Integrating Energy Use Requirements into the Design-Build Acquisition Process

Shanti Pless
Senior Energy Efficiency Research Engineer
National Renewable Energy Laboratory
Great Potential in Commercial Buildings

Where we are today
- 90 (1020) Existing commercial buildings (2003 CBECS)

Where we would be if all buildings were built to current code
- 70.7 (803) New buildings base scenario (Standard 90.1-2004)

Where we could be with current technologies
- 40.3 (458) Max Tech energy efficient scenario (Griffith et al. 2007)

Add renewables and we’re almost to net-zero
- 12.2 (139) Max Tech energy efficient scenario w/PV
Setting Goals

- Measurable goals are better

- From bad to good...
  - I want a green building
  - Design a LEED <rating> building
  - Design a building to use 30% less energy than ASHRAE 90.1-2004
  - Design a building to use less than 25,000 BTU/sqft
  - Design a [NET] ZERO ENERGY BUILDING

- Influencing design process—the owner
Definitions of NZEB’s

- Net Zero Site Energy
- Net Zero Source Energy
- Net Zero Emissions
- Net Zero Energy Cost
- Boundaries and metrics

- ZEB:A – ZEB:D

The Definition used WILL impact the ZEB design strategies!

http://www.nrel.gov/docs/fy06osti/39833.pdf
ZEB Renewable Hierarchy

Energy efficiency FIRST
  – Daylighting, CHP, passive solar

A. Footprint supply options
  – Building mounted PV or wind

B. Site supply options
  – Parking lot PV or wind

C. Imported supply options
  – Wood chips, ethanol

D. Purchase of renewable credits
Achieving Sustainability – Session 4
Greening the Labs

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September 25, 2012

NREL: 2006

NREL PIX
Research Support Facility Vision

- A showcase for sustainable, high-performance design
  - Incorporates the best in energy efficiency, environmental performance, and advanced controls using a “whole-building” integrated design process
- Serves as a model for *cost-competitive*, high-performance commercial buildings for the nation’s design construction, operation, and financing communities
NREL: Today

2012 aerial, Photo by Sincere/Duncan Studios courtesy of JE Dunn Construction
RSF Problem Definition – RFP Objectives Checklist

MISSION CRITICAL
Attain safe work performance/Safe Design Practices
LEED Platinum
Energy Star “Plus”

HIGHLY DESIRABLE
800 staff Capacity
25kBTU/sf/year
Architectural integrity
Honor future staff needs
Measurable ASHRAE 90.1
Support culture and amenities
Expandable building
Ergonomics
Flexible workspace
Support future technologies
Documentation to produce a “How to” manual
“PR” campaign implemented in real-time
Allow secure collaboration with outsiders
Building information modeling
Substantial Completion by 2010

IF POSSIBLE
Net Zero/design approach
Most energy efficient building in the world
LEED Platinum Plus
ASHRAE 90.1 + 50%
Visual displays of current energy efficiency
Support public tours
Achieve national and global recognition and awards
Support personnel turnover

Full Performance RFP ➔ No drawings in RFP = No change orders!
When energy performance is required...

- Force “integrated” design
- Design decisions based on early energy modeling
- Make optimal use of “free” energy sources
  - Data center waste heat recovery
  - Evaporative cooling in dry climate
  - Daylighting
- Radiant heating and cooling integrated into building structural elements
- Architectural amenities budget applied to integrated envelope efficiency solutions
  - Near real time value engineering
A value engineering process that adds value
### $/ft^2 Comparison

<table>
<thead>
<tr>
<th>Project Description</th>
<th>Cost ($/ft²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC Federal Building, Other</td>
<td>$530</td>
</tr>
<tr>
<td>San Joaquin Comm. College, Other</td>
<td>$521</td>
</tr>
<tr>
<td>Fort Bragg Forces Command HQ, Gold</td>
<td>$460</td>
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<tr>
<td>National Association of Realtors, Silver</td>
<td>$442</td>
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<tr>
<td>Aircraft RSF, Silver</td>
<td>$418</td>
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<tr>
<td>Applied Research &amp; Development, Platinum</td>
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<tr>
<td>NASA Sustainability Base, Platinum</td>
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<tr>
<td>Las Cruces Courthouse, Other</td>
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<tr>
<td>1800 Larimer, Platinum</td>
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<tr>
<td>San Joaquin Admin Building, Gold</td>
<td>$369</td>
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<tr>
<td>Leprino Building, Other</td>
<td>$354</td>
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<tr>
<td>Federal Reserve Bank of Kansas City, Other</td>
<td>$326</td>
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<tr>
<td>Arizona State University College of Nursing &amp; Health, Gold</td>
<td>$318</td>
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<tr>
<td>Arizona State University School of Journalism, Silver</td>
<td>$316</td>
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<tr>
<td>Leo Trombatore Office, Silver</td>
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<tr>
<td>Commerce City Civic Center, Silver</td>
<td>$308</td>
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<tr>
<td>Fernald Visitors Center, Platinum</td>
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<tr>
<td>EPA Region 8 Headquarters, Other</td>
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<tr>
<td>Dillard University, Gold</td>
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<tr>
<td>RSF - Total Project Cost without PV, Platinum</td>
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<tr>
<td>RSF - Total Construction Cost with PV, Platinum</td>
<td>$284</td>
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<tr>
<td>Ft. Lewis Barracks and Dinning, Silver</td>
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<tr>
<td>Naval Facilities Southeast Engineering Operations Center, Other</td>
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<tr>
<td>RSF Expansion, Total Construction Cost with PV, Platinum</td>
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<tr>
<td>University of Denver Sturm College, Gold</td>
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<td>Bremerton BEQ, Certified</td>
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<td>Chevron Office, Other</td>
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<td>Omega Center, Platinum</td>
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<td>International Fund for Animal Welfare, Gold</td>
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<td>RSF - Total Construction Cost without PV, Platinum</td>
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<tr>
<td>Ft. Carson Brigade/Battalion HQ, Gold</td>
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<td>Great River Energy Headquarters, Platinum</td>
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<td>The Signature Centre, Platinum</td>
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<td>NVCI Cancer Research, Silver</td>
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<tr>
<td>Leprino Building, Other</td>
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**Data used by permission from the Design-Build project database hosted by DBIA at [www.dbia.org](http://www.dbia.org)**
NREL Energy Performance Based Design Build Projects

• Each project has contractual energy goals
  • RSF, RSF Addition, Parking Garage, Café, Smart Grid Lab

• Based on energy models updated based on Cx and As-built conditions

• Superior performance voluntary incentive ($) program to ensure actual energy use has a chance to meet predicted performance

• Each project has end use metering and public displays of energy performance as part of contractual performance requirements
NREL RSF 3rd Wing

- 33 kBtu/ft², 50% savings, LEED Platinum 3.0
  - Building 17% more efficient than the RSF
  - Cost savings of 5% ($14/ft² cheaper)
1800 Car Staff Parking Garage

- 138 kBtu/parking stall
  - 0.5 kBtu/ft²
  - 175 kBtu/stall RFP goal
  - Does not include electric vehicle charging

- Net-zero energy

Site Entrance Building
NREL Cafeteria

- 30% savings over ASHRAE 90.1-2007
- LEED Gold 3.0 minimum
  - Platinum if possible
- Best in class commercial kitchen equipment
Energy Systems Integration Facility

- 25 kBtu/ft² Office wing
  - not including waste heat use
- 1.06 PUE Super computer, no mechanical cooling
- 30% Savings for all Labs
- LEED Gold minimum
  - Platinum if possible
World Class Efficiency is Possible within our Construction Budgets!

- Spend the time to get RFP right
  - Include absolute EUI requirements
- Set up acquisition process to “force” integrated design
  - Energy modeling guides conceptual design decisions
  - Architecture and envelope are also efficiency measures
- Unwavering commitment to problem statement
  - Unleash power of design/build team of experts to meet your needs – true value engineering
Thanks and Questions?

For additional information:

www.nrel.gov/rsf

Shanti.pless@nrel.gov