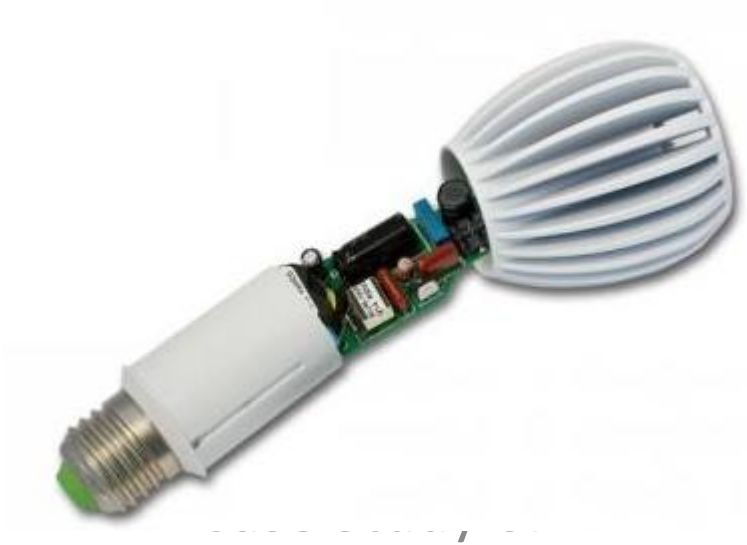
ELG4126
Sustainable Development for Electrical Engineers



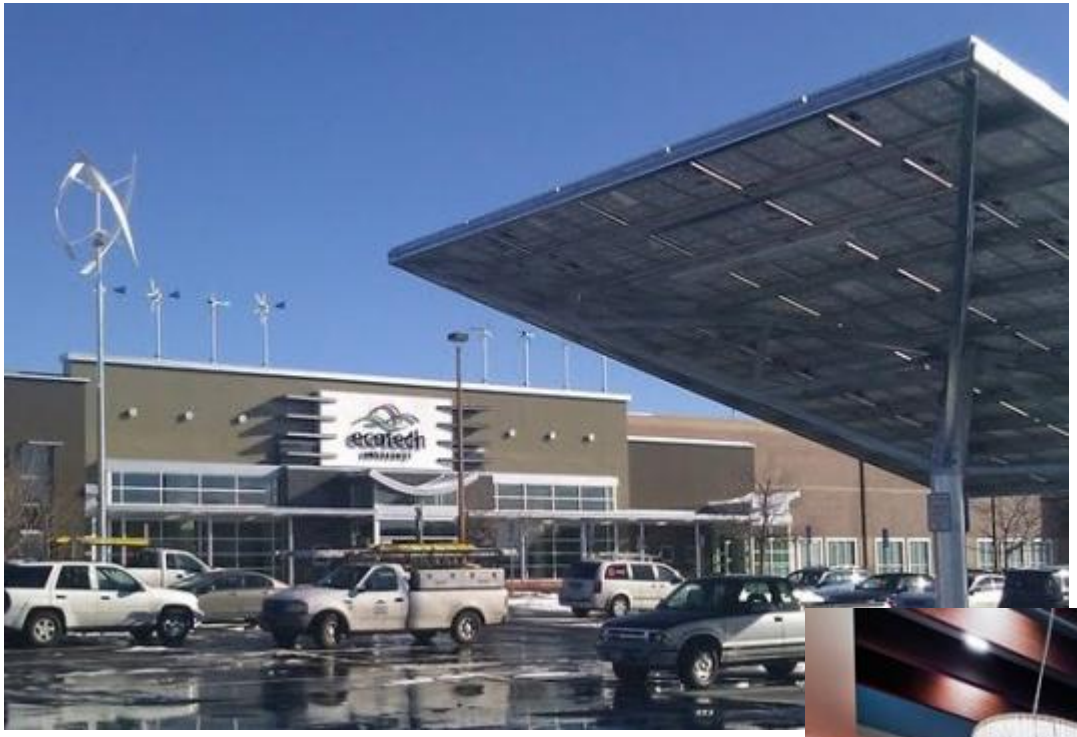
A Case Study on Renewable Energy and Smart Grid

of Three Phases

Phase Three
Sustainable Development for Electrical Engineers

- Conduct a feasibility analysis for initiating a profitable electrical sustainable development for an existing load (building, neighbourhood, small town, part of a town or downtown, etc.). Generally the development can be subdivided into the following four steps:

- **Initiation and Feasibility (concluded by go/no-go)**
  - Consultation.
  - Existing electrical situation assessment (lighting; machines, conductors, etc.)
  - **Technical feasibility:** Description of candidate technology replacements!
  - Obstacles and impacts
  - Planning requirements
  - Economics based on annual energy consumption.
- **Prebuilding (concluded by go/no-go)**
  - Design of new electrical loads and specifications
  - Planning procedures (environmental issues; noise; visual impact; safety)
  - Selection of materials
  - Project financing.
- **implementation**
  - Overview of the process
  - Quality control during implementation
  - Commissioning and handover.
- **Operation and Maintenance**
  - Daily operation
  - Warranties and insurance
  - Maintenance and repair.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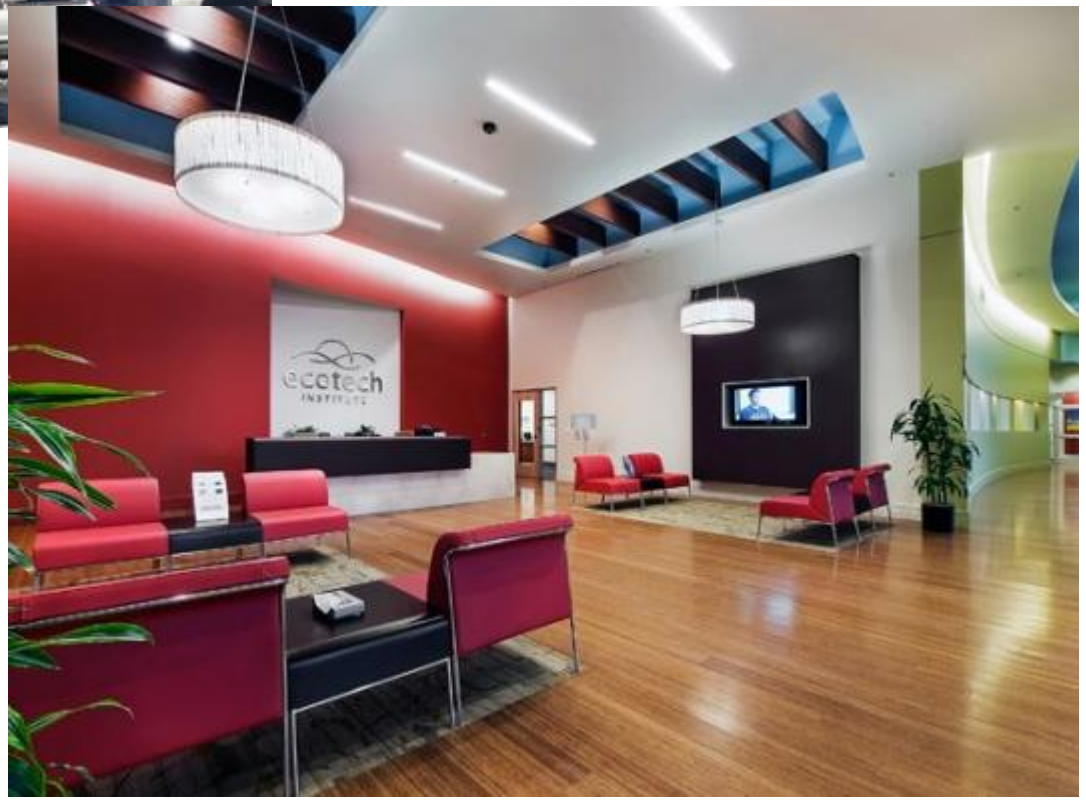
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LEED Rating

- The Leadership in Energy and Environmental Design (LEED) rating systems are a voluntary, third-party means to measure the successful incorporation of sustainable design principles into a building construction project.
- The various LEED rating systems measure several “green” criteria or credits for which you receive points for each credit achieved. The recently upgraded (Version 2.2) LEED for New Construction (LEED-NC) product has a total of 69 credit points (along with seven mandatory prerequisites that must be achieved) to gain project certification.
- Depending on how many total points are achieved, the project can be certified at the following levels: certified (26), silver (33), gold (39), or platinum (52).
- What role can you play in this process? The electrical designer is involved with two of the prerequisites and up to 28 of the 69 total credit points — or just more than **40%** of the total LEED credit points available. With that kind of influence, an electrical designer can affect the project's LEED certification in many ways, including input on the following areas.

Sustainable Sites (SS)

- This section of the LEED rating system has 14 possible points with one prerequisite. The electrical designer is directly responsible for only one of these credits, but can help support another (SSc4.3: Alternative Transportation) by providing charging locations for electrical vehicles.
- Light pollution reduction (SSc8): The industry has provided several ways to minimize light trespass from the building and site, increase night sky access, improve nighttime visibility via glare reduction, and reduce nocturnal environmental impact.
- Lighting for interior spaces shall have occupancy sensors and/or be time controlled, or the interior lighting fixture layout must be designed to minimize light trespass out the windows.
- Exterior fixtures shall be specified as “cut-off” type to eliminate light trespass off site. Proper control of exterior and interior lighting shall conform to ASHRAE/IESNA Standard 90.1-2004.

Energy and Atmosphere (EA)

- This section has 17 possible credit points with three prerequisites. The electrical designer must meet ASHRAE/IESNA 90.1-2004 by designing systems that are energy efficient.
- **Fundamental commissioning of building energy systems (EAp1):** The purpose of this prerequisite is to have the building operating at the design intent performance levels after construction is complete. The primary electrical system to be commissioned will be the lighting system and associated controls. Programming of lighting controls and any day lighting control aspects of the lighting system must be commissioned for optimal performance. It will be the responsibility of the electrical designer to assist with the development of the design intent document and ensure that the project specifications contain commissioning references for the electrical systems that must be commissioned.
- **Minimum energy performance (EAp2):** This prerequisite establishes a baseline for energy consumption of the systems and equipment used in the facility. Electrically, this can range from VFD controllers for motors to lighting and control systems. The building lighting usage must follow the required lighting power densities (watts/sf) per ASHRAE/IESNA Standard 90.1-2004. Incorporating use of creative controls such as occupancy sensors, timers, and daylight harvesting systems will assist in reducing building energy consumption.

- **Optimize energy performance (EAc1):** Under this credit, it is possible to earn up to 10 credit points for demonstrating an improvement in building performance versus a baseline building performance level per ASHRAE/IESNA 90.1-2004. One way this is proven is through a whole building simulation program/energy modeling program. The electrical designer will need to evaluate the energy consumption of the lighting systems during the design process. Furthermore, the electrical designer must provide documentation of improvement through integration of the lighting energy figures into the energy model load calculation program.
- **On-site renewable energy (EAc2):** This credit recognizes the use of on-site renewable energy in order to reduce environmental and economic impacts associated with traditional fuels. The project may achieve up to three credit points, depending on the amount of renewable energy produced as a percentage of the total building consumption. Applicable energy sources for this credit are solar photovoltaic systems, wind turbines, biomass, and low-impact hydro. When exercising these energy strategies, net metering with the local utility company should also be evaluated.

- **Enhanced commissioning (EAc3):** This credit is an expansion of the commissioning requirements from EAp1. Its intent is to involve the commissioning agent during the design process to help incorporate performance strategies before the building is designed as well as involve and inform the commissioning agent of the basis of the electrical design. The electrical designer shall work with the commissioning agent during the design stage to incorporate strategies for optimizing building performance.
- **Measurement and verification (EAc5):** To provide ongoing review of building energy consumption, this credit mandates that an accountability system be implemented and managed by the building owner. This plan will evaluate building and/or system performance. The electrical designer should consider using separate lighting and receptacle panels to make metering of different systems/uses possible.
- **Green power (EAc6):** A credit point is awarded if 35% of the building's energy consumption is supplied by a Green power provider, and the owner has agreed to a minimum two-year contract. The electrical designer may be involved with creating the building's energy model from which the derived electrical consumption of the building is used to calculate the 35% Green power. The electrical designer may also coordinate the Green power purchase.

Materials and Resources (MR)

- **Materials and resources (MR).** This section has 13 possible credit points with one prerequisite. The electrical designer should be aware of product selection and construction means that can contribute to the overall sustainability of the project.

- **Construction waste management (MRc2.1 and 2.2):** One credit point can be earned by diverting 50% of waste from disposal in landfills and incinerators. An additional credit point can be earned if the diversion is increased to 75%. Recycling and diverting through donation of materials to charitable organizations can also achieve these goals. However, a construction waste management plan is necessary to effectively organize this process. The electrical designer should include specific direction in the project specifications so the contractor understands the plan. At minimum, recycling waste copper and conduit materials should be targeted.

- **Recycled content (MRc4.1 and 4.2):** The intent of this credit is to increase the use of building materials that have a high percentage of recycled content. Electrical, mechanical, and plumbing components have been excluded from use in the project's recycled material calculations to achieve these credit points. However, wherever possible, the electrical designer should investigate the potential to meet the intent of this sustainable design strategy, which is to require 10% to 20% of the building products to incorporate recycled content materials.

- **Regional materials (MRc5.1 and 5.2):** These credit points are achieved through the use of a minimum of 10% to 20% (based on cost) of the materials for the project being extracted, processed, and manufactured regionally (within 500 miles of the project site). Electrical, mechanical, and plumbing components have been excluded from use in the project's regional materials calculations to achieve these credit points. However, wherever possible, the electrical designer should investigate the potential to meet the intent of this sustainable design strategy.

Indoor Environmental Quality (EQ)

- This section has 15 possible credit points with two prerequisites. The electrical designer should be aware of product selection that can contribute to a healthier indoor environment for the building, which can lead to improved worker productivity.
- **Low-emitting materials: adhesives/sealants and paints/coatings —(EQc4.1 and 4.2):** These credits promote reduced use of materials that contribute to increased levels of indoor air contaminants. The electrical designer's responsibility is to incorporate low volatile organic compound (VOC) content sealants, adhesives, paints, and coatings into the electrical specifications.
- **Controllability of systems: lighting (EQc6.1):** To earn this credit, a higher level of lighting system control must be installed. This credit requires controllability for a minimum of 90% of the building occupants to promote not only energy efficiency, but also for their comfort, productivity and well-being. Using task and ambient lighting control strategies will enable building occupants to adjust lighting levels to meet their task needs as well as personal preferences.
- **Daylight and views: daylight 75% of spaces (EQc8.1):** The intent of this credit is to provide a building with a day lighting component of 25 foot-candles in 75% of all regular occupied spaces. There are three ways to document compliance for this credit: through calculation (per equation provided in the LEED reference guide), simulation (using a day lighting modeling program), or through measurement (readings taken in 10 foot by 10 foot grid in all occupied spaces after building construction is complete). In all cases, the electrical designer should discuss building orientation on the site with the architect and owner to optimize the day lighting and coordinate lighting controls with the day lighting schemes.

Innovation and Design Process

- **Innovation and design process.** This section has five possible credit points. It recognizes the project's innovative features and stresses the importance of the integrated design process via using a LEED accredited professional.
- **Innovation in design (IDc1.1-1.4):** These four “additional” credits are intended to provide the design team with an opportunity to earn points for exceptional performance above the requirements set forth by LEED. When a designer applies strategies or measures that are not specifically covered by a LEED credit; and that demonstrate an approach or a measurable environmental or health benefit; this can be submitted for consideration as an ID credit. Each ID credit must be applied for in writing and identify the intent of the proposed credit, the proposed requirement for compliance, and the strategies that might be used to meet the requirements. The electrical designer should identify any unique, electrically related energy or environmental aspects of the building for consideration as a potential ID credit and communicate that information to the project team.
- **LEED accredited professional (IDc2):** Should you as the project's electrical design engineer or any other project team member also be a LEED accredited professional (LEED AP), the project will receive this credit point.

Read More

- **Sustainable Design for Electrical Engineers:**
- **http://ecmweb.com/contractor/sustainable-design-electrical-engineers**
- **Lessons Learned from Solid-State Lighting Pilot Projects:**
- http://ecmweb.com/lighting-amp-control/lessons-learned-solid-state-lighting-pilot-projects.
- **Sports Lighting Reliability:**
- http://ecmweb.com/sagsswellsinterruptions/sports-lighting-reliability
- **Digital Lumens LED Installation at Ben E. Keith Foods:**
- http://ecmweb.com/lighting-amp-control/digital-lumens-led-installation-ben-e-keith-foods
- **The Latest Trends in Emergency Lighting:**
- http://ecmweb.com/lighting-amp-control/latest-trends-emergency-lighting
- **Understanding Harmonic Voltage and Current Distortion Levels at Your Facility:**
- **http://ecmweb.com/power-quality/understanding-harmonic-voltage-and-current-distortion-levels-your-facility**