Energy Modeling Done Right: Optimizing Building Energy Outcomes

Today’s panel:

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Associate Technical Director  
New Buildings Institute

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Energy Project Manager  
Willdan

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Program Outreach Lead  
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San Bernardino Community College District

Neil Bulger  
Co-Founder, Principal  
Red Car Analytics
Agenda

• Introductions
• CEDA Introduction
• Design Process Key Stages
• Case Studies
• CEDA Program Technical Modeling Overview
• Q&A

Learning Objectives

• Understand how CEDA’s energy modeling integrates with the design process.
• Become familiar with the timing and key stages in the design process to incorporate modeling.
• Learn from the experience of real project teams that have used energy modeling to improve project outcomes over the years.
• Position yourself to take advantage of CEDA!
What is CEDA?

California Energy Design Assistance (CEDA) provides a free analysis of different energy efficiency options and lays out their potential energy savings, then provides incentives based on energy savings in new construction or major alteration projects.
What Building Projects Can Tap Into CEDA?

- Publicly owned
- Commercial
- High-rise Multifamily
- Industrial
- Agricultural Projects
- PG&E, SCE, SoCalGas, or SDG&E customers*

*Most rate structures eligible

Timing of the CEDA Process
CEDA Process

1. Enrollment
   You provide schematic information about your building through our Energy Design Assistance application.

2. Preliminary Analysis
   Together we perform real-time evaluation of energy-efficiency measures and bundle potential whole-building strategies for further analysis.

3. Final Analysis
   You determine the strategies bundle that best aligns with your project goals, from which projected energy savings and utility incentives are determined.

4. Verification
   We confirm your project was constructed to plan and issue a final report for you and your utility provider.

5. Incentives
   Incentives will be issued for the strategies implemented in your project.

CEDA Program Eligibility

- New construction projects and/or major alterations
- Projects in design phase
- Exceed standard practice, code, and current design
- Owner pays/will pay the Public Purpose Program surcharge on the account where the Energy Efficiency (EE) measures are installed
**Why Participate in CEDA?**

- Receive complimentary custom energy modeling
- Get help identifying and evaluating energy-saving opportunities
- Gain analysis of energy costs and paybacks
- Receive financial incentives to help offset the costs of energy saving measures for qualified projects

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**Design Process Key Strategies**

Alexi Miller  
*Associate Technical Director*  
New Buildings Institute
Benefits of Energy Modeling

- Holistic representation of energy use
- Understand climatic and site parameters
- Inform and optimize design decisions
- Meet owner’s performance goals
- Minimize risk of delays and cost overruns due to change orders
- Decrease operational energy costs and GHG over the life of a building

Using Energy Modeling as a Design Tool

1. **Project Startup**
   Define efficiency target in the Owners Project Requirements (OPR)

2. **Early Design**
   Use CEDA's complimentary energy modeling for preliminary analysis

3. **Ongoing Design**
   Optimize building systems for efficiency and performance with iterative modeling

4. **Construction**
   CEDA confirms project was constructed to plan and issues report for incentives
Potential Modeling Cycles

• ASHRAE 209 standard* for energy modeling during modeling cycles:
  • Conceptual design—Simple-box modeling and conceptual design modeling
  • Schematic design—Load-reduction modeling and HVAC system selection**
  • Design development—Design refinement and design integration and optimization
  • Construction documents—Energy-simulation-aided value engineering
  • Construction and operations—As-designed performance, change orders, and as-built energy performance
  • Post-occupancy—Post-occupancy energy performance comparison

** Note that the Load-reduction modeling and HVAC system selection modeling cycle is the minimum requirement under ASHRAE 209.

Project Startup Phase- OPR Targets

• Set whole-building energy targets- EUI and GHG
• Set system level targets including:
  • Building envelope
  • Lighting
  • Heating, cooling, and ventilation
  • Hot water
  • Controls
  • Other energy-using systems
Why Conduct Modeling Early in Design?

- Understand building energy end uses and potential design strategies to meet EUI and GHG targets
- Consider orientation, massing, and optimize floor plan
- Identify occupant usage patterns and understand program adjacencies – and their impacts on energy

Early Design Phase

- Analyze strategies from among the following:
  - Building envelope
  - Lighting and daylighting
  - HVAC system type
  - Internal equipment loads
  - Outdoor air
  - Passive conditioning and natural ventilation
**Ongoing Design**

- Select measures/packages for final analysis
- Fine-tuning of model parameters
- Conduct another modeling cycle?
- Operations integration (prep for handoff)
- Inform building construction documents/specs

**Verification**

- Final analysis and confirmation that building was constructed according to the plans
- Report issued by CEDA to gain financial incentives
San Bernardino CCD

District Goals:
• Net Zero Energy
• LEED Gold or Platinum
• CalGreen Tier 1 or 2
• Low EUI
San Bernardino CCD

Energy Modeling:
• Not Just a Checkmark
• Drives the Decision
• Best-case and worst-case Scenario
• Feasibility Assessment
• Allows us to take a Measured Risk
• Innovate

Guest Expert

Neil Bulger
Co-Founder,
Principal
Red Car Analytics
High solar on roof - for PV

Solar blocked on south window in summer
Energy Saving Strategies

- All Electric Building - Code Envelope
- Envelope Package 1
- Envelope Package 2
- Envelope Package 3
- High Efficiency HVAC
- Radiant Heat/Cool
- Advanced Lighting
- Maximum PV Generation

Energy Use Intensity (kBtu/sf-yr)

69 67 60 57 44 41 35 48

Decrease PV Size

Maximum PV Generation
Fans
Cooling
Heating
Interior Lighting
Interior Equipment

Increased Insulation
Improved Windows
Decreased Infiltration
Low Pressure Fans
Heat Recovery
Radiant with Expanded Comfort
Daylight Sensors
LEDs
Set Energy Target

Type of Discomfort:
- Radiant Discomfort
- Downdraft Discomfort

What to Measure:
- Mean Radiant Temperature
- Downdraft Speed & Temperature

Function of:
- View Factor
- Interior Temperature of Glass
- Window Height

Variables:
- Window Height
- Window Width
- Occupant Distance to Window
- U-value of Glass
- Exterior Design Temperature
- Room-side low-e coating
- Window Height
- Mullion Projection
Providing Climate Appropriate Comfort

Thermal Comfort with High Performing Envelopes

- 25% feel draft
- 21% feel draft
- 18% feel draft

Metal
Wood
Fiberglass
CEDA Program Modeling Technical Overview

Richard Peske
Energy Project Manager
Willdan

J. Craig Venter HQ, La Jolla, CA
Credit: NBI
Why do we build energy models?

- System Sizing and Design
- Code Compliance
- Third-Party Certifications
- Optimize Building Performance
- Comparative Analysis
- Incentives and Savings

Energy Efficiency – CEDA Program Objectives

- Drive efficiency ... Where it wasn’t happening already
- Societal Impacts
- Moving the needle
- Electrification and Decarbonization
CEDA Modeling Paths

- Varies for Flexibility in Depth and Detail
- Start Early
- Balance effort vs outcome
- What’s the project schedule?
- Custom and Deemed
- CEDA Lite Option

What to expect?

- Collaboration and Exploration
- General Process
- Modeling Tools aligned to scope and schedule
### Comparative Analysis

- Provide accurate comparative analysis early in the design to allow teams to evaluate their options.

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### Meeting the Objectives

- **Model for Savings**
- **Incentivize instead of Reward**
- **CEDA ≠ SBD**
- **Standard Practice Baseline**
Areas of Opportunity

- Heat Pump Water Heating
- VRF Systems
- Heat Recovery Chillers
- Envelope, Lighting, ...

Verification

- Thorough review of as-built documentation
- On-site walkthrough
- Were goals achieved?
- Were the projected savings realized?
Takeaways

- Think about the process as consulting, not just modeling
- Weigh options as early as possible
- At every experience level, find a way to leverage the program
- Model every project!

Questions and Answers
Selected Energy Modeling Design Process Resources

- New Buildings Institute ZNE Project Guide for State Buildings
- New Buildings Institute ZNE Project Guide