ENERGY AND ATMOSPHERE

Buildings in the United States consume greater than 30% of the total energy load and about 60% of the nation’s electricity. Fossil fuels are used to produce about three-quarters of our energy production. The use of fossil fuels such as oil and coal requires extraction, refining, power generation, and distribution, significantly impacting the environment. For example, the production of electricity, particularly from coal, releases carbon dioxide that contributes to global warming. Global warming results in rising sea levels and flooding of coastal areas, severe droughts, heat waves, and disease.

Coal-fired electric utilities produce almost one-third of total emissions of nitrogen oxides, a major contributor to smog, and two-thirds of all emissions of sulfur dioxide, a key element in acid rain. The mining of coal disrupts habitat and can devastate landscapes. Acid mine drainage can further degrade the area. The combustion of coal to produce electricity is the largest generator of fine particles in the United States. These fine particles penetrate deep into the lungs of humans and are responsible for the deaths of tens of thousands of Americans each year from cancer and respiratory illness. In addition, mining is a dangerous occupation where accidents and long-term effects of breathing coal dust result in shortened life spans of coal miners.

Other types of energy production include natural gas, nuclear fission, and hydroelectric generators. Natural gas is a major source of nitrogen oxides and produces greenhouse gases, although not as severe as coal or oil. Nuclear power raises the potential for catastrophic accidents and raises significant waste disposal issues. Hydroelectric generating plants disrupt natural water flows, resulting in disturbance of habitat and depletion of fish populations.

Energy consumption can be dramatically reduced through practices that are economical and readily achievable. Improving the energy performance of buildings reduces operations costs, reduces pollution generated by power plants and other energy producing equipment, and enhances comfort. Most energy efficiency measures have a rapid payback period due to the rising cost of energy.

It is helpful to consider a building’s energy load as a whole, to integrate energy efficiency measures and form synergistic relationships. For example, reduction of energy loads through improved glazing, insulation, daylighting, and use of passive solar features may allow the design team to downsize or even eliminate mechanical HVAC systems. LEED EB recognizes the importance of integrated energy strategies and as a result, most of the prerequisites and credits under this topic are performance-based rather than prescriptive.
Energy and Atmosphere

Prerequisite 1: Existing Building Commissioning (Revision for the Pilot draft of LEED EB – Follow this version or the original version for the LEED EB Pilot)

INTENT:
Verify and ensure that fundamental building systems are operating as intended to meet current needs and performance standards.

REQUIREMENT:
(a) Develop and maintain a Building Operating Plan that defines performance criteria that are consistent with current needs for the building and primary systems. The Building Operating Plan needs to address the: building operating requirements, heating system, cooling system, humidity control system, lighting system, water system, and building controls systems.
(b) Define and implement test procedures that proactively determine that the building and primary systems are operating in accordance with the current Building Operating Plan.
   • If test results show that all aspects of the Building Operating Plan have been met, then this prerequisite has been satisfied.
   • If one or more aspects of the performance of the building or primary systems are not operating in accordance with the Building Operating Plan:
     o Repair or upgrade them so they are operating in accordance with the Building Operating Plan.
     OR
     o Submit a plan for continuous improvement of these aspects until all aspects are in compliance with the Building Operating Plan, in no more than 5 years. Additionally, demonstrate continuous improvement on a yearly basis until all aspects are in compliance with the Building Operating Plan, in no more than 5 years.
(c) If all aspects of the performance of the building or primary systems cannot be tested now to determine if they are operating in accordance with the Building Operating Plan, submit a plan for completing steps (a) and (b) above in no more than 5 years. Additionally, demonstrate continuous progress on a yearly basis until all aspects are completed within 5 years.

EA Prerequisite 1, Section 2a: Submittals for Initial EB Applications:
   o Provide the following:
     • A copy of the current Building Operating Plan.
     • Test results indicating the level of compliance with the current Building Operating Plan.
     • If one or more aspects of the Building Operating Plan were not met, submit a description of the actions already implemented to bring building into compliance with the current Building Operating Plan. Submit a schedule of annual actions to bring building into compliance with all aspects of the current Building Operation Plan within 5 years.
EA Prerequisite 1, Section 2b: Submittals for Subsequent Re-Certification Applications:  
   o Provide the following:  
     • A copy of any changes to the Building Operational Plan made since the previous filing for certification or re-certification under LEED EB.  
     • If one or more aspects of the Building Operational Plan were not met in the previous filing for certification or re-certification under LEED EB, submit a description of the actions implemented since the last application to bring building into compliance with the current Building Operating Plan. The Plan must demonstrate that you are on schedule with implementing the planned annual actions to bring your building into compliance with all aspects of the current Building Operating Plan within 5 years of the initial LEED EB Certification filing.

EA Prerequisite 1, Section 3: Summary of Referenced Standard  
Standards Cited: None cited

EA Prerequisite 1, Section 4: Green building Concerns  
Commissioning is a systematic process to ensure that all building systems perform interactively according to the owner’s current operational needs. Ideally, commissioning activities are initiated in the pre-design phase to document the owner’s requirements. Commissioning activities involve actual performance testing and upgrades as necessary to meet building performance plan requirements.

EA Prerequisite 1, Section 5: Environmental Issues  
Commissioning maximizes energy efficiency and thereby minimizes environmental impacts associated with energy production and consumption. Energy conservation reduces the need for natural resource extraction, improves air quality, and reduces global warming processes.

EA Prerequisite 1, Section 6: Economic Issues  
When commissioning of existing buildings is properly executed, operational cost savings can be substantial. Commissioning often increases energy efficiency by 5% to 10%. As an example, the Oregon Office of Energy studied direct energy savings for two buildings after applying commissioning. In an 110,000 square foot office building, energy savings of $12,276 per year (equivalent to $0.12 per square foot) were realized through commissioning activities. In a 22,000 square foot office building, energy savings equal to $7,630 per year ($0.35 per square foot) were achieved through commissioning.  

In addition to energy performance, occupant productivity is another operational cost impacted by subpar building performance. The study above estimated indirect costs associated with lost productivity due to occupant complaints about the indoor environment. The study estimated that if 20% of building occupants expended 30 minutes per month complaining about lighting or temperature conditions, the employer would lose $0.10 per square foot in annual productivity. For a 100,000 square foot building, this equates to $10,000 per year. This loss does not factor in actual productivity...
reductions resulting from the sub-optimal conditions, but only addresses complaint time. Other potential costs of poor building performance cited by the Oregon Office of Energy include employee illness, loss of tenants, liability related to indoor air quality, and premature equipment replacement.

Increasing system performance through commissioning reduces operating energy consumption and costs. Ensuring proper functioning of systems on a continual basis decreases maintenance costs that accumulate due to negligence of repairs and upkeep, and reduces the frequency of contractor callback. Commissioning may also provide owners the opportunity to receive public benefit fund or utility rebates.

**EA Prerequisite 1, Section 7: Strategies and Technologies**

Implementing an effective Existing Building Commissioning Program can help meet the requirements of other prerequisites and credits in the LEED for EB Rating System. These include:

- Energy and Atmosphere Credit 3: Continuous Existing Building Commissioning and Maintenance
- Energy and Atmosphere Credit 5: Measurement and Verification (Points 5.1, 5.2, & 5.3)
- Indoor Environmental Quality Prerequisite 1: Minimum IAQ Performance
- Indoor Environmental Quality Credit 1: Carbon Dioxide (CO\(_2\)) Monitoring
- Indoor Environmental Quality Credit 7: Thermal Comfort

**Strategy**

Recognizing the broad diversity of buildings, systems and equipment, and the varying degree of measurement technologies resident in existing buildings, this guideline is general in nature so that it may be broadly applied. It is up to building owners to customize a Building Operating Plan suitable to the building’s current operating requirements and needs.

When developing a current Building Operating Plan, the basic strategy is to identify performance criteria that are essential for effective, efficient building operation for the present needs of the building, along with test and measurement procedures that can be conducted in a practical, cost-effective manner. The suggested approach is to identify high-level criteria for the whole building and primary systems for which test and measurement procedures are readily available. Methods that involve continuous monitoring as outlined in other sections of LEED EB may also help meet this requirement.

For those buildings that do not yet have continuous monitoring capabilities, some form of field test is required for certain building systems. While it is up to building owners to determine which methods are most suitable to their specific needs, the approach suggested in this guideline is to conduct performance testing for integrated systems which is a critical component of the commissioning process for existing buildings. The basic concept is that if an integrated system does not pass a performance test, then one or more subsystems, equipment and/or components are
not in compliance with the Building Operating Plan. If this is the case, then a plan must be submitted identifying specific improvement activities for specific equipment and components to bring the overall integrated system into compliance. Applications for renewal of LEED EB certification need to include appropriate documentation demonstrating the specified activities were conducted and the results of the acceptance re-test.

For buildings with proactive building maintenance programs, the standards used in these programs may in aggregate provide much or all of what is needed to meet the requirement for a Building Operating Plan. The regular proactive testing of equipment and systems, that is carried out as part of these programs, may provide much or all of what is needed to meet the requirement for implementing test procedures to demonstrate that the building is operating accordance with the current Building Operating Plan.

**Section 7.1 Building-Level Performance**

### 7.1.1 Operating Schedules

**Operating Plan**

For each area of the building or space use type, document the intended hours of occupancy or operating schedules for the eight day types (Monday through Sunday and holidays). Include seasonal variations, if appropriate, a list of holidays and a description of how partial and after-hour usage is accommodated.

**Performance Test**

Parts A and B all must be completed at the time of application or be included in a plan for completion within a maximum period of 5 years.

*Note:* The preference is for all these tasks to be competed by the time the certification application is submitted. However, if this is not possible, it would be acceptable to complete some of the actions prior to submitting the application and including in the application a schedule for completing the remaining actions within 5 years – with substantial progress in each year of the plan.

**Part A**

For automatic controls, such as time clocks or direct digital controls, visually inspect and document settings for comparison with intended schedules. For manually controlled loads, such as lighting operated by manual switches, provide documentation that sweeps are performed to ensure lights are off after occupied hours or provide other evidence that these loads are controlled in accordance with intended schedules.

**Part B**

Provide runtime reports and/or load profile data to demonstrate that controlled loads comply with intended operating schedules. This method may also help to qualify for

*Note:* These run time reports can be developed using either temporary data loggers or building control systems where they have this capability.

### 7.1.2 Space Environmental Conditions

- **Minimum IAQ Performance**

  Minimum IAQ performance, performance criteria, test and measurement procedures, and documentation requirements are specifically addressed in the following LEED for EB sections:
  - Indoor Environmental Quality Prerequisite 1: Minimum IAQ Performance
  - Indoor Environmental Quality Credit 1: Carbon Dioxide (CO\textsubscript{2}) Monitoring

- **Space Temperature**

  **Operating Plan**
  
  For each area of the building or space use type, document the intended space temperature setpoints for occupied and unoccupied heating and cooling. Describe how space temperatures are controlled (locally, remotely and whether or not occupants have control) and any policies in effect and whether or not they are enforced and how.

  **Performance Test**
  
  Both Parts A and B must be completed at the time of application or be included in a plan for completion within a maximum period of 5 years.

  **Part A**
  
  Visually inspect and document a representative sample\textsuperscript{**} of space temperature setpoints for comparison with intended setpoints. Submit any supporting documentation for policies on space temperature settings and how they are enforced.

  **Part B**
  
  Demonstrate compliance with intended setpoints in all seasons of operation by: 1) Installing loggers to monitor space temperature in representative areas of the building\textsuperscript{**}; or 2) Using building automation system reports or trend log data. This method may also help to qualify for LEED EB Energy and Atmosphere Credit 3: Continuous Building Commissioning.

  If setpoints or temperatures are not in compliance with the Building Operating Plan, then submit a plan for continuous improvement. In subsequent years, submit documentation that improvement activities were conducted on the areas of the original sample, and submit the results of the acceptance re-test. If improvement
cannot be achieved by tune-up commissioning or other system-related activities, submit documentation describing the hurdles preventing improvement.

** Minimum sample size shall be 10% or 5 space temperature control devices or locations, whichever is greater. Applicants are encouraged to exceed the minimum sample whenever possible. For sample sizes less than 10%, perform performance testing on a different sample each year.

Note: Thermal comfort, including humidity requirements, are specifically addressed in LEED EB Indoor Environmental Quality Credit 7.

- **Space Pressurization**

  **Operating Plan**
  For each area of the building or space use type, document the intended space pressurization requirements.

  **Performance Test**
  **Option A**
  Design and conduct a performance test, and submit documentation to demonstrate that space pressurization requirements have been met.

  **Option B**
  Demonstrate compliance with intended space pressurization in all modes of operation by: 1) Installing loggers to monitor space pressure in strategic areas of the building; or 2) Using building automation system reports or trend log data. This method may also help to qualify for LEED EB Energy and Atmosphere Credit 3: Continuous Building Commissioning.

  For those buildings where space pressurization is critical for occupant safety, such as hospitals and laboratories, perform performance tests in accordance with applicable regulatory agency standards.

- **Building Envelope**

  **Operating Plan**
  The building envelope must be caulked and sealed to minimize air infiltration.

  **Performance Test**
  Perform annual inspections of the following building envelope penetrations to ensure compliance with operation Plan:
  - Basic envelop integrity (no glaring holes, gaps or openings)
  - Doors and door jams
  - Windows and window frames
  - Backdraft and mechanically-operated dampers when fans are off
Provide documentation of corrections or a plan for correcting non-compliance. Each year, inspect 20% of the total conditioned space or 250,000 square feet, whichever is greater.

Note: A suggested Innovation Credit is to carry out an infrared building scan once every 5 years and address any problems identified.

Section 7.2 System-Level Performance

7.2.1 Primary HVAC Systems

7.2.1.1 Central Heating/Cooling Systems

- Equipment Sequencing

Operating Plan
Describe the intended sequence of operation for energizing, loading, unloading and de-energizing major, centralized equipment, such as boilers, chillers and cooling towers.

Performance Test
Option A
Design and conduct a performance test, and submit documentation to demonstrate that central heating and cooling systems are sequencing as intended.

Option B
Demonstrate compliance with intended equipment sequencing by: 1) Installing appropriate data logging equipment; or 2) Using building automation system reports and/or trend log data. This method may also help to qualify for LEED EB Energy and Atmosphere Credit 3: Continuous Building Commissioning.

- Supply Temperature Reset

Operating Plan
For each applicable system (hot water, chilled water and condenser water) describe the intended sequence of operation for resetting supply water temperatures.

Performance Test
Option A
Design and conduct a performance test, and submit documentation to demonstrate that supply water temperatures are being reset as intended.

Option B
Demonstrate compliance with intended temperature reset by: 1) Installing appropriate logging equipment; or 2) Using building automation system reports...
and/or trend log data. This method may also help to qualify for LEED EB Energy and Atmosphere Credit 3: Continuous Building Commissioning.

- **Variable Volume Pumping Modulation**
  
  **Operating Plan**
  
  For each applicable variable volume pumping system, describe the sequence of operation and desired “turn-down” or performance criteria for modulation.

  **Performance Test**
  
  **Option A**
  
  Design and conduct performance tests, and submit documentation to demonstrate that variable volume pumping systems are modulating as intended.

  **Option B**
  
  Demonstrate compliance with intended variable volume modulation by: 1) Installing appropriate logging equipment; or 2) Using building automation system reports and/or trend log data. This method may also help to qualify for LEED EB Energy and Atmosphere Credit 3: Continuous Building Commissioning.

7.2.1.2  **Air-Handling Units**

- **Economizers**

  **Operating Plan**
  
  Describe the intended sequence of operation for utilizing outdoor air to minimize mechanical cooling. Specify whether operation is based on enthalpy or dry bulb temperature.

  **Performance Test**
  
  **Option A**
  
  Conduct a field test, and submit documentation to demonstrate that air-handling unit economizers operate as intended.
  
  Note: It may be cost-effective to conduct this test at the same time that testing is performed to comply with Indoor Environmental Quality Prerequisite 1: Minimum IAQ Performance.

  **Option B**
  
  Demonstrate compliance with intended economizer operation by: 1) Installing appropriate data logging equipment; or 2) Using building automation system reports and/or trend log data. This method may also help to qualify for LEED EB Energy and Atmosphere Credit 3: Continuous Building Commissioning.

- **Discharge Air Temperature Reset**
Operating Plan

For each applicable air-handling unit (where terminal unit conditions are used to reset discharge air temperature) describe the intended sequence of operation.

Performance Test

Option A
Design and conduct a performance test, and submit documentation to demonstrate that discharge air temperatures are being reset as intended.

Option B
Demonstrate compliance with intended temperature reset by: 1) Installing appropriate logging equipment; or 2) Using building automation system reports and/or trend log data. This method may also help to qualify for LEED EB Energy and Atmosphere Credit 3: Continuous Building Commissioning.

Variable Air Volume Modulation

Operating Plan

For each air-handling unit with variable air volume capability, describe the sequence of operation and desired “turn-down” or performance criteria for modulation.

Performance Test

Option A
Design and conduct a performance test, and submit documentation to demonstrate that variable air volume systems are modulating as intended.

Option B
Demonstrate compliance with intended variable air volume modulation by: 1) Installing appropriate data logging equipment; or 2) Using building automation system reports and/or trend log data. This method may also help to qualify for LEED EB Energy and Atmosphere Credit 3: Continuous Building Commissioning.

7.2.3 Water Systems

The objective for this Existing Building Commissioning Prerequisite is to ensure that the water systems are operating in accordance with the current Building Operating Plan for the water systems.

Note: Plumbing fixture and irrigation system water usage and process equipment design efficiencies for dishwashers, cooling towers, evaporative cooling equipment, once-through process heating and cooling systems, humidification and make-up water systems are addressed in the LEED EB Water Use and Water Efficiency Section. Operational efficiency (ensuring that these systems operate as intended) should be addressed as part of the system-level operating plan and associated performance tests outlined in this reference guide.
7.2.4 Lighting Systems

Lighting systems play a vital role in both building energy use and indoor environmental quality. The objective for lighting systems in the Existing Building Commissioning Prerequisite is to ensure that the lighting systems are operating in accordance with the current Building Operating Plan for lighting. Operating schedules for lighting systems are addressed in Section 7.1.1, Operating Schedules.

7.2.5 Control Systems

Building Control systems play a vital role in both building energy use and indoor environmental quality. Operating schedules for control systems are addressed in Section 7.1.1, Operating Schedules.

Operating Plan

The control systems operate according to the building operating schedule and provides the equipment in the building with the appropriate signals to maintain the space conditions in accordance with current operating plan for the building.

Performance Test

Demonstrate that the Control Systems are controlling building systems in accordance with the current Building Operating Plan. This demonstration needs to address the following: the Building Level Performance; Operating Schedules (7.1.1); Space Environmental Conditions (7.1.2) and the System Level Performance; Primary HVAC Systems (7.2.1); Water Systems (7.2.2); and, Lighting systems (7.2.3).

EA Prerequisite 1, Section 8: Synergies and Trade Offs

The commissioning process affects all dynamically operated components, equipment, systems and features. Site features on the project that require commissioning attention include alternative fueling stations and exterior lighting fixtures and systems. Water commissioning includes irrigation systems, plumbing fixtures, and plumbing infrastructure. Energy commissioning covers HVAC systems, lighting, and energy generation equipment. Commissioning activities that affect indoor environmental quality include temperature and humidity controls, ventilation systems, monitoring equipment, occupant controls, and daylighting systems.

EA Prerequisite 1, Section 9: Calculations, Template Documents and Other Materials

None are provided for this Prerequisite.

EA Prerequisite 1, Section 10: Other Resources

- **Building Tune-up Resources**

  These documents and references describe general methods and procedures for reviewing/adjusting system control settings, and testing/correcting calibration and operation of system components, such as sensors, actuators and controlled devices. It does not involve making fundamental changes to sequences of operation or system
operating characteristics, such as airflow. Existing publications and references include:

ENERGY STAR Building Upgrade Manual
US EPA Office of Air and Radiation, 6202J, October 2001

Full manual:

Chapter on Recommissioning (building tune-up oriented):

• Full Existing Building Commissioning for Existing Buildings Resources
The references below provide information on rigorous functional performance and performance testing of many of the primary and secondary systems and components commonly found in existing buildings. It involves assessing which systems need to be addressed, development of systems manuals, testing, measuring and making fundamental changes to sequences of operation and operational characteristics to bring systems into compliance with the current operating plan. Existing publications and reference materials for commissioning and recommissioning are extensive. Notable references and related links include:

ASHRAE Guideline 1-1996, The HVAC Commissioning Process
(Plus many other reference materials)

http://www.ashrae.org

A Practical Guide for Commissioning Existing Buildings
Tudi Haasl, Portland Energy Conservation, Inc.
Terry Sharp, Oak Ridge National Laboratory, April 1999


Additional references and links:

http://www.peci.org/cx/index.html

EA- Prerequisite 1: Section 11: Definitions

Existing Building Commissioning: In LEED EB this refers to developing a Building Operating Plan that identifies current building operating requirements and needs and then conducting tests to proactively determine if the building and fundamental systems are operating in accordance with the Building Operating Plan.
EA- Prerequisite 1: Section 12: Case Study

*Note:* A LEED EB Case Study will be added from the LEED EB Pilot Applications when these become available.
Energy and Atmosphere Prerequisite 2: Minimum Energy Performance

EA-Prerequisite 2: Intent
Establish the minimum level of energy efficiency for the base building and systems.

EA-Prerequisite 2, Section 1: Requirement
Demonstrate building energy efficiency and performance as required by the EPA ENERGY STAR Portfolio Manager for buildings (score of 60).

The LEED EB Committee is currently working on an energy achievement benchmarking method to address buildings that fall outside of the range of building types currently addressed by the Energy Star Benchmarking Tool/Portfolio Manager. Please email Tim Jones (timjones@leonardoacademy.org) to get updates on the status of the Committee’s work on this issue.

EA-Prerequisite 2, Section 2a: Submittals for Initial Certification under LEED EB
- Minimum Energy Performance
  - Provide calculations and Portfolio Manager/Benchmarking Tool output showing the building energy efficiency and performance achieved an EPA ENERGY STAR Portfolio Manager score of 60,
  AND
  - Provide a summary of the annual bills for each type of energy used by the building including the annual cost and annual amount of each type of energy used and provide copies of the actual bills.

EA-Prerequisite 2, Section 2b: Submittals for Subsequent, Ongoing Re-Certification under LEED EB
- If there has been no change to this information since previous LEED EB filing provide statement that there has been no change.
- If there has been a change to this information since previous LEED EB filing provide updated information.

EA-Prerequisite 2, Section 3: Summary of Referenced Standards

USEPA ENERGY STAR® Portfolio Manager

ENERGY STAR is a government-backed program helping businesses and individuals protect the environment through superior energy efficiency. Because a strategic approach to energy management can produce twice the savings - for the bottom line and the environment - as typical approaches, EPA's ENERGY STAR partnership offers a proven energy management strategy that helps in measuring current energy performance, setting goals, tracking savings, and rewarding improvements.
Standards Cited:
USEPA ENERGY STAR® Portfolio Manger - (Topic cited: Tools for calculating the USEPA ENERGY STAR® performance score.)

Where to obtain this document:
Organization name: U.S. EPA
Telephone number: (888) 782-7937
Web address: www.energystar.gov

EA-Prerequisite 2, Section 4: Green building Concerns
Building design of the last 50 years has assumed remote energy sources for building operation instead of traditional local and passive energy sources. While the use of these remote energy sources has arguably created more productive spaces than the past, the benefit has been costly to the environment.

As we continue to extract and burn fossil fuels, there is growing evidence connecting energy consumption with global warming. Hydropower activities are moving from regional control to the open market and the impacts on endangered species are becoming a critical element of power planning and allocation efforts. Meanwhile, nuclear power plants are being decommissioned and sufficient storage sites for spent fuel materials have not been established. As these negative impacts of building energy use are becoming better understood, the demand for energy efficiency will continue to grow.

EA-Prerequisite 2, Section 5: Environmental Issues
Energy efficiency reduces the environmental burdens associated with energy production and use. This includes natural resource extraction, air pollution, and water pollution.

EA-Prerequisite 2, Section 6: Economic Issues
Energy Star
Energy management is an important aspect of environmental management which will show healthy dividends for your business. ENERGY STAR has the strategies to make you a leader and set your organization apart. Behind every energy strategy is a measurable rate of return. Organizations that improve energy performance outperform their competitors by as much as 10%.

EPA offers businesses a suite of energy-related financial metrics to help understand the effectiveness of current practices and find opportunities to improve corporate energy management practices. Use of the metrics, allows senior decision-makers and financial analysts to quickly and accurately gauge a company's energy management performance within its specific industry (http://www.energystar.gov/index.cfm?c=assess_value.bus_financial_value_calculator).
The metrics place organization-wide energy expenditures in a strategic financial context. They can be used to assess operating efficiency, business risk, and growth potential. By treating energy management as a strategic issue, companies can:
- Reduce operating costs
- Increase cash flow
• Boost profit margins

EA-Prerequisite 2, Section 7: Strategies and Technologies

Part A: Using the Energy Star Portfolio Manager to Benchmark Building Performance

Use the Energy Star Portfolio Manager to benchmark the energy performance of your building.

To do this, go to the Energy Star Portfolio Manager on the Energy Star web site and:

• Enter the requested energy use and other building data requested
• Print out the data entered and the score received to own, manage, or hold as investment. For the building types listed below, the impact of factors outside of your control (e.g., location, occupancy, and fuel type) are removed, providing a 1-100 ranking of a building's energy performance relative to the national building market. Measured energy consumption forms the basis of the ranking and is the only true measure of performance.

Building Types Currently Covered by the Energy Star Benchmarking Tool

• Office Buildings
• K-12 Schools
• Grocery Stores
• Hospitals
• Hotels

Building Types Being Beta Tested in the Energy Star Benchmarking Tool

• Convenience Stores
• Healthcare
• Warehouses

Building Types that will be Added to Energy Star Benchmarking Tool in 2003

• Many more building types will be added to the Energy Star Benchmarking Tool during 2003
• More building types will be added to the Energy Star Benchmarking Tool in future years

Weather Normalization in Energy Star

The Energy Star Building performance benchmarking tool includes weather normalization so that the building performance can be more accurately compared from year to year. The Portfolio Manager uses your building’s monthly energy data and monthly weather data to carry out weather normalization.

Other Related Energy Star Tools

The Energy Star Target Finder provides an energy budget for architects and designers of new buildings and those under major retrofit. Energy budgets are comparatively based on the energy consumption of real buildings, which provides a meaningful baseline for the impact of adding energy efficiency measures.
The Energy Star Delta Score Estimator provides a quick way to identify the relationship between the percentage energy saved in a standard building and the energy performance rating score of a building using ENERGY STAR.

For More Information on Energy Star
Go to the Energy Star web site at: www.energystar.gov and Click on “Reduce building and facility energy use in you organization.

Special Note for First Time Applications for LEED for Existing Buildings Certification
For first time application for certification under LEED EB, you can use as few as three months of energy use data for your building. This data must be taken following any performance improvement actions you have taken to demonstrate the upgraded building’s energy performance. To calculate the average ratio of the energy use, compare the three previous years of monthly energy use data (specifically, use the data for the months that are identical to the three months of data you would use for documentation) to the total annual energy use in these previous years. To calculate total annual energy use, multiply the three months of “post-improvements” data you have collected by the historical average ratio of the energy use in these three months (ratio = 3 month historical average energy use divided by the historical annual energy use). This calculation gives you the effective annual energy use to use in the performance evaluation to meet this prerequisite. However, subsequent applications for LEED for Existing Buildings Certification require at least one full year of energy use data for your building to demonstrate building energy performance.

EA-Prerequisite 2, Section 8: Synergies and Trade Offs
The Standard is designed to afford significant trade-offs in energy efficient measures while holding the total energy budget of a building constant. Even for the basic compliance path, there are options to trade-off within each of the Envelope, HVAC, Water Heating, Power and Lighting sections. Appropriate ventilation must be included in energy efficiency efforts to ensure optimal IAQ.

EA-Prerequisite 2, Section 9: Calculations, Template Documents and Other Materials
Follow the calculation methodology as prescribed in the referenced standard.

EA-Prerequisite 2, Section 10: Other Resources
Websites
American Council for an Energy Efficient Economy
www.aceee.org
The ACEEE is a nonprofit organization dedicated to advancing energy efficiency as a
means of promoting both economic prosperity and environmental protection.

**The Building Codes Assistance Project**  
[www.bcap-energy.org](http://www.bcap-energy.org)  
BCAP assists states in developing and implementing statewide building energy codes.

**Energy Efficient Building Association**  
[www.eeba.org](http://www.eeba.org)  
The EEBA is a nonprofit organization that promotes the awareness, education, and development of energy efficient and environmentally responsible buildings and communities.

**EPA Buildings Upgrade Manual**  
This document is a guide for Energy Star Buildings Partners to use in planning and implementing profitable energy-efficiency upgrades in their facilities and can be used as a comprehensive framework for your energy strategy.

**New Buildings Institute**  
[www.newbuildings.org](http://www.newbuildings.org)  
The mission of NBI is to encourage the efficient use of energy in buildings and to mitigate the adverse environmental impacts resulting from energy use in buildings.

[www.eren.doe.gov](http://www.eren.doe.gov)  
A comprehensive resource for Department of Energy information on energy efficiency and renewable energy including access to energy links and downloadable documents.

**Print Media**  

**EA Prerequisite 2, Section 11: Definitions**  
No additional definitions prepared at this time.

**EA- Prerequisite 2, Section 12: Case Study**  
*Note: A LEED EB Case Study will be added from the LEED EB Pilot Applications when these become available.*
Energy and Atmosphere Prerequisite 3: Ozone Protection

EA Prerequisite 3: Intent
Reduce ozone depletion.

EA Prerequisite 3, Section 1: Requirement
- Zero use of CFC-based refrigerants in HVAC&R base building systems unless a third-party audit shows that system replacement or conversion is not economically feasible. If CFC-based refrigerants are maintained in the building, reduce annual leakage to 10% or less using USEPA Clean Air Act, Title VI, Rule 608 procedures governing refrigerant management and reporting.

EA Prerequisite 3, Section 2a: Submittals for Initial Certification under LEED EB
- Prerequisite Ozone Protection
  - Provide documentation that HVAC&R base building systems do not use CFCs, OR provide results of third-party audit demonstrating that replacement is not economically feasible.
  - Provide documentation showing compliance with USEPA Clean Air Act, Title VI, Rule 608 governing refrigerant management and reporting.

- EA Prerequisite 3, Section 2b: Submittals for Subsequent, Ongoing Recertification under LEED EB
  - Provide documentation that HVAC&R base building systems do not use CFCs, OR provide results of third-party audit demonstrating that replacement is not economically feasible.
  - Provide documentation showing compliance with EPA Clean Air Act, Title VI, Rule 608 governing refrigerant management and reporting.

EA Prerequisite 3, Section 3: Summary of Referenced Standard
Standards Cited:

USEPA Clean Air Act, Title VI, Rule 608 - (Topic cited: Procedures governing refrigerant management and reporting.)
Where to obtain this document:
Organization name: USEPA
Telephone number: (800) 296-1996

USEPA program, “Building Air Conditioning and Climate Protection” - (Topic cited: Standards and support for this type of analysis to determine if elimination of CFC based refrigerants through system replacement or equipment modification, to allow refrigerant conversion, is economically feasible.)
Where to obtain this document:
Organization name: USEPA
Telephone number: (800) 296-1996
Web address: [www.epa.gov/appdstar/pdf/summit02.pdf](http://www.epa.gov/appdstar/pdf/summit02.pdf)
EA Prerequisite 3, Section 4: Green building Concerns
Conventional refrigeration equipment uses chlorofluorocarbons (CFCs) in refrigerants. CFCs are halogenated substances that have a significant impact on the Earth’s atmosphere because they are confirmed ozone depleting substances that contribute to global warming.

The United States is one of the world’s largest emitters of ozone depleting substances. The world community has recognized the importance of ozone depletion and 160 countries have signed the “Montreal Protocol on Substances that Deplete the Ozone Layer.” This treaty includes a timetable for the phaseout of production and use of ozone depleting substances. Under the timetable requirements, CFC production in the U.S. ceased in 1995.

As part of the U.S. commitment to implementing the Montreal Protocol, the U.S. Congress added new provisions to the Clean Air Act for protection of the ozone layer. Those amendments require the U.S. Environmental Protection Agency to develop and implement regulations for the responsible management of ozone-depleting substances in the U.S. These include programs to end the production of ozone-depleting substances, identifying safe and effective alternatives to ozone-depleting substances, and requiring that manufacturers label products either containing or made with the most harmful Ozone Depletion Potentials (ODPs).

EA Prerequisite 3, Section 5: Environmental Issues
Use of CFCs in refrigeration equipment results in the release of these substances to the stratospheric ozone layer. Here, the CFCs destroy ozone molecules through a catalytic process, reducing the Earth’s natural shield for incoming ultraviolet radiation. CFCs in the stratosphere also absorb infrared radiation and function as potent greenhouse gases.

By banning the use of CFCs in refrigerants, depletion of the ozone layer can be slowed and global warming effects can be minimized.

EA Prerequisite 3, Section 6: Economic Issues
Because CFC production has ceased, replacement chemicals will be exhausted in the coming years. Although it is possible to obtain CFC refrigerants from existing stocks and recycled materials, competition for these materials will increase dramatically in the future, driving up costs.

In new buildings, it is standard practice to use non-CFC building equipment. In existing buildings, additional first costs are required to convert or replace systems currently using CFCs. However, most new non-CFC HVAC systems and refrigerants are cost-competitive with CFC equipment. New HVAC systems also have the benefit of increased energy efficiency. In some existing buildings, conversion or replacement of systems currently using CFC’s may not be economically feasible.

EA Prerequisite 3, Section 7: Strategies and Technologies
Set up loss minimization procedures and systems to meet annual loss minimization standards and reporting requirements. The USEPA program, “Building Air Conditioning and Climate Protection” is developing standards and support for this type of analysis.
Specify only non-CFC-based refrigerants in all new base building HVAC&R systems. Identify all CFC-based refrigerant uses and upgrade the identified equipment before occupancy if this is economically feasible. If not economically feasible, provide a third party analysis demonstrating that it is not feasible and implement a program to minimize leakage to meet specifications.

For conversion or replacement systems, carefully consider the trade-offs among the various CFC substitutes. Refrigerants have varying lifetimes, ozone depletion potentials (ODP) and global warming potentials (GWP). Table 1 provides examples of lifetimes, ozone depleting potential values, and global warming potential values for a variety of refrigerants. It is beneficial to choose refrigerants with low lifetimes as well as low ODP and GWP values. It is also important to check on the phaseout period of CFC substitutes. Some of these refrigerants are acceptable alternatives today but have relatively short (e.g., 10-year) phaseout deadlines. As noted in the table, halons tend to have a considerably greater environmental impact than HCFCs as reflected in the U.S. EPA’s Significant New Alternatives Policy (SNAP) guidance.

**Table 1: Refrigerant Environmental Data**

<table>
<thead>
<tr>
<th>Refrigerant</th>
<th>Lifetime [years]</th>
<th>ODP</th>
<th>GWP</th>
</tr>
</thead>
<tbody>
<tr>
<td>CFC-11</td>
<td>45</td>
<td>1</td>
<td>4,000</td>
</tr>
<tr>
<td>CFC-12</td>
<td>100</td>
<td>1</td>
<td>8,500</td>
</tr>
<tr>
<td>CFC-13</td>
<td>640</td>
<td>1</td>
<td>11,700</td>
</tr>
<tr>
<td>CFC-113</td>
<td>85</td>
<td>1</td>
<td>5,000</td>
</tr>
<tr>
<td>CFC-114</td>
<td>300</td>
<td>1</td>
<td>9,300</td>
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<tr>
<td>CFC-115</td>
<td>1,700</td>
<td>1</td>
<td>9,300</td>
</tr>
<tr>
<td>Halon 1211</td>
<td>11</td>
<td>3</td>
<td>N/A</td>
</tr>
<tr>
<td>Halon 1301</td>
<td>65</td>
<td>10</td>
<td>5,600</td>
</tr>
<tr>
<td>Halon 2402</td>
<td>N/A</td>
<td>6</td>
<td>N/A</td>
</tr>
<tr>
<td>HCFC-22</td>
<td>12</td>
<td>0.06</td>
<td>1,700</td>
</tr>
<tr>
<td>HCFC-123</td>
<td>1</td>
<td>0.02</td>
<td>93</td>
</tr>
<tr>
<td>HCFC-124</td>
<td>6</td>
<td>0.02</td>
<td>480</td>
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<tr>
<td>HCFC-141b</td>
<td>9</td>
<td>0.11</td>
<td>630</td>
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<tr>
<td>HCFC-142b</td>
<td>19</td>
<td>0.07</td>
<td>2,000</td>
</tr>
<tr>
<td>HFC-32</td>
<td>5.6</td>
<td>0</td>
<td>650</td>
</tr>
<tr>
<td>HFC-125</td>
<td>32.6</td>
<td>0</td>
<td>2,800</td>
</tr>
<tr>
<td>HFC-134a</td>
<td>14.6</td>
<td>0</td>
<td>1,300</td>
</tr>
<tr>
<td>HFC-143a</td>
<td>48.3</td>
<td>0</td>
<td>3,800</td>
</tr>
<tr>
<td>HFC-152a</td>
<td>1.5</td>
<td>0</td>
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</tr>
<tr>
<td>HFC-236fa</td>
<td>209</td>
<td>0</td>
<td>6,300</td>
</tr>
</tbody>
</table>

Source: EPA’s Ozone Depletion Web Site
Changing HVAC equipment to meet this prerequisite can increase energy efficiency if equipment is chosen carefully. However, there is no “ideal” alternative for CFCs. HCFC-123 and HFC-134a are the two most attractive substitutes at the present time.

**EA Prerequisite 3, Section 8: Synergies and Trade offs**

This prerequisite is the first step in a two-step process to reduce a building’s contribution to the ozone depletion problem. Also see EA Credit 4. If the project does not contain mechanical refrigeration equipment, then the project meets the requirements of the prerequisite. Refrigeration equipment and refrigerant choices will impact on the energy performance of the building. Thus, it is important to balance energy efficiency with refrigeration choices. In an existing building, it may be costly or difficult to upgrade building equipment using CFCs.

**EA Prerequisite 3, Section 9: Calculations, Template Documents and Other Materials**

If CFC-based refrigerants are in use in existing HVAC&R base building systems, the preferred option is to upgrade or replace these systems so that they do not use CFC refrigerants if it is feasible to do so. It is believed that for much of the older HVAC equipment (chillers) using CFC-based refrigerants, that the efficiency increases resulting from advances in technology will often make replacement of this equipment economically desirable. However, if a third-party analysis is provided that shows that system replacement or conversion is not economically feasible, the HVAC&R base building systems using CFC based Refrigerants can continue to be used in the building. A third party is defined as someone who is not directly involved in the operation and maintenance of the affected HVAC&R base building systems.

**EA Prerequisite 3, Section 10: Other Resources**

**Websites**

**EPA’s Significant New Alternatives Policy (SNAP)**


SNAP is an EPA program to identify alternatives to ozone-depleting substances. The program maintains up-to-date lists of environmentally friendly substitutes for refrigeration and air conditioning equipment, solvents, fire suppression systems, adhesives, coatings, and other substances.

**Benefits of CFC Phaseout**

[www.epa.gov/ozone/geninfo/benefits.html](http://www.epa.gov/ozone/geninfo/benefits.html)

An EPA document on the benefits of CFC phase-out, including brief case studies.

**Coping with the CFC Phaseout**

[www.facilitymanagement.com](http://www.facilitymanagement.com)

Various articles on the issues of CFC phase-out from Facility Management magazine.

**Stratospheric Ozone Protection: Moving to Alternative Refrigerants**

[http://es.epa.gov/program/epaorgs/oar/altrefrg.html](http://es.epa.gov/program/epaorgs/oar/altrefrg.html)
An EPA document with ten case histories on buildings that have been converted to accommodate non-CFC refrigerants.

**Print Materials**


*CFCs, HCFC and Halons: Professional and Practical Guidance on Substances that Deplete the Ozone Layer*, ASHRAE, 2000.


**EA- Prerequisite 3:, Section 11: Definitions**

**Chlorofluorocarbons** (CFCs) are hydrocarbons used as refrigerants in buildings that deplete the stratospheric ozone layer.

**Hydrochlorofluorocarbons** (HCFCs) are refrigerants used in building equipment that deplete the stratospheric ozone layer.

**Refrigerants** are the working fluids of refrigeration cycles. They absorb heat from a reservoir at low temperatures and reject heat at higher temperatures.

**EA- Prerequisite 3:, Section 12: Case Study**

*Note: A LEED EB Case Study will be added from the LEED EB Pilot Applications when these become available.*
Energy and Atmosphere Credit 1: Optimize Energy Performance (Points: 10)

**EA-Credit 1: Intent**
Achieve increasing levels of energy performance above the prerequisite standard to reduce use of non-renewable fuels and to reduce the environmental impacts associated with excessive energy use.

**EA-Credit 1, Section 1: Requirement**
Reduce/maintain energy usage to a level to achieve/maintain an EPA ENERGY STAR Label for Buildings using the ENERGY STAR Label Portfolio Manager.

The LEED EB Committee is currently working on an energy achievement benchmarking method to address buildings that fall outside the range of building types currently addressed by the Energy Star Benchmarking Tool/Portfolio Manager. Please email Tim Jones (timjones@leonardoacademy.org) to get updates on the status of the Committee’s work on this issue.

<table>
<thead>
<tr>
<th>Energy Star Label Scale</th>
<th>LEED Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>70 Score</td>
<td>2</td>
</tr>
<tr>
<td>75 Score</td>
<td>4</td>
</tr>
<tr>
<td>85 Score</td>
<td>6</td>
</tr>
<tr>
<td>90 Score</td>
<td>8</td>
</tr>
<tr>
<td>95 Score</td>
<td>10</td>
</tr>
</tbody>
</table>

Regulated energy components include HVAC systems, building envelope, service hot water systems, lighting and other regulated systems as defined by ASHRAE.

**EA-Credit 1, Section 2a: Submittals for Initial Certification under LEED EB**
- **Optimize Energy Performance**
  - Provide calculations and Portfolio Manager output showing what score the building’s actual energy efficiency and performance for the last year achieves under the EPA ENERGY STAR Label Building Portfolio Manager, AND
  - Provide a summary of the annual bills for each type of energy used by the building including the annual cost and annual amount of each type of energy used and provide copies of the actual bills.

**EA-Credit 1, Section 2b: Submittals for Subsequent, Ongoing Re-Certification under LEED EB**
- If there has been no change to this information since previous LEED EB filing provide statement that there has been no change.
- If there has been a change to this information since previous LEED EB filing provide updated information.

**EA-Credit 1, Section 3: Summary of Referenced Standards**
ENERGY STAR is a government-backed program helping businesses and individuals protect the environment through superior energy efficiency. Because a strategic approach to energy management can produce twice the savings - for the bottom line and the environment - as typical approaches, EPA's ENERGY STAR partnership offers a proven energy management strategy that helps in measuring current energy performance, setting goals, tracking savings, and rewarding improvements.

The Portfolio Manager is designed to assess the comparative energy performance of a wide range of commercial buildings against all similar-use buildings in the United States. To ensure an accurate benchmark score, the portfolio manager's benchmarking models require buildings to meet certain eligibility criteria.

**Eligible Space Types**

To benchmark your building and apply for the label, at least 50% of your building's floor area must consist of the primary space uses listed below. Additional space types will be added in the coming months.

**Office** - Building space used for general office, professional, and administrative purposes. Relevant businesses and industries include banks, insurance, real estate, securities, brokerage firms, consulting, corporate, engineering, law, management, medical, mixed professional, computer center, and data entry. Floor area for all supporting functions, such as staff cafeterias, lobbies, stairways, elevator shafts, etc., should be included in the total.

**Hospitals** - Acute Care and Children's Hospitals are eligible to participate. These are facilities that typically provide a variety of services within the same building or among multiple buildings on a campus, including emergency medical care, physician's office services, diagnostic care, ambulatory care, and surgical care. For multiple-building hospitals (campuses), the sum of the square footage and energy usage of all buildings should be included in the tool.

**Hotel/Motel** - Buildings that rent overnight accommodations on a room/suite basis, with a bath/shower and other facilities in most guest rooms. Floor area for all supporting functions, such as food facilities, laundry facilities, exercise rooms, health club/spas, lobbies, elevator shafts, stairways, etc., should be included in the total square footage. Hotel/motel categories currently eligible for benchmarking include: economy, midscale, upscale, and upper upscale. Resort and extended stay categories are not eligible for benchmarking at this time.

**K-12 Schools** - School buildings for grades Kindergarten through 12th grade. Floor area for all supporting functions, such as lobbies, cafeterias, stairways, elevator shafts, etc., should be included in the total.
Supermarkets and Grocery Stores - Buildings used for the retail sale of food and beverage products. For these building spaces, the entire floor area including warehouse, office, break-room, and storage areas should be included in the area designated as the supermarket/grocery store space type. Minimum total square footage for this space type is 5,000 square feet.

In addition to these primary spaces, the following secondary space uses may also be addressed by the portfolio manager. For each of these secondary space types, the weekly hours of operation and gross square footage must be defined.

Computer Data Center - Refers to space within a building specifically designed and equipped to meet the needs of data storage or computer equipment for controlled temperatures and/or humidity. Typically the air-conditioning system for this type of area is separate from that used to control the space environment in other parts of the building and is usually separated by walls and doors. Computer data center space cannot exceed 10% of the total building space.

Garages and Parking Lots - Refers to enclosed or open parking facilities that operate from the same energy-use meter as the primary building. Garages are categorized as either above-ground or below-ground. Below-ground garages are assumed to have mechanical ventilation. All parking facilities are assumed to have some kind of lighting.

Standards Cited:
USEPA ENERGY STAR® for Buildings using the ENERGY STAR® Label Benchmarking Tool - (Topic Cited: How to calculate ENERGY STAR® building energy performance score.)
Where to obtain this document:
Organization name: USEPA
Telephone number: (888) 782-7937
Web address: www.energystar.gov

EA-Credit 1, Section 4: Green building Concerns
Energy efficiency reduces the environmental burdens of pollution, land degradation, and human health risks associated with energy production and use. Energy efficiency measures can be instituted in buildings without reducing comfort or building services. In fact, many energy efficiency measures result in a more pleasant indoor environment while reducing operating and first costs. Even small energy savings have incremental effects on the environment and cost savings.

EA-Credit 1, Section 5: Environmental Issues
Conventional forms of energy production have devastating environmental effects. Production of electricity from fossil fuels creates air and water pollution, hydroelectric generation plants make waterways uninhabitable for indigenous fish, and nuclear power has safety concerns as well as problems with disposal of spent fuel.
EA-Credit 1, Section 6: Economic Issues

Many energy efficiency measures do not require additional first costs. Those measures that do result in higher first costs often create savings realized from lower energy use over the building lifetime, downsized equipment, reduced mechanical space needs, and utility rebates. These savings can dwarf the increased first costs and payback periods for many off-the-shelf energy efficiency measures are generally short.

The importance of even small energy efficiency measures is significant. For instance, by replacing one incandescent lamp with a fluorescent lamp, production of three-quarters of a ton of carbon dioxide and 15 pounds of sulfur dioxide are avoided over the lifetime of the lamp. This substitution also saves $30-$50 in energy costs over the lifetime of the lamp.

EA-Credit 1, Section 7: Strategies and Technologies

Part A: Using the Energy Star Portfolio Manager to Benchmark Building Performance

Use the Energy Star Portfolio Manager to benchmark the energy performance of your building.

To do this, go to the Energy Star Portfolio Manager on the Energy Star web site and:

- Enter the requested energy use and other building data requested
- Print out the data entered and the score received to own, manage, or hold as investment. For the building types listed below, the impact of factors outside of your control (e.g., location, occupancy, and fuel type) are removed, providing a 1-100 ranking of a building's energy performance relative to the national building market. Measured energy consumption forms the basis of the ranking and is the only true measure of performance.

Building Types Currently Covered by the Energy Star Benchmarking Tool

- Office Buildings
- K-12 Schools
- Grocery Stores
- Hospitals
- Hotels

Building Types Being Beta Tested in the Energy Star Benchmarking Tool

- Convenience Stores
- Healthcare
- Warehouses

Building Types that will be Added to Energy Star Benchmarking Tool in 2003

- Many more building types will be added to the Energy Star Benchmarking Tool during 2003
- More building types will be added to the Energy Star Benchmarking Tool in future years
Weather Normalization in Energy Star
The Energy Star Building performance benchmarking tool includes weather normalization so that the building performance can be more accurately compared from year to year. The Portfolio Manager uses your building’s monthly energy data and monthly weather data to carry out weather normalization.

Other Related Energy Star Tools
The Energy Star Target Finder provides an energy budget for architects and designers of new buildings and those under major retrofit. Energy budgets are comparatively based on the energy consumption of real buildings, which provides a meaningful baseline for the impact of adding energy efficiency measures.

The Energy Star Delta Score Estimator provides a quick way to identify the relationship between the percentage energy saved in a standard building and the energy performance rating score of a building using ENERGY STAR.

For More Information on Energy Star
Go to the Energy Star web site at: www.energystar.gov and Click on “Reduce building and facility energy use in you organization.

Special Note for First Time Applications for LEED for Existing Buildings Certification
For first time application for certification under LEED EB, you can use as few as three months of energy use data for your building. This data must be taken following any performance improvement actions you have taken to demonstrate the upgraded building’s energy performance. To calculate the average ratio of the energy use, compare the three previous years of monthly energy use data (specifically, use the data for the months that are identical to the three months of data you would use for documentation) to the total annual energy use in these previous years. To calculate total annual energy use, multiply the three months of “post-improvements” data you have collected by the historical average ratio of the energy use in these three months (ratio = 3 month historical average energy use divided by the historical annual energy use). This calculation gives you the effective annual energy use to use in the performance evaluation to meet this prerequisite. However, subsequent applications for LEED for Existing Buildings Certification require at least one full year of energy use data for your building to demonstrate building energy performance.

EA-Credit 1, Section 8: Synergies and Trade Offs
The opportunity to employ energy efficiency measures is dependent on the chosen project site and site design. Sites with greater opportunity for solar and wind opportunities are beneficial. Reducing heat island effects can reduce ambient temperature conditions and thus space cooling requirements. Landscaping can be used to protect the building from wind and to provide shade. Design of site lighting can have a significant effect on energy use.
Water systems can also affect energy use. Automated irrigation and plumbing fixtures require energy for operation. Conversely, low-flow plumbing can save energy required for water pumps and hot water heating. Commissioning and measurement & verification activities have a significant effect on energy use and can ensure that predicted energy savings are realized. Reuse of an existing building may prohibit or hamper energy performance efforts, but there are environmental benefits with regard to materials and construction waste.

Building designers may experience trade-offs between energy efficiency and indoor environmental quality. The provisions for energy efficiency should be balanced with the preferred levels of thermal comfort and ventilation effectiveness. For example, thermal comfort criteria will interact with the HVAC design modeled in the simulation.

**EA-Credit 1, Section 9: Calculations, Template Documents and Other Materials**
None developed at this time.

**EA-Credit 1, Section 10: Other Resources**

**Websites**

**DOE2**
A comprehensive energy analysis program used to predict hourly performance of a building’s energy use and utility costs.

**Energy 10**
[www.nrel.gov/buildings/energy10](http://www.nrel.gov/buildings/energy10)
A simple energy analysis program applicable to commercial and residential buildings of 10,000 square feet or less.

**Energy Star Label for Buildings**
[www.energystar.gov](http://www.energystar.gov)
A benchmarking tool created by the EPA to compare a building to other buildings throughout the country.

**U.S. Department of Energy**
[www.eren.doe.gov/EE/buildings.html](http://www.eren.doe.gov/EE/buildings.html)
An extensive website for energy efficiency, it is linked to a number of DOE funded sites that address buildings and energy. Of particular interest is the tools directory that includes the Commercial Buildings Energy Consumption Tool for estimating end-use consumption in commercial buildings. The Tool allows the user to define a set of buildings by principal activity, size, vintage, region, climate zone, and fuels (main heat, secondary heat, cooling and water heating), and view the resulting energy consumption and expenditure estimates in tabular format.
Print Media


**EA- Credit 1.1-10: Section 11: Definitions**

No other definitions developed at this time.

**EA- Credit 1.1-10:, Section 12: Case Study**

*Note: A LEED EB Case Study will be added from the LEED EB Pilot Applications when these become available.*
Energy and Atmosphere Credit 2: Renewable Energy (Points: 3)

EA Credit 2: Intent
Encourage and recognize increasing levels of self-supply through renewable technologies to reduce environmental impacts associated with fossil fuel energy use.

EA-Credit 2, Section 1: Requirement
Supply/maintain a net fraction of the building’s total energy use (as expressed as a fraction of annual energy cost) through the use of on-site renewable energy systems.

<table>
<thead>
<tr>
<th>Percent of Total Energy Cost in Renewables</th>
<th>Pts.</th>
</tr>
</thead>
<tbody>
<tr>
<td>5%</td>
<td>1</td>
</tr>
<tr>
<td>10%</td>
<td>2</td>
</tr>
<tr>
<td>15%</td>
<td>3</td>
</tr>
</tbody>
</table>

EA-Credit 2, Section 2a: Submittals for Initial Certification under LEED EB
- Renewable Energy
  - Provide system schematic diagrams and narrative highlighting on-site renewable energy systems installed in the building.
  - Provide metered energy output of onsite renewable energy system over the last year.
  - Provide calculations showing the percentage of the building’s total energy requirements that were supplied by on-site renewable energy systems for the last year.

EA-Credit 2, Section 2b: Submittals for Subsequent, Ongoing Re-Certification under LEED EB
- If there has been no change to this information since previous LEED EB filing provide statement that there has been no change.
- If there has been a change to this information since previous LEED EB filing provide updated information.

EA-Credit 2, Section 3: Summary of Referenced Standard
Standards Cited: None cited

EA-Credit 2, Section 4: Green building Concerns
Renewable energy sources include solar, wind, and biomass power generation equipment. Renewable energy is superior to conventional energy sources such as coal, nuclear, oil, natural gas and hydropower generation, because of it’s high coefficient of utilization and the absence of transportation costs and impacts. Environmental impacts associated with conventional power generation are avoided and power users are unencumbered by limitations of the local power distribution grid. In the 1990s, renewable energy applications were the fastest growing sources of energy. Opportunities for renewable energy vary by location and climate.

As of 2000, the PV market had an annual growth rate of 20%, providing new economic opportunities for manufacturing host communities. The number of U.S. companies
producing PV panels has doubled since the late 1970s to about 20 in the year 2000. PV module production for terrestrial use has increased 500-fold in the past 20 years. Worldwide PV module shipments in 1993 were 60 megawatts (MW). The United States now shares more than 1/3 of this market.

The U.S. is one of the top five wind power markets in the world, according to the American Wind Energy Association. Large wind farms are being constructed in many states for regional electricity requirements while micro-turbines are being installed for specific applications. The market for small wind systems (< 100 kW) had an estimated growth of 35% in 1999. These small wind systems power homes and small businesses such as farms and ranches.

The U.S. Department of Energy (DOE) estimates that biomass power is the largest source of non-hydro renewable electricity in the world, with an estimated 14,000 MW of annual worldwide installed generation capacity. The U.S. is the largest single “bio-power” generator, representing a $15 billion investment and 66,000 jobs. The DOE reports that with more than 7,000 MW of installed capacity, biomass is the second-most utilized renewable power generation resource in the U.S. The 37 billion kWh of electricity produced each year from biomass is more than the entire state of Colorado uses annually. Generating this amount of electricity requires around 60 million tons of biomass per year. The Electric Power Research Institute (EPRI) has estimated that biomass combustion facilities could satisfy 5% of the total U.S. power market for electricity while increasing overall farm income by $12 billion annually.

Continued need for on-site industrial power, waste reduction, more stringent environmental regulations, and rising consumer demand for renewable energy will provide the main impetus for the industry’s growth.

**EA-Credit 2, Section 5: Environmental Issues**
Use of renewable energy reduces environmental impacts associated with utility energy production and use. These impacts include natural resource destruction, air pollution, and water pollution. Renewable energy can also reduce other environmental impacts. For example, utilization of biomass can reduce the estimated 350 million tons of woody construction, demolition, and land clearing waste that would otherwise be sent to the landfill each year. Conversely, if these wastes are not processed properly, improper combustion could result, leading to air quality impacts.

Wind turbines may have a detrimental effect on bird populations in some areas. Researchers are currently investigating bird mortality rates and possible design and siting solutions.

**EA-Credit 2, Section 6: Economic Issues**
Use of renewable energy sources can result in energy cost savings, particularly if peak hour demand charges are high. Utility rebates are often available to reduce first costs of renewable energy equipment. In some states, first costs can be offset by net metering, where excess electricity is sold back to the utility.

The combined efforts of industry and the DOE reduced PV system costs in the year 2000 by more than 300% since 1982. The cost of PV systems with capacities greater than 1
kW is measured in “levelized” costs per kWh. In other words, the costs are spread out over the system lifetime and divided by kWh output. The levelized cost for these systems is currently estimated at $0.25 to $0.50/kWh. Systems that do not require storage batteries can have significantly lower costs. Usually PV systems are cost effective for customers located farther than a quarter of a mile from the nearest utility line. With Building Integrated PhotoVoltaics (BIPVs) the costs should also include the marginal savings on the replaced elements of the building such as roofing or cladding. The reliability and lifetime of PV systems are also improving. Manufacturers typically guarantee their PV systems for up to 20 years.

**EA-Credit 2, Section 7: Strategies and Technologies**
Design and specify the use of on-site nonpolluting renewable technologies to contribute to the total energy requirements of the project. Consider and employ high temperature solar, geothermal, wind, biomass (other than unsustainably harvested wood), and bio-gas technologies. See Table 1 for system trends. Note that passive solar, solar hot water heating, ground-source heat pumps, and daylighting do not qualify for points under this credit. These strategies are recognized under EA Credit 1.

**Table 1: Renewable System Trends**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind Turbine</td>
<td>Up to 3,000</td>
<td>$900 to $1,000</td>
<td>$500</td>
</tr>
<tr>
<td>Solar Cell</td>
<td>Up to 1,000</td>
<td>$5,000 to $10,000</td>
<td>$1,000 to $3,000</td>
</tr>
<tr>
<td>Biomass</td>
<td>Up to 5,000</td>
<td>$2,000 to $2,500</td>
<td>$1,000</td>
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</tbody>
</table>


Apply the use of net metering by contacting local utilities or electric service providers (ESPs). Net metering is a special metering and billing arrangement that allows renewable energy generators to send excess electricity flows to the regional power grid. These electricity flows offset a portion of the electricity flows drawn from the grid. For more information on net metering in individual states, visit the DOE’s Green Power Network website at [www.eren.doe.gov/greenpower/netmetering](http://www.eren.doe.gov/greenpower/netmetering).

**Photovoltaics** (PVs) are composite materials that convert sunlight directly into electrical power. In the past, these materials were assembled into PV panels that required a structure to orient them to the sun. In recent years, the efficiency of the cells has increased, the cost has dropped, and the panels are smaller in size. As a result, Building Integrated PhotoVoltaics (BIPVs) are now in production. BIPVs are incorporated into building elements such as the roof, the cladding, or window systems.

PVs generate direct current (DC) electricity, which generally must be converted to alternating current (AC) before it can be used in mainstream building systems. The conversion process requires electronic devices between the PV module and electrically powered appliances. Both dispersed and central converter schemes are possible. The conversion process also affords net metering, where power is put back into the utility grid.
when the local demand is less than the capacity of the PV array. As shown in Table 2, PV systems are rapidly becoming cost effective. Spot electricity costs in the summer months of 2000 exceeded the cost of PV power by a factor of four at some locations in the United States.

**Table 2: Photovoltaic Economic Trends**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity Price [¢/kWh]</td>
<td>40-75</td>
<td>25-50</td>
<td>12-20</td>
<td>&lt;6</td>
</tr>
<tr>
<td>Module Efficiency [%]</td>
<td>5-14</td>
<td>7-17</td>
<td>10-20</td>
<td>15-25</td>
</tr>
<tr>
<td>System Cost [$/W]</td>
<td>10-20</td>
<td>7-15</td>
<td>3-7</td>
<td>1-1.50</td>
</tr>
<tr>
<td>System Lifetime [years]</td>
<td>5-10</td>
<td>10-20</td>
<td>&gt;20</td>
<td>&gt;30</td>
</tr>
<tr>
<td>U.S. Cumulative Sales [MW]</td>
<td>75</td>
<td>175</td>
<td>400-600</td>
<td>&gt;10,000</td>
</tr>
</tbody>
</table>

Source: U.S. Department of Energy Photovoltaics Program

**Biomass** is plant material such as trees, grasses, and crops. These materials are renewable and can be produced sustainably, providing a continuous feedstock source for fuel generation. To generate electricity, biomass fuel is converted to heat energy in a boiler or gasifier. The heat is converted to mechanical energy in a steam turbine, gas turbine, or an internal combustion engine, and the mechanical device turns a generator that produces electricity. Current biomass technology produces heat in a direct-fired configuration. The next generation of equipment uses a co-firing configuration where biomass is substituted for a portion of coal in a standard power plant furnace. Biomass gasifiers are also under development and will be introduced to the marketplace in the future.

The most economical and sustainable biomasses are residue materials from regional industrial processes. Example materials include organic by-products of food, fiber, and forest production such as sawdust, rice husks, and bark. In urban areas, pallets and clean woody yard waste may be available. There also may be a steady supply of wood fiber from local waste collection of construction, demolition and land clearing (CDL) debris. The cost to generate electricity from biomass varies depending on the type of technology used, the size of the power plant, and the cost of the biomass fuel supply.

The DOE’s Small Modular Bioenergy Initiative is developing small, efficient, and clean bio-power systems. Feasibility studies and prototype demonstrations will lead to full system integration based on a business strategy for commercialization.

**Wind Energy** systems convert moving air to electricity. Wind energy installations are becoming increasingly popular as corporate power users and utilities realize the benefits of clean, low-cost, reliable wind energy. The U.S. wind industry currently generates about 3.5 billion kilowatt-hours of electricity each year, equivalent to the annual
electricity needs for 1 million people. Horizontal axis wind turbines are the conventional type of wind turbines and use a three-bladed rotor to harness wind energy.

Recent innovations include a larger rotor diameter using advanced airfoils and trailing-edge flaps for over-speed control. In the future, more advanced wind turbines incorporating the latest materials and mechanical technologies will be introduced to the marketplace. One example of advances in the wind turbine industry is the development of a vertical-axis wind turbine relies on simplicity of design and advanced blade configuration to create a low-cost, highly efficient power system.

Employ the use of on-site non-polluting-source renewable technologies contributing to the total energy requirements of the project. Consider and use photovoltaic panels, high temperature solar and/or geothermal, wind, biomass, and bio-gas. Passive solar, solar hot water heating, ground-source heat pumps, and daylighting do not qualify for points under this credit. Credit for these strategies is given in Energy & Atmosphere Credit 1: Optimize Energy Performance.

EA-Credit 2, Section 8: Synergies and Trade Offs
Renewable energy equipment typically impacts the project site and some project sites are more compatible with renewable strategies than others. Renewable energy equipment will impact energy performance of the building and requires commissioning and measurement & verification attention. Finally, building integrated PV systems should be integrated with daylighting strategies.

EA-Credit 2, Section 9: Calculations, Template Documents and Other Materials
To calculate the per cent renewable contribution and the corresponding LEED EB points, use the interpolation rules as shown in Table 3.

Table 3: Point Interpolation Table

<table>
<thead>
<tr>
<th>% Renewable</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.51 – 7.50%</td>
<td>1</td>
</tr>
<tr>
<td>7.51 – 15.50%</td>
<td>2</td>
</tr>
<tr>
<td>&gt;15.51%</td>
<td>3</td>
</tr>
</tbody>
</table>

EA-Credit 2, Section 10: Other Resources

Websites
The Office of Energy Efficiency and Renewable Energy (EERE)
http://www.eere.energy.gov/
The EERE develops and deploys efficient and clean energy technologies to meet the nation’s energy needs enhancing the environment.

Database of State Incentives for Renewable Energy (DSIRE)
www.dcs.ncsu.edu/solar/dsire/dsire.cfm
This database was developed by the North Carolina Solar Center and is designed to contain all available information on state financial and regulatory incentives (e.g., tax credits, grants, and special utility rates) that are designed to promote the application of renewable energy technologies. DSIRE also offers additional features such as preparing and printing reports that detail the incentives on a state-by-state basis.

U.S. Department of Energy Photovoltaics Program
www.eren.doe.gov/pv
A DOE website with the mission of making photovoltaics (PV) a significant part of the domestic economy as an industry as well as an energy resource.

National Center for Photovoltaics (NCPV)
www.nrel.gov/ncpv/
Provides clearinghouse information on all aspects of PV systems.

The American Wind Energy Association (AWEA)
www.awea.org
A national trade association representing wind power plant developers, wind turbine manufacturers, utilities, consultants, insurers, financiers, researchers, and others involved in the wind industry.

The American Bioenergy Association
http://www.biomass.org/
An industry trade association dedicated to developing the entire breadth of the bioenergy industry from power to fuels to bio-based chemicals.

DOE BioPower
http://www.eere.energy.gov/biomass.html
Includes information on the current state of the biomass industry. Of particular interest is the page describing the Small Modular BioPower Initiative. The Initiative is aimed at determining the feasibility of developing systems that are fuel-flexible, efficient, simple to operate, and whose operation will have minimum negative impacts on the environment. The intended power range for these systems is from 5 kilowatts to 5 megawatts.

Print Media

EA- Credit 2, Section 11: Definitions
None developed at this time.

EA- Credit 2, Section 12: Case Study
Note: A LEED EB Case Study will be added from the LEED EB Pilot Applications when these become available.
Energy and Atmosphere Credit 3: Continuous Existing Building Commissioning and Maintenance

Energy and Atmosphere Credit 3.1: Continuous Existing Building Commissioning (Points: 1)

EA Credit 3.1: Intent
Ensure that the building systems are continuously commissioned and maintained appropriately so that they go on delivering target building performance goals over the long term.

EA Credit 3.1, Section 1: Requirement
Establish/maintain a continuous commissioning program that monitors indoor environmental parameters (CO₂, temperature, humidity) on a daily basis to ensure building systems are operating properly to meet standards for indoor environmental quality and optimal levels of energy efficiency as specified by manufacturers, service contractors.

EA Credit 3.1, Section 2a: Submittals for Initial Certification under LEED EB
- Continuous Commissioning Program
  - Provide a description of the program that is in place to demonstrate ongoing verification that building systems continue to operate according to design or audit parameters.
  - Include a description of how the performance of these systems is monitored and how often.
  - Provide a description of how remedial action is implemented when performance varies from established parameters.
  - Provide a copy of the Environmental Parameters plan for system monitoring of indoor environmental parameters on a hourly interval basis to ensure building systems are operating at maximum performance to meet specified standards for indoor environmental quality and optimal levels of energy efficiency.
  - Provide a description of how this data is being used to maintain and improve building performance over time, and one day of actual output of all data recorded.

EA Credit 3.1, Section 2b: Submittals for Subsequent, Ongoing Re-Certification under LEED EB
- If there has been no change to this information since previous LEED EB filing provide statement that there has been no change.
- If there has been a change to this information since previous LEED EB filing provide updated information.
EA Credit 3.1, Section 3: Summary of Referenced Standard

Standards Cited:

Where to obtain this document: Organization name: PECI
Telephone number: 503-248-4636
Web address: www.peci.org

Sheet Metal & Air Conditioning National Contractors (SMACNA) comprehensive maintenance guidelines - (Topic cited: Comprehensive maintenance guidelines.)

Where to obtain this document: Organization name: SMACNA
Telephone number: 703-803-2980
Web address: www.smacna.org

EA Credit 3.1, Section 4: Green building Concerns

The LEED EB commissioning prerequisite establishes a minimum level of commissioning activity on a project. The Continuous Existing Building Commissioning credit enhances integration activities, ensuring that the building is operating in accordance with the Building Operating Plan.

EA Credit 3.1, Section 5: Environmental Issues

Continuous commissioning serves to further increase the building energy efficiency and reduce the environmental effects of energy production and use. Environmental effects include natural resource depletion, air pollution, and water pollution.

EA Credit 3.1, Section 6: Economic Issues

Fees for continuous commissioning are typically higher than fundamental commissioning fees due to the broader scope of services. However, recommissioning of building systems after occupancy can uncover operational flaws and optimize these systems. This can result in significant O&M costs over the lifetime of the building.

EA Credit 3.1, Section 7: Strategies and Technologies

EA Prerequisite 1 establishes the framework of an effective commissioning program. Commissioning is a process, not a technology that can be purchased. Use professional contacts and the World Wide Web to find local experts that understand the governing energy codes and the equipment that local contractors are likely to furnish and install.

EA Credit 3.1, Section 8: Synergies and Trade Offs

The commissioning process affects all dynamically operated components, equipment, systems and features. Site features on the project that require commissioning attention include alternative fueling stations and exterior lighting fixtures and systems. Water commissioning includes irrigation systems, plumbing fixtures, and plumbing infrastructure. Energy commissioning covers HVAC systems, lighting, and energy generation equipment. Commissioning activities that affect indoor environmental quality include ventilation systems, monitoring equipment, occupant controls, and daylighting systems.
EA Credit 3.1, Section 9: Calculations, Template Documents and Other Materials
None developed at this time.

EA Credit 3.1, Section 10: Other Resources
See EA Prerequisite 1 for websites and print media.

EA Credit 3.1, Section 11: Definitions
Additional Commissioning supplements fundamental commissioning and focuses on review of the building design and construction documents to identify areas for improvement as well as re-commissioning of building systems after occupancy.

EA Credit 3.1, Section 12: Case Study
Note: A LEED EB Case Study will be added from the LEED EB Pilot Applications when these become available.
Energy and Atmosphere Credit 3.2: Maintenance Contracts (Points: 1)

EA Credit 3.2: Intent
Ensure that the building systems are continuously commissioned and maintained appropriately so that they go on delivering target building performance goals over the long term.

EA Credit 3.2, Section 1: Requirement
Establish/maintain contracts or in-house resources in place for post warranty equipment maintenance.

EA Credit 3.2, Section 2a: Submittals for Initial Certification under LEED EB
- Contracts/Resources for Post Warranty Equipment Maintenance.
  - Provide copies of the contracts or in-house work orders for post warranty equipment maintenance.

EA Credit 3.2, Section 2.b: Submittals for Subsequent, Ongoing Re-Certification under LEED EB
- If there has been no change to these contracts/resources since previous LEED EB filing provide statement that there has been no change.
- If there has been a change to these contracts/resources since previous LEED EB filing provide updated information.

EA Credit 3.2, Section 3: Summary of Referenced Standard
Standards Cited: None cited

EA Credit 3.2, Section 4: Green building Concerns
If building systems are not well maintained, then performance diminishes over time.

EA Credit 3.2, Section 5: Environmental Issues
None developed at this time.

EA Credit 3.2, Section 6: Economic Issues

EA Credit 3.2, Section 7: Strategies
Use PECI, SMACNA and other comprehensive maintenance guidelines referred to in the LEED EB Reference Guide. Move from crisis to preventative maintenance operational model.

EA Credit 3.2, Section 8: Synergies and Trade Offs
None developed at this time.

EA Credit 3.2, Section 9: Calculations, Template Documents and Other Materials
None developed at this time.
EA Credit 3.2, Section 10: Resources
None developed at this time.

EA- Credit 3.2:, Section 11: Definitions
None developed at this time.

EA- Credit 3.2:, Section 12: Case Study
Note: A LEED EB Case Study will be added from the LEED EB Pilot Applications when these become available.
Energy and Atmosphere Credit 3.3: Comprehensive Preventative Maintenance Program (Points: 1)

EA-Credit 3.3: Intent
Ensure that the building systems are continuously commissioned and maintained appropriately so that they go on delivering target building performance goals over the long term.

EA-Credit 3.3, Section 1: Requirement
Implement/maintain a comprehensive best practice and continuous preventative maintenance program.

EA-Credit 3.3, Section 2a: Submittals for Initial Certification under LEED EB
- Comprehensive Best Practice and Continuous Preventative Maintenance Program.
  - Provide a copy of the comprehensive and best practice preventative maintenance program for the building and equipment list addressed by the program.
  - Provide a list of preventative and reactive maintenance actions completed in the last year.

EA-Credit 3.3, Section 2.b: Submittals for Subsequent, Ongoing Re-Certification under LEED EB
- If there has been no change to these programs since previous LEED EB filing provide statement that there has been no change.
- If there has been a change to these programs since previous LEED EB filing provide updated information.

EA-Credit 3.3, Section 3: Summary of Referenced Standard

Standards Cited:
Where to obtain this document: Organization name: PECI
Telephone number: 503-248-4636
Web address: www.peci.org

Sheet Metal & Air Conditioning National Contractors (SMACNA) comprehensive maintenance guidelines - (Topic cited: Comprehensive maintenance guidelines.)
Where to obtain this document: Organization name: SMACNA
Telephone number: 703-803-2980
Web address: www.smacna.org

EA-Credit 3.3, Section 4: Green building Concerns
None developed at this time.

EA-Credit 3.3, Section 5: Environmental Issues
None developed at this time.
EA-Credit 3.3, Section 6: Economic Issues
None developed at this time.

EA-Credit 3.3, Section 7: Strategies
Use PECI, SMACNA and other comprehensive maintenance guidelines referred to in the LEED EB Reference Guide. Move from crisis to preventative maintenance operational model.

EA-Credit 3.3, Section 8: Synergies and Trade Offs
None developed at this time.

EA-Credit 3.3, Section 9: Calculations, Template Documents and Other Materials
None developed at this time.

EA-Credit 3.3, Section 10: Resources
None developed at this time.

EA-Credit 3.3, Section 11: Definitions
None developed at this time.

EA-Credit 3.3, Section 12: Case Study
*Note:* A LEED EB Case Study will be added from the LEED EB Pilot Applications when these become available.
Energy and Atmosphere Credit 4: Additional Ozone Protection (Points: 1)

EA-Credit 4: Intent
Reduce ozone depletion and support early compliance with the Montreal Protocol.

EA-Credit 4, Section 1: Requirement
[NOTE: The following requirements reflect the standards in LEED 2.0 that are currently undergoing review by the USGBC Technical Scientific Advisory Committee (TSAC). As soon as TSAC completes its review – expected before the end of the LEED EB pilot – the language here will be changed to reflect whatever conclusions the TSAC reaches in the overall environmental costs and benefits for using CFC/HCFC-based refrigerants.]

☐ Do not install any new equipment that uses CFC/HCFC-based refrigerants or Halons,
AND
☐ For equipment that already exists in the building, CFC/HCFC emissions must be reduced to less than 5% of the total charge on an annual basis as determined by USEPA Clean Air Act, Title VI, Rule 608 governing refrigerant management and reporting.

EA-Credit 4, Section 2a: Submittals for Initial Certification under LEED EB

☐ Provide a written statement that you have not installed any new equipment that uses CFC/HFCC-based refrigerants or Halons,
AND
☐ For existing equipment containing CFCs or HCFCs:
  • Provide documentation of CFCs and HCFC inventory in HVAC&R systems, any losses and any additions.
  • Provide calculation showing that the annual releases of each CFCs or HCFCs meet the release minimization standard of no more than 5% and comply with other aspects of EPA Clean Air Act, Title VI, Rule 608 governing refrigerant management and reporting.

EA-Credit 4, Section 2b: Submittals for Subsequent, Ongoing Re-Certification under LEED EB

• If there has been no change to this information since previous LEED EB filing provide statement that there has been no change.
• If there has been a change to this information since previous LEED EB filing provide updated information.

EA-Credit 4, Section 3: Summary of Referenced Standard

Standards Cited:
USEPA Clean Air Act, Title VI, Rule 608 - (Topic Cited: governing refrigerant management and reporting)

Where to obtain this document: Organization name: USEPA
Telephone number: (800) 296-1996
EA-Credit 4, Section 4: Green building Concerns

Hydrochlorofluorocarbons (HCFCs) are one class of chemicals that can be substituted for CFCs in building systems. EA Prerequisite 3 addresses phaseout of CFCs through substitution of HCFCs and other low ozone-depleting refrigerants. While HCFCs are more environmentally friendly than CFCs, HCFCs still have ozone depletion potential (ODP). HCFCs commonly used in building refrigerant systems have ODPs ranging from 0.01 to 0.1. As a result, HCFCs will be phased out in the U.S. by 2030. HCFCs with the highest ODPs will be phased out first, starting in 2003.

Halons are used in fire suppression systems and fire extinguishers. Halon production has been banned in the U.S. since 1994 due to their high ODP values. Halons have particularly high ODPs because they contain bromine, which is many times more effective at destroying ozone than chlorine. Halons commonly used in buildings have ODPs ranging from 3 to 10, many times greater than ODPs for CFCs and HCFCs.

While HCFCs and halons are both addressed under this credit, their effects on the environment are significantly different. The environmental impacts of halons are typically an order of magnitude or greater than HCFCs. See Table 1 for comparisons.

EA-Credit 4, Section 5: Environmental Issues

Similar to CFCs, elimination of HCFCs and halons in building systems reduces ozone depletion. Release of these substances to the stratospheric ozone layer destroys ozone molecules through a catalytic process, reducing the Earth’s natural shield for incoming ultraviolet radiation. These refrigerants and their alternatives (usually HFCs) also impact climate change by virtue of their global warming potential.

EA-Credit 4, Section 6: Economic Issues

Most new HVAC systems and refrigerants without CFCs and fire suppression systems without halons are cost-competitive. As an interim step, many owners are converting to HCFCs while eliminating the use of CFCs. HCFCs will also be banned by 2030 however. Therefore, it may be cost-effective to fully migrate to HFC based equipment now, rather than relying on HCFCs as an interim step.

EA-Credit 4, Section 7: Strategies & Technologies

Research and specify all new building systems with non-ozone depleting equipment. Building systems to consider include HVAC, refrigeration, insulation, and fire suppression systems. Common substitutes for HCFCs in HVAC and refrigeration systems are hydrofluorocarbons (HFCs). While HFCs have substantially lower ODPs, these substances have higher global warming potentials (GWPs). Thus, it is important to study different potential substitutes and choose the most appropriate substitute with the lowest environmental impacts. See Table 1 for a list of common refrigerants and their associated environmental data.

Consider the trade-offs among refrigerants across a range of potential impacts including worker safety, impacts on the ozone layer, energy efficiency, and climate change. These are addressed in the U.S. EPA’s Significant New Alternatives Policy (SNAP) Program which has a mandate to identify alternatives to ozone-depleting substances and to publish lists of acceptable and unacceptable substitutes.
When purchasing new building level equipment, specify equipment that does not contain ozone-depleting substances. Set up existing building loss minimization procedures and systems to meet annual loss minimization standards and reporting requirements.

Table 1: Refrigerant Environmental Data

<table>
<thead>
<tr>
<th>Refrigerant</th>
<th>Lifetime [years]</th>
<th>ODP</th>
<th>GWP</th>
</tr>
</thead>
<tbody>
<tr>
<td>CFC-11</td>
<td>45</td>
<td>1</td>
<td>4,000</td>
</tr>
<tr>
<td>CFC-12</td>
<td>100</td>
<td>1</td>
<td>8,500</td>
</tr>
<tr>
<td>CFC-13</td>
<td>640</td>
<td>1</td>
<td>11,700</td>
</tr>
<tr>
<td>CFC-113</td>
<td>85</td>
<td>1</td>
<td>5,000</td>
</tr>
<tr>
<td>CFC-114</td>
<td>300</td>
<td>1</td>
<td>9,300</td>
</tr>
<tr>
<td>CFC-115</td>
<td>1,700</td>
<td>1</td>
<td>9,500</td>
</tr>
<tr>
<td>Halon 1211</td>
<td>11</td>
<td>3</td>
<td>N/A</td>
</tr>
<tr>
<td>Halon 1301</td>
<td>65</td>
<td>10</td>
<td>5,600</td>
</tr>
<tr>
<td>Halon 2402</td>
<td>N/A</td>
<td>6</td>
<td>N/A</td>
</tr>
<tr>
<td>HCFC-22</td>
<td>12</td>
<td>0.06</td>
<td>1,700</td>
</tr>
<tr>
<td>HCFC-123</td>
<td>1</td>
<td>0.02</td>
<td>93</td>
</tr>
<tr>
<td>HCFC-124</td>
<td>6</td>
<td>0.02</td>
<td>480</td>
</tr>
<tr>
<td>HCFC-141b</td>
<td>9</td>
<td>0.11</td>
<td>630</td>
</tr>
<tr>
<td>HCFC-142b</td>
<td>19</td>
<td>0.07</td>
<td>2,000</td>
</tr>
<tr>
<td>HFC-32</td>
<td>5.6</td>
<td>0</td>
<td>650</td>
</tr>
<tr>
<td>HFC-125</td>
<td>32.6</td>
<td>0</td>
<td>2,800</td>
</tr>
<tr>
<td>HFC-134a</td>
<td>14.6</td>
<td>0</td>
<td>1,300</td>
</tr>
<tr>
<td>HFC-143a</td>
<td>48.3</td>
<td>0</td>
<td>3,800</td>
</tr>
<tr>
<td>HFC-152a</td>
<td>1.5</td>
<td>0</td>
<td>140</td>
</tr>
<tr>
<td>HFC-236fa</td>
<td>209</td>
<td>0</td>
<td>6,300</td>
</tr>
</tbody>
</table>

Source: EPA’s Ozone Depletion Web Site

**EA-Credit 4, Section 8: Synergies and Trade Offs**

This credit is intimately tied with EA Prerequisite 3 and also has impacts on energy performance on the building.

**EA-Credit 4, Section 9: Calculations, Template Documents and Other Materials**

None developed at this time.
EA-Credit 4, Section 10: Resources

Websites

EPA’s Significant New Alternatives Policy (SNAP)
http://www.epa.gov/ozone/snap/index.html
SNAP is an EPA program to identify alternatives to ozone-depleting substances. The program maintains up-to-date lists of environmentally friendly substitutes for refrigeration and air conditioning equipment, solvents, fire suppression systems, adhesives, coatings, and other substances.

DOE Halon Phase-Out Information
Provides interim criteria on the management of the reduction and potential elimination of halon fire extinguishing systems within the DOE.

EPA Ozone Depleting Substances
www.epa.gov/ozone/ods.html
A listing of atmospheric lifetimes, ozone depleting potentials (ODPs), and global warming potentials (GWPs) for various substances and CFC substitutes under the SNAP program (see above).

EPA Stratospheric Ozone Hotline
(800) 296-1996

Print Media


EA-Credit 4, Section 11: Definitions

Hydrochlorofluorocarbons (HCFCs) are refrigerants used in building equipment that deplete the stratospheric ozone layer.

Hydrofluorocarbons (HFCs) are refrigerants that do not deplete the stratospheric ozone layer. However, some HFCs have high global warming potential and thus, are not environmentally benign.

Halons are substances used in fire suppression systems and fire extinguishers in buildings and these substances deplete the stratospheric ozone layer.
EA- Credit 4: Section 12: Case Study

Note: A LEED EB Case Study will be added from the LEED EB Pilot Applications when these become available.
Energy and Atmosphere Credit 5: Measurement and Verification

Energy and Atmosphere Credit 5.1-3: Measurement and Verification (Points: 3)

EA-Credit 5.1-5.3: Intent
Demonstrate the ongoing accountability and optimization of building energy and water consumption performance over time and add incentives for additional energy reduction.

EA-Credit 5.1-5.3, Section 1: Requirements
- Comply with the installed equipment requirements for continuous metering as stated in Option B: Methods by Technology of the U.S. DOE’s International Performance Measurement and Verification Protocol (IPMVP) for the following actions. One point is earned for each of four actions implemented, up to three points total.
  - Lighting systems and controls
  - Building electric meters
  - Indoor water risers and outdoor irrigation systems
  - Process water use
  - Process energy use
  - Chiller efficiency at variable loads (kW/ton)
  - Cooling load
  - Air and water economizer and heat recovery cycle operation
  - Boiler efficiencies
  - Building specific process energy efficiency systems and equipment
  - Constant and variable motor loads
  - Variable frequency drives (VFD) operation
  - Air distribution static pressures and ventilation air volumes

EA-Credit 5.1-5.3, Section 2a: Submittals for Initial Certification under LEED EB
- Metering
  - Provide a copy of the measurement verification plan providing continuous metering of specified items as stated in Option B: Methods by Technology of the U.S. DOE’s International Performance Measurement and Verification Protocol (IPMVP).
  - Include a summary schedule of the instrumentation and controls for the three required monitoring categories, one point per group, highlighting the I/O data points to be collected and programming driving data collection and storage.
  - Provide a description of how this data is being used to maintain and improve building performance over time, and one day of actual output of all data recorded.

EA-Credit 5.1-5.3, Section 2b: Submittals for Subsequent, Ongoing Re-Certification under LEED EB
- If there has been no change to this information since previous LEED EB filing provide statement that there has been no change.
If there has been a change to this information since previous LEED EB filing provide updated information.

EA-Credit 5.1-5.3, Section 3: Summary of Referenced Standard

International Performance Measurement and Verification Protocol
The IPMVP presents best practice techniques available for verifying savings produced by energy and water efficiency projects. While the emphasis is on a methodology geared toward performance contracting for retrofits, the protocol identifies the required steps for new building design in Section 6.0. Section 3.0 provides a general approach, procedures, and issues while Section 4.0 provides guidance on retrofit projects.

Standards Cited:
USDOE’s “International Performance Measurement and Verification Protocol (IPMVP)”
- (Topic cited: Energy savings measurement and verification - Option B: Methods by Technology)


EA-Credit 5.1-5.3, Section 4: Green building Concerns
The benefits of optimal building operation, especially in terms of energy and water performance, are substantial because the lifetime of many buildings is greater than 50 years. Even minor energy and water savings are significant when considered in aggregate. These long-term benefits can be unrealized due to maintenance personnel changes, aging of building equipment, and changing utility rate structures. Therefore, it is important to institute measurement & verification (M&V) procedures to maintain optimal performance over the lifetime of the building through periodic checkups.

EA-Credit 5.1-5.3, Section 5: Environmental Issues
Measurement and verification of a building’s ongoing energy and water consumption allows for optimization of related systems over the lifetime of the building. As a result, the environmental impacts associated with energy and water use can be minimized, including air pollution, water pollution, and natural resource depletion.

EA-Credit 5.1-5.3, Section 6: Economic Issues
Building retrofits that institute effective M&V practices, such as Options B and C outlined in the referenced standard, experience energy savings that are on average 10% to 20% greater than buildings retrofitted with little or no M&V practices. It should be noted that M&V practices will predict performance improvements achieved through Energy Conservation Measures (ECMs) and commissioning, but do not actually create the savings.

The added cost to institute a rigorous M&V program for retrofitting buildings with energy and water equipment is typically 2% to 8% of the total retrofit cost. These
additional first costs are generally repaid within a few months of operation due to energy and water utility savings as well as reduced operations and maintenance costs.

**EA-Credit 5.1-5.3, Section 7: Strategies and Technologies**

Establish a whole facility energy and water utility data collection and analysis procedure and generate quarterly reports that track and compare to target utility use goals and/or install equipment to measure base building systems to allow for comparison, management, and optimization of actual vs. target energy and water performance. Employ building automation systems to perform M&V functions where applicable. Provide for ongoing M&V system maintenance and operating plan in building operations and maintenance manuals.

The LEED EB Commissioning prerequisite and credit provide quality assurance that a built project meets the design intent, ensuring that it is functioning as intended at the beginning of occupancy. The LEED EB Measurement and Verification credit provides an extension of this quality assurance effort, by ensuring that the predicted performance of the functioning building is actually producing savings to the owner.

The referenced standard describes a methodology to ensure that the design team consistently addresses the three basic aspects of energy and water conservation performance:

1. Accurate cataloging of baseline conditions.
2. Verification of the complete installation and proper operation of new equipment and systems specified in the contract documents.
3. Confirmation of the quantity of energy and water savings as well as energy and water cost savings that occur during the period of analysis.

The four basic M&V options are listed in **Table 1**, each method provides a greater level of rigor than those previous. The appropriate level for a particular project is dependent on project specifics such as scope, level of owner interest in M&V, and contractual relationships of the design team.

**Table 1: Measurement and Verification Options for New and Renovation Construction Projects**

<table>
<thead>
<tr>
<th>M&amp;V Option</th>
<th>LEED EB Compliant</th>
<th>Option Description</th>
<th>Savings Calculations</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>No</td>
<td>Focuses on physical assessment of equipment changes to ensure the installation is to specification. Key performance factors such as lighting wattage and chiller efficiency are determined by spot or short-term measures and operation.</td>
<td>Engineering calculations using spot or short-term measurements, computer simulations, and/or historical data.</td>
<td>Typically 1-5% of project construction cost, dependent on number of measurement points.</td>
</tr>
<tr>
<td>B</td>
<td>Yes</td>
<td>Savings are determined after</td>
<td>Engineering</td>
<td>Typically 3-10%</td>
</tr>
</tbody>
</table>
The first technique, Method A, does not satisfy the requirements of the LEED EB M&V credit. The remaining methods (B, C and D) do satisfy the LEED EB requirements. It is only necessary to meet the requirements of Method B to capture the LEED EB credit, although a team may decide to pursue one of the more rigorous methods.

Compliance with the credit requirements can be demonstrated through Engineering Calculations, Operational Estimates, and Utility Meter Billing Analysis, or through more rigorous Statistical Sampling, Metering and Monitoring, and Computer Simulations.

All of the options in the referenced standard require the design team to specify equipment for installation in the building systems to allow for comparison, management, and optimization of actual versus estimated energy and water performance. The mechanical engineer in particular should utilize the building automation systems to perform M&V functions where applicable. Elements of the M&V Plan that are required to comply with the requirements of this credit are listed in Table 2.

<table>
<thead>
<tr>
<th></th>
<th>Yes</th>
<th>After project completions, savings are determined at the “whole-building” or facility level using current year and historical utility meter (gas or electricity) or sub-meter data.</th>
<th>Analysis of utility meter (or submeter) data using techniques from simple comparison to multivariate (hourly or monthly) regression analysis.</th>
<th>Typically 1-10% of project construction cost, dependent on number and type of systems measured and the term of analysis/metering.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>Yes</td>
<td>Savings are determined through simulation of facility components and/or the whole facility.</td>
<td>Calibrated energy simulation and modeling: calibrated with hourly or monthly utility billing data and/or end-use metering.</td>
<td>Typically 3-10% of project construction cost, dependent on number and complexity of systems evaluated.</td>
</tr>
</tbody>
</table>
Table 2: Measurement & Verification Plan Requirements

<table>
<thead>
<tr>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. IPMVP standard language and terminology should be employed.</td>
</tr>
<tr>
<td>2. State which option and method from the document will be used.</td>
</tr>
<tr>
<td>3. Indicate who will conduct the M&amp;V.</td>
</tr>
<tr>
<td>4. State key assumptions about significant variables or unknowns.</td>
</tr>
<tr>
<td>5. Create an accurate baseline using techniques appropriate to the project.</td>
</tr>
<tr>
<td>6. Describe the method of ensuring accurate energy savings determination.</td>
</tr>
<tr>
<td>7. Define a post installation inspection plan.</td>
</tr>
<tr>
<td>8. Specify criteria for equipment metering, calibration, measurement period.</td>
</tr>
<tr>
<td>9. Define the level of accuracy to be achieved for all key components.</td>
</tr>
<tr>
<td>10. Indicate quality assurance measures.</td>
</tr>
<tr>
<td>11. Describe the contents of reports to be prepared, along with a schedule.</td>
</tr>
</tbody>
</table>

Retrofits

Use of Option B in retrofits is appropriate when the end use capacity, demand, or power level of the baseline can be measured, and the energy/water consumption of the equipment or subsystem is to be measured post-installation over time. This option can involve continuous measurement of energy/water both before and after the retrofit for the specific equipment, or it can be measurements for a limited period of time necessary to determine the retrofit savings. Portable monitoring equipment may be installed for a period of time or continuously to measure in-situ, baseline and post-installation periods. Periodic inspection of the equipment is recommended. Energy/water consumption is then calculated by developing statistical models of the end use capacity.

Creating the M&V Plan

The steps to create a Measurement and Verification Plan are described in the following paragraphs.

List all measures to be monitored and verified. Create a summary of any whole building or system specific energy or water conservation measures that will be implemented in the project. In most cases, these will be presented in other LEED EB credit documentation and should be referenced here.

Define the Baseline. Defining a new building baseline is a two-part process. First, a baseline case must be developed and defined. This baseline can range from the stipulation of specific baseline equipment to specifying whole-building compliance with energy codes or standards.

Once the baseline case has been established, computer-aided analytical tools are used to estimate the associated performance baseline. It is sometimes appropriate to “back-engineer” a baseline by deleting specific ECMs or features from the energy efficient building. This approach can be particularly useful for whole building M&V using Option
C with computer simulation methods. For retrofits, the baseline is the existing systems in place and this is a straightforward step.

Besides defining the expected resource usage quantity for the baseline case, include additional assumptions relating to energy and water unit costs, weather, utility distribution, system schedule, occupancy or other factors and their anticipated adjustment to the baseline.

Define the Green Building Design and Projected Savings. The green approach is refined through the building design process and is the final outcome of that process. Computer-aided tools are then used to estimate performance of the final green design, which is subtracted from the baseline performance to generate projected savings. Present the resource quantity and associated cost reductions to be achieved on a measure-specific basis by month. The estimation process should also include the identification and, if possible, quantification of factors that could affect the performance of both the baseline and green design.

Define the General M&V Approach. LEED EB requires Option B as a minimum level of precision for the process. Option B is directed at end-use measures, and Option C addresses whole-building M&V methods. The relative suitability of each approach is a function of:

- The M&V objectives and requirements of any related performance contracts.
- The number of ECMs and the degree of interaction with each other and with other systems.
- The practicality issues associated with M&V of particular ECMs or whole-building ECMs.
- Trends towards holistic building design are guiding M&V requirements towards Option C.

Prepare a Project-Specific M&V Plan. Development of an effective and efficient M&V plan for new buildings tends to be more involved than retrofit projects since performance strategies are usually more complex and the technical issues to address are more challenging.

Technical analyses that are performed in support of design decisions concerning performance during the building design process provide a starting point in defining the M&V objectives and approach. The key elements of energy analyses are also usually key factors in M&V. Therefore, the energy analyses and projections should be well documented and organized with this in mind. M&V considerations should influence certain design decisions such as instrumentation and building systems organization. Identify any applicable data sources (e.g., utility bills, control system points and trending periods, and portable metering), the method of data collection (including equipment calibration requirements and other quality assurance practices), and the identity of monitoring personnel.

Verify Installation and Commissioning of ECMs or Energy Efficient Strategies. Installation and proper operation is verified through site inspections as necessary combined with review of reports such as commissioning reports and fluid balancing reports. Any deviations should be noted and addressed through adjustment of the
affected performance projections.

**Determine Savings Under Actual Post-Installation Conditions.** Virtually all performance projections are predicated upon certain assumptions regarding operational conditions (e.g., occupancy and weather). This affects both the baseline and green design estimations. Deviations from the operational assumptions must be tracked by an appropriate mechanism (e.g., site survey or short and/or long term metering) and the baseline and green projections modified accordingly to determine actual savings.

Describe any engineering calculations and/or software tools that will be used to process the data to demonstrate the savings achieved. This will include identification of any stipulated variables or values to be used in the calculations, as well as baseline adjustment factors, regression analysis (or other) tools to determine significance and weighting of such factors.

**Reevaluate at Appropriate Intervals.** Ongoing performance of ECMs or green building strategies and the associated savings must be reevaluated and verified at intervals and over a time frame appropriate to M&V and related performance contract requirements. This also allows ongoing management and correction of significant deviations from projected performance.

It is important to link contractor final payments to documented M&V system performance, so require all documentation in the final report. The contractor must also provide an ongoing M&V system maintenance and operating plan in the building operations and maintenance manuals.

**Section 8: Synergies and Trade Offs**
Measurement & verification activities affect all equipment that uses energy and water. Site equipment affected includes alternative refueling stations, exterior light fixtures and systems, irrigation systems, water reuse systems, and wastewater treatment facilities. Inside the building, all plumbing fixtures and electrical fixtures as well as HVAC systems are affected. Measurement & verification activities are intimately related to commissioning activities and they should be coordinated in concert.

Energy Star rating of the building is another method to track on-going performance of energy systems. While the label itself does not demonstrate compliance with this credit, it can be used as the basis of a comprehensive measurement and verification tool for portfolio building owners. See the Energy Star web site at [www.energystar.gov](http://www.energystar.gov) for information.

**EA-Credit 5.1-5.3, Section 9: Calculations, Template Documents and Other Materials**
None developed at this time.

**EA-Credit 5.1-5.3, Section 10: Other Resources**

**Websites**
[www.eren.doe.gov/femp/financing/measguide.html](http://www.eren.doe.gov/femp/financing/measguide.html)
Guidelines from the Federal Energy Management Program, includes standard procedures to quantify savings.

**Energy Star**

[www.energystar.gov/](http://www.energystar.gov/)

Energy Star was introduced by the US Environmental Protection Agency in 1992 as a voluntary labeling program designed to identify and promote energy-efficient products, in order to reduce carbon dioxide emissions. EPA partnered with the US Department of Energy in 1996 to promote the Energy Star label, with each agency taking responsibility for particular product categories. Energy Star has expanded to cover most of the buildings sector.

**EA- Credit 5.1-5.3;, Section 11: Definitions**

**Energy Conservation Measures** (ECMs) are installations of equipment or systems, or modifications of equipment or systems, for the purpose of reducing energy use and/or costs.

**EA- Credit 5.1-5.3;, Section 12: Case Study**

*Note: A LEED EB Case Study will be added from the LEED EB Pilot Applications when these become available.*
Energy and Atmosphere Credit 5, Point 4: Emission Reduction Reporting (Points: 1)

EA-Credit 5.4: Intent
Demonstrate the ongoing accountability and optimization of building energy and water consumption performance over time and add incentives for additional energy reduction.

EA-Credit 5.4, Section 1: Requirements
- Identify building performance parameters that reduce energy use and track and record all types of resulting emission reductions. Report all emission reductions resulting from these energy efficiency operations using the Cleaner and Greener\textsuperscript{sm} Environment program and standards or other similar voluntary certification program and standards. Retire at least 10% of the emission reductions delivered by the energy efficiency actions through the Cleaner and Greener\textsuperscript{sm} Environment program or other similar voluntary certification programs and ask your suppliers to do the same.

The Leonardo Academy’s Cleaner and Greener\textsuperscript{sm} Certification Program is a voluntary certification program for organizations taking positive actions to reduce environmental emissions. Leonardo Academy is a charitable 501(c)(3) nonprofit organization. The Cleaner and Greener\textsuperscript{sm} Program has five levels of certification. Certification at Level 4 is required to earn the EA–Credit 5.4 point.

Cleaner and Greener\textsuperscript{sm} Program Certification Levels
Level 1: Support financial rewards to building owners and others for the emission reduction benefits of energy efficiency and other emission reduction actions.
Level 2: Report the energy savings from energy efficiency actions and from other emission reduction actions and calculate emission reductions benefits delivered by these actions.
Level 3: Retire at least 10 percent of the emission reductions delivered by energy efficiency actions by donating them to the Cleaner and Greener\textsuperscript{sm} Program for permanent retirement. This includes all types of emissions caused by energy use.
Level 4: Ask your suppliers to become Cleaner and Greener\textsuperscript{sm} Certified at Level 4.
Level 5: Quantify the total environmental emissions caused by your organization and start to offset these emissions.

Contact information for the Cleaner and Greener\textsuperscript{sm} Program of Leonardo Academy:
Tel: 608-280-0255, Email: info@cleanerandgreener.org, Web site: www.cleantoandgreener.org

EA-Credit 5.4, Section 2a: Submittals for Initial Certification under LEED EB
- Provide a statement that you have participated in the Cleaner and Greener\textsuperscript{sm} or equivalent program and:
  - Provide a list of all building performance parameters that reduce energy use and calculate the total savings of each type of energy reduction
  - Calculate and provide a list of the resulting reductions in all types of environmental emissions resulting from these energy efficiency operations using
the emission reduction calculation protocol of the Cleaner and Greener™ program or other equivalent voluntary certification program. Emission reductions delivered include: carbon dioxide (CO₂), sulfur dioxide (SO₂), nitrogen oxides (NOx), mercury (Hg), small particulates (PM2.5), large particulates (PM10), and volatile organic compounds (VOCs).

- Retire at least 10 percent of the emission reductions delivered by the energy efficiency measures through the Cleaner and Greener™ program or other equivalent voluntary certification programs
- Ask your suppliers to report energy savings, report all types of resulting emissions reductions, retire at least 10 percent of these reductions all through the Cleaner and Greener™ program or equivalent programs.

To complete the steps of the Cleaner and Greener™ Certification Levels for Energy and Atmosphere Credit 5.4, download the necessary documents at the following web link: http://www.cleanerandgreener.org/certification/LEED.htm.

Step 1: Sign up to participate in the Cleaner and Greener™ Certification Program at Level 4:
- Download and fill out a Cleaner and Greener sign up form
- Fax completed Cleaner and Greener sign up form to: 608-255-7202

Step 2: Report energy savings to the Cleaner and Greener™ Certification Program and calculate resulting emission reductions:
- In a spreadsheet, organize energy savings by fuel type: electricity, natural gas, and fuel oil. Calculate emission reductions using the “Emission Factors” link provided on the Cleaner and Greener™ web site.
- Email completed spreadsheet, with your project name and contact information, to info@cleanerandgreener.org.
- Based on information in the spreadsheet, complete and return the Cleaner and Greener “Energy Savings and Emission Reduction Reporting” form.

Step 3: Retire at least 10% of energy savings through the Cleaner and Greener™ program:
- Download and complete the “Template Emission Reduction Retirement Letter”
- Fax completed Reduction Retirement letter to: 608-255-7202

Step 4: Ask your suppliers to do the same:
- Download and the “Template Invitation to Suppliers”
- Email a copy of the invitation sent to your suppliers, including contact information for recipients of invitation, to: info@cleanerandgreener.org.

When your organization has completed these steps, the Cleaner and Greener™ Program will send a letter to the U.S. Green Building Council stating that your organization has fulfilled the requirements for Energy and Atmosphere Credit 5.4 and the emission reductions have been delivered.
Annually update your report of energy savings and emission reductions to the Cleaner and Greener\textsuperscript{sm} program. Annual updates include updating Steps 2 and 3 to cover actual savings from previously reported actions, new savings from new actions, and requesting that new and existing suppliers become Cleaner and Greener\textsuperscript{sm} certified.

**EA-Credit 5.4, Section 2b: Submittals for Subsequent, Ongoing Re-Certification under LEED EB**

- Provide a statement that you have continued to participate in the Cleaner and Greener\textsuperscript{sm} or equivalent program:
  - Annually update the energy savings and reporting and retirement of emission reductions resulting from the building performance parameters, listed in EA-Credit 5.4 Section 2.a. above, to the Cleaner and Greener or equivalent program.
  - Annually update the energy savings and reporting and retirement of emission reductions resulting from new energy efficiency actions.

**EA-Credit 5.4, Section 3: Summary of Referenced Standards**

*Standards Cited:*

Cleaner and Greener\textsuperscript{sm} Emission Reduction Reporting Program and Standards - (Topic cited: Emission reduction reporting program, standards, and process)

*Where to obtain this document:*

Organization name: Cleaner and Greener\textsuperscript{sm} Program

Telephone number: 608-280-0255

Web address: [www.cleanerandgreener.org/certification/LEED.htm](http://www.cleanerandgreener.org/certification/LEED.htm)

**EA-Credit 5.4, Section 4: Green Building Concerns**

Energy use causes a wide range of air emissions that degrade our environment and cause human health problems. Emissions caused by energy use include carbon dioxide (CO\textsubscript{2}), sulfur dioxide (SO\textsubscript{2}), nitrogen oxides (NO\textsubscript{x}), mercury (Hg), small particulates (PM\textsubscript{2.5}), large particulates (PM\textsubscript{10}), and volatile organic compounds (VOCs). Reducing energy use decreases all types of emissions caused by energy use. This is true of both efficiency actions that reduce onsite combustion of fuel and reductions in electricity use that reduce emissions from electric generation plants burning fossil fuels elsewhere. Energy efficiency is the most complete way to reduce air emissions because it eliminates the environmental impacts of fuel extraction as well as the environmental impacts of the infrastructure needed to deliver the fuel to the user. (Reference: Consumer Guide to Green Energy Choices Report)

**Benefits of Level 4 Cleaner and Greener\textsuperscript{sm} Certification to building owners include:**

- Public and company recognition for positive environmental actions. Quantifying and publicizing the emission reductions delivered by energy efficiency and other actions helps building owners recognize and be recognized for the full environmental benefits of their actions.
- Demonstration of a commitment to ongoing environmental improvement by permanently retiring at least 10% of the emission reductions.
- Creating and supporting a green supply chain by asking your suppliers to become Cleaner and Greener\textsuperscript{sm} Certified. This is an important part of sustainability as the consumer end of the supply chain generates as much as 60 percent of the energy use...
emissions caused by production and delivery of goods and services we buy.
(Reference: Cleaner and Greener® report “How We Cause Pollution”)

**EA-Credit 5.4, Section 5: Environmental Issues**
Energy use causes a large percentage of the air pollution emitted to the atmosphere. Energy use in buildings and vehicles causes a wide range of environmental emissions that degrade our environment and cause human health problems. Reducing all of these emissions is important. The health and environmental impacts of the various emissions caused by energy use are numerous. The impacts of a number of these emissions are listed below.

Traditional environmental regulation has been hampered by dealing with emissions one pollutant type at a time instead of in an integrated fashion. Just as integrated solutions are the key to building and operating in sustainable ways, the key to developing low cost ways to reduce emissions is to deal with multiple pollutants in an integrated way. Building owners can lead the way to integrated multiple-pollutant approaches to pollution reduction by quantifying the multiple pollution reduction benefits of their energy efficiency and other emission reduction actions and by supporting recognition and rewards for these emission reductions.

**Table: Sources and Effects of Common Pollutants**

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>Anthropogenic Sources</th>
<th>Human Health Effects</th>
<th>Environmental Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ozone (O₃)</td>
<td>Secondary pollutant formed by chemical reaction of VOCs and NOx in the presence of sunlight.</td>
<td>Breathing problems, reduced lung function, asthma, irritates eyes, stuffy nose, reduces resistance to colds and infections, premature aging of lung tissue.</td>
<td>Damages crops, forests, and other vegetation; damages rubber, fabric, and other materials; smog reduces visibility.</td>
</tr>
<tr>
<td>Nitrogen Oxides (NOₓ)</td>
<td>Burning of gasoline, natural gas, coal, oil. (Cars are a major source of NOₓ.)</td>
<td>Lung damage, respiratory illnesses, ozone (smog) effects.</td>
<td>Ozone (smog) effects; precursor of acid rain, which damages trees, lakes, and soil; aerosols can reduce visibility. Acid rain also causes buildings, statues, and monuments to deteriorate.</td>
</tr>
<tr>
<td>Carbon Monoxide (CO)</td>
<td>Burning of gasoline, natural gas, coal, oil.</td>
<td>Reduces ability of blood to bring oxygen to body cells and tissues.</td>
<td></td>
</tr>
</tbody>
</table>

1 Table adapted from Leonardo Academy Document (Table 1.4, pg. 7): “Consumer Guide to Clean Energy Choices,” 1999.
## Pollutant Sources

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>Anthropogenic Sources</th>
<th>Human Health Effects</th>
<th>Environmental Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Volatile Organic Compounds (VOCs)</strong></td>
<td>Fuel combustion, solvents, paint. (Cars are a major source of VOCs.)</td>
<td>Ozone (smog) effects, cancer, and other serious health problems.</td>
<td>Ozone (smog) effects, vegetation damage.</td>
</tr>
<tr>
<td><strong>Particulate Matter (PM&lt;sub&gt;10&lt;/sub&gt; &amp; PM&lt;sub&gt;2.5&lt;/sub&gt;)</strong></td>
<td>Emitted as particles or formed through chemical reactions; burning of wood, diesel, and other fuels; industrial processes; agriculture (plowing, field burning); unpaved roads.</td>
<td>Eye, nose, and throat irritation; lung damage; bronchitis; cancer; early death.</td>
<td>Source of haze, which reduces visibility. Ashes, smoke, soot, and dust can dirty and discolor structures and property, including clothes and furniture.</td>
</tr>
<tr>
<td><strong>Sulfur Dioxide (SO&lt;sub&gt;2&lt;/sub&gt;)</strong></td>
<td>Burning of coal and oil, especially high-sulfur coal; industrial processes (paper manufacturing, metal smelting).</td>
<td>Respiratory illness, breathing problems, may cause permanent damage to lungs.</td>
<td>Precursor of acid rain, which can damage trees, lakes, and soil; aerosols can reduce visibility. Acid rain also causes buildings, statues, and monuments to deteriorate.</td>
</tr>
<tr>
<td><strong>Lead</strong></td>
<td>Combustion of fossil fuels and leaded gasoline; paint; smelters (metal refineries); battery manufacturing.</td>
<td>Brain and nervous system damage (esp. children), digestive and other problems. Some lead-containing chemicals cause cancer in animals.</td>
<td>Harm to wildlife and livestock.</td>
</tr>
<tr>
<td><strong>Mercury</strong></td>
<td>Fossil fuel combustion, waste disposal, industrial processes (incineration, smelting, chlor-alkali plants), mining.</td>
<td>Liver, kidney, and brain damage; neurological and developmental damage.</td>
<td>Accumulates in food chain. Harm to wildlife (e.g. fish, loons, and eagles)</td>
</tr>
<tr>
<td><strong>Carbon Dioxide (CO&lt;sub&gt;2&lt;/sub&gt;)</strong></td>
<td>Fossil fuel combustion</td>
<td></td>
<td>Contributes to global climate change</td>
</tr>
</tbody>
</table>

### EA-Credit 5.4, Section 6: Economic Issues
Credit 5.4 creates additional benefits for the energy efficiency actions implemented and maintained by the building owner to earn other credits such as the 10 points available for energy efficiency under LEED EB, EA-Credit 1.
For building owners that are businesses or non-governmental organizations, Cleaner and Greener\textsuperscript{sm} certification creates the potential for increased sales resulting from preferential purchasing of goods and services from certified building owners by residential and commercial consumers. In order to earn this credit, building owners must ask their suppliers to become Cleaner and Greener\textsuperscript{sm} certified at Level 4. It is likely that preferential purchasing will start to produce economic benefits for certified building owners.

For building owners that are governmental organizations, this credit provides a mechanism to track and be recognized for all the emission reduction benefits delivered by energy efficiency achievements.

**EA-Credit 5.4, Section 7: Strategies and Technologies**
Incorporate the following Strategies and Technologies:

- Establish whole facility energy and water utility data collection and analysis procedure.
- Generate quarterly reports that track and compare to target utility use goals and/or install equipment to measure base building systems to allow for comparison, management, and optimization of actual vs. target energy and water performance.
- Employ building automation systems to perform measurement and verification (M&V) functions where applicable.
- Provide for ongoing M&V system maintenance and operating plan in building operations and maintenance manuals.

The Cleaner and Greener\textsuperscript{sm} program helps building owners calculate and report all the different types of emission reductions delivered by their energy efficiency improvements and other emission reduction actions. The Cleaner and Greener\textsuperscript{sm} program recognizes and certifies participants for their emission reduction achievements. Cleaner and Greener\textsuperscript{sm} is a program of Leonardo Academy, a charitable nonprofit organization.

**EA-Credit 5.4, Section 8: Synergies and Trade Offs**
This credit creates additional benefits, to the energy efficiency action implemented and maintained to earn other credits, such as the 10 points available for energy efficiency under LEED EB EA-Credit 1.

Cleaner and Greener\textsuperscript{sm} certification creates the potential for preferential purchasing of goods and services from certified building owners by home and commercial consumers. In order to earn this credit, building owner must ask their suppliers to get Cleaner and Greener certified at level 4. It is likely that preferential purchasing will start to produce economic benefits for certified building owners.

**EA-Credit 5.4, Section 9: Calculations, Template Documents and Other Materials**

**Template Filing Statement**

Name of organization: ___________________________________________
Statement of Achievement for Energy and Atmosphere Credit 5.4

This is a statement of achievements of _________________________ (name of organization) during the reporting year from:

State date of reporting year: _____________________________
End date of reporting year: ______________________________

Our organization has participated in the Cleaner and Greener\textsuperscript{sm} or equivalent program and completed the following actions to be certified at Level 4:

1. Provided a list of all building performance parameters that reduced energy use and calculated the total savings of each type of energy.
2. Calculated the resulting reductions in all types of environmental emissions resulting from these energy efficiency operations using the emission reduction calculation protocol of the Cleaner and Greener\textsuperscript{sm} program or other equivalent voluntary certification program.
3. Provided a list of the emission reductions delivered including reductions in:
   a. Carbon Dioxide (CO\textsubscript{2}): ________________
   b. Sulfur dioxide (SO\textsubscript{2}): ________________
   c. Nitrogen oxides (NO\textsubscript{x}): ________________
   d. Small particulates (PM2.5): ________________________
   e. Large particulates (PM 10): ________________________
   f. Volatile organic compounds (VOCs): ________________
   g. Mercury (Hg): ________________________
4. Retired at least 10 percent of the emission reductions delivered by the energy efficiency through the Cleaner and Greener\textsuperscript{sm} program.
5. Asked our suppliers to report energy savings, report all types of resulting emissions reductions, retire at least 10 percent of these reductions through the Cleaner and Greener\textsuperscript{sm} or equivalent program, and ask their suppliers to do the same.

Signature of Head Facility Manager of Organization:  
________________________________________

Name of Head Facility Manager (Typed) of Organization:  
________________________________________

Contact Information for Head Facility Manager of Organization:  
Telephone: ________________________________
Fax: ________________________________
Email address: ________________________________
EA-Credit 5.4, Section 10: Other Resources
Additional information on emission and emission reductions: www.cleanerandgreener.org

EA-Credit 5.4, Section 11: Definitions
None developed at this time.

EA-Credit 5.4, Section 12: Case Study
Note: A LEED EB Case Study will be added from the LEED EB Pilot Applications when these become available.
Energy and Atmosphere Credit 6: Green Power (Points: 1)

**EA-Credit 6: Intent**
Encourage the development and use of grid-source, renewable energy technologies on a net zero pollution basis.

**EA-Credit 6, Section 1: Requirements**
Engage and maintain a contract to purchase power for the whole building generated from renewable sources that meet the Center for Resource Solutions (CRS) Green-E requirements or meets equivalent standards.

**EA-Credit 6, Section 2a: Submittals for Initial Certification under LEED EB**
- **Green Electricity**
  - Provide a copy of the electric utility purchase contract for power generated from renewable sources covering the last year and demonstrating that the entire building’s energy load was met by a green power provider.
  - Provide documentation demonstrating that the supplied renewable power over the last year meets the referenced Green-E requirements.

**EA-Credit 6, Section 2b: Submittals for Subsequent, Ongoing Re-Certification under LEED EB**
- If there has been no change to this information since previous LEED EB filing provide statement that there has been no change.
- If there has been a change to this information since previous LEED EB filing provide updated information.

**EA-Credit 6, Section 3: Summary of Referenced Standard**
Center for Resource Solutions Green-e Products Certification Requirements
The Center for Resource Solutions (415) 561-2100, [www.green-e.org](http://www.green-e.org)

The Green-e Program is a voluntary certification and verification program for green electricity products. Those products exhibiting the Green-e logo are greener and cleaner than the average retail electricity product sold in that particular region. To be eligible for the Green-e logo, companies must meet certain threshold criteria for their products and abide by the Green-e Program rules:

1. Products must contain 50% or more renewables content averaged over one year.
2. Fossil portions of the products must have equal or lower air emissions (SO\(_X\), NO\(_X\), CO\(_2\)) than an equivalent amount of system power.
3. Air emissions from a renewable energy generator using waste materials for fuel must be equal to or less than the emissions that would otherwise be produced from the most common alternative disposal of the waste.
4. Product must not contain any nuclear power other than what is contained in system power purchased for the eligible product’s portfolio.
5. Product must contain at least 5% “new renewable” electricity one year after regulation, 10% the second year (with pending increases of 5% each year until 25%).

**Standards Cited:**
Center for Resource Solutions (CRS) Green-e requirements - (Topic Cited: Green-e standards for renewable electricity.)

**Where to obtain this document:** Organization name: CRS  
Telephone number: 415-561-2100  
Web address: [www.resource-solutions.org](http://www.resource-solutions.org)

Low Impact Hydropower Certification Program, (Topic Cited: Green-e standards for Low Impact Hydropower Certification Program.)  
**Where to obtain this document:** Organization name: Green-e Renewable Energy Certification Program/Low Impact Hydro Power Institute  
Telephone number: (888) 634-7336 (Green-e) or (503) 227-1763 (Low Impact Hydro Power Institute)  
Web address: [http://www.green-e.org](http://www.green-e.org), [http://www.lowimpacthydro.org](http://www.lowimpacthydro.org)

**EA-Credit 6, Section 4: Green building Concerns**
Energy production is a significant contributor to air pollution in the United States. Air pollutants released from energy production include sulfur dioxide, nitrogen oxide, and carbon dioxide. These pollutants cause acid rain, smog, global warming and affect the respiratory system of humans. The Green-e Program was established by the Center for Resource Solutions to promote green electricity products and provide consumers with a method to easily identify green electricity products. These products reduce the air pollution impacts of electricity generation by relying on renewable energy sources such as solar, water, wind, biomass, and geothermal sources.

**EA-Credit 6, Section 5: Environmental Issues**
Green electricity products produce less air pollution than conventional electricity products. This reduces the problems of acid rain, smog and global warming as well as human health problems resulting from air contaminants. In addition, the use of renewable resources avoids nuclear waste and large dams used for hydropower. While green electricity is not environmentally benign, it lessens the environmental impacts of power generation.

**EA-Credit 6, Section 6: Economic Issues**
Current costs for green power products are equal to, or slightly greater than, conventional energy products. However, green power products are derived, in part, from renewable energy sources and these stable sources beget stable energy costs. As the green power market matures and impacts on the environment and human health are factored into power costs, green power products will be less expensive than conventional power products.
EA-Credit 6, Section 7: Strategies and Technologies
Calculate the energy needs for the project through an energy survey. Research power providers in the area and select a provider that guarantees that a fraction of its delivered electric power is derived from net nonpolluting renewable technologies. If the project is in an open market state, investigate green power and power marketers licensed to provide power in that state. Grid power that qualifies for this credit originates from solar, wind, geothermal, biomass, or low-impact hydro sources.

Green-e electricity is currently available in California, Connecticut, New Jersey and Pennsylvania, with participation by electricity providers in other states anticipated in near future. In addition, Massachusetts, New Hampshire, and Rhode Island have open electricity markets and Green-e electricity may be available to projects in these states. See the Green-e website for additional information.

Purchase power from a provider that guarantees a fraction of its delivered electric power is from net nonpolluting renewable technologies. Begin by contacting local utility companies. If the project is in an open market state, investigate Green Power and Power Marketers licensed to provide power in that state. Grid power that qualifies for this credit originates from solar, wind, geothermal, biomass, or low-impact hydro sources. Low-impact hydro shall comply with the Low Impact Hydropower Certification Program.

EA-Credit 6, Section 8: Synergies and Trade Offs
The location of a project will determine if Green-e electricity is available. The choice of electricity source should be included in the overall energy performance of the building.

EA-Credit 6, Section 9: Calculations, Template Documents and Other Materials
None developed at this time.

EA-Credit 6, Section 10: Other Resources
Websites
Green Power Network
www.eren.doe.gov/greenpower/home.shtml
The Green Power Network provides news and information on green power markets and related activities and is maintained by the National Renewable Energy Laboratory for the U.S. Department of Energy.

Renewable Energy Alliance
http://www.penweb.org/issues/energy/realliance-about.html
A nonprofit organization consisting of power marketers interested in expanding the role of renewable energy sources.

Utility Guide
www.utilityguide.com/energy.cfm
Includes information on different power types, including green power, as well as general information on energy efficiency.
EA- Credit 6, Section 11: Definitions
None developed at this time.

EA- Credit 6, Section 12: Case Study
Note: A LEED EB Case Study will be added from the LEED EB Pilot Applications when these become available.