



Queensland Development Code Mandatory Part 4.1—Sustainable buildings guideline

A guide to assist building industry
professionals and homeowners comply
with the sustainable buildings code

May 2011



Growth Management Queensland

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1. Purpose

To assist building industry professionals and homeowners comply with the Queensland Development Code (QDC) Mandatory Part 4.1—Sustainable buildings.

2. Scope

This guideline provides information on the QDC requirements as they apply to a range of building classes. It particularly focuses on new houses and townhouses (class 1 buildings) and multi-unit residential buildings (class 2) with regard to:

- 6-star energy equivalence for houses and townhouses
- 5-star energy rating for multi-unit residential buildings
- optional credits for outdoor living areas, such as decks, verandahs and balconies
- optional credit for photovoltaic (solar) energy systems
- energy efficient lighting
- water conservation
- energy efficient air conditioners.

It also provides information on how these provisions apply to alterations or additions to existing dwellings, such as extensions, renovations or relocations.

For other building classes, information on the following QDC requirements is provided for:

- end-of-trip facilities (buildings defined by the QDC)
- electricity sub-metering (for class 2 and 5 buildings).

The information presented in this guideline is not absolute or exhaustive, and it is not intended to cover every possible building design or its fixtures, fittings and appliances. It should be used as a guide only.

Supporting fact sheets providing general information about sustainable buildings requirements are available on the Department of Local Government and Planning's website at www.dlgp.qld.gov.au

The following reference grid (Table 1) provides an overview of how each QDC sustainable building measure applies to different building classes.



Table 1 QDC's sustainable building measures for building classes

		APPLICATION #				
		New houses and townhouses (class 1)	Existing houses and townhouses (class 1)	New multi-unit residential buildings (class 2)	Existing multi-unit residential buildings (class 2)	Commercial office buildings, shopping centres, hospitals and tertiary education facilities (as defined by the QDC)
Section of guideline	PART 1: BUILDING DESIGN AND FACILITIES					
	6-star houses and townhouses (including optional credits ^A)	●	●			
	5-star multi-unit residential buildings (including optional credits ^B)			● ^C	●	
	End-of-trip facilities					● ^D
	PART 2: FIXTURES, FITTINGS AND APPLIANCES					
	Energy efficient lighting	●	●	●	●	
	Water conservation	●	● ^E	●	● ^E	
	Energy efficient air conditioners F	●	●	●	●	●
	Electricity Sub-metering			●		● ^G

NOTE

- # building classes as defined under the Building Code of Australia, except for end-of-trip facilities which are defined by the Queensland Development Code
- ^A ½ or 1-star credit for an outdoor living area and/or 1-star credit for a photovoltaic (solar) energy system
- ^B ½ or 1-star credit for an outdoor living area
- ^C individual sole occupancy units must achieve a minimum of 4 stars
- ^D only in designated local government areas
- ^E where a building development application and/or plumbing application is required with an alteration or addition, such as an extension, renovation or re-location
- ^F applies to all building classes as defined under the Building Code of Australia
- ^G only in new class 5 buildings (commercial office buildings).



3. Legislation

Under section 30 of the *Building Act 1975* (BA), the Queensland Development Code (QDC) and the Building Code of Australia (BCA) are codes for the purposes of the Integrated Development Assessment System (IDAS). The IDAS is a system of approving development assessment under the *Sustainable Planning Act 2009* that integrates land-use planning and building works. Effectively for building works, the QDC and BCA provide the relevant building assessment provisions. These prescribed building works are assessed as either Code or Self-assessable development when evaluating a building's design and fixtures when they are submitted as part of a building development application through IDAS.

This guideline is to be read in conjunction with the Queensland Development Code MP 4.1—Sustainable buildings and has been prepared under section 258 of the *Building Act 1975* (BA). Section 258 provides for guidelines to be made to assist with achieving compliance with the BA, however strict compliance with this guideline is not mandatory.

The following legislation is referred to in this guideline:

- *Acts Interpretation Act 1954*
- *Building Act 1975*
- *Building Regulation 2006*
- *Building Code of Australia*
- *Electrical Safety Act 2002*
- *Electricity Regulation 2006*
- *Environmental Protection Act 1994*
- *Sustainable Planning Act 2009*
- *Water Efficiency Labelling and Standards Act 2005*
- *Water Supply (Safety and Reliability) Act 2008*.

The following Australian Standards are referred to in this guideline:

- AS/NZS 1170.2: 2002—Structural design actions – Part 2: Wind actions
- AS 1284.1: 2004—Electricity metering – General purpose induction watt-hour meters
- AS/NZS 1768: 2007—Lightning protection



- AS 2890.3: 1993—Parking facilities – Bicycle parking facilities
- AS/NZS 3000:2007 (Amdt 1: 2009)—Electrical installations (or Wiring Rules – as a secondary reference to the Building Code of Australia)
- AS/NZS 3008.1.1: 2009—Electrical installations – Selection of cables
- AS/NZS 3823.2—Performance of electrical appliances – Air conditioners and heat pumps – Energy labelling and minimum energy performance standard (MEPS) requirements
- AS/NZS 4777: 2005—Grid connection of energy systems via inverters (Parts 1, 2 and 3)
- AS/NZS 4859.1: 2002—Materials for the thermal insulation of buildings – Part 1: General criteria and technical provisions
- AS/NZS 5033: 2005—Installation of photovoltaic (PV) arrays
- AS 62053.21: 2005—Electricity metering equipment (AC) – Particular requirements Part 21: Static meters for active energy (classes 1 and 2).

4. Interpretation

4.1 *Acts Interpretation Act 1954*

In case of any ambiguity in the meaning of the Queensland Development Code, the interpretation that will best achieve the purpose of the Code is to be preferred to any other interpretation – section 14A of the *Acts Interpretation Act 1954*.

4.2 Local planning schemes

The Queensland Development Code (QDC) and Building Code of Australia (BCA) apply to all local government areas throughout Queensland. Some local governments have included sustainability requirements that relate to building matters in their planning schemes. Under sections 30, 31 and 32 of the *Building Act 1975*, the QDC and the BCA are codes for the purposes of the Integrated Development Assessment System (IDAS) and they cannot be changed under a planning scheme, local planning instrument or local law.

In accordance with the *Sustainable Planning Act 2009* section 233(7) and section 86, the QDC and BCA override any similar provisions of a local government’s planning instrument. The QDC and BCA regulate sustainable building designs and features, and local governments should not include additional or more stringent



measures in a planning instrument. Where a planning scheme, local planning instrument or local law is inconsistent with a regulation, such as the Building Regulation 2006, the planning scheme, local planning instrument or local law is of no effect.

As part of the state interest check process involved with the preparation of local planning schemes, the Department of Local Government and Planning reviews new and amended planning instruments for the purposes of identifying inconsistencies between planning instruments and building assessment provisions.

4.3 Building certifier's discretions

It is common practice for a building certifier to request a Building Form 15— Compliance Certificate for Building Design or Specification under the Building Regulation 2006 for matters such as building design energy equivalence and energy efficient lighting. It is however not a mandatory requirement. The dwelling's design and lighting configuration can be offered on the plan with specifications or via Form 15. A building certifier may request a Form 15 from a competent person to confirm the design and fixtures complies with a design aspect in good faith and rely on this form without further checking. Alternatively, the building certifier may accept other documentation as evidence of suitability to satisfy them that the dwelling's design and fixtures comply.

The design and fixtures of each dwelling need to be assessed on their merits. While some housing providers offer similar designs with standard house plans, the dwelling's energy efficiency performance is influenced by its location, orientation, materials, window size and type, fixtures, etc. For example, a house design that complies with the 6-star energy equivalence requirement on one property may not necessarily receive the same rating on another site (due to location, orientation, etc). Alternatively, a standard house plan may have a variation to its lighting fixtures and fittings. Therefore each dwelling needs to be separately assessed and approved by a building certifier.

4.3.1 Provisions for changes to building assessment provisions

To assist with transitioning new code requirements, section 37 of the *Building Act 1975* permits a building certifier to use discretion in applying new or amended building assessment provisions, such as the QDC and BCA, to a building development application. Discretion may be used in cases where the building certifier is satisfied that planning work is underway, for example, where a contract to build is in place or substantial negotiations for planning work have commenced.



In such cases it may be appropriate for a building certifier to approve the building against the previous building assessment provisions where more than a minor change to the dwelling's design or fixtures is required to meet the new provisions.

Building certifiers should use this discretion by considering the practicality of meeting the new building assessment provisions in the context of the proposed building and the nature of the new provisions. The building certifier must certify in writing that the new provisions would require a significant change to the design or fixtures.

Building design changes that may be considered more than a minor change include:

- substantial alterations to the building plans, such as incorporating an outdoor living area
- substantial alterations to a major building component, such as significant change in glazing or the roof construction to be changed from flat to pitched
- the need to incorporate a new component in the building design, such as ceiling fans or different types of windows.

However, using a lighter colour for the roof and external walls would be considered a minor change for the purposes of section 37 of the *Building Act 1975*.

The history of previous QDC amendments is outlined in Appendix A.

4.3.2 Alterations—discretions relating to the existing building

The areas of an existing dwelling undergoing alterations and involving new building work that requires a building development application must comply with the building assessment provisions as much as practical. For alterations, including extensions of existing structures, the building certifier (under section 81 of the *Building Act 1975*), may determine the extent to which the existing structure is also required to be upgraded to comply with the current building assessment provisions. This includes consideration of alterations undertaken to the building's structure within the previous three years. How this discretion is exercised will depend on the nature and size of the work, and each case must be assessed on its merits.

Building certifiers should take into account the factors associated with requiring compliance when compared to the potential benefits. For example, if the building work represents more than 50 per cent of the existing building's floor area, the building certifier can impose conditions in the approval that require the existing part of the building to comply with all or a stated part of the current building assessment provisions. The building certifier may reasonably decide not to impose



conditions for upgrading the existing part of the building in circumstances where they consider that applying the new building requirements would:

- not provide a level of benefit commensurate with, or exceeding, the additional costs
- otherwise be overly onerous or technically impractical.

4.3.3 Alternative solutions

Under section 14(4)(b) of the *Building Act 1975*, alternative solutions, as prescribed in the QDC, can be used if the alternative solution meets the relevant performance requirements. Building certifiers are responsible for assessing whether an alternative solution complies with the QDC performance criteria and may rely on a competent person to assist with the assessment. They are also required to keep a record of this decision.



Part 1—Building design and facilities

5. 6-star houses and townhouses

5.1 Application

Since 1 May 2010, new houses and townhouses (class 1 buildings), and any associated enclosed attached garage or carport (class 10a building), must achieve a minimum energy equivalence rating of 6 stars. Optional credits for outdoor living areas and photovoltaic (solar) energy systems towards the 6-star housing requirement can be used in all climate zones.

The 6-star energy requirement also applies to alterations or additions to existing houses and townhouses, such as extensions, renovations or relocations, which require a building development application. It is not practical to apply the 6-star requirement to minor alterations, maintenance and repairs to existing buildings that do not require a building development application. However, where roofing or walls are repaired or replaced (which may be subject to a building development application in some council areas, such as from tile to metal sheet roofing) owners may wish to consider installing insulation and using light colours on external surfaces.

New manufactured homes pre-fabricated off-site need to comply with the 6-star requirement upon construction. Relocated homes moved to a permanent location also need to comply with the 6-star requirement (as far as practical).

Under section 110 of the *Building Act 1975*, if the building work involves a change of classification, for example, if it was proposed to use an existing class 10a building (carport) for habitable purposes (by including a bedroom or kitchen, etc.) to a class 1a (house), then the 6-star requirement applies (as far as practical).

5.2 Design features of 6-star housing

The department's *Design guide for 6-star energy equivalence housing* has been produced to provide further advice on suitable design responses for houses in each of Queensland's four climate zones under the Building Code of Australia (BCA). The guide is available on the department's website.



5.3 Compliance

5.3.1 Compliance methods

The Queensland Development Code (QDC) provides flexibility to achieve compliance with the 6-star housing requirement, and a range of styles and energy efficiency features can be used in the design of new houses and townhouses. Designers need to decide the most suitable compliance path for the design given its location (refer *Design guide for 6-star energy equivalence housing*).

For attached class 1a buildings where there are multiple dwelling units, such as duplexes, villas, townhouses and terrace houses, each unit is assessed as a separate building. Therefore each dwelling unit needs to comply with the 6-star rating.

It is recommended to discuss the house's proposed design and assessment method with a building certifier and energy assessor early in the design process.

Building certifiers should ensure that dwelling plans submitted for approval are consistent with the approved building design and have been stamped and signed. Confirmation of the building design must be documented and should accompany the stamped plans issued with the building approval. This avoids the builder or owner substituting later versions of the plans which may have been amended (i.e. design variation). Any variation to the originally approved plans could compromise the energy efficiency compliance and performance of the dwelling.

There are four assessment methods available to applicants to achieve compliance with the 6-star housing requirement:

(i) Elemental provisions—also known as deemed-to-satisfy (DTS)—as per the BCA (Volume Two, Part 3.12—Energy Efficiency). The elemental (DTS) provisions provide a prescriptive approach based on four different climate zones in Queensland under the BCA (which has eight designated climate zones across Australia):

- climate zone 1—tropical (the coastal zone north of Mackay)
- climate zone 2—sub-tropical (the coastal zone south of Mackay)
- climate zone 3—hot arid (western Queensland)
- climate zone 5—warm temperate (Darling Downs region).

Refer to Appendix B for the location of Queensland's climate zones (based on local government areas). The elemental (DTS) provisions vary to account for energy efficient design standards suitable to each climate zone.



Suspended flooring:

From 1 May 2010, the QDC provides an exemption from certain elemental (DTS) provisions in the BCA for designs that include a suspended floor. Effectively, for houses in climate zones 1 and 2, house designs using the elemental (DTS) compliance method do not need to include insulation for suspended floors.

(ii) Software (simulation)—use of an energy assessment software tool (BERS Pro¹, AccuRate² or FirstRate5³ as accredited under the Nationwide House Energy Rating Scheme (NatHERS)) with a calculation method complying with the Australian Building Codes Board Protocol for Housing Energy Rating Software and is undertaken by a trained house energy assessor. With software, house designs are assessed for their thermal performance relative to the nearest regional centre location using a climate file (which uses averaged climatic data from at least 30 years of recorded data from the Bureau of Meteorology).

There are currently 12 climate files located in Queensland (compared to the four climate zones defined by the BCA). Three additional Queensland climate files are proposed to be incorporated in the future. Refer to Appendix C for the locations of Queensland's climate files.

Where there are two proximate climate files, such as Brisbane and Amberley, designs should be assessed using the most appropriate climate file for the site to best account for sub-regional climate differences, for example sites located closer to coastal areas are assessed against the Brisbane file and more inland areas assessed against the Amberley file.

It is important to note that the software assessment method can provide valuable information on the proposed design through a performance report. This includes whether the predicted annual heating or cooling loads could be a problem with the design, including a breakdown on a room-by-room basis that can identify poorly performing spaces (which can subsequently be improved by altering the design).

Where the software assessment method is used building certifiers must ensure that the requirements of section 3.12.0 of the BCA, including the installation of insulation, thermal breaks and building sealing, are incorporated with the building's design. Refer to the BCA's Information Handbook – Volume Two, Chapter Five Deemed-to-Satisfy Provisions for further information.

¹ provided by Solar Logic—www.solarlogic.com.au

² provided by Hearne Scientific Software—www.hearne.com.au

³ provided by Sustainability Victoria—www.sustainability.vic.gov.au



(iii) **Verification**—using a reference building in accordance with V2.6.2.2 and the definition of V2.6 of the BCA. This allows the intended design to be compared with a design that is known to comply.

(iv) **Peer review**—having an expert review and advise on house designs that may not readily comply with above assessment options. A guideline has been published under the *Building Act 1975* to support the peer review process and can be found on the department’s website.

5.3.2 Accredited house energy assessors

In assessing the energy equivalence of house plans, the building certifier must decide whether a person is competent to assist with design and specifications under section 17 and 18 of the Building Regulation 2006. It is recommended that only a person who is accredited with an assessor accrediting organisation, or who can demonstrate their use of the house energy rating software tool is current and tested, be considered as a competent person to use house energy rating software to meet the energy equivalence requirements.

The NatHERS Protocol for Assessor Accrediting Organisations has been established to approve the operation of accrediting organisations, who in turn administer the registration of accredited assessors. Currently, the Association for Building Sustainability Assessors (ABSA) is the only available accrediting organisation for accredited house energy assessors.

5.3.3 Optional credits

Since 1 May 2010, the QDC provides optional credits for the following design features that can be used towards achieving the 6-star requirement for houses and townhouses across Queensland:

- **outdoor living areas**—either ½ or 1-star credit
- **photovoltaic (solar) energy system**—1-star credit.

One or both features can be combined and used as part of compliance with the 6-star requirement, as long as the dwelling’s building shell achieves a minimum baseline star rating.



Baseline building requirements and optional credits

For houses and townhouses using optional credits towards the 6-star housing requirement, a baseline equivalence star rating for the building shell is required under the QDC. The baseline rating depends on the assessment method used.

Software assessment method

The baseline building requirement depends on the climate zone:

- minimum 4.5 stars in climate zones 1 (tropical), 2 (subtropical) and 5 (warm temperate)
- minimum 5 stars in climate zone 3 (hot arid).

The difference between minimum star ratings required is that more energy is needed to heat and cool dwellings located in climate zone 3, and this can be rated by software.

Elemental (DTS) assessment method

The baseline building requirement is 5-star energy equivalence through the use of the BCA 2009 provisions (Volume Two, Part 3.12). This requirement applies statewide as the BCA 2009 provisions only allow the design of a 5-star house.

Outdoor living areas

Outdoor living areas, such as a deck, verandah or balcony, have been recognised to promote our Queensland lifestyle. They are a design feature that can encourage residents to enjoy the pleasant aspects of Queensland's climate. Occupants can be expected to use less artificial cooling as they spend more time outside given that the outdoor living area provides shade, is accessible to breezes and retains less heat in summer. Also, occupants who spend more time outside and not in air-conditioned spaces can be expected to become more acclimatised to higher ambient temperatures.

Siting the outdoor living area as part of the building's footprint so that it accounts for solar access, shading and prevailing breezes can assist with maximising the home's comfort and energy efficiency.

An optional 1/2-star or 1-star credit towards the 6-star housing requirement is available for houses and townhouses that include a covered outdoor living area.

To achieve a 1/2-star credit the outdoor living area must:

- be directly adjoining and directly accessible from and attached to an internal living area, such as a lounge, kitchen, dining or family room. This does not include bedrooms, a study or home theatre rooms



- have a minimum floor area of 12 square metres and a minimum dimension in all directions of 2.5 metres
- be fully covered by an impervious roof. The roof covering must achieve a minimum total insulation of R-1.5 for downward heat flow
- have two or more sides open or capable of being readily opened, not including the connection between the outdoor living area and the internal living area (i.e. lounge, kitchen, dining or family room), to allow cross-flow ventilation and breezes.

To achieve a **1-star** credit the outdoor living area must meet **all** of the above requirements and have a permanently fixed ceiling fan with a speed controller and a blade rotation diameter of not less than 900 millimetres.

To promote unobstructed breeze paths, the open sides of the outdoor living area should also have at least 900 millimetres clearance from a lot boundary, neighbouring building, fence or other structure. Depending on the lot size and building type, QDC's MP 1.1, 1.2 or 1.3—Design and siting standards, or alternate planning scheme provisions for frontage and set-back clearances and roof height can influence the siting and design of an outdoor living area.

If an outdoor living area is used in the house's design, designers should be mindful of the orientation of the building. While the northern aspect is the preferred orientation for an outdoor living area as it provides best access to sunlight, the benefits of solar access during winter to internal living rooms should also be considered as part of the building's overall design. If an outdoor living area is located over the entire northern aspect of the house, it will result in a loss of access to winter sun and natural light in the adjacent internal rooms.

Additionally, any length of side or wall return that forms part of a room abutting an outdoor living area cannot be calculated towards the minimum requirement of 12 square metres floor area. The length of side measured as part of determining the total floor area must be open or capable of being readily opened.

If a house is to have air conditioning in the internal living area connected to an outdoor living area, owners are recommended to install an automatic switching device (such as a reed switch or other micro switch) to the doors leading to the outdoor living area. The switch could ensure the air conditioning unit switches off if the doors to the outdoor living area remain open for a set time (e.g. one minute), thereby reducing household energy consumption.

Generally, the open sides should be as open as possible to the outside to allow breezes and air movement. However, where two or more sides are open, or where



the outdoor living area is raised above the ground level or on a second or higher level, standard balustrades or walls at a minimum height of one metre for safety are acceptable, with the remainder of the side able to be open to the external elements (e.g. breezes).

A side with floor to ceiling glazing is considered as closed. It is permissible to have roller-blinds, louvres, shutters and awnings that are capable of being readily opened as an open side. A fixed timber lattice typically used as screening on traditional Queensland houses is also considered to be open (only where the total open area of the lattice grid is 50 per cent or greater).

The credit does not apply to an unenclosed area under a house as this area is not directly adjoining and directly accessible from an internal living area. For example, if an existing house is raised, any unenclosed area under the house cannot be considered as an outdoor living area. It also does not apply to a separate structure that may be associated with the house, such as a pavilion connected by a pathway to an internal living area.

A house with a compliant outdoor living area is shown in Figure 1 (floor plan) and Figure 2 (3-D model).



Figure 1 Floor plan of a house with a compliant outdoor living area

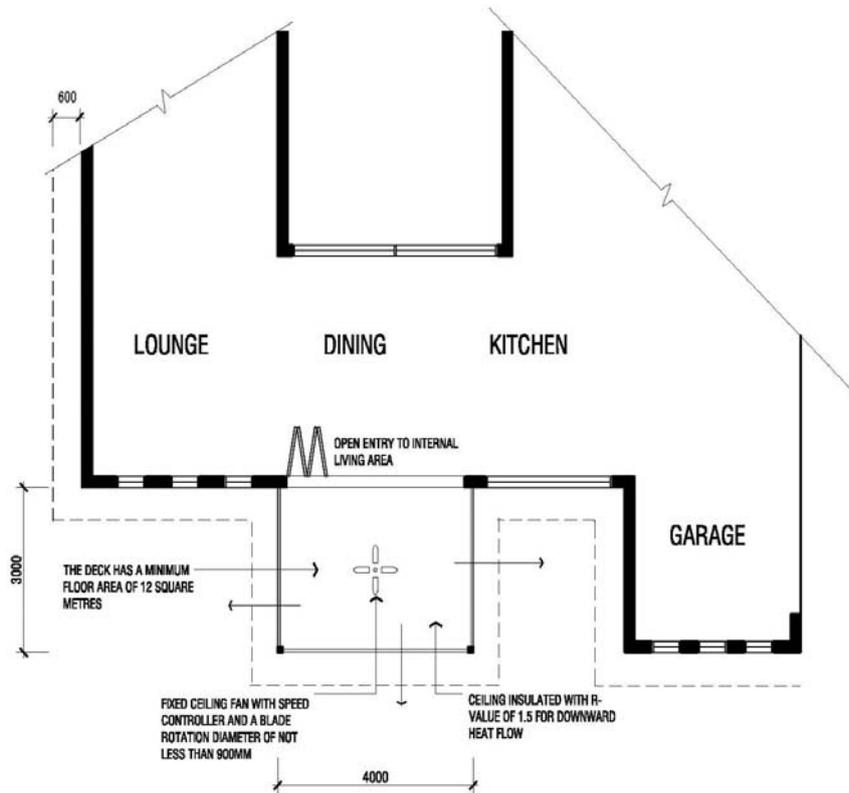


Figure 2 3-D modelled house with compliant outdoor living area



A house with an outdoor living area, with at least two openable sides, can promote the benefits of Queensland's lifestyle, as well as be more energy efficient.



Alternative solutions for outdoor living areas

While most outdoor living areas are rectangular, some may be designed as a different shape and have more than four sides, e.g. semi-hexagonal. Regardless of its shape, at least two sides still need to open to the outside. Other outdoor living areas may be long and narrow (such as a verandah around a traditional Queenslander house). Even though these designs may well exceed the minimum 12 square metres floor area, they may not provide a minimum 2.5 metre clearance in all directions. The building certifier may consider such designs still to meet the QDC performance requirement as an alternative solution due to the large overall size of the verandah and the primary use intended of the entire area (as marked on plans).

Outdoor living areas covered with adjustable shutters as the roof system may be considered by the building certifier as an alternative solution as the occupants can control their comfort level through setting the degree of shading, sunlight and ventilation. However, areas covered with fixed roof blades are not considered suitable as an alternative solution as occupants are unable to adjust the blades.

Case study 1—Outdoor living area

A family is designing a new house (class 1 building) and their plans include a covered outdoor living area with a ceiling fan, which will only be accessible from an internal laundry. Their house design (excluding the outdoor living area) has been rated at 5-stars and the building certifier needs to consider whether the design can achieve compliance with the 6-star requirement by including the outdoor living area credit.

This design will not achieve a 6-star rating as the outdoor living area is only accessible from the internal laundry. It needs to be directly adjoining and directly accessible from and attached to an internal living area, such as a lounge, kitchen, dining or family room. This is because outdoor living areas need to be easy to use and therefore need to be connected to internal living areas so occupants are more likely to enjoy their amenity for socialising, dining, etc.

If the family wishes to gain the optional 1-star credit for the outdoor living area they would need to amend their design to connect it to an internal living area or alternatively ensure the house, excluding consideration of the outdoor living area, meets the 6-star standard.



Photovoltaic (solar) energy systems

To reduce household greenhouse gas emissions and assist with enhancing Queensland's solar energy potential, houses or townhouses that install a photovoltaic (solar) energy system (PV system) with a minimum of one kilowatt (kW) capacity can achieve a 1-star credit towards the 6-star housing requirement. Depending on the location, an average of almost four kilowatt hours (kWh) per day of electricity can be produced by a one kW PV system, which is around 20 per cent of a typical Queensland household's electricity consumption. In more energy efficient houses which minimise electricity use this proportion could be higher. A PV system can be connected to the mains electricity grid (for urbanised areas) or be a stand-alone system (for non-grid and remote areas).

A PV system converts sunlight into energy through photovoltaic cells contained in framed flat panels that are configured as an array which are usually installed on a dwelling's roof. Up to eight square metres of roof space is usually required for every one kilowatt of PV generation capacity. PV systems are low maintenance and typically have at least a 25-year lifespan.

A typical roof-mounted PV system connected to the electricity grid is shown in Figure 3.

Figure 3 How a typical grid-connected PV system works

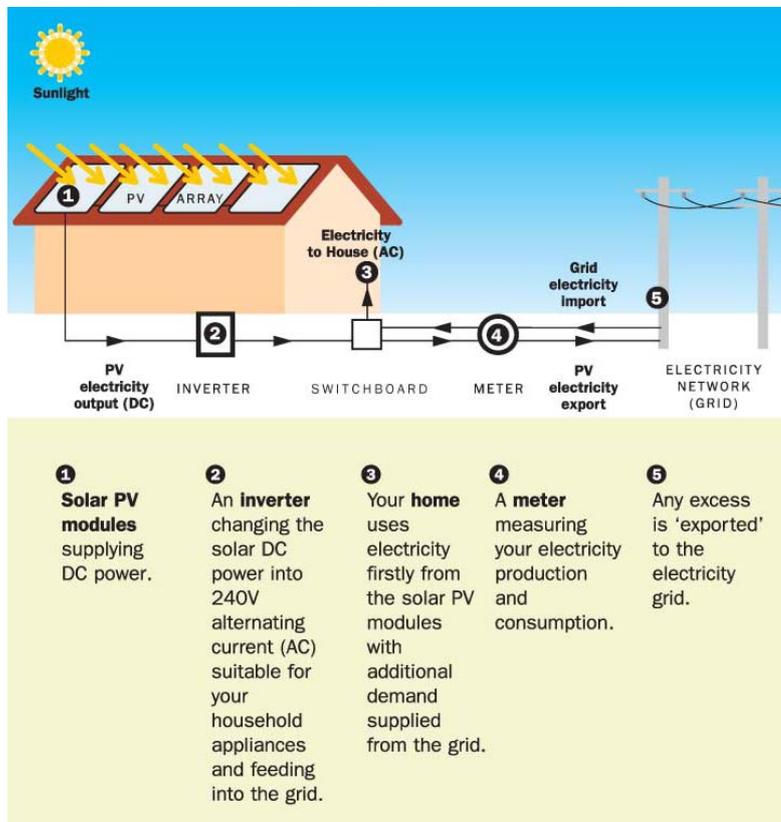


Image courtesy of Clean Energy Council



An inverter is required to convert the direct current (DC) from the solar array to useable alternating current (AC), to export energy either into the electricity grid or to batteries with a stand-alone system. The inverter needs to be installed in a dust-free and shaded area with suitable ventilation as they can become very warm when operating at maximum conversion times. For a grid-connected system, the inverter's AC output inter-connects with the dwelling's electrical switchboard. Inverters often have an in-built display that shows the amount of electricity generated by the PV system.

To optimise solar exposure and yield best performance, the system's panels should be north-facing and free from potential shading throughout the year, for example from neighbouring buildings and tall trees. The system is required to be fixed to ensure structural security to the roof. The system's array frames must be rated for the site in accordance with AS/NZS 1170.2:2002—Structural design actions—Part 2: Wind Action. This is especially important in locations subject to high wind speeds, such as cyclone prone areas and properties on the slopes of a hill.

PV installation

For residential installations, the PV system should be included in the house plans of the new dwelling when they are submitted as a building development application. In South East Queensland, the installation of a PV system on an existing roof is self-assessable building work under the Building Regulations 2006. However, in cyclone exposed regions covered by Building Code of Australia Wind Region C (i.e. northern coastal areas from Bundaberg, approximately 50 kilometres inland) the installation of a PV system on an existing dwelling requires a building development application.

Installation of the PV system, including its mains wiring, panels (array), switchboard and inverter, should comply with several Australian Standards including:

- AS/NZS 1170.2:2002—Structural design actions – Part 2: Wind actions
- AS/NZS 1768:2007—Lightning protection
- AS/NZS 3000:2007—Electrical installations (the Wiring Rules)
- AS/NZS 3008.1.1:2009—Electrical installations—Selection of cables
- AS/NZS 4777:2005—Grid connection of energy systems via inverters (Parts 1, 2 and 3)
- AS/NZS 5033:2005—Installation of photovoltaic (PV) arrays.

Industry guidelines, such as the Clean Energy Council's *Grid-Connected PV System Design Guideline* and the *Installation Guideline*, can provide further guidance



regarding design and installation practices. These guidelines can be found at www.cleanenergycouncil.org.au

The system's installation requirements may also be covered by the electricity distributor as outlined in their Connection and Metering Manuals.

It is recommended to use an accredited operator for the design and installation of a PV system. A list of accredited designers and installers can be found on the Clean Energy Council website at www.cleanenergycouncil.org.au

Grid connection

Householders with systems connected to the electricity grid may be able to sell excess energy back into the grid and thereby lower their electricity bills.

To connect and operate a grid-connected PV system, the property owner must arrange a network connection with their electricity distributor (who owns and operates the grid infrastructure). In Queensland the electricity distributors are Energex and Ergon Energy. The steps involved in arranging network connection can be found on the Clean Energy Council's website at www.cleanenergycouncil.org.au

Financial incentives

Queensland's Solar Bonus Scheme (feed-in tariff)

The Queensland Government's Solar Bonus Scheme currently pays eligible households and other small customers for the surplus electricity generated from the operation of PV systems, which is exported to the Queensland electricity grid. The scheme is designed to make solar power more affordable for Queenslanders, stimulate the solar power industry and encourage energy efficiency. More information is available at www.brightthing.energy.qld.gov.au.

Small-scale Technology Certificates (STCs) and Solar Credits program

As PV systems are a renewable energy technology, small-scale solar systems installed on dwellings may qualify to off-set their purchase cost. Two schemes are applicable, these being Small-scale Technology Certificates (STCs) and Solar Credits.

STCs are created for eligible renewable energy systems that are considered as Small Generation Units which includes PV systems. Since 1 January 2011, STCs have replaced Renewable Energy Certificates (commonly referred to as RECs). More information on STCs is available from the Office of Renewable Energy Regulator at www.orer.gov.au



The Federal Government's Solar Credits program provides additional support for the installation of Small Generation Units by creating additional STCs. Under this incentive, eligible applicants can receive a multiplier of the usual number of STCs for the system's first 1.5 kilowatts as a deduction from the systems purchase cost. More information on Solar Credits is available at www.climatechange.gov.au

5.3.4 Alterations to an existing house or townhouse

The area of the home which is being altered and involves new building work that is the subject of the building development application, must comply with the 6-star housing requirement as far as practical.

Under section 81 of the *Building Act 1975*, the building certifier also has the discretion to determine how the 6-star requirement should apply to the existing area of the house when undertaking alterations and extensions, such as re-configuration of internal rooms or an additional room (refer to section 4.3.2).

To determine the energy equivalence rating for an alteration to an existing house, a software assessment of the building design is recommended. The plans need to include the kitchen area as a reference point to undertake the software assessment to determine internal heat loads. The software assessment could model the area covered by the alteration (inclusive of the kitchen area). Another approach is to undertake two assessments of the entire house, one before and one after the alteration to demonstrate any degree of energy efficiency improvement. The building certifier should consider any of the available practical steps that the energy efficiency assessor has identified that could assist the house to achieve a rating as close to 6-stars as possible.

It is recommended that homeowners discuss possible requirements involved with the alteration with the building certifier as early as possible in the design stage.

Where practical, the following features should be considered and applied to the alteration:

- insulation in new walls, roof lining and ceiling (note, for some councils a change in roof type, for example from tile to metal sheet roofing, is subject to a building development application)
- shading of walls and windows with roof eaves and awnings (note, it would not be expected that existing roof eaves would need to be altered)
- window size, type and location to promote cross ventilation
- lighter colour roof and external walls



- treated glazing
- ceiling fans in living areas and bedrooms.

Case study 2—Alterations to an existing house

The owners of an existing house have lodged a building development application to re-configure the living area, kitchen and bathroom and add an extra room. This work covers more than 50 per cent of the existing dwelling's floor area. Does this new work, as well as the remaining area of the house, have to meet the 6-star requirement?

The areas of the home that are being renovated and involve new building work that is the subject of the building development application must comply with the 6-star requirement as far as practical. It is recommended that a software assessment be undertaken to inform the building certifier of possible features that could be included with the renovation.

As the alteration is greater than 50 per cent of the floor area of the existing house, the building certifier may also require the existing parts of the house to comply with the requirement. For the existing parts of the house, the 6-star provisions should be applied as far as practically possible and certifiers should consider insulation (roof space and accessible walls), shading over windows (awnings), lighter coloured roof and external walls, and ceiling fans.

It would be impractical to incorporate other 6-star design features to the existing area of the house, such as re-orientation, wall insulation (where plasterboard/lining is not being removed), treated glazing and wider eaves to the existing roof structure, etc. However, where existing internal wall linings are removed, the building certifier should consider requiring insulation to be placed in those external walls.

Raised houses

Where an existing house is elevated and as part of building work the lower level is enclosed or partially enclosed to form separate habitable room(s) underneath the dwelling (such as a bedroom and rumpus room), this new building work needs to comply with the 6-star requirement as much as practical. Existing houses that are raised and do not include a habitable area (such as a laundry or storage room) or are un-enclosed at the lower level are not required to comply as there is no habitable area associated with the building work. As the building work involved with the raising of an existing house is associated with an alteration to an existing building, the building certifier also has the discretion to apply current building assessment provisions to the existing dwelling. Refer to section 4.3.2 for further details.

5.3.5 Relocation of an existing house

The relocation of an existing house onto a new site or onto a different part of a lot will be subject to a building development application and may be required to



comply with some or all of the current building assessment provisions. The extent to which the building assessment provisions would apply to the relocated home is dependent on the extent of work needed to upgrade the building and the specific requirements in each case are determined by the building certifier.

For example, if either the internal lining or external wall cladding are not removed or replaced, the building certifier may decide not to require insulation in the walls of the relocated home. However, even if the building work did not involve removal of the roof structure or roof covering it is likely to be reasonable to require ceiling insulation to be installed. Compliance can also be enhanced through good building orientation in positioning the home on the new property, installation of ceiling fans in the living rooms and bedrooms, light coloured roof and external walls, and adding shading over windows e.g. awnings.

If the relocated home is to be elevated and enclosed spaces are created below the building for habitable rooms, e.g. living areas or bedrooms, the new habitable area will need to comply with the 6-star requirement as much as practical.

To determine the relocated house's energy equivalence rating, a software assessment of the building design is recommended. The designer and building certifier should consider any of the available practical steps that the energy efficiency assessor has identified that could assist the house to achieve a star rating as close to 6 stars as possible.

Case study 3—Relocated home

Owners of a home on a 1400 square metre lot wish to sub-divide their land into two separate blocks and relocate their existing house onto one side of the property to allow a new house to be built on the adjacent lot. Does the existing house planned for relocation have to meet a 6-star energy equivalence rating?

Yes, as far as practical. As the existing house is being relocated, it will need to comply with 6-star energy equivalent ratings as much as practical. It is recommended that a software assessment be undertaken to inform the designer and building certifier of possible features that could be included with the renovation.

When relocating an existing house, whether to another location on the same property or to another site, reasonable steps must be taken to comply with the 6-star requirement. This could include optimal orientation of the building on the new lot, adding insulation in the roof/ceiling space, installing ceiling fans to living areas and bedrooms, light coloured roof and external walls, and adding shading over windows, e.g. awnings.



6. 5-star multi-unit residential buildings

6.1 Application

Since 1 March 2010, new multi-unit residential buildings (class 2) must achieve an **average 5-star energy rating** for the entire building, with each individual unit achieving a minimum

4-star energy rating. This difference accounts for the various locations of individual units within the building. For example units with a southern orientation have less potential for solar access and those in the middle of the building have more shading than those on the outside.

Individual sole occupancy units can gain up to 1-star optional credit with the inclusion of an outdoor living area, such as a deck or balcony, in climate zones 1 (tropical) and 2 (sub-tropical) when calculating the average star rating for the entire building.

The 5-star requirement also applies to new work done on existing multi-unit residential buildings, such as alterations. At the time of building development application, the building certifier will need to consider how the 5-star requirement applies to the existing parts of the building.

6.2 Design features of a 5-star unit building

A multi-unit residential building's energy rating is determined by the design of its building shell—its roof, walls, windows and floors. As the 5-star rating for the unit building is performance-based, designers and architects have the flexibility to use a range of styles and passive design features to comply including:

- northern orientation of living areas (where possible)
- minimising east and west facing walls (where possible)
- natural ventilation through windows and doorways
- wider eaves and awnings for shading
- increased insulation
- treated glazing, particularly for windows facing west and north-west
- light coloured roof and external walls
- ceiling fans in living areas and bedrooms
- using optional credits for outdoor living areas, such as a deck or balcony.



6.3 Compliance

6.3.1 Compliance methods

Designers can assess the star energy rating for sole occupancy units within the building using NatHERS accredited software (BERS Pro, AccuRate or FirstRate5). For more information on the use of software as the compliance method to rate dwellings refer to section 5.3.

The common areas and central plant facilities of the building, such as air conditioning and artificial lighting, must also comply with energy efficient design requirements of Section J of the Building Code of Australia (BCA) (Volume One).

6.3.2 Outdoor living areas

An optional credit of **up to 1-star** towards the 5-star requirement is available for units that include an outdoor living area, such as a deck or balcony, in climate zones 1 and 2.

The credit only applies when **calculating the average** rating for the entire building, via the total credits gained for units that include an outdoor living area. It does not apply to the energy rating determined for individual units, e.g. a 3-star unit plus 1-star for the outdoor living area cannot be calculated as a minimum 4-star unit.

In units, the outdoor living area must:

- be directly adjoining and directly accessible from and attached to an internal living area, such as a lounge, kitchen, dining or family room. This does not include bedrooms, study or home theatre rooms
- have a minimum floor area of 12 square metres and a minimum dimension in all directions of 2.5 metres
- be fully covered by an impervious roof. The roof covering must achieve a minimum total insulation of R-1.5 for downward heat flow
- have at least one side open or capable of being readily opened, not including the connection between the internal living area (i.e. lounge, kitchen dining or family room) and the outdoor living area
- where a permanently fixed ceiling fan is included with the outdoor living area, it must have a speed controller and a blade rotation diameter of not less than 900 millimetres
- where an air conditioner is to be installed and operated in the room directly adjacent to the outdoor living area, the full 1-star credit will only be available



where the air conditioner can be switched off by an automatic switching device (such as a reed switch or other micro switch) when an external door providing access to the outdoor living area is open for more than one minute.

The design measures used and the available credits for individual units that include an outdoor living area in a multi-unit residential building are shown in Table 2.

For unit buildings, any length of side or return that forms part of a room abutting an outdoor living area can be calculated towards the minimum requirement of 12 square metres. Generally, the open side should be as open as possible to allow breezes and air movement. However, where more than one side is open or where the outdoor living area is raised above the ground level or on a second or higher level, standard balustrades or walls at a minimum height of one metre for safety, with the remainder of the side able to be open to the external elements (e.g. breezes) are acceptable.

The outdoor living area can also have a degree of screening for privacy and clothes drying, as long as the screen is less than 50 per cent of the openable area. A side with floor to ceiling glazing is considered closed. It is permissible to have roller-blinds, louvres, shutters and awnings capable of being readily openable as an open side. A fixed timber lattice typically used as screening on traditional Queenslander houses is also considered to be open (only where the total open area of the lattice grid is 50 per cent or greater).

Table 2 Design measures required for an outdoor living area

	½-star	1-star
No air conditioner in unit	<ul style="list-style-type: none"> outdoor living area meets QDC requirements, and no ceiling fan 	<ul style="list-style-type: none"> outdoor living area meets QDC requirements, and compliant ceiling fan
Air conditioner in unit	<ul style="list-style-type: none"> outdoor living area meets QDC requirements no ceiling fan, and there must be an automatic switch set at 1-minute shut-off 	<ul style="list-style-type: none"> outdoor living area meets QDC requirements and compliant ceiling fan, and there must be an automatic switch set at 1-minute shut-off



Example:

The average energy star rating for a 10-unit building where six units have an outdoor living area is calculated as follows:

Units and star rating of 10-unit building	Outdoor living area credits	Sub-total of unit star ratings	Average star rating for the unit building
4 units are rated 5 stars (4 x 5 = 20)	4 of these units have an outdoor living area (4 x 1 = 4)	4 x 6 = 24	52 ÷ 10 (units) = 5.2 stars
2 units are rated 5 stars (2 x 5 = 10)	Both of these units do not have an outdoor living area	2 x 5 = 10	
2 units are rated 4 star (2 x 4 = 8)	Both of these units have an outdoor living area (2 x 1 = 2)	2 x 5 = 10	
2 units are rated 4 stars (2 x 4 = 8)	Both of these units do not have an outdoor living area	2 x 4 = 8	

6.3.3 Alterations to an existing unit

The areas of the unit which are being renovated and involve new building work that is the subject of the building development application must comply with the 5-star requirement as far as practical.

Under section 81 of the Building Act 1975, the building certifier has the discretion to determine how the 5-star unit requirement applies to the existing area of the multi-unit residential building when undertaking alterations, such as re-configuration of internal rooms (refer to section 4.3.2). For example, if the alteration represents more than 50 per cent of the volume of the existing unit, the certifier can determine whether the existing unit, along with the new building work, would also need to comply with the requirement.

To determine the energy equivalence rating for an alteration to an existing unit, a software assessment of the building design is recommended. The plans need to include the kitchen area as a reference point to undertake software assessment to determine internal heat loads. The software assessment could model the area covered by the alteration (inclusive of the kitchen area). Another approach is to undertake two assessments of the entire unit, one before and one after the alteration to demonstrate any degree of energy efficiency improvement.



The designer and building certifier should consider any of the available practical steps that the energy efficiency assessor has identified that could assist the unit to achieve a rating as close to 6-stars as possible.

It is recommended that homeowners discuss possible requirements involved with the alteration with the building certifier as early as possible in the design stage.

Where practical, the following features should be considered and applied to the existing area of the unit:

- insulation of new walls, roof lining and ceiling (where accessible)
- shading of windows with awnings
- window size, type and location to promote cross ventilation
- treated glazing
- ceiling fans in living areas and bedrooms.



7. End-of-trip facilities

7.1 Application

Since 26 November 2010, end-of-trip facilities must be included in the following new major developments over 2000 square metres floor area when they are located in a designated local government area, as listed in schedule 1 of the Queensland Development Code (QDC):

- commercial office buildings (class 5, as per the Building Code of Australia (BCA) definition)
- shopping centres (as per the QDC definition)
- hospitals (class 9a, as per the BCA definition)
- tertiary education facilities (as per the QDC definition).

The requirement also applies where development is specified in a local government planning scheme as a major development that is located in a designated local government area.

For existing buildings that fall within the definition of a major development, the QDC does not apply unless a major addition is carried out to the existing building. A major addition is one that results in new floor area of at least 1000 square metres.

For local governments not listed in schedule 1 of the QDC, end-of-trip facilities can also apply where a council has published notice of a resolution to adopt the QDC provisions. The resolution will be published in a local newspaper and be available on the local government's website. It will outline the area considered a designated local government area (which may be all or part of the local government area).

For the purpose of end-of-trip facilities, a local government planning scheme may expand on the QDC requirements by:

- requiring additional bicycle parking and storage facilities, locker facilities and change rooms higher than the QDC requirements
- expanding the definition of a major development to encompass a broader range of buildings.



7.2 Compliance

End-of-trip facilities must be provided for cyclists, joggers and walkers at their place of work and include:

- secure bicycle parking and storage
- locker facilities
- changing facilities, including showers.

End-of-trip facilities should be easily accessible to users and located within the building or on-site within 100 metres of the main entrance to a building. The facilities must also be provided in accordance with prescribed workforce or occupant ratios. It is intended that occupant ratios are used where workforce numbers are not readily available at the design stage.

7.2.1 Concurrence agency's role

In some circumstances it may not be appropriate for a major development to include an end-of-trip facility. The QDC allows for these circumstances, for example, where the development is a significant distance from a population centre or where road conditions would be hazardous to cyclists. In these instances the building development application can be referred to local government in its concurrence agency role to determine whether the major development should be exempt from the requirement to include an end-of-trip facility. Local government may exempt a development from including an end-of-trip facility with regard to:

- the projected population growth and forward planning for road upgrading and development of cycle paths
- whether it would be practical to commute to and from the building on a bicycle, having regard to the likely commute distances and nature of the terrain
- the condition of the road and the nature and amount of traffic potentially affecting the safety of commuters.



Part 2—Fixtures, fittings and appliances

8. Energy efficient lighting

8.1 Application

Since 1 May 2010, new houses and townhouses (class 1 buildings) and sole occupancy units in multi-unit residential buildings (class 2 buildings) must include energy efficient lighting. This requirement applies to the external areas of a building, such as verandahs or balconies, and its enclosed attached garage or carport (class 10a building).

The requirement also applies to alterations or additions to existing dwellings, such as extensions, renovations or relocations that require a building development application.

Minor alterations, maintenance and repairs to existing buildings that do not require a building development application do not need to meet the energy efficient lighting requirement. However, owners should always consider using energy efficient fittings so that they save on energy bills and also reduce their household environmental impact.

New pre-fabricated and manufactured houses need to comply with the energy efficient lighting requirement. Relocated homes moved to a permanent location also need to comply with the requirement as far as practical.

8.2 Compliance

For houses and townhouses (class 1 buildings), two compliance methods are available for energy efficient lighting under the Queensland Development Code (QDC) and Building Code of Australia (BCA):

- **QDC—80 per cent of total fixed artificial lighting (internal and external) must be energy efficient. For a lamp to be energy efficient, it must have a minimum efficacy of 27 lumens per watt; or**
- **BCA—using either lamp power densities (i.e. 5 watts per square metre to internal rooms, with 4 watts per square metre on the verandah or balcony and 3 watts per square metre in an attached garage) or illumination power densities (i.e. allowing for adjustment factors with lighting control devices). Refer to the BCA Volume Two, section 3.12 for more details.**



For sole occupancy units in multi-unit residential buildings (class 2 buildings), only the QDC's 80 per cent methodology applies. As the BCA 2009 is used for compliance with the QDC's 5-star unit building requirement and there were no energy efficient lighting provisions covering sole occupancy units in this edition of the BCA, only the QDC lighting requirements apply for consistency. However, lighting in common areas of a multi-unit residential building will also need to comply with the BCA Volume One.

When using the QDC methodology, light fittings must be energy efficient to a minimum of 80 per cent of the total fixed lighting to both internal and external living areas, such as verandahs, balconies and attached garages.

Depending on their performance, compliant lamps may include fluorescent tubes, compact fluorescent lights (CFLs), light emitting diodes (LED), metal halide and neon. Energy efficient directional CFLs and LEDs suitable for downlights are now available.

This requirement also applies to existing dwellings when undertaking alterations or additions such as extensions, renovations or relocations. Under section 81 of the *Building Act 1975*, the building certifier has discretion to apply the energy efficient lighting provisions to only the new building work or to the entire dwelling, depending if the requirement is considered to provide a level of benefit commensurate with additional cost or is considered as overly onerous or technically impractical.

8.2.1 Lumens per watt (efficacy)

Efficacy is the performance term used to describe a lamp's efficiency at converting electrical power into light, i.e. its lumens per watt. Lumens (lm) are a measure of light output and watts (W) are a measure of energy input. Lumens per watt is calculated by dividing the luminous flux (the light's output, indicated by lumens (lm)) by the lamp's wattage (the light's power (W)). The higher the efficacy (lumens per watt), the better a lamp's energy efficiency will be.

$$\text{lumens (lm)} \div \text{watts (W)} = \text{efficacy (lumens/watt)}$$

$$(\text{QDC} = \text{min. } 27 \text{ lumens/watt})$$

Example:

A lamp with 680 lm and 15 W = **45 lumens/watt (efficacy)**



Some manufacturers provide the lamp's efficacy on the packaging. If the lamp's efficacy is not shown, most manufacturers supply sufficient information in the form of light output (as shown in red below, with 1050 lumens and 630 lumens) on the packaging to readily determine its efficacy. In some cases, the lumens per watt (efficacy) is provided (as shown in blue below with 58 lumens per watt). This product information can also be obtained from the manufacturer's data sheet, either in store from the lighting supplier or from the manufacturer's website.



8.2.2 Fixed lighting (fixtures)

For the purposes of the QDC, fixed lighting is a light fixture which is hard-wired to a household electrical circuit and fixed to the structure of the house, e.g. ceiling or wall. Fittings with more than one lamp but having only one connection to an electrical circuit are counted as one light fixture.

Figure 4 Examples of fixed lighting



8.3 Design principles for energy efficient lighting

Good lighting is more than just providing light to dwellings. An effective and energy efficient lighting system is designed to provide visual comfort through consideration of daylight, type of light, room use and, where appropriate, the inclusion of controls for flexible lighting levels.



**The higher the wattage (W),
the higher the running cost and greenhouse gas emissions.**

Comparative wattages for CFLs with traditional incandescent globes are shown in Table 3:

Table 3 Comparative wattages for CFLs with traditional incandescent globes

Compact Fluorescent Lights (CFL)	Incandescent globe
5-7 watt	25 watt
7-8 watt	40 watt
11-12 watt	60 watt
13-18 watt	75 watt
18-23 watt	100 watt

8.3.2 Using daylight

The first design principal for achieving energy efficient lighting in dwellings is optimising the use of natural light. Using natural light minimises the need to use artificial lighting during the day time.

Daylight can be captured by:

- better consideration of window locations
- better consideration of window size and style
- use of skylights (roof lights) to provide natural light in dark areas, e.g. corridors and store rooms
- using lighter colours for internal surfaces to reflect daylight (thereby reducing the need to use artificial lighting).

In designing dwellings to capture daylight, attention also needs to be given to potential glare, radiant heat gain from reflective outdoor surfaces and the thermal heating and cooling through windows. The sun's path (its movement during the day and throughout the year) should be considered relative to the dwelling's location and design accounting for seasonal differences. Building orientation, shading, window size and location, and room configuration are important aspects in optimising daylight and minimising over-exposed areas. For example, a passively designed dwelling (based on sun path) can achieve good solar access and daylight to living areas (while maximising solar heat gain in cooler months and minimising it in hotter months).



8.3.3 Lighting levels (lux)

Lighting level is the amount of light reaching a surface. It is known as illuminance and is measured in lux. Generally, the lighting level relates to surfaces and positions where tasks are performed, e.g. kitchen bench or table, desk or reading position. The more involved or difficult the task is being performed, the higher the recommended lighting level.

Before selecting which lamps to use, the appropriate or desired average lighting level or lux for different parts of the dwelling needs to be determined. This depends on the type of room and tasks to be conducted in that area. For residential dwellings there are no mandatory light levels in Australian Standards. However, suitable light levels for typical situations can be sourced from other Australian Standards, for example AS/NZS1680.1—Interior and workplace lighting and AS4299—Adaptable housing. Higher lighting levels may be required for householders who experience difficulty reading, have poor sight or have symptoms associated with deteriorating eye conditions such as macular degeneration.

Some typical recommended average lighting levels are shown in Table 4 (specific areas, such as kitchens, may need levels up to 240 lux).

Table 4 Recommended average lighting levels

Room type	Recommended average lighting level ^A (lux)
Kitchen (and other work bench areas)	160
Living/dining	80
Bathroom	80
Bedroom	80
Entry/corridor/stairs	40
Other (day-time use)	40
Other (night-time use)	80

^A For a more precise definition of recommended average lighting levels refer to AS/NZS 1680.1: 2006 Interior and workplace lighting for definition of Recommended Average Maintained Illuminance.

8.3.4 Appropriate lamp selection

There are several factors to consider when selecting lamps to ensure compliance with the QDC and deliver appropriate lighting performance throughout the dwelling including:



- light output (lumens)
- colour appearance
- dimmable function
- installation
- other lighting issues.

Light output (lumens)

As a simple guide for typical ceiling heights (e.g. 2400 millimetres) only approximately half of the light from a ceiling lamp reaches the task areas. The amount of light required from all the lamps installed in a room can be determined by the following formula:

$$\begin{array}{rcccl} \text{Room area} & & \text{Twice the recommended} & & \text{Total light output} \\ \text{(square metres)} & \times & \text{average lighting level} & = & \text{required from lamp} \\ & & \text{(lux)} & & \text{(lumens)} \end{array}$$

Example:

For a living room 4 metres x 4 metres = 16 square metres, the recommended average lighting level is 80 lux (from Table 4), so the lumens required from ceiling lamps can be calculated as:

$$16 \times (80 \times 2) = \mathbf{2560 \text{ lumens (total light output required from lamp)}}$$

The light output (lumens) of lamps is usually marked on its packaging. If this product information is not available it can usually be obtained from the manufacturer's data sheet, which should be available either in store from the lighting supplier or from the manufacturer's website.

Colour appearance

The colour appearance can be different for different types of lamps. Generally, incandescent lamps and halogen down lights have a warm yellowish to white appearance. Fluorescent lamps in all forms (CFLs, circular and linear tube fluorescents) are available in a variety of colour appearances ranging from 'warm white', 'cool white' and 'daylight'. This can also be indicated on the lamp's packaging as 'colour temperature'. The colour appearance and temperature of different lamp types and suggested rooms for their use is shown in Table 5.

In most residential situations warm white lamps are preferred as they provide a soft warmer light comparable to traditional incandescent light bulbs. A cool white lamp provides neutral light, while a daylight lamp provides bright light similar to midday



lighting conditions. Ultimately, the lamp's colour appearance is a matter of personal preference.

Table 5 Lamp colour appearance

Colour appearance	Typical mid-colour temperature (° Kelvin)	Lamp type available	Rooms
warm white	3000	incandescent, halogen, fluorescent, LED	living areas and bedrooms
cool white	4200	fluorescent, LED	bathrooms, toilets and kitchens
daylight	5500	fluorescent, LED	garages and laundries

Dimmable function

All halogen downlights and incandescent lamps are fully dimmable with their light output adjustable from 0 to 100 per cent. Mains voltage (240 volt) and low voltage bulbs (12 volt) are the common types of halogen bulb.

Low voltage (V) ≠ low energy use

Some CFL downlight lamps are available which are dimmable from 10 or 20 per cent to 100 per cent, and they work effectively on standard household dimmers. Details on the appropriate types of dimmers should be checked before using these products, which is normally indicated on the product's packaging.

With special electronic ballasts, most other fluorescent lamps are dimmable. However, these products are expensive and not commonly used in residential situations.

Most LED lamps can be dimmed with appropriate control equipment, and these systems are becoming more affordable. Further information on LEDs and associated products and their performance are available at www.lightingcouncil.com.au

Refer to Appendix D on task lighting with dimmable function and the recommended adjustment factor as part of an alternative solution.



Other lighting issues

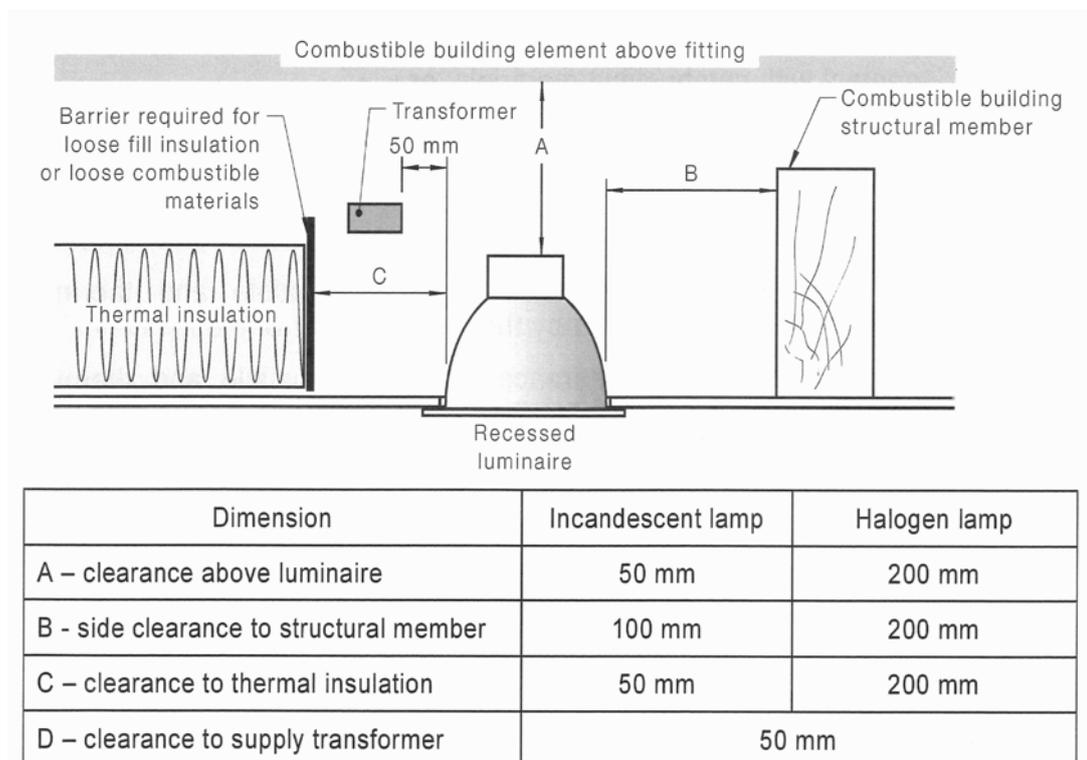
Installation—Fire risk and thermal effects

Some light installations may present a potential fire risk if not properly installed. This applies particularly to halogen downlights with recessed lighting fixtures in the ceiling.

These fixtures can reach a very high temperature, which presents the potential risk of fire or deterioration of nearby materials, especially ceiling insulation.

To enhance electrical safety in the roof space, fire resistant enclosures or caps can be installed over downlights to prevent the risk of fire to ceiling insulation and other adjacent combustible materials. Recommended minimum clearance distances between the downlight, its transformer and ceiling insulation can be specified by the manufacturer with the lamp's packaging. Alternatively, Australian Standards list minimum clearance distances for downlights, as shown in Figure 5. For further details, refer to the Australian Standard 3000:2007 (Amdt 1: 2009)—Electrical installations, commonly referred to as the Wiring Rules (section 4.5.2).

Figure 5 Australian Standard default minimum clearances for downlights



Source: AS/NZS 3000:2007 (Amdt 1: 2009)—Electrical installations (Wiring Rules)

The inclusion of several recessed down lights in the ceiling can reduce the effectiveness of ceiling insulation. In these cases, an increase in the minimum R-



Value of the ceiling insulation should be incorporated. For adjustment values refer to BCA Volume Two.

Additionally, overheating of a compact fluorescent light (CFL) can cause the electronics in the base of the lamp to fail. When this occurs the lamp fails to operate and will need to be replaced. Manufacturers of CFLs often indicate on the packaging if these lamps are not suitable for enclosed down lights or fixtures. When selecting light fixtures, their suitability for the desired lamp type should be considered.

Heat lamps

Heat lamps, commonly used in bathrooms, are used to warm the room. They are therefore not considered to be a lamp for lighting purposes (i.e. they are excluded from the QDC for assessment of energy efficient lighting) as long as there is an

Case study 4—Bathroom heat lamps (3-in-1s)

A building designer has been asked by their client to include a 3-in-1 heat lamp (heater, light and exhaust) in the bathroom of their new house which has an incandescent lamp and two heat lamps. The incandescent lamp is on a separate switch to the heat lamps. Is the fixture subject to assessment under the QDC?

Yes, the incandescent lamp is required to be assessed as part of the energy efficient lighting requirements. As it is an incandescent lamp, it would not qualify as an energy efficient lamp. If the incandescent lamp was replaced with a CFL lamp with a minimum 27 lumens/watt, it would count as an energy efficient lamp as it is on a separate switch for lighting purposes and comply with the QDC requirement.

alternative lamp for lighting purposes on a separate switch. If a lamp inside the heat lamp fixture is wired to a separate switch and is used in isolation to light the bathroom, then that lamp must be counted as part of the energy efficient lighting requirements as it is used for lighting purposes.

Mercury content

There is no mercury in incandescent, halogen or LED lamps. All fluorescent lamps contain very small quantities of mercury sealed within the lamp. However, no mercury is released during normal installation or operation, and these lamps are safe to use in the home. For further information on mercury in lamps and other health matters, including breakages and safe disposal refer to www.climatesmart.qld.gov.au



9. Water conservation

9.1 Application

Since 1 March 2009, the Queensland Development Code's water conservation requirements apply statewide to new houses, townhouses and units (class 1 and 2 buildings) in areas of Queensland serviced by a water service provider. These requirements apply to toilets, tapware in kitchen sinks, basins and laundry troughs, and showerheads as rated under Water Efficiency and Labelling Standards (WELS).

Where a building and plumbing application is required as part of new work with an existing dwelling, such as alterations or additions, including extensions, renovations or relocations, the water conservation requirements can apply to the entire dwelling.

Where only a plumbing application is required as part of new work on an existing dwelling such as a bathroom renovation the water conservation requirements apply only to the fixtures included in the new work.

Minor alterations, maintenance and repairs to existing buildings that do not require a building and/or plumbing application do not need to meet the water conservation requirements. However, owners should always consider using water efficient fixtures so that they save on water bills and also reduce their household environmental impact.

New pre-fabricated and manufactured houses must comply with the water conservation requirements. Relocated homes also need to comply with these requirements.

9.2 Compliance

9.2.1 New dwellings

The following water conservation fixtures must be installed throughout the new dwelling:

- **toilets**—minimum **4-star** WELS rated
- **tapware**—minimum **3-star** WELS rated for kitchen sinks, basins and laundry troughs
- **showerheads**—minimum **3-star** WELS rated.



9.2.2 Existing dwellings

For existing houses, townhouses and units where an extension or renovation requires building and plumbing approval, all existing toilet and showerhead fixtures within the dwelling, regardless of whether or not the fixture is part of the extension or renovation work, must be upgraded to a minimum 4-star WELS rating for toilets and a minimum 3-star WELS rating for showerheads. Tapware installed as part of an extension or renovation to a new area of the dwelling is required to be minimum 3-star WELS rated. There is no requirement to upgrade existing tapware in the dwelling.

Where only a plumbing application is required for new work in a dwelling, only existing fixtures covered as part of the new work must be upgraded to the water conservation requirements. For example, minimum 3-star WELS rated showerhead and tapware would be required as part of a bathroom renovation. If an existing toilet was not moved as part of the plumbing application, it would not be required to be replaced with a 4-star WELS rated system.

Relocated homes must comply with the water conservation requirements as they are subject to building and plumbing applications on their new property.



10. Energy efficient air conditioners

10.1 Background

Increasing installation and use of air conditioners for climate control in homes is contributing to significant growth in average household energy consumption, greenhouse gas emissions and demands on community-owned electricity infrastructure, particularly in periods of peak demand. Around 70 per cent of Queensland households have an air conditioner, which typically accounts for 27 per cent of total household electricity use. Energy efficient buildings, such as 6-star houses and 5-star units, can reduce the need to operate an air conditioner as they are designed to be more comfortable. Air conditioning in non-residential buildings is also becoming more prevalent.

The Minimum Energy Performance Standards (MEPS) set national minimum thresholds for energy efficiency in Australia. For the majority of air conditioners testing and labelling requirements are outlined in AS/NZS 3823.2—Performance of electrical appliances – Air conditioners and heat pumps – Energy labelling and minimum energy performance standard requirements. The MEPS sets minimum energy efficiency standards that air conditioners must meet in order to be sold in Australia; it does not set installation requirements. The MEPS are regulated by state legislation. In Queensland MEPS are regulated under the Electricity Regulation 2006.

Separate ratings exist for the cooling and heating functions of an air conditioner. The measure of energy efficiency for heating is the Coefficient of Performance. The measure of energy efficiency for cooling changes from the Energy Efficiency Ratio (EER) to the Annual Energy Efficiency Ratio (AEER) for models imported or manufactured in Australia after 1 April 2011. In addition, from 1 October 2011 the stringency of the AEER levels will be increased under MEPS by around 10 per cent. Refer to Table 6 for the relevant AEER level, which depends on the type and size of the system.

Under AS/NZS 3823.2, air conditioners that have been grandfathered are permitted. Grandfathering allows the sale of current stock of air conditioners that were imported or manufactured prior to the commencement date of new standards even though they do not comply with the new standard. However, as the Queensland Development Code (QDC) requirement **applies to installation (not sale)** this restricts the ability to install grandfathered systems with less than a tested average EER of 2.9.



The 1 April 2011 AEER measures bring national standards up to a level that is generally equivalent to the current EER standards required in Queensland under the QDC. For compliance with the QDC, air conditioners that meet the 1 April 2011 AEER levels will therefore be considered as comparable to air conditioners with a minimum EER of 2.9 and can be installed in Queensland buildings. The relevant requirements are shown in Table 6.

Table 6 Annual Energy Efficiency Ratio (AEER) levels

Type of air conditioner	Size (capacity)	AEER requirement (models tested after 1 April 2011)	AEER requirement (models tested after 1 October 2011)	AEER requirement (models tested after 1 April 2012)
Wall/window box (unitary), all phases	<10kW	2.84	3.10	3.10
Wall/window box (unitary), all phases	10kW to <19kW	2.75	3.10	3.10
Split system, all phases	<4kW	3.33	3.66	3.66
Split system, all phases	4kW to <10kW	2.93	3.22	3.22
Split system, all phases	10kW to <19kW	2.75	3.10	3.10
Ducted systems, all phases	<10kW	2.75	3.10	3.10
Ducted systems, all phases	10kW to <19kW	2.75	2.75 *	3.10 *
All types/all configurations, all phases	19kW to 39kW	3.05	3.10	3.10
All types/all configurations, all phases	>39kW to 65kW	2.75	2.90	2.90

* N.B. Subject to final approval by the Ministerial Council for Energy in June 2011.

10.2 Application

Since 1 September 2010, **new and replacement air conditioners** installed and connected to the building's electrical wiring using a plug or by permanent wiring in



any building in Queensland must have a tested average Energy Efficiency Ratio of 2.9 or higher for cooling. Air conditioners imported or manufactured in Australia after 1 April 2011 that meet the relevant AEER level under MEPS can also be installed as described above.

The requirement applies to air conditioners under 65 kilowatts (kW) that are required to be tested under the Australian Standard. This covers window and wall systems, split systems and ducted systems as shown in Figure 6.

The Building Code of Australia contains energy efficiency requirements for air conditioning systems over 65 kW in capacity that is typically used in larger buildings.

Figure 6 Examples of air conditioners covered by the Queensland requirement



Split system



Window/wall unit



Ducted system

The requirement does not apply to portable air conditioners, evaporative coolers (as shown in Figure 7) or multi-split air conditioners (i.e. those that have one outdoor unit with two or more indoor units that can be individually controlled) as these are currently not required by MEPS to be tested for energy efficiency (in the absence of a relevant Australian Standard). Evaporative coolers rely more on water than energy to operate (typically installed in dryer climates rather than tropical and subtropical areas given the relative humidity), and portable units are generally small and are not a fixed installation.



Figure 7 Examples of air conditioners not covered by the Queensland requirement



Portable air conditioner / cooler



Evaporative cooler

10.2.1 Energy Efficiency Ratio (EER) and Annual Energy Efficiency Ratio (AEER)

The tested average EER or AEER refers to a measure of how efficient an air conditioning unit is for cooling based on Australian Standard test conditions. A rating indicates the ratio of cooling output in kilowatts for every kilowatt of energy input.

The tested average EER has been referenced in the QDC as it is an industry recognised measure and is based upon actual test results or computer simulations.

Air conditioners imported or manufactured in Australia after 1 April 2011 will have to meet new MEPS standards based on the unit's AEER. The AEER level differs from the EER by including the electricity used by the system's crankcase and standby power, and is therefore more reflective of its total energy use.

A higher tested average EER or AEER = more cooling capacity per kilowatt of electricity used = greater energy efficiency

The tested average EER or AEER of an air conditioner can be obtained:

- from product labels, brochures, manuals and data sheets—supplied by the air conditioning manufacturer. These usually contain the rating for each model. In some cases, the EER shown in product information may be a rated EER, which may not meet the QDC requirements as it is not a tested average value.



Purchasers should therefore check that it is actually the tested average EER that is being referred to.

- by contacting the manufacturer—the tested average EER or AEER can also be found by checking the manufacturer’s website for the product or by directly contacting the manufacturer.

10.2.2 Testing procedures for determining EER and AEER

Tested EER and AEER levels that have been determined under the testing procedures listed in AS/NZS 3823.2 comply with the requirements of the QDC if the tested EER is 2.9 or higher or the relevant minimum AEER is achieved.

Under AS/NZS 3823.2, air conditioners that have been grandfathered are permitted. As such, these products can be used to comply with the QDC requirement provided that their EER is at least 2.9 or they have the relevant minimum AEER for the type and size of system.

The simulation method is currently listed under AS/NZS 3823.2 as an alternative to physical testing for models that are not registered for energy labelling. Simulation models are based on ideal conditions that may not provide a comprehensive representation of the unit’s performance in a real-life testing situation. As a result, actual tests may show a performance lower than that estimated. If a model’s checked results under AS/NZS 3823.2 differ from the simulation results, the physical test results will take precedence over simulated results. From 1 October 2011, the use of simulation results for registration under MEPS will no longer be permitted for ducted air conditioners of less than 30 kW.

Clause 3.3 of AS/NZS 3823.2 currently allows a part-load testing method. Tested EER and AEER levels that have been determined using the part-load testing method can be used to meet the QDC requirement, provided the tested EER is 2.9 or higher or the relevant minimum AEER is met.

10.3 Compliance

The installation of air conditioners is prescribed under schedule 1 of the Building Regulation as self-assessable building work if the air conditioner is not an integral part of the building. It is the responsibility of the building owner to ensure compliance with the QDC when having an air conditioner installed.



10.3.1 New buildings

The QDC requirement applies to any relevant air conditioner that is installed in any building in Queensland.

If an air conditioner has been specified by a client as part of a new building's design, the building designer should incorporate a note on the design plans that the air conditioner meets the minimum tested average 2.9 EER requirement or relevant AEER level.

If a second-hand air conditioner is installed into a new building, it needs to meet the QDC requirement.

Case study 5—Air conditioner as part of a new home package

A couple has purchased a home and land package. The house plans include a ducted air conditioner (18 kW capacity) as part of the cost of the new home. What do they need to confirm?

The owners should check that the house plans should specify an air conditioner with a minimum 2.9 tested average EER or an AEER of 2.75 (depending on the type of system). The owner should ensure that an air conditioner is installed with a tested average EER of 2.9 or higher or a minimum AEER of 2.75 to comply with the QDC.

10.3.2 Existing buildings

The QDC requirement applies to both new air conditioners installed in an existing building as well as the replacement of an air conditioner in an existing building.

Existing air conditioners that are moved from one location to another location within the same building do not need to comply with the QDC requirement. However, if an air conditioner is installed that is either new or new to the building (even if the air conditioner is not new), it needs to meet the minimum 2.9 tested average EER requirement or the appropriate AEER level for the type of system. Existing air conditioners that do not meet the minimum 2.9 tested average EER requirement or relevant AEER level cannot be removed from one building to another building.



Case study 6—Breakdown and replacement of an air conditioner

A homeowner has lived in their current home for a number of years. Recently the split system air conditioner (7 kW capacity) broke down and the homeowner called an air conditioning professional to inspect and repair the system. The professional advised the homeowner it could not be repaired and would need to be replaced. How does the QDC requirement apply in this situation?

Under these circumstances, the homeowner will need to ensure that the replacement system meets the QDC requirement by having an EER of 2.9 or higher or a minimum AEER of 2.93.

10.3.3 Temporary accommodation, relocatable and mining buildings

Where an air conditioner is installed in a new or existing portable or temporary building (e.g. mobile home, relocatable home or mining building), the air conditioner is required to comply with the QDC.

From 1 July 2010, air conditioners in a temporary accommodation building must comply with the QDC Mandatory Part 3.3—Temporary accommodation buildings and structures. Portable or temporary buildings that are not within the scope of QDC Mandatory Part 3.3—Temporary accommodation buildings and structures (e.g. work areas such as class 5 or 8 buildings) must also comply with the air conditioner requirement under the QDC.

If the portable or temporary building already has an air conditioner installed and is relocated with the existing air conditioner, the existing air conditioner does not need to comply with the QDC.

Case study 7—Air conditioner installed in a mining accommodation building

A portable building is being used as temporary accommodation for three workers on a mining site. The portable building has an existing split system air conditioner installed (3 kW capacity) which has a tested average EER of 2.5. The owners of the portable building need to move the building to a new location and have enquired whether the air conditioner will need to be upgraded in order for them to meet the QDC requirements.

Under these circumstances, the air conditioner would not need to meet the QDC requirement. This is because the air conditioner is an existing system within the building and the air conditioner is not being installed as a result of moving the building.

However, if the building previously had no air conditioning and one was being installed (or an existing system broke down and required replacing), a 3 kW split system would need to comply with the QDC requirement of an EER of 2.9 or higher or a minimum AEER of 3.33.



10.3.4 Enforcement and penalties

Local governments have the power to enforce offences under the *Sustainable Planning Act 2009* (SPA). Section 574 of SPA stipulates that self-assessable development must comply with the applicable codes. As the installation of air conditioners is self-assessable development, any installation work must comply with the QDC. A penalty of up to 165 penalty units (equivalent to \$16 500 as at May 2011) is applicable for breaches of self-assessable development conditions.



11. Electricity sub-metering

11.1 Background

With electricity sub-metering, each individual tenant or unit owner is able to be billed for the actual amount of electricity used, which can provide an incentive to reduce their electricity use. Sub-meters allow for accurate billing to ensure individual owners or tenants only pay for the actual amount of electricity they use. Previously, electricity costs may have been shared based on the floor area occupied or lot entitlements of units.

11.2 Application

Since 1 January 2010, the electricity sub-metering requirements apply to new multi-unit residential buildings (class 2) and new commercial office buildings (class 5).

This requirement does not apply to existing buildings undergoing alterations or additions. It also does not apply in buildings where each tenant is or will be a direct customer of an electricity retailer, as the electricity sub-meter will be installed by the electricity retailer.

It should be noted that since 1 May 2010, sub-metering provisions for electricity (and gas) have been included in the Building Code of Australia (BCA) Volume One (referred to as facilities for energy monitoring). These apply to a building or sole occupancy unit in class 2 and 5 buildings with a floor area greater than 500 square metres. For class 5 buildings where the total floor area is over 2500 square metres, the BCA also requires other parts of the building to individually record energy consumption such as the air-conditioning plant, artificial lighting, lifts and the central hot water supply. For class 2 buildings the same provision applies individually to these areas, but only if the common area is more than 500 square metres and the total floor area of the class 2 building is over 2500 square metres. Importantly, the requirement in the Queensland Development Code (QDC) for sole occupancy units to be sub-metered for electricity applies regardless of the building's size. Where there is an inconsistency with QDC and the BCA, the requirement under the QDC prevails to the extent of the inconsistency.



11.3 Compliance

Under the QDC, an electricity sub-meter must be installed to each individual unit or for each storey in a commercial office building where the individual lettable areas have not been identified at the time of lodging a building development application.

The electricity sub-meter must be located in a common area, e.g. foyer or shared car park. It must also be located so that it is easily accessed by a person authorised to read the meter, e.g. electricity retailer or body corporate.

Each electricity sub-meter must have a meter label to identify it to each unit or storey. The meter label must be affixed to or located adjacent to each electricity sub-meter, and must be made of white heat-resistant material with black lettering to ensure readability.



For further information

Regulatory

Queensland Development Code

All parts of the QDC are available on the Department of Local Government and Planning's website at www.dlgp.qld.gov.au

Building Code of Australia

The Australian Building Codes Board (ABCB) includes information on the energy efficiency requirements for residential dwellings at www.abcb.gov.au

Nationwide House Energy Rating Scheme (NatHERS)

Provides information on accredited software rating tools for house energy assessments at www.nathers.gov.au

Australian Standards

Provides access to Australian Standards relevant to the QDC at www.saiglobal.com

Water Efficiency and Labelling Standards (WELS)

Provides information on water star ratings for fixtures and fittings, including toilets, tapware and showerheads at www.waterrating.gov.au

Minimum Energy Performance Standards (MEPS)

Provides information on energy star ratings for appliances, including air conditioners at www.energyrating.gov.au

Building Services Authority

The Building Services Authority (BSA) includes information on licensing and contracting for tradespeople and consumers at www.bsa.qld.gov.au

Electrical Safety Office

The Electrical Safety Office (ESO) includes information on licensing and contracting for tradespeople and consumers at www.electricalsafety.qld.gov.au



Useful websites

Building designers

Building Designers Association of Queensland at www.bdaq.com.au

Architects

Australian Institute of Architects at www.architecture.com.au

Building certifiers

Australian Institute of Building Surveyors at www.aibs.com.au

Royal Institution of Chartered Surveyors at www.rics.org/oceania

Accredited house energy assessors

Accredited house energy assessors are listed at www.absa.net.au

Bureau of Meteorology

Provides historic monthly averages for local climatic data (temperature, humidity, rainfall, wind speed/direction) at www.bom.gov.au

ClimateSmart Living

Provides information on a range of housing design and appliances at www.climatesmart.qld.gov.au

Glazing calculators

Provides calculations to assist with glazing requirements at www.abcb.gov.au

Windows

Provides a list of windows rated for their energy performance at www.wers.net

Insulation handbook

Provides details on insulation requirements for different building types and roofs at www.icanz.org.au/handbook

Your Home Technical Manual

Provides details about specific passive design features at www.yourhome.gov.au/technical

Your Home Buyer's Guide

Provides details about choosing a new home and sustainability features at www.yourhome.gov.au/buyersguide

Your Home Renovators Guide

Provides details about renovating an existing dwelling to improve its sustainable design at www.yourhome.gov.au/renovatorsguide

Designing for Queensland's climate

Provides information on smart and sustainable housing design suitable for Queensland's climate zones at www.works.qld.gov.au



Air conditioning residential best practice guideline

The Australian Institute of Refrigeration, Air conditioning and Heating (AIRAH) provides guidelines for suppliers, installers and maintainers of air conditioners which outlines best practice installation and load calculation, and noise measurement and mitigation at www.airah.org.au

Solar Credits

Provides information on Solar Credits scheme for photovoltaic (solar) energy systems at www.climatechange.gov.au

Office of Renewable Energy Regulator

Provide information on Small-scale Technology Certificates (formerly known as Renewable Energy Certificates (RECs)) which apply to photovoltaic (solar) energy systems at www.orer.gov.au

Living greener

Provides information on sustainability housing features, as well available State and Federal rebate programs at www.livinggreener.gov.au

General reference

Further information on passive design features, photovoltaic (solar) energy systems, air conditioners and lighting is available from the websites listed below.

Orientation

www.climatesmart.qld.gov.au

www.yourhome.gov.au

Sun paths

www.works.qld.gov.au

Shading

www.yourhome.gov.au

Glazing

www.yourhome.gov.au

Windows

www.wers.net



Lighting

www.iesanz.org

www.yourhome.gov.au

www.climatesmart.qld.gov.au

www.lightingcouncil.com.au

Air conditioners

www.yourhome.gov.au

www.energyrating.gov.au

www.bsa.qld.gov.au

Photovoltaic (PV) solar energy systems

www.brightthing.energy.qld.gov.au

www.climatechange.gov.au

www.yourhome.gov.au

www.energex.com.au

www.ergon.com.au

www.cleanenergycouncil.org.au



Classification of buildings

The relevant building classes referred to in this guideline, as defined under the Building Code of Australia (BCA), are:

Class 1—one or more buildings, which in association constitute

a) **Class 1a**—a single dwelling being:

- i) a detached house; or
- ii) one of a group of two or more attached dwellings, each being a building, separated by a fire-resisting wall, including a row house, terrace house, town house or villa unit; or

b) **Class 1b**—a boarding house, guest house, hostel or the like:

- i) with a total area of all floors not exceeding 300 square metres measured over the enclosing walls of the Class 1b building; and
- ii) in which not more than 12 persons would ordinarily be resident, which is not located above or below another dwelling or another Class of building other than a private garage.

Class 2—a building containing 2 or more sole occupancy units each being a separate dwelling.

Class 5—an office building used for professional or commercial purposes, excluding Class 6, 7, 8 or 9

Class 8—a laboratory, or a building in which a handicraft or process for the production, assembling, altering, repairing, packing, finishing, or cleaning of goods or produce is carried on for trade, sale or gain.

Class 9—a building of a public nature

a) **Class 9a** – a health-care building, including those parts of the building set aside as a laboratory.

Class 10—a non-habitable building or structure being

b) **Class 10a** – a non-habitable building being a private garage, carport, shed or the like.

Note—the air conditioner installation requirement applies to all building classes under the BCA in Queensland (not just those listed above).



Definitions

Definitions are provided in the Queensland Development Code, the Building Code of Australia and the relevant legislation. Selected definitions used in this guideline are provided below:

Alteration—under the *Building Act 1975*, an alteration applies to an existing building or structure, including additions to the building or structure.

Building development application—is an application for development approval under the *Sustainable Planning Act 2009* to the extent it is for building work (for Code Assessment).

Under the Building Regulation 2006, a building development application is required for most building work. However, there are concessions for some minor alterations, maintenance and additions depending on the proposed nature and extent of building work to be undertaken. To confirm if building work requires assessment, refer to schedule 1 of the Building Regulation 2006, and contact your local government or building certifier.

Fire-resisting wall—applied to the building element, means having a fire resistance level appropriate for that element.

Floor area—is the gross area of all floors in the building measured over the enclosing walls other than the area of a verandah, roofed terrace, patio, garage or carport in or attached to the building.

Health care building—means a building whose occupants or patients undergoing medical treatment generally need physical assistance to evacuate the building during an emergency and includes:

- a public or private hospital
- a nursing home or similar facility for sick or disabled persons needing full-time care; or a clinic, day surgery or procedure unit where the effects of predominant treatment administered involves patients becoming non-ambulatory and requiring supervised medical care on premises for some time after the treatment.

Private garage—means:

- any garage associated with a class 1 building
- any single storey of a building of another class capable of accommodating not more than three vehicles, if there is only one such storey in the building



- any single separate storey garage associated with another building where such garage is capable of accommodating not more than three vehicles.

Sole occupancy unit—means a room or other part of a building for occupation by one or joint owner, lessee, tenant or other occupier to the exclusion of any other owner, lessee, tenant or other occupier and includes a:

- dwelling; or
- room or suite of rooms in a Class 3 building which includes sleeping facilities; or
- room or suite of associated rooms in a Class 5, 6, 7, 8 or 9 building; or
- room or suite of associated rooms in a Class 9c aged care building, which includes sleeping facilities and any area for the exclusive use of a resident.



Appendix A—Summary of QDC amendments

Part 1—Building design and facilities

6-star houses and townhouses

3.5-star/4-star houses and townhouses

From 1 September 2003, the Building Code of Australia (BCA) required all new houses and townhouses (class 1) in Queensland to achieve a minimum energy equivalence of 3.5-stars in climate zones 1, 2 and 3, and 4-stars in climate zone 5 (refer to Appendix B for locations).

A national 5-star standard commenced under the BCA in 2006. However, Queensland varied the application of the BCA by referring to the BCA 2005 provisions to retain the above requirements (due to concerns with the suitability of the national building provisions and their potential impact on housing construction in Queensland).

5-star houses and townhouses and optional credits

On 1 March 2009, Queensland adopted the national 5-star housing standard. The Queensland Development Code (QDC) also introduced optional credits for houses and townhouses with covered outdoor living areas (such as decks and verandahs) in climate zones 1 and 2 for designs using the software assessment method. Prior to this there had been no previous recognition of the potential energy efficiency benefits associated with outdoor living areas.

Before 1 May 2010, the inclusion of optional credit for photovoltaic (solar) energy systems installed on houses and townhouses was not previously recognised in the QDC as contributing towards the building's energy rating.

5-star multi-unit residential buildings

From 1 May 2005, the BCA required sole occupancy units in a multi-unit residential building (class 2) to achieve a minimum energy equivalence rating of 3.5 stars in climate zones 1, 2 and 3, and 4 stars in climate zone 5 (refer to Appendix B for locations).

Before 1 May 2010, there had been no previous recognition of the potential energy efficiency benefits associated with outdoor living areas and optional credits for



covered outdoor living areas, such as balconies, for units within a multi-unit residential building in climate zones 1 and 2.

End-of-trip facilities

Before 26 November 2010, there had been no previous QDC requirement for end-of-trip facilities in buildings. However, some local governments may have included requirements for end-of-trip facilities in their planning scheme.

Part 2—Fixtures, fittings and appliances

Energy efficient lighting

From 1 March 2006, new houses and townhouses (class 1 buildings) and multi-unit residential unit buildings (class 2) were required to install energy efficient lighting to a minimum of 40 per cent of the dwelling's internal floor area, including the associated garage, with either compact fluorescent lights (CFLs) or fluorescent tubes.

From 1 March 2009, all fixed internal lighting in new houses, townhouses and units were required to be energy efficient to 80 per cent of total light fixtures, with a performance minimum of 27 lumens per watt.

There was no previous requirement for fixed lighting in external outdoor living areas, such as verandahs, decks or balconies, to be energy efficient under the QDC.

The BCA did not previously have energy efficient lighting requirements for houses and townhouses and sole occupancy units in multi-unit residential buildings.

Water conservation

From 1 March 2006, new houses, townhouses (class 1) and multi-unit residential buildings (class 2 buildings) in areas of Queensland serviced by a water service provider had been required to install minimum AAA-rated or 3-star Water Efficiency and Labelling Standards (WELS) rated toilets and AAA-rated or 3-star WELS rated showerheads.

There was no previous minimum water efficiency requirement for tapware in dwellings in the QDC.



Energy efficient air conditioners

From 1 September 2009, the QDC required a minimum standard for the energy efficiency of new or replacement air conditioners installed in houses, townhouses (class 1) and multi-unit residential buildings (class 2) in Queensland.

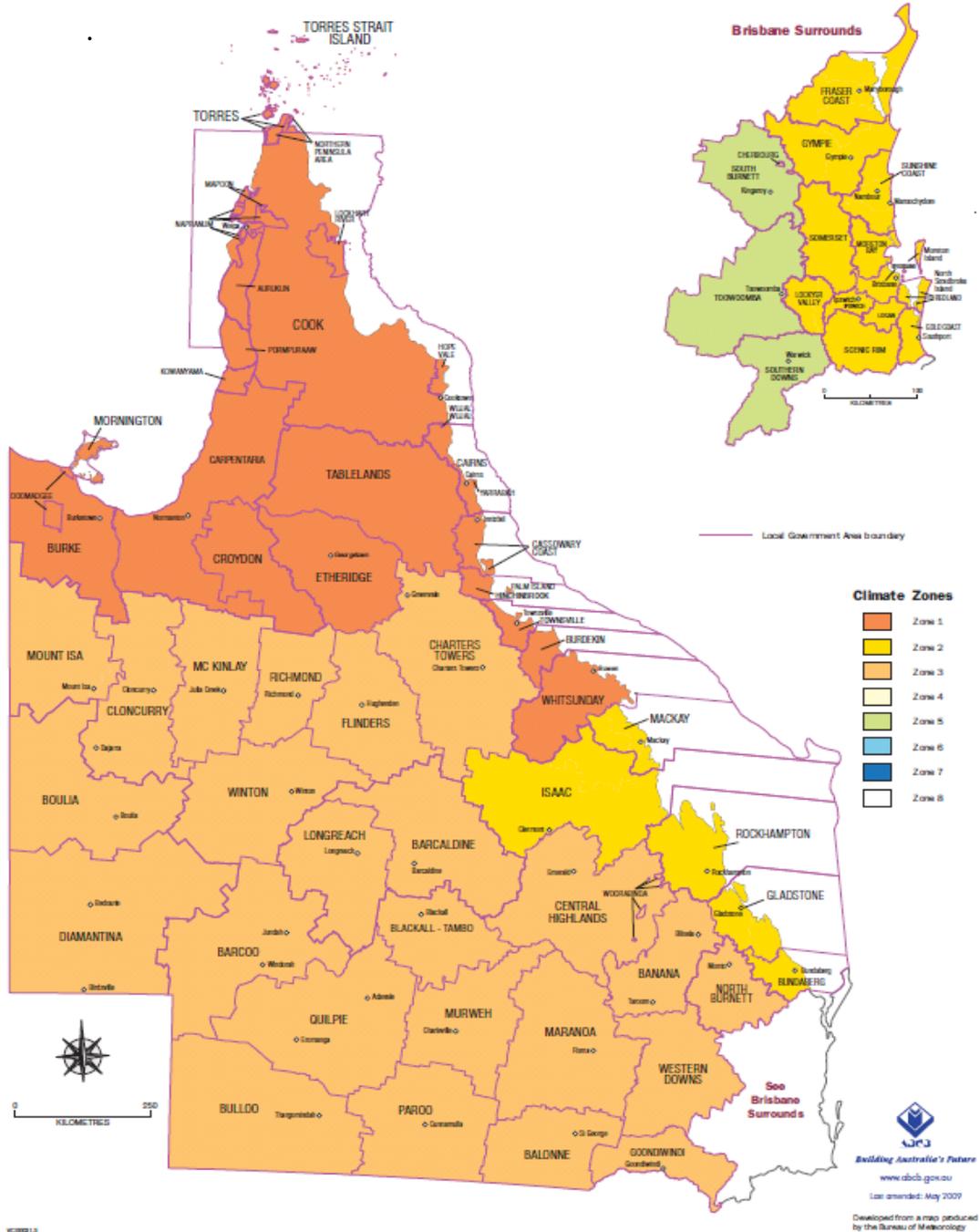
A minimum energy efficiency ratio of 2.9 was also applied to the sale of new air conditioners in Queensland.

Electricity sub-metering

Before 1 January 2010, there had been no previous QDC requirement for electricity sub-metering in new multi-unit residential buildings (class 2) and new commercial office buildings (class 5).



Appendix B—Building Code of Australia’s climate zones

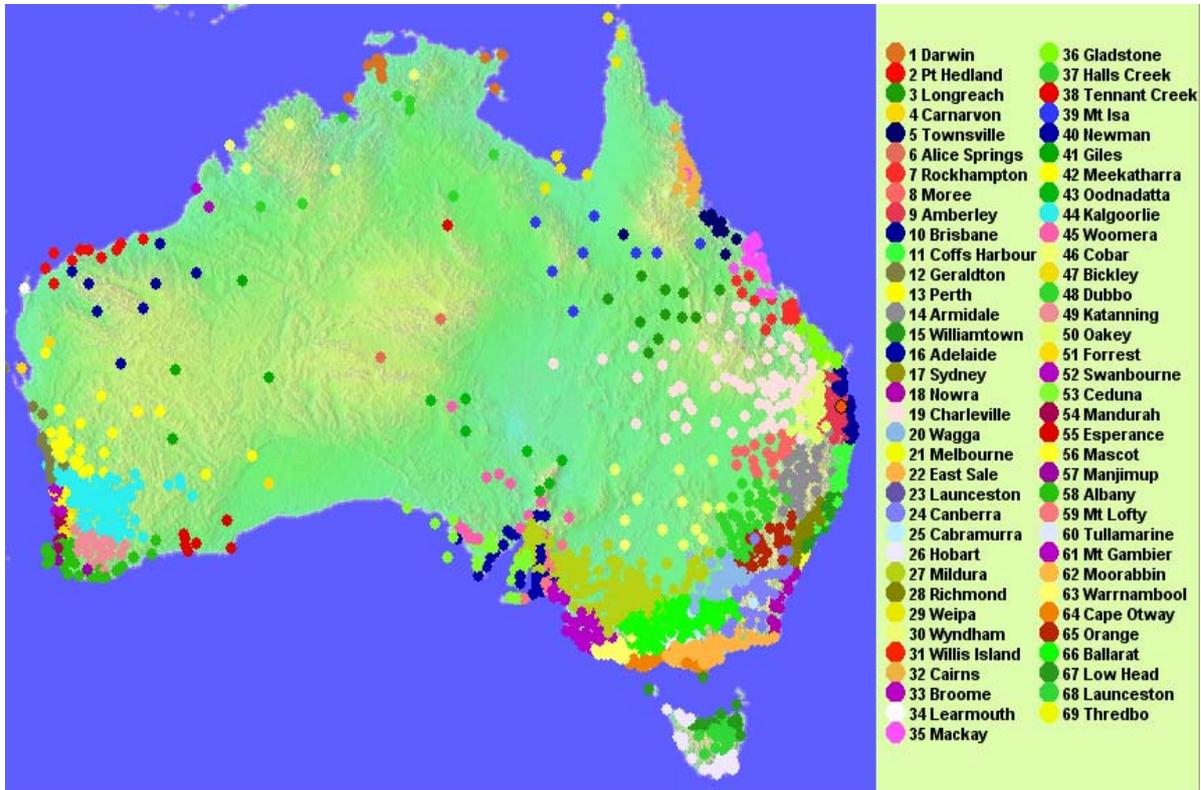


Zone 1 – Tropical	High humidity summer, warm winter
Zone 2 – Sub-tropical	Warm humid summer, mild winter
Zone 3 – Hot arid	Hot dry summer, warm winter
Zone 5 – Warm temperate	Warm summer, cool winter

Note— zone 4 does not exist in Queensland



Appendix C—Software (NatHERS) climate files



Queensland climate files	
Number	Location
3	Longreach
5	Townsville
7	Rockhampton
9	Amberley
10	Brisbane
19	Charleville
29	Weipa
32	Cairns
35	Mackay
36	Gladstone
39	Mount Isa
50	Oakey
	Atherton (proposed)
	Maleny (proposed)
	Toowoomba (proposed)



Appendix D—Alternative solutions for energy efficient lighting: task lighting and BCA 2008 Section J

The *Building Act 1975* provides the framework that allows alternative solutions, and for energy efficient lighting compliance under the Queensland Development Code (QDC), the building certifier can consider:

- **Adjustment factor for task lighting**—a recommended QDC adjustment factor of 0.85 for manually dimmable lights; or
- **Section J methodology Building Code of Australia (BCA) 2008**—for sophisticated lighting control systems, such as a residential lighting management system or a system that is part of a home automation system, using various lighting calculations.

Note, the QDC adjustment factor cannot be used in conjunction with the BCA 2008 Section J methodology for compliance.

An alternative solution allows designers a process to satisfactorily demonstrate to the building certifier that the QDC's performance requirement for energy efficient lighting installations can be achieved through a proposed lighting solution. In effect, while potentially higher lighting power may be installed with some types of lamps, the use of the above methods may result in compliant configurations.

Alternative solutions must be assessed against all relevant performance criteria of the QDC and should be supported with a lighting plan including a lighting layout, lighting schedule and relevant calculations. Building certifiers are responsible for assessing whether an alternative solution complies with the QDC performance requirements for energy efficient lighting. They may rely on expert judgement, such as practitioners who are a Registered Professional Engineer in Queensland (RPEQ), from a Member Illumination Engineering Society (MIES) or have other equivalent qualification, when making that assessment.

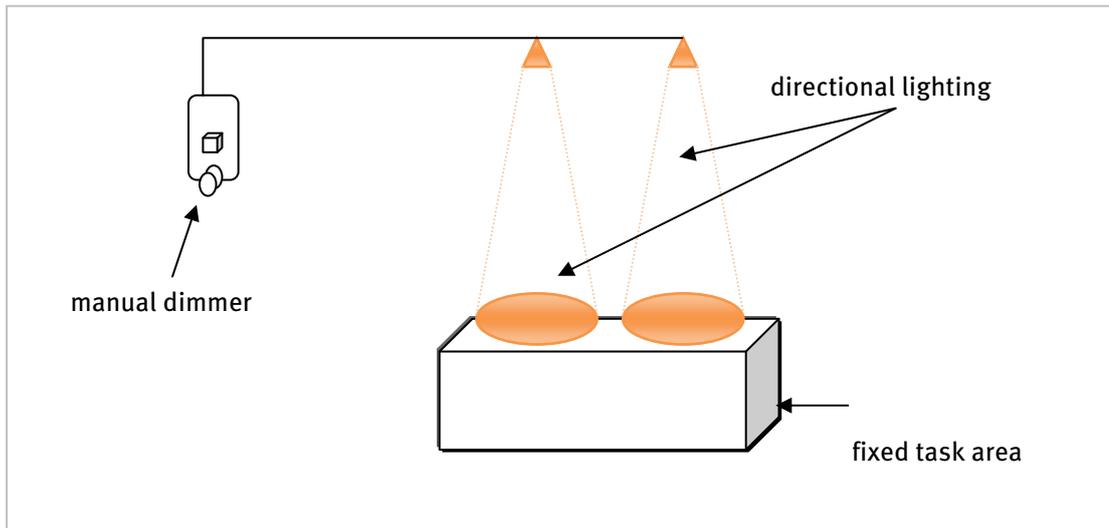
Adjustment factor for task lighting

Directional lighting is often preferred to illuminate fixed task areas, especially a kitchen bench. Where a manual dimmer is installed, task lighting can be adjusted so that the lamps are not operating at 100 per cent the entire time they are switched 'on'. As shown in Figure 8, a dimmer can be used to reduce the lighting level over a fixed task area when the area is not being used for task orientated purposes, but



the light can still contribute to the ambient lighting in the room with reduced energy use.

Figure 8 Task lighting on dimmable control



Directional lighting is generally best achieved with reflector lamps (i.e. a reflector is inside the lamp, such as an infra-red coated (IRC) MR16 lamp). Halogen lamps are predominantly used to produce the desired task level lighting to illuminate narrow bench spaces. The use of a manual dimmer in conjunction with the most energy efficient halogen reflector lamps for directional lighting can achieve a degree of energy efficient lighting.

For the purpose of the QDC, a manual dimmer control on a separate electrical circuit exclusively for lights over a fixed nominated task area, such as kitchen bench can use a recommended adjustment factor of 0.85. Therefore, the adjusted lamp efficacy can be calculated by:

$$\text{specified lamp efficacy (lumens/watt)} \div \text{recommended adjustment factor (0.85)} = \text{Adjusted lamp efficacy}$$



Case study 8—Fixed task lighting and adjusted lamp efficacy

Homeowners are looking to include fixed task lighting into a kitchen area of a new house. They are considering installing a multi-lamp bar and manual dimmer, and need to consider the QDC energy efficiency lighting requirement. How can this be achieved?

Four Infra Red Coated (IRC) MR16 halogen lamps on a multi-lamp bar, having a specified efficacy of 23 lumens per watt, are placed on an electrical circuit with a manual dimmer designed for exclusive lighting of a kitchen bench. The adjusted efficacy of the lamps is recommended to be calculated as:

$$23 \div 0.85 = 27.1 \text{ lumens/watt}$$

(adjusted lamp efficacy)

This lighting configuration can be accepted by the building certifier as complying with the QDC as an alternative solution given the adjusted lamp efficacy is greater than 27

Section J methodology (BCA 2008)

Control systems for limiting lighting energy that would otherwise exceed the QDC acceptable solutions are:

- fixed dimming (limitation on maximum power output to something less than 100 per cent; cannot be adjusted by user)
- programmable dimming (pre-selected lighting scenes determined by combinations of time of day, daylight level and occupancy)
- manual dimming
- dynamic dimming for lamp deterioration
- whole-of-house lighting load limiting
- motion sensing.

To demonstrate if these lighting control systems would comply with the QDC, an alternative solution is required. These types of lighting installations are designed by professional lighting designers and are similar to commercial office and retail lighting arrangements. Therefore, an alternative solution based on BCA's 2008 methodology for maximum Illumination Power Density (IPD) may be considered appropriate by the building certifier through demonstration of lighting calculations (refer to worked examples presented in Appendix E). Lighting arrangements using the BCA equivalence modelling should be designed to provide both a practical level



of lighting illumination as required for the intended use as well as being energy efficient.

Using this BCA 2008 methodology as an alternative solution for a typical house with appropriately designed illumination levels, an equivalent level of watts per square metre (W/square metre) can be ascertained for specified areas, as well as an overall average (W/square metre) for the entire dwelling. Where the calculated average IPD is less than the average allowable IPD, then the lighting scheme can be considered as an alternative solution by the building certifier. If the average IPD is greater than the average allowable IPD, then it cannot be considered as an alternative solution.

When assessing a typical fluorescent lighting scheme without any lighting controls which complies with the QDC performance criteria (i.e. with 80 per cent fluorescent using a combination of CFL, circular or linear fluorescent) a benchmark level for W/square metre needs to be determined (refer to Benchmark House in Appendix E, which has an average allowable IPD of 8.27 W/square metre).

Extending the lighting scheme to include appropriate, good quality, lighting design features incorporating technologies such as directional lamps (narrow beam) for task benches, highlighting features and artwork lighting requires an adjusted IPD of around ten W/square metre under the BCA methodology. Lighting installations with an IPD (before inclusion of adjustment factors as per the BCA IPD methodology) of six W/square metre for most spaces provides good quality lighting design features within the lighting scheme while adhering to the performance criteria of the QDC. For the purpose of the QDC, the recommended maximum IPD for spaces in class 1 and class 2 buildings are shown in Table 7:

Table 7 Maximum illumination power densities for use with the QDC

Space	Maximum illumination power density (W/m ²)
car park, passage ways, separate toilet	3
all other spaces	6

The stated values in the above table are to be used instead of Table J6.2b in Volume One of the BCA 2008 (which are for commercial buildings), but the adjustment



factors for increasing the IPD as described in Table J6.3c of the BCA 2008 can apply⁴.

In addition to benchmarking the QDC performance criteria to the BCA, three lighting schemes for a typical house ranging from a basic lighting design to a high-end dwelling design are presented in Case Study 9: Example Houses A to C with the appropriate calculations and formula provided for illustration and guidance on the modelling process.

Case study 9—Energy efficient lighting using BCA 2008 Section J methodology

Owners of a 3-bedroom house wish to have a more flexible lighting arrangement than predominantly fluorescent lighting. They investigate a number of lighting schemes including combinations of fluorescent lighting, halogen lighting, LED lighting and lighting control systems. How can building certifiers assess these lighting arrangements under the QDC?

Lighting designers may consider using the BCA 2008 method of analysis as an alternative solution for compliance with a comparable maximum Illumination Power Density to a reference house. Worked examples are presented in Appendix E (example houses A, B and C). The house plan for this example is shown in Figure 9.

An analysis of three lighting schemes was undertaken with outcomes shown in Table 8.

Lighting schemes in Example Houses B and C can be considered by a building certifier as an alternative solution under the QDC as the average Illumination Power Density (IPD) has been calculated to be less than the average allowable IPD, with House C having a high amount of lighting controls.

For House C to become compliant with so few fluorescents there has been a very large number of lighting controls installed (as illustrated in Appendix E). Less expensive alternative solutions could be obtained with a more balanced blend of energy efficient lamps.

⁴ This allows the room size adjustment factor to be included in a combined adjustment factor where two or more adjustment factors apply to a space as per Note 7 of Table J6.3c of Volume One of the BCA 2008.
(Note, the current BCA does not allow the room size adjustment factor to be used with another adjustment factor, this is why the BCA 2008 has been adopted.)



Case study 9—Energy efficient lighting using BCA 2008 Section J methodology (cont.)

Figure 9 House plan showing lighting layout

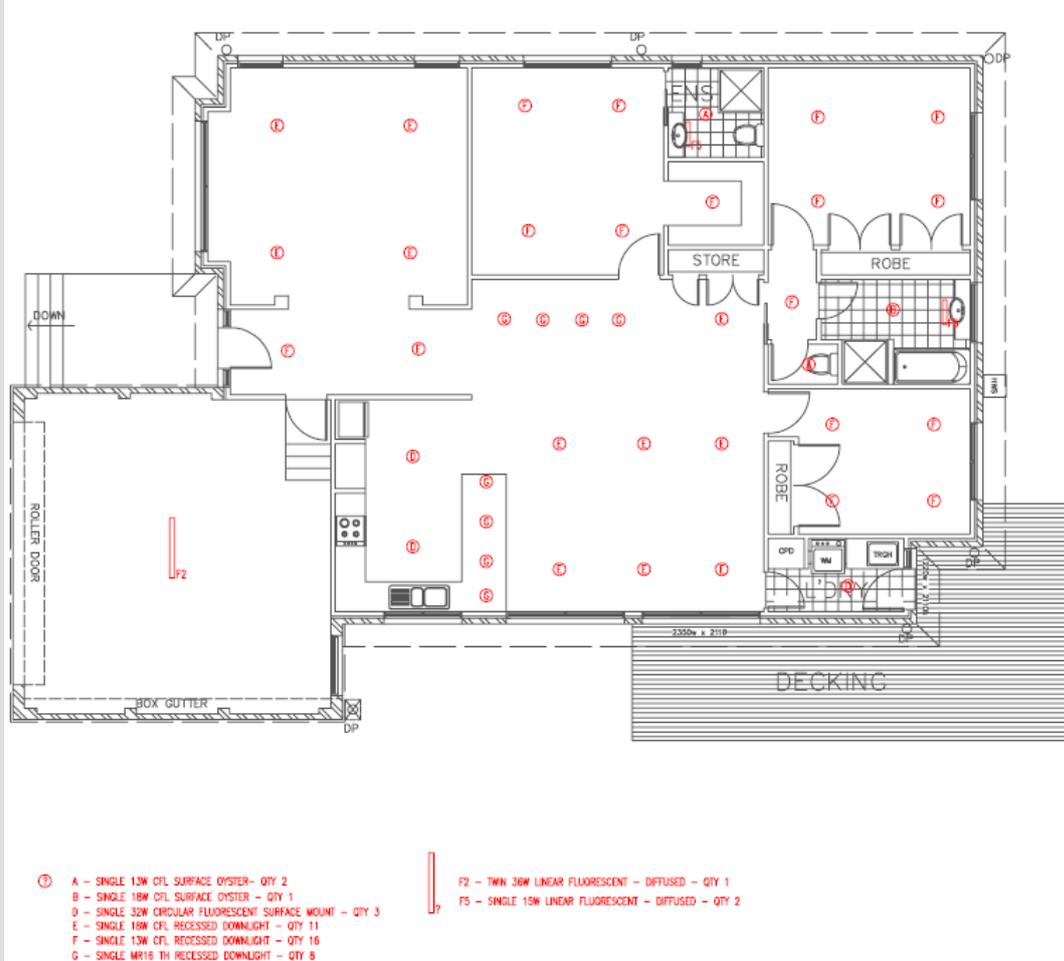


Table 8 Analysis of lighting scheme and QDC compliance

Example House	Lighting scheme	Average IPD (W/m ²)	Average allowable IPD(W/m ²)	% energy efficient lighting	QDC compliant
A	High-end lighting scheme: infra-red coated halogens with lighting controls	10.45	9.45	2.2	NO
B	Mid-range lighting scheme: mix of lamps with lighting controls	8.12	8.36	70.0	YES
C	Mid-range lighting scheme: mix of lamps with lighting controls	6.92	8.36	42.8	YES



How to calculate energy efficient lighting using BCA 2008 Section J methodology

Table 9 can be used in conjunction with the BCA 2008 lighting provisions to assist in calculating the percentage of energy efficient lighting with lighting plans and schedules. Columns M, N, P and Q in Table 9 below correspond to the tables presented in Appendix E, which provide examples of worked analysis spreadsheets.

Table 9 Calculation sheet for BCA methodology

	M	N	P	Q
Room type	Maximum illumination power density for this area (W/m²) (as assigned under the QDC framework)	Room index adjustment factor	Other factors	Total adjustment factor
Kitchen	6			
Dining and family	6			
Living	6			
Entry	6			
Garage	6			
Master bed	6			
Ensuite	6			
Walk in robe (WIR)	6			
Bed 1	6			
Bed 2	6			
Laundry	6			
Passage ways	3			
Toilet (WC)	3			



Calculating columns N, P and Q

Column N—Room index adjustment factor

Values to determine the room index adjustment factor are shown in Table 10 (as per Table J6.2c in the BCA 2008, Volume One (pages 495–97)).

Table 10 **Thresholds for BCA methodology**

Item	Description	Illumination power density adjustment factor
Room size *	Room index not more than 0.7	0.5
	Room index more than 0.7 but not more than 1.5	0.7
	Room index more than 1.5 but not more than 3.0	0.9
	Room index more than 3.0	1.0

* The room index is an expression of the room proportion with respect to the lamps and is determined by the formula:

$$L \times W \div H_m (L+W)$$

Where:

L is the length of the room

W is the width of the room

H_m is the height that the fitting is mounted above the work surface

Room index:

If column E < 0.7, then column N = 0.5

If column E 0.7 to < 1.5, then column N = 0.7

If column E 1.5 to < 3.0, then column N = 0.9

If column E > 3.0, then column N = 1.0

Column P—Other factors

Values to determine the illumination power density adjustment factor are identified in Table J6.2c of the BCA 2008, Volume One (pages 495–97).

Column Q—Total adjustment factor

If column N < column P, then column Q = $N \times (P + (1-P) \div 2)$

If column N > column P, then column Q = $P \times (N + (1-N) \div 2)$



Appendix E—Worked examples of alternative solutions using BCA 2008 Section J

Benchmark house—3-bedroom house—minimum 80 per cent energy efficient lamps (as per QDC) using BCA methodology

Room name	L(m)	W(m)	H(m)	Area (m ²)	room index	lighting applied		energy efficient tag	lamp wattage (W)	numbers of lamps	ballast (W)	numbers of fixtures in this area	total lighting load for this area (W)	allowable IPD for this area (W/m ²)	room index adjustment factor	lighting control	other factors	total adjustment factor	adjusted IPD for this area (W/m ²)	maximum allowable design illumination power load (W)
	A	B	C	D = A x B	E = D / (C x (A + B))	F		G	H	I	J	K	L = (H+I) x I x K	M	N	O	P	Q	R = M/Q	S = R x D
Kitchen	4.2	3.4	2.4	14.28	0.78	general lighting	32W Circ Fluor	Yes	32.0	1	4.4	2	277.8	6	0.7	no control	1	0.7	8.57	122.40
						task area	MR16 35W IRC DL	No	35.0	1	6.0	5				no control	1			
Dining and family	6.6	5.3	2.4	34.98	1.22	general lighting	18W CFL DL	Yes	18.0	1	6.5	7	417.5	6	0.7	no control	1	0.7	8.57	299.83
						decorative lighting	MR16 35W IRC DL	No	35.0	3	6.0	2				no control	1			
Living	5.1	4.7	2.4	23.97	1.02	general lighting	18W CFL DL	Yes	18.0	1	6.5	4	221.0	6	0.7	no control	1	0.7	8.57	205.46
						decorative lighting	MR16 35W IRC DL	No	35.0	3	6.0	1				no control	1			
Entry	4.7	1.7	2.4	7.99	0.52	13W CFL DL		Yes	13.0	1	4.6	2	35.2	6	0.5	no control	1	0.5	12.00	95.88
Garage	6.4	6.1	2.4	39.04	1.30	Twin 36W Fluor		Yes	36.0	2	6.0	1	84.0	3	0.7	no control	1	0.7	4.29	167.31
Master bed	4.1	3.7	2.4	15.17	0.81	13W CFL DL		Yes	13.0	1	4.6	4	70.4	6	0.7	no control	1	0.7	8.57	130.03
Ensuite	1.9	1.8	2.4	3.42	0.39	general lighting	13W CFL Oyster	Yes	13.0	1	4.6	1	38.1	6	0.5	no control	1	0.5	12.00	41.04
						task area	15W Lin Fluor	Yes	15.0	1	5.5	1				no control	1			
WIR	1.9	1.8	2.4	3.42	0.39	13W CFL DL		Yes	13.0	1	4.6	1	17.6	6	0.5	no control	1	0.5	12.00	41.04
Bed 1	4.0	3.5	2.4	14	0.78	18W CFL DL		Yes	18.0	1	6.5	4	98.0	6	0.7	no control	1	0.7	8.57	120.00
Bed 2	3.4	2.9	2.4	9.86	0.65	18W CFL DL		Yes	18.0	1	6.5	4	98.0	6	0.5	no control	1	0.5	12.00	118.32
Bath	3.0	2.0	2.4	6	0.50	general lighting	13W CFL Oyster	Yes	13.0	1	4.6	1	38.1	6	0.5	no control	1	0.5	12.00	72.00
						task area	15W Lin Fluor	Yes	15.0	1	5.5	1				no control	1			
Passage	2.2	0.9	2.4	1.98	0.27	13W CFL DL		Yes	13.0	1	4.6	1	17.6	3	0.5	no control	1	0.5	6.00	11.88



Laundry	3.0	1.7	2.4	5.1	0.45	32W Circ Fluor	Yes	32.0	1	4.4	1	36.4	6	0.5	no control	1	0.5	12.00	61.20
WC	1.7	0.9	2.4	1.53	0.25	13W CFL Oyster	Yes	13.0	1	4.6	1	17.6	3	0.5	no control	1	0.5	6.00	9.18
Total				180.74							44	1467.3							1495.57
				TD							TK	TL							TS

All calculations are illustrative only and may not represent exact specifications of particular lighting products currently available on the market. Designers wishing to use this compliance method should source actual specifications of the lighting products they intend to install in the dwelling.

Average Illumination Power Density = total lighting load / total area: (TL/TD)	8.12 W/m ²
Average Allowable Illumination Power Density = maximum lighting load allowable / total area: (TS/TD)	8.27 W/m ²
Percentage of efficient light sources:	81.8%

Acceptable solution compliant: (using QDC min. 80 per cent energy efficient lamps)	Yes	The percentage of efficient light sources is more than 80 per cent of total fixed lighting.
Alternative solution compliant: (using BCA methodology)	Yes	The designed power load is less than the average allowable Illumination Power Density calculated using the methodology of BCA 2008 section J6.
QDC COMPLIANT	YES	



Example house A—3-bedroom house—high-end lighting scheme (infra-red coated [IRC] halogens with lighting controls)

Room name	L(m)	W(m)	H(m)	Area (m ²)	room index	lighting applied	energy efficient tag	lamp wattage (W)	numbers of lamps	ballast (W)	numbers of fixtures in this area	total lighting load for this area (W)	allowable IPD for this area (W/m ²)	room index adjustment factor	lighting control	other factors	total adjustment factor	adjusted IPD for this area (W/m ²)	maximum allowable design illumination power load (W)
	A	B	C	D = A x B	$E = D / (C \times (A + B))$	F	G	H	I	J	K	$L = (H+) \times I \times K$	M	N	O	P	Q	R = M/Q	S = R x D
Kitchen	4.2	3.4	2.4	14.28	0.78	MR16 35W IRC DL	No	35.0	1	6.0	8	328.0	6	0.7	manual dimmer	0.95	0.68	8.79	125.54
Dining and family	6.6	5.3	2.4	34.98	1.22	MR16 35W IRC DL	No	35.0	1	6.0	9	369.0	6	0.7	program dimming	0.85	0.65	9.27	324.14
Living	5.1	4.7	2.4	23.97	1.02	MR16 35W IRC DL	No	35.0	1	6.0	6	246.0	6	0.7	program dimming	0.85	0.65	9.27	222.12
Entry	4.7	1.7	2.4	7.99	0.52	MR16 35W IRC DL	No	35.0	1	6.0	2	82.0	6	0.5	no control	1	0.50	12.00	95.88
Garage	6.4	6.1	2.4	39.04	1.30	Twin 36W Fluor	Yes	36.0	2	6.0	1	84.0	3	0.7	motion detector (up to 2 lights)	0.55	0.47	6.42	250.52
Master bed	4.1	3.7	2.4	15.17	0.81	MR16 35W IRC DL	No	35.0	1	6.0	4	164.0	6	0.7	motion detector (up to 6 lights)	0.7	0.60	10.08	152.97
Ensuite	1.9	1.8	2.4	3.42	0.39	MR16 35W IRC DL	No	35.0	1	6.0	1	41.0	6	0.5	no control	1	0.50	12.00	41.04
WIR	1.9	1.8	2.4	3.42	0.39	MR16 35W IRC DL	No	35.0	1	6.0	1	41.0	6	0.5	no control	1	0.50	12.00	41.04
Bed 1	4.0	3.5	2.4	14.00	0.78	MR16 35W IRC DL	No	35.0	1	6.0	4	164.0	6	0.7	motion detector (up to 6 lights)	0.7	0.60	10.08	141.18
Bed 2	3.4	2.9	2.4	9.86	0.65	MR16 35W IRC DL	No	35.0	1	6.0	3	123.0	6	0.5	motion detector (up to 6 lights)	0.7	0.43	14.12	139.20
Bath	3.0	2.0	2.4	6.00	0.50	MR16 35W IRC DL	No	35.0	1	6.0	2	82.0	6	0.5	no control	1	0.50	12.00	72.00
Passage	2.2	0.9	2.4	1.98	0.27	MR16 35W IRC DL	No	35.0	1	6.0	1	41.0	3	0.5	no control	1	0.50	6.00	11.88
Laundry	3.0	1.7	2.4	5.10	0.45	MR16 35W IRC DL	No	35.0	1	6.0	2	82.0	6	0.5	motion detector (up to 2 lights)	0.55	0.39	15.48	78.97
WC	1.7	0.9	2.4	1.53	0.25	MR16 35W IRC DL	No	35.0	1	6.0	1	41.0	3	0.5	motion detector (up to 2 lights)	0.55	0.39	7.74	11.85
Total				180.74							45	1888.0							1708.32
				TD							TK	TL							TS

All calculations are illustrative only and may not represent exact specifications of particular lighting products currently available on the market. Designers wishing to use this compliance



method should source actual specifications of the lighting products they intend to install in the dwelling.

Average Illumination Power Density = total lighting load / total area (TL/TD)	10.45 W/m ²
Average Allowable Illumination Power Density = maximum lighting load allowable / total area (TS/TD)	9.45 W/m ²
Percentage of efficient light sources:	2.2%

Acceptable solution compliant: (using QDC min. 80 per cent energy efficient lamps)	No	the percentage of efficient light sources is less than 80 per cent of total fixed lighting.
Alternative solution compliant: (using BCA methodology)	No	the designed power load is more than the average allowable Illumination Power Density calculated using the methodology of BCA 2008 section J6.
QDC COMPLIANT	NO	



Example house B—3-bedroom house—mid-range lighting scheme (mix of lamps with lighting controls)

Room name	L(m)	W(m)	H(m)	Area (m ²)	room index	lighting applied		energy efficient tag	lamp wattage (W)	numbers of lamps	ballast (W)	numbers of fixtures in this area	total lighting load for this area (W)	allowable IPD for this area (W/m ²)	room index adjustment factor	lighting control	other factors	total adjustment factor	adjusted IPD for this area (W/m ²)	maximum allowable design illumination power load (W)
	A	B	C	D = A x B	E = D / (C x (A + B))	F		G	H	I	J	K	L = (H+J) x I x K	M	N	O	P	Q	R = M/Q	S = R x D
Kitchen	4.2	3.4	2.4	14.28	0.78	general lighting	18W CFL Oyster	Yes	18.0	1	6.5	2	254.0	6	0.7	manual dimmer	0.95	0.68	8.79	125.54
						task area	MR16 35W IRC DL	No	35.0	1	6.0	5				manual dimmer	0.95			
Dining and family	6.6	5.3	2.4	34.98	1.22	general lighting	18W CFL DL	Yes	18.0	1	6.5	7	335.5	6	0.7	manual dimmer	0.95	0.68	8.79	307.52
						decorative lighting	MR16 35W IRC DL	No	35.0	1	6.0	4				manual dimmer	0.95			
Living	5.1	4.7	2.4	23.97	1.02	general lighting	18W CFL DL	Yes	18.0	1	6.5	4	262.0	6	0.7	manual dimmer	0.95	0.68	8.79	210.73
						decorative lighting	MR16 35W IRC DL	No	35.0	1	6.0	4				manual dimmer	0.95			
Entry	4.7	1.7	2.4	7.99	0.52	MR16 35W IRC DL		No	35.0	1	6.0	2	82.0	6	0.5	no control	1	0.50	12.00	95.88
Garage	6.4	6.1	2.4	39.04	1.30	Twin 36W Fluor		Yes	36.0	2	6.0	1	84.0	3	0.7	no control	1	0.70	4.29	167.31
Master bed	4.1	3.7	2.4	15.17	0.81	13W CFL DL		Yes	13.0	1	4.6	4	70.4	6	0.7	no control	1	0.70	8.57	130.03
Ensuite	1.9	1.8	2.4	3.42	0.39	general lighting	13W CFL Oyster	Yes	13.0	1	4.6	1	38.1	6	0.5	no control	1	0.50	12.00	41.04
						task area	15W Lin Fluor	Yes	15.0	1	5.5	1				no control	1			
WIR	1.9	1.8	2.4	3.42	0.39	13W CFL DL		Yes	13.0	1	4.6	1	17.6	6	0.5	no control	1	0.50	12.00	41.04
Bed 1	4.0	3.5	2.4	14	0.78	18W CFL DL		Yes	18.0	1	6.5	4	98.0	6	0.7	no control	1	0.70	8.57	120.00
Bed 2	3.4	2.9	2.4	9.86	0.65	18W CFL DL		Yes	18.0	1	6.5	4	98.0	6	0.5	no control	1	0.50	12.00	118.32
Bath	3.0	2.0	2.4	6	0.50	general lighting	13W CFL Oyster	Yes	13.0	1	4.6	1	38.1	6	0.5	no control	1	0.50	12.00	72.00
						task area	15W Lin Fluor	Yes	15.0	1	5.5	1				no control	1			
Passage	2.2	0.9	2.4	1.98	0.27	13W CFL DL		Yes	13.0	1	4.6	2	35.2	3	0.5	no control	1	0.50	6.00	11.88



										6										
Laundry	3.0	1.7	2.4	5.1	0.45	32W Circ Fluor	Yes	32.0	1	4.4	1	36.4	6	0.5	no control	1	0.50	12.00	61.20	
WC	1.7	0.9	2.4	1.53	0.25	13W CFL Oyster	Yes	13.0	1	4.6	1	17.6	3	0.5	no control	1	0.50	6.00	9.18	
Total				180.74							50	1466.9							1511.66	
				TD							TK	TL							TS	

All calculations are illustrative only and may not represent exact specifications of particular lighting products currently available on the market. Designers wishing to use this compliance method should source actual specifications of the lighting products they intend to install in the dwelling.

Average Illumination Power Density = total lighting load / total area: (TL/TD)	8.12 W/m ²
Average Allowable Illumination Power Density = maximum lighting load allowable / total area: (TS/TD)	8.36 W/m ²
Percentage of efficient light sources:	70.0%

Acceptable solution compliant: (using QDC min. 80 per cent energy efficient lamps)	No	the percentage of efficient light sources is less than 80 per cent of total fixed lighting.
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Alternative solution compliant: (using BCA methodology)	Yes	the designed power load is less than the average allowable Illumination Power Density calculated using the methodology of BCA 2008 section J6.
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QDC COMPLIANT	YES
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Example house C—3-bedroom house—mid-range lighting scheme (mix of lamps with lighting controls)

Room name	L(m)	W(m)	H(m)	Area (m ²)	room index	lighting applied		energy efficient tag	lamp wattage (W)	numbers of lamps	ballast (W)	numbers of fixtures in this area	total lighting load for this area (W)	allowable IPD for this area (W/m ²)	room index adjustment factor	lighting control	other factors	total adjustment factor	adjusted IPD for this area (W/m ²)	maximum allowable design illumination power load (W)
	A	B	C	D = A x B	$E = D / (C \times (A + B))$	F		G	H	I	J	K	$L = (H+J) \times I \times K$	M	N	O	P	Q	$R = M/Q$	$S = R \times D$
Kitchen	4.2	3.4	2.4	14.28	0.78	general lighting	32W Circ Fluor	Yes	32.0	1	4.4	2	72.8	6	0.7	no control	1	0.70	8.57	122.40
						task area	None	X	0.0	0	0.0	0				no control	1			
Dining and family	6.6	5.3	2.4	34.98	1.22	general lighting	32W Circ Fluor	Yes	32.0	1	4.4	2	72.8	6	0.7	no control	1	0.70	8.57	299.83
						decorative lighting	None	X	0.0	1	0.0	0				no control	1			
Living	5.1	4.7	2.4	23.97	1.02	general lighting	13W CFL Oyster	Yes	13.0	1	4.6	2	199.2	6	0.7	manual dimmer	0.95	0.68	8.79	210.73
						decorative lighting	MR16 35W IRC DL	No	35.0	1	6.0	4				manual dimmer				
Entry	4.7	1.7	2.4	7.99	0.52	MR16 35W IRC DL		No	35.0	1	6.0	2	82.0	6	0.5	no control	1	0.50	12.00	95.88
Garage	6.4	6.1	2.4	39.04	1.30	Twin 36W Fluor		Yes	36.0	2	6.0	1	84.0	3	0.7	no control	1	0.70	4.29	167.31
Master bed	4.1	3.7	2.4	15.17	0.81	MR16 35W IRC DL		No	35.0	1	6.0	4	164.0	6	0.7	manual dimmer	0.95	0.68	8.79	133.36
Ensuite	1.9	1.8	2.4	3.42	0.39	general lighting	MR16 35W IRC DL	No	35.0	1	6.0	2	102.5	6	0.5	no control	1	0.50	12.00	41.04
						task area	15W Lin Fluor	Yes	15.0	1	5.5	1				no control	1			
WIR	1.9	1.8	2.4	3.42	0.39	13W CFL DL		Yes	13.0	1	4.6	1	17.6	6	0.5	no control	1	0.50	12.00	41.04
Bed 1	4.0	3.5	2.4	14	0.78	MR16 35W IRC DL		No	35.0	1	6.0	4	164.0	6	0.7	manual dimmer	0.95	0.68	8.79	123.08
Bed 2	3.4	2.9	2.4	9.86	0.65	MR16 35W IRC DL		No	35.0	1	6.0	4	164.0	6	0.5	manual dimmer	0.95	0.49	12.31	121.35
Bath	3.0	2.0	2.4	6	0.50	general lighting	13W CFL Oyster	Yes	13.0	1	4.6	1	38.1	6	0.5	no control	1	0.50	12.00	72.00
						task area	15W Lin Fluor	Yes	15.0	1	5.5	1				no control	1			
Passage	2.2	0.9	2.4	1.98	0.27	13W CFL DL		Yes	13.0	1	4.6	2	35.2	3	0.5	no control	1	0.50	6.00	11.88
Laundry	3.0	1.7	2.4	5.1	0.45	32W Circ Fluor		Yes	32.0	1	4.4	1	36.4	6	0.5	no control	1	0.50	12.00	61.20
WC	1.7	0.9	2.4	1.53	0.25	13W CFL Oyster		Yes	13.0	1	4.6	1	17.6	3	0.5	no control	1	0.50	6.00	9.18



Total				180.74						35	1250.2							1510.28
				TD						TK	TL							TS

All calculations are illustrative only and may not represent exact specifications of particular lighting products currently available on the market. Designers wishing to use this compliance method should source actual specifications of the lighting products they intend to install in the dwelling.

Average IPD = total lighting load / total area: (TL/TD)	6.92 W/m ²
Average Allowable IPD = maximum lighting load allowable / total area: (TS/TD)	8.36 W/m ²
Percentage of efficient light sources:	42.9%

Acceptable solution compliant: (using QDC min. 80 per cent energy efficient lamps)	No	the percentage of efficient light sources is less than 80 per cent of total fixed lighting.
Alternative solution compliant: (using BCA methodology)	Yes	the designed power load is less than the average allowable Illumination Power Density calculated using the methodology of BCA 2008 section J6.
QDC COMPLIANT	YES	

