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LEED VERSION 4: IMPACTS AND CASE STUDIES FOR DISTRICT ENERGY

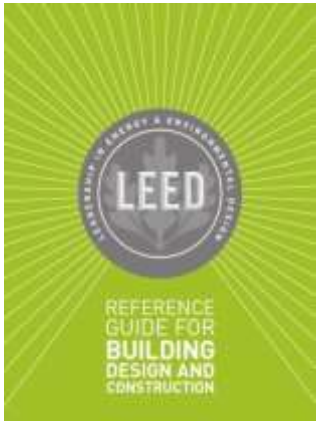
JUNE 13, 2018

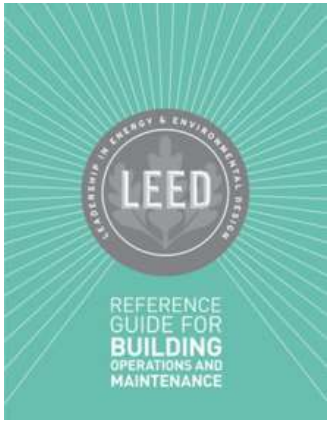
Goals

- Basic understanding of how LEED applies to District Energy Systems.
- Knowledge of how to market to a potential customer interested in LEED.
- Better understanding of how different district energy features help in regards to LEED.

What Matters?

- Your District Energy System's impact on:
  - Energy
  - The Environment
- Two Common LEED Programs
  - LEED V4 BD+C
  - LEED V4 EB:O&M





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EA Prerequisites and Credits

- Four prerequisites in both LEED BD+C and LEED EB:O&M.
- No information is required for prerequisites
- Six LEED EB:O&M credits and a customer's building designer needs info on four credits.
- Seven LEED BD+C credits and a customer's building designer only needs info on five credits.

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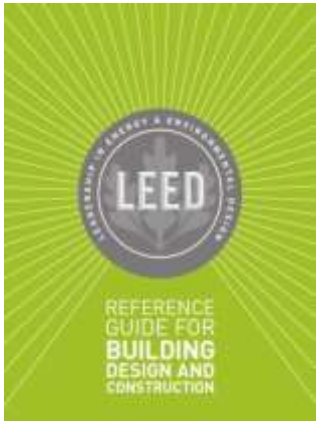
LEED BD+C

- Credit #1: Enhanced Commissioning
- Credit #2: Optimize Energy Performance
- Credit #5: Renewable Energy Production
- Credit #6: Enhanced Refrigerant Management
- Credit #7: Green Power and Carbon Offsets



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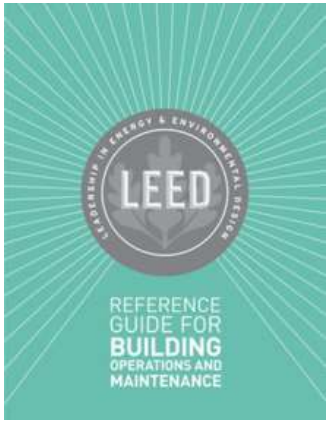
LEED EB:O&M

- Credit #1: Enhanced Commissioning
- Credit #2: Optimize Energy Performance
- Credit #5: Renewable Energy and Carbon Offsets
- Credit #6: Enhanced Refrigerant Management



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CREDIT #1

Enhanced Commissioning

Credit #1 - Comissioning

- Enhanced Commissioning (BD+C and EB:O&M):
  - Upstream equipment is included.
  - Show that preventive maintenance, corrective maintenance, and efficiency monitoring programs have been in place for all relevant DES equipment that ensure ongoing DES energy efficiency performance meets or excess the DES design intent.
  - Show that DES energy efficiency performance has been tested, recorded, and improved as needed under those programs within the past three years of the project building's substantial completion. Any reasonable efficiency metric may be used for this purpose, such as overall system COP, kW/ton, etc.

Other Credits

- BD+C Credits #5 and #7 and EB:O&M Credit #5: Renewable Energy and Green Power.
  - Purchased REC's or renewable energy portions can be passed on to customers proportionally.
  - Can be expensive to add.
- Credit #6: Enhanced Refrigerant Management
  - Mandatory CFC phase-out within 5 years of LEED project completion
  - Difficult credit with typical refrigerants.

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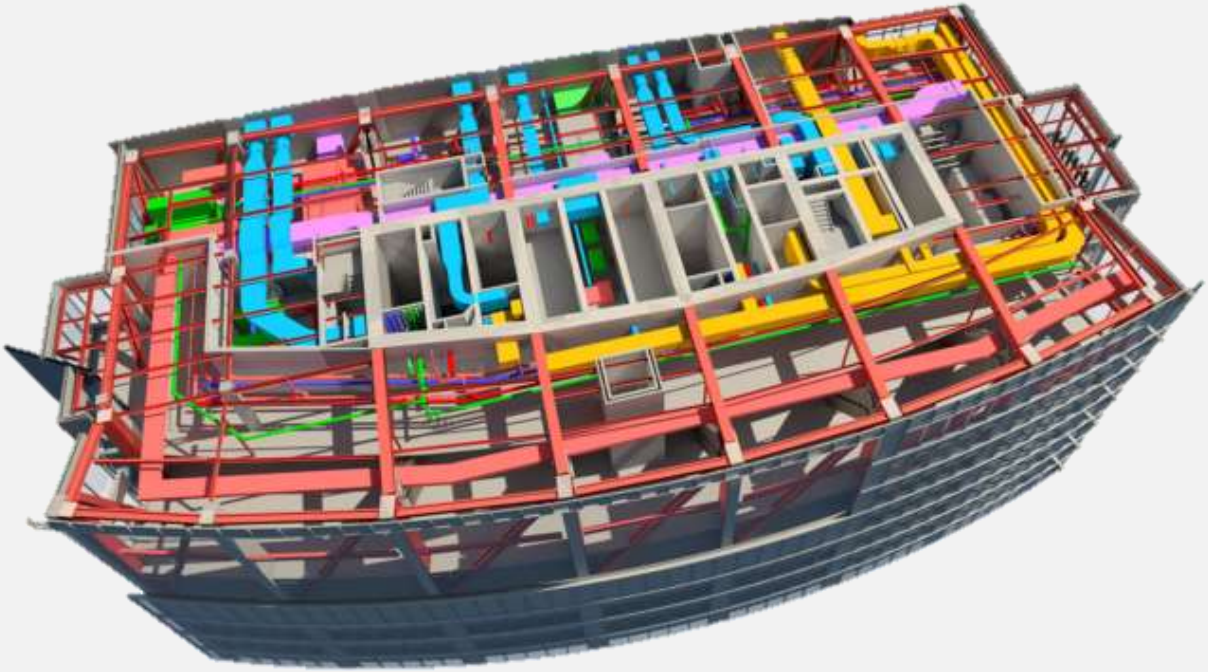

CREDIT #2

Optimize Energy Performance

Why Energy Matters?

- 18 out of 110 points for BD+C
- 20 out of 110 points for EB:O&M

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Credit #2 – Optimize Energy Performance – EB:O&M

- Optimize Energy Performance:
  - **Goal**: Demonstrate energy performance greater than required by the pre-requisite.
  - Method 1: Measure delivered DES energy (DES neutral).
  - Method 2: Full DES performance accounting.
  - Fuel treated in terms of energy, not cost.
  - Doesn't cover nuances like demand reduction (TES)

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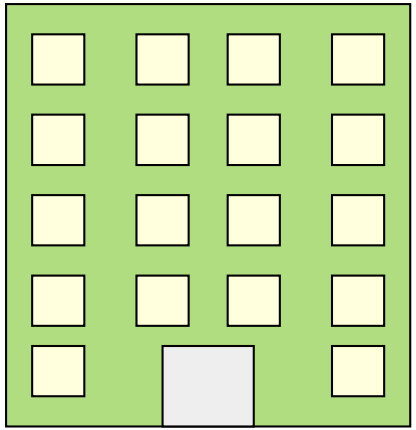
Credit #2 – Optimize Energy Performance – BD+C

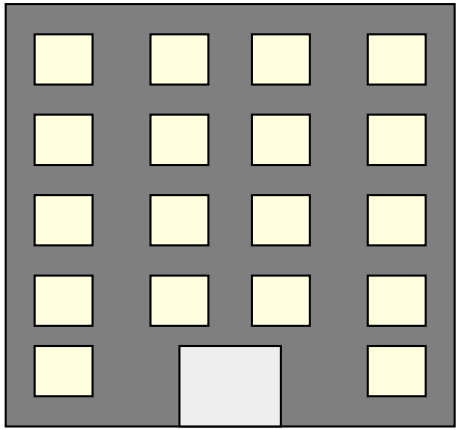
- Optimize Energy Performance:
  - **Goal**: Demonstrate energy performance greater than required by the pre-requisite. (Exceed ASHRAE 90.1-2010 by 5%)
  - Option 1 – Building Energy Simulation
    - Path 1: DES as purchased Energy (**DES neutral**)
    - **Path 2: Full DES Performance Accounting**
  - Option 2 – Prescriptive Compliance: ASHRAE 50% Advanced Energy Guide

Modeling Definitions



Proposed Building:

The design of the building pursuing LEED Certification.



Baseline Building:

Identical except designed to meet minimum ASHRAE 90.1 guidelines.

LEED V4 POINT REQUIREMENTS	
% IMPROVEMENT OVER ASHRAE 90.1-2010	
5%	PREREQUISITE
6%	1
8%	2
10%	3
12%	4
14%	5
16%	6
18%	7
20%	8
22%	9
24%	10
26%	11
29%	12
32%	13
35%	14
38%	15
42%	16
46%	17
50%	18

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ENERGY USE IN DOLLARS

Option 1, Path 1 Model

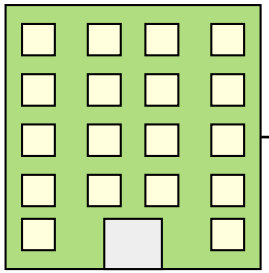
Inputs

Proposed Building

Virtual Chilled Water Rate ($ / year)

Virtual Steam or Heating Hot Water Rate ($ / year)

Other Utilities ($/year)



Output

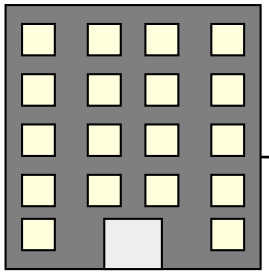
$ per year for total energy use

Baseline Building

Virtual Chilled Water Rate ($ / year)

Virtual Steam or Heating Hot Water Rate ($ / year)

Other Utilities ($/year)



$ per year for total energy use

Result

$$100 * \left(1 - \frac{\text{Proposed Building \$}}{\text{Baseline Building \$}}\right) \geq X$$

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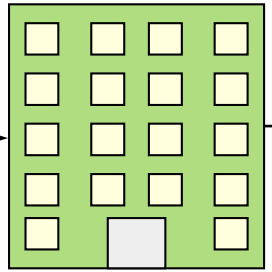
Option 1, Path 2 Model

Virtual DES-equivalent Plant

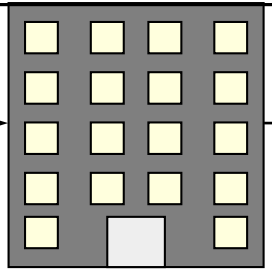


Proposed Building

$ per year for total energy use

$$100 * \left(1 - \frac{\text{Proposed Building \$}}{\text{Baseline Building \$}}\right) = \text{Percentage Improvement}$$

On-Site Equipment per ASHRAE 90.1 - 2010



Baseline Building

$ per year for total energy use

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LEED DISTRICT ENERGY CASE STUDIES

Case Studies

- District Energy System 1– Steam and CHW
- District Energy System 2 – CHW with large TES.
- District Energy System 3 – Steam with large CHP
- District Energy System 4 – Steam with renewable energy source
- District Energy System 5 – CHW TES and CHP

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Baseline – ASHRAE 90.1-2010

- This is what the building performance is being compared against.
- 80% efficient heating water system
- 1.2kW/ton CHW system
- 80% CHW generation on-peak
- For all models heating and cooling treated as 20% of building energy each. This will vary based on region. A 5% improvement in cooling efficiency over ASHRAE 90.1 amounts to a 1% building energy improvement.
- Assume building meets prerequisite without heating and cooling.

LEED V4 POINT REQUIREMENTS	
% IMPROVEMENT OVER ASHRAE 90.1-2010	
5%	PREREQUISITE
6%	1
8%	2
10%	3
12%	4
14%	5
16%	6
18%	7
20%	8
22%	9
24%	10
26%	11
29%	12
32%	13
35%	14
38%	15
42%	16
46%	17
50%	18

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Comparison Case – Unitary Building Equipment

- 88% efficient heating water system
- 1.0kW/ton CHW system, 80% CHW generation on-peak
- 1 LEED point from heating, 2 LEED points from cooling, 3 points total.
- Type of equipment a LEED seeking building would install locally.
- <u>This is what a district energy system is being compared against</u>

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Summary

	UNITARY			CASE 1 STEAM & CHW	CASE 1A CHW ONLY	CASE 2 CHW TES	CASE 3 STEAM CHP	CASE 4 STEAM RENEW.	CASE 5 CHP & TES
	HEATING	COOLING	COMBINED						
LEED POINTS	1	2	3	1	2	3	6	3	6
IMPROVEMENT OVER UNITARY	---	---	---	-2	---	1	5	2	3

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Case Study 1 – Steam and CHW

	ASHRAE 90.1	UNITARY	CASE 1	CASE 1A
HEAT EFFIC	80%	88%	73.1%	-
POINTS	-	1	-1	-
COOL EFFIC	1.20 KW/TON	1.00 KW/TON	0.94 KW/TON	0.94 KW/TON
POINTS	-	2	2	2
TOTAL POINTS	-	3	1	2

- 1 LEED point, 2 points worse than unitary comparison
- Just cooling: 2 LEED points, matching unitary comparison
- Plant efficiency can be negated by distribution

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Case Study 2 – CHW with large TES

	ASHRAE 90.1	UNITARY	CASE 2
COOL EFFIC	1.20 KW/TON	1.00 KW/TON	0.91 KW/TON
ON-PEAK %	80%	80%	60%
TOTAL POINTS	-	2	3

- 3 LEED points, 1 more than unitary comparison
- Improvement is from demand reduction (energy cost based)
- If TES is involved, must use plant power rates for all models.

Case Study 3 – Steam with Large CHP

	ASHRAE 90.1	UNITARY	CASE 3
HEAT EFFIC	80%	88%	32.1%
POWER RATE	-	-	226 KWH/MMBTU
TOTAL POINTS	-	1	6

- 6 LEED points, 5 more than unitary comparison
- Utilizes building power and gas rates.
- Effectiveness highly dependent on differential between power and gas rates.

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Case Study 4 – Steam with Renewable

	ASHRAE 90.1	UNITARY	CASE 4
HEAT EFFIC	80%	88%	50.4%
% RENEWABLE	-	-	67%
TOTAL POINTS	-	1	3

- 3 LEED points, 2 more than unitary comparison
- If renewable energy source is cheaper than gas can be significant.
- Synergizes with Renewable Energy Production Credit, 3 points in this case.

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Case Study 5 – CHW TES and CHP

	ASHRAE 90.1	UNITARY	CASE 5
HEAT EFFIC	80%	88%	50.4%
POWER RATE	-	-	80 KWH/MMBTU
POINTS	-	1	2
COOL EFFIC	1.20 KW/TON	1.00 KW/TON	0.80 KW/TON
ON-PEAK %	80%	80%	60%
POINTS	-	2	4
TOTAL POINTS	-	3	6

- 6 LEED points, 3 more than unitary comparison

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Summary

	UNITARY			CASE 1 STEAM & CHW	CASE 1A CHW ONLY	CASE 2 CHW TES	CASE 3 STEAM CHP	CASE 4 STEAM RENEW.	CASE 5 CHP & TES
	HEATING	COOLING	COMBINED						
HEATING IMPROVEMENT	---	16.7%	16.7%	-9.4%	---	---	61.4%	29.8%	15.9%
COOLING IMPROVEMENT	9.1%	---	9.1%	21.7%	21.7%	32.9%	---	---	40.7%
BUILDING IMPROVEMENT	1.8%	3.3%	5.2%	2.5%	4.3%	6.6%	12.3%	6.0%	11.3%
LEED POINTS	1	2	3	1	2	3	6	3	6
IMPROVEMENT OVER UNITARY	---	---	---	-2	---	1	5	2	3

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Conclusions

- District energy systems can help buildings get some points.
- Distribution losses can negate efficiency gains (steam distribution).
- A district energy system needs a differentiator to be especially attractive in terms of LEED.
- Dependent on rates and load divisions. Many factors are involved.

Questions

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Closing

- Quarterly Column in *District Energy Magazine*
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