The Road to Net Zero

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Deputy Laboratory Director Science & Technology
RSF Workshop
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Managing Costs

Paul Torcellini, PhD, PE
Group Manager, Advanced Commercial Buildings Research Group
• Owner made tough decisions up-front
  • Set budget
  • Sought maximum value for that budget
  • Prioritized goals
• Design-Build procurement process
  • Managed the team to the RFP and its substantiation criteria
  • Rewards
• Allowed design-build team to use creativity to maximize value--innovation
• Owner did not solve the problem (but knew the solution existed)
U.S. Department of Energy’s
RESEARCH SUPPORT FACILITY
at the National Renewable Energy Laboratory (NREL)

Richard L. von Lahrte FAIA LEED AP
RNL, President/Principal in charge
Architect of Record RSF/RSF 2
Performance-Based Design-build

Substantiation

Energy Target / Project Objectives

Incentive Award Fees

PROCUREMENT

Process
INTEGRATED DELIVERY

- Performance Objective / Energy Target
- Front Loaded + Energy Driven Design
- Cost Control / Risk Management
- Bridge the Gap Between Design + Occupancy
REPLICABLE?
Other Certified Silver Gold Platinum

Source: DBIA Project Database

Average Cost: $334/SF
RSF Cost: $259/SF
INTEGRATION

1. Orientation and 60’ (18.3m) Depth
2. PV Array
3. Solar Shading / Daylighting
4. 25% WWR
5. Radiant Cooling & Heating
6. Decoupled Ventilation with UFAD
7. Operable Windows
8. Thermal Mass
9. Transpired Solar Collector
10. Thermal Labyrinth
Passive Design

Baseline Energy Use

- Lighting
- Heating
- Cooling
- Ventilation
- Plug Loads

Passive Design nodes:

- Orientation / Massing
- Daylighting
- High Performance Envelope
- Passive Heating
- Passive Cooling
- Natural Ventilation

Reduced Energy Use

- Lighting
- Heating
- Cooling
- Ventilation
- Plug Loads
## Green Facts

NREL Research Support Facility
Golden, Colorado

<table>
<thead>
<tr>
<th>Category</th>
<th>Rating</th>
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<tr>
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<td>Innovation &amp; Design</td>
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Managing Costs for Net Zero Energy

Philip Macey, AIA  LEED AP
Division Manager - High Performance Building - Haselden Construction
What is different about sustainable projects and their management?

• The traditional approach
  • Balance cost, schedule, and program

• The integrated and green approach
  • Sustainability integrates with all and is a new element
    • Cost – now include the value of energy performance
    • Schedule – balance speed of construction/first cost with energy cost and operations costs
    • Program – now need energy goal in the project description
  • Sustainability – look at whole site and whole building construction, materials and impacts
NREL

Executive Team
- Construction President Architect Project Principal
- Construction CEO Architect Project Principal

Project Management Team
- Architect Client Project Manager
- Construction DB Project Manager

Functional Groups
- Electrical
- Mechanical/Plumbing
- Design
- Functional Groups
  - LEED
  - Building Skin
  - Budget
  - Energy
  - Core/Shell
  - Interiors & Program
  - Commissioning

Design Team Roundtable
- Sr. Preconstruction Manager
- Design Principal
- Sr. Interior Designer
  - Architectural Technical PM
- Project Architect
- Construction Project Manager
- MEP Principal

Early Selected Subcontractors
Constructing Zero Energy
Leadership Teams

Design
Arch Client PM
Client and Contracts

Build
Const. DB PM
Client and Contracts

Arch Tech PM
Tech. and Doc’s

Const. PM
All Construction

Mech. Eng. Client PM
Client and Models

MEP Pre-Const.
All MEP

Mech. Eng. Tech PM
Tech and Doc’s

MEP Pre-Const.
All MEP
Constructing Zero Energy

Integrated Design and Construction
5 Sided Problem Solving

Cost and Budget Models
Energy Models
Thermal Comfort Models
Daylight Models
Architecture and Program Models

Zero Energy Building
Constructing Zero Energy

• The big 5 subcontractors - select early for cost control
  • Structural Steel
  • Mechanical/Plumbing – AHU’s, Hydronic, pumps
  • Electrical – lighting, cabling, electrical distribution
  • **Envelope** – the single most costly per SF and the most impactful to energy
    • Glass and Glazing
    • Pre-cast concrete wall system
Constructing Zero Energy

- LEED Platinum & Cost Control
  - Security and Sustainability: first attention
  - Focus: Long term pay back
  - Contract requirement okay, must allow DB to control point selections
  - Early, team-wide commitment critical – that means put it in your RFP
  - Will change typical choices and costs
  - Limit cost impacts = do it from start