-efficient, *beautiful* garage with carefully considered neighborhood interface
Resources Available at: www.nrel.gov/sustainable_nrel/buildings_garage.html

- Low-Energy Parking Structure Design Guide
- DOE High-Efficiency Parking Structure Lighting Specification
- Energy-Goal-Based Building Procurement Webinar: Achieving 90% Energy Savings in a Parking Structure
- NREL Parking Garage Fact Sheet:
- NREL Feature News Story
Thank you for your time

Questions?
And then the tour!

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