National Energy Efficient Building Project

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pitt&sherry

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Final Report

sustainable*thinking*®

SWINBURNE UNIVERSITY OF TECHNOLOGY

This study has been undertaken on behalf of the Energy Markets and Programs team within the Department of State Development, South Australia and funded by all Australian jurisdictions as part of the National Strategy on Energy Efficiency (NSEE**).**

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Preface

This report presents the outcomes of three inter-related projects that were undertaken by **pitt&sherry** and Swinburne University of Technology. The joint project included a comprehensive consultation process and covered a large number of issues, and therefore the resulting Report is long.

We suggest that the reader begins by examining the Table of Contents, for an overview of the Report's coverage, and then reads the comprehensive Executive Summary. This provides a detailed overview of the review process and key issues, and also an overview of the key recommendations.

Following the Executive Summary, the Report is structured into seven Chapters and six Appendices.

Chapters 1 to 4 provide the context and intent of the review and summarises some of the key outcomes of the consultation and investigative processes undertaken.

Chapter 5 provides **pitt&sherry**'s analysis of the key systemic and process issues that may be contributing to non-compliance with the energy performance requirements in the National Construction Code (the Code), together with our analysis of areas where current energy practices fall short of best practice from an energy performance perspective.

Chapter 6 provides **pitt&sherry**'s analysis of the specific energy performance issues that relate to renovations, additions, extensions and refurbishments.

Chapter 7 provides Swinburne's analysis of the key knowledge management issues that may be contributing to poor compliance or a lack of best practices.

Recommendations are embedded in the text of the Report, to ensure that the context for each is clear. They may be found at the end of Chapter 3, and in each of Chapters 5 to 7.

Table of Contents

Executive Summary

Background

pitt&sherry and Swinburne University of Technology have undertaken a national review of issues relating to energy efficiency in Australian buildings.

The South Australian Department of State Development on behalf of the Australian Government and all States and Territories, commissioned **pitt&sherry** and Swinburne University of Technology to undertake a national review of key systemic or process weaknesses or points of non-compliance with the energy efficiency requirements in the National Construction Code ('the Code') and related issues.

Within this overall objective, **pitt&sherry** also addressed issues specific to building alterations and additions, while Swinburne explored the contribution of knowledge management to building energy performance and Code compliance.

The review reflects long-standing concerns that compliance with the National Construction Code may be poor.

The review was commissioned in the light of concerns, raised by a range of stakeholders in recent years, that compliance with existing energy efficiency requirements in the Code may be poor. During the review, virtually all stakeholders consulted confirmed this view, but it was beyond our terms of reference to quantify the *extent* of compliance or non-compliance. We recommend that further work is done in this area.

The review involved extensive consultation with a wide range of stakeholders...

The key methodology employed was to consult widely with building industry stakeholders, regulators and policy makers across Australia. The review team engaged with over 1000 stakeholders across a broad cross section of industry sectors and in all states/territories. Stakeholders participated in the review by:

- submissions to an Issues Paper (41 received);
- participating in one of seventeen workshops held in all capital cities and a range of regional centres (covering NCC climate zones 1 – 7, with over 271 participants);
- meetings with members of the project team; and/or
- responding to an online survey (with 571 responses).

...and the scope of the review was broad.

The review considers all building types and the specific circumstances of all states and territories. While around half of the survey participants nominated that they had experience in non-residential buildings, the majority of workshop participants and submissions focused on residential buildings, and this is reflected in the balance of issues covered in this Report. Meetings and workshops were held in all states and territories and NCC climate zones, except Zone 8 (Alpine) where there are relatively few buildings.

The conclusions and recommendations of the review reflect the reviewers' professional judgement, and should not be attributed to any other party.

The Report aims to capture the views expressed by these stakeholders in a non-attributed manner. However, the Report's key conclusions and recommendations are based on the professional judgement of the review team and should not be attributed to any particular stakeholder group or government.

Key issues and findings

There are many positive trends that point to the capacity for much higher energy performance in Australian buildings in future.

Stakeholders pointed to many positive trends in building energy efficiency in Australia. These included the increasing availability and affordable prices of high star rating/zero net energy homes and the increasing acceptance and uptake of solar energy technologies. In the commercial sector there is widespread recognition and take-up of initiatives such as NABERS and Green Star, at least at the premium end of the market, along with signature demonstration projects like Grocon's *Pixel* zero carbon office building in Melbourne. High performance buildings and building products are more readily available and more competitively priced than ever. Industry professionals noted an increasing level of competence and interest in efficiency issues amongst recent trainees and apprentices, suggesting that the knowledge management system is working to build the industry's capacity in this area. This will pay dividends in the longer term.

Stakeholders are concerned that compliance with the Code's energy performance requirements is generally poor, and that our energy performance is far from best practice.

However, the same stakeholders also raised a *very* large number of concerns about the effectiveness of current energy performance requirements in the Code and their implementation. These concerns appear systemic in nature, in that they cover all aspects of the building supply chain and regulatory process and all building types. Further, there was a remarkable degree of consistency in the views expressed and issues raised in all states and territories, despite widely varying building markets and conditions. Few stakeholders offered the view that no (major) reforms were needed. Many stakeholders believe that Code compliance is poor and, further, that Australia's building energy performance falls a long way short of best practice. This implies higher energy use, higher emissions and higher overall costs for building owners and occupants.

Issues arise at all stages of the building planning, construction and use cycle...while others relate to the policy, legislative and market environment.

By way of summary, Figure ES1 below provides a high level, schematic overview of the conclusions of this review. It notes (on the left) the key findings of the review – in a highly simplified form – as a characterisation of where we are at in 2014. In the centre, the recommended strategies for effecting change are set out. Finally, on the right, there is a sense of the outcomes that could be expected by 2020 if the strategies are adopted and implemented with vigour.

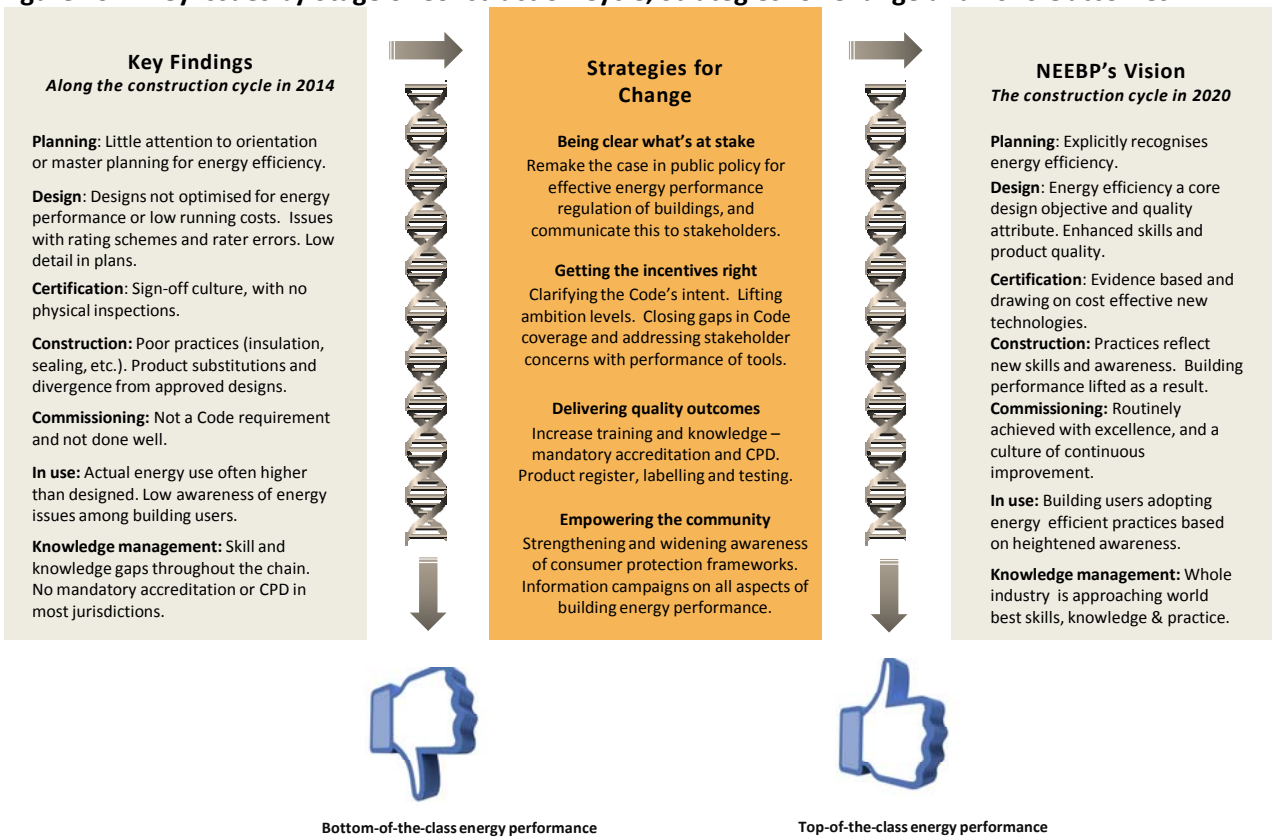
The following sections of this Executive Summary provide further detail on each of these elements.

The Market Environment

The building market is even more competitive than usual, post the GFC... leading to cost-cutting.

Many stakeholders noted that increased commercial pressures post the Global Financial Crisis have led to slimmer margins for many building professions, increased pressure to win and deliver projects profitably on reduced budgets, and an intense focus on cost cutting. In this market context, it should not be surprising that there is pressure to cut corners and save costs.

Figure ES1: Key Issues by Stage of Construction Cycle, Strategies for Change and 2020 Outcomes



Non-compliance can be hard for owners to discover.

A key view expressed to the review team is that the industry perceives little risk that cutting corners on energy performance will be discovered or, if it is, that there will be any serious consequences. First, many energy efficiency features in buildings (solar passive design, insulation and sealing levels, high performance glazing) are not readily apparent to those without a trained eye. Also the expected energy performance of homes in particular is generally not made transparent to the owner at the time of purchase or commissioning (the energy performance of commercial buildings generally, but not always, attracts a higher level of professional scrutiny). As a result, owners/occupants may find it difficult to know whether or not the building is performing as designed, let alone to seek formal redress if the energy performance is sub-standard. We conclude that most home owners implicitly assume that building energy performance regulation will be effective in protecting their interests.

Consumers are reported not to value energy efficiency highly...

The risks of corner-cutting are likely being raised by a widespread view (reported to us by many building professionals rather than directly) that house buyers are largely uninterested in energy efficiency outcomes. The same effect was reported for those commissioning commercial buildings, except for premium, CBD premises. Many industry professionals noted that this routinely translates into energy efficient designs or inclusions being 'traded away' during the design process, or not being specified in the first place.

...but this may reflect both a deficit of knowledge on their part.

In examining this issue, stakeholders explained that residential consumers (particularly in the first home buyers market) appear to have limited understanding of the basic physics of thermal comfort. As a result, they have limited ability to discern sound from unsound advice and also limited willingness to pay for energy efficient designs and inclusions. Many professionals reported that consumers' interests are overwhelmingly focused on achieving a certain 'look', along with considerations of resale value, but interpret affordability or value for money in terms of 'getting the biggest/best house for my budget', and not in terms of the lifecycle costs of house ownership. In short, the industry reports little market pressure to achieve energy efficiency outcomes (with exceptions, as noted earlier, in niches and at the premium end of the market).

Energy ratings appear to be treated as a compliance burden.

Those purchasing new homes or buildings are made aware of the building's (claimed) energy performance rating, as this is a required step in the building design and construction process. However, it was reported by energy assessors that consumers widely treat this requirement as a compliance and cost burden, rather than an opportunity to minimise the lifetime running costs of the building.

Overall, the current market environment suggests that stronger institutions and more informed choice and action are needed.

Overall, we conclude that low levels of consumer awareness of, and interest, in the energy performance of buildings (particularly homes, and within this segment, first homes) creates a market environment in which energy performance is widely seen as a low priority. We note, however, that the market environment is also critically shaped by the nature of policy and regulatory practices (discussed further below). This is because consumers rely heavily on market participants for advice with respect to energy efficiency, and also appear to trust that regulatory processes will work effectively to protect their economic interests. Industry participants appear to hold the view that there is little risk that under-performance in the area of energy efficiency will be detected or punished – by regulators or consumers – contributing to a culture of low energy performance.

The Policy and Regulatory Environment – Code Compliance

Enforcement of the Code is a matter for the States & Territories.

Enforcement of the National Construction Code – or, strictly, of the building laws and regulations of each State and Territory which give legal effect to the Code, with local variations – is a matter for states and territory governments. Practically the burden of enforcement generally falls on state building commissions or similar bodies, although practices vary from state to state.

As detailed in this Report, stakeholders suggest that full compliance with the energy performance requirements in the Code is rare. This view was reported by all stakeholder groups and in all states and territories; for new buildings and refurbishments; and for all building classes. Stakeholders readily acknowledged that there is a shortage of hard evidence to support this view, as few detailed audits have been undertaken. However, the evidence that does exist (reviewed in Chapter 3) tends to support this view.

Regulators report poor resourcing for enforcement, but also treat energy efficiency requirements as the lowest of their priorities.

State and territory regulators reported a shortage of funding with which to undertake key enforcement activities, such as audits, which might potentially lead to enforcement action for non-compliant buildings. Second, the regulators consistently reported that they perceive energy efficiency (strictly, the objective is 'to reduce greenhouse gas emissions') as the lowest of their priorities behind issues such as health, amenity, structural integrity and bushfire safety. The reasons for this view appear to include that the other criteria are viewed as representing more immediate and tangible threats to human welfare than climate change.

This helps to reinforce an overall culture of low energy performance.

The review team formed the view that regulator, industry, consumer and government views appear to be reinforcing each other and contributing to an overall culture of low energy performance: no one party can be singled out as particularly or solely responsible for this situation.

Wider Policy Issues

Stakeholders raised many issues beyond Code compliance...

As noted, stakeholders did not confine their comments to questions of compliance with minimum Code compliance issues. Many other and related issues were raised. We report them for transparency and completeness; because our Terms of Reference are broad (see Appendix A); and finally because each issue plays a role in shaping the overall culture of low energy performance. This culture could also be described as one of low trust in policy frameworks and institutions. In our view, these policy issues must be addressed at the same time as the Code compliance issues if there is to be a significant change in this culture and therefore in the energy performance of Australian buildings.

- ***Low standards***

...starting with the view that energy performance standards are low.

Many – but not all – stakeholders offered the view that energy performance requirements under the Code are low. Most attributed this to two key factors: low ambition levels expressed in the Code itself; and cumbersome and ineffective governance arrangements.

The policy environment aims for 'minimum necessary' energy performance levels...

The Code itself does not aim to deliver best practice or optimal levels of energy efficiency; rather, it aims 'to reduce greenhouse gas emissions to the degree necessary'. Buildings are not required to be energy efficient, but rather to be 'capable of efficiently using energy'. Stakeholders expressed the view that these phrases are poorly defined and open to interpretation, but carry the overall expectation of low to medium rather than high performance. In principle, higher standards could be adopted voluntarily by consumers, but the market environment described above confines this to a small subset of all building consumers.

...while governance of the processes for setting and resetting standards appears cumbersome.

Stakeholders complained that the processes for setting and reviewing energy performance requirements under the Code are non-transparent, lengthy and ineffective. The uncertainty begins with the Code language, as noted above, but extends to:

- the nature of review process to be adopted;
- the criteria used (in practice) to determine stringency levels for performance requirements;
- the frequency and duration of reviews;
- the bodies and Ministers responsible for decision-making (discussed further below);

- the extent to which individual states and territories choose to adopt and enforce the nationally-agreed performance requirements.

In practice, review processes in recent years have been overseen by the Building Ministers Forum, but decisions have been made by the Council of Australian Governments (COAG). Stakeholders noted that many past consultations on building energy performance issues have led to no clear outcome, and that the reasons behind decisions (or non-decisions) were not communicated to industry participants.

- ***Code issues***

Many 'deeply embedded' design concepts and elements of the Code fail to encourage energy efficiency.

Other views expressed by stakeholders regarding Code design and implementation included that:

- Many state and territory variations and additions to energy performance requirements are viewed as poorly justified, and in particular lack evidence of equivalence with Code provisions;
- The focus on the energy performance of buildings 'as designed' rather than 'as built' encourages the regulatory system to focus on documentation rather than actual buildings;
- Deemed to satisfy and modelled solutions are widely believed to lead to different and non-equivalent outcomes (with each path having its supporters and detractors);
- There are many perceived gaps in the Code's coverage (that are relevant to energy performance) including commissioning, maintenance, building documentation, air tightness/ventilation and coverage of existing buildings;
- Many find the Code complex and confusing, while its cost (along with that of supporting Australian Standards) is reported to be a significant barrier to access, particularly for smaller companies/tradespeople.

- ***Mandatory disclosure***

Many stakeholders called for mandatory disclosure of building energy performance.

Another policy issue consistently raised by stakeholders was the need for mandatory disclosure of building energy performance. It was felt that this would provide a much-needed focus on actual, whole-building performance and on existing as well as new buildings. It would also help to provide 'accountability' through the supply chain by making performance outcomes more transparent to consumers.

Issues in Detail

• Planning Issues

Planning authorities noted little focus on energy efficiency in new developments...

Turning to the issues that occur at each stage of the construction cycle, many Councils that engaged in the Review noted that planning schemes rarely take into account the fundamentals of passive solar design, such as appropriate block orientation and solar access. It is also uncommon for set efficiency or distributed generation benchmarks to be applied via 'master plans', as often occurs in new developments in Europe. These situational aspects are vitally important for the lifetime energy performance of residential buildings in particular (commercial buildings are traditionally less responsive to orientation than residential ones, but this is much less true for low energy, passive/hybrid commercial building designs). Solar access will become an increasingly important consideration in planning schemes through time. In coming years we can expect energy prices to continue to rise, while the cost of both passive and active solar technologies will continue to fall, thereby increasing the financial pay off for building owners/developers of appropriate solar access.

...and those reporting audit outcomes noted high levels of non-compliance.

Many Councils noted their strong interest in energy efficiency and sustainability, but also confessed to little concrete knowledge, action or budgets in the area - with the notable exception of certain 'green' developments. Most Councils reported undertaking few or no audits of planning approvals. Those that did undertake and report such audits noted non-compliance rates of up to 70% (Adelaide) or 1800 outstanding non-compliance notifications in the regional city of Launceston alone. This information cannot be assumed to be statistically representative Australia-wide in the absence of further quantitative research, and also the non-compliances may not relate to energy performance issues. However, it does raise the spectre of non-compliance with planning permits being a common feature of the Australian building system.

• Design Issues

Designers are often advocates of energy efficiency, but report little interest from either consumers or the construction industry...

Designers were well represented in the consultation processes for the review, and generally expressed high levels of knowledge about and support for energy efficiency. However, most cited the lack of consumer interest and willingness to pay (noted above) as the primary impediment to the take-up of higher efficiency solutions, except in niche markets (eg, older and wealthier clients commissioning third or fourth homes, or undertaking major renovations). Even potential zero cost or cost saving design changes, it was reported, are often rejected. It appears that consumers often come to the process of commissioning a house or renovation project with ideas fixed in advance, and are resistant to professional advice in the area of energy efficient design. This occurs despite the major additional costs associated with upgrading energy efficiency in the future and the costs of poor energy performance in the interim.

...along with numerous technical and policy barriers.

Beyond this, designers were often critical of the attitudes encountered in the supply chain. They noted in particular the frequency with which builders, and/or their clients, remove energy efficiency features or designs either before or after certification of designs. They also reported widespread substitution of efficiency products and features post certification. Many designers noted issues in the ratings process or flaws in rating tools. Many also claimed a lack of flexibility in achieving compliance for non-standard designs, although some comments betrayed a lack of familiarity with the full range of available compliance options.

However, designers may also participate in practices that lead to poor efficiency outcomes.

At the same time, builders and energy assessors often criticised designers for preparing plans and specifications with insufficient detail to enable accurate assessment/construction, or that were 'patently unbuildable'. The latter is a reference to plans containing excessively thick walls or ceilings (to accommodate large amounts of insulation), for example, or extremely high-specification and therefore expensive glazing, in order to compensate for fundamental design flaws (eg, excessive glazing on western walls). These 'unbuildable' features may be necessary to enable the *design* (not the building) to achieve the mandatory performance standard (eg, 6 star), but may be prepared with the tacit understanding that either the client, or the builder, or both by agreement, will actually substitute more conventional and lower performance solutions, leaving the building 'as built' below the expected performance benchmark, and potentially by a large margin. Any design changes post certification trigger a requirement to re-certify the building, but this is understood to very rarely occur in practice, due to a lack of mandatory inspections (see below) and/or post-hoc compliance audits. We note that such practices are encouraged when parties have little fear of discovery or penalty from the regulatory system, and also when consumers have little awareness of the actual costs and benefits associated with energy efficiency outcomes.

- ***Energy Assessment and Rating Tools Issues***

Energy assessors often feel that their skills are poorly utilised or appreciated, while competition from unaccredited (or unscrupulous) assessors can undermine their work...

Energy assessors noted that they are often brought in at the end of the design and approvals process, too late to influence design outcomes. Further, they are commonly seen as a regulatory burden rather than as an opportunity to improve outcomes for building owners. Assessors spoke of a culture of 'shopping around' by builders in order to secure 'pass' ratings for marginal designs. Assessors noted that the industry is highly competitive, margins are low and training requirements are increasing. Many noted that they face competition from non-accredited competitors (including offshore service providers) without any effective discipline being placed on these competitors by the regulatory system. A recent 'benchmarking' report on assessors showed that about two thirds achieved the correct star rating for regulatory purposes.

...while many concerns were raised regarding rating tools used for regulatory purposes.

Like designers, assessors reported many concerns with rating tools and their use for regulatory purposes. Many reported that the degree of flexibility within the rating tools is such that buildings with questionable design features and inclusions can be given the appearance of compliance – and this for both residential and non-residential buildings. A key issue is that none of the rating tools used for compliance purposes, including for commercial buildings, make transparent the key assumptions, design features or inclusions that are necessary to obtain a compliant rating. Therefore it cannot be readily checked whether these features have in fact been installed in the finished building. This is also one of the causes of the substitution issue discussed further below. Lesser issues included suggestions of too many or too few climate zones, inadequate treatment of warm and humid climates, and inadequate treatment of various behavioural or situational considerations (breezeways, natural shading, use of curtains, etc).

Under-investment in tool administration and development, but also some governance issues, were identified as contributory factors.

Finally there was widespread concern at the lack of investment in research and maintenance of rating tools, leading to key files being described as 'years out of date'. Many also raised governance issues, noting a lack of transparency, stakeholder engagement and a published and appropriate work program for rating tool maintenance and development. These stakeholders readily acknowledged that inadequate budgets were likely to be the underlying causes of at least some of these issues. The review team was made aware that many of these issues are 'in hand' in current or intended future upgrade projects – however, it would appear that the industry is generally not aware of this. Further, some software tools are not directly controlled by governments and would require different strategies to influence outcomes.

- ***Building Surveying and Inspection Issues***

Building surveyors play a critical role, but face practical and commercial tensions in undertaking their work.

Building surveyors play the crucial role of certifying that buildings – or at least designs – comply with the requirements of the Code. While in some states, building regulations make it clear that surveyors owe a duty to building owners, in practice, most are contracted by developers and builders. This can present them with a conflict of interest (although building regulations in some states aim to correct this in a statutory sense). Surveyors operate in an intensely price-competitive market, and risk losing their future income if they develop a reputation for being 'difficult'. The phenomenon of 'shopping around', noted for energy assessors, may also apply to surveyors.

Surveyors lack training in energy efficiency issues and are not required to inspect energy efficiency features...instead they rely on 'sign-offs' by others.

Surveyors note that they are not trained in energy efficiency, that the Code only requires certification of designs and not actual buildings, and that inspecting energy efficiency features would be difficult in practice given poor documentation and labelling of those features. For the most part, surveyors rely on a system of 'sign-offs' by other building professionals but there is little or no auditing of the paper trail. Only one state or territory – NSW – actually requires even a single inspection of an efficiency feature of a building; some states and territories require inspections of structure or other features but not energy efficiency; and some states and territories require no inspections at all.

Mandatory inspections (or an audit program) of energy efficiency features are an essential accountability mechanism.

Despite concerns that mandatory inspections could add to costs, many stakeholders expressed the view that, without this (or a visible and active audit program for completed buildings), there can be no confidence that appropriate outcomes are being achieved, and no commercial or regulatory accountability – noting that many energy efficiency features are not visible or easy to verify once the building is complete. We note that the need for regulatory backed quality assurance is accepted in other fields where the consequences of regulatory failures may be even higher, such as aircraft maintenance. As discussed further below, there are many options for minimising the incremental costs of inspections.

- ***Construction Issues***

Builders also cite a low level of interest from their customers in energy efficiency...

While some builders actively differentiate themselves and their products on the grounds of high energy efficiency (and/ or environmental sustainability), this appears to be the exception rather than the rule. During the review, and as with other stakeholder groups, builders cited as a key impediment a lack of interest in (and willingness to pay for) energy efficiency features by building owners/developers.

...and highlighted a range of practical impediments.

Some builders noted inadequate building documentation from designers, including detailing relevant to energy efficiency (flashings, sealing, insulation details). Similarly, some noted the lack of suitable support materials to ensure appropriate installation of efficiency features, including 'acceptable building practice' information within the Code or other materials. Others said that such material is available, if searched for, but is generally not used on site. Builders confirmed that they are sometimes asked to build 'impossible' designs and that this generally leads to an agreement between the builder and the client to adopt more conventional, lower-specification solutions.

A lack of site supervision and poor integration of sub-contractors may contribute to poor energy efficiency outcomes.

Many stakeholders referred to a lack of overall site supervision by builders (one saying, for example, that '*builders don't build any more; they just sub-contract and project manage*'). We commonly heard of a tendency for one trade to undo the good work of others, for example by removing insulation or penetrating building wraps to install plumbing, wiring, lighting or other services. Too often no-one on site is robustly representing the ultimate building owner's interests, including supervising practices that will materially affect the finished building's energy efficiency.[1] In commercial buildings, a culture of under-bidding followed by 'planned' variations, enforced via contractual disputation, was reported as common-place, with a notable exacerbation of these trends since the global financial crisis due to heightened commercial pressures.

[1] Noting that on larger commercial sites, the owner may employ a client engineer or site supervisor. On the other hand, it was noted that access by owners to residential construction sites is restricted for safety reasons.

A major issue appears to be the (reported) frequency of on-site substitutions of energy efficiency features.

It was reported to us, in every state and territory, that substitution of low efficiency products/systems for the high efficiency versions on building sites is commonplace. High-efficiency glazing was most commonly referred to in this context (perhaps due to its expense, but also due to the difficulty of detecting substitution), but in some cases substitution of insulation products was also noted (again, we note that detection of such changes is challenging once the building is complete). Generally we heard that the cost savings from such substitutions are being passed back to building owners (for example, as a trade off for extra building area or other non-energy features), although some suggested that substitution may also occur without the building owner's knowledge (and no reduction in the price paid). All such design variations in principle require a new building permit to be issued, however we were told that this very rarely occurs.

The lack of testing, certification and appropriate labelling of building products and systems discourages local manufacturing and marketing of innovative and high-performance building components...

Many builders, product suppliers and manufacturers raised concerns regarding the lack of certification, performance testing and appropriate labelling of building products and systems. Concerns included: suggestions of false and misleading claims being made by product suppliers; a lack of responsiveness to these concerns by Fair Trading authorities, the ACCC and Codemark administrators; missing or misleading labelling of products (eg, insulation products); the lack of 'traceability' of components (eg windows). Many noted a dramatic increase in the importation of building materials – including whole commercial building facades – with no checking or testing of compliance claims (if any are indeed made). These trends are claimed to seriously undermine the viability of manufacturing (or even marketing) innovative and performance-verified building products in Australia.

...something which we do not tolerate for domestic appliances.

The lack of energy performance verification for building products (and indeed for whole buildings) compares poorly with the regime that has applied for decades to washing machines, refrigerators and the like. In the case of many energy using appliances it is illegal to sell products that do not meet Australian minimum energy performance standards. In addition requirements are regularly enforced, with numerous successful prosecutions of those breaching standards. Buildings, by comparison, are many orders of magnitude more valuable, more energy intensive and longer lived, yet the buildings themselves, and the building components have no mandatory energy performance verification.

Many stakeholders highlighted lack of accountability throughout the whole design, certification and construction process, and attributed poor energy efficiency outcomes to this. We understood this as a reference to the 'sign off' culture within the wider industry, together with a lack of effective policing of elements of building regulation. It is common practice to focus effort on those things that are routinely checked and devote less effort to those things that are not.

- ***Post Construction Issues***

The way in which buildings are used by owners and occupants can have material effects on energy efficiency...

A common observation offered to the review was that many efficiency features or designs are effectively undermined, or made redundant, by the ways in which owners and occupants use buildings. Examples in residential buildings included installation of over-sized air-conditioners, inappropriate thermostat settings, non-use of passive ventilation strategies (eg, night-time cooling via windows), and inappropriate use of blinds and curtains. For commercial buildings, examples included the quality of tenant fit-outs and inadequate commissioning of building systems and control strategies.

...and we recommend strategies to influence these 'in-use' outcomes.

These considerations are reflected in specific recommendations noted in the report, which aim to improve the 'in-use' energy performance of buildings and influencing occupant behaviours. At the same time, there are practical limitations on the extent to which it is possible or desirable to try to influence occupant behaviours via Code provisions, as distinct from other approaches (information, economic incentives, etc). However, this does not deny the desirability for buildings to at least have the capacity (with normal use) to achieve the energy performance outcomes for which they were designed.

- ***Accreditation Issues***

The current lack of mandatory accreditation requirements, for most building professionals in most states and territories, creates incentives for 'adverse selection'...

A key issue that rose repeatedly during the consultations was the lack of mandatory accreditation requirements for various building professionals in most states and territories (noting that there are exceptions like Tasmania, where all professions are required to be accredited). This is widely perceived to encourage what is known as 'adverse selection', in that persons operating without accreditation may be able to offer lower prices to consumers – based on their lack of *demonstrated* competence and accountability – to the detriment of properly trained and fully accountable professionals. The net loser in such a situation is the consumer who may unknowingly purchase an inferior quality service. While unaccredited service providers may provide a quality service, there is generally no way for consumers to discover, in advance, whether this is true or not in a given case. Worse, they may not even find out where a poor service has been provided, given most consumers' lack of technical knowledge in this area.

- ***Residential versus Commercial Buildings***

Issues raised by stakeholders did not always clearly distinguish between commercial and residential buildings.

Industry stakeholders indicated that problems, causing compliance shortfalls, within design, certification and construction phases were widespread – with both residential and commercial construction being susceptible. However, not all comments were clearly attributed to one building class or another.

In general we note that commercial building projects are typically larger and involve processes that provide greater scrutiny of financial and contractor performance than for residential building projects. However, their complexity also puts greater pressure on those involved to 'prioritise' anything that might hold up or add cost to construction activity. Commercial buildings are often constructed within a sub-contracting environment where relationships are adversarial and performance is often enforced by threats of legal action. Exceptions to this occur with premium buildings, where it is more common to find co-operative and multi-disciplinary teams working to co-ordinate and integrate a wide range of building performance criteria, of which energy performance is just one.

In residential buildings, building owners/occupants generally have less access to expertise than do commercial building clients, as budgets are smaller. Therefore they are more reliant upon the credentials, integrity and expertise of the builder, as well as upon the effectiveness of the regulatory system.

- ***Renovations and Additions***

Alterations and additions represent important investments in the life of a building and an energy efficiency upgrade opportunity...
...that only a few seem willing to take up.

Major alterations and additions, which include renovations/upgrades, occur relatively infrequently over the life of residential or commercial buildings. These events generally provide an opportunity to upgrade the building's energy performance. There is an opportunity cost if energy efficiency improvements are not made - and the opportunity may not come around again for many years.

However, given the prevailing energy efficiency culture described in this report, it appears that few building owners (with certain exceptions, such as owners of premium buildings) express awareness of the opportunities or a willingness to pay for efficiency outcomes. This suggests that consumer education, particular regarding the financial and non-financial benefits of energy efficiency, is necessary.

There are opportunities to demonstrate best practices...

This project has produced brief process guidelines for alterations and additions (Appendix B), but many other opportunities exist to lift awareness. This could include trials and demonstrations of exemplary designs and outcomes, for example using blower door testing and thermal imaging to provide an evidence base for consumers and industry alike.

...and overcome known issues in the use of rating tools.

Energy assessors noted difficulties in applying rating tools to (residential) alterations and additions. While many smaller projects rely on DTS solutions, there are challenges – and different solutions in different states and territories – to modelling these. The opportunity exists to identify best practices from around the jurisdictions and standardise upon those, and indeed this appears to be underway already, at least in some cases.

However, a key issue to overcome is the lack of clarity about when whole buildings (or systems) are required to comply with current Code requirements.

In many but not all states, it is unclear to industry which circumstances trigger a requirement to bring the whole building, or whole building systems, up to current Code specifications. This appears to be a larger concern for commercial buildings, where smaller or partial refurbishments are common. There appears to be no good reason why Code triggers should be unclear and inconsistent, particularly if the desired outcome is compliance (at a minimum).

We recommend model regulatory practices that could be adopted uniformly across Australia.

In the light of the above, we have developed model regulatory practices (see Chapter 6) that could in principle be applied uniformly across Australia. At the same time, we note that regulatory practices currently differ widely, and therefore it will take some effort to align these practices. The reward for doing so, however, would be greater clarity and certainty for all stakeholders and, as a result, greater compliance with building energy performance requirements.

- ***Knowledge Management Issues***

Knowledge management, engagement and training are vital.

Knowledge management and engagement were seen by all stakeholders as vital to the achievement of energy efficiency objectives. From designers, construction managers, assessors, and building trades to educators and policy makers, all need to know the ways in which their roles in the construction cycle can maximize energy efficiency and have the skills and commitment to implement these within a culture of excellence.

This project has created a Register of Information and Training Resources.

The NEEBP **Register of Information and Training Resources** contains a broad range of materials and courses available at the national and state/territory levels and across climate zones. An assessment of the quality of these materials and programs is provided in Chapter 7, as is a needs and gaps analysis. The results of these analyses were supported by the stakeholder consultations, which together indicated several systemic problems in the knowledge management area that need to be addressed despite examples of excellence across the Register. The systemic problems include:

Despite examples of excellence, the Register reveals several systemic problems.

- The *ad hoc* development of fragmented sets of information has resulted in uneven coverage of the diverse aspects of energy efficiency.
- The diversity of (i) climatic zones across Australia, (ii) patterns of regulations and training provision across states/territories, and (iii) the information and skill needs of different roles/stakeholders in the construction cycle require the development and provision of **specific** rather than generic information, guidelines and training programs.
- Uneven opportunities for energy efficiency training across pre-employment training, on-the-job skill development and continuous professional development.

Further systemic problems that lead to 'on the job' practices preventing energy efficiency best practice - often to the extent of non compliance - appear to be commonplace across the industry. Systemic weakness was raised at every workshop and in almost every stakeholder meeting. Particular examples of systemic problems include:

- Pre-employment training in energy efficiency is uneven and there is a perception that many instructors are in need of significant professional development in this area.
- Mismatches between what is delivered in training and the 'wash-out' that occurs when other on-site priorities (especially cost factors and the need to attend more closely to aspects of construction that are most often reviewed by building assessors) undermine the actual application of energy efficiency skills.
- This may reflect problems with the building assessment sector of the construction industry which do not mandate energy efficient testing (e.g through thermal imaging or air pressure tests) and the related course curricula which do not require Cert IV building assessors to show competence in use of rating tools or energy efficiency testing.
- Many excellent training opportunities provided by industry and trade associations are not widely accessed by members as few associations mandate energy efficiency certification.
- Extreme disparities between levels of knowledge and skills for energy efficiency across job roles, which cause on-site communication problems.
- Inaccurate and/or ineffective peer-to-peer explanations and demonstrations of energy efficiency concepts and skills.
- Inappropriate specification or substitution of fit-for-purpose materials and incorrect or incomplete installation.

In many cases, people simply do not know what they don't know.

The uneven availability and quality of information and training resources, together with uneven access and commitment to ongoing professional updating, means that in many cases, people simply do not know what they don't know. Indeed, there are few opportunities for workers to receive feedback on their work or other opportunities to identify their information and training needs.

Consequently, there is a lack of clarity or common understanding across the elements of the construction industry of whether currently available information and training resources are adequate and appropriate or not.

A 'satisficer' culture in some segments of the construction industry undermines the culture of excellence in others.

There is a 'satisficer' culture in segments of the construction industry, in which minimal compliance is all that is aspired to. This can undermine the culture of excellence in other sectors, which, if more widespread, would result in optimal energy efficiency. The provision of information and training alone will not bring about the desired changes in the satisficer segments of the industry. Information and training are but one dimension in a complex policy mix of legal/regulatory, economic and social strategies that together are needed to provide the conditions for appropriate cultural and behaviour change.

Education of householders and consumers is important in creating informed demand for energy efficiency.

The supply-side drivers of energy efficiency (policy and regulation) need to be complemented by increased demand-driven pressures that can be brought about by widespread community consumer awareness of energy efficiency measures and an increased emphasis on mandatory disclosure and other aspects of consumer rights in the construction industry.

Conclusions

Market, policy and knowledge management frameworks are, at best, weakly supportive of energy efficient buildings in Australia...

The market, policy and knowledge management frameworks across the building industry, together with the current administration of regulatory frameworks, are not cohesively encouraging good energy performance of buildings – and in many cases act to effectively undermine compliance with energy efficiency requirements under the Code.

Consumers – along with many in the building industry – appear to hold a set of views about building energy efficiency that is not evidence based. These views are being reinforced by a regulatory system which, due primarily to low levels of enforcement activity, creates little fear of consequences for non-compliance. Governments are providing insufficient resources for auditing and compliance activities, and also oversee a governance process for energy efficiency in buildings that stakeholders find non-transparent and ineffective.

The issues appear ubiquitous across the supply chain, for residential and commercial buildings, for new buildings and alterations and additions, and for every state and territory. Local issues do arise, and often these are linked to state/territory variations to the agreed Code requirements – which go as far as non-application of whole Sections of the Code in at least one case, and substantial variations in many cases.

The net result is a pervasive culture of mediocre energy performance across the Australian building industry – although we stress that there are important exceptions to this rule, particularly at the premium end of the building market. The *extent* of non-compliance with the Code that results from this system is not clear, as auditing is rare. Audits that have occurred show very high non-compliance rates, but further analysis would be required to quantify the materiality of these non-compliances for energy performance.

...and governments have much work to do to turn this situation around.

Overall, the review team formed the view that governments have a great deal of work to do to explain the importance of building energy performance regulation to consumers and the building industry alike, and secondly to ensure that building energy policy and regulatory frameworks are both effective and properly enforced.

Solutions

The large number of issues revealed by this review call for a long-term program of reform.

The widespread, systemic nature of the issues raised in this review calls for a comprehensive and long term program of reform. The review team acknowledges that no one party, government or institution is uniquely accountable for implementing such a program. Indeed, the spread of accountability across organisations (and then it is often very difficult to determine final accountability) is a key cause of the issues raised in this Report. Also the issues we have reported above appear to be long-standing ones, and the resulting culture is deeply embedded and resistant to change.

Therefore, we acknowledge that it will require a significant effort on the part of states and territories and the Australian Government to address these issues, and this over an extended period of time. However, the building sector accounts for some 10% of the Australian economy, and buildings are very long-lived assets. At a personal level, houses are often the largest single investments that Australians will ever make. Therefore, efforts to improve the policy, regulatory and knowledge management frameworks that impact on building energy performance have the potential to create social, economic and environmental benefits that are lasting and cost-effective.

We identify four strategic priorities...

We identify four strategies that we believe should guide this reform program over time:

1. Being clear what is at stake;
2. Getting the incentives right;
3. Delivering quality outcomes;
4. Empowering the community.

Being clear what's at stake...

Being clear what's at stake means clearly articulating and communicating to all key stakeholders – governments, regulators, industry participants and the wider community – what benefits are associated with effective building energy performance policy, regulatory and knowledge management frameworks, and what costs are associated with ineffective frameworks. Until this case is strongly made and communicated, the widespread culture of apathy towards building energy performance in Australia is unlikely to begin to change.

Accepted theories of change start from the proposition that there must be a critical mass of dissatisfaction with the status quo before effective change processes can commence. There must also exist a clear sense of how things could be better. This review suggests that dissatisfaction is indeed widespread amongst at least some building industry professionals – albeit that this relates to a wide range of issues, and perspectives vary. However, this dissatisfaction may not extend to the wider community, regulators or governments. Further, while many stakeholders have a clear sense of what improved outcomes would be (improved compliance rates, increased 'beyond compliance' effort, and the delivery and use of buildings with high energy performance) few have a cohesive vision of how these outcomes might be practically achieved.

The accurate quantification of both the costs, currently being incurred due to poor Code compliance, and the benefits associated with improved compliance, would require specific research projects. These would include audits of a statistically significant sample of newly completed buildings, across all building classes and states and territories, including comparisons of actual vs expected energy performance. Beyond this, quantitative research, and then a sustained communications campaign, would be required to quantify and raise awareness of the importance of effective energy regulation on the part of consumers, industry, regulators and governments.

Getting the incentives right...

Getting the incentives right involves ensuring that the Code, regulations and supporting policies are driving each element of the building system to deliver energy efficient buildings. Getting incentives aligned with the delivery of intended outcomes is fundamental to any policy domain or regulatory regime. If the incentive structure encourages not merely compliance with minimum requirements, but also continual improvement of best practices, then very high compliance rates and very good practice will generally follow.

Delivering quality outcomes...

Delivering quality outcomes includes ensuring that all those involved in the building system have access to the right knowledge, training, tools and products; and that these ingredients are being used to deliver energy efficient buildings.

The first aspect of delivering quality outcomes addresses the outcomes of the policy and regulatory environment. All industry participants should have the confidence that the regulatory system actually delivers what is promised and what the community expects. This strategy therefore includes Code administration, issues relating to rating tools, certification and inspection regimes, and building product labelling and performance verification. As evidenced from the effective enforcement of appliance energy performance standards in recent years, a key element of effective enforcement action in building regulation is that it is high-profile and widely communicated to industry. High profile legal actions against just a few can create strong incentives for compliance among the many.

Second, delivering quality outcomes refers to progressively lifting the capabilities of all industry participants to deliver buildings which are energy efficient in addition to all of the other qualities we demand of buildings...including that they are functional, affordable, durable, safe, healthy and aesthetically pleasing. This includes ensuring that practices on building sites, and indeed finished buildings, fully deliver on the outcomes anticipated by building owners, regulators and certifiers. Stronger attention to excellence and effectiveness in the building energy performance knowledge management system, through three core knowledge management strategies – information, education and training – is the key to delivering these outcomes.

...and empowering the community.

Empowering the community means ensuring that building owners and users understand the value of energy efficiency (and why it is worth investing in); what they should expect from buildings and the building industry; and that they have effective and easily accessible options to ensure that those expectations are met by the building sector.

This theme encompasses a suite of recommendations that both build the capacity of industry and inform the community as to what it has at stake in the energy efficiency of buildings – the potential costs and benefits, financial and otherwise. They are also designed to enhance consumer welfare. Many stakeholders noted that without informed, demanding consumers, the industry has limited incentive to get it right. However, consumers must be supported to fulfil this role, as many are entirely reliant on the advice they receive from industry participants, who themselves may not be fully informed, or whose interests may not always align with those of the consumer.

Overview of Recommendations

We make a large number of recommendations...

As this review has identified a large number of 'systemic and process issues' associated with implementation of the energy performance requirements of the Code, and associated knowledge management issues, we make an correspondingly large number of recommendations for reform. The recommendations are embedded in the Report, to ensure that their context and intent is clear.

...including a mix of long term actions ...

Some recommendations are large in scope and will require a sustained effort over several years to implement. This may include 'proof of concept' studies, to tease out the issues and to identify the optimal interventions. Where Code or regulatory changes are envisaged, there will generally be a need for regulatory impact assessment and/or benefit cost analysis before decisions to implement these changes can be made. Some recommendations cut across the domains of many different agencies, Ministries and jurisdictions. We acknowledge that jurisdictions and agencies will need to prioritise and address the recommendations as they see fit. Despite the challenges, we encourage governments to make a start on these longer term actions, as they deal with the larger issues.

...and short term opportunities.

At the same time, we identify a number of 'quick wins', or opportunities that could be captured in the short term, including during Phase 2 of this project (which runs through FY2015).

We propose 'plan, act, review' approach through time.

Overall, we recommend a 'plan, act and review' approach is maintained through time, to ensure the reform program remains on track and relevant to evolving circumstances.

Much good work is already underway, and it is important that governments communicate this fact effectively to stakeholders.

During the course of this review, we became aware of many initiatives – often collaborative measures supported by all or most states and territories – that will advance some of the key themes and recommendations of this Report. However, it equally became clear that the building industry and wider community is not well aware of these initiatives, and is therefore unnecessarily sceptical about the degree of commitment of governments and policy makers have to addressing their concerns. An enhanced and sustained program of communication with stakeholders, including directly engaging them to the greatest extent possible in the design and delivery of these initiatives, would pay dividends in terms of stronger stakeholder support for action on energy efficiency.

There are some recommendations that would be expected to leverage significant change through time...

- ***Key systemic and process reforms***

Given the systemic nature of the review, it is challenging to single out a few recommendations for particular attention. The recommendations are offered as a set and are intended to be implemented as a whole.

However, we can identify recommendations within each of the four strategies identified above which, if implemented, could be expected to leverage significant change throughout the entire building system. These include:

- A comprehensive documentation of the benefits and costs associated with building energy efficiency regulation – addressing key stakeholder concerns (such as risks of unintended consequences or underperformance of measures or tools) – leading to an extensive and sustained communications campaign to raise awareness of *what is at stake*;
- Making clear the level of ambition that is expected in building energy performance standards through time; that is, *getting the incentives right*. This could occur by amending the objective and functional statements in the Code to require that buildings 'use energy efficiently [or reduce greenhouse gas emissions] to the extent cost-effective', and by putting in place effective governance and review arrangements that ensure this outcome is achieved through time;
- *Ensuring quality outcomes* involves a large number of reforms (reflected in detailed recommendations), but two in particular stand out:
  - First, mandatory inspections of energy efficiency features and inclusions in buildings was identified as a 'make or break' issue. Many stakeholders (but not all) suggested that this would be a key reform, in that it would generate the confidence that design intentions are being given effect, while also helping to reverse a culture of non- or minimal-compliance. We note that regulatory impact assessment would be required to demonstrate the cost-effectiveness of this measure, and we recommend that this is undertaken as a priority. We note that conducting sample inspections on an intelligence-led audit basis, and making use of modern technologies, would help to reduce compliance costs. Enhancing labelling on building products, and ensuring rating schemes generate a list of key features/specifications that the rating relies upon, would also facilitate discovery of substitutions and protect consumer welfare;
  - A second key reform would be to ensure that building industry professionals are subject to mandatory accreditation and continuous professional development regimes in all states and territories (as is already the case in two jurisdictions). Voluntary approaches are held to be undermining those professionals who are trying to do the right thing by consumers. Jurisdictions could pool their experiences to identify best practice features of these regimes and agree to implement them in a consistent manner nationally. We note, as above, that regulatory impact assessment would be necessary as a first step towards implementation.

- Finally, a key measure to *empower the community* would be for building officials to engage with the ACCC and Fair Trading Commissions (or equivalent institutions in each state and territory), as well as Building Commissions, to strengthen consumer protections for building owners. Building on the successful model used in applicance regulation in Australia, this could involve key elements such as publishing a clear and accessible process map of the existing consumer protection system relevant to building energy performance, and developing one or more 'MOUs' between consumer protection bodies and building commissions/government agencies, in order to create a framework for enforcement action.

- ***Short term opportunities***

Some short term opportunities include:

The following opportunities have been drawn out of the Report as having particular potential to leverage outcomes in the short term, and therefore as being highly suitable for implementation in Phase 2 of this project, during FY2015:

Promoting fair trading and consumer rights...

1. Engage with fair trade and consumer protection agencies to identify pathways for improved consumer protection in cases where energy efficiency features present at design, specification and/or approval are compromised or absent in the finished building. Develop Pilot MOUs with selected agencies to test and/or demonstrate the capacity of consumer protection and market pressure to increase energy efficiency in residential buildings in trial areas.

Best practices for building sealing...

2. The Commonwealth national home energy efficiency (building seal) inspection project will collect and interpret recent building performance data from all Australian capital cities. Findings will be interrogated and used to develop industry and consumer information and to recommend a regulatory (or alternative) implementation pathway for nationally-consistent building seal, minimum performance standards.

'As built' energy audits...

3. Engage State and Local Governments to review compliance audit records and undertake a representative sample of on-ground inspections and alternative assessments of residential buildings, underway or recently constructed, to quantify and communicate the level of non-compliance with energy efficiency requirements and calculate consequent (comparative) operational costs to consumers. Develop this information material further to support both industry education and consumer-driven market demand for energy efficient buildings.

Trialling electronic building passports...

4. Local Government-based Pilots to demonstrate effectiveness of an "Electronic Building Passport" to enable long-term controlled access to and management of building documentation from planning, design and assessment to building and operation. This Pilot project will initially focus on a "subset"; those factors affecting energy efficiency and thermal performance. It will include consultation with building regulators and relevant research programs nationally to investigate options for developing a best practice building documentation system to provide a reliable and accessible audit trail for compliance with the EE provisions of the NCC.

Building on this report by developing a 5 year strategic plan...

5. Develop a draft 5 year (to 2020) Strategic Plan for key activities Australia wide in policy, regulatory areas, and in knowledge management, that will harmonize and deliver improved compliance with energy efficiency provisions of the National Construction Code.

Providing feedback to the stakeholders who contributed to Phase 1; and

6. Provide Industry Feedback and web-based materials to communicate with and provide an overview of Phase 1 outcomes and Phase 2 projects to all industry and other stakeholders who engaged in Phase 1 through surveys, submissions, communications or formal workshops held in all States and Territories.

Seeking improved consistency in the energy performance regulation of alterations and additions.

7. Seek improved consistency across all jurisdictions in the application of the energy efficiency requirements in the NCC to alterations and additions and the use of rating tools in assessing alterations and additions.

A Vision for 2020

What would success look like?

When considering a longer term and complex reform program, it can be helpful to form a clear view of the intended outcomes of the reform process. What does success look like? Looking back from 2020, we can understand how each theme helped to transform outcomes across the sector:

Consumers, industry, regulators and governments alike understand the value of effective energy performance regulations for buildings.

The 'business case' – or strictly, public policy case – for effective energy performance regulation for buildings is well understood by all stakeholders, thanks to regular quantitative research that *clearly identifies what's at stake*, and also to an extensive and effective communications program that provides them with clear and compelling information. This includes information regarding not only the financial benefits of improved building performance, but also the health and amenity benefits, environmental benefits, and the enhanced property values and rental yields. Key messages are regularly reinforced by governments and regulators, and the building industry has embraced energy performance as an essential quality attribute of building performance. As a result, skills and knowledge are higher and the Australian building industry is more competitive in winning construction work in demanding overseas markets.

Codes, regulations and policies deliver best practices and a quality built environment...

Thanks to a sustained effort on *getting the incentives right*, by 2020 progressive changes to policy settings, Code provisions and regulations have encouraged industry to deliver good energy efficiency practices as a matter of routine, in all building classes and climates. Industry delivers - not to comply with a law that is resented - but because they have recognised the value of doing so, along with the clear community expectation that they will do so. This expectation – including an awareness of why energy efficiency matters – has created a willingness to pay for quality outcomes. As a result, the quality of Australia's built environment is slowly but inevitably being transformed towards world's best levels of efficiency, comfort and affordability.

Governments, industry and regulators are confident that their operating environment is delivering real value for all parties...

The sustained focus on *delivering quality outcomes* has, by 2020, led to a widespread sense of trust and confidence throughout the building sector and its clientele. There is confidence within all of the building industry professions, because they have fully mastered the design and technical challenges in delivering energy efficient buildings, no matter how challenging the brief or how extreme the climate. The tools they work with (such as energy rating schemes and design tools) are valued as reliable, fit for purpose and cost effective. There is strong and healthy competition between professionals on the basis of the energy performance of their designs and buildings. And there is confidence within governments, policy advisors and regulators that their efforts to create a sound operating environment for the industry are understood and appreciated as delivering valuable outcomes for all parties.

...and the wider community is empowered to look after its own best interests, ensuring that the whole supply and regulatory chain delivers on their behalf.

And due to the enhanced focus on *empowering the community*, consumers have become an effective driver for the building industry to deliver energy efficient buildings. Consumers' understanding of the value of energy efficient buildings has translated into a willingness to pay for this outcome, and this has been accompanied by stronger consumer protections that ensure that industry delivers what consumers have paid for. Consumers are confident that the regulatory framework is protecting their interests and delivering positive outcomes in domains they care about – value for money, quality and environmental sustainability. Mostly because of this, the need for close monitoring of the industry by regulators has fallen away by 2020, as the higher expectations of better informed consumers drive industry behaviour.

1. Introduction

The National Energy Efficient Building Project (NEEBP) is funded through the National Strategy on Energy Efficiency and is being led, on behalf of all states and territories, by the South Australian Government.

A joint team of consultants **pitt&sherry** and Swinburne University have collaborated on this report on the key findings and recommendations of the three projects under the first phase of the NEEBP. The outlook for phase 2 of this project is discussed in Section 1.6 below.

In phase 1, **pitt&sherry** led on systemic issues impacting the efficiency of new builds (Part A project) and alterations & additions (Part B project), while Swinburne led on knowledge management issues among participants in the construction cycle that impact the energy efficiency of all buildings (Part C).

1.1 Review Objectives

The objectives for each Part of the review are set out below:

A. This element focuses primarily on whether there are systemic or process weaknesses, or common points of non-compliance, with the energy performance requirements in the National Construction Code (the Code). Second, we examine options that would help Australia move towards best practices in building energy efficiency. We are seeking to understand the extent to which there is non-compliance with these requirements and, if so, why this is occurring. What factors are contributing to overall energy efficiency outcomes? The scope of issues raised includes the nature of Code itself, state/territory variation/additions, building regulations, local planning and building approval processes, rating tools, assessment and certification processes, designs, materials, construction practices, fit-out, hand-over, occupant behaviours, knowledge and skill issues, or other factors.

B. This element focuses on the uniformity and effectiveness of current standards or regulations to deliver energy efficient renovations, including alterations, additions and retrofits. Through a review of all of the relevant regulations and guidelines, as well as extensive stakeholder engagement, Part B is intended to make recommendations for consideration by state and territory and local government officials. Recommendations for changes to Code provisions or regulations, and other changes that are necessary to apply the guidelines are also provided. Further, the report identifies a set of best practice fact sheets for undertaking energy efficient renovations. The fact sheets will support practices in industry and in local government.

C. This element comprises a national needs and gap analysis, leading to a strategy to develop and support the knowledge and capacity of key professions and trades to deliver best practice energy efficiency to the building industry. A key output is a national information register. This analysis aims to identify optimal content and modes of information delivery and skill development, and prioritise capacity building interventions that could be delivered in the coming months and years.

Please refer to Appendix 1 for further details, where the full terms of reference for each Part of the study may be found.

1.2 Strategic Context

The key driver for the National Energy Efficient Buildings Project is the concern that the construction system in Australia – which includes the regulatory and policy framework around the building industry, building users, as well as all of the building professions and suppliers – may inadvertently be generating a built environment that is less energy efficient than anticipated by the Code. One concern is that compliance with existing energy efficiency requirements in the Code may be poor, or that ambition levels with the Code are low. A different concern is that the effectiveness or cost-effectiveness of the requirements may be lower than anticipated.

In addition to reviewing the research-based evidence, this review has enabled a direct engagement with well over 1000 stakeholders in the building industry to capture their views and recommendations on this question.

This review is interested in elements of Australia's construction and building system - a system of vital strategic and economic importance to Australia. Building construction accounts for a significant slice of the Australian economy. Residential and non-residential building investment is around $70 billion per year in Australia. This represents close to 7% of Australia's economic activity. The construction industry as a whole employs over one million people – about 9% of all Australian workers.

Buildings are deeply entwined with the economic and social life of every country, including Australia. Our built environment supports some 30 million people, residents and visitors[2].

Governments in Australia have long required that minimum construction standards be met. This helps ensure that the industry delivers buildings to occupants that are safe and functional – a fundamental element of a modern and productive economy.

Energy performance requirements were added through provisions in the then Building Code of Australia (now National Construction Code) over the period 2003–2010, based originally on an agreement between all governments in Australia to do so expressed in the 1998 National Greenhouse Strategy[3]. The stringency of performance requirements has been lifted twice for residential buildings, and once for commercial buildings, with the current provisions dating from the 2010 version of the Code (although some States and Territories are yet to introduce all of these measures into their building regulations).

Energy efficiency standards were included in the Code for a number of reasons. When buildings are energy efficient, their occupants are better off – they have lower energy bills and higher levels of comfort and wellbeing. Energy efficient buildings are better for the economy and better for the environment. Reducing energy use and increasing energy performance allows productivity to increase. Money saved on power bills can be invested elsewhere. Australian households spend an average of around $380 million every week on electricity and gas[4]. An average energy efficiency improvement of less than 3% would free up $10 million a week to be invested in other parts of the economy. Energy efficiency improvement also reduces the negative environmental and social costs of energy use – such as greenhouse gas emissions. Indeed, 'to reduce greenhouse gas emissions' is the stated objective of the relevant parts of the Code.

A concern of some stakeholders is that the potential benefits of meeting energy efficiency standards, and the further potential benefits of achieving best practices, are not being captured. The National Energy Efficient Buildings Project aims to understand why opportunities might be left unrealised, and, to the extent that they are, what could and should be done about this.

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[2] ABS 2013, *Yearbook Australia 2012,* 'Population clock, overseas arrivals and departures'.
[3] National Greenhouse Strategy – Strategic Framework for Advancing Australia's Greenhouse Response, Commonwealth of Australia, 1998, p. 48.
[4] ABS,2012, *4670.0 - Household Energy Consumption Survey*

In previous consultations between the building industry and government, many parties have expressed the concern that the building industry as a whole (including policy-makers, regulators and all involved in design, assessment and construction) are underperforming in three areas of energy efficiency performance:

- Compliance with the energy performance requirements in the National Construction Code may be less than ideal. There have been some reports and case studies in individual states that support this view.
- Some aspects of the Code itself may be contributing to a gap between the actual performance of a finished building and the level of energy efficiency that the Code is aiming for. In other words, compliance with the Code may not always lead to acceptable energy efficiency performance in the final building.
- The combined systems of standards, requirements and knowledge and skills development that underpin energy efficient building is not operating as well as it could. The result is that practical and cost-effective opportunities to plan, design, construct and tune more energy efficient buildings are not always taken.

1.3 Scope

Across the three projects, all climate zones and building types are considered. As the project unfolded, most of the stakeholders, who chose to participate, addressed issues relating to residential buildings.

The scope of the review includes making recommendations, which we have prioritised according to strategic importance, and also providing a timeframe for implementation.

Quantifying the extent of non-compliance with Code energy efficiency requirements is outside the scope of this research, although we do review the existing evidence.

1.4 Overview of Methodology

The NEEBP Phase 1 sub-projects 1, 2 and 3 were run in parallel. This was a mutual decision of the NEEBP Project Manager (from the South Australian Government) and the pitt&sherry and Swinburne University project teams. This approach was taken due to the multitude of joint stakeholders, the importance of wide and deep consultation, and the extent of heavily interlinked issues across the three phase 1 sub-projects.

A Project Reference Group, with membership from government policy departments, building regulation authorities, the Australian Building Codes Board, local government and industry provided advice on priorities and approach and acted as a sounding board to the project team.

Figure 1.1 summarises the key activities undertaken.

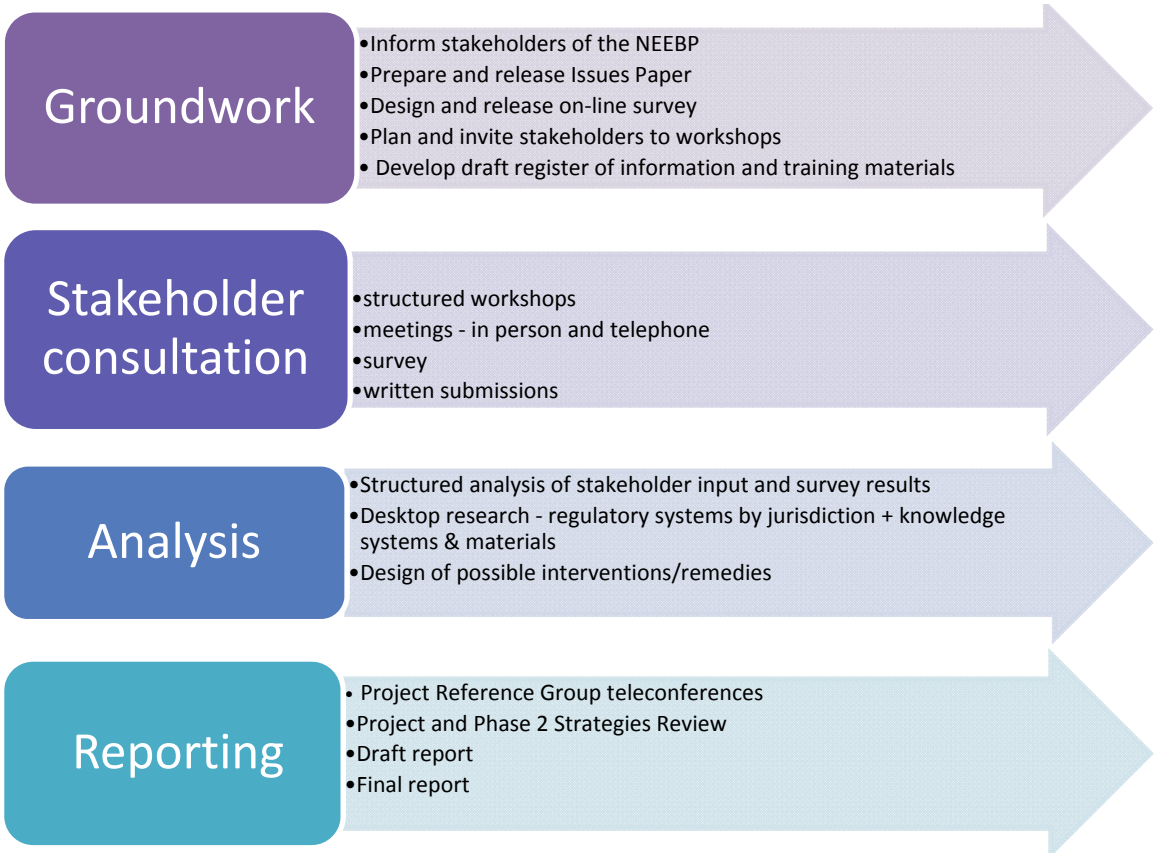


Figure 1-1: NEEBP Phase 1 - Summary of activities

Project 3

In addition to using information gained from the survey, workshops and interviews conducted in collaboration with Project 1 and 2, the Project 3 team:

- Developed a comprehensive national information register of materials that support industry capacity to understand, implement and comply with the energy efficiency provisions of the National Construction Code;
- Conducted a comprehensive stock-take and quality assessment of relevant websites, published materials and training courses that provide energy efficiency knowledge to the Australian planning, approvals, design, assessment and construction industries;
- Conducted a needs and gap analysis of the energy efficiency information and training needs of various players in the building industry, including those involved in policy development, planning, assessment, approval, design, construction, project management, materials supply and specifying, fit-out, modification and retrofit of buildings;
- Consulted with Projects 1 and 2 to further inform and value-add the needs analysis and identify the optimal content and mode of information and skill development required by professions and trades to deliver best practice energy efficiency to the building industry;
- Consulted with the PRG and provided preliminary recommendations for high priority, strategic and effective pilot or demonstration knowledge management and capacity building projects in the Phase 2 work program;

- Developed a series of project plans for a priority work program in the NEEBP Phase 2, and recommendations for projects in the next 12 month period to June 2015 and beyond, to deliver pilot and demonstration knowledge management and capacity building services for industry, local government and other relevant stakeholders.

1.5 Stakeholder Engagement

A crucial element of the NEEBP was collecting views and information from those involved in the construction system. The project team sought to engage with a wide range of stakeholders – differing by role (planners, designers, assessors, certifiers, builders, trades-people, product suppliers, regulators, etc), jurisdiction and climate zone. The consultation activities undertaken are summarised below.

Contacting stakeholders

A database of stakeholders was constructed by the project team.

187 organisations received emails inviting them to participate and asking them to pass on the invitation to their colleagues and members. Key organisations (such as major industry associations and the Australian Local Government Association) were also contacted by phone. The vast majority of contacted organisations did send out information to their own database of contacts/members.

In addition 182 individuals received emails inviting them to participate and asking them to inform their networks of the NEEBP. The Project Reference Group members also informed their network of contacts.

A webpage was set up, which allowed stakeholders to be directed to a single information source (http://www.pittsh.com.au/projects/carbon-and-energy/energy-efficiency/national-energy-efficient-building-project).

Workshops

A total of 17 workshops were conducted in November and December 2013 across 11 locations. In all capitals (except Darwin) 2 workshops were held, one in the morning and one in the late afternoon. This allowed would be participants a choice of attendance time. Regional workshops occurred in Townsville – QLD and Port Augusta – SA, and a meeting held in Wodonga – VIC. The 11 locations allowed representation of all bar one of the ABCB climate zones, all jurisdictions, and a variety of construction issues that vary by geography, industry size, etc. Table 3.1 provides a summary of participant numbers by workshop location and role. For details on the substance of the workshops, please see Appendix C.

Table 1.1 Summary of workshop participants by location and construction process role

Workshop locations and participant role	Regulators, Government	Certifiers	Builders	Product & System Suppliers	Industry Associations	Designers, assessors, efficiency consultants, systems professionals etc	Location totals
Melbourne	2	2	0	2	3	17	**26**
Sydney	6	3	1	4	3	15	**32**
Canberra	9	2	0	0	3	4	**18**

Workshop locations and participant role	Regulators, Government	Certifiers	Builders	Product & System Suppliers	Industry Associations	Designers, assessors, efficiency consultants, systems professionals etc	Location totals
Brisbane	6	1	0	1	3	12	**23**
Adelaide	4	7	0	4	2	22	**39**
Townsville	4	2	1	3	1	10	**21**
Hobart	2	0	1	1	2	10	**16**
Darwin	3	1	0	0	1	13	**18**
Perth	3	4	2	2	3	24	**38**
Port Augusta	5	25	1	0	1	8	**40**
Wodonga	4	2	0	0	0	2	**8**
TOTALS	**48**	**49**	**6**	**17**	**22**	**134**	**276**

Individual meetings and phone calls

In addition to the workshops many meetings took place in person and via telephone.

- The NEEBP project 1 and 2 consultants participated in 37 meetings (in person and via telephone)
- The NEEBP project 3 consultants held 7 additional meetings with stakeholders.

Survey

The online survey was completed by 571 respondents. Detail and discussion on the survey results appears in Chapter 5.

Written Submissions

The NEEBP project team received 41 written submissions, as listed below.

Table 1.2 - Written submissions to NEEBP
AIRAH - The Australian Institute of Refrigeration, Air Conditioning and Heating
Air Barrier Technologies
Air Conditioning and Mechanical Contractors Association
Alan Pears AM – Individual
Australian Institute of Architects
Australian Refrigeration Association
Bernie Hoefer – Individual
Building Dynamics
City of Sydney
City of Whyalla
Clyde Anderson – Individual
CTCG Construction Technology Consulting Group (Australia)
Department of Finance
Department of Industry – Energy Efficiency and Renewables Division
Earth Buildings Association of Australia
Gas Energy Australia
Greenbuild – Emma Thirkell
Henley
Henning Rasmussen
Housing Industry Association
Illuminating Engineering Society of Aus and NZ
International Association of Lighting Designers
John Gosper – Individual
Kingspan Insulation Pty Ltd (Aust)
Kleen Heat
LEHR Consultants International (Aust) Pty Ltd
Lisa Kuiri – Individual
Mahalath Halperin Architects Pty Ltd
Martin Clark – Individual
Michael Lever – Individual
Office of Environment and Heritage – NSW Department of Premier and Cabinet
Peter Overton – Individual
Ramtec Pty Ltd

Table 1.2 - Written submissions to NEEBP
Redbike Systems Pty Ltd
RMIT University
Rob Crowther – Individual
Sustainability House
Sydney Airport Corporation
Tim Edwards – Individual
TPC Solutions

1.6 Next Steps – Phase 2 and Beyond

The National Strategy on Energy Efficiency will fund a second phase of the National Energy Efficient Building Project. Government officials will undertake several projects in the Phase 2 program during FY2015. These will advance the implementation of select recommendations from this report.

Phase 2 projects are likely to be 'proof of concept' and 'test the water' in nature. They will begin the process of implementing changes in line with the four key strategies recommended in this report:

1. *Being clear about what's at stake* – documenting the benefits of building energy performance regulation and communicating these effectively to all stakeholders;
2. *Getting the incentives right* - so that the code, regulations and supporting policies are driving each element of the construction cycle to an energy efficient building;
3. *Delivering quality outcomes* - A) ensuring that all those involved in the construction cycle have access to the right knowledge, training, and tools and products B) checking that the industry are making use of the right ingredients to deliver energy efficient buildings;
4. *Empowering the community* – so that consumers understand what to expect from building energy performance and are empowered to take action to ensure that this level of performance is delivered.

These strategies are explored in greater detail in Chapters 5 - 7.

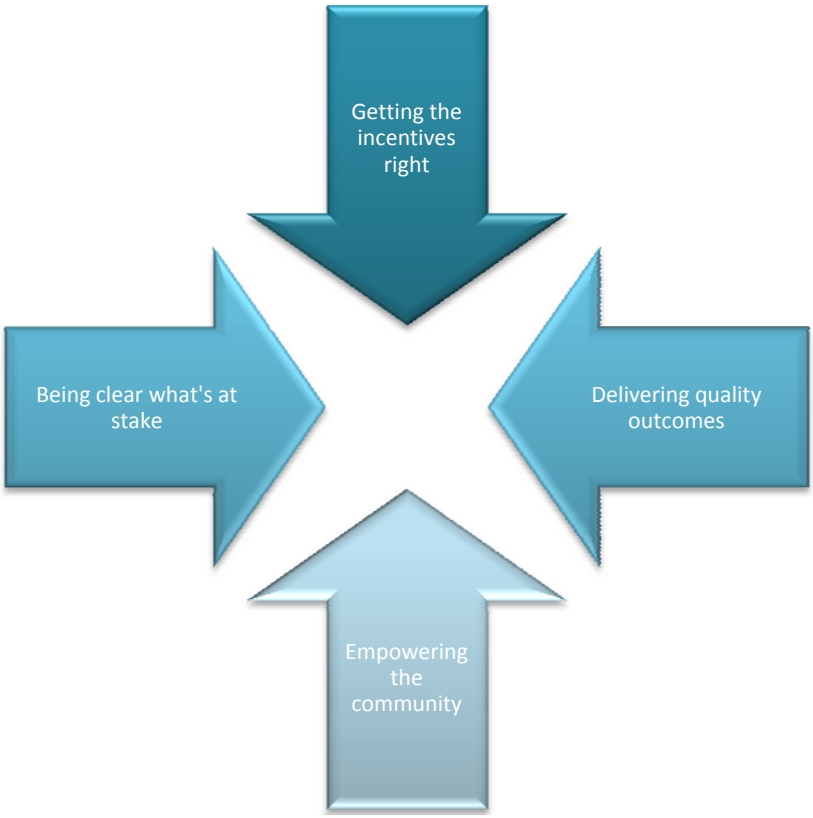


Figure 1.2: Key strategies to deliver more energy efficient buildings in Australia by 2020

1.7 Project Team

Sabina Douglas-Hill of the South Australian Department for State Development is the NEEBP project manager on behalf of the Australian, state and territory governments.

A joint team of consultants from pitt&sherry and Swinburne University were commissioned to assist in the roll out of the Phase 1 NEEBP subprojects 1, 2 and 3 and are the authors of this report. The team consisted of:

pitt&sherry

- Phil Harrington
- Brett Janissen
- Steve Edwards
- Mark Johnston
- Phil McLeod
- Hannah Meade
- Tony Marker
- Kait Gotham
- Rebecca Williamson
- Rebecca Cooper

Swinburne University of Technology

- John Fien
- Tomi Winfree
- Nicole Croker
- Scott McKenry
- Trevor Plumridge
- Martin Pritchard

Project Reference Group

- Vanessa Morris, Principal Policy Officer - Construction Services, ACT
- Clare Culross, Director, Australian Building Codes Board
- Daniel Heath , Senior Program Officer, Business & Government Programs, Public Utilities Office, Government of Western Australia
- Jodie Evans, Chief Project Officer, Building Policy Unit, Government of South Australia
- Tim Farrell, Director, Residential Buildings Team, Department of Industry, Australian Government
- Craig Walker, A/Manager, Energy Markets and Programs, Department of State Development, Government of South Australia
- Natasha Palich, ALGA Representative and Coordinator - Council Alliance for a Sustainable Built Environment
- Jim Woolcock, Managing Director, Sustainability House

2. Consultation Outcomes - Summary

A key element of this project was the opportunity to engage widely – albeit in a compressed time period – with a very large number of parties across the building industry and in all states, territories and climate zones. This Chapter presents the key perspectives offered to the review by stakeholders, including in submissions, one-on-one and small group meetings, or in workshops. Further details on the workshop processes and outcomes in each state and territory may be found in Appendix C.

To preserve the privacy and anonymity of stakeholder comments, the comments and perspectives are grouped by stakeholder type and are not attributed to any particular person or organisation (with a few exceptions, and with permission). This approach risks 'stereotyping' views, or looking through significant differences of opinion within a stakeholder group, and we try to address this by indicating the range of views expressed on a given topic. Also, we note that a very large number of stakeholder perspectives were offered. While we have attempted to do justice to this range, it is possible that not all perspectives and nuances have been captured below.

Stakeholders raised a *very* wide range of issues and concerns with the review team. These covered matters relating to government policy settings, funding levels, Code provisions, state variations and additions, regulatory provisions and practices at state and local levels, knowledge and skill levels in many different industry segments, industry practices (across a wide range of building professions), and building occupant/ owner awareness (or lack thereof) and energy use practices. While there was a strong degree of commonality in the key issues highlighted by stakeholders across Australia, still there were some issues that related to individual jurisdictions, and differences of focus/emphasis in different states and territories/climate zones.

2.1 Policy and Regulations

There was good participation in this Review by the staff of building commissions or similar regulatory bodies. Government policy analysts participated primarily in a project reference group, reviewing rather than contributing material.

The most common comment we heard from this group of stakeholders was the lack of a) financial and b) policy support from governments – and in some cases Parliaments – for their work. Many noted inadequate and often declining funding as a fundamental source of pressure contributing to 'minimum necessary' approaches to regulatory implementation; very limited auditing of any element of the construction cycle; to little evaluation of regulatory outcomes; and, to scant research to inform future regulatory development.

Apart from funding, several regulators told of proposed initiatives for regulatory reform – for example, to improve dispute resolution mechanisms or to enhance consumer protection – were overturned either by governments or Parliaments. When queried as to why this occurred, most identified the over-arching view of governments was that building energy efficiency performance requirements amounted to 'red and green tape', to be minimised wherever possible, and also noted strong pressure brought to bear on governments by industry lobby groups.

Some regulators made comments that indicated a view that energy efficiency requirements were not a 'core' consideration, and less important than other matters covered in the Code, such as structural integrity, and health and amenity. Others noted a lack of clarity as to whether state fair trading offices or building commissions (or equivalents) were responsible for managing complaints and consumer welfare issues with respect to buildings, and told stories that indicated a degree of 'buck passing' on this issue. When pressed on the reasons for this, the most common ones offered were a lack of resources (in both institutions) together with a sense that the legal framework for consumer protection around building performance is weak. Regulators in several states noted that owners generally must have recourse to common law if they wish to pursue claims of under-performance by builders, but that the costs associated with that path, including the low success rate, generally discouraged the pursuit of claims.

The Australian Building Codes Board supported this review and noted that they also have a strong focus on improving compliance with existing energy performance requirements. Their initial focus is on commercial buildings and HVAC performance requirements in particular. The focus on compliance, rather than higher standards, reflected, in part, a view that governments currently have no 'appetite' for higher energy performance requirements, and this notwithstanding evidence that higher standards would be cost-effective, particularly for commercial buildings.

Overall, we formed the view that regulators tend to see energy efficiency aspects of the Code as relatively unimportant, and perhaps a distraction from more important matters. This may in turn reflect a consistent view that governments are relatively uninterested in energy efficiency matters, combined with resource constraints. The predominant concern of the policy advisors appeared to be managing the overt opposition to higher standards (or additional regulatory reforms) by industry groups, and the consequent lack of support for regulatory change from governments.

2.2 Planning

Planning authorities (local governments) participated in workshops and, in some cases, sought individual meetings. Some local governments maintain their own building surveyors, despite a general tendency for this service to be provided by private companies, and some reported conducting audits of building permits. However, most noted that they no longer employ building surveyors, and many lamented this change. Key concerns expressed included a perceived lack of quality control and inspections, while others questioned the experience of private surveyors, and felt that many were conflicted in carrying out their duties as private entities.

One Council in South Australia reported a 70% non-compliance rate on building permits checked, although these did not necessarily relate to energy performance issues. The most common issue noted were unauthorised changes to designs, often involving window placement or sizing, but sometimes much larger changes. Another Council in Tasmania (of modest size) noted that it had 1800 outstanding information requests with builders and other trades- people for required certificates. This data plays into our conclusions in this Report that there is a widespread culture of non-compliance in the building industry, accompanied by a sense of 'impunity' due to a lack of material consequences for non-compliance.

In terms of their own practices, most Councils cited a generally low level of awareness of energy efficiency issues and Code requirements in the planning process, and this despite rising concerns regarding climate change, sustainability and also affordability/costs of living within communities. It was mentioned that energy efficiency is often viewed as a low priority and few resources are allocated to ensuring compliance with planning scheme requirements in this area.[5]

[5] We acknowledge that there are some Councils that strongly buck this trend – such as those Victorian Councils that apply Ecologically Sustainable Development or Energy Efficient Design requirements through their planning schemes – but these were not represented directly in our consultation process.

A concern expressed by planners was the general lack of support for master planning in Australia, with master plans clearly setting out in advance solar orientation, access to light and other key energy efficiency or sustainability requirements. When asked, the reasons cited for this included 'lack of support from Councillors' or 'pressure from developers', or 'maximising the number of lots'. Many noted that this led to many developments proceeding without due consideration of solar passive principles or appropriate orientation of lots. Some exemplary developments reverse the general trend: the City of Sydney, for example, pointed to the Barangaroo development as one such master planned development.

2.3 Building Design

Designers and architects were well represented in the consultation processes for the review. Many showed a keen interest in energy efficiency, sustainability and solar passive design, and we formed the view that much of the drive towards better building efficiency outcomes is due their efforts (along with energy assessors and innovative builders).

However, most immediately followed such positive views with the observation that their clients (prospective house/building owners) were much less interested. There was a strong view that consumers have very little willingness to pay for efficiency features or outcomes, with functional (eg, building size) or aesthetic considerations (getting the 'right look') being top of the table – with the notable exception of certain market segments, including third or fourth home owners in a high income bracket (including upmarket renovations), and corporate headquarters in premium CBD locations. Some noted that popular TV shows on home renovations, award winning or spectacular homes, and the like (such as Grand Designs) are highly influential but also focus owners on aesthetic considerations, while also encouraging unrealistic expectations. To meet budget constraints, efficiency features such as high performance glazing are routinely dropped.

Many designers also reported poor attitudes and low knowledge levels in other parts of the building chain with respect to energy efficiency issues, notably amongst builders but also product suppliers/retailers and real estate agents, and noted that owners' views are often shaped by the advice they receive from these sources. Energy efficiency therefore tends to be a hard sell.

Designers were generally critical of rating tools, and from a number of different perspectives. Some offered the view that deemed-to-satisfy (DTS), elemental approaches to Code compliance remain the norm (for residential and smaller commercial buildings), with recourse to rating tools often being motivated by a desire to achieve a Code compliant solution but at lower cost than DTS. However, others offered the opposite view (that rating tools were more commonly used for compliance). In discussion, it appears that there is some correlation with 'market segment' – that is, DTS may be more commonly used for lower budget projects (and certainly for smaller renovations and additions), while modelled solutions appear to be more common for larger or more up-market developments.

Issues cited with rating tools included wide margins in rating outcomes depending upon the practitioner and rating tool, excessive discretion in the tools allowing for 'gaming' of ratings, insufficient consideration of certain local/site factors (breezeways, vegetation, etc – noting that others felt that there should be less such discretion, as per the previous point). As there were a large number of comments with respect to rating tools, including by other stakeholder groups, these are covered in more detail in Part A below.

Many designers also claimed a lack of flexibility in achieving compliance for non-standard designs. A common remark was that the processes (which vary by state) for achieving approval of 'alternative building solutions' is so complex that it discourages its use by all but specialized designers. However, it is not clear to us that the process is in fact so complex. Also, some comments betrayed a lack of familiarity with the full range of available compliance options, such as use of alternative building solutions. This may point to a lack of knowledge on the part of some designers with respect to the regulatory process.

2.4 Energy Assessments

Energy assessors participated in large numbers in this review, no doubt reflecting their professional interest in energy efficiency. Also, we found that the assessors were, not surprisingly, very well informed on energy efficiency issues – as a group, easily more so than other stakeholders.

We noted that the comments offered by assessors around the country were very similar. The most common concern related to their being treated – by home owners and builders in particular – as purely a compliance process at the end of the approvals chain. This attitude brings with it time pressure, cost pressure, and unwillingness on the part of home owners and builders to consider design or specification changes. Assessors often feel that they are viewed as a regulatory burden rather than as a value proposition. This observation ties into our overall conclusions regarding poor energy efficiency culture in Australia.

Relatedly, most assessors felt that they should be brought in much earlier in the design process if a) energy efficiency outcomes were to be maximised and b) construction costs minimised. Some pointed to the work of Sustainability House (2012) in demonstrating that construction cost savings can be achieved through often simple and low or zero cost design changes. Clearly the opportunity to do so evaporates once the design is settled.

While this point was contested by some assessors, many told us of a culture of builders and/or designers 'shopping around' to find assessors prepared to provide 'generous' assessments of the energy performance of designs. This observation should be linked to that above regarding the view that there is excessive discretion available within rating tools that enable such 'generosity'. Also, assessors noted that the market in which they operate is extremely competitive, with low barriers to entry (see below).

Other assessors objected to the suggestion that there is a practice of shopping around, on the grounds that this may suggest unprofessional conduct. However, we formed the view that the reconciliation of these two perspectives may lie in the degree of discretion available within the rating tools. That is, we were told of assessors 'pushing' the required R values for insulation, or u values for glazing, to enable a plan (with inherently poor solar passive design, for example) to reach 6 star. While these ratings may be valid from a technical perspective, there is also a higher risk that such 'pushed' values may not be able to be constructed – for example, due to insufficient widths in walls or ceilings. In this case, the strict 'non-compliance' may rest with the builder, but the builder could argue that the assessor (or designer) has presented them with an impossible dilemma (or at least an uneconomic and impractical solution). To the extent that such practices occur knowingly, they could be described as 'inciting' non-compliance by others.

A further comment made by virtually all assessors was their objection to the regulatory system allowing competition from non-accredited and potentially poorly-trained assessors. Many were concerned that this risks poor outcomes for consumers, undermining the credibility of all energy assessors, and representing 'unfair' competition.

2.5 Building Surveying

Many building surveyors that engaged in the consultation process reflected a view they are the 'meat in the sandwich' between regulators and the building industry. On the one hand, expectations regarding the ability of surveyors to affect efficiency outcomes tend to be unrealistically high (particularly as only one state – NSW – actually requires even a single inspection of an efficiency feature of a building; some states require no inspections of any type at all for some building classes; others require inspections but of structural features only). On the other hand, surveyors are commonly contracted by developers and builders, providing them with a structural conflict of interest. They operate in an intensely price-competitive market, and risk to lose their future income if they develop a reputation for being 'difficult'. Surveyors note that they are not trained in energy efficiency, that the Code only requires certification of designs and not actual buildings, and that inspecting energy efficiency features would be difficult in practice given poor documentation and labelling of those features. For the most part, surveyors rely on a system of 'sign-offs' by other building professionals but there is little or no checking or auditing of the paper trail.

2.6 Construction Sector/Sites

Builders that participated in this review noted that their key issue was a lack of interest and willingness to pay for efficiency features on the part of building owners and developers. Efficiency features are a 'hard sell', as these are low on the priority list of most developers and intending house owners. Efficiency features are therefore often traded away for other outcomes – such as larger floor area.

Some builders noted inadequate building documentation from designers, including detailing relevant to energy efficiency (flashings, sealing, insulation details). Similarly, some noted the lack of suitable support materials to ensure appropriate installation of efficiency features, including 'acceptable building practice' information within the Code or other materials. Others said that such material is available if searched for but is generally not used on site. Some builders noted that designs may be given 'impossible' features (like excessive insulation thicknesses that will not fit in standard wall studs, or extremely expensive glazing that the client is unlikely to pay for), in order to give the appearance of compliance with energy rating requirements but with the tacit understanding that such features are unlikely ever to be built.

Many stakeholders referred to a lack of overall site supervision by builders (one saying, for example, that 'builders don't build any more; they just project manage'). Relatedly we heard of a tendency for one trade to undo the good work of others, for example by removing insulation or penetrating building wraps to install plumbing, wiring or lighting. Often there is no-one on site representing the ultimate building owner's interests, including supervising practices that will materially affect the finished building's energy efficiency.[6] In commercial buildings, a culture of under-bidding leading to 'planned' variations, enforced via contractual disputation, was reported as common-place, with a notable exacerbation of these trends since the global financial crisis due to heightened commercial pressures.

It was reported to us, in every state and territory, that substitution of high efficiency for low efficiency alternatives on building sites is commonplace. High-efficiency glazing was most commonly referred to in this context (perhaps due to its expense, but also due to the difficulty of detecting substitution), but in some cases substitution of insulation products was also noted (again, we note that detection of such changes may be virtually impossible once the building is complete). Generally we heard that the cost savings from such substitutions are being passed back to building owners (for example, as a trade off for extra building area or other non-energy features), although some suggested that substitution may also occur without the building owner's knowledge. All such design variations in principle require a new building permit to be issued, however we were told that this very rarely occurs.

[6] Noting that on larger commercial sites, the owner may employ a client engineer or site supervisor. On the other hand, it was noted that access by owners to residential construction sites is restricted for safety reasons.

Many stakeholders regretted the lack of accountability throughout the whole design, certification and construction process, and attributed poor energy efficiency outcomes primarily to this. We understood this as a reference to the 'sign off' culture within industry and certifiers, together with a lack of effective policing of building regulations. These factors appear to have contributed, over time, to forming a culture in which there is perceived to be little interest in doing the right thing, and very little risk of being caught for doing the wrong thing.

2.7 Building Products/Systems

Many builders, product suppliers and manufacturers raised concerns regarding the lack of certification, performance testing and appropriate labelling of building products and systems. Concerns raised included suggestions of false and misleading claims being made by product suppliers; a lack of responsiveness to these concerns by Fair Trading authorities, the ACCC and Codemark administrators; missing or misleading labelling of products (eg, insulation products); and, the lack of 'traceability' of components (eg windows), where manufacturer application of indelible registration numbers is optional. Many noted a dramatic increase in the importation of building materials – including whole commercial building facades – with no checking or testing of compliance claims (if any are indeed made). These trends are claimed to seriously undermine the viability of manufacturing (or even marketing) innovative and performance-verified building products in Australia.

The lack of energy performance verification for building products (and indeed for whole buildings) compares poorly with the regime that has applied for decades to washing machines, refrigerators and the like. Such products must meet requirements such as energy labelling and minimum energy performance standards (MPES) and cannot be sold legally without registration. Further, compliance checking occurs – with enforcement action ranging from breach notices and warnings to prosecutions.

Builders and other trades participate in the 'sign off' process referred to above, but it appears that the virtual absence of efficiency-related inspections or audits, together with low consumer awareness, makes this largely a paper-trail with little relationship to actual energy efficiency outcomes.

2.8 Consumer Awareness

A recurrent theme of our consultations was the lack of consumer awareness of the importance and benefits of energy efficient buildings. This translates into limited demand for efficiency features in the first instance, an openness to trade-off such features for a lower capital cost or else for more desirable features (larger floor area, better kitchen, etc), and finally a practical inability for consumers to hold the building supply chain to account for energy performance shortfalls. Many stakeholders felt that raising consumer awareness was a key requirement to lift energy efficiency outcomes.

2.9 Skills and Training

Many of the stakeholders we consulted – representing professions throughout the supply chain – were willing to acknowledge skills gaps within their own ranks. These were generally attributed to a lack of mandatory accreditation and/or training requirements by governments, but also to a lack of auditing/compliance checking by regulators (which some, who were exposed to such checking, acknowledged as providing an important feedback and learning opportunity). Key knowledge and skills gaps nominated included building sealing and detailing for energy efficiency and the fundamentals of passive solar design (building layout and orientation, and appropriate use of glazing, shading and thermal mass).

Many cited the absence of mandatory continuous professional development (CPD) requirements in most states, which was noted as particularly problematic for smaller builders who may struggle to keep up to date with recent knowledge and/or use informal knowledge channels. Others pointed to specific weaknesses in training curricula and information products. The Code itself is considered by some to be of excessive complexity and to lack transparency around 'acceptable building solutions'). Even within the states where CPD is mandatory, the effectiveness of the requirements was questioned. Note that Part C of this report deals with these issues in greater detail.

3. Literature Review

While the terms of reference for this review did not call for a review of literature regarding the degree of non-compliance with Code energy performance requirements, many stakeholders considered this an important dimension. We are not aware of any comprehensive national study in this area. However, many studies have addressed at least some relevant issues, and key ones are summarised below.

3.1 Evaluation of the 5 Star Standard for Residential Buildings

The CSIRO was commissioned by Australian Government energy efficiency officials to look at the impact of the previous 5 star BCA requirement for Class 1 homes in comparison to the older 4 star standard. Over 400 homes spread over 3 climate zones were monitored to assess impacts on actual heating and cooling energy use. The CSIRO also looked at costs and benefits. A final report has been published, and the project team has been briefed on the preliminary findings by the commissioning officials.

Preliminary findings include:

- The 5 star standard resulted in less energy use for heating purposes compared with lower rated homes;
- Actual energy use for cooling in summer in 5 star homes was the same or higher than in lower rated homes;
- The actual cost of constructing 5 star homes was lower than for 4 star homes.

The latter two findings may be considered surprising. However, measurement and analysis that deals with confounding factors such as air-conditioner capacity, behavioural differences, and design differences and construction practice differences, is not complete at this point. Therefore it is difficult to draw definitive conclusions at this time.

3.2 Energy Assessments Benchmarking Study

The Department of Industry commissioned a study to measure the accuracy and consistency of energy rating assessments performed by Nationwide House Energy Rating Scheme (NatHERS) assessors. The resulting report has been published, and the NEEBP team has been briefed on the preliminary findings by Department officials.

Several hundred of the estimated 1400 assessors practicing in Australia participated in the benchmarking study. As part of the study, participants completed a randomly assigned assessment of one of four plans of Class 1 and 2 homes. They also answered a series of questions relating to data entry techniques and understanding of requirements. Key preliminary findings of the study include:

- About 21% of assessments were exactly correct, with another 45% achieving a score within the regulated tolerance for accuracy[7]. About 15% were too high by 1 or more stars. Around 21% were too low by 1 or more stars;
- On average assessors answered 65% of questions correctly;
- Zoning errors were made by 60% of assessors in the zoning of house plan 1. 85% of assessors assigned house plan 4 made errors;

[7] Therefore if these assessments were done for regulatory purposes then the number of assessments that would meet the required standard would be 66%. This is because the standard contains a level of tolerance. In other words 21% of assessments were precisely correct and another 45% were within the accepted tolerance.

- Design complexity correlated with error rates. House plan 1 had simple design and documentation and 57% of those assessing that plan were within a quarter of a star. House 4 was an apartment on the 15th floor of a class 2 building and only 19% of those assessing that plan were within a quarter of a star;
- 20% of assessors made errors concerning net conditioned floor area;
- Errors in modelling the impact of overshadowing was made by 75% of those assessing house 1;
- 22% of participants used Accurate, 43% used FirstRate5 and used 35% BERS Pro;
- Use of a particular tool was correlated with error rates – but not to a statistically significant rate at 95% confidence;
- Assessors belonging to different accrediting organisations (ABSA and BDAV) participated, as did a smaller number of unaccredited assessors. Error rates and ranges did differ along those lines with each type represented in most error bands – but differences were not to a statistically significant rate at 95% confidence.

3.3 Compliance with Building Permits (Victoria)

This report by the Victorian Auditor General, released in December 2011, examined the effectiveness of the Victorian building permit system. The system is intended to assure that proposed works will meet minimum construction and safety requirements under the relevant Act, accompanying regulation and the NCC.

The audit report concluded that it could not be demonstrated that the permit system is working effectively or that building surveyors are performing their intended role.

Some of the key issues raised in the report include:
Inadequate documentation: A building surveyor is required to determine if proposed works will comply with requirements.

- Of the 401 permits, and their accompanying files studied through the audit, only 4% contained information sufficient to award a building permit. That is, 96% of the permits were unjustifiably awarded on the basis of the documentary evidence examined;
- 72% of domestic permit files and 76% of commercial permit files were missing information on 5 or more requirements;
- 8 out of the 10 least compliant permits were for proposed commercial building works;
- Of 116 domestic permits examined for glazing and window elements, 77 had insufficient information for the assessment of compliance with energy efficiency and safety requirements. 52 out of 98 commercial permits were issued without adequate documentary evidence;
- Other areas where documentation was deficient included structural integrity, pool safety, fire safety, ventilation, plan and site details, timber framing and bracing.

The report recommended that the regulator should develop standard templates and procedures that require building surveyors to document their assessment approach (consistently and thoroughly) and their decision basis.

Poor cooperation between councils and regulators on monitoring system performance: Private building surveyors certified the great majority of permits (87%) audited. Councils receive the permit documentation, but do not systematically review the provided information. At the time of the report there was no arrangement between the then building commission and councils to monitor the performance of building surveyors.

Loose approach to regulation: At the time of the report, the commission's audit program mainly covered council building surveyors, although the great majority of permits are certified privately. The audits themselves did not actually assess technical or safety compliance, rather focusing on administrative issues. The report recommended that regulators improve their audit program so that audits are targeted and risk based and consider the actual performance of surveyors.

Imperfect building surveyor registration and competency system: An extensive assessment process for registering building surveyors did exist at the time of the report. However the report recommended that a system of compulsory continuing professional development be introduced.

For further information see the report at:
http://www.audit.vic.gov.au/reports_and_publications/latest_reports/2011-12/20111207-building-permits.aspx

3.4 Victorian Home Alterations Study

This study for the Building Commission of Victoria by BIS characterised alterations and additions in three Melbourne council areas and reviewed the interpretation and implementation of NCC energy efficiency provisions. A sample of findings include:

- The number of permits issued for domestic alterations/additions in inner Melbourne council areas exceeded the number issued for domestic new buildings over the period January 2009 to November 2011;
- The median cost was $260,000 and the median size was 100 square metres;
- 70% of projects triggered the 50% rule – the requirement for the entire building to be brought up to code if the volume of an alteration/addition, together with other plans/work over the previous three years represents more than half the original volume of the building;
- 20% of projects did not provide documents on energy efficiency;
- 41% of projects reported based on HERS method and 39% used the DTS provisions;
- Regarding the reporting of the insulation values in the energy efficiency reporting versus construction drawings, consistency occurred in 38% of cases. In 37% of cases the value reported in the energy efficiency document did not match the value on the construction drawings. In 5% of cases the construction drawings said refer to the energy efficiency documents (did the builder do such a thing?) and as noted above, in 20% of cases energy efficiency documents did not exist;
- Surveys and interviews with energy assessors indicated that many were not clear in their understanding of applying ratings to renovations;
- Surveys and interviews with building surveyors, and examination of documentation, indicated that surveyors generally certify the combination of plans and energy efficiency documents without sufficient scrutiny;
- 50% of the ratings reassessed by an independent assessor were found to fail NCC compliance levels;
- The communication between designers and energy raters/assessors is often poor.

3.5 BASIX Monitoring – Electricity Consumption for 2007/8 and 2008/9

EnergyAustralia (then an electricity network and retail business, now Ausgrid on the network side and the EnergyAustralia name retained by another business with generation and retail activities) analysed the actual electricity consumption in the years 2007/8 and 2008/9 for a sample of several hundred BASIX new Class 1 homes built in NSW over the years 2004 to 2007. The electricity consumption data, along with data on the number of bedrooms per dwelling, occupants per dwelling, and other factors was used to study the actual reduction in greenhouse gas emissions achieved in those dwellings.

In NSW BASIX applies to new Class 1 and 2 homes, and alterations/additions over $50,000. It applies greenhouse and water use reduction targets relative to per person benchmarks. Dwelling benchmarks are based on ABS occupancy rates, multiplied by the per person greenhouse emissions in kg per year. The reduction targets vary by dwelling type and region, however in the coastal areas of NSW the target for Class 1 homes is a reduction of 40%. BASIX is an 'as designed' system with the modelled performance of the planned home compared to the benchmark.

The EnergyAustralia study from June 2010 looked at actual annual electricity use over a year (in a number of different years). This allowed actual performance to be compared with as modelled performance. The study had total consumption data for 'all electric' homes – where gas was not used. For homes where a combination of gas and electricity was used, the total consumption was an estimate based on the sum of actual electricity use and an estimate of gas used (for hot-water, heating etc).

There was a considerable range in performance by year, by house size (number of bedrooms, etc), and by region. The median actual reduction from the benchmarks in all electric homes was about 10 percent. The median estimated reduction in electric + gas homes ranged from around 13 to 22 percent.

The study therefore observed:

- Considerable difference in actual performance and targeted performance;
- Considerable differences in actual performance on a house to house basis.

The study scope did not include an investigation of the causes of the differences which could include a large number of factors such as occupancy rates, occupant behaviour, occupant per sqm metre differences, appliance efficiency levels, and a range of building issues (sealing, insulation, variances from the plan, etc).

For further information, see the study at:
https://www.basix.nsw.gov.au/basixcms/images/energyMonitoringReport2007-2009.pdf

3.6 Impact of Poor Building Practice on the Thermal Performance of Homes

The Department of Industry (then RET) commissioned Sustainability House to investigate the effect of poor building practice on the thermal performance of homes designed to meet the 6 star standard. The method of assessing impact was to model the effect of increased air infiltration rates and substandard insulation installation on 2 designs of six-star class 1 dwellings. The impact was modelled using NatHERS software rather than undertaking measurements in real homes.

The study found that major building faults resulting in high air infiltration and significantly reduced insulation can reduce the rating by up to several stars. Individual minor faults were found to have a fairly minor impact. The combined impact of several minor faults can however combine for a large reduction in the thermal performance of a dwelling.

3.7 Non-conforming Building Products

The Australian Industry Group released a report in November 2013 entitled: *The quest for a level playing field: the non conforming building products dilemma*, which examines the use of products in the construction sector that do not meet requirements under the relevant Australian Standard. The investigation included a survey in which 92% of 222 companies that responded reported the presence of non-conforming products in the Australian market. The report identifies significant gaps in the 'building and construction conformance framework' that allow non conforming products to be used in buildings and other infrastructure across all states and territories.

Gaps that the report suggests need to be closed include a lack of:

- Market and product surveillance by regulators;
- Enforcement by regulators – ie a lack of audit checks, testing and corrective action (fines, rework ordered etc);
- An effective registration or certification system.

The report also finds that building certifiers currently bear a very large responsibility for product conformance. However the regulatory process that certifiers work within does not effectively allow certifiers to meet their product conformance obligations (for instance certification only relies on a limited number of inspections). For more information see: http://www.aigroup.com.au/portal/site/aig/standards/nonconformingproductresearch/

3.8 Increasing Residential Building Efficiency through Building Redesign

Commonwealth energy efficiency officials commissioned Sustainability House to assess the potential for modest dwelling design changes to deliver an increase in thermal performance.

Part 1 of the study looked at the ability of design changes to lift performance from five to six stars – and the cost impacts of those changes. The selected design modifications included improved solar orientation, living area placement, window sizing and placement, selection of roof colour to suit climate zone, floor fabric selection to allow improved use of the thermal mass in concrete floors.

These design changes were selected to assess their ability to boost thermal performance from five to six start without increasing the specification - and therefore cost – of building materials like insulation and glazing.

The study used these design changes to modify the '5 star' plans for 16 different houses and 4 apartment buildings so that 6 star performance could be achieved. In all cases the dwellings were able to meet 6 star requirements through use of the suite of design changes. Interestingly, the design changes actually dropped building cost below the original five star level in many cases. In instances where design changes increased element costs, those were able to be offset by savings achieved in other elements.

The study concluded that optimising design - to match orientation and climate zone - was a cost effective method of achieving a shift from 5 to 6 star thermal performance. The ability of design changes to hold or lower building cost from the '5 star' plan could not be matched by the alternative method of increasing performance through increasing the specification of building elements or products.

Part 2 of the study explored the potential for lifting existing 6 star plans to a higher level of performance for no extra cost. Sustainability House also undertook this work. This study found that modest design changes were capable of lifting performance from 6 to 7 stars. In some cases the performance increase was available for no additional cost, in others, there was a modest cost increase.

3.9 Conclusions

The existing research relating to the extent of compliance/non-compliance with the energy performance requirements is, at best, incomplete. The majority of studies undertaken relate to Class 1a buildings only and some have methodological limitations that limit the interpretation of their findings. Apart from the Victorian Auditor General report mentioned above, there appears to be no studies relating to the extent of Code compliance for buildings other than Class 1. Given the duty that state and territory building commissions have to enforce compliance with the Code, this is a regrettable situation. We recommend that it be remedied as soon as feasible, preferably via a nationally co-ordinated audit, to create a statistically significant 'snapshot' of compliance in a given year (such as FY2014-15). This would enable a similar exercise to be run in, say, three years time and comparisons made. Therefore we recommend:

No.	Recommendation	Strategy	Pathway	Timeline
1	*That state and territory Building Commissions (or equivalent bodies) undertake audits of compliance with the energy performance requirements of the Code in their jurisdictions, aiming to cover a representative (or, ideally, statistically significant) sample of building types constructed in that year, with a particular focus on buildings other than Class 1a.*	Understanding what's at stake	To be commissioned by state/territory Building Commissions, co-ordinated via BIC	FY2015 and ongoing

4. Reviewing the Case for Energy Efficient Standards

The building energy efficiency standards currently agreed and adopted in the National Construction Code reflect a strong probability of benefits for energy users. Analysis carried out in 2009 to check on the costs and benefits likely to flow from adoption of the proposed energy efficiency standards (in the context of a Regulation Impact Statement submitted to COAG) indicated that for many construction types and major population centres, the proposed NCC regulations were close to a break even proposition. This was true for both private residential (classes 1, 2, 4 & 10) and commercial construction (classes 3 & 5-9).

The RIS analysis conducted in 2009 for the ABCB by the Centre for International Economics (CIE), generated results for proposed regulations (equivalent to a move to 6-Star energy efficiency requirements for private residential and the implementation of Section J requirements for other construction types). The published summary outcomes are reproduced in Table 7.1 (for private dwellings) and Table 7.2 (for other construction classes). They reflect the value of net benefits from the regulations for key locations (reflecting differences in costs and climate) and the calculation of benefit-cost ratios using an estimation period spanning 2010 to 2050, and a real discount rate of 7% per annum.

Based on these parameters, the 2009 RIS pointed to an overall net cost to the economy (in NPV terms) of around $259 million for the proposed 6 star efficiency standard, and a net benefit of around $1,138 million from the introduction of Section J requirements for other building classes. These estimates were underpinned by benefit-cost ratios of 0.88 and 1.61 respectively. Greenhouse gas savings of around 470,000 tonnes per year (CO2e) and 1.2 million tonnes per year were predicted to be achieved by these measures by 2020. Indeed, the modelling for both assumes carbon price impacts on energy costs consistent with the CPRS-5 scenario published by the Commonwealth Treasury. And if more ambitious greenhouse targets were assumed, supported by broad based pricing measures, greater greenhouse savings and benefit cost outcomes were predicted.

Importantly, as demonstrated in Tables 4.1 and 4.2, pay-offs varied substantially between locations. Factors such as building cost estimates (which for dwellings were argued to involve increases up to four times those assumed in the modelling) and projected energy prices were also controversial.

It is now historical record that the Council of Australian Governments decided to move ahead with the proposed changes to the energy efficiency requirements of the National Construction Code. Nearly four years on, analysis in this report has highlighted the mixed ambition and progress of various jurisdictions in translating these standards into their own legislation, and in ensuring that they are actually reflected in building practices and outcomes.

Table 4.1 Benefit-cost analysis for Class 1,2,4 & 10 energy efficiency construction standards *(low resolution original)*

1 **Present value of net impact of thermal and lighting provisions on dwellings**

	Darwin	Brisbane	Longreach	Mildura	Adelaide	Perth	Sydney	Melbourne	Canberra	Hobart	Cabramurra
Elemental											
House	1461	-2423	-450	65	62	-558	-1015	4	-1110	-1444	6294
Townhouse	871	-1095	-25	183	115	-320	-634	73	-690	-654	2933
Simulation											
House	1623	-750	-1327	-1683	-1269	-785	-1058	-109	512	-689	5437
Townhouse	128	-510	-1938	-1412	-910	-219	-771	-806	-814	-495	1460
Flat	4391	-454	1301	1323	-2047	-2355	-2192	-1364	-1024	-1254	-1488
Elemental-simulation average											
House	1576	-1235	-1073	-1176	-883	-719	-1045	-77	42	-908	5686
Townhouse	343	-680	-1384	-949	-612	-248	-731	-551	-779	-541	1887
Flat	4391	-454	1301	1323	-2047	-2355	-2192	-1364	-1024	-1254	-1488

Note: The elemental-simulation average is a weighted average of the impacts based on the expected market adoption of simulation (71 per cent) and elemental (29 per cent) compliance and a 7 per cent discount rate.
Source: CIE estimates based on data provided by ABCB (refer appendices).

2 **Benefit cost ratio for thermal and lighting provisions — dwellings**

	Darwin	Brisbane	Longreach	Mildura	Adelaide	Perth	Sydney	Melbourne	Canberra	Hobart	Cabramurra
Elemental											
House	1.84	0.27	0.83	1.03	1.04	0.65	0.45	1.00	0.61	0.53	5.72
Townhouse	2.22	0.32	0.98	1.22	1.14	0.65	0.42	1.10	0.54	0.58	6.47
Simulation											
House	2.04	0.54	0.63	0.54	0.54	0.57	0.44	0.94	1.42	0.71	3.48
Townhouse	1.09	0.50	0.38	0.42	0.50	0.73	0.38	0.50	0.50	0.64	1.73
Flat	3.31	0.62	1.81	1.78	0.50	0.43	0.47	0.51	0.59	0.50	0.52
Elemental-simulation average											
House	1.98	0.42	0.68	0.63	0.63	0.59	0.44	0.96	1.02	0.64	3.93
Townhouse	1.28	0.43	0.46	0.52	0.60	0.70	0.39	0.60	0.51	0.62	2.19
Flat	3.31	0.62	1.81	1.78	0.50	0.43	0.47	0.51	0.59	0.50	0.52

Note: The elemental-simulation average is a weighted average of the impacts based on the expected market adoption of simulation (71 per cent) and elemental (29 per cent) compliance and a 7 per cent discount rate.
Source: CIE estimates based on data provided by ABCB (refer appendices).

It would be a large and complex exercise to review the current standards in the context of likely costs and pay-offs for buildings and occupants across all jurisdictions and key locations and climate zones. This would be a valuable exercise, but a task well beyond the scope of the current project. However, is possible to look with fresh eyes (and the wisdom of hindsight!) at how costs and benefits have changed since 2010, and are likely to change, as a broad refresh of the original analysis and the balance of costs and benefits envisaged.

How do the costs and benefits envisaged in 2010 (and which, for residential construction in particular, indicated end-user pay-offs to be something of a 'line call') stack up when considered in the light of more recent developments?

Table 4.2 Benefit-cost analysis for Class 3 & 5-9 energy efficiency construction standards

3 Net impact assessment, by region and building type

	Form 1: Office 2000m²	Form 2: Office 198m²	Form 1: Retail 2000m²	Form H: Health 2880m²	Form H: School 2880m²
Present value of net impact (NPV) $ per square metre of gross floor area					
Darwin	67.6	2.1	172.1	259.3	35.8
Brisbane	34.2	-69.6	102.6	180.5	48.3
Mt Isa	-64.7	-109.7	63.5	338.7	-17.9
Kalgoorlie	-39.7	-104.1	28.4	76.0	6.0

	Form 1: Office 2000m²	Form 2: Office 198m²	Form 1: Retail 2000m²	Form H: Health 2880m²	Form H: School 2880m²
Sydney	33.0	-50.9	97.1	156.5	-23.8
Adelaide	48.7	9.9	118.4	225.8	-14.0
Perth	33.0	-50.9	97.1	156.5	-23.8
Melbourne	4.1	-34.7	53.1	23.7	7.8
Hobart	-46.0	-89.0	27.3	-47.7	-36.6
Canberra	-19.0	-73.1	82.3	-11.3	-9.6
Thredbo	ns	-247.7	ns	-40.2	-36.0
Benefit–cost ratio					
Darwin	1.71	1.02	2.81	2.96	1.24
Brisbane	1.28	0.70	1.87	2.28	1.44
Mt Isa	0.63	0.54	1.40	2.99	0.89
Kalgoorlie	0.70	0.46	1.23	1.49	1.05
Sydney	1.38	0.62	2.34	3.11	0.77
Adelaide	1.98	1.12	2.71	3.42	0.87
Perth	1.4	0.6	2.3	3.1	0.8
Melbourne	1.05	0.68	1.73	1.20	1.11
Hobart	0.95	0.28	1.30	0.62	0.62
Canberra	0.82	0.41	1.91	0.91	0.90
Thredbo	ns	0.11	ns	0.75	0.74

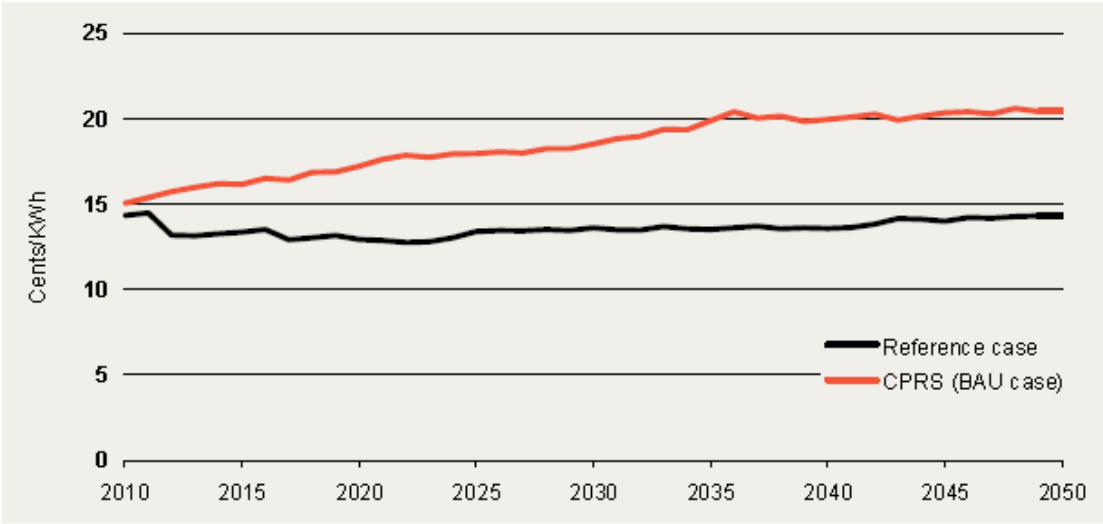
Note: Estimates are presented in 2009 dollars with a 7 per cent real discount rate.
Source: CIE estimates based on data provided by the ABCB and BMT & ASSOC.

4.1 Energy prices: predicted versus observed

Energy cost savings are the major (but by no means only) source of quantified end-user benefits from enhanced building energy standards. Higher energy prices imply a greater pay-off from building improvements that allow occupants to achieve and maintain preferred comfort levels while using less energy.

In the 2009 RIS (which informed the 2010 COAG decision), future energy price forecasts were taken from Treasury analysis of proposed national greenhouse gas emission targets underpinned by a broad based carbon pricing regime. The greenhouse policy setting used to inform the RIS analysis was CPRS-5. This involved the least ambitious domestic target being seriously considered at the time, and had the joint support of government of the day and the (then) federal opposition.

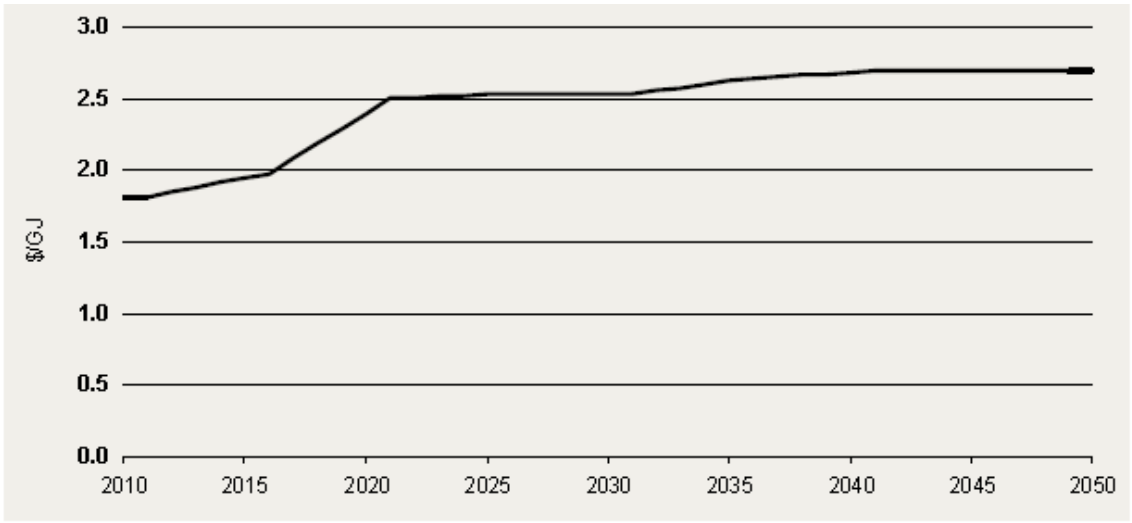
Depictions of the carbon and energy price trajectory implied by CPRS-5 are shown in Figures 4.1 and 4.2 below. These are sourced from the CIE RIS analysis for residential users.



Note: CPRS case relates to the CPRS-5 scenario as modelled by the Treasury in Australian Government (2008).

Source: CIE (2009)Final Regulation Impact Statement for Decision: Proposal to Revise the Energy Efficiency Requirements of the Building Code of Australia for Residential Buildings – Classes 1,2,4 and 10, December 2009, p.217

Figure 4.1 **Retail electricity price projections applied in the 2009 RIS analysis**



Data source: CIE estimates based on MMA (2008b), ABS (2006) and ABARE (2008).

Source: CIE (2009)Final Regulation Impact Statement for Decision: Proposal to Revise the Energy Efficiency Requirements of the Building Code of Australia for Residential Buildings – Classes 1,2,4 and 10, December 2009, p.219

Figure 4.2 **Retail gas price projections applied in the 2009 RIS analysis**

These estimates bear comparison with actual electricity price movements observed in major population centres since 2010. This analysis is provided in Table 4.3. Prices represent real values (in 2009 dollars – consistent with the RIS analysis) and observations are drawn from published AEMC financial year outcomes.

Table 4.3 Comparison of retail electricity prices projected in 2009 with observed outcomes

	2010	2011	2012	2013	2030
	Real 2009 retail electricity prices (cents per kWh)				
Est. RIS prices (Aust average)	15.0	15.5	16.0	16.5	18.0
Observed Aust avg price **(2030 assumes pre-C-price levels)**	19.4	22.4	25.9	27.1	**22.4**
Observed in NSW	18.6		25.4	27.8	
Observed in Vic	19.2		25.7	27.6	
Observed in WA	21.0		26.2	25.0	

Source: CIE RIS estimates and AEMC data

Similarly, recent analysis of the gas market commissioned by the Australian Industry Group suggests that gas prices will far outstrip those projected by CIE in 2009. Further, buoyant demand conditions linked to enhanced east coast export capability (called the 'gas crunch' by AIG) will far outweigh any dampening effect offered by the abolition of an explicit carbon price in Australia. The AIG analysis is reproduced in Figure 4.4 below.

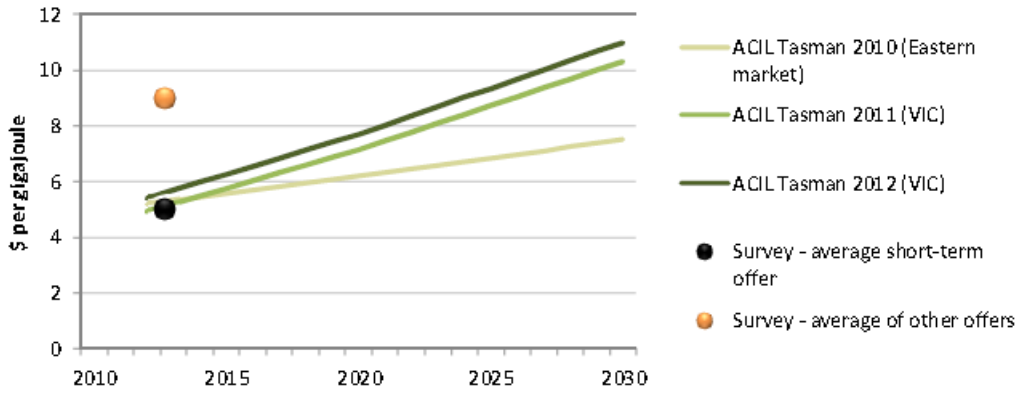
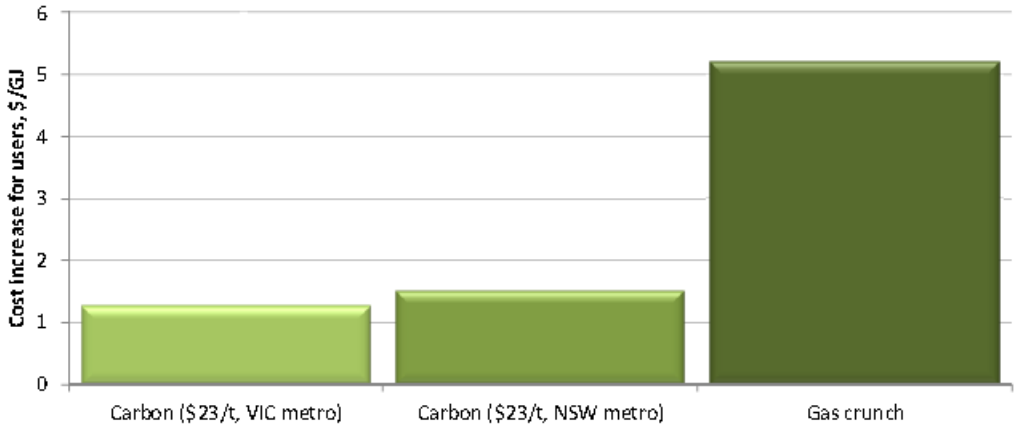


Figure 4.4 Revised gas price projections, and carbon price impact. AIG model and survey analysis of gas prices



Source: Australian Energy Group (2013), Energy Shock: the gas crunch is here, July, Canberra, p.13.

Figure 4.5 AIG analysis of gas price drivers in the Eastern states

The upshot of these observations is that retail price movements for electricity and gas observed in Australia since the RIS was completed appear to have significantly exceeded predictions made at the time. This implies that near term benefits from building energy efficiency improvements have been under-estimated.

What's more, the observed price increases have been so large that removal of the explicit carbon price would do little to diminish the underlying pay-offs to occupants over the medium to long term. The value of energy savings flowing from the 6 star residential and Section J commercial energy efficiency standards has proven to be much stronger than envisaged in the original RIS, and is likely to remain so for many years to come.

A simple net present value (NPV) calculation, based on projected and observed electricity prices, puts this into perspective. If the 2009 RIS electricity price projections are adjusted to reflect actual prices for the 2010 to 2013 period, and the retail electricity price prior to the 2012 introduction of carbon pricing is simply projected forward from 2014 onward (ie. an assumed price fall of around 3.5 cents per kWh from current levels), the value of household electricity savings from moving to the 6 –star standard is still about 28% higher than the RIS estimate. Updates to the retail gas price and allowance for any further escalation in the price of electricity due to network cost pressures would amplify this result. A rough calculation puts the additional savings from adoption of 6-star at about $150 million per year, and supporting a clearly positive result in an updated benefit-cost calculation.

4.2 Building Costs – the other side of the ledger

The costs of energy efficiency improvements in construction have also been controversial. Housing affordability is a 'hot button' issue in all jurisdictions, and consumers and governments alike are sensitive to the cost of acquiring a new home. While it is apparent that preferencing a slate benchtop over better sealing or wall insulation can prove to be a false economy in many cases (because a kitchen can be easily upgraded while wall insulation cannot), there is growing evidence that a home designed for efficiency will not only be cheaper to run but can also be cheaper to build. Construction costs can vary significantly between buildings that utilize the Deemed to Satisfy (DTS) compliance pathway and modelled design solutions.

The 2009 RIS assumed an average increase in building costs for dwellings of 1.25% associated with the proposed move from 5 to 6 star efficiency levels (i.e. $2,500 on a $200,000 house). Many industry stakeholders at the time suggested that cost increases would be more in the order of 3 to 6 per cent, while others pointed to the prospect of lower construction costs eventuating.[8]

This remains a contested area, although there are numerous examples of well designed and highly efficient homes with construction costs that are on par with similarly sized new dwellings. 'Smarter' and' well built' does not need to equate to more expensive.

Recent work by CSIRO (commissioned by the Commonwealth Department of Industry) suggests that higher star rated houses should, in fact, be cheaper to construct than a lower rated house. Based on AccuRate modelling for Brisbane, Adelaide and Melbourne – at least $5,000 cheaper. These results are reproduced in Table 4.4.

[8] CIE (2009), Final Regulation Impact Statement for Decision: Proposal to Revise the Energy Efficiency Requirements of the Building Code of Australia for Residential Buildings – Classes 1,2,4 and 10, December 2009, p.24

Table 4.4 Preliminary estimates of increments costs associated with building energy efficiency standards

	Less than 5 Stars			5 Stars or more		
City	Brisbane	Adelaide	Melbourne	Brisbane	Adelaide	Melbourne
External Wall insulation	$249.40	$905.49	$924.87	$245.48	$993.44	$1,119.57
Internal Wall Insulation	$39.56	$244.40	$140.98	$54.78	$350.05	$137.71
Ceiling/Roof Insulation	$1,718.41	$1,727.35	$1,717.73	$1,669.38	$1,747.74	$1,941.58
Single Glazed Windows	$14,245.27	$12,897.33	$13,784.03	$11,735.70	$10,233.07	$10,324.50
Double Glazed Windows	$349.72	$121.31	$400.15	$0.00	$774.28	$2,241.68
External Walls	$27,510.48	$30,679.32	$30,249.51	$22,932.88	$26,765.32	$26,407.48
Total Cost	$44,112.85	$46,575.20	$47,217.27	$36,638.22	$40,863.91	$42,172.52
Difference				-$7,474.63	-$5,711.29	-$5,044.75

Source: Ambrose M. et al (2013), *The Evaluation of the 5-Star Energy Efficiency Standard for Residential Buildings, Report to the Department of Industry*, (December) Canberra, p.69.

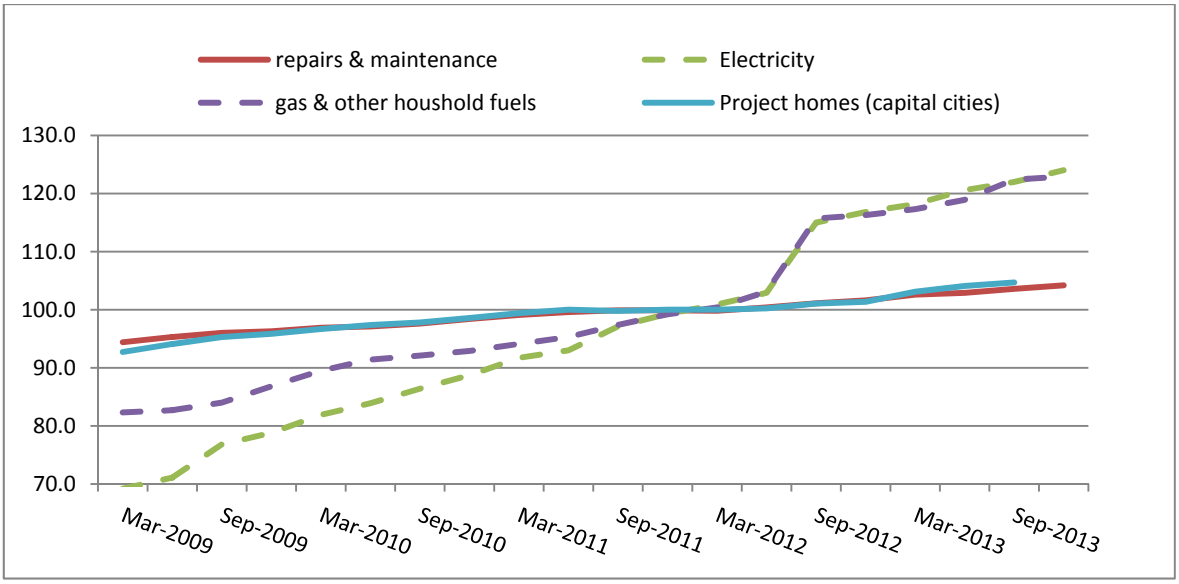
CSIRO notes …

The apparent simplification of design layout has led to the observed reduction in external wall area which is the main reason for the cost savings. Indeed as was discussed earlier, even after correcting for floor area, external wall area has decreased by around 10%. This translates to a cost savings of around 15% for the external walls. Other factors have also contributed including the reduction in glazing area. The cost savings more than compensate for the increased cost of improved insulation. In most cases, the incremental cost of increasing insulation performance is small. For example, the cost difference between R2.5 and R4.0 ceiling insulation is only $3.40/m2.

Ambrose M. et al (2013), *The Evaluation of the 5-Star Energy Efficiency Standard for Residential Buildings*, p.69

Further, ABS data on the cost of newly built homes (ie. 'project homes' net of land costs) in Australian capital cities suggests little change in longer term construction cost trends. This observation also appears to hold for the cost of 'repairs & maintenance' which would be expected to provide an additional window on labour and material costs in the construction sector. Certainly, as demonstrated in Figure 4.5, the prices for electricity and other fuels used by households have risen much faster than the price of new homes and repairs in recent years. Based on ABS price indices (2011-12 = 100.0), the cost of house construction appears to have moderated over the period spanning March quarter 2011 to June quarter 2012, and exhibited growth in line with trend in the prior period.

Moreover, energy prices have exhibited much stronger growth throughout. This suggests the growing case for energy efficiency improvement, given that the price of energy is growing much more rapidly than the price of construction. Numerous studies undertaken since the 2009 RIS have highlighted the major savings available to consumers from smart energy efficiency investment, based on prevailing prices and reasonable expectations of where future prices might head.



Source: ABS Consumer Price Index (Cat. 6401.0)

Figure 4.6 Price indices for newly built homes and energy in Australia (2011-12 = 100.0)

4.3 Broader Implications

pitt&sherry has produced several studies which update analysis of the economics of energy efficiency in the Australian built environment (and in the industry and transport sectors).

pitt&sherry (2012) *Increased Housing Energy Efficiency Standards in WA: Benefit Cost Analysis,* Report for WA Public Utilities Office & WA Building Commission

This study examined the cost effectiveness of moving from the regulatory requirements of 5-Star to 6-star for five typical house designs in six southern WA climate zones, taking into low cost and zero cost design changes. The study also worked out what is the highest star rating that can be cost-effectively achieved for these same houses and climate zones, again focusing on low cost and zero cost design changes (e.g changing orientation, mirroring floor plan, reducing glazing area).

Table 4.5 below shows that, with very limited exceptions, 6-star housing is cost effective in WA for the houses and climate zones studied. Indeed, most houses in most climate zones are highly cost effective at a 6-star performance level, with an average benefit cost ratio (BCR) of 3.6. This means that the financial value of the energy savings from the 6 star houses were, on average, 3.6 times greater than the additional costs of those houses, when both benefits and costs are discounted at 7% over the life of the house. Even if the two highest values in Table 4.5 are ignored as anomalies, the average result is still highly cost effective, at a BCR of 2.4.

Table 4.5: BCR for Improvements to 6-Star for Individual Houses by Climate Zone

HOUSE	Perth	Swanbourne	Mandurah	Bickley	Albany	Kalgoorlie
A	1.8	2.5	2.3	6.1	0.9	3.5
B	1.5	0.8	1.2	2.1	1.8	1.0
C	1.0	0.7	2.2	2.6	23.6	-*
D	4.7	2.8	3.9	5.5	4.0	17.1**
E	2.0	0.9	1.9	2.4	2.1	1.2

(*Small energy saving at small negative cost, **Zero cost mirror imaging design significantly improves BCR)

Table 4.6 below shows that the optimal or break even performance level, for these houses and climate zones, ranged between 5.8 and 7.6 star, with an average result of 6.7 star. Note that no 'learning rate' has been assumed with respect to costs, which means that the BCR results should be considered conservative.[9] Also, electricity and gas prices used in the analysis were medium price (conservative) projections. Higher prices would lead to higher BCRs.

Table 4.6: Star rating at break-even for individual houses by climate zone

HOUSE	Perth	Swanbourne	Mandurah	Bickley	Albany	Kalgoorlie
A	7.3	6.4	6.4	6.6	5.8	7.1
B	6.3	6.2	5.8	6.5	6.6	6.4
C	6.8	6.8	6.9	6.5	6.5	7.3
D	6.9	6.9	7.1	6.9	6.6	7.6
E	6.8	6.7	6.8	6.4	6.4	6.4

pitt&sherry (2012) Pathway to 2020 for Increased Stringency in New Building Energy Efficiency Standards: Benefit Cost Analysis. Report for Department of Climate Change and Energy Efficiency

This study analysed the range of cost-effective savings in the energy consumption of new buildings that could be achieved in Australia by 2015 and 2020, relative to buildings compliant with the current, 2010 version of the Building Code of Australia (BCA2010), based on a number of defined scenarios. A discount rate of 7% was used. The Base Case included a carbon price of $23/t in 2012 rising at 2.5% (in real terms) per year for two years and then assumed to increase at 4% per year. The Base Case also assumed a rate of industry learning of 30% over 10 years. While the carbon price has been scrapped, energy prices (without a carbon price) have turned out to be higher than the forecasts used for this study, so the results presented below would be remain fairly accurate.

Commercial Buildings

The study found that there are very significant cost effective opportunities for energy savings in new commercial buildings in 2015 and 2020 relative to BCA2010. For the Base Case, energy savings of between 54% and 80% were shown to be cost effective for commercial buildings on current policy settings with an average value of 68% by 2020. This high level of cost effective savings is attributed primarily to the relatively low stringency for commercial buildings in BCA2010. With rising energy prices through time (even without a carbon tax), and the cost of savings measures falling, more such opportunities also become cost effective by 2020.

Table 6.6: Base Case-Break even energy savings relative to BCA2010, all commercial buildings

	2015	2020
Western Sydney (CZ6)	58%	68%
Darwin (CZ1)	74%	80%
Brisbane (CZ2)	70%	77%
Adelaide (CZ5)	67%	76%

[9] 'Learning rates' refer to the observation that compliance costs tend to reduce – sometimes quite rapidly – through time, as practices, designs and technologies change, leading to lower or even zero incremental costs after a period of time.

	2015	2020
Hobart (CZ7)	49%	61%
Melbourne (CZ6)	52%	63%
Perth (CZ5)	66%	75%
Canberra (CZ7)	41%	54%
Weighted Average:	**58%**	**68%**

Residential Buildings

Compared to commercial buildings modest but still worthwhile savings, averaging 12% in the Base Case, are cost effective by 2020, with significant variation by climate zone (up to 32% in Perth). The average savings could increase to 16% if largely cost-free passive solar design changes are made to residential buildings before other measures. With PV in the mix, however, zero net energy for new residential buildings were shown to be cost effective by 2020 in all climate zones studied, and even by 2015 in most climate zones.

This particular result follows from the fact that residential PV systems are modelled as cost effective in their own right in most climate zones by 2015, and in all climate zones by 2020. (Note the study assumed a 1:1 feed in tariff but no subsidies. While the feed tariff is now not as generous in most jurisdictions, the cost of PV has come down to the extent that PV remains cost effective).

Table 4.7: Base-Case: Break even energy savings relative to BCA2010, all residential buildings

	2015	2020
Sydney West (CZ6)	9%	14%
Darwin (CZ1)	3%	3%
Brisbane (CZ2)	7%	7%
Adelaide (CZ5)	11%	11%
Hobart (CZ7)	14%	17%
Melbourne (CZ6)	3%	7%
Perth (CZ5)	18%	32%
Canberra (CZ7)	4%	7%
Weighted Average:	**8%**	**12%**

Table 4.8: Base Case: Break Even Energy Savings Relative to BCA2010, All Residential Buildings with PV

	2015	2020
Sydney West (CZ6)	100%	100%
Darwin (CZ1)	100%	100%
Brisbane (CZ2)	100%	100%
Adelaide (CZ5)	100%	100%
Hobart (CZ7)	100%	100%

	2015	2020
Melbourne (CZ6)	3%	100%
Perth (CZ5)	100%	100%
Canberra (CZ7)	4%	100%
Weighted Average:	**79%**	**100%**

4.4 Indicative Costs of Non-compliance with NCC standards

Re-calibration of the 2009 RIS analysis suggests that, even based on conservative revisions to energy price forecasts, failure to achieve a 6 star energy efficiency outcome for new homes built in Australia would add around $150 million per year to the total household energy bill. Failure to adopt the upgrade requirements targeted in commercial buildings by Section J of the NCC would add almost double to this amount.

Unfortunately, the scope and timeframe of this project allowed only a brief – and largely anecdotally based – investigation of the current state of energy efficiency outcomes being achieved under current approaches to Building Code requirements. The dearth of hard data on outcomes should be addressed with targeted audits and research. However, many stakeholders report major concerns with the planning and execution of building energy efficiency across Australia, and the scope for outcomes far below the 6 star level for housing, for example. It appears reasonable to assume that the move to 6 star has not been fully and consistently achieved as a minimum standard for new Australian homes, even in those jurisdictions that support 6 star and Section J, and that even greater costs are being incurred in jurisdictions that have been reticent to adopt the new higher building standard.

Part A: Systemic Issues with the Energy Performance Requirements in the National Construction Code

As noted in Chapter 1, Part A of the review focuses on systemic and process issues associated with the energy performance requirements in the National Construction Code.

5. Systemic and Process Issues

This Chapter presents the key systemic and process issues identified in this review. The analysis represents the views of the review team and should not be taken to reflect the views of any particular stakeholder or stakeholder group consulted during the review. Necessarily, however, we draw on examples and views expressed during consultations, as well as the survey results set out in Appendix E.

We group the issues into four strategies or themes which we believe encompass the key strategic directions that emerge from this review:

- *Being clear about what's at stake* – documenting and communicating persuasively the multiple benefits associated with effective building energy performance regulation;
- *Getting the incentives right* – ensuring that the Code, regulations and supporting policies are driving each element of the construction cycle to deliver energy efficient buildings;
- *Delivering quality outcomes* – ensuring that all those involved in the construction cycle have access to the right knowledge, training, tools and products; and that these ingredients are being used to deliver energy efficient buildings; and
- *Empowering the community* – ensuring that building owners and users understand the value of energy efficiency (and why it is worth investing in); what they should expect from buildings and the building industry; and their role in achieving those expectations.

Within each theme, we structure the key issues into logical groups – generally involving a definable sub-set of interested stakeholders. Each group of issues leads to overall conclusions and a set of recommendations. That said, we accept that many issues and recommendations could equally fall under any one or several of the above themes, and therefore we encourage each recommendation to be treated on its merits and not only on its perceived fit with the nominated theme.

As requested, we provide an indicative timeline or work program for each set of recommendations, starting from financial year 2015 (FY2015) and then extending into the period to 2020. Those projects that are suitable for completion in the short term we refer to as 'short term opportunities'.

We note that the exact timing and implementation path for each recommendation will depend on many factors that are difficult to anticipate including budgets, policy decisions and stakeholder preferences. For example, an initial 'proof of concept' analysis in 2015 regarding a recommended Code change could influence whether there is a need (and an appetite) for a full regulatory impact assessment and/or benefit cost analysis, and ultimately whether the Code change is in fact implemented thereafter. Therefore the overall timeline must be regarded as indicative, and a 'plan, act and review' approach is suggested to ensure that the program remains relevant through time.

5.1 Being Clear About What's At Stake

5.1.1 Re-establishing the Case for Building Energy Performance Standards

As noted in Chapter 2 and Appendix C, during this review we encountered a strong and widespread view that current energy performance requirements for buildings are not well justified in quantitative terms. We found this view surprising because the current requirements are based on published benefit cost analyses and regulation impact assessments. Further, there have been studies published that show that it would be cost effective to lift standards, and by a large margin for some building types. However, it appears that there is both scepticism as to the validity of these studies and also a lack of retrospective analysis to confirm their prospective analyses.

While a detailed analysis of the substance of this issue is beyond the scope of this study, we do briefly review some relevant literature in Chapter 3. However, what is clearly relevant to this study is the lack of stakeholder confidence in the justification for current performance requirements. Since as noted earlier, there is evidence to show that Australian building efficiency standards are already low by international standards, the existence of a view that they are unreasonably high should be a matter of some concern. Such a view is likely to feed into representation by industry lobby groups against raising efficiency standards. However, higher standards that are cost effective unequivocally improve welfare and business competitiveness, including by reducing the lifetime operating costs of buildings.

In our view, it is important that governments tackle this issue head-on. The effectiveness and cost-effectiveness of any policy or regulation is not something that should be speculated about: it should be subjected to rigorous and quantitative analysis. Such a study would draw together all of the currently separate pieces of the puzzle, updating the quantitative analysis where needed, and addressing common myths about energy efficiency. It would cover the benefits and costs associated with compliance with current Code settings, the case for moving beyond the current minimums and describe how different pieces of the policy framework are intended to fit together to deliver social, economic and environmental benefits. It would generate a concise, comprehensive and quantitative evidence base with which to engage with stakeholders.

Therefore we recommend:

No.	Recommendation	Theme	Pathway	Timeline
2	*That governments commission quantitative research – building on and updating where necessary existing research – to examine the effectiveness and cost-effectiveness of current energy performance requirements, as well as the extent to which those requirements could be tightened cost effectively. The study would also address suggested linkages between energy performance requirements and issues such as condensation and 'hot box' syndrome.*	Being clear what's at stake	BIC to commission this research, which should include further engagement with stakeholders	FY2015

5.1.2 Existing Buildings

It was noted above that, generally but not exclusively, Australia's building code focuses on new buildings (and new work in existing buildings). Many stakeholders pointed out that, particularly from an energy efficiency perspective, this misses the vast bulk of all building area in Australia. It is often assumed that around 1% of the building floor area turns over every year. Depending upon the rate of new building work, it could be many decades before a given Code change works its way through the entire building stock. With buildings representing at least 23% of Australia's greenhouse gas emissions[10], and an objective of the Code being to reduce those emissions, it is questionable whether this is an acceptable outcome. It is the case, however, that mandatory disclosure (office buildings/areas greater than 2000 sqm only) and other policies and programs focus on the existing building market.

While we note that it may be unreasonable or excessively expensive to renovate older buildings to the point where their energy performance is equivalent to that of newer ones, this is a question of fact and degree, not principle. Benefit cost analysis can and, we argue, should be used to determine what if any performance requirements should be placed in existing buildings. This applies particularly if it is accepted that the current practice of setting new efficiency standards based on benefit cost analysis should be 'formalised' in the wording of Functional Statements in the Code.

Put another way, the aim 'to reduce the public and private costs of energy use to the extent cost effective' does not in principle discriminate between new and existing buildings – or even embodied energy/emissions by extension – and the same approach (of benefit cost analysis and regulatory impact assessment) may be used to determine the scope to develop and apply energy performance requirements for existing buildings. We note in passing that at least the State of Victoria has expressed policy ambitions in this area. We recommend:

No.	Recommendation	Theme	Pathway	Timeline
3	*That a specific study be commissioned to examine the scope for cost-effective energy performance requirements to be placed on existing buildings, including an examination of available strategies and technologies, costs, benefits and potential implementation strategies.*	Being clear what's at stake	BIC to commission, to be conducted in close consultation with the ABCB and a broad group of stakeholders	FY2015

5.1.3 Commissioning and Maintenance

Stakeholders noted many gaps in the current coverage of the Code that are likely to be contributing to poor energy efficiency outcomes. For commercial buildings (at least any building with centralised HVAC), the absence of a requirement to ensure that a new or renovated building is properly commissioned (and able to be maintained) was raised numerous times. It was noted that as buildings aim for higher energy efficiency – perhaps making use of economy cycles on chillers, passive and hybrid ventilation strategies, conscious use of exposed thermal mass, direct/radiant heating and cooling systems, heat recovery, heat/coolth storage, natural lighting, more sophisticated sensors and controls, etc – the challenge of integrating all of these systems and ensuring that they deliver intended outcomes, through all seasons and weather conditions, grows. Ironically, there is often greater scope for high performance buildings to deviate from design energy consumption than simpler, 'refrigerated boxes', particularly while industry familiarity with some of these strategies and technologies is developing.

[10] pitt&sherry (2010)

Two stories were told over and over again with respect to commercial buildings. The first was about progressive elimination of energy efficiency features and technologies during the design and construction process, as budget considerations come to the fore forcing the building developer (not necessarily the ultimate owner) to make choices. Elements that are highly valued are retained and elements that are not highly valued by the person making that decision – which often includes efficiency and sustainability performance – tend to be eliminated.

The second story was the routine absence of adequate commissioning of buildings and building systems. Commissioning takes considerable time and very considerable know-how, as buildings must be 'put through their paces' – all operating modes and combinations of climate conditions – in a similar manner to how new vessels or aircraft are thoroughly tested before turning them over to their owners. Therefore there is a cost associated with commissioning. Since the beneficiary of this activity is the ultimate occupant, it is in their interests to ensure proper commissioning. However the ultimate occupant may not even be known at the time the building is being commissioned. The building owner may not be aware of the risks and opportunities associated with commissioning, and may not perceive a direct financial interest. They may also lack the detailed knowledge of building systems and their intended operating modes, particularly as these are often inadequately documented (see *Building Documentation* below), and particularly again where older buildings are renovated, potentially resulting in hybrid new/old systems and control strategies.

When done well, commissioning occurs as a collaborative activity between the building designer, builder, systems installers, building owners/manager and potentially an independent commissioning agent (often a specialised building services engineer). While there are few studies that document this, we have been told that the difference between good commissioning and poor or no commissioning can mean double the annual energy consumption. Adequate commissioning is also important to ensure year-round comfort for building occupants.

Of course, building systems require maintenance, tuning and even recommissioning over time if they are to remain in an energy efficient operating condition. While the NCC generally focuses on new building work, exceptions are made for example in the area of fire protection. Building stakeholders (that is, all of us) accept that buildings should remain 'fire-safe' throughout their lifetimes, and not merely when they are new. However, the same realisation does not apply to energy efficiency, or to the Code objective of reducing greenhouse gas emissions, although these interests also persist (and indeed are likely be aggravated) through time.

The HVAC High Efficiency Systems Strategy (HESS) is a national government program that has focused in this area over many years, producing numerous and valuable advisory materials. There is not a shortage of theoretical knowledge in this area. However, perhaps due to the 'landlord/tenant' (or more strictly, principal/agent) and information market failures described above, the incentives to act in this area appear to be weak. Given this scale of impact, and the fact that commercial buildings are complex and long-lived systems, the case for including ongoing maintenance, as well as initial commissioning requirements, within the Code would appear to be strong. We note that, as with any Code changes, a regulation impact statement will be required to confirm this, while an initial investigation or scoping study could commence the investigation. We therefore recommend:

No.	Recommendation	Theme	Pathway	Timeline
4	*That the economic case for including building commissioning and ongoing maintenance requirements (for Class 2 – 9 buildings) be evaluated via an initial scoping study and then regulation impact assessment.*	Being clear what's at stake	Governments via BIC, or ABCB, commission this research and consult stakeholders, followed by RIS.	FY2015 – FY2016

5.2 Getting the Incentives Right

5.2.1 Code Issues

While the majority of stakeholders consulted focused on issues relating to the interpretation and implementation of existing Code provisions, the review has also identified a range of underlying, systemic issues which we believe are key drivers of the poor efficiency attitudes and outcomes reported earlier. Some of these issues may contribute to compliance concerns, and others represent barriers to achieving best practices. Addressing these issues may in some cases require considerable time and effort as well as additional stakeholder consultation. However reforms in these areas may hold the key to 'getting the incentives right' and keeping them right through time.

5.2.2 Objectives and Functional Statement

The Code's current objective relating to energy performance – which is 'to reduce greenhouse gas emissions' – was agreed by the Council of Australian Governments in 2009 and informs versions of the Code from 2010 onwards. It was changed to reflect the primacy of avoiding dangerous anthropogenic climate change as the key objective for energy policy more generally, and energy efficiency policy in particular. It was also facilitated the introduction of greenhouse-intensity (rather than energy efficiency) requirements for certain building services such as domestic hot water. Finally, it recognized that energy efficiency is not an objective in its own right: rather, energy efficiency is an enabler of lower energy costs, greater affordability of energy services and/or reduced environmental (including greenhouse) impact associated with energy use.

The change in objective was controversial, not least because the states and territories differ widely in the greenhouse intensity of their electricity supply, reflecting underlying differences in fuel availability and cost. Therefore a single performance measure expressed in greenhouse terms may present varying degrees of effective stringency (degrees of difficulty) into the Code. However, the key energy performance requirements in the Code remain just that: *energy* rather than greenhouse performance requirements. Thus a 6 star performance requirement for houses does not vary (within a climate zone) when expressed in energy units (such as $MJ/m^2.a$). However, the performance level will be very different in different states and territories when expressed in greenhouse units (such as g CO_2-e/MJ), not due to anything fundamental in the design or construction of the building, but simply because of differences in the greenhouse intensity of the electricity it consumes.

The greenhouse objective is also applied inconsistently in the Code. Building services must obtain their energy *for heating* from a low-greenhouse intensity source (or on-site renewable energy or waste energy), but no similar requirement exists for cooling energy or any other energy end use in the building, let alone for whole buildings. What is special about heating energy, from a greenhouse perspective, is not made clear.

A limitation is placed on the use of renewable energy (for services), and that is that it must be generated on site. This is presumably done on the grounds that it would be too easy for contractual arrangements with off-site sources to be changed over the building's life, thereby undermining the objective of reducing greenhouse gas emissions. However, nothing in the Code requires the on-site renewable energy source to be maintained through time, and use of off-site renewable energy would equally fulfil the Code's stated objective.

A further tension between the objective and functional statement is apparent in the non-treatment of greenhouse gas emissions embodied in building materials. If the objective is to reduce greenhouse gas emissions, and this is a global objective regardless of the location and nature of the emissions source, then it might be expected that the Code would privilege low-carbon materials over high-carbon ones. However, this is not the case.

The functional statement also appears to qualify the objective (of reducing greenhouse gas emissions) by the phrase 'to the degree necessary' – although the supporting Guides to the Code indicate that this phrase is intended to qualify the succeeding text relating to energy efficiency (in which case this modifying clause should be moved to the end of the functional statement; that is, after clause F2.6(b) and equivalent clauses elsewhere in the Code).

The functional statement then reintroduces the idea of energy efficiency, noting that buildings (and services) are to be '*capable of* using energy efficiently'. The Guides to the Code explain that this is intended to recognize, inter alia, that 'there may be levels of energy consumption below which it may be unnecessary or impractical to regulate'[11], and also that the behaviour of building users will affect energy consumption efficiency. However, if the underlying objective is to reduce greenhouse gas emissions, and that can be done by generating renewable energy (whether on-site or off-site), then no such qualification is necessary. That is, emissions could be reduced to zero even when energy consumption is not, and regardless of the behaviour of building users.

However, the phrases 'capable of' and 'to the degree necessary' also appear to signal a low level of ambition with respect to energy efficiency. This issue is considered below, before recommendations are offered with respect to the Code's Objective and Functional Statement.

5.2.3 Low Standards

Many stakeholders offered the opinion that energy performance requirements for Australian buildings are low by international standards. The low level of ambition may be seen as a fundamental contributor to what we describe as a pervasive culture that 'no-one's serious' about improving energy efficiency (or, as one workshop participant put it, 'no-one cares and no-one's looking'). We support this concern, noting that buildings represent long-lived infrastructure. If buildings are unnecessarily energy intensive, then this will penalise economic, social and environmental wellbeing over long periods of time.

Indeed, the Code's functional statements related to energy efficiency (JF1 for Class 2 – 9 buildings and F2.6 for Class 1 – 10 buildings), including 'To reduce greenhouse gas emissions, to the degree necessary' and 'be capable of using energy efficiently', are widely interpreted as signalling an intention to set modest minimum standards. In a recent submission by the ABCB to Planning Panels Victoria, for example, the General Manager of the ABCB, Mr Neil Savery, states: "...the standards set for building construction across Australia are directed at minimum performance levels that have been subjected to rigorous analysis of need, cost and benefit..." and "...the nationally agreed aim of building standards in Australia is to rule out worst practice, not to prescribe best practice".[12]

[11] ABCB, Guide to Volume One, BCA2010, Class 2 – 9 Buildings, p. 547.
[12] ABCB Submission to Planning Panels Victoria, 18/11/2013, relating to Environmentally Efficiency Design Planning Policies.

These statements confirm intent to set minimum standards. This is supported by recent research that shows that current energy performance standards, particularly for Class 2 – 9 buildings, but also for Class 1 buildings when photovoltaic panels (and potentially avoided peak energy infrastructure investment requirements) are taken into account, are indeed low.[13] However, since the objective of the relevant sections of the Code is to reduce greenhouse gas emissions, it may be relevant to note that current per-capita greenhouse gas emissions in Australia are the highest in the OECD. Further, according to the International Energy Agency[14], "We could see six degrees of warming by the end of the Century if current emissions trends continue". In these circumstances, the policy rationale for setting low minimum standards is unclear and not stated in the Code.

In recent practice, energy performance requirements in the Code have been established with reference to economic cost-effectiveness criteria. For example, we have previously noted a target benefit cost ratio (BCR) for energy performance requirements in the Code of 2:1 for commercial buildings, and 1:1 for residential buildings[15]. The rationale for applying different criteria to commercial and to residential buildings is unclear. Nevertheless, this suggests that the practical interpretation of the phrase 'to the degree necessary' in functional statements in the Code is that it refers to a cost effectiveness test. If so, and noting stakeholders comments to the effect that the statements and policy intent are currently unclear, then it would seem logical for the Code to be amended to clarify both the wording and the intent.

For example, if functional statements were expressed as, 'To reduce greenhouse gas emissions, to the extent cost-effective...', then this could be operationalised without ambiguity. It would still be necessary to define 'cost-effective', for example, whether this implies a social benefit cost ratio of 1, or some other number, and at what real discount rate. However, guidance on these matters can be found in general texts, or could be specified in practice notes or even regulations if governments wished to eliminate ambiguity.

The benefit of this approach is that the stringency tests would then be transparent and 'contestable'. Different parties could apply the test independently and form their own view about whether standards are too high or too low. This approach would support the Code's current aim of encouraging the use of low-carbon, renewable or waste energy sources, and would also allow for embodied emissions to be considered if desired. However, we note that this aim is inconsistently applied, in that photovoltaic cells or other distributed renewable energy generation sources are not able to be counted as a part of a building solution (although it is possible that such sources could form part of an 'alternative building solution').

The recommended approach would also provide for greater transparency, consistency and objectivity in setting building performance requirements through time, thus moving Australia in the direction of best energy efficiency practices.

[13] pitt&sherry (2012), *The Pathway to 2020 for Low Energy, Low Carbon Buildings in Australia: Benefit Cost Analysis*, published by the then Department of Climate Change and Energy Efficiency.
[14] Attributed to Maria van der Hoeven, Executive Director of the International Energy Agency, 12 November 2013, as reported in *The Carbon Brief*, accessed on 27/1/2014 from http://www.carbonbrief.org/blog/2013/11/three-graphs-showing-how-the-iea-says-we-can-avoid-six-degrees-warming/
[15] pitt&sherry (2012), *The Pathway to 2020 for Low Energy, Low Carbon Buildings in Australia: Benefit Cost Analysis*, published by the then Department of Climate Change and Energy Efficiency.

Therefore we recommend:

No.	Recommendation	Theme	Pathway	Timeline
5	*That governments agree to change the functional statements for energy performance in the Code to 'To reduce greenhouse gas emissions, to the extent cost-effective'.*	Getting the incentives right	RIS in FY2015	FY2015-FY2016

5.2.4 Code Governance

Many stakeholders noted that building energy performance requirements change only slowly and via what appears to be a cumbersome process, the outcomes of which are non-transparent and difficult to anticipate. As a result, investment and innovation in energy efficiency technologies and know-how is likely to be relatively low, compared to a system in which the level and timing of future stringency settings could be reasonably well anticipated by industry stakeholders. We note that our inclusion of this issue in this Report responds to the elements of our terms of reference that focus on movement towards best practices rather than compliance with existing Code requirements.

Structure

ABCB is overseen by a Building Ministers Forum comprising relevant ministers from each jurisdiction. The Building Ministers Forum is unusual in that it falls outside the Committee structure agreed by the Council of Australian Governments (COAG). This governance arrangement is problematic in that it is unclear what authority the BMF has and, as noted, it has in practice deferred to COAG in the past when it comes to setting energy efficiency performance levels in the Code. This process sets a high hurdle to changing stringency levels through time, regardless of the economic cost effectiveness of doing so. The COAG agenda is often taken up with larger issues, against which building energy regulation issues may struggle for attention.

Further, it has long been unclear which ministers accept accountability for building energy performance. While Building Ministers are generally responsible for the Code, in some jurisdictions this responsibility falls to Planning Ministers. However, energy performance requirements, and energy efficiency matters more generally, are overseen by Energy, Industry or sometimes Environment Ministers. This confusion makes it unclear what processes or should apply to changes in energy performance requirements, who is responsible for funding and undertaking the necessary research and consultation, or where stakeholders should look for leadership (or indeed, to lobby against change). In practice, much of policy leadership and at least half of the funding has come from the Australian Government, despite the fact that it plays no direct role in building regulation.

To address this situation, we recommend:

No.	Recommendation	Theme	Pathway	Timeline
6	*That governments clarify the governance arrangements for the energy performance requirements in the Code, and communicate these arrangements clearly to stakeholders.*	Getting the incentives right	For consideration by governments, via BIC and/or BMF. Governments should consult the ABCB during this process.	FY2015

Funding

Funding for the initial and ongoing development of energy performance requirements has been reported to the review as being 'challenging'. Several state regulators mentioned that the need to find funding for this purpose placed considerable strain on their organisations. We formed the impression that this experience may have created some resentment on the part of building regulators, which may be contributing to the overall negative culture with respect to energy efficiency that we find within the regulatory machinery as well as within industry.

There is a need to ensure that Code maintenance and development – at least with respect to energy performance requirements, which is the focus of this review – is adequately funded, sufficient to ensure that sound professional standards are able to be maintained and that the legitimate concerns of stakeholders are able to be investigated and responded to in a timely manner. As discussed further below, we are aware that there is some pressure to reduce the cost to the building industry of accessing the Code, as an initiative to improve familiarity with its provisions and, hence, to improve compliance, but this too will add to the financial strain associated with Code maintenance and development. This suggests that all governments contributing to the funding of the ABCB need to adopt a 'zero based' approach to establishing a sustainable budget for the ABCB.

With policy and regulatory research relating to building energy performance being funded by policy agencies, rather than the ABCB – at least at present – there is also a need to ensure that adequate funding is available to all related agencies.

Therefore we recommend:

No.	Recommendation	Theme	Pathway	Timeline
7	*That agencies represented on the Building Implementation Committee ensure, through independent, zero-based financial needs assessments, that a) the ABCB has adequate funding for ongoing professional administration of the NCC, including in the context of an initiative to improve access to Code documentation; and that b) there is adequate ongoing funding for policy research required to underpin the development of future energy performance requirements under the Code, and for NatHERS administration.*	Getting the incentives right	BIC and agencies represented on BIC.	For review during FY2015, and additional funding as required from FY2016 onwards.

Regulatory Basis

While not a major issue in the review, a number of stakeholders queried why the Code is given effect by differing legislation at the state/territory level, given that the clear intent of governments, and desire of industry, is for national consistency. The Inter Governmental Agreement that provides for the operation of the ABCB calls, inter alia, for '...the consistent application of the NCC across and within each State and Territory...' and '...encouraging increased harmonisation in the administration of the NCC across Australia.[16] At the same time, it allows for (albeit discourages) variations and additions.

[16] Available from: http://www.abcb.gov.au/en/about-the-australian-building-codes-board/~/media/Files/Download%20Documents/ABCB%20docs/ABCB-2012-IGA.ashx, p. 2.

We note that energy performance standards for appliances and equipment were until 2012 given legislative effect via state and territory Acts (using a 'mirror legislation' that required only one jurisdiction, South Australia, to pass model provisions, while simple Acts in other jurisdictions gave legal effect to the South Australian Act in their territories). However, this machinery was replaced by a single national *Greenhouse and Energy Minimum Standards Act 2012*. As a longer term initiative, state and territory governments may wish to consider a similar 'streamlining' reform for building regulation.

Decision Making (with respect to energy performance requirements)

As noted above, many stakeholders noted that changes in building energy performance requirements appear to occur only infrequently in Australia, and the basis for the underlying decision-making process does not appear to be clearly articulated or generally understood within the industry. We note in this context that an initiative under the 2009 *National Strategy on Energy Efficiency,* to articulate a single and comprehensive *National Building Energy Standard-Setting, Assessment and Rating Framework,* does not appear to have yet led to an agreement between jurisdictions to formally adopt such a framework.

Further we note that there is a history of energy performance requirements for buildings in Australia being controversial with some stakeholders, and it is likely that this has contributed to delays in, and also affected the level of ambition reflected in, past decisions. As was reflected in the above-mentioned *Framework* process, it is important that industry in particular has reasonable certainty about the timing and nature of future Code (energy performance requirement) changes, in order that it can prepare – including adopting innovative new techniques, technologies and work practices – in the security that the associated investment will not be wasted...as may occur when mooted changes to requirements in fact fail to materialise.

Further again, a general characteristic of a good regulatory system is that those with interests in that system have sufficient information as to be able to make reasonable predictions, for their own internal planning purposes, of likely regulatory outcomes. This is often referred to as a 'rules-based' approach to regulation. This is not currently the case for the energy performance regulation of buildings in Australia.

As a result, we recommend that governments should agree to create as much certainty and transparency in the building energy regulatory system as possible, recognising that perfect foresight does not exist, and contingencies may arise, that impact upon 'best laid plans'. That said the risk of contingencies arising should not prevent a good faith attempt on the part of governments to provide regulatory certainty.

In particular, we recommend that the process for setting and re-setting energy performance requirements in the Code be agreed and documented in order to maximise certainty for all parties. We recommend that the agreed intent be to create a rules-based approach for setting performance requirements that is transparent and predictable and removed from politicisation to the greatest extent possible. The appropriate place for such a documented agreement would appear to be the Inter Governmental Agreement referred to above. Therefore we recommend:

No.	Recommendation	Theme	Pathway	Timeline
8	*That, in order to maximise regulatory certainty and transparency for all parties, a rules-based process for setting and resetting energy performance requirements in the National Construction Code be agreed and documented in the Inter Governmental Agreement relating to the existence and operation of the Australian Building Codes Board.*	Getting the incentives right	BIC to develop provisions for agreement by BMF.	FY2015

We note that the past practice of governments has been to rely on benefit cost analysis, and then regulatory impact assessment, as the key processes associated with recommending future building energy performance requirements. This approach would be even more appropriate if Rec. #1 (changed Functional Statement) is adopted, but remains appropriate in any case. However we could also observe that no consistent approach has been brought to bear on such benefit cost analysis, particularly including the required 'hurdle rate' or benefit cost ratio.

In terms of the character of the process to be documented in the IGA, we recommend that this includes at least the following elements:

- That reviews of (and potential changes to) energy performance requirements must occur every three years[17];
- That the primary basis for setting performance requirements is a social benefit cost analysis of the expected cost effectiveness of those requirements over the succeeding 3-year period, noting that the benefit cost analysis should be nested within a wider regulation impact statement which includes analysis of the potential market based/non-regulatory solutions;
- That key parameters for the benefit cost analysis be agreed and defined in the IGA, including the use of an agreed real discount rate, the treatment of 'industry/technology learning' rates on the incremental costs of compliance, the basis of energy price assumptions, the time period over which benefits and costs are measured, and other parameters agreed to be material to the analysis process;
- That a benefit cost ratio of not less than 1, established using the above parameters, is the required cost effectiveness benchmark for setting energy performance requirements in the Code, for all building classes and climate zones. For the avoidance of doubt, we are proposing that where a performance benchmark can be shown not to be cost-effective in a particular climate zone, then that benchmark should be lowered to ensure that a BCR of 1 is the (expected) outcome;
- That climate zones, and not state/territory boundaries, be the basis of setting energy performance requirements;
- That where other considerations are relied upon in the decision-making process, these be publically documented, including providing justified assessments of their materiality;
- That a due process of stakeholder consultation be documented and undertaken each 3 years, including documentation of a process map for such consultation. This would include minimum time periods for consideration of regulatory change processes, public submissions and appropriate standards of 'evidence' for key parameters relied upon in the social benefit cost analysis. Therefore we recommend:

No.	Recommendation	Theme	Pathway	Timeline
9	*That, to give effect to Rec. #8, the rules-based approach for setting energy performance requirements in the IGA include that:* • *Reviews of energy performance requirements occur every 3 years;* • *Social benefit cost analysis, using standardised parameters as detailed in this Report, be the key basis for standard-setting;* • *The benefit cost analysis is nested within a regulation impact statement;* • *A social benefit cost ratio of 1 be the*	Getting the incentives right	BIC to develop provisions for agreement by BMF and inclusion in the IGA.	FY2015

[17] We note that in pitt&sherry (2012) we have previously recommended every five years, but this recommendation was not made in the context of a 'rules based' approach to regulation, as is being proposed here. Also, we note that the extent of energy and certain factor price changes in recent times means that the nature of cost-effective performance requirements has also been changing rapidly.

No.	Recommendation	Theme	Pathway	Timeline
	benchmark for setting energy performance requirements for all building types and climate zones; • *Climate zones and not state/territory boundaries be the basis of setting energy performance requirements;* • *Where other factors are relied upon in setting energy performance requirements, justified assessments of their materiality be published;* • *A process map for stakeholder consultation be published and adhered to in all reviews of building energy performance requirements.*			

5.2.5 State & Territory Variations

Many stakeholders in the review process noted that the justification for current state and territory variations from and additions to the agreed Code is generally unclear (although this may not apply to *all* variations and additions). This was often accompanied by the view that certain states' variations may undermine the intent of the Code or at least not amount to 'equivalent' provisions from an energy performance perspective.

In the IGA referred to above, and in addition to the general agreement to seek national consistency and harmonised administration, Clause 18 on p. 19 includes *inter alia* a commitment to '...reducing or validating variations to the NCC...'. Further we note that new, but not existing, variations are '...subject to Regulatory Impact Assessment...'.

Given that a key overall finding of this review is that stakeholder understanding of and support for the energy performance requirements of the Code is weak – to the point where some stakeholders question their value – we believe that every reasonable effort should be made to recapture missing support, including by providing the evidence that justifies existing as well as new requirements. This could be done by applying a standard regulatory impact assessment process, including social benefit cost analysis, to each significant variation and addition, as indeed is already agreed for new variations, and publishing the results. Such a process would provide either the material basis for communicating the justification for such measures unequivocally to stakeholders, or else an evidence-based case for reform of these measures. Therefore we recommend:

No.	Recommendation	Theme	Pathway	Timeline
10	*That all existing state and territory variations and additions to the agreed energy performance requirements in the NCC be subject to a regulatory impact assessment and benefit cost analysis, in particular to determine their degree of equivalence to agreed Code provisions, with the results to be published.*	Getting the incentives right	BIC to oversee implementation by relevant states and territories	FY2015 - FY2016

5.2.6 'As Designed' or 'As Built'?

A fundamental issue raised by some stakeholders – generally architects and designers but also building surveyors and energy assessors – is the Code's focus on assessing the energy performance of *building designs* rather than *actual buildings*. The advantage of the current approach is that it enables builders to know in advance of construction that the building, when completed according to the approved design and specifications, is at least very likely to comply with the Code. This reduces the risk of expensive rework. The current approach also abstracts from the actual usage conditions of the building, such as occupancy levels, fit-out, hours of operation, etc, all of which may affect actual energy consumption. Designers and developers may see these factors as outside of their control, even if these factors should, and may indeed, inform design and specification choices.

At the same time, an inherent disadvantage of this approach is that it risks creating a gap between design performance (which at best can be simulated or modelled) and actual energy use (which can be measured). The Code's primary focus is on inputs, sub-systems and components and not on outcomes such as the overall energy performance of the finished building. This design focus may contribute to some of the phenomena reported to this review:

- A lack of transparency as to the expected energy performance of finished buildings;
- A lack of clear 'accountability' for the energy performance of finished buildings;
- Suggestions that compliance with Code requirements may be poor in finished buildings (noting the tautology that the Code does not place *specific* energy performance requirements on finished buildings, despite the wording of the Functional Statements reviewed above);
- Barriers to new building owners determining whether the building as delivered conforms with the building as designed (and paid for); and
- An absence of 'whole of building' performance testing, for example for degrees of airtightness.

We do not wish to minimise the difficulty associated with distinguishing between buildings that do not deliver on their design promises, on the one hand, and buildings that are occupied and used in ways which the designer and/or builder did not anticipate, on the other hand.

That said, there are well-developed methodologies for normalising many operating parameters (occupancy, hours of operation, base buildings vs tenant light and power), some of which are already employed in some regulatory solutions (eg, BASIX), rating tools (NABERS, Green Star, etc) and Code provisions/called-up standards (eg, cark park lighting and ventilation requirements). Further, the emergence of technologies such as blower door testing and thermal imaging cameras at reasonable cost, opens up new opportunities for assessment and verification methodologies within the Code. Generally the building industry is quick to innovate around new technologies, using them to increase productivity and quality.

As one objective of this review is to identify opportunities to move towards best energy efficiency practices in Australia, we advocate that governments consider opportunities to progressively shift the energy performance requirements of the Code to a focus on outcomes as-built, rather than a focus on inputs and buildings as-designed. This would be consistent with the expressed overall intention that the Code be performance-based, thereby maximising flexibility for designers to deliver innovative, fit-for-purpose *and* compliant buildings. We recommend:

No.	Recommendation	Theme	Pathway	Timeline
11	*That governments agree to identify opportunities to progressively shift the energy performance requirements in the NCC to an outcomes, 'as built' basis.*	Getting the incentives right	BIC to review and develop specific proposals	FY2015 - FY2020

5.2.7 'Deemed to Satisfy'?

One of the apparently less agreed elements of the review was the attitudes that were expressed relating to the benefits/disbenefits of 'deemed to satisfy' (DTS) provisions or building solutions to demonstrate Code compliance. Some expressed a strong view that DTS be removed from the Code, on the grounds that it:

- Creates 'default' or 'industry standard' solutions which may not be fit-for-purpose in a given building;
- Discourages innovation including the use of new materials for which DTS solutions have not been defined;
- Discourages whole of building modelling (or thinking) which may highlight superior (including more energy efficient and/or lower cost) solutions.

However, others expressed an equally strong view that the Code is currently too complex, difficult to interpret and therefore invites non-compliance. A much simpler Code, it was argued, based on clear and simple DTS solutions and drawings, relevant to each climate zone, would obviate much uncertainty and cost. In particular, this view was expressed by those who doubt the veracity of rating tools. Elements of these perspectives are also discussed in Sections 9.5 and 9.6 below.

In our view there are strengths in both arguments, but they may not need to be treated as alternatives. Clear and simple DTS solutions – provided they are differentiated appropriately by climate zone and do offer a high likelihood of achieving equivalence with a modelled/verified solution – would certainly have appeal in some situations and could also lower compliance costs, for example by reducing inventories and enabling greater economies of scale. At the same time, these solutions are likely to become increasingly less fit-for-purpose, and/or to impose higher construction costs, for more innovative, complex or one-off designs. They may also discourage or slow down innovation, for example if new building materials and systems are not readily able to be utilised under a DTS approach.

We note that a second issue appeared to be in play in this debate. Some designers appeared to be unaware of existing provisions that allow for alternative solutions and assessment methods. As a result, they express frustration that DTS solutions 'hamstrung' their work. Many more designers and assessors were aware of these provisions but expressed the view that accessing such alternatives is too expensive, too time-consuming and/or too uncertain to bother with, except for specialised/premium designs. At a minimum this suggests that more effort needs to be made to familiarise stakeholders with existing Code provisions and flexibility. Second, it may point to a need for states and territories, including building regulators, to review and streamline processes surrounding alternative solutions and assessment methods, and then to ensure that the streamlined arrangements are well understood.

A further issue commonly raised was the suggestion that DTS and modelled solutions are often not equivalent. Again we stress that opinion differed on this, but many argued that DTS remains the default approach (notably for residential and smaller commercial buildings), while reference building modelling is utilised only when it is believed that it will deliver a lower cost building solution (or for more complex and high value designs). Indeed, many suggested this cost minimisation was a primary motivation for using rating tools for compliance purposes. Glazing was routinely cited as a driver for this switch, with many noting that it is possible to use rating tools with much lower cost solutions when the Code's glazing calculator specifies a high-cost glazing solution.

Now it might be argued that this is an intended outcome, enabling designers to identify least-cost and fit-for-purpose solutions. This would be correct but only provided the solutions are in fact equivalent in energy performance terms. Those who criticised the 'gap' between DTS and modelled solutions were expressing the view that this amounts to 'compliance shopping', and it appears to lend weight to the thesis (explored in Section 9.5 below) that there is excessive flexibility in rating tools that can be exploited to make buildings appear compliant.

We note that, in principle, DTS and modelled solutions should be equivalent, and there is an onus on the ABCB to ensure (and to be able to demonstrate) that this is the case. Recommendations relating to this Section are covered in Sections 9.5 and 9.6 below.

5.2.8 Gaps in Code Coverage

Building Documentation

A second gap – or series of gaps, to be more accurate – referred to by stakeholders was inadequacies in various aspects of building documentation. Many builders, assessors and building surveyors noted poor standards of document in designs. Common points raised include missing specification details, particularly on drawings, including R values of insulation and u values of glazing systems. Second, many raised the lack on drawings of building details, notably sealing/weatherproofing details such as flashings, correct fit of building wraps, joins, air gaps and fit of insulation materials. Too often the phrase 'must comply with Code or AS XXXX' substitutes for details that are readily able to be understood on building sites, modelled by energy assessors, and potentially verified by building surveyors or building owners (or their agents). Section 6.1.9 deals with the related issue of access to the Code and supporting Australian Standards.

Designers noted that practices may vary but that, overall, the required documentation standards are not clear. Therefore unless a client demands (and is willing to pay for) a certain level of documentation, then gaps may be the end result. As noted elsewhere, however, the ultimate building 'consumer' may not be involved in this transaction or, even where they are involved, may well lack the awareness of the importance of this issue or the underlying technical know-how to be an adequate 'specifier'. In principle, this may be a greater concern with residential buildings, although we were also told of similar issues with commercial buildings, particularly those that are not premium buildings.

With missing documentation and detail, many parties need to guess what was intended or utilise their judgement and existing body of knowledge. This may contribute to:

- Misunderstandings between designers and energy assessors;
- Energy assessors making assumptions (eg, about insulation levels, glazing choices or other factors) that may not be then communicated back to designers;
- Miscommunication of intent between designers, builders and sub-contractors;
- A lack of 'discoverability' of intent by building surveyors and building owners.

Unintentionally, then, the lack of clear and detailed documentation standards in the Code may be contributing to the problems of substitution of materials on building sites, post-compliance design changes and, ultimately, under-performing (and undiscovered) buildings that are not Code-compliant 'as built'.

Another class of missing documentation lamented by stakeholders was touched on in the Section above on commissioning and maintenance, and that is an adequate set of technical drawings, system descriptions and operating instructions delivered to the ultimate building occupants...a building manual or user guide. Clearly the required degree of sophistication in a building manual will vary depending upon the function and complexity of the building. Nevertheless, if requirements for building documentation, including operating manuals are described in performance- and outcome-based terms, rather than attempting to be overly prescriptive (eg, of the form, "The building manager must be able to..."), then reasonable judgements can be made about the extent of documentation required in any particular case to deliver the required outcomes.

A final aspect of building documentation raised with the review team was the extent of knowledge gaps, 'rework' and unnecessary cost associated with poor access to building documentation through time. This was particularly noted as a concern in the context of mandatory energy performance disclosure – which is already required for some building classes and in some locations – as such requirements will call for ready access to building plans and specifications if disclosure is to occur at least cost. This aspect is discussed further in Section 9.3 below.

However even in the absence of mandatory disclosure, basic building documentation (plans, detail drawings, specification, energy assessments, surveyor's reports, etc) may need to (or could usefully) be accessed by many parties through time:

- A succession of building owners;
- Building managers;
- Building/energy service providers;
- Building designers;
- Energy assessors;
- Energy, telecommunications, water and waste water utilities;
- Local councils;
- Roads authorities and other infrastructure service providers;
- Real estate agents;
- Statistical agencies;
- Policy analysts and designers.

For useful access to occur through time, a prerequisite is that documentation is accurate and sufficient in the first instance, as discussed above. The Code could play a key role in ensuring this outcome. However, a second requirement is that an efficient, low-cost and secure system exists for managing access (including ensuring that access is limited by privacy and other considerations as required by law). This falls outside the scope of the Code itself, but is rather something that is likely to be managed by local planning authorities (or possibly building commissions), with the system design overseen by policy (and perhaps statistical) agencies such as those involved in the Building Implementation Committee.

During the review we were made aware that there may be particular local councils willing to trial the development and implementation of such a system, which could be thought of as an 'electronic passport' or building file, which is maintained for the benefit of at least the parties listed above, and which avoids the costs, time and complexity of recreating documentation that is (currently) poorly accessible, while creating new value via access to information (for example, for policy and statistical purposes, and in de-identified form) at low cost. Successful trials could lead to the wider, or even national, adoption of such a scheme. It was also noted that a general trend towards the use of building information management (BIM) systems may facilitate this approach, as is reported to be the case in some states in America, such as New York, where BIMs are already accepted for regulatory compliance purposes and are also used to inform various information products, such as fault diagnosis, operations and maintenance manuals.
Therefore we recommend:

No.	Recommendation	Theme	Pathway	Timeline
12	*That the NCC include detailed minimum requirements for building documentation (including drawings), including but not limited to elements affecting energy performance and including operational manuals.*	Getting the incentives right	Initial 90 day project to scope out documentation requirements and consult stakeholders; RIS during FY2015	FY2015
13	*That one or more trials of an 'electronic building passport', or document management system, be conducted with a view, over the longer term, that the system be demonstrated as effective, potentially leading to national adoption. Opportunities presented by BIMs should be explored in these trials where feasible.*	Getting the incentives right	Initial 90 day project to recruit trial participants, design and initiate trials, under supervision of BIC.	FY2015 -FY2016

Airtightness / Ventilation

A further gap in Code coverage that was raised by numerous stakeholders is the absence of airtightness performance requirements for Australian buildings. It was put strongly to this review, at many workshops and one-on-one meetings, that improved airtightness is a critical frontier for achieving improved energy efficiency in buildings in Australia. It was noted that standards and assessment and verification methods have been developed and are applied in other jurisdictions, including at least the UK, Europe, Canada and several US states.

In discussions where this issue was raised, there was agreement that airtightness performance requirements must be accompanied by ventilation performance requirements as well, for health and amenity reasons, and we support this view. However, it was apparent that there is a lack of a shared understanding within the industry of a) the causes of condensation in houses, and b) whether or not this is linked to energy performance requirements. This issue is discussed further below.

There is evidence that Australian buildings have high air leakage rates by international standards. A recent study by A.M. Egan (2012) notes that studies of housing air change rates in Australia have found between 12 and 26 ACH50, compared to 0.5 – 2.0 ACH50 in the US and values between 1.5 – 6.0 ACH for houses and apartments in Europe. This study also tested 6 office buildings in Canberra and found an average result of 8.7 ACH50. The study notes (p32) "All of the tested office buildings had much higher leakage values than the European and US office buildings...", and overall concludes that (p.36) "...air leakage rates in Australia are much higher than those reported in Europe and USA". The paper cites overseas studies noting that up to 50% of HVAC energy consumption (which, in turn, is generally around 50% of total building energy consumption) is lost through air leakage. It is likely that improving the air tightness of new Australian buildings would be amongst the largest and most cost-effective energy efficiency improvement opportunities, however we are not aware of Australian studies other than the one cited) that test this thesis. The lack of attention to airtightness in the Australian Code differentiates it from codes in other countries that pay greater attention to energy efficiency. Therefore we recommend:

No.	Recommendation	Theme	Pathway	Timeline
14	*That the ABCB or BIC commission a specific study, across all building types and climate zones, to determine the expected effectiveness and cost-effectiveness of airtightness performance requirements in the Code, making recommendations for appropriate performance requirements and assessment methods.*	Getting the incentives right.	ABCB and/or BIC to commission a technical and benefit cost analysis, which may be followed by a RIS.	FY2015 - 2020

Condensation Concerns

As noted in the workshop summaries, some stakeholders believe that energy efficiency standards contribute to condensation problems in houses. However we believe that this view is poorly justified and over-simplifies a complex issue. Condensation occurs in older houses that pre-date energy efficiency performance requirements, and we are not aware of any evidence that suggests there is a correlation between energy efficiency requirements and condensation, let alone a causal link.

We note that condensation inside houses is a very serious condition, with potentially harmful health outcomes (related to mould growth) and, where condensation occurs inside wall and roof cavities, potentially serious consequences for the structural integrity of buildings (rotting of wooden frames). The general issue of water ingress – but not water vapour – and related health issues is recognised in Section F (Health and Amenity) of the Code; that is, as a separate consideration to energy efficiency.

Where warm moist air within a building comes into contact with a colder inside surface (such as a window), or surfaces within the structure (inside external cladding, for example), condensation can occur. Setting aside leaking facades and other liquid water sources, there are broadly two sources of water vapour inside houses that can, in the right atmospheric conditions, precipitate as liquid water that is known as condensation. The first are internal sources, from showers, bathrooms, clothes dryers and other sources. For such sources, solutions include a) removing the moisture source (eg, venting clothes dryers directly outside houses); b) ensuring there is sufficient ventilation to remove the internal moisture; or c) using correctly installed vapour barriers on internal surfaces to prevent water vapour within the building penetrating the structure; or d) a combination of all three. We note that this first condensation risk is essentially behavioural in origin and unrelated to energy efficiency standards.

A second possible source of water (or water vapour) is external in origin – that penetrates through facades into wall or ceiling cavities, for example. In the right conditions – for example where there is a large temperature difference across the internal and external surfaces of a wall or roof/ceiling structure, the vapour can reach dewpoint and precipitate. This is a natural process which requires that such structures are a) protected by appropriate design, incorporating appropriate use of gaps as well as vapour barriers or sarking, and b) are effectively ventilated and drained. Again, there is no causal link between this process and energy efficiency standards. However, inappropriate design of wall/ceiling/roofing structure, including inappropriate use of insulation and vapour barriers, and inattention to drainage and ventilation requirements, could indeed lead to condensation problems. This is essentially a knowledge and skill issue, and not grounds for opposition to energy efficiency performance requirements.

We note that the ABCB has a Condensation Handbook. However, many stakeholders criticised this product as containing inappropriate content and called for it to be thoroughly revised. While the detail of this issue is beyond the scope of this review, the strength of feeling on this issue suggest that it should be taken very seriously and acted upon in the short term. Therefore we recommend:

No.	Recommendation	Theme	Pathway	Timeline
15	*That the ABCB thoroughly review and revise as necessary its Condensation Handbook, consulting widely with stakeholders in the process.*	Getting the incentives right.	ABCB to establish a review and consultation process, commissioning technical advice as required.	FY2015

5.2.9 Complexity

The complexity of the Code was noted as a source of confusion about what requirements apply in what circumstances. This may discourage its use and application, with 'informal knowledge' being substituted instead. Some found the overall Code structure (as described in Chapter 8) – including objectives, functional statements, performance requirements, multiple building solutions and assessment/verification methods – as inherently complex and confusing. Others argued that the Code is necessarily complex in order to create sufficient flexibility to deal with the multitude of different building issues, functions and types.

Another example cited was the Code's building classification structure, which many noted as appearing to lack a rigorous conceptual basis (and which is not apparently linked with other such classification approaches, such as that used by the Australian Bureau of Statistics and hence in statistical publications). Fine distinctions are made between sub-classes in some areas (for example between the residential building classes – but the purpose of these distinctions is unclear), while important functional types missing or at least not easily recognisable, such as hotels and serviced apartments (residential areas of hotels are Class 3, but how the balance of the building is to be treated is unclear).

If the Code's performance requirements are identical for two building types, then it is superfluous to draw a distinction between them. Put the other way around, every distinction in the classification structure must have an operations purpose in mind, or else it is redundant. As noted, there would be advantages for statisticians, policy analysts, governments and others if the number of different approaches to building classification was minimised.

A further example of complexity that we were offered is the fact that not all energy-related requirements appear in the one location in the Code, with linkages needing to be made to ventilation, indoor air quality and other amenity factors in Section F, for example, and suggestions that there is a lack of guidance about 'competing tensions' between these requirements that are unresolved in the Code. A key example is the tension of the desire of many (discussed further below) to improve standards of air (and weather) tightness in buildings, with appropriate ventilation standards. This tension is certainly reconcilable – but does involve some complexity.

Another example noted was the trend over time to reduce the number of diagrams and drawings in Code Guides that refer to details of acceptable or DTS building solutions. Many stakeholders called for the Code to include more, not less, such diagrams and drawings, noting that these need to be clear and high-quality. Many noted that this has been achieved in New Zealand's Building Code, for example.

A related concern we heard was that the Code provides the 'what' but fails to provide the 'why'. Therefore the reader may not be sure what is intended or how important that is. When in doubt, there is always a risk that a busy professional or tradesperson will assign a low priority to something that is unclear or apparently poorly justified.

Generally, we note that greater clarity in the Code's structure, organisation, classification system, intent, wording and diagrams would all be welcomed by industry. While not certain, it is likely that greater attention to these factors in future versions of the Code would increase its accessibility to the industry, and thereby contribute to compliance.

5.2.10 Cost

A common complaint across the industry was that the cost of subscribing to the Code, combined with the Australian Standards called up by the Code, can amount to many thousands of dollars per year. Particularly for smaller companies and sole traders, this represents a significant disincentive. Particularly if the Code is viewed as a 'compliance burden', and not a valuable information source, then the temptation to make do with informal knowledge, or back-copies of the Code and standards, may be present.

The review team understands that the ABCB has had this issue on its 'radar' for many years, and has already agreed in principle to make the Code available free of charge from the 2015 edition. Our experiences in this review suggest that this will be an important and welcome initiative which should contribute to improved Code compliance in future. That said, we note that the larger cost burden is associated with accessing the related Australian Standards. As these are provided by a commercial party (SAI Global), it may be more difficult for governments to influence the pricing of these products. However, since compliance with the Code assumes access to and familiarity with the detail of Australian Standards – and indeed we have been told that there has been an increasing trend to transfer detail from the Code to Australian Standards – then the intent of this pricing reform could be undermined if the pricing of related standards is not also considered at the same time. Therefore we recommend:

No.	Recommendation	Theme	Pathway	Timeline
16	*That governments provide sufficient annual funding to the ABCB to enable the NCC to be made available free of charge (or for a nominal fee). The cost of access to related Australian Standards should also be considered in this context, and options for reducing the effective cost of those standards to industry investigated.*	Getting the incentives right	Already in train – BIC and ABCB	FY2015

5.2.11 Mandatory Disclosure

At virtually every workshop that we conducted, stakeholders identified mandatory disclosure of building energy performance as a key priority, and a (largely) missing piece of the building energy efficiency puzzle. It was noted that mandatory disclosure would have the benefit of focusing on whole and finished buildings 'as built', to compensate for the Code's 'as designed' focus. It would also cover existing as well as new buildings. Most importantly, stakeholders nominated it as an important and market-based accountability mechanism for the industry. By progressively educating consumers about the range of performance of actual buildings in the market place, it creates the potential for them to exercise consumer sovereignty – potential which currently does not exist for most building classes and in most states and territories – which would in turn drive innovation, competition and higher (energy) performance from the building sector.

We therefore recommend:

No.	Recommendation	Theme	Pathway	Timeline
17	*That governments re-examine the public policy case for mandatory disclosure for all building classes, applying learnings from existing schemes.*	Getting the incentives right	BIC to commission new analysis of cost effectiveness	FY2015

5.3 Delivering Quality Outcomes

5.3.1 Mandatory Accreditation and CPD

While issues relating to knowledge management, skills and training are covered in greater depth in Part C, we note that these issues were also raised in the context of systemic and process issues with the Code. In particular, many stakeholders – but notably energy assessors – decried the lack of mandatory accreditation of practitioners involved in the building design/certification process in most states and territories. The ability for potentially untrained practitioners to compete on an equal footing with those who incur the costs associated with training, accreditation and auditing was deemed unfair.

We note that this is an example of 'adverse selection', whereby market outcomes based on price can tend to drag quality outcomes to the lowest common denominator, as it is difficult for consumers without detailed technical knowledge to discriminate (without assistance from accreditation schemes) between high and low quality work. Unless appropriate minimum standards are set and enforced, those trying to 'do the right thing' may find themselves unable to compete on price with those who are not.

The systemic issue here is the failure, on the part of most but not all states and territories, to legislate to ensure that only properly accredited practitioners are able to practice in their jurisdictions. We do not tolerate such outcomes for engineers or architects, let alone for doctors and nurses, and it is difficult to understand why governments would wish to encourage unaccredited building designers, energy assessors, building surveyors, builders and related trades. Tasmania is an example of a jurisdiction where all of these are required to be accredited and also to undertake continuous professional development (CPD), as is also the case in NSW.

Turning to CPD, many stakeholders noted that this a key strategy to address the skills and knowledge deficits mapped in Part C. Mandatory continuous professional development for all building professions would overcome the low participation rates in voluntary training opportunities and ensure that those practising in the industry keep up to date with the latest concepts, technologies, systems and tools. Clearly, in developing mandatory accreditation and CPD schemes, there will be a need to ensure that there are suitable service providers available in all locations, that the detail and content of these schemes is high quality, leading to effective and cost effective outcomes.

As this issue has been on the public policy agenda for some time (including being incorporated in the 2009 *National Strategy on Energy Efficiency*), and also noting that there are examples of good and excellent practices already in place in some jurisdictions, our process proposal is that this expertise be pooled by jurisdictions as the basis for developing a common, national, best-practice approach for both mandatory accreditation and mandatory CPD. The key requirement will be a political commitment to adopt mandatory requirements, while the adoption of a single and consistent national approach will facilitate participation by industry stakeholders and service providers alike. We therefore recommend:

No.	Recommendation	Theme	Pathway	Timeline
18	*That governments develop and adopt, subject to regulatory impact assessment, a single, national requirement for mandatory accreditation and mandatory continuous professional development for all building professions, drawing on existing examples of best practices and also learnings from those jurisdictions with such schemes.*	Delivering quality outcomes	BIC to facilitate a study internally, or commission an external service provider to consolidate the best practice elements.	FY2014 – FY2015

5.3.2 Rating Tools

Stakeholders raised many issues regarding the performance of rating tools. The primary focus was on the NatHERS family of tools, although some raised issues with software tools used for reference building modelling for Class 2 – 9 buildings as well. The key issues appear to be:

- Excessive 'flexibility', allowing poor designs to achieve required ratings;
- A lack of investment in tool maintenance and upgrading through time;
- A lack of responsiveness to stakeholder concerns and, relatedly, governance structures that are perceived as remote from industry;
- Concerns about the handling of certain climatic factors, from hot, humid climates to local factors such as shading and breezeways.

It is beyond the scope of this review to validate all of the concerns raised. We note that different stakeholders offered competing views in some instances. For example, some were concerned that climate zones were too coarse, failing to resolve subtle differences in the prevailing climate conditions (such as sea-breezes), while others offered the view that the NatHERS tools make too much effort to distinguish minor climatic differences which may not be material from an energy performance/building design perspective. Some argued that shading from trees and garden structures should be taken into account, while others viewed these as temporary and unreliable. Many noted that the very same flexibility that is necessary to resolve detailed design features in buildings may also be used to 'push' poor designs, to give them the appearance of compliance. While some noted that behavioural factors are extremely important for modelling expected energy consumption, others argued that it is not possible to anticipate these behaviours, particularly over the whole life of a building, and that therefore they are not material.

We do draw particular attention to the widespread view that the NatHERS tools perform poorly in hot, humid climates. We consulted informally with some experts in this field, and also attempted to draw out examples and specifics from those offering such views, in order to try and validate them. No stakeholder was able to provide us with specific examples of problems, while several experts in this field noted that this is very largely myth, but also a hang-over from legitimate concerns from the earliest versions of NatHERS, long since addressed. However as with some other concerns, and potential myths, encountered during this review, this one is sufficiently widespread – amongst government policy advisors, regulators, designers and others – that it is contributing to the wider culture of apathy or even hostility towards energy efficiency performance requirements. It is remarkable, for example, that the Northern Territory sets aside the whole of Section J, and BCA2010 requirements for housing, in a context of widespread air conditioning of buildings and high energy costs.

There was widespread concern at the lack of investment in research and maintenance of rating tools, leading to key files being years out of date. One stakeholder claimed, although without providing specific examples or evidence, that there were over 50 known 'bugs' within AccuRate. Relatedly, many complained of a lack of transparency, stakeholder engagement and a published and appropriate work program for tool maintenance and development.

Many noted as a major process flaw that the key assumptions or design features necessary to obtain a compliant rating are not made transparent to the building owner or builder. As a result, it cannot readily be checked whether these features have in fact been installed in the finished building. This is likely to be one of the causes of the substitution issue discussed further below.

We were told of practices whereby designs with poor solar passive features (for example, excessive glazing areas on a western façade) may be specified with impracticably high levels of insulation, or very high performance (and therefore expensive) glazing requirements, in the tacit knowledge that such features are unlikely ever to find their way into the finished building. Therefore while the rating tools may be faithfully modelling the specifications required to achieve a compliant building, the building itself is unlikely to be compliant. While this review offers a range of recommendations to address this concern, a simple and standard-form 'fact sheet', automatically generated by the software tools and certified by the assessor as true and correct, would be a key input into an auditable and accountable system to counter post-approval variations and substitutions.

We recommend:

No.	Recommendation	Theme	Pathway	Timeline
19	*That the NatHERS Administrator develops a mandatory protocol that ensures that the key drivers and assumptions underpinning ratings used for compliance purposes are automatically generated as a 'summary fact sheet' by accredited rating tools, for certification by energy assessors and inclusion as part of required building documentation (cross reference with Rec. #10).*	Delivering quality outcomes	NatHERS Administrator to action, with oversight from BIC – this action is already in train.	FY2015 – FY2016
20	*That governments develop a new governance model for NatHERS, with greater industry participation, and commission an independent, zero-based budget assessment of the ongoing funding for professional standards of tool maintenance and development. This review process should establish a viable ongoing financial model for NatHERS.*	Delivering quality outcomes	These matters are already under consideration by the NatHERS administrator.	FY2015 – FY2016

5.3.3 Inspections

The call for at least one mandatory inspection of the energy performance features of buildings was one of the strongest and most consistent themes of this review. Many put this to us as the 'make or break' issue. One workshop participant said "You can't claim you're serious about energy efficiency if there are no inspections". Our survey results confirm this view, with more than 80% of all respondents agreeing or strongly agreeing that that it is appropriate for energy efficiency to be part of the building inspection and certification process.

At the same time, concerns were expressed about the potential costs associated with such inspections, who should undertake them, how many, and when in the construction cycle. The strongest view appeared to be that, at a minimum, the correct installation of insulation and glazing should be verified through site inspections, prior to finishings. Others noted that, in addition, the finished building should be assessed, for example via a blower door test and thermography. This issue is discussed separately, but we note that until such time as airtightness performance requirements are included in the Code, it is unlikely that mandatory blower door testing could be justified.

Regarding who should conduct these inspections, it was generally agreed that building surveyors are not currently trained in energy efficiency matters and may not be well placed to fulfil this role. By contrast, energy assessors do possess the required skills and may be better placed.

In terms of cost concerns, a number of suggestions were made that could limit incremental costs. First, it was noted that virtually all builders and tradespersons carry smart phones that would enable still or video images, date-stamped, to be sent to an energy assessor (or building surveyor). Second, some felt that it would be excessive to verify every building, and that rather an audit-based approach should be adopted. In this approach, a sample of buildings (for example, from a project home builder) could be selected for inspection and testing. Over time, those builders with a consistently strong track record could have an inspection requirement waived, with physical inspections increasingly focused on those with a past track record of non-compliance.

Therefore we recommend:

No.	Recommendation	Theme	Pathway	Timeline
21	*That governments develop and apply model Code provisions and/or regulations to give effect to a nationally-consistent, audit-based approach to inspections to ensure appropriate installation of insulation, glazing and other design features, consistent with approved designs and specifications, subject to regulatory impact assessment.*	Delivering quality outcomes	BIC to commission a 'proof of concept' study, including benefit cost analysis, to be followed by RIS	FY2015 – FY2016

5.4 Empowering the Community

5.4.1 Protecting Consumer (and Producer) Rights

During the review process, many stakeholders noted that protections for consumers' interests in achieving Code-compliant, energy efficient buildings are weak in most jurisdictions. A consistent pattern described was of a disgruntled new home owner shuttling between building commissions, fair trade commissions, local councils and builders (or their lawyers). As is often noted, houses are often the largest investment a person will make in their lifetimes. If they are unable to ensure that the performance levels that are regulated and for which they have paid are effectively delivered, then they will suffer a material financial loss in the form of higher than necessary energy costs throughout the lifetime of that building.

We note that similar concerns were once expressed with respect to claims of non-compliance with minimum energy performance requirements in the area of domestic appliances and industrial/commercial equipment, now regulated under the federal *Greenhouse and Energy Minimum Standards (*GEMS*) Act 2012*. In this area, the federal agency responsible for the oversight of such standards negotiated a Memorandum of Understanding with the ACCC, which provides the basis for what has proved to be a highly effective surveillance and enforcement mechanism. A number of high-profile actions have resulted in substantial fines for those found flouting the rules and, more importantly, a strong signal has been sent to the entire market that non-compliance will not be tolerated.

While perspectives vary on this, many believe that an effective enforcement regime cannot exist unless there is a) a reasonable chance that those not complying with regulations will be discovered, and b) there is a shared understanding that those discovered not complying will face a substantial sanction. Both of these conditions apply for washing machines and televisions, but neither for buildings. Importantly – as has been the case in appliances – once it is understood by industry that compliance will be enforced, industry then self-regulates and instances of prosecution become rare. By contrast, absent an effective and active enforcement regime – as in buildings – non-compliance is likely to flourish. Such self-regulation can be encouraged by high-profile communication campaigns that 'spread the word' that someone, after all, is looking and does care.
Therefore we recommend:

No.	Recommendation	Theme	Pathway	Timeline
22	*That governments, through BIC, negotiate with the ACCC (and/or state fair trading commissions) memoranda of understanding to develop an effective regime for a) monitoring and b) enforcing compliance with Code energy performance requirements. Once agreed, the intent to enforce these requirements should be clearly communicated to industry.*	Empowering the community	BIC to manage this project internally, or else contract an external project manager/facilitator, to scope out the MOU(s) and engage with relevant stakeholders.	FY2015 – FY2016

During the review, we were also made aware of a second dimension of missing regulatory disciplines in this sector, and that is the impact that this is having on local manufacturers of high (energy) performance products and systems. In a similar manner to accredited energy assessors facing unfair competition from non-accredited assessors, so local manufacturers of accredited materials (such as insulation products) – who incur the costs associated with independent product testing, and in some cases certification under schemes such as Codemark – also face unfair competition from products (often but not always imported) for which there is no product testing, performance verification, validation of claimed compliance with Australian Standards, or even no identifying labelling whatsoever. This competition is another example of adverse selection, where unscrupulous operators may drive honest ones out of the market. One manufacturer told us that Australia's brand for high-quality, authenticated products – which enables that manufacturer to export insulation products around the Asian region, notwithstanding cheaper products manufactured locally – was currently at risk, due to missing product certification and non-enforcement of compliance with Australian Standards. We were also presented with evidence of the ACCC choosing not to engage in a claim of 'false and misleading claims' action in this sector, although we are not privilege to all of the details of this case. It was presented to us in evidence of a wider malaise, being the lack of interest in enforcing the law in this sector, encouraging the proliferation of non-compliant and untested product in the Australian building market.

While, as noted, it would be unfair to characterize all such product as imported, the review was surprised to learn of a marked change in the buildings product and even buildings market in recent years. We were told that is now common-place for not just building material, but whole building facades, or even whole buildings, to be imported into Australia for local assembly. As there is no requirement for such materials to be tested for compliance with Australian Standards, there is at least the persistent perception that much of it does not comply, representing another source of commercial pressure on those marketing quality products.

Clearly, many of these issues are complex and addressing them extends well beyond the scope of this review. However, we feel it is important to draw attention to these issues as examples of systemic and process concerns that are impacting on Code compliance and the energy performance of Australian buildings. More targeted research will be required to tease out all of the issues and to develop effective solutions. We note that the Australian Industry Group released a report on these issues in November 2013 entitled *The Quest for a level playing field: the non-conforming building products dilemma* which deals directly and in much greater detail with this issue.

We recommend:

No.	Recommendation	Theme	Pathway	Timeline
23	*That governments commission a product conformance improvement roadmap, working closely with stakeholders to develop solutions (such as a product register, product labelling, product testing, integration with NCC documentation requirements, etc) and pathways for their implementation.*	Empowering the community	BIC to commission a scoping study including targeted consultation	FY2015 – FY2016

5.4.2 Lifting Community Awareness

Markets perform best when there is access to quality and relevant information. In the case of building energy efficiency, it was reported to us by almost all stakeholders that consumers (home buyers, in particular, but also those commissioning commercial building projects) show little awareness of or interest in energy efficiency concerns. This was noted as translating into a low willingness-to-pay for energy efficient designs and specifications.

Another take on this issue is that while consumers are generally aware of at least some benefits of energy efficiency (such as the prospect of lower power bills); they have very little *technical* knowledge in this area. Therefore they rely heavily on builders (and other building professionals and equipment suppliers/retailers) to advise them as to their best interests. Particularly for first home buyers, they tend to have a limited capital budget (borrowing capacity) – renovators and second/third home owners are more likely to specify efficiency features. The consumers' lack of knowledge may make them vulnerable to professionals who may themselves have limited technical knowledge in this area and/or to parties with commercial interests that do not align with the consumer's.

There is a literature that concerns 'revealed discount rates' which suggests that, in certain circumstances, people may tend to privilege short term over longer term benefits, and to discount future costs and risks, more heavily than conventionally assumed. However, it also may be the case that consumers are simply unaware of the connections between building designs and specification and the ultimate annual running costs of the building. As a result, they are not equipped to value this connection and therefore perceive no interest in specifying energy efficient buildings. Also, the doubling of real electricity prices in Australia over the last five or so years is so recent that consumers may not have had sufficient time to adjust their behaviours and preferences to the new reality. They may also – and with some justification – see such rapid price rises as unsustainable and therefore unlikely to continue into the future.

Regardless of the cause, it is evident that better informed consumers would be more likely to insist upon – and be willing to pay for – energy efficiency outcomes, and that this would drive market outcomes. That said the challenges and costs associated with attempts to change broad community perceptions are not to be taken lightly. Public information campaigns, to be effective, must be well researched, designed and executed, and potentially sustained over a long period of time. They can cost many millions of dollars, and yet the outcome is not guaranteed.

Therefore we note that community engagement campaigns need to be carefully considered. Other recommendations from this review – such as re-establishing the financial case for efficiency standards – would feed directly into such campaigns by providing compelling facts. We note that specific recommendations in this area are contained in Part C of this Report.

6. Issues Specific to Alterations and Additions

This Chapter reviews the set of issues raised with respect to 'alterations and additions' of existing buildings. Note that we use this phrase as short-hand that also includes renovations and retrofits. The focus on this subset of building work reflects the fact that a decision to undertake significant investment in an existing building is an important stage in a building's life-cycle. From an energy efficiency perspective, and particularly where a building was constructed prior to the inclusion of energy performance requirements in the Code, the investment may represent an opportunity to improve the energy performance of the building, thereby helping to reduce its running costs and further the Code objective of reducing greenhouse gas emissions.

Generally speaking, the Code applies to 'new building work' and not to existing buildings. However, alterations and additions represent new work on an existing building. A key issue, then, is when does this new work trigger the application of current Code energy performance requirements? It appears that there is considerable uncertainty about this within the building community, and it is likely that this is an important source of Code non-compliance.

6.1 Survey and Consultation Results Recap

As described in more detail in Appendices D and E, **pitt&sherry** and Swinburne University of Technology conducted an on-line survey as part of the national review. This Section highlights the results specific to alternations and additions.

Of the survey respondents, 14% are involved mainly or only in alterations and additions, while a further 49% split their work equally between new builds and alterations and additions. 32% of respondents disagreed with the proposition that 'it is easy to know when building code thresholds have been triggered', with a slightly higher proportion of negative responses from those involved in commercial building projects. A further 25% were unsure.

Figure 6.1 below indicates that, with the exception of the Northern Territory (where Section J is waived for commercial buildings as is 6 star for residential buildings), between 50% and 80% of stakeholders disagreed that 'the energy efficiency provisions (relating to alterations and additions) in the building code, and the relevant requirements in my state/territory, are clear'. The most negative results are reported in the ACT, WA and NSW. Well over 50% 'strongly disagreed' with the proposition in the ACT – more than double the 'strongly disagreed' score in other jurisdictions – suggesting there may be particular local circumstances in play. Overall, these results appear to confirm that there is a significant level of confusion regarding the application of Code performance requirements to alterations and additions.

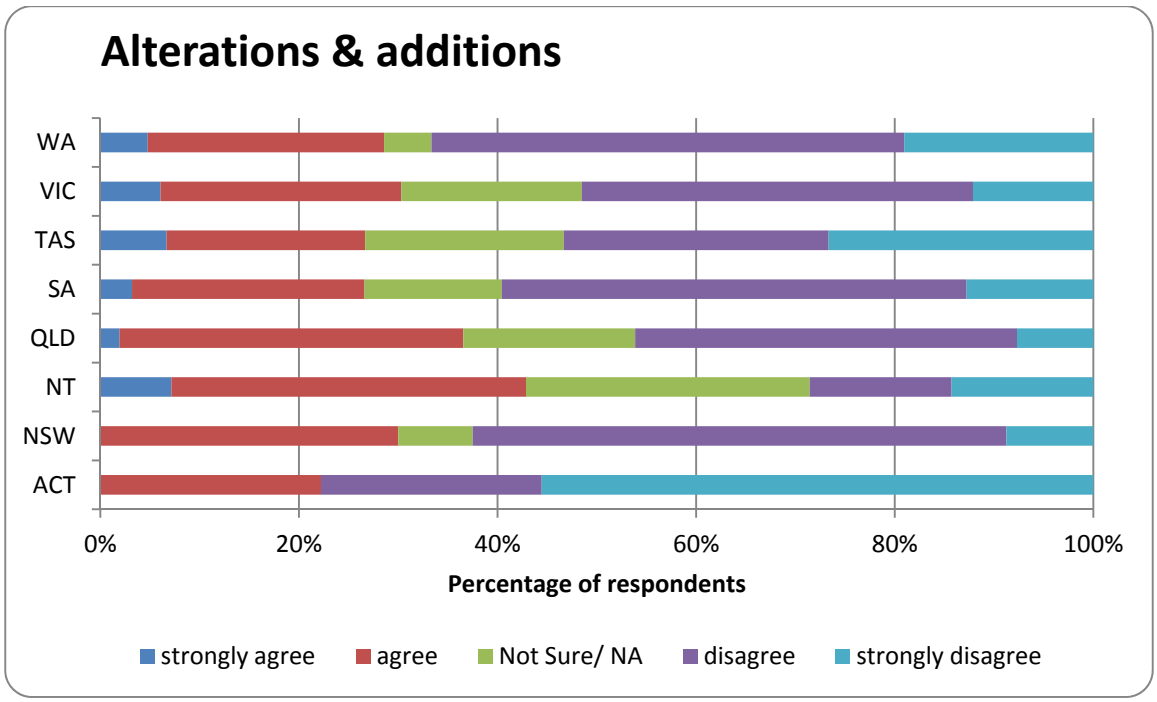


Figure 6.1 Jurisdictional stakeholder responses to proposition: 'The energy efficiency provisions in the building code (and relevant requirements in my state/territory) are clear and easy to follow'

Figure 6.2 below shows the results for the proposition 'the energy efficiency provisions in the building code are being strictly implemented', with respect to alternations and additions. In every state and territory, more than 50% of respondent disagreed or strongly disagreed with this proposition (except the ACT, which is slightly under 50%). Results are more uniform across the jurisdictions than in Figure 6.1, although in Queensland, over 75% of respondents disagreed with the proposition. At a minimum this suggests very widespread concern that Code compliance for alterations and additions may be low. However, we note that similar results are reported for new builds.

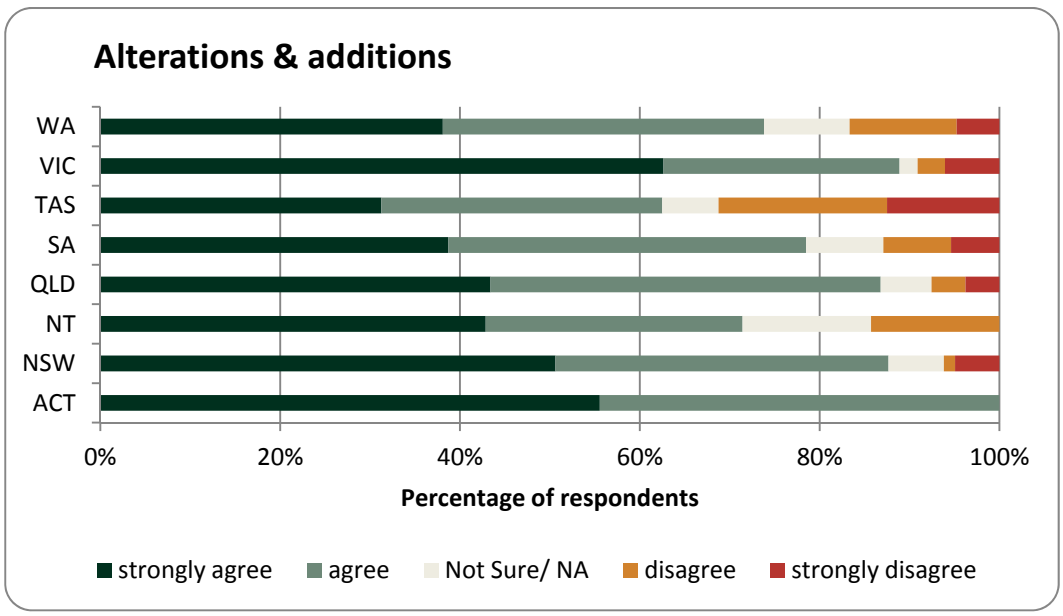


Figure 6.2 Jurisdictional stakeholder responses to proposition: 'The energy efficiency provisions in the building code are being strictly implemented'

Figure 6.3 addresses the proposition, 'The energy efficiency provisions in the building code enjoy strong support within industry'. Here also, negative results significantly outweigh positive ones, with generally 60% or more, and at least 50%, disagreeing or strongly disagreeing with the proposition. While the results are similar for new builds, there is a higher share of both 'strongly disagree' and 'disagree' for alterations and additions.

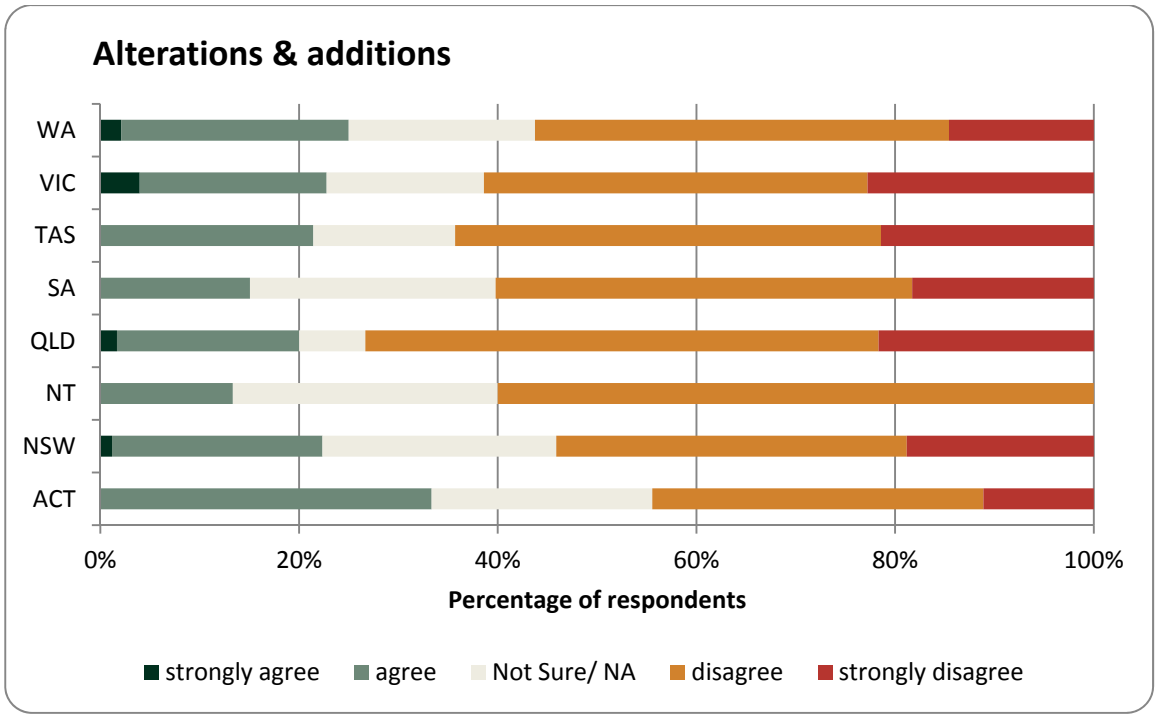


Figure 6.3 Jurisdictional stakeholder responses to proposition: 'The energy efficiency provisions in the building code enjoy strong support within industry'

For a more positive note, Figure 6.4 below indicates that up to 60%, and generally over 40%, strongly agree with the proposition that 'it is appropriate for energy efficiency requirements to be part of building inspections and certification', specifically with respect to alterations and additions. 75% or more of respondents agreed or strongly agreed with this proposition, except in Tasmania where the score nevertheless exceeded 60%. Similar results were reported for new builds. This represents a strong 'vote' for mandatory efficiency inspections from at least this survey population.

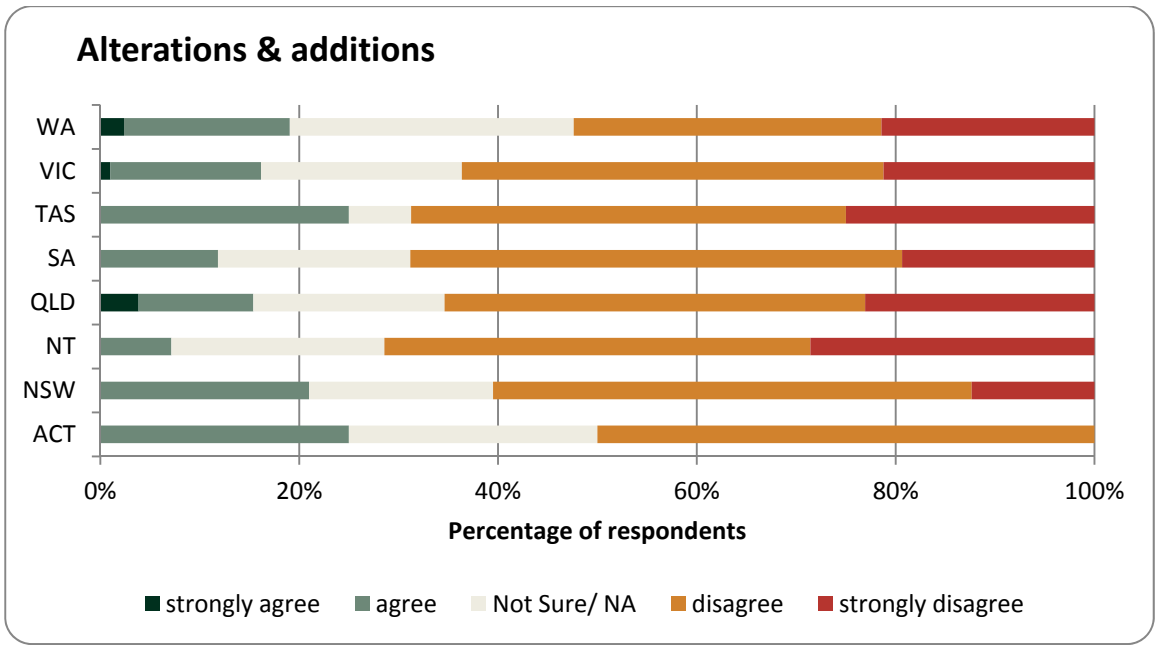


Figure 6.4 Jurisdictional stakeholder responses to proposition: 'It is appropriate for energy efficiency requirements to be part of building inspections and certification'

In Figure 6.5 below, only around 30% of respondents reported that they agreed with the proposition that rating tools – as applied to alterations and renovations – have the confidence of industry. Results were very similar for new buildings. Almost 70% of the respondents in the Northern Territory disagreed with this view, which may reflects the widespread view that rating tools are less appropriate in hotter, humid climates. This issue is discussed in Part A of the review.

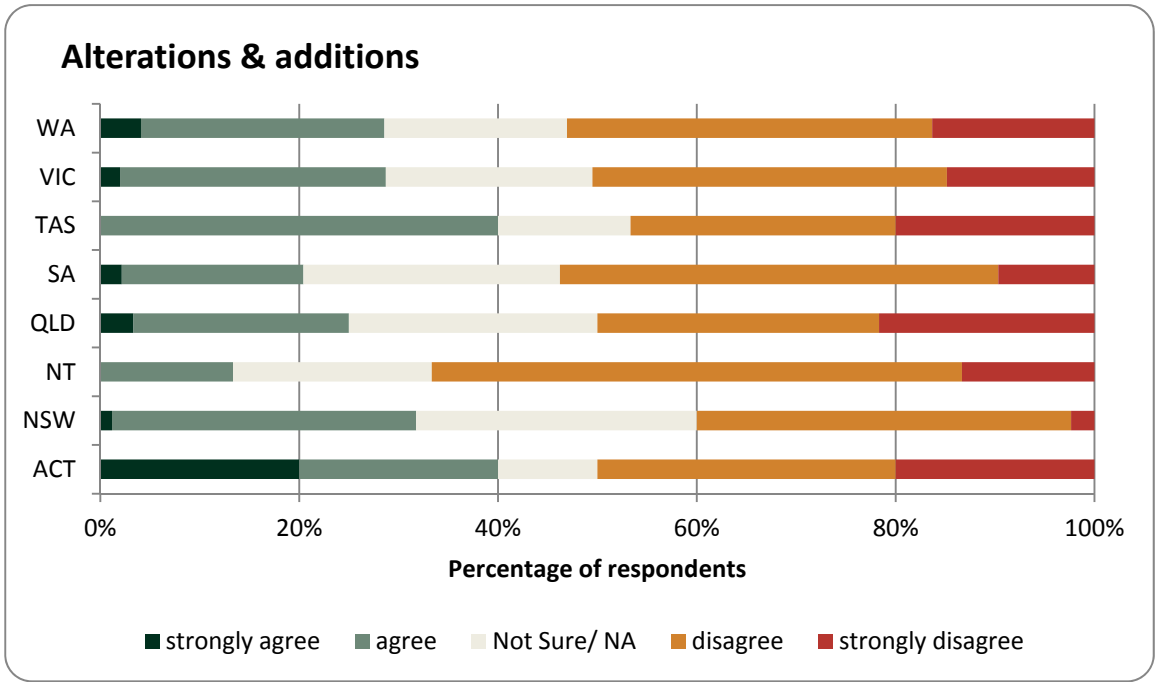


Figure 6.5 Jurisdictional stakeholder responses to proposition: 'Energy efficiency rating and assessment tools have the confidence of industry'

Overall, we can summarise that the majority of survey respondents believe that, for alterations and additions:

- Code provisions and requirements are unclear;
- Code energy performance requirements are not being strictly implemented;
- The energy performance requirements, and also rating and assessment tools, do not enjoy the support of industry; and
- Energy efficiency should be included with the scope of building inspections and certification.

As noted, however, the strength of these views is only marginally stronger than for new buildings, at least in most cases.

6.2 Stakeholder Comments

For the most part, stakeholders' comments in workshops and one-on-one meetings did not distinguish strongly between new buildings and alterations and additions, with the limited exceptions set out below. This was despite facilitators' attempts to draw out from workshops any specific issues in this sector. Overall we formed the impression that the overwhelming concern is the lack of clarity with respect to Code triggers for alterations and additions, while the general tenor of other comments offered to the review apply both to new builds and 'alts and adds'.

6.2.1 Triggers for Whole Building Upgrades

With respect to triggers for application of energy performance requirements, stakeholders' comments reflected the fact that different arrangements apply in different states and territories, and sometimes between local government areas, as to what degree of building renovation, alterations or addition triggers a requirement to ensure that the entire building complies with the current energy performance requirements in the Code.

It is generally clear that the current Code requirements do apply in the area of new work (but see below), and some states' building regulations also specify the circumstances in which the whole building must comply. In Victoria, for example, Regulation 608 under the *Building Regulations 2006* applies to alterations to an existing non residential building. This requires that building work to alter an existing building complies with NCC standards. The trigger point occurs when the planned renovations, combined with any other alterations undertaken in the previous 3 years, constitute more than half the original volume of the building (the 50% rule). The relevant building surveyor may grant permission for partial compliance but only if the floor area of the extension is not greater than the lesser of: 25% the floor area of the existing building, or 1000m^2. Dispensation from the energy efficiency requirements is determined by the building surveyor who judge how *reasonable* full compliance would be in each instance. Work would be considered unreasonable if costs obviously outweigh benefit. For example a building surveyor may judge that a particular set of intended alterations to the fit out of one floor of a six floor building would be required to comply with some parts of Section J such as lighting, but not other parts such as glazing.

However, discretion also creates uncertainty, and potentially scope for pressure to be brought to bear upon parties to exercise discretion in a particular direction. For example, what degree of change or investment to an area within a building counts towards the 50% volume trigger? How is volume measured - to the ceiling, or total building volume? And which sub-systems of building elements are required to be upgraded? For example, if 51% of a building's lighting system is replaced, does this trigger a requirement that the other 49% also be upgraded? Also, does this investment also trigger a requirement to upgrade other elements to current Code requirements at the same time, or only if the upgrade replaces these elements?

In posing such questions, we were told that, in practice, building surveyors, and sometimes local planning authorities, exercise their judgement. However, the principles that should apply to this discretion are not spelled out. Also, it appears that where – in effect – the decision is devolved to local planning authorities (because the trigger that is applied is whether or not a planning permit/development application is required for the works), then different triggers apply depending upon the preferences and circumstances in that local government area. For example, the City of Sydney indicated that their requirement is value-based: any commercial building renovation project of $5million or more in value requires a planning permit; and the requirement for a planning permit triggers application of the NCC. When discussing this issue with local councils, many referred to building surveyors' judgement as the key factor that practically determines whether or not a particular alteration/addition triggers application of the energy performance requirements for the whole building.

As a matter of principle, it is not clear why the application of the Code's energy performance requirements should be devolved to the local level. These requirements have been agreed by all states and territories and subject to extensive benefit cost analysis. Further, the IGA clearly expresses the intention that the requirements be applied across Australia in a consistent manner. Therefore, it is inconsistent with, and indeed undermines, this policy intent to allow discretion for non-application of these requirements at the local level to all new building work.

Stakeholders in the commercial building industry raised a second order level of uncertainty: where a renovation project triggers a building permit and development approval, and hence triggers the application of the Code including its energy performance requirements, there appears to be uncertainty about the circumstances in *which particular* performance requirements for building services and systems are triggered. We were told that building systems and services (such as lighting, domestic hot water, glazing and facades) did not have to be upgraded to current code standards unless the renovation project in question replaced or at least substantially replaced these elements. It appeared to be unequivocal that, for example, where base building lighting is replaced, the new system would need to comply with Code deemed-to-satisfy performance requirements. However, no stakeholder appeared to be clear about what degree of 'new work' represented the minimum trigger for such Code application. For example, where facades are partially renovated, do glazing DTS requirements apply? Neither industry nor government stakeholders appeared to be clear about this. It seems that building surveyors are again called upon to exercise their judgement about such questions.

To limit uncertainty, we recommend:

No.	Recommendation	Theme	Pathway	Timeline
24	*That the triggers for the application of energy performance requirements to whole buildings, where renovations, alterations and/or additions are undertaken, be clearly stated within the Code itself, and therefore applied consistently across all states and territories.*	Delivering quality outcomes	BIC/ABCB to agree triggers and Codify	FY2015 – FY2016

6.2.2 Application of Rating Tools

A second – but seemingly less pressing – issue raised by stakeholders related to difficulties and/or uncertainty in the use of rating tools for alterations and additions. The issue appears to relate primarily to residential buildings, although a few stakeholders mentioned that similar concerns exist with non-residential buildings.

By way of background, most stakeholders indicated the majority of alterations and additions achieve compliance via the 'elemental', deemed-to-satisfy building solutions. Particularly for smaller extensions, almost all stakeholders (designers and builders in particular) noted that this was their approach. Use of rating tools appeared to be confined to larger (as a share of the existing building floor area) alterations and additions, and also more 'up-market' projects. Using the elemental approach, there is limited scope for uncertainty about the energy performance requirements that apply (to the area of new work).

However, when the designer/assessor chooses to utilise rating tools, AccuRate and FirstRate5 require the presence of a kitchen zone to model the extension appropriately (it was noted that BERS Pro does not have such a requirement). Where the extension/renovation does not in fact include a kitchen, the tools cannot function effectively. One option is to model the whole house but, particularly for an older house, the specifications and inclusions may have poor efficiency characteristics, or be unknown.

A practice has evolved in some states – apparently starting in Victoria – whereby the specifications of the new work (eg, insulation and glazing levels, lighting energy density) may be assumed to also apply in the existing building, for modelling purposes. If the whole building reaches the minimum performance requirement on this basis, then the addition/extension complies.

Several state regulators noted that, due to industry concerns in this area, plans are in place to provide remedies. The above process (more than once referred to as 'the Victoria solution') appears to be being more widely adopted in other states, generally through Practice Notes being issued to this effect. We understand this approach will be adopted in Tasmania, for example. In Western Australia, the Building Commission is currently working to implement a locally developed solution (as described in Section 6.10).

Noting that processes are underway to address the issue in some jurisdictions, and for the purposes of clarity and national consistency, we recommend:

No.	Recommendation	Theme	Pathway	Timeline
25	*That states and territories agree to adopt a single, nationally consistent solution to the application of rating tools to alterations, renovations and/or additions, based upon the advice of the ABCB as to the agreed best-practice solution.*	Delivering quality outcomes	BIC/ABCB to agree preferred solution and amend building regulations (or Practice Notes) to reflect this.	FY2015 – FY2016

6.2.3 Consumer Attitudes and Best Practices

A third group of issues that was raised by stakeholders, specific to alterations and additions, related not to Code compliance but rather to the attitudes of building owners/renovators, their level of awareness of energy efficiency issues, and the extent to which best efficiency practices are or are not being demanded and achieved.

Many stakeholders offered us the view that the popularity of reality television shows involving house renovation is such that it is impacting noticeably on a) the demand for renovation activity, and b) the attitudes that home-owners bring to the renovation design process. In particular, designers reported a strong focus on the part of renovators with achieving a particular 'look', including a 'wow factor'. Attempts to discuss the energy performance of the design concept were generally described as unsuccessful. Rather, home owners were reported as bringing well-formed views to the process that they were reluctant to let go of, including if those views clashed with efficiency considerations.

In some cases, for example where the renovation/addition involves extensive areas of glazing – which may have unfavourable orientation from a solar thermal perspective due to the need to overlook gardens or views – there was a reluctance to accept that high performance glazing, and/or shade structures, may be required. It was also reported that many consumers are seeking to achieve large internal volumes and high levels of natural light in living areas. While these are clearly viewed as desirable attributes, there appears to be limited awareness that they can also lead to problems with over-heating in summer and excessive heating requirements in winter. One designer quipped that he was increasingly seeing "…8-star bedrooms and 2-star living areas", in place of 6 star houses. Where the '2 star' living area represents an addition or extension, it is apparent that compliance with energy performance requirements may be problematic.

Stories such as the above were often accompanied by the perspective, on the part of energy assessors and designers alike, that house owners mostly viewed achievement of efficiency requirements as a compliance burden rather than a positive comfort or design outcome, and/or that they considered efficiency considerations too late in the design process to be willing (or financially able) to consider further changes. Some offered the perspective that house owners' views may have been influenced by builders seeking to maximise the area of new work and therefore their margins. While the survey results offer some support for this view – noting the generally poor opinion of energy efficiency requirements and rating tools in the construction sector of the industry – other stakeholders simply noted that this was 'the market' and that designers and builders have little choice but to give house owners what they ask for and are prepared to pay for.

6.3 Model Regulatory Practice

The review team was challenged to respond to the uncertainty and inconsistency of regulatory practices across the different states and territories, as noted above, by articulating a model approach that could potentially be adopted on a nationally consistent basis. This is indeed challenging, as each jurisdiction has evolved its own machinery to administer its own building laws and regulations. However, as noted earlier, the Inter Governmental Agreement that provides for the operation of the ABCB calls for '...the consistent application of the NCC across and within each State and Territory...' and '...encouraging increased harmonisation in the administration of the NCC across Australia.[18] There should be a presumption of consistency in the application of nationally-agreed laws, with any derogation clearly justified (see Recommendation 10).

We stress that our intention, in putting these proposals forward, is not necessarily to change current practices, but rather to create clarity and certainty for industry and other stakeholders as to what are the requirements of the law.

[18] Available from: http://www.abcb.gov.au/en/about-the-australian-building-codes-board/~/media/Files/Download%20Documents/ABCB%20docs/ABCB-2012-IGA.ashx, p. 2.

6.3.1 Triggers to be contained in the Code

As discussed in Section 6.2 above, we strongly recommend that triggers for the application of building energy performance requirements be included within the Code itself. This will ensure that state and territory laws and regulations that call up the Code will include these triggers by default. This, combined with the recommendation (10) that state and territory variations be justified by regulatory impact assessment, should limit and hopefully eliminate trigger variations from place to place. Industry has cited such variation, and the resulting uncertainty, as a primary concern.

6.3.2 'To the degree cost-effective'

Second, we recall the discussion from the previous Chapter that notes that the phrase 'to the degree necessary', found throughout the Code, is ambiguous. This can be further evidenced by asking, 'what does 'to the degree necessary' mean in the context of energy performance requirements of an alteration or addition?'. We are not aware that there is a good answer to this question. As a matter of sound regulatory practice, regulations should not call up provisions that are ambiguous, as this invites both non-compliance and legal disputation.

Therefore we restate our recommendation that the phrase 'to the degree necessary' be replaced, in at least Section J and Section 3.12, by the phrase 'to the degree cost-effective'. The latter is an objective test that takes into account prevailing economic and policy conditions, which in turn are based on socially-determined judgements regarding acceptable public policy outcomes. Further, the test is contestable by all parties, which means that evidence and reasoned argument may be brought to bear by any party to help resolve the application of the phrase in any particular case.

6.3.3 Provisions to apply to 'a building or part thereof'

Currently, the Code's energy performance requirements apply to 'a building'. Read in context, this implies a whole building, and at best is ambiguous about whether the requirements are intended to apply to alterations and additions (including renovations). This ambiguity could be eliminated by amending the Code text, in Section J and Part 3.12, to replace the phrase 'a building' with the phrase 'a building or part thereof'. This would require a definition of 'part thereof' to be developed and included within the Code text. We suggest that an appropriate definition could be as follows:

> " 'part thereof' refers to any new building work for which a building permit is required".

In most states and territories, all new building work requires a building permit. However, some states and territories have minor exceptions to this, and the above definition would respect those exceptions.

6.3.3.1 No area limitation

In the definition of the building area to which the energy performance requirements are intended to apply, as stated above, we propose that there is no need to apply an area limitation (eg, a minimum size threshold). First, and as noted, it is possible that no building permit will be required for minor works, in which case the new building work will not trigger the energy performance requirements. Second, it is intended that all new work – other than the specific case just covered – would indeed trigger the energy performance requirements. This reflects the fact that these requirements have been agreed by all jurisdictions and have passed the required benefit cost and other regulatory hurdles. Therefore the presumption should be that they apply to all new building work, except where explicitly excluded.

6.3.4 Requirements to upgrade whole buildings to current Code performance levels

The cases considered thus far relate to new building work, be that new buildings or alterations and additions. However, at least some current state and territory regulations – for example, Regulation 608 under the Victorian Building Act – specify thresholds for new building work in existing buildings which trigger a requirement to upgrade the whole building performance to the currently-prevailing new building level.

The intent of such provisions appears to be that *major* renovations of or major extensions to existing buildings are akin to investments in new buildings, and therefore standards relevant to new building work should apply. This also recognises the economic reality that such major renovations or extension represent important (and rare) investment points in the economic life of a building, where there are likely to be cost synergies available in achieving energy performance upgrades – for example, because building professionals will already be onsite, because the new work is required to meet current standards in any case and due to economies of scale.

Regulation 608, which applies only to residential buildings in Victoria, contains elements that could be considered for national application. However, we note that stakeholders noted some limitations to and concerns with the Victorian approach. Two key issues related to the extent of discretion afforded for 'partial compliance' and, secondly, the 3-year/50% of volume trigger, which creates the risk that work conducted in years 1 and 2, which did not comply with current Code provisions (because they did not affect 50% of more of the building volume), might need to be redone, along with the rest of the building, if the trigger is passed in year 3. This would appear to be economically inefficient.

The building surveyor may accept partial compliance where the area of an extension is less than 25% of the floor area of the existing building and less than 1000 sqm, and also where the 50% volume rule is triggered. By implication, therefore, only extensions of between 25% and 50% must comply with the current Code performance requirements, without discretion. The rationale for this is unclear. If the intention of the first provision (less than 25% or 1000 sqm) is the exclude 'minor works', then this should not apply to alterations and additions above the 50% rule. Also, 25% is a high threshold for genuinely minor works.

However, the Practice Note makes it clear that discretion also applies above the 50% threshold, specifically relating to whether the rest of the building is required to be upgraded to current performance standards. On page 6 of the Practice Note, it is made clear that benefit cost considerations should be brought to bear on the investment in question. This is consistent with the approach recommended in this Report, for alterations and addition and for new building work more generally. However, a cost effectiveness test should not be provided as a discretion. If the intention is to not require investments to be made (in energy performance) where they are not cost effective, then this should be clearly stated and applied in defined circumstances.

There appears to be little reason not to apply the current performance requirements to new building work, regardless of size. Smaller extensions/alterations can generally follow well-established DTS rules of thumb. The larger economic question is whether the 'rest of the building' should also be required to comply. Here it would seem appropriate to apply a cost-effectiveness test. To avoid discretion, the form of the wording should create a *requirement* to upgrade (eg, when the 50% test is passed, subject to comments below), *unless* it can be shown that the requirement is not cost effective in the particular case. As noted earlier, the phrase cost effective is amenable to a clear definition, such as 'an investment where the present value of social benefits associated with the investment exceeds the present value of social costs, where both costs and benefits are discounted to present values at a 7% real discount rate'. This form of wording would place the onus on the applicant to provide evidence that it would not be cost-effective to upgrade the entire building. This evidence should be discoverable and contestable. Building surveyors may note that they are not well qualified at present to assess cost-effectiveness in a technically correct manner. However we note that, in Victoria at least, they are doing this already – and therefore if they lack the required skills, this should be attended to through mandatory CPD and accreditation arrangements, as discussed elsewhere in this report.

Returning to Regulation 608, when circumstances apply that allow the surveyor to exercise their discretion to allow partial compliance, it is not clear what 'partial compliance' means in practice. There appears to be no guidance to the surveyor as to what energy performance levels are deemed acceptable. There is the risk that partial compliance could be interpreted as 'no compliance', even if the Practice Note above suggests otherwise. In the solution proposed above, the concepts of 'partial compliance' and 'discretion' would not exist, at least with respect to energy performance requirements. Instead there would be just three possibilities, and these clearly spelled out in the Code text. That is, the new building work is either:

1. Excluded from complying (e.g., due to having a 'minor works' nature);
2. Required to comply; or
3. Required to comply, subject to a cost effectiveness test.

With respect to the 50% volume trigger, this appears a reasonable basis for determining whether a building alteration or addition has a 'major' character. However, as noted, the test as currently applied in Victoria could risk some works undertaken in years 1 and 2 being made redundant by the cut-in of the trigger conditions only in year 3. It is apparent that this test is designed to circumvent the intent of the regulations being undermined by unscrupulous building owners who artificially extend renovations works over multiple years, to avoid triggering the upgrade requirement. At the same time, it is not uncommon for renovations of commercial buildings to be undertaken floor-by-floor, both for financial reasons but also to minimise disruption to building tenants. We note that it is the building owner who carries the risk of having to redo works conducted in years 1 and 2. This should militate against owners 'trying it on', particularly where all discretion is removed from the decision-making process, as recommended. If Practice Notes and other forms of communication were issued, subsequent to a decision to change the regulatory processes for alterations and additions as proposed here, then this could further discourage 'gaming' behaviours. Also, as noted elsewhere, well-publicised prosecutions of those found breaking the law are highly effective deterrents for third parties.

6.3.5 Which performance requirements?

There is a need for the Code to be clear about *which* performance requirements are required to be met when appropriate trigger conditions are met. This is particularly the case for commercial buildings, where Section J requirements apply to numerous building services and not only to facades, but also in the case of residential buildings (where energy performance requirements currently apply to lighting, hot water services, insulation of services and pool/spa pumps).

The easiest answer to this question might be 'all energy performance requirements'. However, we note that this is not the approach taken in Regulation 608, where hot water (and Victorian water tank) requirements for new buildings are not applied to alterations and extensions. By implication, a 'reasonableness' or 'cost effectiveness' test is being applied.

We can envisage three solutions that would limit the requirement for discretion, and therefore maximise transparency and predictability.

First, the requirement to upgrade building services to current Code energy performance requirements (where triggers are passed) could be limited to *the building services being renovated*. That is, where the new building work included replacement of lighting systems but not glazing systems, then only the lighting systems would be required to comply with current Code requirements. This is consistent with current practices.

Second, the requirements could be limited to *sole occupancy units* where new building work is being undertaken. In practice, this could mean that the requirement to achieve current Code performance requirements could be limited to a single tenancy in an office or retail building, or to a unit or floor within a Class 2 building, without triggering a requirement for the balance of the building to be likewise upgraded.

A third option would be to apply a general requirement to upgrade the *whole building* to current Code requirements, in the circumstances where the triggers are met, but *subject to a cost effectiveness limitation*, as described in Section 6.3.4. Practically, this test could require a building owner who is refurbishing lighting on one floor, which triggers the Code requirements, to also upgrade lighting on other floors (which were not intended to be upgraded at this time) because it may be impossible to show that such an upgrade would not be cost effective – most lighting upgrades are cost-effective. However, in the same situation, the owner would not be required to upgrade glazing or HVAC systems, as these may not be cost effective.

When compared with the previous two tests, however, this approach could still involve greater compliance costs, for example the requirement to demonstrate that certain investments (not contemplated by the owner) would not be cost effective. To limit this risk, the cost effectiveness test could be applied only when the first two are not relied upon. That is, the Code would be clear that, above relevant triggers:

- First, where a particular building service is being renovated, it must comply with current energy performance requirements for that service;
- Second, where a sole occupancy unit is being renovated, the requirement to meet current energy performance requirements is limited *both* to the building services being renovated and to the sole occupancy unit or units being renovated; and
- Third, where the 50% volume trigger is met, and multiple sole occupancy units and/or building systems are being renovated, the whole building including its building services must comply with current energy performance requirements, subject to a cost-effectiveness test.

6.3.6 Application of rating tools to alterations and additions

A final question addressed in this model regulations section is how and when building rating tools should be able to be applied to show compliance in the case of building alterations and additions. As a general rule, building owners can choose between deemed to satisfy provisions and alternative building solutions, and use appropriate assessment and verification methods, for any new building work. The problem is that some rating tools, including AccuRate and FirstRate, which are widely used for residential building rating, including for compliance purposes, suffer limitations in their ability to model small sub-sections of houses. For example, the area of new work must include a kitchen for the model to accurately calculate expected energy consumption. However, if the proposed new work does not include a kitchen, the tools may not be able to be used.

One solution to this is simply to rely on DTS provisions. Indeed many stakeholders indicated to the review that this is their current practice, in all bar very large (and expensive) renovations. However, if it is intended to also allow rating tools to be used in these circumstances, it would again seem preferable to adopt uniform requirements across Australia. During the review, we were told that the 'Victorian approach' – where the energy assessor can apply the *r* and *u* values from the extension to the existing building, with the aim of demonstrating that the whole building is compliant (eg, with 6 star) on that basis – is being adopted by some other states and territories, but not all. The limitations of this approach are evident. The ability to show that the whole building meets the current energy performance requirements will be materially affected by the design of the original building. If the original design is poor, from the perspective of thermal performance, then it may remain relatively poor even with higher (assumed) energy performance inclusions (insulation, glazing). In effect, this process implies an averaging of the thermal performance of the old and new building areas, albeit with some assumed modifications to the old, with the net result that the new area may be required to 'over-perform' in order that the whole building achieves the required rating. In this case, it is very likely that the building owner would choose a DTS solution that applies only to the area of new work.

Within the scope of this review, we can only note that there would be some doubt as to the value of applying the 'Victorian solution' to modelled verification methods for alterations and additions, when compared with DTS solutions. Perhaps the option of allowing such a solution should exist, but it appears unlikely to be used often. Further examination of this issue, including simulations of particular alterations and additions under different assessment methods, may be required to determine the most cost-effective approaches.

6.3.7 Summary

To summarise this section, model Code provisions (which should then be consistently applied via building regulations) should seek to eliminate, or at least tightly circumscribe, the exercise of discretion and also concepts of 'partial compliance'. They should take the form of an objective set of criteria, where evidence can be presented, assessed and contested as necessary, to determine when and what requirements apply. Clear instruction on how to demonstrate compliance with requirements is also needed.

Such provisions should specify that, above any agreed 'minor works' thresholds, all new building work is required to comply with current energy performance requirements. This should apply to all building classes (at least those that may be space conditioned).

In the case of major refurbishments, above Victoria's 50% rule for example, the Code should specify that *the whole building is required to comply with the current energy performance requirements, unless evidence can be provided, to the satisfaction of the building surveyor, that such a requirement would not be cost effective in the particular case*. The Code should further specify that the evidence presented in such cases must be publically discoverable (published on a Building Commission website, for example) and contestable through an appropriate legal process.

For the case of alterations and additions that are limited to particular building services, or to particular sole occupancy units, and provided the area being refurbished is less that the Victorian '50% rule', then the requirement should be only for those services or sole occupancy units to comply with current Code energy performance requirements.

6.4 Draft Best Practice Guidelines

Part B of the review included a requirement to develop draft best practice guidelines for alterations and additions, for use by Councils, building owners and the wider industry. We note that, as the roles of these groups vary, so too do the aspects of best practice that are most relevant for them. As a result, our guidelines are sub-divided for each stakeholder group.

The status of these guidelines as 'draft' reflects several factors. We have focused on producing guidance to the overall *process* to alterations and additions. The guidance is largely in the form of checklists and associated explanation. We have not produced information on what *form* best practice should take. We note that the technical issues involved in achieving best practice energy efficiency are extensive – and that Part C of this review has produced a national register of information products – including many related to best energy efficiency practices in building renovation. Therefore we make no attempt to duplicate such materials. Also, Phase 2 of this review is expected to produce additional materials that would be relevant to shaping consumer attitudes towards energy efficient alterations and additions, such as the financial case. Please refer to Appendix B for the Draft Process Guidelines.

7. Knowledge Management

7.1 Introduction

Knowledge management and engagement were seen by all stakeholders as vital to the achievement of energy efficiency objectives. From designers, construction managers, assessors, and building trades to educators and policy makers, all need to know the ways in which their roles in the construction cycle can maximize energy efficiency. All must possess the skills and commitment to implement these if a culture of excellence is to exist.

The aims of Project 3 were:

- To develop a comprehensive national information register of materials that support industry capacity to understand, implement and comply with the energy efficiency provisions of the National Construction Code.
- To conduct a stock-take and quality assessment of all existing websites, published materials and training courses that provide energy efficiency knowledge to the Australian planning, approvals, design, assessment and construction industries.
- To conduct a needs and gap analysis of the energy efficiency information and training needs of various players in the building industry, including those involved in policy development, planning, assessment, approval, design, construction, project management, materials supply and specifying, fit-out, modification and retrofit of buildings.
- To provide preliminary recommendations for high priority, strategic and effective pilot or demonstration knowledge management and capacity building projects in the Phase 2 work program.
- To develop a business case for both a priority work program in the NEEBP Phase 2, and in the next 12 month period to June 2015 and beyond, to deliver pilot and demonstration knowledge management and capacity building services for industry, local government and other relevant stakeholders.

These aims were pursued through independent desktop research and industry interviews, and in collaboration with the Project Teams for projects 1 and 2 in order (i) to share in the conduct of a national survey and a series of national workshop consultations, (ii) to inform and value-add the needs analysis, and (iii) to identify the optimal content and mode of information and skill development required by professions and trades to deliver best practice energy efficiency to the building industry.

7.2 Register

7.2.1 Introduction

A national Register of information materials and training opportunities designed to support industry capacity to understand, implement and comply with the energy efficiency provisions of the National Construction Code was developed. This was done through extensive desktop research, industry interviews and referrals from the national series of workshops conducted with Projects 1 and 2. The Register comprises a comprehensive selection of approximately 250 websites, published materials and training courses that provide energy efficiency knowledge to the Australian planning, approvals, design, assessment and construction industries.

The Register is provided separately to this report as a database spreadsheet and as Appendix C.

Several factors needed to be taken into account in compiling, classifying and evaluating the items for the Register.

First, concern was taken to ensure that the items selected were generally accessible and recommended by stakeholders and/or our own experience as useful. This prevented the inclusion of items that were not easily accessible or that were not generally considered useful (e.g. in terms of out-datedness, narrowness of focus, lack of depth or accuracy, lack of how-to diagrams, too theoretical, etc.).

Second, there is not a fixed distinction between information and training, especially in relation to material resources with many information resources also relevant to the process of education and to training provision. Indeed, these might be seen to lie along a continuum. This made the classification of items in the Register difficult. Thus, the primary 'objective' and the 'pedagogical process' of each item was used to classify the nature or medium of the identified items.

Strategy	Information ⟷	Education ⟷	Training
Objective	To increase awareness & understanding of energy efficiency in construction	To promote: • Knowledge and understanding of energy efficiency in construction as well as • An ability to think about relevant issues, and • An attitude of concern for energy efficiency	To provide practical skills to apply knowledge, skills on the job
Processes	Dissemination of information in a variety of media.	Facilitation of learning through the use of information, communication and pedagogical processes that develop individual and group knowledge, motivation and skills.	• Demonstration, practice and mentoring. • On-going auditing and review of performance and skill upgrading
Example	Website; book, brochure; PDF	VET/TAFE course for certification	Industry or industry association training

Figure 7.1: The continuum of information, education and training used to classify items in the Register

Third, a series of parameters needed to be developed to analyse the patterns across the items in the Register and undertake a quality assessment. Figure 7.2 details the parameters and how the items were categorized and analysed in the Register.

PARAMETERS	CATEGORIES	
Knowledge management strategy	• Information • Education • Training	
Resource Description	• Detailed brief summary of resource	
Endorsement (The organisation promoting the material in addition or if different from above publisher, owner or provider)	• Government • Industry • Education body • Community • Nil	
Level	• General (awareness) • Beginner (introductory info but more in-depth than awareness raising), Intermediate (post certificate or qualification) • Advanced (specialist level)	
Primary Audience	• General Audience (majority of these listed), • Planners/Designers (urban planner, building designer, architect, drafter, HVAC or building service designer, etc.), • Regulatory Assessors (building inspector/ surveyor), • Builders / Managers (construction, project or building/facilities managers), • Energy / Sustainability Assessors (those who conduct walk throughs, use energy modeling software, conduct energy audits or an advisor like a GBCA professional), • Semi-skilled (insulation installer), • Trades (electrician, plumber, carpenter glazer), • Owners/Occupants (those who own or occupy a building), • Other (any other key area, such as real estate agents)	
Format	• Digital • Face to Face • Blended	
Resource Availability	• Public (free) • Private (fee provision) • Unavailable (internal resource not available to the public)	
Link to the NCC	• Design (planning, architecture, drafting, etc.) • Assessment / Verification (energy modelling or verification) • Climate specific	• HVAC • Services (insulated ducts, hot water, pools, spas, etc.) • Maintenance & Monitoring Handover / Operations • As built assessment (post

PARAMETERS	CATEGORIES	
	• Glazing • Alterations / Additions • Building fabric / Thermal / Sealing • Lighting	construction) • Other • All
Building Type	• Residential • Commercial • Both	
Geographical Location	• Australia wide • Tasmania • Victoria • ACT • New South Wales	• Queensland • Northern Territory • Western Australia • South Australia
Link to source	• Internet link to resource or face to face training description	
Notes	• Additional notes	
Other associated links	• As noted	

Figure 7.2 Parameters and categories used to describe items in the Register

Finally, a quality assessment of all items in the register was undertaken according to three criteria: Validity (accuracy), accessibility, and endorsement. Figure 7.3 details how this assessment was undertaken.

QUALITY ASSESSMENT CRITERIA	
Validity	*Level of Accuracy:* To what extent does the information accurately inform the audience about compliance or going beyond compliance? • High (3) • Medium (2) • Low (1)
Accessibility	*Availability and utility*: To what extent is the item accessible, easy to find and use, and inexpensive? • High (3) • Medium (2) • Low (1)
Endorsement	*Endorsement* - To what extent has the item been endorsed by industry or an education provider? • High (3) • Medium (2)

QUALITY ASSESSMENT CRITERIA	
	• Low (1)
Quality Average	Average of the three quality criteria

Figure 7.3 Parameters used to assess the quality of the items in the Register

The following sections summarise the patterns in the Information Register (Section 7.2.2) and provides an assessment of the quality of the items listed (Section 7.2.3). The analysis of the Register, together with the results of the survey and industry consultations, were then used to conduct a needs and gap analysis of the energy efficiency information and training needs in the building industry. The results of this analysis are also reported in Section 7.4 Implications.

It should be noted that the Register is not a complete stocktake of every information resource or training opportunity available on energy efficiency in Australia. Similarly, the quality assessment that has been undertaken is limited to a few criteria and was completed by a small, unrepresentative team. However, the exercise proved not only useful in identifying criteria for assessing the quality of available industry and training as well as identifying gaps and needs but also in proving the value of establishing national standards for energy efficiency information materials and training. The difficulty in locating and collating these materials also proved the value of establishing a national clearinghouse.

Therefore, we recommend:

No.	Recommendation	Theme	Pathway	Timeline
26	*That a national clearinghouse for efficiency information materials and training be established. To be comprised of representatives from government, industry and consumer groups and be established to maintain a national clearinghouse for energy efficiency information materials and training, including the development of standards for the quality assessment of entries.* *The clearinghouse would be responsible for sourcing, validating and disseminating information, education materials, and training links to accredited providers. Ideally this would serve as a one-stop-shop for government, industry and education providers to access searchable online information when and where they need it.*	*Delivering quality outcomes* *Engaging industry and the community*	*BIC/ABCB to review and develop specific proposals; the Energy Efficiency Exchange could host. Consortium led by the ASBEC with invitations to all stakeholder groups.*	*FY2015-2016*

7.2.2 Patterns of information materials and training opportunities

Knowledge management strategy

The Register contains 231 items, including 43 per cent that were information only, 35 per cent that were educational in purpose, and 22 per cent that were for industry training, as depicted in Figure 7.4. Of this total, 61 per cent related specifically to residential buildings and 39 per cent to commercial buildings. Only a tiny fraction of the items in the Register related specifically to energy efficiency materials, systems or tools for alterations, additions or retrofits for either residential or commercial.

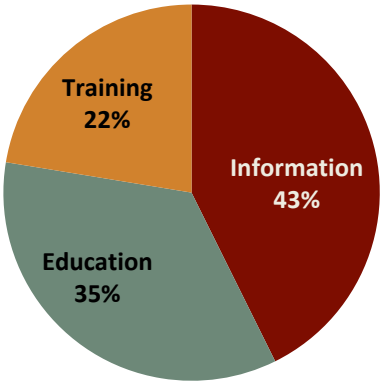


Figure 7.4: Classification of strategies for knowledge management.

Intended audiences

The conceptual and skill levels of the items in the Register are quite diverse and spread across general, beginner, intermediate and advanced audiences, as shown in Figure 7.5. Most of the information and training resources were classified as 'intermediate', i.e. designed for post-trade or post-professional qualification. The beginner level accounted for 22 per cent with only 15 per cent at an advanced level (e.g. for energy specialists in the building industry). Another quarter of the materials was uneven in level and have been classified as 'general' but it should be noted that one problem with this set of items is the lack of direct audience focus.

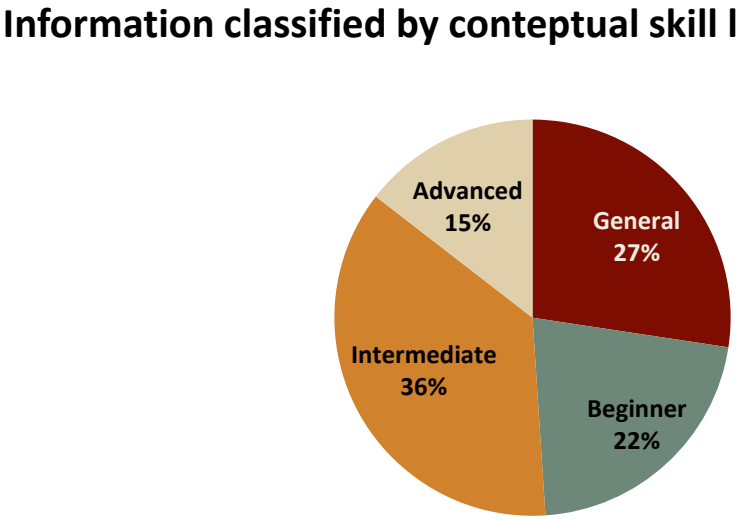


Figure 7.5: Classification of items by conceptual and skill level.

This is also a problem when the items are analysed according to the phase/role in the construction cycle as more than a quarter of the items were for a general or semi-skilled audience (Figure 7.6) – with the tendency perhaps to be interpreted as not relevant for particular roles or trades. By far the majority of the items were specifically prepared for planners/designers, energy/sustainability assessors or regulatory assessors. This may indicate that information and training directed to the steps of designing for energy efficiency prior to construction and then assessing the design or finished building are appropriately catered for. However, only 12 per cent of the items were for building managers and 14 per cent for all the trades combined – perhaps indicating a reason for the problems that undermine energy efficiency outcomes discussed in Projects 1 and 2, such as inappropriate workmanship, installation and substitution of specified materials.

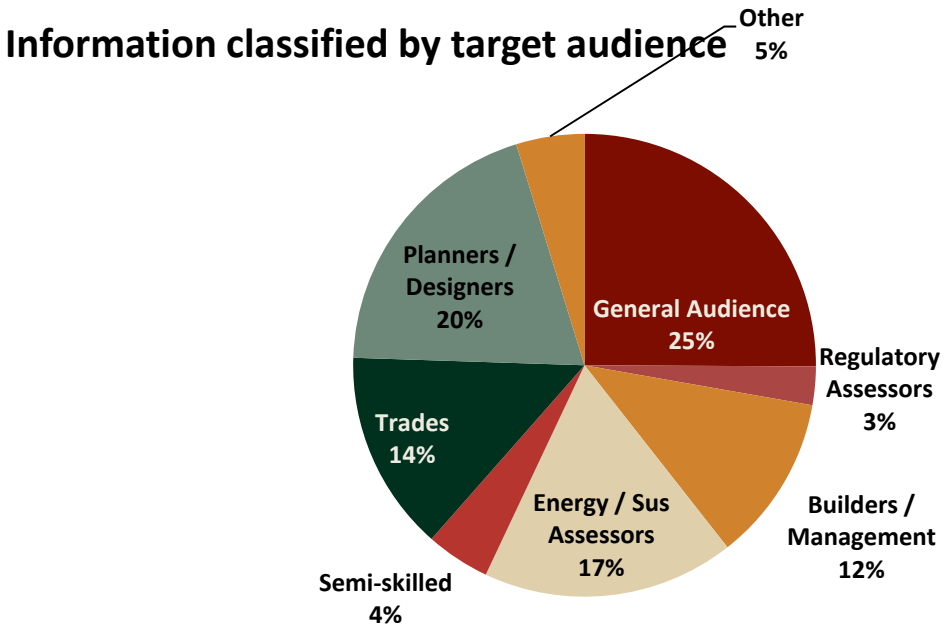


Figure 7.6: Classification of items by intended trade or professional audience

Format and availability of items

The items in the Register were almost all available to anyone, either free of cost (53%) or for sale (46%). Only 1 per cent was for private use internal to an organisation.

The items were primarily electronic or digital in format or source, comprising websites and associated guidelines, calculators, tools, toolboxes, brochures, e-books, etc. Figure 7.7 shows these as being 73 per cent while 20 per cent involved face-to-face courses. The small balance comprised resources that integrated on-line resources with course attendance.

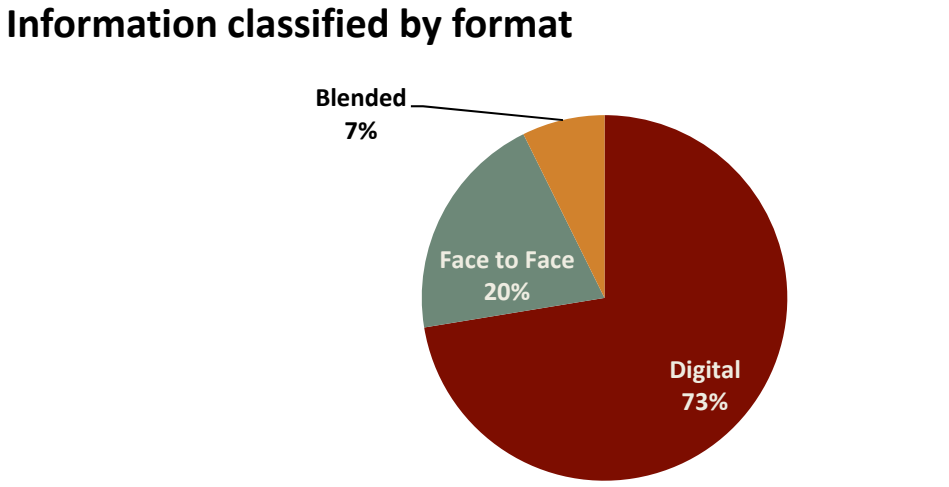


Figure 7.7: Formats of items in the Register

Link to the National Construction Code

Most of the items in the Register were linked to the National Construction Code (NCC) either directly or by their relevance to related themes. As shown in Figure 7.8, the items quite evenly spread across the key areas of the NCC. Similar to findings in the stakeholder survey reported below, the majority of the items focus on design, glazing, lighting, HVAC, services, building fabric, thermal comfort and sealing. There is still an opportunity to target key hand over stages and maintenance and monitoring in the building cycle as well as support to build capacity in alterations and additions and as built performance assessments.

It should be noted that although information and training for homeowners / owner builders was outside the scope of this project, there seemed to be a particular dearth of adequate information, thus indicating consumer responsibility should be a priority area for further research.

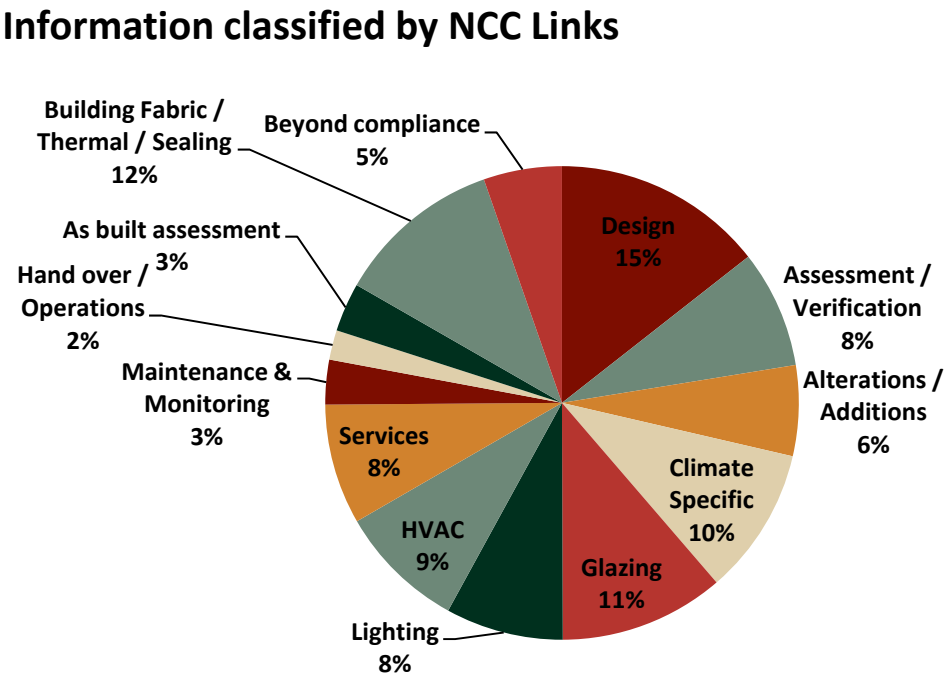


Figure 7.8: Relevance of items to the NCC

Geographic relevance

Although the Information Register is not fully inclusive of all the available information in Australia, Figure 7.9 shows that nearly two-thirds of the items in the Register have a national focus and are not aligned to the regulatory environment of any particular state/territory or to a specific climate zone. This generality is fine for communicating general principles of energy efficiency but can lead to problems in the implementation of the principles in specific building projects in specific location. Added to the lack of relevance of the majority of items in the Register to specific audiences/construction roles, this lack of specificity is a severe shortcoming in terms of the practical utility of the items in the Register and their value as actual implementation guides.

In particular, it should be noted that very few items were specific to the climates in the tropical north or inland desert areas of Queensland, Western Australia, and the Northern Territory. The face-to-face stakeholder contributions validated these findings indicating climate specific information and training is a key area for improvement in energy efficiency in Australia.

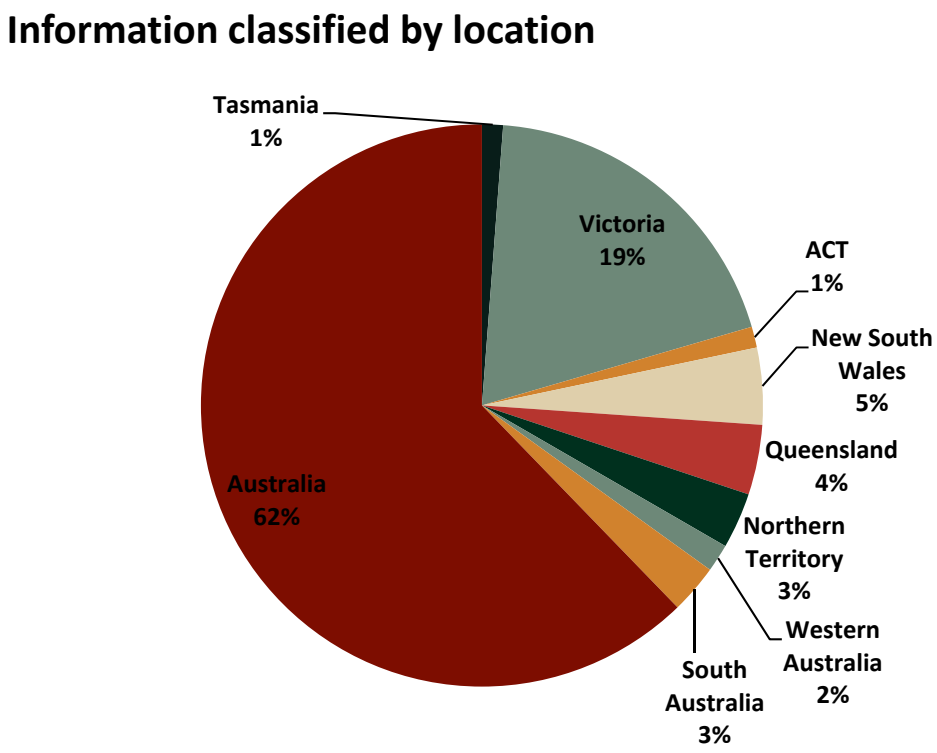


Figure 7.9: Relevance of items in the Register to different geographic areas

7.2.3 Quality assessment

The criteria used to assess the quality of the items in the Register were outlined in Figure 7.3. These were: Validity/accuracy; Accessibility; and Endorsement. Each item in the register was assessed on these criteria using the parameters listed. This resulted in a score out of 3 for each criterion, and an average quality score across the three criteria:

- ***Validity or the Level of Accuracy***: To what extent does the information accurately inform the audience about compliance or going beyond compliance
- ***Availability and utility***: To what extent is the item accessible, easy to find and use, and inexpensive
- ***Endorsement***: To what extent has the item been endorsed by industry or an education provider

Sometimes, scores could not be given for all three criteria for some items due to cost or because it is a training program that members of the wider Swinburne team had not undertaken. These were assessed as Not Applicable reducing the overall average. However, if the education or training course is specified accredited it would automatically be assessed at a medium without further endorsement due to the quality assurance imposed in the accreditation process.

The scores on the three quality criteria are provided in Figure 7.10A. Overall, there is little variation between them with the majority of items in the Register being assessed as being of average and high quality overall (Figure 7.10B).

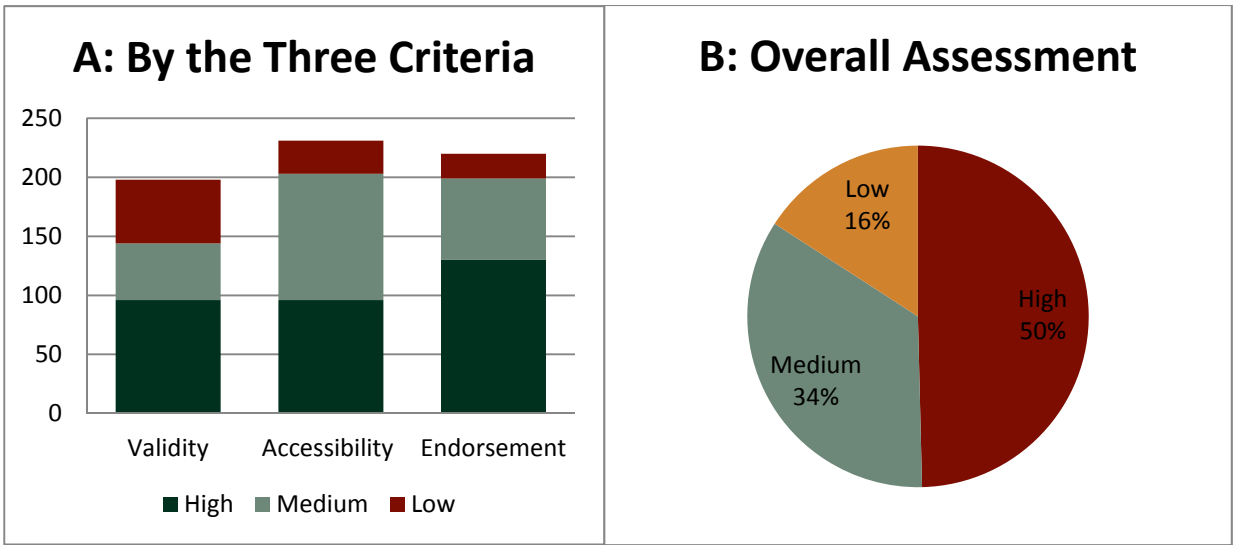


Figure 7.10: Quality assessment of items in the Register

The quality assessment of the items in the Register indicates that there is no lack of quality (accurate, accessible and endorsed) information, education or training for energy efficiency in Australia. Rather, as discussed below in relation to the stakeholder consultations, there is a significant lack of engagement from industry practitioners on the topic. The reasons for this were discussed at length with stakeholders. Their responses are analysed in Section 7.3, but briefly, the reasons related to the following summary of the items in the Register.

In general, the majority of available information resources and training opportunities are too general in terms of:

- Conceptual and skill level,
- Theoretical orientation rather than pracitial utility for application,
- Geographical/climate zone specificity, and
- Trade or profession specificity.

In the stakeholder workshops, concerns were also expressed about the abstract nature of the language used in materials and difficulty for many skilled trades and professionals to read. No assessment of readability levels were made as it was outside the scope of this study but this appears to be a major issue for future work.

In conclusion, the key problem is not the lack of availability of quality information or training but that what is available does not offer practical application to implementation - the 'how to' information, education and training – that can readily be integrated into daily work tasks.

7.3 Stakeholder perspectives

7.3.1 Introduction

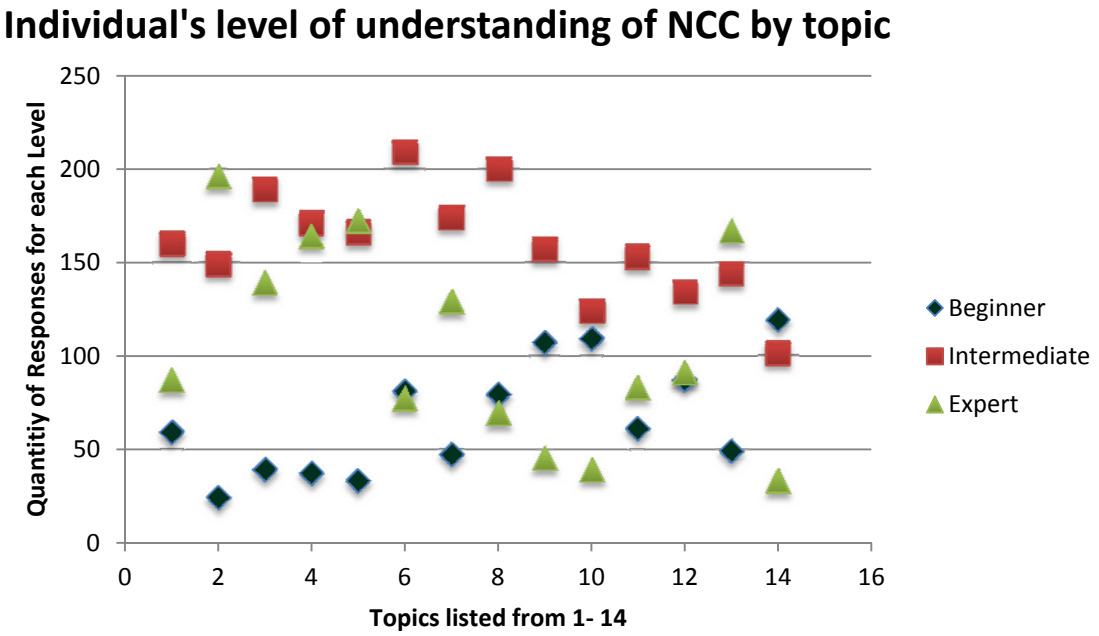
The perspectives of stakeholders in all states/territories and climate regions, and in roles at all phases in the construction cycle, were solicited for this review. This was undertaken in two ways: through an open online survey and through a series of workshops/focus group discussions held in all states/territories and in almost all climate zones. This summary of stakeholder perspectives below is based upon both sets of data.

As previously indicated, the survey respondents indicated that the lowest response was from tradespeople and end users (e.g. facility managers and building owners together accounted for only 3% of responses). However, amongst the remaining respondents, there was good spread across other professional groups with energy assessors and those responsible for building design best represented. The remaining 13% of respondents either did not report a profession (5%) or nominated service activities such as draftsmen, estimators, academics and those involved in research and education, government policy makers and regulators or sustainability professionals working for building operators. Builders, construction supervisors and engineers as a group accounted for about 14% of responses, while building surveyors accounted for 11% of responses.

7.3.2 Survey

Self-rating of Level of Understanding

Several questions in the survey sought responses about the provision of appropriate information and training opportunities. They were first asked to rate their level of understanding of compliance requirements for building energy efficiency outlined in the National Construction Code. If the topic was unrelated to their role, they were asked to omit it. Based on the respondents, Figure 7.11 shows a majority rated their current level of understanding as intermediate (red square) or expert (green triangle).



Legend

1. Planning and subdivision
2. Building fabric
3. Glazing
4. Thermal mass
5. Building sealing and insulation
6. Air conditioning and ventilation
7. Materials specification
8. Artificial lighting and power
9. Hot water supply, swimming pools and spa pool plant
10. Access for maintenance and facilities for monitoring
11. Retrofit
12. Section J compliance
13. Passive solar design
14. Ducting

Figure 7.11: Respondents' self-rating of understanding of energy efficiency topics in the NCC

Self-rating at the expert level of understanding were provided for: passive solar design, thermal mass, building fabric, and building sealing and insulation. The key areas in which an improved understanding is required are in the following specialist areas of practice:

- Planning and subdivision
- Air conditioning and ventilation
- Ducting
- Artificial lighting and power
- Hot water supply, swimming pools and spa pool plant
- Section J compliance
- Access for maintenance and facilities for monitoring
- Retrofit

Current Level of Education

Figure 7.12 shows that 248 of the over 500 respondents indicated that they had trade or professional training at the Certificate / Diploma (42%), Graduate (31%) or Post Graduate levels (27%). 66% of these indicated that they had completed some form of training in passive solar design as part of their qualification. This means that two-thirds of half the respondents (ie approximately one-third) indicated that they had undertaken training in passive solar design.

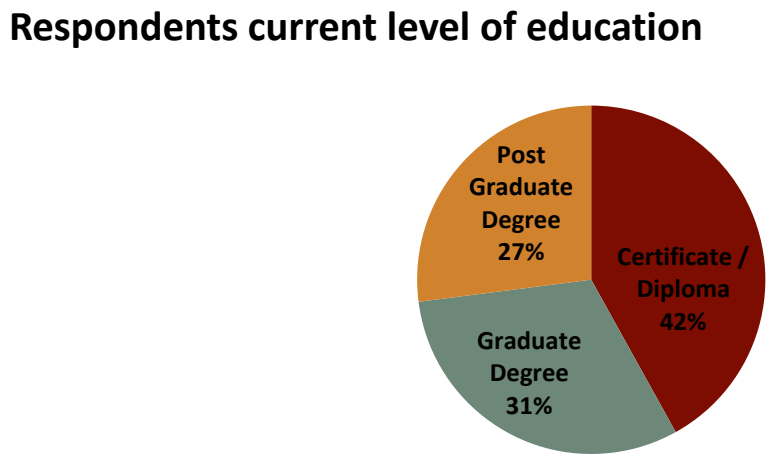


Figure 7.12: Levels of training of respondents in general

Adequacy of Information

The participants were also asked about their perception of the adequacy of the information materials available on various building energy efficiency topics. They were asked to rate the adequacy of the available information on a three-point scale (1 = Poor; 2 = Acceptable; and 3 = Excellent). As Figure 7.13 shows, most information was rated as 'acceptable' or 'excellent'.

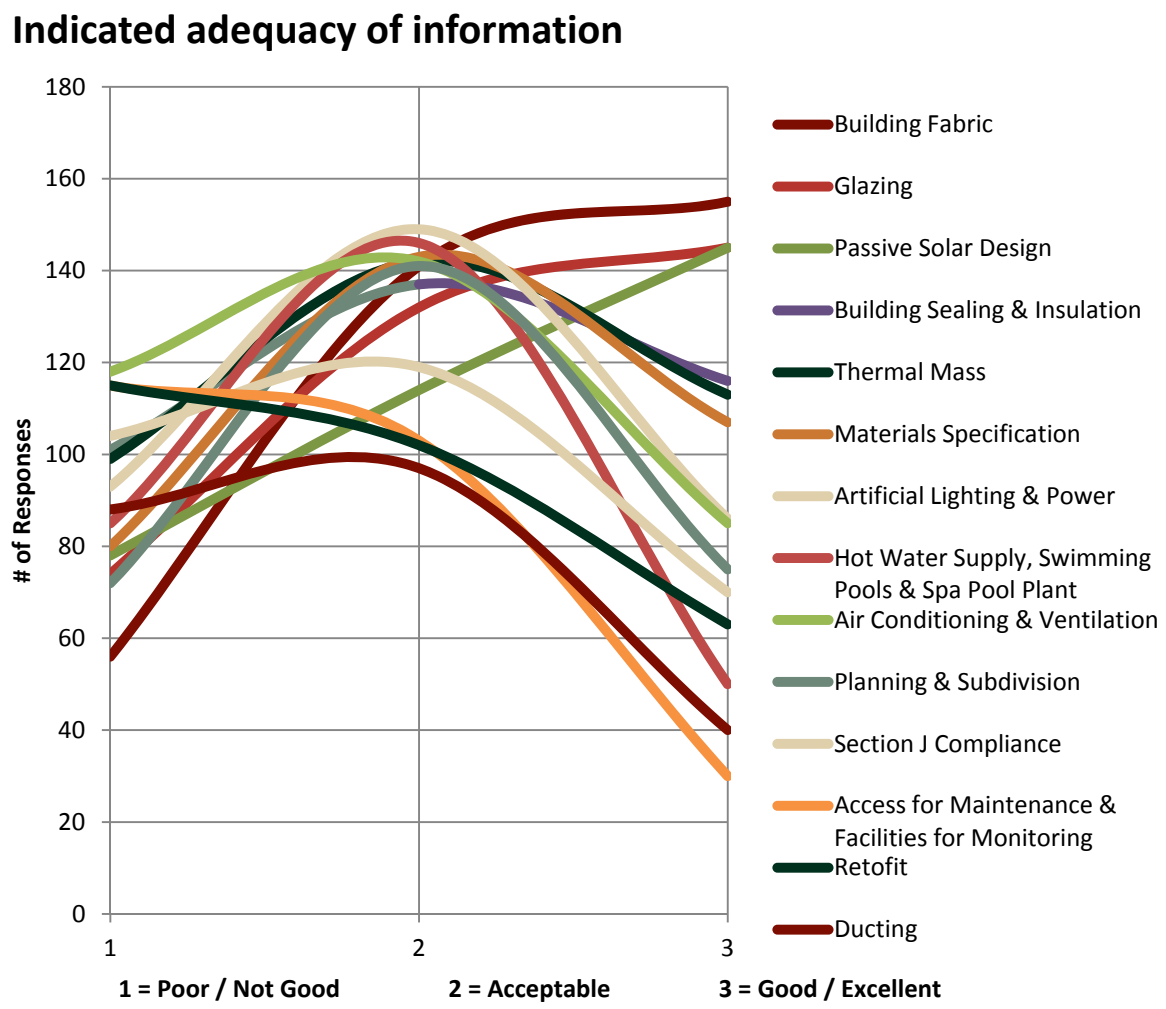


Figure 7.13: Adequacy of Available Information

The topics rated as being 'excellent' most often included:

1. Building Fabric
2. Glazing
3. Passive Solar Design
4. Building Sealing & Insulation
5. Thermal Mass

The topics rated as being 'poor' most often included:

1. Air-conditioning and ventilation
2. Access for Maintenance & Facilities for Monitoring
3. Retrofit
4. Planning and Subdivision
5. Section J Compliance

An invitation to provide open comments indicated a strong need for information on:

- Energy Efficiency Foundations
  - Energy efficiency principles
  - Healthy materials, indoor air quality, condensation risk, etc.
  - The need to look at Energy efficiency as part of a whole - not all about a single item
  - Shading devices
- Retrofit
- Energy Assessment
  - When to use which DTS solution in EP & HERS software and how they differ
  - Thermal Performance Assessments & Part 3.12 NCC BCA V2
  - Material Thermal Performance Assessment
  - Air Pressure Testing
- Sealing
  - Air infiltration and ex filtration
  - Sealed buildings, ventilation and consequential leaking buildings syndrome
- Design
  - Climate response building elements for dry hot climates
  - Climate response building elements for tropical climates
  - Use of vegetation, landscaping, orientation for ventilation etc.
- Construction - Different types of construction
- Energy & HVAC
  - Appropriate renewable and sustainable technologies and renewable energy systems. Solar cooling
  - Energy efficiency performance validation.
  - Information about low energy consuming ventilation systems (e.g. Ventis) is very inadequate. Ventilation often combined with air conditioning, could be better treated separately
- Lighting
  - Controls and automation.
  - Daylight
- Beyond compliance
- Landscape design for amelioration of microclimate and urban design / environmental impacts of built form

One written statement seems to summarize the predicament in this area – and a solution:

> *It [Information on energy efficiency] should be removed from the BCA into a standalone, easy to read, plain English document.*

Further Developing Knowledge & Skills

Participants were asked to indicate their level of interest in developing their knowledge and skills in building energy efficiency further. An overwhelming 90 per cent responded positively while 4 per cent indicated a firm lack of interest (Figure 7.14).

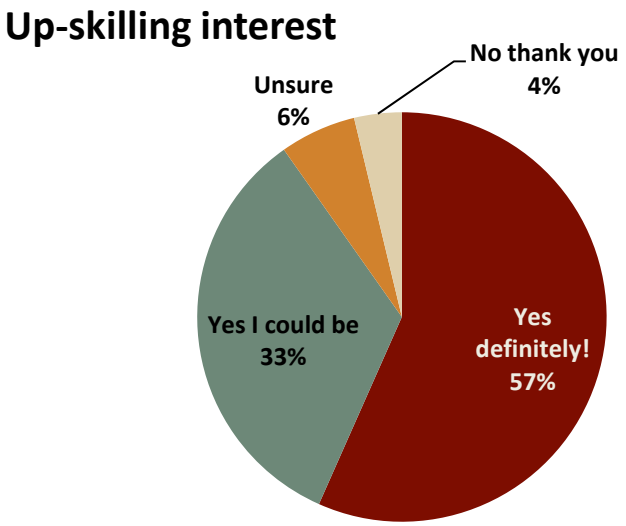


Figure 7.14: Level of interest in developing energy efficiency knowledge and skills further

Motivations and Drivers for Training

Figure 7.15 shows that the top three motivations for further training were: (i) that the training related to compliance issues; (ii) training is a requirement for a license or professional accreditation; and (iii) industry association promotion.

The least influential drivers included: (i) the offer of 'freebies' for attendance; (ii) costs; and (iii) that a university or vocational educator provides the training. With regards to the latter, one of the comments was that the trainers needed to be current industry practitioners who have experience and currency with regard to theory and practice.

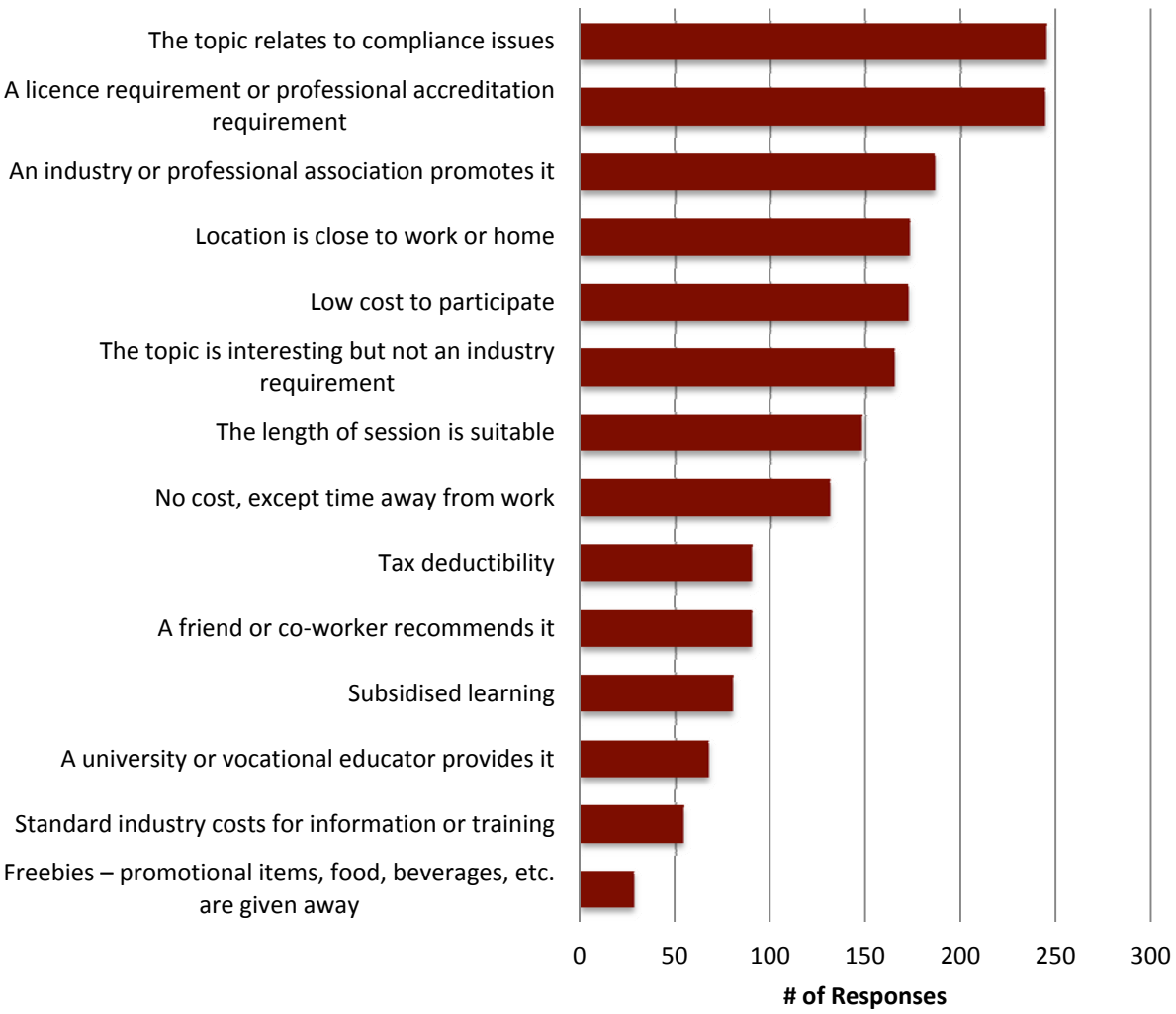
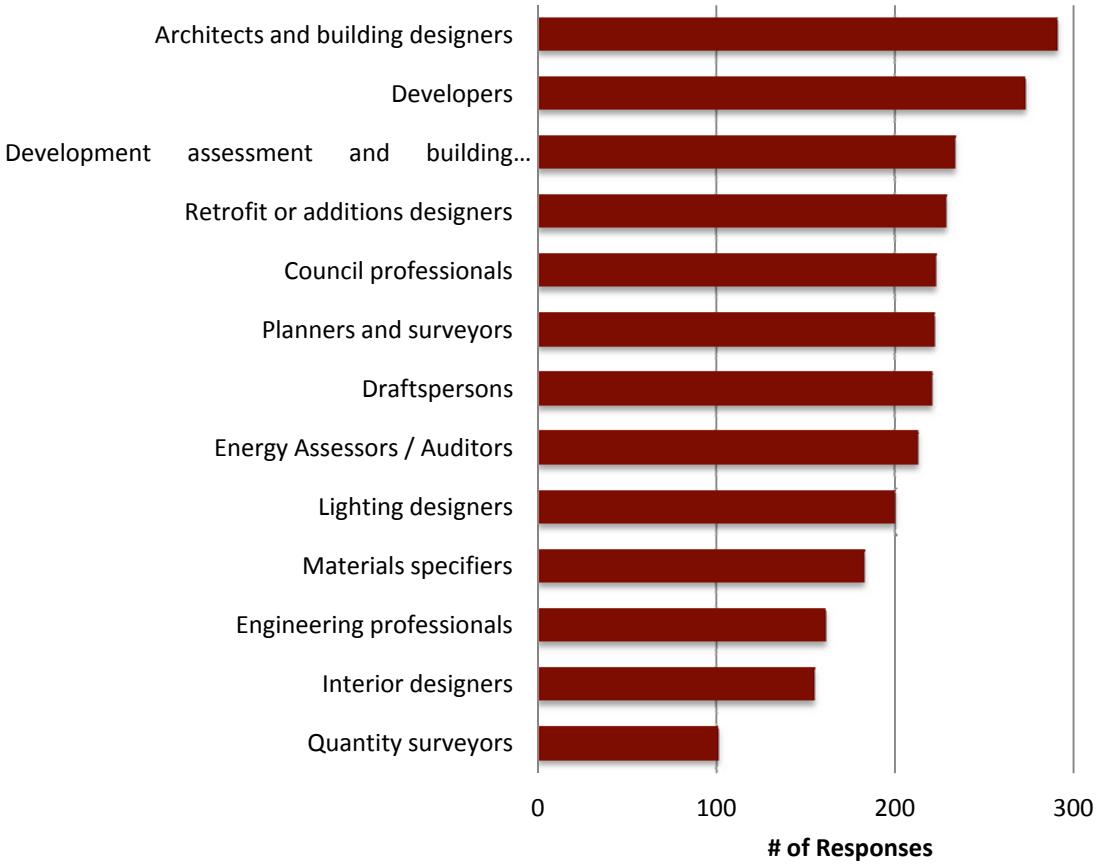


Figure 7.15: Motivations and drivers for training

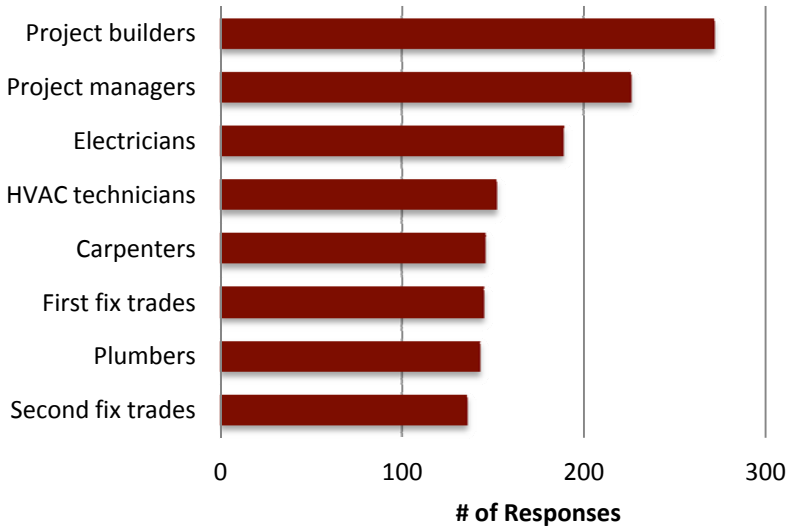
Perception of Training Needs by Roles in the Construction Cycle

Respondents were asked to indicate which roles they believed would benefit most from additional energy efficiency training and skills support. Figure 7.16 indicates responses to this question according to three phases of the construction cycle - pre-construction, construction and supply chain roles. The roles perceived to benefit most are listed at the top. The top three nominated from across the industry were: Developers; Architects and building designers; and Owner builders or clients. These are predominantly pre-construction roles.

Pre-construction roles



Construction roles



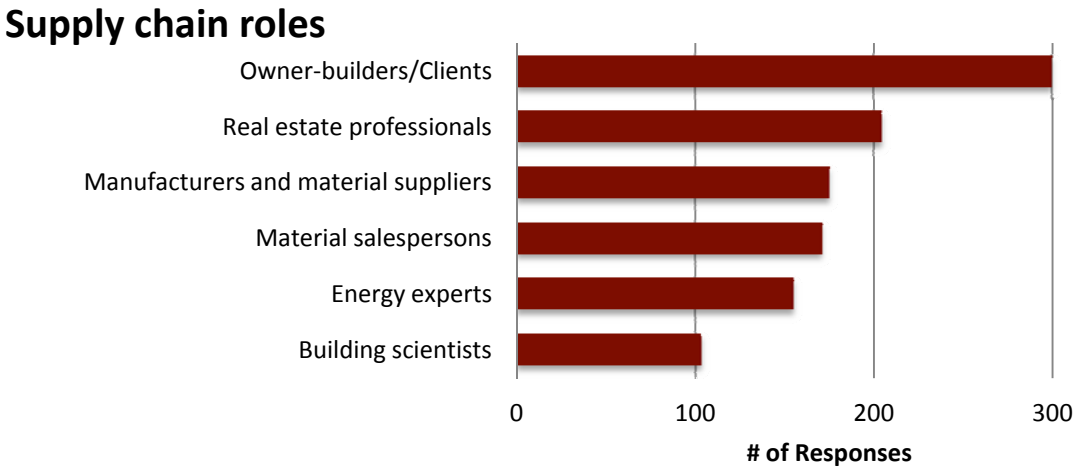


Figure 7.16: Perceived need for training in different construction roles

Information and Training Preferences

Survey participants were asked a range of questions related to their preferences for information and training.

As Figure 7.17 shows, the preferred Information mediums were:

- Online information (websites, links, You Tube)
- Online tools or calculators
- Paperbased information, e.g. brochures or factsheets

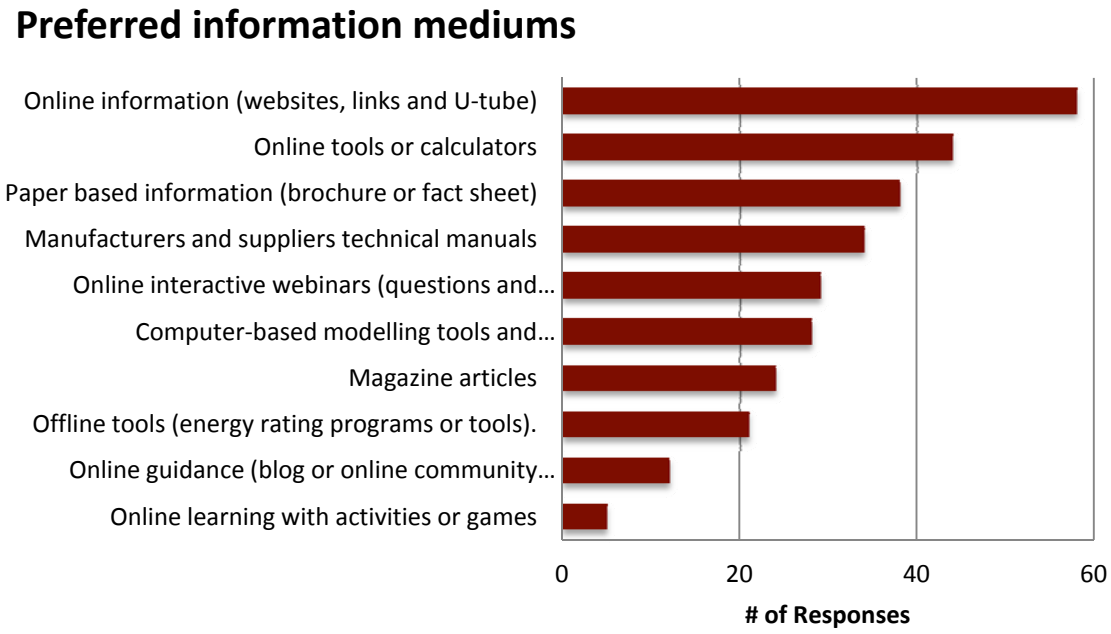


Figure 7.17: Preferred information mediums

As Figure 7.18 shows, the preferred Types of Training mediums were:

- Industry-led formal training (seminars and workshops)
- Industry-led informal training (trade nights, expos)
- Fellow workers or industry associated on the job training (peer to peer)

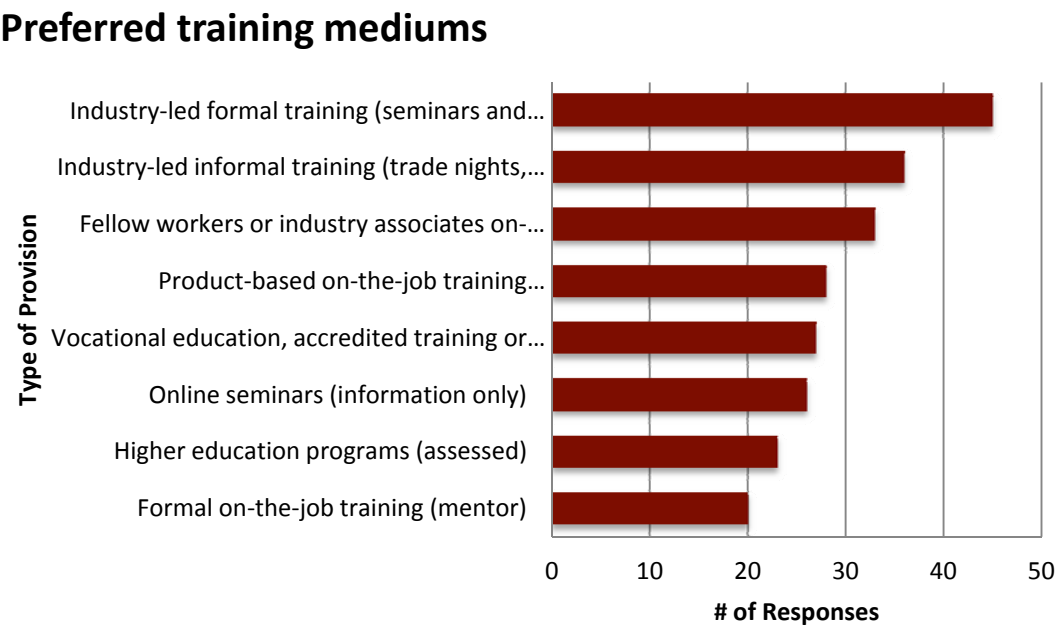


Figure 7.18: Preferred types of training

Figure 7.19 shows a variety of preferences for Face to Face Training Delivery Methods with the three most preferred being:

- Face to face workshops with information and activities
- Face to face seminars with information only
- Short face to face workshops with no assessment

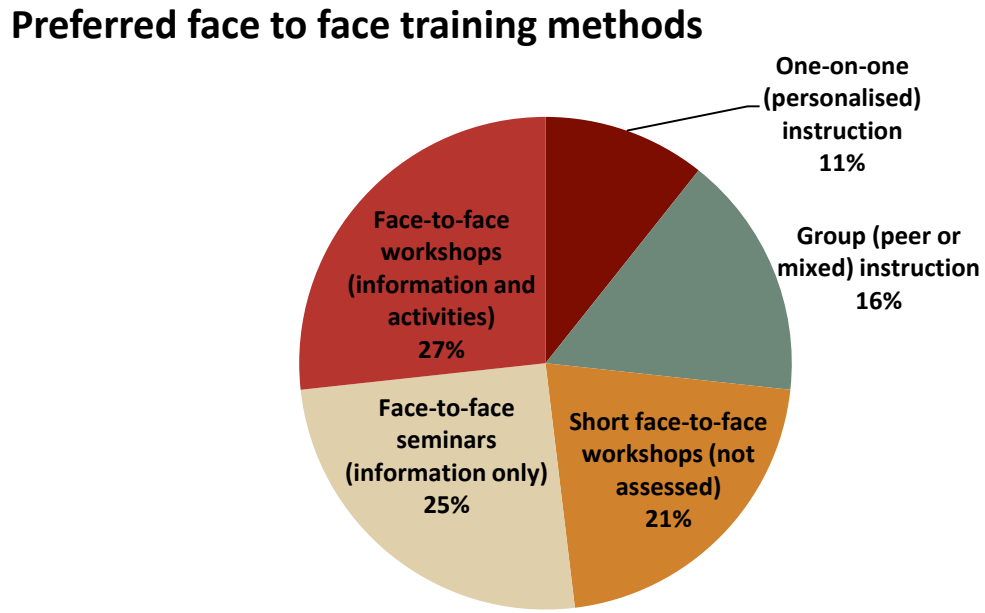


Figure 7.19: Preferred types of face-to-face training methods

As Figure 7.20 shows, the preferred times for training are:

- Tuesday to Friday mornings, followed closely by Monday morning
- Monday to Thursday afternoons, followed by Friday afternoon
- Monday to Thursday evenings, followed by Saturday morning

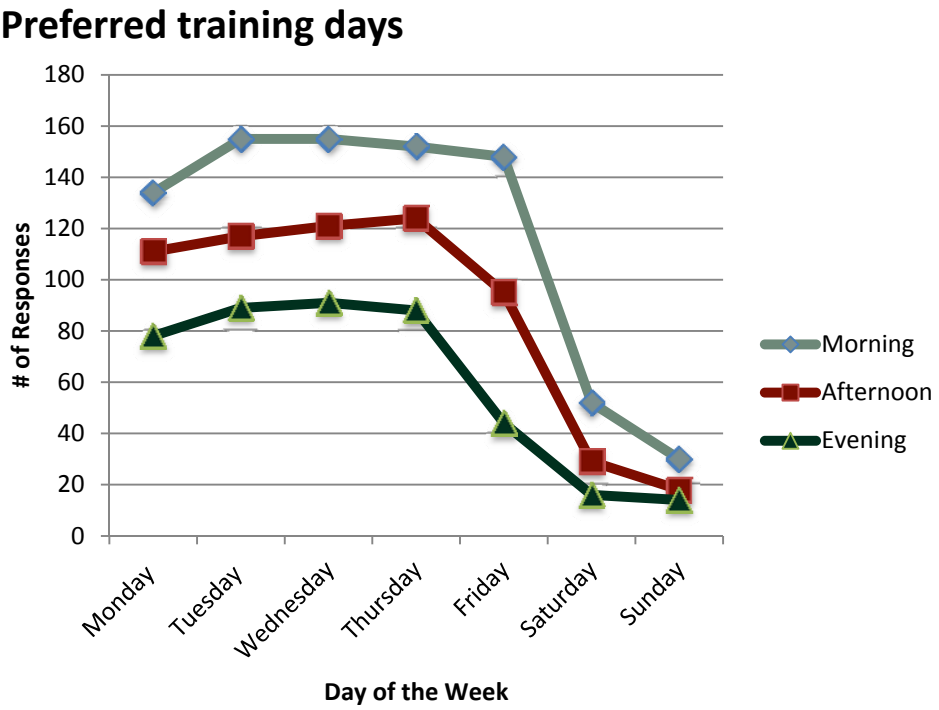


Figure 7.20: Preferred times for training

In terms of duration, most respondents indicated a preference for short training sessions in one sitting rather than sessions drawn out over several days or weeks. Some indicated a need for flexible online engagement at times of their choosing (Figure 7.21).

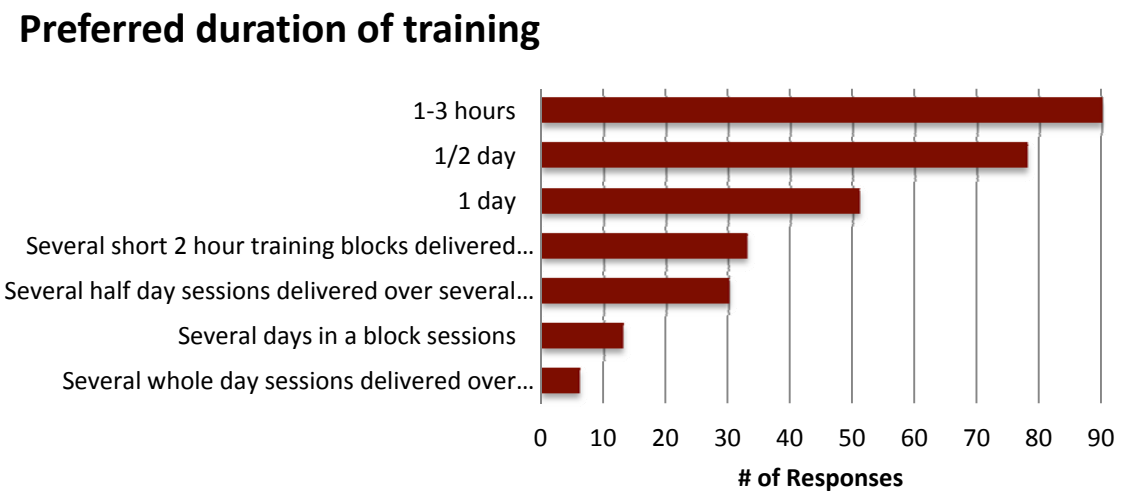


Figure 7.21: Preferred duration of training

Summary of Survey Responses

Overall, the responses to the survey questons on information and training indicate:

- A need for free online materials directly related to the National Construction Code
- A preference for training to be provided in short sessions linked to an overarching body of knowledge linked back to the fundamental principles of energy efficiency and sustainable design.
- A balanced focus on theory and proven methods with examples of how skills can be used in practice.
- A preference for industry-led training and peer mentoring on the job.
- Training to be directly linked to compliance or a license or professional accreditation requirement.
- 90 percent of survey respondents would definitely be or could be interested in further develoing their knowledge and skills in energy efficiency.

7.3.3 Stakeholder Consultations

As previously noted, face to face consultations were carried out with participants from all roles within the construction cycle and representation from each state and territory. Although a diverse range of issues related to the NCC, rating tools, inspections, etc. were expressed, comments on knowledge management and engagement were quite consistent across the nation. The general message is that there is a significant need to review and support information and training related to:

- Energy conservation measures, energy efficiency, carbon abatement and sustainable building methods;
- Compliance with the NCC and assessment;
- Responsibility sharing and accountability of various industry roles to ensure each role has the correct information and skills for compliance;
- Continuing professional development and regulatory license requirements.

Industry associations reported providing information and engaging those currently in the workforce, although it was indicated that these programs need to be directed more to the mainstream, not those in niche markets such as Green Star commercial buildings and bespoke housing.

A major structural flaw undermining the goal of optimal energy efficiency was repeatedly identified as a generally poor attitude across significant parts of the construction industry to both (i) quality workmanship, and (ii) energy efficiency. These are structural or systemic problems in that such attitudes cannot be attributed to isolated individuals. Rather the flaws in the regulatory environment combined with extreme cost pressures on a the majority of construction industry participants appears to produce a culture that accepts 'shortcuts' or 'near enough is good enough'. This prompted discussion of the failings of the pre-vocational system and the narrowness of the form of competency-based training upon the system is founded. The attitudinal and knowledge base of competencies were seen as being diluted through the lack of emphasis on basic sustainability thinking, foundational understanding of energy efficiency concepts, and critical thinking. This often resulted in simplistic teaching towards, and assessment of, minimum standards of skill performance. Coupled with the "minimum standards" on which the National Construction Code is based, the practice of minimal skill accreditation in training do not provide the basis for a culture of excellence in workplace practice. New approaches to pre-vocational education and training were seen as vital.

Nevertheless, several excellent approaches to training were recommended. These were generally in the CPD phase of training and were the result of mandatory training and auditing for continued accreditation. BDVA and plumbing programmes were recommended as worthy of further study and replication as was the mentoring program of the Australian Apprenticeship Centre and the Graduate Certificate of Sustainability for VET instructors convened by Swinburne University.

Information development and support

The participants in consultation indicated that these key areas and opportunties are of critical importance across the states and territories:

- There are ongoing quality assurance issues related to workmanship and competing priorities due to a lack of knowledge, skills, commercial pressures and material suppliers.
- What are the trusted sources?
  - Independent sources
  - Institutions
  - Local government or councils
  - Energy providers are often not trusted
- The NCC is viewed as 'best practice', not minimum compliance, it is hard to read, understand and implement.
- Energy conservation measures and efficiency gains are viewed as too complex and instead of developing some foundational knowledge, the tasks are outsourced to specialists, but not always at the most suitable time.
- There are often gaps in the process cycles and information provision between building practitioners, thus encouraging of 'tick and flick' assessments rather than appropriate care and evaluation.
- A review is needed of the quality of training related to facility managers for efficient operations, management and maintenance of buildings.

- Universities and TAFEs are often producing graduates with insufficient skills to deliver energy efficiency outcomes and are slow in responding to industry needs.
- Development and support for market based mechanisms, such as rating systems, to drive improvements and engagement in education.
- Training, accreditation and licensing is not consistent in all states and territories.
- Revise the ABCB Handbook to increase the use of 'plain English' and incorporate more 'how to' diagrams and drawings with instructions.
- Use a branded, well recognised, trusted organisation and marketing strategy.
- Develop a series of demonstration buildings (physical or online) to demonstrate the variations to design, materials and construction methods with post – construction performance test verification descriptions for climate specific buildings.
- Consumer information on home operation and maintenance is vital: "A new TV has a 100 page manual but a new building comes with zero instructions - why?". Similarly: "you get a roadworthy certificate, a manual and maintenance schedule when purchasing a car, but often nothing with the purchase of a new home".
- Use smart phones to deliver training and engage consumers
- Your Home Technical Manual could incorporate more guidance and interpretation of the detailed, technical information. The 'Your Future Home' is viewed as overly 'simple'.
- Develop a beyondbasix.com website (this exact website title would be used in NSW) to assist practitioners to achieve best practice, not just minimum compliance.
- Make the NCC freely available online
- Develop short sharp easy to understand resources - role / industry specific - aligned to key aspects of the NCC in plain English such as
  - Factsheets on key aspects like air tightness, passive and active ventilation, alterations and additions, maintanence opportunities, etc.
  - Product selection pit-falls – what to look out for!
  - Glazing cheat sheets.
  - Case studies on costs and benefits.
  - Case studies on construction methods.
  - Case studies for consumers on operational oportunities.
  - "End to end case studies" on building testing post construction to demonstrate the design and construction features which contribute to performance.
  - Develop comparative lifestyle, building type, location comparisons.
  - Collect and disaggregate energy use based on building types to develop case studies
- Engage the Clean Energy Finance Corporation (or similar) to communicate awareness on standards and techniques used to measure, calculate and guarantee exact financial savings.
- Development of a database of materials aligned to climate zones for building pracitioners.
- Develop a standardised data framework to enable information sharing on the translation from design features to construction performance.
- Compliant product register – voluntary registration of products with certification.

Industry Engagement Support

The consultation participants indicated that these key areas and opportunties were of critical importance in increasing industry engagement with energy efficiency training:

- Clear and consistant training programmes are vital.
- Basic energy literacy across all roles is an issue. Beyond the basics, building science is a key gap in the market.
- Engage with industry associations to review and /or develop training to deliver to industry.
- Develop a marketing strategy to engage building pracitioners in knowledge and skills development -as one participant said, “Our members don’t know we do training”.
- All building practitioners need to be required to engage in continuing professional development via a licensing / accreditation requirement.
- Develop and deliver a knowledge management program to create industry awareness about the opportunities related to integrated project design and delivery processes, including design workshops for both commercial and residential building projects. This would facilitate the integration of industry roles at an earlier stage in the construction process to reduce costs and achieve compliance requirements through group upskilling.
- Use post construction mandatory disclosure to validate and communicate issues as lessons learnt for industry and consumers, establishing a leader board of the most efficient buildings and builders.
- Use mainstream media to deliver ‘case studies’ on how to efficiently operate your home and other opportunities.
- Engage in the use of social media with tangible demonstrations.
- There are very limited CPD requirements for builders and associated trades. For instance there are no requirements for members to be assessed as a ‘master’ builder or ‘master trade’.
- Encouraging politicians to take note of longer term considerations.

Consumer Education

One of the opportunities repeatedly emphasised was the need for building owners and occupants to participate in energy efficiency training from pre-construction stages, through construction to handover (including commissioning the building with occupants). This was seen as especially important given the lack of mandatory disclosure requirements. It was recognized that comsumers need to be aware of, indeed, knowledgable about issues such as:

- What the energy rating means
- Thermal comfort
- Indoor Environmental Quality (IEQ) - Benefits and risks of an airtight building
- Passive vs. active ventilation
- Opportunities related to alterations and additions
- Costs and benefits and when to engage to get the most savings – at various stages of design, construction specifications, operations and alterations/additions and retrofits
- How to engage an energy assessor and why it is important
  - Walk through assessments
  - Thermal imaging

  - Blower door testing
- Consumer expectations and rights
- The value of energy efficient houses in the real estate market.

7.3.4 Summary

The key messages about information and training from the analysis of the Register, the survey data and the stakeholder consultation are that:

- There is an abundance of material and courses but there is no way of knowing how well they are being accessed or used.
- Generally, the view is that only those interested in energy efficiency are accessing information and training. For the rest, it is a case of "You don't know what you don't know'.
- Excellent training and mentoring programs are available but uptake is generally low unless it is a mandatory requirement.
- Appropriately written, illustrated and designed materials for both print, video and web distribution were seen as vital and to be welcomed. This was due to a recognition that information and learning resources are necessary for continuous skill updating.
- It was also due to a recognition that a large proportion of materials are written in technical language, without appropriate illustrations and interpretation. Further, much is too general, i.e. without specific relevance to particular phases of the construction cycle, trades or climate regions.
- Many organizations are providing information and training but have no means of assessing uptake or evaluating effectiveness.
- As a set, the information resources are very fragmented, uneven in quality and depth, often descriptive, and fail to provide practical guidelines for implementation by specific roles or specific climate zones.
- There is a particular need for additional support guidelines for the tropical climate zone.
- There is a vital need to develop a national program on building energy efficiency information based upon:
  - Using trusted sources
  - Well-illustrated
  - Written in a clear, simple and easy to act on way
  - Specific to climate zones
  - Specific to particular roles in the construction cycle.

Together, these conclusions provide guidance on the nature of the materials and training to be included in a building energy efficiency clearing house (as per Recommendation 26). These points are taken up in the following section and associated recommendations.

7.4 Implications

7.4.1 Introduction

The implications of the analysis of the Register, the survey and the stakeholder consultations are discusssed in terms of (i) a needs and gap analysis, and (ii) a summary of optimal content and modes of delivery for information and training. It is these implications that inform the development of recommendations for Project 3.

7.4.2 Gaps and Needs Analysis

This gap and needs analysis has not been undertaken on the level of specific topics or modes of delivery for particular roles in the construction industry. That is, it has not been undertaken at the level of identifying, for example, that there are insufficient You Tube clips for glaziers on how to select and install High performance (energy efficient) windows and glass in buildings in Hot Climate Zones 1, 2 & 3 in Western Australia, Northern Territory and Queensland. Such an analysis, while important, would not provide guidance on how to address the central problems of (i) perceptions of information and training quality, (ii) the regulatory environment and culture of the construction industry, and (iii) the associated lack of incentives and intrinsic motivation for those that require the information or training to actually access it.

Rather, the analysis has been undertaken to reveal the points of leverage in the system that can facilitate rapid and optimal improvement in the provision and uptake of information and training for energy efficiency in the construction industry.

Information Gaps and Needs

The premier gap – and point of leverage if addressed – is the quality, scope and accessibility of available information and training.

Gap	Addressing this gap needs:
As a rule, while voluminous, information resources on building energy efficiency are fragmented, uneven in depth and scope, and variable in fit-for-purpose and intended audience.	• The National Construction Code, and commonly used resources such as the *ABCD Handbook* and *Your Home* be made more widely and easily available and, where practicable, revised in plain language and additional 'how-to' diagrams. • The identification and compilation of information and learning experiences that can generate the capacity to think sustainably, ie systems thinking. • Basic information and training on energy efficiency concepts and principles and passive solar design. • Specific and practical, well-illustrated guides written (i) for all roles in the construction cycle and (ii) for all climate zones. • Based on building science and energy efficiency principles, such a series of guides could be integrated as one 'set' for transparency but contain sections specifically tailored to: – Marketers and real estate agents – Building owners and occupants – Building managers – Site planners and developers

	– Artchitects and designers – Builders – Site supervisors – Trades peoples • Such guides to be multi-format, i.e. the same information presented in different formats to suit different learning styles and locations/occasions for learning: – Book / e-book – Book section / booklet (or PDF download) – Web access – Video and You Tube – Mobile apps – Integratd Toolboxes – Training manuals
Lack of agreed standards for materials	• Agreed standards for all materials should be developed and a quality verification and endorsement process be initiated.
Difficulty in locating relevant materials	• An official digital Clearing House be established as a one-stop shop for informtion on energy efficiency in building and training opportunities (Recommendation 27B).

Figure 7.22 – Information Gaps and Needs

To address these gaps and needs, we recommend that:

No.	Recommendation	Theme	Pathway	Timeline
27	*In the areas of information provision, the Clearinghouse should have ongoing functions that include:* • *Revising commonly used resources such as Your Home and the ABCB Handbook to use more plain English and incorporate more 'how to' diagrams and drawings with instructions.* • *Developing standards and guidelines for the development and assessment of energy efficiency materials and training courses based upon* o *Information and learning experiences that develop the capacity to think sustainably, i.e. systems thinking.* o *Knowledge and skills on foundational energy efficiency concepts and principles and passive solar design.* o *Applications (materials, building systems, tools, skills) specific to each role in the construction cycle, and for all climate zones.* • *Developing a framework for disseminating materials in multiple formats be prepared, e.g. as Book / e-book; Book section / booklet (or PDF download); Toolbox, Training course, Video and You Tube; Web access; Mobile apps, etc.*	Delivering quality outcomes	Consortium led by the ASBEC with invitations to all stakeholder groups	FY 2015-2020

No.	Recommendation	Theme	Pathway	Timeline
28	*Develop national protocols and guidelines for the development of appropriate E-learning and blended learning for pre-vocational training and CPD in energy efficiency be developed.*	Delivering quality outcomes	• NCVER • Industry Skill Councils • VET accreditation bodies • Building Commissions and other related regulatory bodies • All relevant trade and professional associations	FY 2015

Training Gaps and Needs

The second major gap is in the provision and processes of training for building energy efficiency.

Gap	Addressing this gap needs:
There is a perception that training is often not up-to-date and that instructors are not experts in energy efficiency	• All training must be based upon accurate and high quality information. Hence, all the needs outlined above are fundamental to the provision of the appropriate information resoruces upon which training can be based
Training is often not available where and when it is needed.	• The goal is for appropriate training to be available anywhere at anytime. This makes the development of digital or e-learning a priority need. • E-learning coupled with face-to-face experiences (i.e. blended learning) can be an ideal way of providing training at the levels of pre-vocational training and CPD.
Teaching and learning methods used in pre-vocational training and CPD often do not lead to effective on-the-job performance.	• All pre-vocational training and CPD needs to be based upon strong learning theory for skills development. This requires an emphasis on experiential and action learning approaches that involve the 'praxis' of cycles of: (i) Practical encounters with unfamiliar material or skill; (ii) Encouragement to process the information and integrate/generalize within existing knowledge and skill sets; (iii) Exploration of implications and alternatives; (iv)Trial and application; and (v) Feedback and evaluation.
Pre-vocational Training packages are not adequate as they do not cover new energy efficient knowledge, materials and tools.	• Pre-vocational Training Packages need a major review to ensure that they are 'role-relevant' and that 'best pratice' in energy efficiency is being taught. • All Cert IV courses (or other courses required for mandatory accreditation) should include training and demonstrated

Gap	Addressing this gap needs:
	competence in the use of rating tools. • Regular CPD for VET instructors (train-the-trainers) is vital.
There is a low up-take of CPD opportunities.	• CPD and regular accreditation, especially in energy efficiency, and particularly for designers, energy assessors and building surveyors, must be mandatory in the building industry. • CPD and other accreditation measures need to be regularly updated with consideration given to: the frequency rate of audits, the impications of failing an audit; and remedial/mentoring approaches.
There are few opportunities for all involved in the industry to familiarise with leading practice exemplars of energy efficiency in various phases of the construction cycle.	• Short (perhaps half-day) field days would provide the kind of hands-on experience that can motivate to seek out additional information and opportunities for skills development

Figure 7.23 Training Gaps and Needs

To address these gaps and needs, we recommend that:

No.	Recommendation	Theme	Pathway	Timeline
29	*All relevant Training Packages be reviewed for the inclusion of (i) sustainability (systems) thinking skills, (ii) foundational concepts for energy efficiency and passive solar design, (iii) materials, building systems and tools for energy efficiency in specific industry work profiles.*	Delivering quality outcomes	Industry Skill Councils in collaboration with Professional and Trade Associations	FY 2015
30	*In the area of professional development in VET, there should be compulsory CPD for VET instructors as a condition of continuing certification and accreditation with national guidelines and sample training guides developed to support train-the-trainer programs for VET instructors.*	Delivering quality outcomes	VET accreditation bodies	FY 2015 - 2016
32	*Case studies be undertaken of recognized examples of excellence in CPD and accreditation for energy efficiency, and a cross-case analysis be undertaken to develop principles of leadership and innovation for professional development in the construction industry.*	Delivering quality outcomes	BIC to review and action	FY 2015
33	*Short, half-day, field days be provided to enable peer-to-peer demonstration of energy efficiency in design and building practice.*	Engaging industry and the community	BIC to review and action	FY 2015

Engagement Gaps and Needs

Two key issues seem to be undermining the *effectiveness* of engagement with the available information resources and training opportunities. These are:

- The inappropriateness of current approaches to competency-based instruction; and
- The need for individual capacity building to be seen as but one element of a wider industry change strategy.

Problems with competency-based training

Competency-based training was originally introduced in Vocational Education and Training with the admirable goals of, first, identifying the practical skills that comprise different occupational profiles and the standards of performance required for successful employment; and second, their incorporation into national qualification systems that provided mechanisms to standardize and update the different qualification profiles required by industry.

However, experience in Australia and elsewhere reveals a down-side to competency-based training that has the potential to undermine the goals of energy efficiency. This is because the concept of competence has ambiguous meanings and is subject to multiple interpretations in occupational profiles, VET curricula, and in classroom and industry practice. Indeed, the fundamental question about the nature of a competence (e.g. whether a competence is a personal attribute, an act, or an outcome of behaviour) remain unanswered. As a result, training often is reduced to things that (we think) can be observed and measured. The effect is that competency-based VET has all too readily adopted behaviouristic training principles that negate critical thinking and a corresponding commitment to a culture of excellence in the work place. It is not within the scope of this report to prescribe changes in the national VET system in Australia. However, it is worth bearing in mind that a rethinking of how competency-based training is interpreted and practised in Australia can do much to address the structural or systemic problems with the achievement of energy efficiency goals outlined earlier.

The South African VET framework has addressed these and related problems through the conceptualization of "applied competencies". Applied competencies have three elements (Figure 7.24):

- *Practical competence* (performing a skill);
- *Foundational competence* (knowing why the skill is important and why it is done a particular way); and
- *Reflexive competence* (being able to adapt knowledge and skills to new situations and reflect critically on the implications of what you are doing).

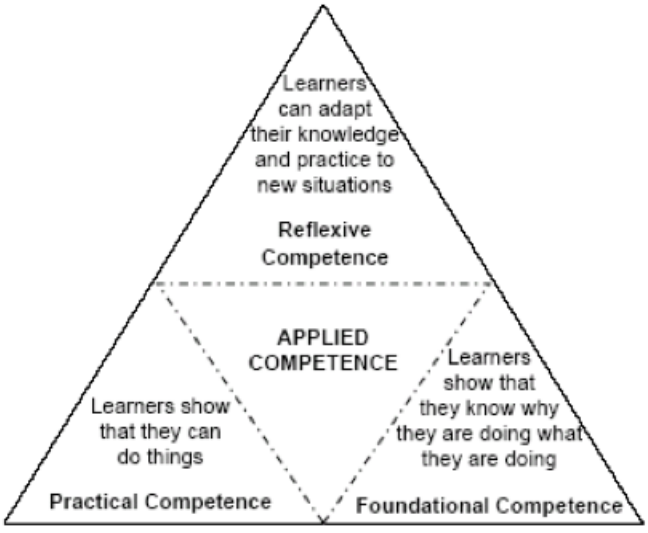


Figure 7.24: The practical, foundational and reflexive dimensions of an applied competence[19]

[19] Lotz-Sisitka, H. & Raven, G. (2008) South Africa: Applied competence as the guiding framework for environmental and sustainability education. In J. Fien, R. Maclean & M-G. Park (eds) *Work, Learning and Sustainable development: Opportunities and Challenges*. Springer, Dortrecht, pp. 309-317.

The South African system emphasizes the notion of reflexivity to create an integrated model of education and training that moves beyond skills development to encouraging the lifelong learning of competencies through learners engaging critically with social and economic change. Indeed, it is argued in South Africa, that it is only within the context of reflexivity and applied competence that broader goals of VET (such as 'adaptability in the face of change, understanding and participation in the management of work roles and production systems, taking responsibility for contingencies, quality control, innovation and flexible responses') will be achieved.[20] This emphasis on 21st Century skills is a reflection of a similar situation in Germany where it has been argued that VET "falls short when it limits itself to instruction and teaching processes. More essential is the encouragement of deeper insights into how to safeguard the future through sustainability … and social responsibility".[21]

The problems with focusing on individual behaviour change

The provision of information and training is often seen as a way of improving the way individuals work. However, such capacity building needs to be seen as but one element of a wider industry change strategy. Changing materials, technology and building systems for energy efficiency certainly require individuals at all phases of the construction cycle to learn new knowledge and skills, as do changes in regulatory systems and economic conditions. As the findings on Projects 1 and 2 indicate, information and training are significant in achieving energy efficiency outcomes for new build and renovation projects. However, a very significant factor in whether information and training will be effective is the industry culture in which individuals operate. This is why the recommendations from Projects 1 and 2 aimed at addressing cultural issues in the construction industry are so vital.

Indeed, without them, the 'satisficer' ("she'll be right") culture in segments of the construction industry, which focuses on minimum compliance, will continue to undermine the culture of excellence in other sectors, which, if more widespread, would result in optimal energy efficiency. The provision of information and training alone will not bring about the desired changes in the satisficer segments of the industry. Information and training must be supported by a complex policy mix of legal/regulatory, economic and social strategies that together provide the conditions for appropriate cultural and behaviour change.

The resulting supply-side drivers of energy efficiency also need to be complemented by increased demand-driven pressure. This can be brought about by widespread community consumer awareness of energy efficiency measures and an increased emphasis on mandatory disclosure and other aspects of consumer rights in the construction industry. Thus there is a need for significant effort in consumer education for energy efficiency.

To address these gaps and needs, we recommend that:

No.	Recommendation	Theme	Pathway	Timeline
34	*A national forum (or series of state/territory/region-based ones) be held as soon as possible after the release of this report to engage industry stakeholders in discussions about the nature of recommendations and priority future steps.*	Engaging industry and the community	BIC to review and action	FY 2015

[20] Kraak, A. (1999) Competing education and training policy discourses: A 'systemic' versus 'unit standards' framework. In Jansen, J. & Christie, P. (eds) *Changing Curriculum: Studies of Outcomes Based Education in South Africa.* Juta & Co Ltd., Cape Town, pp. 21-40.

[21] Mertineit, K.-D. (2013) *TVET for Sustainable Development*. GIZ, Bonn. (Available online at <www.enterprise-development.org/download.ashx?id=2249>. Accessed 29.11.2013).

35	*A national forum (or series of state/territory/region-based ones) be held on the theme of "Towards a Culture of Excellence" to explore the future of education and training for the built environment and construction industries.*	Engaging industry and the community	BIC to review and action	FY 2015
36.	*Scope the goals, modes and key messages for a national social marketing campaign to educate consumers, home owners and purchasers about building energy efficiency.*	Engaging industry and the community	BIC to review and action	FY 2015

7.4.3 A framework for identifying optimal content and modes of delivery

A requirement under the ToR for Project 3 is to identify the optimal content and modes of delivery for information and training for building energy efficiency in Australia. This can only be done at a general level as providing detailed listing of knowledge and skills that might be seen as 'optimal' for energy efficiency performance. Thus, this section serves as a summary of the findings and recommendations of Project 3 and is provided in the form of a framework for identifying optimal content and modes of delivery. The framework comprises two parts: (i) aims and objectives which provide a structure for the identification and sequencing of knowledge for energy efficiency, and (ii) a guide to the presentation, style and pedagogy of information, education and training resources.

Aim and objectives

The aim of building energy efficency information, education and training is that:

> *All engaged in the construction industry in Australia are able to work in such a way that they strive to achieve excellence in all they do, especially in relation to ensuring maximum energy efficiency in the buildings upon which they are working.*

To achieve this aim, the objectives of information, education and training programs for energy efficiency in the Australian construction industry are:

1. *To develop foundational knowledge of:*
   - *sustainability and how it relates to the built environment,*
   - *energy efficiency concepts and principles, and*
   - *how these relate to particular roles in the construction cycle.*
2. *To develop specialist knowledge of energy efficiency materials, building systems, implementation procedures and assessment processes appropriate to both (i) particular skill, trade and professional areas of expertise and (2) the climate zones in which one is working.*
3. *To develop practical skills for applying the knowledge outlined in (1) and (2)*
4. *To develop thinking skills that enable judgements to be made about the implications of where and how particular work tasks are performed and to be able to identify alternative, more energy efficient ways of undertaking tasks.*
5. *To clarify attitudes and values appropriate to a culture of excellence, especially in relation to ensuring maximum energy efficiency*

Figure 7.25 shows how these objectives can be expressed as a guide to the selection and development of optimal content for information, education and training in energy efficiency.

Optimizing engagement with information, education and training through effective delivery

Publications such as Your Home and the ABCB Handbook series provide the bulk of the information necessary for self-instruction and education and training programs. As the conclusion to Section 7.34 stated, the need is for the available knowledge base to be reorganized, rewritten and /or taught in ways that maximize engagement and uptake. That is, the information needs to be made available in (i) a structured form; (2) engaging presentation style; and (3) integrate/be based upon an appropriate pedagogy such as experiential learning theory.

In a *structured* form, the materials would sequentially:

- Develop foundational knowledge of:
  - Sustainability and how it relates to the built environment
  - Energy efficiency concept and principles, and
  - How these relate to different climate zones and different roles in the construction cycle.
- Develop specialist knowledge of energy efficiency materials, building systems, implementation procedures and assessment processes appropriate to
  - particular skills, trades and professional areas of expertise for different roles in the construction cycle, and
  - specific climate zones
- Develop practical skills for applying the knowledge outlined above

In an engaging *style*, the materials would:

- Use and build upon trusted sources;
- Be well-illustrated; and
- Be written in a clear, simple and easy to act on way.

In addition, such material should be prepared so that it is easily presented in multiple formats, i.e. the same information presented in different formats to suit different learning styles and locations/occasions for learning:

- Book / e-book
- Book section / booklet (or PDF download)
- Web access
- Video and You Tube
- Mobile apps
- Integratd Toolboxes
- Training manuals

Appropriate pedagogy: The remaining theme in the framework relates to ways of building the effectiveness of engagement with the available information and education and training opportunities through a pedagogy that integrates theory and practice.

Thus, it is strongly advised that all pre-vocational training and CPD be based upon strong learning theory for knowledge, skills and attitudinal development. This requires an emphasis on experiential and action learning approaches that involve the 'praxis' of cycles of:

- Practical encounters with unfamiliar material or skill;
- Facilitated guidance to process the information and integrate/generalize within existing knowledge and skill sets;
- An exploration of implications and alternatives;
- Trial and application in different situations; and
- Feedback and evaluation.

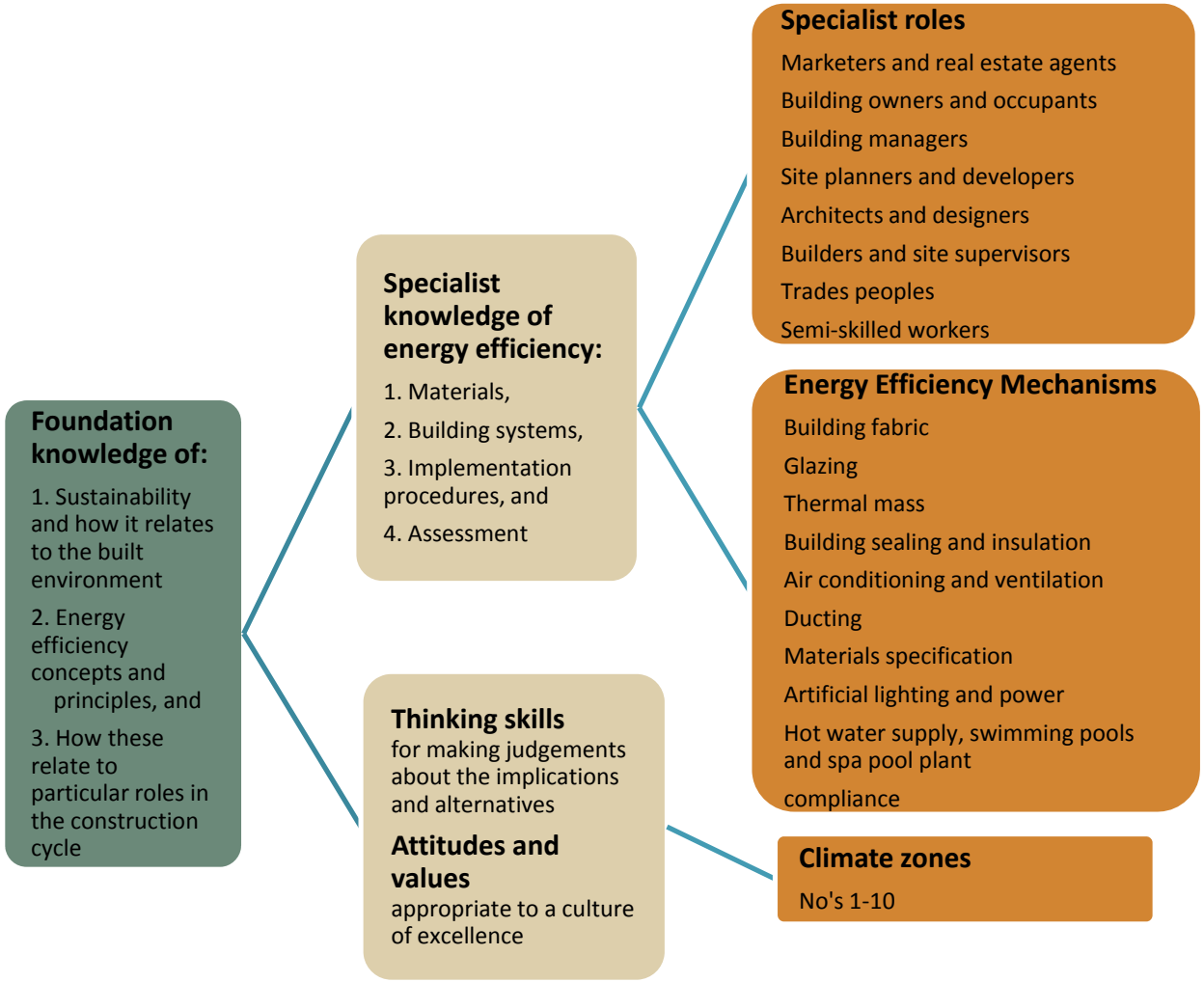


Figure 7.25: A framework for the identification and selection of optimal content for energy efficiency information, education and training

7.5 Action Plan for Enhancing and Promoting Knowledge Management

A 2020 Vision and an Action Plan for Projects 1, 2 and 3 were presented earlier in this Report. This Action Plan was organised under strategic and inter-linked themes:

1. Being clear what's at stake
2. Getting the incentives right;
3. Delivering quality outcomes; and
4. Empowering industry and the community.

The previous sections also identified a range of short term opportunities across these themes. By and large, the recommended projects related to Knowledge Management were outlined under Themes 3 & 4, although there are obvious links to the other themes. For example, providing improved access to information, education and training is designed to enhance the delivery of quality outcomes.

The 2020 Vision and an Action Plan defined the Themes in the following way:

- *Being clear what's at stake* refers to making a clear case in public policy for effective energy performance regulation of buildings, and communicating that case to all stakeholders.
- *Delivering quality outcomes* includes ensuring that all those involved in the building system have access to the right knowledge, training, tools and products; and that these ingredients are being used to deliver energy efficient buildings.
- *Empowering industry* refers to the opportunities and benefits of capacity building. Three knowledge management strategies – information, education and training - are involved in this.
- *Empowering the community* means ensuring that building owners and users understand the value of energy efficiency (and why it is worth investing in); what they should expect from buildings and the building industry; and their role in achieving those expectations.

Despite the obstacles outlined in this report, the Australian built environment sector is progressing towards compliance with the requirements for low energy buildings and carbon reductions. However, this could be accelerated through a cultural change that shifts the industry from a concern with minimum skills and minimum compliance towards a culture of excellence. This will require progressive steps by the government and industry/professional associations in relation to the systemic issues and code weaknesses outlined in this report. In addition, specific steps can be taken to improve the knowledge management and skill development of built environment practitioners, consumers and government administrators.

To meet both current compliance requirements and establish a culture of excellence in the Australian built environment sector, the following series of 'if-then' relationships aim to establish a case for action based on the NEEBP recommendations related to knowledge management:

- If practitioners are to embrace energy efficiency opportunities and practices, then the societal, business and individual benefits need to be communicated clearly to industry stakeholders, consumers and government agencies using a consistent communication package across the three stakeholder groups.

- If practitioners are to engage in education and training, then they will require adequate incentives, such as training related to compliance or alignment with license or professional accreditation requirements supported by an industry or professional association.
- If practitioners are to integrate opportunities related to energy efficiency and carbon abatement into their work practices, then they must have the full foundational knowledge base, specialist knowledge, generic skills (systems and critical thinking) and the specific practical skills for implementation including ready-made solutions for immediate integration into their day to day work practices.
- If practitioners are to engage with information, then the information must be trusted, proven, easily accessible, easy to understand, and specific to individual job roles, construction cycles and project needs, including climate and jurisdictional variations.
- If builders and trades, in particular, are expected to up-skill, then increased flexibility and support is required related to the provision of informal on the job and peer-to-peer training.
- If the emerging workforce is required to seamlessly integrate and potentially influence a culture of excellence in the built environment, then they need to be equipped with the underpinning theory and proven techniques, as well as assertiveness to influence change within the current workforce.
- If the education and training sector is to deliver quality outcomes, then the industry practitioners that provide the programs must have specific experience and currency (theory and practice) and must be able to relate to the day-to-day work practices relative to the job roles in which they are engaging in training.
- If the high number of interconnected job roles and sectors involved in the construction cycle from pre-construction, construction and efficient operations are to effectively contribute to the building systems, then there is a critical need for better communication, responsibility sharing and accountability.
- If such integration is to be successfully achieved, then each sector and associated roles must have the correct information, skills development and an understanding and appreciation for each other's contributions.

These assumptions underpinned the recommendations from Project 3 set out in this Chapter. These recommendations have been developed into a series of related projects across a 90 day, one year and five year strategy. This Change Strategy synthesises these Recommendations into the following six objectives:

Recommendation	Objective	Project Title	Start date	Duration		
#34 A national or series of state/territory forums to engage industry stakeholders. (Theme 3)	**Objective 1:** *To disseminate and build commitment to the findings of this report.*	Towards a Culture of Excellence: Establishing a National Built Environment Clearinghouse on Energy Efficiency and Low Carbon Education	2014	90 Days		
#35 A national or series of state/territory forums on the theme of "Towards a Culture of Excellence" with the aim of establishing a National Clearinghouse to support knowledge management. (Theme 3)			2014	90 Days		
#26 & 27 Establish a National Clearinghouse for knowledge management & training for energy efficiency and carbon abatement in the built environment. (Themes 2 & 3)			2015		1 year	5 years
#36 Establish a national social marketing campaign about building energy efficiency. (Theme 3)	**Objective 2:** *To scope the goals, modes and key messages for a national social marketing campaign to educate consumers, homeowners and purchasers about building energy efficiency.*	Engaging communities to save money, reduce energy use and carbon while improving future housing.	2014	90 Days		5 years
#28 Establish national protocols and best practice guidelines for the development of appropriate E-learning and blended. (Theme 2)	**Objective 3:** *To provide national leadership in the provision & quality assessment of information, education and training resources and opportunities in Australia, including protocols and guidelines for the development of appropriate E-learning and blended learning for pre-vocational training and CPD in energy efficiency.*	National protocols and best practice guidelines for blended and e-learning to increase participant engagement	2014	90 Days		
#29 Systematic review of relevant Training Packages by selected industry specialists. (Theme 2)	**Objective 4:** *To review and revise relevant Training Packages to ensure the inclusion of appropriate energy efficiency underpinning knowledge (theory) and skills.*	Delivering quality vocational education & training for a low carbon built environment	2015		1 year	
#30 Provision of compulsory professional development for vocational educators (Theme 2)	**Objective 5:** *To mandate continuous professional development in energy efficiency for all instructors, professionals, trades and workers at all stages of the construction cycle.* **Objective 6:** *To prepare case studies of recognised examples of excellence in CPD and accreditation for energy efficiency, and develop principles of leadership and innovation for professional development in the construction industry.*	Securing an low carbon built environment workforce	2015		1 year	
#33 Peer-to-peer demonstration field days on energy efficiency and carbon reduction in design and building practice. (Theme 3)			2014	90 Days		
#32 EE Excellence: CPD and accreditation case studies. (Theme 2)			2014	90 Days		
#31 Industry Accreditation and CPD. (Themes 2 &3)			2015		1 Year	

The aim of this strategy is:

To ensure that information, education and training opportunities that will build capacity for delivering energy efficiency in the construction industry are available and accessible to all professionals, trades and workers systemically at all stages of the construction cycle in ways that maximise uptake.

Achieving this aim requires action on the following six objectives:

1. To disseminate and build commitment to a national clearing house on Energy Efficiency in the Built Environment Sector.
2. To scope the goals, modes and key messages for a national social marketing campaign to educate consumers, homeowners and purchasers about building energy efficiency.
3. To provide national leadership in the provision and quality assessment of information, education and training resources and opportunities in Australia, including national protocols and guidelines for the development of appropriate E-learning and blended learning for pre-vocational training and CPD in energy efficiency.
4. To review and revise relevant Training Packages to ensure the inclusion of appropriate energy efficiency knowledge and skills.
5. To mandate continuous professional development in energy efficiency for all instructors, professionals, trades and workers at all stages of the construction cycle.
6. To prepare case studies of recognized examples of excellence in CPD and accreditation for energy efficiency, and develop principles of leadership and innovation for professional development in the construction industry.

These objectives and associated actions are detailed below:

<table>
<tr><th colspan="2">Objective 1: To disseminate and build commitment to a national clearing house on Energy Efficiency in the Built Environment Sector</th></tr>
<tr><td colspan="2">Recommendation(s)
#34 A national or series of state/territory forums to engage industry stakeholders. (Theme 3)
✓ Timeframe: 90 days
#35 A national or series of state/territory forums on the theme of “Towards a Culture of Excellence” with the aim of establishing a National Clearinghouse to support knowledge management. (Theme 3)
✓ Timeframe: 90 days
#26 & 27 Establish a National Clearinghouse for knowledge management and training for energy efficiency and carbon abatement in the built environment. (Themes 2 & 3)
✓ Timeframe: 1 year to establish
✓ 5 years ongoing</td></tr>
<tr><td>Project Title: Towards a Culture of Excellence: Establishing a National Built Environment Clearinghouse on Energy Efficiency and Low Carbon Education</td><td>Description: As soon as possible after the release of this report, hold a national forum (or series of state/territory/region-based ones) to engage industry stakeholders in discussions about the nature of recommendations and priority future steps.
As part of the forum(s) initiate a discussion on “Towards a Culture of Excellence” to explore the future of knowledge management for the built environment and construction industries, with a view to establishing a National Built Environment Clearinghouse with the following functions:
• Engagement with organisations and groups associated with the energy efficiency and carbon abatement in the built environment:
– Leading international agencies and organisations
– Commonwealth and state/territory government authorities and agencies
– Built environment research centres and universities
– Industry and professional associations</td></tr>
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<table>
<tr><td></td><td colspan="2">

– Industry Skills Councils
– Industry Accreditation Bodies
– Building Regulatory Authorities

Research functions to identify and establish best practice information and program guidelines (SEE RECC 28-29, 31-32)
Knowledge management of information and resources
Dissemination of best practice information and guidelines
Third party sourcing with a web-based knowledge management search function.

Once the Clearinghouse is established, the following needs to be implemented to initiate the provision of user-friendly evidence-based information. This is an opportunity to revise, promote and broaden and narrow specific resources commonly used, such as Your Home and the ABCB Handbook(s) into plain English formats offered in bite sized sections, with the incorporation of more ‘how to’ diagrams, drawings or video demonstrations and instructions accessible when and where it’s needed most.
The aims are to:
a) Establish an overarching set of industry wide principles and standards using a common language
b) Develop a series of interlinked climate and job role specific best practice guides based on the established principles, language and validated information based upon

Information and learning experiences that develops the capacity to think sustainably, i.e. systems thinking.
Knowledge and skills on foundational energy efficiency concepts and principles, passive solar design and detailed climate zone variations.
Applications (materials, building systems, tools, skills relevant to specific roles and climatic variations).

c) Rapid dissemination of materials in searchable multiple formats, e.g. as Book / e-book; Book section / booklet (or PDF download); Toolbox, Training course, Video / You Tube; Web access; Mobile apps, etc.
</td></tr>
<tr><td>Target Audience
Suitable for all built environment audiences.

Regulators
Designers
Energy and Sustainability Assessors
Design and Building Certifiers
Engineers
Builders
Trades (Plumbers, Electricians, Carpenters, HVAC&R, etc.)
Built environment information, education and training providers

** Prioritize the development of climate specific, practical guides for planners, builders, high impact trades (plumbers,</td><td>Phase of the construction cycle
Suitable to all phases.

Planning
Design
Certification
Construction
Inspection
Commissioning
Use / Operation

** Prioritize the development of practical guides for the local government planning, construction, inspection, commissioning and use / operational phases initially.</td><td>Potential Partner(s)
Consortium led by the Cooperative Research Centre for Low Carbon Living and the Australian Sustainable Built Environment Council with invitations to all stakeholder groups such as

National Centre for Vocational Education Research (NCVER)
Industry / Professional Associations and accrediting bodies (ABSA, AIA, AIRAH, AMCA, Consult Australia, Engineers Australia, HIA, MBA, MPMSAA, RICS, etc.)
Industry Skills Councils (CPSISC, E-Oz, MSA, etc.)
Regulatory authorities
Local planning authorities

</td></tr>
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electricians, carpenters, etc.) and building users initially.		

Objective 2: *To scope the goals, modes and key messages for a national social marketing campaign to educate consumers, homeowners and purchasers about building energy efficiency.*		
Recommendation *#36 Establish a national social marketing campaign about building energy efficiency.* (Theme 3) ***Timeframe:*** ✓ 90 days - Establish campaign program ✓ 5 years - Program duration		
Project Title: Engaging communities to save money, reduce energy use and carbon while improving future housing	***Description:*** Engage a national media company to scope the goals, modes and key messages for a national social marketing campaign to educate the general public about home energy efficiency, including: • What to consider when purchasing or leasing • What rental tenants can do to reduce their energy use • What to consider when renovating or doing an addition • What to consider when engaging a designer • What to consider when engaging a builder • What to consider when engaging a trade • What to consider when 'doing it yourself' • How the local council or planning authority can help • Tools to get it done - steps to ensure you get what you expect from those you engage to carryout work • How to manage your home & who to call for help	
Target Audience • Consumers • Rental tenants • Homeowners • Potential purchasers • Local council or government agency • Local Planning Authority	***Phase of the construction cycle*** • Planning • Renovations • Additions • Operations	***Potential Partner(s)*** • DIMITRE (SA) • Sustainability Victoria (VIC) • Department of Environment and Heritage (NSW) • Cool Mob (NT) All other state equivalents or those agencies who already engage and are trusted by consumers

Objective 3: *To provide national leadership in the provision and quality assessment of information, education and training resources and opportunities in Australia, including national protocols and guidelines for the development of appropriate E-learning and blended learning for pre-vocational training and CPD in energy efficiency.*

Recommendation #28 Establish national protocols and best practice guidelines for the development of appropriate E-learning and blended. (Theme 2)

Timeframe:

- ✓ 90 days

Project Title: National protocols and best practice guidelines for blended and e-learning to increase participant engagement	***Description:*** Develop national protocols and guidelines for the development of appropriate E-learning and blended learning for pre-vocational training and CPD in energy efficiency be developed.	
Target Audience • E-learning providers • CPD providers • Vocational educators • Higher education providers	***Phase of the construction cycle*** All (as above), but specifically education providers in the built environment.	***Potential Partner(s)*** • NCVER • Industry Skills Councils (CPSISC, E-Oz, MSA, etc.) • VET accreditation bodies • Industry / Professional Associations and accrediting bodies (ABSA, AIA, AIRAH, AMCA, Consult Australia, Engineers Australia, HIA, MBA, MPMSAA, RICS, etc.) who provide education and training to members • State / territory building regulators and other related regulatory bodies.

Objective 4: *To review and revise relevant Training Packages to ensure the inclusion of appropriate energy efficiency knowledge and skills.*

Recommendation(s)

#29 Systematic review of relevant Training Packages by selected industry specialists. (Theme 2)

- ✓ Timeframe: 1 year

Project Title: Delivering quality vocational education & training for a low carbon built environment	Description: All relevant Training Packages be reviewed to ensure the adequate inclusion of (i) sustainability (systems) thinking skills, (ii) foundational concepts for energy efficiency and passive solar design, (iii) materials, building systems and tools for energy efficiency in specific industry work profiles.	
Target Audience All built environment trades and professionals – starting with these in order of importance: Primary audience • Vocational education & training providers Secondary audience • Builders, • Insulation installers, • Designers, • Drafters, • Energy / sustainability	***Phase of the construction cycle*** All (as above) • Energy assessment • Construction • Design • Building certification	***Potential Partner(s)*** • NCVER • Industry Skills Councils (CPSISC, E-Oz, MSA, etc.) • VET accreditation bodies *Any relevant trade and professional associations*

assessors, • Carpenters, • Plumbers (HVAC&R), • HVAC&R designers and installers, • Electricians.		

Objective 5: *To mandate continuous professional development in energy efficiency for all instructors, professionals, trades and workers at all stages of the construction cycle.*

Objective 6: *To prepare case studies of recognized examples of excellence in CPD and accreditation for energy efficiency, and develop principles of leadership and innovation for professional development in the construction industry.*

Recommendation(s)

#30 Provision of compulsory professional development for vocational educators (Theme 2)

- ✓ Timeframe: 1 year

#31 Industry Accreditation and CPD. (Themes 2 &3)

- ✓ Timeframe: 1 year

#32 EE Excellence: CPD and accreditation case studies. (Theme 2)

- ✓ Timeframe: 90 days

#33 Peer-to-peer demonstration field days on energy efficiency and carbon reduction in design and building practice. (Theme 3)

- ✓ Timeframe: 90 days

Project Title: Securing an low carbon built environment workforce	***Descriptions:*** Project A, B, C: **Project A:** Coordination and recruitment of leaders and participants to carry out a series of 4-hour field days to enable peer-to-peer demonstration of energy efficiency and carbon reduction strategies in practice focused on design and on-site construction practices. **Project B:** Investigate industry continuing professional development and accreditation programs to promote principles of leadership and innovation in the construction industry. Undertake a cross-case analysis of continuing professional development programs and accreditation requirements for each of the highest impact roles and develop case studies to recognize examples of best practice programs, excellence in energy efficiency / carbon reduction integration or outcomes. Promote these across the built environment sub-sectors as options to improve the workforce through engagement, mandatory CPD, and inclusion of energy efficiency in industry accreditation requirements. **Project C:** In the area of industry accreditation and CPD, all states and territory authorities or professional / industry associations need to mandate that: • In the area of professional development in VET, there is a need for compulsory CPD for VET instructors as a condition of continuing certification (currency) and accreditation with national guidelines and sample training guides developed to support train-the-trainer programs for VET instructors aligned to specific industry sectors and job roles. • Built environment professional and trade roles are accredited by a suitable body, including appropriate training, ongoing CPD, auditing and sanctions regimes with the aim to ban practices by non-accredited individuals/organisations. • The current workforce can demonstrate competence in energy efficiency and carbon reduction strategies applicable to their specific job role(s) or daily work requirements. Those who hold current accreditation or membership with a professional or industry body or association, include a mandatory requirement for CPD points to be acquitted for energy efficiency awareness and knowledge: a) in all states in FY 2015 (catch-up); and b) in every financial year in which the building energy performance requirements are scheduled to be changed or technological developments require up-skilling to maintain industry currency with the aim to abolish myths and eliminate inadequate practices.	
Target Audience All built environment trades and	***Phase of the construction cycle*** All (as above)	***Potential Partner(s)*** • Accreditation bodies • Building Regulatory Authorities and other related

professionals – starting with these in order of importance: • Vocational educators • Builders, • Insulation installers, • Designers, • Drafters, • Energy / sustainability assessors, • Carpenters, • Plumbers (HVAC&R), • HVAC&R designers and installers, • Electricians.	Prioritising: • Local government planning • Energy assessment - accreditation and mentoring for energy assessors, designers and building certifiers / assessors. • Construction - CPD for on-site construction management and trades and local government planners. • Design • Building certification *** Eliminating poor practices and banning unaccredited individuals from practicing.	regulatory bodies • Industry / Professional Associations and accrediting bodies (ABSA, AIA, AIRAH, AMCA, Consult Australia, Engineers Australia, HIA, MBA, MPMSAA, RICS, etc.) • Industry Skills Councils (CPSISC, E-Oz, MSA, etc.) • Vocational education and training providers by application

7.6 The Business Case for Knowledge Management

In addition to the current research, consultations and gap analysis, the recommendations supporting knowledge management have been influenced by countless national and sector specific studies and the growing trend to invest in knowledge and skills to build capacity for delivering energy efficiency, green construction and reducing carbon in the built environment internationally. The recommendations were influenced by some of the literature listed in Section 6 relevant to Project 3, in addition to the following reports:

- Winfree T., Podkalicka A., Hargroves C. (2013) Education for Low Carbon Living – Built Environment, *CRC for Low Carbon Living.*
- RMIT University (2012) National industry education and training vision and action plan for the 21st century, *Built Environment Industry Innovation Council for the Council of Australian Governments, Canberra.*
- Winfree T. (2012) Construction Efficiency Opportunities: Setting the foundation for net-zero energy homes, *International Specialised Skills Institute and the Construction and Property Services Industry Skills Council.*
- Allen Consulting and Swinburne University (2012) Review of Energy Efficiency Skills Demands and Training Provision Across the Trades and Professions, *Commonwealth Department of Industry Innovation, Science, Research and Tertiary Education.*
- Fien, J. & Guevara, J.R. (2012) Skills for a Green Economy: Practice, Possibilities and Prospects, in Maclean, R. & Jagannathan (eds) *Skills for Inclusive and Sustainable Growth in Developing Asia - Pacific*, Springer, Dordrecht, Ch. 14.
- Maclean, R., Tsang, E. & Fien, J. (2012) Hong Kong, China Employers' Perspectives on a Carbon-Constrained Economy and How Technical and Vocational Education and Training Should Respond, in Maclean, R. & Jagannathan (eds) *Skills for Inclusive and Sustainable Growth in Developing Asia - Pacific*, Springer, Dordrecht, Ch. 17.
- Allen Consulting and Swinburne University (2011) Skills for Carbon Abatement, *Victorian Skills Commission.*

- Maclean, R. & Fien, J. (2011) Education for Sustainable Development: Lessons from the Private Sector, in Masemann, V., Majhanovich, S. & Nhung Truon, eds, *Clamouring for a Better World*, Sense Publishers, Rotterdam, Ch. 12.
- ARUP, naked (2010) A Framework for a Community Engagement Strategy for the Built Environment, *Built Environment Industry Innovation Council for the Council of Australian Governments, Canberra.*
- Charlesworth, E. & Fien, J. (2010) Sustainable Cities: Next Steps, in Charlesworth, E. & Adams, R. eds, *The EcoEdge: Case Studies in Building Sustainable Cities*, Routledge, London, Ch. 16.
- Fien, J., Maclean, R. & Wilson, D. (2010) Learning to Work for the Future, in Peterson, P., Baker, E. & McGaw, B., eds, *International Encyclopedia of Education*, Vol. 8, Elsevier, Oxford, 416-422.
- Horne, R., Moloney, S. & Fien, J. (2010) Transitioning to Low Carbon Communities: Lessons from Community-Based Initiatives in Australia, *Energy Policy*. Vol. 38, No. 10, 7614-7623. Republished in Fudge, F., Peter, M., Hoffman. & Wehrmeyer, W. (eds) (2013) *Environmental Responsibility and Individual responsibility: Encouraging Sustainable Lifestyles,* Edward Elgar
- Gidley, J., Fien, J., Smith, J-A., Thomsen, D. & Smith, T. (2009) Participatory Futures Methods: Towards Adaptability and Resilience In Climate-Vulnerable Communities, Environmental Policy & Governance, Vol. 19, No. 6, 427-440.
- Fien, J., Moloney, S., Bates. M. & Horne, R. (2009) Carbon Neutral Communities: A Perspective from Learning and Social Change, in J. Martin, M Rogers & C. Winters, eds, Climate Change in Regional Australia: Social Learning and Adaptation, VURRN Press, Bendigo (for Academy of Social Sciences in Australia), 65-87.
- Fien, J., Maclean, R. & Park, M., eds. (2008) Work, Learning and Sustainable Development, Springer, Dortrecht.

Appendix A

Terms of Reference

Background

South Australia is leading a national project funded through the National Strategy on Energy Efficiency (NSEE) to improve the energy efficiency of new residential and commercial buildings and renovations, including alterations, additions and retrofitting projects.

Measures 3.2.1 and 3.3.1 of the NSEE relate to improving the energy efficiency requirements for all classes of residential and commercial buildings in the National Construction Code (NCC). Such improvements have been made, commencing with the 2010 National Construction Code and have been adopted, to varying degrees, by all States and Territories.

Nationally, discrepancies exist between the energy efficiency provisions of the National Construction Code (NCC) and the standard of energy efficiency demonstrated in our building stock. There is a growing body of evidence that Australia-wide, new buildings and renovations often deliver lower energy efficiency performance than identified during the design, assessment and approvals process and fail to meet the energy efficiency requirements (and objectives) of the National Construction Code.

The key outcomes of the NEEBP, which will be conducted in two phases, with both phases to be completed before June 30th 2014, are:

- A national strategy for best practice and compliance with the energy efficiency provisions of the National Construction Code (including trialling of innovative interventions supporting compliance);
- A national strategy for special purpose energy efficiency guidelines, recommendations or regulations for renovations (viz: alterations, additions and retrofits).

Phase 1 of the NEEBP will commence in October 2013 and be completed by the end of February 2014 and Phase 2 will run from February to June 30 2014. Due to funding arrangements, there is no opportunity for extension of these timeframes.

Phase 1 has been divided into three principle projects to commence investigations, make recommendations and design strategic interventions.

The Phase 2 project(s) will be largely informed by Phase 1 analysis and recommendations and will implement strategic interventions identified and scoped in Phase 1.

These may include, for example, recommendations for change in policy, regulations, guidelines and compliance methods to stakeholder agencies, including the Australian Building Codes Board (ABCB), and targeted industry and local government knowledge-sharing, training or demonstration pilots.

The NEEBP aims to identify key factors negatively impacting on energy efficiency wherever they occur in the construction cycle; from design, development assessment and approval, to materials specifying and supply, building and project management, to trades, final-fit, hand-over and compliance checking. Causes of non-compliance in the final building at hand-over or on completion of major renovations are extremely varied but may include: inconsistencies between jurisdictions or regions in approvals process, discrepancy between approved plans and final build, cost-cutting specification of non-complying materials, incorrect installation of insulation and glazing, poor thermal envelope seal and post-build trades interventions that compromise the eventual energy rating.

The Phase 1 projects are:

Project 1: National review of key systemic or process weaknesses or common points of non-compliance with the energy efficiency requirements of the National Construction Code. *("Review of process weaknesses")*

Project 2: National review of the uniformity and effectiveness of current standards or regulations to deliver energy efficient renovations, including alterations, additions and retrofits. *("Review of alts and adds regulations")*

Project 3: National industry-based information register, needs *and* gap analysis and strategy to develop and support the knowledge and capacity of key professions and trades to deliver best practice energy efficiency to the building industry. *("Review of knowledge management")*

The legacy of the National Energy Efficient Building Project (NEEBP) will be:

1. A well-documented and communicated national and industry-wide understanding of key barriers to achieving best-practice energy efficiency in new buildings and renovations, including alterations, additions and retrofits.
2. Practical strategies to garner and facilitate industry-wide engagement across the design, assessment and construction sector, to improve industry capacity and compliance with the energy efficiency provisions of the National Construction Code.
3. Key recommendations to the Australian Building Codes Board, state and territory planning authorities and building regulators and local government for inclusions and amendments to regulatory, advisory and guiding documentation relevant to building energy efficiency and specifically the requirements of the National Construction Code for new buildings and renovations.
4. A clear strategy and business case for targeted interventions for capacity building in the planning, design, assessment and construction industry to develop and support best practice energy efficiency outcomes in new buildings and renovations (alterations, additions and retrofits).

Specification / Scope of Requirements

PROJECT 1

DMITRE requires a suitable Provider to undertake a national review of key systemic or process weaknesses or common points of non-compliance with the energy efficiency requirements of the National Construction Code. ("Review of process weaknesses")

Project 1 will include an investigation of all building classes listed in the National Construction Code, *however* the project methodology should define a process to determine the priority focus and/or spread of this review and the proportional time and budget allocated to specified building types. Phase 2 interventions will target those factors identified in Phase 1 as having the most effective and immediate potential to influence building energy efficiency as well as longer-term strategies. It may be possible to achieve greatest national impact if, for example, this project focuses on Classes 1 and 2 of the NCC, however this will need to be substantiated in the methodology.

The objectives of this review are to:

- Investigate and prioritise the contributing factors to non-compliance with energy efficiency requirements of the NCC throughout the construction life-cycle, including:
  - policy, regulations, provisions and guidelines;
  - planning and building approvals and privatisation of building certification;
  - construction industry, trades, specifiers, project management and material suppliers;
  - different administrative or geographic regions, climates or building types.
- Analyse and assess key weaknesses across the construction life-cycle in achieving energy efficiency from design and approval, to materials supply, building and project management, to trades, final-fit and hand-over.
- Design a broad program of targeted interventions for implementation in Phase 2, in the next 12 months period to June 2015 and beyond. These will be high priority actions focussed on target audiences, processes and regions, with the potential to improve industry capacity and compliance with energy efficiency provisions of the NCC.

  Common examples of factors that may result in non-compliance include:
  - Building designs that do not meet minimum energy efficiency provisions;
  - Errors in undertaking assessments or ratings of the thermal performance of buildings;
  - Energy efficiency features of original designs not being incorporated into final plans;
  - Lack of knowledge or skills in materials specifying or implementing energy efficiency features of building plans;
  - Energy efficiency design being modified as part of late-stage or post-approval building work;
  - Lack of quality assurance checking of energy efficiency features at the time of project hand-over from builders to client.

Services Required

The successful Provider will:

- Provide an agreed project methodology shortly after project commencement and in accordance with the schedule of deliverables.
- Identify all industry sectors and government agencies relevant to the project, including those that operate nationally or in specific regions, jurisdictions or climate zones. The Project Reference Group (PRG) can assist in compiling this list.
- Undertake research, consultation and surveys to gather evidence of the key systemic or process weaknesses or common points of non-compliance with the energy efficiency requirements of the National Construction Code. It is expected that this will include:
  - Research, including integration of existing studies, on the level of non-compliance with the energy efficiency requirements of the NCC, the causes of such non-compliance and any potential remedies. It is expected this will identify and review any existing interventions to address non-compliance issues and assess the effectiveness or otherwise of such interventions.

  - Consultation, involving significant engagement processes including, but not limited to, targeted survey(s), face-to-face consultation and focus-groups across all State and territory jurisdictions and preferably all 8 climate zones identified in the National Construction Code. The consultation methodology will enable an optimal regional spread acknowledging diversity in geography, governance, trade skills, access to materials and technology and building styles.

- Undertake expert quantitative and qualitative data analysis and interpretation of the research and consultation findings, with data analysed by jurisdiction, process (or stage in the construction life-cycle), industry and building type. The analysis will quantify and compare the impact of non-complying activities on building energy efficiency.
- Develop key recommendations and design an intervention work plan for Phase 2. This will be done in consultation with the Project Manager and the Project Reference Group. Interventions will be assessed and prioritised by greatest energy efficiency benefit for the least cost and be organised by:
  - Type of intervention (policy, regulatory, communications, training etc);
  - Target audience for the intervention (relevant part of construction life cycle or industry sector);
  - Estimated cost of the intervention;
  - Benefit of the intervention (in terms of the amount of energy efficiency improvement it can provide, the cost-effectiveness of the improvement, etc);
  - Highest priority pilot, trial or demonstration activity for selected interventions.
- Provide Draft Report and a Draft Intervention Strategy to enable the detailed scoping of Phase 2 projects.
- Document data, analysis and interpretation of the national review and provide Final Report including Strategy for both Phase 2 and on-going priority interventions over the next 12 month period to June 2015 and beyond.
- Adhere to scheduled reporting and milestone delivery, respond to reasonable informal reporting and communication requests from the Project Manager and ensure effective communication and integration with other Phase 1 project teams.

In undertaking this work, the successful provider will:

- Consult broadly and effectively with key government and industry stakeholders, other Phase 1 project teams and the Project Reference Group.
- Consider and utilise relevant information previously or concurrently published that informs the process and outcomes of this project.
- Communicate with allied or complementary projects, commissioned through the Commonwealth Building Energy Efficiency Branch, the Australian Building Codes Board, the Low Carbon CRC and other informative Commonwealth and State projects as applicable.

Deliverables & Timing

The following timeframe applies to this work and any deviation to this timeframe must be agreed to in writing with the project manager.

Deliverable	*Date Completed*
Commencement of contract	*28/10/13*
Agreed methodology	*1/11/13*
Combined Phase 1 Projects Review - Project Ref. Group teleconf.	*2/12/13*
Project & Phase 2 Strategies Review teleconference	*20/1/14*
Draft report and proposed Phase 2 strategies - PRG teleconf.	*27/1/14*
Final report	*24/2/14*

In addition to this schedule the successful provider will provide updates to the Project Manager on a fortnightly basis, as a minimum. These updates may include a teleconference and may also involve members of the Project Reference Group.

The Project Manager will be available for discussion and clarification as necessary throughout the project to assist with cross-project integration.

Quality Requirements

The Respondent for the purposes of this tender is required to provide details of their quality assurance process to allow DMITRE to assess its appropriateness.

The tenders will be assessed according to the following criteria:

Selection Criteria
1. Expert knowledge relevant to the project.
2. Innovative and thorough project methodology that demonstrates an understanding of the brief and incorporates strong capacity to facilitate cross-project integration, skills and time and resource efficiencies.
3. Demonstrated experience of the project team relevant to the project.
4. Capacity of the project team to deliver to tight project schedules.
5. Value for money.

PROJECT 2

DMITRE requires a suitable Provider to conduct a national review of the uniformity and effectiveness of current standards or regulations to deliver energy efficient alterations, additions and retrofits in all buildings. *("Review of alts and adds regulations")*

Project 2 will include analysis and review of all current standards or regulations affecting renovations (viz: alterations, additions and retrofits) in all jurisdictions and in all building classes. The project will then develop a series of *draft* best practice guidelines to support national consistency in energy efficient renovations for use by Local Government and industry stakeholders. It will also develop strategic recommendations for regulatory inclusion and/or amendment at targeted levels of governance, in all jurisdictions and including the NCC.

The objectives of this review are to:

- Conduct a national review across all building types, jurisdictions, regions and industry sectors to determine the effectiveness of current practices, standards, codes and regulations to deliver energy efficient renovations (alterations, additions and retrofits).
- Develop draft best practice guidelines to support national consistency in approvals and building practice for energy efficient renovations and the uniform interpretation of NCC energy efficiency provisions across jurisdictions, where appropriate.
- Draft recommendations for regulatory inclusion and/or amendment at targeted levels of national governance, in all jurisdictions and including the Australian Building Codes Board for consideration of future amendments to the NCC.

Services Required

The successful Provider will:

- Provide an agreed project methodology shortly after project commencement and in accordance with the schedule of deliverables.
- Identify, nationally and on a per-jurisdiction basis factors affecting the energy efficiency requirements for alterations, additions and retrofits, including:
  - all relevant industry sectors, policy agencies and approval authorities;
  - the policy development processes;
  - the regulatory control processes in place to ensure compliance;
  - guidelines, interpretive materials and interventions in place;
  - industry and regulatory capacity.
- As part of undertaking this assessment, conduct targeted, jurisdictionally and regionally representative survey(s), consultation, focus-group, review and analysis to identify key inconsistencies and process issues affecting energy efficiency requirements for alterations, additions and retrofits across jurisdictions.
- Develop draft best practice guidelines to support national consistency in approvals and building practice for energy efficient renovations and the uniform interpretation of NCC energy efficiency provisions where appropriate.
- Draft recommendations for regulatory inclusion and/or amendment at targeted levels of national governance, in all jurisdictions and the Australian Building Codes Board, for consideration of future amendments to the NCC to improve energy efficiency outcomes in alterations, additions and retrofits.
- Provide a Final Report including:
  - Documented data, analysis and interpretation of the national review;
  - Draft best practice guidelines in format suitable for limited published distribution;
  - Documented recommendations for regulatory change;
  - Strategy for both Phase 2 and on-going priority interventions over the next 12 month period to June 2015 and beyond.
- Adhere to scheduled reporting and milestone delivery, respond to reasonable informal reporting and communication requests from the Project Manager and ensure effective communication and integration with other Phase 1 project teams.

In undertaking this work, it is expected the successful provider will:

- Consult broadly and effectively with key government and industry stakeholders, other Phase 1 project teams and the Project Reference Group.
- Consider and utilise relevant information previously or concurrently published that informs the process and outcomes of this project.
- Communicate with allied or complementary projects commissioned through the Commonwealth Building Energy Efficiency Branch, the Australian Building Codes Board, the Low Carbon CRC and other informative Commonwealth and State projects as applicable.

Deliverables & Timing

The following timeframe applies to this work and any deviation to this timeframe must be agreed to in writing with the project manager.

Deliverable	*Date Completed*
Commencement of contract	*28/10/13*
Agreed methodology	*1/11/13*
Combined Phase 1 Projects Review - Project Ref. Group teleconf.	*2/12/13*
Project Review teleconference	*20/1/14*
Draft guidelines, draft recommendations for regulatory change and draft Phase 2 interventions – PRG teleconference	*27/1/14*
Final report	*24/2/14*

In addition to this schedule the successful provider will provide updates to the Project Manager on a fortnightly basis, as a minimum. These updates may include a teleconference and may also involve members of the Project Reference Group.

The Project Manager will be available for discussion and clarification as necessary throughout the project to assist with cross-project integration.

Quality Requirements

The Respondent for the purposes of this tender is required to provide details of their quality assurance process to allow DMITRE to assess its appropriateness.

The tenders will be assessed according to the following criteria:

Criteria
1. Expert knowledge relevant to the project.
2. Innovative and thorough project methodology that demonstrates an understanding of the brief and incorporates strong capacity to facilitate cross-project integration, skills and time and resource efficiencies.
3. Demonstrated experience of the project team relevant to the project.
4. Capacity of the project team to deliver to tight project schedules.
5. Value for money.

PROJECT 3

DMITRE requires a suitable Provider to develop a national industry-based information register, needs and gap analysis and strategy to develop and support the knowledge and capacity of key professions and trades to deliver best practice energy efficiency to the building industry. *("Review of knowledge management")*

Project 3 will develop a comprehensive industry-based information register and needs *and* gap analysis identifying the optimal content and mode of information and skill development required by professions and trades to deliver best practice energy efficiency to the building industry. Project 3 will also develop a detailed business case for a range of best-fit and targeted capacity-building interventions in Phase 2 of the NEEBP, in the next 12 month period to June 2015 and beyond.

The objectives of this project are to:

- Develop a comprehensive national information register of materials that support industry capacity to understand, implement and comply with the energy efficiency provisions of the National Construction Code.
- Undertake a Needs and Gap Analysis to identify omissions and inadequate provision of information and training products in energy efficiency across the planning, approvals, design, assessment and construction industry, including material manufacturers and specifiers, project managers and trades.
- Develop a business case for both a priority work program in Phase 2, in the next 12 month period to June 2015 and beyond, to deliver pilot and/or demonstration, knowledge management and capacity building services for industry, local government and other relevant stakeholders.

Services Required

The successful Provider will:

- Provide an agreed project methodology shortly after project commencement and in accordance with the schedule of deliverables.
- Develop a comprehensive national information register of materials that support industry capacity to understand, implement and comply with the energy efficiency provisions of the National Construction Code.
- Conduct a stock-take and quality assessment of all existing websites, published materials and training courses that provide energy efficiency knowledge to the Australian planning, approvals, design, assessment and construction industries.
- Through consultation, survey, etc., conduct a needs *and* gap analysis of the energy efficiency information and training needs of various players in the building industry, including those involved in policy development, planning, assessment, approval, design, construction, project management, materials supply and specifying, fit-out, modification and retrofit of buildings.
- Consult with the teams responsible for Phase 1, Projects 1 and 2 to further inform and value-add the needs analysis and identify the optimal content and mode of information and skill development required by professions and trades to deliver best practice energy efficiency to the building industry.

- Consult with the Project Reference Group and provide preliminary recommendations for high priority, strategic and effective pilot or demonstration knowledge management and capacity building projects in the Phase 2 work program.
- Develop a business case for both a priority work program in the NEEBP Phase 2, and in the next 12 month period to June 2015 and beyond, to deliver pilot and demonstration knowledge management and capacity building services for industry, local government and other relevant stakeholders.
- Deliver final report incorporating:
  - national information register;
  - stock-take, quality assessment and partnering opportunities;
  - needs *and* gap analysis identifying the optimal content and mode of information and skill development required by stakeholders;
  - business case for interventions in Phase 2 and in the next 12 month period to June 2015 and beyond.

In undertaking this work, it is expected the successful provider will:

- Consult broadly and effectively with key agency and industry stakeholders, other Phase 1 project teams and the Project Reference Group.
- Consider and utilise relevant information previously or concurrently published that informs the process and outcomes of this project.
- Communicate with allied or complementary projects commissioned through the Commonwealth Building Energy Efficiency Branch, the Low Carbon CRC and other informative Commonwealth and State projects as applicable.

Deliverables and Timing

The following timeframe applies to this work and any deviation to this timeframe must be agreed to in writing with the project manager.

Deliverable	*Date Completed*
Commencement of contract	*4/11/13*
Agreed methodology	*8/11/13*
Combined Phase 1 Projects Review - Project Ref. Group teleconf.	*2/12/13*
Project & Phase 2 Strategies Review teleconference	*22/1/14*
Draft strategy and business case for Phase 2– PRG teleconf.	*3/2/14*
Final report	*28/2/14*

In addition to this schedule the successful provider will provide updates to the Project Manager on a fortnightly basis, as a minimum. These updates may include a teleconference and may also involve members of the Project Reference Group.

The Project Manager will be available for discussion and clarification as necessary throughout the project to assist with cross-project integration.

Quality Requirements

The Respondent for the purposes of this tender is required to provide details of their quality assurance process to allow DMITRE to assess its appropriateness.
The tenders will be assessed according to the following criteria:

Criteria
1. Expert knowledge relevant to the project.
2. Innovative and thorough project methodology that demonstrates an understanding of the brief and incorporates strong capacity to facilitate cross-project integration, skills and time and resource efficiencies.
3. Demonstrated experience of the project team relevant to the project.
4. Capacity of the project team to deliver to tight project schedules.
5. Value for money.

Appendix B

Best Practice Guidelines – Renovations

A seven point check list for Councils

Aiming for best practice – approving energy efficient alterations and additions to existing buildings

A National Energy Efficient Building Project publication

Introduction

An alteration or addition is an important point in the life of a building. From an energy efficiency perspective, the planned work is an opportunity to improve the building's energy performance. Running costs can be reduced and building comfort can be increased. The National Construction Code's energy efficiency objective to reduce greenhouse gas emissions can be achieved.

Councils play twin roles within the fairly long and complicated process of planning, designing, and constructing an energy efficient addition / alteration. First councils help ensure that the work that is planned will at least meet minimum requirements under state laws and the code. Second, they can help the move beyond compliance – encouraging and guiding the various parties to deliver best practice energy efficiency.

So best practice for councils means that they:

- Fulfil all their obligations (in the spirit and letter) under the legislative framework that applies in their state;
- actively and effectively encourage the energy efficiency of the addition-alteration, and the whole of the existing building, to be as high as cost effectively possible.

This check list runs through the seven key ingredients needed for councils to bake their layer of the energy efficient alterations/additions vanilla slice[22]. Details on the tick off process are not provided here – that would require a very long document that few would use. Rather, the idea behind this sheet is that if councils comprehensively run through all seven points they will develop their own 'fit for purpose' guide. Then councils will be well on the way to maximising their positive influence on the energy efficiency of additions and alterations.

The seven point check list

☑ Know the role of Councils under state law

Make sure that relevant Council officers fully understand the legal role of the Council within the construction process.

Roles are set by state building and planning legislation and administered by state building regulators. Generally the council acts as the gatekeeper to new work via the 'building approval process'. They issue a permit or equivalent that allows a planned renovation or alteration/addition on an existing building to proceed. Often a private building surveyor will certify the proposed work as meeting or exceeding requirements. However the council still issues the approval and has associated obligations. Understand what these and other obligations are and make sure all relevant officers know how to meet them. You might have to talk with your state building regulator if the story is unclear.

☑ Understand the minimum energy efficiency requirements

In all states legislation calls up the energy efficiency provisions in the National Construction Code (some additions and variations apply for certain building types).

Section J of Volume 1 of the code contains key performance requirements for Class 2 –

[22] The French version of a vanilla slice is called a mille-feuille, 'a thousand sheets' and is composed of three layers of puff pastry (each layer itself has numerous sheets) around 2 layers of custard.

9 buildings (non residential and multi-dwelling residential). Part 3.12 in Volume 2 of the code has the requirements of Class 1 and 10 buildings (houses).

Council officers should have a good understanding of what the requirements are and how buildings can be designed to meet those requirements

☑ Know when and how the minimum energy efficiency requirements apply to alterations and additions

Generally speaking, under state legislation the code's energy efficiency requirements apply to both new buildings and any alterations and additions. However the application of this legislative requirement is not uniform – and even varies from council to council within a single state. This non uniformity is not best practice.

Councils should know, for instance:

- When the code's requirements are triggered in their state. In some states the codes requirements are triggered for any scale of work. In others a threshold applies – such as work valued at over $50,000 in NSW.

- When the code applies just to the alteration/addition and when the code applies to the whole building being altered. For instance in Victoria and Queensland a 50% rule applies. Roughly speaking when an alteration covers less than 50% of the total square metres of the building, the code just applies to the altered component; when it covers more than 50%, the whole building may be brought up to code performance requirements.

- How the code requirements are applied. Sometimes the requirements are restricted depending on the nature of the alteration. In some states the certifier can judge whether all or some of the requirements should apply. For example work on the interior of an office building might be judged to trigger lighting requirements, but not glazing requirements.

☑ Explain the requirements to others

Some information about the building approval process is generally provided by individual councils. Often though, information on energy efficiency requirements for alterations / additions is not clear and comprehensive.

Councils should ensure that building surveyors/certifiers, builders, designers, building owners, energy assessors and other construction cycle participants that interact with Council know exactly what they need to do.

A reinvention of the wheel is not required – rather councils can assist by supplying easy and coordinated access to existing information produced by building regulators and the Australian Building Codes Boards and other government entities. When it is apparent that the information does not exist – councils should request its provision from their state regulator.

☑ Understand the difference between minimum compliance and best practice energy efficiency.

The legal role of council is based around ensuring compliance with building requirements. However councils are well placed to encourage proponents of alterations and additions to push beyond compliance and maximise energy efficiency.

An alteration / addition will achieve best practice energy efficiency by taking all cost effective opportunities to maximise efficiency. For instance compliance might be achieved by a design encompassing a new north facing wall with no shading of the windows and highly rated insulation and glazing. A best practice solution could involve the use of eaves or shade structure that allows the sun to strike the windows and interior in winter and not summer

along with optimised use of thermal mass, insulation, glazing, efficient appliances etc.

Council officers are well placed to guide interested applicants beyond compliance when they understand the principles and practices involved in moving from compliance to best practice.

☑ Provide information on best practice energy efficiency

Alongside information that explains compliance requirements on energy efficient alterations / additions, council should provide access information on how to hit best practice. Again, the wheel does not need reinvention, links can be provided to best practice information already available online. See for instance http://www.sustainability.vic.gov.au/services-and-advice/households/smarter-renovations

☑ Collect and check data

Councils should ensure that they collect all information that documents the energy efficiency of an alteration/addition. This requires:

- Templates for certifiers etc that list required documentation
- An internal system that collects and organises documentation. The system should also allow the recording of key data, and facilitate the provision of data to building regulators and other interested parties.

A seven point check list for home owners

Aiming for best practice – energy efficient alterations and additions to existing homes

A National Energy Efficient Building Project publication

Introduction

An alteration or addition is an important point in the life of a house. From an energy efficiency perspective, the planned work is a great opportunity to improve the energy performance of your home. That means lower running costs and higher comfort - a double bonus worth grabbing.

In practice, best practice for home owners means that they:

- Ensure that the minimum requirements for energy efficiency under state laws are met or exceeded.
- actively push beyond the minimum standard. Owners should ensure that all cost effective opportunities to improve energy efficiency are found and taken.

Sometimes owners feel a little overwhelmed by the complexity of the planning, design and construction process. There's plenty to think about for an alteration and energy efficiency can get a bit overlooked.

This quick check list runs through seven key things that you should do to help deliver a high performance alteration. Not much detail is provided here – but if you can confidently give yourself a tick under each point, you'll be well on the way to having a very energy efficient alteration.

The seven point check list

☑ Understand a house is an energy using system

A house contains lots of equipment that uses energy. The energy is used to provide services – like heating in winter, cooling in summer, refrigerated food, television viewing – and many others. A house that is energy efficient will deliver the same services – but using less energy than a less energy efficient home. In other words energy efficiency minimises the waste of energy.

☑ Understand the main routes to energy efficiency

The first main way to have a more energy efficient house is to make the building itself work so that less energy is needed. This is done by ensuring the house has good thermal performance so that less energy to produce heat is needed in winter and less is needed for cooling in summer. Insulation, eliminating uncontrolled air leaks, controlling the access of sun, choosing a sensible size and grade of window, are all house shell issues.

The second is to use systems and equipment that are more energy efficient. This has three elements. You should design or select a system that efficiently does the work that you need. For instance selecting small / medium air conditioners for each space that needs conditioning may be more efficient than a ducted system – and will certainly be way more efficient than using radiator type heaters. Hot water is a big energy user – consider solar. Design an efficient lighting system – LED systems are still more expensive to install than halogen but the running costs are so low the payback will be short. Make sure you select efficient models when choosing your fridge, television, washing machine – you can compare in store using the energy label or the energy rating app – which you can download at http://www.energyrating.gov.au/

The final step in maximising energy efficiency is to actively control your house. Putting down western awnings in the

summer and raising them in winter will lower both cooling and heating energy use. Opening windows at night in summer once the outside temperature has dipped below the inside level is another sensible move.

The remainder of this checklist is about using an alteration to improve energy efficiency through a better house shell.

☑ Include energy efficiency in the design process

The design of the alteration will have a big impact on energy efficiency. Time spent getting your design right will pay dividends. Orienting the living space and selecting the ideal window position and size is important. Making sure eaves, verandahs, awnings, etc. are 'solar access smart' will also reduce your heating and cooling cost. All these design elements will make your house a more pleasant place to be as well as reducing energy bills!

☑ Do a whole house energy assessment

You're going to have designers/builders around in the planning stage. Then the builder will be joined by professionals like electricians, plumbers etc on site for your alteration.

Often these people can be grabbed to improve the efficiency of the whole house while they are on site – saving on the cost of improvements.

So before work starts do an energy assessment. Do lots of research and do it yourself or appoint a professional. Perhaps your designer is also an energy assessor? The idea is to find ways to improve the energy efficiency of the existing home. Then the improvements can be done at the same time as the alteration.

For instance an assessor with a thermal camera can find air leaks and insulation gaps. Then you ask the builder to send a worker around with a caulking gun, some weather sealing devices and a few bags of insulation to fix those leaks and gaps. It won't be expensive but will be effective.

You might already have lots of halogen down-lights. After your electrician has installed your new stove, get them to replace those halogens with some LEDs.

☑ Know the roles of those involved with the alteration.

There are many people involved in the alteration process. It is worth knowing key roles and their impact on energy efficiency. Then impress upon them the fact that you care about energy efficiency and want them to contribute to an energy efficient result.

Maybe you are planning to get your project manager (builder, architect etc) to deal with each of the role leaders. In that case it's still worth knowing the roles – and ensuring that the project manager brief includes stepping each role leader through their energy efficiency responsibilities.

For example:

The building surveyor should understand that energy efficiency is a priority and that the designs, plans, structure should all be thoroughly checked from an efficiency angle. The electrician should know, for example, that they can't pull out insulation and not replace it when wiring. The carpenter should know that you are aware that the high performance window needs to be installed carefully, with no gaps around the frame.

All these people might perform these aspects of their role perfectly anyway – but they have plenty of things to keep an eye on, and will react positively to your priorities.

☑ Choose energy efficient products and make sure that they are used

The products that you choose will make a difference to the energy efficiency of the alteration – and of the whole house.

If you are in a warm climate choose a cool roof – one with a light colour. Select a high performance window with the help of the Window Energy Rating Scheme, see http://www.wers.net/werscontent/how-wers-works

Then make sure your builder buys and installs the specified roofing material or window!

☑ Check and inspect

With the best intentions, things can go wrong. So make sure you or the project manager is constantly checking.

It is also sensible to get the building surveyor - or an expert you have selected - to do an independent check with an energy efficiency focus – in addition to any compulsory structural/safety inspections that might be required in your state.

This will help pick up defects that will impact energy efficiency. For instance get the wall insulation checked before the plaster board goes on. Make sure the insulation is the correct grade and correctly installed with no gaps.

A eight point check list for non residential building owners and managers

Aiming for best practice – energy efficient alterations and additions to existing buildings

A National Energy Efficient Building Project publication

Introduction

An alteration or addition is an important point in the life of a non residential building. From an energy efficiency perspective, the planned work is a great opportunity to improve the energy performance of the building. That means lower running costs and higher comfort. Whether you are an owner-occupier, or rent out your building, the benefits of energy efficiency effectively increase the building's value – so is a bonus worth grabbing.

In practice, best practice for building owners & managers means that they:

- Ensure that the minimum requirements for energy efficiency under state laws are met or exceeded.
- actively push beyond the minimum standard. Owners & managers should ensure that all cost effective opportunities to improve energy efficiency are found and taken.

It is common to feel a little overwhelmed by the complexity of the planning, design and construction process. There's plenty to think about for an alteration and energy efficiency can get a bit overlooked.

This quick check list runs through eight key things that you should do to help deliver a high performance alteration. Great detail is not provided here – but if you can confidently give yourself a tick under each point, you'll be well on the way to having a very energy efficient alteration.

The eight point check list

☑ Understand a building is an energy using system

A building contains lots of equipment that uses energy. The energy is used to provide services – like heating in winter, cooling in summer, hot water, light, computing and many others. A building that is energy efficient will deliver the same level of services – but using less energy than a less energy efficient building. In other words energy efficiency minimises the waste of energy.

☑ Understand the main routes to energy efficiency

The first route to a more energy efficient building is to ensure it has good thermal performance so that less energy is needed. That way less energy to produce heat is needed in winter and less for cooling in summer. Facade design, insulation, glazing design and material, allowing natural ventilation are all thermal performance issues.

The second is to use systems and equipment that are more energy efficient. For example select heating, cooling and ventilation systems of the right capacity, choose efficient motors, fans etc, and design and tune the system so it is optimised for effect and energy performance.

The final way to maximise energy efficiency is to actively control your building. For example make sure the Building Management System is set to recognise the hours of building use and minimises service provisions when they are not needed.

☑ Include energy efficiency in the design process

The design of the alteration will have a big impact on energy efficiency. Make sure the scope of the alteration design includes energy efficiency. Even if you are doing a simple interior refit of a floor, it is worth talking to a lighting specialist. Commonly lighting upgrades have very quick paybacks. Larger projects will have many energy efficiency aspects – and their design brief should always encompass energy efficiency.

☑ Do a whole building energy assessment

While professional energy assessments are an investment in themselves, they will find cost effective opportunities for improvement that will otherwise remain hidden.

There are two sound reasons for undertaking an energy assessment during the planning stages of an alteration.

The assessment will identify your building's existing energy efficiency weaknesses and strengths. This knowledge can make the design of your alteration much punchier by finding the 'quick wins'.

Second, there are going to be lots of professionals around the building during the alteration. Builders, electricians, plumbers, HVAC technicians etc will all be involved at some point.

Often these people can be grabbed to improve the efficiency of the whole building while they are on site – saving on the cost of improvements.

For example the assessment might have identified that the HVAC system is overdue for a clean and maintenance program. So grab the HVAC technicians that are going modifications on one floor to undertake the cleaning work. The extra cost will be minimal.

☑ Know the roles of those involved with the alteration.

There are many people involved in the alteration process. It is worth knowing key roles and their impact on energy efficiency. Then impress upon them the fact that you care about energy efficiency and want them to contribute to an energy efficient result.

Maybe you are planning to get your project manager (builder, architect etc) to deal with each of the role leaders. In that case it's still worth knowing the roles – and ensuring that the project manager brief includes stepping each role leader through their energy efficiency responsibilities.

For example:

The building surveyor should understand that energy efficiency is a priority and that the designs, plans, structure should all be thoroughly checked from an efficiency angle.

The HVAC supplier should know that you view energy efficiency as a priority and are not interested in an oversized unit.

These people certainly might perform these aspects of their role well anyway – but they already have plenty of things to keep an eye on, and will react positively to your priorities.

☑ Choose energy efficient products and make sure that they are used

The products that you choose will make a difference to the energy efficiency of the alteration – and of the whole building.

Ensure that the lighting designer's product specs are followed by the builder. Make sure the high efficiency boilers specced by the HVAC engineers are bought and installed by the technician.

☑ Check and inspect

With the best intentions, things can go wrong. So make sure the project manager is constantly checking.

It is also sensible to get the building surveyor, or expert of your choice, to do an independent check with an energy efficiency focus – in addition to any compulsory structural/safety inspections that might be required in your state.

This will help pick up defects that will impact energy efficiency. For instance get the wall insulation checked before wall's skin is complete. Make sure the insulation is the correct grade and correctly installed.

☑ Tune and maintain for energy efficiency

Even with the right gear installed, new systems for HVAC and hot water needed to be tuned for optimal performance.
This is not an easy job, but ideally the building manager should work with a professional to tune the building systems and learn how to keep them running as designed. Otherwise, some of the potential capacity for high performance provided by the careful design and build will be wasted.

Appendix C

Workshop Findings

Summaries of Stakeholder workshops

Workshops were held in all capital cities and a handful of regional centres in order to capture major industry trends and outcomes for differing climate zones and population centres. A total of 17 workshops were held over a 3 week period from 28 November 2013 (with morning and afternoon workshops held in most centres). An overview of outcomes by location is provided below.

These summaries reflect the views and issues raised in the workshops – although we stress that it was not possible to capture every individual comment. Also, workshops were conducted under Chatham House rules - so no comments are attributed to individual parties. The summaries reflect stakeholder ideas, opinion and discussion – rather than a set of objective or verified facts. Note that they do not necessarily reflect the unanimous view of those in attendance, or the views or conclusions of the consultants that facilitated the workshop discussions. They are reported simply as further input to the issues and analysis relevant to building energy efficiency policy approaches and implementation within Australia.

Table C.1: Perth (WA) workshop outcomes (4 December 2013)

Location: Perth **Climate zone: 5** **Number of participants: 37**	
Topic: Building Code provisions – New construction	
Issues/ problems/ opportunities	**Proposed actions**
Greater national consistency desirable Requirements are complex to read and understand Alternative Solutions: not well understood Contradictions in NCC technical notes (eg. definition of 'conditioned' spaces) Limited to thermal performance not energy performance (narrow) Customer apathy over energy efficiency pay-offs Scepticism that DTS/ Expert advice/ Reference Building approaches are consistently meeting 6 star standards Insufficient interface with local government decisions on block size & planning, orientation, other trade-offs (fire safety, ventilation).	Need to review and draw on tools and experience from overseas Greater focus - and testing – of ACTUAL performance Make NCC free Make sections easier to understand for trades (colour diagrams and 'cheat sheets'), support with YouTube video tutorials
Topic: Building Code requirements – alteration& additions	
Issues/ problems/ opportunities	**Proposed actions**
Concern that EE knock on effects of some additions are not captured eg. adding a patio or sail creates shading effect that alters EE characteristics of main house Patios and car ports are most common residential additions DTS used most commonly for alts & adds Rating software performs poorly here Incentives to avoid triggering an energy efficiency requirement by staying under the threshold	

Topic: Energy efficiency rating tools, DTS and alternative solutions	
Issues/ problems/ opportunities	**Proposed actions**
Lack of parity between rating tools (eg. AccuRate, BERS Pro, FirstRate 5): giving rise to differing results (and 'fuzzy science') Star rating system 'flawed' – discrepancies with respect to overshadowing of neighbours, conditioned spaces, elevated floors. Lack of a 'worst case scenario' for user behaviour in models Lack of investment and improvement in the software (eg. air changes, operability versus infiltration, real usage of houses, new materials); little support from software developers, few updates to library files or training AccuRate prone to data entry errors (though it does allow scope for 'creation' of new material attributes) Lack of audit and quality control in tool usage, EE modelling particularly poor for commercial buildings ABSENCE OF ACCREDITATION/ QUALITY CONTROL FOR ENERGY ASSESSORS IS A MAJOR PROBLEM IN WA RESULTING IN 'RUBBER STAMPING' OF DESIGNS AND A RACE TO THE BOTTOM Reported incidents of assessors advertising their ability to generate a higher EE star rating for a particular design than their competitors! Narrowness of EE rating can be an issue – desire for 'sustainability' rating tools that address water, embodied energy, life cycle analysis, appliance efficiency, etc DTS approach disconnected from energy rating system and Reference Building approach	Building Code should nominate preferred software or accuracy level Upgrade rating tools (eg. material files, distinction between opaque and glazing materials, etc) Require minimum training (eg Cert IV) and accreditation for energy assessors Require 'holistic' approach to commercial building assessment Implement audits of EE assessments, with sanctions for low quality outputs/ practitioners Review problems/ performance in a sample of established projects.
Topic: Activities in the construction phase	
Issues/ problems/ opportunities	**Proposed actions**
Many buildings fall well short of original design specs and are non-compliant **(a participant estimate of 3.5 stars being achieved on average in a 6 star design build was not significantly contested)** Poor installation of insulation is common: thermal bridging, insufficient air gap, holes in vapour barriers, poor window sealing, squashed bulk insulation, no insulation in last 3 brick courses, tears in insulation, insufficient sarking Product quality can be poor (and below minimum specification), common with cheapest insulation and glazing products Culture of compliance rather than performance	Need training and accreditation for installation installers Develop a compliant products register relevant at a National and State level, police false and misleading material performance claims Ensure proper product performance labelling and minimum standards Ensure at-specification materials used in construction with appropriate verification and paper trail Promote/ require continuous professional development for all key service providers
Topic: Inspection and certification	
Issues/ problems/ opportunities	**Proposed actions**
No requirement for building inspections in WA – is at investors discretion Lack of resources for enforcement of Code requirements, little political will in this area Significant incidence of certification of non-EE compliant	Enhanced education/ awareness raising for trades and builders Implement EE audit/ inspection regime DURING construction phase, and afterward Greater use of thermal cameras (very low cost way of

structures occurring in WA WA system lacks control/ accountability after occupancy certificate is issued Client relationship with builder leads to conflict of interest for certifier Inherent difficulty for certifiers in identifying non-compliant products, general knowledge and experience of a building surveyor is not sufficient for detailed energy efficiency assessment	detecting gaps) mandate handover of written maintenance manual for new builds Enforce greater accountability for builders/ service providers (and easier progression and resolution of owner claims)
Topic: Information, knowledge management & training	
Issues/ problems/ opportunities	**Proposed actions**
Significant uncertainty and confusion in the industry lack of knowledge/ understanding of differences between 3 key design compliance methods Conflicting outcomes from rating tools	

Key observations

Lack of certification requirements for WA energy assessors emerged as a major issue in the Perth workshops, and was seen as a key contributor to under-delivery of targeted energy efficiency outcomes in that jurisdiction. A perception that more efficient buildings cost more to construct and a reluctance on the part of major builders to depart from (or materially upgrade) established designs and construction practices was reportedly fuelling demand for generous assessments that effectively 'waved through' and 'rubber stamped' house designs that fell well short of the legal 6 star energy efficiency requirement. Participants reported an energy assessment market where service providers did not require formal accreditation in the use of the energy efficiency rating tools, and where there was little effort to assess and assure the quality of the ratings given. Very low cost rating services were available, but serious doubts were raised about the reliability of those ratings. The suspicion was that these service providers frequently certified sub-standard homes to the 6 star minimum requirement. Participants accepted the feasibility of a bold claim that many 6 star rated homes were likely to deliver closer to 3.5 stars if reliably assessed. In Perth, some assessors were openly advertising their ability to deliver a higher rating outcome on a house design than their peers.

'Building affordability' appears to be given primacy by many WA policymakers. Recognition that better designs can be both cheaper to build AND run is not dominant, and effort to police or uphold building code requirements relating to energy efficiency appears to be languishing. Likewise, analysis demonstrating that compliance with 6 star energy efficiency outcomes delivers substantial net economic benefits to owner-occupiers has not resulted in significant effort to police the system to ensure these consumer benefits are actually delivered. Building energy efficiency into the design and construction stage is substantially cheaper than trying to improve thermal energy performance after the building is delivered. While there is recognition of this by a handful of leading designers, project managers and bespoke builders, in general, awareness of the consumer benefits and priority given to delivering mandated energy efficiency outcomes in Perth and surrounds appears to be low. This is permeating decision making and activity throughout the construction chain, and appears to be dominating both residential and commercial building activity.

Table C.2: Adelaide workshop outcomes

Location: Adelaide Number of participants: 39	Climate zone: 5
Topic: Building Code provisions – New construction	
Issues/ problems/ opportunities	**Proposed actions**
DEEMED TO SATISFY allows too much slack – the software can be used to design around the requirements – and there is a belief that it does not matter as you can just retrofit later. POTENTIAL POLITICAL INFLUENCES. Concern that the notion of reducing energy use and greenhouse gases was political - with a loss of focus on basic economics and consumer benefits. OUTDATED LEGISLATION. The Development Act is now 20 years old and out dated. It was introduced on the belief that planning and building was intertwined and it has shifted the job of policing from council and on to builders. STATE VARIATIONS. While the code prescribes minimum construction requirements it is the State legislation that dictates the processes and procedures but these vary across State's which causes confusion for those who operate across States. It was also mentioned that it wasn't considered fair that other states receive certificates for good EE performance and SA does not. LIMITED SCOPE. Building Sealing is not incorporated in the code. Additionally, it was raised that there was no consideration for the size of your house or the number of appliances.	Rephrase the objectives of Section J in a manner that removes potential political alignment Review of the currency of the Act. National consistency – suggestion for a National Building Act. Central leadership to govern the states Include building sealing in the code Discounted council rate as an incentive to rectify entire property
Topic: Building Code requirements – alteration& additions	
Issues/ problems/ opportunities	**Proposed actions**
Code is hard to apply for renovations	
Topic: Energy efficiency rating tools, DTS and alternative solutions	
Issues/ problems/ opportunities	**Proposed actions**
Basic architectural principles have been forgotten. Ie. orientation to face north. TOOL PRACTICALITY: Dynamic components can be changed. (ie curtains removed). Does not incorporate verandahs and garden structures, which are widely used in SA. TOOL RELIABILITY Concern that some elements were not technically correct.	Bring it back to first principles. Education and Awareness. Remove the heating and cooling component as people will leave the windows open and the air-con on if they can. Educate owner on assumptions used in the tools, OR remove those components. (?) Glazing calculator needs to be revised
Topic: Activities in the construction phase	
Issues/ problems/ opportunities	**Proposed actions**
INCORRECT INSTALLATION. Particularly with respect to the installation of insulation, but also in terms of corners being cut and buildings not being built as designed. PRODUCT SUBSTITUTION/DESIGN CHANGES. A council officer said that for 70% of their inspections there is a	Stricter penalties for non-compliance Product certification Mandatory use of a mechanism like CodeMark – fund CSIRO to undertake product testing. Barcode products so that they can be scanned and checked at

call-back due to different materials or a variation from the approved plans.	inspections.
Topic: Inspection and certification	
Issues/ problems/ opportunities	**Proposed actions**
LIMITED NUMBER OF INSPECTIONS. Estimated that approx only 5% of buildings are actually inspected in SA TIMING OF INSPECTIONS. The final inspection that is done was said to be the one that, while not the main priority, can include checking energy efficiency requirements, however this is physically restrained by the fact the walls and roof are on. SYSTEMIC ISSUE. The intertwining of planning and building (and ensuring what's planned is delivered) LIMITED RESOURCES. Council have had to employ additional staff to undertake inspections due to the demand but they are still struggling to meet the requirements of the legislation	Need greater effort to ensure good practice and outcomes DURING construction (when things can most easily be viewed and corrected) Use of thermal imaging and blower door testing Additional funding to support more inspectors
Topic: Information, knowledge management & training	
Issues/ problems/ opportunities	**Proposed actions**
LACK OF CONSUMER AWARENESS: While the designer can make recommendations it is the client/ owner that has the final say – and if there is no information available to them they have limited ability to know what they want. The attitude of end users was also raised as an issue – being focused on short term costs and benefits LACK OF ACCREDITATION: there is a lack of qualification requirements on assessors –' in SA anyone can complete a section J'.	National advertising campaign on energy efficiency. Introduce energy efficiency into school curriculum from primary school onwards Develop a checklist for owners on questions they should be asking their builders Raise awareness on both the cost savings and comfort increasing benefits of energy efficiency Provision of a home owner manual Require qualified professionals to complete section J. Have an accreditation for "green" builders.

Key observations:

In South Australia there is a different process to other States with the Development Act governing the process and being heavily planning focussed. Some stakeholders felt that this led to a lack of technical expertise being applied to building technical matters (including building efficiency) than in other jurisdictions.

The structure in South Australia is that the building surveyors are all local council employees and accordingly the demand on the limited resources was a concern. Surveyors were thought only able to undertake limited numbers of inspections and checking on energy efficiency was not the top priority when they did. There was a consensus that additional training requirements, and continued professional development would be beneficial in the construction industry to alleviate pressures on surveyors if the builders and trades were to have got it right in the first place. Implementation of required formal document trails, product certification and mandatory disclosure were all possible improvement options.

The concept of mandatory disclosure received significant attention with delegates questioning why it was not already in place following previous consultations on the topic. Following from this there was concern raised over the potential politics and competing political agendas that could contravene any resultant action from this process.

More broadly, the delegates also discussed how to not only reach best practice in new building and those being renovated but also the existing building market and whether it could be feasible to extend the code and set objectives to retrofit all buildings up to the minimum standard.

Table C.3: Port Augusta (SA) workshop outcomes

Location: Port Augusta	**Climate zone: 4**
Number of participants: 44	
Topic: Building Code provisions – New construction	
Issues/ problems/ opportunities	**Proposed actions**
CONFLICTING LEGISLATION The 'one-stop shop' of amalgamating building and planning together is not working. NCC is RIGID and does not cover all climate zones Inherent conflict with harmonising the regulations nationally as all States/ areas are quite different. HARD TO UNDERSTAND. '... even if it is free no one will use it' MISSING EMBEDDED ENERGY. There is no mention of embedded energy in the NCC	Harmonise the planning and development planning process Review/ update legislation There needs to be more flexibility in the process so consumers can make choices. Reinvigorate the building commission to put out technical notes and useful information like they used to. Refer to the NZ model as a guide
Topic: Building Code requirements – alteration& additions	
Issues/ problems/ opportunities	**Proposed actions**
(issues of concern - as above)	
Topic: Energy efficiency rating tools, DTS and alternative solutions	
Issues/ problems/ opportunities	**Proposed actions**
RATING ACCURACY: Discussion that the rating tools do not allow for detailed local situations – that they were only designed as educational tools and are not appropriate for the building industry. NatHERs apparently does not take into consideration two storeys SOFTWARE DOES NOT PROMOTE BEST PRACTICE: The use of renewable vs heating and cooling focus. The addition of photovoltaics in place of good design.	Review tool files and reliability Adjust the weighting of the tools on good design vs add-on extras.
Topic: Activities in the construction phase	
Issues/ problems/ opportunities	**Proposed actions**
PRODUCT SUBSTITUTION going unnoticed as trades not skilled to identify different quality products. COST OF ENERGY EFFICIENT PRODUCTS: The affordability of EE by the average buyer was discussed and that the market did not accurately reflect the premium for purchasing top quality products. HOT BOX SYNDROME. Due to the smaller blocks, 6 star compliance rating and poor design solutions (ie. no eaves). Windows cannot be opened , no natural ventilation	Mandatory vents in bathrooms, toilets, laundries

Topic: Inspection and certification	
Issues/ problems/ opportunities	**Proposed actions**
INSPECTION PRIORITISATION: discussed that inspections focussed on safety, which meant there was no time for energy efficiency – and no emphasis on glazing TIMING OF INSPECTIONS	Mandate "as built" inspections and assessments
Topic: Information, knowledge management & training	
Issues/ problems/ opportunities	**Proposed actions**
POOR CONSUMER AWARENESS. Affordability and energy pay-offs are not understood - LACK OF INFORMATION!	Incentives to first home buyers for energy efficient buildings Long term public education program Demonstrate benefit of EE to customer More detail and supporting material for builders Increased amount of free EE government advice

Key observations:

This workshop was primarily attended by building surveyors, thanks to the event being hosted by the local chapter of AIBS. However, numerous participants joined from other locations, including Adelaide, representing different professions. It was the single best attended workshop.

While the issues raised were similar to other workshops, considerable time was spent discussing the 'hot box syndrome', referred to in the notes above. We took this to refer to houses that overheat in summer. Some participants attributed this to energy performance regulations, although other factors – notably design and construction choices (no eaves, black roofs, excessive glazing) were also mentioned.

Table C.4: Darwin (NT) workshop outcomes (10 December 2013)

Location: Darwin **Climate zone: 1** **Number of participants: 18**	
Topic: Building Code provisions – New construction	
Issues/ problems/ opportunities	**Proposed actions**
NT mandates Class 1 performance to 5 star only, no Section J requirement Additional costs of adopting 6 star are unlikely to be offset and are unattractive. There is a lack of political will (and broad based community support) to push for higher energy efficiency requirements BCA doesn't deal well with tropical climate conditions and liveability options (eg. flow through ventilation - which detracts from insulating properties – versus focus on 'conditioned' space) Desire to promote lightweight and 'free flowing' tropical house design as a legitimate 'liveability' paradigm alongside conditioned concrete block paradigm (which has found favour as a more cyclone resistant solution) High tenancy rates also detract from 'return to owner' of increased capital costs associated with higher energy efficiency requirements Dissatisfaction with the integration of building interaction, eg. shading from other buildings affecting heating/ cooling characteristics, etc. Concern that 'thermal insulation' focus of the energy	Need to re-establish the economic benefits of the building code energy efficiency provisions to home owners/ builders Clarify the energy performance modelling and relative rating and 'liveability' outcomes for free flowing and conditioned spaces in the tropics Greater emphasis on education of value and relevance of the EE provisions of the building code – particularly around benefits of moving from 5 to 6 star and mandating Section J for commercial buildings.

efficiency provisions ignores other problems and opportunities (eg. condensation build up, better ventilation management)	
Topic: Building Code requirements – alteration& additions	
Issues/ problems/ opportunities	**Proposed actions**
BCA provisions apply to alterations to 'any habitable area'. Ie. No minimum threshold for application of 5 star requirements to Class 1 property renovations (though a Class 10 addition does not invoke energy efficiency requirements). (no EE requirements for commercial buildings and associated re-fits)	Low cost nature of the current 5 star requirement has led EE to be a non-issue in the NT. A move to 6 star will require a convincing and detailed economic case
Topic: Energy efficiency rating tools, DTS and alternative solutions	
Issues/ problems/ opportunities	**Proposed actions**
Lack of quality assurance or registration requirements for EE assessors – this compounded by incentives for builders to work with 'easy' raters (ie. those most likely to rubber stamp a non-compliant design) DTS dominates design approach for housing (little engagement with models or innovative design solutions) Assessors from interstate don't use/ understand local building practices Lack of consumer protection from poor practice in the EE rating industry Poor understanding among designers and builders about the extent that different features affect an EE rating outcome No clear advice (or policing) on EE assessment protocols	Government should provide clear advice on EE assessment protocols Establish (and police) accreditation requirements for energy efficiency (EE) assessors Require ongoing professional development for building industry practitioners
Topic: Activities in the construction phase	
Issues/ problems/ opportunities	**Proposed actions**
Cost and availability of materials in the NT is problematic, limiting design options and innovation Cheap construction is given a heavy emphasis, and there is no requirement for builders of Class 1 dwellings to have formal building qualifications (a record of satisfactory construction activity in the past is sufficient) Priority is given to building strength and cyclone resistance, thermal energy efficiency is seen as a second (or third!) order issue.	Implement a more rigorous building inspection process (with a greater focus on BCA energy efficiency compliance outcomes) Encourage greater training and professional development among builders and trades people Mandate ongoing license review and compliance requirements
Topic: Inspection and certification	
Issues/ problems/ opportunities	**Proposed actions**
There is no Section J requirement for commercial construction in the NT. For these projects it is common for the design team to also certify/commission the building for Class 1 constructions, mandatory inspections on 5-7 occasions throughout the build (less stringent requirements apply in the Tennant Creek area) There are cases where building certifiers also offer EE rating assessment services (with a potential for conflict of interest and 'soft' EE outcomes) Despite heavy emphasis on period inspection of construction projects in the NT, there is still little	Introduce Section J requirements Mandate audit/ verification of EE assessments, and accreditation of EE assessors Require inspection of EE features in construction stage Require and provide a greater focus on education builders, certifiers and sub-trades on energy efficiency benefits and installation practices (Noting that it is far cheaper and easier to 'get it right' in the initial design and build than to repair or retrofit).

opportunity to verify quality of insulation installation, etc. Certifiers will continue to rely heavily on Builder's Declarations that construction has occurred in accordance with approved design.	
Topic: Information, knowledge management & training	
Issues/ problems/ opportunities	**Proposed actions**
Topic (added by discussants): Building operations	
Issues/ problems/ opportunities	**Proposed actions**
Many buildings – once delivered – are not operated to their EE potential Poor maintenance can also impede ongoing energy efficiency outcomes Characteristics and opportunities can differ on a regional basis	Greater education of building managers/ occupants Possible legal requirements to ensure proper maintenance

Key observations:

The Northern Territory has demonstrated considerable reluctance to mandate higher energy efficiency requirements for construction. It has not embraced 6 star requirements for Class 1 (residential) buildings, nor has it adopted Section J requirements for commercial buildings. Concerns over the ability of NatHERS modelling to adequately capture climate and liveability conditions in the tropics appear to be fundamental to this position. Scepticism over the NatHERS modelling also translates to the economics of boosting energy efficiency standards for buildings in the Territory. The need to re-establish the 'business case' for energy efficiency requirements (and demonstrate the private pay –offs) is apparent.

However, even if current reluctance to 'push' energy efficiency at a policy level was reversed through demonstration of a clear and convincing business case, effective action in this area would also require key changes to ensure the quality of energy efficiency rating and advisory services that are used as inputs to the building design phase.

A lack of accreditation (and audit) requirements among energy efficiency assessors appears to be eroding quality in the market. Practices such as 'rubber stamping' and poor attention to detail lend themselves to reducing business costs, quicker turnarounds and scope to undercut competitors' fees. However, if left unchecked they will eventually destroy confidence in the market, drive out higher quality practitioners and lock in excessive energy consumption and running costs for building occupants in the Territory. A greater emphasis on quality in energy efficiency assessment and execution in the construction phase via education and verification is a complementary priority for the Territory. This requirement is equally relevant to evaluation of implementing Section J provisions in this jurisdiction.

Table C.5: Hobart (Tas) workshop outcomes

Location: Hobart	**Climate zone: 7**
Number of participants: 16	
Topic: Building Code provisions – New construction	
Issues/ problems/ opportunities	**Proposed actions**
Cost of purchasing Code and standards Information Resources Missing information Functions of professions not clearly specified (assessors,	More NCC handbooks Documentation standards Mandatory disclosure Blower door testing and thermal cameras

surveyors) Lack of inspections Post-approval variations Mandatory CPD for all professions DTS/alternative solutions equivalence 'Toxic products' – eg, imported polystyrenes – not tested Glazing – big focus of substitution problems: surveyors don't pick it up; builders go with cheapest quote Testing of products – go with international standards to minimise costs (eg, DIN standards)	Councils to require certification of insulation installed "As built" performance disclosure Physical inspection of insulation, sealing, architraves, taping of membranes Raise awareness of lifecycle cost implications Make the whole system 'trade understandable' – dimensions based, diagrams of a couple of wall systems, clear documentation Highlight the financial savings Set ambitious targets! Actually police compliance – don't guess
DTS for windows is poor Coverage of existing buildings...but need a solution for heritage buildings Energy codes and fire code conflict Heating /cooling sources must be regulated as well	End the exemption for electric storage hot water Address existing building stock Promote health and comfort benefits of EE Change the culture – better training
Topic: Building Code requirements – alteration& additions	
Issues/ problems/ opportunities	**Proposed actions**
(HVAC systems – Section J) Compliance – look separately at Class 1 and 2 - 9 Clear triggers required Requirements not clear	
Topic: Energy efficiency rating tools, DTS and alternative solutions	
Issues/ problems/ opportunities	**Proposed actions**
Rating tools – 6 star to apply from 2014	
Use of tools increasing vs DTS Focus on certification, eg, for glazing – use of WERS Reports need to use 'layman's language' Windows files in rating tools very old – could use WERS instead? Rating tools don't handle edge insulation of slabs Can model thermal bridging, but not in rating mode Governance is poor – unresponsive	Reduce discretion in tools Builders should not be able to do own rating – conflicted! Automatic flagging of 'extreme' or implausible values in rating Change metrics to include fuel source, solar HW, PV
Topic: Activities in the construction phase	
Issues/ problems/ opportunities	**Proposed actions**
Consumer protection mechanisms needed Costs more to do it right – payback? More savings in getting frames right than windows Lack of airtightness a major issue – are resources like the Passivhaus Handbook/Catalogue Mandatory airtightness AND ventilation standards Ireland a world leader in this area Should also incentivise use of natural materials Favour local materials over imported – product miles Building wraps poorly labelled, understood and used Condensation too long, missing mandatory requirements	Mandate 140mm studs in climate zone 7 – bring down the cost More diagrams! Insulation handbook for builders – knowledge of materials, r vs u values, installation methods

Topic: Inspection and certification	
Issues/ problems/ opportunities	**Proposed actions**
Important, but how and whom? Privatisation created conflicts of interest – who do they work for?	Directors list – legal document surveyor must sign off with all EE features noted Mandatory blower door testing Mandatory inspections of insulation – but may be able to use thermal cameras Example from electrical industry – use random audits and a 'black mark' system. Plumbing does the same. Councils to audit 20% of surveyors approvals.
Topic: Information, knowledge management & training	
Issues/ problems/ opportunities	**Proposed actions**
Trades supervision and training Too much reliance on product suppliers – not independent Trades skills in EE very poor Lack of awareness around sealing gaps, even small ones Better training for assessor and surveyors in EE issues Mandatory accreditation of building certifiers	"It has to be checked" Retrain designers – too many plans with poor orientation and solar passive features Support for younger professionals Lift consumer awareness Better understanding of condensation issues

Key observations:

These were active workshops, with broad representation from regulators, builders, assessors, designers, and planning authorities. Some people had travelled 4 hours to attend! Discussion focused on condensation issues, noting that they were complex in origin and not easy to fix with simple prescriptive solutions. There is a need to ensure that planes are drained and houses ventilated.

There was a strong focus on the need for mandatory inspections, but also a view that blower door testing and thermal imaging could supplement this. Many issues with rating tools were raised. There was a general view that standards in Tas were lower than elsewhere, without good justification. There were stories of weakening of consumer protections in recent years, and also of the failure of the Tasmanian Parliament to pass a bill that would have created a dispute resolution mechanism. Another strong theme was the need to apply the KISS principle – express Code requirements in clear language, with clear diagrams (like in NZ), with prescriptive solutions appropriate to local climate (like 140mm studs). Reportedly the Code and associated Australian Standards are not closely followed in many instances. This was attributed to their high cost.

Table C.6: Melbourne (Vic) workshop outcomes

Location: Melbourne **Climate zone: 6** **Number of participants: 26**	
Topic: Building Code provisions – New construction	
Issues/ problems/ opportunities	**Proposed actions**
ACCESSIBILITY OF THE CODE. The BCA is essentially a piece of legislation that is required to be followed – but it is required to be purchased, which can be a deterrent. Additionally, the code refers to Australian Standards, which are required to be purchased at an additional cost. LANGUAGE OF THE CODE. The code is written in 'code-	Free online access to the NCC. The ABCB is apparently already looking into this. There was also support for the provision of Australian Standards free but acknowledgement that this may be a harder task Improve online navigation The Practice Notes provided by the Victorian Building Authority are useful – plain language explanations. More of these targeted at all

speak' or legalese, which requires interpretation. Industry bodies are reluctant to provide interpretation guides because then they can be held accountable for any misinterpretation. Additionally, it was mentioned that State Regulations did not look after residential owners. CODE LIMITATIONS. For example, Building sealing and ventilation could be improved in the code.	the specific areas would be beneficial particularly if they were nationally applicable. Liaison between the different state building commissions to develop national practice notes on the interpretation of the NCC However, it was pointed out that the plumbing code assumes a house is not air tight as this is a fire safety hazard (gas leaks). Lighting standards to be based on brightness rather than luminescence
Topic: Building Code requirements – alteration& additions	
Issues/ problems/ opportunities	**Proposed actions**
(issues as above)	
Topic: Energy efficiency rating tools, DTS and alternative solutions	
Issues/ problems/ opportunities	**Proposed actions**
TOOL RELIABILITY. There was concern that the tools do not reflect reality and that there are some technical problems in them. Deemed to Satisfy method and BASIX Calculator is problematic and has expensive specifications for windows First Rate gets a hostile reaction from builders as it is seen not to work in practice. COMPETING PRIORITIES. For example, it was mentioned that architects are less well versed in thermal performance as it hinders creativity; when trying to minimise expenditure the capital cost of an energy efficient product could detract from the whole-of-life savings TOOL INCONSISTENCIES: There was concern raised over the ability to game the system through modelling.	Review the glazing calculator NatHers tool offers the same service but was seen to do a better job. Education. Implement stricter protocols Accreditation of thermal modellers Develop a tool specifically for Alterations and Additions
Topic: Activities in the construction phase	
Issues/ problems/ opportunities	**Proposed actions**
CONSUMER RIGHTS. Participants noted that the owner/developer is paying for a product (albeit a building) that they have been told is going to be X but the result is Y. In any other field this would be an ACCC case. INFERIOR PRODUCTS. There is currently no easy way of knowing if the product you have paid for (as specified in the design) is actually the product that has been installed, as it could for example meet the required R value for the insulation but that is as determined by, the participant used the Saudi government as an example, and not by an Australian approval process checking that it is what it claims to be. PROFESSIONAL ACCOUNTABILITY Are builders or building surveyors ever deregistered? Concern that privatisation of building surveyors was like '... putting Dracula in charge of the blood bank'.	Mandatory disclosure. A means of appeal Product certification – "CodeMark" Document all product receipts so owner/builder knows exactly what they have received An audit process to check that Ensure that VCAT supports Building Surveyors in doing their job properly Make the accountability to comply on builders/contractors not on the surveyors
Topic: Inspection and certification	
Issues/ problems/ opportunities	**Proposed actions**
UNREALISTIC EXPECTATIONS ON BUILDING SURVEYORS. There was acknowledgement that Building Surveyors have a hard job. It is the Building Surveyors	Educate specialist trades and distribute the responsibility so that it is not all on building surveyors

responsibility to sign off (a) that the design is in accordance with the code, and then (b) that the constructed building is as the design intended. A degree of this is based on the relevant designers signing off that they have inspected certain areas on the way. It is not physically possible for the surveyor to check everything. SKILLS SHORTAGE. There is currently only 500 building surveyors and 500 inspectors LIMITED NUMBER OF INSPECTIONS. Building inspections for 'as-builts' are lacking – and often energy efficiency requirements are not checked at all.	Empower Facility Managers to certify Provide training for owners/project managers on how to check for EE compliance Implement an Energy Efficiency Auditing program – so there is always the potential that the building could be audited. Make building surveying a more attractive role to encourage more people to do it. As noted above, share the load amongst other disciplines. For example Energy Efficiency auditors. Make is mandatory for the final building to be checked and signed off on. A thermo imaging camera could be used to test for thermal leaks as an energy inspection at completion The energy rater who did the initial assessment could return once its completed Introduce inspection to check insulation installation
Topic: Information, knowledge management & training	
Issues/ problems/ opportunities	**Proposed actions**
LACK OF KNOWLEDGE. This was in terms of both the most effective energy efficiency practice in general by the public at large, and also by specialist trades that have not been trained in all the latest energy efficiency requirements INFORMATION GAPS. There were a couple of areas highlighted were there was insufficient information available including: COMMUNICATION GAPS. A building is designed and rated based on assumptions on how it is going to be used – however the occupant is not made aware of these assumptions.	Training. Public Awareness program (social marketing) to generate demand-side compliance not just supply side drivers (More) education at a Cert III level better/focussed/applicable Compulsory continual professional development (CPD) Provision of an owner manual detailing the expected usage of the building in order to maximise the energy efficiency benefits.

Key observations:

Victoria has been proactive in reviewing and auditing the procedures surrounding implementation of the National Construction Code over the past couple of decades. Most recently the Building Commission was dissolved and the Victorian Building Authority formed, and previously building surveyors were privatized in order to alleviate pressures on local councils. However, despite this, there is still concern over the limited number of professional surveyors available to perform inspections and there are unrealistic expectations placed on them to cover everything.

There was a push from delegates for increased levels of education, and continued professional development amongst trades in the construction industry with delegates highlighting the benefit of nationally 'upskilling' trades in order to be a smarter industry. This would reduce the pressure upon building surveyors as there would be fewer cases of under-compliance to identify as the level of performance in the construction industry would hopefully increase – and the sign off role could be shared for example to include facility managers.

In addition to training, holding each stream of professionals accountable for their work and for their sign-offs on was seen as an important step in improving performance – and upholding the rights of consumers for receiving what they have paid for.

The education concern was extended from professionals to the public at large. The need to educate the public and raise consumer awareness was strongly expressed by delegates, particularly to convey the message that reducing energy usage results in cost savings and higher building occupant comfort.

Finally, the delegates raised concern that the requirement to purchase the NCC was a potential barrier to its use and therefore implementation. It was put forward that as it contained legislated requirements it should be freely available – in accordance with principles of best practice regulation.

Table C.7: Sydney (NSW) workshop outcomes (28 & 29 November 2013)

Location: Sydney	**Climate zone: 5**
Number of participants: 32	
Topic: Building Code provisions – New construction	
Issues/ problems/ opportunities	**Proposed actions**
NSW use of BASIX alternative to National Construction Code for residential construction 'There are 10 thousand pages of regulations referring to building a house in NSW' There is no Australian guidance for building sealing BASIX needs to be holistic – not just tick a couple of boxes / cherry picking But BASIX delivery approach is intuitive and user friendly – it should be applied nationally Balancing different aims can be problematic eg: child safety versus ventilation Bushfire and EPA contradict each other in codes Standards committees are driven / controlled by manufacturers Under BASIX can "do anything" to get 6 stars Code implementation = one way street, ie: information out without consideration of the local and state differences (for assessors) no clear explanation for this Section J is consistent, but domestic is not – Eg BASIX may be okay but difficult to coordinate with BCA etc Accurate / Firstrate5 etc ... factors should be used, but which ones? = conflict Currently builders use old BCA copies or none at all Needs to be better communication between govt departments Availability of BCA to smaller assessors is an issue Is the "deemed to satisfy" always ok for BCA – not flexible At the DA stage where information is not complete the process is flawed as there is no second check Some scepticism over use of alternative solutions as alternative to 'deemed to satisfy' (DTS) More prescriptive requirements needed in standards (leaking bathrooms is detailed but EE is not) NCC is complex and there is a role for third parties to interpret the code, but change makes this difficult and there is the risk of inconsistent interpretation Climate zones aren't clear cut anymore – a complication Code inconsistencies between local governments in	Make BCA FREE Change make up of standards committees – more independent members to bring in better scrutiny of materials A prescriptive minimum is possible and required Cannot rely on the architect to know Section J – a specialist section J consultant is required and this specialist input should be sought early in the design process

interpretation and application Section J analysis at certification stage is too late – designers need to be thinking about Section J compliance during the design phase and should get section J compliance certificate at DA stage (same as BASIX for residential buildings)	
Topic: Building Code requirements – alteration & additions	
Issues/ problems/ opportunities	**Proposed actions**
Minimal separate discussion – see above	
Topic: Energy efficiency rating tools, DTS and alternative solutions	
Issues/ problems/ opportunities	**Proposed actions**
Many architects are vague on energy efficiency Assessors around country are doing different things, and various rating systems with scope that can vary Good passive design is especially bad with whole suburb developments – town planning has to be improved "alternative solution" gets abused with software generating a certificate for materials that may not work when installed	Boost EE awareness & training Minimum prescriptive code is required Time effective online tool ie: cost analyses Scaled rating tool for Green Star rating Large subdivisions – town planning required for better passive design SEDA (NSW authority) – tool for councils and developers to do subdivision layouts, State planning for bigger developments
Topic: Activities in the construction phase	
Issues/ problems/ opportunities	**Proposed actions**
Worst cases: insulation goes in for certification and then taken back out Insulation does little if not sealed and needs to be installed correctly Problem – unlicensed trades (eg. insulation) and lack of EE training Some products not performing – how can these be certified better? Perhaps like BBA in UK. Can't get insurance if uses sub-standard materials. In the UK, a BBA certificate is required – insurance companies give warranty on performance Too many materials on market for architects and builders to know them all and many products are "self certified" (there is only one Australian NATA lab for insulating material) Also too complicated for building certifiers to be across all materials, so they currently rely on a certificate from the trades Problem – no one is responsible for the design – no formal process to make one person responsible ... so don't end up with full specification, builder makes many choices and decision on the run – impacting EE of building at the end On site quality control and no testing – currently installer verifies their own work – need independence	greater requirements for professional development in registration of trades include EE as a mandatory part of continuous professional development Accredited training for insulation installers Stage testing throughout construction A register of approved/ tested products would be useful – using international standards (too expensive to test everything locally) If it's got certification (ILAC) and demonstrated performance overseas, can put on register – reducing cost of certification R value and condensation is analyse in the UK (to ISO standard) and must have mandatory certification – a document that can be handed over independent of the builder
Topic: Inspection and certification	
Issues/ problems/ opportunities	**Proposed actions**
Private certifiers are paid by builders – is there a conflict of interests? Building certifiers not well positioned to review EE	Checks need to be made DURING construction rather than afterwards – so that changes / fixes can be made during building, like proving your concrete has certain

compliance – need to test / actually check What is measured is managed BASIX cert but then changes in process ... during build ... so need certification later in process. At construction certificate stage. Councils aren't matching BASIX and construction certificates currently – they should be matching them. Might get a section 94 change but not do BASIX again. Very easy to recast BASIX to check on what the impact of changes would be.	strength = legislate for staged testing, eg: blower door testing Link retention payment (last payment to builder) to performance of building – proof that the rating was met – payment follows More sophisticated metering installed during construction so can benchmark against other similar buildings – a cheaper way to ensure building is operating to design - may end up with a "leader board" to make performance transparent Audit of certification system Electronic access for certifiers – central point for certificates – all held in one place so certifiers can do better job and can be audited (not currently making best use of information that is currently there). Implement 'as built' standards for performance and have stage testing to ensure it meets this as-built std at the end, QA process with trades taking photos for example to upload and demonstrate install requirements are being met Blower testing and thermal imaging to ensure performance standards met at the end
Topic: Information, knowledge management & training	
Issues/ problems/ opportunities	**Proposed actions**
Need to educate users and facility managers so that design is maintained, eg: users of passive heat/cooled buildings still demand air conditioning Benefits of EE not well understood, lack of end user demand Uni graduates don't have enough EE skills and knowledge Energy efficiency training can be hijacked by product / materials suppliers Councils are the gateway to educating residents 'Your Home' Technical Manual (Australia's guide to sustainable homes) is too technical Need better energy assessment tools eg. climate specific BCA / climate specific KPIs	Government can drive change as a tenant – eg: only rent a 4.5star building ... could use this power to drive other changes Give students free access to "AccuRate" etc Materials register Green star or other tools for small projects Building sciences in curriculum (lagging) Develop a simple LCA tools for sector Educate designers to approach a project with a holistic approach (both passive and technology elements of design) Share information via case studies and focus groups Develop better region specific tools demonstrating pay-offs from energy efficiency improvement
Topic (added by discussants): Building operations	
Issues/ problems/ opportunities	**Proposed actions**
One star tenants in a 6 star home! As built compliance only delivers the potential for energy savings. Actual usage determines how much of that potential is delivered.	Greater education of building managers/ occupants Possible legal requirements to ensure proper maintenance Occupants need a manual / handover process to know how to use your home so they understand how to use their building properly

Key observations:

Although NSW requires assessment of energy efficiency of all building development (for both new builds and major renovations), there are some snags limiting the impact of this regulatory system.

A great advantage of the NSW Building Sustainability Index or BASIX system for residential buildings is that a BASIX certificate must be prepared as part of the development approval process, ensuring that energy efficiency is given consideration during the design phase. Additionally, BASIX is viewed positively for its user-friendliness. However, the system is open to misuse and many designers feel that it drives the use of insulation and glazing products to achieve energy efficiency goals over the application of fundamental solar passive design principles. Additionally there is some frustration that the index can be manipulated to give a building a 6 star rating when it will not necessarily deliver energy efficiency in use.

In contrast the Section J certificate required for commercial and industrial buildings is not required until much later in the development process than for residential buildings, so that energy efficiency is often "bolted on" to a complete design. Thus an over reliance on insulation and glazing to meet energy efficiency requirements is again reported.

NSW designers commented that energy efficient design is sometimes limited by a complex web of building codes, where codes for bushfire or window safety can conflict with optimum energy efficient design.

A review of the NSW compliance inspection system could help to improve energy efficiency of buildings.

Currently, enforcement of energy efficiency requirements in NSW is limited, with compliance inspections that are infrequent and not necessarily timed correctly to catch deviations from the approved design (eg: incorrect materials or faulty installation). Additionally, private certifiers are engaged by the builder and it is perceived there may sometimes be a conflict of interest as a result. Improvements may include: more frequent mandatory inspections; and a mechanism to track all information about a building, such as an electronic database.

While the building code has tight prescriptive requirements for some building elements (eg: leaking bathrooms), energy efficiency elements are in the hands of designers and builders. For residential developments it is common to save costs on full specification during building design and instead entrust detailed design to builders during construction. Decisions during construction are often driven by cost and time conservation however so that other priorities, such as energy efficiency of the final building, can be lost. A mechanism to ensure energy efficiency is given due consideration during construction would thus have a great impact. This may take the course, for example, of linking final payments to proof of energy efficiency such as five years performance data or testing of the complete building.

Better training and ready access to better materials information are two improvements which would support progress in NSW building energy efficiency;

- Not all trades are licensed (eg: insulators are not) and even for trades which are, energy efficiency is not a mandatory topic for continuing professional development.
- A great number of building materials are marketed with inconsistent and sometimes poor quality information such that a register of certified materials would be of use.

NSW regulators recognise the importance of building energy efficiency. The current NSW 10 year strategic plan *NSW 2021- A Plan to Make NSW Number One*, includes specific targets for energy use to assist "place downward pressure on the cost of living". These focus on low income households (to reduce energy use by 20% by 2014) and retrofit of commercial floor space in NSW (so that 50% reaches a minimum 4 star NABERS energy and water rating by 2020).

The market has not yet caught up with the importance of energy efficiency in buildings however, particularly in the residential property sector. Neither real estate agents nor buyers understand the value of reduced operating costs from energy efficient design, and building professionals at the Sydney consultation sessions frequently expressed disappointment that their clients chose high end appliances and fittings over energy efficient elements when constrained by a fixed capital budget. While the design energy efficiency of commercial buildings is advertised, this is not currently the case with residential properties, and the actual energy use of any class of buildings is not publicised. NSW stakeholders agreed that a mechanism to communicate both design and actual energy efficiency of buildings, would help to shift perceptions to place value on more efficient buildings.

Attendees at the Sydney workshops also agreed that user behaviour is pivotal. Educating building users to ensure they understand energy efficient features and used them as designed was considered paramount to achieving good energy efficiency outcomes.

Table C.8: Brisbane (Qld) workshop outcomes, 3 December 2013

Location: Brisbane **Climate zone: xx** **Number of participants: 23**	
Topic: Building Code provisions – New construction	
Issues/ problems/ opportunities	**Proposed actions**
Need evidence of performance that looks at the building envelope (seals, thermo testing) etc The code must eliminate worst practice Compliance with the code is mediocre Short term changes in industry/professionals mean the code isn't implemented Guidance is needed on how to apply the code Gap between the design phase (paper based) and the building phases (trying to build from specification) Poor education of the industry No mandatory policing, no auditing Lack of design/construct/user/operational transference No 'code of practice' for ESD, EE, NatHERS, BERS consultants Code used more for post-justification of design/build not implementation/operation Can be a complicated document/process Limited engagement with users (who is using the code? Not builders) No mandatory requirements for handover of user manuals and standard of documentation Communication of code needs to be sexier to the i-generation Code needs to focus on end goal and work back to achieve it	Industry needs evidence that there actually is a problem with EE (what, why, where, when?) Professional education for consultants and trades on EE Provide information on what resources already exist Incentives for industry associations to bring training under their banner Need a register of competent persons (assessors) Criteria for people, who they are, competency issues There's a structure in place but it needs to be implemented Deemed to satisfy should be abandoned Elements of the building have to comply but the whole doesn't Holistic building needed Current tool requires skill of assessor beyond tool capability Mandate the need for user operator manuals Mandate the level of qualifications required for NatHERS / section J work Installation work to be policed by certifiers EE assessment methods only go so far Assumptions on how a building will be used vs how it is used Quantify and publish the number of GHG emissions that a building should meet Review the assessment tool vs the code objectives

Topic: Building Code requirements – alteration& additions	
Issues/ problems/ opportunities	**Proposed actions**
The original building might be old bud the code requires a new build to meet the requirements There is a wide variety of answers in QLD about interpretations of renovation & the BCA section J A lot of building courses don't have a requirement for understanding the building code	Introduce a performance base for renovations Base the assessment on the impact the alteration has on the entire room not just on the new alteration Introduce education or courses that include requirements for understanding the BCA
Topic: Energy efficiency rating tools, DTS and alternative solutions	
Issues/ problems/ opportunities	**Proposed actions**
see above	
Topic: Activities in the construction phase	
Issues/ problems/ opportunities	**Proposed actions**
Negative builder attitude (overrides all others) Air leakage is not being addressed Maintenance is not regulated Need to establish refurbishment equity for users Technological benefits of buildings need to be promoted either through training or advertising No incentives/rebates to move towards energy efficiency Need to encourage builders to promote higher performing homes Need physical testing of building performance Need end user awareness	Change the attitude of builders Improve the awareness of the end user Provide a rebate for energy efficiency purchases and show that payback is short – medium term Training to lift the awareness and capability of trades regarding energy efficiency ('dumb down' the real reason for changes) Enforcement to ensure the market changes.
Topic: Inspection and certification	
Issues/ problems/ opportunities	**Proposed actions**
Cost of high end modelling No integration of passive design & emission factors Reluctance to change design concept Lack of knowledge & application by designers/architects & reliance on software to ' engineer' solutions The Code needs to be intellectually applied Building commissioning should be based on years Buildings should be run to energy efficiency or comfort Need better user expectations and understanding of comfort levels	Monitor building performance (collect data) Provide professional development through industry associations on the BCA and EE requirements/benefits Communicate BCA and EE requirements with people in all phases (e.g. builders, planners, certifiers, consumers) Introduce more demonstration buildings to monitor and report on real world building performance Ban air conditioning in certain jurisdictions (64% of offices are within thermal comfort range) Look at all areas in design stage for EE (e.g. orientation, lot design) Increase the level knowledge, appreciation and acceptance of EE and passive design in industry. Occupants to also understand and accept comfort zones. Provide a building commissioning and operations manual when handing over a house/building Provide incentives for passive design Generate a price signal for energy and water (but equitable) to push efficiency implementation Incentivise early adoption of sustainable/EE components or houses Increase trade experience of designers so they can understand the implementation barriers of EE design Implement measure to address understanding and behavioural change across all sectors

	Create more flexibility in the code and more prescriptive on passive design as the base (not the alternative)
Topic: Information, knowledge management & training	
Issues/ problems/ opportunities	**Proposed actions**

Key observations:

The Brisbane workshop was largely attended by architects, building surveyors, energy efficiency consultants and asset managers. There was a strong interest in the BCA and state legislation with two tables of participants discussing this topic. When discussing this topic it was highlighted that communication of the BCA as a significant issue both in how the code requirements are disseminated (e.g. understanding the BCA is often not a requirement in building studies) and how the code relates to the QLD jurisdiction as no clear link is drawn between the two.

There was a clear perception from participants that the building industry is a low-margin industry. As a result, participants felt that builders were willing to accept cheaper building components over quality energy efficient design. A large number of participants also held the view that there is a lack of industry policing, particularly around checking design versus end build compliance for energy efficiency requirements.

Participants also discussed the need to incentivise adoption of sustainable/energy efficient housing or building components as the cost of these items can sometimes be prohibitive. Difficulty financing sustainable purchases was highlighted as a key barrier, however it was noted that there are organisations (e.g. Queensland Country Credit Union) who do provide finance for purchase of sustainable/energy efficient items which should be made available through other institutions.

Table C.9: Townsville (Qld) workshop outcomes, 5 December 2013

Location: Townsville **Climate zone: 1** **Number of participants: 21**	
Topic: Building Code provisions – New construction	
Issues/ problems/ opportunities	**Proposed actions**
Orientation of building property is not properly addressed Code needs to address small lots/subdivisions Buildings often inherit old problems Public perception of ' good building' needs to be understood Code of ethics needs to be looked at for developers vs architects, certifiers, designers etc Inspections should be part of achieving good outcomes Ongoing building costs need to be considered for operation Need a suitable code for the tropics (BCA is not suitable) Lack of professional development / design kills for builders & designers	Reduce urban sprawl (build up not out, make lot sizes smaller) Provide more guidance on building on small lots Promote the 'code of ethics' to developers & builders Need to change planning schemes Implement staged inspections for EE rather than at the end of a build Consumers to demand EE provisions

Topic: Building Code requirements – alteration& additions	
Issues/ problems/ opportunities	**Proposed actions**
Need a general awareness of options for energy efficiency Star rating current policy is not entirely applicable for tropical climates Need knowledge of available materials Need quality consultants Behaviour needs to fit with renovations e.g 6 star building with 1 star user A number of old 'Queenslander' homes are being renovated and closed up to accommodate air conditioning	Embed knowledge of what the most important sustainability steps are (where to place the best effort) Implement energy management reporting to demonstrate progress across large organisations (measurement & verification) Provide incentives for heritage buildings Include more flexibility for old buildings in the code Provide information and education of benefits of passive design principals to people undertaking renovations in the tropics
Topic: Energy efficiency rating tools, DTS and alternative solutions	
Issues/ problems/ opportunities	**Proposed actions**
Diminishing block sizes leads to affordability Public perspective on what is 'good' or 'popular' needs to be understood and changed Apartment blocks lends to affordability and infrastructure savings Many designers don't think of sustainability – push should come from the client or developers People use BERS to tick the box	Implement a star rating that is suitable for the tropics (e.g. Tropics Code)
Topic: Activities in the construction phase	
Issues/ problems/ opportunities	**Proposed actions**
Rare for building to comply with BCA Buyers only see upfront costs, not ongoing costs Need better understanding of best industry practice (e.g. roof insulation)	Promote the 'code of ethics' to developers & builders Provide ongoing feedback of building energy efficiency performance Remove the 10 star rating and move to a 5 star rating (in line with hotels, restaurants etc) Create a user manual for a better designed home Any changes made need to be left over time, not changed with Government cycles Finance sustainable items Introduce mandatory disclosure of star rating for houses at point of sale Lift the level of star rating systems and improve computer systems/tools Mandate energy monitoring in houses Change user-behaviour on how houses are being operated Capture better data on how buildings perform
Topic: Inspection and certification	
Issues/ problems/ opportunities	**Proposed actions**
Code of ethics needs to be reviewed and enforced Sometimes the certifiers don't see inside a building, need inspections during the building process Is it difficult for certifiers to say 'no' to developers? Class 2-9 buildings not in BCA for inspections, no mandatory inspections but certifiers still legally responsible for build National code but state-specific guidelines (makes it	Implement staged inspections for EE rather than at the end of a build Ensure builders provide new building owners with education on how to operate a house once occupied

difficult)	
Topic: Information, knowledge management & training	
Issues/ problems/ opportunities	**Proposed actions**
Need more stories about the 'good stuff' that is taking place is not being shared/available Educate people on their ongoing energy usage Need more efficient hot water systems Need: • clear demonstration that sustainability measures are not expensive (get onto social media) • collaboration between government, utilities, industry and business • consistent information for all parties • consistent policies and information from all levels of government • clear and consistent training parameters • knowing where to go for good information	Share stories and experiences of implementing the BCA and EE measures in meaningful ways Industry and consumers to provide feedback to regulators on star rating Tap into local knowledge and share (differences in BCA and local provisions) Include LCA costs of additions Break down silos and work across groups (for commercial buildings) Buildings to include energy monitors to understand baseline energy consumption to know how to improve Provide industry with examples of approaches to the BCA or EE that are working well Provide examples of an average family home ongoing energy consumption in different types of buildings with different types of appliances as there are currently no ' average family homes' as examples Improve ease of access to sustainable materials Change communication to consumers from upfront costs of EE to ongoing costs for houses

Key observations:

The Townsville workshops were strongly attended by local government, residents, and non-government organisations with small representation from the building industry.

There were several clear themes evident in the discussion of the Townsville workshop. The first focussed on the success local government had achieved in observing and communicating the benefits of light-reflective roofing in Townsville. The ability (or lack thereof) of local government to mandate white roof requirements in the planning process was highlighted as a simple measure toward addressing energy efficiency in the tropics.

When discussing the building industry, participants highlighted the fact that components can often be installed incorrectly (e.g. roof insulation), but that builders see a competitive edge in installation techniques and therefore won't share knowledge with competitors. A similar theme which was observed in the Brisbane workshop surrounded a strong perception that the building industry is willing to accept cheaper building components over quality design. Furthermore a link was drawn to the consumer knowledge/awareness, and that unless a consumer specifically requests energy efficient housing or building components, builders will not supply it.

Finally the majority of participants agreed that 'you can't manage what you can't measure'. This view was two-fold, the first relating to building performance and needing to have real-time usage feedback in place to understand how a building operates under different conditions. There was a common agreement that there needs to be examples of what energy a house or commercial building consumes. The second view related to the expected performance of building components (e.g. appliances) and the need to understand how they perform in terms that consumers understand (e.g. a new fridge will cost a household the equivalent of 2 cheeseburgers a day to operate rather than kWh).

Perhaps one of the most consistent items of discussion was around the lack of applicability of the BCA to workable and comfortable tropical buildings. The important role of the local strategy of reflection of heat through radiant insulation, backed up by air movement to provide evaporative heat loss, is at odds with the focus on sealed and bulk insulated buildings in the code driven designs. Sealed and bulk insulated buildings are seen as simply not workable in the tropical climate. This different response to a different climate creates anomalies like a tendency to install multiple radiant heat barriers in roofs, but no bulk insulation above the ceiling and, in some areas, installation of combination insulation (foil backed thermal blanket) upside down to ensure trapped condensation does not cause corrosion (a problem which simply does not occur in cooler and less humid climates). A building with two layers of reflective sarking in a ventilated roof cavity - and no bulk insulation above the ceiling - does not rate highly in many assessment tools or schemes but works well in the tropics. An interesting anomaly is the commercial focus on small blocks where legislated clearance from fences leads to creating eave-less houses in order to squeeze in more floor area. This is anathema to comfortable housing in the tropics, yet is supported by (some) rating tools and systems. Such conflicts appear to have (rightly or wrongly) significantly eroded trust in the BCA's energy provisions.

Table C.10: Canberra (ACT) workshop outcomes (29 November 2013)

Location: Canberra	**Climate zone: 7**
Number of participants: 18	
Topic: Building Code provisions – New construction	
Issues/ problems/ opportunities	**Proposed actions**
Difficult to understand BCA EE provisions in both residential and non-residential sections – this leads to growing use of 'specialist' consultants and removal of energy efficiency from mainstream design process Builders still adjusting to changes in format of BCA for 6 star eg: modelling as part of DTS and new 'how to' clauses The BCA is functioning as a 'best practice' document instead of a minimum standard document with respect to energy efficiency sections. NCC is not user friendly Language is difficult (jargon) Technically focussed – therefore difficult for anyone to read other than builders Structure is not intuitive	Simplify Building Code provisions Provide greater education and training on BCA changes Reduce the cost of the Code and any updates Plain English (no NCC jargon) Index NCC Make more user friendly Plain English guidelines for different audiences ie: govt officers/regulators?
Topic: Building Code requirements – alteration& additions	
Issues/ problems/ opportunities	**Proposed actions**
The document which amends the BCA to cover energy assessment for extensions and refurbishment in the ACT is viewed as 'dysfunctional'. ACT variation for glazing is unclear Jurisdictions have different thresholds for applying EE provisions; concern over appropriateness of ACT approach Whole of house 6 star requirement can be difficult/ costly – can lead to decision to knock down and rebuild rather than modify Current amendment to Section 3.12 does not achieve what it sets out to do. It does not provide adequate info on applying DTS solutions and is confusing with regard	Nationally consistent approach to alteration thresholds recommended Introduce a more streamlined application process for alterations

to using software solutions. A much simpler method is required – eg: accepting a threshold improvement level from existing NATHERS rating to improved NATHERS rating (1 star improvement for instance).	
Topic: Energy efficiency rating tools, DTS and alternative solutions	
Issues/ problems/ opportunities	**Proposed actions**
No Code of practice for ACT assessors (without AA?) – leads to problems with flow of information, new practice notes, etc NatHERS material files need updating. Inadequately reflect new materials and EE opportunities (eg. slab edge insulation) Inconsistency re what clients and certifiers expect for an assessment report/certificate There are two different systems for mandatory disclosure and new house rating in the ACT – this leads to confusion across tool requirements Residential (Class 1,2 and 4): input is overly complex ie: too many opportunities for errors (may need a version with simplified input/output) Commercial and residential (other):- not based on consistent modelling practice (different tools/protocols/input assumptions) - non-residential vastly more variable than residential BIM (building information modelling) framework needed – arch and design, energy, QS… DTS fairly blunt (commercial) JU3 can be complex/expensive Loopholes in JU3 lead to poor outcomes Assessments undertaken too late Don't limit emissions/m2 – can have compliant building but inefficient NATHERS – brilliant tool, but: - wrong metric (carbon not energy and per household not per sq. metre - does not address climate change (historic climate data for zone requirements, not demands of future climate) - lack of outcome verification	Simplify and update EE rating tools Re-focus energy efficiency objectives on building energy use and occupant running costs
Topic: Activities in the construction phase	
Issues/ problems/ opportunities	**Proposed actions**
Poor specifications/understanding of EE/technology/materials Commissioning almost non-existent (in NCC, building regs) due to: no budget or no time Fire safety is mandatory for maintenance in the code, why not energy? A new TV has a 100 page manual, but not a new building…. Lack of obligations for maintenance NABERS Commitment Agreement – is it enough? Shifting of responsibility between parties No input from eventual owners/operators on substitutions and variations – need better involvement	Training, training, training! Labels at point of consumption or decision to buy Greater transparency of material performance rating or characteristics (eg. laser etching, specification plates) GECA, FSC, Green tag Trusted certification only – get rid of greenwash/green bling rating systems

(maybe address in building regs?) Varying skill levels in installation and design Performance of products/ materials often don't match claims, or material substitution occurs Not building in accordance with approved plans, or getting plans re-approved – maybe because of fees/delays in getting new approval. Difficult to verify all aspects of construction, material, attention to detail trades – often receive sub-standard materials for builders, don't often understand good practice or what it achieves	
Topic: Inspection and certification	
Issues/ problems/ opportunities	**Proposed actions**
Conflict of interest for certifiers commonly commissioned or recommended by builders EE not front and centre for resourcing (govt.) Not enough information on plans about EE (not standard), often not a transparent technical characteristic Lack of certifier education Need to close loop with design	Certifiers should be engaged by homeowners not builders (different views on this) promote owner commissioned assessment as a certification option, supported by auditing by building regulator More EE information on the house plans (DA plans) EE disclosure on houses ie: star rating? Better documentation (ie: plans that have been assessed are kept with occupancy certificate?) Require technical values on the BA plans thereby making it easier for certifier to check house once built Increase number of mandatory inspections Tougher consequences for breaches/ poor workmanship by builder/ sub-contractors
Topic: Information, knowledge management & training	
Issues/ problems/ opportunities	**Proposed actions**
Inconsistent training/accreditation/ licensing systems for assessors in all states/territories Lack of skill, knowledge and motivation - trades - certifiers - builders - designers Lack of info for consumers at point of decision for material purchases. Need more information on savings to end users to stimulate demand for EE Some architects don't understand basic EE principles and see regulations as a box to tick.	EE display homes (touch and feel) equals positive understanding. Cost (and pay-off) is a big driver for consumers More training opportunities for understanding the NCC EE requirements (and why they are there) Increase awareness of training available Expand GECA, FSC, GreenTag and introduce stars to facilitate comparison

Key observations

ACT participants generally agreed that a rigorous approach to building energy efficiency had been adopted by government in the ACT, but end users and many industry participants had not developed a full appreciation of energy efficiency goals, and the benefits to end users flowing from these. Energy efficiency was widely seen as a cost rather than a benefit, and the frequent separation of investor and occupant in the construction chain (eg. in project homes, apartments and commercial premises) led to an under-emphasis on ongoing energy costs relative to upfront construction costs. This tendency to 'build cheaply' and at scale with diminished emphasis on energy efficiency attributes is commonly exacerbated by poor understanding on the part of builders and trades people of how the thermal efficiency attributes of a building are affected by alternative material choices and attention to detail in installation. Poor labelling and certification of energy efficiency materials also detracts from 'as built' energy performance aims by allowing substitution of inferior product - which is difficult to detect at the certification stage, or by subsequent occupants.

There are also mixed views on 'conflict of interest' issues associated with privatisation of building certification services. While few deny the potential for a direct commercial relationship between builders and certifiers to attenuate the independence of the certifier and delivery of 'frank and fearless' advice, some considered that improvements in income, efficiency and professionalism associated with commercialisation of this service had led to superior outcomes being achieved. ACT government representatives noted that building certifiers were frequently reminded that their recommendations had legal status and while their fees were being paid by private entities, they were effectively working on behalf of the government- and would be periodically reviewed on that basis. A system of routine desktop audits, backed up by periodic site audits, was reportedly working well in terms ensuring the independence and quality of building certification reports.

Nevertheless, certifiers themselves identified the challenges (and cost) of monitoring all quality aspects of the build, and the need to rely heavily on the assurances and certificates provided by the builder indicating that specified materials had been used and installed in the quantities and configurations required. Conflicts, role and effectiveness of the building certification function were identified as issues for further discussion with other jurisdictions and stakeholders.

Improved training and awareness-raising among builders and trades people was seen as critical to achieving targeted energy efficiency outcomes reliably and at least cost. This, backed up by greater transparency and accountability for the thermal efficiency attributes of the completed building (eg. rectification of significant air leakage, insulation gaps, hot spots, etc), would help ensure the effective realisation of design stage energy efficiency requirements at building hand over.

Also note that a 'mini-workshop' session was held with staff of Wodonga City Council on 19 December 2013, in addition to separate face to face meetings with a builder of leading energy efficient homes in the area and a local quantity surveyor servicing projects in both Victoria and NSW. The detail of these discussions has not been reported in the interests of confidentiality, but their content has been reflected in the discussion and conclusions of this report.

Appendix D

Stakeholder Survey Instrument

National Energy Efficient Building Project (NEEBP)

Thank you for accessing the National Energy Efficient Building Project Stakeholder Feedback survey.

Your input is valued and completion of the survey should only take 10 minutes of your time.

This survey is being run by pitt&sherry (a national engineering and policy consulting company) and all results will be aggregated to protect anonymity and the privacy of individuals.

No identifying information will be released to others or passed on without your explicit permission.

If you have any questions regarding this survey please contact the pitt&sherry team at consultations-survey@pittsh.com.au

Please provide us with some background information about your work experience.

1. How many years have you personally been involved in the construction industry?

◯ Less than 2 years ◯ 2 to 5 years ◯ 5 to 10 years ◯ more than 10 years

2. Which state/territory do you mainly operate in? (select one)

3. Within this jurisdiction, how is your work spread between urban and rural areas?

◯ Only in cities and major urban population areas
◯ Mainly in cities and major urban population areas
◯ Equally between urban and rural areas
◯ Mainly in rural and regional areas
◯ Only in rural and regional areas
◯ Other (please specify)

4. How is your work within the building industry split between new builds and alterations/additions?

◯ Only new builds
◯ Mainly new builds
◯ Equally between new builds and alterations/additions
◯ Mainly alterations and additions
◯ Only alterations and additions
◯ Other (please specify)

National Energy Efficient Building Project (NEEBP)

5. What is the postcode of your main business address?

6. The following is a list of the building classes as per the building code, select those which you have experience in:

- ☐ 1a Dwellings detached house, or attached houses
- ☐ 1b Boarding house, guesthouse (small)
- ☐ 2 Dwellings – multi-residential
- ☐ 3 Residential other than class 1 or 2 (eg. Hostels, school boarding houses, aged care)
- ☐ 4 Single residential dwelling in a class 5-9 building (eg caretaker flat)
- ☐ 5 Offices
- ☐ 6 Retail
- ☐ 7a Carparks
- ☐ 7b Warehouse & wholesale
- ☐ 8 Factory/Laboratory
- ☐ 9a Healthcare
- ☐ 9b Education
- ☐ 9c Aged Care
- ☐ All of the above

7. How would you describe your attitude and that of the construction industry to the energy efficiency objectives in the building code?

	Strongly negative	Negative	Neutral/ NA	Positive	Strongly positive
Your attitude	◯	◯	◯	◯	◯
Your industry's attitude	◯	◯	◯	◯	◯
Construction industry as a whole's attitude	◯	◯	◯	◯	◯

***8. Please indicate the type of construction that you feel most experienced to comment on:**

- ◯ residential construction (Class 1 and 10: NCC Section 2.6 & Part 3.12)
- ◯ non-residential construction (Class 2-9 NCC Section J)
- ◯ both residential and non-residential construction

National Energy Efficient Building Project (NEEBP)

***9. What is your main business activity?**

- ◯ Architect
- ◯ Building Designer
- ◯ Engineer
- ◯ Developer
- ◯ Local Council Officer
- ◯ Planner
- ◯ Energy Assessor
- ◯ Tradesperson
- ◯ Product Supplier
- ◯ Builder
- ◯ Construction Supervisor
- ◯ Building Surveyor
- ◯ HVAC installer
- ◯ Building Owner
- ◯ Facility Manager
- ◯ Other (please specify)

10. Please specify the type of [Q9]

- ◯ carpenter
- ◯ electrician
- ◯ plumber/gas fitter

Other (please specify)

National Energy Efficient Building Project (NEEBP)

11. Please indicate how often you have witnessed the following occurring on site in the past 12 months.

	Never	Rarely	Not Sure	Sometimes	Often	Always
Plans and drawings that are difficult to follow	○	○	○	○	○	○
Deviation from plans and drawings	○	○	○	○	○	○
Poorly installed insulation	○	○	○	○	○	○
Unrepaired damage to insulation in walls or ceiling cavities	○	○	○	○	○	○
Poorly installed windows and seals	○	○	○	○	○	○
Poorly installed heating, cooling & ventilation (HVAC) equipment and lagging	○	○	○	○	○	○
Use of below specification insulation	○	○	○	○	○	○
Use of below specification glazing	○	○	○	○	○	○
Use of below specification heating, cooling & ventilation (HVAC) equipment and lagging	○	○	○	○	○	○
Use of below specification lighting	○	○	○	○	○	○
Insufficient quality product information and certification to support compliance	○	○	○	○	○	○
Other	○	○	○	○	○	○

If other please specify

12. Please specify the type of [Q9]

- ○ Structural
- ○ Mechanical
- ○ Civil
- ○ Environmental
- ○ Electrical
- ○ Other (please specify)

National Energy Efficient Building Project (NEEBP)

13. Please identify your level of satisfaction on a scale of 1 to 5 (1=very poor, 5=excellent) with the energy efficiency rating tools you have personally used.

	Have not used	Very poor	Poor	Neutral	Good	Very good
BASIX	☐	☐	☐	☐	☐	☐
Accurate	☐	☐	☐	☐	☐	☐
FirstRate	☐	☐	☐	☐	☐	☐
natHERS	☐	☐	☐	☐	☐	☐
Green Star	☐	☐	☐	☐	☐	☐
NABERS	☐	☐	☐	☐	☐	☐
Other	☐	☐	☐	☐	☐	☐

If other please specify

14. What is the highest level of training you have reached?

- ◯ certificate/ diploma
- ◯ graduate degree
- ◯ post graduate degree

15. Have you undertaken training in passive solar design?

- ◯ no
- ◯ yes at certificate/diploma level
- ◯ yes at graduate level
- ◯ yes at post-graduate level

16. Please indicate the extent to which you agree with the following statements:

	strongly disagree	disagree	not sure	agree	strongly agree
Design concepts relating to building energy efficiency are well understood by my clients	◯	◯	◯	◯	◯
Design concepts targeting energy efficiency can be readily incorporated into land management subdivisions	◯	◯	◯	◯	◯
Planners and surveyors play a pivotal role in incorporating good thermal design	◯	◯	◯	◯	◯
Building materials needed to deliver on energy efficiency requirements are readily available	◯	◯	◯	◯	◯
Designs are interpreted accurately on-site during construction	◯	◯	◯	◯	◯
My original specifications are adhered to on site by trades	◯	◯	◯	◯	◯
I liaise with energy assessors to achieve good energy efficiency outcomes	◯	◯	◯	◯	◯
There is adequate information available for me to specify energy efficient materials and systems	◯	◯	◯	◯	◯
There are no barriers to specifying better energy efficiency enhancing materials	◯	◯	◯	◯	◯
There is sufficient knowledge and experience in the materials supply industry to support energy efficient design	◯	◯	◯	◯	◯

National Energy Efficient Building Project (NEEBP)

17. Please explain any barriers you encounter in specifying better energy efficient materials

18. For the projects which you have been involved in over the past 12 months which of the following statements is most true?

- ◯ Project energy efficiency was likely to be substantially below design requirements on completion
- ◯ Project energy efficiency was likely to be slightly below design requirements on completion
- ◯ Unsure or not confident to answer
- ◯ Project energy efficiency was likely to exceed design requirements on completion
- ◯ Project energy efficiency was likely to fully meet design requirements on completion

19. Please indicate the extent to which the following factors impact on achieving the planned energy efficiency outcomes:

	Have not witnessed	No impact	Not sure	Minimal impact	Significant impact
Poor detail or unclear specifications in plans and drawings	◯	◯	◯	◯	◯
Poor interpretation of plans and drawings	◯	◯	◯	◯	◯
Poor attention to detail and workmanship in first fit	◯	◯	◯	◯	◯
Deviation from original design due to practical problems (eg. site issues, material availability, etc)	◯	◯	◯	◯	◯
Deviation from original design to reduce construction costs	◯	◯	◯	◯	◯
Time and cost pressures on building certifiers	◯	◯	◯	◯	◯
Client requests	◯	◯	◯	◯	◯
Other	◯	◯	◯	◯	◯

If other please specify

Please answer the following based on your experience

National Energy Efficient Building Project (NEEBP)

20. Please select the extent to which you agree with the following statements for NEW CONSTRUCTION and ALTERATIONS & ADDITIONS in terms of [Q8]

	New Construction	Alterations & Additions
It is easy to know when building code thresholds have been triggered		
The energy efficiency provisions in the building code (and relevant requirements in my state/territory) are clear and easy to follow		
The energy efficiency provisions in the building code are being strictly implemented		
The energy efficiency provisions in the building code enjoy strong support within industry		
It is appropriate for energy efficiency requirements to be incorporated at the planning and design stage		
It is appropriate for energy efficiency requirements to be part of building inspections and certification		
Ensuring that energy efficiency provisions are met is a high priority in the building industry		
Deemed to Satisfy (DTS) solutions support favourable energy efficiency outcomes		
Energy efficiency rating and assessment tools have the confidence of industry		

Provide details if you wish

21. Over the last 12 months, in projects that you have seen which have varied from the approved plans - how often did the changes significantly compromise energy efficiency outcomes?

	Never	Rarely	Unsure	Sometimes	Often
New Constructions	○	○	○	○	○
Alterations and Additions	○	○	○	○	○

Additional Comments

22. In a few words, please indicate the most common variations or practices that are likely to affect energy performance levels:

National Energy Efficient Building Project (NEEBP)

23. Please rank the following priorities in building projects from your perspective

- [ ] Cost
- [ ] Environment
- [ ] Client Satisfaction
- [ ] Compliance
- [ ] Time
- [ ] Quality
- [ ] Safety
- [ ] Client Demands
- [ ] Brand Image
- [ ] Energy Efficiency

This is once the building has been constructed/altered and is ready for tenants/ residents

24. At handover is there enough communication between designers/ builders with future building owners/users into the most energy efficient management of the building design, fabric and features?

- ◯ Definitely not
- ◯ Room for improvement
- ◯ Not sure
- ◯ Yes
- ◯ Most definitely

Additional Comments

25. Is there a role for a "building use manual" or hands-on training for building owners and users in optimal energy efficiency?

- ◯ No it is not needed
- ◯ No it would not be used
- ◯ It is already required in my state/territory and is useful
- ◯ It is already required in my state/territory and is not useful
- ◯ Yes that could be helpful
- ◯ Yes most definitely
- ◯ Other

National Energy Efficient Building Project (NEEBP)

The following questions address knowledge and training needs. Thinking about your current work, reflect on the information, resources and support you need to understand and fully comply with the energy efficiency requirements of the building code.

26. Please indicate how you rate your level of understanding of each of the subject areas below, and how well the available information on this subject meets your needs (IGNORE topics that are not relevant to you).

	Level of Understanding	Adequacy of Information
Planning and subdivision		
Building fabric		
Glazing		
Thermal mass		
Building sealing and insulation		
Air conditioning and ventilation		
Materials specification		
Artificial lighting and power		
Hot water supply, swimming pools and spa pool plant		
Access for maintenance and facilities for monitoring		
Retrofit		
Section J compliance		
Passive solar design		
Tried and tested application methods		
Ducting		
Other		

If other please specify

27. Please suggest any additional topics (with a focus on building energy efficiency) that you think need to be covered, and the level that these should be aimed at:

National Energy Efficient Building Project (NEEBP)

28. Please indicate those groups of service providers you believe could benefit most from additional energy efficiency training and skill support (select all that apply):

- ☐ Not applicable
- ☐ Planners and surveyors
- ☐ Developers
- ☐ Real estate professionals
- ☐ Owner-builders/Clients
- ☐ Architects and building designers
- ☐ Engineering professionals
- ☐ Draftspersons
- ☐ Energy Assessors / Auditors
- ☐ Development assessment and building approval professionals
- ☐ Council professionals
- ☐ Materials specifiers
- ☐ Quantity surveyors
- ☐ First fix trades
- ☐ Second fix trades
- ☐ Plumbers
- ☐ Carpenters
- ☐ Electricians
- ☐ HVAC technicians
- ☐ Manufacturers and material suppliers
- ☐ Material salespersons
- ☐ Project builders
- ☐ Lighting designers
- ☐ Interior designers
- ☐ Retrofit or additions designers
- ☐ Project managers
- ☐ Energy experts
- ☐ Building scientists
- ☐ Other (please specify)

National Energy Efficient Building Project (NEEBP)

29. What are the best methods for you personally to build your knowledge or skills? (select all that apply)

- ☐ Paper based information (brochure or fact sheet)
- ☐ Online information (websites, links and U-tube)
- ☐ Online tools or calculators
- ☐ Online seminars (information only)
- ☐ Online interactive webinars (questions and discussions online)
- ☐ Online learning with activities or games
- ☐ Online guidance (blog or online community website)
- ☐ Computer-based modelling tools and assessment programs
- ☐ Offline tools (energy rating programs or tools).
- ☐ Manufacturers and suppliers technical manuals
- ☐ Magazine articles
- ☐ Fellow workers or industry associates on-the-job (peer to peer or mentor)
- ☐ Product-based on-the-job training (manufacturer or supplier demonstration)
- ☐ Formal on-the-job training (mentor)
- ☐ Industry-led informal training (trade nights, expos)
- ☐ Industry-led formal training (seminars and workshops)
- ☐ Face-to-face seminars (information only)
- ☐ Face-to-face workshops (information and activities)
- ☐ Vocational education, accredited training or short courses (assessed)
- ☐ Higher education programs (assessed)
- ☐ Short face-to-face workshops (not assessed)
- ☐ One-on-one (personalised) instruction
- ☐ Group (peer or mixed) instruction
- ☐ If other please specify

30. What most influences your decision to engage in information or training sessions? (select all that apply)

- ☐ A licence requirement or professional accreditation requirement
- ☐ The topic relates to compliance issues
- ☐ The topic is interesting but not an industry requirement
- ☐ An industry or professional association promotes it
- ☐ A university or vocational educator provides it
- ☐ A friend or co-worker recommends it
- ☐ The length of session is suitable
- ☐ Location is close to work or home
- ☐ Freebies – promotional items, food, beverages, etc. are given away
- ☐ No cost, except time away from work
- ☐ Low cost to participate
- ☐ Subsidised learning
- ☐ Standard industry costs for information or training
- ☐ Tax deductibility
- ☐ Other (please specify)

National Energy Efficient Building Project (NEEBP)

31. Are you interested in furthering your knowledge and skills in building energy efficiency?

- ◯ Definitely not
- ◯ No thank you
- ◯ Unsure
- ◯ Yes I could be
- ◯ Yes definitely!

32. What is your preferred session length?

- ◯ 1-3 hours
- ◯ 1/2 day
- ◯ 1 day
- ◯ Several days in a block sessions
- ◯ Several short 2 hour training blocks delivered over several weeks
- ◯ Several half day sessions delivered over several weeks
- ◯ Several whole day sessions delivered over several weeks
- ◯ Certificate of attendance
- ◯ Formal certificate or qualification
- ◯ Industry accreditation

Other (please specify)

33. Which time of day and day{s) of the week do you prefer for information or training sessions? (select all that apply)

	Morning	Afternoon	Evening
Monday	☐	☐	☐
Tuesday	☐	☐	☐
Wednesday	☐	☐	☐
Thursday	☐	☐	☐
Friday	☐	☐	☐
Saturday	☐	☐	☐
Sunday	☐	☐	☐

Other (please specify)

National Energy Efficient Building Project (NEEBP)

Thank you for completing the questionnaire.

We would welcome any final comments or issues you would like to highlight related to the implementation of energy efficiency standards in building design and construction

34. Any Additional Comments

35. As noted, all individual responses will be kept confidential and used only in an aggregated form. However, if you were willing to discuss your comments further with one of the survey team that would be very much appreciated. If you would be comfortable to take a call or email on the ideas and issues raised, please provide your contact details below

Alternatively, please feel free to contact a pitt&sherry team member by emailing consultations-survey@pittsh.com.au

Name

Email

Phone Number

36. go into the draw to win an ipad mini! (enter contact details above)

- ◯ I wish to remain anonymous - my details are just for the ipad draw
- ◯ I am happy to be further contacted regarding NEEBP & go into the draw for an ipad
- ◯ I do not wish to leave my details at all.

Appendix E

Survey Findings

Survey Findings

Introduction

pitt&sherry and Swinburne University developed an online questionnaire designed to capture feedback from a wide range of stakeholders involved in the building industry. The NEEBP survey provides a broad ranging perspective on stakeholder attitudes across the country, with a focus on energy efficiency activities and outcomes in building design and construction sector. Details of the survey instrument are provided in Appendix F.

The survey was launched online on 24 November 2013 and remained open until 13 January 2014. It was promoted through:

- A project website hosted by pitt&sherry
- Email to the full stakeholder organisation email list inviting survey details to be distributed widely
- Invitation to stakeholders in meetings and workshops
- Client email distribution.

An iPad Mini® was also offered as a prize to encourage survey responses from a wide range of participants.

Multiple choice format was used for the majority of questions, with a smaller number of rating and open comment questions, to ensure ease and speed of use for respondents. Respondents were also invited to make comments and suggestions, or book a consultation session with a member of the project team should they have additional views they wished to discuss.
The survey sought information and perspectives on:

- Participant skills, industry experience and profile (noting that the anonymity of respondents would be protected)
- Perceptions and experience of energy efficiency aims and outcomes relating to building types, new construction and alterations and the interactions along the construction chain
- Knowledge management, communication and training.

Participant Profile and Activity Focus

A total of 571 individuals responded to the NEEBP survey, drawn from across Australia and a wide spectrum of activities within the building sector. Over 67% reported having at least 10 years experience in the building industry.

Figure E.1 shows the locations in which survey respondents operate. Considering population densities, this shows a good spread of response across different states and across those working in urban and major population centres versus those operating in rural and regional areas. Victoria accounted for around 22% of responses, while NSW and South Australia each accounted for about 20%. As might be expected, the majority of respondents reported cities and urban areas as the main focus of business operations, although there was also strong representation of experience from rural and regional areas.

Figure E.2 shows the split of respondents involved with new builds and renovations, again showing a good spread of response across both categories of building work. Around half of respondents reported an equal split of experience between new construction and alterations.

Respondents were also asked which classes of building they were experienced with. Figure E.3 shows the spread across all building classes, with experience in each different class consistently reported by more than 20% of respondents and around 19% of respondents reporting experience in all classes. Class 1a - Detached dwellings was nominated by the most respondents (76%), and Class 2 - multi unit dwellings was the next most nominated class (63%).

Taken at face value, these results suggest a deep base of experience reflected in the survey responses.

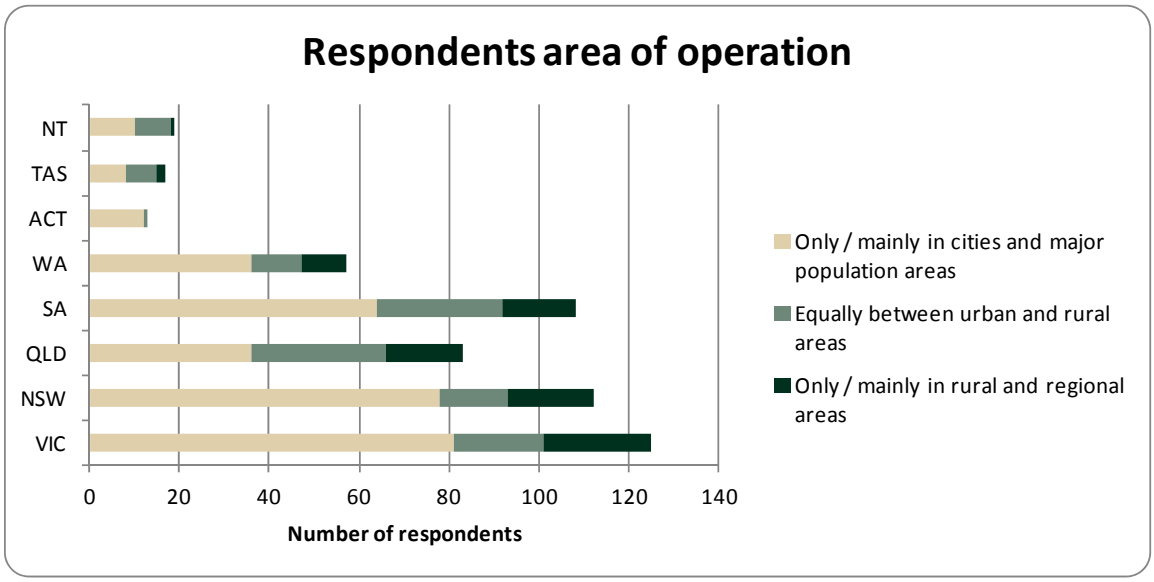


Figure E.1: Respondents area of operation

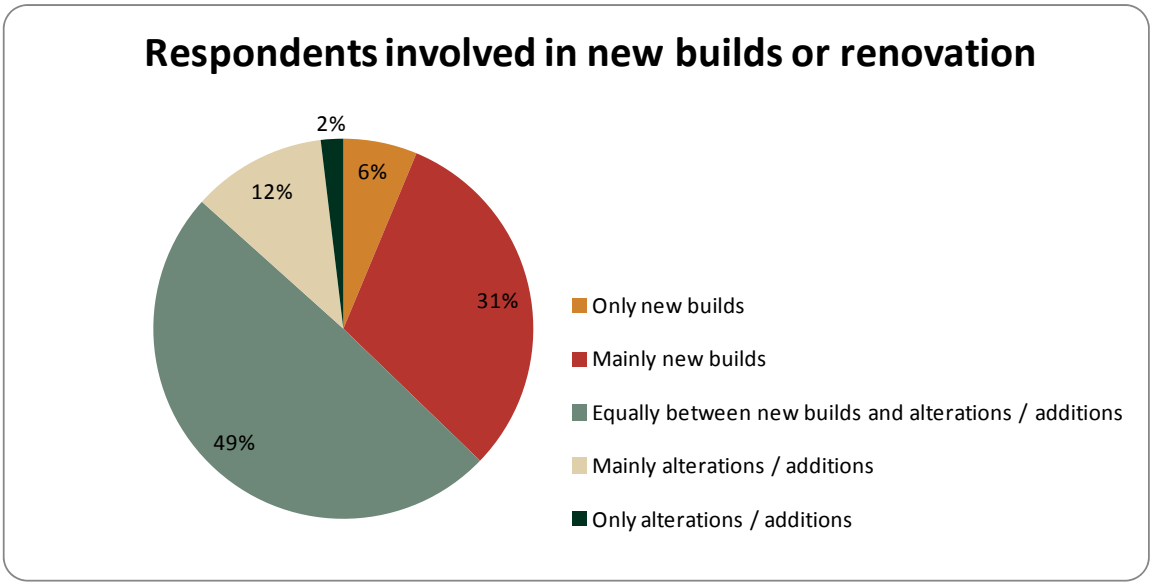


Figure E.2: Respondents involved in new builds or renovations

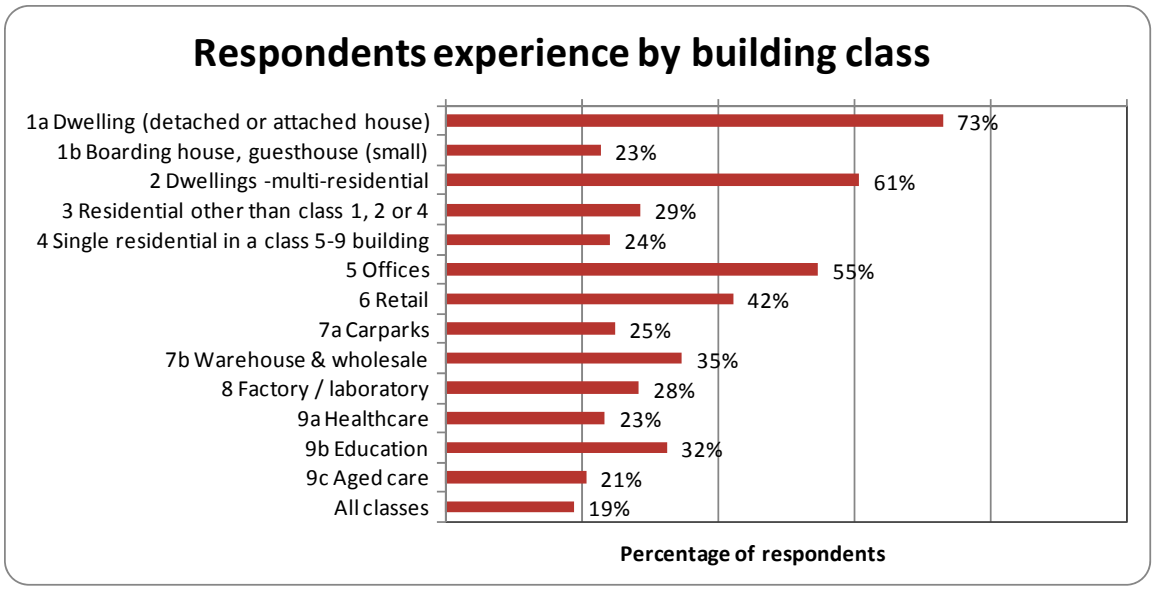


Figure E.3: Building class with which respondents are experienced

The profession of survey respondents is shown Figure E.4. Of the groups targeted tradespeople and end users (eg. facility managers and building owners together accounted for about 3% of responses) were the least well represented amongst survey respondents. There was however a good spread across other professional groups with energy assessors and those responsible for building design best represented. 13% of respondents either did not report a profession (5%) or nominated service activities such as draftsmen, estimators, academics and those involved in research and education, government policy makers and regulators, and sustainability professionals working for building operators. Builders, construction supervisors and engineers as a group accounted for about 14% of responses, while building surveyors accounted for about 11% of responses.

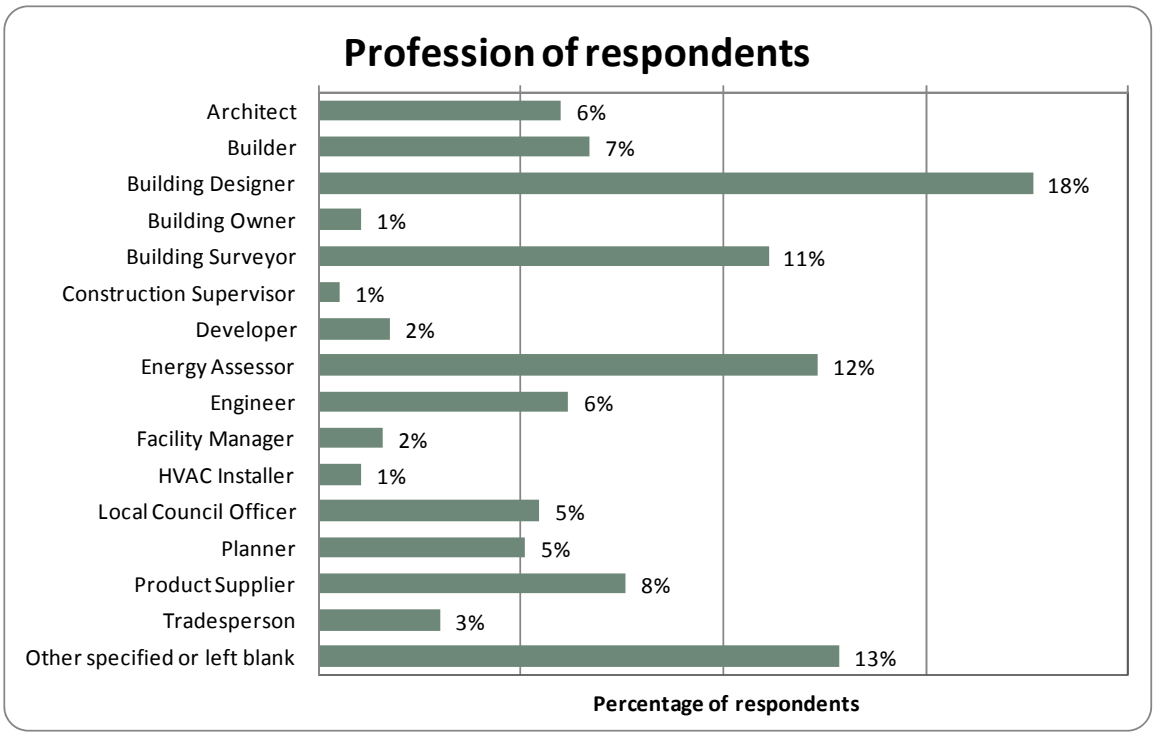


Figure E.4: Professions of respondents

Attitudes to Energy Efficiency

Survey respondents were asked to rate their attitude to energy efficiency objectives in the National Construction Code. Most stakeholders indicated that their own commitment to energy efficiency is high, but that this view was not shared by other professionals in the construction industry.

Consistently across all professions and jurisdictions the majority of respondents rated their own attitude as positive or strongly positive (82% of respondents), however they rated the prevailing attitude of their own industry as less positive (47% as positive or strongly positive and 27% as negative or strongly negative). Importantly, aggregation of all responses highlighted a concern about perceptions of energy efficiency in the industry generally.

Only 23% of respondents considered that energy efficiency aims in the Building Code were viewed positively within the construction sector, with only 1% describing attitudes as 'strongly positive'. About a third of respondents considered that energy efficiency aims were viewed 'neutrally' within the industry, but around 45% believed that a negative view toward energy efficiency was widely held within industry.

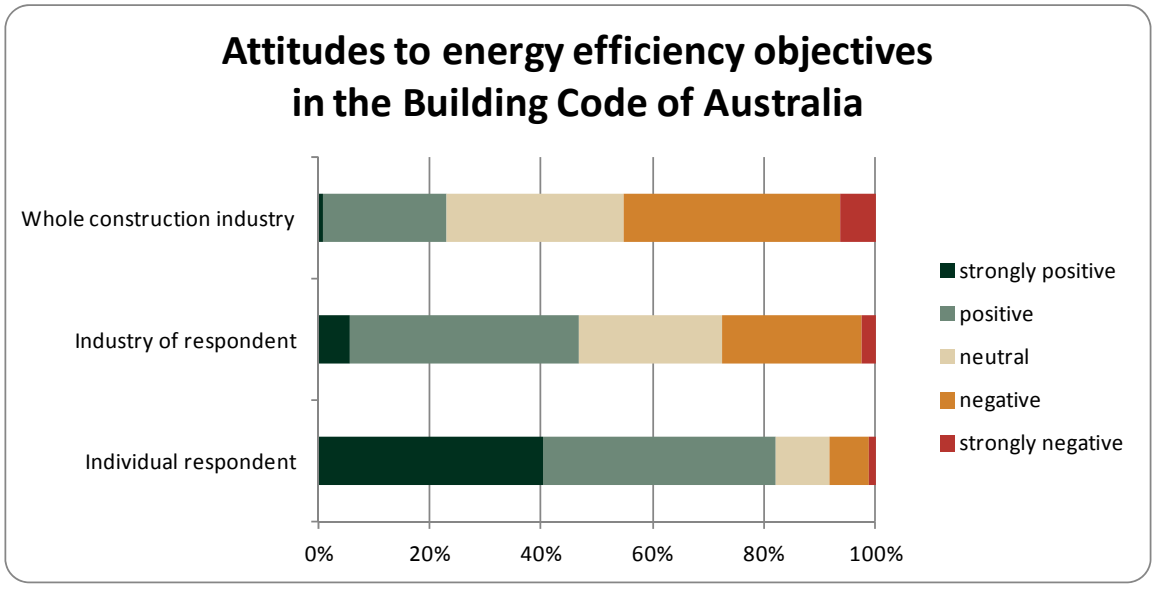


Figure E.5: Attitude of respondents to energy efficiency in the Building Code of Australia

Survey respondents also ranked the priorities of building projects from their perspective. The top priorities as determined by weighted scoring across the combined responses of all respondents, are Client Satisfaction, Cost and Compliance – with Energy Efficiency ranking sixth, as shown in Table E.1.

When survey responses were examined on a state by state and on a professional group basis, these issues were consistently ranked as top priorities across all groups along with safety and quality.

Table E.1: Overall ranking* of issues by all survey respondents.

Issue	Overall ranking*
Client Satisfaction	1
Cost	2
Compliance	3
Quality	4
Safety	5
Energy Efficiency	**6**
Client Demands	7
Time	8
Environment	9
Brand Image	10

**(Weighted scoring by assigning 10 points to issues ranked number 1 priority, down to 1 point for issues ranked lowest priority – overall ranking assigned by sum of points across all responses).*

Only three professional groups included energy efficiency in their top three priorities. These were architects, energy assessors, and construction supervisors. (However, we note the relevance of samples size, with only two construction supervisors responding to this question).

Factors Influencing Energy Efficiency

Survey respondents were also asked to comment on factors influencing the energy efficiency of buildings, for both new builds and alterations/renovations. Responses are characterised in Table E.2 below, and in Figure E.6.

Table E.2: Stakeholder views on factors influencing building energy efficiency

It is easy to know when building code thresholds have been triggered	Across all responses, 41% agreed and 32% disagreed. Slightly higher proportion of respondents disagreed for alterations and additions of commercial buildings, compared to new builds and to residential projects.
The energy efficiency provisions in the building code (and relevant requirements in my state/territory) are clear and easy to follow	Mixed opinions from respondents with overall 40% agreeing and 49% disagreeing. Most agreement from building designers (45%), engineers (43%) and architects (38%) and most disagreement from building surveyors (63%), council officers (60%) and building owners (59%). State by state those in agreement ranged from 28% of respondents (TAS & ACT) to 41% (QLD) and those in disagreement ranged from 41% (NT) to 56% (WA).
The energy efficiency provisions in the building code are being strictly implemented	Across all groups the majority (65%) of respondents reported that building code energy efficiency provisions are not implemented strictly

The energy efficiency provisions in the building code enjoy strong support within industry	Across all groups survey shows that building code EE provisions are not strongly supported by industry
It is appropriate for energy efficiency requirements to be incorporated at the planning and design stage	Across all groups the majority of respondents (over 90%) agreed that EE requirements should be incorporated at the planning and design stage
It is appropriate for energy efficiency requirements to be part of building inspections and certification	In all groups of respondents more than 80% agreed or strongly agreed that it is appropriate for EE to be part of the building inspection and certification process
Ensuring that energy efficiency provisions are met is a high priority in the building industry	Overall the majority of respondents believe that meeting EE provisions is not a priority for the building industry (51%), but opinion is mixed with 33% of respondents agreeing or strongly agreeing that EE is of high priority (builders (39%) and building designers(38%) were the professional groups with the most number of positive responses)
Deemed to Satisfy (DTS) solutions support favourable energy efficiency outcomes	Mixed opinion for DTS solutions, with 37% of respondents overall agreeing and 39% disagreeing. This spread of opinion was reflected by similar results across all jurisdictions and across all professional groups.
Energy efficiency rating and assessment tools have the confidence of industry	Overall 25% of respondents agree and 50% disagree. The spread of opinion was similar across all jurisdictions, and professional groups.

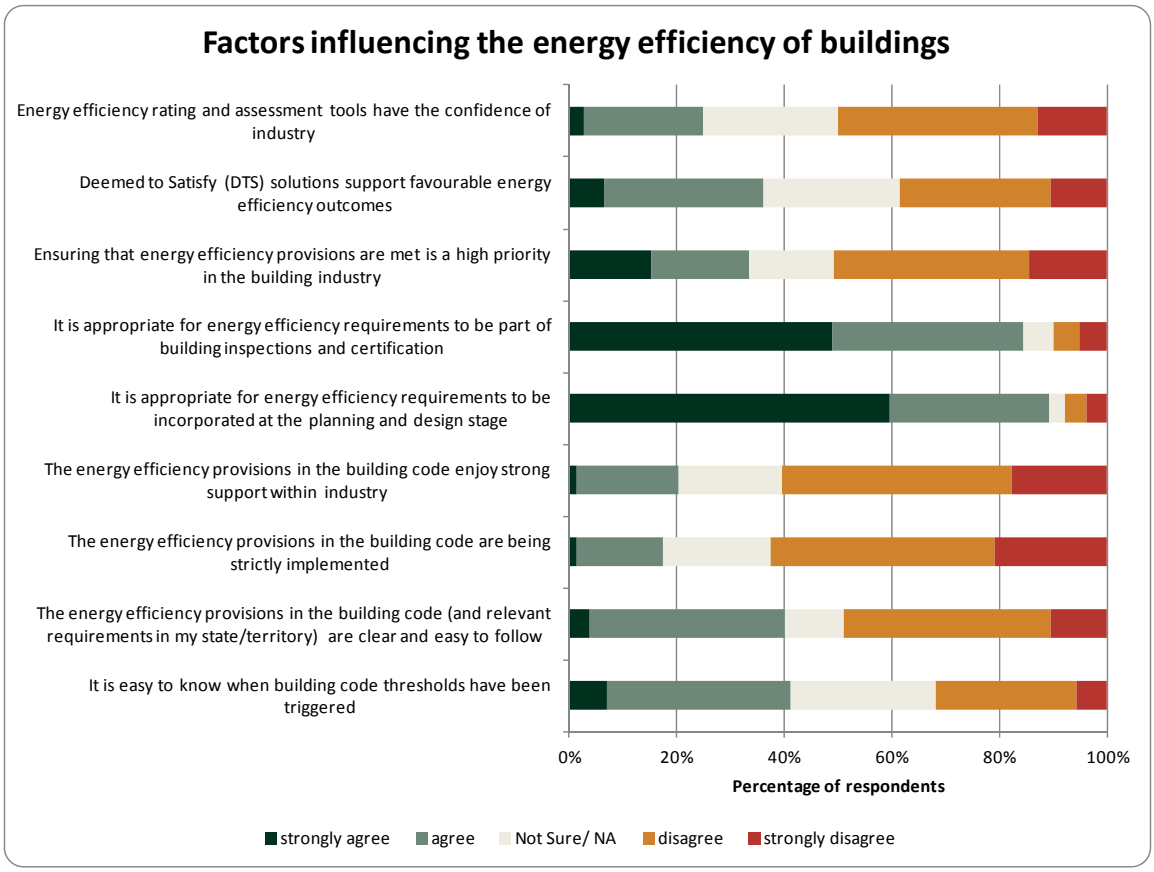


Figure E.6: Total responses for factors influencing building energy efficiency (all classes for both new builds and renovations/alterations)

Impact of Design Variations

Survey respondents were asked whether variations from approved plans compromised the energy efficiency of buildings. Figure E.7 gives a summary of responses for all stakeholders who completed the survey, showing that just over half of respondents believe that this indeed is the case. Departures from plan are frequently seen to result in a dilution of the energy efficiency characteristics of a building project.

Responses were similar for new constructions and alternation and additions, and similar for all jurisdictions (between 40% and 60% responded that EE was compromised sometimes or often) with the exception of Tasmania where 81% of respondents believe new construction is comprised and 82% believe energy efficiency is compromised in a renovation project.

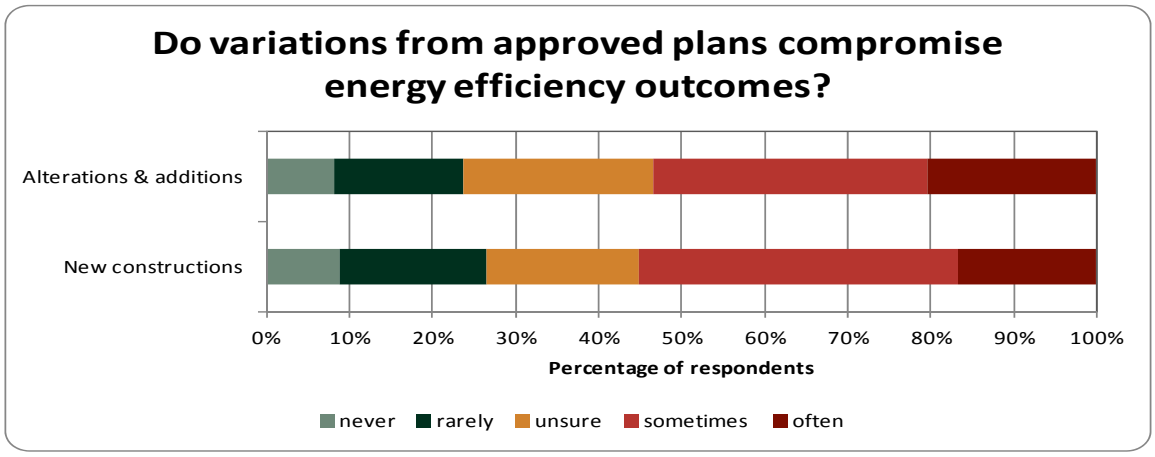


Figure E.7: Impact of variations during construction on energy efficiency of new constructions and renovations

Figure E.8 shows the distribution of views across stakeholder groups. Builders and facility managers were by far the most positive groups, with around 60% answering that building energy efficient was never or rarely compromised by project variations. In contrast, most other groups saw deviations from plan to be a key avenue for deterioration of energy efficiency characteristics.

Between 50-70% of other skill groups and service providers considered that energy efficiency was compromised sometimes or often through variations with developers (81%) and construction supervisors (100%) most consistently of this view.

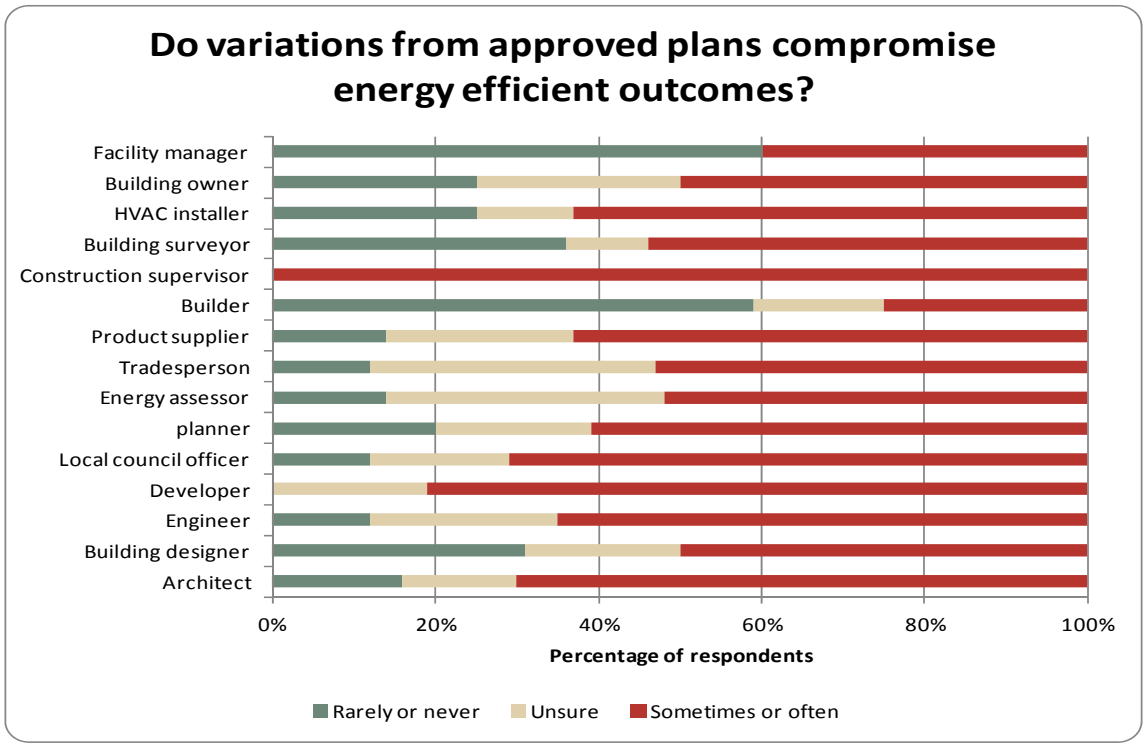


Figure E.8: Opinion of different professional groups on impact of variations during construction on energy efficiency of buildings

Stakeholders also commented on the variations or practices that most commonly affect energy efficiency outcomes.

Respondents indicated that construction most frequently varied from design due to cost and client preferences. A poor understanding of building energy efficiency pay-offs among the public (clients) and some building professionals, combined with lax regulatory and inspection systems (eg. for installation of at-specification glazing, insulation and sealing) were also key threats to achieving targeted energy efficiency outcomes.

Both glazing and insulation were raised by over 30% of respondents as elements where variations from design specifications reduce energy efficiency of completed buildings. Respondents also mentioned changes to window and door number, design and placement as well as substitution of inferior glazing (eg. single glazing installed instead of specified double glazing) and poor installation (eg: poor sealing). Factors affecting insulation outcomes included:

- Poor installation
- Substitution of inferior materials and
- Insulation not being installed at all – contrary to specification.

Other variations during construction frequently noted by respondents included – changes to lighting, awnings, verandas and outdoor areas, external wall and roof materials and colours, and changes to heating and cooling systems.

Several respondents also commented on the influence of occupants post-construction through 'operation' of the building and choices around heating and cooling demands and technologies, hot water, lighting and other equipment, and minor alterations including changing external colours, and changes to awnings, verandas and outdoor areas.

Views of Planning and Design Specialists

Planning and design phase respondents were the best represented group of stakeholders, with a total of 273 planners, building designers, architects, energy assessors, engineers and developers responding to the survey.

Among other things, this group was asked about the performance of energy rating tools. Respondents were asked about their satisfaction with BASIX, AccuRate, FirstRate, NatHERS, Green star, NABERS or other tools (where the most frequently mentioned "other" tools were BERS, BERS Pro, STEPS and SDS). Responses showed a spread of preferences across all of the tools. No particular tool stood out as greatly preferred above the other, nor were any of the tools disliked more than the others. The only significant difference in tool use and preference was the understandably low use of the NSW BASIX tool outside the state compared to more generic tools.

However, a number of respondents noted experiencing glitches and errors in the lighting and glazing calculations of various rating tools, and that older construction techniques can be difficult to incorporate - and this can be a significant problem for modelling renovation works. Many respondents expressed a desire for higher weighting of passive solar design elements in the energy rating tools, rather than a perceived emphasis on glazing and insulation specifications.

Most respondents felt that energy efficient design was not well understood by clients, but all professions agreed that they liaised with energy assessors to good effect in achieving energy efficiency outcomes

(including energy assessors themselves). There were some differences in responses on whether adequate information was available to specify energy efficient materials, but all professions agreed that energy efficient materials were readily available.

Summary commentary on survey responses is presented in Table E.3 below.

Table E.3: Experiences of planning and design professionals on energy efficiency issues

Design concepts relating to building energy efficiency are well understood by my clients	54% of respondents disagreed that clients understand EE design concepts. Developers were the most negative group (100% disagreed) Architects were the most positive (almost 50:50 opinion split)
Design concepts targeting energy efficiency can be readily incorporated into land management subdivisions	Consistently across all groups most respondents agreed (68%) that EE can be incorporated into subdivisions
Planners and surveyors play a pivotal role in incorporating good thermal design	Consistently across all groups most respondents agreed that planners and surveyors play a pivotal role (68%). Planners themselves were the most positive group where 85% agreed that they play a pivotal role
Building materials needed to deliver on energy efficiency requirements are readily available	Most respondents agreed that EE materials were readily available (77%) Developers stood out as the least positive group (38% disagreed that EE materials were readily available, though 50% agreed that they were)
Designs are interpreted accurately on-site during construction	Consistently across all groups opinion was fairly evenly divided Overall 36% of respondents agreed, 35% disagreed and the remaining 29% were unsure
My original specifications are adhered to on site by trades	Opinion was fairly evenly divided across all groups: overall 36% agreed and 27% disagreed For example: architect respondents: 50% agreed, 41% disagreed engineer respondents: 39% agreed, 39% disagreed
I liaise with energy assessors to achieve good energy efficiency outcomes	All professions agreed that liaison with energy assessors to achieve good energy efficiency outcomes was positive 73% of all respondents agreed with the statement (including 72% of energy assessors themselves)
There is adequate information available for me to specify energy efficient materials and systems	Consistent responses that adequate information is available to specify EE materials (70% of respondents overall agreed) Over 70% of architect, building designer, energy assessor, engineer, planners agreed with the statement Developers less positive (38% agreed, 38% disagreed)
There are no barriers to specifying better energy efficiency enhancing materials	Most respondents feel there are barriers to specifying EE materials, overall 28% agree and 51% disagreed

There is sufficient knowledge and experience in the materials supply industry to support energy efficient design	Mixed responses consistently across all groups, overall 38% agreed and 43% disagreed

In end-notes, many respondents commented on the importance of passive solar design over selection of materials; that the elements of energy efficient design (including orientation, openings, colours and open space) do not typically suffer the same barriers as using energy efficient materials and have a greater impact on building performance. Similarly, several respondents commented that the energy efficiency of buildings is often let down by poor site design regardless of any other elements of building design.

Specification and Use of Energy Efficiency Materials

Most respondents agreed that there are barriers to incorporating energy efficient materials in building design, as per the summary of survey responses in Table E.1. Planning and design phase respondents were asked to comment further on the barriers they have encountered to specifying energy efficient materials. Responses fell into three main categories – cost and efficiency pay-offs, familiarity of materials and knowledge about energy efficient materials, and regulatory issues, as described below.

Material costs and pay-offs from efficiency

The additional cost of EE materials was the most frequently mentioned barrier to their specification in building design. Respondents frequently commented that residential clients would rather spend capital on high end appliances and fit out rather than energy efficiency. Design professionals also believed that different materials are substituted during construction to save costs, without consultation with the designer. They reported that additional expenditure on energy efficiency beyond minimum compliance is not favoured by the majority of clients or builders.

Further, as some planning and some design phase specialists suggested that property valuers and banks do not credit energy efficiency as adding value to houses, so that banks will not loan additional money for the additional costs of energy efficient materials. Respondents proposed several potential solutions to this barrier:

- Market research to understand quantify the increase in re-sale value from enhanced energy efficiency,
- Mandatory house energy efficiency rating (as applies in the ACT to house sales, and introduced nationally for commercial buildings) to make the energy efficiency of different residential buildings more transparent, and act as a market driver to win sales or lease contracts,
- Greater transparency of whole of life costs and explanation of the financial pay-offs to the building occupant of energy efficiency investment. While initial capital cost increase is off-putting, designers felt that clients could be convinced of the value in energy efficiency by looking at whole of life costs. It was also suggested however that a 6 star rated residential building might typically take 10 years to achieve payback on the additional costs incurred to achieve this rating and – in the absence of greater support in the re-sale market – this could explain a low level of interests among clients who expect to live in a residential building for only 5-10 years.

Of course, the economics of energy efficiency pay-offs will be sensitive to changes in building material and design costs, changes in energy prices and individual consumer attitudes toward additional 'benefits' from thermal efficiency such as enhanced comfort, environmental sustainability and protection from future energy price increases.

Knowledge of energy efficient building materials

Many respondents reported that clients (especially residential) prefer conventional materials and designs with which they are familiar, and that construction tradespeople lack experience in installing innovative materials and alternate construction systems. There can be risk in using unfamiliar and untested materials. One respondent characterized this view within the construction industry as … "We don't want to be the leader, we want to be an early adopter". Respondents also reported that builders are reluctant to bear the cost of training in new energy efficient construction systems and materials.

Many respondents also reported that few energy efficient materials are tested for local conditions and that there is insufficient access to materials samples. Respondents frequently reported that material suppliers do not have the right information available and do not understand designers' technical information requirements, or climate zone needs Some designers reported some material suppliers as "pushing 'climate wrong' products" due to their lack of understanding and desire to make a sale. Some respondents were also concerned that inappropriate use of materials was counterproductive and damaging to the broader reputation of energy efficient materials and policy aims in this area. Some respondents felt there is a need for local "warts and all case studies". Some respondents servicing tropical regions were particularly concerned with the appropriateness of energy efficiency materials for their climate.

A number of respondents also expressed a desire for inclusion of life cycle analysis in materials selection so that embodied energy, transport and materials disposal could be considered in building design with the aim of achieving more 'eco-friendly' building outcomes.

This highlights the tension between the Code's current focus on thermal energy efficiency (for residential housing) and the desire for a more holistic environmental approach that recognises and invites trade-offs between other environmental attributes – but may deliver a lower direct running cost saving to the building occupant.

Views of Specialists in the Construction Phase

Construction phase respondents were well represented with a total of 127 responses from builders, building surveyors and local council officers (compliance officers). This group of stakeholders was asked specifically to comment on whether energy efficiency aspects of buildings were realised at the completion of construction as per design.

There was little difference perceived between commercial and residential construction outcomes, with residential buildings thought to be marginally more likely to meet or exceed energy efficiency design requirements. There was however a significant difference in the opinions of the three professional groups. This is highlighted in Figure E.9.

While around 60% of builders surveyed reported that the energy efficiency of the finished project is likely to meet or exceed design requirements, 60% of local council officers and 65% of building surveyors believe energy efficiency outcomes are likely to be slightly or substantially below design requirements.

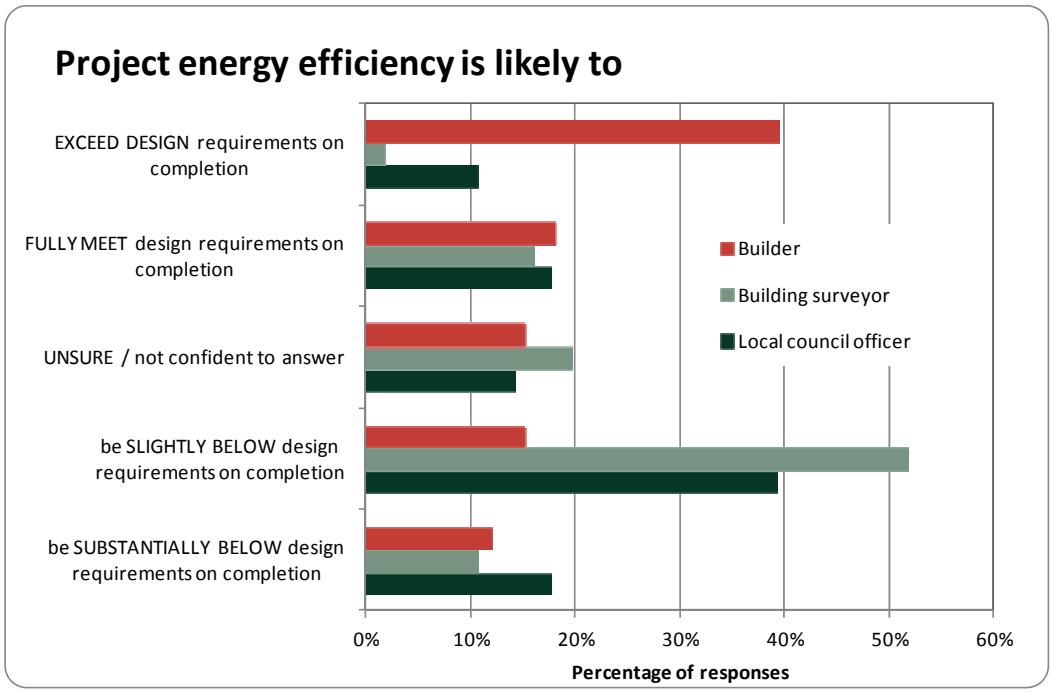


Figure E.9: Completed buildings meeting EE design (per professional group)

Construction phase respondents were also asked to rate the impact of various aspects of construction on energy efficiency outcomes at completion. Responses were similar for both commercial and residential buildings, with a combined summary presented in Figure E.10 below.

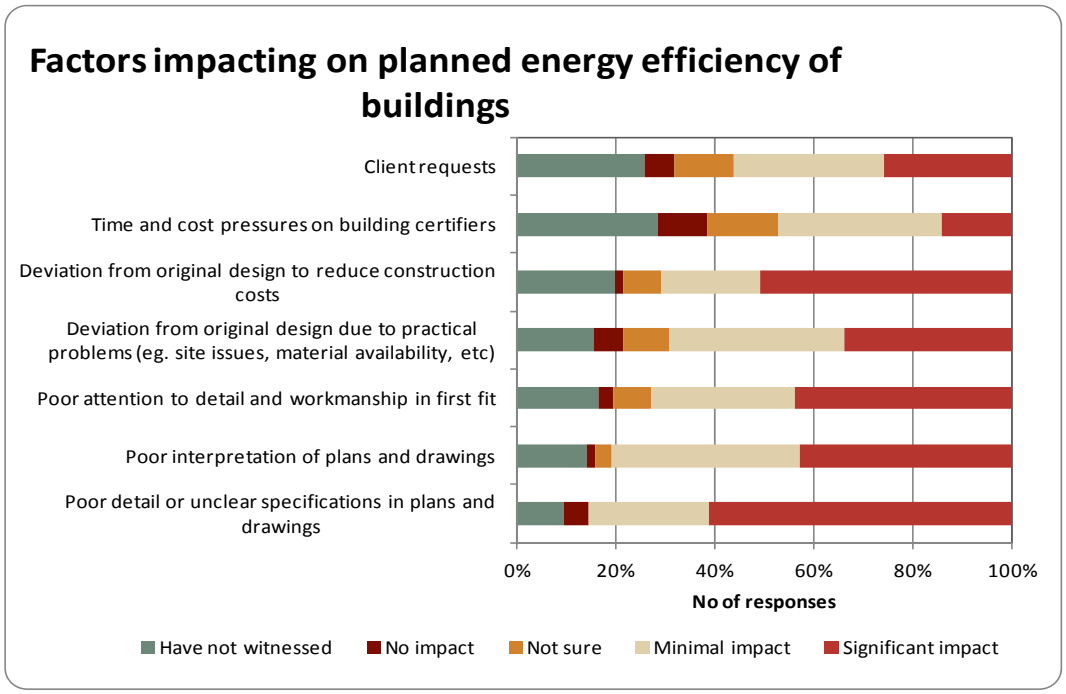


Figure E.10: Factors impacting planned energy efficiency of buildings

Poor or unclear plans and drawings were considered by respondents to have the most significant impact – and were cited as a significant problem by 60% of respondents. Attention to detail during construction (emphasized by 42% of respondents) and deviations from original design to save on construction costs (emphasized in around 50% of responses) were also considered to have a significant impact.

Building Trades

Tradespersons were the least well represented group with a total of 18 responding to the survey including: electricians (7), HVAC installers / technicians (7), carpenters (2), plumbers (1) and glaziers (1). Tradespersons were asked specifically about their observations over the last 12 months with multiple choice prompts for factors which are affecting building energy efficiency.
Responses are presented in Figure E.11 below. The most commonly observed issues were:

- Issues with the building design - either difficult to follow plans or deviations from plans occurring during construction,
- Issues with the quality of insulation -either poorly installed or suffering unrepaired damage, and
- Insufficient information about construction materials to ensure energy efficient outcomes.

For most problems, the overall trend was for respondents to volunteer that they had sometimes observed these in projects over the last 12 months. For the majority of problems, 10-20% of respondents reported seeing these 'often' over the previous year, with an handful of respondents (5-10%) suggesting that in their experience problems relating to plan deviations, interpretation difficulties and damage to insulation were 'always' present. For issues such as insufficient product information, poorly installed or damaged insulation or deviations from building plans, 50% or more of respondents reported seeing some occurrence of these problems in construction projects over the previous 12 months.

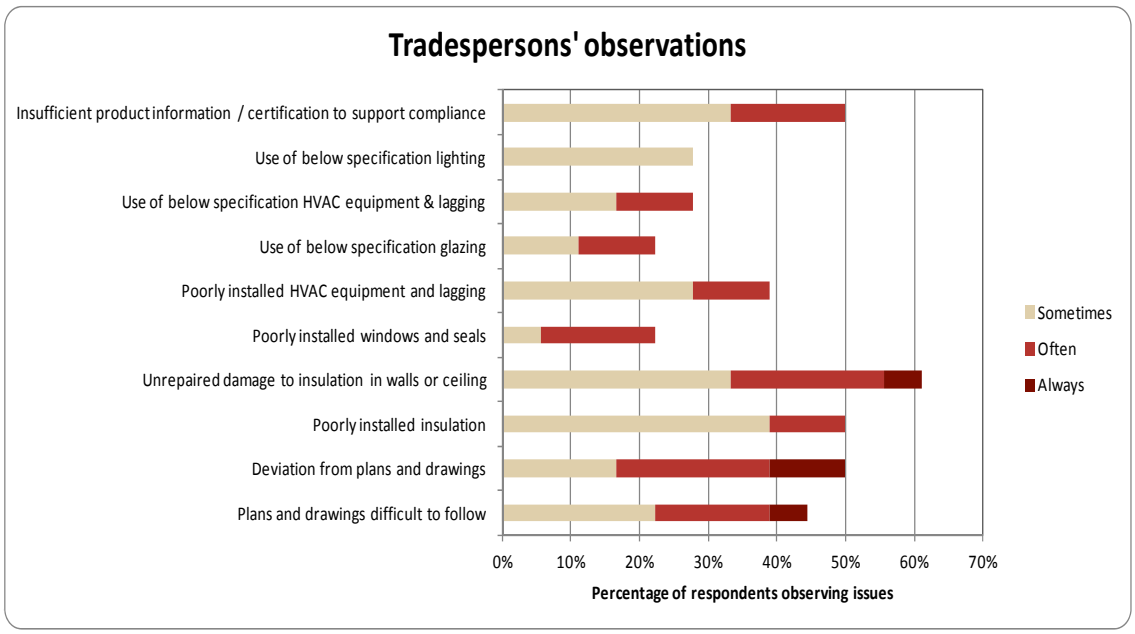


Figure E.11: Tradespersons' observations of factors impacting planned energy efficiency of buildings

Attitudes and Outcomes at a Jurisdictional Level

The survey also allowed analysis at a jurisdictional level. This provided useful insights to perceived attitudes, problems and successes in the promotion of energy efficiency outcomes across the building sector in Australian states and territories.

Stakeholder responses, split by the jurisdiction in which they operate, are set out in the figures below. These depict the degree of support among stakeholders for a range of propositions around the clarity of energy efficiency provisions in the Code applied in the relevant state or territory, industry attitudes to efficiency aims, and supporting tools and inspection requirements.

Responses relating to requirements and outcomes for new construction projects and alterations & additions are reported separately.

Figure E.12 indicates that degree of satisfaction with the clarity and user-friendliness of Code provisions relating to energy efficiency. In general, 40-50% of respondents in all jurisdictions agreed that the Code was clear and easy to follow. This share approached 65% in the Northern Territory. However, this might be at least partly attributable to the NT's perseverance with the long standing 5 star residential energy efficiency standard, and the lack of Section J requirements for other relevant building classes.

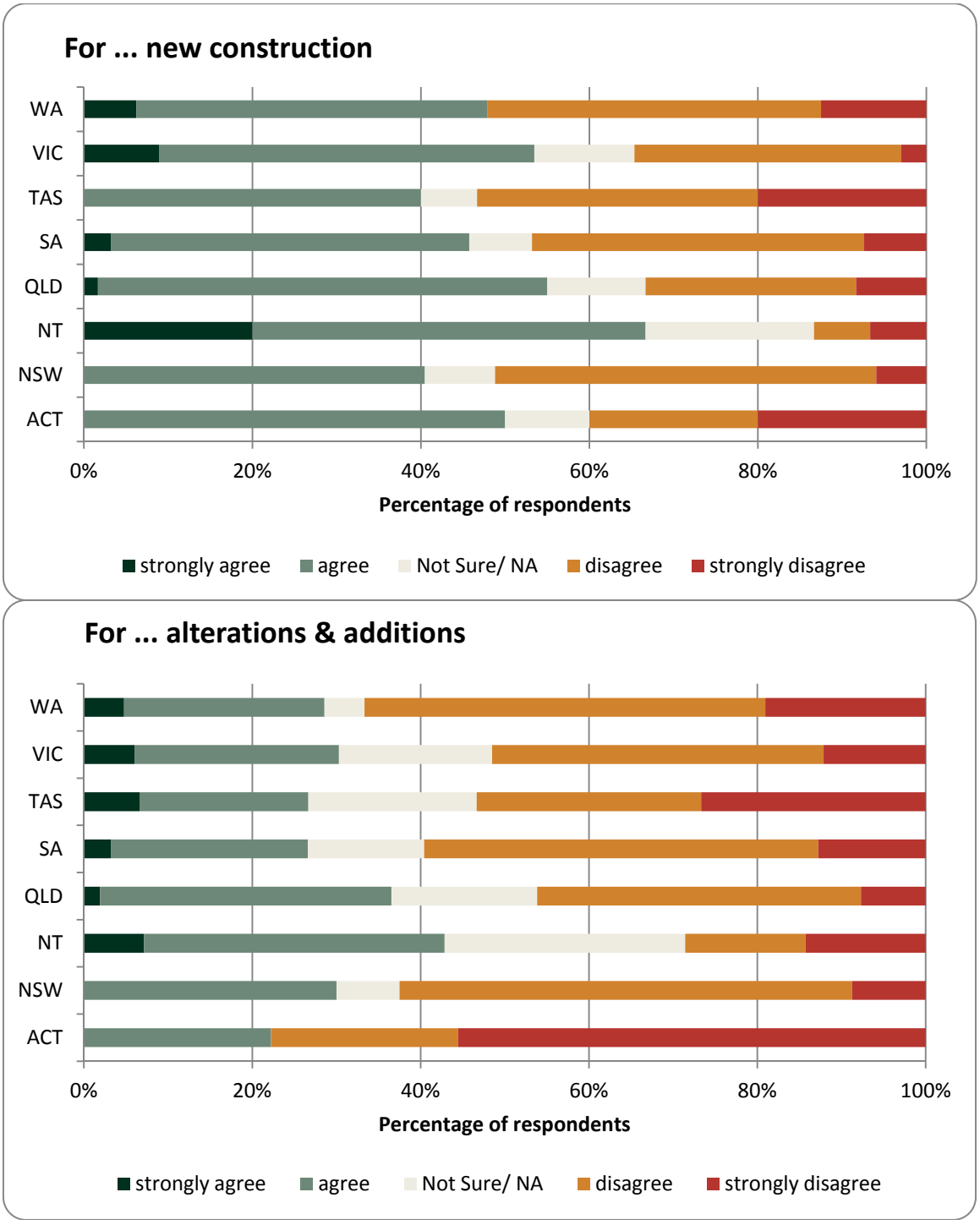


Figure E.12: Jurisdictional stakeholder responses to proposition: 'The energy efficiency provisions in the building code (and relevant requirements in my state/territory) are clear and easy to follow'

Overt dissatisfaction with Code requirements, for new construction, was expressed most strongly (reflected in 50% or more of responses) in WA, Tasmania and NSW.

A high degree of dissatisfaction with Code provisions relating to alterations and additions is clear across all jurisdictions - with the notable exception of NT – and is most apparent among respondents from the ACT, WA and NSW.

In terms of implementation of Building Code provisions, Figure E5.13 shows mixed views across jurisdictions. Adherence to Code provisions is considered to be strongest in the ACT – albeit with a little over 40% of (the 16) responses recorded for that location indicating energy efficiency provisions were not being strictly implemented. The level of responses indicating a lack of adherence to the energy efficiency provisions of the Building Code was generally much higher in other locations.

For Queensland, over 70% of responses indicated a lack of strict implementation of the energy efficiency provisions of the Building Code, while in Tasmania, South Australia, Victoria and the Northern Territory around 60% of respondents reflected this view.

Respondents indicated similar outcomes across both new construction and alterations & additions.

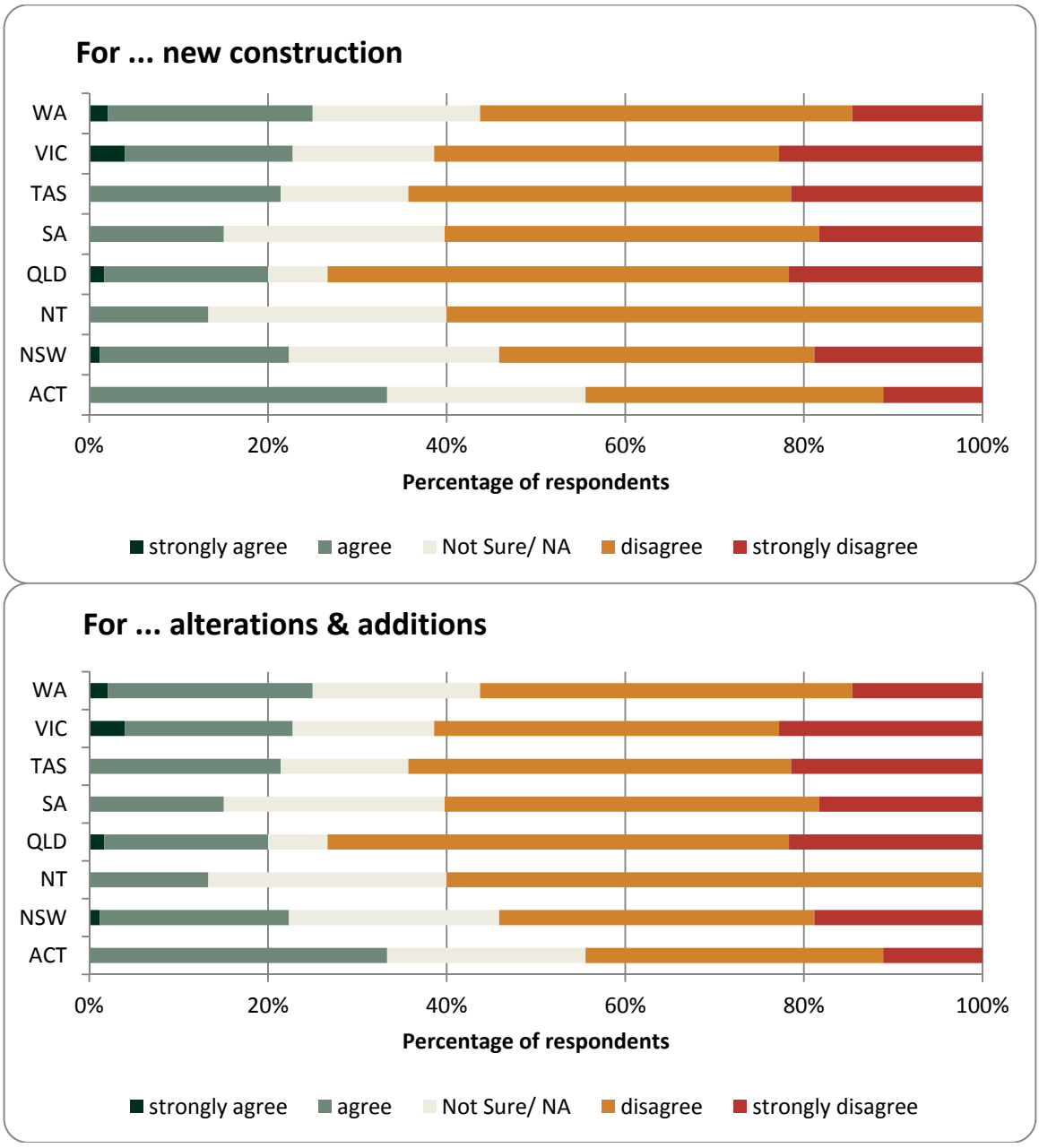


Figure E.13: Jurisdictional stakeholder responses to proposition: 'The energy efficiency provisions in the building code are being strictly implemented'

Industry acceptance and support for energy efficiency provisions also varies considerably across jurisdictions. However, no jurisdiction enjoyed clear industry support for energy efficiency, according to a majority of survey participants.

Figure E.14 indicates that energy efficiency for new construction projects is thought to enjoy strongest industry support in the ACT, where around 10% of respondents strongly agreed with this proposition, a further 25% agreed and only 45% disagreed with it (with no one strongly disagreeing). In contrast, in the Northern Territory over 65% of responses indicated that energy efficiency provisions did not have strong industry support, and a large share of these respondents were strongly of this view. Similar results were recorded for South Australia, Queensland and Tasmania, with WA, NSW and VIC also showing a worrying degree of discontent with the Code being reported.

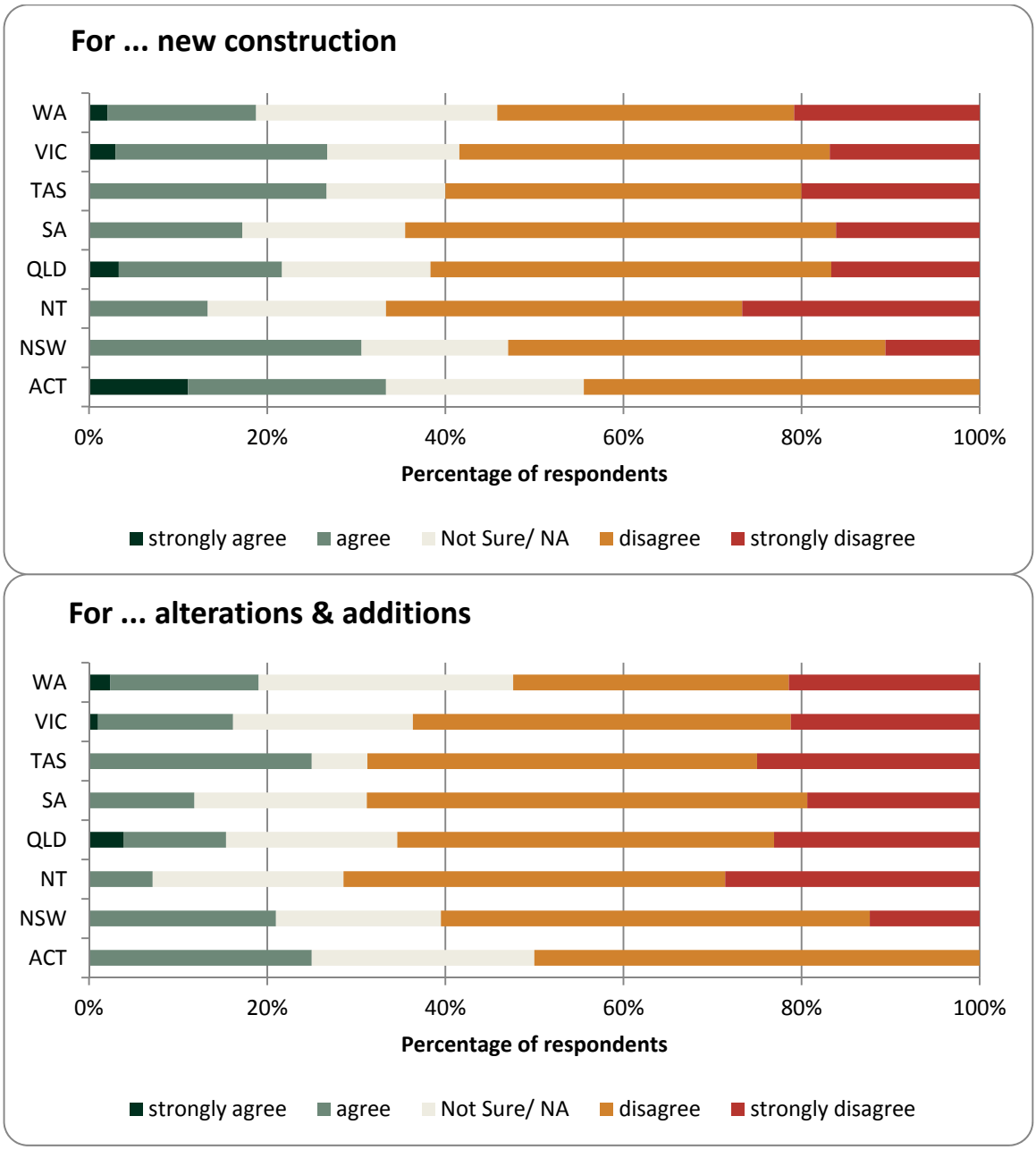


Figure E.14: Jurisdictional stakeholder responses to proposition: 'The energy efficiency provisions in the building code enjoy strong support within industry'

A similar pattern of jurisdictional responses can be observed for energy efficiency requirements for alterations & additions, but with lower levels of overall support, and higher levels of antagonism, reported across the board.

Responses from all jurisdictions also indicated overwhelming support for energy efficiency requirements to form part of building inspection and certification practices. This support was expressed consistently across new construction and renovation activities alike, and is reflected in Figure E.15.

In Victoria, Queensland, NSW and the ACT around 90% of responses favoured energy efficiency as a compliance criterion for building inspections and sign off, with many respondents strongly supportive of this view. In WA and SA support was around 80%, with slightly lower levels of support (and some significant opposition or uncertainty) recorded by respondents from Tasmania and the NT.

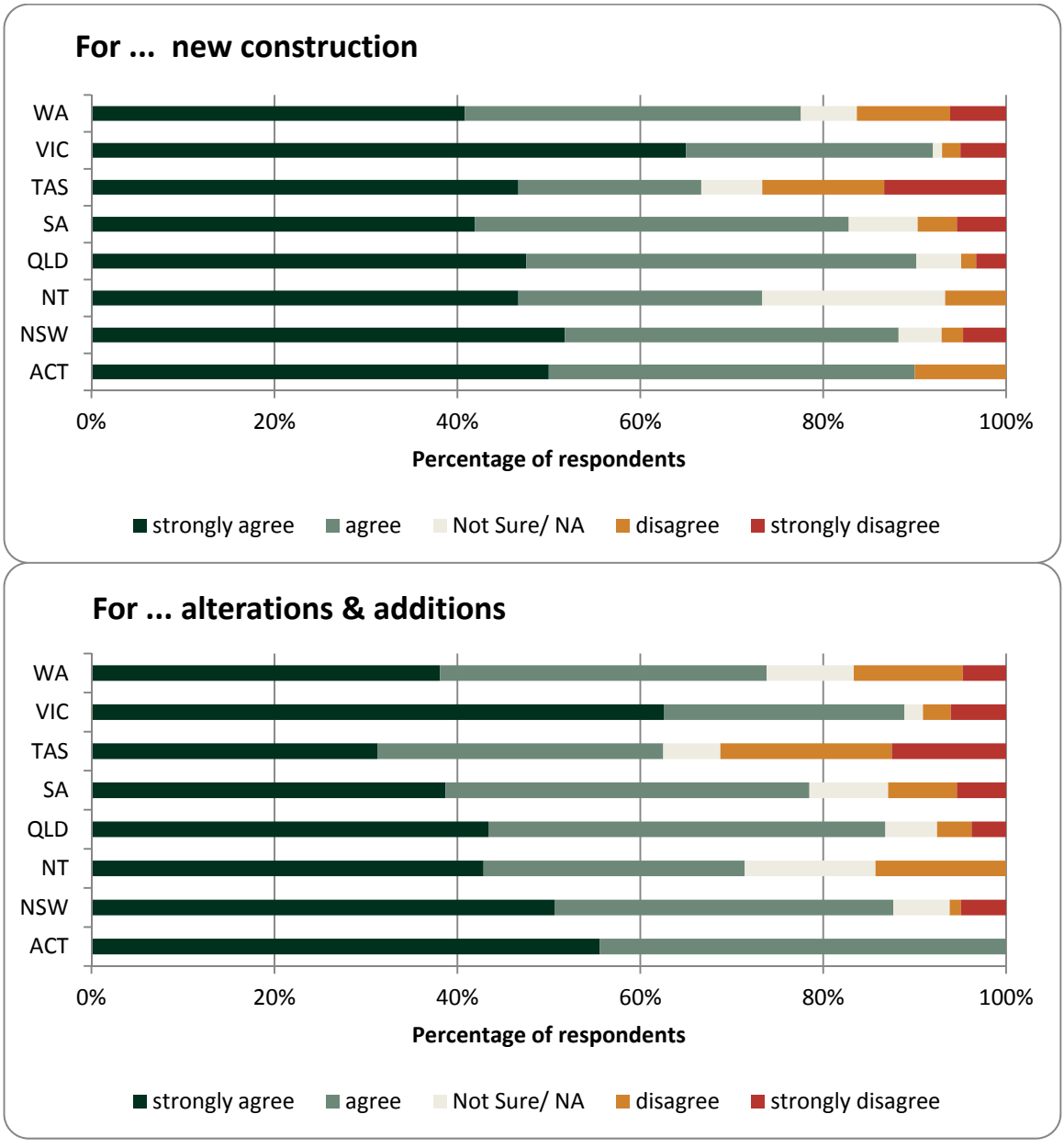


Figure E.15: Jurisdictional stakeholder responses to proposition: 'It is appropriate for energy efficiency requirements to be part of building inspections and certification'

However, responses also indicate that more needs to be done to correct and improve the assessment tools that are currently applied to rate the energy performance of building projects at the design stage. The highest level of confidence reported for energy rating tools was among ACT respondents, but even here the maximum only reached 40% of responses – and views were strongly polarized. Around 20% of ACT respondents strongly agreed that rating tools had the confidence of industry, while 20% strongly disagreed.

In other jurisdictions scepticism around the relevance and reliability of the tools appears to be stronger, as indicated in Figure E.16. In the NT, nearly 70% of responses indicated a lack of confidence in the tools, while for other jurisdictions negative attitudes toward the rating tools were expressed in about half of the responses provided, with strong scepticism around support for the tools being reported much more frequently than a strong degree of confidence.

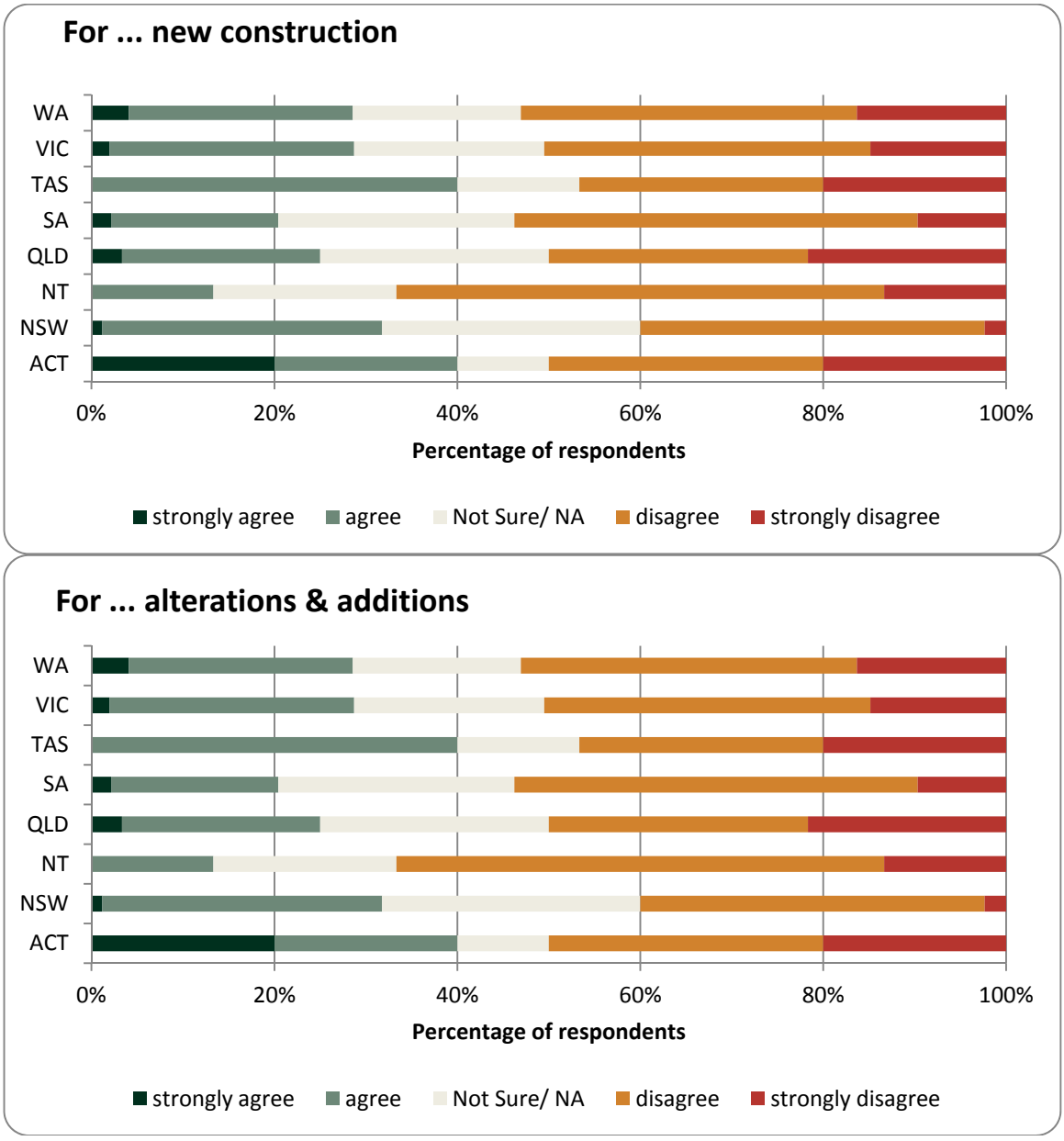


Figure E.16: Jurisdictional stakeholder responses to proposition: 'Energy efficiency rating and assessment tools have the confidence of industry'

Similar patterns of response were expressed for rating tool usage relating to design of both new buildings and alterations & extensions across jurisdictions.

Summary of Findings

While the survey does not purport to be a stratified statistical sample of professions and jurisdictions, the 571 responses captured provide an important indicator of the strength and breadth of concerns surrounding the planning and delivery of minimum building energy efficiency performance standards within Australia.

The survey reflects a diverse range of skills, backgrounds and attitudes – and significant variation in attitudes and outcomes at a jurisdictional level. Importantly, these outcomes appear to line up quite well with issues and concerns raised in private meetings and workshops across the country. The overall picture to emerge is that energy efficiency aims are, at best, enjoying only modest support within the building sector. And in some jurisdictions, the level of scepticism and indifference to energy efficient design and construction is worryingly high.

Around 80% of respondents described themselves as either positive or strongly positive in their attitudes toward energy efficiency objectives, yet their characterization of attitudes toward energy efficiency across the construction industry as a whole was largely negative or neutral (with almost 80% of responses indicating this outcome). These findings reinforce other observations we made during this review of a tendency, across all industry professions, to point to others as the source of the poor energy efficiency culture.

About half of responses highlighted dissatisfaction with the reliability of the energy rating tools and also with the understandability of the Code, with very few indicating strong confidence in these fundamental instruments. With the exception of the ACT, where a solid share of respondents strongly agreed that rating tools had the confidence of industry, the share of responses in other jurisdictions reflecting strong agreement on this point was generally below 5%. In Tasmania and the Northern Territory, no respondents reflected this view. Across all states and territories other than NSW and Tasmania, 50% or more of respondents rejected the notion that industry had confidence in the energy rating tools. Discussions on other aspects of this report suggest that this result might be a reflection of the character and scope of the rating tools themselves, and the way they are applied by some operators.

Nearly 60% of builders who responded to the survey indicated that completed projects generally met or exceeded energy efficiency design requirements, but 27% felt that projects fell slightly or substantially below. Importantly, around 60% of building surveyors and local council officers held the latter view. Upwards of 40% of trades people who responded to the survey reported seeing plan deviations, problems with materials, damaged insulation or poor installation procedures that would materially detract from energy efficiency outcomes, within the last 12 months.

The survey findings support our wider conclusions in this review that there are clear grounds for concern that energy efficiency outcomes are not being achieved as intended in the Australian building industry. These problems are affecting all jurisdictions, a wide spectrum of building classes, and new construction and renovation alike.

Appendix F

Regulatory Framework

This section provides an overview of how energy efficiency provisions are set and implemented across Australia. Code provisions and supporting regulations, practice notes and advisory material are extensive and complex, and therefore this Chapter cannot be comprehensive. Further details can be obtained from the Australian Building Codes Board (ABCB) Secretariat or from state Building Commissions.

Overview

The National Construction Code (NCC) is a set of agreed performance requirements for building, plumbing and drainage works across Australia. The detailed provisions often reference other documents – such as Australian Standards. The NCC is administered by the ABCB on behalf of the Australian, state and territory governments. The Code is given legislative effect via state and territory rather than national legislation.

The NCC consists of three volumes with the Building Code of Australia (BCA) making up the first two volumes. The BCA contains efficiency provisions along with provisions on structure, fire resistance, access and other matters to do with the design and construction of safe and functional buildings. Volume One of the BCA covers Class 2 to 9 buildings and Volume Two covers Class 1 and 10. The provisions are national and are accordingly designed to allow for factors that vary across Australia (such as climate) that influence the energy efficiency of a particular building on a particular site.

The NCC is not applied uniformly across Australia, although there is a broad intention (for example, reflected in an *Inter Governmental Agreement*) that it should be applied as consistently as possible. Each state and territory government controls building requirements in their jurisdiction; the Australian government has no regulatory role in applying the NCC. Broadly speaking, there are two general ways in which energy efficiency requirements differ by state.

The first style of difference by jurisdiction is related to the take-up of the technical provisions themselves. The National Construction Code (NCC) is endorsed by all Australian jurisdictions and most jurisdictions adopt the energy efficiency provisions of the NCC. However there are areas of exception, or 'variations and additions', that are published as appendices to the NCC. For example NSW has developed an alternative system of energy efficiency requirements for residential buildings in the form of BASIX (discussed further below). The Northern Territory provides another significant departure from BCA requirements as Section J of the BCA is not applied to Class 3 and 5 to 9 buildings.

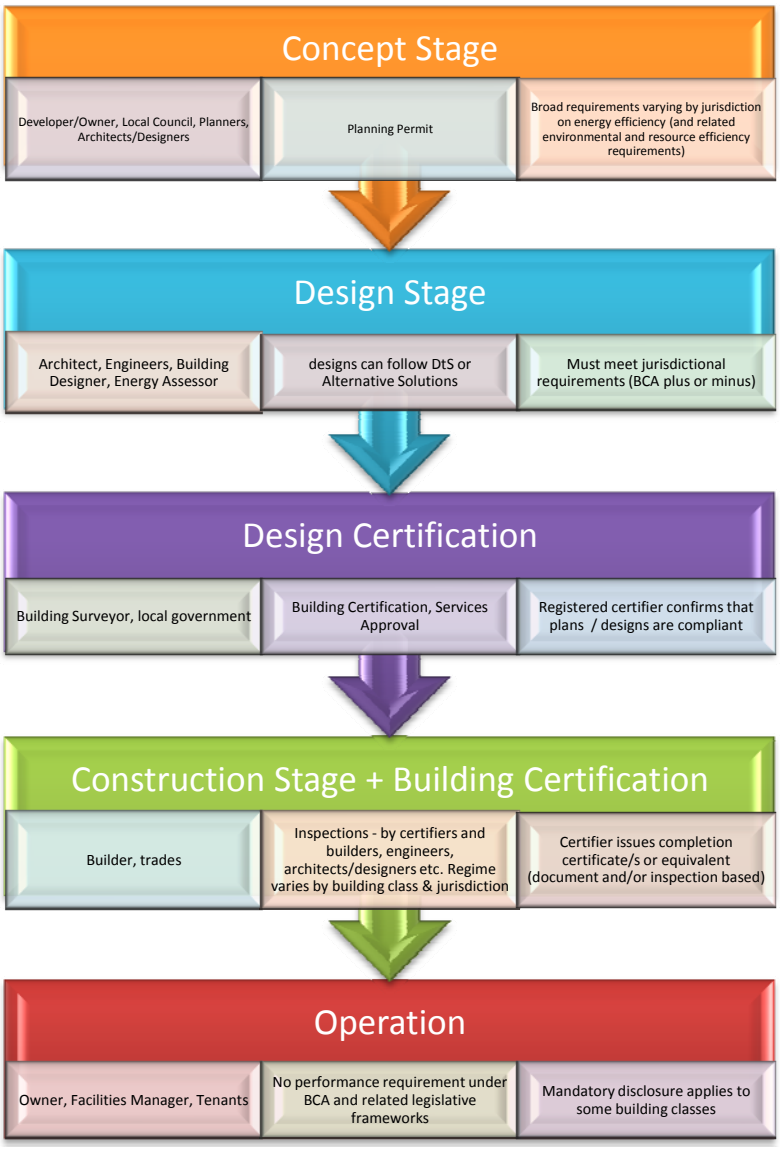


Figure F.1: The general construction and certification process in Australian jurisdictions

The second source of difference is the method of administering building requirements where the approaches used by each jurisdiction are broadly similar but differ in the method of execution. Each state and territory 'starts' with planning legislation that to a greater or lesser extent have reference to energy efficiency goals. Building legislation is the vehicle for making the technical provisions of the current BCA (or the variations / additions that apply like BASIX) into legal requirements. Importantly the building approvals process under each legislative framework varies, as does the process of regulating industry participants. Differences include varying requirements for applying for and gaining permission to plan, design, construct, commission and then occupy a building. Rules around who can carry out each of these steps also vary. The diagram below sets out the general approach that is roughly followed in every jurisdiction. Following sections discuss the arrangements in each jurisdiction in more detail.

National Construction Code – Energy Performance Requirements

The National Construction Code (NCC) is endorsed by all Australian jurisdictions and, in conjunction with standards that address minimum structural, fire and safety requirements, specifies energy efficiency features and performance levels for new buildings. The Code requirements are structured into a performance hierarchy of:

Level 1 - Objectives. The stated objective of energy efficiency is 'to reduce greenhouse gas emissions'.

Level 2 - Functional Statements. For Class 2–9 buildings, for example, the functional statement is:
'To reduce greenhouse gas emissions, to the degree necessary –

(a) A building, including its services, is to be capable of efficiently using energy; and

(b) A building's services for heating are to obtain their energy from –

(i) A source that has low greenhouse gas intensity; or

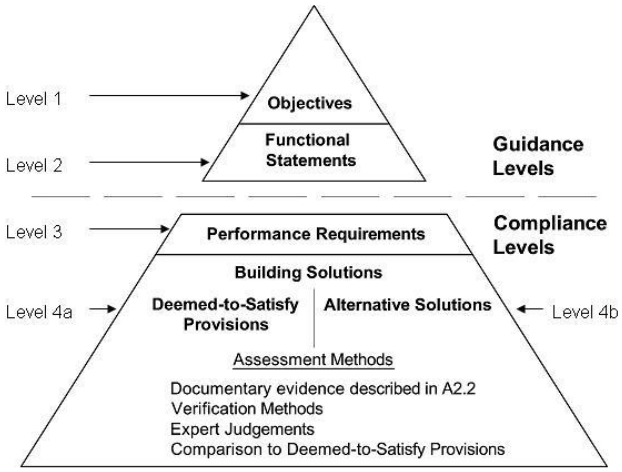
(ii) A source that is renewable on-site; or

(iii) Another process as reclaimed energy.'

These broad objectives and functional statements then cascade down to increasingly more specific performance requirements - Level 3, and then to building solutions - Level 4.

At Level 4, Code users are offered a choice between deemed to satisfy provisions (essentially, prescriptive requirements for particular building elements like fabric, glazing, etc.) and alternative solutions, which must be shown to be at least equivalent to the deemed to satisfy provisions. The final consideration is the assessment methods that are used to demonstrate that a building solution complies with the performance requirements.

This hierarchy is illustrated below:



Source: ABCB Website - http://www.abcb.gov.au/about-the-national-construction-code/the-building-code-of-australia/hierarchy-of-the-performance-based-bca

Figure F.2: Hierarchy of the Performance Based BCA

ACT

Variations and Additions to the National Construction Code

The ACT currently has no variations to Section J of Volume 1 for Class 2 to 9 buildings. However additional provisions, particularly in the case of alterations/additions are under consideration.

There are no variations to Part 3.12 of Volume 2 for Class 1 and 10 buildings in the ACT.

Administrative and implementation arrangements

The ACT Planning and Land Authority (ACTPLA) controls development and building approvals in the ACT. The Acts and regulations that apply to the building approval process in the ACT include:

- *Building Act 2004;*
- *Building (General) Regulation 2008;*
- *Construction and Energy Efficiency Legislation Amendment Act 2013;*
- *Construction Occupations (Licensing) Regulation 2004.*

The process is broadly similar for both class all classes of building. However the ACT requires a wider range of expertise for some construction chain participants that are involved with Class 2 – 9 buildings. The broad process is described below:

- The client (building owner) commissions a designer to provide a plan. An energy assessment from building assessor is required. The client also needs to engage a licensed builder and an ACT licensed building surveyor as the building certifier;
- The building certifier submits all required planning documents for Development Application, and project proceeds subject to ACTPLA approval;
- Construction proceeds with at least four mandatory inspections by certifier, in addition to a surveyor's certification that the building is correctly positioned:
  - Residential inspections are: foundation formwork, slab, framing before sheeting, final
  - Commercial inspections are similar but additional prior to concrete pours
- Subject to satisfactory compliance report from certifier, ACTPLA provides a certificate of occupancy. The certifier must provide appropriate documentation covering services provided by other licensed construction occupations and relevant inspections of such work (e.g. BEPCON certificate for electrical work).

Approach to alterations and additions

The building approval process in the ACT, together with the related NCC requirements, applies to both new buildings and alterations/additions. However, as explained above some provisions specific to alterations/additions are under consideration.

New South Wales

Variations and Additions to the National Construction Code

NSW variations to the NCC that relate to energy efficiency are as follows.

Volume 1 – Class 2 to 9 Buildings

- NSW Subsection J(B) The provision has been amended to reference the energy efficiency provisions of BCA 2013
- Section J has been replaced with NSW Section J(A) F1. This variation that replaces Section J requirements with BASIX only applies to Class 2 buildings and Class 4 parts of a building.

Volume 2

- AS 4234 'Heated water systems - Calculation of energy consumption'. Amendments 1 and 2 referenced.
- Part 3.12 – Energy Efficiency. In NSW this part does not apply and is replaced by BASIX.

These variations reflect the existence of separate energy efficiency requirements in NSW for residential buildings. BASIX was introduced by the NSW Government in 2004 before the introduction of the BCA Energy Efficiency requirements in 2006. BASIX is the predominant control mechanism that drives the energy efficiency requirements for Class 1, 2 and 3 buildings and Class 4 parts of buildings.

Administrative and implementation arrangements

In NSW, the NCC Volumes One and Two are administered by the Department of Planning and Infrastructure, while Volume Three is administered by NSW Fair Trading (NSW Department of Planning & Infrastructure 2013c).

The implementation of building energy efficiency requirements within NSW falls under several different systems for the assessment of development proposals. Most development is local or regional. In these cases state planning legislation generally dictates the planning requirements followed by local government when processing these development applications (DA). However, when it comes to energy efficiency requirements, the process and level of detail required for a DA submission can vary significantly between local government areas. Typically energy efficiency provisions for new buildings and alterations / additions within NSW either fall within two categories, that is, those residential buildings covered by the Building Sustainability Index (BASIX) and those non-residential buildings that are covered by section J of the BCA.

The Figure below shows the typical assessment process in NSW.

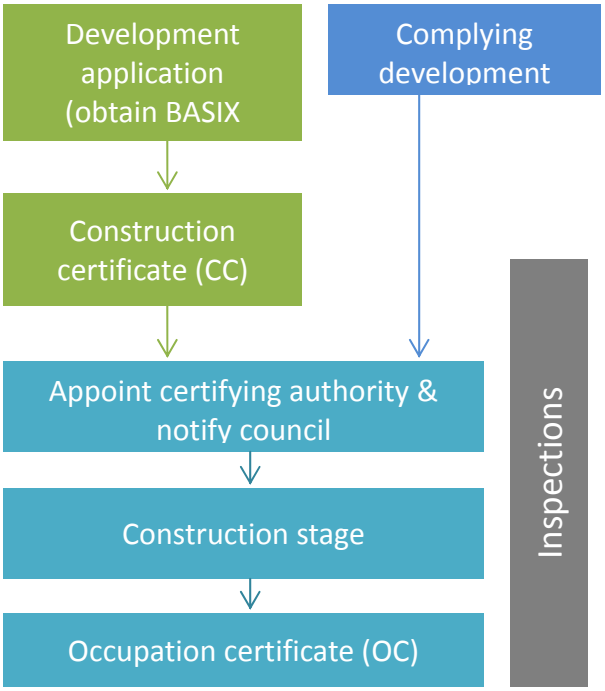


Figure F.3: NSW planning and building approval process

Local government certifiers/surveyors and private building certifiers (otherwise known as a PCA - Principal Certifying Authority) operate under the NSW State building legislation to carry out the functions related to building approvals. Only the person with the benefit of development consent (usually the landowner) can appoint the PCA; the builder cannot appoint the PCA, unless they are also the landowner (Building Professionals Board 2011 c). The role of the certifier is to ensure a building complies with the requirements of the BCA and any accompanying state and local variations. They also oversee on site construction, again to ensure compliance with the BCA and building legislation.

The Building Professionals Board (BPB) is a NSW Government authority established under the *Building Professionals Act 2005* to regulate and support building certifiers in NSW (Building Professionals Board 2013d). Among their range of duties, four key services the BPB provide include:

- NSW certifier accreditation;
- Complaint investigations;
- Advisory reviews into the work of certifiers;
- Professional development and education.

Residential requirements

All new housing and alterations/addition (classes 1 and 2) with a total estimated cost of works of $50,000 or more are required to have a BASIX Certificate before they can receive planning approval. The need to fulfil commitments on the BASIX certificate becomes a prescribed condition of any development consent and applies regardless of whether nominated as part of council's conditions of consent (Building Professionals Board 2011). Alterations/additions costing under $50,000 do not require a BASIX certificate.

Non Residential Requirements

New Class 2-9 buildings and renovation work is required to comply with Section J of the BCA as directed under the NSW Environmental Planning and Assessment Act 1979.

Local councils also have various provisions in place in relation to energy efficiency requirements in new builds and renovations. They vary from simple application of the national BCA requirements on energy efficiency (Section J), through to additional council specific energy efficiency criteria that need to be met. Some councils do not appear to explicitly reference the BCA requirements.

Examples of different local government expression of energy efficiency requirements for non residential building work are included in Table 8.1 below.

Approach to alterations and additions

BASIX applies to all residential renovation work above $50,000 as explained above.

The precise application of Section J to non residential alteration and additions appears to vary council by council. While the BCA requirements would legally apply under the NSW legislative framework, some councils do not require energy efficiency to be considered under development applications of a certain value. Therefore there is no actual requirement to demonstrate compliance with BCA requirements relating to energy efficiency in some local government areas.

Table F.1: NSW Local Government – different expressions of energy efficiency requirements for non residential buildings

Requirements	Examples	Council
DA required to meet Section J of BCA	All new buildings and new work in existing buildings must comply with Section J of the BCA. The proposed energy efficiency elements must be detailed and certified by a qualified consultant as complying with the Building Code of Australia	Wagga Wagga Council DA Guidelines
Construction certificate with details meeting BCA for energy efficiency	Details of compliance with the relevant BASIX and Building Code of Australia energy efficiency and water saving requirements	Port Stephens Council DA Guidelines
DA required additional report by accredited energy consultant on design efficiency	Energy efficiency performance report required for new commercial & industrial developments. The report must be prepared by an accredited energy consultant and should discuss how the proposal incorporates energy efficient design principles	Ryde Council DA Guidelines
DA required to meet Council criteria on energy efficiency	For developments not covered by BASIX, energy and water efficiency are still important and you must describe how the proposal promotes energy efficiency in terms of orientation, sun and shade control, insulation, natural ventilation, heating and cooling, water recycling and water heating	Gosford Council DA Guidelines

Requirements	Examples	Council
DCP outlining energy efficient planning controls	Plan 35. To promote the principles of ecological sustainable development through energy efficient methods, storm water management, waste reduction techniques, landscaping and crime prevention techniques	Botany Council DA Guidelines
DA required energy efficiency to be addressed under Statement of Environment Effects	Energy and water efficiency is required for all new buildings (including alterations and additions) where BASIX is not applicable	Marrickville Council DA Guidelines

Proposed planning amendments

Currently there are no requirements on who can prepare building design plans, apart from residential flat buildings under *State Environmental Planning Policy No 65 —Design Quality of Residential Flat Development.* There are also no requirements as to who can design building services, such as air handling systems and fire protection systems (NSW Government 2013).

To address this, the 2013 *White Paper – A New Planning System for NSW* proposed that plans be prepared and certified by appropriately qualified persons for complex buildings, and critical building services and elements. This will ensure consideration has been given to building code requirements, planning approvals and other standards during the design phase. It will ensure design requirements are right from the start. It will reduce the need for applications to be modified as work progresses and will minimise defects that need to be rectified.

Accredited building designers, along with registered architects, will be responsible for preparing plans for more complex building types (eg townhouses, large retail shops and factories that contain an office) and will have to sign off their designs (NSW Government 2013).

Accredited specialist engineers, fire protection system designers and energy efficiency consultants will prepare plans for building services designs, such as structural, hydraulic, geotechnical, mechanical and storm water designs, energy efficiency requirements and fire safety provisions (NSW Government 2013).

Northern Territory

Variations and Additions to the National Construction Code

There are very significant variations in place in the Northern Territory.

Volume 1 BCA 2013 Section J

- Section J on energy efficiency has been replaced with Section J of BCA 2009 for Class 2 and Class 4 buildings. Building Note 68 states that a 3.5 star average rating will apply to all sole occupancy units within Class 2 and 4 buildings
- Section J does not apply in the Northern Territory for Class 3 or Class 5 - 9 buildings.

Volume 2 BCA 2013

- Parts 2.6 and 3.12 are replaced with BCA 2009 requirements (5 star) for the Northern Territory.

Administrative and implementation arrangements

In the Northern Territory the Building Advisory Services Branch of the Department of Lands, Planning and the Environment administer the Building Act, Building Regulations and the Plumbers and Drainers Licensing Act. The Building Act makes reference to the Building Code of Australia and the National Plumbing Code (AS3500).

Building Certifiers are responsible for interpreting compliance with the energy efficiency provisions. The Building Certifier may decide that a particular level of performance is not required. The ultimate decision in all situations rests with the Building Certifier.

Documents submitted to the Building Certifier must contain details on achieving compliance. Approved plans need to specify the details of components, generic reference is not acceptable. Schedules and tables for evidencing requirements should reference drawings for building fabric, ventilation, glazing and shading areas.

Residential Building Assessment Process

AccuRate is the only approved software under the alternative solutions pathway. Additionally the Northern Territory is able to access the Queensland peer review Expert Judgement system that applies to architect designed free running class 1 buildings. A free running building is defined as a well ventilated building without mechanical cooling. The Northern Territory gives recognition to experts on the Queensland Peer Review Panel.

Approach to alterations and additions

NT guidance on the application of the BCA to alterations/additions is summarized in the table below.

Table F.2 Northern Territory guidance on BCA application to alterations/additions

Alteration, Addition or Extension	Compliance Measure
New habitable room addition to an existing Class 1 dwelling	Compliance of new work with all measures
Extension to an existing habitable room in existing Class 1	Compliance of new work with all measures
Conversion of a Class 10 to a Class 1	Compliance with all measures
Non habitable room addition and extensions	Services, if provided, to comply

Queensland

Variations and Additions to the National Construction Code

The Queensland Development Code MP 4.1 – Sustainable buildings (QDC 4,1) varies some of the energy efficiency aspects of the NCC.

QDC 4.1 contains Queensland-specific variations for Class 1 buildings, including:

- optional credits for housing designs that provide an outdoor living area and/or photovoltaic (solar) energy system
- exemption for insulation of suspended flooring in tropical and subtropical climates, and

- type of hot water system.

A variation is also in place for Class 2 buildings where BCA 2009 Section J is applied. In effect, QDC 4.1 provides a 5-star rating average for sole-occupancy units within a multi-unit residential building.

The QDC is subordinate legislation under the *Building Act 1975*. QDC 4.1 contains specific requirements for sustainable buildings (current version dated 15 January 2013 and commenced 1 February 2013). These provisions are intended to ensure Class 1 and Class 2 buildings contain water and energy efficient design features. QDC 4.1 specifies thermal performance requirements (6 star for detached houses and 5 star average for sole-occupancy units). It also specifies acceptable solutions to each performance requirement as per Table F.3 below. QDC 4.1 also makes possible the use of appropriate alternative solutions via the *Building Act 1975*.

Additionally QDC 4.1 amends BCA requirements for hot water systems supplying Class 1 and 10 buildings, providing a variation so that BCA performance requirement P2.6.2 and deemed-to-satisfy clause 3.12.5.6 for energy efficient hot water systems do not apply.

Table F.3: Energy efficiency requirements from QDC 4.1

Building class	QDC 4.1 Performance requirement		Acceptable solution	BCA reference
Class 1 building & attached, enclosed Class 10a building	P1	6 star energy equivalence	Flexible design options available via: i. 6-star building shell only ii. Baseline building shell (depending on climate zone) plus use of optional credits. Optional credits are available where the design includes a: a. outdoor living area = ½ star where it is connected to an internal area of the house, is insulated with a total R-value of at least R-1.5 for downward heat flow and has a minimum 12m^2 floor area. Another ½ star is available if the outdoor living area includes a compliant ceiling fan, b. solar energy system = 1 star with a minimum 1 kilowatt capacity.	BCA 2010 Vol2 P2.6.1
Sole-occupancy units in Class 2 buildings	P2	5 star average rating for all sole-occupancy units with a Class 2 building, with no individual unit to achieve less than 4 stars	Optional credits are available where the design includes an outdoor living area (½ star per unit) where it is connected to an internal area of the house, is insulated with a total R-value of at least R-1.5 for downward heat flow and has a minimum 12m^2 floor area. Another ½ star per unit is available if the outdoor living area includes a compliant ceiling fan, To achieve the optional credits for each unit, an air-conditioner servicing any room adjacent to the outdoor living area must automatically shut down when an external door to the outdoor living area is open for more than 1 minute.	BCA 2009 Vol1 JP1

Building class	QDC 4.1 Performance requirement		Acceptable solution	BCA reference
Class 1 building & enclosed class 10a building attached to class 1 building	P3	Artificial lighting	Flexible compliance methods are available, either by: i. QDC 4.1 where a minimum of 80% of total fixed artificial lighting is energy efficient, or. ii. using BCA 2010 Part 3.12.5.5 methodology for energy efficient lighting based on the number of Watts/m^2.	BCA 2010 Vol2 P3.12.5.5
Sole occupancy units in class 2 buildings	P4	Artificial lighting	Flexible compliance methods are available, either by: i. QDC 4.1 where a minimum of 80% of total fixed artificial lighting is energy efficient, or ii. using BCA 2008 Vol 1, Section J methodology for energy efficient lighting (as noted in QDC 4.1 Guideline).	BCA Vol 1
Class 1 and 10 buildings	P5	Hot water system	A water heater in a hot water supply system can be an electrical resistance heater or any other type of heater.	

Administrative and implementation arrangements

Building approvals are issued by private building certifiers or the local government, under the Queensland *Building Act 1975*. The Act details the parts of the Queensland Development Code (QDC) which have legislative effect. Where there are any inconsistencies with the National Construction Code, the QDC prevails to the extent of the inconsistency. In addition to the *Building Act 1975*, there are other pieces of legislation that relate to building and planning assessment, for example, the *Sustainable Planning Act 2009*.

Although some works are self-assessable or exempt from building approval as defined in the *Building Regulation 2006* (small sheds, fences and regular maintenance works for example), most construction works require a building approval. This applies to both new builds and renovations.

A building development approval or building permit is required before starting construction and may be obtained from either local council or a private building certifier (registered by the Queensland Building and Construction Commission).

In addition to the *Sustainable Planning Act 2009*, the *Building Act 1975* and any specific Queensland Development Codes, construction in Queensland is controlled by the individual planning schemes of 73 local government authorities (Queensland Department of Local Government and Planning 2012). Planning schemes may include: building character and design requirements, such as aesthetics, heights and floor space ratios, and certain amenities. Where a relevant QDC provision is also included in a planning scheme, the QDC will override the local requirement to the extent of the inconsistency.

Building Certification

The Queensland building certification process involves independent assessments and approvals of building design and construction to ensure it complies with all relevant building requirements. Necessary assessment checks and building inspections are undertaken by the building certifier as part of the

certification process. Guidance on building inspections to meet *Building Act 1975* and Building Regulation 2009 are published by Department of Housing and Public Works (www.hpw.qld.gov.au). A schedule for building inspections for Class 1 and Class 10 buildings is prescribed, but a risk-based approach is taken to schedule inspections required for Class 2 to Class 9 buildings.

The final building inspection confirms that it is constructed as designed in accordance with its building approval. Thereafter, there is no requirement to inspect buildings to ensure their energy efficiency 'as designed' is met. In practice the codes and legislation incorporate energy efficiency in the building design phase. In the operational phase, energy efficiency is the responsibility of the building owner or operator with no requirements for maintaining the building's performance for energy efficiency.

Approach to alterations and additions

Relevant building provisions, including energy efficiency, apply to existing buildings when undertaking an alteration or addition. The building certifier has discretion as to how to apply the requirements and their discretion will depend on the scale and nature of the proposed work, with each case to be assessed on its merits. A building certifier can require practical energy efficient design features to be included with the alteration or addition. Where renovation is greater than 50 per cent of floor area, they can decide not to impose a condition for upgrading the existing part of the building completely in circumstances where they consider that this would:

- not provide a level of benefit equal with, or would exceed, the additional financial costs, or
- otherwise be overly onerous or technically impractical.

South Australia

Variations and Additions to the National Construction Code

South Australia has a number of energy efficiency requirements that are additional or vary from those in the NCC. They are listed below.

BCA Volume 1, Section J

- SA JP4 - Heating for a hot water supply system that only serves a single sole-occupancy unit in a Class 2 building must, to the degree necessary, obtain energy from a source that has a greenhouse gas emission profile not exceeding 300 kilograms of carbon dioxide equivalent per gigajoule of heated water (300 kgCO2-e/GJ).
- J7.0 - Deemed to Satisfy Provisions. Performance requirement JP4 is satisfied by complying with SA J7.5
- SA J7.5 Complying Heated Water Services. Provides the acceptable types of hot water supply.
- SA JV4 - Compliance with Performance Requirement SA JP4 for a heater in a hot water supply system is verified when the annual greenhouse gas intensity of the water heater does not exceed 300 g CO2-e/MJ of thermal energy load determined in accordance with AS/NZS 4234
- SA J1.3 (e) – Roof and ceiling construction. An additional requirement for class 5-9 buildings to have a solar absorbance value of not more than 0.4 if they are in climate zones 4 or 5, have a pitch of less than 5degrees, and has a conditioned space (an area controlled by air-con)/
- SA J7.2 – Hot Water Supply. The design and installation of heated water services in South Australia is regulated by Directions issued by the South Australian Water Corporation pursuant to Regulation 17 of the Waterworks Regulations 1996.

BCA Volume 2

- In South Australia, a sunroom or the like is deemed to be a Class 10a building and must comply with Part 3.12.1.6.
- Heating and Cooling Loads
  - (a) reference to the use of a house energy rating software to achieve minimum of six star rating.
  - Rather than refer to R values it refers to a lightweight flooring system and for climate zone 4 or a number of councils 5 stars is acceptable (as opposed to the 6 star standard for other climate zones)
- 3.12.5.0 – rather than comply with Australian Standards the hot water supply is required to comply with the Waterworks Act 1932 and the Waterworks Regulations 1996

Volume Two of the Building Code of Australia with the South Australian variations as listed above is the only regulatory document for house construction in the state. Prior to 1 May 2012 the South Australian Housing Code was an acceptable construction manual – but now it can only be referred to for applications lodged for building rules consent prior to 1 may 2012.

Administrative and implementation arrangements

The Development *Act 1993* establishes the powers and responsibilities of the different planning players, including giving councils the power and responsibility for building inspections in their areas.

Applications for building rules consent are assessed against the Building Code of Australia, published by the Australian Building Codes Board. Applications may be granted building rules consent by Council or a private certifier.

Consent is considered by a building surveyor who assesses the application against the technical requirements of the Building Code of Australia, minister's specifications and any relevant Australian Standards. Together with the *Development Regulations 2008* these are known as the Building Rules and they cover issues including:

- structural adequacy
- fire safety
- health and amenity
- equitable access for people with disabilities
- energy efficiency.

Once assessment against the development plan and the building rules have taken place, and these consents have been granted the final development approval is issued by the council. The building work and/or change in land use can then proceed. Details of whether further approvals are required may be obtained from the relevant council.

All new buildings and alterations/additions (apart from minor alterations – eg those not impacting on a habitable space) must comply with energy efficiency requirements under the BCA and South Australian variations. Councils or a private certifier can make assessments and issue the approval. When energy rating software has been used to demonstrate compliance, the rating report must be included in the application documents. The rater does not need to be accredited or registered.

Approach to alterations and additions

Energy efficiency requirements apply to both new buildings and alterations/additions under the Development *Act 1993.*

Tasmania

Variations and Additions to the National Construction Code

A variation is in place for Class 1 Buildings with the previous 5 star standard rather than the current 6 star standard applying.

Tasmania does not apply any variations to the energy efficiency requirements of Section J, Volume 1 that apply to Class 2 to 9 Buildings.

Administrative and implementation arrangements

In Tasmania the NCC is referenced from the *Building Act 2000* as the technical standard for building work and plumbing work.

Work on new and existing buildings is regulated through a certification process. Proposed construction or alteration work is assessed against the requirements of Tasmanian building legislation (Building Act 2000, Building Regulations 2004, Plumbing Regulations 2004) and the National Construction Code (NCC).

Councils act as the Permit Authority.

All building work requires a permit unless it is exempted under the Building Regulations 2004. Exemptions include small sheds, pergolas, flagpoles, some fences etc. Councils interpret this requirement as they are the permit authority.

Steps in obtaining a building permit include:

- A building surveyor must be engaged (either a private or council employed building surveyor);
- The building surveyor undertakes a technical assessment of the building design against the NCC;
- The building surveyor issues a Certificate of Likely Compliance.

A process of inspections by building surveyors occurs during the construction phase. A certification process including an occupancy certificate signed by the building surveyor occurs at the end of the construction phase.

Approach to alterations and additions

The Tasmanian framework only exempts very minor work from the BCA provisions. Therefore energy efficiency requirements apply to both new buildings and alterations/additions.

Victoria

Variations and Additions to the National Construction Code

The only Victorian variation to the NCC Volume 1, Classes 2-9, Section J is that Section J7.2 (relating to the design and installation of hot water supply for food preparation and sanitation) does not apply.

The following variations to the NCC Volume 2, Classes 1 and 10, Part 3.12 apply:

- 3.12.0(a) has the additional requirement that in the case of Class 1 buildings they are to have either a rainwater tank connected to all sanitary flushing systems, or a solar water heater system, installed in accordance with the Plumbing Regulations 2008;
- 3.12.5.0 does not apply in Vic. (regarding the design and installation of hot water supply systems);
- 3.12.5.6 does not apply in Vic. (Water heater in a hot water supply system).

Administrative and implementation arrangements

Building work in Victoria is subject to the Building Act 1993, Building Regulations 2006 (the Regulations) and the NCC unless specifically exempted.

The Victorian Building Authority (VBA) commenced work on 1 July 2013. It acts as the regulator and single point of reference for the building and plumbing industries. The VBA replaces the Building Commission and associated bodies.

Local Councils are responsible for assessing and issuing planning permits. Local councils are also responsible for administering and enforcing parts of the *Building Act 1993*, and for appointing municipal building surveyors who, along with their private counterparts, authorise and oversee building works. The **Building Surveyors** are responsible for certifying buildings and ensuring that all NCC requirements are met. They are required to be qualified and registered by the VBA.

Approach to alterations and additions

The *Building Regulations 2006* relate to the design, construction, use and demolition of buildings. Regulation 608 applies to alterations to an existing non residential building and requires that building work to alter an existing building complies with NCC standards. There is a threshold trigger which applies as to whether the rest of the building must also comply and be brought up to current standards. The trigger point occurs when the planned renovations combined with any other alterations undertaken in the previous 3 years constitute more than half the original volume of the building (the 50% rule).

The relevant building surveyor may grant permission for partial compliance but only if the floor area of the extension is not greater than the lesser of: 25% the floor area of the existing building, or 1000m^2. Dispensation from the energy efficiency requirements is determined by the building surveyor who judge how *reasonable* full compliance would be in each instance. Work would be considered unreasonable if costs obviously outweigh benefit. For example a building surveyor may judge that a particular set of intended alterations to the fit out of one floor of a six floor building would be required to comply with some parts of section J such as lighting, but not other parts such as glazing.

For further explanation and examples see the practice notes at the link below
http://www.buildingcommission.com.au/__data/assets/pdf_file/0003/8769/PN_2007_12.pdf

http://www.buildingcommission.com.au/__data/assets/pdf_file/0019/8722/PN_2011_55.pdf

Western Australia

Variations and Additions to the National Construction Code

In Western Australia, there are no variations to the energy efficiency requirements in the National Construction Code Volumes 1 and 2 that apply to *new* buildings.

A variation applies to alterations/additions on existing Class 1 and 10 buildings. The Building Regulations 2012 prescribe an additional transition period to 30 April 2014 for NCC requirements for renovations, additions etc. As an example the '5 star' deemed-to-satisfy requirements of BCA 2009 can be applied to alterations to homes (class one buildings) being undertaken up to 1 May 2014. See http://www.buildingcommission.wa.gov.au/docs/advisory-notes/an024_v2.pdf

A further advisory note is under development. This will include an alternative solution and is likely to amend the transition period arrangements. Further details are provided in the *approach to alterations and additions* section below.

Administrative and implementation arrangements

The *Building Act 2011* commenced on 2 April 2012 and sets out the building approvals process in WA from design through to occupation of a building. The *Building Regulations 2012* support the *Building Act 2011.* The National Construction Code is referenced by the regulations.

The diagrams below summarise WA's building approval processes for homes and other building classes.

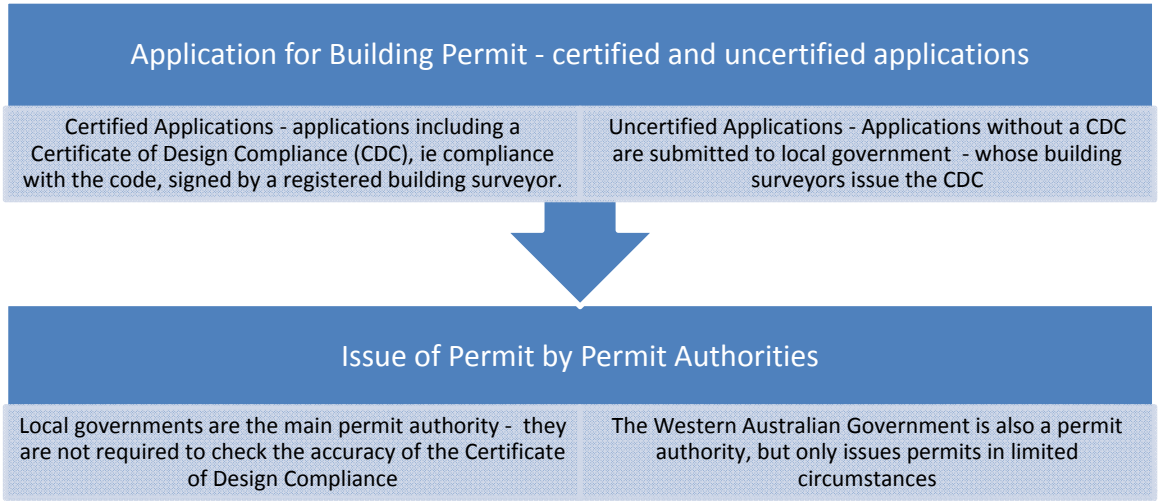


Figure F.4: WA Building Approval Process summary diagram for Class 1 & 10 buildings

Figure notes:

1. *Inspections are not required for Class 1 & 10 buildings*
2. *Occupancy permits and building approval certificates are not required for Class 1 & 10 buildings*

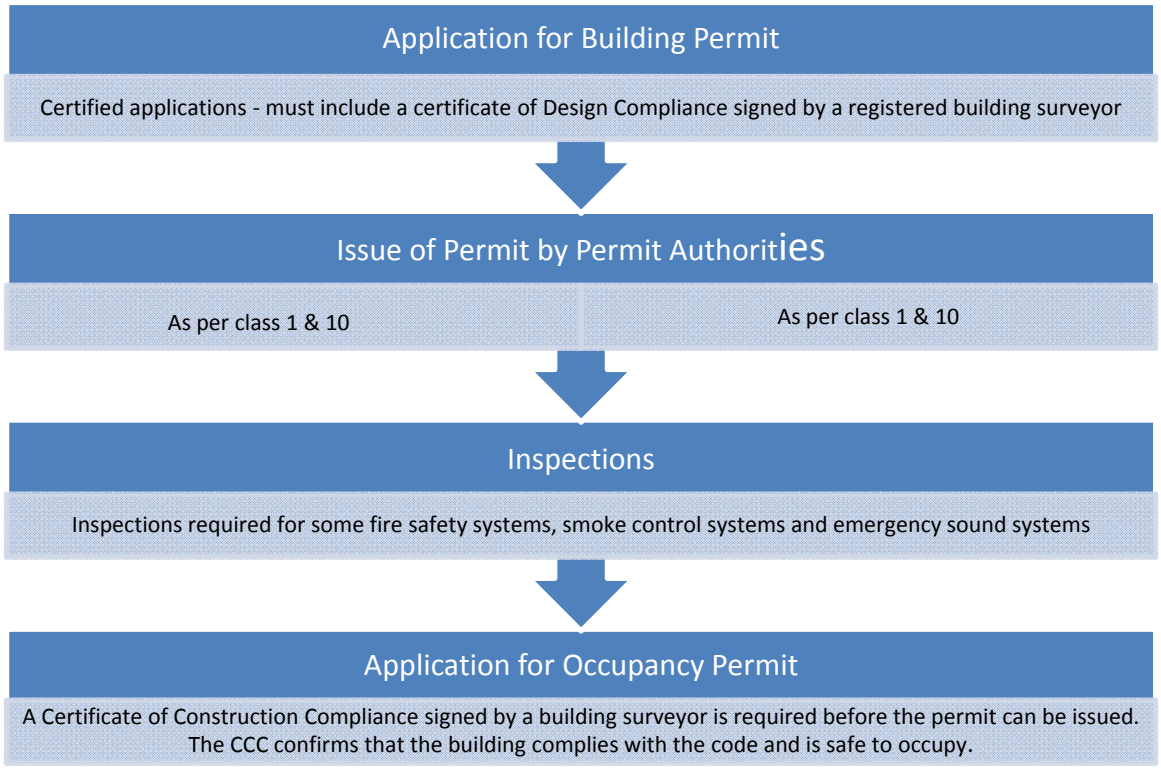


Figure F.5: WA Building Approval Process summary diagram for Class 2-9 buildings

Figure note: The Act makes provision for the regulations to stipulate what the Building Surveyor must do before signing the CCC (section 57.6). At present, the regulations do not make any such stipulation.

Approach to alterations and additions

Regulatory and industry participants in the construction industry in WA recognised, with the change to BCA requirements for Class 1 and 10 buildings, that there is uncertainty in the application of energy efficiency provisions to alterations and additions. In order to provide a clear route to compliance an alterations-additions protocol is in the final stages of development following considerable work and consultation. The protocol will consist of an Advisory Note issued by the WA Building Commission and will include a technical document and a suite of calculators to enable identification of requirements and solutions. The likely implementation date is 1 May 2014 with a 12 month transition period.

The approach in WA to alterations and additions to the energy efficiency provisions of Section J for Class 2-9 buildings does not differ from new builds.

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