Incremental Costs of Zero Net Energy Buildings

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Learning Objectives

- Understand the parameters of ZNE “cost”
- Describe incremental cost and cost tradeoffs
- Learn the latest research on ZNE cost
- Access resources to support cost discussions
2014 Getting to Zero Status Update

• ZNE is a major trend in the industry

• ZNE goal, absolute target a significant contributor to success

• Assembling the right team, with the know-how appears essential for success

• Policies, codes and incentives will help pave the way to more rapid growth across the building industry
Characterizing Costs

While this study’s focus was primarily on energy performance and trends, there are some consistent findings from the research of NBI and others:

- **Costs for getting to zero are not distinguishable from overall project costs.** Energy efficiency and renewable technologies do have specific costs, but the design and technology tradeoffs due to the advanced systems blur the line of incremental costs.

- **Green, LEED and/or zero net energy building costs are within the range of other like-type buildings.** When total construction costs for these buildings are analyzed against control groups, they are approaching comparable costs.

- **Design firms and early targets reduce costs.** The experience of the team and the explicit goal of ZNE throughout the process are cited as critical to managing costs.
Building “Cost” includes what?

**Developer**
- Hard Costs
- Soft Costs
- Capital Costs/Valuation
- Leasing Costs
- Debt Service
- Vacancy/Absorption Rate
- NOI (income – operating expenses)

= IRR

**Owner/Tenant**
- Hard/Soft Costs
- Salary/Benefits
- Operating Expenses
- Tenant Improvements
- Churn
- Absenteeism
- Turnover

= Margin
Is there a relationship between cost and performance?

![Graph showing relationship between construction cost premium and advanced building EUIs.](image-url)
PV cost trend makes ZNE accessible

Source: P. Mints, Navigant Solar Services Program, 2011
Richardsville Elementary School

- Bowling Green, KY
- 72,300 SF
- Education K-12
- Completed in 2010
- LEED Gold
- $206/SF
- Warren County Public Schools
- Sherman Carter Barnhart, Architect
- CMTA, Mechanical and Electrical

Photo: Sherman Carter Barnhart
• Local, state, and national **policy innovation to provide incentives** for high-performance green buildings.

• **Integrated Valuation Tool™** development to inform a new generation of appraisal and valuation models that account for ecological and social value creation.

• Industry transformation through new standards, protocols, and processes around **appraisals, valuation, lending, and investment**
“The study’s central finding is that ZNE buildings will be technically feasible for much of California’s new construction market in 2020.”
New this week:

Report Findings:

- Costs for getting to zero are difficult to distinguish from overall project costs
- 1-12% premium for energy efficiency
- 5-19% for net zero energy
- ROI for energy efficiency alone 5-12%
- ROI for net zero up to 30%

www.newbuildings.org
New this week:

Policy Roadmap Recommendations:

• Define net zero

• Consider community-level approaches

• Encourage transition to outcome-based energy codes

• Establish new and modify existing financial incentives to encourage deep savings

• Address limitations of the grid and acknowledge the changing role of utilities

www.newbuildings.org
“La Jolla Commons is one further step in our objective to put new building strategies and technologies into practice in an economically viable way, using our experience to continually reset our own standards of quality. First and foremost, we designed a Class A, commercially viable property, then we devised strategies to make it net-zero.”

- Hines President and CEO Jeff Hines

http://www.hines.com/press/releases/12-12-12.aspx
building types

statistical analysis

- community centers (learning/visitor)
- k-12 schools
- office buildings – low-rise
- wet labs

88 high-performance buildings
normalize data

- common location
- common time

establish comparison baseline

- the project’s original budget
- the project itself, without the green elements
- similar projects
K-12 statistical analysis

$ / SF

BUILDINGS MEASURED
community centers
statistical analysis

BUILDINGS MEASURED

$ / SF

Control Green Platinum NZE/LB
low-rise office building

statistical analysis
energy performance: predicted vs. actual EUI
statistical analysis
findings
comparison of component costs

- High Performance buildings are happening
- There are two distinct families
  - Demonstration projects
  - ‘Mainstream’ projects – (a growing cohort)
- HPB are getting there by reducing consumption
- Costs are approaching ‘conventional’ buildings
- We could use good metrics for non-energy performance
cost of learning curve

statistical analysis
cost of learning curve

statistical analysis
• Passive night cooling
• Upgraded exterior insulation with thermal mass walls
• Ceiling fans extend comfort temperature range
• Custom operable skylights use prevailing breezes to induce internal airflow
• High performance glazing – no need for external shades
• Daylighting to all occupied spaces
• Skylights designed to provide equal light levels in summer and winter, and 15% higher levels at equinox
• High efficiency LED lighting (.5W/sf)
• Integral daylight, occupancy, and temperature sensors at every light fixture
• Individually controlled desk fans and task lights
• Metering by load type (lighting, plug loads, mechanical)
• Building energy use dashboard
• Occupancy sensor controlled plug strips
impact of night purge: **typical day**

**Closed Windows**

- OA Temp
- West Zone Air Temp
- West Zone MRT
- Slab Temp

**Automated Windows**

- OA Temp
- West Zone Air Temp
- West Zone MRT
- Slab Temp
• Performance based lease provides carrot (and stick) for good occupant behaviour
• Added construction cost = $44/sf including 32,000 sf PV array
• Drastically reduced reserve requirements for maintenance and HVAC
• Reduced operating expenses – utilities, landscape, etc
• Demisability to reduce churn costs
• Unanticipated cost reductions (e.g. no mechanical screen)
• IF actual energy use meets predicted, than the financial model is more profitable than standard practice (build to code)
• Future projects – higher rents and lease rates
conclusion
DON’Ts
next gen green

- tolerate team members that are more obstacles than problem-solvers
- be discouraged at each hurdle (there will be many)
- forget that the community can be engaged in powerful ways and can be an important secondary tier of support
DOs
next gen green

- ensure owner buy-in
- set clear project goals, including cost constraints
- plan the work carefully
  - set checkpoints for system integration
  - design a careful flow of team meetings / decision-making
- perform regular cost checking, including timely small batch costing for decision-making
- hold early and regular meetings with regulatory officials
- be willing to educate all constituents along the way
DOs
next gen green

- build a strong, resilient, next gen team
- develop a spirit of exploration / inventiveness / problem-solving … willingness to push the envelope
- build a diverse project team
- get contractor, specialty subs, suppliers on-board early
- assume the design will evolve and improve as the team moves through the process
- encourage each other at every step
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contact / feedback
MONEY ISN’T EVERYTHING

How Load-Reducing Design Cuts Costs and Changes Buildings
THE LOWEST-COST CURVE

- Higher Costs
  - Aesthetics
  - Better Components

- Lower Costs
  - Value Engineering
  - Better Design

- More Efficient

Lowest Cost Building at Each Level of Efficiency
NEGATIVE-COST MEASURES

Glass Curtain Wall
- More expensive
- Less efficient
- Pretty?

Wall
- Less expensive
- More efficient
- Good for hanging things

VS.
NO-COST MEASURES

- Alberici Headquarters
  - 34 kBtu/sf/yr

- Measures:
  - Orientation
  - Footprint
  - Window shape
Empire State Building

- Invest to reduce load
  - DCV, more insulated windows, improved controls, daylighting
- Downsized chiller load
  - 1,600 tons
  - Saved $17.3 million on chiller upgrade
Load-reducing design features dominate HPB designs
WE’RE HALFWAY THERE...

Lowest Cost Building at Each Level of Efficiency

Aesthetics
Better Components

Value Engineering
Better Design

LESS EFFICIENT
MORE EFFICIENT
LOWER COSTS
HIGHER COSTS

YOU ARE HERE
Efficiency measures hit a point of exponentially diminishing returns.
DESTINATION HIGH PERFORMANCE
FREE LUNCH?
NON-ENERGY TRADEOFFS

- Aesthetics
- Functionality
- Comfort
TRIANGLE OF TRADEOFFS

Energy Aspects

Costs

Non-Energy Aspects
Making the Tradeoffs

- Environmental Organizations
- Progressive A&E Firms
- Public Facilities
- Corporations with Sustainability Goals
TRIANGLE OF TRADEOFFS

Energy Aspects

Costs

Non-Energy Aspects
Unique façade that screams sustainability!

Bullpen style layout to encourage collaboration!

Fresh air and sunlight!
Thank You!

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Cost of ZNE
Conclusions

• Zero net energy buildings do not need to cost more than code compliant peers
• Load-reducing design and cost tradeoffs are key to achieving extraordinary performance at similar construction costs
• We need to spread the compelling information we have - that these tradeoffs do not make the building worse, just different
• In many cases, the difference creates value – it helps drive messaging and gives the owner and occupants the feeling they are part of something special