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BRANZ's position on MBIE's Proposal 1. Energy efficiency for housing and small buildings

Executive summary

BRANZ is supportive of MBIE's intent to greatly improve the energy efficiency (and therefore thermal comfort) of new dwellings. This is essential given the multitude of benefits for occupant health, running costs and lifetime climate change impact.

BRANZ does not agree with the approach outlined by MBIE in Proposal 1 of the consultation document. We are concerned that concentrating on elemental insulation values alone is fundamentally flawed and will not result in significant thermal performance improvement in residential buildings. Our position is that there are better options than retaining the elemental examination of residential buildings' thermal performance.

In our submission, we have outlined the current science and evidence that indicates a better pathway and outcome for New Zealand. We have provided a suggestion for an intermediate option – recognising that improving energy efficiency is fast becoming an urgent issue and that MBIE wants to signal that there must be change.

These are the key points BRANZ would like to highlight:

- The Schedule Method approach is no longer fit for addressing energy efficiency.
- Proposal 1 must be aligned with the ambitions of the Building for Climate Change (BfCC) Transforming Operational Efficiency framework. We acknowledge that this work has not been finalised but is well signalled.
- The industry needs to see a roadmap of the changes MBIE is wanting to make towards future performance demands. This is to provide clarity around the timelines so that training, education, design and 'buildability' can be developed to meet MBIE's requirements.
- The latest research on higher-performance constructions to facilitate robust solutions that can be readily adopted by industry should be recognised in the final approach.
- Progressive checks during construction need to be incorporated to ensure quality and performance objectives are being met.
- Even in the absence of the finalised BfCC framework, the issue of both operational and embodied carbon must be considered.

BRANZ recommends a phase-out of the Schedule Method for showing compliance with H1. Aligned with the BfCC approach, we propose a move to a whole-building thermal performance target. Our response below provides details and rationale for this recommendation.

Further, BRANZ is concerned that a wider systems perspective does not seem to be considered in Proposal 1. MBIE is signalling changes to increased insulation levels (through increased R-values). This will require designers, builders, consenting officials, manufacturers and product suppliers to all do things differently. While some in the industry know how to deliver higher-performing homes, they are the minority.

If MBIE chooses to phase out the Schedule Method, additional guidance and education on how to achieve proposed performance levels **must** be available for all parts of the building and construction industry, along with the time required to upskill.

Reliance on the Schedule Method to achieve compliance

Our key concern with MBIE Proposal 1 is the continued reliance on the Schedule Method as the primary means of compliance for clause H1 *Energy efficiency*.

The objective of clause H1 is to facilitate the efficient use of energy in residential buildings. At present, the most popular method of compliance is using Acceptable Solution H1/AS1, with around 90% of building consent applications relying on the Schedule Method. This method is an elemental lookup table for minimum insulation values. Compliance is demonstrated by ensuring the building's thermal envelope meets or exceeds the table's minimum R-values for each of the building elements. Over the years, with new science, tools and knowledge being developed, the Schedule Method has become a blunt tool to show compliance.

The following are reasons why BRANZ does not support continuing to use the Schedule Method.

Non-alignment with recommended good practice in dwelling thermal efficiency

It treats dwellings as an overly simplistic thermal 'system', which has been shown not to be able to address well-reported issues such as overheating, thermal mass, ventilation and airtightness. In work commissioned by the Department of Building and Housing in 2006, Isaacs and Donn[1] showed the limitations of this simplistic approach. The following points are relevant today:

- A new measure is required to deal with energy efficiency, conservation and overheating.
- In the past, the New Zealand Building Code has not dealt with 'good design' – orientation, use of mass, shading and so on. The next steps will need to include these and other design issues.
- Infiltration must be considered before significant improvements can be gained in managing heat loss because of the increasing proportion of heat losses due to infiltration losses.
- An improved calculation method to determine the whole-wall R-value is required.

[1] Isaacs, N. P. & Donn, M. R. (2006*). NZBC clause H1 – short term opportunities*. A paper prepared for the Department of Building and Housing. Judgeford, New Zealand: BRANZ Ltd.

Research findings are undervalued, with some key recommendations being glossed over

In a recent MBIE commissioned review,[2] there were several key qualifiers and concerns expressed that have not been addressed in this consultation document:

- Improved overheating design using orientation-specific external shading systems and targeted ventilation.
- The recent Beacon Pathway study, which examined the current state of thermal performance of in situ external wall framing in 47 case study dwellings. Thermal resistance of external walls (as-built via thermal modelling) was found to be "*well below recommended levels set out in NZ Building Code Clause H1 and also below the required minimum of R1.5 set out in Building Code Clause E3 … wall panels with large areas of thermal bridging … will result in a pathway for excessive heat loss and therefore present a condensation and mould risk*". *Consequently, the logistics and practicalities of aiming for considerably higher wall R-values needs a whole new approach to wall specification and construction.*
- Simple and cost-effective solutions using alternative methods of improving the thermal performance of new residential builds should be examined. Examples include thorough passive solar design, improving airtightness combined with whole-house mechanical ventilation with heat recovery and reducing thermal bridging over the whole building envelope.
- The NZBC needs to move past R-value Schedule Method lookup tables for whole-building thermal assessment due to their many limitations. For example, in a single-storey house, the roof and floor are considerably more thermally important to the envelope than in a multi-storey house. Similarly, a house that is more prone to overheating may see much greater gains from glazing upgrades that reduce solar heat gain, such as high-performance triple glazing. More-comprehensive thermal models will provide considerably more robust and useful insights into year-round comfort and performance. Energy efficiency/thermal performance across each of the dwelling typologies cannot be equalised simultaneously with the same elemental R-values.

Little alignment to BfCC framework

It is known that new residential buildings are a significant contributor to our nation's greenhouse gas emissions. The Schedule Method is unable to consider any material-related carbon effects of materials. Additionally, the BfCC programme describes operational efficiency targets and timelines around achieving these. The targets and approach are progressive and should be reflected in the proposed changes to H1.

[2] www.building.govt.nz/building-code-compliance/annual-building-code-updates/2021-building-code-update/

Steps to improve energy efficiency requirements

BRANZ recommends the following steps to improve energy efficiency requirements for residential buildings (housing and small buildings) in New Zealand.

1) Decommission the Schedule Method as not being fit for purpose

Residential buildings need to be recognised as a complex system requiring a more holistic thermal assessment that considers all key aspects of thermal design. Year-round thermal comfort needs to be accounted for in a reasonable amount of detail in an assessment tool. There are tools readily available.[3] By examining space heating and space cooling separately, specific design guidance for improvement can be provided.

2) Allow a performance target (kWh/m^2/yr)

This will start to align H1 with the BfCC programme, specifically Transforming Operational Efficiency 2020 targets, in terms of thermal performance demand. At present, the BfCC thermal performance demands are capped nationally at 60, 30 and 15 kWh/m^2/yr. These values decrease over time to reflect the progressively more stringent requirements for whole-house space conditioning. This more-comprehensive approach examines house design as a complex system, which is very different from the energy efficiency for housing focus on R-values of individual building elements.

As part of the alignment, the BfCC targets within the untitled table on page 8 of the Transforming Operational Efficiency document need to be reset to reflect New Zealand's reasonably diverse climate. BRANZ has modelled (using PHPP) the thermal performance demand of a typical recently consented house respecified with the proposed new H1 R-values (see Figure 1). The bar chart shows the energy demand in each of the six new climate zones. As can be seen, the BfCC 60 and 30 kWh/m^2/yr thermal performance demand targets are readily achievable in MBIE's Options 1 and 2 in the current consultation document for Auckland.

However, BfCC's most challenging cap of 15 kWh/m^2/yr is still a long way from being achievable, even though the building element R-values are what most would consider extreme – R6.6 roof, R0.48 windows for the most temperate of all New Zealand climates. Houses in Queenstown would not be able to meet anything but the 60 kWh/m^2/yr cap. Moreover, Queenstown houses would struggle to meet the 15 kWh/m^2/yr cap even with a R9.0 roof and triple glazing in uPVC or timber joinery. A single thermal performance target of 15 kWh/m^2/yr as proposed[4] does not make much sense in a country such as New Zealand with reasonably diverse climate conditions.

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[3] Australia's new accredited HERO home rating tool and the USA's Ekotrope RATER both use hourly simulation engines. Alternatively, simpler transparent specialist tools based on the latest standards can be developed for New Zealand that assess both summertime overheating and wintertime space heating needs separately.

[4] MBIE. (2020). *Transforming operational efficiency*. Wellington, New Zealand: Ministry of Business, Innovation and Employment.

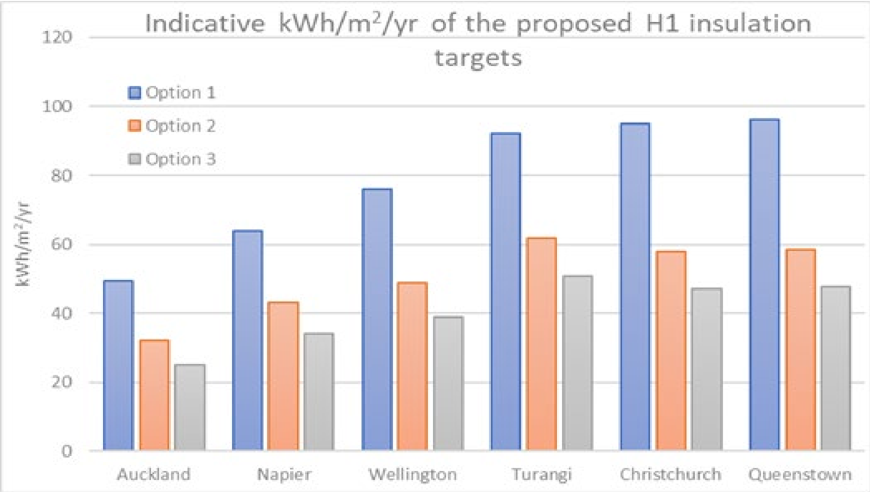

Figure 1. Space conditioning implications of proposed BfCC minimum insulation level for case study house.

3) Clearly signal climate-appropriate energy efficiency/thermal performance demands

This includes signalling the levels of desired performance as well as when they will occur well in advance. This is essential to provide building industry confidence, providing adequate lead-in times to plan effectively.

Introduce a new limit on heating and cooling in kWh/m^2/yr that is consistent with international best practice. We suggest changes to these limits do not occur more frequently than once every 5 years.

4) Include the recently developed evaluation methods to improve installed glazing performance

Windows will become even more critical with higher thermal envelope R-values. This has been a known weak point for some time. BRANZ has been working with the glazing industry and MBIE to provide more certainty around two critical aspects of higher-performing windows – thermal and weathertightness function. The recently released BRANZ Evaluation Method 9 (EM9) provides a procedure for the management of inadvertent water ingress around the perimeter of an external window installation. An associated BRANZ Evaluation Method EM8 assesses window installation thermal performance. It can be used to set targets and benchmark one installation system compared to another and aims to realise the better thermal characteristics of higher-performance windows.

5) Introduce ways to account for thermal underperformance of light timber construction walls

Underperformance of light timber walls is due to thermal bridging. Beacon Pathway has identified that efforts to reduce the framing through optimisation of the detailing process have shown it is very difficult to get below 25% framing. This is true even for a relatively simple single-storey dwelling of modest dimensions using very well installed insulation that has all the weak points dealt with (corners, internal-to-external wall junctions and so on).

6) Take thermal losses in wall/floor/ceiling/roof junctions into account

These losses play an increasingly important role as element insulation levels rise. Ideally, there should be Acceptable Solutions outlining junction details that have heat losses under a set threshold for the industry to reference. BRANZ has been working with PHINZ over the last year to provide a reasonably comprehensive set of high-performance construction junction details in the form of a free reference book. It provides a detailed thermal performance, construction cost and carbon assessment of junction characteristics and could be easily adapted to a Verification Method/Acceptable Solution.

7) Provide robust guidance to minimise risk of interstitial condensation in building assemblies

Air leakage is a primary risk factor for long-term accumulation of moisture, which is amplified with insufficient ventilation. Moisture deposited by air leakage should not be trapped by the assembly. It is critical that solutions to achieve higher R-values do not inadvertently create a structure where the potential to accumulate moisture outweighs the ability of the assembly to dry. An example is applying an insulation product with very low vapour permeability on the inside of wall. This substantially reduces the ability of a wall to dry towards the interior.

8) Update the outdated science around the importance of infiltration energy loss

The energy loss due to infiltration has been historically exaggerated. Much of the industry does not understand the distinction that the airtightness test result for a building is not a true reflection on its performance in service. The unsophisticated methods to perform this conversion in standards like EN 832 (or equivalent) are outdated, attributing considerably more leakage than what happens in situ. The physics is more complicated, and the replacement standards (EN 15242 then EN 16798-7:2017) are more suited to higher-performance dwellings.

Thebault and Millet[5] provide a good comparison between the rule of thumb method (which is effectively that in EN 832), EN 15242 and tracer gas measurements. This would allow New Zealand to move away from the 'air changes' metric (biased towards larger buildings). This would also align New Zealand with Australia, which is using a permeability metric of m^3/m^2 of surface at 50 Pa difference. This can be set according to durability risk by assessing a range of assemblies with hygrothermal modelling.

9) Undertake progressive checks during construction/post-construction performance evaluation

These will be required with the advent of higher-performance construction to ensure a quality build results. Progressive checks might include:[6]

[5] Thebault, S. & Millet, J. (2017). Cost-effective air flow rate estimations using blower door and wind speed measurements to assess building envelope thermal performances. *Journal of Building Physics*, *40*(6), 504–529.

[6] For more, see EPA. (2008). *ENERGY STAR qualified homes thermal bypass checklist guide*. Washington, DC: US Environmental Protection Agency.

- designing out the necessity for penetrations in external walls
- ensuring bottom plates have sealants applied before skirting boards are installed
- window installation is carried out to EM8 and EM9
- bottom plate/floor is sealed to internal lining to prevent infiltration.

10) Account for associated carbon

This includes both the upfront (embodied) carbon within the materials selected to achieve the new energy efficiency targets as well as the ongoing carbon emissions, given our nation's 2050 climate change commitment.

BRANZ and Massey University collaborative carbon budget studies show that the New Zealand residential building sector has an important part to play in meeting the 2050 targets.[7] It has been calculated that materials in new-build residential buildings contribute between 37% and 50% of the total carbon impact, with the remaining emissions from operational energy, which accrues over time.

Thus, efforts should focus on both reducing operational energy use and utilising materials with low carbon footprints. Limits on both up front as well as ongoing embodied carbon need to be established in concert with the BfCC programme.

BRANZ recommendation

Research has shown that there is currently a large reliance by industry on the Schedule Method to show H1 compliance. It is recognised that this simplistic method is not delivering the desired performance outcomes.

Therefore, BRANZ recommends that the Schedule Method is phased out. We recommend that MBIE clearly signals the move to a thermal demand approach (in kWh/m^2/yr), with comfort limits for overheating, to demonstrate H1 compliance. To allow flexibility in dynamic simulation tools used, a thermally well-performing reference dwelling (of the same typology) could be utilised for setting an appropriate threshold thermal demand. This performance-based approach needs to rely on a comprehensive year-round assessment of individual internal zones, using hourly based climate data.

The implications to the whole building and construction system need to be considered. This includes associated training, education and upskilling of the industry to support this transition.

We recommend that the Schedule Method be phased out and the thermal demand approach phased in as soon as practical.

BRANZ is committed to challenging Aotearoa New Zealand to create a building system that delivers better outcomes for all. We are willing and able to engage with MBIE and industry to co-create and

[7] McLaren, S. (2021). Carbon budget for NZ housing. *Build*, *182*, 48–49.

develop any required resources (roadmaps, tools, models) that would support our sector to achieve its goals.

BRANZ is available to discuss this response with MBIE and provide further evidence and supporting information.

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