

Ene 02 Prediction of energy use in operation

(All buildings)

Aim

This issue seeks to promote and reward the application of detailed energy modelling to assess the influence of occupancy and usage patterns, inform design decisions that mitigate the risk of energy underperformance, and provide a realistic projection of the building's energy use and operational carbon emissions.

Overview

Assessment type	Credits available	Applicable assessment criteria
Fully fitted	4 + 2 exemplary	All (see ref 3.0)
Shell and core	4 + 2 exemplary	All (see ref 1.0, 2.0, and 3.0)
Shell only	4 + 2 exemplary	Not applicable
Residential: Fully fitted	4 + 2 exemplary	All (see ref 2.0 and 3.0)
Residential: Partially fitted	4 + 2 exemplary	All (see ref 2.0 and 3.0)
EU taxonomy	-	None

Minimum standards

Rating level	Credits
-	None

Assessment type specific notes

Reference	Assessment type specific note
1.0	<p>Shell and core – Energy forecast credits</p> <p>Where the building occupiers are unknown, the modelling assumptions should be based on typical occupancy and servicing for the building type unless green fit-out commitments are in place, see appendix 3.</p>

Building type specific notes

Reference	Building type specific note
2.0	<p>Single dwellings</p> <p>This issue is filtered out for single dwellings.</p>

Issue specific notes

Reference	Building type specific note
3.0	Small buildings This issue will be filtered out where the building meets the following criteria: Buildings with an area (A_{temp}) (including common areas) < 1,000 m ²

Assessment criteria

This issue is split into three parts:

- Energy forecast – four credits
- Exemplary credit – Disclosing an in-use energy performance target
- Exemplary credit – Preparing for in-use measurement of energy

Energy forecast – four credits

Energy strategy – One credit

- 1 Define an energy strategy for the building at the concept design stage that describes qualitatively how the energy use in operation and related carbon performance of the building will be minimised (See M1.1).

Energy coordinator – One credit

- 2 A suitably qualified energy coordinator has been appointed prior to completion of concept design stage, see definition Ene 01.
- 3 The appointed energy coordinator shall:
 - 3.a Be responsible of developing and following up the energy strategy (criterion 1) through the project's lifecycle until the building is completed and commissioned.
 - 3.b Ensure that energy modelling and calculations are carried out using appropriate and accepted calculation methods (see M1).
 - 3.c Coordinate the integration of energy performance requirements into design and construction processes.
 - 3.d Monitor compliance with specified energy targets and report any deviations to the client.
 - 3.e Facilitate communication between design team, contractors, and client regarding energy performance objectives.
 - 3.f If applicable, ensure that a measurement plan/strategy for energy performance (Ene 03) is established
 - 3.g If applicable, participate in commissioning and hand over, and aftercare (Man 04 and 05)

Energy forecast – One credit

- 4 Estimate activity/household energy use and occupancy patterns for the building (see M1.2.1).
- 5 A detailed energy model is constructed by a suitably qualified energy coordinator using an accepted DSM software at the design stage (see definitions Ene 01). Undertake sensitivity analysis and scenario modelling to explore the impact of key parameters and assumptions on energy consumption.
- 6 Predict annual energy use by fuel type for the building based on the scenario modelling. The modelling must be updated at the post-construction stage to account for any changes to the building specification.
- 7 Calculate climate impact in kgCO₂e/m² (BTA) from the building's annual energy use according to methodology for B6 in Mat 01. The calculations should be based on the central case scenario (see M1.2.2),

Risk assessment and mitigation – One credit

- 8 Achieve the energy forecast credit (criteria 4 to 7).
- 9 Highlight any significant design, technical and process risks that might prevent the buildings achieving energy performance target and indicate how these risks will be mitigated throughout the construction and commissioning process (see M1.3).

Exemplary credit - Disclosing an in-use energy performance target

- 10 An in-use energy performance target has been disclosed to stakeholders and been made publicly available prior to practical completion.

Exemplary credit - Preparing for in-use measurement of energy

- 11 Achieve the energy forecast credit (criteria 4 to 7).
- 12 Achieve maximum available credits in Ene 03 Energy monitoring.
- 13 The energy modelling outputs include a breakdown of the energy use by sub-meter that aligns with the energy monitoring strategy for the building.

Checklists and tables

None

Methodology

M1: Energy forecast

M1.1: Energy strategy

An energy strategy for the building must be generated at the concept design stage. This should outline the fabric performance specification and the energy servicing strategies and describe qualitatively how these will contribute to reducing energy use in operation. The energy strategy should also demonstrate that the use of local low and zero carbon (LZC) technologies have been considered and specified, where feasible.

The energy strategy may be supported by early-stage design models based on calculations made in Ene 01, but can also be derived from simple energy modelling results, benchmarks, data for similar projects, or simple engineering calculations. It should indicate any energy related performance targets that are set for the building at the concept design stage.

M1.2: Energy forecast

Energy forecast modelling must be carried out by a suitably qualified energy coordinator. They must use BREEAM approved DSM software with advanced capabilities for HVAC systems and controls to explore how the building will perform under different operating conditions. DSM should use a detailed HVAC systems approach where applicable (see CN1).

Alternatively, where the building meets the following criteria alternative modelling approaches may be used:

- The building will be controlled by a single occupier.
- Is serviced by simple building systems with no complex controls.
- The building does not rely on thermal mass.
- The building does not have complex geometry.

Where an alternative modelling approach is used a suitably qualified energy coordinator must confirm that the alternative approach selected will be able to model the building performance with sufficient accuracy.

In all cases the predictive energy modelling must predict the annual energy consumption of the building over the course of a year based on the expected unregulated energy loads and expected occupancy patterns for the building.

Assuming the standard occupancy patterns used for Ene 01 is not sufficient for this issue.

M1.2.1: Estimating activity/household energy loads and occupancy patterns

Identify which of the following energy end uses will be present in the building:

- Energy use for lighting not covered by building regulations
- Energy use for equipment
- Energy use for catering
- Energy use for server rooms
- Energy use for any other types of unregulated plant and equipment – e.g., commercial refrigeration, medical equipment etc.
- Energy use for industrial process load

For each of the end uses present, estimate the energy use profiles based on project specific information on occupancy and usage patterns, wherever possible.

The anticipated operating hours should be requested from the intended occupier, for example through structured interview. This information together with the design and control regimes for proposed systems (e.g. optimum start controls, night set back and night purge) should be used to estimate the hours of operation for the plant and equipment.

Where no intended occupier has been identified, the assumptions should be based on in use benchmarks or unregulated energy loads and occupancy patterns for similar buildings.

M1.2.2: Sensitivity analysis and scenario modelling

Sensitivity analysis should be undertaken to explore the effect of assumptions relating to the following input variables:

- The efficiency of major energy consuming components.
- Alternative system configurations and control strategies.
- Occupancy density and hours of use.
- Management and occupant behaviour.
- Current and future weather scenarios.

It is not necessary to consider all input variables, the sensitivity analysis should focus on those that are expected to have the most significant impact on annual energy consumption.

The sensitivity analysis should be used to inform the development of scenarios that reflect the likely energy performance range for the building. The scenarios must include:

- A central case scenario which represents the most reasonable assumptions about occupancy, fabric and building system efficiencies and control strategies.
- A high-end scenario based on uncertainties relating to key input parameters which result in higher energy consumption.
- A low-end scenario based on uncertainties relating to key input parameters which result in lower energy consumption.

M1.2.3: Predicting annual energy use in operation

The predicted annual energy use in operation for the building must be based on the scenario modelling results and be higher than that for central case scenario.

How high the predicted energy use should be set above the central case scenario should be informed by the range of the scenario modelling results, the extent to which risks of underperforming in use have been mitigated, and previous experience with other similar projects.

An uncertainty margin of 20% over the central case scenario should be used as a default unless a lower or higher modelling margin is recommended by a suitably qualified energy coordinator in which case the margin used must be justified in the energy modelling report (See M1.2.4).

M1.3: Risk assessment and mitigation

The risk assessment should consider situations where the design assumptions and operational situation could have a significant negative impact on operational energy consumption in use.

Risks to be considered include:

- Product specification and the management of value engineering decisions
- Construction quality
- System installation considerations, particularly for complex or novel systems
- Appropriate commissioning of servicing systems
- Ensuring that end users understand how to operate the building as intended.

Note that not all risks will be relevant for every project and there may be additional project specific risks.

Options for mitigating these risks include:

- Product specification and the management of value engineering decisions – Contractual requirements relating to changes to the design specification.
- Construction quality – Achieving the Testing and inspecting building fabric credit in Man 04.
- System installation considerations, particularly for complex or novel systems – The use of experienced installers and contractors.
- Appropriate commissioning of servicing systems – Achieving the Commissioning building services credit in Man 04 and/or the In-use commissioning credit in Man 05.
- Ensuring that end users understand how to operate the building as intended – Achieving the Handover credit in Man 04.

Note that alternative mitigation measures may be used.

Where it can be demonstrated that the expected benefits of implementing a mitigation measure is minimal the measure does not have to be implemented.

M2: Disclosing an in-use energy performance target

The energy target should be expressed as an annual energy use normalised by floor area (A_{temp}).

The scope of energy uses included in the target must be explicitly stated, for example, whole building or core building services and common areas only.

Where a target is set in units other than delivered energy (for example, carbon emissions or primary energy), factors to convert these to delivered energy must be provided. In all cases the floor metric must be defined (for example, BRA or BTA).

This information must be made available to building stakeholders (for example, prospective owners and occupiers of the building) and be accessible to members of the public.

Compliance notes

Reference	Terms	Description
CN1	Local energy production	For this issue, annual energy use may be reduced by on-site renewable energy generated from solar, wind, geothermal, air or water sources. It shall be clearly stated whether the energy is allocated to the building's energy use or to household- or activity-related energy use. Hourly matching between produced and used electricity shall be demonstrated.

Evidence

Criteria	Interim design stage	Final post-construction stage
Energy strategy		
1	Energy strategy for the building, detailing all the requirements within the criteria and M1.1.	No further actions required post-construction, no additional evidence is required other than that listed for the design stage.
Energy coordinator		
2-6	<p>Letter of appointment for energy modelling engineer.</p> <p>Supporting evidence such as updated reports for each work stage, correspondence and meeting minutes to verify their ongoing involvement in the project.</p> <p>Evidence that the energy coordinator meets the definition for this role.</p>	Updated energy modelling report to account for any changes to the building specification, where required.
Energy forecast		
7-9	<p>Energy modelling report which includes</p> <ul style="list-style-type: none"> • Estimated energy uses and occupancy patterns used within the detailed energy modelling. • Sensitivity analysis and scenario modelling. • The predicted annual operational energy consumption in use by fuel type based on the results. <p>Evidence that the energy modelling engineer meets the definition for this role.</p>	Updated energy modelling report to account for any changes to the building specification, where required.
10	Calculation of carbon emissions.	Updated calculation of carbon emissions to account for any changes to the building specification, where required.
Risk assessment and mitigation		
11-12	Energy modelling report or other document that includes a risk assessment and details of mitigation measures, in line with M1.3.	Same evidence as the design stage but with confirmation of mitigation measures that have already been implemented.
Disclosing an in-use energy performance target		
13	Contract documentation or a letter of commitment from the client or developer to disclose the in-use energy performance target to stakeholders and make it publicly available prior to practical completion.	Weblink or other documentation that indicates where the performance target can be viewed by stakeholders and the general public.

Definitions

Accepted DSM software

See definition in Ene 01.

Activity energy

The electricity or other energy used for activities in non-residential buildings. Examples are process energy, lighting, computers, copying machines, TV, refrigerated/frozen food displays/counters, appliances and other devices for the activities, as well as ovens, refrigerators, freezers, dishwashers, washing machines, dryers, other household appliances and the like.

Household energy

The electricity or other energy used for household purposes. Examples are the electricity used for dishwashers, washing machines, dryers (including in a shared laundry room), stoves, refrigerators, freezers and other household appliances as well as lighting, computers, TV and other home electronics and the like.

Industrial process loads

The energy used during manufacturing, production, waste treatment or other industrial processes (for example, chemical, physical, electrical, or mechanical processes during the production or manufacture of products).

The energy may be used for activities such as heating, cooling, mechanical work, chemical reactions, and other operations essential for the transformation of raw materials into finished products or goods.

Suitably qualified energy coordinator

See definition in Ene 01.

The building's energy use

The energy that, under normal use during a standard year, needs to be supplied to the building for:

- space heating
- air conditioning (comfort cooling)
- domestic hot water
- fixed lighting in public and operating spaces
- heating cables
- building service installations such as pumps, fans, motors, and control and monitoring equipment

Energy generated on-site from solar, wind, ground, air or water sources and used for the above purposes is not included in the building's energy use.

Additional information

None