

Electrical Design and LEED®



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LEED® - NC: New Construction



LEED-NC

Green Building Rating System
For New Construction &
Major Renovations

Version 2.2

For Public Use and Display

October 2005

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Project Checklist

Sustainable Sites

14 Possible Points

		Required
Prereq 1	Construction Activity Pollution Prevention	
Credit 1	Site Selection	1
Credit 2	Development Density & Community Connectivity	1
Credit 3	Brownfield Redevelopment	1
Credit 4.1	Alternative Transportation , Public Transportation Access	1
Credit 4.2	Alternative Transportation , Bicycle Storage & Changing Rooms	1
Credit 4.3	Alternative Transportation , Low Emitting & Fuel Efficient Vehicles	1
Credit 4.4	Alternative Transportation , Parking Capacity	1
Credit 5.1	Site Development , Protect or Restore Habitat	1
Credit 5.2	Site Development , Maximize Open Space	1
Credit 6.1	Stormwater Design , Quantity Control	1
Credit 6.2	Stormwater Design , Quality Control	1
Credit 7.1	Heat Island Effect , Non-Roof	1
Credit 7.2	Heat Island Effect , Roof	1
Credit 8	Light Pollution Reduction	1



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Energy & Atmosphere

17 Possible Points

Prereq 1	Fundamental Commissioning of the Building Energy Systems	Required
Prereq 2	Minimum Energy Performance	Required
Prereq 3	Fundamental Refrigerant Management	Required
Credit 1	Optimize Energy Performance	1-10
Credit 2	On-Site Renewable Energy	1-3
Credit 3	Enhanced Commissioning	1
Credit 4	Enhanced Refrigerant Management	1
Credit 5	Measurement & Verification	1
Credit 6	Green Power	1



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Energy & Atmosphere

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Credit 5	Measurement & Verification	1
Credit 6	Green Power	1



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Energy & Atmosphere

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Credit 1	Optimize Energy Performance	1-10
Credit 2	On-Site Renewable Energy	1-3
Credit 3	Enhanced Commissioning	1
Credit 4	Enhanced Refrigerant Management	1
Credit 5	Measurement & Verification	1
Credit 6	Green Power	1



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Indoor Environmental Quality 15 Possible Points

Prereq 1	Minimum IAQ Performance	Required
Prereq 2	Environmental Tobacco Smoke (ETS) Control	Required
Credit 1	Outdoor Air Delivery Monitoring	1
Credit 2	Increased Ventilation	1
Credit 3.1	Construction IAQ Management Plan , During Construction	1
Credit 3.2	Construction IAQ Management Plan , Before Occupancy	1
Credit 4.1	Low-Emitting Materials , Adhesives & Sealants	1
Credit 4.2	Low-Emitting Materials , Paints & Coatings	1
Credit 4.3	Low-Emitting Materials , Carpet Systems	1
Credit 4.4	Low-Emitting Materials , Composite Wood & Agrifiber Products	1
Credit 5	Indoor Chemical & Pollutant Source Control	1
Credit 6.1	Controllability of Systems , Lighting	1
Credit 6.2	Controllability of Systems , Thermal Comfort	1
Credit 7.1	Thermal Comfort , Design	1
Credit 7.2	Thermal Comfort , Verification	1
Credit 8.1	Daylight & Views , Daylight 75% of Spaces	1
Credit 8.2	Daylight & Views , Views for 90% of Spaces	1



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Innovation & Design Process

5 Possible Points

Credit 1.1	Innovation in Design	1
Credit 1.2	Innovation in Design	1
Credit 1.3	Innovation in Design	1
Credit 1.4	Innovation in Design	1
Credit 2	LEED Accredited Professional	1

Project Totals

69 Possible Points

Certified 26–32 points Silver 33–38 points Gold 39–51 points Platinum 52–69 points

LEED for New Construction Version 2.2
October 2005



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LEED® - NC Electrical Design Scorecard:

- Total Possible Points 69
- Possible Points with Electrical Credits 17
- Possible Additional Innovation Credits 5

Total Possible Points with Electrical Credits 22



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How do we get there from here?

SS Credit 8: Light Pollution Reduction

1 Point

Intent

Minimize light trespass from the building and site, reduce sky-glow to increase night sky access, improve nighttime visibility through glare reduction, and reduce development impact on nocturnal environments.

Requirements

FOR EXTERIOR LIGHTING

Only light areas as required for safety and comfort. Do not exceed 80% of the lighting power densities for exterior areas and 50% for building facades and landscape features as defined in ASHRAE/IESNA Standard 90.1-2004, Exterior Lighting Section, without amendments.

All projects shall be classified under one of the following zones, as defined in IESNA RP-33, and shall follow all of the requirements for that specific zone:

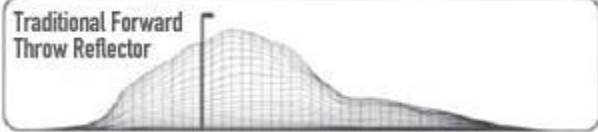
LZ3 — Medium (Commercial/Industrial, High-Density Residential)

Design exterior lighting so that all site and building mounted luminaires produce a maximum initial illuminance value no greater than 0.20 horizontal and vertical footcandles at the site boundary and no greater than 0.01 horizontal footcandles 15 feet beyond the site. Document that no more than 5% of the total initial designed fixture lumens are emitted at an angle of 90 degrees or higher from nadir (straight down). For site boundaries that abut public rights-of-way, light trespass requirements may be met relative to the curb line instead of the site boundary.



Light Pollution Reduction - Light Trespass: LEED® SS Credit 8

Traditional Forward
Throw Reflector



R4SC/SR4SC
Forward Throw



Consistent with LEED® goals
& Green Globes™ criteria
for light pollution reduction

Data and Images Courtesy of :



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How do we get there from here?

EA Credit 1: Optimize Energy Performance 1-10 Points

Intent

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

Requirements

Select one of the three compliance path options described below. Project teams documenting achievement using any of the three options are assumed to be in compliance with EA Prerequisite 2.

OPTION 1 — WHOLE BUILDING ENERGY SIMULATION (1-10 Points)

Demonstrate a percentage improvement in the proposed building performance rating compared to the baseline building performance rating per ASHRAE/IESNA Standard 90.1-2004 (without amendments) by a whole building project simulation using the Building Performance Rating Method in Appendix G of the Standard. The minimum energy cost savings percentage for each point threshold is as follows:

New Buildings	Existing Building Renovations	Points
10.5%	3.5%	1
14%	7%	2
17.5%	10.5%	3
21%	14%	4
24.5%	17.5%	5
28%	21%	6
31.5%	24.5%	7
35%	28%	8
38.5%	31.5%	9
42%	35%	10



Optimize Energy Performance

LEED® EA Credit 1 - ASHRAE 90.1 Requirements

ASHRAE 90.1 Part 9: Lighting

9. LIGHTING

9.1 General

Lighting systems and equipment shall comply with the requirements of 9.2 and 9.3. This section shall apply to the following:

- a. interior spaces of *buildings*;
- b. exterior building features, including facades, illuminated roofs, architectural features, entrances, exits, loading docks, and illuminated canopies; and
- c. exterior building grounds lighting provided through the *building's* electrical service.

Exceptions to 9.1:

- (a) emergency lighting that is automatically off during normal *building* operation,
- (b) lighting within living units,
- (c) lighting that is specifically designated as required by a health or life safety statute, ordinance, or regulation,
- (d) decorative gas lighting systems.

9.2 Mandatory Provisions

9.2.1 Lighting Control

9.2.1.1 **Automatic Lighting Shutoff.** Interior lighting in *buildings* larger than 5000 ft² shall be controlled with an *automatic control device* to shut off *building* lighting in all spaces. This *automatic control device* shall function on either

- a. a scheduled basis using a time-of-day operated control device that turns lighting off at specific programmed times—an independent program schedule shall be provided for areas of no more than 25,000 ft² but not more than one floor—or
- b. an *occupant sensor* that shall turn lighting off within 30 minutes of an occupant leaving a space—or
- c. a signal from another control or alarm system that indicates the area is unoccupied.

9.2.1.2 **Space Control.** Each space enclosed by ceiling-height partitions shall have at least one *control device* to independently *control the general lighting* within the space. Each *control device* shall be activated either manually by an occupant or automatically by sensing an occupant. Each *control device* shall

- a. *control* a maximum of 2500 ft² area for a space 10,000 ft² or less and a maximum of 10,000 ft² area for a space greater than 10,000 ft²,
- b. be capable of overriding the shutoff *control* required in 9.2.1.1 for no more than four hours, and
- c. be readily accessible and located so the occupant can see the controlled lighting.

Exception to 9.2.1.2: Remote location shall be permitted for reasons of safety or security when the remote control device has an indicator pilot light as part of or next to the control device and it shall be clearly labeled to identify the controlled lighting.

9.2.1.3 **Exterior Lighting Control.** Lighting for all exterior applications not exempted in 9.1 and 9.3.2 shall be controlled by a photosensor or astronomical time switch that is capable of automatically turning off the exterior lighting when sufficient daylight is available or the lighting is not required.

Exception to 9.2.1.3: Lighting for covered vehicle entrances or exits from buildings or parking structures where required for safety, security, or eye adaptation.

9.2.1.4 Additional Control.

- a. **Display/Accent Lighting**—display or accent lighting shall have a separate *control device*.
- b. **Case Lighting**—lighting in cases used for display purposes shall have a separate *control device*.
- c. **Hotel and Motel Guest Room Lighting**—hotel and motel guest rooms and guest suites shall have a master *control device* at the main room entry that *controls* all *permanently installed luminaires* and switched receptacles.
- d. **Task Lighting**—supplemental task lighting, including *permanently installed* undershelf or undercabinet lighting, shall have a *control device* integral to the *luminaires* or be controlled by a wall-mounted *control device* provided the *control device* is readily accessible and located so that the occupant can see the controlled lighting.
- e. **Nonvisual Lighting**—lighting for nonvisual applications, such as plant growth and food warming, shall have a separate *control device*.
- f. **Demonstration Lighting**—lighting equipment that is for sale or for demonstrations in lighting education shall have a separate *control device*.

9.2.2 **Tandem Wiring.** Luminaires designed for use with one or three linear fluorescent lamps greater than 30 W each shall use two-lamp tandem-wired ballasts in place of single-lamp ballasts when two or more luminaires are in the same space and on the same control device.

Optimize Energy Performance LEED® EA Credit 1 ASHRAE 90.1 and Lighting Controls



Images Courtesy of :

 **WattStopper**

 **legrand**

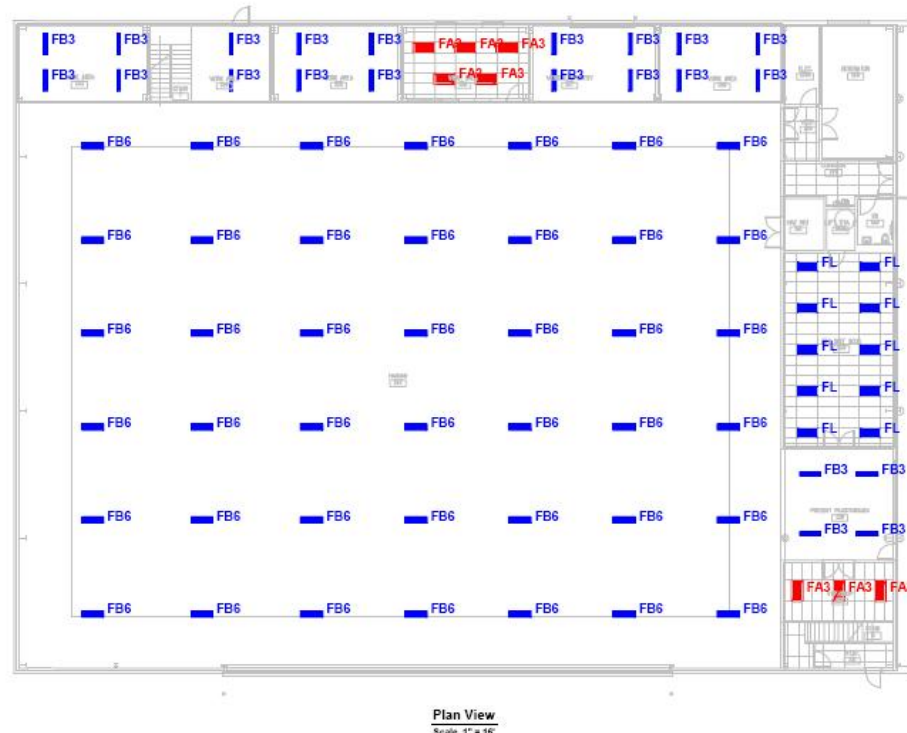
Optimize Energy Performance

LEED® EA Credit 1 - Efficient Fluorescents

Calculation – Hangar Bay using Luminaires with T8 Fluorescent lamps

STATISTICS				
Description	Avg	Max	Min	Max/Min
DRY SUIT RM 163	57 ft	67 ft	44 ft	1.5:1
FREIGHT PASSTHROUGH 150	52 ft	61 ft	34 ft	1.8:1
HANGAR 152	45 ft	65 ft	19 ft	3.4:1
VEHICULAR ENTRY 157	63 ft	71 ft	47 ft	1.5:1
WORK AREA 153	59 ft	69 ft	45 ft	1.5:1
WORK AREA 154	46 ft	56 ft	33 ft	1.7:1
WORK AREA 155	63 ft	72 ft	47 ft	1.5:1
WORK AREA 156	64 ft	90 ft	27 ft	3.3:1
WORK AREA 158	59 ft	67 ft	46 ft	1.5:1
WORKSHOP 164	51 ft	63 ft	37 ft	1.7:1

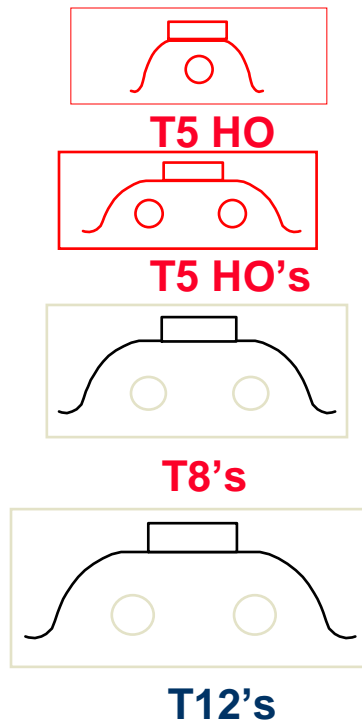
LUMINAIRE SCHEDULE					
Symbol	Label	Qty	Description	Lamp	Watts
	FA3	8	GRID TROFFER, 2'X4' 3LP T8 A12 1/3 ELEC	2500 LM LAMP	84
	FB3	22	EXTRUDED DIFFUSE METAL HOUSING, FABRICATED SEMI-SPECULAR METAL END PLATES, FORMED METAL REFLECTOR WITH PREMIUM SPECULAR FINISH, OPEN BOTTOM.	THREE 54-WATT T-5 SYLVANIA FP54/841/HO LINEAR FLUORESCENTS.	170.6
	FB6	42	EXTRUDED DIFFUSE METAL HOUSING WITH FABRICATED DIFFUSE METAL END PLATES, FORMED MULTI-FACETED METAL REFLECTOR WITH PREMIUM SPECULAR FINISH, OPEN BOTTOM. LAMP IN UPPER COMPARTMENT NOT ENERGIZED FOR THIS TEST.	SIX 54-WATT T-5 SYLVANIA FP54/835/HO LINEAR FLUORESCENTS.	330
	FL	10	WET LOCATION TROFFER 2' X 4' 3 LAMP	THREE 32-WATT T8 LINEAR FLUORESCENT. T8 84/12125 LENS 1/3 ELECT	88



Data and Images Courtesy of :

Optimize Energy Performance

LEED® EA Credit 1 - Efficient Fluorescents



Luminaire profile comparison

T5 HO Fluorescent Lamps

- Color temperatures: 3000K, 3500K & 4100K
- 82 CRI
- Luminous efficacy to 104 LPW
- Miniature bi-pin bases
- New, shorter length for better fit into ceiling grids
- Higher temperature tolerance
- Starting temperature 0°F
- Maintains 95% light output over life
- 20,000 hours life

Data and Images Courtesy of :



Optimize Energy Performance

LEED® EA Credit 1 - Efficient Fluorescents

HID Application Retrofitted with T5/HOs



Data and Images Courtesy of :



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How do we get there from here?

EA Credit 2: On-Site Renewable Energy 1-3 Points

Intent

Encourage and recognize increasing levels of on-site renewable energy self-supply in order to reduce environmental and economic impacts associated with fossil fuel energy use.

Requirements

Use on-site renewable energy systems to offset building energy cost. Calculate project performance by expressing the energy produced by the renewable systems as a percentage of the building annual energy cost and using the table below to determine the number of points achieved.

Use the building annual energy cost calculated in EA Credit 1 or use the Department of Energy (DOE) Commercial Buildings Energy Consumption Survey (CBECS) database to determine the estimated electricity use. (Table of use for different building types is provided in the Reference Guide.)

% Renewable Energy	Points
2.5%	1
7.5%	2
12.5%	3

Potential Technologies & Strategies

Assess the project for non-polluting and renewable energy potential including solar, wind, geothermal, low-impact hydro, biomass and bio-gas strategies. When applying these strategies, take advantage of net metering with the local utility.



On-Site Renewable Energy - LEED® EA Credit 2

Photo-Voltaic Window Glazing: Denali Visitors Center - LEED® Silver



Data and Images Courtesy of :

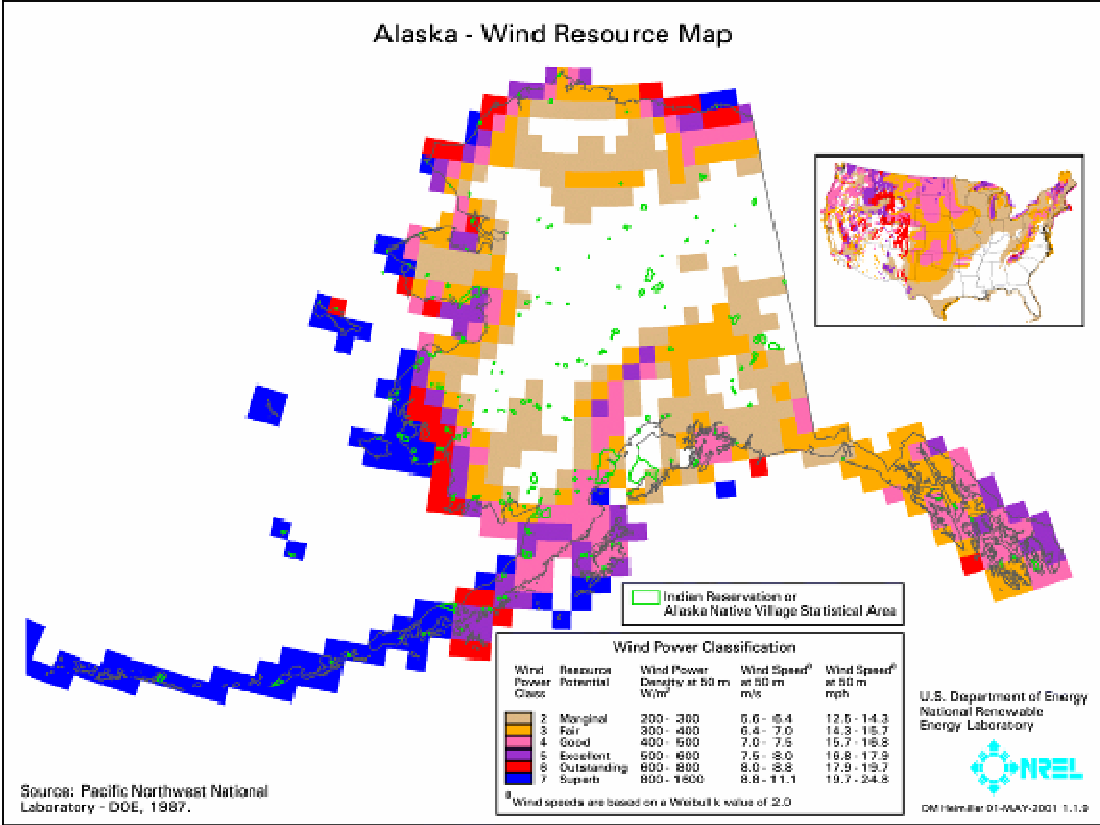
COFFMAN
ENGINEERS

nps.gov

National Park Service
U.S. Department of the Interior

On-Site Renewable Energy - LEED® EA Credit 2

Alaska Wind Map – Wind Power Potential



Data and Images Courtesy of :



On-Site Renewable Energy - LEED® EA Credit 2

Wind Turbines in operation or planned for the Alaskan Bush Communities of:
Gambell, Tooksook Bay, Selawik, Savoonga, Hooper Bay, Chevak, St Paul



Data and Images Courtesy of :



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How do we get there from here?

EA Credit 5: Measurement & Verification

1 Point

Intent

Provide for the ongoing accountability of building energy consumption over time.

Requirements

- Develop and implement a Measurement & Verification (M&V) Plan consistent with Option D: Calibrated Simulation (Savings Estimation Method 2), or Option B: Energy Conservation Measure Isolation, as specified in the *International Performance Measurement & Verification Protocol (IPMVP) Volume III: Concepts and Options for Determining Energy Savings in New Construction, April, 2003*.
- The M&V period shall cover a period of no less than one year of post-construction occupancy.

Potential Technologies & Strategies

Develop an M&V Plan to evaluate building and/or energy system performance. Characterize the building and/or energy systems through energy simulation or engineering analysis. Install the necessary metering equipment to measure energy use. Track performance by comparing predicted performance to actual performance, broken down by component or system as appropriate. Evaluate energy efficiency by comparing actual performance to baseline performance.



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How do we get there from here?

EA Credit 6: Green Power

1 Point

Intent

Encourage the development and use of grid-source, renewable energy technologies on a net zero pollution basis.

Requirements

Provide at least 35% of the building's electricity from renewable sources by engaging in at least a two-year renewable energy contract. Renewable sources are as defined by the Center for Resource Solutions (CRS) Green-e products certification requirements.

DETERMINE THE BASELINE ELECTRICITY USE

Use the annual electricity consumption from the results of EA Credit 1.

OR

Use the Department of Energy (DOE) Commercial Buildings Energy Consumption Survey (CBECS) database to determine the estimated electricity use.

Potential Technologies & Strategies

Determine the energy needs of the building and investigate opportunities to engage in a green power contract. Green power is derived from solar, wind, geothermal, biomass or low-impact hydro sources. Visit www.green-e.org for details about the Green-e program. The power product purchased to comply with credit requirements need not be Green-e certified. Other sources of green power are eligible if they satisfy the Green-e program's technical requirements. Renewable energy certificates (RECs), tradable renewable certificates (TRCs), green tags and other forms of green power that comply with Green-e's technical requirements can be used to document compliance with EA Credit 6 requirements.



Green Power

LEED® EA Credit 6 – REAP/Denali Green Tags



The Bonneville Environmental Foundation (BEF) is partnering with REAP to offer you *Denali Green Tags*, a new BEF Green Tag product comprised of new, Green-e® certified wind resources, 10% of which are produced in Alaska. You can now purchase *Denali Green Tags* to "green" your energy-consuming activities, including your use of electricity, natural gas, and your auto and air travel.

Supporting the development of wind and other renewable energy sources in Alaska is especially important since today almost all of Alaska's 200 small remote villages rely almost exclusively on imported and expensive diesel fuel to generate electricity. Because the wind is free, wind power is already helping to stabilize electric rates in villages that pay 25-70 cents/kWh for electricity. Your purchase of ***Denali Green Tags*** helps increase the amount of local, clean, and inexhaustible power that can be harvested by those villagers.

This is BEF's first product that is comprised of resources from wind farms developed by **Kotzebue Electrical Association (KEA) and TDX Power in Alaska. In addition, BEF has committed to reinvesting a percentage of the proceeds from sales of *Denali Green Tags* to support REAP's activities, and to support additional renewable energy projects in Alaska.**



Data and Images Courtesy of :



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How do we get there from here?

EQ Credit 6.1: Controllability of Systems: Lighting

1 Point

Intent

Provide a high level of lighting system control by individual occupants or by specific groups in multi-occupant spaces (i.e. classrooms or conference areas) to promote the productivity, comfort and well-being of building occupants.

Requirements

Provide individual lighting controls for 90% (minimum) of the building occupants to enable adjustments to suit individual task needs and preferences.

AND

Provide lighting system controllability for all shared multi-occupant spaces to enable lighting adjustment that meets group needs and preferences.

Potential Technologies & Strategies

Design the building with occupant controls for lighting. Strategies to consider include lighting controls and task lighting. Integrate lighting systems controllability into the overall lighting design, providing ambient and task lighting while managing the overall energy use of the building.



Controllability of Systems – Lighting LEED® EA Credit 6.1



Images Courtesy of :

 **WattStopper**

 **legrand**

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How do we get there from here?

ID Credit 2: LEED Accredited Professional **1 Point**

Intent

To support and encourage the design integration required by a LEED-NC green building project and to streamline the application and certification process.

Requirements

At least one principal participant of the project team shall be a LEED Accredited Professional (AP).

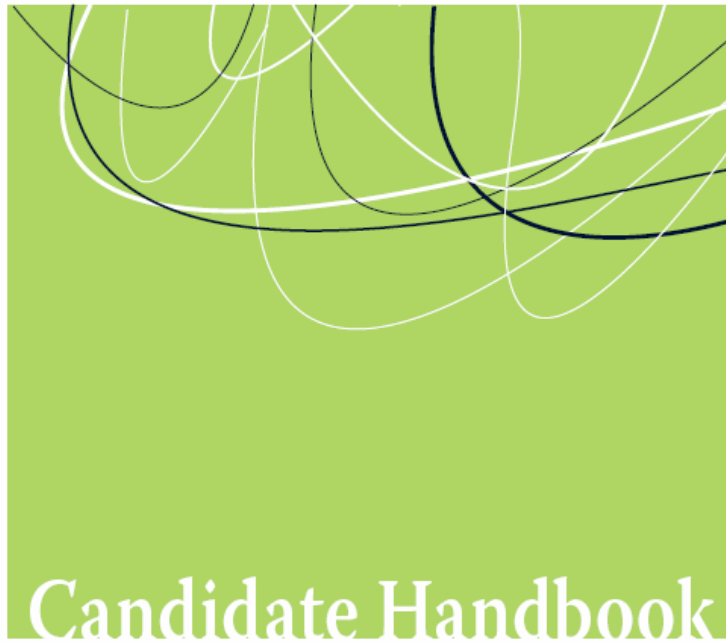
Potential Technologies & Strategies

Educate the project team members about green building design & construction and application of the LEED Rating System early in the life of the project. Consider assigning the LEED AP as a facilitator of an integrated design & construction process.



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LEED AP® Accredited Professional



LEED® Professional Accreditation Exam
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