National Energy Efficient Building Project

A joint Australian, state and territory government project

Issues Paper

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 has been engaged to assist and has prepared this paper.

1 Project introduction

There is a growing concern that the actual energy efficiency of buildings in Australia – both new builds and renovations/additions – may not always match the energy performance requirements in the National Construction Code ('the Code'). The National Energy Efficient Building Project aims to understand why this discrepancy exists, the extent and what could and should be done to address the problem. At the same time the NEEBP project team intends to identify ways to encourage and support positive steps beyond minimum compliance and towards best practice.

The NEEBP will occur in several phases. In this first phase, we are focusing on three main areas:

1. A national review of systemic or process weaknesses, or common points of non-compliance, with the energy performance requirements in the Code. We are seeking to understand the extent of non-compliance; , why and where it occurs in the building life-cycle. What factors are contributing to overall energy efficiency outcomes? Is it the nature of the Code itself; the state or territory variation and additions; building regulations; local planning and building approval processes; ratings tools, assessment and certification processes; designs, materials or construction practices; fit-out, hand-over, occupant behaviours, knowledge and skill issues; or indeed, is it other factors?

2. A national review of 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, as well as extensive stakeholder engagement, this project aims to develop a set of best practice guidelines for energy efficient renovations. The guidelines will support improved practices in industry and in local government. In addition, this national review will develop wider administrative or policy recommendations including potentially, changes to the provisions in the Code or related regulations.

3. 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. This will include development of a national industry-based information register. This analysis aims to identify optimal content and modes of information delivery and skill development. One outcome of this project is to identify and prioritise industry capacity building interventions that could be delivered in the coming months and years.

Your participation in this project will help to ensure it is focused, targeted and effective. Section 4 below sets out how you can get involved.

2 Background to the issues

2.1 Buildings are a vital part of the 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. These construction workers build and maintain the built environment relied on by the 30 million people who live in and visit Australia each year (ABS 2013, *Yearbook Australia 2012,* 'Population clock, overseas arrivals and departures').

2.2 It is important that buildings are energy efficient

When buildings are energy efficient their occupants are better off – they have lower energy bills and higher levels of comfort and well-being. Energy efficient buildings are better for the economy and better for the environment. Reducing energy use allows the money saved to be invested elsewhere. For example, Australian households spend an average of approximately $380 million every week on electricity and gas (*ABS Energy Consumption Survey*). 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 impacts of energy use – such as greenhouse gas emissions.

2.3 Building energy performance requirements have been in place for up to 10 years

Energy efficiency provisions were introduced into the Building Code of Australia (now National Construction Code) over the period 2003–2006. This major achievement was made possible through an agreement by all governments in Australia expressed in the 1998 National Greenhouse Strategy[1]. Since then 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).

The performance requirements are set out in Section 2.6 (Class 1 and 10 residential) and Section J (Class 2 and 4 residential and Class 3 and 5–9 non-residential) of the Code. State and Territory governments have responsibility for legislating and giving effect to Code provisions, modified in some cases by state-based variations and/or additions.

2.4 The energy efficiency of new and renovated buildings is lower than it could be

In various consultations between the building industry and government many parties have expressed their concerns that the building industry as a whole (including policy-makers, regulators and all involved in design, assessment and construction) is under-achieving on the energy efficiency front. They have identified three main areas of concern:

- 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 or 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 fine-tune more energy efficient buildings are not always taken.

The purpose of this project is to find practical solutions. The NEEBP is searching, with your help, for incremental improvements in all parts of the system. What are the changes to Code provisions, regulations, practices, information resources or indeed any other factors, that might improve both compliance and energy efficiency outcomes? We are interested in hearing about issues in all building classes, all climate zones, all levels of government and all stages of the building life cycle.

[1] National Greenhouse Strategy – Strategic Framework for Advancing Australia's Greenhouse Response, Commonwealth of Australia, 1998, p. 48.

3 What do we need?

All active participants in the building industry have the 'inside knowledge' that will help us develop effective strategies to support the delivery of energy-efficient buildings. We want your help to gather information on:

- issues and activities that make the delivery of energy-efficient buildings and renovations less likely. We are interested in the difficulties in achieving compliance and in the challenges that need to be overcome to achieve best practice (which means that every cost-effective opportunity to maximise energy efficiency will be taken);
- practical ways to help industry comply with or exceed the energy efficiency provisions of the Code;
- recommendations to the Australian Building Codes Board (ABCB), 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;
- identification of information and training or accreditation programs that will support industry (in each of its parts – such as designers, assessors, carpenters, electricians, etc.) to deliver energy-efficient buildings. We also need to find the spots where more help would make a difference.

4 How can you get involved?

There are four ways you can get involved in this important project: make a submission, complete a brief online survey, attend a workshop, or have a private meeting.

Make a submission or register interest

Respond to the topics and questions that follow in the Issues Paper. Send us a quick email (even just to register your area of interest straight-away) or a detailed submission if you prefer. We need your response by Friday 13 December. Please email it to:

consultation@pittsh.com.au with 'NEEBP submission' included in the subject title.

Complete a brief, online survey

Spend 10–15 minutes on our NEEBP online survey. From Monday 25 November, go to https://www.surveymonkey.com/s/NEEBP to complete the survey. Please complete the survey by Friday 13 December and note that it will no longer be possible to do so after Friday 20 December.

Attend a workshop

Come along to one of the industry workshops being held at different times in 11 locations around the country. Take the opportunity to discuss the issues with a range of industry players and make your views known to our team. Please email RSVP@pittsh.com.au with the location in the subject box to let us know you're coming.

Have a private meeting

While the project timeline is tight, we will have three consultation teams visiting every capital city and a number of regional centres. If you are unable to attend a workshop, or if you would prefer a private, bilateral consultation, we will do our best to meet you either face to face or over the phone.

Please send a request to RSVP@pittsh.com.au – first in, best dressed!

5 Food for thought - issues you may wish to consider before you talk to us

5.1 Is the Code aiming at the right target(s)?

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:

1. Objectives. The stated objective of energy efficiency is 'to reduce greenhouse gas emissions'.
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 –

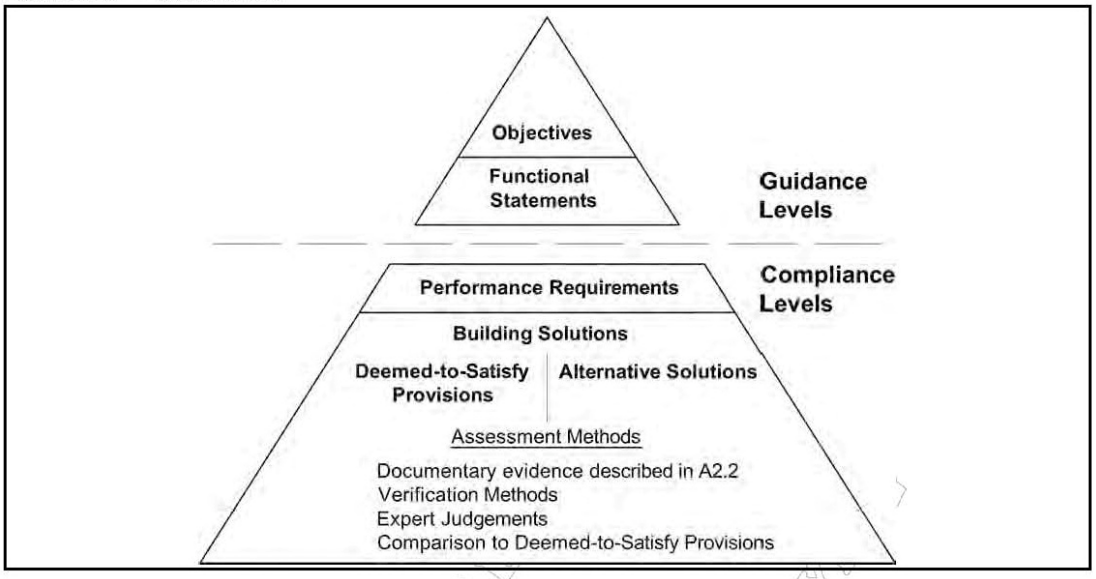
      (i) A source that has low greenhouse gas intensity; or

      (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 this point, 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.

Figure A0.3 — BCA Structure



Without wishing to limit responses, some issues we can note include:

- The Code's energy performance requirements are design-only (one might say, a design and documentation only), as distinct from verified, 'as built' performance requirements. This is different in some other countries, where whole building performance testing, using blower door techniques and thermal imaging, and commissioning requirements, can be found.
- Whole of building energy performance targets are not clearly stated in the Code. Rather they are 'constructed' from the required elements, with the overall result essentially unique to each building.
- The widespread use of deemed to satisfy performance provisions can lead to design sub-optimisation and a lack of concern for overall building performance as designed, let alone as built and operated. This widespread use of deemed to satisfy provisions is probably related to the inherent complexity of the Code.

These issues increase the chances of a gap occurring – between the energy efficiency standards of the Code and the level of efficiency that is actually achieved when the building is occupied. To understand these issues better, and to uncover possible solutions, we seek comments – which could be responses to the following questions:

1. Is the 'pyramid' hierarchy and overall structure of the Code too complex? Does this contribute to difficulties in complying?
2. Is it sufficient to assess the energy performance of buildings 'as designed', or should there also be some consideration of the actual energy performance 'as built'?
3. Do 'Deemed to Satisfy' (DTS) provisions tend to erode or support good energy efficiency practice and outcomes?

4. How widely used are 'Alternative Solutions', and how effective are they in encouraging innovative designs while meeting energy performance requirements?

5. Should the energy performance requirements be more transparent? If so, how could this be achieved?

6. Are jurisdictional and climate zone variations in the NCC generating confusion or energy efficiency 'loopholes'?

7. Is there scope to improve energy efficiency outcomes at the building design and development approval stage? If so, how?

8. Are the energy efficiency rating tools used by building designers and assessors giving robust and reliable depictions of the actual energy performance capabilities of the completed building?

9. What is the scope for 'user error' in the application of the ratings tools or 'expert judgement', and how frequently does this occur?

10. Do you have any other comments to make on the use of rating tools?

11. Other issues you would like to raise?

5.2 The planning, design and certification phase

The final energy efficiency of a building is influenced long before construction starts. Building construction projects can be long and complex, require the input of many trade professionals and a significant investment of time and money.

Buildings and their energy efficiency are shaped by many factors, including:

- the orientation and slope of building sites – does the site allow solar sensitive design? Is there adequate access to light?
- the presence or absence of 'master plans' that might affect the energy or other performance dimensions of the eventual building;
- desirable and undesirable views;
- the building design;
- budgetary and financial restrictions;
- the nature of regulatory incentives and 'sticks';
- local industry knowledge and practices;
- the nature of contractual relationships between parties involved in the process;
- construction detail and quality;

- the availability and cost of high performance building equipment (glazing, lighting systems, etc.);
- inspection and certification practices;
- approvals requirements;
- building commissioning (or 'tuning') practices;
- occupant information guides;
- occupant behaviours and fit-out decisions;
- building maintenance, and
- many other factors.

Given this complexity, there is ample opportunity for things to go wrong.

Owner-builders have an incentive to closely supervise each construction stage – and pay particular attention to verifying important activities that would be difficult to substantiate at a later date. For example ensuring the correct grade of insulation goes into the wall cavities prior to the Gyprock being applied, and effective installation to the edge of the window and door frames. However, in many instances the investor will not be the person who occupies the completed building or space. In construction – as in all other commercial activities – there is a perennial incentive to minimise cost and sell at the highest price possible.

The resulting cost constraints (on labour time and materials) combine with a range of challenges that confront trade professionals including:

- reliability of material/equipment specifications;
- variable availability of 'high specification product' (this only applies to some elements of the building 'system');
- incomplete knowledge/training on the often complex interrelationships between site, materials, equipment and other parts of the designed building system.

For expensive, complex and long-lived projects such as buildings there is benefit in having an expert and independent assessment made of compliance with the design specifications and, in particular, that mandatory minimum requirements under the Code are being met. While this independent inspection and certification function was the province of local governments and building authorities, State and Territory jurisdictions have moved progressively to outsource this function.

Today, in all Australian jurisdictions, building certifiers are hired on a fee-for-service basis to inspect and report on the standard of construction, and its compliance with government building requirements. In practice, many builders recommend or appoint certifiers that they are familiar with. The method of managing this issue varies by state/territory, but many appear to have a reasonable system in place. Comments are welcomed.

Perhaps a larger issue is the number and type of inspections that are (or are not) required – and whether they are effective in ensuring compliance with energy efficiency requirements. Physical inspections tend to be infrequent, but it may be expensive to run a very thorough inspection regime of all the factors effecting end energy efficiency. A program of auditing and end testing could offer a way forward, for example. We are interested in the industry's views.

We also encourage responses to the following questions:

1. What are the key challenges you meet when dealing with materials and equipment that impact energy efficiency? Do the impacts vary by location / climate / different building types?

2. What are your key interactions with other planning / design / certification professionals that impact energy efficiency? Does the answer vary for different building types, or different locations, or other factors?

3. How important are planning rules, schemes and requirements in determining the energy performance of buildings? Do you think the planning and building requirements/systems could work better together? How?

4. Are the building inspection and certification processes providing sufficient scrutiny of construction practices, and robust assessments of compliance with energy efficiency provisions of the NCC?

5. How active are regulators in enforcing energy efficiency standards and practices in construction?

6. Do the arrangements, in your state or territory, work to maintain the quality and independence of building certification?

7. What improvements could be made to the inspection and certification system in particular jurisdictions?

5.3 The construction phase

The National Construction Code specifies 'deemed to satisfy' practices that may be adhered to in order to achieve targeted levels of energy performance within new buildings and renovations, but 'alternative solutions' may also be followed where they can be shown to lead to at least equivalent outcomes. However, moving from design to final build and handover requires the input and effective coordination of a variety of suppliers and tradespeople. Each must deliver their own services and input to the quality required, and also ensure that their work does not materially detract from the work of others. The use

and appropriate installation of specified building materials, insulation, lighting, plumbing and glazing can be critical to achieving as-designed outcomes.

Challenges presented by on-site conditions and coordination of trades and suppliers, in addition to commercial pressures to deliver on-time and on-budget, may cause actual performance in construction to fall below best practice. Major concerns arise and energy performance of the completed structure can fall dramatically, when actual practice falls below minimum Code requirements.

Once construction is complete, even moderately complex buildings need to be 'tuned' or commissioned in a way that takes energy efficiency into account. A building with the ingredients for energy efficiency can have weaker than possible performance if tuning is not done well.

We seek industry and stakeholder responses to the following questions:

1. Are NCC energy efficiency requirements and practices, detailed in Section 2.6 and Part 3.12 (Class 1 and 10) and Section J (Class 2–9) clear and well understood by builders, tradespeople and other building professionals?
2. How much importance and attention to detail is devoted to delivering on NCC energy efficiency requirements?
3. Are there major gaps or uncertainties in the NCC energy efficiency provisions that are causing problems for builders and service providers in delivering structures as specified and in line with energy performance standards?
4. Where are these gaps or uncertainties most severe?
5. What are the key reasons for design standards of energy efficiency not being met?
6. Do commercial pressures play an important role in non-compliance? How so?
7. What proportion of building projects (within a particular building class) embody significant deviations from design specifications that are likely to materially affect targeted levels of energy performance?
8. Are availability and timeliness of delivery of energy efficient materials and products (e.g. insulation, high performance double glazed windows, hot water and HVAC systems) a major problem?
9. How common is substitution of below-specification energy efficiency material or products?
10. Could the 'building requirements system' improve final performance? Could it, for instance, influence better 'tuning' practice?
11. Is there scope to address these problems through amendments to the National Construction Code (please provide details), state building regulations, local planning provisions, information and training support, or in other ways?

5.4 Renovations and additions

Renovations and additions are estimated to account for around 16% of residential construction and about 10% of non-residential. They are clearly an important aspect of building activity in Australia but can introduce a range of compliance and verification challenges from an energy efficiency perspective – the first of which is determining those renovation projects that must comply with the energy efficiency provisions laid down in the Code.

In some states and territories it is not clear when, and how, the requirements are 'triggered' by renovation (alterations/additions) work. Neither is the interaction of the energy efficiency requirements on the 'new' part of the building and the existing building always clear. Particular issues include:

- minimum thresholds (triggers) are specified in different ways (area of new work, value of new work, area or value of new work as a percentage of total area or value); and
- different interpretation or application of the triggers between local planning authorities and states and building classes.

In the case of commercial buildings, it is not uncommon for the practical threshold to be set by the local planning authority based on locally-relevant triggers, such as the total value of the refurbishment project. However, the value of the works done and the extent to which energy using (or energy-influencing) systems are changed, may be completely unrelated.

In some cases, local planning authorities collect limited information regarding detail of works and may be unaware of the extent to which energy efficiency provisions should or may apply.

Further, even when triggers are passed, there is uncertainty regarding which building elements are required to comply with the Code and whether this depends upon the nature of the works carried out (e.g. are energy-using systems affected or only cosmetic changes), the extent of the works (some percentage of the system renovated?) or the value/area of the work being proposed.

The application of ratings tools for additions and extensions can also be arbitrary and problematic. Generally tools require complete building plans to generate accurate results. However, it may be quite expensive to model whole building performance when a modest refurbishment is undertaken, and this can particularly be the case for commercial and multi-tenanted spaces.

We seek industry and stakeholder responses to the following questions:

1. Are the circumstances and thresholds that describe when Section 2.6, Part 3.12 and Section J provisions apply to renovations clear and reasonable?
2. When a threshold is passed, is it then clear which energy performance requirements apply, to which energy-using systems? How much discretion is exercised by building surveyors in determining answers to these questions?

3. Are there valid reasons why thresholds (for the application of Code energy efficiency requirements) should be applied by planning authorities rather than at a higher level, such as in the Code itself?

4. How much do these thresholds vary from location to location and from building type to building type?

5. Are 'Deemed to Satisfy' approaches a satisfactory mechanism for streamlining compliance while still upholding energy efficiency aims?

6. Are energy rating and estimation tools well suited to the assessment of renovation projects?

5.5 Information and training needs

Phase 1 aims to develop a national information register of materials to support professionals' and tradespeople's in understanding, identifying fit-for-purpose opportunities, selecting suitable materials and implementation solutions without contradicting other key energy advantages. These materials must support compliance with the energy efficiency provisions of the National Construction Code.

The project team would like to explore how information needed for successful energy efficiency compliance and performance can be made available and accessible to the construction industry workforce. We need your help to identify the key problems you experience in sourcing and accessing accurate fit-for-purpose information and training that will enable your compliance with the Code. Your responses will inform the development of strategies to support the industry to not only improve compliance, but also to support those who aim to go beyond.

As part of this process, available materials will be collated into an information register to determine gaps and opportunities to support Phase 2. The project team will collate the information sources and assess the quality based on alignment with the Code, accessibility, validity and endorsement by industry or education institutions. The next phase aims to develop and trial effective industry engagement programs to achieve compliance with the Code and improve understanding of energy efficiency opportunities in the building life-cycle.

The key concerns related to non-compliance with the energy efficiency requirements of the NCC in relation to communication and education may include:

- the historic nature of the industry with a desire to maintain the status quo;
- ad-hoc development of fragmented sets of information sources and delivery of programs to sub-sectors which may prove ineffective across the industry as a whole;
- mandatory requirements for continuing professional development in the majority of states and territories, especially for trades and construction management professionals;
- energy efficiency related accreditation programs (or the lack of) for qualified professionals, trades, assessors and inspectors. This may lead to extreme disparity between levels of knowledge and skills associated with EE causing communication issues and inconsistency across job roles);

- informal verbal and demonstrative peer-to-peer onsite learning which has the potential to lead to ineffective or inaccurate installation methods (learning to do something wrong doesn't make it right);
- integrated knowledge and skills needs across sub-sectors to support effective implementation based on the design intent or construction related contradictions;
- specifications and implementation to support compliance with the Code (i.e. specifications on sealing the building envelope on the building plans or specifying untested / inadequate materials);
- incorrect (fit-for-purpose) materials specified or selected based on climatic variations, exposure or material combinations;
- insufficient knowledge about products/technology and required installation methods due to an increasingly high number entering the marketplace;
- material quality testing (i.e. building envelope materials/barrier layers) leading to the specification, selection or installation of sub-standard materials based on minimum costs;
- site induction or effective construction management (i.e. issues with scheduling trades or assessment of trade related compliance);
- a need for foundation principles to support guidance on energy-efficient opportunities or inform material specifications and compliance (i.e. optimising energy-efficiency opportunities to achieve higher ratings); and
- contradictory planning or building approval processes that negates the energy-efficiency opportunities (i.e. overshadowing from other buildings with solar technology or rejection based on proposed use of innovative techniques or technologies).

A number of questions are posed below – we would appreciate your views on the subjects that interest you.

Overall - How can the information required for successful energy efficiency compliance and performance be made available and accessible to all in the built environment sector?

1. Does information or education products exist that assist you to comply with the energy efficiency requirements of the Code?
    - Is the information provided accurate and sufficient? If not, please describe or list the inaccurate or insufficient materials.
    - If they do not exist, are they under development? By whom?
2. What are the major barriers to increased implementation and compliance based on accessible and accurate information?

3. What are the most effective information sources that you are currently using?
    - Examples - building modelling software or factsheets
4. What required information is missing in order to successfully comply? What are the gaps in the available information or training which need to be addressed?
5. What new information or materials do you need developed to support compliance or to go beyond compliance?
6. What are the most effective communication and engagement methods?
    - information only (brochure or technical manual)
    - industry-led informal information (trade or professional night)
    - online or mobile education
    - online tools or calculators
    - modelling tools and assessment programs
    - informal on-the-job training (peer to peer or mentoring)
    - product-based on-the-job training (manufacturer or supplier demonstration)
    - vocational education accredited training or short course (assessed) face-to-face
    - higher education program (assessed) face-to-face
    - industry short course (assessed) face-to-face
    - a mix of the above.
7. Which providers are effectively engaging you in professional development to enable you to meet the energy efficiency regulations? Please describe your engagement, including the title of the program, provider and/or the engagement methods.
8. What upstream or downstream job roles or subsectors negatively or positively impact on your requirements to comply the energy efficiency requirements of the Code? Please describe who and the cause and effect scenario. How can this be improved?
9. What is the preferred length of an information or education session? Please include which day(s) of the week and time of the day?
10. What influences contribute to you attending or engaging in further professional development?

The Last Word

Thank you for taking the time to read this Issues Paper, and please take advantage of the opportunity to make a submission to the NEEBP team - as set out in Section 4.

Over the remainder of December and January the consultants' teams will be analysing the information gathered from the on-line survey, the 20 national workshops, private interviews and independent written submissions. From this, for the first time, it will be possible to form an industry-wide picture of how building energy efficiency is tracking nationally.

The next stage will be to develop strategic recommendations across all three projects - new builds, renovations (pitt&sherry) and capacity building (Swinburne Uni). These strategic work plans will span both the short term, Phase 2, and the longer term planning horizon. The Phase 2 program between February and June 2014 is designed to 'test the water' with practical interventions for industry and draft recommendations for regulatory agencies and will be the first evidence 'on the ground' of our findings from the National Energy Efficient Building Project.

If you would like to provide more information over the Christmas period or contact the team in the New Year please email the pitt&sherry NEEBP Consultation hotline: consultation@pittsh.com.au

Thanks again for your valued contributions.

The NEEBP Team