



June 3, 2021

Doug Crawford, Chair  
c/o Dominique Danis, Secretary  
Canadian Commission on Building and Fire Codes  
National Research Council / Government of Canada  
1200 Montreal Road, Ottawa, Ontario K1A 0R6

RE: New Information in Relation to PCF 1617 - Tiered Code Requirements

Dear Mr. Crawford,

I am writing to alert you to new and critical information regarding PCF 1617, Tiered Code Requirements, which suggests that the Standing Committee on Energy Efficiency (SC-EE) should revisit the technical requirements proposed for “tier 5” before the PCF moves further ahead in the approval process. The misalignment of tier 5 with net zero energy ready performance, which has been identified in this new detailed analysis, shows that the proposed requirements are off track with the stated goals of the federal government and the Provincial Territorial Advisory Committee on Codes (PTPACC). However, the Canadian Home Builders' Association's (CHBA's) analysis points to small but significant adjustments that could bring the proposed requirements into alignment. We are currently working to resolve procedural issues on this same PCF 1617 with the Deputy Chair as soon as possible, and it is our hope that expeditious action by SC-EE can resolve the technical issues as well without throwing off the publication schedule for the 2020 edition of the National Building Code.

Although the proposed requirements for tier 5 were intended to represent a net zero energy ready level of performance, research completed earlier this month with the assistance of Natural Resources Canada (NRCan) shows that the tier 5 requirements, as currently proposed, go far beyond what is required for net zero energy ready levels of performance based on NRCan's EnerGuide Rating System.

An analysis of 447 net zero energy ready homes built under CHBA's Net Zero Home labelling program was conducted by the Canadian Home Builders' Association (CHBA) and NRCan. The results of the detailed analysis show that the tier 5 requirements are far beyond net zero energy ready levels of performance. The analysis shows that tier 4 is actually representative of net zero energy ready levels of performance, and in fact the tier 5 requirements do not align with the majority of labelled net zero energy ready homes. If unchanged, the ultimate goal in the National Building Code—the target for 2030—will be much more difficult to reach, both technically and in terms of cost. This would thereby also render achieving the actual goals set out by government much more difficult to reach and make rapid provincial adoption far less feasible.

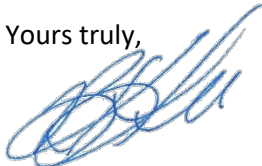
In light of this new information, CHBA urges the Canadian Commission on Building and Fire Codes to ask SC-EE to review the comparative analysis and revisit the technical requirements proposed for tiers 4 and 5 with a view to aligning PCF 1617 with the intended ultimate goal of net zero energy ready at the highest tier before proceeding further in the approval process. In this way, attaining

Canada's goals in relation to energy-efficient housing will become more realistic, attainable and affordable, and in line with what was intended.

We would be pleased to provide a presentation on the results of the research comparing CHBA Net Zero Homes to tier 5 requirements and have attached a summary of the research for your consideration.

Thank you in advance for your attention to this matter.

Yours truly,



Kevin Lee, P.ENG., M.ARCH.  
CEO, CHBA

Attach.

c.c.: Ruth Talbot, Director, Buildings and Energy, Natural Resources Canada  
Jamie Hulan, Director, Homes and Communities Division, Natural Resources Canada  
Anne Gribbon, Deputy Chair, Canadian Commission on Building and Fire Codes  
James Orr, Chair, Provincial Territorial Advisory Committee on Codes  
Andrew Pride, Chair, Standing Committee on Energy Efficiency  
Marianne Brown, Acting Chair, Standing Committee on Housing and Small Buildings



# Does Tier 5 Represent Net Zero Energy Ready?

## CHBA Net Zero Home Labelling Program

- Voluntary
- Active since 2015
- Over 600 homes labelled to date

## National Building Code Part 9.36.

- Proposed “tiered” requirements developed by the Standing Committee on Energy Efficiency
- Tiers intended to align with levels achieved by existing voluntary programs

Tier	Intended Alignment
1	NBC 9.36. 2015 (ERS 78)
2	R2000 (2005) (ERS 80)
3	Energy Star
4	R2000 (2012) (ERS 86)
5	<b>Net Zero Energy Ready</b>

This is an analysis of how proposed tiered code requirements align with net zero energy ready performing homes built under the CHBA Net Zero Home labelling program.

CHBA’s Net Zero Home labelling program is a voluntary set of technical requirements builders can follow to show that their homes either generate more energy than they use or could if a modest PV system were installed later. The program has been operational since 2015, and in that time over 600 homes have achieved either the Net Zero or Net Zero Ready label.

The Canadian Commission on Building and Fire Codes (CCBFC) is developing prescriptive and performance-based tiered energy requirements in the context of the *CCBFC Position Paper on a Long-Term Strategy for Developing and Implementing More Ambitious Energy Codes*.

At the outset, the intent was that the top tier of the energy-efficiency requirements would be equivalent to net zero energy ready homes. Lower tiers would be equivalent to other less stringent voluntary programs.



## CHBA Net Zero Home Label Technical Requirements

Follows EnerGuide Rating System procedures

### CHBA Net Zero

- 0 GJ home, using installed on-site renewable energy generation.

### CHBA Net Zero Ready

- 0 GJ home, on-site renewable energy system is modelled but not yet installed.

### Envelope Efficiency

- Airtightness less than 1.5 ACH@50pa.
- 33% better than that of the reference house.

### Cooling criteria

- If no mechanical cooling, annual cooling load <2 MJ/m<sup>3</sup>, or model standard AC unit.

This slide describes the high-level technical requirements to get a CHBA Net Zero or Net Zero Ready label.

Firstly, the home is modelled using EnerGuide Rating System procedures. Energy use calculated includes lighting and appliances.

In order to get a Net Zero label, the predicted energy used annually by a home must be so small that it can be offset by the energy generated by on site renewables which have been installed. A Net Zero Ready label is available for those who have not installed renewables, but have demonstrated that there is capacity to install sufficient generation at a future date to meet the full net zero requirements.

In addition to this high-level requirement, in order to encourage an efficient building envelope, all labelled homes must demonstrate that both an airtightness target and an envelope efficiency target are met. The airtightness target for CHBA Net Zero Ready homes is 1.5 ACH@50pa or less for detached homes and 2.0 for attached homes. The envelope efficiency target for the CHBA Net Zero program is set at 33% better than reference house. The methodology for our program looks at the space heating energy load, which must be, using a standardized heating system to normalize the calculation, at least 33% lower than that of a reference house. Keep in mind this is not the same envelope metric methodology used by the codes.

If space cooling is not provided it must be demonstrated that the house uses less than a fixed annual cooling load per m<sup>3</sup>, and if this is not met, the house must be modelled with a basic air-conditioning unit as an “energy penalty” to account for possible additional future load.

The program requires builders to prove a high-performance envelope and minimal annual energy consumption which can be offset by renewable energy.



## Proposed Tiered Requirements for NBC 9.36. - Technical Requirements

### Proposed vs Reference

- Envelope Improvement
  - Heat loss through conduction, air leakage and ventilation
- Energy Improvement
  - Excludes lighting and appliances
- Peak Cooling Load
  - Cannot be greater than the reference house

### Additional details:

- Full benefit of heat pump space heating
- Small volume relaxations
- Airtightness testing “optional”

Target Metric	Applicable Energy Performance Tier				
	1	2	3	4	5
Envelope Improvement	N/A	≥5%	≥10%	≥20%	≥40%
Energy Improvement	≥0%	≥10%	≥20%	≥40%	≥70%
Cooling	✓	✓	✓	✓	✓

The proposed tiered requirements use a proposed versus reference approach, which means that all design criteria require the proposed home performance to be compared against a reference model with similar geometry, defined (mostly) by the prescriptive minimum code and some modelling assumptions. The reference house approach was chosen to level the playing-field for different energy simulation tools, which might generate different absolute values for energy on the same house but are likely to be much closer together at modelling improvement of that house over a reference.

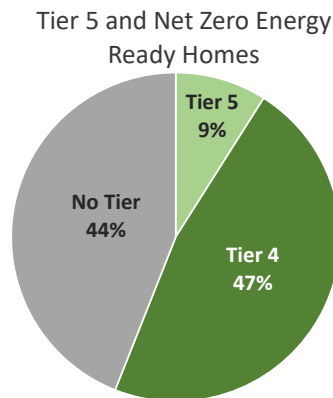
There are three main requirements, all three of which must be met to qualify for a tier.

1. The code targets for envelope improvement: This represents the heat lost through the envelope via conduction, air leakage and ventilation. It needs to be less than that of the reference house by a percentage set out for each tier. There is no envelope target at tier 1. (Note that this metric differs slightly from the NZ approach to envelope.)
2. The code targets for energy improvement: The total energy used for heating, ventilation, air conditioning and hot water needs to be less than that of the reference house by a percentage set out for each tier. (Note that this does not include lighting or appliances.)
3. The peak cooling load (usually on the hottest modelled day) must be less than or equal to the reference house peak cooling load. The cooling load requirement is a prerequisite for achieving any tier.

An adjustment to the modelling assumptions for tiers permits the full benefit of heat pumps used in space heating to be claimed. There are some additional details, which allow relaxations for homes smaller than 300 cubic metres, and which provide an energy penalty for not testing airtightness.



## Tier 5 Overshoots the Goal



*The proposed Tier 5 requirements do not reflect net zero energy ready homes built*

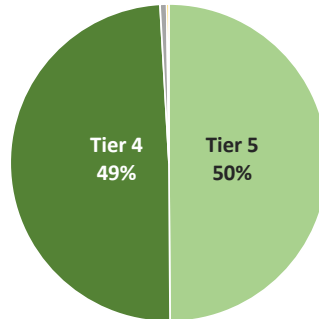
Here is the overall result:

- 100% of the CHBA labelled homes in the study have proven that they achieve net zero performance levels, yet the tier 5 requirements are in alignment with only 9% of these homes
- This shows tier 5 is misaligned given that tier 5 was intended to align with net zero energy ready
- Note that the 44% that do not meet any proposed tier are in this situation due to the pass/fail cooling approach taken in the proposed tiered code requirements, which is out of alignment since these homes are all achieving net zero energy ready performance levels (explained in detail later in this summary)



## What We Found: Envelope

Tier 5 Envelope Target  
and Net Zero Energy Ready Homes



*The proposed Tier 5 envelope target reflects only half of net zero energy ready homes built*

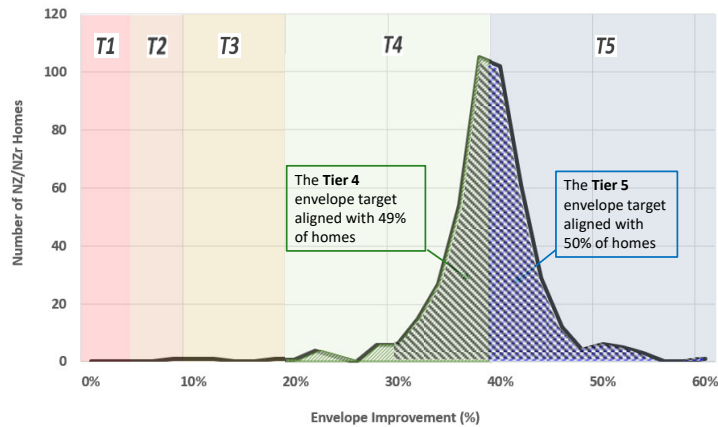
In this chart, we are comparing the CHBA Net Zero Ready home's performance levels to the current proposed tiered code requirements for the NBC, looking specifically at the proposed envelope improvement targets.

The proposed tier 5 envelope target aligned with about 50% of Net Zero Ready homes. The tier 4 target was in alignment with 99% of Net Zero Ready homes.

This shows that the envelope target for tier 5 is much more stringent than necessary to achieve net zero energy ready levels of performance.



## What We Found: Envelope



This chart shows the distribution of envelope performance of CHBA Net Zero Ready homes.

The X-axis shows the % envelope improvement, while the Y-axis shows the number of homes at that level of improvement.

The tier 4 target is in closer alignment with most net zero energy ready labelled homes than the tier 5 target.

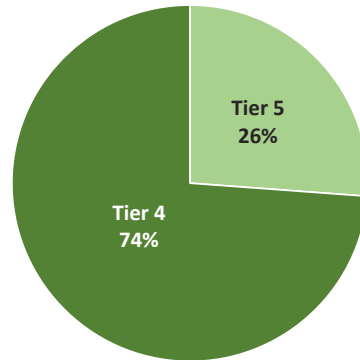
A tier 5 envelope target of 30% would align with 96% of the CHBA net zero homes (see the black shaded area).





## What We Found: Energy

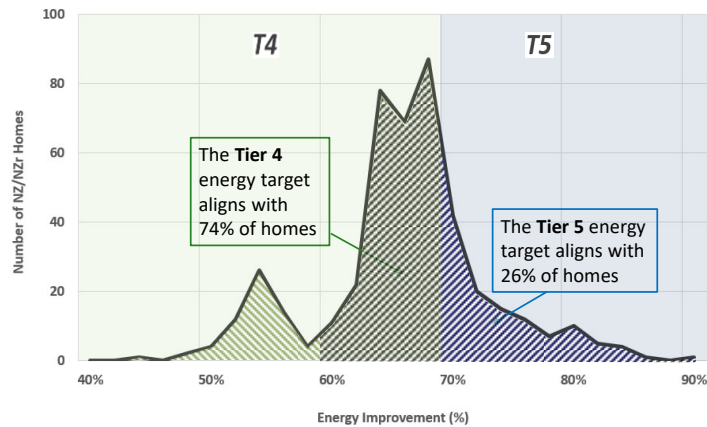
Tier 5 Energy Target and Net Zero Energy Ready Homes



*74% of CHBA-labelled homes perform at NZr level below what is proposed at tier 5 target*

The proposed energy target for tier 5 is in alignment with only 26% of the homes built that achieve net zero energy ready performance. Net zero energy ready homes are achieving net zero ready performance levels with less stringent requirements than those proposed for tier 5.

## What We Found: Energy

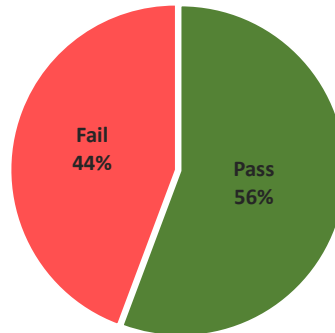


This chart shows that the tier 4 energy target is in closer alignment with net zero energy ready homes—all of the Net Zero homes in this study met or exceeded the tier 4 energy target.



## What We Found: Cooling

The **peak cooling** target and Net Zero Energy Ready Homes



*The peak cooling target reflects only 56% of NZr homes*

As currently proposed, to meet any tier, the peak cooling load for the proposed house must not be greater than the peak cooling load for the code reference house. This criterion does not consider actual energy efficiency, or protection from overheating.

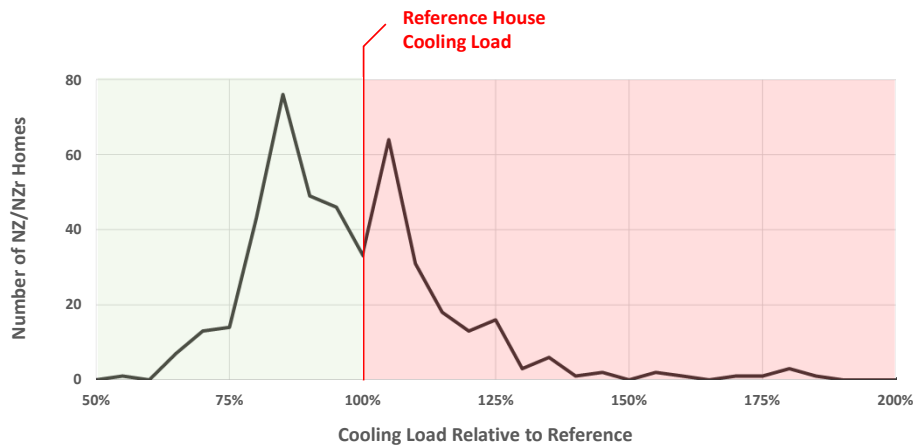
The study shows that the proposed tier 5 criterion only reflected 56% of the CHBA-labelled homes. This shows that the proposed pass/fail cooling load criterion is not appropriate to evaluate net zero energy ready performance.

Under the Net Zero Home labelling program, the cooling requirements do not apply if space cooling is provided. There is currently no requirement for cooling in the tiered requirements proposed for the National Building Code.

Field experience shows that higher insulation levels and higher-performance windows often increase cooling requirements. It is therefore an inappropriate expectation and metric to simply require a cooling load that is at or lower than the reference house. It would be more appropriate to ensure—as cooling is often required—that the additional energy use is included in the energy calculations to meet a tier.

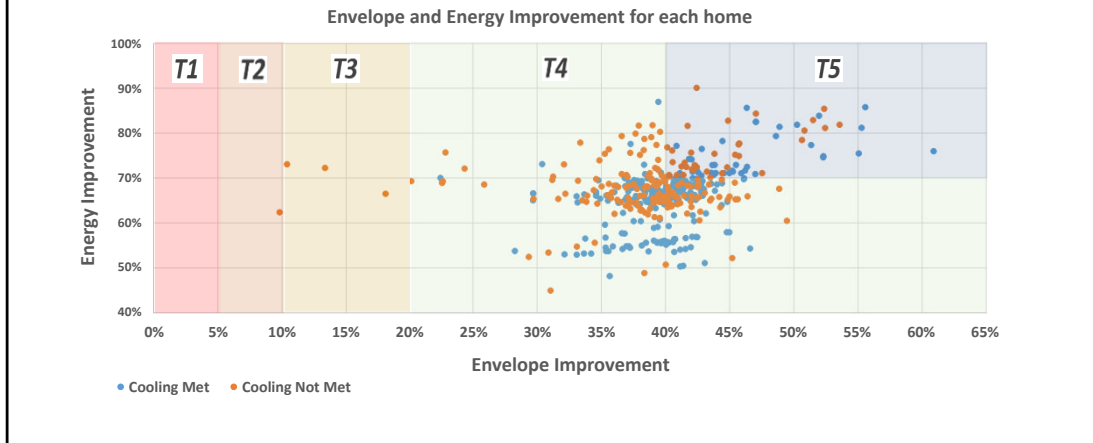


## What We Found: Cooling



This graph shows peak cooling load as a percentage of the reference house peak cooling load. The tiers align with the homes to the left of the red line on the green background as these homes have a lower cooling load than the reference house. The criterion did not align with the homes to the right of the red line on the pink background.

## What We Found: All Targets



This chart combines the three proposed technical requirements in one chart.

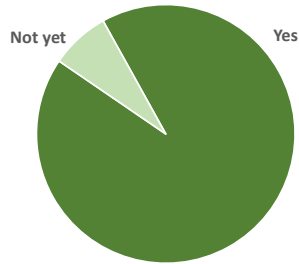
This chart shows where the envelope, energy and cooling criteria align with each individual net zero energy ready home—each home is represented by a dot on the chart. Envelope improvement is the bottom scale and increases from left to right; energy improvement is the left scale and increases from bottom to top.

The cooling requirement was in alignment with the homes in blue, while the cooling requirement was not in alignment with the homes represented by the orange dots.

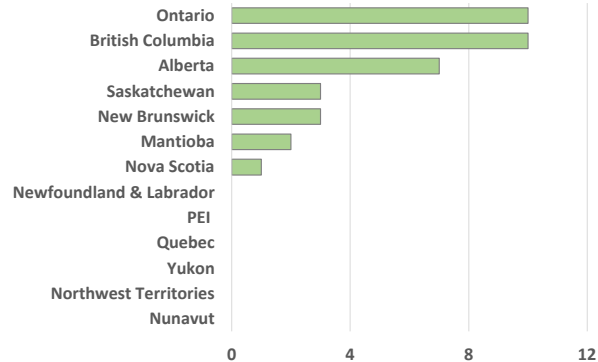


## Qualitative Analysis: NZ Builder Survey

Are you a Qualified Net Zero Builder/Renovator?



Region of Builders Surveyed



CHBA conducted a survey of Qualified Net Zero Builders in April/May 2021. Qualified Net Zero Builders have built homes in every province in Canada except Prince Edward Island so far, with the majority coming from Ontario, British Columbia, and Alberta. The builders surveyed covered 7 regions as shown in the chart above.

These industry leaders have demonstrated experience in net zero energy ready residential construction.

The vast majority of builders across Canada, however, do not have this experience.



## Survey Findings



- 55% said the envelope requirement is unnecessarily stringent
- 65% said the energy requirement is unnecessarily stringent
- 62% said the cooling criterion is unnecessarily stringent or takes the wrong approach.

Remember that these are the opinions of Net Zero Builders who have experience building high-performance net zero energy ready homes. The views of the industry at large would no doubt be stronger.

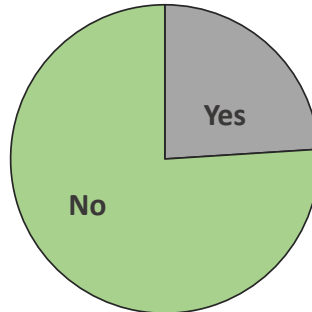
- 55% of NZ Builders said the code envelope requirement for tier 5 is too stringent
- 65% of NZ Builders said the code energy requirement for tier 5 is too stringent
- 62% of NZ Builders said the cooling criterion is unnecessarily stringent or takes the wrong approach





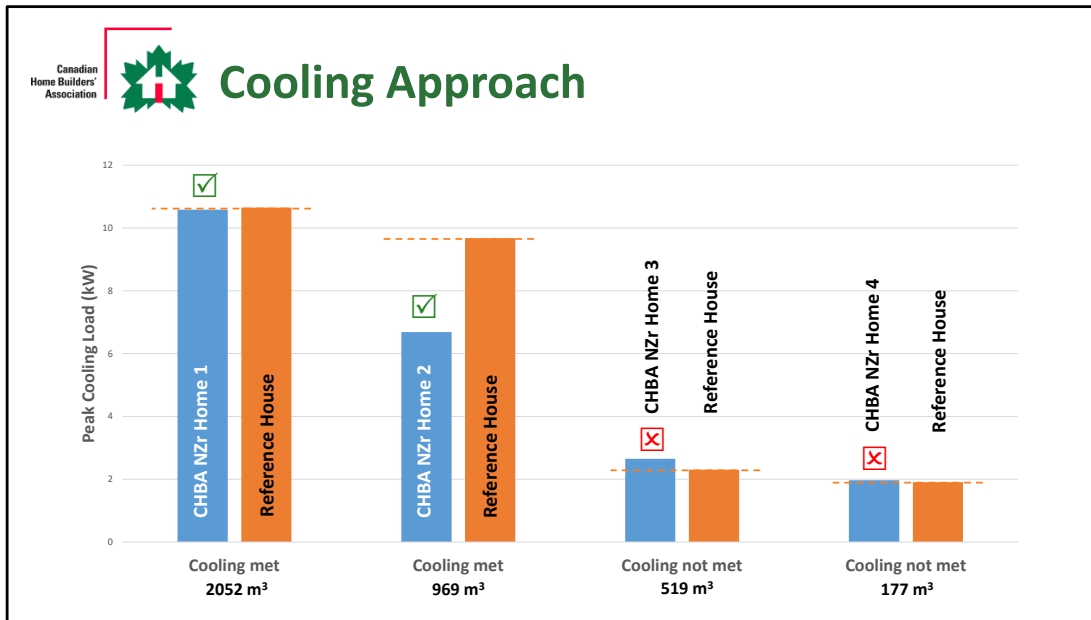
## Overheating

Have you experienced overheating issues in the NZ/NZr homes that you have built/renovated?



24% of Net Zero Builders said that one or more of their homes had some issues with overheating. Most homes had space cooling provided at sale and were therefore less likely to overheat.

As noted earlier, under the CHBA Net Zero Home labelling program, the cooling requirements do not apply if space cooling is provided. There is currently no requirement for cooling in the tiered requirements proposed for the NBC.



There is one aspect of the cooling requirement that may not be obvious. These four sets of data represent four homes in the Net Zero data set. Proposed cooling criteria are in line with the two homes on the left that have relatively high cooling loads (in blue) since the homes have lower cooling loads than the reference house load (in orange). The cooling criterion is not in line with the two homes on the right which have relatively low cooling loads—since the reference cooling load is even lower.

The criterion would have accommodated Home 2 even if it had a much higher cooling load—almost as high as Home 1, which is twice as big. With an adjustment to the window to wall ratio or the solar heat gain coefficient, Home 4 may have been able to meet the cooling load, but that may not be the case for Home 3 which has a bigger difference. Home 3 is also more than twice the size of home 4 but has only a slightly higher cooling limit.

This shows that the proposed peak cooling criterion is counterproductive where the goal is energy efficiency. The proposed cooling criteria appears arbitrary and unrelated to energy efficiency.



## Conclusions and Recommendations

### Conclusions

- Tier 5 overshoots the intended net zero ready levels of performance
- More effective solutions were found with slightly relaxed targets
- Cooling criteria currently proposed for NBC are counterproductive

### Recommendations

- Align the highest tier with demonstrated net zero energy ready performance levels by
  - removing tier 5 so that tier 4 becomes the highest tier and reflects actual net zero energy ready performance
  - aligning the code's cooling approach with that of the Net Zero Home labelling program

Though tier 5 was originally conceived as an equivalent to Net Zero Ready, that aim has not been achieved. Changing the targets slightly will bring them in line with net zero energy ready homes, and lead to more effective solutions.

Voluntary energy-efficiency programs have always played an important role in informing the path of the codes. We've seen a very consistent pattern of the codes following behind voluntary programs, allowing the voluntary programs to provide lessons learned, and confidence in an approach before moving forward with regulation.

To have tier 5 sit at a net zero energy ready performance level, changes are necessary to bring the proposed code requirements into alignment with the experience demonstrated in the field.

To bring the highest tier in the proposed code requirements into alignment with demonstrated net zero energy ready performance levels, the following adjustments would suffice:

- Remove tier 5 so that tier 4 becomes the highest tier and reflects the actual energy and envelope improvement performance of net zero energy ready homes
- Align the approach to cooling in the tiered code requirements with the approach taken in the Net Zero Home labelling program so as to rightly include cooling in energy calculations and help address the issue of overheating