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Enabling innovation in building sustainability: Australia's National Construction Code

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Abstract

The National Construction Code (NCC) is a performance-based code for building and plumbing, which provides the minimum necessary requirements for safety, health, amenity and sustainability in the design and construction of new buildings.

There are two pathways for achieving compliance with the NCC's mandatory performance requirements; (i) developing a performance solution, or (ii) following a prescriptive solution. Typically, performance solutions are unique designs proposed as achieving compliance with respective performance requirements; whereas prescriptive solutions are generic solutions deemed by regulators as complying with respective performance requirements.

A recent study has identified that there is a potential productivity gain of $1.1bn by increasing the use of performance solutions within the Australian building and plumbing industry [1].

While the NCC has been a performance-based code since 1996, there is still a reliance on prescriptive solutions as it has been difficult to quantify performance requirements [2]. This has resulted in designers and practitioners not being confident in using some performance requirements, such as those for energy efficiency. The Australian Building Codes Board (ABCB) is currently undertaking a project to help increase the use of performance solutions, including in the area of energy efficiency, through quantifying the performance requirements, changing culture, building capacity and removing potential impediments within the industry. This includes looking at appropriate metrics, the use of verification methods, engaging with regulators to improve the tools they use for handling performance solutions and developing educational materials aimed at both residential and commercial building practitioners.

The aim of this work is to help increase productivity and innovation within the building industry through enabling the development of tailored innovative performance solutions, and in the case of energy efficiency, aligning methodologies with best-practice voluntary sustainability schemes as appropriate.

This paper describes how the NCC facilitates innovation within the building industry in relation to energy efficiency and sustainability performance.

Peer-review under responsibility of the organizing committee iHBE 2016.

Keywords: performance-based; regulation; quantification; building; energy efficiency; sustainability; code; performance

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1. Introduction

A performance-based building code (PBC) allows the freedom for architects, engineers, building designers, developers and builders to create innovative building solutions. It also allows for flexibility in responding to unique design challenges, the use of alternative approaches to design and construction in the absence of regulatory change and adaptation to the scale and pace of technological change, which prescriptive regulation cannot keep up with.

The Australian Building Codes Board (ABCB) has been the author of the Building Code of Australia (BCA), the Plumbing Code of Australia (PCA) and the National Construction Code (NCC), since 1992. In 1996, the BCA shifted from a prescriptive code, to a PBC. However, the uptake of the performance culture has been slow, and in some cases has reverted to a prescriptive mindset, which has inhibited the potential for innovation within the industry.

Nomenclature

ABCB	**Australian Building Codes Board**
BASIX	**Building Sustainability Index**
BCA	**Building Code of Australia**
CIE	**Centre for International Economics**
CO_2-e	**Carbon dioxide equivalent**
COAG	**Council of Australian Governments**
COP	**Conference of Parties**
DtS	**Deemed-to-Satisfy**
MJ	**Megajoules**
NABERS	**National Australian Built Environment Rating System**
NatHERS	**Nationwide House Energy Rating Scheme**
NCC	**National Construction Code**
NEPP	**National Energy Productivity Plan**
PBC	**Performance-based Code**
PCA	**Plumbing Code of Australia**
VM	**Verification Method**

2. Background

Performance-based regulation is not a new concept, with examples dating back nearly 4000 years, to the code of Hammurabi [3]. However, in modern building regulation a PBC has only been in force in Australia for approximately 20 years, with varied success.

The fundamental principle of the PBC is to allow the development of innovative solutions by regulating building outcomes as opposed to providing both the way and means of building [3]. A PBC facilitates this through a series of mandatory statements that are qualitative in nature. These qualitative statements describe the building occupant's needs rather than setting a quantitative metric for compliance.

An example of this is the performance requirement in room heights: "A habitable room or space must have sufficient height that does not unduly interfere with its intended function" [4]. This statement, while describing what occupants require, provides no direction on how it is achieved. Quantitative measures for compliance have typically

been situated within the deemed-to-satisfy (DtS) or prescriptive provisions, for example “Ceilings heights must be not less than 2.4m in a habitable room” [4].

In 2012, the ABCB commissioned the Centre for International Economics (CIE) to undertake a review of building regulatory reform since the establishment of the BCA. The report determined that the implementation of a PBC had delivered a benefit of approximately $780m annually to the economy up to that point, consistent with the findings in 2004 of the Productivity Commission in its report into the reform of building regulation. It also identified that there was the potential for similar productivity gains through further increases in the use of performance solutions [1].

The findings have led to significant changes to the latest edition of the NCC [4] to facilitate the increased use of performance, with complementary education programs, administrative actions and further technical changes underway.

3. How a PBC enables innovation

Many countries have shifted building regulation to a PBC; however, to date no country has a full set of performance-based procedures to support these codes [5]. The shift was driven by the need for flexibility within regulation as well as to facilitate innovation within construction while still maintaining health, safety and amenity levels [3].

To see how performance-based design can facilitate innovation it is worthwhile examining two industry sectors that have embraced performance. Firstly, it is widely acknowledged that the field of structural engineering is an example of a mature industry operating within the performance framework [5]. The second industry is the relatively new discipline of fire engineering where already the vast majority of performance solutions within the commercial sector are for fire safety measures [1].

Performance requirements for structural engineering are relatively consistent throughout the world and typically consistent of a simple statement regarding structural adequacy. Structural performance requirements typically use references to design standards, such as Eurocode, America Society of Civil Engineers standards and Australian Standards, to outline the compliance procedure. These standards outline serviceability and strength criteria, design loads and material properties. With this framework, the designer has the key input information and is then free to develop a structural solution tailored to each circumstance.

This approach has led to structural engineers being able to freely develop innovative solutions, whether it is through adaptive material use or allowing the creation of radical architectural forms.

In regards to fire engineering, the uptake of performance solutions is being driven by the heavy costs associated with the prescriptive requirements of codes [1]. By incorporating performance solutions into the fire safety measures of a building, fire engineers have been able to develop innovative approaches to fire safety tailored to the specific building. An example of this is the Museum of Old and New Art in Tasmania, Australia. By incorporating a performance solution for the fire systems, the facility was able to have large open galleries that exceed the compartment spaces allowed within the DtS provisions of the NCC.

These two areas of successful adoption of performance solutions give an insight into the ability of PBC to facilitate the adoption of innovative practice. This has the potential to be very important for energy efficiency and sustainability, where again the NCC in setting a floor below which practice for design and construction will be considered unacceptable, will nevertheless be unable to maintain an elaborate and contemporary array of prescriptive provisions to support the scope of innovation and technology in this field.

The PBC itself does not prescribe for innovative approaches to be adopted. However, it does provide a clear framework that allows practitioners, builders, owners, etc., to tailor a building solution to meet their specific requirements. Whereas prescriptive solutions are restrictive by nature as they cannot contain every possible permutation of building design.

In an industry that has a prescriptive mindset, the risk is that instead of innovation occurring, there will be a desire to force building solutions into the set of prescriptive rules within regulation. In doing so this has the potential to constrain new and ultimately more cost effective approaches to achieving (and in some cases exceeding) the performance requirements, as well as avoiding a culture of mediocrity.

Performance solutions allow designers, builders or researchers to explore a specific circumstance and develop an approach that may contain many examples of innovation that can eventually become part of mainstream practice (e.g. materials, construction practices or adaptive uses of space).

3.1. The NCC and innovation

Despite performance solutions promoting greater flexibility, innovative approaches and solutions, there is still a heavy reliance on prescriptive solutions [2]. Anecdotal evidence collected from a survey of NCC users conducted by the ABCB in 2013 and engagement by the ABCB over many years with practitioners, indicates that industry and in some cases regulators, still have an entrenched prescriptive mindset. This mindset can be said to be inhibiting innovation within the building and plumbing sectors, and risks not only a reduction in national productivity, but also a lack of preparedness to respond to the rapid changes in technology and construction practices.

As stated previously, the NCC (and formerly the BCA) has been a PBC since 1996. Increasing responsiveness to innovation has been one of the key drivers to the introduction of the PBC, which has already proven to be successful [6]. In interviews conducted, twenty percent of respondents stated that innovation was the predominant reason for undertaking performance solutions [6].

As mentioned previously, fire engineering is one of the principal areas where performance solutions are currently implemented [1]. While this was driven mostly by cost, it had the added benefit of fostering innovation within this sector. The change in Australia from a prescriptive code to a PBC in 1996 made this possible and has seen significant advances in fire engineering solutions to increasingly complex buildings at a much larger scale. This trend is set to continue with increased density in development and internationally, the march towards urbanisation in developing economies.

One of the key reasons the NCC allows for this level of innovation is that it has a set of clearly stated objectives [6]. Although this includes the overt requirement for the NCC to be performance-based, the ABCB's Inter-government Agreement sets out to provide the framework for an internationally competitive building sector and to achieve this through a minimum approach to regulation that is proportionate to a necessary need. The introduction of verification methods (VM) into the code has also formalised analytical methods [6] to aid in assessing compliance of performance solutions, though there is still more work to be done in this area.

4. NCC reforms to increase performance

The apparent disconnect between industry's willingness to adopt performance solutions and regulators reluctance to move to a performance framework may be attributed to the flexibility a PBC offers. Whilst being a benefit when designing a performance solution, it may make assessing compliance exceptionally difficult [7]. This is not directly attributable to a deliberate attitude on the part of regulators or others, but more likely a combination of many factors. These factors include cultural legacy from when the code first moved away from prescription, a lack of appropriate training, a comfort for many to operate in a highly structured regulatory environment and a concern on the part of some that the performance outputs do not achieve the same minimum standards of the comparable DtS solution.

This last point has been identified as a key issue through in-house surveys and consultation conducted by the ABCB, where many practitioners in particular have become accustomed to treating the DtS provisions as the mandatory requirements of the NCC. This mindset becomes an effective barrier to the greater use of performance, but also has the potential to undermine the basis of a PBC.

It also lends additional weight to quantifying the performance requirements to enable practitioners and regulators to identify the intended target to be achieved and importantly provide certainty and confidence to those assessing performance solutions that they meet the requirement. If this point can be reached, it is possible that culture and mindsets can be changed so that higher prescriptive standards or an insistence on the use of prescriptive solutions is not imposed by some regulatory authorities as a safeguard.

It stands to reason that if this position can be reached, then productivity dividends will be delivered [1], as well as facilitating innovation, which over time can translate into industry cost savings. A good example of this is the move to modular construction and the use of mass cross-laminated timber. This has major benefits for the economy, but can also benefit building outcomes in the medium to long-term.

As a result of these findings, the ABCB has commenced a series of reforms to the NCC and supporting material to help foster a performance culture and mindset within the sector, with the aim of increasing innovation and productivity in building, plumbing and drainage solutions. It has been identified that these actions need to occur simultaneously with the quantification of the performance requirements so as to avoid the situation that arose at the time of the PBC being introduced in 1996, when the measures were simply added to the existing DtS provisions, with no associated training and support materials to help everyone within the industry transition.

One of the major problems to be solved with the implementation of a PBC was developing the appropriate link between qualitative statements and quantitative criteria [8]. Unfortunately, the work to develop appropriate quantified measures or linkages to the qualitative compliance statements was not adequately pursued at the time and despite previous attempts, it is only under the ABCB's 2014 *Building Regulatory Reform* agenda that a commitment and resources have been allocated to complete this task [7,9].

In doing so, it is recognised that the use of performance solutions will have greater appeal and utility to different parts of the building and plumbing industry, and that prescriptive solutions remain a valid form of demonstrating compliance with the performance requirements. This will particularly be the case in those parts of the industry where design, construction and installation are mass produced and repetitive in nature, such as detached domestic housing construction. Even here though, innovation will occur and it will be important that the opportunity exists through a PBC for these new approaches to be applied without necessarily having them adopted as DtS solutions. In other words, it is sometimes useful to allow new methods to be road tested before they become part of mainstream construction.

As part of these reforms, three issues were identified as potential impediments:

- An established prescriptive mindset;
- A need to build industry capacity; and
- Qualitative performance requirements.

The response to these issues can be summarised into two main areas of reform:

- Education of NCC users complemented with support materials (breaking prescriptive mindset and building capacity); and
- Technical code reform (quantification of performance requirements).

The ABCB believes that by addressing these two areas, major inroads to increasing the use of performance can be made. While the technical aspects do pose a major barrier, the education of NCC users, supported by materials that can help simplify the process for all involved, is seen as critical and one that can start to be immediately addressed.

Some tertiary education institutions introduce students to the philosophy of the PBC but provide little instruction in its real life application [3], in other cases the NCC is not even provided as part of the curriculum for professions likely to encounter the PBC.

In order to assist the shift in culture to increase capacity for performance solutions and change NCC users' mindset, the ABCB has undertaken to consult with these institutions, as well as industry associations involved in training, to create new guidance and educational material for practitioners and students that help to promote and understand performance-based design.

4.1. Adopting a Performance Mindset

The ABCB *Building Regulatory Reform* agenda adopted in 2014 dedicated a program of action to increase the use of performance, establishing a Board Steering Committee and allocating resources for what was acknowledged as a long-term project. With the support of the Building Ministers' Forum, it also took the critical step of making the NCC free online, which was an essential step in increasing exposure of the PBC to a much wider audience of practitioners. In the space of 12 months, the number of registered users of the NCC has risen from 11,000 to 100,000, with students being an important group.

In 2015, the ABCB released a document entitled “Performance Requirements extracted from the National Construction Code 2015” [10]. While this document was only released as guidance, its intention was to highlight that the NCC performance requirements are the mandatory technical requirements. This was considered particularly important in order to alert the new users of the NCC to its design so as to influence their mindset from their first contact.

The 2016 release titled the “Consolidated Requirements” [4] was the next generation of this simplified document, which included the addition of a consolidated form of the general provisions from the three volumes of the NCC and importantly moved from an informal guide to being part of the NCC suite of documents. This step highlighted the importance of the general requirements, that they support the performance requirements, and together they comprise the mandatory NCC requirements. The title change also further reinforced the fact that these are the mandatory requirements of the code.

In addition to the release of the “Consolidated Requirements”, further changes to the general requirements were included in the NCC to emphasise performance solutions as a compliance pathway. These changes included revising and simplifying the NCC compliance structure and changing terminology. The revision of the NCC compliance structure is illustrated in the diagram in Figure 1.

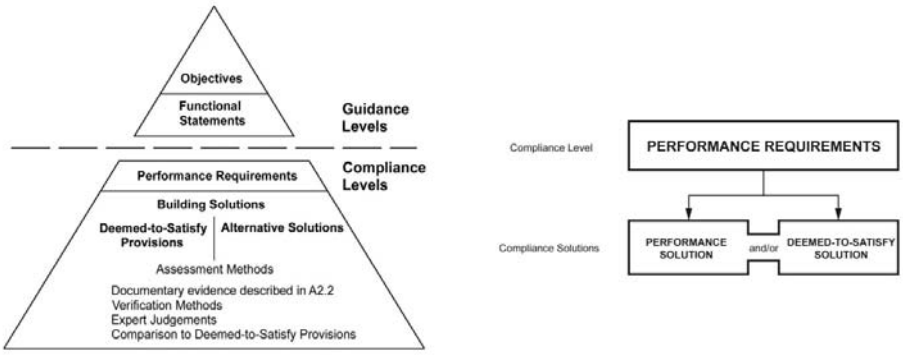

Fig 1 NCC Compliance Structures (NCC 2015 left, NCC 2016 right) [4,10]

The change from the ‘pyramid’ to the so-called ‘dumb-bell’ makes the identification between guidance and compliance levels clearer (by removing the guidance level from the structure). It reinforces and strengthens the message that the performance requirements are the mandatory level of the NCC technical requirements and that performance solutions and DtS solutions are equally acceptable compliance pathways. This also brings the NCC in line with other international building code compliance structures, such as New Zealand, as illustrated in Figure 2.

Changing terminology, by renaming the defined term “alternative solution” to “performance solution”, also reinforces that they serve as a key pathway to compliance of an equal weight to a DtS solution. As opposed to the view of some, that they are an alternative to when a DtS solution cannot be attained.

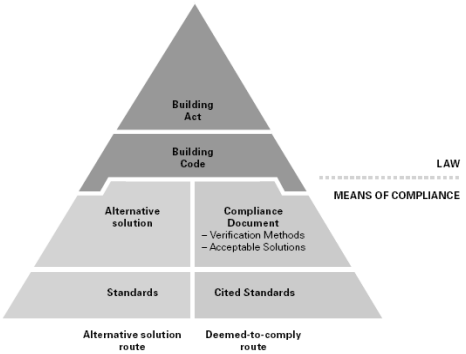

Fig 2 New Zealand Building Regulation Framework [11]

4.2. Building Performance Capacity

User surveys revealed that understanding of performance solutions, the NCC compliance structure and the benefits of a PBC is less than desirable. As a result, the ABCB has commenced development of better information and tools to help with the education of NCC users.

Several key items of this strategy developed to date include:

- Developing a simplified guidance document to undertake a Performance Solution
- Infographics that better illustrate the choice to meet the NCC Performance Requirements
- Regularly publishing technical articles
- Improving tertiary resource kits to cover performance-based design
- Making performance a focus of some of the ABCB's direct learning interactions with practitioners, regulators and industry associations, such as its national seminar series and presentations at national conferences.

The ABCB is creating this information to supplement the material previously developed (such as non-mandatory handbooks) to guide current and future industry participants. It is also envisaged that the tertiary education sector and industry training associations adopt these materials within their courses in order to increase student understanding of a performance-based NCC prior to them entering the workforce. It is also important that the ABCB work with regulatory bodies to adopt agreed tools used as part of universal practice to encourage wider application and establish benchmarks for what level and quality of information will be accepted.

4.3. Quantification of Performance Requirements

While education is seen as a critical element in changing the psyche of NCC users, additional technical changes have to be incorporated into the NCC to allow for easier development of solutions and reviewing of compliance. This is being delivered through quantification of the NCC performance requirements.

In its purest sense, quantification of the performance requirements can be achieved by inserting high-level metrics within the performance requirements. One of the problems with having quantitative statements within mandatory provisions is that law is not expected to change significantly over time, while the tools, methods and information available to designers can change significantly, resulting in the quantitative metrics being obsolete and a change required to the mandatory provisions [8]. This, however, is less problematic than having these metrics contained in prescriptive measures, which describe both what is required and how they are to be delivered.

Nevertheless, because of this the approach of developing VMs as one method for quantification has been adopted, particularly where it is difficult to establish a suitable metric in the performance requirement. While this is not strictly quantification in its untainted form, it is seen as an effective method. A VM contains quantified information that designers and regulators can use to verify compliance, but still maintains the performance requirement as changes to them should be kept at a minimum. It also has the added benefit of not restricting the designer, in so much as, if the VM does not appropriately cater for their building, a full performance solution may still be developed.

As a result of the CIE report, a renewed effort on quantifying the performance requirements is being conducted by the ABCB. This has resulted in eight new VMs being incorporated within the NCC, across all three volumes, since 2014. These VMs cover a range of topics (such as structural reliability, weatherproofing and ventilation) and use varied approaches to quantify and foster an increased use of performance.

The ABCB's aim is to quantify all the performance requirements, where possible, either within the performance requirement or via a VM. Priority areas of fire safety (including bushfires), plumbing, health and safety are well progressed and the remaining work including energy efficiency, scheduled for consideration as part of NCC 2019.

There are currently four performance requirements for energy efficiency in the BCA, two in each volume [4]. The BCA has also always contained a VM for the building fabric aspect of the performance requirements and a quantified value for the energy source used for heating [4]. The VM is in the form of a comparative approach, which compares the proposed energy use of a building to the energy use of a reference building that reflects the DtS

provisions, whilst the quantified performance requirement is expressed in greenhouse gas intensity, in CO_2-e/MJ of thermal energy load [4].

5. Improving building energy efficiency through an innovative NCC

The energy efficiency of buildings is regarded not only as a pilot for innovation in the design and construction of buildings, but as a showcase. Like everything else, this needs to be seen in the context of the ABCB charter and objective for the NCC, which is to set minimum and proportionate performance-based measures where a societal need is established. Beyond this, voluntary pathways can be anticipated to exist that will push higher levels of performance than those established by regulation, which when adopted over time and become mainstream and cost effective, potentially set the new floor below which practice becomes unacceptable.

Bearing in mind that energy efficiency is still a relatively new and evolving part of building design and construction; examples of this approach exist in both the commercial sector with the Green Building Council of Australia's Green Star and the residential sector with the Housing Industry Associations GreenSmart initiative.

It also needs to be recognised that what constitutes the minimum and therefore acceptable societal cost, will be shaped by a number of factors, not the least of which is industry capacity, which involves the ability to adapt and adopt new practices and technologies, and political direction setting.

In the case of the latter, this now exists both in respect to the adoption by the Council of Australian Governments' (COAG) Energy Council of the National Energy Productivity Plan (NEPP), but also the Government's Conference of Parties (COP) 21 commitments to reduce greenhouse gas emissions [12,13]. As for the former, the available evidence appears to indicate a greater capacity in the commercial sector in the first instance to accommodate further and potentially significant reductions in energy use [14,15].

This in part can be attributable to a mindset that has had to be more accepting of performance-based design given the complexity and uniqueness of a large proportion of the buildings constructed. It is also where systems have had to innovate in order to achieve the expectations of many clients who are more demanding in meeting life-cycle cost reductions or wish to promote an image as part of their societal profile.

Residential on the other hand, has struggled to both achieve end user acceptance in the context of other discretionary choices, as well as overall compliance with the requirements of the NCC [16,17]. This is in an environment where there is a more established culture towards long-term established practice that is less willing or in need to embrace change. Here prescriptive solutions are preferred over performance solutions as the nature of the industry is geared more to the repetitive and less engineered end of the construction process, which although works well, means it is potentially less prepared to deal with constant innovation.

Having regard to the context in which the regulation of energy efficiency for buildings must operate, the opportunity is to best identify where the NCC can enable better practice. This process had already commenced prior to any new policy direction being established following the last changes to the BCA energy efficiency requirements in 2010. This included working with industry to review the utility of the air-conditioning and ventilation requirements where changes were made to improve their useability; the examination of levels of building compliance to determine how the NCC may be contributing; the assessment of summer energy performance to increase the adoption of the NCC's minimum requirements particularly in the tropical climate zones, resulting in the development of a free-running dwelling national advisory note with a number of case studies; and initial analysis for quantifying the energy efficiency performance requirements of the NCC.

During this period, there have been significant innovations within the building industry in relation to energy efficiency and sustainability performance, including the widespread adoption of co-generation and tri-generation, onsite renewables, modular building construction, the use of mass timber construction and software tools that can account for new products or systems. Further innovation in both technology and construction practices can also be anticipated, some of which have the potential for adverse and unanticipated consequences, such as the inclusion of combustible insulation material in some cladding products designed to contribute to the energy efficiency performance of a building.

Another area of consequence that must also be taken into account in parallel with the review of further increases in energy efficiency levels, quantification of the performance requirements and overall levels of compliance with the NCC is condensation. The ABCB has already commenced a major piece of work on this subject in order to buttress

the NCC, and therefore future construction, to the potential adverse effects of further energy efficiency provisions, which could affect the health and amenity of building occupants.

In looking ahead, and in very general terms, it can be anticipated that in response to the policy direction, the ABCB will, for both commercial and residential, where necessary quantify and potentially adapt the energy efficiency performance requirements of the NCC, provide a suite of VMs and simplify the DtS provisions. By example, the quantification of the performance requirements may involve:

- requiring a percentage improvement compared to a baseline year;
- expanding the suite of VMs for commercial buildings that could include a stated value, a reference building, or the use of National Australian Built Environment Rating System (NABERS) and Green Star;
- expanding the suite of VMs for residential buildings, which could include a stated value, a reference building and the use of the Nationwide House Energy Rating Scheme (NatHERS), Building Sustainability Index (BASIX) or another nationally recognised rating tool.

In addition to quantification of performance requirements, more simplified DtS provisions would be developed. This would involve a concerted effort to improve the readability and understanding of the provisions, which is a broader exercise applying to the whole of the NCC under the umbrella of its capacity and capability initiatives.

As indicated, the strategy focuses in the first instance on determining the feasibility, method and construct of new energy efficiency requirements for commercial buildings with a view to their inclusion in NCC 2019. This would occur in tandem with the assessment and design of a new methodology for residential buildings energy efficiency that would move beyond the thermal shell of the building, combined with the current efforts to obtain compliance with the current energy efficiency requirements of the NCC.

In the absence of the capacity and capability building exercise, an incremental increase in stringency based on the current method is unlikely to yield the necessary results, whereas it can be anticipated that obtaining compliance and adapting the utility of the methodology can deliver similar dividends in the short-term and lay the foundations for the next step in the minimum requirements anticipated in 2022.

Beyond this, an accepted and adopted trajectory for future increments to energy efficiency requirements under the NEPP will be an essential accompaniment to assist industry in anticipating change, which allows for adaptation and promotes innovation [12].

The potential benefits of this approach are many, but include:

- The provision of a much broader range of compliance options
- Enabling the use of a suite of accepted sustainability tools
- Greater national consistency through less state and territory variations
- For residential, a move to a whole-of-house methodology
- Improved application of DtS provisions for those who prefer the ‘recipe’ approach
- A foundation for concessions for onsite renewables and broader sustainability measures, noting the scale and pace of change in this area has the potential to out-strip a prescriptive regulatory environment
- Increased use of performance to better enable the application of new innovations, which if established can become mainstream practice reducing both the unproductive use of energy (and hence cost) and greenhouse gas emissions
- Increased overall level of compliance with the NCC requirements.

At the same time it will be necessary to exercise caution in the resolution of a number of complex issues; not to be overly ambitious, including having regard to the capacity of all involved to adapt; and to understand that through a greater range of compliance methods there is the potential for some inconsistency in that they will not necessarily produce exactly the same results.

6. Conclusion

The NCC has been a PBC since 1996. During this 20-year period the NCC has delivered approximately $780m annually in productivity gains arising out of being performance based [1].

The ABCB, through its authoring of the NCC and associated guidance material, is attempting to promote a performance culture and facilitate innovation within the building and plumbing industry. This is primarily through a combination of mindset change and capacity building initiatives, along with quantification of the performance requirements.

NCC requirements relating to the energy efficiency of buildings has the potential to become a showcase for how a PBC is designed to operate. In doing so, this not only delivers on a renewed policy emphasis in this area, but innovation in design, construction techniques and products. It also has to be accompanied by increased levels of compliance, which having quantified targets and improved methodologies for the NCC requirements can contribute to.

However, the ABCB alone cannot significantly influence the next generation of practitioners. The education sector, industry associations and regulators play a key role in developing a performance mindset for future generations, enabling openness to innovative solutions and new approaches to delivering policy outcomes, including energy efficiency.

By shifting to a performance mindset, further substantial productivity gains should be realised through the development of innovative building solutions, as well as position the sector for the inevitable disruptive technologies and construction practices that are emerging and can-not be responded to satisfactorily through rigid prescriptive responses.

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