

HEAT



Global Alliance
for Buildings and
Construction

DEVELOPMENT OF GREEN BUILDING STANDARDS FOR GHANA



BEEG USER MANUAL

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1 Introduction

Welcome to the Building Energy Efficiency Guidelines (BEEG) User Manual for Ghana. This comprehensive guide serves as your essential companion for implementing energy-efficient building practices that align with Ghana's climate objectives and sustainable development goals.

1.1 Purpose and Scope

This manual provides practical guidance for architects, engineers, developers, contractors, and building owners on how to effectively apply the BEEG. These guidelines represent a critical step toward transforming Ghana's built environment, reducing energy consumption, lowering operational costs, and contributing to the country's Nationally Determined Contributions (NDCs) under the Paris Agreement.

1.2 Target Outcomes

By following this manual, users will be equipped to:

- Achieve measurable reductions in building energy consumption
- Integrate passive design strategies appropriate for Ghana's climate zones
- Select and specify energy-efficient systems and technologies
- Navigate the certification and compliance processes effectively
- Contribute to Ghana's broader climate resilience and energy security objectives

1.3 How to Use This Manual

This guide is structured to accommodate both newcomers to energy-efficient building design and experienced professionals seeking to enhance their practice. Each section builds upon previous concepts while remaining accessible as standalone reference material for specific applications.

2 Overview

2.1 Framework and Purpose

The BEEG constitute a comprehensive set of evidence-based recommendations and requirements designed to ensure buildings are planned, constructed, and operated with optimal energy performance. While primarily focused on reducing energy consumption and enhancing efficiency, these guidelines also promote co-benefits in water conservation, indoor environmental quality, and sustainable material selection, creating holistic improvements in building performance.

The guidelines support Ghana's commitment to sustainable development and climate action while addressing the growing energy demands of the country's rapidly expanding built environment. They are applicable across diverse building typologies, including residential developments, commercial facilities, institutional buildings, and office structures throughout Ghana's varied climate zones.

2.2 Key Components of the Guidelines

2.2.1 Energy Efficiency (Primary Focus)

Requirements and strategies for substantially reducing energy consumption through:

- Passive design optimisation tailored to Ghana's tropical climate

- High-performance building envelope specifications
- Efficient system selection and sizing
- Advanced lighting design and daylighting integration
- Smart building controls and energy management systems

2.2.2 Renewable Energy Integration

Guidelines for incorporating clean energy generation to offset building energy demands through:

- Solar photovoltaic system design and installation standards
- Solar water heating implementation for residential and commercial applications
- Integration strategies for distributed renewable energy systems
- Grid-tie and energy storage considerations for Ghana's electricity network

2.2.3 Low-Carbon Construction Materials

Guidelines for selecting and specifying materials that minimise both embodied and operational energy impacts:

- Locally-sourced materials with reduced transportation energy
- Materials with recycled content and low carbon footprints
- High-performance insulation and glazing products suitable for tropical climates
- Cement alternatives and low-carbon concrete specifications

2.3 Performance Framework

These guidelines establish a tiered approach to energy efficiency implementation:

- **Mandatory Requirements:** Basic energy performance standards applicable to all new construction and major renovations
- **Recommended Practices:** Enhanced measures that deliver superior energy savings and operational benefits
- **Leadership Standards:** Advanced strategies for exemplary buildings targeting net-zero energy performance

2.4 Application Scope

The guidelines accommodate Ghana's diverse building sector needs while maintaining flexibility for:

- **Climate Zone Variations:** Specific recommendations for coastal, forest, and savanna regions
- **Building Scale Diversity:** From individual residential units to large-scale commercial complexes
- **Local Construction Practices:** Integration with existing building methods and available expertise

3 First steps

Whether you are a building professional responsible for compliance or an enforcement official overseeing implementation, following these initial steps will strengthen your capacity to successfully apply the BEEG and achieve optimal building performance outcomes.

3.1 Step 1 – Developing Working Familiarity with the Guidelines

3.1.1 Comprehensive Review Process

Begin with a systematic review of the BEEG document to understand both mandatory requirements and voluntary enhancement measures. This foundational knowledge enables informed decision-making throughout your project lifecycle.

3.1.2 Understanding Intent and Philosophy

Develop an appreciation for the underlying principles driving each requirement, from reducing Ghana's energy import dependency to improving occupant comfort in tropical conditions. This conceptual understanding facilitates creative compliance solutions and maximises co-benefits, including reduced operational costs, enhanced indoor air quality, and improved building resilience.

3.1.3 Targeted Focus Areas

Concentrate your study on the sections most relevant to your role and project types:

- **Building Professionals:** Focus on design strategies, system specifications, and performance verification methods for your typical building types (residential, commercial, institutional)
- **Supply Chain Stakeholders:** Emphasise material specifications, performance standards, and certification requirements for products like insulation, glazing, lighting, and HVAC equipment
- **Enforcement Officials:** Prioritise compliance verification procedures, documentation requirements, and performance testing protocols

This targeted approach recognises that successful implementation requires engagement across Ghana's entire building ecosystem—from architects and contractors to material suppliers, importers, and retailers.

3.2 Step 2 – Identification of Applicable Requirements

3.2.1 Project-Specific Requirements Assessment

Systematically identify all applicable guidelines for your specific building project or business operations. Ghana's diverse building types and climate zones may trigger different requirement sets based on factors such as:

- Building typology (residential, commercial, institutional, industrial)
- Geographic location and climate zone
- Building size and occupancy patterns
- Renovation scope vs. new construction

3.2.2 Compliance Checklist Development

Create a comprehensive project checklist organised by building system categories:

Building Envelope: Insulation requirements, glazing performance, air sealing standards

Mechanical Systems: HVAC efficiency requirements, sizing guidelines, control strategies

Electrical Systems: Lighting power densities, daylighting integration, equipment specifications

Renewable Energy: Solar installation requirements, system sizing, grid integration

Verification and Documentation: Required testing, commissioning, and reporting procedures

This systematic approach ensures no requirements are overlooked while facilitating coordination among project team members.

3.3 Step 3 – Collaborative Compliance Planning

3.3.1 Integrated Team Approach

Develop a comprehensive compliance strategy in partnership with all key project stakeholders, including architects, engineers, contractors, and relevant specialists. Early collaboration ensures energy efficiency measures are seamlessly integrated rather than added as afterthoughts.

3.3.2 Implementation Strategy Development

Your compliance plan should address:

- **Material and Technology Selection:** Utilise Ghana's approved energy efficiency materials and technologies database to identify compliant options suitable for local conditions
- **Design Integration:** Coordinate passive design strategies with active system selections to optimise overall building performance
- **Construction Coordination:** Establish quality control procedures ensuring installation practices align with design intent and performance requirements
- **Timeline and Milestone Planning:** Sequence compliance activities to avoid delays while maintaining quality standards

3.4 Step 4 – Building Performance Modelling and Verification

3.4.1 Strategic Modelling Approach

Building energy modelling serves dual purposes: demonstrating regulatory compliance and providing valuable insights for optimising building performance and operational cost savings. This analysis enables data-driven decisions that can significantly impact long-term building economics.

3.4.2 Modelling Implementation

Follow Ghana's Building Energy Efficiency Guidelines, which provide:

- **Software Selection:** Approved energy modelling tools suitable for Ghana's climate conditions
- **Modelling Protocols:** Standardised procedures for creating baseline and proposed building models
- **Input Parameters:** Climate data, operational schedules, and system performance specifications appropriate for Ghanaian conditions
- **Results Interpretation:** Guidance for analysing outputs and identifying optimisation opportunities

3.4.3 Technical Modelling Requirements

Utilise certified building energy modelling software to create detailed simulations comparing your proposed design against a code-compliant reference building. Ensure accurate representation of:

- Building envelope thermal performance under Ghana's tropical climate conditions
- HVAC system sizing and efficiency appropriate for high cooling loads and humidity
- Lighting systems optimised for daylighting availability and visual comfort requirements
- Internal loads reflecting typical Ghanaian building operation patterns
- Local climate data ensuring realistic performance predictions

3.4.4 Verification and Optimisation

Use modelling results to refine design decisions, validate compliance, and identify additional energy savings opportunities that may enhance project economics while supporting Ghana's broader energy efficiency objectives.

4 Using Tools for Effective Implementation

Strategic use of specialised tools significantly streamlines compliance with the BEEG by simplifying complex calculations, standardising assessment approaches, and providing clear guidance throughout the project lifecycle. These tools range from comprehensive building performance modelling software to practical checklists and technology databases, each serving specific roles in successful implementation.

The following tools include both resources provided directly through the BEEG and complementary tools available through various sources—from free, user-friendly applications to sophisticated commercial software requiring advanced technical expertise.

4.1 Building Performance Modelling Tools

4.1.1 Purpose and Application

Building energy modelling tools provide quantitative analysis of energy consumption across all building systems, enabling accurate prediction of operational performance under Ghana's specific climate conditions. These simulations support both compliance demonstration and optimisation of design decisions to maximise energy savings and cost-effectiveness. The benefits include:

- Compliance Verification: Demonstrate adherence to mandatory energy performance requirements early in the design process
- Design Optimisation: Evaluate trade-offs between different efficiency strategies to identify optimal solutions for Ghana's tropical climate
- Economic Analysis: Quantify energy cost savings and payback periods for efficiency investments
- Permitting Support: Provide documentation required for building permit approval and utility interconnection

4.1.2 Implementation Process

Following BEEG, the modelling process involves:

1. Data Input and Model Development:
 - a. Building Geometry: Input accurate architectural plans, including orientation, floor areas, and thermal zoning appropriate for Ghana's climate.
 - b. Envelope Specifications: Define wall, roof, and glazing thermal properties meeting or exceeding guideline requirements.

- c. System Parameters: Specify HVAC equipment capacities, efficiencies, and control strategies optimised for high cooling loads and humidity.
 - d. Operational Schedules: Apply occupancy patterns, equipment usage, and setpoint schedules reflecting typical Ghanaian building operations.
 - e. Climate Data: Utilise verified weather data for specific Ghanaian locations to ensure accurate environmental modelling.
2. Performance Assessment and Analysis:
 - a. Baseline Comparison: Evaluate proposed design performance against code-compliant reference building.
 - b. End-Use Breakdown: Analyse energy consumption by system (cooling, lighting, equipment, etc.) to identify optimisation opportunities.
 - c. Sensitivity Analysis: Test the impact of key design variables on overall performance to guide decision-making.
 - d. Compliance Documentation: Generate reports demonstrating adherence to energy performance requirements.
 3. Scenario Analysis Capabilities:
 - a. Design Alternatives: Compare different envelope configurations, system types, and efficiency measures.
 - b. Renewable Integration: Evaluate solar photovoltaic and solar thermal system performance and sizing.
 - c. Operational Strategies: Assess the impact of different control strategies and operational practices on energy consumption.

4.2 Compliance Checklists and Documentation Tools

4.2.1 Systematic Compliance Management

Comprehensive checklists ensure systematic consideration of all guideline requirements throughout the project lifecycle, reducing the risk of non-compliance and facilitating smooth permit approval and inspection processes.

4.2.2 Project-Specific Checklist Development

Create customised checklists by systematically reviewing the BEEG and identifying requirements applicable to your specific:

- Building typology (residential, commercial, institutional)
- Project scale and complexity
- Geographic location within Ghana
- Renovation scope or new construction parameters

4.2.3 Phase-Based Implementation Framework

1. Design Phase Compliance Tools
 - a. Requirement Verification: Confirm all mandatory measures are incorporated into design documents.
 - b. Performance Target Setting: Establish specific energy performance goals beyond minimum requirements.

- c. Technology Selection: Document equipment and material specifications meeting guideline criteria.
 - d. Integration Coordination: Verify coordination between architectural, mechanical, and electrical design elements.
- 2. Construction Phase Quality Assurance
 - a. Material Verification: Confirm installed materials match specifications and meet performance requirements.
 - b. Installation Quality: Monitor proper installation of insulation, air sealing, and high-performance glazing.
 - c. System Commissioning: Verify HVAC system performance through systematic testing and optimisation.
 - d. Documentation Completion: Compile required compliance documentation for final inspection and occupancy.
- 3. Operational Phase Monitoring
 - a. Performance Verification: Conduct post-occupancy energy performance monitoring and verification.
 - b. Maintenance Planning: Establish maintenance schedules ensuring continued compliance with efficiency requirements.
 - c. System Optimisation: Monitor and adjust system operations to maintain optimal energy performance.
 - d. Reporting Requirements: Complete any required ongoing compliance reporting to relevant authorities.

4.3 Energy Efficiency Technologies Database

4.3.1 Comprehensive Technology Resource

The Energy Efficiency Technologies Database provides information on equipment, materials, and systems that meet or exceed guideline performance requirements. This resource streamlines technology selection while ensuring compatibility with local climate conditions and market availability.

4.3.2 Database Structure and Content

- 1. Building Envelope Technologies
 - a. Insulation Materials: Thermal performance specifications, appropriate applications for Ghana's climate, and local supplier information
 - b. High-Performance Glazing: Solar heat gain coefficients, visible light transmission, and thermal performance ratings suitable for tropical conditions
 - c. Air Sealing Products: Materials and techniques for achieving required envelope air tightness levels
- 2. Mechanical and Electrical Systems
 - a. HVAC Equipment: Cooling system efficiency ratings, sizing guidelines, and performance optimisation strategies for high-humidity environments
 - b. Lighting Technologies: LED fixtures, controls, and daylighting systems optimised for Ghana's solar conditions and visual comfort requirements

- c. Building Controls: Energy management systems, occupancy sensors, and automated control strategies appropriate for local building operations
- 3. Renewable Energy Systems
 - a. Solar Photovoltaic: System components, sizing methodologies, and integration strategies for Ghana's solar resource conditions
 - b. Solar Water Heating: Equipment specifications, installation guidelines, and performance expectations for tropical applications
- 4. Decision-Support Features
 - a. Performance Comparisons: Side-by-side analysis of technology alternatives with cost and performance implications
 - b. Local Availability: Information on suppliers, distributors, and installation contractors within Ghana
 - c. Case Studies: Real-world examples of successful technology implementations in similar Ghanaian projects
 - d. Economic Analysis Tools: Cost-benefit calculators incorporating local utility rates and financing options

4.3.3 Regular Updates and Verification

The database requires periodic updates to ensure its continued relevance and accuracy for Ghana's evolving building market. These updates incorporate new technology developments and market introductions as manufacturers expand their product offerings and performance capabilities. The database could also be expanded to integrate updated performance testing results and field experience data from actual building installations across Ghana, providing users with real-world performance validation rather than solely theoretical specifications. Finally, regular updates should account for the evolution of costs and economic considerations, including fluctuations in equipment prices, changes in utility rates, and the introduction of new financing mechanisms or incentive programs that may affect the cost-effectiveness analysis of different technology options.

5 Tips for Successful Implementation

Achieving excellence in building energy efficiency requires strategic planning, stakeholder coordination, and commitment to continuous improvement. The following best practices will help practitioners not only meet Ghana's Building Energy Efficiency Guidelines but also establish market leadership in sustainable building performance.

5.1 Early Stakeholder Engagement and Team Integration

1. **Establish a collaborative framework from project inception** - engage all critical project stakeholders (including architects, engineers, contractors, facility managers, and building owners) during the earliest planning phases to ensure a unified understanding of energy efficiency objectives and individual roles in achieving compliance. This integrated approach prevents costly design changes and construction delays while maximising opportunities for innovative energy-saving solutions.
2. **Define clear roles and responsibilities**- establish specific accountability for energy efficiency implementation across the project team. Assign dedicated responsibility for compliance monitoring, performance verification, and quality assurance to ensure no requirements are overlooked during design development or construction execution.

3. **Foster communication and coordination**- Implement regular project coordination meetings focused specifically on energy efficiency compliance, creating opportunities to address challenges proactively and share innovative approaches that exceed minimum requirements.

5.2 Commitment to Continuous Learning and Market Leadership

4. **Stay current with evolving best practices** - actively monitor developments in building energy efficiency technologies, design strategies, and regulatory updates relevant to Ghana's climate and market conditions. Subscribe to relevant technical publications, participate in professional development programs, and engage with industry associations to maintain cutting-edge knowledge.
5. **Pursue performance excellence beyond compliance**- use Ghana's Building Energy Efficiency Guidelines as a foundation rather than a ceiling for your projects. Explore advanced strategies such as net-zero energy design, passive house principles adapted for tropical climates, and innovative renewable energy integration that can differentiate your projects in the marketplace.
6. **Document and share lessons learned**- Create systematic processes for capturing performance data, identifying successful strategies, and documenting challenges encountered during implementation. This institutional knowledge becomes invaluable for optimising future projects and contributing to Ghana's broader building efficiency improvement.

5.3 Strategic Utilisation of Financial Incentives and Support Programs

7. **Comprehensive incentive research and application**- Thoroughly investigate available financial incentives supporting building energy efficiency in Ghana, including government rebates, tax incentives, utility programs, and international climate financing mechanisms. Many projects qualify for multiple incentive programs that can significantly improve project economics.
8. **Leverage documentation tools for incentive applications** - Utilise the compliance documentation and performance modelling tools provided with Ghana's Building Energy Efficiency Guidelines to strengthen applications for financial incentives. Comprehensive performance documentation demonstrates project credibility and quantifies expected benefits for funding decision-makers.
9. **Explore innovative financing mechanisms**- Investigate emerging financing options such as on-bill financing for energy improvements, performance contracting arrangements, and green building loan programs that may be available through Ghana's financial institutions or international development partners.

5.4 Performance Monitoring and Continuous Improvement

10. **Implement systematic performance verification** - establish regular building performance monitoring protocols using both the provided compliance tools and advanced metering systems to verify that actual energy consumption aligns with design predictions. This verification process identifies opportunities for operational optimisation and validates the effectiveness of implemented efficiency measures.
11. **Conduct post-occupancy evaluations** - systematically evaluate building performance after occupancy to assess the real-world effectiveness of energy efficiency strategies under actual operating conditions. Compare measured performance against modelling predictions to refine future design approaches and improve the accuracy of energy saving estimates.
12. **Apply lessons learned to future projects**- develop organisational processes for capturing and applying insights from completed projects to enhance the design and implementation of future developments. Create databases of successful strategies, technology performance data, and cost-effectiveness analysis to inform project decision-making.

5.5 Market Leadership and Professional Development

13. **Champion** industry advancement- position your organisation as a leader in Ghana's building energy efficiency market by consistently delivering projects that exceed minimum requirements and demonstrate measurable energy performance improvements. Share success stories and technical insights with the broader professional community to advance industry best practices.
14. **Invest in technical capability development**- provide ongoing training for project teams on evolving energy efficiency technologies, modelling tools, and implementation strategies. Consider pursuing relevant professional certifications and maintaining memberships in international green building organisations to access global best practices adapted for local conditions.
15. **Build Strategic Partnerships** - develop relationships with technology suppliers, equipment manufacturers, and service providers who demonstrate commitment to high-performance building solutions suitable for Ghana's market. These partnerships enable access to cutting-edge technologies and technical support that can differentiate your projects.

5.6 Quality Assurance and Risk Management

16. **Establish robust quality control processes** - implement systematic quality assurance procedures throughout design development and construction to ensure proper installation of energy efficiency measures and achievement of specified performance levels. Regular quality inspections prevent performance degradation due to installation errors or material substitutions.
17. **Plan for long-term performance maintenance**- develop comprehensive maintenance planning and training programs, ensuring building operators understand the proper operation and maintenance of energy efficiency systems. Well-maintained systems deliver sustained energy savings throughout the building lifecycle.
18. **Monitor regulatory compliance evolution**- stay informed about potential updates to Ghana's Building Energy Efficiency Guidelines and related regulations to ensure ongoing compliance and identify opportunities to incorporate enhanced requirements into current projects proactively.