BUILDING PERFORMANCE

QUICK GUIDE

Resilient homes – higher temperatures

Strategies to protect against higher temperatures and overheating

VERSION 1

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MINISTRY OF BUSINESS, INNOVATION & EMPLOYMENT
HĪKINA WHAKATUTUKI

Te Kāwanatanga o Aotearoa
New Zealand Government

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Ministry of Business, Innovation and Employment (MBIE)
Hīkina Whakatutuki – Lifting to make successful

MBIE develops and delivers policy, services, advice, and regulation to support economic growth and the prosperity and wellbeing of New Zealanders.

The Resilient homes – higher temperatures quick guide is produced by the Building System Performance branch. It is intended to provide information to homeowners with practical tips to create a higher temperature resilient home.

While MBIE has taken care in preparing the document it should not be relied upon as establishing compliance with all relevant sections or clauses of the Building Act or clauses of the Building Code in all cases that may arise. This document does not contain legal advice and should not be relied upon as such. The latest version is available on the Building Performance website www.building.govt.nz.

MORE INFORMATION

Information, examples and answers to your questions about the topics covered here can be found on our website: www.mbie.govt.nz.

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Preparing homes to be resilient to higher temperatures

A higher temperature resilient home is one that is designed, built, and used in a way to reduce the impacts of higher temperatures because of a changing climate.

Aotearoa New Zealand's climate is changing, and heatwaves are becoming more common. As a result of climate change, warmer days above 25°C will become more common across the country, with a possibility of more frequent and severe heat waves. New Zealanders will need to prepare their homes for the effects of higher temperatures. Active or mechanical means of cooling such as heat pumps are the most popular way to cool homes, but relying on these solutions can lead to higher power bills for homeowners and greater demand on the national grid, reducing the resilience of our national infrastructure.

The World Health Organisation's *Housing and Health Guidelines*, published in 2018, has identified 18˚C as a safe minimum indoor temperature. However, a safe indoor maximum temperature has not been defined because a comfortable temperature is personal and different for everyone. The effects of higher temperatures may cause overheating in homes.

> Insulation slows down the rate of heat transfer, rather than providing heating or cooling. This means that if a home is warm, and it is cold outside, it will retain that warmth. If a home is cool and it is hot outside, it will feel cooler inside. The result is that it will cost less to heat or cool your home if it is properly insulated.

For new homes, there are some design strategies to reduce the impacts of higher temperatures. For existing homes, homeowners can make small changes to their homes or increase their resilience through operating their homes well. Reducing the impacts of higher temperatures also helps homes retain warmth in the cooler months, meaning that they are more comfortable all year round without relying on expensive heating and cooling methods.

THE PURPOSE OF THIS GUIDE

The purpose of the quick guide is to provide practical and affordable strategies to homeowners who are planning to buy or build a new home. This guide may also be useful for those renovating, retrofitting, or repairing an existing home, and want to make their home more resilient to the impacts of higher temperatures.

DAMAGING EFFECTS OF HIGHER TEMPERATURES ON HOMES AND COMMUNITIES

Higher temperatures can cause homes to overheat, which may impact the health, wellbeing, and comfort of those who live in them. Higher temperatures can damage homes and deteriorate building elements, such as causing roofing or façade systems to warp, blister or crack. When higher temperatures are combined with high moisture levels in buildings, this can result in higher levels of humidity. This can also lead to mould growth, which is a risk to people's health. Causes of overheating in homes include:

- higher outdoor temperatures
- large areas of unshaded glazing, typically on the north and west sides of the building
- inadequate ventilation
- limited/no window shading (such as overhangs, blinds or curtains), or limited/no eaves
- occupant behaviour.

Higher temperature resilient strategy

1. COLLABORATE – THE RIGHT PROFESSIONALS ARE INVOLVED EARLY IN THE DESIGN STAGE

Homeowners are responsible for managing risks to their property. The right professionals engaged early in the design phase can propose solutions for reducing or minimising the impacts of overheating. Architects and building scientists can provide advice on ways to minimise overheating. Some councils also offer an eco-design advisor service.

2. UNDERSTAND THE RISK TO MAKE BETTER INFORMED DECISIONS

Knowing the risk of how higher temperatures could impact your home is an important step in deciding what approach to take when designing, renovating, or making changes to your home.

Higher temperature risk is the combination of the hazard (higher temperatures), exposure and vulnerability. In other words it is the possibility that overheating could happen, the likelihood that it will happen and the impact on people and property.

For example: a home is built on a site with little shade

Climate risk = **Climate hazard** Higher temperatures that may result in overheating x **Exposure** The home is located in an area that has no shade or wind flow x **Vulnerability** The home and its occupants are vulnerable if orientation on site and internal layout in the design stage are not considered, which will result in the home overheating

Information on the risk of climate hazards can be found in several places, including:

- Aotearoa New Zealand climate projections:
  Aotearoa New Zealand climate projections | Ministry for the Environment
- National Institute of Water and Atmospheric Research's climate change advice:
  Providing climate change advice for New Zealand | NIWA
- Ministry for the Environment:
  Climate Change | Ministry for the Environment.

3. UNDERSTAND THE RULES

THE BUILDING CODE

All building work needs to comply with the Building Code, even if a building consent is not required. This is the case for both new buildings and for some repairs and alterations to existing buildings. However, there is work that can be done without the need for a building consent that can improve protection against overheating.

MBIE has published a guide on building work that does not require a building consent and has interactive resources like www.canibuildit.govt.nz.

> Building to the minimum requirements of the Building Code may not be sufficient protection from higher temperatures.

The Building Code sets the minimum performance requirements of buildings so that people who use buildings are safeguarded from injury or illness. The Building Code also aims to protect other property from damage.

There is no specific Building Code clause that sets requirements for performance during periods of high temperatures. The Building Code clauses work together to ensure that homes perform to a minimum standard.

It is important to note that even if building work for a new home complies with the Building Code, this does not guarantee that the home won't be affected by higher temperatures at some time in the future.

Building Code clauses that relate to the performance of buildings for higher temperatures are:

Buildings and the materials and components that they are made from can be affected by higher temperatures, which can impact the performance of the building related to structure and weathertightness, as set out in the following Building Code clauses:

- **Structure and stability (B1):** Building materials and components may be vulnerable to expanding and contracting during fluxes across higher temperature ranges, adding loads to the structure.
- **Durability (B2):** Higher temperatures and subsequent higher humidity could affect the durability of building materials and components.
- **External moisture (E2):** High temperatures can have an effect on cladding systems and subsequently the performance of the building related to weathertightness.
- **Energy efficiency (H1):** Energy use needs to be considered when heating or cooling buildings. Homes need to be airtight, insulated, ventilated, and heated or cooled in an energy and cost-effective way.

Building Code clauses related to internal comfort of occupants:

There are currently no Building Code requirements to protect occupants against overheating or high indoor temperatures. Building better than the minimum requirements of the Building Code will result in a more resilient home. However, the following Building Code clauses must work together to ensure homes perform well.

- **Internal moisture (E3):** Internal moisture needs to be managed. Higher temperatures, along with high moisture levels, can cause internal moisture build-up.
- **Ventilation (G4):** Passive ventilation, mechanical ventilation, or a combination of both can manage humidity and reduce the risk of overheating.
- **Interior environment (G5):** There are provisions for minimum temperatures to be maintained for old people's homes and early childhood centres. However, there are no maximum temperature requirements.
- **Natural light (G7):** Windows can be located and sized to provide passive ventilation, as well as providing natural light and access to views.

New homes need to comply with the Building Code. The Building Code sets the minimum performance requirements of buildings. Building better than the minimum that is required by the Building Code will result in a more resilient home.

4. INVEST IN GOOD DESIGN | WORK WITH NATURE | DESIGN TO THE CONDITIONS

The biggest impact on how well a new home will perform during periods of higher temperatures are decisions made during the design phase, often with little or no extra cost.

A site analysis will consider factors such as site location, size and orientation of the proposed building, and prevailing wind direction. A good site analysis should result in a building responding to the individual characteristics of the site, which results in a better performing building.

A building that performs well will have the following features:

It will be airtight	It will have adequate insulation	It will be well ventilated, preferably with a heat recovery system	It will have the ability for passive or manual operation of windows and blinds	It will have the ability to be heated and cooled

Ensuring that each of these features are provided to a sufficient extent is a complex task, but if done well will result in a higher performing and more comfortable home during periods of higher temperatures. Year-round thermal performance needs to be considered carefully in the design of new homes, as often decisions made to limit the need for heating during cooler periods will also impact the potential for overheating. Consider adding solar-control low-E glazing in windows that are difficult to shade in summer, such as on the western side of the building. While there are some 'rules of thumb' that can be followed to design for passive heating and cooling, a whole-building analysis using a thermal simulation model will show the impacts of design decisions on the potential thermal performance specifically for your home throughout the year. The following illustration shows some strategies that may result in improved higher temperature resilience.

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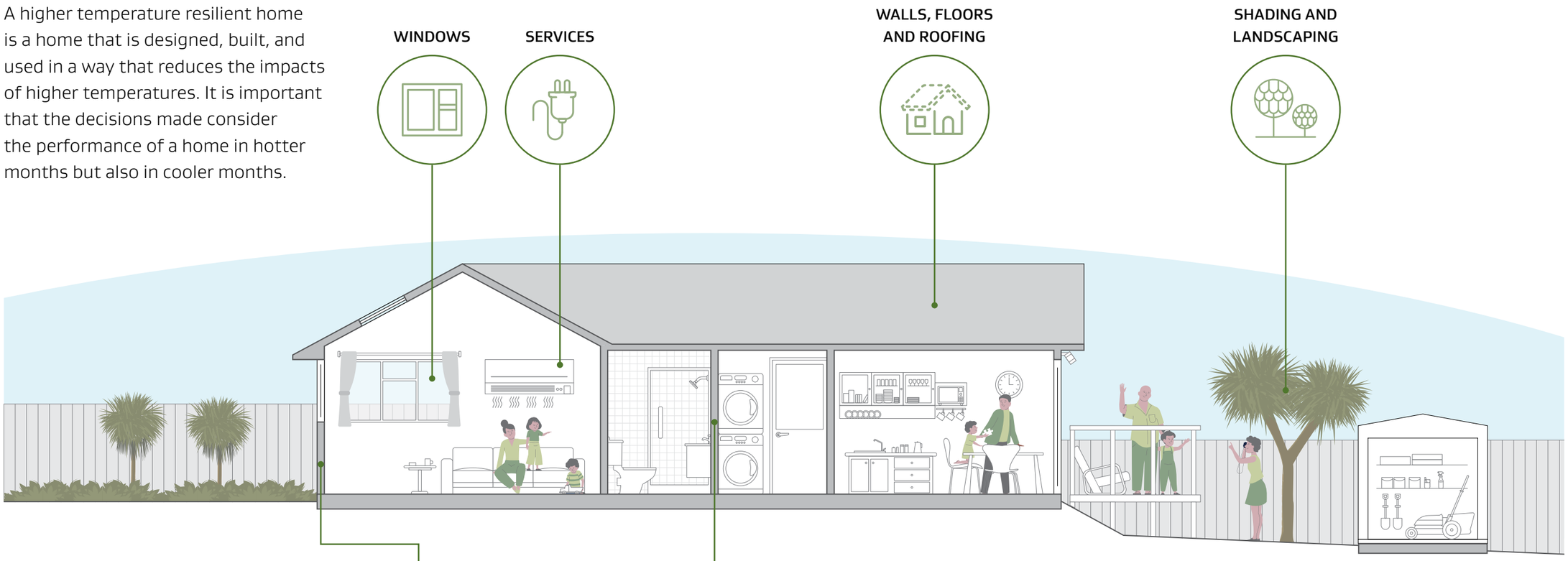
HIGHER TEMPERATURE RESILIENT HOME

A higher temperature resilient home is a home that is designed, built, and used in a way that reduces the impacts of higher temperatures. It is important that the decisions made consider the performance of a home in hotter months but also in cooler months.



This illustration presents some practical and affordable strategies for homeowners who are planning to build a new home, or are renovating or retrofitting an existing home, to make it more resilient to the impacts of higher temperatures. It also includes some strategies for operating existing homes in a way that reduces the risk of overheating.

CONTACT THE LOCAL COUNCIL AND YOUR INSURANCE COMPANY

It is important to speak with the local council and your insurance company as early as possible in the design stage.

SEEK INDEPENDENT PROFESSIONAL ADVICE

Before applying any of these strategies shown you should seek independent professional advice.

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HIGHER TEMPERATURE RESILIENT HOME

AN EXISTING HOME

When altering or repairing an existing home, consider including higher temperature resilient design features.

Homes are altered for several reasons. It may be to add an extension, alter the internal layout, or to increase the performance of the home by adding insulation or upgrading windows. Cooling and heating homes can be expensive. By including resilient design features, some of these costs may be reduced.

A NEW HOME

New homes need to comply with the Building Code. The Building Code sets the minimum performance requirements for buildings. Building better than the minimum that is required by the Building Code will result in a more resilient home.

APPLIES TO NEW HOMES ONLY
All other strategies apply to both new and existing homes

WINDOWS

- Design window size, location, and openability for optimal cross ventilation
- Consider higher level openable windows (for example, a clerestory window) to give heat a way to escape (known as stack ventilation)
- Open windows once the outdoor temperature drops below the indoor temperature in the evenings or early morning to cool the house down. This is called purge ventilation
- Consider including windows that can be securely left open when nobody is home
- Window restrictors are necessary on upper floors to stop young children from falling, but can limit ventilation. Consider solutions such as sashes for these windows.
- Reduce or carefully consider the area of glazed areas in the design
  - Reduce or remove skylights, or provide blinds for them
  - North facing windows should be largest as they can let in desirable heat from the sun in winter. Eaves, overhangs and awnings can be designed to block the sun in summer while letting in winter sun
  - East facing windows allow morning sun and some heat
  - South facing windows will provide consistent light and limited heat
  - West facing windows allow light and heat in the afternoon and are most difficult to passively manage as the sun is low in the sky and the house has already been heated by the sun throughout the day
- Identify and choose windows with the correct solar heat gain coefficient
  - This coefficient is an indication of how much of the sun's heat can pass through glazing
  - The lower the number, the more shading the glazing provides
  - The solar heat gain coefficient can be different on each façade
  - Windows that are difficult to shade in summer, such as on the west side of the building, should be limited in size and have glazing with a low solar heat gain coefficient
  - Windows on the north side that can harness the sun's heat in winter should be moderately large and have glazing with a high solar heat gain coefficient, provided they have external shading for summer, such as well-designed eaves, overhangs or awnings

INSULATION

- Insulate the walls, under the floor and the roof to at least the minimum required by the Building Code. Insulation can be installed either on the underside of the roof, or on top of the ceiling. If the insulation is installed on the underside of the roof, this will prevent the roof space from heating up.

BUILDING SIZE, ORIENTATION AND LAYOUT

- Design the layout and form to enable adequate passive cross ventilation
- Design the internal layout and form to reduce large areas of unshaded north and west facing windows
- Consider the areas that need the most light and heat. Rooms on the south side may be cooler, and rooms on the north or west side of a home may be warmer.

WALLS, FLOORS AND ROOFING

- Choose building materials that are UV stabilised and tested for New Zealand conditions
- Ensure that the home is airtight so that it will take less energy to heat and cool
- Darker façade colours can attract more heat. Use lighter colours on roofs and walls
- Consider applying a solar or heat reflective paint to walls and roofing
- Thermal mass (for example, exposed polished concrete floors) can be used to absorb heat during the day.

SHADING AND LANDSCAPING

- Choose thermally backed or thermacell insulated blinds (also known as honeycomb blinds) or curtains
- Use wide eaves or awnings on the north side to provide horizontal shading when the sun is high in the sky
- Use movable vertical shading for east and west
- Add shade sails or other structures like a pergola to reduce the amount of heat from the sun on the north and west sides of the house while still providing dappled light
- Wide eaves or awnings will shade the summer sun, for effective all year-round shading consider louvered shutters
- Plant deciduous trees on the north side of the house to act as a shade in summer, but still allow sun through in winter.

SERVICES – VENTILATION, HEATING AND COOLING

Providing the ability to ventilate a home to maintain a comfortable indoor temperature in warmer months is important. Although homes should be designed to maintain a healthy indoor temperature passively most of the time, heat pumps are an efficient way of providing additional heating and cooling when needed.

- Design for passive crossflow ventilation by considering the width and layout of the house, and the sizing and placement of opening windows and doors
- Consider a mechanical ventilation (preferably with heat recovery) system, especially in homes where windows cannot be opened (like in areas where there are issues with outside noise, where security is a concern, or in townhouses or apartments where openable windows are limited to two or three façades)
- Install a heat pump that is sized correctly for the space. Set to cooling only in warmer months, rather than 'automatic' which will both heat and cool a space. Consider setting the cooling temperature to a higher temperature (for example 24 or 25°C) to reduce energy use
- Limit internal heat gains. For example, insulate hot water cylinder pipework, and turn off appliances that aren't in use.

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