

ENGINEERING

S Y S T E M S O L U T I O N S

This issue provides an update to Edition 20 of Engineering System Solutions, LEED®

Energy and Atmosphere, Credit 1 – Measuring Efficiency to Maximize Points, April 2004, available on www.mcquay.com.

Beginning in 2006, all new construction and major renovation projects registering for LEED certification must use the new LEED for New Construction and Major Renovations (LEED-NC) version 2.2. There are many significant updates from LEED-NC version 2.1, including Energy and Atmosphere, Credit 1 (EA Credit 1). The revised credit now references ASHRAE 90.1-2004 Informative Appendix G – Performance Rating Method, to measure energy efficiency and earn points. It also references the Advanced Energy Design Guide and the Advanced Buildings Benchmark, Version 1.1 for easier compliance methods. This newsletter focuses on the use of Informative Appendix G and the positive impact it brings to EA Credit 1 and the LEED certification program.

For more information on high performance HVAC system design, or the LEED certification program and its impact on HVAC system design, contact your local McQuay representative or visit our GreenWay™ HVAC System Solutions resource center at www.mcquay.com.

Carol Marriott P.Eng.
Applications Manager
McQuay International

Informative Appendix G and LEED Energy and Atmosphere, Credit 1 – Optimize Energy Performance

First cost typically accounts for 43% of an HVAC system's life cycle cost. Maintenance and replacement account for 7%, and the balance (50%) is devoted to energy usage (Washington State Department of General Administration, *Energy Life Cycle Cost Analysis*, <http://www.ga.wa.gov/Eas/elcca/intro.html>). Therefore, HVAC efficiency improvements can go a long way towards reducing the overall life cycle costs of an HVAC system.

LEED-NC rewards energy efficiency in two ways in the Energy and Atmosphere category. The first is a prerequisite for meeting ASHRAE Standard 90.1-2004 requirements to ensure that buildings are built to the same minimum standard of care. This has been updated from LEED-NC version 2.1, which referenced ASHRAE 90.1-1999.

The second, EA Credit 1, rewards projects that exceed the requirements of the prerequisite and "optimize energy performance." Up to 10 points can be awarded based on the percentage improvement over the prerequisite requirements. The percentage improvement required to earn points has been updated and points are now awarded as follows:

LEED NC -New Buildings	LEED NC -Major Renovations	Points
10.5%	3.50%	1
14.0%	7.0%	2
17.5%	10.5%	3
21.0%	14.0%	4
24.5%	17.5%	5
28.0%	21.0%	6
31.5%	24.5%	7
35.0%	28.0%	8
38.5%	31.5%	9
42.0%	35.0%	10

It is important to note that HVAC changes alone will not earn all 10 points under this credit. Figures 1 and 2 illustrate a typical 60,000 ft² office building using VAV with reheat and an air cooled chiller. In a northern climate (Figure 1), HVAC accounts for about 30% of the annual building energy cost. In a warm, humid climate (Figure 2), HVAC accounts for almost 50% of the annual building energy cost. Therefore, the mechanical engineer should also be looking to the architect and electrical engineer in order to maximize the number of LEED points for EA Credit 1.

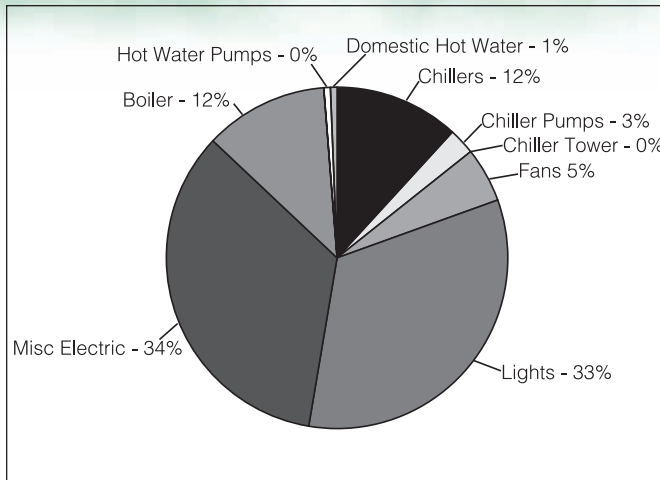


Figure 1 – 60,000 ft² office building using VAV with reheat and an air-cooled chiller in a northern climate.

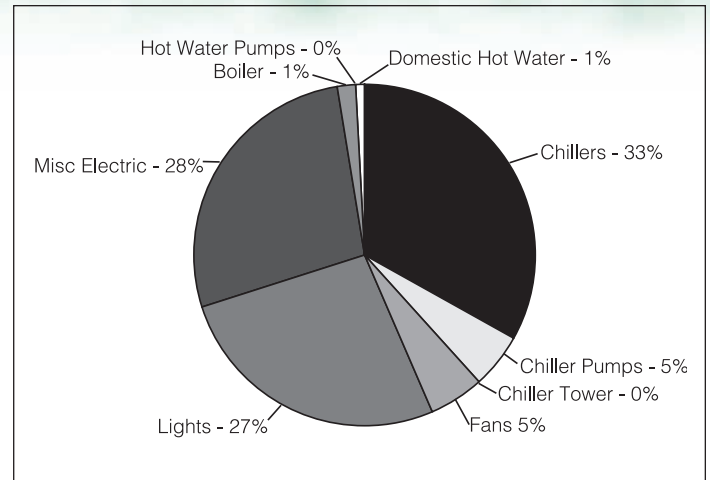


Figure 2 – 60,000 ft² office building using VAV with reheat and an air-cooled chiller in a warm, humid climate.

LEED-NC Version 2.2

There are 3 compliance paths to earn LEED points for EA Credit 1 in LEED-NC version 2.2. The first path uses a whole building simulation as outlined in ASHRAE Standard 90.1-2004 Informative Appendix G - Performance Rating Method. This has been updated from LEED NC version 2.1, which used the ASHRAE Energy Cost Budget (ECB) Method of Standard 90.1. What remains the same is that in order to earn maximum points for this credit, a full building energy simulation must be completed to measure efficiency and determine the number of points earned.

The second path uses the ASHRAE Advanced Energy Design Guide for Small Office Buildings less than 20,000 ft². Up to four points can be earned without performing a full building energy simulation using this path.

The final path is to use the Advanced Buildings Benchmark™ Version 1.1. One point can be earned using this path. While there is no limit on the building size, the Advanced Building Benchmark is not suitable for all building types.

ASHRAE Standard 90.1 Appendix G – Performance Rating Method

The original purpose of the ECB method, which was used in LEED-NC version 2.1, was to allow for design

trade-offs to meet the minimum requirements of Standard 90.1. It was not intended to be used to show performance differences between HVAC systems or performance that exceeded Standard 90.1. The ECB method defines the budget building design. For example, if a designer using the ECB method chose a geothermal heat pump system for a typical rooftop application as part of the budget building design, that system would be seen as only meeting one of the prerequisites of Energy and Atmosphere. The ECB did not give credit for changing mechanical system types, so installing a more efficient system than is typically installed in an application did not contribute to earning points for EA Credit 1. Only after additional design changes to improve efficiency above the budget building design would that HVAC system contribute to earning points for EA Credit 1. This provided no incentive for designers seeking to maximize EA Credit 1 points to start with more efficient HVAC systems.

Appendix G differs from the ECB method in that it recognizes performance above and beyond Standard 90.1 requirements. It defines a “baseline” HVAC system for buildings based on the number of floors, square footage and energy source. Any efficiency

improvement for an alternative HVAC system that exceeds this baseline is recognized. This encourages the designer to adopt more non-typical and more energy efficient HVAC designs in their buildings. Table 1 is adapted from tables G3.1.1A and G3.1.1B of ASHRAE 90.1-2004 Appendix G – Performance Rating Method.

The following equation is provided to determine the percent improvement in the Design Energy Cost versus the performance baseline:

$$\text{Percent Savings} = 100 \times \frac{\text{Performance Baseline} - \text{Design Energy Cost}}{\text{Performance Baseline}}$$

Additional requirements for using Appendix G are as follows:

- Average state energy rates may be used and are available at the following location www.eia.doe.gov
- Minimum HVAC equipment efficiencies must be met. This is part of the mandatory section of the Standard.
- Fan energy must be modeled separately. If fan energy is combined in the Energy Efficiency Ratio (EER) of a product, it must be separated out.
- Ventilation Rates must be the same for both the performance baseline and design building models, with the

Table 1 – Baseline HVAC system Types Depending on Building Size and Number of Floors¹

Building Type *		Fossil Fuel & Purchased Heat	Electric & Other
Number of Floors	Area (ft ²)		
3 or Less	< 75,000	Packaged Rooftop Constant Volume	Packaged Rooftop Heat Pump Constant Volume
4 or 5	< 75,000	Packaged Rooftop VAV with Reheat	Packaged Rooftop VAV with Parallel Fan Powered Boxes
5	75,000 to 150,000		
More Than 5	Any	VAV with Reheat & Chillers	VAV with Parallel Fan Powered Boxes & Chillers
Any	> 150,000		

* residential systems are not shown.

- exception of modeling demand control ventilation strategies.
- ASHRAE Standard 90.1-2004 requires energy recovery with a 50% effectiveness if more than 5,000 CFM and 70% of the supply air is outdoor air. There are many exceptions to this requirement in the Standard, but if energy recovery is required, it should be modeled in the baseline building. If energy recovery is not required by the Standard and it is included as part of the design building model, it would not be included in the baseline building model. This may result in further energy savings and more LEED points.
- Airside economizers may be required in the baseline building, depending on the building size and climate zone. Systems not requiring airside or waterside economizers may employ these strategies to further show energy savings over the baseline building design.
- The design supply air rates in the baseline building must be modeled using a Delta T of 20°F. In addition, the baseline building model must use the same fan type for return and relief fans as proposed in the design building model. The air volume for return and relief fans is based on the supply air volume. For example,

supplying 50°F air to the building spaces instead of the usual 55°F, with a setpoint of 75°F, can reduce the design supply air volume by 20%. This represents a huge capital savings by reducing the size of ducts, air handling units and fan motors. However, there is a slight penalty on the refrigeration system because colder water will be required to produce the lower supply air temperature. An energy analysis should be done to find the energy balance between the two systems. Refer to Edition 12 of Engineering System Solutions, *Optimal Air Systems – Benefits and Design Tips* (July 2002), on www.mcquay.com.

In Practice

A process for putting Appendix G into practice is outlined in Edition 21 of Engineering System Solutions, *Designing Green Does Not Have To Cost More* (October 2004), on www.mcquay.com. The exception to this process is that Appendix G already defines the performance baseline HVAC system as shown in Table 1.

ASHRAE Advanced Energy Design Guide for Small Office Buildings

LEED-NC v.2.2 recognizes the Advanced Energy Design Guide (AEDG) as an alternative to full building simulation. Four points are

awarded for following the prescriptive guidelines specified in the AEDG.

The AEDG provides prescriptive requirements by climate zone. One simply finds their climate zone and follows the prescriptive requirements provided in Chapter 3. Sample buildings and recommendations for unitary air-cooled, heat pump and gas furnace efficiencies are provided for each climate zone. Prescriptive requirements for when economizers should be used, and recommendations for control types, such as CO₂ control for outdoor air, are also included.

Chapter 4 of the AEDG gives recommendations on how to apply the prescriptive requirements and provides tips for further improving energy efficiency, such as the inclusion of energy recovery in the exhaust air stream. The AEDG is available through the ASHRAE bookstore at www.ASHRAE.org.

ASHRAE is also developing guidelines for other markets, such as retail spaces. As more and more of these guidelines are developed, it is reasonable to assume that the U.S. Green Building Council (USGBC) will pursue incorporating these prescriptive solutions in the LEED certification program.

Advanced Buildings Benchmark Version 1.1

LEED-NC v.2.2 also recognizes the Advanced Buildings Benchmark Version 1.1 as an alternative to full building energy simulation. One point is awarded for following the prescriptive guidelines specified in the Advanced Buildings Benchmark Version 1.1. There are prescriptive efficiency requirements for HVAC products, including a separate path for water-cooled centrifugal chillers with VFD's. This recognizes the significant energy impact (savings) that VFD's can have on chiller energy consumption. It recommends a much tighter part load efficiency for chillers with VFD's than Standard 90.1, while allowing for the minimal motor drive

¹Adapted from ANSI/ASHRAE/IESNA Standard 90.1-2004 tables G3.1.1A and G3.1.1B.

losses of the VFD at full load. The Advanced Buildings Benchmark is available through the New Buildings Institute at www.newbuildings.org.

Conclusion

The changes to EA Credit 1 in LEED-NC version 2.2 help simplify the credit and encourage more energy efficient design by improving clarity on the paths to compliance. In the May 2005 Progress Report on Sustainability,

published by Building Design and Construction magazine (www.bdcmag.com), 85% of registered projects obtained at least one point EA Credit 1. The change to LEED-NC version 2.2 should help more buildings achieve multiple points for this credit.

The data and suggestions in this document are believed current and accurate at the time of publication, but they are not a substitute for trained, experienced professional service. Individual applications and site variations can significantly affect the results and effectiveness of any information, the reader must satisfy him/herself regarding the applicability of any article and seek professional evaluation of all materials. McQuay disclaims any responsibility for actions based on this document.

For comments or suggestions, please call or write:

Chris Sackrison, Editor

McQuay International

13600 Industrial Park Boulevard

Minneapolis, MN 55441

Phone: (763) 553-5419

E-mail: chris.sackrison@mcquay.com

For more information on McQuay products and services, or to speak with your local representative, call (800) 432-1342, or visit our web page at www.mcquay.com.

©2006 McQuay International

