

Retrofitting for Resilience

Exploring how to enable home, garden
and neighbourhood upgrades for extreme
weather in Mount Alexander Shire

PREPARED BY

 castlemaine
institute

 CENTRAL VICTORIAN
Greenhouse Alliance

 ADAPT
LODDON MALLEE
Adaptation Services & Support

Retrofitting for Resilience:

Exploring how to enable home, garden and neighbourhood upgrades for extreme weather in Mount Alexander Shire

Acknowledgements

A report by Amy Atkinson, Annika Kearton, Lisa Merkesteyn and Alison Whitten
Prepared for Victorian Department of Energy, Environment and Climate Action
July 2023

The Retrofitting for Resilience project is funded through ADAPT Loddon Mallee. The CI and CVGA would like to extend their gratitude to the Department of Energy, Environment and Climate Action for supporting this important work.

The authors would also like to thank the Policy and Community Reference Groups, household and key informant interview participants and the University of Melbourne's Community Engagement for Disaster Risk Reduction project team. This project would not have been possible without the care and time invested by these individuals and organisations in Mount Alexander Shire and beyond.

© 2023 Castlemaine Institute

Castlemaine Institute is a research and learning hub for regenerative economics, community and landscapes. We exist to support the ongoing transformation and development of individuals, collectives, landscapes, and systems which are evolving to meet the urgent opportunity of our times. We do this through applying multidisciplinary depth to complex problems, drawing on and developing local wisdom through our work.

Castlemaine Institute
Castlemaine VIC 3450
info@castlemaineinstitute.org

castlemaineinstitute.org.au

PREPARED FOR



PREPARED BY



Table of Contents

Acknowledgements	2
About this report	5
Acronyms	6
Glossary	7
Executive summary	9
1. Background	21
2. Research purpose and approach	23
2.1. Research objectives	23
2.2. Project design	24
3. Climate risk and policy in Victoria	29
3.1. Impacts of extreme weather in Victoria	29
3.2. Victoria’s housing stock	31
3.3. Disproportionate impacts of extreme weather	32
3.4. Climate adaptation and disaster risk reduction policy landscape	33
4. Home, garden and neighbourhood retrofit options	37
4.1. Household-level building retrofit options	37
4.2. Landscapes and gardens	38
4.3. Neighbourhood-scale interventions	38
5. Current retrofit resources for households and neighbourhoods	41
5.1. Guidance and information	42
5.2. Programs and services	43
5.3. Financial incentives	47
6. Limitations to broad uptake of resilience retrofits	50
6.1. Retrofits as long-term infrastructure investment	50
6.2. Barriers to household action	51
6.3. Market development	52
7. Case study context: Mount Alexander Shire	54
7.1. Extreme weather risks in the Shire	55
7.2. Housing stock in the Shire	60
7.3. The Shire’s community profile	63
7.4. What our community thinks about risk	65

8. Summary of findings from community engagement	69
8.1. Climate change and local risks	70
8.2. Behaviours	71
8.3. Ability	74
8.4. Opportunity	79
8.5. Motivation	91
9. Analysis and recommendations	95
9.1. Risk awareness	96
9.2. Retrofit information, engagement and access to resources	98
9.3. Motivations for action	101
9.4. Financial incentives	103
9.5. Retrofit market and implementation	105
9.6. Neighbourhood- and community-scale retrofits	108
9.7. Planning and regulation	110
10. Conclusions and next steps	113
Case Studies	
CASE STUDY 1: Victoria’s Early Intervention Investment Framework (EIIF): funding to improve social outcomes by addressing root causes	35
CASE STUDY 2: Little Stringybark Creek: a networked, neighbourhood-scale approach to waterway management	39
CASE STUDY 3: Castlemaine 500: a place-based approach to building capacity for home energy upgrades	44
CASE STUDY 4: Housing for Health: a community-based model for home upgrades to improve health outcomes	46
Appendices	
APPENDIX 1: Home retrofit resources reviewed	115
Guidance and information	115
Programs and services	117
Financial incentives	118
APPENDIX 2: Policy and Community Reference Group members	120
APPENDIX 3: Key informant interview participant summary	121
APPENDIX 4: Household interview participant summary	122
References	125

About this report

The Retrofitting for Resilience project emerged out of a need to better understand how households can be encouraged and supported to upgrade or retrofit their homes to build their resilience and adapt to a changing climate.

The Castlemaine Institute, Central Victorian Greenhouse Alliance and Adapt Loddon Mallee (Victorian Department of Energy, Environment and Climate Action) collaborated to explore this question through community-based research in Mount Alexander Shire.

This report brings together the findings from our research and recommends a series of actions to facilitate 'resilience retrofits', with a focus on households that are disproportionately impacted by extreme weather events.



Acronyms

AAP	Adaptation Action Plan
ACOSS	Australian Council of Social Service
AEP	Annual Exceedance Probability
BAL	Bushfire Attack Level
BEAAP	Built Environment Adaptation Action Plan
BMO	Bushfire Management Overlay
CALD	Culturally and linguistically diverse
CASBE	Council Alliance for a Sustainable Built Environment
CEDRR	Community Engagement for Disaster Risk Reduction project
CFA	Country Fire Authority
DEECA	Department of Energy, Environment and Climate Action
DELWP	Department of Environment, Land, Water and Planning
EUA	Environmental Upgrade Agreement
FO	Flood Overlay
LGA	Local Government Area
LIEEP	Low Income Energy Efficiency Program
LSIO	Land Subject to Inundation Overlay
MASG	Mount Alexander Sustainability Group
NatHERS	Nationwide House Energy Rating Scheme
NCC	National Construction Code
NCCMA	North Central Catchment Management Authority
NILS	No Interest Loans Scheme
RACE for 2030	Reliable, Affordable, Clean Energy for 2030
RAS	Regional Adaptation Strategy
RBC	Resilient Building Council
RSA	Recognition and Settlement Agreement
SES	State Emergency Service
VCOSS	Victorian Council of Social Service
VEEC	Victorian Energy Efficiency Certificate
VEU	Victorian Energy Upgrades
WEREG	West End Resilience Energy Group

Glossary

The following terms are used throughout the report.

Climate adaptation is the process of adjusting to actual or expected changes in climate to reduce or avoid the negative impacts that are likely to occur as a result of these changes.

Climate mitigation refers to actions undertaken to limit changes in global climate caused by human activities.

Climate risk refers to the likelihood of negative consequences resulting from the impacts of climate change. It is the product of the interaction of three factors: hazards (climate change-induced extreme weather events), vulnerability (the ability of individuals or communities to respond to and recover from hazards) and exposure (the extent to which hazards are expected to impact individuals or communities).

Disaster management is the process of reducing the impact of natural or human-made disasters on people and the environment, across the four phases of mitigation, preparedness, response and recovery.

Energy efficiency is the reduction in the amount of energy required to provide services or undertake tasks (such as mechanically heating or cooling a home or running household appliances).

Extreme weather and extreme weather events refer to weather patterns or occurrences that exceed normal, expected ranges. We include storms and extreme heat and cold in this definition, and also use the term to refer to bushfire and flooding disasters. Extreme weather events often negatively impact human health and safety and cause damage to the built and natural environments. Alternative phrasing used in this report includes 'climate and weather extremes' and 'extreme weather and climate events'. We note that 'extreme' is a specific classification in the Australian Fire Danger Rating system, but in this report the word is applied in a general sense.



Green-blue infrastructure refers to the use of natural features such as vegetation, soils and natural processes in an urban environment to simultaneously deliver landscape management and water management benefits, including reduction in the scale of flooding and in the incidence of flash flooding.

Resilience refers to the capacity of individuals, communities, businesses, institutions and systems to survive, adapt and thrive no matter what chronic stresses and acute shocks they experience. In this sense, resilience is inclusive of climate adaptation.

Retrofitting refers to the process of upgrading or modifying existing properties (homes and gardens), structures, systems or equipment to improve their performance. Performance can be in relation to energy efficiency, resilience or health and safety. We use the terms ‘resilience retrofit’ and ‘adaptation home upgrade’ interchangeably and specify the performance criteria of the retrofit/upgrade when differentiating between retrofits for different purposes.

Storms are defined as violent disturbances of the atmosphere with strong winds and usually heavy rain, thunder, lightning or hail.

Executive summary

Retrofitting for Resilience: Exploring how to enable home, garden and neighbourhood upgrades for extreme weather in Mount Alexander Shire, a community-based research project grounded in a case study of Mount Alexander Shire (the Shire) in regional Victoria, explored the opportunities to increase the uptake of home retrofit actions by households for the purpose of increasing their resilience to extreme weather events (bushfire, flooding, storms, heat and cold). The project's four key objectives were to:

PROJECT OBJECTIVES

1. Understand existing levels of community awareness about climate-related risks, household exposure and vulnerability, and potential adaptation measures at the household level.
2. Identify a suite of 'resilience retrofit' options for different housing types and situations.
3. Identify existing and hypothetical resources, services and incentives that could support households to retrofit their homes, with a focus on disproportionately impacted groups.
4. Explore community preferences and attitudes towards resilience retrofits, including the key drivers, enablers and barriers to uptake.

We applied a mixed-methods approach to our research, including a desktop review of existing policies and resources, a detailed exploration of climate risk in the Shire and interviews with 29 key informants and 14 households. The cumulative findings from this work informed our recommendations.

Retrofitting for Resilience project inclusions and considerations

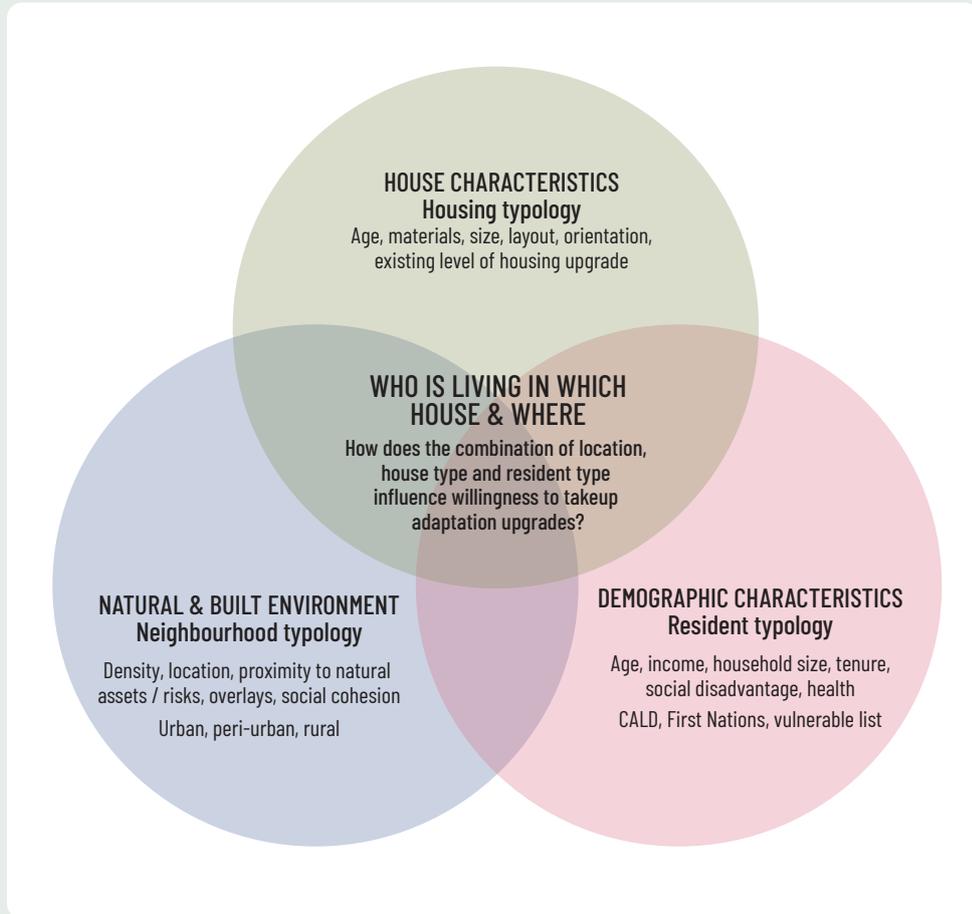


FIGURE 1 – Retrofitting for Resilience project inclusions and considerations

Climate risk and policy in Victoria

Extreme weather events have generated significant health, social, environmental and economic impacts in Victoria in recent years. The costs of climate change will only continue to rise, even under a low-emissions scenario, making a response to these challenges increasingly urgent.

The majority of housing in Victoria was built prior to the introduction of minimum performance standards. Older homes (built prior to 2005) are more likely to have poor thermal comfort, inadequate fixings, gaps and thin glazing, making them both inefficient to operate and more vulnerable in extreme weather. In addition, new development still occurs in high-risk areas, such as flood zones, due to the use of out-of-date flood maps that largely reflect historical data rather than future climate projections. This perpetuates and sometimes worsens communities’ vulnerability to extreme weather events.

People facing systemic disadvantage, including low-income or low-wealth households, older people, people with a disability, Aboriginal and Torres Strait Islander communities, culturally and linguistically diverse communities and renters, are more likely to be displaced by or face the physical and mental health impacts of extreme weather events.

Recent climate adaptation and emergency management policies point to the need for, and value of, effective coordinated programs at all levels to ensure that households and neighbourhoods are able to prepare for extreme weather. While no single policy or strategy specifies mechanisms for progressing resilience retrofits at scale, collectively, the enabling environment for progressing this work, including actions identified through our research, is strong.

Retrofitting homes, gardens and neighbourhoods for resilience

There are significant opportunities to improve the resilience of existing homes and gardens and surrounding landscapes at a neighbourhood scale. In addition to reducing the negative impacts of climate change on residents' safety, health and wellbeing, resilience retrofits also allow households to save money through reduced future property damage costs and reduced operational expenses resulting from improved energy efficiency.

In general, retrofits designed to improve the exterior of a building can increase the resilience of existing housing stock to multiple hazards. Additional actions aimed at reducing risks related to flood and fire are often specific to the context and home typology.

Gardens and landscapes can improve resilience to extreme heat, flooding and bushfire. At a household level, planting species that are suited to local growing conditions and future climate projections, and improving growing conditions, increases the resilience of landscapes. At a neighbourhood scale, considered tree plantings and application of green-blue infrastructure can reduce localised heat and the broader downstream effects of flooding.

A more detailed set of retrofit options for homes and gardens is provided in the *Housing Typologies and Retrofit Options Guide* developed through this research, which identifies actions that households can take based on their housing typology and the types of extreme weather to which they are most exposed.

Current retrofit resources and limitations

We reviewed a range of existing resources designed to support household and neighbourhood scale retrofits for resilience and energy efficiency, as well as some targeting health and safety. These include guidance and information, programs and services, and financial incentives facilitating all parts of the retrofitting 'journey', from awareness raising to assessment to action. Most resources focus on either resilience or efficiency, with very few taking an integrated approach. Considerable guidance and information on resilience retrofits is available

to inform and raise awareness; but programs, services and financial incentives related to retrofitting are much less developed than those for energy efficiency. In addition, most resources are oriented to homeowners, highlighting the limitations of the actions that renters can take on their own. Nonetheless, these resources together provide a strong foundation from which resilience retrofit activities can be developed and expanded.

Our review also highlighted several key themes related to the systemic barriers to the uptake of retrofit actions of any type, which must be addressed through future investment and program design:

Retrofits as long-term infrastructure investment

Evidence increasingly verifies the large-scale economic benefits of investing in resilience; but under current policies and financial models, government funding for disaster response and recovery far outstrips funding for resilience building. Within this positioning, home retrofits are understood to be the responsibility of households, incremental investments for personal gain, rather than being seen as large-scale infrastructure investment by government.

Barriers to household action

Navigating the retrofitting journey is complicated; barriers to household action primarily include insufficient risk awareness and motivation to act, cost and time, inability to make changes to homes (for renters), challenges navigating and applying available information, and mistrust of programs and services.

Market development

The market for retrofit work is still nascent, especially in regional areas. The labour-intensive requirements of retrofit work make it less attractive to tradespeople, particularly as an understanding of the scale of need and demand for retrofits in the context of a changing climate is still emerging.

"I would never in my wildest dreams [have] thought we would flood again within a decade"

"In the last two decades I have experienced increases in bushfire awareness and neighbouring threats, several flooding events, storm events, summer heatwaves [of] long duration, droughts, and winter cold snaps."

"Just thinking about our house in the broader context of the neighbourhood is an interesting idea that a lot of people don't have."

"The community needs shelters for bushfires, heat and cold, particularly for elderly residents and people without good heating and cooling at home."

"My view is now that the only people that can change it [attention on resilience in building practices] are the builders."

"I am a little bit worried about what my premium will be. I don't know what that's gonna look like... Which is why I've been thinking a bit about well, how do I mitigate risk? Because I have to have insurance. I have a mortgage."

"I don't want to over-invest or whatever, overcapitalise. It's a point at which you might just have to start again, and make a nice warm new house."

"To be honest, like a lot of people I don't know where to start (on retrofitting for flood) . Because there's probably a lot of things we could do, you know, which ones do you do first?"

"Because 'retrofit' means you need to, other than minor things, you need to hire an expert of some sort and they are so expensive in this country."

"We do get anxious about future water availability and what that means for the way that we live and [if] our approaches to thermal comfort get impacted by the ability of our trees to survive."

"The real estate agent told us that it was in a flood area, which is why I think we got it cheaper than probably we otherwise would have ..."

"I am no expert, and I am not partnered, so the reliance on trawling through all the available information falls to me. So something like the government reports, all of those things being readily available would be really meaningful to me."

"Because none of us has an endless amount of money, so I need to decide where I am going to put the money. I can't have all of this."

"We put in a few loads of gravel, when the actual flood hit we were able to get the SES to sandbag the place. But our hands are tied because we're renting. We're not in a position to get in there and do earthworks."

"[I] have requested a shade pergola out the back. If it can be demonstrated that it is necessary due to 'medical conditions', public housing will organise; otherwise, they will give permission for the resident to arrange construction and payment."

"It's very hot here and it gets very cold. It's like a paper bag. You know, I have to have heating and cooling. Like it's getting warm in here now. And it's not a particularly hot day."

MOUNT ALEXANDER SHIRE CASE STUDY

Climate risk and community engagement findings

Our case study of Mount Alexander Shire first focused on understanding local climate risk as a combination of relevant climate hazards, house typologies and demographics. The Shire is expected to get hotter and more prone to bushfire and flood events as a result of climate change. Mapping the predominant house typologies in bushfire- and flood-prone parts of Castlemaine, Chewton and Campbells Creek helped to identify the level of vulnerability of households in these higher-risk areas while also enabling consideration of neighbourhood-scale retrofit options to reduce the risk posed by extreme weather events. The community demographic profile identified that households are smaller, older and lower-income, with a higher rate of rental stress, than the Victorian average.

To understand our community's risk understanding and appetite, we drew on initial outputs from the University of Melbourne's multi-year Community Engagement for Disaster Risk Reduction (CEDRR) project. Of the 179 residents in Mount Alexander Shire surveyed in 2022:

- A majority felt exposed to high risk at least 'a few' days throughout the year.
- Most reported a moderate to low risk appetite.
- Most felt that they had put in either 'some' or 'little' effort to reduce risks.
- Over half had taken some form of flood mitigation action.

Participants identified a range of options for improving the support (social, financial, information) provided by multiple sources, particularly government.

Most significantly, our interviews with households and key informants provided a rich set of perspectives on the types of resilience retrofit actions households are undertaking, as well as their knowledge/awareness of both risks and potential retrofit options, what they have not pursued (and why), and the types of mechanisms that would enable broader uptake of action. The interviews included walking participants through the *Housing Typologies and Retrofit Options Guide* that we developed to assist participants in considering retrofit options of different levels of difficulty and cost that would be suitable for their houses and properties. We summarised our interview findings according to the following four themes drawn from a behaviour change framework:

Behaviours

Households are undertaking minor upgrades and taking steps to prepare their homes for extreme weather events, to varying degrees, including through garden maintenance and landscaping works. A smaller number of households have undertaken moderate to major upgrades, and many households expressed interest in more resource-intensive actions that provide a mix of resilience and energy efficiency benefits.

Ability

Households are broadly aware of the risk overlays on their property, including which risks are within their control to manage. Many feel confident to undertake minor retrofits on their own and would prefer to be self-sufficient in these endeavours where possible. For those seeking professional support, identifying trustworthy resources can be a challenge; finding trusted sources of information and referrals to tradespeople is important. Moreover, cost is a barrier to the uptake of more extensive retrofit work.

Opportunity

Some households had accessed information and financial resources on retrofits, but households and community services providers alike noted that residents are time-poor and struggling with information overload. Information alone is insufficient to prompt action; attaching resilience retrofit programs to existing services would be beneficial, particularly for households currently receiving social and health support. The nascence of the retrofits market was also identified as a barrier to uptake by households.

Motivation

Households identified sustainability values and concerns about climate change, comfort, wellbeing and energy security as motivators for investing in home retrofits. The '80:20 rule' (80% of benefit can come from 20% of the effort) was raised to account for households' justification for not undertaking many more extensive retrofit actions, particularly those requiring substantial work by tradespeople. Relative to energy efficiency retrofits, resilience retrofit actions were more difficult for households to justify economically. Likewise, landlords were understood to have different motivations from those of owner-occupiers, and key informants noted that regulation is required to ensure that landlords undertake retrofit actions that benefit tenants.

The body of our full report features extensive direct quotes from interviewees to foreground the perspective of project participants and enrich understanding of the themes that emerged.

Recommendations

Informed by our collective research findings, our recommendations propose a series of actions that can increase the uptake of resilience retrofits at both the household and neighbourhood scales. While we have identified many actions, most involve modifications of existing programs rather than extensive investment in new programs or incentives.

The proposed actions highlight that broad uptake of resilience retrofits requires coordinated efforts across multiple sectors, including local and state government, community-based organisations and the property sector, among others. This is particularly true for actions specifically designed to support households that are likely to be disproportionately impacted by extreme weather events.

1. Risk awareness

Information about climate-related risks should be consistent, context-specific, based on future climate projections, and applied and shared with communities in clear and locally relevant ways. This will ensure that households have climate risk information that is useful to them and can inform their decision-making about their future. Recommended actions include:

- A. Apply a rigorous and consistent approach to the development and updating of flood maps and Municipal Emergency Management Plans that is based on future climate projections (see Rec. 7A).
- B. Develop regional-scale flood maps that inform local flood maps and reflect the catchment-level impacts of new development and coordinated opportunities for risk mitigation.
- C. Consistently incorporate climate risks into strategic land use planning projects (including housing and neighbourhood character strategies, structure plans and framework plans) to identify the need for neighbourhood-scale mitigation actions and reduce potential future impacts on households (including decision-making about the location and nature of new development).
- D. Explicitly inform buyers and renters of property-specific climate risks at the point of sale or rental and provide information about actions that can be taken in response to such risks.
- E. Develop and deliver sustainable, ongoing community-based programs to raise awareness of localised climate risks and resources available for reducing these risks and responding to extreme weather events.

2. Retrofit information, engagement and access to services

Guidance on home retrofitting should be integrated into a 'whole-of-home' approach that encompasses resilience, health, safety, comfort, energy efficiency and environmental benefits. This will facilitate household understanding of retrofit options that are suitable and of greatest value to them and their properties and help households make optimal decisions about investing in their home. It will also minimise the chances of maladaptive actions and leverage current energy efficiency programs. Recommended actions include:

- A. Broaden and reorient current home retrofit information and programs to take an integrated whole-of-home approach that combines the benefits of energy efficiency and resilience retrofits, ensuring that information targeting the general public is broadly accessible.
- B. Link general information about whole-of-home retrofit options to self-assessment tools to enable households to personalise information to their individual property contexts.
- C. Adopt the Resilient Building Council's Resilience Rating system as an industry-wide standard that complements energy efficiency ratings.
- D. Expand the remit, responsibility and expertise of Home Energy Assessors to include a whole-of-home scope that covers both energy efficiency and resilience.
- E. Establish a single Victorian Government channel that provides unbiased and accessible, easy-to-understand information to households about all home retrofit programs and associated incentive schemes, including a platform for peer-to-peer discussion and 'ask an expert' guidance.

3. Motivations for action

Messaging and incentives to encourage home retrofits should be holistic to respond to household priorities, motivations and ability to pay. This will maximise the reach of programs into communities, including households most exposed to climate-related risks.

Recommended actions include:

- A. Develop targeted messaging drawn from the multiple benefits of whole-of-home retrofits that appeals to individual households' varied motivations for taking action, including those related to cost savings, risk reduction, environmental, and health and safety factors.
- B. Undertake further research on the relative value and impact of retrofit options to inform household prioritisation of and investment in different actions.
- C. When developing incentives for retrofit actions, design options based on an understanding of households' ability to pay, and with the combined objectives to: 1) equitably support low-wealth households, 2) encourage broad action by owner-occupiers of all income levels and 3) incentivise landlords to take action.

4. Financial incentives

Financial incentives for the uptake of resilience retrofits should be integrated into energy efficiency programs to align with a whole-of-home approach and should be scaled to reflect both the individual and collective financial and environmental benefits of reducing the impacts of extreme weather events, on both households and the broader community. This will motivate households across income levels to undertake home upgrades and will maximise the benefits of preventative investment to government. Recommended actions include:

- A. Expand Victorian Government home retrofit rebate schemes, including those targeting landlords, to include products with resilience benefits (see Rec. 7C).
- B. Quantify the financial and embodied energy cost-benefit ratios of investing in residential and neighbourhood resilience retrofits at scale in Victoria, relative to current and projected annual spending on emergency response, recovery and rebuilding.
- C. Expand home loan interest rate discount programs for energy efficiency to include discounts for resilience retrofit actions and high Resilience Rating scores (see Rec. 2C).
- D. Introduce discounts on insurance premiums based on resilience retrofit actions and high Resilience Rating scores (see Rec. 2C).
- E. Monitor the outcomes of the Australian Government's \$1.3 billion Household Energy Upgrades Fund and apply the lessons learned from its low-interest loan program to resilience retrofits.

5. Retrofit market and implementation

While the home retrofit market is growing, investment should be provided to expand and diversify the local workforce, build trust in the skills and quality of work of local tradespeople, and facilitate retrofit activities among households that are not in a position to undertake or manage the work themselves. This will ensure that there is sufficient and diverse local expertise to meet future demand for retrofit work for all households. Recommended actions include:

- A. Undertake a pilot in Mount Alexander Shire of the Resilient Building Council's assessment methodology across a selection of low-income households, and pursue resourcing to undertake relevant retrofit actions through innovative financing mechanisms.
- B. Invest in the development of place-based home retrofit services to build local skills in retrofit activities (including whole-of-home assessment), connect households with relevant services and resources, and provide project management support for households around coordinating the retrofit work on their homes.
- C. Develop training in home assessment and retrofit work targeting culturally and linguistically diverse, First Nations and gender-diverse communities to provide employment pathways for these groups and establish a market of tradespeople who are representative of local communities.
- D. Expand current retrofit training programs for tradespeople to include a whole-of-home approach and provide incentives for individuals and businesses to participate in these programs to ensure a broader upskilling of the sector.
- E. Regulate the quality standards for all retrofit work.
- F. Expand My Aged Care Home Care Packages and Department of Veterans' Affairs Rehabilitation Appliances Program to include home resilience retrofits.

6. Neighbourhood- and community-scale retrofits

Investment should be directed to local government and community groups to take neighbourhood- and community-scale action to improve physical infrastructure and build resilience through social connection. This will achieve greater resilience outcomes, and in some cases it will be necessary to reduce household-level risks. Recommended actions include:

- A. Establish a process and funding mechanism to ensure that the local infrastructure (particularly drainage) required to manage extreme weather events can be constructed where it does not already exist and future-proofed when requiring repair or replacement, instead of replacing like for like (see Rec. 7A).
- B. Expand and enforce town-scale integrated water management and urban greening plans and actions, accounting for the ongoing costs of maintaining assets, to respond to local conditions and provide flood mitigation and urban cooling benefits (see Rec. 7A).
- C. Support community-developed programs and groups to enable social connectedness, resilience building and environmental action.

7. Planning and building regulation

Climate change and associated risks should be central to planning and building standards and decision-making at the local, state and federal levels to respond to current and anticipated future climate conditions and avoid potential risks generated by new development.

Due consideration at the planning and building stages will reduce the required resilience investment into the future. Recommended actions include:

- A. Implement the recommendations outlined in Climate Change & Planning in Victoria to increase the centrality of climate change in decision-making, thereby minimising climate risks and the impacts of new developments and responding to existing risks consistently.
- B. Set minimum Resilience Rating standards for new homes to complement the minimum energy efficiency ratings already in the National Construction Code (see Rec. 2C).
- C. Set minimum home energy efficiency and Resilience Rating standards for rental properties (see Recs. 2C and 4A).
- D. Adopt a national scheme requiring the mandatory disclosure of home energy efficiency and resilience ratings at properties' point of sale (see Rec. 2C).





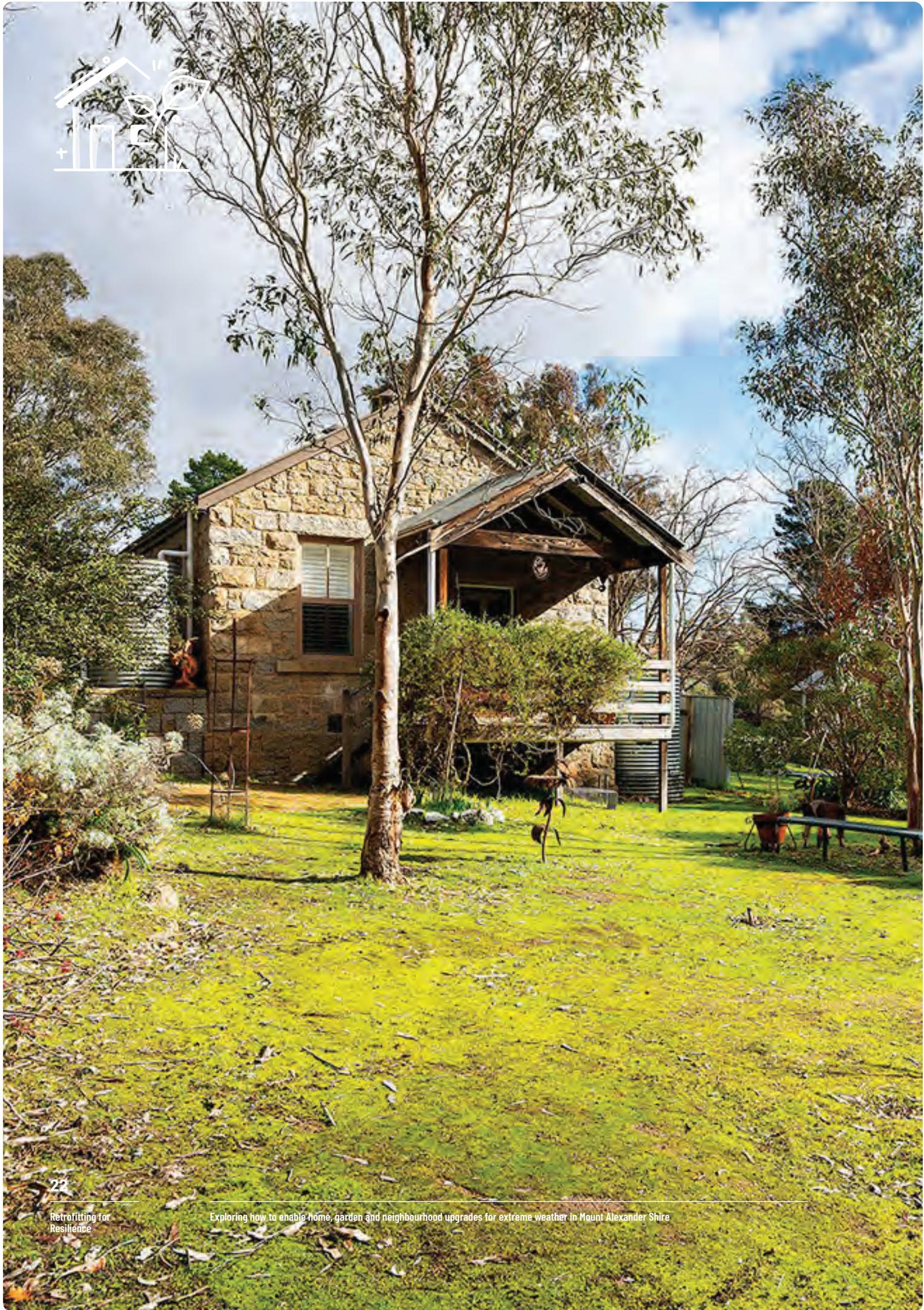
1. Background

Many Victorian households have experienced property damage and health impacts as a result of climate change-related extreme weather events, including bushfires, storms, floods, heat and cold, and most of these risks are expected to increase due to the worsening effects of climate change. Much of the state's housing stock is older and was not designed or constructed to withstand projected rising temperatures and more frequent and extreme weather events.

The finance, mortgage and insurance sectors are taking a greater interest in how households may be impacted by a changing climate, and what households are doing to increase their resilience and reduce the associated risks. The Climate Council recently released *Uninsurable Nation: Australia's Most Climate-Vulnerable Places*, which outlines the top 20 federal electorates most at risk to climate change-related extreme weather events. Seven of the 10 Local Government Areas (LGAs) in Victoria's Loddon Mallee region are in the top 20.¹

Similarly, household resilience is identified as a strategic policy priority across Victoria's seven system-based Adaptation Action Plans (AAPs) and six complementary community-led Regional Adaptation Strategies (RASs). Released in 2022, these plans and strategies collectively aim to build the state's resilience to climate-related hazards and reduce the risks and impacts for residents living in homes and on properties that are not suited to the current and projected future climate.^{2,3}

We need to improve the capability and capacity of communities to upgrade their homes, gardens and neighbourhoods for climate resilience. Significant opportunities exist to improve household safety and wellbeing by modifying existing homes and surrounding landscapes. By improving the resilience of their properties and neighbourhoods, residents will not only reduce the negative impacts of climate change on their health and wellbeing but also decrease carbon emissions and save money through reduced future property damage costs and lower household expenses associated with year-round heating and cooling. The co-benefits of housing upgrades to health, wellbeing and economic security are particularly important to populations facing systemic disadvantage.



2. Research purpose and approach

This project was undertaken to explore opportunities to increase the uptake of home retrofits to support adaptation to climate change and resilience in the face of extreme weather events.

2.1. Research objectives

This project had four key objectives:

PROJECT OBJECTIVES

1. Understand existing levels of community awareness about climate-related risks, household exposure and vulnerability, and potential adaptation measures at the household level.
2. Identify a suite of 'resilience retrofit' options for different housing types and situations.
3. Identify existing and hypothetical resources, services and incentives that could support households to retrofit their homes, with a focus on disproportionately impacted groups.
4. Explore community preferences and attitudes towards resilience retrofits, including the key drivers, enablers and barriers to uptake.

At the policy level, the project aimed to develop evidence-based recommendations for local and state government policy and programs which motivate and enable households to undertake resilience retrofits, responding to local climate risk profiles.

At the community level, the project aimed to work collaboratively with households and local organisations to generate and share knowledge and identify localised opportunities to support resilience retrofits. This work was informed by a recognition of the value of the research process itself.

2.2. Project design

Our research was designed with a place-based focus to generate benefits from both the new knowledge we produced and the activities undertaken in the course of the project.

2.2.1. Case study focus

We applied a case study approach to enable in-depth analysis of place-based climate risks and adaptation options and to understand the experiences of different households within a locality.

Mount Alexander Shire (the Shire), in Victoria's Loddon Mallee region, was the location for this research due to its characteristics as a medium-sized regional LGA with diverse socio-demographic segmentation, housing typologies and geographic features, and a mix of urban and rural postcodes (Figure 2).



FIGURE 2 – Mount Alexander Shire case study context

We engaged a cross-section of households in the Shire, with a focus on socio-demographic groups disproportionately impacted by climate change. We defined these cohorts as community members self-identifying as low-wealth, elderly, living with a disability (and their carers), Aboriginal or Torres Strait Islander, culturally and linguistically diverse (CALD) and/or renters. Project participants ultimately represented most but not all of these groups (see Appendix 4).

Adopting a place-based approach, we focused on extreme weather events identified by regional climate information and research participants as presenting high current or future risks in the Shire. These events included bushfire, flood, storms, heat and cold.

2.2.2. Research methods

We applied a range of research methods to address the project objectives, as summarised in Table 1. Data was collected and analysed between August 2022 and May 2023. Programs and evidence developed after this period were outside the scope of this research and are therefore not included in this report. We acknowledge, however, that this is a live space, and that new information is likely to be available by the time of publication.

Literature review	Collation of information on relevant policy; climate risks and awareness; and existing resources to support household and neighbourhood-scale retrofits, to inform understanding of the gaps in existing resources.
Desktop studies	Synthesis of secondary data on the Shire’s climate risk, housing typologies and socio-demographic profile, drawing on a range of data sources, most significantly: <i>Mount Alexander Shire Housing and Neighbourhood Character Strategy: Castlemaine, Campbells Creek and Chewton</i> – identifying the predominant building material in each residential street <i>Victorian Housing Stock Model</i> – profiling the number, age, floor areas and energy efficiency-related aspects of dwelling types by LGA <i>Community Engagement for Disaster Risk Reduction (CEDRR) Project</i> (University of Melbourne) – preliminary findings from a recent survey of 179 households in the Shire exploring attitudes towards risk
Key informant interviews	Semi-structured, qualitative interviews with representatives (n=29) from relevant local and state organisations (government, service providers, community groups, the property sector and others – see Appendix 3)
Household interviews	In-depth interviews with households in the Shire (n=14) to explore their experiences of extreme weather events and attitudes towards climate risks and resilience retrofit options at the household and neighbourhood levels (see Appendix 4)

TABLE 1 – Summary of research methods for the Retrofitting for Resilience project

2.2.3. Reference groups

Two reference groups guided and supported the research: a Policy Reference Group comprising state government policy experts and a Community Reference Group comprising local experts from community groups and organisations operating across the Shire. A full list of the members of both groups is included in Appendix 2.

The reference groups met at key points throughout the research process to share information with the research team and provide critical feedback on the research scope, questions, methods, findings and outputs. Both groups also contributed to the oversight of data quality and research ethics.

Members of both reference groups participated in key informant interviews and the Community Reference Group also assisted with the recruitment of household interview participants.

2.2.4. Housing Typologies and Retrofit Options Guide

To facilitate our interviews with households, we developed a guide on retrofit options relevant to the Shire’s housing and climate risk profile. *The Housing Typologies and Retrofit Options Guide* (the Guide, Figure 3) profiles the character and performance of different housing typologies found throughout the Shire, aligned to those in the Victorian Government’s Housing Stock Model. For each typology, the Guide describes the typical construction and associated risk profile in extreme weather events. It recommends how residents can improve the performance of their property in extreme weather, both generally and in relation to specific typologies. Retrofit actions are classified as ‘Preparation’, ‘Minimal’, ‘Medium’ and ‘Extensive’ based on their relative cost, ease and time to implement and whether they are likely to require a skilled tradesperson.

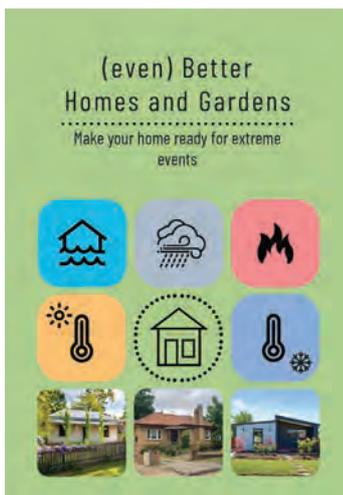


FIGURE 3 – Cover of the *Housing Typologies and Retrofit Options Guide* developed for this project

We identified similar guides in the literature review, but no existing resource sufficiently met our requirements for simplicity, inclusion of information about multiple types of extreme weather, and relevance to the local context. To fill these gaps, our goals for the Guide were to:

- profile relevant housing typologies and consider how extreme weather events may impact houses of different ages and construction types
- outline retrofit options both general and specific to a housing type, including options requiring different scales of investment based on the time, money and/or skills needed to undertake them
- be accessible and easy to follow for non-technical audiences
- include recommended actions available for renters to undertake based on the Residential Tenancies Act 1997 (Vic) and its more recent amendments.

The Guide was developed in consultation with the Community Reference Group and was reviewed by relevant organisations during the key informant interviews.

2.2.5. Retrofitting for resilience

Our research focused on resilience retrofits that respond to extreme weather events that are both currently impacting households and expected to be made worse by climate change (climate adaptation). In some cases, these upgrades overlap with actions to reduce emissions or increase energy efficiency (climate mitigation). We acknowledge the intersection of the adaptation and mitigation benefits of some home upgrades (Figure 4). Our recommendations therefore speak to the need for an integrated approach to whole-of-home retrofits that includes both adaptation and mitigation measures.

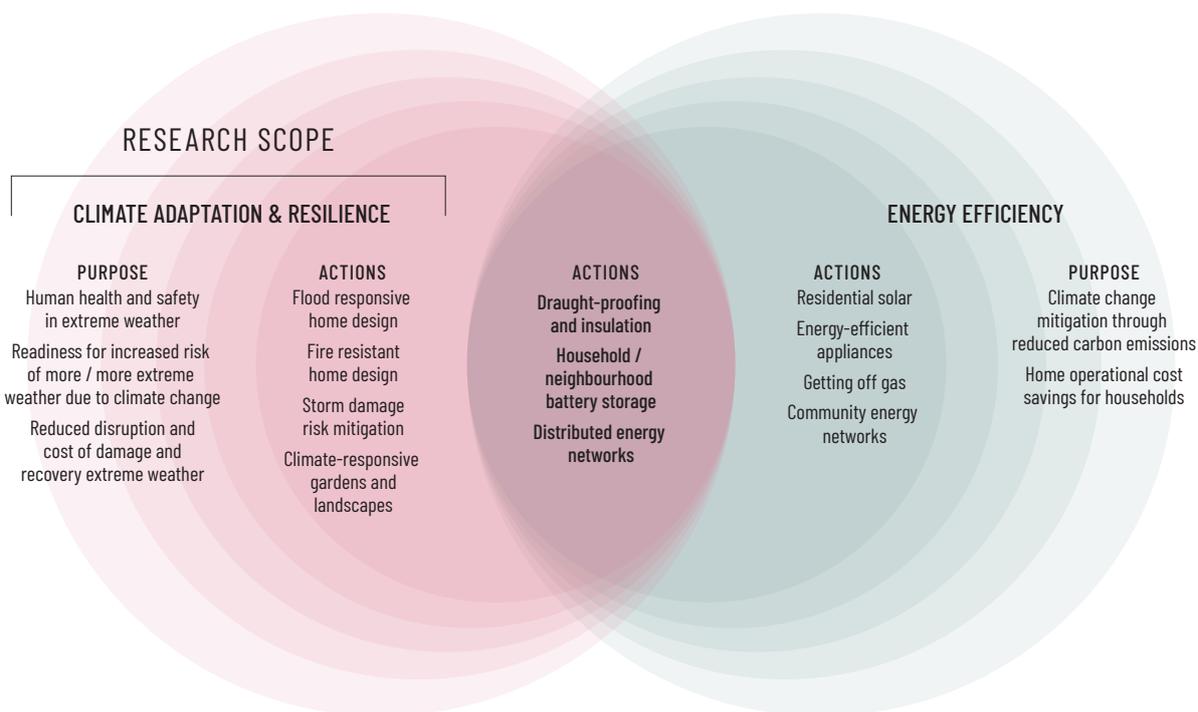
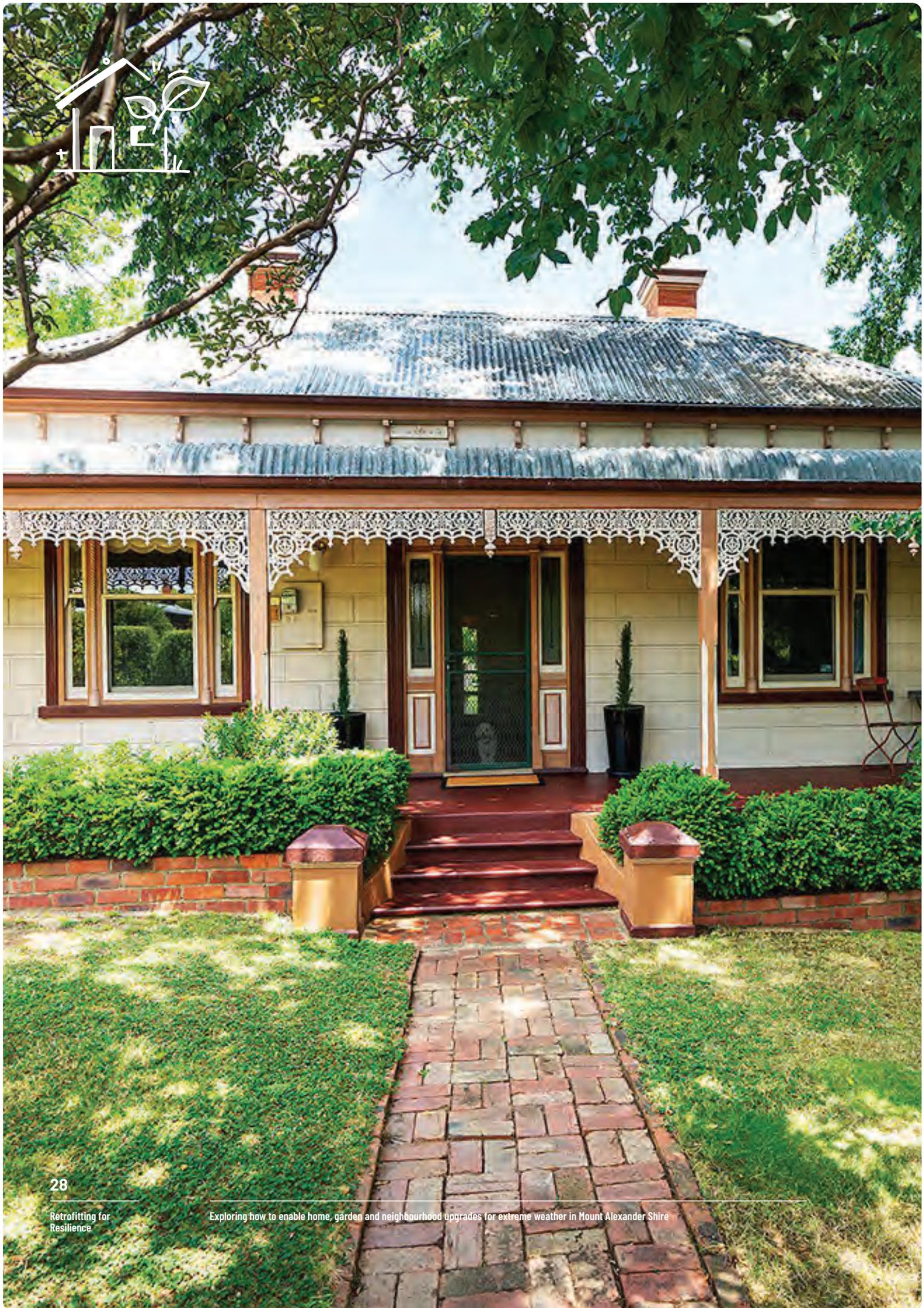


FIGURE 4 – Research scope for the *Retrofitting for resilience* project, focused on home retrofits for climate adaptation and resilience purposes



3. Climate risk and policy in Victoria

Climate change is already having significant effects on households in Victoria. Our housing stock is largely unprepared for events such as the 2022 floods and 2019–2020 bushfires, leaving households exposed and vulnerable to extreme weather. Moreover, community members facing systemic disadvantage are disproportionately impacted by these events due to the increased likelihood of their properties being affected and of prolonged disruption based on the cost and complexity of recovery. Policies at all levels of government are increasingly acknowledging the need for greater investment in climate adaptation and resilience, now and into the future.

3.1. Impacts of extreme weather in Victoria

Our research focused on the extreme weather events and climate risks identified by ADAPT Loddon Mallee and the Community Reference Group as most impacting this region, now and into the future.^{4,5} These are bushfire, flood, storms, heat and cold, all of which have had significant health, social, environmental and economic impacts in Victoria in recent years. Each is discussed in turn below.

Bushfire In Victoria, the 2019–2020 bushfires burned over 1.3 million hectares of land, destroyed close to 400 homes and resulted in five deaths. Total insurance loss from the fires was approximately \$184 million in Victoria – representing just 8% of Australia’s total loss. Across the state, economic losses from the fires have been estimated at \$2.1 billion over an 11-year period, not counting the \$250 million that the Victorian Government has provided to impacted communities for relief and recovery. These figures do not reflect the enormous social, environmental and health impacts of the fires, financial and otherwise, felt at the community and household levels.⁶

Flood The 2022 floods that occurred throughout Victoria damaged more than 35,000 homes across 63 LGAs and led to two deaths.⁷ The State Emergency Service (SES) received over 16,100 requests for assistance in a six-week period, including 3,049 in a 24-hour period in October.^{8,9}

It is difficult to quantify the total impact of the event at the time of writing, as many households have not returned to their homes and repairs to infrastructure are still underway.

Storms While the nature of the climate–storm relationship in non-tropical Australia is still not fully understood, storms present persistent challenges due to their frequency, tendency to impact larger urban areas and difficulty to predict.¹⁰ In June 2021, severe storms across 34 LGAs in Victoria left over 500 homes damaged or destroyed and over 300,000 homes and businesses without power. More than \$200 million (from both state and federal sources) has been dedicated to recovery from these storms, the impacts of which were still being felt over a year after the event.¹¹

Heat and cold Least visible but most pernicious, heatwaves take a significant toll on human health, particularly among older people or those with chronic health challenges. In 2009, 374 deaths in Victoria were attributed to the heatwave that preceded the Black Saturday bushfires, far exceeding the 173 deaths from the fires themselves. Heatwaves place strain on health systems and are consistently the greatest cause of death among all extreme weather event types.¹² Cold was also included in the scope of this project because of the Shire’s current temperature ranges. The World Health Organization has identified a link between cold indoor temperatures and poor health, even in moderate climates, and the types of actions that households can take to respond to heat and cold are often similar.¹³

The multiple costs of climate change will only continue to rise, even under a low-emissions scenario (Figure 5), making a response to these challenges increasingly urgent.

Projected economic costs and the components of costs to 2060, under low-emissions scenario by type of natural disaster

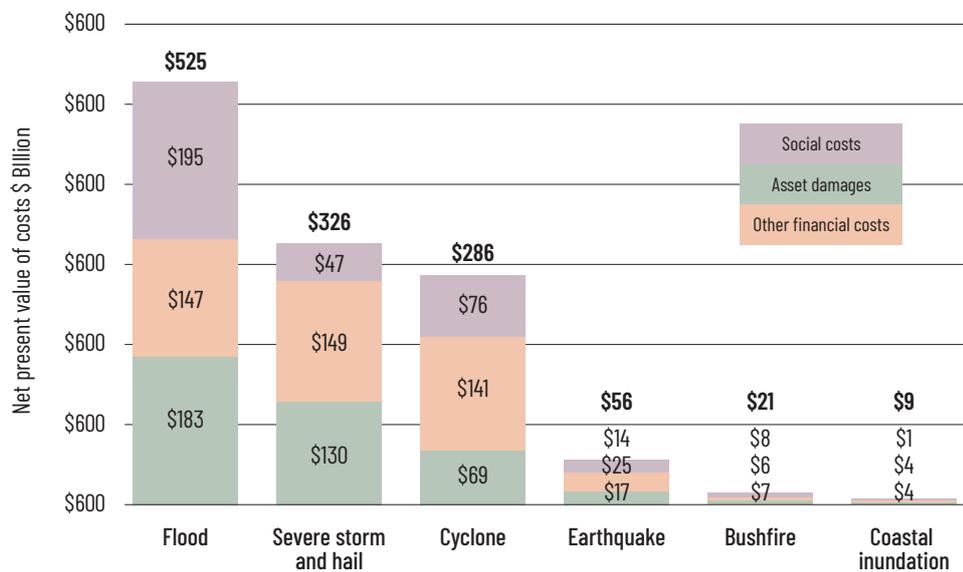


FIGURE 5 – Projected economic costs and the components of costs to 2060, under low-emissions scenario by type of natural disaster (\$billion in present value)¹⁴

3.2. Victoria's housing stock

The current and projected impacts of climate change will be significant for many Victorian households as a result of the age and unsuitability of much of the state's housing stock. On average, homes in Victoria are of poor quality and are unprepared for the extreme weather they will continue to face with increased severity and frequency. In the summary report of its Victorian Healthy Homes research, Sustainability Victoria identified that, as of the 2016 census, 65.4% of Class 1 dwellings^a in Victoria were rated at 2 stars or below according to the Nationwide House Energy Rating Scheme (NatHERS),^b with 1,367,766 homes considered substandard.¹⁵ Approximately 60% of detached and semi-detached dwellings were constructed prior to the introduction of insulation regulations in 1991.¹⁶ These homes are poorly insulated, leaky, inefficient, and expensive to heat and cool – if they even have mechanical heating and cooling systems.

Housing construction standards improved following a change to construction codes in 1996, but even homes built since then are only required to meet the minimum provisions set out in the National Construction Code (NCC): Victorian homes were subject to a 4-star energy efficiency rating as of 2004–2005, increasing progressively to 6 stars by 2011 and 7 stars in 2022.^{c 17, 18, 19} While the NCC is regularly amended to address the impacts of extreme events such as fire, flood or cyclone, it applies predominantly to new buildings and therefore has not led to improvements to the state's ageing housing stock. Older homes (built prior to 2005) are more likely to have poor thermal comfort, inadequate fixings, gaps and thin glazing, making them more vulnerable to extreme weather. Studies have also shown that even in new homes, poor construction quality leads to ongoing discomfort in extreme temperatures due to draughts, even when insulation and double glazing are used. This can also lead to poor internal air quality in the case of bushfires.²⁰

At a larger scale, planning controls still enable new development to occur in high-risk areas, such as flood zones. In many LGAs, flood maps are out-of-date, and where they are being updated, they are often largely reflective of historical data rather than future climate projections. Mapping approaches and associated policies across LGAs are inconsistent, contributing to different approaches to decision-making about development. In addition, agreeing on the respective roles of local and state governments in managing climate risks has been a source of contention, particularly in the aftermath of the 2022 Victorian floods.^{21, 22, 23} While new development is largely outside the scope of this project, we note the ongoing impacts of these issues on households.

A recent comprehensive review of the planning system's approach to climate change, *Climate Change & Planning in Victoria*, commissioned by the Victorian Greenhouse Alliances and the Council Alliance for a Sustainable Built Environment (CASBE), highlights that day-to-day planning decisions in Victoria often conflict with long-term state government goals for climate change action. The report makes clear that the complexity of the planning system,

a – Single, stand-alone houses and houses attached horizontally, such as townhouses and row houses.

b – The NatHERS assesses homes for energy efficiency, including comfort and cost to run, on a scale of 0–10.

c – Building regulations on energy efficiency and thermal comfort have gradually improved over time:

1980s – regulation requiring wall vents removed

1991–2003 – walls and ceilings required to be insulated and any open fireplaces fitted with a damper to stop unwanted air leakage when not in use

2004–2005 – first minimum performance standards introduced in Victoria, a minimum 4-star rating requirement

the influence of multiple actors (including the development sector) and the unclear language in state and local government Planning Schemes are resulting in development outcomes that are putting communities at risk, now and into the future. The report's 41 recommendations for substantial change to the planning system can be divided into the following three categories:

- recognising the fundamental role the planning scheme plays in guiding decision-makers, and its weight as statutory law
- ensuring that the scheme and its application of controls is consistent with the scientific evidence base and best practice
- focusing on changes that will assist in getting the fundamentals of future development areas right.²⁴

These conditions, combined with the scale and frequency of disasters, have led the insurance sector to decrease its risk tolerance, with many insurers making blanket decisions about raising rates or limiting insurance availability across entire suburbs, regardless of flooding history or the characteristics of individual properties.²⁵ Households increasingly face unaffordable insurance premiums or are unable to secure insurance at all, thereby limiting their ability to obtain a mortgage. The Climate Council's Climate Valuation tool indicates that in LGAs such as Shepparton and Wangaratta, well over half of all properties will be classified as 'high risk' by 2030, raising questions about whether these properties will be deemed uninsurable in the near term.^{26, 27}

2006-2010 - minimum performance standards upgraded to 5-star requirement; this included a transition period for timber-floored housing to move from the 4-star standard to the 5-star standard
2011-2022 - minimum 6-star performance standard
2022 onwards - minimum 7-star performance standard

3.3. Disproportionate impacts of extreme weather

Extreme weather events and their effects on health and household finances disproportionately impact people who are already facing systemic disadvantage. These include low-income or low-wealth households, older people, people with a disability, Aboriginal and Torres Strait Islander communities, CALD communities and renters.

Low-income households' inability to maintain thermal comfort is often cited as an example of this.²⁸ In a recent study by the Australian Council of Social Service (ACOSS), nearly 90% of Centrelink payment recipients surveyed sometimes or always felt unwell in high heat. While almost 70% of participants had air-conditioning, many noted that their system worked poorly or that inadequate insulation rendered it ineffective, and nearly all reported that the high cost of electricity deterred them from using it. Over 70% of participants lived in private rentals or public or social housing, limiting their ability to make substantial changes to their homes themselves.²⁹

Some thermal comfort requirements for rental properties have been introduced through recent changes to the Residential Tenancies Act, including the provision of a fixed, efficient heater. Minimum standards for insulation are also under discussion, but more extensive resilience-based requirements do not exist.³⁰

In addition, studies have shown that flood and fire disproportionately impact some segments of the population. For example, studies of older people in bushfires note higher levels of mental distress, worse among those with poor social connections and support, due to fear and feelings of helplessness.³¹ Following the 2017 Northern Rivers floods, people with a disability and their carers were found to be twice as likely to experience flooding in their homes (due to the relative affordability of houses in higher-risk locations) and four times as likely to be displaced, with significant impacts on mental health including post-traumatic stress disorder.³² Recent research also links housing insecurity with higher levels of trauma and mental distress following disasters: renters in particular face a high risk of forced relocation due to tenure uncertainty, tight rental markets and limited eligibility for disaster recovery resources, which usually target homeowners.³³

Recognising these severe effects, particularly on low-income households, organisations such as the Victorian Council of Social Service (VCOSS) and the Brotherhood of St. Laurence are calling on the government and working with community groups to support an equitable approach to climate action.^{34, 35} Similarly, Future Earth Australia released *A National Strategy for Just Adaptation*, identifying five building blocks that address systemic disadvantage in relation to climate action:

- practising recognition of all people and their knowledge
- fostering inclusion of marginalised communities
- addressing ongoing injustices
- overcoming barriers and acknowledging limits
- transforming for just adaptation.³⁶

In summary, Victoria's housing stock is not prepared for future – or even current – extreme weather events resulting from climate change, and those who are least equipped to prepare themselves are most impacted physically, mentally and financially by these events. Social service advocates are calling for action from all sectors and levels of government to address these critical challenges.

3.4. Climate adaptation and disaster risk reduction policy landscape

Climate change adaptation and resilience increasingly feature in Victorian State Government policy. The *Climate Change Act 2017* (Vic) called for the development of AAPs across key systems; seven of these, including the *Built Environment Adaptation Action Plan 2022–2026* (BEAAP), were released in 2022. *Plan Melbourne 2017–2050* also includes goals to adapt to climate change to reduce the risk and impact of natural disasters.³⁷

The BEAAP notes the cumulative effects of climate change and identifies that these “often have a complex interplay with other issues, such as social vulnerability”.³⁸ It acknowledges the importance of incorporating adaptation into planning and management to reduce the need for retrofits and upgrades in the future but also suggests that:

*“Individual community members are key participants in adaptation. They have a big impact on it, and will be affected by climate change and adaptation actions. Individual leadership and community engagement are critical to support activities and programs, in order to manage risk and achieve adaptation. This will rely on effective communication and the provision of information.”*³⁹

The key actions outlined in the BEAAP include reviews of planning and building regulations, building retrofits, extended hazard modelling, and capacity and skills building for industry and communities.

The Victorian emergency services sector is also increasingly incorporating community resilience building into its remit. The Victorian SES’s *VICSES Community Resilience Strategy Renewal 2019–22* includes a strategic objective on “Reducing Disaster Impacts”, with a long-term measure on reducing the number of homes damaged by extreme weather events. The strategy anticipates that systemic change to reduce disaster impacts will take time but identifies opportunities for behaviour change to support community and household action beyond immediate pre-event preparedness.⁴⁰

These state-level strategies are reinforced by growing national investment in disaster risk reduction. Evidence from the Insurance Council of Australia and others informed the launch of the Disaster Ready Fund, which will invest up to \$1 billion over five years into disaster risk reduction, starting in the 2023–2024 financial year. This investment is underpinned by the *National Disaster Risk Reduction Framework*, which was collaboratively developed by all levels of government and private sector representatives in 2018.^{41, 42} In Victoria, the Early Intervention Investment Framework (EIIF) provides a platform suitable for proactive investment in resilience-building, but it has not yet been applied to home retrofits (see Case Study 1).⁴³

Victoria's Early Intervention Investment Framework (EIIF)

Funding to improve social outcomes by addressing root causes

The EIIF funds programs and services that support preventative measures to improve societal outcomes and reduce government expenditure over the long term. While it has not been used to fund resilience retrofit activities to date, such activities are strongly aligned with the EIIF's objectives.

The EIIF developed by the Victorian Department of Treasury and Finance (DTF) is a budgeting tool designed to guide investments in early interventions that improve the lives of Victorians and deliver better outcomes across the service system.¹⁴¹ The DTF works with service delivery departments to identify early interventions that will pay for themselves over time with costs avoided in other government services.

The EIIF links government funding to quantifiable impacts for both the people using the services and the service system, and guides investments to where timely assistance will improve life outcomes and reduce the pressure on acute services.



This quarantined budget pool has been embedded in Victoria's annual state budget process since 2021-22 and has provided a total of \$828 million in funding to early intervention initiatives targeting various cohorts, such as people experiencing homelessness, families at risk of child protection involvement, disengaged young people, and people living with mental illness or chronic health conditions. The DTF estimates that these investments will generate benefits worth around \$500 million over the coming decade from improved outcomes for individuals and reduced use of acute services. These savings will be reinvested in future EIIF initiatives that improve outcomes for Victorians.¹⁴²

The EIIF is based on a rigorous evidence base and a collaborative approach that involves multiple departments, agencies, service providers and stakeholders. It seeks to measure the impact of early interventions through outcomes and avoided costs, and to re-balance the system towards earlier intervention over time.¹⁴³

Initiatives supporting home retrofits for resilience, energy efficiency and health and safety are ideal candidates for support through the EIIF. Such initiatives align with the EIIF principles of targeting disadvantaged cohorts, addressing the root causes of problems, delivering long-term benefits, and leveraging existing programs and platforms. They are also consistent with the Victorian Government's commitments to climate action and social justice.

Cost-benefit estimates for climate resilience retrofits vary between 1:4 and 1:11. Many of these benefits take the form of reduced government expenditure. Climate resilience retrofits can improve the lives of Victorians by enhancing their comfort, health, safety and wellbeing, as well as reducing their energy bills and emissions. They can also deliver better outcomes across the service system by reducing the demand for and cost of acute and crisis services, such as emergency response, health care, social welfare and infrastructure repair.

dtf.vic.gov.au/funds-programs-and-policies/early-intervention-investment-framework

Image source: Parliament of Victoria, Melbourne. iStock

At a regional scale, the *Loddon Mallee Climate Ready Plan* applies a climate justice lens and place-based approach to defining locally relevant actions. Developed through extensive community engagement, the Climate Ready Plan emphasises the needs of those disproportionately impacted by climate change.⁴⁴

More locally, DJAARA (the Dja Dja Wurrung Clans Aboriginal Corporation, which undertakes land management activities on Country in the Shire) released its first climate strategy in May 2023, *Dja Dja Wurrung Climate Change Strategy: Turning 'wrong way' climate, 'right way'*. The strategy places climate action in the context of the Dja Dja Wurrung Recognition and Settlement Agreement (RSA), giving legal weight to the need to care for the environment “for the benefit of future generations” and identifying the ways in which extreme weather events “affect dja dja wurrung’s ability to heal Country, practice culture and achieve our aspirations as laid out in the Country Plan, enact our rights in the RSA and manage the six parks and reserves DJAARA jointly manages with the State”.⁴⁵

Finally, Mount Alexander Shire Council’s *Climate Change Strategy*, adopted in mid-2023, will contribute to achieving Council’s 2021–2031 Community Vision. While much of the strategy necessarily focuses on Council’s own operations and oversight of the public realm, Goal 5 – “Our community is connected and has the capacity to adapt to climate change” – involves direct engagement with households on climate action, particularly those most at risk of being impacted by climate change.⁴⁶

Collectively, these policies and strategies point to the need for and value of effective, coordinated programs at the national, state, regional and local levels to invest in infrastructure and support households to prepare their homes for extreme weather in its multiple forms.

4. Home, garden and neighbourhood retrofit options

There are significant opportunities to improve the resilience of existing homes and gardens and surrounding landscapes at a neighbourhood scale. Improving the resilience of houses and landscapes can reduce the negative impacts of climate change on residents' safety, health and wellbeing and allow households to save money through reduced future property damage costs and reduced operational expenses from greater energy efficiency.

Approaches to property- and neighbourhood-scale resilience retrofits are summarised below; key actions are further specified in the *Housing Typologies and Retrofit Options Guide*. The actions identified draw on the range of resources reviewed in the project literature review (Appendix 1).

4.1. Household-level building retrofit options

Retrofits that focus on improving the exterior of the building can increase the resilience of existing housing stock.

Sealing exterior gaps, securing exterior cladding and roofing, improving window frames and glazing, and draught sealing and insulating can improve the general performance of a home in the face of multiple extreme weather events, including storms/extreme rainfall, fire, flood and extreme temperatures. By strengthening the shell of the building, many of these actions can provide multiple benefits, including increased energy efficiency. Priority actions for households are typically based on the home's context and characteristics.

Specific options to avoid flood waters entering a home include raising the building above the flood level, installing flood barriers and improving drainage. Where it is impossible or less feasible to avoid inundation, homes can be retrofitted with resilient internal finishes and raised services, appliances and cabinetry to minimise damage from water entering.^{47, 48}

The Victorian planning scheme does not require existing housing stock to be upgraded to meet Bushfire Attack Level (BAL) ratings unless a substantial renovation is proposed. But existing homes in bushfire-prone and bushfire management areas would benefit from retrofits such as gutter and valley guards, enclosed or steel mesh screens on subfloors, steel mesh screens on windows and doors, and external gap sealing with fire-rated sealant.⁴⁹

4.2. Landscapes and gardens

Gardens can be designed to improve resilience to extreme heat, flooding and bushfire. Homeowners can adapt their green spaces to climate change by carefully selecting plant species that are suited to local growing conditions, including species that are less vulnerable to future climatic conditions (such as decreased rainfall and increased average temperatures).⁵⁰ Households can also improve the growing conditions for plants to increase their health and therefore their resilience and resistance to adverse climate conditions.

Planting gardens and increasing tree cover bring cooling benefits by providing shade and transpiration. While some resources suggest minimising plantings to reduce fire risk, this approach discounts the value of greening for human wellbeing and biodiversity conservation. Fire risk from plantings can be reduced by maintaining the greenness of vegetation through irrigation, planting trees and shrubs in discrete patches with consideration of the direction of likely fire, vertically separating vegetation layers, and managing mulch and hedges to reduce flammability.⁵¹ Gardens with more permeable surfaces can better absorb rainfall; paired with rainwater harvesting systems, this improves the resilience of the property and slows the release of stormwater into public infrastructure (thereby reducing the risk of downstream flooding) in the case of extreme rainfall events.

4.3. Neighbourhood-scale interventions

Interventions at the neighbourhood scale can mitigate the risks posed by extreme weather events such as extreme heat, floods and storms.

Considered placement of street trees of suitable species delivers cooling benefits for human thermal comfort. Managing street trees in unison with urban water management ensures that trees are well watered through passive or active irrigation, via water-sensitive urban design and/or the provision of alternative water sources.⁵²

‘Green-blue infrastructure’ refers to the use of natural features such as vegetation, soils and natural processes in an urban environment to simultaneously deliver landscape management and water management benefits, including reduction in the scale of flooding and in the incidence of flash flooding. Research suggests that intensive application of green infrastructure can substantially reduce flood depth and velocity in a catchment; residual risk remains, however, particularly during storm and flood events.⁵³

As a result, particularly in heavy rainfall, allowing water to temporarily pond in the landscape by increasing permeability, directing stormwater into vegetated areas and integrating sunken areas into the landscape will enhance water quality and reduce the pressure on drains and stormwater infrastructure.⁵⁴ The example of Little Stringybark Creek (see Case Study 2) highlights how a networked approach to green-blue infrastructure can provide benefits in relation to water quality and flood management.

Little Stringybark Creek

A networked, neighbourhood-scale approach to waterway management

The Little Stringybark Creek Project demonstrated neighbourhood-scale environmental action across public and private land using market-based financial incentives and direct investment. It was designed to improve water quality, but similar approaches could be applied to neighbourhood-scale adaptation and resilience projects.

The Little Stringybark Creek Project tested whether catchment-scale stormwater retention could restore hydrology, water quality and ecological structure and function to a degraded urban stream.

The project was run through the Co-operative Research Centre for Freshwater Ecology and partly funded by Melbourne Water. It studied 16 independent catchments located east of Melbourne and found that conventionally piped stormwater drainage systems are the primary source of degradation of waterways in urban catchments.

The project generated a quantitative model of instream ecological response to 'effective imperviousness', which refers to the proportion of a catchment covered by impervious surfaces with direct, piped connection to the stream. This model suggested that connected, impervious areas should be kept as far below 2% as possible to avoid degradation from urban runoff.

The project ran from 2008 to 2017 and tested interventions at a neighbourhood scale. Stormwater control measures included water sensitive urban design installations on 243 private properties, 17 larger-scale stormwater treatment measures and two filters on private and public land, and 49 raingardens or infiltration chambers on nature strips. The combination of household- and streetscape-scale works improved the quality of stormwater entering the creek by treating, harvesting and infiltrating stormwater into the ground at each scale.

The project resulted in an improvement to the water quality of Little Stringybark Creek and has informed new approaches to the management of stormwater, urban water and streams and a re-evaluation of the costs and benefits of stormwater retention and harvesting. The work also guided knowledge exchange among state government departments, local government and water authorities.

In addition to enhancing the management of water quality, water harvesting and water-sensitive urban design systems, such as those tested through the Little Stringybark Creek Project, the project reduced runoff and peak flows from urban developments, increased local retention times and minimised impervious areas to control the flow of stormwater, and decreased inundation during extreme weather events.¹⁴⁴

urbanstreams.net

Tanks for the petrol station

With support from the Little Stringybark Creek Project, Mount Evelyn Fast Fuel will soon install a stormwater harvesting system that will supply water to its car wash.

Stormwater will be collected from all sealed surfaces on the property and directed to rainwater tanks totaling 140,000L. The harvested water will then be treated to a high standard by a combination of filtration and UV exposure.

It is expected that the treated stormwater will supply 75% of the water used in the car wash, around 1,300,000L a year.

This not only helps save water, but greatly benefits Little Stringybark Creek, as this 1.3 Ml of water will no longer barrel its way into the creek, causing erosion and destroying biodiversity.

Some of the collected water will also be left to slowly trickle to the creek. This flow, which will be filtered, is designed to provide a natural baseflow to the Little Stringybark Creek, helping provide habitat for frogs and fish during dry periods.

www.urbanstreams.unimelb.edu.au

A research project working to restore the health of Little Stringybark Creek (Mount Evelyn) through the capture, use and treatment of stormwater.

- > 144 participating properties
- > 6 ha of roof & road treated
- > 19.7 million litres of stormwater harvested each year
- > 213 tanks installed (with total volume of over 1.5 million litres)
- > 3 'neighbourhood' raingardens built

Logos for: DEPARTMENT OF WATER RESOURCES, MELBOURNE WATER, VICTORIA, and CRMP.

Image source: urbanstreams.net



5. Current retrofit resources for households and neighbourhoods

Building resilience to extreme weather has traditionally focused on large infrastructure projects or, at a community scale, disaster preparedness. More recently, community resilience building has extended to include strengthening social connection to ensure that people can support one another when disasters occur. As the Australian Institute for Disaster Resilience states,

“People and communities need tools, ability, and knowledge beyond traditional emergency management to resist, absorb, accommodate, recover, transform, and thrive in response to the effects of shocks and stresses.”⁵⁵

Retrofitting or upgrading homes to better withstand the effects of extreme weather is gaining visibility as an aspect of community resilience building, particularly after the Black Saturday bushfires and the 2022 floods across the east coast of Australia. Most resources designed to encourage home retrofits, however, focus on climate change mitigation through homeowner actions that boost energy and water efficiency, with the combined goals of reducing carbon emissions and water use, lowering household utility bills and improving thermal comfort and health. These types of retrofits are designed to minimise the impacts of extreme temperatures and may offer indirect resilience benefits in relation to other types of disasters.

The following sections provide an overview of the types of existing resources that support home retrofits, with data on their impact noted where available; the overall strengths of and gaps in these resources are considered in the analysis section of this report.

Each resource focuses on one or more steps in the retrofitting ‘journey’, which begins with awareness raising and moves through to assessment and then action. A complete annotated list of the resources we reviewed – including guidance and information, programs, services and financial incentives – is presented in Appendix 1.

5.1. Guidance and information

Accessing information about why and how to retrofit homes for climate resilience is a foundational first step in the retrofitting journey and such information is broadly available, largely through government sources.

Awareness raising

General guides on resilience retrofits have been published by the Commonwealth,⁵⁶ state⁵⁷ and local⁵⁸ governments. In Victoria, a guide initially developed by a group of Gippsland councils in collaboration with the Victorian State Government has been replicated for use in the Loddon Campaspe region, hosted online by the City of Greater Bendigo.⁵⁹ Other organisations have developed guides focused on specific disasters, such as Melbourne Water's *Flood Resilient Guide to Retrofitting Your Home*⁶⁰ and Beyond Zero Emissions' *Cooling Your Home: Home Retrofits, Appliances and Adaptions for a Hotter Future*.⁶¹

Collectively, these guides provide a wealth of information about household-level actions, often leading with the economic rationale for homeowner investment in resilience retrofits. Most tend to focus on one aspect of retrofitting (such as energy efficiency or resilience/climate adaptation) rather than taking an integrated approach; and only a subset of the guides reviewed address options available to renters, and these options are limited in scope.

Assessment

Some print and online guides extend beyond sharing information and include checklists or self-assessment tools for households, such as the Queensland Government's *Climate Change Risk Management Tool for Queensland Households*.⁶²

Locally, Maldon Neighbourhood Centre's publication *Climate Ready Maldon* provides guidance on how to self-assess homes for thermal comfort, including action plans with specific responses to common household-level challenges. The information and self-assessment guide have been complemented by a podcast on climate action.⁶³

The most developed assessment tool is the Bushfire Resilience Rating Home Assessment developed by the Resilient Building Council (RBC), which is due for release in the second half of 2023. The app's focus is on bushfire, but its capabilities will be extended over time to include multiple hazards. The tool is based on a methodology initially developed for professional assessors. It not only enables users to understand the risk profile of their home based on its location and characteristics but also produces a Resilience Rating and a list of actions for households to consider taking, including a short list of priority actions that would have the greatest benefit. The purpose of the Resilience Rating is to provide a standardised and trusted means of measurement, complementary to what the Residential Efficiency Scorecard provides for home energy efficiency. The RBC's goal is for this rating to inform insurance assessments and generate financial incentives for resilience retrofits to be undertaken.⁶⁴

Action

The RBC app is envisioned as a one-stop shop where users can access information about how to undertake resilience retrofits once they have identified priority actions.⁶⁵ Until this consolidated source of knowledge is developed and localised, however, limited information exists to connect households with local service providers and tradespeople who are qualified to undertake retrofit work.

5.2. Programs and services

Programs and services, including trades, that are specifically focused on supporting households to navigate the resilience retrofitting journey (sometimes inclusive of financial incentives, but not always) are limited. Lessons can be drawn, however, from emergency management, energy efficiency and biodiversity programs and services to inform resilience retrofit work.

Awareness raising

Resilience features prominently in emergency management community engagement programs, such as the Victorian SES's *Community Safety Program for Flood* and the Emergency Expo delivered in 2021 and 2022 by the Shire and multiple services. However, these initiatives are designed to focus on pre-disaster preparedness rather than overall risk reduction to households.⁶⁶

Multiple energy efficiency programs in Victoria have included awareness-raising components. Under the banner of the national Low Income Energy Efficiency Program (LIEEP), GV Community Energy conducted workshops targeting low-income households not typically engaged with energy-saving activities. These sessions were found to be cost-effective and a useful means of sharing information, and effectively changed participants' beliefs and attitudes towards energy-saving activities and behaviours. They were less likely than household-specific assessments, however, to prompt participants to make significant changes to their homes.⁶⁷

EcoMaster, based in Melbourne, provides an extensive library of video resources and masterclasses as entry points to accessing more personalised services and identifying suitable products to purchase.⁶⁸ Locally, the Mount Alexander Sustainability Group (MASG) and West End Resilience Energy Group (WEREG) have held an expo and workshops, respectively, for residents to learn about energy efficiency, including simple actions that households can undertake themselves, such as draught proofing. Workshops delivered by WEREG have been more positively received when information delivered was not overly technical. Workshop and expo participants also reflected positively on being able to see examples of materials and engage in discussions directly with tradespeople about options specific to their homes.^{69, 70} The Castlemaine 500 project (Case Study 3), run in 2006, found that workshops generated a strong 'community of practice' and built capacity in relation to actions to reduce household energy use.⁷¹

Assessment

GV Community Energy's LIEEP program identified that household assessments were more effective than general workshops for prompting participants to take direct action and make changes to their homes that would increase energy performance and comfort. The personalised, contextualised recommendations provided through household assessments both increased energy literacy relevant to individual circumstances and encouraged permanent changes to homes.⁷²

Services or programs that assess home resilience are limited, in contrast with the level of government support for assessors to provide in-person, tailored Residential Efficiency Scorecard ratings.⁷³ Bushfire consultants can provide expertise in assessing a property's BAL, but this work is single-risk and most often undertaken prior to obtaining planning or building permits for new construction.⁷⁴ The RBC is continuing to expand its training of professional

Castlemaine 500

A place-based approach to building capacity for home energy upgrades

The Castlemaine 500 project is an example of a place-based model for community-wide capacity building supported by a network of local volunteers and suppliers. While this project specifically aimed to motivate and enable households to increase energy efficiency and reduce energy consumption, similar place-based approaches are applicable to engaging households and building capacity for resilience retrofits.

Castlemaine 500 sought to tackle climate change through a community-based behaviour change model supporting households to reduce their energy use by 15–30%. Over two years from 2006 to 2008, the Central Victorian Greenhouse Alliance partnered with Third Ecology to run the project, enlisting the MASG to train Home Energy Assessors. The project was designed to build the capacity of the local community to take over the work while developing a model that could be replicated in other locations.

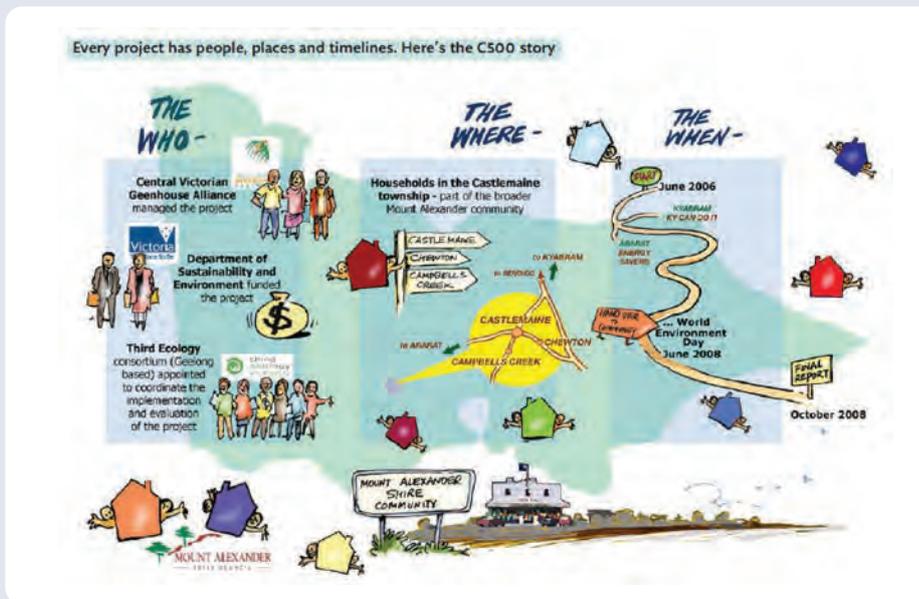
The project worked from an assumption that if households had an action plan in place, their likelihood of achieving goals for reduced energy use would increase. Households self-assessed their energy consumption behaviours using a Home Energy Assessment Tool. Energy smart actions were then outlined

for each participating household and completion dates were set for these actions in a Home Energy Action Plan.

The program invited every household in Castlemaine to participate. A group of local volunteers formed a Community Leadership program to contribute to the project goals and train peers to become household energy assessors. Partnerships were formed with energy providers to obtain household energy data and offer energy-saving products to participants. The

program tapped into existing networks and created a social network map, with local groups, organisations and businesses available to support households to reduce their energy consumption.

Castlemaine 500 educated over 300 households, reduced household emissions by approximately 15% from lower gas use and 8% from lower electricity use. The project amplified the conversation about climate change and motivated the community towards climate action through a series of events, workshops and home visits. It developed community skills around energy efficiency, with leaders and partners going on to run projects and lead further community initiatives on sustainability and housing affordability.¹⁴⁵



assessors based on its methodology for resilience assessments, to both extend the range of hazards included and incorporate the Scorecard tool to produce a more holistic assessment and rating.⁷⁵

The Torrens Resilience Institute developed a Community Disaster Resilience Scorecard Tool, which was rolled out through community groups and service providers who could conduct household assessments with community members facing disadvantage, such as older people or people with a disability. This initiative took a systems-based, multi-hazard view of risk but focused primarily on behavioural responses rather than retrofits to homes.⁷⁶

Action

Multiple energy efficiency programs within and beyond Victoria have found that effectively supporting action in home retrofits is dependent on several factors, including the availability of tradespeople and direct support to households to project-manage retrofit work. In the case of GV Community Energy's and Sustainability Victoria's work with low-income households, direct project management support provided an end-to-end service to ensure that retrofit work was completed.^{77,78} Other programs in Victoria funded retrofits for low-wealth households to increase energy efficiency and thermal comfort. Sustainability Victoria's Victorian Healthy Homes Program retrofitted the homes of 1,000 low-income households over three years, reporting that work costing an average of less than \$3,000 per home resulted in meaningful increases in comfort and health for residents.⁷⁹ Currently, Homes Victoria is investing \$112 million in the Energy Efficiency in Social Housing Program to retrofit 35,000 public, community and Aboriginal housing units.⁸⁰

To assist with building a market for retrofits, Retrofitworks in the United Kingdom offers an example of a service that connects households to tradespeople and manages retrofit projects directly. The cooperative model focuses on local tradespeople and collaboration with community-based organisations.⁸¹

To enable people to continue living independently in their own homes, the Australian Government, Department of Veterans' Affairs (DVA) supports home modifications through the Rehabilitation Appliances Program;⁸² the Australian Government similarly supports older households through My Aged Care Home Care Packages.⁸³ Some of the services provided through these programs, such as gutter cleaning, can reduce the risk posed by extreme weather events, but most program inclusions focus on self-care and in-home safety and mobility.

Housing for Health (see Case Study 4) is another service model designed to improve health outcomes through basic improvements to homes. It began in regional Aboriginal communities and applies community engagement and education elements to upgrade homes for health and safety. The program currently focuses on public health measures that generally do not extend to resilience retrofit-type actions.⁸⁴

Housing for Health

A community-based model for home upgrades to improve health outcomes

The Housing for Health model can be used as a blueprint for upskilling local community members to deliver place-based, whole-of-home retrofits in diverse communities.

The Housing for Health model focuses on improving public health by making sure that homes have the 'health hardware' required to keep occupants healthy. Established in 1988, with an initial focus on remote Aboriginal communities, the program is run by Health Habitat. Project teams work with local communities and skilled tradespeople to survey and fix thousands of homes across Australia.

Housing for Health projects follow a seven-stage methodology to give projects every chance of success. The foundations for a project include local community discussion and agreement to commit to the model, the employment of local Indigenous staff, and funding and local tradespeople ready to complete urgent work from the start of the project. A high level of engagement, project planning, team development and the commitment of resources builds community trust.

Housing for Health: The Guide has been developed to share the knowledge, data and tools developed through the program to improve health outcomes for households. The guide can be used for anyone who works or studies in the areas of health, housing construction or management, community development, government or manufacturing.



The Housing for Health program is a community model that works at a national scale. The program prioritises local involvement to build trust and embed knowledge and skills in local communities, leaving a legacy that results in ongoing improvements to housing conditions. The program communicates about complex systems in an accessible manner and ensures that resources are available to make immediate improvements to homes. The program invests in preventative measures that benefit the lives of people through improved health outcomes and thereby reduces the cost of health care.¹⁴⁶

housingforhealth.com

RACE for 2030 has set a goal of retrofitting one million homes for thermal efficiency in five years by attracting private finance. To operate effectively at a large scale, RACE for 2030 has adopted a 'portfolio approach' that includes six 'leverage points': technical, portfolio oversight, operational model, delivery, communications and engagement, and policy and regulatory.⁸⁵ The program is early in its implementation, so its success is yet to be evaluated.

Based on a broad review of existing retrofit programs, RACE for 2030 has identified key delivery success factors for any program or service, including:

- building and maintaining trust with homeowners
- engaging homeowners at trigger points (such as point of purchase or renovation)
- providing clear messages and influence across all sectors (government, private industry and homeowners) using a values-based approach and communicating retrofit benefits
- conducting whole-of-home assessments and quality control of work.⁸⁶

5.3. Financial incentives

In Victoria, the financial incentives available for households to independently undertake retrofits are focused on energy efficiency; some examples of financial incentives for resilience retrofits exist elsewhere in Australia and internationally.

Awareness raising

The Victorian Government's scheme offering \$250 to compare energy providers has encouraged households to raise their awareness of retail energy options. While not specifically focused on home retrofits, the program provides an example of a broad incentive for increasing energy literacy.⁸⁷ In the first month of the scheme's fourth round (March–April 2023), 40% of participants – over 1 million households – switched providers. Lower-income electorates in Melbourne have taken up the scheme at high rates, but the uptake has been lower in regional Victoria.⁸⁸

Assessment

In May 2023, the Victorian Government launched an initiative that will generate Victorian Energy Efficiency Certificates (VEECs) for undertaking a home energy assessment, which households can then sell to retailers. This financial incentive seeks to increase the uptake of the Residential Efficiency Scorecard.

Action

In recent years, a range of financial incentives have emerged that encourage households to retrofit their homes, primarily for energy efficiency and thermal comfort, but in some cases for climate resilience. In Queensland, eligible lower-income households along the coast can receive a grant of up to 75% of the cost of work, at a maximum of \$11,250, to reduce the risk of cyclone impact.⁸⁹ In the flood-prone Northern Rivers region, the New South Wales and Commonwealth governments have established a \$700 million Resilient Homes fund to provide eligible residents with up to \$100,000 to elevate their homes, up to \$50,000 to retrofit for flood risk or a buy-back option enabling households to sell their homes to government and relocate. Over 6,400 households have registered with the program; the retrofit and home-raising streams are just commencing at the time of writing, but the buy-back scheme has identified 650 eligible homes.⁹⁰

The Victorian Government has funded a range of programs over time that encourage households to increase their home energy efficiency and thermal comfort. For example, the Victorian Energy Upgrades (VEU) program offers discounts and rebates for energy-efficient appliances and retrofits to increase thermal comfort. Eligible activities can qualify households to earn VEECs, which can be monetised through sale to energy retailers.⁹¹ The Solar Homes Program, administered by Solar Victoria, similarly offers rebates and interest-free loans on solar panels for primary residences and rental properties, as well as rebates on efficient electric hot water systems and batteries (battery rebates are to transition to interest-free loans as of 30 June 2023). The program requires purchase through authorised retailers to ensure the quality of products and installation.⁹²

Locally, the More Australian Solar Homes (MASH) Bulk-Buy program began in 2014 to facilitate residential uptake of solar panels and generate local community benefits. From its inception until 2021, MASH supported over 450 households across the Shire to add solar; at the time of writing, the program is undergoing a review to consider its future direction in light of state government incentives for solar installations.⁹³

The concept of mandatory disclosure of home energy ratings at the point of sale is what originally prompted the development of the Residential Efficiency Scorecard. In the Australian Capital Territory, where this has been a requirement since 2003, studies have shown that improving energy ratings by a half star can increase a home's median value by 1.2%, though this appeal may be tied to other design features present in higher-quality homes.⁹⁴ The desirability of mandatory disclosure is gaining momentum nationally, with banks, insurers, superannuation funds and the building sector lobbying for a national disclosure scheme underpinned by a unified energy efficiency and resilience rating system.^{95, 96}

Insurance-based incentives for resilience retrofits exist in pockets. In Queensland, households retrofitting their homes to resist cyclone impacts have reported an 8.5% reduction in insurance premiums for cyclone; such benefits are not broadly available, however. The insurance sector's access to big data enables individualised risk-based pricing, but there is no consistent way to factor in household actions to reduce risk (a gap that the RBC's Resilience Rating intends to address, and which insurance companies are seeking to fill).^{97, 98, 99} As a result, many households have no quantifiable financial incentive, such as reduced premiums, to invest in resilience retrofits. Even following a disaster, payouts for total replacement value do not specify any benefit for additional investment in resilience-building measures to reduce the impacts of future extreme weather events.¹⁰⁰

Similarly, banks, such as Bank Australia, are beginning to offer discounts on home loan packages or pauses on repayments to encourage households to invest in energy efficiency upgrades. However, these incentives do not include benefits for resilience retrofits.¹⁰¹



6. Limitations to broad uptake of resilience retrofits

Current research on climate risks highlights the barriers and challenges that are slowing the uptake of home retrofits, for both energy efficiency and resilience.

6.1. Retrofits as long-term infrastructure investment

Multiple sources point to the long-term shortfall in systemic investment in climate adaptation and resilience in Australia and globally. Where climate risks are concerned, such investment has been found to be highly efficient, with the United States National Institute of Building Sciences identifying a benefit-to-cost ratio of up to 11:1, and 4:1 specifically for private home retrofits.¹⁰² Yet, in the 2005–2022 period, the Australian Government spent \$24 billion on disaster recovery and relief, and only \$0.51 billion on resilience; and the latter will be only slightly increased through the Disaster Ready Fund.^{103, 104}

Research by ClimateKIC on adaptation finance has identified a fundamental mismatch between the design of adaptation projects (typically small and oriented to grant funding) and the financing structures (such as bonds) required to support them at scale.¹⁰⁵ Home retrofits have recently been identified as an example of this, with researchers positioning the extent of retrofitting need as a large-scale infrastructure challenge which is the responsibility of government rather than individual households: “The benefits of retrofitting a house outlive the current residents. It should be seen as an investment in the national housing stock rather than a handout to individual households.” Such research is critical of the short-term nature of rebates for energy bills, framing it as equivalent to funding disaster response instead of risk reduction measures.¹⁰⁶

6.2. Barriers to household action

In addition to cost, various sources point to a range of barriers to undertaking resilience retrofits at the household level, based on both the lessons learned from energy efficiency programs and evidence from the emergency management sector:

Risk awareness

Many households do not fully understand the risks that they face; for example, following the widespread damage from storms in 2021, community surveys identified that 60% of households impacted had not believed that they faced any risk prior to the storm.¹⁰⁷

Motivation to act

Research underpinning the Victorian SES's 2016–2019 strategy noted that risk awareness does not translate into action, and that a large proportion of the population is not interested in or planning to take action in relation to hazards that they face.¹⁰⁸

Renters' ability to make changes to homes

Renters have a limited ability to retrofit their homes, and while programs designed to incentivise landlords to upgrade rental properties have emerged, regulation and stronger minimum standards for rental properties are increasingly identified as critical to drive meaningful change. In addition, concerns exist that, even with greater regulation, the costs of upgrades could be passed on to renters.^{109, 110}

Ability to understand and apply available information

Victoria's diverse communities require information to be delivered in different ways. For example, VCOSS has identified lack of awareness, largely arising from language and digital literacy barriers, as the primary reason why qualifying Victorians do not access energy concessions.¹¹¹

Trust

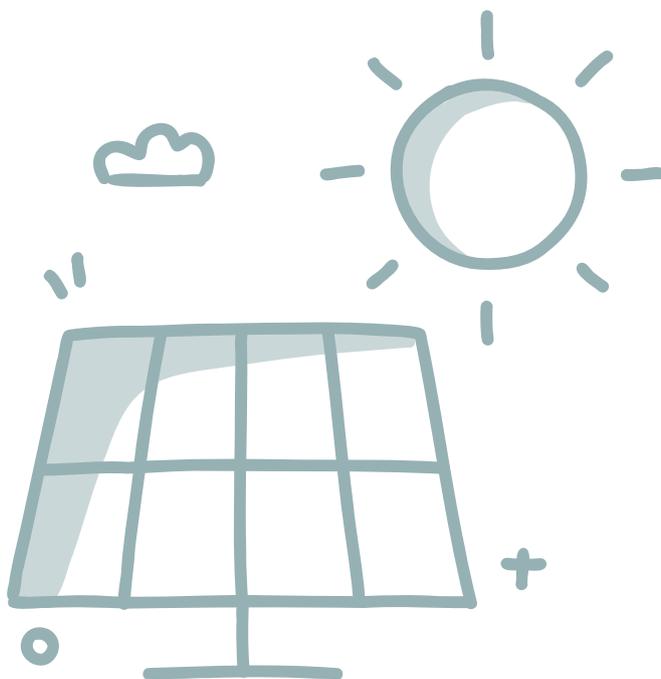
Multiple program reviews have found that engaging households on preparedness for climate risks requires relationships of trust, pointing to a need for localised community development approaches that do more than simply provide information.^{112, 113}

6.3. Market development

Even for homeowners who are prepared to research, self-manage and self-fund retrofit work, the market for this work is nascent, particularly in regional areas. For example, the Victorian Government's VEU program requires households to work with certified suppliers and assessors to access rebates and VEECs from qualifying activities, but none of these suppliers are based in regional Victoria.¹¹⁴

Reviews of programs in Australia and abroad, such as California's energy upgrades program, have found that insufficient skills and capacity among tradespeople exist for multiple reasons:^{115, 116}

- The bespoke and detailed nature of retrofit work means that it is less cost-effective for businesses to undertake.
- The market is not set up to support innovation, which would increase the attractiveness of retrofit work to the building sector.
- As with the general population, many tradespeople are still building awareness of the importance of retrofitting homes and of the corresponding market opportunity that exists for this work.
- For tradespeople who do retrofit work, skills typically only relate to directly undertaking the work, rather than assisting households to understand how they can make the most of upgrades to their homes.





7. Case study context – Mount Alexander Shire

Mount Alexander Shire (the Shire) is located in the Loddon Campaspe region in Central Victoria (Figure 6). We have taken a place-based approach by focusing our research on this case study location, but we anticipate opportunities to apply lessons from this context to other parts of regional Victoria facing similar climate risks.



FIGURE 6 – Mount Alexander Shire context and primary towns / settlements

7.1. Extreme weather risks in the Shire

As noted earlier, we have identified the primary current and projected extreme weather risks in the Loddon Mallee region and the Shire as bushfire, flood, storms and extreme temperatures (Figure 7). Climate modelling indicates that as global temperatures rise, by the 2050s the Shire will experience higher temperatures and an increased number of heatwave days, resulting in more fire weather days, as well as more days of extreme rainfall, resulting in more floods.¹¹⁷ By identifying the locations impacted by climatic events and the types of housing in those locations, we can also identify the properties that are most exposed to one or multiple risks.

By the 2050s, Loddon Campaspe can expect the following:

	Average temperature increase up to 3.0°C
	Twice as many days >38°C
	Annual rainfall to decrease by as much as 20mm
	Extreme rainfall and flooding expected to be more intense
	Longer fire seasons and 62% more very high fire days
	Bendigo's climate could be more like Shepparton's

FIGURE 7: Climate projections in the Loddon Campaspe region of Victoria¹¹⁸



Climate Projections for Mount Alexander Shire

	Historical 1986-2005	2030s	2050s	2070s
Annual average maximum daily temperature (°C)	17.7 - 21.0	+19.4 - 22.5 (+1.5-1.7)	20.3 - 23.4 (+2.4-2.6)	21.4 - 24.5 (+3.7-4.5)
Annual average minimum daily temperature (°C)	6.4 - 8.3	7.2 - 9.1 (+0.8)	7.9 - 9.9 (+1.5-1.6)	8.7 - 10.7 (+2.3-2.4)
Days over 35°C	4 - 13	9 - 24 (+5-11)	13 - 30 (+9-17)	17 - 39 (+13-26)
Days over 40°C	0 - 1	1 - 4 (+1-3)	2 - 6 (+2-5)	2 - 8 (+2-7)
Number of heatwave days	10 - 12	16 - 18 (+6)	24 - 27 (+14)	35 - 40 (+15-18)
Rainfall (mm)	477-739	447-739	436-715	430-711
Extreme & heavy rainfall 1 in 20-year rainfall event (mm)	69.14	92.00 (+22.86)	111.63 (+42.49)	110.08 (+40.94)

Table 2 – Climate Projections for Mount Alexander Shire Annual Multi-Model Mean Summary Information RCP8.5 emissions scenario¹¹⁹

7.1.1. Extreme temperature risk

The Shire currently experiences very hot and very cold temperatures, and climate models project an increase in the number of days over 35°C and more heatwave days as global temperatures rise.

In a high-emissions scenario, it is projected that the annual average daily maximum temperature will increase by 1.7°C in the 2030s, with an additional six heatwave days annually. In the 2050s, the annual average daily maximum temperature will increase by 2.6°C, with an additional 14 heatwave days.¹²⁰

The Shire is in a cool temperate climatic zone,¹²¹ experiencing a mean of 53.6 days with temperatures of less than or equal to 2°C.¹²² The number of cold days is not projected to increase in the future, but they present a risk for many households due to the poor thermal performance of existing housing stock.

While all households are exposed to extreme temperatures, locations across the Shire that are most impacted by extreme heat have low tree canopy coverage and high cover of built-up and paved areas, suggesting that their urban environments are not well-adapted to rising temperatures.

7.1.2. Storm risk

CSIRO does not project that the frequency or intensity of storms in non-tropical Australia will increase considerably due to climate change, but such events are a current hazard that will continue to impact the Shire in the future.

While storm events are difficult to predict geographically and are considered to have an impact across the Shire, Council's Emergency Management Coordinator has observed that Harcourt, Elphinstone and Taradale have been more prone to storm events over the past 10 years.¹²³

7.1.3. Bushfire risk

The Loddon Mallee region is expected to experience longer fire seasons and approximately 62% more very high fire danger days.¹²⁴

Ninety percent of the Shire's dwellings are located in areas nominated as 'bushfire-prone', with only 1,044 properties in central Castlemaine excluded from this designation (see Figure 8).¹²⁵

The Bushfire Management Overlay (BMO) is an indication of properties that are at a higher risk of bushfire; approximately 10% of dwellings in the Shire are within the BMO and are subject to bushfire prevention measures as a result. Table 3 presents the total population and number of dwellings within the Shire's towns that have populations of over 500 people and those dwellings in the BMO. Dwellings in land classified as Farming Zone are excluded.

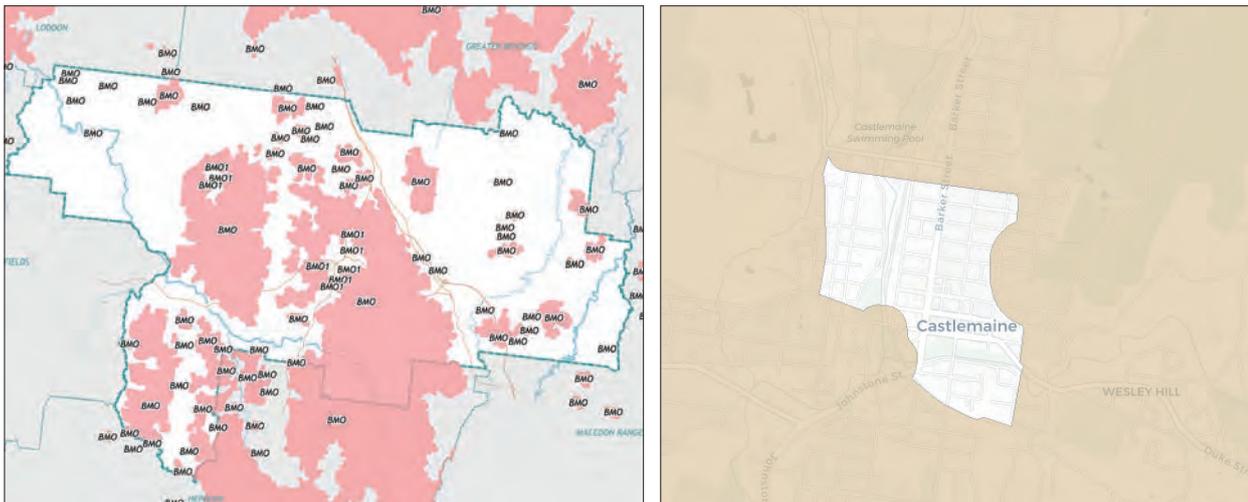


Figure 8: Left: Mount Alexander Shire Bushfire Management Overlay (red) and Bushfire Prone areas (brown) Right: The area in Castlemaine that is excluded from the Bushfire Prone (brown) areas.¹²⁶
Source: mapshare.vic.gov.au/vicplan



Mount Alexander Shire dwellings in the Bushfire Management Overlay (BMO)

	Population (ABS 2021)	Dwellings (ABS 2021)	Estimated dwellings in BMO*	Estimated % of all dwellings**
Mount Alexander Shire	20,253	10,124	1,025	10.1%
Castlemaine	7,506	3,678	367	10%
Campbells Creek	2,071	903	172	19%
Chewton	763	398	284	71%
Maldon	1,665	1,039	155	15%
Harcourt	1,038	468	7	1.5%
Newstead	820	436	39	9%
Elphinstone	633	315	1	0.3%
Taradale	524	256	0	0%

TABLE 3 – Mount Alexander Shire dwellings in the Bushfire Management Overlay (BMO)²⁷
* Excluding Farming Zone

7.1.4. Flood risk

Rainfall is projected to decline in the future, but extreme and heavy rain is projected to rise, leading to an increased likelihood of flooding.

Approximately 2% of dwellings in the Shire are within a known flood or inundation overlay or are in the 1% Annual Exceedance Probability (AEP). Castlemaine, Campbells Creek and Chewton have recently had their flood mapping updated and introduced a Floodway Overlay (FO) and a Land Subject to Inundation Overlay (LSIO), which recommend flood protection measures for new development (Figure 9). Flood mapping of the remainder of the Shire is not complete. Table 4 presents the population and number of dwellings within towns that have populations of over 500 people in flood-prone areas. Dwellings in the Farming Zone are excluded.

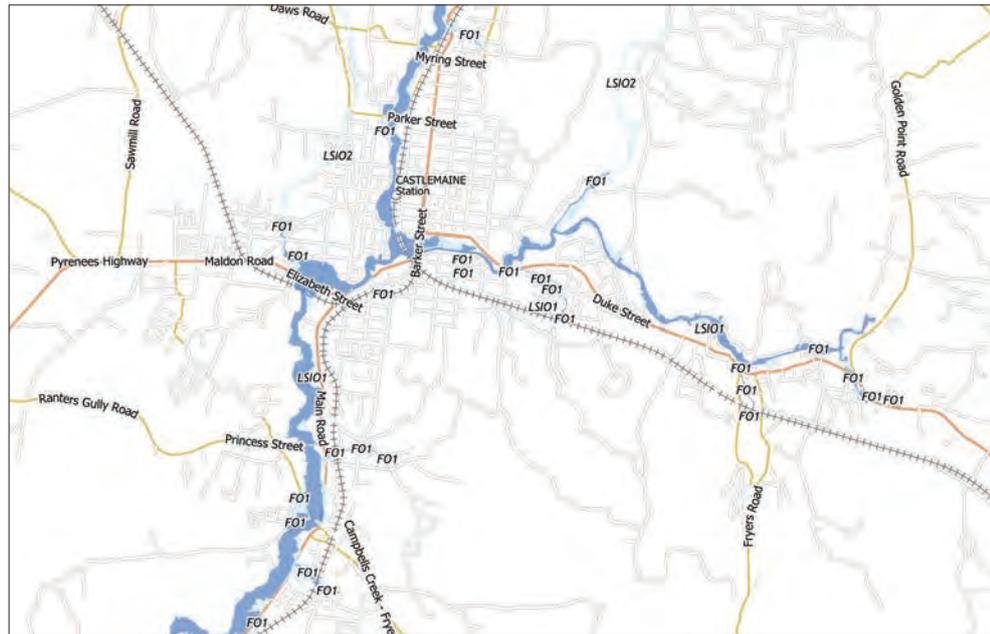


FIGURE 9: Flood Overlay and Land Subject to Inundation Overlays for Castlemaine, Campbells Creek and Chewton (recent flood mapping for other parts of the shire is not complete).¹²⁹ Source: mapshare.vic.gov.au/vicplan

Mount Alexander Shire dwellings in the Flood and Land Subject to Inundation Overlays¹³⁰

	Population (ABS 2021)	Dwellings (ABS 2021)	Estimated dwellings in BMO*	Estimated % of all dwellings**
Mount Alexander Shire	20,253	10,124	198	1.95%
Castlemaine	7,506	3,678	151	4.1%
Campbells Creek	2,071	903	99	10.9%
Chewton	763	398	3	0.7%
Maldon	1,665	1,039	0	0%
Harcourt	1,038	468	31**	6.6%
Newstead	820	436	67**	15.4%
Elphinstone	633	315	0	0%
Taradale	524	256	0	0%
Baringhup	185	93#	11	Over1.1%

TABLE 4 – Mount Alexander Shire dwellings in the Flood and Land Subject to Inundation Overlays¹³⁰
 * Based on VicPlan Flood and Land Subject to Inundation Overlays, excluding Farming Zone
 **Flood Extent 1% AEP – North Central Catchment Management Authority flood mapping for Newstead and Harcourt is in development

7.2. Housing stock in the Shire

In the Shire, 93.5% of dwellings are detached. Over two-thirds of the housing stock was constructed before construction standards were strengthened in 1996, and 78% before star ratings for energy efficiency were introduced.¹³¹ Figure 10 identifies that the Shire’s housing stock is older than that of Victoria as a whole, with a much higher proportion of homes built prior to World War II.

Housing stock by age range in Mount Alexander Shire and Victoria

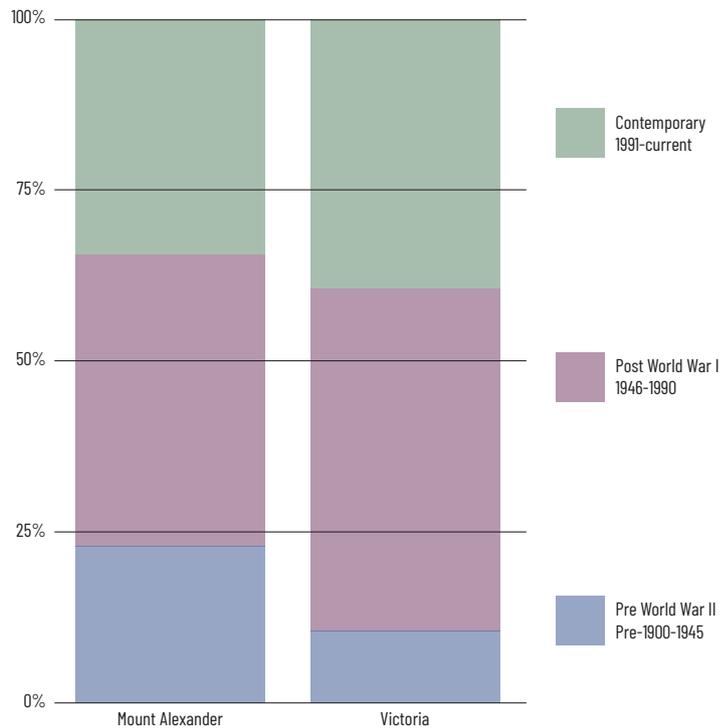


FIGURE 10: Housing stock age distribution for Mount Alexander Shire and Victoria¹³²

Background work undertaken for Mount Alexander Shire Council’s *Housing and Neighbourhood Character Strategy* has identified the predominant building material in each residential street. The Victorian Housing Stock Model profiles the number and floor areas of dwelling types, including their energy efficiency-related features, by LGA. Overlaying the information from these two sources with the bushfire and flood risk areas in planning maps, it is possible to identify the number and typology, or material composition, of vulnerable dwellings in a particular risk area. Figures 11 and 12 approximate the mix of house typologies in the BMO and in flood-prone areas, respectively, in Castlemaine, Chewton and Campbells Creek.

Predominant Building material in bushfire management overlay

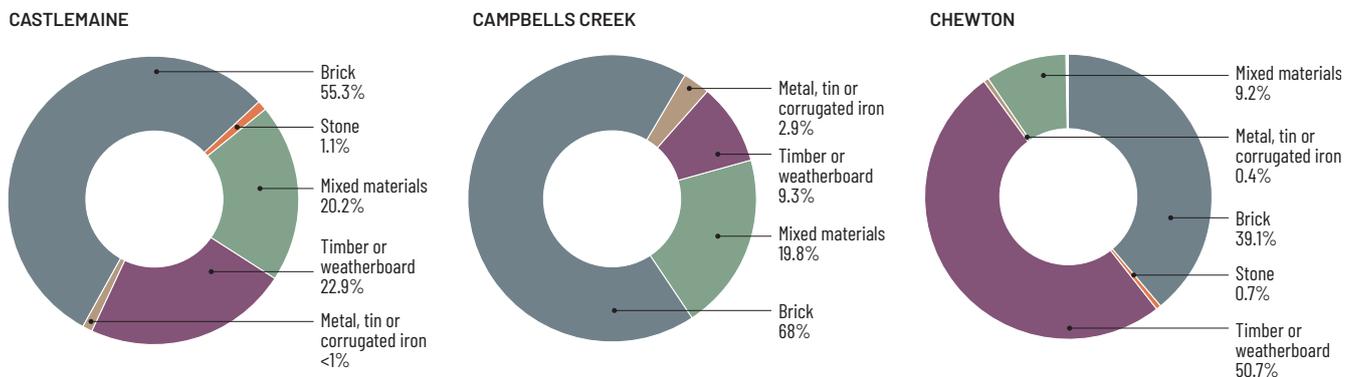


FIGURE 11: Predominant building material in Bushfire Management Overlay in Castlemaine, Campbells Creek and Chewton¹³³

Predominant Building material Flood Overlay and Land Subject to Inundation Overlay

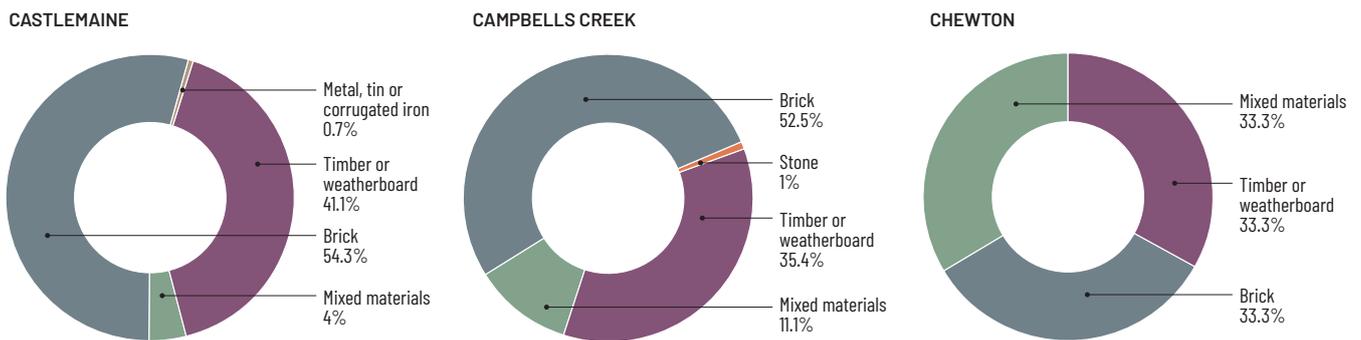


FIGURE 12: Predominant building material in Flood Overlay and Land Subject to Inundation Overlay in Castlemaine, Campbells Creek and Chewton¹³⁴

This consolidated information has been developed to increase awareness of the characteristics of homes in high-risk areas, which can in turn improve understanding of the level of vulnerability of these homes based on the suitability of specific typologies to a particular risk. It is important that risk profiles for dwellings account for both the locality’s exposure to particular extreme weather events and the vulnerability of the housing stock to those events. For example, a house in a flood area that is constructed above the projected flood level with flood-resilient materials may withstand a flood, whereas housing stock that sits below the flood level and is not built to withstand flood is likely to be damaged.



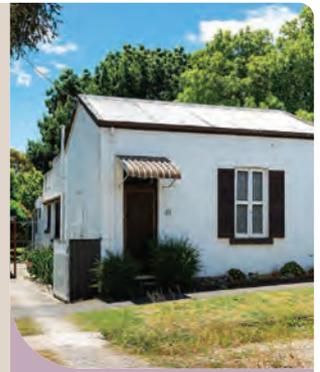
20,253

Mt Alex Shire
population
ABS 2021



24.6%

earn less than
\$650 per week



2.2

Average number
of people per
household



48.5%

homes owned
outright



15.9%

of families are one
parent families



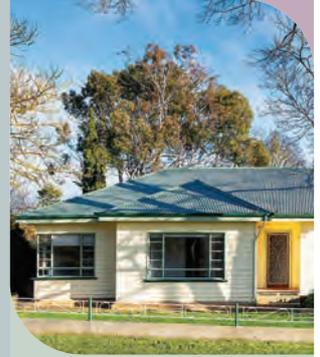
64%

families
(household
composition)



33.2%

single person
(household
composition)



15%

rented
(tenure type)



\$1,252

Median weekly gross
household income



1.3%

identify as Aboriginal
or Torres Strait
Islander



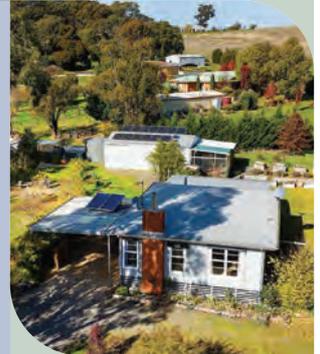
13.4%

have mortgage
payments greater than
30% of household
income



37.5%

have rent payments
greater than 30% of
household income



28.7%

of people have
a Bachelor Degree
or higher



5.7%

of residents live
with a disability
requiring assistance



28.5%

aged 65 years
or older

7.3. The Shire’s community profile

The demographic profile of the Shire reveals that households tend to be smaller, older and lower-income than Victoria as a whole (Table 5). While the Shire has a lower rental rate than Victoria as a whole, those who are renting face rental stress at a higher rate than others across the state.

Notably, the Shire is home to 963 women over the age of 65 who are living alone in private dwellings (including both renters and owner-occupiers); this cohort has increasingly been identified in policy circles as disproportionately at risk of insecure housing.¹³⁵

Tenure and landlord by dwelling structure 2021

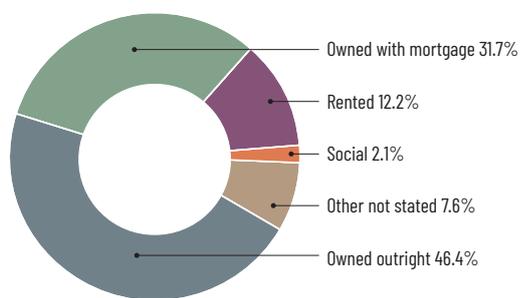


FIGURE 13: Distribution of housing tenure in Mount Alexander Shire¹³⁷



Demographic profile of Mount Alexander Shire

	Mount Alexander Shire	Victoria
Population	20,253	6,503,491
Average number of people per household	2.2	2.5
Household composition	64% family 33.2% single person 2.8% group households	70.1% family 25.9 single person 4% group households
Tenure type	48.5% homes owned outright 33.4% owned with a mortgage 15% rented	32.2% homes owned outright 36.1% owned with a mortgage 28.5% rented
Household income: People who earn less than \$650 total weekly gross income	24.6%	16.4%
Household income: People who earn more than \$3,000 total gross household weekly income	13.6%	24.2%
Median weekly gross household income	\$1,252	\$1,759
Households that have rent payments of greater than 30% of household income	37.5%	30.9%
Households that have mortgage repayments of greater than 30% of household income	13.4%	15.5%
People aged 15 years and over who do not participate in the labour force	41.5%	32.2%
Residents aged 65 years or older	28.5%	16.8%
Residents with a disability requiring them to obtain daily assistance with personal care, communication or mobility	5.7%	5.5%
People who identify as Aboriginal or Torres Strait Islander	1.3%	1%
Single or one-parent families	15.9% 73.8% of single parents are female	15.2% 80.9% of single parents are female
People who have a bachelor's degree or higher level of educational attainment	28.7%	29.2%

TABLE 5 – Demographic profile of Mount Alexander Shire¹⁵⁶

7.4. What our community thinks about risk

The CEDRR project is a multi-year research project, led by Associate Professor Brian Cook at the University of Melbourne, that aims to empower local communities to become more resilient, informed and prepared for disasters and emergencies, with a focus on flood risk.

A case study undertaken by the CEDRR project in the Shire was designed to gauge community perceptions of and preparedness for risk at the household scale, and to measure the impact of survey completion on participants.

From November 2022, survey-interviews were conducted with 179 residents across the Shire. While it does not capture a representative sample, the CEDRR survey includes a cross-section of participants from key socio-demographic groups within the Shire, including:

- households earning less than the median annual household income for Victoria (n=56)
- renters (n=17)
- older residents (>=65 years old)(n=33)
- younger residents (<25 years old)(n=6)
- residents who mainly speak a language other than English at home (n=5)
- residents who identify as Aboriginal or Torres Strait Islander (n=2).

The preliminary findings from the project's initial engagement with households in the Shire are summarised below, highlighting local households' perceptions of their own exposure and vulnerability to risk, and the risk mitigation actions that households have taken.¹³⁸

7.4.1. Perceived risk

When asked about their perceptions of risk, Shire residents participating in the CEDRR survey considered themselves exposed to bushfire and flood to varying degrees.

- Just over half (53%) of participants thought that their home is situated in a fire-prone area.
- Less than a quarter (21%) thought that their home may be at risk of flooding.

When asked how many high-risk days they think their household is exposed to over the course of a year:

- 16% of participants said that they were not exposed to any high-risk days.
- A majority (51%) felt exposed to high risk 'a few' days throughout the year.
- A further 22% of participants felt exposed to high risk 'some' (more than 'a few') days throughout the year.
- 6% of participants felt exposed to high risk 'many' days throughout the year, and a further 3% felt exposed to high risk 'most' days.
- When asked what the biggest risks they think they will be exposed to in the next 10 years, participants identified bushfires (47%), followed by climate change and extreme weather events (31%), flooding (26%), health-related risks (21%), and financial and economic risks (21%) as risks of concern.

7.4.2. Attitudes towards risk

In relation to attitudes towards risk, most survey participants indicated a moderate to low risk appetite.

- 42% of participants were 'risk neutral' (comfortable with risk taken for a good reason).
- 30% were 'risk Pareto' (only comfortable taking risk when there is a substantial reward).
- 14% were 'risk-averse' (preferring the safest path).
- 9% were 'risk seeking' (comfortable with high risk in a calculated manner).

7.4.3. Action to mitigate risk

When asked how much effort they had put into risk reduction for their household, a majority of participants (61%) felt that they had put in either 'some' (35%) or 'little' (26%) effort to reduce the risks to their household.

The most commonly reported risk reduction action(s) taken by households included:

- house/garden maintenance (n=144)
- insurance (n=138)
- home safety equipment (n=103).

Just over half (54%) of the residents surveyed had taken flood mitigation measures at the household level, ranging from minor to more extensive actions.

The most commonly reported flood mitigation actions included:

- 'landscaping' and digging trenches to improve drainage or divert water from their homes (n=45)
- 'cleaning and/or replacing gutters' and downpipes (n=20)
- 'elevating' or purchasing houses with flood in mind (n=7)
- purchasing or using a pump to divert water away from their house (n=6).

7.4.4. Assistance

When asked what support could help to mitigate against perceived current and/or future risks, participants identified the need for:

- more locally specific information (n=38) and resources (n=18), particularly around flood risk, to support risk mitigation action by households
- council and other levels of government to listen to the community and provide greater support for community initiatives to prompt action (n=32)
- greater support from state and federal government (n=21) and local government (n=16), including:
 - more financial ‘incentives’ such as rebates or subsidies to support risk mitigation at the household and community scale (n=10)
 - improved communication (n=7) and transparency (n=2) from Mount Alexander Shire Council around risk, responsibility and development.

Multiple participants commented on the role of local and state government in relation to planning approvals and improving flood infrastructure and local drainage, emphasising the need to listen to and address the needs and concerns of the local community:

“Community represents a small voice compared to developers and commercial sector. Need to amplify and respect the voices of community. Community needs to feel listened to, and supported by, council and other powerful actors.”¹³⁹

Community connectedness also emerged as an important resource for households across the Shire to reduce their vulnerability to risk. A majority of participants reported that they would rely on friends, family or neighbours in an emergency, followed by local emergency services and community groups. Almost all participants agreed (44%) or strongly agreed (49%) that they could ‘draw on their neighbours for support’ in an emergency.



8. Summary of findings from community engagement

This section details what we heard from the professionals and Shire residents we interviewed as part of this project. We summarised the findings using a behaviour change framework adapted from the public health, water and sanitation sector (see Table 6) to explore the key factors influencing household behaviours in relation to the uptake of resilience retrofits.¹⁴⁰

The findings include extensive quotations from our interviews to foreground the perspectives of project participants and to enrich understanding of the themes that emerged. Quotes are edited for length and clarity.

Framework applied to analysis of interviews conducted, adapted from aligned frameworks from public health and water and sanitation sectors

Behaviours	Resilience retrofits that households are undertaking Resilience retrofits that households are considering
Ability	Knowledge and understanding of climate risks Skills and self-efficacy to undertake resilience retrofits Social supports Decision-making ability Affordability
Opportunity	Access to information and guidance Access to products, programs and services Access to financial incentives Roles and responsibilities of government Insurance Planning and building regulations
Motivation	Attitudes towards resilience retrofits Values and social drivers Competing priorities Intention to act

TABLE 6 – Framework applied to analysis of interviews conducted, adapted from aligned frameworks from public health and water and sanitation sectors

8.1. Climate change and local risks

When prompted to consider climate-related risks, households in the Shire identified a range of different risks, including bushfires, storms, flooding, rising temperatures, drought, heatwaves and extreme cold, often based on their own past experiences.

“Although a range of weather events are expected, in the last two decades I have experienced increases in bushfire awareness and neighbouring threats, several flooding events, storm events, summer heatwaves [of] long duration, droughts, and winter cold snaps.” (HH14)

Homes in the Shire have sustained damage from storms, heavy winds and heavy rainfall events in recent years. Nine of the households we spoke to had experienced minor or major flooding of their property or home. Others had experienced a near miss.

“So it feels like it’s only a matter of time. It’s never flooded, but you know, it’s a changing world.” (HH12)

None of the households we spoke to had been impacted by bushfire, but almost all households mentioned bushfire as a major concern in the next 10 years.

“bushfire would probably be something that would come close and probably impact us because it might impact the town, ember fall from that.” (HH8)

Households are concerned about roof valleys exposing homes to ember attack, and thin windows at risk of leaking or shattering in storms and providing little thermal protection from heat and cold.

“No, we do have roof valleys. And embers can settle in that. The glass is thin – when we were hit by the hail – it’s old, some of it’s, some of it’s old blown glass, not factory made, it’s antique.” (HH9)

In relation to resilience more broadly, households are concerned about water and energy security. Some are considering actions that they could take to retain more water in the landscape in between periods of heavy rainfall to assist with flood mitigation and to support the health of vegetation and wildlife.

“We do get anxious about future water availability and what that means for the way that we live and [if] our approaches to thermal comfort get impacted by the ability of our trees to survive.” (HH12)

“I would like a dam, just to hold some water, because there is none in the creek, just for the wildlife more than anything ... I’m looking at getting some excavations done to the rear of the house to widen the space that water can run off from the back.” (HH9)

Almost all households we spoke to identified energy efficiency and electrification as a priority, to reduce the costs of heating and cooling their homes, to reduce emissions and to increase resilience during emergency events.

“one of the things I’m considering is whether I need to look at switching off gas and having a battery and everything be electrical, because I worry about the price of gas and the availability of gas. I kind of know that if I’m going to do it, then I would need to have a battery as a part of that, so that I had some level of self-sufficiency in emergencies like blackouts and things like that.” (HH5)

8.2. Behaviours

8.2.1. Resilience retrofits that households are undertaking

Most households have undertaken some upgrades and steps to prepare their homes for extreme weather events, but these are to varying degrees. The actions commonly mentioned by households fall within the emergency preparedness and minor (low-cost) upgrade sections of the *Housing Typologies and Retrofit Options Guide* (see Table 7).

Many households are planting out their gardens to help with cooling and improving drainage around their property, and some are considering fire-resilient species and native gardens to prepare for a changing climate.

“It’s a very old timber miner’s cottage, so it’s cactus if the fire gets that close. So we have planted now pretty densely around it with European trees. And I’m quite conscious of keeping indigenous plantings – which we have done quite a lot of – I have probably got a couple of hundred metres’ buffer between the house yard and the [indigenous plants].” (HH9)

The CEDRR survey similarly found that the most common risk reduction actions taken by households in the Shire were house and garden maintenance, landscaping and digging trenches to improve drainage and divert water away from houses, and cleaning and/or replacing gutters and/or downpipes.

Some households have also taken steps to improve thermal comfort, including draught proofing and establishing rooms within the house that can be heated efficiently in winter.

“And all the external doors, we’ve got some six external doors, and they all seal, they’re all done like that ... I did that just to stop the draughts coming through. It was better than snakes because when you close the door it just seals, you don’t have to think about it.” (HH9)

A smaller number of households have undertaken medium to extensive upgrades, such as landscaping to remove concrete and increase permeability to improve drainage around the yard; installing insulation in the floors, walls or ceiling; double glazing windows; installing air-conditioning units or fans; and installing mesh coverings around the subfloor, windows or doors to mitigate the risks posed by ember attack.

Actions households have taken

	PREPARATION	MINIMAL	MEDIUM	EXTENSIVE
 <p>GARDEN</p>	Sandbag before heavy rain Clean yard around the house	Plant gardens	Increase permeable surfaces Improve drainage around the yard	
 <p>FLOORS</p>		Inspect insulation and fill any gaps	Install under floor insulation Enclose subfloor with mesh	
 <p>WALLS</p>		Fill exterior gaps	Install bulk wall insulation Add steel posts	
 <p>ROOF</p>			Install bulk insulation in the ceiling Install gutter guards	
 <p>DOOR & WINDOWS</p>		Seal draughts around the home	Install verandahs and awnings or other shading Install fire-resistant window frames	Install double glazing
 <p>INTERIOR</p>	Create a warm or cool room	Install thermally backed curtains or blinds, or honeycomb blinds	Install air-conditioning or fans	

TABLE 7 – Home retrofit actions that many households interviewed have undertaken

10.2.2. Resilience retrofits that households are considering

When asked what additional actions they might consider taking to improve the resilience of their home, households expressed interest in insulation to increase thermal comfort and energy efficiency; mesh covering for subfloor, windows and doors to protect from ember attack; and solar panels and home battery systems to increase energy resilience during emergency events, reduce energy bills and support a transition from gas to electricity (Table 8).

A number of households are interested in installing double-glazed windows, more energy-efficient hot water systems and split-cycle air-conditioners to improve thermal comfort. But these participants acknowledged that these actions would be costly, and that more could be achieved through simple actions (such as installing curtains and blinds) and minor behavioural shifts (such as wearing warm clothes, using electric blankets and hot water bottles in winter, and ventilating the house in summer).

“My understanding is that the best thing of all is just ‘grandma curtains’, so if I had the money to spend I’d put in pelmets ... I don’t have a problem with double glazing, but I’m not sure that it achieves ... I would do it, but the bucket [of money] is only that big, and I think I would achieve more in other ways.” (HH11)

Household participants expressed a general preference for minimising the use of air-conditioners for heating and cooling, both to save money on energy bills and with principles of energy efficiency and sustainability in mind.

“It’s a brick house, so it’s kind of a bit ‘passive solar’ just by good luck. ... I mean, we block off rooms and that kind of thing. And even as far as the cooling goes, we close all the curtains ... We like to be living lightly. It’s easy to have air-conditioning and a big fridge, but we try and take responsibility for those things a bit more.” (HH7)

“I think air-conditioning is a really important thing for little people, and elderly people, people in hospital, people in retirement, people whose health is compromised ... having the capacity to cool down is really vital for them, but everyone else in the middle, I think they just need to learn to sweat ... And I have the same thing with heat. Hot water bottles, extra jumpers, extra blankets.” (HH11)

Actions households are considering

	PREPARATION	MINIMAL	MEDIUM	EXTENSIVE
GARDEN 		Plant fire resistant trees and vegetation	Increase permeable surfaces Improve drainage around the yard	
FLOORS 			Install under floor insulation Enclose subfloor with mesh	
WALLS 			Install bulk wall insulation	
ROOF 		Roof and cladding maintenance	Install bulk insulation in the ceiling	Install solar and or battery
DOOR & WINDOWS 		Seal draughts around the home	Install verandahs and awnings or other shading Covers windows / doors with steel mesh	Install double glazing
INTERIOR 			Install air-conditioning or fans Install heat pump hot water system	

TABLE 8 – Home retrofit actions that many households interviewed are considering

8.3. Ability

8.3.1. Knowledge and awareness of risk posed to homes by climate change

Households are broadly aware of the risk overlays on their property, the way that water flows in their neighbourhood, the direction that a bushfire is most likely to come from and the thermal performance of their home.

Residents living in older homes complained about the poor performance of their home in hot and cold weather due to poor insulation, thin windows, gaps and draughts.

“It’s very hot here and it gets very cold. It’s like a paper bag. You know, I have to have heating and cooling. Like it’s getting warm in here now. And it’s not a particularly hot day.” (HH10)

Residents living in newer homes have better insulation, double-glazed windows, and efficient heating and cooling.

“So with my double glazing, mass of insulation, actually it’s not too bad my house. The front room is the best room because of the sun in winter.” (HH2)

The renters we spoke to had significant concerns about thermal performance, with no insulation, inefficient heating, and gaps and draughts throughout the house. One renter had installed a split-cycle air-conditioner in a caravan on the property, where they spent much of their time in winter for warmth.

“I put in the reverse cycle air-conditioner in the caravan instead of using the heater halfway through winter. It made a huge difference, both in the comfort and it would appear the power use is pretty close [to what we want]. Our last power bill was the lowest it’s been in a long time. Yeah, but that’s only for the van, that’s only heating one room.” (HH6)

Apart from thermal performance, households appeared to have less understanding of the specific risk profile of their homes and how this might change over time, particularly in relation to floods.

“I would never in my wildest dreams [have] thought we would flood again within a decade ... Because I suppose the last time this town flooded really badly was back in like 1932 or something, which was when they put the levees in. So it was a very long time and you go, ‘Well, it’s happened, and that’s a long time ago.’” (HH10)

Two of the households we spoke to had received information in the mail from Mount Alexander Shire Council when the flood overlay on their property changed and were concerned to learn that they were now living in a frequent flood zone.

“[The] Section 32 told me was that if I ran a line through my grass out there in the yard that that was a one-in-100-year [flood] zone, and then on the paddock was a one-in-10-year zone. Six months later I got the letter saying it had been reclassified, and so my yard and neighbour’s house was all now one-in-10-year zone.” (HH5)

“I got a letter saying that we’re now in a frequent flood [zone]. So there was a frequent flood overlay put on to the properties ... And I just thought, oh my god, I wouldn’t have bought a property if it had a frequent flood overlay on it.” (HH10)

A local insurance broker expressed concern that households are generally not aware of how risks are changing due to climate change.

“I think a lot of people are now weighing up cost versus risk. And so they’re like, alright, well, a flood only occurs once every 50 years. So I’ve had my flood now so I should be good for another 50 years ... I think that people aren’t aware of the statistics of how many events there are so people are only aware of what occurs to them.” (Insurance broker in regional Victoria)

Local emergency management and emergency services personnel expressed concern that new residents who have relocated to the Shire from Melbourne since the start of the COVID-19 pandemic may have less understanding of regional living and local environmental risks.

8.3.2. Skills and self-efficacy to undertake resilience retrofits

Many residents expressed their confidence in relation to undertaking minor retrofits on their own and that they would prefer to be self-sufficient in this regard where possible, and not have to rely on tradespeople.

“I have always wanted to make sure that I can cover my own bases rather than relying on someone else.” (HH7)

“I’ve contracted a plumber who came in to do a little bit of work that was needed and an electrician, of course. Because you get the safety certificates, but in most cases I work with them, because I can do the grunt work.” (HH9)

Some residents have professional backgrounds in construction and architecture or connections with people who have relevant knowledge and skills. For others, understanding different retrofit options and knowing where to start can be a challenge.

“To be honest, like a lot of people I don’t know where to start. Because there’s probably a lot of things we could do, you know, which ones do you do first?” (HH8)

Local providers of home energy products and services noted that clients are often looking for single, higher-profile solutions, such as solar panels or double glazing on windows, and may not be aware of how other simple, low-cost measures and behavioural changes can improve thermal comfort and energy bills, such as blinds, draught proofing and electric blankets.

Older residents recognise that undertaking retrofits may become more difficult over time.

“We’re both in our 60s, so fit and healthy right now. But you know, as time went on, if we wanted to stay there, that could be a factor.” (HH7)

Most residents reported that they would seek advice from or engage a tradesperson to undertake more complex retrofits.

“It’s obviously different for every single person as to what they feel comfortable doing but I don’t feel across stormwater, and how to think about engineering that, so that would be something that would be good to have advice on.” (HH12)

While some households are happy to find a tradesperson online, for many, the ability to seek advice and recommendations through local networks is key to feeling confident that they can engage the right tradesperson, with appropriate knowledge and skills.

“I wouldn’t be able to do it myself. I know a few people around here and that’s great, but it’s always good to get recommendations of particular tradespeople who do particular jobs.” (HH10)

8.3.3. Social supports

Households we spoke to value being part of a vibrant and well-connected community.

“I’ve lived in the area for 33 years so, you know, [it’s] obviously communities, people, and it’s your friends and all of those things. My children were brought up here. My granddaughter. So we’ve got a lot of ties.” (HH10)

“It’s the resilience of the community already is something that really appeals. The vibrant nature of the community.” (HH7)

Social support and connections were highlighted by many households as important, particularly during emergency events. Most households are connected with their neighbours and wider community and in the past have communicated with one another, worked together or offered assistance in the lead-up to the fire season or heavy rainfall events.

“With the last one I grabbed the neighbour and got him to come with me to go get some sandbags and stuff and his yard floods.” (HH6)

“So the lady next to us, she’s still quite capable. She’s 70. And the ones on either side, they’re school teachers, they are probably 40ish. So we all kind of know each other and might have a group chat and just say, ‘Is everyone okay?’” (HH7)

“I met an older couple here, and they were very nice to me, so I just gave them my number and said, you know, I’m a tall guy, if you need a hand or ever need simple stuff, quick stuff, I have the time and I’m willing to help clean your gutters.” (HH1)

Several of the households we spoke to are members of neighbourhood groups on Facebook and WhatsApp that share information, resources and support. Some of these groups were established during the COVID-19 pandemic to allow neighbours to support each other and have continued.

One household spoke about sharing information about flooding with neighbours who were new to the area.

“I did talk with my neighbour next door ... I just went, ‘We’ve got to do this now’ ... Most people in the area around me here are new to this area since the last flood, and they would not have had any idea.” (HH10)

Another household spoke of the importance of building connections with neighbours for community resilience.

“Just thinking about our house in the broader context of the neighbourhood is an interesting idea that a lot of people don’t have ... How you work with your neighbours to think about the broader contributions they’ve all made to water quality and the heat impacts and everything like that is interesting. And that’s sort of what our long game is, we’ve been building connections with our neighbours with laneway dinners and things hoping that we get there.” (HH12)

Local sustainability groups are also supporting households to take action at both the individual and neighbourhood scales through information sharing, workshops and working bees, with an emphasis on building social connections, in addition to the knowledge and skills required to undertake home retrofit work.

“With what’s coming it would be beneficial for us to have better communication channels and to know one another, where our vulnerable people are, so we can look out for one another. So that’s our key reason for being.” (Community energy group member)

A resident living in a newer housing development spoke about the challenges they had faced gaining support from their neighbours for community resilience initiatives, like urban greening along nature strips and community energy projects, due to the lack of connection between households, which they attributed, in part, to the lack of public space for gathering in their neighbourhood.

Another household highlighted the importance of community spaces and infrastructure to support those most at risk from climate change and extreme weather events.

“The community needs shelters for bushfires, heat and cold, particularly for elderly residents and people without good heating and cooling at home.” (HH3)

8.3.4. Decision-making ability

The households we spoke to understand that decisions about risk mitigation are made at different levels, and that their ability to manage some risks at the household level is limited.

Households are making decisions and taking action to mitigate the risks associated with bushfires, heat and cold at the individual level. The risks associated with flooding and storms, however, were attributed to broader planning decisions, flood mitigation works, drainage infrastructure, and decisions made at the neighbourhood and council level.

One household expressed frustration with the pace and adequacy of municipal flood mitigation works.

“It is pretty frustrating to have been impacted by floods twice when really a lot of mitigation work was supposed to happen after 2011 but didn’t.” (HH10)

Two of the households we spoke to commented on how the installation of fencing around their property had increased risk to their neighbour.

“The next-door house flooded, with water coming in through the vents. The solid fencing blocked the flood water from entering the backyard, but it then spilled onto the road and entered the property at the front, cutting off access ... Because I’ve installed these [solid] fences, that’s pushed more water back into their backyard.” (HH5)

When it comes to decisions made at the household level, renters have the least decision-making power and must negotiate with landlords and property managers to undertake retrofits or repairs.

“Renters can often struggle for basic maintenance let alone expecting landlords to step up and offer improvements that consider climate resilience.” (Public health professional)

“We put in a few loads of gravel, when the actual flood hit we were able to get the SES to sandbag the place. But our hands are tied because we’re renting. We’re not in a position to get in there and do earthworks.” (HH6)

Local housing service providers told us that renters in the region are struggling the most from cost-of-living pressures, are living with some of the poorest housing standards in the region and are not in a position to invest in even basic home upgrades.

“Even just buying small things is hard for some of our clients. People are in more basic survival mode.” (Local tenancy advocate)

We also heard that tax arrangements are a barrier to landlords investing in resilience retrofits when such retrofits are considered home ‘upgrades’ or ‘improvements’, as opposed to essential maintenance.

“I’ve taken the landlord around and shown him where the rot is and stuff like that. He’s shown no interest in doing anything about it as the rent is quite low by today’s standards ... when I have talked to him about a couple of things, his response has been that, that would cost him tax wise, you know, it affects his tax status if he makes improvements on the property.” (HH6)

Public housing residents also face barriers when seeking approval for retrofits and a medical certificate is often required to demonstrate that the resident has a specific health need before retrofits or upgrades can be approved.

“[I] have requested a shade pergola out the back. If it can be demonstrated that it is necessary due to ‘medical conditions’, public housing will organise; otherwise, they will give permission for the resident to arrange construction and payment.” (HH5)

We heard from two community services providers about the challenges public housing tenants have faced when seeking to have air-conditioning installed, which up until recently required a medical certificate. This requirement is changing with the adoption of the Health and Human Services Climate Change Adaptation Action Plan 2022–2026, which recognises air-conditioning as an essential need as part of a healthy home.

8.3.5. Affordability

Most of the households we spoke to consider minor upgrades and actions to prepare for climate-related extreme weather events to be affordable, particularly if they are able to undertake these actions themselves. For many, time is a more significant barrier to undertaking minor upgrades.

“money’s not the reason ... it’s getting around to it.” (HH9)

Local service providers told us, however, that many people in the community are struggling at the moment with the cost-of-living crisis.

“If they own their own homes, they don’t have the capacity to do anything different, they’re struggling just to maintain them really.” (Council Access and Support Worker)

The up-front cost of undertaking moderate or major upgrades is a significant barrier for most households, including those on higher incomes.

“Even for us, we are quite lucky people, but even for us, we are above-average salary Australians, but this is very, very expensive ... Because ‘retrofit’ means you need to, other than minor things, you need to hire an expert of some sort and they are so expensive in this country....” (HH1)

Some households expressed their concern about ‘over-capitalising’ by undertaking a major retrofit and reflected on whether it might make more financial sense to move to a new home.

“So yeah, I think at some point we’ll re-clad and re-insulate, and then we can also potentially get new windows. It’s quite an investment. I don’t want to over-invest or whatever, overcapitalise. It’s a point at which you might just have to start again, and make a nice warm new house.” (HH14)

Specific demographic groups face additional affordability challenges. Council staff noted that the Shire has a significant and growing number of older, single women, with little to no superannuation, who are experiencing poverty and are at risk of homelessness.

Local sustainability groups also commented on the increasing costs of the products and services required for comprehensive energy efficiency retrofits.

“All this takes money. Pre-COVID we estimated an average of \$23,400 per house for a net zero retrofit. Post-COVID, it’s more like \$30,000.” (Local sustainability group member)

8.4. Opportunity

8.4.1. Access to information and guidance

Some households are accessing information about climate risk through online risk assessment tools, local emergency services and Council.

One of the households we spoke to had taken advantage of the home bushfire risk assessment service provided by the Country Fire Authority (CFA) to obtain advice on priority risk mitigation and preparedness actions to protect their home.

Another household had accessed an online climate risk assessment tool developed by the University of Queensland to assess levels of risk under different climate scenarios for bushfires and floods, before purchasing a property in the Shire.

“We did our own research because there was no way we would purchase a [high-risk] property...” (HH1)

Another household reflected on the need for information to be provided at the point of sale to assist households to understand the specific risk profile of a property.

“I wonder what can be done when people purchase properties, because in Australia you have to do your due diligence, and I totally get it ... you need to do your own homework, but at the same time I wonder what councils can do so that people understand their property a bit more.” (HH1)

One resident told us that a real estate agent had informed them about the flood risk to their property when they were looking to buy their house and had also provided them with information about insurance.

“The real estate agent told us that it was in a flood area, which is why I think we got it cheaper than probably we otherwise would have ... And they helped us with getting insurance, because not many insurers would even do it. So they helped us out and told us who the previous owner was insured with and they were happy to continue insuring us.” (HH14)

Another resident, who had moved into public housing after their home was flooded in Rochester, indicated that they did not have accurate information about the flood risk to their property.

“Living in Rochester at the time, many people were preparing for flood just in case, but I was told that where my house was located would be fine ... The house was not prepared at all. I came back two weeks after the flood event ... it was devastating. Everything was gone.” (HH4)

Local emergency services workers noted that the CFA is funded to provide community education and advice to households, with a focus on bushfire risk, but that the SES is not currently funded to undertake similar community engagement on risk mitigation and preparedness for floods, storms or other climate-related extreme weather events.

“Communication is key, but there isn’t enough money at the local community level to do education and communication.” (Local emergency services worker)

Similarly, community members noted that local information about bushfires is available but that less information is available about storms and floods.

“I just hadn’t realised how uneducated I was around floods. I mean bushfire I feel like we’ve been provided information. But the flooding, you know, you actually have to leave before it’s a threat.” (HH5)

Local events in Mount Alexander Shire, such as the Emergency Services Expo showcasing the services of emergency management organisations and related community groups, have attracted large crowds in recent years but are not funded on a regular or ongoing basis.

Households generally want more information on climate-related risks and adaptation options, tailored to the local context.

“I feel like there’s a lot of resources out there for most other aspects of building design except for floods ... it would be nice to have some more localised resources on flood retrofits and design, how you can kind of work with what you’ve got.” (HH12)

When asked about trusted sources of information, households emphasised the importance of unbiased information, presented without a sales focus. Households felt that information from salespeople is provided to encourage them to make purchases and is therefore not reliable. Phone calls, door-knockers and pamphlets from legitimate companies with information about available rebates or energy efficiency upgrades were viewed suspiciously by older people in the community in particular – a cohort that would benefit from energy savings.

“Looking at electric hot water systems, having something that’s like, ‘This is this size which would be suitable for a family of this size, or water usage to this limit’. So that I can look at something that’s not got a salesperson.” (HH5)

“[P]eople feel like there’s so many companies that are almost predatory in trying to get you to sign up through them to do whatever the thing is. And then you feel not quite confident that that’s how it’s meant to be or if that person is actually taking advantage or is that the true value of the deal?” (Local media professional)

“a lot of plumbers will talk you out of switching out of gas because they don’t think heat pumps work so well, and some of those old ideas. So I think some independent advice is always good, if someone can help guide you through why something’s worth doing.” (HH12)

Facebook groups and other online ‘communities of interest’ are valued sources of peer-to-peer information. Some households valued the opportunity to seek advice from people with lived experience, who have undertaken home upgrades, is valued over official sources of information.

“We are gardeners, so we follow permaculture principles. So we have Milkwood and famous sort of sources, and unlike any other source we trust them 100% because it’s community-based, essentially a community, that is all about helping each other and completely sustainable.” (HH1)

“My Efficient Electric House, the Facebook group, is the one that we would use the most. It kind of has trumped [Sustainability Victoria]. I would never go to the Sustainability Victoria website anymore, and things that I might have gone to in the past. It feels like a much quicker thing just to ask someone a question.” (HH 12)

Households reported that most of the information currently available about specific products, services, programs and incentives to support home upgrades is focused on energy efficiency and electrification.

“I think the flooding stuff, I’ve kind of been curious about whether there’s another group of people that have expertise around adaptation, because a lot of that expertise at the moment that’s out there is around energy efficiency and energy, but not so much around the adaptation stuff.” (HH12)

Community services providers expressed concern that their clients are overwhelmed by the number and complexity of government programs and incentive schemes for energy upgrades, and by the number of different government agencies involved in the administration and delivery of these programs.

“It’s a bit of a rabbit warren because, there’s Solar Victoria, Sustainability Victoria, there’s the federal government, there’s local governments. So it becomes quite confusing to people.” (Local Scorecard assessor)

Households and community services providers alike told us that they are time-poor and struggling with information overload. A more coordinated and streamlined approach to the provision of information on government resources, programs and services is needed, with information on home energy upgrades and broader resilience retrofits located in one place.

“There’s just so much information. I get information overload.” (Council Access and Support Worker)

“I am no expert, and I am not partnered, so the reliance on trawling through all the available information falls to me. So something like the government reports, all of those things being readily available would be really meaningful to me.” (HH5)

“There’s just so many options, like, we’re looking at insulation and there’s like a hundred different types of insulation. And it’s like, do I do the ceiling? Do the walls? Do I do the floor? What matters? Why use this type of insulation instead of this type? I don’t know. There’s just so much information out there. I have to be a professional to know what’s right.” (HH14)

Multicultural services providers expressed concern that government departments are not providing information about home energy upgrades in plain English to support comprehension and translation. These key informants emphasised that information on climate risks and adaptation options must also be provided in multiple languages, in both written and audio-visual forms, and through culturally appropriate channels, to support behaviour change within CALD communities. Some members of multicultural communities and recently arrived migrants and refugees have the necessary technical skills and expertise to understand and assist others with home adaptation upgrades.

Households would like more specific information about the relative benefits of different resilience retrofits, and how to prioritise actions, based on what will have the greatest impact for the cost.

“I think it’s true that more information [is needed], putting it in a bit more perspective what sort of ‘game changer’ this could potentially be? ... because none of us has an endless amount of money, so I need to decide where I am going to put the money. I can’t have all of this.” (HH1)

“I feel it’s still probably a process of how to prioritise which of these things you do ... Whether it’s like a more generic, some sort of decision tree guidance around thinking about your house in the context of where it is. Which of these things are most important?” (HH12)

Community services providers noted that information is necessary but not sufficient to enable households to undertake resilience retrofits.

“Programs need to be accessible, based on people’s lived experiences, relevant to their day-to-day lives, and go beyond basic provision of information to provide practical and tangible support.” (Neighbourhood House Coordinator)

A local Residential Efficiency Scorecard assessor similarly commented that households are seeking tailored advice and practical support with home energy upgrades.

“I think if it was easier, like the process and the complexities were reduced, I think more people would probably go down (the retrofit) track because it can be daunting, especially if it’s a single person on their own who doesn’t have the confidence....” (Local Scorecard assessor)

“I probably give them too much [information] and it’s a bit overwhelming, and there’s a lot of decision-making around it. So I’ve just been working on this. I’ve been working with a client that I do the Scorecard for to oversee the retrofit for her, because I just had time, and she didn’t have the confidence or the technical knowledge.” (Local Scorecard assessor)

Households and local service providers alike identified opportunities to build on existing outreach services – including Scorecard assessment services, the CFA’s home bushfire risk assessment service, and in-home aged care programs provided by Council – to provide tailored information and advice on local climate risks, adaptation options, incentives and supports.

“A human being who could actually come to my house and tell me this is what I have – and that person can say, ‘These are the incentives, these are the easy wins, these are the things that are going to cost a bit more money, but this is what it provides’, to actually help people now ... I think local councils, it should be put upon them. [I know] it’s really hard, but all of the in-home services, the whole ‘trying to keep the people in their homes as long as possible’, it should extend to this kind of thing.” (HH5)

Feedback on Housing Typologies and Retrofit Options Guide

Households were asked to provide feedback on the Housing Typologies and Retrofit Options Guide developed for this project and used as a discussion tool in the interviews, with the understanding that the Guide may be further developed for broader distribution.

Households generally found the Guide useful for identifying actions that they may not have thought about before, and for prompting further self-guided research.

"I think it's a great idea what you're doing. This is a really good, this is very well laid out this booklet you've got, and it sounds like a complex sort of thing to get your head around, but I think you've made it more simple and easy to understand, and become a more practical sort of thing." (HH8)

"So then a point I find very interesting is here, the second last, installing bushfire screens and shutters. Because that is something that I didn't know, that there are more or less safe bushfire screens or shutters. So that is something that I will now go home and investigate." (HH1)

While some households found the Guide simple and easy to use and liked the layout and focus on individual risks and different scales of action, others felt overwhelmed by the amount of information presented. Several households also indicated that they would like further advice on what actions to prioritise.

"[The Guide] looks useful, but not sure people will engage with it. Too much information. Some people are just not interested." (HH2)

"So, and I feel it's still probably a process of how to prioritise which of these things you do ... I feel slightly overwhelmed still about which thing first." (HH12)

Some households felt that more information was needed to explain the 'how' and 'why' of each of the recommended retrofit actions. Households highlighted the importance of using simple language and symbols for people who do not understand technical or industry terms. One household suggested that community workshops would be helpful to talk households through the Guide and provide more nuanced advice. Workshops and working bees were also identified by local sustainability group members as a potentially effective way to promote and support action by households.

"Workshops to discuss the Guide in sections would be good. Invite people, provide some cake and coffee. Look at one section at a time. People can ask questions and get advice. Advice is not always straightforward; for example, you need certain fencing for bushfire safety, but this creates issues with flooding and heat. This needs to be discussed." (HH2)

A package of funding support for households could be built around recommended actions.

"Resource [the Guide] would be nicely coupled with a funding program to support some of the recommended works." (HH10)

Households suggested a range of distribution channels for the Guide, including Bunnings, Council and local libraries. Another household suggested that the Guide, or a similar resource, should be targeted at builders.

"My view is now that the only people that can change it [attention on resilience in building practices] are the builders." (HH2)

8.4.2. Access to programs and services

A range of organisations are active in emergency management across the Shire and are providing services to households for home energy, safety, and accessibility assessments and upgrades.

Local government staff noted that most of the emergency management services provided by Council are focused on preparedness for extreme weather events, such as clearing out gutters and drains, and sandbagging in preparation for heavy rainfall.

For local emergency services, the focus is on response. Further investment to support their work in risk mitigation and preparedness is needed as climate change increases the frequency and severity of extreme weather events.

“For emergency services and other related organisations, all BAU [business as usual] stops post-disaster because of the massive focus on response, which means preparedness programs aren’t active.” (Local emergency services worker)

Local service providers mentioned several existing Council and community-run services that provide outreach and household-level support to community members who are experiencing barriers accessing local services – including elderly residents, people living with a disability, people with complex mental health issues, renters at risk of homelessness and public housing tenants. These services are delivered within a community development framework that focuses on building trust and rapport, understanding the needs of individuals, empowering individuals to make decisions about their lives, and connecting people to community groups and services. Community services providers told us that this model is critical to effectively engaging marginalised residents and increasing access to information and services.

Community services providers felt that they would be best placed to engage and support specific cohorts to understand and respond to climate risk, building on established trust and relationships. But community services workers providing outreach services also told us that talking to clients about climate risks and home adaptation upgrades is outside the scope of their work, due to limited resourcing and a necessary focus on immediate needs. One community services manager noted that there may be an opportunity to integrate home energy assessments into property modification assessments undertaken as part of outreach services for in-home aged care.

Service providers delivering home energy assessments in the region – both formal Residential Efficiency Scorecard assessments and informal energy efficiency assessments – told us that they are integrating information on climate risks into their work where relevant and where they have sufficient knowledge, but that this approach is dependent on the knowledge of individual assessors.

“But definitely, if they are having to do upgrades and they’re in a BAL-rated area I would talk about appropriate materials to use. As well as appropriate things like shutters or definitely external window coverings and things like that. But that will just be me, because of my awareness, not because it’s part of the Scorecard.” (Local Scorecard Assessor)

Local sustainability groups are actively supporting home energy upgrades through bulk-buy programs and pilot projects for zero emissions home retrofitting. However, these groups are struggling to secure government support to scale up pilot initiatives and have turned to crowd-funding to continue their work.

“MASG, Bendigo Sustainability Group, Geelong Sustainability Group and Goulburn Valley Community Energy have had many conversations about the need for deep retrofitting in our communities. We have discussed training needs. We have discussed financial models. Lately the conversation has turned in a DIY direction ... Let’s look at crowd-funding, start small, and do it!” (Local sustainability group member)

Skills gaps and labour shortages across regional Victoria are making it difficult for households in the Shire to access tradespeople for both minor and major home upgrades. There are limited local providers offering products and services to support resilience retrofits.

“I’ve been working with a woman on this, and she’s learned a lot. But I also found it a bit frustrating because I was recommending things that she could do but I couldn’t provide any local people to do it. But I’m finding a few young people who are sort of interested in this...” (Local Scorecard assessor)

“The Australian construction industry has not taken on retrofits as a skill or marketing opportunity ... Another barrier is the lack of construction industry competence. There are only a few companies providing retrofits in Victoria, [and] most only provide one aspect, e.g., insulation, and the level of activity is low.” (Local sustainability group member)

“As far as builders go, it seems pretty hard to get builders ... all the builders seem to be pretty busy for a really long time.” (HH14)

Many of the residents we spoke to also expressed a lack of trust in the ability of builders and tradespeople to provide reliable advice or do a good job when it comes to home adaptation upgrades, suggesting that further training and workforce development is needed.

“if we were to raise the house, like under stumps, it is really hard to find non-cowboys, and the trust involved with certain trades is, there’s not a lot of trust out there that they’ll do what you’re asking them to. Even getting roof insulation put in, we opted to do it ourselves because I wasn’t confident that someone would do it properly.” (HH12)

Housing service providers noted that renters who are living in squalor or struggling with hoarding behaviour are also less likely to invite tradespeople into their homes.

Local multicultural services also commented on the lack of cultural diversity in the local trades sector, which can be a barrier to CALD and First Nations households engaging service providers for home upgrades. In addition to the benefits of increased training opportunities for CALD and First Nations young people, local tradespeople and Scorecard assessors would also benefit from cultural competency training to ensure that they can work sensitively and effectively with CALD and First Nations families.

“A lot of people were coming into the Scorecard having done training purely on a desktop. So they haven’t dealt with people. And there is no training around diversity issues.” (Local Scorecard assessor)

Neighbourhood Houses in the Shire offer a range of programs, such as eco-carpentry, handy DIY skills for women, and gardening and sustainability, that could be extended to support local retrofitting. A coordinator at Castlemaine Community House noted that having the right facilitator for education and training programs is critical. Facilitators need to be knowledgeable and to have relevant technical skills and experience. But they also need to be passionate, engaging and flexible, and have the skills to work with and support a diverse group of people, tailoring content and adapting support to individuals’ interests and needs.

Local service providers involved in home energy assessment and retrofit programs in the Shire recommended a coordinated approach to the delivery of retrofit programs to stimulate the market for local tradespeople.

“If home assessors could bundle up jobs for tradies then they would see it as more worthwhile to come out and do the work ... Perhaps the assessor does the assessment, then contacts whoever it is and says, you know, these are the things to do, so there’s more than one job ... I think being able to sort of coordinate that together makes it worthwhile.” (Local Scorecard assessor)

“What has made the difference in Europe has been that government and the community housing sector has created a pipeline of continuing retrofitting work and an annual open tender process has attracted the construction industry to rapidly increase the quality of the retrofit, decreased the time taken (typically one week) and dropped the unit cost every year since their program began in 2016.” (Local sustainability group member)

8.4.3. Access to financial incentives

Several of the residents we spoke to had accessed financial incentives through Solar Victoria for solar panels and heat pumps. One resident had also installed an air-conditioner through the VEU scheme.

Households told us that financial incentives are important to allow low-income households to manage the up-front costs associated with home adaptation upgrades, and to motivate households in general to undertake priority upgrades when they are juggling multiple, competing priorities.

“Any government incentive, wherever it’s coming from local, federal, state, it doesn’t matter ... Some people will be thinking about it for a long time, and just that extra help, maybe 10–15%, it gets them along across the line...” (HH8)

One household indicated that access to low insurance premiums or low mortgage rates for households that undertake resilience retrofits could be a simple and effective alternative to complex government rebates and incentive schemes for home upgrade products, highlighting the opportunity to expand on the green loans currently offered by banks, which reduce interest rates for homeowners building or investing in upgrades for an energy-efficient home.

“I think if there was something with the bank or the insurance company that allowed us to access lower rates for doing stuff that might help ... that’s kind of heading towards the question of Residential EUAs [Environmental Upgrade Agreements], but I don’t know whether I would bother much, if it was really clunky and really complicated, versus a bank that could possibly knock off X percent ... I think that might just be more straightforward.” (HH12)

This was echoed by a local insurance broker:

“I think really, there needs to be some sort of incentive for people to move. So currently, there isn’t any ... So why would a person building a home, unless they’re made to do it, put that extra cost in? And so if there was some sort of incentive for people to make those sorts of financial choices, they’re more likely to do so.” (Insurance broker in regional Victoria)

Community services providers also identified the No Interest Loans Scheme (NILS) as an avenue through which low-income households might access financial support for minor home energy and adaptation upgrades if the program could be expanded to accommodate this. This scheme provides loans of up to \$1,000 for emergency support, to be paid off within 12 months. A coordinator from Castlemaine Community House noted that there is good uptake of this program in the Shire. Financial counselling is provided alongside the loan, and most recipients pay the loan back within 12 months and go on to access subsequent loans.

Local sustainability groups involved in energy efficiency and net zero retrofit pilots noted the many benefits for households and governments that investment in comprehensive retrofitting could deliver.

“When the multiple benefits of retrofit programs are added together – health cost savings, energy bill savings, emissions savings, winter and summer peak demand infrastructure savings – the benefits of retrofitting at scale outweigh the costs and an expensive retrofit can be paid off in under 10 years.” (Local sustainability group member)

In an interview with the Commissioner for Residential Tenancies, we heard that split incentives for retrofits – in which renters and landlords share the cost of the work – have been explored for rental properties, but that they are generally not advisable due to the undue burden they place on low-income renters. According to the Commissioner, and a local real estate agent we spoke to, the short tenure of leases (currently averaging 15 months, despite regulatory changes designed to support longer leases) and the period for which properties remain in the rental market (averaging approximately five years) limit the practicality of shared-cost approaches.

“The lease is not long enough. The renter might say, that sounds great, but then we’ve got a 12-month lease and the owner will go halves on the system, but then they can say, well, we’re moving back into the house. There needs to be some sort of consideration for that.” (Real estate agent)

8.4.4. Government roles and responsibilities

Households and local professionals see local government as playing a critical role as a trusted source of local information on climate risks, risk mitigation and preparedness for extreme weather events.

“In terms of extreme events, well, probably Council would be my first port of call. Definitely.” (HH10)

“Local government is complained about, but trusted.” (Community services manager)

“[For] Mount Alexander Shire to have effective and efficient monitoring systems which really respond and communicate actions to support all their residents/ratepayers.” (HH14)

Local government was also seen by households and emergency service workers as playing a critical role in risk mitigation through local planning decisions and amendments, and maintenance of and upgrades to drainage. These participants indicated that councils are not doing enough in these areas to reduce risk.

“Council should be involved but not too much, acknowledging that their decisions on development and operation of infrastructure are part of the problem.” (Local emergency services worker)

“[There is] poor, non-existent council drainage, which must have been approved for the development ... Stormwater coming from street runoff blocks drains, [which are] not maintained. Storm events mean water explodes from council ‘grates’ into our property.” (HH14)

Most of the households we spoke to who had been impacted by flooding attributed this to poorly maintained stormwater drains and the slope of their blocks, as opposed to direct flooding from rivers or creeks. A local insurance broker made a similar observation, commenting on the recent flooding that occurred across regional Victoria in 2022.

“But the majority of the flooding issues didn’t come from a river. They came from the drainage system. Had the drains been sorted, it wouldn’t have been the issue that it is.” (Insurance broker in regional Victoria)

Residents were also aware that flood mitigation works undertaken by Council and local utilities can change how properties are impacted by extreme weather events.

“It’s never flooded, but you know, it’s a changing world. And I suppose even the impact of what Council does upstream with levees and other things, what Powercor does with levees and how they will change the flood patterns. You never know. So that’s our main risk.” (HH12)

Households and local service providers saw the role of state government as resourcing local government, regulating the building industry, providing financial incentives to households and businesses, providing independent information on energy efficiency and resilience products, and undertaking seasonal risk reduction activities.

“The state government is the biggest player in this because effectively it can allow local governments to find local solutions with their communities to all of these things, or it can try and do the top-down, one-size-fits-all approach, and that will be a debacle if it tries to do that.” (Local permaculture trainer)

“It’s more about behaviour change. It would have to go through the builders and the legislation ... it must really come from the builders and the government, or people won’t do it.” (HH2)

“You know, maybe there’s room there for a state government mailing list that’s targeted to this that has, you know [information] – ‘We’re coming into this season, have you thought about this, that or the other?’ Just so that it’s front of mind, because otherwise, the pace of life is so quick that you don’t even think about it, you know? So I would subscribe to an impartial state government [newsletter] so that I got that prompt, ‘Now’s the time to be doing or thinking about these things.’” (HH5)

8.4.5. Insurance

Households told us about the challenges they have faced in accessing adequate home insurance in the areas affected by the 2022 floods, and their concerns about the future insurability of their homes.

“I was insured but I wasn’t insured enough. So I was able to get some furniture and start off again. I lost about \$40,000 worth of stuff. And I only got \$25,000.” (HH4)

"I am a little bit worried about what my premium will be. I don't know what that's gonna look like ... Which is why I've been thinking a bit about well, how do I mitigate risk? Because I have to have insurance. I have a mortgage." (HH10)

A local insurance broker commented on the impact that climate change is having on the industry and how whole areas have become uninsurable.

"So what's happening currently, and it hasn't happened previously, is that insurance companies are now retreating from markets that they no longer wish to deal in. And so if you are anywhere in a flood zone, anywhere near a tree, anywhere that's a potential risk, where multiple people could be damaged at the same time. They're retreating from that." (Insurance broker in regional Victoria)

We also heard about the limitations of insurance when it comes to building back better following a disaster event.

"So as long as you're adequately insured, it's a new for old replacement. So you can either choose to rebuild where you are on that particular land, or you can take your cash settlement and run, but it is a new for old replacement value." (Insurance broker in regional Victoria)

"Houses get fixed after events, not redesigned." (Local emergency services worker)

Insurers are assessing risk and applying premiums at a neighbourhood scale, rather than looking at the individual context. There are currently no insurance-based incentives for households to invest in retrofits for risk mitigation.

"... even if you put sprinklers on top of your house in the bushfire zone, or you've got bushfire-rated building products, they won't look at that. They look at a whole suburb and either say yes or no. You could build a giant brick fence around your house in a flood zone and put a gate out the front, a flood gate, and it makes no difference ... If we looked at each individual property and asked, 'What have you done to resolve this?', then there might be more people inclined to retrofit their homes." (Insurance broker in regional Victoria)

8.4.6. Planning and building regulations

Households described how planning decisions and new developments are increasing, the risks to homes in their neighbourhood, particularly in relation to flooding.

"There have been instances where there's been a lot of water on the road and stormwater blockages coming down from further up with these housing estates and just sort of the speed of it and things like that." (HH12)

"There used to be a lake, like a little dam, but all the drain water went into there. Of course, it's now going to be developed, and they've packed sand into the dam. And it was a wildlife refuge, you know, for ducks and kangaroos and all sorts of little animals, and big trees. Everyone enjoyed it." (HH2)

Local emergency services workers and an insurance broker also commented on the impact of new developments on flooding.

"Where new estates have been built, the water flows have changed. There is water over some roads now where that never occurred before." (Local emergency services worker)

“Governments need to consider where new housing is being built, and how drainage is being maintained, as that is heavily impacting flood risk for existing homes ... The other thing is where they’re putting that housing, because in this area the new housing has pushed water to areas that had never been flooded before...”
(Insurance broker in regional Victoria)

Land and water management decisions are also impacting households.

“Well, recently, we had flooding for the first time. Not major, but a dam belonging to Parks [Parks Victoria] next door was cleared out about seven or eight years ago, and they dumped the stuff at the back of our place and it just changed where the water would overflow.” (HH6)

Several of Council’s officers and local emergency services workers we spoke to expressed concern that local planning and emergency management decisions are being made based on historical data and with reference to past events, without due consideration of future climate scenarios.

“How can we prepare for the future based on past events? ‘One-in-100-year’ floods are happening all the time, and the weather is impacting us beyond what we are designing for. We need to plan and design for more frequent and intense extreme weather events.” (Local emergency services worker)

Households commented on the need for stronger building regulations and environmentally sustainable design standards to increase resilience to climate-related risks and extreme weather events.

“And on a broader scale, the government doesn’t regulate the construction of houses properly. New housing estates they’re mad, just some of these houses aren’t being properly designed. And that’s a real issue. And I think it’s just the developers having their way with it. And the government needs to toughen up on building regulations, on eco [design].” (HH8)

“The houses in the estate are set up to make money. Because they didn’t take into [account] the northern light, [and] it doesn’t allow wildlife to navigate ... But it is all about how many blocks we can squeeze in. And I can tell you, in 10 years this will be a slum. Because of the heat and no trees.” (HH2)

One household we spoke to whose home is situated in a newer housing development expressed concern that even newer homes, built in recent years, will require retrofitting for energy efficiency and resilience, highlighting the need for stronger building regulations and training.

“They are inflexible, the builders ... I wanted to have electrical everything in there [the kitchen], for my cooking, but no ... ‘we supply and it’s up to you to change it later’ ... And I can’t even go electrical now, because it costs so much.” (HH2)

A local home energy service provider noted that minimum energy efficiency requirements for new builds will be coming into effect, but that there is no forward planning or schedule to strengthen these standards over time to enable industry to plan for this.

We heard from the Department of Energy, Environment and Climate Action (DEECA) and the RBC that they are exploring the potential for a combined energy efficiency and resilient rating system to inform mandatory disclosures of home performance at the point of sale. A local real estate agent we spoke to saw benefits to this approach for rental properties too.

“Well, it’s what we’ve already got in play for new properties. So it’s bringing the rest of the properties into line with that. And that’s probably where we’re going to go. And it makes sense ... If a property’s old, it’s been retrofitted and people have done the work, then the star rating would be nice.” (Real estate agent)

8.5. Motivation

8.5.1. Values and drivers

When asked what they like about where they live, the households we spoke to told us that a sense of community, proximity to nature, and access to town services and public transport are important. Home gardens are also valued by many of the households we spoke to.

Households that had invested in home adaptation upgrades, particularly in relation to energy, told us that sustainability values and concerns around climate change were primary drivers.

“Financially it’s not that much benefit at this stage, but in the long term it will be. But it’s probably more environmentally [that] would probably be the first, the first reason I reckon.” (HH8)

Households also mentioned comfort, wellbeing and energy security as factors motivating their investment in home energy upgrades.

“I wanted something really robust and because I have also been a single parent for a long time – that’s a marathon within itself – so my motivation was that I can’t do summers with a toddler on my own, when we’re both ratty because we haven’t slept [because of] the heat. So it was about overall wellbeing.” (HH5)

“Probably comfort. And, and kind of knowing what’s coming and trying to be as less dependent as we can on energy because the grid goes down and we don’t want to be stuck in a house really dependent on active cooling and heating. And that’s for the thermal comfort stuff anyway.” (HH12)

One resident explained how thinking about climate risk when choosing what property to buy was an important consideration for their long-term mental health and wellbeing.

“The last five years have certainly got us on top of our toes to not take any risks, and to really have, unfortunately, a quite conservative approach [to buying a house] ... It meant that we didn’t put offers in on a lot of properties ... I think it’s a bit related to mental health as well, that we don’t freak out about that every time there is something relatively close by, like heavy rainfall...” (HH1)

For landlords, the motivation for investing in resilience retrofits differed from that of homeowners. A local real estate agent indicated that attracting and keeping good tenants and meeting regulatory obligations under the Residential Tenancies Act are the primary drivers for landlords investing in home repairs and upgrades.

Local housing advocates commented on how the minimum standards set out in the Residential Tenancies Act are driving repairs to rental properties and improving thermal comfort for renters. Repairs for broken heating and cooling units are now considered urgent, and rental properties must have window coverings, with tenants also allowed to install their own temporary window coverings or window film for insulation. Significant gaps in the Residential

Tenancies Act were also identified, however. Current minimum standards do not require insulation, only require heating units rated to 2-star, and do not include any standards for the thermal properties of window coverings.

Mandatory disclosure of the energy efficiency and resilience of rental properties was considered by housing advocates and real estate agents to be important but not sufficient to motivate landlords to take action, particularly in rural and regional areas where the rental market is tight. There is significant competition for a small number of affordable rental properties in the Shire, and little market incentive for landlords to invest in resilience retrofits or other home upgrades. Ultimately, key informants agreed that regulation and stronger minimum standards will be required to drive action by landlords.

***“Unless it’s legislated, you’ll always have landlords who won’t act.”
(Local tenancy advocate)***

8.5.2. Attitudes towards resilience retrofits

The ‘80:20 rule’ was mentioned or alluded to by several of the households we spoke to, who shared the attitude that undertaking basic preparation and minor resilience retrofits would get them 80% of the way towards a more resilient home; and beyond that, more significant or costly retrofits may be harder to justify.

***“Well, I just mean, it kind of fits with, what’s the old 80:20 [rule]? Exactly.
So, I kind of feel like we’re in that ballpark, so we don’t have to do it 100%.” (HH7)***

8.5.3. Competing priorities

While households see a clear return on investment from energy efficiency upgrades, the cost-benefit ratio for resilience retrofits is not as clear, and financial incentives may be required to motivate households to take action.

“It would probably have to be a financial incentive, not necessarily a big one, but I don’t – rightly or wrongly – I don’t consider it that essential for me, I’m not sure I have the motivation. And that might be a lack of understanding of how much it will do to [benefit] me.” (HH1)

Households told us that they want more information about the relative benefits of different home upgrade options to help them to prioritise. Households are keen to understand how much safer they will be if they invest in a recommended upgrade, and whether the benefits will outweigh the costs.

“But sometimes it’d be good to have an idea about, if you did these things, then this is the kind of difference you could expect. So, whether it’s like your house might be a degree cooler, or a degree warmer, that sort of stuff.” (HH10)

“People are trying to weigh up their costs, you know, you throw in the cost of living and all those sorts of things. People have got to weigh that up.” (Insurance broker in regional Victoria)

Households are also thinking about how strategies to mitigate one type of risk could increase other risks, and they are considering what types of retrofits to prioritise, based on the specific risk profile of their home.

“I guess everything you do is going to have an impact on something else that might make it worse ... It’s interesting to think about trade-offs with other risks. If we replaced external doors with flood doors would that reduce our northern light?” (HH12)

Finding the time to research, understand and implement different resilience retrofit options is a challenge for many households.

“I mean some of this, honestly, I find that with some of this stuff, that unfortunately it could be just a full-time job. Full-time working on this. And then don’t worry about anything else.” (HH7)

Community services providers working with households that are struggling with the cost of living, health issues and other types of personal or financial hardship indicated that home upgrades to mitigate future risk are a lesser priority for households than more immediate concerns, such as the ability to access food, pay energy bills, and keep warm or cool.

“They are focused on immediate needs, not future risks.” (Council Access and Support Manager)

Even households that can afford home adaptation upgrades may not prioritise resilience retrofits over other desired upgrades.

“We spend more money building a second toilet than to do more insulation.” (HH2)

10.5.4. Intention to act

Households are more likely to take action to reduce risks in the aftermath of a disaster event.

Local emergency services providers told us that calls to action for risk mitigation and preparedness are most effective immediately after events, and that there is a short window in which people will act. Calls to action after disaster events in other parts of the country can also be effective when these events receive widespread media coverage.

One resident explained how their level of awareness and intention to act is higher during the bushfire season but then quickly dissipates after the season, particularly if there have been no major fire events.

“And we haven’t talked about it this year because it just hasn’t been a fiery summer. But you know, quite often, when we have had a few fires around, we go, ‘We haven’t actually got a fire plan, we haven’t actually got a bag packed or anything like that’, and then it passes.” (HH7)



9. Analysis and recommendations

This section brings together the findings from the literature review, the case study and our interviews to highlight some key themes, which directly inform and substantiate our recommendations.

Our recommendations propose a series of actions that can increase the uptake of resilience retrofits at the household and neighbourhood scales. While quite a number of actions have been identified, many of these involve modifications of existing programs, rather than extensive investment in new programs or incentives.

The recommendations are all based on evidence gathered through our research. Many of them are independently reinforced by related work that is ongoing across the research, government, planning and community services sectors. Our proposed actions highlight that the broad uptake of resilience retrofits requires coordinated efforts across multiple sectors, including local and state government, community-based organisations and the property sector, among others. This is particularly true for actions specifically designed to support households that are likely to be disproportionately impacted by extreme weather events.

The subsections below outline the key themes identified in this research and the tables specify the recommended actions and who we propose is most suitable to implement them. The actions are divided into the following three types:

- **Deliver** – includes direct project management and accountability
- **Fund** – includes ongoing funding where required and catalytic funding where actions may pay for themselves over time (e.g., through reduced emergency recovery spending)
- **Regulate** – includes policy development, legislation and enforcement

9.1. Risk awareness

Our conversations with households supported evidence from emergency services research and the recent CEDRR survey in the Shire about household awareness of extreme weather risks.

Overall, the households generally had a broad awareness of risks related to extreme weather but an inconsistent understanding of what this could mean for their own properties, including the influence of their home's typology. Walking households through the *Housing Typologies and Retrofit Options Guide* helped the interviewees to understand how their home's design features or materials could either reduce or increase the impact of extreme weather, as well as what retrofit options are particularly suitable for their circumstances, including their home's typology.

Both the literature and our interviews support the conclusion that household and public understanding of risk is largely driven by past experience. This is reinforced by models and maps of climate risks (particularly flood) that are based on historical data and not climate projections. Households in flood zones were aware of flood risks at the point of purchase, but for some households, this classification changed after they had been living in their home for some time, therefore shifting their understanding of their risk levels. As identified in the aftermath of the 2022 floods in Victoria, there is a need for flood maps and other risk assessment tools, such as Municipal Emergency Management Plans, to consistently factor in climate change projections. Without this occurring, households will continue to have limited information about their evolving risk levels and what actions they should undertake to prepare for future extreme weather events.

At a broader scale, our analysis of houses by typology in flood and fire zones in Castlemaine, Chewton and Campbells Creek identified the need to integrate new data sets being created by local councils as part of their housing and neighbourhood character strategies into climate risk assessments. The analysis helped to specify the collective risk faced in high-risk areas based on home characteristics and identified the opportunity for community-scale retrofitting among clusters of similar homes. This highlights the additional value of housing and neighbourhood character strategies and related strategic planning activities as they are undertaken across regional Victoria.

Beyond their properties, households are aware of the role of surrounding land and infrastructure in either increasing or decreasing their risk levels in the case of extreme weather events. Management of these factors fall outside households' sphere of influence, however, and points to the role of councils, catchment management authorities and state governments in understanding and responding to risk at a regional scale.

Some households reported that real estate agents had informed them of any property-specific risks at the time of purchasing their homes, consistent with the purpose of the Section 32 Vendor Statement to disclose climate-related risks to property buyers. While disclosure of this information is required, there is no mandate for real estate agents or conveyancers to work with buyers to identify risk reduction measures, including resilience retrofit options. Given that the point of purchase is a time when households often undertake renovations, an opportunity clearly exists to educate buyers about resilience retrofit resources. For renters, no disclosure requirements at the point of lease exist; an opportunity therefore exists for agents to provide such disclosure and guidance about actions that renters can take.

Generally, locally led public education on extreme weather continues to be important and necessary, as noted in the disaster resilience literature and confirmed by our key informants from emergency management services and local government. As with many preventative resilience-building measures, funding support for delivering such programs is currently inconsistent, limiting the potential to extend their scope to include risk mitigation through resilience retrofits.

In summary, information about climate-related risks should be consistent, context-specific, based on future climate projections, and applied and shared with communities in clear and locally relevant ways. This will ensure that households have climate risk information that is useful to them and can inform their decision-making about the future.

RISK AWARENESS Recommended actions		Implemented by			Building on
		Deliver	Fund	Regulate	
A	Apply a rigorous and consistent approach to the development / updating of flood maps and Municipal Emergency Management Plans that is based on future climate projections (see Rec. 7A)	Local gov	Vic Gov	Vic Gov	Current requirements for LGA-level flood maps and Municipal Emergency Management Plans
B	Develop regional-scale flood maps that inform local flood maps and reflect catchment-level impacts of new development and coordinated opportunities for risk mitigation	Catchment Management Authority	Vic Gov	Vic Gov	Current catchment-scale maps
C	Consistently incorporate climate risks in strategic land use planning projects (including housing and neighbourhood character strategies, structure plans and framework plans) to identify needs for neighbourhood-scale mitigation actions and reduce potential future impacts on households (including decision-making about the location and nature of new development)	Local gov	Vic Gov	Vic Gov	Current state government resourcing / requirements for local councils to develop neighbourhood character strategies
D	Explicitly inform buyers and renters of property-specific climate risks at the point of sale or rental and provide information about actions can be taken in response	Landlords, vendors and their real estate agents	Vic Gov (for rental)	Aus Gov	Information provided in Section 32 Vendor Statement for property sales; minimum standards in Residential Tenancies Act (at state level)
E	Develop and deliver sustainable, ongoing community-based programs to raise awareness of localised climate risks and resources available for reducing risks and responding to extreme weather events	Local gov Emergency management services	—	—	Existing localised emergency management education programs

TABLE 9 – Recommendations: risk awareness

9.2. Retrofit information, engagement and access to resources

Our research indicates that households would benefit from retrofit information and programs that apply a whole-of-home approach by integrating energy efficiency, resilience and basic health outcomes. This approach would recognise the co-benefits of many retrofit actions and ensure that works undertaken provide holistic health, safety and climate benefits to households. Moreover, the household cost savings deriving from energy efficiency improvements would help to cross-subsidise works undertaken for health and resilience purposes, from which financial benefits may not flow immediately. Information about retrofits should also be accessible and provided through coordinated channels.

To make effective decisions, households require information sources that are unbiased, independent and trusted. Households interviewed indicated that trusted sources include emergency services, local and state government, and environmental organisations. Information and recommendations shared by peers are highly regarded as they help households decide on the actions they should take and connect households to trusted service providers or tradespeople.

Information needs to be accessible; that is, available in print and online and in different languages so that it reaches community segments who are not digitally literate or for whom English is a second language. Some members of the community do not have the capacity to undertake research about retrofit upgrades. These cohorts may be considered the most vulnerable in our community and disproportionately impacted by climate change. Providing these more vulnerable cohorts with the support needed to access information from a trusted organisation or individual is essential to ensure an equitable adaptation journey.

Extensive guidance and information about resilience and energy efficiency retrofit options are currently available across multiple sources, but the information tends to be:

- oriented to homeowners
- general in nature, and not often tailored to a home's age, construction or location, which all influence the suitability and value of various retrofit options
- highly technical and therefore not very accessible for many people
- not sufficiently localised to reflect relevant cost ranges or the complexity of specific requirements of undertaking retrofits in different locations
- occasionally conflicting in its advice, or failing to consider the pros and cons of different risk mitigation measures
- impersonal, and therefore not reflective of the value of service providers (such as home assessors and tradespeople) building rapport with individuals.

The above considerations informed our approach to developing the *Housing Typologies and Retrofit Options Guide*. The feedback from our interview participants noted the Guide's simplicity, usefulness and relevance to their homes and reinforced the limitations of many existing resources.

Similarly, the interviews highlighted the challenge of finding information about existing retrofit programs and services due to the fragmentation of such information across multiple government sites. A one-stop-shop approach that provides a single channel where households can access information about programs and incentives would reduce the time and effort required.

In relation to climate adaptation and resilience, households identified that they seek information to understand the climate risks they face and the potential impacts on their property or wellbeing; the actions they can undertake to reduce their risk; the incentives, resources and services available to help them make changes; and the costs and benefits associated with undertaking relevant actions.

When discussing home retrofits, however, households spoke broadly about concepts of climate adaptation, energy efficiency and disaster preparedness, interlinking these objectives as all related to climate change. A whole-of-home approach therefore represents an opportunity to integrate energy efficiency, emissions reduction (e.g., converting from gas to electric appliances), and health, safety and resilience factors into the provision of information, home assessments, programs and services. Such an approach would reduce maladaptive and short-term actions and maximise the benefits to households of investing in retrofit work. This is particularly important given the detailed and costly nature of retrofit work. A whole-of-home approach can help households to determine which home interventions and upgrades to prioritise based on multiple objectives and can enable multiple actions to be undertaken simultaneously to increase the efficiency of investment.

Adopting a whole-of-home approach would also provide the Victorian Government with an opportunity to support the extension of existing single-focus programs, such as the Residential Efficiency Scorecard assessment, into more holistic programs, rather than developing new programs.

Both the literature and our interviews made it clear that providing information to residents, including through our Guide, is necessary but insufficient to support retrofit action. Linking information about retrofit options to home assessment tools and services would allow for the identification of property-specific risks and personalised upgrade opportunities. Linked to an industry-wide rating standard, like that currently being developed by the RBC with partners from government and industry, rating assessments can also provide important information to prospective renters and buyers.

In summary, guidance on undertaking home retrofits should be integrated into a whole-of-home approach that encompasses resilience, health, safety, comfort, energy efficiency and environmental benefits. This would enable households to determine the retrofit options that are most suitable and of greatest value to them and their properties and to make optimal decisions about investing in their home. It would also minimise the chances of maladaptive actions and leverage current energy efficiency programs.

RETROFIT INFORMATION, ENGAGEMENT AND ACCESS TO RESOURCES Recommended actions		Implemented by			Building on
		Deliver	Fund	Regulate	
A	Broaden and reorient current home retrofit information and programs to take an integrated, 'whole-of-home' approach that combines benefits of energy efficiency and resilience retrofits, ensuring that information targeting the general public is broadly accessible	Aus Gov Vic Gov Local gov Community groups	Aus Gov Vic Gov	—	Existing but separate information and programs on energy efficiency and resilience retrofits
B	Develop regional-scale flood maps that Link general information about 'whole-of-home' retrofit options with self-assessment tools to enable households to personalise information to individual property contexts	RBC Local gov Vic Gov	Aus Gov Vic Gov	—	RBC bushfire-based self-assessment app
C	Adopt the Resilient Building Council's Resilience Rating system as an industry-wide standard that complements energy-efficiency ratings	RBC	Aus Gov	Aus Gov Vic Gov	RBC incorporation of the NatHERS / Residential Efficiency Scorecard rating systems
D	Expand the remit, responsibility and expertise of home energy assessors to include a 'whole-of-home' scope that covers both energy efficiency and resilience	Aus Gov	Aus Gov	Aus Gov	Energy assessments tied to Residential Efficiency Scorecard
E	Develop a single Victorian Government channel with unbiased and accessible, easy-to-understand information for households about all home retrofit programs and associated incentive schemes, including a platform for peer-to-peer discussion and 'ask an expert' guidance	Vic Gov	Vic Gov	—	Range of existing resources and peer-to-peer networks

TABLE 10 – Recommendations: retrofit information, engagement and access to resources

9.3. Motivations for action

Our research revealed that the provision of information to enhance awareness of climate-related risks and adaptation options is necessary but not sufficient to motivate household action. This finding is consistent with research undertaken by the SES in Victoria, and broader understandings of behavioural change identified in public health literature and programs.

In our interviews we heard that households in the Shire are motivated by a range of factors including attitudes towards risk (risk appetite and perceptions of risk exposure, and understanding of the costs and benefits of actions to reduce risk); personal values (sustainability); household priorities (comfort, health and wellbeing); financial drivers (cost savings and willingness to pay); and social drivers (social norms and community support).

The results from the CEDRR survey, which focused on perceptions of risk, show that many households in the Shire are aware of climate risks but consider their direct exposure to these risks to be minimal. This is consistent with what we heard in our interviews – that households are generally aware of climate-related risks but have limited information on or understanding of what this means for their home or property. To inform and motivate action, households need locally specific, contextual information on their exposure and vulnerability to current and future climate risk. In the absence of this information, and other practical guidance and support, most of the households we spoke to, and those participating in the CEDRR survey, have undertaken only minor home adaptation upgrades to date.

In light of competing household priorities and cost-of-living pressures, households also want to understand the ‘return on investment’ before undertaking more significant resilience retrofits. The CEDRR survey found that most households had a low to moderate appetite for risk: willing to take risks only if there is a good reason, or a substantial reward, for doing so. In our interviews, households told us that the reasons and rewards for undertaking home adaptation upgrades are not always clear. Households want more information on different adaptation options, on the rationale for undertaking one action over another, and on the potential benefits, in both financial terms and for broader household health and wellbeing.

When the cost-benefit analysis, return on investment and financial incentives are clear, households have been motivated to invest in home upgrades, such as installing solar PV and energy-efficient appliances. Many of the households we spoke to were also motivated to invest in home energy upgrades due to sustainability values and concerns about climate change, alongside other household priorities, including comfort, health and wellbeing, and saving money on energy bills.

The motivations of landlords to invest in resilience retrofits differ from those of homeowners. In rural and regional areas where the rental market is tight, with significant competition for a small number of affordable rental properties, there is little incentive for landlords to invest in home upgrades. Regulation and stronger minimum standards for rental properties will ultimately be required to motivate landlords to undertake resilience retrofits.

Whole-of-home assessments have been identified by RACE for 2030, and by the local key informants we interviewed, as critical to motivating households to undertake home energy and broader adaptation upgrades. We heard from local stakeholders that workshops can be an effective tool for information sharing, awareness raising and building a community of practice,

but that they are not as effective as household assessments when it comes to motivating and enabling action at the household level. This is consistent with the evaluation findings from home retrofit and energy upgrade programs across Australia, identified in our literature review. Personalised and contextualised recommendations arising from household assessments are more likely to increase a household’s awareness of their exposure and vulnerability to risk, and to motivate household action to reduce this risk.

The timing of household assessments, and access to other practical guidance and incentives, is also critical to motivate household action. We heard from local key informants that households are more likely to form an intention to upgrade their home when purchasing and moving into a new house, undertaking renovations or immediately after a disaster event. This is consistent with the points identified by RACE for 2030 in its assessment of factors influencing the success of retrofit programs and services.

In summary, messaging and incentives to encourage home retrofits should be holistic to respond to household priorities, motivators and ability to pay. This will maximise the reach of programs into communities, including households most exposed to climate-related risks.

MOTIVATIONS FOR ACTION Recommended actions		Implemented by			Building on
		Deliver	Fund	Regulate	
A	Develop targeted messaging drawn from the multiple benefits of ‘whole-of-home’ retrofits that can appeal to individual households’ varied motivations for taking action, including cost savings, risk-reduction, environmental and health and safety factors	Vic Gov Local gov	Vic Gov	—	Existing but separate information and programs on energy efficiency and resilience retrofits
B	Undertake further research on the relative value and impact of retrofit options to inform household prioritisation of and investment in different actions	Researchers	Aus Gov Vic Gov	—	Existing knowledge of materials performance
C	When developing incentives for retrofit actions, design options based on an understanding of households’ varying ability to pay, and combined objectives to 1) equitably support low-wealth households, 2) encourage broad action by owner-occupiers of all income levels and 3) incentivise landlords to take action	Aus Gov Vic Gov	Aus Gov Vic Gov	Aus Gov Vic Gov	Lessons from uptake of existing financial incentives for energy efficiency upgrades

TABLE 11 – Recommendations: motivations for action

9.4. Financial incentives

Households told us that more targeted financial incentives are needed to enable those on low incomes to undertake resilience retrofits. Broad incentives are also needed to motivate households with financial resources to prioritise investment in resilience upgrades.

Households with financial resources are accessing rebates and loans through the VEU and Solar Victoria schemes, but the up-front cost of the products and services on offer remains a barrier for low-income households. Local service providers told us that many of the households they work with find these schemes complex and confusing to navigate, and that support from trusted community groups and local service providers is needed.

The literature suggests that low-interest loans, such as those offered for solar PV and home batteries, are unlikely to be accessible to households with limited financial resources or desirable for those with considerable debt. The Australian Government's recent announcement of a \$1.3 billion Household Energy Upgrades Fund, offering low-interest loans to low-income households, presents an opportunity to evaluate and draw lessons from such schemes. There are also opportunities to build on existing schemes, such as the NILS, which has had good uptake across the Shire and is a well-known and trusted loan scheme for low-income households.

Renters told us that tax arrangements are a barrier to landlords investing in upgrades that are not considered 'essential maintenance'. The uptake of Solar Homes solar panel rebates by landlords has been slow. We also heard from the Commissioner of Residential Tenancies that split incentive schemes for resilience retrofits are not advisable due to the undue burden they place on renters, particularly those on low incomes. Financial incentives for landlords are important to enable upgrades to rental properties, but incentives alone are unlikely to motivate action. Stronger minimum standards for (and mandatory disclosure of) the resilience and energy efficiency of rental properties at the point of rent are required.

As noted by ClimateKIC and others in the literature, there is a mismatch between current financial incentive schemes and the scale of the retrofit challenge that we face. There are opportunities to strengthen and expand on existing rebate and loan schemes for home energy efficiency to support broader resilience retrofits, and to move beyond the incentivising of individual products and services to promote whole-of-home retrofits, as we are starting to see in flood-prone areas of Queensland and New South Wales. Financial incentives for resilience retrofits should be considered an investment in the nation's housing stock, for the health and safety of residents, now and into the future.

There is scope for both the banking and insurance sectors to provide financial incentives for households to undertake comprehensive whole-of-home retrofits. Some banks are offering discounted green home loans to build, refinance or upgrade to a more energy-efficient home, but these loans do not currently extend to resilience retrofits. Insurance payouts currently limit the ability of households to 'build back better' following a disaster, and insurance premiums are applied at the suburb level, with no recognition or incentive for individual households that have undertaken upgrades to reduce risk.

Households we spoke to indicated that discounted interest rates and insurance premiums could be a simpler and more effective alternative to complex government rebate and loan schemes for home upgrades. The Resilience Rating system currently under development by the RBC (which will complement the Residential Efficiency Scorecard, with both integrated into a single assessment) and requirements for mandatory disclosure can support this.

In summary, financial incentives for resilience retrofits should be integrated into energy efficiency programs to align with a whole-of-home approach and should be scaled to reflect both the individual and collective financial and environmental benefits of reducing the household and community-wide impacts of extreme weather events. This will motivate households of all income levels to undertake home upgrades and will maximise the benefits of preventative investment to government.

FINANCIAL INCENTIVES Recommended actions		Implemented by			Building on
		Deliver	Fund	Regulate	
A	Expand Victorian Government home retrofit rebate schemes, including those targeting landlords to include products with resilience benefits (see Rec. 7C)	Vic Gov	Vic Gov	—	Existing energy efficiency rebate schemes
B	Quantify the financial and embodied energy cost-benefit ratios of investing in residential and neighbourhood resilience retrofits at scale in Victoria, relative to current and projected annual spending on emergency response, recovery and rebuilding	Researchers	Vic Gov	—	International evidence of the return on investment in built environment resilience / risk mitigation
C	Expand home loan interest rate discount programs for energy efficiency to include discounts for resilience retrofit actions and high Resilience Rating scores (see Rec. 2C)	Banks	Banks	—	Emerging interest rate discount programs for energy efficiency home upgrades
D	Develop discounts on insurance premiums based on resilience retrofit actions and high Resilience Rating scores (see Rec. 2C)	Insurance sector	Insurance sector	—	N/A
E	Monitor outcomes of the Australian Government's \$1.3B Household Energy Upgrades Fund and apply lessons from its low-interest loan program to resilience retrofits	Researchers	Aus Gov	—	Roll-out of Household Energy Upgrades Fund

TABLE 12 – Recommendations: financial incentives

9.5. Retrofit market and implementation

The retrofit industry in Australia is growing, particularly where energy efficiency is the primary focus. It is still nascent relative to future need, however, and any investment in incentives to both encourage energy efficiency retrofits and increase demand for resilience retrofits requires corresponding investment to ensure the availability, skills and quality of relevant tradespeople and service providers.

Our interviews identified that households with relevant skills and physical capabilities prefer to undertake minor home upgrades themselves, but trades are also required for more extensive or specialised interventions and for households without the ability or time to undertake the work themselves. As identified in multiple interviews, a shortage of regional tradespeople is limiting the availability of skilled workers to undertake smaller, often more complex retrofit jobs. This is compounded by a lack of training, skills and industry focus in relation to common resilience retrofit activities, as service providers who do support home retrofits (household-level assessors, retailers and tradespeople) generally only offer energy efficiency retrofits. It is therefore challenging for households to translate general information about resilience retrofits into what is most relevant to their property, and to access trusted local services that can help them to take action. More tradespeople and service providers with a broader range of skills are necessary to facilitate high-quality whole-of-home retrofits at scale. The literature review revealed similar supply chain issues in overseas retrofit programs, even prior to the shortages in tradespeople prompted by the COVID-19 pandemic.

Common tradespeople such as plumbers, electricians and carpenters require upskilling to ensure that they consider how a house operates as a holistic system and to understand their role in whole-of-home retrofits. This upskilling should involve knowledge of the benefits of new energy-efficient technologies, thermal efficiency concepts relating to insulation and the building envelope, and the impacts of current and future climate risks on particular home types. Multiple interviewees noted, in line with reviews of existing retrofit programs, that tradespeople often advise clients to use outdated technologies, such as gas appliances and standard finish materials, based on their familiarity with these products. Our interviewees also reflected on the insurance sector's tendency to fund like-for-like replacement after disaster events, thereby perpetuating the use of less resilient materials and gas appliances.

Our key informants' reflections on current training programs for trades suggest that without stronger building regulations, design standards or incentives to encourage tradespeople to participate, under-utilisation of these programs will continue. In addition, current programs do not maximise the potential for the retrofit industry to generate new employment pathways for diverse members of society. As noted by the interviewees, the development of such pathways could increase the reach of retrofit activity into a broader range of communities (such as Aboriginal and Torres Strait Islander, CALD and gender-diverse households) across the state.

Reviews of existing programs affirm our interview findings that some members of the community are unwilling or unable to manage the steps required to undertake retrofit work. Sourcing, engaging and project managing multiple specialist tradespeople is time-consuming and a barrier to undertaking resilience retrofits for many types of households, particularly those with complex health and social support needs. Previous energy efficiency retrofit programs have trialled services that manage the full retrofitting journey, from assessment to

implementation, which mirror existing state and federal programs supporting older people to remain in their homes. Expanding these independent living programs to include whole-of-home retrofits is one potential pathway to reaching households likely to be disproportionately impacted by climate risks, particularly extreme temperatures. Extending the scope of eligible households and retrofit services provided beyond these programs is necessary, however.

Multiple retrofit programs, services and tools we reviewed began as pilots. We did not identify any pilots designed to test an end-to-end, whole-of-home retrofit service model, which highlights the opportunity for a dedicated pilot for this purpose. The RBC's methodology, which incorporates the Residential Efficiency Scorecard, is well positioned to support such a pilot and thereby to improve understanding of the total investment and management structure required for whole-of-home retrofits. Lessons from whole-of-home approaches are needed to incorporate a climate adaptation and resilience lens into current programs designed to facilitate home retrofits at scale, such as RACE for 2030's initiative to retrofit one million low-income homes. An integrated approach would also enable the ongoing financial benefits of energy efficiency retrofit actions (through lower operational costs for households) to subsidise the cost of actions with more specific adaptation and resilience benefits (see the Venn diagram on page 24, Figure 4 in the scope section).

In summary, while the home retrofit market is growing, investment is needed to expand and diversify the local workforce, build trust among households in the skills and quality of local tradespeople, and facilitate retrofit activities for households that are not in a position to undertake or manage the work themselves. This will ensure sufficient and diverse local expertise to meet future demand for retrofit work for all households.

RETROFIT MARKET AND IMPLEMENTATION Recommended actions		Implemented by			Building on
		Deliver	Fund	Regulate	
A	Undertake a pilot in Mount Alexander Shire of the Resilient Building Council's assessment methodology with a selection of low-income households, and pursue resourcing to undertake relevant retrofit actions through innovative financing mechanisms	RBC Local Gov	Vic Gov	—	RBC methodology already trialled in NSW
B	Invest in the development of place-based home retrofit services to build local skills in retrofit activities (including 'whole-of-home' assessment), connect households with relevant services and resources and provide project management support for households requiring assistance coordinating retrofit work on their homes	Community groups Neighbourhood houses Local Gov	Local Gov Vic Gov	—	Local community development, education programs and home care programs
C	Develop training in home assessment and retrofit work targeting CALD, First Nations and gender diverse communities to provide employment pathways for these groups and develop a market of tradespeople reflective of local communities	TAFE Construction sector	Vic Gov	Vic Gov	Industry apprenticeship programs
D	Expand current retrofit training programs for tradespeople to include a 'whole-of-home' scope and develop incentives for individuals and businesses to participate in these programs to ensure a broader upskilling of the sector	Vic Gov Construction sector	Vic Gov	Vic Gov	Existing energy efficiency training programs
E	Regulate quality standards for all retrofit work	—	—	Vic Gov	Certified providers for energy efficiency upgrades
F	Expand My Aged Care Home Care Packages and Department of Veterans' Affairs' Rehabilitation Appliance Program to include home resilience retrofits	Aus Gov	Aus Gov	Aus Gov	Existing My Aged Care and DVA programs

TABLE 13 – Recommendations: retrofit market and implementation

9.6. Neighbourhood- and community-scale retrofits

Retrofits at an individual property level can contribute significantly to household comfort and safety in the face of some types of extreme weather events, but neighbourhood- and community-scale action is required to effectively mitigate some risks. Flood risk is particularly tied to neighbourhood-scale interventions, and heat can likewise be reduced through coordinated approaches to managing neighbourhood landscapes and water.

The management and 'future proofing' of local infrastructure emerged as a theme in both the CEDRR survey and our household interviews, particularly in relation to flood risk reduction. Investment in increasing the resilience of stormwater systems and drainage on public land was highlighted as critical to reduce the extent and duration of damage from future flood events. Multiple residents noted the existence of planned infrastructure maintenance or upgrades known to government agencies but not acted upon in time to reduce the impacts of the 2022 floods. Additional resourcing beyond Council's annual budget may be required on an ongoing basis to ensure that infrastructure maintenance and repair programs can respond adequately to the impacts of extreme weather events.

In addition to grey infrastructure, green infrastructure offers clear opportunities to increase climate resilience at a neighbourhood scale. Many households identified that they have planted their personal landscapes to absorb rainwater and respond to current and projected levels of heat. The same principles apply to the public realm, where integrated water management and water-sensitive urban design can help to manage stormwater flows and irrigate public landscapes. Furthermore, coordinating tree planting, increasing greening, reducing impervious surfaces and using materials with higher reflectivity can support the longevity of canopy shade in the landscape without increasing local fire risk.

Beyond physical infrastructure, community connection at the neighbourhood, town and shire levels was identified as an asset and benefit of living in the Shire. CEDRR survey participants particularly noted the need for more resources for community-led initiatives to build resilience. This supported our key informants' reflections on the value of existing community connection programs, and the extensive literature highlighting the importance of strong social networks in the face of any type of disaster event.

In summary, investment should be directed to local government and community groups to allow them to take neighbourhood- and community-scale action to improve physical infrastructure and build resilience through social connection. This will achieve greater resilience outcomes, and in some cases it is necessary to reduce household-level risks.

NEIGHBOURHOOD- AND COMMUNITY SCALE RETROFITS Recommended actions		Implemented by			Building on
		Deliver	Fund	Regulate	
A	Establish a process and funding mechanism to ensure that local infrastructure (particularly drainage) required to manage extreme weather risks is able to be sufficiently constructed where it doesn't exist, and future-proofed at the point of repair or replacement instead of replacing like-for-like (see Rec. 7A)	Local Gov Vic Gov Developers	Local Gov Vic Gov	Local Gov Vic Gov	Existing physical infrastructure construction and maintenance programs
B	Expand and enforce town-scale integrated water management and urban greening plans and actions, accounting for ongoing costs of maintaining assets, that respond to local conditions and provide flood-mitigation and urban cooling benefits (see Rec. 7A)	Local Gov Developers	Local Gov Vic Gov	Local Gov Vic Gov	Existing stormwater and urban greening initiatives
C	Support community-developed programs and groups to support social connectedness, and resilience-building and environmental action	Community groups Neighbourhood Houses	Vic Gov	—	Existing community development programs

TABLE 14 – Recommendations: neighbourhood- and community-scale retrofits

9.7. Planning and regulation

While our primary focus was on retrofitting existing homes and neighbourhoods, the findings highlight that the planning and regulation of new development has an impact on the resilience outcomes for new and existing homes and communities alike.

The design and location of new development in the Shire and regional Victoria featured, unprompted, in multiple interviews. Participants' reflections on the planning of new neighbourhoods extended beyond the location and nature of these developments; they also spoke to the impacts that these developments appear to be having on existing homes. These reflections were fresh in participants' minds given the recency of the late-2022 floods in Victoria and the ongoing recovery, which has highlighted the public infrastructure in the Shire that is particularly vulnerable.

Local observations echo the questions raised across Victoria after last year's floods about the role of the planning system in allowing development to occur in high-risk areas and the respective responsibilities of local and state governments in taking climate action. Actions proposed in the *Climate Change & Planning in Victoria* report would position climate risk as a central factor in the decision-making and planning for new developments, to the benefit of both new and existing communities.

At a property scale, households' concerns about the design and quality of new home construction, including homes built since energy rating standards were introduced into the NCC, affirm that the energy efficiency requirements for new construction do not consistently translate into thermal comfort in practice. Multiple households living in homes built in 2007 or later cited the need for significant retrofits to make their homes comfortable to live in. This suggests that contemporary building standards, and/or their enforcement, continue to be insufficient to ensure comfort and wellbeing.

Beyond the issue of energy efficiency standards for new homes, no minimum standard for climate resilience or adaptation currently exists. The RBC's Resilience Rating system appears to offer the most advanced approach, with the greatest potential for broad industry uptake, but it is yet to be applied in Victoria. Without such a standard, quantifiable benefits to households from undertaking resilience retrofits (such as through reduced insurance premiums or discounted mortgage interest rates) are not likely to be available. At a larger scale, understanding of the vulnerability or risk exposure of the Victoria-wide housing stock also remains limited.

For rental properties, the responsibility for retrofits falls primarily on landlords, and our interviewees overwhelmingly identified that significant improvements to both the energy efficiency and climate resilience of rentals will not occur unless minimum standards are set and enforced. This corroborates the extensive research that has raised awareness of the poor quality of rental housing stock in Australia and the resultant disproportionate impacts on people facing systemic disadvantage, who are less likely to own their homes. Notably, any changes to regulation would need to include a mechanism to ensure that renters would not bear the brunt of the cost of retrofits undertaken by landlords.

Finally, current policy debates about mandating the disclosure of energy efficiency ratings at the time of property sales prompted talk in the interviews about the merits of mandatory disclosure as a means of encouraging homeowners to undertake retrofits. While this is expected to add to the administrative burden on the real estate sector, it is increasingly seen as necessary and looks likely to be adopted by the sector in the future. The ability to incorporate a resilience-related rating would have additional benefits to buyers and banks alike in terms of understanding the relative strength or vulnerability of a given property to climate risks.

Climate change and associated risks should be central to planning and building standards and decision-making at the local, state and federal levels to respond to current and anticipated future climate conditions and avoid the potential risks generated by new development. Due consideration at this stage will reduce the required resilience investment into the future.

PLANNING AND REGULATION Recommended actions		Implemented by			Building on
		Deliver	Fund	Regulate	
A	Implement the recommendations in Climate Change & Planning in Victoria to increase the centrality of climate change in decision-making, minimising climate risks and impacts of new developments and responding to existing risks consistently	Vic Gov Local Gov	–	Vic Gov Local Gov	Advocacy from Climate Change and Planning Advocacy Group
B	Set minimum Resilience Rating standards for new homes to complement minimum energy efficiency ratings already in the National Construction Code (see Rec. 2C)	Aus Gov	–	Aus Gov	Minimum energy efficiency standards for new homes
C	Set minimum home energy efficiency and Resilience Rating standards for rental properties (see Recs. 2C and 4A)	Vic Gov Aus Gov	–	Vic Gov Aus Gov	Existing requirements in the Residential Tenancies Act
D	Adopt a national mandatory disclosure scheme to require disclosure of home energy efficiency and resilience ratings at properties' point-of-sale (see Rec. 2C)	Aus Gov	–	Aus Gov	ACT mandatory disclosure program

TABLE 15 – Recommendations: planning and regulation





13. Conclusions and next steps

This study of Mount Alexander Shire presents a rich, nuanced picture of the needs, opportunities and barriers associated with adapting homes to better prepare for current and future climate risks.

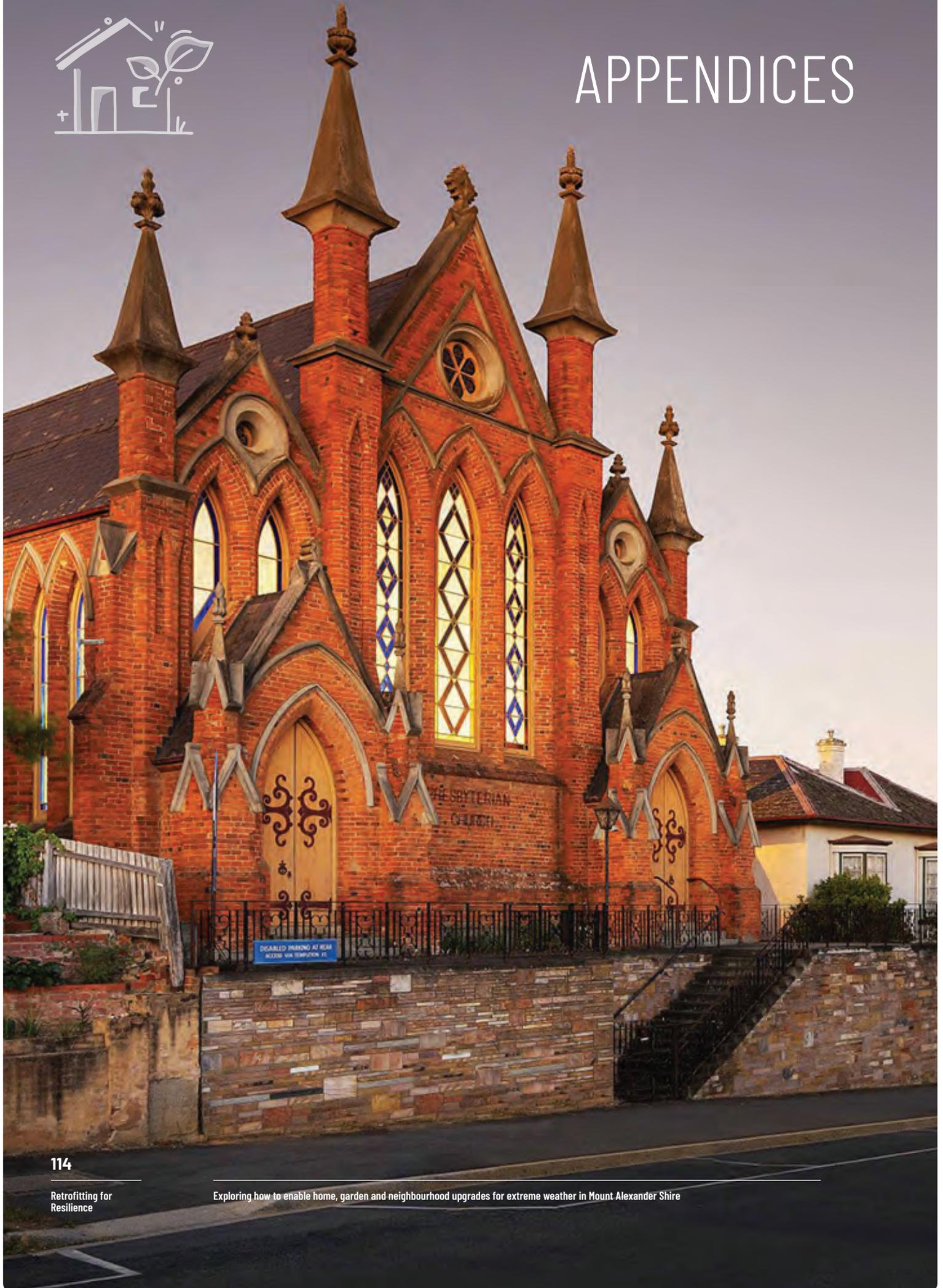
We have combined an integrated, place-based and collaborative approach to data collection with knowledge from existing research on retrofitting to underpin our recommended actions with a rich evidence base. While we anticipate that consideration and adoption of these actions will take time, we plan to pursue a number of activities to build on the momentum generated by our research, including:

- securing incremental funding to finalise, publish and distribute the *Housing Typologies and Retrofit Options Guide* for public use
- collaborating with Mount Alexander Shire Council to incorporate the findings from our research into emergency management and response approaches
- pursuing opportunities to pilot the RBC home self-assessment app and mechanisms to support home retrofit actions identified from it with low-income residents in the Shire
- working with the Castlemaine Community House to inform local skill-building programs
- continuing conversations with project partners across the Victorian Government to identify opportunities for our recommendations to inform their work.

We are grateful to all project participants for the time and considered contributions that have made this work possible.



APPENDICES



APPENDIX 1: Home retrofit resources reviewed

GUIDANCE AND INFORMATION

RESOURCE TITLE / NAME	RESOURCE TYPE	SOURCE / PUBLISHER	SCALE	JOURNEY STEP	HAZARDS INCLUDED	PRIMARY AUDIENCE(S)
<u>Building Resilience: Making homes climate-ready</u>	Information guide	Victorian State Government and local councils (Greater Bendigo, Campaspe, Central Goldfields, Loddon and Mount Alexander) Based on parallel guides released by other regional shire councils	Regional	Awareness raising	Bushfire, flood, heat, storm	Homeowne
<u>Bushfire best practice guide: retrofits</u>	Website	CSIRO	National	Awareness raising	Bushfire	Homeowners
<u>Conceptual drawings of standard water sensitive urban design treatments for small-scale development</u>	Technical resource	Water Sensitive SA	State / territory	Awareness raising	Flood, water ecology	Building / development sector Local government
<u>Cooling your home: Home retrofits, appliances and adaptations for a hotter future</u>	Information guide	Beyond Zero Emissions	State / territory	Awareness raising	Heat	General public
<u>Disaster Resilience Education Victoria</u>	High school curriculum resources	Victorian State Government, supported by SES and CFA	State / territory	Awareness raising	General / multi-hazard	Educators and students years 7-9
<u>Flood resilient guide to retrofitting your home</u>	Information guide	Melbourne Water	Regional	Awareness raising	Flood	Homeowners
<u>Flood resilient guidelines for Queensland homes</u>	Information guide	Queensland State Government	State / territory	Awareness raising	Flood	Homeowners
<u>Get Ready Queensland</u>	Website	Queensland State Government	State / territory	Awareness raising	Bushfire, cyclone, storm surge, flood, storm	General public
<u>One House</u>	Online guide / prototype	Suncorp, with CSIRO, James Cook University and Room11 Architects	National (targeting QLD)	Awareness raising	Bushfire, cyclone, flood	Homeowners
<u>Plan for emergencies at home</u>	Website	Victorian State Emergency Service	State / territory	Awareness raising	Flood (primary)	General public
<u>Renovate a home for energy efficiency</u>	Website	Sustainability Victoria	State / territory	Awareness raising	Cold, heat	General public

Retrofitting for Resilience	Webinar series	Renew	National	Awareness raising	Bushfire	Homeowners
<u>Systemic Disaster Risk</u>	Handbook	Australian Institute for Disaster Resilience	National	Awareness raising	General / multi-hazard	Policy / decision-makers Community leaders
<u>Your Home: Adapting to climate change</u>	Website	Commonwealth Government	National	Awareness raising	Bushfire, cyclone / extreme wind, drought, flood, heat, sea level rise / storm surge, storm	Homeowners
<u>Your Resilient Home Guide</u>	Information guide	ACT Government Suburban Land Agency	State / territory	Awareness raising	Bushfire, cold, drought, flood, heat, pollen storms, storm	Homeowners Building / development sector
<u>Built for Comfort</u>	Information guide and video	Camden Council	Local	Awareness raising Assessment	Cold, drought, heat	Homeowners
<u>Climate Change Risk Management Tool for Queensland Households</u>	Handbook and checklist	Queensland State Government	State / territory	Awareness raising Assessment	Acidic ocean, bushfire, coastal erosion, cyclone, drought, flood, heat, storm	General public
<u>Climate Wise Communities</u>	Website with online assessment tool and access to experts Online Assessment tool	Kur-ring-gai Council, in consultation with emergency management agencies and NSW State Government	Regional	Awareness raising Assessment	Bushfire, flood, heat, storm	General public
<u>Your Guide to Property Protection</u>	Information guide	Country Fire Authority	State / territory	Awareness raising Assessment	Bushfire	Homeowners
<u>Community Disaster Resilience Scorecard Toolkit</u>	Household resilience scorecard	Torrens Resilience Institute	National	Assessment	General / multi-hazard (including non-climate-related events)	Community groups and service providers working with disadvantaged community members
<u>Resilience Rating System</u>	Home assessment tool / rating system	Resilient Building Council	National	Assessment	Bushfire (current), soon to be multi-hazard	Homeowners Building / development sector Insurance sector

PROGRAMS & SERVICES

PROGRAM SERVICE / NAME	RESOURCE TYPE	SOURCE / PUBLISHER	SCALE	JOURNEY STEP	HAZARDS INCLUDED	PRIMARY AUDIENCE(S)
<u>Castlemaine 500</u>	Community-based energy efficiency and behaviour change program for households	Central Victorian Greenhouse Alliance / community volunteers	Local	Awareness raising Assessment Action	Cold, heat	Homeowners Renters
<u>Community Safety Program for Flood</u>	Engagement and education program	Victorian State Emergency Service	State / territory	Awareness raising	Flood	General public
<u>Cosy Homes Oxfordshire</u>	Home retrofit service	Cosy Homes Oxfordshire	Local (UK)	Awareness raising Assessment Action	Cold	Homeowners Renters Landlords
<u>Low Income Energy Efficiency Program: Power Down Project</u>	Low-income energy efficiency retrofit program	Australian Government / GV Community Energy	Regional project through national program	Awareness raising Assessment Action	Cold, heat	Low-income households, including renters
<u>Retrofitting the West</u>	Retrofit assistance program	WAGA Councils - particularly Brimbank, Maribyrnong and Moonee Valley City Councils	Regional	Awareness raising Assessment Action	Cold, heat	General public
<u>Community Emergency Risk Assessment</u>	Facilitated risk assessment process	Victorian State Emergency Service	State / territory	Assessment	General / multi-hazard	Municipal Emergency Management Planning Committees
<u>Residential Efficiency Scorecard</u>	Household energy efficiency assessment	Victorian State Government	National	Assessment	Cold, heat	Homeowners
<u>Housing for Health</u>	Retrofits for health and safety	Housing for Health	Regional	Assessment Action	Cold, heat	Regional / remote Aboriginal communities
<u>MAS6 ZNet retrofit project</u>	Retrofit program for social housing	Mount Alexander Sustainability Group (funded by Lord Mayors Charitable Foundation)	Local	Assessment Action	Cold, health and safety, heat	Social housing residents
<u>My Aged Care Home Care Packages</u>	Independent living services	Australian Government	National	Action	Self-care / health and safety	Elderly households requiring assistance
<u>One Million Homes</u>	Large-scale retrofit program	RACE for 2030	National	Action	Cold, heat	Homeowners in Class 1a homes Renters in Class 1a homes

Rehabilitation Appliances Program	Independent living services	Australian Government (Department of Veterans' Affairs)	National	Action	Self-care / health and safety	Veterans with Gold or White cards and eligible prescribed healthcare needs
<u>Retrofitworks</u>	Cooperative facilitator to connect households with trades	Retrofitworks	Regional (UK)	Action	Cold	Homeowners
<u>Safer Together</u>	Bushfire risk reduction program	Vic State Government (DELWP, EMV, Parks Vic), CFA, local governments, other agencies	State / territory	Action	Bushfire	Communities

FINANCIAL INCENTIVES

FINANCIAL INCENTIVE NAME	RESOURCE TYPE	SOURCE / PUBLISHER	SCALE	JOURNEY STEP	HAZARDS INCLUDED	PRIMARY AUDIENCE(S)
<u>Mandatory disclosure of energy efficiency ratings</u>	Home market value	ACT Government	State / territory	Awareness raising Assessment Action	Cold, heat	Homeowners Homebuyers
<u>Power Saving Bonus / Victorian Energy Compare</u>	Cash rebate	Victorian State Government	State / territory	Assessment	Cold, heat	General public
<u>Energy Upgrade California — Home Upgrade program</u>	Rebates	Pacific Gas & Electric and other partners (California)	State / territory	Assessment Action	Cold, heat	Homeowners
<u>Building energy resilience to storms and bushfires</u>	Funding	Victorian State Government	State / territory	Action	Bushfire, storm	Hard-hit communities: 2019-20 bushfires and 2021 storms
<u>Clean Energy Home Loans</u>	Discounted home loans for energy-efficient new builds / retrofits	Bank Australia	National	Action	Cold, heat	Homeowners Homebuyers
<u>Household Resilience Program</u>	Grant funding	Queensland State Government	State / territory	Action	Cyclone, flood	Eligible homeowners in coastal parts of Queensland
<u>MASH Community Solar</u>	Community solar bulk-buy	MASH	Local	Action	Cold, heat	Homeowners
<u>Northern Rivers Resilient Homes Fund</u>	Funding	NSW and Commonwealth Government (50:50 contributions)	State / territory	Action	Flood	Homeowners
<u>Solar Savers Program</u>	Finance (loan) and rebate	Eastern Alliance for Greenhouse Action and member councils	Regional	Action	Cold, heat	Low-income homeowners

Solar Homes program	Rebates and no-interest loans	Victorian State Government	State / territory	Action	Cold, heat	Homeowners Renters Landlords
'Superbonus' for retrofitting	Tax rebate	Italian government	National	Action	Cold, heat, seismic risk	Homeowners
Victorian Energy Efficiency Certificates	Sellable certificate	Victorian State Government	State / territory	Action	Cold, heat	Homeowners
Victorian Energy Upgrades for Households	Finance and rebates	Victorian State Government	State / territory	Action	Cold, heat	General public

APPENDIX 2: Policy and Community Reference Group members

Policy Reference Group

Marion Byass
Planner, Planning Systems, DEECA

Georgina Cann
Senior Policy Officer, Planning Systems Reform, DEECA

David Craven
Manager Residential Efficiency Scorecard, Energy Smart Low Emissions Buildings, DEECA

Bernardo Cutter
Senior Project Manager, Sustainable Design Team, Homes Victoria

Stuart Fawcett
Senior Policy Officer, Climate Change Policy, DEECA

Sarah Fiess
Team Leader, Sustainable Homes, Regions and Partnerships, Sustainability Victoria

Stephanie Schrank
Senior Policy Officer, Housing Upgrades, DEECA

Marcus Terjung
Senior Planner, Planning Systems, DEECA

Katie Wallace
Senior Policy Officer, Climate Adaptation, DEECA

Katrina Wolfe
Principal Policy Officer, Climate Change Coordination, Energy Strategy, DEECA

Jessica Zito
Principal Policy Officer, Energy Strategy, DEECA

Community Reference Group

Leah Berger
Housing Justice

Shannon Burdeau
Maldon and District Community Bank

Kathryn Coff
Nalderun

Kerrily Jennings
Castlemaine Community House

Melanie Marshall
Mount Alexander Shire Council

Terry Murphy
U3A

Carolyn Neilson
My Home Network

Rosalie Rogers
Mount Alexander Shire Council

Lauren Watt
Mount Alexander Shire Council

Ilka White
West End Resilience Energy Group

Terry White
Mount Alexander Sustainability Group

APPENDIX 3: Key informant interview participant summary

Maldon and District Community Bank	1
Mount Alexander Shire Council	5
Local Emergency Services	2
Newstead EnviroShop (renewable energy / energy efficiency product retailer and service provider)	1
Local insurance broker	1
Local media	1
Loddon Campaspe Multicultural Service	2
Castlemaine Community House	1
Local permaculture educator	1
Bendigo Health	1
Local real estate agent	1
Residential Energy Efficiency Scorecard assessor	1
Mount Alexander Sustainability Group	1
West End Resilience Energy Group	1
Housing Justice	1
Dja Dja Wurrung Clans Aboriginal Corporation (DJAARA)	1
Local Landcare representative	1
Victorian Council of Social Service	1
Victorian Department of Energy, Environment and Climate Action	3
Resilience Building Councils of Australia	1
Victorian Residential Tenancies Commissioner	1

APPENDIX 4: Key informant interview participant summary

We spoke to 16 residents across 14 households, including six men and 10 women, ranging in age from 30 to 80 years old.

Interviews were conducted in rural (n=2), peri-urban (n=3) and urban (n=8) settings across Mount Alexander Shire, with one interview conducted in Bendigo (n=1) to explore the experiences of a public housing resident.

Location	Number of Household Interviews
Castlemaine	5
Campbells Creek	4
Maldon	2
Welshmans Reef / Newstead	1
Taradale	1
Other (Bendigo)	1

One interviewee self-identified as living with a disability, and another was a carer of a person living with disability. No interview participants self-identified as Aboriginal or Torres Strait Islander. Two interviewees were from non-English speaking backgrounds, but both were fluent English speakers.

A majority of residents had been living in their home for a decade or more, up to 17 years. Two residents had moved into their home more recently, one or two months prior to the interviews. Eleven of the interviews we conducted were with homeowners, and three were with renters.

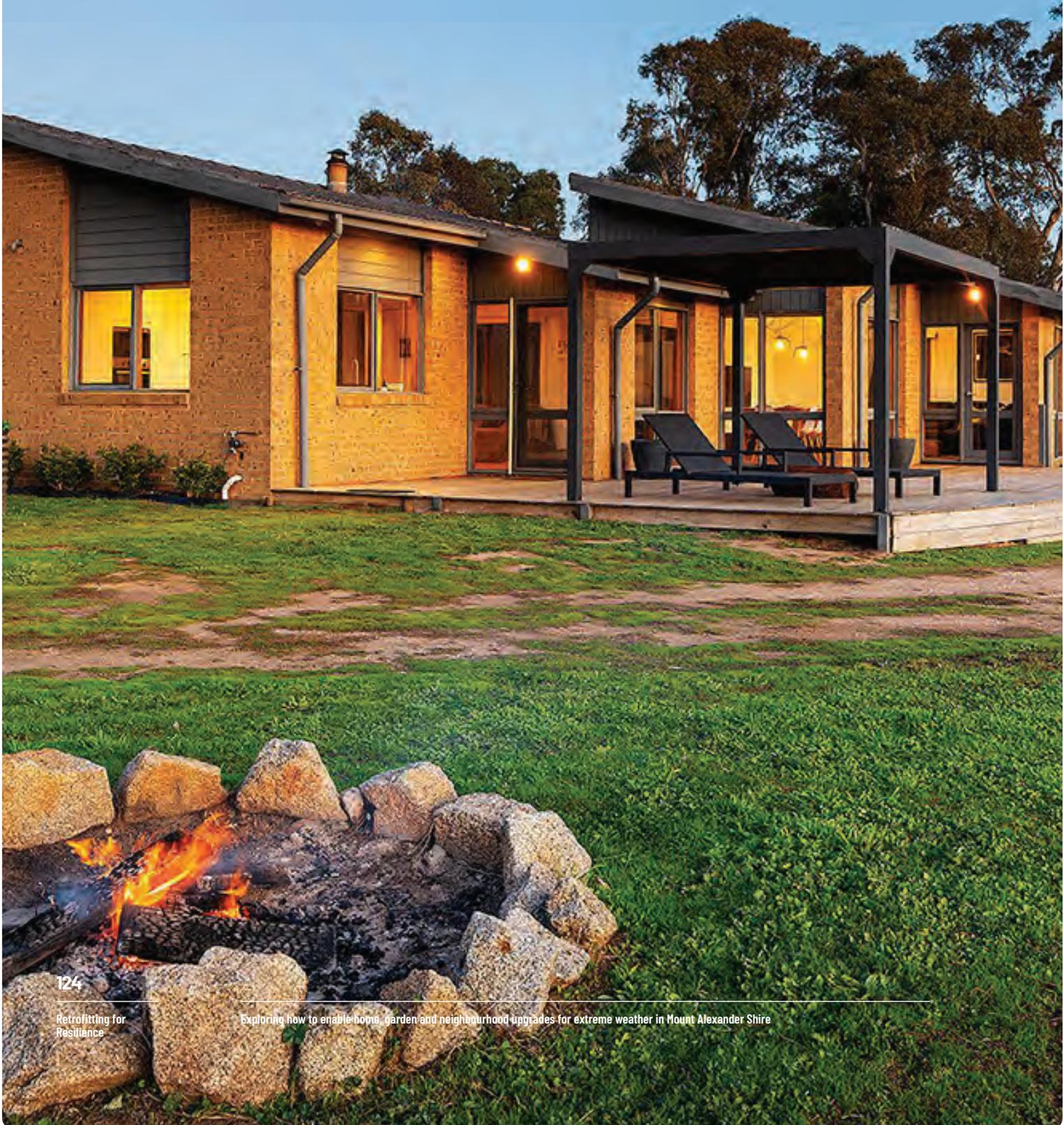
Household composition varied, from sole occupants, to shared housing arrangements with 2-3 people, and families with up to seven people. Interestingly, five of the households we spoke to had a caravan, small flat or converted shed on their property being used to provide additional, affordable accommodation to residents, friends or family.

Housing types captured in the household interview sample varied, reflecting the range of housing in Mount Alexander Shire, from contemporary homes built in the last decade, to post-WWII homes and older pre-WWII homes, with a mix of lightweight and heavyweight construction.

Five residents we spoke to live in flood-prone areas. All interviewees from Mount Alexander Shire live in bushfire-prone areas, with some directly exposed to neighbouring bushland and others at risk of ember attack.

Households were recruited for interviews through the Community Reference Group, and advertising in local newspapers. A mix of purposive and convenience sampling was used to recruit households for interviews through the Community Reference Group and advertising in local newspapers. Specific population cohorts were targeted through the established networks of Community Reference Group members, to ensure a diverse sample, reflective of different demographics in the Shire. The project team also followed up with residents who self-selected for interviews by responding to an advertisement in the local newspaper.

Interviews were conducted in-person by a member of the project team, at the participant's home or a central location in Castlemaine. Interviews typically took one hour, and participants were provided with a local supermarket voucher as a token for their time and contribution to the research.



References

1. Climate Council, *Uninsurable Nation: Australia's Most Climate-vulnerable Places* (Climate Council of Australia Ltd, 2022), https://www.climatecouncil.org.au/wp-content/uploads/2022/05/CC_Report-Uninsurable-Nation_V5-FA_Low_Res_Single.pdf
2. "Adaptation Action Plans," Victorian Department of Energy, Environment and Climate Action, published 15 February 2022, <https://www.climatechange.vic.gov.au/building-victorias-climate-resilience/our-commitment-to-adapt-to-climate-change/adaptation-action-plans-a-major-step-forward-for-climate-resilience-in-victoria>
3. "Supporting local action on climate change," Victorian Department of Energy, Environment and Climate Action, published 5 December 2022, <https://www.climatechange.vic.gov.au/supporting-local-action-on-climate-change>
4. "Climate Ready Victoria," Adapt Loddon Mallee, published 2019, <https://www.adaptloddonmallee.com.au/about/climate-ready-victoria/>
5. Victorian Department of Environment, Land, Water and Planning, *Victoria's Climate Science Report 2019* (Melbourne: Victorian State Government, 2019), https://www.climatechange.vic.gov.au/___data/assets/pdf_file/0029/442964/Victorias-Climate-Science-Report-2019.pdf
6. Glyn Wittwer, Kuo Li and Shenglang Yang, "The Economic Impacts of the 2019-20 Bushfires on Victoria," *Victorian Economic Bulletin* 5 (June 2021), <https://www.dtf.vic.gov.au/victorias-economic-bulletin-volume-5/economic-impacts-2019-20-bushfires-victoria>
7. Gus McCubbing, "The high cost of living in a flood zone," *Australian Financial Review*, 21 October 2022, <https://www.afr.com/policy/energy-and-climate/the-high-cost-of-living-in-a-flood-zone-20221020-p5brb9#:~:text=At%20least%20two%20people%20have,the%20neighbouring%20New%20South%20Wales>
8. Victorian SES, "Victorian Floods 2022," *Community Matters* 21 (Summer 2022), <https://www.ses.vic.gov.au/documents/8655930/8656662/VICSES+Community+Matters+edition+21+Summer+2022.pdf/73ee0869-213d-d0f4-c64a-0955b93ecc12?t=1670976478201>
9. "Inquiry probes 2022 Victoria floods," Parliament of Victoria, published 16 March 2023, <https://new.parliament.vic.gov.au/news/environment/floodsubmissions/>
10. Jess Davis and Rachel Carbonell, "Storms are Australia's most costly natural disasters, so why are we so unprepared for them?," ABC News, 19 October 2022, <https://www.abc.net.au/news/2022-10-19/storms-most-costly-natural-disasters-but-residents-unprepared/101523928>
11. "Recovery from storms and floods continues one year on," Victorian Department of Energy, Environment and Climate Action, published 9 June 2022, <https://www.deeca.vic.gov.au/media-centre/media-releases/recovery-from-storms-and-floods-continues-one-year-on>
12. Doctors for the Environment Australia, *Heatwaves and Health in Australia* (Doctors for the Environment Australia, 2020), <https://dea.org.au/wp-content/uploads/2021/01/DEA-Fact-Sheet-HeatwavesWEB.pdf>
13. Sustainability Victoria, *The Victorian Healthy Homes Program: Research findings* (Melbourne: Victorian State Government, August 2022), <https://assets.sustainability.vic.gov.au/susvic/Report-Energy-Victorian-Healthy-Homes-program-research.pdf>
14. Davis and Carbonell, "Storms," ABC News, data drawn from Deloitte Access Economics

15. Sustainability Victoria, *Healthy Homes Program*
16. Victorian Department of Environment, Land, Water and Planning (DELWP), Prepared by Energy Efficient Strategies Pty. Ltd. with assistance from Aspire Web, *Victorian Housing Stock Model* (Melbourne: Victorian State Government, Preliminary Draft V0.13 April 2019)
17. DELWP, *Victorian Housing Stock Model*
18. Nationwide House Energy Rating Scheme, *Administrative and Governance Arrangements* (NatHERS, 2015), <https://www.nathers.gov.au/sites/default/files/Admin%2520Governance%2520Arrangements-August%25202015.pdf>
19. "7 star energy efficiency building standards," Victorian Department of Energy, Environment and Climate Action, published 16 June 2023, <https://www.energy.vic.gov.au/for-households/7-star-energy-efficiency-building-standards#:~:text=On%2026%20August%202022%2C%20Victoria,help%20reduce%20greenhouse%20gas%20emissions>
20. Peter Hannam, "Tougher seven-star energy efficiency standards for new Australian homes set to be approved," *The Guardian*, 25 August 2022, <https://www.theguardian.com/australia-news/2022/aug/25/tougher-seven-star-energy-efficiency-standards-for-new-australian-homes-set-to-be-approved>
21. Elizabeth Redman, "New homes could be built in flood risk zones, town planners warn," *Sydney Morning Herald*, 19 August 2022, <https://www.smh.com.au/property/news/new-homes-could-be-built-in-flood-risk-zones-town-planners-warn-20220818-p5basi.html>
22. Tamsin Rose and Benita Kolovos, "Australian governments urged to scrap 'one-in-100-year' flood standard and update risk maps," *The Guardian*, 27 October 2022, <https://www.theguardian.com/australia-news/2022/oct/27/australian-governments-urged-to-scrap-one-in-100-year-flood-standard-and-update-risk-maps>
23. Cara Waters, "Out-of-date flood maps mean homes built on flood plains," *The Age*, 18 October 2022, <https://www.theage.com.au/politics/victoria/out-of-date-flood-maps-mean-homes-built-on-flood-plains-20221017-p5bqbl.html>
24. Hansen Partnership, *Climate Change & Planning in Victoria: Ensuring Victoria's planning system effectively tackles climate change* (Climate Change and Planning Advocacy Group, 2021), https://www.gmca.org.au/uploads/8/4/3/6/84367754/hansen_report_-_climate_change_and_planning_in_victoria_clean.pdf
25. Khaled Al Khawaldeh, "Extreme weather and rising premiums make parts of regional Australia 'uninsurable'," *The Guardian*, 19 May 2023, <https://www.theguardian.com/australia-news/2023/may/19/extreme-weather-and-rising-premiums-make-parts-of-regional-australia-uninsurable>
26. Natasha May and Christopher Knaus, "The Australian suburbs where more than half of properties will be insurable by 2030," *The Guardian*, 26 November 2022, <https://www.theguardian.com/australia-news/2022/nov/26/australias-unraveling-climate-risk-leaving-more-homes-uninsurable-against-flooding-expert-warns>
27. "Climate Risk Map of Australia", Climate Council, published 2 May 2022, <https://www.climatecouncil.org.au/resources/climate-risk-map/>
28. "Climate change and low-income housing," AHURI, published 16 November 2021, <https://www.ahuri.edu.au/research/brief/Climate-change-and-low-income-housing>
29. ACOSS, *ACOSS 2023 Heat Survey: How hotter days affect people on lowest incomes first, worst and hardest* (ACOSS, February 2023), https://www.acoss.org.au/wp-content/uploads/2023/02/Heat-Survey-Report_20230228.pdf
30. "Rental properties - minimum standards," Consumer Affairs Victoria, published 9 February 2023, <https://www.consumer.vic.gov.au/housing/renting/repairs-alterations-safety-and-pets/minimum-standards/minimum-standards-for-rental-properties>

31. ACT Health, *Older adults' experience during the 2019/2020 bushfires: The PATH Through Life Project* (Canberra: ACT Government, February 2023), <https://health.act.gov.au/sites/default/files/2023-02/Older%20Adults%27%20Experiences%20During%20the%202019-2020%20Bushfires.pdf>
32. Jodie Bailie et al., "Exposure to risk and experiences of river flooding for people with disability and carers in rural Australia: a cross-sectional survey," *BMJ Open* 12, e056210 (2022), <https://bmjopen.bmj.com/content/bmjopen/12/8/e056210.full.pdf>
33. Ang Li, Mathew Toll and Rebecca Bentley, "Climate-related disasters leave behind trauma and worse mental health. Housing uncertainty is a major reason why," *The Conversation*, 6 June 2023, https://theconversation.com/climate-related-disasters-leave-behind-trauma-and-worse-mental-health-housing-uncertainty-is-a-major-reason-why-206861?utm_source=flipboard&utm_content=topic%2Fmortgage
34. "An equitable response to climate change," Victorian Council of Social Service, published 28 May 2021, <https://vcoss.org.au/budget/2021/05/an-equitable-response-to-climate-change/>
35. "Climate change and energy," Brotherhood of St. Laurence, published 2023, <https://www.bsl.org.au/research/our-research-topics/climate-change-and-energy/>
36. Future Earth Australia, *A National Strategy for Just Adaptation* (Canberra: Australian Academy of Science, 2022), <https://www.futureearth.org.au/sites/default/files/2022-09/a-national-strategy-for-just-adaptation.pdf>
37. "Adaptation Action Plans," Victorian Department of Energy, Environment and Climate Action
38. Victorian Department of Energy, Environment and Climate Action, *Built Environment Adaptation Action Plan 2022-26* (Melbourne: Victorian State Government, 2022), 7, https://www.planning.vic.gov.au/_data/assets/pdf_file/0037/557389/Built-Environment-Climate-Change-Adaptation-Action-Plan-2022-2026.pdf
39. Victorian Department of Energy, Environment and Climate Action, *Built Environment Adaptation Action Plan 2022-26*, 9
40. Victorian SES, *VICSES Community Resilience Strategy Renewal 2019-22* (Melbourne: Victorian SES, 2019), <https://www.ses.vic.gov.au/documents/8655930/8796798/VICSES+Community+Resilience+Strategy+Renewal+2019-22.pdf>
41. "Disaster Ready Fund," National Emergency Management Agency, published 2023, <https://nema.gov.au/disaster-ready-fund>
42. Australian Government Department of Home Affairs, *National Disaster Risk Reduction Framework* (Canberra: Australian Government, 2019), <https://www.homeaffairs.gov.au/emergency/files/national-disaster-risk-reduction-framework.pdf>
43. "Early Intervention Investment Framework," Victorian Department of Treasury and Finance, published 16 June 2023, <https://www.dtf.vic.gov.au/funds-programs-and-policies/early-intervention-investment-framework>
44. Adapt Loddon Mallee, *Loddon Mallee Climate Ready Plan* (Victorian State Government, 2022), https://www.climatechange.vic.gov.au/_data/assets/file/0030/549813/Loddon-Mallee-Climate-Ready-Plan-accessible-version.pdf
45. DJAARA, *Turning 'wrong way' climate, 'right way': Dja Dja Wurrung Climate Change Strategy 2023-34* (DJAARA, 2023), <https://djadawurrung.com.au/wp-content/uploads/2023/05/DJA46.-Climate-Change-Strategy-230523.pdf>
46. Mount Alexander Shire Council, *Climate Change Strategy* (Castlemaine: Mount Alexander Shire Council, 2023), https://hdp-au-prod-app-mtalex-shape-files.s3.ap-southeast-2.amazonaws.com/5716/8724/2223/Final_Climate_Change_Strategy_-_adopted_20_June_2023.pdf

47. Victorian State Government and Councils of City of Greater Bendigo and Campaspe, Central Goldfields, Loddon and Mount Alexander Shires, *Building Resilience: Making Homes Climate Ready* (Bendigo: City of Greater Bendigo), <https://www.bendigo.vic.gov.au/sites/default/files/2018-10/Building-Resilience-Making-Homes-Climate-Ready.pdf>
48. Melbourne Water and JDA, *Flood resilient guide to retrofitting your home* (Melbourne: Melbourne Water, 2020), <https://www.melbournewater.com.au/media/15581/download>
49. Victorian State Government et al, *Building Resilience*
50. Cassia Read and Meredith Cosgrove, *Cool-it Tree Selection: Evaluation of street trees for future climate in the Mallee, Loddon-Campaspe and Central Highlands regions* (Castlemaine: Castlemaine Institute, 2021), https://www.cvga.org.au/uploads/9/8/3/8/9838558/ci-r-cr-trees_for_climate_210225__1_.pdf
51. Phillip Gibbons et al., "Options for reducing house-losses during wildfires without clearing trees and shrubs," *Landscape and Urban Planning* 174 (June 2018): 10-17, DOI 10.1016/j.landurbplan.2018.02.010
52. Andrew Coutts and Nigel Tapper, *Trees for a cool city: Guidelines for optimised tree placement*, (Melbourne: CRC for Water Sensitive Cities Ltd., 2017), https://watersensitivecities.org.au/wp-content/uploads/2017/11/Trees-for-a-cool-city_Guidelines-for-optimised-tree-placement.pdf
53. J.L. Webber et al., "Is green infrastructure a viable strategy for managing urban surface water flooding?" *Urban Water Journal* 17, issue 7 (2020): 598-608, <https://www.tandfonline.com/doi/full/10.1080/1573062X.2019.1700286>
54. E2Designlab and Victorian Department of Environment, Land, Water and Planning, *Planning a Green-Blue City: A how-to guide for planning urban greening and enhanced stormwater management in Victoria* (Melbourne: Victorian State Government, February 2017), https://www.water.vic.gov.au/___data/assets/pdf_file/0029/89606/Green-blue-Infrastructure-Guidelines-Feb17.pdf
55. Australian Institute for Disaster Resilience, *Systemic Disaster Risk Handbook* (Melbourne: Australian Institute for Disaster Resilience, 2021), x, https://knowledge.aidr.org.au/media/9228/handbook_systemic_disaster_risk_2022-03-17_v11.pdf
56. Australian Department of Climate Change, Energy, the Environment and Water, "Adapting to Climate Change," *YourHome: Australia's Guide to Environmentally Sustainable Homes*, published 2023, <https://www.yourhome.gov.au/live-adapt/adapting-climate-change>
57. Suburban Land Agency, *Your Resilient Home Guide* (Canberra: ACT Government, 2022), <https://suburbanland.act.gov.au/uploads/ckfinder/files/YourResilientHome-Interactive.pdf>
58. *Climate Wise Communities*, Ku-ring-gai Council, published 2023, <https://climatewisecommunities.com.au/>
59. Victorian State Government et al, *Building Resilience*
60. Melbourne Water and JDA, *Flood resilient guide*
61. Beyond Zero Emissions, *Cooling your home: Home retrofits, appliances and adaptations for a hotter future* (Melbourne: Beyond Zero Emissions Inc, October 2021), <https://bze.org.au/wp-content/uploads/2021/11/Cooling-your-home-24-Nov-compressed.pdf>
62. Fahim Tonmoy and David Rissik, *Climate Change Risk Management Tool for Queensland Households* (Queensland State Government, 2020), https://www.qld.gov.au/___data/assets/pdf_file/0023/132386/ccrmt-households-full.pdf
63. "Climate Ready Maldon," Maldon Neighbourhood Centre, published 2021, <https://www.maldonnc.org.au/whats-on/climate-ready-maldon>
64. Interview with Resilient Building Council, March 2023

65. Interview with Resilient Building Council
66. Victorian SES, *Community Safety Program for Flood* (Melbourne: Victorian SES, 2020), <https://www.ses.vic.gov.au/documents/8655930/8689153/VICSES+Community+Safety+Program+for+flood.pdf/26006c61-b796-60ad-5406-896b5daab8e7?t=1622616983471#:~:text=VICSES%20role%20in%20flood%20warnings,BoM%20Flood%20Watch%20and%20Warnings>
67. GV Community Energy, *Low Income Energy Efficiency Program: Power Down project* (Murchison: Australian Government, 2016), https://www.energy.gov.au/sites/default/files/gv_community_energy_powerdown_project.pdf
68. "EcoMaster: Your Home Energy Efficiency Experts," EcoMaster, published 2020, <https://www.ecomaster.com.au/>
69. Interview with West End Resilience Energy Group, April 2023
70. Interview with Mount Alexander Sustainability Group, March 2023
71. Clear Horizon Consulting and Geoff Brown, *How We Ran a Behaviour Change Pilot Program and the Lessons We Learnt: Telling the Performance Story of Castlemaine 500* (Clear Horizon, 2008), <https://clearhorizon.circle.so/c/collaborative-outcomes-reporting/cor-in-action>
72. GV Community Energy, *Low Income Energy Efficiency Program*
73. "Residential Efficiency Scorecard," Victorian State Government, accessed May 2023, <https://www.73.homescorecard.gov.au/>
74. "Building in the bushfire management overlay," Victorian State Government, published 9 June 2023, <https://www.planning.vic.gov.au/policy-and-strategy/bushfire/bushfire-hazard#:~:text=A%20bushfire%20hazard%20site%20assessment,requirements%2C%20water%20supply%20and%20access>
75. Interview with Resilient Building Council
76. Paul Arbon et al, *Developing a model and the tools to measure community resilience* (Adelaide: Torrens Resilience Institute, 2012), <https://www.flinders.edu.au/content/dam/documents/research/torrens-resilience-institute/community-resilience-report-toolkit.pdf>
77. GV Community Energy, *Low Income Energy Efficiency Program*
78. Sustainability Victoria, *Healthy Homes Program*
79. Sustainability Victoria, *Healthy Homes Program*
80. "Energy efficiency in social housing," HousingVic, published 20 December 2022, <https://www.housing.vic.gov.au/energy-efficiency-social-housing>
81. "Homepage," Retrofitworks, published 2023, <https://retrofitworks.co.uk/>
82. "RAP overview," Australian Government Department of Veterans' Affairs, published 2023, <https://www.dva.gov.au/providers/rehabilitation-appliances-program-rap/rap-overview#items-available-through-rap>
83. "Home Care Packages," My Aged Care, published 31 May 2023, <https://www.myagedcare.gov.au/help-at-home/home-care-packages>
84. "The Health Story," Healthhabitat, published 2023, <https://www.housingforhealth.com/>
85. RACE for 2030, *Pathway to scale: Retrofitting One Million+ homes* (AusIndustry Cooperative Research Centres Program, 2021), https://www.racefor2030.com.au/wp-content/uploads/2021/12/One-Million-Homes_Final-Report-9.12.21.pdf

86. RACE for 2030, *Pathway to scale*
87. "Welcome - Victorian Energy Compare," Victorian Energy Compare, published 25 June 2023, <https://compare.energy.vic.gov.au/>
88. Broede Carmody, "Energy bonus worth \$250 going begging in regions and among wealthy Bayside residents," *The Age*, 27 April 2023, <https://www.theage.com.au/politics/victoria/energy-bonus-worth-250-going-begging-in-regions-and-among-wealthy-bayside-residents-20230425-p5d32p.html>
89. "Household Resilience Program," Queensland State Government, published 2 August 2022 <https://www.qld.gov.au/housing/buying-owning-home/financial-help-concessions/household-resilience-program>
90. "Resilient Homes Fund," New South Wales State Government, published April 2023 <https://www.nsw.gov.au/regional-nsw/northern-rivers-reconstruction-corporation/resilient-homes-fund>
91. "Victorian Energy Upgrades for households," Victorian State Government, published 4 January 2023 <https://www.energy.vic.gov.au/for-households/victorian-energy-upgrades-for-households>
92. "Welcome to the Solar Homes Program," Solar Victoria, published 26 May 2023, <https://www.solar.vic.gov.au/>
93. "MASH Community Solar," MASH, published September 2022, <https://mash.org.au/>
94. Stephen White, "Energy star ratings for homes? Good idea, but it needs some real estate flair," *The Conversation*, 17 February 2016, <https://theconversation.com/energy-star-ratings-for-homes-good-idea-but-it-needs-some-real-estate-flair-54056>
95. Interview with Victorian Department of Energy, Environment and Climate Action, February 2023
96. Rachel Williamson, "Big banks join call to harmonise energy ratings," *One Step off the Grid*, 20 April 2023, <https://onestepoffthegrid.com.au/big-banks-join-call-to-harmonise-home-energy-ratings/>
97. Interview with Resilient Building Council
98. Royce Kurmelovs, "Fire and flood: 'Whole areas of Australia will be uninsurable'," *The Guardian*, 2 April 2021 <https://www.theguardian.com/australia-news/2021/apr/02/fire-and-flood-whole-areas-of-australia-will-be-uninsurable>
99. Rachel Williamson, "Big banks join call," *One Step off the Grid*
100. Interview with local insurance broker, February 2023
101. "Clean Energy Home Loan," Bank Australia, published 2023, <https://www.bankaustralia.com.au/banking/home-loans/clean-energy-home-loan>
102. Multi-Hazard Mitigation Council, *Natural Hazard Mitigation Saves* (Washington, DC: National Institute of Building Sciences, 2019), https://www.nibs.org/files/pdfs/NIBS_MMC_MitigationSaves_2019.pdf
103. Davis and Carbonell, "Storms," *ABC News*
104. "Disaster Ready Fund," National Emergency Management Agency
105. Genevieve Mortimer, Belinda Whelan and Christopher Lee, *Adaptation Finance: Emerging approaches to solve the climate adaptation finance gap* (ClimateKIC Australia, 2020), https://climate-kic.org.au/wp-content/uploads/2020/11/Adaptation-Finance_300ppi.pdf
106. Trivess Moore and Ralph Horne, "Budget home energy funding a good start, but dwarfed by the scale of the task," *One Step off the Grid*, 11 May 2023, <https://onestepoffthegrid.com.au/budget-home-energy-funding-a-good-start-but-dwarfed-by-the-scale-of-the-task/>
107. Davis and Carbonell, "Storms," *ABC News*, data drawn from Deloitte Access Economics

108. Victorian SES, *Safer Communities - Together: VIC SES Community Resilience Strategy 2016-19* (Melbourne: Victorian SES, 2016), <https://www.ses.vic.gov.au/documents/8655930/8796798/VICES+-+Community+Resilience+Strategy+2016-2019.pdf/baafdd0c-186c-a56a-a3d9-dc859599f8d6?t=1620874396496>
109. Tristan Edis, "An extra \$1.3bn to upgrade Australia's energy-inefficient homes might not do much - here's what would help," *The Guardian*, 17 May 2023 <https://www.theguardian.com/commentisfree/2023/may/16/an-extra-13bn-to-upgrade-australias-energy-inefficient-homes-might-not-do-much-heres-what-would-help>
110. "Climate change and low-income housing," AHURI
111. Victorian Council of Social Service, *The Missing 14%: Why so many Victorians are missing out on energy concessions* (Melbourne: Victorian Council of Social Service, May 2023), <https://vcoss.org.au/wp-content/uploads/2023/05/The-Missing-14-per-cent.pdf>
112. "Practice Review - how are we Safer Together?", BehaviourWorks Australia, published 2019, <https://www.behaviourworksaustralia.org/projects/safer-together-bushfire-preparedness-and-response>
113. Paul Arbon et al, *How do we measure and build resilience against disaster in communities and households?* (Adelaide: Torrens Resilience Institute, 2013), <https://www.preventionweb.net/english/hyogo/gar/2015/en/bgdocs/inputs/Arbon%20et%20al.,%202013.%20How%20do%20we%20measure%20and%20build%20resilience%20against%20disaster%20in%20communities%20and%20households.pdf>
114. "Find an accredited provider," Essential Services Commission, published 27 June 2023, <https://www.esc.vic.gov.au/victorian-energy-upgrades/energy-saving-information-consumers/find-accredited-provider>
115. RACE for 2030, *Pathway to scale*
116. EMI Consulting, *Energy Upgrade California - Home Upgrade Program Process Evaluation 2014-2015* (Seattle: EMI Consulting, 2016), https://www.calmac.org/publications/EUC_Home_Upgrade_Process_Evaluation_Report_Draft_2016.08.24_%28CLEAN%29.pdf
117. CSIRO, *State of Climate Report* (CSIRO, 2022), <https://www.csiro.au/en/research>
118. Adapt Loddon Mallee, *Loddon Mallee Climate Ready Plan* (Victorian State Government, 2022), https://www.climatechange.vic.gov.au/_data/assets/file/0030/549813/Loddon-Mallee-Climate-Ready-Plan-accessible-version.pdf
119. Victorian Department of Energy, Environment and Climate Action, *Victorian Future Climate Summary Report: Mount Alexander Shire* (Melbourne: Victorian State Government, 2022), derived from Victoria's Future Climate Tool, <https://vicfutureclimatetool.indraweb.io/>
120. Victorian Department of Energy, Environment and Climate Action, *Victorian Future Climate Summary Report: Mount Alexander Shire*
121. "NCC Climates," CSIRO, accessed 25 June 2023, <https://ahd.csiro.au/dashboards/energy-rating/ncc-climates/>
122. "Climate statistics for Australian locations: Castlemaine Prison," Australian Bureau of Meteorology, published 23 March 2023, http://www.bom.gov.au/climate/averages/tables/cw_088110_All.shtml
123. Interview with Emergency Management Coordinator, Mount Alexander Shire Council, May 2023
124. Adapt Loddon Mallee, *Climate Ready Plan*
125. Analysis derived from "VicPlan version 2.4.4," Victorian Department of Transport and Planning, accessed March 2023, <https://mapshare.vic.gov.au/vicplan/>
126. Analysis derived from "VicPlan version 2.4.4," Victorian Department of Transport and Planning

127. Analysis derived from "VicPlan version 2.4.4," Victorian Department of Transport and Planning and "2021 Census All persons QuickStats," Australian Bureau of Statistics, published 2022, <https://abs.gov.au/census/find-census-data/search-by-area>
128. Adapt Loddon Mallee, *Loddon Mallee Climate Ready Plan*
129. "VicPlan version 2.4.4," Victorian Department of Transport and Planning
130. Analysis derived from "VicPlan version 2.4.4," Victorian Department of Transport and Planning and "2021 Census All persons QuickStats," Australian Bureau of Statistics
131. DELWP, *Victorian Housing Stock Model*
132. DELWP, *Victorian Housing Stock Model*
133. Analysis derived from "VicPlan version 2.4.4," Victorian Department of Transport and Planning and Plan2Place, *Housing and Neighbourhood Character Strategy for Castlemaine, Chewton and Campbells Creek* (Castlemaine: Mount Alexander Shire Council, 2023), <https://shape.mountalexander.vic.gov.au/housing-and-neighbourhood-character-strategy>
134. Analysis derived from "VicPlan version 2.4.4," Victorian Department of Transport and Planning and Plan2Place, *Housing and Neighbourhood Character Strategy*
135. Hayden Brown, *Profile of Older (65+), Lone Persons in Mount Alexander Shire from the findings of the 2021 Census*, 7 June 2023
136. "Mount Alexander: 2021 Census All persons QuickStats," Australian Bureau of Statistics, published 2022, <https://abs.gov.au/census/find-census-data/quickstats/2021/LGA25430>
137. "Mount Alexander: 2021 Census All persons QuickStats," Australian Bureau of Statistics
138. Ruby Kammoora et al, *Mount Alexander Case Study: Draft Report for Community Engagement for Disaster Risk Reduction Study*, (Melbourne: University of Melbourne, May 2023)
139. CEDRR survey participant cited in Ruby Kammoora et al, *Mount Alexander Case Study*
140. Jacqueline Devine, *Introducing SaniFOAM : a framework to analyze sanitation behaviors to design effective sanitation programs* (English)(Washington, DC: World Bank Group, 1 October 2009), <http://documents.worldbank.org/curated/en/272351468334778050/Introducing-SaniFOAM-a-framework-to-analyze-sanitation-behaviors-to-design-effective-sanitation-programs>

CASE STUDY REFERENCES

141. "Early Intervention Investment Framework," Victorian Department of Treasury and Finance
142. "Early Intervention Investment Framework," Victorian Department of Treasury and Finance
143. ANZSOG, *Implementing the Early Intervention Framework* (Melbourne: Australia and New Zealand School of Government, May 2022), <https://anzsog.edu.au/app/uploads/2023/05/23-ANZSOG-May-2022-final-RI.pdf>
144. Chris Walsh, "Little Stringybark Creek," Urbanstreams.net, accessed April 2023, <https://urbanstreams.net/lsc/index.htm>
145. Clear Horizon Consulting and Geoff Brown, *How We Ran a Behaviour Change Pilot Program*
146. "The Health Story," Healthhabitat

Retrofitting for Resilience

Exploring how to enable home, garden
and neighbourhood upgrades for extreme
weather in Mount Alexander Shire

