



GREEN BUILDING CERTIFICATION SYSTEM

**SUPPLEMENTAL REVIEW OF USGBC'S LEED V4 SYSTEMS:
BD+C: NC, O+M: EB AND ID+C: CI**

**PREPARED FOR:
THE U.S. GENERAL SERVICES ADMINISTRATION
OFFICE OF GOVERNMENT-WIDE POLICY
OFFICE OF FEDERAL HIGH-PERFORMANCE GREEN BUILDINGS**

AUGUST 2014

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ACKNOWLEDGEMENTS:

THIS SUPPLEMENTAL REVIEW WAS CONDUCTED UNDER THE DIRECTION OF BRYAN STEVERSON AND DONALD HORN OF THE U.S. GENERAL SERVICES ADMINISTRATION (GSA). DAN JACKSON, KATHARINE (JONI) TETER, JIM BLACKLEDGE, CHRISTOPHER JUNIPER, JOHN MLADE AND JOSH RADOFF WERE THE KEY MEMBERS OF THE LMI PROJECT TEAM. BRENDAN OWENS SERVED AS THE POINT OF CONTACT FOR THE US GREEN BUILDING COUNCIL.

Executive Summary

This Supplemental Review evaluates the following systems within the U.S. Green Building Council's Leadership in Energy and Environmental Design Version 4 (LEED v4) certification system.

- ◆ LEED v4 for Building Design and Construction (LEED BD+C): New Construction and Major Renovation ("LEED v4 NC")
- ◆ LEED v4 for Building Operations and Maintenance (LEED O+M): Existing Buildings ("LEED v4 EB")
- ◆ LEED v4 for Interior Design and Construction (LEED ID+C): Commercial Interiors ("LEED v4 CI")

The objective of this Review is to determine alignment between Federal statutory, regulatory and Executive Order high performance green building requirements, and the requirements of these three LEED systems. This Review is a supplement to GSA's Green Building Certification System Review (2012, PNNL 20996), and uses the same criteria and general approach developed in the 2012 PNNL Report.

FRAMEWORK FOR REVIEW

A set of review criteria were developed in the 2012 PNNL Report, based on requirements from the Energy Independence and Security Act (EISA)¹, to evaluate how the certification systems perform in helping the government meet its green building objectives. EISA requires "an evaluation of the robustness" of green building certification systems that includes criteria related to building design and operations. The "robustness" criteria include a set of measures intended to assess how each system aligns with Federal performance requirements. Building performance is an important, current focus in the Federal sector, and this multi-part criterion compares the legal requirements applicable to Federal real estate portfolios against each certification system's technical components (such as energy, water, siting, etc.).

Other criteria, termed "non-robustness" in the 2012 PNNL Report, were identified that evaluated how the certification systems and the organizations that developed them operated and how the systems were used in the market. The evaluation framework developed in the 2012 PNNL Report is maintained in this Supplemental review. Non-robustness criteria include:

- ◆ Availability of technically qualified auditors or assessors

¹ These criteria are specified in section 436(h) of the Energy Independence and Security Act of 2007

-
- ◆ Documented verification method
 - ◆ Transparency of certification systems’ approach to collecting and addressing public comments
 - ◆ Consensus-based standard for documenting a development and revision process
 - ◆ System maturity
 - ◆ Usability of the system
 - ◆ National recognition within the building industry.

NON-ROBUSTNESS CRITERIA

The 2012 PNNL Report found that the LEED system generally aligned well with the EISA-defined criteria included in the non-robustness category. USGBC’s approach to the development and implementation of the LEED v4 systems has not changed significantly since the 2012 PNNL Report, thus supporting the 2012 PNNL Report’s conclusion. Appendix G contains information supporting this conclusion.

CONFORMANCE METHODS (M-C-I)

The conformance evaluation considers the methods used by LEED v4 NC, LEED v4 EB and LEED v4 CI to determine whether requirements contained within each prerequisite or credit are satisfied. Requirements and methods in the LEED v4 systems were categorized as “Measured,” “Calculated” or “Evidence of Intent” following the structure created in the 2012 PNNL Report. However, definitions for these categories were updated for this Review, and the Federal requirements were re-categorized to conform to the updated definitions.

Measured: Where conformance with LEED v4’s requirements is demonstrated through measured performance, those methods are designated “M” in this Review. For purposes of this evaluation, “M” also includes conformance requirements based on verification of an installation or activity with accompanying documentation.

Calculated: Where conformance with LEED v4’s requirements is demonstrated through calculation or modeling, those methods are designated “C” in this Review.

Evidence of Intent: Where conformance with LEED v4’s requirements is demonstrated through development of policies, operating procedures or specifications, those methods are designated “I” in this Review.

Relative to LEED 2009, LEED v4 has moved towards measurement as the preferred means to demonstrate conformance in a number of areas. For all three systems, measurement is now the primary method or included as a component in demonstrating conformance in the following areas:

- ◆ Integrated Design, Assessment, Operations and Maintenance:
- ◆ Building System Controls (metering)
- ◆ Siting
- ◆ Renewable Energy
- ◆ Measurement and Verification (metering)
- ◆ Acoustics

LEED v4 NC and LEED v4 CI rely on calculations to achieve the energy efficiency credits. LEED v4 NC now requires building-level water metering as a prerequisite. LEED v4 CI provides an option for sampling to demonstrate conformance with indoor air quality credit. LEED v4 EB offers options for both measured performance and conformance with design calculations to achieve the energy efficiency credit. LEED v4 EB also relies on measurement as a component in the following areas:

- ◆ Moisture Control
- ◆ Thermal Comfort
- ◆ Daylighting
- ◆ Integrated Pest Management

ROBUSTNESS CRITERIA

Robustness criteria are used to determine how closely prerequisites and credits in the certification systems align with current Federal requirements.² The same quarter/half/full circle scheme (Harvey Balls) developed in the 2012 PNNL Report has been used to illustrate the degree of alignment between LEED v4 credits and Federal green building requirements (“robustness criteria”). The definitions below for each alignment rating category have been updated to improve clarity without changing content:

- ◆ Full circles (green) mean that the Federal requirement would automatically be met if the building was certified because the system and Federal re-

² Through May 2014.

quirements fully align, and the requirement within the green building certification system is a prerequisite.

- ◆ Three-quarter circles (green) mean that the certification system has an option (e.g., point, credit, etc.) that meets the Federal requirement; if that option is included in the certification package, the Federal requirement would be met.
- ◆ A half circle (yellow) means the certification system includes an option related to but not directly aligned with the Federal requirement. The certification systems may have a lower standard, different baselines, different calculation methods, or different ways to document compliance with the Federal requirement.
- ◆ An empty circle means the Federal requirement is not an identified component within the certification system.

The analysis of alignment between the LEED v4 systems and Federal requirements is presented in the “Robustness Review” tables (Appendices A, C and E). The following table [Table 1] illustrates the results of this analysis.

Table 1. Alignment with Federal Requirements

	LEED v4 NC	LEED v4 EB	LEED v4 CI
Robustness—Integrative Principles			
Integrated Assessment, Operation and Management			
Commissioning			
Building System Controls (Not in GP)			
Siting (Not in GP)			
Greenhouse Gas (Not in GP)			
Robustness—Energy			
Energy Efficiency			
On-Site Renewable Energy and Green Power			
Measurement and Verification			
Benchmarking			
Robustness—Water			
Indoor Water			
Process Water			
Outdoor Water			N/A
Measurement of Water Use			N/A
Stormwater			N/A
Water-Efficient Products			
Robustness—Indoor Environment			
Ventilation			
Thermal Comfort			
Integrated Pest Management	N/A		N/A
Daylighting			
Environmental Tobacco Smoke Control			
Moisture Control			
Protect Indoor Air Quality During Construction		N/A	
Low-Emitting Materials			
Acoustics (Not in GP)			
Robustness—Materials			
Recycled Content			
Bio-based Content			
Environmentally Preferable Products			
Waste and Materials Management			
Ozone Depleting Compounds			

Note:

Full circle: Federal requirement met automatically because LEED v4 includes prerequisite that fully aligns with the federal requirement

Three-quarters circle: LEED v4 has a credit that meets the Federal requirement

Half-circle: LEED v4 has a credit that is related to, but not specifically aligned, with the Federal requirement.

Empty circle: Federal requirement is not an identified component within the LEED v4 certification system.

A summary of LEED v4's alignment with Federal green building requirements follows.

Integrative Design

LEED v4 offers a number of prerequisites and credits that support an integrative approach to building design, construction, operations and maintenance. However, taken collectively, these credits are related to but do not fully align with all aspects of the Federal requirements. Commissioning requirements are automatically met through prerequisites in LEED v4 NC and LEED v4 CI, but a credit must be achieved to meet these requirements in LEED v4 EB. For purposes of this Supplemental Review, "building system controls" are defined as systems which are used to manage the whole building (i.e., building automation systems [BAS] or building management systems [BMS]). Controls specific to one component of a building (such as lighting systems) do not meet the federal definition. Building system controls are not addressed in LEED v4; Federal requirements for siting can be met through credits. Numerous LEED v4 prerequisites address reduction of greenhouse gas emissions, which align with Federal requirements.

Energy

LEED v4 prerequisites for reduction of energy use support Federal requirements, but credits must be obtained to fully meet Federal requirements. There are no prerequisites for renewable energy use; LEED v4 credits support, but do not fully align with Federal requirements. Federal requirements for auditing and for measurement and verification can be met if credits are achieved in LEED v4 NC and LEED v4 CI, but LEED EB's credits only partially align. Benchmarking is not addressed in LEED v4 NC, but Federal requirements for Existing Buildings can be met if the credit in LEED v4 EB and LEED v4 CI is achieved.

Water

LEED v4 NC and LEED v4 CI include a prerequisite compliance path that fully aligns with Federal requirements for water reduction, but the credit must be achieved in LEED v4 EB. LEED v4 NC and LEED v4 CI fully meet Federal requirements for process water. There are no prerequisites for stormwater and outdoor water use, but Federal requirements can be met if credits are achieved. LEED v4 only partially supports requirements for measurement and WaterSense products.

Indoor Environmental Quality

The only Federal requirements that can automatically be met through LEED v4 are ventilation and no smoking. LEED v4 EB and LEED v4 CI credits can be used to meet Federal requirements for thermal comfort, protection of indoor air quality during construction and acoustics, but LEED v4 NC only partially aligns

in these areas. All other Federal requirements are only partially supported by LEED v4 credits.

Materials

LEED v4 supports but does not fully align with Federal requirements for procurement and ozone depleting compounds. Federal requirements can be met if credits are achieved only in the areas of Environmentally Preferable Products and solid waste reduction.

ACRONYMS AND ABBREVIATIONS

ANSI	American National Standards Institute
ASHRAE	American Society of Heating Refrigerating and Air Conditioning Engineers
CTS	DOE's Compliance Tracking System portal
DOE	U.S. Department of Energy
EISA	Energy Independence and Security Act of 2007
E.O.	Executive Order
GBCI	Green Building Certification Institute
GBCS	Green Building Certification System
GBI	Green Building Initiative
GSA	U.S. General Services Administration
Guiding Principles	Guiding Principles for Federal Leadership in High Performance and Sustainable Buildings (MOU 1/24/2006; Guidance 12/01/08)
IES	Illuminating Engineering Society of North America
LEED	Leadership in Energy and Environmental Design, a green building certification system of the USGBC
LEED v4 CI	LEED v4 ID+C: Commercial Interiors
LEED v4 EB	LEED v4 O+M: Existing Buildings
LEED v4 NC	LEED v4 BD+C: New Construction
PNNL	Pacific Northwest National Laboratory
RECs	Renewable Energy Credits
USGBC	U.S. Green Building Council

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Chapter 1

Introduction

1.1. PROJECT GOAL

This Supplemental Review evaluates the recently released version of the U.S. Green Building Council's Leadership in Energy and Environmental Design Version 4 (LEED v4) green building certification system to determine alignment with Federal statutory, regulatory and Executive Order high performance green building requirements.

This report is a supplement to GSA's most recent Green Building Certification System Review (2012, PNNL 20996). These Reviews have been conducted to fulfill the requirements contained in section 436(h) of the Energy Independence and Security Act of 2007 (EISA).

This Review supports Federal agencies and interagency discussions regarding use of LEED v4 to advance agency compliance with high performance green building requirements embodied in the Energy Policy Act of 2005, EISA, Executive Order 13423, Executive Order 13514, Executive Order 13653, the Guiding Principles for Federal Leadership in High Performance and Sustainable Buildings (Guiding Principles), and related requirements.

The green building certification systems to be analyzed were identified by GSA's Office of Federal High-Performance Green Buildings:

- ◆ LEED v4 for Building Design and Construction (LEED BD+C): New Construction and Major Renovation
- ◆ LEED v4 for Operations and Maintenance (LEED O+M): Existing Buildings
- ◆ LEED v4 for Interior Design and Construction (LEED ID+C): Commercial Interiors

For brevity, these systems are referred to in this review as follows:

- ◆ "LEED v4 NC" means LEED v4 for Building Design and Construction: New Construction and Renovation
- ◆ "LEED v4 EB" means LEED v4 for Operations and Maintenance: Existing Buildings

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- ◆ “LEED v4 CI” means LEED v4 for Interior Design and Construction: Commercial Interiors

Two other certification systems were reviewed in the 2012 PNNL Report. The Green Building Initiative is beginning its process of updating their 2010 ANSI standard (ANSI/GBI 01-2010: Green Building Assessment Protocol for Commercial Buildings), and as such, their Green Globes rating systems may change. As a result, GSA elected not to re-review the Green Globes rating systems at this time with these changes looming. GSA intends to conduct a similar review when GBI’s process is complete. In addition, at the start of this supplemental review the International Living Building Institute had not released its newest version of the Living Building Challenge (Living Building Challenge 3.0); thus it was not reviewed in this supplement.

1.2. PROCEDURAL APPROACH

The procedural approach included the following steps:

Step 1–GBCS System Owner Engagement

The U.S. Green Building Council (USGBC) agreed to collaborate with GSA by providing relevant materials that documented changes to LEED since GSA’s previous review, including any changes to the systems development and implementation.

Step 2–Robustness and Conformance Review

The Robustness analysis evaluated the extent to which the LEED v4 systems promote or ensure meeting Federal green building requirements as of May 2014.

The Conformance analysis considered the methods and metrics used by the LEED v4 systems to determine whether a facility has met requirements of LEED. The following categories capture this analysis: measured (M); calculated or modeled (C); or through development of a policy, meeting a specification, or developing a statement of intent (I).

Step 3–Peer Review and Opportunity for GBCS Owner Input

The draft report and tables detailing the alignment of credits were provided to the U.S. Green Building Council for their review and comment, and to allow them an opportunity to provide an opinion. USGBC’s comments are included in Appendix G. Concurrently, GSA conducted a third-party peer review with green building experts in the Federal government, academia, and the private sector.

1.3. METHODOLOGY

FRAMEWORK FOR REVIEW

A set of criteria were developed in the 2012 PNNL Report to evaluate how different systems perform in helping the government meet its green building objectives. These criteria were drawn from EISA, and grouped into “non-robustness” and “robustness categories” for purposes of evaluation. The evaluation framework developed in the 2012 PNNL Report is maintained in this Supplemental Review.

As described in the 2012 report, the non-robustness criteria evaluate how the certification systems and the organizations that developed them operate and how the systems are used in the marketplace. Non-robustness criteria include:

- ◆ Availability of technically qualified auditors or assessors
- ◆ Documented verification method
- ◆ Transparency of certification systems’ approach to collecting and addressing public comments
- ◆ Consensus-based standard for documenting a development and revision process
- ◆ System maturity
- ◆ Usability of the system
- ◆ National recognition within the building industry.

In addition, EISA requires an evaluation of the robustness of green building certification systems that includes criteria related to the building design and operations. The “robustness” criteria include a set of measures intended to assess how each system aligns with Federal performance requirements. Building performance is an important, current focus in the Federal sector, and this multi-part criterion compares the legal requirements applicable to Federal real estate portfolios against each certification system’s technical components (such as energy, water, siting, etc.).

The following Federal requirements guided the 2012 PNNL Report. These requirements were also used to guide this Supplemental Review.

- ◆ EPCA 2005 (Public Law 109-58, codified as amendments to the National Energy Conservation Policy Act, 42 USC 8251 et seq)
- ◆ Guiding Principles for Federal Leadership in High Performance and Sustainable Buildings (MOU 1/24/2006; Guidance 12/01/08)

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- ◆ EISA 2007 (42 USC Part 152)
 - ◆ Strengthening Federal Environmental, Energy, and Transportation Management (E.O. 13423, 2007)
 - ◆ Federal Leadership in Environmental, Energy and Economic Performance (E.O. 13514, 2009)

In addition to the requirements identified above, two new sets of requirements were included in this Supplemental review.

- ◆ Preparing the United States for the Impacts of Climate Change (E.O. 13653, 11/06/2013)
- ◆ Presidential Memorandum on Federal Leadership in Energy Management (12/05/2013)

Specific requirements arising from each of the statutes, Executive Orders and Presidential Memorandum listed above are identified and discussed by topic in the Robustness sections of this review.

There are also a number of environmental requirements (established by statute, regulation and Executive Order) that are applicable to Federal facilities. These requirements include use and disposal of toxic and hazardous chemicals; storage and disposal of hazardous waste; hazard communication and health and safety management; and procurement of non-toxic or less-toxic alternatives. This report does not address LEED v4 alignment with those requirements.

Robustness Review

This evaluation applies the same criteria developed for use in the 2012 PNNL Report. The “Robustness” criteria were updated to include new and modified Federal requirements in the energy category. Tables updated from the 2012 PNNL Report include:

- ◆ Robustness Criteria Tables (2012 PNNL Report Appendices F and G). Each table includes a succinct summary of the LEED v4 prerequisites and/or credits relevant to each Robustness criterion, and the reasoning underlying the alignment determination. The updated tables are located in Appendix A, C, and E of this Supplemental Review.
- ◆ Measured, Calculated and Evidence of Intent Requirements (2012 PNNL Report, Appendix K). These tables identify the methods and metrics employed by the certification system to determine a project’s conformance with the certification system’s underlying requirements. These tables are titled “Conformance Methods: Measured, Calculated and Evidence of Intent” and are located in Appendix B, D, and F of this Supplemental Review.

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- ◆ Table 4.10 from the 2012 PNNL Report summarizing energy requirements, has been updated to reflect changes in LEED v4. The updated table appears as Table 3.2, “Energy Use Reduction” in this Supplemental Review.

The same quarter/half/full circle scheme (“Harvey Balls”) used in the 2012 PNNL Report has been used to illustrate the degree of alignment between LEED v4 credits and Federal green building requirements (“robustness criteria”). The definitions below for each alignment rating category have been updated to improve clarity without changing content:

- ◆ Full circles (green) mean that the Federal requirement would automatically be met if the building was certified because the system and Federal requirements fully align, and the requirement within the green building certification system is a prerequisite.
- ◆ Three-quarter circles (green) mean that the certification system has an option (e.g., point, credit, etc.) that meets the Federal requirement; if that option is included in the certification package, the Federal requirement would be met.
- ◆ A half circle (yellow) means the certification system includes an option related to but not directly aligned with the Federal requirement. The certification systems may have a lower standard, different baselines, different calculation methods, or different ways to document compliance with the Federal requirement.
- ◆ An empty circle means the Federal requirement is not an identified component within the certification system.

Federal requirements applicable to LEED v4 for Commercial Interiors were drawn from the Federal requirements for new construction with the exception of daylight and energy, which are drawn from Federal requirements for existing buildings. When evaluating LEED v4 CI, it is important to note a policy interpretation that changes this report’s analysis of alignment for some prerequisites and credits. A reduced robustness rating (half circle) is provided as a starting point for certain energy and water reduction requirements in LEED v4 CI since the Guiding Principles identify these requirements as applicable to the “whole building.” Thus, even if a prerequisite fully aligns with the specific elements included in a Federal requirement, that prerequisite is identified as a “half circle” because the entire building has not been evaluated.

The term “prescriptive” is used in this report to describe a performance path in which compliance methods are specified, rather than left to the discretion of the design or facility management team. Prescriptive approaches provide step-by-step instructions on how to meet the requirements of a prerequisite or credit. In contrast, performance-based approaches generally identify a target or baseline, leav-

ing the methods to achieve those objectives to the discretion of the design or facility management team.

Non-robustness Review

The non-robustness criteria and approach developed in the 2012 PNNL Report and presented in the 2012 report's Appendix E have not been changed (independence, availability, verification, transparency, consensus-based, system maturity, usability, national recognition). The evaluation team asked USGBC to provide an update to the 2012 report Appendix E where non-robustness items may have changed. Changes in these categories are addressed in this Supplemental Report in Appendix G.

Reference materials developed by USGBC were the primary source of LEED-related information to inform this review. USGBC was contacted at the outset of the project and asked to identify a point of contact to supply materials and to be available to the review team for questions. Upon request, USGBC provided publicly available materials outlining the changes from LEED 2009 to LEED v4 and identification of changes to the Non-Robustness Criteria. All materials provided by USGBC are included as Appendices to this report (See Appendix G). Material referenced for the Robustness analysis includes: LEED v4 NC, EB and CI Green Building Rating Systems; LEED Reference Guides; LEED User; LEED Credit Forms; and the LEED Credit Library.

Separate robustness tables were developed for LEED v4 NC (Appendix A), LEED v4 EB (Appendix C) and LEED v4 CI (Appendix E). These tables were separated into sections based on the order presented in the Guiding Principles to allow for more detailed commentary and discussion in manageable pieces. Full circle, three-quarter, half, and empty circles are used to illustrate alignment as defined above.

Organization of This Report

This report provides information about the alignment of selected LEED v4 systems in two formats: narrative summaries are below in sections 3.1 and 3.2 while detailed analysis is provided in the Robustness Tables in the Appendices. Relevant information about USGBC and its certification systems is provided via summaries in section 2 below and in Appendix G.

This evaluation is organized around the following topics contained in the Guiding Principles:³

- ◆ “Employ Integrated Design Principles” and “Employ Integrated Assessment, Operation, and Management Principles” became “Integrative Principles

³ “The Guiding Principles for Federal Leadership in High Performance and Sustainable Buildings can be found at: http://www1.eere.energy.gov/femp/pdfs/guidance_hpsb.pdf.

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- ◆ “Optimize Energy Performance” became “Energy”
 - ◆ “Protect and Conserve Water” became “Water”
 - ◆ “Enhance Indoor Environmental Quality” became “Indoor Environmental Quality”
 - ◆ “Reduce Environmental Impact of Materials” became “Materials”

Chapter 2

USGBC's Approach to Green Building Certification

2.1. OVERVIEW AND ORGANIZATION OF LEED v4

The LEED v4 green building certification system is a voluntary and consensus-driven process for quantifying the impact of the built environment and construction activities across several impact categories. The categories address globally-significant environmental, social, health, and economic issues and provide performance metrics as well as best practices and processes for improving buildings in these areas.

The certification process is designed to provide projects an opportunity to receive third-party certification for green building planning, design, construction, and on-going performance, operations, and maintenance activities. As described in the publicly available document “LEED v4 Impact Category and Point Allocation Development Process⁴,” the USGBC has identified the following goals for the LEED Rating System:

- ◆ Reverse Contribution to Global Climate Change
- ◆ Enhance Individual Human Health and Well Being
- ◆ Protect and Restore Water Resources
- ◆ Protect, Enhance and Restore Biodiversity and Ecosystem Services
- ◆ Promote Sustainable and Regenerative Material Resources Cycles
- ◆ Build a Greener Economy
- ◆ Enhance Social Equity, Environmental Justice, and Community Quality of Life

With these goals in mind, relative social, environmental and economic impacts were considered for each credit in accordance with USGBC's weighting methodology.

⁴ Available at:
http://www.usgbc.org/sites/default/files/LEED%20v4%20Impact%20Category%20and%20Point%20Allocation%20Process_Overview_0.pdf

LEED v4 consists of 21 rating systems designed to address a diverse range of building types. Related rating systems are grouped together under the umbrellas of four LEED categories:

- ◆ Building Design and Construction (BD+C)
- ◆ Interior Design and Construction (ID+C)
- ◆ Building Operations and Maintenance (O+M)
- ◆ Neighborhood Development (ND)

For example, LEED BD+C includes rating systems that address New Construction and Major Renovations, Core and Shell Development, Schools, Retail, Data Centers, and Healthcare.

For all rating systems, credits are grouped into the following credit categories: Integrative Process (IP), Location and Transportation (LT), Sustainable Sites (SS), Water Efficiency (WE), Energy and Atmosphere (EA), Materials and Resources (MR), Indoor Environmental Quality (EQ) and Innovation (I). There are also Regional Priority credits that are intended to address the most pressing regional challenges as defined by local USGBC chapters.

The LEED Rating System consists of prerequisites in all credit categories that must all be earned in order to achieve certification at any level; and optional credits that are achieved to earn points that accumulate to earn higher levels of certification. Project teams are free to pursue any mix of credits to achieve the desired level of certification.

Each of the LEED rating systems consists of 110 points that are allocated to credits according to their relative social, environmental and economic impacts in accordance with the weighting methodology.

The level of certification awarded to a project is based on the number of points that are earned:

- ◆ Certified: 40–49 points
- ◆ Silver: 50–59 points
- ◆ Gold: 60–79 points
- ◆ Platinum: 80 points or more

The LEED v4 Impact Category and Point Allocation Development Process provides detailed information on the weighting methodology and scorecard development. Additional information on LEED rating systems can be found in the Rating

System Selection Guidance section of all LEED v4 Reference Manuals and also on the USGBC website.

Chapter 3

Certification System Review

3.1. ANALYSIS OF CONFORMANCE METHODS

The conformance evaluation considers the methods used by LEED v4 NC, LEED v4 EB and LEED v4 CI to determine whether requirements contained within each prerequisite or credit are satisfied. Requirements and methods in the LEED v4 systems were categorized as “Measured,” “Calculated” or “Evidence of Intent” following the structure created in the 2012 PNNL Report. Definitions for these conformance categories were updated for this Review; the definitions used in the Review are discussed below.

3.1.1 Categories of Conformance Methods

There is an urgent need to better measure, match and track building design and performance in the Federal sector. “Measured performance” is important for several reasons. First, many Federal reporting requirements are based on a demonstration of actual performance. Second, facility managers must understand how a building is actually performing in order to adjust operations to improve performance. Finally, operational policies and procedures are most effectively updated to support continual improvement if they are evidence-based.

Various methods to measure actual performance are now widely available for energy and water performance data; other areas where performance can be quantitatively measured include quantities of recycled or re-used materials procured, waste generation and diversion, indoor air quality, and acoustic quality.

Quantitative measurement of performance is not possible for all aspects of high-performance building design, construction or operation. Demonstrations of anticipated performance are frequently based on calculations, modeling, or design projections (“calculated” methods) using industry standards and assumptions to estimate how a project or building will perform. “Calculated” performance for energy and water use can be verified post occupancy using “measured” performance methods.

Some aspects of operational performance are most appropriately addressed through development and implementation of policies and standard operating procedures (“evidence of intent”) (e.g., non-smoking policies). Some conformance requirements are based on specifying particular products or strategies within appropriate design or operational documents.

MEASURED (M)

Where conformance with LEED v4's requirements is demonstrated through measured performance, those methods are designated "M" in this Review. Metering energy or water use is a common form of measurement; quantities of recycled materials, waste generation, and indoor air quality sampling are also examples of measured performance. For purposes of this evaluation, "M" also includes conformance requirements based on verification of an installation or activity with accompanying documentation. For example, commissioning is a process that occurs throughout design and construction: it is considered "M" because completion of the commissioning process is verified through documentation.

CALCULATED (C)

Where conformance with LEED v4's requirements is demonstrated through calculation or modeling, those methods are designated "C" in this Review. Calculated methods may be based on models or industry standards used to estimate or project how a building will perform. Energy modeling and projections of water use based on fixture specifications are examples of calculated methods. Quantities of recycled content and re-used materials used within a building or project are also examples of calculated metrics; recycled content in a project may be calculated based on material cut sheets and related documentation.

EVIDENCE OF INTENT (I)

Where conformance with LEED v4's requirements is demonstrated through development of policies, operating procedures or specifications, those methods are designated "I" in this Review.

MULTIPLE CONFORMANCE METHODS

Many management strategies include multiple conformance paths. For example, reduction of ozone depleting compounds is achieved through policy, as is the case with the Federal requirements, and by specification of the proper equipment; this would be assigned an "I." If the specified equipment is within the scope of a commissioning process, the installation of the equipment will also be validated, and that aspect of the strategy would be assigned an "M".

Another example is the use of WaterSense products. LEED v4 EB requires their use through a policy regarding future renovations (I), while LEED v4 NC would require they be specified for inclusion in the project. If WaterSense products are included as part of the commissioning scope, conformance could also be verified (M).

3.1.2. Summary of LEED v4 M-C-I Analysis

Conformance Methods in Federal Requirements

In the 2012 PNNL Report, the Guiding Principles were evaluated to determine whether conformance with Federal requirements requires measured performance data, calculated values, or evidence of intent. That report concluded that “evidence of intent” was the primary conformance method used by the Guiding Principles for both new construction and existing buildings.

For this Review, the conformance methods required by Federal requirements were re-evaluated based on the revised definitions outlined above. This re-analysis resulted in changes to the conformance categories for some Federal requirements:

Integrative Principles: Conformance with commissioning requirements was changed from “intent” to “measured” since the commissioning process is verified through documentation.

Energy: Conformance with thermal comfort and ventilation requirements was reclassified as “calculated,” (versus “intent”) because conformance is demonstrated by meeting industry standards (ASHRAE 55 and 62.1)

Water: Stormwater conformance methods were classified as “calculated” versus “intent.”

Materials: Conformance with Ozone Depleting Compounds was changed from “measured” to “intent,” since no measurements are taken at the facility.

Several Federal requirements that were not evaluated in the 2012 PNNL Report are also included in this Review. These requirements are not included in the Guiding Principles, but arise from other Federal requirements (statutes, Executive Orders or Presidential Memoranda). These include:

- ◆ Building System Controls (EISA §436(h))
- ◆ Siting (EISA §436(h) and E.O. 13514)
- ◆ Greenhouse Gas Emission Reduction (E.O. 13514 and E.O. 13423)
- ◆ Acoustics (EISA §436(h))

The M-C-I tables were also reorganized to follow the Guiding Principles sequence used throughout this review.

Conformance Methods in LEED v4

Analysis of conformance methods in LEED v4 is presented in the tables entitled “Conformance Methods: Measured, Calculated and Evidence of Intent” (Appendices B, D and F). Significant changes to the conformance methods used by LEED are summarized below.

Relative to LEED 2009, LEED v4 has moved towards measurement as the preferred means to demonstrate conformance in a number of areas. For all three systems, measurement is now the primary method or included as a component in demonstrating conformance in the following areas:

- ◆ Integrated Design, Assessment, Operations and Maintenance:
- ◆ Building System Controls (metering)
- ◆ Siting
- ◆ Renewable Energy
- ◆ Measurement and Verification (metering)
- ◆ Acoustics

LEED v4 NC and LEED v4 CI rely on calculations to achieve the energy efficiency credits. LEED v4 NC now requires building-level water metering as a prerequisite. LEED v4 CI provides an option for sampling to demonstrate conformance with the indoor air quality credits.

LEED v4 EB offers options for both measured performance and conformance with design calculations to achieve the energy efficiency credit. LEED v4 EB also relies on measurement as a component in the following areas:

- ◆ Moisture Control
- ◆ Thermal Comfort
- ◆ Daylighting
- ◆ Integrated Pest Management

3.2. ROBUSTNESS CRITERIA: ALIGNMENT BETWEEN LEED v4 AND FEDERAL REQUIREMENTS

Robustness criteria are used to determine how closely prerequisites and credits in the certification systems align with current Federal requirements.⁵ The evaluation contained in this Supplemental Review compares strategies, standards, technologies and analyses specifically identified in Federal requirements to the strategies, standards, technologies and analyses contained in LEED v4 prerequisites and credits. In some cases, either Federal requirements or LEED prerequisites/credits may be “prescriptive;” i.e., specifying the actions that must be taken in order to meet a requirement or fulfill a prerequisite/credit. In other cases, actions are “discretionary;” i.e., multiple potential approaches can be taken to meet a Federal requirement or fulfill a LEED credit. The analysis of alignment between the LEED v4 systems and Federal requirements is presented in the “Robustness Review” tables (Appendices A, C and E) and is summarized in the remaining sections of this report. Table 3-1 illustrates the results of this analysis.

⁵ Through May 2014.

Table 3-1. Alignment with Federal Requirements

	LEED v4 NC	LEED v4 EB	LEED v4 CI
Robustness—Integrative Principles			
Integrated Assessment, Operation and Management			
Commissioning			
Building System Controls (Not in GP)			
Siting (Not in GP)			
Greenhouse Gas (Not in GP)			
Robustness—Energy			
Energy Efficiency			
On-Site Renewable Energy and Green Power			
Measurement and Verification			
Benchmarking			
Robustness—Water			
Indoor Water			
Process Water			
Outdoor Water			N/A
Measurement of Water Use			N/A
Stormwater			N/A
Water-Efficient Products			
Robustness—Indoor Environment			
Ventilation			
Thermal Comfort			
Integrated Pest Management	N/A		N/A
Daylighting			
Environmental Tobacco Smoke Control			
Moisture Control			
Protect Indoor Air Quality During Construction		N/A	
Low-Emitting Materials			
Acoustics (Not in GP)			
Robustness—Materials			
Recycled Content			
Bio-based Content			
Environmentally Preferable Products			
Waste and Materials Management			
Ozone Depleting Compounds			

Note:

Full circle: Federal requirement automatically because LEED v4 includes prerequisite that fully aligns with the federal requirement

Three-quarters circle: LEED v4 has a credit that meets the Federal requirement

Half-circle: LEED v4 has a credit that is related to, but not specifically aligned, with the Federal requirement.

Empty circle: Federal requirement is not an identified component within the LEED v4 certification system.

3.2.1. Integrative Principles

This portion of the analysis focuses on Federal requirements that direct an integrative approach to design, construction and operation of buildings. Federal requirements reviewed within this section include:

- ◆ Integrated Design, Assessment, Operations and Management
- ◆ Environmental Management Systems
- ◆ Commissioning
- ◆ Building System Controls
- ◆ Siting
- ◆ Greenhouse Gas Emissions

LEED v4 offers a number of prerequisites and credits that support an integrative approach to building design, construction, operations and maintenance. However, taken collectively, these credits are related to but do not fully align with all aspects of the Federal requirements. Commissioning requirements are automatically met through prerequisites in LEED v4 NC and LEED v4 CI, but a credit must be achieved to meet these requirements in LEED v4 EB. For purposes of this Supplemental Review, “building system controls” are defined as systems which are used to manage the whole building (i.e., building automation systems [BAS] or building management systems [BMS]). Controls specific to one component of a building (such as lighting systems) do not meet the federal definition. Building system controls (building automation systems) are not addressed in LEED v4; Federal requirements for siting can be met through credits. Numerous LEED v4 prerequisites address reduction of greenhouse gas emissions, which align with Federal requirements.

INTEGRATED DESIGN, ASSESSMENT, OPERATIONS AND MANAGEMENT

Federal Requirements

- ◆ E.O. 13514 includes a number of “integrative” requirements that drive the Federal government’s approach to high performance buildings, but are not specified in the Guiding Principles. The Guiding Principles outline a “whole building” approach to design, construction, operation and deconstruction of buildings and to management of an agency’s real estate.
 - Agencies must ensure that at least 15% of the agency’s existing buildings and building leases meet the Guiding Principles by fiscal year 2015.

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- Agencies must demonstrate annual progress toward 100% conformance with the Guiding Principles for its entire portfolio.
 - Agencies and facilities are directed to pursue cost-effective, innovative strategies to minimize consumption of energy, water, and materials.
 - Agencies and facilities are directed to manage existing building systems to reduce energy, water, and materials consumption.
 - Agencies and facilities are directed to identify alternatives to renovation that reduce deferred maintenance costs.
 - Before adding new facilities, agencies are directed to consider a number of factors, including optimizing performance of the real estate portfolio, reducing environmental impacts, and opportunities to consolidate and dispose of existing assets.
 - When renovating historic buildings, facilities are directed to use best practices and technologies.
- ◆ Requirements to implement Environmental Management Systems (EMSs) are established by Executive Order. Agencies are directed to implement an EMS program at various organizational levels with facilities required to develop and implement EMS as an aspect of facility performance.
 - ◆ The Guiding Principles for New Construction direct that the design process be collaborative and integrative, using an integrated design team modeled on the framework provided in the Whole Building Design Guide (<http://www.wbdg.org>). OMB's directive on capital asset planning and development of the business case must be integrated in the facility's planning and design process. The design plan must consider all stages of a building's lifecycle (including deconstruction); include performance goals for siting, energy, water, materials, and indoor environmental quality (at a minimum); and ensure that these performance goals are incorporated into the buildings' design and operation throughout the lifecycle of the building.
 - ◆ The Guiding Principles for Existing Buildings direct establishment of an integrated facility team charged with developing and implementing policies and programs to ensure sustainable operations and maintenance. Strategies identified include:
 - Establishment of operational performance goals for energy, water, material use and recycling, and indoor environmental quality for the lifecycle of the building.

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- Developing a building management plan to implement appropriate strategies to achieve the goals on an ongoing basis. Tenant education is called out as a key element in the management plan.
 - Creating operational procedures for major building systems and facility management, with an ongoing program of assessment and continuous improvement. Occupant feedback on workspace satisfaction is identified as a key component in the ongoing assessment program. Sustainable operations and maintenance practices are to be incorporated within EMSs.

E.O. 13653 (Nov. 2013)⁶ generally addresses the inclusion of climate change impacts and resilience planning in Federal government activities. The requirements of this Executive Order are not specifically addressed in this Supplemental Review because they are not specific enough to analyze for green building certification systems. Only Section 5 is directly focused on Federal government operations. It requires agencies to develop Climate Adaptation Plans that include identifying risks to an agency's ability to accomplish its missions, operations and programs; a description of activities the agency will take to manage climate risks and build resilience; and (most directly affecting real estate management) a description of how the agency will consider the need to improve climate adaptation and resilience including the costs and benefits of such improvement with respect to agency suppliers, supply chain, real property investments, and capital equipment purchases such as updating agency policies for leasing, building upgrades, relocation of existing facilities and equipment, and construction of new facilities.

LEED v4 Analysis

LEED v4 NC and LEED v4 CI each offer one credit (Integrated Design) directly aimed at creating an integrative process for design. Preliminary energy analysis and development of a water budget are to be included within relevant design documents, but performance goals for other aspects called out by the Guiding Principles are not addressed. The credit does not direct teams to consider the lifecycle of the building, nor does it address requirements for capital planning and business case as required by OMB; however, there is no restriction on incorporating additional elements into the plan. All of the prerequisites and credits in the Materials and Resources and Indoor Environmental Quality sections could be used to establish performance goals; if those goals are incorporated into the design plans required for the Integrated Design credit, the Guiding Principles requirement for integrated performance goals would be met.

LEED v4 EB does not require either establishment of a cross-disciplinary facility management team, development of a building management plan, or an EMS. A

⁶ Available at: <http://www.whitehouse.gov/the-press-office/2013/11/01/executive-order-preparing-united-states-impacts-climate-change>.

number of prerequisites and credits require development of elements that would be included in a building management plan and EMS including energy, water, ongoing commissioning, purchasing and waste, indoor air quality, and facility maintenance/renovation. However, there is no requirement to integrate these individual plans into a “whole building” approach. A credit is also provided to support ongoing use of occupant feedback as a management strategy, but tenant education is not included as an aspect of sustainable operations.

All LEED v4 systems award one point to projects that include a LEED Accredited Professional as part of the design team.

COMMISSIONING

Federal Requirements

- ◆ Facilities are directed by statute to commission newly installed equipment, and to follow up by developing operations and maintenance plans that include measures to verify ongoing energy and water performance, including recommissioning, as a strategy for existing buildings.
- ◆ EISA requires energy and water assessments for all facilities on a 4-year rotating cycle. This requirement may be met through routine recommissioning.
- ◆ The Guiding Principles approach commissioning more broadly than the statute, directing that commissioning and recommissioning be “tailored to the size and complexity of the building and its system components.” Criteria outlined to meet this requirement include: using an experienced commissioning provider; including commissioning requirements in construction documents; developing a commissioning plan; and verifying installation and performance of commissioned systems with the commissioning agent producing a written report. DOE FEMP’s Guidance for Commissioning Existing Buildings is cited as a guideline. Ongoing commissioning (using building automation systems and auditing techniques) is an emerging best practice for Federal agencies.

LEED v4 Analysis

LEED v4 NC and LEED v4 CI each include a commissioning prerequisite that directly aligns with Federal requirements. However, ASHRAE Guidelines 0-2005 and 1.1-2007 are identified as standards instead of the FEMP guidance. Criteria for commissioning agent qualifications are outlined in the prerequisite. Additional points can be earned through an optional credit containing two options and three compliance paths, any of which can be used to meet Federal requirements. One path is aimed at integrating commissioning into both construction and ongoing maintenance, outlining steps such as a review of construction documents and development of an on-going commissioning plan. A second path prescribes a moni-

toring approach to be used for energy and water systems. The additional option addresses commissioning of the building envelope; this option also supports achievement of Federal requirements for moisture control.

LEED v4 EB does not include a prerequisite for commissioning; three optional credits are provided. One credit addresses the use of commissioning as an auditing and assessment tool. This credit aligns with Federal requirements with one exception: commissioning is to be conducted on a five-year cycle, versus the four-year cycle identified in the statute. A second credit directs that the facility implement low-cost improvements and develop a five-year plan for capital improvements identified through the commissioning process; building operator training and a formal tracking and verification plan are also required. The third credit addresses ongoing commissioning, outlining essential elements to be included in an ongoing commissioning program. Portions of the ASHRAE Guidance and USGBC's Recertification Guidance are identified as standards.

BUILDING SYSTEM CONTROLS

Federal Requirements

The Federal government does not have specific requirements for building system controls. EISA requires GSA to include building system controls in its review criteria when evaluation green building certification systems.

LEED v4 Analysis

LEED v4 does not directly address Building Automation Systems (BAS). Some building system controls are included among the requirements for LEED v4 prerequisites and credits in the Energy, Water and Indoor Environmental Quality sections. LEED v4 NC and LEED v4 EB require building level metering for energy and water as prerequisites. LEED v4 NC and LEED v4 EB require building level metering for energy as prerequisites. Optional credits are available for sub-metering. LEED v4 CI includes an optional credit focused on energy sub-metering for tenant spaces. LEED v4 NC and LEED v4 CI contain credits that require occupant controls, thermal comfort and interior lighting. LEED v4 EB addresses lighting controls, but does not appear to address controls for thermal comfort.

SITING

Federal Requirements

- ◆ Requirements for siting of new facilities are established by statute and Executive Order, directing that facilities be located in central cities or town centers and that site selection criteria include consideration of factors promoting transit and pedestrian access.
- ◆ E.O. 13514 expands on this requirement, directing that agencies address the following in their portfolio planning processes:

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- Ensure that planning for new building or leases includes consideration of sites that are pedestrian friendly, near existing employment centers, accessible to public transit, and located in city or town centers.
 - Participate in regional transportation planning to support community transportation infrastructure.
 - Support local planning for energy choices through agency policies. Identify and analyze impacts from energy usage and alternative energy sources in all National Environmental Policy Act (NEPA) evaluations.
 - Coordinate with regional programs for watershed, and environmental management.

LEED v4 Analysis

There are no prerequisites for siting in any of the three LEED v4 systems reviewed. All three systems include credits that require access to alternative transportation, which aligns with the Federal requirements for transportation. LEED v4 NC and LEED v4 CI also direct development towards neighborhoods with relatively high density, which generally supports the Federal requirement to locate Federal facilities in town and city centers.

GREENHOUSE GAS EMISSIONS

Federal Requirements

- ◆ Greenhouse Gas (GHG) emission reduction requirements are established through Executive Order 13514. Federal agencies are required to develop comprehensive GHG inventories (including scopes 1-3), establish GHG reduction targets at the agency level, and report annually on progress in reducing GHG emissions.
 - Requirements to reduce Scope 1 and 2 GHG emissions include reducing reliance on fossil fuels and increasing use of renewable energy.
 - Requirements to reduce Scope 3 GHG emissions include:
 - Transportation: Use alternative fuel vehicles, optimize fleet size, and reduce total consumption of petroleum products within the fleet by 2% annually through fiscal year 2020 (2005 baseline). Use conferencing and accommodations strategies that support low-carbon commuting and travel by staff.
 - Procurement: Pursue opportunities to reduce GHG emissions in the supply chain through contractual requirements and vendor selection strategies.

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- ◆ Because E.O. 13514 post-dates the Guiding Principles, GHG emissions are not addressed in the Guiding Principles.

LEED v4 Analysis

Each LEED v4 system reviewed addresses GHG emission reduction through a number of prerequisites and credits. Prerequisites and optional credits for energy use reduction and refrigerant management contribute to reduction of Scope 1 GHG emissions. Credits awarding points for green power and renewable energy use contribute to Scope 1 or 2 GHG emission reductions while offsets address scopes 1 and 3.

LEED v4 NC and LEED v4 CI include four credits that support Scope 3 GHG emission reduction by supporting alternative transportation modes. LEED v4 EB includes one credit addressing alternative transportation modes. Credits and prerequisites addressing life cycle impact reduction, green purchasing (including environmental product declarations[EPDs]), solid waste diversion, and construction waste diversion can also be used to support scope 3 GHG emission reductions.

3.2.2. Energy

Federal requirements for energy include energy reduction targets for agencies and strategies to achieve those targets at the facility level. Targets for energy reduction, renewable energy and energy efficient products are established by statute and Executive Order. Requirements for measurement and verification, benchmarking, auditing and commissioning are established by statute. The Guiding Principles establish strategies to achieve target reductions, which are expressed as requirements. Agencies report energy use, energy use reduction and renewable energy use through DOE's Compliance Tracking System (CTS) portal.

Auditing, commissioning, building metering, power management for equipment and procurement of energy efficient equipment (certified through Federal labeling programs) are also required by statute. The Guiding Principles address metering and commissioning and partially addresses procurement of energy efficient equipment (omitting the Electronic Product Environmental Assessment Tool (EPEAT)). The Guiding Principles do not directly address auditing, servers, power management or building system controls.

Federal requirements reviewed within this section include:

- ◆ Energy Use Reduction
- ◆ Renewable Energy
- ◆ Auditing, Benchmarking, and Measurement and Verification

LEED v4 prerequisites for reduction of energy use support Federal requirements, but credits must be obtained to fully meet Federal requirements. There are no pre-

requisites for renewable energy use; LEED v4 credits support, but do not fully align with Federal requirements. Federal requirements for auditing, and for measurement and verification can be met if credits are achieved in LEED v4 NC and LEED v4 CI, but LEED v4 EB's credits only partially align. Benchmarking is not addressed in LEED v4 NC, but Federal requirements for Existing Buildings can be met if the credit in LEED v4 EB and LEED v4 CI is achieved.

ENERGY USE REDUCTION

Federal Requirements

- ◆ Agencies are required to achieve a 30% reduction in building energy use in aggregate by 2015 (relative to a 2003 baseline).
- ◆ A number of strategies to reduce energy use are required by statute and/or Executive Order 13514. These required strategies include:
 - Purchase of FEMP designated, ENERGY STAR and EPEAT certified products and equipment.
 - Enabling power management and energy efficiency features and using best practices for energy efficiency in servers and data centers.
 - Employing the most energy efficient designs, systems and equipment based on life cycle cost effectiveness.
- ◆ The Guiding Principles for New Construction apply the 30% energy reduction target at the facility level for new construction based on the ASHRAE 90.1-2007 standard. Major renovations are assigned a target of 20% reduction based on a 2003 pre-renovation baseline. There is no Federal target established for interior renovations.
- ◆ A pending Department of Energy regulatory change would require all Federal agencies to achieve a 30% reduction for new construction/20% reduction for major renovation against the ASHRAE 90.1-2010 standard, retroactive to July 2014.

LEED v4 Analysis

Reduced energy use is a prerequisite in all three systems. However, LEED v4 NC is based on the updated ASHRAE 90.1-2010 standard, which is more stringent than the 2007 standard cited in the Guiding Principles. Because of differences in the standard, targets and methodology used by LEED v4, only the prerequisite in LEED v4 EB directly aligns with Federal requirements. The multiple compliance paths available in LEED v4 are summarized in more detail in Table 3.2

The LEED v4 NC prerequisite requires a 5% reduction against the 2010 ASHRAE standard for new construction, and a 3% reduction for major renova-

tions. This target does not directly align with the Guiding Principles target of 30% for new construction and 20% for major renovations based on the 2007 ASHRAE standard. Analysis by PNNL⁷ concluded that the 90.1-2010 baseline provided 24.5% greater site energy savings (on average) than the 90.1-2007 baseline. The additional energy savings required by the LEED v4 NC prerequisite (5%/3% additional energy reduction beyond the 2010 baseline) appears to provide the same level of energy reduction as the Guiding Principles' requirement. The LEED v4 NC prerequisite also includes two prescriptive compliance paths for qualifying buildings based on the same energy reduction standard. However, these prescriptive options are based on best practices rather than meeting a baseline, so they do not align with Federal requirements.

The optional credit in LEED v4 NC supports the requirement to use energy efficient designs, systems and equipment, but does not directly address Federally-labeled energy products. LEED v4 NC also includes these products among the list of acceptable products identified in credits relating to procurement in the Materials and Resources section. LEED v4 NC does not address power management.

The prerequisite in LEED v4 CI can be met by modeling a 3% reduction against the ASHRAE 90.1-2010 baseline. The LEED v4 CI prerequisite also includes reductions in lighting power density and use of ENERGY STAR products. The prescriptive path provided in LEED v4 CI relies on best practices rather than meeting a baseline. The optional credit in LEED v4 CI offers two paths: further reduction in tenant energy use (calculated through modeling simulations) or pursuing strategies to improve energy efficiency base building systems, HVAC systems, interior lighting, equipment and appliances.

The prerequisite in LEED v4 EB includes 3 compliance paths, two of which align with Federal requirements. Option 1 of the LEED v4 EB prerequisite requires an ENERGY STAR Portfolio Manager score of 75, identical to the Guiding Principles. Option 2 establishes a target that exceeds the target identified in Option 2 of the Guiding Principles (25% versus 20% reduction in energy use). Credits for additional energy can be achieved reduction in LEED V4 EB through the ENERGY STAR Portfolio Manager system or through benchmarking against historical data, national average data or a combination. The optional credit does not directly address Federally-labeled energy products. (These products are included among the list of acceptable products identified in credits relating to procurement in the Materials section.)

⁷ PNNL-22972 National Cost-effectiveness of ASHRAE Standard 90.1-2010 Compared to ASHRAE Standard 90.1-2007, November, 2013

Table 3-2. Summary of LEED v4 Energy Point Paths/Options

<p>LEED v4 NC</p>	<p>EAc2 Option 1. Whole-Building Energy Simulation (1-18 points)</p> <p>Percent reduction in modeled energy use compared to the baseline. Baseline energy use is simulated according to ANSI/ASHRAE/IESNA Standard 90.1-2010, Appendix G, with errata and must include all energy consumption and costs within and associated with the building project.</p> <p>A minimum of 5% reduction for new construction and 3% reduction for major renovations is required to meet the prerequisite.</p>	<p>EAc2 Option 2. Prescriptive Compliance: ASHRAE 50% Advanced Energy Design Guide (1–6 points)</p> <p>Implement and document compliance with the applicable recommendations and standards in Chapter 4 for the appropriate ASHRAE 50% Advanced Energy Design Guide and climate zone.</p> <p>The prerequisite requires compliance with the mandatory and prescriptive provisions of ANSI/ASHRAE/IESNA Standard 90.1–2010, with errata for HVAC and Service Water Heating requirements including equipment efficiency, economizers, ventilation, and ducts and dampers in Chapter 4 for the appropriate ASHRAE 50% Advanced Energy Design Guide.</p>	<p>EAc2 Option 3. Prescriptive Compliance: Advanced Buildings Core Performance Guide (Prerequisite option only—no credit available)</p> <p>Compliance with the mandatory and prescriptive provisions of ANSI/ASHRAE/IESNA Standard 90.1-2010, with errata, and with Advanced Building Core Performance Guide’s Sections 1, 2, and 3 as applicable.</p> <p>Note: To be eligible for Option 3, the project must be less than 100,000 square feet. Healthcare, warehouse or Laboratory projects are ineligible for Option 3.</p>
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LEED v4 EB	<p>EAc4 Case 1.</p> <p>Using the ENERGY STAR Portfolio Manager tool, the project must achieve an efficiency rating of at least 75. (3-20 points)</p>	<p>EAc4 Case 2.</p> <p>For projects not eligible for an ENERGY STAR Rating, the project's performance must be compared to national averages, actual buildings, or the buildings previous performance</p>		
	<p>Option 1. Benchmark Against Typical Buildings</p> <p><u>Path 1.</u> National Average Data Available (1–20 points)</p> <p>Demonstrate energy efficiency performance that is 26% better than the median energy performance of similar buildings.</p> <p>A minimum of 25% reduction is required to meet the prerequisite.</p> <p><u>Path 2.</u> National Average Data Not Available (2–14 points)</p> <p>If comparable national data is not available, demonstrate a 27% performance improvement when compared to at least three similar buildings.</p> <p>A minimum of 25% reduction is required to meet the prerequisite.</p>	<p>Option 2. Benchmark Against Historical Data (2–14 points)</p> <p>If national average data is not available, demonstrate a 27% performance improvement for the preceding 12 months of the building's energy data as compared to 3 contiguous years of energy data drawn from the previous 5 years.</p> <p>A minimum of 25% reduction is required to meet the prerequisite.</p>	<p>Option 3. Benchmark Against Both Similar Buildings and Historical Data (1–20 points)–</p> <p>Applicable to projects achieving either Option 1: Path 2, or Option 2.</p> <p>If comparable national data is not available, follow the requirements of both Option 1, Path 2, and Option 2 demonstrate a 27% performance improvement when compared to at least three similar buildings and the building's historic data.</p> <p>A minimum of 25% reduction is required to meet the prerequisite.</p>	
				<p>Option 3. Benchmark Against Both Similar Buildings and Historical Data (1–20 points)–</p> <p>Applicable to projects achieving either Option 1: Path 2, or Option 2.</p> <p>If comparable national data is not available, follow the requirements of both Option 1, Path 2, and Option 2 demonstrate a 27% performance improvement when compared to at least three similar buildings and the building's historic data.</p> <p>A minimum of 25% reduction is required to meet the prerequisite.</p>

<p>LEED v4 CI</p>	<p>Option 1. Tenant-Level Energy Simulation (1–25 points)</p> <p>Percent reduction in modeled energy use compared to the baseline. Baseline energy use is simulated according to ANSI/ASHRAE/IESNA Standard 90.1-2010, Appendix G, with errata and must include all energy consumption and costs within and associated with the building project.</p> <p>A minimum 3% reduction is required for the prerequisite.</p>	<p>Option 2. Prescriptive Compliance (1–16 points)</p> <p>Compliance with the mandatory and prescriptive provisions of ANSI/ASHRAE/IESNA Standard 90.1-2010, with errata, ASHRAE 50% Energy Design Guides, daylighting controls, HVAC Zoning and Controls, and ENERGY STAR as appropriate.</p> <p>Base Building Systems (2–6 points)</p> <ul style="list-style-type: none"> - HVAC Systems (2 pts.) - Interior Lighting Power (1–4 pts.) - Interior Lighting Controls (1–2 pts.) - Equipment and Appliance (1–2 pts.) <p>Compliance with the mandatory and prescriptive provisions of ANSI/ASHRAE/IESNA Standard 90.1-2010, with errata and:</p> <ul style="list-style-type: none"> - Reduce LPD by 5% - Install ENERGY STAR appliances for 50% of total ENERGY STAR eligible products 	
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Reference: Update to PNNL 2012 Report, Summary of Green Globes and LEED Energy Point Paths/Options, page 4.14

RENEWABLE ENERGY

Federal Requirements

Targets for renewable energy are established by statute, Executive Order and Presidential Memorandum. Requirements for measurement and verification, benchmarking, auditing and commissioning are established by statute.

- ◆ Agencies are required by statute to increase use of renewable energy to 7.5% by fiscal year 2013 and beyond. Agencies are also statutorily required to meet 30% of hot water demand through the installation of solar hot water heaters (when lifecycle cost effective). Executive Order 13423 requires that 50% of renewable energy come from “new” sources (defined as 1999 or later). The Guiding Principles reiterate the statutory requirements.
- ◆ The 2013 Presidential Memorandum on Federal Leadership in Energy Management revises these requirements. Agencies are now required to meet 20% of total electric energy consumption through renewable sources by fiscal year 2020, with “acceptable” sources of renewable energy closely defined. The definition of “new” has been changed to a rolling definition: only renewable energy sources that have come into service within 10 years of the fiscal year can be used to meet this requirement.

LEED v4 Analysis

LEED v4 has no prerequisites addressing use of renewable energy. All three systems reviewed include optional credits that support, but do not fully align with Federal requirements. LEED v4 requires renewable energy certificates (RECs) to be Green-e certified, which is more restrictive than the Federal requirements. System by system differences are outlined below.

LEED v4 NC and LEED v4 CI each contain two optional credits that address renewable energy. One credit awards points to projects that produce between 1–10% of energy requirements (1–5% in CI) through on-site renewables. Both LEED v4 systems allow off-site renewable energy to contribute to this percentage if the off-site project is owned or leased by the project owners and renewable energy certificates (RECs) are also acquired. This strategy aligns with one of the “acceptable” options outlined in the Presidential Memorandum. The second credit awards points if 50–100% of the project’s energy needs for 5 years are met through RECs or carbon offsets acquired in 2005 or later. This strategy partly aligns with an “acceptable” option: RECs are allowed by the Presidential Memorandum, but the 2005 fixed date established by LEED v4 does not align with the “new renewables” definition of a rolling 10 year period, and carbon offsets are not among the “acceptable” options identified in the Presidential Memorandum.

LEED v4 EB offers one credit addressing renewable energy with points awarded for each 1.5% of energy consumed (up to 7.5%) of energy consumed that is produced through on-site renewables, or the purchase of RECs/carbon offsets for a 2-year period. This strategy partly aligns with an “acceptable” option: RECs are allowed by the Presidential Memorandum, but the 2005 fixed date established by LEED v4 does not align with the “new renewables” definition of a rolling 10 year period, and carbon offsets are not among the “acceptable” options identified in the Presidential Memorandum.

AUDITING, BENCHMARKING, AND MEASUREMENT AND VERIFICATION,

Federal Requirements

Requirements for auditing, benchmarking, measurement and verification (M&V) and commissioning are established by statute. Required strategies include:

- ◆ Agencies must perform comprehensive energy evaluations in 25% of the portfolio⁸ every year (auditing every facility at least once every 4 years). Facilities must follow up on audit findings by commissioning equipment, developing operations and maintenance plans, and measuring and verifying energy savings. The DOE CTS portal is used to track and certify compliance with this requirement.
- ◆ Whole building meters were required to be installed on all Federal buildings by 10/1/2012 where life cycle cost effective. The statute also directs that energy data from metered buildings be entered into a benchmarking system, such as the ENERGY STAR Portfolio Manager.
- ◆ The Guiding Principles reiterate the statutory requirements for auditing, benchmarking and M&V, but adds requirements for benchmarking. For new construction and major renovations, facilities are directed to compare energy performance data from the first year of occupancy with the energy design target, verifying that the building is meeting its design target or operating within 10% of the energy budget for similar building types. Managers of existing buildings are directed to compare performance data to the previous year annually.
- ◆ The Presidential Memo on Energy Management (2013) adds requirements that metered data be entered into the ENERGY STAR Portfolio Manager System to support benchmarking. Annual energy performance data will continue to be publicly disclosed through DOE’s CTS system, and agencies are also directed to incorporate the Green Button system (where feasible) to support additional analytics and automation at a future date.

⁸ “Covered facilities” EISA §432.

LEED v4 Analysis

LEED v4 NC and LEED v4 EB require building level metering for energy as prerequisites. Optional credits are available for sub-metering. LEED v4 CI does not include a prerequisite for metering, but does include an optional credit focused on sub-metering tenant spaces.

LEED v4 NC does not require that metered data be entered into ENERGY STAR Portfolio Manager. LEED v4 EB's prerequisite for minimum energy performance is built on ENERGY STAR, so entry of metered data into Portfolio Manager would be required.

Data collected through metering must be reported to USGBC, creating a double reporting requirement for Federal agencies (since energy data is already reported the DOE CTS portal).

3.2.3. Water

Targets for reduction of water use, requirements for water efficient equipment and auditing requirements are all established by Executive Order. Requirements for stormwater management, process water, measurement and verification and benchmarking are established by statute. EISA also requires restoration of pre-development site hydrology for all new construction and major renovations.

Federal requirements for water include water reduction targets for agencies and strategies to achieve those targets at the facility level. Federal water reduction requirements address three primary areas: reduction of potable water use; reduction of water used for irrigation and industrial purposes; and stormwater management. Measurement of water use is encouraged through installation of building level meters and sub-meters where appropriate.

In addition to the agency targets and facility level strategies for plumbing fixture and irrigation contained in the Guiding Principles (discussed in more detail below), other water reduction strategies expressed as requirements include:

- ◆ Perform comprehensive water evaluations in 25% of the portfolio⁹ every year, so that every facility is audited at least once every 4 years.
- ◆ Follow up on audit findings including implementing identified water efficiency measures, commissioning equipment, developing operations and maintenance plans, measuring and verifying water savings.
- ◆ Purchase WaterSense and water efficient equipment.
- ◆ Apply water conservation strategies to process water used in HVAC systems.

⁹ "Covered facilities" EISA §432.

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- ◆ Agencies report water use through DOE's CTS portal.

Federal requirements reviewed within this section include

- ◆ Potable Water Use Reduction and Measurement of Water Use (Indoor Water)
- ◆ Process Water
- ◆ Water Efficient Products
- ◆ Water for Irrigation and Industrial Purposes (Outdoor Water)
- ◆ Stormwater Management

LEED v4 NC and LEED v4 CI include a prerequisite compliance path that fully aligns with Federal requirements for water reduction, but the credit must be achieved in LEED v4 EB. LEED v4 NC and LEED v4 CI fully meet Federal requirements for process water. There are no prerequisites for stormwater and outdoor water use, but Federal requirements can be met if credits are achieved. LEED v4 only partially supports requirements for measurement and WaterSense products.

POTABLE WATER USE REDUCTION AND MEASUREMENT OF WATER USE (INDOOR WATER)

Federal Requirements

- ◆ Each agency is directed by Executive Order to reduce potable water consumption by 26% in 2020 (relative to a 2007 baseline).
- ◆ E.O. 13514 also directs that agencies identify, promote, and implement water reuse strategies that reduce potable water consumption, consistent with State law.
- ◆ For New Construction/Major Renovations, the Guiding Principles direct that (a) facilities meet the fixture requirements of the 2006 Uniform Plumbing Code or the 2006 International Plumbing Code, then (b) achieve at least a 20% reduction in potable water use against the indoor water use baseline calculated for the building based on these codes. Suggested strategies include installation of water meters, use of harvested rainwater, treated wastewater, and air conditioner condensate where feasible to reduce potable water use.
- ◆ For Existing Buildings, the Guiding Principles provide two options/strategies to achieve potable water reduction at the facility level: 100% of plumbing fixtures must meet the standards of the 2006 Uniform Plumbing

code or 2006 International Plumbing Code; or the facility must reduce building potable water use by 20% against a specified baseline year.

LEED v4 Analysis

LEED v4 has changed the system's focus from potable water to "total water use," which more closely aligns LEED with Federal requirements. By focusing on total water use and requiring reductions through efficiency measures, potable water reductions are required to be met through efficiency rather than through the use of alternate water sources.

For LEED v4 NC, one prerequisite is identical with the Federal requirement: projects must achieve a 20% water efficiency target through installation of water-efficient fixtures. A second prerequisite requires installation of building-level water metering, which is consistent with Federal metering and auditing requirements. The non-potable water strategies outlined in the Guiding Principles can be used to pursue additional points through a multi-point credit. LEED v4 CI uses the same approach as LEED v4 NC for fixture installation, but metering is an option, not a prerequisite.

LEED v4 EB does not provide a prerequisite which conforms precisely to the federal requirement. A calculated baseline, based on year of occupancy, is used to establish the water reduction target to be attained through fixture installation. Buildings occupied in 1995 or later that achieve the prerequisite target would meet the Federal requirement. However, the calculated baseline for buildings occupied in 1994 or earlier is different than the Federal requirement. Additional points for water use reduction can be achieved through additional efficiencies measured by calculation (fixture installation) or through sub-metered data. LEED v4 EB also includes a prerequisite requiring installation of building level metering with additional points available through an optional credit for sub-metering major systems (irrigation, indoor plumbing fixtures and fittings, cooling towers, domestic hot water, reclaimed water, other process water).

For all systems, data from water metering must be reported to USGBC, which creates a double reporting requirement for Federal agencies, (who already report water usage data through the DOE CTS portal).

PROCESS WATER

Federal Requirements

No reduction targets or strategies are specified in the Federal requirements. Cooling towers are referenced in the Federal requirements with direction to employ life cycle cost effective strategies when implementing energy efficiency improvements. Typical process water uses include cooling towers, non-regulated domestic uses, and appliances such as washing machines, spray valves, ice makers, and industrial applications.

LEED v4 Analysis

LEED v4 has added prescriptive requirements for process water efficiency (including cooling towers). LEED v4 NC includes a prerequisite requiring that the facility meet efficiency standards for common process water uses; additional points are available for increased efficiency achieved through cooling tower water management. LEED v4 CI requires process water reductions within the prerequisite for indoor water use, so if process water reductions are within the scope of the project, Federal requirements would be met. LEED v4 EB includes a credit through which points can be achieved by analyzing cooling tower water use and developing a management plan aimed at water use efficiency.

WATER EFFICIENT PRODUCTS

Federal Requirements

The Guiding Principles direct facilities to use WaterSense-labeled products or other water conserving products when available, and choose irrigation contractors who are certified through a WaterSense labeled program.

LEED v4 Analysis

LEED v4 requires use of WaterSense fixtures in the indoor water use reduction prerequisites and credits for all systems. It does not require use of WaterSense certified irrigation contractors. If the facility does not use irrigation, Federal requirements can be met through the LEED v4 prerequisites in all three systems.

WATER FOR IRRIGATION AND INDUSTRIAL PURPOSES (OUTDOOR WATER)

Federal Requirements

- ◆ Each agency is directed to reduce irrigation and industrial water consumption by 20% in 2020 (relative to 2010 baseline).
- ◆ For New Construction/Major Renovations, the Guiding Principles direct facilities to reduce outdoor water use consumption by 50% (over conventional means) by employing water efficient landscaping and irrigation strategies. Use of outdoor water meters is encouraged.
- ◆ For Existing Buildings, the Guiding Principles provide three strategies to achieve this reduction at the facility level: Reduce potable irrigation water by 50% relative to conventional methods; reduce potable irrigation water by 50% relative to measured irrigation water use in 2003; use no potable water for irrigation.

LEED v4 Analysis

LEED v4 NC is more specific than the Federal requirements with a lower water reduction target. The prerequisite requires a 30% reduction in the total amount of water used for irrigation (both potable and non-potable) before considering use of non-potable sources. Building level water meters (including outdoor water) are required and included in the prerequisite. Additional points can be attained through sub-metering and use of efficiency strategies and/or non-potable water sources. The EPA WaterSense Water Budget Tool is used to calculate water use and projected savings. LEED v4 CI only applies to indoor water use, so this requirement is not addressed.

LEED v4 EB does not include a prerequisite for outdoor water use reduction. The optional credit offers 3 strategies to reduce irrigation water:

- ◆ Use no water for irrigation.
- ◆ Reduce irrigation water use against a baseline calculated through the EPA WaterSense Water Budget Tool.
- ◆ Reduce irrigation water use compared to historic use (3 years of consecutive data within the last 5 years) based on metered data. Data from metering must be reported to USGBC.

Because LEED v4 does not establish specific reduction targets, the Guiding Principles requirement of a 50% reduction is not directly addressed. The baseline requirement of “conventional means” is also not addressed; this baseline might be met through the WaterSense Water Budget Tool.

Data collected through metering must be reported to USGBC, creating a double reporting requirement for Federal agencies (since water use data is already reported through the DOE CTS portal).

STORMWATER MANAGEMENT

Federal Requirements

- ◆ Facilities are required by statute to maintain or restore the predevelopment hydrology of a site to the maximum extent feasible through design, construction and ongoing maintenance. Temperature, rate, volume, and duration of flow are all factors to be considered in managing stormwater.
- ◆ The Guiding Principles direct use of strategies that reduce storm water runoff and discharges of polluted water offsite whenever undertaking a major project.

LEED v4 Analysis

LEED v4 does not address pre-development hydrology, nor is temperature (a Clean Water Act pollutant) included. LEED v4 NC has no prerequisite that directly addresses stormwater. The optional credit establishes a baseline built around the 95th percentile storm event, and requires that 25% of hard surface areas be addressed through low impact development practices. Additional points are available for an ongoing site improvement plan addressing hydrology, vegetation, and soils. LEED v4 CI only applies to indoor water use, so this requirement is not addressed.

LEED v4 EB includes a prerequisite that indirectly includes stormwater management by requiring “environmentally sensitive” practices. Additional points can be attained through development of a management and/or site improvement plan. Optional credits are also available for “rainwater management” using the same approach as LEED v4 NC with a focus on frequent, low-intensity rain events.

3.2.4. Indoor Environmental Quality

Strategies to address thermal comfort, ventilation, daylighting, moisture control and procurement of low-emitting materials are established in the Guiding Principles. Requirements for integrated pest management are established by statute and Executive Order. Smoking in Federal facilities is prohibited by statute. Inclusion of acoustics within the scope of this review is directed by statute.

Workplace design/space utilization and worker mobility are key strategies that drive the operational performance of buildings and heavily influence occupant health and productivity. Neither the Federal requirements nor LEED v4 specifically address this aspect of high performance buildings.

Federal requirements reviewed within this section include:

- ◆ Ventilation and Thermal Comfort
- ◆ Moisture Control
- ◆ Indoor Air Quality during Construction
- ◆ Daylighting and Lighting Controls
- ◆ Low Emitting Materials
- ◆ Integrated Pest Management
- ◆ Tobacco Smoke
- ◆ Acoustics

The only Federal requirements that can automatically be met through LEED v4 are ventilation and no smoking. LEED v4 EB and LEED v4 CI credits can be used to meet Federal requirements for thermal comfort, construction IAQ and acoustics, but LEED v4 NC only partially aligns in these areas. All other Federal requirements are only partially supported by LEED v4 credits.

VENTILATION AND THERMAL COMFORT

Federal Requirements

The Guiding Principles direct facilities to meet the requirements of ASHRAE 62.1-2007 (ventilation) and ASHRAE 55-2004 (thermal comfort).

LEED v4 Analysis

LEED v4 NC is consistent with Federal requirements for ventilation. LEED v4 NC has a prerequisite for providing adequate fresh air for occupants that is required by ASHRAE Standard 62.1-2007. LEED v4 NC's prerequisite for fundamental commissioning and verification references the updated and more stringent version of the standard; ASHRAE 62.1-2010.

LEED v4 EB is consistent with Federal requirements for ventilation and thermal comfort, although there is not direct alignment between LEED and the strategies identified in the Guiding Principles. All three systems reviewed include a prerequisite requiring that facilities meet the requirements of ASHRAE 62.1-2010 (the most current version of the applicable ventilation standard). Additional points can be achieved through optional credits addressing source control (entryways and interior cross contamination) and/or provision of fresh air for occupants above the ASHRAE standard. LEED v4 EB includes thermal comfort and indoor air quality within an optional credit governing administration of an occupant comfort survey. Corrective action is required for issues on which more than 20% of occupants express dissatisfaction.

However, there are no prerequisites in any of the three systems that address thermal comfort. Optional credits in LEED v4 NC requires compliance with the ASHRAE 55-2010 and provision of thermal comfort controls in at least 50% of individual occupants multi-occupant spaces. Optional credits in LEED v4 CI and LEED v4 EB offer two options: adherence to the ASHRAE 55-2010 standard, or designing HVAC systems and the building envelope to meet the requirements of ISO 7730:2005 (ergonomics of the thermal environment). These credits also require thermal comfort controls for occupants.

MOISTURE CONTROL

Federal Requirements

The Guiding Principles direct facilities to develop moisture control strategies aimed at preventing building damage, minimizing mold contamination, and re-

ducing health risks. For Existing Buildings, the Guiding Principles identify a specific strategy for façade renovations.

LEED v4 Analysis

None of the three LEED systems reviewed includes prerequisites that address moisture control. ASHRAE 55, the industry standard underlying LEED v4's thermal comfort credits, includes moisture as an aspect of occupant comfort. LEED v4 NC and LEED v4 CI contain an optional credit that includes some aspects of moisture control as part of a construction IAQ plan. The Enhanced Commissioning credit in LEED v4 NC includes an option for commissioning of building envelopes, with moisture control addressed through a series of specified management strategies.

An optional credit in LEED v4 EB addresses moisture control as part of an integrated indoor air quality management program. Humidity can be addressed in credits relating to thermal comfort and administration of an occupant comfort survey. Corrective action is required for issues on which more than 20% of occupants express dissatisfaction.

INDOOR AIR QUALITY DURING CONSTRUCTION

Federal Requirements

The Guiding Principles direct that new construction and major renovation projects follow Indoor Air Quality (IAQ) guidelines developed by the Sheet Metal and Air Conditioning Contractor's National Association (SMACNA) to control air quality during construction. Building flush-out is required prior to and after occupancy. The Guiding Principles for Existing Buildings do not address indoor air quality during construction.

LEED v4 Analysis

LEED v4 NC and LEED v4 CI do not include prerequisites governing construction IAQ, but optional credits in each system address both construction IAQ and flush-outs (through the indoor air quality assessment credit). The standards and requirements underlying these credits are aligned with Federal requirements; LEED v4 NC also provides an option for indoor air quality testing, which goes beyond the Federal requirements. LEED v4 EB includes a prerequisite to develop a facility maintenance and renovation policy with the SMACNA guidelines identified in the Guiding Principles as an underlying standard.

DAYLIGHTING AND LIGHTING CONTROLS

Federal Requirements

- ◆ The Guiding Principles for New Construction requires that facilities achieve a minimum daylight factor of 2% in 75% of primary workspace, with lighting controls and appropriate glare control provided.
- ◆ The Guiding Principles for Existing Buildings identifies two acceptable strategies: provide daylighting in 50% of occupied spaces or provide occupant control of lighting in 50% of occupied spaces.

LEED v4 Analysis

Daylighting is not addressed as a prerequisite in any of the 3 systems reviewed. Each LEED v4 system includes multi-option credits with different strategies to achieve points for daylighting.

LEED v4 employs a different metric and calculation method than the strategy identified in the Guiding Principles. The metric used for LEED v4 NC and LEED v4 CI (300 lux) probably exceeds the Federal requirement of a 2% daylight factor (calculated to be equivalent to 200 lux). However, these systems allow for a lower percentage of the building's regularly occupied areas to be daylit than the Federal standard (55% of regularly occupied areas vs. 75% of all space occupied for critical visual tasks). Assuming that 75% of all space occupied is less than 55% of all regularly occupied areas, the Federal requirement would be met if the facility achieves the number of points associated with 75% of regularly occupied daylit areas to meet the Federal requirement.

LEED v4 EB includes optional credits that address interior lighting and daylight views. The interior lighting credit does not require automated lighting controls. With this exception, alignment with Federal requirements can be attained if Option 2 in the lighting credit and Option 1 in the daylight credit are achieved. LEED v4 EB includes lighting within an optional credit governing administration of an occupant comfort survey. Corrective action is required for issues on which more than 20% of occupants express dissatisfaction.

LOW EMITTING MATERIALS

Federal Requirements

- ◆ The Guiding Principles for New Construction direct design teams to specify materials and products with low pollutant emissions in composite wood products, adhesives, sealants, interior paints and finishes, carpet systems, and furnishings.

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- ◆ The Guiding Principles for Existing Buildings direct use of low emitting materials for building modifications, maintenance, and cleaning, adding solvents and janitorial supplies to the list described above.

LEED v4 Analysis

None of the LEED v4 systems reviewed include prerequisites for low-emitting materials. The credits in LEED v4 NC and LEED v4 CI align with Federal requirements, so if these points are achieved, the Federal requirements for New Construction will be met. The LEED v4 EB credit does not fully align with Federal requirements: points can be achieved for developing a facility maintenance and renovation plan without addressing low emission products. Janitorial supplies are in the green cleaning credit, but solvents are not included among the products to be addressed.

INTEGRATED PEST MANAGEMENT

Federal Requirements

The statutory requirement is to use an integrated pest management (IPM) approach for landscaping. The Guiding Principles for Existing Buildings adds a requirement to use only EPA-registered pesticides. Integrated pest management is not addressed in the Guiding Principles for New Construction.

LEED v4 Analysis

LEED v4 EB does not include a prerequisite for integrated pest management. The optional credit fully aligns, so if the IPM credit is achieved, Federal requirements will be met.

TOBACCO SMOKE

Federal Requirements

A long-standing Federal statute prohibits smoking in Federal buildings. The Guiding Principles add requirements to prohibit smoking within 25 feet of all building entrances, operable windows, and building ventilation intakes. Implementation of a policy and signage is required for new construction.

LEED v4 Analysis

Prerequisites are included in all versions of LEED v4 that fully align with the Federal requirements.

ACOUSTICS

Federal Requirements

The Federal government does not have specific requirements for building acoustics. EISA requires GSA to include acoustics in its review criteria when evaluating green building certification systems.

LEED v4 Analysis

There are no prerequisites addressing acoustics in any of the three systems reviewed. LEED v4 NC includes a credit with two options to control interior noise. Option 1 is achieved by meeting ASHRAE and ANSI standards developed for HVAC background noise, sound isolation, reverberation time, and sound reinforcement and masking systems, with measures put in place to improve acoustical comfort for building occupants. Option 2 is achieved by meeting specified requirements for acoustical finishes and site exterior noise. The LEED v4 CI credit includes the same requirements as Option 1 in LEED v4 NC. Acoustics are addressed in LEED v4 EB as part of a credit requiring administration of an occupant comfort survey. Corrective action is required for issues on which more than 20% of occupants express dissatisfaction.

3.2.5. Materials

Federal agencies are increasingly trying to address the environmental impact of materials by focusing on the life cycle of products. As currently written, the Federal requirements do not support this integrated life cycle management approach because procurement and disposition of products are addressed as separate elements. Different types of products are addressed in different parts of the Guiding Principles, which adds confusion to this area of requirements.

Strategies relating to procurement and use of materials are addressed in four of the five Guiding Principles categories:

- ◆ Procurement of energy efficient products is addressed within the energy category.
- ◆ Procurement of water efficient products is addressed within the water category.
- ◆ Low-emitting products and products used for pest management are addressed in the indoor environmental quality category.
- ◆ Ozone Depleting Compounds (ODC), recycled content, biobased and Environmentally Preferable Products (including EPEAT certified products) are addressed in the materials category.

Federal requirements reviewed within this section include:

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- ◆ Procurement of Recycled Content, Biobased and Environmentally Preferable Products
 - ◆ Waste, Pollution and Toxics requirements
 - ◆ Elimination of Ozone Depleting Compounds (ODC)

LEED v4 supports but does not fully align with Federal requirements for procurement and materials management. Federal requirements can be met if credits are achieved only in the areas of Environmentally Preferable Products, solid waste reduction and Ozone Depleting Compounds.

PROCUREMENT OF RECYCLED CONTENT, BIOBASED AND ENVIRONMENTALLY PREFERABLE PRODUCTS

Federal Requirements

- ◆ Requirements to procure recycled content and biobased products are established by statute with the procurement targets and reporting requirements set by Executive Order.
- ◆ Requirements to procure Environmentally Preferable Products are established by regulation while procurement targets and reporting requirements set by Executive Order based on statute.
- ◆ Requirements for waste and pollution reduction (including reduction of toxic and hazardous chemical use) and reduction of ozone-depleting substances are established by statute, regulation and Executive Order.
- ◆ The Guiding Principles reiterate statutory procurement requirements in all of the areas outlined above.
- ◆ E.O. 13514 establishes a target for agencies requiring that 95% of new procurement contracts specify the following standards for products and services:
 - Energy-efficient (ENERGY STAR or Federal Energy Management Program (FEMP) designated)
 - Water-efficient
 - Biobased
 - Environmentally preferable (including EPEAT certified)
 - Non-ozone depleting
 - Contain recycled content

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- Non-toxic or contain less-toxic alternatives
 - ◆ E.O. 13514 further requires that agencies promote electronics stewardship, in particular by:
 - Ensuring a procurement preference for EPEAT-registered electronic products, and ensuring procurement of ENERGY STAR and FEMP-designated electronic products
 - Establishing and implementing policies to enable energy efficient power management and use of energy efficient features in equipment and implementing best management practices for servers and data centers
 - Employing environmentally sound disposition practices for excess or surplus electronic products.

LEED v4 Analysis

LEED v4 is not directly aligned with Federal requirements. While LEED v4 is less prescriptive than Federal requirements, it provides mechanisms to address the life cycle approach that Federal agencies have been working toward. The procurement targets and reporting requirements that Federal agencies must meet are not addressed by LEED v4.

Most of the Federal standards that agencies are required to meet when procuring products and services are included among LEED v4's list of "acceptable" standards (USDA's Biobased and Bio-preferred standards are omitted). However, LEED v4 does not specifically require that the Federal standards be met. The standards accepted by LEED v4 are identified in the "standards and tools" row for each credit within the Robustness Analysis tables (Appendices A, C and E).

Neither LEED v4 NC nor LEED v4 CI include prerequisites related to product procurement. Points can be achieved through optional credits addressing disclosure of product ingredients on a life cycle basis and installation of a specified percentage of materials whose impacts are below industry averages in specified areas (global warming potential, depletion of the stratospheric ozone layer, acidification of land and water resources, eutrophication, formation of tropospheric ozone; and depletion of nonrenewable energy sources).

LEED v4 EB includes a sustainable purchasing policy prerequisite which explicitly links purchasing with waste management. Additional points are available through optional credits, which require implementation of programs that address ongoing purchases of sustainable products in areas relating to facility renovation and ongoing maintenance.

WASTE, POLLUTION AND TOXICS REQUIREMENTS

Federal Requirements

E.O. 13514 requires that agencies:

- ◆ Minimize waste and pollution through source reduction
- ◆ Divert at least 50% of solid waste by fiscal year 2015 and increase diversion of compostable and organic material
- ◆ Divert at least 50% of construction and demolition materials and debris by fiscal year 2015
- ◆ Reduce and minimize acquisition, use and disposal of toxic and hazardous chemicals while increasing use of acceptable alternatives
- ◆ Report use, disposal and releases of pollutants and toxic substances in accordance with the Community Right to Know Act
- ◆ Decrease use of chemicals that contribute to greenhouse gas emissions
- ◆ Implement integrated pest management and other appropriate landscape management strategies.

Re-use, recycling and disposal of materials is addressed within the materials category in the Guiding Principles. However, only solid waste diversion, recycling and composting is directly addressed: statutory and regulatory environmental requirements applicable to facilities are neither identified nor addressed.

- ◆ The Guiding Principles identify strategies to be used, including minimizing waste, increasing diversion of compostables and organic materials, and maintaining cost effective waste prevention and recycling programs.
- ◆ The Guiding Principles for New Construction apply the 50% reduction target to facilities adding strategies that facilities should pursue (including identification of local services and markets for reusable and recyclable items). The Guiding Principles for Existing Buildings requires provision of recycling facilities for various solid waste streams.

LEED v4 Analysis

None of the LEED v4 systems fully align with Federal requirements. LEED v4 NC and LEED v4 CI include prerequisites requiring installation of dedicated areas for recyclables management as well as development of a construction waste management plan for facility construction and renovations. Federal requirements can be met through LEED v4 NC and LEED v4 CI credits. Additional points can be achieved by reusing building materials, using salvaged building materials

and/or diverting materials towards recycling and reuse. To achieve one point, the facility must divert at least 50% of construction and demolition materials from at least three waste streams; 75% diversion from four waste streams is required to achieve two points. However, the strategies to divert wastes are not prescribed.

LEED v4 EB's prerequisites require establishment of recycling storage areas, development of policies to address wastes generated through facility and maintenance, and development of the combined purchasing and waste management policy discussed as part of procurement above. Additional points can be achieved by developing ongoing programs to address common facility waste streams (including batteries and mercury-containing lamps). No reduction targets or strategies to divert waste are prescribed,

ELIMINATION OF OZONE DEPLETING COMPOUNDS (ODC)

Federal Requirements

- ◆ Agencies are required by statute to decrease use of ODC chemicals and increase use of alternatives. Agencies are also required by Executive Order to report on acquisition of products and services containing ozone depleting substances.
- ◆ The Guiding Principles add requirements to eliminate use of ODC during and after construction, referencing EPA's Significant New Alternatives Policy (SNAP) program as the source for acceptable alternatives.

LEED v4 Analysis

LEED v4 does not address the full scope of Federal requirements for elimination of ODCs. All three LEED v4 systems reviewed include a prerequisite that restricts the use of CFCs in refrigeration equipment, including phase-out of existing equipment. Additional points are available through an optional credit in each system, focused on reduction of ODCs used in refrigeration equipment. LEED v4 does not address ODCs' outside the context of refrigeration equipment, nor does it establish a reporting system to track ODC products and associated services.