US Army Corps of Engineers

ENGINEERING AND CONSTRUCTION BULLETIN

No. 2024-02 **Issuing Office:** CECW-EC **Issued:** 09 Apr 24 **Expires:** 09 Apr 26

SUBJECT: Energy Optimization & Life Cycle Cost Analysis Requirement Update

CATEGORY: Guidance

1. **References:**

a. Code of Federal Regulations, Title 10 Part 433 Energy Efficiency Standards for the Design and Construction of New Federal Commercial and Multi-Family High-Rise Residential Buildings. https://www.wbdg.org/ffc/fed/code-federal-regulations/10-cfr-part-433

b. Code of Federal Regulations, Title 10 Part 435 Energy Efficiency Standards for the Design and Construction of New Federal Low-Rise Residential Buildings. https://www.wbdg.org/ffc/fed/code-federal-regulations/10-cfr-part-435

c. Unified Facilities Criteria 1-200-02, High Performance and Sustainable Building Requirements. https://www.wbdg.org/ffc/dod/unified-facilities-criteria-ufc/ufc-1-200-02

d. Memorandum, ASA (IE&E), Sustainable Design and Development Policy Update, 17 JAN 2017. https://www.wbdg.org/ffc/army-coe/policies-and-guidance-army-design-and-construction/army-sdd-policy-update

e. Engineer Regulation 1110-1-8173, Energy Modeling and Life Cycle Cost Analysis. https://www.publications.usace.army.mil/Portals/76/Publications/EngineerRegulations/ER_1110-1-8173.pdf

f. Engineering and Construction Bulletin 2023-8, Electrification, Decarbonization, and Executive Order (E.O.) 14057. https://wbdg.org/ffc/dod/engineering-and-construction-bulletins-ecb/usace-ecb-2023-08

g. Memorandum, USD (A&S), Electrification of Standard Building Operations, 29 MAR 23

h. Memorandum, DASA (IH&P), Army Electrification Guidance for Military Construction (MILCON) and Sustainment, Restoration and Modernization (SRM) Projects, 5 FEB 2024

i. ANSI/ASHRAE/IES Standard 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings, 2019

j. IECC, International Energy Conservation Code, 2021

k. Army Sustainability Implementation Guide. https://mrsi.erdc.dren.mil/sustain/

2. **Purpose.** Revisions to Federal regulations, electrification policy, and other recent Army policy impact the methodology for energy optimization and Life Cycle Cost Analysis (LCCA). This Engineering and Construction Bulletin (ECB) provides clarification for energy optimization and LCCA for compliance with federal regulations, Unified Facilities Criteria, and Army policy. Additionally, it addresses electrification impacts, and reinforces existing guidance (references a-k).

3. **Applicability.** This ECB applies when the U.S. Army Corps of Engineers (USACE) is the Design and Construction Agent for Army military construction (MILCON) projects, as well as for Army renovation and modernization (R&M) projects as further defined in the subsequent sections. For projects being completed for other services and Interagency and International Support (IIS), comply with owner agency guidance.

4. **Guidance**

a. **Electrification impacts to energy optimization/LCCA.** This guidance applies to projects that meet the applicability requirements as outlined in ECB 2023-08 (reference f). In accordance with DoD and Army Electrification Policies and ECB 2023-08 (references f-h), all alternative features and strategies used for energy optimization and LCCA must be all-electric, subject to the specific rules and requirements of the associated Federal, DoD, and service-component policies and guidance. For those projects required to meet ASHRAE 90.1-2019, use fossil-fuel or electric baseline systems as required by Appendix G (reference i). For projects required to use the IECC 2021 (reference j), the "standard reference design" (baseline) must comply with the Total Building Performance Analysis in section R405.

b. **Clarification for ASHRAE Baseline Building 2019.** This section addresses the ASHRAE Baseline Building's role in energy analyses and LCCA based on ASHRAE 90.1 Appendix G methodology, for applicable MILCON and R&M projects. The methodology in ASHRAE 90.1-2019 provides a baseline for calculating energy cost reduction but does not provide a baseline for determining initial/first costs, operation and maintenance costs, and other expenses included in life cycle cost analyses. Ultimately, the methodology for establishing the ASHRAE 90.1-2019 LCCA baseline are left at the discretion of the project team. Recommended methods are available in Attachment A.

c. **LEED and LCCA.** The Army Sustainable Design and Development Policy (reference d) provides the requirements for achieving Leadership in Energy and Environmental Design (LEED) Silver certification for applicable Army projects. Where LEED Silver certification is required, it must be achieved regardless of whether doing so is life cycle cost effective relative to established baselines. For additional information and guidance, refer to Attachment B.

d. **Additional guidance.** Requirements exist within ER 1110-1-8173 (reference e) and guidance existed in several expired ECBs that will be incorporated into the next ER update. These must be considered during design and design-build request for proposal preparation. Additional guidance is provided in Attachment C.

5. **Date of Applicability.** This ECB is effective immediately.

6. **Point of Contact.** HQUSACE point of contact for this ECB is Brandon T. Martin, P.E., CECW-EC, (502) 315-6407.

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Enclosures:
Attachment A - Clarification for ASHRAE Baseline Building 2019
Attachment B - LEED and LCCA
Attachment C - General Energy Modeling and LCCA Guidance

Attachment A: Clarification for ASHRAE Baseline Building 2019

References:

- Code of Federal Regulations, Title 10 Part 433 Energy Efficiency Standards for the Design and Construction of New Federal Commercial and Multi-Family High-Rise Residential Buildings. https://www.wbdg.org/ffc/fed/code-federal-regulations/10-cfr-part-433
- Unified Facilities Criteria 1-200-02, High Performing and Sustainable Buildings.
- Engineering and Construction Bulletin 2023-1, Meet the Requirements of ASHRAE 90.1-2019 to Optimize Energy Performance. https://www.wbdg.org/ffc/dod/engineering-and-construction-bulletins-ecb/usace-ecb-2023-1
- ANSI/ASHRAE/IES Standard 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings, 2019
- Army Sustainability Implementation Guide. https://mrsi.erdc.dren.mil/sustain/

Updates:

This guidance will be updated, as necessary, in the Army Sustainability Implementation Guide.

Background:

Federal regulations and UFC require energy optimization and life cycle cost analyses (LCCA) utilizing the Performance Rating Method detailed in ASHRAE 90.1-2019, Appendix G.

The ASHRAE Baseline Building is defined for energy performance in ASHRAE 90.1, Appendix G. In the past, Appendix G generally referred to Mandatory and Prescriptive Path requirements within ASHRAE 90.1 to define performance for the baseline features and systems. The latest update to 10 CFR 433 adopts ASHRAE 90.1-2019, which alters the Appendix G methodology, making the baseline building performance (BBP) match ASHRAE 90.1-2004 performance. 10 CFR 433 requires the use of a Performance Cost Index (PCI) and Performance Cost Index Target (PCIt) to determine the percentage energy reduction reported by a project. The PCIt calculation adjusts the "2004 baseline" energy cost performance to a "2019 baseline" energy cost performance via the use of a Building Performance Factor (BPF). This methodology establishes a baseline for determining energy cost performance improvement.

The methodology described above does not serve as a baseline for determining initial or first costs (investment costs), operation and maintenance (O&M) costs (recurring and replacement costs), and other costs included in the life-cycle cost. A mechanism for determining feature or system costs for the ASHRAE Baseline Building is needed to develop a LCCA.

Guidance:

One available approach for determining the initial/first costs, operation and maintenance costs, and other non-energy costs, associated with ASHRAE Baseline Building 2019, is to base them on compliance with the Mandatory and Prescriptive Path requirements within ASHRAE standard 90.1-2019. Where Appendix G indicates requirements for each feature or system, the Mandatory

and Prescriptive Path requirements from ASHRAE 90.1-2019 may be substituted. This approach is referred to as the "Prescriptive Baseline Override".

For LCCA purposes, energy costs for the baseline may be calculated by either of the methods below. Identify the method for calculating the LCCA energy costs in the design analysis:

- The Baseline Building Performance (BBP), as defined by ASHRAE 90.1-2019, Appendix G, modified by the "prescriptive baseline override", may be used as the energy cost for the LCCA. (Note: The energy cost calculated will more closely match an ASHRAE 90.1-2019 compliant design but may not match the costs used for the energy performance improvement percentage calculation.*)

- Energy cost may be determined by BBUEC + (BPF) x BBREC as defined in ASHRAE 90.1-2019, Chapter 4**. Do not use the "Prescriptive Baseline Override" for this calculation. Definitions for BBUEC, BPF, and BBREC, along with values for BPF, are in ASHRAE 90.1, Chapter 4. (Note: This will match the energy performance percentage improvement calculation.*)

For the purpose of calculating the energy performance percentage improvement, the formula shown in 10 CFR 433.101(a)(5) is required without using "Prescriptive Baseline Overrides". This calculation is solely for determining the improvement achieved and does not apply to developing the energy cost for LCCA.

*Note that, due to the methods used to develop the PCIt in ASHRAE 90.1-2019, energy performance based on ASHRAE 90.1-2019 compliance using mandatory and prescriptive measures may not match energy performance using the Performance Rating Method (ASHRAE 90.1-2019, Appendix G and Chapter 4). The methods for determining the baseline energy cost for LCCA are left at the discretion of the project team to determine; however, the calculation of energy performance percentage improvement must utilize the Performance Rating Method.

**For LCCA, BLCC5 requires input of the energy consumption associated with each energy source and application of a utility cost rate to each (the utility cost rate is escalated each year in the analysis). In this case, the energy consumption for each fuel is broken into unregulated energy and regulated energy, regulated energy is multiplied by the BPF, and the resulting sum of unregulated energy and regulated energy is entered in BLCC5 as the fuel consumption rate. For example: Electricity Consumption UEC + BPF x Electric Consumption REC.

Attachment B: LEED and LCCA

References:

- Memorandum, ASA (IE&E), 17 Jan 2017, subject: Sustainable Design and Development Policy Update.
- Engineering and Construction Bulletin 2023-8, Electrification, Decarbonization, and Executive Order (E.O.) 14057.
- Army Sustainability Implementation Guide. https://mrsi.erdc.dren.mil/sustain/

Updates:

This information will be updated, as necessary, in the Army Sustainability Implementation Guide.

Guidance:

In accordance with Army policy, applicable building projects are required to achieve a mandatory level of LEED certification, currently set at LEED Silver. A large portion of the points available for a project come from the energy optimization related credits, such as Optimize Energy Performance or Renewable Energy. To eliminate confusion regarding whether the mandated LEED certification level is subject to LCC constraints, it is essential to understand that the mandatory LEED certification level must be achieved, even if the strategies required for achieving it are not life cycle cost-effective compared to LEED-defined baselines or the ASHRAE Baseline Building.

- Example: A project is required to achieve LEED Silver certification and has maximized all other feasible credits. Out of the minimum 50 required points (without any buffer), 36 points are already projected. Any combination of 14 points is required from Optimize Energy Performance and Renewable Energy Production to achieve LEED Silver. Ten (10) points is the maximum number of points that is LCC effective relative to the LEED-defined baseline for the project. Optimizing the massing/orientation, envelope, and HVAC systems in a way that is LCCE versus baseline results in 10 points. The design must achieve the 14 points regardless of the LCC effectiveness relative to baseline. The team decides that solar PV will be used to get the last 4 points even though the solar PV is not LCCE.

Attachment C: General Energy Modeling and LCCA Guidance

References:

- Unified Facilities Criteria 1-200-02, High Performing and Sustainable Buildings
- Engineer Regulation 1110-1-8173, Energy Modeling and Life Cycle Cost Analysis.
- ANSI/ASHRAE/IES Standard 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings, 2019

Guidance:

The following represent best practices or are requirements included in existing policy and are recommended for incorporation into all projects that must include energy optimization and LCCA. Many of these items are included in ER 1110-1-8173, and several will be included in future updates to the ER.

- The project Technical Lead has the responsibility to ensure that the energy optimization and LCCA is performed and fully documented. The project team, including architects and the mechanical, electrical, and cost engineers, must employ integrated design principles in accordance with UFC 1-200-02. Include the early design energy optimization and LCCA documentation in a separable volume of the design analyses and retain with the project documentation. This documentation may be included with the Energy Compliance Analysis (ECA) (refer to UFC 1-200-02) with the final design submission but must remain a separable section of the ECA. The energy optimization/LCCA report and the ECA documents serve different purposes: one demonstrates how the project design systems/features were selected early in design and the other demonstrates the final calculated energy performance percentage improvement along with energy models reflecting final design. The design analysis is important documentation to justify decision-making for Sustainable Design and Development Policy validation surveys and Army audits that validate policy and statutory compliance.

- Exercise good engineering judgment and use past experience in identifying the best alternatives for analysis. Where there are less than three feasible alternatives for the project, include a justification in the documentation. Document all alternatives considered, including those not analyzed and the reason. Provide justification when sensitivity analyses or non-quantitative considerations impact alternative selection.

- Previous energy optimization and LCCA, or parts thereof, developed for past projects may be reused provided that the building and climate, utility rates, costs, occupancy, and usage are sufficiently similar. Sensitivity analyses from the past studies may be used to determine the extent of change in these parameters that warrant an update. Where initial/first costs, operations and maintenance costs, and utility costs have changes by more than 10% since the previous analysis, update the associated data in the analyses.

- Any changes to the project scope beyond completion of the 35% design (or completion of Code 2) that impact energy savings (more than 30% of building total energy cost) or project cost (more than 30% of program amount) require an update to the energy optimization and LCCA.

- Some installations have preferred systems or systems that they prohibit. Installation preferences do not supersede Army policy or Unified Facilities Criteria.

- Full credit for on-site renewable power is to be used for the energy performance percentage improvement calculation. ASHRAE 90.1-2019, Chapter 4.2.1.1 formula for PCIt does not limit renewable energy credit for the purposes of demonstrating energy performance improvement in accordance with ASHRAE 90.1, Appendix G. ASHRAE 90.1-2019 only limits credit for renewable energy when using the Performance Rating Method to demonstrate compliance with the standard in Chapter 4. Renewable energy must also be used when LCC effective relative to not implementing it (the "do nothing" case), as required by UFC 1-200-02.

- Design-Build. As stated in ER 1110-1-8173, the energy optimization and LCCA is prepared during the development of the solicitation package (request for proposal) for design-build projects. The resulting systems/feature selections will be incorporated as requirements in the design-build contract. The design-build contractor selection criteria must require that betterments provided by offerors that significantly affect energy efficiency be supported by a LCCA. Acceptance of such a betterment must take the life-cycle cost into consideration.

- Quality Assurance. District architects and engineering subject matter experts (SME) must review and approve alternatives proposed for analysis, prior to the start of the energy optimization and LCCA, to ensure that a sufficient number and variation of alternatives is analyzed for the project and that alternatives that are not acceptable are not included. Include a statement that the proposed alternatives have been reviewed and approved, signed by the SME(s), in the project design analysis. The results of the LCCA are used to establish features/systems for the project; therefore, District SMEs will review the energy optimization and LCCA report submittal to ensure compliance with energy optimization and LCCA requirements prior to design progression. Include a statement, that the submittal has been reviewed for compliance with sustainability criteria, signed by the SME(s), in the project design analysis. Update and include the statement as part of any required review documentation (including BCOES reviews).

Energy Optimization & LCCA Report:

Refer to ER 1110-1-8173 and UFC 1-200-02 for further information. Energy optimization and LCCA documentation must be detailed enough and well organized to provide sufficient information for the analysis to be auditable or repeatable by a third party. Provide the following with the design documentation:

Narrative

- Identify applicable criteria.
- Documentation of any exemptions approved by higher headquarters.
- Identify the proposed design resulting from the analysis and include thorough description of process/reasoning for selection. If the alternative selected is not compliant with the requirements for energy performance relative to LCC, provide justification (maintainability, base preference, initial cost, etc.).

- Summary description of each alternative analyzed including assumptions and references used to determine each parameter. Include summary of baseline.
- List any alternatives considered but not selected for analysis and reasoning. Include description of installation/stakeholder preferences and restrictions or DD Form 1391 requirements that influenced selection of alternatives.
- Provide a table comparing alternatives that shows current year initial cost, annual energy consumption, annual energy cost, maintenance/replacement costs, other operating costs (if applicable), salvage/residual costs, and present-value life-cycle cost.
- If component/system level analyses were performed to support development of whole building analyses, provide similar tables comparing alternatives for each feature/system (wall-to-wall, roof-to-roof, HVAC-to-HVAC). Provide the same information for renewable energy and alternative water system analyses.
- Describe results of sensitivity analysis and any impact on selection for proposed design.
- Identify software used for energy modeling and LCCA including the vendor and version.
- Identify sources of information for initial costs, maintenance/removal costs, service life, residual/salvage value, energy/water utility data, etc.
- List utility rate data and explain how utility rate structure was applied.
- Confirm/identify source of discount and escalation rates for the LCCA.
- Statement that alternatives proposed for analysis were reviewed and approved prior to beginning LCCA, signed by the reviewing SME(s).

Analysis Documentation

- Provide cost analysis for initial costs and maintenance/operational costs.
- Provide input/output reports from software (BLCC) for the LCCA for each whole building alternative. If component/system level analyses were performed to support development of the whole building analyses, include the input/output reports for each component/system.
- Provide input/output reports from energy modeling software for each alternative included in the LCCA.
- In the electronic submission (PDF), bookmark locations for energy analysis, cost analysis, and LCCA separately. Subdivide by alternative and baseline and bookmark. The intent is for reviewer to quickly find the modeling, cost, or LCCA information relevant to a particular alternative.