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model for success …

Energy Analysis for LEED Certification

From the editor …
A well-constructed energy model can serve various purposes throughout a building project, as Dr. Malcolm Lewis, PE, and Tom Lunneberg, point out in their case study of the David L. Lawrence Convention Center [1]. *During the planning stage, an energy model helps establish the peak cooling and heating loads. At the design development stage, it aids evaluation of energy-saving concepts, such as the effects of high-efficiency lighting, HVAC optimization strategies, and high-performance glazing. Near the end of the construction, when the design is finalized, the model can be used to document compliance with ASHRAE Standard 90.1 or the local energy code and validate the building's eligibility for LEED certification.*

As Lewis and Lunneberg note, "… [the] energy model was able to serve multiple beneficial purposes because the design team was constantly looking for new uses for the model."

When and how do you use energy models in your design work? The following article focuses on the role of modeling for LEED certification, but we encourage you to identify opportunities to make better use of this informative tool from the planning phase of your projects forward.

The U.S. Green Building Council's (USGBC) green-building rating system, Leadership in Energy and Environmental Design (LEED®), challenges the building industry to develop high-performance, sustainable buildings. To that end, LEED assesses building performance based on metrics for sustainability in six areas: site sustainability, water efficiency, energy and atmosphere, materials and resources, indoor environmental quality, and innovation and design process.

"the ultimate objective of LEED is to make each building as sustainable and affordable as possible"

The metrics consist of prerequisites, which must be met for any LEED certification, and "extra credit," which awards points for exceeding the minimum requirements. The number of points earned determines the certification level, that is: certified (26–32 points), silver (33–38 points), gold (39–51 points), and platinum (52–69 points). The higher the certification level, the greater the potential environmental and economic benefits.

Our focus in this *Engineers Newsletter* are Prerequisite 2 and Credit 1 in the Energy and Atmosphere category of LEED-NC Version 2.2:*

- *EA Prerequisite 2: Minimum Energy Performance (EAp2)* sets the minimum level of energy efficiency for the building and its systems, in effect, requiring compliance with ASHRAE Standard 90.1–2004 (or with the local building code, if it's more stringent than the standard).
- *EA Credit 1: Optimize Energy Performance (EAc1)* awards points for exceeding ASHRAE Standard 90.1–2004 or the local energy code, whichever is most stringent [2].

Together, EAp2 and EAc1 reward building projects that reduce the negative environmental impacts associated with excessive energy use. Comparative computer simulations that conform to LEED's energy modeling protocols are required to demonstrate eligibility.

This article examines the nature of these models and the requirements for the software used to generate them.

* The current version of LEED-NC is Version 2.1; but with official release of Version 2.2 anticipated for later this year, we chose to address the requirements in the pending release. The public comment period for the first draft of LEED-NC Version 2.2 ended on February 1, 2005, and availability of a second draft is imminent. Official release of Version 2.2 is anticipated by fall 2005, following balloting of the USGBC membership.

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EAp2: Minimum energy performance

Intent: Establish the minimum level of energy efficiency for the proposed building and systems.

Requirements: Design the building project to comply with both:

(a) The mandatory provisions (Sections 5.4, 6.4, 7.4, 8.4, 9.4, and 10.4) of ASHRAE/IESNA Standard 90.1–2004 (without amendments); and,

(b) The prescriptive requirements (Sections 5.5, 6.5, 7.5, and 9.5) or performance requirements (Section 11) of ASHRAE/IESNA 90.1–2004 (without amendments), or the local energy code, whichever is more stringent [2].

In effect, before a building project can be considered for LEED certification (let alone receive points for energy performance), the project team first must show that the building and its systems satisfy the energy standard's compulsory conditions for compliance. The team then must demonstrate compliance with whichever criteria is most rigorous:

- All of the prescriptive provisions in Standard 90.1–2004, or
- The Energy Cost Budget Method defined in Section 11 of Standard 90.1–2004; or,
- The requirements in the local energy code.

It's comparatively easy to show compliance with either Standard 90.1's prescriptive provisions or the local energy code; however, neither of these approaches accommodates unique designs or affords as much design flexibility as the Energy Cost Budget (ECB) Method.

Using the ECB Method, the designer still must meet the mandatory provisions of the standard but can "trade off" prescriptive requirements by designing other parts of the building to reduce energy costs. As an example, a design team may find that it's impractical to implement the prescriptive requirement for an economizer on a particular project. In lieu of the economizer, they could reduce energy costs by installing more efficient lighting and mechanical systems and by using low-pressure-drop filters.

For LEED certification, the team must show that the energy costs of the proposed design are less than or equal to the energy costs of a similar

Modeling requirements for simulation software

Simulation software can be invaluable for designing building loads and analyzing energy consumption. But for the results to be considered valid for certification under LEED-NC Version 2.2, the software must be approved by the adopting authority and conform explicitly to the modeling requirements outlined in Section 11 and Appendix G in ANSI/ASHRAE/IESNA Standard 90.1–2004.

Most of the capabilities required to model the Energy Cost Budget (ECB) Method and the Performance Rating (PR) Method are identical. The following table summarizes the functionality required for each method and highlights some of the differences. Be sure to consult the standard for definitive modeling requirements.

Programs that are suitable for ECB and PR modeling include (but are not limited to) TRACE™ 700, DOE-2, EnergyPlus, BLAST, and HAP.

If the simulation software cannot adequately model some aspect of the design, the authority having jurisdiction may approve an "exceptional" calculation method. In such cases, the project team must document the exceptional calculations and provide sufficient evidence of their accuracy. •

Energy Cost Budget Method (from 90.1 Section 11 for EAp2) [3]	**Performance Rating Method** (from 90.1 Appendix G for EAc1) [3]
Individually calculates at least 1,400 hours of building operation to simulate annual energy use	Individually calculates 8,760 hours of building operation to simulate annual energy use
Accounts for hourly variations (defined separately for each day of the week and holidays) in occupancy, lighting power, miscellaneous equipment power, thermostat setpoints, and HVAC operation	[Same]
Accounts for thermal mass effects	[Same]
Models 10 or more thermal zones	[Same]
Accounts for part-load performance of mechanical equipment	[Same]
Includes capacity and efficiency corrections for mechanical cooling and heating equipment	[Same]
Models airside and waterside economizers with integrated control	Models airside economizers with integrated control
Models budget building design characteristics per Section 11.5	Models baseline building design characteristics per Section G3
Calculates design loads	[Same]
Uses hourly weather data, such as temperature and humidity, for the climate that best represents the location of the proposed design	[Same]
Calculates annual energy costs using rates for purchased energy approved by the adopting authority; or, exports hourly reports of energy use to a program that can	Calculates annual energy costs using either actual rates for purchased energy or state average energy prices published by DOE's Energy Information Administration, http://www.eia.doe.gov/; or exports hourly reports of energy use to a program that can
Tested in accordance with ASHRAE Sd 140–2004, *Standard Method of Test for the Evaluation of Building Energy Analysis Computer Programs*	Includes calculation methodologies for the building components being modeled

"budget" building that complies with the minimum requirements of Standard 90.1—in this case, one with an economizer. To be considered valid, the comparison must be based on a model created with acceptable simulation software (see inset, p. 2).

Note: Understand that an ECB analysis is NOT *necessary if the proposed design meets or exceeds all of the prescriptive requirements plus the mandatory provisions in Standard 90.1–2004. By the same token, not meeting even one of the prescriptive requirements automatically necessitates an ECB model to show compliance with EAp2.*†

Use the ECB Method to demonstrate compliance

The Energy Cost Budget Method compares the energy cost of the proposed building design with that of a hypothetical *budget building design*, which determines the annual energy cost budget and, in turn, minimum compliance with Standard 90.1. Creating an acceptable ECB model involves several steps.

Step 1: Verify compliance with the mandatory provisions of Standard 90.1–2004. Before constructing the comparative model, make sure that the proposed building design satisfies all of the mandatory provisions in the 2004 standard. Requirements related to the HVAC system address:

- Minimum equipment efficiencies
- Thermostat deadbands
- Off-hours control strategies
- Insulation of ductwork and piping
- Duct tightness
- System completion (documentation, balancing, and commissioning)

Step 2: Determine which prescriptive requirements to implement. Once the proposed building meets these mandatory provisions, determine which of the prescriptive requirements align with the design goals for the project. Prescriptive requirements related to the HVAC system include:

- Restrictions on simultaneous heating and cooling
- Economizers in certain climates
- Stipulations on the design and control of hydronic systems
- Energy recovery for systems with large amounts of outdoor air or simultaneous loads for cooling and service water heating
- Fan-power restrictions based on nameplate horsepower

Step 3: Model the *proposed* design in accordance with Section 11.3 of Standard 90.1. Model the proposed building, taking care that the simulation represents the actual design as closely as possible. Include all control strategies, heat-recovery devices, and equipment capacities. Also, make sure that the schedules for occupancy, lights, HVAC, and so on represent realistic operation of the building. Use utility rates approved by the adopting authority (that is, the agency or agent that adopted Standard 90.1–2004) for the economic calculations.

Step 4: Model the *budget* design to determine the annual energy cost budget. Basically, this step creates a second building model that's based on the proposed design but changes all Standard 90.1-governed design details to represent minimum compliance. Often, the budget building model differs from the proposed design in:

- Envelope characteristics (U-factors, C-factors, F-factors, solar heat gain coefficients, and percentage of fenestration in walls and/or roofs)
- Lighting power densities
- Economizer type (if required)
- Heat-recovery type (if required)
- HVAC system type (cooling, heating, and fan control types, per Figure 11.3.2 and Table 11.3.2A in Section 11 in the standard)
- Fan energy
- Cooling equipment (capacity and energy rate)
- Heating equipment (capacity and energy rate)
- Omission of daylighting or shading via overhangs‡

All details *not* covered by the 2004 energy standard must be identical in both models. Furthermore, the heat capacitance represented for opaque assemblies (walls, roofs, floors, and doors) must be the same in both models, despite any differences in the envelopes of the proposed and budget building designs.

Step 5: Compare the annual energy costs of the two models. To comply with the ECB method of Standard 90.1–2004, the *projected energy cost* of the proposed building must not exceed that of the nearly identical budget building (which is minimally compliant with the standard). If the proposed building design meets this criterion for minimum energy performance, the project team can submit their modeling results in conjunction with the LEED-NC Letter Template for EAp2.

Note: As stated earlier, it's not necessary to create an ECB model if (in addition to the mandatory provisions) the project meets or exceeds all of the prescriptive requirements in the standard.

† LEED-NC Version 2.1, which is still current, uses the Energy Cost Budget Method to compare the operating cost of the proposed design with a base building, and then assigns points accordingly under EA Credit 1 [4].

‡ The Energy Cost Budget Method does not allow the "budget building design" model to account for the effects of daylighting and shading.

EAc1: Optimize energy performance

Intent: Achieve increasing levels of energy performance above the baseline in the prerequisite standard to reduce environmental impacts associated with excessive energy use.

Requirements: Reduce the proposed building performance rating compared to the baseline building performance rating per ASHRAE/IESNA Standard 90.1–2004 (without amendments), for the total energy consumption within and associated with the building project, as demonstrated by a whole building project simulation using the Building Performance Rating Method in Appendix G of the Standard [2].

EA Credit 1 of LEED-NC Version 2.2 awards a proposed building design up to 10 points for exceeding the minimum energy performance requirements of EAp2. That is, an eligible design receives 1 point if the project team successfully demonstrates energy cost savings of 10.5% and 1 point for each additional 3.5% of savings.** Cost savings are determined by comparing the performance of the proposed building design with that of the baseline design, which meets the *prescriptive* requirements of the 2004 standard:

$$100 \times \frac{\textit{baseline bldg perf} - \textit{proposed bldg perf}}{\textit{baseline bldg perf}}$$

The performance of the proposed and baseline building designs must be calculated in accordance with the Performance Rating (PR) Method detailed in Appendix G of Standard 90.1–2004.

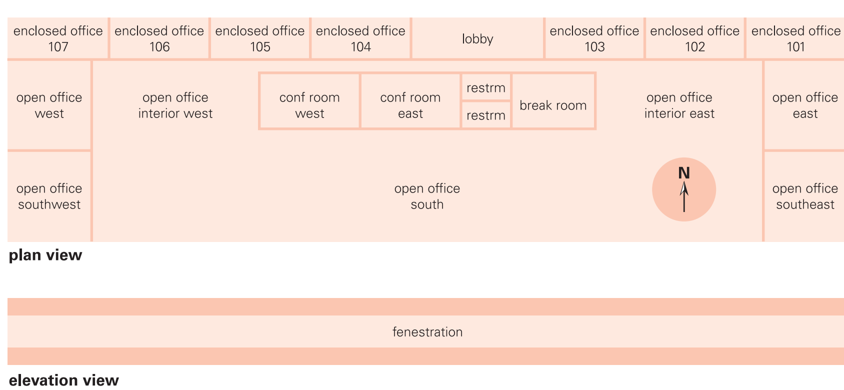
Use the PR Method to quantify energy savings. Like the ECB Method, the Performance Rating Method relies on computer modeling to simulate the energy performance of two designs: one representing the proposed building (or actual building, if it already exists), and one representing a baseline building that complies with the minimum requirements of Standard 90.1 *but with slight modifications (in accordance with Appendix G of the standard) as compared to the ECB model for EAp2.* For example, the simulation for EAc1:

- Includes receptacle and process energy consumption.
- Takes credit for automatic lighting controls in the proposed design, either in accordance with Table G3.2 or via modified lighting schedules.
- Averages the performance of the baseline building at its actual orientation and when rotated 90°, 180°, and 270°. For each of the rotated simulations, the cooling and heating equipment are resized to 1.15 and 1.25 times the design capacity, respectively.
- Uses lightweight assembly types for opaque assemblies, and U-factors, F-factors, and C-factors corresponding to weather/location-dependent values in Tables 5.5-1 through 5.5-8 of the standard.
- Models vertical fenestrations as evenly distributed bands of glass on all building orientations and limits them to not more than 40% of the above-grade wall area.
- Calculates fan and pump energy in accordance with the equations in Appendix G.
- Uses the appropriate HVAC system type (cooling, heating, and fan control types) from Tables G.3.1.1A and G.3.1.1B.

Note: The PR Method can be used to evaluate the performance of alterations or additions to existing buildings, as well as that of new construction and major renovations. Systems that aren't yet designed or that already exist and are unmodified must be modeled identically for the proposed and baseline buildings. If the proposed design includes future building components, then the components must be modeled as conforming to the minimum prescriptive requirements of Standard 90.1–2004

The performance of both building models must be calculated using the same weather data, the same energy rates, and the same simulation software. (The software requirements for modeling the PR Method as compared to the ECB Method are summarized in the inset on p. 2.)

Figure 1. Office building for Performance Rating Method example



**LEED-NC 2.1 awarded 1 point for the first 15% of energy cost savings for *regulated* loads in new construction and 1 point for each additional 5% of savings [4]. LEED-NC 2.2 lowers the eligibility threshold and the incremental savings necessary to earn EAc1 points; this is due to the inclusion of *process (non-regulated)* and receptacle loads, and because ASHRAE Standard 90.1–2004 uses lower lighting power allowances than the 1999 standard.

To get a better idea of what's entailed to earn EAc1 points using the Performance Rating Method, let's step through an example.

An example office building. Figure 1 (p. 4) illustrates the plan and elevation views of the design for our example office building. Table 1–Column A provides further details about the design, which meets or exceeds all of the mandatory provisions and prescriptive requirements in Standard 90.1–2004.

To determine whether our above-standard design saves enough energy to earn EAc1 points toward LEED certification, we'll need to model its performance and compare the results with those of a baseline building. Both designs must comply with the modeling requirements defined in Appendix G of the 2004 energy standard. (Table 2, p. 6, highlights some of these requirements by contrasting the proposed and baseline building designs.)

Step 1: Model the *proposed* design in accordance with Section G3. The proposed building design should represent, as closely as possible, the architectural and system-related details in the actual design documents. As noted in Table 2, the proposed building design should model:

- All end-use loads
- Any energy-saving strategies (for example, daylighting and natural ventilation), where applicable
- Actual lighting power if the lighting system already is designed, or the lighting power allowance in accordance with Section 9 of the standard
- Energy-saving architectural features, such as light shelves, overhangs, and other permanent shading devices
- Any undesigned systems as identical to the baseline building design

Table 1. Modeling details for Performance Rating Method example

		A	B
		Actual/proposed design	**Baseline design**
Project	Location	St. Louis, Missouri	Same as proposed design
	Building type	Office	Same as proposed design
	Conditioned floor area	15,000 ft²	Same as proposed design
Envelope	Opaque assemblies	Lightweight assemblies; equivalent to Std 90.1 minimum	Same as proposed design
	Fenestration	40% of wall area; no skylights	Same as proposed design
Lighting	Power density	0.9 W/ft²	**1.0 W/ft²**
	Control type	Daylighting sensors	**Lighting schedules**
HVAC system	Type	Packaged rooftop air conditioner	**Packaged single-zone air conditioner**[a]
Cooling equipment	Type	Direct expansion	Direct expansion[a]
	Design capacity	40 tons	**115% of actual design capacity**
	Efficiency	10.0 EER 10.4 IPLV	**9.5 EER** **9.7 IPLV**[b]
	Fan control	Variable volume	**Constant volume**[a]
Heating equipment	Equipment type	Natural gas-fired heat exchanger (preheat)	**Fossil fuel furnace**[a]
		Electric resistance heat (in VAV boxes for zone reheat)	**None**
	Design capacity	530 MBh	**125% of actual design capacity**
	Efficiency	82% natural gas 100% electric resistance	**80% natural gas**
HVAC options	Fan pressure optimization	Yes	**Not applicable for constant-volume fans**
	Economizer type	Comparative enthalpy	**No economizer**[c]
	Ventilation control	Ventilation reset	**Per ASHRAE Std 62**

[a] Tables G3.1.1A and G3.1.1B determine the HVAC system type (based on building type and size) and description for the baseline building design. Our example requires System 3–PSZ-AC, which represents the system type, cooling type, heating type, and fan control.

[b] From Section 6.4 of Standard 90.1–2004. Per Appendix G3.1.2.1, the baseline building design must use minimum full-load and part-load efficiencies to model all HVAC equipment. Appendix D of the standard tells us that St. Louis is in Climate Zone 4a.

[c] Conditioned floor area, zone type (that is, interior versus perimeter), and climate determine whether the baseline building design must include an outdoor air economizer.

Typically, the design team already will have completed an ECB model of the proposed design in order to demonstrate that the project satisfies the minimum energy performance of EA Prerequisite 2, which requires compliance with the stricter of Standard 90.1 or the local energy code.

Step 2: Model the *baseline* design in accordance with Section G3. The baseline building design closely resembles the proposed design. Any differences between these models (which are prescribed in Table G3.1 of the 2004 standard) enable appropriate credit for the energy-saving features in the proposed design.

(continues on p. 7)

Table 2. Some of the modeling requirements for the Performance Rating Method [a,b]

Model element	Proposed building design [c]	Baseline building design [d]
Building configuration, size	Consistent with design documents	Number of floors and conditioned floor area matches proposed design
Space use classification	Specify a single building type (per Section 9.5.1), unless the building is a mixed-use facility; or one or more space-type classifications (per Section 9.6.1)	Same as proposed design
Schedules	Hourly variations in occupancy, lighting power, miscellaneous equipment power, thermostat setpoints, and HVAC system operation are typical of the proposed building type *Exception:* May model energy-saving strategies if approved by the rating authority. (Such strategies include daylighting, natural ventilation, demand-controlled ventilation, and reductions in service water heating loads)	Same as proposed design … unless the proposed design models nonstandard efficiency measures
	Model all conditioned spaces as both heated and cooled	Same as proposed design
Building envelope	Consistent with architectural drawings (or "as-built" for existing buildings)	Dimensions: Exterior envelope components, roofs, doors, floors, and exposed perimeters of concrete slabs on grade are equivalent to proposed design
		Opaque assemblies: Use lightweight assembly types and U-factors, F-factors, and C-factors from Tables 5.5-1 through 5.5-8
		Vertical fenestration: Model as 40% of the above-grade wall area (or equal to the proposed design, whichever is smaller), configured as horizontal bands distributed uniformly across all orientations
	Include effects of automated shades/blinds and permanent shading devices, such as fins, overhangs, and light shelves	Omit effects of shading projections, manual window shading devices, and self-shading of the building due to orientation
Lighting	Use actual lighting power if the system exists; or lighting power allowance in accordance with Sections 9.1.3 and 9.1.4 if the system is designed; or lighting power in accordance with the Building Area Method if the lighting system is yet to be specified	Use the maximum lighting power allowed for the building- or space-type classification(s) in the proposed design
	Includes task, furniture-mounted, parking garage, and façade lighting	Same as proposed design
	Account for automatic lighting controls, such as daylighting	Excludes automatic lighting controls (The baseline lighting schedule reflects the mandatory control requirements in Standard 90.1–2004.)
Thermal blocks (HVAC zones) [e]	Model each HVAC zone as a separate thermal block	Same as proposed design
HVAC systems	Model HVAC system, equipment, and controls types as designed. If no heating and/or cooling system exists, then system characteristics match those in baseline model	Use HVAC system types and descriptions specified in Tables G3.1.1A, G3.1.1B, and in Sections G3.1.2 and G3.1.3 For fan and pump energy, use values specified in Sections G3.1.2 and G3.1.3
Receptacle and other loads	Use estimates based on the building- or space-type classification	Same as proposed design *Exception:* Use the lowest allowable efficiency for components subject to the efficiency requirements in Section 10

[a] The information presented here represents a subset of the modeling requirements and calculations for proposed and baseline building performance. Be sure to read Appendix G of ANSI/ASHRAE/IESNA Standard 90.1–2004 in its entirety for complete details.

[b] All sections and tables identified in this table refer to the 2004 version of Standard 90.1.

[c] Proposed building performance is based on a single simulation that uses the building orientation and equipment efficiencies of the actual design.

[d] Baseline building performance represents the average of the results of four simulations: one at the actual building orientation, and the others at 90°, 180°, and 270°. In the rotated-orientation simulations, cooling equipment is resized to 1.15 times the cooling design capacity and heating equipment is resized to 1.25 times the heating design capacity.

[e] A thermal block consists of one or more HVAC zones (not necessarily contiguous) that are modeled as a single entity. All HVAC zones in a thermal block must share the same space-type classification, and they must be served by the same HVAC system or by the same kind of HVAC system. Also, all of the HVAC zones within the thermal block that are adjacent to an exterior wall must face the same orientation or their orientations must differ by less than 45°.

(continued from p. 5)

Table 1–Column B (p. 5) highlights the changes made to arrive at the baseline model for our example office building. To comply with the modeling requirements in Table G3.1, we:

- Set the lighting power density to the maximum value allowed for this building type per Table 9.5.1.;
- Omitted the economizer, as allowed by Table G3.1.2.6A;
- Changed the HVAC system type and description per Tables G3.1.1A and G3.1.1B, based on the building type and size;
- Used the minimum efficiencies specified in Table 6.8.1A (cooling) and 6.8.1E (heating); and,
- Oversized the cooling and heating equipment based on the requirements in Section G3.1.2.2.

Step 3: Calculate the energy performance of the *proposed* design. This is a matter of simulating one *entire* year (individually calculating each of 8,760 hours) of operation based on representative climate data (hourly variations in temperature and humidity) for the proposed building's geographic location. For our example office building in St. Louis, the proposed design yields an annual energy cost of $17,706.[††]

Step 4: Calculate the energy performance of the *baseline* design. Unlike the proposed building design, which represents a single simulation, the energy performance for the baseline model averages the results of four simulations of one year of operation. One simulation is based on the actual orientation of the building on the site; the others rotate the entire building by 90°, 180°, and 270°, which enables the proposed design to receive credit for a well-sited building. (Requiring four simulations for the baseline building may seem daunting but may not involve more than re-entering a handful of values, depending on the simulation software used.)

In each simulation, the cooling and heating equipment is sized at 115% and 125%, respectively, of the design capacity for that building orientation. The annual energy cost of the baseline design in our example averaged $24,590.

[††]Annual energy costs were calculated using TRACE™ 700 building energy and economic analysis software and the energy rates of a local St. Louis, Missouri, utility company.

Step 5: Calculate the performance improvement of the proposed design. Having calculated the energy performance of the proposed and baseline models, the resulting values then are applied in the equation (from Section G1.2) to quantify the energy cost savings of the proposed design:

$$100 \times \frac{\textit{baseline bldg perf} - \textit{proposed bldg perf}}{\textit{baseline bldg perf}}$$

$$100 \times = \frac{\$24{,}590 - \$17{,}706}{\$24{,}590} = 27.995\% \textit{ improvement}$$

In the example, the proposed design for our office building yields energy savings of 27.995%, making it eligible for up to 5 points under EA Credit 1 of LEED-NC 2.2 (first public review draft); see Table 3. One might think that this value could be rounded to 28% and earn 6 EAc1 points, but the USGBC does not permit rounding to reach the threshold of the next point.

Step 6: Verify model accuracy. The objective here is to make sure that the proposed design receives as many of the points available for EAc1 as possible. (Only 0.005% prevented our example office building from receiving 6 points for energy performance.) Check your entries to verify the accuracy of the proposed and baseline models. The simulation software may include documentation to simplify this task.

Table 3. Allocation of EAc1 points in LEED-NC Version 2.2 (first public review draft)

% Energy cost savings[a] (minimum)	Points earned
10.5%	1
14%	2
17.5%	3
21%	4
24.5%	5
28%	6
31.5%	7
35%	8
38.5%	9
42%	10

[a] Energy cost savings result from a comparison of the total energy consumption for the proposed building project with that of a baseline building per ASHRAE Standard 90.1–2004 (without amendments).

If the models are accurate but the energy cost savings are smaller than expected, the project team may consider additional conservation measures to improve the energy performance of the proposed design.

Documenting the results

The USGBC defines submittal requirements for each of the prerequisites and credits in its LEED products. In general, the evidence required to support EA Prerequisite 2 and EA Credit 1 includes:

- Calculated values for baseline and proposed building performance
- A list of all energy-related features in the actual design, with the differences between the two models clearly identified
- Simulation results that break down energy usage (at minimum) by lights, internal equipment loads, service water heating equipment, space heating equipment, space cooling and heat rejection equipment, fans, and other HVAC equipment (such as pumps)
- Simulation results showing the amount of time that any loads are

not met by the HVAC system in each model

- An explanation of errors, if any, reported by the simulation software in the simulation results

Closing thoughts

This article discussed the modeling requirements to earn points for energy performance as defined by the first public review draft of LEED-NC Version 2.2. Success requires that the proposed building design first satisfies *EA Prerequisite 2–Minimum Energy Performance*, which means that it:

- Meets the mandatory provisions of ANSI/ASHRAE/IESNA Standard 90.1–2004; and
- Complies *either* with the standard's prescriptive or performance requirements, *or* with the local energy code, whichever is stricter.

Modeling the proposal to comply with the Energy Cost Budget Method can provide the necessary documentation for a design that "trades" one or more of the standard's prescriptive requirements for energy savings elsewhere in the building. The project team then must show, using the Performance Rating Method, that the proposed design performs notably better (that is, yields energy costs at least 10.5% less) than a baseline design, which minimally complies with the mandatory and prescriptive provisions of Standard 90.1–2004 as embodied in its Appendix G.

In effect, the documentation that's required for LEED certification means that the project team must either possess the necessary modeling capabilities in-house or engage the services of a firm that does.

One final observation: On the surface, the modeling tasks described here might be construed as point-garnering exercises. However, it's important not to let the mechanics of certification overshadow the ultimate objective of LEED, which is to make each building as sustainable and affordable as possible. •

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