Centre for Design
sustainability | research | solutions

International comparison of building energy performance standards

Horne, R E, Hayles, C, Hes, D, Jensen, C, Opray, L, Wakefield, R, and Wasiluk, K.

This Report has been prepared by the Centre for Design at RMIT University, Melbourne in association with staff from the RMIT School of Property Construction and Management and SBE Architects Ltd

Prepared for Australian Greenhouse Office, Department of Environment and Heritage

Final Report

September 2005

Acknowledgements

Contributors to the Canada DTS review work include Canadian Agencies and building professionals. With special thanks to:

- Mr. Anil Parekh (NRCan) with Natural Resources Canada (Ottawa)
- Oliver Drerup, Canada Mortgage & Housing Corporation- Super E Program
- Jennifer Shaw, R-2000/ EnerGuide Administrator, British Columbia
- Richard Kadulski, Architect, Vancouver
- Wilma Leung, Wisa Homes, Vancouver
- Jackie Jenish, Jenish House Designs, Vancouver
- Doris Penner, Quiniscoe Homes, British Columbia

Contributors to the UK DTS review include the Building Research Establishment, UK.

Contributors to the USA DTS review include Pulte Homes and acknowledgements are particularly due to Mike Walker, Vice President of Pulte Homes Sources consulted during the US review work are included in the References and Bibliography.

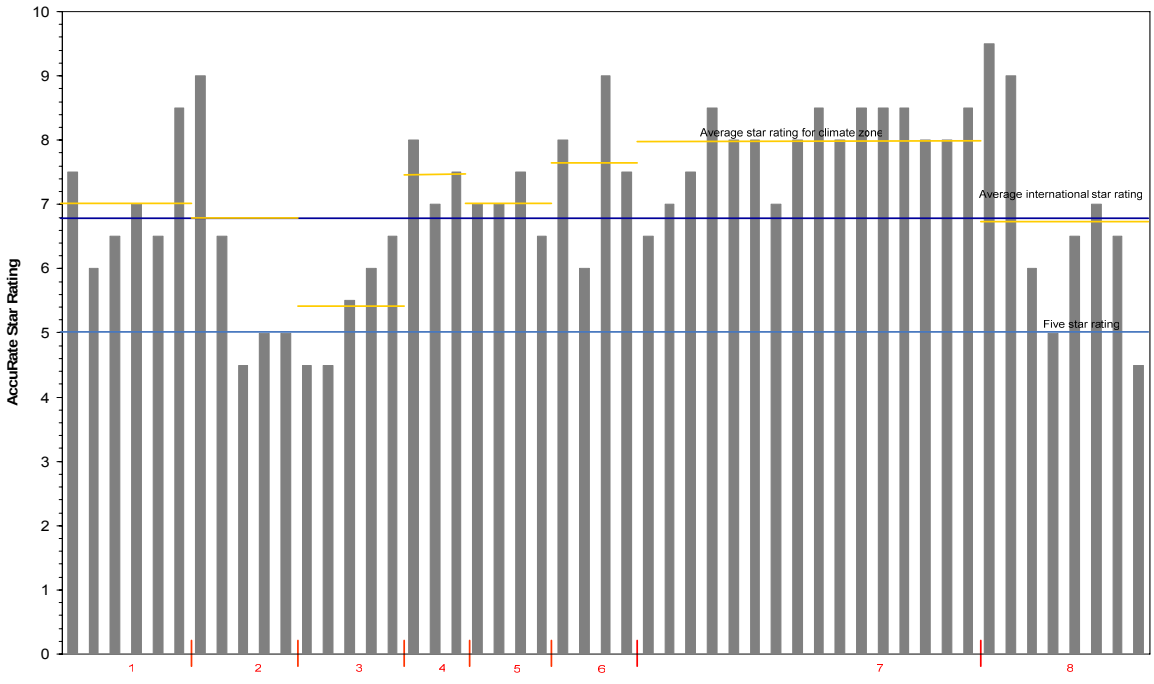
Executive Summary

The background to this study is the proposed changes to the Building Codes of Australia energy efficiency provisions. Specifically, these include the proposed 5-star Australian standard (BCA Verification Method V2.6.2.1) and enhancement of the DTS provisions (refer BCA Part 3.12). The aims of this study are two-fold:

- Test the relative stringency of the proposed 5-star Australian standard (BCA Verification Method V2.6.2.1) against housing performance in comparative countries, and;
- Compare the enhanced DTS provisions (refer BCA Part 3.12) with comparative countries.

In addressing these aims, the eight different Australian climate zones described in the BCA have been matched to overseas locations. For each location, a selection of standard house designs which meet host country equivalent DTS provisions has been obtained and rated using the latest version of AccuRate rating software to model its heating and cooling load requirements and provide a comparable 'star rating' of performance. Data has also been collected on the performance levels of materials and building components required under the enhanced Australian DTS provisions (refer BCA Part 3.12), as well as for equivalent provisions in Building Codes pertaining to the overseas locations.

The Graph below and Table overleaf show the performance of the houses rated for this study, by equivalent Australian climate zone and overall.



Summary Analysis of AccuRate Results.
Note: A full size version is contained within section 4 of the main report)

Australian equivalent climate zone	Comparison location	Total number of plans rated	AccuRate stars Range	AccuRate stars median	**AccuRate stars Mean**
Zone 1 Darwin	Florida	6	6-8.5	6.5-7	**7**
Zone 2 Brisbane	Texas	5	4.5-9	5	**6**
Zone 3 Longreach	N. Carolina	5	4.5-6.5	5.5	**5.4**
Zone 4 Dubbo	Arizona	4	6.5-7.5	7	**7**
Zone 5 Perth	California (Bakersfield)	3	7-8	7.5	**7.5**
Zone 6 Melbourne	California (SF Bay)	4	6-9	7.5-8	**7.6**
Zone 7 Hobart	UK: Canada	16	6.5-8.5	8	**7.2**
Zone 8 Thredbo	Pennsylvania: Mass.	8	4.5-9.5	6.5	**6.8**
ALL ZONES	**-**	**51**	**4.5-9.5**	**7.5**	**6.8**

Summary Analysis of AccuRate Results.

The overall median rating is 7.5 stars, and the overall mean rating is 6.8 stars. Therefore, across the 51 overseas ratings undertaken, **the proposed 5-star standard is 1.8-2.5 stars below comparable average international levels of performance.** Within each climate zone, there are variations, although all mean climate zone comparison performance levels are above 5 stars. Generally, apartments and townhouses perform better than detached houses. Overall, the results indicate that **current standards of house designs used in this study are significantly higher than the proposed 5-star standard, and will use significantly less energy than 5-star Australian homes.**

The house designs obtained from the UK and Canada indicate that in these countries, substantial houses are built to relatively very high standards, in compliance with relatively stringent DTS building code requirements. The typical format of lightweight construction on slab seen in housing across the USA is more akin to that of Australia. The question then arises as to why the US houses perform better, despite similar basic structural characteristics.

It is clear from the design ratings that, in general, these buildings are heavily insulated. They do not have sustainable design principles outside of high performance building elements. They are, however, insulated to (on average) R2.5 in the walls, R5.5 in the ceilings, and have double or double low E glazing. One or two houses in Texas have single glazing, but otherwise all are double or double low E glazed. In addition, all the states seem to predominantly use vinyl frames (PVC) and this has a benefit in energy ratings (despite raising questions over other environmental impacts). Typically, from the US designs used in this study and previous experience of the authors in rating Australian house designs, US glass to floor area ratios are significantly lower than those in Australia. Further basic improvements are possible in US houses, especially across the southern states, for example, by incorporating window shading, better cross-flow ventilation and more appropriate window placement.

The main exception across the pattern of DTS requirements is the building control regime in California. This has a long history, and current standards are significantly advanced when compared to the other states, and to Australia. The two climate zones which provide Californian comparisons in this study (Australian zones 5 and 6) show clear differences in the performance results from having more stringent building codes. This

provides a clear conclusion: **More stringent building codes DTS requirements are currently practicable in similar lightweight, large house construction regimes to Australia, and these provide significant environmental benefits in reduced energy demand.**

The current efficiency of Australian homes is well below comparative international standards in terms of energy efficiency and greenhouse gas emissions. Going forward, this can be expected to translate into a brake on the Australian economy in a world of increasing fossil fuel scarcity and rising prices. The adoption of 5 stars as a minimum standard is clearly a step forward for energy efficiency of Australian homes. However, **actual typical house designs in comparison countries use significantly less energy than the proposed 5-star standard. This demonstrates an opportunity for significantly more stringent standards and further reductions in energy demand in the future.**

Contents

1. Introduction

1.1 Background

The incorporation of a national 5-star standard for homes is proposed for implementation in May 2006. Under the proposals, the Building Code of Australia (BCA) minimum energy performance standards for detached and semi-detached dwellings can be met by either complying with the Deemed-to-Satisfy (DTS) Provisions in the BCA (refer Part 3.12), or achieving the required house energy performance rating using an accredited software tool (refer Verification Method V2.6.2.1).

This raises the question of whether the national 5-star standard is an appropriate performance requirement, or whether it is too high or too low. There is currently a great deal of interest both within the residential building industry in Australia and overseas, and within the research community, to see a process of international standardisation of ratings. Hence, this study is timely, as it will help address the following questions:

- What rating would a house designed to local codes overseas get in Australia, given the equivalent climatic zone and correct application of AccuRate?
- How does this equivalent rating vary between different climatic zone and typical house type comparisons?
- In what ways do the BCA DTS provisions in Part 3.12 vary with the equivalent DTS codes overseas?
- How do specific design requirements (double glazing, glazing%, equivalent to R5 insulation, etc.) vary in DTS comparisons?

1.2 Aims and Objectives

The aims of this study are two-fold:

- Test the relative stringency of the proposed 5-star Australian standard (BCA Verification Method V2.6.2.1) against housing performance in comparative countries, and;
- Compare the enhanced DTS provisions (refer BCA Part 3.12) with comparative countries.

In order to achieve these aims, the following objectives need to be met:

- Eight different Australian climate zones are described in the BCA, and each must be matched against an equivalent zone or zones overseas, by developing and applying an appropriate mapping methodology;
- A selection of standard house designs which meet host country equivalent DTS provisions must be obtained;
- Each overseas house design must then be rated using the latest version of Australian rating software to model its heating and cooling load requirements and provide a comparable ‘star rating’ of performance;
- Data must be collected on the performance levels of materials and building components required under the enhanced Australian DTS provisions (refer BCA Part 3.12), as well as for equivalent provisions in Building Codes pertaining to the rated overseas standard house designs;
- Analysis of this data can then be undertaken, and cross-referenced to the rated performance in order to establish both the international comparisons and potential reasons for any differences.

2. Methods

Three principal research methods have been developed for use in this study. These are introduced in the proceeding subsections.

2.1 Comparative climate zone selection

The following provides a brief summary of how decisions were made in choosing USA, UK and Canadian locations with which to compare data from the 8 Australian Climatic Zones, as identified in the Building Codes of Australian (BCA).

Firstly the 8 climatic zones of Australia were mapped geographically and the archetypical climatic data for this region identified (Figure 1).

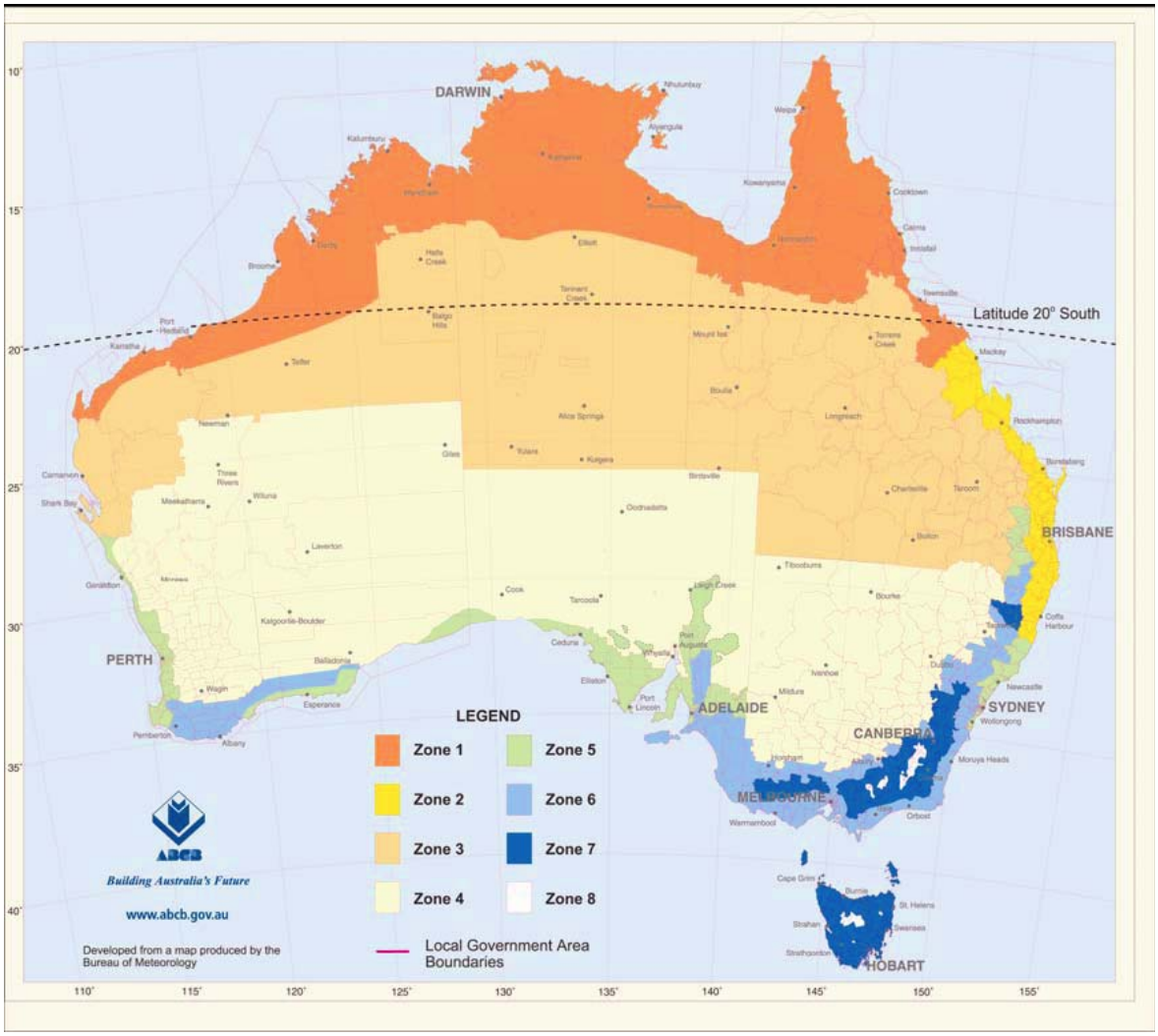


Figure 1. The 8 climatic zones of Australia
Note: Image reproduced courtesy of Australian Building Codes Board.

As a result, eight representative conurbations were chosen and mean meteorological data collected. These were identified as follows:

1. Topical: Hot humid summers, warm winters: Darwin
2. Topical: Warm humid summers, mild winters: Brisbane
3. Topical: Warm humid summers, mild winters: Longreach
4. Temperate: Hot dry summer, cold winter: Dubbo
5. Temperate: Warm summer, cool winter: Perth
6. Cool: Warm summer, cold winter: Melbourne
7. Cool: Mild summer, cold winter: Hobart
8. Cool: Mild summer, alpine winter: Thredbo

It was then necessary to collect comparative climatic data from the USA, UK and Canada. Once collated, this information could be cross-referenced with the relevant Australian climate zone data, to determine from which USA, UK and Canadian locations data needed to be obtained. The next stage is to access building standards and housing plans from each of the locations in order to complete the 'Deemed To Satisfy' provision comparisons and assessments of the Nationwide House Energy Rating Scheme (NatHERS) energy efficiency star rating and heating & cooling energy load (see below).

2.2 Deemed-To-Satisfy Provisions

It should be noted that achieving a level of energy efficiency equivalent to 5 stars is only expressly stated in Verification Method V2.6.2.1 of the proposed provisions. It is not a level of compliance that can be applied to every aspect of the proposed provisions. In this regard, it is important to note that the DTS provisions in Part 3.12 are simply an "enhancement" of the existing DTS provisions and should not be considered to necessarily equate to 5 stars. Notwithstanding, it is important to compare DTS provisions, as a separate exercise to the comparison of house energy ratings using Verification Method V2.6.2.1. This will provide an indication of difference both in approach to DTS and in performance requirements using this compliance option.

The method for comparison of enhanced Australian DTS provisions with overseas requirements is driven by the requirements of the comparison exercise and the nature of the various building codes. The comparison is intended to allow analysis of the stringency of the Australian DTS provisions compared with overseas design requirements. Therefore, a quantitative comparison is required. This requires conversion of performance requirements of building elements in the various codes into similar units, such as R-Values. However, a qualitative comparison is also required, since the various codes are formulated in different ways, and, invariably, there is more than one method allowed in demonstrating that the basic code requirements are met. Hence, the method for the DTS comparisons work involves the following work steps;

- Identification of Australian energy efficiency DTS provisions for each climatic zone;
- Identification of equivalent building code provisions for each comparison location;
- Qualitative description of the comparison location DTS provisions;
- Quantitative comparison of the enhanced BCA DTS provisions with the relevant overseas building regulation requirements in common R-Value terms;
- Analysis of the approach and stringency of the enhanced Australian DTS provisions (refer Part 3.12) compared with overseas DTS requirements.

2.3 5-Star Comparisons

The stringency of the proposed BCA 5-star requirement (Verification Method V2.6.2.1) can be tested by assessing comparative overseas designs of houses, using approved Australian house energy rating software (AccuRate). This study used AccuRate Accredited Regulatory Version dated June 2005, provided by the Australian Greenhouse Office. The software was used in rating mode, which provides some standard settings for heating and cooling requirements, as well as window covering settings.

The comparisons include all 8 BCA climate zones and typical house designs within each. The assessment of six standard residential designs across eight climatic zones requires a minimum of 48 designs to be obtained. The method for rating each design is as follows;

- Check that it does not significantly exceed the minimum codes requirements in the country of origin
- Check that it displays a design response similar to the equivalent Australian climate across all the required climate categories
- Undertake assessment of the nationwide house energy rating scheme energy efficiency star rating and heating and cooling energy load (MJ/m²) using equivalent Australian climate zone and AccuRate rating software.

3. Results

3.1 Selection of Comparative Locations

The climatic zone comparisons work shows that the USA has eight climatic zones, as identified in Figure 2. By comparing this climatic data it was determined that two of the USA's 8 climate zones are not present in Australia. Of the 6 remaining, there was some overlap as identified in Figure 2, where conurbations within zones can be matched with Australia (Figure 3).

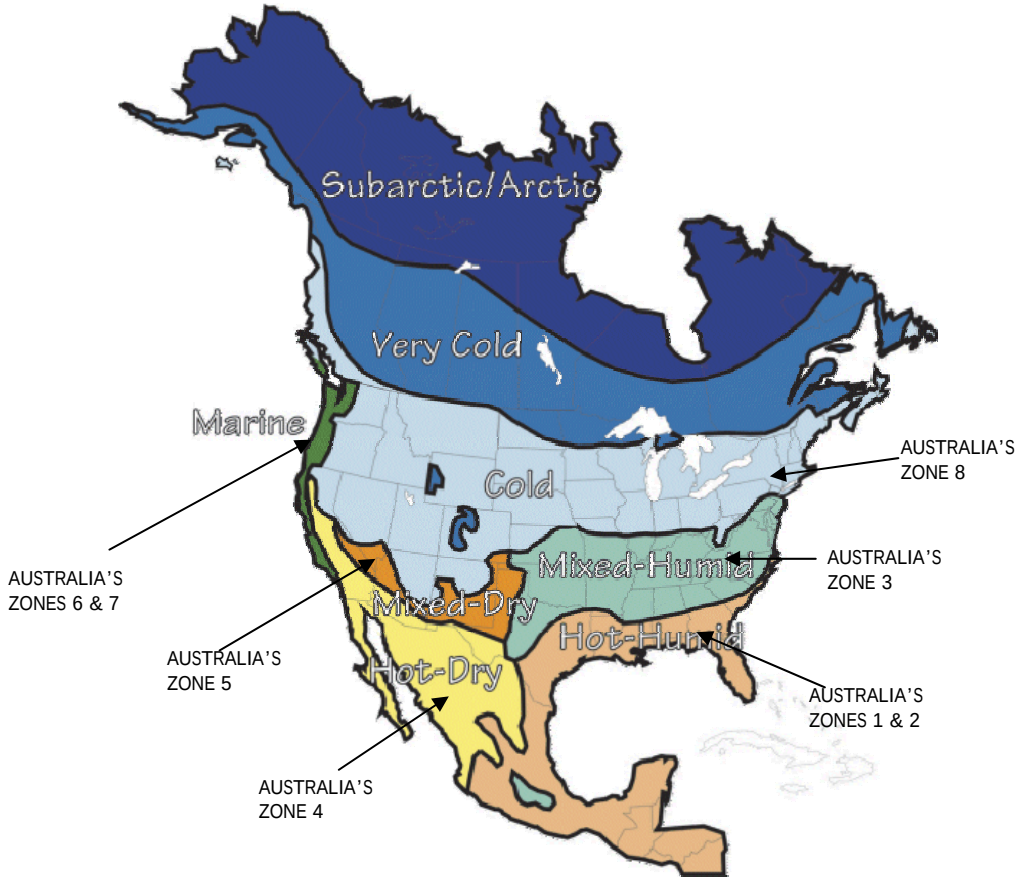


Figure 2: Map of USA Identifying Climate Zones and Nearest Equivalent Australian Zone(s)
Prepared with information taken from http://www.buildingscience.com/housesthatwork/hygro-thermal.htm [accessed 10/05/05]

Using climate data (Tables 1-3), comparisons of Australia with Canada and UK show that the south west of England (Exeter) can be directly compared with climatic zone 7; and Vancouver, Canada can be compared with a combination of Australian climatic zones 6/7/8 due to its warmer summers (comparable with Australian zone 6) but colder winters (comparable with zone 8) and distinctly seasonal precipitation patterns.

Climatic zone and typical locale	Max summer temp deg C	Min summer temp deg C	Max winter temp deg C	Min winter temp deg C
Zone 1 Darwin	31.8	24.8	30.5	19.3
Zone 2 Brisbane	29	20.9	20.7	8.8
Zone 3 Longreach	37.1	23	23.5	6.9
Zone 4 Dubbo	33	17.9	15.2	2.6
Zone 5 Perth	31.6	16.9	17.8	8.1
Zone 6 Melbourne	25.8	14.2	13.4	5.9
Zone 7 Hobart	22.4	11.9	12.4	4
Zone 8 Thredbo	20.9	6.8	5.2	-3.7

Table 1. Temperature in Australian Climatic Zones
Note: Mean Average Values Are Given In Each Case

Climatic zone and typical locale	Summer rainfall mm	Winter rainfall mm	Annual rainfall mm
Zone 1 Darwin	423.3	1.4	1713.9
Zone 2 Brisbane	100.6	31.3	828.1
Zone 3 Longreach	78	19.6	447.2
Zone 4 Dubbo	60.9	44.8	586.5
Zone 5 Perth	8.8	161.9	786.4
Zone 6 Melbourne	48.2	47.9	653.2
Zone 7 Hobart	41.6	45	507.2
Zone 8 Thredbo	106.8	157.8	1786.5

Table 2. Precipitation in Australian Climatic Zones
Note: Mean Average Values Are Given In Each Case
[http://www.bom.gov.au/climate/environ/travel/map.shtml] accessed 9 May 2005

TEMPERATURE	max summer temp deg C	min summer temp deg C	max winter temp deg C	min winter temp deg C
Vancouver	26.17	11.83	7.0	0.22
Exeter	21.0	12.0	8.0	2.0

PRECIPITATION	Summer rainfall mm	Winter rainfall mm	Annual rainfall mm
Vancouver	21.8	145.8	999
Exeter	45	95	950

Table 3. Precipitation and Temperature Data from Comparative Locations in UK and Canada
Note: mean average values are given in each case
Data taken from http://seattle.about.com/library/facts/blvancouver.htm;
http://www.met.rdg.ac.uk/~brugge/ukclimate.html#REngland;
http://www.visitsouthwest.co.uk/international.cfm
http://www.metoffice.com/climate/uk/location/southwestengland/rainfall.html

The results of the climate zone comparison work are summarised in Table 4. This cross-referencing of relevant Australian climate zone data, has been used to determine from which USA, UK and Canadian locations data needs to be obtained. It shows the areas from which US, UK and Canadian house designs and building codes must be drawn for the ratings and DTS work, respectively. Australia's zone 7 is covered by the UK and Vancouver locations, and the US Marine zone is therefore split so that only the zone 6 sector is required.

Country	Climate zone	Australian equivalent	Representative locale
USA	Hot humid	Zones 1 & 2	Florida (zone 1) Texas (zone 2)
	Mixed – humid	Zone 3	Charlotte, North Carolina
	Hot-dry	Zone 4	Phoenix, Arizona
	Mixed dry	Zone 5	Roseville, Bakersfield, CA
	Marine	Zones 6 & 7	Los Angeles, San Francisco Bay, CA (zone 6)
	Cold	Zone 8	Boston, Massachusetts and Pennsylvania
UK	Mild summer, cold winter	Zone 7	Exeter, Devon
CANADA	Mild summer, cold winter	Zone 7	Vancouver, BC

Table 4. USA, UK and Canadian Climates Compared to Australian Zones

3.2 Deemed-to-Satisfy: UK

The UK building regulations are set by three authorities with one authority regulating building works in England and Wales, another for Northern Ireland, and the third for Scotland. There is very little difference between the provisions for compliance between the Building Regulations of England and Wales with that of Scotland, however, at present the Northern Ireland standard have lower provisions than the rest of the UK. The provisions of Northern Ireland are not considered in this report.

In the UK there are three methods of compliance for demonstrating reasonable provision for limiting heat loss through the building fabric of a dwelling. It is required that a dwelling must conform to one of the three methods in order to comply with the building regulations. The three methods of compliance in the standards are called the Elemental Method, the Target U-value Method and the Carbon Index Method.

The Elemental Method of compliance for the Building Regulations of England and Wales (The Stationery Office, 2001), is based upon simple look-up tables within the document that specify the acceptable fuel source and efficiency of the heating system installed in a dwelling and also specifies the maximum allowable U-values that the building elements can achieve. The Elemental Method for the Scottish Building Standards (Scottish Building Standards, 2004) is very similar; however, it imposes no restrictions on the fuel source or efficiency of the heating system to be used, although the U-values are made more demanding if a low efficient boiler is used. Due to the simplicity of the Elemental Method, small developers and builders often opt to comply via this option.

The Target U-value Method involves calculating the heat loss from a dwelling by considering the U-values and areas of the building elements and comparing this value to the heat loss from a notional building of the same size and shape of the actual dwelling but including the effects from the heating system and solar gains. This method is often adopted by large volume developers as the Target U-value Method allows for trading off between the U-values, areas of glazing and the efficiency of the heating system.

The Carbon Index Method of compliance requires an energy balance calculation to be carried out on the whole dwelling. The calculation procedure for this is known as a SAP calculation (Standard Assessment Procedure) which allows a Carbon Index Rating for the dwelling to be identified. The Carbon Index Rating can vary between 0.0 and 10.0 where 0.0 corresponds to a dwelling that produces a large amount of CO_2 and 10.0 corresponds to a dwelling that produces very little CO_2. For a dwelling to comply via the Carbon Index

Method it must achieve a Carbon Index Rating of 8.0 or higher. This method of compliance allows for a much wider variation in the design of the dwelling but in practice it is very rarely used.

The typical constructions of walls in the UK are either cavity walls with partial fill or full fill insulation or timber frame. Roofs are typically pitched with insulation at ceiling level (100 mm of insulation between the joists and 150 mm over the joists) and ground floors are typically of a solid construction with 100 mm of expanded polystyrene or an equivalent insulating material, although concrete (beam/ block) suspended floors are also fairly common.

3.2.1 Summary of requirements of Part L1

There are three methods of compliance for demonstrating reasonable provision for limiting heat loss through the building fabric of a dwelling for both the Building Regulations of England and Wales and the Building Regulations of Scotland. In both regulations it is a requirement that a dwelling must comply with one of the three methods and also satisfy guidance for limiting thermal bridging and air leakage of a dwelling. Other provisions that must be met involve heating controls, hot water systems and lighting.

The three methods of compliance are the Elemental Method, Target U-value Method and the Carbon Index Method which are summarised below. The requirements for limiting thermal bridging and air leakage of a dwelling and the provisions for heating controls, hot water systems and lighting are also summarised below.

The Elemental Method of compliance is based upon look up tables within the Part L1 document for maximum allowable element U-values that a dwelling can have and acceptable heating systems that can be installed. Although there is no scope for trading off the performance of the building elements or heating system via this method it is the preferred method of compliance amongst small developers and builders due to its simplicity. The Elemental Method can be used for assessing the compliance of dwelling extensions, alterations and new builds. In the case of a block of apartments the whole building is assessed rather than each separate dwelling.

The first requirement of the Elemental method is that the heating system installed in the dwelling must be based on either a gas or oil system with a certain degree of efficiency. The allowable heating systems are summarised below:

The heating system used in the dwelling must be based on either a gas or oil boiler with:

1. a SEDBUK rating of at least 78% for mains natural gas, 80% for LPG and 85% for oil.
2. a heat pump
3. community heating with CHP
4. biogas or biogas fuel

The Elemental Method also requires that the U-values of the construction elements cannot exceed a certain U-value and also that the total areas of windows, doors and roof lights must not be greater than 25% of the total floor area. A summary of the maximum allowable U-values for each building element are given in the Table 5.

Exposed element	U-value (W/m²K)
Pitched roof with insulation between the rafters	0.20
Pitched roof with integral insulation	0.25
Pitched roof with insulation between the joists	0.16
Flat roof	0.25
Walls, including basement walls	0.35 (England and Wales only)
Floors, including ground floors and basement floors	0.25
Windows doors and rooflights (area weighted average) glazing in metal frames	2.20
Windows doors and rooflights (area weighted average) glazing in wood or PVC frames	2.00

Table 5. English Standard Elemental U-values

The requirements for a dwelling to comply with the Elemental Method of the Scottish Building Standards are very similar to that of the Building Regulations for England and Wales. There are, however, some key differences which are given below:

1. There are no restrictions applied to the type of heating system that can be used in a dwelling or its SEDBUK rating (e.g. electrical heating or a gas boiler with a SEDBUK rating of less than 78% can be used).
2. The maximum allowable U-values of the exposed building elements is determined by the efficiency of the heating system or boiler used in the dwelling. The method requires that dwellings with low efficiency boilers, electric heating and solid heating systems must achieve lower U-values to compensate for the increase in energy consumption.
3. The maximum allowable wall U-value is 0.3 W/m²K as in Scotland the climate is slightly more severe.

The Target U-value Method of compliance requires a basic heat loss calculation of the whole dwelling to be calculated based on the areas and U-values of the building elements and the type of heating system installed. The Target U-value method can also take into account any solar gains that the building will attain. This method of compliance, within certain limits allows for a greater flexibility in the design of the dwelling by trading off the performance of the heating system, the U-values of the building elements and the areas of windows, doors and rooflights against each other. The Target U-value Method is mostly used by large volume developers who are attracted by the opportunity to trade off building elements against each other. The Target U-value is only applicable to complete dwellings. A summary of the Target U-value Method is given below.

The Target U-value Method involves calculating the average U-value of the dwelling (from the building element U-values and areas) and comparing this value to the calculated Target U-value based on the efficiency of the heating system installed and, if required, any solar gains that the dwelling will attain. For a dwelling to comply via this method, the calculated average U-value of the dwelling must not exceed the adjusted Target U-value. The Target U-value of a dwelling is calculated as follows:

$$U_T = \left[0.35 - 0.19\left(\frac{A_R}{A_T}\right) - 0.10\left(\frac{A_{GF}}{A_T}\right) + 0.413\left(\frac{A_F}{A_T}\right) \right]$$

Where:

U_T is the target U-value prior to any adjustments for heating system performance or solar gain

A_R is the exposed roof area

A_{GF} is the ground floor area

A_F is the total floor area (all storeys)

A_T is the total area of exposed elements of the dwelling (including the ground floor).

The above calculated Target U-value (U_T) is then adjusted to allow for the efficiency of the heating system that is to be used in the dwelling.

The U_T value is adjusted for the heating system as follows:

1. If the proposed SEDBUK rating of the boiler is equal to the reference SEDBUK ratings (78% for mains natural gas, 80% for LPG and 85% for oil), then there is no adjustment to the U_T value. If the proposed SEDBUK rating is better or worse than the reference rating then the U_T value is tightened or eased by multiplying the calculated U_T value by a factor f_e, where f_e is:

$$f_e = \frac{\text{Proposed boiler SEDBUK (\%)}}{\text{Reference boiler SEDBUK (\%)}}$$

2. If the dwelling is to be heated by a system other than gas or oil (e.g. electrical heating), or if the system is undecided then the Target U-value is made more demanding by dividing the U_T value by a factor of 1.15 to compensate for higher carbon emissions.

If the dwelling fails to comply with the requirements of the Target U-value (i.e. the average U-value of the dwelling exceeds the Target U-value) after the provisions for the heating system have been included, then the Target U-value can be increased by allowing for the solar gains that the dwelling may achieve. The optional allowance for solar gains are as follows:

1. For dwellings whose windows have metal frames the Target U-value can be increased by multiplying by a factor of 1.03 to take account of the additional solar gain due to the greater glazed area.

2. For dwellings where the area of glazed openings on the South elevations are greater than the North, the benefit of solar heat gains can be taken into account by adding ΔS to the Target U-value, where ΔS is equal to:

$$\Delta S = 0.04 \times \left[\frac{(A_S - A_N)}{A_{TG}} \right]$$

Where

A_S= Area of glazed openings facing South

A_N= Area of glazed openings facing North

A_{TG}= Total area of glazed openings in the building

If adjustments are being made to the Target U-value for the heating system or window type (i.e. metal frames) as well as for solar gains, the adjustment for solar gains is applied last.

The requirements for compliance via the Target U-value Method for the Scottish Building Standards is very similar to the requirements for England and Wales with the only variation being that the Target U-value equation is dependant on the roof type used on the dwelling. For example

a. Pitched roof with insulation between ceiling ties or collars

$$U_T = 0.3 - 0.14\left(\frac{A_R}{A_T}\right) - 0.05\left(\frac{A_{GF}}{A_T}\right) + 0.425\left(\frac{A_F}{A_T}\right)$$

b. Pitched roof with insulation between rafters

$$U_T = 0.3 - 0.1\left(\frac{A_R}{A_T}\right) - 0.05\left(\frac{A_{GF}}{A_T}\right) + 0.425\left(\frac{A_F}{A_T}\right)$$

c. Flat roof or roof with integral insulation

$$U_T = 0.3 - 0.05\left(\frac{A_R}{A_T}\right) - 0.05\left(\frac{A_{GF}}{A_T}\right) + 0.425\left(\frac{A_F}{A_T}\right)$$

Where:

U_T is the Target U-value prior to any adjustment for heating system performance or solar gain

A_R is the roof area

A_{GF} is the exposed floor area

A_F is the total floor area

A_T is the total area of exposed building elements

Compliance via the Carbon Index Method requires a SAP (Standard Assessment Procedure) calculation to be carried out on the proposed dwelling. A SAP calculation is a steady state energy calculation which takes into account the dimensions, ventilation rates, orientation, heating system and the U-values of a dwelling. The SAP calculation also incorporates energy used for space and water heating requirements, heat gains from electrical appliances and fuel and water costs to provide a SAP rating which ranges from 1 to 120 with 1 being the lowest standard of energy efficiency and 120 being the highest standard. From the SAP calculation a Carbon Index value is calculated which is based on the CO_2 emissions associated with space and water heating. The Carbon Index Rating is calculated with respect to the floor area of the dwelling and is thus independent of the dwelling size.

The Carbon Index value calculated from the SAP calculation ranges between 0.0 and 10.0 with the higher the number the better the performance. For a dwelling to comply with Part L1 via this method the Carbon Index value must not be less than 8.0.

The aim of this method of compliance is to allow for a higher degree of flexibility in the design of new dwellings while maintaining a similar overall energy performance to that obtained via the Elemental Method (The Stationery Office, 2001b). The Carbon Index Method of compliance is very rarely used as it is quite difficult to achieve a Carbon Index value greater than 8. In the case of a block of apartments the Carbon Index Method must be applied to each individual apartment.

There is no variation or difference in the method for compliance with the Carbon Index Method between the Scottish Building Standards and the Building Regulations of England and Wales.

3.2.2 Thermal bridging, air leakage, heating and lighting

To limit the effects of thermal bridging at junctions and around openings and also to limit air leakage, designers and architects are advised to adopt the recommendations given in the robust construction details, which give examples of design details and constructional practices that can deliver the required performances.
To control heating within dwellings, room thermostats or thermostatic radiator valves should be fitted in heated rooms with the ability to switch the boiler in gas or oil fired central heating systems on or off depending on whether heat is required. Timing devises should also be provided to control when heating systems operate. In order to reduce heat loss from heating systems, hot water pipes and air heating ducts outside the building insulation layer(s) must be insulated with 35 mm of polyurethane pipe insulation.
Internal lighting in dwellings should be located where it can be expected to have the most use and fixed internal lights must also be fitted with sockets that only take lamps having a luminous efficiency greater than 40 lumens per circuit-watt. External lighting must either have sockets that can only be used with lamps having an efficiency greater than 40 lumens per circuit-watt or lighting systems that automatically extinguish when not required at night and also when there is enough daylight.

3.2.3 Typical new build house designs in the UK

A major UK volume house builder has provided information on the constructions of typical UK house designs, and this has been supplemented here with general local knowledge of typical new build wall constructions in the UK.

The information supplied by the volume house builder consisted of three semi-detached house designs, four detached houses designs and two terraced designs. From the designs supplied it was found that the constructions of the building elements and the type of heating systems installed were the same for each house design. It is likely that the method of compliance for these dwellings was via the Target U-value Method. The constructions of the exposed elements and heating system of the dwellings are provided in Table 5, while other typical wall constructions of newly built dwellings in the UK are provided in Table 6.

The typical insulation thicknesses of pitched roofs in the UK is often 250 mm of mineral wool insulation with 100 mm of mineral wool between the joists and 150 mm over the joists, while ground floors typically have 100 mm of expanded polystyrene or an equivalent insulating material. The typical constructions of walls in the UK are either cavity walls with partial fill or full fill insulation or timber frame. Roofs are typically pitched with insulation at ceiling level (100 mm of insulation between the joists and 150 mm over the joists) and ground floors are typically of a solid construction with 100 mm of expanded polystyrene or an equivalent insulating material, although concrete (beam/ block) suspended floors are also fairly common.

External cavity wall:	102 mm Facing Brick
	50 mm Clear unventilated cavity
	25 mm Kingspan TW 50 insulation board
	100 mm Celcon insulating blocks (2.8 N/mm² upper floors, 7 N/mm² for ground floors)
	12.5 mm Plasterboard on dabs
	5 mm Skim finish
	U-value= 0.44 W/m²K
Pitched Roof:	Concrete roof tiles
	50 mm × 25 mm timber battens
	1F felt
	Trussed rafters
	Glasswool quilt (100 mm over ceiling rafters and 100 mm between)
	15 mm Plasterboard
	Skim finish
	U-value= 0.20 W/m²K
In-situ suspended ground floor slab:	Power floated finish (150 mm concrete slab)
	1200 gauge DPM (turned up at edges)
	75 mm high compression EPS
	Blinding
	U-value= 0.27 W/m²K (for a perimeter to area ratio of 0.45)
Windows:	PVCu frame and Pilkington k low emissivity glass
	U-value= 2.0 W/m²K
Doors:	Insulated metal in timber sub frames
	U-value= 2.0 W/m²K
Heating system:	Gas condensing boiler
	SEDBUK rating= 78%

Table 5. UK example of exposed elements and heating system from a volume housebuilder

Full fill cavity wall:	13 mm render
	102 mm brick
	70 mm blow fill fibre insulation
	100 mm lightweight concrete blocks
	Plasterboard on Dabs
	U-value= 0.36 W/m²K
Timber frame cavity wall:	102 mm brick
	54 mm ventilated cavity
	9 mm plywood
	140 mm mineral wool between timber frame
	12.5 mm plasterboard
	U-value= 0.30 W/m²K

Table 6. Typical wall constructions of newly built dwellings in the UK

In conclusion, within the UK building regulations there are three methods of compliance for demonstrating reasonable provision for limiting heat loss through the building fabric of a dwelling. The Elemental Method of compliance for the Building Regulations of England and Wales is based upon look up-tables within the document that specify the acceptable fuel source and efficiency of the heating system installed in a dwelling and also specifies the maximum allowable U-values that the building elements can achieve. The Elemental Method for the Scottish Building Standards is very similar, however, it imposes no restriction on the fuel source or efficiency of the heating system to be used, although the U-values are made more demanding if a low efficient boiler is used. Due to the simplicity

of the Elemental Method, small developers and builders often opt to comply via this option.

The Target U-value Method of compliance involves comparing the heat loss from the notional building with that of the actual building by considering the areas and U-values of the building elements as well as the energy performance of the heating system and solar gains. This method is often adopted by large volume developers as the Target U-value Method allows for trading off between the U-values, areas of glazing and the efficiency of the heating system.

The Carbon Index Method of compliance is seldom used. It requires an energy balance calculation to be carried out on the whole dwelling. The calculation procedure for this is known as a SAP calculation (Standard Assessment Procedure) which allows a Carbon Index Rating for the dwelling to be identified. The Carbon Index Rating can vary between 0.0 and 10.0 where 0.0 corresponds to a dwelling that produces a large amount of CO_2 and 10.0 corresponds to a dwelling that produces very little CO_2. For a dwelling to comply via the Carbon Index Method it must achieve a Carbon Index Rating of 8.0 or higher. This method of compliance allows for a much wider variation in the design of the dwelling although it is very rarely used.

3.3 Deemed-to-Satisfy: Canada

Buildings in Canada are regulated by a variety of codes, standards, bylaws, regulations and acts which can vary from province to province and from municipality to municipality. Under Canadian law, the regulation of building construction is the responsibility of provincial governments, who in turn can delegate this power to their municipalities. The federal government, however, can also become involved in building regulations in a secondary role when an act requires that buildings be built to certain standards in order to qualify for the provisions of the Act. Regulations under such an act take precedence over provincial acts, although provincial requirements can still apply if they are not in conflict.

Code requirements often reference other codes and standards since it is not practical to include everything – such as Fire Code and Plumbing Code- in the same code. The Canadian National Building Code (NBC) references over 190 different codes and standards published by seven different standards writing agencies. (The terms ‘codes’ and ‘standards’ are commonly used interchangeable). An updated version of the NBC will be released in the last quarter of 2005.

3.3.1 Building Codes

Prior to the 1970’s, provinces generally delegated the responsibility of regulating buildings to municipalities. During the last decade, however, provincial codes began to replace municipal building bylaws. Most provinces now have acts to regulate building construction, and the regulations under these acts are based in whole or in part on the National Building Code. In provinces without provincial building regulations, the NBC is usually the basis for municipal building bylaws either by choice of the municipality or as a condition under a provincial act.

Building codes in Canada are increasingly being used to achieve objectives beyond the traditional concerns of health and safety. Some provincial building codes contain requirements related to energy conservation, although these have not been included in the National Building Code. Instead model energy conservation requirements have been issued under separate cover. For example, in Quebec, a separate act regulates energy conservation in buildings and the regulations under the act are based on these model requirements.

3.3.2 Residential Standards

The Residential Standards is used as the minimum standard for housing constructed under the National Housing Act. The Canada Mortgage and Housing Corporation (CMHC), who administers the Act, uses the Standards to help achieve its objective of improved housing.

Each province also maintains 'housing corporations' to administer provincial housing programs and provide input into joint federal-provincial programs. They may also own and administer public housing constructed to fill particular provincial objectives. Provincial housing corporations may have additional construction requirements aimed at providing greater durability or lower maintenance and operating costs. Municipalities may also have their own housing maintenance bylaws that apply to existing residential buildings.

3.3.3 Canadian Agencies involved in Codes and Standards

The National Research Council of Canada (NRCC), through its Associate Committee on the National Building Code, is responsible for producing the National Building Code, the Measures for Energy Conservation in New Buildings, the Residential Standards and other code-related documents. The NRCC is a federally funded research agency. It does not operate a general standards writing organization, nor does it provide a certification and listing service for building products.

The Canadian Standards Association (CSA) produces most of the codes and standards referenced in the National Building Code. CSA is a non-profit, non-government agency that not only prepares standards but maintains a testing, certifying and listing service for various products. The Underwriters' Laboratory of Canada (ULC) is also a non-profit, non-government standards writing agency providing a testing, certification and listing service. ULC standards generally apply to products or systems related to fire safety.

3.3.4 Voluntary energy efficiency programs in the housing construction

Besides the Canadian Building Code, provincial and municipal building codes, Canada has taken steps to further improve the quality and energy efficiency of homes through the introduction of the R-2000 program in the late seventies and the more recent EnerGuide for Houses program. Both programs are based on a voluntary participation from the Canadian construction industry and consumers and were developed by Natural Resources Canada (NRC), a federal agency.
While the R-2000 program was developed following the oil crisis from the early seventies, the EnerGuide program is part of Canada's commitment to the Kyoto agreement. The R-2000 standard is a voluntary national standard that is in addition to and beyond building code requirements. It sets out the criteria a new home must meet in order to be eligible for R-2000 certification. The technical requirements involve three main areas of construction: energy performance, indoor air quality and environmental responsibility.

The R-2000 standard is a performance based standard. It sets criteria for how a house must perform rather than specify exactly how it must be constructed. The builder is free to choose the best and most cost-effective approach for each home- construction techniques, building products, mechanical equipment, lighting and appliances. One of the most important aspects is the energy target for space and water heating. The target is calculated for each house, taking in consideration size, fuel type, lot orientation and location (to account for climate variations across Canada). Typically R-2000 homes will use 30% less energy than a comparable non R-2000 home.

In order to achieve these energy savings, every R-2000 home is designed and built to reduce heat loss and air leakage. Extra insulation, energy efficient windows and doors, and careful air-sealing are standard features. A blowerdoor is used to measure the air-tightness of the building envelope to ensure that air leakage does not exceed the rate set out in the R-2000 standard. This test is part of the mandatory R-2000 quality assurance process for every R-2000 home.

The mechanical systems for heating, cooling and ventilation are chosen for efficiency and performance. Natural gas, oil, or electric systems are all permitted under the standard which also allows for advanced systems such as integrated space and hot water heating systems, heat pumps or solar-assisted systems. R-2000 construction always includes controlled ventilation to maintain good indoor air quality.

Every R-2000 home must have a mechanical ventilation system to bring fresh air in from the outside and exhaust stale air to the outside. Most R-2000 builders use a heat recovery ventilator, or HRV, to provide continuous balanced ventilation. In winter, HRVs use the heat from the outgoing air to preheat the incoming air, in summer, this process is reversed. To further protect the indoor air quality, R-2000 builders use building products specifically aimed at reducing chemicals, dust and other indoor air pollutants. This includes products such as low chemical paints, varnishes and floor finishes, low emission cabinetry or the use of hardwood floors.

The R-2000 standard recognizes the importance of resource conservation both during the construction of the home and later during the ongoing operation of the home. R-2000 homes use only water saving toilets, showers and taps. Builders are also required to use materials with recycled content. R-2000 is updated periodically to reflect the ongoing evolution of the construction technology and development of new materials, products and systems. This ensures that it continues to represent the leading edge of housing technology, and that homebuyers will continue to benefit from the latest advances in new home construction.

The Energuide for Houses Program was launched by Natural Resources Canada (NRC) in April 1998. It is primarily targeted at existing housing (less that 3 storeys, less than 600m^2 footprint , residential occupancy). NRC has also developed an EnerGuide for New Housing program. Both programs offer unbiased, third party home energy evaluations by qualified and licensed energy-efficiency advisors in communities across Canada. Advisors use their expertise in combination with NRCan's energy modelling software to prepare a report to help the homeowner plan for energy efficiency renovations. 70% of homeowners who have an EnerGuide evaluation of their homes implement some or all of the recommended energy renovations. The average EnerGuide for Houses recipient reduces energy consumption by about 14%, which represents a reduction of 1.4 tonnes of CO^2 per house, per year.

The most popular retrofits are draught proofing (60%), window and door retrofit or replacement (56%) and insulation (50%), including 24% attic,17% basement and 14% walls. Another benefit of the EnerGuide for Houses evaluations is that homeowners are provided with information about healthy ventilation levels. 70% of new homes (those without properly working heat recovery ventilators) have been shown to be under-ventilated. Since the inception of the program in 1998, almost 200,000 homes across Canada have been evaluated.

3.3.5 Vancouver, British Columbia (Australian Climate Zone 7)

British Columbia has two climate zones: the wet milder coastal region and the drier inland region. The mandatory BC building Code recognizes the need for specific energy efficiency requirements for both zones. The Canadian house plans used in the AccuRate

ratings in this study are intended for the coastal region (Australian Climate zone equivalent 7), and have the following insulation levels and glazing requirements:

- Roof insulation: R40 (RSI 7.0)
- Vaulted ceilings: R28 (RSI 4.9)
- Walls: R20 (RSI 3.5) – In the Vancouver area only, gas heated: min.R14)(RSI2.45)
- Exposed, suspended floors: R28 (RSI 4.9)
- Foundation walls to 24" below grade: R12 (RSI 2.1)
- Concrete slab on grade: R10 (RSI 1.8)
- Heated slab on grade: R12 (RSI 2.1)
- Double glazing is mandatory – but clear glazing is adequate

3.4 Deemed-to-Satisfy: USA

In the USA, there is a national level Model Energy Code. This is supplemented by software which is used to demonstrate compliance with the code. Discussion of these is included below, prior to state-level discussion of DTS requirements.

3.4.1 Model Energy Code

The Model Energy Code is updated annually and republished every three years in a process involving local building code officials, builders, manufacturers, state and federal officials and other stakeholders. Model Energy Code (MEC) requirements apply to the construction of new one- and two-family homes and low-rise (three stories or less) multifamily buildings such as town homes, plus additions to existing buildings.

> *"The Model Energy Code, published by the Council of American Building Officials, is the most commonly used residential building energy code in the United States. Approximately half of the states have adopted it, or a code that is as stringent, if not more so. More than 50 percent of new homes constructed today are required to build to state codes that meet or exceed the Model Energy Code." (National Conference of State Legislators, 1997).*

The MEC establishes minimum thermal performance standards for ceilings, walls, floors and windows. It also sets criteria that restricts air leakage, insulates ducts and pipes, seals ducts, and controls domestic hot water heating systems. Most residential equipment already meets standards set by the National Appliance Energy Conservation Act, which the MEC does not supersede. MEC minimum standards permit tradeoffs among window efficiencies, insulation requirements for ceilings, walls, floors and foundations, and heating and air conditioning equipment, so long as the house meets the minimum energy use requirements. For example, if the prescribed ceiling insulation in a home exceeds the minimum requirements, that excess efficiency can be traded for less floor or wall insulation, within basic boundaries provided by minimum code requirements. and the home will still comply with the code. Also, these minimum building envelope thermal requirements vary according to climate zone, hence, for example, insulation requirements in southern climates are less stringent than in the northern climates.

3.4.2 REScheck

RES*check* is a group of products for demonstrating and verifying compliance with the Model Energy Code. It comprises maps of state climate zones, tables of prescriptive requirements, easy-to-use software, worksheets, and a comprehensive manual. Together, this package is designed to ease the MEC compliance evaluation process, and simplify compliance determinations for building officials, plan checkers and inspectors

RES*check* offers three ways to determine compliance with the Model Energy Code:

- The ***prescriptive approach*** allows builders or designers to select from various combinations of energy conservation measures based on climate zone location. Specifications are provided for insulation levels, glazing levels, glazing U-values (thermal performance), and sometimes heating and cooling equipment efficiency.
- The ***trade-off worksheet approach*** enables users to vary insulation levels in the ceiling, wall, floor, basement wall, slab-edge and crawl space; glazing and door areas; and glazing and door U-values. Based on proposed plans and specifications, the user enters information on a worksheet and calculates a total insulation value. The worksheet can be used to examine the effect of different combinations of insulation levels, window or door products.
- The **RES*check* *software approach*** does the same calculations as the trade-off worksheet but automates the procedure. Trade-offs can be made for heating and air conditioning equipment efficiency, as well as window and insulation efficiencies.

3.4.3 EPA Energy Star®

The U.S. Environmental Protection Agency (EPA) set up the voluntary Energy Star® energy efficiency program in 1995. Energy Star® qualified homes are independently verified to be at least 30% more energy efficient than homes built to the 1993 national Model Energy Code or 15% more efficient than the state energy code, whichever is more rigorous. These savings are based on heating, cooling, and hot water energy use and are typically achieved through a combination of:

- Building envelope upgrades;
- High performance windows;
- Controlled air infiltration;
- Upgraded heating and air conditioning systems;
- Tight duct systems; and
- Upgraded water-heating equipment.

Energy Star® also encourages the use of energy-efficient lighting and appliances, as well as features designed to improve indoor air quality. A number of local communities recognize Energy Star® as a compliance method for their local energy codes. A new updated version of Energy Star® is currently out for review and will be launched in 2006.

3.4.4 Florida (Australian Climate Zone 1)

Florida's residential building energy code is currently based on the International energy conservation code (IECC) 2000. The current Florida Building Code is being reviewed with a view to move Florida to IECC 2003 for residential buildings. The new Florida Building Code 2004 standard will come into effect on October 1st 2005.

There are currently three methods of compliance for single-family residential buildings and multiple-family buildings of three stories or less. These are:

- Method A – Whole Building Performance Method;
- Method B – Component Prescriptive Method; and
- Method C – Limited Applications Prescriptive Method.

In method A, the building as a whole, rather than its component parts, must "meet or exceed" an energy efficiency standard (an energy budget). Florida's Residential *EnergyGauge* software provides for all the calculations and reports required for compliance. Although prescriptive code compliance pathways are available (Methods B and C), they are based on worst-case Method A analyses and less than 10% of applicants choose to use them. Hence, there are few prescriptive standards that the individual

components (walls, windows, floors, doors, etc.) must meet, and substitution low- and high-performance energy components are allowed provided the whole building "meets or exceeds" the overall efficiency standard.

The conceptual approach taken in method A is that of a ‘baseline’ or building component performance target to determine whole building performance. The insulation characteristics (R-value) of the building elements are set to a specific value for the 'baseline' home. This baseline is used to establish an 'energy budget' that the proposed home must meet or exceed. This does not mean that 'baseline' home component performance characteristics constitute a prescriptive requirement for the individual components of a proposed home. Just because the 'baseline' home requires R-11 wall insulation, it does not mean that every proposed home requires R-11 wall insulation. In fact, a proposed home can comply with the energy code with R-0 wall insulation, as long as the building compensates for this low wall insulation value elsewhere in the home's performance.

In 2001, significant changes were made to the code's 'baseline' home that impacted on the required overall efficiency of proposed homes in the 2001 Florida Building Code, effective March 1st, 2002. The 'baseline' home heating system was changed from electric strip resistance with an HSPF (Heating Season Performance Factor) of 3.4 to an electric heat pump with an HSPF of 6.8 for central and south Florida climate zones. Meanwhile, the 'baseline' home is now assumed to have a "leaky" air distribution (duct) system. Previously, it was assumed to be air-tight, and the new system allows homes with air distribution systems that are tested to be "leak free" to gain a substantial credit for their improved duct systems. Furthermore, in the 2001 Florida Building Code, the Solar Heat Gain Coefficient (SHGC) value for the 'baseline' home windows has been reduced from 0.61 to 0.40.

These changes brought the 2001 Florida Building Code into alignment with the 1998 (and 2000) International Energy Conservation Code (IECC), the prevailing federal standard for residential energy codes at that time. The new Florida Building Code standard will bring the state requirements in alignment with the 2003 International Energy Conservation code.

3.4.5 Texas

In Texas, state-wide implementation of the 2000 version of the nationally-recognized building energy code, *The International Energy Conservation Code (IECC),* commenced on September 1st 2001. This was the result of the passing of two bills by the State Legislature. Senate Bill 365 introduced the 2000 International Residential Code [IRC], which is a building code for all residential construction (new and remodelling). The IRC was adopted by Municipalities (incorporated towns only) in the State of Texas on January 1, 2002. At this time Municipalities were also required to adopt the Nation Electrical Code (NEC) for residential building.

Senate Bill 5 introduced the Energy Chapter (11) of the IRC for single-family residential dwellings and the integration of the 2000 International Energy Conservation Code [IECC] into the Texas State IRC. The IECC code became effective for all sectors of construction as of September 1, 2002. Energy Chapter (11) is used if the building’s glazing area does not exceed fifteen percent of the area of the exterior walls for single-family or duplex dwelling and twenty-five percent for townhouses. All applicable requirements of this chapter must be met to meet DTS requirements. In other cases, there are three methodologies which can be used to achieve DTS requirements. The Prescriptive Method is laid out in chapter 6 of the IECC, and provides tables of minimum materials performance within set glazing limits. REScheck Software Analysis is another option, as described in Section 4.2.2 above, and System Analysis (Performance Method) is the most

accurate but complex method. It allows greater design flexibility and is therefore most applicable for non-standard buildings (see IECC, chapter 8).

Austin, Texas (Australian Climate Zone 2)

The City of Austin has adopted the mandatory State energy codes along with local amendments (City of Austin Ordinance 011129-78). There are two main local amendments to the IECC 2000 code; the attic ventilation exception and the vapour barrier ban. Attic ventilation is prohibited if it were to introduce unconditioned air into locations within the thermal envelope (insulation). For example, if the attic insulation is at the rafters instead of the attic floor, the attic shall not be ventilated [Amendment section 502.1.61]. A vapour barrier (permeability rating of less than 1.0) on the warm-in-winter side of framing is not allowed (see below in relation to Central Texas)

The Central Texas energy codes have applied to all single-family housing in Texas since January 2002 and contain key elements of the 2000 International Energy Conservation Code [IECC] and Chapter 11 of the 2000 International Residential Code [IRC]. They apply to the greater central Texas region around Austin. However, for the City of Austin itself, there are relatively few significant differences in the new energy codes from long-standing previous regulations (although it should be noted that in other parts of Texas this is not necessarily the case).

A recent Austin amendment under vapour barrier requirements [IECC 502.1.1], means that vapour barriers (material with a permeability rating of 1.0 or higher) are no longer allowed on the warm-in-winter side of the a wall. In the hot, humid parts of Texas (Climate areas 2B, 3B-C, 4B, 5A-B) outside Austin, vapour barriers on the warm-in-winter side of a wall are not required by code, indeed, they are not recommended. This is because in a hot, humid climate, vapour barriers on the warm-in-winter side cause moisture and mould problems. In cold climates, vapour barriers on the warm-in-winter side prevent moisture problems. Furthermore, Kraft paper-faced insulation batts, are not recommended in the hot, humid climate. Unfaced batts or blown-in insulation are preferred.

A further development is improved requirements to reduce heat-gain through glass. The more descriptive term Solar Heat Gain Coefficient (SHGC) is now used instead of Shading Coefficient (SC). A SHGC of 0.40 is the maximum heat gain through glass now allowed [IECC 502.1.5], whereas the former Austin code allowed a maximum SHGC of 0.455 or a SC of 0.50.

Air conditioning duct sealing, insulating, and air-balancing requirements are also provided [IECC 503.3.3]. R-8 duct insulation is required for ducts outside the thermal envelope, and duct sealing must be in accordance with the Mechanical Code [IMC]. Only lifetime mastic and UL-181A or B tapes are allowed for sealing. Air flow in ducts must be balanced with balancing dampers or other means [IECC 503.3.3.7].

Storage type water heaters with vertical risers must have heat traps on the inlet and outlet of the water heater. Water heaters in Austin must be gas-fired, or if electric, then they must be heat-pump type, solar, or have a heat recovery or heat reclaim system. Cooling equipment must be sized using ACCA Manual J load calculations [IRC M1401.3].

3.4.6 North Carolina (Australian Climate Zone 3)

The 2002 edition of the North Carolina Residential Building Codes requires that homes comply with the North Carolina Energy Code. The 2002 North Carolina Energy Code includes the complete text of the 2000 International Energy Conservation Code, with limited North Carolina amendments.

Hence, the 2002 North Carolina Energy Code is based closely on the national MEC. It provides a prescriptive Table with R-Values for insulation and U-Values for windows provided that a detached home has no more than 15% of its exterior walls made up of windows (25% for town homes). If these limits are exceeded, the applicant is required to show compliance by using prescriptive tables in the Energy Code, or by using REScheck. To verify that the plans are in compliance, applicants must provide the following on their plans:

- Square feet of windows in heated areas of the home (use the nominal window dimensions for this calculation);
- Square feet of exterior walls (use only wall areas enclosing conditioned space);
- Percentage of exterior wall that is window;
- Proposed U-values of windows; and
- Proposed R-values of all insulation.

3.4.7 Arizona (Australian Climate Zone 4)

Arizona is a home rule state, and no mandatory state level energy inspection procedures exist for building construction. However, on a state-wide level, there has been an effort to develop consistent baseline standards and guidelines for potential incentive programs operating in Arizona. The Arizona State energy code is based on the 2000 IECC for low-rise residential construction. The code is voluntary and incentive based.

In addition, a number of communities have adopted local mandatory energy codes or building codes that contain energy chapters, such as the International Residential Code (IRC). For example, the Maricopa Association of Governments (MAG), which serves as the regional agency for the metropolitan Phoenix area, provides regional planning and policy decisions in areas of transportation, air quality, environment analysis, regional development, and social services. MAG has adopted a mandatory system for buildings performance. In addition to compliance methods listed in the IRC and IECC, for any detached one and two-family dwelling, compliance may also be demonstrated by participation in the Energy Star, Engineered for Life, Environments for Living, and other such nationally recognized third party energy programs.

Elsewhere, the City of Tucson has adopted the 2003 International Energy Conservation Code (IECC) and Pima County has adopted the 2000 International Energy Conservation Code (IECC).

3.4.8 California (Australian Climate Zones 5 & 6)

The Californian Energy Efficiency Standards for Residential (and Non-residential) Buildings were established in 1978, in response to a legislative mandate to reduce California's energy consumption. The current standards were adopted by the Californian Building Standards Commission in 2001. The new 2005 California energy code will take effect October 1, 2005, and will supersede the 2001 Standards. It is also worth noting that on May 5th 2004, the California Energy Commission approved a new limited-term Compliance Option for early compliance with the residential lighting standards portion of the 2005 Building Energy Efficiency Standards.

There are two methods for complying with the residential energy standards; Prescriptive Packages (Alternative Component Packages) and Performance Methods (Alternative Calculation Methods). The Prescriptive Packages are the simplest approach in which each individual component of the proposed building must meet a prescribed minimum energy requirement. Software-based Performance Methods provide the most flexibility and accuracy in calculating energy use, since detailed accounting of energy trade-offs between measures is possible. With either compliance path, there are mandatory measures that still must be installed.

The mandatory measures include minimum ceiling, wall, and raised floor insulation, and minimum HVAC (heating, ventilating and air conditioning) and water heating equipment efficiencies. The mandatory measures are required features with either the prescriptive or performance standards. For example, a building may only need R-Value 7 floor insulation to meet the performance standards, but R-Value 19 must be installed, because that is the mandatory minimum. New mandatory requirements in the 2005 codes include the fact that the current method for specifying water piping and cooling system line insulation requirements that is used for non-residential and high-rise residential buildings, will be applied to low-rise residential buildings. The requirements for residential lighting will also be upgraded to include high efficiency lighting equipment or energy savings controls for permanently installed luminaries in all lighting functions, and recessed luminaries in insulated ceilings will need to be airtight.

Two prescriptive packages are designated for each climate zone by the letters C or D. Within any given package, every single feature must be met in order for the building to comply. Both packages C and D require diagnostic testing of air distribution ducts, split system air conditioners and split system heat pumps. Package C has higher insulation levels, but permits electric resistance heat. Package C may only be used in areas where natural gas is not available. Package D requirements form the basis of trade-offs using the performance method. There is also an Alternative to Package D that substitutes high efficiency equipment and high performance glazing (depending on climate zone) for duct sealing, thermostatic expansion values (TXV)s or refrigerant charge and airflow measurement.

With the 2005 changes, area-weighted average U-factors will be allowed to be used to comply with U-factor requirements. The U-factor requirements in Package D will be updated to match the new National Fenestration Rating Council (NFRC) test procedures. Also, area weighted average Solar Heat Gain Coefficients (SHGCs) will be allowed to be used to comply with SHGC requirements for fenestration products other than skylights, and air conditioners and heat pumps will be required to meet new federal appliance standards as specified in the Appliance Efficiency Regulations. Furthermore, water heaters will be required to meet new federal appliance standards as specified in the Appliance Efficiency Regulations. For systems serving individual dwelling units, either a single gas storage type water heater, 50 gallons or smaller, with no recirculation pumps and meeting the mandatory insulation requirements for storage tanks and hot water pipes to the kitchen, or instantaneous gas water heaters will be required. For systems serving multiple dwelling units, a central recirculating water heating system with gas water heaters with timer controls will be required. Hot water pipes from the water heater to the kitchen fixtures that are ¾ inch or greater in diameter with be required to be insulated.

The following compliance documentation (showing that the building complies) is required to be submitted with the prescriptive approach: Certificate of Compliance; Mandatory Measures Checklist; Construction Assembly U-factor (if applicable); Masonry Wall Assembly (if applicable); Field Verification and Diagnostic Testing (if applicable); Solar Heat Gain Coefficient Worksheet (if applicable); and DHW-1 Water Heating Calculations (if applicable).

The greatest flexibility is provided by the software-based performance method. The energy budget is determined from a standard design, which is then altered to achieve minimum compliance. To comply with the Standards, the predicted combined "Energy Use" of the Proposed Design cannot exceed the combined "Energy Budget" of the Standard Design. With 2005 updates, the water heating budget for systems serving multiple dwelling units will be based on a central recirculating water heating system with gas water heaters and timer controls. For systems serving individual dwelling units, a single storage type gas water heater meeting the prescriptive and mandatory standards

will be the basis of the energy budget. The energy budget for systems serving individual dwelling units will also be met by installation of an instantaneous gas water heater. The space conditioning budgets will be changed to be based on the revised prescriptive requirements using an approved calculation method meeting the requirements of the residential Alternative Calculation Method (ACM) approval manual.

The following compliance documentation showing that the building complies is required to be submitted with the performance approach: Certificate of Compliance; Mandatory Measures Checklist; Computer Method Summary; and Construction Assembly U-factor (if applicable).

Specific energy use requirements depend partly on climate conditions, which differ throughout the state of California. The Energy Commission has established 16 climate zones across the state, and specific comparisons with the two Australian climate zones 5 and 6 are provided in Table 7. Cities may occasionally straddle two climate zones. In such cases, the exact building location and correct climate zone should be verified before any calculations are performed. If a single building development is split by a climate zone boundary line, it must be designed to the requirements of the climate zone in which 50% or more of the dwelling units are contained.

3.4.9 Massachusetts (Australian Climate Zone 8)

The code provisions for Massachusetts state are contained in the Massachusetts 780 CMR Appendix J *Energy Conservation for New Construction Low-Rise Residential Buildings* (1998). The code is based on the Council of American Building Officials Model Energy Code 1995 (MEC 95). The provisions apply to new residential occupancy buildings and additions to existing residential buildings three stories or less in height. The code regulates building design and construction to achieve required levels of thermal resistance (U-value), air leakage, and space heating and cooling and water heating equipment efficiencies. It also requires that window U-values be determined in accordance with the National Fenestration Rating Council (NRFC) 100 and labelled and certified by the manufacture.

The code also includes a set of generic requirements (found in section J4.0) that address the following specific practices:

- Installation of an approved vapour retarder in frame walls, floors, and ceilings;
- Insulation of exterior walls of basement;
- Insulation of slab-on-grade floors;
- Insulation of floors above crawlspaces;
- Insulation of access openings; and
- Return-air ceiling plenums.

It also establishes requirements to limit air leakage through window and door assemblies; joints, seams, or penetrations in the building envelope; and recessed lighting fixtures. The code also specifies required space heating and cooling load calculation methods, heating and cooling equipment sizing requirements, equipment efficiency performance requirements, and heating and cooling system controls requirements. Additional requirements apply to air distribution system insulation and sealing for forced-air systems and piping insulation for boiler systems.

The code provides flexibility to builders in determining a compliant design. There are five methods for demonstrating energy code compliance, each of which allows many combinations of insulation, window performance, and heating system efficiency. The methods are summarised below:

1. Prescriptive package method
The prescriptive package method specifies required insulation levels, window U-values, and equipment efficiency levels. The requirements vary based on climate, defined by heating degree-days (HDD), and window area (as a % of total wall area).

2. Component performance method
The component performance approach allows the builder to demonstrate compliance using a trade-off approach that takes into account trade-offs among all building envelope components and heating and cooling system efficiencies.

3. REScheck
The RES*check* software approach is the most common approach used.

4. Systems approach
The systems approach requires an annual energy analysis for the proposed building compared to a standard building designed to just meet the code.

5. Design utilising renewable energy sources approach
This approach allows the builder to use the systems approach (no. 4) and to discount a portion of the building's calculated energy use if energy is provided by solar, geothermal, wind, or another renewable energy source.

3.5 Deemed-To-Satisfy Comparisons.

The qualitative descriptions of DTS provisions in the UK, Canada and the US indicate that there are a range of methods by which minimum energy performance can be achieved. Unfortunately, it is not possible to directly compare performance levels by comparing these methods. Therefore, in order to provide a measure of relative stringency of the BCA DTS provisions (refer Part 3.12) against international equivalent DTS provisions, quantitative performance levels for various building elements have been extracted from the relevant codes and converted into common R-value metrics. These are generally extracted from the prescriptive-type method approaches, which are invariably one of the possible methods of compliance under each system. The results of this exercise are presented in Table 7.

Table 7. Quantitative comparisons in housing performance

CLIMATE ZONE 1 (Darwin) – Hot humid summer, water winter Comparison City Orlando Florida USA Florida Building Code 2004 – Chapter 13 Energy Efficiency for Building Construction (takes effect Oct 1, 2005) Climate Zone 5, Method B – Prescriptive Compliance Method			
ELEMENT	COUNTRY	LOCATION IN THE CODE	MINIMUM TOTAL R-VALUE (UNLESS STATED)
ROOF	Australia	Table 3.12.1.1	2.7 Heat flow downwards
	USA – Orlando Florida	Table 6B-1 of Form 600B-04	5.2 (No single assembly ceilings permitted)
EXTERNAL WALL	Australia	Table 3.12.1.3	1.9
	USA – Orlando Florida	Table 6B-1 of Form 600B-04	0.88 Masonry 1.9 Wood frame
SUSPENDED FLOOR	Australia	Table 3.12.1.4	Nil Concrete slab Nil - 1.0 Other Heat flow upwards
	USA – Orlando Florida	Table 6B-1 of Form 600B-04	Nil Slab on grade 1.2 Raised concrete 3.3 Raised timber
CENTRAL HEATING WATER PIPING	Australia	Table 3.12.5.1	0.2 Internal Piping 0.3 Within ventilated wall space/ enclosed bldg subfloor/roof space 0.3 Outside bldg or unenclosed bldg sub-floor or roof space
	USA – Orlando Florida	Table 6B-1 of Form 600B-04	N/A to Method B compliance
HEATING AND COOLING DUCTWORK	Australia	Table 3.12.5.2	1.0– 1.5 External to bldg/under enclosed or suspended floor 0.1– 1.5 Roof Space (varies by insulation location)
	USA – Orlando Florida	Table 6B-1 of Form 600B-04	N/A to Method B compliance
GLAZING	Australia	Table 3.12.2.1 Constants for Conductance and Solar Heat Gain Aggregate conductance factor not directly comparable with u-factors	2.4 Floor w/direct contact to ground Standard or High Ventilation 2.4 Suspended floor Standard or High Ventilation
	USA Orlando, Florida	13-Table 601.1.ABC.1 Method can only be used for dwellings with less than 25% glazed area to conditioned area	1.30 Single pane (clear or tinted) 0.87 Double pane (clear or tinted)
GLAZING (Solar Heat Gain Co-efficient)	Australia Refer to Figure 1.1 for Total U-Value ranges for glazing based on NFRC guidelines	Table 3.12.2.1 Constants for Conductance and Solar Heat Gain Aggregate SHGC factor not directly comparable with SHGC factor	(Solar Heat Gain Co-efficient) 0.09 – 0.12 Floor w/direct contact to ground Standard or High Ventilation 0.07 – 0.09 Suspended floor Standard or High Ventilation
	USA Orlando, Florida	Method can only be used for dwellings with less than 25% glazed area to conditioned area	(Solar Heat Gain Co-efficient) 0.75 Single pane clear 0.64 Single pane tinted 0.66 Double pane clear 0.55 Double pane tinted

CLIMATE ZONE 2 (Brisbane) – Warm humid summer, mild winter Comparison City Austin, Texas USA International Energy Code 2000 Climate Zone 8, Method 1 – Prescriptive Method (only for buildings with less than 15% glazing or 25% for townhouses)			
ELEMENT	COUNTRY	LOCATION IN THE CODE	MINIMUM TOTAL R-VALUE (UNLESS STATED)
ROOF	Australia	Table 3.12.1.1 (see Figure 3.12.1.1 for deemed to satisfy requirements of various roof structures)	2.7 Altitude less than 300M/Heat flow downwards 3.0 Altitude more than 300M/Heat flow downwards & upwards
	USA – Austin Texas	IECC Prescriptive Packages Climate Zone 8	Data not available
EXTERNAL WALL	Australia	Table 3.12.1.3 (see Figure 3.12.1.3 for deemed to satisfy requirements for various wall configurations)	1.9 below 300M altitude 1.9 above 300M altitude
	USA – Austin Texas	IECC Prescriptive Packages Climate Zone 8	1.9 - 2.2 varies based on percentage of glazing in wall (8% to 25%) assumes normal efficiency heating/cooling
SUSPENDED FLOOR	Australia	Table 3.12.1.4	Nil concrete slab Nil - 1.0 other (Heat flow downwards or upwards)
	USA – Austin Texas	IECC Prescriptive Packages Climate Zone 8	1.9 - 2.2 (floors over unconditioned space)
CENTRAL HEATING WATER PIPING	Australia	Table 3.12.5.1	0.2 Internal Piping 0.3 Within ventilated wall space/ enclosed bldg subfloor/roof space 0.3 Outside bldg or unenclosed bldg sub-floor or roof space
	USA – Austin Texas		Data not available
HEATING AND COOLING DUCTWORK	Australia	Table 3.12.5.2	1.0– 1.5 External to bldg/under enclosed or suspended floor 0.1 – 1.5 Roof Space (varies by insulation location)
	USA – Austin Texas		1.4 Ducts in attics/outside buildings 1.0 Ducts in unconditioned space
GLAZING	Australia	Table 3.12.2.1 Constants for Conductance and Solar Heat Gain Aggregate conductance factor not directly comparable with u-factors	2.5 Floor w/direct contact to ground Standard or High Ventilation 2.5 Suspended floor Standard or High Ventilation
	USA Austin Texas	Model National Energy Code Zone 8	0.40 – 0.65 (varies based on glazed area 8-25% assumes normal efficiency heating/cooling
GLAZING (Solar Heat Gain Co-efficient)	Australia Refer to Figure 1.1 for Total U-Value ranges for glazing based on NFRC guidelines	Table 3.12.2.1 Constants for Conductance and Solar Heat Gain Aggregate SHGC factor not directly comparable with SHGC factor	(Solar Heat Gain Co-efficient) 0.15 – 0.23 Floor w/direct contact to ground Standard or High Ventilation 0.11 – 0.17 Suspended floor Standard or High Ventilation
	USA Austin Texas	IECC 502.1.5 Double Pane Glazing	(Solar Heat Gain Co-efficient) 0.40

CLIMATE ZONE 3 (Longreach) – Warm humid summer, mild winter Comparison City Charlotte, North Carolina USA, based International Energy Code 2000 (specific local code not accessible online) Climate Zone 11, Method 1 – Prescriptive Method (only for buildings with less than 15% glazing or 25% for townhouses)			
ELEMENT	COUNTRY	LOCATION IN THE CODE	MINIMUM TOTAL R-VALUE (UNLESS STATED) (*)
ROOF	Australia	Table 3.12.1.1 (see Figure 3.12.1.1 for deemed to satisfy requirements of various roof structures)	2.7 Heat flow downwards & upwards
	USA Charlotte North Carolina	IECC Prescriptive Packages Climate Zone 11 (NC State Energy – pd access only)	5.2 – 8.6 (varies on glazed area of 8-25%)
EXTERNAL WALL	Australia	Table 3.12.1.3 (see Figure 3.12.1.3 for deemed to satisfy requirements for various wall configurations)	1.9
	USA Charlotte North Carolina	IECC Prescriptive Packages Climate Zone 11 (NC State Energy – pd access only)	2.2 – 3.3 (varies on glazed area of 8-25%)
SUSPENDED FLOOR	Australia	Table 3.12.1.4	Nil concrete slab Nil - 1.0 other Heat flow downwards or upwards
	USA Charlotte North Carolina	IECC Prescriptive Packages Climate Zone 11 (NC State Energy – pd access only)	3.3 – 5.2 (varies on glazed area of 8-25%)
CENTRAL HEATING WATER PIPING	Australia	Table 3.12.5.1	0.2 Internal Piping 0.3 Within ventilated wall space/ enclosed bldg subfloor/roof space 0.3 Outside bldg or unenclosed bldg sub-floor or roof space
	USA Charlotte North Carolina	IECC Prescriptive Packages Climate Zone 11 (NC State Energy – pd access only)	Data not available
HEATING AND COOLING DUCTWORK	Australia	Table 3.12.5.2	1.0– 1.5 External to bldg/under enclosed or suspended floor 0.1 – 1.5 Roof Space (varies by insulation location)
	USA Charlotte North Carolina	IECC Prescriptive Packages Climate Zone 11 (NC State Energy – pd access only)	Data not available
GLAZING	Australia	Table 3.12.2.1 Constants for Conductance and Solar Heat Gain Aggregate conductance factor not directly comparable with u-factors	1.6 Floor w/direct contact to ground Standard or High Ventilation 1.6 Suspended floor Standard or High Ventilation
	USA Charlotte North Carolina	IECC Prescriptive Packages Climate Zone 11 (NC State Energy – pd access only)	0.29 – 0.55 (varies based on glazed area 8-25%)
GLAZING (Solar Heat Gain Co-efficient)	Australia Refer to Figure 1.1 for Total U-Value ranges for glazing based on NFRC guidelines	Table 3.12.2.1 Constants for Conductance and Solar Heat Gain. Aggregate SHGC factor not directly comparable with SHGC factor	(Solar Heat Gain Co-efficient) 0.10 – 0.13 Floor w/direct contact to ground Standard or High Ventilation 0.08 – 0.10 Suspended floor Standard or High Ventilation
	USA Charlotte North Carolina		Data not available

CLIMATE ZONE 4 (Dubbo) – Hot dry summer, cold winter Comparison City Phoenix Arizona USA, International Energy Code 2003/amended ICC w/city of Phoenix amendments Climate Zone 3, Method 1 – Prescriptive Method (only for buildings with less than 15% glazing or 25% for townhouses)			
ELEMENT	COUNTRY	LOCATION IN THE CODE	MINIMUM TOTAL R-VALUE (UNLESS STATED) (*)
ROOF	Australia	Table 3.12.1.1 (see Figure 3.12.1.1 for deemed to satisfy requirements of various roof structures)	0.09 Heat flow upwards
	USA – Phoenix Arizona	Zone 3 Single-Family Prescriptive Packages 1998/2000 IECC	0.09 – 5.2 (varies on glazed area of 8-25% and other prescriptive elements) (No state energy code at this time – up to local areas to address – Phoenix Building Code has adopted the 2003 IECC amended 2004 ICC w/Phoenix amendments)
EXTERNAL WALL	Australia	Table 3.12.1.3 (see Figure 3.12.1.3 for deemed to satisfy requirements for various wall configurations)	2.2
	USA – Phoenix Arizona	Zone 3 Single-Family Prescriptive Packages 1998/2000 IECC	1.9 – 2.2 (varies on glazed area of 8-25% and other prescriptive pkg elements)
SUSPENDED FLOOR	Australia	Table 3.12.1.4	1.0 – 2.0 concrete slab 2.0 – 3.0 other Heat flow downwards
	USA – Phoenix Arizona	Zone 3 Single-Family Prescriptive Packages 1998/2000 IECC	Data not available
CENTRAL HEATING WATER PIPING	Australia	Table 3.12.5.1	0.2 Internal Piping 0.45 Within ventilated wall space/ enclosed bldg subfloor/roof space 0.6 Outside bldg or unenclosed bldg sub-floor or roof space
	USA – Phoenix Arizona		Data not available
HEATING AND COOLING DUCTWORK	Australia	Table 3.12.5.2	1.0– 1.5 External to bldg/under enclosed or suspended floor 0.1 – 1.5 Roof Space (varies by insulation location)
	USA – Phoenix Arizona		Data not available
GLAZING	Australia	Table 3.12.2.1 Constants for Conductance and Solar Heat Gain Aggregate conductance factor not directly comparable with u-factors	1.2 Floor w/direct contact to ground Standard or High Ventilation 1.2 Suspended floor Standard or High Ventilation
	USA – Phoenix Arizona	Zone 3 Single-Family Prescriptive Packages 1998/2000 IECC	0.55 – 0.90
GLAZING (Solar Heat Gain Co-efficient)	Australia Refer to Figure 1.1 for Total U-Value ranges for glazing based on NFRC guidelines	Table 3.12.2.1 Constants for Conductance and Solar Heat Gain Aggregate SHGC factor not directly comparable with SHGC factor	(Solar Heat Gain Co-efficient) 0.13 – 0.17 Floor w/direct contact to ground Standard or High Ventilation 0.09 – 0.11 Suspended floor Standard or High Ventilation
	USA – Phoenix Arizona		Data not available

CLIMATE ZONE 5 (Perth) – Warm summer, cool winter Comparison City Bakersfield California USA, California Title 24 Energy Code, Part 6 Climate Zone 13, Method 1 – Prescriptive Package (2005 standards to be in effect as of October 2005)			
ELEMENT	COUNTRY	LOCATION IN THE CODE	MINIMUM TOTAL R-VALUE (UNLESS STATED) (*)
ROOF	Australia	Table 3.12.1.1 (see Figure 3.12.1.1 for deemed to satisfy requirements of various roof structures)	3.2 Heat flow upwards
	USA – Bakersfield California	Table 151-B Alternative Component Package C***	8.6 (Ceiling)
EXTERNAL WALL	Australia	Table 3.12.1.3 (see Figure 3.12.1.3 for deemed to satisfy requirements for various wall configurations)	1.9
	USA – Bakersfield California	Table 151-B Alternative Component Package C***	5.1 Wood framed walls
SUSPENDED FLOOR	Australia	Table 3.12.1.4	Nil concrete slab Nil – 1.0 other Heat flow downwards
	USA – Bakersfield California	Table 151-B Alternative Component Package C***	1.2 slab floor perimeter 5.2 raised floors
CENTRAL HEATING WATER PIPING	Australia	Table 3.12.5.1	0.2 Internal Piping 0.3 Within ventilated wall space/ enclosed bldg subfloor/roof space 0.3 Outside bldg or unenclosed bldg sub-floor or roof space
	USA – Bakersfield California	Table 151-B Alternative Component Package C***	1.4 Duct Insulation
HEATING AND COOLING DUCTWORK	Australia	Table 3.12.5.2	1.0– 1.5 External to bldg/under enclosed or suspended floor 0.1 – 1.5 Roof Space (varies by insulation location)
	USA – Bakersfield California	Table 151-B Alternative Component Package C***	Data not available
GLAZING	Australia	Table 3.12.2.1 Constants for Conductance and Solar Heat Gain Aggregate conductance factor not directly comparable with u-factors	2.2 Floor w/direct contact to ground Standard or High Ventilation 2.2 Suspended floor Standard or High Ventilation
	USA – Bakersfield California	Table 151-B Alternative Component Package C***	0.40 Maximum total area 16% Maximum West facing area 5%
GLAZING (Solar Heat Gain Co-efficient)	Australia	Table 3.12.2.1 Constants for Conductance and Solar Heat Gain Aggregate SHGC factor not directly comparable with SHGC factor	(Solar Heat Gain Co-efficient) 0.17 – 0.26Floor w/direct co tact to ground Standard or High Ventilation 0.13 – 0.19 Suspended floor Standard or High Ventilation
	USA – Bakersfield California		Data not available

CLIMATE ZONE 6 (Melbourne) – Warm summer, cold winter Comparison City San Francisco Bay, California USA, California Title 24 Energy Code, Part 6 Climate Zone 13, Method 1 – Prescriptive Package (2005 standards to be in effect as of October 2005)			
ELEMENT	COUNTRY	LOCATION IN THE CODE	MINIMUM TOTAL R-VALUE (UNLESS STATED)
ROOF	Australia	Table 3.12.1.1 (see Figure 3.12.1.1 for deemed to satisfy requirements of various roof structures)	3.7 Heat flow must be upwards
	USA – San Francisco Bay, California	Table 151 – B Alternative Component Package C***	6.6 (Ceiling)
EXTERNAL WALL	Australia	Table 3.12.1.3 (see Figure 3.12.1.3 for deemed to satisfy requirements for various wall configurations)	2.2
	USA – San Francisco Bay, California	Table 151-B Alternative Component Package C***	4.4 Wood framed walls
SUSPENDED FLOOR	Australia	Table 3.12.1.4	1.0 - 2.0 concrete slab 2.0 - 3.0 other heat flow downwards
	USA – San Francisco Bay, California	Table 151-B Alternative Component Package C***	1.2 slab floor perimeter 5.2 raised floors
CENTRAL HEATING WATER PIPING	Australia	Table 3.12.5.1	0.2 Internal Piping 0.45 Within ventilated wall space/ enclosed bldg subfloor/roof space 0.6 Outside bldg or unenclosed bldg sub-floor or roof space
	USA – San Francisco Bay, California		Data not available
HEATING AND COOLING DUCTWORK	Australia	Table 3.12.5.2	1.0– 1.5 External to bldg/under enclosed or suspended floor 0.1– 1.5 Roof Space (varies by insulation location)
	USA – San Francisco Bay, California	Table 151-B Alternative Component Package C***	1.4 Duct Insulation
GLAZING	Australia	Table 3.12.2.1 Constants for Conductance and Solar Heat Gain Aggregate conductance factor not directly comparable with u-factors	1.4 Floor w/direct contact to ground Standard or High Ventilation 1.1 Suspended floor Standard or High Ventilation
	USA – San Francisco Bay, California	Table 151-B Alternative Component Package C***	0.42 (maximum 14% of total area)
GLAZING (Solar Heat Gain Co-efficient)	Australia	Table 3.12.2.1 Constants for Conductance and Solar Heat Gain Aggregate SHGC factor not directly comparable with SHGC factor	(Solar Heat Gain Co-efficient) 0.19 – 0.31 Floor w/direct contact to ground Standard or High Ventilation 0.19 – 0.31 Suspended floor Standard or High Ventilation
	USA – San Francisco Bay, California		Data not available

CLIMATE ZONE 7 (Hobart) – Mild summer, cold winter Comparison City (2) Vancouver, British Columbia CANADA – British Columbia Building Code – Energy Efficiency Requirements Exeter, Devon UK – Part L1 (Conservation of Fuel and Power) - Elemental Method			
ELEMENT	COUNTRY	LOCATION IN THE CODE	MINIMUM TOTAL R-VALUE (UNLESS STATED)
ROOF	Australia	Table 3.12.1.1 (see Figure 3.12.1.1 for deemed to satisfy requirements of various roof structures)	4.3 Heat flow must be upwards
	Canada – Vancouver, BC		7.0 Roof Insulation ONLY
	UK – Exeter, Devon	Approved Document L1 Table 1 – Elemental Method: U-values for construction elements (pg. 12)	5.0 Pitched roof w/insulation between rafters 4.0 Pitched roof w/ integral insulation 6.25 pitched roof w/insulation between joists 4.0 Flat roof
EXTERNAL WALL	Australia	Table 3.1.12.3 (see Figure 3.12.1.3 for deemed to satisfy requirements for various wall configurations)	2.4
	Canada – Vancouver, BC		3.5 in British Columbia 2.45 Vancouver only, gas heating
	UK – Exeter, Devon	Table 1 – Elemental Method: U-values for construction elements (p.12)	2.857 incl. Basement walls
SUSPENDED FLOOR	Australia	Table 3.12.1.4	1.5 to 2.5 concrete slab 2.5 to 3.5 other heat flow downwards
	Canada – Vancouver, BC		4.9 exposed suspended floors UNSUSPENDED FLOORS 1.8 concrete slab on grade (unsuspended) 2.1 heated concrete slab on grade (unsuspended)
	UK – Exeter, Devon	Table 1 – Elemental Method: U-values for construction elements (pg. 12)	4.0 all floors incl. Ground floors & basement floors
CENTRAL HEATING WATER PIPING	Australia	Table 3.12.5.1	0.2 Internal Piping 0.45 Within ventilated wall space/ enclosed bldg subfloor/roof space 0.6 Outside bldg or unenclosed bldg sub-floor or roof space
	Canada – Vancouver, BC		Data not available
	UK – Exeter, Devon		Data not available
HEATING AND COOLING DUCTWORK	Australia	Table 3.12.5.2	1.0– 1.5 External to bldg/under enclosed or suspended floor 0.1 - 1.5 Roof Space (varies by insulation location)
	Canada – Vancouver, BC		Data not available
	UK – Exeter, Devon		Data not available
GLAZING	Australia	Table 3.12.2.1 Constants for Conductance and Solar Heat Gain Aggregate conductance factor not directly comparable with u-factors	1.4 Floor w/direct contact to ground Standard or High Ventilation 1.1 Suspended floor Standard or High Ventilation
	Canada – Vancouver, BC		Double glazing mandatory
	UK – Exeter, Devon		2.2 Metal frames 2.0 Wood or PVC frames
GLAZING (Solar Heat Gain Co-efficient)	Australia	Table 3.12.2.1 Constants for Conductance and Solar Heat Gain Aggregate SHGC factor not directly comparable with SHGC factor	(Solar Heat Gain Co-efficient) 0.26 – 0.43 Floor w/direct contact to ground Standard or High Ventilation 0.26 – 0.43 Suspended floor Standard or High Ventilation
	Canada – Vancouver, BC		Data not available
	UK – Exeter, Devon		Data not available

CLIMATE ZONE 8 (Thredbo) – Mild summer, alpine winter Comparison City Boston Massachusetts USA Massachusetts 780 CMR Appendix J – Energy Conservation for New Construction Low-Rise Residential Buildings (1998) Prescriptive Envelope Criteria Methodology.			
ELEMENT	COUNTRY	LOCATION IN THE CODE	MINIMUM TOTAL R-VALUE (UNLESS STATED) (*)
ROOF	Australia	Table 3.12.1.1 (see Figure 3.12.1.1 for deemed to satisfy requirements of various roof structures)	4.8 Heat flow upwards
	USA – Boston Massachusetts	780 CMR Appendix J TABLE J5.2.1b	5.2 – 6.6
EXTERNAL WALL	Australia	Table 3.12.1.3 (see Figure 3.12.1.3 for deemed to satisfy requirements for various wall configurations)	3.3
	USA – Boston Massachusetts	780 CMR Appendix J TABLE J5.2.1b	2.2 – 3.3
SUSPENDED FLOOR	Australia	Table 3.12.1.4	2.0 – 3.0 concrete slab 3.0 – 4.0 other Heat flow downwards
	USA – Boston Massachusetts	780 CMR Appendix J TABLE J5.2.1b	3.3 – 4.4 (not clear if suspended floor)
CENTRAL HEATING WATER PIPING	Australia	Table 3.12.5.1	0.2 Internal Piping 0.6 Within ventilated wall space/ enclosed bldg subfloor/roof space 0.6 Outside bldg or unenclosed bldg sub-floor or roof space
	USA – Boston Massachusetts		Data not available
HEATING AND COOLING DUCTWORK (not including evaporate cooling systems)	Australia	Table 3.12.5.2	1.5 External to bldg/under enclosed or suspended floor 0.1 – 1.5 Roof Space (varies by insulation location)
	USA – Boston Massachusetts	780 CMR Appendix J TABLE J5.2.1b	Data not available
GLAZING	Australia	Table 3.12.2.1 Constants for Conductance and Solar Heat Gain Aggregate conductance factor not directly comparable with u-factors	0.7Floor w/direct contact to ground Standard or High Ventilation 0.7 Suspended floor Standard or High Ventilation
	USA – Boston Massachusetts	780 CMR Appendix J TABLE J5.2.1b	0.31 – 0.52 (varies based on glazed area and number of annual heating days)
GLAZING (Solar Heat Gain Co-efficient)	Australia Refer to Figure 1.1 for Total U-Value ranges for glazing based on NFRC guidelines	Table 3.12.2.1 Constants for Conductance and Solar Heat Gain Multiple factor by area of the storey, measured within the closed walls Aggregate SHGC factor not directly comparable with SHGC factor	(Solar Heat Gain Co-efficient) 0.32 – 0.54 Floor w/direct contact to ground Standard or High Ventilation 0.32 – 0.54 Suspended floor Standard or High Ventilation
	USA – Boston Massachusetts		Data not available

Table 7. Quantitative comparisons in housing performance

Note: The effectiveness of insulation is measured by its "R-Value". The higher a material's R-Value, the better it resists the flow of heat, and therefore, the better it insulates the building. For example, R-19 insulation retains heat better than R-11 insulation. Generally by Australian Definition Total R-Value is achieved by adding R-value of basic element, roof ceiling, walls, floor, and R-value of any additional insulation incorporated into the element. R-values entered for UK, are based on data for "Elemental Method" of compliance. Two alternative methods of compliance are Target U-Value Method or Carbon Index Method. For Elemental Method the heating must be by gas or oil boiler, heat pump, community heating with CHP, biogas or biomass fuel.

3.6 BCA 5-Star Provisions Results

With reference to the proposed BCA 5-star Provisions (refer Verification Method V2.6.2.1), a total of 51 house energy ratings have been undertaken of comparison country house plans, as described in Section 2. The full set of AccuRate result sheets is contained within Appendix A. The plans used to undertake the ratings are summarised in Table 8, as are the results.

	Equivalent Australian Climate zone	House	AccuRate star rating	Heating	Cooling (sensible)	Cooling (Latent)	Total Energy
				MJ/m^2.annum			
Florida	1	Baypointe Spring Isle	7.5	0	253.8	132.1	385.9
		Davenport	6	0	315.2	128.7	443.9
		Desoto	6.5	0	289.4	130.6	420
		Destin	7	0	295.3	123.7	419
		Devonshire	6.5	0	325.3	112.5	437.8
		Ventura Springs	8.5	0	171	114.1	285.1
Texas	2	Cypress, Grayson Park 2038	9	0	34.5	17.2	51.9
		Rancho Verde 3179	6.5	0.8	47.2	22.1	70.1
		Rancho Verde 4229	4.5	4.2	53.1	20.7	78
		Riata 4331	5	6.7	51.8	18.8	77.3
		Riata 3253	5	1.5	45	29.2	75.7
North Carolina	3	Amber	4.5	0.7	135.1	24.2	160
		Bayview	4.5	1.3	141.6	15.8	158.7
		Birch	5.5	0.1	133.8	17.8	151.7
		Danville	6	3.1	103.8	15.2	122.2
		Mendenhall	6.5	0.6	94.1	16.4	111
California (Bakersfield)	4	Canyon Ranch 1	8	28.5	41	5.6	75.2
		Canyon Ranch 3	7	35.9	60.1	5.8	101.8
		Canyon Ranch 4	7.5	32.03	47.8	6.5	86.7
Arizona	5	Merrill Ranch 4536	7	4.7	40.9	8	53.6
		Merrill Ranch 4540	7	4	42.4	7.7	54.1
		Stetson II 4010	7.5	14.6	42.1	8	64.8
		Stetson II 4011	6.5	6.7	55.8	7.2	69.6
California (San Fransico Bay Area)	6	Danbury Place	8	31.7	19.6	4.1	55.4
		Devon Square	6	21.6	23.5	8.5	53.5
		Rose Street Apt	9	2.8	17.8	4.9	25.6
		Westpark Village 3	7.5	28.9	37.6	4.2	70.8
Canada	7	52652	6.5	131.1	7.7	0.8	139.7
		53653	7	104.2	9.2	1	114.4
		73872	7.5	80.6	13	1.2	94.8
		83236	8.5	49.5	7.9	1.2	58.5
		83227	8	71.9	8.7	3.1	83.7
		J313	8	69.8	6.7	1.2	77.7
		Murfield	7	80.3	23.6	10.5	114.4
UK	7	Byron	8	66	21.1	12.4	99.5
		Chatsworth	8.5	46.3	11	7.5	64.9
		Chesterton	8	78.1	12.2	6.3	96.6
		Coalport	8.5	61.3	5.9	3.9	71.1
		Halisham A	8.5	7.3	37	27.3	71.7
		Hereford	8.5	69.2	9.7	6.1	85
		Kempton	8	76	3.5	2.4	82
		Kensington	8	72.7	16.6	4.1	93.4
		Shelley	8.5	32.4	15.3	9.3	57
Pennsylvania	8	Lansdale building D Unit C	9.5	84.8	0.2	0.1	85.2
		Lansdale building D Unit D	9	32.1	0.8	1.7	34.5
Massechussetts	8	Cambridge	6	287.7	0.1	0	287.8
		Dartmore	5	385.9	0.1	0.1	386
		Huntington	6.5	238.3	0.5	0.1	238.8
		McKinley	7	229.1	0.1	0	229.3
		Milstone	6.5	248.3	0.2	0	248.5
		Milton	4.5	423.5	3.5	0.4	427.4

Table 8. Plans used in AccuRate ratings, with origin and equivalent Australian Climate Zone including summary results from AccuRate (MJ/m^2/yr)

4. Analysis

Figure 3 (next page) shows the AccuRate results of comparison house designs, arranged by equivalent Australian BCA climate zone. The yellow bars indicate the mean star rating performance for the overseas houses within each equivalent climate zone. The dark blue bar indicates the overall mean average of the overseas ratings, while the light blue bar indicates the proposed BCA 5-star standard. This graphical representation on a 'star-equivalent' basis shows clearly that there is a significant performance gap between the overseas house designs and the proposed 5-star standard. Only 4 house designs out of 51 drop below the proposed 5-star standard, and all climate zone comparison means averages are well above it. In the majority of climate zones, the comparison country house designs perform at 7 stars or above.

In more detail, Table 10 shows the mean performance of the houses rated for this study, by equivalent Australian climate zone and overall. It is clear that the worst performing category is North Carolina (equivalent to Zone 3), with a mean equivalent of 5.4 stars.

Australian equivalent climate zone	Comparison location	Total number of plans rated	AccuRate stars Range	AccuRate stars median	**AccuRate stars Mean**
Zone 1 Darwin	Florida	6	6-8.5	6.5-7	**7**
Zone 2 Brisbane	Texas	5	4.5-9	5	**6**
Zone 3 Longreach	N. Carolina	5	4.5-6.5	5.5	**5.4**
Zone 4 Dubbo	Arizona	4	6.5-7.5	7	**7**
Zone 5 Perth	California (Bakersfield)	3	7-8	7.5	**7.5**
Zone 6 Melbourne	California (SF Bay)	4	6-9	7.5-8	**7.6**
Zone 7 Hobart	UK: Canada	16	6.5-8.5	8	**7.2**
Zone 8 Thredbo	Pennsylvania: Mass.	8	4.5-9.5	6.5	**6.8**
ALL ZONES	**-**	**51**	**4.5-9.5**	**7.5**	**6.8**

Table 10. Summary Analysis of AccuRate Results.

The mean star rating overall is 6.843. This indicates clearly that the performance of overseas equivalent housing is significantly out-performing both current Australian housing and the proposed Australian 5-star national requirements. There is no particular pattern of performance according to warmer or cooler climates, or dry or humid climates.

The typical format of lightweight construction on slab seen in current new housing in Australia is also seen in the USA. However, in order to meet generally more stringent building codes requirements for building fabric (especially roofs) and windows, US house designs generally incorporate more insulation and lower window areas per unit floor area. As a result, predicted energy use is typically cut by 30-50% beyond the proposed Australian 5-star requirements.

Further analysis of the AccuRate results (Appendix A) along with the DTS requirements results (Section 3 and Table 7) is presented by climate zone in the following Sections 4.1-4.8.

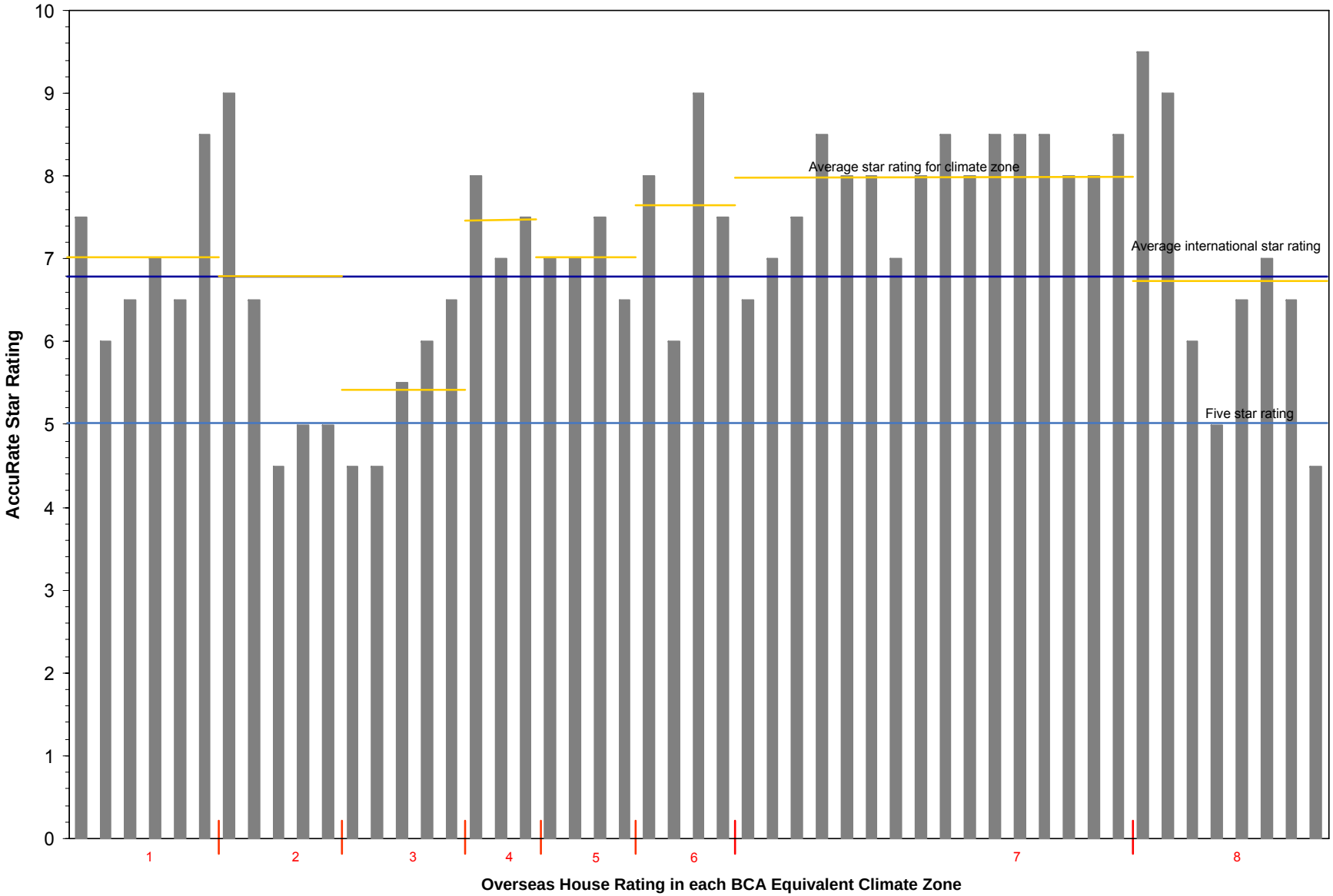


Figure 3. Star Ratings of Overseas House Designs Compared to the Proposed 5-Star Standard.

4.1 Climate Zone 1

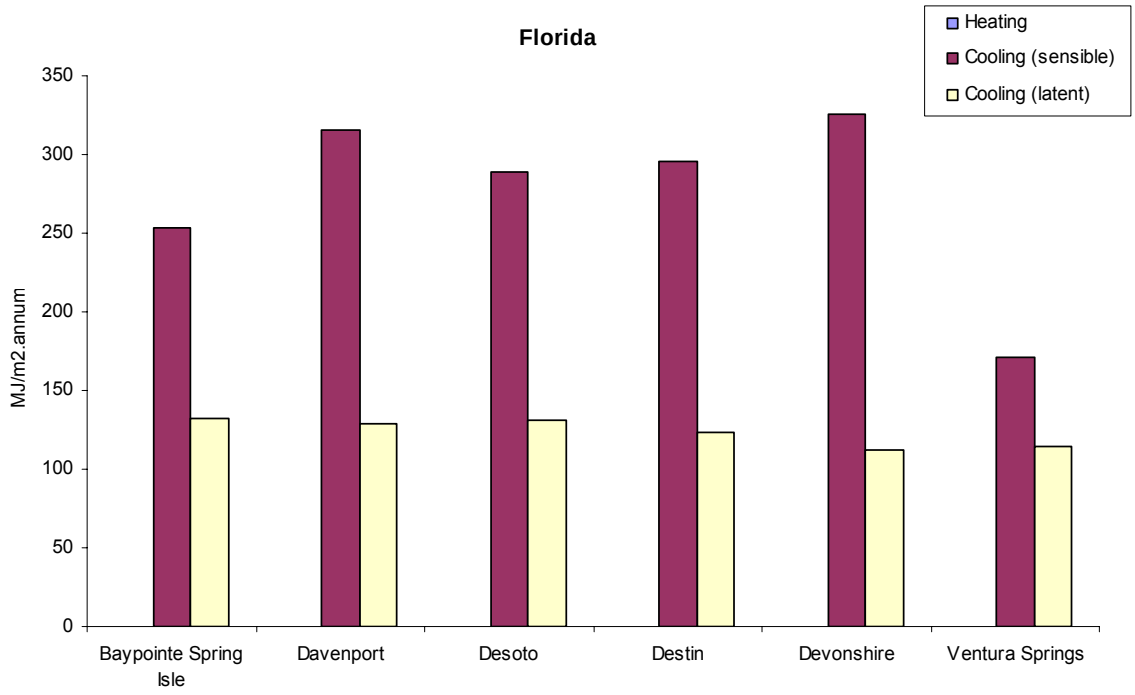


Figure 4. AccuRate Results for Florida

Figure 4 shows the AccuRate results for Orlando, Florida, the comparison climate zone for Australia zone 1. Overall performance of the Florida house designs is better than the proposed Australian 5-star standard. Indeed, the Florida designs vary between an equivalent 6-8.5 stars under the Australian NatHERS system.

Ventura Springs and Baypointe springs are both townhouses, and this accounts for the extra benefit in performance seen here. Otherwise, the results are consistent. Unsurprisingly for this climate zone, cooling demand is the dominant factor, and improvements in ventilation would make a large difference to the cooling load. Window openings are smaller than in Australian comparisons. Also, Florida shows a difference to the rest of the US house designs in that they all have ground floors of heavyweight materials, whereas in other states the fabric tends to be lightweight.

With regard to the comparison of DTS requirements as presented in Section 3 and Table 7, the building code performance requirements of main fabric materials are generally equal or lower in Darwin than Orlando, and this further illustrates the difference in the comparative stringency of housing energy performance.

4.2 Climate Zone 2

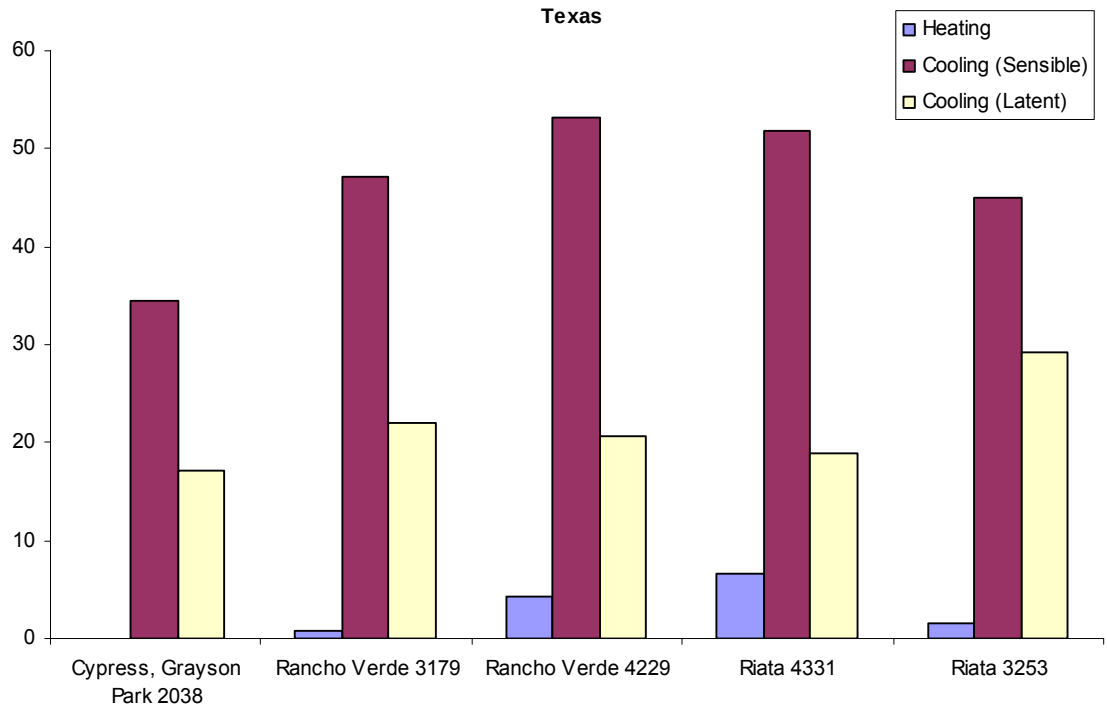


Figure 5. AccuRate Results for Texas

Figure 5 shows the AccuRate results for Austin, Texas, the comparison climate zone for Australia zone 2. In the majority of cases, performance of the Texas house designs is equal to or better than the proposed Australian 5-star standard.

The Texas designs vary between an equivalent 4.5-9 stars under the Australian NatHERS system. However, Grayson Park is a townhouse, and accounts for the improved performance seen in this case. All of the others are single or double storey detached houses, and the best performer is Rancho Verde 3179, with 6.5 stars equivalent. In general, it would appear that Texas houses have large void spaces between the upper and lower floor, which reduces their energy performance considerably. As a result, Texas is one of the worst performing states, with 3 out of 5 houses equivalent to or below the Australian proposed standard. High insulation and glazing is generally used, but the designs are not top-performers thermally, especially for this climate zone.

With regard to the comparison of DTS requirements as presented in Section 3 and Table 7, the building code performance requirements of main fabric materials are generally of the same order in Brisbane as in Austin, and this explains the modest gap in the comparative stringency of housing energy performance.

4.3 Climate Zone 3

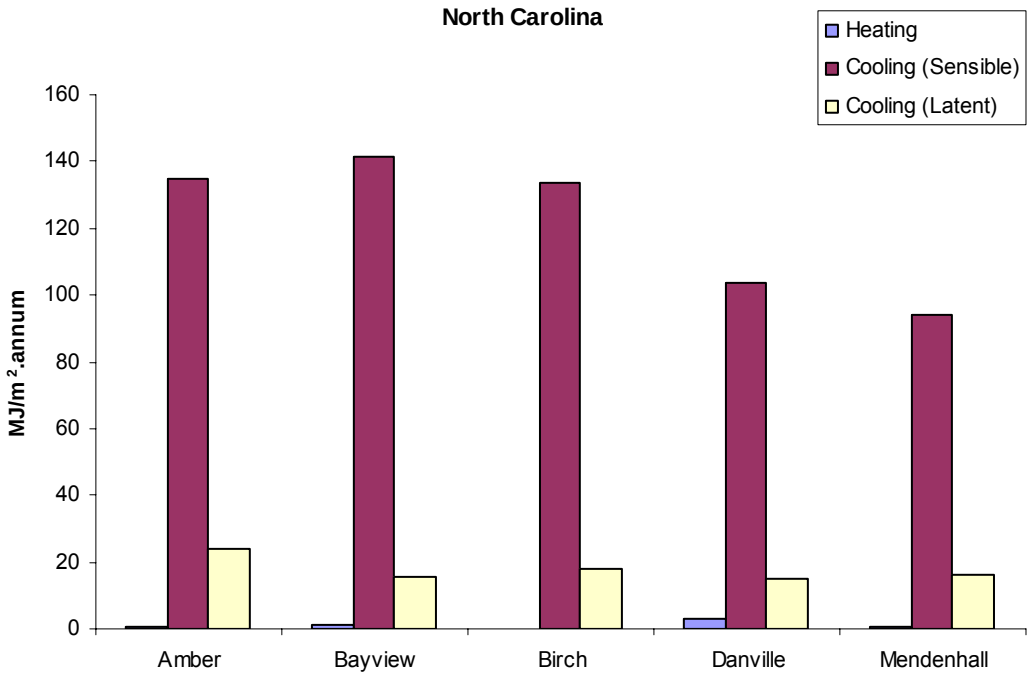


Figure 6. AccuRate Results for North Carolina

Figure 6 shows the AccuRate results for Charlotte, North Carolina, the comparison climate zone for Australia zone 3. The overall performance of the Charlotte house designs is equal to or better than the proposed Australian 5-star standard. The Charlotte designs vary between an equivalent 4.5-6.5 stars under the Australian NatHERS system.

The house designs available for current construction in North Carolina show a broad and consistent similarity of style and build type. They are relatively very large houses, with generally more thermal mass in them than those in other states. As in the case of Florida, passive cooling would be greatly improved by better cross-flow ventilation. Some of these houses didn't have double glazing, and this, combined with the poor window shading, resulted in poor cooling performance.

With regard to the comparison of DTS requirements as presented in Section 3 and Table 7, the building code performance requirements of roofing are lower in Longreach than Charlotte. However, glazing performance requirements are higher. Overall, there are broad similarities therefore in overall stringency of housing energy performance.

4.4 Climate Zone 4

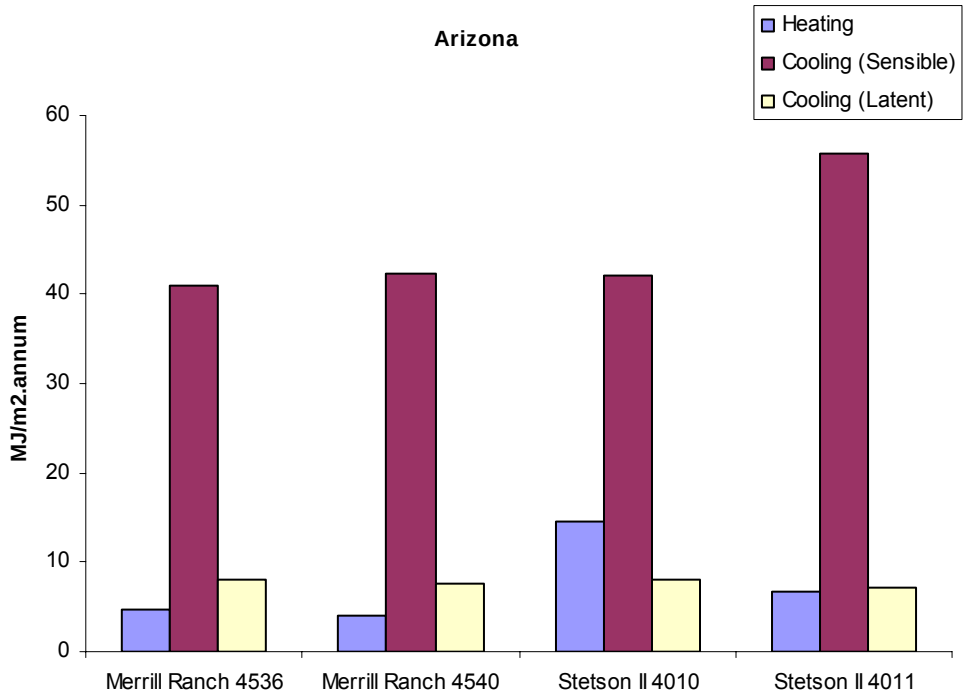


Figure 7. AccuRate Results for Arizona

Figure 7 shows the AccuRate results for Phoenix, Arizona, the comparison climate zone for Australia zone 4. The overall performance of the Phoenix house designs is better than the proposed Australian 5-star standard. Indeed, the Phoenix designs vary between an equivalent 6.5-7.5 stars under the Australian NatHERS system.

Both the single and double storey version of the houses rated are relatively very large, in excess of 250m^2. The house designs generally did not have high specification glazing (double Glazing but not low E), although this did not seem to greatly affect their performance. The climate in this zone is relatively mild, so building envelope performance is not as critical as in zones 1 and 8. Nevertheless, substantial cooling requirements dominate the energy demand picture.

With regard to the comparison of DTS requirements as presented in Section 3 and Table 7, the building code performance requirements of main fabric materials are generally similar overall in Phoenix and Dubbo. However, the house designs rated perform well above the 5-star standard. There are two possible explanations for this. The enhanced Australian DTS provisions do not necessarily prescribe 5-star performance, and may therefore be relatively more stringent when applied to this climate zone than others. Alternatively, although the plans have been checked for over compliance, the major housebuilder who supplied the plans may use designs in Phoenix which marginally exceed the code requirements, since there are a number of code variations across Arizona and the surrounding region.

4.5 Climate Zone 5

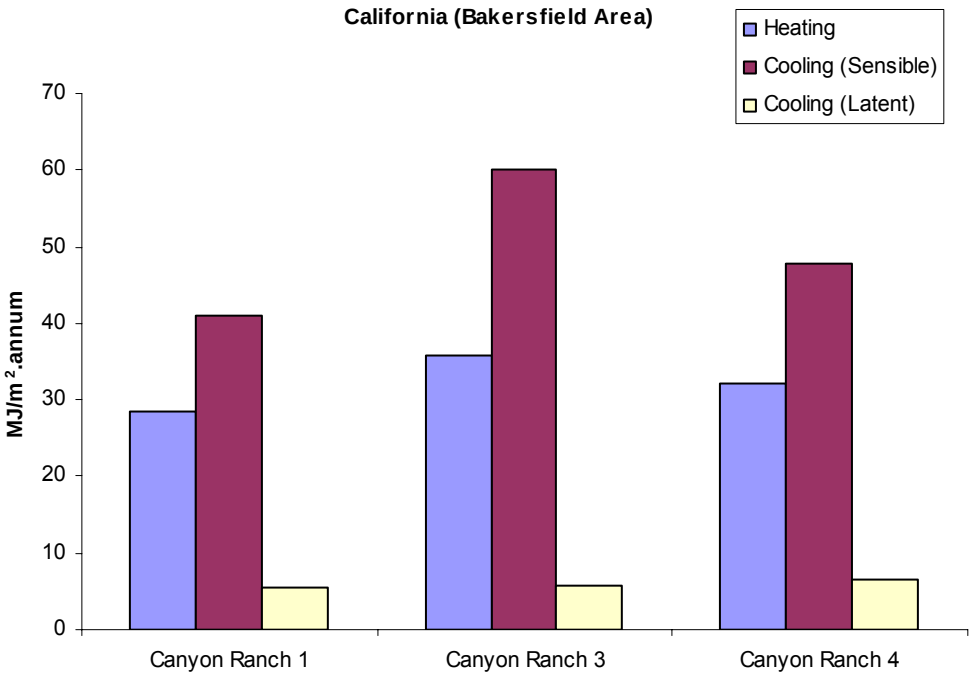


Figure 8. AccuRate Results for California (Bakersfield area)

Figure 8 shows the AccuRate results for Bakersfield, California, the comparison climate zone for Australia zone 5 (e.g. Perth). The overall performance of the Bakersfield house designs is markedly better than the proposed Australian 5-star standard. Indeed, the Bakersfield designs vary between an equivalent 7-8 stars under the Australian NatHERS system.

The Bakersfield houses are similar to each other. While there are also similarities with the other US designs, the closest is San Francisco Bay, simply because of the higher specifications of these designs. As a result of these higher performance standards, the AccuRate outcomes are consistently very high.

With regard to the comparison of DTS requirements as presented in Section 3 and Table 7, the building code performance requirements of main fabric materials are substantially and consistently lower in Perth than in Bakersfield, and this further illustrates the marked difference in the comparative stringency of housing energy performance.

4.6 Climate Zone 6

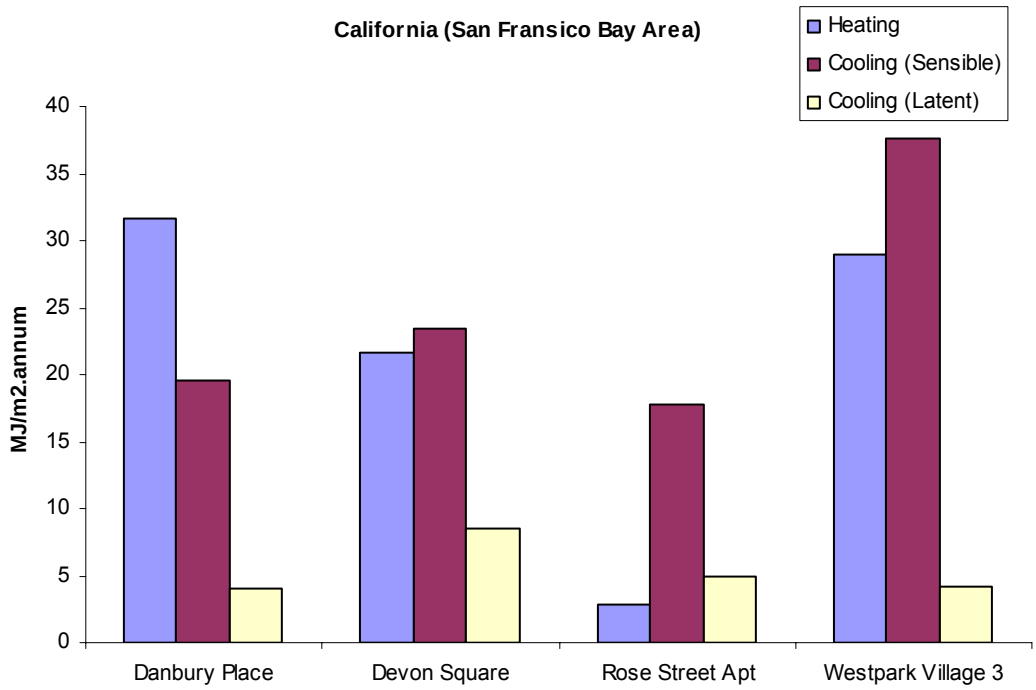


Figure 9. AccuRate Results for California (SF Bay)

Figure 9 shows the AccuRate results for San Francisco Bay, California, the comparison climate zone for Australia zone 6 (e.g. Melbourne). The overall performance of the San Francisco Bay house designs is markedly better than the proposed Australian 5-star standard. Indeed, the San Francisco Bay designs vary between an equivalent 6-9 stars under the Australian NatHERS system.

All of the houses represented here are either townhouses or apartments, since this is the dominant design type in the Bay area. Generally, in this study, apartments and townhouses perform better than detached houses, so this may have been a factor in the high performance of the designs rated here. For example, Rose Street is an apartment, and this partly explains its 9-star equivalent rating. However, the designs supplied consistently contain high insulation R5.5 ceilings, R2.5 walls, double glazed low E glass in vinyl frames with small windows (although no shading to the windows). Hence, the high specification is clearly a factor in the high performance.

With regard to the comparison of DTS requirements as presented in Section 3 and Table 7, California has much higher standards for thermal performance under its DTS requirements. The building code performance requirements of main fabric materials are therefore substantially and consistently lower in Melbourne than in San Francisco Bay, and this further illustrates the marked difference in the comparative stringency of housing energy performance.

4.7 Climate Zone 7

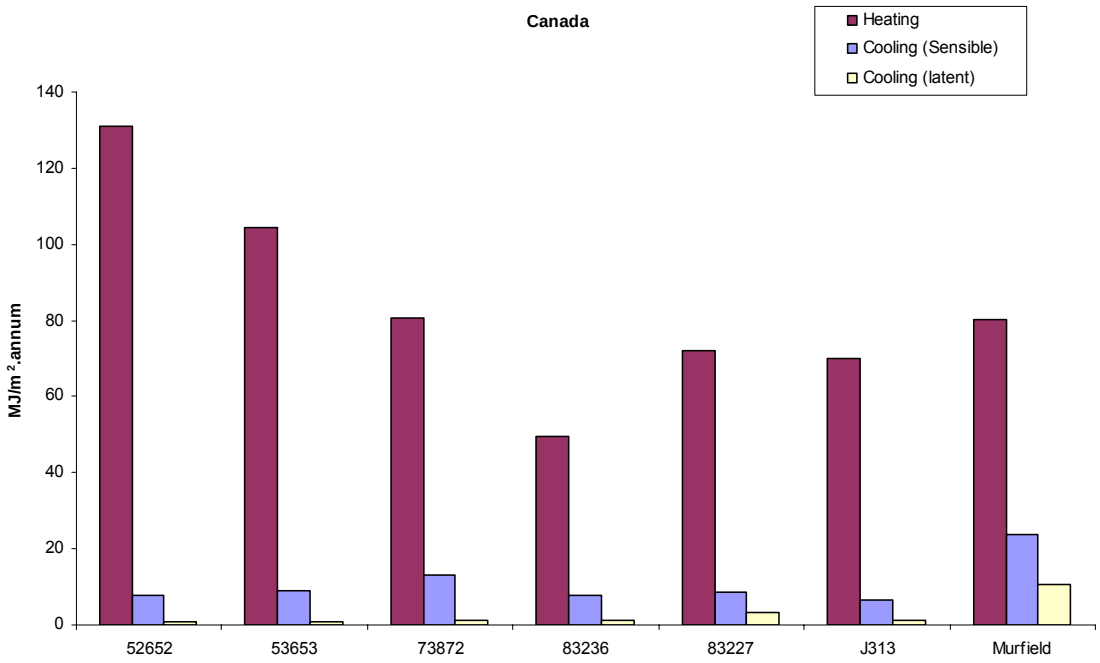


Figure 10. AccuRate Results for Canada, Vancouver BC

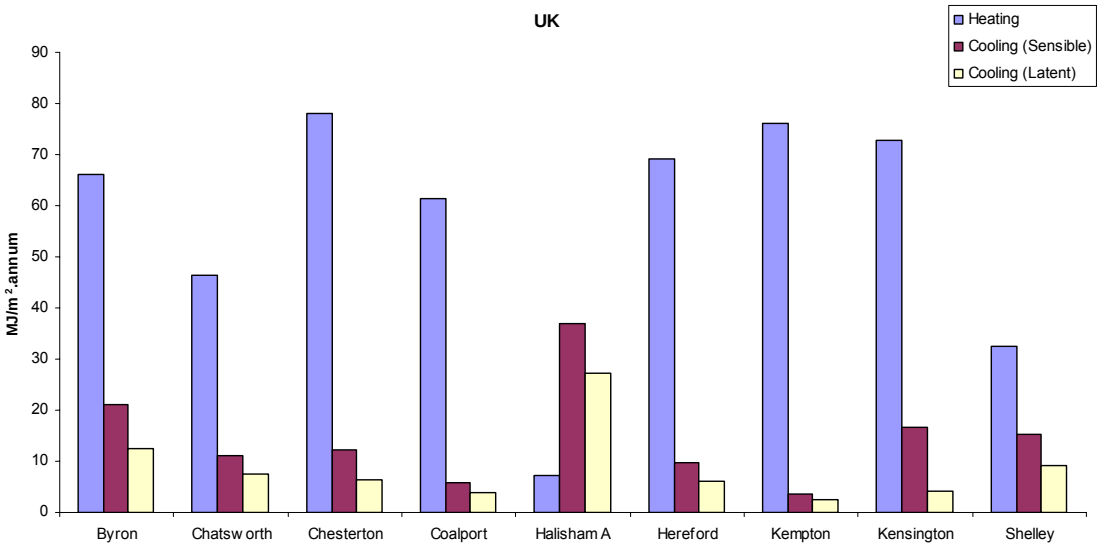


Figure 11. AccuRate Results for the UK, Exeter

Figures 10 and 11 show the AccuRate results for Vancouver BC, Canada, and Exeter, UK, respectively. These provide equivalent comparison climate zones for Australia zone 7 (e.g. Hobart). In each case, overall performance of the Vancouver and Exeter house designs is better than the proposed Australian 5-star standard. The Vancouver designs vary between an equivalent 6.5-8.5 stars under the Australian NatHERS system, while the Exeter designs show an equivalent range of 8-8.5 stars.

Upon initial rating, the 'Halisham A' (Exeter) house had a high cooling load and low heating load, which is counter-intuitive given the climate zone. Further investigations

were duly undertaken into the cause of this, which revealed that the design is the only apartment in the set, and has a shared roof, with bedrooms facing Australian equivalent of north and living rooms facing equivalent Australian south. This is the worst possible combination, especially considering the low opportunity for ventilation. The apartment was subsequently remodelled with 180 degree orientation change, and an unshared ceiling, to provide a more typical result. Incidentally, the unsharing of the roof had only a minor effect on the cooling/heating loads, while the orientation change greatly increased the heating load, making it more consistent with the other designs.

With regard to the comparison of DTS requirements as presented in Section 3 and Table 7, the building code performance requirements of main fabric materials are substantially and consistently lower in Hobart than Vancouver and Exeter, and this further illustrates the difference in the comparative stringency of housing energy performance.

4.8 Climate Zone 8

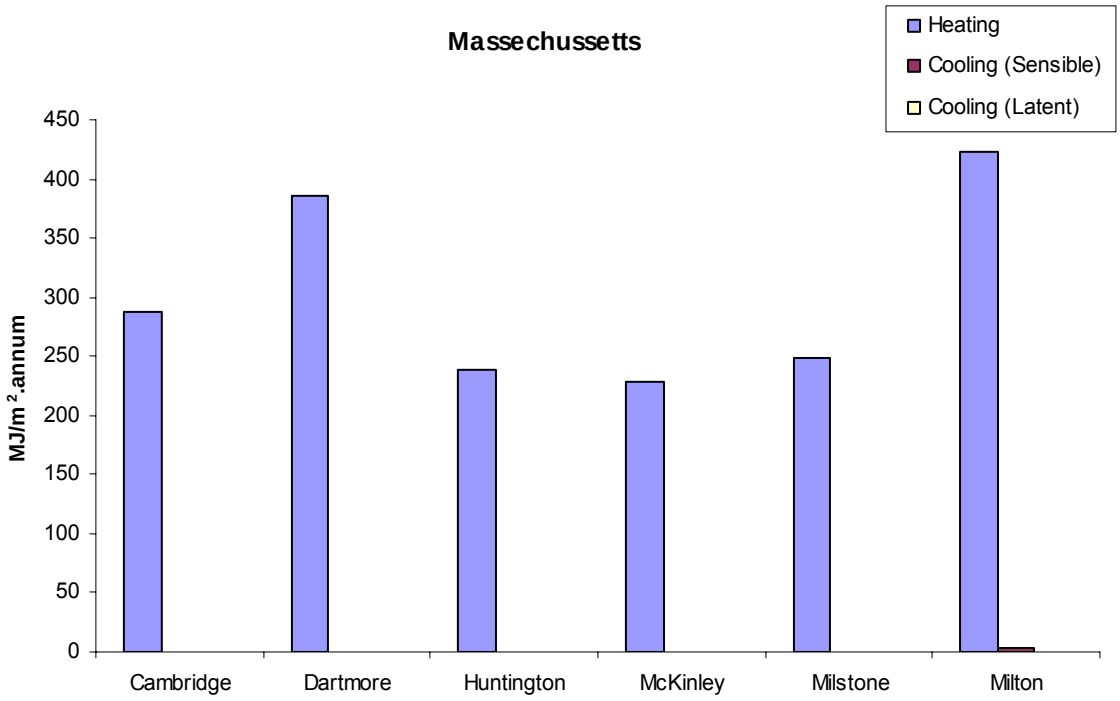


Figure 12. AccuRate Results for Massachusetts

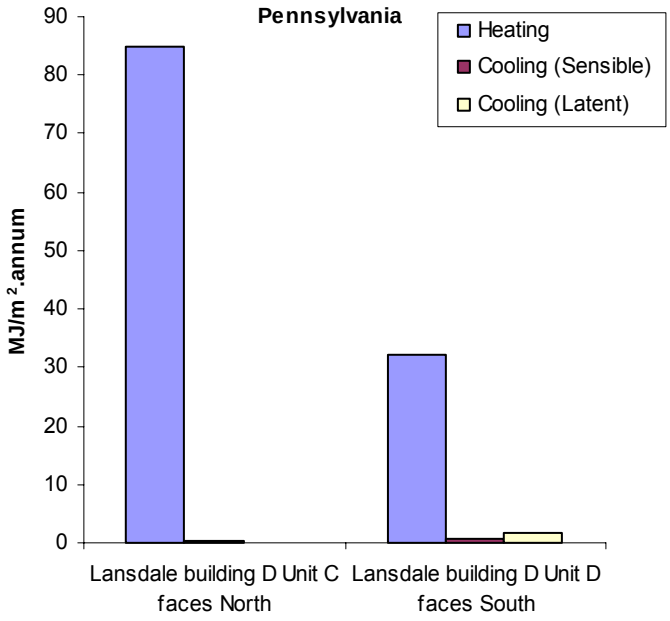


Figure 13. AccuRate Results for Pennsylvania

Figures 12 and 13 show the AccuRate results for Massachusetts and Pennsylvania, respectively. These provide equivalent comparison climate zones for Australia alpine zone 8 (e.g. Thredbo). The overall performance of the Pennsylvania house designs is much better than the proposed Australian 5-star standard. The two Pennsylvania designs are rated equivalent 9 and 9.5 stars under the Australian NatHERS system. However, it should be noted that these are both apartments, which can be expected to have a higher than average energy performance.

The AccuRate results for Massachusetts are more mixed, showing an equivalent range of 4.5-7 stars. The Milton design is relatively particularly low performing amongst this group at 4.5 stars. This has been reviewed in detail, with rotating and other adjustments to check the consistency of the rating, with the conclusion that it is an accurate reflection of a relatively low-performing house.

With regard to the comparison of DTS requirements as presented in Section 3 and Table 7, some of the DTS building code performance requirements of main fabric materials are similar in Thredbo and Massachusetts, and this explains the similarity in housing performance at the lower end. However, roof R-Value requirements are much higher in Boston, which may explain the higher performance of Boston designs at the top end.

5. Conclusions

The aims of this study are to test how the proposed 5-star Australian standard and DTS provisions compare on an International level with relevant standard residential properties and requirements in locations of similar climate. In addressing these aims, the eight different Australian climate zones described in the BCA have been matched to overseas locations. For each location, a selection of standard house designs which meet host country equivalent DTS provisions has been obtained and rated using the latest version of AccuRate rating software to model its heating and cooling load requirements and provide a comparable 'star rating' of performance. Data has also been collected on the performance levels of materials and building components required under the enhanced BCA DTS provisions (refer Part 3.12), as well as for equivalent provisions in Building Codes pertaining to the rated overseas standard house designs. Analysis of the rating and DTS data has also been undertaken.

The results and analysis show that, in general, the proposed Australian 5-star standard is not an onerous requirement, when compared generally to housing performance levels being achieved in comparative overseas locations.

The overall median rating is 7.5 stars, and the overall mean rating is 6.8 stars. Therefore, across the 51 overseas ratings undertaken, **the proposed 5-star standard is 1.8-2.5 stars below comparable average international levels of performance.** Within each climate zone, there are variations, although all mean climate zone comparison performance levels are above 5 stars. Generally, apartments and townhouses perform better than detached houses. Overall, the results indicate that **current standards of house designs used in this study are significantly higher than the proposed 5-star standard, and will use significantly less energy than 5-star Australian homes.**

The house designs obtained from the UK and Canada indicate that in these countries, substantial houses are built to relatively very high standards, in compliance with relatively stringent building code requirements. In the USA, the picture is less clear, although two general conclusions can be drawn here. Firstly, **houses in the US tend to be more akin to those in Australia, being of very lightweight construction, although typically having a slab floor**. Secondly, **although there are local variations, the overall performance is comfortably above Australia 5-star equivalent**.

The question then arises as to why the US houses perform better, despite similar basic structural characteristics. It is clear from the design ratings that, in general, these buildings are simply heavily insulated. They do not have sustainable design principles outside of high performance building elements. They are, however, insulated to (on average) R2.5 in the walls, R5.5 in the ceilings, and have double or double low E glazing. One or two houses in Texas have single glazing, but otherwise all are double or double low E glazed. In addition, all the states seem to predominantly use vinyl frames (PVC) and this has a big benefit in the energy ratings (despite raising questions over other environmental impacts). Typically, from the US designs used in this study and previous experience of the authors in rating Australian house designs, US glass to floor area ratios are significantly lower than those in Australia. With some basic improvements, including window shading, better cross-flow ventilation and more appropriate window placement, further passive cooling benefits would be obtained across the southern states.

The main exception across the pattern of DTS requirements indicated above, is the building control regime in California. This has a long history, and current standards are significantly advanced when compared to the other states, and to Australia. The two climate zones which provide Californian comparisons in this study (Australian zones 5 and

6) show clear differences in the performance results from having more stringent building codes. This provides a clear conclusion: **More stringent DTS building codes and performance requirements are currently practicable in similar lightweight, large house construction regimes to Australia, and these provide significant environmental benefits in reduced energy demand.**

The current efficiency of Australian homes is well below comparative international standards in terms of energy efficiency and greenhouse gas emissions. Going forward, this can be expected to translate into a brake on the Australian economy in a world of increasing fossil fuel scarcity and rising prices. The adoption of 5 stars as a minimum standard is clearly a step forward for energy efficiency of Australian homes. However, **actual typical house designs in comparison countries use significantly less energy than the proposed 5-star standard. This demonstrates an opportunity for significantly more stringent standards and further reductions in energy demand in the future.**

References

The Stationery Office, 2001. The Building Regulations 2000, Approved Document L1: Conservation of fuel and power in dwellings. 2002 edition. London, The Stationery Office, 2001.

Scottish Building Standards, 2004. Technical Handbook, Domestic 2004

The Stationery Office, 2001b. Limiting thermal bridging and air leakage: Robust construction details for dwellings and similar buildings, The Stationery Office, 2001.

US DTS Sources

Arizona

Arizona department of commerce (2005). State energy codes. http://www.commerce.state.az.us/energy/state%20energy%20code.asp [accessed 8 July 2005]

The Maricopa Association of Governments (2005). Building codes committee. www.mag.maricopa.gov/pdf/cms.resource/attachcombine_125.pdf [accessed 8 July 2005]

City of Tucson (2005). Adoption of building codes with local amendments http://www.ci.tucson.az.us/dsd/Codes___Ordinances/Building_Codes/building_codes.html [accessed 8 July 2005]

Pima County (2005). Building codes - an informational newsletter. www.dsd.co.pima.az.us/ [accessed 8 July 2005]

U.S. Environmental Protection Agency (2005). ENERGY STAR® for new homes. http://www.energystar.gov/index.cfm?c=new_homes.hm_index [accessed 8 July 2005]

California

California Building Standards Commission (2005). 2005 California Energy Code, California Code of regulations Title 24, Part 6. International Code Council Inc., Falls Church, Virginia.

California energy commission website http://www.energy.ca.gov/maps/climate_zone_map.html [accessed 7 July 2005]

California Title 24 Energy Code Compliance Analysis Services http://www.title24express.com/title_24_codes.htm [accessed: 7 July 2005]

Florida

Energy Gauge (2005) Energy and Economic Analysis Software - Energy and Economic Analysis Software for the New Millennium. hhtp://www.energygauge.com [accessed 12 July 2005]

The Florida Department of Community Affairs (2005). Building code information system. http:// www.floridabuilding.org/ [accessed 12 July 2005]

Massachusetts

Massachusetts State (1998) 780 CMR Appendix J. Energy Conservation Code for New Construction Low-Rise Residential Buildings. Massachusetts Board of building regulations and standards, Boston, Massachusetts.

XENERGY Inc. (2001) Impact of the Massachusetts 1998 Residential Energy Code Revisions. Report prepared for the Massachusetts Board of building regulations and standards, Boston, Massachusetts.

Council of American Building Officials (1995) Model Energy Code; 1995 Edition (MEC 95). Falls Church, Virginia.

North Carolina

Hadley, D. and Smith, D. (2000) Recommended programme for North Carolina State Energy Code Compliance Study. US Department of Energy, Building Energy Code programme. http://www.energycodes.gov/implement/pdfs/northcarolina.pdf [accessed 8 July 2005]

National Conference of State Legislators (1997). The Model Energy Code for Residential Buildings. State Legislative Report June 1997 Vol. 22, No. 4.
http://www.ncsl.org/programs/energy/modelec.htm [accessed 8 July 2005]
Texas
US Department of energy (2002) Texas – additional state information, Building energy code programme, Energy efficiency and renewable energy.
http://www.energycodes.gov/implement/state_codes/state_stat_more.php?state_AB=TX [accessed 12 July 2005]

Seale, A. (2002) Conventional Energy Code Compliance
http://www.starlink2000.com/ARTICLESpagesSITE/EnergyCodeRequire.htm [accessed 12 July 2005]

Green Building Program. 2005. "The City of Austin's Energy Code." Austin City Connection: the official website of The City of Austin.
http://www.ci.austin.tx.us/greenbuilder/energycode.htm [accessed 12 July 2005]

Appendix: AccuRate offprints

Equivalent Australian Climate Zone 1

	AccuRate Star Rating
Baypointe Spring Isle	7.5
Davenport	6
Desoto	6.5
Destin	7
Devonshire	6.5
Ventura Springs	8.5

AccuRate Regulatory Version June 2005 (expires 30 Sept 2005)

Nationwide House Energy Rating Scheme

Project Details

Project Name:	**Postcode:** 820
File Name: W:\SBE\admin\7-05\75053 DEH-FR & Int rating comparison\K2	**Climate Zone:** 01
Design Option: Base Design	
Description: Baypointe - Spring isle 0445	

Client Details

Client Name: International		
Phone: (02) 6274 1888	**Fax:**	**Email:**
Postal Address: Australian Greenhouse Office GPO Box 787 CANBERRA ACT 2601		
Site Address:		
Council submitted to (if known by assessor):		

Assessor Details

Assessor Name: Sustainable Built Environments P/L			**Assessor No.**
Phone: +61 3 9670 9820	**Fax:** +61 3 9670 9890	**Email:** info@sbe.com.au	
Assessment date: 24/8/2005			**Time:** 9:43
Assessor signature:			

RATED ENERGY REQUIREMENTS*

Heating	Cooling (sensible)	Cooling (latent)	Total Energy	Units
0.0	253.8	132.1	385.9	MJ/m².annum
0.0	70.5	36.7	107.2	kWh/m².annum

* These energy requirements have been calculated using a standard set of occupant behaviours and so do not necessarily represent the usage pattern or lifestyle of the intended occupants. They should be used solely for the purposes of rating the building. They should not be used to infer actual energy consumption or running costs. The settings used for the simulation are shown in the building data report.

Conditioned floor area	139.0 m²
Area-adjusted star band score	375

Star Rating

★★★★★★★★☆ **7.5 STARS**

Area-adjusted star band score thresholds

1 Star	2 Stars	3 Stars	4 Stars	5 Stars	6 Stars	7 Stars	8 Stars	9 Stars	10 Stars
828	722	640	575	521	471	419	357	280	180

AccuRate Regulatory Version June 2005 (expires 30 Sept 2005)

Nationwide House Energy Rating Scheme

Project Details

Project Name:	**Postcode:** 820
File Name: W:\SBE\admin\7-05\75053 DEH-FR & Int rating comparison\K2	**Climate Zone:** 01
Design Option: Base Design	
Description: The Davenport	

Client Details

Client Name: International		
Phone: (02) 6274 1888	**Fax:**	**Email:**
Postal Address: Australian Greenhouse Office GPO Box 787 CANBERRA ACT 2601		
Site Address:		
Council submitted to (if known by assessor):		

Assessor Details

Assessor Name: Sustainable Built Environments P/L		**Assessor No.**
Phone: +61 3 9670 9820	**Fax:** +61 3 9670 9890	**Email:** info@sbe.com.au
Assessment date: 24/8/2005		**Time:** 9:46
Assessor signature:		

RATED ENERGY REQUIREMENTS*

Heating	Cooling (sensible)	Cooling (latent)	Total Energy	Units
0.0	315.2	128.7	443.9	MJ/m².annum
0.0	87.6	35.8	123.3	kWh/m².annum

* These energy requirements have been calculated using a standard set of occupant behaviours and so do not necessarily represent the usage pattern or lifestyle of the intended occupants. They should be used solely for the purposes of rating the building. They should not be used to infer actual energy consumption or running costs. The settings used for the simulation are shown in the building data report.

Conditioned floor area	190.3 m²
Area-adjusted star band score	449

Star Rating

★★★★★★ **6 STARS**

Area-adjusted star band score thresholds

1 Star	2 Stars	3 Stars	4 Stars	5 Stars	6 Stars	7 Stars	8 Stars	9 Stars	10 Stars
828	722	640	575	521	471	419	357	280	180

AccuRate Regulatory Version June 2005 (expires 30 Sept 2005)

Nationwide House Energy Rating Scheme

Project Details

Project Name:	**Postcode:** 820
File Name: W:\SBE\admin\7-05\75053 DEH-FR & Int rating comparison\K2	**Climate Zone:** 01
Design Option: Base Design	
Description: The desoto	

Client Details

Client Name: International		
Phone: (02) 6274 1888	**Fax:**	**Email:**
Postal Address: Australian Greenhouse Office GPO Box 787 CANBERRA ACT 2601		
Site Address:		
Council submitted to (if known by assessor):		

Assessor Details

Assessor Name: Sustainable Built Environments P/L			**Assessor No.**
Phone: +61 3 9670 9820	**Fax:** +61 3 9670 9890	**Email:** info@sbe.com.au	
Assessment date: 24/8/2005			**Time:** 9:50
Assessor signature:			

RATED ENERGY REQUIREMENTS*

Heating	Cooling (sensible)	Cooling (latent)	Total Energy	Units
0.0	289.4	130.6	420.0	MJ/m².annum
0.0	80.4	36.3	116.7	kWh/m².annum

* These energy requirements have been calculated using a standard set of occupant behaviours and so do not necessarily represent the usage pattern or lifestyle of the intended occupants. They should be used solely for the purposes of rating the building. They should not be used to infer actual energy consumption or running costs. The settings used for the simulation are shown in the building data report.

Conditioned floor area	211.1 m²
Area-adjusted star band score	431

Star Rating

★★★★★★☆ **6.5 STARS**

Area-adjusted star band score thresholds

1 Star	2 Stars	3 Stars	4 Stars	5 Stars	6 Stars	7 Stars	8 Stars	9 Stars	10 Stars
828	722	640	575	521	471	419	357	280	180

AccuRate Regulatory Version June 2005 (expires 30 Sept 2005)

Nationwide House Energy Rating Scheme

Project Details

Project Name:	**Postcode:** 820
File Name: W:\SBE\admin\7-05\75053 DEH-FR & Int rating comparison\K2	**Climate Zone:** 01
Design Option: Base Design	
Description:	

Client Details

Client Name: International		
Phone: (02) 6274 1888	**Fax:**	**Email:**
Postal Address: Australian Greenhouse Office GPO Box 787 CANBERRA ACT 2601		
Site Address:		
Council submitted to (if known by assessor):		

Assessor Details

Assessor Name: Sustainable Built Environments P/L			**Assessor No.**
Phone: +61 3 9670 9820	**Fax:** +61 3 9670 9890	**Email:** info@sbe.com.au	
Assessment date: 24/8/2005			**Time:** 9:14
Assessor signature:			

RATED ENERGY REQUIREMENTS*

Heating	Cooling (sensible)	Cooling (latent)	Total Energy	Units
0.0	295.3	123.7	419.0	MJ/m².annum
0.0	82.0	34.4	116.4	kWh/m².annum

* These energy requirements have been calculated using a standard set of occupant behaviours and so do not necessarily represent the usage pattern or lifestyle of the intended occupants. They should be used solely for the purposes of rating the building. They should not be used to infer actual energy consumption or running costs. The settings used for the simulation are shown in the building data report.

Conditioned floor area	154.7 m²
Area-adjusted star band score	409

Star Rating

★★★★★★★ **7 STARS**

Area-adjusted star band score thresholds

1 Star	2 Stars	3 Stars	4 Stars	5 Stars	6 Stars	7 Stars	8 Stars	9 Stars	10 Stars
828	722	640	575	521	471	419	357	280	180

AccuRate Regulatory Version June 2005 (expires 30 Sept 2005)

Nationwide House Energy Rating Scheme

Project Details

Project Name:	**Postcode:** 820
File Name: W:\SBE\admin\7-05\75053 DEH-FR & Int rating comparison\K2	**Climate Zone:** 01
Design Option: Base Design	
Description: devonshire	

Client Details

Client Name: International		
Phone: (02) 6274 1888	**Fax:**	**Email:**
Postal Address: Australian Greenhouse Office GPO Box 787 CANBERRA ACT 2601		
Site Address:		
Council submitted to (if known by assessor):		

Assessor Details

Assessor Name: Sustainable Built Environments P/L			**Assessor No.**
Phone: +61 3 9670 9820	**Fax:** +61 3 9670 9890	**Email:** info@sbe.com.au	
Assessment date: 24/8/2005			**Time:** 10:02
Assessor signature:			

RATED ENERGY REQUIREMENTS*

Heating	Cooling (sensible)	Cooling (latent)	Total Energy	Units
0.0	325.3	112.5	437.8	MJ/m².annum
0.0	90.4	31.3	121.6	kWh/m².annum

* These energy requirements have been calculated using a standard set of occupant behaviours and so do not necessarily represent the usage pattern or lifestyle of the intended occupants. They should be used solely for the purposes of rating the building. They should not be used to infer actual energy consumption or running costs. The settings used for the simulation are shown in the building data report.

Conditioned floor area	196.3 m²
Area-adjusted star band score	445

Star Rating

★★★★★★☆ **6.5 STARS**

Area-adjusted star band score thresholds

1 Star	2 Stars	3 Stars	4 Stars	5 Stars	6 Stars	7 Stars	8 Stars	9 Stars	10 Stars
828	722	640	575	521	471	419	357	280	180

AccuRate Regulatory Version June 2005 (expires 30 Sept 2005)

Nationwide House Energy Rating Scheme

Project Details

Project Name:	**Postcode:** 820
File Name: W:\SBE\admin\7-05\75053 DEH-FR & Int rating comparison\K2	**Climate Zone:** 01
Design Option: Base Design	
Description: Santa Anna Ventura Serona Springs 0452	

Client Details

Client Name: International		
Phone: (02) 6274 1888	**Fax:**	**Email:**
Postal Address: Australian Greenhouse Office GPO Box 787 CANBERRA ACT 2601		
Site Address:		
Council submitted to (if known by assessor):		

Assessor Details

Assessor Name: Sustainable Built Environments P/L			**Assessor No.**
Phone: +61 3 9670 9820	**Fax:** +61 3 9670 9890	**Email:** info@sbe.com.au	
Assessment date: 24/8/2005			**Time:** 10:04
Assessor signature:			

RATED ENERGY REQUIREMENTS*

Heating	Cooling (sensible)	Cooling (latent)	Total Energy	Units
0.0	171.0	114.1	285.1	MJ/m².annum
0.0	47.5	31.7	79.2	kWh/m².annum

* These energy requirements have been calculated using a standard set of occupant behaviours and so do not necessarily represent the usage pattern or lifestyle of the intended occupants. They should be used solely for the purposes of rating the building. They should not be used to infer actual energy consumption or running costs. The settings used for the simulation are shown in the building data report.

Conditioned floor area	105.4 m²
Area-adjusted star band score	282

Star Rating

★★★★★★★★★☆ **8.5 STARS**

Area-adjusted star band score thresholds

1 Star	2 Stars	3 Stars	4 Stars	5 Stars	6 Stars	7 Stars	8 Stars	9 Stars	10 Stars
828	722	640	575	521	471	419	357	280	180

Equivalent Australian Climate Zone 2

	AccuRate Star Rating
Cypress, Grayson Park 2038	9
Rancho Verde 3179	6.5
Rancho Verde 4229	4.5
Riata 4331	5
Riata 3253	5

AccuRate Regulatory Version June 2005 (expires 30 Sept 2005)

Nationwide House Energy Rating Scheme

Project Details

Project Name:	**Postcode:** 4000
File Name: W:\SBE\admin\7-05\75053 DEH-FR & Int rating comparison\K2	**Climate Zone:** 10
Design Option: Base Design	
Description: Grayson Park 2038	

Client Details

Client Name: International		
Phone: (02) 6274 1888	**Fax:**	**Email:**
Postal Address: Australian Greenhouse Office GPO Box 787 CANBERRA ACT 2601		
Site Address:		
Council submitted to (if known by assessor):		

Assessor Details

Assessor Name: Sustainable Built Environments P/L			**Assessor No.**
Phone: +61 3 9670 9820	**Fax:** +61 3 9670 9890	**Email:** info@sbe.com.au	
Assessment date: 23/8/2005			**Time:** 10:57
Assessor signature:			

RATED ENERGY REQUIREMENTS*

Heating	Cooling (sensible)	Cooling (latent)	Total Energy	Units
0.1	18.3	19.1	37.5	MJ/m².annum
0.0	5.1	5.3	10.4	kWh/m².annum

* These energy requirements have been calculated using a standard set of occupant behaviours and so do not necessarily represent the usage pattern or lifestyle of the intended occupants. They should be used solely for the purposes of rating the building. They should not be used to infer actual energy consumption or running costs. The settings used for the simulation are shown in the building data report.

Conditioned floor area	136.7 m²
Area-adjusted star band score	35

Star Rating

★★★★★★★★★ **9 STARS**

Area-adjusted star band score thresholds

1 Star	2 Stars	3 Stars	4 Stars	5 Stars	6 Stars	7 Stars	8 Stars	9 Stars	10 Stars
177	141	114	94	80	68	59	49	38	23

AccuRate Regulatory Version June 2005 (expires 30 Sept 2005)

Nationwide House Energy Rating Scheme

Project Details

Project Name:	**Postcode:** 4000
File Name: W:\SBE\admin\7-05\75053 DEH-FR & Int rating comparison\K2	**Climate Zone:** 10
Design Option: Base Design	
Description: Rancho Verde 3179	

Client Details

Client Name: International		
Phone: (02) 6274 1888	**Fax:**	**Email:**
Postal Address: Australian Greenhouse Office GPO Box 787 CANBERRA ACT 2601		
Site Address:		
Council submitted to (if known by assessor):		

Assessor Details

Assessor Name: Sustainable Built Environments P/L			**Assessor No.**
Phone: +61 3 9670 9820	**Fax:** +61 3 9670 9890	**Email:** info@sbe.com.au	
Assessment date: 22/8/2005			**Time:** 17:24
Assessor signature:			

RATED ENERGY REQUIREMENTS*

Heating	Cooling (sensible)	Cooling (latent)	Total Energy	Units
0.8	47.2	22.1	70.1	MJ/m².annum
0.2	13.1	6.1	19.5	kWh/m².annum

* These energy requirements have been calculated using a standard set of occupant behaviours and so do not necessarily represent the usage pattern or lifestyle of the intended occupants. They should be used solely for the purposes of rating the building. They should not be used to infer actual energy consumption or running costs. The settings used for the simulation are shown in the building data report.

Conditioned floor area	127.1 m²
Area-adjusted star band score	63

Star Rating

★★★★★★☆ **6.5 STARS**

Area-adjusted star band score thresholds

1 Star	2 Stars	3 Stars	4 Stars	5 Stars	6 Stars	7 Stars	8 Stars	9 Stars	10 Stars
177	141	114	94	80	68	59	49	38	23

AccuRate Regulatory Version June 2005 (expires 30 Sept 2005)

Nationwide House Energy Rating Scheme

Project Details

Project Name:	**Postcode:** 4000
File Name: W:\SBE\admin\7-05\75053 DEH-FR & Int rating comparison\K2	**Climate Zone:** 10
Design Option: Base Design	
Description:	

Client Details

Client Name: International		
Phone: (02) 6274 1888	**Fax:**	**Email:**
Postal Address: Australian Greenhouse Office GPO Box 787 CANBERRA ACT 2601		
Site Address:		
Council submitted to (if known by assessor):		

Assessor Details

Assessor Name: Sustainable Built Environments P/L			**Assessor No.**
Phone: +61 3 9670 9820	**Fax:** +61 3 9670 9890	**Email:** info@sbe.com.au	
Assessment date: 22/8/2005			**Time:** 14:24
Assessor signature:			

RATED ENERGY REQUIREMENTS*

Heating	Cooling (sensible)	Cooling (latent)	Total Energy	Units
4.2	53.1	20.7	78.0	MJ/m².annum
1.2	14.8	5.8	21.7	kWh/m².annum

* These energy requirements have been calculated using a standard set of occupant behaviours and so do not necessarily represent the usage pattern or lifestyle of the intended occupants. They should be used solely for the purposes of rating the building. They should not be used to infer actual energy consumption or running costs. The settings used for the simulation are shown in the building data report.

Conditioned floor area	218.0 m²
Area-adjusted star band score	81

Star Rating

★★★★☆ **4.5 STARS**

Area-adjusted star band score thresholds

1 Star	2 Stars	3 Stars	4 Stars	5 Stars	6 Stars	7 Stars	8 Stars	9 Stars	10 Stars
177	141	114	94	80	68	59	49	38	23

AccuRate Regulatory Version June 2005 (expires 30 Sept 2005)

Nationwide House Energy Rating Scheme

Project Details

Project Name:	**Postcode:** 4000
File Name: W:\SBE\admin\7-05\75053 DEH-FR & Int rating comparison\K2	**Climate Zone:** 10
Design Option: Base Design	
Description: Riata 4331	

Client Details

Client Name: International		
Phone: (02) 6274 1888	**Fax:**	**Email:**
Postal Address: Australian Greenhouse Office GPO Box 787 CANBERRA ACT 2601		
Site Address:		
Council submitted to (if known by assessor):		

Assessor Details

Assessor Name: Sustainable Built Environments P/L			**Assessor No.**
Phone: +61 3 9670 9820	**Fax:** +61 3 9670 9890	**Email:** info@sbe.com.au	
Assessment date: 23/8/2005			**Time:** 10:44
Assessor signature:			

RATED ENERGY REQUIREMENTS*

Heating	Cooling (sensible)	Cooling (latent)	Total Energy	Units
6.7	51.8	18.8	77.3	MJ/m².annum
1.9	14.4	5.2	21.5	kWh/m².annum

* These energy requirements have been calculated using a standard set of occupant behaviours and so do not necessarily represent the usage pattern or lifestyle of the intended occupants. They should be used solely for the purposes of rating the building. They should not be used to infer actual energy consumption or running costs. The settings used for the simulation are shown in the building data report.

Conditioned floor area	209.9 m²
Area-adjusted star band score	80

Star Rating

★★★★★ **5 STARS**

Area-adjusted star band score thresholds

1 Star	2 Stars	3 Stars	4 Stars	5 Stars	6 Stars	7 Stars	8 Stars	9 Stars	10 Stars
177	141	114	94	80	68	59	49	38	23

AccuRate Regulatory Version June 2005 (expires 30 Sept 2005)

Nationwide House Energy Rating Scheme

Project Details

Project Name:	**Postcode:** 4000
File Name: W:\SBE\admin\7-05\75053 DEH-FR & Int rating comparison\K2	**Climate Zone:** 10
Design Option: Base Design	
Description: 3253 - Riata	

Client Details

Client Name: International		
Phone: (02) 6274 1888	**Fax:**	**Email:**
Postal Address: Australian Greenhouse Office GPO Box 787 CANBERRA ACT 2601		
Site Address:		
Council submitted to (if known by assessor):		

Assessor Details

Assessor Name: Sustainable Built Environments P/L			**Assessor No.**
Phone: +61 3 9670 9820	**Fax:** +61 3 9670 9890	**Email:** info@sbe.com.au	
Assessment date: 22/8/2005			**Time:** 16:04
Assessor signature:			

RATED ENERGY REQUIREMENTS*

Heating	Cooling (sensible)	Cooling (latent)	Total Energy	Units
1.5	45.0	29.2	75.7	MJ/m².annum
0.4	12.5	8.1	21.0	kWh/m².annum

* These energy requirements have been calculated using a standard set of occupant behaviours and so do not necessarily represent the usage pattern or lifestyle of the intended occupants. They should be used solely for the purposes of rating the building. They should not be used to infer actual energy consumption or running costs. The settings used for the simulation are shown in the building data report.

Conditioned floor area	199.1 m²
Area-adjusted star band score	77

Star Rating

★★★★★ **5 STARS**

Area-adjusted star band score thresholds

1 Star	2 Stars	3 Stars	4 Stars	5 Stars	6 Stars	7 Stars	8 Stars	9 Stars	10 Stars
177	141	114	94	80	68	59	49	38	23

Equivalent Australian Climate Zone 3

	AccuRate Star Rating
Amber	4.5
Bayview	4.5
Birch	5.5
Danville	6
Mendenhall	6.5

AccuRate Regulatory Version June 2005 (expires 30 Sept 2005)

Nationwide House Energy Rating Scheme

Project Details

Project Name:	**Postcode:** 4730
File Name: W:\SBE\admin\7-05\75053 DEH-FR & Int rating comparison\K2	**Climate Zone:** 03
Design Option: Base Design	
Description: Amber	

Client Details

Client Name: International		
Phone: (02) 6274 1888	**Fax:**	**Email:**
Postal Address: Australian Greenhouse Office GPO Box 787 CANBERRA ACT 2601		
Site Address:		
Council submitted to (if known by assessor):		

Assessor Details

Assessor Name: Sustainable Built Environments P/L			**Assessor No.**
Phone: +61 3 9670 9820	**Fax:** +61 3 9670 9890	**Email:** info@sbe.com.au	
Assessment date: 22/8/2005			**Time:** 12:46
Assessor signature:			

RATED ENERGY REQUIREMENTS*

Heating	Cooling (sensible)	Cooling (latent)	Total Energy	Units
0.7	135.1	24.2	160.0	MJ/m².annum
0.2	37.5	6.7	44.4	kWh/m².annum

* These energy requirements have been calculated using a standard set of occupant behaviours and so do not necessarily represent the usage pattern or lifestyle of the intended occupants. They should be used solely for the purposes of rating the building. They should not be used to infer actual energy consumption or running costs. The settings used for the simulation are shown in the building data report.

Conditioned floor area	238.5 m²
Area-adjusted star band score	170

Star Rating

★★★★☆ **4.5 STARS**

Area-adjusted star band score thresholds

1 Star	2 Stars	3 Stars	4 Stars	5 Stars	6 Stars	7 Stars	8 Stars	9 Stars	10 Stars
351	281	228	188	158	134	112	87	57	17

AccuRate Regulatory Version June 2005 (expires 30 Sept 2005)

Nationwide House Energy Rating Scheme

Project Details

Project Name:	**Postcode:** 4730
File Name: W:\SBE\admin\7-05\75053 DEH-FR & Int rating comparison\K2	**Climate Zone:** 03
Design Option: Base Design	
Description: Bayview	

Client Details

Client Name: International		
Phone: (02) 6274 1888	**Fax:**	**Email:**
Postal Address: Australian Greenhouse Office GPO Box 787 CANBERRA ACT 2601		
Site Address:		
Council submitted to (if known by assessor):		

Assessor Details

Assessor Name: Sustainable Built Environments P/L			**Assessor No.**
Phone: +61 3 9670 9820	**Fax:** +61 3 9670 9890	**Email:** info@sbe.com.au	
Assessment date: 22/8/2005			**Time:** 13:05
Assessor signature:			

RATED ENERGY REQUIREMENTS*

Heating	Cooling (sensible)	Cooling (latent)	Total Energy	Units
1.3	141.6	15.8	158.7	MJ/m².annum
0.4	39.3	4.4	44.1	kWh/m².annum

* These energy requirements have been calculated using a standard set of occupant behaviours and so do not necessarily represent the usage pattern or lifestyle of the intended occupants. They should be used solely for the purposes of rating the building. They should not be used to infer actual energy consumption or running costs. The settings used for the simulation are shown in the building data report.

Conditioned floor area	239.8 m²
Area-adjusted star band score	168

Star Rating

★★★★☆ **4.5 STARS**

Area-adjusted star band score thresholds

1 Star	2 Stars	3 Stars	4 Stars	5 Stars	6 Stars	7 Stars	8 Stars	9 Stars	10 Stars
351	281	228	188	158	134	112	87	57	17

AccuRate Regulatory Version June 2005 (expires 30 Sept 2005)

Nationwide House Energy Rating Scheme

Project Details

Project Name:	**Postcode:** 4730
File Name: W:\SBE\admin\7-05\75053 DEH-FR & Int rating comparison\K2	**Climate Zone:** 03
Design Option: Base Design	
Description: The Birch	

Client Details

Client Name: International		
Phone: (02) 6274 1888	**Fax:**	**Email:**
Postal Address: Australian Greenhouse Office GPO Box 787 CANBERRA ACT 2601		
Site Address:		
Council submitted to (if known by assessor):		

Assessor Details

Assessor Name: Sustainable Built Environments P/L			**Assessor No.**
Phone: +61 3 9670 9820	**Fax:** +61 3 9670 9890	**Email:** info@sbe.com.au	
Assessment date: 19/8/2005			**Time:** 15:10
Assessor signature:			

RATED ENERGY REQUIREMENTS*

Heating	Cooling (sensible)	Cooling (latent)	Total Energy	Units
0.1	133.8	17.8	151.7	MJ/m².annum
0.0	37.2	5.0	42.2	kWh/m².annum

* These energy requirements have been calculated using a standard set of occupant behaviours and so do not necessarily represent the usage pattern or lifestyle of the intended occupants. They should be used solely for the purposes of rating the building. They should not be used to infer actual energy consumption or running costs. The settings used for the simulation are shown in the building data report.

Conditioned floor area	106.2 m²
Area-adjusted star band score	134

Star Rating

★★★★★☆ **5.5 STARS**

Area-adjusted star band score thresholds

1 Star	2 Stars	3 Stars	4 Stars	5 Stars	6 Stars	7 Stars	8 Stars	9 Stars	10 Stars
351	281	228	188	158	134	112	87	57	17

AccuRate Regulatory Version June 2005 (expires 30 Sept 2005)

Nationwide House Energy Rating Scheme

Project Details

Project Name:	**Postcode:** 4730
File Name: W:\SBE\admin\7-05\75053 DEH-FR & Int rating comparison\K2	**Climate Zone:** 03
Design Option: Base Design	
Description: Danville	

Client Details

Client Name: International		
Phone: (02) 6274 1888	**Fax:**	**Email:**
Postal Address: Australian Greenhouse Office GPO Box 787 CANBERRA ACT 2601		
Site Address:		
Council submitted to (if known by assessor):		

Assessor Details

Assessor Name: Sustainable Built Environments P/L			**Assessor No.**
Phone: +61 3 9670 9820	**Fax:** +61 3 9670 9890	**Email:** info@sbe.com.au	
Assessment date: 22/8/2005			**Time:** 13:09
Assessor signature:			

RATED ENERGY REQUIREMENTS*

Heating	Cooling (sensible)	Cooling (latent)	Total Energy	Units
3.1	103.8	15.2	122.2	MJ/m².annum
0.9	28.8	4.2	33.9	kWh/m².annum

* These energy requirements have been calculated using a standard set of occupant behaviours and so do not necessarily represent the usage pattern or lifestyle of the intended occupants. They should be used solely for the purposes of rating the building. They should not be used to infer actual energy consumption or running costs. The settings used for the simulation are shown in the building data report.

Conditioned floor area	264.4 m²
Area-adjusted star band score	132

Star Rating

★★★★★★ **6 STARS**

Area-adjusted star band score thresholds

1 Star	2 Stars	3 Stars	4 Stars	5 Stars	6 Stars	7 Stars	8 Stars	9 Stars	10 Stars
351	281	228	188	158	134	112	87	57	17

AccuRate Regulatory Version June 2005 (expires 30 Sept 2005)

Nationwide House Energy Rating Scheme

Project Details

Project Name:	**Postcode:** 4730
File Name: W:\SBE\admin\7-05\75053 DEH-FR & Int rating comparison\K2	**Climate Zone:** 03
Design Option: Base Design	
Description: Mendenhall - no basement - slab on ground	

Client Details

Client Name: International		
Phone: (02) 6274 1888	**Fax:**	**Email:**
Postal Address: Australian Greenhouse Office GPO Box 787 CANBERRA ACT 2601		
Site Address:		
Council submitted to (if known by assessor):		

Assessor Details

Assessor Name: Sustainable Built Environments P/L			**Assessor No.**
Phone: +61 3 9670 9820	**Fax:** +61 3 9670 9890	**Email:** info@sbe.com.au	
Assessment date: 22/8/2005			**Time:** 13:12
Assessor signature:			

RATED ENERGY REQUIREMENTS*

Heating	Cooling (sensible)	Cooling (latent)	Total Energy	Units
0.6	94.1	16.4	111.0	MJ/m².annum
0.2	26.1	4.5	30.8	kWh/m².annum

* These energy requirements have been calculated using a standard set of occupant behaviours and so do not necessarily represent the usage pattern or lifestyle of the intended occupants. They should be used solely for the purposes of rating the building. They should not be used to infer actual energy consumption or running costs. The settings used for the simulation are shown in the building data report.

Conditioned floor area	262.7 m²
Area-adjusted star band score	120

Star Rating

★★★★★★☆ **6.5 STARS**

Area-adjusted star band score thresholds

1 Star	2 Stars	3 Stars	4 Stars	5 Stars	6 Stars	7 Stars	8 Stars	9 Stars	10 Stars
351	281	228	188	158	134	112	87	57	17

Equivalent Australian Climate Zone 4

	AccuRate Star Rating
Canyon Ranch 1	8
Canyon Ranch 3	7
Canyon Ranch 4	7.5

AccuRate Regulatory Version June 2005 (expires 30 Sept 2005)

Nationwide House Energy Rating Scheme

Project Details

Project Name:	**Postcode:** 2830
File Name: W:\SBE\admin\7-05\75053 DEH-FR & Int rating comparison\K2	**Climate Zone:** 14
Design Option: Base Design	
Description: Canyon Ranch 1	

Client Details

Client Name: International		
Phone: (02) 6274 1888	**Fax:**	**Email:**
Postal Address: Australian Greenhouse Office GPO Box 787 CANBERRA ACT 2601		
Site Address:		
Council submitted to (if known by assessor):		

Assessor Details

Assessor Name: Sustainable Built Environments P/L			**Assessor No.**
Phone: +61 3 9670 9820	**Fax:** +61 3 9670 9890	**Email:** info@sbe.com.au	
Assessment date: 25/8/2005			**Time:** 14:28
Assessor signature:			

RATED ENERGY REQUIREMENTS*

Heating	Cooling (sensible)	Cooling (latent)	Total Energy	Units
28.5	41.0	5.6	75.2	MJ/m².annum
7.9	11.4	1.6	20.9	kWh/m².annum

* These energy requirements have been calculated using a standard set of occupant behaviours and so do not necessarily represent the usage pattern or lifestyle of the intended occupants. They should be used solely for the purposes of rating the building. They should not be used to infer actual energy consumption or running costs. The settings used for the simulation are shown in the building data report.

Conditioned floor area	173.8 m²
Area-adjusted star band score	73

Star Rating

★★★★★★★★ **8 STARS**

Area-adjusted star band score thresholds

1 Star	2 Stars	3 Stars	4 Stars	5 Stars	6 Stars	7 Stars	8 Stars	9 Stars	10 Stars
413	327	260	208	168	135	106	78	46	7

AccuRate Regulatory Version June 2005 (expires 30 Sept 2005)

Nationwide House Energy Rating Scheme

Project Details

Project Name:	**Postcode:** 2830
File Name: W:\SBE\admin\7-05\75053 DEH-FR & Int rating comparison\K2	**Climate Zone:** 14
Design Option: Base Design	
Description: Canyon Ranch 3 Representative of BCA Climate Zone 4	

Client Details

Client Name: International		
Phone: (02) 6274 1888	**Fax:**	**Email:**
Postal Address: Australian Greenhouse Office GPO Box 787 CANBERRA ACT 2601		
Site Address:		
Council submitted to (if known by assessor):		

Assessor Details

Assessor Name: Sustainable Built Environments P/L		**Assessor No.**
Phone: +61 3 9670 9820	**Fax:** +61 3 9670 9890	**Email:** info@sbe.com.au
Assessment date: 25/8/2005		**Time:** 15:51
Assessor signature:		

RATED ENERGY REQUIREMENTS*

Heating	Cooling (sensible)	Cooling (latent)	Total Energy	Units
35.9	60.1	5.8	101.8	MJ/m².annum
10.0	16.7	1.6	28.3	kWh/m².annum

* These energy requirements have been calculated using a standard set of occupant behaviours and so do not necessarily represent the usage pattern or lifestyle of the intended occupants. They should be used solely for the purposes of rating the building. They should not be used to infer actual energy consumption or running costs. The settings used for the simulation are shown in the building data report.

Conditioned floor area	201.5 m²
Area-adjusted star band score	104

Star Rating

★★★★★★★ **7 STARS**

Area-adjusted star band score thresholds

1 Star	2 Stars	3 Stars	4 Stars	5 Stars	6 Stars	7 Stars	8 Stars	9 Stars	10 Stars
413	327	260	208	168	135	106	78	46	7

AccuRate Regulatory Version June 2005 (expires 30 Sept 2005)

Nationwide House Energy Rating Scheme

Project Details

Project Name:	**Postcode:** 2830
File Name: W:\SBE\admin\7-05\75053 DEH-FR & Int rating comparison\K2	**Climate Zone:** 14
Design Option: Base Design	
Description: canyon ranch 4	

Client Details

Client Name: International		
Phone: (02) 6274 1888	**Fax:**	**Email:**
Postal Address: Australian Greenhouse Office GPO Box 787 CANBERRA ACT 2601		
Site Address:		
Council submitted to (if known by assessor):		

Assessor Details

Assessor Name: Sustainable Built Environments P/L			**Assessor No.**
Phone: +61 3 9670 9820	**Fax:** +61 3 9670 9890	**Email:** info@sbe.com.au	
Assessment date: 25/8/2005			**Time:** 14:19
Assessor signature:			

RATED ENERGY REQUIREMENTS*

Heating	Cooling (sensible)	Cooling (latent)	Total Energy	Units
32.3	47.8	6.5	86.7	MJ/m².annum
9.0	13.3	1.8	24.1	kWh/m².annum

* These energy requirements have been calculated using a standard set of occupant behaviours and so do not necessarily represent the usage pattern or lifestyle of the intended occupants. They should be used solely for the purposes of rating the building. They should not be used to infer actual energy consumption or running costs. The settings used for the simulation are shown in the building data report.

Conditioned floor area	223.0 m²
Area-adjusted star band score	91

Star Rating

★★★★★★★½ **7.5 STARS**

Area-adjusted star band score thresholds

1 Star	2 Stars	3 Stars	4 Stars	5 Stars	6 Stars	7 Stars	8 Stars	9 Stars	10 Stars
413	327	260	208	168	135	106	78	46	7

Equivalent Australian Climate Zone 5

	AccuRate Star Rating
Merrill Ranch 4536	7
Merrill Ranch 4540	7
Stetson II 4010	7.5
Stetson II 4011	6.5

AccuRate Regulatory Version June 2005 (expires 30 Sept 2005)

Nationwide House Energy Rating Scheme

Project Details

Project Name:	**Postcode:** 6000
File Name: W:\SBE\admin\7-05\75053 DEH-FR & Int rating comparison\K2	**Climate Zone:** 13
Design Option: Base Design	
Description:	

Client Details

Client Name: International		
Phone: (02) 6274 1888	**Fax:**	**Email:**
Postal Address: Australian Greenhouse Office GPO Box 787 CANBERRA ACT 2601		
Site Address:		
Council submitted to (if known by assessor):		

Assessor Details

Assessor Name: Sustainable Built Environments P/L			**Assessor No.**
Phone: +61 3 9670 9820	**Fax:** +61 3 9670 9890	**Email:** info@sbe.com.au	
Assessment date: 25/8/2005			**Time:** 12:11
Assessor signature:			

RATED ENERGY REQUIREMENTS*

Heating	Cooling (sensible)	Cooling (latent)	Total Energy	Units
3.0	38.8	7.9	49.8	MJ/m².annum
0.8	10.8	2.2	13.8	kWh/m².annum

* These energy requirements have been calculated using a standard set of occupant behaviours and so do not necessarily represent the usage pattern or lifestyle of the intended occupants. They should be used solely for the purposes of rating the building. They should not be used to infer actual energy consumption or running costs. The settings used for the simulation are shown in the building data report.

Conditioned floor area	288.4 m²
Area-adjusted star band score	56

Star Rating

★★★★★★★☆ **7.5 STARS**

Area-adjusted star band score thresholds

1 Star	2 Stars	3 Stars	4 Stars	5 Stars	6 Stars	7 Stars	8 Stars	9 Stars	10 Stars
263	196	147	113	90	75	63	50	34	10

AccuRate Regulatory Version June 2005 (expires 30 Sept 2005)

Nationwide House Energy Rating Scheme

Project Details

Project Name:	**Postcode:** 6000
File Name: W:\SBE\admin\7-05\75053 DEH-FR & Int rating comparison\K2	**Climate Zone:** 13
Design Option: Base Design	
Description: 4540 Merrill Ranch	

Client Details

Client Name: International		
Phone: (02) 6274 1888	**Fax:**	**Email:**
Postal Address: Australian Greenhouse Office GPO Box 787 CANBERRA ACT 2601		
Site Address:		
Council submitted to (if known by assessor):		

Assessor Details

Assessor Name: Sustainable Built Environments P/L			**Assessor No.**
Phone: +61 3 9670 9820	**Fax:** +61 3 9670 9890	**Email:** info@sbe.com.au	
Assessment date: 25/8/2005			**Time:** 10:38
Assessor signature:			

RATED ENERGY REQUIREMENTS*

Heating	Cooling (sensible)	Cooling (latent)	Total Energy	Units
2.2	39.2	7.6	49.0	MJ/m².annum
0.6	10.9	2.1	13.6	kWh/m².annum

* These energy requirements have been calculated using a standard set of occupant behaviours and so do not necessarily represent the usage pattern or lifestyle of the intended occupants. They should be used solely for the purposes of rating the building. They should not be used to infer actual energy consumption or running costs. The settings used for the simulation are shown in the building data report.

Conditioned floor area	278.2 m²
Area-adjusted star band score	54

Star Rating

★★★★★★★☆ **7.5 STARS**

Area-adjusted star band score thresholds

1 Star	2 Stars	3 Stars	4 Stars	5 Stars	6 Stars	7 Stars	8 Stars	9 Stars	10 Stars
263	196	147	113	90	75	63	50	34	10

AccuRate Regulatory Version June 2005 (expires 30 Sept 2005)

Nationwide House Energy Rating Scheme

Project Details

Project Name:	**Postcode:** 6000
File Name: W:\SBE\admin\7-05\75053 DEH-FR & Int rating comparison\K2	**Climate Zone:** 13
Design Option: Base Design	
Description: 4010 Stetson II Represents climate zone 5	

Client Details

Client Name: International		
Phone: (02) 6274 1888	**Fax:**	**Email:**
Postal Address: Australian Greenhouse Office GPO Box 787 CANBERRA ACT 2601		
Site Address:		
Council submitted to (if known by assessor):		

Assessor Details

Assessor Name: Sustainable Built Environments P/L			**Assessor No.**
Phone: +61 3 9670 9820	**Fax:** +61 3 9670 9890	**Email:** info@sbe.com.au	
Assessment date: 25/8/2005			**Time:** 14:48
Assessor signature:			

RATED ENERGY REQUIREMENTS*

Heating	Cooling (sensible)	Cooling (latent)	Total Energy	Units
9.1	39.0	8.0	56.0	MJ/m².annum
2.5	10.8	2.2	15.6	kWh/m².annum

* These energy requirements have been calculated using a standard set of occupant behaviours and so do not necessarily represent the usage pattern or lifestyle of the intended occupants. They should be used solely for the purposes of rating the building. They should not be used to infer actual energy consumption or running costs. The settings used for the simulation are shown in the building data report.

Conditioned floor area	120.1 m²
Area-adjusted star band score	49

Star Rating

★★★★★★★★ **8 STARS**

Area-adjusted star band score thresholds

1 Star	2 Stars	3 Stars	4 Stars	5 Stars	6 Stars	7 Stars	8 Stars	9 Stars	10 Stars
263	196	147	113	90	75	63	50	34	10

AccuRate Regulatory Version June 2005 (expires 30 Sept 2005)

Nationwide House Energy Rating Scheme

Project Details

Project Name:	**Postcode:** 6000
File Name: F:\Arizona - 4011 Stetson II.PRO	**Climate Zone:** 13
Design Option: Base Design	
Description: 4011 Stetson II	

Client Details

Client Name: International		
Phone: (02) 6274 1888	**Fax:**	**Email:**
Postal Address: Australian Greenhouse Office GPO Box 787 CANBERRA ACT 2601		
Site Address:		
Council submitted to (if known by assessor):		

Assessor Details

Assessor Name: Sustainable Built Environments P/L			**Assessor No.**
Phone: +61 3 9670 9820	**Fax:** +61 3 9670 9890	**Email:** info@sbe.com.au	
Assessment date: 25/8/2005			**Time:** 8:54
Assessor signature:			

RATED ENERGY REQUIREMENTS*

Heating	Cooling (sensible)	Cooling (latent)	Total Energy	Units
3.8	52.3	7.1	63.2	MJ/m².annum
1.1	14.5	2.0	17.6	kWh/m².annum

* These energy requirements have been calculated using a standard set of occupant behaviours and so do not necessarily represent the usage pattern or lifestyle of the intended occupants. They should be used solely for the purposes of rating the building. They should not be used to infer actual energy consumption or running costs. The settings used for the simulation are shown in the building data report.

Conditioned floor area	149.4 m²
Area-adjusted star band score	59

Star Rating

★★★★★★★ **7 STARS**

Area-adjusted star band score thresholds

1 Star	2 Stars	3 Stars	4 Stars	5 Stars	6 Stars	7 Stars	8 Stars	9 Stars	10 Stars
263	196	147	113	90	75	63	50	34	10

Equivalent Australian Climate Zone 6

Danbury Place	8
Devon Square	6
Rose Street Apt	9
Westpark Village 3	7.5

AccuRate Regulatory Version June 2005 (expires 30 Sept 2005)

Nationwide House Energy Rating Scheme

Project Details

Project Name:	**Postcode:** 3000
File Name: W:\SBE\admin\7-05\75053 DEH-FR & Int rating comparison\K2	**Climate Zone:** 21
Design Option: Base Design	
Description: danbury place	

Client Details

Client Name: International		
Phone: (02) 6274 1888	**Fax:**	**Email:**
Postal Address: Australian Greenhouse Office GPO Box 787 CANBERRA ACT 2601		
Site Address:		
Council submitted to (if known by assessor):		

Assessor Details

Assessor Name: Sustainable Built Environments P/L			**Assessor No.**
Phone: +61 3 9670 9820	**Fax:** +61 3 9670 9890	**Email:** info@sbe.com.au	
Assessment date: 24/8/2005			**Time:** 16:52
Assessor signature:			

RATED ENERGY REQUIREMENTS*

Heating	Cooling (sensible)	Cooling (latent)	Total Energy	Units
31.7	19.6	4.1	55.4	MJ/m².annum
8.8	5.4	1.1	15.4	kWh/m².annum

* These energy requirements have been calculated using a standard set of occupant behaviours and so do not necessarily represent the usage pattern or lifestyle of the intended occupants. They should be used solely for the purposes of rating the building. They should not be used to infer actual energy consumption or running costs. The settings used for the simulation are shown in the building data report.

Conditioned floor area	104.6 m²
Area-adjusted star band score	49

Star Rating

★★★★★★★★ **8 STARS**

Area-adjusted star band score thresholds

1 Star	2 Stars	3 Stars	4 Stars	5 Stars	6 Stars	7 Stars	8 Stars	9 Stars	10 Stars
337	274	222	179	142	111	84	58	32	5

AccuRate Regulatory Version June 2005 (expires 30 Sept 2005)

Nationwide House Energy Rating Scheme

Project Details

Project Name:	**Postcode:** 3000
File Name: W:\SBE\admin\7-05\75053 DEH-FR & Int rating comparison\K2	**Climate Zone:** 21
Design Option: Base Design	
Description: devon square	

Client Details

Client Name: International		
Phone: (02) 6274 1888	**Fax:**	**Email:**
Postal Address: Australian Greenhouse Office GPO Box 787 CANBERRA ACT 2601		
Site Address:		
Council submitted to (if known by assessor):		

Assessor Details

Assessor Name: Sustainable Built Environments P/L			**Assessor No.**
Phone: +61 3 9670 9820	**Fax:** +61 3 9670 9890	**Email:** info@sbe.com.au	
Assessment date: 24/8/2005			**Time:** 15:39
Assessor signature:			

RATED ENERGY REQUIREMENTS*

Heating	Cooling (sensible)	Cooling (latent)	Total Energy	Units
21.6	23.5	8.5	53.5	MJ/m².annum
6.0	6.5	2.3	14.9	kWh/m².annum

* These energy requirements have been calculated using a standard set of occupant behaviours and so do not necessarily represent the usage pattern or lifestyle of the intended occupants. They should be used solely for the purposes of rating the building. They should not be used to infer actual energy consumption or running costs. The settings used for the simulation are shown in the building data report.

Conditioned floor area	114.7 m²
Area-adjusted star band score	48

Star Rating

★★★★★★★★ **8 STARS**

Area-adjusted star band score thresholds

1 Star	2 Stars	3 Stars	4 Stars	5 Stars	6 Stars	7 Stars	8 Stars	9 Stars	10 Stars
337	274	222	179	142	111	84	58	32	5

AccuRate Regulatory Version June 2005 (expires 30 Sept 2005)

Nationwide House Energy Rating Scheme

Project Details

Project Name:	**Postcode:** 3000
File Name: W:\SBE\admin\7-05\75053 DEH-FR & Int rating comparison\K2	**Climate Zone:** 21
Design Option: Base Design	
Description:	

Client Details

Client Name: International		
Phone: (02) 6274 1888	**Fax:**	**Email:**
Postal Address: Australian Greenhouse Office GPO Box 787 CANBERRA ACT 2601		
Site Address:		
Council submitted to (if known by assessor):		

Assessor Details

Assessor Name: Sustainable Built Environments P/L			**Assessor No.**
Phone: +61 3 9670 9820	**Fax:** +61 3 9670 9890	**Email:** info@sbe.com.au	
Assessment date: 24/8/2005			**Time:** 11:33
Assessor signature:			

RATED ENERGY REQUIREMENTS*

Heating	Cooling (sensible)	Cooling (latent)	Total Energy	Units
2.8	17.8	4.9	25.6	MJ/m².annum
0.8	5.0	1.4	7.1	kWh/m².annum

* These energy requirements have been calculated using a standard set of occupant behaviours and so do not necessarily represent the usage pattern or lifestyle of the intended occupants. They should be used solely for the purposes of rating the building. They should not be used to infer actual energy consumption or running costs. The settings used for the simulation are shown in the building data report.

Conditioned floor area	49.4 m²
Area-adjusted star band score	25

Star Rating

★★★★★★★★★ **9 STARS**

Area-adjusted star band score thresholds

1 Star	2 Stars	3 Stars	4 Stars	5 Stars	6 Stars	7 Stars	8 Stars	9 Stars	10 Stars
337	274	222	179	142	111	84	58	32	5

AccuRate Regulatory Version June 2005 (expires 30 Sept 2005)

Nationwide House Energy Rating Scheme

Project Details

Project Name:	**Postcode:** 3000
File Name: W:\SBE\admin\7-05\75053 DEH-FR & Int rating comparison\K2	**Climate Zone:** 21
Design Option: Base Design	
Description: Wespark village Bay area	

Client Details

Client Name: International		
Phone: (02) 6274 1888	**Fax:**	**Email:**
Postal Address: Australian Greenhouse Office GPO Box 787 CANBERRA ACT 2601		
Site Address:		
Council submitted to (if known by assessor):		

Assessor Details

Assessor Name: Sustainable Built Environments P/L			**Assessor No.**
Phone: +61 3 9670 9820	**Fax:** +61 3 9670 9890	**Email:** info@sbe.com.au	
Assessment date: 24/8/2005			**Time:** 13:17
Assessor signature:			

RATED ENERGY REQUIREMENTS*

Heating	Cooling (sensible)	Cooling (latent)	Total Energy	Units
28.9	37.6	4.2	70.8	MJ/m².annum
8.0	10.4	1.2	19.7	kWh/m².annum

* These energy requirements have been calculated using a standard set of occupant behaviours and so do not necessarily represent the usage pattern or lifestyle of the intended occupants. They should be used solely for the purposes of rating the building. They should not be used to infer actual energy consumption or running costs. The settings used for the simulation are shown in the building data report.

Conditioned floor area	182.7 m²
Area-adjusted star band score	70

Star Rating

★★★★★★★★☆ **7.5 STARS**

Area-adjusted star band score thresholds

1 Star	2 Stars	3 Stars	4 Stars	5 Stars	6 Stars	7 Stars	8 Stars	9 Stars	10 Stars
337	274	222	179	142	111	84	58	32	5

Equivalent Australian Climate Zone 7

	AccuRate Star Rating
52652	6.5
53653	7
73872	7.5
83236	8.5
83227	8
J313	8
Murfield	7

AccuRate Regulatory Version June 2005 (expires 30 Sept 2005)

Nationwide House Energy Rating Scheme

Project Details

Project Name:	**Postcode:** 7000
File Name: S:\Centre for Design\COMMON\E - PROJECT AREAS\0 - Building	**Climate Zone:** 26
Design Option: 52652	
Description: Canada / Vancouver - this is equivalent to climate zone 7 in Australia.	

Client Details

Client Name: International		
Phone: (02) 6274 1888	**Fax:**	**Email:**
Postal Address: Australian Greenhouse Office GPO Box 787 CANBERRA ACT 2601		
Site Address:		
Council submitted to (if known by assessor):		

Assessor Details

Assessor Name: Sustainable Built Environments P/L			**Assessor No.**
Phone: +61 3 9670 9820	**Fax:** +61 3 9670 9890	**Email:** info@sbe.com.au	
Assessment date: 25/8/2005			**Time:** 10:36
Assessor signature:			

RATED ENERGY REQUIREMENTS*

Heating	Cooling (sensible)	Cooling (latent)	Total Energy	Units
131.1	7.7	0.8	139.7	MJ/m².annum
36.4	2.1	0.2	38.8	kWh/m².annum

* These energy requirements have been calculated using a standard set of occupant behaviours and so do not necessarily represent the usage pattern or lifestyle of the intended occupants. They should be used solely for the purposes of rating the building. They should not be used to infer actual energy consumption or running costs. The settings used for the simulation are shown in the building data report.

Conditioned floor area	141.1 m²
Area-adjusted star band score	126

Star Rating

★★★★★★☆ **6.5 STARS**

Area-adjusted star band score thresholds

1 Star	2 Stars	3 Stars	4 Stars	5 Stars	6 Stars	7 Stars	8 Stars	9 Stars	10 Stars
494	394	313	250	199	157	120	84	46	2

AccuRate Regulatory Version June 2005 (expires 30 Sept 2005)

Nationwide House Energy Rating Scheme

Project Details

Project Name:	**Postcode:** 7000
File Name: S:\Centre for Design\COMMON\E - PROJECT AREAS\0 - Building	**Climate Zone:** 26
Design Option: 53653	
Description: Canada / Vancouver - this is equivalent to climate zone 7 in Australia	

Client Details

Client Name: International		
Phone: (02) 6274 1888	**Fax:**	**Email:**
Postal Address: Australian Greenhouse Office GPO Box 787 CANBERRA ACT 2601		
Site Address:		
Council submitted to (if known by assessor):		

Assessor Details

Assessor Name: Sustainable Built Environments P/L			**Assessor No.**
Phone: +61 3 9670 9820	**Fax:** +61 3 9670 9890	**Email:** info@sbe.com.au	
Assessment date: 25/8/2005			**Time:** 10:44
Assessor signature:			

RATED ENERGY REQUIREMENTS*

Heating	Cooling (sensible)	Cooling (latent)	Total Energy	Units
104.2	9.2	1.0	114.4	MJ/m².annum
28.9	2.5	0.3	31.8	kWh/m².annum

* These energy requirements have been calculated using a standard set of occupant behaviours and so do not necessarily represent the usage pattern or lifestyle of the intended occupants. They should be used solely for the purposes of rating the building. They should not be used to infer actual energy consumption or running costs. The settings used for the simulation are shown in the building data report.

Conditioned floor area	135.1 m²
Area-adjusted star band score	102

Star Rating

★★★★★★★ **7 STARS**

Area-adjusted star band score thresholds

1 Star	2 Stars	3 Stars	4 Stars	5 Stars	6 Stars	7 Stars	8 Stars	9 Stars	10 Stars
494	394	313	250	199	157	120	84	46	2

AccuRate Regulatory Version June 2005 (expires 30 Sept 2005)

Nationwide House Energy Rating Scheme

Project Details

Project Name:	**Postcode:** 7000
File Name: S:\Centre for Design\COMMON\E - PROJECT AREAS\0 - Building	**Climate Zone:** 26
Design Option: 73872	
Description: Canada / Vancouver - this is equivalent to climate zone 7 in Australia	

Client Details

Client Name: International		
Phone: (02) 6274 1888	**Fax:**	**Email:**
Postal Address: Australian Greenhouse Office GPO Box 787 CANBERRA ACT 2601		
Site Address:		
Council submitted to (if known by assessor):		

Assessor Details

Assessor Name: Sustainable Built Environments P/L			**Assessor No.**
Phone: +61 3 9670 9820	**Fax:** +61 3 9670 9890	**Email:** info@sbe.com.au	
Assessment date: 25/8/2005			**Time:** 10:51
Assessor signature:			

RATED ENERGY REQUIREMENTS*

Heating	Cooling (sensible)	Cooling (latent)	Total Energy	Units
80.6	13.0	1.2	94.8	MJ/m².annum
22.4	3.6	0.3	26.3	kWh/m².annum

* These energy requirements have been calculated using a standard set of occupant behaviours and so do not necessarily represent the usage pattern or lifestyle of the intended occupants. They should be used solely for the purposes of rating the building. They should not be used to infer actual energy consumption or running costs. The settings used for the simulation are shown in the building data report.

Conditioned floor area	141.5 m²
Area-adjusted star band score	86

Star Rating

★★★★★★★★☆ **7.5 STARS**

Area-adjusted star band score thresholds

1 Star	2 Stars	3 Stars	4 Stars	5 Stars	6 Stars	7 Stars	8 Stars	9 Stars	10 Stars
494	394	313	250	199	157	120	84	46	2

AccuRate Regulatory Version June 2005 (expires 30 Sept 2005)

Nationwide House Energy Rating Scheme

Project Details

Project Name:	**Postcode:** 7000
File Name: S:\Centre for Design\COMMON\E - PROJECT AREAS\0 - Building	**Climate Zone:** 26
Design Option: 83227	
Description: Canada / Vancouver - this is equivalent to climate zone 7 in Australia	

Client Details

Client Name: International		
Phone: (02) 6274 1888	**Fax:**	**Email:**
Postal Address: Australian Greenhouse Office GPO Box 787 CANBERRA ACT 2601		
Site Address:		
Council submitted to (if known by assessor):		

Assessor Details

Assessor Name: Sustainable Built Environments P/L			**Assessor No.**
Phone: +61 3 9670 9820	**Fax:** +61 3 9670 9890	**Email:** info@sbe.com.au	
Assessment date: 25/8/2005			**Time:** 10:54
Assessor signature:			

RATED ENERGY REQUIREMENTS*

Heating	Cooling (sensible)	Cooling (latent)	Total Energy	Units
71.9	8.7	3.1	83.7	MJ/m².annum
20.0	2.4	0.9	23.2	kWh/m².annum

* These energy requirements have been calculated using a standard set of occupant behaviours and so do not necessarily represent the usage pattern or lifestyle of the intended occupants. They should be used solely for the purposes of rating the building. They should not be used to infer actual energy consumption or running costs. The settings used for the simulation are shown in the building data report.

Conditioned floor area	115.7 m²
Area-adjusted star band score	73

Star Rating

★★★★★★★★ **8 STARS**

Area-adjusted star band score thresholds

1 Star	2 Stars	3 Stars	4 Stars	5 Stars	6 Stars	7 Stars	8 Stars	9 Stars	10 Stars
494	394	313	250	199	157	120	84	46	2

AccuRate Regulatory Version June 2005 (expires 30 Sept 2005)

Nationwide House Energy Rating Scheme

Project Details

Project Name:	**Postcode:** 7000
File Name: S:\Centre for Design\COMMON\E - PROJECT AREAS\0 - Building	**Climate Zone:** 26
Design Option: 83236	
Description: Canada / Vancouver - this is equivalent to climate zone 7 in Australia	

Client Details

Client Name: International		
Phone: (02) 6274 1888	**Fax:**	**Email:**
Postal Address: Australian Greenhouse Office GPO Box 787 CANBERRA ACT 2601		
Site Address:		
Council submitted to (if known by assessor):		

Assessor Details

Assessor Name: Sustainable Built Environments P/L			**Assessor No.**
Phone: +61 3 9670 9820	**Fax:** +61 3 9670 9890	**Email:** info@sbe.com.au	
Assessment date: 25/8/2005			**Time:** 10:56
Assessor signature:			

RATED ENERGY REQUIREMENTS*

Heating	Cooling (sensible)	Cooling (latent)	Total Energy	Units
49.5	7.9	1.2	58.5	MJ/m².annum
13.8	2.2	0.3	16.3	kWh/m².annum

* These energy requirements have been calculated using a standard set of occupant behaviours and so do not necessarily represent the usage pattern or lifestyle of the intended occupants. They should be used solely for the purposes of rating the building. They should not be used to infer actual energy consumption or running costs. The settings used for the simulation are shown in the building data report.

Conditioned floor area	160.0 m²
Area-adjusted star band score	55

Star Rating

★★★★★★★★★☆ **8.5 STARS**

Area-adjusted star band score thresholds

1 Star	2 Stars	3 Stars	4 Stars	5 Stars	6 Stars	7 Stars	8 Stars	9 Stars	10 Stars
494	394	313	250	199	157	120	84	46	2

AccuRate Regulatory Version June 2005 (expires 30 Sept 2005)

Nationwide House Energy Rating Scheme

Project Details

Project Name:	**Postcode:** 7000
File Name: S:\Centre for Design\COMMON\E - PROJECT AREAS\0 - Building	**Climate Zone:** 26
Design Option: J313	
Description: Canada / Vancouver - this is equivalent to climate zone 7 in Australia	

Client Details

Client Name: International		
Phone: (02) 6274 1888	**Fax:**	**Email:**
Postal Address: Australian Greenhouse Office GPO Box 787 CANBERRA ACT 2601		
Site Address:		
Council submitted to (if known by assessor):		

Assessor Details

Assessor Name: Sustainable Built Environments P/L			**Assessor No.**
Phone: +61 3 9670 9820	**Fax:** +61 3 9670 9890	**Email:** info@sbe.com.au	
Assessment date: 25/8/2005			**Time:** 11:00
Assessor signature:			

RATED ENERGY REQUIREMENTS*

Heating	Cooling (sensible)	Cooling (latent)	Total Energy	Units
69.6	6.7	1.2	77.6	MJ/m².annum
19.3	1.9	0.3	21.6	kWh/m².annum

* These energy requirements have been calculated using a standard set of occupant behaviours and so do not necessarily represent the usage pattern or lifestyle of the intended occupants. They should be used solely for the purposes of rating the building. They should not be used to infer actual energy consumption or running costs. The settings used for the simulation are shown in the building data report.

Conditioned floor area	144.1 m²
Area-adjusted star band score	71

Star Rating

★★★★★★★★ **8 STARS**

Area-adjusted star band score thresholds

1 Star	2 Stars	3 Stars	4 Stars	5 Stars	6 Stars	7 Stars	8 Stars	9 Stars	10 Stars
494	394	313	250	199	157	120	84	46	2

AccuRate Regulatory Version June 2005 (expires 30 Sept 2005)

Nationwide House Energy Rating Scheme

Project Details

Project Name:	**Postcode:** 7000
File Name: S:\Centre for Design\COMMON\E - PROJECT AREAS\0 - Building	**Climate Zone:** 26
Design Option: Murfield	
Description: Canada / Vancouver - this is equivalent to climate zone 7 in Australia	

Client Details

Client Name: International		
Phone: (02) 6274 1888	**Fax:**	**Email:**
Postal Address: Australian Greenhouse Office GPO Box 787 CANBERRA ACT 2601		
Site Address:		
Council submitted to (if known by assessor):		

Assessor Details

Assessor Name: Sustainable Built Environments P/L			**Assessor No.**
Phone: +61 3 9670 9820	**Fax:** +61 3 9670 9890	**Email:** info@sbe.com.au	
Assessment date: 25/8/2005			**Time:** 11:07
Assessor signature:			

RATED ENERGY REQUIREMENTS*

Heating	Cooling (sensible)	Cooling (latent)	Total Energy	Units
80.3	23.6	10.5	114.4	MJ/m².annum
22.3	6.6	2.9	31.8	kWh/m².annum

* These energy requirements have been calculated using a standard set of occupant behaviours and so do not necessarily represent the usage pattern or lifestyle of the intended occupants. They should be used solely for the purposes of rating the building. They should not be used to infer actual energy consumption or running costs. The settings used for the simulation are shown in the building data report.

Conditioned floor area	175.9 m²
Area-adjusted star band score	111

Star Rating

★★★★★★★ **7 STARS**

Area-adjusted star band score thresholds

1 Star	2 Stars	3 Stars	4 Stars	5 Stars	6 Stars	7 Stars	8 Stars	9 Stars	10 Stars
494	394	313	250	199	157	120	84	46	2

Equivalent Australian Climate Zone 7

	AccuRate Star Rating
Byron	8
Chatsworth	8.5
Chesterton	8
Coalport	8.5
Halisham A	8.5
Hereford	8.5
Kempton	8
Kensington	8
Shelley	8.5

AccuRate Regulatory Version June 2005 (expires 30 Sept 2005)

Nationwide House Energy Rating Scheme

Project Details

Project Name:	**Postcode:** 7000
File Name: W:\SBE\admin\7-05\75053 DEH-FR & Int rating comparison\K2	**Climate Zone:** 26
Design Option: Base Design	
Description: Byron - unshared walls	

Client Details

Client Name: International		
Phone: (02) 6274 1888	**Fax:**	**Email:**
Postal Address: Australian Greenhouse Office GPO Box 787 CANBERRA ACT 2601		
Site Address:		
Council submitted to (if known by assessor):		

Assessor Details

Assessor Name: Sustainable Built Environments P/L			**Assessor No.**
Phone: +61 3 9670 9820	**Fax:** +61 3 9670 9890	**Email:** info@sbe.com.au	
Assessment date: 10/8/2005			**Time:** 12:16
Assessor signature:			

RATED ENERGY REQUIREMENTS*

Heating	Cooling (sensible)	Cooling (latent)	Total Energy	Units
66.0	21.1	12.4	99.5	MJ/m².annum
18.3	5.9	3.5	27.6	kWh/m².annum

* These energy requirements have been calculated using a standard set of occupant behaviours and so do not necessarily represent the usage pattern or lifestyle of the intended occupants. They should be used solely for the purposes of rating the building. They should not be used to infer actual energy consumption or running costs. The settings used for the simulation are shown in the building data report.

Conditioned floor area	61.1 m²
Area-adjusted star band score	74

Star Rating

★★★★★★★★ **8 STARS**

Area-adjusted star band score thresholds

1 Star	2 Stars	3 Stars	4 Stars	5 Stars	6 Stars	7 Stars	8 Stars	9 Stars	10 Stars
494	394	313	250	199	157	120	84	46	2

AccuRate Regulatory Version June 2005 (expires 30 Sept 2005)

Nationwide House Energy Rating Scheme

Project Details

Project Name:	**Postcode:** 7000
File Name: W:\SBE\admin\7-05\75053 DEH-FR & Int rating comparison\K2	**Climate Zone:** 26
Design Option: Base Design	
Description: Chatsworth	

Client Details

Client Name: International		
Phone: (02) 6274 1888	**Fax:**	**Email:**
Postal Address: Australian Greenhouse Office GPO Box 787 CANBERRA ACT 2601		
Site Address:		
Council submitted to (if known by assessor):		

Assessor Details

Assessor Name: Sustainable Built Environments P/L			**Assessor No.**
Phone: +61 3 9670 9820	**Fax:** +61 3 9670 9890	**Email:** info@sbe.com.au	
Assessment date: 10/8/2005			**Time:** 12:24
Assessor signature:			

RATED ENERGY REQUIREMENTS*

Heating	Cooling (sensible)	Cooling (latent)	Total Energy	Units
46.3	11.0	7.5	64.9	MJ/m².annum
12.9	3.1	2.1	18.0	kWh/m².annum

* These energy requirements have been calculated using a standard set of occupant behaviours and so do not necessarily represent the usage pattern or lifestyle of the intended occupants. They should be used solely for the purposes of rating the building. They should not be used to infer actual energy consumption or running costs. The settings used for the simulation are shown in the building data report.

Conditioned floor area	68.8 m²
Area-adjusted star band score	49

Star Rating

★★★★★★★★★☆ **8.5 STARS**

Area-adjusted star band score thresholds

1 Star	2 Stars	3 Stars	4 Stars	5 Stars	6 Stars	7 Stars	8 Stars	9 Stars	10 Stars
494	394	313	250	199	157	120	84	46	2

AccuRate Regulatory Version June 2005 (expires 30 Sept 2005)

Nationwide House Energy Rating Scheme

Project Details

Project Name:	**Postcode:** 7000
File Name: W:\SBE\admin\7-05\75053 DEH-FR & Int rating comparison\K2	**Climate Zone:** 26
Design Option: Base Design	
Description: Chesterton - no conservatory - no shared walls	

Client Details

Client Name: International		
Phone: (02) 6274 1888	**Fax:**	**Email:**
Postal Address: Australian Greenhouse Office GPO Box 787 CANBERRA ACT 2601		
Site Address:		
Council submitted to (if known by assessor):		

Assessor Details

Assessor Name: Sustainable Built Environments P/L			**Assessor No.**
Phone: +61 3 9670 9820	**Fax:** +61 3 9670 9890	**Email:** info@sbe.com.au	
Assessment date: 10/8/2005			**Time:** 12:32
Assessor signature:			

RATED ENERGY REQUIREMENTS*

Heating	Cooling (sensible)	Cooling (latent)	Total Energy	Units
78.1	12.2	6.3	96.6	MJ/m².annum
21.7	3.4	1.7	26.8	kWh/m².annum

* These energy requirements have been calculated using a standard set of occupant behaviours and so do not necessarily represent the usage pattern or lifestyle of the intended occupants. They should be used solely for the purposes of rating the building. They should not be used to infer actual energy consumption or running costs. The settings used for the simulation are shown in the building data report.

Conditioned floor area	75.6 m²
Area-adjusted star band score	75

Star Rating

★★★★★★★★ **8 STARS**

Area-adjusted star band score thresholds

1 Star	2 Stars	3 Stars	4 Stars	5 Stars	6 Stars	7 Stars	8 Stars	9 Stars	10 Stars
494	394	313	250	199	157	120	84	46	2

AccuRate Regulatory Version June 2005 (expires 30 Sept 2005)

Nationwide House Energy Rating Scheme

Project Details

Project Name:	**Postcode:** 7000
File Name: W:\SBE\admin\7-05\75053 DEH-FR & Int rating comparison\K2	**Climate Zone:** 26
Design Option: Base Design	
Description: Coalport - unshared walls	

Client Details

Client Name: International		
Phone: (02) 6274 1888	**Fax:**	**Email:**
Postal Address: Australian Greenhouse Office GPO Box 787 CANBERRA ACT 2601		
Site Address:		
Council submitted to (if known by assessor):		

Assessor Details

Assessor Name: Sustainable Built Environments P/L			**Assessor No.**
Phone: +61 3 9670 9820	**Fax:** +61 3 9670 9890	**Email:** info@sbe.com.au	
Assessment date: 10/8/2005			**Time:** 12:38
Assessor signature:			

RATED ENERGY REQUIREMENTS*

Heating	Cooling (sensible)	Cooling (latent)	Total Energy	Units
61.3	5.9	3.9	71.1	MJ/m².annum
17.0	1.6	1.1	19.8	kWh/m².annum

* These energy requirements have been calculated using a standard set of occupant behaviours and so do not necessarily represent the usage pattern or lifestyle of the intended occupants. They should be used solely for the purposes of rating the building. They should not be used to infer actual energy consumption or running costs. The settings used for the simulation are shown in the building data report.

Conditioned floor area	85.1 m²
Area-adjusted star band score	56

Star Rating

★★★★★★★★★☆ **8.5 STARS**

Area-adjusted star band score thresholds

1 Star	2 Stars	3 Stars	4 Stars	5 Stars	6 Stars	7 Stars	8 Stars	9 Stars	10 Stars
494	394	313	250	199	157	120	84	46	2

AccuRate Regulatory Version June 2005 (expires 30 Sept 2005)

Nationwide House Energy Rating Scheme

Project Details

Project Name:	**Postcode:** 7000
File Name: W:\SBE\admin\7-05\75053 DEH-FR & Int rating comparison\K2	**Climate Zone:** 26
Design Option: Base Design	
Description: Halisham A	

Client Details

Client Name: International		
Phone: (02) 6274 1888	**Fax:**	**Email:**
Postal Address: Australian Greenhouse Office GPO Box 787 CANBERRA ACT 2601		
Site Address:		
Council submitted to (if known by assessor):		

Assessor Details

Assessor Name: Sustainable Built Environments P/L			**Assessor No.**
Phone: +61 3 9670 9820	**Fax:** +61 3 9670 9890	**Email:** info@sbe.com.au	
Assessment date: 17/8/2005			**Time:** 9:55
Assessor signature:			

RATED ENERGY REQUIREMENTS*

Heating	Cooling (sensible)	Cooling (latent)	Total Energy	Units
63.5	38.1	27.6	129.1	MJ/m².annum
17.6	10.6	7.7	35.9	kWh/m².annum

* These energy requirements have been calculated using a standard set of occupant behaviours and so do not necessarily represent the usage pattern or lifestyle of the intended occupants. They should be used solely for the purposes of rating the building. They should not be used to infer actual energy consumption or running costs. The settings used for the simulation are shown in the building data report.

Conditioned floor area	41.2 m²
Area-adjusted star band score	102

Star Rating

★★★★★★★★☆ **7.5 STARS**

Area-adjusted star band score thresholds

1 Star	2 Stars	3 Stars	4 Stars	5 Stars	6 Stars	7 Stars	8 Stars	9 Stars	10 Stars
494	394	313	250	199	157	120	84	46	2

AccuRate Regulatory Version June 2005 (expires 30 Sept 2005)

Nationwide House Energy Rating Scheme

Project Details

Project Name:	**Postcode:** 7000
File Name: W:\SBE\admin\7-05\75053 DEH-FR & Int rating comparison\K2	**Climate Zone:** 26
Design Option: Base Design	
Description: Halisham A	

Client Details

Client Name: International		
Phone: (02) 6274 1888	**Fax:**	**Email:**
Postal Address: Australian Greenhouse Office GPO Box 787 CANBERRA ACT 2601		
Site Address:		
Council submitted to (if known by assessor):		

Assessor Details

Assessor Name: Sustainable Built Environments P/L			**Assessor No.**
Phone: +61 3 9670 9820	**Fax:** +61 3 9670 9890	**Email:** info@sbe.com.au	
Assessment date: 17/8/2005			**Time:** 9:53
Assessor signature:			

RATED ENERGY REQUIREMENTS*

Heating	Cooling (sensible)	Cooling (latent)	Total Energy	Units
14.5	37.5	27.3	79.3	MJ/m².annum
4.0	10.4	7.6	22.0	kWh/m².annum

* These energy requirements have been calculated using a standard set of occupant behaviours and so do not necessarily represent the usage pattern or lifestyle of the intended occupants. They should be used solely for the purposes of rating the building. They should not be used to infer actual energy consumption or running costs. The settings used for the simulation are shown in the building data report.

Conditioned floor area	41.2 m²
Area-adjusted star band score	62

Star Rating

★★★★★★★★★☆ **8.5 STARS**

Area-adjusted star band score thresholds

1 Star	2 Stars	3 Stars	4 Stars	5 Stars	6 Stars	7 Stars	8 Stars	9 Stars	10 Stars
494	394	313	250	199	157	120	84	46	2

AccuRate Regulatory Version June 2005 (expires 30 Sept 2005)

Nationwide House Energy Rating Scheme

Project Details

Project Name:	**Postcode:** 7000
File Name: W:\SBE\admin\7-05\75053 DEH-FR & Int rating comparison\K2	**Climate Zone:** 26
Design Option: Base Design	
Description: Halisham A	

Client Details

Client Name: International		
Phone: (02) 6274 1888	**Fax:**	**Email:**
Postal Address: Australian Greenhouse Office GPO Box 787 CANBERRA ACT 2601		
Site Address:		
Council submitted to (if known by assessor):		

Assessor Details

Assessor Name: Sustainable Built Environments P/L			**Assessor No.**
Phone: +61 3 9670 9820	**Fax:** +61 3 9670 9890	**Email:** info@sbe.com.au	
Assessment date: 17/8/2005			**Time:** 9:34
Assessor signature:			

RATED ENERGY REQUIREMENTS*

Heating	Cooling (sensible)	Cooling (latent)	Total Energy	Units
47.2	35.4	25.4	108.0	MJ/m².annum
13.1	9.8	7.0	30.0	kWh/m².annum

* These energy requirements have been calculated using a standard set of occupant behaviours and so do not necessarily represent the usage pattern or lifestyle of the intended occupants. They should be used solely for the purposes of rating the building. They should not be used to infer actual energy consumption or running costs. The settings used for the simulation are shown in the building data report.

Conditioned floor area	41.2 m²
Area-adjusted star band score	93

Star Rating

★★★★★★★★☆ **7.5 STARS**

Area-adjusted star band score thresholds

1 Star	2 Stars	3 Stars	4 Stars	5 Stars	6 Stars	7 Stars	8 Stars	9 Stars	10 Stars
494	394	313	250	199	157	120	84	46	2

AccuRate Regulatory Version June 2005 (expires 30 Sept 2005)

Nationwide House Energy Rating Scheme

Project Details

Project Name:	**Postcode:** 7000
File Name: W:\SBE\admin\7-05\75053 DEH-FR & Int rating comparison\K2	**Climate Zone:** 26
Design Option: Base Design	
Description: Halisham A	

Client Details

Client Name: International		
Phone: (02) 6274 1888	**Fax:**	**Email:**
Postal Address: Australian Greenhouse Office GPO Box 787 CANBERRA ACT 2601		
Site Address:		
Council submitted to (if known by assessor):		

Assessor Details

Assessor Name: Sustainable Built Environments P/L			**Assessor No.**
Phone: +61 3 9670 9820	**Fax:** +61 3 9670 9890	**Email:** info@sbe.com.au	
Assessment date: 10/8/2005			**Time:** 13:09
Assessor signature:			

RATED ENERGY REQUIREMENTS*

Heating	Cooling (sensible)	Cooling (latent)	Total Energy	Units
7.3	37.0	27.3	71.7	MJ/m².annum
2.0	10.3	7.6	19.9	kWh/m².annum

* These energy requirements have been calculated using a standard set of occupant behaviours and so do not necessarily represent the usage pattern or lifestyle of the intended occupants. They should be used solely for the purposes of rating the building. They should not be used to infer actual energy consumption or running costs. The settings used for the simulation are shown in the building data report.

Conditioned floor area	41.2 m²
Area-adjusted star band score	62

Star Rating

★★★★★★★★★☆ **8.5 STARS**

Area-adjusted star band score thresholds

1 Star	2 Stars	3 Stars	4 Stars	5 Stars	6 Stars	7 Stars	8 Stars	9 Stars	10 Stars
494	394	313	250	199	157	120	84	46	2

AccuRate Regulatory Version June 2005 (expires 30 Sept 2005)

Nationwide House Energy Rating Scheme

Project Details

Project Name:	**Postcode:** 7000
File Name: W:\SBE\admin\7-05\75053 DEH-FR & Int rating comparison\K2	**Climate Zone:** 26
Design Option: Base Design	
Description: Hereford	

Client Details

Client Name: International		
Phone: (02) 6274 1888	**Fax:**	**Email:**
Postal Address: Australian Greenhouse Office GPO Box 787 CANBERRA ACT 2601		
Site Address:		
Council submitted to (if known by assessor):		

Assessor Details

Assessor Name: Sustainable Built Environments P/L			**Assessor No.**
Phone: +61 3 9670 9820	**Fax:** +61 3 9670 9890	**Email:** info@sbe.com.au	
Assessment date: 10/8/2005			**Time:** 13:21
Assessor signature:			

RATED ENERGY REQUIREMENTS*

Heating	Cooling (sensible)	Cooling (latent)	Total Energy	Units
69.2	9.7	6.1	85.0	MJ/m².annum
19.2	2.7	1.7	23.6	kWh/m².annum

* These energy requirements have been calculated using a standard set of occupant behaviours and so do not necessarily represent the usage pattern or lifestyle of the intended occupants. They should be used solely for the purposes of rating the building. They should not be used to infer actual energy consumption or running costs. The settings used for the simulation are shown in the building data report.

Conditioned floor area	58.5 m²
Area-adjusted star band score	63

Star Rating

★★★★★★★★★☆ **8.5 STARS**

Area-adjusted star band score thresholds

1 Star	2 Stars	3 Stars	4 Stars	5 Stars	6 Stars	7 Stars	8 Stars	9 Stars	10 Stars
494	394	313	250	199	157	120	84	46	2

AccuRate Regulatory Version June 2005 (expires 30 Sept 2005)

Nationwide House Energy Rating Scheme

Project Details

Project Name:	**Postcode:** 7000
File Name: W:\SBE\admin\7-05\75053 DEH-FR & Int rating comparison\K2	**Climate Zone:** 26
Design Option: Base Design	
Description: Kempton 2 party walls treated as external	

Client Details

Client Name: International		
Phone: (02) 6274 1888	**Fax:**	**Email:**
Postal Address: Australian Greenhouse Office GPO Box 787 CANBERRA ACT 2601		
Site Address:		
Council submitted to (if known by assessor):		

Assessor Details

Assessor Name: Sustainable Built Environments P/L			**Assessor No.**
Phone: +61 3 9670 9820	**Fax:** +61 3 9670 9890	**Email:** info@sbe.com.au	
Assessment date: 10/8/2005			**Time:** 13:26
Assessor signature:			

RATED ENERGY REQUIREMENTS*

Heating	Cooling (sensible)	Cooling (latent)	Total Energy	Units
76.0	3.5	2.4	82.0	MJ/m².annum
21.1	1.0	0.7	22.8	kWh/m².annum

* These energy requirements have been calculated using a standard set of occupant behaviours and so do not necessarily represent the usage pattern or lifestyle of the intended occupants. They should be used solely for the purposes of rating the building. They should not be used to infer actual energy consumption or running costs. The settings used for the simulation are shown in the building data report.

Conditioned floor area	102.5 m²
Area-adjusted star band score	68

Star Rating

★★★★★★★★ **8 STARS**

Area-adjusted star band score thresholds

1 Star	2 Stars	3 Stars	4 Stars	5 Stars	6 Stars	7 Stars	8 Stars	9 Stars	10 Stars
494	394	313	250	199	157	120	84	46	2

AccuRate Regulatory Version June 2005 (expires 30 Sept 2005)

Nationwide House Energy Rating Scheme

Project Details

Project Name:	**Postcode:** 7000
File Name: W:\SBE\admin\7-05\75053 DEH-FR & Int rating comparison\K2	**Climate Zone:** 26
Design Option: Base Design	
Description:	

Client Details

Client Name: International		
Phone: (02) 6274 1888	**Fax:**	**Email:**
Postal Address: Australian Greenhouse Office GPO Box 787 CANBERRA ACT 2601		
Site Address:		
Council submitted to (if known by assessor):		

Assessor Details

Assessor Name: Sustainable Built Environments P/L			**Assessor No.**
Phone: +61 3 9670 9820	**Fax:** +61 3 9670 9890	**Email:** info@sbe.com.au	
Assessment date: 10/8/2005			**Time:** 15:16
Assessor signature:			

RATED ENERGY REQUIREMENTS*

Heating	Cooling (sensible)	Cooling (latent)	Total Energy	Units
72.7	16.6	4.1	93.4	MJ/m².annum
20.2	4.6	1.1	25.9	kWh/m².annum

* These energy requirements have been calculated using a standard set of occupant behaviours and so do not necessarily represent the usage pattern or lifestyle of the intended occupants. They should be used solely for the purposes of rating the building. They should not be used to infer actual energy consumption or running costs. The settings used for the simulation are shown in the building data report.

Conditioned floor area	97.5 m²
Area-adjusted star band score	76

Star Rating

★★★★★★★★ **8 STARS**

Area-adjusted star band score thresholds

1 Star	2 Stars	3 Stars	4 Stars	5 Stars	6 Stars	7 Stars	8 Stars	9 Stars	10 Stars
494	394	313	250	199	157	120	84	46	2

AccuRate Regulatory Version June 2005 (expires 30 Sept 2005)

Nationwide House Energy Rating Scheme

Project Details

Project Name:	**Postcode:** 7000
File Name: W:\SBE\admin\7-05\75053 DEH-FR & Int rating comparison\K2	**Climate Zone:** 26
Design Option: Base Design	
Description: Shelley - shared walls - no conservatory	

Client Details

Client Name:		
Phone: (02) 6274 1888	**Fax:**	**Email:**
Postal Address: Australian Greenhouse Office GPO Box 787 CANBERRA ACT 2601		
Site Address:		
Council submitted to (if known by assessor):		

Assessor Details

Assessor Name: Sustainable Built Environments P/L			**Assessor No.**
Phone: +61 3 9670 9820	**Fax:** +61 3 9670 9890	**Email:** info@sbe.com.au	
Assessment date: 10/8/2005			**Time:** 14:45
Assessor signature:			

RATED ENERGY REQUIREMENTS*

Heating	Cooling (sensible)	Cooling (latent)	Total Energy	Units
32.4	15.3	9.3	57.0	MJ/m².annum
9.0	4.2	2.6	15.8	kWh/m².annum

* These energy requirements have been calculated using a standard set of occupant behaviours and so do not necessarily represent the usage pattern or lifestyle of the intended occupants. They should be used solely for the purposes of rating the building. They should not be used to infer actual energy consumption or running costs. The settings used for the simulation are shown in the building data report.

Conditioned floor area	57.4 m²
Area-adjusted star band score	48

Star Rating

★★★★★★★★★☆ **8.5 STARS**

Area-adjusted star band score thresholds

1 Star	2 Stars	3 Stars	4 Stars	5 Stars	6 Stars	7 Stars	8 Stars	9 Stars	10 Stars
494	394	313	250	199	157	120	84	46	2

Equivalent Australian Climate Zone 8

	AccuRate Star Rating
Lansdale building D Unit C	9.5
Lansdale building D Unit D	9

AccuRate Regulatory Version June 2005 (expires 30 Sept 2005)

Nationwide House Energy Rating Scheme

Project Details

Project Name:	**Postcode:** 2625
File Name: W:\SBE\admin\7-05\75053 DEH-FR & Int rating comparison\K2	**Climate Zone:** 25
Design Option: Base Design	
Description: Unit C building D	

Client Details

Client Name: International		
Phone: (02) 6274 1888	**Fax:**	**Email:**
Postal Address: Australian Greenhouse Office GPO Box 787 CANBERRA ACT 2601		
Site Address:		
Council submitted to (if known by assessor):		

Assessor Details

Assessor Name: Sustainable Built Environments P/L			**Assessor No.**
Phone: +61 3 9670 9820	**Fax:** +61 3 9670 9890	**Email:** info@sbe.com.au	
Assessment date: 18/8/2005			**Time:** 9:46
Assessor signature:			

RATED ENERGY REQUIREMENTS*

Heating	Cooling (sensible)	Cooling (latent)	Total Energy	Units
32.1	0.8	1.7	34.5	MJ/m².annum
8.9	0.2	0.5	9.6	kWh/m².annum

* These energy requirements have been calculated using a standard set of occupant behaviours and so do not necessarily represent the usage pattern or lifestyle of the intended occupants. They should be used solely for the purposes of rating the building. They should not be used to infer actual energy consumption or running costs. The settings used for the simulation are shown in the building data report.

Conditioned floor area	131.8 m²
Area-adjusted star band score	34

Star Rating

★★★★★★★★★☆ **9.5 STARS**

Area-adjusted star band score thresholds

1 Star	2 Stars	3 Stars	4 Stars	5 Stars	6 Stars	7 Stars	8 Stars	9 Stars	10 Stars
959	766	612	490	392	311	239	169	92	1

AccuRate Regulatory Version June 2005 (expires 30 Sept 2005)

Nationwide House Energy Rating Scheme

Project Details

Project Name:	**Postcode:** 2625
File Name: W:\SBE\admin\7-05\75053 DEH-FR & Int rating comparison\K2	**Climate Zone:** 25
Design Option: Base Design	
Description: Unit D Building D	

Client Details

Client Name: International		
Phone: (02) 6274 1888	**Fax:**	**Email:**
Postal Address: Australian Greenhouse Office GPO Box 787 CANBERRA ACT 2601		
Site Address:		
Council submitted to (if known by assessor):		

Assessor Details

Assessor Name: Sustainable Built Environments P/L			**Assessor No.**
Phone: +61 3 9670 9820	**Fax:** +61 3 9670 9890	**Email:** info@sbe.com.au	
Assessment date: 18/8/2005			**Time:** 10:10
Assessor signature:			

RATED ENERGY REQUIREMENTS*

Heating	Cooling (sensible)	Cooling (latent)	Total Energy	Units
84.8	0.2	0.1	85.2	MJ/m².annum
23.6	0.1	0.0	23.7	kWh/m².annum

* These energy requirements have been calculated using a standard set of occupant behaviours and so do not necessarily represent the usage pattern or lifestyle of the intended occupants. They should be used solely for the purposes of rating the building. They should not be used to infer actual energy consumption or running costs. The settings used for the simulation are shown in the building data report.

Conditioned floor area	107.1 m²
Area-adjusted star band score	84

Star Rating

★★★★★★★★★ **9 STARS**

Area-adjusted star band score thresholds

1 Star	2 Stars	3 Stars	4 Stars	5 Stars	6 Stars	7 Stars	8 Stars	9 Stars	10 Stars
959	766	612	490	392	311	239	169	92	1

Equivalent Australian Climate Zone 8

	AccuRate Star Rating
Cambridge	6
Dartmore	5
Huntington	6.5
McKinley	7
Milstone	6.5
Milton	4.5

AccuRate Regulatory Version June 2005 (expires 30 Sept 2005)

Nationwide House Energy Rating Scheme

Project Details

Project Name:	**Postcode:** 2625
File Name: W:\SBE\admin\7-05\75053 DEH-FR & Int rating comparison\K2	**Climate Zone:** 25
Design Option: Base Design	
Description: Cambridge	

Client Details

Client Name: International		
Phone: (02) 6274 1888	**Fax:**	**Email:**
Postal Address: Australian Greenhouse Office GPO Box 787 CANBERRA ACT 2601		
Site Address:		
Council submitted to (if known by assessor):		

Assessor Details

Assessor Name: Sustainable Built Environments P/L			**Assessor No.**
Phone: +61 3 9670 9820	**Fax:** +61 3 9670 9890	**Email:** info@sbe.com.au	
Assessment date: 17/8/2005			**Time:** 19:31
Assessor signature:			

RATED ENERGY REQUIREMENTS*

Heating	Cooling (sensible)	Cooling (latent)	Total Energy	Units
287.7	0.1	0.0	287.8	MJ/m².annum
79.9	0.0	0.0	79.9	kWh/m².annum

* These energy requirements have been calculated using a standard set of occupant behaviours and so do not necessarily represent the usage pattern or lifestyle of the intended occupants. They should be used solely for the purposes of rating the building. They should not be used to infer actual energy consumption or running costs. The settings used for the simulation are shown in the building data report.

Conditioned floor area	173.3 m²
Area-adjusted star band score	279

Star Rating

★★★★★★ **6 STARS**

Area-adjusted star band score thresholds

1 Star	2 Stars	3 Stars	4 Stars	5 Stars	6 Stars	7 Stars	8 Stars	9 Stars	10 Stars
959	766	612	490	392	311	239	169	92	1

AccuRate Regulatory Version June 2005 (expires 30 Sept 2005)

Nationwide House Energy Rating Scheme

Project Details

Project Name:	**Postcode:** 2625
File Name: W:\SBE\admin\7-05\75053 DEH-FR & Int rating comparison\K2	**Climate Zone:** 25
Design Option: Base Design	
Description: Dartmore	

Client Details

Client Name: International		
Phone: (02) 6274 1888	**Fax:**	**Email:**
Postal Address: Australian Greenhouse Office GPO Box 787 CANBERRA ACT 2601		
Site Address:		
Council submitted to (if known by assessor):		

Assessor Details

Assessor Name: Sustainable Built Environments P/L			**Assessor No.**
Phone: +61 3 9670 9820	**Fax:** +61 3 9670 9890	**Email:** info@sbe.com.au	
Assessment date: 17/8/2005			**Time:** 17:13
Assessor signature:			

RATED ENERGY REQUIREMENTS*

Heating	Cooling (sensible)	Cooling (latent)	Total Energy	Units
385.9	0.1	0.1	386.0	MJ/m².annum
107.2	0.0	0.0	107.2	kWh/m².annum

* These energy requirements have been calculated using a standard set of occupant behaviours and so do not necessarily represent the usage pattern or lifestyle of the intended occupants. They should be used solely for the purposes of rating the building. They should not be used to infer actual energy consumption or running costs. The settings used for the simulation are shown in the building data report.

Conditioned floor area	176.2 m²
Area-adjusted star band score	380

Star Rating

★★★★★ **5 STARS**

Area-adjusted star band score thresholds

1 Star	2 Stars	3 Stars	4 Stars	5 Stars	6 Stars	7 Stars	8 Stars	9 Stars	10 Stars
959	766	612	490	392	311	239	169	92	1

AccuRate Regulatory Version June 2005 (expires 30 Sept 2005)

Nationwide House Energy Rating Scheme

Project Details

Project Name:	**Postcode:** 2625
File Name: W:\SBE\admin\7-05\75053 DEH-FR & Int rating comparison\K2	**Climate Zone:** 25
Design Option: Base Design	
Description: Huntington	

Client Details

Client Name: International		
Phone: (02) 6274 1888	**Fax:**	**Email:**
Postal Address: Australian Greenhouse Office GPO Box 787 CANBERRA ACT 2601		
Site Address:		
Council submitted to (if known by assessor):		

Assessor Details

Assessor Name: Sustainable Built Environments P/L			**Assessor No.**
Phone: +61 3 9670 9820	**Fax:** +61 3 9670 9890	**Email:** info@sbe.com.au	
Assessment date: 17/8/2005			**Time:** 16:59
Assessor signature:			

RATED ENERGY REQUIREMENTS*

Heating	Cooling (sensible)	Cooling (latent)	Total Energy	Units
238.3	0.5	0.1	238.8	MJ/m².annum
66.2	0.1	0.0	66.3	kWh/m².annum

* These energy requirements have been calculated using a standard set of occupant behaviours and so do not necessarily represent the usage pattern or lifestyle of the intended occupants. They should be used solely for the purposes of rating the building. They should not be used to infer actual energy consumption or running costs. The settings used for the simulation are shown in the building data report.

Conditioned floor area	232.6 m²
Area-adjusted star band score	253

Star Rating

★★★★★★☆ **6.5 STARS**

Area-adjusted star band score thresholds

1 Star	2 Stars	3 Stars	4 Stars	5 Stars	6 Stars	7 Stars	8 Stars	9 Stars	10 Stars
959	766	612	490	392	311	239	169	92	1

AccuRate Regulatory Version June 2005 (expires 30 Sept 2005)

Nationwide House Energy Rating Scheme

Project Details

Project Name:	**Postcode:** 2625
File Name: W:\SBE\admin\7-05\75053 DEH-FR & Int rating comparison\K2	**Climate Zone:** 25
Design Option: Base Design	
Description: McKinley	

Client Details

Client Name: International		
Phone: (02) 6274 1888	**Fax:**	**Email:**
Postal Address: Australian Greenhouse Office GPO Box 787 CANBERRA ACT 2601		
Site Address:		
Council submitted to (if known by assessor):		

Assessor Details

Assessor Name: Sustainable Built Environments P/L			**Assessor No.**
Phone: +61 3 9670 9820	**Fax:** +61 3 9670 9890	**Email:** info@sbe.com.au	
Assessment date: 17/8/2005			**Time:** 17:22
Assessor signature:			

RATED ENERGY REQUIREMENTS*

Heating	Cooling (sensible)	Cooling (latent)	Total Energy	Units
229.1	0.1	0.0	229.3	MJ/m².annum
63.6	0.0	0.0	63.7	kWh/m².annum

* These energy requirements have been calculated using a standard set of occupant behaviours and so do not necessarily represent the usage pattern or lifestyle of the intended occupants. They should be used solely for the purposes of rating the building. They should not be used to infer actual energy consumption or running costs. The settings used for the simulation are shown in the building data report.

Conditioned floor area	206.3 m²
Area-adjusted star band score	234

Star Rating

★★★★★★★ **7 STARS**

Area-adjusted star band score thresholds

1 Star	2 Stars	3 Stars	4 Stars	5 Stars	6 Stars	7 Stars	8 Stars	9 Stars	10 Stars
959	766	612	490	392	311	239	169	92	1

AccuRate Regulatory Version June 2005 (expires 30 Sept 2005)

Nationwide House Energy Rating Scheme

Project Details

Project Name:	**Postcode:** 2625
File Name: W:\SBE\admin\7-05\75053 DEH-FR & Int rating comparison\K2	**Climate Zone:** 25
Design Option: Base Design	
Description: Milstone	

Client Details

Client Name: International		
Phone: (02) 6274 1888	**Fax:**	**Email:**
Postal Address: Australian Greenhouse Office GPO Box 787 CANBERRA ACT 2601		
Site Address:		
Council submitted to (if known by assessor):		

Assessor Details

Assessor Name: Sustainable Built Environments P/L			**Assessor No.**
Phone: +61 3 9670 9820	**Fax:** +61 3 9670 9890	**Email:** info@sbe.com.au	
Assessment date: 17/8/2005			**Time:** 17:47
Assessor signature:			

RATED ENERGY REQUIREMENTS*

Heating	Cooling (sensible)	Cooling (latent)	Total Energy	Units
248.3	0.2	0.0	248.5	MJ/m².annum
69.0	0.1	0.0	69.0	kWh/m².annum

* These energy requirements have been calculated using a standard set of occupant behaviours and so do not necessarily represent the usage pattern or lifestyle of the intended occupants. They should be used solely for the purposes of rating the building. They should not be used to infer actual energy consumption or running costs. The settings used for the simulation are shown in the building data report.

Conditioned floor area	212.9 m²
Area-adjusted star band score	256

Star Rating

★★★★★★☆ **6.5 STARS**

Area-adjusted star band score thresholds

1 Star	2 Stars	3 Stars	4 Stars	5 Stars	6 Stars	7 Stars	8 Stars	9 Stars	10 Stars
959	766	612	490	392	311	239	169	92	1

AccuRate Regulatory Version June 2005 (expires 30 Sept 2005)

Nationwide House Energy Rating Scheme

Project Details

Project Name:	**Postcode:** 2625
File Name: W:\SBE\admin\7-05\75053 DEH-FR & Int rating comparison\K2	**Climate Zone:** 25
Design Option: Base Design	
Description: Milton	

Client Details

Client Name: International		
Phone: (02) 6274 1888	**Fax:**	**Email:**
Postal Address: Australian Greenhouse Office GPO Box 787 CANBERRA ACT 2601		
Site Address:		
Council submitted to (if known by assessor):		

Assessor Details

Assessor Name: Sustainable Built Environments P/L			**Assessor No.**
Phone: +61 3 9670 9820	**Fax:** +61 3 9670 9890	**Email:** info@sbe.com.au	
Assessment date: 17/8/2005			**Time:** 18:27
Assessor signature:			

RATED ENERGY REQUIREMENTS*

Heating	Cooling (sensible)	Cooling (latent)	Total Energy	Units
448.5	0.6	0.1	449.2	MJ/m².annum
124.6	0.2	0.0	124.8	kWh/m².annum

* These energy requirements have been calculated using a standard set of occupant behaviours and so do not necessarily represent the usage pattern or lifestyle of the intended occupants. They should be used solely for the purposes of rating the building. They should not be used to infer actual energy consumption or running costs. The settings used for the simulation are shown in the building data report.

Conditioned floor area	171.4 m²
Area-adjusted star band score	434

Star Rating

★★★★☆ **4.5 STARS**

Area-adjusted star band score thresholds

1 Star	2 Stars	3 Stars	4 Stars	5 Stars	6 Stars	7 Stars	8 Stars	9 Stars	10 Stars
959	766	612	490	392	311	239	169	92	1

AccuRate Regulatory Version June 2005 (expires 30 Sept 2005)

Nationwide House Energy Rating Scheme

Project Details

Project Name:	**Postcode:** 2625
File Name: W:\SBE\admin\7-05\75053 DEH-FR & Int rating comparison\K2	**Climate Zone:** 25
Design Option: Base Design	
Description: Milton	

Client Details

Client Name: International		
Phone: (02) 6274 1888	**Fax:**	**Email:**
Postal Address: Australian Greenhouse Office GPO Box 787 CANBERRA ACT 2601		
Site Address:		
Council submitted to (if known by assessor):		

Assessor Details

Assessor Name: Sustainable Built Environments P/L			**Assessor No.**
Phone: +61 3 9670 9820	**Fax:** +61 3 9670 9890	**Email:** info@sbe.com.au	
Assessment date: 17/8/2005			**Time:** 18:15
Assessor signature:			

RATED ENERGY REQUIREMENTS*

Heating	Cooling (sensible)	Cooling (latent)	Total Energy	Units
413.5	3.4	0.4	417.2	MJ/m².annum
114.9	0.9	0.1	115.9	kWh/m².annum

* These energy requirements have been calculated using a standard set of occupant behaviours and so do not necessarily represent the usage pattern or lifestyle of the intended occupants. They should be used solely for the purposes of rating the building. They should not be used to infer actual energy consumption or running costs. The settings used for the simulation are shown in the building data report.

Conditioned floor area	171.4 m²
Area-adjusted star band score	403

Star Rating

★★★★☆ **4.5 STARS**

Area-adjusted star band score thresholds

1 Star	2 Stars	3 Stars	4 Stars	5 Stars	6 Stars	7 Stars	8 Stars	9 Stars	10 Stars
959	766	612	490	392	311	239	169	92	1

AccuRate Regulatory Version June 2005 (expires 30 Sept 2005)

Nationwide House Energy Rating Scheme

Project Details

Project Name:	**Postcode:** 2625
File Name: W:\SBE\admin\7-05\75053 DEH-FR & Int rating comparison\K2	**Climate Zone:** 25
Design Option: Base Design	
Description: Milton	

Client Details

Client Name: International		
Phone: (02) 6274 1888	**Fax:**	**Email:**
Postal Address: Australian Greenhouse Office GPO Box 787 CANBERRA ACT 2601		
Site Address:		
Council submitted to (if known by assessor):		

Assessor Details

Assessor Name: Sustainable Built Environments P/L			**Assessor No.**
Phone: +61 3 9670 9820	**Fax:** +61 3 9670 9890	**Email:** info@sbe.com.au	
Assessment date: 17/8/2005			**Time:** 18:12
Assessor signature:			

RATED ENERGY REQUIREMENTS*

Heating	Cooling (sensible)	Cooling (latent)	Total Energy	Units
430.8	3.2	0.3	434.4	MJ/m².annum
119.7	0.9	0.1	120.7	kWh/m².annum

* These energy requirements have been calculated using a standard set of occupant behaviours and so do not necessarily represent the usage pattern or lifestyle of the intended occupants. They should be used solely for the purposes of rating the building. They should not be used to infer actual energy consumption or running costs. The settings used for the simulation are shown in the building data report.

Conditioned floor area	171.4 m²
Area-adjusted star band score	420

Star Rating

★★★★☆ **4.5 STARS**

Area-adjusted star band score thresholds

1 Star	2 Stars	3 Stars	4 Stars	5 Stars	6 Stars	7 Stars	8 Stars	9 Stars	10 Stars
959	766	612	490	392	311	239	169	92	1

AccuRate Regulatory Version June 2005 (expires 30 Sept 2005)

Nationwide House Energy Rating Scheme

Project Details

Project Name:	**Postcode:** 2625
File Name: W:\SBE\admin\7-05\75053 DEH-FR & Int rating comparison\K2	**Climate Zone:** 25
Design Option: Base Design	
Description: Milton	

Client Details

Client Name: International		
Phone: (02) 6274 1888	**Fax:**	**Email:**
Postal Address: Australian Greenhouse Office GPO Box 787 CANBERRA ACT 2601		
Site Address:		
Council submitted to (if known by assessor):		

Assessor Details

Assessor Name: Sustainable Built Environments P/L			**Assessor No.**
Phone: +61 3 9670 9820	**Fax:** +61 3 9670 9890	**Email:** info@sbe.com.au	
Assessment date: 17/8/2005			**Time:** 18:23
Assessor signature:			

RATED ENERGY REQUIREMENTS*

Heating	Cooling (sensible)	Cooling (latent)	Total Energy	Units
423.5	3.5	0.4	427.4	MJ/m².annum
117.7	1.0	0.1	118.7	kWh/m².annum

* These energy requirements have been calculated using a standard set of occupant behaviours and so do not necessarily represent the usage pattern or lifestyle of the intended occupants. They should be used solely for the purposes of rating the building. They should not be used to infer actual energy consumption or running costs. The settings used for the simulation are shown in the building data report.

Conditioned floor area	171.4 m²
Area-adjusted star band score	413

Star Rating

★★★★☆ **4.5 STARS**

Area-adjusted star band score thresholds

1 Star	2 Stars	3 Stars	4 Stars	5 Stars	6 Stars	7 Stars	8 Stars	9 Stars	10 Stars
959	766	612	490	392	311	239	169	92	1