Using LEED-NC® in Colorado: Tips, Resources and Examples

Helpful information for using the
LEED-NC® version 2.1 rating system
to build better buildings in Colorado

Colorado Governor's Office of Energy Management & Conservation
in collaboration with
U.S. Green Building Council, Colorado Chapter

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Funding and Project Management:
Colorado Governor's Office of Energy Management & Conservation (OEMC)
225 East 16th Avenue, Suite 650,
Denver, CO 80203
303-866-2100
Linda Smith, LEED AP, Sr. Program Manager
Edited by Joan Gregerson, LEED AP,
Consultant under contract to OEMC
E-mail: rebuildco@state.co.us
Website: www.colorado.gov/rebuildco

In Collaboration With:
U.S. Green Building Council, Colorado Chapter
Amy Jiron, Executive Director
303-229-9429
E-mail: amy@usgbccolorado.org
Website: www.usgbc.org/chapters/colorado

Written By:
Architectural Energy Corporation
2540 Frontier Avenue, Suite 201
Boulder, CO 80301
Website: www.archenergy.com
Authors: Amanda Portman, Caroline Clevenger and Courtney France

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Advisory Committee:
Lauren Yarmuth and Josie Plaut, DOMANI; Peter D'Antonio, PCD Engineering Services, Inc; Doug Hargrave, Long & Associates; Kristi Ennis, Boulder Associates, Inc.

Disclaimer:
The information herein is intended to aid in the use of the LEED-NC Rating System in Colorado. This information is provided only as a guide. The information reflects the authors and reviewers experience with LEED projects in Colorado, plus information from project teams and is not comprehensive. No guarantee of accuracy is implied. Refer to the USGBC for specific details of applying the LEED Rating System and to project teams for information about individual buildings. Also note that this Guide is geared toward the LEED-NC version 2.1. This version of the LEED Rating System applies to projects that registered before January 1, 2006. Projects registering after that date will use the LEED-NC version 2.2 Rating System. Look for updated versions of this Guide in the future.

Use of this Guide:

Cover Photo:
Poudre School District's Fossil Ridge High School is the first LEED-NC Silver certified high school in Colorado. Photo courtesy: RB+B Architects.

Preface

Rebuild Colorado, a program of the **Governor's Office of Energy Management and Conservation**, offers technical assistance to help Colorado's state and local governments to help get better buildings through energy efficiency. Services include expertise and resources for every phase of a building's life including high performance design for new buildings, energy management for optimizing daily operations, and assistance identifying and implementing comprehensive energy-saving improvements in aging buildings. Visit the *Rebuild Colorado* website at www.colorado.gov/rebuildco to download this Guide, and for case studies and additional resources.

Table of Contents

Introduction

This Guide was developed to provide helpful information for applying the LEED-NC rating system to build better buildings in Colorado. This section provides information to get you started: an introduction to the U.S. Green Building Council and the LEED rating system, an introduction to LEED Certified projects in Colorado, and information about how to use this Guide.

CH2M HILL Denver Campus
Three LEED-NC Certified buildings: North, South & West Buildings

Courtesy: CH2M HILL

Getting Started: USGBC & LEED

United States Green Building Council
The U.S. Green Building Council (USGBC) is a nonprofit organization working to promote buildings that are environmentally responsible, profitable and healthy places to live and work. The USGBC represents thousands of sustainable building industry volunteers working through committees to provide green building guidance, products and resources. Through this volunteer effort, the USGBC created the LEED® Green Building rating system as a tool to transform the building market. In support of LEED and market transformation, the USGBC offers green building educational resources through workshops, programs, study guides, product listings, etc. The USGBC Colorado Chapter also works towards the adoption of policies and educational tools for sustainable building practices within Colorado. For more information on LEED and other green building resources please visit the USGBC website at www.usgbc.org and the Colorado Chapter website at www.usgbc.org/Chapters/colorado.

LEED: Leadership in Energy and Environmental Design
The LEED rating system is a market driven, green building rating system designed to facilitate the development of high performance and environmentally responsible buildings.

USGBC now has three LEED rating systems available:

- New Construction and Major Renovation projects (LEED-NC)
- Existing Buildings (LEED-EB)
- Commercial Interiors (LEED-CI)

Three additional rating systems are in the Pilot phase of development:

- Core and Shell (LEED-CS)
- Homes (LEED-H)
- Neighborhood Development (LEED-ND)

This Guide focuses on the LEED-NC Version 2.1 rating system. This rating system allows up to 69 points for implementing strategies in six areas:

- Sustainable Sites (5 possible points)
- Water Efficiency (5 possible points)
- Energy and Atmosphere (17 possible points)
- Materials and Resources (13 possible points)
- Indoor Environmental Quality (15 possible points)
- Innovation and Design (5 possible points)

Projects are awarded a certification level depending on the number of points achieved:

- Certified 26 to 32 points,
- Silver 33 to 38 points,
- Gold 39 to 51 points, or
- Platinum 52 or 69 points.

Project teams using other LEED rating systems will find useful information within ***Using LEED-NC in Colorado***, as the other LEED rating systems are based, to some degree, on LEED-NC.

Remember, It's Not About the Points
The LEED rating system is intended to help the design team consider effective energy efficient and environmentally preferable features. Ensure that the design team is not pursuing ineffective strategies solely to garner additional points. Focus first on good design, rather than the points.

Costs and Benefits of LEED
Research has shown that high performance design buildings provide a variety of benefits including improved learning, occupant health and satisfaction, and lower energy and water costs. Refer to Appendix D for information and links to many examples of this research.

How cost effective is LEED-NC in Colorado? The Governor's Office of Energy Management & Conservation launched a targeted research effort in 2006 to address this question. This information will be available in late 2006, online at www.colorado.gov/rebuildco.

About this Guide

Using LEED-NC in Colorado: Tips, Resources and Examples provides helpful credit-by-credit guidance to applying the LEED-NC version 2.1 (v2.1) rating system in Colorado, as a complement to the official information from USGBC.

To learn about the LEED-NC v2.1 rating system, begin by obtaining the official information about from USGBC at www.usgbc.org/leed:

- LEED-NC v2.1 Rating System and Errata (free download)
- LEED-NC v2.1 Checklist (free download)
- LEED-NC v2.1 Reference Guide (available for purchase)
- LEED-NC Credit Interpretation Rulings (CIRs) (available to USGBC members or registered project teams)
- LEED-Online: a new feature that allows project teams to submit documentation online for v2.1 now, and other rating systems soon

Using LEED-NC in Colorado presents the following information for each credit:

- **Brief Description** of the credit,
- **Recommendations** for pursuing the credit,
- **Helpful Hints** from lessons learned,
- **Examples** from Colorado projects, and
- **Resources** including links to referenced standards and Colorado-specific organizations and resources,
- **Quick Facts** box with implementation recommendation and historical data.

The **implementation** rating shown in the Quick Facts box is one of the following:

- **Required**: Prerequisites
- **Strongly Recommended**: Easily achievable for most Colorado projects
- **Recommended**: Achievable for some Colorado projects, or
- **Worth Considering**: Rarely achievable for Colorado projects, but still worth considering.

The **Historical Data** shown in the Quick Facts box shows the percentage of projects that have achieved this credit. The projects included in this calculation are the 14 Colorado projects that were certified under LEED-NC version 2, as listed by USGBC in December 2005. (Aspen Skiing Company's Sundeck Restaurant was certified under version 1 and thus is not included in the historical data.)

What's New in 2.2?
Most existing projects are registered under LEED-NC version 2.1. Yet, any new projects registered after December 31, 2005, will use LEED-NC version 2.2. What are the changes from version 2.1 to version 2.2?

The USGBC reports that *nearly every credit has been altered in some way*! Refer to the USGBC LEED-NC version 2.2 Reference Guide for details. For a quick overview of the changes, see Appendix C of this Guide.

Downloads, Comments, Corrections?
To download a free version of this Guide, provide input to the authors or to check for future versions of this Guide, visit the *Rebuild Colorado* website at www.colorado.gov/rebuildco.

LEED Certified Projects in Colorado

The growing experience with LEED in Colorado provides a wealth of cost-effective strategies and locally available materials. Highlights from many of these projects are included in ***Using LEED-NC in Colorado***. All LEED-NC certified projects in Colorado through 2005 are pictured and listed in this section. There are a total of 15 LEED-NC certified projects, including the Gold certified University of Denver Frank H. Ricketson Jr. Law Building.

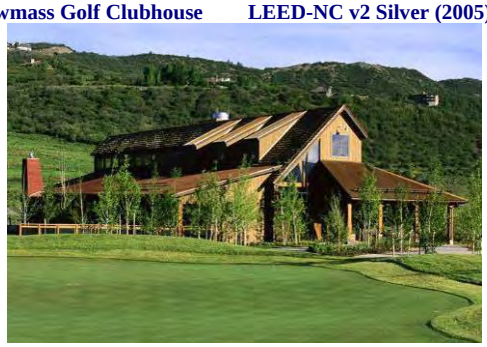
Refer to Appendix A of this Guide for a detailed list of credits achieved by these projects and Appendix B for an at-a-glance list.

In addition to LEED-NC projects, there are now LEED-EB and LEED-CI projects coming online in Colorado. This includes Amerimar Realty's LEED-EB Gold certified Denver Place and Boulder Associates LEED-CI Gold certified office.

LEED Certified Projects in Colorado (as of December 2005)

LEED for New Construction

Aspen Skiing Company
Snowmass Golf Clubhouse LEED-NC v2 Silver (2005)



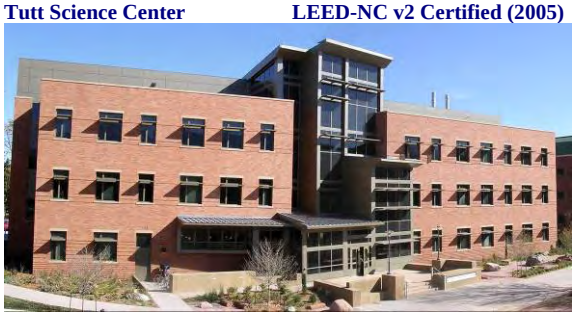
Aspen Skiing Company
Sundeck Restaurant LEED-NC v1 Bronze (2000)

Boulder, City of
North Boulder Recreation Center LEED-NC v2 Silver (2003)

Boulder Community Hospital
Foothills Hospital LEED-NC v2 Silver (2003)

CH2M HILL - Three Certified buildings
North, South & West LEED-NC v2 Certified (2003- 2004)

Colorado College
Tutt Science Center LEED-NC v2 Certified (2005)



Colorado Springs Utilities
Laboratory LEED-NC v2 Silver (2005)

Colorado Department of Labor & Employment
CDLE Office Addition LEED-NC v2 Certified (2005)

LEED for New Construction *(continued)*

Continuum Partners, LLC
Belmar Building 2M3 **LEED-NC v2 Silver (2005)**

Pikes Peak Regional Development Center
Regional Building Department **LEED-NC v2 Silver (2005)**

Poudre School District
Fossil Ridge High School **LEED-NC v2 Silver (2005)**

Opus Northwest Construction
U.S. Dept. of Transportation **LEED-NC v2 Silver (2004)**

University of Denver
Ricketson Law Building **LEED-NC v2 Gold (2005)**

LEED for Commercial Interiors

Boulder Associates
Boulder Associates Office **LEED-CI v2 Gold (2005)**

LEED for Existing Buildings

Amerimar Realty Company
Denver Place N/S Towers **LEED-EB pilot (2004)**

Historical Data for LEED-NC Certified Colorado Projects

The following table presents the percent of Colorado LEED-NC version 2 certified projects that have achieved each credit. This data includes the 14 projects certified as of December 2005. Refer to Appendix A for a list of credits achieved by project.

LEED-NC Credit	Credit Name	LEED Points Possible	Projects Achieving this Credit
Sustainable Sites (14 Points Possible)			
SSp1	*Erosion & Sedimentation Control*	*Required*	
SSc1	Site Selection	1	71%
SSc2	Urban Redevelopment	1	14%
SSc3	Brownfield Redevelopment	1	7%
SSc4.1	Alternative Transport., Public Transportation Access	1	71%
SSc4.2	Alternative Transport., Bicycle Storage & Changing Rooms	1	93%
SSc4.3	Alternative Transport., Alternative Fuel Refueling Stations	1	29%
SSc4.4	Alternative Transport., Parking Capacity	1	43%
SSc5.1	Reduced Site Disturbance, Protect or Restore Open Space	1	7%
SSc5.2	Reduced Site Disturbance, Development Footprint	1	71%
SSc6.1	Stormwater Management, Rate or Quantity	1	21%
SSc6.2	Stormwater Management, Treatment	1	57%
SSc7.1	Landscape & Ext Design to Reduce Heat Islands, Non-Roof	1	50%
SSc7.2	Landscape & Ext Design to Reduce Heat Islands, Roof	1	43%
SSc8	Light Pollution Reduction	1	50%
Water Efficiency (5 Points Possible)			
WEc1.1	Water Efficient Landscaping, reduce by 50%	1	79%
WEc1.2	Water Efficient Landscaping, No Potable Use or No Irrigation	1	36%
WEc2	Innovative Wastewater Technologies	1	0%
WEc3.1	Water Use Reduction, 20% Reduction	1	64%
WEc3.2	Water Use Reduction, 30% Reduction	1	29%
Energy & Atmosphere (17 Points Possible)			
EAp1	*Fundamental Building Systems Commissioning*	*Required*	
EAp2	*Minimum Energy Performance*	*Required*	
EAp3	*CFC Reduction in HVAC&R Equipment*	*Required*	
EAc1.1	Optimize Energy Performance, 20% New / 10% Existing	2	100%
EAc1.2	Optimize Energy Performance, 30% New / 20% Existing	2	75%
EAc1.3	Optimize Energy Performance, 40% New / 30% Existing	2	29%
EAc1.4	Optimize Energy Performance, 50% New / 40% Existing	2	11%
EAc1.5	Optimize Energy Performance, 60% New / 50% Existing	2	7%
EAc2.1	Renewable Energy, 5%	1	0%
EAc2.2	Renewable Energy, 10%	1	0%
EAc2.3	Renewable Energy, 20%	1	0%
EAc3	Additional Commissioning	1	93%
EAc4	Ozone Depletion	1	36%
EAc5	Measurement & Verification	1	43%
EAc6	Green Power	1	57%

Historical Data for LEED-NC Certified Colorado Projects *(continued)*

LEED-NC Credit	Credit Name	LEED Points Possible	Projects Achieving this Credit
Materials & Resources (13 Points Possible)			
MRp1	*Storage & Collection of Recyclables*	*Required*	
MRc1.1	Building Reuse, Maintain 75% of Existing Shell	1	7%
MRc1.2	Building Reuse, Maintain 100% of Shell	1	0%
MRc1.3	Building Reuse, Maintain 100% Shell & 50% Non-Shell	1	0%
MRc2.1	Construction Waste Management, Divert 50%	1	86%
MRc2.2	Construction Waste Management, Divert 75%	1	14%
MRc3.1	Resource Reuse, Specify 5%	1	14%
MRc3.2	Resource Reuse, Specify 10%	1	7%
MRc4.1	Recycled Content, Specify 25%	1	79%
MRc4.2	Recycled Content, Specify 50%	1	71%
MRc5.1	Local/Regional Materials, 20% Manufactured Locally	1	100%
MRc5.2	Local/Regional Materials, of 20% Above, 50% Harvested Locally	1	100%
MRc6	Rapidly Renewable Materials	1	0%
MRc7	Certified Wood	1	0%
Indoor Environmental Quality (15 Points Possible)			
EQp1	*Minimum IAQ Performance*	*Required*	
EQp2	*Environmental Tobacco Smoke (ETS) Control*	*Required*	
EQc1	Carbon Dioxide (CO2) Monitoring	1	50%
EQc2	Increase Ventilation Effectiveness	1	36%
EQc3.1	Construction IAQ Management Plan, During Construction	1	71%
EQc3.2	Construction IAQ Management Plan, Before Occupancy	1	71%
EQc4.1	Low-Emitting Materials, Adhesives & Sealants	1	100%
EQc4.2	Low-Emitting Materials, Paints	1	79%
EQc4.3	Low-Emitting Materials, Carpet	1	100%
EQc4.4	Low-Emitting Materials, Composite Wood	1	29%
EQc5	Indoor Chemical & Pollutant Source Control	1	79%
EQc6.1	Controllability of Systems, Perimeter	1	14%
EQc6.2	Controllability of Systems, Non-Perimeter	1	0%
EQc7.1	Thermal Comfort, Comply with ASHRAE 55-1992	1	71%
EQc7.2	Thermal Comfort, Permanent Monitoring System	1	36%
EQc8.1	Daylight & Views, Daylight 75% of Spaces	1	14%
EQc8.2	Daylight & Views, Views for 90% of Spaces	1	57%
Innovation & Design Process (5 Points Possible)			
IDc1.1	Innovation in Design	1	100%
IDc1.2	Innovation in Design	1	79%
IDc1.3	Innovation in Design	1	79%
IDc1.4	Innovation in Design	1	57%
IDc2	LEED Accredited Professional	1	100%

Source: Compiled from USGBC website www.usgbc.org/leed

Sustainable Sites

Thoughtful site selection can help reduce the disruption to local plant and animal life, as well as help restore and enhance the surrounding environment. LEED Sustainable Sites credits encourage best practice measures through strategies such as alternative transportation, effective site lighting design, development of high-density and brownfield sites, and stormwater management. Many owners are also realizing financial benefits from choosing and maintaining a sustainable site, from tax incentives for brownfield development to reduced space conditioning by choosing cool roofing materials.

Frank H. Ricketson Jr. Law Building, home of the University of Denver Sturm College of Law, is the only Colorado project, to date, to receive LEED-NC Gold Certification.
Courtesy: H+L Architecture

SS Prerequisite 1: Erosion & Sedimentation Control

Nearly all cities require erosion and sedimentation control as part of the building code requirements. Control measures can include the use of silt fences, straw bales and sediment traps to minimize negative effects on receiving waters. The EPA defines a variety of "Best Management Practices" (BMPs). These practices are subdivided into two main categories:

- The exclusion of infiltrating surface water, and
- The exclusion of laterally migrating ground water.

Recommendations:

- The general contractor/construction manager should take photographs of the measures implemented to document achievement of this prerequisite.
- Successful Erosion Control Plans have included but are not limited to the following measures:
  - Minimize disturbance of current vegetation.
  - Use of free draining gravel on temporary roadway.
  - Temporary seeding to prevent soil loss.
  - Silt fence with straw bales.
  - Catch basin silt sack sediment trap.
  - Catch basin straw bale sediment trap.
  - Prompt planting of permanent vegetation upon completion.

Helpful Hints:

- Most cities require documentation of erosion control measures for permitting purposes. In general, there is no additional cost related to achieving the prerequisite, and is usually achieved with normal construction practice. Verify local code requirements and best management practices with the project's civil engineer.
- First time users often incorrectly assume the "Erosion & Sedimentation Control Plan" requested by LEED as supporting documentation is a lengthy and detailed narrative. Erosion and sedimentation control drawings and related construction details depicting erosion control measures in the Civil Engineering drawings will suffice.

QUICK FACTS

Implementation: Required.

Colorado Department of Labor and Employment
Silt fence minimizes construction disturbance

Example:

- The North Boulder Recreation Center achieved the prerequisite by stockpiling soil, and installing silt fences and detention ponds, straw bales and stone stabilization pads following the most stringent erosion control practices between the City of Boulder and the EPA BMPs.

Resources:

The Stormwater Manager's Resource Center
Fact Sheet- Erosion & Sedimentation Control
Website: www.stormwatercenter.net/

Arapahoe County's Grading, Erosion and Sediment Control Manual
Website:
www.co.arapahoe.co.us/Departments/PW/Engineering/GESC.asp

Referenced Standard: U.S. Environmental Protection Agency
Storm Water Management for Construction Activities, Chapter 3, Document No. EPA 832/R-92-005 (September 1992),
Website:
www.epa.gov/npdes/pubs/owm0307.pdf

SS Credit 1: Site Selection

Site selection is based on the previous uses and condition of the building site. Specific requirements are outlined in the LEED Rating System. In general, achievement of this credit is the responsibility of the land owner upon selection of the site.

Helpful Hints:

- This point is a generally a "go / no-go" point based on site criteria.
- The FEMA 100-year flood plain is most often the preventative requirement for many projects. Check the FEMA website early.
- It is also important to verify that the site is not located in prime farmland as defined by LEED.
- In cases where no data is available from FEMA, data from the Army Corps of Engineers is an acceptable alternative.
- The 100 foot setback from wetlands includes the location of wastewater treatment systems or other support systems (cooling towers etc.) for the building.

Resources:

U.S. Department of Agriculture Definition of Prime Agricultural Land as stated in U.S. Code of Federal Regulations
Website: www.gpoaccess.gov/cfr/index.html
(go to "Browse and/or search the CFR").

Colorado Prime Farmland
This resource is a map of Colorado counties with links to maps of Colorado farmland by county.
Website:
www.co.nrcs.usda.gov/technical/soil/important-farmlands/prime-farm-lands.html

Whole Building Design Guide
Guidance on using whole system approach to design, beginning with site selection.
Website:
www.wbdg.org/design/site_potential.php

QUICK FACTS

Implementation: Strongly recommended.

Historical Data: 71% of Colorado LEED certified projects have successfully earned this credit.

Federal Emergency Management Agency (FEMA) 100-Year Flood Definition
Includes a database of flood maps; searchable by address or region. Go to 'FEMA Flood Map Store' and then click on the 'Map Search' tab at the top of the Flood Map Store web page.
Website: www.fema.gov

Colorado Division of Wildlife
This website includes a Colorado listing of endangered, threatened and wildlife species of special concern, with links to specific animal habitats.
Website: wildlife.state.co.us/WildlifeSpecies/
(go to "Threatened & Endangered Species")

Definition of Wetlands in the U.S. Code of Federal Regulations:
"Wetlands consist of areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturate soil conditions."

Colorado Division of Wildlife
Colorado Wetlands Partnership
This website includes general information on wetlands, wetland types in Colorado and Wetlands Partnership site locations.
Website:
wildlife.state.co.us/LandWater/WetlandsProgram/WetlandsHome.htm

Public Parkland
Various websites exist for locating national parklands, including the following from NCSU Libraries.
Website: www.lib.ncsu.edu/gis/index.html

SS Credit 2: Development Density

The intent of the credit is to encourage high-density development to preserve open space and reduce urban sprawl. This credit can be difficult to achieve outside of major cities, since the project must be surrounded by the equivalent of two-story downtown development, though some exceptions have been made for smaller communities and for university and college buildings. The key is to develop in an area that is already within an urban environment.

Recommendations:

- Obtain a copy of the site/surrounding master plan to quickly assess whether the credit is even potentially viable. When the surrounding area is privately owned, information may be difficult to obtain. Local planning departments typically have this information. Aerial photographs, available on the internet, may also be of help.

Helpful Hints:

- Urban sites can be more expensive; however, this credit is not usually a driving factor for site selection. Typically, the site either fits the requirements or it doesn't, and thus does not add cost to a project.
- For locations that already have well-established infrastructure, it is acceptable to take into consideration future planned neighboring developments to determine the area's density (per requirements of Credit Interpretation Request (CIR) for SSc2 ruling dated 12/23/2002). In order to determine credit compliance in this situation, it is necessary to quantify that proposed future density, and document that the developments meet the density goals of the urban revitalization plan.
- Reference the USGBC CIRs for additional information.
- Note: Parking (structured or open) must be included in density calculations.
- Exclude roads and right-of-way areas as well as parks and water bodies from the calculations. See LEED Reference Guide for more information.

QUICK FACTS

Implementation: Strongly recommended.

Historical Data: 14% of Colorado LEED certified projects have successfully earned this credit.

Colorado Department of Labor and Employment
Courtesy: Colorado Department of Labor and Employment

- This credit is relevant in City infill projects or campus applications. The LEED Campus Application Guide requires, "the project complies with a regional or master planning effort to redevelop an area with existing infrastructure into a higher density area with an ultimate intended density that reflects local development conditions…On sites where the contiguous property is over 15 acres, the project may use the campus boundaries in lieu of a documentation circle to calculate density." LEED-NC projects in campus settings may use this approach as an *alternative compliance path* to achieving the credit.

Example:

- Colorado Department of Labor & Employment earned this credit by building a 40,000 square foot addition (in place of an existing parking structure) in downtown Denver.

Resources:

Colorado Sprawl Action Center
Growth Management Tool Kit
This resource lists a comprehensive table of contents with links to different issues dealing with urban development and growth management.
Website:
www.sprawlaction.org/toolkit/index.html

Planning Commissioners Journal
Sprawl Guide
This online Sprawl Guide is designed to familiarize you with key issues associated with sprawl, and direct you to some of the wealth of information available on the Web. The Colorado section includes links to the Boulder County Comprehensive Plan, Smart Growth & Development Initiatives and examples of communities using smart growth initiatives.
Website:
www.plannersweb.com/sprawl/place-co.html

Colorado Office of Smart Growth
This office provides direct technical and financial assistance to local governments in the areas of land use planning and growth management.
Website:
www.dola.state.co.us/SmartGrowth/

Google Earth
Google Earth combines satellite imagery, maps and the search features to provide tools that simplify development density calculations.
Website: earth.google.com

Starting a new LEED-NC project?
Beginning in January 2006, project registering with LEED-NC will use version 2.2, rather than version 2.1. Refer to the USGBC for version 2.2 details or see Appendix C of this Guide for a quick overview of major changes from version 2.1.

SS Credit 3: Brownfield Redevelopment

Whether or not a site is eligible for this point depends on its classification by the EPA or local jurisdictions, typically through an ASTM Environmental Site Assessment. It may also be possible to identify the existence of on-site containments through a Phase Two Environmental Site Assessment performed by an environmental professional (not associated with the project team.) In this case, a letter from the examining environmental professional may be sufficient to qualify the project for this LEED credit. The Phase Two Site Assessment should be made available as supporting documentation.

Recommendation:

- Readily achievable where real or perceived contamination may exist, such as former industrial sites or gas stations.

Helpful Hints:

- This point is achieved through *remediation* of the contamination on the site.
- Thoroughly document all remediation efforts.
- There is no requirement for a minimum quantity of pollution requiring mitigation.
- Contamination remediation can include removal of asbestos inside of a building.

Example:

- Belmar 2M3 project documented site contaminant remediation, and to date is the only Colorado project to date to achieve this credit.
- The GSA EPA Office Building in downtown Denver is pursuing this LEED credit based on the remediation of the site contamination from the previous owner, documented in a Phase Two Environmental Site Assessment.

Resources:

U.S. Environmental Protection Agency
Introduction to Brownfields
This resource includes information on the EPA's definition of a Brownfield site and links to many other Brownfield resources such as FAQs, grant information and tools for success.
Website:
www.epa.gov/region08/land_waste/bfhome/bfhome.html

QUICK FACTS

Implementation: Strongly recommended (if eligible).

Historical Data: 7% of Colorado LEED certified projects have successfully earned this credit.

Belmar 2M3
Courtesy: Continuum Development

Colorado Department of Public Health and the Environment
Brownfield Site Assessments and Colorado Brownfields
A public-private partnership, the Colorado Brownfields Revolving Loan Fund, encourages the cleanup of unused or underused contaminated properties. Provides state incentives through tax credit. Download *The Colorado Brownfields Handbook: A Local Government Guide to Site Reuse and Economic Redevelopment* (2005).
Website:
www.cdphe.state.co.us/hm/rpbrownfields.asp

NCAT - Smart Communities Network
This resource includes information on Brownfield success stories, case studies and benefits.
Website:
www.smartcommunities.ncat.org/landuse/brownf.shtml

Referenced Standard: ASTM E1903-97 Phase II Environmental Site Assessment
Website:
http://www.astm.org/cgi-bin/SoftCart.exe/DATABASE.CART/REDLINE_PAGES/E1903.htm?E+mystore

SS Credit 4.1: Alternative Transportation, Locate Near Public Transportation

Reducing car usage in or around the site can reduce the pollution and general land development impacts of the project both during construction and post-occupancy. Many populated areas in the Denver-metro area have strong public transportation systems already in place.

Recommendations:

- Confirm the minimum number of routes (two) is available to meet the credit. The existence of a convenient bus stop is not all that is needed.
- Project the distance from the main building entrances to public transit stops to determine if the distance required is feasible early in the project. This distance is measured by walking route, not radius.
- Confirm the RTD/mass transit map includes the number of routes necessary for documentation, or find additional supporting information. Most bus maps only show single lines, not separate routes.

Helpful Hints:

- New RTD/mass transit stops can be requested for a new building with a sizable population.
- The designation of a new public transit stop can be achieved with only the addition of a sign (i.e. requiring the bus to stop if a rider is present.) Many project teams incorrectly assume a transit stop shelter or bench is necessary and therefore expect a higher cost impact to achieve the credit.
- Colleges, universities and schools are often located in close proximity to the required public transportation; however, school buses that are not open to the public do not count toward credit achievement.

Example:

- Boulder Community Foothills Hospital (BCFH) was sufficiently confident in its employee ridership of RTD that it constructed an additional bus stop along Arapahoe Drive. The intent is to have RTD take over ownership and maintenance of the stop in the future. In addition, the Hospital has a company policy to provide Eco Passes (bus passes) to all BCFH employees, and received a waiver from the City to build 25 percent less parking capacity than code required. BCFH earned SSc4.1 and was able to earn an additional Innovation in Design credit for exemplary promotion of Alternative Transportation.

QUICK FACTS

Implementation: Strongly recommended.

Historical Data: 71% of Colorado LEED certified projects have successfully earned this credit.

Boulder Community Foothills Hospital
Additional bus stop
Courtesy: Boulder Associates, Inc.

Resources:

The Regional Transportation District
The RTD website includes bus routes that serve the Denver Metro and surrounding areas.
Website:
www.rtd-denver.com/

American Public Transportation Association
The American Public Transportation Association has a Colorado Transit Links web page that includes links to local public transportation agencies by county. This resource can be used to look up routes that serve the project location.
Website:
www.apta.com/links/state_local/co.cfm

SS Credit 4.2: Alternative Transportation, Bicycle Storage & Changing Rooms

Many communities in Colorado are particularly friendly to bicycle commuters, and Colorado in general has a very high number of bicycles per capita. This credit is attractive to many building owners and occupants and is relatively inexpensive to achieve (if occupant accessible showers are planned and/or desirable).

Recommendation:

- Ensure the design includes convenient changing locations, as well as showers.

Helpful Hints:

- Showers and changing facilities can be located in a neighboring building as long as it is within 200 yards of the building and occupants will be able to use the facilities.
- LEED-NC 2.1 states that *covered* bike storage is required for 15 percent of the building occupants in residential buildings.
- Most bicycle racks accommodate two bikes, so the quantity on the plans may be one-half of the number required for the LEED calculation.
- While bicycle storage is required for five percent or more of full-time building occupants, remember shower/changing facilities are one for every eight bicycling occupants (or storage slots).
- Although visitors must be used in the calculation for the number of bike storage slots, they are not required to be included in the occupant count for calculating the number of shower/changing areas. Visitors or 'transients', are defined as people who stay at the building for less than seven hours. (For example students attending class, or visitors coming to a recreation center or a hospital).
- Note, in general, the calculations for credits 4.2, 4.3, and 4.4 should be rounded up to the next whole number (i.e. a calculation of 5.2 requires 6 bike storage slots be installed).

QUICK FACTS

Implementation: Strongly recommended.

Historical Data: 93% of Colorado LEED certified projects have successfully earned this credit.

North Boulder Recreation Center
Courtesy: Architectural Energy Corporation

Examples:

- Boulder Community Foothills Hospital installed over sixty (covered) bicycle racks in their underground parking facility.
- The University of Colorado ATLAS Building is providing showers accessible to all building occupants as well as showers in dressing rooms with limited access. Only showers that are accessible to all building occupants qualify for the credit.

Resources:

Building Green
Green Spec
This resource includes links to bicycle storage manufacturers, articles and case studies related to alternative transportation (*GreenSpec requires paid subscription).*
Website:
www.buildinggreen.com/auth/productsByLeed.cfm?LEEDCreditID=5

SS Credit 4.3: Alternative Transportation, Alternative Refueling Stations

This credit has been highly criticized because of the apparent futility due to the lack of electric vehicles in use today. Many projects have not pursued this credit under LEED version 2.1; however, alternative compliance paths including providing hybrid vehicles for building occupants have been approved through the Credit Interpretation Ruling (CIR) process.

Recommendations:

- Alternative compliance paths make this credit more feasible than it may first appear. It can be achievable either for campuses that use electric maintenance vehicles for transport or for companies that wish to provide low emitting and fuel efficient fleet vehicles.
- Electric recharging stations can be added late in the project if proper electric cabling is available. Several projects have elected to run conduit or cable out to the parking area early in the project when it is much less expensive to do so, in order to leave the option of later installation of the recharging stations.

Helpful Hints:

- Note that the requirement is for the total number of cars that can be fully recharged within the service limits of the station and normal operating hours. Typically two cars can be recharged over eight hours, cutting the number of chargers required in half. Signage is also required.
- Supplying fleet vehicles with biodiesel fuel can be an acceptable approach to achieving the intent of this credit. See CIR under SSc4.3 dated 3/30/05 for further explanation.
- Charging stations must be installed for credit achievement. 120 Volt or 240 Volt exterior outlets do not comply.
- Purchasing a fleet of hybrid vehicles can meet credit requirements.
- Contracting for the use of shared cars has also been demonstrated to meet the credit intent.

QUICK FACTS

Implementation: Worth considering.

Historical Data: 29% of Colorado LEED certified projects have successfully earned this credit.

Examples:

- The North Boulder Recreation Center was able to achieve this credit early in the history of the LEED rating system with conventional 120v exterior outlets installed in the light poles in the parking lot. Multiple subsequent CIRs have provided much stricter requirements for the qualifications of a recharging station.
- The U.S. Department of Transportation more recently was awarded LEED credit for installing 13 *qualified* rechargers in the project.

Resources:

Colorado Greening Government
Transportation
Information about alternative fuels, carpooling and resources for state agencies and others
Website:
www.colorado.gov/greeninggovernment/programs/transportation

Governor's Office of Energy Management and Conservation
Transportation & Alternative Fuel Programs
Includes tax credits
Website:
www.state.co.us/oemc/programs/transportation/index.htm

U.S. Department of Energy- Energy Efficiency & Renewable Energy
Alternative Fuels Data Center- industry contacts, FAQs
Interactive fuel station mapping system, listings of available alternative fuel vehicles, and more.
Website: www.eere.energy.gov/afdc/
Incentives: www.fleet-central.com/af/fleet_incentives/articles/incentives_altfuel.pdf

SS Credit 4.4: Alternative Transportation, Parking Capacity

This credit restricts parking capacity for the project to the minimum amount of parking required by local code and has an additional requirement for designated carpool spaces. Even if parking is not part of the project, carpool spaces must be provided in the surrounding area (or nearby parking lots) to achieve this credit.

Helpful Hints:

- Existing parking stalls can be converted into reserved carpool stalls by adding signage posts or pavement markings.
- This credit can be difficult to achieve in retail settings due to high parking requirements.
- In residential projects the credit may be achieved by providing a car-share program serving at least five percent of the residential occupants.
- Special provisions from the Application Guides for Lodging and Campuses may apply.

Examples:

- While the University of Colorado ATLAS building does not provide any new parking, the University is designating carpool parking spaces in a nearby existing parking structure.
- Boulder Community Foothills Hospital was successful in getting a variance from the City of Boulder to install a parking capacity 25 percent below that required by local code.

QUICK FACTS

Implementation: Strongly recommended.

Historical Data: 43% of Colorado LEED certified projects have successfully earned this credit.

U.S. Department of Transportation
Preferred parking carpool spaces
Courtesy: Opus Northwest

SS Credit 5.1: Reduced Site Disturbance, Protect or Restore Open Space

This credit can be achieved in two ways. If your site is a Greenfield (undeveloped) site, the requirement calls for limitation of site disturbance. For previously developed sites, the requirement is to restore 50 percent of the site area (excluding the building footprint) with native or adaptive vegetation.

Recommendations:

- Engage the landscape architect early so that they know to incorporate native or adaptive vegetation in the original landscape design.
- In Colorado, using native or adaptive vegetation has some synergies with WEc1.1, Water Efficient Landscaping.
- This credit is not easily achievable for projects on zero lot-line sites.

Helpful Hints:

- Most projects find it hard to comply with the greenfield option for this credit because of clearing or grading during site preparation.
- For previously developed sites, though restoration of 50 percent of the site area (excluding the building footprint) can be easy to achieve, it is the restoration with native/adaptive plant species that can make the credit more difficult. The USGBC characterizes native or adaptive species as an area that will not be mowed.
- CIR SSc5.1 6/26/2003 states that areas that have been disturbed may be classified as "previously developed" even if no building was erected on the site depending on previous site conditions and uses.
- Agricultural land may qualify as previously developed; however, if the land is lying fallow and has been allowed to return to its natural state, it will be considered a greenfield site.

Example:

- The North Boulder Recreation Center is the only Colorado project to date to earn this credit. The City restored 50 percent of the project site by transplanting existing trees, preserving existing trees, installing fescue grass and planting native shrubs.

QUICK FACTS

Implementation: Worth considering.

Historical Data: 7% of Colorado LEED certified projects have successfully earned this credit.

Resources:

NCAT - Smart Communities Network
Open Space
This resource can be used to gather examples and guidelines for reducing site disturbance.
Website:
www.smartcommunities.ncat.org/landuse/open.shtml

Stapleton, Colorado
Emphasizing the preservation of open space, the reduction of pollution and the conservation of natural resources, the Stapleton Development Corporation is constructing a community comprising a network of urban villages, employment centers and greenways on the 4,700-acre former site of Stapleton International Airport near Denver.
Website:
www.smartcommunities.ncat.org/success/stapleton.shtml

SS Credit 5.2: Reduced Site Disturbance, Development Footprint

To earn this credit it is necessary to exceed local zoning open space requirements by 25 percent; or in areas with no local zoning requirements, such as many college campuses or federal government projects, open space equal to the building footprint must be designated adjacent to the building. Recent CIRs have allowed projects that are within a campus setting to designate open space in other areas of the campus, if adjacent open space is not available.

Recommendations:

- This may not be a good credit to target for projects on tight building sites.
- This credit is not easily achievable for projects on zero lot-line sites

Helpful Hints:

- The designated open space required by this credit does not have to be one contiguous space, but can be pieces (within the site area) that you add together, all over the site.
- For areas with no local zoning requirements: though the LEED Reference Guide calls for open space equal to the "development footprint", the USGBC released a revision to replace "development footprint" with "building footprint" for this credit. This substantially changes the scope of designated open space for projects with large site areas, but smaller building footprints.
- Dedicating open space for the life of the project may be difficult depending on the transition of ownership and life expectancy of the building.
- In campus applications it may be possible to earn credit by dedicating open space on neighboring sites if it is paid for using the project's construction budget. In this case that total project budget would need to be applied consistently across all credits which may have negative impact on other credit calculations.

QUICK FACTS

Implementation: Recommended.

Historical Data: 71% of Colorado LEED certified projects have successfully earned this credit.

Examples:

- Boulder Community Foothills Hospital provided 62 percent open space on the project site although only 20 percent was required by code.
- Fossil Ridge High School had no local zoning requirement for open space but earned credit by providing open space greater than the area of the *building* footprint.
- The Tutt Science Center at Colorado College provided a letter from the college's Board of Trustees dedicating the appropriate area as open space for the life of the building.

Resources:

Colorado Office of Smart Growth
Dedication Requirements- Protecting Colorado's Open Space
Includes background on city initiatives for open space zoning requirements as well as example open space dedication requirements for a number of cities (see page 6).
Website:
www.dola.state.co.us/SmartGrowth/Documents/Openspacededication.pdf

Aspen Valley Land Trust
Colorado Conservation Tax Credits
Colorado taxpayers can promote the preservation of open space by purchasing conservation easement tax credits.
Website:
www.avlt.org/docs/AVLT_TaxCredits.pdf

SS Credit 6.1: Stormwater Management, Rate & Quantity

Though *some* jurisdictions require stormwater management that will fulfill the requirements of this credit, this credit can be difficult to achieve in Colorado. While it is relatively easy to decrease the *rate* of stormwater run-off through design, it can be difficult to reduce the *quantity*, particularly if there is more impervious area post-development than pre-development. *Retention* ponds are generally discouraged in permitting due to Colorado's unique water right laws and the risk of West Nile Virus from standing water. However, *detention* ponds are allowed and will contribute to the achievement of this credit.

Recommendation:

- The use of pervious paving materials, bioswales, green roofs and/or stormwater reuse are examples of design strategies which assist to achieve this credit.

Helpful Hints:

- When doing the calculations for this credit do not overlook run-off from the roof.
- The stormwater management for this credit can be costly depending on the design.
- Underground water storage has become more prevalent, but can be costly.
- Many of the strategies used for this credit will also contribute to SSc6.2.
- LEED uses a two-year storm event as the basis for the LEED SSc6.1 calculation.
- Typical stormwater management solutions such as cisterns or roof catchment systems are not allowed in most Colorado jurisdictions.

Examples:

- The North Boulder Recreation Center decided against pursuing this credit because they did not want to construct a detention pond close to a residential area.
- The Tutt Science Center at Colorado College was able to achieve a 3.6 percent reduction in the quantity of water run-off. However, since over 50 percent of their original site was impervious they did not achieve LEED credit since a 25 percent reduction was required.

QUICK FACTS

Implementation: Worth considering.

Historical Data: 21% of Colorado LEED certified projects have successfully earned this credit.

Fossil Ridge High School constructed pond allows on-site stormwater runoff to be detained for irrigation

- Fossil Ridge High School constructed detention facilities to control the discharge of stormwater, and the entire quantity of two-year storm water is retained on-site and used for irrigation.

Resources:

U.S. Environmental Protection Agency
Stormwater Best Management Practice Design Guide
The Stormwater Best Management Practice Design Guide includes information with respect to; watershed factors, terrain factors, physical site factors, community and environmental factors, and location and permitting factors.
Website:
www.epa.gov/ORD/NRMRL/pubs/600r04121/600r04121.pdf

The Stormwater Manager's Resource Center
Fact Sheet- Stormwater Management Practices
This resource includes a series of fact sheets on the most common stormwater management practices with quick summary descriptions of practices, including planning level cost information.
Website:
www.stormwatercenter.net/

Colorado Local Technical Assistance Program
Article: *Drainage and Stormwater Management*
The Colorado LTAP website includes information about drainage workshops, articles, current stormwater regulations and a library of reference materials.
Website:
ltap.colorado.edu/newsletter/sept02/5.php

SS Credit 6.2: Stormwater Management, Treatment

Although building codes require most projects to achieve the Total Suspended Solids (TSS) required treatment for this credit, the Total Phosphorous (TP) removal is frequently not addressed. To earn this credit, a treatment system must be installed which removes both TSS and TP.

Recommendations:

- Common strategies for reducing TSS and TP (which come from agricultural fertilizers, animal dung, etc.) in water can include bioswales, filtration basins (filters), detention ponds and vegetated filter strips.
- Work with the landscape architect to properly direct stormwater run-off from the site so that it can be treated to the requisite level before discharged.

Helpful Hints:

- Oil interceptors at parking lots do not count for this credit.
- The USGBC has ruled (CIR SSc6.2 11/9/01) that in most cases NO calculation is required for this credit. A simple narrative recorded in the LEED Template can suffice to demonstrate the suitability of the selected Best Management Practices (BMPs) to the project specifics.
- Building owners should consider cost (and maintenance labor requirement) for filter replacement in water treatment system selection.
- Roof run-off must also be treated.
- Projects do not need to account for TP removal of they can document the lack of phosphates entering the site.

Examples:

- Fossil Ridge High School achieved this credit through the use of grass-lined bioswales to collect the run-off and retain the water for irrigation.
- Boulder Community Foothills Hospital's site is adjacent to Boulder Creek so it was imperative to have high quality stormwater run-off. They were able to achieve this credit through a variety of measures including constructed wetlands, vegetated filters and a system of stormwater interceptors.

QUICK FACTS

Implementation: Recommended.

Historical Data: 57% of Colorado LEED certified projects have successfully earned this credit.

Boulder Community Foothills Hospital site design protects nearby Boulder Creek

Resources:

The Stormwater Manager's Resource Center
Stormwater Management Fact Sheet: On-Lot Treatment
A great source of treatment methods, design considerations, cost, etc. This fact-sheet references residential development, but applies to commercial development as well.
Website:
www.stormwatercenter.net/Assorted%20Fact%20Sheets/Tool6_Stormwater_Practices/On-lot/Onlot.htm

U.S. Environmental Protection Agency
Managing Urban Stormwater: Treatment Techniques
This paper, written by the NSW Environmental Protection Authority, describes non-proprietary stormwater treatment techniques and could be a valuable resource for information about treating stormwater.
Website:
www.epa.nsw.gov.au/resources/treattech.pdf

Governor's Office of Energy Management and Conservation
Treating Wastewater With Constructed Wetlands
This report is the product of a multidisciplinary task force assembled to demonstrate the benefits and applicability of wetlands for wastewater treatment. The website also includes resources linked to "best practices" learned.
Website:
www.state.co.us/oemc/programs/waste/wetlands.htm

U.S. Environmental Protection Agency
Clean Water State Revolving Fund
The Clean Water State Revolving Fund (CWSRF) programs provided about $4 billion annually in recent years to fund water quality protection projects for wastewater treatment, nonpoint source pollution control, and watershed and estuary management.
Website: www.epa.gov/OW-OWM.html/cwfinance/cwsrf/index.htm

SS Credit 7.1: Landscape & Exterior Design to Reduce Heat Islands, Non-Roof

This credit's difficulty depends greatly on the amount of asphalt or other dark impervious surfaces on the project site. Strategies are discussed in terms of *albedo*, a measure of reflectivity of a surface. There are three main strategies that are most often used to achieve this credit: use of high-albedo impervious surfaces, shading of low-albedo impervious surfaces or underground or covered parking. This credit can be achieved fairly easily, and at a no-cost premium, if the only impervious areas you have on your site are concrete side walks or concrete parking areas. In this case, the credit can most likely be achieved with the albedo value of standard concrete. However, if large asphalt parking areas are planned for the project, it is best to supply covered (or shaded) parking. Some projects with uncovered asphalt paved parking have been able to achieve this credit by combining areas of standard concrete, light colored hardscaped areas, and shading from trees on the asphalt to produce a weighted average calculation for the total site. Structured or underground parking, where the surfaces are shaded, automatically qualify the project for this credit.

Recommendation:

- In Colorado, with its particularly strong solar radiation, achieving this credit makes the site more appealing and comfortable for the building occupant, and can reduce building cooling loads.

Helpful Hints:

- Standard grey concrete complies with credit requirements as a high albedo product.
- If using a weighted average calculation, specifying white (high reflectance) cement can greatly increase the average reflectivity of your impervious areas. This is a potential cost increase above standard asphalt paving.
- In campus applications check campus standards for acceptable concrete mixes. Light or colored concrete may not be acceptable.
- Pervious pavement is required to meet the same reflectivity standards as other hard surface areas such as concrete.
- Shading of non-roof impervious site surfaces is calculated on June 21 at solar noon.

QUICK FACTS

Implementation: Strongly Recommended.

Historical Data: 50% of Colorado LEED certified projects have successfully earned this credit.

Fossil Ridge High School uses concrete and trees to minimize heat island
Courtesy: RB+B Architects

Examples:

- Belmar Block 2 achieved this credit by providing more than 50 percent of its parking underground.
- Fossil Ridge High School achieved this credit primarily by using concrete for a large plaza area and sidewalks and by providing shade trees in the parking areas.

Resources:

See Landscape and Exterior Design to Reduce Heat Islands, Non-Roof credit (SSc7.2).

SS Credit 7.2: Landscape & Exterior Design to Reduce Heat Islands, Roof

Reducing roof heat islands can be achieved by installing high reflectance roofs and/or garden roofs. High reflectance roofs (most commonly white membrane roofs) are becoming more prevalent with numerous color options, and have less and less of a cost premium compared to standard roofing materials. Garden (or "green") roofs in Colorado can be a design and permitting challenge. The intensity of the sun and minimal rainfall make the plant pallet small, and irrigation necessary. Though garden roof tops can have a considerable cost impact on the project, they may have a higher resale value to high-rise residential and office buildings. Garden roofs also help contribute to achieving credits SS 6.1 and 6.2 and EA credit 1, but may hurt irrigation requirements for WE credit 1.

Recommendations:

- Most commercial buildings are internally load dominated and benefit from a high reflectance roof by reducing the cooling load. However, elementary schools and other buildings may not benefit. Energy modeling can aid in this choice.
- Particularly in buildings with packaged rooftop units, a white roof contributes to a reduced cooling load by avoiding excess "pre-heating" of the intake air from a hot dark roof.

Helpful Hints:

- High-albedo standard roofs do not only mean white roofs. High-albedo roofs now come in a wide variety of colors and styles.
- Membrane roofs in kitchen/restaurant applications may require extra precautions (e.g. second layer of membrane), as they quickly degrade under grease exhaust.
- Confirm roofing cutsheets include the appropriate ASTM standards (emissivity and reflectance) required by this credit, as well as the ENERGY STAR rating.
- Calculation methods that average the reflectance over the net roof area may be used to show compliance.
- Garden roofs may be difficult to permit in jurisdictions where they have not yet been applied.

QUICK FACTS

Implementation: Recommended.

Historical Data: 43% of Colorado LEED certified projects have successfully earned this credit.

GSA Federal Department of Transportation
Lakewood office building's white membrane roof
Courtesy: Opus Northwest

Examples:

- Both Boulder Community Foothills Hospital and the Department of Transportation Building had to provide additional information from the product manufacturer on test results and the standards used for the USGBC to award this credit. Recently, manufacturers are making compliance information more readily available.
- Fossil Ridge High School achieved this credit through the use of an ENERGY STAR rated membrane roof.
- The University of Colorado researched roof tiles to find products that matched the architectural signature of the tile roofs on campus, yet also met the properties required to qualify as a cool roof product.

Resources:

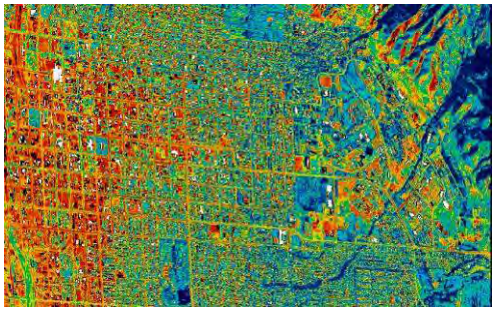
The Heat Island Group
The Heat Island Group is a research group from Lawrence Berkeley National Labs that has researched and gathered information on the effects of urban heat islands. This resource includes publications, information on the cause of the heat island effect and ways to mitigate it.
Website:
www.harc.edu/mitchellcenter/download/HIRIREV.pdf

EPA: ENERGY STAR
Refer to this website for ENERGY STAR labeled roofing products.
Website: www.energystar.gov

Cool Roof Rating Council
The Cool Roof Rating Council (CRRC) is an independent and non-biased organization that has established a system for providing Building Code Bodies, Energy Service Providers, Architects & Specifiers, Property Owners and Community Planners with accurate radiative property data on roof surfaces that may improve the energy efficiency of buildings while positively impacting our environment.
Website: www.coolroofs.org/

USGBC News
Article: *Is the Future of Roofing Industry 'Green'?*
Written by Anand Natarajan, presents components, manufacturers and applications (3/16/2006)
Website:
www.usgbc.org/News/USGBCInTheNewsDetails.aspx?ID=2271

Whole Building Design Guide
Extensive Green Roofs
Detailed information about features, leak detection, wildlife habitat, codes and standards, and photos.
Website: www.wbdg.org/design/greenroofs.php



Urban Heat Island Effect: Salt Lake City
This NASA photo illustrates the heat island effect for downtown Salt Lake City (left) which appears hotter than less developed areas (right). Photo was taken on July 13, 1998 at noon. Dark vegetative areas are at a temperature of about 90°F, while urban white 'hot spots' are at about 160°F.
Note: View/print this image in color to see heat island effect.
Courtesy: NASA/Marshall Space Flight Center

Science/NASA
Heat island research includes overflights of cities and infrared imaging.
Website:
science.nasa.gov/newhome/headlines/essd21jul98_1.htm

U.S. Environmental Protection Agency
Heat Island Reduction Initiative
The Heat Island Reduction Initiative website includes information on urban heat islands and strategies to reduce them.
Website:
www.epa.gov/heatisland/

SS Credit 8: Light Pollution Reduction

This credit requires the electrical engineer or lighting designer to produce a photometric plan which plots the footcandles of light on the site. Documentation verifying that the maximum candela value of interior lighting does not fall out through the windows of the building is also required. Footcandle plots must show the illuminance level (footcandles) at the site boundary. Note that site boundaries must be consistent for all LEED credits. This credit is more difficult to achieve in high-density areas, retail applications and sites with tight boundaries. LEED does allow certain allocations for required security lighting that exceed the credit requirements; see the CIRs for additional information.

Recommendation:

- Work with the electrical engineer or lighting designer to confirm all exterior lights have the appropriate IESNA cut off designation.

Helpful Hints:

- Exterior luminaires with lamps over 1,000 lumens must be shielded and those with lamps of 3,500 or more lumens must be full cut-off fixtures, as defined by IESNA.
- If city street lights are being installed as part of the project scope and they are located within the project's site boundary, these fixtures must comply with credit requirements.
- In campus settings, a project need not have zero footcandles at the site boundary and can take a comprehensive approach to the campus lighting plan. See the LEED Campus Application Guide for more details.
- Projects should be especially cautious with monument, flagpole and signage lighting, artistic or building up lighting and landscape up lighting.
- Special consideration should also be taken when projects are required to match business complex, campus, or city fixture standards.

Examples:

- The Belmar Block 2 project team decided not to pursue this credit in a retail setting.

QUICK FACTS

Implementation: Recommended.

Historical Data: 50% of Colorado LEED certified projects have successfully earned this credit.

The North Boulder Recreation Center
Full cutoff and shielded exterior luminaires minimize might trespass
Courtesy: Barker Rinker Seacat Architecture

Resources:

Illuminating Engineering Society of North America (IESNA)
IESNA provides a variety of reference material including Advance Lighting Guidelines and the IESNA Lighting Handbook.
Website: www.iesna.org

International Dark Sky Association
This association is dedicated to reducing night-time light pollution.
Website: www.darksky.org/index.html

Water Efficiency

Rapid development, rising population and reliance on a limited and variable water supply increases the importance of water conservation in Colorado. Drought conditions in recent years have heightened the potential environmental strain and negative impact produced by water scarcity. All building projects in Colorado should be encouraged to emphasize water efficiency in their design and operation. Minimizing water usage will reduce operational expenses and lessen the environmental burden on local water supplies. It is recommended that building projects pursuing LEED in Colorado attempt several, if not all, Water Efficiency Credits.

CH2M HILL Denver Campus
Courtesy: CH2M HILL

WE Credit 1.1: Water Efficient Landscaping, Reduce by 50%

In Colorado, this credit is readily achievable with a twofold approach: native or adaptive plantings, which require little or no supplemental water, and efficient irrigation. Recent municipal watering restrictions have given rise to the popularity, availability and acceptability of low water plants. Often, these types of plants and landscape designs are called, respectively, *xeric* or *Xeriscape*™. Numerous xeriscape demonstration gardens can be found in locations all over Colorado and an increasing number of landscape architects have experience with xeric plantings and are excited to implement xeriscape design principles.

Xeriscaping provides an aesthetically pleasing alternative to more traditional, water-intensive landscaping, but may not be suitable to all applications. For instance, some drought tolerant grasses do not meet campus standards since they are not resilient in areas of high pedestrian traffic. Certain clients may wish to combine traditional and xeriscaping strategies by using traditional landscaping techniques in some areas and xeriscaping in other areas.

Another strategy which assists in achieving the Water Efficient Landscaping credits is the use of water efficient irrigation strategies. Strategies include low-volume or drip systems (water applied directly to the root zone through surface piping), sub-irrigation (water delivered to root zone through underground systems), and "smart" control systems (central/satellite controls, weather based, soil-moisture systems). The LEED calculator provides credit for "drip" or "other" systems as alternatives to the traditional sprinkler system. If "other" is selected, the landscape architect will need to provide the "irrigation efficiency" of the system. Many of these systems may have a higher first cost than a traditional sprinkler system, and may or may not provide operational cost savings depending on the local water usage rate structure. However, recent years have seen a trend to increase water usage rates by many Colorado municipalities, and many projects will benefit from lower water usage over the lifetime of the building.

QUICK FACTS

Implementation: Strongly recommended.

Historical Data: 79% of Colorado LEED certified projects have successfully earned this credit.

North Boulder Recreation Center

Rainwater harvesting is the process of intercepting stormwater run-off and putting it to beneficial use, such as irrigation. The diversion or harvest of rainwater is subject to Colorado law. Any rainwater harvesting strategy more sophisticated than simply positioning roof gutter downspouts in areas you wish to water may have legal barriers. Before developing a rainwater harvesting system, check with the Colorado Division of Water Resources and local building, zoning, and environmental departments to determine what legal requirements, plumbing requirements, local restrictions, neighborhood covenants or other regulations or guidelines might apply.

Similarly, graywater systems (i.e. systems that reuse water drained from baths, showers, washing machines and sinks) may present difficulties from a water quality perspective. Graywater is regulated under the State of Colorado Guidelines on Individual Sewage Disposal Systems and applicable county Individual Sewage Disposal System (ISDS) regulations. Graywater reuse systems require permitting and may trigger monitoring requirements.

Recommendations:

- Use the LEED calculator early to determine the project baseline irrigation water use and required improvements to reach the 50 percent water reduction. Incorporate water saving strategies into the initial landscape design to achieve the 50 percent water reduction with minimal design and overall project costs.
- Specify drought tolerant plants and efficient irrigation techniques.
- Check with the Colorado Division of Water Resources and your local building, zoning, and environmental departments before attempting rainwater harvest or graywater systems. These solutions may be illegal and/or and challenging.
- Include a maintenance specification or manual into the project documents to promote proper operation of the irrigation system and maintenance of the drought tolerant plants.
- Include a detailed narrative describing installed landscaping and the actual irrigation source for the plants.

Helpful Hints*:*

- When creating the LEED calculator baseline case, it is helpful to assume a reasonable worst case scenario for the Colorado climate. This is not to say that using 100 percent bluegrass in the baseline case is reasonable in our climate. Look to similar existing building types in surrounding areas or typical practices used by developers that have water intensive landscaping to establish a reasonable baseline.
- Campus applications may require revisions to campus standards to allow the native/adaptive plantings. Xeriscaping may not be applicable in all high-usage areas.
- Some native plants may not be appropriate for facilities where allergies or compromised immune systems are of primary concern.
- Non-potable water systems (untreated irrigation water) may be prone to problems with mineral deposits in irrigation piping and nozzles. Check with local installers on product maintenance records in local installations.

Examples*:*

- The North Boulder Recreation Center earned this LEED credit primarily by providing drip irrigation instead of sprinklers and reducing or eliminating landscaped areas from the original design. The final design also included an electronic, weather based control system.
- Boulder Community Foothills Hospital was also able to earn this LEED credit through proper landscape design.

Boulder Community Foothills Hospital

Starting a new LEED-NC project?

All new LEED-NC projects will register under version 2.2 (as of January 2006). Refer to the USGBC for complete information about version 2.2. Also, see Appendix C of this Guide for a quick overview of the changes from version 2.1 to 2.2.

Resources:

XERISCAPE COLORADO!, INC.
Xeriscape Colorado is a non profit membership group promoting creative approaches to water conserving landscapes. This resource includes example gardens in Colorado, workshops and more. Xeriscape is a registered trademark of Denver Water.
Website: www.xeriscape.org/

Colorado Office of Smart Growth
Waterwise Landscaping Best Practices Manual
This best practices manual, designed for communities along the Front Range, includes waterwise principals and guidelines, waterwise plant lists and more.
Website:
www.dola.state.co.us/smartgrowth/documents/WaterWise%20Landscaping%20Best%20Practices%20Manual.PDF

Denver Botanic Gardens, in partnership with Colorado State University
Denver Botanic Gardens, in partnership with Colorado State University and the green industry, are teaching people about the hundreds of varieties of plants that will flourish in our climate.
Website: www.ext.colostate.edu/
Website for Plant Select® plants:
www.plantselect.org

U.S. Environmental Protection Agency
Water Efficient Landscaping
This booklet describes the benefits of water efficient landscaping. It includes several examples of successful projects and programs, as well as contacts, references and a short bibliography.
Website: www.epa.gov/owm/water-efficiency/final_final.pdf

Colorado Springs Utilities
Offers a website for xeriscaping needs in Colorado, including a database of xeric plants.
Website:
www.csu.org/environment/xeriscape/index.html

Colorado State University
Cooperative Extension Gardening Online
Gardening online fact sheets including trees, shrubs, grasses and vines of Western Colorado
Website:
www.ext.colostate.edu/pubs/garden/pubgard.html
Resources:

- Colorado Native Plant Society
- Colorado - The Colorado Natural Heritage Program
- Colorado Rare Plant Field Guide
- Irrigation Management: Types of Sprinklers

Colorado State University
Graywater Reuse and Rainwater Harvesting
This paper includes information on graywater systems, water quality issues surrounding graywater reuse in Colorado and water rights issues surrounding graywater reuse in Colorado.
Website:
www.ext.colostate.edu/PUBS/natres/06702.html

Green Industries of Colorado (GreenCO)
GreenCO is an alliance of seven trade associations representing diverse aspects of the plant and landscape industry dedicated to water conservation and water quality. GreenCO has robust Colorado-specific resources including Water Budget Calculator, Watering Guidelines, Reservoir Reports and Best Management Practices manual and trainings.
Website: www.greenco.org

Colorado Greening Government
Water Conservation and Water Quality
Information for Colorado state government and others on resources and assistance for water conservation and water quality.
Website:
www.colorado.gov/greeninggovernment/programs/water

WE Credit 1.2: Water Efficient Landscaping, No Potable Use or No Irrigation

This credit is achieved through either 100 percent non-potable water use, or no irrigation. While temporary irrigation can be used to establish plantings during a typical period of two years, it must then be removed to earn credit. Furthermore, only above ground flexible piping can be used in the irrigation systems during this establishment period.

It is possible to use non-potable water, which is defined as water that is not suitable for human consumption, for irrigation on some projects. Projects may have one waterline for building water use and a second waterline for non-potable irrigation water. In Colorado, many larger landscape sites like golf courses, parks and industrial sites are irrigated with non-potable water. Currently, the USGBC is not entirely consistent in their requirements for non-potable water. In general, any type of water that could be treated (e.g. streams, lakes, rivers), or is municipally provided cannot count towards the credit. Look to future CIRs for additional information on using non-potable water to earn this LEED credit.

Colorado receives about 12 to 15 inches of rainfall a year. This makes it difficult for many landscape designs, especially large ones, to survive without supplemental irrigation. Furthermore, standing bodies of water such as detention ponds are sometimes *not* considered advisable for safety or health hazard, e.g., they are places for mosquitoes to breed. If deemed acceptable, a detention pond can also contribute to earning Stormwater Management SSc6.1.

Recommendations:

- It is difficult for most projects to completely eliminate the need for some form of irrigation from their landscape design. Projects that have earned this credit either have access to non-potable irrigation water or have very limited or no landscaping included in the project budget.

QUICK FACTS

Implementation: Recommended.

Historical Data: 36% of Colorado LEED certified projects have successfully earned this credit.

CH2M HILL earned this credit for all three buildings. The Meridian International Business Park wastewater system provides non-potable water for irrigation to all needs on the campus in Englewood.
Courtesy: CH2M HILL

- One of the most effective measures for reducing water consumption is to educate the maintenance staff. While this will not earn LEED credit, requiring climate appropriate watering schedules that include deep soakings rather than frequent light sprinklings, system maintenance to minimize leaks, etc. will significantly contribute to operational water savings.

Helpful Hints:

- Research the potential health issues associated with using graywater for irrigation. Graywater is not always a safe product. It can contain bacteria and other potential pathogens. Some plants are not suited well for graywater irrigation; therefore, it is important to pay careful attention to plant selection and tolerance to graywater irrigation.
- The USGBC has strict standards on what can be considered usable graywater or non-potable water for irrigation. Any type of water that could be treated (e.g. streams,

lakes, rivers), or is municipally provided non-potable water, cannot count towards this credit. Research the proposed design carefully for consistency with the LEED requirements. (Version 2.2 does allow municipal non-potable water for this credit.)

- The USGBC does not consider hard-piped underground irrigation lines to be acceptable as a temporary irrigation system; however, hose connections and above ground drip systems can be used for up to two years to get plants established.
- When designing a site, consider the addition of a detention pond or the use of an existing pond to provide a source of untreated, non-potable water for landscape irrigation. This credit may be complimentary to a detention pond used for storm water management, SSc6.1.
- Using graywater for irrigation purposes can only be implemented via drip or rotary head irrigation systems. Spray systems are prohibited due to potential health hazards.

Examples:

- All three CH2M HILL buildings earned this credit by using non-potable water provided to all sites within the Meridian Park development. The non-potable water is the treated water exiting from the central wastewater treatment plant, which supplies 100 percent of the CH2M HILL buildings' irrigation needs. Water efficiency in irrigation was further encouraged by the water budgets established by the Meridian Business Park. As a result, in much of the landscaping, drought-resistant plants were selected.
- Poudre School District built a detention pond that provides untreated water for irrigation for four sites: Zach Elementary School, Fossil Ridge High School and two city recreation fields. Although this meets the intention for the LEED credit, they were not able to achieve the credit because they still need approximately 25 percent of their irrigation water from the municipal supply.
- The North Boulder Recreation Center decided against a detention pond due to child safety concerns.
- Colorado Department of Labor & Employment eliminated the need for irrigation for the narrow strip that could have been landscaped, by using rock exclusively. The project did not earn this credit. Though this is a water-saving strategy, the ruling is based on the LEED philosophy that *credits are awarded for action*, rather than inaction.

Resources:

See Water Efficient Landscaping credit (WEc1.1).

WE Credit 2: Innovative Wastewater Technologies

This credit requires a reduction in wastewater, specifically in the amount of potable water used for sewage conveyance. The two main strategies for earning this credit are reducing the need for sewage conveyance through the use of water-saving flush fixtures and/or meeting the reduced conveyance load through the use of non-potable water such as graywater or stormwater. Before pursuing the non-potable water strategies, the project team should carefully research all health code issues related to using non-potable water for flush fixtures.

Recommendations:

- Reducing water used for flushing is often the most cost-effective way to achieve this credit. Consider no-water urinals and dual-flush toilets.
- Even if project teams elects not to pursue the credit, no-water urinals may be an effective strategy to implement.
- Innovative mechanical or plumbing engineers are essential to achieving this credit.
- Investigate the potential design risk of reduced sewage flow due to the reduction in water for conveyance.

Helpful Hints:

- While no-water urinals have gained acceptance in several projects, the majority of Colorado projects are not currently willing to incorporate composting toilets. Coordinate with plumbing inspector in early design stages to ensure they are acceptable in your project's permitting region.
- Limited information is available since few projects elect to pursue this credit. As fixture types and sewage conveyance technologies improve, there may be additional opportunities to pursue the credit.
- Significant opportunities may exist through the use of biodigesters and Living Machine technologies, which have been used successfully in other regions. For example, the Lewis Center at Oberlin College in Ohio uses a Living Machine to process wastewater from all sinks and toilets in the building.

QUICK FACTS

Implementation: Worth considering.

Historical Data: 0% of Colorado LEED certified projects have successfully earned this credit.

No-Water Urinals
Falcon Waterfree Technologies

Dual Flush Toilets
Courtesy: Coroma

Examples:

- New Belgium Brewery is striving to treat 100 percent of its wastewater onsite through biodigesters at its existing facility in Fort Collins. The system has the added benefit of generating biogas to fuel a generator that can be operated during peak times to cut electricity costs.

Resources:

Colorado State University
Graywater Reuse and Rainwater Harvesting
This paper includes information on graywater systems, water quality issues surrounding graywater reuse in Colorado and water rights issues surrounding graywater reuse in Colorado.
Website:
www.ext.colostate.edu/PUBS/natres/06702.html

NSF International
Wastewater Treatment Systems
This resource includes links to provide consumers with general information about septic systems, as well as alternative wastewater systems. NSF International is an independent, non profit organization that certifies products and develops standards for food, water, air and consumer goods.
Website:
www.nsf.org/consumer/wastewater_treatment_systems/index.asp?program=WastewaterTreSys

High Performance Buildings Database
Oberlin College Case Study
Information and photos of the Living Machine at Adam Joseph Lewis Center for Environmental Studies, Oberlin College, Ohio. (Pictured below.)
Website:
www.eere.energy.gov/buildings/database/overview.cfm?ProjectID=18

Courtesy: Robb Williamson, NREL PIX 10870

WE Credit 3.1 and 3.2: Water Use Reduction, 20% or 30% Reduction

Most projects have the opportunity to earn one or two credits for water use reduction under this credit. Well thought-out specification and design by the plumbing engineer can easily result in a 20 percent savings, which is the threshold required to earn WEc3.1. The plumbing engineer should complete the LEED calculator early in the design process to see what additional strategies could be specified to achieve the 30 percent savings to earn the second Water Use Reduction credit. In addition to the flow rates for fixtures, automatic controls, such as infra-red sensors and flow restrictors, contribute to credit achievement. Finally, the USGBC has a clearly established precedent for awarding an Innovation in Design credit to a project which achieves a 40 percent overall water use reduction.

Recommendations:

- Complete the LEED calculator early in the design process to determine the project's potential for water use reduction. Design and specify fixtures in the original design to meet desired water savings threshold.
- Advise project facilities and maintenance departments to speak with existing facilities departments with successful water saving strategies to help quell concerns over maintenance and operations issues that may be associated with certain fixtures.
- Projects should consult/involve local code officials early in the project to ensure waterless fixtures will be approved for the project.
- Projects that have had doubts about the effectiveness and reliability of waterless fixtures have included stub-outs for flow fixture replacement. It should be noted that this eliminates some of the potential financial benefits of reducing piping and drains, but does offer peace of mind.
- There may be a slight increase in health risks (such as legionella bacteria) with the use of aerators or flow restrictors.
- Simple strategies include, but are not limited to, aerators, 0.5 gallon per flush urinals, and low-flow shower heads or water closets. More aggressive strategies may include pressure assisted water closets, waterless fixtures and dual flush water closets.

QUICK FACTS

Implementation: Strongly recommended for both WEc3.1 & WEc3.2.

Historical Data:
64% of Colorado LEED certified projects have successfully earned WEc3.1.
29% of Colorado LEED certified projects have successfully earned WEc3.2.

University of Denver Ricketson Law Building earned both credits for water use reduction
Courtesy: Mary Weikert for the University of Denver Sturm College of Law

Examples:

- The Ricketson Law Building at the University of Denver achieved both credits by using a wide variety of water-saving strategies, including no-water urinals.
- Aspen Skiing Company's Snowmass Golf Clubhouse uses Australian dual-flush toilets, in addition to low-flow shower heads.
- Boulder Community Foothills Hospital installed many water saving strategies in public areas but not in the medical areas, due to health code requirements, and did not attempt this LEED credit.

Resources:

U.S. Environmental Protection Agency
Using Water Efficiently: Ideas for Industry
This paper is a resource that includes strategies for industrial projects to reduce water consumption.
Website: www.epa.gov/owm/water-efficiency/industry.pdf

U.S. Environmental Protection Agency
Using Water Efficiently: Ideas for Commercial Businesses
This paper is a resource that includes strategies for commercial projects to reduce water consumption.
Website: www.epa.gov/owm/water-efficiency/commercial.pdf

U.S. Environmental Protection Agency
Clean Water State Revolving Fund
Clean Water State Revolving Fund (CWSRF) programs provided about $4 billion annually in recent years to fund water quality protection projects for wastewater treatment, nonpoint source pollution control, and watershed and estuary management. .
Website: www.epa.gov/OW-OWM.html/cwfinance/cwsrf/index.htm

U.S. Environmental Protection Agency
Funding Water Efficiency Through the State Revolving Fund Program
America's largest water quality financing source.
Website: www.epa.gov/owm/water-efficiency/wef_final.pdf

Whole Building Design Guide
No-Water Urinals: A Technical Evaluation
Provides list of manufacturers, and information about codes and test data. (March 2003)
Website:
www.wbdg.org/pdfs/nowaterurinals_techeval.pdf

Energy and Atmosphere

Using energy wisely is a cornerstone of sustainable design. LEED recognizes the importance of optimizing energy performance by allocating the greatest number of potential points within this category. In general, points can be earned through efficient design, use of renewable energy, deliberate mechanical and electrical system selection, and proper commissioning and monitoring. Because energy savings translate directly into operational savings, Energy and Atmosphere credits typically have the highest payback of all LEED credits for the owner. Many opportunities exist within this category for synergistic design, and it is best to get the engineering team engaged early in the design process to encourage a successful, integrated design process.

Poudre School District - Fossil Ridge High School
Courtesy: RB+ B Architects

EA Prerequisite 1: Fundamental Building Systems Commissioning

Building commissioning is a comprehensive and systematic process to verify that new buildings are designed and constructed to meet or exceed the original design intent. Commissioning is essential to building performance and is a prerequisite in the Energy and Atmosphere LEED category.

Commissioning can be very cost effective. A study of over 200 commercial buildings by Lawrence Berkeley National Laboratories found that commissioning results in a median 4.8 year payback. Catching potential mistakes early in design reviews or prior to equipment installation can provide significant cost savings to the project.

While the commissioning agent for this credit is required to be independent, they may work for the project's design or construction company, so long as they are not responsible for the building design or construction. This contrasts with the Additional Commissioning credit EAc3 which requires the commissioning agent to be both independent and from a third party company that is not a part of the design or construction team.

The primary requirements of the prerequisite are independent design reviews and functional testing. These activities can provide tremendous value to the owner and the design teams because potential problems are identified at the earliest possible point. Project specifications must include commissioning language to ensure commissioning is properly addressed. In addition, the inclusion of commissioning specifications insures that contractors and sub-contractors know their work will be verified by a commissioning agent independent of the design team.

As part of the prerequisite, the commissioning agent must produce a Commissioning Plan that describes the implementation of the commissioning process and provides a framework for integrating commissioning activities into the construction and acceptance process. The commissioning plan and the design reviews will serve as supporting documentation for the prerequisite.

QUICK FACTS

Implementation: Required.

Commissioning Field Work
Courtesy: Architectural Energy Corporation

Recommendation:

- The commissioning agent will need to coordinate and set up meetings with the contractors and subcontractors on-site. Incorporate the commissioning agent's milestones into the project schedule.

Helpful Hints:

- The commissioning agent should be contracted as soon as possible in the design process, ideally during programming or conceptual design stages.
- This credit has synergy and cost savings with additional commissioning credit EAc3, so be aware of both the prerequisite and the credit when scoping and bidding this work.
- This credit has synergy and cost savings with measurement and verification activities in credit EAc5, so be aware of both credits when scoping and bidding this work.
- LEED only requires HVAC&R systems be commissioned, but it is recommended that fire protection, security, IT, medical gas, etc. be considered, as well.

Example:

- The University of Colorado in Boulder is performing its own commissioning on both the Wolf Law School and the ATLAS Center. Since they are the owner and not part of either the Design Team or the Construction Team this is acceptable.

Resources:

American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)
ASHRAE Guideline 0P- *The Commissioning Process* is still in development. ASHRAE Guideline 1-1996 *The HVAC Commissioning Process* is available at the ASHRAE website along with other articles and commissioning resources.
Website: www.ashrae.org

National Institute of Building Sciences (NIBS)
NIBS has a total building commissioning process that provides resources and guidelines for building commissioning being developed under the auspices of the National Institute of Building Sciences.
Website: www.nibs.org

Building Commissioning Association (BCA)
BCA has published a popular Building Commissioning Handbook that gives an overall understanding of the commissioning process. The association also offers a list of members, an online forum and electronic newsletter.
Website: www.bcxa.org

Portland Energy Conservation Inc. (PECI)
PECI was the founder of the National Conference on Building Commissioning and has numerous resources such as a model commissioning plan and guide specifications, a guide for commissioning existing buildings, and training seminars on commissioning practices.
Website: www.peci.org

Energy Design Resources (EDR)
EDR is a guide to energy efficient design practices and includes information on the commissioning process. It has many building commissioning resources on their website including design briefs, design guidelines, electronic articles and more.
Website: www.energydesignresources.com

Governor's Office of Energy Management & Conservation (OEMC)
Rebuild Colorado Business Partners
This directory includes contact information for commissioning agents that serve Colorado.
Website:
www.colorado.gov/rebuildco/partners/business.htm

Governor's Office of Energy Management & Conservation (OEMC)
Commissioning
OEMC offers a brief introduction to commissioning, why it's needed, and includes rules of thumb for budgeting for commissioning.
Website:
www.colorado.gov/rebuildco/services/commissioning.htm

Starting a new LEED-NC project?
All new LEED-NC projects will register under version 2.2 (as of January 2006). Refer to the USGBC for complete information about version 2.2. Also, see Appendix C of this Guide for a quick overview of the changes from version 2.1 to 2.2.

EA Prerequisite 2: Minimum Energy Performance

While in certain jurisdictions compliance with minimum energy performance standards are mandated by code, the State of Colorado has energy guidelines rather than a minimum energy performance requirement. Nevertheless, meeting the LEED Minimum Energy Performance prerequisite is straightforward and should be standard design practice.

To achieve the minimum energy compliance for this credit, as gauged by ASHRAE Standard 90.1-1999, the building should start with a good envelope. This means complying with, or exceeding, building envelope requirements as found in Appendix B of the ASHRAE standard. Generally, this means at least double-pane low-E glazing and well insulated walls and roof, typically with continuous insulation for colder climates. If mechanical equipment meets minimum ASHRAE requirements, maximum lighting power densities are not exceeded, and the numerous *mandatory* provisions are met (for example, automatic lighting control) *generally*, the building will meet minimum compliance for EAp2.

Recommendations:

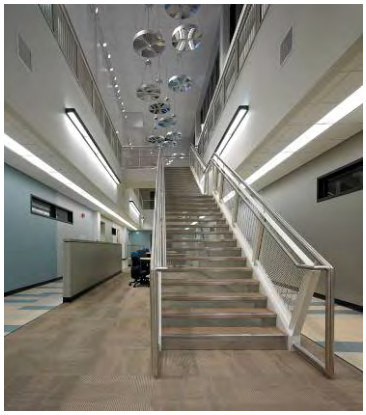
- Ensure this prerequisite early: Confirm with the mechanical engineer and electrical engineer that the design will meet all ASHRAE minimum and mandatory compliances for this credit.
- The documentation for the Minimum Energy Performance Prerequisite can either be produced by the mechanical engineer (typically using prescriptive methods) or by the Energy Modeler who produces the documentation for EAc1 (based on performance calculations).

Helpful Hints:

- For best results, consider mechanical and electrical engineers for the project team whose standard practice meets or exceeds this prerequisite.
- The Federal Energy Policy Act of 2005 contains revisions to energy codes and incentives to exceeding energy codes. Refer to the Act and resulting policies that may impact your building.
- Refer to the discussion for Optimize Energy Efficiency, EAc1, for energy-saving strategies.

QUICK FACTS

Implementation: Required.



Colorado Springs Utilities Laboratory uses high-efficiency lighting with diffusers, automated dimming, photo sensors, and interior windows that provide shared lighting.
Courtesy: Ed LaCasse Photography

University of Denver Ricketson Law Building The energy-efficient design of this LEED-NC Gold certified building is expected to save the college 40 percent on energy costs.
Courtesy: H+L Architecture

Resources:

Referenced standard- ASHRAE/IESNA Standard 90.1-1999: Energy Standard for Buildings Except Low-Rise Residential
ASHRAE Standard 90.1 sets the minimum energy efficiency requirements used by LEED as long as the local code is not more stringent. Depending on what building/mechanical code the project is using, designers will need to check and make sure they are meeting the most stringent standards for the LEED submittal. ASHRAE Standard 90.1-1999 is available at the ASHRAE website.
Website: www.ashrae.org
Website: www.coloradoenergy.org/codes/colorado.asp

American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE)
ASHRAE has published a Standard 90.1-2004 User's Manual that can be used in conjunction with the standard. It streamlines compliance calculations with examples, standard forms and reference materials. This resource can be purchased on the ASHRAE website.
Website: www.ashrae.org

ENERGY STAR
Energy Star is a federal government program that provides resources for improving the energy efficiency of buildings, processes and products. Resources such as guidelines for energy management, service and product provider listings and energy efficiency programs can be found at the website.
Website: www.energystar.gov

ColoradoEnergy.org
For a list of energy codes in Colorado by county, see the Colorado Energy website. Check with the project leader to make sure this is the code being used because it might vary by project.
Website: www.coloradoenergy.org

Building Energy Code Program (BECP)
BECP is an information resource from the DOE that intends to inform users about national and local energy codes. Resources on the website include compliance tools, training, education and general code information.
Website: www.energycodes.gov

U.S. Energy Policy Act of 2005
Tax Credits
The Energy Policy Act of 2005 mandates credits for energy efficiency improvements and alternative energy, with most beginning in January 2006 and remaining in effect through 2007.
Website: www.energy.gov/taxbreaks.htm

EA Prerequisite 3: CFC Reduction in HVAC&R Equipment

Reducing or eliminating the use of chlorofluorocarbons (CFCs) is known to reduce ozone depletion. The Montreal Protocol of 1987 was an agreement by 160 countries including the U.S. to phase out the use of CFCs. This prerequisite, therefore, is achieved if the project uses new packaged equipment. If the project's mechanical design incorporates an existing central cooling plant, or existing base building equipment which uses CFCs, however, a comprehensive CFC phase-out plan must be implemented to meet this prerequisite.

Recommendation:

- If your project is planned for a campus setting and/or relies on the use of a central plant, identify the coolant used in the central plant early and research the numerous Credit Interpretations Rulings (CIRs) regarding central plants for this prerequisite.

Helpful Hints:

- This credit has ties to EAc4, Ozone Protection, so be aware of both when specifying HVAC equipment. An additional point is available if the coolant is also HCFC free; see EAc4.

Examples:

- The Tutt Science Center at Colorado College was able to meet this prerequisite by referencing a CIR ruling dated 2/15/2002 (0323-EAp30-03502) which states that emergency back-up chillers that are CFC-based are not included in the prerequisite requirement.
- The University of Colorado is carrying out a five-year phase out plan to eliminate CFC usage in its central chiller plant which qualifies to meet the prerequisite.

Resources:

ARI: Air-Conditioning and Refrigeration Institute
ARI is a knowledgeable source for refrigerant information. It provides standards, white papers and guidelines that involve fluorocarbon refrigerants.
Website: www.ari.org

QUICK FACTS

Implementation: Required.

Colorado College Tutt Science Center
Laboratory classroom
Courtesy: Colorado College

Significant New Alternatives Policy (SNAP)
SNAP is a great resource to identify alternative refrigerants that will satisfy the LEED prerequisite. It also includes global warming potential values, toxicity information and manufacturer information.
Website:
www.epa.gov/ozone/snap/general/index.html

Building Owners Management Association (BOMA)
The Refrigerant Manual: Managing the Phase-Out of CFCs
BOMA has published a manual that includes owner options for refrigerant compliance, case studies, ruling from the EPA and much more.
Website: www.boma.org

International council of Air-Conditioning and Refrigeration Manufacturers' Association (ICARMA)
ICARMA has developed a program that evaluates the performance and presents data on new and existing refrigerants. This Program is called the Global Refrigerant Environmental Evaluation Network (GREEN).
Website: www.icarma.org

EA Credit 1: Optimize Energy Performance

This credit poses the largest potential for point accumulation within the LEED system. It accounts for mechanical system performance, lighting power densities, solar hot water contributions and many other strategies which enhance energy performance. It is important to note, however, that LEED awards credit based on energy *cost* savings rather than energy *use* savings. Energy performance is calculated relative to a baseline as defined by ASHRAE or the local energy code, whichever is more stringent. It is best to consult with an energy modeler or consultant to see how various energy saving strategies will impact overall energy costs. LEED documentation requires energy calculations or hourly modeling results to be presented using the Energy Cost Budget (ECB) method as defined in the LEED Reference Guide. Most projects achieve an average of two points for this credit. However, significantly higher point awards are possible for more efficient buildings.

Recommendations:

- The Colorado climate is particularly conducive to certain energy saving strategies. Refer to the list later in this section for more detail.

Helpful Hints:

- EAc1 example documentation is available on the USGBC website. It is best to follow the USGBC format precisely and not use custom tables or graphs.
- Due to inherent variations in mechanical design requirements for differing building types (recreation centers versus office buildings, for example) many issues have been raised surrounding the energy modeling requirements of this credit. In some cases, separate guidelines (e.g. LEED for Labs) are being developed specifically to address perceived shortcomings in the current energy performance evaluation system. In general, it is best to work with an energy modeler who is versed in LEED Energy Cost Budget requirements to best estimate the percentage of energy cost savings that will be approved by the USGBC for a given project or building type.

QUICK FACTS

Implementation: Strongly recommended.

Historical Data: 100% of Colorado LEED certified projects have successfully earned *at least two points* for this credit. One project to date has earned *ten points*, which is the maximum available.

Fossil Ridge High School uses details such as tilting windows in a west wall to minimize summer overheating.
Courtesy: RB+B Architects

Fossil Ridge High School Condensing Boilers
Time and money spent on fine-tuning the energy efficiency, yields savings because the school uses much smaller heating, cooling and electrical systems.
Courtesy: Governor's Office of Energy Management & Conservation

- The USGBC allows interpolation of energy costs savings to establish point thresholds. See https://www.usgbc.org/Docs/LEEDdocs/Amendment_LEED-NC2%200-EAc1-133%20PDF.pdf for amended point interpolation tables.
- To maximize the points in this credit, consider renewable energy-based HVAC systems or systems that use waste heat recovery.
- Consider incorporating energy performance contracting as a way of financing additional energy efficiency in new buildings.
- The Federal Energy Policy Act of 2005 offers tax incentives of $1.80 per square foot for new commercial buildings designed to exceed the ASHRAE Standard 90.1 standard by 50 percent or more.

Examples:

- Fossil Ridge High School is the only project to date to earn all ten LEED points for this credit. The design projected 59 percent energy cost savings. The district annually saves over $80,000 per year in lower energy costs compared to a similar size school built ten years earlier. Energy efficiency measures included an efficient building envelope, high performance glazing, high efficiency lighting, condensing boilers, and exhaust heat recovery.
- The North Boulder Recreation Center projected to achieve 36.7 percent energy cost savings and earned five LEED points for EAc1. Energy efficiency measures included efficient lighting, solar hot water heating, occupancy sensors, increased roof insulation and white roofing, as well as increased heating system efficiency.

Energy Saving Strategies

- ✓ Improved building envelope including greater insulation, high quality glazing and light reflective roofing materials.
- ✓ Heat recovery wheels utilized to preheat and precool make up air.
- ✓ High efficiency HVAC equipment including high efficiency condensing boilers, automated building systems controls and occupancy sensors.
- ✓ Thermal Energy Storage (TES) system shifts peak demand for cooling loads and can reduce chiller size by half, using ice storage.
- ✓ Evaporative Cooling. This is a particularly effective strategy in the dry Colorado climate and also eliminates the use of refrigerants from the design, which provides synergies with LEED EAc4. The University of Colorado has extensive experience and success using Evaporative Cooling in their buildings. Contact Pieter van der Mersch, Department of Facilities Management at CU (303-492-2909) for more information.
- ✓ Low Lighting Power Densities (LPDs). Lower wattage electrical lighting designs typically produce electrical energy savings, as well as savings in mechanical cooling.
- ✓ Advanced daylighting coupled with proper solar control (shading and high performance glass) and automated electric light integration can save energy costs through reduced electrical lighting, as well as mechanical savings. Automated technologies including daylighting sensors and dimmable ballasts will help to reduce energy use further.
- ✓ Solar Hot Water Systems. Note that Solar Hot Water Systems do not count towards the Renewable Energy Credit (EAc2) but do contribute to the overall energy cost savings of a project to support this credit.

North Boulder Recreation Center's solar water system helped the project earn five points for this credit (rather than the other renewable energy credits.) The system saves the city money year after year by reducing the amount of natural gas needed.
Courtesy: Barker Rinker Seacat Architecture

Resources:

See Appendix G for sources of grants and incentives for high performance design.

Governor's Office of Energy Management and Conservation (OEMC)
Rebuild Colorado
Resources for high performance design, including grants for state-owned new construction projects using LEED.
www.colorado.gov/rebuildco

Governor's Office of Energy Management and Conservation (OEMC)
Business and Strategic Partners
OEMC maintains a directory of both business and strategic partners (e.g. nonprofits, associations, government groups, etc.) to assist Colorado businesses in improving energy efficiency.
Website:
www.colorado.gov/rebuildco/partners/index.html

Colorado Greening Government
Energy Efficiency
Information for Colorado state government and others on executive orders, performance contracting, high performance design, energy management and LEED.
Website:
www.colorado.gov/greeninggovernment/programs/energy

Energy Design Resources (EDR)
Design Practices: Integrated Energy Design
Energy Design Resources offers a valuable palette of energy design tools and resources that help make it easier to design and build energy-efficient commercial and industrial buildings.
Website:
www.energydesignresources.com/category/integrateddesign/

U.S. Department of Energy
Energy Efficiency and Renewable Energy
This resource highlights information on the DOE programs on energy efficiency and renewable energy as well as provides additional links to websites and online documents.
Website:
www.eere.energy.gov

Whole Building Design Guide (WBGD)
The WBDG is a web-based portal providing government and industry practitioners with one-stop access to up-to-date information on a wide range of building-related guidance, criteria and technology from a whole building perspective.
Website: www.wbdg.org

U.S. Energy Policy Act of 2005
Tax Credits
The Energy Policy Act of 2005 mandates credits for energy efficiency improvements and alternative energy, with most beginning in January 2006 and remaining in effect through 2007.
Website: www.energy.gov/taxbreaks.htm

EA Credit 2: Renewable Energy, 5%, 10%, or 20%

In the past, few projects have pursued this point because even the lowest threshold of producing 2.51 percent (see interpolation table, below) of the building's total energy cost through renewables can be cost prohibitive. However, Colorado Amendment 37 will allow eligible Colorado projects to receive money credits for installing on-site renewable generation systems. In some cases, a building owner may elect to install demonstration renewable energy systems (solar powered parking lot lighting, for example) as a visible expression of support for renewable energy and sustainability, while the systems may not be sufficient to earn LEED credit. The Energy Policy Act of 2005 also offers incentives for renewable energy use.

Recommendations:

- Research the applicability of Colorado Amendment 37 or other grants to your particular project that make installing renewable generation systems more attractive and affordable.
- The Federal Energy Policy Act of 2005 allows a 30 percent tax credit to businesses for installing fuel cell technology (up to $500 credit for each half kilowatt of electrical capacity).

Helpful Hints:

- The USGBC has published an interpolation table for calculating points for this credit. It is as follows:

2.51 - 7.50 %	1 point
7.51 - 15.50 %	2 points
> 15.51 %	3 points

- The installation of renewable energy generation systems (wind, photovoltaics, biomass etc.) may be incorporated into an education and outreach program for an Innovation in Design credit.
- This credit has synergies with EAc1 energy saving calculations. In a certain sense, renewable energy generation is doubly rewarded by the LEED rating system.
- Purchased offsite renewable energy is addressed in the Green Power credit EAc6.
- Hot water solar systems are not included in this credit. Instead they are credited through an increase in energy efficiency in EAc1.

QUICK FACTS

Implementation: Worth considering.

Historical Data: 0% of Colorado LEED certified projects have successfully earned this credit.

Fossil Ridge High School photovoltaic array
Courtesy: RB+B Architects

Examples:

- Belmar Development Project in Lakewood plans to install small wind turbines at the top of parking lot lighting to power the individual fixtures.
- Fossil Ridge High School includes a photovoltaic array at the entrance of the building. The array provides an educational opportunity for the district, but was not large enough to qualify for this credit.

Resources:

See Appendix G for sources of grants and incentives for high performance design.

Referenced standard- ASHRAE/IESNA Standard 90.1-1999: Energy Standard for Buildings Except Low-Rise Residential
Renewable or recovered energy that is produced at the site is considered free energy by the Energy Cost Budget (ECB) Method, and therefore, is not included in the Design Energy Cost. ASHRAE Standard 90.1 is the energy standard used by LEED.
Website: www.ashrae.org

Colorado Solar Energy Industries Association (COSEIA)
COSEIA promotes the use of renewable energy in Colorado and maintains a helpful directory of a variety of industry members (manufacturers, distributors, etc) in Colorado.
Website: www.coseia.org

Colorado Renewable Energy Society (CRES)
CRES promotes the use of renewable energy in Colorado with information, annual conference, meetings and annual awards.
Website: www.cres-energy.org

Governor's Office of Energy Management & Conservation (OEMC)
Colorado Biomass Information Clearinghouse
This clearinghouse provides research and resources for using biomass in Colorado.
Website: www.state.co.us/oemc/biomass/

Governor's Office of Energy Management & Conservation (OEMC)
Wind Energy Program
Provides wind resource map for Colorado, loans of anemometers to measure wind resource for small wind generation projects, and video.
Website:
www.state.co.us/oemc/programs/renewable/windenergy.htm

National Renewable Energy Laboratory (NREL)
NREL is part of the DOE's Office of Energy Efficiency and Renewable Energy. It is a leading research and development facility that provides information on renewable energies. Resources such as GIS maps with renewable resources by area, renewable energy conferences, and many publications are available on the NREL website.
Website: www.nrel.gov/

The Colorado Renewable Energy Portal: Odysen
Odysen is an online newsletter that provides renewable energy resources for Colorado. The website includes calculators, upcoming events and links to other renewable energy resources.
Website:
www.odysen.com/location/Main.php?s=Colorado

Source Guides: The Source for Renewable Energy
Source Guides is a list of resources for renewable energy throughout the world. You can search by country, state or geographic location for businesses, products, and news that relate to renewable energy.
Website: energy.sourceguides.com/index.shtml

Database for State Incentives for Renewable Energy (DSIRE)
DSIRE is a source of information on state, local, utility, and selected federal incentives that promote renewable energy. It includes resources for loans, rebates, green power, and much more. The site is organized by state so it is easy to identify the local resources.
Website: www.dsireusa.org/

U.S. Energy Policy Act of 2005
Tax Credits
The Energy Policy Act of 2005 mandates credits for energy efficiency improvements and alternative energy, with most beginning in January 2006 and remaining in effect through 2007.
Website: www.energy.gov/taxbreaks.htm

EA Credit 3: Additional Commissioning

This credit expands on the commissioning requirements from the Commissioning prerequisite and calls for additional best practices commissioning activities. The Additional Commissioning credit addresses commissioning activities during the Design and Post-Occupancy Phases with specific requirements to conduct a design review prior to the Construction Documents Phase, again near the completion of the Construction Documents, review contractor submittals of commissioned equipment and develop an energy management (Re-Commissioning) manual. This credit requires that the commissioning agent be an independent third party, and not part of the design or construction team.

Recommendation:

- This credit is easily achievable for most projects, as proven by the 93 percent of Colorado projects that have earned this credit.
- Costs for implementing this credit can be reduced through planning and leveraging efforts made for the commissioning prerequisite (EAp1) and for the measurement and verification credit (EAc5).

Helpful Hints:

- A good rule of thumb is that the cost premium of the Additional Commissioning credit is an additional one-third the cost of the Fundamental Commissioning credit.
- The commissioning MUST be contracted prior to 100 percent design documents and the start of construction documents.
- Some requirements for this credit occur just prior to substantial completion. Note that LEED requires that documentation is "readily available" prior to submittal.
- When a Commissioning Authority reviews key submittals for compliance with the specifications and design intent, the whole project team benefits by getting an extra set of eyes to look at the details of equipment and control integration at a very early phase of the project. These reviews can help to integrate the equipment suppliers and control vendors prior to equipment being ordered, which facilitates on-site integration and keeps "head-scratching" to a minimum.

QUICK FACTS

Implementation: Recommended.

Historical Data: 93% of Colorado LEED certified projects have successfully earned this credit.

Commissioning Field Work
Courtesy: Architectural Energy Corporation

Examples:

- The Colorado Department of Labor & Employment's additional commissioning proved to be a valuable resource for maintenance staff. The efforts include a seasonal commissioning, a post occupancy (ten month) review and a systems and energy manual for ongoing facility maintenance.
- All three of the CH2M HILL Denver Campus buildings earned this credit. An added benefit was that the Facilities Engineer participated in the commissioning process, providing him with in-depth knowledge about the building systems even before the building was occupied.

Resources:

See Fundamental Building Systems Commissioning credit (EAp1).

EA Credit 4: Ozone Depletion

This credit expands on EAp2 to include the elimination of HCFC and halon from *all* equipment, again including central plant equipment.

Recommendation:

- This credit is easily achievable for projects specifying new mechanical equipment. There has been controversy surrounding this credit, when projects use refrigerant based equipment, because many mechanical engineers have argued that the mechanical equipment which does not use HCFCs is generally less efficient and more likely to leak refrigerant. In response, the USGBC has revised their credit interpretation to allow for equipment which uses HCFC equipment in cases where it can be proven to be more environmentally benign for the project. See www.usgbc.org/Docs/LEED_tsac/TSAC_Refrig_Report_Final-Approved.pdf and various Credit Ruling Interpretations (CIRs) for additional information.

Helpful Hints:

- Small HVAC units that are used to cool equipment support rooms, such as computer, telephone and data rooms, are not considered part of the base building system and are not subject to the requirements of this credit.
- Evaporative cooling (direct or indirect) can a great solution for the dry Colorado climate, eliminating the need for refrigeration equipment.
- Also consider district cooling (chilled water distribution), if your project is in the Denver area.

Examples:

- The Opus Northwest Construction Department of Transportation project in Lakewood, Colorado achieved this credit by installing chillers that use R-134a, which is a non-HCFC refrigerant.
- The Aspen Skiing Company's Snowmass Golf Clubhouse achieved this credit by using water-source heat pumps to provide heating and cooling. In addition to eliminating the need for refrigerants, the system also eliminates the need for a gas-fired boiler.

QUICK FACTS

Implementation: Recommended.

Historical Data: 36% of Colorado LEED certified projects have successfully earned this credit.

Snowmass Golf Clubhouse uses the pond on Hole 18 of the golf course as a heat sink for water-source heat pumps in summer and winter, shown under construction (top) and completed (bottom). *Courtesy: Aspen Skiing Company*

Resources:

See CFC Reduction in HVAC&R Equipment credit (EAp3).

EA Credit 5: Measurement & Verification

The practice of measurement and verification contains two parts: the plan and the implementation of the plan after occupancy. Only the plan is required to earn LEED credit along with additional information regarding the scheduling and type of equipment which will be used to implement the plan. Actual implementation need not be demonstrated prior to submittal since, presumably, it will occur in the building after LEED certification. Projects often realize significant cost savings with the implementation of the procedures outlined in the Measurement and Verification Plan.

Recommendation:

- One successful approach to measurement and verification monitoring is using short-term monitored data along with building automation trended data to address all of the energy conservation measures and end-uses that the USGBC desires. This approach does not require that a project add expensive monitoring equipment to their existing or new mechanical equipment.
- This credit has synergies with the Fundamental Building Systems Commissioning prerequisite (EAp1) and the Additional Commissioning credit (EAc3).
- Sophisticated Electrical Management Systems, Building Automation Systems or Direct Digital Control systems inherently include most of the required monitoring points.

Helpful Hints:

- Target this LEED credit early and inform both the mechanical and electrical engineer to allow them to design their systems for easy monitoring (i.e. consolidating all the electric lighting circuits on one panel to allow for easy breakout of data.) These design requirements may be no-cost items, if part of the original design.
- Some requirements for this credit occur just prior to substantial completion. Note that LEED requires that documentation is "readily available" prior to submittal.

QUICK FACTS

Implementation: Recommended.

Historical Data: 43% of Colorado LEED certified projects have successfully earned this credit.

Installation of data loggers to verify performance
Courtesy: Architectural Energy Corporation

Examples:

- Fossil Ridge High School in Fort Collins and the Department of Transportation Project in Lakewood both successfully achieved this LEED credit by submitting a plan that complies with Option D of the International Performance Measurement and Verification Protocol (IPMVP).

Resources:

Referenced Standard- International Performance Measurement and Verification Protocol, Volume 1, 2001 Version (IPMVP)
The IPMVP referenced standard is available for download at the IPMVP website. They also present best practice techniques, offer protocol development and technical training seminars among the many resources.
Website: www.ipmvp.org/

ENERGY STAR: Portfolio Manager
The Portfolio Manager from ENERGY STAR is a free tool for benchmarking building energy performance. Simply enter 12 months of electricity and gas use and other basic information about the building (area, schedule, etc.) to get a preliminary score. A professional engineer is required to verify the score if an official ENERGY STAR label is desired (for buildings with a score of 75 or higher.)
Website:
www.energystar.gov/index.cfm?c=evaluate_performance.bus_portfoliomanager

U.S. Department of Energy Energy Efficiency and Renewable Energy (EERE)
The EERE has an M & V resource page that has a planning tool, report outlines, example scope of work and many other M & V related resources.
Website:
www.eere.energy.gov/femp/financing/superespcs_mvresources.cfm

Association of Energy Engineers (AEE)
AEE has a program that teaches individuals about the basics of M & V and certifies them as Measurement and Verification Professionals. It also offers courses to prepare you for the required exam and gives an overview of the measurement and verification process.
Website:
www.aeecenter.org/store/detail.cfm?id=757&category_id=4

Energy Efficient Design Applications: Measurement and Verification Documents
Lawrence Berkeley National Laboratory has provided this resource that includes guidelines, check lists, training opportunities, and other great resources for M & V. For more information, see the M & V Documents website.
Website: ateam.lbl.gov/mv/

EA Credit 6: Green Power

The Green Power LEED credit requires a two-year contract for 50 percent of the building's electricity cost in support of the generation of power from renewable sources. Currently there are three different strategies to achieve this credit in Colorado:

1. Contract *Green-e equivalent power* from Xcel Energy Fort Collins Utilities or others.
2. Contract *Green-e certified power* from suppliers such as Holy Cross, Colorado Springs Utilities, and Yampa Valley Electric Association.
3. Purchase Green-Tags from *any* Green Broker (example Renewable Choice, GT Energy).

Recommendation:

- Cost premiums for green power have come down significantly over the last several years. It is now possible to purchase green power for a 1.0¢ per kWh premium or less. In fact, the price for a limited amount of wind power, announced in 2005 by Xcel Energy, was less than the standard electricity rate.

Helpful Hints:

- Don't forget to contact your electric utility for availability and pricing comparison when shopping for green power.
- The project is guaranteed an Innovation in Design credit if it contracts for two years at 100 percent green power, or four years at 50 percent green power.
- Achieving this credit does not impact design or construction budgets. Cost premium is carried in owner's operations budget.
- Unlike many credits, this credit can often be considered until the last minute of a LEED submission. Implementation can even be added as needed as a re-submittal to the USGBC.
- Green power reps are savvy to LEED requirements in today's market and therefore, should be able to easily provide required submittal documentation.
- Onsite generation and solar hot water systems do not apply to this credit.

QUICK FACTS

Implementation: Strongly recommended.

Historical Data: 57% of Colorado LEED certified projects have successfully earned this credit.

Platte River Power Authority Medicine Bow Wind Project supplies wind power to Fort Collins, Loveland, Estes Park and Longmont.
Courtesy: Platte River Power Authority

Examples:

- The University of Colorado at Boulder Student Union mandates a 100 percent subscription for green power *if* student fees are used to help fund building projects.

Resources:

Referenced Standard: Center for Resource Solutions' Green-e Product Certification Requirement

Products that are labeled with the Green-e logo are greener and cleaner than the average electricity product sold in that region. The standard may be downloaded from the Green-e website.
Website: www.green-e.org/

ColoradoEnergy.org

ColoradoEnergy.org provides information about green power available in the state of Colorado. The website lists places to sign up for green power in Colorado as well as local events and news briefs.
Website: www.coloradoenergy.org/issues/greenpower/default.htm

Database for State Incentives for Renewable Energy (DSIRE)

DSIRE is a database, organized by state that allows users to browse many renewable energy resources. Included in these resources is a listing of places in Colorado that currently purchase green power and how they are doing it.
Website: www.dsireusa.org/library/includes/map2.cfm?CurrentPageID=1&State=CO

U.S. Environmental Protection Agency Green Power Partnership

The Green Power Partnership is a program that supplies information on renewable energy and where to buy in your region. The website has a list, by state, of participating utilities, what renewable source they are using and other useful information. It also lists products with Green-e certification and additional information.
Website: www.epa.gov/greenpower/locator/co.htm

U.S. Department of Energy (DOE) Green Power Network

The DOE's Office of EERE (Energy Efficient and Renewable Energy) has an online Green Power Network that has everything you need to know about green power including, state policies, pricing, renewable energy certificates and much more.
Website: www.eere.energy.gov/greenpower/

Materials and Resources

Over 136 million tons of construction and demolition waste are generated each year in the United States. The effect a building has on the environment can be substantially minimized with the efficient use and disposal of building materials. In its simplest form of conservation, LEED looks at the products and materials that are used in building construction and requires that they be used efficiently, conservatively and pragmatically, from specification of recycled material content in design to ensuring the project is managing its waste stream effectively during construction and beyond.

Boulder Community Foothills Hospital
Courtesy: Ed LaCasse Photography

MR Prerequisite 1: Storage & Collection of Recyclables

Storage and collection of recyclables is one of the most basic sustainable strategies. This is a credit that can be integrated creatively, exhibiting the environmental initiatives taken on by the building through signage, pictures and even demonstrations that can contribute to Innovation in Design credits. This credit is achieved with a twofold approach: interior recycling collection areas and storage of recyclables for disposal. Materials recycled must include, at a minimum, paper, corrugated cardboard, glass, plastics and metals.

Helpful Hints:

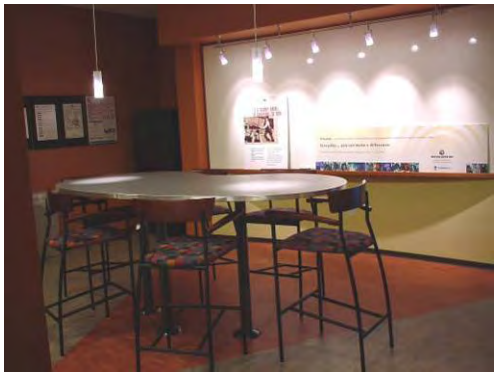
- The building owner should create a recycling plan, if one is not already in use.
- The architect is responsible for designing areas dedicated to recycling according to the owner or tenant's recycling plan and recycling needs.
- Look into local recycling facility availability early on! Provisions may need to be made if local facilities do not accommodate all of the five required materials to be recycled.

Examples:

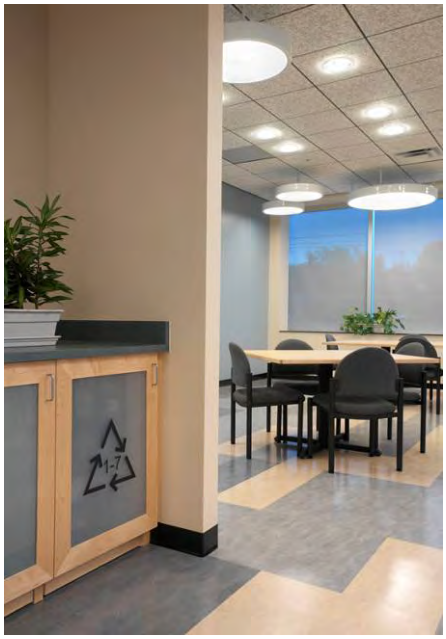
- Boulder Foothills Community Hospital went above and beyond the requirements of this prerequisite and was awarded "Overall Recycler of the Year 2001" by Colorado Recycles. The hospital not only recycles the standard five requirements, but also coordinates recycling of batteries, printer cartridges, furniture/supplies and computers. Additionally, the Maternity Department uses cloth diapers instead of disposables to minimize waste.
- CH2M HILL's facilities staff worked closely with the architect to design an effective system for collection and storage of recyclable materials. As a result, each central coffee room features recycling containers built into the cabinetry. These rooms were also designed as creative work settings that encourage informal meetings and employee interaction.
- Colorado Springs Utilities Laboratory break room uses cabinetry with stylized recycling designs to encourage recycling of aluminum cans, plastics, and other recyclable products.

QUICK FACTS

Implementation: Required.



CH2M HILL Coffee Room
Courtesy: CH2M HILL



Colorado Springs Utilities Laboratory
Courtesy: Ed Lacasse Photography

Resources:

Colorado Recycles
Colorado Recycling Guide
This guide to statewide recycling resources has been prepared as a public service and convenience. It is intended to be a resource to identify recyclers and the materials and products that they accept for recycling.
Website: www.colorado-recycles.org/searchfolder/search.html

Colorado Greening Government
Information for Colorado state government and others for waste reduction and recycling and environmentally preferable purchasing.
Website:
www.colorado.gov/greeninggovernment

Colorado Assocation for Recycling
Information and annual conference promoting increasing the amount and effectiveness of recycling in Colorado.
Website: www.cafr.org/

California Integrated Waste Management Board
Business Waste Reduction
Fact sheets, a resource index, case studies and information on the economic benefits of recycling.
Website: www.ciwmb.ca.gov/bizwaste/

Montgomery County Public Schools
Recycling Program & Recycling Regulations
Example plan put together by MCPS including procedures and a list of materials to be recycled.
Website:
www.mcps.k12.md.us/departments/recycling/regulation.htm

Starting a new LEED-NC project?
All new LEED-NC projects will register under version 2.2 (as of January 2006). Refer to the USGBC for complete information about version 2.2. Also, see Appendix C of this Guide for a quick overview of the changes from version 2.1 to 2.2.

MR Credit 1: Building Reuse

If your project is new construction, with no existing structure, the building reuse credits cannot be pursued. To achieve the first of the three credits, a *minimum* of 75 percent of the existing walls, floors and roof must be reused. The second point requires 100 percent of the walls to be reused and few projects pursue these credits because most projects do not include existing buildings. The third point requires 100 percent shell and 50 percent non-shell reuse. Building reuse may be more readily achievable in urban areas due to a greater selection of existing building stock.

Helpful Hints:

- Renovation and/or expansion projects are applicable to these credits.

Example:

- The North Boulder Recreation Center earned this credit with reuse of 83 percent of the existing facility in its expansion.
- Aspen Skiing Company recycled or reused 86 percent of the materials when it deconstructed the existing building, saving $42,000 in construction costs on the Sundeck Restaurant, certified under LEED version 1.0.

Resources:

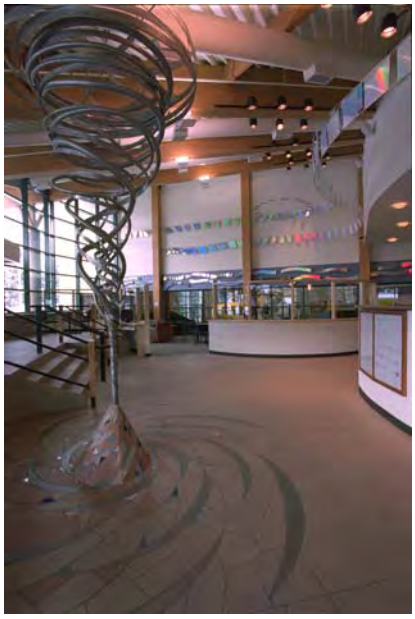
New Life Journal
Article: *Building Recycling: Sustainable Reuse of Existing Structures (April – May 2004)*
Website:
www.findarticles.com/p/articles/mi_m0KWZ/is_5_5/ai_n6175401

QUICK FACTS

Implementation: Worth Considering.

Historical Data:
7% of Colorado LEED certified projects have successfully achieved MRc1.1
0% have earned MRc1.2 or MRc1.3

Aspen Skiing Company Sundeck Restaurant
Courtesy: Paul Morrison



North Boulder Recreation Center
Courtesy: Barker Rinker Seacat Architecture

MR Credit 2: Construction Waste Management, Divert 50% or 75%

Few industries impact the amount of waste generated in the U.S. like the construction process. In the last few years construction waste management has become more commonplace for many Colorado contractors. LEED projects now underway in the Front Range are often able to divert 75 percent of the construction waste. The availability of recycling locations has made this credit readily achievable. Though some projects may still separate recyclables into designated bins, the waste recycling industry is moving toward commingled recyclables. Construction waste recycling should result in a cost savings..

Recommendations:

- Help contractors develop a waste management plan early to ensure best practices from the initial phases of the project.
- Education of subcontractors on recycling practices and established penalties (such as fees) for not following these practices is key to achieving the highest percentage of construction waste diverted from the landfill.
- Incentives, given by the general contractor or owner, to subcontractors for meeting targeted recycling goals can both motivate and benefit all involved.
- The owner may want to consider tying progress payments with the general contractor's progress submittal for tracking waste recycling percentages.
- The general contractor should confirm the waste/recycling hauler is providing weights (in tons) for tracking hauls instead of the standard cubic yard totals.
- Currently, gypsum wall board is the most difficult of all common construction materials to recycle in Colorado. Investigate local agricultural or site recycling opportunities, such as grinding the gypsum and using it as a soil amendment.

QUICK FACTS

Implementation: Strongly recommended.

Historical Data:
86% of Colorado LEED certified projects have successfully earned MRc2.1
14% have earned both MRc2.1 and 2.2.

Poudre School District staggers recycling containers to save space on jobsites.

Helpful Hints:

- Tight project sites, with minimal laydown yards to store equipment and materials, may have difficulty setting up multiple recycling bins on site. Work with the contractor to stagger bins to match construction schedule; for example, drywall recycling bins are not needed until late in the construction process. Alternatively, the project may require additional bins be stored on adjacent lots.
- Specifications and instructions to bidders should include returned waste/leftover product from the project in "Diverted Waste" totals. In other words, if extra cubic yards of concrete (still in the concrete truck) go back to the batch plant, this can be considered diverted waste from the landfill and contribute to the total percentages for this credit.

Examples:

- On the Fossil Ridge High School project, the district diverted the drywall from the landfill by land-applying it as a soil amendment pilot project funded by the EPA.
- The U.S. Department of Transportation project minimized contaminated recycle bins by dedicating a person to weekly reviews and inspections of the bins.

Resources:

Resource Venture
Construction Waste Management Plan Template
The following website provides a basic contractor's template for the Construction Waste Management Plan.
Website:
www.resourceventure.org/rv/publications/building/WasteMgmtPlan.doc

Associated General Contractors of America
Recycle This! (Brochure)
Information on construction waste management, geared towards contractors. This brochure includes case studies, statistics and resources.
Website:
www.agc.org/content/public/pdf/Environmental_Info/recycle_brochure.pdf

NAHB
Construction Waste Management
Background, resources and publications on construction waste management.
Website:
www.nahbrc.org/tertiaryR.asp?TrackID=&DocumentID=2776&CategoryID=1495

Courtesy: Larimer County Landfill

California Integrated Waste Management Board, Construction & Demolition Materials
One of the most thorough websites available, with a large section dedicated to recycling of construction and demolition materials.
Website: www.ciwmb.ca.gov/ConDemo/

RecyclingPlus Program Manual: Best Practices for Construction Site Recycling
The Recycling Plus Program was developed to provide construction companies with a model program for reducing construction waste on your job sites through using the "three R's" – Reduce, Reuse and Recycle. The intent was to create a user-friendly program emphasizing cost-effective methods to minimize waste on the job site and to make sure most of the waste that does occur gets recycled. Modeled after successful job-site safety programs, the program includes a manual and visual aids for training field personnel. Program materials can be customized by incorporating your company name with the Recycling Plus Program logo.
Website: www.cwc.org/wood/wd_htm/CDL96-1rpt.htm

Wastespec
Model Specifications for Construction Waste Reduction, Reuse and Recycling
WasteSpec provides example specification language that enables Specification writers to better understand what sections contribute to construction waste reduction, reuse and recycling.
Website:
www.tjcog.dst.nc.us/regplan/wastspec.htm

Whole Building Design Guide
Construction Waste Recycling Database
Guide to companies that recycle construction waste, searchable by material and location.
Website: www.wbdg.org/tools/cwm.php

MR Credit 3: Resource Reuse, Specify 5% or 10%

This credit is more difficult to achieve due to the required percentage thresholds (5 to 10 percent of the building material cost) with reused materials. Also, architects often prefer not to reuse materials with unknown histories or voided warranties. As reuse centers become more commonplace and Internet-based materials databases and tools, make finding reused materials that fit a project's needs an easier task, the possibilities of incorporating reused materials into a project continue to grow.

Recommendation:

- This can be a great credit for projects with high-end or large wood-based interior finishes such as residential projects.

Helpful Hints:

- Be sure to distinguish the requirements of this credit from the *Building Reuse credit*. The LEED Reference Guide specifies that "Materials salvaged during a building renovation…that will be reinstalled to serve in their original function must be applied to MRc1". This is a key component to keep in mind when an existing building and components are being reused.

QUICK FACTS

Implementation: Worth considering.

Historical Data:
14% of Colorado LEED certified projects have successfully earned MRc3.1
7% have earned both MRc3.1 and 3.2.

Resources:

City of Boulder
Building Materials Reuse and Recycling Contacts
A spreadsheet of building materials reuse and recycling contacts includes materials and location; and specifies pick-up, acceptance and fees.
Website: www.ci.boulder.co.us/environmentalaffairs/green_points/resources.html

GreenSage
Assistance locating reclaimed wood products, connections to resellers to recycle materials.
Website: www.greensage.com/06064-reclwood.html

U.S. Department of Agriculture (USDA)
The USDA published a directory in 2005 that lists companies involved in wood-framed building deconstruction, dismantling and reused building materials; with an emphasis on those that use, resell and/or re-manufacture salvaged wood.
Website: www.fpl.fs.fed.us/documnts/fplgtr/fpl_gtr150.pdf

Center for ReSource Conservation
The Center for ReSource Conservation' projects include Resource 2000 in Boulder and Resource Fort Collins. Both locations salvage used building materials and resell them at economical prices.
Boulder Website: www.resource2k.org/
Fort Collins Website: www.resourceftcollins.org/

MR Credit 4: Recycled Content, Specify 5% or 10%

Obtaining both Recycled Content credit 4.1 (for 5 percent recycled content) and 4.2 (for 10 percent) is easily achievable for most projects in Colorado. This is a direct result of evolving industry processes that allow recycled content in many building materials. Because this credit is based on a percentage of your total building materials cost, your most expensive items will be the largest contributors for this point. In the project specifications, require post-consumer or post-industrial recycled content for the top five or ten most expensive items in the project. This will ensure purchase of building materials with the highest possible recycled content, and greatly streamline the process for achieving these credits.

Recommendation:

- Target high-dollar items early in the project to include recycled content in the specifications.
- Products that often inherently contain recycled content include steel, drywall, concrete and carpet backing.

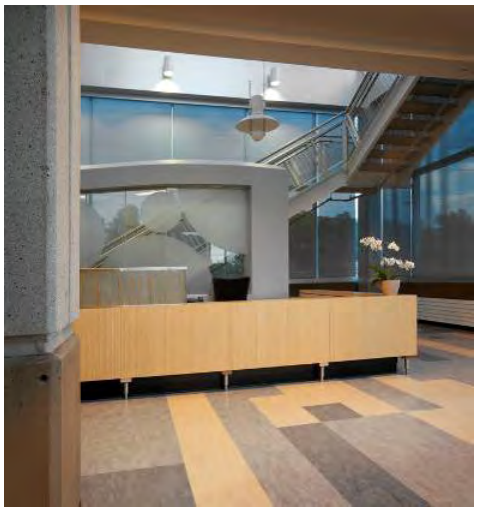
Helpful Hints:

- Only CSI Divisions 2-13 are considered for this credit.
- Contractor documentation and supporting submittals are critical to successfully achieving these credits.
- Document, document, document! Several LEED document submittals have been delayed because of difficulty getting documentation from the contractor. It is much more difficult to go back and dig up records after the project is built than at the time of construction submittals.
- Numerous Colorado projects have doubled the second threshold for this credit (10 percent) and also achieved an Innovation in Design credit.

QUICK FACTS

Implementation: Strongly recommended.

Historical Data:
79% of Colorado LEED certified projects have successfully earned MRc4.1.
71% have earned both MRc4.1 and 4.2.



Colorado Springs Utilities Laboratory is one of several Colorado projects to have earned both Recycled Content credits 4.1 and 4.2
Courtesy: Ed Lacasse Photography

Resources:

USGBC Colorado Chapter
Colorado Chapter LEED Materials Matrix
The Colorado Chapter of the USGBC offers this regional products list as a free download. Each entry contains company contact information and information about LEED credit attributes: locally-manufactured, locally-harvested, recycled content, rapidly renewable and certified wood.
Website: www.usgbc.org/chapters/colorado/regional_products_list.asp

California Integrated Waste Management Board
Recycled Content Product (RCP) Directory
Lists thousands of recycled products and provides information on companies that reprocess, manufacture and/or distribute these products.
Website: www.ciwmb.ca.gov/RCP/

U.S. Environmental Protection Agency
Comprehensive Procurement Guidelines
A list of designated products and the accompanying recycled-content recommendations along with a supplier database which includes manufacturers, vendors and suppliers for each item.
Website: www.epa.gov/cpg/products.htm

Whole Building Design Guide
Federal Green Construction Guide for Specifiers
Comprehensive guide for procuring green building products and construction services. Sample specification language by CSI division. Developed by a partnership between EPA, Federal Environmental Executive and the Whole Building Design Guide.
Website: www.wbdg.org/design/greenspec.php

MR Credit 5: Local/Regional Materials

The local regional materials credits are composed of two points; the first for 20 percent locally manufactured materials, and the second for locally harvested (or mined) materials. Like the recycled content credits, achieving the local/regional materials credits can be streamlined by pinpointing high-dollar materials and listing Colorado manufacturers and harvesting locations in the specifications. For instance, gypsum board can be found both manufactured and harvested locally; however, most wood products (though they may be manufactured locally) come from the Pacific North West.

Recommendation:

- Target high-dollar items early in the project to include local manufacturers and/or harvesting in the specifications.
- Colorado regional products that are *both manufactured and harvested* include (but are not limited to) drywall, ceramic tile, concrete components and limestone.

Helpful Hints:

- Only CSI Divisions 2-13 are considered for this credit.
- Projects can specify preference for products from the manufacturing facility closest to the project site.
- Document, document, document! Several LEED document submittals have been delayed because of difficulty getting documentation from the contractor. It is much more difficult to go back and dig up records after the project is built than at the time of construction submittals.
- Like MRc4, numerous Colorado projects have doubled the required thresholds for this credit and achieved an Innovation in Design credit.

Example:

- Colorado Department of Labor & Employment earned this credit and innovation credits for significantly exceeding the requirements for recycled content and locally manufactured materials. Specifying local and recycled content of structural steel was a key factor in this success.

QUICK FACTS

Implementation: Strongly recommended.

Historical Data: 100% of Colorado LEED certified projects have successfully earned both MRc5.1 and 5.2.

Colorado Department of Labor & Employment structural steel has recycled content and was manufactured locally
Courtesy: Colorado Department of Labor & Employment

Resources:

USGBC Colorado Chapter
Colorado Chapter LEED Materials Matrix
The Colorado Chapter of the USGBC offers this regional products list as a free download. Each entry contains company contact information and information about LEED credit attributes: locally-manufactured, locally-harvested, recycled content, rapidly renewable and certified wood.
Website: www.usgbc.org/chapters/colorado/regional_products_list.asp

AIA Colorado
Sustainable Design Resource Guide
AIA Colorado offers a guide organized according to the sixteen divisions of the Construction Specifications Institute (CSI). Each division is prefaced by an introduction that outlines specific concerns related to the products and systems in that division. This is followed by product listings and information designed to help purchase or specify sustainable building products. (1997)
Website: www.aiacolorado.org/SDRG/home.htm

MR Credit 6: Rapidly Renewable Materials

Like the resource reuse credit, using rapidly renewable materials can be difficult to achieve due to the required threshold of 5 percent of the cost of all building materials and products. This credit is also difficult because it generally comes with a cost premium for renewable materials. However, use of rapidly renewable materials poses the opportunity to showcase the sustainable practices of the project. Visible characteristics such as bamboo or cork flooring can create a marketing edge.

Recommendation:

- Like the resource reuse credit, projects with high-end interiors or residential applications have a great opportunity to find creative ways to use renewable materials. Consider wheat board cabinetry, stained cork floors in a lobby or recycled paper countertops.

Helpful Hints:

- Ensure application of renewable materials is appropriate. For example, wheat board may have a rough finish and be a problem with splinters, depending on specifications and placement.
- Projects can specify preference for products from the manufacturing facility closest to the project site.

Example:

- Although no LEED-NC projects have achieved this yet in Colorado, Boulder Associates did achieve the Rapidly Renewable credit in a LEED-CI project – the interior finish of the Boulder Associates office. This credit is more readily achievable for interior projects, as few exterior products are rapidly renewable.

Resources:

USGBC Colorado Chapter
Colorado Chapter LEED Materials Matrix
This regional products list is offered as a free download. Each entry contains company contact information and information about LEED credit attributes: locally-manufactured, locally-harvested, recycled content, rapidly renewable, and certified wood.
Website: www.usgbc.org/chapters/colorado/regional_products_list.asp

QUICK FACTS

Implementation: Worth considering.

Historical Data: 0% of Colorado LEED certified projects have successfully earned this credit.

Boulder Community Foothills Hospital uses linoleum flooring, a rapidly renewable material
Courtesy: Boulder Associates, Inc.

California, Division of the State Architect
Article: *Sustainable Schools- Rapidly Renewable Materials*
This article includes information on the use of rapidly renewable materials in schools, including links to featured resources.
Website: www.sustainableschools.dgs.ca.gov/SustainableSchools/sustainabledesign/materials/rapidlyrenewablematerials.html

Build It Green
Materials Database
This nonprofit organization provides a material resource database including many sustainable building material listings for products all over the country.
Website: builditgreen.org/guide/

MR Credit 7: Certified Wood

Fifty percent of the total wood budget must be dedicated to Forest Stewardship Council (FSC) certified wood in order to achieve this credit; so needless to say, projects with a minimal wood budget can often achieve this credit more easily than projects with large wood budgets. Wood scopes that may contribute to this credit include formwork (owned, not rented), permanent wood shoring, rough carpentry, finish carpentry, doors and door cores, millwork, telephone backer boards and temporary construction, to name a few. In recent years, the cost premiums for certified wood have decreased dramatically, except for rare species.

Recommendations:

- Minimize the need for fire-treated FSC wood by substituting metal strapping for all interior blocking/backing.
- Confirm lead time for any and all FSC materials; this has potential to impact the project schedule.
- Confirm all FSC suppliers can provide the required documentation, e.g. chain-of-custody certificate numbers.

Helpful Hints:

- Though cost premiums for certified wood have often scared projects away from this credit in the past, numerous LEED registered projects in the Front Range area are finding this credit to be cost-effective and achievable in recent years.
- Don't forget large wood scopes like wood shoring can completely eradicate the possibility to get this credit if not FSC certified!
- This credit has synergies with EQc4.4, composite wood.
- Blocking/backing or other fire-retardant materials may be more challenging to find as FSC certified.
- Document, document, document! Several LEED document submittals have been delayed because of difficulty getting documentation from the contractor. It is much more difficult to go back and dig up records after the project is built than at the time of construction submittals.

QUICK FACTS

Implementation: Strongly recommended.

Historical Data: 0% of Colorado LEED certified projects have successfully earned this credit.

Resources:

Forest Certification Resource Center
Certified Products
List of FSC certified wood sources; searchable by building material. The Center also provides information on forest management and product certification worldwide.
Website:
www.certifiedwoodsearch.org/SearchProducts.aspx

Scientific Certifications Systems, Inc.
Through its Chain-of-Custody Certification Division, SCS certifies wholesalers, manufacturers, distributors and retailers, who handle wood coming from forests certified according to FSC standards. Includes links to a current list of companies certified for Chain-of-Custody.
Website:
www.scscertified.com/forestry/forest_coc.html

Build It Green
Fact Sheet
This nonprofit organization provides a material resource database including many sustainable building material listings for products all over the country. This link provides direct access to an FSC certified wood fact sheet.
Website:
builditgreen.org/resource/index.cfm?fuseaction=factsheet_detail&rowid=12

USGBC Colorado Chapter
Colorado Chapter LEED Materials Matrix
The Colorado Chapter of the USGBC offers this regional products list as a free download. Each entry contains company contact information and information about LEED credit attributes: locally-manufactured, locally-harvested, recycled content, rapidly renewable, and certified wood.
Website:
www.usgbc.org/chapters/colorado/regional_products_list.asp

Indoor Environmental Quality

A building's indoor environment is the result of a complex interaction between site, climate, building mechanical systems, contaminant sources and the building occupants. The goal of the Indoor Environmental Quality category in LEED is to provide a healthy, comfortable and productive indoor environment for building occupants. Creating and maintaining such an environment requires the successful integration of multiple design decisions and addressing such issues as adequate ventilation for occupants, off-gassing from finish materials and mechanical equipment, tobacco smoke, microbiological contamination and outside air pollutants.

Aspen Skiing Company – Snowmass Golf Clubhouse
Courtesy: Aspen Skiing Company

EQ Prerequisite 1: Minimum IAQ Performance

This prerequisite requires the designer to meet the minimum requirements of the ventilation standard: ASHRAE 62-1999 and approved addenda, with a reference to ASHRAE 62-2001 Appendix H. ASHRAE 62-1999 sets contaminant standards for indoor environmental quality. Standard mechanical design practices in Colorado generally promote compliance with ASHRAE 62-1999.

ASHRAE 62-2004 is an acceptable threshold for compliance as well. If, however, ASHRAE 62.1-2004 is used to demonstrate compliance with the prerequisite, it must also be used in calculations applied to EQc1.

Recommendation:

- Engineers should confirm that the project meets the minimum requirements of ASHRAE 62-1999 upfront and early in design.

Helpful Hints:

- Ventilation systems may be mechanical or natural. If natural ventilation and infiltration are being used, compliance with ASHRAE 62-1999 can be demonstrated using a tracer gas test (described in ASHRAE 55-1999) or by performing calculations of natural ventilation based on wind pressure and thermal buoyancy (stack-effect) driven ventilation as described in the ASHRAE Handbook of Fundamentals, Chapter 22 or the ASHRAE Standard 62-2001.
- ASHRAE 62.1-2004 combines Standard 62-2001 and published addenda, thereby providing an easy-to-use consolidated standard. Standard 62.1-2004 specifies minimum ventilation rates and indoor air quality that will be acceptable to human occupants and are intended to minimize the potential for adverse health effects.

QUICK FACTS

Implementation: Required.

Resources:

Referenced Standard: ASHRAE Standard 62-1999: Ventilation for Acceptable Indoor Air Quality
The ASHRAE reference standard is available at the ASHRAE website. Interpretations, approved addenda, and the recent versions (Standard 62-2001 and 2004) can also be accessed.
Website: www.ashrae.org

U.S. Environmental Protection Agency
Indoor Air Quality in Large Buildings
This resource includes publications, information and tools for indoor air quality assessment.
Website:
www.epa.gov/iaq/largebldgs/index.html

EQ Prerequisite 2: Environmental Tobacco Smoke (ETS) Control

In March 2006, Colorado became the 13th state in the U.S. to adopt a statewide smoking ban. The law prohibits smoking in bars, restaurants, and most workplaces and takes effect July 1, 2006. Exemptions to the smoking ban include private homes; automobiles, if not used for child care or public transportation of children; privately hired limousines; as much as 25 percent of hotel and motel rooms; retail tobacco businesses; the outdoor area of any business; places of employment not open to the public with three or fewer employees; casinos; and Denver International Airport.

Thus, this prerequisite is not a given for all projects in Colorado. Residential applications can be especially difficult since it is necessary to accommodate and respect personal preference regarding smoking. LEED provides two ways to achieve this prerequisite: 1) prohibit smoking in the project facilities and designate exterior smoking areas away from main entrances/exits, or 2) provide negatively pressurized, fully enclosed designated smoking rooms in the building.

Recommendations:

- If the project includes smoking rooms, make sure the project budget/scope includes allotted fees and requirements for tracer gas testing.
- Many CIRs have been posted regarding residential applications and meeting LEED requirements through alternative compliance options. CIR 12/3/2003 addresses these options in detail.
- Designated exterior smoking areas should be shown on the site/civil or landscape furnishing plans. Avoid locating these areas near building entrances/exits.

QUICK FACTS

Implementation: Required.

Examples:

- Continuum Partners' Belmar Block 2 development project provided a signed letter template stating that smoking is prohibited inside project facilities. In addition, they provided an excerpt from the tenant guidelines outlining the building's non-smoking policy to the tenants, and a site plan highlighting designated smoking areas in the proper location.

Resources:

Referenced Standard: ASHRAE Standard 129-1997: Measuring Air-Change Effectiveness
ASHRAE Standard 129-1997 that describes the method to perform the tracer gas testing can be found on the ASHRAE website.
Website: www.ashrae.org

Colorado Clean Indoor Air Act
The statewide smoking ban was signed into law on March 26, 2006 and takes effect July 1, 2006.
Website:
www.state.co.us/gov_dir/leg_dir/olls/sl2006a/sl_22.htm

Group to Alleviate Smoking Pollution
Provides details on smoking bans for individual cities and counties in Colorado.
Website:
www.gaspforair.org/gasp/ordinance/ordinance_index.php

American Lung Association
This article provides information on secondhand smoke, the effects and prevention.
Website:
www.lungusa.org/site/pp.asp?c=dvLUK9O0E&b=35421

EQ Credit 1: Carbon Dioxide (CO_2) Monitoring

The intent of this credit is to provide improved indoor air quality by addressing (minimizing) carbon dioxide levels in occupied spaces. Although higher ventilation rates may be required, carbon dioxide monitors act as surrogate occupancy sensors and only provide higher ventilation rates when required. In this way, energy savings can be realized by not over-ventilating a space during periods of intermittent or variable occupancy. In general, it is left to the discretion of the mechanical engineer to assure the design of the carbon dioxide monitoring system accurately reflects occupancy and demand ventilation levels. Residential applications have been able to meet the credit requirement through CO_2 monitoring in public or common areas and carbon monoxide monitors in areas near combustion equipment (See CIR 9/3/04).

Recommendation:

- Proper system design and CO_2 sensor placement is critical. Locating sensors only in densely occupied areas can unnecessarily drive ventilation systems. Similarly problematic is grouping spaces with dissimilar occupancy patterns.
- When used with demand controlled ventilation, properly placed CO_2 sensors can pay for themselves in three years or less, by limiting the amount of unnecessary outside air for ventilation.

Helpful Hints:

- Operational adjustment of building systems due to CO_2 monitor feedback can be interpreted as either automatic adjustment or manual adjustment.
- The CO_2 monitoring system does not require that sensors be located in every room, but rather are representative of appropriate areas or mechanical zones.

Examples:

- The Opus Northwest Department of Transportation building successfully achieved this credit by providing a signed letter template, a narrative and specifications describing the installation, operational design and controls/zones for the CO_2 monitoring system.

QUICK FACTS

Implementation: Recommended.

Historical Data: 50% of Colorado LEED certified projects have successfully earned this credit.

The North Boulder Recreation Center
CO_2 monitoring is most effective when controlling ventilation in areas with large variations in occupancy
Courtesy: Barker Rinker Seacat Architects

Resources:

Design Share
The International Forum for Innovative Schools
Article: *Indoor Air Quality in Schools: The Importance of Monitoring Carbon Dioxide Levels*
(July 2003)
Website:
www.designshare.com/Research/Sundersingh/IAQ_Monitoring.htm

Environmental Design + Construction
Article: *IAQ Monitoring for Occupant Health*
(November 15, 2004)
Website:
www.edcmag.com/CDA/Archives/cf4fdb719c697010VgnVCM100000f932a8c0

GSA LEED Applications Guide
Guidance on relative cost effectiveness of LEED strategies, including carbon dioxide monitoring.
Website:
www.wbdg.org/ccb/GSAMAN/gsaleeda.pdf

EQ Credit 2: Ventilation Effectiveness

The goal of this credit is to achieve maximum effectiveness of the ventilation provided by optimizing proper air mixing and flow. In other words, the freshest air should be most accessible to the building occupants. Adequate ventilation has been shown to result in higher occupant productivity and satisfaction.

Recommendations:

- This credit requires extensive documentation. Mechanical engineers may require approximately 24 to 40 hours to sufficiently document this credit.
- This credit is most readily achievable with underfloor air distribution or displacement ventilation system.

Helpful Hints:

- This credit is not just about air changes, but also about the *mixing* of the air (airflow).
- Higher ventilation rates do not necessarily correlate with better mixing of the ventilation air. Higher ventilation rates (ach) may reduce the air change effectiveness, because at these higher ventilation rates the residence time (age) of the air is lower and there is less time to mix the air.
- Use ASHRAE 62-2001 guidelines to support the declaration that a project achieves the higher ventilation effectiveness rate.
- Compliance may be demonstrated through performance (testing) or design. In the past there has been confusion as to the documentation requirements to demonstrate compliance. See CIRs (7/19/2004 and others) for further explanation of proper design and calculation procedures.
- Computational Fluid Dynamic calculations and modeling may assist in providing supporting documentation.
- This credit can be achieved using natural ventilation if it is demonstrated that the design provides effective ventilation in at least 90 percent of each room or zone area in the direction of airflow for at least 95 percent of the hours of occupancy. According to the USGBC, "the best way to demonstrate ventilation effectiveness in a naturally ventilated building is to develop a multinodal model of airflow. However, a convincing narrative using demonstrated natural ventilation principles, and including diagrams accurately representing the spaces in question, and supporting calculations based on space characteristics could be used to demonstrate achievement of this credit."

QUICK FACTS

Implementation: Worth considering.

Historical Data: 36% of Colorado LEED certified projects have successfully earned this credit.

Boulder Community Foothills Hospital
Courtesy: Bounder Associates, Inc

Examples:

- The Tutt Science Center at Colorado College successfully documented credit compliance by providing data from Titus Electronic Air Management System software showing the isothermal throw data at 150 fpm, 100 fpm, and 50 fpm supply air velocities and air diffusion performance index (ADPI) information.
- Boulder Community Foothills Hospital successfully documented credit compliance (even though it was an overhead distribution system) by providing a design narrative with air diffusion performance index (ADPI) calculations, and a section and plan of each major space showing inlets, outlets, furniture and occupants, with airflow patterns graphically illustrated to scale. In addition, cutsheets and specification tables for all terminal vents, grills and registers

were provided and cross-referenced to the drawings. Finally, an as-built inspection report was developed documenting the system installation, including photographs of each major room type.

Resources:

Referenced Standard: ASHRAE 129-1997: Measuring Air Change Effectiveness
This standard provides a method for measuring air-change effectiveness in mechanically-ventilated buildings and spaces.
Website: www.ashrae.org

ASHRAE Fundamentals Handbook 2001, Chapter 32: Space Air Diffusion
This guideline provides descriptions of air diffusion strategies and technologies, methods of evaluation, and system design considerations.
Website: www.ashrae.org

U.S. Department of Energy's Energy Efficiency and Renewable Energy
Air Handling, Ventilation and Air Quality
This resource includes links to product information, tools, codes and standards.
Website:
www.eere.energy.gov/buildings/info/components/hvac/air.html

Advanced Buildings
Displacement Ventilation
Introduction to how displacement ventilation works, provided by Natural Resources Canada.
Website:
www.advancedbuildings.org/_frames/fr_t_vent_displ_vent.htm

EQ Credit 3.1: Construction IAQ Management Plan, During Construction

This credit revolves around successful development and implementation of an Indoor Air Quality (IAQ) Management Plan by the general contractor, as outlined in the SMACNA Guidelines for Occupied Buildings Under Construction. Requirements include five control measures that must be documented on three *different* occasions during building construction. These measures, taken by the contractor, help prevent construction activities from negatively affecting the indoor air quality, both during construction and once the building is occupied. Finally, the IAQ Plan should also address the use of MERV 8 filtration media during construction and the replacement thereof with MERV 13 filters prior to occupancy. If the project is also pursuing EQc3.2, the IAQ Plan will also call for either building flush-out or IAQ testing. Ideally, IAQ plan provisions will be cited in the project's specifications for subcontractors to reference as well. It is also a good idea for the general contractors to distribute the IAQ Plan to relevant subcontractors.

Recommendations:

- This credit may not be possible for residential projects with smaller air handling units, as small units may not be able to handle the required MERV 13 filters.
- Mechanical engineers have pointed out that the installation of high efficiency filters may increase fan energy and, therefore, can detract from overall building energy efficiency. The project team should evaluate this credit early in the design process.

Helpful Hints:

- Pictures! Pictures! Pictures! Assign the responsible party for documenting how the project is following the five SMACNA approaches early in construction. As LEED requires these photos from three different occasions in the project, it is not possible to take all of them at the end of the project. Captions of each SMACNA approach identified should be included.
- Creating the IAQ Plan before construction begins will ensure adequately addressing all SMACNA approaches. Specification language should be included where possible.

QUICK FACTS

Implementation: Strongly recommended.

Historical Data: 71% of Colorado LEED certified projects have successfully earned this credit.

US Department of Transportation
HVAC Protection During Construction
Courtesy: Opus Northwest

- The required control measures are generally standard construction practices in such facilities as hospitals or laboratories where high indoor environmental air quality is important.

Examples:

- To earn LEED credit, the Belmar Block 2 development project provided an excerpt from the Tenant Criteria Manual documenting specific guidelines for tenant construction IAQ management consistent with the documented core and shell build-out performance.
- On the Tutt Science Center at Colorado College, the mechanical system was not used during construction. MERV 8 filters were not required but installation of MERV 13 filters were required prior to occupancy to earn credit.

Resources:

Referenced Standard: Sheet Metal and Air Conditioning National Contractors Association (SMACNA) IAQ Guideline for Occupied Buildings under Construction, 1995, Chapter 3
Website: www.smacna.org

Chelsea Group, Ltd.
LEED- Maintaining Indoor Air Quality During Construction
Highlights solutions to achieve EQc3
Website: 66.155.72.72/newsletter/BDXLEED-Maintaining%20Indoor%20Air%20Quality%20During%20Construction.pdf

Resource Venture
Construction IAQ for LEED 2.1 in Seattle
Includes resources, cost, guidelines and practices required to achieve the credit. Applicable to all locations, not just Seattle.
Website: www.resourceventure.org/rv/publications/building/LEED-IAQ.pdf

EQ Credit 3.2: Construction IAQ Management Plan, Before Occupancy

This credit can be earned independently of EQc3.1 and requires either conducting a building flush-out, post-construction and prior to occupancy, or contracting an independent Indoor Air Quality Test. Note that performing a two-week building flush-out grants award of the LEED credit, but adds two weeks to the construction schedule. Performing an Indoor Air Quality Test adds a day to the construction schedule, but earns LEED credit *only* if test results demonstrate that the air quality passes the required standard.

Recommendations:

- If the flush-out option is chosen, revise the construction project schedule to include the appropriate two-week milestones.
- If IAQ testing is chosen, determine if the associated cost will be a contractor's or owner's contingency.

Helpful Hints:

- Some projects include both flush-out and testing options in the specifications and allow the construction schedule to dictate whether the two-week building flush-out is feasible. Alternatively, if the schedule does not permit, IAQ testing is already in the project budget.
- New MERV 13 filtration equipment must be installed prior to and after the flush-out.
- It is possible to stage the flushing of a building if areas are separated physically and the mechanical systems can operate separately. Once the area has been flushed out, however, it is necessary to maintain separation from areas under construction per SMACNA Guidelines for Occupied Buildings.
- If IAQ testing is chosen, quality control in the field will be more stringent due to strict LEED requirements about what can and cannot be present during testing (furniture, etc.). See the many CIRs that address this issue.
- If the flush-out procedure is performed the project team should carefully address the following issues:

QUICK FACTS

Implementation: Strongly recommended.

Historical Data: 71% of Colorado LEED certified projects have successfully earned this credit.

1. Allowable work during the flush-out period:
   - Punch-list items are part of construction and must be completed prior to building flush out.
   - Commissioning is not part of construction and, as long as the process of commissioning does not introduce any additional contaminants into the building, commissioning activities may occur during flush out.
   - Moving items into the building such as furniture may add a chemical sink to the interior of the building.
   - Occupant training and installation of security systems etc. is acceptable during flush-out.
   - "LEED-NC prefers, but does not require, the flush to occur before furniture installation." (CIR 3/17/05)
2. Owner move-in times and dates must take place after the flush-out.

Example:

- A large majority, if not all, LEED certified projects in Colorado that have achieved this credit have done so by performing the two week building flush-out rather than performing the IAQ testing.

EQ Credit 4: Low-Emitting Materials

EQ credits 4.1 through 4.4 target the primary source of contaminants that contribute to poor indoor air quality in a building. The goal is to reduce or eliminate the introduction of harmful chemicals through the proper selection of building materials on the project, by minimizing volatile organic compounds (VOCs). With the exception of EQc4.4, these credits can all be achieved at no additional cost. In recent years, material suppliers and manufacturers have become particularly savvy to LEED requirements and the documentation required to identify low-VOC products is readily available. Note that EQ credits 4.1-4.4 are applicable to interior materials only. The USGBC defines interior products as "products inside the exterior moisture protection." Furniture, fit-out, equipment, exterior paints, or any shop-applied or finish applied off-site prior to installation are not subject to credit requirements.

General Recommendations:

- Since these credits pertain to multiple building materials, it is critical that compliance is specified in the project specifications. Ideally, the material specification requirements will be repeated in each applicable division so that the subcontractors who only read their relevant section will still be made aware of the requirements.
- The general contractor should review all relevant product submittals and oversee all subcontractor activities on-site to avoid mistaken non-compliant product substitutions.
- Document, document, document! Several LEED document submittals have been delayed because of difficulty getting documentation from the contractor. It is much more difficult to go back and dig up records after the project is built than at the time of construction submittals.

Helpful Hints:

- In general, these credits require 100 percent compliance. However, an alternative compliance path is available, if necessary. A project can complete a "VOC Budget", if use of a *minimal* amount of a high-VOC product is unavoidable. This calculation procedure demonstrates the project's actual overall VOC level for paints *or* adhesives is less than the permissible total threshold for low-VOC products on the project. This may be necessary if the USGBC rules a paint or adhesive non-compliant during their preliminary review.
- Consider potential Innovation in Design credits relating to low-emitting materials such as:
    1. Low-VOC interior furnishings.
    2. Exterior paints and stains.
- The USGBC has not clearly specified a minimum requirement regarding product quantity for these credits. Thus, a project could potentially request LEED credit EQc4.3 for using one square foot of low-admitting carpet in a building with all concrete floors. It is up to the project team to be reasonable in their application for these credits.

Resources:

Scientific Certification Systems, Inc.
Scientific Certification Systems, Inc. has released an Indoor Air Quality Performance certification program for interior products. The program is designed to demonstrate product conformance with the indoor emissions limits associated with California's Section 01350 specification, as well as emission criteria in the LEED Rating System and international standards for environmental labeling.
Website: www.scscertified.com/iaq/

GreenGuard Environmental Institute
Product Guide
Provides a searchable database for low-emitting materials
Website:
www.greenguard.org/DesktopDefault.aspx?tabid=12

California High Performance Schools (CHPS)
CHPS has drafted a "compliant materials table" that lists materials that have low VOC values. This table can be used as a resource to find many material manufacturers from adhesives to building insulation.
Website: www.chps.net/manual/lem_table.htm

EQ Credit 4.1: Low-Emitting Materials, Adhesives & Sealants

See EQ Credit 4 for general information on the Low-Emitting Materials credits.

Recommendation:

- This credit is not difficult, but does require diligent documentation by the general contractor.

Helpful Hints:

- This credit applies to Divisions 2-16. Don't forget about plumbing, HVAC (duct sealants) and fire caulking when tracking for this credit.
- Some industrial-grade adhesives and sealants are difficult to find with low VOCs.

Examples:

- The USGBC questioned two products in the preliminary review of Fossil Ridge High School adhesives and sealant submittal, but the project team was able to provide additional information demonstrating the materials were specialty coatings that complied with applicable VOC standards.
- The Belmar Block 2 development project provided an excerpt from the tenant guidelines outlining the recommendations are consistent with building core and shell performance.
- Colorado Department of Labor & Employment employees were pleasantly surprised that the new addition had 'no new building smell', due to the attention to low-VOC adhesives, paints and carpets.

Resources:

Adhesives Referenced Standard: VOC limits of South Coast Air Quality Management District Rule #1168
Website:
www.aqmd.gov/rules/reg/reg11/r1168.pdf

Sealants Referenced Standard: Bay Area Air Quality Management District Reg. 8, Rule 51
Website:
www.baaqmd.gov/dst/regulations/rg0851.pdf

QUICK FACTS

Implementation: Strongly recommended.

Historical Data: 100 % of Colorado LEED certified projects have successfully earned this credit.

Colorado Springs Utilities Laboratory
Protects air quality in the laboratory atmosphere, and achieved all four low-emitting materials credits.
Courtesy: Ed LaCasse Photography

EQ Credit 4.2: Low-Emitting Materials, Paints

See EQ Credit 4 for general information on the Low-Emitting Materials credits.

Recommendation:
- This credit is not difficult, but does require diligent documentation by the general contractor.

Helpful Hints:
- The LEED requirements apply only to opaque top-coat, interior paints. Stains and transparent finishes are outside of the LEED scope.
- Interior materials that are painted off-site do not count for this credit; however, even materials painted off-site are recommended to be low-VOC compliant, especially if IAQ testing is planned (EQc3.2).
- Some industrial-grade paints are difficult to find with low VOCs.
- Low-VOC black paint, although becoming more available, is particularly hard to find. In this instance, consider the use of black dry-fall, a spray application that dries to a dust before reaching the floor.

Examples:
- Belmar Block 2 prepared a VOC budget when the preliminary USGBC review initially rejected the credit stating that one paint did not meet the standard. Because the non-compliant paint was used on a small area, the "VOC Budget" demonstrated compliance and the project was awarded the point.

QUICK FACTS

Implementation: Strongly recommended.

Historical Data: 79% of Colorado LEED certified projects have successfully earned this credit.

Boulder Community Foothills Hospital
Low-VOC interior paints contribute to superior indoor air quality to promote health
Courtesy: Boulder Associates, Inc.

Resources:

Green Seal
Provides product standards and certification for paints and coatings.
Website:
www.greenseal.org/certproducts.htm#paints

Toolbase Services
Low or No VOC Paints
Includes benefits, costs, and resources.
Website:
www.toolbase.org/tertiaryT.asp?TrackID=&CategoryID=1312&DocumentID=2174

EQ Credit 4.3: Low-Emitting Materials, Carpet

See EQ Credit 4 for general information on the Low-Emitting Materials credits.

Recommendation:

- While this credit requires diligent documentation from the contractor, it is one of the most easily achievable of all the LEED credits, due to the market availability of low-emitting carpets.

Helpful Hints:

- This credit will have synergies with EQc4.1 (adhesives & sealants) for carpet adhesive.
- Don't forget, this credit applies to the entire carpet system - carpet fiber, carpet backing and the carpet padding. Manufacturer's documentation can be misleading; make sure the entire carpet system will meet the Carpet and Rug Institute's standards required by this credit.

Resources:

Building Green
Article: *Carpeting, Indoor Air Quality & The Environment*
Website:
www.buildinggreen.com/features/crpt/carpets.cfm

Carpet and Rug Institute (CRI)
Certifies products that meet or exceed the CRI's Indoor Air Quality Testing requirements.
Website: www.carpet-rug.org/index.cfm#

QUICK FACTS

Implementation: Strongly recommended.

Historical Data: 100% of Colorado LEED certified projects have successfully earned this credit.

CH2M HILL
Low-VOC carpet minimizes air pollutants
Courtesy: CH2M HILL

EQ Credit 4.4: Low-Emitting Materials, Composite Wood

See EQ Credit 4 for general information on the Low-Emitting Materials credits.

Recommendations:

- While many Front Range suppliers can provide urea-formaldehyde free composite wood at no extra cost, high demands have created long lead times for this type of wood, in some cases. Confirm this credit and the scope early in project design so long lead times will not hinder the construction schedule.
- This credit can be forfeited late in construction by a careless on-site substitution of non-compliant composite wood products. Subcontractors should be made aware that all last minute runs to the lumber yard are subject to the same urea-formaldehyde free requirements as the rest of the project.

Helpful Hints:

- Plywood, particleboard, OSB, MDF, strawboard, wheatboard, and similar products are all composite wood and agrifiber products subject to the credit requirements. Note that composite wood components used in assemblies are also controlled. Don't forget the following composite wood products:

  - Door cores
  - Telephone backerboard
  - Millwork
  - Backing on wall pads in gymnasiums
  - Plywood sections of I-beams

Examples:

- Aspen Skiing Company's Snowmass Golf Clubhouse used formaldehyde-free strawboard cabinets.
- Boulder Community Foothills Hospital and Colorado Department of Labor & Employment, both initially pursued this credit. In both cases, the projects were unsuccessful because the encased particleboard core of the "solid core" wood doors used was not urea formaldehyde-free.

QUICK FACTS

Implementation: Recommended.

Historical Data: 29% of Colorado LEED certified projects have successfully earned this credit.

Snowmass Golf Clubhouse
Courtesy: Aspen Skiing Company

Resources:

Advanced Buildings Technologies and Practices
Formaldehyde-Free MDF
This fact sheet gives a brief description of formaldehyde-free MDF including, applications, cost and example manufacturers with contact information.
Website:
www.advancedbuildings.org/main_t_finishes_formaldehyde.htm

EQ Credit 5: Indoor Chemical & Pollutant Source Control

This credit intends to minimize occupant exposure to indoor air pollutants, including particulate matter entering the building from foot traffic at entryways, liquid chemical waste and chemical use from copy rooms and janitorial/housekeeping rooms. These three pollutant sources are mitigated through use of permanent entry mats, full-height walls and separate outside exhaust at copy and janitor rooms, and proper plumbing for disposal of liquid chemical waste.

Recommendations:

- Identify possible pollution sources related to this credit early in design. This will help to prevent expensive change orders for exhaust fans, pocket doors or other elements needed to revise the building design to meet the credit requirements.
- Call out walk-off mats and label relevant drains and deck-to-deck partitions on project drawings.

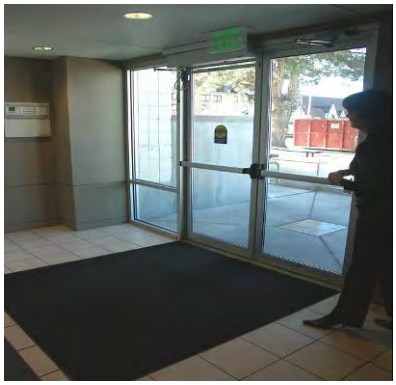
Helpful Hints:

- Credit requirements are readily included in the project design and most codes include requirements for plumbing where chemical use occurs.
- Residential or dormitory units with separate, exterior entrances must have permanent entry mats. However, if the units share one exterior entrance, only central entry walk-off mats will be required. According to the USGBC, "any door that is intended to be used regularly and frequently by building occupants should be considered high volume for the purposes of this credit."
- Small, low-volume copiers are not considered pollutant sources and do not require full height partition walls under this credit. The USGBC leaves the definition of a convenience copier or printer to the discretion of the design team, but states that they are generally the smaller printers and copiers shared by many office personnel for short print and copy jobs. Include a narrative in the LEED submittal describing the use and location of these low-volume copiers and why they are exempt from the LEED requirements.

QUICK FACTS

Implementation: Strongly recommended.

Historical Data: 79% of Colorado LEED certified projects have successfully earned this credit.



Colorado Dept. of Labor & Employment
Inset interior walk-off mats minimize the introduction of outdoor pollutants at entryways
Courtesy: Colorado Department of Labor & Employment

Example:

- Fossil Ridge High School successfully earned this credit by providing documentation indicating the location of installed entryway walk-off mats, room separations and required ventilation supported by annotated building plans, cut sheets, contractor submittals and mechanical details.

Resources:

Colorado Department of Public Health & Environment, Indoor Air Quality
Lists local IAQ consultants and resources.
Website: www.cdphe.state.co.us/ap/IAQhom.asp

California, Division of the State Architect
Article: *Sustainable Schools- Indoor Environmental Quality*
Website:
www.sustainableschools.dgs.ca.gov/SustainableSchools/sustainabledesign/ieq/iaq/pollutantsourcecontrol.html

EQ Credit 6.1: Controllability of Systems, Perimeter

Two systems must be provided to achieve this credit: operable windows and lighting controls for all regularly occupied, perimeter spaces. Providing the sufficient number of operable windows is generally the more difficult (and expensive) design challenge. Designs that include enclosed perimeter offices typically provide sufficient lighting controls to meet the credit based on the square footage of the layout. In designs with open offices or other multi-occupant settings (gymnasiums, classrooms etc.), LEED requires a group multi-occupant space calculation be performed. In such cases, it is generally possible to meet the lighting control requirements through proper design of on/off switches, occupancy sensors, daylight sensors, etc. The number of operable windows required, however, is always based on square footage requirements regardless of the distribution of occupants within the occupied spaces (approximately one window every 13 linear feet along the perimeter.) Although the majority of building occupants consider operable windows highly desirable, operable windows are not common design practice in commercial buildings. Reasons include security, safety, maintenance and mechanical system stability.

Recommendations:

- Consider and discuss operable windows early in design to determine if they are an appropriate and viable design option for the project type.
- Reference the group multi-occupant calculation methodology in the LEED Reference Guide to determine required number of lighting controls for rooms such as conference rooms, open office area, etc.
- Review drawings carefully as the design develops to ensure the required number of operable windows and lighting controls are provided and documented.

Helpful Hints*:*

- For the purposes of this credit, the USGBC defines "regularly occupied" as: if in the course of a regular daily experience users could be expected to find themselves in the space. However, support areas for copying, storage, mechanical equipment, laundry, and restrooms should be excluded from the calculation.

QUICK FACTS

Implementation: Worth considering.

Historical Data: 14% of Colorado LEED certified projects have successfully earned this credit.

Colorado College Tutt Science Center
Courtesy: Colorado College

- If 75 percent or more of a room is within 15 feet of the perimeter wall, the area of the entire room should be classified as perimeter area.
- Lighting controls in residences are generally considered to be individually controlled and meet the intent of this credit.
- Task lighting may be applied to this credit (as an additional lighting control), only if it is hardwired.
- LEED does not exempt laboratory or retail spaces from the operable window requirement. For such cases, transom windows may be an option.

Examples:

- The Tutt Science Center and Snowmass Golf Clubhouse are the only certified projects to date that have achieved this credit in Colorado.
- Although Boulder Community Foothills Hospital did not attempt this credit, operable windows equipped with contact switches connected to the room's VAV box were installed in each patient room. This allowed the mechanical system to damper down to a minimum supply in spaces where the windows were open.

Resources:

The Center for the Built Environment (CBE)
The CBE at the University of California, Berkeley is a National Science Foundation Industry/University Cooperative Research Center. This website includes extensive research on occupant indoor environmental quality issues including operable window studies.
Website: www.cbe.berkeley.edu/

American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)
ASHRAE has many articles publications with regard to occupant comfort and individually controlled spaces. (Search for "occupant comfort", "controllability", "individual control")
Website: www.ashrae.org

U.S. Department of Energy
Article: *Health and Productivity Gains from Better Indoor Environments and Their Implications for the U.S. Department of Energy*, Summarizes numerous studies that show productivity increases due to improved indoor environments. (2000)
Website: eetd.lbl.gov/IED/viaq/pubs/LBNL-47458.pdf

See Appendix D for additional resources on the benefits of high performance design.

Starting a new LEED-NC project?
All new LEED-NC projects will register under version 2.2 (as of January 2006). Refer to the USGBC for complete information about version 2.2. Also, see Appendix C of this Guide for a quick overview of the changes from version 2.1 to 2.2.

EQ Credit 6.2: Controllability of Systems, Non-Perimeter

Three systems must be provided in all regularly occupied non-perimeter spaces to earn this credit: temperature controls, airflow controls and lighting controls. The number of controls required to earn credit is not based on square footage. Instead, the requirements are all based on providing controls for 50 percent (one out of two people) of the occupants in each interior space. Interior spaces are defined as spaces that are at least 15 feet from the outer wall of the building. Providing the required number of lighting controls is typically not an issue. Occupancy sensors, daylighting controls, dimming switches and manual automatic on/off switches can all be counted as two lighting controls and the group multi-occupant calculation methodology applies (see LEED Reference Guide). The lighting designer or electrical engineer should perform preliminary calculations early in the design to confirm the credit requirements are being met.

The focus for this credit is generally on airflow and temperature controls. Depending on the type of system, this credit might be easily achieved. For example, in an office building with interior offices and a VAV distribution system, this credit is achieved by providing one VAV box for every two offices. However, this credit may be costly or increase energy use if additional mechanical zones and associated air distribution units are added merely to attain the credit. (This credit frequently requires multi-zones in multi-occupant spaces.) In some cases, the same device may provide temperature and airflow controls. For example, an adjustable underfloor air diffuser or a thermostat controlling a VAV box may be considered both a temperature and airflow control. As with the lighting controls, the mechanical engineer should perform preliminary calculations to determine if the number of airflow and temperature controls will meet the credit requirements.

Recommendations:

- Review credit requirements and do preliminary calculations to determine if the design is meeting the requirements or if temperature, airflow and lighting controls need to be added to achieve the credit.

QUICK FACTS

Implementation: Worth considering.

Historical Data: 0% of Colorado LEED certified projects have successfully earned this credit.

- Review drawings early in design to ensure they show the appropriate number of temperature, airflow and lighting controls.

Helpful Hints*:*

- Reference the group multi-occupant calculation methodology in the LEED Reference Guide for rooms such as conference rooms, open office area, etc.
- The control strategies can't rely on average temperature inputs, individual temperature control must be provided.
- Check CIRs if there are questions regarding a certain control device serving as both a temperature and airflow control.

Examples:

- North Boulder Recreation Center attempted to achieve this credit. Preliminary review stated that sufficient controls must be provided for 50 percent of the occupants themselves, not 50 percent of occupied spaces. Final review showed that the required ratio of 1:1:2 for terminal box to controller to occupant was not achieved.

EQ Credit 7.1: Thermal Comfort, Comply with ASHRAE 55-1992

This credit promotes optimal occupant comfort through temperature and humidity control. For mechanically ventilated space, EQc7.1 requires meeting the ASHRAE Standard 55-1992 for thermal comfort standards, and for naturally ventilated spaces the project must comply with the 90 percent acceptability limits of the adaptive comfort temperature boundaries in the Collaborative for High Performance Schools (CHPS).

LEED recently adopted the ASHRAE 55-2004 standard, which eliminates the lower humidity limit. This has significant implications for projects in Colorado's dry climate, since it eliminates the need to install humidification systems to meet the requirement.

Recommendation:

- Since humidification is no longer required by ASHRAE in Colorado's dry climate, most standard mechanical designs now meet the requirements of this credit.
- Engineers should confirm that the project meets the minimum requirements of ASHRAE 55-1992 upfront and early in design.

Helpful Hints:

- Psychometric analysis or output from a building energy model can be used to demonstrate that a building meets ASHRAE Standard 55 for 98 percent of the time that the building is occupied.
- An example of information sufficient to demonstrate compliance includes:
    a. Initial Design Criteria - Outdoor Ambient Design Conditions and Indoor Design Conditions.
    b. Initial assumptions for thermal comfort with regard to climate, activity level, clothing, etc. per referenced ASHRAE 55 standard.
    c. Air movement ranges for each air handler.

QUICK FACTS

Implementation: Strongly recommended.

Historical Data: 71% of Colorado LEED certified projects have successfully earned this credit.

University of Denver Ricketson Law Building
Courtesy: H+L Architecture

Examples:

- Several projects in Colorado successfully earned this credit by providing the following documentation for their project: a LEED Letter Template declaring that the project has been designed to maintain indoor comfort within ranges established in ASHRAE Standard 55-1992, Addenda 1995, a table listing control ranges and installed control methods, and psychometric analysis charts.

Resources:

Referenced Standard: ASHRAE 55-1992: Thermal Environmental Conditions for Human Occupancy
ASHRAE 55-1992, Addenda 1995 is the energy standard referenced by the LEED-NC v2.1 Reference Guide.
Website: www.ashrae.org

Referenced Standard: California High Performance Schools (CHPS) Best Practices Manual, Appendix C – A Field Based Thermal Comfort Standard for Naturally Ventilated Buildings, Figure 2.
Website: www.chps.net

USGBC
The USGBC has accepted ASHRAE Standard 55-2004 as an alternative compliance Referenced Standard in a Credit Interpretation Ruling dated 9/8/2004. In Colorado and other arid regions, this is advantageous because the new ASHRAE standard does not give a recommended lower humidity limit.
Website: www.usgbc.org/

Whole Building Design Guide
The whole building design guide is a comprehensive resource for the building industry. It includes cost studies, design guidance, references, case studies and much more.
Website: www.wbdg.org/

EQ Credit 7.2: Thermal Comfort, Permanent Monitoring System

While the previous credit requires that thermal comfort be maintained, this credit requires that temperature and humidity conditions be monitored and controlled through a permanently installed monitoring system. Like EQc7.1, this credit has become more readily achievable since humidification is no longer required for projects in Colorado.

Recommendations:

- Temperature and humidity monitoring and control system design is largely left to the discretion of the mechanical engineer and commissioning agent. Evaluate EQc7.1 and EQc7.2 early in the design process to establish credit viability.
- Projects have successfully designed adequate monitoring and control systems based on the mechanical engineer's and commissioning agent's recommendations. Documentation should include a narrative describing how the measurement points and operator interface, as designed, comply with the credit requirements.

Helpful Hints:

- In general, the project needs to demonstrate that humidity is controlled, or demonstrate through modeling/analysis that humidity control will not be necessary to maintain comfort.
- Monitoring systems (thermostats and humidistats) are required regardless of whether humidification/dehumidification control systems are required. However, humidity sensors can be used in place of humidistats if humidification control systems are not provided.
- Monitoring systems are required to be tested as part of the EAp1 Fundamental Building Systems Commissioning scope of work.

Example:

- North Boulder Recreation Center achieved this credit using a system that connected temperature and humidity sensors to the buildings Direct Digital Control (DDC) system.

QUICK FACTS

Implementation: Worth considering.

Historical Data: 36% of Colorado LEED certified projects have successfully earned this credit.

EQ Credit 8.1: Daylight & Views, Daylight 75% of Spaces

EQ Credits 8.1 and 8.2 examine the availability of daylight and access to views in the building. EQc8.1 requires 75 percent of the regularly occupied spaces achieve a minimum two percent Daylight Factor. The Daylight Factor is defined as the ratio of interior horizontal illuminance to exterior horizontal illuminance. This credit can be documented with the use of daylight modeling software or equations (and spreadsheets) supplied by the USGBC. Colorado's sunny climate offers many excellent opportunities for aggressive daylight harvesting, making this an attractive credit to pursue for nearly all types of projects.

Recommendation:

- Use of effective solar control strategies (overhangs) and high performance glazings are highly recommended to limit associated solar gains. Achieving the daylight credit is likely to contribute to increased energy savings in the Energy and Atmosphere credits. This is largely due to savings in the electrical lighting that result from well daylit spaces.

Helpful Hints:

- The USGBC calculation methods (requiring a two percent Daylight Factor) can require prohibitively high interior illuminance levels in climates with high exterior illuminance levels, like Colorado. The USGBC has ruled that if computer modeling can demonstrate that 25 horizontal footcandles are provided under clear sky conditions, at noon, on the equinox, at 30 inches above the floor, the credit is achieved. This alternative calculation method makes the credit considerably more accessible.
- EQc8.1 excludes spaces where tasks would be hindered by the use of daylight, e.g., photography dark rooms and x-ray viewing rooms.
- Daylight glazing (above 7'-6") offers the most benefit for harvesting daylight deeper into the space (although they do not count towards EQc8.2).
- This credit may have synergies with the lighting control strategies required in EQc6.1 and EQc6.2.

QUICK FACTS

Implementation: Worth considering.

Historical Data: 14% of Colorado LEED certified projects have successfully earned this credit.

Fossil Ridge High School Media Center
Courtesy: RB+B Architects

Examples:

- Although Fossil Ridge High School is very well daylit, the project did not achieve this credit because it did not have a 2 percent Daylight Factor. While the credit was not achieved, the careful daylighting design of the high school provides a pleasant atmosphere, much of the energy savings for the building, and an environment designed to promote learning.
- Projects that have achieved this credit in the past have successfully delineated spaces where daylight would hinder required tasks, therefore exempting the spaces from the calculation.

Resources:

Collaborative for High Performance Schools (CHPS)
CHPS provides an array of free resources for school districts and designers, including best practices manuals, fact sheets on daylighting and other strategies, and a list of low-emitting materials.
Website: www.chps.net

Lawrence Berkley Laboratories
Daylight in Buildings: A Source Book on Daylighting Systems and Components Lawrence Berkley Laboratories, A report of IEA SHC Task 21/ ECBCS Annex 29 (July 2000)
Website: gaia.lbl.gov/iea21/ieadownload.htm

Heschong Mahone Group
Daylighting Productivity Studies
This firm has performed a variety of productivity studies measuring the impact of daylighting on retail sales and student performance. Test results showed students in rooms with daylighting learned quicker than those in non-daylit rooms. Poudre School District was one of the districts included in this study.
Website: www.h-m-g.com/projects/daylighting/projects-PIER.htm

Daylight Dividends
A collaboration of the U.S. Department of Energy, Lighting Research Center and others is working to document productivity improvements and other benefits of daylighting. Find a variety of case studies and research at this website, hosted by Rensselaer Polytechnic Institute
www.lrc.rpi.edu/programs/daylighting/index.asp

EQ Credit 8.2: Daylight & Views, Views for 90% of Spaces

This credit requires 90 percent of regularly occupied spaces achieve a direct line of sight to vision glazing. Vision glazing, as defined by the USGBC, includes windows located between 2'-6" and 7'-6" above the floor. Therefore, skylights or clerestory windows cannot be included in the calculations. Building orientation and floor plate size and layout should all be considered to improve access to daylight and views. For example, a square building with a large floor plate may have difficulty achieving either of the daylight credits because of the distance between core building spaces to the perimeter glazing. A long, narrow building makes it easier to situate regularly occupied spaces adjacent to the perimeter. It is beneficial to locate spaces with open layouts (i.e. open offices) near the perimeter, and circulation and support spaces near the core to help deliver daylight and views to the spaces that benefit from it most.

Recommendation:

- The views credit is achievable with simple yet important design decisions made early in the project, such as footprint shape and space layout. A building that provides sufficient views to the outside will maintain healthier and happier building occupants.

Helpful Hints:

- Design the building floorplate so that as many regularly occupied spaces as possible are located near the perimeter, with access to glazing. Open offices should be located at the perimeter with enclosed spaces and support areas near the building core.
- Glazing should be shaded appropriately to control solar heat gains in Colorado's sunny climate.
- Include interior transom glazing to add views to enclosed spaces away from the perimeter of the building.

Examples:

- North Boulder Recreation Center was able to earn this credit by adding a view window in the large gymnasium space.
- The GSA Department of Transportation project was able to provide views to the exterior from 91 percent of the regularly occupied interior spaces.

QUICK FACTS

Implementation: Strongly recommended.

Historical Data: 57% of Colorado LEED certified projects have successfully earned this credit.

US Department of Transportation
Courtesy: Opus Northwest

Colorado Department of Labor & Employment
Courtesy: Colorado Department of Labor & Employment

- In the Colorado Department of Labor & Employment addition, unemployment claims call center staff work areas were positioned near windows. This provides mountain and city views for employees who are on the telephone most of the day.

Innovation and Design Process

The Innovation and Design Process section rewards projects that exemplify sustainable strategies and building practices that are not fully embodied in existing LEED credit requirements. Exemplary performance can be demonstrated in two different ways: by reaching a new credit threshold (in most cases, by doubling the existing threshold) or through the implementation of sustainable design approaches outside those defined by the LEED-NC scope.

Colorado Springs Utilities Laboratory
applied Labs21 environmental performance criteria
to achieve an Innovation in Design credit
Courtesy: Ed Lacasse Photography

ID Credits 1.1 to 1.4: Innovation in Design

LEED provides four "wild card" credits where it is up to the project team to identify the intent of the proposed credit, define the requirements for compliance and documentation, and demonstrate that the project's design approach meets the credit requirements as defined.

Recommendations:

- Many credit interpretations (CIRs) exist regarding Innovation in Design (ID) credits. It is best to thoroughly research these CIRs and learn from past successes in order to glean valuable ideas and identify effective strategies for earning ID credits.
- Although it is best not to waste the USGBC reviewer's time with frivolous credit attempts, it is highly recommended to pursue these credits. Achievement of these credits can distinguish a project from other LEED projects and showcase its sustainable features.

Helpful Hints:

- A project can apply for a maximum of four ID credits at one time. However, a project can substitute replacement ID credits, if a proposed ID credit is denied during the preliminary review process. This, in effect, provides a project with eight chances to achieve four additional credits.
- Since the intent of ID credits is to promote innovation, the USGBC has become stricter in their acceptance of proposed innovations over time. For example, many projects earned ID credit for educational outreach programs. To earn credit, early LEED projects needed only to effectively inform the public of the building's participation in the LEED program. Recently, however, the USGBC has begun to require projects provide specific and extensive educational policies and procedures to be eligible to earn credit.
- Adopt a credit from another LEED product such as LEED-CI or LEED-EB that is not a credit under LEED-NC.

QUICK FACTS

Implementation: Strongly recommended.

Historical Data: Colorado projects have, on average, earned *three of the four* available Innovation in Design credits.

Colorado Department of Labor & Employment earned an innovation credit for green housekeeping, which includes an environmentally-preferred product purchasing policy and cleaning procedures.
Courtesy: Colorado Department of Labor & Employment

- The USGBC has defined acceptable exceedence thresholds for many existing credits (See the USGBC website). If a project exceeds the established threshold, it is assured award of LEED ID credit. A maximum of four ID credits can be awarded to a project, regardless of the number of exceedences achieved.
- Generally, if a credit has several components or related requirements (i.e. SSc4.1-4.4), the project team must demonstrate superior performance in all related areas to be awarded an ID credit.
- To be consistent with other LEED credits, the USGBC tries to adhere to the principle that all proposed ID credits have to be achieved through action rather than inaction.
- Other than reaching the established exceedences, there is no guaranteed way to earn an ID credit. Ultimately every ID credit is up to the discretion of the USGBC reviewer.

Examples:
The following is a list of some strategies that Colorado projects have successfully used to earn ID credits:

- Green housekeeping
- Low-emitting furniture systems
- Applying Labs21 Criteria
- Environmentally preferable services
- Sustainability education
- Exemplary encouragement of alternative transportation
- Radon mitigation
- Donation and protection of open space
- Exceeding established exceedence thresholds or demonstrating exceptional performance within the following established LEED categories:
  - SSc4 Alternative Transportation
  - SSc7.1 Reduce Heat Islands, Non-Roof
  - WEc3 Water Use Reduction
  - EAc6 Green Power
  - MRc4 Recycled Content
  - MRc5.1 Locally Manufactured
  - MRc5.2 Regionally Extracted

See the USGBC website, CIRs, or contact individual project teams for additional information.

Resources:

USGBC
Refer to the rating systems for other products, such as LEED-EB, LEED-CI or others for ideas for innovation credits.
Website: www.usgbc.org/leed

Labs21: Labs for the 21st Century
Began by the U.S. EPA and DOE, Labs21 is a voluntary partnership program dedicated to improving the environmental performance of U.S. laboratories.
Website: www.labs21century.gov

CH2M HILL's procurement of Herman Miller furniture systems earned an Innovation credit for the notable environmental attributes of the furniture, including use of recycled materials and recyclability. In addition, much of the furniture was delivered in reusable blanket wraps to reduce packaging materials.
Courtesy: CH2M HILL

CH2M HILL earned an innovation credit for its T-Rex Tamer website for employees and others in the area. The site promotes carpooling, bicycling, and alternative transportation, and provides information to help reduce or avoid traffic congestion.
Courtesy: CH2M HILL

ID Credit 2: LEED Accredited Professional

Project teams can achieve one credit for having a LEED Accredited individual on the project team.

Recommendation:

- With the growing number of LEED Accredited Professionals, plan on achieving this credit by including at least one LEED AP on your project team.

QUICK FACTS

Implementation: Strongly recommended.

Historical Data: 100% of Colorado LEED certified projects have successfully earned this credit.

Resources:

USGBC
Refer to the USGBC website for the LEED AP Directory.
Website: www.usgbc.org/leed

USGBC Colorado Chapter
The Colorado Chapter of the USGBC provides resources such as guidance on how to choose LEED consultants, as well as a chapter member directory.
Website: www.usgbc.org/Chapters/colorado

Governor's Office of Energy Management & Conservation (OEMC)
Rebuild Colorado Business Partners
In some cases, a project team needs a person or company that has LEED accreditation that also performs other tasks such as energy modeling, daylighting analysis, or energy design assistance. This directory includes contact information for energy efficiency consultants that serve Colorado (who are not necessarily LEED accredited).
Website:
www.colorado.gov/rebuildco/partners/business.htm

Appendices

A: Credits Achieved for Colorado LEED-NC Version 2 Certified Projects
B: Colorado LEED Certified Projects at a Glance
C: What's New in 2.2?
D: Cost and Benefits of Green Building
E: Sources for Case Studies
F: Local Green Building & High Performance Design Associations
G: Funding Sources for Green Building
H: General Green Building Resources

Colorado Department of Labor & Employment Addition
First state-owned building in Colorado to earn LEED-NC certification
Courtesy: Frank Ooms Photography

Appendix A: Credits Achieved for Colorado LEED-NC Version 2 Certified Projects

This appendix lists the credits achieved for the projects included in the **Historical Data** factor in the **Quick Facts** box for each credit. The projects included are those projects that were listed on the USGBC website as LEED-NC version 2 certified as of December 2005. The information was compiled by *Rebuild Colorado* from the USGBC website. Refer to the website at www.usgbc.org/leed for more information.

For additional information about LEED certified projects in Colorado (including updates of this list, contact names and links to case studies), see:

Rebuild Colorado High Performance Design
Governor's Office of Energy Management & Conservation
www.colorado.gov/rebuildco/services/highperformance/index.htm

USGBC Colorado Chapter
www.usgbc.org/chapters/colorado

Credits Achieved for Colorado LEED-NC Version 2 Certified Projects (as of December 2005)

			Aspen Skiing Company Snowmass Golf Clubhouse	Belmar, Building 2M3	Boulder, City of North Boulder Recreation Center	Boulder Community Foothills Hospital	CH2M Hill North Building	CH2M Hill South Building	CH2M Hill West Building	Colorado College Russell T. Tutt Science Center	Colorado, State of Department of Labor and Employment	Colorado Springs Utilities Laboratory	Pikes Peak Regional Development Center	Poudre School District Fossil Ridge High School	University of Denver Ricketson Law Building	US Department of Transportation	*Percent of Projects Achieving this Point*
	Level achieved Certified 26-32 points, Silver 33-38 points, Gold 39-51 points, Platinum 52 or more		SILVER	SILVER	SILVER	SILVER	LEED	LEED	LEED	LEED	LEED	SILVER	SILVER	SILVER	GOLD	SILVER	
	Date certified		2/2/05	8/10/05	3/4/03	12/3/03	6/22/04	5/13/03	1/4/04	3/10/05	8/1/05	5/23/05	11/28/05	7/12/05	6/12/05	10/11/04	
	Total points achieved (certified projects) or pursued (registered projects)		**34**	**34**	**33**	**33**	**26**	**27**	**26**	**26**	**28**	**34**	**38**	**36**	**39**	**35**	
LEED Credit	Credit Name	**LEED Points Possible**															
Sustainable Sites (14 Points Possible)			**5**	**8**	**8**	**7**	**4**	**5**	**4**	**5**	**6**	**4**	**9**	**7**	**8**	**8**	
SSp1	*Erosion & Sedimentation Control*	***Required***	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*	
SSc1	Site Selection	**1**		1	1		1	1	1	1	1		1		1	1	*71%*
SSc2	Urban Redevelopment	**1**		1							1						*14%*
SSc3	Brownfield Redevelopment	**1**		1													*7%*
SSc4.1	Alternative Transportation, Public Transportation Access	**1**	1	1	1	1		1		1	1		1		1	1	*71%*
SSc4.2	Alternative Transportation, Bicycle Storage & Changing Rms	**1**	1	1	1	1	1	1	1	1		1	1	1	1	1	*93%*
SSc4.3	Alternative Transportation, Alternative Fuel Refueling Stations	**1**			1								1		1	1	*29%*
SSc4.4	Alternative Transportation, Parking Capacity	**1**	1	1	1	1									1	1	*43%*
SSc5.1	Reduced Site Disturbance, Protect or Restore Open Space	**1**			1												*7%*
SSc5.2	Reduced Site Disturbance, Development Footprint	**1**	1			1	1	1	1	1		1	1	1		1	*71%*
SSc6.1	Stormwater Management, Rate or Quantity	**1**	1										1	1			*21%*
SSc6.2	Stormwater Management, Treatment	**1**				1	1	1	1			1	1	1	1		*57%*
SSc7.1	Landscape & Ext Design to Reduce Heat Islands, Non-Roof	**1**		1						1	1		1	1	1	1	*50%*
SSc7.2	Landscape & Ext Design to Reduce Heat Islands, Roof	**1**		1	1	1					1			1		1	*43%*
SSc8	Light Pollution Reduction	**1**			1	1					1	1	1	1	1		*50%*
Water Efficiency (5 Points Possible)			**3**	**1**	**1**	**1**	**3**	**3**	**3**	**0**	**1**	**4**	**3**	**1**	**4**	**1**	
WEc1.1	Water Efficient Landscaping, reduce by 50%	**1**	1		1	1	1	1	1			1	1	1	1	1	*79%*
WEc1.2	Water Efficient Landscaping, No Potable Use or No Irrigation	**1**					1	1	1			1			1		*36%*
WEc2	Innovative Wastewater Technologies	**1**															*0%*
WEc3.1	Water Use Reduction, 20% Reduction	**1**	1	1			1	1	1		1	1	1		1		*64%*
WEc3.2	Water Use Reduction, 30% Reduction	**1**	1									1	1		1		*29%*
Energy & Atmosphere (17 Points Possible)			**7**	**5**	**7**	**5**	**6**	**5**	**5**	**6**	**4**	**6**	**9**	**13**	**8**	**8**	
EAp1	*Fundamental Building Systems Commissioning*	***Required***	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*	
EAp2	*Minimum Energy Performance*	***Required***	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*	
EAp3	*CFC Reduction in HVAC&R Equipment*	***Required***	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*	
EAc1.1	Optimize Energy Performance, 20% New / 10% Existing	**2**	2	2	2	2	2	2	2	2	2	2	2	2	2	2	*100%*
EAc1.2	Optimize Energy Performance, 30% New / 20% Existing	**2**	2	1	2	2	1	1	1	1		2	2	2	2	2	*75%*
EAc1.3	Optimize Energy Performance, 40% New / 30% Existing	**2**			1							1	2	2	2		*29%*
EAc1.4	Optimize Energy Performance, 50% New / 40% Existing	**2**											1	2			*11%*
EAc1.5	Optimize Energy Performance, 60% New / 50% Existing	**2**												2			*7%*
EAc2.1	Renewable Energy, 5%	**1**															*0%*
EAc2.2	Renewable Energy, 10%	**1**															*0%*
EAc2.3	Renewable Energy, 20%	**1**															*0%*
EAc3	Additional Commissioning	**1**	1		1	1	1	1	1	1	1	1	1	1	1	1	*93%*
EAc4	Ozone Depletion	**1**	1	1						1			1			1	*36%*
EAc5	Measurement & Verification	**1**		1			1	1	1					1		1	*43%*
EAc6	Green Power	**1**	1		1		1			1	1			1	1	1	*57%*

Credits Achieved for Colorado LEED-NC Version 2 Certified Projects (as of December 2005)
(*continued*)

			Aspen Skiing Company Snowmass Golf Clubhouse	Belmar, Building 2M3	Boulder, City of North Boulder Recreation Center	Boulder Community Foothills Hospital	CH2M Hill North Building	CH2M Hill South Building	CH2M Hill West Building	Colorado College Russell T. Tutt Science Center	Colorado, State of Department of Labor and Employment	Colorado Springs Utilities Laboratory	Pikes Peak Regional Development Center	Poudre School District Fossil Ridge High School	University of Denver Ricketson Law Building	US Department of Transportation	*Percent of Projects Achieving this Point*
Materials & Resources (13 Points Possible)			3	5	6	5	5	5	5	2	5	5	5	5	5	6	
MRp1	*Storage & Collection of Recyclables*	***Required***	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*	
MRc1.1	Building Reuse, Maintain 75% of Existing Shell	**1**			1												*7%*
MRc1.2	Building Reuse, Maintain 100% of Shell	**1**															*0%*
MRc1.3	Building Reuse, Maintain 100% Shell & 50% Non-Shell	**1**															*0%*
MRc2.1	Construction Waste Management, Divert 50%	**1**		1	1	1	1	1	1		1	1	1	1	1	1	*86%*
MRc2.2	Construction Waste Management, Divert 75%	**1**			1											1	*14%*
MRc3.1	Resource Reuse, Specify 5%	**1**		1	1												*14%*
MRc3.2	Resource Reuse, Specify 10%	**1**		1													*7%*
MRc4.1	Recycled Content, Specify 25%	**1**	1			1	1	1	1		1	1	1	1	1	1	*79%*
MRc4.2	Recycled Content, Specify 50%	**1**				1	1	1	1		1	1	1	1	1	1	*71%*
MRc5.1	Local/Regional Materials, 20% Manufactured Locally	**1**	1	1	1	1	1	1	1	1	1	1	1	1	1	1	*100%*
MRc5.2	Local/Regional Materials, of 20% Above, 50% Harvested Locally	**1**	1	1	1	1	1	1	1	1	1	1	1	1	1	1	*100%*
MRc6	Rapidly Renewable Materials	**1**															*0%*
MRc7	Certified Wood	**1**															*0%*
Indoor Environmental Quality (15 Points Possible)			11	10	9	10	4	5	5	11	8	10	9	5	9	7	
EQp1	*Minimum IAQ Performance*	***Required***	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*	
EQp2	*Environmental Tobacco Smoke (ETS) Control*	***Required***	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*	
EQc1	Carbon Dioxide (CO2) Monitoring	**1**		1	1	1					1		1		1	1	*50%*
EQc2	Increase Ventilation Effectiveness	**1**		1		1				1			1		1		*36%*
EQc3.1	Construction IAQ Management Plan, During Construction	**1**	1	1		1	1		1	1		1	1		1	1	*71%*
EQc3.2	Construction IAQ Management Plan, Before Occupancy	**1**	1		1	1		1		1	1	1	1		1	1	*71%*
EQc4.1	Low-Emitting Materials, Adhesives & Sealants	**1**	1	1	1	1	1	1	1	1	1	1	1	1	1	1	*100%*
EQc4.2	Low-Emitting Materials, Paints	**1**	1	1		1	1	1	1	1	1	1	1	1			*79%*
EQc4.3	Low-Emitting Materials, Carpet	**1**	1	1	1	1	1	1	1	1	1	1	1	1	1	1	*100%*
EQc4.4	Low-Emitting Materials, Composite Wood	**1**	1		1							1			1		*29%*
EQc5	Indoor Chemical & Pollutant Souce Control	**1**	1	1	1	1		1	1	1	1	1		1	1		*79%*
EQc6.1	Controllability of Systems, Perimeter	**1**	1							1							*14%*
EQc6.2	Controllability of Systems, Non-Perimeter	**1**															*0%*
EQc7.1	Thermal Comfort, Comply with ASHRAE 55-1992	**1**	1	1	1	1				1	1	1		1	1	1	*71%*
EQc7.2	Thermal Comfort, Permanent Monitoring System	**1**		1	1	1				1		1					*36%*
EQc8.1	Daylight & Views, Daylight 75% of Spaces	**1**	1										1				*14%*
EQc8.2	Daylight & Views, Views for 90% of Spaces	**1**	1	1	1					1	1	1	1			1	*57%*
Innovation & Design Process (5 Points Possible)			5	5	2	5	4	4	4	2	4	5	3	5	5	5	
IDc1.1	Innovation in Design	**1**	1	1	1	1	1	1	1	1	1	1	1	1	1	1	*100%*
IDc1.2	Innovation in Design	**1**	1	1		1	1	1	1		1	1		1	1	1	*79%*
IDc1.3	Innovation in Design	**1**	1	1		1	1	1	1		1	1		1	1	1	*79%*
IDc1.4	Innovation in Design	**1**	1	1		1						1	1	1	1	1	*57%*
IDc2	LEED Accredited Professional	**1**	1	1	1	1	1	1	1	1	1	1	1	1	1	1	*100%*

Appendix B: Colorado LEED Certified Projects at a Glance

LEED-NC Certified Colorado Projects

Owner	Project	City	LEED Rating	Ver.	Date Certified
Aspen Skiing Company	Snowmass Golf Clubhouse	Snowmass	Silver	2	2/25/05
Aspen Skiing Company	Sundeck Restaurant	Aspen	Bronze	1	2/1/00
Continuum Partners, LLC	Belmar 2M3	Lakewood	Silver	2	8/10/05
Boulder Community Hospital	Boulder Community Foothills Hospital	Boulder	Silver	2	12/3/03
Boulder, City of	North Boulder Recreation Center	Boulder	Silver	2	3/4/03
CH2M HILL	CH2M HILL North Building	Englewood	Certified	2	6/22/04
CH2M HILL	CH2M HILL South Building	Englewood	Certified	2	5/13/03
CH2M HILL	CH2M HILL West Building	Englewood	Certified	2	1/4/04
Colorado College	Russell T. Tutt Science Center	Colorado Springs	Certified	2	3/10/05
Colorado Springs Utilities	Colorado Springs Utilities Laboratory	Colorado Springs	Silver	2	5/23/05
Colorado Department of Labor and Employment	Colorado Department of Labor and Employment Addition	Denver	Certified	2	8/1/05
Pikes Peak Regional Development Center	Pikes Peak Regional Building Department	Colorado Springs	Silver	2	11/28/05
Poudre School District	Fossil Ridge High School	Fort Collins	Silver	2	7/12/05
Opus Northwest Construction, L.L.C.	U.S. Department of Transportation	Lakewood	Silver	2	10/11/04
University of Denver	Frank H. Ricketson Jr. Law Building	Denver	Gold	2	6/12/05

LEED-NC Total Number of Certified Projects in Colorado: 15

LEED-CI Certified Colorado Project

Boulder Associates	Boulder Associates Office	Boulder	Gold	2	11/1/05

LEED-EB Certified Colorado Project

Amerimar Realty Company of Colorado	Denver Place	Denver	Gold	Pilot	11/5/04

Note: Includes projects certified as of December 2005. Compiled from www.usgbc.org/leed

Appendix C: What's New in 2.2?

This section was adapted from the article, LEED 2.2 vs. 2.1 – What's the difference?, Colorado Building Green, USGBC Colorado Chapter newsletter, Nov-Dec 2005, authored by Ambient Energy, Inc. with permission. Refer to Colorado Building Green's monthly "LEED Update" article series for additional information. www.usgbc.org/chapters/colorado

Beginning in January 2006, all new LEED-NC projects will register under version 2.2 (v2.2). Overall, LEED-NC version 2.2 is an improvement over the previous LEED-NC versions. It benefits from experience with numerous certified and registered projects, credit interpretation rulings, volunteer LEED committees working diligently to improve each category, and an effort to streamline the LEED process. The changes will increase the cost of securing some credits. This section offers a cursory overview of some of the more conspicuous changes. Please refer to the rating system and Reference Guide for complete details.

Logistical Changes

How does the launch of v2.2 change the logistics for LEED projects? The key factors are highlighted as follows:

- **LEED-Online:** In November 2005, USGBC announced that LEED was going 'paperless'. LEED projects can now submit 100 percent of their documentation online in an easy-to-use interface featuring Adobe LiveCycle technology. Via LEED-Online, project team members to upload credit templates, track Credit Interpretation Requests (CIRs), manage key project details, contact customer service, and communicate with reviewers throughout the design and construction reviews. *Projects registered under earlier LEED-NC versions can also use the LEED-Online feature.*
- **Timing:** v2.2 and associated Reference Guide were officially launched in November 2005. Projects registered in November or December 2005 had the option of choosing v2.1 or v2.2. After December 31, 2005, all projects will be registered under v2.2.
- **LEED AP Exam:** The LEED Accreditation Exam will change sometime in mid-2006. So if you plan to take the test in 2006, check on if this switch has been made. If not, study the v2.1 reference guide, in addition to v2.2.
- **Earlier versions still valid:** All registered LEED-NC v2.0 and/or v2.1 projects will still be able to apply for certification using the standard in place at the time of project registration.
- **No mix and match:** Unlike the transition from v2.0 to v2.1, in this revision, projects will not be able to mix different versions of credits within one submittal.
- **Optional switch to v2.2:** If you are currently registered for v2.0 or v2.1, and you determine that v2.2 would work better for your project, you can switch entirely to v2.2 with no additional registration cost.
- **Two-phase review:** Instead of having a single review at the end of the project, v2.2 provides a design review and a construction review. This change should make it easier for projects to manage the tracking and submittals for credits that are completed during the design phase.
- **Certification fees:** The fee structure has changed to match the two-phase review, and the fees have increased. The total certification fees for both reviews for members are:
  - $1,750 for projects less than 50,000 square feet
  - $3.5 cents per square foot for projects from 50,000 to 500,000 square feet, and
  - $17,500 for projects over 500,000 square feet.

Credit Changes

What are the main difference between v2.1 and v2.2? Some credits have major revisions, some have minor revisions, and a few have no revisions. This section provides the official summary of major changes from USGBC, as well as information about additional changes from the USGBC Colorado Chapter.

USGBC reports that nearly every credit has been altered in some way; refer to the USGBC LEED-NC v2.2 Reference Guide for details about individual credits. The following page presents the information in the Fact Sheet issued by the USGBC to summarize the transition from v2.1 to v2.2. Following this is a list of additional changes published by the USGBC Colorado Chapter.

USGBC Official List of Major Credit Changes from v2.1 to v2.2

Alternative compliance paths have been added for the following credits:

- *SSc2 Development Density and Community Connectivity*
- *SSc4.3 Alternative Transportation: low-Emitting and Fuel-Efficient Vehicles*
- *SSc4.4 Alternative Transportation: Parking Capacity*
- *SSc6.1 Stormwater Design: Quality Control*
- *EAc6 Green Power*

LEED-NC Credit	Description of Change
Sustainable Sites	
SSc5.2 Site Development: Maximize Open Space	Open space definition has been refined to address both urban and suburban settings
SSc6.2 Stormwater Design: Quality Control	Stormwater control systems must be capable of treating 90% of runoff and removing 80% of total suspended solids. System performance information on phosphorous removal is no longer required.
SSc7.2 Heat Island Effect: Roof	New performance metric (Solar Reflectance Index)
SSc8 Light Pollution Reduction	Requirements for control of interior lighting to prevent spillover and restructuring of the exterior lighting requirement
Water Efficiency	
WEc1.2 Water Efficient Landscaping	Use of municipally provided non-potable water is acceptable for credit compliance
Energy and Atmosphere	
EAp1 and EAc3 commissioning credits	Major clarifications were made to the credit to standardize LEED Commissioning Scope of Work
EAp2 and EAc1 energy performance credits	Updated Referenced Standard (ASHRAE Standard 90.1-2004), new energy modeling protocol, two new prescriptive compliance paths
EAc4 Enhanced Refrigerant Management	Credit is now based on refrigerant management methodology established in TSAC refrigerant report
Materials and Resources	
MRc4 Recycled Content	Updated Referenced Standard (ISO 14201)
MRc5.1 Regional Materials	New requirements on what constitutes “regional”
Indoor Environmental Quality	
EQ Prerequisite 1 Minimum IAQ Performance	Updated Referenced Standard (ASHRAE Standard 90.1-2004)
EQc2 Increased Ventilation	Credit basis has been changed from ventilation effectiveness to provision of higher than code minimum ventilation
EQc3.2 Construction IAQ Management Plan: Before Occupancy	Clarification on building flush-out procedures provided. New IAQ testing protocol has been established. Requirement for installation of MERV 13 filters has been moved to EQc5

USGBC Official List of Major Credit Changes from v2.1 to v2.2 *(continued)*

EQc4.3 Low-Emitting Materials: Carpet Systems	Updated, enhanced Referenced Standard (Green Label Plus)
EQc4.4 Low-Emitting Materials: Composite wood & Agrifiber Products	Revised definition of composite wood. Laminating adhesives used to fabricate on-site and shop-applied composite wood and agrifiber assemblies shall contain no added urea-formaldehyde resins
EQc5 Indoor Chemical & Pollutant Source Control	Provision of properly sized and maintained walk off mats is now acceptable. Mechanically ventilated buildings must have MERV 13 or higher filtration media.
EQc6 Controllability of Systems	Re-structured credit basis: EQc6.1 lighting, EQc6.2 thermal controls based on ASHRAE 55-2004
EQc7 Thermal Comfort	EQ7.1 and EQ7.2 have an updated Referenced Standard (ASHRAE 55-2004). EQc7.2 now requires a survey method for verification.
EQ8.1 Daylight & Views: Daylight 75% of Spaces	Credit can be achieved by three compliance paths: calculation of glazing factor; daylight simulation; or direct measurement of daylighting performance in completed building

Source: USGBC LEED-NC Version 2.2 Fact Sheet
Website: https://www.usgbc.org/FileHandling/show_general_file.asp?DocumentID=1100

Additional Credit Changes noted by USGBC Colorado Chapter from v2.1 to v2.2

LEED-NC Credit	Description of Change
Sustainable Sites	
SS Prerequisite 1 Construction Activity Pollution Prevention	References Phase I and Phase II of the National Pollutant Discharge Elimination System (NPDES) program instead of EPA Storm Water Management for Construction Activities, Chapter 3.
SSc2 Development Density and Community Connectivity	Added an alternative method to calculation of development density based on proximity to basic services. The changes make it easier to achieve the credit.
SSc4.2 Alt Transportation – Bicycle Storage and Changing Rooms	Changing and shower requirements changed to 0.5 full time equivalent (FTE) employees.
SSc4.3 Alt Transportation – Low Emitting and Fuel Efficient Vehicles	Changed to reserve parking for low-emitting, fuel-efficient, or alternative fuel vehicles. Low emitting and fuel-efficient are defined as vehicles that are classified as Zero Emission Vehicles or have achieve a green score of 40 or more by ACEEE annual vehicle rating guide (see www.greencar.com)
SSc4.4 Alt Transportation – Parking Capacity	Differentiation between type of project and parking provided.
SSc5.1 Site Development – Protect or Restore Habitat	Defines native and adapted vegetation.
SSc6.1 Stormwater Design – Quantity and Quality Control	Defines more exactly the requirements for stormwater management. Focuses only on reducing total suspended solids (TSS).
SSc7.1 Heat Island Effect – Non-Roof	Sets goal of 50% shade and/or light colored paving and/or open grid paving. Defines paving by Solar Reflectance Index (SRI) or 50% parking spaces underground or covered.
SSc8 Light Pollution	Changes requirements to include both indoor lighting and outdoor lighting. Exterior lighting is based on type of space (rural, urban, etc.). Interior lighting needs controls when building is unoccupied to turn lights off.
Water Efficiency	
WEc2 Innovative Wastewater Technology	Reduced requirement for treating wastewater from 100% to 50%.
Energy and Atmosphere	
EAp1 Fundamental Commissioning of the Building Energy Systems	For projects over 50,000 ft^2 the commissioning agent should be independent of the project's design and construction teams, though they may be employees of the firms providing those services. For projects under 50,000 the commissioning agent can include qualified persons on the design or construction teams who have the required experience.
EAc1 Optimize Energy Performance	ASHRAE Standard 90.1-2004 Appendix G methodology is used to define the base case and the design case, which is a similar but more complicated than the Energy Cost Budget method used in the 1999 version to document compliance. Percentage of energy savings required reduced since it is a more stringent energy code. For example, the maximum allowable lighting power density for offices is 1.0 compared to 1.3 watts per SF in the 1999 version. The prescriptive method of the ASHRAE Advanced Energy Design Guide for Small Office Buildings can be used to show compliance for office buildings less than 20,000 sf or the Advanced Buildings Benchmark can be utilized to show compliance. Since the prerequisite ASHRAE Standard 90.1-2004 sets a tougher standard, less of a percentage reduction is required in order to score LEED points: 1 point for 10.5% less and a point for each 3.5% beyond that up to 10 points for a 42% reduction. For renovating existing buildings it is 1 point for 3.5% less and up to 10 points for 35% less than ASHRAE Standard 90.1-2004.

Additional Credit Changes noted by USGBC Colorado Chapter from v2.1 to v2.2 *(continued)*

EAc2 On-Site Renewable Energy	Required percentage of annual energy use from on-site renewable energy is reduced. Also, the requirements have been revised to allow solar thermal systems to contribute to this credit. The years 2006 and 2007 are the years to design, install, and purchase solar due to incentives from utilities in Colorado and Federal tax credits! Additional guidance on calculations and definitions is provided in the Reference Guide.
EAc4 Enhanced Refrigerant Management	The credit provides a complicated formula to balance a refrigerants lifetime ozone depletion potential against the lifetime global warming potential. Allows a credit if no refrigerant is utilized.
EAc5 Measurement and Verification	Only Option B (energy conservation measure isolation) or Option D (calibrated simulation) of the International Measurement and Verification Protocol (IPMVP) can be utilized to determine compliance of one year of post-occupancy data.
EAc6 Green Power	Requirements reduced to 35% of total annual electricity usage, but this does include plug loads.
Materials and Resources	
MRc4 Recycled Content	Credit requirements increased from 5% and 10% to 10% and 20% for one and two credits, respectively. Does not include mechanical and electrical equipment. Furniture may be counted if consistently counted with rest of credits.
MRc5 Regional Materials, Extracted, Processed, and Manufactured Regionally	Simplifies to 10% and 20% for one and two credits, respectively, for products extracted, processed, and manufactured locally.
MRc6 Rapidly Renewable Materials	Reduced requirement from 5% to 2.5% of building material cost.
MRc7 Certified Wood	Removes the requirement for temporary construction applications of wood.
Indoor Environmental Quality	
EQc1 Outdoor Air Delivery Monitoring	Requirement that only densely populated areas need carbon dioxide sensors and the rest need outdoor air measurement devices. Sensor must be in occupied space 3-6 feet from the floor, rather than in the return air duct.
EQc2 Increased Ventilation	Requires 30% more outside air ventilation than ASHRAE 62-2004. Keep in mind that in Colorado's climate there will be an energy penalty for bringing in more air than necessary. However, studies have found that this may increase indoor air quality, depending on the location of the building. If pursuing this option, heat recovery would be recommended.
EQc3.2 Construction IAQ Management Plan: Before Occupancy	Rather than a 2 week flush out with 100% outside air, LEED v2.2 requires 14,000 cubic feet of flush-out air per square foot of building space. The new credit allows the space to be occupied after 3,500 cf of flush-out, but only if the ventilation is maintained at 0.30 cfm/sf. OR, the credit may be met by monitoring which many may opt for considering the cost of keeping the finished building unoccupied for the 32 days (at 0.3 cfm/sf) it would take to circulate 14,000 cf/sf and the cost of conditioning that quantity of outside air to the required 60 F minimum and 60% relative humidity maximum.

Source: USGBC *Colorado Building Green* (Nov-Dec 2005), author Ambient Energy, Inc
Website: www.usgbc.org/chapters/colorado/docs/pdf/CBG-Nov-Dec2005.pdf

Appendix D: Cost and Benefits of Green Building

Following are examples of studies related to sustainable design, LEED or studies on specific buildings. For more industry research, visit www.usgbc.org/leed, select Resources, then Research.

Cost Effectiveness of LEED-NC in Colorado
Governor's Office of Energy Management & Conservation, *Rebuild Colorado*
(Project underway in 2006)
Rebuild Colorado is interviewing Colorado LEED-NC certified building owners and compiling information about the cost and benefits of using LEED-NC. A white paper summarizing the research is due out in late 2006.
Website: www.colorado.gov/rebuildco

GSA LEED Cost Study, Steven Winters, October 2004
The U.S. General Services Administration (GSA) commissioned a study to estimate the cost of achieving LEED certification for both new construction and major renovation projects for federal buildings. The report provides a detailed review of hard and soft costs of achieving three levels of LEED certification: Certified, Silver and Gold:
Website:
www.wbdg.org/newsevents/news_040105.php

The Costs and Financial Benefits of Green Buildings: A Report to California's Sustainable Building Task Force, Greg Kats (Capital E) et al., October 2003
Commissioned by the California's Sustainable Buildings Task Force, this study consists of an economic analysis that evaluates the cost and benefits of sustainable building. Findings show that initial cost premium of building green is quickly recouped through reduce operation and maintenance costs. General findings were that minimal increases in upfront costs of 0 to 2 percent to support green design will result in life cycle savings of 20 percent of total construction costs -- more than ten times the initial investment.
Website:
www.usgbc.org/Docs/Resources/CA_report_GBbenefits.pdf

Green City Buildings: Applying the LEED™ Rating System, Xenergy, June 2000
This study considered the financial impacts of applying LEED to three conventionally built facilities in Portland, Oregon. It found that life-cycle savings average 15 percent of initial costs for LEED buildings, and that the premium associated with using LEED building practices ranged from just 0 to 2.2 percent over the cost of conventional buildings.
Website:
www.sustainableportland.org/CityLEED.pdf

Costing Green: A Comprehensive Cost Database and Budgeting Methodology, Davis Langdon, July 2004
Authored by Lisa Fay Matthiessen and Peter Morris, this study compares construction costs of green buildings with comparable conventional buildings. General findings were that many building projects can incorporate sustainable design principles without an increased budget, or with very small additional funding.
Website:
www.usgbc.org/Docs/Resources/Cost_of_Green_Full.pdf#search='Costing%20Green:%20Davis%20Langdon

Health and Productivity Gains from Better Indoor Environments and Their Implications for the U.S. Department of Energy, William J. Fisk, 2000
This publication summarizes numerous studies that show increased productivity due to improved indoor environments. Indoor environments significantly influence the occurrence of communicable respiratory illness, allergy and asthma symptoms, sick building symptoms, and worker productivity. Improving indoor environmental quality leads to lower health care costs, reduces sick leave, and minimizes periods of illness-impaired work performance. Obtaining a high level of indoor environmental quality could result in $20-50 billion in productivity gains annually in the U.S. (1996 dollars).
Website: eetd.lbl.gov/IED/viaq/pubs/LBNL-47458.pdf

Heschong Mahone Group: Daylighting Productivity Studies
This firm has performed a variety of productivity studies measuring the impact of daylighting on retail sales and student performance. Test results showed students in rooms with daylighting learned quicker than those in non-daylit rooms. Poudre School District was one of the districts included in this study.
Website: www.h-m-g.com/projects/daylighting/projects-PIER.htm

Daylight Dividends
A collaboration of the U.S. Department of Energy, Lighting Research Center and others is working to document productivity improvements and other benefits of daylighting. Find a variety of case studies and research at this website, hosted by Rensselaer Polytechnic Institute
www.lrc.rpi.edu/programs/daylighting/index.asp

Appendix E: Sources for Case Studies

USGBC
The Project List presents all LEED-certified projects. LEED scorecards and case study details are available for many of these projects.
Website: www.usgbc.org/leed

USGBC Colorado Chapter
Information on LEED Certified projects, green building resources, and newsletters include case studies.
Website: www.usgbc.org/chapters/colorado

Governor's Office of Energy Management and Conservation, Rebuild Colorado
Provides case studies on high performance design and energy performance contracting projects in Colorado.
Website: www.colorado.gov/rebuildco

Colorado Green Consortium
Provides case studies and video series highlighting green buildings in Colorado.
Website: www.greenconsortium.com

U.S. DOE's High Performance Building Database
The EERE has constructed a database of 74 high performance buildings that include one or more notable environmental features.
Website:
www.eere.energy.gov/buildings/highperformance/case_studies/

Fort Collins Utilities
Case studies on energy-efficiency and high performance projects in Fort Collins including Poudre School District, Pioneer School for Expeditionary Learning, Value Plastics, and City of Fort Collins buildings.
Website: www.fcgov.com/powertosave

Better Bricks
Case studies for a wide variety of green buildings.
Website: www.betterbricks.com

Colorado Greening State Government
Provides information on activities in Colorado including Executive Orders, case studies and resources.
Website:
www.colorado.gov/greeninggovernment

U.S. DOE's Smart Communities Network
A large number of sustainable development success stories from communities across the United States. Website:
www.sustainable.doe.gov/management/sstoc.shtml

Appendix F: Local Green Building & High Performance Design Associations

AIA Denver Committee on the Environment
Monthly educational meetings on environmental building topics.
Website: www.aiacolorado.org

American Society of Heating, Refrigeration and Air-conditioning Engineers (ASHRAE), Rocky Mountain Chapter
Website: www.rockymtnashrae.com

Association of Energy Service Professionals (AESP), Rocky Mountain Chapter
E-mail: rm-aesp@summitblue.com
Website : www.aesp.org

Boulder Green Building Guild
Monthly educational meetings in Boulder on residential and commercial green building topics.
Website: www.bgbg.org

Colorado Alliance of Sustainable Business Associations (CASBA)
Facilitates communication and networking for sustainable business associations.
Website: www.casba.info

Colorado Association of School District Energy Managers (CASDEM)
Education and networking for school energy managers.
Website: www.casdem.org

Colorado Business Energy Partnership – Project of the Wirth Chair
Assists for-profit, nonprofit and public sector members develop money saving strategies to boost energy efficiency, and protect Colorado's and the nation's climate.
Website: thunder1.cudenver.edu/cbep/

Colorado Renewable Energy Society (CRES)
CRES promotes the use of renewable energy in Colorado with information, annual conference, meetings and annual awards.
Website: www.cres-energy.org

American Society of Landscape Architects (ASLA), Colorado Chapter
Website: www.ccasla.org

Colorado State University Institute for the Built Environment (IBE)
Fosters stewardship and sustainability of the built environment through a research-based, interdisciplinary educational forum.
Website: www.ibe.colostate.edu

Council of Education Facilities Planners Intl (CEFPI), Rocky Mountain Chapter
Provides regional education for school facilities planners.
Website: rockymountain.cefpi.org

Energy Services Coalition (ESC), Colorado Chapter
Performance contracting education
Website:
www.energyservicescoalition.org/chapters/CO/

Pikes Peak Sustainable Business Network
Provides networking and education for sustainable businesses in the Pikes Peak region.
Website: www.catamountinstitute.org/ppsbn

Rocky Mountain Association of Energy Engineers (RMAEE)
Education and networking of engineers for energy efficiency analysis and design, and energy management.
Website: www.rmaee.org

USGBC Colorado Chapter
Online information, newsletter and monthly education and networking programs focusing on the LEED rating system and green buildings, technologies and strategies in Colorado.
Website: www.usgbc.org/chapters/colorado

Appendix G: Funding Sources for High Performance Design

The following programs offer design assistance and/or cash incentives to help Colorado non-residential building owners design and build high performance buildings. Contact funding organizations early in the design process – before siting and orientation decisions are made – for maximum funding opportunities.

In addition to the entries below, inquire about incentives from your local :

- Water utility
- Gas utility
- Electric utility
- City and county governments, and
- Federal government: www.grants.gov

Colorado Department of Education (CDE)
School District Capital Construction Assistance Program
The Public School Finance Unit of the CDE administers this program. The program is for school renovation projects and, occasionally, new school construction. A matching contribution is generally required for all projects.
Ted Hughes
303-866-6948
Hughes_t@cde.state.co.us
Website:
www.cde.state.co.us/cdefinance/CapConstMain.htm

Colorado Department of Local Affairs
Energy and Mineral Impact Assistance Fund
This program assists state communities in offsetting the direct impacts of energy and mineral development and in meeting other needs indirectly related to such development. Entities eligible to receive funds include municipalities, counties, school districts, special districts and other political subdivisions and state agencies. Typical projects funded include water and sewer improvements, road improvements, construction/improvements to recreation centers, senior centers and other public facilities, fire protection buildings and equipment, and local government planning.
Website:
www.dola.state.co.us/LGS/FA/emia.htm

Community Office for Resource Efficiency (CORE), Renewable Energy Mitigation Project (REMP)
Offers cash incentives for energy efficiency and renewable energy projects in the Roaring Fork Valley, for commercial and residential projects.
Gary Goodson
970-544-9808
gary@aspencore.org
Website: www.aspencore.org

Fort Collins Utilities
Integrated Design Assistance Program
Offers grants for non-residential buildings to be built in the Fort Collins Utilities electric service territory. Grants can be used for professional services such as energy modeling, daylighting analysis or additional design services. (Refer to Platte River Power Authority for incentives for energy saving equipment.)
Gary Schroeder, Energy Services Engineer
970-221-6395
gschroeder@fcgov.com
Website: www.fcgov.com/powertosave

Governor's Office of Energy Management & Conservation, *Rebuild Colorado*
Provides high performance design grants for Colorado state agencies and state-owned higher education. Numerous tools and resources as well as limited support are available to assist local government projects.
Linda Smith, Senior Program Manager
303-866-2100
rebuildco@state.co.us
Website: www.colorado.gov/rebuildco

Energy Performance Contracting
Energy performance contracting is an innovative financing mechanism that uses energy cost savings to totally or partially fund energy efficiency capital improvement projects. This model has been used successfully for retrofit as well as new construction projects. The Rebuild Colorado of the Governor's Office of Energy Management & Conservation provides sample documents online available to all, and additional expertise and services as available for state and local governments.
See listing above for contact information.

Kresge Foundation
Green Building Initiative
Offers grants of between $25,000 and $100,000 for green building design. The grants are available to nonprofits, hospitals, higher education, and schools serving disabled students.
248-643-9630
Website: www.kresge.org

USDA Farm Energy Section 9006 Grants
Renewable energy and energy efficiency grants for rural communities.
Website: www.farmenergy.org

Smart Communities Network
Strategies and resources for mobilizing capital toward sustainable projects.
Website: www.smartcommunities.ncat.org

Platte River Power Authority
Electric Efficiency Program
Provides incentives to help pay the incremental cost of equipment that reduces electric demand during summer afternoons via greater energy efficiency or load shifting (e.g., thermal energy storage). Available to commercial electric customers in Longmont, Loveland, Estes Park or Fort Collins.
Paul Davis, Customer Services Engineer
970-226-4000
energyservices@prpa.org
www.prpa.org/productservices/eepoverview.htm

Xcel Energy
Energy Design Assistance
Offers funding and services to help pay for energy modeling and other design assistance for Xcel Energy customer buildings over 50,000 square feet. The program also offers cash incentives to help pay for energy saving strategies.
Business Solutions Center
800-481-4700
www.xcelenergy.com

U.S. Energy Policy Act of 2005
Tax Credits
The Energy Policy Act of 2005 mandates credits for energy efficiency improvements and alternative energy, with most beginning in January 2006 and remaining in effect through 2007.
Website: www.energy.gov/taxbreaks.htm

Appendix H: General Green Building Resources

Green Building Initiative
The Green Building Initiative organization provides useful resources such as a partial list of communities that have created their own consumer-oriented green building guidelines. The list contains links to community websites nationwide that have set their own green building standards and can be used to get ideas and examples of sustainable practices.
Website:
www.thegbi.org/consumer/guidecountry.asp

The Sustainable Design Resource Guide
Denver AIA Committee on the Environment has created a guide organized according to the sixteen divisions of the Construction Specifications Institute (CSI). Each division is prefaced by an introduction that outlines specific concerns related to the products and systems in that division. This is followed by product listings and information designed to help purchase or specify sustainable building products.
Website: www.aiacolorado.org/SDRG/home.htm

Building Green.com
Building Green.com is a comprehensive resource that includes articles written about environmental topics such as land-use, energy and water conservation, waste management, design considerations and much more. The site also includes case studies and environmentally friendly product listings known as Green Spec (See description below).

Green Spec
Product Directory
Green Spec is Building Green's product information service. It contains detailed listings for more than 1,800 environmentally preferable building products with descriptions, manufacturer information, and links to additional resources. The database is searchable by CSI division or LEED credit.
Website:
www.buildinggreen.com/menus/index.cfm

Environmental Design and Construction
Environmental Design and Construction is a high-performance building publication and website that provides resources, services and building product information including print magazine and electronic newsletter.
Website: www.edcmag.com/

Greener Buildings
Greener Buildings is a resource that includes an overview of the world of greener buildings, including the latest findings on the bottom-line payoffs and resources per LEED credit.
Website: www.greenerbuildings.com/

Resource Venture
A Contractors Introduction to LEED
This resource includes a fact sheet providing information and resources to assist contractors in understanding LEED. This publication is Seattle-specific, but an overview applicable to all contractors.
Website:
www.resourceventure.org/rv/publications/building/LEEDIntro.pdf

Advanced Buildings Technologies & Practices
The Advanced Buildings' website has developed a guide of technologies and practices that improve the energy and resource efficiency of commercial and multi-unit residential buildings.
Website: www.advancedbuildings.org/

BEES 3.0
The BEES (Building for Environmental and Economic Sustainability) software is a tool for selecting cost-effective, environmentally-preferable building products.
Website:
www.bfrl.nist.gov/oae/software/bees.html

New Buildings Institute
New Buildings Institute, Inc. is a not-for-profit public benefits corporation, helping to make buildings better for people and the environment.
Website: www.newbuildings.org

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To download a free version of this Guide, provide input to the authors or to check for future versions of this Guide, visit the *Rebuild Colorado* website at www.colorado.gov/rebuildco.