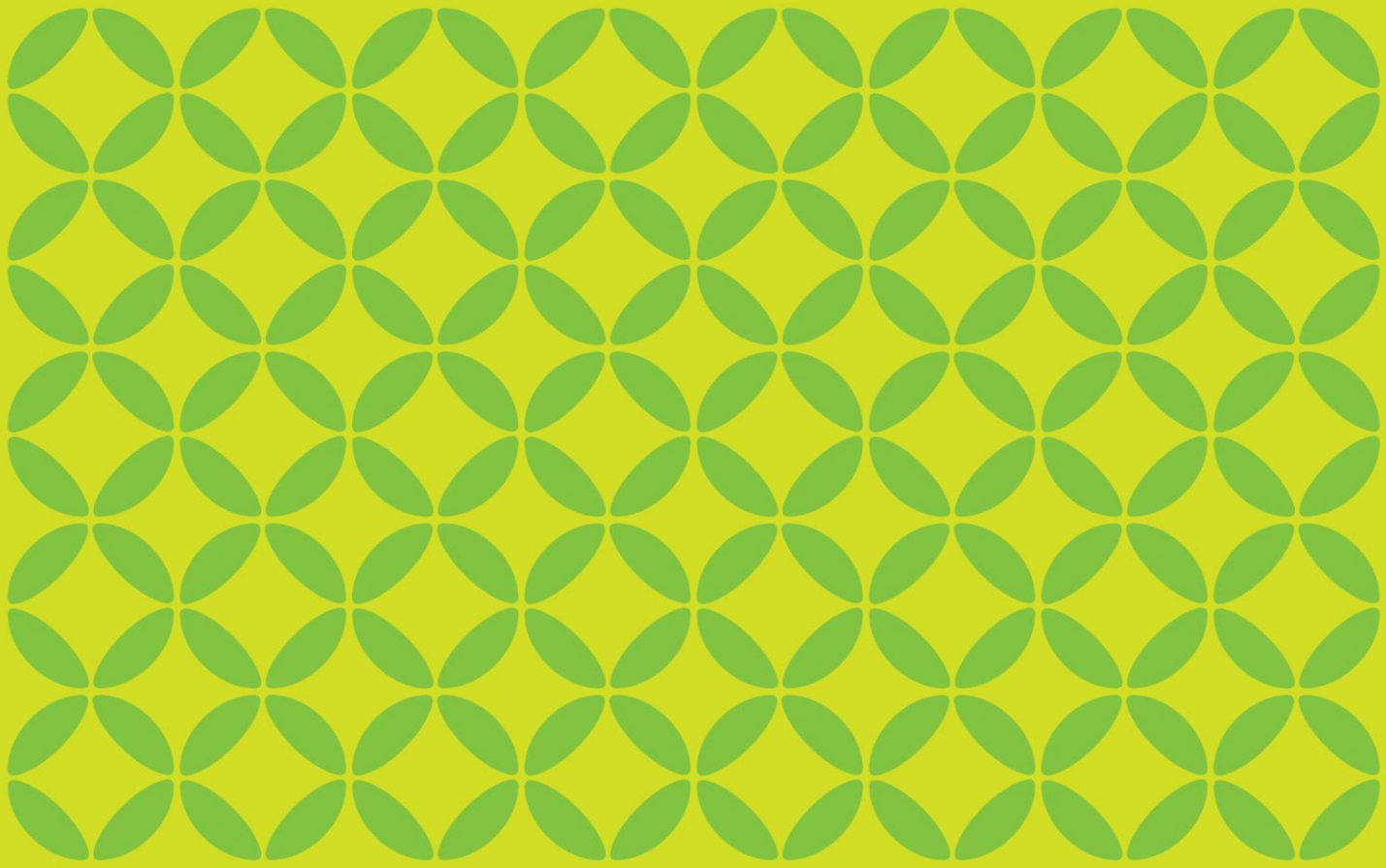
greenstar

Energy Use calculation guide

Guidance on calculation methods for the Energy Use credit in Green Star Buildings v1.1



Version 1.1

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Green Building Council Australia

Building a sustainable future

Version control

This guide applies to projects registered under version 1.1 of Green Star Buildings (all revisions). This guide is not applicable to projects targeting Green Star Buildings v1. These projects should refer to the *Energy Use calculation guide v1*.

Release	Date	Description of changes
1	19/06/2026	Initial release for Green Star Buildings v1.1 (Adapted from Green Star Buildings v1)

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Introduction

About this guide

This document sets out the basis on which project energy consumption modelling is to be completed for all Green Star Buildings v1.1 projects targeting *Pathway A: Reference building pathway* in the *Energy Use* credit. This guide:

- Provides definitive guidance on the requirements for modelling of project energy performance, in terms of end use inclusions and key considerations for the *Reference* and *Proposed building*.
- Provides flexibility to the project team to adjust default operating profiles where appropriate to better reflect the anticipated operation of the project.
- Provides meaningful information to inform the ongoing monitoring and management of project energy performance.

Based on the completed project energy performance modelling, the energy consumption reduction is calculated by entering the *Reference* and *Proposed building* annual energy consumption data into the *Energy Use – Pathway A: Reference building* calculator.

This guide applies to projects registered under version 1.1 of Green Star Buildings (all revisions). This guide is not applicable to projects targeting Green Star Buildings v1. These projects should refer to the *Energy Use calculation guide v1*.

About the Energy Use credit in Green Star Buildings v1.1

Green Star Buildings v1.1 recognises advances industry has made with electrification whereby all-electric buildings are the standard. This is acknowledged as the *Reference building* in the *Energy Use* credit. The credit also intends to place a stronger focus on energy efficiency improvements in the building by separating the recognition of on-site renewables.

Minimum provisions

In the *Minimum Expectation,* in addition to demonstrating a reduction in energy use, each building system must be compliant with the relevant Deemed-to-Satisfy (DTS) provisions in NCC Section J for wall-glazing constructions, display windows, fan systems, pump systems, refrigerant chillers, heat rejection equipment and artificial lighting systems as noted in the Submission Guidelines.

As an alternative for wall-glazing constructions and display windows, project teams may follow the approach in *Appendix F. Alternative method to the Minimum Provisions requirements*.

Interdependence with other Green Star credits

The assumptions included in the energy modelling of the project must be consistent across the project's Green Star submission including approaches to other credits. The relevant credits and assumptions are noted below. For specific projects, there may be more interdependent credits based to the project's design. Project teams should take care to ensure consistency is maintained.

Verification and Handover

Designing and testing for airtightness is included in the *Commissioning and Tuning* criterion in *Minimum Expectation*. The correlation between airtightness and energy efficiency is accounted for in the Certified assessment by including the airtightness test results in the energy modelling. For the Designed Assessment, the airtightness targets set under the same criterion should be used.

Clean Air

Ventilation rates and the method of ventilation control as applied in the *Clean Air* credit must be consistent with the quantities and controls claimed in this credit.

Light Quality

Artificial lighting and daylight calculations must be consistent with the assumptions claimed for lighting in this credit.

Energy Source

The *Minimum Expectation* in this credit means that all rated buildings are all-electric and have no infrastructure for fossil fuels for hot water, space heating and cooking. Therefore all-electric reference systems are outlined in this guide for the *Reference building*. The all-electric systems installed in the building will also be included in the *Proposed building*.

Refrigerant Systems Impacts

This credit has specific considerations and requirements around the refrigerants installed in the refrigerant-based systems for the project. This may mean that due to the project's ambitions, the available refrigerant-based systems options may differ from standard practice. Where this has disadvantaged the project's ability to demonstrate energy use reductions, project teams are encouraged to contact the GBCA via a Technical Question with a justification.

Water Use

The usage profile and properties of the water-based systems in the building must consistent in both the *Water Use* and *Energy Use* credit. This includes for both the *Reference* and *Proposed building* for each credit. Water-based systems may include domestic hot water, heat rejection, evaporative cooling and/or chilled water systems.

Domestic hot water usage for the *Reference* and *Proposed buildings* must be based on the calculations completed in the *Water Use calculator*. The calculator provides an annual total usage figure only; the project team must convert this to an hourly usage profile for use in conjunction with the simulation model. Guidance on water consumption profiles is provided (refer to *Modelling domestic hot water systems*).

Heat rejection water consumption for the *Proposed* building is calculated by the *Water Use calculator* based on monthly total heat rejection values, or by entering the total usage value calculated as part of the energy performance simulation or through supplementary manual calculations. Please refer to the *Water Use calculation guide* for guidance on completing the heat rejection section of the *Water Use calculator*.

Where direct or indirect evaporative cooling systems are used in the *Proposed building*, the associated water consumption must be calculated as part of the energy performance simulation and the total entered into the *Water Use calculator*.

Relationship with the National Construction Code (NCC)

Section J of the NCC sets out minimum thermal performance standards and forms the basis of the *Reference building*. The J1V3 and J1V5 methodologies have been adopted and modified to outline a standard practice all-electric building.

For the purposes of Green Star ratings:

- Where this document makes references to Section J requirements of the NCC, this refers to either NCC 2022 or NCC 2025, whichever version the building's approval is subject to, with all parts being applicable. No state amendments or exclusions are allowed.
- Projects are not permitted to reference a version earlier than NCC 2022.
- Project teams may elect to use a later version than current at the time of Green Star registration to align with the modelling and reporting with the version the building's approval is subject to. Please contact the GBCA prior to registration if your project is subject to a later version than NCC 2025.
- Where there are any discrepancies between the requirements of this document and those of Specification 34, this document takes precedence.

Definitions

Air conditioning

Describes the control of the temperature, and where applicable humidity, within a conditioned space (as defined herein) by application of either or both mechanical heating and mechanical cooling. These may include one or more of combustion, refrigeration (including reverse-cycle operation), direct electric heating, evaporative cooling or other processes specifically for the purpose of controlling the temperature in one or more spaces in a building. The heating or cooling effect in the space may be remote from the actual heating or cooling plant, with one or more transport media, such as air, water or refrigerant, used to transfer heat between the conditioned space and plant. An air conditioning system may also provide mechanical ventilation, but this is not necessary for the system to be classified as air conditioning.

Unlike the NCC definition, for the purposes of Green Star, air conditioning includes any services that directly maintain specialised conditions for any equipment or process, if that equipment or process is within the scope of the Green Star rating (refer to *Scope*).

Building's approval

This refers to the process which confirms the applicable version of the NCC that the project is subject to and must be reflected in the built outcome. The process differs between states however is generally when application for a construction approval is sought.

Conditioned space

A conditioned space is, as per the definition in the NCC, an internal space within a building, including a ceiling or under-floor supply air plenum or return air plenum, where the environment is likely, by the intended use of the space, to have its temperature controlled by air conditioning.

A conditioned space may use natural, mechanical or mixed-mode ventilation, but is always air conditioned (whether by design or intent).

Deemed-to-Satisfy (DTS) provisions

Prescriptive provisions in the NCC which are deemed to satisfy the Performance Requirements.

Energy use

Total amount of energy a building consumes during operations.

Mechanical ventilation

Supply and/or exhaust of controlled amounts of ventilation (outside) air by the use of mechanical equipment, typically comprising fans, filters, ductwork and terminal air devices. The temperature of the supply ventilation air may be controlled, but this is not necessary for the system to be classified as mechanical ventilation. May apply to conditioned or unconditioned spaces.

Mixed-mode ventilation

A building control strategy in which natural ventilation occurs during favourable conditions, and mechanical ventilation occurs independently or supplementally when natural ventilation cannot satisfy requirements. The mechanical ventilation mode is typically coupled with temperature control by air conditioning and operates independently of natural ventilation, but this is not always the case, and is not necessary for the system to be classified as mixed-mode.

National Construction Code

Section J of the National Construction Code (NCC) Volume One (referenced as NCC Section J in this document) addresses energy efficiency requirements for Class 2 to 9 buildings and sets the minimum standard of performance required for the *Reference building*.

Natural ventilation

Supply and/or exhaust of uncontrolled amounts of ventilation (outside) air by the use of openings in the building envelope (e.g. windows, non-powered ventilators and solar chimneys) which are connected to the conditioned space (as defined herein). Openings may be automatically or manually controlled. Active heating or cooling may be present in naturally Ventilated spaces but may be subject to additional requirements. Ceiling fans are not considered active heating or cooling for the purposes of Green Star.

Process loads

A process load is defined as the load on a project resulting from the consumption of energy by a manufacturing, industrial or commercial process, and are unrelated to lighting, heating, ventilation, cooling and water heating or the comfort of occupants.

Project scope

All areas and activities in a project that have been registered for Green Star. This includes all buildings and any ancillary areas such as parking, landscaping and shared facilities.

Proposed building

The building to be rated under the Green Star Buildings rating tool, as designed and modelled by the project team.

Reference building

A hypothetical project of the same size, shape, floor area and same glazing shape and areas as the *Proposed building*, but whose building fabric, building services characteristics and air temperatures (as nominated in the NCC) are based predominantly on the NCC Section J DTS provisions as defined in this document, and whose process energy consumption is based on appropriate benchmarks.

Sole-Occupancy Unit (SOU)

As defined by the NCC, a room or other part of a building for occupation by one or joint owner, lessee, tenant or other occupier.

Calculation requirements

Scope

The following end uses must be included in the assessment of the building's energy use, as a minimum:

- All HVAC systems for control of the internal environment in buildings, including server, communications, equipment, electrical rooms and temperature-controlled warehouse/storage facilities.
- All internal and external artificial lighting, including task lighting, provided as part of the services engineer's scope of works (lighting provided as part of architectural or furniture, fixtures and equipment (FF&E) scope of works are excluded).
- All water supply and treatment systems, including cold water pressurisation, domestic hot water heating, rainwater distribution, grey or blackwater treatment and distribution (including reverse osmosis, ultraviolet or other filtration systems).
- Vertical and horizontal transportation systems, including lifts, escalators and moving walkways.
- All swimming pool plant systems, including water heating, circulation pump(s), and underwater lighting. This includes general swimming pools and spas in leisure centres, gymnasia and residential buildings, and specialist pools, e.g. hydrotherapy pools.
- Where a space is defined as a conditioned space, but the design does not include any specific air conditioning provision to service the space (i.e. a cold shell), the energy use of the fit out is based on systems that meet the NCC Deemed-to-Satisfy (DTS) provisions for the expected space type. If a tenancy fitout guide integrated into lease agreements is provided with specific requirements for systems, this is to be assumed to determine the energy use.
- Appliances in Class 2 residential projects.

Note that lift and domestic hot water energy consumption must be included in both the *Proposed* and *Reference building* energy consumption for Green Star ratings; NCC Section J Specification S34C4 (h) does not apply.

Heat loads due to process loads must be accounted for, whether as airside or waterside system loads, but direct energy consumption due to operation of the process is not included, except for appliances in residential projects (NCC Class 2). The definition of process load includes, but is not limited to:

- Computers and similar IT equipment in office-type work environments.
- IT and communications equipment in server rooms, data centres and communications rooms.
- Specialist healthcare equipment such as MRI, CT, PET and X-ray imaging equipment.
- Medical gas reticulation, compressed air generation and reticulation, steam used solely for the purposes of sterilisation/autoclaves, and other similar healthcare loads.
- Commercial catering operations. Note that the associated kitchen ventilation systems are not process loads and must be included in the calculation.
- Commercial laundry operations. Note that the associated ventilation systems are not process loads and must be included in the calculation.
- Operation of freezer rooms, cool rooms and hot rooms in laboratories, warehouses and similar (the heat load in adjacent conditioned spaces must account for the temperature differential between them).
- Refrigerated display cabinets in food retail premises.
- Heating and cooling of, plunge pools, saunas and steam rooms in leisure facilities (the heat load in adjacent conditioned spaces must account for the temperature differential between them). Note that the associated ventilation systems are not process loads and must be included in the calculation.
- All industrial manufacturing processes.
- Electric vehicle charging in any building type.

On-site renewable energy generation systems connected behind the meter and energy exported to the grid do not contribute to reductions in energy use of the building for the purposes of energy modelling for the *Energy Use* credit.

On-site energy generation and energy exported to the grid may only be included in energy modelling for a Life Cycle Assessment for the *Impacts Disclosure* credit.

Simulation software standards

Simulation software used for the purposes of this credit is required to have been tested in accordance with *ASHRAE Standard 140-2007* and have been demonstrated to be within the allowable range of results for all tests, as per the software requirements for Section J Verification Methods. The ABCB does not maintain a register of complying software, but software previously documented to have demonstrated compliance with the requirements includes (BC, 2006):

- Beaver (developed by ACADS-BSG)
- EnergyPlus (developed by LBNL and DOE)
- Tas (developed by EDSL)
- IES <VE> (developed by IES)
- IDA ICE (developed by Equa Solutions)
- TRACE 800 (developed by Trane CDS)
- HAP E20-II (developed by Carrier).

These requirements are adopted by the GBCA as the basis of demonstrating the suitability of software for completing the assessments detailed in this document. Projects using software other than those in the above list must demonstrate that the requirements of the Protocol are satisfied as part of the credit submission.

Additionally, all projects must demonstrate that software users or verifiers have received formal training from the software vendor in the use of the software, or has at least 3 years experience in energy modelling and modelled at least 3 similar buildings.

Use of software and other calculation methods

For the purposes of Green Star, the software must be used for the calculation of all air conditioning system loads (i.e. air side coil loads) and energy consumption. Where practicable, the software must also be used for the calculation of all HVAC plant loads and associated energy consumption.

However, it is recognised that all software packages have limitations and that some system components and/or arrangements may not be able to be assessed by the software directly. Where this is the case, the project team may use supplementary manual calculations (such as in a spreadsheet), but all components that have been calculated in this way must be disclosed, and a description of the methodology given, including commentary on any limitations of the methodology and their effect on the results of the calculation. Where applicable, the same alternative calculation method must be used in the calculations for both the *Proposed* and *Reference building*.

Modelling criteria

General modelling criteria

The following table defines the main features of the *Proposed* and *Reference buildings* to be used in the simulation model to assess the associated energy consumption for the Certified assessment. For Designed assessments, all references to as-built documents and material selections shall be read as references to equivalent design documents (e.g. tender or contract issue).

The information in this section shall be read in conjunction with the supplementary definitions (refer to *Definitions*).

Table 1: Modelling requirements for the Proposed and Reference building

Item	Description	Proposed building	Reference building
1	Thermal calculation method	A thermal calculation method that complies with ASHRAE Standard 140-2007 (or later).	As *Proposed building* model (as NCC Section J Specification S34C3 (1)(a)).
2	Location (selection of climate file)	CSIRO Typical Meteorological Year (TMY) weather files drawn from the years 1990 to 2015 are used. For all building classes excluding Class 2 sole-occupancy units under NCC 2025, projected weather files using a projection at year 2050 made under a Representative Concentration Pathway (RCP) of 8.5 is used. Projects under NCC 2022 are recommended to model their energy consumption under a 2050 projection. Both datasets can be obtained from the CSIRO Data Shop here for the TMY weather files and here for the projected weather files. Please submit a Technical Question to the GBCA for approval of alternative climate files if the project cannot comply with any of the above options, or if an alternative source of weather data is considered to be more suitable for use given the nature of the project.	As *Proposed building* model (as NCC Section J Specification S34C3 (3) and Specification S45C3 (1c).
3	Adjacent structures and features	Overshadowing from the surrounding environment must be taken into account in the model.	As *Proposed building* model (as NCC Section J Specification S34C3 (1)(d) and Specification S45C3 (1)(e))

Item	Description	Proposed building	Reference building
		Existing adjacent buildings, including any already under construction, must be included in the model. Proposed buildings on adjacent sites may be excluded if construction has not already commenced at the time of registration of the project. Where the building is a stage in a precinct being developed by the same building owner, future proposed buildings in the precinct should be taken into account in the model.	
4	Environmental conditions	Factors such as ground reflectivity, sky and ground form factors, and temperatures of external bounding surfaces must be specified appropriately for the local conditions.	As *Proposed building* model (as NCC Section J Specification S34C3 (6)(m)).
5	Orientation	The representation of the *Proposed building* orientation shall be consistent with the as built documents.	As *Proposed building* model (as NCC Section J Specification S34C3 (1)(e) and Specification S45C3 (1)(f)).
6	Geometric model	The representation of *Proposed building* geometry shall be consistent with the as built documents.	As *Proposed building* model (as NCC Section J Specification S34C3 (1)(f) and Specification S45C3 (1)(g)).
7	Building envelope	The simulation of the *Proposed building* envelope shall be consistent with the as built documents and material selections. Actual construction R and U values shall be modelled inclusive of thermal bridging effects as required by NCC Section J Part J4D3 (5). Where limitations exist to the definition of thermal bridges in the modelling software, it is acceptable to reduce the thickness of the insulation layer in a homogeneous construction until the actual R or U value is achieved. Manual fenestration shading devices such as blinds or shades may be modelled using realistic operating criteria.	The *Reference Building* thermal envelope shall be modelled based on the minimum performance requirements of NCC Section J Parts J4 and J5 (per NCC Section J Specification S34C2 (a)). Glazing-wall construction parameters shall be determined using Specification 37 calculation method 2 in Specification S37C4 and S37C6. Performance requirements shall be calculated for each building class within the project separately from the rest of the project (i.e. aggregation of wall-glazing is not permitted). For Class 2 SOU parts of buildings, the requirements in NCC Section J Part J2D2 (2) and Part J3 shall be adopted. For walls and glazing, performance shall be determined in accordance with Part J3D9 (and Parts J3D8 and J3D11 to J3D13 will not apply). For climate zones 7 and 8, the SHGC shall be 0.60 for all orientations. In order to maintain uniform building areas in the geometry models (per NCC Section J Specification S34C3 (5)), the modeller may manipulate either the insulation layer thickness, the insulation material thermal conductivity value, or both to achieve the required reference R or U value without

Item	Description	Proposed building	Reference building
			affecting the building area where the modelling software uses defined construction thicknesses to determine net internal floor area. Glazing performance may not exceed U value 5.8 W/m².K and/or solar heat gain coefficient 0.87 on the basis that such performance is not physically realistic. The total R value of a wall construction shall not be less than the specified minimum value in NCC Section J Part J4D6 (4), or more than 4.0 m².K/W. External feature shading which has been included in the *Proposed building* specifically for the control of solar radiation entering the building shall be excluded from the *Reference building*. Shading that occurs due to intrinsic features of the building form, such as reveals and returns in the building structure, and balconies or other amenities, shall be included in both the *Proposed* and *Reference building*. Where boundary conditions are defined for the *Proposed building* which are not based directly on the hourly weather data, the same boundary conditions must be applied for the *Reference building* (as NCC Section J Specification S34C3 (6)(b)). Internal fenestration shading devices such as blinds or shades shall be modelled using the same colour and operating criteria as for *the Proposed building* (as NCC Section J Specification S34C3 (5)(d) and Specification S45C3 (1)(i)).
8	External surfaces solar absorptance	The simulation of the *Proposed building* envelope shall be consistent with the as built documents and material selections, including the shading effect of any PV panels and rooftop gardens.	For building other than Class 2 SOUs: • Walls: a solar absorptance of 0.6 (as NCC Section J Specification S34C2 (b)). • Roofs: a solar absorptance and thermal emittance as per NCC 2025 Section J Part J4D4 (2)(c) and Part J4D4 (3)(c). For climate zone 8, a solar absorptance of 0.7 and a thermal emittance of 0.85 is used. Solar PV panels or rooftop gardens shall be modelled for their shading effect as per Part J4D4 (4). For Class 2 SOUs:

Item	Description	Proposed building	Reference building
			• External walls: solar absorptance in accordance with NCC Section J Part J3D8 (3). Where any value is permitted, 0.6 is used. • Roofs: solar absorptance in accordance with NCC Section J Part J3D7 (9). Where any value is permitted, 0.7 is used.
9	Infiltration rate	For Designed stage modelling, the air tightness targets set for the project shall be used. For Certified stage modelling, the airtightness testing results as determined as part of the *Commissioning and Tuning* criterion in *Minimum Expectation* under the *Verification and Handover* credit are used. The whole building infiltration rate can be determined using Tables 4.16 to 4.24 of *CIBSE Guide A* (as NCC Section J Specification S34C3 (7)).	The whole building infiltration rate applied for all spaces shall be as specified in NCC Section J Specification S34C2 (d).
10	Building operation	Operation should be specified based on the default operating profiles (refer to Appendix C. Default operating schedules*Appendix C. Default operating schedules*) for the relevant space types. The simulation must incorporate variations for all day types as appropriate. Public holidays applicable to the project location shall be included in the simulation, and, unless specifically stated otherwise, will use the weekend or Sunday profile. Where the anticipated operating hours of the *Proposed building* differ from the default operating hours, the project team may adjust them to better align with expectations. Where operation is varied by more than 10% of total default operating hours, this must be confirmed with the GBCA by a Technical Question prior to implementation in the model and must be supported by design documentation or a statement from the client confirming the operational intent.	As per the *Proposed building*. Operating hours must be the same in both models.
11	HVAC zones	The simulation of the HVAC zones shall be consistent with the as-built documents.	As *Proposed building* model (NCC Section J Specification S34C3 (6)(f)), unless required to be modified to meet the system zoning requirements as described in Table 40.

Item	Description	Proposed building	Reference building
		For residential units in Class 2 buildings, the simulation must include separate Internal zones for daytime air-conditioned zones, and bedroom (night-time) and other zones, using the assumptions given in NCC Section J Specification S45C3 (1)(n).	For residential units in Class 2 buildings, as per *Proposed building*.
12	Heating, Ventilation and Air Conditioning	The HVAC system type and configuration must be modelled based on the design documents for Designed assessments, and as-built documents for Certified assessments. The simulated internal gains must be in accordance with *Appendix B. HVAC system simulation parameters*. Where variable volume control is specified, part-load fan power shall be modelled using one of the methods (refer to Variable air volume fan speed control). All ventilation-only systems (e.g. in car parks, loading docks and industrial working spaces) must be included in the energy model. Refer to *Appendix C. Default operating schedules* which must be used for these system types. Where a system includes HEPA filters or other high-pressure drop components required for the process served, system fan power must include the effect of this component(s). Credit may be taken for installing atmospheric contaminant monitoring systems and variable-speed fan control in car parks and loading docks by using the Adjustment Factor (refer to Car park and loading dock atmospheric contaminant control systems). Any areas of the building which are only fitted out to shell and core standard, a notional fit out must be modelled that meets the NCC Section J DTS provisions. If a tenancy fitout guide integrated into lease agreements is provided with specific requirements for systems, this is to be modelled. The design team must demonstrate the design provision (e.g. space allowance) that has been made for accommodating the system type modelled.	The *Reference building* HVAC system type(s), configuration and performance parameters must be as specified in Appendix D (*Reference building HVAC Systems*). The design internal occupancy and equipment gains must be the same as for the *Proposed building* (refer to *Appendix A. HVAC system design parameters*). The simulated internal occupancy and equipment gains must be the same as for the *Proposed building* (NCC Section J Specification 34 Clause S34C3 (6)(g)), except where additional control features are included in the *Proposed building*. Those spaces in the *Proposed building* which are mechanically ventilated (such as car parks, loading docks and industrial working spaces), shall be fully mechanically ventilated in the Reference building (i.e. with no passive supply/passive exhaust) to the minimum requirements as per *AS 1668.2:2024*. The *Reference building* ventilation systems shall meet the minimum fan efficiency requirements of NCC Section J Part J6D5.
13	Artificial internal lighting	The artificial internal lighting system types and configuration must be modelled based on the as-built documents.	The lighting power density used in the *Reference building* must be in accordance with NCC Section J Part J7 and based on the design lighting levels as applied in the *Proposed building* (as NCC Section J Specification

Item	Description	Proposed building	Reference building
		The annual energy consumption from internal artificial lighting, excluding emergency lighting, must be calculated on the basis of the proposed level of artificial lighting in the project with the daily profiles (refer to *Appendix C. Default operating schedules*). This includes any internal car park lighting. Credit may be taken for lighting zoning and automatic controls which exceed the requirements of NCC Section J Part J6 (refer to *Automatic lighting controls).* Any areas of the building which are only fitted out to shell and core standard, the fit out must be modelled to meet the NCC Section J DTS provisions.	S34C3 (6)(d)). The *Reference building* lighting power density can be adjusted for Room Aspect Ratio (as per NCC Section J Table J7D3a note (3)), but not for control devices (as per NCC Section J Table J7D3a note (4)) (as NCC Section Specification 34 Clause S34C2 (e)). The same operating profiles must be used as are used in the *Proposed building* (refer to *Appendix C. Default operating schedules*).
14	Artificial external lighting	The artificial external lighting system types and configuration must be modelled based on the as-built documents. The annual energy consumption from external artificial lighting must be calculated on the basis of the proposed level of external artificial lighting provided with the daily profiles (refer to *Appendix C. Default operating schedules*). All external lighting within the project title boundary, but excluding emergency lighting, must be included in the Proposed building energy consumption calculation (this includes landscape and decorative lighting). Where the *Proposed building* design lighting levels do not meet the horizontal illuminance requirements as per SA, 2005, the power density used in the energy consumption calculation must be the greater of: • The proposed design lighting power density • The reference lighting power density (refer to *Reference building pump power*) for the applicable lighting type category. (This ensures that providing poor lighting amenity is not rewarded in this credit as an energy-saving measure.)	The annual energy consumption from the external lighting shall be calculated with the external lighting power density (refer to *External artificial lighting* in Appendix D) and the same daily profiles as used in the *Proposed building*. The same external areas shall be illuminated in the *Reference building* as for the *Proposed building* excluding any landscape, decorative and emergency lighting. To establish which standard practice power density should be used for a particular area, the lighting designer must identify the appropriate category from *AS/NZS 1158.3.1:2020* Clause 2.4.

Item	Description	Proposed building	Reference building
15	Domestic hot water systems It is necessary to complete the *Water Use calculator* before the energy consumption from the *Proposed* and *Reference building* domestic hot water system(s) can be calculated.	The *Proposed building* domestic hot water system types and configuration must be modelled based on the as-built design. The *Proposed building* hot water consumption shall be as calculated by the Green Star Potable Water calculator. The domestic hot water usage of the *Proposed building* depends on the water efficiency of the taps and showers. Reduction in the volume of domestic hot water usage by installing water efficient fittings is one way to reduce energy use associated with the building. Where make up water is provided from the mains water service, the water temperature shall be based on the monthly values in Table A6 of SA, 2008 for the climate zone applicable to the building location. Where from another source, the building team shall make appropriate assumptions which must be stated in the submission.	The *Reference building* hot water consumption shall be as calculated by the *Water Use calculator*. Refer to *Reference building domestic hot water systems* for details of the Reference Building system properties. Make up water temperature shall be the same as for the *Proposed building*.
16	On-site energy generation	On-site energy generation may not be used to reduce the calculated annual energy consumption of the building. Therefore, the energy associated with on-site generation is not required to be reported in the Energy Use – Pathway A calculator.	None
17	Lifts	The energy consumption is based on the installed systems and calculated generally in accordance with *ISO 25745-2:2015*. Refer to *Lift energy calculation methodology* for further details.	Lifts shall be modelled based on the minimum performance requirements in NCC Section J Part J7D8 and energy performance calculated generally in accordance with *ISO 25745-2:2015*. Refer to *Lift energy calculation methodology* for further details.
18	Other energy consumption	All services required for the operation of the building must be included in the energy consumption. Any other energy consumed on site for base building facilities such as a water-recycling treatment plant, must be included. All assumptions used in the calculation must be provided in the documentation and justified.	None

Item	Description	Proposed building	Reference building
19	Small power and process loads	The direct energy consumption by small power or process equipment is not included in the assessment, except for residential parts of buildings (BCA Class 2 SOU), refer to item 20. This energy consumption is related to the function of the building rather than the physical attributes of the building fabric and services which is being assessed in this credit. However, the internal heat gains resulting from operation of the equipment must be included in the simulation of the HVAC energy consumption (refer to *Appendix B. HVAC system simulation parameters*).	As *Proposed building* model.
20	Appliances Applicable to Green Star Buildings residential parts of buildings (NCC Class 2 SOU)	Energy consumption of appliances and equipment must be included in the building energy consumption, as follows: • Refrigerators/freezer • Dish washers • Clothes washers • Clothes dryers The energy consumption shall be taken as the energy rating of the appliance (normalised energy consumption in kWh/annum). Refer to www.energyrating.gov.au. If only some of the above appliances are being provided as part of the apartment fitout, then for those appliances not being provided, the same energy performance as for the Reference building shall be assumed. All other appliances are considered small power.	Refer to *Reference building appliances* in Appendix D for energy consumption standards applicable to the *Reference building* appliances.
21	Swimming pools	The make up water requirement for a swimming pool, and the associated heat load for heating of make up water, is a function of water evaporation from the pool water surface and backflushing of filters. The project must estimate daily heating loads due to this water heating requirement.	The following attributes of the swimming pool shall be as per the *Proposed building*: • Swimming pool water volume and surface area • Water design temperature (except all outdoor pools are assumed to be unheated)

Item	Description	Proposed building	Reference building
		Where make up water is provided from the mains water service, the water temperature shall be based on the monthly values in Table A6 of *AS/NZS 4234:2008* for the climate zone applicable to the project location. Pump hours of operation and timing of backflushing cycles used in calculations must be justified by the design team. For internal pools, all other heat loss pathways may be ignored; for heated external pools, calculation of ground conduction, surface convection and body radiation heat transfer must also be included.	• Hours of operation of swimming pool and associated plant • Pool make up water temperature The following apply to the *Reference building* swimming pool: • Pool blanket is in use for all hours outside of normal operating hours • Air-source heat pump water heater with efficiency as for Domestic Hot Water • Water recirculation time of 2 hours, or as otherwise regulated. • Circulation of the pool water shall be continuous throughout the hours of operation • Circulation pumps shall have minimum pump power (refer to *Reference building pump power*) based on the flow rate defined by the recirculation rate and using the same system pressure head as for the *Proposed building* • No underwater pool lighting • Operation of backflushing cycle for a period of 10 minutes per filter cell once a week. Number of filter cells shall be the same as for the *Proposed building*.

Operating profiles

Default operating profiles for all project types are provided in *Appendix C. Default operating schedules*. Modifications to suit project specific conditions are acceptable as follows:

- Changes of no more than 10% of equivalent full-load operating hours: all changes made for the purpose of the assessment must be declared in the project submission; or
- Changes of more than 10% of equivalent full-load operating hours: all changes requested for the purpose of the assessment must be submitted for approval as a Technical Question and must be accompanied by confirmation from the client that the changes made are in accordance with the anticipated project operation.

Modelling daylight-controlled artificial lighting systems

Where credit is claimed for dimming control of artificial lighting in response to measured daylight in a space, other than by use of the deemed adjustment factors (refer to *Automatic lighting controls*), either of the following calculation methods may be applied:

- Calculation of hourly internal daylight levels by the project energy performance simulation software from first principles; or
- Calculation of daylight compensation by the project energy performance simulation software based on user-defined daylight factors and solar radiation from the weather data file.

Where points are claimed in the *Light Quality* credit for the achievement of internal daylight levels, (refer to *Automatic lighting controls*) for details of required inputs to the project energy performance simulation model.

Modelling control of natural-ventilation and mixed-mode systems

The purpose of the inclusion of simulation control parameters for natural ventilation and mixed-mode systems is to provide consistency in simulations which could otherwise potentially produce widely varying results depending on the parameters applied, particularly where a system relies on occupant control. While there is no absolute correct specification of the control parameters, the following guidelines have been developed to be consistent with the holistic objectives of Green Star. Variation from these parameters, other than where specifically stated, is therefore not allowed.

For the following three systems, these controls are only required to be applied during the hours of project or plant operation, as specified in the operating schedules, not continuously. Natural ventilation openings would be expected to be fully closed outside of these times.

Naturally-ventilated spaces with heating only

Modelling shall be completed on the basis of agreed minimum space temperature. Where the control temperature is less than the conventional value (21 °C for generally occupied spaces, or 18 °C for transitory occupied spaces), confirmation of client agreement of the minimum space temperature must be provided as part of the submission. The project team shall assume the following control actuation:

- Minimum operable device opening factor: 10%
- Heating system operates when $T_{space} < T_{lower} + 0.5$
- Operable devices open from minimum position when $T_{OA} > 12$ ℃ and $T_{space} \geq T_{lower} + 0.5$ (i.e. heating is off in the space)
- Operable devices are fully open when $T_{space} = 24$ ℃
- Operable devices close to minimum position during any hour when the following conditions occur:
  - $T_{OA} > 35$ ℃
  - $v_{wind} > 5$ m/s

Where T_{space} is the space temperature (dry bulb, operative or other as applicable to the method of temperature control), T_{lower} is the lower limit of the space temperature control range, T_{OA} is the outdoor air dry bulb temperature (all °C), and v_{wind} is the external wind speed (m/s).

Note that this means that natural ventilation is the only means of ventilation. Operable devices will be open at all time during occupancy, including when heating systems are operational, and outside air load will contribute directly to the room heating load. If operable devices are closed, no ventilation air enters the building.

Naturally ventilated spaces with heating and cooling

Modelling shall be completed on the basis of agreed space temperature limits. Where the temperature control range is wider than the conventional range (21-24 °C for generally occupied spaces, or 18-25 °C for transitory occupied spaces), confirmation of client agreement of the temperature limits must be provided as part of the submission. The project team shall assume the following control actuation:

- Minimum operable device opening factor: 10%
- Heating system operates when $T_{space} < T_{lower} + 0.5$
- Operable devices open from minimum position when $T_{OA} > 12$ ℃ and $T_{space} \geq T_{lower} + 0.5$ (i.e. heating is off in the space)
- Operable devices are fully open when $T_{space} = T_{upper} - 1.0$
- Mechanical cooling system operates when $T_{space} > T_{upper} - 0.5$
- Operable devices close to minimum position during any hour when the following conditions occurs:
  - $T_{OA} > 30$ ℃ or $T_{OA} < 15$ ℃
  - $v_{wind} > 5$ m/s

Where T_{space} is the space temperature (dry bulb, operative or other as applicable to the method of temperature control), T_{lower} and T_{upper} are the lower and upper limits of the space temperature control range respectively, T_{OA} is the outdoor air dry bulb temperature (all °C), and v_{wind} is the ambient wind speed (m/s).

Note that this means that natural ventilation is the only means of ventilation. Operable devices will be open at all time during occupancy, including when cooling and heating systems are operational, and outside air load will contribute directly to the room heating or cooling load. If operable devices are closed, no ventilation air enters the building.

Mixed-Mode Spaces

Modelling shall be completed on the basis of agreed space temperature limits. Where the temperature control range is wider than the conventional range (21-24 °C for generally occupied spaces, or 18-25 °C for transitory occupied spaces), confirmation of client agreement of the temperature limits must be provided as part of the submission. The project team shall assume the following control actuation, based on a mixed-mode strategy incorporating air conditioning:

- Heating system operates when $T_{space} < T_{lower} + 0.5$
- Heating system is deactivated and operable devices begin to open when $T_{space} = T_{lower} + 0.5$
- Operable devices are fully open when $T_{space} = T_{upper} - 1.0$
- Operable devices close when $T_{space} = T_{upper} - 0.5$
- Mechanical cooling system operates when $T_{space} > T_{upper} - 0.5$

Where T_{space} is the space temperature (dry bulb, operative or other as applicable to the method of temperature control), and T_{lower} and T_{upper} are the lower and upper limits of the space temperature control range respectively (all °C).

Systems revert to or continue air conditioning operation regardless of the internal temperature at any time when:

- $T_{OA} > 30$ ℃ or $T_{OA} < 15$ ℃
- $v_{wind} > 5$ m/s

If the project is implementing an alternative form of automatic control, an alternative simulation control methodology may be proposed by the project team. A Technical Question must be submitted prior to implementation in the model. Where system operation is dependent on occupant control of operable devices, the above criteria may not be modified under any circumstances.

Note that 'Mixed-Mode Spaces' means that natural ventilation only operates when space temperature is within the centre of the control range and ambient conditions are favourable, when active heating and cooling systems are off. When operable devices are closed, ventilation occurs via the mechanical/AC system.

Modelling operation of air conditioning systems

The air conditioning system component of the energy model must account for all of the following features of system operation, as relevant to the system and its control:

- Individual fans, fan duties (air flow and static pressure) and fan part-load performance characteristics (for variable-speed control systems) (as NCC Section J clauses Specification S34C4(b) and S34C4(e))
- Economy cycle operation and control lockouts
- Heat recovery system operation, control lockouts, ancillary components (i.e. pumps in runaround coil systems and fan motors in rotary thermal wheel systems), and heat transfer effectiveness (sensible and latent components)
- Supply air temperature reset controls
- Ductwork distribution system heat gains and losses
- Minimum flow rate settings for variable volume systems
- Independent specification of supply air and outdoor air flow rates
- Humidity control, including dehumidification and humidification, as applicable
- Evaporative cooling stages
- Cycling of fan operation with temperature control systems in packaged air conditioning units.

Modelling operation of chilled water refrigeration plant

The chilled water plant component of the energy model must account for all of the following features of plant operation, as relevant to the system design and its control:

- Individual chillers, chiller capacities, and chiller part-load performance characteristics, including effect of compressor part-load, ambient relief and chilled water leaving temperature set point
- Hydraulic configuration of chillers, including parallel, series, sidecar and combinations of these
- Interlocked operation of chilled water and condenser water pumps, and variable speed control of pumps
- Operation of secondary pumps, including variable speed control and staged control of ganged pumps as applicable
- Staging and sequencing control of chillers in response to cooling load or other system variable
- Operation of oil sump heaters to maintain the oil temperature above a minimum threshold (where applicable)
- Chilled water set point temperature reset control
- Distribution pipework thermal gains
- Any additional cooling loads imposed on the chilled water system due to end uses other than space cooling, e.g. direct water cooling of process equipment
- Heat rejection to individual or multiple heat rejection units, including staging control of heat rejection units
- Condenser water temperature reset in response to ambient temperature and fan speed control in response to leaving water temperature

- Cooling tower fan power and variable speed control of fans
- Staging and sequencing control of cooling towers in response to heat rejection load or other system variable
- Any other requirements as per NCC Section J Specification S34C4(b) and S34C4(c), and, for pumping energy, per NCC Section J Specification S34C4(f)

Additionally, where the condenser water system is used to service heat rejection applications other than chilled water plant heat rejection, the following must be included, as relevant to the system design and control:

- Heat rejection from tenant supplementary heat rejection systems
- Any additional cooling loads imposed on the condenser water system due to end uses other than space cooling, e.g. direct water cooling of process equipment
- Operation of condenser water pumps, and variable-speed control of pumps

Modelling operation of heat pump hot water plant

The heating hot water plant component of the energy model must account for all of the following features of plant operation, as relevant to the system design and its control:

- Individual heat pumps/compressors, compressor capacities, and compressor part-load performance characteristics, including effect of compressor part-load, ambient relief and heating hot water leaving temperature set point
- Hydraulic configuration of heat pumps, including parallel, series, sidecar and combinations of these
- Interlocked operation and variable speed control of primary pumps
- Operation of secondary pumps, including variable speed control and staged control of ganged pumps as applicable
- Staging and sequencing control of heat pumps in response to heating load
- Operation of defrost cycle in response to ambient temperature and evaporator coil frost build up
- Operation of oil sump heaters to maintain the oil temperature above a minimum threshold (where applicable)
- Heating hot water set point temperature reset control
- Where 4-pipe chillers are implemented for shared heating and cooling duty, the availability of each unit for operation in only a single mode, or simultaneous operation if specified
- Distribution pipework thermal losses
- Any other requirements as per NCC Section J Specification S34C4(b) and S34C4(c), and, for pumping energy, per NCC Section J Specification S34C4(f)

Additionally, where other means of heating is provided, for example direct electric resistance heating, electric boilers or others, these should be fully described with the method of modelling their control and performance clearly explained.

Modelling domestic hot water systems

Residential units in Class 2 buildings

For the purposes for NCC Section J Part J1V5, the *Proposed* and *Reference building* domestic hot water system energy consumption shall be based on the total domestic hot water usage calculated by the *Water Use calculator* (refer to *Water Use*) using the assumptions specified in NCC Specification 45 Clause S45C3 (1)(k). These assumptions include consumption rates, seasonal load profiles, water inlet temperature of the monthly ground temperature, water outlet temperature and standing losses.

Other building types

The *Proposed* and *Reference building* domestic hot water system energy consumption shall be based on the total domestic hot water usage calculated by the *Water Use calculator* (refer to *Water Use*).

Where the *Proposed building* features multiple independent systems, the *Reference building* must include the same number of systems serving the same areas of the project. The total domestic hot water usage for the project, as determined by the *Water Use calculator*, must be apportioned to each of these systems. The project team must demonstrate how this has been calculated. This may be by consideration of the building area served by each system, the relative water usage for each end use in the project, by use of available reference or empirical data whether project specific or generic (e.g. the histograms in *CIBSE Guide G*), or any combination of these or other methods. Where the same system type with the same primary energy source serves more than one part of the project, they may be aggregated for calculation purposes.

Where the project team is of the opinion that hot water usage included in the *Water Use calculator* is outside of the scope of the applicable rating type, and should be excluded from the calculations, this should be addressed in a Technical Question.

Where a system is indirectly heated from another thermal energy source, e.g. heating hot water system or recovered energy from another process, the annual total water usage for the system shall be converted to an hourly usage profile by consideration of:

- The number of days of project operation and the extent of operation per day (i.e. whether all or only a proportion of the end uses served by the system are operational)
- The usage during each day of operation. This may be by consideration of the hours of operation of the project the relative water usage for each end use in the project and the times at which these are likely to occur, by use of available reference data whether project specific or generic (e.g. the histograms in *CIBSE Guide G*), or any combination of these.

Estimation of hourly usage profiles is necessary in these cases to ensure that consideration is given to the simultaneity of energy availability and energy demand, and the consequential impacts on overall energy utilisation and system efficiency and performance.

Calculations of energy consumption may generally be based on total annual delivery volume of domestic hot water, with due account made for system losses from tanks, pipework and other components as applicable. Refer to *Reference building domestic hot water systems* for default values, which are to be used for the *Reference building* in all cases, and for the *Proposed building* where the project team chooses. Where the project team chooses to apply loss factors for the *Proposed building* that is less than the *Reference building* values, these must be justified by the project team. Make up water temperature is the time-weighted average of the defined reference values. However, for indirect-fired systems as described above, calculations must be based on an hourly calculation of demand, losses and input. Such calculations must be completed as part of the overall energy and it is expected that the software would facilitate the calculation of losses based on system physical characteristics (including storage tank geometry and insulation thickness, and distribution pipework system length, representative diameter, and insulation thickness) and environmental temperatures (which may be based on unconditioned space temperatures calculated in the thermal simulation model, for example); where this is the case, *Proposed building* losses must be calculated in this way.

The general form of the annual energy calculation is:

$$Q_{input} = \frac{q_{DHW} c_p \Delta T}{1000 \eta_{heater}} \left(1 + f_{standing} + f_{distribution}\right)$$

Where Q_{input} is the system total annual energy consumption (MJ/annum), q_{DHW} is the system annual domestic hot water usage (L/annum), c_p is the specific heat capacity of water (approximately 4.19 kJ/kg.K), ΔT is the temperature difference between supply and make up water temperatures (K), η_{heater} is the gross thermal efficiency of the water heater (%), $f_{standing}$ is a factor accounting for standing losses in the system, and $f_{distribution}$ is a factor accounting for distribution losses in the system. The factor 1000 adjusts from kilojoules to megajoules. Note that for the purpose of this calculation it is assumed that 1 L of water has a mass of exactly 1 kg, regardless of temperature.

Energy consumption of circulation pumps and other ancillary system components must be included in the building total energy consumption for both the *Proposed* and *Reference building*. For the *Reference building*, these values may be determined by prorating the *Proposed building* values as follows:

$$X_{ref} = \frac{q_{ref}}{q_{prop}} X_{prop}$$

Where X is the quantity to be prorated, q is the annual domestic hot water usage (L/annum) for the system, and subscripts ref and prop refer to the *Reference building* and *Proposed building* values respectively.

Modelling local shared services utilities

Where the project energy is sourced from a local shared services utility as one or more of electricity, chilled water, heating hot water or domestic hot water, the modelling shall be completed so as to determine the demand to be met at the point of interface with the utility service. Specific considerations that must be addressed in the model include:

- Hydraulic configuration of chilled water interface in chilled water system
- Staging and sequencing of chilled water interface where other conventional chilled water equipment is also provided in the building for duty operation
- Hydraulic configuration of heating hot water interface in heating hot water system
- Staging and sequencing of heating hot water interface where other conventional heating hot water equipment is also provided in the building for duty operation

Electrical demand loads shall be entered into the credit calculator as kWh values, and thermal demand loads (chilled, heating and domestic hot water) shall be entered into the credit calculator as MJ values.

Modelling water usage of evaporative cooling systems

Evaporative cooling (direct or indirect) system water consumption models must account for direct evaporation due to system cooling operation. Direct evaporation shall be based on latent heat of vaporisation of water of 2,450 kJ/kg.

In systems utilising variable-speed fan control, the effect of air speed on saturation efficiency of the evaporative media shall be considered (generally, the lower the air speed the higher the efficiency) (e.g. DOE, 2013).

Modelling water usage of heat rejection systems

Water consumption due to conventional cooling towers is calculated in the *Water Use calculator* based on the monthly total heat rejection load (refer to *Water Use*). The simulation is only required to calculate water usage of heat rejection systems where technology other than conventional cooling towers (e.g. adiabatic coolers) is used. The calculation must account for water usage due to:

- Direct evaporation due to system cooling operation
- Drift loss due to carry over of atomised water droplets in the air stream
- Blowdown loss due to the purging of high-mineral concentration water from either the condenser water (if an open condenser water system) or from the dedicated recirculation cooling water (if a closed condenser water system)

Direct evaporation shall be based on latent heat of vaporisation of water of 2,450 kJ/kg.

If water softening equipment is used to reduce the hardness of water prior to supply to the heat rejection equipment, the energy consumption of this equipment must be included in the project total energy consumption.

References

ASHRAE, 2007. American Society of Heating, Refrigerating and Air-Conditioning Engineers. “Standard 140-2007. Standard method of test for the evaluation of building energy analysis computer programs,” American Society of Heating, Refrigerating and Air-Conditioning Engineers, USA. 2007.

ASHRAE, 2011. American Society of Heating, Refrigerating and Air-Conditioning Engineers. “HVAC Applications Handbook,” American Society of Heating, Refrigeration and Air Conditioning, USA. 2011.

ASHRAE, 2013. American Society of Heating, Refrigerating and Air-Conditioning Engineers. “Fundamentals Handbook,” American Society of Heating, Refrigeration and Air Conditioning, USA. 2013.

ASHRAE, 2013. American Society of Heating, Refrigerating and Air-Conditioning Engineers. “Standard 55-2013. Thermal environmental conditions for human occupanct,” American Society of Heating, Refrigeration and Air Conditioning, USA. 2013.

ASHRAE, 2022. American Society of Heating, Refrigerating and Air-Conditioning Engineers. “Standard 90.1-2007. Energy Standard for Sites and Buildings Except Low-Rise Residential Buildings (SI Edition),” American Society of Heating, Refrigerating and Air-Conditioning Engineers, USA. 2007.

ATTMA, 2010. Air Tightness Testing and Measurement Association. “Technical Standard L2 Measuring Air Permeability of Building Envelopes (Non-Dwellings),” Air Tightness Testing and Measurement Association, UK. October 2010. http://www.attma.org/wp-content/uploads/2013/10/ATTMA-TSL2-Issue-1.pdf (accessed 12th March 2014).

ABCB, 2022. Australian Building Codes Board. “Building Code of Australia Volume One: Class 2 to Class 9 Buildings,” Australian Building Codes Board, Australia. 2022.

ABCB, 2025. Australian Building Codes Board. “Building Code of Australia Volume One: Class 2 to Class 9 Buildings,” Australian Building Codes Board, Australia. 2025.

Bannister, 2011. Bannister, Paul, Chris Bloomfield, and Haibo Chen. “Empirical Prediction of Office Building Lift Energy Consumption,” Proceedings of Building Simulation 2011: 12th Conference of International Building Performance Simulation Association, Australia. November 2011. http://www.ibpsa.org/proceedings/BS2011/P_1815.pdf (accessed 12th March 2014).

Barney, 2007. Barney, Gina. “Energy Efficiency of Lifts – Measurement, Conformance, Modelling, Prediction and Simulation,” Gina Barney Associates, UK. 2007. http://www.cibseliftsgroup.org/docs/Barney-on-energy%20efficiency%20of%20lifts.pdf (accessed 13th March 2013).

BC, 2006. Building Commission Victoria. “Practice Note 2006-09. Building energy analysis for commercial buildings,” Building Commission Victoria, Australia. June 2006. Superseded.

BSI, 1991. British Standards Institute. “BS 5925:1991 Code of Practice for Ventilation principles and designing for natural ventilation,” British Standards Institute, UK. 1991.

CIBSE, 2004. Chartered Institute of Building Services Engineers. “CIBSE Guide G: Public health engineering,” Chartered Institute of Building Services Engineers, UK. 2004.

CIBSE, 2005. Chartered Institute of Building Services Engineers. “CIBSE Guide D: Transportation systems in buildings,” Chartered Institute of Building Services Engineers, UK. 2005.

CIBSE, 2015. Chartered Institute of Building Services Engineers. “CIBSE Guide A: Environmental Design,” Chartered Institute of Building Services Engineers, UK. 2015.

DEE, 2018. Department of Environment and Energy. “Australian National Greenhouse Accounts: National Greenhouse Accounts Factors” Department of Environment and Energy, Australia. July 2018. https://www.environment.gov.au/system/files/resources/80f603e7-175b-4f97-8a9b-2d207f46594a/files/national-greenhouse-accounts-factors-july-2018.pdf (accessed 6th May 2019).

DOE, 2013. United States Department of Energy. “Energy Plus Engineering Reference Manual,” United States Department of Energy, USA. October 2013. http://apps1.eere.energy.gov/buildings/energyplus/pdfs/engineeringreference.pdf (accessed 19th March 2014).

E3, 2010. Energy Efficient Strategies. “Appliance Energy Consumption in Australia: Equations for Appliance Star Ratings,” Equipment Energy Efficiency (E3) Committee, Australia. September 2010. http://www.energyrating.gov.au/wp-content/uploads/2011/02/appliance-star-ratings1.pdf (accessed 26th March 2014).

EPA, 2013. United States Environment Protection Agency. “Glossary of Climate Change Terms,” United States Environment Protection Agency, USA. 2013. http://www.epa.gov/climatechange/glossary.html (accessed 13th March 2014).

IEA, 2012. International Energy Agency. “IEA Statistics: Natural Gas Information,” International Energy Agency, France. 2012. http://www.iea.org/media/training/presentations/statisticsmarch/NaturalGasInformation.pdf (accessed 13th March 2014).

IPCC, 1996. Intergovernmental Panel on Climate Change. “Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories,” UN. http://www.ipcc-nggip.iges.or.jp/public/gl/invs1.html (accessed 13th March 2014).

ISO, 2012. International Organization for Standardization. “ISO 25745-1:2012 Energy performance of lifts, escalators and moving walks – Part 1: Energy measurement and verification,” International Organization for Standardization, Switzerland. 2012

ISO, 2015. International Organization for Standardization. “ISO 25745-2:2015 Energy performance of lifts, escalators and moving walks – Part 2: Energy calculation and classification for lifts (elevators),” International Organization for Standardization, Switzerland. 2015

NIST, 2001. Emmerich, Steven J and Andrew K Persily. “State-of-the-Art Review of CO_2 Demand Controlled Ventilation Technology and Application,” Building and Fire Research Laboratory, National Institute of Standards and Testing, USA. March 2001. http://fire.nist.gov/bfrlpubs/build01/PDF/b01117.pdf (accessed 9th March 2014).

SA, 2008. Standards Australia. “AS/NZS 4234:2008 Heated water systems – Calculation of energy consumption,” Standard Australia. 2008.

SA, 2008. Standards Australia. “AS/NZS 4776.2:2008 Liquid-chilling packages using the vapour compression cycle, Part 2: Minimum energy performance standard (MEPS) and compliance requirements,” Standards Australia. 2008.

SA, 2020. Standards Australia. “AS/NZS 1158.3.1:2005 Lighting for roads and public spaces. Part 3.1: Pedestrian area (Category P) lighting - Performance and design requirements,” Standards Australia. 2020.

SA, 2024. Standards Australia. “AS 1668.2:2024 Standards Australia. The use of ventilation and airconditioning in buildings, Part 2: Mechanical ventilation in buildings,” Standards Australia. 2024.

SA, 2024. Standards Australia. “AS 1668.4:2024 Standards Australia. The use of ventilation and airconditioning in buildings, Part 4: Natural ventilation in buildings,” Standards Australia. 2024.

UNEP, 2010: United Nations Energy Program. “Common Carbon Metric: Protocol for Measuring Energy Use and Reporting Greenhouse Gas Emissions from Building Operations (Draft for Pilot Testing),” Sustainable Buildings Climate Initiative, United Nations Energy Program, USA. 2010. http://www.unep.org/sbci/pdfs/Common-Carbon-Metric-for_Pilot_Testing_220410.pdf (accessed 13th March 2014).

Appendix

Appendix A. HVAC system design parameters

For the purpose of sizing the HVAC systems in the *Reference building*, the thermal loads shall be consistent with the design parameters applied for the Proposed building system design, as per Table 2.

Table 2: HVAC system design parameters

Design load parameter	Proposed building	Reference building
Design weather conditions (summer dry bulb and wet bulb, and winter dry bulb temperatures; solar radiation)	As per design	As *Proposed building*
Room design temperature and humidity (where applicable)	As per design	As *Proposed building*, except: • Swimming pools: Room design conditions of water temperature +2 K and 40-60% relative humidity • Kitchens (preparation and store areas): 18 to 26 °C
Room occupant density	As per design	As *Proposed building*
Occupant heat gain (sensible and latent)	As per design	As *Proposed building*
Equipment heat gain (sensible and latent)	As per design	As *Proposed building*
Lighting heat gain	As per design	As per Table J7D3a (note 1)
Outdoor air rate	As per design	As per NCC Section J Specification S34C2(a)(ii), i.e. “the amount of ventilation required by Part F4”, and consistent with the baseline calculation in the Clean Air credit.
Building envelope	As per design	Refer to *Modelling criteria*
Infiltration rate	As per air permeability target set at design for Designed assessment, and as per the actual test results achieved for Certified assessment	Refer to *Modelling criteria*

Note 1: Healthcare interventional suites (such as surgical operating theatres) are excluded from the requirements of NCC Section J Part J7. For these space types, a Reference building lighting power density of 25 W/m² shall be assumed.

Appendix B. HVAC system simulation parameters

The peak gain values that must be used for both the *Proposed* and *Reference building* during the project simulation are as specified in this section, which (refer to *Modelling criteria*) must be used in place of those given in NCC Section J Specification S35C2(1).

Table 3: HVAC simulation parameters – for all buildings

Item	Proposed building	Reference building
Temperature and humidity control band	For all air-conditioned spaces, including process/manufacturing spaces and specialist labs such as clean rooms, the air conditioning must be modelled on the basis of the design temperature and humidity (where applicable) control ranges. Where spaces in the project have been designed to operate comfortably within a broader temperature band than for the *Reference building*, this widened temperature band may be used in the modelling provided that: • The design criteria for the project lists these space temperatures in the mechanical specifications for system sizing and selection; and • The owner provides confirmation in a letter that the spaces will be operated under the design criteria provided; and that the thermostats will be programmed to these values; and • Where an anchor tenant (at least 30% of NLA) has been confirmed for a speculative development, an executed lease agreement or letter from the tenant confirming their agreement for operating within this broader temperature band, is provided.	Where the design temperature range is within the relevant range below for the space occupancy type, the *Reference building* shall use the same control band as the *Proposed building*. Where the design temperature range is outside of this range, the Reference building shall use the temperature limits described in the NCC 2025 Section J Specification S34C2 (c): • For transitory occupancy – within the temperature range 18 to 25 °C for at least 95% of plant operating hours (excluding the first hour of operation in each day) in all conditioned spaces, and, • For all other conditioned spaces - within the temperature range 21 to 24 °C for at least 95% of plant operating hours (excluding the first hour of operation in each day) in all conditioned spaces. The intent of this requirement is so that the *Reference building* matches the *Proposed building*'s level of occupant service. Additionally, gains in energy efficiency do not come at the expense of comfort, except where the building owner has explicitly accepted this outcome. For any spaces where humidity control is also provided, the *Reference building* shall use the same temperature and humidity control bands as the *Proposed building*. Exceptions to the above are as follows: • Swimming pools: as per design conditions • Kitchens (preparation and store areas): as per design conditions
Maximum occupancy	The maximum occupancies that should be used in conjunction with the appropriate occupancy schedules, is the maximum design occupancy when known. Where it is not known, the occupancies given in NCC Section D Table D2D18 should be used.	As *Proposed building* (per NCC Section J Specification S34C3 (6)(e) and Specification 45 Table S45C (3)(d)).
Sensible and latent heat gain per person	The degree of activity within each space must be assessed by the design team and the appropriate sensible and latent gains used, and must be appropriate for the space design temperature.	As *Proposed building* (per NCC Section J Specification S34C3 (6)(e)).

Item	Proposed building	Reference building
	Acceptable sources of metabolic rates *ASHRAE Standard 55-2013* (or later) and *CIBSE Guide A*.	
Maximum lighting	The maximum lighting power density that should be used in conjunction with the lighting profile should be the adjusted lighting power density based on the *Proposed building* lighting design and control i.e. after the adjustment factors (refer to *Automatic lighting controls*) have been applied.	The maximum lighting power density that is permitted by NCC Section J Clause J7D3. For residential units in a Class 2 building, as *Proposed building,* using day- and night-time lighting power densities in NCC Section J Specification 45 Table S45C3d.
Maximum equipment	The equipment loads that must be used in conjunction with the equipment profiles are given in Table 4 below.	As *Proposed building*. For residential units in a Class 2 building, as *Proposed building,* using cooking and appliances power density in NCC Section J Specification 45 Table S45C3d.
Outdoor air rate	Outdoor air rates must be in accordance with the design. Outdoor air rates may be modulated if demand-controlled ventilation systems are specified; otherwise the design outdoor air rate must be simulated at all times during the projects operating hours.	*Reference building* outdoor air rate must be as per NCC Section J Specification S34C2(a)(ii)„ i.e. “the amount of ventilation required by Part F4” and Part J6D4 (1).
Energy usage calculations	Energy usage for all items of plant must consider: • Part load performance, • plant staging, • For cooling plant – impact of chilled water temperature, condenser water temperature, ambient temperature on plant efficiency, pumps, thermal losses, auxiliary equipment such as controls or oil heating; • For heating plant – impact of water temperature on plant efficiency, pumps, thermal losses and thermal mass • Fan and pumps methods of capacity regulation, and fixed/variable pressure controls, fixed static pressure head	As specified in Tables 63 and 64.

Note 1: Healthcare interventional suites (such as surgical operating theatres) are excluded from the requirements of NCC Section J Part J7. For these space types, a Reference building lighting power density of 25 W/m² shall be assumed.

Table 4: Additional HVAC simulation parameters for a class 2 sole-occupancy unit (apartment)

Item	Proposed building	Reference building
Heating and cooling load calculations	The amount of energy that is removed from conditioned spaces annually using the HVAC system must be calculated	As per the *Proposed building* (NCC Section J Specification S45C3).

Item	Proposed building	Reference building
	using the heating degree hours, cooling degree hours and dehumidification gram hours given in NCC Section J Specification 45 Table S45C3.	
Internal zones	The HVAC simulation must include separate Internal zones for daytime air-conditioned zones, kitchen zones, bedroom and other zones, using the assumptions given in NCC Section J Specification S45C3.	As *Proposed building*.

Table 5: HVAC system simulation equipment loads

Space type (note 1)		Equipment load (W/m²)
Office (including any BCA Class 5-type space in a building of another classification)		11
Industrial space	Where temperature control is localised and is not designed to handle equipment loads (e.g. manufacturing space)	0
	General industrial spaces (e.g. laboratory, workshop, warehouse)	15
	Where the HVAC system has been specifically designed to handle the equipment loads from a defined industrial process (e.g. clean room, server room, cold room)	Realistic operational loads must be estimated by the design team. The design loadings must not be used as these are intended to be maximum loads and not realistic operational loads. The methodology must be clearly documented.
Retail	Showroom (including in a building of another classification)	5
	Stores	40
	Mall, food court, public amenities	Realistic operational loads must be estimated by the design team. The design loadings must not be used as these are intended to be maximum loads and not realistic operational loads. The methodology must be clearly documented.
Fire Station		8 (office areas) 1 (all other areas)
Kitchen		Realistic operational loads (sensible and latent) must be estimated by the design team, including consideration of the effect of exhaust ventilation on the load manifested in the space relative to the total heat and moisture generated by the kitchen equipment. The design loadings must not be used as these are

Space type (note 1)		Equipment load (W/m²)
		intended to be maximum loads and not realistic operational loads. The methodology must be clearly documented.
Gymnasium (including any gymnasium space in a building of another classification)		15
Secondary spaces (e.g. circulation, corridors, stairways, store rooms, car parks)		0
Healthcare		Realistic operational loads must be estimated by the design team. The design loadings must not be used as these are intended to be maximum loads and not realistic operational loads. The methodology must be clearly documented.
Residential	Living Space	1100 W (sensible), 750 W (latent) (with kitchen) 0 (excluding kitchen)
	Bedrooms	0
School	Classroom, multi-purpose space, library	5
	Computer/science laboratory	27
	Canteen, workshop	25
University	Dry laboratories, specialist learning spaces, libraries	27
	Wet laboratories	40

Note 1: For any space types not referenced in this table, realistic operational loads must be estimated by the design team. The design loadings must not be used as these are intended to be maximum loads and not realistic operational loads. The methodology must be clearly documented.

Appendix C. Default operating schedules

This section contains the occupancy and operational profiles which must be applied to each zone within the project under assessment for calculation of the annual energy consumption.

In all cases, system operating hours are based on one hour of preconditioning occurring prior to the start of project occupancy. The modeller should verify that design temperatures are met at the start of project occupancy in the *Proposed building*. Where this does not occur, the start time of system operation should be advanced until design temperatures are satisfied. This is not required in the *Reference building*, except to the extent required to ensure that temperatures are within the limits set by NCC Section J Specification S34C2 (c)(i).

Where a specific space usage present in the project is not included in this section, then the model may adopt any one of the following alternatives:

- Use any other operational profile in this section that suitably reflects the hours of operation and variability of internal heat gains
- Use any other operational profile from NCC Section J Specification S35C2 that suitably reflects the hours of operation and variability of internal heat gains
- Use any other operational profile from the Handbook for Estimating NABERS Ratings that suitably reflects the hours of operation and variability of internal heat gains.

The equivalent full-load hours (per day type) are stated for all profiles and should be used as the basis of evaluation of the variance (refer to *Operating profiles*).

Office

To be used for all NCC Class 5 areas, in both NCC Class 5 and other building types, and for minor spaces which accommodate clerical or administrative type activities, where occupants are primarily working seated at desks.

Table 6: Office operating schedules

Hour of day	Weekday				Weekend			
	Occup	Lighting	Equip	HVAC	Occup	Lighting	Equip	HVAC
1	0%	15%	50%	OFF	0%	15%	50%	OFF
2	0%	15%	50%	OFF	0%	15%	50%	OFF
3	0%	15%	50%	OFF	0%	15%	50%	OFF
4	0%	15%	50%	OFF	0%	15%	50%	OFF
5	0%	15%	50%	OFF	0%	15%	50%	OFF
6	0%	15%	50%	OFF	0%	15%	50%	OFF
7	0%	15%	50%	OFF	0%	15%	50%	OFF
8	10%	40%	65%	ON	0%	15%	50%	OFF
9	20%	90%	80%	ON	5%	25%	55%	OFF
10	70%	100%	100%	ON	5%	25%	55%	OFF
11	70%	100%	100%	ON	5%	25%	55%	OFF
12	70%	100%	100%	ON	5%	25%	55%	OFF
13	70%	100%	100%	ON	5%	25%	55%	OFF
14	70%	100%	100%	ON	5%	25%	55%	OFF
15	70%	100%	100%	ON	5%	25%	55%	OFF
16	70%	100%	100%	ON	5%	25%	55%	OFF
17	70%	100%	100%	ON	5%	25%	55%	OFF
18	35%	80%	80%	ON	0%	15%	50%	OFF
19	10%	60%	65%	OFF	0%	15%	50%	OFF
20	5%	60%	55%	OFF	0%	15%	50%	OFF
21	5%	50%	55%	OFF	0%	15%	50%	OFF
22	0%	15%	50%	OFF	0%	15%	50%	OFF
23	0%	15%	50%	OFF	0%	15%	50%	OFF
24	0%	15%	50%	OFF	0%	15%	50%	OFF
Total hours	6.45	13.3	17.0	11	0.45	4.5	12.45	0

Healthcare general areas (12 hours/day)

This profile is typical of the operation of a large number of small healthcare facility spaces. It may also be appropriate for a number of hospital spaces. This profile can be applied to spaces that operate for five or seven days of the week. Examples of space types which would use this profile for five days of the week include outpatients, waiting areas, consulting areas, diagnostic areas, medical records, pathology, pharmacy, auditoriums and seminar rooms. Examples of space types which would use this profile for seven days of the week include cafes and the hospital main receptions.

Table 7: Healthcare general areas (12 hours/day) operating profiles

Hour of day	Weekday				Weekend			
	Occup	Lighting	Equip	HVAC	Occup	Lighting	Equip	HVAC
1	0%	10%	10%	OFF	0%	10%	10%	OFF
2	0%	10%	10%	OFF	0%	10%	10%	OFF
3	0%	10%	10%	OFF	0%	10%	10%	OFF
4	0%	10%	10%	OFF	0%	10%	10%	OFF
5	0%	10%	10%	OFF	0%	10%	10%	OFF
6	0%	10%	10%	OFF	0%	10%	10%	OFF
7	0%	10%	15%	OFF	0%	10%	10%	OFF
8	15%	40%	25%	ON	0%	10%	10%	OFF
9	50%	80%	70%	ON	0%	10%	10%	OFF
10	70%	100%	100%	ON	0%	10%	10%	OFF
11	70%	100%	100%	ON	0%	10%	10%	OFF
12	70%	100%	100%	ON	0%	10%	10%	OFF
13	70%	100%	100%	ON	0%	10%	10%	OFF
14	70%	100%	100%	ON	0%	10%	10%	OFF
15	70%	100%	100%	ON	0%	10%	10%	OFF
16	70%	100%	100%	ON	0%	10%	10%	OFF
17	70%	100%	100%	ON	0%	10%	10%	OFF
18	50%	80%	60%	ON	0%	10%	10%	OFF
19	15%	60%	25%	ON	0%	10%	10%	OFF
20	5%	40%	15%	OFF	0%	10%	10%	OFF
21	5%	20%	15%	OFF	0%	10%	10%	OFF
22	0%	10%	10%	OFF	0%	10%	10%	OFF
23	0%	10%	10%	OFF	0%	10%	10%	OFF
24	0%	10%	10%	OFF	0%	10%	10%	OFF
Total hours	7.0	12.2	11.15	12.0	0	2.4	2.4	0

Healthcare general areas (24 hours/day)

Areas that are conditioned for 24 hours a day, seven days a week and that have peak operation for five days of the week and reduced operation overnight and at the weekends. These profiles are typical of the operation of a large number of hospitals space types. They may also be appropriate for some spaces in smaller healthcare facilities. Examples of spaces that would use these profiles include medical imaging, recovery, central sterilising services department, pathology and pharmacy areas, within a hospital.

Table 8: Healthcare general areas (24 hours/day) operating profiles

Hour of day	Weekday				(excl 7 day/week areas)			
	Occup	Lighting	Equip	HVAC	Occup	Lighting	Equip	HVAC
1	10%	25%	30%	ON	10%	25%	30%	ON
2	10%	25%	30%	ON	10%	25%	30%	ON
3	10%	25%	30%	ON	10%	25%	30%	ON
4	10%	25%	30%	ON	10%	25%	30%	ON
5	10%	25%	30%	ON	10%	25%	30%	ON
6	10%	25%	30%	ON	10%	25%	30%	ON
7	10%	25%	30%	ON	10%	25%	30%	ON
8	15%	40%	50%	ON	10%	25%	30%	ON
9	60%	80%	70%	ON	10%	25%	30%	ON
10	70%	100%	100%	ON	10%	25%	30%	ON
11	70%	100%	100%	ON	10%	25%	30%	ON
12	70%	100%	100%	ON	10%	25%	30%	ON
13	70%	100%	100%	ON	10%	25%	30%	ON
14	70%	100%	100%	ON	10%	25%	30%	ON
15	70%	100%	100%	ON	10%	25%	30%	ON
16	70%	100%	100%	ON	10%	25%	30%	ON
17	70%	100%	100%	ON	10%	25%	30%	ON
18	50%	80%	60%	ON	10%	25%	30%	ON
19	15%	60%	30%	ON	10%	25%	30%	ON
20	10%	40%	30%	ON	10%	25%	30%	ON
21	10%	25%	30%	ON	10%	25%	30%	ON
22	10%	25%	30%	ON	10%	25%	30%	ON
23	10%	25%	30%	ON	10%	25%	30%	ON
24	10%	25%	30%	ON	10%	25%	30%	ON
Total hours	8.2	12.75	13.7	24	2.4	6.0	7.2	24

Healthcare interventional suite (12 hours/day)

Operating suite areas that will predominantly operate five days per week (Mon-Fri) for 12 hours per day. While it might be expected that the operating suite may be used on weekends, this is not its expected primary use pattern. Examples of spaces that would use this profile include general and endoscopy operating suite areas.

Table 9: Healthcare interventional suite (12 hours/day) operating profiles

Hour of day	Weekday				Weekend			
	Occup	Lighting	Equip	HVAC	Occup	Lighting	Equip	HVAC
1	0%	15%	15%	ON	0%	15%	30%	ON
2	0%	15%	15%	ON	0%	15%	30%	ON
3	0%	15%	15%	ON	0%	15%	30%	ON
4	0%	15%	15%	ON	0%	15%	30%	ON
5	0%	15%	15%	ON	0%	15%	30%	ON
6	0%	15%	15%	ON	0%	15%	30%	ON
7	30%	50%	50%	ON	0%	15%	30%	ON
8	30%	50%	50%	ON	0%	15%	30%	ON
9	50%	80%	80%	ON	0%	15%	30%	ON
10	60%	90%	90%	ON	30%	50%	50%	ON
11	70%	90%	90%	ON	30%	50%	50%	ON
12	70%	90%	90%	ON	30%	50%	50%	ON
13	70%	90%	90%	ON	30%	50%	50%	ON
14	70%	90%	90%	ON	30%	50%	50%	ON
15	70%	90%	90%	ON	30%	50%	50%	ON
16	60%	90%	90%	ON	0%	15%	30%	ON
17	50%	80%	80%	ON	0%	15%	30%	ON
18	30%	50%	50%	ON	0%	15%	30%	ON
19	0%	15%	15%	ON	0%	15%	30%	ON
20	0%	15%	15%	ON	0%	15%	30%	ON
21	0%	15%	15%	ON	0%	15%	30%	ON
22	0%	15%	15%	ON	0%	15%	30%	ON
23	0%	15%	15%	ON	0%	15%	30%	ON
24	0%	15%	15%	ON	0%	15%	30%	ON
Total hours	6.6	11.2	11.2	24	1.8	5.7	8.4	24

Healthcare interventional suite – 24 hours/day

This profile should be used for interventional suites that are intended to be in operation for 24 hours per day, seven days per week. A typical area that would use this profile is an operating suite in the emergency department of a hospital.

Table 10: Healthcare interventional suite (24 hours/day) operating profiles

Hour of day	All days			
	Occup	Lighting	Equip	HVAC
1	15%	25%	30%	ON
2	15%	25%	30%	ON
3	15%	25%	30%	ON
4	15%	25%	30%	ON
5	15%	25%	30%	ON
6	20%	30%	40%	ON
7	25%	40%	45%	ON
8	30%	50%	50%	ON
9	50%	80%	80%	ON
10	60%	90%	90%	ON
11	70%	90%	90%	ON
12	70%	90%	90%	ON
13	70%	90%	90%	ON
14	70%	90%	90%	ON
15	70%	90%	90%	ON
16	60%	90%	90%	ON
17	50%	80%	80%	ON
18	30%	50%	50%	ON
19	25%	40%	45%	ON
20	20%	30%	40%	ON
21	15%	25%	30%	ON
22	15%	25%	30%	ON
23	15%	25%	30%	ON
24	15%	25%	30%	ON
Total hours	8.55	12.55	13.3	24

Healthcare emergency department

This profile should be used for all emergency department areas (except for the emergency interventional suites, which should use the Interventional Suite – 24 hour profile). All emergency areas are assumed to be conditioned for 24 hours per day, seven days per week. Two profiles are provided; one that should be used for the off-peak period between Sunday and Thursday and the other that should be used for the peak period of Friday and Saturday.

Table 11: Healthcare emergency department operating profiles

Hour of day	Sunday – Thursday				Friday – Saturday			
	Occup	Lighting	Equip	HVAC	Occup	Lighting	Equip	HVAC
1	10%	100%	50%	ON	10%	100%	50%	ON
2	10%	100%	50%	ON	10%	100%	50%	ON
3	10%	100%	50%	ON	10%	100%	50%	ON
4	10%	100%	50%	ON	10%	100%	50%	ON
5	10%	100%	50%	ON	10%	100%	50%	ON
6	10%	100%	50%	ON	10%	100%	50%	ON
7	10%	100%	50%	ON	10%	100%	50%	ON
8	20%	100%	55%	ON	20%	100%	55%	ON
9	30%	100%	60%	ON	30%	100%	60%	ON
10	40%	100%	70%	ON	40%	100%	75%	ON
11	50%	100%	80%	ON	50%	100%	80%	ON
12	50%	100%	80%	ON	60%	100%	80%	ON
13	50%	100%	80%	ON	60%	100%	80%	ON
14	50%	100%	80%	ON	60%	100%	80%	ON
15	50%	100%	80%	ON	60%	100%	80%	ON
16	50%	100%	80%	ON	60%	100%	80%	ON
17	40%	100%	70%	ON	70%	100%	85%	ON
18	30%	100%	60%	ON	80%	100%	90%	ON
19	20%	100%	55%	ON	90%	100%	95%	ON
20	10%	100%	50%	ON	100%	100%	100%	ON
21	10%	100%	50%	ON	100%	100%	100%	ON
22	10%	100%	50%	ON	100%	100%	100%	ON
23	10%	100%	50%	ON	100%	100%	100%	ON
24	10%	100%	50%	ON	100%	100%	100%	ON
Total hours	6.0	24	14.5	24	12.5	24	17.9	24

Healthcare inpatient units

All areas that are for the care and recovery of patients (in beds) which are occupied 24 hours per day, seven days per week. Areas that are expected to use this profile are all inpatient wards, maternity wards and critical care areas. It should also be used for the ward offices and nurse's stations.

Table 12: Healthcare inpatient unit operating profiles

Hour of day	All days			
	Occup	Lighting	Equip	HVAC
1	50%	10%	70%	ON
2	50%	10%	70%	ON
3	50%	10%	70%	ON
4	50%	10%	70%	ON
5	50%	10%	70%	ON
6	50%	25%	70%	ON
7	50%	25%	70%	ON
8	60%	80%	70%	ON
9	60%	100%	70%	ON
10	70%	100%	70%	ON
11	70%	100%	70%	ON
12	70%	100%	70%	ON
13	70%	100%	70%	ON
14	70%	100%	70%	ON
15	70%	100%	70%	ON
16	70%	100%	70%	ON
17	70%	100%	70%	ON
18	60%	80%	70%	ON
19	60%	25%	70%	ON
20	50%	25%	70%	ON
21	50%	25%	70%	ON
22	50%	10%	70%	ON
23	50%	10%	70%	ON
24	50%	10%	70%	ON
Total hours	14.0	12.65	16.8	24

Kitchens

This profile should be used for large kitchens for full catering operations. The profile assumes 16 hour operation, seven days per week.

Table 13: Kitchen operating profiles

Hour of day	All days			
	Occup	Lighting	Equip	HVAC
1	0%	10%	10%	OFF
2	0%	10%	10%	OFF
3	0%	10%	10%	OFF
4	0%	10%	10%	OFF
5	0%	10%	10%	OFF
6	70%	100%	100%	ON
7	70%	100%	100%	ON
8	70%	100%	100%	ON
9	50%	100%	50%	ON
10	50%	100%	50%	ON
11	70%	100%	100%	ON
12	70%	100%	100%	ON
13	70%	100%	100%	ON
14	50%	100%	50%	ON
15	50%	100%	50%	ON
16	70%	100%	100%	ON
17	70%	100%	100%	ON
18	60%	100%	100%	ON
19	50%	100%	50%	ON
20	50%	100%	50%	ON
21	50%	100%	50%	ON
22	0%	10%	10%	OFF
23	0%	10%	10%	OFF
24	0%	10%	10%	OFF
Total hours	9.7	16.8	13.3	13.3

Circulation (12 hours/day)

This profile should be used for all spaces that are lit and have low-level transient occupancy during the day only. This profile is expected to be used for corridors and stairways within facilities or departments with daytime operation only. Note that waiting areas are not considered transitory spaces.

Table 14: Circulation (12 hours/day) profiles

Hour of day	Weekday				Weekend			
	Occup	Lighting	Equip	HVAC	Occup	Lighting	Equip	HVAC
1	0%	10%	0%	OFF	0%	10%	0%	OFF
2	0%	10%	0%	OFF	0%	10%	0%	OFF
3	0%	10%	0%	OFF	0%	10%	0%	OFF
4	0%	10%	0%	OFF	0%	10%	0%	OFF
5	0%	10%	0%	OFF	0%	10%	0%	OFF
6	0%	10%	0%	OFF	0%	10%	0%	OFF
7	0%	10%	0%	OFF	0%	10%	0%	OFF
8	0%	40%	0%	ON	0%	10%	0%	OFF
9	0%	80%	0%	ON	0%	10%	0%	OFF
10	0%	100%	0%	ON	0%	10%	0%	OFF
11	0%	100%	0%	ON	0%	10%	0%	OFF
12	0%	100%	0%	ON	0%	10%	0%	OFF
13	0%	100%	0%	ON	0%	10%	0%	OFF
14	0%	100%	0%	ON	0%	10%	0%	OFF
15	0%	100%	0%	ON	0%	10%	0%	OFF
16	0%	100%	0%	ON	0%	10%	0%	OFF
17	0%	100%	0%	ON	0%	10%	0%	OFF
18	0%	80%	0%	ON	0%	10%	0%	OFF
19	0%	60%	0%	ON	0%	10%	0%	OFF
20	0%	40%	0%	OFF	0%	10%	0%	OFF
21	0%	20%	0%	OFF	0%	10%	0%	OFF
22	0%	10%	0%	OFF	0%	10%	0%	OFF
23	0%	10%	0%	OFF	0%	10%	0%	OFF
24	0%	10%	0%	OFF	0%	10%	0%	OFF
TOTAL	0	12.2	0	12	0	2.4	0	0

Circulation (24 hours/day)

This profile should be used for all spaces that are lit and have low-level transient occupancy 24 hours per day, 7 days per week. This profile is expected to be used for corridors and stairways within facilities or departments with 24-hour operation. Note that waiting areas are not considered transitory spaces.

Table 15: circulation (24 hours/day) profiles

Hour of day	All days			
	Occup	Lighting	Equip	HVAC
1	0%	100%	0%	ON
2	0%	100%	0%	ON
3	0%	100%	0%	ON
4	0%	100%	0%	ON
5	0%	100%	0%	ON
6	0%	100%	0%	ON
7	0%	100%	0%	ON
8	0%	100%	0%	ON
9	0%	100%	0%	ON
10	0%	100%	0%	ON
11	0%	100%	0%	ON
12	0%	100%	0%	ON
13	0%	100%	0%	ON
14	0%	100%	0%	ON
15	0%	100%	0%	ON
16	0%	100%	0%	ON
17	0%	100%	0%	ON
18	0%	100%	0%	ON
19	0%	100%	0%	ON
20	0%	100%	0%	ON
21	0%	100%	0%	ON
22	0%	100%	0%	ON
23	0%	100%	0%	ON
24	0%	100%	0%	ON
TOTAL	0	24.0	0	24

Back of house

This profile should be used for back of house spaces which have very low transient occupancy and that are only lit during those periods of occupancy. Examples of areas that would use this profile are engineering or maintenance services, mechanical services and materials management areas. The HVAC section of this profile only applies to those back of house spaces which are conditioned; for all other areas, this should be taken as OFF. Regardless of the conditioning of the space, lighting is to be modelled as per this profile.

Table 16: Back of house operational profiles

Hour of day	Weekday				Weekend			
	Occup	Lighting	Equip	HVAC	Occup	Lighting	Equip	HVAC
1	0%	10%	10%	OFF	0%	10%	10%	OFF
2	0%	10%	10%	OFF	0%	10%	10%	OFF
3	0%	10%	10%	OFF	0%	10%	10%	OFF
4	0%	10%	10%	OFF	0%	10%	10%	OFF
5	0%	10%	10%	OFF	0%	10%	10%	OFF
6	0%	10%	10%	OFF	0%	10%	10%	OFF
7	0%	10%	10%	OFF	0%	10%	10%	OFF
8	0%	50%	15%	ON	0%	10%	10%	OFF
9	0%	50%	70%	ON	0%	10%	10%	OFF
10	0%	50%	100%	ON	0%	10%	10%	OFF
11	0%	50%	100%	ON	0%	10%	10%	OFF
12	0%	50%	100%	ON	0%	10%	10%	OFF
13	0%	50%	100%	ON	0%	10%	10%	OFF
14	0%	50%	100%	ON	0%	10%	10%	OFF
15	0%	50%	100%	ON	0%	10%	10%	OFF
16	0%	50%	100%	ON	0%	10%	10%	OFF
17	0%	50%	100%	ON	0%	10%	10%	OFF
18	0%	50%	60%	ON	0%	10%	10%	OFF
19	0%	50%	25%	ON	0%	10%	10%	OFF
20	0%	10%	15%	OFF	0%	10%	10%	OFF
21	0%	10%	15%	OFF	0%	10%	10%	OFF
22	0%	10%	10%	OFF	0%	10%	10%	OFF
23	0%	10%	10%	OFF	0%	10%	10%	OFF
24	0%	10%	10%	OFF	0%	10%	10%	OFF
Total hours	0	7.2	11.0	12	0	2.4	2.4	0

School classroom and multipurpose spaces

This profile should be used for all teaching spaces, including computer and science laboratories, manual workshops, and libraries. This profile should also be used for common spaces and gymnasia, except that the equipment load will be 0% at all times.

Table 17: School classroom or multipurpose space operational profiles

Hour of day	Weekday				Weekend			
	Occup	Lighting	Equip	HVAC	Occup	Lighting	Equip	HVAC
1	0%	5%	5%	OFF	0%	10%	10%	OFF
2	0%	5%	5%	OFF	0%	10%	10%	OFF
3	0%	5%	5%	OFF	0%	10%	10%	OFF
4	0%	5%	5%	OFF	0%	10%	10%	OFF
5	0%	5%	5%	OFF	0%	10%	10%	OFF
6	0%	5%	5%	OFF	0%	10%	10%	OFF
7	0%	30%	85%	OFF	0%	10%	10%	OFF
8	15%	30%	85%	ON	0%	10%	10%	OFF
9	15%	100%	100%	ON	0%	10%	10%	OFF
10	100%	100%	100%	ON	0%	10%	10%	OFF
11	100%	100%	100%	ON	0%	10%	10%	OFF
12	100%	50%	70%	ON	0%	10%	10%	OFF
13	50%	100%	100%	ON	0%	10%	10%	OFF
14	100%	100%	100%	ON	0%	10%	10%	OFF
15	100%	100%	100%	ON	0%	10%	10%	OFF
16	100%	100%	100%	ON	0%	10%	10%	OFF
17	100%	30%	30%	ON	0%	10%	10%	OFF
18	15%	30%	30%	OFF	0%	10%	10%	OFF
19	15%	5%	5%	OFF	0%	10%	10%	OFF
20	0%	5%	5%	OFF	0%	10%	10%	OFF
21	0%	5%	5%	OFF	0%	10%	10%	OFF
22	0%	5%	5%	OFF	0%	10%	10%	OFF
23	0%	5%	5%	OFF	0%	10%	10%	OFF
24	0%	5%	5%	OFF	0%	10%	10%	OFF
Total hours	8.1	9.3	10.6	10	0	2.4	2.4	0

School canteen

Table 18: School canteen operational profiles

Hour of day	Weekday				Weekend			
	Occup	Lighting	Equip	HVAC	Occup	Lighting	Equip	HVAC
1	0%	0%	10%	OFF	0%	0%	10%	OFF
2	0%	0%	10%	OFF	0%	0%	10%	OFF
3	0%	0%	10%	OFF	0%	0%	10%	OFF
4	0%	0%	10%	OFF	0%	0%	10%	OFF
5	0%	0%	10%	OFF	0%	0%	10%	OFF
6	0%	0%	10%	OFF	0%	0%	10%	OFF
7	0%	0%	10%	OFF	0%	0%	10%	OFF
8	0%	0%	10%	OFF	0%	0%	10%	OFF
9	0%	0%	10%	OFF	0%	0%	10%	OFF
10	0%	0%	10%	ON	0%	0%	10%	OFF
11	50%	100%	50%	ON	0%	0%	10%	OFF
12	100%	100%	100%	ON	0%	0%	10%	OFF
13	100%	100%	100%	ON	0%	0%	10%	OFF
14	100%	100%	100%	ON	0%	0%	10%	OFF
15	100%	100%	100%	ON	0%	0%	10%	OFF
16	0%	0%	10%	ON	0%	0%	10%	OFF
17	0%	0%	10%	OFF	0%	0%	10%	OFF
18	0%	0%	10%	OFF	0%	0%	10%	OFF
19	0%	0%	10%	OFF	0%	0%	10%	OFF
20	0%	0%	10%	OFF	0%	0%	10%	OFF
21	0%	0%	10%	OFF	0%	0%	10%	OFF
22	0%	0%	10%	OFF	0%	0%	10%	OFF
23	0%	0%	10%	OFF	0%	0%	10%	OFF
24	0%	0%	10%	OFF	0%	0%	10%	OFF
Total hours	4.5	5.0	6.5	7.0	0	0	2.4	0

University teaching and classroom spaces

Table 19: University teaching and classroom space operational profiles

Hour of day	Weekday				Weekend			
	Occup	Lighting	Equip	HVAC	Occup	Lighting	Equip	HVAC
1	0%	5%	0%	OFF	0%	5%	0%	OFF
2	0%	5%	0%	OFF	0%	5%	0%	OFF
3	0%	5%	0%	OFF	0%	5%	0%	OFF
4	0%	5%	0%	OFF	0%	5%	0%	OFF
5	0%	5%	0%	OFF	0%	5%	0%	OFF
6	0%	5%	0%	OFF	0%	5%	0%	OFF
7	0%	5%	0%	OFF	0%	5%	0%	OFF
8	50%	50%	0%	ON	0%	5%	0%	OFF
9	50%	100%	0%	ON	0%	5%	0%	OFF
10	100%	100%	0%	ON	0%	5%	0%	OFF
11	100%	100%	0%	ON	0%	5%	0%	OFF
12	100%	80%	0%	ON	0%	5%	0%	OFF
13	50%	100%	0%	ON	0%	5%	0%	OFF
14	100%	100%	0%	ON	0%	5%	0%	OFF
15	100%	100%	0%	ON	0%	5%	0%	OFF
16	100%	100%	0%	ON	0%	5%	0%	OFF
17	100%	100%	0%	ON	0%	5%	0%	OFF
18	20%	20%	0%	OFF	0%	5%	0%	OFF
19	20%	20%	0%	OFF	0%	5%	0%	OFF
20	20%	20%	0%	OFF	0%	5%	0%	OFF
21	5%	5%	0%	OFF	0%	5%	0%	OFF
22	5%	5%	0%	OFF	0%	5%	0%	OFF
23	5%	5%	0%	OFF	0%	5%	0%	OFF
24	5%	5%	0%	OFF	0%	5%	0%	OFF
Total hours	9.3	10.45	0	10	0	1.2	0	0

University dry laboratories, speciality learning spaces and libraries

Table 20: University dry laboratory, speciality learning space and library operational profiles

Hour of day	Weekday				Weekend			
	Occup	Lighting	Equip	HVAC	Occup	Lighting	Equip	HVAC
1	0%	5%	5%	OFF	0%	5%	5%	OFF
2	0%	5%	5%	OFF	0%	5%	5%	OFF
3	0%	5%	5%	OFF	0%	5%	5%	OFF
4	0%	5%	5%	OFF	0%	5%	5%	OFF
5	0%	5%	5%	OFF	0%	5%	5%	OFF
6	0%	5%	5%	OFF	0%	5%	5%	OFF
7	0%	5%	5%	OFF	0%	5%	5%	OFF
8	50%	50%	50%	ON	0%	5%	5%	OFF
9	50%	50%	50%	ON	0%	5%	5%	OFF
10	100%	100%	100%	ON	0%	5%	5%	OFF
11	100%	100%	100%	ON	0%	5%	5%	OFF
12	100%	100%	100%	ON	0%	5%	5%	OFF
13	50%	80%	70%	ON	0%	5%	5%	OFF
14	100%	100%	100%	ON	0%	5%	5%	OFF
15	100%	100%	100%	ON	0%	5%	5%	OFF
16	100%	100%	100%	ON	0%	5%	5%	OFF
17	100%	100%	100%	ON	0%	5%	5%	OFF
18	20%	20%	20%	OFF	0%	5%	5%	OFF
19	20%	20%	20%	OFF	0%	5%	5%	OFF
20	20%	20%	20%	OFF	0%	5%	5%	OFF
21	0%	5%	5%	OFF	0%	5%	5%	OFF
22	0%	5%	5%	OFF	0%	5%	5%	OFF
23	0%	5%	5%	OFF	0%	5%	5%	OFF
24	0%	5%	5%	OFF	0%	5%	5%	OFF
Total hours	9.1	9.95	9.85	10	0	1.2	1.2	0

University common spaces

Table 21: University common space operational profiles

Hour of day	Weekday				Weekend			
	Occup	Lighting	Equip	HVAC	Occup	Lighting	Equip	HVAC
1	0%	5%	0%	OFF	0%	5%	5%	OFF
2	0%	5%	0%	OFF	0%	5%	5%	OFF
3	0%	5%	0%	OFF	0%	5%	5%	OFF
4	0%	5%	0%	OFF	0%	5%	5%	OFF
5	0%	5%	0%	OFF	0%	5%	5%	OFF
6	0%	5%	0%	OFF	0%	5%	5%	OFF
7	0%	5%	0%	OFF	0%	5%	5%	OFF
8	5%	30%	0%	ON	0%	5%	5%	OFF
9	15%	30%	0%	ON	0%	5%	5%	OFF
10	100%	100%	0%	ON	0%	5%	5%	OFF
11	100%	100%	0%	ON	0%	5%	5%	OFF
12	100%	100%	0%	ON	0%	5%	5%	OFF
13	50%	80%	0%	ON	0%	5%	5%	OFF
14	100%	100%	0%	ON	0%	5%	5%	OFF
15	100%	100%	0%	ON	0%	5%	5%	OFF
16	100%	100%	0%	ON	0%	5%	5%	OFF
17	100%	100%	0%	ON	0%	5%	5%	OFF
18	20%	30%	0%	OFF	0%	5%	5%	OFF
19	5%	30%	0%	OFF	0%	5%	5%	OFF
20	0%	5%	0%	OFF	0%	5%	5%	OFF
21	0%	5%	0%	OFF	0%	5%	5%	OFF
22	0%	5%	0%	OFF	0%	5%	5%	OFF
23	0%	5%	0%	OFF	0%	5%	5%	OFF
24	0%	5%	0%	OFF	0%	5%	5%	OFF
Total hours	7.95	9.6	0	10	0	1.2	1.2	0

University wet laboratories

Table 22: University wet laboratory operational profiles

Hour of day	Weekday				Weekend			
	Occup	Lighting	Equip	HVAC	Occup	Lighting	Equip	HVAC
1	0%	15%	5%	OFF	0%	15%	5%	OFF
2	0%	15%	5%	OFF	0%	15%	5%	OFF
3	0%	15%	5%	OFF	0%	15%	5%	OFF
4	0%	15%	5%	OFF	0%	15%	5%	OFF
5	0%	15%	5%	OFF	0%	15%	5%	OFF
6	0%	15%	5%	OFF	0%	15%	5%	OFF
7	15%	15%	25%	OFF	0%	15%	5%	OFF
8	15%	15%	25%	ON	0%	15%	5%	OFF
9	100%	100%	100%	ON	0%	15%	5%	OFF
10	100%	100%	100%	ON	0%	15%	5%	OFF
11	100%	100%	100%	ON	0%	15%	5%	OFF
12	100%	100%	100%	ON	0%	15%	5%	OFF
13	50%	80%	70%	ON	0%	15%	5%	OFF
14	100%	100%	100%	ON	0%	15%	5%	OFF
15	100%	100%	100%	ON	0%	15%	5%	OFF
16	100%	100%	100%	ON	0%	15%	5%	OFF
17	100%	100%	100%	ON	0%	15%	5%	OFF
18	100%	100%	100%	OFF	0%	15%	5%	OFF
19	35%	50%	40%	OFF	0%	15%	5%	OFF
20	35%	50%	40%	OFF	0%	15%	5%	OFF
21	35%	50%	40%	OFF	0%	15%	5%	OFF
22	35%	50%	40%	OFF	0%	15%	5%	OFF
23	0%	15%	5%	OFF	0%	15%	5%	OFF
24	0%	15%	5%	OFF	0%	15%	5%	OFF
Total hours	11.2	11.3	12.2	10	0	3.6	1.2	0

University gymnasia

Table 23: University gymnasium operational profiles

Hour of day	Weekday				Weekend			
	Occup	Lighting	Equip	HVAC	Occup	Lighting	Equip	HVAC
1	0%	5%	5%	OFF	0%	5%	5%	OFF
2	0%	5%	5%	OFF	0%	5%	5%	OFF
3	0%	5%	5%	OFF	0%	5%	5%	OFF
4	0%	5%	5%	OFF	0%	5%	5%	OFF
5	0%	5%	5%	OFF	0%	5%	5%	OFF
6	0%	5%	5%	OFF	0%	5%	5%	OFF
7	80%	100%	80%	ON	0%	5%	5%	OFF
8	80%	100%	80%	ON	0%	5%	5%	OFF
9	80%	100%	80%	ON	0%	5%	5%	OFF
10	25%	100%	25%	ON	0%	5%	5%	OFF
11	25%	100%	25%	ON	0%	5%	5%	OFF
12	25%	100%	25%	ON	0%	5%	5%	OFF
13	100%	100%	100%	ON	0%	5%	5%	OFF
14	100%	100%	100%	ON	0%	5%	5%	OFF
15	25%	100%	25%	ON	0%	5%	5%	OFF
16	25%	100%	25%	ON	0%	5%	5%	OFF
17	25%	100%	25%	ON	0%	5%	5%	OFF
18	80%	100%	80%	ON	0%	5%	5%	OFF
19	80%	100%	80%	ON	0%	5%	5%	OFF
20	80%	100%	80%	ON	0%	5%	5%	OFF
21	35%	100%	35%	ON	0%	5%	5%	OFF
22	35%	100%	35%	ON	0%	5%	5%	OFF
23	0%	5%	5%	OFF	0%	5%	5%	OFF
24	0%	5%	5%	OFF	0%	5%	5%	OFF
Total hours	9.0	16.4	9.4	16	0	1.2	1.2	0

Working spaces (1 shift/day)

This profile should be used for workshops, galleries, function spaces, libraries, classrooms, laboratories, clean rooms and any other space that will be occupied during normal business hours only. This profile is based on 5 day per week operation; if the space is in use for longer, the profile should be adjusted accordingly.

Table 24: Working space (1 shift/day) operational profiles

Hour of day	Weekday				Weekend			
	Occup	Lighting	Equip	HVAC	Occup	Lighting	Equip	HVAC
1	0%	15%	15%	OFF	0%	15%	15%	OFF
2	0%	15%	15%	OFF	0%	15%	15%	OFF
3	0%	15%	15%	OFF	0%	15%	15%	OFF
4	0%	15%	15%	OFF	0%	15%	15%	OFF
5	0%	15%	15%	OFF	0%	15%	15%	OFF
6	0%	15%	15%	OFF	0%	15%	15%	OFF
7	0%	15%	15%	OFF	0%	15%	15%	OFF
8	15%	40%	65%	ON	0%	15%	15%	OFF
9	50%	90%	80%	ON	0%	15%	15%	OFF
10	70%	100%	100%	ON	0%	15%	15%	OFF
11	70%	100%	100%	ON	0%	15%	15%	OFF
12	70%	100%	100%	ON	0%	15%	15%	OFF
13	70%	100%	100%	ON	0%	15%	15%	OFF
14	70%	100%	100%	ON	0%	15%	15%	OFF
15	70%	100%	100%	ON	0%	15%	15%	OFF
16	70%	100%	100%	ON	0%	15%	15%	OFF
17	70%	100%	100%	ON	0%	15%	15%	OFF
18	40%	80%	80%	ON	0%	15%	15%	OFF
19	15%	60%	65%	OFF	0%	15%	15%	OFF
20	5%	60%	55%	OFF	0%	15%	15%	OFF
21	5%	50%	55%	OFF	0%	15%	15%	OFF
22	0%	15%	15%	OFF	0%	15%	15%	OFF
23	0%	15%	15%	OFF	0%	15%	15%	OFF
24	0%	15%	15%	OFF	0%	15%	15%	OFF
Total hours	6.9	13.3	13.5	11	0	3.6	3.6	0

Industrial working spaces (>1 shift/day)

This profile should be used for warehouse spaces and production/manufacturing spaces, and any other spaces which operate with multiple shifts per day. This profile is based on 5 day per week operation; if the space is in use for longer, the profile should be adjusted accordingly.

Table 25: Industrial working space (>1 shift/day) operational profiles

Hour of day	Weekday				Weekend			
	Occup	Lighting	Equip	HVAC	Occup	Lighting	Equip	HVAC
1	0%	15%	15%	OFF	0%	15%	15%	OFF
2	0%	15%	15%	OFF	0%	15%	15%	OFF
3	0%	15%	15%	OFF	0%	15%	15%	OFF
4	0%	15%	15%	OFF	0%	15%	15%	OFF
5	15%	40%	65%	ON	0%	15%	15%	OFF
6	50%	90%	80%	ON	0%	15%	15%	OFF
7	70%	100%	100%	ON	0%	15%	15%	OFF
8	70%	100%	100%	ON	0%	15%	15%	OFF
9	70%	100%	100%	ON	0%	15%	15%	OFF
10	70%	100%	100%	ON	0%	15%	15%	OFF
11	70%	100%	100%	ON	0%	15%	15%	OFF
12	70%	100%	100%	ON	0%	15%	15%	OFF
13	70%	100%	100%	ON	0%	15%	15%	OFF
14	70%	100%	100%	ON	0%	15%	15%	OFF
15	70%	100%	100%	ON	0%	15%	15%	OFF
16	70%	100%	100%	ON	0%	15%	15%	OFF
17	70%	100%	100%	ON	0%	15%	15%	OFF
18	70%	100%	100%	ON	0%	15%	15%	OFF
19	70%	100%	100%	ON	0%	15%	15%	OFF
20	70%	100%	100%	ON	0%	15%	15%	OFF
21	70%	100%	100%	ON	0%	15%	15%	OFF
22	40%	80%	80%	ON	0%	15%	15%	OFF
23	15%	60%	65%	OFF	0%	15%	15%	OFF
24	0%	15%	15%	OFF	0%	15%	15%	OFF
Total hours	11.7	18.45	18.65	18	0	3.6	3.6	0

Industrial working spaces (24 hours/day)

This profile should be used for production/manufacturing spaces, and any other spaces which operate 24 hours per day. This profile is based on 5 day per week operation; if the space is in use for longer, the profile should be adjusted accordingly.

Table 26: Industrial working space (24 hour/day) operational profiles

Hour of day	Weekday				Weekend			
	Occup	Lighting	Equip	HVAC	Occup	Lighting	Equip	HVAC
1	70%	100%	100%	ON	0%	15%	15%	OFF
2	70%	100%	100%	ON	0%	15%	15%	OFF
3	70%	100%	100%	ON	0%	15%	15%	OFF
4	70%	100%	100%	ON	0%	15%	15%	OFF
5	70%	100%	100%	ON	0%	15%	15%	OFF
6	70%	100%	100%	ON	0%	15%	15%	OFF
7	70%	100%	100%	ON	0%	15%	15%	OFF
8	70%	100%	100%	ON	0%	15%	15%	OFF
9	70%	100%	100%	ON	0%	15%	15%	OFF
10	70%	100%	100%	ON	0%	15%	15%	OFF
11	70%	100%	100%	ON	0%	15%	15%	OFF
12	70%	100%	100%	ON	0%	15%	15%	OFF
13	70%	100%	100%	ON	0%	15%	15%	OFF
14	70%	100%	100%	ON	0%	15%	15%	OFF
15	70%	100%	100%	ON	0%	15%	15%	OFF
16	70%	100%	100%	ON	0%	15%	15%	OFF
17	70%	100%	100%	ON	0%	15%	15%	OFF
18	70%	100%	100%	ON	0%	15%	15%	OFF
19	70%	100%	100%	ON	0%	15%	15%	OFF
20	70%	100%	100%	ON	0%	15%	15%	OFF
21	70%	100%	100%	ON	0%	15%	15%	OFF
22	70%	100%	100%	ON	0%	15%	15%	OFF
23	70%	100%	100%	ON	0%	15%	15%	OFF
24	70%	100%	100%	ON	0%	15%	15%	OFF
Total hours	16.8	24.0	24.0	24	0	3.6	3.6	0

Industrial retail, factory shop and showroom

These profiles should be used for areas involved in the sale of goods, such as direct factory outlets. This profile is based on 6 day per week operation; if the space is in use for longer, the profile should be adjusted accordingly.

Table 27: Industrial retail, factory shop and showroom operational profiles

Hour of day	Monday – Saturday				Sunday			
	Occup	Lighting	Equip	HVAC	Occup	Lighting	Equip	HVAC
1	0%	15%	15%	OFF	0%	15%	15%	OFF
2	0%	15%	15%	OFF	0%	15%	15%	OFF
3	0%	15%	15%	OFF	0%	15%	15%	OFF
4	0%	15%	15%	OFF	0%	15%	15%	OFF
5	0%	15%	15%	OFF	0%	15%	15%	OFF
6	0%	15%	15%	OFF	0%	15%	15%	OFF
7	0%	15%	15%	OFF	0%	15%	15%	OFF
8	10%	100%	70%	ON	0%	15%	15%	OFF
9	20%	100%	70%	ON	0%	15%	15%	OFF
10	20%	100%	70%	ON	0%	15%	15%	OFF
11	15%	100%	70%	ON	0%	15%	15%	OFF
12	25%	100%	70%	ON	0%	15%	15%	OFF
13	25%	100%	70%	ON	0%	15%	15%	OFF
14	15%	100%	70%	ON	0%	15%	15%	OFF
15	15%	100%	70%	ON	0%	15%	15%	OFF
16	15%	100%	70%	ON	0%	15%	15%	OFF
17	15%	100%	70%	ON	0%	15%	15%	OFF
18	5%	100%	70%	ON	0%	15%	15%	OFF
19	5%	100%	70%	OFF	0%	15%	15%	OFF
20	0%	15%	15%	OFF	0%	15%	15%	OFF
21	0%	15%	15%	OFF	0%	15%	15%	OFF
22	0%	15%	15%	OFF	0%	15%	15%	OFF
23	0%	15%	15%	OFF	0%	15%	15%	OFF
24	0%	15%	15%	OFF	0%	15%	15%	OFF
Total hours	1.85	13.8	10.2	11	0	3.6	3.6	0

Common area

These profiles should be used for foyers, lobbies, reception areas, break-out spaces, lunch rooms, and small gymnasia or fitness rooms. This profile is based on 5 day per week operation; if the space is in use for longer, the profile should be adjusted accordingly.

Table 28: Common areas operational profiles

Hour of day	Monday – Saturday				Sunday			
	Occup	Lighting	Equip	HVAC	Occup	Lighting	Equip	HVAC
1	0%	15%	15%	OFF	0%	15%	15%	OFF
2	0%	15%	15%	OFF	0%	15%	15%	OFF
3	0%	15%	15%	OFF	0%	15%	15%	OFF
4	0%	15%	15%	OFF	0%	15%	15%	OFF
5	0%	15%	15%	OFF	0%	15%	15%	OFF
6	0%	15%	15%	OFF	0%	15%	15%	OFF
7	20%	100%	100%	ON	0%	15%	15%	OFF
8	50%	100%	100%	ON	0%	15%	15%	OFF
9	5%	100%	100%	ON	0%	15%	15%	OFF
10	0%	100%	100%	ON	0%	15%	15%	OFF
11	5%	100%	100%	ON	0%	15%	15%	OFF
12	85%	100%	100%	ON	0%	15%	15%	OFF
13	100%	100%	100%	ON	0%	15%	15%	OFF
14	5%	100%	100%	ON	0%	15%	15%	OFF
15	0%	100%	100%	ON	0%	15%	15%	OFF
16	50%	100%	100%	ON	0%	15%	15%	OFF
17	0%	100%	100%	ON	0%	15%	15%	OFF
18	20%	100%	100%	ON	0%	15%	15%	OFF
19	20%	100%	100%	ON	0%	15%	15%	OFF
20	0%	15%	15%	OFF	0%	15%	15%	OFF
21	0%	15%	15%	OFF	0%	15%	15%	OFF
22	0%	15%	15%	OFF	0%	15%	15%	OFF
23	0%	15%	15%	OFF	0%	15%	15%	OFF
24	0%	15%	15%	OFF	0%	15%	15%	OFF
Total hours	3.6	14.65	14.65	13	0	3.6	3.6	0

Fire stations

These profiles should be used for the sleeping and living areas of fire stations; administrative and equipment areas should use the relevant profiles from other sections. Profiles are given separately for sleeping and other areas; both of these apply 7 days per week.

Table 29: Fire station sleeping and living area operational profiles

Hour of day	Sleeping areas				Living areas			
	Occup	Lighting	Equip	HVAC	Occup	Lighting	Equip	HVAC
1	100%	0%	100%	ON	100%	100%	100%	ON
2	100%	0%	100%	ON	100%	100%	100%	ON
3	100%	0%	100%	ON	100%	100%	100%	ON
4	100%	0%	100%	ON	100%	100%	100%	ON
5	100%	0%	100%	ON	100%	100%	100%	ON
6	100%	0%	100%	ON	100%	100%	100%	ON
7	0%	100%	100%	ON	100%	50%	100%	ON
8	0%	100%	100%	ON	100%	50%	100%	ON
9	0%	0%	100%	ON	100%	50%	100%	ON
10	0%	0%	100%	ON	100%	50%	100%	ON
11	0%	0%	100%	ON	100%	50%	100%	ON
12	0%	0%	100%	ON	100%	50%	100%	ON
13	0%	0%	100%	ON	100%	50%	100%	ON
14	0%	0%	100%	ON	100%	50%	100%	ON
15	0%	0%	100%	ON	100%	50%	100%	ON
16	0%	0%	100%	ON	100%	50%	100%	ON
17	0%	0%	100%	ON	100%	50%	100%	ON
18	0%	0%	100%	ON	100%	50%	100%	ON
19	0%	100%	100%	ON	100%	100%	100%	ON
20	0%	100%	100%	ON	100%	100%	100%	ON
21	0%	100%	100%	ON	100%	100%	100%	ON
22	0%	100%	100%	ON	100%	100%	100%	ON
23	100%	100%	100%	ON	100%	100%	100%	ON
24	100%	0%	100%	ON	100%	100%	100%	ON
Total hours	8.0	7.0	24.0	24	24.0	18.0	24.0	24

Retail stores

This profile should be used for all speciality retail, mini majors, majors, department stores and food and beverage outlets. It can be used for standalone retail outlets, and those in retail shopping centres and strip malls. This profile is based on 6 day per week operation; if the space is in use for longer, the profile should be adjusted accordingly.

Table 30: Retail centre stores operational profiles

Hour of day	Monday – Saturday				Sunday			
	Occup	Lighting	Equip	HVAC	Occup	Lighting	Equip	HVAC
1	0%	5%	0%	OFF	0%	5%	0%	OFF
2	0%	5%	0%	OFF	0%	5%	0%	OFF
3	0%	5%	0%	OFF	0%	5%	0%	OFF
4	0%	5%	0%	OFF	0%	5%	0%	OFF
5	0%	5%	0%	OFF	0%	5%	0%	OFF
6	0%	5%	0%	OFF	0%	5%	0%	OFF
7	0%	5%	0%	OFF	0%	5%	0%	OFF
8	10%	100%	100%	ON	0%	5%	0%	OFF
9	85%	100%	100%	ON	0%	5%	0%	OFF
10	100%	100%	100%	ON	0%	5%	0%	OFF
11	95%	100%	100%	ON	0%	5%	0%	OFF
12	95%	100%	100%	ON	0%	5%	0%	OFF
13	75%	100%	100%	ON	0%	5%	0%	OFF
14	75%	100%	100%	ON	0%	5%	0%	OFF
15	50%	100%	100%	ON	0%	5%	0%	OFF
16	50%	100%	100%	ON	0%	5%	0%	OFF
17	50%	100%	100%	ON	0%	5%	0%	OFF
18	0%	5%	0%	OFF	0%	5%	0%	OFF
19	0%	5%	0%	OFF	0%	5%	0%	OFF
20	0%	5%	0%	OFF	0%	5%	0%	OFF
21	0%	5%	0%	OFF	0%	5%	0%	OFF
22	0%	5%	0%	OFF	0%	5%	0%	OFF
23	0%	5%	0%	OFF	0%	5%	0%	OFF
24	0%	5%	0%	OFF	0%	5%	0%	OFF
Total hours	6.85	10.7	10.0	10	0	1.2	0	0

Retail centre public spaces areas

This profile should be used for all malls, food court, amenities and promotional areas. This profile is based on 6 day per week operation; if the space is in use for longer, the profile should be adjusted accordingly.

Table 31: Retail centre public spaces operational profiles

Hour of day	Monday – Saturday				Sunday			
	Occup	Lighting	Equip	HVAC	Occup	Lighting	Equip	HVAC
1	0%	5%	0%	OFF	0%	5%	0%	OFF
2	0%	5%	0%	OFF	0%	5%	0%	OFF
3	0%	5%	0%	OFF	0%	5%	0%	OFF
4	0%	5%	0%	OFF	0%	5%	0%	OFF
5	0%	5%	0%	OFF	0%	5%	0%	OFF
6	0%	5%	0%	OFF	0%	5%	0%	OFF
7	0%	5%	0%	OFF	0%	5%	0%	OFF
8	0%	100%	100%	ON	0%	5%	0%	OFF
9	85%	100%	100%	ON	0%	5%	0%	OFF
10	85%	100%	100%	ON	0%	5%	0%	OFF
11	100%	100%	100%	ON	0%	5%	0%	OFF
12	100%	100%	100%	ON	0%	5%	0%	OFF
13	95%	100%	100%	ON	0%	5%	0%	OFF
14	95%	100%	100%	ON	0%	5%	0%	OFF
15	95%	100%	100%	ON	0%	5%	0%	OFF
16	75%	100%	100%	ON	0%	5%	0%	OFF
17	50%	100%	100%	ON	0%	5%	0%	OFF
18	0%	5%	0%	OFF	0%	5%	0%	OFF
19	0%	5%	0%	OFF	0%	5%	0%	OFF
20	0%	5%	0%	OFF	0%	5%	0%	OFF
21	0%	5%	0%	OFF	0%	5%	0%	OFF
22	0%	5%	0%	OFF	0%	5%	0%	OFF
23	0%	5%	0%	OFF	0%	5%	0%	OFF
24	0%	5%	0%	OFF	0%	5%	0%	OFF
Total hours	7.8	10.7	10.0	10	0	1.2	0	0

Retail centre back of house

This profile should be used for back of house areas which are continuously occupied during retail centre operating hours.

Table 32: Retail centre back of house operational profiles

Hour of day	Monday – Saturday				Sunday			
	Occup	Lighting	Equip	HVAC	Occup	Lighting	Equip	HVAC
1	0%	15%	15%	OFF	0%	15%	15%	OFF
2	0%	15%	15%	OFF	0%	15%	15%	OFF
3	0%	15%	15%	OFF	0%	15%	15%	OFF
4	0%	15%	15%	OFF	0%	15%	15%	OFF
5	0%	15%	15%	OFF	0%	15%	15%	OFF
6	0%	15%	15%	OFF	0%	15%	15%	OFF
7	25%	40%	40%	OFF	0%	15%	15%	OFF
8	50%	90%	90%	ON	0%	15%	15%	OFF
9	100%	100%	100%	ON	0%	15%	15%	OFF
10	100%	100%	100%	ON	0%	15%	15%	OFF
11	100%	100%	100%	ON	0%	15%	15%	OFF
12	100%	100%	100%	ON	0%	15%	15%	OFF
13	100%	100%	100%	ON	0%	15%	15%	OFF
14	100%	100%	100%	ON	0%	15%	15%	OFF
15	100%	100%	100%	ON	0%	15%	15%	OFF
16	100%	100%	100%	ON	0%	15%	15%	OFF
17	50%	80%	80%	ON	0%	15%	15%	OFF
18	0%	60%	60%	OFF	0%	15%	15%	OFF
19	0%	60%	60%	OFF	0%	15%	15%	OFF
20	0%	15%	15%	OFF	0%	15%	15%	OFF
21	0%	15%	15%	OFF	0%	15%	15%	OFF
22	0%	15%	15%	OFF	0%	15%	15%	OFF
23	0%	15%	15%	OFF	0%	15%	15%	OFF
24	0%	15%	15%	OFF	0%	15%	15%	OFF
Total hours	9.25	12.95	12.95	10	0	3.6	3.6	0

Car parks and loading docks

This profile should be used for all internal car parks and loading docks for any building type. It is based on operation 6 days per week. In buildings which operate for longer or shorter periods, the profile should be adjusted accordingly.

Table 33: Car park and loading dock operational profiles

Hour of day	Monday – Saturday				Sunday			
	Occup	Lighting	Equip	HVAC	Occup	Lighting	Equip	HVAC
1	0%	0%	0%	OFF	0%	0%	0%	OFF
2	0%	0%	0%	OFF	0%	0%	0%	OFF
3	0%	0%	0%	OFF	0%	0%	0%	OFF
4	0%	0%	0%	OFF	0%	0%	0%	OFF
5	0%	0%	0%	OFF	0%	0%	0%	OFF
6	0%	0%	0%	OFF	0%	0%	0%	OFF
7	0%	0%	0%	OFF	0%	0%	0%	OFF
8	0%	0%	0%	OFF	0%	0%	0%	OFF
9	0%	100%	100%	ON	0%	0%	0%	OFF
10	0%	100%	100%	ON	0%	0%	0%	OFF
11	0%	100%	100%	ON	0%	0%	0%	OFF
12	0%	100%	100%	ON	0%	0%	0%	OFF
13	0%	100%	100%	ON	0%	0%	0%	OFF
14	0%	100%	100%	ON	0%	0%	0%	OFF
15	0%	100%	100%	ON	0%	0%	0%	OFF
16	0%	100%	100%	ON	0%	0%	0%	OFF
17	0%	100%	100%	ON	0%	0%	0%	OFF
18	0%	100%	100%	ON	0%	0%	0%	OFF
19	0%	0%	0%	OFF	0%	0%	0%	OFF
20	0%	0%	0%	OFF	0%	0%	0%	OFF
21	0%	0%	0%	OFF	0%	0%	0%	OFF
22	0%	0%	0%	OFF	0%	0%	0%	OFF
23	0%	0%	0%	OFF	0%	0%	0%	OFF
24	0%	0%	0%	OFF	0%	0%	0%	OFF
Total hours	0	10.0	10.0	10	0	0	0	0

External lighting

This profile should be used for external lighting applications including pathway lighting, decorative lighting, landscape lighting and external car park lighting. It does not include external lighting for sports events. Three profile types are given, as follows:

- Normal: to be used when all parts of a project function for no more than 12 hours per day during normal business hours;
- Long: to be used when any part of a project operates for more than 12 hours but less than 20 hours per day; and
- 24 hour: to be used when any part of a project operates for more than 20 hours per day.

Where a project operates less than 7 days per week, the applicable profile shall be used for all operating days, and the Normal profile for all other days.

Table 34: External lighting operational profiles

Hour of day	Normal	Long	24-hour
1	15%	15%	100%
2	15%	15%	100%
3	15%	15%	100%
4	15%	100%	100%
5	15%	100%	100%
6	15%	100%	100%
7	0%	0%	0%
8	0%	0%	0%
9	0%	0%	0%
10	0%	0%	0%
11	0%	0%	0%
12	0%	0%	0%
13	0%	0%	0%
14	0%	0%	0%
15	0%	0%	0%
16	0%	0%	0%
17	0%	0%	0%
18	0%	0%	0%
19	100%	0%	100%
20	15%	0%	100%
21	15%	100%	100%
22	15%	100%	100%
23	15%	100%	100%
24	15%	15%	100%
Total hours	2.65	6.6	12.0

Multi-unit residential living space (including kitchen)

These profiles should be used for the primary living space within an apartment and for the kitchen space if separate.

Table 35: Apartment living space (including kitchen) operational profiles

Hour of day	All days				
	Occup	Lighting	Equip-Sens	Equip-Latent	HVAC
1	0%	0%	0%	0%	OFF
2	0%	0%	0%	0%	OFF
3	0%	0%	0%	0%	OFF
4	0%	0%	0%	0%	OFF
5	0%	0%	0%	0%	OFF
6	0%	0%	0%	0%	OFF
7	0%	0%	0%	0%	OFF
8	100%	60%	0%	0%	ON
9	100%	60%	0%	0%	ON
10	50%	0%	0%	0%	ON
11	50%	0%	0%	0%	ON
12	50%	0%	0%	0%	ON
13	50%	0%	0%	0%	ON
14	50%	0%	0%	0%	ON
15	50%	0%	0%	0%	ON
16	50%	0%	0%	0%	ON
17	50%	0%	0%	0%	ON
18	75%	100%	0%	0%	ON
19	75%	100%	0%	0%	ON
20	75%	100%	0%	0%	ON
21	75%	100%	0%	0%	ON
22	75%	100%	0%	0%	ON
23	0%	0%	0%	0%	ON
24	0%	0%	0%	0%	ON
Total hours	9.75	6.2	0	0	17

Multi-unit residential living space (excluding kitchen)

These profiles should be used for any secondary living spaces, and for all corridors and amenity spaces within an apartment.

Table 36: Apartment living space (excluding kitchen) operational profiles

Hour of day	All days				
	Occup	Lighting	Equip-Sens	Equip-Latent	HVAC
1	0%	0%	0%	0%	OFF
2	0%	0%	0%	0%	OFF
3	0%	0%	0%	0%	OFF
4	0%	0%	0%	0%	OFF
5	0%	0%	0%	0%	OFF
6	0%	0%	0%	0%	OFF
7	0%	0%	0%	0%	OFF
8	100%	60%	0%	0%	ON
9	100%	60%	0%	0%	ON
10	50%	0%	0%	0%	ON
11	50%	0%	0%	0%	ON
12	50%	0%	0%	0%	ON
13	50%	0%	0%	0%	ON
14	50%	0%	0%	0%	ON
15	50%	0%	0%	0%	ON
16	50%	0%	0%	0%	ON
17	50%	0%	0%	0%	ON
18	75%	100%	0%	0%	ON
19	75%	100%	0%	0%	ON
20	75%	100%	0%	0%	ON
21	75%	100%	0%	0%	ON
22	75%	100%	0%	0%	ON
23	0%	0%	0%	0%	ON
24	0%	0%	0%	0%	ON
Total hours	9.75	6.2	0	0	17

Multi-unit residential bedroom

These profiles should be used for all bedrooms within an apartment.

Table 37: Apartment bedroom operational profiles

Hour of day	All days				
	Occup	Lighting	Equip-Sens	Equip-Latent	HVAC
1	100%	0%	0%	0%	ON
2	100%	0%	0%	0%	ON
3	100%	0%	0%	0%	ON
4	100%	0%	0%	0%	ON
5	100%	0%	0%	0%	ON
6	100%	0%	0%	0%	ON
7	100%	0%	0%	0%	ON
8	0%	0%	0%	0%	ON
9	0%	0%	0%	0%	ON
10	0%	0%	0%	0%	OFF
11	0%	0%	0%	0%	OFF
12	0%	0%	0%	0%	OFF
13	0%	0%	0%	0%	OFF
14	0%	0%	0%	0%	OFF
15	0%	0%	0%	0%	OFF
16	0%	0%	0%	0%	OFF
17	0%	0%	0%	0%	ON
18	0%	0%	0%	0%	ON
19	0%	0%	0%	0%	ON
20	0%	100%	0%	0%	ON
21	0%	100%	0%	0%	ON
22	0%	100%	0%	0%	ON
23	100%	100%	0%	0%	ON
24	100%	0%	0%	0%	ON
Total hours	9.0	4.0	0	0	17

Multi-unit residential common areas

These profiles should be used for common areas such as foyers, lobbies, hallways and corridors areas (i.e. areas which are not part of a private dwelling).

Table 38: Multi-unit residential common area operational profiles

Hour of day	All days				
	Occup	Lighting	Equip-Sens	Equip-Latent	HVAC
1	0%	0%	0%	0%	OFF
2	0%	0%	0%	0%	OFF
3	0%	0%	0%	0%	OFF
4	0%	0%	0%	0%	OFF
5	0%	0%	0%	0%	OFF
6	0%	50%	0%	0%	OFF
7	0%	50%	0%	0%	ON
8	0%	100%	0%	0%	ON
9	0%	100%	0%	0%	ON
10	0%	100%	0%	0%	ON
11	0%	100%	0%	0%	ON
12	0%	50%	0%	0%	ON
13	0%	50%	0%	0%	ON
14	0%	50%	0%	0%	ON
15	0%	50%	0%	0%	ON
16	0%	50%	0%	0%	ON
17	0%	50%	0%	0%	ON
18	0%	100%	0%	0%	ON
19	0%	100%	0%	0%	ON
20	0%	100%	0%	0%	ON
21	0%	100%	0%	0%	ON
22	0%	100%	0%	0%	ON
23	0%	100%	0%	0%	ON
24	0%	50%	0%	0%	ON
Total hours	0	14.5	0	0	18

Appendix D. Supplementary building and systems - definitions and calculation methods

Reference building refrigerated cool room and cold room wall construction

Where refrigerated cool rooms and/or cold rooms are present, the assumed construction for the *Reference building* shall be taken as follows:

Table 39: Reference building construction for refrigerated cool rooms and cold rooms

Construction (ordered outside to inside of refrigerated room)	R value (m² K/W)
Concrete (100mm) Insulation (90mm) Cavity (50mm) Composite Panel (25mm)	4.17

Reference building HVAC Systems

The following guidance has been based on Appendix G of ASHRAE Standard 90.1-2022 and where appropriate the requirements have been modified to better suit the Australian market and the intent of Green Star Buildings v1.1.

The *Reference building* HVAC systems must be of the type and description given in Table 40 as applicable to all of the space usages within the *Proposed building*. Where reference system types are based on space usage areas, areas are for that specific space usage only; refer to the below example of *Reference building* HVAC systems definition. The systems shall meet the general HVAC system requirements and any system-specific requirements as nominated in Table 41 (items 1-10 and 11-25 respectively) that are applicable to the *Reference building* HVAC system type(s). All requirements given in NCC Section J Part J6 must be met by the *Reference building* HVAC systems.

Where the *Proposed building* HVAC services incorporate humidity control (whether dehumidification, humidification or both) for some or all systems, the same areas within the *Reference building* shall be provided with humidity control by an equivalent means compatible with the reference system type applicable to those areas. Where the design team considers that the reference HVAC system for a specific space usage is not appropriate to achieve the specified humidity control range, the reference system may be modified to be of the same type as the proposed system for those areas only.

For all projects, any areas of the building which are only fitted out to shell and core standard, a notional fit out must be modelled that meets the NCC Section J DTS provisions. The design team must demonstrate the HVAC design provision (e.g. space allowance, available pipework or ductwork connections) and basis of thermal zoning (e.g. design guidance included in the tenant fit out guide) that has been incorporated to accommodate the system type modelled.

Where a space usage within the *Proposed building* is not adequately represented by any of the defined space usages in Table 40, the project team should either:

- Select the most appropriate system type from those available in Table 40 with appropriate justification for the system selected;

  or

- Adopt the same system type as the *Proposed building* and apply cooling and heating to the space usage in question by comparable means to the reference systems in the adjacent spaces, e.g. CHW/HHW coils if VAV AHU or FCU, VRF if VRF FCU, etc.

Example *Reference building* HVAC systems definitions

Reference system types are based on space usage therefore buildings with multiple difference space usages would expect to include a variety of reference systems.

The following example is for a mixed office and hotel building in climate zone 5. The total office NLA is 11,000 m2 across low- and high-rise portions (i.e. two rises for mechanical services) and the hotel has a total of 70 guest suites and associated guest facilities.

<table>
<tr><td colspan="3">Office high-rise floors (8,000 m^2 NLA): System type 7a (high-rise set)</td></tr>
<tr><td colspan="2" rowspan="2">Office low-rise floors (3,000 m^2 NLA): System type 7a (low-rise set)</td><td>Hotel guest suites (total number 70): System type 4c (one per floor)</td></tr>
<tr><td>Hotel guest facilities:

Swimming pool and gym: System type 6 for swimming pool and System type 4c for gym

Restaurant, bar and kitchen: System type 4c for restaurant and bar and System type 5 for kitchen</td></tr>
<tr><td colspan="2">Office main entry: System type 7a (combined with low-rise set)</td><td>Hotel main entry: System type 4c</td></tr>
<tr><td>Car park: NA (unconditioned)</td><td>Office end of trip facility: System type 4 (refer to Table 41 Item 1)</td><td>Hotel BOH facilities: System type 4c</td></tr>
</table>

Table 40: Reference building HVAC system types by space usage type

Space usage type	System description		
	Climate zone 1, 2 and 5	Climate zone 3, 4, 6 and 7	Climate zone 8
Residential spaces including SOUs and common areas for residents			
Residential SOUs for small apartment blocks <100 apartments	**System type 1:** Air-source packaged/split DX reverse cycle (heat pump) systems (one per SOU) and local outside air provision.	**System type 1**	**System type 1**
Residential SOUs for large apartment blocks >=100 apartments	**System type 2a:** Air- source heat pump VRF (one per floor) with dedicated outside air fan (one per SOU) sized to AS1668.2-2024 Table A.1 requirements	**System type 2a**	**System type 2a**
Residential common areas, excluding sole-occupancy units and swimming pool areas	**System type 2b:** Air- source heat recovery VRF (one per floor) with dedicated outside air fan (one per floor) sized to AS1668.2-2024 Table A.1 requirements	**System type 2b**	**System type 2b**
Spaces with daytime operation only and occasional overnight use			
Industrial - warehouses	**System type 3:** Naturally ventilated. Where temperature-controlled, packaged roof-top heat pump with variable-speed compressors. DCV appropriate unless precluded by the functional requirements of the space usage	**System type 3**	**System type 3**
Non-office and non-retail buildings (including healthcare, education and university buildings)	**System type 4a:** Air-source heat recovery VRF (one per floor) Dedicated outside air system with variable volume fan coil units (one per zone). DCV appropriate	**System type 4a**	**System type 4a**

Space usage type	System description		
	Climate zone 1, 2 and 5	Climate zone 3, 4, 6 and 7	Climate zone 8
Commercial kitchen	**System type 5:** For general cooking areas: variable volume 100% outside air make up air to balance the total kitchen exhaust (excess outside air from other parts of the same floor may be used to reduce the required make up air where suitable consistent with the proposed design), tempered to minimum 18 °C and maximum 26 °C or 8 K below the ambient dry bulb temperature, whichever is the greater. Total exhaust air flow rate as per the applicable requirements of *AS1668.2:2024*, including exhaust of all cooking and dishwashing equipment. Exhaust and make up air demand may be assumed to follow the equipment load profile in Table 13. DCV not appropriate For preparation and store areas: spot cooling by constant volume fan coil units. Cooling and heating in kitchen areas shall be by a comparable means to the adjacent spaces, e.g. CHW/HHW coils if VAV AHU or FCU, VRF if VRF FCU, etc.	**System type 5**	**System type 5**
Swimming pool	**System type 6:** Constant volume 100% outside air make up air to balance the total exhaust (excess outside air from other parts of the same floor may be used to reduce the required make up air where suitable consistent with the proposed design) with ventilation heat recovery (sensible heat transfer effectiveness of 60%), and supply air heating only . Total exhaust air flow rate as per the applicable	**System type 6**	**System type 6**

Space usage type	System description		
	Climate zone 1, 2 and 5	Climate zone 3, 4, 6 and 7	Climate zone 8
	requirements of AS1668.2:2024. DCV not appropriate.		
Office (includes all front of house transitory areas, e.g. main entry and lift lobbies)			
Office base building systems for office areas up to 5,000 m² NLA	**System type 4a**	**System type 4a**	**System type 4a**
Office base building systems for office areas between 5,000 m^2 to 20,000 m^2 NLA	**System type 7a:** Variable air volume AHUs with terminal electric duct heaters only, one system per perimeter orientation (where differing by 45° or more) and for internal zones based on the same number of rises as the proposed building. DCV appropriate Air-cooled chillers *Where provided for the Proposed building, tenant supplementary condenser water system with open-circuit cooling towers*	**System type 7b:** Variable air volume AHUs with terminal reheat, one system per perimeter orientation (where differing by 45° or more) and for internal zones based on the same number of rises as the proposed building. DCV appropriate Air-source heat pump (shared with cooling) *Where provided for the Proposed building, tenant supplementary condenser water system with open-circuit cooling towers*	**System type 7b** *Where provided for the Proposed building, tenant supplementary condenser water system with open-circuit cooling towers*
Office base building systems for office areas greater than 20,000 m^2 NLA	**System type 7d:** Variable air volume AHUs with terminal electric duct heaters only, one system per perimeter orientation (where differing by 45° or more) and for internal zones based on the same number of rises as the proposed building. DCV appropriate Water-cooled chillers *Where provided for the Proposed building, tenant supplementary condenser water system with open-circuit cooling towers*	**System type 7e:** Variable air volume AHUs with terminal reheat, one system per perimeter orientation (where differing by 45° or more) and for internal zones based on the same number of rises as the proposed building. DCV appropriate Water-cooled chillers Air-source heat pumps *Where provided for the Proposed building, tenant supplementary condenser water system with open-circuit cooling towers*	**System type 7e** *Where provided for the Proposed building, tenant supplementary condenser water system with open-circuit cooling towers*

Space usage type	System description		
	Climate zone 1, 2 and 5	Climate zone 3, 4, 6 and 7	Climate zone 8
Retail (includes all front-of-house circulation areas, e.g. malls)			
Retail that is street facing (any size)	**System type 1:** Air-source packaged/split DX reverse cycle (heat pump) systems (one per retail unit) and local outside air provision.	**System type 1**	**System type 1**
Retail with enclosed area (including large format retail) up to 10,000 m^2 GLA	**System type 8a:** Air-source heat pump VRF for shops and food courts Dedicated outside air system with variable volume fan coil units (one per zone). DCV appropriate Air-source packaged roof-top heat pump for other common areas	**System type 8a**	**System type 8a**
Retail with enclosed area between 10,000 m^2 to 20,000 m^2 GLA	**System type 8b:** AHUs with variable air volume with electric duct heaters only for common areas Dedicated outside air system with variable volume CHW fan coil units for shops and food court (with zonal electric heaters) (one per zone). DCV appropriate Air-cooled chillers	**System type 8c:** Variable air volume AHUs with terminal reheat for common areas Dedicated outside air system with variable volume fan coil units for shops and food court (one per zone). DCV appropriate Air-source heat pumps (shared with cooling)	**System type 8c**

Space usage type	System description		
	Climate zone 1, 2 and 5	Climate zone 3, 4, 6 and 7	Climate zone 8
Retail with enclosed area greater than 20,000m^2 GLA	**System type 8d:** Variable air volume AHUs with electric duct heaters only for common areas (one system per floor) Dedicated outside air system and variable volume CHW fan coil units for shops and food court (with zonal electric heaters) (one per zone). DCV appropriate Water-cooled chillers	**System type 8e:** Variable air volume AHUs with terminal reheat for common areas (one system per floor) Dedicated outside air system with variable volume CHW/HHW fan coil units for shops and food court (one per zone). DCV appropriate Water-cooled chillers Air-source heat pumps	**System type 8f:** Variable air volume AHUs with terminal reheat for common areas (one system per floor) Dedicated outside air system with variable volume HHW fan coil units for shops and food court (one per zone). DCV appropriate Air-source heat pumps (shared with cooling)
Buildings with permanent overnight operation (hospital ward, aged care or hotel)			
Residential aged care (Class 9c)	**System type 4b:** Air-source heat recovery VRF (one system per floor). Dedicated outside air fan sized to AS1668.2-2024 Table A.1 requirements (one per floor) with constant volume fan coil units serving all conditioned areas (one per zone). DCV not appropriate	**System type 4b**	**System type 4b**
Hotels (<100 guest rooms)	**System type 4c:** Air-source heat recovery VRF (one system per floor) Dedicated outside air system with constant volume FCUs serving all conditioned areas(one per zone). DCV not appropriate	**System type 4c**	**System type 4c**

Space usage type	System description		
	Climate zone 1, 2 and 5	Climate zone 3, 4, 6 and 7	Climate zone 8
Hotels (≥100 guest rooms)	**System type 9a:** Variable air volume AHUs and terminal VAV units with electric heaters for common areas (one AHU for each functional space type e.g. conference rooms, main entry administration offices, restaurant and bar, wellness suite, *etc* with non-conditioned bathrooms/toilets; and one terminal unit per zone). DCV appropriate Dedicated outside air system incorporating heat recovery from guest room bathroom exhaust with variable volume FCUs with electric heaters for guest suites (one per room) and corridors (one per zone). DCV not appropriate. Water-cooled chillers	**System type 9b:** Variable air volume AHUs and terminal VAV units with reheat for common areas (one AHU for each functional space type e.g. conference rooms, main entry administration offices, restaurant and bar, *etc* with non-conditioned bathrooms/toilets; and one terminal unit per zone). DCV appropriate Dedicated outside air system incorporating heat recovery from guest room bathroom exhaust with variable-volume FCUs for guest suites (one per room) and corridors (one per zone). DCV not appropriate. Water-cooled chillers Air-source heat pumps	**System type 9c:** Variable air volume AHUs and terminal VAV units with reheat for common areas (one AHU for each functional space type e.g. conference rooms, main entry administration offices, restaurant and bar, *etc* with non-conditioned bathrooms/toilets; and one terminal unit per zone). DCV appropriate Dedicated outside air system incorporating heat recovery from guest room bathroom exhaust with variable-volume FCUs for guest suites (one per room) and corridors (one per zone). DCV not appropriate. Air-source heat pumps (shared with cooling)
Hospitals with wards *For hospitals without wards and other healthcare facilities refer to Buildings with daytime operation only and occasional overnight use*	**System type 10a:** Constant volume AHUs for common areas and non-ward rooms applying the same zoning and configuration as per the proposed building systems. DCV appropriate unless precluded by the functional requirements of the space usage Dedicated outside air system with CHW variable air volume FCUs with terminal electric heaters for ward rooms (one per room). DCV not appropriate Air-cooled chillers (cooling only) Electric duct heaters (for each HVAC zone and terminal unit)	**System type 10b:** Constant volume AHUs for common areas and non-ward rooms applying the same zoning and configuration as per the proposed building systems. DCV appropriate unless precluded by the functional requirements of the space usage Dedicated outside air system CHW/HHW with variable air volume FCUs for ward rooms (one per room). DCV not appropriate Air-cooled chillers Air-source heat pumps	**System type 10c:** Constant volume AHUs for common areas and non-ward rooms applying the same zoning and configuration as per the proposed building systems. DCV appropriate unless precluded by the functional requirements of the space usage CHW/HHW Variable air volume FCUs for ward rooms with dedicated outside air system. DCV not appropriate Air-source heat pumps (shared with cooling)

Table 41: Reference building HVAC system design and operating parameters

Item	Description	Requirement
1	Standard practice HVAC system type and description	The HVAC systems in the *Reference building* shall be based on the usage, conditioned floor area and heating sources as specified in Table 40. For unitary/packaged system types 1, 2, and 4 (packaged or split DX units), each thermal block (HVAC zone) shall be modelled with its own HVAC system. Zones with different occupancy or internal gains must be modelled with a separate HVAC system, unless a VRF HVAC system with heat recovery is modelled. Individual spaces that have occupancy or process loads or schedules that differ significantly (note 1) from the rest of the space type, or with specific pressurization requirements, require separate single-zone systems conforming to the requirements of unitary/packaged system type 1, 2 or 4 (if less than 500 m²), or an independent CAV or VAV system type 5, 6 or 7 (if greater than 500 m²) (whichever of these system types most closely aligns with the system(s) serving the rest of the space type). (Modified from G3.2.1 from *ASHRAE Standard 90.1-2022*) All mechanical ventilation systems must be capable of being deactivated when the building or part of the building served by that system is unoccupied as per NCC Section J Part J6D3.
2	Equipment efficiencies	All equipment efficiencies in the *Reference building* shall be modelled in accordance with NCC Section J Parts J6 to J8 and/or *Minimum Energy Performance Standards (MEPS)* requirements as applicable to the type and capacity of equipment.
3	Equipment capacities	The *Reference building* HVAC plant shall be sized to meet the design criteria of the Reference building (refer to Appendix A. HVAC system design parameters). The number of unmet load hours from the system simulation must be reported. It must be justified that the accuracy of the simulation is not significantly compromised by the unmet cooling or heating loads.
4	Fan system operation	Supply and return fan operation in the *Reference building* shall be as required by NCC Section J Part J6D5. Where variable air flow control applies, minimum fan air flow shall be set to 25% of maximum flow.
5	Economizers	The *Reference building* HVAC systems shall include economy cycles where required by NCC Part J6D3.
6	Design outside airflow rates	In accordance with the minimum requirements of NCC Part F6 and consistent with the baseline calculation in the *Clean Air* credit (i.e. in accordance with *AS1668.2:2024* or *AS1668.4:2024* without any improvement in outdoor air where required in the *Clean Air* credit).
7	Ventilation heat recovery, demand-controlled ventilation or indirect evaporative cooling	Where required by NCC Section J Part J6D4, either a ventilation energy reclaim system, demand-controlled modulating ventilation or indirect evaporative cooling must be included in accordance with the requirements of this clause. Reference systems descriptions in Table 40 include nomination of DCV appropriate or not. Energy reclaiming systems must have a minimum sensible heat transfer effectiveness of 60%, and be capable of allowing outdoor air to bypass the heat reclaiming system when conditions do not provide a heat reclaim benefit.
8	Dedicated outside air system	100% outside air system providing required outside air for ventilation of occupied spaces served by fan coil units, incorporating the required control measure as per item 7 above and supplementary heating and cooling coils as required. Heating and cooling shall be by the same method as the fan coils served, i.e. direct electric, VRF or air-source heat pumps for heating, VRF or chillers for cooling. Supply air dry bulb temperature set point for heating 18 °C and for cooling 24 °C.

Item	Description	Requirement
9	Design supply airflow rates	System design supply airflow rates for the *Reference building* shall be based on a supply-air-to-room-air temperature difference of 11 K, or the required ventilation air or makeup air, whichever is greater. If return or relief fans are specified in the *Proposed building*, then the *Reference building* shall also be modelled with fans serving the same functions and sized for the *Reference building* (modified from G3.2.2.7.1 from *ASHRAE Standard 90.1-2022*).
10	System fan power	The system fan power of the *Reference building* system design shall be as specified below: The method for determining reference fan power is as follows. The same method is applied for all fans applicable to the R*eference building*: • System pressure loss is based on the design value without adjustment. Where a project considers there to be reasonable further benefit to be demonstrated by a more detailed calculation of the equivalent reference building pressure loss, as per NCC Section J Parts J6D5 (3) and (4), this is allowed, but detailed calculation is not mandatory. • System flow rate is calculated for air conditioning systems from the total building cooling/heating load (as calculated by the software) and the defined system supply air temperature difference herein; and for ventilation-only systems based on the design supply or exhaust value, or the minimum quantity required by the most recent version of the *AS 1668.2*. • The above pressure and flow parameters define the reference duty point for the fan. • The fan system efficiency is minimum required value, as per NCC Section J Part J6D5 (2), assuming the same fan type and installation arrangement as for the actual system. • The fan power is calculated as: $$P_{ref} = \frac{q\Delta p}{1{,}000{,}000 \cdot \eta_{system}}$$ Where P_{ref} is the reference fan power (kW), q is the duty flow rate (L/s), Δp is the system duty pressure loss (Pa) and η_{system} is the system efficiency (and pressure and efficiency are either static or total values, as applicable for the fan installation type).
11	Air-to-air heat pumps (unitary AC) (System types 1 and 2)	Heat pumps shall be modelled with the required EER (cooling mode) and COP (heating mode) as per the minimum requirements of NCC Section J Part J6D12 or MEPS. Where only EER is specified, the COP shall be assumed to be equal to the EER. Where AEER and ACOP values are specified, the EER and COP shall be taken as equal to the stated values. Part load operation of heat pumps should be modelled as per the specified unit, and must consider varying ambient temperatures and coil air on and air off temperatures. The same part load curves must be used for both the proposed and reference models.
12	Air-source VRF (System type 4)	Air-source VRF systems shall be modelled with the required EER (cooling mode) and COP (heating mode) as per the minimum requirements of NCC Section J Part J6D12 or MEPS. Where only EER is specified, the COP shall be assumed to be equal to the EER. Where only AEER and ACOP values are specified, the EER and COP shall be taken as equal to the stated values. For the purpose of reference system design sizing, the heating-to-cooling capacity ratio of the outdoor unit at the reference conditions applicable to NCC Section J Part J6D12 or MEPS shall be taken as 1.1, regardless of the design sizing of room loads (this is to ensure that the part-load characteristics of the system are appropriately represented in both modes of operation). Part load operation of heat pumps should be modelled as per the specified unit and must consider varying ambient temperatures and coil air on and air off temperatures. The same part load curves must be used for both the proposed and reference models.

Item	Description	Requirement
		System cooling operation shall not be permitted below ambient dry bulb temperature of 4 °C and heating operation shall not be permitted above ambient dry bulb temperature of 16 °C.
13	Direct electric heating	Where applicable, direct electric heating will be applied with an associated efficiency of 100%. If in any instance a reference system specified with electric heating coils has a system heating capacity exceeding the maximum allowable value in NCC Section J Part J6D10(1)(e) then they must be substituted for HHW coils served by air-source heat pumps.
14	Air-to-water heat pumps	All space heating fuel sources shall be electric, and heating equipment is shared with the cooling system where specified in Table 40. The number and capacity of air source heat pumps or 4-pipe chillers shall be determined as follows: • For heat pumps, minimum of two heat pumps sized equally and limited to 1,000 kWr each heat pump. Where the total system load exceeds 2,000 kWr, add heat pumps as required such that they are sized equally and less than 1,000 kWr each at design conditions. • For 4-pipe chillers shared with cooling duty, minimum of three 4-pipe chillers sized equally and limited to 1,000 kWr each chiller. Where the total system load exceeds 3,000 kWr, add 4-pipe chillers as required such that they are sized equally and less than 1,000 kWr each at design conditions. The capacity of units shall be based on the larger of the required heating or cooling duty, and the ratio of heating to cooling capacity at rated conditions shall be 1.1. For heat pumps and 4-pipe chillers, staging shall be assumed to occur in increments of one unit added/removed at a time at the load threshold of 85% of a single heat pump's capacity, e.g. for a system with three units of capacity 800 kW, first staging threshold is at 680 kW (1 unit below and 2 units above) and second staging threshold is at 1360 kW (2 units below and 3 units above). Part load operation of heat pumps or 4-pipe chillers (heating mode) should be modelled as per the specified unit and must consider varying ambient temperature and leaving water temperature. Each connected group of air-source heat pumps, including 4-pipe reverse cycle chillers, shall meet the requirements of NCC 2025 Section J6D10 (8)(a) and (b), as applicable. All air-source heat pumps shall be modelled with the same COP for heating mode and EER for cooling mode
15	Heating hot water supply and operating temperature	Heating hot water system design flow and return temperatures fixed at 55 and 45°C respectively. Operational temperatures shall be reset as follows: • Outside air temperature <7 °C: 55 °C supply temperature • Outside air temperature 7-16 °C: linear variation from 55 to 45 °C • Outside air temperature >16 °C: 45 °C supply temperature.
16	Heating hot water pumps	Systems shall be modelled with one pump per heat pump and pump operation interlocked with operation of the associated heat pump. The *Reference building* hot-water pumps shall meet all the requirements of the NCC Part J6D8 (refer to *Reference building pump power*).
17	Piping losses and thermal inertia	Piping losses for heating hot water and chilled water shall be the same for the *Reference building* as modelled in the *Proposed building*. Thermal inertia for heating hot water systems in the *Reference building* shall be varied in proportion to the ratio of the peak heating load between the *Reference* and *Proposed building*.

Item	Description	Requirement
18	Type and number of chillers	Chillers shall be modelled in parallel configuration. The number and capacity of chillers shall be determined as follows: • For 4-pipe chillers shared with heating duty, minimum of three 4-pipe chillers sized equally and limited to 1,000 kWr each chiller. Where the total system load exceeds 3,000 kWr, add 4-pipe chillers as required such that they are sized equally and less than 1,000 kWr each at design conditions. The capacity of units shall be based on the larger of the required heating or cooling duty, and the ratio of heating to cooling capacity at rated conditions (as per NCC 2025 Part J6D10) shall be 1.1. • For air-cooled chillers, minimum of two chillers sized equally and limited to 1,000 kWr each chiller. Where the total system load exceeds 2,000 kWr, add chillers as required such that they are sized equally and less than 1,000kWr each at design conditions. Air-cooled scroll chillers shall be used unless the chiller thermal capacity > 528kWr, for which variable-speed screw chillers shall be used. • For water-cooled chillers, minimum of two chillers sized equally and limited to 2,000 kWr each chiller. Where the total building load exceeds 4,000 kWr, add chillers as required such that they are sized equally and less than 2,000 kWr each at design conditions. Centrifugal chillers shall be used except in the following scenarios: – In climate zones 1, 2 and 3, VSD screw chillers for chiller capacity <265 kWr – In all other climate zones, VSD screw chillers for chiller capacity <1400 kWr • For all chiller types, staging shall be assumed to occur in increments of one chiller added/removed at a time at the load threshold of 85% of a single chiller's capacity, e.g. for a system with three units of capacity 800 kW, first staging threshold is at 680 kW (1 unit below and 2 units above) and second staging threshold is at 1360 kW (2 units below and 3 units above). The chillers will have the minimum required EER and IPLV values as given in the NCC 2025 Section J Part J6D11 (2). Chiller operation across the operating range must be modelled using the performance curve details in Table 42 (applicable to NCC 2022) (see Note 2) or Table 43 (applicable to NCC 2025).
19	Chilled water design and operating supply temperature	Chilled-water design supply temperature shall be modelled at 6 °C and return water temperature at 12 °C. Operational temperatures shall be reset as follows: • Outside air temperature <16 °C: 10 °C supply temperature • Outside air temperature 16-25 °C: linear variation from 10 to 6 °C • Outside air temperature >25 °C: 6 °C supply temperature
20	Chilled water pumps	Systems shall be modelled with one pump per chiller or 4-pipe heat pump and pump operation interlocked with operation of the associated chiller or 4-pipe heat pump. The *Reference building* chilled water pumps shall meet the requirements of the NCC Part J6D8 (refer to *Reference building pump power*). Pumping systems shall be modelled with variable primary flow, with a minimum flow rate of 70% of design through each chiller.
21	Heat rejection	The *Reference building* heat rejection fan power shall meet the requirements of the NCC Section J Part J6D13 for the applicable fan type.
22	Condenser water pumps	Systems shall be modelled with one pump per chiller and pump operation interlocked with operation of the associated chiller. The *Reference building* condenser water pumps shall meet all the requirements of the NCC Section J clause J6D8 (refer to *Reference building pump power*). Pumping

Item	Description	Requirement
		systems shall be modelled with variable primary flow, with a minimum flow rate of 70% of design through each chiller.
23	Tenant condenser water supplementary heat rejection	Where Tenant supplementary heat rejection is provided by the base building, this shall be provided by a dedicated single-cell axial fan cooling tower sized for 100% of duty. Staged primary/secondary variable speed pumping (both two pumps each at 50% of design flow rate) shall be used, with a heat exchanger to separate primary (open) and secondary (closed) systems. Where actual heat rejection duty is unknown, assume 50% of design load Monday to Friday, 8am to 6pm, and 20% of design load at all other times. Cooling tower control shall be based on maintaining a tower leaving condenser water temperature of 25 °C with minimum wet bulb approach of 5 K; and a heat exchange temperature difference of 1 K (i.e. nominal secondary system flow temperature of 26°C). The cooling tower fan shall be variable-speed controlled to maintain leaving water temperature at set point. The *Reference building* condenser water pumps shall meet all the requirements of the NCC Section J clause J6D8 (refer to *Reference building pump power*). The minimum variable speed pump operating point shall be assumed to be 25% of design flow rate (for an individual pump). The minimum flow rate through the cooling tower shall be assumed to be 40% of design flow rate. The variable primary pump speed shall modulate to maintain the secondary circuit flow temperature at 26°C – reducing its speed for less water flow when the secondary circuit flow temperature drops below 26°C. The Reference building cooling tower fan power shall meet the requirements of NCC Section J Part J6D13 for the applicable fan type.
24	VAV minimum flow setpoints	Minimum turndown ratio for each zone of a VAV system shall be modelled at 30% of design supply air flow rate or equal to the outdoor air supply rate, whichever is greater.
25	VAV fan part-load performance	VAV system supply fans and return air fans (where applicable) shall have variable speed drives, and their part-load performance characteristics shall be modelled using Method 2 *in Variable air volume fan speed control* in Appendix D.

Note 1: Peak thermal loads that differ by 30% or more from the average of other spaces served by the system, or schedules that differ by more than 40 equivalent full-load hours per week from other spaces served by the system are considered to differ significantly.

Note 2: In order to model chiller part-load operation to achieve the required IPLV, apply the multipliers as per Table 42 to the full-load EER to calculate the EER at 75%, 50% and 25% of full-load output at nominated reference conditions (modified from *AS/NZS 4776.2:2028*).

Table 42: Reference building chiller part-load EER multipliers (applicable to NCC 2022)

Chiller Type		Capacity		EER Multiplier at Part Load Factor		
Heat Rejection	Compressor	Min	Max	75%	50%	25%
Air-cooled	Any	0	528	1.59	1.79	1.2
Air-cooled	Any	>528		1.62	1.83	1.22
Water-cooled	Screw	0	264	1.51	1.71	1.16
Water-cooled	Screw	264	528	1.49	1.69	1.11
Water-cooled	Screw	528	1055	1.52	1.68	1.17

Chiller Type		Capacity		EER Multiplier at Part Load Factor		
Water-cooled	Screw	1055	2110	1.48	1.68	1.14
Water-cooled	Screw	>2110		1.49	1.7	1.15
Water-cooled	Centrifugal	0	528	1.54	1.75	1.13
Water-cooled	Centrifugal	528	1055	1.39	1.59	1.12
Water-cooled	Centrifugal	1055	1407	1.49	1.68	1.11
Water-cooled	Centrifugal	>1407		1.49	1.7	1.15

Table 43: Reference building chiller part-load performance curve parameters (applicable to NCC 2025)

	Type 1	Type 2	Type 3	Type 4	Type 5	Type 6	Type 7	Type 8
Type	4-pipe (cooling mode)	Air-cooled	Air-cooled	Water-cooled	Water-cooled	Water-cooled	Water-cooled	Water-cooled
Rated capacity range (kWr)	All	≤550	>550	≤250	>250 and ≤500	>250 and ≤500	>500 and ≤1500	>1500
Climate zone	All	All	All	All	1,2,4,5,6,7 and 8	3	All	All
Rated ELWT (°C)	7	7	7	7	7	7	7	7
Rated CEAT (°C)	35	35	35	NA	NA	NA	NA	NA
Rated CEWT (°C)	NA	NA	NA	30	30	30	30	30
CAPFT C00	1.456040	1.479360	1.479360	1.263510	1.417910	1.456040	1.479360	1.443750
CAPFT C10	0.046280	0.051520	0.051520	0.018070	0.038870	0.046280	0.051520	0.043750
CAPFT C20	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
CAPFT C01	-0.021268	-0.022512	-0.022512	-0.011817	-0.019297	-0.021268	-0.022512	-0.020625
CAPFT C02	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
CAPFT C11	-0.000676	-0.000784	-0.000784	-0.000169	-0.000529	-0.000676	-0.000784	-0.000625

	Type 1	Type 2	Type 3	Type 4	Type 5	Type 6	Type 7	Type 8
EIRFT C00	0.619585	0.615120	0.606807	0.758578	0.673578	0.656660	0.637832	0.648045
EIRFT C10	-0.019703	-0.020680	-0.020592	-0.011829	-0.017230	-0.018287	-0.018655	-0.017805
EIRFT C20	0.000628	0.000709	0.000716	0.000181	0.000537	0.000677	0.000790	0.000643
EIRFT C01	0.007314	0.006654	0.006835	0.007127	0.005058	0.003657	0.002715	0.004423
EIRFT C02	0.000453	0.000499	0.000506	0.000161	0.000439	0.000542	0.000625	0.000520
EIRFT C11	-0.000675	-0.000742	-0.000764	-0.000205	-0.000600	-0.000760	-0.000906	-0.000744
EIRFPLT C00	0.160932	0.160932	0.118251	0.273871	0.204911	0.187251	0.147880	0.118251
EIRFPLT C10	0.005255	0.005255	0.072325	-0.146594	-0.036630	0.004090	0.026743	0.072325
EIRFPLT C20	0.833813	0.833813	0.809424	0.872724	0.831720	0.808659	0.825376	0.809424
EIRFPLT C01	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
EIRFPLT C02	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
EIRFPLT C11	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000

ELWT: Evaporator leaving water temperature

CEAT: Condenser entering dry bulb air temperature (for air-cooled chillers and 4-pipe chillers (cooling mode))

CEWT: Condenser entering water temperature (for water-cooled chillers)

Coefficients in Table 66 are to be used in conjunction with the following biquadratic equations, as are commonly implemented in simulation software, to determine the adjustment factors to be applied to rated capacity and rated energy input ratio (EIR = 1/COP) to define chiller performance across the range of operating temperatures and load:

- Capacity as a function of chilled water temperature and condensing temperature (condenser water entering temperature for water-cooled chillers and entering ambient dry bulb temperature for air-cooled and 4-pipe chillers) (CAPFT):

$$CAPFT(T_{chw}, T_{cond}) = C00 + C10T_{chw} + C20T_{chw}^2 + C01T_{cond} + C02T_{cond}^2 + C11T_{chw}T_{cond}$$

- Energy input ratio (EIR = 1/EER) as a function of chilled water temperature and condensing temperature (condenser water entering temperature for water-cooled chillers and entering ambient dry bulb temperature for air-cooled and 4-pipe chillers) (EIRFT):

$$EIRFT(T_{chw}, T_{cond}) = C00 + C10T_{chw} + C20T_{chw}^2 + C01T_{cond} + C02T_{cond}^2 + C11T_{chw}T_{cond}$$

- EIR as a function of part-load ratio and chiller temperature difference ($T_{diff} = T_{cond}-T_{chw}$) (EIRFPLT):

$$EIRFPLT(p, T_{diff}) = C00 + C10p + C20p^2 + C01T_{diff} + C02T_{diff}^2 + C11pT_{diff}$$

Table 44: Reference building unitary AC – Variable Refrigerant Flow (VRF) performance

Cooling Capacity (kWr)	Energy Efficiency Ratio (EER)
<39	3.48
>39	3.17

Table 45: Reference building water-cooled unitary AC performance

Cooling Capacity (kWr)	Water-cooled unitary AC (package conditioners, split DX or VRF)
<65	As required by MEPS
>=65	4.0

Variable air volume fan speed control

Where the *Proposed* and/or *Reference building* contain variable air volume (VAV) systems their part-load performance characteristics shall be modelled using Method 1 given below (based on Method 2 – Part-Load Fan Power Equation from Table G3.2.3.15 in *ASHRAE Standard 90.1-2022*). Where the *Proposed building* adopts system pressure optimisation reset control, Method 2 may be applied:

Method 1 – part-load fan power equation for standard control

$$P_{fan} = 0.0013 + 0.1470PLR_{fan} + 0.9506PLR_{fan}^2 - 0.0998PLR_{fan}^3$$

Where P_{fan} is the proportion of full-load fan power used at any given fan part-load ratio, and PLR_{fan} is the fan part-load ratio (ratio of actual system air flow rate (m³/s) in any given hour to the design system air flow rate (m³/s)).

Method 2 – part-load fan power equation for system pressure optimisation reset control

$$P_{fan} = 0.0012 - 0.0579PLR_{fan} + 0.5864PLR_{fan}^2 + 0.4712PLR_{fan}^3$$

Where definitions of variables P_{fan} and PLR_{fan} are as per Method 1.

The difference in proportion of full-load fan power calculated using these methods is illustrated in Figure 1:

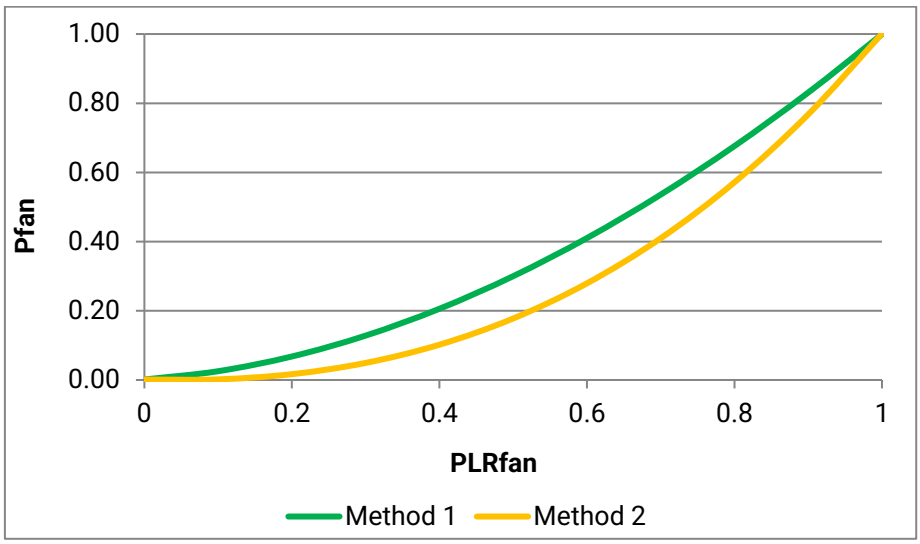

Figure 1: Proportion of full-load fan power for Method 1 and Method 2

Reference building pump power

The method for determining reference pump power is as follows. The same method is applied for all pumps applicable to the *Reference building*:

- System pressure loss is based on the design value without adjustment. Where a project considers there to be reasonable further benefit to be demonstrated by a more detailed calculation of the equivalent *Reference building* pressure loss, as per NCC Section J Part J6D8, this is allowed, but detailed calculation is not mandatory.
- System flow rate is calculated from the total building cooling/heating load (as calculated by the software) and the defined system temperature flow and return temperatures herein.
- The above pressure and flow parameters define the reference duty point for the pump.
- To determine the pump motor power, assuming the same pump type and rated motor speed as for the actual system:
  - For glandless impeller pumps, pump motor input power is based on the reference power as follows, assuming that the maximum flow and head values occur are at the reference duty point:

$$P_{ref} = 0.623 \cdot q\Delta p + 17\left(1 - e^{-0.11 \cdot q\Delta p}\right)$$

    Where P_{ref} is the reference pump power (W), q is the duty flow rate (L/s) and Δp is the system pressure loss (kPa); and

  - For other pump types, pump efficiency is based on the minimum required efficiency as per EU 547/2012 Annex III, assuming that the reference duty point is the best efficiency point (BEP), as follows:

$$\eta_{pump} = 88.59 \cdot \ln n_s + 13.46 \cdot \ln q - 11.48(\ln n_s)^2 - 0.85(\ln q)^2 - 0.38 \cdot \ln n_s \cdot \ln q - C$$

    Where η_{pump} is the pump combined mechanical and hydraulic efficiency (%), n_s is pump specific speed, q is the duty flow rate (m³/hour) and C is an efficiency parameter. Pump specific speed is defined as follows:

$$n_s = n \frac{\sqrt{q}}{\left({}^{1}/_{i}\,\Delta p\right)^{\frac{3}{4}}}$$

    Where n is the pump speed (rev/minute), i is the number of pump stages (in the case of a multistage pump), and Δp is the system pressure head (m). C values are defined as follows, based on the specified minimum efficiency index (MEI) of 0.4:

Table 46: Pump efficiency parameter (C) by pump type and speed [MEI = 0.4]

Pump type	Pump speed (rev/minute)	C
End suction – own bearing	1450	128.07
	2900	130.27
End suction – close coupled	1450	128.46
	2900	130.77
End suction – close coupled inline	1450	132.30
	2900	133.69
Multistage – vertical	2900	133.95
Multistage – submersible	2900	128.79

    The pump power is then evaluated as:

$$P_{ref} = \frac{2.725 \cdot q\Delta p}{\eta_{pump} \cdot \eta_{elec}}$$

Where P_{ref} is the reference pump power (W), q is the duty flow rate (m³/hour), Δp is the system pressure head (m) and η_{elec} is the overall electrical efficiency of the pump drive system (motor and variable speed drive). This value is taken to be the product of the MEPS minimum motor efficiency as applicable to the motor type (assuming high efficiency motor) (note: 2900 rev/minute is a 2-pole and 1450 rev/minute is a 4-pole motor) and a default value of 97% for a variable speed drive. MEPS values must be based on the 2018 GEMS Determination, not the 2012 version. Since the motor efficiency is a function of motor rated output, it is necessary to apply an iterative approach. With an initial efficiency value of 0.85, calculate the motor power and hence efficiency, then adjust the efficiency value in the motor power calculation to the new efficiency value. Continue until the successive values of P_{ref} differ by no more than 0.1, which generally requires only three or four iterations.

Reference building domestic hot water systems

The *Reference building* domestic hot water system(s) must generally be of the same type as installed in the *Proposed building*, except that in all cases the fuel will be electricity. Where a system in the *Proposed building* has a design peak usage exceeding 150 L/hour then it will be a heat pump water heater supplemented with direct electric heating; otherwise a direct electric water heater. The efficiency of direct electric water heaters shall be as per Table 41 Item 11. The efficiency of heat pump water heaters shall be nominal coefficient of performance of 3.25 at 7 °C ambient dry bulb temperature. The effect of ambient temperature variation on heating output and power input shall be included as follows (heat pump operation is assumed to be limited to ambient dry bulb temperature of 0 °C and above, hence the direct electric heating operates below this temperature):

Table 47: DHW heat pump full-load performance parameters

Ambient dry bulb temperature	Proportion of rated heating output	Proportion of rated electricity input
<0	1.0	3.25
0	0.82	0.97
4	0.92	0.99
7	1.00	1.00
10	1.08	1.01
15	1.21	1.03
20	1.29	1.05
25	1.38	1.07
30	1.42	1.09
40	1.47	1.11

The benefit of any solar thermal collectors may be excluded in the assessment of the *Reference building*.

Storage systems and tanks

Where the *Proposed building* has storage systems, the *Reference building* may assume that the total storage volume is varied in proportion to the annual domestic hot water usage by use of the prorating method (refer to *Modelling operation of heat pump* hot water plant

The heating hot water plant component of the energy model must account for all of the following features of plant operation, as relevant to the system design and its control:

- Individual heat pumps/compressors, compressor capacities, and compressor part-load performance characteristics, including effect of compressor part-load, ambient relief and heating hot water leaving temperature set point
- Hydraulic configuration of heat pumps, including parallel, series, sidecar and combinations of these
- Interlocked operation and variable speed control of primary pumps
- Operation of secondary pumps, including variable speed control and staged control of ganged pumps as applicable
- Staging and sequencing control of heat pumps in response to heating load
- Operation of defrost cycle in response to ambient temperature and evaporator coil frost build up
- Operation of oil sump heaters to maintain the oil temperature above a minimum threshold (where applicable)
- Heating hot water set point temperature reset control
- Where 4-pipe chillers are implemented for shared heating and cooling duty, the availability of each unit for operation in only a single mode, or simultaneous operation if specified
- Distribution pipework thermal losses
- Any other requirements as per NCC Section J Specification S34C4(b) and S34C4(c), and, for pumping energy, per NCC Section J Specification S34C4(f)

Additionally, where other means of heating is provided, for example direct electric resistance heating, electric boilers or others, these should be fully described with the method of modelling their control and performance clearly explained.

Modelling domestic hot water systems), and that the number of storage tanks is equal to the *Proposed building*.

The standing loss factors shall be used for the *Reference building*, shown below. The storage tank volume is the volume of each individual storage tank in the system. Interpolation between values is allowed, but not outside of the range:

Storage tank volume (L)	Storage tank turnover ratio			
	0.5	1	2	5
25	0.46	0.38	0.30	0.21
50	0.38	0.30	0.23	0.15
100	0.31	0.24	0.17	0.09
250	0.23	0.16	0.10	0.02
500	0.17	0.11	0.05	0.01
1000	0.12	0.06	0.02	0

The storage tank turnover ratio is a measure of the number of times the water within the tank is replaced per day. This is calculated as follows:

$$R_{tank} = \frac{q_{DHW}}{NV_{total}}$$

Where R_{tank} is the storage tank turnover ratio (cycles per day), q_{DHW} is the system annual domestic hot water usage (L/annum), N is the annual number of days of operation of the system (days/annum), and V_{total} is the total storage volume of all tanks in the system.

The standing loss factor of 0.03 shall be used for the *Reference building*.

Distribution loss factor

For all system types the distribution loss factor is as follows. For the *Reference building*, use the values noted with an asterisk (*):

No of outlets per system	Without recirculation pump	With recirculation pump
1-10	0.01*	0.01
11-50	0.04*	0.03
51-100	0.07	0.05*
100-250	0.10	0.08*
251-500	0.13	0.10*
500+	0.20	0.15*

For the *Reference building*, these values may be determined by prorating the *Proposed building* values as follows:

$$X_{ref} = \frac{q_{ref}}{q_{prop}} X_{prop}$$

Where X is the quantity to be prorated, q is the annual domestic hot water usage (L/annum) for the system, and subscripts *ref* and *prop* refer to the *Reference building* and *Proposed building* values respectively.

External artificial lighting

Lighting power densities to be applied for the *Reference building* (and *Proposed building* where minimum illuminance values as per *AS 1158.3.1:2020* are not achieved by the design) shall be applied according to the applicable lighting subcategory as defined in *AS 1158.3.1:2020* as follows:

Table 48: Standard practice external lighting power densities

Category	Power density	Category	Power density
PR1 and PP1 (note 1)	7.1 W/m	PA3	0.8 W/m²
PR2 and PP2 (note 1)	4.3 W/m	PE1	1.7 W/m²
PR3 and PP3 (note 1)	3.5 W/m	PE2	Match adjacent category
PR4 and PP4 (note 1)	3.5 W/m	PC1	1.5 W/m²
PR5 and PP5 (note 1)	2.6 W/m	PC2	0.6 W/m²
PR6 (note 1)	2.2 W/m	PC3	0.2 W/m²
PA1	2.1 W/m²	PCD and PCX	9.0 W/m²
PA2	1.4 W/m²		

Note 1: Based on path widths up to 6 metres. For path widths greater than 6 metres, multiply power density by number of 6 metre widths or part thereof, e.g. if path is 8 metres wide, this is 1.33 widths, therefore multiply by 2.

Lift energy calculation methodology

In this section all symbols used are as defined in and references to table numbers and formulae are to *ISO 25745-2:2015* (as *AS ISO 25745.2:2019*) unless stated otherwise.

Based on design specifications (at Design Review), lift technical data (at As-Built Submission) and building design, determine the following parameters for each lift (the same values of all variables apply to both the *Reference* and *Proposed building*):

- Number of stopping floors (i.e. floors with opening doors)
- One-way terminal travel distance for the reference cycle, i.e. the distance travelled between the bottom and top terminal landings (s_{rc}, m)
- Travel distance within any express zone for the lift (where an express zone is defined as three or more consecutive levels at which a lift car does not stop) (s_{ez}, m) (this is an additional item included here to represent better the energy consumption of lift cars with express zone travel)
- Rated load (Q, kg)
- Rated speed, acceleration and jerk (v, a and J, m/s, m/s² and m/s³)

Based on the definitions in Table A.1, determine the usage category for each lift within the project.

Based on either the definitions in Table A.1 or with reference to project brief, PPR or similar documentation, determine the number of operating days ($n_{days,r}$, per annum) for each lift (where Table A.1 states 360 days, use 365 days; where Table A.1 states 260 days, use 260 days less any public holidays included in the assessment as per Table 1 (of this guide) item 10, if appropriate for the building type).

Based on the usage category, determine the number of trips (n_d, per day) for each lift from Table 1.

Based on the usage category and number of stopping floors, determine the average travel distance factor (k_{av}) for each lift from Table 2 and hence the average one-way travel distance (s_{av}, m) for each lift as follows:

$$s_{av} = k_{av}(s_{rc} - s_{ez}) + s_{ez}$$

For the Reference building

Determine the reference door opening cycle time (t_d, s) for each lift from Table 49 based on assumed lift door opening, closing and hold times (adapted from *CIBSE Guide D*):

Table 49: Reference building lift door opening cycle times

Lift Rated Speed (m/s)	Door Opening time (s)	Door Hold Time (s)	Door closing time (s)	Opening cycle time (s)
≤2.5	2.4	6.0	2.6	11.2
>2.5	1.7	6.0	2.5	10.2

Determine the average travel time (t_{av}) for each lift as per Equation 13

Determine the total running time per day (t_{rd}) for each lift as per Equation 12

Determine the total non-running time (t_{nr})of each lift as per Equation 14

Based on NCC Table J7D8b, determine the energy efficiency class of each lift for its usage category and hence the applicable daily running energy consumption formula in Table 7. Calculate the daily running energy consumption for each lift using the rated load and applicable values of number of trips per day, average travel distance and non-running time determined above

Based on NCC Table J7D8a and the specified rated load, determine the idle and standby energy performance level of each lift, and hence from Table 6 determine the 30-minute standby power (P_{st30}, W) for each lift. Calculate the daily total energy consumption on days when not operating ($E_{d,nr}$, kWh/day) as follows:

$$E_{d,nr} = \frac{24P_{st30}}{1000}$$

For the Proposed building

Based on design specifications (at Design Review) or lift technical data or measurement (at As-Built Submission) determine the following additional parameters for each lift:

- Lift type (traction, hydraulic or positive drive)
- Counterbalancing (counterbalance mass divided by rated load, Q).

By simulation (at Design Review) or measurement (at As-Built Submission), determine the one-way travel distance of the short-cycle (s_{sc}, m), running energy consumption of the reference and short cycles (E_{rc} and E_{sc} respectively, Wh), standby power at idle, 5-minute standby and 30-minute standby (P_{id}, P_{st5} and P_{st30}, W), and door opening cycle time (t_d, s) for each lift. Refer to *ISO 25745-1:2012* (as *AS ISO 25745.1:2019*) for further details.

Calculate the average energy consumption of a running cycle with an empty car (E_{rav}) using Formulae 1 to 3, which can be combined as follows for simplicity:

$$E_{rav} = E_{rc} + (E_{rc} - E_{sc})\left(\frac{s_{av} - s_{rc}}{s_{rc} - s_{sc}}\right)$$

Or If the travel distance for the short cycle does not allow the rated speed to be reached use Formula 4.

Based on the usage category and rated load, determine the average car load (%Q) for each lift from Table 3, then, based on the lift type, counterbalancing and average car load, determine the applicable load factor (k_l) of each lift as per Formulae 6 to 11 (notes 1 and 2 may be applied where applicable)

Calculate the daily running energy consumption (E_{rd}) as per Formula 5.

Determine the average travel time (t_{av}) for each lift as per Formula 13

Determine the total running time (t_{rd}) for each lift as per Formula 12

Determine the total non-running time (t_{nr})of each lift as per Equation 14

Based on the usage factor, determine the time ratios in idle and standby mode for each lift from Table 4 and hence calculate the daily non-running energy consumption (E_{nr}) as per Formula 15.

Calculate the daily total energy consumption on days when operating (E_d) as per Formula 16.

Calculate the daily total energy consumption on days when not operating ($E_{d,nr}$) as follows:

$$E_{d,nr} = \frac{24P_{st30}}{1000}$$

For both the Reference and Proposed building

Calculate the annual energy consumption for each lift for both buildings based on the daily running and non-running energy consumption and number of days of running operation as follows:

$$E_{annual} = E_d n_{days,r} + E_{d,nr}(365 - n_{days,r})$$

Hence calculate the total lift energy consumption for each building as the sum of the annual energy consumption of each lift.

Reference building appliances

For Class 2 buildings, appliances shall be included in the building total energy consumption. The performance standard to be used in the *Reference building* is as follows:

Table 50: Reference building appliance energy ratings

Item	Reference specification	Reference performance	Maximum available rating (note 1)	Normalised energy consumption
Refrigerator/ freezer	Group: 5T Fresh food: 250 L Freezer: 100 L	1.5-star below maximum available star rating **2.5 Star**	4 Star	436 kWh/annum (2.5 Star)
Dishwasher	Place settings: 12	1.5-star below maximum available star rating **3.0 Star**	4.5 Star	282 kWh/annum (3.0 Star)
Clothes washer (note 2)	Load: 7 kg	1.5-star below maximum available star rating **3.5 Star**	5 Star	367 kWh/annum (3.5 Star)
Clothes dryer	Load: 6 kg	1.5-star below maximum available star rating **4.5 Star**	6 Star	200 kWh/annum (4.5 Star)

Note 1: Based on energy performance reported at www.energyrating.gov.au current at the time of publication of this guide.

Appendix E. Energy consumption adjustment factors

Car park and loading dock atmospheric contaminant control systems

The following energy consumption adjustment factors apply to the installation of atmospheric contaminant monitoring systems and associated variable-speed fan control in car parks and loading docks. The adjustment factor provided in Table 51 is used to establish the adjusted full-load absorbed fan power as follows:

$$P_{fan,adj} = P_{fan} \times F_{adj}$$

Where $P_{fan,adj}$ is the adjusted full-load absorbed fan power (kW), P_{fan} is the absorbed fan power at the specified operating duty point (kW), and F_{adj} is the adjustment factor for atmospheric contaminant monitoring and variable speed fan control from Table 51.

The adjusted absorbed fan power is then used with the appropriate car park/loading dock HVAC profile to establish the annual energy use of the *Proposed building*.

Table 51: Adjustment factor for atmospheric contaminant monitoring and variable-speed fan control

Requirement for adjustment factor	Adjustment factor
Car park and/or loading dock mechanical ventilation fans that include variable-speed drives on supply and exhaust fans (as applicable) controlled by an atmospheric contaminant monitoring system in accordance with AS1668.2:2024	0.7

Where a project contains multiple physically separate car parks and/or loading docks, the adjustment factor must be applied individually to each area with a qualifying atmospheric contaminant monitoring and variable-speed fan control system.

Automatic lighting controls

The adjustment factors are used to establish an adjusted illumination power density for the *Proposed building* as follows:

$$LPD_{prop,adj} = LPD_{prop} \times F_{adj}$$

Where $LPD_{prop,adj}$ is the adjusted proposed lighting power density (W/m²), LPD_{prop} is the nominal proposed lighting power density (W/m²), and F_{adj} is the adjustment factor for the proposed automatic lighting control system, as detailed in Table 52.

The adjustment factors can only be applied to luminaires controlled by the control system, not to the entire space.

Where more than one illumination power density adjustment factor applies to an area, they are to be combined using the following formula:

$$F_{adj} = F_{adj,A} \times \left(F_{adj,B} + \frac{1 - F_{adj,B}}{2}\right)$$

Where $F_{adj,A}$ is the lowest of the applicable lighting power density adjustment factors, and $F_{adj,B}$ is the second lowest of the applicable lighting power density adjustment factors. Note that if addressable lighting control is included, the fixed increment should be subtracted *after* the above calculation.

The adjusted proposed lighting power density is then used with the standard lighting profile for the space type (refer to *Appendix C. Default operating schedules*) to establish the annual lighting energy use of the *Proposed building*.

If your project includes automatic lighting controls that are not included here, approval to use specific alternative adjustment factors is required from the GBCA. The project team may submit a Technical Question describing how they propose to apply adjustments for the specific control features and how the improvements have been assessed.

Table 52: Automatic lighting control adjustment factors

Item	Requirement for the use of the adjustment factor		Adjustment Factor
	Reference specification	Reference performance	
Motion detector in accordance with Specification J6	All spaces within a building except for 'industrial spaces' and car parks	Where an area of 200 m² or less is switched or dimmed as a block by one or more detectors.	0.9 (note 1)
	For 'industrial spaces'	Where the maximum area switched or dimmed as a block by one or more detectors is the area of the space divided by 10, or 2000 m², whichever is smaller. The minimum required block size is 200 m².	0.9 (note 1)
	All spaces within a building except for car parks	Where up to and including 6 lights are switched or dimmed as a block by one or more detectors.	0.7 (note 1)
		Where up to and including 2 lights are switched or dimmed as a block by one or more detectors.	0.55 (note 1)
	Car parks	Where an area of a car park of less than 500 m2 is switched or dimmed as a block by one or more detectors.	0.7 (note 1)
Fixed dimming (note 4)	All	Lighting is controlled by fixed dimmers that reduce the overall lighting level and the power consumption of the lighting.	% of full power to which the dimmer is set
Daylight sensor and dynamic lighting control in accordance with Specification J6 – dimming or stepped switching of lights adjacent to windows and/or roof lights	All	(a) Lights within the space adjacent to windows other than roof lights for a distance from the window equal to the floor-to-window-head height.	0.75 (notes 2 and 3)
		(b) Where the total area of roof lights is less than 10% of the floor area, but greater than 5%.	0.8 (notes 2 and 3)
		(c) Where the total area of roof lights is 10% or more of the floor area	0.75 (notes 2 and 3)
		For spaces other than those described under (a), (b) and (c), where lighting is controlled by dynamic dimming (note 5)	0.95 (notes 2 and 3)
Addressable lighting control system	All	Where an individually addressable system is installed, the adjustment factor can be further reduced by	additional fixed increment of 0.05

Item	Requirement for the use of the adjustment factor		Adjustment Factor
	Reference specification	Reference performance	
		subtraction of an additional fixed increment.	

Note 1: Where luminaires are not switched off, but are only dimmed, the following equation must be used to determine the modified adjustment factor applicable to these luminaires:

$$F_{adj,dimmed} = F_{adj,switched} + \left(P_{dimmed} \times F_{adj,switched}\right)$$

Where $F_{adj,dimmed}$ is the adjustment factor to be applied to dimmed luminaires, $F_{adj,switched}$ is the adjustment factor applicable to switched luminaires (as per this table), and P_{dimmed} is the proportion of full-load power to which the luminaire input reduces when it is dimmed.

Note 2: These adjustment factors do not apply to tungsten halogen or other incandescent sources.

Note 3: These adjustment factors are conservative. If the design team believes that increased benefit will be realised, then the control operation should be modelled (refer to Modelling daylight-controlled artificial lighting systems). The benefits of automatic controls can also be demonstrated by proposing modifications to the lighting schedules to be used. Such modified lighting schedules need to be approved by the GBCA through the standard Technical Question process before being used in the modelling process.

Note 4: Fixed dimming is the control through control gear adjustment or lighting control software of the maximum luminaire light output that cannot be adjusted by the space user.

Note 5: Dynamic dimming is the automatic and continuous control of the luminaire light output in response to the signal from a photoelectric cell to compensate for the availability of natural light.

Appendix F. Alternative method to the Minimum Provisions requirements

As an alternative to meeting the DTS provisions for the performance of wall-glazing constructions and display windows (NCC Section J Part J4D6), project teams may demonstrate compliance using the below:

- The project team demonstrates that energy use is equal or less (MJ/m^2), than a *Reference building* modelled in accordance with the Table 1 of this guide for both the:
  - *Proposed building fabric*
  - *Proposed building*
- All three buildings (Reference, *Proposed building fabric* and *Proposed building*) meet the thermal comfort requirements where:
  - 95% of the mechanically ventilated regularly occupied areas achieve a PMV (thermal comfort) value of +1 and -1 for 98% of the annual operating hours of the building in line with *ASHRAE Standard 55–2013*.
  - All naturally ventilated regularly occupied areas maintain the comfort level within 80% of acceptability limits in line with *ASHRAE Standard 55–2013*.

Definitions

Predicted mean vote (PMV) method

The PMV index predicts the mean response of a large group of people on a 7-point thermal sensation scale, from +3 (hot) to -3 (cold), where 0 is neutral. The metric is designed for fully mechanically ventilated buildings and is determined in accordance with *ASHRAE Standard 55-2013*. A PMV of -1 to +1 means that 80% of people are satisfied and comfortable.

Proposed building fabric

A hypothetical building of the same size, shape, floor area and same glazing shape and areas as the *Proposed building*, and including all the same building envelope design and performance characteristics as the *Proposed building*, but building services characteristics and air temperatures (as nominated in the NCC)) are based predominantly on the NCC Section J Deemed-to-Satisfy provisions as defined in this document, and whose process energy consumption is based on appropriate benchmarks.

This was formerly known as Intermediate Building under *Green Star - Design & As Built v1.3*.

Thermal comfort parameters

For the purposes of PMV calculation, thermal comfort parameters are:

- Air Temperature (°C)
- Air Speed (m/s)
- Relative Humidity (%)
- Mean Radiant Temperature (°C)
- Metabolic rates (met)
- Clothing Levels (clo)

Clothing level (clo) and Metabolic rate (met)

ASHRAE Standard 55-2013 is utilized for Clothing level (clo) and Metabolic rate (met), when determining PMV levels in the *Proposed building*, and the comfort levels achieved by the modelling HVAC systems and building fabric. The below default figures shall be used:

Building class space use	Clothing level (clo)	Metabolic rate (met)
Class 2 & 3 – All living areas (Summer)	0.36	1.0
Class 2 & 3 – All living areas (Winter)	0.74	1.0
Class 5 – Office (Summer)	0.61	1.1
Class 5 – Office (Winter)	0.96	1.1
Class 6 – Shopping Centre (Summer clothing)	0.5	1.7
Class 6 – Shopping Centre (Winter clothing)	1.0	1.7
Class 7 – Distribution areas	0.96	2.1
Class 7 – Storage areas	0.96	1.7

Where alternative values are proposed, or where the building use or class is not adequately described in the above table, these shall be determined in accordance with *ASHRAE Standard 55-2013*, and a letter provided from the building owner confirming that the occupant clothing proposed, relating to these values, is appropriate for the proposed use of the building.