



**Pikes Peak ASHRAE Luncheon
January 20, 2011**

LEED & GSHP Systems

Q. Can a GSHP system earn LEED points, and if so, how?

A. Ground source heat pump systems by themselves do not justify a LEED point directly. However, due to the efficiency of a GSHP system and related attributes, LEED points may be earned with the following:

1. Energy performance improvement (ASHRAE 90.1)
 - a. Higher COP and EER ratings for GSHP performance, net reduction in energy consumed vs. energy delivered compared to any conventional products
 - b. Potential additional performance using ECM blowers and multiple-stage compressors
2. CFC reduction/management

Other potential LEED points that may be awarded by teaming other design strategies with GSHP systems:

1. Comply with ASHRAE 55 (thermal comfort standards)
2. Include temperature and humidity monitoring with humidification and/or dehumidification capabilities
3. Provide IAQ monitoring via CO₂ sensor
4. Provide for effective delivery and mixing of fresh air, including energy recovery ventilation (ERV)
5. Design system for air change effectiveness greater than or equal to 0.9 AC/H per ASHRAE 129.
6. Prevent IAQ problems resulting from the construction/renovation process AND provide MERV13 filtration media

Additional points may be earned related to the GSHP system using other strategies, including load sharing demonstrated in detailed modeling, post-installation commissioning, etc.

Q. Do GSHP systems have any advantage for LEED energy modeling?

Baseline comparison for energy simulation is advantageous for GSHP applications; the prerequisite is 10% better than 90.1-2007 which 10% more stringent than 90.1-2004 (from

LEED v3 2009 edition). This will provide even more justification for GSHP installations in the future.

Q. Are economizers required for LEED points using GSHP systems?

A. No, according to LCCA: ASHRAE 90.1-2007 GSHP systems are not required to have economizers. However, if they make sense for the application, they may enhance the system.

Q. How many energy points are possible for LEED ratings?

A. Previously the maximum energy points available to contribute to a LEED rating was 10. USGBC has increased this; LEED Version 3 -2009 now offers up to 19 energy credits for 48% over 90.1-2007.

This change provides much more value to a LEED effort, as energy efficiency proves much more benefit to the end-user in terms of reduced operating cost, clearly an advantage of GSHP systems. Further impacts on other considerations include reducing grid load from power providers, emissions reduction from point sources, increasing the use of domestic vendors (most GSHP components are manufactured in the USA), etc.

When compared to the overall benefits of other LEED objectives, GSHP systems have the potential to increase the “triple bottom line” as noted by the Geothermal Academy* to “...produce tremendous economic, environmental, and social benefits”.

* The Geothermal Academy is an association developed by Colorado School of Mines with support provided by the National Renewable Energy Laboratory (NREL) to explore and define the benefits of GSHP technology.

Q. Are there any difficult problems with some LEED points and GSHP systems?

A. Yes, not all LEED efforts are easy to earn. For example, some are not economic or justifiable for all commercial applications. These include the following:

- MERV 13 filters required for heat pumps; 2” available but create a high static pressure.
- IEQ Credit 2 Increased Ventilation 30% over ASHRAE 62.1; this is difficult to achieve with designs at minimum outside air.
- Credit 6.2 Thermal Comfort – Controllability requires 50% of occupants to have individual control; difficult for some buildings to create small heat pump zones.

Q. Why are some GSHP life cycle cost analysis demonstrating high paybacks and even higher operating costs for some buildings?

A. A GSHP option is not always the best application for every building. However, many of the poor projections for GSHP systems are completed by people with little or no experience that understand how to design or evaluate a GSHP system. Unless the evaluator is experienced with designing GSHP systems, the evaluation will be flawed. This is true when generating projections for other mechanical options as well.

One common tool for life cycle costing is eQuest. The reason for this is that eQuest is free, and many people who use it have little or no mechanical design experience, much less with a GSHP system or design fundamentals. Even the user manual for eQuest states that inputs for a ground loop option should be generated from an outside software program such as GHLEPRO, GCHPCalc or GLD, and the user should consult an experienced asset for assistance if incapable of using these tools.

We recently reviewed one 50,000 ft² project where the evaluation firm predicted a 30+ year payback on the GSHP system option, and strongly recommended to their client not to use it. The client was amazed and sought another opinion. After providing input for actual, realistic variables, the payback dropped to under 5 years.

The evaluation firm made no effort to identify key variables. For example, input for the loopfield was obtained from a mechanical contractor who had no design or installation experience with GSHP systems other than a failed residential installation. His “design” support consisted of one 200’ hole with ¾” circuit pipe for every nominal ton of heat pump capacity.

This is particularly objectionable as the client assumed he would be provided with a detailed, professional analysis based on reasonable due diligence, for a substantial fee. Further, this client would have ended up with a system that did not meet his energy objectives or LEED energy requirements. This facility did go with the GSHP option, but only after additional unnecessary time, expense and effort.

* * * * *

Input for this brief FAQ sheet courtesy of Mr. Ken Merola, PE, CPMP, LEED AP - BESECx, Inc., and Ms. Beth Doty, PE, CGD, LEED AP - BDK Engineering.



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Major Geothermal

Geologist

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AEE Certified GeoExchange Designer #16

IGSHPA CGD Instructor

Colorado Division of Water Resources Closed Loop Certification #GT-13

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Narratives from USGBC documentation:

LCCA: ASHRAE 90.1-2007 doesn't require GSHP systems to have economizers:

c. The system shall have an air economizer where indicated in Table 6.5.1, with controls as indicated in Tables 6.5.1.1.3A and 6.5.1.1.3B and with either barometric or powered relief sized to prevent overpressurization of the building. Where the cooling *efficiency* meets or exceeds the *efficiency* requirement in Table 6.3.2, no economizer is required. *Outdoor air* dampers for economizer use shall be provided with blade and jamb seals.

LEED Version 3 -2009 now offers up to 19 energy credits for 48% over 90.1-2007:

OPTION 1. Whole Building Energy Simulation (1-19 points for NC and Schools, 3-21 points for CS)

Demonstrate a percentage improvement in the proposed building performance rating compared with the baseline building performance rating. Calculate the baseline building performance according to Appendix G of ANSI/ASHRAE/IESNA Standard 90.1-2007 (with errata but without addenda¹) using a computer simulation model for the whole building project. The minimum energy cost savings percentage for each point threshold is as follows:

New Buildings	Existing Building Renovations	Points (NC & Schools)	Points (CS)
12%	8%	1	3
14%	10%	2	4
16%	12%	3	5
18%	14%	4	6
20%	16%	5	7
22%	18%	6	8
24%	20%	7	9
26%	22%	8	10
28%	24%	9	11
30%	26%	10	12
32%	28%	11	13
34%	30%	12	14
36%	32%	13	15
38%	34%	14	16
40%	36%	15	17
42%	38%	16	18
44%	40%	17	19
46%	42%	18	20
48%	44%	19	21



Baseline comparison for energy simulation is advantageous for GSHP; prerequisite is 10% better than 90.1-2007 which 10% more stringent than 90.1-2004. From LEED v3 2009 edition:

OPTION 1. Whole Building Energy Simulation

NC, SCHOOLS & CS

Demonstrate a 10% improvement in the proposed building performance rating for new buildings, or a 5% improvement in the proposed building performance rating for major renovations to existing buildings, compared with the baseline building performance rating.

Calculate the baseline building performance rating according to the building performance rating method in Appendix G of ANSI/ASHRAE/IESNA Standard 90.1-2007 (with errata but without addenda¹) using a computer simulation model for the whole building project.



LEED 2009 for New Construction and Major Renovation Project Scorecard

Project Name:
Project Address:

Yes ? No

SUSTAINABLE SITES 26 Points

<input checked="" type="checkbox"/>	Prereq 1	Construction Activity Pollution Prevention	Required
<input checked="" type="checkbox"/>	Credit 1	Site Selection	1
<input checked="" type="checkbox"/>	Credit 2	Development Density and Community Connectivity	5
<input checked="" type="checkbox"/>	Credit 3	Brownfield Redevelopment	1
<input checked="" type="checkbox"/>	Credit 4.1	Alternative Transportation - Public Transportation Access	6
<input checked="" type="checkbox"/>	Credit 4.2	Alternative Transportation - Bicycle Storage and Changing Rooms	1
<input checked="" type="checkbox"/>	Credit 4.3	Alternative Transportation - Low-Emitting and Fuel-Efficient Vehicles	3
<input checked="" type="checkbox"/>	Credit 4.4	Alternative Transportation - Parking Capacity	2
<input checked="" type="checkbox"/>	Credit 5.1	Site Development - Protect or Restore Habitat	1
<input checked="" type="checkbox"/>	Credit 5.2	Site Development - Maximize Open Space	1
<input checked="" type="checkbox"/>	Credit 6.1	Stormwater Design - Quantity Control	1
<input checked="" type="checkbox"/>	Credit 6.2	Stormwater Design - Quality Control	1
<input checked="" type="checkbox"/>	Credit 7.1	Heat Island Effect - Nonroof	1
<input checked="" type="checkbox"/>	Credit 7.2	Heat Island Effect - Roof	1
<input checked="" type="checkbox"/>	Credit 8	Light Pollution Reduction	1

Yes ? No

WATER EFFICIENCY 10 Points

<input checked="" type="checkbox"/>	Prereq 1	Water Use Reduction	Required
<input checked="" type="checkbox"/>	Credit 1	Water Efficient Landscaping	2 to 4
<input type="checkbox"/>		Reduce by 50%	2
<input type="checkbox"/>		No Potable Water Use or Irrigation	4
<input checked="" type="checkbox"/>	Credit 2	Innovative Wastewater Technologies	2
<input checked="" type="checkbox"/>	Credit 3	Water Use Reduction	2 to 4
<input type="checkbox"/>		Reduce by 30%	2
<input type="checkbox"/>		Reduce by 35%	3
<input type="checkbox"/>		Reduce by 40%	4

Yes ? No

ENERGY & ATMOSPHERE 35 Points

<input checked="" type="checkbox"/>	Prereq 1	Fundamental Commissioning of Building Energy Systems	Required
<input checked="" type="checkbox"/>	Prereq 2	Minimum Energy Performance	Required
<input checked="" type="checkbox"/>	Prereq 3	Fundamental Refrigerant Management	Required
<input checked="" type="checkbox"/>	Credit 1	Optimize Energy Performance	1 to 19
<input type="checkbox"/>		Improve by 12% for New Buildings or 8% for Existing Building Renovations	1
<input type="checkbox"/>		Improve by 14% for New Buildings or 10% for Existing Building Renovations	2
<input type="checkbox"/>		Improve by 16% for New Buildings or 12% for Existing Building Renovations	3
<input type="checkbox"/>		Improve by 18% for New Buildings or 14% for Existing Building Renovations	4
<input type="checkbox"/>		Improve by 20% for New Buildings or 16% for Existing Building Renovations	5
<input type="checkbox"/>		Improve by 22% for New Buildings or 18% for Existing Building Renovations	6
<input type="checkbox"/>		Improve by 24% for New Buildings or 20% for Existing Building Renovations	7
<input type="checkbox"/>		Improve by 26% for New Buildings or 22% for Existing Building Renovations	8
<input type="checkbox"/>		Improve by 28% for New Buildings or 24% for Existing Building Renovations	9
<input type="checkbox"/>		Improve by 30% for New Buildings or 26% for Existing Building Renovations	10
<input type="checkbox"/>		Improve by 32% for New Buildings or 28% for Existing Building Renovations	11
<input type="checkbox"/>		Improve by 34% for New Buildings or 30% for Existing Building Renovations	12
<input type="checkbox"/>		Improve by 36% for New Buildings or 32% for Existing Building Renovations	13
<input type="checkbox"/>		Improve by 38% for New Buildings or 34% for Existing Building Renovations	14
<input type="checkbox"/>		Improve by 40% for New Buildings or 36% for Existing Building Renovations	15
<input type="checkbox"/>		Improve by 42% for New Buildings or 38% for Existing Building Renovations	16
<input type="checkbox"/>		Improve by 44% for New Buildings or 40% for Existing Building Renovations	17
<input type="checkbox"/>		Improve by 46% for New Buildings or 42% for Existing Building Renovations	18
<input type="checkbox"/>		Improve by 48%+ for New Buildings or 44%+ for Existing Building Renovations	19
<input checked="" type="checkbox"/>	Credit 2	On-Site Renewable Energy	1 to 7
<input type="checkbox"/>		1% Renewable Energy	1
<input type="checkbox"/>		3% Renewable Energy	2
<input type="checkbox"/>		5% Renewable Energy	3
<input type="checkbox"/>		7% Renewable Energy	4
<input type="checkbox"/>		9% Renewable Energy	5
<input type="checkbox"/>		11% Renewable Energy	6
<input type="checkbox"/>		13% Renewable Energy	7
<input checked="" type="checkbox"/>	Credit 3	Enhanced Commissioning	2
<input checked="" type="checkbox"/>	Credit 4	Enhanced Refrigerant Management	2
<input checked="" type="checkbox"/>	Credit 5	Measurement and Verification	3
<input checked="" type="checkbox"/>	Credit 6	Green Power	2



LEED 2009 for New Construction and Major Renovation
Project Scorecard

Project Name:
Project Address:

Yes ? No
Yes ? No

2 MATERIALS & RESOURCES 14 Points

Y	Prereq 1	Storage and Collection of Recyclables	Required
1	Credit 1.1	Building Reuse - Maintain Existing Walls, Floors and Roof	1 to 3
		Reuse 55%	1
		Reuse 75%	2
		Reuse 95%	3
1	Credit 1.2	Building Reuse - Maintain Interior Nonstructural Elements	1
2	Credit 2	Construction Waste Management	1 to 2
		50% Recycled or Salvaged	1
		75% Recycled or Salvaged	2
1	Credit 3	Materials Reuse	1 to 2
		Reuse 5%	1
		Reuse 10%	2
1	Credit 4	Recycled Content	1 to 2
		10% of Content	1
		20% of Content	2
1	Credit 5	Regional Materials	1 to 2
		10% of Materials	1
		20% of Materials	2
1	Credit 6	Rapidly Renewable Materials	1
1	Credit 7	Certified Wood	1

Yes ? No

INDOOR ENVIRONMENTAL QUALITY 15 Points

Y	Prereq 1	Minimum Indoor Air Quality Performance	Required
Y	Prereq 2	Environmental Tobacco Smoke (ETS) Control	Required
1	Credit 1	Outdoor Air Delivery Monitoring	1
1	Credit 2	Increased Ventilation	1
1	Credit 3.1	Construction Indoor Air Quality Management Plan - During Construction	1
1	Credit 3.2	Construction Indoor Air Quality Management Plan - Before Occupancy	1
1	Credit 4.1	Low-Emitting Materials - Adhesives and Sealants	1
1	Credit 4.2	Low-Emitting Materials - Paints and Coatings	1
1	Credit 4.3	Low-Emitting Materials - Flooring Systems	1
1	Credit 4.4	Low-Emitting Materials - Composite Wood and Agrifiber Products	1
1	Credit 5	Indoor Chemical and Pollutant Source Control	1
1	Credit 6.1	Controllability of Systems - Lighting	1
1	Credit 6.2	Controllability of Systems - Thermal Comfort	1
1	Credit 7.1	Thermal Comfort - Design	1
1	Credit 7.2	Thermal Comfort - Verification	1
1	Credit 8.1	Daylight and Views - Daylight	1
1	Credit 8.2	Daylight and Views - Views	1

Yes ? No

INNOVATION IN DESIGN 6 Points

1	Credit 1	Innovation in Design	1 to 5
		Innovation or Exemplary Performance	1
		Innovation or Exemplary Performance	1
		Innovation or Exemplary Performance	1
		Innovation	1
		Innovation	1
1	Credit 2	LEED® Accredited Professional	1

Yes ? No

REGIONAL PRIORITY 4 Points

1	Credit 1	Regional Priority	1 to 4
		Regionally Defined Credit Achieved	1
		Regionally Defined Credit Achieved	1
		Regionally Defined Credit Achieved	1
		Regionally Defined Credit Achieved	1

Yes ? No

2 PROJECT TOTALS (Certification Estimates) 110 Points

Certified: 40-49 points Silver: 50-59 points Gold: 60-79 points Platinum: 80+ points