Best Practices for Net Zero Energy Cost Control

New Project for FY14

2014 Building Technologies Office Peer Review

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Shanti Pless, Shanti.Pless@NREL.gov
National Renewable Energy Laboratory

Project Summary (through Month 5 of 11)

Timeline:

Start date: **11/1/2013**

Planned end date: 09/30/2014

Key Milestones

1. Detailed Project Plan; 12/31/2013
2. Guide and Fact Sheet; 09/30/2014

Budget:

Total DOE $ to date: $150k ($55k spent)

Total future DOE $: TBD

Target Market/Audience:

Building owners, engineers, and project design and construction teams

Key Partners:

Practitioner	Market Outreach
CMTA	Energy Center of Wisconsin
Mortenson	Cornell University
JE Dunn	NBI

Project Goal:

For net zero energy (NZE) building performance to become the norm in commercial new construction, it will be necessary to demonstrate that it can be achieved cost effectively. We aim to increase and accelerate the adoption of NZE design and construction practices by changing the perception of NZE as being cost prohibitive.

Project Context

Perception is that NZE is cost-prohibitive:

- Industry audiences commonly cite first cost as a critical barrier to NZE
- Objective: change the question owners ask about NZE
  - Old question: How much more will NZE cost us?
  - New question: How can we achieve NZE on our budget?

Past NREL campus efforts demonstrated that NZE can be achieved on a typical new construction budget:

- RSF has achieved NZE at $259/ft^2 (leveraging a PPA for PV)
- Foundational work has documented the cost control strategies that enabled the RSF to achieve its NZE goal on budget

Accelerating market uptake of NZE:

- Expanding and validating foundational cost control guidance with specific implementation examples from industry leaders in NZE will inspire confidence in potential adopters

Purpose and Objectives

Problem Statement: Key commercial building audiences (owners, project teams) need greater confidence in the economic feasibility of NZE buildings before they can adopt NZE as a performance goal at scale. The high perceived cost of NZE is often referred to as a critical barrier to widespread adoption of NZE design and construction principles.

Target Market and Audience: The target market is all commercial new construction and deep retrofits. 75% of commercial building floor space is expected to be new or renovated by 2035 (source: EIA). The target audience is building owners and project design and construction teams, which are key parties that influence construction capital cost.

Impact of Project:

1. Direct output: NZE cost control guide and 2-page fact sheet
2. Impact paths:
   a. Near term: share guide and factsheet with more early adopters; market outreach partners provide training and technical assistance
   b. Mid term: owner/practitioner adoption of best practices in projects
   c. Long term: peer organizations replicate successes of early adopters

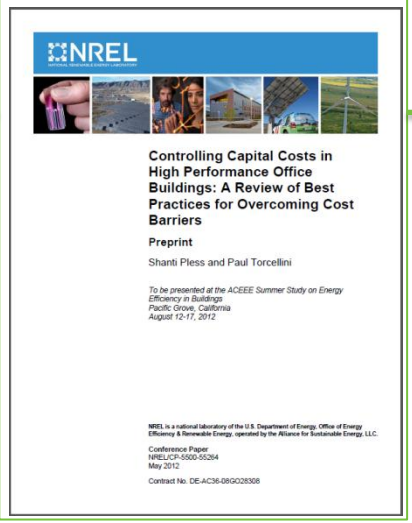
Project Flow Diagram

RSF Project

- NZE on a typical construction budget
- $259/ft^2
- LEED Platinum

Best Practice Documentation:

- ACEEE Paper
- EERE Webinar
- iiSBE Paper



FY14 Effort

Validation and Expansion:

- CMTA
- Mortenson
- JE Dunn

Deployment Pilots:

- Cornell
- Arizona State

Market Outreach:

- NBI
- ECW
- DBIA

Future Work

Market Uptake of NZE on a Budget

Approach

Approach:

- Validate and expand foundational work from NREL campus projects.
- Quantify lessons learned from leading industry practitioners.
  - Inspire market confidence: “Our peers are doing this.”
- Develop cost control guidance that meets needs of target audiences.
- Show the value of using our materials to market outreach organizations and building portfolio owners.

Key Issues:

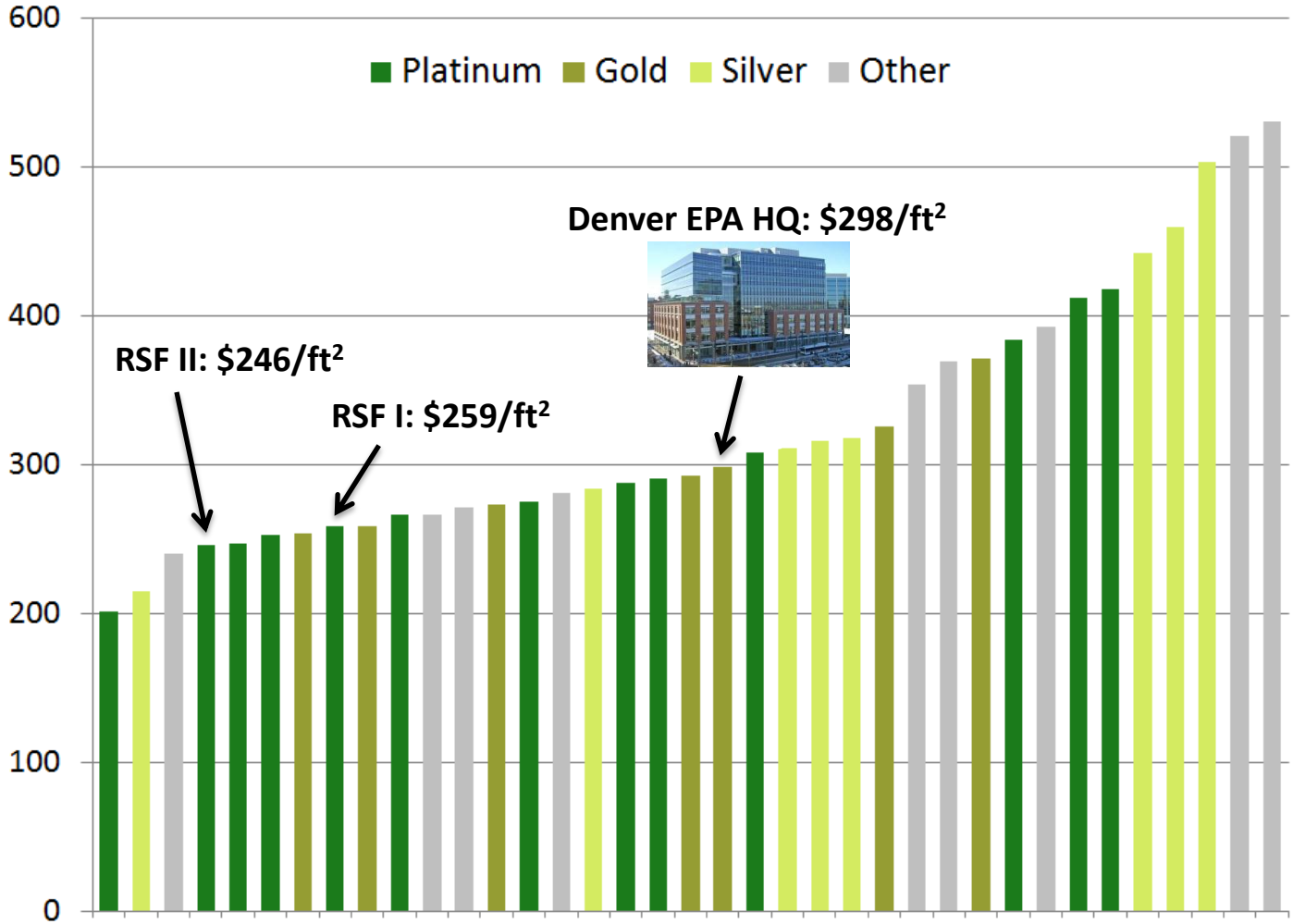
- Real world examples of NZE on a budget are limited.
- Perception is that NZE is cost prohibitive.
- Stakeholders lack the confidence to overcome perceived risk of adoption.

Distinctive Characteristics:

- Developing how-to examples to enable the replication of best practices
- Document successful processes of industry experts in NZE

Can NZE be Achieved on a Budget?

Cost per Square Foot of Comparable New Construction Projects



ACEEE Summer Study 2012: http://www.nrel.gov/docs/fy12osti/55264.pdf

We Have the Attention of Industry

March 2014 Building Green Article:

Credit: Building Green

Foundational Work: NREL Campus Lessons Learned

Contractually Require an Energy Performance Goal

- Utilize performance-based design-build delivery
- Incentivize energy performance
- Competitively procure innovation for the best value

Importance of Integrated Design

- Cost control best practices span the full project cycle
- Open and ongoing communication between all members of the project team aligns decisions with energy performance and cost implications
- Utilize individual team member talents to achieve a shared performance goal

Integration of Architecture and Engineering

- Design architectural features to take advantage of efficiency opportunities

Continuous Energy Modeling

- Energy modeling should be used early and often to track the impact of design and construction decisions on energy performance
- Better data sooner saves cost in the long run

Leveraging Appropriate Decision Factors

- First cost considerations should be balanced with life cycle benefits, and non-energy benefits

Working List of NZE Cost Control Strategies

Owner and Developer Strategies:

1. Utilize performance-based procurement
2. Include measureable energy goal in contract
3. Prioritize project objectives early on
4. Procure an experienced project team
5. Incorporate efficiency into equipment procurement specifications

Designer Strategies:

6. Leverage value added benefits
7. Consider life cycle cost benefits
8. Integrate simple and passive efficiency strategies
9. Allow for cost tradeoffs across disciplines
10. Optimize window area for daylighting, views, and thermal performance
11. Maximize use of modular design strategies
12. Leverage alternative financing

Contractor Strategies:

13. Maximize use of off-site modular construction
14. Use continuous value engineering to map construction decisions to energy goal
15. Integrate experienced subcontractors early on

RSF: Precast wall panels

NZE Cost Control Example: Ground Source Heat Pumps

Critical Uptake Barrier: GSHP Is Perceived As Being Too Expensive

Hiring an Experienced Team:

- Confidence in execution reduces cost of implementation
  - Contractor bids compensate for perceived risk
  - Engineers oversize well fields to ensure that systems will meet loads
- Process efficiencies are identified through experience
  - All-HDPE piping on exterior and interior streamlines installation and alleviates need for chemical treatment

Cost Tradeoffs:

- Invest in envelope improvements to reduce required system capacity

Simple and Passive Design:

- Account for life cycle benefit of simpler long-term maintenance

CMTA: Richardsville Elementary School

Progress and Accomplishments

Lessons Learned:

- Our guidance needs to relate to and resonate with multiple audiences.
- Qualitative value justifications can be as important as cost analyses.
- Level of supporting analysis varies.

Accomplishments:

- Previously demonstrated cost control strategies through campus efforts
  - Identified strategies that work within the constraints of a real project
- Established partnerships to create market impact
  - Engaged practitioners enthusiastic to spread NZE expertise
  - Collected specific examples that add value to cost control strategies
  - Established relationships for near- and long-term deployment

Market Impact:

- Initial uptake of cost control strategies
  - Applying cost control strategies to Army NZE hotel project
  - Early outside interest for other deployment paths
  - Matching practitioner strategies to deployment audience use cases
- Development of deployment paths is proceeding as planned

Project Integration and Collaboration

Project Integration:

- Industry collaboration and coordination is the key to project success.
- Goal is to expand and validate foundational cost control strategies with industry-driven compilation of detailed examples.

Partners, Subcontractors, and Collaborators:

- Industry leaders have volunteered to bolster impact.
  - Practitioner partners:
    - Pairing strategies with examples that demonstrate cost effectiveness
  - Market outreach and deployment partners:
    - Shaping cost control guidance to maximize market impact
    - Representing the perspectives of key industry audiences
    - Identifying impactful deployment paths (training, specific projects, etc.)

Communications:

- ACEEE Summer Study 2012: http://www.nrel.gov/docs/fy12osti/55264.pdf
- iiSBE Net Zero Symposium 2014: http://www.nrel.gov/docs/fy14osti/61365.pdf
- EERE Webinar: http://www1.eere.energy.gov/buildings/alliances/media/20111031_webinar_controlling_costs.wmv
- Energy Performance-Based Acquisition: https://buildingdata.energy.gov/cbrd/energy_based_acquisition/

Project Integration and Collaboration

Practitioner Partners:

- CMTA Consulting Engineers
  - Engineering firm, leader in NZE K-12 school design and construction
  - Advanced solution expertise (ground source heat pumps, insulated concrete forms, air barrier testing)
  - Operational performance expertise (continuous commissioning)
- Mortenson Construction
  - Commercial building contractor
  - Acquisition and delivery expertise (performance-based procurement, integrated project delivery)
  - Construction solution expertise (standardized detailing to ensure building tightness, modular design and construction)
- JE Dunn Construction
  - Commercial building contractor
  - Acquisition and delivery expertise (performance-based procurement, integrated project delivery)
  - Construction solution expertise (modular design and construction)
  - Occupant-driven design expertise (“patient-centric” hospitals, designing offices “from the desk out”)

Project Integration and Collaboration

Market Outreach and Deployment Partners:

- New Buildings Institute
  - Leader in NZE policy and market research
  - Heavy focus on market outreach (Getting to Zero Status Updates and Webinars)
- Energy Center of Wisconsin
  - Leader in deployment of advanced technologies at regional level
  - Provides design assistance and training to local projects
  - Advocate for the value of energy modeling
- Cornell University
  - Large building portfolio owner
  - In a position to apply NZE cost control strategies in the near term
    - In the design phase for a new NZE building
    - Considering an NZE retrofit project
- Arizona State University
  - Large building portfolio owner
  - In a position to apply NZE cost control strategies in the near term
    - Pursuing its first NZE project

Next Steps and Future Plans

Next Steps and Future Plans:

- By Project Completion:
  - Develop market-facing guidance documents
  - Coordinate with partners to maximize market relevance and impact
  - Explore potential deployment paths with individual partners

- Future Deployment Opportunities:
  - Implement viable deployment strategies with individual partners
    - 0% incremental cost NZE working group
    - Empower market leaders to demonstrate feasibility of replication
  - Identify specific projects to apply and refine NZE cost control strategies
    - Detailed cost assessment between robust baseline and NZE design
    - Practical considerations of implementation
  - Expand outreach beyond owner-occupied audience
    - Spec office, big-box retail, small commercial, etc.

REFERENCE SLIDES

Project Budget

Project Budget: This is a new project for FY2014 with a $150K budget for this year. Proposals for FY2015 work will be informed by discussions this year with market outreach and deployment partners about pathways for market uptake and industry needs beyond FY2014 scope.
Variances: None
Cost to Date: $55K
Additional Funding: None

Budget History					
n/a – FY2013 (past)		FY2014 (current)		FY2015 – TBD (planned)	
DOE	Cost-share	DOE	Cost-share	DOE	Cost-share
-	-	$150K	-	TBD	TBD

Project Plan and Schedule

- Initiated: November 2013. Planned completion: September 2014.
- Schedule and Milestones:
  - Detailed project plan (completed 12/31/2013)
  - Meeting notes and draft skeleton outline of guide (completed 3/31/2014)
  - Draft guide and fact sheet (due 6/30/2014)
  - DOE feedback on draft guidance documents (due 7/18/2014)
  - DOE decision on final drafts of guidance documents (due 8/29/2014)
  - Published guide and fact sheet; incorporation into Commercial Buildings Resource Database; webinar content; conference submission (due 9/30/2014)
- All milestones to date have been delivered on time.
- Go/no-go decision points:
  - DOE feedback on draft guidance documents (due 7/18/2014)
  - DOE decision on final drafts of guidance documents (due 8/29/2014)
  - DOE decision to proceed with FY15 activities (e.g., impact verification) (due 9/30/2014)
- Current and future work:
  - Begin drafting guide and fact sheet
  - Share early draft with industry partners in May for feedback
  - Iterate and deliver drafts to DOE in June
  - Iterate and publish in Q4
  - *See next slide for detail*

Project Plan and Schedule