Department of
Building and Housing
Te Tari Kaupapa Whare

Energy efficiency of buildings:

Consultation on energy efficiency revisions to the New Zealand Building Code and Compliance Documents

Closing date for public comment: 22 December 2006

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Foreword

Our homes and workplaces are fundamental to the way we live and work and to our quality of life. Improving the way we use energy is a top priority for this Government.

This document asks for your feedback on some easy, relatively inexpensive changes to the way we insulate our homes, heat our hot water and light commercial buildings so we can lower power and gas bills and make warmer, drier, healthier, and more comfortable homes and workplaces a reality.

The changes are:

- requiring better insulation for new homes, including double-glazing
- making it easier to install solar water-heating systems
- improving the efficiency of lighting in commercial buildings.

Energy efficiency is not just about making savings in energy bills. Lifting the energy efficiency of homes and commercial buildings means gains for the environment. New Zealand's energy-related greenhouse gas emissions are expected to increase by 30 percent in the next 25 years under a 'business-as-usual' scenario. Given that residential and commercial buildings, and the appliances in them, consume nearly a quarter of all energy in this country, this is a key area where efficiencies can be made.

The proposals also give Kiwis easier access to new, innovative and more efficient technologies.

This project complements other government work in this area, including the Building Code review, and the National Energy Efficiency and Conservation Strategy. While a new Building Code is still some time away, these are measures we can take in the short to medium term to improve the energy efficiency of buildings.

Significant cost savings can be made through better insulation. Increasing insulation requirements for ceilings, walls and floors, as well as introducing double-glazing in new homes, could reduce the amount of energy needed to heat new homes by up to 30 percent. While the South Island and cooler parts of the North Island will see the greatest benefit, better insulation means warmer, dryer, healthier, more comfortable homes across the country.

The solar heating proposals will make installing solar hot water systems in new and existing homes a lot easier and about 10 percent cheaper. This saving is in addition to the substantial cost savings (about $200 per year) from using solar water heating.

Greater energy efficiency in the workplace is also easily achieved. Energy savings of between 10 and 30 percent can be made by changing performance requirements for lighting in commercial buildings to take account of new technologies. For example, smart controls that take account of natural light in a building and adjust the illumination to meet lighting standards are now readily available and reliable, as are energy efficient light bulbs.

The Government will consider the submissions on these proposed measures and make decisions by March 2007. Putting the energy efficiency measures into place means changes to the Building Code and/or new Department of Building and Housing Compliance Documents. The

New Zealand Building Code sets the standards buildings must achieve but does not prescribe how to do it. Compliance Documents set out ways to design or build to meet the standards.

This is your opportunity to provide your input into the suggested ways of lifting the energy efficiency of residential and commercial buildings. The consultation closes on 22 December 2006. I urge you to have your say on the proposals to improve the energy efficiency in our homes and workplaces.

Hon Clayton Cosgrove MP
Minister for Building Issues

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Appendices

The appendices are available in electronic form on the Department's website at www.dbh.govt.nz/blc-compliance-documents

Appendix 1: NZBC Clause H1 review House insulation cost benefit analysis, Page I, QC5048 BRANZ (2006).

Appendix 2: Thermal simulations to compare the energy performance of solid construction and timber framed houses, Bellamy L, Ensys (2006).

Appendix 3: A report to analyse options to change the definition of the Building Performance Index (BPI), Westergard D (2006).

Appendix 4: BPI Definitions and Targets for H1 2006, Stoecklein, A, BRANZ (2006).

Appendix 5: House Analysis and Data Collection for Cost Benefit Analysis, Isaacs N, French L and Donn M, EC1198/1 BRANZ (2006).

Request for comment

The Department of Building and Housing seeks feedback on the proposed energy efficiency initiatives described in this document.

Your comment is sought on specific changes to the Building Code and Compliance Documents. All submissions received by the Department will be carefully considered before a final decision is made on the proposals contained in this document.

The proposals have been packaged together into one consultation document rather than releasing the amendments individually. Comments can be submitted on individual topic areas.

How to comment

Please submit your comments in writing. Typed comments are preferred, but clear handwriting will be accepted. You can return comments by letter, fax or email. Additional copies of this document can be downloaded as a PDF from the Department's website at www.dbh.govt.nz/blc-compliance-documents

They can also be obtained by calling the Department on 0800 242 243.

The closing date for submitting comments on the proposed changes is **22 December 2006**

They need to be sent to:

Consultation Feedback – Energy Efficiency
Department of Building and Housing
Building Controls
PO Box 10-729
Wellington
New Zealand

or emailed to comments@dbh.govt.nz. Please put 'Consultation Feedback – Energy Efficiency' in the subject line

or faxed to (04) 494 0290.

Important note

Please note that all responses will be public information. Responses may be the subject of requests for information under the Official Information Act 1982 (OIA). The OIA specifies that information is to be made available to requesters unless there are sufficient grounds for withholding it, as set out in the OIA. Submitters may wish to indicate grounds for withholding specific information contained in their submission, such as that the information is commercially sensitive or that they wish personal information to be withheld. Any decision to withhold information requested under the OIA is reviewable by the Ombudsman.

Executive summary of proposals

Proposal 1: Improved new house thermal insulation

Better thermal insulation for new houses would reduce energy bills and would mean warmer, drier, healthier and more comfortable homes for New Zealanders.

The proposals are to:

- reduce the Building Performance Index (BPI) by approximately 35 percent, which would increase house thermal insulation requirements
- change the definition of the BPI to reflect improved understanding of energy use and the thermal performance of houses
- update the Compliance Documents H1/VM1 and H1/AS1 by referencing the New Zealand Standard NZS 4218: 2004 Energy Efficiency – Small Building Envelope, modified by increasing R-values (thermal resistance) to match the reduced BPI values.

Most new houses would require:

- better insulation
- double-glazed windows
- skylights to be double-glazed
- a specific design solution for houses with large areas of glazing.

The changes are expected to increase the cost of building a new house by approximately $3,000-$5,000 (depending on the location, house size, window area and whether double glazing is required) and to result in a 30 percent reduction in the energy required to heat the house. Financially, these changes would be:

- most beneficial to building users in the South Island
- beneficial to building users in cooler parts of the North Island
- cost neutral to building users in warmer parts of the North Island.

There would be other non-financial benefits, including to the health and wellbeing of building users, and to the environment through the reduced use of fossil fuels and cleaner air.

Proposal 2: Reduced energy consumption of commercial lighting

Reducing the energy consumption of commercial lighting would reduce New Zealand's energy demand and would bring financial benefits to building owners.

The Department of Building and Housing proposes to increase the performance requirements for lighting in commercial buildings.

The Department would update the relevant Acceptable Solution to reflect modern lighting design standards. The updated Acceptable Solution would codify what is currently accepted as good design practice.

Commercial buildings designed and built to the updated Acceptable Solution would have the same lighting performance as the existing standards, but would use less energy and would require fewer lamp replacements.

Compared to average, current design practice, the proposed changes would accrue energy savings estimated to be about 104 GWh, or about $8 million based on current energy prices, over a decade.

The cost to the consumer of achieving these savings would be negligible.

Proposal 3: A new Acceptable Solution for solar water heating

Publishing an Acceptable Solution for solar water heating would make it cheaper and easier for homeowners to install such systems.

The Department of Building and Housing proposes to publish an Acceptable Solution for solar water heating installations.

The absence of an Acceptable Solution for solar water heating makes it difficult for solar water system installations to demonstrate compliance with the Building Code. Building consent authorities currently have to look at each installation on its own merits. This problem affects approximately 3500 new systems installed in New Zealand every year.

The main benefit of the new Acceptable Solution would be to remove a major barrier to the uptake of solar water heating technology. An average household, spending about $400 per year on water heating, could save as much as $200 or 50 percent of its water heating cost (depending on its geographical location and other variables) by installing a solar water heating system.

The Department of Building and Housing expects the cost of installing a new solar water heating system to drop by as much as 10 percent, or as much as $500, with the publication of the Acceptable Solution.

1 General reasons for the proposals

The Government is committed to promoting greater energy efficiency, energy conservation and the use of renewable energy sources in New Zealand.

Achieving these goals would mean lower energy bills and warmer, healthier and drier homes for New Zealanders. Our air would be cleaner, our children healthier and our homes more comfortable. We would consume less fossil fuel, especially for electricity generation, and would reduce our impact on the environment.

These goals fit well with the strategic direction of the Department of Building and Housing, that:

> The people of New Zealand have access to quality homes and buildings that meet their needs and reflect our New Zealand environment.

Sustainable development is one of the purposes of the Building Act 2004. As well as making people warmer, healthier and more comfortable in their homes, energy efficiency measures can also contribute to sustainable development.

In October 2006, the Minister for Building Issues, Hon Clayton Cosgrove MP, announced a package of initiatives to improve the energy efficiency of new and existing homes and commercial buildings, and to reduce their energy demand and associated greenhouse gas emissions.

The Minister's announcement identified four areas of priority for inclusion into the package of initiatives. These are:

- increasing the performance requirements for thermal insulation in new houses
- improving the documentation that helps solar water heating installations demonstrate compliance with the Building Code, and investigating how to improve hot water systems for increased energy effectiveness and efficiency
- increasing the performance requirements for lighting systems in commercial buildings
- improving the performance requirements for heating, ventilation and air-conditioning (HVAC) systems in commercial buildings.

This document contains specific proposals on three of these four priority areas: solar water heating, improved thermal insulation in new houses, and more energy efficient lighting in commercial buildings.

The Department of Building and Housing intends to undertake further work on the HVAC and hot water systems and to report to the Minister for Building Issues by 31 March 2007 with specific proposals. This is because HVAC and hot water issues require considerable industry consultation.

The proposals in this document would bring direct financial benefits to New Zealand homes and businesses. Other non-financial benefits would follow, including those to health, wellbeing and the environment. The proposals also make it easier for consumers to adopt new energy saving technologies, such as solar water heating and efficient lighting.

The Department considers the proposals an important step in improving the quality of New Zealand homes and buildings, and contributing to the Government's energy efficiency and climate policy goals.

The proposals fit well with work that is being undertaken by other government agencies, including the EnergyWise home retrofit programme by the Energy Efficiency and Conservation Authority and the Warm Homes initiative by the Ministry for the Environment. The proposals are part of a coordinated, multi-agency effort to meet the Government's energy efficiency and climate change objectives.

1.1 Building Code energy efficiency provisions

Building Code Clause H1 Energy Efficiency was last revised in 2001. Since then, several factors have changed.

- In real terms, the cost of energy has increased. The 2001 revision assumed that energy costs would increase by 2 percent per annum. Recent data shows that electricity costs have increased by 3 percent per annum between 1995 and 2005, and that between 2000 and 2005, electricity costs have risen by 4.4 percent per annum. Over the 10-year period from 1995 to 2005, the actual electricity price increase was 10 percent higher than projected. These increases, which are predicted to continue, mean it is beneficial to strengthen the energy efficiency provisions of the Building Code. Homeowners can now save money by improving insulation, and as a result gain health and other benefits.
- Some technologies that reduce energy consumption have become cheaper, making energy efficiency initiatives more attractive financially. For example, insulation prices have dropped by as much as 15 percent in real terms since 1995.
- Improvements to the energy efficiency of buildings are important to achieving the Government's outcomes for energy efficiency, lowering energy demand, and reducing greenhouse gas emissions, as mandated by the Building Act 2004, the National Energy Efficiency and Conservation Strategy (currently being redeveloped), and the Kyoto Protocol.
- Improvements to the insulation of buildings would reduce the need for heating, which would significantly reduce the use of solid-fuel burners for home heating in many parts of New Zealand. A reduction in the use of solid-fuel burners would support the National Environmental Standards Relating to Certain Air Pollutants, Dioxins and Other Toxins (September 2005).
- Research has improved the understanding of the thermal performance of houses and the health benefits of increased house insulation. Increased insulation does not deliver 100 percent of the theoretical energy savings when some of the energy is used to improve the indoor environment. It has been estimated that for low-income households, the health benefits that derive from these improvements in the environment are approximately twice the value of the energy used.[1]

[1]. Chapman R, Howden-Chapman P and O'Dea D (2004). A cost-benefit evaluation of housing insulation: results from the New Zealand '*Housing, Insulation and Health*' study.

2 Background

This consultation document proposes initiatives to improve the energy efficiency provisions of the New Zealand Building Code in the short term.

The Department of Building and Housing is reviewing the Building Code. The proposed amendments are in advance of the wider review. They support the Government's initiatives to improve energy efficiency and conservation, as shown by:

- the Building Act 2004, which requires that buildings be designed, constructed and used in ways that promote sustainable development
- the Energy Efficiency and Conservation Act 2000 and the National Energy Efficiency and Conservation Strategy (being reviewed), which identify reductions in energy demand and increased use of renewable energy sources as priorities
- Kyoto Protocol commitments, which require greenhouse gas emissions be reduced.

2.1 The New Zealand Building Code

The New Zealand Building Code sets the performance requirements for buildings but does not prescribe how these are to be achieved. For those people who prefer specific guidance, Compliance Documents, issued by the Department of Building and Housing, provide detailed methods for establishing compliance with the Building Code.

Compliance Documents include Acceptable Solutions and Verification Methods. Acceptable Solutions are examples of materials, components and construction methods that, if used or followed, would ensure compliance with the New Zealand Building Code.

This consultation document proposes changes to the Building Code and Compliance Documents.

2.2 Energy use in buildings

Residential and commercial buildings consume 22 percent of the energy used in New Zealand. Further:

- 56 percent of the electricity used in New Zealand is used in buildings in some way
- the annual cost of electricity and gas consumed by residential buildings is about $2.3 billion
- about a third of the total energy consumed is used to heat water, a third to heat space and a third to power household appliances and lights
- of the energy used in commercial buildings, about a third is used for lighting, a third for heating and cooling, and a third to power equipment.

3 Improved new house thermal insulation

Summary of proposals

Better thermal insulation for new houses would reduce energy bills and would mean warmer, drier, healthier and more comfortable homes for New Zealanders.

The proposals are to:

- reduce the Building Performance Index (BPI) by approximately 35 percent, which would increase house thermal insulation requirements
- change the definition of the BPI to reflect improved understanding of energy use and the thermal performance of houses
- update the Compliance Documents H1/VM1 and H1/AS1 by referencing the New Zealand Standard NZS 4218: 2004 Energy Efficiency – Small Building Envelope, modified by increasing R-values (thermal resistance) to match the reduced BPI values.

Most new houses would require:

- better insulation
- double-glazed windows
- skylights to be double-glazed
- a specific design solution for houses with large areas of glazing.

The changes are expected to increase the cost of building a new house by approximately $3,000-$5,000 (depending on the location, house size, window area and whether double-glazing is required) and to result in a 30 percent reduction in the energy required to heat the house. Financially, these changes would be:

- most beneficial to building users in the South Island
- beneficial to building users in cooler parts of the North Island
- cost neutral to building users in warmer parts of the North Island.

There would be other non-financial benefits, including to the health and wellbeing of building users, and to the environment.

3.1 Background

The house thermal insulation requirements of Building Code Clause H1 Energy Efficiency were last reviewed in 2001. The requirements are based on knowledge of building thermal performance, people's behaviour, and a 1995 cost-benefit analysis. Knowledge of building thermal performance and environmental factors has improved greatly since then. New Zealand's national interests have also changed, partly because of the implementation of Kyoto Protocol commitments and energy supply concerns.

These changes prompted a re-evaluation of the Building Code house thermal insulation requirements in Clause H1 Energy Efficiency.

The Department of Building and Housing has reviewed the thermal insulation requirements of houses, including house capital and operating cost analysis. The analysis looked at recent energy prices, expected energy price increases, reductions in insulation costs, and social and environmental impacts.

The review and analysis have resulted in the proposed changes to the energy efficiency provisions of the Building Code and Compliance Documents to improve house thermal insulation.

3.2 What options were considered to improve house thermal insulation?

The Department proposes better insulation by increasing house thermal insulation requirements in the Building Code. The Department proposes to reduce the Building Performance Index (BPI) and to increase the R-values (thermal resistance) in the corresponding Compliance Documents.

Currently, the Building Code requires that buildings be constructed so that their BPI does not exceed:

- 0.13 kWh in a warm location
- 0.12 kWh in a cool location.

The Department investigated several options for increasing house thermal insulation.

3.2.1 Option 1: Do nothing (not recommended)

Leaving the Building Code and Compliance Documents unchanged would rely on market forces to bring about a change in building practices resulting in better insulation.

Option 1 is not recommended because:

- budget constraints often drive the specifications for new houses to meet only the minimum requirements of the Building Code, and these specifications then become the norm
- short-term financial considerations of developers and some home owners do not match the payback periods of some energy efficiency measures or the life cycle of buildings (on average, houses are sold every 8 years and last for 50 years)
- despite it being clearly cost-effective to improve the thermal performance of new houses beyond the Building Code requirements, based on current energy and insulation prices, this is not happening in some parts of New Zealand. By contrast, approximately 90 percent of new homes in the South Island have double-glazing. This is a good example of market-driven innovation that should be applied across New Zealand.
- it is impractical to increase insulation levels after the house is built in all areas except the ceiling, which can ‘lock-in’ poor energy efficiency for the life of the building

- making no change to the Building Code and Compliance Documents would be inconsistent with the objectives of the Building Act and the National Energy Efficiency and Conservation Strategy

For example, a typical house in Christchurch can save as much as $1,320 per year in heating costs with better insulation (assuming a suitable heating regime). Doing nothing would not only prevent this cost saving; it would mean additional costs as the price of electricity and/or gas continues to increase.

3.2.2 Option 2: Amend Compliance Documents without changing the BPI limits in the Building Code (not recommended)

The Department of Building and Housing considered replacing the existing reference to New Zealand Standard NZS 4218: 1996 Energy Efficiency – Small Building Envelope with the updated Standard NZS 4218: 2004 in the Acceptable Solution H1/AS1, without changing the BPI definition and limits in the Building Code.

This option would have the effect of:

- double-glazing being used in the South Island and the Central Plateau of the North Island (Zone 3, as defined in NZS 4218)
- taking better account of the effect of glazing on the thermal performance of houses (eg, limiting the use of the schedule method to houses where the area of glazing is ≤ 30 percent of total wall area).

Option 2 is not recommended. It is not preferred because it is now cost-effective to insulate beyond the requirements of NZS 4218: 2004. The option would also introduce greater inconsistency between the current schedule method and the BPI specified in the Building Code.

3.2.3 Option 3: Decrease BPI limits, change how the BPI is calculated and amend Compliance Documents (recommended)

The Department considers that the best way to improve house thermal insulation is by:

- decreasing the BPI limits for houses
- changing the way the BPI is calculated
- amending Compliance Documents.

Option 3 is recommended as the preferred option.

3.2.4 How was option 3 chosen?

To determine the appropriate BPI limits for houses, the Department tested several insulation scenarios using lower BPI limits and increased R-values (refer to Appendix 1 and 5). The Department evaluated the benefits and costs of each scenario.

The scenarios were based on insulation levels specified in NZS PAS 4244: 2003 Insulation of Lightweight-framed and Solid Timber Houses. The Standard provides for:

- a minimum level of insulation, corresponding to the current Building Code specification (based on NZS 4218: 1996)
- increased insulation that is 'better' than the current Building Code (this increase in insulation levels is based on what can be achieved using the most common construction practices ie, the highest wall R-value that can be achieved using 100 mm framing timber)
- even more insulation ('best' level) (this increase in insulation levels is based on what can be achieved using the best possible current construction techniques for thermal performance eg, if 150 mm studs were used in wall construction and the cavity was filled with insulation material).

These three levels of insulation, for floors, walls and ceilings, were combined with options for improved glazing insulation levels, giving several possible scenarios.

The Department identified the scenario corresponding to 'better' levels of insulation coupled with double-glazing as its preferred option.

3.2.5 What does option 3 propose?

This option would:

- reduce the current BPI limits for houses by approximately 35 percent
- reference NZS 4218: 2004 in Compliance Documents H1/AS1 and H1/VM1, but with higher R-values than those specified in the Standard to ensure consistency between methods of compliance (R-values specified in Tables 1, 2, 3 and 4 of the Standard would be replaced by higher values specified in the Compliance Documents)
- change the definition of BPI to take account of improved understanding of energy use and thermal performance of houses.

The R-values for timber-framed houses were determined by the cost-benefit analysis. Approximately 90 percent of all houses built in New Zealand are of timber-framed construction. Thermal simulations were completed to compare the energy performance of solid construction and timber-framed houses. The results of these simulations were used to determine the appropriate R-values for houses of solid construction that result in similar thermal performance to the R-values for timber-framed houses. The report describing the results of these simulations is included in Appendix 2.

Two different tables of R-values for solid construction have been proposed because the thermal performance of houses with solid timber walls is different from that of houses with solid concrete walls. These two tables, 2a and 2b, are proposed to replace Table 2 in NZS 4218.

3.2.6 Why should the definition of the BPI be changed?

The Department proposes to change the definition of the BPI to take account of improved understanding of energy use and thermal performance of houses.

The BPI method provides the greatest design flexibility to the consumer to comply with the Building Code. This means consumers can choose from a range of solutions to make their new homes and buildings more energy efficient. Changing the definition would make the BPI method simpler and more accessible.

The new definition would:

- use the updated Annual Loss Factor design tool (ALF 3) to calculate the heating energy for houses
- use monthly average temperatures to take account of climate variations, rather than Heating Degree Days (HDD)
- correct discrepancies in the current calculation, whereby smaller houses are treated less favourably than larger ones.

The current definition of the BPI involves calculating the heating energy for the house using the ALF (Annual Loss Factor) analysis, divided by the floor area and Heating Degree Days (HDD) based on 15°C for 4 months of the year (May-August).

$$\text{Current BPI} = \frac{\text{Calculated energy use for heating (ALF2)}}{\text{Floor area } (m^2) * \text{Heating Degree Days (HDD)}}$$

The proposed new definition of the BPI is the heating energy for the house calculated using the ALF 3 (Annual Loss Factor), divided by the floor area, **plus wall area** and Heating Degree **Months** based on 14^{o}C for **the whole year**.

$$\text{Proposed BPI} = \frac{\text{Calculated energy use for heating (ALF 3)}}{\text{(Floor area + wall area) } (m^2) * \text{Heating Degree Months } (HDM_{14})}$$

Currently, the BPI is calculated using ALF 2, based on a fixed 4-month heating season throughout New Zealand, which is not representative of actual heating behaviour. Research shows that heating seasons vary from 6 months in Auckland to 10 months in Dunedin.[2] These findings have been incorporated into ALF 3, which more accurately calculates actual heating energy use.

The Department proposes climate normalisation using monthly average temperatures (in the form of annual Heating Degree Month data) because this data is readily available. Climate normalisation is currently based on Heating Degree Day data, which has become more difficult to obtain.

It is easier for a large house to achieve the BPI limit than a small house because the larger house has a lower proportion of wall area to floor area. As a result, larger houses can meet the BPI target using insulation with a lower R-value than smaller houses. The Department proposes to redress this anomaly by changing the definition of the BPI so that the floor and wall areas are

[2] Report on Year 9 Analysis for the Household Energy End-use Project (HEEP), BRANZ (2005).

used in the calculation. This would better reflect the relative areas of building elements through which heat is lost.

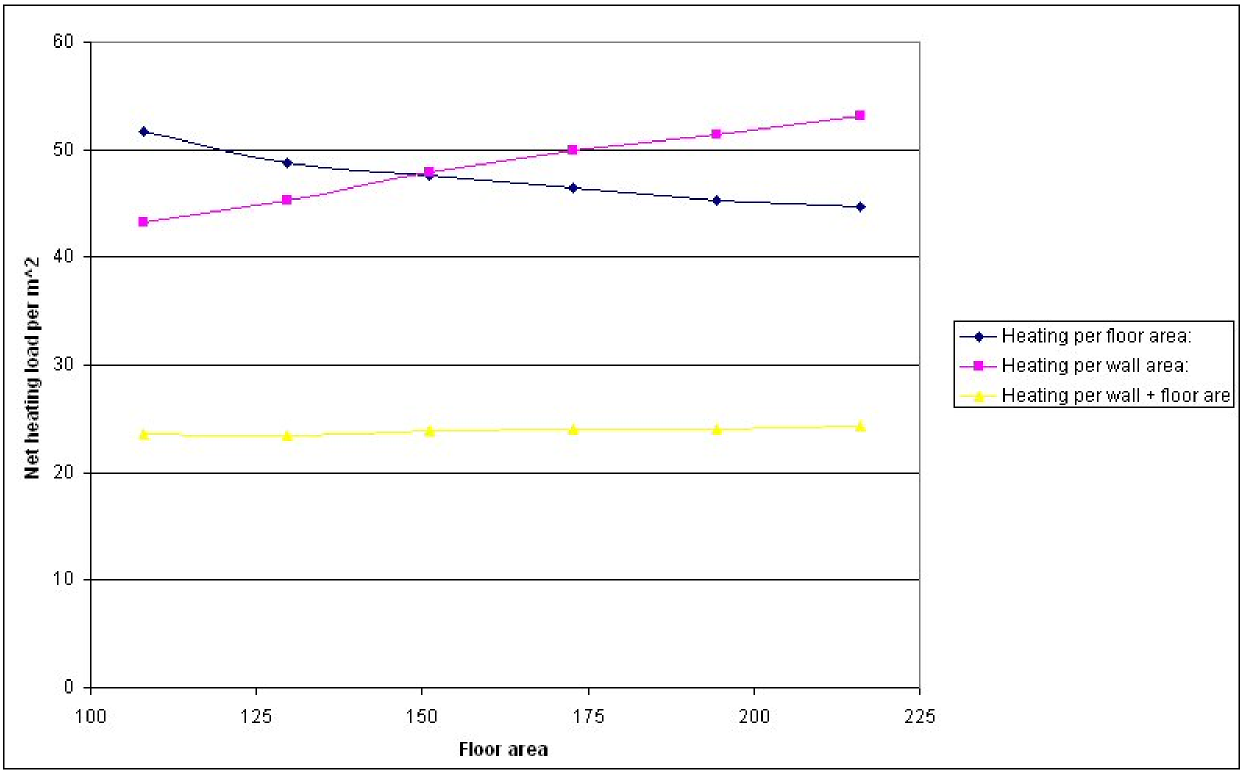
The Department considered six different options to account for this effect. Details of the options considered and the analysis is included in Appendix 3.

Consideration of the various BPI definitions that were investigated shows that:

- as floor area increases, the heating energy requirement per unit of floor area decreases
- as floor area increases, the heating energy requirement per unit of wall area increases
- if floor area and wall area are combined in the BPI definition, these two effects balance each other out.

Using this approach, as floor area increases, the heating load per unit floor area remains approximately the same, as shown in Figure 1. Therefore, the BPI would be similar for a small house as it is for a large house insulated with material of the same R-value.

Figure 1: Changes in net heating load and house size



3.2.7 What is the effect of changing the BPI definition on the Building Code BPI limit?

The numerical value of the BPI calculated using the new definition would be nominally higher than current figures. This is because of the change in the mathematical formula defining the BPI. However, the overall practical effect would still be an increase in insulation requirements. The proposed new limit would be 1.5 kWh/(m^2 °C year) throughout New Zealand (refer to Appendix 4).

3.2.8 Why are there no longer 'warm' and 'cool' locations as in the current Building Code?

The proposed changes to the BPI definition would result in a BPI that more accurately reflects the thermal performance of houses and therefore removes the requirement for different BPI limits for warm and cool locations.

This proposed change is consistent with the performance-based nature of the Building Code.

3.3 What are the benefits, costs and implications of Option 3?

3.3.1 Cost-benefit analysis of the different option 3 insulation scenarios

Analysis shows that it is cost-effective to install 'better' insulation and windows in all parts of New Zealand. The energy savings and payback times are most favourable in the cooler areas of New Zealand (zone 3). However, the proposed changes are also worthwhile in the warmer areas (zones 1 and 2).

These findings come from a cost-benefit analysis of several insulation scenarios by BRANZ Ltd (BRANZ). BRANZ used computer modelling to establish heat losses from houses with and without the proposed levels of insulation. The current Building Code insulation requirements were used as the reference case to compare with the different scenarios. Combinations of three different house sizes (small, medium and large) in four different climates (Auckland, Wellington, Christchurch and Dunedin) were modelled for each scenario. The cost-benefit analysis takes account of quantifiable financial factors, such as insulation costs and energy prices. BRANZ completed further analysis by taking into account broader social and environmental benefits, such as health improvements, reduced CO_2 emissions, improved air quality (from reduced emissions from woodburners), increased security of electricity supply, and impacts on gross domestic product. The most important results are summarised in Table 1.

Table 1: Summary results of cost-benefit analysis

	Auckland	Wellington	Christchurch	Dunedin
Additional initial cost ($)	3,800	3,790	3,370	3,410
Annual energy consumption: †				
a) Current requirements (kWh)	7993	11173	17133	23903
b) Proposed insulation (kWh)	2788	4452	7665	11183
Annual energy savings (kWh)	5,205	6,721	9,468	12,720
Annual cost saving ($)*	700	880	1,320	1,880

† annual energy consumption is based on the heating regime described below

* based on current energy prices (refer Appendix A).

Table 1 compares a house built under the current Building Code with one built under the proposed new insulation requirements (i.e. ‘better’ insulation and double-glazed windows). The house is medium-sized, timber-framed, with a concrete floor (this represents about 80% of all houses constructed in New Zealand annually). The analysis also assumes the entire house will be heated to 16°C all day, and living areas will be heated to 20°C in the morning (7am-9am) and in the evening (5pm-11pm). Therefore, there is an assumption that occupants will heat their house to a healthy and comfortable level. This heating regime has been established from actual measurements of modern homes in New Zealand, during research undertaken by BRANZ. While this heating regime is greater than most New Zealanders currently use, the proposal seeks to ensure that future occupants will not be disadvantaged by poor current practice. The calculated annual cost savings in Table 1 reflect this approach.

A copy of the BRANZ report of cost-benefit analysis is included as Appendix 1, which is available on the Department’s website.

3.3.2 Further benefits of increasing the thermal performance of houses

There are several benefits to increasing the thermal performance of houses beyond the immediate financial savings considered in the cost-benefit analysis above. The reduction in CO_2 emissions has been estimated at 18,000 tonnes per year, 975,000 tonnes after 10 years and 5,760,000 tonnes after 25 years. Other benefits have not been quantified, but include:

- improved health, productivity and comfort because of warmer and drier houses
- reduced peak energy demand, which is largely met from non-renewable resources
- reduced particulate emissions because of reduced use of solid-fuel burners (this is most important in areas where the air quality is affected by the high levels of particulates from solid-fuel burners)
- slightly better noise insulation in houses because of double-glazing (this is most important for apartments, areas with in-fill housing, and in areas near airports or industrial sites)
- reduced energy use in houses with heat pumps, which are used for air-conditioning in the summer months (these energy savings have not been included in the cost-benefit analysis).

3.3.3 Benefits of changing the BPI definition

Changing the BPI definition would:

- take account of improved understanding of energy use and thermal performance of houses
- better reflect the new sustainable development requirement in the Building Act 2004 by requiring similar insulation requirements in small and large houses
- create a single BPI limit that applies throughout New Zealand.

3.3.4 Financial implications

The Department expects the changes to increase the cost of building a new house by approximately $3,000-$5,000 (depending on the location and the area of glazing) and to result in a 30 percent reduction in the heating energy required. These proposals are cost-effective based on current predictions of energy and insulation prices, and related social and environmental impacts.

3.3.5 Double-glazing

The Department expects the proposed changes will mean that double-glazing will be required for most new houses in New Zealand.

When the schedule method is used to show compliance with the Building Code, windows and skylights would need to be double-glazed to attain the specified R-values. The cost-benefit analysis shows double-glazing is beneficial.

Manufacturers of double-glazed window units would need to respond to any resultant increased demand, and builders would need to master the skills required to install such units. The Department does not consider this an obstacle to adopting the technology. Some skill transfer would need to take place between the South Island market, where double-glazing installation skills are well established, and the rest of New Zealand. The introductory period proposed below would help the industry to comply.

Double-glazed windows are expected to last 30-35 years (this has been taken into account in the cost-benefit analysis), but some may need to be replaced after this time. Homeowners would need to be aware of this new maintenance requirement so that they can plan for new maintenance expense, which can be funded out of the energy savings achieved.

3.3.6 Thirty percent glazing rule

The new Standard NZS 4218: 2004 limits the use of the schedule method to houses with areas of glazing 30 percent or less of the total wall area. Glazing ratios higher than this significantly affect the thermal performance of the house. In this case, a specific design solution would be required.

In addition, all skylights would be required to have a thermal resistance of at least R 0.26 m^2 °C/W, which effectively means that they would need to be double-glazed. These restrictions on using the schedule method ensure the building envelope is constructed to ‘provide adequate thermal resistance’ and that it would achieve the proposed new BPI limits.

3.3.7 Structural implications

Although a double-glazed window unit is heavier than the equivalent single-glazed unit, the Acceptable Solution for the design and construction of timber-framed structures (not requiring specific engineering design) has no additional structural requirements for houses with double-glazed windows.

3.3.8 Overheating of houses

The possibility of increased insulation requirements leading to increased overheating in houses in warmer areas has been considered. Analysis shows that increasing the levels of thermal insulation results in a decrease in the hours of overheating in most cases. Therefore, overheating, because of increasing thermal insulation requirements is not an issue.[3] The proposed changes would result in a decrease in the hours of overheating and therefore a reduced need for cooling by air-conditioners.

3.5 Other Compliance Document changes

3.5.1 NZS 4214 reference

The Department proposes to reference the 2006 revision of NZS 4214 Methods of Determining the Total Thermal Resistance of Parts of Buildings, to supersede the 1977 revision. This is an updated revision of an old Standard. There are no major implications in this change.

3.5.2 NZS 4246 reference

The Department proposes to reference a new Standard NZS 4246: 2006 Installing Insulation in Acceptable Solution H1/AS1. This Standard details insulation methods which, if followed, will ensure the design thermal performance and thermal durability of the building elements is achieved.

The publication of this Standard is expected in December 2006. The public comment draft is available from the Department or Standards New Zealand.

3.6 Transitional arrangements

The Department of Building and Housing proposes that these changes be phased in to allow suppliers time to respond to the new requirements. The changes would not have a strong impact in zone 3 where more than 90 percent of new houses already have double-glazing installed. In zones 1 and 2, the changes would be more significant. In zones 1 and 2, more time would be needed to allow suppliers to adapt to the changed requirements.

The proposed publishing date, introductory period and effective date for each of the zones are shown in Table 2. The Department intends to provide building consent authorities and the industry time to familiarise themselves with the new provisions during the introductory period. Building consent applicants may choose to use the new provisions as alternative solution proposals in building consent applications.

[3] House Analysis and Data Collection for a Cost Benefit Analysis, BRANZ (2006).

Table 2: Transitional arrangements

Climate zone	Proposed publishing date	Introductory period	Proposed effective date
3	June 2007	4 months	October 2007
2	June 2007	12 months	June 2008
1	June 2007	15 months	September 2008

Transition proposals relating to building consents and Building Code compliance are listed below.

3.6.1 Building consents issued before 31 March 2005

Where a building consent has been issued before 31 March 2005, the code compliance certificate will be issued if the completed building work complies with the Building Code in place at the time the consent was issued. The revised Compliance Documents for Building Code Clause H1 (Amendment 3) as currently proposed in this paper will not apply to building work where the building consent was issued before 31 March 2005.

3.6.2 Building consents issued after 31 March 2005 and before the effective date

Where a building consent is applied for between 31 March 2005 and the effective date, a building consent will be issued if the building work complies with either:

- the Building Code and Compliance Documents for Building Code Clause H1 (Amendment 1 and, as yet unpublished, Amendment 2) in place at the time the consent was issued, or
- the revised Building Code and Compliance Documents for Building Code Clause H1 (Amendment 3) as proposed in this paper.

This approach will also apply in the situation where a building consent is applied for before the effective date, but the building consent is issued after the effective date.

Where the building consent is applied for between 31 March 2005 and the effective date, a code compliance certificate will be issued for that building consent if the building work complies with the building consent.

3.6.3 Building consent issued after the effective date

Where a building consent is applied for after the effective date, the building work must meet the requirements of the revised Building Code and Compliance Documents (Amendment 3) as proposed in this paper. A code compliance certificate will be issued if the building work complies with the building consent.

4 Reduced energy consumption of commercial lighting

Summary of proposals

Reducing the energy consumption of commercial lighting would reduce New Zealand's energy demand and would bring financial benefits to building owners.

The Department of Building and Housing proposes to increase the performance requirements for lighting in commercial buildings.

The Department would update the relevant Acceptable Solution to reflect modern lighting design standards. The updated Acceptable Solution would codify what is currently accepted as good design practice.

Commercial buildings designed and built to the updated Acceptable Solution would have the same lighting performance as the existing standards, but would use less energy and would require fewer lamp replacements.

Compared to average, current design practice, the proposed changes would accrue energy savings estimated to be about 104 GWh, or about $8 million based on current energy prices, over a decade.

The cost to the consumer of achieving these savings would be negligible.

4.1 Background

The Acceptable Solution H1/AS1 references lighting provisions in New Zealand Standard NZS 4243: 1996 Energy Efficiency – Large Buildings. This Standard sets lighting power density limits for different building uses, and provides an alternative method to calculate limits for individual spaces within a building.

NZS 4243 is being updated to reflect current good design practices and the use of modern lighting technology that is readily available. Using the revised Standard in the Acceptable Solution would reduce the energy consumption of commercial lighting installations.

NZS 4243: 1996 refers to NZS 6703: 1984 Interior Lighting Design for values of illuminance to be used when determining lighting power density limits.

Since NZS 6703: 1984 was produced, there have been important changes in lighting technology and lighting design procedures. The Standard specified values for service illuminance (average illuminance over time). The light output from lamps used at the time the Standard was set decreased markedly with age, and the specified values of service illuminance were set high to allow for the reduction of light output with age. Modern lamps do not have such a marked drop-off in light output. Modern lighting design Standards are based on a different value of illuminance, namely maintained illuminance, which is the lowest illuminance of an installation before maintenance—such as lamp replacement or the cleaning of luminaires—must be carried out. Because modern lamps do not demonstrate the drop-off in performance that was allowed for in designs using older lamps, lighting installations with new lamps do not need to be over-lit to the same degree.

The revised standard NZS 4243 would reference the AS/NZS 1680 series of Standards for lighting design. This series recommends a maintained illuminance value for each type of installation. It is also more precise about the procedure for measuring illuminance levels, meaning the lighting designer no longer has to make additional allowance for possible differences in measurement techniques.

The lamps themselves, and their associated control equipment, have also become more effective, and are even subject to Minimum Energy Performance Standards, administered by the Energy Efficiency and Conservation Authority.

4.1.1 Current status of lighting Standards

Standards New Zealand has produced a draft revision of NZS 4243 Energy Efficiency – Large Buildings. This draft revision reflects the changes to design procedure resulting from the move from NZS 6703: 1984 to the AS/NZS 1680 series. There are consequential changes to the lighting power density limits specified by the Standard.

The draft revision of NZS 4243 has separate sections for the lighting requirements and building thermal envelope requirements.

4.1.2 International examples

Various lighting energy efficiency programmes in operation around the world could be used to improve the Acceptable Solution for artificial lighting (H1/AS1, Paragraph 6.0). The majority of these relate to lighting components, such as lamps, ballasts or luminaires (light fittings). New Zealand’s minimum energy performance standards for tubular fluorescent lamps and for ballasts for fluorescent lamps fall into this category. The experiences in Australia and England and Wales are representative and relevant.

4.1.2.1 England and Wales

Energy efficiency regulations in England and Wales control the overall efficacy of the luminaires used, but do not limit the overall energy used. A disadvantage with this approach is that simply placing a restriction only on the luminaire efficacy does not prevent over-lighting. Even with good design, it is still difficult to achieve a uniform distribution of light using high efficacy luminaires (ie, luminaires that have a high light output). These luminaires tend to emit light mostly downwards, which means that more luminaires, spaced closer together, are needed to achieve uniform illumination. The result is an over-lit and inefficient installation.

4.1.2.2 Australia

The Australian requirements for lighting energy efficiency are contained in the Building Code of Australia. The approach is broadly similar to that used in New Zealand in that the lighting power density is used as the measurement. However, the requirements are more extensive than the current New Zealand requirements, and contain no reference to, or correlation with, the lighting design Standards used in New Zealand and Australia (see the AS/NZS 1680 series). Therefore, if the Building Code of Australia lighting requirements were adopted in New Zealand, they could involve unwarranted and unjustifiable compliance costs.

4.2 What options were considered to reduce the energy consumption of commercial lighting?

4.2.1 Option 1: Do nothing (not recommended)

The current Acceptable Solution, which references the energy efficiency Standard NZS 4243: 1996 and (in turn) the lighting Standard NZS 6703: 1984, no longer reflects design best practice. Significant energy efficiency benefits could be obtained by amending the Acceptable Solution.

This option is not recommended.

4.2.2 Option 2: Amend Acceptable Solution H1/AS1 and reference the AS/NZS 1680 series of Standards (recommended)

The Department proposes to amend the Acceptable Solution H1/AS1 and to reference the joint Australian/New Zealand AS/NZS 1680 series of Standards on lighting design in place of NZS 6703: 1984.

Therefore, illuminance levels would be expressed in terms of maintained (ie, minimum) illuminance instead of service (or average) illuminance. Apart from this, the approach is similar to the current regime, which installers find familiar. Applying the AS/NZS 1680 series of Standards would therefore not involve any new processes, nor impose any additional compliance costs.

It is timely to update the Acceptable Solution, and to reference the AS/NZS 1680 series of Standards, because advances in technology have resulted in lighting power density limits becoming less for installations using fluorescent lamps. The Acceptable Solution should reflect this. The present lighting limits were set at a generous level to allow the industry to get used to working to lighting power density limits, and do not generally require conscious consideration of energy performance for lighting systems to comply.[4]

Lighting controls have also developed, giving greater flexibility for installations having effective automatic lighting control.

AS/NZS 1680 may be applied to any large building, including buildings not covered by the Acceptable Solutions (ie, ‘commercial buildings and communal non-residential buildings whose

[4] Arnold, P and Donn, M (2004). *Review of the Use of NZS4243:1996:Artificial lighting energy efficiency requirements*, a report commissioned by the Energy Efficiency and Conservation Authority.

floor area is greater than 300 m^2[5]). This would allow widespread application of the Standard and would increase designers' familiarity with it.

4.2.3 Consultation and public comment

The Department proposes to make changes to the Building Code Acceptable Solution (H1/AS1, Paragraph 6.0 Artificial Lighting) at the same time that Standards New Zealand is seeking public comment on the draft Standard DZ 4243. The Department and the Standards New Zealand committee developing the Standard will consider all comments received. Once the Standard is finalised, the Department will notify the outcome in the *New Zealand Gazette*.

4.3 What are the benefits, costs and implications of Option 2?

An analysis of lighting in commercial buildings[6] established that, in addition to energy savings, introducing lighting energy efficiency requirements would result in a reduced capital cost due to the use of fewer luminaires. There would be additional ongoing savings from replacing fewer lamps.

Updating the Acceptable Solution would codify what is currently accepted as good design practice. Taking a conservative view, applying the revised Acceptable Solution would generate only modest additional savings relative to current practice. Even so, the energy savings are estimated to be 1.89 GWh per year. Savings are compounded (ie, three times that in the second year of implementation, six times that in the third year, etc) and, after 10 years, would amount to cumulative savings of 104 GWh or $8 million dollars in present value.

The cost to the consumer of achieving these savings would be negligible.

The savings are likely to be greater than indicated above as many lighting designs are likely to exceed the energy efficiency requirements, rather than only just meeting them, as assumed in the analysis. Further savings would also arise because the requirements apply to communal non-residential buildings, which have not been considered in this cost calculation. The Department of Building and Housing considers it likely that lighting designers would apply the Standard to other types of building on a voluntary basis.

As is the case now, the proposed Acceptable Solution includes alternative ways of compliance: a schedule method and a calculation method. The Department expects that most designers would follow the schedule method because it is simpler. If additional flexibility of design is desired, the calculation method could be followed. This gives consumer choice regarding the solutions they wish to use.

[5] Refer to Building Code Clause H1.2(c).

[6] 'Economic Analysis of Building Code Lighting Energy Efficiency Measures', December 1995.

Table 3: Estimated savings

Annual value of building consents for offices and administration buildings	$676 million
Average building cost	$1075/m^2
Total building area (=676x10^6 / 1075)	629,000 m^2
Annual hours of operation	2,000 h
Average saving due to the revised requirements This assumes that half the designs would comply already, and that the remainder would fail to meet the requirements by an average of 3W/m^2. This reflects the different market drivers on design procedures.	1.5 W/m^2
Therefore annual energy savings	1.89 GWh
Electricity price	$0.14/kWh
Assumed discount rate	10%

4.4 Transitional arrangements

The Department proposes to publish an amended Acceptable Solution for Clause H1 of the Building Code in 2007, which would include any changes to this proposal that might result from the consultation. A 3-month introductory period would follow.

Transition proposals for building consents and code compliance are listed below.

4.4.1 Building consents issued before 31 March 2005

Where a building consent has been issued before 31 March 2005, the code compliance certificate will be issued if the completed building work complies with the Building Code in place at the time the consent was issued. The revised Compliance Documents for Building Code Clause H1 (Amendment 3) as currently proposed in this paper will not apply to building work where the building consent was issued before 31 March 2005.

4.4.2 Building consents issued after 31 March 2005 and before the effective date

Where a building consent is applied for between 31 March 2005 and the effective date, a building consent will be issued if the building work complies with either:

- the Building Code and Compliance Documents for Building Code Clause H1 (Amendment 1 and, as yet unpublished, Amendment 2) in place at the time the consent was issued, or

- the revised Building Code and Compliance Documents for Building Code Clause H1 (Amendment 3) as proposed in this paper.

This approach will also apply in the situation where a building consent is applied for before the effective date, but the building consent is issued after the effective date.

Where the building consent is applied for between 31 March 2005 and the effective date, a code compliance certificate will be issued for that building consent if the building work complies with the building consent.

4.4.3 Building consent issued after the effective date

Where a building consent is applied for after the effective date, the building work must meet the requirements of the revised Building Code and Compliance Documents (Amendment 3) as proposed in this paper. A code compliance certificate will be issued if the building work complies with the building consent.

5 A new Acceptable Solution for solar water heating

Summary of proposals

Publishing an Acceptable Solution for solar water heating would make it cheaper and easier for homeowners to install such systems.

The Department of Building and Housing proposes to publish an Acceptable Solution for solar water heating installations.

The absence of an Acceptable Solution for solar water heating makes it difficult for solar water system installations to demonstrate compliance with the Building Code. Building consent authorities currently have to look at each installation on its own merits. This problem affects approximately 3500 new systems installed in New Zealand every year.

The main benefit of the new Acceptable Solution would be to remove a major barrier to the uptake of solar water heating technology. An average household, spending about $400 per year on water heating, could save as much as $200 or 50 percent of its water heating costs (depending on its geographical location) by installing a solar water heating system.

The Department of Building and Housing expects the cost of installing a new solar water heating system to drop by as much as 10 percent, or as much as $500, with the publication of the Acceptable Solution.

5.1 Background

The New Zealand solar water heating industry is well established and approximately 35,000 solar hot water systems have been installed. Approximately 3500 new systems are installed each year. Over the last 5 years, the annual growth in new installations has been around 40 percent.

Standards for the manufacture and installation of solar water heating products are established and are currently being revised to be up to date and applicable to New Zealand conditions.

Barriers to more installations include installation costs and the lack of experienced installers. The latter partly contributes to the former. Another impediment to the uptake of solar water heating is the cost of obtaining a building consent, which can be 10 percent of the total cost.

The Department of Building and Housing is aware that building consent authorities have differing requirements for issuing building consents for solar hot water systems. As a consequence, the fees charged for solar installation consents vary widely.

Installing some systems is relatively simple, consisting of minor plumbing work. About 60 percent of new solar water systems being installed use an existing hot water cylinder within the building envelope. Other systems, where the water storage container, which can weigh 350 kg, is on the roof, pose greater risks and need a detailed consideration of roof strength.

Solar water heating systems are either ‘packaged’, where the system is designed as an integrated whole from components, or ‘custom built’, where an existing cylinder might be used.

For example, a system on an existing house, using a collector, pump and controllers connected to an existing hot water container, would be a custom-built system. While packaged systems can be tested as a system and documentation produced to show compliance, demonstrating compliance for custom built systems is more difficult.

5.2 What options were considered to assist the adoption of solar water heating technology?

Two solar water heating-related Standards, AS/NZS 2712 Solar and Heat Pump Water Heaters – Design and Construction and AS/NZS 3500.4 Plumbing and Drainage – Heated Water Services, are being reviewed by Standards expert committees. This work is expected to be completed in February 2007.

5.2.1 Option 1: Do nothing (not recommended)

The absence of clear guidance information is an obstacle to the increased adoption of solar water heating technology, which could achieve important energy efficiency and cost gains.

This option is not recommended.

5.2.1 Option 2: Reference updated Standards in Acceptable Solution G12/AS1 only (not recommended)

One option for resolving compliance difficulties is to reference the two solar Standards in Acceptable Solution G12/AS1 (after appropriate consultation) when they are published in 2007. However, several solar installation issues need specific solutions and consultation.

Referencing the Standards without providing the broader context by publishing an Acceptable Solution is not a preferred option.

5.2.2 Option 3: Reference the updated Standards and publish a guidance document only (not recommended)

Another option is to include the two solar Standards in Acceptable Solution G12/AS1 next year and produce a guidance document at that time to help with system design and Building Code compliance. However, a guidance document would not provide the same certainty for owners, installers and building consent authorities as a separate Acceptable Solution.

The Department does not recommend this option.

5.2.3 Option 4: Reference the updated Standards in a new Acceptable Solution (G12/AS2) and publish a Guidance Document (Recommended)

The Department considers that a new, separate Acceptable Solution, which would reference the two Standards, is the best option. The Department also proposes to publish a guidance document.

5.2.4 What does Option 4 propose?

The Department of Building and Housing proposes to introduce a new Acceptable Solution, to become G12/AS2, to address the installation of solar water heating systems. This proposal would address compliance by providing clarity and uniformity to applicants and building consent authorities. The Acceptable Solution would also provide building consent authorities with the ability to distinguish between those installations where there is potential risk to property and inhabitants due to the extra roof load, and those that can be treated as minor plumbing work.

The Acceptable Solution would reference Standards AS/NZS 2712: 2007 for system manufacture and AS/NZS 3500.4: 2007 for installation.

The solar water heating provisions in G12/AS2 would:

- distinguish systems that need significant consideration (such as those with structural issues because of increased roof loads) from systems that are minor plumbing works
- provide specific references to AS/NZS 2712 and AS/NZS 3500.4 for installation of solar water heating systems in New Zealand
- establish requirements for custom-built applications
- clarify solar water heating installation requirements to meet the Building Code to building consent applicants and authorities.

The proposed Acceptable Solution is provided in part 6.

5.2.5 A future guidance document

To support the introduction of G12/AS2, the Department of Building and Housing, EECA and the Solar Industries' Association propose preparing a joint guidance document describing the application of the Acceptable Solution. This document would replace the voluntary Code of Practice.

5.3 What are the costs, benefits and implications of Option 4?

5.3.2 Benefits

The proposal would remove a barrier to achieving the Government's policy for increased uptake of renewable energy. Clarity of the requirements should also reduce the need for unnecessary engineering reports for installations that are minor plumbing work.

The cost of installing a new solar water heating system could be reduced by about 10 percent, or as much as $500.

The cost reduction could have a major impact on the uptake of solar water systems because, not being a primary source of hot water, their installation is especially cost-sensitive.

5.3.1 Costs

The review of the two solar water heating Standards is supported by manufacturers and installers in Australia and New Zealand. The revisions to the Standards are unlikely to result in any increase in equipment and installation cost. The revisions would make it easier to connect solar hot water systems in existing houses in New Zealand.

The draft Acceptable Solution G12/AS2 contains a requirement for heating stored water to at least 60°C once a day to kill any legionella bacteria. This requirement is not contained in the draft AS/NZS 3500.4 and would be specific to New Zealand. Although some additional cost would be incurred, it is consistent with the Building Code requirements for controlling legionella in plumbing systems.

5.4 Transitional arrangements

The Department proposes to include the new solar Acceptable Solution in the Clause G12 Compliance Document. As noted above, the two referenced Standards are under review and are expected to be finalised in February 2007. When they are published, the Department will issue a *New Zealand Gazette* notice advising that the 2007 versions of the Standards are about to be referenced in the Acceptable Solution.

The Department expects the new Acceptable Solution to be published in May 2007.

6 Proposed changes to the Building Code and Compliance Documents

Proposed changes: Building Code Clause A2 (Definitions) and definitions for H1/VM1 and H1/AS1

<table>
<tr><th>Current text</th><th>Proposed changes</th></tr>
<tr><td>Building performance index (BPI), in relation to a building, means the energy from a network utility operator or a depletable resource (measured in kilowatt-hours per square metre of floor area and per degree-day, and calculated using the Building Research Association of New Zealand’s Annual Loss Factor Design Manual 1990 or some other method that can be correlated with that manual) needed to maintain the building at a constant internal temperature for the period from 1 May to the close of 31 August under the following standard conditions:

a) A continuous temperature of 20°C throughout the building.
b) An air change rate of 1 change per hour or the actual air leakage rate, whichever is the greater.
c) A heat emission contribution arising from internal heat sources for the period being considered of 1000 kWh for the first $50m^2$ of floor area and 10 kWh for every additional square metre of floor area.
d) No allowance for –
(i) carpets, or
(ii) blinds, curtains, or drapes, on windows.
e) Windows to have a shading coefficient of 0.6 (made up of 0.8 for windows and recesses and 0.75 for site shading).</td><td>Building performance index (BPI) is the heating energy of a building normalised as follows:

$$\text{BPI} = \frac{\text{Heating energy}}{\text{Heating degree months} \times (\text{floor area} + \text{total wall area})}$$</td></tr>
<tr><td>Cool location means a location in New Zealand where the degree-day total is 920 or more.</td><td>Deleted</td></tr>
</table>

Degree-day in relation to any location on any day, – a) If a base temperature of 15ºC is greater than the mean of the maximum and minimum outdoor temperatures at that location on that day, means the number of degrees Celsius by which that base temperature is greater than that mean. b) If a base temperature of 15ºC is not greater than the mean of the maximum and minimum outdoors temperatures at that location on that day, means zero.	*Deleted*
Degree-day total in relation to any location, means the sum of the degree-days for that location for the period of 1 May to 31 August, as derived from Average Degree day Tables – Selected NZ Stations (Miscellaneous Publication 159, 1978 of the New Zealand Meteorological Service).	*Deleted*
New entry	**Floor area** is the total interior living floor area in a house.

New entry	**Heating energy** is the energy from a network utility operator or a depletable resource needed to maintain the building at a constant internal temperature throughout the year under the following standard conditions: a) A continuous temperature of 20^{o}C throughout the building. b) An air change rate of 1 change per hour or the actual air leakage rate, whichever is the greater. c) A heat emission contribution arising from internal heat sources for the period being considered of 1000 kWh for the first 50m^2 of floor area and 10 kWh for every additional square metre of floor area. d) No allowance for: (i) carpets, or (ii) blinds, curtains or drapes on windows. e) Windows to have a shading coefficient of 0.6 (made up of 0.8 for windows and recesses and 0.75 for site shading). The heating energy shall be calculated using the BRANZ's *ALF 3, The 'Annual Loss Factor' Method, A design toll for energy-efficient houses*, 3rd edition (April 2000), or some other method that can be correlated with that manual.
New entry	**Heating degree months** is the annual sum of the difference between the base temperature of 14°C and the mean monthly temperature, when the mean monthly temperature is less than 14°C. Heating degree months must be calculated using temperature data from 'Temperature normals for New Zealand for the period 1961 to 1990' by A I Tomlinson and John Sansom, NIWA, ISBN 0478083343. If the *heating degree months* is less than 12 °C.month, then a value of 12 may be used instead.
New entry	**Total wall area** is the wall area plus the area of vertical glazing. Wall area is the area of internally exposed exterior wall, including any door openings.
Warm location means a location in New Zealand where the degree-day total is less than 920.	*Deleted*

Your comments on proposed changes to Building Code Clause A2 (Definitions) and definitions for H1/VM1 and H1/AS1

Proposed changes to Building Code Clause H1 Energy Efficiency

Current text	Proposed changes
Performance **H1.3.2** Buildings must be constructed to ensure that the building performance index does not exceed: (a) 0.13 kWh in a warm location; and (b) 0.12 kWh in a cool location.	**Performance** **H1.3.2** Buildings must be constructed to ensure the building performance index does not exceed 1.5 kWh/(°C. month. m^2).

Your comments on proposed changes to Building Code Clause H1 Energy Efficiency:

Proposed changes: References for H1/VM1 and H1/AS1

At the beginning of the section, insert:

For the purposes of New Zealand Building Code compliance, the Standards and documents referenced in this Compliance Document (primary reference documents) must be the editions, along with their specific amendments, listed below. Where these documents (primary reference documents) refer to other Standards or documents (secondary reference documents), which in turn may also refer to other Standards or documents, and so on (lower-order reference documents), then the version in effect at the date of publication of this Compliance Document must be used.

Current text	Proposed changes
Standards New Zealand	**Standards New Zealand**
NZS 4214:1977 Methods of determining the total thermal resistance of parts of buildings	NZS 4214: 2006 Methods of determining the total thermal resistance of parts of buildings
NZS 4218:1996 Energy efficiency–housing and small building envelope	NZS 4218: 2004 Energy efficiency – housing and small building envelope
NZS 4243:1996 Energy efficiency–Large buildings	NZS 4243: 2007* Energy efficiency – Large buildings: Part 1 Thermal Envelope
	NZS 4243: 2007* Energy efficiency–Large buildings: Part 2 Lighting
	NZS 4246: 2006* Installing insulation
BRANZ	**BRANZ**
ALF Manual: 1990 Annual loss factor design manual. An aid to thermal design of buildings	ALF 3: The 'Annual Loss Factor' Method. A design tool for energy efficient houses, 3rd edition (April 2000)
M.R. Bassett, R.C. Bishop and I.S van der Werff	Albrecht Stoecklein and Mark Bassett

New Zealand Meteorological Service Average degree-day tables – selected NZ stations (Miscellaneous publication 159, 1978) **Comment:** This publication is no longer available, but the relevant information is summarised in the Degree-days data sheets of the ALF Manual referenced above.	***Deleted***
New entry	**National Institute of Water and Atmospheric Research (NIWA)** 'Temperature normals for New Zealand for the period 1961 to 1990', ISBN 0478083343 A I Tomlinson and John Sansom, COMMENT: Heating degree months must be calculated using temperature data from this document.

* These standards are being revised, with draft copies available for comment at www.standards.co.nz

Your comments on proposed changes to the references for H1/VM1 and AS1:

Proposed changes: Verification Method H1/VM1

Current text	Proposed changes
New entry 1.1.2	**1.1.2** NZS 4218 Tables 1, 2, 3 and 4 are replaced with the tables that follow.
1.2.1 The building performance index (BPI) may be calculated by following the procedures of the ALF Design Manual. Clause H1.3.1 (a) is satisfied by complying with the BPI. COMMENT: 1. The NZBC has no requirement for the maintenance of interior temperatures except as required by NZBC G5 for old people's homes and early childhood centres. The 20°C stated in the definition of building performance index is for calculation purposes only. 2. To satisfy the requirements of E3/AS1 for Internal Moisture, it may be necessary, depending on the method adopted, to provide more insulation (greater R-value) than that required to satisfy energy efficiency provisions alone. See NZS 4218 clauses 1.3.3 and 3.2.6. 3. For buildings in locations where the degree-day total is more than about 1400 (such as alpine areas), there may be benefits in higher levels of insulation than required in the cool location. 4. BRANZ has published an upgraded version of ALF (ALF3 The Annual Loss Factor Method, 3rd Ed, Judgeford, BRANZ, 2000) which uses a procedure that has been correlated with ALF 1990. Note that the ALF procedures are intended for DETACHED DWELLINGS and are not suitable for MULTI-UNIT DWELLINGS.	**1.2.1** Clause H1.3.1 (a) is satisfied by complying with the BPI. COMMENT: 1. The NZBC has no requirement for the maintenance of interior temperatures except as required by NZBC G5 for old people's homes and early childhood centres. The 20°C stated in the definition of *building performance index* is for calculation purposes only. 2. To satisfy the requirements of E3/AS1 for internal moisture, it may be necessary, depending on the method adopted, to provide more insulation (greater R-value) than that required to satisfy energy efficiency provisions alone. See NZS 4218 clauses 1.3.3 and 3.2.6. *Existing Comment 3 deleted* 3. BRANZ will publish an upgraded version of ALF 3 (2007), which will also calculate the BPI defined in this amendment of the building code. Note that the ALF procedures are intended for DETACHED DWELLINGS and are not suitable for MULTI-UNIT DWELLINGS.

1.3.1 The modelling method described in NZS 4243 section 4.7, is a verification method for NZBC Clause H1.3.1 (a) for buildings other than HOUSING having a total floor area greater than 300 m^2. COMMENT: 1. If artificial lighting is included when applying the modelling method of NZS 4243 section 4.7, there is no need to comply separately with section 4.5 or 4.6 of that Standard. 2. Note the limit on application to NZBC Clause H1.2 (a) and H1.2 (c).	**1.3.1** The modelling method described in NZS 4243 – Part 1, Section 4.4 is a verification method for NZBC Clause H1.3.1 (a) for buildings other than HOUSING having a total floor area greater than 300 m^2. COMMENT: *Existing Comment 1 deleted* 1. Note the limit on application to NZBC Clause H1.2 (a) and H1.2 (c).

Replacement Table 1 – Non-solid construction – minimum R-values for schedule method (only where area of glazing is 30 percent or less of total wall area and skylights have total area less than 1.2 m^2)

Building thermal envelope component	Minimum R-values (m^2 °C/W)		
	Climate zone 1	Climate zone 2	Climate zone 3
Roof	R 2.6	R 2.6	R 3.1
Wall	R 2.1	R 2.1	R 2.1
Floor	R 1.9	R 1.9	R 1.9
Glazing (vertical)	R 0.26	R 0.26	R 0.26
Glazing (skylights)	R 0.26	R 0.26	R 0.31

Notes

(1) The R-values given in this table are those applicable to the reference building as described in NZS 4218.

(2) Climate zone boundaries are shown in Appendix B of NZS 4218.

(3) If the sum of the area of glazing on the east-, south- and west-facing walls (see Appendix H of the Standard) is more than 30 percent of the total wall area of all of these walls, then either the calculation or modelling method shall be used.

(4) Carpets or floor coverings are not included in the floor R-value.

(5) The R-values for glazing refer to whole-window R-values (glass and frame). The values in this table are for a standard WERS window (Appendix G). Any proposed area of glazing shall be considered to have an R-value as given in Appendix G.

(6) There are no R-value requirements for the opaque parts of a door or a door set.

Replacement Table 2(a) – For solid timber construction – minimum R-values for schedule method (only where area of glazing is 30 percent or less of total wall area and skylights have a total area less than 1.2 m^2)

Building thermal envelope component	Minimum R-values (m^2 $^oC/W$)					
	Climate zone 1		Climate zone 2		Climate zone 3	
Roof	R 3.5	R 3.5	R 3.5	R 3.5	R 3.5	R 3.5
Wall	R 1.3	R 1.0	R 1.45	R 1.1	R 1.6	R 1.2
Floor	R 1.9	R 1.9	R 1.9	R 1.9	R 1.9	R 1.9
Glazing (vertical)	R 0.26	R 0.31	R 0.26	R 0.31	R 0.26	R 0.31
Glazing (skylights)	R 0.26	R 0.31	R 0.26	R 0.31	R 0.31	R 0.31

Notes

(1) The R-values given in this table are those applicable to the reference building as described in NZS 4218.

(2) Climate zone boundaries are shown in Appendix B of NZS 4218.

(3) If the sum of the area of glazing on the east-, south- and west-facing walls (see Appendix H of the Standard) is more than 30 percent of the total wall area of all of these walls, then either the calculation or modelling method shall be used.

(4) Carpets or floor coverings are not included in the floor R-value.

(5) The R-values for glazing refer to whole-window R-values (glass and frame). The values in this table are for a standard WERS window (Appendix G). Any proposed area of glazing shall be considered to have an R-value as given in Appendix G.

(6) There are no R-value requirements for the opaque parts of a door or a door set.

Replacement Table 2(b) – For solid masonry construction – minimum R-values for schedule method (only where area of glazing is 30 percent or less of total wall area and skylights have a total area less than 1.2 m^2)

Building thermal envelope component	Minimum R-values (m^2 °C/W)					
	Climate zone 1		Climate zone 2		Climate zone 3	
Roof	R 3.5	R 3.5	R 3.5	R 3.5	R 3.5	R 3.5
Wall	R 1.0	R 0.8	R 1.25	R 0.95	R 1.4	R 1.1
Floor	R 1.9	R 1.9	R 1.9	R 1.9	R 1.9	R 1.9
Glazing	R 0.26	R 0.31	R 0.26	R 0.31	R 0.26	R 0.31
Glazing (skylights)	R 0.26	R 0.31	R 0.26	R 0.31	R 0.31	R 0.31

Notes

(1) The R-values given in this table are those applicable to the reference building as described in NZS 4218.

(2) Climate zone boundaries are shown in Appendix B of NZS 4218.

(3) If the sum of the area of glazing on the east-, south- and west-facing walls (see Appendix H of the Standard) is more than 30 percent of the total wall area of all of these walls, then either the calculation or modelling method shall be used.

(4) Carpets or floor coverings are not included in the floor R-value.

(5) The R-values for glazing refer to whole-window R-values (glass and frame). The values in this table are for a standard WERS window (Appendix G). Any proposed area of glazing shall be considered to have an R-value as given in Appendix G.

(6) There are no R-value requirements for the opaque parts of a door or a door set.

Replacement Table 3 – Heated walls, ceilings or floors – minimum R-values for the schedule method

Building thermal envelope component	Minimum values for climate zones 1, 2 and 3 ($m^2\ {}^oC/W$)
Heated ceiling (R_{OUT})	R 3.5
Heated wall (R_{OUT})	R 2.6
Heated floor (R_{OUT})	R 1.9
where $R_{IN}/R_{OUT}<0.1$ and R_{IN} is the thermal resistance between the heated plane and the inside air R_{OUT} is the thermal resistance between the heated plane and the outside air.	
NOTE – Carpets or floor coverings are not included in the floor R-value. Floor coverings, eg, carpet or cork, will reduce the efficiency of the heated floor.	

Replacement Table 4 – Reference building – area of glazing R-values

Building thermal envelope component	Minimum R-values (m^2 $^oC/W$)		
	Climate zone 1	Climate zone 2	Climate zone 3
Area of glazing up to 30% of total wall area	0.26	0.26	0.26
The proportion of the area of glazing over 30% of total wall area	0.31	0.31	0.36
Glazing – skylights	0.26	0.26	0.31

Notes

(1) The minimum R-values for the area of glazing shall be accepted as 0.22 and 0.26 for single low-e glazing and clear insulating glass units (IGU) respectively, except where a higher R-value can be demonstrated by calculation or measurement using NZS 4214 or an internationally accepted computer software program. The value of 0.31 relates to an IGU with a low-e pane (see Appendix G).

(2) Total area of glazing over 50 percent of total wall area may cause excessive heat gain and/or heat loss, and the modelling method shall be used in these cases.

(3) Non-glazed areas of door openings greater than 3 m^2 are treated as wall.

(4) This table applies to both solid and non-solid construction.

Your comments on proposed changes to Verification Method H1/VM1:

Proposed changes: Acceptable Solution H1/AS1

Current text	Proposed changes
New entry 1.0.4	**1.0.4** NZS 4218 Tables 1, 2, 3 and 4 are replaced with the tables that follow.
2.1.1 **COMMENT:** 1. Section 3.2 “calculation method” of NZS 4218 compares the proposed building with the “reference building” which is insulated in accordance with Tables 1 and 2. This method permits wall, floor and ceiling insulation combinations which differ from Tables 1 and 2, but the building must still perform at least as well as the “reference building” used in Tables 1 and 2. 2. Thermal mass, such as provided by exposed concrete floors and earth walls, in conjunction with solar design, can give improved energy efficiency. 3. To satisfy the requirements of E3/AS1 for Internal Moisture, it may be necessary, depending on the method adopted, to provide more insulation (greater R-value) than that required to satisfy energy efficiency provisions alone. 4. Table 2 of NZS 4218 permits buildings of solid construction to have lower R-values than buildings of non-solid construction. This results from taking account of the different costs and benefits to the building owner of adding extra insulation to certain types of construction. ‘Solid construction’ does not mean the full wall thickness must consist of the same material throughout.	**2.1.1** **COMMENT:** 1. Section 3.2 “calculation method” of NZS 4218 compares the proposed building with the “reference building”, which is insulated in accordance with Tables 1 and 2 (replaced as in Paragraph 1.0.4). This method permits wall, floor and ceiling insulation combinations that differ from Tables 1 and 2, but the building must still perform at least as well as the “reference building”. *Existing Comment 2 deleted* 2. To satisfy the requirements of E3/AS1 for internal moisture, it may be necessary, depending on the method adopted, to provide more insulation (greater R-value) than that required to satisfy energy efficiency provisions alone. 3. Table 2 of NZS 4218 (replaced as in Paragraph 1.0.4) permits buildings of solid construction to have lower R-values than buildings of non-solid construction. This results from taking account of the different costs and benefits to the building owner of adding extra insulation to certain types of construction. “Solid construction” does not mean the full wall thickness must consist of the same material throughout.
2.2.1 Construction in accordance with NZS 4243 section 4.3 or 4.4 satisfies the requirements of NZBC H1.3.1 (a) for the thermal resistance of the building envelope in buildings other than HOUSING having a total floor area of greater than 300 m^2. *New entry 2.3*	**2.2.1** Construction in accordance with NZS 4243 Part 1, clause 4.2 or 4.3 satisfies the requirements of NZBC H1.3.1 (a) for the thermal resistance of the building envelope in buildings other than HOUSING having a total floor area of greater than 300 m^2. **2.3** Acceptable methods for installing insulation material are contained in NZS 4246.

6.1.1 Artificial lighting energy consumption in COMMERCIAL, ASSEMBLY SERVICE and ASSEMBLY CARE buildings having a total floor area of greater than 300 m^2 shall comply with NZS 4243 clause 4.5 or 4.6 to satisfy the requirements of NZBC H1.3.5.	**6.1.1** Artificial lighting energy consumption in COMMERCIAL, ASSEMBLY SERVICE and ASSEMBLY CARE buildings having a total floor area of greater than 300 m^2 shall comply with NZS 4243 – Part 2, clause 3.3 or 3.4 to satisfy the requirements of NZBC H1.3.5.

Replacement Table 1 – Non-solid construction – minimum R-values for schedule method (only where area of glazing is 30 percent or less of total wall area and skylights have total area less than 1.2 m^2)

Building thermal envelope component	Minimum R-values (m^2 $^oC/W$)		
	Climate zone 1	Climate zone 2	Climate zone 3
Roof	R 2.6	R 2.6	R 3.1
Wall	R 2.1	R 2.1	R 2.1
Floor	R 1.9	R 1.9	R 1.9
Glazing (vertical)	R 0.26	R 0.26	R 0.26
Glazing (skylights)	R 0.26	R 0.26	R 0.31

Notes

(1) The R-values given in this table are those applicable to the reference building as described in NZS 4218.

(2) Climate zone boundaries are shown in Appendix B of NZS 4218.

(3) If the sum of the area of glazing on the east-, south- and west-facing walls (see Appendix H of the Standard) is more than 30 percent of the total wall area of all of these walls, then either the calculation or modelling method shall be used.

(4) Carpets or floor coverings are not included in the floor R-value.

(5) The R-values for glazing refer to whole-window R-values (glass and frame). The values in this table are for a standard WERS window (Appendix G). Any proposed area of glazing shall be considered to have an R-value as given in Appendix G.

(6) There are no R-value requirements for the opaque parts of a door or a door set.

Replacement Table 2(a) – For solid timber construction – minimum R-values for schedule method (only where area of glazing is 30 percent or less of total wall area and skylights have a total area less than 1.2 m^2)

Building thermal envelope component	Minimum R-values ($m^2\ {}^oC/W$)					
	Climate zone 1		Climate zone 2		Climate zone 3	
Roof	R 3.5	R 3.5	R 3.5	R 3.5	R 3.5	R 3.5
Wall	R 1.3	R 1.0	R 1.45	R 1.1	R 1.6	R 1.2
Floor	R 1.9	R 1.9	R 1.9	R 1.9	R 1.9	R 1.9
Glazing (vertical)	R 0.26	R 0.31	R 0.26	R 0.31	R 0.26	R 0.31
Glazing (skylights)	R 0.26	R 0.31	R 0.26	R 0.31	R 0.31	R 0.31

Notes

(1) The R-values given in this table are those applicable to the reference building as described in NZS 4218.

(2) Climate zone boundaries are shown in Appendix B of NZS 4218.

(3) If the sum of the area of glazing on the east-, south- and west-facing walls (see Appendix H of the Standard) is more than 30 percent of the total wall area of all of these walls, then either the calculation or modelling method shall be used.

(4) Carpets or floor coverings are not included in the floor R-value.

(5) The R-values for glazing refer to whole-window R-values (glass and frame). The values in this table are for a standard WERS window (Appendix G). Any proposed area of glazing shall be considered to have an R-value as given in Appendix G.

(6) There are no R-value requirements for the opaque parts of a door or a door set.

Replacement Table 2(b) – For solid masonry construction – minimum R-values for schedule method (only where area of glazing is 30 percent or less of total wall area skylights have a total area less than 1.2 m^2)

Building thermal envelope component	Minimum R-values (m^2 °C/W)					
	Climate zone 1		Climate zone 2		Climate zone 3	
Roof	R 3.5	R 3.5	R 3.5	R 3.5	R 3.5	R 3.5
Wall	R 1.0	R 0.8	R 1.25	R 0.95	R 1.4	R 1.1
Floor	R 1.9	R 1.9	R 1.9	R 1.9	R 1.9	R 1.9
Glazing	R 0.26	R 0.31	R 0.26	R 0.31	R 0.26	R 0.31
Glazing (skylights)	R 0.26	R 0.31	R 0.26	R 0.31	R 0.31	R 0.31

Notes

(1) The R-values given in this table are those applicable to the reference building as described in NZS 4218.

(2) Climate zone boundaries are shown in Appendix B of NZS 4218.

(3) If the sum of the area of glazing on the east-, south- and west-facing walls (see Appendix H of the Standard) is more than 30 percent of the total wall area of all of these walls, then either the calculation or modelling method shall be used.

(4) Carpets or floor coverings are not included in the floor R-value.

(5) The R-values for glazing refer to whole-window R-values (glass and frame). The values in this table are for a standard WERS window (Appendix G). Any proposed area of glazing shall be considered to have an R-value as given in Appendix G.

There are no R-value requirements for the opaque parts of a door or a door set.

Replacement Table 3 – Heated walls, ceilings or floors – minimum R-values for schedule method

Building thermal envelope component	Minimum values for climate zones 1, 2 and 3 (m^2 $^oC/W$)
Heated ceiling (R_{OUT})	R 3.5
Heated wall (R_{OUT})	R 2.6
Heated floor (R_{OUT})	R 1.9
where $R_{IN}/R_{OUT}<0.1$ and R_{IN} is the thermal resistance between the heated plane and the inside air R_{OUT} is the thermal resistance between the heated plane and the outside air.	
NOTE – Carpets or floor coverings are not included in the floor R-value. Floor coverings, eg, carpet or cork, will reduce the efficiency of the heated floor.	

Replacement Table 4 – Reference building – area of glazing R-values

Building thermal envelope component	Minimum R-values (m^2 $^oC/W$)		
	Climate zone 1	Climate zone 2	Climate zone 3
Area of glazing up to 30% of total wall area	0.26	0.26	0.26
The proportion of the area of glazing over 30% of total wall area	0.31	0.31	0.36
Glazing – skylights	0.26	0.26	0.31

Notes

(1) The minimum R-values for the area of glazing shall be accepted as 0.22 and 0.26 for single low-e glazing and clear insulating glass units (IGU) respectively except where a higher R-value can be demonstrated by calculation or measurement using NZS 4214 or an internationally accepted computer software program. The value of 0.31 relates to an IGU with a low-e pane (see Appendix G).

(2) Total area of glazing over 50 percent of total wall area may cause excessive heat gain and/or heat loss, and the modelling method shall be used in these cases.

(3) Non-glazed areas of door openings greater than 3 m^2 are treated as wall.

(4) This table applies to both solid and non-solid construction.

Your comments on proposed changes to Acceptable Solution H1/AS1:

Proposed Acceptable Solution G12/AS2

References

For the purpose of New Zealand Building Code compliance, acceptable reference documents include only the quoted edition and specific amendments as listed below.

Note: These referenced documents apply specifically to solar hot water installations. Other referenced documents listed in the G12 Compliance Document will also apply as they relate to plumbing installations in general. The referenced documents listed below will be incorporated in the overall G12 Compliance Document listing in the final published version.

NZS 4203: 1992 Code of practice for general structural design and design loadings for buildings

NZS 3604: 1999 Timber framed buildings

Revision of AS/NZS 3500: 2003, Part 4 - Heated water services, Section 6. (To be a 2007 amendment)*

Revision draft DR06573 of AS 2712: 2002 Solar and heat pump water heaters - Design and construction. (To be a 2007 amendment)*

AS 4032.2: 2005 Water Supply – Valves for the control of hot water supply temperatures – Tempering valves and end of line temperature activated devices

* These Standards are being revised, with draft copies available for comment from the Department of Building and Housing.

1.0 Scope

…………………………………………………………………………………………………….

This Acceptable Solution applies to the design, construction and installation of systems for heating water using solar radiation, as well as the associated plumbing connections. It covers the requirements of the following clauses of the New Zealand Building Code.

- G12 Water Supplies
- B1 Structure
- B2 Durability
- E2 External Moisture
- H1 Energy Efficiency

2.0 Installing Solar Hot Water Systems

…………………………………………………………………………………………………..

2.0.1 AS/NZS 3500.4, Section 6 is an acceptable means of installing solar hot water systems, except as modified by specific requirements of this Acceptable Solution.

COMMENT:

AS/NZS 3500.4 does not specifically address the requirements of New Zealand Building Code Clauses B2 Durability and E2 External Moisture, and does not adequately cover protection against growth of legionella bacteria in solar systems.

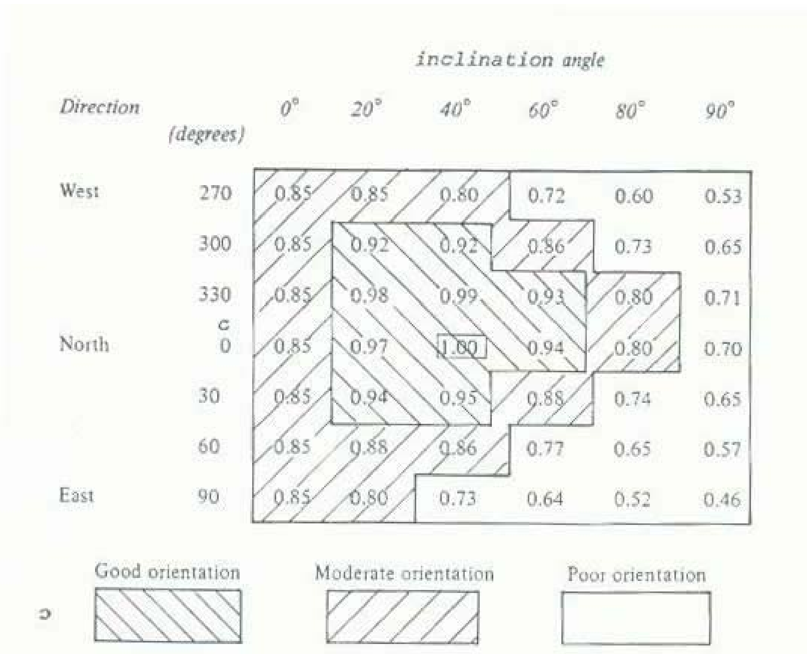
2.1 Solar orientation

2.1.1 Solar collector panels must be oriented facing within 45 degrees of the geographic north. They must be inclined at an angle within 20 degrees of the angle of latitude from the horizontal (see Figure 1).

COMMENT:

Deviations from north will affect the performance of the collectors. In New Zealand, the geographic north is approximately 20 degrees west of the magnetic north, as shown by a compass.

Figure 1: Factors for inclination and solar orientation



Direction	(degrees)	inclination angle 0°	20°	40°	60°	80°	90°
West	270	0.85	0.85	0.80	0.72	0.60	0.53
	300	0.85	0.92	0.92	0.86	0.73	0.65
	330	0.85	0.98	0.99	0.93	0.80	0.71
North	0	0.85	0.97	1.00	0.94	0.80	0.70
	30	0.85	0.94	0.95	0.88	0.74	0.65
	60	0.85	0.88	0.86	0.77	0.65	0.57
East	90	0.85	0.80	0.73	0.64	0.52	0.46

FACTORS FOR INCLINATION AND SOLAR ORIENTATION

The relative performance of flat plate collectors in different orientations is illustrated. It is clear that collectors should face within about 45º of north, and be fitted at an inclination angle between 20º and 50º.

If for some reason it were necessary to place collectors facing due west at 60º inclination, then to avoid loss in performance, the collectors would have to be 1/0.72 (or 1.4) as large, i.e. increased by 40 % in the collector area.

Where collectors other than flat-plate type (cylindrical shape for instance) are used similar optimum requirements for orientation will apply, i.e. the axis of the cylinder should be inclinded at 20º to 50º. The performance loss by using poorer orientations has not been as fully explored as for the flat-plate case.

2.2 Shading

2.2.1 Solar collector panels should be clear of shade for 3 hours either side of the time at which the collectors are pointing directly towards the sun (See Table 1).

COMMENT:

Table 1 shows solar altitude at mid-winter for various locations. The solar altitude as observed at the position of the lower edge of the collector(s) indicates whether nearby buildings, trees, and so on. will cast a shadow on the collector(s). For example, if a building or a tree as observed from the bottom edge of the collector is above the mid-winter solar altitude, then that building will cast a shadow on the collector.

Systems with collectors not receiving the full solar energy gain, either because of shading or poor orientation, will have reduced hot water output. Hot water output can be increased by increasing the collector area.

Table 1: Solar altitude in mid-winter

City	Latitude	9.30 am	12.30 pm	3.30 pm
	deg.	deg.	deg.	deg.
Auckland	37	16	30	16
Wellington	41	13	25	13
Christchurch	44	11	23	11
Invercargill	46	9	20	9

Note: The solar altitude may be determined using a commercial "sun locator". A simple solar altitude sight may be constructed using the diagrams given in Appendix C of AS/NZS 3500.4.

3.0 Structural Support

…………………………………………………………………………………………………..

3.0.1 This section covers:

a) Assessing the suitability of existing building roof structures for solar water heating system installation, and

b) Certain strengthening measures to support the additional loads imposed by installing solar water heating units and storage containers.

3.0.2 Roofs to which this section applies are:

a) Skillion or close-coupled roofs built in accordance with NZS 3604, or

b) Truss roofs that have been designed and constructed to support live and wind loads determined in accordance with NZS 4203.

3.0.3 This section provides criteria that will permit some buildings to accept the additional loading of solar water heating panels without the need for further strengthening.

3.0.4 This section only covers containers that are on top of the roof cladding. It is limited to cylindrical containers with their longitudinal axis horizontal and parallel to the roof surface.

COMMENT:

Installations that fall outside the scope of this section will require a specific design solution by a structural engineer.

3.1 Solar collector panels

Note: Solar collector panels must be securely attached to the roof so they will not be dislodged by wind or earthquake.

3.1.1 Solar collector panels that weigh less than 19 kg per square metre may be mounted on a roof, over the top of the existing roof cladding, with no extra strengthening of the roof structure.

3.1.2 Where concrete or ceramic tiles are removed and replaced by steel sheet profiled roofing, solar collector panels that weigh less than 40 kg per square metre may be installed over the top of the existing roof cladding, with no extra strengthening of the roof structure.

3.1.3 Where solar collector panels are mounted on top of roof cladding, they must be mounted so that the weight of the panels is transferred directly to underlying rafters without applying loads that tend to bend either the roof cladding or roof battens.

3.1.4 Where these conditions cannot be met, the installation of solar collector panels must be the subject of specific design by a structural engineer. Such designs are outside the scope of this Acceptable Solution.

3.2 Storage containers

Specific design

3.2.1 Where a new roof structure has been designed to support a storage container in a specified location on the roof, the details of that design must be followed. Such designs are outside the scope of this Acceptable Solution.

Tanks on top of existing roofs

3.2.2 This section covers the strengthening of existing roofs to support cylindrical insulated hot water storage containers with their longitudinal axis mounted horizontally. Such containers must have the following minimum length.

Table 2: Container length

Container capacity (litres)	Container minimum length (mm)
150	1200
200	1400
250	1700
300	2000
350	2400
400	2700
450	3000

3.2.3 The maximum height perpendicular to the roof surface to the centreline of the container is 400 mm.

3.2.4 The weight of the container must be supported by additional struts installed within the ceiling space that transfer the weight of the container to internal partitions within the building. The container must be supported on at least two supports. The container supports must transfer the weight of the container directly to underlying rafters without applying loads that tend to bend the roof cladding, purlins or roof battens.

3.2.5 Struts supporting the weight of the storage container must satisfy the following requirements:

a) Both ends of a strut must be cut to bear over the full area of the section against both the rafter and the support at its lower end, and

b) Struts must be a snug fit and be secured in position with at least two 90 mm skew nails at each end or by timber connectors of equivalent strength, and

c) Struts must bear against a rafter within 200 mm (measured along the rafter) from a point directly below each container support, and

d) The maximum slope of a strut is 1:3 (1 horizontal to 3 vertical)

3.2.6 The lower end of a strut:

a) Must be directly above an internal or external full height wall, and

b) Must not be directly above a door or window lintel.

c) Must be supported by one of:

i) a top plate directly above a full-height wall stud, or

ii) a 600 x 100 x 50mm blocking on its flat that is supported on the wall top plate, or

iii) a 600 x 100 x 50mm blocking on its flat that is supported above ceiling joists by blocking pieces that bear on the wall top plate.

3.2.7 Struts must be sized in accordance with Table 3.

Table 3: Strut sizes

	Maximum strut length (m)		
	Strut size		
Container capacity (litres)	100 x 75	100 x 50	75 x 50
150	3.0	3.0	3.0
200	3.0	3.0	3.0
250	3.0	3.0	2.8
300	3.0	3.0	2.4
350	3.0	2.6	2.2
400	3.0	2.4	2.2
450	3.0	2.2	2.0

3.2.8 Securing the container against earthquake loads must be by ensuring the container support connections penetrate the roof cladding and are fastened to the supporting rafters.

3.2.9 Where these conditions cannot be met, the installation of the system must be the subject of specific design by a structural engineer. Such designs are outside the scope of this Acceptable Solution.

Containers in the ceiling space

3.2.10 Solar hot water storage containers in a ceiling space must be supported and secured in accordance with AS/NZS 3500, Part 4, Section 5. Such containers must be secured to resist seismic loads in accordance with G12/AS1, Paragraph 6.11.4.

4.0 Solar Hot Water Systems

………………………………………………………………………………………………..

4.1 Solar water heaters and components

4.1.1 Water heaters supplied as a packaged system are acceptable if they comply with AS/NZS 2712.

4.1.2 Collectors, containers, pumps and controllers, supplied as components of a custom-built solar hot water system or to be retrofitted to an existing hot water installation, that comply with the relevant sections of AS/NZS 2712: 2007, will be acceptable.

4.2 Solar controller

4.2.1 Control systems to give supplementary heating must be provided. They must incorporate a mechanism to control when supplementary heating is activated to provide boosting for short periods when needed, while avoiding boosting before receiving solar energy.

4.3 Sizing of systems

4.3.1 The capacity of the container must be not less than 1 day's expected use.

4.3.2 The ratio of container volume to collector area must be no less than 50 litres per square metre of collector area.

> COMMENT:
>
> Information on annual solar energy reception at various sites in New Zealand is shown in Appendix H of AS/NZS 3500.4. As a guide, most installations should be sized to give up to 70% of the normal annual hot water energy requirement of the household. System suppliers must provide a calculation of the expected annual solar reception and the expected performance of the installation.
>
> Better overall solar performance can usually be obtained with a somewhat larger container, up to 1.5 to 2 times the daily use. In particular, if the system is time clock limited or used with off-peak (night rate) auxiliary electric heating, then a container capacity of at least 1.5 times the daily use is recommended.
>
> For a given area of collector, ratios at the lower end of the range will give quicker response to solar input. Those at the higher end will give better overall solar savings, but generally slower recovery.

4.4 Water supply to solar water heaters

4.4.1 Water supply to storage containers of solar hot water systems must comply with G12/AS1 Paragraph 6.2.

4.5 Materials

Effect on water quality

4.5.1 Refer to G12/AS1 for component Standards.

Pipe materials

4.5.2 Pipe materials must comply with G12/AS1, Table 1.

COMMENT:

All pipes and pipefittings used for the piping of water must be:

a) Suitable for the temperatures and pressures within that system, and

b) Compatible with the water supply and environmental conditions in the particular location, and

c) Resistant to ultraviolet light where installed in an exposed situation.

4.6 Operating and safety devices

4.6.1 Storage containers in solar hot water systems must have operating and safety devices in accordance with G12/AS1, Paragraphs 6.3 and 6.4.

Valves

4.6.2 Pressure relief valves and expansion control valves must have:

a) A flow rate capacity of no less than the rate of cold water supply, and

b) A maximum pressure rating of no more than the working pressure of the hot water storage container.

4.6.3 Expansion control valves must have a pressure rating of no less than that of the water supply pressure to the storage water heater, but less than the pressure rating of the relief valve.

4.6.4 Temperature/pressure relief valves and the pressure relief valves must have a capacity of not less than the total output power of the collectors at 99°C and 1200 W/m^2 and 40°C effective ambient temperature, plus the rated input power of any auxiliary energy sources heating the water.

Relief valve drains

4.6.5 Relief valve drains must comply with G12/AS1, Paragraph 6.7.

Vent pipes

4.6.6 Vent pipes for open vented solar hot water systems must comply with G12/AS1, paragraph 6.8.

Heat exchangers

4.6.7 Units complying with AS/NZS 2712, Section 5 are acceptable.

Stagnation conditions

4.6.8 Systems meeting the requirements of AS/NZS 2712, Section 4 are acceptable for providing protection against damage under stagnation conditions.

COMMENT:

A collector, or integral collector and container, must be able to withstand temperatures that it will encounter under some or all of the following conditions:

a) When empty during installation, and

b) When empty during its service life; and

c) When full of water, but not being used in peak summer conditions.

4.7 Safe water temperatures

Maximum temperatures

4.7.1 The delivered hot water temperature from any solar hot water system to any sanitary fixture used for personal hygiene must not exceed:

a) 45°C for early childhood centres, schools, old people's homes, institutions for people with psychiatric or physical disabilities, and hospitals, or

b) 55°C for all other buildings.

COMMENT:

Refer to G12/AS1.

Hot water delivered from storage water heaters

4.7.2 An acceptable method of limiting hot water temperature delivered from storage water heaters is to install a mixing device between the outlet of the water heater and the sanitary fixture (see G12/AS1, Figure 16).

4.7.3 Tempering valves must comply with AS 4032.2.

Protection against growth of legionella bacteria

4.7.4 The supplementary heating controller must operate so that the temperature of stored water is raised at least once a day to not less than 70°C for a period of not less than 60 minutes to prevent the growth of legionella bacteria.

4.7.5 Where the solar hot water system is pre-heating water for an instantaneous water heater, the water must be heated to not less than 85°C by the instantaneous heater whenever the temperature of pre-heated water in the storage container is less than 60°C.

5.0 Installation Methods

…………………………………………………………………………………………………….

5.0.1 Solar hot water systems must be installed in accordance with the system or component manufacturer's instructions.

5.0.2 Storage cylinders and collectors of solar hot water systems must have:

a) Safe trays complying with G12/AS1, Paragraph 5.2.3, and

b) Connections compatible with the pipe material used.

5.0.3 Storage cylinders of solar hot water systems must have drain pipes that:

a) Have an easily reached isolating valve, and terminate with a cap or plug to empty the vessel for maintenance, or

b) Terminate outside the building with a cap only.

5.1 Pipe installation

5.1.1 Pipes and their supports must be electrochemically compatible or be electrically separated.

5.1.2 Except where anchor points are necessary, the pipes must be installed and supported to permit thermal movement.

Support spacing

5.1.3 Above ground, water supply pipe work must be supported at centres of no greater than those given in G12/AS1, Table 7.

Penetrations

5.1.4 Wherever pipe work penetrates the building cladding, the penetration must be flashed or sealed to comply with Building Code Clause E2 External Moisture.

Protection from freezing

5.1.5 Collectors that have passed the test in AS/NZS 2712 at level 1 are acceptable in climate zones A and B. Collectors that have passed the test at level 2 are acceptable in climate zone C when installed in a system using the same or equivalent freeze protection mechanism (Figure 2).

Systems are acceptable if protected by any of the following methods:

a) Indirect heat transfer system with a suitable concentration of anti-freeze liquid, or

b) Automatic drain-down, or

c) Auxiliary panel heater.

Figure 2: New Zealand climate zones for frost protection

5.2 Pumps

5.2.1 The pump in a direct system must draw water from the low point of the container, circulate it through the collector and return the heated water to the container at a point higher than the draw-off point.

5.2.2 An anti-thermosiphon loop at the points of entry of the circulation pipes to the container is a means of preventing unintended circulation ("back circulation") of fluid from the container to the collector. Any non-return valve (check valve) shall be of a type recommended by the system or pump manufacturer and installed in accordance with their instructions.

5.3 Wetback water heaters

5.3.1 Where a wetback is used in conjunction with a solar hot water system, the circuits for the two heat sources must be arranged with independent piping so as not to interact hydraulically with each other.

5.3.2 Any wetback circuit must be open-vented. Where a wetback is used in conjunction with a container operating at a pressure that cannot be open vented, the wetback shall operate on an indirect loop with a heat-exchanger coil built into the container to transfer heat from the low-pressure wetback to the higher-pressure domestic supply.

Your comments on proposed Acceptable Solution G12/AS2: