Federal Republic of Nigeria

National Building Energy Efficiency Code

FIRST EDITION

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Content

FOREWORD

When President Muhammadu Buhari signed the Paris Agreement committing to minimum nationally determined contributions to be made by Nigeria to reduce the impact of global warming, he was reiterating Nigeria's commitment to remain a respected and respectable member of the civilized global community.

The responsibility for delivering on that commitment now lies with the people of Nigeria in the public and private sectors of the Nigerian society.

Government agencies, like the Federal Ministry of Power, Works and Housing have a leadership role to play in formulating policies, making regulations and developing or approving programmes that guide the conduct of public and private operators in the use of climate impacting resources, such as energy.

This is why I am delighted to contribute this FOREWORD to the Building Energy Efficiency Code.

The code speaks eloquently to the commitment of Nigeria to the Paris Agreement on a Global Stage, as it does to our Road Map to reliable Power Supply through Incremental, Steady and Uninterrupted Power Supply.

Conservation, waste reduction, and efficient energy use are critical contributors to increasing supply of energy, stabilizing supply of energy and ensuring unfailing supply of energy; because, whatever is wasted will never be enough.

Building Energy Efficiency Code gives the comparative advantage when utilized effectively in planning and construction of buildings.

Building Energy Efficiency Code specifies minimum energy required to achieve energy efficient buildings which in turn impacts on the socio-economic wellbeing of citizens and country at large.

The code when implemented has the capacity to save 40% of current energy usage in buildings.

We have in existence, a National Building Code which is being revised according to world best practices after being in operation for some years. It is expected that the National Building Energy Efficiency Code will complement the demands for energy efficient buildings in detail.

Building Energy Efficiency Code sets the minimum efficiency requirements for new buildings to achieve reductions in energy use and gas emissions over the life of the building. It saves building owners and renters huge amounts of money in energy costs.

Building Energy Efficiency Code gives thermally comfortable and healthy buildings. It also allows for new job creation. This project was undertaken with the support of the Nigerian Energy Support Programme (NESP) and other relevant stakeholders. It is my belief and hope that with the application of this code, a paradigm shift in the building construction industry will emerge, ushering new prosperity for all.

Babatunde Raji Fashola, SAN

Honourable Minister of Power, Works and Housing

ADMINISTRATIVE PART

1. Preface

1.1 Overview of BEEC Development

The need to evolve a National Energy Efficiency Building Code (BEEC) arose from the threatening lack of sufficient power supply on the one hand and energy policies requiring action in the field of energy efficiency in buildings on the other hand.

In view of the above, the Federal Ministry of Power, Works and Housing (Housing Sector) deemed it necessary and initiated the process of evolving a National Energy Efficiency Building Code in order to contribute to ensuring constant availability of electricity in Nigeria and to implement energy efficiency in the building sector according to overarching policies.

The National Energy Efficiency Building Code was developed in several stages:

- Development of the National Building Energy Efficiency Guideline (BEEG) promoting bioclimatic buildings, taking into account stakeholders' view. This was approved and launched by the Ministry in June 2016;
- Development of the Technical BEEC Study identifying minimum energy efficiency requirements and other necessary elements of the BEEC, taking into account stakeholders' view during stakeholder workshops;

- Development of the Draft National Building Energy Efficiency Code based on the BEEG and the Technical BEEC Study, and validated by means of stakeholder review processes and a validation workshop.

The Ministry made all three documents publicly available on their website;

- National Building Energy Efficiency Code (BEEC);
- Technical BEEC Study;
- National Building Energy Efficiency Guideline (BEEG).

1.2 Acknowledgements

The following groups have contributed to the success of the First Edition of the National Building Energy Efficiency Code:

- The Professionals in the Building Industry and their respective Regulatory Bodies;
- Development Control FCT Abuja;
- Ministries, Departments and Agencies;
- Private Sector Stakeholders;
- The Nigerian Energy Support Program NESP funded by the German Government and the European Union;
- Resource persons at various stages of the development of this edition of the code.

Their valuable contributions are hereby acknowledged.

2. Commencement and Definitions

2.1 Title, Aim, Scope and Adoption of BEEC

2.1.1 **Title:** This code shall be known as the "National Building Energy Efficiency Code" hereinafter referred to as "the BEEC".

2.1.2 **Aim:** The aim of the BEEC is to set minimum requirements on Building Energy Efficiency and to provide for their proper implementation, control, and enforcement.

2.1.3 Scope of the BEEC

2.1.3.1 The BEEC consists of the following elements;

- Minimum energy efficiency requirements and verification methods;
- Calculation methods and tools;
- Building energy label and energy efficiency incentives;
- Control and enforcement;
- Qualification of experts;
- Review and adaptation.

2.1.3.2 The standards specified in the BEEC shall constitute the minimum requirement from which other energy-related regulations may be derived. Wherever any derived energy-related regulation is in conflict with any section of the BEEC, the provision in the BEEC prevails.

2.1.3.3 Affected buildings: The BEEC applies to new buildings only and those that fit into the building classifications according to National Building Code listed below;

- Group B – Business and Professional (Spaces used primarily for office work)
- Group R – Residential Buildings
    - Group R-2 (Apartment houses, vacation timeshare properties)
    - Group R-3 (One or two-family dwelling units)
    - Group R-4 (Detached one or two-family dwellings)

2.1.3.4 For Group R (Residential) building types, a minimum threshold of 85m² gross floor area applies. This is to apply to a standalone building only.

2.1.3.5 Scope on federal level: The provisions of the BEEC apply directly to the Public buildings of the Ministry responsible for the National Building Energy Efficiency Code. In this regard, the competent authority in this document is synonymous with the responsible Ministry.

2.1.3.6 Scope on state and local level: In addition, the BEEC shall be adopted by the states and local governments in order to apply the provisions to all relevant matters within their responsibility.

2.1.4 Adoption of the BEEC

2.1.4.1 Adoption of the BEEC in the states and local governments includes the determination of the competent authority in charge of implementing the BEEC in the respective territory.

2.1.4.2 Adoption of the BEEC in the states and local governments can include adaptations taking into account specific climatic conditions, provided that adaptations are scientifically substantiated and shall not reduce the minimum requirements.

2.1.4.3 Entering into force: After adoption, the BEEC is voluntary for up to a maximum of two years to allow for an adoption and inception phase. After this period, the competent authority shall then make all BEEC requirements mandatory.

2.2 Definitions

APPLICABILITY	Specifies which buildings the requirements are applicable to.
AS-BUILT DRAWINGS	All architectural, structural, mechanical and electrical and other specialist drawings showing the building as built, prepared by registered architects and registered engineers and as-built survey prepared by registered surveyors.

BEEC CALCULATOR	Tool for verifying compliance with minimum energy efficiency requirements.
BEEC INTERVENTION	Energy efficiency measures specified in the BEEC.
BEEC LABEL	A comparative building label that rates a building depending on how many of the BEEC interventions have been implemented.
BEEC MODELLING PROTOCOL	Ensures that all buildings follow the same procedures for modelling, irrespectively of the software used.
BUILDING OFFICIAL	The officer or other designated authority charged with the administration and enforcement of this code, or a duly authorized representative.
BUILDING PERMIT	Authorization that must be granted by the competent authority before the construction of a building can legally occur.

CERTIFICATE OF USE AND HABITATION	The certificate issued by the Code Enforcement Officer, which permits the use of a building in accordance with the provisions of law for the use and occupancy of the building in its several parts together with any special stipulations or conditions of the building permit.
COMPETENT AUTHORITY	The authority in charge of implementing the BEEC in the respective territory.
EER/COP	Energy Efficiency Ratio (EER) and Coefficient of Performance (COP) are indicators for the energy efficiency of Air Conditioning systems. EER refers to the ratio of power input to cooling output whilst COP refers to the ratio of power input to heating output.
ENERGY EFFICIENCY INSPECTOR	A qualified person having the competence necessary to inspect a particular type of construction and assess compliance with minimum energy efficiency requirements
ENERGY EFFICIENCY REQUIREMENT	Specifies the prescriptive requirement.
ENERGY	Energy is measured in Wh (watt hours). It is the power consumption over a certain time interval.

FLOOR AREA (GROSS)	The floor area within the perimeter of the out-side walls of the building under consideration, without deduction for hallways, stairs, closets, thickness of walls, columns, or other features.
METHOD OF VERIFICATION	Specifies the method of calculation and documentation to be submitted to the competent authority, in order to verify evidence of compliance in both the design stage (prior to obtaining the Building Permit) and the as-built stage (prior to obtaining the Certificate of Use and Habitation).
MINIMUM ENERGY EFFICIENCY REQUIREMENT	Energy-related properties shall not be worse than specified by the minimum requirement. Energy-related properties can be better than specified by the minimum requirement.
PERMIT	An official document or certificate issued by the Code Enforcement Division/Section/Unit authorizing the performance of a specified activity regulated by the Code.
POWER	Is measured in W (Watt). It is a measure of the instantaneous electrical usage.

SHALL	As used in this code shall be construed to be mandatory.
THE MINISTRY	The Federal Ministry responsible for the National Building Energy Efficiency Code.

TECHNICAL PART

3. Minimum Energy Efficiency Requirements and Verification Methods

3.1 General Provisions

3.1.1 Minimum energy efficiency requirements apply to all climatic zones in Nigeria.

3.1.2 Energy efficiency interventions are specified based on bioclimatic principles described in the National Building Energy Efficiency Guideline (BEEG) and include;

- Reduction of overall Window to Wall Ratio or implementing of shading;
- Reduction of installed lighting power density;
- Minimum requirements for roof insulation;
- Minimum performance of air conditioning equipment specified;
- Installation of non-inverter split units to be restricted.

3.1.3 The energy consumption for the following shall not be included;

- Appliances for offices and households;
- Energy consumption related to industrial or other processes;
- Energy consumption for heating water.

3.1.4 Two methods are possible to demonstrate compliance with the BEEC.

3.1.4.1 Compliance Method 1 Prescriptive approach - For this option, building projects must adhere to all the requirements as a checklist.

3.1.4.2 Compliance Method 2 Performance approach - Project teams may deviate from the prescriptive requirements, provided that the theoretical energy use of the building is less than or equal to that of the same building with all the prescriptive requirements included. A whole building analysis using energy simulation software must be carried out.

3.1.5 Verification documents for demonstrating compliance shall be submitted to the competent authority two times; (1) prior to obtaining the Building Permit, and (2) prior to obtaining the Certificate of Use and Habitation.

3.2 Compliance Method 1 - Prescriptive Route to Compliance

3.2.1 Window to Wall Ratio and Shading

3.2.1.1 Window to Wall Ratio for any orientation shall not exceed 20%. Where the design is such that this cannot be achieved, then all glazing elements on the relevant facades are to be adequately shaded.

3.2.1.2 Applicability: This requirement shall apply to all buildings within the scope of the code.

3.2.1.3 Method of verification

Design stage

Documents to show compliance - building permit stage

- Architectural plan layouts and elevation drawings of façade and fenestration
- Fenestration schedules or drawings showing the areas of fenestration
- Calculation showing the Window to Wall Ratio
- Completed BEEC Calculator for Window to Wall Ratio or shading

As-built stage

Documents to show compliance – after completion

- Material from design stage updated to “as-built”

Comparison of physically implemented measures with submitted documents

3.2.2 Lighting

3.2.2.1 Lighting power density shall not exceed 6 W/m² for residential buildings and 8 W/m² for office buildings. Calculations are to be carried out over the gross floor area of a building. Installed power and energy consumption of artificial lighting should be minimized by the use of more efficient lamp/ballast systems and luminaires. The requirements include ballast losses.

3.2.2.2 Applicability: This requirement shall apply to all buildings within the scope of the code. Exemptions are Emergency lighting and Outdoor recreational facilities.

3.2.2.3 Method of verification

Design stage

Documents to show compliance – building permit stage

- Lighting layout plan
- Lighting schedules showing the numbers, locations and types of lighting luminaries used
- Technical product information of the lighting luminaries used
- Completed BEEC Calculator for lighting

As-built stage

Documents to show compliance – after completion

- Material from design stage updated to “as-built”

Comparison of physically built-in fittings with submitted documents

3.2.3 Roof Insulation

3.2.3.1 All roof constructions are to include a layer of insulation with thermal resistance not less than 1.25 m^2K/W (R-value).

3.2.3.2 Applicability: This requirement shall apply to all buildings within the scope of the code.

3.2.3.3 Method of verification

Design stage

Documents to show compliance - building permit stage

- Plan layout and sectional details of the different roof types
- Detailed sectional drawings showing the roof composition including the position of the insulation
- Technical product information showing the thermal conductivity in W/(mK) (k-value) of insulation
- Completed BEEC Calculator for insulation

As-built stage

Documents to show compliance – after completion

- Material from design stage updated to “as-built”

Comparison of physically built-in products with submitted documents (during construction or after completion, depending on accessibility of roof)

3.2.4 Air-conditioning (AC)

3.2.4.1 All air-conditioning units shall have a minimum EER/COP of 2.8 and shall be of the inverter type. Only air conditioners with inverters shall be accepted for installation in buildings.

3.2.4.2 Applicability: This requirement shall apply to all buildings within the scope of the code.

3.2.4.3 Method of verification

Design stage

Documents to show compliance – building permit stage

- Air-conditioning equipment schedule showing manufacturer and model number for all installed equipment
- Product technical data showing inputs required for BEEC Calculator
- Completed BEEC Calculator for air-conditioning

As-built stage

Documents to show compliance – after completion

- Material from design stage updated to “as-built”

Comparison of physically built-in products with submitted documents

3.2.4.4 Buildings without active cooling systems (no air-conditioning provided for the building) shall still adhere to the other prescriptive requirements of the code (lighting, insulation and Window to Wall Ratios).

3.3 Compliance Method 2 - Performance Route to Compliance

3.3.1 In the performance route, buildings shall have an overall energy performance determined by a competent person using an approved energy simulation program, less than or equal to that of a reference building designed in accordance with the prescriptive requirements for building elements and services defined in the BEEC.

3.3.2 Therefore, for this compliance method, the building energy simulation should be performed twice: once for a building as it has been designed (referred to as the *design building)*, and the second simulation for the *reference building.* The reference building shall meet all the minimum prescriptive requirements specified in the BEEC.

3.3.3 BEEC Calculator: All inputs to energy modelling shall be captured in the BEEC Calculator as per the prescriptive requirements. The completed BEEC Calculator clearly shows the predicted energy use of the building for lighting and cooling and its comparison to a BEEC compliant building.

3.3.4 Completed BEEC Modelling Report: This shall be provided for the project outlining the project's adherence to the BEEC Modelling Protocol.

3.3.5 This method shall also be applied to buildings with no air-conditioning that do not meet the prescriptive requirements for roof insulation, lighting and window to wall ratio. Such buildings must be modelled with air-conditioning to show that they would still use less energy than the reference building if AC was provided in the future.

4. Calculation Methods and Tools

4.1 The BEEC Calculator shall be used to show compliance with Compliance Method 1 (Prescriptive route) and with Compliance Method 2 (Performance route) (electronic Annex I).

4.2 Simulation software packages used for demonstrating compliance with Compliance Method 2 shall be certified for energy modelling by at least one of the following organizations or equivalent, ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers), IECC (International Energy Conservation Code)

4.3 When using Compliance Method 2, in addition to the BEEC Calculator a standardized Reporting mechanism according to BEEC Modelling Protocol shall be followed (electronic Annex II).

5. Building Energy Label and Energy Efficiency Incentives

5.1 During the voluntary phase of introducing the BEEC, a comparative building energy label named BEEC Label shall be awarded to the building owner together with the Certificate of Use and Habitation.

5.1.1 Compliance Method 1 – Prescriptive route to compliance: During the voluntary phase, the BEEC Label rates a building depending on how many of the BEEC interventions have been implemented.

5.1.1.1 The scale for the star rating is displayed in Table 1 (Compliance Method 1 – Prescriptive route to compliance). A BEEC compliant building is rated 4 star. A building better than required by the BEEC is rated 5 star.

Table 1 Star rating for energy efficiency label

Rating	Intervention	Minimum Specification
1 star	Window to Wall Ratio or shading	20% maximum and/or shading as per BEEC Calculator
2 star	Window to Wall Ratio or shading	20% maximum and/or shading as per BEEC Calculator
	Lighting - Residential	Maximum lighting power density 6 W/m²
	Lighting - Office	Maximum lighting power density 8 W/m²
3 star	Window to Wall Ratio or shading	20% maximum and/or shading as per BEEC Calculator
	Lighting – Residential	Maximum lighting power density 6 W/m²
	Lighting - Office	Maximum lighting power density 8 W/m²
	Roof insulation	Minimum R-value 1.25 m²K/W
4 star	Window to Wall Ratio or shading	20% maximum and/or shading as per BEEC Calculator
	Lighting - Residential	Maximum lighting power density 6 W/m²
	Lighting - Office	Maximum lighting power density 8 W/m²
	Roof insulation	Minimum R-value 1.25 m²K/W
	Air-conditioning minimum performance[1)]	Minimum EER/COP 2.8 and Inverter Compressor
5 star	On application only. This allows for taking into account renewable energy systems (Photovoltaic, Solar water heating) which are currently outside BEEC.	

[1)] Only if air-conditioning is necessary.

5.1.2 Compliance Method 2 – Performance route to compliance: During the voluntary phase, the BEEC Label rates a building depending on how much it exceeds the energy consumption of the reference building with all BEEC interventions implemented. E.g., for a 1 star building, its energy use is greater than that of the reference building but not exceeding it by more than 40%.

5.1.2.1 The scale for the star rating is displayed in Table 2 (Compliance Method 2 – Performance route to compliance). A BEEC compliant building is rated 4 star. A building better than required by the BEEC is rated 5 star.

Table 2 Star rating for energy efficiency label

Rating	Allowance for Exceeding BEEC Compliant Building
1 star	40% to 31%
2 star	30% to 21%
3 star	20% to 11%
4 star	10% to 0%[1)]
5 star	Below 0%[2)]

[1)] 0% excess energy consumption compared with the code requirements means that the building is compliant with the BEEC.

[2)] Less energy consumption than compared with code requirements means that the building is better than required by the BEEC.

5.2 The layout of the BEEC Label is displayed in Figure 1. The higher the rating the more efficient the building, i.e.: a 4 star rated building is more efficient than a 1, 2, or 3 star (example in Figure 1). The competent authority provides its logo as an endorsement of the label as they adopt the BEEC.

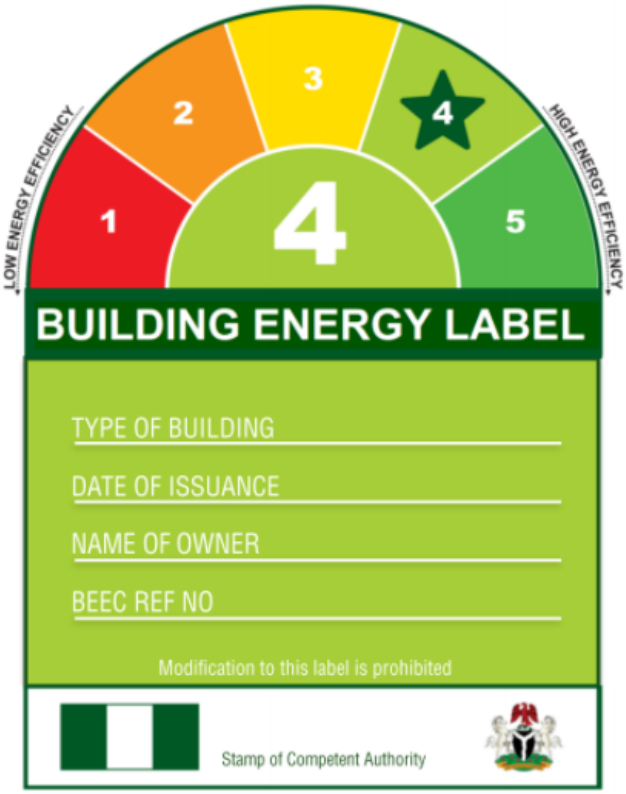

Figure 1 BEEC Label for compliant building

5.3 New building applications targeting a 2 star (or higher) BEEC label are offered the non-financial incentive of expedited permitting.

5.4 Appropriate options for energy efficiency incentives are linked with the label and are defined as part of accompanying measures. They can be offered depending on strategy and availability and will be publicized by the competent authority.

6. Control and Enforcement

6.1 The competent authority shall check the compliance of the building design with BEEC minimum energy efficiency requirements by means of the submitted verification documents prior to issuing the Building Permit.

6.2 At building permit stage, improvements shall be required if non-compliance is detected. After the voluntary phase has ended, this shall be the condition for Building Permit approval.

6.3 The competent authority shall check the compliance of the completed building by means of the submitted verification documents prior to issuing the Certificate of Use and Habitation.

6.4 Energy Efficiency Inspectors shall physically check that measures, products and systems have been installed in accordance to the submitted verification documents (spot check, sampling size 5%).

6.5 Appraisals and site checks of completed buildings shall be undertaken in-house by the competent authority and shall not be outsourced.

6.6 After the voluntary phase has ended, buildings not complying after completion shall be rated as BEEC non-compliant and the result of the rating shall be publicized.

6.7 Building Officials in charge of control and enforcement shall be trained on the procedural requirements of the BEEC and on the background knowledge of energy efficiency in general.

6.8 The training shall include exams that must be passed.

6.9 The training will cover all aspects of the BEEC including but not limited to:

- Understanding building physics;
- How to use minimum energy efficiency requirements calculation sheets (BEEC Calculator);
- Recognising correct details pertaining to minimum energy efficiency requirements on drawings;
- Spot checks for all items;
- Recognising different types of equipment (i.e. distinguishing an inverter type from a non-inverter type Air-Conditioning system);
- How to use new forms and procedures to process applications, track progress and keep a database;
- Understanding the performance route to compliance.

7. Qualification of BEEC Experts

7.1 Qualification of experts preparing and submitting verification documents to the competent authority shall meet defined minimum qualification requirements, namely completed undergraduate studies in building, or architecture, or engineering. In addition, experts shall attend the specified training and pass the examination.

7.2 The official version of the trainings to be passed is publicized by the competent authority.

8. Review and Adaptation

8.1 All elements of the BEEC shall be reviewed regarding their effectiveness, namely the energy efficiency minimum requirements, the calculation methods and tools, the label and incentives, and the control and enforcement.

8.2 Review will take place after the voluntary phase has ended and then 3-5 years from adopting the BEEC, followed by adjustments as appropriate.

8.3 The review shall also investigate to what extent the BEEC stimulates bioclimatic design and good indoor comfort and how this can be improved.

8.4 The review will pay specific attention to indoor air quality aspects.

8.5 In future, revised versions of the BEEC document will be available, depending on the results of regular review and adaptation. The BEEC document shall be publicized by the competent authority and the most recent official version of BEEC shall be clearly marked.

9. Annex I: BEEC Calculator

The BEEC Calculator consists of an Excel File and a Manual. The BEEC Calculator is available only in electronic format.

10. Annex II: BEEC Modelling Protocol

The BEEC Modelling Protocol also contains the outline of the BEEC Modelling Report. The BEEC Modelling Protocol is available only in electronic format.

11. Annex III: Change log

The changelog serves to document changes of revised versions.

The first edition is named version 1.0. Small revisions will result in version 1.1, 1.2 and so on.

A major revision will result in a new edition, namely second edition named version 2.0.

Version	Date	Affected chapter	Description of change
1.0	30th June 2017	---	---