The case for high energy performance buildings has been well demonstrated. Such buildings can be more comfortable, safer in extreme weather, more affordable to operate and maintain, a lesser burden on the energy system and generate low or even 'net positive' emissions.

Australia’s comparatively mild climate and historically low energy prices have meant energy performance has not been a high priority for many building designers, developers, owners or occupants. However, a combination of factors (rising energy prices, energy security concerns, the Paris Climate Change Agreement and the prospect of increased weather extremes in the future) are driving increased focus on improving the energy performance of Australian buildings.

Energy requirements for new construction in building codes are widely recognised as key to driving energy and emissions outcomes. Leading jurisdictions around the world have or are in the process of establishing long-term targets of net or near zero energy buildings as part of integrated policy packages designed to drive innovation, investment and market transformation in the property and construction sectors.

The Australian Sustainable Built Environment Council (ASBEC) and ClimateWorks Australia are working to develop an industry-led forward trajectory for the energy requirements in the National Construction Code (NCC). The project aims to support governments, via the Building Ministers Forum, to establish long-term targets and trajectories for the NCC energy requirements and consider necessary support measures. Details of the project are provided in Attachments 1 and 2.

The project will support and add impetus to concurrent work on the NCC and on energy and emissions policy at national, state and territory levels, including work on the 2019 NCC update by the Australian Building Codes Board, and building regulation reforms being investigated by Commonwealth, State and Territory Governments. The project will also seek to inform key national energy and emissions policy processes including the Independent Review into the Future Security of the National Electricity Market ('Finkel Review'), government’s response to this review, and the Commonwealth Review of Australia’s Climate Change Policies. It will illustrate how improved NCC energy requirements could contribute to reducing emissions and achieving energy affordability and security objectives.

At this early stage, ASBEC and ClimateWorks are seeking input and feedback from a range of industry, government and consumer stakeholders. Your views are important to us and will help ensure the project is useful, relevant and achieves its intended outcomes. We welcome feedback on any or all of the questions outlined in the paper below - it is not necessary to provide written responses to cover every question.

**How to Provide Feedback**

Provide written feedback by Friday 28 July 2017 via email to Michael Li: michael.li@climateworksaustralia.org. Written feedback can be provided in any form, either directly in the body of an email, as annotations to this document, or in a separate written response.
About us

Project partners

The project is a partnership between ASBEC and ClimateWorks Australia.

The Australian Sustainable Built Environment Council is the peak body of key organisations committed to a sustainable built environment in Australia. ASBEC members consist of industry and professional associations, non-government organisations and government and academic observers who are involved in the planning, design, delivery and operation of our built environment.

ASBEC provides a collaborative forum for organisations who champion a vision of sustainable, productive and resilient buildings, communities and cities in Australia.

ClimateWorks Australia is an expert, independent adviser, acting as a bridge between research and action to enable new approaches and solutions that accelerate Australia’s transition to net zero emissions by 2050. It was co-founded in 2009 by The Myer Foundation and Monash University and works within the Monash Sustainable Development Institute.

In the pursuit of its mission, ClimateWorks looks for innovative opportunities to reduce emissions, analysing their potential then building an evidence-based case through a combination of robust analysis and research, and clear and targeted engagement. They support decision makers with tailored information and the tools they need, as well as work with key stakeholders to remove obstacles and help facilitate conditions that encourage and support Australia’s transition to a prosperous, net zero emissions future.

Supporters

The project is steered by an ASBEC Working Group comprising government, industry and academic stakeholders and chaired by Tony Arnel, a former Board member of the Australian Building Codes Board (ABC), Chair of the Energy Efficiency Council and Global Director of Sustainability, NDY.

RACV is a lead project sponsor. RACV is the prime Victorian provider of a wide range of member services relating to motoring, including emergency roadside assistance and insurance, home services, travel and accommodation, resorts and lifestyle, loyalty programs. RACV is the prime transport advocate in Victoria for improvements in road safety, road and public transport projects and services, road user behaviour, vehicle safety and technology initiatives, transport mobility options, and sustainable transport.


The project will establish a Technical Advisory Group of relevant specialists in building design, construction and operation, energy performance in buildings, building energy modelling and cost-benefit analysis.

Technical partner

The Cooperative Research Centre for Low Carbon Living (CRCLCL) is a national research and innovation hub for the built environment, funded by the Australian Government’s Cooperative Research Centres Programme. The CRCLCL is leading and providing funding for technical analysis for the Building Code Energy Performance Trajectory Project, in partnership with CSIRO, Energy Action (EA), Strategy. Policy. Research. (SPR) and the University of Wollongong (UoW).

The CRCLCL brings together industry and government organisations with leading Australian researchers to develop new social, technological and policy tools for reducing greenhouse gas emissions in the built environment. It seeks to grow industry confidence to invest in low carbon innovations, providing evidence to inform best practice Australian building codes and standards.
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Australia is facing major challenges in housing affordability and delivering cost-effective and reliable energy. The ‘energy trilemma’ of security, affordability and emissions reduction has been emphasised through the Independent Review into the Future Security of the National Electricity Market1. The Paris Climate Change Agreement marked a significant milestone in limiting the impacts of global warming. Almost every country has signed up to the Agreement, which commits nations to transition to net zero emissions in the second half of the century. The impacts of climate change are already being felt2, so limiting global warming to less than two degrees will require acceleration of existing efforts to reduce emissions. Yet Australia’s emissions are now on the rise3.

Improving energy performance in buildings could be a powerful, multi-purpose solution to these inter-related issues, because:

• Energy use in buildings accounts for almost one quarter of Australia’s annual emissions, and yet we know that buildings can reach net zero emissions using proven, affordable technologies to improve energy efficiency, reduce reliance on gas, wood and other fossil fuels, and adopt on-site renewable energy4.

• Buildings account for more than half of Australia’s electricity consumption5, and are a major driver of ‘peak demand’. Improved energy efficiency, smart building controls and on-site generation with storage can help reduce the burden buildings place on the electricity grid and improve grid management for reliability.

• Rising electricity prices are having an impact, particularly for low-income households6, small businesses and energy-intensive businesses.

ASBEC’s *Low Carbon, High Performance* report confirms that a net zero emissions building sector is possible by 2050, and would deliver almost $20 billion in energy cost savings for households and businesses by 2030, while at the same time contributing more than 10 per cent of Australia’s 2030 emissions reduction target, and up to half of the 2030 energy productivity target7. Improving energy performance could also improve occupant resilience to heat waves and prolonged cold.

Unfortunately, progress in improving energy performance in the built environment sector has been limited to a small segment of market leaders, particularly developers of premium and A-grade office buildings and boutique sustainability-focused developments. For the sector as a whole, improvements of just 2 per cent and 5 per cent in energy intensity* have been observed across commercial buildings and residential buildings respectively over the course of a decade8.

More effort is required in order to remove barriers and introduce incentives and capacity building to improve energy performance and unlock the full potential of the built environment sector to help address energy, emissions, living affordability and resilience issues.

*Energy intensity* refers to the amount of energy used per unit of output or other metric, for example energy use per year per square metre of commercial building floor space, or energy use per year per household.
A forward trajectory for the NCC

Mandatory energy performance requirements in building codes are widely recognised as a key driver of improved building energy performance. Codes apply at the point of design and construction; often the easiest and cheapest time to deliver energy performance outcomes. Over time, the energy and emissions impacts of new construction quickly add up. High-level estimations performed by ClimateWorks indicate that at current rates of construction and demolition, buildings constructed after 2019 could make up a quarter of the total building stock in both the residential and commercial sectors by 2030. By 2050, this proportion could increase to 52 per cent of all residential dwellings and 59 per cent of commercial floor space.

A recent international best practice policy review by the CRC for Low Carbon Living identified a pathway or forward trajectory for building code requirements as a critical component of an integrated package of policies necessary to drive low carbon outcomes in the built environment. The study notes that such a forward trajectory is necessary to:
- Provide certainty for planning and investment;
- Enable innovation; and
- Encourage and reward over-achievement.
A forward trajectory can also provide clearer guidance as to when, how and to what degree energy requirements should be changed over time. Without this guidance, stakeholder consultations on proposed regulatory change take place without clear ground rules, resulting in “discretionary interventions in the decision-making process” for code upgrades. This may in part explain the long delay since the last increase in stringency for the NCC energy requirements (in 2010), and the fact that no update in stringency of residential energy requirements is currently planned until 2022¹⁰.

At its core, a forward trajectory may include long-term targets for different building types, illustrative trajectories for each building type to achieve those targets, a clear and efficient process for Code updates and associated research and analysis required to prepare for each update and adapt to changed circumstances, and necessary complementary measures.

This project aims to provide an industry-led evidence base to support the establishment of a forward trajectory for the Code energy requirements, including:

- Proposed objectives that reflect the full benefits of energy performance requirements;
- Proposed long-term targets for energy performance requirements, with target years based on analysis of cost-effective trajectories for key building types; and
- Discussion and recommendation of necessary complementary measures.

Further detail on the project methodology is provided in Attachments 1 and 2.
Issues and questions

Objectives

The objectives of the National Construction Code are important for defining the intent of the Code and communicating the expectations of governments to industry and the community. With clear objectives, the ABCB is able to facilitate regulatory change processes and consultations in line with the overarching goals, and designers and builders are better able to plan for future Code changes. For an Objective statement to be effective in driving behaviours in the industry, it should be translatable into specific performance requirements in the Code.

The NCC defines the following Objective for energy efficiency:

“The Objective is to reduce greenhouse gas emissions.”

This Objective sets the expectation that the mandatory energy performance requirements of the Code will reduce emissions associated with the operation of all new buildings and major renovations in Australia. The Objective statement aligns with Australia’s obligations under the Paris Climate Change Agreement, but does not explicitly acknowledge the implication of that agreement, which is the need to transition to a net zero emissions economy by the second half of this century and likely by 2050 for developed countries like Australia.

The Inter-Governmental Agreement (IGA) that outlines the purpose and limitations for the ABCB states that codes and standards should mandate the “minimum necessary” requirements to achieve sustainable outcomes. It would be important for any Objective statement incorporated into the Code to align with this “minimum necessary” approach. For example, it could be made clear that a net zero emissions Objective is necessary for Australia to meet its emissions reduction obligations.

While the Code currently focuses on a singular objective to reduce emissions, there could be potential for the Code to include other benefits of energy efficiency in the Objective statement. These broader benefits could include occupant comfort, health and safety, living affordability, economic growth and reduced electricity network costs. For example, the European Union’s (EU) Energy Performance of Buildings Directive 2010/31/EU aims to promote “the improvement of energy performance of buildings within the Union, taking into account outdoor climatic and local conditions, as well as indoor climate requirements and cost-effectiveness.”
The advantage of incorporating broader benefits into the Objective statement of the Code is that the requirement to balance between energy efficiency, comfort, health and safety, cost and other factors is embedded into the Code. Importantly, it is also embedded in Code update processes and supporting analysis, and, by extension, industry practices. For example, acknowledging the broader benefit of integrating buildings (as energy generators and local batteries) on a precinct-wide basis. On the other hand, it may also add complexity to the Code requirements and raise concerns about overreach beyond the traditional remit and scope of the Code.

**LONG-TERM TARGETS**

One of the central purposes of the Building Code Energy Performance Trajectory Project is to define a set of evidence-based long-term targets for the performance requirements of new building work. Numerous jurisdictions around the world have committed to long term targets for building energy performance, and Australia can draw on these case studies to define the long-term target/s for the National Construction Code. Assessing the strengths and weaknesses of the options that have been adopted globally by leading jurisdictions assists with the selection of an appropriate aspiration for the Australian context.

The EU’s Energy Performance of Buildings Directive requires that member states implement measures to achieve nearly zero energy for all new buildings by 31 December 202015. The energy consumption of a building can be offset to achieve nearly net zero energy through the use of renewable energy produced on-site or nearby. Each member state is required to prepare a strategy to contribute to the goal of the Directive. Similarly to Australia, where the States and Territories are responsible for the enforcement of the Code, compliance of new buildings with EU Directives is the responsibility of individual member states.

Some examples of leading EU member states’ energy performance targets include16:

- The Netherlands and Austria define targets that align with the EU Directive. Their building codes require all new buildings to reach near zero energy by 2020;
- The Denmark building energy code requires that, nationally, energy consumed by buildings in 2020 is 75 per cent less than a 2008 baseline;
- The building code in Sweden requires that all new buildings are net zero energy by 2020;

**QUESTION**

Should the Objective include broader benefits of energy performance, such as occupant comfort, health and safety, living affordability, economic growth and/or reduced electricity network costs?

Should the Objective cover practices and benefits beyond minimum practice?
In Finland, the building code requires all new residential buildings to meet Passive House standards by 2015 en route to achieving near zero energy for all new buildings by 2020 (as per the EU Directive);

- The French building code states a target for all new buildings to be energy-positive by 2020;

- The German building code requires all new buildings to operate with no fossil fuels by 2020;

- Ireland has previously set the most ambitious target for new builds of net zero energy buildings by 2013. However, the 2017 revision of the building code will implement the near zero energy by 2020 target in line with the EU Directive; and

- In 2006, the UK Government declared a target for all new homes to be zero carbon (from energy use) by 2016 as part of the Code for Sustainable Homes. This policy was abandoned by the UK Government in 2015, a decision that was criticised by industry and environmental groups for creating regulatory uncertainty and impeding the transition to a sustainable built environment.

In the United States, each state independently develops its building code and sets targets for building energy performance. The 2030 Challenge, a program facilitated in the United States by non-profit organisation Architecture 2030, has been a significant driver in inspiring local, state and federal government to enact legislation to improve energy performance of buildings. The aspiration of the 2030 Challenge is that "all new buildings, developments and major renovations shall be carbon-neutral by 2030". Adopters of the 2030 Challenge are encouraged to target a reduced fossil fuel energy consumption of 70 per cent compared with a standard practice baseline (to be set by each jurisdiction) in the short term. This fossil fuel consumption target is then to increase to 80 per cent by 2020, 90 per cent by 2025 and carbon neutral by 2030.

Inspired by the aspirations of the 2030 Challenge, the State of California is aiming for all new residential buildings to be net zero energy by 2020, with all new commercial buildings to meet this target by 2030. California defines a net zero energy building as one that produces on-site renewable energy equal to the building’s energy demand. The Washington State energy code, rather than meeting an absolute energy target, is aiming for a 70 per cent reduction in net annual energy consumption by new buildings in 2030 compared with the 2006 Washington State Energy Code. The State of Massachusetts has established a Task Force that recommends net zero energy for new buildings by 2030. These moves are not just limited to state authorities: the City of Boulder, Colorado, recently adopted an Energy Conservation Code that sets a target of net zero energy for new buildings by 2031.

The EU Energy Performance of Buildings Directive and the 2030 Challenge have been the primary drivers of building code energy performance legislation in Europe and the United States respectively. Other countries to have implemented targets for building energy efficiency include Japan (net zero energy for new commercial buildings by 2030) and Canada (net zero energy for all new buildings by 2050).

The aspirations of voluntary certifications can also provide insight into the future direction of building practices according to industry leaders; for example, the Green Building Council of Australia is currently exploring the potential for its Green Star tool to require all new certified buildings to achieve net zero emissions before 2030.
The case studies suggest the following options for defining a long-term building code energy performance target:

- **Nearly zero energy** - most energy consumption of the building is offset by renewable energy on-site or nearby;
- **Net zero energy** - all energy consumption of the building is offset by renewable energy on-site or nearby;
- **Net positive energy** - renewable energy on-site or nearby produces enough energy to offset building energy consumption plus export surplus to the grid;
- **Net zero carbon emissions** - all carbon emissions from the building are offset. The scope for this target may be limited to energy emissions, or may include non-energy emissions such as emissions from refrigerants or embodied emissions in building materials;
- **Zero fossil fuel consumption** - the building does not consume any fossil fuel energy sources (including from electricity); and
- **Reduction in energy consumption from a standard practice benchmark.**

Based on these case studies, **nearly zero energy** and **net zero energy buildings** appear to be the most common targets adopted by these jurisdictions. This aligns with work undertaken by the Global Buildings Performance Network (GBPN) that identified a zero energy target as an important component of best practice for long-term planning of energy codes27.

**QUESTION**

Are there other options for defining a building code energy performance target that you believe should be considered?

What are the benefits and drawbacks of each of these options for defining the building code energy performance target?

Should offsets such as renewable energy be considered in the target? If so, how should they be included in the target, i.e. could other offsetting options (such as renewable energy nearby, as defined by the EU Directive) be considered?

Do you believe there should be a single building code energy performance target for all building types, or separate targets for different sectors?

Is it important for the definition of the target to align with the wording of the stated Objective of the code? For example, if the Objective is to reduce greenhouse gas emissions, do you believe the target should also relate to emissions?

What do you believe is the most appropriate long-term building code energy performance target for new construction in Australia?

What do you believe is an appropriate timeframe for achieving the long-term target/s?
Modelling trajectories

The core analytical component of this project involves integrated building energy modelling and ‘techno-economic analysis’ to investigate and develop cost-effective trajectories to the proposed long-term target/s for eight representative building types across three climate zones. A detailed methodology is presented in Attachment 2.

Modelling scenarios

The project is proposing to model two scenarios: a ‘reference’ scenario and a ‘high performance buildings’ scenario.

The proposed ‘reference’ scenario is one in which the built environment sector achieves net zero emissions by 2050, but primarily through adoption of renewable energy and storage, both large-scale (centralised) and small- and medium-scale (distributed). In this scenario, the Code energy requirements do not increase beyond 2016 levels.

The ‘high performance buildings’ scenario would see increased energy performance in new construction, including ambitious energy efficiency improvements, as well as accelerated distributed renewable energy and storage uptake. These improvements would be driven by progressive increases in the Code energy requirements towards an ambitious long-term target, and by a package of complementary market transformation measures (see ‘Implementation and complementary measures’ section below).

Building archetypes and climate zones

The project will assess potential cost-effective trajectories to achieve the long-term target for eight building types (three residential and five commercial) across three climate zones (proposed to use climate zones 2, 5 and 6).

The proposed building types to benchmark trajectories and stringency analysis are:

• For residential buildings
  - Detached, (either single or double storey);
  - Attached townhouse/terrace; and
  - Apartment
• For commercial buildings
  - Office tower;
  - Hotel tower;
  - Large retail;
  - Small retail; and
  - Healthcare.

* Note that the following sections discuss and provide an opportunity to highlight potential issues or concerns raised by other aspects of the methodology.
It is proposed that typical floor plans and construction details for the benchmark building types will be developed initially from previous research\textsuperscript{28} and then further developed to suit proposed stringency analysis.

The proposed climate zones have been selected based on the locations of major population centres:

- Climate zone 2 - Warm humid summer, mild winter (e.g. Brisbane)
- Climate zone 5 - Warm temperate (e.g. Sydney, Adelaide, Perth)
- Climate zone 6 - Mild temperate (e.g. Melbourne)

**QUESTION**

What are the appropriate criteria for selecting the eight building archetypes and three climate zones?

Which eight building archetypes are most appropriate to be used for the modelling, in order to best represent the range of building types and capture the bulk of new construction?

Are there existing building archetype models that should be used or adapted in developing the models for this project?

Which three climate zones are most appropriate to be used for the modelling?

Should the modelling assume a future climate affected by climate change?

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Climate zones

1
2
3
4
5
6
7
8

Technology analysis

The assessment of potential forward trajectories will involve a review of existing precedents for potential stringency paths, including literature on zero and near zero energy buildings, and available data on technology projections for future efficiency of building components. The modelling will cover components that fall within the scope of the Code (the design and construction of building fabric and fixed equipment and appliances) and some components that currently fall outside the scope of the Code (such as residential solar PV and comfort levels for the final build).

The potential for energy performance improvements through changes to plug-in equipment or appliances will be discussed qualitatively, as will the potential impacts of greater uptake of battery storage and electric vehicles.

Each component will be tested individually to determine its potential impact on energy use. Components showing limited impact will be disregarded or relegated, while those having the greatest impact will be selected as lead technologies for detailed modelling. The modelling will investigate which combinations of technologies can best achieve different levels of overall performance improvement, and ultimately to create a technological trajectory that incrementally improves performance in a manner that best meets the proposed targets given known information about the technologies and their current maturity and expected rates of improvement.

From this, a series of advancing technology trajectories for the eight building types will be developed. The incremental capital costs of each of these trajectories will be assessed to establish an overall benefit–cost position for each.

All analysis will consider and discuss potential unintended consequences, such as condensation issues resulting from air tightness. This analysis will be used to determine appropriate target years for achieving the long-term targets.

This analysis will include building-level outputs for each building type over time relating to:

- Energy (MJ/m²/annum, MJ/annum, heating/cooling loads, splits by fuel type, MWh/m²/annum, MWh/annum, peak grid demand);
- Financial costs and benefits (additional capital costs per household and per m²; energy costs/yr per household and per m²; net energy cost savings/yr/household; cost/tonne of emissions reductions; payback periods); and
- Occupant comfort.

This analysis will include consideration of potential design improvements to increase energy performance, including reduced window-to-wall ratios and passive solar design. Implementing design changes would require a change in design practices from what may otherwise occur, particularly in light of the trend in residential construction towards volume building and factory production.

The technology analysis will deliver 'building-level' outputs for each of the eight key building types, which will be aggregated to a State, Territory and national level using a building stock model and CSIRO’s energy system model.
A shadow carbon price approach will be undertaken to account for the social benefit of reducing emissions in the absence of a carbon pricing policy. In 2015, the Climate Change Authority commissioned Jacobs to prepare key modelling assumptions, which were published as Consultation Paper: Modelling illustrative electricity sector emissions reduction policies. This source will be used to provide a reference shadow carbon price scenario, while higher or lower values may be included in an energy price sensitivity analysis.

**QUESTION**

To what extent should the project incorporate design changes like reduced window-to-wall ratio and passive solar design to optimise for energy performance?

The analysis will need to make assumptions about plug-in appliances and occupant behaviour as an input to the modelling. What are appropriate assumptions to utilise in these respects?

The analysis will consider opportunities to shift from gas, wood and other fossil fuels to electricity. What considerations should be factored into this analysis, and in particular should the analysis include an eventual phase-out of gas towards all-electric buildings in some or all building types?

What potential unintended consequences of increased stringency should the analysis pay particular attention to? (e.g. condensation, indoor air quality, degradation of sealants over time)

What do you believe are the important assumptions to make about the pace at which industry can adapt to change, and how this may impact on costs?

What are the emerging technologies that will have an impact on building performance? How do you believe these should be costed?

Are there any other key outputs we should consider other than those articulated above?

Do you have any other issues or concerns in relation to the technology analysis?
Modelling challenges and limitations

The modelling undertaken for this project is limited in a number of ways, including:
• Limited number of building archetypes;
• Limited number of climate zones;
• Two scenarios only; and
• Limited scope for sensitivity analyses (some allowance has been made for limited sensitivity analysis around industry ‘learning rates’).

The modelling is also limited by the current scope of the National Construction Code. The Code does not address existing buildings, which make up the majority of Australia’s building stock, although improving the standard for new buildings could be expected to have a knock-on effect of encouraging upgrades of existing buildings and improving building industry capability. The Code also does not consider the embodied emissions in the materials used to construct a building, emissions from the construction phase of the building or emissions due to the transport of building occupants. As electric vehicles are expected to become more prevalent in Australia, the contribution of vehicles to the energy consumption of buildings will increase, so this will become an important consideration for building design in the future.

It is expected that further analysis will need to be undertaken outside the scope of this work, in particular by governments, to investigate these issues and address these limitations, such as ‘deep dives’ on specific building types and climate zones, additional scenarios and additional sensitivity analyses. The intention with this work is to provide sufficient evidence, developed with strong input and engagement of key industry stakeholders, to identify an appropriate future direction for the energy requirements in the Code.

QUESTION

Are there any other key challenges or limitations relating to the proposed modelling approach that we should be aware of?

Are there any other key assumptions not identified above which need to be considered?

Which of the modelling inputs and scenario assumptions are particularly uncertain? If these key assumptions fail to play out, or vary from what is modelled, what impact could this have on the modelling results?
Implementation and complementary measures

A trajectory could potentially be implemented through changes in the Code itself, changes to the Intergovernmental Agreement governing the operation of the ABCB, and through changes to the policies surrounding the Code. This project will consider and discuss these complementary measures.

Changes might include:
• Improved compliance and enforcement processes;
• Establishment of long-term targets; or
• Establishment of a process by which Code updates are to be aligned with the long-term targets and/or trajectories. For example, the ABCB could be directed to update the Code regularly in line with the trajectory unless certain conditions are met.

Updates to the NCC energy efficiency provisions will not, in isolation, be sufficient to transition the buildings sector towards lower emissions. Complementary measures could lower the cost of meeting Code requirements, enable higher standards to be achieved sooner, and also ensure that the Code is not required to do all the work, risking regulatory over-reach. One of the key objectives of the broader package of complementary policies and programs is to drive market transformation of the built environment sector.

Market transformation refers to the use of a targeted suite of measures to ensure that the costs of high-performance building elements are reduced to affordable levels, to move them out of market niches and into the mainstream. Overseas experience has shown that well-designed measures - focusing on suppliers, intermediaries and consumers as appropriate - can lead to permanent changes in the product and pricing mix in the market, and in industry and consumers behaviours, without the need for ongoing policy intervention. This can enable higher standards of performance to be reached without higher costs.

The Global Building Performance Network (GBPN) has undertaken a comparative analysis of energy codes for new buildings for jurisdictions around the world to determine best practices in mandatory energy regulations. As part of the analysis, the GBPN identified fifteen categories, divided across five themes, that could provide a common framework for comparing building codes against best practice. The GBPN themes and categories are summarised in Table 1. This provides a useful framework for implementation of a trajectory alongside necessary complementary measures.
Table 1: Summary of themes and categories from the GBPN assessment framework for energy codes

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<tbody>
<tr>
<td>Performance based approach</td>
<td>Zero energy target</td>
<td>Good enforcement</td>
<td>Building shell</td>
<td>On-site</td>
</tr>
<tr>
<td><em>A focus on energy performance, whether modelled or metered.</em></td>
<td><em>A realistic target with an end date, and a roadmap to achieve the target.</em></td>
<td><em>Robust compliance systems are in place.</em></td>
<td><em>Includes minimum energy efficiency standards for the building envelope.</em></td>
<td><em>Includes maximum limits on the energy end demand.</em></td>
</tr>
<tr>
<td>Performance to include all energy types or uses</td>
<td>Revision cycles</td>
<td>Certification</td>
<td>Technical systems</td>
<td>Primary energy</td>
</tr>
<tr>
<td><em>The scope includes the important energy uses.</em></td>
<td><em>A clear and documented process for regularly updating the energy code.</em></td>
<td><em>The awarding and disclosure of certificates that confirm compliance with standards.</em></td>
<td><em>Includes minimum energy efficiency standards for engineering systems.</em></td>
<td><em>Includes maximum limits on the primary energy consumption.</em></td>
</tr>
<tr>
<td>Energy efficiency and renewable energy</td>
<td>Levels beyond minimum requirements</td>
<td>Policy packages</td>
<td>Renewable energy systems</td>
<td>Greenhouse gas emissions</td>
</tr>
<tr>
<td><em>A focus on passive energy measures, supplemented by renewables.</em></td>
<td><em>Incentives for buildings to achieve standards beyond the minimum requirements.</em></td>
<td><em>Complementary policies and programs to support the implementation of the energy code.</em></td>
<td><em>Includes minimum requirements for renewable energy.</em></td>
<td><em>Includes maximum limits on the greenhouse gas emissions.</em></td>
</tr>
</tbody>
</table>

Key elements of a holistic approach to improving building energy performance, for consideration alongside the implementation of a trajectory include:

- **Education** and awareness of the proposed changes and long-term trajectory;
- **Training** to equip the industry with skills and knowledge to implement increasingly stringent energy efficiency regulations in practice;
- Increased **transparency**, through the use of certification or mandatory disclosure; and
- Improved **enforcement** of the building energy regulations.

A coordinated education campaign would be needed to increase awareness of proposed changes to the Code, as it has been shown that knowledge of the purpose and benefits of building energy regulations can increase public acceptance of the changes[^33]. The education and awareness approach should focus on the benefits to consumers of improved energy efficiency, including comfort and living affordability. An effective awareness campaign that engages the relevant stakeholders (including the general public) will reduce the likelihood of resistance from industry, governments and the community to increased Code stringency.
Training is an important component of the broader implementation strategy, particularly if it delivers the right information to the right people, at the time at which they most need the information. The first step in preparing an education and training strategy is to assess the current capacity of industry professionals to implement evolving building energy standards into design and construction practices. Some key questions to ask at this point may include: Are there examples of projects that are already designed or built to a ‘future Code standard’ of the trajectory? What are the current knowledge and skills gaps? Does the industry have the capacity to continually evolve its practices in line with Code upgrades? Industry-recognised modelling and rating tools such as Green Star could provide a framework for designing an effective training strategy for environmentally sustainable design.

Complementary to education and training are measures to increase the transparency of the building industry with respect to energy performance. A current ‘market failure’ is the lack of information on the energy-efficient design attributes and ongoing performance of buildings, which limits the ability of prospective buyers and tenants to select buildings based on expected energy costs. Therefore, there is an opportunity to boost demand for energy-efficiency buildings through market mechanisms by increasing the availability of energy efficiency data. This transparency could also provide an incentive for projects to go beyond minimum requirements. A best practice method that is currently in place in other jurisdictions is the issue and mandatory disclosure of building energy certificates for new buildings, which demonstrate that the buildings meet minimum energy requirements.

Enforcement of the Code is a critical part of an effective implementation strategy. In Australia, the States and Territories are responsible for enforcement of the National Construction Code. There are currently concerns around under-compliance of new building developments with the energy standards of the Code. Best practice enforcement is enabled by robust structures and processes for checking compliance, such as a system of regular on-site third-party inspections and effective penalties that deter non-compliance. This could be supported by the development of tools (including standardised metrics and indicators) that make it easier for governments to assess the compliance of buildings with the energy requirements of the Code.

**QUESTION**

What do you see as the priorities for specific complementary (policy and other) initiatives in order to support industry implementation of long-term targets and trajectories?
Planning for uncertainty

The implementation of a forward trajectory is likely to take place over a decade or longer. Over this time, the context in which governments are managing the energy regulations in the Code will change. In order to be successful in contributing to Australia’s emissions reduction efforts, the implementation strategy for the Building Code Energy Performance Trajectory will need to be robust and resilient to potential external changes.

The development of the implementation strategy can be informed at this early planning stage by facilitating discussion amongst stakeholders on the following two topics:

• Identify the vulnerabilities in the assumptions used in developing the implementation strategy, including the scenarios assumed for the modelling, and the potential ‘disruptors’ to achieving the objectives of the strategy; and

• Propose ‘coping strategies’ to improve the robustness of the implementation strategy, including the identification of ‘positive’ disruptors that could potentially enable the design of these coping strategies.

QUESTION

What barriers may be faced in implementing targets and trajectories in policy and regulation, and how might these be overcome?

What immediate barriers may be faced by industry in implementing targets and trajectories and the associated changes in building design and construction practice, and how might these be overcome?

What else could go wrong? What medium- or long-term disruptions (political, economic, social, institutional, technological, legal and environmental, etc.) could undermine the implementation or achievement of long-term targets?

What ‘coping strategies’ could be put in place in order to improve the likelihood of success in light of these potential disruptors?

What potential positive ‘disruptors’ may occur? What strategies could be put in place in order to take advantage of potential positive disruptors?
Next steps

ASBEC and ClimateWorks will be running consultation workshops in July 2017 focused on the key consultation questions identified in this paper. These consultations, along with written feedback received, will inform the remainder of this project.

The key milestones for the project are outlined below:

- **July 2017**: Review and consolidation of feedback
- **November 2017**: Publication of interim report, focusing on potential short-term cost-effective stringency increases
- **March 2018**: Publication of final report, focusing on long-term targets and trajectories

End notes

1 Finkel, 2017.
5 CRC for Low Carbon Living, 2017, p 19.
7 ASBEC, 2016, p 77.
8 ClimateWorks Team Analysis based on Office of the Chief Economist, 2015.
10 ABCB, 2016a.
11 ABCB, 2016b, p 41 and ABCB, 2016c, p 39. Although the Section J Objective statement (JO) was removed from Volume One in the NCC 2016 update when the Objective statements were removed from all chapters, it is included in the NCC Guide to Volume One: http://www.abcb.gov.au/Resources/Publications/NCC/NCC-2016-Guide
12 ABCB, 2015, p 8.
13 IEA, 2013a, p 15 and Finkel, 2017, p 154
14 European Commission, 2010, p L153/17
15 European Commission, 2010, p L153/21
16 As summarised by GBPN, 2013a.
17 GBPN, 2013a.
18 SEA, 2017.
21 GBPN, 2013a.
25 Summarised in Table 6.5 from IEA, 2013b.
26 GBCA, 2017
27 GBPN, 2013b, p 25
29 CCA, 2015.
30 ClimateWorks Australia, 2017.
31 CRC for Low Carbon Living, 2017, p 50
32 GBPN, 2013b, pp 9–11
33 IEA, 2013a, p 50
34 CRC for Low Carbon Living, 2017, p 46
35 IEA, 2013a, p 52
36 CRC for Low Carbon Living, 2017, p 38
37 GBPN, 2013b, p 26
38 ASBEC, 2016, p 95
39 GBPN, 2013b, p 26
40 IEA, 2013a, p 52
41 Based on the planning intervention methodology proposed by Malekpour, et al., 2017.
Summary of questions for consultation

**OBJECTIVES**

Do you believe that the Objective as currently written in the Code is appropriate for enabling a long-term improvement in energy performance requirements?

Is additional detail needed to clarify the Objective, for example a reference to long-term economy-wide emissions reduction targets?

Should the Objective include broader benefits of energy performance, such as occupant comfort, health and safety, living affordability, economic growth and/or reduced electricity network costs?

Should the Objective cover practices and benefits beyond minimum practice?

**LONG-TERM TARGETS**

Are there other options for defining a building code energy performance target that you believe should be considered?

What are the benefits and drawbacks of each of these options for defining the building code energy performance target?

Should offsets such as renewable energy be considered in the target? If so, how should they be included in the target, i.e. could other offsetting options (such as renewable energy nearby, as defined by the EU Directive) be considered?

Do you believe there should be a single building code energy performance target for all building types, or separate targets for different sectors?

Is it important for the definition of the target to align with the wording of the stated Objective of the code? For example, if the Objective is to reduce greenhouse gas emissions, do you believe the target should also relate to emissions?

What do you believe is the most appropriate long-term building code energy performance target for new construction in Australia?

What do you believe is an appropriate timeframe for achieving the long-term target/s?

**MODELLING TRAJECTORIES**

Do you believe the proposed modelling scenarios are appropriate given the project objectives? If not, what issues or concerns would you raise, and what alternative scenarios may be appropriate?

What are the appropriate criteria for selecting the eight building archetypes and three climate zones?

Which eight building archetypes are most appropriate to be used for the modelling, in order to best represent the range of building types and capture the bulk of new construction?

Are there existing building archetype models that should be used or adapted in developing the models for this project?

Which three climate zones are most appropriate to be used for the modelling?

Should the modelling assume a future climate affected by climate change?

To what extent should the project incorporate design changes like reduced window-to-wall ratio and passive solar design to optimise for energy performance?
The analysis will need to make assumptions about plug-in appliances and occupant behaviour as an input to the modelling. What are appropriate assumptions to utilise in these respects?

The analysis will consider opportunities to shift from gas, wood and other fossil fuels to electricity. What considerations should be factored into this analysis, and in particular should the analysis include an eventual phase-out of gas towards all-electric buildings in some or all building types?

What potential unintended consequences of increased stringency should the analysis pay particular attention to? (e.g. condensation, indoor air quality, degradation of sealants over time)

What do you believe are the important assumptions to make about the pace at which industry can adapt to change, and how this may impact on costs?

What are the emerging technologies that will have an impact on building performance? How do you believe these should be costed?

Are there any other key outputs we should consider other than those articulated above?

Do you have any other issues or concerns in relation to the technology analysis?

Are there any other key challenges or limitations relating to the proposed modelling approach that we should be aware of?

Are there any other key assumptions not identified above which need to be considered?

Which of the modelling inputs and scenario assumptions are particularly uncertain? If these key assumptions fail to play out, or vary from what is modelled, what impact could this have on the modelling results?

IMPLEMENTATION AND COMPLEMENTARY MEASURES

How do you believe targets and trajectories should be implemented in policy and regulation?

What do you see as the priorities for specific complementary (policy and other) initiatives in order to support industry implementation of long-term targets and trajectories?

What barriers may be faced in implementing targets and trajectories in policy and regulation, and how might these be overcome?

What immediate barriers may be faced by industry in implementing targets and trajectories and the associated changes in building design and construction practice, and how might these be overcome?

What else could go wrong? What medium- or long-term disruptions (political, economic, social, institutional, technological, legal and environmental, etc.) could undermine the implementation or achievement of long-term targets?

What ‘coping strategies’ could be put in place in order to improve the likelihood of success in light of these potential disruptors?

What potential positive ‘disruptors’ may occur? What strategies could be put in place in order to take advantage of potential positive disruptors?
Bibliography


Attachments (Attached separately)

Attachment 1
Project Overview

Attachment 2
Draft Methodology
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