

A large, light gray, stylized oak leaf graphic serves as a background for the title text. It has a central vertical stem and three main lobes on each side, with smaller indentations between them.

# LEED v4.1 BUILDING OPERATIONS AND MAINTENANCE

February 6, 2023

U.S. Green Building Council

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# LOCATION AND TRANSPORTATION (LT)

## LT PREREQUISITE: TRANSPORTATION PERFORMANCE

### 6–14 points

This prerequisite applies to

- O+M: Existing Buildings (6–14 points)
- O+M: Interiors (6-14 points)

### Intent

To reduce pollution and land development effects from transportation.

### Requirements

#### EB, INTERIORS

Conduct a transportation survey of building occupants on their commute patterns.

Regular building occupants must be surveyed. Building occupants shall provide information on their two-way commutes over one work week and consider seasonal variations and variations in work schedules. Visitors are encouraged to be surveyed, especially if the daily average is greater than the number of regular building occupants. Visitors shall provide information on their one-way travel to the building for that day in particular.

Conduct the survey at least once per year, using the required survey methodology outlined in the LEED v4.1 O+M beta guide. Use the survey results to calculate a transportation performance score for the project.

For initial certification, obtain a minimum transportation performance score of 40. Additional points for this prerequisite are awarded for transportation performance scores above 40, according to Table 1.

**Table 1. LEED Points for Transportation Performance Score**

| Transportation Performance Score        | LEED Points                            |
|---|--|
| 40 (Required for initial certification) | 6 (Required for initial certification) |
| 47                                      | 7                                      |
| 54                                      | 8                                      |
| 61                                      | 9                                      |
| 68                                      | 10                                     |
| 75                                      | 11                                     |
| 83                                      | 12                                     |
| 90                                      | 13                                     |
| 97                                      | 14                                     |

### The Transportation Performance Score

The transportation performance score rates the project's greenhouse gas emissions measured in carbon dioxide equivalent emissions (CO<sub>2</sub>e) resulting from transportation to and from the building against other high performing buildings worldwide.

The score is a value from 1-100 based on the project's average CO<sub>2</sub>e **per** one-way trip per occupant (lbs.).

### Transportation Performance Score Calculation

To calculate a transportation performance score, the following data is required. All data is collected via the transportation survey. At least one survey every 365 days must be conducted:

- Number of regular building occupants and visitors.
- For Hospitality projects, number of hotel or lodging guests (these occupants may be excluded from the survey even though they are considered regular building occupants).
- Regular building occupant survey responses
  - # of routes for 2-way commutes over one week
  - Per route,
    - Commuting transportation mode(s),
    - Distance traveled (in miles or kilometers)
- Visitor occupant responses
  - Commuting transportation mode(s),
  - Distance traveled (in miles or kilometers)

An emissions value is calculated for each building occupant that completes the survey as follows:

1. A CO<sub>2</sub>e value is calculated for each route provided for the occupant, using the commuting transportation mode(s), distance traveled, transportation emissions factors, and Equation 1:

Equation 1: CO<sub>2</sub>e for route (lbs.) = (CO<sub>2</sub>e lbs./mile) \* distance traveled in miles

The transportation greenhouse gas emission factors use the latest U.S. Environmental Protection Agency's (EPA) Emission Factors Hub for CO<sub>2</sub>e lbs per occupant mile [coefficients](#) and are kept up to date with U.S. EPA release updates.

2. For each occupant, CO<sub>2</sub>e is calculated using Equation 2:

Equation 2: CO<sub>2</sub>e for individual occupant (lbs.) = (Σ CO<sub>2</sub>e for routes) / # routes

For visitors, calculations include one route (as their survey includes only one way and one day)

For regular building occupants, calculations may include more than one route (as their survey requests information regarding two way commutes over one week, and includes all seasons/yearly variations). Each route is weighed equally.

An average emissions value is calculated by taking an average of the individual emissions, using Equation 3.

Equation 3: Project CO<sub>2</sub>e per one-way trip per occupant (lbs.) = (Σ CO<sub>2</sub>e for individual occupants) / # occupants in survey

The project's average **CO<sub>2</sub>e per one-way trip per occupant (lbs.)** value is then input into the transportation scoring function (see Figure 2) to produce a transportation performance score:

Figure 2: Transportation scoring function

Transportation score

Average lbs. of CO2e per one-way trip per occupant

The transportation scoring function was developed using transportation patterns reported by LEED buildings, certified under LEED O+M v2009. The data set includes buildings that earned [SS credit 4 Alternative Commuting Transportation](#).

# SUSTAINABLE SITES (SS)

## SS CREDIT: RAINWATER MANAGEMENT

### 1 point

This credit applies to

- O+M: Existing Buildings (1 point)

### Intent

To reduce runoff volume and improve water quality by replicating the natural hydrology and water balance of the site, based on historical conditions and undeveloped ecosystems in the region.

### Requirements

#### **EB**

Use *low-impact development (LID)* practices to infiltrate, evapotranspire, collect and reuse water onsite from 25% of the impervious surfaces for the 95th percentile storm event.

Establish and implement an annual inspection and maintenance program of all rainwater management facilities to assure continued performance.

Document the annual inspections, including identification of areas of erosion, maintenance needs, and repairs. Perform necessary maintenance, repairs, or stabilization within 60 days of inspection.

## SS CREDIT: HEAT ISLAND REDUCTION

### 1 point

This credit applies to

- O+M: Existing Buildings (1 point)

### Intent

To minimize effects on microclimates and human and wildlife habitats by reducing heat islands.

### Requirements

#### EB

Have in place strategies to minimize the project's overall contribution to heat island effects and that meet the following criterion:

$$\frac{\text{Area of Nonroof Measures}}{0.50} + \frac{\text{Area of High-Reflectance Roof}}{0.75} + \frac{\text{Area of Vegetated Roof}}{0.50} \geq \frac{\text{Total Site Paving Area}}{\text{Total Roof Area}}$$

Alternatively, an SRI and SR weighted average approach may be used to calculate compliance.

Use any combination of the following strategies.

#### **Nonroof Measures**

- Plants that provide shade over paving areas (including playgrounds) on the site. For newly installed plants, base shade area on 10-year canopy width at noon.
- Vegetated planters.
- Shade with structures covered by energy generation systems, such as solar thermal collectors, photovoltaics, and wind turbines.
- Shade with architectural devices or structures that have a three-year aged *solar reflectance (SR)* value of at least 0.28. If three-year aged value information is not available meet an initial SR of at least 0.33.
- Shade with vegetated structures.
- Paving materials with a three-year aged *solar reflectance (SR)* value of at least 0.28. If three-year aged value information is not available, meet an initial SR of at least 0.33.
- *Open-grid pavement system* (at least 50% unbound).

#### **High-Reflectance Roof**

Roofing materials with an SRI equal to or greater than the values in Table 1. Meet the three-year aged SRI value if available, otherwise, meet the initial SRI value.

**Table 1. Minimum solar reflectance index value, by roof slope**

|                   | Slope  | Initial SRI | 3-year aged SRI |
|-------------------|--------|-------------|-----------------|
| Low-sloped roof   | ≤ 2:12 | 82          | 64              |
| Steep-sloped roof | > 2:12 | 39          | 32              |



Roof area that consists of functional, usable spaces (such as helipads, recreation courts, and similar amenity areas) may meet the requirements of nonroof measures. Applicable roof area excludes roof area covered by mechanical equipment, solar energy panels, skylights, and any other appurtenances.

***Vegetated Roof***

Vegetated roof. If newly installed, sufficient growing medium and plant material must be in place to provide full vegetative cover within 3-years.

Have in place a maintenance program that ensures all high-reflectance surfaces are cleaned at least annually to maintain good reflectance, all vegetation is maintained for plant health, and any vegetated structures or vegetated roofs are maintained for good structural condition.

## **SS CREDIT: LIGHT POLLUTION REDUCTION**

### **1 point**

This credit applies to

- O+M: Existing Buildings (1 point)

### **Intent**

To increase night sky access, improve nighttime visibility, and reduce the consequences of development for wildlife and people.

### **Requirements**

#### **EB**

Meet the requirements of one of the options below:

#### **Option 1. Fixture Shielding**

Shield all exterior fixtures (where the sum of the mean lamp lumens for that fixture exceeds 2,500) such that the installed fixtures do not directly emit any light at a vertical angle more than 90 degrees from straight down.

OR

#### **Option 2. Perimeter Measurements**

Measure the night illumination levels at regularly spaced points on the project boundary, taking the measurements with the building's exterior and site lights both on and off. At least eight measurements are required, at a maximum spacing of 100 feet (30 meters) apart. The illumination level measured with the lights on must not be more than 20% above the level measured with the lights off.

## **SS CREDIT: SITE MANAGEMENT**

### **1 point**

This credit applies to

- O+M: Existing Buildings (1 point)

### **Intent**

To provide environmentally sensitive site management practices that protect and enhance habitat, reduce pollutants and waste, protect soils and hydrology and reduce site domestic water use.

### **Requirements**

#### **EB**

Conduct a site assessment to identify and document natural areas providing habitat.

Have in place a site management plan that demonstrates how the following best practices are met:

- Monitor and eradicate invasive and exotic plant species from natural habitat areas.
- Manage snow and ice in ways that limit degradation of water quality, surrounding plants and soil health from chemical deicer applications.
- Prevent erosion by maintaining vegetative cover, and restore any eroded soils.
- Reduce noise and air pollution resulting from gasoline powered equipment.
- Divert from landfills 100% of plant material waste for composting reuse.
- Reduce fertilizer use to only as needed for plant health applications based on soil testing. Eliminate preventive applications of herbicides, pesticides and fungicides applying only as needed for occurrences.
- Prepare an Integrated Pest Management plan.
- Add one or more inches of organic matter mulch, such as compost, to soil surfaces in planting areas annually.
- Irrigate vegetation, other than planted containers, only with automatic controlled systems utilizing either rain shutoff, moisture sensing or weather based controls.
- Monitor irrigation systems at least bi-weekly during the operating season and correct any leaks, breaks, inappropriate water usage, or incorrect timing.
- Store materials and equipment to prevent air and site contamination.

# WATER EFFICIENCY (WE)

## WE PREREQUISITE: WATER PERFORMANCE

### 6–15 points

This prerequisite applies to

- O+M: Existing Buildings (6–15 points)
- O+M: Interiors (6–15 points)

### Intent

To support water management and reduce water consumption.

### Requirements

#### EB, INTERIORS

Have permanently installed water meters that measure the total potable water use for the project and associated grounds. All potable or reclaimed water supplied to the project must be metered.

For Interiors projects, have permanently installed sub-meters that measure total potable water use for any fixtures or fittings in the project scope. Alternately, interiors projects may pro-rate water use, using occupancy and base building water use over twelve consecutive months.

Measure total potable water use on a monthly basis for twelve consecutive months (one full year).

Input the twelve months of potable water use data and calculate a water performance score for the project.

For initial certification, obtain a minimum water performance score of 40. Additional points for this prerequisite are awarded for Water Performance Scores above 40, according to Table 1.

Interiors projects that do not have fixtures or fixture fittings in the project scope are exempt from the requirement to obtain a minimum water performance score of 40, but must provide twelve months of base building potable water use data, pro-rated by occupancy, and calculate a water performance score for the project.

**Table 1. LEED Points for Water Performance**

| <b>Water Performance Score</b>          | <b>LEED Points</b>                     |
|---|--|
| 40 (Required for initial certification) | 6 (Required for initial certification) |
| 44                                      | 7                                      |
| 50                                      | 8                                      |
| 57                                      | 9                                      |
| 64                                      | 10                                     |
| 70                                      | 11                                     |
| 77                                      | 12                                     |
| 84                                      | 13                                     |
| 90                                      | 14                                     |
| 97                                      | 15                                     |

### Water performance score

The water performance score rates the building's total water consumption against the total water consumption of comparable high-performing buildings.

The score is a value from 1-100 based on the project's water consumption per occupant and water consumption per floor area.

### Performance score calculation

To calculate a water performance score, the following data is required:

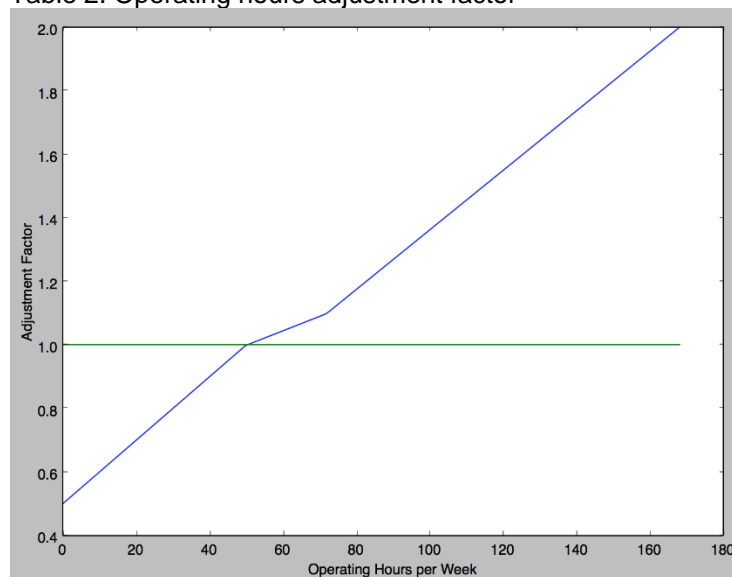
1. Annual water consumption (gallons), with monthly or daily totals
2. Gross floor area (sq. ft. or sq. m.)
3. Weighted occupancy
4. Weighted operating hours

The water consumption is adjusted for weighted operating hours and converted into daily water consumption using Equation 1.

Equation 1: adjusted daily water consumption = annual water consumption \* operating hours adjustment factor / 365 days

The operating hours adjustment factor is determined using Table 2. The adjustment factor accounts for typical LEED buildings operations of 50 hours a week.

Table 2. Operating hours adjustment factor



Daily water consumption per occupant is calculated by dividing the daily water consumption by the weighted occupancy, using Equation 2.

Equation 2: adjusted daily water consumption per occupant = adjusted daily water consumption / weighted occupancy

Daily water consumption per floor area is calculated by dividing the daily water consumption by the gross floor area, using Equation 3.

Equation 3: adjusted daily water consumption per floor area = adjusted daily water consumption / gross floor area

The project's daily water consumption per occupant AND daily water consumption per floor area are input into the water scoring function for the specific project type to produce a water performance score.

The water scoring functions were developed using water consumption data from high-performing buildings. The data set includes LEED buildings that shared their water consumption data with USGBC as part of the [whole-building energy and water usage requirement](#).

# ENERGY AND ATMOSPHERE

## EA PREREQUISITE: ENERGY EFFICIENCY BEST MANAGEMENT PRACTICES Required

This prerequisite applies to

- O+M: Existing Buildings
- O+M: Interiors

### Intent

To promote continuity of information to ensure that energy-efficient operating strategies are maintained and provide a foundation for training and system analysis.

### Requirements

#### EB, INTERIORS

Conduct an energy audit that meets both the requirements of the ASHRAE preliminary energy use analysis and an ASHRAE Level 1 walk-through assessment identified in the ASHRAE Procedures for Commercial Building Energy Audits or equivalent. Projects in Europe may use the energy audit procedure defined in EN 16247-2:2014.

Prepare and maintain a current facilities requirements and operations and maintenance plan that contains the information necessary to operate the project efficiently. The plan must include the following:

- a current sequence of operations for the building;
- the project occupancy schedule;
- equipment run-time schedules;
- setpoints for all HVAC equipment;
- setpoints for lighting levels throughout the project;
- minimum outside air requirements;
- any changes in schedules or setpoints for different seasons, days of the week, and times of day;
- a systems narrative describing the mechanical and electrical systems and equipment in the project; and
- a preventive maintenance plan for equipment described in the systems narrative.

#### Data Centers

Use the U.S. Department of Energy's DC PRO Profiling Tool to perform a preliminary assessment of energy consumption in data center spaces for critical systems.

## EA PREREQUISITE: FUNDAMENTAL REFRIGERANT MANAGEMENT Required

This prerequisite applies to

- O+M: Existing Buildings
- O+M Interiors

### Intent

To reduce stratospheric ozone depletion.

### Requirements

#### EB, INTERIORS

Do not use chlorofluorocarbon (CFC)-based refrigerants in heating, ventilating, air-conditioning, and refrigeration (HVAC&R) systems unless a third-party audit shows that system replacement or conversion is not economically feasible or unless a phase-out plan for CFC-based refrigerants is in place. Phase-out plans should be scheduled for completion within 10 years. The replacement or conversion of HVAC&R equipment is considered not economically feasible if the simple payback of the replacement or conversion is greater than 10 years. Perform the following economic analysis:

$$\text{Simple payback} = \frac{\text{Cost of replacement or conversion}}{\text{Resulting annual energy cost difference} + \text{Resulting annual maintenance and refrigerant cost difference}} > 10$$

If CFC-based refrigerants are maintained in the project, reduce annual leakage to 5% or less using the procedures in the Clean Air Act, Title VI, Rule 608, governing refrigerant management and reporting (or a local equivalent for projects outside the U.S.), and reduce the total leakage over the remaining life of the unit to less than 30% of its refrigerant charge.

Small HVAC&R units (defined as containing less than 0.5 pound [225 grams] of refrigerant), standard refrigerators, small water coolers, and any other cooling equipment that contains less than 0.5 pound (225 grams) of refrigerant are exempt.



## EA PREREQUISITE: ENERGY PERFORMANCE

### 13–33 points

This prerequisite applies to

- O+M: Existing Buildings (13–33 points)
- O+M: Interiors (13–33 points)

### Intent

To support energy management and reduce environmental and economic harms associated with excessive energy use by reducing greenhouse gas emissions and achieving higher levels of operating energy performance.

### Requirements

#### EB, INTERIORS

Have permanently installed energy meters or submeters that measure total building energy consumption (electricity, natural gas, chilled water, steam, fuel oil, propane, etc.). Utility-owned meters capable of aggregating total project energy use are acceptable.

For Interiors projects, have permanently installed sub-meters that measure all electricity and fossil fuels for equipment within the project scope. Alternately, interiors projects may pro-rate energy use, using occupancy and base building energy use over twelve consecutive months.

Calibrate meters within the manufacturer's recommended interval if the project owner, management organization, or tenant owns the meter. Meters owned by third parties (e.g., utilities or governments) are exempt.

Measure the project's energy use on a monthly basis for twelve consecutive months (one full year). Use the twelve months of energy use data to obtain an energy performance score.

LEED points are based on project energy performance across two metrics: greenhouse gas emissions and source energy.

**Table 1. LEED Points for GHG Emissions Score**

| <b>GHG Emissions Score</b>              | <b>LEED Points</b>                       |
|---|--|
| 40 (Required for initial certification) | 6.5 (Required for initial certification) |
| 41                                      | 7  |
| 44                                      | 7.5                                      |
| 47                                      | 8  |
| 50                                      | 8.5                                      |
| 54                                      | 9  |
| 57                                      | 9.5                                      |
| 60                                      | 10                                       |
| 63                                      | 10.5                                     |
| 66                                      | 11                                       |
| 69                                      | 11.5                                     |
| 72                                      | 12                                       |
| 75                                      | 12.5                                     |
| 78                                      | 13                                       |
| 81                                      | 13.5                                     |
| 84                                      | 14                                       |

|    |      |
|----|------|
| 87 | 14.5 |
| 90 | 15   |
| 93 | 15.5 |
| 96 | 16   |
| 99 | 16.5 |

AND

**Table 2. LEED Points for Source Energy Score**

| <b>Source Energy Score</b>              | <b>LEED Points</b>                       |
|---|--|
| 40 (Required for initial certification) | 6.5 (Required for initial certification) |
| 41                                      | 7  |
| 44                                      | 7.5                                      |
| 47                                      | 8  |
| 50                                      | 8.5                                      |
| 54                                      | 9  |
| 57                                      | 9.5                                      |
| 60                                      | 10                                       |
| 63                                      | 10.5                                     |
| 66                                      | 11                                       |
| 69                                      | 11.5                                     |
| 72                                      | 12                                       |
| 75                                      | 12.5                                     |
| 78                                      | 13                                       |
| 81                                      | 13.5                                     |
| 84                                      | 14                                       |
| 87                                      | 14.5                                     |
| 90                                      | 15                                       |
| 93                                      | 15.5                                     |
| 96                                      | 16                                       |
| 99                                      | 16.5                                     |

LEED points are calculated based on the project score for each metric; the GHG emissions score and source energy score are each weighted 50% of the energy performance score. LEED points are rounded up to the nearest whole number and awarded according to Table 3.

**Table 3. LEED Points for Energy Performance Score**

| <b>Energy Performance Score</b>         | <b>LEED Points</b>                      |
|---|---|
| 40 (Required for initial certification) | 13 (Required for initial certification) |
| 41                                      | 14                                      |
| 44                                      | 15                                      |
| 47                                      | 16                                      |
| 50                                      | 17                                      |
| 54                                      | 18                                      |
| 57                                      | 19                                      |
| 60                                      | 20                                      |
| 63                                      | 21                                      |
| 66                                      | 22                                      |
| 69                                      | 23                                      |
| 72                                      | 24                                      |
| 75                                      | 25                                      |
| 78                                      | 26                                      |

|    |    |
|----|----|
| 81 | 27 |
| 84 | 28 |
| 87 | 29 |
| 90 | 30 |
| 93 | 31 |
| 96 | 32 |
| 99 | 33 |

### GHG emissions score

The GHG emissions score rates the building's total greenhouse gas emissions against the total greenhouse gas emissions of comparable high-performing buildings.

The score is a value from 1-100 based on the project's GHG emissions per occupant and GHG emissions per floor area.

### GHG emissions score calculation

To calculate a GHG emissions score, the following data is required:

- Annual Energy consumption (kBtu), with monthly or daily totals and distinguished by fuel type
- Gross floor area (sq. ft. or sq. m.)
- Weighted occupancy
- Weighted operating hours
- Outside air temperature
- Location

The energy consumption is converted into equivalent GHG emissions, using the latest U.S. Environmental Protection Agency's (EPA) [regional grid mix coefficients](#) for U.S. and Canadian projects, and other emission factor lists as appropriate for international projects such as national grid mix coefficients from the International Energy Agency. The grid mix coefficient values are kept up to date with release updates.

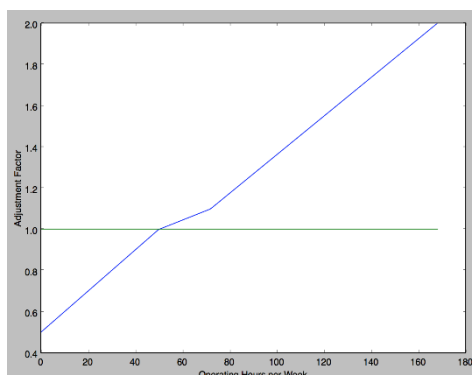
This is the Annual Emissions (mTCO<sub>2</sub>e)

GHG emissions are adjusted for weighted operating hours and outside temperature and converted into daily GHG emissions using Equation 1.

Equation 1: adjusted GHG emissions = (GHG emissions \* outside temperature adjustment factor \* operating hours adjustment factor) / 365 days

The operating hours adjustment factor is determined using Figure 1. The adjustment factor accounts for typical LEED buildings operations of 50 hours a week.

Figure 1. Operating hours adjustment factor



GHG emissions per occupant is calculated by dividing the adjusted GHG emissions by the weighted occupancy

Equation 2. GHG emissions per occupant = adjusted GHG emissions / weighted occupancy

GHG emissions per floor area is calculated by dividing the adjusted GHG emissions by the gross floor area.

Equation 3: GHG emissions per floor area = adjusted GHG emissions / gross floor area

The project's calculated GHG emissions per occupant and GHG emissions per floor area are input into the energy scoring function for the specific project type.

The energy scoring function was developed using energy consumption data from high-performing buildings. The data set includes LEED buildings that shared their energy consumption data with USGBC as part of the whole-building energy and water usage requirement.

### **Source energy score**

The source energy score rates the building's total energy consumption against the total energy consumption of comparable high-performing buildings.

The score is a value from 1-100 based on the project's source energy consumption per occupant per floor area.

### **Source energy score calculation**

To calculate a source energy score, the following data is required:

- Annual Energy consumption, with monthly or daily totals and distinguished by fuel type
- Gross floor area (sq. ft. or sq. m.)
- Weighted occupancy
- Weighted operating hours
- Outside air temperature
- Location

## EA CREDIT: ENHANCED REFRIGERANT MANAGEMENT

### 1 point

This credit applies to

- O+M: Existing Buildings (1 point)
- O+M: Interiors (1 point)

### Intent

To reduce ozone depletion and support early compliance with the Montreal Protocol while minimizing direct contributions to climate change.

### Requirements

#### EB, INTERIORS

#### **Option 1. No Refrigerants or Low-Impact Refrigerants (1 point)**

Do not use refrigerants, or use only refrigerants (naturally occurring or synthetic) that have an ozone depletion potential (ODP) of zero and a global warming potential (GWP) of less than 50.

OR

#### **Option 2. Calculation of Refrigerant Impact (1 point)**

Select refrigerants that are used in heating, ventilating, air-conditioning, and refrigeration (HVAC&R) equipment to minimize or eliminate the emission of compounds that contribute to ozone depletion and climate change. The combination of all new and existing base building and tenant HVAC&R equipment that serve the project must comply with the following formula:

| IP units  | SI units   |
|---|--|
| $\frac{LCGW}{P} + \frac{LCOD}{P} \times 10^5 \leq 100$                              | $\frac{LCGW}{P} + \frac{LCOD}{P} \times 10^5 \leq 13$                                |
| <b>Calculation definitions for LCGWP + LCODP x 10<sup>5</sup> ≤ 100 (IP units)</b>  | <b>Calculation definitions for LCGWP + LCODP x 10<sup>5</sup> ≤ 13 (SI units)</b>    |
| LCODP = [ODPr x (Lr x Life + Mr) x Rc]/Life   | LCODP = [ODPr x (Lr x Life + Mr) x Rc]/Life  |
| LCGWP = [GWPr x (Lr x Life + Mr) x Rc]/Life   | LCGWP = [GWPr x (Lr x Life + Mr) x Rc]/Life  |
| LCODP: Lifecycle Ozone Depletion Potential (lb CFC 11/Ton-Year)                     | LCODP: Lifecycle Ozone Depletion Potential (kg CFC 11/(kW/year))                     |
| LCGWP: Lifecycle Direct Global Warming Potential (lb CO <sub>2</sub> /Ton-Year)     | LCGWP: Lifecycle Direct Global Warming Potential (kg CO <sub>2</sub> /kW-year)       |
| GWPr: Global Warming Potential of Refrigerant (0 to 12,000 lb CO <sub>2</sub> /lbr) | GWPr: Global Warming Potential of Refrigerant (0 to 12,000 kg CO <sub>2</sub> /kg r) |
| ODPr: Ozone Depletion Potential of Refrigerant (0 to 0.2 lb CFC 11/lbr)             | ODPr: Ozone Depletion Potential of Refrigerant (0 to 0.2 kg CFC 11/kg r)             |
| Lr: Refrigerant Leakage Rate (2.0%)   | Lr: Refrigerant Leakage Rate (2.0%)  |

|   |  |
|---|--|
| Mr: End-of-life Refrigerant Loss<br>(10%)   | Mr: End-of-life Refrigerant Loss<br>(10%)  |
| Rc: Refrigerant Charge<br>(0.5 to 5.0 lbs of refrigerant per ton of gross AHRI<br>rated cooling capacity) | Rc: Refrigerant Charge<br>(0.065 to 0.65 kg of refrigerant per kW of AHRI<br>rated or Eurovent Certified cooling capacity) |
| Life: Equipment Life<br>(10 years; default based on equipment type,<br>unless otherwise demonstrated)     | Life: Equipment Life<br>(10 years; default based on equipment type,<br>unless otherwise demonstrated)                      |

For multiple types of equipment, calculate a weighted average of all base building HVAC&R equipment, using the following formula:

| IP units  | SI units   |
|---|--|
| $\frac{\sum (LCGWP + LCODP \times 10^5) \times Q_{unit}}{Q_{total}} \leq 100$ | $\frac{\sum (LCGWP + LCODP \times 10^5) \times Q_{unit}}{Q_{total}} \leq 13$ |

| Calculation definitions for<br>[ $\sum (LCGWP + LCODP \times 10^5) \times Q_{unit}$ ] / $Q_{total}$<br>$\leq 100$<br>(IP units) | Calculation definitions for<br>[ $\sum (LCGWP + LCODP \times 10^5) \times Q_{unit}$ ] / $Q_{total}$<br>$\leq 13$<br>(SI units) |
|---|--|
| Qunit = Gross ARI rated cooling capacity of an individual HVAC or refrigeration unit (Tons)                                     | Qunit = Eurovent Certified cooling capacity of an individual HVAC or refrigeration unit (kW)                                   |
| Qtotal = Total gross ARI rated cooling capacity of all HVAC or refrigeration  | Qtotal = Total Eurovent Certified cooling capacity of all HVAC or refrigeration (kW)   |

### Retail

Meet Option 1 or 2 for all HVAC systems.

Stores with commercial refrigeration systems must comply with the following.

- Use only non-ozone-depleting refrigerants.
- Achieve an average HFC refrigerant charge of no more than 1.75 pounds of refrigerant per 1,000 Btu/h (2.72 kilograms of refrigerant per kW) total evaporator cooling load.
- Achieve a store-wide annual refrigerant emissions rate of no more than 15%.

Alternatively, stores with commercial refrigeration systems may provide proof of attainment of EPA GreenChill's silver-level store certification for fully operational food retail stores.

## EA CREDIT: GRID HARMONIZATION

1 point

This credit applies to

- O+M: Existing Buildings (1 point)

### Intent

To increase participation in demand response technologies and programs that make energy generation and distribution systems more affordable and more efficient, increase grid reliability, and reduce greenhouse gas emissions.

### Requirements

#### **EB**

Evaluate building systems and equipment for participation in a demand response program. On-site electricity generation does not meet the intent of this credit.

#### **Case 1. Demand Response Program Available and Participation (1 point)**

Participate in an existing demand response (DR) program and complete the following activities.

- Have in place a system with the capability for real-time, fully automated DR based on external initiation by a DR program provider. Semi-automated DR may be utilized in practice.
- Enroll in a minimum one-year DR participation amount contractual commitment with a qualified DR program provider, with the intention of multiyear renewal, for at least 10% of the annual on-peak electricity demand. On-peak demand is based on electric utility bills with an on-peak demand period defined by the local utility. The on-peak demand may vary based on the utility climate and pricing structures.
- Develop a comprehensive plan for meeting the contractual commitment during a Demand Response event.
- Include the DR processes in the current facilities requirements and operations and maintenance plan.
- Initiate at least one full test of the DR plan.

OR

#### **Case 2. Demand Response Capable Building (1 point)**

- Have infrastructure in place to take advantage of future demand response programs or dynamic, real-time pricing programs and complete the following activities. Develop a comprehensive plan for shedding at least 10% of the annual on-peak electricity demand. Peak demand is based on electric utility bills.
- Include the DR processes in the current facilities requirements and operations and maintenance plan.
- Initiate at least one full test of the DR plan as part of the building commissioning program.
- Contact local utility representatives to discuss participation in future DR programs.

OR

#### **Case 3: Load Flexibility and Management Strategies (1 point)**

Analyze the building's annual load shape and peak load based on metered electricity use and electric utility bills. Review the regional grid load profile using the metric of peak load or peak carbon emissions.

The U.S. Environmental Protection Agency's (EPA) AVOIDed Emissions and geneRation Tool (AVERT) provides regional grid emissions data; local utilities may also provide this data.

Coordinate review of building load shape and peak load with review of the regional grid profile to identify the best value load management strategies that the building can provide.

Implement one or more of the load flexibility and management strategies described below. All projects must install interval recording meters and have equipment capable of accepting an external signal.

Load Flexibility and Management Strategies:

- ▶ Peak Load Optimization: demonstrate that strategy reduces on-peak load by at least 10% as compared to peak electrical demand (1 point)
- ▶ Flexible Operating Scenarios: demonstrate that strategy moves at least 10% of peak load by a time period of 2 hours (1 point)
- ▶ On-site thermal and/or electricity storage: demonstrate that strategy reduces on-peak load by at least 10% as compared to peak electrical demand (1 point)
- ▶ Grid resilience technologies: project served by utilities with resilience programs in place, which leverage strategies such as islanding and part-load operation, automatically achieve this credit (1 point)

Include load flexibility and management strategies and installed technologies in the Facilities Requirements and Operations and Maintenance Plan.

Contact local utility representatives to discuss participation in future DR programs and to inform utility of building load flexibility and management strategies.



# MATERIALS AND RESOURCES (MR)

## MR PREREQUISITE: PURCHASING POLICY Required

This prerequisite applies to

- O+M: Existing Buildings
- O+M: Interiors

### Intent

To reduce the environmental harm from materials and products purchased and used during operations and maintenance of buildings.

### Requirements

#### EB, INTERIORS

Have in place an environmentally preferable purchasing (EPP) policy for materials and products purchased for the project during regular operations. Include at a minimum:

- Ongoing Consumables
  - The five most purchased product categories based on total annual purchases.
  - Paper, toner cartridges, binders, batteries, and desk accessories.
  - Food and beverage.
- Electronic Equipment
  - Lamps (indoor and outdoor, hard-wired and portable fixtures).
  - Office equipment, appliances, and audiovisual equipment.
  - Electric powered equipment.

The policy should address performance targets for purchases that meet the criteria in MR Credit: Purchasing.

The policy must cover at least those product purchases within the building and site management's control. For interiors projects, the policy must cover product purchases within the project's control.

#### INTERIORS

In addition to the requirements above, Interiors projects must recommend best practices for environmentally preferable purchasing for purchases outside of the project's control.

## MR PREREQUISITE: FACILITY MAINTENANCE AND RENOVATION POLICY Required

This prerequisite applies to

- O+M: Existing Buildings
- O+M: Interiors

### Intent

To reduce the environmental harms associated with the materials purchased, installed, and disposed of during maintenance and renovation activities.

### Requirements

#### EB, INTERIORS

Have in place a facility maintenance and renovation policy that includes guidelines for renovation and maintenance activities, using LEED rating system strategies, to be implemented at the discretion of building owners, operators, or tenants. Renovation activities include building improvements and tenant fit-outs. Maintenance activities include general repair and replacement.

The policy must cover at least those product purchases within the building and site management's control. The policy must address purchasing, waste management and indoor air quality.

#### Purchasing Policy for Maintenance and Renovations

Have in place a purchasing policy for product and materials purchased for facility maintenance and renovation activities. Include at a minimum:

- Base building elements permanently or semi-permanently attached to the building (mechanical, electrical and plumbing components and specialty items such as elevators are excluded). Exclude fixtures, and equipment, which are not considered base building elements;
- Furniture and furnishings as well as components and parts needed to maintain them

#### Waste Management Policy for Maintenance and Renovations

Have in place a waste management policy addressing the following:

- *Facility maintenance waste.* The policy should address safe storage and recycling and diversion of waste associated with maintenance activities.
- *Renovation waste.* The policy should describe the procedure for creating an individual plan for each renovation project. Each renovation project should establish waste diversion goals, target five materials for diversion, approximate the volume of waste anticipated, and identify waste diversion strategies to be used.
- *Separation of facility maintenance and renovation waste from ongoing waste:* The policy should indicate that facility maintenance and renovation waste are handled separately from ongoing waste.
- *Furniture waste (Multifamily only).* The policy should address storage locations for furniture and reuse or recycling of furniture waste.

The policy should address the criteria in the following credits:

- MR Credit: Waste Performance

#### Indoor Air Quality Policy for Maintenance and Renovations

Have in place an indoor air quality policy for facility maintenance and renovation activities addressing the criteria below. For maintenance activities implement the policy as applicable. For renovation activities create an individual plan for each renovation project as outlined in the policy.

- Follow the recommended control measures of the Sheet Metal and Air Conditioning National Contractors Association (SMACNA) IAQ Guidelines for Occupied Buildings under Construction, 2nd edition (2007), ANSI/SMACNA 008–2008, Chapter 3
  - Protect stored on-site and installed absorptive materials from moisture damage.
  - Do not operate permanently-installed air handling equipment during construction unless filtration media with a minimum efficiency reporting value (MERV) of 8, as determined by ASHRAE 52.2–2007, with errata (or equivalent filtration media class of F5 or higher, as defined by CEN Standard EN 779–2002, Particulate Air Filters for General Ventilation, Determination of the Filtration Performance), are installed at each return air grille and return or transfer duct inlet opening such that there is no bypass around the filtration media.
- Develop a procedure to, before occupancy, replace all filtration media with the final design filtration media.
- Develop a plan to determine whether a flush-out or air quality testing is needed after construction ends and all interior finishes are installed but before occupancy.

## MR PREREQUISITE: WASTE PERFORMANCE

### 3-8 points

This prerequisite applies to

- O+M: Existing Buildings (3-8 points)
- O+M: Interiors (3-8 points)

### Intent

To track and reduce the waste that is generated by building occupants and hauled to and disposed of in landfills and incinerators.

### Requirements

#### **EB, INTERIORS**

Have in place storage locations for recyclable materials, including mixed paper, corrugated cardboard, glass, plastics, and metals. Safely store and dispose of batteries and all lamps (indoor and outdoor, hard-wired and portable fixtures).

Track and measure all ongoing waste and durable goods waste.

Measure the total weight of waste (in lbs., kg, or tons) that is generated, and the total weight that is diverted from landfills and incineration facilities for one full year or from a waste analysis. Exclude any facility renovations waste.

Input generated and diverted waste totals and calculate a waste performance score for the project.

LEED points for this prerequisite are awarded for waste performance scores above 40, according to Table 1.

**Table 1. LEED Points for Waste Performance**

| Waste Performance Score | LEED Points |
|-------------------------|-------------|
| 40                      | 3           |
| 44                      | 4           |
| 57                      | 5           |
| 69                      | 6           |
| 82                      | 7           |
| 94                      | 8           |

#### **Waste performance score**

The waste performance score rates the resource consumption and resource use efficiency of the building (waste generated and diverted) against the consumption and efficiency of comparable high-performing buildings.

The score is a value from 1-100 based on the project's total weight of waste generated and the total weight of waste diverted from landfills and incineration facilities.

#### **Waste performance score calculation**

To calculate waste performance score, the following data is required:

- Total waste generated (lbs., kg, or tons)
- Total waste diverted (lbs., kg, or tons)
- Weighted occupancy

The waste generated is converted into an average daily waste generated per occupant, using Equation 1.

Equation 1. Average daily waste generated = (waste generated / # days associated with waste total) / occupancy

The waste diverted is converted into a daily waste undiverted per occupant, using Equation 2.

Equation 2. Daily waste undiverted per occupant = (waste diverted / # days associated with waste total) / occupancy

The daily undiverted waste is calculated using Equation 3.

Equation 3. Daily undiverted waste per occupant = daily waste generated per occupant– daily waste diverted per occupant

The project's calculated average daily waste generated per occupant AND average daily waste undiverted per occupant are input into the waste scoring function to calculate the waste performance score.

The waste scoring function was developed using waste information reported by high-performing buildings. The data set includes LEED buildings that pursued MR credit 6. [Solid waste management – waste stream audit](#).

## MR CREDIT: PURCHASING

### 1-4 points

This credit applies to

- O+M: Existing Buildings (1 point)
- O+M: Interiors (1-4 points)

### Intent

To reduce environmental harm and human health risks from materials and products purchased, used, installed, and disposed of during the operations and maintenance of buildings.

### Requirements

#### **EB, INTERIORS**

Interiors projects may select up to four options, to earn 4 points.

#### **Option 1. Ongoing Consumables (1 point, 1-2 points Interiors only)**

For at least one month, track all ongoing consumable purchases. Purchase at least 50% (1 point) or 75% (2 points, Interiors only), by cost, of total ongoing consumables that meet at least one of the following criteria.

- *Recycled materials and products.* The content of purchases must meet or exceed the levels listed in the U.S. Environmental Protection Agency Comprehensive Procurement Guidelines. Products not covered by the Guidelines can get credit for their recycled content with no minimum.
- *Extended use.* Batteries must be rechargeable. Toner cartridges for laser printers must be remanufactured.
- *Bio-based products.* Bio-based products must meet the Sustainable Agriculture Network's Sustainable Agriculture Standard. Bio-based raw materials must be tested using ASTM Test Method D6866 and be legally harvested, as defined by the exporting and receiving country. Exclude hide products, such as leather and other animal skin material.
- *Paper and wood products.* Paper and wood products must be certified by the Forest Stewardship Council or USGBC-approved equivalent.
- *Materials reuse.* Reuse includes salvaged, refurbished, or reused products.
- *Extended producer responsibility.* Products purchased from a manufacturer (producer) that participates in an extended producer responsibility program or is directly responsible for extended producer responsibility.
- *Cradle to Cradle Certified.* Products purchased have earned Cradle to Cradle certification of any level, Version 3 or newer.

#### **Option 2. Building Materials (1 point, 1-2 points Interiors only)**

For at least one month, track all building material purchases (including furniture) used and/or installed as part of space reconfigurations, additions/alternations, or renovations. Purchase at least 50% (1 point) or 75% (2 points, Interiors only), by cost, of total building materials that meet at least one of the following criteria under Reporting, Optimization, and other attributes.

Reporting:

- *Health Product Declaration.* The end use product has a published, complete Health Product Declaration with full disclosure of known hazards in compliance with the Health Product Declaration open Standard.
- *Cradle to Cradle Certified.* Products purchased have earned Cradle to Cradle certification of any level, Version 3 or newer.

- Declare. The Declare label must indicate that all ingredients have been evaluated and disclosed down to 1000 ppm.
- *ANSI/BIFMA e3 Furniture Sustainability Standard*: Documentation from the assessor or scorecard from BIFMA must demonstrate the product earned at least 3 points under 7.5.1.3 Advanced Level in e3-2014 or 3 points under 7.4.1.3 Advanced Level in e3-2012.
- *Product Lens certification*
- *Facts - NSF/ANSI 336*. Sustainability Assessment for Commercial Furnishings Fabric at any certification level
- *Environmental product declaration (EPD)*: Products having an environmental product declaration that conform to ISO 14025, 14040, 14044, and EN 15804 or ISO 21930 and have at least a cradle to gate scope. The EPD can be either industry-wide (generic) EPD or product specific Type III EPD with third party external verification in which the manufacturer is explicitly recognized as the participant by the program operator.

#### Optimization:

- GreenScreen v1.2 Benchmark. Products with fully inventoried chemical ingredients to 100 ppm with no Benchmark 1 hazards.
- Cradle to Cradle certified. Products purchased have earned Cradle to Cradle certification of any level, Version 3 or newer.
- *EPD Optimization path*: Products with Environmental Product Declarations (EPDs) that are third-party certified and demonstrate impact reduction below industry average in at least three of the following categories:
  - global warming potential (greenhouse gases), in CO<sub>2</sub>e;
  - depletion of the stratospheric ozone layer, in kg CFC-11;
  - acidification of land and water sources, in moles H<sup>+</sup> or kg SO<sub>2</sub>;
  - eutrophication, in kg nitrogen or kg phosphate;
  - formation of tropospheric ozone, in kg NO<sub>x</sub>, kg O<sub>3</sub> eq, or kg ethene; and
  - depletion of nonrenewable energy resources, in MJ.
- Product Manufacturer Supply Chain Optimization: Purchase products meeting any of the following supply chain optimization criteria:
  - Are sourced from product manufacturers who engage in validated and robust safety, health, hazard, and risk programs which at a minimum document at least 99% (by weight) of the ingredients used to make the building product or building material, and
  - Are sourced from product manufacturers with independent third party verification of their supply chain that at a minimum verifies:
    - Processes are in place to communicate and transparently prioritize chemical ingredients along the supply chain according to available hazard, exposure and use information to identify those that require more detailed evaluation
    - Processes are in place to identify, document, and communicate information on health, safety and environmental characteristics of chemical ingredients
    - Processes are in place to implement measures to manage the health, safety and environmental hazard and risk of chemical ingredients.
    - Processes are in place to optimize health, safety and environmental impacts when designing and improving chemical ingredients.
    - Processes are in place to communicate, receive and evaluate chemical ingredient safety and stewardship information along the supply chain. Safety and stewardship information about the chemical ingredients is publicly available from all points along the supply chain
- *Extended producer responsibility*. Products purchased from a manufacturer (producer) that participates in an extended producer responsibility program or is directly responsible for extended producer responsibility.
- *Wood products*. Wood products must be certified by the Forest Stewardship Council or USGBC-approved equivalent.
- *Materials reuse*. Reuse includes salvaged, refurbished, or reused products.
- *Recycled content*. Recycled content is the sum of postconsumer recycled content plus one-half the preconsumer recycled content, based on cost.

- *Bio-based products.* Bio-based products must meet the Sustainable Agriculture Network's Sustainable Agriculture Standard. Bio-based raw materials must be tested using ASTM Test Method D6866 and be legally harvested, as defined by the exporting and receiving country. Exclude hide products, such as leather and other animal skin material.

Other:

- *Low formaldehyde for composite wood.* Built-in cabinetry and architectural millwork containing composite woods must be constructed from materials documented to have low formaldehyde emissions that meet the California Air Resources Board requirements for ultra-low-emitting formaldehyde (ULEF) resins or no-added formaldehyde based resins. Salvaged and reused architectural millwork more than one year old at the time of occupancy is considered compliant, provided it meets the requirements for any site-applied paints, coatings, adhesives, and sealants.
- *Low emissions of volatile organic compounds for products other than furniture:* Products (thermal and acoustic insulation, flooring materials and finishes, ceiling materials and finishes and wall materials and finishes) must either be inherently non-emitting or be tested and determined compliant in accordance with California Department of Public Health Standard Method v1.2–2017, using the applicable exposure scenario. For products for school classrooms, the testing should be performed using the classroom scenario, for all other products use the default private office scenario. Both first-party and third-party statements of product compliance must follow the guidelines in CDPH SM v1.2–2017, Section 8. Organizations that certify manufacturers' claims must be accredited under ISO Guide 65. Laboratories that conduct the tests must be accredited under ISO/IEC 17025 for the test methods they use.
- *VOC content for wet-applied products.* In addition to meeting the requirements for low emissions of volatile organic compounds (above), on-site wet-applied products must not contain excessive levels of VOCs, for the health of the installers and other trades workers who are exposed to these products. To demonstrate compliance, a product must meet the following requirements, as applicable. Disclosure of VOC content must be made by the manufacturer. Any testing must follow the test method specified in the applicable regulation.
  - All paints and coatings wet-applied on site must meet the applicable VOC limits of the California Air Resources Board (CARB) 2007, Suggested Control Measure (SCM) for Architectural Coatings, or the South Coast Air Quality Management District (SCAQMD) Rule 1113, effective June 3, 2011.
  - All adhesives and sealants wet-applied on site must meet the applicable chemical content requirements of SCAQMD Rule 1168, July 1, 2005, Adhesive and Sealant Applications, as analyzed by the methods specified in Rule 1168. The provisions of SCAQMD Rule 1168 do not apply to adhesives and sealants subject to state or federal consumer product VOC regulations.
  - If the applicable regulation requires subtraction of exempt compounds, any content of intentionally added exempt compounds larger than 1% weight by mass (total exempt compounds) must be disclosed.
  - If a product cannot reasonably be tested as specified above, testing of VOC content must comply with ASTM D2369-10; ISO 11890, part 1; ASTM D6886-03; or ISO 11890-2.
  - For projects in North America, methylene chloride and perchloroethylene may not be intentionally added in paints, coatings, adhesives, or sealants.
- *Zero Waste Manufacturing:* Products are made from manufacturers that have achieved certification of their waste minimization during operations. Acceptable certifications include third-party verified TRUE (zero waste certification) and UL Standard 2799.

Furniture specific requirements:

- Any of the optimization related attributes are applicable to furniture.
- *Low emissions of volatile organic compounds for furniture:* Low emissions of volatile organic compounds. Products must have been tested, following ANSI/BIFMA Standard Method M7.1–2011, and must comply with ANSI/BIFMA e3-2011 Furniture Sustainability Standard 7.6.2. For classroom furniture, use the standard school classroom model in CDPH Standard Method v1.2.



Salvaged and reused furniture more than one year old at the time of use is considered compliant, provided it meets the requirements for any site-applied paints, coatings, adhesives, and sealants.

### **Option 3. Electronic Equipment (1 point)**

For at least one month, track all electronic equipment purchases. Purchase at least 50%, by cost, electronic equipment that meets at least one of the following criteria. In addition, create a phase-out plan to replace remaining products with compliant equipment at the end of their useful life.

- *EPEAT rating.* The equipment must have a silver Electronic Product Environmental Assessment Tool (EPEAT) rating or better.
- *ENERGY STAR rating.* If the equipment does not yet fall under the EPEAT rating systems, it must be ENERGY STAR® qualified or performance equivalent for projects outside the U.S.
- *Lamps.* Lamps must contain no mercury (with equivalent energy efficiency as mercury containing lamps) or have an average low mercury content of 25 picograms per lumen-hour or less.

### **Option 4. Food and Beverage (1 point)**

For at least one month, track all food and beverages. Purchase at least 15%, by cost, of total combined food and beverage purchases must meet at least one of the following criteria. Exclude wine, beer, and liquor purchases from the credit calculations.

- *Sustainable agriculture.* The food or beverage must be labeled USDA Organic, Food Alliance Certified, Rainforest Alliance Certified, Protected Harvest Certified, Fair Trade, or Marine Stewardship Council's Blue Eco-Label, or labeled with the European Community Organic Production logo in accordance with Regulations (EC) No. 834/2007 and (EC) No. 889/2008.
- *Local sourcing.* The food or beverage must contain raw materials harvested and produced within 100 miles (160 kilometers) of the site.

# INDOOR ENVIRONMENTAL QUALITY (EQ)

## EQ PREREQUISITE: MINIMUM INDOOR AIR QUALITY Required

This prerequisite applies to

- O+M: Existing Buildings
- O+M: Interiors

### Intent

To contribute to the comfort and well-being of building occupants by establishing minimum standards for indoor air quality (IAQ).

### Requirements

#### EB, INTERIORS

Maintain the ventilation system equipment and associated components based on Table 8.2 of ASHRAE 62.1-2016. Include information on ventilation system operation and preventative maintenance in the current facilities requirements and operations and maintenance plan required for compliance with EA prerequisite Energy Efficiency Best Management Practices.

For spaces with mechanical exhaust, test and confirm proper operation of the exhaust systems as outlined in the current facilities requirements and operations and maintenance plan

Ventilate the project spaces mechanically or naturally as follows:

For mechanically ventilated spaces, measure the total quantity of outdoor air delivered and verify the results are within 10 percent of the rates outlined in the current facilities requirements and operations and maintenance plan. Measurements shall quantify the amount of outdoor air for each air handling unit serving the project. Measurements taken within five years prior to project submission are acceptable. The rates must meet the following minimum requirements for each air handling unit:

In IP units:

Minimum outdoor air rate in cfm =  $0.06 \text{ cfm/sf} \times \text{gross building area (in sf)} + \text{people outdoor air rate from Table 1 (cfm/person)} \times \text{building occupancy}$

In SI units:

Minimum outdoor air rate in L/s =  $0.3 \text{ L/s} \cdot \text{m}^2 \times \text{gross building area (in m}^2\text{)} + \text{people outdoor air rate from Table 1 (L/s per person)} \times \text{building occupancy}$

**Table 1. People outdoor air rate**

| Occupancy category*   | People outdoor air rate |                |
|---|-------------------------|----------------|
|   | cfm per person          | L/s per person |
| Auditorium seating area<br>Libraries<br>Office space<br>Places of religious worship | 5                       | 2.5            |
| Mall common areas<br>Museums  | 7.5                     | 3.8            |
| Classrooms<br>Daycare   | 10                      | 5              |

|                       |    |    |
|-----------------------|----|----|
| General manufacturing |    |    |
| Health club/aerobics  | 20 | 10 |

\*For additional occupancy categories, see Table 6.2.2.1 of ASHRAE 62.1-2016

Alternatively, the rates may meet the Ventilation Rate Procedure outlined in Section 6.2 of ASHRAE 62.1 editions 2016, 2013, 2010, or 2007.

For naturally ventilated spaces, meet the minimum requirements in Table 2:

Table 2. Minimum opening location and size requirements for naturally ventilated spaces\*

| Opening type        | Location of opening   | Size of opening         |
|---------------------|---|-------------------------|
|                     | Maximum distance from operable openings**   | Minimum opening area*** |
| Single side opening | 2 x ceiling height  | 4% of floor area        |
| Double side opening | 5 x ceiling height  | 4% of floor area        |
| Corner opening      | 5 x ceiling height (along a line drawn between the two openings that are farthest apart.; for floor area outside line, comply with single side opening) | 4% of floor area        |

\*Adopted from Section 6.4.1 of ASHRAE 62.1-2016

\*\*For ceilings that are increasing in height as distance from the openings is increased, the ceiling height shall be determined as the average height of the ceiling within 6 m (20 ft) from the operable openings.

\*\*\*If the window is covered with louvers, insect screens, or otherwise obstructed, the openable area must be based on the free unobstructed area through the opening.

### Multifamily

For all common areas in the building, meet requirements above.

For residential units, have an operable window in each bedroom with the total openable window area a minimum of 4% of the room floor area or meet the following minimum requirements for the entire unit:

In IP units:

Minimum outdoor air rate in cfm =  $0.03 \text{ cfm/sf} \times \text{dwelling unit floor area (in sf)} + 7.5 \text{ cfm/person} \times (\text{number of bedrooms} + 1)$

In SI units:

Minimum outdoor air rate in L/s =  $0.15 \text{ L/s} \cdot \text{m}^2 \times \text{dwelling unit floor area (in m}^2) + 7.5 \text{ cfm/person} \times (\text{number of bedrooms} + 1)$

In each full bathroom, have either an exhaust fan that vents directly to the outdoors or an operable window.

## **EQ PREREQUISITE: ENVIRONMENTAL TOBACCO SMOKE CONTROL Required**

This prerequisite applies to

- O+M: Existing Buildings
- O+M: Interiors

### **Intent**

To prevent or minimize exposure of building occupants, indoor surfaces, and ventilation air distribution systems to environmental tobacco smoke.

### **Requirements**

For this prerequisite smoking includes tobacco smoke, as well as smoke produced from the combustion of cannabis and controlled substances and the emissions produced by electronic smoking devices.

### **EB**

Prohibit smoking in the building.

Prohibit smoking outside the building except in designated smoking areas located at least 25 feet (7.5 meters) from all entries, outdoor air intakes, and operable windows. Also prohibit smoking outside the property line in spaces used for business purposes.

Smoking does not have to be prohibited within 25 feet (7.5 meters) if the code explicitly prohibits it.

Communicate the no-smoking policy to occupants of the building and have in place provisions for enforcement.

### **Residential only**

#### **Option 1. No Smoking**

Meet the requirements above.

OR

#### **Option 2. Compartmentalization of Smoking Areas**

Prohibit smoking in all common areas of the building.

Prohibit smoking outside the building except in designated smoking areas located at least 25 feet (7.5 meters) from all entries, outdoor air intakes, and operable windows. Also prohibit smoking outside the property line in spaces used for business purposes.

The prohibition must be communicated in building rental or lease agreements or condo or coop association covenants and restrictions. Make provisions for enforcement.

If the requirement to prohibit smoking within 25 feet (7.5 meters) cannot be implemented because of code, provide documentation of these regulations.

Each unit must be compartmentalized to prevent excessive leakage between units:

- Weather-strip all exterior doors and operable windows in the residential units to minimize leakage from outdoors.
- Weather-strip all doors leading from residential units into common hallways.

- Minimize uncontrolled pathways for the transfer of smoke and other indoor air pollutants between residential units by sealing penetrations in the walls, ceilings, and floors and by sealing vertical chases (including utility chases, garbage chutes, mail drops, and elevator shafts) adjacent to the units.
- Demonstrate a maximum leakage of 0.50 cubic feet per minute per square foot (2.54 liters per second per square meter) at 50 Pa of enclosure (i.e., all surfaces enclosing the apartment, including exterior and party walls, floors, and ceilings) or establish a baseline and demonstrate a 30% improvement in leakage.

#### Schools

Prohibit smoking on site.

Signage must be posted at the property line indicating the no-smoking policy.

#### **INTERIORS**

Prohibit smoking in the project spaces.

Smoking must also be prohibited in all common areas used by the project occupants and any areas of the building served by the same HVAC system as the project.

If smoking is permitted in other areas of the building, ensure that ETS cannot migrate into the project spaces.

Communicate the no-smoking policy to occupants of the project and have in place provisions for enforcement.

## **EQ PREREQUISITE: GREEN CLEANING POLICY Required**

This prerequisite applies to

- O+M: Existing Buildings
- O+M: Interiors

### **Intent**

To reduce levels of chemical, biological, and particulate contaminants that can compromise air quality, human health, building finishes, building systems, and the environment.

### **Requirements**

#### **EB, INTERIORS**

Operate the project using green cleaning best practices.

#### **Option 1. In-House Green Cleaning Policy**

Have in place a green cleaning policy for the green cleaning procedures, materials, and services that are within the project and site management's control. Include the following elements:

##### *Performance Targets*

- Use of cleaning products and materials that meet the green cleaning criteria in EQ Credit: Green Cleaning
- Use of cleaning equipment that meets the criteria in EQ Credit: Green Cleaning

##### *Goals and Strategies*

- Standard operating procedures for effective cleaning of hard floors and carpets that will be consistently used, managed, and audited.
- Provisions for addressing protection of building occupants during cleaning, including vulnerable populations.
- Guidelines for selection and appropriate use of disinfectants and sanitizers.
- Guidelines for safe handling and storage of cleaning chemicals used in the building, including a plan for managing hazardous spills and mishandling incidents.
- Strategies for reducing the toxicity of the chemicals used for laundry, ware washing, and other cleaning activities.
- Strategies for conserving energy, water, and chemicals during cleaning.
- Strategies for promoting and improving hand hygiene.

##### *Personnel*

- Requirements for maintenance personnel including contingency planning to manage staffing shortages under a variety of conditions to ensure that basic cleaning services are met and critical cleaning needs are addressed. Include a process to obtain occupant and custodial staff input and feedback after contingency plans are implemented.
- Timing and frequency of training for maintenance personnel in the hazards of use, disposal, and recycling of cleaning chemicals, dispensing equipment, and packaging.

#### **Option 2. Certified Cleaning Service**

Clean the project with a cleaning service certified and in good standing under one of the following:

- Green Seal's Environmental Standard for Commercial Cleaning Services (GS-42); or

- International Sanitary Supply Association (ISSA) Cleaning Industry Management Standard for Green Buildings (CIMS-GB); or
- Local equivalent for projects outside the U.S.

In addition, work with the cleaning contractor to create goals and strategies for conserving energy, water, and chemicals during cleaning.

## EQ PREREQUISITE: INDOOR ENVIRONMENTAL QUALITY PERFORMANCE

### 8-20 points

This prerequisite applies to

- O+M: Existing Buildings (8-20 points)
- O+M: Interiors (8-20 points)

### Intent

To assess how well the building is performing for the occupants, in particular with regards to indoor air quality and comfort.

### Requirements

#### **EB, INTERIORS**

Conduct an occupant satisfaction survey **and/or** an indoor air quality evaluation.

For the occupant satisfaction survey, regular building occupants must be surveyed. The required number of responses that must be received is outlined in Figure 1.

For the indoor air quality evaluation, test for **any** of the following contaminants:

#### Inorganic Contaminants:

- Carbon Monoxide (CO)
- Carbon Dioxide (CO<sub>2</sub>)
- Ozone (O<sub>3</sub>)
- PM2.5

#### Volatile Organic Compounds:

- Acetaldehyde (75-07-0)
- Benzene (71-43-2)
- Styrene (100-42-5)
- Toluene (108-88-3)
- Naphthalene (91-20-3)
- Dichlorobenzene (1,4-) (106-46-7)
- Xylenes-total (108-38-3, 95-47-6, and 106-42-3)
- Formaldehyde (50-00-0)
- Total volatile organic compounds (TVOC) (as defined in ISO 16000-6)

Points are awarded based on the results from the CO<sub>2</sub> and TVOC measurements.

Take the indoor air measurements in locations representative of all occupied spaces, within the breathing zone (between 3 and 6 feet (900 and 1800 millimeters) above the floor), during normal occupied hours, under typical minimum ventilation conditions.

Conduct the survey at least once per year and calculate an occupant satisfaction score for the project.

Conduct at least one indoor air quality evaluation per year. Input measured contaminant levels and calculate a CO<sub>2</sub> score and TVOC score for the project.

For initial certification, obtain a minimum human experience Score of 40. Additional points for this prerequisite are awarded for human experience scores above 40, according to Table 1.

The human experience score is based on three components which are weighted differently:

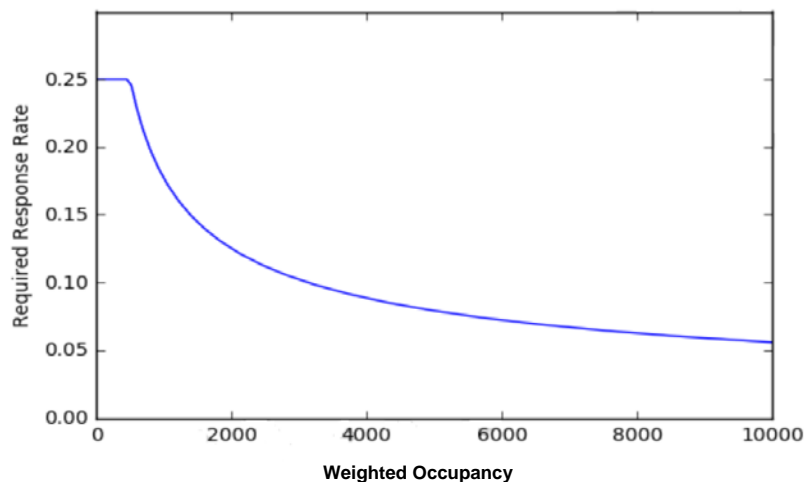


1. Occupant satisfaction score (50% weighting)
2. CO2 score (25% weighing)
3. TVOC score (25% weighting)

**Table 1. LEED Points for Human Experience**

| Human Experience Score                  | LEED Points                            |
|---|--|
| 40 (Required for initial certification) | 8 (Required for initial certification) |
| 43                                      | 9                                      |
| 48                                      | 10                                     |
| 53                                      | 11                                     |
| 58                                      | 12                                     |
| 63                                      | 13                                     |
| 68                                      | 14                                     |
| 73                                      | 15                                     |
| 78                                      | 16                                     |
| 83                                      | 17                                     |
| 88                                      | 18                                     |
| 93                                      | 19                                     |
| 98                                      | 20                                     |

**Figure 1. Required Response Rate for Occupant satisfaction survey**



Equation: Response rate= 100 \* (0.25 / square root (occupancy / 500))

### **Occupant satisfaction score**

The occupant satisfaction score rates the satisfaction occupants have with the building against satisfaction of occupants of comparable LEED certified buildings.

The score is a value from 1-100 based on the project's average occupant satisfaction level taking and the variance in the occupant responses.

### **Occupant satisfaction score calculation**

To calculate an occupant satisfaction score, the following data is required. All data is collected via the occupant satisfaction survey. At least one survey every 365 days must be conducted:

1. Number of regular building occupants and visitors
2. For Hospitality projects, number of hotel or lodging guests
3. Occupant satisfaction level (for each survey response)

The project's occupant satisfaction score is calculated by taking the average of the satisfaction levels for each building occupant that completes the survey, and considering the variance in the responses, using Equation 1.

Equation 1: Occupant satisfaction score = (Average occupant satisfaction level x 10) - variance in occupant satisfaction level

### CO2 score

The CO2 score rates the building's CO2 levels against the industry benchmark level of 1000 ppm.

The score is a value from 1-100 based on the project's average 95<sup>th</sup> percentile CO2 value.

### CO2 score calculation

To calculate a CO2 score, the following data is required:

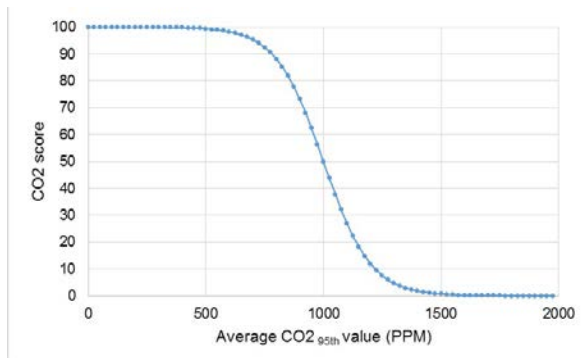
1. Measurement location
2. Date and time for each measurement
3. Measured CO2 concentration (ppm)

The 95<sup>th</sup> percentile value for each location (CO2<sub>95th</sub>) is calculated. The 95<sup>th</sup> percentile is the CO2 value where 95% of the data falls below.

An average CO2<sub>95th</sub> value is calculated for the indoor environmental quality evaluation.

The project's average CO2<sub>95th</sub> value is then input into the CO2 scoring function (see Figure 2) to produce a CO2 score for the project.

**Figure 2. CO2 scoring function**



The CO2 scoring function was developed based on the industry benchmark level of 1000 ppm.

### TVOC score

The TVOC score rates the building's TVOC levels against the industry benchmark level of 500 µg/m<sup>3</sup>.

The score is a value from 1-100 based on the project's maximum TVOC value.

### TVOC score calculation

To calculate a TVOC score, the following data is required:

- Measurement location
- Measurement date(s)
- Start and end time(s) for each measurement
- Measured TVOC concentration (µg/m<sup>3</sup>)

An average TVOC level (TVOCavg) is calculated for each location by averaging all of the TVOC measurements taken at that location during the indoor air quality evaluation.

A maximum TVOC level (TVOCmax) is determined by taking the highest TVOCavg value for the indoor environmental quality evaluation.

The project's maximum TVOC level (TVOCmax) is then input into the TVOC scoring function to produce a TVOC score for the project.

The TVOC scoring function was developed based on the LEED TVOC limit of 500  $\mu\text{g}/\text{m}^3$ .

## **EQ CREDIT: GREEN CLEANING**

### **1-3 points**

This credit applies to

- O+M: Existing Buildings (1 point)
- O+M: Interiors (1-3 points)

### **Intent**

To reduce levels of chemical, biological, and particulate contaminants, which can compromise human health, building finishes and systems, and the environment, by implementing effective cleaning procedures.

### **Requirements**

#### **EB, INTERIORS**

Interiors projects may select up to three options to earn up to 3 points.

#### **Option 1. Custodial Effectiveness Assessment (1 point)**

Perform routine inspection and monitoring of the facility's green cleaning policy to verify that the specified strategies are being used and to identify areas in need of improvement.

Additionally, conduct an annual audit in accordance with APPA Leadership in Educational Facilities' Custodial Staffing Guidelines, or a local equivalent, to determine the appearance level of the facility. The facility must score 2.5 or better.

**OR**

#### **Option 2. Entryway Systems (1 point)**

Have in place permanent entryway systems at least 10 feet (3 meters) long in the primary direction of travel to capture dirt and particulates entering the building at regularly used exterior entrances. Acceptable entryway systems include permanently installed grates, grilles, slotted systems that allow for cleaning underneath, rollout mats, and any other materials manufactured as entryway systems with equal to or better performance. Maintain all on a weekly basis.

##### Warehouses & Distribution Centers only

Buildings are not required to provide entryway systems at doors leading from the exterior to the loading dock/garage, but must provide them between these spaces and adjacent office areas.

##### Multifamily only

Common area entrances shall meet the requirements above. For residential units with a direct entrance to the exterior, have in place a walk off mat.

**OR**

#### **Option 3. Powered janitorial equipment (1 point)**

At least 40%, by cost, of all powered janitorial equipment (purchased, leased, or used by contractors) used to clean the project meets the following criteria.

The equipment must have the following features:

- safeguards, such as rollers or rubber bumpers, to avoid damage to building surfaces;

- ergonomic design to minimize vibration, noise, and user fatigue, as reported in the user manual in accordance with ISO 5349-1 for arm vibrations, ISO 2631–1 for vibration to the whole body, and ISO 11201 for sound pressure at operator's ear; and
- as applicable, environmentally preferable batteries (e.g., gel, absorbent glass mat, lithium-ion) except in applications requiring deep discharge and heavy loads where performance or battery life is reduced by the use of sealed batteries.
- Vacuum cleaners must be certified by the Carpet and Rug Institute Seal of Approval/Green Label Vacuum Program and operate with a maximum sound level of 70 dBA or less in accordance with ISO 11201.
- Carpet extraction equipment, for restorative deep cleaning, must be certified by the Carpet and Rug Institute's Seal of Approval Deep Cleaning Extractors and Seal of Approval Deep Cleaning Systems program.
- Propane-powered floor equipment must have high-efficiency, low-emissions engines with catalytic converters and mufflers that meet the California Air Resources Board or EPA standards for the specific engine size and operate with a sound level of 90 dBA or less, in accordance with ISO 11201.
- Automated scrubbing machines must be equipped with variable-speed feed pumps and either (1) on-board chemical metering to optimize the use of cleaning fluids or (2) dilution control systems for chemical refilling. Alternatively, scrubbing machines may use tap water only, with no added cleaning products.

OR

#### **Option 4. Cleaning products and materials (1 point)**

At least 75% of all cleaning products and materials, by cost must meet at least one of the following standards. Compliance may be demonstrated via a product inventory or from total annual purchases.

Cleaning products must meet one or more of the following standards, or a local equivalent for projects outside the U.S.:

- Green Seal GS-37, for general-purpose, bathroom, glass and carpet cleaners used for industrial and institutional purposes;
- UL EcoLogo 2792 for cleaning and degreasing compounds;
- UL EcoLogo 2759 for hard-surface cleaners;
- UL EcoLogo 2795, for carpet and upholstery care;
- Green Seal GS-40, for industrial and institutional floor care products;
- UL EcoLogo 2777 for hard-floor care;
- EPA Safer Choice Standard; and/or
- Cleaning devices that use only ionized water or electrolyzed water and have third-party-verified performance data equivalent to the other standards mentioned above (if the device is marketed for antimicrobial cleaning, performance data must demonstrate antimicrobial performance comparable to EPA Office of Pollution Prevention and Toxics and Design for the Environment requirements, as appropriate for use patterns and marketing claims).

Disinfectants, metal polish, or other products not addressed by the above standards must meet one or more of the following standards (or a local equivalent for projects outside the U.S.):

- UL EcoLogo 2798 for digestion additives for cleaning and odor control;
- UL EcoLogo 2791 for drain or grease trap additives;
- UL EcoLogo 2796 for odor control additives;
- Green Seal GS-52/53, for specialty cleaning products;
- California Code of Regulations maximum allowable VOC levels for the specific product category;
- EPA Safer Choice Standard; and/or
- Cleaning devices that use only ionized water or electrolyzed water and have third-party-verified performance data equivalent to the other standards mentioned above (if the device is marketed

for antimicrobial cleaning, performance data must demonstrate antimicrobial performance comparable to EPA Office of Pollution Prevention and Toxics and Design for the Environment requirements, as appropriate for use patterns and marketing claims).

Disposable janitorial paper products and trash bags must meet the minimum requirements of one or more of the following programs, or a local equivalent for projects outside the U.S.:

- EPA comprehensive procurement guidelines, for janitorial paper;
- Green Seal GS-01, for tissue paper, paper towels and napkins;
- UL EcoLogo 175, for toilet tissue;
- UL EcoLogo 175, for hand towels
- Janitorial paper products derived from rapidly renewable resources or made from tree-free fibers;
- FSC certification, for fiber procurement;
- EPA comprehensive procurement guidelines, for plastic trash can liners; and/or
- California integrated waste management requirements, for plastic trash can liners (California Code of Regulations Title 14, Chapter 4, Article 5, or SABRC 42290-42297 Recycled Content Plastic Trash Bag Program).

Hand soaps and hand sanitizers must meet one or more of the following standards, or a local equivalent for projects outside the U.S.:

- no antimicrobial agents (other than as a preservative) except where required by health codes and other regulations (e.g., food service and health care requirements);
- Green Seal GS-41, for industrial and institutional hand cleaners;
- UL EcoLogo 2784 for hand cleaners and hand soaps;
- UL EcoLogo 2783 for hand sanitizers;
- EPA Safer Choice Standard.

For projects outside the U.S., any Type 1 eco-labeling program as defined by ISO 14024: 1999 developed by a member of the Global Ecolabelling Network may be used in lieu of Green Seal or UL Ecolabel standards.

## **EQ CREDIT: INTEGRATED PEST MANAGEMENT**

### **1 point**

This credit applies to

- O+M: Existing Buildings (1 point)
- O+M: Interiors (1 point)

### **Intent**

To minimize pest problems and exposure to pesticides.

### **Requirement**

#### **EB, INTERIORS**

##### **Option 1. In-house IPM program**

Have in place an integrated pest management (IPM) plan for the building and grounds within the project boundary. The IPM plan must include the following elements.

- Identification of an IPM team. Identify roles for building management, pest management contractors, maintenance staff, and liaisons with building occupants.
- Provisions for identifying and monitoring pests. Specify inspections, pest population monitoring, and a reporting system that allows occupants, maintenance staff, and others to report evidence of pest infestations.
- Action thresholds for all pests likely encountered in the building. Also describe a process for modifying action thresholds, if necessary, through active communication between occupants and the IPM team.
- Nonchemical pest preventive measures, either designed into the structure or implemented as part of pest management activities.
- Pest control methods to be used when action thresholds are exceeded. For each pest, list all potential control methods considered and adopt the lowest-risk options, considering the risks to the applicator, building occupants, and the environment. The plan must preferentially require nonchemical approaches, with pesticides registered for the site applied only if those approaches fail. Give preference to the use of least-risk pesticides based on inherent toxicity and exposure potential. If a pesticide that is not in the least-risk category is selected, document the reason.
- A mechanism for documentation of inspection, monitoring, prevention, and control methods and for evaluation of the effectiveness of the IPM plan. Specify the metrics by which performance will be measured, and describe the quality assurance process to evaluate and verify successful implementation of the plan.
- A strategy for communications between the IPM team and the building occupants (for schools, faculty and staff). This strategy should include education about the IPM plan, participation in problem solving, feedback mechanisms (e.g., a system for recording pest complaints), and provision for notification of pesticide applications. At a minimum, the facility manager must notify any building occupant or employee who requests it and post a sign at the application site, which must remain in place for 24 hours prior to application. Notifications must include the pesticide name, EPA registration number, treatment location, and date of application. Applications of least-risk pesticides do not require notification. For an emergency application of a pesticide, anyone who requested notice must be notified within 24 hours of the application and given an explanation of the emergency.

**Option 2. Certified IPM service**

Use an IPM service for the building and grounds within the project boundary that is certified and in good standing with GreenPro, EcoWise, GreenShield, or local equivalent.



# INNOVATION (IN)

## IN CREDIT: INNOVATION

### 1 point

This credit applies to

- O+M: Existing Buildings (1 point)
- O+M: Interiors (1 point)

### Intent

To encourage projects to achieve exceptional or innovative performance. To encourage integration of LEED expertise and collaboration toward project priorities.

### Requirements

#### EB, INTERIORS

#### **LEED Accredited Professional**

At least one principal participant of the project team must be a LEED Accredited Professional (AP) with a specialty in Operations and Maintenance.

AND

#### **Innovation Strategy**

Achieve significant, measurable environmental performance using a strategy not addressed in the rating system, including prerequisites, base points, and strategies contributing to the scores within the five performance categories.

Identify the following:

- the intent of the proposed innovation strategy;
- proposed requirements for compliance;
- submittals to demonstrate compliance and proposed metric(s) for tracking (if applicable); and
- the design approach or strategies used to meet the requirements.

Examples of strategies may be found in the Innovation Catalog.

OR

#### **Pilot Credit**

Register for, achieve, and submit a feedback survey for one eligible pilot credit from USGBC's LEED Pilot Credit Library.