CHP
EPA COMBINED HEAT AND POWER PARTNERSHIP

LEED Certification With a Focus on CHP

Susan Wickwire
EPA CHP Partnership Program
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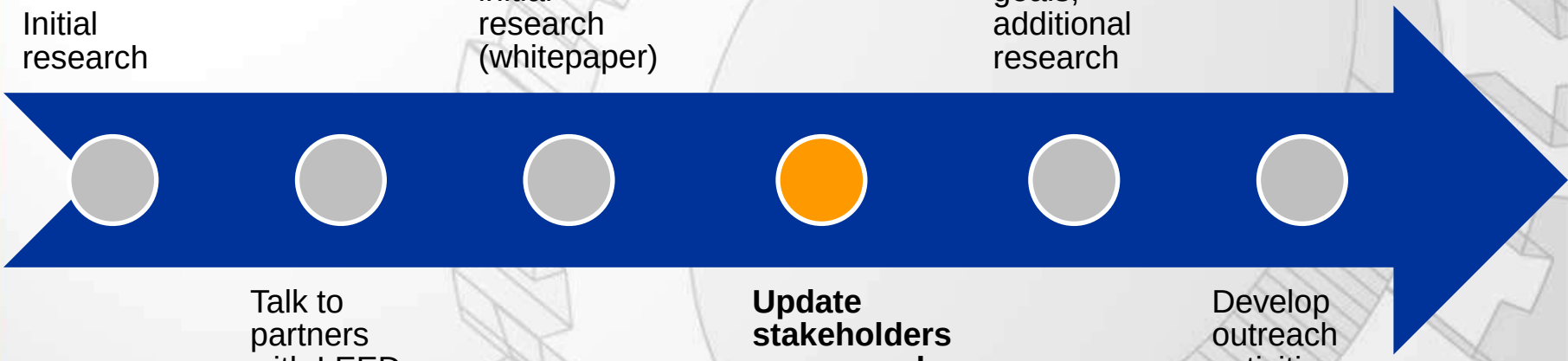
Agenda

- Introduction and purpose of research
- Process timeline
- Research focus
- Projects using CHP
- Summary of Minimum Energy Performance prerequisite and Optimize Energy Performance credit
- USGBC methodology for modeling CHP
- Estimating CHP's point impact
- Observations based on research
- Next steps

Introduction and Purpose of Research

- Who we are: EPA CHP Partnership
  - Focused on raising awareness and promoting the opportunities and benefits of CHP
- Why we are engaged
  - Use of LEED to recognize the energy performance of buildings and facilities continues to grow at a rapid pace
  - Stakeholders often lack knowledge of LEED's treatment of CHP
- Research project goal
  - Help educate project developers, architects, LEED professionals, and other stakeholders on how CHP can contribute to a project's LEED point total

Process Timeline



Research Focus

- Current Focus
  - On-site CHP (not district energy)
  - LEED Building Design + Construction
  - LEED v4 and LEED v2009
  - Minimum Energy Performance prerequisite and Optimize Energy Performance credit
    - Maximum LEED point-earning credit, and most directly related to CHP
- Possible Future Areas of Investigation
  - District energy applications
  - CHP treatment in other LEED rating systems (e.g., LEED Existing Buildings)
  - Other LEED credits where CHP can help earn points (e.g., Enhanced Refrigerant Management, Innovation in Design)
  - Green Globes

Importance of Energy & Atmosphere: Optimize Energy Performance Credit

LEED Version	Total # of Pts. Available	Total # of Pts. Needed to Earn LEED Certified*	Total # of Optimize Energy Performance Pts. Available
LEED v4	110	40	18 (16 for Schools; 20 for Healthcare)
LEED v2009	110	40	19

*LEED Certified is the lowest level that can be achieved under LEED. LEED Silver is earned with 50 points; LEED Gold is earned with 60 points; LEED Platinum is earned with 80 points.

➔Achieving all of the available Optimize Energy Performance credits would represent 45 percent (LEED v4) and 47.5 percent (LEED v2009) of the points needed to earn certification at the "LEED Certified" level.

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CHP's Demonstrated Point Impact

Building	# of Apts.	CHP Type/Size	Pts. w/out CHP	Pts. w/CHP
1	620	130 kW MT	2	8
2	340	65 kW MT	2	10
3	500	200 kW MT	2	7
4	100	65 kW MT	1	7
5	185	65 kW MT	3	9
6	250	65 kW MT	1	7
7	230	200 kW MT	0*	9
8	40	75 kW Recip	0*	4

* Would not meet Prerequisite w/out CHP

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Whole Foods Market – Brooklyn, NY

- 56,000 square feet
- Seeking LEED Platinum
- Plans to achieve all 19 Optimize Energy Performance points
- CHP system
  - 157 kW plant with additional 250 kW backup generator
  - Offers the store black start and islanding capability (meaning it can continue to operate in the event of a grid outage).
- 100 and 168 ton Broad absorption chillers
  - No (synthetic) man made chemical refrigerants
  - CO2 direct expansion (transcritical) refrigeration system
  - Sub cooling provided by CHP for added efficiency
- 320 kw solar PV canopy array w/ rain water catchment for irrigation
- NYSERDA incentive participant

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Minimum Energy Performance Prerequisite

- Must be met by all projects seeking LEED certification
- 3 compliance pathways
  - Option 1: Whole Building Energy Simulation (Performance-based)
  - Option 2: ASHRAE Advanced Energy Design Guides (Prescriptive)
  - Option 3: Advanced Buildings Core Performance Guide (Prescriptive)
- Only Option 1 likely to be considered for CHP
- Projects using Options 2 and 3 cannot earn significant points under the related credit

Option 1: Whole Building Energy Simulation

- LEED v4
  - Projects must demonstrate savings of 5% (new construction), 3% (major renovations), and 2% (core and shell) in the proposed building (the “Design Building”) compared to a baseline case meeting the minimum requirements of ASHRAE 90.1-2010 (the “Baseline Building”).
- LEED v2009
  - Projects must demonstrate savings of 10% (new construction) or 5% (major renovations) in the Design Building compared to a Baseline Building meeting the minimum requirements of ASHRAE 90.1-2007.
- Savings are based on energy costs and determined by running energy models for the Design and Baseline Buildings

USGBC Methodology for Modeling CHP

Methodology for Modeling Combined Heat & Power for EAp2/c1 in LEED 2009

http://www.usgbc.org/resources/methodology-modeling-combined-heat-amp-power-eap2c1-leed-2009

- Guidance on how to account for CHP in the energy model required by Option 1
- Applies to on-site CHP systems which can either have the same ownership as the project (Case 1) or different ownership (Case 2)

USGBC Methodology for Modeling CHP

- Essentially…
  - Energy requirements for the Baseline Building (which must meet requirements of ASHRAE 90.1) are estimated using an energy model.
  - Based on the model output, the cost of purchased grid electricity and purchased fuel to generate thermal energy is calculated.
  - The same process is used with the Design Building (the one with CHP).
  - The cost of fuel for the CHP and any purchased electricity or fuel used to produce thermal energy is calculated.
  - Optimize Energy Performance points are calculated based on the percentage reduction in energy cost for the Design Building.

Optimize Energy Performance Credit (Option 1)

Percent Improvement over Baseline	Points	
	LEED v4	LEED v2009
6%	1	---
14%	5	2
22%	9	6
38%	15	14
48%	---	19
50%	18	---

Estimating CHP's point impact

	Office Building in NYC	Hotel in San Francisco
Electricity requirements of Design Building	4,017,000 kWh	2,596,000 kWh
Thermal requirements of Design Building	4,157 MMBtu	13,358 MMBtu
Natural gas cost	$14/MMBtu	$8/MMBtu
Electricity price	$0.20/kWh	$0.15/kWh
Boiler efficiency	80%	80%
CHP system size	800 kW	200 kW
CHP prime mover	Reciprocating engine	Reciprocating engine
CHP P/H ratio	0.67	0.67
CHP operating hours	3,028	7,686
CHP electrical efficiency	30%	30%
Points achieved using SHP	1	1

CHP's point impact

Building	Separate Heat and Power		CHP		CHP Point Impact
	% Improvement Over Baseline	Points Achieved	% Improvement Over Baseline	Points Achieved	
Office Building in NYC	6%	1	21	8	7
Hotel in San Francisco	6%	1	33	13	12

Observations Based on Research

- The cost basis approach to calculating energy savings under Option 1 does not fully recognize the environmental benefits of CHP.
  - The use of a cost metric to evaluate energy savings has been discussed significantly in both ASHRAE public comment and USGBC public comment. In both cases, the cost metric was deemed to be the best overall metric that was currently available for evaluating building energy performance.

Observations Based on Research (cont.)

- Since the percentage savings requirements of Option 1 are based on energy costs rather than energy use, the value of CHP (along with other energy efficiency measures), in terms of earning LEED points, is dependent on the fuel costs (purchased electricity, natural gas, or other) used in the model for the Baseline and Design Buildings.
  - For example, in the case of two identical systems with different spark spreads, the system with the larger spark spread will earn more points, even though the systems result in the same energy savings.

Observations Based on Research (cont.)

- Projects that export electricity generated by the CHP system achieve lower cost savings percentages and fewer points compared to projects that retain all CHP outputs within the project boundary.
- It's possible that other methodologies could be used to earn points with CHP.
  - A LEED Interpretation can always be submitted for consideration if a group or project team would like to provide a creditable path for documenting compliance using an alternate metric or method. These will be evaluated by the USGBC Energy & Atmosphere Technical Advisory Group, which consists of volunteer experts from the energy and engineering community.

Next Steps

- Continue working with USGBC
- Develop one or more project case studies
- Scope a training module
- Develop outreach products (e.g., whitepaper, fact sheet, online point impact estimator)
- Potentially develop a list of projects that have used CHP to earn points
- Highlight CHPP Partners that provide LEED services
- Evaluate CHP's treatment in district energy applications and other LEED rating systems

We'd Love to Hear from You

- What kind of final product or outreach activity would be of most use?
- What kind of info should that product/activity contain?
- What are people's general impressions of how LEED treats CHP?
- What are the LEED credits where people know that CHP can earn points?
  - Optimize Energy Performance, On-Site Renewable Energy (v 2009), Renewable Energy Production (v4), Enhanced Refrigerant Management
  - Innovation in Design (v2009), Innovation (v4)
- Do people know of projects where CHP has been used to earn LEED points?

Contacts

Susan Wickwire
U.S. Environmental Protection Agency
Combined Heat and Power Partnership
202-343-9155
wickwire.susan@epa.gov

Gary McNeil
U.S. Environmental Protection Agency
Combined Heat and Power Partnership
202-343-9173
mcneil.gary@epa.gov

APPENDIX

Research Conducted to Date

- Optimize Energy Performance credit language
- LEEDuser (www.leeduser.com)
- USGBC's *Methodology for Modeling Combined Heat & Power for EAp2/c1 in LEED 2009*
- USGBC Credit Interpretation Requests relevant to CHP
- Calls with the following:
  - Partners involved with LEED project certification
  - USGBC and GBCI staff, including members of the LEED Energy & Atmosphere Technical Advisory Group
  - People involved with projects who have used CHP to earn LEED points

➔Developed internal whitepaper that summarizes research findings and main observations

Approach to Estimate Point Impact of CHP

- Simple spreadsheet tool to estimate point impact of CHP over separate heat and power (SHP)
- Underlying methodology:
  1. Design Building achieves a certain energy cost savings over the Baseline Building when using SHP (e.g., 5%) – allows calculation of Baseline Bldg. energy cost
  2. Design Building has an annual electricity and thermal load
  3. Tool estimates energy cost savings under 2 cases to calculate CHP point impact: (1) when the Design Building uses SHP and (2) when the Design Building uses CHP
- Input variables include:
  - Natural gas cost
  - Electricity cost
  - Electricity/thermal loads of Design Bldg.
  - Boiler efficiency
  - CHP system size
  - CHP P/H ratio
  - Operating hours of CHP
  - CHP electrical efficiency

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