

# HARVARD UNIVERSITY



## **Green Building Standards**

December 2014

## Overview

The Harvard Green Building Standards apply to all capital projects and should be included in all Requests for Proposals issued for new projects and referenced in contracts for design consultants and construction managers. They have helped to establish Harvard as an internationally recognized leader in green building and are an essential component of the University's commitment to sustainability, including the five-year Sustainability Plan and the goal to reduce greenhouse gas emissions 30% below 2006 levels by 2016, including growth.

The Standards identify a minimum level of design and process requirements for all new construction and renovation projects, while providing enough flexibility for individual project teams to meet project goals. The Standards also include recommendations that project teams should attempt to achieve.

The requirements and recommendations are organized within six categories that are aligned with Harvard's six project tiers as described below.

Tier 1	Tier 2			Tier 3	Tier 4
<b>New Building or Major Renovation</b>	<b>Tier 2A Fit-Outs &gt; \$5 million</b>	<b>Tier 2B Fit-Outs \$1 - \$5 million</b>	<b>Tier 2C Fit-Outs &lt;\$1 million</b>	<b>System Upgrades</b>	<b>Non-Energy</b>
New Buildings and Building-Wide Full-Gut Renovations	Partial Building Interior Fit-Outs HVAC, Lighting, and Materials Within the Scope			Limited Scope Projects w / Energy and GHG Impact	Limited Scope Projects w / No or Limited Energy and GHG Impact

**Tier 1:** Tier 1 projects include all new buildings and full building renovations with a comprehensive scope that includes room configuration modifications, new HVAC systems, envelope modifications, and new lighting.

**Tier 2:** Tier 2 projects are partial renovations or fit-outs of existing facilities in which systems within the renovated spaces are largely replaced (e.g. lighting, finishes, plumbing, and/or HVAC), but base building HVAC systems and the building envelope remain unaffected. Tier 2 is further divided into subcategories based on project costs:

- **Tier 2A:** >\$5 million in total costs
- **Tier 2B:** \$1-\$5 million in total costs
- **Tier 2C:** <\$1 million in total costs

**Tier 3:** Tier 3 projects include renovations to systems with an energy impact but are focused only on those systems (e.g. controls upgrades, AHU replacement, lighting replacement, etc.)

**Tier 4:** Tier 4 projects have no or limited energy and GHG impact, such as a landscape project or a project which only renovates finishes and furnishings.

This version of the Standards was developed by Harvard's Sustainability and Environmental Management Council, led by the Office for Sustainability and Green Building Services, and approved by the Administrative Deans Council. They build upon the 2007 Green Building Guidelines and the 2009 Green Building Standards, and will be formally updated periodically as required.

In addition to the guidance within this document, there is an associated set of Appendices, provided within a single Microsoft Excel document entitled "Deliverables Checklist", that contains templates for documentation, deliverables, and guidance on review requirements.

## Definitions

**Integrated Design:** In order to assist project teams in the vetting and setting of sustainability goals and objectives, Harvard has identified different levels of formal integrated design requirements for projects depending on their scope of work.

**Life Cycle Costing:** In order to assist project teams assess the total cost of ownership impacts that decisions have throughout the course of design, Harvard has identified various levels of Life Cycle Cost (LCC) analysis for projects depending on their scope of work. Responsible Life Cycle Costing includes an analysis of utility rebates, grants, stimulus funding, or other alternative funding sources. It is best practice to include building operations staff in all LCC and value engineering review.

**Energy Modeling/GHG Calculations:** In order to assist project teams in creating energy efficient designs that yield reduced or zero greenhouse gas emissions, Harvard has identified different levels of building energy simulation appropriate for projects depending on their scope of work.

**Prescriptive Requirements:** Harvard requires projects to achieve prescriptive levels of environmental performance according to project size and scope. New construction and major renovation projects (Tier 1) are required to register and achieve Gold certification using version 4 of the US Green Building Council's (USGBC) Leadership in Energy and Environmental Design (LEED™) green building certification rating systems. All projects are encouraged to pursue aggressive levels of energy efficiency and sustainable design using recognized performance standards as design minimums. Additional requirements apply to lab and data center projects.

**Metering and Ongoing Verification of Performance:** In order to facilitate efficient building operations, assist with energy conservation measure verification, and to allow engagement of building occupants, Harvard has identified various levels metering and sub-metering for projects depending on their scope of work. These requirements are based on the premise that “one can't reduce what they can't measure.”

**Close-Out Documentation/O&M Readiness:** In order to capture critical project data and ensure building managers have the necessary tools to reduce facility emissions at optimal levels, Harvard has identified various levels of Closeout Documentation / Operations and Maintenance Readiness for projects.

## Resources and References

**Tools, templates, and appendices to support Standards implementation:**

Green Building Resource, [green.harvard.edu/theresource](http://green.harvard.edu/theresource)

**Information on Harvard's University-wide commitment to sustainability:**

Sustainability at Harvard, [green.harvard.edu](http://green.harvard.edu)

**Technical questions or clarifications:**

Harvard Green Building Services, [joel\\_mckellar@harvard.edu](mailto:joel_mckellar@harvard.edu)

# Tier 1 - Whole Buildings: New Buildings and Building-Wide Gut Renovations

## Analysis

Prior to the end of the Schematic Design (SD) phase evaluate the feasibility of pursuing Living Building Challenge Certification as an alternative to the LEED-NC requirement. If applicable, include the analysis in the project Request for Proposals (RFP). Projects are not required to pursue LBC certification but must demonstrate that it was evaluated:

- Review applicable Harvard Green Building Standards with team during conceptual design.
- When setting goals, look at each Living Building Challenge credit and petal and seek to set goals that align with this Standard, regardless of whether full certification is pursued.
- Viable components should be implemented as appropriate.
- Please complete the “Tier 1 – LBC Feasibility” tab in the *Green Building Standards - Deliverables Checklist* and explain why credits cannot be achieved as appropriate.

Prior to the end of the SD phase, present the feasibility of pursuing net zero energy and determine the renewable energy generation potential of the site. Consider including net zero energy performance in the RFP or Owner’s Project Requirements (OPR) as a stretch goal. Projects are not required to pursue net zero energy or on-site renewables, but must demonstrate that they were evaluated:

- Using internal benchmarks, develop an energy target for the project in kBtu per square foot per year.
- Complete an analysis for renewable potential assuming the site and project roof are capable of and compare to the energy target.
- While project teams may pursue more enhanced strategies for developing the energy use intensity and site generation potential of the project, teams are only required to complete the “Tier 1 - Net Zero Feasibility” tab in the *Green Building Standards - Deliverables Checklist* which uses University-wide benchmarks.

## Integrated Design

At least three integrated design charrettes are required, the first of which should happen at the time of project kickoff and prior to the end of Schematic Design. Charrettes should include identification and tracking of project goals and analyzing the life cycle cost impacts of potential design options. Charrettes should include representation of major stakeholders including occupants and operations staff.

For laboratory and data center projects, additional charrette requirements are provided in the “Prescriptive Requirements and Certification” section of this document.

Adhere to the requirements of LEED IP Credit 1: Integrative Process (based on ANSI Consensus National Guide 2.0 for Design and Construction of Sustainable Buildings and Communities – February 2, 2012) to formalize the integrated design process, which focuses on energy and water analysis. See the LEEDv4 Reference Guide for full details.

## Life Cycle Costing

Life Cycle Costing (LCC) will be performed to quantify the 20 year impacts on GHG, energy costs, maintenance costs, etc. The scope of LCC will vary depending on project, but will typically include envelope, HVAC, electrical, and many other building systems. Requirements by design phase include:

<b>Planning/Conceptual Design</b>	Initial Harvard LCC calculator presenting options for optional design elements with major budget implications
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<b>Schematic Design</b>	Harvard LCC calculator presenting options for major energy-consuming systems
<b>Value Engineering (Any Phase)</b>	Harvard LCC calculator presenting impacts beyond initial capital outlay

The Harvard Life Cycle Calculator can be downloaded on the [Harvard Green Building Resource](#).

## Energy Modeling

Utilize eQuest, Energy Plus, or compatible plug-ins for Revit or other BIM platforms to model proposed building designs, assist with life cycle costing, estimate greenhouse gas (GHG) emissions, and facilitate future measurement and verification.

At a minimum, the following deliverables or reports summarizing these deliverables are required:

<b>Schematic Design</b>	Initial model results of massing, orientation, and/or major HVAC systems with sensitivity analysis
<b>Design Development</b>	Multiple parametric runs comparing options of systems and strategies as determined in the initial and/or subsequent integrated design charrettes
<b>Construction Documents</b>	Complete design and base case models used for LEED and/or code compliance verification
<b>Building Turnover</b>	As-built energy model & electronic files

## Prescriptive Requirements and Certification

Unless Living Building Challenge certification is being pursued, use the appropriate LEED Rating System and achieve the credits identified by Harvard. All projects must achieve at least **LEED version 4 Gold** certification, recognizing that projects achieving all Harvard required credits and those that are inherent in design best practices at the University will have at least enough credits for the Gold level certification. For LEED credits listed below, refer to the Reference Guide for detailed requirements.

<b>Energy</b>	<p>On a project-by-project basis, establish maximum Energy Use Intensity (kBtu/square foot and kBtu/person) goals.</p> <p><i>New Construction*</i>: Demonstrate, via energy modeling, a minimum 30% reduction below ASHRAE 90.1-2010 based on energy reductions.</p> <p><i>Existing Buildings – Major Renovations*</i>: Demonstrate, via energy modeling, a minimum 18% reduction below ASHRAE 90.1-2010 based on energy reductions.</p> <p><i>*Laboratories</i>: Demonstrate, via energy modeling, a minimum 19.5% reduction below ASHRAE 90.1-2010 based on energy reductions.</p>
<b>Commissioning</b>	<p>Meet the requirements of <i>LEED-NCv4 Enhanced Commissioning: Option 1, Path 1, Enhanced Systems Commissioning</i> credit.</p> <p>If the project scope includes the development of new or substantially</p>

	renovated facades, the team must also pursue the <i>LEED-NCv4 Enhanced Commissioning: Option 2, Envelope Commissioning</i> credit.
<b>Indoor Potable Water Use</b>	Meet the requirements of <i>LEED-NCv4 Indoor Water Use Reduction</i> credit, including reducing indoor potable water use by a minimum of <b>35%</b> .
<b>Outdoor Potable Water Use</b>	Sub-meter irrigation separately from other potable water use.  Comply with the <i>LEED-NCv4 Outdoor Water Use Reduction</i> credit, including a reduction of water use by at least 50% using the EPA's WaterSense Water Budget tool or provide no irrigation from potable sources.
<b>Materials</b>	<p>Meet the requirements of:</p> <p><i>LEED-NCv4 Building Product Disclosure and Optimization – Environmental Product Declarations: Option 1 – Environmental Product Declaration (EPD)</i></p> <p><i>LEED-NCv4 Building Product Disclosure and Optimization – Sourcing of Raw Materials: Option 1 – Raw Material Source and Extraction Reporting</i></p> <p><i>LEED-NCv4 Building Product Disclosure and Optimization – Material Ingredients: Option 1 – Material Ingredient Reporting</i></p> <p><i>LEED-NCv4 Construction and Demolition Waste Management: Divert at minimum of 90% of construction waste from landfills</i></p> <p>Teams are not required to achieve the following credits, but they are to pursue documentation of them within LEED Online in an effort to further understand the feasibility of such requirements applying to all projects:</p> <p><i>LEED-NCv4 Building Product Disclosure and Optimization – Environmental Product Declarations: Option 2 – Multi-Attribute Optimization</i></p> <p><i>LEED-NCv4 Building Product Disclosure and Optimization – Sourcing of Raw Materials: Option 2 – Leadership Extraction Practices</i></p> <p><i>LEED-NCv4 Building Product Disclosure and Optimization – Material Ingredients: Option 2 – Material Ingredient Optimization</i></p> <p><i>LEED-NCv4 Building Product Disclosure and Optimization – Material Ingredients: Option 3 – Product Manufacturer Supply Chain Optimization</i></p>
<b>Education</b>	Complete a Project Profile using Harvard's standard case study template for posting on the Harvard Green Building Resource.
<b>Labs</b>	<p><i>High Energy Equipment Isolation:</i> Examine options for co-locating equipment with high heat generation (e.g. -80 freezers) in a distinct space that permit the use of hydronic cooling loops or other means of high-efficiency heat rejection.</p> <p>Meet the requirements of the following credits in the <a href="#">Labs21</a></p>

	<p><a href="#">Environmental Performance Criteria version 3.0 (07.11.2010):</a></p> <p><i>WE EPC Prerequisite 1: Laboratory Equipment Water Use</i> Do not use once-through water for process cooling.</p> <p>Recommended: Teams are not required to achieve the following requirements, but are encouraged to do so as scope and budget allow:</p> <p>Re-commission the lab one year post-occupancy, at a minimum. Monitoring-based commissioning applications can be utilized in lieu of a traditional re-commissioning process.</p> <p>Review the Harvard SEMC’s Labs Best Practices ECM Checklist during one of the integrated design charrettes to ensure all items are considered.</p>
<p><b>Data Centers</b></p>	<p><a href="#">EU Code of Conduct on Data Centres – 2014 Best Practices v5.1.1:</a> As part of at least one design charrette, the project team should consider the applicability of the best practices suggested in the referenced document.</p> <p><i>BSR/ASHRAE 90.4* – Energy Standard for Data Centers and Telecommunications Buildings:</i> Project teams are to calculate the anticipated energy use with respect to the following PUE metrics and compare to the design minimums suggested in each section, though compliance with the standard is not required at this time:</p> <ul style="list-style-type: none"> <li>• Mechanical Design PUE (Section 6.4.1.1)</li> <li>• Annualized Mechanical Energy PUE ( Section 6.4.1.2)</li> </ul> <p>*ASHRAE 90.4 is currently in draft form, and has not been fully approved by the relevant ASHRAE committees. Pending adoption of the official standard, design teams are directed to reference ASHRAE 90.4P, which is the proposed standard language.</p>

## Metering and Ongoing Verification of Performance

Follow the applicable sections of the Harvard Engineering and Utilities’ metering and service guidelines document “Information & Requirements for Utility Services.” Separately meter all utilities coming into the building. When appropriate to project scope, separately sub-meter significant use types within the building. At a minimum, separately meter:

Parking Garages

Large Kitchens

Commercial Spaces

Data Centers or Large Data Closets

**LEED Compliance:** Meet the requirements of either *LEED-NCv4 Advanced Energy Metering* or *LEED-NCv4 Enhanced Commissioning, Option 1, Path 2, Enhanced and Monitoring-Based Commissioning*. These credits provide infrastructure for ensuring comprehensive information about the performance of major building systems is available.

**M&V Strategy:** For each project, the design team will be tasked with developing an M&V strategy for the applicable goals as determined by Project Manager and appropriate Building Manager or department operations staff. Ensure this plan aligns with efforts related to either or both of the LEEDv4 Advanced Energy Metering or Enhanced Commissioning, Monitoring Based Commissioning requirements.

**Operations Staff Feedback:** The project’s M&V strategy will address requests and recommendations from Harvard’s operations team, determine the minimum level of measurement and verification that is

required for the applicable goals, and include flexibility in engineering and architectural designs for obtaining additional information in the future.

**Energy Intensive Programs:** Some projects with energy intensive occupancies such as labs, data centers, and collections of rare books and art may need additional guidance when determining the best M&V strategy. At that point the project's design team has an opportunity to meet with other University staff members who have similar installations on campus and can provide their expertise to determine minimum requirements while balancing operational needs. Continue to meter kitchens, data centers, and parking garages separately.

**VE:** Value engineering and changes during construction must be reviewed by Harvard's internal operations team in conjunction with the project's M&V strategy before approval.

**Support:** Technical guidance for implementation of specific methods of M&V and best practices will be provided by others. For example, Engineering & Utilities (E&U) and regional utility companies already have guidelines for utility meter installations, and E&U plans to develop a comparable guideline for sub-meters. Similarly, the Operations & Logistics department could address requirements when projects plan to connect to the central BAS.

**Post-occupancy:** Evaluate the feasibility of LEED-EBOM certification one year post-occupancy.

## **Close-Out Documentation/O&M Readiness**

Projects must collect and turn over documentation that will assist with efficient operations of the space or will be beneficial to the performance of future University projects. This process should be done in a consistent and thorough process and includes the following requirements:

- Follow an asset management program and coordinate all documentation to follow a consistent naming convention. Use School or Unit specific standard or refer to the Phase 1: Asset Management Program Development document dated December 2008 from the Allston Development Group as a model to create a school specific plan.
- Prepare and turn over to the Facilities Department a Systems Manual following the requirements of ASHRAE Guideline 4-2008. This is frequently delivered as part of the project's commissioning (Cx) efforts.
- Official acceptance of O&M documentation must be approved by the School's or Unit's facilities director (or designated appointee)
- Turn-over documentation required by PIRC, including as-built energy model with summary of inputs and outputs and electronic model file
- Complete a Project Profile using Harvard's standard case study template for posting on the Harvard Green Building Resource.
- Provide access to LEED-Online to [harvardgbs@gmail.com](mailto:harvardgbs@gmail.com) for University-wide metric tracking purposes.



# Tier 2 - Fit-Outs: Partial Building Interior Fit-Outs

The following requirements and recommendations apply to the project unless the affected system or strategy is not within the scope of the project.

## Integrated Design

**All Tier 2 Projects:** Review applicable Harvard Green Building Standards with team during conceptual design.

**Tier 2A and 2B:** At least twice during project meetings, the first of which should happen at the time of project kickoff, specifically address goal setting and tracking that sets expectations and evaluates project success.

**Tier 2A Recommendation:** Projects are encouraged, but not required, to adhere to the requirements of LEED IP credit 1: Integrative Process (based on ANSI Consensus National Guide 2.0 for Design and Construction of Sustainable Buildings and Communities – February 2, 2012) to formalize the integrated design process, which focuses on energy and water analysis.

**Tier 2C:** No formal requirements, though project teams are encouraged to pursue integrated design practices to the extent that it is feasible.

## Life Cycle Costing

**Tiers 2A, 2B, and 2C:** Life Cycle Costing (LCC) will be performed to quantify the 20 year impacts on GHG, energy costs, maintenance costs, etc. The scope of LCC will vary depending on project, but will typically include envelope, HVAC, electrical, and many other building systems. Requirements by design phase include:

<b>Planning/Conceptual Design</b>	Initial Harvard LCC calculator presenting options for optional design elements with major budget implications
<b>Schematic Design</b>	Harvard LCC calculator presenting options for major energy-consuming systems
<b>Value Engineering (Any Phase)</b>	Harvard LCC calculator presenting impacts beyond initial capital outlay

## Energy Modeling/GHG Calculations

**Tiers 2A, 2B, and 2C:** As appropriate to the project type, estimate the energy demand and consumption impacts, as well as GHG emissions, from proposed design options and propose a strategy to verify performance.

## Prescriptive Requirements and Certification

Project performance must meet the requirements of select LEED credits **only if work affecting those systems is included in the scope**. LEED Version 4 certification is encouraged as deemed appropriate by the School or Unit. All projects will include a LEED feasibility section in the initial design submission.

### **STANDARDS**

<b>Energy</b>	<i>LEED-Civ4 Optimize Energy Performance:</i> Though LEED-CI certification isn't required, pursue a <i>minimum</i> of 8 points within this
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	<p>credit, or demonstrate a 6% reduction beyond ASHRAE 90.1-2010 if the <i>Option 1 – Tenant-Level Energy Simulation</i> compliance path is pursued.</p> <p><i>Base Building Systems</i>  Building Envelope, Opaque (2 points)  Building Envelope, Glazing (2 points)  HVAC Equipment Efficiency (2 points)</p> <p><i>HVAC Systems</i>  HVAC Zoning and Controls (2 points)</p> <p><i>Interior Lighting Power</i>  Lighting Power Density: 10-25% Reduction (1–4 points)</p> <p><i>Interior Lighting Controls</i>  Daylighting Controls (1 point)  Occupancy Sensor Lighting Controls (1 point)</p> <p><i>Equipment and Appliances</i>  ENERGY STAR Equipment and Appliances: 70-90% Compliance (1–2 points)</p>
<b>Commissioning</b>	Meet the requirements of <i>LEED-Civ4 Enhanced Commissioning: Option 1, Enhanced Systems Commissioning</i> credit.
<b>Indoor Potable Water Use</b>	Meet the requirements of <i>LEED-Civ4 Indoor Water Use Reduction</i> including reducing indoor potable water use by a minimum of 35%.
<b>Outdoor Potable Water Use (if in scope)</b>	Sub-meter irrigation separately from other potable water use.
<b>Materials</b>	<p>Tiers 2A and 2B must meet the requirements of:</p> <p><i>LEED-Civ4 Building Product Disclosure and Optimization – Environmental Product Declarations: Option 1 – Environmental Product Declaration (EPD)</i></p> <p><i>LEED-Civ4 Building Product Disclosure and Optimization – Sourcing of Raw Materials: Option 1 – Raw Material Source and Extraction Reporting (1 Point)</i></p> <p><i>LEED-Civ4 Building Product Disclosure and Optimization – Material Ingredients: Option 1 – Material Ingredient Reporting (1 Point)</i></p> <p><i>LEED-Civ4 Construction and Demolition Waste Management: Divert at minimum of 90% of construction waste from landfills</i></p> <p>Tiers 2A and 2B must perform the following analysis: Teams are not required to achieve the following credits, but they are to pursue documentation of them within LEED Online in an effort to further understand the feasibility of such requirements applying to all projects:</p> <p><i>LEED-Civ4 Building Product Disclosure and Optimization – Environmental Product Declarations: Option 2 – Multi-Attribute Optimization</i></p> <p><i>LEED-Civ4 Building Product Disclosure and Optimization – Sourcing of Raw Materials: Option 2 – Leadership Extraction Practices</i></p> <p><i>LEED-Civ4 Building Product Disclosure and Optimization – Material Ingredients: Option 2 – Material Ingredient Optimization</i></p>

	<i>LEED-Civ4 Building Product Disclosure and Optimization – Material Ingredients: Option 3 – Product Manufacturer Supply Chain Optimization</i>
<b>Education</b>	Complete a Project Profile using Harvard’s standard case study template for posting on the Harvard Green Building Resource.
<b>Labs</b>	<p>Meet the requirements of the following credits in the <a href="#">Labs21 Environmental Performance Criteria version 3.0 (07.11.2010)</a>:</p> <p><i>WE EPC Prerequisite 1: Laboratory Equipment Water Use</i> Do not use once-through water for process cooling.</p> <p>Recommendations: Teams are not required to achieve the following requirements, but are encouraged to do so as scope and budget allow:</p> <p>Re-commission the lab one year post-occupancy, at a minimum. Monitoring-based commissioning applications can be utilized in lieu of a traditional re-commissioning process.</p> <p>Review the Harvard SEMC’s Labs Best Practices ECM Checklist during one of the integrated design charrettes to ensure all items are considered.</p>
<b>Data Centers</b>	<p><a href="#">EU Code of Conduct on Data Centres – 2014 Best Practices v5.1.1</a>: As part of at least one design charrette, the project team should consider the applicability of the best practices suggested in the referenced document.</p> <p><i>BSR/ASHRAE 90.4* – Energy Standard for Data Centers and Telecommunications Buildings</i>: Project teams are to calculate the anticipated energy use with respect to the following PUE metrics and compare to the design minimums suggested in each section, though compliance with the standard is not required at this time:</p> <ul style="list-style-type: none"> <li>• Mechanical Design PUE (Section 6.4.1.1)</li> <li>• Annualized Mechanical Energy PUE ( Section 6.4.1.2)</li> </ul> <p>*ASHRAE 90.4 is currently in draft form, and has not been fully approved by the relevant ASHRAE committees. Pending adoption of the official standard, design teams are directed to reference ASHRAE 90.4P, which is the Proposed standard language.</p>

## **RECOMENDATIONS**

The following credits are not required to be achieved by project teams, but are strongly recommended as project scope, budget, and other considerations allow.

<b>LEED Certification</b>	Tier 2 projects are encouraged to pursue LEED-CI certification. Feasibility should be assessed early in design.
<b>Rainwater Management</b>	LEED-NC SS credit 4: Incorporate green infrastructure and low impact development strategies into the site design in order to manage on-site 100% of the total volume of runoff calculated for the 95th percentile rainfall event for the site.
<b>Heat Island Reduction</b>	LEED SSc5: Non-roof and roof heat island reduction required for new buildings, optional for existing buildings.

<b>Light Pollution Reduction</b>	LEED SSc8: Meet the requirements of LEED v4 SSc8.
<b>Sustainable Sites Initiative</b>	If project is a primarily a landscape project, adhere to Sustainable Sites Initiative requirements.

## Metering and Ongoing Verification of Performance

As appropriate to the scope of this project, follow the applicable sections of the Harvard Engineering and Utilities' metering and service guidelines document "Information & Requirements for Utility Services." Separately meter all utilities coming into the building. When appropriate to project scope, separately sub-meter significant use types within the building. At a minimum, separately meter:

Parking Garages

Large Kitchens

Commercial Spaces

Data Centers or Large Data Closets

Harvard encourages separately metering utilities by end use, such as separating lighting loads from plug loads. If this level sub-metering is not part of the project scope, teams are encouraged to wire / pipe the building in such a way that sub-metering may be utilized at a later date to help identify utility demand and consumption by end use. Meters and sub-meters must be tied into the building management system when one exists.

## Close-Out Documentation/O&M Readiness

Projects must collect and turn over documentation that will assist with efficient operations of the space or will be beneficial to the performance of future University projects. This process should be done in a consistent and thorough process and includes the following requirements:

- Follow an asset management program and coordinate all documentation to follow a consistent naming convention. Use School or Unit specific standard or refer to the Phase 1: Asset Management Program Development document dated December 2008 from the Allston Development Group as a model to create a School specific plan.
- Prepare and turn over to the Facilities Department a Systems Manual following the requirements of ASHRAE Guideline 4-2008. This is frequently delivered as part of the project's commissioning (Cx) efforts.
- Turn-over documentation required by PIRC, including as-built energy model with summary of inputs and outputs and electronic model file.
- Official acceptance of O&M documentation must be approved by the School's or Unit's facilities director or designated appointee.
- If the project completed LEED certification, provide access to LEED-Online to [harvardgbs@gmail.com](mailto:harvardgbs@gmail.com) for University-wide metric tracking purposes.

# Tier 3 – System Upgrades: Limited Scope Projects with Energy and GHG Impact

The following requirements and recommendations apply to the project unless the affected system or strategy is not within the scope of the work being performed.

## Integrated Design

Review applicable Harvard Green Building Standards with team when project begins.

Recommendation: Projects are encouraged, but not required, to adhere to the requirements of LEED IP credit 1: Integrative Process (based on ANSI Consensus National Guide 2.0 for Design and Construction of Sustainable Buildings and Communities – February 2, 2012) to formalize the integrated design process, which focuses on energy and water analysis.

## Life Cycle Costing

Life Cycle Costing (LCC) should be performed to compare design options based on 20 year impacts on GHG, energy costs, maintenance costs, etc. The scope of LCC will vary depending on project, but will typically include envelope, HVAC, electrical, and many other building systems. Requirements by design phase include:

**Design:** LCC template for design options with 20 year impacts on GHG, energy costs, maintenance costs, etc.

## Energy Modeling/GHG Calculations

As appropriate to the project type, estimate the energy demand and consumption impacts, as well as GHG emissions, from proposed design options and propose a strategy to verify performance.

## Prescriptive Requirements

Project performance must meet the requirements of select LEEDv4 credits as outlined below **only if work affecting those systems is included in the scope.**

### STANDARDS

<b>Energy</b>	<p>Review the feasibility of meeting the following credits in <i>LEED-CIv4's Optimize Energy Performance - Prescriptive Energy Requirements.</i></p> <p><i>Base Building Systems</i>            Building Envelope, Opaque (2 points)            Building Envelope, Glazing (2 points)            HVAC Equipment Efficiency (2 points)</p> <p><i>HVAC Systems</i>            HVAC Zoning and Controls (2 points)</p> <p><i>Interior Lighting Power</i>            Lighting Power Density: 10-25% Reduction (1–4 points)</p> <p><i>Interior Lighting Controls</i>            Daylighting Controls (1 point)            Occupancy Sensor Lighting Controls (1 point)</p> <p><i>Equipment and Appliances</i>            ENERGY STAR Equipment and Appliances: 70-90% Compliance (1–2 points)</p>
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<b>Commissioning</b>	Meet the requirements of LEED Enhanced Commissioning, including envelope commissioning if in scope.
<b>Indoor Potable Water Use</b>	Meet the requirements of LEED-NC v4 WEc2, including reducing indoor potable water use by a minimum of 35%.
<b>Outdoor Potable Water Use</b>	Sub-meter irrigation separately from other potable water use.  WE Credit 1: Reduce water use by at least 50% using the EPA's WaterSense Water Budget tool or provide no irrigation from potable sources. Strive for a 100% reduction.
<b>Labs</b>	Meet the requirements of the following credits in the <a href="#">Labs21 Environmental Performance Criteria version 3.0 (07.11.2010)</a> :  <i>WE EPC Prerequisite 1: Laboratory Equipment Water Use</i> Do not use once-through water for process cooling.  Guidelines: Teams are not required to achieve the following requirements, but are encouraged to do so as scope and budget allow:  Re-commission the lab one year post-occupancy, at a minimum. Monitoring-based commissioning applications can be utilized in lieu of a traditional re-commissioning process.  Review the Harvard SEMC's Labs Best Practices ECM Checklist during one of the integrated design charrettes to ensure all items are considered.
<b>Data Centers</b>	<a href="#">EU Code of Conduct on Data Centres – 2014 Best Practices v5.1.1</a> : The project team should consider the applicability of the best practices suggested in the referenced document.

## **RECOMMENDATIONS**

The following credits are not required to be achieved by project teams, but are strongly recommended as project scope, budget, and other considerations allow.

<b>Rainwater Management</b>	LEED-NC SS credit 4: Incorporate green infrastructure and low impact development strategies into the site design in order to manage on-site 100% of the total volume of runoff calculated for the 95th percentile rainfall event for the site.
<b>Heat Island Reduction</b>	LEED SSc5: Non-roof and roof heat island reduction required for new buildings, optional for existing buildings.
<b>Light Pollution Reduction</b>	LEED SSc8: Meet the requirements of LEED v4 SSc8.
<b>Sustainable Sites Initiative</b>	If project is a primarily a landscape project, adhere to Sustainable Sites Initiative requirements.

## **Metering and Ongoing Verification of Performance**

As appropriate to the scope of this project, follow the applicable sections of the Harvard Engineering and Utilities' metering and service guidelines document "Information & Requirements for Utility Services." Separately meter all utilities coming into the building. When appropriate to project scope, separately sub-meter significant use types within the building. At a minimum, separately meter:

Parking Garages

Large Kitchens

Commercial Spaces

Data Centers or Large Data Closets

Harvard encourages separately metering utilities by end use, such as separating lighting loads from plug loads. If this level sub-metering is not part of the project scope, teams are encouraged to wire / pipe the building in such a way that sub-metering may be utilized at a later date to help identify utility demand and consumption by end use. Meters and sub-meters must be tied into the building management system when one exists.

## **Close-Out Documentation/O&M Readiness**

Projects must collect and turn over documentation that will assist with efficient operations of the space or will be beneficial to the performance of future University projects. This process should be done in a consistent and thorough process and includes the following requirements:

- Follow a consistent naming convention. Use School or Unit specific standard or refer to the Phase 1: Asset Management Program Development document dated December 2008 from the Allston Development Group as a model to create a school specific plan.
- Add Energy Conservation Measure details into the ECM Database (as applicable to project type) in HARA

## Tier 4 – Non-Energy: Limited Scope Projects with No or Limited Energy/GHG Impact

The following requirements and recommendations apply to the project unless the affected system or strategy is not within the scope of the work being performed.

### Integrated Design

Review applicable Harvard Green Building Standards with team when project begins.

### Prescriptive Requirements

Project performance must meet the requirements of select LEEDv4 credits as outlined below **only if work affecting those systems is included in the scope.**

#### **STANDARDS**

<b>Indoor Potable Water Use</b>	Meet the requirements of LEED-NC v4 WEc2, including reducing indoor potable water use by a minimum of 35%.
<b>Outdoor Potable Water Use (if in scope)</b>	Sub-meter irrigation separately from other potable water use.  WE Credit 1: Reduce water use by at least 50% using the EPA’s WaterSense Water Budget tool or provide no irrigation from potable sources. Strive for a 100% reduction.

#### **RECOMMENDATIONS**

The following credits are not required to be achieved by project teams, but are strongly recommended as project scope, budget, and other considerations allow.

<b>Rainwater Management</b>	LEED-NC SS credit 4: Incorporate green infrastructure and low impact development strategies into the site design in order to manage on-site 100% of the total volume of runoff calculated for the 95th percentile rainfall event for the site.
<b>Heat Island Reduction</b>	LEED SSc5: Non-roof and roof heat island reduction required for new buildings, optional for existing buildings.
<b>Light Pollution Reduction</b>	LEED SSc8: Meet the requirements of LEED v4 SSc8.
<b>Sustainable Sites Initiative</b>	If project is a primarily a landscape project, adhere to Sustainable Sites Initiative requirements.