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
Many Pieces

- So many ways to assemble the pieces

- Design is about making decisions – need motivation to make the right decisions

- Who are the decision makers?

- Today’s decisions mortgage the energy futures of the world.

Used by permission: Paul Torcellini/NREL
• RSF uses 50% less energy than if it were built to current commercial codes at no extra capital cost

• RSF increases space at NREL by 60% but only increases energy use by 6%
The Process

• Owner made tough decisions up-front
  • Set budget
  • Sought maximum value for that budget
  • Prioritized goals
• Created a Performance Based RFP
  • Managed the team to the RFP and its substantiation criteria
  • Rewards
• Allowed contractor team to use creativity to maximize value--innovation
• Owner did not solve the problem (but knew the solution existed)
Problem Definition: RFP Objectives

**MISSION CRITICAL**
Attain safe work performance/Safe Design Practices

**LEED Platinum**
Energy Star “Plus”

**HIGHLY DESIRABLE**
800 staff Capacity
25 kBTU/ft²/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**
Zero energy
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
Problem Definition: RFP Objectives

- Attain safe work performance/
  Safe Design Practices
- LEED Platinum
- ENERGY STAR “Plus”
Problem Definition: RFP Objectives

- 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
Problem Definition: RFP Objectives

• 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
Owner Role

- Spend the time to get RFP right
  - Design/build team will study to pass the test
- Set up acquisition process to “force” integrated design
  - Energy modeling guides conceptual design decisions
  - Architecture and envelope are also efficiency measures

NREL/17833
Owner Role

• Unwavering commitment to problem statement

  • Unleash power of design/build team of experts to meet your needs
    • true value engineering

• Commit to your objectives and the prioritization and don’t adjust

Clockwise from top: NREL/18784, 24690, 17823
Guidance for Unknowns

• Benchmarked current plug loads and data center load
  – Provided peak uses and occupancy schedule by plug load type
    • Laptops, monitors, copiers, kitchen equipment, task lights, etc.
    • 65 Watts/occupant 24/7 for datacenter
  – Allowed design-build team to make recommendations on plug load reductions.
Steps…

• RFQ: Short list to 3 teams
• Pay for conceptual design (share the risk)
• Select best value for fixed price
• Incentives
• Require substantiation
**COMMERCIAL BUILDING CONSTRUCTION COST**

**PROJECTS AND LEED CERTIFICATION**

Legend:
- **NOT RATED**
- **LEED CERTIFIED**
- **LEED GOLD**
- **LEED SILVER**
- **LEED PLATINUM**

**SOURCES:**
- www.fayobserver.com
- www.dbia.com
- www.nasa.gov
- www.eomega.org
- www.oregonsustainabilitycenter.org
- www.americas.rlb.com
- http://greensource.construction.com
- www.1800larimer.com
- www.usgbc.org
- www.smithgroup.com
- www.cronkite.asu.edu

<table>
<thead>
<tr>
<th>PROJECTS</th>
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<td>RSF II</td>
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<tr>
<td>Average</td>
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</table>
The PV system is sized for an annual EUI of 35.1 kBtu/ft².
Research Support Facility

- 800 people
- 220,000 ft\(^2\)
- 25 kBtu/ft\(^2\)
- 50% energy savings
- $259/ft\(^2\)
- LEED Platinum
- Replicable
  - process
  - technologies
  - cost
- Site, source, carbon, cost ZEB
  - Includes plugs loads and datacenter
- Design/Build Process with required energy goals
Is this photo significant?

Credit: Jennifer Scheib/NREL
Window Design

A light redirecting device reflects sunlight to the ceiling, creating an indirect lighting effect.

Fixed sunshades limit excess light and glare.

Credit: RNL
PV System

Natural Ventilation

Thermal Mass

Transpired Collectors

Daylighting

Thermal Bridging

Enhanced Envelope

Radiant Cooling

Radiant Heating

Workplace

UFAD

Electrical Lighting

Outdoor Air Pre-cool
PROJECTS AND LEED CERTIFICATION

COMMERCIAL BUILDING CONSTRUCTION COST

LEGEND:
- NOT RATED
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- www.cronkite.asu.edu

RSF
- Platinum $259

RSF II
- Platinum $246

Average
- Platinum $355
You Can Get Involved?

• Teaming up with Utility Incentive Programs (started with Connecticut)
• Incentive programs to support innovative process
• Owners get our expertise to help with the procurement process
BIG Architects
Clayco/Forum

- EUI – 46
- Hybrid Geothermal w/
Condensing Boilers and
Campus Chilled Water
- FCU in residential units

Perkins + Will
Pepper Construction

- EUI – 52
- Hybrid Geothermal w/
Condensing Boilers and
Campus Chilled Water
- Radiant panels with DOAS

Hopkins Architects
Holabird and Root
Gilbane

- EUI – 54
- Condensing Boilers and
Campus Chilled Water
- FCU in residential units

Studio Gang Architects
Mortenson Construction

- EUI – 51
- Condensing Boilers and
Campus Chilled Water
- Radiant Slab with DOAS

54 kBtu/ft²/yr
51 kBtu/ft²/yr

46 kBtu/ft²/yr
52 kBtu/ft²/yr