Supporting Document

NCC Volume One

# NCC 2019

# Energy Efficiency

## Commercial Buildings

Overview

ABCB

This document provides an overview of the key changes proposed to the energy efficiency provisions for commercial buildings in the National Construction Code (NCC) 2019 Volume One. The changes apply to Class 2 common areas, Class 3 and 5 to 9 buildings.

# Introduction

Under the Council of Australian Governments (COAG) 2015 National Energy Productivity Plan (NEPP), and with endorsement by the Building Ministers' Forum, the Australian Building Codes Board (ABCB) was requested to update the energy efficiency provisions in NCC 2019.

The NEPP is a COAG Energy Council agreed package of measures, which aims to improve Australia's energy productivity by 40 per cent by 2030. Measure 31 of the NEPP forecasts strong productivity and emissions reduction benefits from revising the NCC's energy efficiency provisions for residential and commercial buildings. However, it also recognises that there is a need to gather more evidence on the effectiveness of the existing provisions, particularly for residential buildings.

The NEPP was informed by research commissioned by the former Department of Climate Change and Energy Efficiency in 2012[1]. This research was updated in 2016 by the Department of the Environment and Energy[2]. The updated research found that changes to the NCC could achieve energy savings of up to 53 per cent for commercial buildings, but only up to 18 per cent for residential buildings[3].

On this basis, for NCC 2019 the ABCB was instructed to focus on increasing the stringency of the energy efficiency provisions for commercial buildings (the subject of this document). For residential buildings, the ABCB's work for NCC 2019 involves improving interpretation and compliance with the current provisions, in preparation for potentially being asked to increase stringency in the future (These changes are detailed in a separate document).

[1] Pitt & Sherry, Pathway to 2020 for Increased Stringency in New Building Energy Efficiency Standards: Benefit Cost Analysis, January 2012.

[2] Pitt & Sherry, Pathway to 2020 for Increased Stringency in New Building Energy Efficiency Standards: Benefit Cost Analysis: Commercial Buildings: 2016 Update, 10 May 2016; Pitt & Sherry, Pathway to 2020 for Increased Stringency in New Building Energy Efficiency Standards: Benefit Cost Analysis: 2016 Update for Residential Buildings, 13 May 2016.

[3] Assuming a learning rate of 3 per cent per annum for 10 years.

# Proposed changes for NCC 2019

## NCC Volume One

### Performance Requirements

| *Provision* | *Proposed change* | *Notes* |
|---|---|---|
| Building energy efficiency (JP1) | The existing Performance Requirement JP1 has been rewritten. It now includes a quantified level of performance for buildings with a conditioned space. | This change has been made as part of the ABCB's broader initiative to quantify the NCC's Performance Requirements. The level of energy efficiency must also be appropriate to the function and use of the building and the required level of human comfort. |
| Greenhouse gas intensity of heating energy (JP3) | The current Performance Requirement (JP3) favouring low greenhouse gas intensity heating energy has been deleted. | This Performance Requirement is no longer viable due to the increasing price of gas and the accessibility of grid electricity with low emissions intensity. The use of on-site renewable energy is addressed in the new version of JP1 through the defined term 'regulated energy'.<br>Note that this requirement remains in Part BP2.8(b) of NCC Volume Three in relation to heated water. |

## Verification Methods

| *Provision* | *Proposed change* | *Notes* |
|---|---|---|
| NABERS Energy (JV1) | A new Verification Method for Class 5 buildings has been included based on the NABERS Energy Commitment Agreement process. | This change will formalise acceptance of buildings with 5.5-star NABERS Energy Commitment Agreements as being compliant with most of the NCC's energy efficiency requirements. Additional provisions are listed in the new Specification JVa (see below). |
| NABERS Energy (JV1) | Includes a defined thermal comfort target based on the metric of Predicted Mean Vote. | Setting a quantified thermal comfort target is considered important to help guard against poorly performing building façades reducing occupant comfort. |
| Green Star (JV2) | A new Verification Method for all commercial buildings has been inserted based on the Green Star rating process and simulation schedules. A thermal comfort target, based on the metric of Predicted Mean Vote, has also been included (as above). | This change will formalise acceptance of buildings with Green Star ratings as being compliant with most of the NCC's energy efficiency requirements. Additional provisions are listed in the new Specification JVa (see below). |
| Reference building (JV3) | Improvements have been made to the existing reference building Verification Method (JV3). This includes replacing 'annual energy consumption' with 'annual greenhouse gas emissions' as the primary metric for comparing the proposed building against the reference building. A thermal comfort target, based on the metric of Predicted Mean Vote, has also been included (as above). | Using greenhouse gas emissions as a proxy for energy consumption is considered necessary to reconcile the different emissions intensity of gas and electricity and allow credit for on-site renewable energy. |
| Reference building (JV3) | The additional provisions and modelling requirements have been relocated into the new Specifications JVa and JVb (see below). | The restructuring of the Verification Method is designed to improve readability by consolidating the building modelling requirements in one place. |

| *Provision* | *Proposed change* | *Notes* |
|---|---|---|
| Building envelope sealing (JV4) | A new Verification Method for building envelope sealing has been added. The new Verification Method only applies to certain building classifications and climate zones. | The new Verification Method is based on using blower door testing to verify that a building's envelope has been sealed to an appropriate level. Research by consultants, Energy Action and ARUP, were used to determine the appropriate climate zones and rates of air leakage permeability.<br>Given the complexity of building envelope sealing, detailed guidance material is likely to be developed to support this new Verification Method. |
| Additional verification requirements (Specification JVa) | A new specification has been inserted which sets out requirements that need to be carried out in addition to the modelling requirements in JV1, JV2 and JV3. The additional requirements are mostly based on the Deemed-to-Satisfy (DTS) Provisions in Section J. | The intent of this specification is to ensure buildings designed and constructed using JV1, JV2 or JV3 cover the same elements as the DTS Provisions. |
| Modelling parameters (Specification JVb) | The modelling requirements applicable to JV1, JV2 and JV3 have been consolidated into a new Specification JVb. | The requirements in this specification are mostly relocated from the existing Verification Method JV3. Modifications have been made to the formatting and content to improve interpretation and the accuracy of modelling. |
| Modelling profiles (Specification JVc) | The existing Specification JV has been re-numbered and updated. | Minor improvements have been made to the occupancy and operating profiles. Minor changes have also been made to the table formatting to improve readability. |

## Deemed-to-Satisfy (DTS) Provisions

| *Provision* | *Proposed change* | *Notes* |
|---|---|---|
| Building fabric Total R-Values<br>(J1.2) | A new subclause has been added to provide options for determining how to achieve the required Total R-Values of building elements. This includes direct reference of NZS 4214 (Methods of determining the total thermal resistance of parts of buildings). | NZS 4214 is a normative reference of AS/NZS 4859.1, which is already referenced in Section J. Directly referencing NZS 4214 in Section J will ensure practitioners are aware of the need to use this standard when determining how to achieve the required level of thermal resistance of building elements. This includes taking account of thermal bridging. Research has shown that many common construction types have much lower inherent R-Values when thermal bridging is properly considered. Performance Solutions may need to be considered where it is difficult to achieve the minimum Total R-Values. |
| Roofs<br>(J1.3) | The current provisions have been replaced with simpler provisions for roof thermal resistance and solar absorptance. | The change to a single value for solar absorptance is based on analysis indicating that this represents the most cost-effective option for improving roof performance. In turn, this simplifies the requirements for roof Total R-Values in that they no longer need to vary on the basis of the roof solar absorptance.<br>As a consequence of this change, the table adjusting for the loss of ceiling insulation (Table J1.3b) and the separate thermal break provisions (J1.3(c)) have been removed. These provisions are captured within the NZS 4214 calculation method and the new Specification J1.2b. |
| Roof lights<br>(J1.4) | Changes have been made to improve the performance of roof lights and simplify the provisions. | Analysis of benefit has resulted in a single Total U-Value for roof lights and a simplified table of Solar Heat Gain Coefficients (SHGCs). |

| *Provision* | *Proposed change* | *Notes* |
|---|---|---|
| Wall-glazing construction (J1.5) | The glazing provisions currently in Part J2 have been incorporated into J1.5. A minimum Total U-Value and SHGC must be achieved for the whole façade instead of separate targets for glazing and walls. Minimum Total R-Values have also been specified for walls. | This approach is fundamentally different to the currently separate provisions for walls and glazing. The change is based on the principle that the overall façade performance is more important than that of the individual elements, particularly as the DTS Provisions are made more stringent.<br>The new performance values are based on analysis indicating that glazing SHGC is generally more important for facades as stringency increases. Separate values for daytime versus overnight operating buildings have been retained, reflecting the different demands on the façade.<br>The new stringencies for wall-glazing constructions were selected on a cost-benefit basis to suit Australian conditions. Note that the new values are broadly comparable to the values in the US energy code, ANSI/ASHRAE/IES Standard 90.1-2016.<br>Compared to the NCC 2016 methodology, the new NCC 2019 methodology has a number of benefits. In addition to being more transparent, it is simpler to calculate glazing requirements and does not necessitate a separate glazing calculator. The new methodology also has the benefit of being easier to update if necessary, including if another stringency increase is required in the future.<br>As a consequence of these changes, in some instances, lower wall Total R-Values than the current NCC provisions may be permissible to meet the total facade U-Values. However, the total façade performance (wall and glazing) will generally be more stringent. |

| *Provision* | *Proposed change* | *Notes* |
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| | | It should also be noted that there are two methods for determining compliance. The first method is based on each façade direction (i.e. North, South, East and West) being assessed separately. The second method allows all façade directions to be assessed together.<br>The reduction in the number of façade directions reflects feedback on current industry practice and a desire for some simplification of the provisions.<br>As a consequence of these changes in methodology, significantly less tables are required. This includes the need for detailing options for achieving the necessary levels of wall thermal resistance.<br>Guidance documents will be developed to assist practitioners in interpreting and applying the new provisions. As is currently the case, this will include emphasis on the use of glazing performance values determined in accordance with the technical protocols and procedures of the Australian Fenestration Rating Council (AFRC). |
| Floors<br>(J1.6) | The current provisions have been simplified, including through a consolidated table of minimum Total R-Values. | The new provisions do not fundamentally alter the stringency of the current provisions when the thermal resistance of any subfloor space or material (e.g. ground) is taken into account. The note to the new Table J1.6 directs practitioners to CIBSE Guide A for this information. |
| Glazing<br>(Part J2) | Part J2 has been deleted. | This change is a consequence of incorporating the glazing provisions into J1.5. |

| *Provision* | *Proposed change* | *Notes* |
|---|---|---|
| Building sealing (Part J3) | Numerous minor changes have been made to this Part. | These changes are primarily intended to strengthen the current provisions with more detail. |
| Air-conditioning system control (J5.2) | Includes more precise provisions on how air-conditioning systems are to be controlled, including ensuring adjoining air-conditioning systems operate in a coordinated manner. | The additional controls are intended to increase the ability for air-conditioning systems to be operated efficiently. |
| Air-conditioning system control (J5.2) | The requirements for an economy cycle have been limited to larger air-conditioning systems in the cooler climate zones. | This change is based on modelling of outdoor air economy cycles which demonstrated that the current provisions are slightly too stringent. |
| Air-conditioning system control (J5.2) | The provisions for time switches have been relocated into this clause from the current Specification J6. | This change is intended to improve the readability of the provisions. |
| Mechanical ventilation system control (J5.3) | The general changes to these provisions include extending the requirements for energy reclaiming systems and demand control, and incorporating the requirements for miscellaneous exhaust systems and time switches (currently in J5.4 and Specification J6). | These changes are intended to provide more nuanced control of ventilation energy use and improve the readability of the provisions. |
| Mechanical ventilation system control (J5.3) | The provisions also extend the requirement for carbon monoxide (CO) sensors as part of carpark exhaust systems. | The CO sensors will ensure the fans are only operated when necessary and should result in significant energy use reductions. |
| Fan systems (J5.4) | These new provisions establish a more stringent whole-of-system approach based on minimising system pressure drop. It includes specific fan component level requirements. | The changes increase the efficiency of fans to a level modelled to be cost effective. The provisions were developed in consultation with the fan manufacturers' industry association, FMAANZ.<br>Requiring the calculation of actual pressure drop reduces the chance of a system consuming higher than expected energy use and is predicted to improve system design. |

| *Provision* | *Proposed change* | *Notes* |
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| Fan systems<br>(J5.4) | A fan system performance-type solution has been introduced to enable fan system designers to use a DTS system pressure drop as a benchmark for their proposed system. | The option of a whole-of-system DTS Solution allows for greater flexibility in system design and encourages properly designed solutions. |
| Ductwork insulation and sealing<br>(J5.5, J5.6) | The current provisions for ductwork insulation and sealing in Specification J5.2b have been relocated to Part J5. | The intent of this change is to increase the readability of the provisions by placing related information in one place. |
| Air-conditioning pumps<br>(J5.7) | The current provisions based on $W/m^2$ have been replaced with minimum pump power efficiencies and maximum allowable pressure drops within pipework. | These changes establish component-level efficiencies for circulator pumps based on a calculation method used in European Union regulations. For all other pumps, the provisions are based on a calculation of how much time it will operate at its “peak efficiency” level. The new bases for measuring pump efficiency and pipework are considered more closely aligned with what drives the energy use of HVAC pumps. The changes are also more closely aligned with industry practice in pump specification and should encourage better designed and more energy efficient systems.<br>The new component level metrics ensure that the pumps selected are both fit for purpose for the system they are operating in, and the most efficient. |
| Air-conditioning pumps<br>(J5.7) | A pump system performance-type solution has been introduced to enable pump system designers to use a DTS system pressure drop as a benchmark for their proposed system. | The option of a whole-of-system DTS Solution allows for greater flexibility in system design and encourages properly designed solutions. |

| *Provision* | *Proposed change* | *Notes* |
|---|---|---|
| Pipework insulation (J5.8) | The current provisions for pipework insulation in Specification J5.2c have been relocated to Part J5. The minimum R-Values have also been increased. | The increase in minimum R-Values is based on cost-benefit analysis. It was also determined to be more appropriate to base pipe insulation levels on the temperature of the transported fluid, rather than its state. |
| Space Heating (J5.9) | The current provisions for space heating in Specification J5.2d have been relocated to Part J5. The gross thermal efficiency of gas water heaters (boilers) has also been increased. | The changes to the DTS Provisions for gas boilers is based on analysis indicating higher levels of gross thermal efficiency are cost effective, with current technology, across all boiler sizes. On the basis of industry feedback, a lower level of stringency for smaller boilers was introduced to accommodate non-condensing boilers. |
| Refrigerant chillers (J5.10) | The current provisions for chillers in Specification J5.2e have been relocated to Part J5. The provisions specify more stringent energy efficiency ratios (EERs) and cover chillers of all capacities. | The new EERs are based on the US energy code, ANSI/ASHRAE/IES Standard 90.1-2016.<br>Two options, or sets of EERs, are provided to accommodate whether the chillers are likely to be used predominantly under full or part load.<br>As a consequence of increasing stringency, it has become necessary to specify EERs for chillers of all capacities, rather than just for those not covered by Minimum Energy Performance Standards (MEPS). |
| Unitary air-conditioning equipment (J5.11) | The current provisions for packaged air-conditioning equipment in Specification J5.2e have been relocated to Part J5 and renamed. More stringent EERs have been specified. | The proposed EERs were determined by cost-benefit analysis and are anticipated to mirror future MEPS for unitary air-conditioning equipment. |

| *Provision* | *Proposed change* | *Notes* |
|---|---|---|
| Heat rejection equipment (J5.12) | The current provisions for heat rejection equipment fans in Specification J5.2a have been relocated to Part J5. The methodology for calculating fan motor power has been aligned to the provisions for fan systems in J5.4. | These changes are intended to increase the readability and interpretation of the provisions.<br>Forced draft, closed circuit coolers are no longer included in the provisions because they are considered to be highly inefficient. |
| Artificial lighting (J6) | The stringency of the artificial lighting provisions has been increased. This includes reductions to the maximum Illumination Power Densities (IPDs) for interior artificial lighting. Improvements have also been made to the interior lighting adjustment factors. | The stringency increases are based on advances in current lighting technology, particularly LED technology. The improvements to the adjustment factors include consideration of contemporary technology, colour rendering and colour temperature. The adjustment factors provide considerable flexibility for achieving the necessary IPDs for interior artificial lighting. |
| Lifts (J6.7) | New provisions for lift efficiency have been introduced. | Lifts can be relatively significant energy users, especially as other aspects of a building's energy use become more efficient. The proposed new efficiency levels are based on an international standard, ISO 25745-2. |
| Escalators (J6.8) | New provisions inserted for escalators and moving walkways. | The new provisions are intended to reduce the energy use of escalators and moving walkways when not in use. |
| Swimming pool and spa heating (J7.3) | A number of changes have been made to the provisions for swimming pool and spa heating. This includes the need for gas water heaters to achieve minimum levels of gross thermal efficiency, and pool covers must achieve a minimum R-Value. | The gas water heater requirements mimic the new provisions for boilers used for air conditioning in J5.9. |
| Facilities for energy monitoring (J8.3) | Improvements made to the existing provisions for energy monitoring. | These changes are intended to ensure that energy monitoring is installed that can provide useful data to facilities managers about the performance of a building. |

| *Provision* | *Proposed change* | *Notes* |
|---|---|---|
| Material properties (Specification J1.2a) | Tables reformatted. | This change has been made to improve readability. |
| Metal framed roof and wall construction (Specifications J1.2b and J1.2c) | New specifications inserted detailing the Total R-Values achieved by certain forms of metal framed roof and wall construction. | Only common forms of metal framed roof and wall construction are covered by the new specifications. The specifications take into account the effects of thermal bridging and the compression of insulation on Total R-Values. |
| Spandrel panels (Specification J1.2d) | New specification inserted detailing how to determine the thermal performance of spandrel panels. | The specification takes into account the effects of the frame and panel construction. |
| Roof, wall and floor construction (Specifications J1.3, J1.5 and J1.6) | Existing Specifications J1.3, J1.5 and J1.6 have been deleted. | This is a consequence of the changes to Part J1 and the general stringency increase of the new provisions. Practitioners will be required to determine the Total R-Value of building elements on a case-by-case basis, taking into account thermal bridging.<br>More appropriately, the content of these specifications may be incorporated into guidance documents. |
| Lighting power control (Specification J6) | Minor improvements made to the provisions for lighting timers, time switches and motion detectors. | |

## Schedules

| *Provision* | *Proposed change* | *Notes* |
|---|---|---|
| Abbreviations and symbols (Schedule 2) | Additional abbreviations and symbols inserted. | Additional abbreviations and symbols have been inserted to support some of the technical changes made throughout Section J. |
| Definitions (Schedule 3) | A number of new defined terms have been added and existing terms updated. Several existing defined terms have also been deleted. | Defined terms have been inserted and updated to ensure the correct application of the Section J clauses where these terms appear. Several existing defined terms have been deleted because they are no longer used in Section J. |
| Referenced documents (Schedule 4) | A number of new referenced documents have been included and existing documents updated. Two existing referenced documents have also been deleted. | Referenced documents have been inserted and updated, with their full details, to ensure the correct documents are used in conjunction with the of the Section J clauses where they appear. Two existing referenced documents have been deleted because they are no longer used in Section J. |