# LEED®
# The Use of Smart Communicating Devices to Garner LEED® Points

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## Overview

This white paper is intended to educate system integrators, building owners and operators about LEED® and sustainable building design principles, as well as the value of Smart Communicating Devices in terms of overall building cost and operation.

This paper contains the following topics:



## Executive summary


A holistic approach to design and development is required to achieve a reduction in the environmental footprint of construction activities. LEED® provides this much-needed holistic approach. It promotes a whole building approach to sustainability through the principles of green building and integrated building design.

This paper describes the need for integrated building design and the importance of the application of Smart Communicating Devices that can integrate the various necessary functions within a building. It also explains how LEED® strategies and the LEED® points system, along with current market trends merge with Smart Communicating devices to provide more sustainable and environmentally-friendly buildings that enhances occupant comfort while reducing environmental impact.


## About the Author


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Mark is a registered engineer in most States in the Western US, LEED accredited professional, and AABC certified building commissioning authority. Mark is an engineering graduate of the University of Kansas and a member of ASHRAE and ASPE. Mark offers 30 years of mechanical engineering experience, as well as mechanical contracting and land development experience. Mark has traveled internationally as an account executive for a major air conditioning manufacturer overseeing equipment installation and performing Construction Administration services. Technical Designs provides 3-D BIM MEP design, controls and building automation consulting, LEED design and documentation support, as well as building commissioning services.

# Green building, the LEED® approach, and Integrated Building Design

What is “Green” Building?

Green building design is the whole-building approach that encourages and guides a collaborative, integrated design and construction process. The outcome of this approach is a systematically integrated design of building systems, such as HVAC, lighting, water management, and other mechanical systems with the building design itself, so as to achieve higher levels of performance. This holistic approach optimizes environmental and economic factors from the beginning of the design / conception throughout the life of the building. Sustainability, in this holistic approach, is measured not only in the project's initial costs and long term energy use, but in how structures will be used in the future in the changing communities in which they are built.

According to the United States Green Building Council (USGBC) (LEED Core Concepts, First Edition), in the United States, buildings account for the highest proportion of resource use and waste generation.

In the United States, buildings account for:

- 72% of electricity consumption
- 39% of all energy use
- 38% of all carbon dioxide ($CO_2$) emissions
- 40% of raw materials use
- 30% of waste output (136 million tons annually)
- 14% of potable water consumption

Designers are now accountable for  increasing the efficiency with which buildings use resources during construction and consume during the life of the building; while reducing building impacts on human health and the environment during the building’s lifecycle. This is achieved through better site selection, building orientation, design, construction, operation, and maintenance.

## The LEED® Approach

In 1993, a private non-profit organization was formed to establish minimum criteria and methods by which sustainable developments can be measured. Following the formation of the United States Green Building Council (USGBC), the membership quickly realized that a priority for the sustainable building industry was to have a system to define and measure green buildings. The USGBC developed the Leadership in Energy and Environmental Design (LEED®) Green Building Rating System. The USGBC’s goals, based on their mission statement, is to promote the design and construction of buildings that are environmentally responsible, profitable, and healthy places to live and work. By educating owners and practitioners in the latest technologies in various building sectors, lead the transformation to more sustainable building practices.

Today, LEED® is an internationally recognized benchmark for the design, construction, and operation of high-performance green buildings. The LEED® Green Building Rating System is a voluntary, consensus-based, market-driven building rating system that defines and promotes green designs, and rewards organizations that adopt some or all of its principles towards green or integrated building design. LEED® promotes a whole-building approach to sustainability by recognizing performance in five key areas influenced by the building and construction process and occupant environmental health concerns: sustainable sites (SS), water efficiency (WE), energy and atmosphere (EA), materials and resources (MR), and indoor environmental quality (IEQ).

In 2009, the USGBC introduced the latest LEED® rating system (Version 3) that incorporates credit weightings that strive to equally compare the various factors impacting design, construction, operation, and maintenance of a building. The latest standard incorporates the EPA's TRACI environmental categories as the basis for weighting each credit and a combination of methods are used, such as computer modeling, life-cycle assessments, environmental and transportation studies.

The LEED process is available in several "flavors": Building Design and Construction, Existing Building, Interiors, Core and Shell, Retail, Health Care, Schools, Homes, and Neighborhood Development. The categories have a unique points structure and is designed to address the particular challenges faced by each type of construction. To begin the LEED® process, an Owner would evaluate his particular project and submit documentation to the GBCI (Green Building Certification Institute) LEED program for evaluation for his attempted points. The GBCI would grade the project and award or deny points based on whether the project

has met the LEED® criteria. Please visit USGBC.org for more information on each sub-category. Contact a LEED® Accredited Professional in your area to help evaluate your needs.

The green building trend is picking up remarkable momentum on both the commercial and residential fronts. Since the inception of green building practices and sustainability, the private sector has responded positively, often establishing green design standards for others to follow. In fact, the growth of green building is being fueled by demand, as more owners become convinced of the benefits of green buildings. Eco-capitalist have found using LEED® strategies, can reduce building energy use, management costs, increasing ROI and the advantage of marketing the differentiated position of reduced green house emissions and good global stewards. Some markets have seen tax incentive, while others are motivated by mandates. In the United States, federal, state, county, and municipal governments have begun to incorporate green building into construction standards. Together with a proactive federal government, they are starting to transform conventional practices in the building industry into an approach that reduces the environmental impact of construction-related activities, while producing meaningful savings to the building owner.

An indirect, but very meaningful result of using green strategies has created new opportunities for existing resources. By re-using materials, infill development (Brownfield), reclaiming existing development sites, LEED® has been able to recognize and admire organizations that develop more with less demand on limited resources. For example, a large Casino organization in Nevada focused on reducing water demand for its laundry facilities and by using the latest laundry technologies, cleaning the same amount of laundry per year, saved enough water to allow for 1,000 more homes to be developed without changing the delicate balance of local water demand. Taxpayers benefit from the most efficient use of resources and reducing or deferring costs for new infrastructures while creating a tax base from areas that were once considered "abandoned".

Now that we understand what LEED® is and how it works, let's look at how communicating devices within a building can help a building owner meet his LEED® goals. LEED® is a holistic approach to building design, construction, operation, and maintenance and there is no way a single idea or concept will help an owner obtain his goal. To say a product or service is "LEED" is meaningless without proper credit context. As such, communicating devices are not "LEED" but devices may be applied in concepts and strategies to garner LEED points. And LEED® is structured whenever possible, to push new ideas and innovations. Any person can participate in the LEED® process to help an owner obtain his specific goals. Even if an Owner is not interested in pursuing LEED® ratings, it is well worth the time for anyone participating in any construction activity to understand how their business or service can improve the construction process by learning the latest technologies in your chosen area of expertise. According to the Green Building Alliance, spending on green building products in the US will exceed $30 billion in FY2010.

For the rest of this discussion, we will focus on Building Design and Construction category of LEED® points to show how communicating devices are integrated into LEED® concepts; although each sub-category has many opportunities for communicating devices.

## Integrated Building Design

Integrated building design is a process that includes integrating green building strategies into conventional design criteria for building form, function, performance, and cost. The goal is to achieve high performance and multiple benefits at a lower cost than the total for all the components combined. It is during this phase when many of the building's systems are identified and when complimentary technologies are used to reduce overall energy consumption that will impact the building throughout its operational life.

Several trends have converged simultaneously to bring about the ability for communicating devices to play a pivotal role in many LEED® concepts. These trends are:

- Standardization of communication protocols
- Smart technologies applied all types of end devices for little or no cost.
- Traditional controls companies are being replaced by system integrators.
- Smart power grids and how this technology is bringing value to the end user.
- Increased utility costs or an awareness that change is on its way. De-regulation has created new issues with delivery of services and the associated costs.
- Federal mandates for renewal energy and how utility companies find a way to integrate wind and solar.

## Communication Protocols

The most compelling change in the design and construction of buildings today is the advent and acceptance of standardized communication protocols. This allows for integration, interoperability, and connectivity between building systems. Lighting systems, building access and surveillance, water controls, HVAC, indoor air quality / gas monitoring, elevators, alternate energy systems, remote building operation, global IP access, fire and life safety, and utility monitoring can all integrate into one package that can share a wealth of information gathered from previously proprietary "closed" systems. Communications protocols such as BacNet, ModBus, and LON allow for end devices from all types of vendors to share on an "open" platform. Wireless technologies such as Bluetooth and Zigbee have untold possibilities to change how devices are used and communicate within buildings. As we will discuss later, the LEED® concepts can be integrated into the building for a low cost when the systems installation is simplified and share common devices whenever possible. Also, management and maintenance costs are reduced with integrated systems in the areas of interface, monitoring, and training. An example would be a PIR sensor that could function as an occupancy sensor to turn on lights, HVAC systems, and alert surveillance systems that someone has entered the space. Likewise, a surveillance card reader could identify the entering individual, log security records, open doors only required for proper access, turn on lights and HVAC systems and even set individual temperature preferences. All of the above could be accessed from any web enabled device and none of this would be possible without smart devices integrated using standardized communications protocols.

## Smart Technologies

Internet Protocol 6 (IPv6) has become the standard for all types of devices to give us all kinds of information by increasing the number of unique addresses that devices may use to talk to one another. M2M means machine to machine and in the world of LEED®, it means the ability of collect data in a building from all types of devices to "measure and verify" or find problem areas throughout the life of the building. It could mean all of the faucets in the building can tell you the overall water usage in the building or sensors embedded in the walls to tell you the expected heating or cooling load and do utility demand limiting. Most of these communication devices will be integrated by manufacturers for little to no cost and will change the way we "sustain" buildings.

## Controls Companies as System Integrators

Before the advent of "open" platforms, building automation was the domain of proprietary DDC control solutions. Even though available solutions varied from manufacturer to manufacturer, they all shared an intrinsic quality: the solution manufacturer was the sole-source provider. They manufactured the controllers, developed the application software, were often the only installer, and unilaterally charted product development, deployment and product line diversity. When a owner selected a proprietary control solution they were not merely buying a product they were establishing a partnership. Far too often this partnership became one-sided in favor of the manufacturer and it was impractical, if not financially impossible, to change to another manufacturer after making the initial investment in their solution. This situation became known as the sole-source lock.

Open platforms have changed how the building automation industry conducts business. The relationship between owner, system integrator, and manufacturer has been irrevocably changed. Owners now have the option to select products, applications, and installers for their open system solution based on LEED® concepts and can competitively bid for the most compelling overall cost solution. Manufacturers also have the option of incorporating third-party products, technology, and applications into their solution, which follow open system guidelines. By doing this manufacturers can expand their solution offering without the burden of R&D and focus on solution application, feature sets, services, and addressing the strategic business requirements of the customer.

Antiquated and expensive controls architecture using wired sensors and relays are being replaced by wireless devices and software commands at a fraction of the old controls proprietary systems cost. Owners looking to the future should always make sure that all control devices are "open" with non-expiring licenses; both at the global controller level and at the end device. Sustainable controls design includes the use of smart devices with an open communication protocol where the same device is available from a number distribution channels. Too many owners have been forced to replace devices and re-program new devices with new licenses when a control vendor phased out support for a particular product line; or worse, ceased business. With the same device available from multiple sources, it is hard to force an owner into costly problems.

For LEED® concepts to be easily incorporated into a project, there must be an integration of all types of devices and crossing of "party lines". Control companies need to move away from the "one size fits all" controller than needs to be programmed, to specific controller smart devices. Products that arrive on site and think they're a "toaster" then have to be programmed to meet a particular function, need to be replaced with smart devices that know already how to control a rooftop or fan coil. Smart end devices need to and have an easy to use intuitive interface to allow the owner to enjoy lower maintenance costs and more service options. Control companies need to focus on being system integrators and learn how to interface and communicate with all of the smart devices that will arrive on the jobsite. One of the great features of LEED® is the ability to submit for review "Innovative Credits". Innovative Credits are available to any project that can improve the performance and sustainability of a construction project. It is predicted that many Innovation Credits will be awarded for new strategies that come from smart devices and how their data is used within buildings.

### Utility Companies - The Sleeping Giant

Utility companies are investing is "smart grid" technologies and the reason is that a fair portion of what is generated is lost in transmission and distribution. For various reasons, the losses are multiplied throughout the utility distribution system. Costly peak generation costs, de-regulated utilities, and federal mandates to incorporate alternate energy have created many problems / opportunities. Google has recently formed "Google Energy" to buy and sell electricity admittedly as a way to protect their largest investment. The net result: Building owners looking for sustainable building designs will need to be able to handle more of the project details in the areas of site developed alternate energy, demand limiting, and careful internal metering of all utilities. As more technology is brought into buildings, owners need to develop contingency plans with infrastructure. Smart end devices will play a major part in the integration of this paradigm shift. As always, LEED rewards owners that consider a sustainable energy future for on site renewable energy, measure and verification, monitoring, lighting controls, HVAC controls.

## LEED Green Building Rating System

Now that we have reviewed LEED® and the trends that have driven smart programmable devices into buildings, let's look specifically at the LEED® points system and how smart communicating field devices help an owner achieve LEED® credits.

Controls can impact the LEED process in the following LEED® points:

- WE - Water Efficiency and water use reduction - This would include smart water fixtures and advanced landscape irrigation systems. Smart controllers can control and monitor gray water systems.
- EA Prereq 1: Fundamental Commissioning - A mandatory requirement of a LEED® certified project is to incorporate a systems commissioning plan. Smart communication devices can play an important part in the building commissioning process.
- EA Credit 1: Optimized Energy Performance 1-10 possible points - this point is part of the many control strategies that are integrated into the project and evaluated using energy modeling software. ASHRAE standards determine the baseline case and then based on the proposed building orientation, building elements, selection of mechanical systems, and operational strategies, a proposed building model can be formulated. Points are assigned based on % improvements over baseline as compared on a $/sq ft basis. Additional concepts are day lighting / controls, and HVAC design including economizers, geothermal, control strategies where programmable end devices provide control and feedback.
- EA Credit 2: On-site Renewable Energy - Controls and end device monitoring is crucial in determining proper performance.
- EA Credit 3: Enhanced Commissioning - As mention as part of the Fundamental Commissioning requirement, smart end devices play a key role in improving the commissioning process. Not only is it possible to place a piece of equipment into several operational modes and verify functional performance, it is also possible to continuously monitor devices and report any "out of range" results. Testing of calibrated limits can also be measured and verified if smart end devices control set points and monitor controller outputs.
- EA Credit 5: Measurement and Verification - Smart end devices will be essential in monitoring building systems and compare the actual results to the proposed modeled results. Owners who embrace this concept will find problems before an actual failure occurs, or identify system design flaws and be proactive with solutions, and bring a new level to occupant comfort and service.

- EQ Credit 1: Outdoor Air Delivery Monitoring - Measurement of outdoor ventilation rates within the building to +/- 15% of minimum values and CO2 measurement of densely populated areas within the building require smart end device controllers.
- EQ Credit 2: Increased Ventilation - Increased ventilation is related to EQ Credit 1 above. Baseline values are established, based on ASHRAE standards and then increased 30% above this value. The credit does not require smart controls to measure ventilation rates, but in complicated systems where air flows are varied and breathing zone calculations may be a mixed use occupancy, smart end devices can provide enough data to make accurate calculations in order to deliver increased amounts of outdoor air. Although the downside to this strategy is the additional energy costs to condition more outdoor air, the benefit is a healthier, more productive environment.
- EQ Credit 6: Controllability of Lighting and Thermal Comfort (2 points) - Through the concept of daylight harvesting and dimming, lighting controls, achieve sustainable development through energy savings, greater flexibility, and improved occupant satisfaction. Daylight harvesting refers to the controlled admission of natural light into the space with the intent of limiting the need for electrical lighting. It occurs when a light-level sensor measures an area's illumination, communicating with a smart controller that adjusts the lighting output to maintain a desired light level. Combining results from time schedules, light-level sensors, and override buttons, controllers can easily determine when lights need to be on and when lights can be off for maximum savings. With advanced lighting designs, utilization of available daylight can enable energy savings approximately 50% in existing buildings and 35% in new construction. More thermostatic controls points within a building environment allows more occupants to have an environment that is most suited to their needs. The LEED® credit requires 50% of the occupants to have comfort controls to adjust for individual needs. Communicating end devices play a major role in providing this function.
- EQ Credit 7: Thermal Comfort Design and Verification - This credit involves making sure that comfort requirements for building occupants is measured and verified. To qualify for this credit, occupant surveys are taken after occupancy. In addition, a permanent monitoring system is provided to log and verify that the system is operating with the design guideline comfort zone.
- Innovative Credits - As mentioned previously, innovative credits can be submitted. Innovation credits are available for exemplary performance. A database of past credits can be accessed and can be used if the point fits your particular application. If a particular project has a unique approach, this may be submitted and if found to be acceptable will be awarded and be added to the database. Because the LEED® process can be extremely detailed oriented, a point is awarded for the use of an LEED® Accredited Professional as Project Administrator.

## Conclusion

LEED® can improve the current standards related to green building and sustainability by defining thresholds of performance in relation to sustainable sites, water efficiency, energy and atmosphere, indoor environmental quality, and material resources.

There are many benefits to LEED® certification; however, the key underlying theme is savings associated with:

- Reduced waste sent to landfills
- Conservation of energy and water
- A healthier and safer work area for building occupants
- Reduction in harmful greenhouse gas emissions
- Attractive tax rebates, zoning allowances and other incentives
- Eco-capitalism that lowers operating costs and increased asset value while demonstrating a commitment to environmental stewardship
- Reduces technical and administrative uncertainties because of the holistic process and holds the design and construction team to a higher standard of performance

LEED® certification is a powerful tool that enables internalization of the green building process. With the growing demand for energy efficiency and changing trends in power utilities, integrated technology, and communications, the need for smart end devices are required to integrate the key principles of LEED® into the whole design process. This enables designers to create sustainable environmentally-friendly solutions that promote energy savings, human comfort, reduce waste and water usage, and protect the environment.