

# Report

## **New Home Energy Efficiency Compliance Inspections**

### **National Energy Efficient Buildings Project - Phase 2**





The NEEBP Phase 2, Project 1 Team (comprising Healthy Environs Pty Ltd as lead consultant, Sustain SA, dsquared Consulting and Leading Edge Town Planners) has prepared this report for the South Australian Department of State Development.

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**SustainSA**

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# Executive Summary

## Project Aim

The 'New Home Energy Efficiency Compliance Inspections Project' formed part of the National Energy Efficient Buildings Project (NEEBP) Phase Two investigations. The aim was **to develop and pilot a practical 'as built' inspection process to validate compliance with the energy efficiency provisions of the National Construction Code (NCC).**

## The Context

The NEEBP is a joint State and Territory Government project, led by South Australia, undertaken as part of the National Strategy on Energy Efficiency. The NEEBP aims to address key systemic or process weaknesses and points of non-compliance with the energy efficiency requirements in the NCC.

The need for 'as built' compliance assessment was an important finding of the Phase One NEEBP research, which involved wide-ranging industry stakeholder consultation. Phase One highlighted the need for validation of the 'as built' energy efficiency compliance of new homes (in accordance with their approved design) and the potential value this would provide in improving regulatory and consumer assurances.

## Project Approach

### ➤ A Voluntary Pilot Approach with Building Authorities

A number of Local Government Authorities were recruited to work with the Project Team to develop and test inspection resources. These Pilot Authorities were targeted to represent a range of state/territory jurisdictions across Australia, residential growth regions in metropolitan and rural areas as well as a mix of climate zones. Eleven Councils worked with the Project Team to develop the 'proof of concept' inspection resources, whilst nine Pilot Councils committed to undertaking site inspections, within their feasible resources, during the trial period.

### ➤ Developing the Pilot Inspection Tools

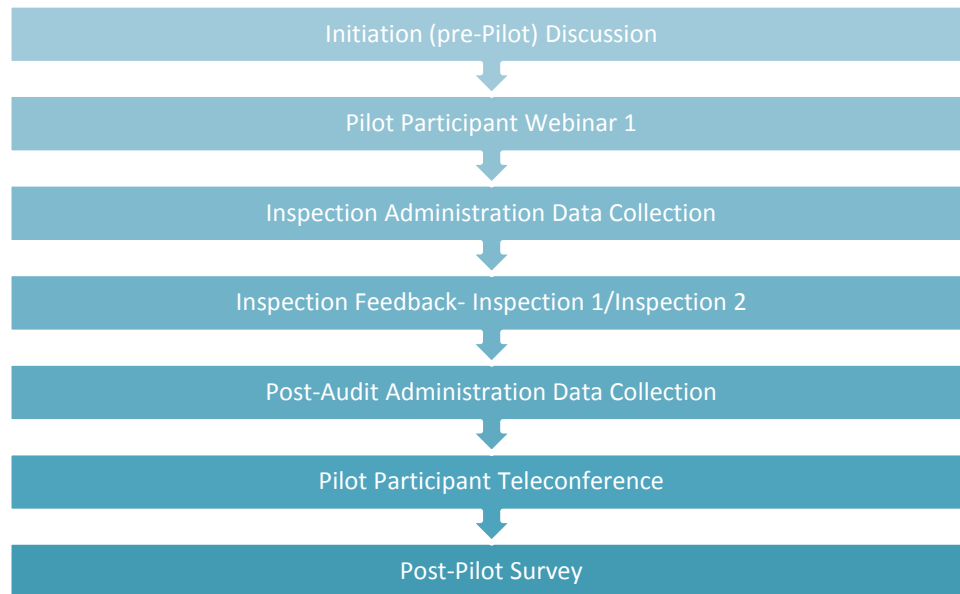
It was crucial that the project resulted in the development of an inspection process and associated tools to suit the needs of Councils and other Building Authorities. An Inspection Checklist was scoped according to the NCC energy efficiency provisions. The Checklist content took into account the findings of the Phase One research, the legislative context for NCC compliance in each state/territory, and examples of 'as built' inspection or audit approaches. The Checklist and other resources were tested with Councils, through webinar consultation meetings and improved before use in site inspections.

### ➤ Piloting and Improving the Inspection Resources

The piloting of the Inspection Checklist took place from 4 May 2015 to 12 June 2015. It aimed to assess construction compliance at two key points in the building process (generally a post-frame inspection and a near final inspection). It was not always feasible to assess both construction stages on the same property. The Pilot Council participants provided significant contribution to the project through the completion of 86 inspections across 59 homes within the piloting timeframe. The Pilot testing process was used to inform the development of a final Inspection Checklist recommended for expert reference group review and further trialling.



**Figure – The Pilot Approach**



## **Piloting Compliance Inspections – The Key Findings**

*The ‘New Home Energy Efficiency Compliance Inspection Pilot’ (the Pilot) was a significant step in working with Authorities to inform the development of compliance assessment resources. The results of the 86 inspections provide quantitative evidence of the feasibility of inspecting different NCC provisions across different house types in a variety of jurisdictional settings. Through the Pilot, participating Councils also provided important qualitative feedback on options for improving construction energy efficiency compliance in Australia. The material findings of the Pilot research are summarised in the following Sections.*

### **➤ The Value of ‘As Built’ Inspections**

*Councils recognised the benefits of assessing ‘as built’ energy efficiency compliance for promoting quality, sustainable buildings in their regions. The importance of promoting accountable industry performance with the NCC and protecting new home consumers were key drivers for Council involvement. The Pilot inspection process facilitated awareness of the NCC energy efficiency provisions for Council Officers as well as the builders who were assessed. The Pilot highlighted the opportunity for Council Sustainability/Environmental Management staff and Building Surveyors to work collaboratively in promoting energy efficiency performance for residential construction.*

### **Determining Compliance**

*The Pilot program highlighted the necessity of an integrated approach to driving NCC compliance, from the design through to the approval and construction stages of residential development. Through the Pilot inspections across 59 homes, compliance was noted against various checklist parameters although the limitations reported by Council Officers, such as lack of detail in documentation flowing from approval processes and energy assessments, made accurate on-site assessment difficult.*

*Compliance varied depending on the jurisdiction. For example, in the City of Launceston a high level of compliance was found across all checklist elements.*

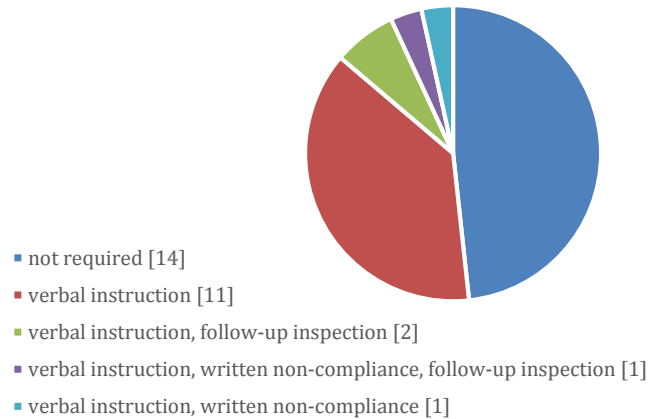
Early inspections often provided opportunity for the Council Officer to liaise with the Builder regarding issues identified. Issues rectified between inspections were not necessarily deemed as non-compliant.

Identified areas of non-compliance included:

- Roof colour not as specified.
- Insulation not as specified.
- Insulation not included under flooring (where specified).
- Insulation not installed in accordance with the NCC.
- Alternate lighting installed by owner not as specified.
- Glazing not as specified.
- Inadequate sealing of glass/windows.

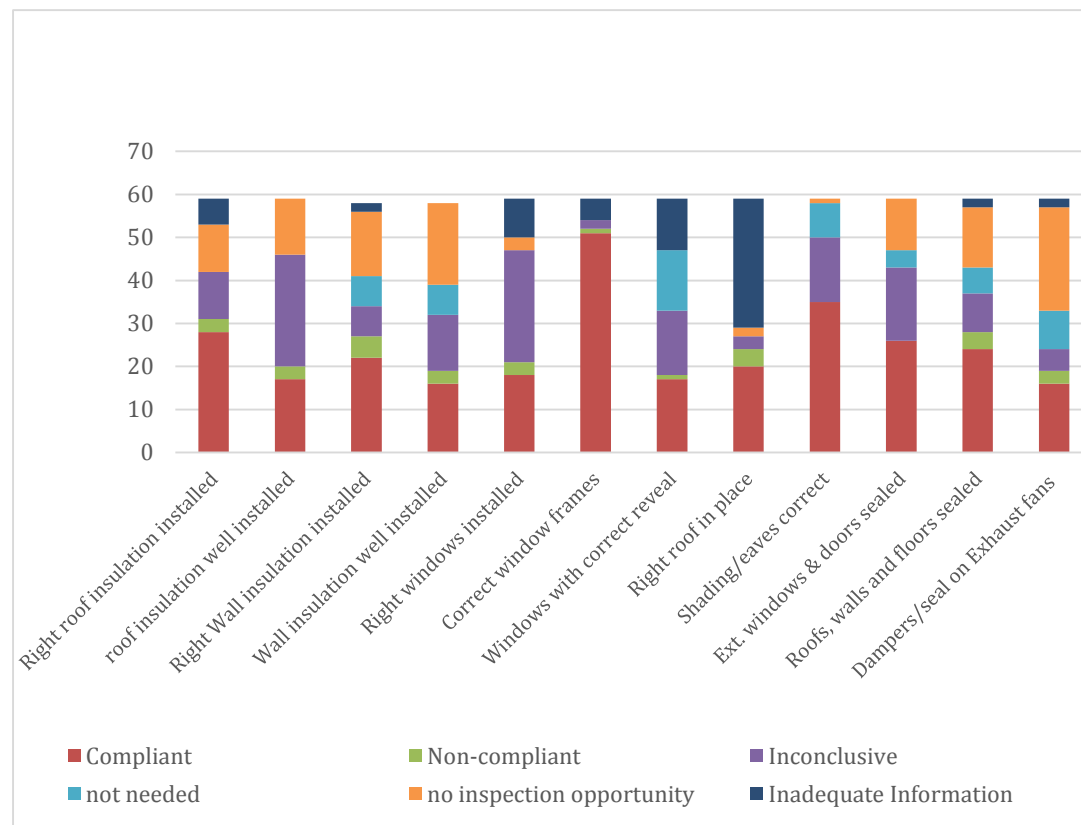
#### Compliance response noted by Inspectors\*

\*Note that for over half of inspected homes [30 out of 59] a compliance response was not indicated



Site inspection results across key aspects of the Inspection Checklist are summarised in the figure below.

Figure – Inspection Results for 59 Homes



A variety of Building Surveyor inspection responses suggested areas yet to be completed or unable to be visually assessed. This led to a significant number of inspection elements rated by Surveyors as “inconclusive” rather than a confident assessment of compliance or non-compliance being determined. The qualitative feedback during the Pilot period and through the post-Pilot evaluation, highlighted the various system elements needed to enable verification of compliance and to support an ‘as built’ inspection regime, such as:

- *Provision and access to verification documentation*

*Inspection limitations need to be addressed where possible through verification documentation such as: insulation/window certificates and purchase details; photographic evidence from builders etc. and captured as part of the Electronic Building Passport.*

- *Appropriate timing of inspections*

*The other common issue raised was the difficulty of timing inspections to be able to visually inspect certain items, mainly roof insulation, glazing type and wall insulation (it is either too late or too early to observe before linings). Whilst it was acknowledged that the NCC energy efficiency provisions require assessment at various stages of the construction cycle, it was highlighted that Councils do not have the resource capacity for site inspections beyond those mandated in each jurisdiction.*

- *Adequate information from the approval and energy assessment stage*

*In many areas, compliance could not be measured due to lack of information provided in the development approval documentation with the most common areas including: roof colour not specified, lighting type not specified, air conditioning not specified and hot water not specified. This demonstrates a lack of information at building approval stage to fully reflect the basis on which the building has been considered compliant with the energy efficiency requirements of the NCC.*

- *Factoring for performance improvements*

*In some cases improvements in construction and resultant energy efficiency were noted, but there appeared to be no way of estimating the impact of the improvements or offsetting the benefits against items of non-compliance.*

## ➤ *The Value of the Compliance Tools*

*The Inspection Checklist was designed according to the NCC energy efficiency provisions and was considered thorough in content by participating Councils. Time and resources to complete the Checklist was highlighted as an important consideration for Councils. However, there was a preference towards piloting a detailed Checklist and refining the content through the Pilot process (the Pilot Checklist is provided in Appendix F).*

*Post-Pilot evaluation of the Checklist revealed inspection elements considered to be higher priority including: glazing, insulation and sealing.*

*It was determined that at least two inspections across the construction cycle would generally be needed to assess the energy efficiency provisions. However, participants expressed that the introduction of additional inspections by their Council (unless mandated) would be unlikely and therefore where possible, energy efficiency checks should be incorporated within existing inspection stages. The dilemma however, is that mandated stages do not align with the ideal construction timeframes to check energy efficiency. At frame stage, an inspection is often too early for insulation to have been installed. During final inspections many elements have been concealed and can no longer be inspected.*

Councils expressed a preference for the Checklist to be tailored for climate zones or jurisdictions. The Project Team also reflected on the quality of information presented in the Pilot Checklists, as well as the information needed to ascertain compliance, to refine the content in order to prompt Building Surveyors on assessment decisions and detail required. The refined checklist is provided in Appendix H. A review of the inspection results also provided important information on where visual assessment is needed, as opposed to other methods, such as documentation review or installer certification.

### ➤ **Policy and System Support for Compliance Assessment**

*It was stressed by participating Councils that an on-site inspection regime cannot work effectively without the necessary regulatory frameworks and systems in place to achieve the following:*

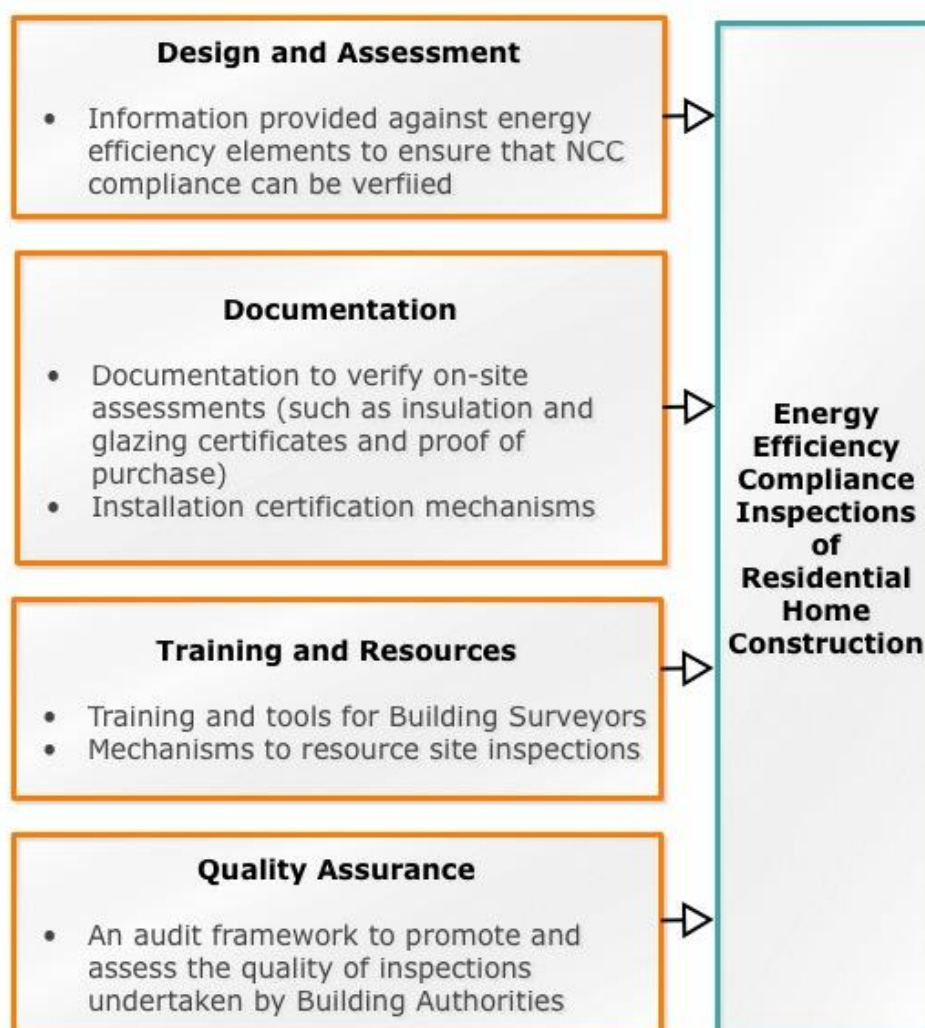
- *Improved design assessment and documentation.*
- *Verification of product performance through documentation.*
- *Professional development and training for Building Surveyors.*

*Inspection results support this view by identifying elements that were difficult to inspect or verify and numerous examples of building documentation not including adequate information at the time of the inspection.*

*Resourcing of inspections is a key concern for Councils (as determined through the Phase One study) and it was felt that additional inspections are unlikely to be supported by Councils, unless mandated. While inspections took up to 90 minutes, some were as short as 10 minutes and it is anticipated that Councils could ultimately incorporate energy inspections to suit their existing regime and to inspect key building features efficiently.*

*A key message was that Councils are not the only player in compliance assessment and that an inspection regime forms part of an overall compliance system and cannot be implemented effectively in isolation. The potential role of other stakeholders at other parts of the construction cycle, such as Energy Assessors and the construction industry, should be considered as part of an overall compliance framework. In this way, the information and evidence to support compliance can be collected and checked effectively.*

*Figure - System Elements to Support Compliance Inspections During Construction*



## **Recommended Directions**

*From this Pilot study we make a number of recommendations addressing both: the next steps for trialling and developing compliance inspection resources; and the system elements needed to support an 'as built' inspection regime.*

### **1. Policy and Regulatory Frameworks**

*The results of this Pilot highlighted that an effective compliance inspection regime for energy efficiency requires a national framework that articulates a number of characteristics. Further regulatory emphasis on energy efficiency along with appropriate education and awareness materials, would facilitate Councils and Authorities to prioritise and fund energy efficiency compliance activity. It is important that this report and its findings create a long- term legacy by making it publicly available for all stakeholders and interested parties, especially for those states currently undertaking legislative reform processes. Complimentary compliance mechanisms and the roles of other stakeholders including Energy Assessors and industry, should also continue to be reviewed through the NEEBP.*

## **Recommendations**

- 1.1 *The Pilot findings support the Phase One recommendation to develop and apply model code provisions and/or regulations to guide an inspection regime (guiding Councils/Authorities on a sample approach to undertaking inspections). A nationally consistent Audit Quality Framework and an approach to evaluating inspection performance should be incorporated.*
- 1.2 *That the NEEBP reference group (or Commonwealth) prepare a project workshop and briefing for each State and Territory Government covering the following agencies or departments: Planning; Building; Energy; Sustainability and Local Government.*
- 1.3 *Integrate the NCC provisions and checklist elements into mandated inspection stage guidelines and resources (where applicable).*
- 1.4 *Undertake a more in-depth review of the costs, benefits and limitations of complementary compliance models in consultation with Authorities and Industry (exploring the role of Energy Assessors and extending private certification for certain elements).*

## **2. Moving from Pilot to a Voluntary Trial**

*The Pilot project provided useful insights for the successful design of a trial program. It is clear that further stakeholder and industry consultation is needed to further develop the inspection materials and integrate them with the proposed Electronic Building Passport (Project Two of the NEEBP) before a trial should commence. An extended timeframe to trial voluntary inspection resources across a greater number of homes is warranted, to further develop an integrated compliance model. An extended trial would also enable integrated testing with the Electronic Building Passport product as well as the new NatHERS certificate.*

*There is also a need to engage private sector Building Surveyors/Certifiers in resource development and testing. Future trials need to consider timing needed for Council/Authority recruitment and inspections at opportune stages in the construction process.*

## **Recommendations**

- 2.1 *Establish an expert panel including representatives from a range of Councils, a Building Authority, a professional representative body and Government (Commonwealth, State and Local) to:*
  - *Undertake a post Pilot and technical review of all three projects of NEEBP Phase Two.*
  - *Further consult with stakeholders to develop an integrated compliance model.*
  - *Further consultation on the role of industry groups in driving implementation (Councils/Authorities, builders and product suppliers).*
  - *Refine roles for the Inspection Checklist completion.*

*Representation of Council staff covering building and planning assessment, building surveying and sustainability is recommended, for inclusion in the expert panel.*

- 2.2 *Develop an electronic version (Web or App based) of the proposed Home Energy Efficiency Inspection Checklist to allow proponents and Council notes from the planning stage to automatically populate the Home Energy Efficiency Inspection Checklist.*

- 2.3 *Adapt the Checklist for each Climate Zone to reflect the various provisions of the NCC.*
- 2.4 *The Checklist (electronic) should be further adapted and developed to include a sliding NatHERS Scale so that changes during the construction stage could be immediately incorporated on-site, to determine impacts on star ratings. This could be achieved through linking this recommendation with recommendation 2.2*
- 2.5 *Develop an in-depth trial with one to three Councils/Authorities, to fully integrate the energy efficiency compliance requirements within their planning and building assessment processes, Council policies and current assessment tools.  
The in-depth trial should involve representatives from:*
- *One of the Growth Alliance Councils, a smaller regional Council and a state based Authority.*
  - *Different states.*
  - *Different climate zones.*
- 2.6 *That a guide for piloting or trialling the next stage be adopted as follows:*
- *Six week recruitment period for Councils and Authorities to participate.*
  - *Guidelines for participation such as inspection details, to be provided.*
  - *Four to six months for compliance inspection to take place for each new home.*
  - *Majority of inspection to be timetabled between September and April each year (depending on Climate zone).*
- Six week period of engagement and testing of outcomes with stakeholders.*
- 2.7 *Develop Pilot legacy communications aimed at senior Council management, Sustainability staff and Building staff collectively.*
- 2.8 *Develop a partnership agreement between the NEEBP and professional bodies (such as the Australian Institute of Building Surveyors and the Surveying and Spatial Sciences Institute) to facilitate their involvement in the next phase of NEEBP.*
- 2.9 *An extensive Council/Authority engagement and recruitment phase is recommended, combined with awareness presentations to state, territory and regional networks and industry stakeholders.*

### **3. Knowledge Management**

*The inspection Pilot project highlighted important considerations for the NEEBP knowledge management program, which is critical to support a cultural shift in improving energy efficiency performance. In this instance, knowledge management will need to be cross-jurisdictional, multidisciplinary in terms of professions and stakeholders and cater for consumers being the ultimate end user of an energy efficiency inspection compliance regime for new houses. Professional development will be needed to bridge the knowledge gap on energy efficiency provisions of the NCC across industry, inspectors and Councils/Authorities.*

#### **Recommendations**

- 3.1 *Incorporate the inspection resources and guideline into an accessible online knowledge platform (National Clearinghouse) for Building Surveyor professionals and other stakeholders.*



- 3.2 *Develop awareness raising materials (building on recommendation 2.3) on the opportunities and benefits of compliance with NCC energy efficiency requirements and the outcomes of NEEBP Projects 1, 2 and 3.*
- 3.3 *Target specific stakeholder audiences such as Local Government Elected Members and senior management, on the benefits of NCC compliance through a range of avenues such as:*
  - *Australian Local Government Association (ALGA) National conferences;*
  - *State Local Government Association (LGA) conferences;*
  - *Individual Councils and Authorities;*
  - *National and State Building and Building Control conferences;*
  - *National Planning conferences; and*
  - *Industry conferences and forums.*
- 3.4 *Provide incentives for an accredited professional development program on energy efficiency for stakeholders, industry and Councils and advocate for a mandated system.*
- 3.5 *Develop a training module for the compliance assessment tool, guideline and inter-relationship with the Electronic Building Passport, to support the project trial phase (via an e-learning module).*
- 3.6 *Engage experienced Building Surveyors involved in the Pilot project to provide an advisory and mentoring role through involvement on the Expert Panel (recommendation 2.1).*

#### **4. Empowering Community**

*The Consumer is the ultimate beneficiary of an improvement in energy efficient performance of new homes. Consumers have the potential to drive the market demand for compliance with the energy efficiency performance of new homes under the NCC. The Pilot findings support the need for improved consumer awareness (as identified in Phase One) to support an inspection compliance assessment culture. Consumer knowledge related to appliances/fixtures and across the real estate industry would enable communication on the benefits of household energy efficiency performance to consumers.*

*It is necessary to ensure that issues of liability for the Building Surveyor profession are covered with regard to any housing energy efficiency compliance advice or guides provided to consumers.*

#### **Recommendations**

- 4.1 *Support a national social marketing campaign to educate consumers, home owners/purchasers and the real estate industry, about building energy efficiency (as recommended in NEEBP Phase One).*
- 4.2 *Review the applicability of the energy efficiency checklist elements within consumer protection mechanisms (such as assessment or contracts at the point of sale).*
- 4.3 *Develop home occupier energy efficiency guidance material and encourage circulation through Councils/Authorities and the building industry.*
- 4.4 *Assess the professional liability implications for Building Surveyors, Councils and Authorities, in assessing energy efficiency compliance and the adequacy of legislative protection mechanisms and common insurance schemes.*



# 1 Introduction

While the building sector is not the largest contributor to GHG emissions, it is one of the fastest growing sources, accounting for almost 20% of emissions<sup>1</sup>. The National Energy Efficient Buildings Project (NEEBP) is working to improve energy efficiency in new buildings, renovations and additions.

Phase One of the NEEBP involved a national review of key process weaknesses and points of non-compliance with the energy efficiency requirements in the National Construction Code (NCC)<sup>2</sup>.

The *New Home Energy Efficiency Compliance Inspections Project* was part of the second phase of the NEEBP investigations. The project sought to work with building regulators (Councils and relevant Authorities) to develop a practical 'as built' inspection process to validate compliance with the energy efficiency provisions of the NCC. Through a pilot methodology, the project aimed to deliver a 'proof of concept' and recommended approach to energy efficiency compliance inspections.

## ***Project Aim...***

***To develop and pilot a practical 'as built' inspection process to validate compliance with the energy efficiency provisions of the NCC.***

## 1.1 The NEEBP – An Overview

The NEEBP is working to improve energy efficiency in new buildings, renovations and additions. The NEEBP is funded through the National Strategy on Energy Efficiency and is being led, on behalf of the Commonwealth and all states and territories, by the South Australian Government.

The NEEBP works with local government, relevant authorities and industry, to develop and support greater understanding, improved trade skills and formal compliance with best practice energy efficient design, construction, services and retrofitting of residential buildings under the NCC.

In Phase One of the NEEBP, Pitt&Sherry led research on systemic issues impacting the efficiency of new builds (Part A project) and alterations and additions (Part B project), while Swinburne University led research into knowledge management issues among participants in the construction cycle, that impact on the energy efficiency of all buildings (Part C)<sup>3</sup>.

The *New Home Energy Efficiency Compliance Inspections Project* formed part of the Phase Two NEEBP investigations.

## 1.2 The Case for Compliance Assessment - Insights from NEEBP Phase One

Phase One of the National Energy Efficient Buildings Project (NEEBP) comprised a national review of systematic or process weaknesses or points of non-compliance with the energy efficiency requirements of the NCC and related issues<sup>3</sup>. The review (undertaken by Pitt&Sherry and Swinburne University of Technology) involved wide-ranging consultation with building industry stakeholders, regulators and policy makers across Australia. The views expressed by stakeholders confirmed “that compliance with the Code’s energy performance requirements is generally poor, and that our energy performance is far from best practice”. The review findings highlighted gaps with optimising the Code compliance across the construction cycle, including but not limited to<sup>3</sup>:

- Limited focus on energy efficiency at the planning stage.
- A “culture of low compliance with minimum energy performance” attributed to low levels of consumer awareness and the market environment (there is little risk associated with cutting corners).
- Poor utilisation of energy assessments to add value to the process.
- Poor resourcing and lack of prioritisation for enforcement activities (such as compliance inspections).
- The need for improved knowledge management across the industry.

Industry and stakeholder consultation across Australian states and territories revealed the need for improved regulatory quality control to assess compliance with the energy efficiency provisions of the NCC.

The Phase One research highlighted that on ground site inspections to assess the ‘as built’ implementation of the NCC energy efficiency provisions are seldom undertaken, due to<sup>3</sup>:

- Shortage of funding and resources for enforcement activities.
- Energy efficiency provisions not being prioritised against other building factors to be assessed such as health amenity, structural performance and bushfire safety.

The result is an “overall culture of low compliance with minimum energy performance” and discrepancies between the ‘as designed’ and ‘as built’ energy performance of homes<sup>3</sup>.

The research also portrayed the various improvement elements required to support ‘as built’ compliance inspection practice, such as details at the planning approval stage, supportive regulatory frameworks and resource support for relevant building Authorities.

In particular, participants in Phase One emphasised that insulation and glazing needed to be part of an inspection regime.

## 1.3 Project Scope – Phase Two New Home Compliance Inspections

Building on the Phase One NEEBP research findings, the Phase Two *New Home Energy Efficiency Compliance Inspections Project* sought to develop and test a compliance inspection process and to establish a foundation for energy efficiency compliance assessments by building Authorities.

### 1.3.1 Focus on ‘As Built’ Compliance

The Inspections Project focused on the perceived gap between the theoretical energy efficiency of residential buildings as demonstrated in an energy assessment and/or building design and the ‘as built’ energy efficiency performance of new homes.

The Pilot did not incorporate a critique of the approved energy efficiency design. However, potential system improvement findings, across the planning and construction cycle, are documented in Section 6 of this report.

### 1.3.2 Working with a Pilot Council Team

The project scope required the engagement of up to ten Pilot Authorities. The selection of Pilot Authorities was based on a range of criteria including geographic and/or population location, volume of new residential approvals and climate zone. Pilot Authorities participated on a voluntary basis and were tasked with:

- Collaborating with the Project Team to develop an ‘as built’ energy efficiency inspection protocol for new homes. *Note: The inspection Pilot scope focused on Class 1 (a. and b.) residential buildings as defined in the NCC<sup>2</sup>.*
- Piloting the inspection protocol on up to five residential buildings (Class 1), at two key points during the construction cycle (generally a post-frame inspection and a near final inspection).

### 1.3.3 Pilot versus Trial

The piloting of energy compliance inspections was not intended as a trial (which would be the final test of a process to ultimately be rolled out). Rather, the piloting of inspections was intended to test the extent to which inspections can be delivered cost-effectively and can add value to stakeholders. The Pilot aimed to collect pertinent information to guide the development of energy efficiency compliance tools and an overall compliance framework.

### 1.3.4 Project Timeframe

The project commenced at the beginning of March 2015 with completion required by the end of July 2015.

## 1.4 Project Team

Sabina Douglas - Hill of the South Australian Department of State Development is the NEEBP Project Manager on behalf of the Australian, State and Territory Governments.

Healthy Environs was engaged as the project manager of a collaborative consultancy team to deliver the project, comprising:

- Phil Donaldson – Sustain SA
- Heather Smith – Sustain SA
- Deborah Davidson – dsquared Consulting
- Darren Starr – Leading Edge Town Planners
- Sally Modystach – Healthy Environs

The Project Team provided experience of relevance to the project in the following areas: sustainability policy for Local Government; development assessment and regulatory processes and building energy efficiency design and assessment. Representatives of the NEEBP Project 1 Reference Group guided the team, as required.

### 1.4.1 Project Reference Group

The Project Reference Group included:

- Sabina Douglas-Hill – Project Manager/Policy NEEBP. Department of State Development. SA.
- Vanessa Morris – Policy Coordinator. Construction Services. Environment and Sustainable Development. ACT.
- Robert Enker – Specialist Sustainability Advisor. Victorian Building Authority. VIC.
- Dan Ellis-Jones – Policy Officer. Building Commission. Department of Commerce. WA.
- Jodie Evans – Team Leader Building Policy Unit. Department of Planning, Transport and Infrastructure. SA.
- Gordon McAllister – Assistant Manager Residential Buildings Team. Department of Industry and Science. ACT.
- Craig Walker – Policy Demand Management and Energy Services. Department of State Development. SA.
- Natasha Palich – Coordinator Council Alliance for a Sustainable Built Environment. Municipal Association of Victoria (Australian Local Government Association representative). VIC.
- Mary O'Neill – Principal Program Officer. Office of Environment and Heritage, Department of Premier and Cabinet. NSW.

## 1.5 Energy Efficiency Provisions of the National Construction Code

The NCC is made up of three distinct volumes and has been developed in an attempt to incorporate Australian construction requirements into a single consistent code. Developed by the Council of Australian Governments and implemented by State and Territory Governments, the NCC consists of the *Building Code of Australia* Volume One and Volume Two, as well as a third volume, which deals with plumbing and drainage in association with buildings. A new version (online and free) of the NCC became available on 1 May 2015<sup>1, 2</sup>.

One of the key aims of the NCC is to provide nationally consistent standards of construction that deal with issues including structural safety, health, fire safety and energy efficiency. The *New Home Energy Efficiency Compliance Inspections Project* dealt specifically with the compliance of residential building construction with residential energy efficiency building requirements within the NCC: Part 2.6 of the NCC (Volume 1 May 2015)<sup>2</sup>.

## 1.6 Relationship to Other Phase Two NEEBP Projects

The *New Home Energy Efficiency Compliance Inspections Project* is one of a range of NEEBP research projects. Assessing compliance with the NCC energy efficiency provisions is one of the various focus areas being investigated to promote improved energy efficiency performance in the building sector. The Project Team considered the interrelationship of the *New Home Energy Efficiency Compliance Inspections Project* with the other Phase Two NEEBP projects:

- Project Two: Pilot Electronic Building Passport focused on documentation of factors affecting energy efficiency. Undertaken by Pitt&Sherry.
- Project Three: Improving compliance and consistency in the application of National Construction Code energy performance requirements to additions and alterations. Undertaken by Sustainability House.

Liaison with the other Phase Two consultancy teams was undertaken as required, throughout the project.

## 1.7 Terms used in this document

The terms used to describe inspections, compliance and approvals vary between jurisdictions. The project sought to be consistent with the terms used on the project website and in correspondence from the outset. The following terminology is worth noting:

**Council or building authority:** The authority responsible for confirming compliance with the NCC differs across Australian states and territories. In some jurisdictions, Local Government has responsibility, while in other areas the State Government is involved. Some jurisdictions use private certifiers in parts of the building compliance process. ‘Pilot Councils or building Authorities’ is used when considering the broader context. Local Government Authorities only participated in the trial, so the report more commonly refers to ‘Councils’.

**Compliance auditing:** The project was defined as energy efficiency compliance audits, but the use of the word 'audit' can be confusing. Energy auditing is typically used to indicate the role of energy efficiency specialists who look for energy saving opportunities in an operational home. In Local Government, 'auditing' is the more frequently used term for checking that a compliance or inspection system is working correctly. The staff who are authorised to enter building sites and inspect for energy efficiency compliance, are generally undertaking inspections as Authorised Officers under the relevant legislation, so this report primarily refers to 'inspections'.

**Energy efficiency compliance:** The NCC defines the energy performance requirements for residential buildings and the focus of this project is Class 1 residential buildings. States and territories have adopted the NCC in slightly different ways, so this report refers to the 'relevant energy efficiency provisions of the NCC' in relation to the compliance expectations in each jurisdiction.

**Rated standard and design standard:** Within the NCC, there are options for a design to meet energy performance requirements through "deemed to satisfy" methods or through NatHERS modelling. In the final report of Phase 1 NEEBP, it was highlighted that often the design complies with the NCC but the building construction varies from the design and these variations lead to poorer energy efficiency performance. We have used the terms 'rated standard' and 'design standard' to refer loosely to the design and equipment energy performance that led to a design being considered as 'energy efficiency compliant' and hence approved for construction.

**Approvals:** While there are often a number of approvals in the process, the approval that allows building to commence has been referred to as building approval, to distinguish it from planning and development approval.

**Building Surveyor** – Professional title used throughout this report when referring to Council or Authority staff who are qualified as Building Surveyors and authorised to assess compliance in their jurisdiction. In some cases, these staff may also be titled Building or Development Officers.

## 2 Pilot Methodology and Approach

### 2.1 Methodology

The project methodology, explained in detail in the following sections, aimed to develop and pilot a compliance Inspection Checklist and guideline in collaboration with a group of Pilot Councils. The project involved the following stages:

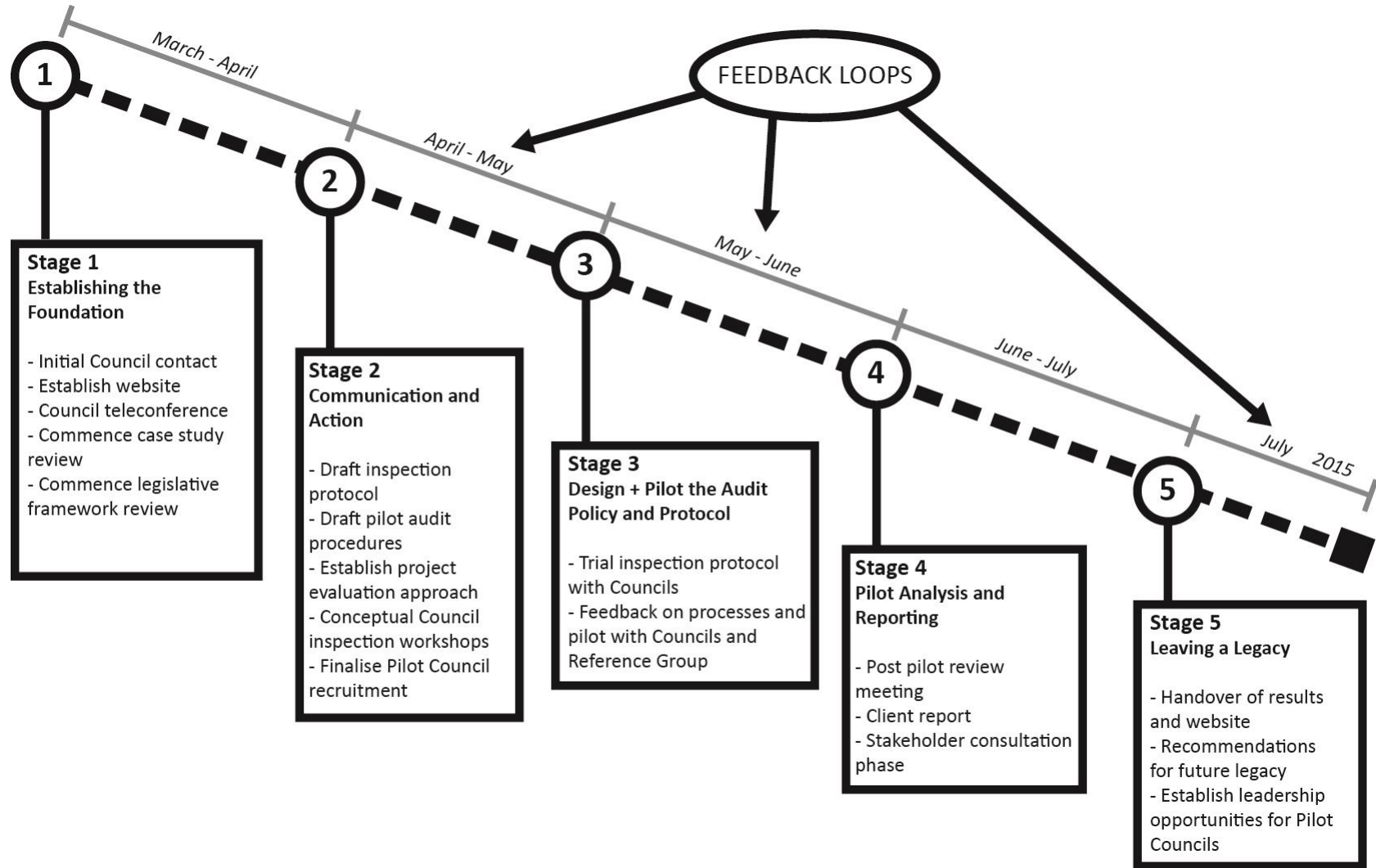
1. Engagement and recruitment of up to ten Pilot Councils to assist in the development and on-site testing of the project compliance Inspection Checklist.
2. A scan of current energy efficiency compliance inspection practice and relevant 'as built' inspection tools.
3. A review of the legislative context for NCC compliance in each state/territory.
4. Consultation with the Pilot Council group to review a 'proof of concept' Inspection Checklist.

5. Council piloting of the site Inspection Checklist by authorised building staff (note: the focus was on Class 1 residential buildings at two key points during the construction cycle, generally a post-frame inspection and a near final inspection).
6. Establishment of a pilot evaluation system to capture energy compliance/non-compliance data as well as feedback from Councils on their inspection experiences.
7. Analysis of the inspection findings and compliance/non-compliance data.

## 2.2 Approach

The project approach involved an iterative Inspection Checklist development process, in consultation with the Pilot Council group, as summarised in Figure 1.

Figure 1 – Project Stages





## 2.3 Recruiting Pilot Authorities

The project required the recruitment of ten Pilot Councils or building Authorities with the aim of achieving:

- **Coverage of every jurisdiction** – as the National Construction Code allows variations at the jurisdictional level and the implementation of the energy requirements in the NCC therefore varies slightly in each State and Territory.
- **Different climate zones** – as building types vary significantly across the country, mostly in response to climate but to some extent, a response to local building materials as well. See Figure 2 – Australian Building Codes Board Climate Zones.
- **A mixture of regional/city and small/large** – to manage the variation in resourcing and capacity that different Councils will have, in particular the ability to conduct inspections with appropriately skilled inspectors.
- **Interest in leadership** and legacy after the Pilot stage.

The process used to recruit Councils involved a mixture of semi-official and official contact. The main processes used included the following:

- Advertisement in ALGA and State/Territory LGA newsletters.
- Targeting Australian Growth Councils Alliance.
- Targeting Councils associated with the Phase One NEEBP research.
- Targeting Council sustainability networks.
- Targeting Project Team and NEEBP Reference Group contacts.

Overall 23 Councils around Australia were contacted and of these, 11 Councils were engaged through the Expression of Interest (EOI) process (refer to the EOI in Appendix A). Whilst 11 Councils provided initial input into the ‘proof of concept’ inspection resources, due to project timeframe and resource constraints, only nine Councils were able to participate in the on-site piloting of the energy efficiency Inspection Checklist. Participating Councils are shown in Figure 2 and included:

- Whyalla City Council, SA.
- City of Playford, SA.
- District Council of Mt Barker, SA.
- Cairns Regional Council, QLD.
- Noosa Shire Council, QLD.
- City of Mandurah, WA.
- Lake Macquarie City Council, NSW.
- Parramatta City Council, NSW.
- Launceston City Council, TAS.
- City of Joondulup, WA (early input at ‘proof of concept’ phase)
- Mildura Rural City Council, VIC (early input at ‘proof of concept’ phase).

Three Councils, City of Playford, Cairns Regional Council and Launceston City Council, participated in both the *New Home Energy Efficiency Compliance Inspections Project* as well as the **Electronic Building Passport (EBP) Project**, to provide input into both pilot resources (in particular the relationship between the two compliance assessment tools).

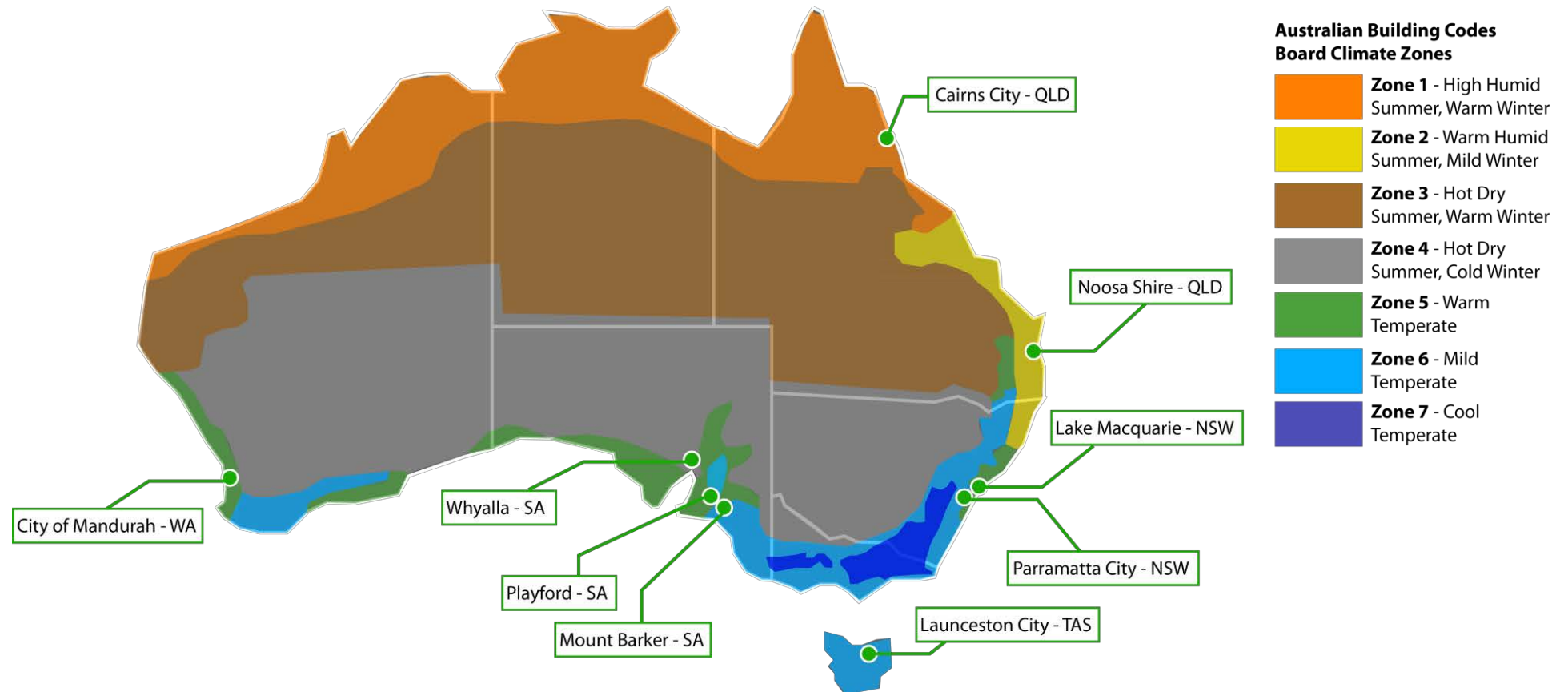
The recruited Councils successfully covered both small and large regions with variable capacity and different climate zones. Councils were also selected based on the degree of residential development occurring within their areas. Other drivers for involvement included:

- Leadership in their area locally, regionally or nationally.
- Alliance with their strategic plan objectives.
- Commitment to environmental sustainability and addressing climate change.
- Acknowledgment they had a role to play in compliance inspections for energy efficiency.

The telephone liaison with Councils and other stakeholders during the recruitment phase, highlighted a range of issues, opportunities and considerations for supporting energy efficiency compliance assessment. Key points arising from these early discussions, as well as lessons learnt from the recruiting phase, are summarised in Section 6 of this report.

A number of Councils expressed interest in the project and though they were unable to participate in the Pilot, they were invited to join a broader Reference Group of Councils to be kept informed of the Project and provide feedback as required.

Figure 2 – Map of Pilot Inspection Council Participants



## 2.4 Background Research – Existing Approaches and Legislative Context

Research to develop the pilot inspection approach involved a review of existing ‘as built’ inspection approaches. The review considered current approaches to building inspections generally (all aspects of the NCC) and energy efficiency (energy efficiency elements of the NCC), drawing on the findings of the NEEBP Phase One research.

There were limited actual examples of compliance assessment tools related to the energy efficiency provisions of the NCC. However, each Council uses an Inspection Checklist for mandatory assessments.

The development and building assessment process in each state and territory and the current interface with the energy efficiency provisions identified in the NCC, was reviewed and summarised, to inform the Pilot process and inspection approach.

## 2.5 ‘Proof of Concept’ Review of the Inspection Resources

Draft inspection resources were circulated to Pilot Council representatives and the Project Reference Group for review and feedback, including:

- A – A Model Policy for New Home Energy Efficiency Compliance Inspections.
- B – New Home Energy Efficiency Inspection Guideline.
- C – Residential Building Energy Efficiency Compliance Inspection Checklist.

Consultation webinars were held on the following dates to discuss the Pilot approach and obtain feedback on the Pilot resources:

- Webinar 1 – 31 March 2015
- Webinar 2 – 28 April 2015

A sample webinar presentation is provided in Appendix B.

## 2.6 Site Testing of the Inspection Checklist

The piloting of the Inspection Checklist took place between 4 May 2015 and 12 June 2015. Nine Pilot Councils committed to undertaking site inspections within their available resources, during this period. The checklist aimed to assess construction compliance at two key points in the building process (generally a post-frame inspection and a near-final inspection). However, due to the constraint of the overall project timeframe and the Pilot period involved, it was not always feasible to assess both construction stages on the same property.

For the purpose of the Pilot, the near-frame inspection and near-construction inspections were either undertaken on the same property or on different properties of similar construction type. This approach was suitable for the purpose of testing the inspection approach. However, in further developing and trialling the inspection resources, it will be important to allow adequate time to assess all relevant stages of the construction process.

## 2.7 A Staged Approach - Analysis and Evaluation

The project evaluation methodology was designed to allow for review of the inspection resources and to test the following idea: “Compliance Inspections can be delivered effectively and add value to the construction process”.

Essentially, our evaluation asked the following key questions:

1. Do the NCC energy efficiency audit resources (Guideline and Inspection Form) add value to the construction process by:
  - Effectively monitoring compliance?
  - Improving levels of compliance?
  - Providing additional benefits?
2. Are the audit resources considered useful and practical by relevant Authorities?

The evaluation also incorporated the collection of quantitative and qualitative data:

- Quantitative data collection – Audit time (administrative and on-site), staff resources and compliance results.
- Qualitative data collection – Driving factors for project participation, officer experience in using the inspection resources and feedback on the Pilot approach generally.

The Pilot evaluation involved use of a range of tools including Pilot participant webinars, telephone conversations and surveys (via Google forms). *Note that Council staff were provided with feedback options: completing online forms, utilising an online discussion forum on the project website, or liaising with Project Team members via email and/or telephone.*

The project evaluation methodology is summarised in Figure 3. Pre-Pilot and post-Pilot surveys used to guide discussion and input from Pilot Councils, are provided in Appendix C.

**Figure 3 – Pilot Evaluation Methodology**



## 2.8 Industry Consultation and Council Reference Group Consultation

Interested Councils and targeted industry groups were alerted to the project through an email newsletter and reference to the project website<sup>4</sup>. Stakeholders were invited to comment on the potential value and industry applicability of the compliance assessment resources.

At this stage, further feedback was received from two participating Pilot Councils as well as the Australian Windows Association. The Housing Industry Association also provided input into the project via telephone discussion.

Figure 4 – Project Website



**National Energy Efficient Building Project**  
Project 1 - New Home Energy Efficiency Compliance Inspections  
Help us to design an inspection process that will best work for you!

About Updates Project Stages Pilot Findings Get Involved Resources Our Team More

**ABOUT THIS SITE**  
Over the last four months we have been working on a national pilot to develop inspection resources for assessing residential constructions against the energy efficiency requirements of the National Construction Code.  
This site provides up to date information on project developments and resources. It provides a platform for everyone involved to share their experiences and provide feedback.  
Your feedback will assist us to develop valuable auditing resources, which meet the needs of local government and building authorities.

**Sign up to be part of the project\*:**  
Email Address  
Name  
Organisation  
Project role  
Subscribe  
\*We will only use your information for the NEEBP project

<http://neebp1.wix.com/energycompliance>

## 3 Background Research

The development of compliance inspection resources was informed by the NEEBP Phase One study as well as research into:

- The legislative framework for NCC adoption and compliance in each state and territory; and
- Current 'as built' audit practice within Australia and overseas.

A description of this research and considerations for energy efficiency compliance inspection tools is provided in this Section.

### 3.1 The Legislative Framework for Energy Efficiency Inspections

A legislative framework assessment was undertaken to develop an inspection approach that considered state and territory variances in the adoption of the NCC (a legislative framework review report is provided in Appendix D). While the NCC has been implemented in each Australian jurisdiction, it has not been adopted in its entirety in all jurisdictions and in many instances additional requirements for building standards have been imposed. A short summary of the key departures from the residential energy efficiency provisions of the NCC in each jurisdiction is outlined in Table 1.

Through the legislative review and consultation with the project Pilot Councils, the following jurisdictional differences were noted as being particularly relevant to developing an energy efficiency compliance approach:

- There are different mandatory points of inspection in each state and territory (as shown in Table 1 and Table 5). This impacts on the ease of incorporating energy efficiency compliance inspections into the current compliance regime.
- There are varying construction phase notification obligations for builders in each state and territory. This impacts on the Authority's ability to access the construction site at the ideal timing to assess the energy efficiency provisions of the NCC.
- Authorities may be private entities in some jurisdictions or government organisations in others (Councils or State Government).

All jurisdictions have processes for assessing the skills and expertise of Building Surveyors/Certifiers to qualify for authorisation under the relevant legislation. Authorisation defines permission to access the construction site and carry out inspections.

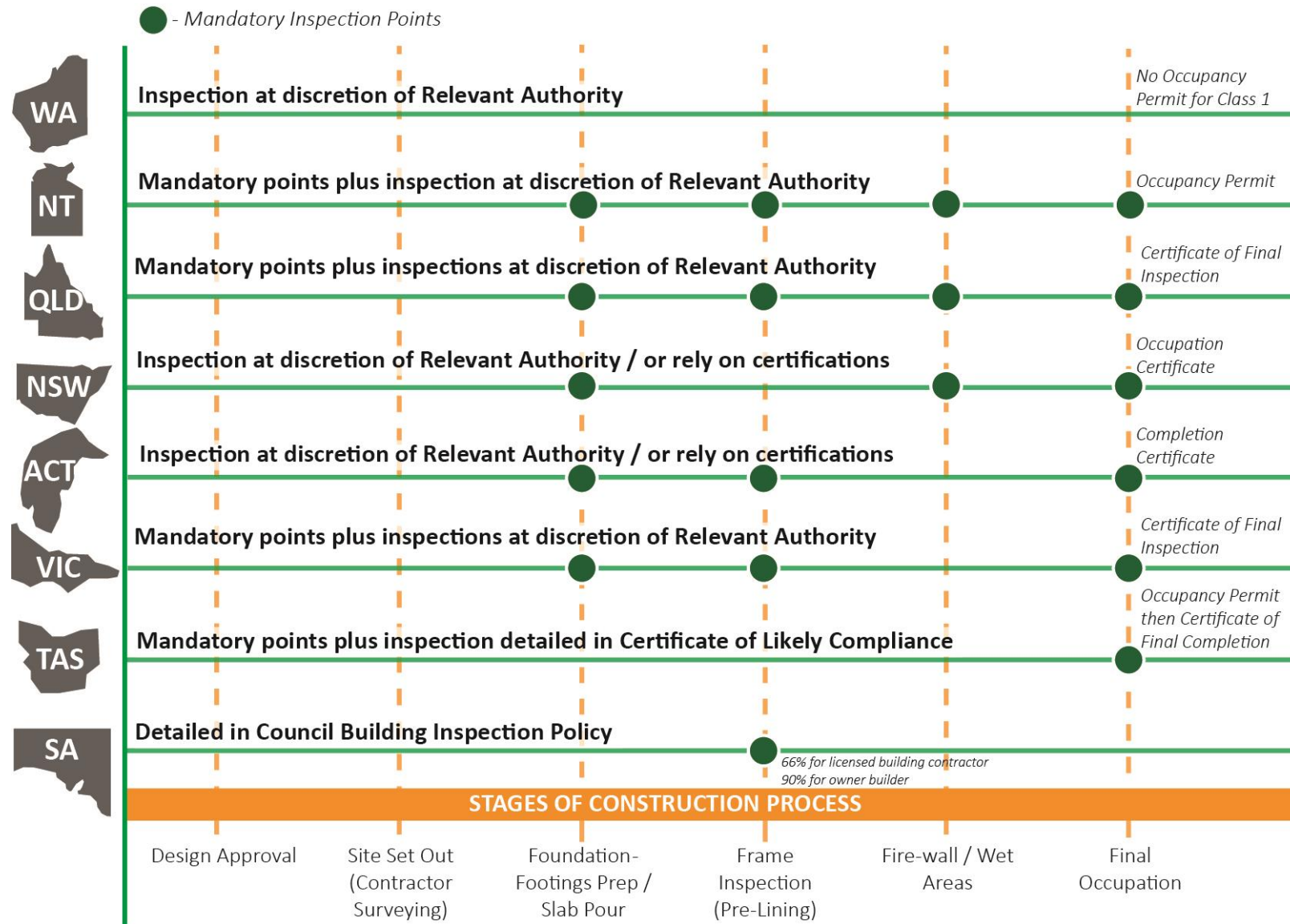
A number of jurisdictions around Australia are undertaking or investigating legislative reform of their local planning and building systems. For example, an Expert Panel on Planning Reform was established in South Australia and has made recommendations on amendments to planning and building systems to the State Government, with new legislation introduced to the SA Parliament in October 2015, which will impact on the building process in SA. The ongoing focus on the reform of planning and building processes, illustrates the importance of presenting the findings of this project to relevant state and territory departments.

**Table 1 – Summary of the State and Territory Legislative Framework for National Construction Code Compliance**

State/ Territory	Key Building Legislation	Departures from the NCC/BCA for residential buildings (new builds only)	Permit Authority	Building Inspections (during construction)
<b>WA</b>	Building Act 2011 Building Regulations 2012	No variations to energy efficient requirements in NCC for new buildings. Variation to alterations and/or additions to residential buildings to allow for a transition to NCC requirements.	Local Government (Council) or WA State Government is the permit authority	Occupancy permit is not required for residential buildings (Class 1 & 10 buildings).
<b>NT</b>	Building Act 2015 Building Regulations 2008	Section 2.6 Energy Efficiency Performance Provisions & 3.12 Energy Efficiency Acceptable Construction not applicable in NT.  Reference is made in legislation to the 2009 BCA which required 5 star energy performance.	Registered building certifier will assess the proposed buildings, will issue a permit to build and permit to occupy the building	Two-tier inspections process. Inspections required in populated areas e.g. Darwin but not in other building control areas.  Registered building certifier will undertake any necessary inspections during the construction process.
<b>QLD</b>	Building Act 1975 Building Regulations 2006	Queensland Development Code (QDC) Mandatory Part 4.1 contains additional provisions for residential buildings including requirements for sustainable buildings.	Final Inspection certificate issued by building certifier and application is recorded as finalised.	Inspections are carried out when footings are prepared, prior to the pouring of the building slab, prior to pouring of masonry block wall (if applicable) when the building frame is in place and completion.
<b>NSW</b>	Environmental Planning and Assessment Act 1979 Environmental Planning and Assessment Regulations 2000 Building Professionals Act 2005	3.12 Energy Efficiency Acceptable Construction does not apply in NSW and these issues are addressed in the Building Sustainability (BASIX) system.	Principal Certifying Authority (accredited private certifier or Local Council) will issue an occupation certificate	Principal Certifying Authority will inspect building during construction or rely on certifications.
<b>ACT</b>	Building Act 2004 Building Regulations 2008	No variations to energy efficient requirements in NCC for new buildings in ACT.	Planning and Land Authority issue final certificate of occupancy and use.	Certifier will conduct inspections and will issue a completion certificate.
<b>VIC</b>	Building Act 1993 Building Regulations 2006	Additional requirements for rainwater tanks and variations to hot water supply.	Local Government (Council) or Private Certifiers are able to issue Building Permits.	Building surveyor will inspect at specific stages including prior to footings, once the building frame is erected and at the completion of the building in order to issue an Occupancy Permit or Certificate of Final Inspection (depending on Building Permit requirements).
<b>TAS</b>	Building Act 2000 Building Regulations 2004	No variations to energy efficient requirements in NCC for new buildings	Local Government issue final Development Permit.	Inspection stages detailed in the Certificate of Likely Compliance.  Certificate of Completion issued followed by an Occupancy Permit.
<b>SA</b>	Development Act 1993 Development Regulations 2008	Departures primarily relate to hot water services and supply, heating and cooling loads and 6 star energy rating.	Local Government issue final Development Approval.	<i>Development Act 1993</i> outlines that each local government must establish a building inspection policy.



Figure 5 – State and Territory Compliance Inspection Points



## 3.2 Research into Current Audit Practice

Energy efficiency compliance assessment with the NCC is based on the following methods:

- Provision of a National House Energy Rating Scheme (NatHERS) certificate by a registered Home Energy Assessor – a ‘Deemed to Satisfy’ modelling approach.
- ‘Deemed to Satisfy’ provisions within the National Construction Code (NCC) – a ‘Deemed to Satisfy’ elemental approach.
- An alternative method that combines elemental and modelling approaches by modelling the design performance against a reference house.

The NEEBP Phase One research recognised that both of these options rely heavily on assessment of documentation prepared at design stage, rather than the actual construction of the residential dwelling. One of the key findings was that energy compliance checks during construction are rare and when they do occur, a high level of non-compliance is found.<sup>3</sup> One of the Phase One recommendations to ensure quality outcomes, was an audit framework for construction inspections of energy efficiency features in residential buildings.

Due to limited energy efficiency compliance inspection practice within Australia (as determined through the NEEBP Phase One research), it was not possible to source examples of compliance tools (specific to energy efficiency aspects of the NCC, as adopted by each state/territory). The Project Team considered other relevant approaches to assessing ‘as built’ energy efficiency performance on a national and international basis. A summary of relevant energy auditing approaches is provided in Appendix E.

## 4 Pilot Inspection Resources

### 4.1 Inspection Checklist

The Pilot *'Residential Energy Efficiency Compliance Inspection Checklist'* used by Council Building Surveyors is presented in Appendix F. The refined Inspection Checklist based on Pilot feedback, is provided in Appendix G.

#### 4.1.1 Process to Develop the Checklist

The Checklist was developed to closely follow the NCC requirements for energy efficiency. Based on our pre-Pilot consultation and research, it was decided that a three stage process allowed the Inspector to best capture all of the required information in one combined Checklist. These stages are:

1. Desktop review of development documentation.
2. Inspection 1 – Inspection required prior to the application of internal linings and ceilings, to allow visual inspection of building elements and ideally after the installation of walls, roof, windows and insulation.
3. Inspection 2 – Inspection required after completion of Second Fix, to allow visual inspection of lighting, sealing, etc.

The Checklist was developed in Excel and provided to the Councils in raw form (so that it could be integrated with their own processes) and in a PDF, for ease of printing.

The Inspection Checklist was developed as part of a staged process with the Pilot Council group. Webinar meetings were held to review the draft Checklist and update it for the Pilot period. Councils generally considered that the usability of the Checklist would need to be affirmed through on-site testing. It was noted that not all aspects of the Checklist applied in each state/territory or to certain types of construction. Councils were asked to make notes on relevant aspects of the Checklist within their jurisdiction.

#### 4.1.2 Checklist Format – Paper Based versus Electronic

Whilst most of the Pilot Councils currently use a paper based inspection form, one Pilot Council uses an electronic form and another Pilot Council indicated that they were investigating an electronic option. Digital checklists and tools, where inspectors can use phones or tablets on-site, enable immediate recording of results and submission of details into Council property databases. Providing the Checklist in a digital form was not within the scope of this Pilot. However, the potential future progression towards digital approaches was considered in the project recommendations, for further Checklist use and testing by Authorities. This becomes particularly relevant, if the EBP and the universal certificate for energy ratings, can automatically provide the information required by Inspectors.

#### 4.1.3 Inspection Checklist – Pilot Iterations

During the Pilot period, the Checklist was refined with the assistance of the Pilot Councils. Most of the refinements related to usability and the general information presented on the front page of the form.

The Councils agreed on the final Pilot Home Energy Inspection Checklist format (Appendix F) and used a hard copy version on site.

There was opportunity to amend the Checklist 'proof of concept' during the pre-Pilot webinar meetings. A technical review meeting was also held at the mid-point of the Pilot phase to make amendments if necessary. Key checklist amendments included:

**1. The first iteration of the Checklist allowed Council Building Surveyors to note some of the extra features that would need to be inspected, based on jurisdictional requirements.**

For example, the legislation in Queensland identifies features that allow properties to gain concessions against the national energy efficiency standard of 6 stars<sup>9, 10</sup>. Under certain circumstances, star-rating concessions can be obtained if the house incorporates an insulated outdoor area with or without a fan (1/2 - 1 star) or has a solar power system above 1kW (1 star). Location can affect star ratings with the selection of an 'exposed' location needing verification because of the significant impact on the rating. There are also exemptions for floor insulation in suspended floors and for insulating block walls in some Queensland climate zones. The Checklist was modified to allow Inspectors to note if these concessions had been used to achieve compliance. However, it was noted during the feedback that these do not actually contribute to the star rating. Instead, they allow a 5 star rating plus concession as evidence of compliance, rather than the mandatory 6 star requirement.

To manage some of these variations, a question was included to capture additional items that must be checked for compliance because they form part of the approval.

Other variations across jurisdictions and methods were generally managed within the Checklist, because the desktop review prior to inspection noted various details from the approved design.

**2. Modifications to manage the inspections within the compressed timeframe for the Pilot.**

The Checklist cover page was amended to reflect that Inspection 1 (post frame) and Inspection 2 (between frame and final) could be undertaken on two different properties (if constructed by the same builder and of similar construction type), for the purpose of completing the Pilot within the project timeframe.

**3. Final modifications for the proposed Pilot period.**

The results of all audits carried out across the Pilot Councils and the results of the Council post-Pilot Survey were evaluated, to make recommendations on those elements where inspections provide the most value to improving compliance and energy outcomes. This evaluation process provided direction on the best way to deal with variations across jurisdictions and methods. It also highlighted priority energy efficiency elements for on-site assessment. The final evaluation informed the content of the final version of the Checklist provided in Appendix G.

## 4.2 Pilot Inspection Guideline

Guideline notes were prepared for Councils describing the process of undertaking the Energy Efficiency Inspection on-site. Guidance points are documented according to the steps in the approval process through to the construction project cycle, so it can be understood how compliance is assessed against the NCC at various stages (refer to Figure 6). The guideline is provided in Appendix H.

It was apparent that the compliance review of new house design against the NCC, is undertaken by Council Officers during the Development Approval stage. The role of the authorised Inspector is therefore not to undertake an on-site compliance review against the NCC, but rather to inspect the energy efficiency provisions of the design. The NCC has three compliance paths for energy efficiency:

1. 'Deemed to satisfy' elemental assessment against the provisions of the Code.
2. 'Deemed to satisfy' modelling assessment using approved modelling software (or BASIX in NSW).
3. Alternative method comparing the design against a reference house using approved modelling software.

The Residential Energy Efficiency Compliance Inspection Checklist has been designed so that it can be used regardless of the compliance path chosen (which is largely based on the elemental provisions of the NCC). While each state and territory in Australia has a slightly different approach to the design and approval of new residential buildings, there is an element of commonality in all design and approval processes that is summarised in Figure 6.

**Figure 6 – Process Summary for Incorporating Energy Compliance Inspections**



**The Residential Energy Efficiency Compliance Inspection Stages** are summarised as follows:

### **1. Building Design**

- Early design without significant detail may already have been submitted to approval Authority – e.g. for planning approval.
- Design Team carry out detailed design of project in accordance with Energy Efficiency provisions of the National Construction Code.
- Design Team decide on energy compliance method (elemental assessment, modelling or alternative method).
- Design may be altered during assessment process in order to reach compliance.
- Design Team or Developer provides energy efficiency information and submits with application for building approval.

## **2. Building Approval**

- Relevant Authorities, e.g. Council or Private Certifiers, carry out a desktop review of the project against the energy efficiency measures described by the Design Team or Developer in NatHERS Assessment Certificate, elemental or alternative method. This is reviewed against the energy efficiency provisions of the NCC and relevant jurisdictional variations.

## **3. Construction Documentation**

- Design Team or Developer required to provide updated energy efficiency information with final Construction package. This should be structured to include all relevant schedules and information to support on-site inspections and will ultimately flow from use of the electronic building passport or universal certificate. Changes made in the design that affect energy efficiency, must be reflected in the final energy assessment.

## **4. Desktop Review for On-site Inspections**

- The Inspector for the relevant Authority carries out a desktop review of the project against the energy efficiency measures described by the Design Team or Developer against the energy efficiency provisions of the NCC.
- These energy efficiency measures would be noted in the 'Desktop Review' section of the Inspection Checklist or appended as schedules and drawings to support the inspections. Where information is missing, attempts need to be made to obtain additional information from the Developer at this stage.

## **5. Construction**

- Construction commences on-site. Developer required to notify relevant Authorities of construction program to include anticipated inspection dates.

## **6. Site Home Energy Efficiency Inspection 1**

- Inspection to be carried out by relevant Authority's nominated Inspector.
- Inspection required prior to the application of internal linings and ceilings to allow visual inspection of building elements and ideally after installation of walls, roof, windows and insulation. Note that 'framing' stage is often too early.
- Inspector to complete all elements of the 'Residential Energy Efficiency Compliance Inspection Checklist' that can be inspected adequately, to assess compliance at this time. Inspection based on building documentation collected during the desktop review.
- Inspector to attach photos and/or evidence as appropriate.
- Inspector to assess construction and note non-conformances or potential compliance issues. Corrective action issued to Developer, if required.

## **7. Site Home Energy Efficiency Inspection 2**

- Inspection to be carried out by the relevant Authority's nominated Inspector.
- Inspection required after completion of Second Fix to allow visual inspection of lighting, sealing, etc.

- Inspector to complete remaining elements of the Home Energy Efficiency Inspection Checklist so that all elements have been assessed between the two inspections. Inspection based on building documentation collected during the desktop review.
- Inspector to attach photos and/or evidence as appropriate.
- Inspector to note elements that could not be assessed and require alternative evidence to verify compliance, e.g. receipts and verification from builder.
- Inspector to assess construction and note non-conformances or potential compliance issues. Corrective action issued to Developer, if required.

#### **8. Issue Completion/Occupation Certificate OR Non-Conformance Report**

- Inspector is satisfied that the construction meets the energy efficiency provisions described in the design and the desktop review for the Home Energy Efficiency Inspection Checklist.
- OR Inspection raises Non-conformance Report.

#### **9. Documentation**

- Documentation records:
  - Results of inspections;
  - Additional evidence such as inspection photos;
  - Alternative evidence from others, such as receipts and verification from builder; and
  - Compliance issues and evidence that they have been satisfactorily dealt with.



## 5 Pilot Process Findings – An Overview

The *‘New Home Energy Efficiency Compliance Inspection Pilot’* was a significant step in consulting with Authorities to develop practical compliance resources. Councils involved provided valuable feedback on the value of an ‘as built’ inspection approach and the overall policy, as well as system improvements needed to support a site inspection regime.

In particular, the project sought to engage Councils and relevant building Authorities to develop and pilot resources to support a culture of NCC compliance and accountability.

This Phase Two research had regard to the following key findings of the Phase One study:

- With regard to energy efficiency compliance with the NCC, there is a ‘culture of low compliance with minimum energy performance’ attributed to low levels of consumer awareness and the market environment.
- There is poor resourcing and a lack of prioritisation for enforcement activities to assess compliance.

Industry and stakeholder consultation during Phase One, highlighted the need for improved regulatory quality control to assess compliance with the energy efficiency provisions of the NCC.

The various stakeholder discussions involved in this Pilot, research during engagement and recruitment of Pilot Councils, onsite piloting of inspection resources and post-Pilot evaluation, highlighted considerations for establishing a legacy of compliance activity.

Importantly, it was stressed by compliance Authorities that an on-site inspection regime cannot work effectively without the necessary regulatory frameworks and systems in place to:

- Improve design assessment and documentation.
- Enable verification of product performance through documentation.
- Support the professional development and training for Building Surveyors involved.

On-site assessment tools and equipment to verify compliance, such as thermal imaging, also need to be considered. In other words, other aspects of the NEEBP project research being undertaken are essential to enabling effective compliance inspections of residential construction.

The project findings are provided according to the following Pilot stages:

- Engaging Council Participation – Qualitative findings from the Council recruitment phase.
- Preparing for Pilot Inspections – Initial qualitative input into the inspection approach and ‘proof of concept’ resources.
- Mid-Pilot Review – Qualitative feedback at the mid-point of the Pilot phase.
- Site Inspection Results – Qualitative and quantitative findings of on-site inspections.
- Post-Pilot Review – Qualitative feedback on the Inspection Checklist and guideline as well as feedback on strategic support needed to support compliance activity.

## 6 The Pilot Process Experience

The Pilot Project Team liaised with Councils throughout various phases including:

- Initial recruitment
- Pilot initiation
- Pilot process reviews
- Post-Pilot discussions

Project Team members were available for liaison and support to Pilot Councils via telephone, email and online feedback mechanisms on the project website. Council staff contacted during the initial recruitment phase, contributed valuable input into the benefits and barriers to regulating energy efficiency for new home developments. The discussions during the Council recruitment phase (through telephone liaison with twenty three (23) Councils) also revealed Council perspectives on energy efficiency compliance. The persistent themes are summarised in this Section.

### 6.1 Engaging Council Participation – the Drivers and the Barriers

The Project Team liaised with 23 Councils via a combination of telephone contact and email to initially recruit at least ten Councils across Australian jurisdictions and climate zones. The Project Team sought to highlight the importance of the issue and the value of Council involvement for developing suitable resources. The recruited Pilot Councils had important drivers for participating in the Pilot, some of which were dependent on their jurisdiction.

#### 6.1.1 Drivers for Council Participation

##### 6.1.1.1 *Leading the way for energy efficiency*

Being at the forefront of energy efficiency and sustainability commitment, was a clear driver for some Councils. There was an interest in participating in the Pilot to facilitate Council awareness of the issues and being 'on the front foot' in relation to policy directives in this area. One Council was particularly interested in facilitating the ongoing legacy of the Project by promoting their involvement and sharing their experiences with the Australian Growth Councils Network.

***We're interested in integrating the results of the project with our planning and development change management process. (Pilot Council representative)***

#### *6.1.1.2 Delivering compliance for communities*

It was acknowledged that Councils have a responsibility to protect homeowners and to ensure houses are built to perform according to the requirements of the NCC for energy efficiency. It was also acknowledged that lack of compliance with energy efficiency provisions in new homes, is a potential liability issue for Councils. However, community complaints in relation to energy efficient building standards were not common for the Councils involved. For some Councils, there was an interest in utilising the Pilot findings to inform a review of Council inspection processes and templates.

#### *6.1.1.3 Gaining knowledge on compliance status*

Councils involved were curious to find out whether or not builders are incorporating all of the required energy efficiency requirements into their projects and if not, why not. There was an interest in increasing their knowledge of compliance status in their region and to share this knowledge by contributing to state and national decisions relating to building energy efficiency. In NSW, the project was considered an opportunity to test BASIX performance and contribute information towards future reviews of BASIX.

***The lack of compliance with EE provisions in new homes is a potential liability issue for Council. It's important for quality assurance. (Pilot Council representative)***

#### *6.1.1.4 Providing a Local Government view point on compliance approaches*

The project was considered a mechanism to provide a Local Government viewpoint on compliance assessment systems and expectations of Councils. It was clear that the Pilot Councils considered that private Building Surveyors and energy efficiency Assessors also have a potential role in an effective compliance assessment system. There was an interest in ensuring that recommendations for driving compliance consider the resource implications on Local Government.

***We want to participate and make sure we get the process right for Councils. (Pilot Council representative)***

#### *6.1.1.5 Pilot incentive funding and access to technical resources*

The conduct of energy efficiency compliance inspections was not current practice for the Councils involved, although Launceston City Council has incorporated some energy efficiency elements into the existing inspection pro forma. The provision of Pilot incentive funding was therefore an important feature of the Pilot incentive program, to support Council staff or contractor resources in undertaking the Pilot site inspections. Councils also recognised the value of participation for having access to technical energy efficient inspection templates and guidance resources.

## 6.1.2 Barriers to Participation

The issues and barriers to participation are important to note and to take into consideration, in order to expand Council involvement as a legacy of the project.

### 6.1.2.1 *Timing and resource limitations*

The conduct of energy efficiency inspections was considered a new program requiring additional resources and strategic commitment within Council.

The Pilot project was compressed into a period shorter than typical construction timeframes. The piloting period was approximately two months, with completion required by the end of May 2015. The timeframe for approval and participation was a barrier to some Councils participating in the Pilot. Lead-in time (ranging from one to six weeks) was required to obtain permission to participate from within Council.

The period of recruitment fell over Easter and school holidays and in some cases, this resulted in an extended period for Councils to consider Pilot participation and obtain the necessary approvals.

As the Pilot phase of the project was closer to the wetter winter months in some jurisdictions, this impacted on the Pilots, due to emergency events (storms on the eastern seaboard) and construction delays.

### 6.1.2.2 *Appropriate compliance Authority*

Councils were not necessarily the approving Authority and some of these Councils felt that they did not have much to offer the Pilot. This was particularly evident in Victoria where Private Certifiers (engaged directly by the building owner), have a significant role in compliance assessment. Whilst a number of Victorian Councils were interested in the project (in particular those involved in the Victorian Council Alliance for a Sustainable Built Environment), Council Building Departments did not necessarily have the mandate to test the Pilot resources, due to direct private certifier engagement. Establishing a partnership arrangement with the relevant professional bodies representing private operators, will be an important next step in testing the compliance inspection resources.

### 6.1.2.3 *Sustainability and building staff – the need for joint involvement*

During initial contact with Councils, it was evident that energy efficiency was seen as a Sustainability/Environmental officer role rather than a Building Inspector role. In some cases, the Project Team had to work across Council sections to encourage communication between relevant staff to encourage commitment. In fact, the project provided an important mechanism for liaison between Council staff on housing energy efficiency.

While enthusiasm was evident from staff initially contacted (be they Sustainability, Environment, Building, Planning or Corporate Strategy officers), they were not necessarily authorised to make the final decision on Pilot commitment.

#### *6.1.2.4 Perceived limitations in knowledge and expertise*

Some Councils were concerned that they did not have the expertise to assess energy efficiency compliance. Energy efficiency was considered an area requiring ‘specialist’ expertise. There was also concern in being able to clearly interpret and assess compliance against modelled energy assessments. Whilst mentoring and support was available through the Project Team, ‘face to face’ training was not part of the project scope.

## **6.2 Preparing for Pilot Inspections**

Pre-Pilot webinar forums and discussions with each Council highlighted a number of considerations for the Pilot and a suitable energy efficiency compliance tool and approach.

#### *6.2.1.1 Timing of inspections within the construction cycle*

The current approach to compliance inspections and the timing of mandatory inspections varies across states and territories (as depicted in Figure 5). Pilot Councils indicated that they prioritise compliance assessments according to the mandated inspection requirements in their jurisdiction. Requirements vary from mandatory inspections at certain points in the construction process through to inspections undertaken at the discretion of the compliance authority, such as in response to complaints. In jurisdictions of less frequent mandatory inspections, such as Western Australia and South Australia, Councils highlighted the potential difficulty in accessing developments at the appropriate construction stage, to assess energy efficiency compliance with the NCC. In some cases, proactive communication with builders on Pilot participation was needed, to access and inspect the construction of new homes.

#### *6.2.1.2 Notification of construction stages*

In each state and territory, there are varying provisions and/or requirements for builders to notify Councils/Authorities of stages in the construction process, to enable compliance assessment. Notification requirements tend to coincide with mandatory inspection points (where applicable). Notification requirements can also be stipulated as part of the Development Approval, which is the approach in South Australia. Notification mechanisms for construction stages to assess energy efficiency (such as post frame and pre-lining), were not in place for the Councils involved. Liaison with builders about the Pilot program was therefore necessary in some instances, to gain access to the property at the optimum time.

#### *6.2.1.3 Manual versus electronic inspection tool*

During the Pilot preparation discussions, it was noted that some Councils are investigating digital checklists and tools where Inspectors can use phones or tablets on-site to easily record results and immediately submit reports. This may have the potential to interact with Project Two – EBP. Digital tools such as iAuditor are structured on yes/no inputs with the occasional uploading of photographs. Whilst the development of digital tools was not within the scope of this Pilot, the ability to adapt content on a digital platform was considered.

#### *6.2.1.4 Knowledge of Building Surveyors*

Confidence in understanding the energy efficiency provisions of the NCC varied, with Building Surveyors involved indicating that they were ‘partially familiar’ through to ‘very familiar’ with the NCC energy efficiency provisions. Pre-Pilot and mid-Pilot discussions involving Council representatives were undertaken, to ensure sharing of findings and experiences in the field.

#### *6.2.1.5 Terminology – Inspection versus audit*

Clarification was sought on the terminology for compliance resources and it was suggested during one of the pre-Pilot webinars that 'Inspection Checklist' more accurately reflected the nature of the compliance activity being piloted than 'Audit Checklist'. The Project focused on compliance inspections (under relevant legislation) by authorised Building Surveyors and the terminology needed to reflect this scope.

The Phase One report recommended audits, in the sense of less frequent and randomised inspections. This Pilot has tested an inspection tool that can be used by Councils with a regular or mandatory inspection regime. It may be applied as part of random and selective inspections and can be used by private certifiers.

A stricter definition of 'audit' would be an infrequent, randomised and detailed check of the whole approval process and quality framework for energy efficiency compliance. In other words, a suitably skilled person audits the quality of the information used for pre- and post-build approvals, the record keeping and the inspection approach.

### **6.3 Mid-Pilot Review**

During the piloting phase, the team undertook a teleconference with the participating Pilot Council representatives to obtain feedback on the Pilot process and inspection resources. The Project Team was also available to liaise with Building Surveyors as needed, during the Pilot phase. Issues that arose during the Pilot period are summarised in this Section.

#### *6.3.1.1 Access to properties and timing of visits at the right construction stage*

As anticipated, it was difficult to access and time visits to properties at the appropriate stage of construction, for assessing elements such as insulation installation, due to: lack of notification to Council; a limited time period between the frame completion and installing wall linings; limited contact with builders, or lack of authority to enter properties for trial purposes, particularly in jurisdictions where there are minimal mandatory inspection requirements.

Councils highlighted a preference for integrating energy efficiency compliance checks with their existing inspection regime, (where it exists), but this does not necessarily achieve the right timing for the energy efficiency results.

#### *6.3.1.2 Workplace safety considerations*

Building Surveyors performed site inspections in accordance with relevant state/territory and Council safe work procedures and practices and legislative requirements. Council safety procedures generally do not permit Surveyors to work at heights or enter roof spaces. Limitations in closely inspecting insulation installation were therefore sometimes reported by Pilot Councils.

### 6.3.1.3 Training, knowledge and consistency

The degree of knowledge and confidence in interpreting and assessing energy efficiency elements varied. It was felt by some Surveyors that energy efficiency assessment is a specialist area and it was stressed that the profession needs to continually keep up to date with an increasing amount of technical training and mandated requirements. Whilst face to face training and on-site mentoring was beyond the scope of the Pilot project, the Project Team shared learning and examples across the Pilot Council group.

### 6.3.1.4 Undertaking two phase inspections in the Pilot timeframe

The Pilot scope and Inspection Checklist Guideline recommended two inspections at ideal times during the construction cycle (generally Inspection 1 - Post-frame construction and Inspection 2 near completion). However, the Pilot timeframe did not allow for Inspection 1 and 2 phases to be undertaken on the same property. It was agreed that where time did not allow for complete assessment on the one property, that inspections would be undertaken on different properties (of similar construction type). For the purpose of the Pilot, this still enabled testing of the checklist tool at varying stages of construction. However, it posed limitations in using the data for complete compliance assessment of the residential constructions assessed on-site.

## 6.4 Site Inspection Results

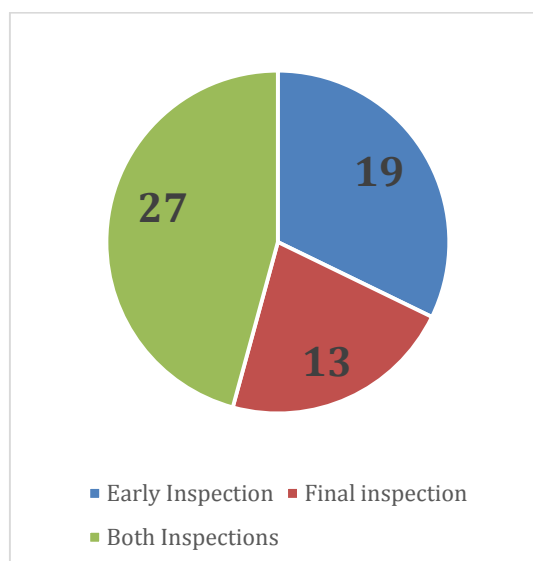
The Pilot Council participants provided significant contribution to the project through the completion of 86 inspections across 59 homes within the piloting timeframe.

**Table 2 – Inspections Conducted**

	Early Inspection	Final inspection	Both Inspections	Total Homes
<b>Homes Inspected</b>	19	13	27	59

*\*It is unwise to draw general conclusions from this sample. It is an insignificant number in the context of homes built per year. The variation across Councils, climate zones and building type was sought specifically for this Pilot but reduces the ability to generalise from the results.*

**Figure 7 – Homes Inspected**



It should be noted that compliance issues noted during early inspections could often be addressed before the final inspection. Homes with only an early inspection provide inconclusive results about non-compliance because construction is incomplete. Homes with only a final inspection are likely to have multiple elements that could not be inspected.

The completed Inspection Checklists provide a wealth of information across several key areas including:

- The success of an on-site inspection tool in measuring compliance.
- Common areas of compliance and non-compliance.
- Timing of inspections needed to assess elements of the checklist.
- Issues in the documentation and approvals stage which affect the inspection results.

The following issues were addressed by the Inspection Checklist:

- Roof and wall insulation, thermal breaks and air voids.
- Glazing and windows.
- Roofs and shading.
- Building sealing (especially external windows and doors, construction of the roof, walls and floors and dampers on exhaust fans).
- Building services including air-conditioning, hot water and lighting and related insulation of ductwork/piping.

The following elements were also included in the Inspection Checklist and were uncommon or non-existent in the buildings inspected:

- Roof ventilators.
- Roof lights/skylights.
- Sealing of roof lights, chimneys and flues.
- Floor insulation.
- Floor heating or cooling.
- Evaporative coolers.
- Renewable and alternative energy sources (eg solar photovoltaics).
- Electric resistance space heating.
- Swimming pool or spa pool.

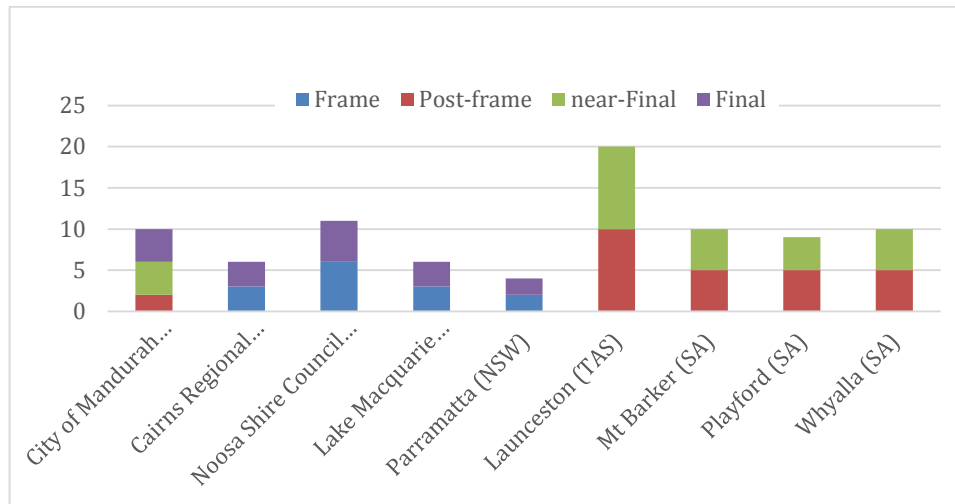
*Note that the project aimed to test inspection tools, policies and protocols through a Pilot program. The inspections were undertaken under Pilot conditions and in some cases, builder participation in the Pilot program was sought to ensure access to housing construction projects. Whilst the Pilot findings provide an insight into compliance performance, further inspections would be required to provide a more accurate quantitative assessment of national compliance or non-compliance issues related to the energy efficiency provisions in the NCC.*



**Table 3 – Summary of Audits Completed and Results**

Pilot Council	Existing Inspection Regime	No. and timing of Inspections for Pilot	Number of Homes	Star Rating (Range)	Compliance Follow-up (where reported)
<b>City of Mandurah (WA)</b>	At discretion of Council or in response to a complaint.	10 inspections: - 2 post-frame - 4 near completion - 4 at completion	8 (2 homes inspected twice)	5 to 6.5	Builders of 5 homes were given verbal instructions to install dampers to exhaust. Building sealing often not delivered, yet installations tight fitting.
<b>Cairns Regional Council (QLD)</b>	Structural (footing, masonry block core fill and frame) and a final.	6 inspections - 3 at frame - 3 at final	6	6.5 to 7	None reported.
<b>Noosa Shire Council (QLD)</b>	Structural (footing, masonry block core fill and frame) and a final.	12 inspections - 6 at frame - 6 at final	6	6 to 7.5 and DTS	3 builders provided verbal instructions. Reflective foil insulation not taped over penetrations or butted/lapped along ridge (2 homes). Incomplete insulation coverage at end of roof sheet (1 home).
<b>Lake Macquarie (NSW)</b>	Slab, footings, wet area and final.	6 inspections - 3 at frame - 3 at final	6	Basix Assessment	2 builders given verbal instructions, 1 builder given written notice. Non-compliant roof colour (1 home) and window thickness (1 home).
<b>Parramatta (NSW)</b>	Footings, slab, stormwater, frame, waterproofing and final.	4 inspections - 2 at frame - 2 at final	4	Basix Assessment	None reported.
<b>Launceston (TAS)</b>	Footing, framing, final.	20 inspections - 10 post-frame - 10 near final	10 (some units)	6.1 to 7.4	None reported.
<b>Mt Barker (SA)</b>	Footing, framing, wet area inspection, final (60%/90% owner builder)	10 inspections (as well as follow-up visits) all between frame and final	5	6 to 6.6	Discussions with builders where issues identified: insulation exceeding wall cavity thickness and compressed when installed. Light globes not as prescribed. Verbal directive (1 home) – Insulation not in accordance with specified thickness/R-value.
<b>Playford (SA)</b>	Footing, framing, wet area inspection, final (60%/90% owner builder)	9 inspections - 5 post frame - 4 near final	9	6	None reported.
<b>Whyalla (SA)</b>	Footing, framing, wet area inspection, final (60%/90% owner builder)	10 inspections - 5 post frame' - 5 near final	5	Verification Method	None reported.

**Figure 8 - Number of Inspections per Council**



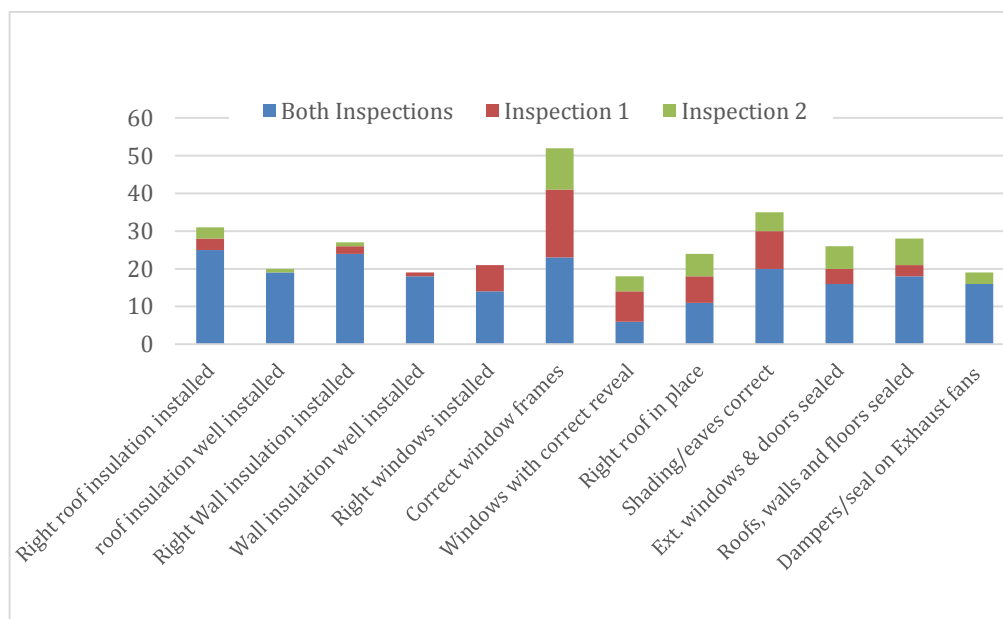
### 6.4.1 The timing of energy efficiency compliance inspections

In many Council areas, inspections are already carried out at key stages of the construction process (refer inspection timeline). It is therefore appropriate to check energy efficiency elements at these times. However, the Inspection Checklists show that the timing of inspections is critical, with many being carried out too early or too late, to enable completion of the NCC compliance elements in the Checklist. It appears that at least two (2) inspections are essential to capture all of the construction elements in the Checklist.

The other common issue raised was not being able to visually inspect certain items, mainly roof insulation, glazing type, insulation (too late or too early to see it before linings).

In some instances, fixtures such as lighting, hot water systems and outdoor fans, were intended to be installed by the owner post-construction or at the last possible moment to avoid theft. Compliance with these elements of the checklist could therefore not be assessed.

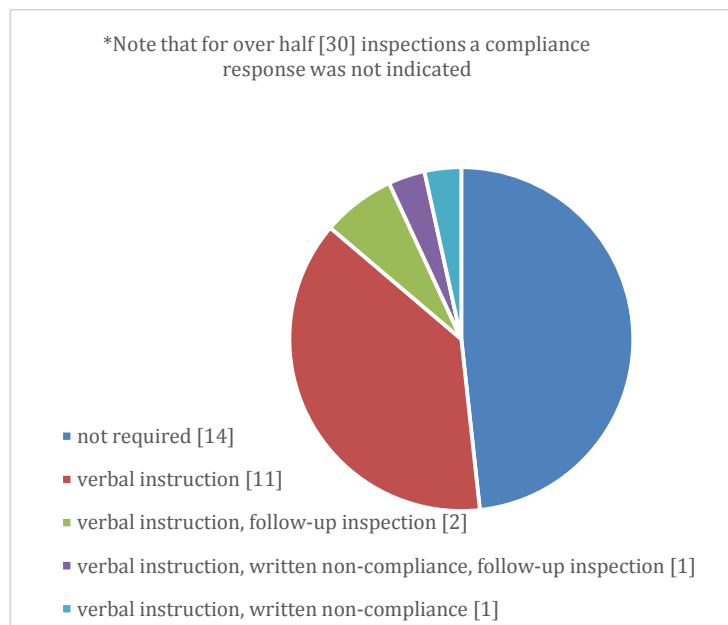
**Figure 9 – Conclusive Results from Site Inspections – 59 Homes**



### 6.4.2 Common areas of compliance and non-compliance

Compliance was noted against various checklist parameters, although it was noted that the limitations reported, such as lack of detail in planning documentation, made accurate on-site assessment difficult. The inability to view elements on-site resulted in Inspectors relying on builder verification in some instances and inconclusive assessment in others. The inspections also provided the opportunity to rectify any issues identified between inspections and work 'yet to be completed' was not necessarily considered as non-compliant. Identified areas of non-compliance are provided in the detailed results below.

Figure 10 – Compliance Response noted by Inspectors\*



### 6.4.3 Detailed Results

The responses to the Inspection Checklist were often beyond 'yes' or 'no' answers. The following categories were used to analyse results provided by Building Surveyors:

- **Compliant:** This item was identified in desktop review and checked in a way that means the expected installation occurred.
- **Non-compliant:** This item was identified in desktop review but when checked, is considered to be non-compliant.
- **Inconclusive:** It is unclear if the item is compliant but there is a level of information and inspection results to suggest that it may well be.
- **Not needed:** The desktop check suggested this item would not be installed.
- **Not inspected:** No inspection opportunity.
- **Inadequate information:** Insufficient information exists to know why this item has not been inspected or what would have made the item compliant.

Appendix I records the results for both the 27 homes, which received the full regime of two home inspections, as well as the results across all 59 homes.

### 6.4.3.1 Roof and Wall Insulation

Insulation was proposed in the Phase One Report as one of the key elements to inspect on-site. A series of questions in the Inspection Checklist was used to establish:

- The type of roof insulation installed.
- The installation quality of roof insulation.
- The type of wall insulation installed.
- The installation quality of wall insulation.

Both the early and final inspections were used at times to check roof insulation. When two inspections were used, all of the 27 houses were able to be inspected. Twenty four out of 27 were considered to have the right insulation, one out of 27 was not and in two out of 27 cases, insulation was installed but the Inspector could not verify the R value. Where a house only received a single inspection, approximately one third of inspections failed to occur at a time when the roof insulation could be inspected.

**Table 4 – Insulation: Number of houses with different compliance results out of 59 houses inspected\***

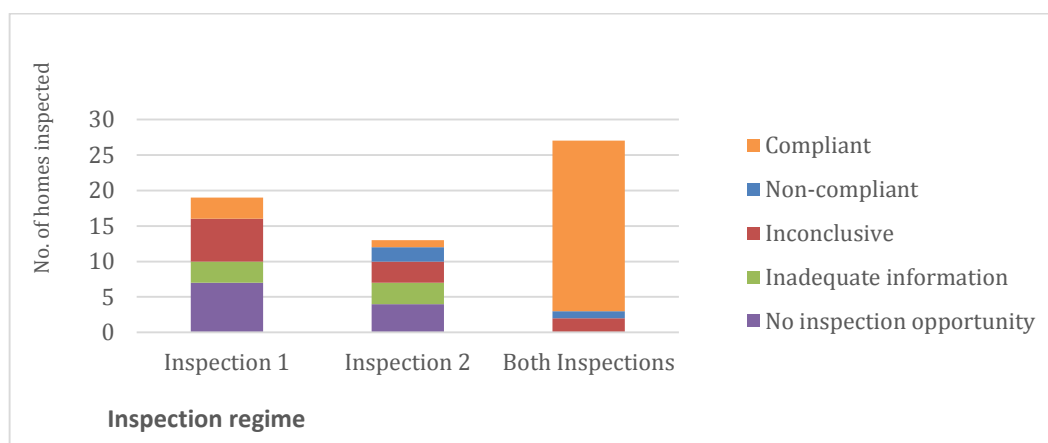
\*Note full results are tabulated in Appendix I by different inspection regimes

	Compliant	Non - compliant	Inconclusive	No inspection opportunity
<b>Correct roof insulation</b>	28	3	11	11
<b>...well installed</b>	17	3	26	13
<b>Correct Wall insulation</b>	22	5	7	15
<b>...well installed</b>	16	3	13	19

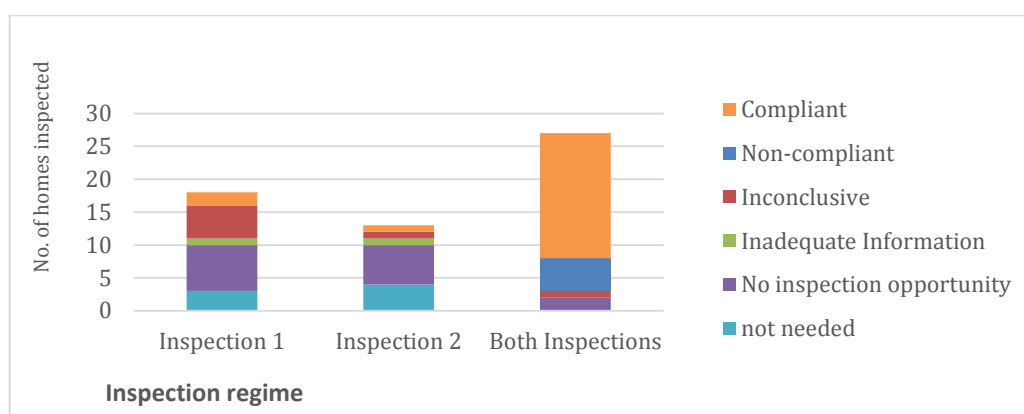
Inspectors were often able to identify R value for insulation during the desktop review but not thickness. This is the main reason for roof insulation in 11 out of 59 houses not being fully verified. In some of these cases, the builder's sign off was relied upon, instead of verification by the inspector. In six out of 59 houses, adequate information was not available at desktop review stage and therefore the inspector could not verify on-site.

Further details from the different inspection regimes are provided in Figures 11 to 22.

**Figure 11 – Correct Roof Insulation: Number of houses with different compliance results, as it relates to the different inspection regimes.**



**Figure 12 – Correct Wall Insulation: Number of houses with different compliance results, as it relates to the different inspection regimes.**

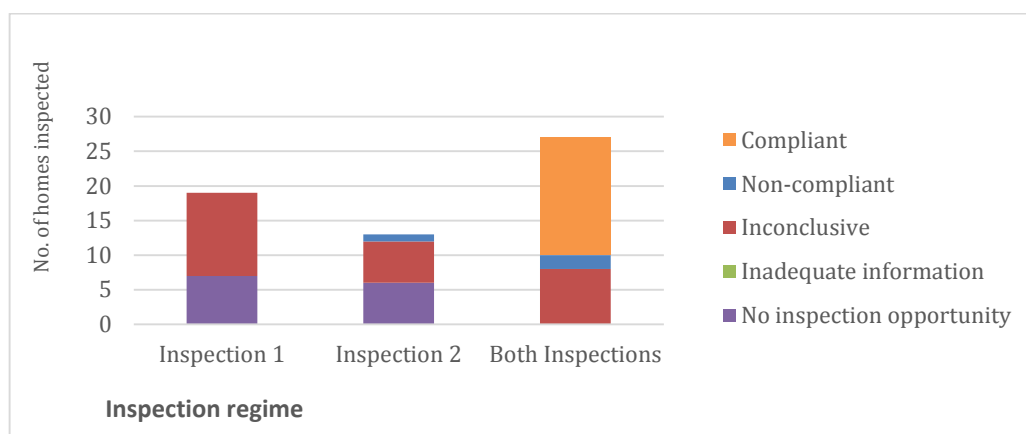


### Key Discussion Points for Roof and Wall Insulation type

Adequate information needs to flow from energy assessment to Inspectors, including thickness of material, R Value and additional roof sarking. Other means could be considered to verify insulation type such as photographic evidence, receipts and builder or insulation installer verification.

Installation quality was more difficult to assess. In early inspections, the roof insulation was often only partially installed. In final inspections, it was more likely that the Inspector could not view the complete installation. A number of ambiguous answers to the questions which were asked, suggest that the Inspectors were often less confident about assessing the installation quality. In the post-Pilot survey, three out of six Inspectors rated this item 'difficult to inspect'.

**Figure 13 – Roof Insulation Well Installed: Number of houses with different compliance results, as it relates to the different inspection regimes.**



### Key Discussion Points for Roof Insulation Installation

This is an area where training for Inspectors and clear information about the correct installation for different products can be a benefit. Photographic evidence is useful for non-compliance but unwieldy to collect comprehensively.

Wall insulation was more difficult to inspect than roof insulation and most likely to occur during an early inspection, timed to coincide with the short window available when wall insulation is visible. Seven homes in WA and Northern Queensland, did not need wall insulation. The difficulty inspecting wall insulation type and installation quality was confirmed by the post-Pilot survey.

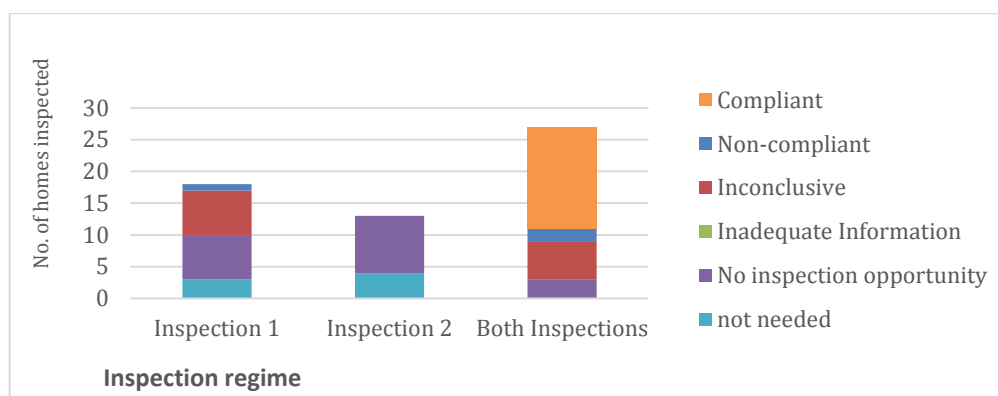
The Phase One Report had noted that insulation thickness can be increased at energy assessment stage beyond the capacity of the designed wall thickness. This problem was noted in only one of the 59 homes inspected.

Penetrations through the wall insulation caused compliance issues in one case. This is an example of subsequent trades undoing the early energy compliance work in order to install services, as highlighted in the Phase 1 Report. The problem could be greater than was detected in this Pilot because the majority of inspections signed this element off during the early inspection, when lighting, hot water and other plumbing services had not yet been installed.

Observations of non-compliance included:

- Reflective foil insulation not taped over penetrations or butted/lapped along ridge.
- Incomplete insulation coverage at end of roof sheet.
- Insulation exceeding wall cavity thickness and compressed when installed.
- Insulation not in accordance with specified thickness/R-value.
- Insulation not included under flooring (where specified).

**Figure 14 – Wall Insulation Well Installed: Number of houses with different compliance results, as it relates to the different inspection regimes.**



### Key Discussion Points for Wall Insulation Installation

Given the potential difficulty of timing the inspection of this item, secondary forms of confirmation should also be considered. Self-verification by builders/installers backed by some photographic evidence or thermographic testing could be considered.

It was also expected that thermal breaks and air voids would be inspected. Thermal breaks are particularly relevant for steel framed houses but the majority of inspections involved homes based on a timber frame on a concrete slab. Specifically designed air voids (less than 50mm) provide a form of resistance to thermal flow and therefore contribute to the insulation). This is relevant to walls and roofs without a large roof space.

The detailed questions relating to thermal breaks and air voids were often answered ambiguously. The majority assessed air voids and thermal breaks as not applicable, suggesting some lack of understanding about the implications of these construction code elements.

### Key Discussion Points for Additional Roof and Wall Elements

Adequate information needs to flow from energy assessment to Inspectors, especially where the energy rating or approval relies on the specific installation/construction of air voids, thermal breaks and roof sarking.

#### 6.4.3.2 Glazing and windows

Glazing was the other element highlighted in the Phase 1 Report as a key item to inspect. The Inspection Checklist asked a series of questions in order to verify:

- The type of glazing in windows.
- The type of window frames.
- The depth of the window reveal.

**Table 5 – Glazing and Windows: Number of houses with different compliance results out of 59 houses inspected\***

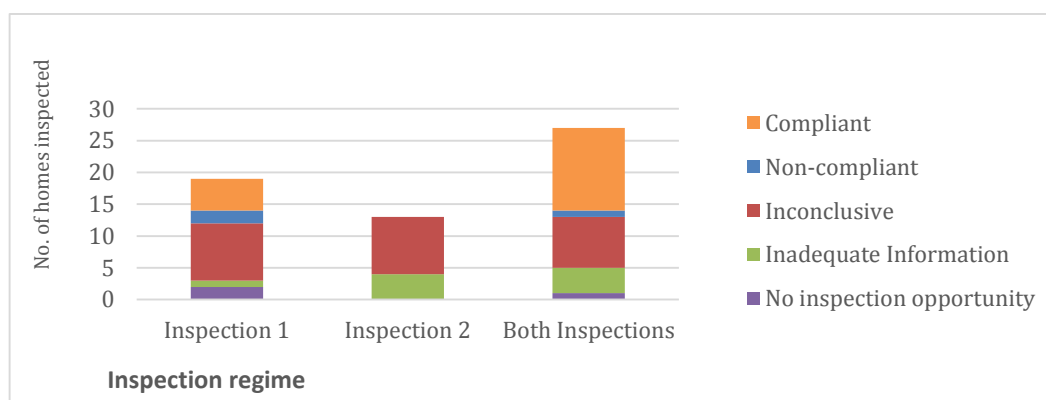
\*Note full results are tabulated in Appendix I by different inspection regimes

Element assessed	Compliance result	Compliant	Non-compliant	Inconclusive	Inadequate information
Correct glazing		18	3	26	9
Correct window frames		51	1	2	5
Correct depth of window reveal		17	1	15	12

In general, the jurisdictions in the Pilot had climates that only required single glazing. In most cases there were limitations in inspecting window glazing compliance due to lack of detail on glazing specifications in building plans and approval documentation. It was not always possible to measure glass thickness at the time of inspection or to determine thickness through product labelling (i.e. no sticker labels on windows installed).

Building Inspectors were split on the ease of inspecting glazing, with prior experience ranging from those who regularly inspected windows to jurisdictions where this was not standard practice. In Tasmania for example, Inspectors were accustomed to requiring a comprehensive window schedule and were armed with a tool to verify glass thickness, due to regularly checking homes for bushfire safety. Others struggled to identify the glazing for the home in the desktop review (some had a U value but no information on glass thickness) or once on site, struggled to verify the glazing. A number of inspectors were fortunate to inspect glazing while the stickers identifying the glazing type were still in place.

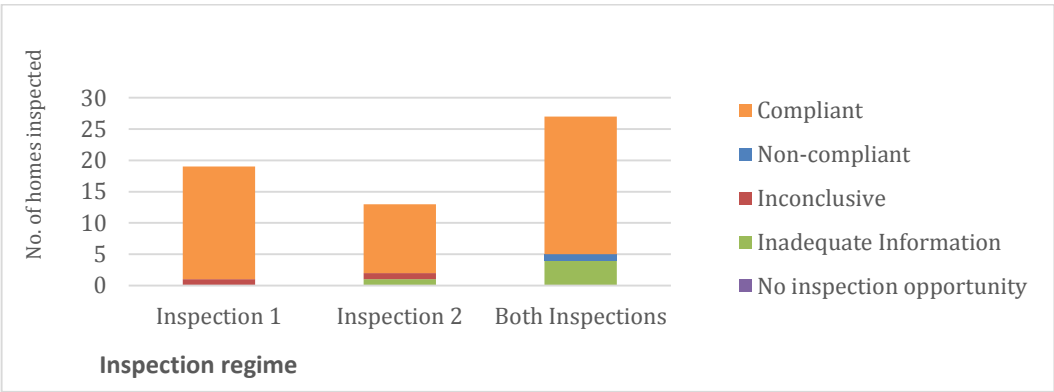
**Figure 15 – Correct Glazing: Number of houses with different compliance results, as it relates to the different inspection regimes.**



Window frames were easy to identify as aluminium or timber frames. A number of houses had both and in one case, timber had been swapped for aluminium. In a number of inspections, the installation of windows was incomplete.

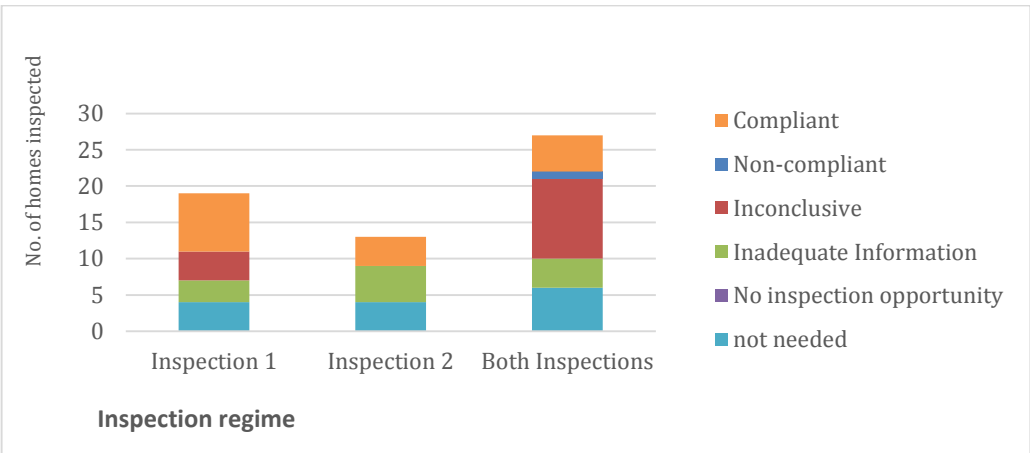


**Figure 16 – Correct Depth of Window Reveal: Number of houses with different compliance results, as it relates to the different inspection regimes.**



The depth of the window reveal appeared to be easy to inspect but not necessarily understood by all Inspectors, as 14 homes were marked as N/A. As for window information, many Inspectors had access to inadequate information at the desktop review stage. Many noted that the windows matched the drawings, but detail was lacking.

**Figure 17 – Correct Depth of Window Reveal: Number of houses with different compliance results, as it relates to the different inspection regimes.**



### Key Discussion Points for Glazing and Window Frames

A window schedule needs to be generated as part of the energy assessment, for inspectors to be able to check the glazed area against the energy rating or approval. This could include the depth of window reveals that has been used for approvals. Tools for verifying glass thickness need to be used by all inspectors. Secondary forms of evidence such as photos, stickers and receipts could all be used to verify that the glazing type and area, matches the energy approved design.

### 6.4.3.3 Roofs and Shading

Inspectors checked for the correct roof type and colour and the level of shading from eaves. There were also questions about shading materials.

**Table 6 – Roofs and Shading: Number of houses with different compliance results out of 59 houses inspected\***

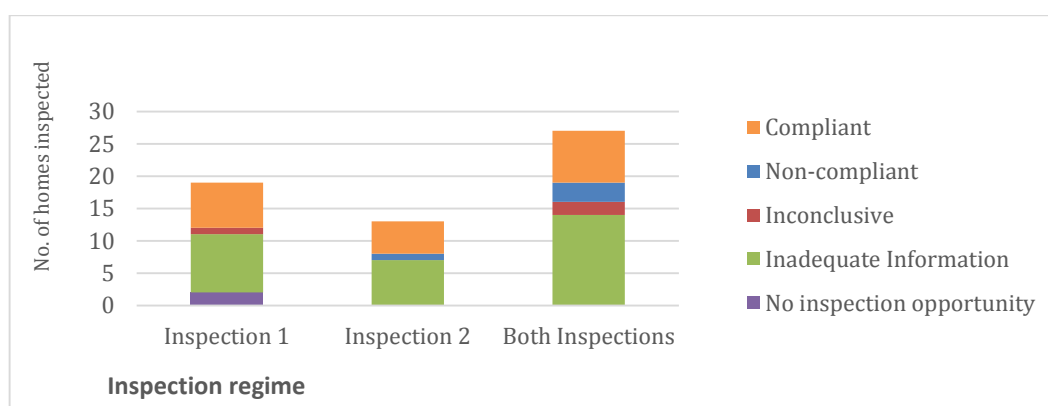
\*Note full results are tabulated in Appendix I by different inspection regimes

Compliance result Element assessed	Compliant	Non-compliant	Inconclusive	Not needed	Inadequate information
<b>Correct roof</b>	20	4	3	0	30
<b>Correct shading/eaves</b>	35	0	15	8	0

In more than half the desktop reviews, Inspectors were unable to identify the roof colour before inspection. In many cases, roof colour was marked as 'light' or 'medium' and the Inspector was expected to understand if the final colour complied.

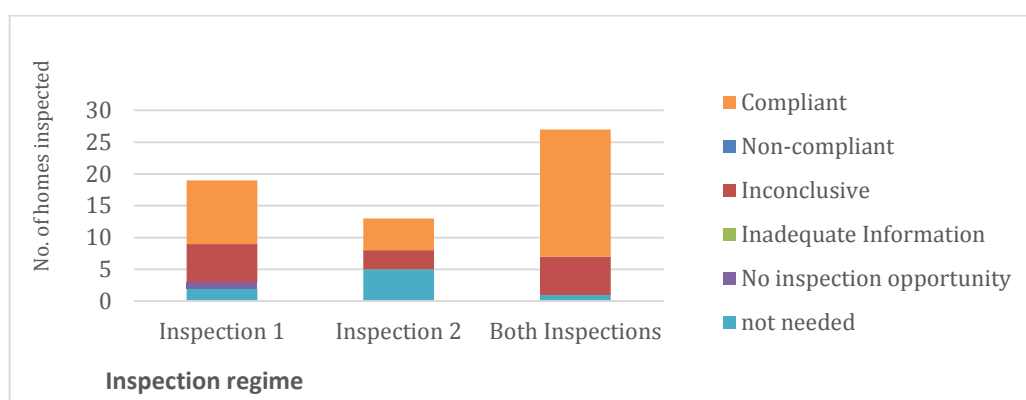
In at least one case, the approved roof colour changed between the drawings originally submitted and the energy approved design. In one case where the roof colour was wrong, the Inspector agreed that the house should be fitted with additional insulation to counter the effects of the non-compliance.

**Figure 18 – Correct Roof Type and Colour: Number of houses with different compliance results, as it relates to the different inspection regimes.**



While many houses had no shading, this was an easy item to inspect. In fifteen (15) inspections the information was incomplete, mainly because the eave depth was not specified on the drawings. In these cases, Inspectors indicated that they were not completely sure that the eaves appeared correct.

**Figure 19 – Correct Shading/Eaves: Number of houses with different compliance results, as it relates to the different inspection regimes.**



In general, the questions about shading materials were not completed and as a result, desktop reviews did not highlight any houses that relied on additional shading. It appears that even final inspections occur before shading materials are added.

### Key Discussion Points for Roofs and Shading

The inspection of roofs and shading is relatively straightforward, however difficulties will occur if the details of the energy approved design are not clear. This is likely to be a key area where Inspectors will need guidance, particularly the implications of non-compliance, as rectifying non-compliance is likely to require significant works and associated cost.

#### 6.4.3.4 Building Sealing

In order to examine the sealing of a building, the most common elements that require checking include external windows and doors, construction of the roof, walls and floors and dampers on exhaust fans. It is unlikely that building sealing was “not needed” and yet a number of Inspectors failed to inspect these elements.

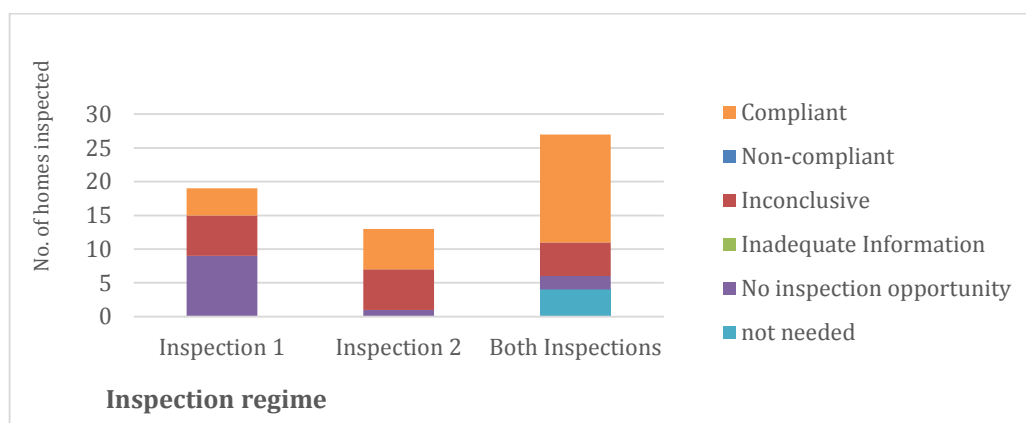
**Table 7 – Building Sealing: Number of houses with different compliance results out of 59 houses inspected\***

\*Note full results are tabulated in Appendix I by different inspection regimes

Building Sealing	Yes	No	Inconclusive	Not needed	No inspection opportunity
External windows and doors	26	0	17	4	12
Roof, walls and floors	24	4	9	6	14
Dampers on exhaust fans	16	3	5	9	24

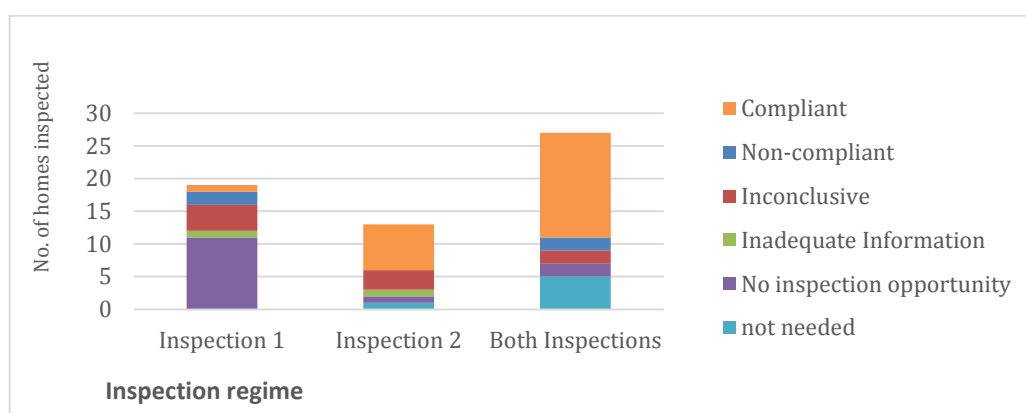
The sealing of windows and doors appeared to be easy to inspect. It was unlikely to be sufficiently complete during an early inspection but there was only one case of a final inspection failing to see this element adequately. A variety of inspection responses suggesting areas yet to be completed or unable to be fully seen, led to a significant number of inspections rated as “inconclusive” rather than a confident assessment. In some cases, whilst weather seals were incorporated in external door frames, there was no caulking of joints.

**Figure 20 – Sealing of External Windows and Doors: Number of houses with different compliance results, as it relates to the different inspection regimes.**



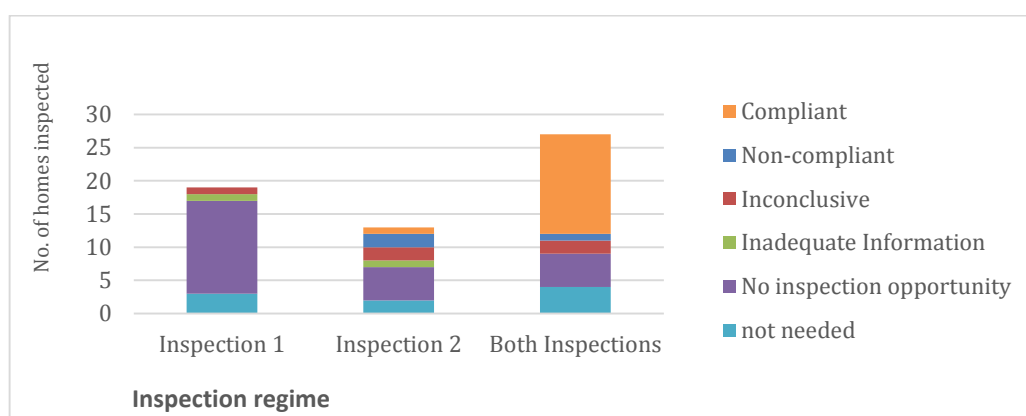
The construction of roof, walls and floors was often explained as “tight fitting” and this was considered adequate before caulking, sealing, skirtings or architraves were needed. A number of Inspectors noted “standard construction” to explain the level of building sealing. The impression from many of the final Inspection Checklists is that the completion of skirtings and architraves was still ongoing. Inspectors considered this element more difficult to inspect than windows and doors.

**Figure 21 – Sealing of Roofs, Walls and Floors: Number of houses with different compliance results, as it relates to the different inspection regimes.**



The dampers on exhaust fans appeared to be difficult to inspect and as a result, this question led to a mixture of inspection responses.

**Figure 22 – Sealing and Dampers on Exhaust Fans: Number of houses with different compliance results, as it relates to the different inspection regimes.**



**Key Points for building sealing:** The installation of insulation and the sealing of the building both rely on workmanship rather than product purchase. Insulation is an area where training for inspectors could be beneficial as well as clear information about the correct sealing approach for building type. Photographic evidence is useful for non-compliance but unwieldy to collect in a comprehensive manner.

#### 6.4.3.5 Building Services

Homes are commonly serviced by air-conditioning, hot water and lighting, with related insulation of ductwork/piping.

**Table 8 – Building Services: Number of houses with different compliance results out of 59 houses inspected\***

\*Note full results are tabulated in Appendix I by different inspection regimes

Building Services	Compliant	Non-compliant	Inconclusive	Not needed	No inspection opportunity	Inadequate Information
<b>Air conditioning System</b>	1	0	13	23	10	12
<b>Ductwork Insulation</b>	0	1	6	38	12	2
<b>Hot water</b>	8	0	18	1	19	13
<b>Heating/cooling pipework Insulation</b>	0	5	7	25	18	4
<b>Lighting</b>	14	3	16	1	15	10

Building services are often installed late in the construction cycle – sometimes to avoid theft and sometimes to allow for installation by the building owner. In approximately one third of final inspections, there was still no opportunity to inspect most building services, although in some cases, plumbing for a gas hot water system was evident.

There were a number of potential compliance issues but it appeared that none of these were considered grave enough by Inspectors to warrant follow up. Hot water pipework was frequently uninsulated. In one case, alternate lighting was installed by the owner (post-construction).

Although the Inspection Checklist called for detail about the energy performance of these services, the information provided was limited, as follows:

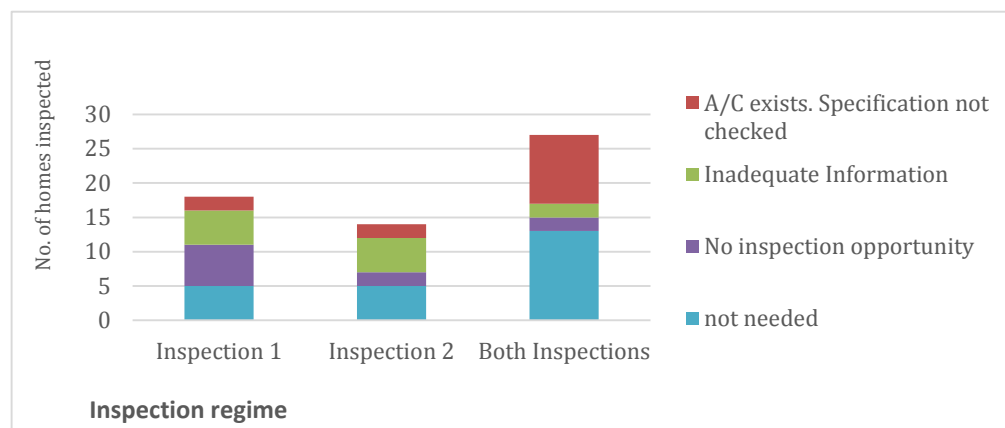
- No checklists were provided for the Certificate of Purchase details for the air conditioning system.
- Hot water was generally “gas” with no information about the system rating.

Lighting required a schedule or diagram and the majority were detailed. In many cases the Inspector noted Light Emitting Diode (LED) or energy efficient lamps.

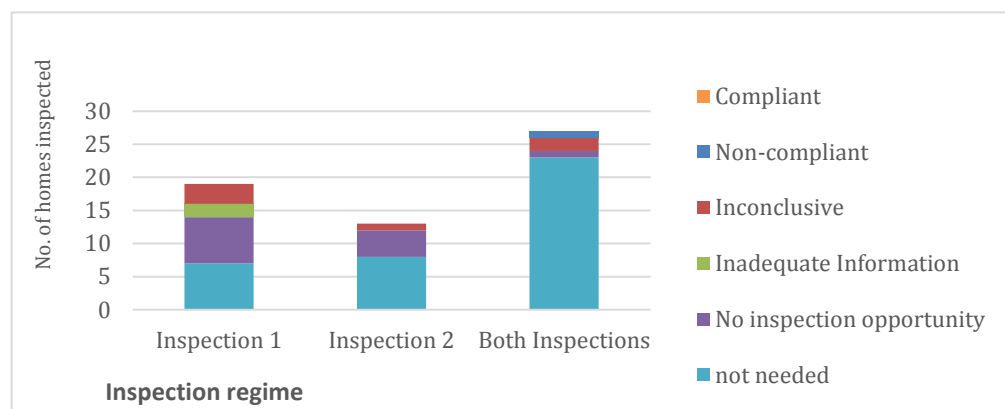
At the final stage of the construction, insulation on pipework and ductwork was relatively difficult to inspect. The desktop review often suggested it was not needed, which is likely to mean that detail was missing at this stage.

Key results are graphed in Figures 23 to 27.

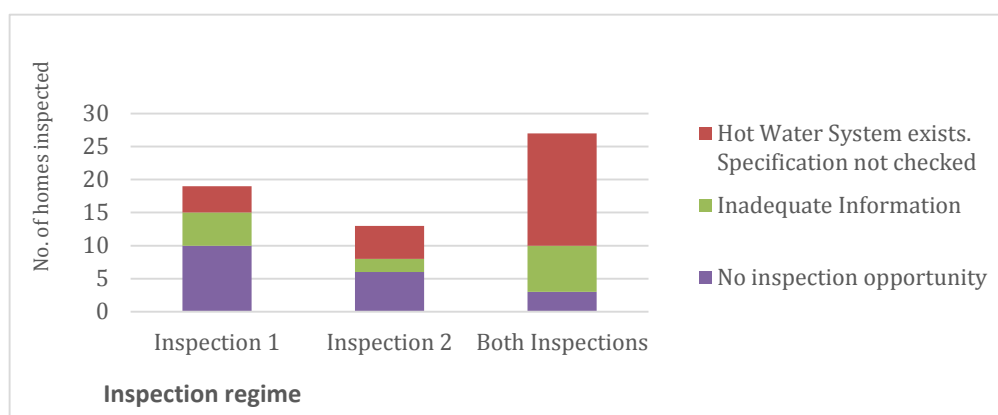
**Figure 23 - Airconditioning: Number of houses with different compliance results, as it relates to the different inspection regimes.**



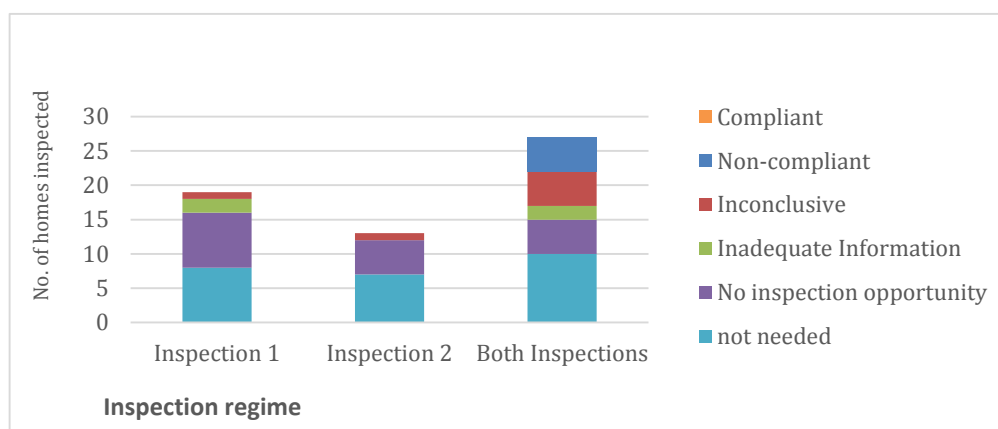
**Figure 24 – Ductwork Insulation: Number of houses with different compliance results, as it relates to the different inspection regimes.**



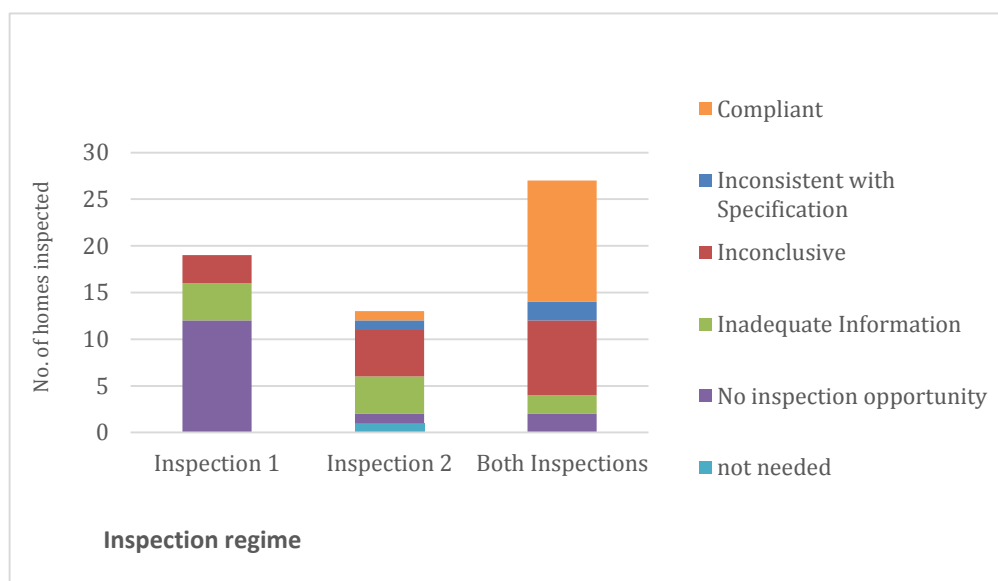
**Figure 25 – Hot Water System: Number of houses with different compliance results, as it relates to the different inspection regimes.**



**Figure 26 – Insulation of Heating/Cooling Pipework: Number of houses with different compliance results, as it relates to the different inspection regimes.**



**Figure 27 - Lighting: Number of houses with different compliance results, as it relates to the different inspection regimes.**



## Key Discussion Points for Building Services

Receipts, photographs of equipment nameplates and photographs of pipework and ductwork insulation may provide better evidence of compliance than reliance on the inspection of these items, given the difficulty of timing the inspections.

### 6.4.3.6 *Uncommon Elements*

The following elements were also included in the Inspection Checklist and were uncommon or non-existent in the buildings inspected:

- Roof ventilators (3)
- Roof lights/skylights (2)
- Sealing of roof lights, chimneys and flues (2)
- Floor insulation (2)
- Floor heating or cooling (0)
- Evaporative coolers (1)
- Renewable and alternative energy sources (e.g. solar photovoltaics) (0)
- Electric resistance space heating (6)
- Swimming pool or spa pool (0)

These elements could be removed from the main Inspection Checklist to reduce its size and only included as necessary.

### 6.4.3.7 *Building improvements*

In some cases, improvements in construction and resultant energy efficiency were noted, compared to the specifications in the building approval, such as:

- Higher rating insulation installed than specified.
- Lighter roof colour used.

There appeared to be no way of estimating the impact of the improvements or offsetting the benefits gained against items of non-compliance.

### 6.4.3.8 *Limitations experienced*

Pilot Councils were asked to document any limitations experienced in the site inspection process, to help refine the Checklist and support strategies.

### 6.4.3.9 *Design and approval documentation*

In many areas, compliance could not be measured due to a lack of information in the Development Approval documentation, most commonly: roof colour not specified, lighting type not specified, air conditioning not specified, hot water not specified. This demonstrates a lack of information at Planning and Development Approval stages. There were also cases of the information provided not lending itself to inspection, for example R value of insulation is more easily inspected as thickness of insulation.



It is noted however, that the newly developed standardized NatHERS Certificates will include more information about design and construction features included in the design (and NatHERS assessment), including a more detailed breakdown of wall and glazing elements, specified roof colour, notes on building sealing, predominant lighting type and space for notes on specific issues. This will allow a more detailed completion of the 'desktop review' section of the Checklist prior to on-site inspection, as well as the capture of relevant information within the Electronic Building Passport.

#### *6.4.3.10 Workplace safety considerations*

Due to individual State and Territory workplace safety procedures and Council risk management policies, staff can be restricted in inspecting buildings, particularly double storey buildings and the need to inspect at heights. In single storey internal inspections, the roof space may be viewed, unless there are enclosed ceiling/roof spaces, internal flat ceilings or sloping 'cathedral' ceilings clad 'on the rake', which make inspection impossible.

It is noted that inspections of ceiling/roof spaces and other confined spaces may be carried out through using elevated digital cameras. Awareness and guidance for Building Surveyors on this method is recommended.

#### *6.4.3.11 Checklist version and Pilot timeframe*

The Project adopted an iterative approach to reviewing the Inspection Checklist. Councils therefore used slightly different versions of the Checklist during the Pilot period. However, the final Checklist benefitted from the iterative approach during the Pilot. Due to the short Pilot timeframe, many of the recommended Inspection 1 and Inspection 2 stages were not completed for the same property. Councils were encouraged to test the Checklist at varying construction stages (as summarised in Table 3).

#### *6.4.3.12 Inspection Checklist detail and verification*

The level of detail provided against elements of the Checklist and the degree of assessment evidence provided, such as documentation and photos, varied. The assessment was in some cases subjective, based on the expertise and knowledge of the Surveyor carrying out the inspection.

In some cases, there was a reliance on the builder to verify construction details, due to the inability to view certain Checklist elements. Surveyors were reluctant to confirm the compliance/non-compliance status in the site inspection and relied on builder verification.

Whilst Pilot Councils shared examples of completed inspections, the varying depth of detail in the completed Checklists, highlights the need for assessment training as well as template examples of completed Checklists, to guide those involved in further trials. Verification documentation captured through an EBP system is also needed for Surveyors to complete their compliance assessment.

#### *6.4.3.13 Compliance action taken*

In most cases Council discussed the findings with the builder on-site to highlight issues noted. More formal written compliance tools were instigated in two instances - one in relation to non-compliant roof colour and another in relation to timber framing defects noted during an inspection.

Through Pilot and post-Pilot discussions, Surveyors emphasized the importance of providing

opportunity for natural justice and ensuring that enforcement measures used are proportionate to the severity of the non-compliance. This highlights the potential need for guidance on the materiality and severity of breaches with the energy efficiency provision of the NCC.

#### 6.4.3.14 Time taken to complete inspections

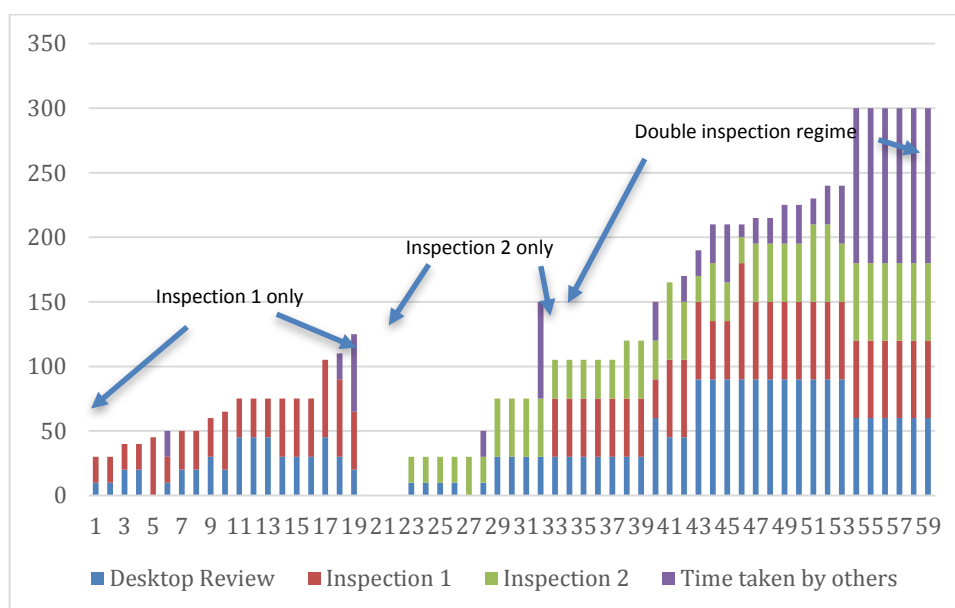
Time taken to complete inspection phases varied considerably as summarised in the following table. It is noted that the degree of detail provided in Inspection Checklists varied across Councils and this would have impacted on the inspection time taken.

**Table 9 – Time Taken to Complete Inspections**

Assessment Stage	Minimum Time Taken (minutes)	Maximum Time Taken (minutes)	Average Time Taken (minutes)
<b>Desktop Review</b>	20	90	44
<b>Site Inspection 1</b>	10	90	45
<b>Site Inspection 2</b>	20	60	40

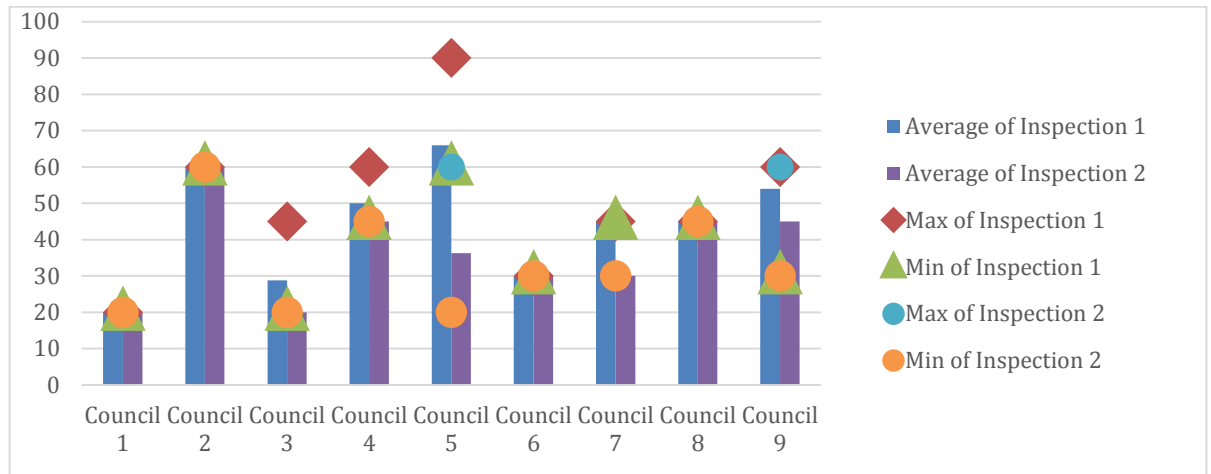
The total time invested in an inspection regime is included in Figure 27.

**Figure 28 – Total Inspection Time Recorded**



The variation in inspection timing and detail appeared to reflect Council systems and culture. In the graph below, Council 1 and 2 are both in the same state, yet every inspection in Council 1 took 20 minutes and every inspection in Council 2 took 60 minutes. Similarly Council 3 and 4 are in the same state. Council 3 used four different inspectors which accounts for some variation. Councils 5, 6 and 7 are also in the same state. Council 6 was the only other Council to use more than 1 Inspector (2 different staff members conducted inspections) and reported no time differences at all.

**Figure 29 – Comparison of Inspection Times for Different Councils**



## 6.5 Post-Pilot Feedback

Council representatives provided overall Pilot feedback through a post-Pilot webinar meeting as well as post-Pilot survey. Feedback was sought on:

- The usability of the inspection resource. The Checklist benefits, issues and limitations, integration options and priority assessment elements.
- Advice for establishing a legacy of compliance inspections: the role of Councils/Authorities, the role of the Building Surveyor profession and the potential role of other stakeholders.
- Input into strategic policy and support frameworks for driving energy efficiency compliance.

A Project Survey was also sent to interested Reference Group Councils as well as key industry stakeholders inviting their input into the potential value of compliance resources.

Stakeholders raised a wide range of issues, opportunities and considerations for developing an improved compliance assessment culture. Various themes identified through the Phase 1 NEEBP research were re-iterated, in relation to establishing an effective compliance approach. These themes are detailed in this Section, with an emphasis on supporting on-site energy efficiency compliance inspections. Some themes are general in nature and applicable to all jurisdictions, while others are specific to state/territory circumstances.

### 6.5.1 Feedback on the inspection resource

#### 6.5.1.1 The checklist content

Overall, Councils found the Checklist useful in increasing awareness of the NCC energy efficiency provisions and it was considered thorough in covering the NCC elements. It was suggested that the Checklist be provided as a self-assessment guide to the building industry. Councils also reported the following:

- The Pilots have raised awareness of the NCC EE provisions among Building Officers and Builders involved in inspections.

- Generally, Pilot Councils consider the audit to be a useful summary of the NCC EE requirements. They can see benefit in working on the resources to further tailor the Checklist to climate zones and to integrate the checklist elements with their current mandatory inspection framework (where appropriate).
- Councils see value in making the Checklist available to industry for self-assessment.
- There is the potential to apply the Checklist during construction, for renovations and alterations (Project 3) as well as at 'point of sale'.

***Formalising an Inspection Checklist that is specific to the climate zone regions would assist in the effectiveness and efficiency of the audit process.  
(Pilot Council representative)***

Councils provided the following feedback for refining the Checklist product:

- The Checklist needs to be more concise to enable for a more efficient inspection time.
- Certain Checklist elements were considered higher priority than others and some of the issues are relatively insignificant. The Checklist should therefore be refined to encapsulate the NCC elements of greater priority or energy efficiency materiality. Priority elements to be assessed include: design compliance, glazing, insulation installation, light installation and thermal imaging performance.
- There are various NCC provisions which only apply in certain states or for certain construction types. Councils suggested that state specific checklists would be more useful.
- Inspection tools such as glass measurers and document verification methods, are needed to support the Checklist product.
- Floor, roof and wall insulation can be difficult to visually assess depending on the methods of construction and inspection timing.

State specific feedback included:

- WA – Surveyors were restricted in accessing building sites, as mandatory inspections are not required in WA. Most inspections were therefore undertaken during near completion or completed stage.
- SA – It was difficult to time inspections as Council is not notified of the relevant construction stages.
- NSW – The BASIX Assessment reports do not detail all NCC energy efficiency elements included in the Checklist such as minimum R value for insulation and thermal breaks in walls.
- QLD – Various elements of the Checklist do not apply to masonry construction. Some designs in climate zone 2 do not require wall insulation.
- TAS – The Checklist needs to be assessed in conjunction with relevant documentation. A schedule for windows and doors is needed to facilitate checking.

#### 6.5.1.2 Verification mechanisms

The requirements for verification methods such as documentation and/or product labelling, was highlighted by Councils. Verification methods are needed to address the common visual site assessment limitations experienced by Building Surveyors. Suggestions included:

- A reliable glazing certification and labelling system.
- Glazing certification details (such as the certification for Australian Window Association members).
- Supplier letters/sign-off on products, to confirm their standard.
- Receipts for installed items.
- Appliance documentation
- Photos
- Thermal imaging
- Glazing calculators
- Blower door tests

***Marking individual products e.g. glazing, would make inspections easier and ensure that compliance can readily be audited. Difficult to validate what's been installed and rely on certification. (Pilot Council representative).***

***Improved clarity by branding materials to reflect useful information would also be helpful. (Pilot Council representative)***

#### 6.5.1.3 Building documentation to support the inspection process

Adequate approvals and design documentation is needed to support the inspections. It was suggested that Councils request the following details to support energy efficiency inspections:

- A window and door installation schedule.
- Accurate information for the desktop review of the design. If the information provided is not clear the Inspector should have a mechanism to obtain more information.

#### 6.5.1.4 Innovation and technology

The potential for digital inspection tools was highlighted, noting that some Councils are moving towards digital inspection approaches and one Council already uses iPads in the field.

***Innovations and processes can always improve with technology advancement. There is potential for implementation of a mobile device application that is integrated with the checklist and relating to the applicable climate zone area details for the region selected. (Pilot Council representative)***

## 6.5.2 Feedback on strategies to support compliance inspections

### 6.5.2.1 Building and Assessment Documentation

Inadequate design and assessment detail places significant limitations on the site inspection process. Surveyors noted a lack of builder awareness of the energy assessment requirements and assessment documentation. Building Surveyors expressed concerns with the assessment method involved.

***There is a disconnect between building approval documentation and documentation used in the field. Approval documentation doesn't suffice in the first instance. The potential issue is that the Surveyor starts prescribing what is required. (Pilot Council representative)***

### 6.5.2.2 Policy and regulations

Participants emphasised the need for mandatory regulations to support energy efficiency compliance assessment. It was highlighted that the allocation of further Council resources for additional site inspections for energy efficiency, would unlikely be supported, in the absence of regulatory requirements.

***Legislate - councils are time poor already and would require strong political will to do anything above and beyond otherwise. (Pilot Council representative)***

Conversely, Councils expressed concern regarding the resource pressures of additional regulation, as well as the professional development pressures, which would be placed on Building Surveyors who need to be across an increasing range of technical and regulatory knowledge.

The practicality of mandating energy efficiency inspections was also questioned due to the difficulty in timing inspections to check the NCC energy efficiency provisions. Other compliance and performance incentive mechanisms were suggested, such as:

- A revision Energy Assessment by approved Energy Assessors post-construction.
- A rigid structure for product specification and installation.
- Builder notification/report on insulation installation.
- An assessment at 'point of sale' for all homes.
- A compliance assessment one year into occupancy.

### 6.5.2.3 Consumer awareness and empowerment

Councils highlighted that energy efficiency is not a common cause of community complaints in relation to building standards. Checking energy efficiency compliance is therefore not prioritised or addressed through follow-up inspections. This could change with increasing consumer awareness and empowerment and improved consumer protection mechanisms for building energy efficiency performance.

Consumer awareness is also critical for continually achieving the building's energy efficiency performance. Consumers need to be aware of ongoing maintenance requirements and energy efficiency standards through renovations and retrofits (the subject of research in Project 3). Consumer education on fittings, appliance selection, use and maintenance is needed, for sustained improvements.

***We need market drivers. Consumer awareness and trust controls need to be put in place. (Pilot Council representative)***

#### 6.5.2.4 Skills, training and professional development

Training in applying an energy efficiency Checklist would help reduce some of the subjectivity in compliance assessment and promote consistency in applying the inspection tool. There was a varying degree of confidence across Surveyors in the energy efficiency elements of the NCC. Training and knowledge sharing for Surveyors was suggested, although some Surveyors had concerns about the increasing knowledge expectations required of the profession, highlighting the need for professional recognition and development incentives.

#### 6.5.2.5 State perspectives

Certain feedback provided by Pilot Councils related specifically to the jurisdictional context for NCC compliance. The following suggestions were highlighted through the Pilot and post-Pilot discussions:

- It is important the project findings are considered as part of State level reviews of BASIX in NSW.
- It was proposed that study findings be provided to relevant jurisdictional departments to inform their legislative review processes. There was a desire to ensure that the current planning reforms in South Australia, Tasmania, Western Australia and the Australian Capital Territory, consider building application, assessment and compliance methods.
- The project highlighted the necessity of Building Surveyor professional training and qualifications.
- It was suggested that Checklist elements be incorporated into relevant Queensland Government inspection guidelines established under the *Building Act 1975*.

## 6.6 Stakeholder Perspectives

The Project Team liaised informally with industry representatives including the Housing Industry Association and the Australian Windows Association to obtain their input into the project. Key points raised included:

- Energy efficiency compliance needs to be considered along with other NCC compliance priorities such as structural stability. There is still a need to improve compliance assessment consistency across Australia for building structure and safety.
- The cost to consumers of non-compliance needs to be considered.

- Guidance on the severity of non-compliance is warranted, to determine how far a discrepancy in star rating is taken, that is, from half star through to 5 star. Owner responsibility for the ongoing energy performance of the home also needs to be taken into account.
- Priority energy efficiency elements should be the focus of compliance assessment such as windows, insulation and building sealing.
- Certain elements of the Checklist relating to windows would be difficult to visually assess. Thickness of windows is not necessarily a measure of energy efficiency performance. The Checklist needs to ensure that inspections of windows are performance-based and enable verification of the product standard through Window Energy Rating System (WERS) labelling, as per the 'Australian Fenestration Rating Council' requirements.

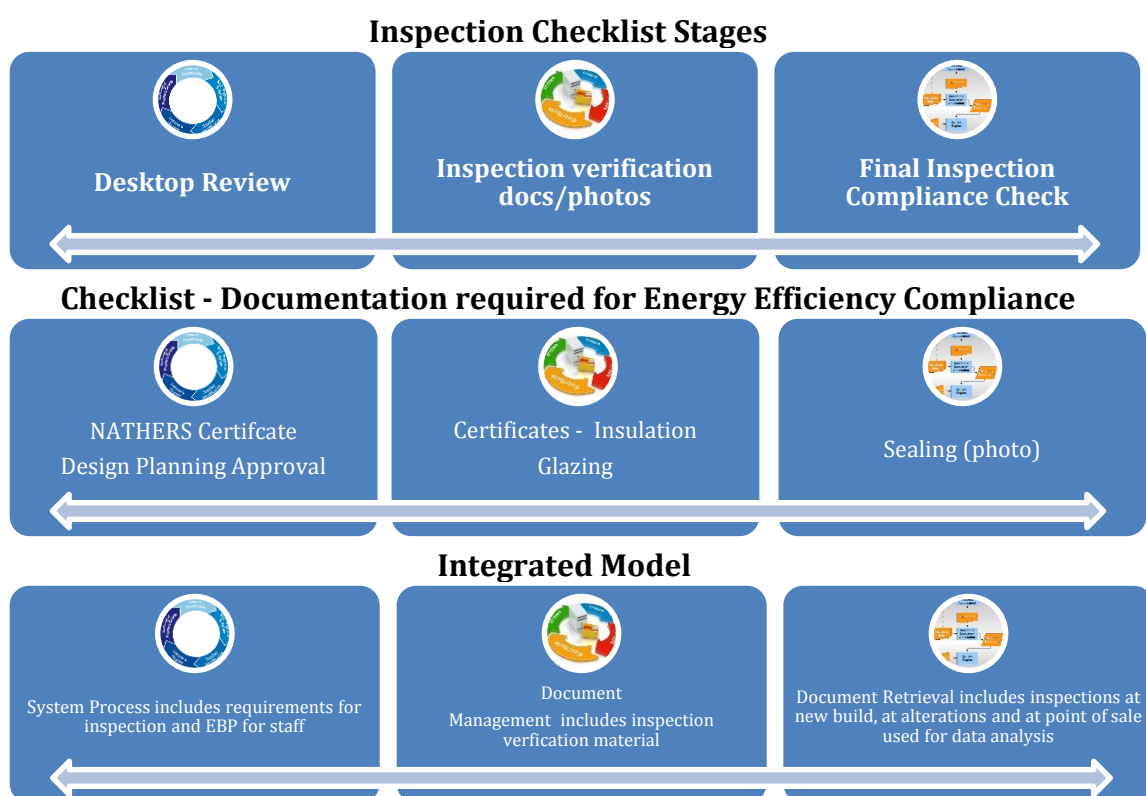
## 6.7 Integration with the EBP

Councils experienced limitations on site in being able to verify and check energy efficiency requirements under the NCC. Given that one of the barriers to compliance and inspections approaches was resource requirements and funding, it will be important to ensure that the outcomes of this Report inform the next steps towards the integration of the three Pilot research projects.

We have explored the process of the energy efficiency inspections and intersection with the EBP System. To maximise efficiency and reduce impacts, a way of integrating the two Projects is suggested in Figure 30, as a best practice approach. Figure 30 outlines the different stages of the Inspection Compliance Checklist approach and where it would be appropriate to ensure that information is captured in an Electronic Building Passport system at different approval stages. Project 3 outcomes could be easily further integrated into this model.



**Figure 30 – Inspection and Building Passport Integration Concept**



Further detail on the linkages between the EBP document capture fields and the Inspection Checklist is shown in Appendix J.

The actual nature of an integrated model will need further development and discussion with industry, Councils and Government prior to any further Pilot or trial. It would be ideal if the integrated model was developed by engaging an expert panel, in the same way that Australian Standards are developed. A suggested expert panel would include representatives from a range of Councils, a building Authority, a professional representative body and Government (Commonwealth, State and Local). Representation of staff covering building and planning assessment, building surveying and sustainability is recommended. The expert panel would undertake a post-Pilot and technical review of all three (3) Projects of NEEBP Phase Two, in developing the integrated model.

## 7 Recommendations

### 7.1 Policy and Regulatory Frameworks

The NEEBP Phase One study identified the need for at least one mandatory inspection of the energy performance features of new buildings. More than 80% of survey respondents in this Project, agreed that energy performance needs to be part of the inspection and certification process. However (and also consistent with the results of the Phase One Study), concern was expressed by Pilot participants regarding the resource implications of this undertaking, as well as the practicality of mandating inspections (due to the timing difficulties and limitations in inspecting energy efficiency elements).

Through the consultation with Pilot Council representatives (Building and Sustainability staff), it was evident that whilst participating Councils recognise the need for improved energy efficiency compliance, they would place ongoing priority on mandatory inspection requirements, that is, those inspection stages required by regulation, where applicable. The role of various players, such as Energy Assessors and Auditors within a mandatory framework also needs to be explored. Some pilot representatives highlighted that Councils would be unlikely to prioritise energy efficiency compliance inspections, in the absence of regulatory requirements. It is important that the findings of this study are provided to State and Territory Governments and considered as part of the current legislative reform processes (such as planning and building reforms currently in progress in South Australia, Tasmania, Western Australia and the Australian Capital Territory). The findings also need to be available to industry, Local Government and consumers in order to create leadership opportunities and ongoing legacy outcomes of this work.

Inspections by Building Surveyors were completed to a varying level of detail, highlighting the need for a nationally consistent guide and overarching 'Audit Quality Framework' for an energy efficiency compliance inspection regime.

Feedback from Pilot Councils highlighted the importance of recognising the range of potential players and options for driving improved compliance and that further exploration of a range of compliance options is needed. Looking beyond Local Government, to determine roles for driving improved compliance, was emphasised. Common feedback was that Energy Assessors should be re-engaged post-construction to undertake an 'as built' energy assessment. Self-assessment and certification by industry was also suggested.

## **1. Recommendations – Policy and Regulatory Frameworks**

- 1.1 The Pilot findings support the Phase One recommendation to develop and apply model code provisions and/or regulations to guide an inspection regime (guiding Councils/Authorities on a sample approach to undertaking inspections). As a result of the Pilot, it is also recommended that a nationally consistent 'Audit Quality Framework' be developed incorporating an approach to evaluating inspection performance.

Framework elements should incorporate details for: the goals of the inspection regime, Inspector skills and qualifications, frequency and timing of inspections, quality principles, targets for percentage of new homes inspected, representation of types of homes inspected and assessment/audit of the inspection regime.

- 1.2 That the NEEBP reference group (or Commonwealth) prepare a workshop and briefing for each State and Territory Government involving the following agencies (or departments):

- Planning
- Building code
- Energy
- Sustainability
- Local Government

That a copy of this report be provided to each of these groups at this briefing to assist states and territories in addressing energy efficiency provisions of the NCC and to inform current legislative reform processes such as those in South Australia, Tasmania, Western Australia and the Australian Capital Territory.

- 1.3 Integrate the NCC provisions and Checklist elements into mandated inspection stage guidelines (where applicable); for example, the Queensland Government inspection guidelines established under the *Building Act 1975*.

- 1.4 Undertake an in-depth review of the costs, benefits and limitations of complementary compliance models in consultation with Authorities and Industry (exploring the role of Energy Assessors and extending private certification for certain elements).

## 7.2 Moving from Pilot to a Voluntary Trial

The Pilot project provided useful insights for the successful design of a trial program. It is clear that further stakeholder and industry consultation is needed to further develop the inspection and EBP products and define stakeholder roles (Councils/Authorities and the Construction Industry), in the application of an integrated compliance framework. Whilst there is a call for tighter regulatory compliance frameworks for energy efficiency, these recommendations are directed at supporting voluntary energy efficiency compliance assessment by Councils and relevant Authorities.

An extended timeframe to trial voluntary inspection resources across a greater number of homes is warranted, in order to:

- Further refine an integrated model (as outlined in Section 6.7).
- Allow 'real time' integrated testing with the EBP product as well as the new NatHERS certificate.
- Promote knowledge and awareness across the sector.
- Obtain further data on compliance performance.

There is also a need to engage private sector Building Surveyors/Certifiers in the further development of resources, such as the recommended Audit Framework and Inspection Checklist. There is a need to work with professional representative bodies such as the Australian Institute of Building Surveyors, to engage private surveyors and certification businesses in the next phase of the project. A partnership agreement between the NEEBP and relevant professional bodies to facilitate their involvement in the next phase, is recommended.

The Pilot identified the need to ensure that any recommendation to move from a Pilot to a voluntary trial, needs to take into account the time and resource implications for Councils, stakeholders and industry. For instance, an electronic version (web or app based) of the proposed Residential Energy Efficiency Compliance Inspection Checklist could save time for both Councils/Authorities and proponents. The notes of both proponents and Council staff during the planning stage could be inserted to automatically populate the Residential Energy Efficiency Compliance Inspection Checklist. This saves time for the Inspector prior to visiting the site. This could then be part of a package linking to, or incorporated within, the EBP (Project Two) for Councils/Authorities to trial.

To enable the Inspector to identify the impact of construction changes whilst on site, that is, the actual difference in substituting a different glazing system or insulation product to that included in the design documentation, the Checklist could include a sliding NatHERS scale. This would start at the Star rating given by the NatHERS certificate and would give an approximate impact on the Star rating for certain changes. This would help identify major non-conformances that require action against minor non-conformances that make little difference to energy performance.

The Pilot experience highlighted some important parameters to consider for the next voluntary trial phase:

- Enabling a trial timeframe that gives adequate time for obtaining agreement from Councils/Authorities to participate and for testing the compliance inspection resources from desktop analysis through to new home construction and completion.

- Ideally, a planned 4-6 month trial period once Councils/Authorities start the process, would provide the necessary points for a full compliance inspection to take place.
- The majority of inspection compliance should be timetabled to take place between September and April each year, to maximise the likelihood of being able to complete inspections without weather interruptions.

Recognition of involvement was an important driver for Councils. In order to implement the next stage of the recommendations of this Report (and for the other two Projects), a communication and engagement plan should be implemented with appropriate project branding and communication materials. This would facilitate promotion of the Project and help Councils/Authorities to promote their involvement in their communities.

The following recommendations need to be taken into account with the suggested integration approach as outlined in Section 6.7 and developed through liaison with the Project 2 NEEBP team.

2. <b><i>Recommendations – Moving from Pilot to Trial</i></b>	
2.1 Establish an expert panel including representatives from: a range of Councils, a building Authority, a professional representative body and Government (Commonwealth, State and Local) to:	<ul style="list-style-type: none"> <li>• Undertake a post Pilot and technical review of all three projects of NEEBP Phase Two.</li> <li>• Further consult with stakeholders to develop an integrated compliance model.</li> <li>• Further consultation on the role of industry groups in driving implementation (Councils/Authorities, builders and product suppliers).</li> <li>• Refine roles for the Inspection Checklist completion.</li> </ul> <p>Representation of Council staff including building and planning assessment, building surveying and sustainability is recommended for inclusion in the expert panel.</p>
2.2 Develop an electronic version (web or app based) of the proposed <i>Residential Energy Efficiency Compliance Inspection Checklist</i> to allow the notes of proponents and Council staff during the planning stage to automatically populate the Checklist.	
2.3 Adapt the Checklist for each Climate Zone to reflect the various provisions of the NCC.	
2.4 The electronic Checklist should be further adapted and developed to include a sliding NatHERS scale so that changes during the construction stage could be immediately incorporated on-site to determine impacts on star ratings. This could be achieved through linking this recommendation with recommendation 2.2	

## **2. Recommendations – Moving from Pilot to Trial**

- 2.5 Develop an in-depth trial with one to three Councils/Authorities to fully integrate the energy efficiency compliance requirements within their planning and building assessment processes, Council policies and current assessment tools.

The in-depth trial should involve representatives from:

- One of the National Growth Areas Alliance Council members, a smaller regional Council and a state based authority.
- Different states.
- Different climate zones.

- 2.6 That a guide for piloting or trialling the next stage be adopted as follows:

- Six week recruitment period for Councils/Authorities to participate.
- Guidelines for participation such as inspection detail to be provided.
- Four to six months for compliance inspection to take place for each new home.
- Majority of inspection to be timetabled between September and April each year (depending on climate zone).
- Six week period of engagement and testing of outcomes with stakeholders.
- Any incentive for participation should be flexible to gain maximum benefit.

- 2.7 Develop Pilot legacy communications aimed at senior Council management, Sustainability and Building section staff collectively.

- 2.8 Develop a partnership agreement between the NEEBP and professional bodies (such as AIBS, Building Quantity Surveyors and the Surveying and Spatial Sciences Institute) to facilitate their involvement in the next phase of NEEBP.

- 2.9 An extensive Council/Authority engagement and recruitment phase is recommended, combined with awareness presentations to state, territory and regional networks and industry.

## 7.3 Knowledge Management

The NEEBP Phase One Report includes an Action Plan for enhancing and promoting knowledge management to support a cultural shift towards improving energy efficiency performance. The Inspection Pilot Project highlighted important considerations for the NEEBP Knowledge Management program. Knowledge management is the process of capturing, developing, sharing, and effectively using organisational knowledge. It refers to a multi-disciplinary approach to achieving organisational objectives by making the best use of knowledge. In the context of the NEEBP Knowledge Management, it should be relevant across a range of stakeholders such as Councils, Building Authorities, the building industry and the community.

A trusted, industry neutral and relevant host platform should be adopted for knowledge sharing. For knowledge sharing regarding compliance inspection resources targeting Building Surveyors, potential partners include: the Australian Building Construction Board, the Local Government Associations in each state /territory and professional bodies.

Critical to knowledge sharing is the different forums in which material is communicated and acted upon by all relevant stakeholders in the value chain. Developing nationally consistent materials to raise awareness and providing a national series of NEEBP presentations to Council Elected Members and senior management, on the practical sustainability benefits of NCC compliance, will be important aspects of the knowledge management approach for the ongoing legacy of this Project. Forums such as the conferences of the Australian Local Government Association and state/territory municipal associations, are potential avenues.

A knowledge sharing platform needs to incorporate industry and stakeholder training and development. Incentives could be provided to ensure the knowledge gap is bridged over time to ensure experts in energy efficiency are available within Council and at a regional level, through appropriate training programs. As recommended in NEEBP Phase One, energy efficiency excellence should be integrated within a continual professional development and accreditation framework for the construction industry (including Building Surveyors) and the NEEBP stakeholders should advocate for a mandated system.

Experienced staff from Councils/Authorities, industry or professional bodies, could provide a valuable mentoring role to others, to raise the level of expertise in undertaking energy efficiency inspections. They could provide communication networks to expand the legacy of this project and to share knowledge and information with their stakeholders.

### 3. ***Recommendations – Knowledge Management***

3.1 Following the expert panel review (recommendation 2.1) incorporate the inspection resources and guideline into an accessible online knowledge platform (National Clearinghouse) for Building Surveyor professionals and other stakeholders.

3.2 Develop awareness raising material (building on recommendation 2.3) on the opportunities and benefits of compliance with NCC energy efficiency requirements and the outcomes Projects One, Two and Three.

3. <b>Recommendations – Knowledge Management</b>
3.3     Target specific stakeholder audiences such as Local Government Elected Members and senior management, on the benefits of NCC compliance through a range of avenues such as: <ul style="list-style-type: none"> <li>• Australian Local Government Association (ALGA) national conference;</li> <li>• State Local Government Association (LGA) conferences;</li> <li>• Individual Councils and Authorities;</li> <li>• National and State Building and Building Control conferences</li> <li>• National Planning conferences; and</li> <li>• Industry conferences and forums.</li> </ul>
3.4     Provide incentives for an accredited professional development program on energy efficiency for stakeholders, industry and Councils/Authorities and advocate for a mandated system.
3.5     Develop a training module for the compliance assessment tool, guideline and interrelationship with the EBP, to support the project trial phase (via an e-learning module).
3.6     Engage experienced Building Surveyors involved in the Pilot project to provide an advisory and mentoring role through involvement on the Expert Panel.

## 7.4 Empowering the Community

While the project focused on builder compliance with the Code through an inspection regime, the priority given to energy efficiency for new homes needs to be driven by the consumer. Councils reported that energy efficiency is not a common topic of community complaint and therefore, there are few complaint-based inspections on these provisions of the Code. The Pilot findings support the need for improved consumer awareness (as identified in NEEBP Phase One) to support a compliance assessment culture. Ongoing energy performance of homes also relies on consumer use and knowledge of appliances/fixtures and on the real estate industry articulating the benefits of energy efficiency to new home buyers.

Social marketing seeks to develop and integrate marketing concepts with other approaches to influence behaviors that benefit individuals and communities for the greater social good. In linking knowledge management and empowerment of communities (and in this instance, stakeholders), it is a useful tool in shifting awareness to action on energy efficiency.

While the Checklist is provided as a guide, it is only when the legal ramifications of a house not performing to that which it is purported to do, that the consumer has a recourse through State consumer protection policies and legislation. It is therefore important to understand where the Checklist elements intersect with consumer protection mechanisms.



Guidance material on energy efficiency and the rights of consumers will be an important element in moving from awareness to empowerment and action. It is important that this is available as part of a package of information to address energy efficiency compliance with stakeholders, the building construction industry, Local Government, consumers and the real estate industry.

The overall effect of addressing compliance with the energy efficiency requirements under the NCC is to ensure that issues of liability are covered in any advice, advisory notices or guides to consumers. There is a need to ensure that the implications of people undertaking energy efficiency inspections and compliance are fully understood from a legal liability and insurance perspective.

<b>4.     <i>Recommendations – Empowering the Community</i></b>	
4.1	Support a national social marketing campaign to educate consumers, home owners/purchasers and the real estate industry, about building energy efficiency (as recommended in NEEBP Phase One).
4.2	Review the applicability of the energy efficiency checklist elements within consumer protection mechanisms (such as assessment or contracts at the point of sale).
4.3	Develop home occupier energy efficiency guidance material and encourage circulation through Councils and the building industry.
4.4	Assess the professional liability implications for Building Surveyors and Councils/Authorities, in assessing energy efficiency compliance and the adequacy of legislative protection mechanisms and common insurance schemes.

## 8 References

1. National Construction Code Series Volume 2. Building Code of Australia Class 1 and Class 10 Buildings. Australian Building Codes Board. Second Edition. 2015.
2. National Construction Code Volume One. Energy Efficiency Provisions. Handbook. Third Edition. 2015.
3. State of South Australia. National Energy Efficient Building project. Prepared by Pitt and Sherry and Swinburne University of Technology, 2014
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5. *Building Act 2011*, WA
6. *Building Regulations 2012*, WA
7. *Building Act 2015*, NT
8. *Building Regulations 2008*, NT
9. *Building Act 1975*, QLD
10. *Building Regulations 2006*, QLD
11. *Environmental Planning and Assessment Act 1979*, NSW
12. *Environmental Planning and Assessment Regulations 2000*, NSW
13. *Building Professionals Act 2005*, NSW
14. *Building Act 2004*, ACT
15. *Building Regulations 2008*, ACT
16. *Building Act 1993*, VIC
17. *Building Regulations 2006*, VIC
18. *Building Act 2000*, TAS
19. *Building Regulations 2004*, TAS
20. *Development Act 1993*, SA
21. *Development Regulations 2008*, SA

## **Appendix A – Pilot Council Expression of Interest**

## National Pilot Council on Energy Efficiency Auditing

### Expression of Interest

The National Energy Efficient Buildings Project (NEEBP), managed through the South Australian Department of State Development, is entering the second phase of its 2 year investigation. This phase includes “on ground” pilot projects across Australia working with local government and building regulatory authorities to improve compliance with the energy efficiency provisions of the National Construction Code (NCC).

Healthy Environs has been engaged to undertake Project 1 ‘Residential Building Audits’ (leading a multi-disciplinary project team including Sustain SA, dSquared and Leading Edge Town Planners).

The aim of this project is to work collaboratively with local government and building authorities to develop and pilot practical ‘as built’ residential energy efficiency audit policies and protocols which assess compliance with the NCC. Our team will work with pilot participants to develop audit resources that improve the auditing process, can be delivered cost-effectively and can add value to stakeholders.

In accepting this invitation to participate as a pilot council in the *Project 1 ‘Residential Building Audits’* (by signing this form) you commit to:

- Undertake 5 audits of class 1 residential buildings (note: the site audit period will occur during the 1<sup>st</sup> to the 30<sup>th</sup> April 2015).
- Undertake 2 on-site inspections at construction stages to be agreed in the protocol (or as otherwise agreed).
- Undertake site audits in accordance with safe work practices and the requirements of work health and safety legislation in your State/Territory.
- Participate in ‘consultations’ with our team (teleconference workshops and other mechanisms) to develop and review the pilot audit resources.
- Provide completed audit results (*note: results will be de-identified for analysis and reporting purposes*)
- Share your learning’s with other councils and building authorities during and beyond the pilot stage.

A cash incentive of \$1000 plus GST is provided for each audit (comprising of 2 site visits), be it undertaken by Council Officers, an appointed auditor or working with one of our technical staff. Our project team will be available to guide Officers on the interpretation of the NCC and pilot audit resources.

Invoices can be issued to Healthy Environs upon completion and submission of the audit findings. Invoices will be paid within 30 days.

Councils will need to recommend a staff contact for the duration of the pilot project which is expected to finish on May 31<sup>st</sup> 2015. Any monies not spent on the audits and project may need to be returned and reinvested in other pilot councils.

---

Signed on behalf of (Council Name)

Authorised Council Officer


Date

Witness

Date

Staff contact details for project:

## Appendix B – Pre-Pilot Webinar Presentation



National Energy Efficient Building Project  
**Project 1 – New Home**  
**Energy Efficiency Compliance Audits**  
 Webinar – Tuesday 28<sup>th</sup> April

<http://neebp1.wix.com/energycompliance>


## Welcome

### WEBINAR outline April 2015

<b>Welcome</b>	Sally Modystach
Round- web - table introduction to councils and project team	
Introduction to NEEBP	Sabina Douglas Hill
<b>Project 1</b>	Sally Modystach
• Methodology	Sally Modystach
• Pilot councils and recruitment	Phil Donaldson
• Expectations and consultation	Phil Donaldson
• Evaluation and communications	Heather Smith
The webinar process	Sally Modystach
Policy - Audit and Protocol –feedback	Sally Modystach
Sum up and next steps	Sally Modystach

## The Context to Project 1

### Introduction to the Project Team



## Pilot Councils

- City of Playford (SA)
- District Council of Mt Barker (SA)
- City of Whyalla (SA)
- City of Cairns (QLD)
- Mildura City Council (VIC)
- Noosa Shire Council (QLD)
- City of Joondalup (WA)
- City of Mandurah (WA)
- Lake Macquarie City Council (NSW)
- Parramatta City Council (NSW)

## The NEEBP

### National Energy Efficient Buildings Project

Managed by the Department of State Development (SA) on behalf of all jurisdictions as part of the National Strategy on Energy Efficiency

## NEEBP Framework

- NEEBP overseen and funded by all jurisdictions through the COAG Energy Council
- NEEBP sets out to investigate understand and influence
  - Discrepancies in designed vs built energy efficiency
- NEEBP Phase 1 – learn and interpret
  - Pitt and Sherry final report
- NEEBP Phase 2 – demonstrate and influence
  - “on-ground” **demonstration pilots, regulatory review, consumer info & change strategies**

- NEEBP commenced November 2012, through the Select Council on Climate Change
- Now overseen and funded by all jurisdictions through the COAG Energy Council
- SA leads the project with active input from Project Reference Group (PRG) representing building EE expertise from state & territory and local government
- Project reports to COAG Energy Council senior officials through the Council's Buildings Committee

The NEEBP sets out to investigate, understand & influence

- Apparent discrepancies in anticipated energy efficiency between building as designed and building when lived in
- Common points of non-compliance with the energy efficiency requirements of the National Construction Code (NCC)
- Effectiveness of regulations nationally in delivering consistent energy efficient alterations or additions
- Strategies to catalyze and support all players in the building cycle (concept to key) to achieve EE compliance with the NCC and ultimately to deliver energy efficient building stock

NEEBP Phase 1 – learn & interpret

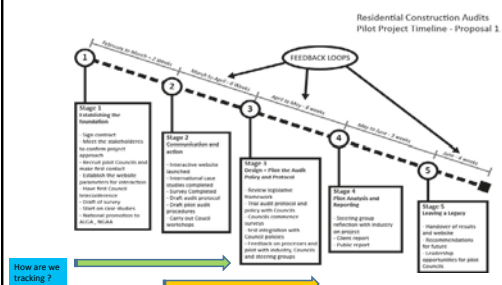
- Phase 1 undertook industry and agency consultation through Australia-wide **workshops** (20), **survey** (600), formal **submissions** (50) and open **dialogue** (1000 plus)
- Pitt & Sherry - Swinburne University of Technology managed 3 projects collaboratively to understand:
  1. Key systemic or process weaknesses and common points of non-compliance
  2. Issues specific to achieving consistent energy efficiency in Alterations and Additions
  3. Role of industry knowledge and skills in delivering building energy performance and NCC compliance

## Phase 2 – demonstrate & influence

- Phase 2 is delivering “on-ground” **demonstration pilots, regulatory review, consumer info & change strategies**:
  - Piloting compliance audits for residential buildings under construction
  - Piloting EBP-based documentation control systems for EE
  - Improving EE compliance and consistency in Alts & Ads
  - Improving capacity of consumer protection agencies to advocate for home owners on home energy performance
  - 2020 Steps – recommended strategic actions to achieve NCC compliance and improve building energy efficiency

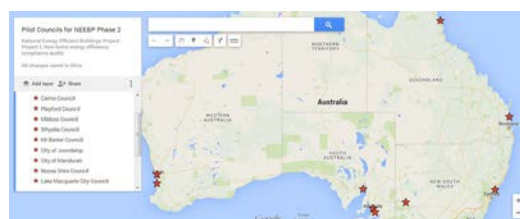
## Project 1

### Methodology and timeline



## Project 1

### Council recruitment



### Key questions

**What are your expectations of your involvement in this project?**

**Who is involved and who else needs to be involved to support you?**

**What is the councils expectations of their involvement in this project at a:**

- How widely do you want to be consulted?**

How much contact do you want from the project team and what works best for you ?

[illegible]

<http://neebo1.wix.com/energycompliance>

```

graph TD
    A[Initiation (pre-pilot) Discussion] --> B[Pilot Participant Webinar 1]
    B --> C[Inspection Administration Data Collection]
    C --> D[Inspection Feedback- Inspection 1/Inspection 2]
    D --> E[Post-Audit Administration Data Collection]
    E --> F[Pilot Participant Webinar 2]
    F --> G[Public Report]
  
```

### Pilot Evaluation Goal

The aim of the pilot evaluation is to assess the viability of New Home Energy Efficiency Compliance Audits.

Our evaluation aims to test the following idea, “audits can be delivered effectively and add value to the construction process”

Essentially our evaluation asks:

Do the NCC energy efficiency audit resources (Policy, Guideline and Inspection Form) add value to the construction process

- 1) Effectively monitoring compliance  
Improving levels of compliance  
Providing additional benefits
- 2) Are the audit resources considered useful  
and practical by relevant Authorities?

Q. Do we need an overall policy which can be adapted to Local Government to enact compliance with the NCC for energy efficiency for new houses

### Policy Objective

To ensure that the energy efficiency provisions of the NCC are realised in as built residential buildings.

### Policy Outcomes

Through assessing construction compliance with energy efficiency design features for new homes, we aim to:

- Increase the energy efficiency of new housing now and into the future.
- Improve the capacity and knowledge on energy efficiency standards in the industry.
- Increase consumer confidence in the energy efficiency performance of residential buildings.

Q. Does the following diagram adequately describe the construction process

- |   |  |
|---|--|
| ➤ | Developer or design team submit Energy Efficiency information as part of DA  |
| ➤ | Council/Authority Building Approvals Section review Energy Efficiency information against drawings and documentation         |
| ➤ | Form updated by Developer or design team for Construction Certificate/Permit   |
| ➤ | Council/Authority reviews the Residential Building Energy Efficiency Inspection Checklist against drawings and documentation |
| ➤ | Contractor notifies Council building approvals team of construction program to plan inspection dates                         |
| ➤ | Site Home Energy Efficiency Inspection 1   |
| ➤ | Site Home Energy Efficiency Inspection 2   |
| ➤ | Issue relevant building consent (e.g. certificate or permit) or non-compliance documentation                                 |
| ➤ | Council/Authority provides feedback through evaluation   |

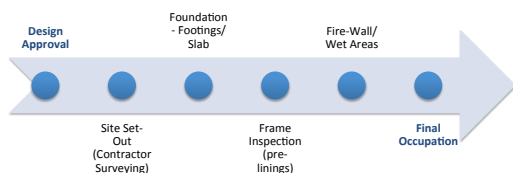
- best timing for two inspections?
- any gaps?
- identifiers?
- time needed to inspect?

[illegible]



## Project 1

### Timing for energy efficiency inspections



## Project 1

### BASIX Discussion



- What is the potential role of 'as built energy efficiency compliance inspections' as part of BASIX assessment and compliance system?
- Can the current checklist be used to record and inspect the BASIX Certificate and approved residential design details for energy efficiency ?

## Project 1

### Inspection Checklist - Summary

Open discussion on the following:

- Inspection format – paper or electronic?
- Non-conformances – how are these dealt with and how should we include into checklist? How to define major or minor non-conformances?
- Can inspectors give advice on energy efficiency? If yes, would a sliding NatHERS scale be of benefit to address non-conformance issues?

## Project 1

### Sum up and next steps

- 1/ Thank you – general comments on process
- 2/ The notes of the webinar will be written up and circulated for you to add to if you have thought of something else during ( or since) the webinar and weren't able
- 3/ Circulation of drafted policy guideline and inspection checklist for approval for next iterations for other councils input.
- 4/ Phone calls to individual councils to refine process for house identifications
- 5/ Invite others to be involved and interact through the website

National Energy Efficient Building Project  
**Project 1 – New Home**  
**Energy Efficiency Compliance Audits**  
 Webinar – Tuesday 28<sup>th</sup> April



<http://neebp1.wix.com/energycompliance>

Thank you for your support, attendance and contribution

Sally Modystach on behalf of the project team

## Appendix C – Pre- and Post-Pilot Surveys

# Pilot region initiation survey1

When you sign up as a Pilot Region we will collect these details by phone and you can submit additional information directly in this form.

\* Required

1. Please enter your name \*

\*We are using these details as ID tags throughout the process. All data will be de-identified and aggregated for reporting purposes.

.....

2. What are the benefits of participating in this pilot and why did you sign up?

.....

.....

.....

.....

.....

3. Please identify your authority\* \*

Mark only one oval.

☐ Whyalla Council

☐ Playford Council

☐ Mildura Council

☐ Mt Barker Council

☐ Cairns Council

☐ Parramatta City

☐ Other: .....

4. What value could be provided by regular inspections for energy compliance?

Think of the benefits also for your organisation, builders, occupiers. Who else benefits?

.....

.....

.....

.....

.....

5. Who will be carrying out site inspections for energy compliance?

Mark only one oval.

- ☐ Me - at least sometimes/probably
- ☐ One of my council/authority colleagues
- ☐ A private building certifier
- ☐ Other: .....

6. What is the training or title of the person carrying out the energy inspection?

.....

.....

.....

.....

.....

7. What additional skills or training for energy inspections do you think is needed at this stage?

.....

.....

.....

.....

.....

8. What is your ideal inspection routine currently?

for example - % of houses inspected, no. of inspections per house

.....

.....

.....

.....

.....

9. To what extent do you meet your ideal inspection regime?

Mark only one oval.

	1	2	3	4	5	
A long way off	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	we meet it

10. How do you deal with compliance issues that become evident during inspections?

.....

.....

.....

.....

.....

11. How familiar are you with the requirements of the National Construction Code as it relates to energy efficiency?

Mark only one oval.

	1	2	3	4	5	
not very familiar	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	expert

12. What tools do you use to conduct inspections?

Check all that apply.

- ☐ paper based form
- ☐ electronic form
- ☐ iAuditor app
- ☐ Special inspection tools
- ☐ Other: .....

13. If we just focused on the installation of the correct windows and insulation - what is the most efficient way to monitor these two building elements?

Please contribute your ideas for an efficient inspection regime and the ideal timing for inspection/s

.....

.....

.....

.....

.....

14. Would you like a follow up phone call so that you can explain more?

Mark only one oval.

- ☐ Yes
- ☐ No

# Post Pilot Evaluation Survey

This survey captures feedback from pilot participants on the effectiveness of the inspections that have been undertaken.

\* Required

1. Please provide your name\* \*

\*We are using these details as ID tags throughout the process. All data will be de-identified and aggregated for reporting purposes.

.....

2. Please indicate your authority\* \*

Mark only one oval.

- ☐ Whyalla Council
- ☐ Playford Council
- ☐ Mt Barker Council
- ☐ Cairns Council
- ☐ City of Mandurah
- ☐ Noosa Shire Council
- ☐ Lake Macquarie Council
- ☐ Launceston City Council
- ☐ Paramatta City Council
- ☐ Other: .....

3. Please rate the value of inspecting different items from 1 to 5:

Mark only one oval per row.

	1. Not worth inspecting	2. Difficult to inspect	3. Easy to inspect	4. Important to inspect due to regular non compliance	5. Essential item to inspect
Correct roof insulation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Good installation of roof insulation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Sarking/sisalation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Roof colour and type	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Roof ventilators	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Roof lights	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Correct wall insulation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Good installation of wall Insulation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Floor insulation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Under floor heating/cooling	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Depth of shading	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Shading materials (eg louvres)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Glazing Type	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Window frames	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Window reveals	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Seals on chimneys and flues	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Sealing of external windows and doors	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Dampers/filters on exhaust fans	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Sealed construction of roofs, walls and floors	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Evaporative coolers	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Heating/cooling pipework Insulation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Ductwork Insulation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Air conditioning System	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Hot water	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Electric resistance space heating	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Lighting	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Swimming Pool or Spa Pool	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Renewable and alternative energy sources	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

4. **Would you like to explain any of your answers further?**

.....

.....

.....

.....

.....

5. **Are there any other items that should be inspected?**

.....

.....

.....

.....

.....

6. **How many non-compliance issues were identified and how were these dealt with?**

Please indicate the part of the enforcement hierarchy invoked - eg education > compliance > enforcement > prosecution

.....

.....

.....

.....

.....

7. **What time for desktop preparation and building inspections should be allocated to energy efficiency compliance?**

If possible please split this time into 1)preparation, 2) inspection1 and 3) inspection2

.....

8. **What inspection regime would you recommend in order to include energy compliance?**

*Check all that apply.*

- ☐ Incorporate into a single existing inspection
- ☐ Incorporate into two existing inspections
- ☐ Incorporate into three existing inspections
- ☐ provide an additional single energy inspection
- ☐ provide an additional two energy inspections

9. **What resources and skill levels should be allocated for energy efficiency compliance activities?**

.....

10. **What training would you recommend?**

.....



11. **What costs and benefits did the builder (and other professionals involved in the development) incur/accrue due to energy efficiency compliance activities?**

.....

.....

.....

.....

.....

12. **What strengths can you identify in the process you used for preparation and the two inspections?**

.....

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.....

13. **What are the challenges and limitations of energy efficiency compliance?**

Please include any record keeping issues, difficulties with access and timing and inefficiencies that you identified

.....

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.....

14. **What improvements or innovations would you suggest to the process you used?**

.....

.....

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15. **Will participation in this pilot lead to any changes in your building inspection regime?**

please provide your answer and a brief explanation

.....

.....

.....

.....

.....

16. **Please provide your phone number if you would like a follow up phone call.**

.....

## Appendix D – NCC Legislative Framework Review

### Introduction

The National Construction Code (NCC), made up of three distinct volumes, has been developed in an attempt to incorporate Australian construction requirements into a single consistent code. Developed by the Council of Australian Governments and implemented by state and territory governments the National Construction Code consists of *The Building Code of Australia* (Volumes One and Volume Two) and Volume 3 which deals with plumbing and drainage in association with buildings. A new version (online and free) of the NCC was adopted (in part) by states and territories on 1 May 2015.

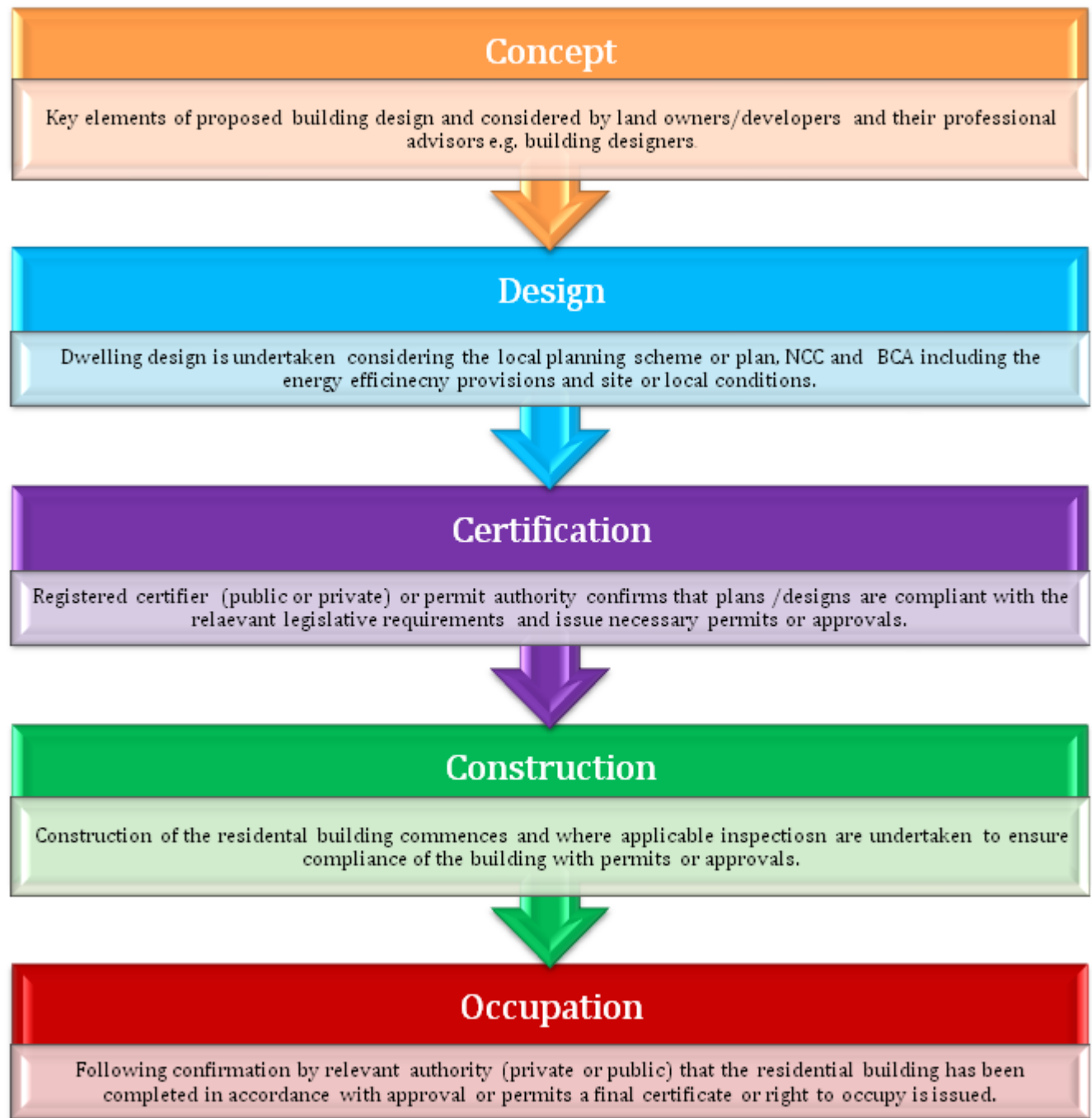
One of the key aims of the NCC is to provide nationally consistent standards of construction that deal with issues including structural safety, health, fire safety and energy efficiency. This project 'New Home Energy Efficiency Compliance Inspections' deals specifically with the compliance of residential building construction with residential energy efficiency building requirements within the NCC. This project focuses on the construction phase of residential building and compliance with the energy efficiency requirements as per the approved design. The operation and implementation of the NCC is enabled through legislation enacted by each state and territory. Each state and territory as part of this process has the ability to adopt all or some of the provisions of the NCC or make additional requirements on construction outside of the provisions of the NCC. This requires that the provisions of the NCC are read in conjunction with relevant state or territory based legislation or regulation to determine which principles and requirements are relevant to the locality in which building is proposed.

While the NCC has been implemented in each Australian jurisdiction (Western Australia, Northern Territory, Queensland, New South Wales, Australian Capital Territory, Victoria, Tasmania and South Australia) it has not been adopted in its entirety in all jurisdictions and in many instances additional requirements on building standards have been imposed. As part of the operation of the NCC, the Australian Building Codes Board (ABCB) have developed a series of non-mandatory handbooks to assist building and associated practitioners with the implementation and interpretation of the NCC, including the most recent handbook dealing with the energy efficiency provisions the NCC, Volume 1 Energy Efficiency Provisions 2014.

## National Construction Code – Legislative Framework Review

While this summary will outline that each state and territory in Australia has a slightly different approach to the design and approval of new residential buildings, there is an element of commonality to all design and approval processes that is summarised in Figure 1.

**Figure 1 – The Design and Approval of New Residential Buildings**



### National Construction Code Energy Efficiency Provisions

Part 2.6 of the NCC (Volume 1 May 2015) relates to the requirements for residential buildings to be energy efficient. The overall objective for residential buildings is:

*The Objective is to reduce greenhouse gas emissions*

This objective is expanded via functional statements and performance requirements in the construction and ongoing use of residential buildings. As outlined above there is the ability for local variation to these principles and within a number of jurisdictions additional requirements are in force for example the BASIX program in New South Wales.

The objective is further elaborated in functional statement F2.6 and the performance standards outlined in P2.6.1:

#### **F2.6**

*To reduce greenhouse gas emissions, to the degree necessary—*

*(a) a building, including its domestic services, is to be capable of efficiently using energy; and*

*(b) a building's domestic services for heating are to obtain their energy from—*

*(i) a low greenhouse gas intensity source; or*

*(ii) an on-site renewable energy source; or*

*(iii) another process as reclaimed energy.*

#### **P2.6.1 Building**

*A building must have, to the degree necessary, a level of thermal performance to facilitate the efficient use of energy for artificial heating and cooling appropriate to—*

*(a) the function and use of the building; and*

*(b) the internal environment; and*

*(c) the geographic location of the building; and*

*(d) the effects of nearby permanent features such as topography, structures and buildings; and*

- (e) solar radiation being—*
  - (i) utilised for heating; and*
  - (ii) controlled to minimise energy for cooling; and*
- (f) the sealing of the building envelope against air leakage; and*
- (g) the utilisation of air movement to assist cooling.*

### **P2.6.2 Services**

*Domestic services, including any associated distribution system and components must, to the degree necessary—*

- (a) have features that facilitate the efficient use of energy appropriate to—*
  - (i) the domestic service and its usage; and*
  - (ii) the geographic location of the building; and*
  - (iii) the location of the domestic service; and (iv) the energy source; and*
- (b) obtain heating energy from—*
  - (i) a source that has a greenhouse gas intensity that does not exceed 100 g CO<sub>2</sub>e/MJ of thermal energy load; or*
  - (ii) an on-site renewable energy source; or*
  - (iii) another process as reclaimed energy.*

Building designers have two options to demonstrate that the energy efficiency performance of a proposed residential building meets the requirements of the NCC. Section 3 of the NCC Volume 2 contains deemed to satisfy provisions where use in a residential building will be taken to meet the NCC requirements. Alternatively a building designer can choose to develop a performance based solution that can be shown to meet the provision of the NCC to at least an equivalent standard as the deemed to satisfy provisions.

Section 3.12 deals with energy efficiency including specific provisions in relation to building fabric, glazing and sealing, air movement and building services. A selection of some of the acceptable building and construction practices are outlined below:

### 3.12.0.1 Heating and cooling loads

*(a) To reduce heating or cooling loads, a building must achieve an energy rating using house energy rating software, of not less than—*

*(i) 6 stars; or*

*(ii) for a building in climate zones 1 or 2, 5.5 stars if the building has an outdoor living area as described in **(b)** if the outdoor living area—*

*(A) is fully covered with an impervious roof having a Total R-Value of at least 1.5 (for downward heat flow); or*

*(B) has at least one permanently installed ceiling fan; or*

*(iii) for a building in climate zones 1 or 2, 5 stars if the building has an outdoor living area as described in (b) if the outdoor living area—*

*(A) is fully covered with an impervious roof having a Total R-Value of at least 1.5 (for downward heat flow); and*

*(B) has at least one permanently installed ceiling fan.*

### 3.12.1.1 Building fabric thermal insulation

*(a) Where required, insulation must comply with AS/NZS 4859.1 and be installed so that it—*

*(i) abuts or overlaps adjoining insulation other than at supporting members such as columns, studs, noggings, joists, furring channels and the like where the insulation must butt against the member; and*

*(ii) forms a continuous barrier with ceilings, walls, bulkheads, floors or the like that inherently contribute to the thermal barrier; and*

*iii) does not affect the safe or effective operation of a domestic service or fitting.*

### 3.12.2.1 External glazing

*(a) The aggregate conductance of the glazing in each storey, including any mezzanine, of a building must—*

*(i) not exceed the allowances resulting from—*

*(A) in climate zone 1, multiplying the area of the storey, including any mezzanine, measured within the enclosing walls, by the constant CU obtained from **Table 3.12.2.1**; and*

*(B) in climate zones 2 to 8, using the constant CU obtained from **Table 3.12.2.1**.*

### 3.12.3.3 External windows and doors

*(a) A seal to restrict air infiltration must be fitted to each edge of an external door, openable window and other such opening—*

*(i) when serving a conditioned space; or*

*(ii) in climate zones 4, 5, 6, 7 and 8, when serving a habitable room.*

*(b) A window complying with the maximum air infiltration rates specified in AS 2047 need not comply with **(a)**.*

*(c) A seal required by **(a)**—*

*(i) for the bottom edge of an external swing door, must be a draft protection device; and*

*(ii) for the other edges of an external swing door or the edges of an openable window or other such opening, may be a foam or rubber compressible strip, fibrous seal or the like.*

### 3.12.3.5 Construction of roofs, walls and floors

*(a) Roofs, external walls, external floors and any opening such as a window frame, door frame, roof light frame or the like must be constructed to minimise air leakage in accordance with **(b)** when forming part of the external fabric of—*

*(i) a conditioned space; or*

*(ii) a habitable room in climate zones 4, 5, 6, 7 and 8.*

*(b) Construction required by **(a)** must be—*

*(i) enclosed by internal lining systems that are close fitting at ceiling, wall and floor junctions; or*

*(ii) sealed by caulking, skirting, architraves, cornices or the like.*



### 3.12.5.1 Insulation of services

*Thermal insulation for central heating water piping and heating and cooling ductwork must—*

*(a) be protected against the effects of weather and sunlight; and*

*(b) be able to withstand the temperatures within the piping or ductwork; and*

*(c) use thermal insulation material in accordance with AS/NZS 4859.1.*

The energy efficiency of a residential building is further demonstrated through the provision of an energy assessment as part of the building approval. This is a design based assessment of a building's possible/probable environmental performance undertaken using approved house energy rating software that is accredited under the Nationwide House Energy Rating Scheme (NatHERS).

The *New Home Energy Efficiency Compliance Inspections* project is in part addressing the perceived gap between the theoretical energy efficiency of residential buildings as demonstrated in an energy assessment and/or building design and the as built energy efficiency of residential buildings.

The energy efficiency of residential buildings can also be significantly impacted at the land use planning and land division stages of residential housing construction through the orientation of land and building layout. Though these elements can impact both the environmental performance of residential buildings and the building materials required to be used to meet energy efficiency standards within the NCC, the land use planning and land development processes are not considered in detail as part of this project.

As outlined earlier in this summary while the NCC has been implemented in each Australian jurisdiction it has not been adopted in its entirety in all jurisdictions and in many instances additional requirements on building standards have been imposed. A short summary of the key departures from the residential energy efficiency provisions of the NCC in each jurisdiction is outlined in *Summary Table 1: Building Legislation and Adoption of the NCC*.

### Planning and Building Assessment Systems

As identified in the *National Energy Efficient Building Project* review prepared by Pitt and Sherry and Swinburne University of Technology all jurisdictions in Australia have a broadly similar process for the approval of residential buildings. A two part process whereby in part 1 a residential building is granted (or in some instances not granted) a planning approval or planning permit that determines that the building is appropriate for its location and the design meets relevant urban planning plans or codes. The next stage involves a building approval or permit being granted following an assessment that the residential building complies with various building criteria contained both within the NCC and local Authority documents. While the broad process is similar, there are particular elements within the various planning and building approval systems unique to each jurisdiction. In addition some of those specific differences may have had an impact on the manner in which the *New Home Energy Efficiency Compliance Inspections* were undertaken in each state/territory. For that reason a summary of the key elements of the planning and building legislative frameworks and practice is outlined below.

A summary of the processes where residential buildings are inspected, or not inspected, during the legislative processes in each jurisdiction is also outlined below and in *Summary Table 2: Private Certification & Building Inspections*.

#### Tasmania

The Tasmanian planning and building approval system is predominantly managed through the provisions of the *Building Act 2000*, *Building Regulations 2004*, the *Land Use Planning and Approvals Act 1993* and *Tasmanian Planning Commission Act 1997*.

Applications for planning permits are assessed against the local Planning Scheme. Upon receipt of the planning permit then an application must be made for a Building Permit to the relevant local authority (Council).

Applications for a Building Permit are assessed against the Tasmanian adopted provisions of the NCC and other local relevant codes. Assessment of applications for a Building Permit in Tasmania is made by building surveyors employed by the local government where the building is proposed.

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An independent private building surveyor can undertake an assessment of the building and issue a Certificate of Likely Compliance which is used to by the local government (Council) who will issue the building permit and final 'Development Permit' as the permit authority.

Residential buildings are inspected by building surveyors during construction to allow the issue of a final occupancy permit at the completion of the construction process.

Inspection stages are detailed as part of the Certificate of Likely Compliance and the building surveyor must be notified of the completion of various stages to allow an inspection to occur.

A final inspection will be undertaken to allow the issue of a Certificate of Final Inspection and Certificate of Completion. The building surveyor undertaking the building inspections could be one employed by the local council or a private building surveyor, although the local government is nominated as the permit authority in Tasmania.

### Victoria

The Victorian planning and building approval system is predominantly managed through the provisions of the *Planning and Environment Act 1987*, the *Building Act 1993* and *Building Regulations 2006*.

Each Council in Victoria has a Planning Scheme that contains state and local policies which guide development and the use of land. The objectives and policies within the Planning Scheme provide the criteria against which planning permit applications are assessed. If the planning permit application is considered to meet the provisions of the Scheme, or on balance is considered to show sufficient merit, the proposal is granted a planning permit.

Upon receipt of the planning permit an application must be made for a Building Permit. Applications for a Building Permit are assessed against the provisions of the NCC, (Volume 2 Building Code of Australia) and other relevant codes or standards.

## National Construction Code – Legislative Framework Review

Assessment of applications for Building Permit in Victoria can be made by building surveyors employed by the local government (Council) where the building is proposed or an independent registered private building surveyor who has been registered by the Victorian Building Authority.

In Victoria the building surveyor who issued the necessary building permit (either the building surveyor employed by the local Council or an independent and registered building surveyor) will inspect the site at specific stages including prior to footings, once the building frame is erected and at the completion of the building in order to issue a Certificate of Final Inspection or Occupancy Certificate.

Builders are also required to notify the relevant building surveyor at the completion of key stages to allow inspections to occur.

### South Australia

The South Australian planning and building approval system is predominantly managed through the provisions of the *Development Act 1993* & *Development Regulations 2008*. The *Development Act 1993* establishes the planning and development system framework and the various statutory processes relating to the development of land while the *Development Regulations 2008* support the operation of the Act and contains much of the procedural detail that impacts on the development of land.

The *Development Act 1993* sets out the definition of development, which guides whether a development application must be submitted. In order to commence development an applicant is required to obtain three (3) separate approvals being:

1. Development Plan Consent (Planning Approval);
2. Building Rules Consent (Building Approval); and
3. Development Approval (granted when the planning consent and building consent have been reviewed for consistency).

An application for Development Plan Consent (Planning Approval) is assessed against the relevant Council Development Plan and zoning provisions. Upon receipt of the Development Plan Consent then an application is made for Building Rules Consent. Applications for Building Rules Consent (Building

## National Construction Code – Legislative Framework Review

Approval) are assessed against the provisions of the NCC (Volume 2 Building Code of Australia), the provisions of the *Development Act 1993* and any other relevant codes or standards. Assessment of applications for Building Rules Consent can be made by Council or an independent private certifier who has been registered by the Minister for Planning. Upon receipt of both Development Plan Consent and Building Rules Consent the applicant can apply to the relevant local government authority (Council) for 'Development Approval'. No development should commence on site unless Development Approval has been granted.

In South Australia the inspection of residential buildings during construction is undertaken by local government in line with the provisions of the *Development Act 1993*. Section 71A (1) of the Act outlines that each local government must establish a building inspection policy that:

*(2) A council must, in its building inspection policy, specify—*

*(a) a level or levels of audit inspections to be carried out by the council on an annual basis with respect to building work within its area (including building work assessed by private certifiers under Part 12) involving classes of buildings prescribed by the regulations; and*

*(b) the criteria that are to apply with respect to selecting the buildings that are to be inspected under the policy.*

*(4a) A building inspection policy must comply with any regulation prescribing a minimum level of inspections to be carried out by the council on an annual basis with respect to building work within its area (including building work assessed by private certifiers under Part 12).*

The requirements for inspections of residential buildings during construction require the builder to notify the relevant local government at key stages within the construction process including:

- *one business day's notice of the commencement of building work on site;*
- *one business day's notice prior to the commencement of the pouring of footings;*

## National Construction Code – Legislative Framework Review

- *one business day's notice after the completion of wall and roof framing;*
- *one business day's notice of wet areas prior to tiling;*
- *one business day's notice after the completion of building works.*

Council staff will then determine if an inspection of that building will occur and where an inspection is undertaken a record of the inspection and its outcome will be made and retained by the local government. The *Development Act 1993* requires that each Council will prepare and make available its building inspection policy. It has been reported that currently these inspections may not specifically consider the use of energy efficient material within the building, in line with the approved plans, in many local government areas.

However where buildings are inspected for compliance with the relevant provisions of the NCC energy efficient features or solutions approved as part of the building consent process should be considered.

Feedback to the project team was that inspection for energy efficiency compliance is limited, although an indicative approach was flagged that, subject to resources, an inspection regime by local government could include an assessment of compliance with the energy efficient features of the building design or the system could allow an independent auditor option where an independent third party (Accredited Energy Assessor) undertook a separate inspection and reporting process.

## New South Wales

The New South Wales planning and building approval system is predominantly managed through the provisions of the *Environmental Planning and Assessment Act 1979*, the *Environmental Planning and Assessment Regulations 2000* and the *Building Professionals Act 2005*.

The building assessment process can be undertaken in NSW by either private building certifiers or building surveyors employed by the relevant local government (Council). Following granting of a Development Consent a Construction Certificate is required which confirms the building plans are consistent with the development consent and meet the relevant provisions of the NCC.

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Within New South Wales the energy efficiency provisions within the NCC do not apply and energy efficiency requirements are determined through the Building Sustainability (BASIX) system. Introduced in 2004 the BASIX addresses the sustainability of residential buildings including water and energy use. Assessment is undertaken via an online assessment tool and produces a BASIX certificate for each proposed dwelling. The BASIX certificate is submitted as part of the development application and construction certificate process.

New South Wales legislation requires that a Principal Certifying Authority (accredited private certifier or local Council) is appointed for each building project by the landowner and the Principal Certifying Authority (PCA) is responsible for ensuring compliance with the relevant provisions of the NCC. This will include inspection of the building during various stages of construction, or reliance on certification from other professionals who are part of the building process, and issuing of the final occupation certificate.

### Australian Capital Territory

The Australian Capital Territory planning and building approval system is predominantly managed through the provisions of the *Building Act 2004*, *Building Regulations 2008*, *Planning and Development Act 2007* and *Planning and Development Regulations 2008*.

The building approval process in the ACT involves the appointing of a licensed building certifier by the land owner, (often after Development Approval has been granted by the ACT Planning and Land Authority) and building approval by the building certifier.

The certifier will conduct inspections at various points in the building construction process including pouring of a slab and internal framing to ensure compliance with the building design and relevant provisions of the NCC and will, if satisfied, issue a Completion Certificate to the Planning and Land Authority who will issue a final Certificate of Occupancy and Use.

Unlike the other states and territories in Australia the ACT does not have local government authorities and in the ACT the Planning and Land Authority administers much of the planning and building system.

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### Queensland

The Queensland planning and building approval system is predominantly managed through the provisions of the *Building Act 1975*, *Building Regulations 2006* and the *Sustainable Planning Act 2009*.

The building approval process involves the issuing of a building permit by either a Council (local government) building certifier or a private building certifier. Whether a building certifier is employed by a local government or is a private certifier they must be registered by the Building and Construction Commission.

Within the QLD system mandatory building inspections are carried out at various times in the construction process in accordance with the requirements nominated within the building approval and it is the responsibility of the builder to inform the building certifier in writing when the building is completed to a stage to allow inspection.

Inspections are carried out when footings are prepared, prior to the pouring of the building slab, when the building frame is on place and on completion.

Legislation in Queensland (Schedule 1 of the *Building Act 1975*) also makes reference to the legislative requirements of the Queensland Development Code (QDC). The QDC contains building standards that relate only to Queensland that are either outside the scope of the NCC or are in addition to NCC requirements. Elements of the QDC have legislative effect, while other sections are of an advisory nature only.

While there are guidelines for inspection of class 2 to 9 buildings which detail requirements for inspections under *Building Act and Regulations*, there are no specific guidelines for the inspection of Class 1 & 10 buildings. Inspections are carried out when footings are prepared, prior to the pouring of the building slab, when the building frame is in place and on completion.



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### Northern Territory

The Northern Territory planning and building approval system is predominantly managed through the provisions of the *Building Act 2015*, *Building Regulations 2008* and *Planning Act 2015*.

The Building Approval process involves the engagement of a registered building certifier who will assess the proposed buildings compliance with the relevant section of the NCC, will issue a permit to build and permit to occupy the building and will undertake any necessary inspections during the construction process. The builder is responsible for informing the building certifier that the necessary stages of construction are ready for inspection.

The Northern Territory operates a two-tiered building approval process in recognition of the significant distances within the Territory and potential difficulties in land owners engaging building certifiers. As part of that two-tier process mandatory building inspections are required in more populated areas including Darwin and Alice Springs but are not required in other building control areas.

### Western Australia

The Western Australian planning and building approval system is predominantly managed through the provisions of the *Building Act 2011*, *Building Regulations 2012* and the *Planning and Development Act 2005*.

In Western Australia a building permit is issued by a 'permit authority' which is the relevant local government or in select circumstances the WA State Government. An application for a building permit in WA can be un-certified or certified. A certified application will include the submission of a Certificate of Design Compliance (CDC) to the permit authority.

A certified application will involve engaging a registered building surveyor to complete the Certificate of Design Compliance. An uncertified application can be made for Class 1 and 10 and does not have a CDC completed by a registered building surveyor. On receipt of the application for building approval the

## National Construction Code – Legislative Framework Review

permit authority will assess the application for compliance with the relevant provisions of the NCC and determine whether to grant a permit.

An occupancy permit is not required for residential buildings consisting of Class 1 & 10 buildings in Western Australia.

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**Summary Table 1: Building Legislation and Adoption of the NCC**

<b>State/ Territory</b>	<b>Key Building Legislation</b>	<b>Departures from the NCC/BCA for residential buildings (new builds only)</b>
<b>WA</b>	Building Act 2011 Building Regulations 2012	No variations to energy efficient requirements in NCC for new buildings.  Variation to alterations and/or additions to residential buildings to allow for a transition to NCC requirements.
<b>NT</b>	Building Act 2015 Building Regulations 2008	Section 2.6 Energy Efficiency Performance Provisions & 3.12 Energy Efficiency Acceptable Construction not applicable in NT.  Reference is made in legislation to the 2009 BCA which required 5 star energy performance.
<b>QLD</b>	Building Act 1975 Building Regulations 2006	Queensland Development Code contains additional provisions for residential buildings including requirements for sustainable buildings.
<b>NSW</b>	Environmental Planning and Assessment Act 1979 Environmental Planning and Assessment Regulations 2000 Building Professionals Act 2005	3.12 Energy Efficiency Acceptable Construction does not apply in NSW and these issues are addressed in the Building Sustainability (BASIX) system.
<b>ACT</b>	Building Act 2004 Building Regulations 2008	No variation to 3.12 Energy Efficiency Acceptable Construction in ACT.
<b>VIC</b>	Building Act 1993 Building Regulations 2006	Additional requirements for rainwater tanks and variations to hot water supply.
<b>TAS</b>	Building Act 2000 Building Regulations 2004	5 star energy performance rather than NCC requirement for 6 stars.
<b>SA</b>	Development Act 1993 Development Regulations 2008	Departures primarily relate to hot water services and supply, heating and cooling loads and 6 star energy rating.

## National Construction Code – Legislative Framework Review

**Summary Table 2: Private Certification & Building Inspections**

Where buildings are inspected for compliance with the relevant provisions of the NCC one of the elements to be reviewed should be the energy efficient (EE) features or solutions approved as part of the building permit process.

<b>State/ Territory</b>	<b>Private Certification (assessment)</b>	<b>Permit Authority</b>	<b>Building Inspections (during construction)</b>
<b>WA</b>	Registered building surveyor can complete the Certificate of Design Compliance which will be considered by the relevant local government in issue of Building Permit.	Local government (Council) or WA State Government is the permit authority.	Occupancy permit is not required for residential buildings (Class 1 & 10 buildings).  There are no mandatory inspections required during construction. Inspections are at the discretion of the Authority.
<b>NT</b>	Registered building certifier can assess the proposed buildings compliance with the relevant section of the BCA and will issue a permit to build and permit to occupy the building.	Registered building certifier will assess the proposed buildings, will issue a permit to build and permit to occupy the building.	Two-tier inspections process. Inspections required in populated areas e.g. Darwin but not in other building control areas.  Registered building certifier will undertake any necessary inspections during the construction process, generally: Foundation/Frame/Fire Wall, Wet Areas/Final
<b>QLD</b>	Issuing of a building permit by either a Council (local government) building certifier or a private building certifier.	Final Inspection certificate issued by building certifier and application is recorded as finalised.	Inspections are carried out when footings are prepared, prior to the pouring of the building slab, when the building frame is in place and completion.

## National Construction Code – Legislative Framework Review

State/ Territory	Private Certification (assessment)	Permit Authority	Building Inspections (during construction)
<b>NSW</b>	Building assessment process by private building certifiers or local government.	Principal Certifying Authority (accredited private certifier or local Council) will issue an occupation certificate.	Principal Certifying Authority will inspect building during construction or rely on certifications. Inspected at Foundation, Fire Wall/Wet Areas and Final.
<b>ACT</b>	Licensed building certifier appointed by land owner.	Planning and Land Authority issue final certificate of occupancy and use.	Certifier will conduct inspections and will issue a completion certificate. Inspections conducted at foundation, frame and final.
<b>VIC</b>	Private Certifiers are able to issue Building Permit.		Building surveyor will inspect at specific stages including prior to footings, once the building frame is erected and at the completion of the building in order to issue a Certificate of Final Inspection.
<b>TAS</b>	Private Certifiers are able to issue a Certificate of Likely Compliance.	Local Government issue final Development Permit.	Inspection stages detailed in the Certificate of Likely Compliance.  Final inspection to allow the issue of a Certificate of Final Inspection and Certificate of Completion.
<b>SA</b>	Private Certifiers can issue Building Consent.	Local Government (Council) issue Development Approval.	<i>Development Act 1993</i> outlines that each local government must establish a building inspection policy and make it publically available. Council policy requires a frame inspection on 66% builder sites and 90% owner/builder sites.

## **Appendix E – Synopsis of ‘As Built’ Energy Assessment Approaches**

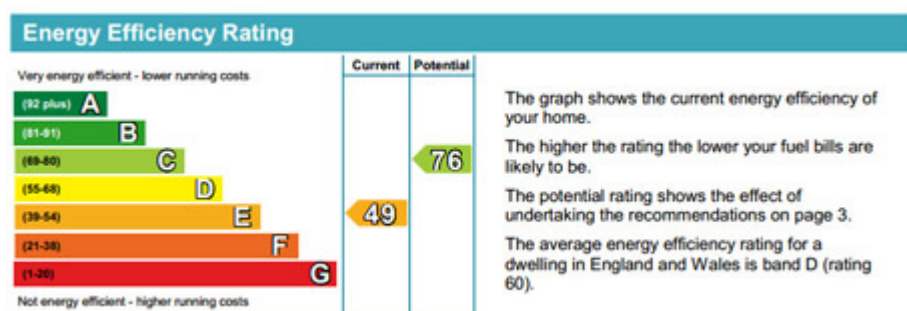
## Appendix - Examples of Energy Auditing Approaches

*Due to limited energy efficiency compliance inspection practice within Australia (as determined through the NEEBP Phase 1 research), it was not possible to source examples of compliance tools (specific to energy efficiency aspects of the NCC as adopted by each state/territory). The Project Team considered other relevant approaches to assessing 'as built' energy efficiency performance on a national and international basis.*

### United Kingdom - Environmental Performance Certificates

All homes constructed, rented or sold in the UK must obtain an Energy Performance Certificate. Homes are assessed once construction is complete, or at any point during operation, by accredited Domestic energy assessors (DEA's). Energy Performance Certificates (EPCs) were introduced in 2002 by the Energy Performance of Buildings Directive (EPBD, Directive 2001/91/EC) as a mandatory requirement for the EU Member States.

A combination of visual inspection and technologies, such as blower door testing and thermal imaging, are used to determine the building's energy efficiency rating and an environmental impact (CO<sub>2</sub>) rating. There are seven bands for both of these ratings, from A to G.



*Example rating scale from EPC certificate*

One of the key benefits of the EPC system is that it also provides advice on improvement opportunities for future renovations, including cost (divided into lower cost opportunities of up to 500 pounds and higher cost measures), savings per year and likely improvement to the performance rating. In 2011 the UK government launched Green Deal, a grant scheme allowing home owners to obtain low interest loans to assist with implementing these recommended upgrades.

A recent study by the Buildings Performance Institute Europe (BPIE) has found that whilst EPC's are considered a successful tool, there are many issues to be addressed relating to lack of consistency, lack of training, and lack of enforcement.

#### Relevance to the NEEBP Inspection Pilot:

This is a successful scheme addressing the energy efficiency of both new buildings and the outcomes of renovations. In time, this scheme should contribute to increased energy efficiency across the building stock in the UK. The post construction audit assessment relies on the expertise of the DEA to determine compliance, with visual inspection, use of technologies and photographs.

## Building Research Establishment, UK

The Code for Sustainable Homes (CSH) is an environmental assessment method for rating and certifying the performance of new homes based on BRE Global's EcoHomes scheme. It is a Government owned national standard intended to encourage continuous improvement in sustainable home building.

The Code for Sustainable Homes is mandatory for all Social Housing in the UK. Its covers a range of sustainability indicators, including energy, water, materials, etc. It is assessed in two stages as follows:

- An initial assessment is carried out at the design stage, based on detailed documentary evidence and commitments which results in an interim certificate of compliance.
- Final assessment and certification is carried out at the post construction stage. Based on the design stage review, this includes a confirmation of compliance, including site records and visual inspection, and results in a final certificate of compliance.

### Relevance to the NEEBP Inspection Pilot:

Ecohomes Inspectors review documentation and carry out site inspections to provide detailed documentation and calculations on the actual energy consumption of the project. This is more advanced and costly than the auditing approach recommended for NEEBP at this stage. This may be an model for rating buildings above minimum compliance in future.

## Home Quality Mark, UK

Home Quality Mark is a new certification launched by BRE for homeowners who wish to certify their homes environmental performance above the minimum required by Code. This is a voluntary scheme, designed to allow home owners to be in charge of the sustainability decisions in their home. It is assessed by qualified assessors who again review the project at Design Stage and then again Post Construction.

### Relevance to the NEEBP Inspection Pilot:

This is a voluntary scheme for projects wishing to achieve sustainability aspirations well above minimum compliance. This may be an model for rating buildings above minimum compliance in future.



## USA

### Home Energy Rating System

Similar to the Australian system, the Office of Energy Efficiency and Renewable Energy in the USA has a Home Energy Score system, for use during the construction or renovation of new homes, or in assessing the performance of existing homes. A registered energy assessor is employed to carry out the assessment on the design or existing property. These ratings are voluntary and not subject to disclosure. There is no mandatory construction inspection of energy performance at a national level.

### Portland - Earth Advantage Certification

As there is no mandatory energy efficiency inspections, some of the more environmentally progressive States have created their own voluntary tools. In Portland, Oregon, Earth Advantage certification ensures that new homes are at least 15% more energy efficient than building code. Certification involves inspections at least twice during construction by an accredited inspector, who is a trained building science professional. The inspections give home owners peace of mind that their home is built to last, is energy efficient and has been verified by a third part inspector.

#### Relevance to the NEEBP Inspection Pilot:

The inspections occur during the construction process so there are some lessons learned from the timing of these inspections. At the first inspection the inspector verifies insulation and air-sealing best practices, mechanical equipment efficiency, window air sealing and flashing installation, and wood moisture content levels. The final inspection occurs at completion to assess operation of heating and cooling systems, mechanical ventilation systems, finished products, and overall airtightness of the homes. Once the Technical Building Consultant has verified the home has met the requirements of selected measures and passed all tests, the house is certified and an Earth Advantage certificate is issued and a verification sticker is placed on the home's electrical box.

### LEED (Leadership in Environmental and Energy Efficient Design)

Initially a sustainable building design tool for the commercial market, LEED has branched into homes in recent years. LEED for Homes is a set of design guidelines which result in a highly sustainable home. Its it not linked to local building code, although a LEED rated building would exceed the energy requirements of the code. To obtain a rating and certificate, you must employ a Green Rater (who must have completed the LEED approved training courses). The Green Rater will assess your building plans and carry out site inspections, before submitting evidence to the US Green Building Council for third party certification.

#### Relevance to the NEEBP Inspection Pilot:

Like Green Star in Australia, this is a voluntary rating system in excess of local building code requirements for energy efficiency. Home owners could chose to apply for this in addition to the mandatory compliance, but would still have to prove compliance with the local building code.

## New Zealand

### Homestar

Homestar is New Zealand's environmental and energy efficiency rating for both new and existing homes. Homestar™ is a Joint Venture partnership between BRANZ and the New Zealand Green Building Council. Homestar is a single residential rating tool for New Zealand's new and existing homes. Funding partners have been critical in order to bring the tool to market. Homestar™ is independently administered by the New Zealand Green Building Council, a not for profit, industry owned association. Homestar may be used for self-assessment by home owners (using myHomestar). Certified Homestar ratings may also be sought through professional Homestar Assessors (experts on building science and technology who have mastered the professional version of the Homestar rating tool). As a voluntary tool, a Homestar assessment may be applied at various stages of the building construction cycle (such as at the design phase or during construction). Home renters or new home purchasers may also use the tool.

## Australia

### BASIX, New South Wales

BASIX was introduced 1st July, 2004 by the NSW Government. Mandatory in NSW under the NCC, it addresses minimum requirements for water, energy and thermal comfort.

BASIX is a free online tool that can be completed by anyone, however the thermal comfort section does use NatHERS certification as a pathway for complex buildings (requiring a certified NatHERS professional to undertake this assessment).

The BASIX certificate must be presented at Development Application Stage for desktop audit by Council. It is then required to be updated and presented with the construction documents. All BASIX requirements must be clearly marked on the construction documents, which are again reviewed by Council in a desktop audit. The Certifying Authority is only able to issue Occupation Certificate once they are certain the BASIX provisions are included in the final product. However, no on-site audit of BASIX provisions are undertaken.

A recent study for the NSW Department of Planning and Infrastructure BASIX Compliance Audit Program (David Eckstein, 2013) found that whilst compliance was generally high, the desktop audit was time consuming in some cases and could be simplified.

#### Relevance to the NEEBP Inspection Pilot:

NSW appear to enforce a higher level of NCC compliance auditing than the other States and Territories, albeit at a desktop level. NSW Councils need to be engaged in piloting an inspection for 'as built' performance against approved BASIX elements.

## Voluntary Home Energy Audits, Australia

Home Energy Audits can be carried out by a professional or home-owners with do-it-yourself kits. These are carried out in existing homes, and identify opportunities for households to save energy through changes such as switching light fittings, minimising drafts and changing home owner behaviour.

### Relevance to the NEEBP Inspection Pilot:

Whilst Home Energy Audits focus on existing homes, the checklists are user-friendly and should be considered in the pilot inspection resource style.

## Green Star

The Green Building Council of Australia (GBCA) provide a Green Star rating for multi-unit residential homes, but not for individual dwellings. The scheme is worthy of mention here for its rigorous auditing process, which whilst based solely on documentation, is well-regarded for its independence and comprehensiveness.

Green Star projects undertaking an As-Built assessment must formally submit 'As Built' or 'As-Constructed' documentation in the form of drawings, letters of confirmation, commissioning reports and reports from appropriately qualified professionals as evidence that the building has been constructed as intended by the design team. This evidence is gathered in a submission which is sent to the GBCA and reviewed by two independent experts, providing a third party accreditation of the projects sustainability credentials. By relying on the relevant professionals to sign off on construction documentation, a site inspection is not deemed to be required.

### Relevance to the NEEBP Inspection Pilot:

This represents a method of improving the accuracy of desktop based auditing, but may require some additional training for Council planning staff.

## Built Environment Sustainability Scorecard, Victoria

The Built Environment Sustainability Scorecard (BESS) has been designed specifically to support the Sustainable Design Assessment in the Planning Process (SDAPP) framework (a voluntary initiative of the Victorian Council Alliance for a Sustainable Built Environment). The tool assists planning permit applicants to submit information about how their proposed development addresses sustainability, either as a Sustainable Design Assessment (SDA, for small scale developments) or Sustainability Management Plan (SMP, for large scale developments). The tool can be used by BESS is provided free of charge to planning permit applicants. The tool is funded by participating local governments the Council Alliance for a Sustainable Built Environment.

Relevance to the NEEBP Inspection Pilot:

This represents a method of desktop based sustainability auditing. As voluntary scheme the NCC energy efficiency elements may be recognised yet are not enforceable through this approach.

**Appendix F – Residential Energy Efficiency Compliance Inspection Checklist  
– Pilot Version A**

**Residential Building (Class 1 a and b) Energy Efficiency Compliance Inspections**  
**PILOT Inspection Checklist**

Building Information	Inspection 1	Inspection 2
Local Council/Building Authority		
Address <small>(note - to be de-identified for pilot analysis)</small>		
BCA Climate Zone		
Building class		
Builder or Owner-builder		
Construction Stage		
Inspection Dates		

Inspector Information	
Inspector ID	
Inspection Reference Number	
Organisation	
Position	
Phone	
Email	

NCC Compliance Method	
Compliance Method	
Assessor <small>(note - to be de-identified for pilot analysis)</small>	
Star Rating from NatHERS Assessment	
NatHERS Software Used (if relevant)	
Additional Environmental Feature & Reason (where used to meet Star compliance)	

Follow Up Action	Comments
Not Required	
Verbal instruction	
Written Non-Compliance	
Follow Up Inspection	

Ref	Construction	Energy Efficiency Provisions	SECTION 1 Enter details from Approved Design	Inspection Checklist	SECTION 2 Inspection 1 Comments (Inspect before first fix)	SECTION 3 Inspection 2 Comments (Inspect at Final Inspection)
<b>Building Fabric</b>						
<b>1</b>	Roof Insulation	Thickness (mm)		Is the specified insulation thickness installed?		
				Does the insulation maintain its thickness?		
		Type/density (Manufacturer name and product name/specification/specified density kg/sqm or R Value)		Is the product as specified (manufacturer and density or specified R value)?		
				Does the insulation form a continuous barrier?		
				Does the insulation overlap by 150mm or has taped edges?		
				Is the insulation damaged, compressed or water-logged?		
<b>2</b>	Roofs	Specified roof colour		Is the roof colour as specified?		
		Wind driven ventilators specified		Are wind driven ventilators installed?		

**Residential Building (Class 1 a and b) Energy Efficiency Compliance Inspections**  
**PILOT Inspection Checklist**

Ref	Construction	Energy Efficiency Provisions	SECTION 1 Enter details from Approved Design	Inspection Checklist	SECTION 2 Inspection 1 Comments (Inspect before first fix)	SECTION 3 Inspection 2 Comments (Inspect at Final Inspection)
		Roof insulation thermal breaks specified		Have thermal breaks been installed to roof members?		
		Roof air void thickness (mm)		Has the specified roof air void thickness been maintained?		
3	Roof lights	Product manufacturer and specification		Have the specified roof lights been installed?		
4	Wall Insulation	Thickness (mm)		Is the specified insulation thickness installed?		
				Does the insulation maintain its thickness?		
		Type/density (Manufacturer name and product name/specification/specified density kg/sqm or R Value)		Is the product as specified (manufacturer and density or specified R value)?		
				Does the insulation form a continuous barrier?		
				Does the insulation overlap by 150mm or has taped edges?		
				Is the insulation damaged or water-logged?		
5	External Walls	Wall frame thermal breaks specified		Have thermal breaks been fitted to wall framing?		
		Wall air void thickness (mm)		Has the specified roof air void thickness been maintained?		
6	Floors	<b>Where suspended floors are present:</b>		Is the specified insulation thickness installed?		
		Specified insulation thickness (mm)		Does the insulation maintain its thickness?		
		Type/density (Manufacturer name and product name/specification/specified density kg/sqm or R Value)		Is the product as specified (manufacturer and density or specified R value)?		
				Does the insulation form a continuous barrier?		
				Does the insulation overlap by 150mm or has taped edges?		
		<b>Where an In-floor heating or cooling system has been specified:</b>		Is the specified insulation thickness installed?		
				Does the insulation maintain its thickness		
		Type/density (Manufacturer name and product name/specification/specified density kg/sqm or R Value)		Is the product as specified (manufacturer and density or specified R value)?		

**Residential Building (Class 1 a and b) Energy Efficiency Compliance Inspections**  
**PILOT Inspection Checklist**

Ref	Construction	Energy Efficiency Provisions	SECTION 1 Enter details from Approved Design	Inspection Checklist	SECTION 2 Inspection 1 Comments (Inspect before first fix)	SECTION 3 Inspection 2 Comments (Inspect at Final Inspection)
				Does the insulation form a continuous barrier?		
				Does the insulation overlap by 150mm or has taped edges?		
				Is the insulation damaged or water-logged?		
7	Shading	Depth of shading (mm)		Has the depth of shading been provided?		
				Has the shading been provided to all windows and walls as shown on the drawings?		
		Shading material specified (e.g. Solid, louvers, opaque)		Has the specified shading material been used?		
<b>External Glazing</b>						
8	Glazing Type	Glazing type specified (manufacturer, WERS number)		Has the specified window been installed?		
		Number of panes (single, double, triple)		Has the correct window type been installed?		
		Thickness of glass specified		Is the glass the correct thickness?		
		For double glazing, thickness of air gap specified		Has the specified air gap between panes been provided?		
		Coating or tint specified (e.g. Low E)		Has the correct tint or coating been applied?		
		Frame material specified (e.g. Timber, aluminium)		Has the specified frame material been used?		
9	Window reveals	Depth of window reveal		Has the window been installed with the specified depth of reveal?		
<b>Building Sealing</b>						
10	Chimney and flues	Solid fuel appliance installed or not		Where a solid fuel appliance has been installed, is it fitted with a damper or flap?		
11	Roof lights			Have roof lights been fitted with seals?		
12	External windows and doors			Have external windows been fitted with seals?		
				Have all external window edge joints with linings been caulked/sealed?		
				Have external door edges been fitted with gaskets/seals?		
				Have external door frame edge joints with linings been caulked/sealed?		



**Residential Building (Class 1 a and b) Energy Efficiency Compliance Inspections**  
**PILOT Inspection Checklist**

Ref	Construction	Energy Efficiency Provisions	SECTION 1 Enter details from Approved Design	Inspection Checklist	SECTION 2 Inspection 1 Comments (Inspect before first fix)	SECTION 3 Inspection 2 Comments (Inspect at Final Inspection)
13	Exhaust fans			Have exhaust fans been fitted with self closing dampers or filters?		
14	Construction of roofs, walls and floors			Are internal lining systems close fitting at ceiling, wall and floor junctions?		
				Are internal lining systems sealed at all edges and joints by caulking, skirting, architraves or		
15	Evaporative coolers	Evaporative Coolers installed or not		Are evaporative coolers fitted with self-closing dampers?		
<b>Building Services</b>						
16	Heating/cooling pipework Insulation	Specified insulation thickness (mm)		Is the specified insulation thickness installed		
				Does the insulation maintain its thickness		
		Type/density (Manufacturer name and product name/specification/specified density kg/sqm or R Value)		Is the product as specified (manufacturer and density or specified R value)		
				Does the insulation form a continuous barrier		
				Is the insulation damaged or water-logged		
17	Ductwork Insulation	Specified insulation thickness (mm)		Is the specified insulation thickness installed		
				Does the insulation maintain its thickness		
		Type/density (Manufacturer name and product name/specification/specified density kg/sqm or R Value)		Is the product as specified (manufacturer and density or specified R value)		
				Does the insulation form a continuous barrier		
				Are the edge joints sealed		
				Is the insulation damaged or water-logged		
18	Air conditioning System	Specified Compressor COP		Has the installed compressor have the specified COP		
19	Hot water	Specified system type (electric, gas, solar)		Has the specified system been installed		
20	Renewable and alternative energy sources	Specified system type and capacity (e.g. 1.5kWe solar PV)		Has the specified system been installed		
				Has the system been installed with the specified capacity		
21	Electric resistance space heating	Installed or not		Have separate switches, timers, and zone temperature controls been fitted		

**Residential Building (Class 1 a and b) Energy Efficiency Compliance Inspections**  
**PILOT Inspection Checklist**

Ref	Construction	Energy Efficiency Provisions	SECTION 1 Enter details from Approved Design	Inspection Checklist	SECTION 2 Inspection 1 Comments (Inspect before first fix)	SECTION 3 Inspection 2 Comments (Inspect at Final Inspection)
22	Lighting	Specified fitting type		Has the specified fitting type been installed		
		Number of fittings installed		Have the specified fitting quantities been installed		
		Lighting control system specified (manual switching, manual dimming, programmable dimming, motion control, daylight control etc)		Has the specified system of lighting control been installed		
		Perimeter lighting specified		Does perimeter lighting have daylight sensor control		
23	Swimming Pool or Spa Pool	Specified heating system type		Has the specified heating type been installed		
				Does the heating system have a time switch		
				Does the pool pump have a time switch		
				Has the pool been fitted with a cover		

**Appendix G – Residential Energy Efficiency Compliance Inspection Checklist  
– Post Pilot Version**

**Residential Building (Class 1 a and b) Energy Efficiency Compliance Inspections  
PILOT Inspection Checklist**

Building Information	Inspection 1	Inspection 2
Local Council/Building Authority		
Address <small>(note - to be de-identified for pilot analysis)</small>		
BCA Climate Zone		
Building class		
Builder or Owner-builder		
Construction Stage		
Inspection Dates		

NCC Compliance Method	
Compliance Method	
Assessor <small>(note - to be de-identified for pilot analysis)</small>	
Star Rating from NatHERS Assessment	
NatHERS Software Used (if relevant)	
Additional Environmental Feature & Reason (where used to meet Star compliance)	

Inspector Information		
Inspector ID		
Inspection Reference Number		
Organisation		
Position		
Phone		
Email		

Follow Up Action	Comments	
Not Required		
Verbal instruction		
Written Non-Compliance		
Follow Up Inspection		

COMMENTS - PLEASE ENTER COMPLIANT, MINOR NON-COMPLIANCE OR MAJOR NON-COMPLIANCE. IN ALL NON-COMPLIANT CASES PLEASE PROVIDE ADDITIONAL NOTES							
Ref	Construction	Energy Efficiency Provisions	SECTION 1 Enter details from Approved Design	Inspection Checklist	SECTION 2 Inspection 1 Comments (Inspect before first fix)	SECTION 3 Inspection 2 Comments (Inspect prior to Completion)	Attach Supporting Documentation/ Photographs
<b>Building Fabric</b>							
1	Roof Insulation	Describe thickness and type/density (Manufacturer name and product name/specification/specified density kg/sqm or R Value)		Is the correct insulation installed?			Attach photo or evidence of roof insulation
				Is the insulation installed correctly (maintains thickness, continuous barrier, not damaged?)			
2	Roofs	Describe specified roof colour.		Is the roof colour as specified?			NA
3	Roof lights	Product manufacturer and specification		Have the specified roof lights been installed?			NA
4	Wall Insulation	Describe thickness and type/density (Manufacturer name and product name/specification/specified density kg/sqm or R Value)		Is the correct insulation installed?			Attach photo or evidence of wall insulation
				Is the insulation installed correctly (maintains thickness, continuous barrier, not damaged?)			
5	External Walls	Wall frame thermal breaks specified		Have thermal breaks been fitted to wall framing?			NA
		Wall air void thickness (mm)		Has the specified roof air void thickness been maintained?			NA

**Residential Building (Class 1 a and b) Energy Efficiency Compliance Inspections  
PILOT Inspection Checklist**

Ref	Construction	Energy Efficiency Provisions	SECTION 1 Enter details from Approved Design	Inspection Checklist	SECTION 2 Inspection 1 Comments (Inspect before first fix)	SECTION 3 Inspection 2 Comments (Inspect prior to Completion)	Attach Supporting Documentation/ Photographs
6	Floors	Describe floor type (e.g. Suspended, in floor heating, etc)		Is the specified insulation thickness installed?			Attach photo or evidence of floor insulation
		Specified insulation thickness (mm)		Is the insulation installed correctly (maintains thickness, continuous barrier, not damaged?)			
7	Shading	Describe shading, including depth and material (e.g. Solid, louvers, opaque)		Has shading been provided as specified?			NA
<b>External Glazing</b>							
8	Glazing Type	Glazing type specified (include manufacturer, WERS number, number of panes, thickness of glass, air gap, tint, etc)		Has the specified window been installed?			Attach WERS glazing certificate or glazing receipt, or similar
		Frame material specified (e.g. Timber, aluminium)		Has the specified frame material been used?			
9	Window reveals	Depth of window reveal		Has the window been installed with the specified depth of reveal?			NA
<b>Building Sealing</b>							
10	Chimney and flues	Solid fuel appliance installed or not		Where a solid fuel appliance has been installed, is it fitted with a damper or flap?			NA
11	Roof lights			Have roof lights been fitted with seals?			NA
12	External windows and doors			Have external windows been fitted with seals?			NA
13	Exhaust fans			Have exhaust fans been fitted with self closing dampers or filters?			NA
14	Construction of roofs, walls and floors			Are internal lining systems close fitting and sealed appropriately at ceiling, wall and floor junctions?			NA
15	Evaporative coolers	Evaporative Coolers installed or not		Are evaporative coolers fitted with self-closing dampers?			NA
<b>Building Services</b>							
16	Heating/cooling pipework Insulation	Describe thickness and type/density (Manufacturer name and product name/specification/specified density kg/sqm or R Value)		Is the specified insulation thickness installed?			NA
				Is the insulation installed correctly (maintains thickness, continuous barrier, not damaged?)			NA
17	Ductwork Insulation	Describe thickness and type/density (Manufacturer name and product name/specification/specified density kg/sqm or R Value)		Is the specified insulation thickness installed?			NA
				Is the insulation installed correctly (maintains thickness, continuous barrier, not damaged?)			NA
18	Air conditioning System	Specified Compressor COP		Has the installed compressor have the specified COP?			Provide Star rating certificate
19	Hot water	Specified system type (electric, gas, solar)		Has the specified system been installed?			Provide Star rating certificate

**Residential Building (Class 1 a and b) Energy Efficiency Compliance Inspections  
PILOT Inspection Checklist**

Ref	Construction	Energy Efficiency Provisions	SECTION 1 Enter details from Approved Design	Inspection Checklist	SECTION 2 Inspection 1 Comments (Inspect before first fix)	SECTION 3 Inspection 2 Comments (Inspect prior to Completion)	Attach Supporting Documentation/ Photographs
20	Electric resistance space heating	Installed or not		Have separate switches, timers, and zone temperature controls been fitted?			NA
21	Lighting	Specified fitting type		Has the specified fitting type and quantity been installed?			Attach receipt or invoice for lighting systems
		Lighting control system specified (manual switching, manual dimming, programmable dimming, motion control, daylight control etc)		Has the specified system of lighting control been installed?			
		Perimeter lighting specified		Does perimeter lighting have daylight sensor control?			

## **Appendix H – Residential Energy Efficiency Compliance Inspection Checklist – Guideline**

# National Energy Efficiency Building Project

## Home Energy Inspection Guideline

The following guideline notes describe the process of undertaking the Energy Efficiency Inspection on-site. To fully understand the process, we have documented the steps in the approvals process throughout the project life cycle, so it can be understood how the project is assessed against the NCC at various stages.

It has become clear that the compliance review against the NCC is already undertaken by Council Officers during the Development Approval stage. Therefore the role of the Energy Efficiency Inspector is not to undertake an on-site compliance review against the NCC, but rather to inspect the Energy Efficiency provisions of the design.

The NCC has three compliance paths for energy efficiency:

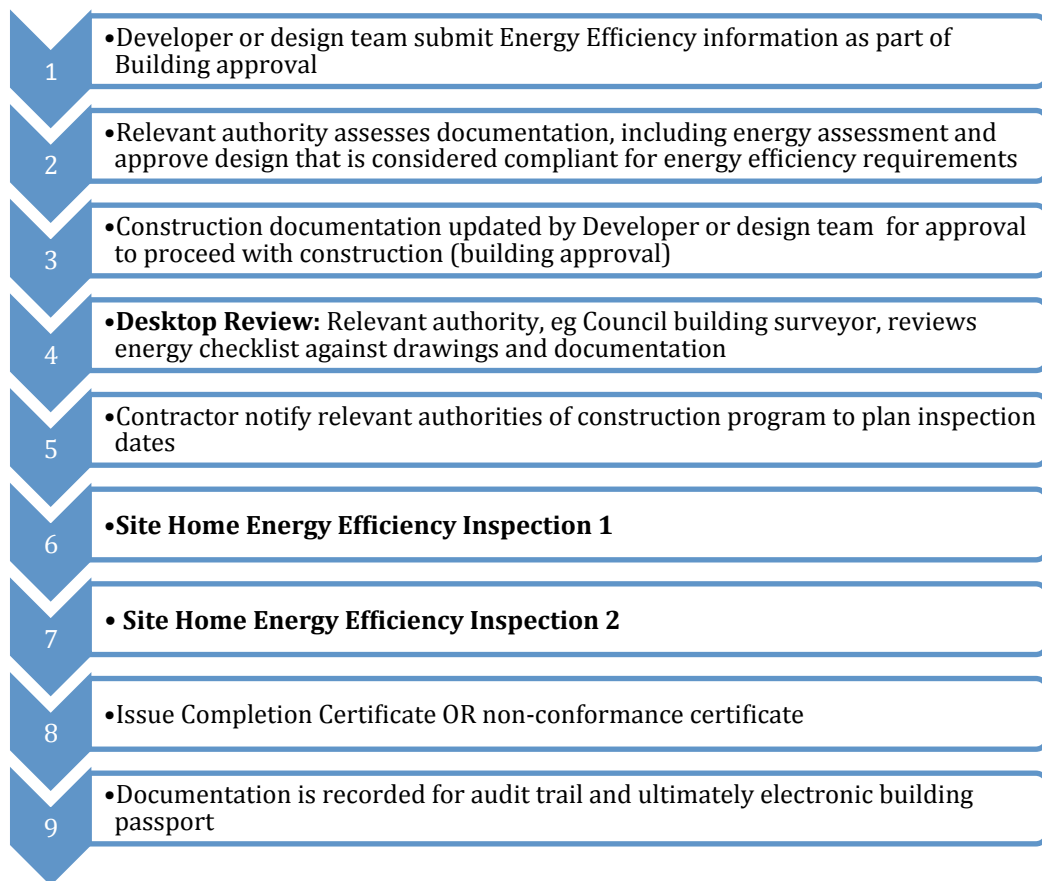
1. Deemed-to-satisfy elemental assessment against the provisions of the Code
2. Deemed-to-satisfy modelling assessment using approved modelling software (or BASIX in NSW)
3. Alternative method comparing the design against a reference house using approved modelling software.

The Home Energy Inspection Checklist has been designed so that it can be used regardless of the compliance path chosen (which are largely based on the elemental provisions of the NCC).

While each state and territory in Australia has a slightly different approach to the design and approval of new residential buildings, there is an element of commonality to all design and approval processes that is summarised in Figure 1.



**Figure 1 –Process Summary for Incorporating Energy Compliance Inspections**



The steps involved in the inspection process are detailed below.

## **Residential Energy Efficiency Compliance Inspection Stages**

### **1. Building Design**

- Early design without significant detail may already have been submitted to approval authority – eg for planning approval
- Design team carry out detailed design of project in accordance with Energy Efficiency provisions of the National Construction Code.
- Design team decide on energy compliance method (elemental assessment, modelling or alternative method).
- Design may be altered during assessment process in order to reach compliance.
- Design team or Developer provide energy efficiency information and submit with Application for building approval.

### **2. Building Approval**

- Relevant authorities, eg council or private certifiers, carry out a desktop review of the project against the energy efficiency measures described by the Design Team or Developer in NatHERS Assessment Certificate, elemental or alternative method. This is reviewed against the energy efficiency provisions of the NCC and relevant jurisdictional variations.

### **3. Construction Documentation**

- Design team or Developer required to provide updated energy efficiency information with final Construction package. This should be structured to include all relevant schedules and information to support on-site inspections and will ultimately flow from use of the electronic building passport or universal certificate. If changes have been made in the design that affect energy efficiency, these changes must be reflected in the final energy assessment.

#### **4. Desktop review for on-site inspections**

- The inspector for the relevant authority carries out a desktop review of the project against the energy efficiency measures described by the Design Team or Developer against the energy efficiency provisions of the NCC.
- These energy efficiency measures would be noted in the 'Desktop Review' section of the Inspection Checklist or appended as schedules and drawings to support the inspections. Where information is missing, attempts need to be made to obtain additional information from the developer at this stage.

#### **5. Construction**

- Construction commences on-site. Developer required to notify relevant authorities of construction program to include anticipated inspection dates.

#### **6. Site Home Energy Efficiency Inspection 1**

- Inspection to be carried out by relevant authority's nominated inspector.
- Inspection required prior to the application of internal linings and ceilings to allow visually inspection of building elements, and ideally after installation of walls, roof, windows and insulation. Note that 'framing' stage is often too early.
- Inspector to complete all elements of the Home Energy Efficiency Inspection Checklist that can be inspected adequately to assess compliance at this time. Inspection based on building documentation collected during the desktop review.
- Inspector to attach photos and/or evidence as appropriate.
- Inspector to assess construction and note non-conformances or potential compliance issues. Corrective action issued to Developer, if required.

#### **7. Site Home Energy Efficiency Inspection 2**

- Inspection to be carried out by relevant authority's nominated inspector.
- Inspection required after completion of Second Fix to allow visual inspection of lighting, sealing, etc.
- Inspector to complete remaining elements of the Home Energy Efficiency Inspection Checklist such that all elements have been inspected between the two inspections. Inspection based on building documentation collected during the desktop review.
- Inspector to attach photos and/or evidence as appropriate.
- Inspector to note elements that could not be assessed and require alternative evidence to verify compliance, eg receipts and verification from builder.
- Inspector to assess construction and note non-conformances or potential compliance issues. Corrective action issued to Developer, if required.

## 8. Issue Completion/Occupation Certificate OR Non-Conformance Report

- Inspector is satisfied that the construction meets the energy efficiency provisions described the design and the desktop review for the Home Energy Efficiency Inspection Checklist.
- OR Inspection raises Non-Conformance Report.

## 9. Documentation

- Documentation records:
  - the results of inspections;
  - additional evidence such as inspection photos
  - alternative evidence from others such as receipts and verification from builder
  - compliance issues and evidence that they have been satisfactorily dealt with

## Glossary

**First fix** comprises all the work needed to take a building from foundation to putting plaster on the internal walls. This includes constructing walls, floors and ceilings, and inserting cables for electrical supply and pipes for water supply.

**Second fix** comprises all the work after the plastering to a finished house. Electrical fixtures are connected to the cables, sinks and baths connected to the pipes, and doors fitted into doorframes.

## Appendix I – Summary Inspection Results

## Appendix I - Inspection Results

Raw results were received from inspectors in the form of the original checklist filled in by hand or on the computer. These checklists included various written responses reflecting what the inspector was able to understand and assess based on the designs and information provided and the visual inspection. The results were then categorized to determine the level of compliance reflected in the results by the key elements for which compliance was sought.

The results below reflect the data generated by the categorization of the inspection checklists. The data is provided based on the three inspection regimes that were achieved throughout the pilot and the feedback from inspectors. There are five tables below:

- 27 homes that were inspected twice – this reflects the regime that the pilot was mainly designed to test.
- All results for 59 homes
- 19 results for homes with one early inspection
- 13 results for homes with one late/final inspection
- 6 results from inspectors on the feasibility of inspecting different elements

### Full inspection regime (Based on 2 inspections per home)

The Table below records the results for the 27 homes which received two inspections and therefore had the most chance of being adequately assessed.

Compliance?	Yes	No	Inconclusive	Not needed	No inspection opportunity	Inadequate Information
Element assessed						
<b>INSULATION</b>						
Correct roof insulation	24	1	2	0	0	0
...well installed	17	2	8	0	0	0
Correct Wall insulation	19	5	1	0	2	0
...well installed	16	2	6	0	3	0
<b>WINDOWS</b>						
Correct glazing	13	1	8	0	1	4
Correct window frames	22	1	0	0	0	4
Correct depth of window reveal	5	1	11	6	0	4
<b>ROOFS AND SHADING</b>						
Correct roof	8	3	2	0	0	14
Correct shading/eaves	20	0	6	1	0	0
<b>BUILDING SEALING</b>						
External windows and doors sealed	16	0	5	4	2	0
Roof, walls and floors	16	2	2	5	2	0
Dampers on exhaust fans	15	1	2	4	5	0
<b>BUILDING SERVICES</b>						
Air conditioning System	0	0	10	13	2	2
Ductwork Insulation	0	1	2	23	1	0
Hot water	5	0	12	0	3	7
Heating/cooling pipework						
Insulation	0	5	5	10	5	2
Lighting	13	2	8	0	2	2

Compliance?	Yes	No	Inconclusive	Not needed	No inspection opportunity	Inadequate Information
Element assessed						
<b>UNCOMMON ITEMS</b>						
Roof ventilators	0	0	1	26	0	0
Rooflights / skylights	0	0	0	27	0	0
Sealing of rooflights	0	0	0	27	0	0
Sealing of chimneys and flues	1	0	0	24	1	1
Correct Floor insulation	1	1	0	25	0	0
...well installed	0	1	1	25	0	0
Floor heating or cooling	0	0	0	22	1	4
Evaporative coolers	0	0	0	27	0	0
Renewable energy sources	0	0	0	26	1	0
Electric resistance space heating	1	0	5	20	1	0
Swimming pool/ spa pool	0	0	0	26	1	0

|

## All results for 59 homes inspected

Compliance?	Yes	No	Inconclusive	Not needed	No inspection opportunity	Inadequate Information
Element assessed						
<b>INSULATION</b>						
Correct roof insulation	28	3	11	0	11	6
...well installed	17	3	26	0	13	0
Correct Wall insulation	22	5	7	7	15	2
...well installed	16	3	13	7	19	0
<b>WINDOWS</b>						
Correct glazing	18	3	26	0	3	9
Correct window frames	51	1	2	0	0	5
Correct depth of window reveal	17	1	15	14	0	12
<b>ROOFS AND SHADING</b>						
Correct roof	20	4	3	0	2	30
Correct shading/eaves	35	0	15	8	1	0
<b>BUILDING SEALING</b>						
External windows and doors sealed	26	0	17	4	12	0
Roof, walls and floors	24	4	9	6	14	2
Dampers on exhaust fans	16	3	5	9	24	2
<b>BUILDING SERVICES</b>						
Air conditioning System	1	0	13	23	10	12
Ductwork Insulation	0	1	6	38	12	2
Hot water	8	0	18	1	19	13
Heating/cooling pipework Insulation	0	5	7	25	18	4
Lighting	14	3	16	1	15	10
<b>UNCOMMON ITEMS</b>						
Roof ventilators	1	1	1	54	1	1
Rooflights / skylights	1	0	1	55	2	0
Sealing of rooflights	0	0	1	56	2	0
Sealing of chimneys and flues	1	0	0	56	1	1
Correct Floor insulation	1	1	0	56	1	0
...well installed	0	1	1	56	1	0
Floor heating or cooling	0	0	0	54	1	4
Evaporative coolers	0	0	1	58	0	0
Renewable energy sources	0	0	0	53	4	2
Electric resistance space heating	1	0	5	47	4	2
Swimming pool/ spa pool	0	0	0	55	3	1

## Results for 19 homes with one early inspection

Compliance?	Yes	No	Inconclusive	Not needed	No inspection opportunity	Inadequate Information
Element assessed						
<b>INSULATION</b>						
Correct roof insulation	3	0	6	0	7	3
...well installed	0	0	12	0	7	0
Correct Wall insulation	2	0	5	3	7	1
...well installed	0	1	7	3	7	0
<b>WINDOWS</b>						
Correct glazing	5	2	9	0	2	1
Correct window frames	18	0	1	0	0	0
Correct depth of window reveal	8	0	4	4	0	3
<b>ROOFS AND SHADING</b>						
Correct roof	7	0	1	0	2	9
Correct shading/eaves	10	0	6	2	1	0
<b>BUILDING SEALING</b>						
External windows and doors sealed	4	0	6	0	9	0
Roof, walls and floors	1	2	4	0	11	1
Dampers on exhaust fans	0	0	1	3	14	1
<b>BUILDING SERVICES</b>						
Air conditioning System	1	0	2	5	6	5
Ductwork Insulation	0	0	3	7	7	2
Hot water	1	0	3	1	10	4
Heating/cooling pipework						
Insulation	0	0	1	8	8	2
Lighting	0	0	3	0	12	4
<b>UNCOMMON ITEMS</b>						
Roof ventilators	0	0	0	18	1	0
Rooflights / skylights	0	0	0	17	2	0
Sealing of rooflights	0	0	1	16	2	0
Sealing of chimneys and flues	0	0	0	19	0	0
Correct Floor insulation	0	0	0	19	0	0
...well installed	0	0	0	19	0	0
Floor heating or cooling	0	0	0	19	0	0
Evaporative coolers	0	0	0	19	0	0
Renewable energy sources	0	0	0	15	3	1
Electric resistance space heating	0	0	0	15	3	1
Swimming pool/ spa pool	0	0	0	16	2	1



## Results for 13 homes with one late/final inspection

Compliance?	Yes	No	Inconclusive	Not needed	No inspection opportunity	Inadequate Information
Element assessed						
<b>INSULATION</b>						
Correct roof insulation	1	2	3	0	4	3
...well installed	0	1	6	0	6	0
Correct Wall insulation	1	0	1	4	6	1
...well installed	0	0	0	4	9	0
<b>WINDOWS</b>						
Correct glazing	0	0	9	0	0	4
Correct window frames	11	0	1	0	0	1
Correct depth of window reveal	4	0	0	4	0	5
<b>ROOFS AND SHADING</b>						
Correct roof	5	1	0	0	0	7
Correct shading/eaves	5	0	3	5	0	0
<b>BUILDING SEALING</b>						
External windows and doors sealed	6	0	6	0	1	0
Roof, walls and floors	7	0	3	1	1	1
Dampers on exhaust fans	1	2	2	2	5	1
<b>BUILDING SERVICES</b>						
Air conditioning System	0	0	1	5	2	5
Ductwork Insulation	0	0	1	8	4	0
Hot water	2	0	3	0	6	2
Heating/cooling pipework						
Insulation	0	0	1	7	5	0
Lighting	1	1	5	1	1	4
<b>UNCOMMON ITEMS</b>						
Roof ventilators	1	1	0	10	0	1
Rooflights / skylights	1	0	1	11	0	0
Sealing of rooflights	0	0	0	13	0	0
Sealing of chimneys and flues	0	0	0	13	0	0
Correct Floor insulation	0	0	0	12	1	0
...well installed	0	0	0	12	1	0
Floor heating or cooling	0	0	0	13	0	0
Evaporative coolers	0	0	1	12	0	0
Renewable energy sources	0	0	0	12	0	1
Electric resistance space heating	0	0	0	12	0	1
Swimming pool/ spa pool	0	0	1	12	0	0

## 6 Inspector opinions on importance of inspecting different items

Result Element assessed	Not worth Inspecting	Difficult to Inspect	Easy to Inspect	Important due to non-compliance	Essential item to inspect
<b>INSULATION</b>					
Correct roof insulation	0	1	2	0	3
...well installed	0	3	2	1	0
Sarking / sisalation	0	2	2	0	2
Correct Wall insulation	0	3	1	0	1
...well installed	0	4	1	1	0
<b>WINDOWS</b>					
Correct glazing	0	2	2	1	1
Correct window frames	0	1	3	1	1
Correct depth of window reveal	1	1	3	0	1
<b>ROOFS AND SHADING</b>					
Correct roof	1	0	2	0	3
Correct shading/eaves	0	0	4	0	2
Shading Materials	0	1	3	0	2
<b>BUILDING SEALING</b>					
External windows and doors sealed	0	1	4	0	1
Roof, walls and floors	0	3	2	0	1
Dampers on exhaust fans	1	5	0	0	0
<b>BUILDING SERVICES</b>					
Air conditioning System	0	1	4	0	1
Ductwork Insulation	1	3	1	0	1
Hot water	0	1	4	0	1
Heating/cooling pipework Insulation	1	3	1	0	1
Lighting	0	1	3	1	1
<b>UNCOMMON ITEMS</b>					
Roof ventilators	0	1	2	1	2
Rooflights / skylights	0	1	2	1	2
Sealing of chimneys and flues	0	5	1	0	0
Correct Floor insulation	0	2	2	0	2
Floor heating or cooling	0	1	4	0	1
Evaporative coolers	1	3	1	0	1
Renewable energy sources	0	1	4	0	1
Electric resistance space heating	1	3	1	0	1
Swimming pool/ spa pool	0	1	3	1	1

## **Appendix J – Inspection and Electronic Building Passport Integration**

**Figure - Summary of the potential integration between the Electronic Building Passport and site inspections**

Inspection Process Stage	Verification Documentation - Current	Verification Documentation - Potential
Desk-top Review	Building and allotment plans, drawings and specifications  House Energy Rating Report	Construction schedule - windows and doors
On-site Inspection <ul style="list-style-type: none"> <li>▪ Sealing</li> <li>▪ Glazing</li> <li>▪ Installation</li> <li>▪ Lighting/Fixtures</li> </ul>	On-site Inspection <ul style="list-style-type: none"> <li>▪ Sealing - site photo/air movement and building sealing certification</li> <li>▪ Glazing certificate, purchase order/photo</li> <li>▪ Insulation certificate/purchase order/photo</li> <li>▪ Lighting/fixtures - purchase order/photos</li> <li>▪ Documents - energy efficiency appliances/photos</li> <li>▪ Amended building plans and energy rating reports (if applicable)</li> </ul>	Glazing - label  Inspection photographs - insulation, glazing, sealing
Post-Inspection	Completed Inspection Checklists  Construction/Occupation Certificate	Reviewed Energy Rating Report (as built)  Point of sale assessment.