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Scoring LEED® Points with CHP

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December 7, 2016

Our Work

- Why we are engaged
  - Use of LEED to recognize the environmental performance of buildings and facilities continues to grow at a rapid pace
  - Stakeholders often lack knowledge of LEED's treatment of CHP
- Goal of LEED Project
  - Help educate project developers, architects, LEED professionals, and other stakeholders on how CHP can contribute to a project's LEED point total
- Focus to date:
  - LEED for Building Design & Construction: New Construction and Major Renovations
    - Stand-alone buildings
    - Buildings connected to a district energy system

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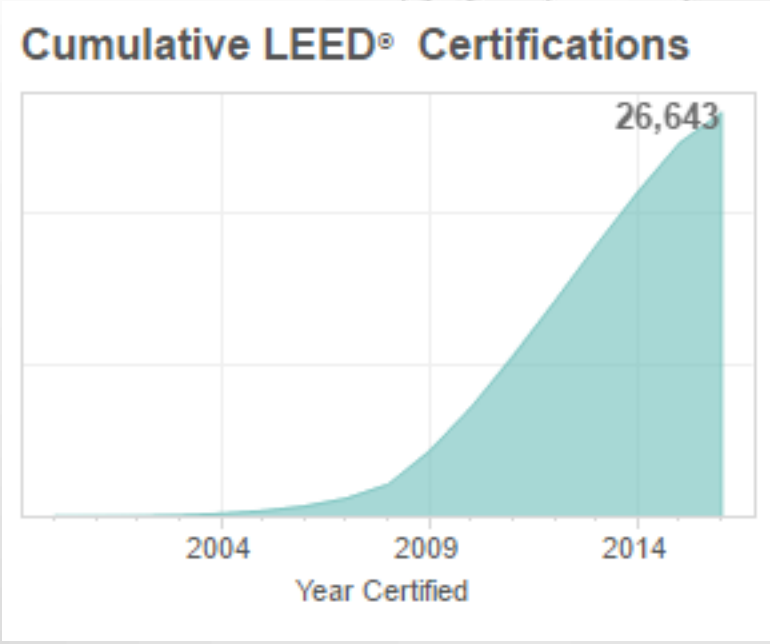
Growth of LEED®

- LEED® green building program launched in 2000
- In the U.S. (as of September 2, 2016):
  - More than 26,000 LEED®-certified commercial projects (3.4 billion GSF)
    - Annual certifications have grown from 24 in 2000, to more than 3,200 in 2015
  - More than 33,000 additional LEED®-registered commercial projects (5.2 billion GSF)



LEED® Projects by Building Type

Office/Mixed-Use: 36%
Education: 15%
Retail: 14%
Public Assembly: 6%
Residential: 5%
Health Care: 4%
Industrial Manufacturing: 3%
Laboratory: 3%
Military: 3%
Lodging: 3%

LEED® v4 Certification Levels

Level	Points
Certified	40-49
Silver	50-59
Gold	60-79
Platinum	80-110

56 credits worth a maximum of 110 points

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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 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 of the points needed to earn the "LEED Certified" level.

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How Points are Earned

1. Determine Energy Costs of Baseline Building
   - Estimate energy loads using an energy model (Baseline Building must meet requirements of ASHRAE 90.1).
   - Determine total building energy cost by combining purchased electricity and fuel costs for thermal production
2. Determine Energy Costs of Design Building (includes CHP)
   - Estimate energy loads using an energy model.
   - Determine energy cost for building by summing cost of CHP input fuel and any additional purchased electricity and purchased thermal needed.
3. Determine OEP Points
   - OEP points are calculated based on the percentage reduction in energy cost of the Design Building compared to the Baseline Building.

Optimize Energy Performance Points

Percent Improvement Over Baseline*	Points	
	LEED® v2009	LEED® v4
6%	---	1
10%	---	3
14%	2	5
18%	4	7
22%	6	9
26%	8	11
30%	10	---
34%	12	---
38%	14	15
42%	16	16
46%	18	17
48%	19	---
50%	---	18

* Selection of OEP point thresholds

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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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CHP Plant "315 on A" – Boston, MA

- 225,000 square feet apartment building
- Aegen ThermoPower 75kW
- Provides domestic hot water heating (100%) and (80%) building heat
- Provides 28% of building's electrical load
- LEED® Gold
- System earned 8 OEP points; CHP responsible for 4 of them

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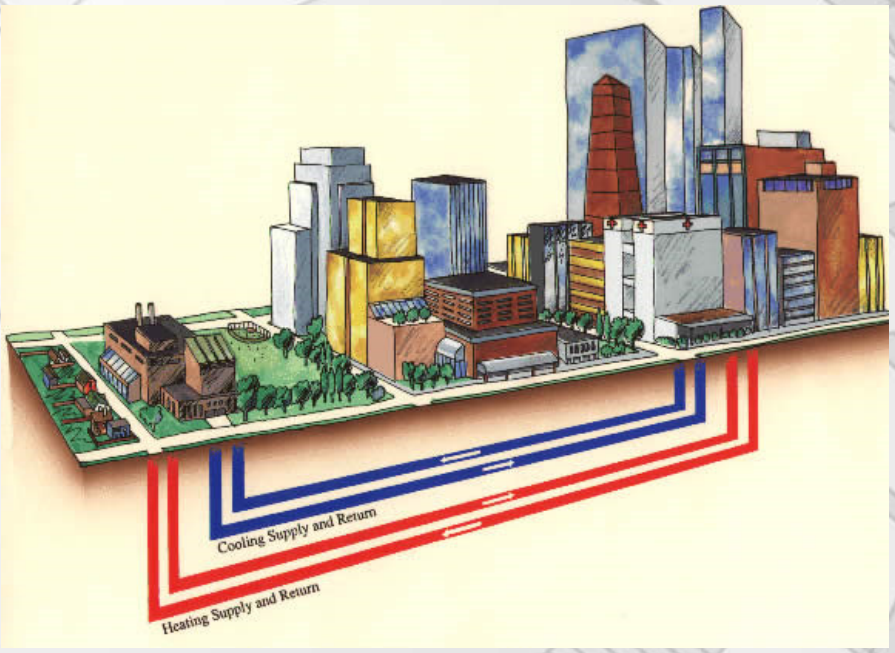
CHP and District Energy

- LEED v4 also allows credits to be obtained when a building is supported by a CHP-equipped DES

- Methodology assigns a portion of central plant CHP input fuel and electricity output to connected building based on proportion of thermal energy supplied to building.



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EPA's CHP LEED® Resources

- **Treatment of CHP in LEED® for Building Design and Construction: New Construction and Major Renovations**
  - Introduces CHP and its benefits to architects and engineers
  - Summarizes how CHP is treated under LEED® BD+C: New Construction
  - https://www.epa.gov/chp/treatment-chp-leedr-building-design-and-construction-new-construction-and-major-renovations
- **LEED® CHP Calculator**
  - Estimates the energy cost savings and "Optimize Energy Performance" points a building meeting the requirements of ASHRAE 90.1 can achieve with CHP
  - Intended to be used at very early stages of building design so that CHP is given consideration as an energy option
  - https://www.epa.gov/sites/production/files/2015-10/chp_leed_calculator.xlsm
- **Treatment of District Energy CHP Outputs in LEED® for Building Design and Construction: New Construction and Major Renovations**
  - Summarizes how a building connected to a district energy system with CHP earns LEED® points
  - https://www.epa.gov/chp/treatment-district-energy-chp-outputs-leedr-building-design-and-construction-new-construction

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Key Takeaways

- CHP can have a dramatic impact on the level of LEED certification
- Think of CHP for your next project
- The EPA CHP Partnership is here to help!

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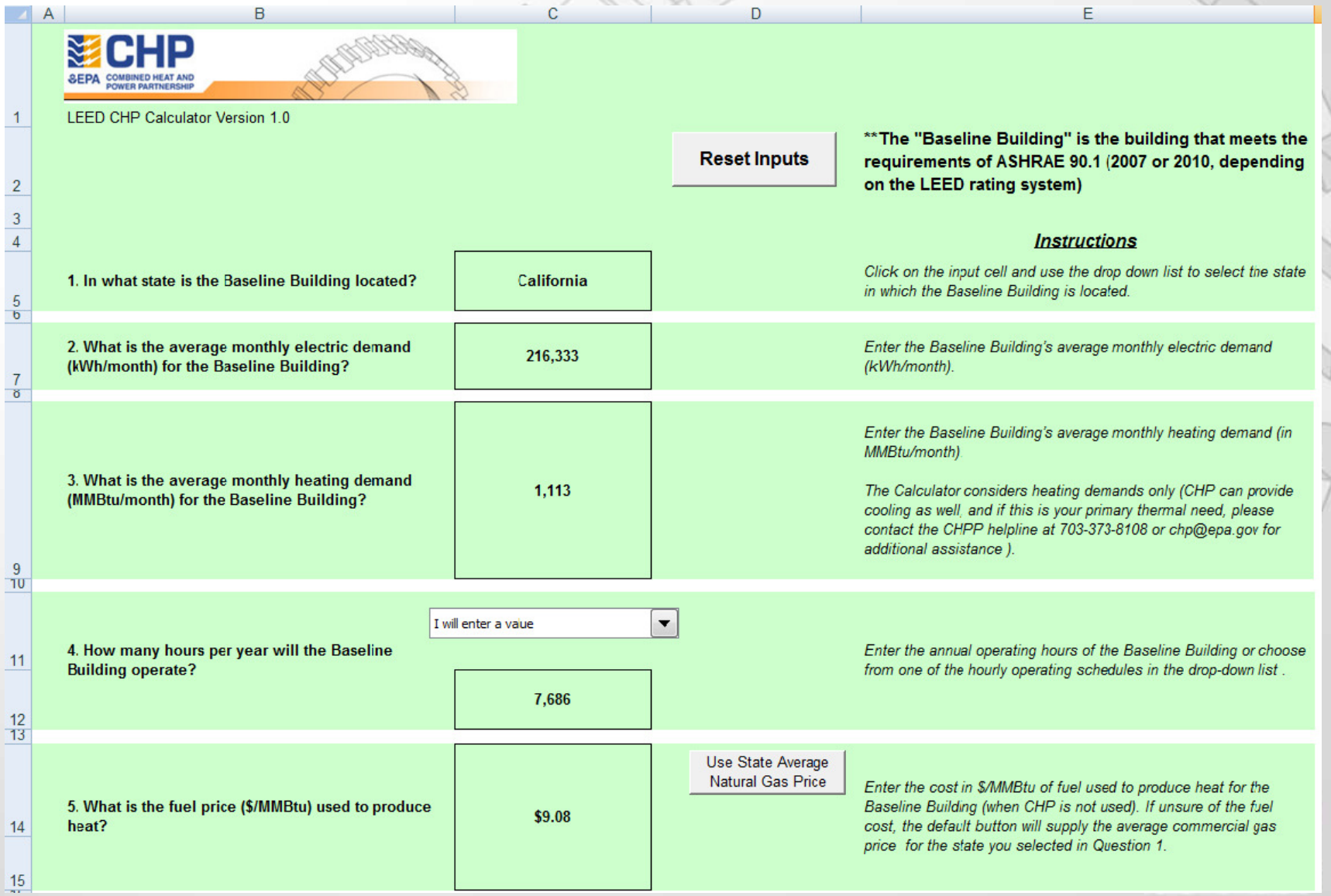
LEED® CHP Calculator



LEED CHP Calculator Version 1.0

Reset Inputs

**The "Baseline Building" is the building that meets the requirements of ASHRAE 90.1 (2007 or 2010, depending on the LEED rating system)

Instructions

1. In what state is the Baseline Building located?	California	*Click on the input cell and use the drop down list to select the state in which the Baseline Building is located.*
2. What is the average monthly electric demand (kWh/month) for the Baseline Building?	216,333	*Enter the Baseline Building's average monthly electric demand (kWh/month).*
3. What is the average monthly heating demand (MMBtu/month) for the Baseline Building?	1,113	*Enter the Baseline Building's average monthly heating demand (in MMBtu/month)* *The Calculator considers heating demands only (CHP can provide cooling as well, and if this is your primary thermal need, please contact the CHPP helpline at 703-373-8108 or chp@epa.gov for additional assistance).*
4. How many hours per year will the Baseline Building operate?	I will enter a value 7,686	*Enter the annual operating hours of the Baseline Building or choose from one of the hourly operating schedules in the drop-down list .*
5. What is the fuel price ($/MMBtu) used to produce heat?	$9.08	Use State Average Natural Gas Price *Enter the cost in $/MMBtu of fuel used to produce heat for the Baseline Building (when CHP is not used). If unsure of the fuel cost, the default button will supply the average commercial gas price for the state you selected in Question 1.*

LEED® CHP Calculator

CHP System Information*

CHP System Type	Recip Engine
CHP System Capacity, kW	260
CHP Electric Efficiency	27.0%
CHP Heat Output, Btu/kWh	6,690
CHP Heat Output, MMBtu/hour	1.7
CHP System Fuel Cost (Natural Gas), $/MMBtu	$9.08
CHP O&M Cost, cents/kWh	$0.0240

Estimate of Annual Energy Costs of the Baseline Building with and without CHP

	Baseline Building: No CHP	Baseline Building: With CHP	Difference
Energy Use			
Annual Electricity Use			
Annual Purchased Power, kWh	2,595,996	700,015	(1,895,981)
Annual CHP Power Generation, kWh	0	1,895,981	1,895,981
Total Annual Electricity Use, kWh	*2,595,996*	*2,595,996*	*0*
Annual Thermal Energy Use			
Non-CHP Thermal Use*, MMBtu/yr	13,356	672	(12,684)
CHP Thermal Used, MMBtu/yr	0	12,684	12,684
Total Thermal Energy Use, MMBtu/yr	*13,356*	*13,356*	*0*
Annual Fuel Use			
Non-CHP Thermal Fuel Use*, MMBtu/yr	16,695	840	(15,855)
CHP Fuel Use, MMBtu/yr	0	23,960	23,960
Annual Total Fuel Use, MMBtu	*16,695*	*24,799*	*8,104*
Energy Costs			
Purchased Electricity	$406,793	$139,402	($267,390)
Purchased Fuel	$151,591	$225,178	$73,588
Annual Energy Costs	*$558,383*	*$364,581*	*($193,802)*
Energy Cost Savings			***$193,802***
			34.71%

Estimated "Optimize Energy Performance" Points Earned with CHP

	Energy Cost Savings		Points Earned with CHP
LEED v2009	$193,802	34.71%	12
LEED v4	$193,802	34.71%	13

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USGBC Methodology for Modeling CHP

Methodology for Modeling Combined Heat & Power for EAp2/c1 in LEED® 2009 and v4

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)

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