Green Building Certification System Review

Findings Report

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Prepared for the U.S. General Services Administration by LMI.

June 2024

Acknowledgements

The U.S. General Services Administration (GSA), Office of Federal High-Performance Green Buildings, under the direction of Kevin Kampschroer, conducted this review under the direction of Bryan Steverson and Patrick Dale from the GSA project team and with support from Meredith Holland from the LMI project team.

The following green building certification system owners responded to the request for information regarding their systems:

- Victoria Papp, BOMA BEST Sustainable Buildings
- Breana Wheeler, Building Research Establishment's Environmental Assessment Method (BREEAM) USA
- Emily Marx, Green Building Initiative (Green Globes)
- Elizabeth Beardsley, U.S. Green Building Council (LEED)
- Patsy Heasly, International Living Building Institute (LBC)
- Al Mitchell, Passive House Institute US, Inc. (PHIUS)

Green Building Certification System Review: Findings Report

June 2024

Executive Summary

Section 436(h) of the Energy Independence and Security Act of 2007 (EISA) (42 U.S.C. 17092) requires the General Services Administration's (GSA's) Office of Federal High-Performance Green Buildings to complete a review of green building certification systems every 5 years. After the review, GSA recommends to the Secretary of Energy the green building certification systems most likely to lead to a comprehensive and environmentally sound approach to certifying green federal buildings.

GSA conducted a market analysis of the U.S. commercial green building certification system marketplace focusing on whole-building certification systems. This screening identified six systems:

- BOMA BEST 4.0 for Sustainable Buildings
- BREEAM USA In-Use Commercial, version 6
- Green Globes, version 2021 (for New Construction) and 2023 (for Existing Buildings)
- Leadership in Energy and Environmental Design (LEED), version 4.1
- Living Building Challenge (LBC), version 4.0 and Core Green Building Certification
- PHIUS, 2021 CORE, CORE REVIVE, ZERO and ZERO REVIVE

GSA invited the identified system owners to complete a survey, which asked for information on the technical components of the certification system that address federal green building performance requirements and industry best practices (effectiveness criteria, Table ES-1) as well as the processes by which the system was created and awards certification (development and conformance criteria, Table ES-2). GSA

developed the list of effectiveness criteria and development and conformance criteria based on specific building requirements found in:

- The Green Building Certification Systems Requirement for New Federal Buildings and Major Renovations of Federal Buildings Final Rule,[1] Department of Energy (DOE) [DOE Final Rule].
- EISA section 436(h).
- The Guiding Principles for Sustainable Federal Buildings, December 2020 (Guiding Principles).[2]

After evaluating and verifying the survey responses, GSA determined how well building certification systems aligned with the effectiveness criteria and development and conformance criteria. GSA evaluated 30 sub-criteria for new construction and 30 sub-criteria for existing buildings systems. This evaluation is not intended as a judgment on the relative quality of these green building certification systems and should not be used to rank these systems against each other. Each certification system offers a unique framework and assumes different user baselines and organizational sustainability expertise. Some certification systems assume a higher level of user sustainability sophistication and do not include some of the basic elements of sustainable design contained in the guiding principles. As such, GSA simply evaluates the alignment of each certification system with federal green building performance criteria. Table ES-1 summarizes the findings of certification system alignment to the effectiveness criteria.

Table ES-1. Summary of Review Findings, Effectiveness Criteria

	The number of federal sub-criteria met by system	The number of federal sub-criteria partially met by system	The number of federal sub-criteria not met by system
	✔	!	✖
New Construction and Major Renovation Building Certification Systems			
Green Globes NC	23	6	1
LBC NC	25	5	0
LBC Core NC	21	5	4
LEED BD+C	25	3	2
PHIUS NC	15	3	12

[1] [6450-01-P] Department of Energy 10 Code of Federal Regulations Parts 433, 435 and 436 [Docket No. EE RM/STD-02-112] RIN 1904-AC13. Available at https://www.federalregister.gov/documents/2014/10/14/2014-24150/green-building-certification-systems-for-federal-buildings.

[2] Available at: https://www.sustainability.gov/pdfs/guiding_principles_for_sustainable_federal_buildings.pdf.

Note: The number of effectiveness sub-criteria met (✔), partially met (!), or not met (✖) by each system. Abbreviations: Building Design and Construction (BD+C), New Construction (NC), Operations and Maintenance (O+M), Existing Buildings (EB), and Interior Design and Construction (ID+C).

Table ES-1. Summary of Review Findings, Effectiveness Criteria

	The number of federal sub-criteria met by system	The number of federal sub-criteria partially met by system	The number of federal sub-criteria not met by system
	✓	!	✗
Existing Building Certification Systems			
BOMA BEST	21	4	5
BREEAM	26	3	1
Green Globes EB	29	1	0
LBC EB	25	5	0
LBC Core EB	21	5	4
LEED O+M	21	5	4
PHIUS EB	15	3	12

Note: The number of effectiveness sub-criteria met (✓), partially met (!), or not met (✗) by each system. Abbreviations: Building Design and Construction (BD+C), New Construction (NC), Operations and Maintenance (O+M), Existing Buildings (EB), and Interior Design and Construction (ID+C).

Table ES-2 summarizes the alignment of the certification systems with the seven development and conformance sub criteria. Appendix A includes additional information on usability in narrative form, as well as general system overview information.

Table ES-2. Summary of Review Findings, Development and Conformance Criteria

Criteria	Sub-criteria	BOMA BEST[c]	BREEAM[c]	Green Globes	LBC	LBC Core	LEED	PHIUS
Process for Developing and Administering the Certification System	Consensus-based approach	✓	✗	✓	✗	✗	✓	✓
	Transparency	✓	✓	✓	!	!	✓	✓
	Usability[a]	✓	✓	✓	✓	✓	✓	✓
	Maturity	✓	✓	✓	✓	✓	✓	✓
Conformity Assessment	Independence	✓	✓	✓	✓	✓	✓	✓
	Verification[b]	✓	✓	✓	✓	✓	✓	!
	Post Occupancy evaluation	✓	✓	!	!	!	✓	✗

[a] See Appendix A for more information about the cost of each system.

[b] Not included in DOE rule.

[c] The DOE rule does not apply to systems certifying existing buildings. The rule does apply to new construction and major renovations of projects that are above the prospectus threshold; however, these major renovations are captured in the new construction systems.

Although each building certification system offers a unique framework and approach to achieving building certification, they all agree on the general aspects of building design, construction, operation, and maintenance that lead to green commercial office buildings. While each system addresses the primary criteria that define green buildings, no single system fully aligns with all federal green building performance requirements.

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Chapter 1
Purpose of Review

Section 436(h) of the Energy Independence and Security Act of 2007 (EISA) (42 U.S.C. 17092) requires the General Services Administration's (GSA's) Office of Federal High-Performance Green Buildings to evaluate green building certification systems every 5 years. After the review, GSA recommends to the Secretary of Energy the green building certification systems that are most likely to lead to a comprehensive and environmentally sound approach to certifying green federal buildings. Appendix A includes additional background information on the statutory and other drivers that establish the federal green building performance requirements.

This report objectively summarizes the findings of GSA's green building certification system review. The information from this report will inform the development of a set of recommendations from GSA to the Secretary of Energy.

Green Building Certification Systems

Green building certification systems focus on an integrated design approach to building projects to reduce environmental impacts and use resources more efficiently throughout a building's lifecycle. They offer both design and operational guidance to achieve a set of specified criteria and reward relative levels of achievement for meeting environmental and sustainable design goals and requirements.[1] This review does not include building certification systems that focus on single building attributes (e.g., single sustainable product certifications or single aspects of building performance such as energy efficiency) or a limited scope of building attributes, even if they have a similar purpose of improving building performance (see Appendix A).

Federal Use of Green Building Certification Systems

EISA does not require federal agencies to use green building certification systems, although agencies may choose to do so to support conformance with federal green building performance requirements contained in statutes and executive orders, as well as the Guiding Principles. Although achieving a green building certification does not guarantee compliance with all federal building performance requirements for new and existing buildings, building certification systems provide several advantages to federal agencies.[2]

Green building certification systems:

- Provide a well-established framework for documenting and ensuring compliance with energy, water, materials, and indoor environmental quality requirements.

[1] For an expanded definition, see the Whole Building Design Guide: https://www.wbdg.org/resources/green-building-standards-and-certification-systems.

[2] List of advantages adapted from GAO-15-667 Report: "Federal Efforts and Third-Party Certification Help Agencies Implement Key Requirements, but Challenges Remain," https://www.gao.gov/assets/680/671618.pdf and feedback from past GSA reviews.

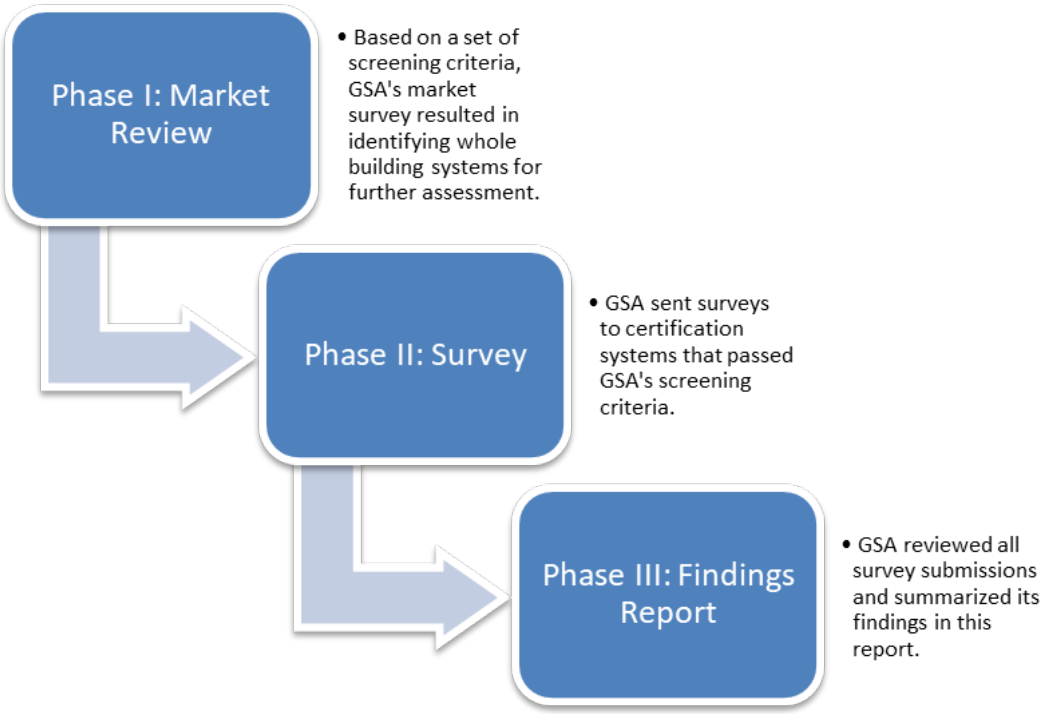
- Offer additional strategies and opportunities to improve building efficiency by encouraging a holistic, integrated approach to building performance.
- Are useful in connecting the federal sector with the current, commercially available private sector standards.
- Serve as a tool to communicate with contractors and the public.
- Reduce the need for additional staff to verify that a building meets requirements
- Are cheaper and preferable to developing internal, proprietary, or non-consensus certification systems (at the federal or agency level). The National Technology Transfer and Advancement Act directs federal agencies to use existing consensus-based certification systems or standards in the private sector where available.

Chapter 2
Review Method

Review Approach

Figure 2-1 depicts the three phases of GSA's review of green building certification systems. In Phase I, GSA identified applicable certification systems based on four screening criteria that align with EISA requirements and the DOE Final Rule.[1,2] In Phase II, system owners completed a survey to demonstrate alignment with GSA's effectiveness criteria and development and conformance criteria.[3] In Phase III, GSA evaluated and verified the survey responses and system alignment with the effectiveness criteria and development and conformance criteria. This report summarizes the methods and results of each phase.

Figure 2-1. GSA's Green Building Certification System Review Process



Phase I: Market Review

To identify systems that fall within the scope of this review, GSA screened the market for all green building certification systems that were commercially available as of the end of April 2023. GSA applied the following four screening criteria, which are aligned with

[1] https://www.federalregister.gov/documents/2014/10/14/2014-24150/green-building-certification-systems-for-federal-buildings.
[2] Phase I completed in April 2023.
[3] Phase II completed in December 2023.

EISA requirements and the DOE Rule, to select green building certification systems for further review. GSA used the following screening criteria:

1. Are currently available for use in the U.S. commercial buildings market and not limited to one climate zone or geographic region.
2. Address whole buildings (rather than individual products) with multiple performance and sustainable design attributes from EISA, including energy, water, materials, and indoor environmental quality.
3. Award certification based on validation by an independent, third-party assessor.
4. Incorporate, where feasible, measurable or calculated metrics to assess building performance.[4]

GSA found over 100 building certification systems[5] available in the market. The following six systems met the initial screening criteria for further assessment:

1. BOMA BEST 4.0 for Sustainable Buildings (http://www.bomabest.org), developed by the Building Owners and Managers Association (BOMA) of Canada.
2. BREEAM USA In-Use Commercial, version 6 (http://www.breeamusa.com), developed by BREEAM USA.
3. Green Globes, version 2021 and 2023 (http://www.thegbi.org), developed by the Green Building Initiative.
4. LBC, version 4.0 and Core Green Building Certification (https://living-future.org/lbc/), developed by the International Living Future Institute.
5. LEED, version 4.1 (https://new.usgbc.org/leed), developed by the U.S. Green Building Council (USGBC).
6. PHIUS, 2021 CORE, CORE REVIVE, ZERO and ZERO REVIVE (https://www.phius.org/), developed by Passive House Institute US, Inc.

GSA notified these six building certification system owners in May 2023 of its intent to review their building certification systems. The six system owners expressed interest in participating.

GSA identified specific criteria and sub-criteria to evaluate system development, how projects achieve certification, and how effectively the systems align with specific federal green building performance requirements. GSA based these criteria on EISA Section 436(h), the DOE Final Rule, the Guiding Principles, and other federal drivers (listed in Appendix A). The GSA evaluation criteria are divided into two broad categories:

1. Effectiveness Criteria.
2. Development and Conformance Criteria.

Effectiveness Criteria

These criteria evaluate the technical components of the certification system that align with federal green building performance requirements in the Guiding Principles (for both

[4] For example, the criteria prefer directly measuring a building's generated waste (quantitative) to baseline and reduce over time to simply developing a waste management plan (qualitative, suggesting only evidence of intent to reduce building waste).

[5] See Appendix B for a full list of systems.

new construction and existing buildings), EISA, and industry best practices. Table 2-1 lists each criterion and sub-criteria and includes the requirements and/or compliance metrics language from the Guiding Principles.

Table 2-1. Effectiveness Criteria and Sub-Criteria Descriptions

Effectiveness Criteria	Sub-criteria	Guiding Principles Language
Employ Integrated Design Principles	Integrated Design and Management	Use a collaborative and integrated process to plan, design, construct, commission, and transition to operation each new building or modernization project. Consider design choices and operational components that improve environmental performance. Consider all stages of the building's lifecycle when designing for all elements related to the Guiding Principles criteria. For existing buildings, apply integrated management principles to assess current and planned operating conditions to identify areas for optimization. Agencies should ensure plans include provisions or the ability to accommodate temporary changes to normal operating conditions due to emergencies or significant events.
	Sustainable Siting	Follow an integrated site development process to conduct a site assessment that considers environmental, economic, and mission impacts and works to inform decisions on site design, construction, operations, and maintenance. Identify and mitigate current and projected site-specific long-term risks through considerations that provide resilience to manmade and natural events such as hurricanes, storm surge, drought, flood, wind, and wildfire risks. Consider potential significant impacts to ensure the protection of historic properties and other cultural resources. Use historic properties available to the agency, to the maximum extent feasible, as designated by statute. Agencies should seek to find the right balance among sustainability, cost, and security considerations.
	Stormwater Management	Meet statutory requirements for new construction, modernizations, and renovations, and employ strategies that reduce stormwater runoff and discharges of polluted water offsite to protect the natural hydrology and watershed health. Where feasible, use low impact development (LID) strategies to maintain or restore the natural, pre-developed ability of a site to manage rainfall.
	Infrastructure Utilization and Optimization	Seek location-efficient sites, prioritizing locations that promote robust transportation choices, align with local and regional planning goals, and maximize the use of existing resources. Evaluate and provide appropriate electric vehicle charging infrastructure, consistent with current and anticipated future agency mission needs, when designing or renovating associated infrastructure, in accordance with applicable statutes, regulations, local laws, and agency policies.
	Commissioning	Employ the appropriate commissioning tailored to the size and complexity of the building type and its system components to optimize and verify performance of building systems. Ensure buildings have operational policies that support continued compliance with all relevant statutory requirements for ongoing energy and water audits, where applicable.
Optimize Energy Performance	Energy Efficiency	Comply with all relevant statutory and regulatory requirements that establish federal building energy efficiency standards and require the purchase, installation, and use of energy efficient products and/or equipment. Employ strategies that continue to optimize energy performance and minimize energy use throughout the operation and life of the building.
	Energy Metering	Install building level meters for electricity, natural gas, and steam to track and continuously optimize energy performance. As required by statute, install advanced meters to the maximum extent practicable. Standard meters should be used when advanced meters are not appropriate.
	Renewable Energy	Employ strategies to develop and integrate the use of lifecycle cost-effective renewable electric energy and thermal renewable energy, in alignment with agency priorities to support applicable renewable energy goals.

Table 2-1. Effectiveness Criteria and Sub-Criteria Descriptions

Effectiveness Criteria	Sub-criteria	Guiding Principles Language
	Benchmarking	Benchmark building performance at least annually. Regularly monitor building energy performance against historic performance data and peer buildings to identify operating inefficiencies and conservation opportunities.
Protect and Conserve Water	Indoor Water Use	Minimize the use and waste of indoor potable water and, in accordance with statute, implement water conservation technologies to the maximum extent that the technologies are lifecycle cost-effective. Purchase water conserving products and ensure optimized indoor water operations to the maximum extent practicable.
	Water Metering	Install building level water meters to track and continuously optimize indoor potable water use, including detection of leaks.
	Outdoor Water Use	Utilize current best practices and management strategies for water efficient landscaping, and employ, to the maximum extent practicable, water efficient irrigation strategies to track and reduce outdoor potable water consumption. Use non-irrigated, drought-tolerant native landscaping where practicable.
	Alternative Water	Maximize the use of alternative sources of water to the extent practicable and where permitted under local laws and regulations.
Enhance the Indoor Environment	Ventilation and Thermal Comfort	Comply with all relevant statutory requirements to provide occupants with safe and healthy ventilation and thermal comfort, in alignment with applicable ASHRAE standards.
	Daylighting and Lighting Controls	Maximize opportunities for and benefits of daylighting in regularly occupied space to introduce daylight and views into the spaces (except where not appropriate because of building function, mission, or structural constraints); reinforce circadian rhythms; and reduce the use of electrical lighting. Ensure appropriate lighting controls and task lighting.
	Low-emitting Materials and Products	Purchase, acquire, and ensure the use or application of low-emitting materials and products during the planning, construction, modification, maintenance, and operations of the facility.
	Radon Mitigation	Ensure compliance with statutory and regulatory requirements to test for and mitigate radon in buildings, where appropriate.
	Moisture and Mold Control	Implement moisture control strategies to minimize mold growth and associated health risks during building operations.
	IAQ During Construction and Operations	Implement necessary policies and protocols to prevent moisture damage to building materials and protect indoor air quality during renovations, repairs, and construction. Ensure indoor air quality procedures are in place that protect the air quality for occupants of the building during operations.
	Environmental Smoking Control	Prohibit smoking in any form within the building and near all building entrances, operable windows, and building ventilation intakes, as specified by statute and regulations.
	Integrated Pest Management	Implement and maintain a plan to encourage an environmentally responsible, integrated pest management approach that emphasizes proactive solutions, minimizes pesticide use, and, where chemical pesticides are needed, uses the least-toxic options.
	Occupant Health and Wellness	Design building features and integrate programs and initiatives that promote voluntary physical health and wellness opportunities for the building occupants.
Reduce the Environmental Impact of Materials	Recycled Content	Use products that meet or exceed the Environmental Protection Agency's (EPA's) recycled content recommendations for building construction, modifications, operations, and maintenance, where applicable and as required by statute.

Table 2-1. Effectiveness Criteria and Sub-Criteria Descriptions

Effectiveness Criteria	Sub-criteria	Guiding Principles Language
	Biobased Content	Use products with the highest content level per the U.S. Department of Agriculture's (USDA's) bio-based content recommendations, where applicable and as required by statute.
	Environmentally Preferable Products	Procure and utilize construction materials and building supplies that have a lesser or reduced effect on human health and the environment over their lifecycle when compared with competing products that serve the same purpose.
	Ozone Depleting Substances	Comply with all relevant statutory requirements and regulations that identify substitutes for ozone depleting substances.
	Hazardous Waste	Ensure compliance during construction and operations with all relevant statutory requirements for hazardous waste management, including generation, storage, transport, and releases of hazardous substances.
	Solid Waste Management	Reduce waste disposed of in landfills and incineration facilities by recovering, reusing, and recycling materials. Provide in building design, construction, renovation, and operation for the collection and storage of recyclable materials, including, as appropriate, compostable materials. Maintain a waste reduction and recycling program and maximize waste diversion to the extent practicable. Pursue cost effective waste minimization during the construction and renovation phase of the building, and maximize reuse or recycling of building materials, products, and supplies.
Assess and Consider Building Resilience	Risk Assessment	Determine the long-term mission criticality of the building and the operations to be housed in the building. Identify and assess both potential current and future regional risks to ensure resilient building design and operations and reduce potential vulnerabilities. Where applicable, align assessment and planning activities with local and regional efforts to increase community resilience.
	Building Resilience and Adaptation	Incorporate resilient design and operational adaptation strategies that reduce the risk to and increase the resilience of the building. Avoid or mitigate the short- and long-term adverse impacts associated with projected climate changes and acute weather events, including storms, wildfires, droughts, and floods. To protect and ensure investments in federal facilities, balance options to address current and projected risks against mission criticality, cost, and security needs over the building's intended service life.

Development and Conformance Criteria

GSA created the development and conformance criteria (Table 2-2) to assess the processes by which the system was created and by which it awards certification. These criteria are based on requirements from EISA and the DOE Final Rule. GSA also worked with the EPA to align methods and terminology with the EPA Guidelines for the Assessment of Environmental Performance Standards and Ecolabels for Federal Procurement for consistency with a related federal effort to recognize systems and standards that certify products.[6] GSA added one additional sub-criterion, "usability," to evaluate the cost of completing the certification process and describe any project support offered to achieve certification.

[6] https://www.epa.gov/greenerproducts/guidelines-assessment-environmental-performance-standards-and-ecolabels-federal.

Table 2-2. Development and Conformance Criteria and Sub-Criteria Descriptions

Development and Conformance Criteria	Sub-criteria	EISA/DOE Rule Language
Process for Developing and Administering the Building Certification System	Consensus based approach	42 U.S.C. 17092(h)(2)(D): the ability of the standard to be developed and revised through a consensus-based process.
	Transparency	42 U.S.C. 17092(h)(2)(C): the ability of the applicable standard-setting organization to collect and reflect public comment.
	Usability	42 U.S.C. 17092(h)(2)(E): affordable cost of use; the building certification system organization offers product support.
	Maturity	DOE Rule 10 Code of Federal Regulations (CFR) Parts 433, 435, and 436, Green Building Certification Systems for Federal Buildings: the system under which the building is certified must be subject to periodic evaluation and assessment of the environmental and energy benefits that result under the rating system (part 433.33(b)(4)).
Conformity Assessment	Independence	42 U.S.C. 17092(h)(2)(B): the ability and availability of assessors and auditors to independently verify the criteria and measurement of metrics.
	Verification	42 U.S.C. 17092(h)(2)(B): the ability and availability of assessors and auditors to independently verify the criteria and measurement of metrics.
	Post-occupancy evaluation	DOE Rule 10 CFR Parts 433, 435 and 436: Green Building Certification Systems for Federal Buildings: The system under which the building is certified must include a verification system for post occupancy assessment of the rated buildings to demonstrate continued energy and water savings at least every four years after initial occupancy (part 433.300(b)(5)).

Phase II: Survey

Certification system owners have the most knowledge about how their system was developed, which technical components of building performance are assessed, and how projects achieve certification. Therefore, GSA asked the system owners to complete a survey to inform GSA's review (Appendix D).

GSA designed the survey to collect information to determine system alignment with the effectiveness criteria (Table 2-1) and development and conformance criteria (Table 2-2). GSA distributed the survey via an electronic form that consisted of a combination of multiple choice and free-form responses with options to attach supporting documentation as necessary (Appendix D). The survey contains three major components:

1. Part I. General information, such as the name of the system, contact information for the representative completing the survey, and the system's public website. Each system owner completed this section only once.
2. Part II. Information on how the system supports the effectiveness criteria and sub-criteria, with supporting justification. System owners completed this part for each applicable certification system, e.g., new construction and existing buildings.
3. Part III. System development and conformity assessment. Each system owner completed this section only once.

GSA sent out the system owner survey in June 2023, indicating which certification systems to include (e.g., new construction, existing buildings). GSA welcomed system owners to submit clarifying questions after reviewing the survey templates. GSA received all completed surveys and supporting documentation by January 2024. Appendix D contains the completed surveys as submitted to GSA.

Phase III: Findings Report

GSA conducted an independent evaluation and verification of the submitted survey responses. The independent review process verified the following:

1. Completeness of the answers
2. Accuracy of the answers
3. Alignment of the building certification system with the effectiveness criteria and development and conformance criteria.

GSA commissioned LMI to support the review of all submitted survey responses. GSA supplied LMI with a template to ensure a consistent process and documentation across the review. First, the completeness and accuracy of the survey responses were confirmed by analyzing the system owner's documentation and publicly available information. All unanswered, incomplete, factually incorrect, and unclear responses were noted. Using the information from each certification systems' completed survey, GSA then assessed the alignment of the building certification system with the effectiveness criteria and development and conformance criteria.

This report's findings (see Chapter 3) are based on the information supplied from each system owner. Appendix C details each survey response and GSA's findings.

Chapter 3
Findings

GSA evaluated the following systems and organized findings based on building certification system type:

- New construction and major renovations
  - Green Globes 2023 for New Construction (Green Globes NC)
  - LBC version 4.0 for New Construction (LBC NC)
  - LBC Core for New Construction (LBC Core NC)
  - LEED version 4.1 for Building Design and Construction (LEED BD+C)
  - PHIUS 2021 CORE and 2021 ZERO for New Construction (PHIUS NC)
- Existing buildings
  - BOMA BEST 4.0 for Sustainable Buildings (BOMA BEST)
  - BREEAM USA In-Use version 6 (BREEAM)
  - Green Globes 2021 for Existing Buildings (Green Globes EB)
  - LBC version 4.0 for Existing Buildings (LBC EB)
  - LBC Core for Existing Buildings (LBC Core EB)
  - LEED version 4.1 for Building Operations and Maintenance (LEED O+M)
  - PHIUS 2021 CORE REVIVE and 2021 ZERO REVIVE for Existing Buildings (PHIUS EB)

Effectiveness Criteria Review Findings

Tables 3-1 and 3-2 are based on the review of survey responses. Table 3-3 summarizes the information in these tables at a high level by adding up the results across all reviewed systems. GSA evaluated 30 sub-criteria for new construction and 30 sub-criteria for existing buildings systems.

Appendix C contains a detailed explanation of the scoring results in the tables below. For some of the sub-criteria, the survey responses were evaluated against multiple levels of questions related to federal requirements. Although a green building certification system may address a specific sub-criterion used in GSA's review, it may not align with the prescriptive federal green building performance requirement for that sub-criterion. For example, a building certification system may not fully align with the specific Guiding Principles metric for energy use reduction to achieve energy efficiency 30 percent better than ASHRAE Standard 90.1 or one of the other compliance options to

meet that specific federal requirement.[1] In this case, GSA would consider this as partial alignment with the federal requirement for energy use reduction. While the intent to reduce energy may be evident in the system requirements, the system does not assess compliance in the same way as the federal requirement. The following symbols depict degree of alignment with federal requirements:

- ✔ Green check: system demonstrates alignment with prescriptive federal building requirements for the specific sub-criterion.
- ! Yellow exclamation: system demonstrates partial alignment with prescriptive federal building requirements for the specific sub-criterion.
- ✖ Red "X": system does not demonstrate alignment with prescriptive federal building requirements and/or is not addressed in the system for the specific sub criterion.

Some certification systems contain prerequisites that must be met for a project to achieve certification while others do not. LEED has a different number of prerequisites for each building certification system type[2] while LBC requires all credits, called "imperatives", be met to achieve certification. Green Globes, BREEAM, BOMA, and PHIUS do not have prerequisites as part of their building certification systems. The notes in the findings tables indicate when building certification systems require a prerequisite related to that sub-criterion.

Table 3-1. Effectiveness Criteria Findings for New Construction and Major Renovation Building Certification Systems

Criteria	Sub-criteria	Green Globes NC	LBC NC	LBC Core NC	LEED BD+C	PHIUS NC
Employ Integrated Design Principles	Integrated Design and Management	✔	✔	✔	✔	✔
	Sustainable Siting	✔	✔	✔	✔	!
	Stormwater Management[c]	✔	✔	✔	✔	✖
	Infrastructure Utilization and Optimization	✔	✔	✔	✔	✖
	Commissioning	✔	!	!	✔	✔
Optimize Energy Performance	Energy Efficiency	!	✔	✔	✔	✔
	Energy Metering[c]	✔	✔	✔	✔	!
	Renewable Energy[b]	✔	✔	✔	✔	✔
	Benchmarking[a]	!	✔	✔	!	✔
Protect and Conserve Water	Indoor Water Use[c]	✔	✔	✔	✔	✔
	Water Metering[c]	✔	✔	✔	✔	✖
	Outdoor Water Use[c]	✔	✔	✔	✔	✖
	Alternative Water[b]	✔	✔	✖	✔	✖

[1] Other Guiding Principles' compliance paths for energy use reduction include energy use 20 percent below the FY 2015 energy use baseline; energy use 30 percent below the FY 2003 energy use baseline; an ENERGY STAR rating of 75 or higher; or for building types not in ENERGY STAR Portfolio Manager, where adequate benchmarking data exists, placement in the top quartile of energy performance for its building type.

[2] LEED BD+C (New Construction and Major Renovation) includes 12 prerequisites. LEED O+M (Existing Buildings) includes 16 prerequisites.

Table 3-1. Effectiveness Criteria Findings for New Construction and Major Renovation Building Certification Systems

Criteria	Sub-criteria	Green Globes NC	LBC NC	LBC Core NC	LEED BD+C	PHIUS NC
Enhance the Indoor Environment	Ventilation and Thermal Comfort[c]	✓	✓	✓	✓	✓
	Daylighting and Lighting Controls[b]	✓	✓	✓	✓	✗
	Low-emitting Materials and Products[c]	✓	✓	✓	✓	✓
	Radon Mitigation	✓	✓	✗	✗	✓
	Moisture and Mold Control[c]	✓	!	✗	✓	✓
	IAQ During Construction and Operations[c]	✗	✓	✓	✓	✓
	Environmental Smoking Control[c]	✓	✓	✓	✓	✓
	Integrated Pest Management	✓	✓	✓	✓	!
	Occupant Health and Wellness[c]	✓	✓	✓	✓	✗
Reduce the Environmental Impact of Materials	Recycled Content	!	!	!	!	✗
	Biobased Content[b]	!	!	!	!	✗
	Environmentally Preferable Products[c]	✓	✓	✓	✓	✓
	Ozone Depleting Substances[c]	!	✓	✗	✓	✓
	Hazardous Waste	!	✓	✓	✗	✗
	Solid Waste Management	✓	✓	✓	✓	✗
Assess and Consider Building Resilience	Risk Assessment	✓	!	!	✓	✗
	Building Resilience and Adaptation	✓	✓	!	✓	✓

[a] LEED has a prerequisite that is related to this sub-criterion. Green Globes, BREEAM, and BOMA BEST rating systems do not have prerequisites.

[b] LBC has a prerequisite that is related to this sub-criterion. Green Globes, BREEAM, and BOMA BEST rating systems do not have prerequisites.

[c] Both LEED and LBC have a prerequisite that is related to this sub-criterion. Green Globes, BREEAM, and BOMA BEST rating systems do not have prerequisites.

Table 3-2. Effectiveness Criteria Findings for Existing Building and Major Renovation Certification Systems

Criteria	Sub-criteria	BOMA BEST	Green Globes EB	LBC EB	LBC Core EB	LEED O+M	PHIUS EB
Employ Integrated Design Principles	Integrated Design and Management	✓	✓	✓	✓	!	!
	Sustainable Siting	✓	✓	✓	✓	✓	✓
	Stormwater Management[c]	✓	✓	✓	✓	✓	✗
	Infrastructure Utilization and Optimization	✓	✓	✓	✓	✓	✓
	Commissioning	✗	✓	!	!	✗	✓
Optimize Energy Performance	Energy Efficiency	✓	✓	✓	✓	!	!
	Energy Metering[c]	✓	✓	✓	✓	✓	✓
	Renewable Energy[b]	✓	✓	✓	✓	✗	✓
	Benchmarking[a]	✓	✓	✓	✓	✓	✓
Protect and Conserve Water	Indoor Water Use[c]	✓	!	✓	✓	✓	!
	Water Metering[c]	✓	✓	✓	✓	✓	✓
	Outdoor Water Use[c]	!	✓	✓	✓	✓	!
	Alternative Water[b]	✓	✓	✓	✗	✓	✓
Enhance the Indoor Environment	Ventilation and Thermal Comfort[c]	✓	✓	✓	✓	✓	✓
	Daylighting and Lighting Controls[b]	✓	✓	✓	✓	✓	✓
	Low-emitting Materials and Products[c]	✓	✓	✓	✓	✓	✓
	Radon Mitigation	✓	✓	✓	✗	✗	✓
	Moisture and Mold Control[c]	✓	✓	!	✗	✓	✓
	IAQ During Construction and Operations[c]	✓	✓	✓	✓	✓	✓
	Environmental Smoking Control[c]	✓	✓	✓	✓	✓	✗
	Integrated Pest Management	✓	✓	✓	✓	✓	✓
	Occupant Health and Wellness[c]	✓	✓	✓	✓	!	✗

Table 3-2. Effectiveness Criteria Findings for Existing Building and Major Renovation Certification Systems

Criteria	Sub-criteria	BOMA BEST	Green Globes EB	LBC EB	LBC Core EB	LEED O+M	PHIUS EB
Reduce the Environmental Impact of Materials	Recycled Content	!	✓	!	!	!	✗
	Biobased Content[b]	!	✓	!	!	!	✗
	Environmentally Preferable Products[c]	✓	✓	✓	✓	✓	✓
	Ozone Depleting Substances[c]	✓	✓	✓	✗	✓	✓
	Hazardous Waste	✓	✓	✓	✓	✓	✓
	Solid Waste Management	✓	✓	✓	✓	✓	✓
Assess and Consider Building Resilience	Risk Assessment	✓	✓	!	!	✗	✓
	Building Resilience and Adaptation	✓	✓	✓	!	✓	✓

[a] LEED has a prerequisite that is related to this sub-criterion. Green Globes, BREEAM, and BOMA BEST rating systems do not have prerequisites.

[b] LBC has a prerequisite that is related to this sub-criterion. Green Globes, BREEAM, and BOMA BEST rating systems do not have prerequisites.

[c] Both LEED and LBC have a prerequisite that is related to this sub-criterion. Green Globes, BREEAM, and BOMA BEST rating systems do not have prerequisites.

Table 3-3. Summary of Review Findings, Effectiveness Criteria

	The number of federal sub-criteria met by system	The number of federal sub-criteria partially met by system	The number of federal sub-criteria not met by system
	✓	!	✗
New Construction and Major Renovation Building Certification Systems			
Green Globes NC	23	6	1
LBC NC	25	5	0
LBC Core NC	21	5	4
LEED BD+C	25	3	2
PHIUS NC	15	3	12
Existing Building Certification Systems			
BOMA BEST	21	4	5
BREEAM	26	3	1
Green Globes EB	29	1	0
LBC EB	25	5	0
LBC Core EB	21	5	4
LEED O+M	21	5	4
PHIUS EB	15	3	12

Note: The number of effectiveness sub-criteria met (✓), partially met (!), or not met (✗) by system.

This evaluation is not intended as a judgment on the relative quality of these green building certification systems and should not be used to rank these systems against

each other. Each certification system offers a unique framework and assumes different user baselines and organizational sustainability expertise. Some certification systems assume a higher level of user sustainability sophistication and do not include some of the basic elements of sustainable design contained in the guiding principles. As such, GSA simply evaluates the alignment of each certification system with federal green building performance criteria.

Development and Conformance Criteria Review Findings

Table 3-4 shows the alignment of all assessed certification systems against the seven development and conformance criteria described in Chapter 2. Each rating system's development and conformance assessment process is consistent across their products. The symbols in the table correspond to the following interpretations of how the system aligns with the development sub-criteria:

- ✔ Green check: Building certification system complies with the EISA or DOE Rule requirement.
- ! Yellow exclamation: Building certification system does not fully comply with the EISA or DOE Rule requirement but may align with the intent of the requirement.
- ✖ Red "X": Building certification system does not comply with the EISA or DOE Rule requirement.

Table 3-4. Summary of Review Findings, Development and Conformance Criteria

Criteria	Sub-criteria	BOMA BEST[c]	BREEAM[c]	Green Globes	LBC	LBC Core	LEED	PHIUS
Process for Developing and Administering the Certification System	Consensus-based approach	✔	✖	✔	✖	✖	✔	✔
	Transparency	✔	✔	✔	!	!	✔	✔
	Usability[a]	✔	✔	✔	✔	✔	✔	✔
	Maturity	✔	✔	✔	✔	✔	✔	✔
Conformity Assessment	Independence	✔	✔	✔	✔	✔	✔	✔
	Verification[b]	✔	✔	✔	✔	✔	✔	!
	Post Occupancy evaluation	✔	✔	!	!	!	✔	✖

[a] See Appendix A for more information about the cost of each system.

[b] Not included in DOE rule.

[c] The DOE rule does not apply to systems certifying existing buildings. The rule does apply to new construction and major renovations of projects that are above the prospectus threshold; however, these major renovations are captured in the new construction systems.

Chapter 4
Summary

This report provides an objective evaluation of the alignments of whole-building certification systems available for use in the United States with federal green building performance criteria. Many factors influence the decision of an agency to pursue (or not pursue) certification, including the cost of the certification, agency-specific mission and policy requirements, specialized building characteristics, and familiarity with a particular building certification system.

While each system reviewed for this report addresses the primary criteria that define high-performance green buildings, no single system fully aligns with all the federal building performance requirements. Each system offers a unique framework and approach to achieving building certification, but all the systems agree on the general aspects of building design, construction, operation, and maintenance that lead to green commercial office buildings.