NABERS Commitment Agreements

Handbook for estimating NABERS ratings

Version 2.0 – September 2021

Formatting conventions used in this document:

Items of significant note to the reader are highlighted with a grey tint.

Text appearing **dark blue and bold** is a defined term, as explained in Section 1.2.

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1. Introduction

The National Australian Built Environment Rating System (NABERS) is a performance-based rating system for different **space types** like office buildings, office tenancies, shopping centres, data centres or apartment buildings.

A NABERS rating is an assessment of the actual environmental impact of the operations of a **space type**. A rating must be performed by a NABERS Accredited **Assessor** and comply with **the Rules** for it to be accredited by NABERS.

This Handbook outlines how a **space type**'s energy consumption - and therefore its NABERS performance star rating - can be estimated prior to operation. This estimation can be used in a NABERS Energy **Commitment Agreement.**

A NABERS Energy **Commitment Agreement** permits the use of the relevant NABERS Energy trademark after certain conditions have been met and prior to completing an accredited rating.

Note that estimation alone does not permit the use of NABERS trademark.

This Handbook must be read in conjunction with the latest version of the **NABERS Energy Commitment Agreement** contract, the version of **the Rules** for the relevant **space type** current at the **Date of Agreement** and any further **Rulings** for the relevant **space type**. These documents take precedent over any information provided in this handbook.

In addition, **Commitment Agreements** for Apartment Buildings and Residential Aged Care and Retirement Living are currently in pilot until June 2022. If you wish to get a **Commitment Agreement** for an Apartment Building or Residential Aged Care and Retirement Living, please contact the **National Administrator** before proceeding.

1.1 About this Handbook

1.1.1 Who this Handbook is for

This Handbook is provided for those developing an **Estimate** of the energy consumption of a **space type** for a **NABERS Energy Commitment Agreement**. The person developing the **Estimate** will be known from here as 'the **Estimator**'.

If you are a developer or project manager entering into a **Commitment Agreement** and you require guidance in relation to procuring or using a NABERS **Estimate**, please refer to the information available on the NABERS website and / or your **Commitment Agreement** contract.

1.1.2 Previous versions

This Handbook replaces previous versions of the Handbook for Estimating NABERS Ratings, the NABERS Energy Guide to Building Energy estimation and the NABERS Energy Guide to Tenancy Energy estimation.

1.1.3 NABERS Energy Commitment Agreement

A **Commitment Agreement** is a contract between the NABERS **National Administrator**, the Department of Planning, Industry and Environment (DPIE) and the building proponent to design, build, commission and operate the premises to achieve a NABERS Energy star rating of 4 or more without Greenpower.

For new office base buildings only, the minimum star rating target for a **Commitment Agreement** is 5 stars without Greenpower. This applies to new office construction projects only and does not include refurbishment projects. If you are using a **Commitment Agreement** to meet energy efficiency requirements in the National Construction Code, you need to sign a contract targeting 5.5 stars or above.

The contract typically spans a number of years and remains in effect until the building has received its NABERS Energy rating in operation.

The **NABERS Energy Commitment Agreement** allows developers, building owners and tenants to promote and market the expected greenhouse performance of a new or refurbished **space type** from the design stage.

NABERS Ratings currently covered under the **NABERS Energy Commitment Agreement** process are:

- Office – Base Building
- Office – Whole Building
- Office – Tenancy
- Shopping Centre
- Hotel
- Data Centre – Infrastructure
- Data Centre – IT Equipment
- Data Centre – Whole Facility
- Apartment Building (please contact the **National Administrator** for more information)
- Residential Aged Care (please contact the **National Administrator** for more information)
- Retirement Living (please contact the **National Administrator** for more information)
- Co-located Residential Aged Care and Retirement Living (please contact the **National Administrator** for more information).

1.1.4 NABERS Independent Design Review

After entering a **Commitment Agreement**, the proponent must develop an energy **Estimate** in line with this Handbook.

This **Estimate** *must* then be reviewed by a NABERS **Independent Design Reviewer**. The **Reviewer** must be independent of the design team and the review must be undertaken sufficiently early in the design process to enable design changes to be made. The cut-off for the Independent Design Review is the granting of a Construction Certificate (or equivalent) for the project.

The NABERS **Independent Design Reviewer** will review all aspects of the assumptions, design documentation and model used by the **Estimator** to identify risks and opportunities in relation to the NABERS rating. The **National Administrator** will review the Independent Design Review report and get back to the **Independent Design Reviewer** with any questions as part of the approval process. Based on the suggestions made by the **Independent Design Reviewer** and the **National Administrator**'s reasonable opinion, the **National Administrator** may terminate the **Commitment Agreement** or modify the star rating target.

1.1.5 Relationship to requirements by the GBCA, NCC, NatHERS and BASIX

The purpose of this Handbook is to create an energy consumption **Estimate** that reflects how the **space type** is expected to operate. This is distinct from energy consumption **Estimate**s that are developed for the purpose of verifying that a design complies with the National Construction Code (NCC) or Green Star design targets.

However, where the **Estimator** reasonably believes that principles or inputs used in Green Star, Section J of the NCC, NatHERS, BASIX or elsewhere match expected operation then these may be used to **Estimate** aspects of performance for a **Commitment Agreement**.

1.1.6 The role of estimation in design

Estimation in accordance with this handbook is compulsory for all NABERS **Commitment Agreements**. A checklist for reporting the **Estimate** to **Independent Design Reviewer** can be found in section 4.6 of this Handbook.

Estimation works best when:

1. It is used to inform decisions from early design through to post-construction tuning
2. Assumptions made about the operation of systems reflect expected operation
3. Limitations are clearly disclosed.

The use of estimation purely for a single-point prediction of performance or compliance represents poor practice and is discouraged.

For estimations used with the **Commitment Agreement**, a range of **off-axis scenarios** must be addressed as part of an Energy Efficiency Risk Assessment. **Off-axis scenarios** test the building's response to changes in operating patterns. Minimum requirements around **off-axis scenarios** and **off-axis models** are outlined in Section 3.12 of this Handbook.

1.1.7 Disclaimer

It is the responsibility of the **Estimator** to comply with all requirements as far as is possible.

Where an issue of technical interpretation cannot be resolved between the **Estimator** and the **Independent Design Reviewer**, the NABERS **National Administrator** may be approached to resolve the issue.

No party associated in any way with the production or distribution of this Handbook accepts any liability for any loss, financial or otherwise, caused directly or indirectly in association with the use of this Handbook. In all cases, the sole responsibility for the estimation lies with the project team, not the NABERS Administrator.

Persons or organisations quoting NABERS Energy ratings that are not substantiated by a NABERS certified rating or a signed NABERS Energy **Commitment Agreement** contract are in breach of trademark and may be subject to legal proceedings. This includes advertising and/or promoting projects to achieve a NABERS rating or a specific star rating without a formal **Commitment Agreement** in place.

1.2 Definitions

Term	Definition
Assessor	An Accredited Assessor of the NABERS scheme, authorised by the National Administrator to conduct accredited ratings.
Base case model	A reference model that represents the space type as it is expected to operate.
Co-located Residential Aged Care and Retirement Living Facility	A facility that has a residential aged care facility and retirement living facility located within the same site area.
Date of Agreement	Agreement Date means the date the Commitment Agreement fee payment has been received and NABERS / DPIE have counter-signed the Commitment Agreement contract. The Agreement Date will be designated by NABERS/DPIE.
Estimate	A realistic Estimate of the NABERS rating of a new or refurbished space type, developed in accordance with the requirements of this Handbook. The Estimate does not constitute a NABERS Accredited Assessment.
Estimator	The person who develops the NABERS Estimate. While there are no compulsory requirements for the Estimator's qualifications or experience, it is recommended that the Estimator's skills include: • Ability to conduct a NABERS performance assessment for the relevant project type. This could be demonstrated, for example, if the Estimator is an Accredited Assessor • Ability to construct a thermal simulation in an appropriate simulation package • Ability to identify performance risks that are likely to emerge for the types of building, services and technology covered by the Estimate. This could be demonstrated, for example, by the Estimator's experience working in existing buildings of this type.

NABERS

Term	Definition
Independent Design Reviewer	A person appointed by the project proponent to review the NABERS Estimate for compliance with this Handbook. The Reviewer will also assess all aspects of the design, documentation and project team assumptions for NABERS risks and opportunities and report back to the project design team. The Independent Design Reviewer must be: • A member of the NABERS Independent Design Review panel (appointed and maintained by the NABERS National Administrator) • Independent of the project design team • Independent of the NABERS Estimator.
Metering system	Device(s) providing an individual measurement which include all of the following: • The meter • The processes that convert the initial meter signal into an energy reading (for example, current transformers and K factors for electricity meters and pressure correction factors for gas meters) • The interface through which the meter reading is taken (for example, manual readings, utility software or a Building Management System).
Minimum energy coverage	Minimum scope of energy consumption to be included in a NABERS Rating. The Minimum energy coverage is defined in the relevant version of The Rules.
NABERS Energy Commitment Agreement or Commitment Agreement	A contract between the NABERS National Administrator, the Department of Planning, Industry and Environment (DPIE)) and the building proponent to design, build and commission the premises to achieve a NABERS Energy star rating of 4 or more. For office base buildings, minimum star target rating is 5 stars.
National Administrator	The body responsible for administering the NABERS scheme, in particular for: • Establishing and maintaining the standards and procedures • Determining issues that arise during the operation of the scheme and the making of ratings • Accrediting assessors and awarding accredited ratings in accordance with NABERS standards and procedures.
Off-axis model	A model that represents the space type after factoring in a minimum of four off-axis scenarios.
Off-axis scenario	A scenario representing operational change/s, such as how a building is occupied, controlled or maintained. off-axis scenarios are designed to test a building’s ability to reach the targeted star rating with modelled changes to assumptions and inputs.

Term	Definition
Online calculator	The online calculator is available on the NABERS website. It allows the calculation of the star rating that would be achieved given specific rating calculation inputs.
Prediction tool	A tool that estimates the potential impact on NABERS Energy ratings due to forecasted National Greenhouse Accounts (NGA) Emissions Factors on 1 July 2025 and 1 July 2030.
Rating types	The NABERS Rating types covered by the Commitment Agreement process are: • Office Energy – Base building, tenancy and whole building • Shopping Centre Energy • Hotel Energy • Data Centre Energy – IT equipment, infrastructure, and whole facility • Apartment Building (please contact the National Administrator for more information) • Residential Aged Care and Retirement Living (please contact the National Administrator for more information).
Rating scope	The rating scope identifies what energy coverage is required for a rating, and what inputs and methodologies are required to calculate the rating result. For Offices, rating scope can mean: • Base building • Tenancy • Whole building. For Data Centres, rating scope can mean: • IT equipment • Infrastructure or • Whole facility. For Residential Aged Care and Retirement Living, rating scope can mean: • Residential aged care • Retirement living • Co-located residential aged care and retirement living.
Reverse calculator	The reverse calculator is available on the NABERS website. Reverse calculators allow the calculation of the maximum amounts of energy and water a building can use to achieve a star rating that is specified.
Ruling	An authoritative decision by the NABERS National Administrator which acts as an addition or amendment to the NABERS Rules.

Term	Definition
Simulation model	An entire building energy model used to calculate the thermal performance of a building in response to its external environment (e.g. weather) and internal loads (e.g. occupants and equipment). The calculation process must account for hourly changes in loading, internal conditions, and the impact of the thermal inertia of the building. Minimum outputs from the simulation model include energy consumption, internal temperatures achieved and plant and equipment loading. The thermal simulation model may be supplemented by a variety of other Estimates such as simple spreadsheet calculations (e.g. for lift energy) or other simulation tools (such as for light levels).
Simulation package	A software package used to input, run and report on the thermal simulation model. The simulation package must meet the requirements of ANSI/ASHRAE Standard 140. The simulation must contain a thermodynamic representation of the building, its content and its environment. The thermal simulation model may be supplemented by other simulation tools (such as a simulation of light levels or data centre IT equipment) for small / low energy consuming systems. All large systems, such as the HVAC central plant, must be modelled in an appropriate simulation package. A variety of other estimation techniques may be used for small / low energy consuming systems, but all methodologies and assumptions must be described and disclosed for the Independent Design Review.
Space type	A building, or part of a building able to have its future operational performance Estimated through a NABERS Commitment Agreement. The space types covered by the Commitment Agreement process are: • Office • Office tenancy • Shopping centre • Hotel • Data centre • Apartment building • Residential Aged Care and Retirement Living. Some space types have multiple rating scopes available. See the Rating scope definition for more details.

Term	Definition
The Rules	The version of the NABERS Rules that is current at the Date of Agreement. Separate Rules documents are published for each of the following space types: • Office • Shopping centre • Hotel • Data centre • Apartment building • Residential Aged Care and Retirement Living. The latest versions can be found on the NABERS website. The Rules must be considered together with any current Rulings issued by the National Administrator.

2. Using NABERS Rules to determine inputs and scope

NABERS Energy awards stars based on greenhouse gas performance, with a higher number of stars for better performance.

A NABERS rating estimation does not constitute an accredited NABERS rating. An accredited rating can only be provided after a period of operation and must be performed by an Accredited **Assessor**.

The NABERS **National Administrator** strongly recommends that a NABERS Accredited **Assessor** be consulted prior to the project entering into a **Commitment Agreement**.

If there is any doubt as to the application of the NABERS Energy **Rules** to the project, advice should be sought from a NABERS Accredited **Assessor**.

2.1 NABERS rating inputs

An estimated NABERS Rating is calculated using an **Estimate** of energy consumption along with a number of other inputs. These inputs are then entered into the NABERS **online calculator** which can be found on the NABERS website (www.nabers.gov.au). A list of these inputs at the time of publishing is listed below, however the calculator should be checked for the input requirements current at the **Date of Agreement.**

Rules on how to calculate each of these inputs can be found in the relevant section of **The Rules** and other **Rulings** released by the **National Administrator**.

Note that for each rating input, the intended operational value should be used. Variations on these inputs, including vacancy rates, should be modelled in **off-axis scenarios**.

An estimated NABERS rating, and the performance rating used to verify the outcome of a Commitment Agreement, is always a rating calculated without Greenpower or other off-site renewable energy.

Rating type	rating scope	Rating inputs
Office	Base building	• Address • Postcode • Rated Area • Rated Hours • Annual energy consumption
	Whole building	• Address • Postcode • Rated Area • Rated Hours • Annual energy consumption

Rating type	rating scope	Rating inputs
		• Computer count
	Tenancy	• Address • Floor/level • Postcode • Rated Area • Rated Hours • Annual energy consumption • Computer count
Shopping Centre	N/A	• Address • Postcode • Rated Area • Centrally serviced shopping centre area • Mechanically ventilated car parking spaces • Naturally ventilated car parking spaces • Annual number of trading days • Weekly hours of service • Floor configuration • Annual energy consumption
Hotel	N/A	• Address • Postcode • Hotel star rating • Hotel rooms • Hotel rooms with full-service laundering • Function room seats • Surface area of heated pools • Annual energy consumption
Data Centre	IT Equipment	• Address • Postcode • Processing capacity • Storage capacity • Annual energy consumption
	Infrastructure	• Address • Postcode • Annual energy consumption of IT equipment • Annual energy consumption of whole data centre
	Whole facility	• Address • Postcode • Processing capacity • Storage capacity • Annual energy consumption
Apartment Building	N/A	• Address • Postcode • Number of apartments

Rating type	rating scope	Rating inputs
		• Service categories for energy (central air conditioning, lifts, pools, gym) • Car parking spaces • Annual energy consumption
Residential Aged Care and Retirement Living	Residential Aged Care	• Post Code • Occupied Bed Days (OBDs) • Heated pool surface area • Presence of on-site heavy laundry (Yes/No) • Number of meals cooked on-site for non-Residential Aged Care residents
	Retirement Living	• Postcode • Average weekly meals cooked on site • Number of dwellings • Heated pool / unheated pool surface area • Number of serviced apartments • Site area
	Co-located residential aged care and retirement living	• Postcode • Occupied Bed Days (OBDs) • Presence of on-site heavy laundry (Yes/No) • Number of dwellings • Heated Pool Surface area • Site Area • Average weekly meals cooked on site for non-residents • Average weekly meals served to Residential Living residents

2.2 NABERS rating energy scope

An **Estimate** for a rating must include all sources of external energy supplied to the rated premises and must cover all of the energy end uses specified for the **rating type** and **rating scope** in the relevant NABERS **Rules** document.

No Greenpower or other off-site renewable energy can be used when calculating an **Estimate** for a rating.

Correctly interpreting what energy consumption should be included is essential to the accuracy of the estimated NABERS Energy rating.

The sections of the **Rules** referring to the **minimum energy coverage** for each **rating type** and **rating scope** must be used to ensure all required energy is being considered.

Energy outside the scope of the rating may be excluded using a **metering system**. If there is any doubt as to whether certain energy should be included the **rating type** and scope targeted, it is advised that this is checked by someone with extensive experience with the appropriate NABERS **Rules**.

If energy cannot be excluded using metering, then it must be included in the estimated energy consumption. This reflects what will happen in practice when the **space type** receives an actual NABERS rating.

More information on requirements for metering can be found in the relevant **Rules** document.

3. Estimating energy using a simulation

Energy consumption is to be estimated by simulating a new or refurbished **space type** as it is expected to operate using best practice inputs and principles.

Estimates for major energy systems and equipment (such as heating, ventilation and air conditioning HVAC) must be completed using a compliant dynamic **simulation software package**. However, it is recognised that for other small / low energy consuming systems, a spreadsheet will often be enough (such as for domestic hot water or back of house lighting). When supplementary manual calculations have been used, it must be disclosed for the **Independent Design Review**, along with justification for use. This should include a description of the methodology and commentary on any limitations of this calculation method. Effects on the results of the calculation must be described.

This section outlines best practice inputs and principles. **Estimator**s must address all relevant items and comply with any requirements described. If variations are necessary, they must be adequately noted and justified. **Off-axis scenarios** modelled and their impact on predicted rating results should be listed in the **Estimator**'s report.
Wherever possible, the inputs to the model should reflect expected operation. If this information is not available, Section 6 of this Handbook provides guidance on defaults that can be used. Any use of defaults should be a last resort. The use of defaults must be justified by the **Estimator**.

The **Estimator** must distinguish between the energy consumed by appliances or lighting, and the HVAC heat loads produced by this equipment. The **Estimator** must ensure that each impact is treated in accordance with the NABERS **Rules**.

For example, with an office base building rating, tenant equipment loads must be considered as an HVAC load, but the actual energy consumption of the plug load is not considered. In the office whole building rating however, both the HVAC load and the plug load must be included in the **Estimate**.

In addition, note that not all sections are required for all **rating types**. For example, in Chapter 3 only Sections 3.2, 3.7 and 3.11 are relevant to a NABERS Data Centre IT equipment rating.

3.1 The HVAC software simulation package and model

Simulation packages should be used for the calculation of all HVAC Energy.

All HVAC **simulation package**s and models have limitations. It is critical that the client and the **Estimator** understand the limitations of the simulations and any models developed in order to adequately interpret the validity of the final results.

The **Estimator** is to confirm the ability of the proposed **simulation package**s to model the **space type** as part of the report delivered to the **Independent Design Reviewer**. The **Estimator** must:

- Establish that the **simulation package**/s:
  - Support the development of a dynamic energy **simulation model**, assessing performance on an hourly basis for a full year
  - Are validated through ANSI/ASHRAE Standard 140, Standard Method of Test for the Evaluation of Building Energy Analysis Computer Programs
- Establish that the HVAC plant and system **simulation package**/s:
  - Represent the proposed air conditioning system and controls with reasonable accuracy
  - Allow part load/low load performance, staging (if applicable), minimum downturn and control strategy characteristics of plant and system components to be included. Most models make compromises in this area and these can lead to significant differences between predicted (simulated) energy use and actual (operational) energy use
- Establish that the glazing or window model:
  - Accounts for the varying angles of incidence of direct solar radiation
  - Accounts for the total U-value and total SHGC performance
  - Calculates daylighting effects (if applicable)
- Identify any other aspects that have not been modelled accurately or where compromises have been made.

3.2 Data centre IT Equipment simulation package

When IT equipment energy use is estimated for an IT Equipment or Whole Facility **Commitment Agreement**, an appropriate Cloud **simulation package** must be used to represent the proposed hardware architecture.

This will require specialist input from a Data Centre analyst.

3.3 Weather data

Weather data used in the energy estimation is to be from a weather station with a climate representative of the climate local to the **space type**. Caution is required in some cities which exhibit a range of distinct weather patterns across the urban area.

Weather data should be for a reference year dataset for a local weather station representative of local area. Weather data must use actual recorded solar radiation, temperature and humidity data from the local weather station or other site-specific source.

Climate data should be the ACADS-BSG/CSIRO Nominated Test Reference Year (TRY), a Typical Meteorological Year (TMY), variants of Weather Year for Energy Calculations (WYEC), International Weather Year for Energy Calculation (IWEC) or other standard weather year data. Considering whether current or predicted future climate files are relevant to your project or off-axis scenarios is also recommended.

If none of these climate files are available for the site, then any alternative methodology used (such as multiple years) must be justified by the **Estimator**.

Additional analysis is recommended to quantify the potential effect of non-average weather conditions and climate change on future ratings. Predictive (future) weather files have been developed and are available on the Commonwealth Scientific and Industrial Research Organisation (CSIRO) website for this purpose. Two types of weather files are being made available for modelling commercial buildings: updated 'typical meteorological year' weather files and 'predictive weather' files. The predictive weather files will allow building designs to be simulated against expected weather to test performance more accurately. The typical meteorological year weather files were developed in 2016. These files use detailed Australian weather data up to and including the year 2015 across 80 Australian locations. The CSIRO has also developed predictive weather files for commercial buildings based on the 2016 files. The CSIRO will host both sets of files, available for free, on its Ag Climate Data Shop website. This is the central portal for all of CSIRO's agriculture-related weather and climate data. User guide for each set of files is available in links below:

Predictive weather files for building energy modelling. Ag Climate Data Shop (csiro.au)

Typical Meteorological Year weather files for building energy modelling. Ag Climate Data Shop (csiro.au)

Note that care should be taken by the **Estimator** if manipulating weather data files. Changes due to climate change could potentially be modelled by using the site-specific weather data with the highest dry bulb data in the last 10 years.

3.4 The building

The building model used in the simulation software is to be a close representation of the designed building's physical shape and materials. The building should be modelled in zones that are true to the operational and thermal characteristics of its location. This includes representation of the building in which a data centre or tenancy is housed. The following items are to be considered, where relevant:

- Building form: The building form is to be modelled completely, with all levels represented (for multi-storey centres).
- External shading: Shading must be represented comprehensively, including shading devices such as awnings, fins and overhangs, self-shading by parts of the structure and shading by neighbouring buildings and trees. In locations where hills cause the horizon to be substantially higher than a flat plane, additional shading or horizon modelling must be included to represent the impact of this on building performance.
- Glazing systems: Window / glazing systems must be modelled with an incident angle modifier function and should allow specification of a complex glazing system by using NFRC / AFRC product spectral data or custom measurements from an appropriate measurement laboratory. This is particularly important when the window-to-wall ratio exceeds 25%. Impact of frame U-values must also be considered.
- Insulation: Model input must account for thermal bridging effects in insulated wall, floor and ceiling systems. For further guidance on how to model thermal bridging, the **Estimator** can refer to NZS 4214 "Methods of determining the total thermal resistance of parts of buildings" or BRE "Conventions for calculating linear thermal transmittance and temperature factors".
- Orientation: The building orientation is to be correctly modelled.

- Impact of car parks on HVAC loads: Where basement parking is provided, at least one level of basement car park is to be modelled to account for heat transfer/comfort impacts between unconditioned basement and conditioned ground floor. Infiltration rates in the basement should reflect the car park ventilation system in operation.
- Car park lighting and ventilation: Where car park lighting and ventilation energy is to be estimated, schedules accounting for movement sensor lighting control and CO controlled car park ventilation should be applied if fitted.

3.5 Occupancy

The modelled occupancy should reflect a realistic projection of the operating patterns of the site.

This can be based on the operating patterns of the previous site/s if such data is available. If a space is not intended for occupancy by people, such as in a data centre, then this should be modelled.

Variation in occupancy at different times of the year should be considered where appropriate, for example in summer for shopping centres. Variation throughout the week, for example due to working from home patterns, may also need to be considered for some **space types**.

Where occupation is unknown, a default value and schedule as deemed appropriate by the **Estimator** can be used. Examples of defaults are given in Section 6.

Design occupant densities should not be used as these are normally intended to be maximum loads rather than typical operational loads.

3.6 Lighting

The **Estimator** should distinguish between the lighting electricity consumption and the HVAC heat load produced by the lighting, to ensure that each element is treated correctly under NABERS.

Lighting energy consumption estimates should be based on the specified design and expected operating patterns for the intended occupants.

Where the lighting design is unknown, a default value and schedule as deemed appropriate by the **Estimator** can be used. Examples of defaults are given in Section 6, however the appropriateness of these default values should be considered in relation to project specifics.

Note that lighting energy consumption should also include any exterior lighting or signage which is covered by the NABERS **Rules** under **minimum energy coverage** for the relevant **rating type** and **rating scope**.

3.6.1 Lighting power density

The installed lighting power should be assessed from the lighting layout drawings and luminaire schedules.

The power consumption used for individual fittings shall include the power consumption of the lamp along with any associated control gear and transformers. The total circuit watts of these components should be confirmed by manufacturers' data or by in-situ measurement.

3.6.2 Lighting hours of use

The lighting schedule should be set to represent the expected operating pattern, including the effect of automatic control systems. **Estimator**s are also advised to give particular consideration of the after-hours operation of lights for occupancy, cleaning, security and council requirements, including for external lighting.

Consideration should also be given to using different lighting schedules in the common areas used to service after hours spaces and any sections with different operating hours.

Where daylight controls are to be fitted, a **simulation package** with daylight modelling capability should be selected. If this is not available, then a separate assessment of daylighting effects should be undertaken and incorporated into the model.

Occupancy detectors will require some judgement in relation to expected occupancy patterns.

In shopping centres, hotels and residential aged care facilities in particular, there will be a degree of variation between the different areas in the buildings. Further guidance is provided in Section 6 in relation to the development and application of operating schedules for various types of spaces. It is recommended that **Estimator**s consider this information when establishing operating schedules for their **Estimate**, even where defaults are not used.

3.7 Equipment

The **Estimator** should distinguish between the equipment electricity consumption and the HVAC heat load produced by the equipment, to ensure that each element is treated correctly under NABERS.

If the fit-out and occupants are known, the specified loads should be modelled. Hourly operating schedules should be developed based on the intended occupants/tenants.

Where the equipment levels are unknown, a default value and schedule as deemed appropriate by the **Estimator** can be used. Examples of defaults are given in Section 6.

Note that back of house equipment energy consumption may also need to be included.

3.7.1 Equipment loads

Loads based on fit outs should be modelled on a zonal basis to ensure that the variability of loads passed through to the air-conditioning is captured.

Please also refer to the guidance in Section 3.8.3 on System Loads when modelling equipment loads.

3.7.2 Equipment hours of operation

The equipment schedule should be set to represent the expected operating pattern. Note that it is common for a portion of equipment to be left operating overnight, or on standby.

In shopping centres and hotels in particular, there will be a degree of variation between the different areas in the buildings. Further guidance is provided in Section 6 in relation to the development and application of operating schedules for various types of spaces. It is recommended that **Estimator**s consider this information when establishing operating schedules for their **Estimate**, even where defaults are not used.

3.7.3 Data centre IT equipment

As described in Section 3.2, where IT equipment is specified (for example in relation to a Whole Facility or IT equipment **Commitment Agreement**), IT equipment energy should be simulated using an appropriate Cloud **simulation package** to represent the energy consumption of the proposed hardware architecture. This will require specialist input from a Data Centre analyst.

For IT infrastructure projects, where the details of IT equipment selections are unlikely to be available, a range of equipment loads should be simulated to allow for uncertainties (for example varying from 50% to 150% of the projected load based on business forecasting). For further guidance and background information, refer to Section 6.6.2.

The **Estimate** should also represent diverse IT equipment loading across different parts of the facility in areas served from different air conditioning systems and PDUs. In particular, loading on individual air handling units (AHUs) or power distribution units (PDUs) could be varied from 10% to 100% of design loads while maintaining the overall loading in the centre at a fixed value set with reference to the business growth projection.

3.8 HVAC plant and systems

3.8.1 HVAC configuration

The HVAC plant and system input to the simulation program must be an accurate representation of intended operation. This includes the specified number, capacity and configuration of plant and equipment – including but not limited to chillers, boilers, cooling towers, pumps, air handling units, fan coil units and terminal units.

Default performance curves built into the **simulation package** for part load and low load operation are to be replaced by realistic performance data for the specified equipment.

Estimators should also note that plant performance quoted by manufacturers is generally presented under standard condenser air and water conditions which do not correctly represent part load conditions. The **Estimator** should contact the manufacturer to request performance data that represents the intended condenser air and temperature controls.

3.8.2 System control

The **Estimator** must consider how well the simulated control system actually represents the designed control system. Some key problem areas where there is often misalignment are:

- Economy cycle for an air-based system

- Primary duct temperature control for air-based systems
- Control of airflow for variable speed fan systems
- Chiller sequencing and part load performance for larger chilled water plant
- Turndown ratios for large equipment
- Control loop type e.g. proportional, proportional-integral (PI) or proportional-integral-derivative (PID).

Estimators must also consider target temperature control ranges. While there is no specific range required for NABERS, air conditioning within the conditioned space should meet requirements outlined in the NCC and also consider NABERS **Rules** requirements regarding plant warm up time before Rated Hours when the space should be safe, lit and comfortable. Temperature ranges may also differ throughout different areas of a project, for example in patient rooms in aged care facilities.

3.8.3 System loads

Internal loads are not likely to be evenly distributed in the space. Zonal variation should be built into the model.

In addition, fans place a heat load on HVAC systems which must be considered in addition to their power use.

3.8.4 Additional considerations for data centres

In addition to the items listed above, the following items should be considered for data centres:

- Hot / cold aisle and UFAD representation: These types of data centre cooling systems require careful model setup. In order to represent this, the data centre space needs to be divided into multiple zones based on the hot and cold areas of the space, contrary to the "fully mixed zone" default assumption in energy **simulation model**s. This means that zoning should be set up with hot aisle, cold aisle and in-rack temperatures as appropriate.
- Electrical infrastructure efficiencies: Part-load efficiencies of Uninterruptible Power Supply (UPS) and Power Distribution Unit (PDU) components are technology-dependent and should be based on manufacturer's curves or verified performance data.
- Redundancy: The model should represent the proposed redundancy configuration as this will affect the way the load is spread between the plant and electrical components.

3.9 Other items

The **Estimator** must ensure that the **Estimate** covers all other energy uses within the scope of the relevant **rating type** and **rating scope**.

Calculation methods for many of these items can be found in the Green Building Council of Australia's Energy Consumption and Greenhouse Gas Emissions Calculator Guide, available on their website www.gbca.org.au.

These could include:

- Supplementary air conditioning loops – note that the electrical input into supplementary units should be determined on the basis of realistic loads

- Standby system and/or generator fuel (including sump heaters and any other standing loads)
- Lifts and other vertical transport
- Domestic hot water
- Car park ventilation and lighting
- Servicing of back of house areas
- Communications equipment
- Security systems
- Fire protection systems
- Building Management System (BMS)
- Access Control systems
- Hydraulic pumps
- Other building services
- On-site generation – in accordance with **the Rules**. Note that excess generation exported from the site cannot be used to improve a NABERS Rating
- Any additional energy consumption which may need to be included due to limitations of the energy **metering system**. If energy use outside the scope of the rating cannot be excluded using metering, then it must be included in the assessed energy consumption. This reflects what will happen in practice when the project receives an actual NABERS rating.

Note that no Greenpower or off-site renewable energy can be used when calculating an **Estimate** for a rating.

3.10 Modelling margin

As the modelling is conducted prior to construction and operation, various factors may prevent the building from reaching the targeted rating. Modellers usually incorporate a modelling margin to account for these unforeseen circumstances.

NABERS does not recommend a specific margin but requires **Estimator**s to implement and justify an appropriate modelling margin for each project. This should be based on project specifics and related risk, including but not limited to the stage of the project, complexity of the HVAC system and level of detail / completeness of design documentation.

In cases where the Independent Design Review highlights risks associated with the modelled design, operation or control of a building, the **Independent Design Reviewer** can recommend a higher margin than the **Estimator**'s original modelling margin.

Modelling margins apply to the total estimated energy. As such, the total estimated energy with modelling margin would be calculated as follows:

*Total estimated energy with margin = total estimated energy * (1 + margin in %)*

For the **base case model**, the estimated rating obtained with the **Online Calculator** will need to be calculated using the total estimated energy with margin figure.

The modelling margin does not need to be added to the **off-axis model** estimated energy consumption as outlined in Section 3.12. Rather, the modelling margin should be recalculated to understand the impact of each **off-axis scenario** modelled.

3.11 Additional considerations for data centres

The energy use of electrical power infrastructure is significant in all data centres. Key components that should be represented include:

- Uninterruptible Power Supply (UPS) losses*:* UPS systems have good efficiency at high load but as loads reduce the fixed losses in these systems can become large as a proportion of total supply. These losses are a direct energy waste and can be a significant load on the HVAC system. Manufacturer's data on efficiency versus load characteristics for the UPS systems must be incorporated into the model, including accurate representation of efficiency at part load.
- Back-up power: Back-up systems such as generators carry some fixed losses in terms of jacket heating plus energy consumption during regular testing. These should be represented in the model as well.

There is no need to include losses from distribution unless they are expected to be unusually high. The NABERS Energy Data Centre rating already includes a default figure of 3% in its calculations.

Finally, note that if in-rack cooling fan energy is not able to be distinguished through the proposed metering arrangement, the **Estimate** must include 24/7 operation of in-rack cooling fans at full rated load.

3.12 Additional considerations for hotels

Consideration should be given to the hotel grading or star rating which classifies hotels according to the level of services and facilities provided. A 2-star hotel would provide fewer amenities than a 4-star hotel. A 1-star hotel might offer more basic facilities, such as only a bed and bathroom, limited reception hours and no on-site restaurant. Ultimately, a 5-star hotel would provide more facilities and offer additional amenities such as 24-hour reception services, large screen TVs, minibar or fridges, hair dryers, heated pools or on-site gyms or fitness centres. These differences, and other project-specific ones, should be considered and taken into account when modelling energy use in all hotel projects.

3.13 Off-axis model based on performance risks

The **base case model** should be varied in order to explore the building's resilience to real-world performance risks. The scenarios modelled should consider the risks most likely to impact the project. Examples of **off-axis scenarios** may include:

- Incomplete specification or substitution of equipment
- Incomplete specification or in-use change of controls
- Commissioning errors or omissions
- Changes or uncertainty in occupancy and other operating patterns including the impacts of extended low vacancies

- Comfort or capacity problems
- Challenges around the use of sub-meters to include or exclude energy from the rating
- Impact on the target rating of changes to emissions factors due to predicted grid decarbonisation or a rapid decarbonisation scenario.

All projects should also conduct analysis on the impact of changing emissions factors on future rating results. This is covered in more detail in Section 3.13.1. This analysis is in addition to required **off-axis scenarios**, and should be reported on in the **Estimator**'s Report.

Model variations should encompass a minimum of four changes called **off-axis scenarios**, to quantify these risks (and opportunities). This will provide valuable input to the design and delivery process, and to energy management when the building is in use.

The NABERS **National Administrator** requires an absolute minimum of two models for **Commitment Agreement**s. The first model is a **base case model** and second is an **off-axis model** incorporating a minimum of four **off axis scenarios**. Analysis on the impact of changing emissions factors is in addition to the **base case model** and **off-axis scenarios**.

The scenarios should be chosen to test the impact of parameters that are the least well defined, have the potential for high impact to a project or are deemed to have a high likelihood of occurring.

Potential parameters are listed below. These parameters apply to a variety of **space types** and **rating types**, but should be adapted based on the servicing arrangements in each individual project being assessed.

More detailed guidance around data centres is given in Section 3.13.10.

The modelling margin as outlined in Section 3.10 does not need to be applied to the **off-axis model Estimate**.

3.13.1 Grid decarbonisation and changing emissions factors

In July 2021, after extensive stakeholder consultation, NABERS updated the way that Energy ratings are calculated to reflect that the electricity grid is decarbonising. This means that Energy performance ratings will now be calculated based on greenhouse gas emissions factors that are updated every five years with the latest emissions factors. This is instead of the fixed emissions factors used when NABERS Energy ratings were first developed.

This change means that the emissions factors current at the design stage of a building may be different to the emissions factors current when the required performance rating is undertaken for the building.

To help **Estimators**, **Independent Design Reviewer**s and Building Owners understand the potential impact of these changes, NABERS has released the **Prediction Tool**.

This tool is available on the NABERS website and uses available data to provide an **Estimate** of what star ratings may be when the emissions factors are next updated. These **Estimate**s, or others deemed appropriate and justifiable by the **Estimator**, should be used to understand any impacts to future performance ratings of changing emissions factors.

As the target rating for a **Commitment Agreement** is calculated using the emission factors current at the **Date of Agreement**, there is potential uncertainty if a certified performance rating is calculated using different emission factors. As such, all **Commitment Agreement** projects retain the right to request that the achievement of a **Commitment Agreement** target rating is determined based on a rating result calculated using the emissions factors current at the time of the Agreement being signed with NABERS. All projects will still need to get a certified performance rating to verify the outcome of the target rating. However, if the target rating is not achieved in the first two ratings and the project team can demonstrate that the target rating would have been achieved using the emissions factors current at the time of the **Date of Agreement**, the **National Administrator** can approve the Agreement as being 'Achieved' on the NABERS website and provide confirmation of this to third parties if needed.

3.13.2 HVAC controls

Common control failure modes for the particular building or system configuration are to be identified. Consideration should be given to simulating the impact of control changes or failures.

Potential scenarios include:

- Increased overnight infiltration rates, for example due to failure to switch off tenant kitchen exhaust fans overnight
- Failed CO_2 sensors leading to the system continually operating at design ventilation rates rather than ramping down
- Failed or disabled economy mode / cycle
- Tighter control bands on temperature control, for example no deadband and heating and cooling proportional bands only 0.5°C each.

3.13.3 After hours operation

Some HVAC systems may be unable to turn down to match low occupancy or other low loads. It is particularly important to determine how efficiently the plant can respond to the low loads generated from partial or after-hours operation.

Testing the effect of significant AHAC hours for small zones, leading to the system running at low load, should be considered in addition to **base case** after-hours assumptions for relevant projects.

3.13.4 Lighting hours of use

Where there are no specific technologies in place, lighting can operate much longer than expected. The impact of these longer hours of operation on the **Estimate** should be considered.

Technology failures leading to longer lighting hours should also be considered.

3.13.5 HVAC loads

Almost all buildings will contain areas with atypical loads that can cause, for example, cooling demand in the middle of winter. The effect of this on system performance is to be considered and any inputs used or assumptions made outlined in the **Estimator**'s report for the **Independent Design Review**. Specific items may include:

- Variation in temperature set point

- Lower or higher occupant density or other internal loads
- Failed lighting controls
- Chiller energy consumption at low level base loads (for example a 24/7 major tenant in a shopping centre)
- Fan turndown capability, and how this affects the minimum area to be served in response to an after-hours request.

3.13.6 Infiltration

Sensitivity of the model should be tested to a range of infiltration scenarios, in recognition of the difficulty of infiltration to predict. This is due to the possibility of infiltration increasing if façade construction is poor, doors are left open or exhaust fans are left running longer than expected.

3.13.7 Compound effects

Buildings, tenancies and data centres are highly interactive systems, so it is important to consider the compound effects of a single system not functioning as expected. Consider the flow-on effects to other systems to more accurately assess the total potential impacts of one system malfunctioning or functioning at lower efficiency than predicted.

The four **off-axis-scenarios** in the **off-axis model** should address the related and compound effects of each scenario on the others if relevant.

3.13.8 Risk factors around other NABERS inputs

Variability around the other NABERS inputs should also be considered, for example:

- Lower or higher NABERS Rated Area due to differences in lease rate or servicing arrangements
- Longer or shorter operating hours or trading hours
- Long periods of low occupancy during the rating period
- Changes to emissions factors impacting rating results as the grid decarbonises.

3.13.9 Metering systems

Where sub-meters (and in particular thermal meters) will be used to calculate a NABERS rating, it is important that the **Estimator** consider the associated operational risks.

The effects of sub-meters (in particular thermal meters) not functioning as designed - leading to all exclusions measured by that meter being included in a rating - should be considered for projects relying on this equipment for a large proportion of exclusions.

Refer also to Section 4.2 of this Handbook.

3.13.10 Data centres

In addition to those parameters listed above, the following should also be considered for data centres:

- Tighter temperature and humidity control bands in the data areas. While the ASHRAE TC 9.9 White Paper issued in 2011 *recommends* a fairly wide operating temperature/moisture envelope and *allows* an even wider envelope under some circumstances, many data centres run within very tight temperature and humidity limits. (The operating envelope recommended by ASHRAE TC 9.9 is bounded by dry bulb temperatures of 18°C to 27°C dry bulb temperature, and dew points of 5.5°C to 15°C, with a RH limit of 60%).
- Greater diversity in IT equipment loading than is modelled in the **base case** – that is, with greater variations in PDU and air conditioning loads. This should allow for very low loads in some areas, for example to represent the fact that UPS systems and Computer Room Air Conditioners (CRACs) typically run at very low efficiency below 30% load.
- Failed or modified controls on occupancy sensing systems for lighting, and fresh air ventilation, if applicable.
- Failed economy cycle control.
- Increased infiltration due to poor construction quality, particularly if airtightness is not specified or tested as part of the design process.
- Poor water flow turndown for water-cooled CRACs, representing missing or poorly controlled isolating controls and head pressure controls.
- Increase fan pressure due to, for example, poor duct construction or dirty filters.
- Failed thermal metering on heat rejection systems if the data centre will reject heat into a general-purpose condenser water loop that also serves other systems in the building. In this case, the NABERS **Rules** allow the rating to proceed with an assumption that the heat rejection energy is 40 W per kW rejected.

4. Report requirements for Estimators

For an Estimation to comply with this Handbook, a report must be provided to the selected Independent Design Review which contains the following:

1. Input data and assumptions
2. Metering description
3. Simulation results including:
    a) **off-axis scenarios** modelled and impact to the predicted rating
    b) analysis on changing emissions factors and impact on the predicted and future ratings
4. Risk assessment
5. Disclaimer
6. Compliance checklist.

The format for each of these items is provided in the sections below. While exact use of the format provided is not essential, at a minimum the documentation must cover the information required in a clear and concise manner. The documentation requirements have been designed to provide a degree of error checking. The forms also provide an opportunity to list all the potential issues with the **simulation model** and the associated results.

Estimators are strongly advised to be full and frank in identifying problems and compromises in the **Estimate**.

4.1 Input data and assumptions for base case model

Input data, as listed below, must be outlined in the report for the **Independent Design Review** and any compromises and assumptions that have been made must be outlined and justified.

For each input, outline any differences between specification documents and what has been modelled. Provide reasons for any discrepancies and describe any measures taken to mitigate the impact of differences on **estimation** results.

This is not a comprehensive list and there may be additional information that is needed dependent on project specifics.

Item	Description	Office	Hotel	Shopping centre	Data centre	Apartment Buildings	Residential Aged Care and Retirement Living
Manual calculations	Describe where computer software was used and where manual calculations, such as spreadsheets, were used. Provide justification and outline assumptions for any manual calculations. *Note that simulation software, not spreadsheets, must be used for all major systems and equipment.	✓	✓	✓	✓	✓	✓
Default inputs	Describe where default values were used and what assumptions have been used for **Estimate**s in the model. Outline why no better information was available for items where defaults have been used.	✓	✓	✓	✓	✓	✓
Simulation Package	Provide an overview of the **simulation package**'s capabilities, as outlined in Section 3.1. Highlight any features or characteristics which may cause inaccuracies in modelled consumption and describe how these have been mitigated / treated.	✓	✓	✓	✓	✓	✓
Climate data	Describe type of data and weather station locations used.	✓ Note 1	✓	✓	✓ Note 3	✓ Note 6	✓ Note 6
Energy coverage	Describe the energy uses and types covered. Describe what is covered by each meter and highlight any end uses that may need to be apportioned, excluded or included for a NABERS rating. Highlight any use of thermal meters and energy uses covered by these meters. Identify any exclusions or any items outside the scope of a NABERS Energy rating that have had to be included in the energy coverage because of lack of metering.	✓	✓	✓	✓	✓	✓
Document referencing	List drawing and specification versions and dates used to source information (for each input).	✓	✓	✓	✓	✓	✓

Item	Description	Office	Hotel	Shopping centre	Data centre	Apartment Buildings	Residential Aged Care and Retirement Living
Building form	Describe how this has been represented. Any simplifications must be identified.	✓ Note 1	✓	✓	✓ Note 3	✓ Note 6	✓ Note 6
External shade	Describe how this has been represented in the model. Describe any variations from current shading to the site.	✓ Note 1	✓	✓	✓ Note 3	✓ Note 6	✓ Note 6
Glazing	Describe the type of glazing and how it has been represented in the model.	✓ Note 1	✓	✓	✓ Note 3	✓ Note 6	✓ Note 6
Insulation	Describe how insulation levels have been modelled.	✓ Note 1	✓	✓	✓ Note 3	✓ Note 6	✓ Note 6
Car parks	Describe what has been modelled for car parks.	✓ Note 2	✓	✓		✓	✓
Floor area	Describe the modelled floor area, which may not be the same as the rated floor area. Differences should be described in the report.	✓	✓	✓	✓ Note 3	✓	✓
Lighting	**Lighting Power Density:** Identify lighting power density in each area of the model. **Lighting hours:** Provide a full description of the schedule. Include assumptions about the operation of cleaners or after-hours workers on site. **Lighting Controls:** Describe controls that have been modelled, including notes on how control effects were modelled.	✓	✓	✓	✓ Note 3	✓	✓

Item	Description	Office	Hotel	Shopping centre	Data centre	Apartment Buildings	Residential Aged Care and Retirement Living
Equipment	**Equipment Density:** Describe equipment type, power consumption per unit and number of units (if known). Include assumptions made for equipment load per person or per space in the model (if applicable). **Equipment Hours:** Describe the pattern of equipment use assumed for the model and the consequent effective equipment operating hours.	✓	✓	✓	✓	✓	✓
Occupancy	**Occupant density:** Describe how this figure was derived, e.g. based on tenancy type or **space type**. **Occupancy hours:** Describe the hours for each space and how this was derived and modelled.	✓	✓	✓	✓ Note 4	✓ Note 7	✓ Note 7
HVAC system type	Describe the system that has been modelled and any differences between the design and modelled systems. For shopping centres and offices, the description should address whether or not the area is centrally serviced.	✓ Note 1	✓	✓	✓ Note 3	✓ Note 6	✓ Note 6
HVAC hours	Describe the hours of operation of the HVAC plant.	✓ Note 1	✓	✓		✓ Note 6	✓ Note 6
HVAC after-hours	Describe the representation of after-hours operation used and why this figure has been used.	✓ Note 1	✓	✓		✓ Note 6	✓ Note 6
HVAC plant	Describe the plant sizes used and specifically note any areas where the simulation was allowed to default rather than use data from the design. Describe the chiller and boiler efficiencies. Describe any miscellaneous plant items (e.g. toilet exhaust systems). Describe how any limitations of the selected system/s have been modelled. Describe how low loads have been modelled.	✓ Note 1	✓	✓	✓ Note 3	✓ Note 6	✓ Note 6

Item	Description	Office	Hotel	Shopping centre	Data centre	Apartment Buildings	Residential Aged Care and Retirement Living
HVAC zoning	Describe the zoning of the HVAC systems and identify any differences between the design and the model. For offices and shopping centres, describe how HVAC zoning has been considered when modelling AHAC / extended hours for a NABERS rating.	✓ Note 1	✓	✓	✓ Note 3	✓ Note 6	✓ Note 6
HVAC control	Describe the differences between the known or likely control methodologies of the actual system and those modelled.	✓ Note 1	✓	✓	✓ Note 3	✓ Note 6	✓ Note 6
HVAC commissioning	Describe any known commissioning plans or strategies.	✓ Note 1	✓	✓	✓ Note 3	✓ Note 6	✓ Note 6
Infiltration	Describe how infiltration is modelled in internal and external zones.	✓ Note 1	✓	✓	✓ Note 3	✓ Note 6	✓ Note 6
Domestic hot water	Identify system type and end-use fitting selections (e.g. shower heads and taps). Describe assumptions around how hot water will be used (e.g. per occupant) and hot water distribution losses.	✓	✓ Note 5	✓		✓ Note 5	✓ Note 5
Trading days / trading hours	Identify trading days and ensure that other schedules are developed with a consideration of trading days.			✓			
Room rental rate and number of occupants per room	Described and/or build into the occupancy schedule.		✓				✓
Swimming pool area and heating arrangements	Identify the area, heating hot water equipment, distribution equipment and controls modelled.		✓			✓ Note 8	✓ Note 8

Note 1	May not be required for **Estimate**s used with tenancy **Commitment Agreements** if no tenant AC equipment is fitted.

Item	Description	Office	Hotel	Shopping centre	Data centre	Apartment Buildings	Residential Aged Care and Retirement Living
Note 2	Only applies to whole building and base building ratings.						
Note 3	Only applies to infrastructure and whole facility ratings.						
Note 4	Only applies to infrastructure and whole facility ratings if there is occupancy within the data halls.						
Note 5	Hot water is typically a minor end use for this **space type** and an appropriate default may be used.						
Note 6	May not be required for Apartment Building or Retirement Living **Estimate**s if no central HVAC system is installed.						
Note 7	May not be required for Apartment Building or Retirement Living **Estimate**s if no occupied spaces are included in the rating, in accordance with the **Rules**.						
Note 8	May not be required if there is no pool.						

4.2 Metering description requirements

This table must provide a full description of the metering arrangements assumed or required to allow the NABERS Energy rating to be conducted. Any risks around metering and the NABERS scope should be identified. In addition, if sub-meters are to be used to calculate the NABERS rating, the risks associated with this method should be noted (Refer to Section 3.12.8).

Metering Requirements	Energy Coverage
Meter 1 Description and Location	Describe the energy items covered by this meter.
Meter *n* Description and Location	Repeat as necessary for additional meters. Include any sub-metering required to exclude non-rated energy from the assessment.

The project team may also find it useful to have a monthly breakdown of expected energy consumption by meter or meter group for use during building operation. This may assist with fault detection.

As noted in Section 3.12.8, it is important that the **Estimator** note the operational risks associated with sub-meters. Where there are no specific risks which can be modelled, the **Estimator** may note the following in their Energy Efficiency Risk Assessment:

> *There are operational risks associated with the use of sub-meters to calculate NABERS ratings, for example relating to commissioning, record-keeping, reliability and accuracy across the full load range. In general, ratings that rely on thermal metering are more likely to be problematic. A meter management plan should be developed to identify and mitigate these risks.*

4.3 Simulation inputs and results for base case and off-axis models

A minimum of two models is required, the first being a **base case model** and the second being an **off-axis model** representing a minimum of four **off-axis scenarios** (i.e. four operational changes or failures).

Additional analysis on the impact of changing emission factors must also be done to understand predicted future ratings results. This includes the use of the NABERS **prediction tool** to forecast scenarios estimating the impact of different emission factors on the rating.

This section must list each scenario, identifying:

- Any changes between this scenario and the base case
- The purpose of the scenario
- Results for the scenarios and model in the format presented in the following subsections.

For the inputs into the NABERS Energy rating calculation, refer to Section 2 and Section 3.

4.3.1 NABERS rating inputs summary

The following information about each input detailed in Section 2.1 must be presented for the **base case model** and each **off-axis model**.

Item	Figure used for NABERS Rating	Notes
Each input should have a separate line item (e.g. postcode, Rated Area, Rated Hours, Computer Count … etc.)		Explain how this figure was determined.

Additionally, identify the modelling margin used and describe why this figure is appropriate for the building being modelled. Consider stage of design and specification drawings, any unknown factors relating to design, construction or operation and limitations of modelling **simulation software** when deciding on and describing the appropriateness of the selected modelling margin.

4.3.2 NABERS rating energy consumption summary

For the energy consumption inputs, the information must be presented as follows for the base case model and each **off-axis model**.

For the **base case model**, total energy consumption and total energy consumption with margins must be clearly detailed.

Energy End Use	Total Electricity Use	Total Gas / Fuel Use	Electricity included in the Rating	Gas / Fuel Included in the Rating
Each end use should have a separate line (e.g. lighting, equipment)				
Total for all Energy End uses				
Total for all Energy End uses with margin (**base case model** only)				

4.3.3 NABERS rating results summary

The estimated NABERS Rating for the **base case model** and the **off-axis model** (or each **off-axis scenario** if relevant) must be obtained using the **online calculator** and the inputs detailed in Section 4.3.1 and 4.3.2. The results obtained must be presented and include the following information:

- The NABERS Energy star rating (without Greenpower or other off-site renewable energy only)
- The performance level in MJ p.a. and kg CO_2-e p.a.
- The intensity values (MJ p.a./m^2, kg CO_2-e p.a./m^2) when relevant for the **Rating type** considered
- The modelling margin or buffer for **base case model** and each **off-axis model**
- The rating results taking into account the impact of changing emission factors (use of the NABERS **prediction tool**).

For the **base case model**, the total energy consumption with modelling margin figures should be used to obtain the estimated NABERS rating results.

4.4 Risk assessment

The **Estimator** must summarise any risk factors that might prevent the project from achieving its estimated rating. These risks must include at a minimum:

- Differences between the specification documents and model
- Building design
- Materials specified
- Equipment specified
- Risks as derived from the **off-axis scenarios**
- Risks as derived from analysis of the impact of changing emissions factors
- Risks associated with changes made after the design phase
- Risks associated with commissioning and controls when in operation
- Any other risks identified through assumptions and inputs used when estimating the rating.

Other risks for a specific project must also be included in the report for the **Independent Design Reviewer**.

For each risk outlined, the **Estimator** must describe the potential impact as well as how the risk has been or might be mitigated. The table below can be used for this.

Risk	Potential Impact	Potential Mitigation
Describe the area of risk, e.g. "Mechanical equipment hours of use sensitivity"	Describe the potential impact, e.g. "Changing mechanical equipment hours of use changed the rating from four stars to three stars."	Describe how the problem might be approached, e.g. “Ensure adequate plant run time monitoring is in place to avoid mechanical equipment running unintentionally or unnecessarily."

NABERS

Risk	Potential Impact	Potential Mitigation
	Repeat as necessary.	

In addition, it is required that the following information at a minimum is provided for each model (excluding NABERS Data Centre IT equipment and Apartment Building ratings where there is no central HVAC system):

- The percentage of occupied hours that any conditioned spaces lie outside the nominated control range (i.e. temperature control targets not being met)
- The percentage of plant operation hours that the HVAC plant fails to meet the system load demands (i.e. system failing to meet peak demand).

4.5 Disclaimer

The report must include, as a minimum, the following disclaimer:

> *Computer simulation provides an* estimate of performance. This estimate *is based on simplifications that do not and cannot fully represent all of the intricacies of performance once built. As a result, simulation results only represent an interpretation of the potential performance. No guarantee or warrantee of performance in practice can be based on simulation results alone.*

4.6 Compliance checklist

This table must be completed in the report submitted to the **Independent Design Reviewer**. A complying estimation must include all the items listed in the compliance table.

Item	Included?	Notes
Input data, including assumptions and source documentation referencing for **base case model**	Yes / no	
Metering requirements	Yes / no	
Off-axis scenarios and **off-axis model** listing	Yes / no	
Analysis of the impact of changing emissions factors using the NABERS **prediction tool**	Yes / no	
NABERS rating inputs summary for base case and **off-axis models**	Yes / no	
NABERS Energy end-use summary for base case and **off-axis models**	Yes / no	

Item	Included?	Notes
NABERS rating simulation results for base case, **off-axis models** and results based on changing emissions factors	Yes / no	
Risk assessment	Yes / no	
Disclaimer	Yes / no	

5. Report requirements for Independent Design Reviewers

The role of an Independent Design Review is to provide an additional level of certainty that the assumptions, inputs and model appear reasonable for a **space type** and are likely to reflect its operational performance. To do this, the Review should include a risk assessment of the assumptions, model, design and related documentation used by the **Estimator**. The risk assessment should include a clear and detailed description of each risk to enable the design team to propose appropriate responses, actions or changes to manage identified risks. Risks identified during the Independent Design Review are for consideration by the design team, who retain responsibility for the completed **Estimate** reflecting the energy consumption of the **space type** when operational.

An Independent Design Review should also include a review of a **space type**'s design and equipment, to ensure that both are capable of achieving their intended outcomes and good environmental performance. **Off-axis scenarios** modelled and the impact of changing emissions factors and any impacts on the predicted rating results should be included in the Independent Design Review report.

Where an Independent Design Review is being undertaken in compliance with this Handbook, the Independent Design Review report must contain at a minimum:

1. Risk assessment for each of the following categories, as detailed in the **Estimator** report and following review of the model
    a) Input data and assumptions for **base case model**
    b) Metering description
    c) Simulation results for base case and **off-axis model**
    d) Report on buffer/margin above target for base model, **off-axis scenarios** and analysis on the impact of changing emissions factors
    e) Design and equipment review
    f) **Estimator**'s risk assessment
    g) Disclaimer
    h) Compliance checklist.
2. Final risk assessment checklist
3. Summary.

A format for each of these items is provided in the sections below. While exact use of the format provided is not essential for most items, at a minimum all items listed must be reviewed. The Independent Design Review report must cover all information required in a clear and concise manner.

It is expected that Reviewers will review and assess some items covered in the table below more comprehensively than others. For example, the design and equipment review should cover more than just the points provided in the table. Reviewers must use their judgement and expertise to assess how in-depth area or topic reviews should be for a particular project.

Items needed to satisfy an **Independent Design Reviewer** that a project's assumptions, model, documentation, design features and equipment selection meet its specific requirements and are capable of achieving their intended outcomes should be reviewed and reported on, in a format the Reviewer determines to be appropriate. **Estimator**s and Reviewers are expected to work from documents that can reasonably be expected to represent the **space type** as constructed, or the most appropriate documents given the design stage of the building. Reviewers should include a risk assessment of design documentation if required for a specific project, for example on Reviews done early in the design process.

Documents that must be reviewed include at a minimum mechanical drawings and specifications, electrical drawings and specifications, control strategies documents and architectural plans and specifications. Other documents might also be reviewed dependent on the project.

If the **Estimator**'s report doesn't contain the minimum details as outlined in Section 4, missing information must be requested before the Independent Design Review report can be finalised. Similarly, any estimates or assumptions made by the **Estimator** that the Reviewer deems inaccurate or a risk to the target rating being achieved must be addressed or justified before the final Independent Design Review report is sent to NABERS.

Reviewers should send the final Independent Design Review report to NABERS via email once complete. Upon reviewing the **Independent Design Review** report, the **National Administrator** will get back to the **Reviewer** with any questions or concerns regarding the energy simulation report before formally signing off this part of the Commitment Agreement process as complete. Once the report has been signed off by NABERS, the Commitment Agreement Certificate will be sent to the Applicant.

For all **Commitment Agreements**, the Independent Design Review must be conducted by a member of the NABERS Independent Design Review Panel, or a Reviewer who was a member at the **Date of Agreement** if contracted before membership expired. Panel members must always be independent of the design team.

The purpose of the Independent Design Review is to provide a clear indication on whether the target rating is on track to be achieved or not. The Independent Design Review report should identify inconsistencies or errors and give recommendations to ensure that the project appears to be capable of achieving the target rating.

5.1 Identified risks

The table below outlines the minimum categories to be covered in the Independent Design Review report. The review must also cover sub-category items including, but not limited to, those listed in the table.

For each item, confirm that what has been specified in design documentation and what has been modelled are the same. Any assumptions or simplifications should be reasonable and unlikely to create a significant difference between modelled and operational energy use. For each item, at a minimum Reviewers should clearly identify and detail risks relating to:

- Inputs used for the design and model
- Differences between design documentation and model
- Assumptions regarding design and equipment choices
- A building's first or subsequent rating results given changes to emissions factors over time.

After the review, Reviewers should be able to make a clear statement that they are satisfied or not with:

- The model's ability to reasonably represent the building's actual energy performance
- The building's likelihood of meeting the targeted star rating.

The below format is not required for an Independent Design Review, however at a minimum all information outlined in the table below must be included in a Reviewer's Independent Design Review report in a clear and concise format.

Item	Description	Office	Hotel	Shopping centre	Data centre	Apartment Buildings	Residential Aged Care and Retirement Living
Input data and assumptions							
Manual calculations	Confirm all major systems and equipment have been modelled in simulation software as opposed to manual calculations being used (e.g. spreadsheets). Confirm assumptions used appear reasonable and are used appropriately in the building simulation. Review manual calculations, such as those calculated in spreadsheets, where used.	✓	✓	✓	✓	✓	✓
Default values	Confirm assumptions and default values used appear reasonable and are used appropriately in the building simulation.	✓	✓	✓	✓	✓	✓
Simulation package	Confirm **simulation package** meets the minimum requirements as outlined in Section 3.1.	✓	✓	✓	✓	✓	✓
Climate data	Review type of data used and weather station locations.	✓ Note 1	✓	✓	✓ Note 3	✓ Note 6	✓ Note 6
Energy coverage	Review the energy uses and fuel types covered. Confirm meters and energy uses covered by each simulated meter are correct according to specification documents. Confirm any exclusions or any items outside the scope of the NABERS Energy rating that are not appropriately metered have been included in energy consumption calculations.	✓	✓	✓	✓	✓	✓

Item	Description	Office	Hotel	Shopping centre	Data centre	Apartment Buildings	Residential Aged Care and Retirement Living
Document referencing	Review all drawing and specification versions and dates used to source information (for each input). Confirm what has been modelled matches appropriate specification documents.	✓	✓	✓	✓	✓	✓
Building form	Review representation of building.	✓ Note 1	✓	✓	✓ Note 3	✓ Note 6	✓ Note 6
External shade	Review external shade representation and confirm any assumptions appear reasonable.	✓ Note 1	✓	✓	✓ Note 3	✓ Note 6	✓ Note 6
Glazing	Confirm that glazing and glazing thermal performance have been appropriately represented in the model.	✓ Note 1	✓	✓	✓ Note 3	✓ Note 6	✓ Note 6
Insulation	Confirm that insulation has been appropriately represented in the model for walls, roofs and floors.	✓ Note 1	✓	✓	✓ Note 3	✓ Note 6	✓ Note 6
Car parks	Review what has been modelled for car parks.	✓ Note 2	✓	✓		✓	✓
Floor area	Review the modelled floor area, which may not be the same as the rated floor area. When appropriate for the **rating type** considered, confirm that Rated Area assumptions are reasonable and in line with the NABERS **Rules**.	✓	✓	✓	✓ Note 3	✓	✓

Item	Description	Office	Hotel	Shopping centre	Data centre	Apartment Buildings	Residential Aged Care and Retirement Living
Lighting	**Lighting Power Density:** Confirm that lighting power densities have been appropriately represented in the model. Confirm density used is appropriate and does not have unconsidered impacts on heat loads or energy estimation. **Lighting hours:** Review schedule and assumptions about the operation of cleaners or after-hours workers on site. Confirm it has been appropriately modelled. **Lighting Controls:** Review modelled controls and assumptions. Confirm assumptions match control brief.	✓	✓	✓	✓ Note 3	✓	✓
Equipment	**Equipment Density:** Confirm that equipment densities have been appropriately represented in the model. Confirm density assumptions have been appropriately documented (equipment type, power consumption per unit and number of units) and do not have further impacts on energy estimation. Review assumptions made for equipment load per person or per space (if applicable). **Equipment Hours:** Review assumed pattern of equipment use and the consequent effective equipment operating hours.	✓	✓	✓	✓	✓	✓

Item	Description	Office	Hotel	Shopping centre	Data centre	Apartment Buildings	Residential Aged Care and Retirement Living
Occupancy	**Occupant density:** Review the figure used. **Occupancy hours:** Review the hours assumed for each space and confirm they appear reasonable.	✓	✓	✓	✓ Note 4	✓ Note 7	✓ Note 7
HVAC system type	Review the system that has been modelled. Confirm there are no unacceptable differences between modelled system and specified and/or designed system.	✓ Note 1	✓	✓	✓ Note 3	✓ Note 6	✓ Note 6
HVAC hours	Review the hours of operation of the HVAC Plant.	✓ Note 1	✓	✓		✓ Note 6	✓ Note 6
HVAC after-hours	Review the representation of after-hours operation used and confirm it appears reasonable.	✓ Note 1	✓	✓		✓ Note 6	✓ Note 6
HVAC plant	Confirm that all components of HVAC plant have been appropriately represented in the model. Specifically, review assumptions for any areas where the simulation was allowed to default rather than use data from the design. Review all parameters that could impact the predicted energy consumption (efficiencies, plant size, capacity of the system to operate at part load/low load). Review all included miscellaneous plant (e.g. toilet exhaust systems) and confirm completeness.	✓ Note 1	✓	✓	✓ Note 3	✓ Note 6	✓ Note 6
HVAC zoning	Review the zoning of HVAC. Confirm this has been taken into consideration when estimating the AHAC hours for a NABERS rating	✓ Note 1	✓ Note 3	✓	✓ Note 3	✓ Note 6	✓ Note 6

Item	Description	Office	Hotel	Shopping centre	Data centre	Apartment Buildings	Residential Aged Care and Retirement Living
HVAC control	Review the differences between the known or likely control methodologies of the actual system and those modelled. Confirm assumptions and modelled inputs appear reasonable. Confirm that modelled HVAC control is based on control briefs.	✓ Note 1	✓	✓	✓ Note 3	✓ Note 6	✓ Note 6
Infiltration	Review how infiltration is modelled in internal and external zones. Confirm assumptions and modelled inputs appear reasonable.	✓ Note 1	✓	✓	✓ Note 3	✓ Note 6	✓ Note 6
Domestic hot water	Review system type and end-use fitting selections (e.g. shower heads and taps). Review assumptions regarding use of hot water (e.g. per occupant) and modelled hot water distribution losses.	✓	✓ Note 5	✓		✓ Note 5	✓ Note 5
Trading days / trading hours	Review trading days and confirm that other schedules are developed with a consideration of trading days.			✓			
Room rental rate and number of occupants per room.	Confirm that this has been described explicitly and / or built into the occupancy schedule.		✓				✓
Swimming pool area and heating arrangements	Review the area, heating hot water plant, distribution equipment, and controls modelled.		✓			✓ Note 8	✓ Note 8

Item	Description	Office	Hotel	Shopping centre	Data centre	Apartment Buildings	Residential Aged Care and Retirement Living
Metering requirements							
Meter descriptions and locations	Review the locations and coverage descriptions of all meters. Confirm what has been modelled is specified in design documents. Confirm arrangement of proposed meters and submeters results in appropriately metered end uses for the relevant NABERS **rating scope**. Confirm any required apportioning can be calculated in line with NABERS **Rules** for any shared services or facilities.	✓	✓	✓	✓	✓	✓

Item	Description	Office	Hotel	Shopping centre	Data centre	Apartment Buildings	Residential Aged Care and Retirement Living
Simulation results							
Off-axis scenarios	Confirm a minimum of two models, including the **base case model** and one **off-axis model** including four **off-axis scenarios**, have been modelled. Review description of **off-axis scenarios** and confirm inputs and purpose are reasonable. Confirm the impact on modelling margins is reasonable and assess the impact of changing emission factors on performance rating results.	✓	✓	✓	✓	✓	✓
NABERS rating inputs	Review NABERS inputs for the **base case model** and **off-axis model**. Confirm they are in accordance with **the Rules**, and match the design documentation, model inputs and the assumptions used. Confirm **Estimate**s or assumptions for these items are reasonable.	✓	✓	✓	✓	✓	✓
NABERS rating energy consumption	Review information provided for the **base case model** and **off-axis model**. Confirm total included energy use figures are in accordance with the model and calculation outputs. Confirm a suitable modelling margin has been used for the **base case model**. Highlight any risks with the modelling margin.	✓	✓	✓	✓	✓	✓
NABERS rating results summary	Review estimated performance in MJ / [rating unit], kg CO2-e and NABERS Energy Stars. Review scenarios and caveats and confirm reasonable.	✓ MJ/m2	✓ MJ/ room	✓ MJ/m2	✓ Note 9	✓ MJ/ apartment	✓ MJ/m2

NABERS

Item	Description	Office	Hotel	Shopping centres=	Data centre	Apartment Building	Residential Aged Care and Retirement Living
Design and equipment review							
Design Review	Review design features and confirm they are capable of achieving project-specific requirements. Review design features and confirm they are capable of achieving intended outcomes and good environmental performance.	✓	✓	✓	✓	✓	✓
Equipment review	Review equipment selection and confirm selections are capable of achieving project-specific requirements. Review equipment selection and confirm selections are capable of achieving intended outcomes and good environmental performance.	✓	✓	✓	✓	✓	✓
Risk assessment							
Risk assessment	Review described risk factors, level of risk and mitigation strategies and confirm that actions taken to mitigate risks so far are appropriate. Highlight any risks that have not been mitigated or have been inappropriately mitigated. Confirm stated risks are unlikely to prevent the building achieving its targeted star rating if managed as described.	✓	✓	✓	✓	✓	✓

	Review **Estimator** comments on system and plant performance. Confirm inputs and assumptions are appropriate. Review additional information provided and confirm percentage hours where temperature or load demands aren’t met are reasonable and as expected. Include a risk matrix table identifying the probability/likelihood and severity of each risk factor.	✓	✓	✓	✓	✓	✓
Other items							
Disclaimer	Review disclaimer in **Estimator** report and confirm it meets minimum requirements and is reasonable for the simulation.	✓	✓	✓	✓	✓	✓
Compliance checklist	Review the compliance checklist prepared by the **Estimator** and confirm all items have been covered in the report If required, request any missing information before the Independent Design Review is finalised.	✓	✓	✓	✓	✓	✓
Commissioning plans	Review commissioning plans and confirm they appear to be good practice. If no commissioning plans are available, assess risk for the project and recommend future commissioning if required.	✓	✓	✓	✓	✓	✓

Notes	
Note 1	May not be required for Independent Design Reviews used with tenancy **Commitment Agreements** if no tenant AC equipment is fitted.
Note 2	Only applies to whole building and base building ratings.
Note 3	Only applies to infrastructure and whole facility ratings.
Note 4	Only applies to infrastructure and whole facility ratings if there is occupancy within the data halls.

Note 5	Hot water is typically a minor end use for this **space type** and an appropriate default may be used.
Note 6	May not be required for Apartment Building or Retirement Living IDRs if no common area HVAC system is installed.
Note 7	May not be required for Apartment Building or Retirement Living IDRs if no occupied spaces are included in the rating, in accordance with The **Rules**.
Note 8	May not be required if no pool is included in the rating.
Note 9	kWh/GHz for IT equipment and whole facility ratings and PUE for infrastructure ratings.

5.2 Final risk checklist

Following the risk assessment process, Reviewers should complete the table below. The table is intended to clearly summarise results of the review and clearly identify and detail the risks that could prevent the project from achieving its targeted star rating. Each risk should be detailed enough to enable the design team to clearly understand the issue and propose an action to address the issue or mitigate the risk. Reviewers can also propose potential mitigations or provide guidance on how the design could be made more efficient.

Risks that could jeopardise a model's ability to accurately represent the **space type** as designed and specified, or a design's ability to meet the star rating targeted, should be located at the top of the table for clarity and marked as 'high risk'.

This table is required to be included in all Independent Design Review reports to make it clear what the largest risks to achieving the target rating are and how these risks are being addressed. Reviewers may also choose to add a column to indicate the likelihood of a risk occurring so that high risk, high likelihood issues can be addressed as a priority.

Risk	Comment	Potential mitigation (optional)	Risk category
Describe the identified risk, e.g. "Modelled hours of 70 hours/week are unlikely to be accurate and give a misleading rating result."	Make any necessary comments, e.g. "The design team should consider alternative ways of reducing energy consumption in the building if more appropriate rated hours in the model result in a decreased rating result or a result below the targeted modelling margin. If lower modelled hours result in a decreased rating result or a result below the targeted modelling margin, there is a high risk the building will not achieve the targeted star rating."	Describe a potential solution, e.g. "Consider modelling rated hours of 45 hours/week and ensuring that updated results maintain the targeted modelling margin."	High

Risk	Comment	Potential mitigation (optional)	Risk category
Describe the identified risk, e.g. "Modelled chilled water efficiency at low load is unlikely to be accurate and may give a misleading rating result."	Make any necessary comments, e.g. "Chilled water system efficiency modelled at low loads appears optimistic given the current arrangement of equally sized chillers."	Describe a potential solution, e.g. "Readjust model to accurately represent operation of specified system. Consider reviewing the chiller arrangement or staging to improve efficiency at low load."	Medium
Describe the identified risk, e.g. "Design documentation specifies an optimum start strategy for mechanical equipment, which has not been effectively modelled to incorporate longer pre-start periods on very hot or cold days."	Make any necessary comments, e.g. "The **Estimator** should model variable start up conditions that account for longer pre-start periods for key mechanical equipment."	Describe a potential solution, e.g. "Consider 60-90 minute pre-start periods in the middle of summer and winter, decreasing to 30-45 minutes in shoulder seasons."	Medium
	Repeat as necessary.		

5.3 Summary statement

After completing the risk checklist, Reviewers must provide a clear, short summary in their report for the project stating that they are satisfied or not that the project is likely to achieve the targeted star rating. Reviewers can add conditions to this statement, based on the risks identified and suggestions made. Conditions could include that:

- Key or all identified risks are addressed
- Key or all suggestions are actioned
- Any other reasonable conditions are met.

If the Reviewer has significant doubts or concerns about a project reaching the targeted star rating, any steps that the Reviewer believes need to be taken to rectify the issue/s must be outlined to the applicant. Where necessary, a change to the star rating target could be considered by the applicant and discussed with the **National Administrator** before the Independent Design Review report is finalised and issued.

6. Appendix – Defaults

Wherever possible, Estimates must include data from the design and expected operation of the space type being modelled.

Where this is not available, the following defaults or other appropriate defaults can be used. The **Estimator** must explain and justify any use of defaults.

6.1 Office – Base building

6.1.1 Occupancy

Default peak occupancy can be set at 1 per 10 m². However, the maximum typical occupancy is 70% of the peak, as listed in the default schedule in Section 6.1.4.

6.1.2 Equipment loads

Installed equipment loads are likely to vary from zone-to-zone and this should be represented in the model. By default, zone loads should be set at 50%, 70%, and 90% of design equipment loads in ratios of 1:2:1 to give an average load of approximately 70% of the design equipment load. If the design equipment load is unknown, a default of 15 W/m2 should be used.

6.1.3 Lighting

The default lighting load in tenancies can be set at the relevant minimum compliance value as detailed in the National Construction Code.

6.1.4 Schedules

Default Schedules which can be used are provided below.

The schedules correspond notionally to a 50 hour a week schedule. However, this is sensitive to the relative size of the after-hours zones.

The “Saturdays (after-hours zones)” schedule (which operates the HVAC from 9.00am – midday on Saturday) can be applied to a single after-hours zone of the building (for example, the smaller of 10% of the building, one storey, or an individual and distinct tenancy with area greater than 5% of the total building).

Weekdays (All Zones)

Time period	Occupancy	Lighting (Automated time of use control)	Lighting (limited control)	Equipment	HVAC Operation
0000-0100	0%	5%	15%	25%	Off
0100-0200	0%	5%	15%	25%	Off
0200-0300	0%	5%	15%	25%	Off
0300-0400	0%	5%	15%	25%	Off
0400-0500	0%	5%	15%	25%	Off
0500-0600	0%	5%	15%	25%	Off
0600-0700	0%	5%	15%	25%	Off
0700-0800	10%	30%	40%	65%	On
0800-0900	20%	75%	90%	80%	On
0900-1000	70%	100%	100%	100%	On
1000-1100	70%	100%	100%	100%	On
1100-1200	70%	100%	100%	100%	On
1200-1300	70%	100%	100%	100%	On
1300-1400	70%	100%	100%	100%	On
1400-1500	70%	100%	100%	100%	On
1500-1600	70%	100%	100%	100%	On
1600-1700	70%	100%	100%	100%	On
1700-1800	35%	75%	80%	80%	On
1800-1900	10%	25%	60%	65%	Off
1900-2000	5%	15%	60%	55%	Off
2000-2100	5%	15%	50%	25%	Off
2100-2200	0%	5%	15%	25%	Off
2200-2300	0%	5%	15%	25%	Off
2300-2400	0%	5%	15%	25%	Off

Saturdays (after-hours zones)

The below schedule (which operates the HVAC from 9.00am – midday on Saturday) can be applied to a single after-hours zone of the building (for example, the smaller of 10% of the building, one storey, or an individual and distinct tenancy with area greater than 5% of the total building).

Time period	Occupancy	Lighting (Automated time of use control)	Lighting (limited control)	Equipment	HVAC Operation
0000-0100	0%	5%	15%	25%	Off
0100-0200	0%	5%	15%	25%	Off
0200-0300	0%	5%	15%	25%	Off
0300-0400	0%	5%	15%	25%	Off
0400-0500	0%	5%	15%	25%	Off
0500-0600	0%	5%	15%	25%	Off
0600-0700	0%	5%	15%	25%	Off
0700-0800	0%	5%	15%	25%	Off
0800-0900	5%	40%	25%	25%	Off
0900-1000	15%	40%	40%	25%	On
1000-1100	15%	40%	40%	25%	On
1100-1200	15%	40%	40%	25%	On
1200-1300	5%	15%	25%	25%	Off
1300-1400	5%	15%	25%	25%	Off
1400-1500	5%	15%	25%	25%	Off
1500-1600	5%	15%	25%	25%	Off
1600-1700	5%	15%	25%	25%	Off
1700-1800	0%	5%	15%	25%	Off
1800-1900	0%	5%	15%	25%	Off
1900-2000	0%	5%	15%	25%	Off
2000-2100	0%	5%	15%	25%	Off
2100-2200	0%	5%	15%	25%	Off
2200-2300	0%	5%	15%	25%	Off
2300-2400	0%	5%	15%	25%	Off

Weekends and Holidays (Non-after-hours zones) and Sundays and Holidays (After-hours zones)

Time period	Occupancy	Lighting (Automated time of use control)	Lighting (limited control)	Equipment	HVAC Operation
0000-0100	0%	5%	15%	25%	Off
0100-0200	0%	5%	15%	25%	Off

0200-0300	0%	5%	15%	25%	Off
0300-0400	0%	5%	15%	25%	Off
0400-0500	0%	5%	15%	25%	Off
0500-0600	0%	5%	15%	25%	Off
0600-0700	0%	5%	15%	25%	Off
0700-0800	0%	5%	15%	25%	Off
0800-0900	5%	15%	25%	25%	Off
0900-1000	5%	15%	25%	25%	Off
1000-1100	5%	15%	25%	25%	Off
1100-1200	5%	15%	25%	25%	Off
1200-1300	5%	15%	25%	25%	Off
1300-1400	5%	15%	25%	25%	Off
1400-1500	5%	15%	25%	25%	Off
1500-1600	5%	15%	25%	25%	Off
1600-1700	5%	15%	25%	25%	Off
1700-1800	0%	5%	15%	25%	Off
1800-1900	0%	5%	15%	25%	Off
1900-2000	0%	5%	15%	25%	Off
2000-2100	0%	5%	15%	25%	Off
2100-2200	0%	5%	15%	25%	Off
2200-2300	0%	5%	15%	25%	Off
2300-2400	0%	5%	15%	25%	Off

6.1.5 Tenant supplementary air-conditioning

Where the tenant is unknown, the energy use can be estimated based on the following:

- COP as required by the Mandatory Energy Performance Standards (MEPS)
- Cooling loads at 50% of the system capacity for 10 hours each day
- Cooling loads at 20% of the system capacity for the remainder of the time.

Where the tenant is known, the energy use of the tenant units shall be derived on the basis described in Section 6.2. This can be used as an input to reasonable modelling of the cooling tower and pump operation.

6.1.6 Vertical transportation

Lift energy can be calculated using ISO 25745-2 (2015). Where this is impractical or unsuitable, the GBCA's Energy Consumption and Greenhouse Gas Emissions Calculator Guide available from www.gbca.org.au can be used.

6.1.7 Domestic hot water

A default which can be used for domestic hot water demand is 4L/person/day. If there are no end-of-trip facilities and if basin taps are WELS 4 star or above, it may be appropriate to use a lower demand **Estimate**. To convert the hot water demand **Estimate** to an energy consumption **Estimate**, the **Estimator** will need to consider distribution and generation losses. this can be done using the domestic hot water calculation method in the GBCA's Energy Consumption and Greenhouse Gas Emissions Calculator Guide available from www.gbca.org.au.

6.1.8 Infiltration

Where no envelope air tightness testing data is available (for example in a refurbished building or from a similar building), use 0.7 air changes per hour throughout all zones during hours when the zone has no mechanically supplied outside air and 0.35 air changes per hour at all other times.

6.2 Office – Tenancy

6.2.1 Occupancy

The occupant density can be modelled as one person per workstation. The default schedule for occupancy is in Section 6.1.4.

6.2.2 Lighting power density

The lighting power density must be modelled as per the tenancy fit out. No alternative is acceptable.

6.2.3 Lighting hours of use

Lighting as per the expected operation should be modelled, with detailed assessment of the effectiveness of the intended controls.

By way of guidance:

- De-rate operating power from 100% to 90% where motion detectors control an area of 200 m2 or less, and motion sensors control groups of more than 6 fittings.
- De-rate operating power from 100% to 70% where motion detectors control groups of 3-6 light fittings
- De-rate operating power from 100% to 55% where motion detectors control groups of 2 or fewer light fittings.
- During daylight hours, de-rate operating power from 100% to 50% for light fittings adjacent to windows or roof lights that are controlled by daylight sensors.

Where daylight linking is claimed, daylight modelling should be used to demonstrate the percentage reduction in use.

6.2.4 Equipment loads

The energy associated with equipment use in the tenancy should refer to the actual expected equipment use. where required, the following tables can be used to estimate in-use and standby equipment loads for each item.

Computers

Actual measurements should be used to establish equipment loads for installed computers in use and in standby mode. The methodology used for such estimates is to be clearly documented.

Where actual measurements are unavailable (for example at the early stage of a project), the following data can be used:

Case	Operating mode (W/unit)	Standby mode (W/unit)
Standard desktop computer, unknown screen type	120W	8W
Standard desktop computer, LCD screen	90W	5W
Laptop computer using inbuilt screen	35W	3W
Laptop computer using external LCD screen only 50W	50W	5W
Laptop computer using both inbuilt and external LCD screen	65W	5W

The number of computers per workstation modelled should be in accordance with **the Rules**.

Server Rooms

Server room energy use can be estimated either by:

- Measurement of in-situ energy consumption or where this is unavailable
- 140W per server room computer, plus 4.5W per computer for all computers in the tenancy or
- Estimated lump consumption of the server room energy use. The methodology used for this estimate is to be clearly documented.

Refrigerators, freezers, refrigerated drink dispensers and hot water/chilled water units

Refrigerator/freezer energy consumption shall be referenced to the annual energy consumption shown on the Energy Rating label (see www.energyrating.gov.au) or, if not available, determined by measurement or by default set at 32+0.1Vr Watts where Vr is the number of litres of refrigerated storage plus 38+0.2Vf Watts where Vf is the number of litres of freezer storage.

Refrigerated drink dispensers can be set to 110W continuous.

Hot water units can be assessed on the basis of manufacturer's data for standing losses, in-situ measured data for standing loss or 100W default standing loss plus 12.5 kWh (equivalent to 5W per person for 10 hours a day) per person per annum served by the unit. Chilled water units can be assessed on the basis of the manufacturer's data for energy use in standing loss, in-situ measured data for standing loss or 50W default. Where the unit is operated by a timeclock, the standing losses shall be limited to 70 hours a week.

Other equipment

Energy use associated with other equipment can be referenced to the annual energy consumption shown on the Energy Rating label (see www.energyrating.gov.au) if available. Alternatively, measurements of the equipment to be installed can be used to verify energy consumption in use and after-hours (standby). Alternatively, use the following table to estimate the energy use for each item. If an item is not listed, an alternative figure could be obtained preferably through in-situ measurements. The methodology used for such estimates is to be clearly documented.

Item	Operating mode (W/unit)	Standby mode (W/unit)
A4 laser printer	110	22
Fax/inkjet printer	20	5
Copier	150	5
TV	65	5
Shredder	10	2
Electronic whiteboard	10	2
Scanner	8	8
Laminator	65	37.2
Binder	8	2
Dishwasher	46	0
Oven	60	0
Microwave	62	2
Small kitchen appliances (e.g. jug, toaster, griller)	100	0
Coffee machine	150	0
Hot water service, showers	200	200

6.2.5 Equipment schedule

The default schedule for equipment loads is in Section 6.1.4. The schedules outline the proportion of computers and equipment operating in "operating" mode. The remainder of the equipment can be modelled as operating in "standby" mode.

When developing schedules, consider operational control of equipment to determine the likelihood of certain equipment operating during core hours and after-hours. Poor / low level control implies that efficiency is reliant on individual tenant behaviour, which often sees equipment left on after hours and overnight. "Good control" implies that systems are in place that will ensure (independent of tenant behaviour) that the equipment will switch off or move into a hibernation / sleep mode when not in use or after hours. Strategies to ensure this may include:

- Settings that cannot be changed by staff that guarantee sleep / hibernate mode operation during non-occupancy hours for all computers and office equipment (with the contract for IT staff stipulating this requirement)
- A software program is implemented to initiate automatic shutdown procedure to the computers after-hours (with the contract for IT staff stipulating this requirement)
- A hard-wired electrical relay isolates power to office equipment and computers.

6.2.6 Tenant supplementary air-conditioning

The default methodology for the calculation of tenant loads attributable to supplementary air-conditioning is as follows:

a) Where the total design cooling load by supplementary systems for the tenancy is less than 100kW of cooling:

   i Air conditioning for server, communication and other rooms with continuous loads shall operate at 75% of full design cooling load 24 hours a day. If dehumidification is installed, reheat elements shall be counted as operating at 15% duty 24 hours a day. Such systems may, at the energy modeller's discretion, be modelled under the provisions of (b) below.

   ii Air-conditioning for other spaces shall be assumed to operate at full load for 2 hours per day if provided with demand-based switching. If not provided with demand-based switching, such systems shall be assumed to operate at full load 4 hours a day and fan-only for 6 hours a day.

b) Where the total cooling load from supplementary systems for the tenancy is greater than 100kW of cooling, the energy use of the system shall be modelled with a thermal **simulation package** meeting the requirements of this Handbook.

In either (a) or (b), the calculation can be based on the intended control arrangement, including staging, the running of redundant units, fan energy, fresh air inputs and lighting energy in the space.

6.2.7 Domestic hot water

Where domestic hot water is included within the domain of the tenant metering, the energy used by the domestic hot water can be based on a demand of 2kWh/m² plus storage and circulation losses.

6.3 Office - Whole building

A whole building rating is the combination of Base Building rating and Tenancy rating. Refer to Sections 6.1 and 6.2 for details.

6.4 Shopping centres

6.4.1 Hours of service

No default hours of service are provided – this item is expected to be known by the developer. Note that hours vary significantly in different jurisdictions.

6.4.2 Trading days

No default trading days are provided – this item is expected to be known by the developer.

6.4.3 Common area operations

Occupant density

The default peak occupancy rates for common areas are generally based on NCC egress requirements as below:

- General mall areas: 3.5 m^2 per person on ground floor and 5 m^2 per person on other floors
- Food court areas: 1 m^2 per person

However, typical maximum occupancy is well under peak occupancy, as defined in the following schedules.

Occupancy schedule

Shopping centre occupancy has a significant impact on energy use by the HVAC system, as people contribute heating loads, both sensible and latent. Outcomes become even more sensitive to occupancy schedules when fresh air controls are linked to occupant numbers. Therefore, it is critical that the design team takes special effort to understand the operation and occupancy of the proposed shopping centre.

"Occupancy" in this instance refers to the number of shoppers visiting the shopping centre and is represented as a percentage of the design occupancy.

For example, many shopping centres have 'late night trading' on a given weekday, and slightly shorter trading hours on a Sunday. Fridays and Saturdays often seem to have higher occupancy. With these considerations, and example 'typical week' occupancy schedule is provided below.

Hour beginning	Hour ending	Percentage of peak occupancy				
		Mon - Wed	Thu	Fri	Sat	Sun
0	1	0%	0%	0%	0%	0%
1	2	0%	0%	0%	0%	0%
2	3	0%	0%	0%	0%	0%
3	4	0%	0%	0%	0%	0%
4	5	0%	0%	0%	0%	0%
5	6	0%	0%	0%	0%	0%

Hour beginning	Hour ending	Percentage of peak occupancy				
		Mon - Wed	Thu	Fri	Sat	Sun
6	7	1%	1%	1%	1%	1%
7	8	3%	3%	3%	3%	2%
8	9	8%	12%	12%	9%	5%
9	10	16%	22%	22%	20%	13%
10	11	20%	23%	23%	27%	20%
11	12	24%	25%	28%	30%	21%
12	13	20%	24%	25%	26%	18%
13	14	18%	23%	22%	22%	16%
14	15	16%	22%	21%	18%	13%
15	16	14%	21%	20%	14%	10%
16	17	12%	18%	16%	10%	6%
17	18	6%	12%	8%	5%	4%
18	19	3%	8%	3%	3%	2%
19	20	1%	5%	1%	1%	1%
20	21	0%	3%	0%	0%	0%
21	22	0%	1%	0%	0%	0%
22	23	0%	0%	0%	0%	0%
23	24	0%	0%	0%	0%	0%

This ‘typical week’ occupancy schedule is to be modified for periods of known higher occupancy. For example, in school holiday periods and the Easter break, occupancy is typically higher than usual. The weeks before and after Christmas/New Year usually have the highest occupancy in the year. Therefore, a multiplication factor of two could be used for the school holiday and Easter periods a multiplication factor of three could be used for the two weeks around Christmas and New Year.

It is reiterated that the project modelling team must review these default schedules for relevance to their proposed shopping centre design. The schedules should be modified as appropriate, and documentation of these assumptions must be included in the report.

Lighting density

No default lighting density is provided for common area lighting – this item is expected to be known by the developer.

Lighting schedule

The following default schedules are provided based on observed common area lighting operating hours in existing centres. Schedules are defined in relation to centre trading hours, noting that these may vary in different locations. Note that controls arrangements vary significantly from centre to centre, for example with overnight lighting operation varying from 10% to 90% of daytime loads across the selection of centres sampled (typically in the range of 33% - 50%).

In the event that more advanced controls are used, shorter operating hours may be justified.

	Over-night baseload	3 hours before opening	2 hours before opening	Last hour before opening	Normal trading hours	1st, 2nd, 3rd hour after closing	4th, 5th hour after closing
General mall lighting	45%	75%	85%	100%	100%	90%	75%
Toilets	20%	70%	90%	100%	100%	95%	65%
Car park lighting (internal)	20%	60%	65%	65%	100% in areas with minimal daylight access. Otherwise, reduce in line with expected daylight switching patterns.	100%	100%
Car park lighting (external)	50%	50%	20%	10%	Through to 6pm: 0% if daylight sensing control is installed. Otherwise 5%. After 6pm: 100%	100% after 6pm	90%
Back of house lighting (e.g. plant rooms)	5%	5%	5%	15%	15%	15%	5%

Equipment density

No default equipment density is provided for common area equipment – this item is expected to be known by the developer.

Equipment schedule

By default:

- Advertising displays are assumed to run at normal daytime operating load throughout the centre during opening hours and at 50% overnight.
- Hand-dryer operating loads are assumed to vary in line with occupancy rates throughout normal centre operating hours.
- Toilet exhaust fans are assumed to run whenever the centre is open and for 2 hours before opening and 2 hours after closing. Toilets near 'major' tenants could use ventilation fan operating hours that match the trading hours of the major tenant (plus 2 hours before opening and 2 hours after closing).

6.4.4 Tenancy operations

Occupant density

- The default peak occupant density in general retail tenancies is 5 m^2 per person
- The default peak occupancy in restaurants and cafes is 1 m^2 per person.

These values are based on egress provisions of the NCC and peak occupancy rates established in Appendix of AS1668.2 - 2012.

Occupancy schedule

Occupant density within tenancies is assumed to vary in line with general variations in occupancy throughout the shopping centre.

Light and power density

No default installed light and power density is set. Please refer to the hourly schedules below which define total tenancy operating loads.

Light and power schedule

Default schedules listed in Table 1 represent operating loads (as opposed to installed loads) in a variety of tenancy types (other than prepared food sales, which are set out in Table 3). The schedules are defined relative to the opening hours of the Centre and should be adjusted to recognise extended trading hours at peak times (for example around Christmas).

If tenancy types aren't known, **Estimators** should use a variety of tenancy types and also test different tenancy types through an **off-axis model** covering four **off-axis scenarios**.

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Table 1: Lighting and equipment load – speciality goods, fresh food, and services tenancies

Tenancy type	Lighting and equipment load in each time period (W/m^2 of tenancy area)			
	Within centre trading hours	First hour after closing	Last hour before opening	Other times outside centre trading hours
Bags & Luggage	11	8	2	1
Banks & other financial, government or administrative services	11	9	9	4
Communication, Electronics & Games	11	10	7	5
Fashion, Accessories and Footwear	12	13	3	1
Fresh Food	35	33	23	19
Gifts & Flowers	8	9	3	3
Hair, Beauty & Massage	10	9	4	2
Homewares	7	7	1	1
Newsagent & Stationary	6	2	13	2
Optometrist & Health services	17	13	9	5
Pharmacy & Health retail	8	5	7	2

Some examples of how this schedule is applied in a centre with standard NSW trading hours (as summarised below) are shown in Table 2:

- Monday to Wednesday, Friday: 09:00 – 17.30
- Thursday 09:00 – 21:00
- Saturday 09:00 – 17.00
- Sunday 10:00 – 16:00

Table 2: Examples of tenancy lighting and equipment schedules applied to NSW standard trading hours

Time	Bags & Luggage - lighting and equipment load, W/m^2				Banks & other financial, government or administrative services - lighting and equipment load, W/m^2				Communication, Electronics & Games - lighting and equipment load, W/m^2			
	Mon-Wed, Fri	Thu	Sat	Sun	Mon-Wed, Fri	Thu	Sat	Sun	Mon-Wed, Fri	Thu	Sat	Sun
0:00	1	1	1	1	4	4	4	4	5	5	5	5
1:00	1	1	1	1	4	4	4	4	5	5	5	5
2:00	1	1	1	1	4	4	4	4	5	5	5	5
3:00	1	1	1	1	4	4	4	4	5	5	5	5
4:00	1	1	1	1	4	4	4	4	5	5	5	5
5:00	1	1	1	1	4	4	4	4	5	5	5	5
6:00	1	1	1	1	4	4	4	4	5	5	5	5
7:00	1	1	1	1	4	4	4	4	5	5	5	5
8:00	2	2	2	1	9	9	9	4	5	5	5	5
9:00	11	11	11	2	11	11	11	9	11	11	11	5
10:00	11	11	11	11	11	11	11	11	11	11	11	11
11:00	11	11	11	11	11	11	11	11	11	11	11	11
12:00	11	11	11	11	11	11	11	11	11	11	11	11
13:00	11	11	11	11	11	11	11	11	11	11	11	11
14:00	11	11	11	11	11	11	11	11	11	11	11	11
15:00	11	11	11	11	11	11	11	11	11	11	11	11
16:00	11	11	11	8	11	11	11	9	11	11	11	10
17:00	9.5	11	8	1	10	11	9	4	10.5	11	10	5
18:00	4.5	11	1	1	6.5	11	4	4	7.5	11	5	5
19:00	1	11	1	1	4	11	4	4	5	11	5	5
20:00	1	11	1	1	4	11	4	4	5	11	5	5
21:00	1	8	1	1	4	9	4	4	5	10	5	5
22:00	1	1	1	1	4	4	4	4	5	5	5	5
23:00	1	1	1	1	4	4	4	4	5	5	5	5

Operating light and equipment loads for food tenancies are listed in Table 3. The hours are defined with respect to the trading hours of the tenancy, in recognition that the operating hours of these tenancies may differ from the general centre trading hours – particularly where the tenancy has its own external access and may provide a dinner service as well as a lunch service. The default assumption could be that only a lunch service is provided, with the lunchtime peak period defined as 11.30am to 3pm. Dinner service can be assumed to run from 5pm to 8pm if the tenancy is open for evening trading.

It is also noted that a large proportion of the daytime electrical loads set out in Table 3 will be associated with cooking, washing and exhaust fans. Much of the heat associated with these items is directly extracted (for example through the range hood or to the sewer), rather than introduced or recirculated as a heat load to the space. It is therefore suggested that only 50% of the load above the baseload is applied to the HVAC heat loads.

Similarly, gas consumption is not considered, in recognition that gas cooking equipment will be located under hoods and therefore the extent of heat introduced to the space will be minimal.

Table 3: Lighting and equipment loads in pre-prepared food tenancies (cafes, restaurants and takeaways)

Tenancy type	Lighting and equipment load in each time period (W/m^2 of tenancy area)			
	Overnight baseload	Peak meal service periods (e.g. lunch, dinner)	Other trading hours outside of peak periods	Prep period (2 hours before opening) clean up period (2 hours after closing)
Cafes and Restaurants (with seating within tenancy)	18	70	50	40
Food court and takeaway (no seating within tenancy)	11	85	70	40

It is noted that the above figures are based on fully centrally serviced tenants and therefore do not include any energy consumption associated with tenant-fitted fan coil supply fans. Energy consumption of these fans needs to be included in the heat load calculation where chilled water or heating water is supplied to the tenancies. This could be based on design selection, or, where this information is unavailable, the default figure is 2.5 W/m² based on 5 l/s/m² air delivery at 250 Pa total pressure rise and 50% total efficiency including fan and motor losses.

6.4.5 Vertical transport

Lift energy can be calculated using ISO 25745-2 (2015). Where this is impractical or unsuitable, the GBCA's Energy Consumption and Greenhouse Gas Emissions Calculator Guide available from www.gbca.org.au can be used.

The following annual default can also be used: 1.5 kWh / average m^2 of GLAR per floor. Average GLAR per floor can be calculated by dividing GLAR served by the lift by the number of floors served by the lift.

6.4.6 Domestic hot water

No default allowance is made for showering and sinks within tenancies or hot water associated with cleaning and dishwashing in food tenancies since water heating for use in these applications will in most cases be on the tenant's meter.

In the event that domestic hot water is provided to these spaces through the landlord's meter, the hot water use can be estimated using the Green Star Potable Water Calculator, available on the GBCA's website www.gbca.org.au.

Basin tap hot water use in mall bathroom and baby care rooms can be estimated based on:

- Hot water use (l / hour) = 0.26 (tap uses / hour) x number of occupants in the building x 20 (seconds per use) x tap flow rate, where:
  - The number of occupants in the building is determined based on the design occupant density, de-rated using the appropriate schedule. Note that this assessment should consider all spaces in the building, including spaces that are not centrally serviced. Cinema and gymnasium occupants can be excluded if these spaces provide their own toilets for patrons and staff.
- 0.26 tap uses/hour is the value assumed in the Green Star Potable Water Calculator across commercial **space type**s.

To convert the hot water consumption figure to energy consumption, the GBCA's Energy Consumption and Greenhouse Gas Emissions Calculator Guide available from www.gbca.org.au can be used.

The following parameters can also be used if required: a delivered temperature of 42°C and an average distribution system efficiency of 90%.

6.4.7 Infiltration

Infiltration schedules for modelling should be based on the typology of the shopping centre. Large, covered shopping centres with a limited number of access doorways (particularly with motorised doors) will have limited infiltration deep in the centre.

The manner in which the model has been divided into thermal zones will also impact infiltration. Zones near the perimeter will have higher infiltration rates compared to zones located in the interior.

The preferred method of modelling is to simulate openings based on wind direction and speed, i.e. using air network method or similar.

Alternatively, a simple default value of 0.7 air changes per hour throughout all zones during hours when the zone has no mechanically supplied outside air and 0.35 air changes per hour at all other times can be used. This number should be reviewed and increased for shopping centres that have a more "village"-like design, with many buildings that have exposure to the outside.

6.5 Hotels

Where no site-specific information is available, the following default values are recommended.

The following defaults do not account for variations in occupancy at different times of the year or different days of the week. These patterns are expected to be different for CBD business hotels than hotels that are orientated towards the leisure market (for example in regional locations) and need to be assessed on a case-by-case basis.

Consideration should also be given to the hotel grading or star rating (from 1 star to 5 stars) which classifies hotels according to the services and facilities provided. These services and facilities will influence equipment and operation, and these variations should be taken into account.

The **Estimator** should ensure that any default used are appropriate for the hotel being modelled. These values should be used only if actual schedules are not known.

6.5.1 Hotel rooms

Occupant density

The default number of occupants per guest room is 1.6.

Light and power density

No default lighting density is provided for hotel rooms – this should be set as per design.

Equipment loads should be established based on the planned fit out of each space. A small additional allowance should be made for guest IT equipment such as phones and laptops that are likely to be charged and used within the rooms.

In the event that the fit out is not known, a default load figure of 160W per room should be used (excluding fridge). 70 W (continuous) should be added for bar fridges where present, 150W for TVs and 50W for guest IT equipment.

Schedules

The default occupancy schedules for occupancy, equipment and lighting operation in guest rooms are outlined below.

Note that the percentages in the equipment schedule are expressed as a proportion of the in-room equipment load, including an allowance for guest IT equipment. The installed load associated with irons, kettles, hair dryers, microwaves and other small, high-power devices does not need to be explicitly considered when calculating the room equipment load (for example, if a room has 200 W of IT, TV and audio equipment, plus a 1.5 kW hair dryer, then room load is taken as 200 W and the operating percentages in the schedule are applied to this). However, the default operating schedule does make an implicit allowance for some short periods of use for this type of equipment. Fridges need to be explicitly added to the equipment load and the operating schedule by assuming they run continuously at the average load indicated on their Energy Rating label.

Consideration should be given to guest room lighting during “welcome” mode operation, including when and how this is initiated. If such operating patterns are not known, then the default schedules provided with this Handbook may be used. However, these schedules are based on observed lighting hours of operation at existing hotel sites, where lighting controls and controllability are likely to be poorer than at new hotel sites (for example due to increased use of LED fittings at new sites compared with less responsive lighting types such as HID and fluorescents). These schedules are therefore considered to be conservative. In all areas, modellers are advised to consider setup and cleaning times.

If key cards or occupancy sensing are used to prevent lights from being left on in vacant rooms, the **Estimator** can also consider reducing lighting hours during low-occupancy periods (for example with minimum daytime lighting loading falling from 20% to 5%).

Note that many hotels have financial or business models with expected occupancy for the hotel being designed, based on occupancy patterns of similar hotels. If these models exist and seem appropriate, they should be used instead of the occupancy outlined in the schedule below. However, changes in occupancy patterns throughout the day, as shown in the schedule below, should be modelled as appropriate given the maximum occupancy determined from the hotel’s financial or business model.

Time	Weekdays (Mon - Thu)			Fri			Sat			Sun		
	Occupancy	Lighting	Equipment	Occupancy	Lighting	Equipment	Occupancy	Lighting	Equipment	Occupancy	Lighting	Equipment
0:00	90%	30%	20%	90%	30%	20%	100%	31%	21%	100%	31%	21%
1:00	90%	20%	20%	90%	20%	20%	100%	21%	21%	100%	21%	21%
2:00	90%	20%	15%	90%	20%	15%	100%	21%	16%	100%	21%	16%
3:00	90%	20%	15%	90%	20%	15%	100%	21%	16%	100%	21%	16%
4:00	90%	20%	15%	90%	20%	15%	100%	21%	16%	100%	21%	16%
5:00	80%	20%	15%	80%	20%	15%	100%	21%	16%	100%	21%	16%
6:00	70%	20%	40%	70%	20%	40%	87%	21%	42%	87%	21%	42%
7:00	60%	30%	80%	60%	30%	80%	75%	31%	84%	75%	31%	84%
8:00	60%	40%	50%	60%	40%	50%	75%	42%	52%	75%	42%	52%
9:00	30%	40%	30%	30%	40%	30%	37%	42%	31%	37%	42%	31%
10:00	10%	20%	20%	10%	20%	20%	12%	21%	21%	12%	21%	21%
11:00	10%	20%	20%	10%	20%	20%	12%	21%	21%	12%	21%	21%
12:00	10%	20%	20%	10%	20%	20%	10%	20%	20%	10%	20%	20%
13:00	10%	20%	20%	10%	20%	20%	10%	20%	20%	10%	20%	20%
14:00	10%	20%	20%	10%	20%	20%	10%	20%	20%	10%	20%	20%
15:00	10%	20%	20%	10%	20%	20%	10%	20%	20%	10%	20%	20%
16:00	20%	20%	20%	20%	20%	20%	20%	20%	20%	18%	20%	20%
17:00	30%	50%	40%	37%	52%	42%	37%	52%	42%	27%	43%	35%
18:00	40%	60%	40%	50%	63%	42%	50%	63%	42%	36%	52%	35%
19:00	50%	70%	50%	62%	73%	52%	62%	73%	52%	45%	61%	43%

Time	Weekdays (Mon - Thu)			Fri			Sat			Sun		
	Occupancy	Lighting	Equipment	Occupancy	Lighting	Equipment	Occupancy	Lighting	Equipment	Occupancy	Lighting	Equipment
20:00	60%	70%	60%	75%	73%	63%	75%	73%	63%	54%	61%	52%
21:00	70%	60%	60%	87%	63%	63%	87%	63%	63%	63%	52%	52%
22:00	70%	60%	40%	87%	63%	42%	87%	63%	42%	63%	52%	35%
23:00	90%	40%	20%	100%	42%	21%	100%	42%	21%	81%	35%	17%

6.5.2 Common areas (lobbies, foyer and corridors)

Consideration should be given to the hotel grading or star rating from 1 star to 5 stars which classifies hotels according to the services or facilities provided. The **Estimator** should ensure that any schedule used is appropriate for the hotel being modelled.

Occupant density

Occupant density in corridors and hotel lift lobbies is ignored due to the transient nature of occupancy in these spaces.

Peak occupant density for the main entry lobby can be set at 1 person per 1.5 m^2 in the area immediately adjacent to the reception counter, that is, in front of the reception counter and to a depth of 5m. Elsewhere in the foyer, the peak occupant density can be set to 1 person per 6m^2.

For dining rooms, function rooms and adjacent breakout spaces, please refer to appropriate sections below.

Occupancy schedule

Default occupancy schedule for the foyer is listed in the following table:

Time	Weekday	Weekend
0:00	0%	0%
1:00	0%	0%
2:00	0%	0%
3:00	0%	0%
4:00	0%	0%
5:00	10%	0%
6:00	20%	10%
7:00	50%	20%
8:00	90%	50%
9:00	50%	100%
10:00	30%	50%
11:00	30%	30%
12:00	30%	50%
13:00	30%	50%
14:00	30%	30%
15:00	30%	30%
16:00	30%	30%
17:00	50%	50%

Time	Weekday	Weekend
18:00	90%	50%
19:00	50%	50%
20:00	30%	30%
21:00	30%	30%
22:00	20%	30%
23:00	10%	20%

Lighting density

No default lighting density is provided for these spaces – design values should be used.

Lighting schedule

Lighting should be assumed to run continuously at 100% of installed power except where automatic controls are provided. No adjustment is made for scheduled on/off controls (i.e. due to the likely unreliability of this control method in most circulation spaces in hotels, which could be sporadically occupied at any time of day). The following table shows the fraction of common area lighting that is assumed to operate during each hour for a variety of other automatic control arrangements (expressed as a percentage of the installed lighting). Where daylight sensors are also in use, their effectiveness should be evaluated through an appropriate **simulation package** and applied as an additional factor together with any occupancy-sensing controls.

Time	No automatic controls	Motion detectors controlling 7+ fittings	Motion detectors controlling 3 – 6 fittings	Motion detectors controlling 1-2 fittings	Daylight sensors – for internal fittings adjacent to roof lights and windows
0:00	100%	90%	70%	55%	100%
1:00	100%	90%	70%	55%	100%
2:00	100%	90%	70%	55%	100%
3:00	100%	90%	70%	55%	100%
4:00	100%	90%	70%	55%	100%
5:00	100%	90%	70%	55%	100%
6:00	100%	90%	70%	55%	100%
7:00	100%	90%	70%	55%	50%
8:00	100%	90%	70%	55%	50%
9:00	100%	90%	70%	55%	50%
10:00	100%	90%	70%	55%	50%
11:00	100%	90%	70%	55%	50%

Time	No automatic controls	Motion detectors controlling 7+ fittings	Motion detectors controlling 3 – 6 fittings	Motion detectors controlling 1-2 fittings	Daylight sensors – for internal fittings adjacent to roof lights and windows
12:00	100%	90%	70%	55%	50%
13:00	100%	90%	70%	55%	50%
14:00	100%	90%	70%	55%	50%
15:00	100%	90%	70%	55%	50%
16:00	100%	90%	70%	55%	50%
17:00	100%	90%	70%	55%	50%
18:00	100%	90%	70%	55%	50%
19:00	100%	90%	70%	55%	100%
20:00	100%	90%	70%	55%	100%
21:00	100%	90%	70%	55%	100%
22:00	100%	90%	70%	55%	100%
23:00	100%	90%	70%	55%	100%

- De-rate operating power from 100% to 90% where motion detectors control an area of 200 m2 or less, and motion sensors control groups of more than 6 fittings.
- De-rate operating power from 100% to 70% where motion detectors control groups of 3-6 light fittings
- De-rate operating power from 100% to 55% where motion detectors control groups of 2 or fewer light fittings
- During daylight hours, de-rate operating power from 100% to 50% for light fittings adjacent to windows or roof lights that are controlled by daylight sensors.

Equipment density

No default equipment density is provided for these spaces – values as expected in operation should be used.

Equipment schedule

Monitors and associated computers used for directional displays or tourist information displays in public spaces should be assumed to run at 100% from 6am – 10pm and 75% outside these hours.

Water features should be assumed to run at 100% on a 24/7 basis, provided that the **Estimator** makes adequate allowance for normal duty cycling of the pumping equipment.

6.5.3 Dining areas (restaurants and cafes)

Occupant density

Occupant density should be established based on the planned fit out of the space. If this information is not available, then a default figure of 1 person per 3 m² could be used.

If the facility is a bar only (i.e. no restaurant), the peak occupant density could be set to 1 m² per person.

Occupancy schedule

Occupancy schedule for hotel restaurants should be confirmed with consideration of the trading hours of the facility.

Default occupancy schedules for restaurants are suggested below. Peak occupancy hours should be extended during the earlier and later evening if the facility functions as a bar.

Time	Weekday	Weekend
0:00	0%	0%
1:00	0%	0%
2:00	0%	0%
3:00	0%	0%
4:00	0%	0%
5:00	10%	10%
6:00	60%	30%
7:00	80%	60%
8:00	60%	80%
9:00	30%	60%
10:00	10%	30%
11:00	30%	30%
12:00	80%	80%
13:00	60%	80%
14:00	30%	60%
15:00	10%	30%
16:00	10%	10%
17:00	30%	30%
18:00	60%	60%
19:00	80%	80%
20:00	80%	80%
21:00	60%	60%

Time	Weekday	Weekend
22:00	30%	30%
23:00	10%	30%

Light and power density and schedule

Lighting and power density for the eating area of the restaurant should be established on the basis of the planned fit out of the space.

If no automatic controls are fitted in the space, the lighting could be assumed to operate from 2 hours before the start of the first service until 1 hour after the end of the last service, with lighting running at 100% during service periods and for 1 hour before and 1 hour after and switch off down to 30% of normal service lighting hours overnight. If automatic occupancy sensing is installed, then lighting could be assumed to switch down to 5% of its full power during times that the restaurant is closed, allowing for 1 hour set up and clean-up before and after each meal service. If programmable scene controls are fitted without occupancy sensing, then lighting could be assumed to switch down to 15% of its full power during times that the restaurant is closed, allowing for 1 hour set up and clean-up before and after each meal service.

By default, in-restaurant equipment (for example toasters, bain-maries, coffee machines) could be assumed to run at 60% of the installed load during service periods. The default assumption is that 2/3 of the heat gain from these appliances is sensible, 1/3 is latent. Note that there is an assumption that no exhaust hoods are applied to food preparation equipment in the dining area.

Most equipment will be switched off between service periods, except for coffee machines which are likely to be left in standby mode. Installed load could be established from the unit specification, or a default value of 2 kW per unit could be used if no other information is available.

Refrigeration equipment located within the dining / service area (i.e. not walk-in refrigerators) could be assumed to run at 320W per unit on a 24/7 basis if the size and type of the unit is unknown. Where the size is known, energy consumption should be based on the Energy Label or advice from the manufacturers or Table 5 of ASHRAE Fundamentals Section 29[1].

An example schedule for a restaurant with breakfast, lunch and dinner service periods is shown below. The total equipment schedule should be built up based on the proportions of refrigeration equipment vs other food and beverage equipment in the space. When applying these schedules, the **Estimator** should consider whether the equipment is likely to be used during all service periods (for example, a toaster is only likely to be switched on at breakfast).

Time	Refrigeration equipment		Other in-restaurant food prep/heating equipment	
	Weekday	Weekend	Weekday	Weekend
0:00	100%	100%	10%	10%
1:00	100%	100%	10%	10%

[1] Note that the values provided in this section are 24-hour averages which consider variation in loads at different times of the day. They are not full rated power.

Time	Refrigeration equipment		Other in-restaurant food prep/heating equipment	
	Weekday	Weekend	Weekday	Weekend
2:00	100%	100%	10%	10%
3:00	100%	100%	10%	10%
4:00	100%	100%	10%	10%
5:00	100%	100%	30%	30%
6:00	100%	100%	60%	30%
7:00	100%	100%	60%	60%
8:00	100%	100%	60%	60%
9:00	100%	100%	30%	60%
10:00	100%	100%	10%	30%
11:00	100%	100%	30%	30%
12:00	100%	100%	60%	60%
13:00	100%	100%	60%	60%
14:00	100%	100%	30%	60%
15:00	100%	100%	10%	30%
16:00	100%	100%	10%	10%
17:00	100%	100%	30%	30%
18:00	100%	100%	60%	60%
19:00	100%	100%	60%	60%
20:00	100%	100%	60%	60%
21:00	100%	100%	60%	60%
22:00	100%	100%	30%	60%
23:00	100%	100%	10%	20%

6.5.4 Kitchen equipment energy use

Kitchen energy use will vary depending on operating hours, menu type, appliance selection, layout and operator behaviour. International research shows relatively strong relationships between kitchen energy use and financial turnover. The preferred method of estimating consumption is therefore to create a benchmark using operational data from similar sites (for example other sites operated as part of the same hotel chain), adjusted for projected sales.

Otherwise, a default kitchen energy consumption figure of 2.4 kWh / meal could be used for electricity and 1.9 kWh / meal used for gas. This figure is for cooked meals with multiple courses and does not include lighting and ventilation energy use, which must be modelled and accounted for separately. The appropriateness of this figure should be considered for the hotel being modelled, and could be adjusted to reflect simpler or uncooked meals. Number of meals should be based on business projections for the hotel. If this is not available, a default figure of 2.5 meals per guest per day can be used. The **Estimator** should ensure that the default energy use is appropriate for the hotel type.

Alternatively, if the fit out is broadly known, appliance energy consumption using Table 5 of ASHRAE Fundamentals Section 29 can be used.

No time of use profiles are presented as the kitchen equipment is assumed to have only a very limited impact on thermal load in the hotel due to the typical practice of providing supply/exhaust ventilation in this area, i.e. so that air is not recirculated.

6.5.5 Laundry equipment energy use and schedule

In the absence of other information, the laundry equipment energy use could be estimated as: 23,100 MJ / annum per guest room (gas) with full laundry service (all sheets, towels and other items washed at the on-site laundry). This figure can be scaled down where needed, and should be adjusted for the proportion of rooms receiving full or part laundry services.

Equipment power density should be estimated from the fit out or use of the space (for example for a laundry). When modelling laundry heat loads, take care to adjust for any equipment that is directly exhausted (for example gas dryers), as this will reduce the contribution of the equipment to the heat loads in the space.

In the absence of other information, laundry equipment density can be based on default laundry energy **Estimate**, evenly divided over the operating hours of the laundry.

6.5.6 Back of house areas

Occupant density

Occupant density could be assessed on the following basis:

- 1 person per 15 m^2 for management office areas, kitchens and laundries, or based on peak shift size in laundry and kitchen areas
- 1 person per 20 m^2 for maintenance workshop areas, or based on peak shift size
- Negligible occupancy in plant rooms and corridors.

Occupancy schedule

Occupancy schedule should be assessed based on the planned staffing roster for each area.

Light density

Lighting density in these spaces should be established based on lighting drawings.

Light schedule

Back of house corridor lighting should be modelled as operating 24/7, unless automatic controls are provided. Where automatic controls are provided, lighting power density can be de-rated as described below.

Workspace lighting time of use and management office equipment defaults are as follows. These schedules assume service hours of 8am to 7pm. The schedules could be adapted for areas with longer and shorter operating hours (for example based on shift times).

Time	Lighting (limited time of use control: manual or timeclock)	Lighting (advanced time of use control e.g. occupancy sensors)
0:00	15%	5%
1:00	15%	5%
2:00	15%	5%
3:00	15%	5%
4:00	15%	5%
5:00	15%	5%
6:00	40%	30%
7:00	90%	75%
8:00	100%	100%
9:00	100%	100%
10:00	100%	100%
11:00	100%	100%
12:00	100%	100%
13:00	100%	100%
14:00	100%	100%
15:00	100%	100%
16:00	100%	100%
17:00	100%	100%
18:00	100%	100%
19:00	80%	75%
20:00	60%	25%
21:00	60%	15%
22:00	50%	15%
23:00	15%	5%

Equipment density and schedule

Equipment density and schedule should be assessed based on the planned staffing roster and use of each space. For office spaces, the default values provided in Section 6.2 could be used.

6.5.7 Conference areas (including function rooms)

Occupant density

Occupant density in these rooms is highly variable and could be based on the number of advertised seats in the room. For function room foyers, the occupant density should be based on the advertised capacity.

Occupancy schedule

The use of function rooms is highly variable. The default schedule is based on analysis of 12 months of booking patterns at an existing business hotel. The schedule reflects both the probability that a room will be booked, and the number of occupants for the booking relative to the maximum advertised capacity of the room. Where no further details are available, the default schedule could be applied across all the rooms, with Day 1 to Day 7 reassigned on a rolling basis i.e. so that for Room 1, Day 1 = Monday Room 2, Day 1 = Tuesday Room 3, Day 1 = Wednesday, etc.

Time	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
	No booking	All day	Morning only	Lunch-afternoon	All day	No booking	Evening
0:00	0%	0%	0%	0%	0%	0%	0%
1:00	0%	0%	0%	0%	0%	0%	0%
2:00	0%	0%	0%	0%	0%	0%	0%
3:00	0%	0%	0%	0%	0%	0%	0%
4:00	0%	0%	0%	0%	0%	0%	0%
5:00	0%	0%	0%	0%	0%	0%	0%
6:00	0%	0%	20%	0%	0%	0%	0%
7:00	0%	20%	20%	0%	20%	0%	0%
8:00	0%	20%	80%	0%	40%	0%	0%
9:00	0%	20%	80%	0%	40%	0%	0%
10:00	0%	20%	80%	20%	60%	0%	0%
11:00	0%	40%	60%	40%	60%	0%	0%
12:00	0%	40%	60%	40%	60%	0%	0%
13:00	0%	40%	20%	40%	80%	0%	0%
14:00	0%	40%	0%	40%	60%	0%	0%
15:00	0%	40%	0%	100%	40%	0%	20%
16:00	0%	40%	0%	100%	20%	0%	20%

Time	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
	No booking	All day	Morning only	Lunch-afternoon	All day	No booking	Evening
17:00	0%	20%	0%	100%	20%	0%	40%
18:00	0%	20%	0%	20%	20%	0%	80%
19:00	0%	0%	0%	0%	0%	0%	100%
20:00	0%	0%	0%	0%	0%	0%	80%
21:00	0%	0%	0%	0%	0%	0%	60%
22:00	0%	0%	0%	0%	0%	0%	60%
23:00	0%	0%	0%	0%	0%	0%	20%

Light and power density

No default is set for conference room lighting power density – this should be assessed based on the design fit out.

Equipment should be based on the fit-out information if available, allowing in addition for 20 W of IT equipment per guest for weekday daytime functions. If no information is available on in-room projection and IT equipment, assume 150 W per room.

Bain-maries and tea / coffee urns also need to be allowed defaults values can be found in Table 5 Section 29 of ASHRAE Fundamentals or CIBSE Guide A Section 6.6.

Light and power schedule

The default function room lighting schedule is below. This schedule includes a set-up / clean-up (bump in / bump out) of one hour before and after each booking. The percentage of lighting running outside occupancy times could be reduced from 15% to 5% if an automated control system is used to switch off the lights when the space is not in use (for example, scene controller linked to room booking times). In all areas, modellers are advised to consider setup and cleaning times.

Time	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
	No booking	All day	Morning only	Lunch-afternoon	All day	No booking	Evening
0:00	15%	15%	15%	15%	0%	15%	15%
1:00	15%	15%	15%	15%	0%	15%	15%
2:00	15%	15%	15%	15%	0%	15%	15%
3:00	15%	15%	15%	15%	0%	15%	15%
4:00	15%	15%	15%	15%	0%	15%	15%
5:00	15%	15%	15%	15%	0%	15%	15%
6:00	15%	15%	90%	15%	0%	15%	15%
7:00	15%	90%	90%	15%	90%	15%	15%
8:00	15%	90%	90%	15%	90%	15%	15%
9:00	15%	90%	90%	15%	90%	15%	15%

Time	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
	No booking	All day	Morning only	Lunch-afternoon	All day	No booking	Evening
10:00	15%	90%	90%	90%	90%	15%	15%
11:00	15%	90%	90%	90%	90%	15%	15%
12:00	15%	90%	90%	90%	90%	15%	15%
13:00	15%	90%	90%	90%	90%	15%	15%
14:00	15%	90%	15%	90%	90%	15%	15%
15:00	15%	90%	15%	90%	90%	15%	90%
16:00	15%	90%	15%	90%	90%	15%	90%
17:00	15%	90%	15%	90%	90%	15%	90%
18:00	15%	90%	15%	90%	90%	15%	90%
19:00	15%	15%	15%	15%	15%	15%	90%
20:00	15%	15%	15%	15%	15%	15%	90%
21:00	15%	15%	15%	15%	15%	15%	90%
22:00	15%	15%	15%	15%	15%	15%	90%
23:00	15%	15%	15%	15%	15%	15%	90%

The default function room equipment schedule is as follows:

Time	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
	No booking	All day	Morning only	Lunch-afternoon	All day	No booking	Evening
0:00	5%	5%	5%	5%	5%	5%	5%
1:00	5%	5%	5%	5%	5%	5%	5%
2:00	5%	5%	5%	5%	5%	5%	5%
3:00	5%	5%	5%	5%	5%	5%	5%
4:00	5%	5%	5%	5%	5%	5%	5%
5:00	5%	5%	5%	5%	5%	5%	5%
6:00	5%	5%	70%	5%	5%	5%	5%
7:00	5%	70%	70%	5%	70%	5%	5%
8:00	5%	70%	70%	5%	70%	5%	5%
9:00	5%	70%	70%	5%	70%	5%	5%
10:00	5%	70%	70%	70%	70%	5%	5%
11:00	5%	70%	70%	70%	70%	5%	5%

Time	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
	No booking	All day	Morning only	Lunch-afternoon	All day	No booking	Evening
12:00	5%	70%	70%	70%	70%	5%	5%
13:00	5%	70%	70%	70%	70%	5%	5%
14:00	5%	70%	5%	70%	70%	5%	5%
15:00	5%	70%	5%	70%	70%	5%	70%
16:00	5%	70%	5%	70%	70%	5%	70%
17:00	5%	70%	5%	70%	70%	5%	70%
18:00	5%	70%	5%	70%	70%	5%	70%
19:00	5%	5%	5%	5%	5%	5%	70%
20:00	5%	5%	5%	5%	5%	5%	70%
21:00	5%	5%	5%	5%	5%	5%	70%
22:00	5%	5%	5%	5%	5%	5%	70%
23:00	5%	5%	5%	5%	5%	5%	70%

6.5.8 Swimming pools

No default figure is provided for swimming pool heating energy or pumping energy. This should instead be built up based on swimming pool latent and sensible heat losses to the surrounding environment. Pool covering arrangements, ventilation rate and temperature / humidity set points in the pool room, and heating and pump plant selections and distribution systems will also need to be considered. As a guide, the NABERS Hotels correction factor for heated pools is 11,000 MJ gas per year per square meter of heated pool area. Heating requirements for individual pools will vary based on the factors described above.

6.5.9 Domestic hot water

Hot water use could be assumed to be 75 L per sole occupancy unit per day for hotel guest rooms and 9L per meal for dining room, restaurant and cafe areas. Where the number of meals is not known, an overall figure of 120 L per day per leased room can be used.

Alternatively, this can be revised based on tapware selections and expected patterns of showering and bathing based on other sites from the same portfolio.

Appropriate allowances for generation and distribution hot water need to be included.

6.5.10 Vertical transport

Lift energy can be calculated using ISO 25745-2 (2015). Where this is impractical or unsuitable, the GBCA's Energy Consumption and Greenhouse Gas Emissions Calculator Guide available from www.gbca.org.au can be used.

The following default can also be used:

Annual energy consumption (kWh) = 1700 x lift floors, where "lift floors" is the total number of floors served by lifts. For example, a five-floor high building with two five-floor high lifts has 10 lift floors.

6.5.11 Infiltration

Infiltration schedules for modelling should be based on the design of the hotel. Large, covered areas with a limited number of access doorways (particularly with motorised doors) will have limited infiltration deep in the building. The manner in which the model has been divided into thermal zones will also impact infiltration. Zones near the perimeter will have higher infiltration rates compared to zones located in the interior.

The preferred method of modelling is to simulate openings based on wind direction and speed, i.e. using air network method or similar.

Alternatively, a simple default value of 0.7 air changes per hour throughout all zones during hours when the zone has no mechanically supplied outside air and 0.35 air changes per hour at all other times can be used. This number should be reviewed and increased for designs with a large amount of exposure to the outside.

6.6 Data centres – Infrastructure

Where no site-specific information is available, the following default values are recommended for Infrastructure ratings.

No defaults are provided for IT Equipment Ratings as the actual equipment values should be used. For Whole Facility ratings, the client will generally be known. As such, defaults should not need to be used.

6.6.1 IT equipment density

No default is provided for equipment density: this should be based on "expected" IT load from business growth models. It is recommended that a range of 50% to 150% of the base assumption equipment density should be modelled to allow for the uncertainties in this area.

By way of general guidance:

- If the data centre clients are known, then IT equipment density should be discussed with IT staff from the client organisations or their IT equipment suppliers.
- For co-location data centres, the load is difficult to predict. An Australian data centre operator indicated that Power Use Effectiveness targets were modelled over ranges of 10% - 90% of capacity in order to address this uncertainty.
- American Power Conversion indicates that "Studies conducted by reputable consulting engineering firms and power supply manufacturers indicate that the nameplate rating of most IT devices is well in excess of the actual running load by a factor of at least 33%".
- Schneider Electric note that "The research is clear: The average data centre operates at 65% below the design [IT Equipment capacity] value."
- Schneider also indicates that data centres typically take up to 5 years to ramp up to their normal operating IT load, and that this eventual level is up to one third below the business expectations.

6.6.2 Equipment schedule

While data centre equipment loads will vary in response to the number and intensity of active processes, the default assumption is that IT equipment power use is flat over a 24/7 basis. For Whole Facility and IT Equipment projects with known users, this assumption should be tested based on the existing operating profile.

6.6.3 Lighting density

No default lighting density is given – the **Estimator** should reference the design values.

6.6.4 Occupant density

Default peak occupant density for the data centre can be set at 1 person per 25 m^2. This is based on the egress provisions of Table D.1.13 of the Section J of the National Construction Code. However, typical occupancy is likely to be much lower than this. This is reflected in the default occupancy schedules.

6.6.5 Lighting and occupancy schedule

The default lighting and occupancy schedule is as follows. Two occupancy schedules are provided, i.e. for standalone data centres and for data centres that are housed as a secondary function within another facility (for example a data centre housed within an office building). Occupant densities are likely to be higher in these data centres due to their smaller size and the practice of housing some IT technical staff close to or within the data centre area.

Time	Lighting - advanced control	Occupancy - standalone data centre	Occupancy – data centre located as a secondary service within another facility
0:00	5%	5%	5%
1:00	5%	5%	5%
2:00	5%	5%	5%
3:00	5%	5%	5%
4:00	5%	5%	5%
5:00	5%	5%	5%
6:00	5%	5%	5%
7:00	5%	5%	5%
8:00	15%	15%	30%
9:00	15%	15%	30%
10:00	15%	15%	30%
11:00	15%	15%	30%
12:00	15%	15%	30%
13:00	15%	15%	30%
14:00	15%	15%	30%
15:00	15%	15%	30%
16:00	15%	15%	30%
17:00	15%	15%	30%
18:00	5%	5%	5%
19:00	5%	5%	5%
20:00	5%	5%	5%
21:00	5%	5%	5%
22:00	5%	5%	5%
23:00	5%	5%	5%

6.7 Apartment buildings

Where no site-specific information is available, the following default values can be used. However, given variability in apartment buildings, it is recommended designers and modellers consider the appropriateness of these values for each project. Any other values used should be justified for the Independent Design Review report.

6.7.1 Apartments

Occupant density

The default figure which could be used for occupancy, where occupancy is not known, is 2 occupants per apartment.

Light and power density

Lighting should be based on the lighting design of each apartment. In the event that this is not known, the default lighting load in apartments can be set at the relevant minimum compliance value as detailed in the National Construction Code.

Equipment loads could be set at the following levels:

- Living spaces with a kitchen: 1100W (sensible) and 750W (latent)
- Living spaces without a kitchen and bedrooms: 0W

Schedules

The default schedule which could be used for the primary living space within an apartment and for the kitchen space if separate is as follows. Note that this schedule could be used for all days of the week.

Time	Occupancy	Lighting	Equipment - Sensible	Equipment - Latent	HVAC
0:00	0%	0%	9.1%	0%	OFF
1:00	0%	0%	9.1%	0%	OFF
2:00	0%	0%	9.1%	0%	OFF
3:00	0%	0%	9.1%	0%	OFF
4:00	0%	0%	9.1%	0%	OFF
5:00	0%	0%	9.1%	0%	OFF
6:00	0%	0%	9.1%	0%	OFF
7:00	100%	60%	36.4%	40.3%	ON
8:00	100%	60%	9.1%	9.3%	ON
9:00	50%	0%	9.1%	4.7%	ON
10:00	50%	0%	9.1%	4.7%	ON
11:00	50%	0%	9.1%	4.7%	ON
12:00	50%	0%	9.1%	4.7%	ON

Time	Occupancy	Lighting	Equipment - Sensible	Equipment - Latent	HVAC
13:00	50%	0%	9.1%	4.7%	ON
14:00	50%	0%	9.1%	4.7%	ON
15:00	50%	0%	9.1%	4.7%	ON
16:00	50%	0%	9.1%	4.7%	ON
17:00	75%	100%	9.1%	7.0%	ON
18:00	75%	100%	100%	100%	ON
19:00	75%	100%	22.7%	7.0%	ON
20:00	75%	100%	22.7%	7.0%	ON
21:00	75%	100%	22.7%	7.0%	ON
22:00	0%	0%	9.1%	0%	ON
23:00	0%	0%	9.1%	0%	ON

The default schedule which could be used for the secondary living space within an apartment (excluding kitchens) and for all corridors and amenity spaces within an apartment is as follows. Note that this schedule could be used for all days of the week.

Hour of Day	Occupancy	Lighting	Equipment - Sensible	Equipment - Latent	HVAC
0:00	0%	0%	0%	0%	OFF
1:00	0%	0%	0%	0%	OFF
2:00	0%	0%	0%	0%	OFF
3:00	0%	0%	0%	0%	OFF
4:00	0%	0%	0%	0%	OFF
5:00	0%	0%	0%	0%	OFF
6:00	0%	0%	0%	0%	OFF
7:00	100%	60%	0%	0%	ON
8:00	100%	60%	0%	0%	ON
9:00	50%	0%	0%	0%	ON
10:00	50%	0%	0%	0%	ON
11:00	50%	0%	0%	0%	ON
12:00	50%	0%	0%	0%	ON
13:00	50%	0%	0%	0%	ON
14:00	50%	0%	0%	0%	ON

Hour of Day	Occupancy	Lighting	Equipment - Sensible	Equipment - Latent	HVAC
15:00	50%	0%	0%	0%	ON
16:00	50%	0%	0%	0%	ON
17:00	75%	100%	0%	0%	ON
18:00	75%	100%	0%	0%	ON
19:00	75%	100%	0%	0%	ON
20:00	75%	100%	0%	0%	ON
21:00	75%	100%	0%	0%	ON
22:00	0%	0%	0%	0%	ON
23:00	0%	0%	0%	0%	ON

The default schedule which could be used for bedrooms within an apartment is as follows. Note that this schedule could be used for all days of the week.

Hour of Day	Occupancy	Lighting	Equipment - Sensible	Equipment - Latent	HVAC
0:00	100%	0%	0%	0%	ON
1:00	100%	0%	0%	0%	ON
2:00	100%	0%	0%	0%	ON
3:00	100%	0%	0%	0%	ON
4:00	100%	0%	0%	0%	ON
5:00	100%	0%	0%	0%	ON
6:00	100%	0%	0%	0%	ON
7:00	0%	0%	0%	0%	ON
8:00	0%	0%	0%	0%	ON
9:00	0%	0%	0%	0%	OFF
10:00	0%	0%	0%	0%	OFF
11:00	0%	0%	0%	0%	OFF
12:00	0%	0%	0%	0%	OFF
13:00	0%	0%	0%	0%	OFF
14:00	0%	0%	0%	0%	OFF
15:00	0%	0%	0%	0%	OFF
16:00	0%	0%	0%	0%	ON
17:00	0%	0%	0%	0%	ON
18:00	0%	0%	0%	0%	ON
19:00	0%	100%	0%	0%	ON

Hour of Day	Occupancy	Lighting	Equipment - Sensible	Equipment - Latent	HVAC
20:00	0%	100%	0%	0%	ON
21:00	0%	100%	0%	0%	ON
22:00	100%	100%	0%	0%	ON
23:00	100%	0%	0%	0%	ON

6.7.2 Common areas (lobbies, foyer and corridors)

Occupant density

Occupant density in corridors and lift lobbies is ignored due to the transient nature of occupancy in these spaces.

Lighting density

No default lighting density is provided for these spaces – design values should be used.

Lighting schedule

Lighting should be assumed to run continuously at 100% of installed power except where automatic controls are provided. No adjustment is made for scheduled on/off controls (i.e. due to the likely unreliability of this control method in most circulation spaces in apartment buildings, which could be sporadically occupied at any time of day) – these are to be treated as having no automatic controls.

The following table shows the fraction of common area lighting that is assumed to operate during each hour for a variety of other automatic control arrangements (expressed as a percentage of the installed lighting). Where daylight sensors are also in use, their effectiveness should be evaluated through an appropriate **simulation package** and applied as an additional factor together with any occupancy-sensing controls.

Alternatively, the project team may wish to use the default profiles in the NCC, but they must justify use in accordance with the control strategy in place.

Time	No automatic controls	Motion detectors controlling 7+ fittings	Motion detectors controlling 3 – 6 fittings	Motion detectors controlling 1-2 fittings	Daylight sensors – for internal fittings adjacent to roof lights and windows
0:00	100%	90%	70%	55%	100%
1:00	100%	90%	70%	55%	100%
2:00	100%	90%	70%	55%	100%
3:00	100%	90%	70%	55%	100%

Time	No automatic controls	Motion detectors controlling 7+ fittings	Motion detectors controlling 3 – 6 fittings	Motion detectors controlling 1-2 fittings	Daylight sensors – for internal fittings adjacent to roof lights and windows
4:00	100%	90%	70%	55%	100%
5:00	100%	90%	70%	55%	100%
6:00	100%	90%	70%	55%	100%
7:00	100%	90%	70%	55%	50%
8:00	100%	90%	70%	55%	50%
9:00	100%	90%	70%	55%	50%
10:00	100%	90%	70%	55%	50%
11:00	100%	90%	70%	55%	50%
12:00	100%	90%	70%	55%	50%
13:00	100%	90%	70%	55%	50%
14:00	100%	90%	70%	55%	50%
15:00	100%	90%	70%	55%	50%
16:00	100%	90%	70%	55%	50%
17:00	100%	90%	70%	55%	50%
18:00	100%	90%	70%	55%	50%
19:00	100%	90%	70%	55%	100%
20:00	100%	90%	70%	55%	100%
21:00	100%	90%	70%	55%	100%
22:00	100%	90%	70%	55%	100%
23:00	100%	90%	70%	55%	100%

- De-rate operating power from 100% to 90% where motion detectors control an area of 200 m2 or less, and motion sensors control groups of more than 6 fittings.
- De-rate operating power from 100% to 70% where motion detectors control groups of 3-6 light fittings
- De-rate operating power from 100% to 55% where motion detectors control groups of 2 or fewer light fittings.
- During daylight hours, de-rate operating power from 100% to 50% for light fittings adjacent to windows or roof lights that are controlled by daylight sensors.

Equipment density

No default equipment density is provided for these spaces – values as expected in operation should be used.

Equipment schedule

Monitors and associated computers used for informational displays in common areas should be assumed to run at 100% from 6am – 10pm and 75% outside these hours.

Water features should be assumed to run at 100% on a 24/7 basis, provided that the **Estimator** makes adequate allowance for normal duty cycling of the pumping equipment.

6.7.1 Other facilities

Common laundry facilities

No default figure is provided for common laundry facilities as the energy consumption should be based on the design of the facility. When modelling laundry heat loads, take care to adjust for any equipment that is directly exhausted (for example gas dryers), as this will reduce the contribution of the equipment to the heat loads in the space.

Swimming pools and saunas

No default figure is provided for swimming pool and sauna heating energy or pumping energy. This should instead be built up based on swimming pool latent and sensible heat losses to the surrounding environment. Pool covering arrangements, ventilation rate and temperature / humidity set points in the pool room, and heating and pump plant selections and distribution systems will also need to be considered. Heating requirements for individual pools will vary based on the factors described above. If the apartment building being modelled has a heated pool, contact the NABERS **National Administrator** for default heating energy values to be used.

Gymnasiums

No default figures are provided for gymnasiums as the energy consumption should be based on the design of the facility.

6.7.2 Back of house areas

Back of house areas in apartment buildings could include building or facility management offices, strata committee meeting rooms, storage spaces, contractor workspaces or other non-apartment spaces not listed above that will be the responsibility of the body corporate.

Occupant density

Occupant density could be assessed on the following basis:

- 1 person per 15 m^2 for management office areas
- 1 person per 20 m^2 for maintenance workshop areas
- Negligible occupancy in plant rooms, corridors.

Occupancy schedule

Occupancy schedule should be assessed based on the expected occupancy or staffing for each area.

Light density

Lighting density in these spaces should be established based on lighting drawings.

Light schedule

Back of house corridor lighting should be modelled as operating 24/7, unless automatic controls are provided. Where automatic controls are provided, lighting power density can be de-rated as described below.

Workspace lighting time of use and management office equipment defaults are as follows. These schedules assume service hours of 8am to 7pm. The schedules could be adapted for areas with longer and shorter operating hours (for example based on shift times).

Time	Lighting (limited time of use control: manual or timeclock)	Lighting (advanced time of use control e.g. occupancy sensors)
0:00	15%	5%
1:00	15%	5%
2:00	15%	5%
3:00	15%	5%
4:00	15%	5%
5:00	15%	5%
6:00	40%	30%
7:00	90%	75%
8:00	100%	100%
9:00	100%	100%
10:00	100%	100%
11:00	100%	100%
12:00	100%	100%
13:00	100%	100%
14:00	100%	100%
15:00	100%	100%
16:00	100%	100%
17:00	100%	100%
18:00	100%	100%
19:00	80%	75%
20:00	60%	25%
21:00	60%	15%
22:00	50%	15%
23:00	15%	5%

Equipment density and schedule

Equipment density and schedule should be assessed based on the planned occupancy or staffing and use of each space. For office spaces, the default values provided in Section 6.2 could be used.

6.7.3 Domestic hot water

Hot water use could be assumed to be 75 L per apartment per day if there is a shared system servicing both common areas and apartments. Hot water use should only be included to the extent that it services common areas such as gyms or pools. Requirements for metering to exclude energy not attributable to common areas should be noted in the appropriate version of the **Rules** to ensure that an eventual performance rating does not need to include more energy than necessary.

Alternatively, hot water use can be calculated based on tapware selections and expected patterns of water use based on other similar apartment buildings.

Appropriate allowances for generation and distribution hot water need to be included.

6.7.4 Vertical transport

Lift energy can be calculated using ISO 25745-2 (2015). Where this is impractical or unsuitable, the GBCA's Energy Consumption and Greenhouse Gas Emissions Calculator Guide available from www.gbca.org.au can be used.

The following default can also be used:

Annual energy consumption (kWh) = 1700 x lift floors, where "lift floors" is the total number of floors served by lifts. For example, a five-floor high building with two five-floor high lifts has 10 lift floors.

6.7.5 Infiltration

Infiltration schedules for modelling should be based on the design of the apartment building. Large, covered areas with a limited number of access doorways (particularly with motorised doors) will have limited infiltration deep in the centre. The manner in which the model has been divided into thermal zones will also impact infiltration. Zones near the perimeter will have higher infiltration rates compared to zones located in the interior.

The preferred method of modelling is to simulate openings based on wind direction and speed, i.e. using air network method or similar.

Alternatively, a simple default value of 0.7 air changes per hour throughout all zones during hours when the zone has no mechanically supplied outside air and 0.35 air changes per hour at all other times can be used. This number should be reviewed and increased for designs with a large amount of exposure to the outside.

6.8 Residential Aged Care

Where no site-specific information is available, the following default values can be used. However, given the variability of service offerings in aged care facilities, it is recommended the **Estimator** considers the appropriateness of these values for each project. For example, facilities providing 'premium' services may have higher internal equipment loads, specialist lighting and meal options requiring the default values to be scaled up as required.

Any other values used should be justified for the Independent Design Review report.

6.8.1 Bedrooms

Occupant density

Occupancy of bedrooms should be as per the design. The default figure which could be used for occupancy, where occupancy is not known, is 1 occupant per bedroom.

Light and power density

Lighting should be based on the lighting design of each bedroom. In the event that this is not known, the default lighting load in apartments can be set at the relevant minimum compliance value as detailed in the National Construction Code.

The **Estimator** is to determine the heat load for each bedroom based on the facilities and equipment provided. Default values may be found in Chapter 17 and 18 of the ASHRAE Handbook - Fundamentals. In the event that the fit out is not known, a default load figure of 160W per room should be used (excluding fridge). 70W (continuous) should be added for bar fridges where present and 150W for TVs.

Schedules

The default schedule which could be used for bedrooms in standard level care areas is as follows. Note that this schedule could be used for all days of the week.

Hour of Day	Occupancy	Lighting	Equipment
0:00	90%	30%	20%
1:00	90%	20%	20%
2:00	90%	20%	15%
3:00	90%	20%	15%
4:00	90%	20%	15%
5:00	80%	20%	15%
6:00	70%	20%	40%
7:00	60%	30%	80%
8:00	60%	40%	50%
9:00	30%	40%	30%

Hour of Day	Occupancy	Lighting	Equipment
10:00	10%	20%	20%
11:00	10%	20%	20%
12:00	10%	20%	20%
13:00	10%	20%	20%
14:00	10%	20%	20%
15:00	10%	20%	20%
16:00	20%	20%	20%
17:00	30%	50%	40%
18:00	40%	60%	40%
19:00	50%	70%	50%
20:00	60%	70%	60%
21:00	70%	60%	60%
22:00	70%	60%	40%
23:00	90%	40%	20%

The default schedule which could be used for bedrooms in high level care areas is as follows. Note that this schedule could be used for all days of the week.

Hour of Day	Occupancy	Lighting	Equipment
0:00	90%	30%	20%
1:00	90%	20%	20%
2:00	90%	20%	15%
3:00	90%	20%	15%
4:00	90%	20%	15%
5:00	80%	20%	15%
6:00	70%	20%	40%
7:00	60%	30%	80%
8:00	60%	40%	50%
9:00	50%	40%	30%
10:00	50%	20%	20%
11:00	50%	20%	20%
12:00	50%	20%	20%

Hour of Day	Occupancy	Lighting	Equipment
13:00	50%	20%	20%
14:00	50%	20%	20%
15:00	50%	20%	20%
16:00	50%	20%	20%
17:00	50%	50%	40%
18:00	60%	60%	40%
19:00	60%	70%	50%
20:00	70%	70%	60%
21:00	90%	60%	60%
22:00	90%	60%	40%
23:00	90%	40%	20%

6.8.2 Common areas (lobbies, foyer and corridors)

Occupant density

Occupant density in foyers, lobbies, corridors and lift lobbies is not considered due to the transient nature of occupancy in these spaces.

Lighting density

Lighting should be based on the lighting design of each space. In the event that this is not known, the default lighting load in apartments can be set at the relevant minimum compliance value as detailed in the National Construction Code.

Lighting schedule

Lighting should be assumed to run continuously at 100% of installed power except where automatic controls are provided. No adjustment is made for scheduled on/off controls (due to the likely unreliability of this control method in most circulation spaces in aged care facilities, which could be sporadically occupied at any time of day) – these are to be treated as having no automatic controls.

The following table shows the fraction of common area lighting that is assumed to operate during each hour for a variety of other automatic control arrangements (expressed as a percentage of the installed lighting). Where daylight sensors are also in use, their effectiveness should be evaluated through an appropriate simulation package and applied as an additional factor together with any occupancy-sensing controls.

Alternatively, the project team may wish to use the default profiles in the NCC, but they must justify use in accordance with the control strategy in place.

Time	No automatic controls	Motion detectors controlling 7+ fittings	Motion detectors controlling 3 – 6 fittings	Motion detectors controlling 1-2 fittings	Daylight sensors – for internal fittings adjacent to roof lights and windows
0:00	100%	90%	70%	55%	100%
1:00	100%	90%	70%	55%	100%
2:00	100%	90%	70%	55%	100%
3:00	100%	90%	70%	55%	100%
4:00	100%	90%	70%	55%	100%
5:00	100%	90%	70%	55%	100%
6:00	100%	90%	70%	55%	100%
7:00	100%	90%	70%	55%	50%
8:00	100%	90%	70%	55%	50%
9:00	100%	90%	70%	55%	50%
10:00	100%	90%	70%	55%	50%
11:00	100%	90%	70%	55%	50%
12:00	100%	90%	70%	55%	50%
13:00	100%	90%	70%	55%	50%
14:00	100%	90%	70%	55%	50%
15:00	100%	90%	70%	55%	50%
16:00	100%	90%	70%	55%	50%
17:00	100%	90%	70%	55%	50%
18:00	100%	90%	70%	55%	50%
19:00	100%	90%	70%	55%	100%
20:00	100%	90%	70%	55%	100%
21:00	100%	90%	70%	55%	100%
22:00	100%	90%	70%	55%	100%
23:00	100%	90%	70%	55%	100%

- De-rate operating power from 100% to 90% where motion detectors control an area of 200 m2 or less, and motion sensors control groups of more than 6 fittings.
- De-rate operating power from 100% to 70% where motion detectors control groups of 3-6 light fittings
- De-rate operating power from 100% to 55% where motion detectors control groups of 2 or fewer light fittings

- During daylight hours, de-rate operating power from 100% to 50% for light fittings adjacent to windows or roof lights that are controlled by daylight sensors.

Equipment density

No default equipment density is provided for these spaces – values as expected in operation should be used.

Equipment schedule

Monitors and associated computers used for directional displays or information displays in public spaces should be assumed to run at 100% from 6am – 10pm and 75% outside these hours.

Water features should be assumed to run at 100% on a 24/7 basis, provided that the **Estimator** makes adequate allowance for normal duty cycling of the pumping equipment.

6.8.3 Lounge / Clubrooms

Occupant density

Occupant density should be established based on the planned fit out of the space. If this information is not available, then a default figure of 1 person per 2 m^2 could be used.

Light and power density

Lighting should be based on the design values for each space. In the event that this is not known, the default lighting load in apartments can be set at the relevant minimum compliance value as detailed in the National Construction Code. The effect of lighting controls can be considered in line with Section 6.2.3.

The **Estimator** is to determine the heat load for each space based on the facilities and equipment provided. Default values may be found in Chapter 17 and 18 of the ASHRAE Handbook - Fundamentals.

Schedules

The default schedule which could be used for lounge areas is as follows. Note that this schedule could be used for all days of the week.

Hour of Day	Occupancy	Lighting	Equipment
0:00	0%	5%	5%
1:00	0%	5%	5%
2:00	0%	5%	5%
3:00	0%	5%	5%
4:00	0%	5%	5%
5:00	0%	5%	5%
6:00	0%	5%	5%
7:00	5%	30%	5%

Hour of Day	Occupancy	Lighting	Equipment
8:00	15%	30%	5%
9:00	50%	60%	5%
10:00	100%	100%	5%
11:00	90%	100%	5%
12:00	70%	90%	5%
13:00	90%	80%	5%
14:00	100%	100%	5%
15:00	100%	100%	5%
16:00	100%	100%	5%
17:00	100%	100%	5%
18:00	50%	60%	5%
19:00	15%	30%	5%
20:00	5%	5%	5%
21:00	0%	5%	5%
22:00	0%	5%	5%
23:00	0%	5%	5%

Equipment density

No default equipment density is provided for these spaces – values as expected in operation should be used.

6.8.4 Dining areas

Occupant density

Occupant density should be established based on the planned fit out of the space. If this information is not available, then a default figure of 1 person per 3 m² could be used.

Occupancy schedule

Default occupancy schedules for dining areas are suggested below.

Time	Weekday	Weekend
0:00	0%	0%
1:00	0%	0%
2:00	0%	0%

Time	Weekday	Weekend
3:00	0%	0%
4:00	0%	0%
5:00	10%	10%
6:00	60%	30%
7:00	80%	60%
8:00	60%	80%
9:00	30%	60%
10:00	10%	30%
11:00	30%	30%
12:00	80%	80%
13:00	60%	80%
14:00	30%	60%
15:00	10%	30%
16:00	10%	10%
17:00	30%	30%
18:00	60%	60%
19:00	80%	80%
20:00	80%	80%
21:00	60%	60%
22:00	30%	30%
23:00	10%	30%

Light and power density and schedule

Lighting should be based on the design values for each space. In the event that this is not known, the default lighting load in spaces can be set at the relevant minimum compliance value as detailed in the National Construction Code. The effect of lighting controls can be considered in line with Section 6.2.3.

By default, service equipment (for example toasters, bain-maries, coffee machines) could be assumed to run at 60% of the installed load during service periods. The default assumption is that 2/3 of the heat gain from these appliances is sensible, 1/3 is latent. Note that there is an assumption that no exhaust hoods are applied to food preparation equipment in the dining area.

Most equipment will be switched off between service periods, except for coffee machines which are likely to be left in standby mode. Installed load could be established from the unit specification, or a default value of 2 kW per unit could be used if no other information is available.

Refrigeration equipment located within the dining / service area (i.e. not walk-in refrigerators) should be calculated as per the specified equipment. Where the size is known, energy consumption should be based on the Energy Label or advice from the manufacturers or Table 5 of ASHRAE Fundamentals Section 29[2].

An example schedule for a dining area with breakfast, lunch and dinner service periods is shown below. The total equipment schedule should be built up based on the proportions of refrigeration equipment vs other food and beverage equipment in the space. When applying these schedules, the **Estimator** should consider whether the equipment is likely to be used during all service periods (for example, a toaster is only likely to be switched on at breakfast).

Time	Refrigeration equipment		Other in-restaurant food prep/heating equipment	
	Weekday	Weekend	Weekday	Weekend
0:00	100%	100%	10%	10%
1:00	100%	100%	10%	10%
2:00	100%	100%	10%	10%
3:00	100%	100%	10%	10%
4:00	100%	100%	10%	10%
5:00	100%	100%	30%	30%
6:00	100%	100%	60%	30%
7:00	100%	100%	60%	60%
8:00	100%	100%	60%	60%
9:00	100%	100%	30%	60%
10:00	100%	100%	10%	30%
11:00	100%	100%	30%	30%
12:00	100%	100%	60%	60%
13:00	100%	100%	60%	60%
14:00	100%	100%	30%	60%
15:00	100%	100%	10%	30%
16:00	100%	100%	10%	10%
17:00	100%	100%	30%	30%
18:00	100%	100%	60%	60%
19:00	100%	100%	60%	60%
20:00	100%	100%	60%	60%
21:00	100%	100%	60%	60%

[2] Note that the values provided in this section are 24-hour averages which consider variation in loads at different times of the day. They are not full rated power.

Time	Refrigeration equipment		Other in-restaurant food prep/heating equipment	
	Weekday	Weekend	Weekday	Weekend
22:00	100%	100%	30%	60%
23:00	100%	100%	10%	20%

6.8.5 Kitchen equipment energy use

Kitchen energy use will vary depending on operating hours, menu type (for example, whether all food is cooked in bulk or if there is an a la carte service), appliance selection, layout and operator behaviour.

The preferred method of estimating consumption is to create a benchmark using operational data from similar sites (for example other sites operated as part of the same aged care provider), adjusted for number of occupants.

Otherwise, a default kitchen energy consumption figure of 2.0 kWh / meal could be used. Number of meals should be based on the level of service provided. If this is not available, a default figure of 3.5 meals per occupant per day. This does not include lighting and ventilation energy use which must be modelled and accounted for separately.

Alternatively, if the fit out is broadly known, appliance energy consumption using Table 5 of ASHRAE Fundamentals Section 29 can be used.

No time of use profiles are presented as the kitchen equipment is assumed to have only a very limited impact on thermal load in the facility due to the typical practice of providing supply/exhaust ventilation in this area, i.e. so that air is not recirculated.

6.8.6 Laundry equipment energy use and schedule

In the absence of other information, the laundry equipment energy use could be estimated as: 5,000 MJ / annum per bedroom (electric).

Equipment power density should be estimated from the fit out or use of the space (for example for a laundry). When modelling laundry heat loads, take care to adjust for any equipment that is directly exhausted (for example gas dryers), as this will reduce the contribution of the equipment to the heat loads in the space.

In the absence of other information, laundry equipment density can be based on default laundry energy estimate, evenly divided over the operating hours of the laundry.

6.8.7 Other facilities

Swimming pools and saunas

No default figure is provided for swimming pool and sauna heating energy or pumping energy. This should instead be built up based on swimming pool latent and sensible heat losses to the surrounding environment. Pool covering arrangements, ventilation rate and temperature / humidity set points in the pool room, and heating and pump plant selections and distribution systems will also need to be considered. Heating requirements for individual pools will vary based on the factors described above. If the residential aged care facility being modelled has a heated pool, contact the NABERS National Administrator for default heating energy values to be used.

6.8.8 Staff Areas

Occupant density

Occupant density should be established based on the planned fit out of the space. If this information is not available, then a default figure of 1 person per 10 m² could be used.

Light and power density

Lighting should be based on the design values for each space. In the event that this is not known, the default lighting load in apartments can be set at the relevant minimum compliance value as detailed in the National Construction Code. The effect of lighting controls can be considered in line with Section 6.2.3.

The **Estimator** is to determine the heat load for each space based on the facilities and equipment provided. Default values may be found in Section 6.2 or Chapter 17 and 18 of the ASHRAE Handbook - Fundamentals.

Schedule

The default schedule which could be used for staff areas is as follows. Note that this schedule could be used for all days of the week.

Hour of Day	Occupancy	Lighting	Equipment
0:00	10%	25%	30%
1:00	10%	25%	30%
2:00	10%	25%	30%
3:00	10%	25%	30%
4:00	10%	25%	30%
5:00	10%	25%	30%
6:00	10%	25%	30%
7:00	10%	25%	30%
8:00	15%	40%	50%
9:00	60%	80%	70%
10:00	70%	100%	100%
11:00	70%	100%	100%
12:00	70%	100%	100%
13:00	70%	100%	100%
14:00	70%	100%	100%
15:00	70%	100%	100%
16:00	70%	100%	100%
17:00	70%	100%	100%

Hour of Day	Occupancy	Lighting	Equipment
18:00	50%	80%	60%
19:00	15%	60%	30%
20:00	10%	40%	30%
21:00	10%	25%	30%
22:00	10%	25%	30%
23:00	10%	25%	30%

6.8.9 Domestic hot water

Hot water use should be established based on tapware and shower selections and expected patterns of showering and bathing. Where this is not known, this could be assumed to be 75 L per room per day and 9L per meal per day.

Appropriate allowances for generation and distribution hot water need to be included.

6.8.10 Vertical transport

Lift energy can be calculated using ISO 25745-2 (2015). Where this is impractical or unsuitable, the GBCA's Energy Consumption and Greenhouse Gas Emissions Calculator Guide available from www.gbca.org.au can be used.

The **Estimator** is to determine the number of lift trips based on the number of floors, resident mobility, level of care and building layout. It is suggested that either the 'Low' or 'Medium' lift duty options are used from the GBCA's Energy Consumption and Greenhouse Gas Emissions Calculator Guide.

6.8.11 Ancillary Allowance

The Estimator is to allow for an additional allowance for ancillary uses, which could include but is not limited to:

- Cleaning
- Motorised beds
- Electric cart charging
- Electric barbecues
- CCTV
- Personal device charging.

6.8.12 Cafes and other facilities

The energy use of cafes and other facilities such as hairdressers operated primarily for resident and guest use should be considered by the **Estimator** and included in the Estimate. The **Estimator** is to determine the estimated energy use based on operating hours, menu type, appliance selection, layout and operator behaviour.

6.8.13 Infiltration

Infiltration schedules for modelling should be based on the design of the building. Large, covered areas with a limited number of access doorways (particularly with motorised doors) will have limited infiltration deep in the centre. The manner in which the model has been divided into thermal zones will also impact infiltration. Zones near the perimeter will have higher infiltration rates compared to zones located in the interior.

The preferred method of modelling is to simulate openings based on wind direction and speed, i.e. using air network method or similar.

Alternatively, a simple default value of 0.7 air changes per hour throughout all zones during hours when the zone has no mechanically supplied outside air and 0.35 air changes per hour at all other times can be used. This number should be reviewed and increased for designs with a large amount of exposure to the outside.

Where operable windows are provided, such as in aged care facilities, **Estimators** must incorporate the expected operation of these windows in the simulation including the effect of reasonable human controls.

6.9 Retirement Living

Retirement living buildings are typically very similar to apartments. As such, where no site-specific information is available, the **Estimator** can use the default values presented in Section 6.7.

Given variability of service offering in retirement living buildings, where additional services are provided, the **Estimator** can use the default values presented in Section 6.8 while considering the appropriateness of these values for each project. Any other values used should be justified for the Independent Design Review report.

6.10 Co-located Facility

When assessing co-located retirement living and residential aged care facilities, the **Estimator** can use the default values outlined in Section 6.7 and 6.8. The **Estimator** is to carefully consider the energy coverage of these facilities in accordance with the Rules.