
# An industry-led roadmap for quality control and safety in the installation of insulation in buildings

Enabling insulation to deliver comfortable, healthy buildings to Australians

## Consultation Paper (Interim Report)

September 2020

## About the Energy Efficiency Council

The Energy Efficiency Council is Australia's industry association for energy management, energy efficiency and demand response. The Energy Efficiency Council is a not-for-profit membership association for businesses, universities, governments and NGOs.

Founded in 2009, the Energy Efficiency Council's members are diverse, but are united by a common cause: building a sophisticated market for energy management products and services that delivers:

- Healthy, comfortable buildings;
- Productive, competitive businesses; and
- An affordable, reliable and sustainable energy system for Australia.

The Energy Efficiency Council's job is to make Australia a global leader in smart energy management. To this end, the Council works with its members and partners to:

- Drive ambitious government policy by advocating for smart energy management policies and programs that deliver for all Australians;
- Support business decision making and growth with trusted, impartial information on energy so that businesses have confidence making the right energy management investments; and
- Ensure quality with standards and professional development by supporting standards development and benchmarking for the sector, and training and professional development for professionals across Australia.

The Energy Efficiency Council is a national organisation with headquarters in Melbourne.



Energy Efficiency Council
Level 7, 222 Exhibition Street
Melbourne 3000 VIC
Phone: +61 (03) 9069 6588
Email: info@eec.org.au
Web: www.eec.org.au

## Table of Contents

# 1. Executive summary

The Government of New South Wales, Government of Victoria, Insulation Australasia (IA) and the Insulation Council of Australia and New Zealand (ICANZ) have engaged a project team to develop an industry-led roadmap to ensure that insulation is installed in Australia in a manner that is safe and delivers quality outcomes. The project team consists of the Energy Efficiency Council (EEC) and the Australian Sustainable Built Environment Council (ASBEC).

The aim of the industry-led insulation roadmap is to facilitate actions from industry, government and community that will derisk insulation. An industry-led approach will ensure that the roadmap is supported by the best available information the experts and the market, and will ensure that each party (industry, government and community) plays the role that they are best suited to undertake.

This Consultation Paper sets out the initial findings of this project in order to seek input from stakeholders in a broad range of fields, including policy makers, insulation installers, the construction industry and experts in building design and sustainability. The consultation paper includes a set of 'potential solutions', which are not firm recommendations and are included to elicit critique. The Project Team is solely responsible for the content of this paper, and the 'potential solutions' do not represent the views of the project funders.

The Consultation Paper aims to considers the installation of insulation in both residential and commercial settings, and in retrofits, renovations and new builds. However, the paper particularly focusses on insulation into smaller residential buildings, because of the complex issues around quality control and safety. We encourage readers to provide comments to ensure that the report also covers issues around commercial buildings and apartments.

## 1.1 Summary of findings

A wide range of products are used to insulate buildings, including batts, panels, loose-fill, sprays, structural insulated panels and foils. Ensuring that new and existing buildings have adequate insulation can deliver major benefits to the Australian community, including:

- Improved comfort, health and wellbeing for building occupants;
- Reduced energy bills;
- Reduced greenhouse gas emissions; and
- Improved productivity, job creation and economic growth.

Installing insulation has lower risks compared to many other construction activities, but appropriate measures must be taken manage risks that include:

- Working in an enclosed space;
- Working at heights;
- Contact with hazardous materials; and
- Electrical safety, particularly when retrofitting insulation in roof cavities.

Australian jurisdictions have quite significant regulations and processes in place to manage health and safety on construction sites, which affects insulation installation in new builds and renovations. However, there are fewer processes in place in relation to insulation retrofits.

Enhancing quality control processes for insulation installation could deliver significant benefits for both new builds, renovations and retrofits. Insulation products need to be correctly installed to maximise their benefits and reduce risks for building occupants, including:

- Minimising unnecessary gaps in the coverage of insulation;
- Leaving space around heat-generating equipment (e.g. heating fans and downlights); and
- Basic moisture management, such as ensuring that ceiling insulation batts don't touch the roof or sarking.

To identify options to improve the safety and quality of insulation installation, we examined international case studies, specifically Germany, Ireland, the United States and New Zealand (Section 8). A number of themes emerged from these case studies, including:

- All countries set clear requirements for insulation in their building code;
- Several governments have fostered quality control in insulation installation by making access to incentives contingent on quality control processes;
- Several countries required either companies or appropriately accredited people to sign-off and confirm that insulation installations met the relevant standards; and
- Countries were increasingly looking beyond simply ensuring quality control processes in insulation installation and encouraging the development of a workforce that can deliver integrated energy efficiency retrofits.

Based on these findings and extensive interviews with stakeholders, we have drafted a number of potential solutions to improve the safety and quality of insulation installation. These are summarised in Section 2 and explained fully in Section 9.

The potential solutions firmly focus on ensuring safety and quality control in the installation of insulation. However, we were cognisant of broader issues when we developed these potential solutions, and recommend that further work be taken to improve integrated building design and construction and retrofit. While ensuring that insulation is safely and correctly installed will deliver multiple benefits, the full benefits of insulation can only be delivered through integrated design that considers the whole thermal envelope (including glazing and minimising thermal bridging), air tightness and systems for heating, cooling and ventilation.

## 1.2 Next steps

This consultation paper will be released on 29 September for consultation until 30 October, and several stakeholder forums will be held during this period. After stakeholders have provided their input, the Project Team will develop a final industry roadmap, which the insulation industry and governments can use to support their decision making.

Written submissions can be sent to consultation@eec.org.au by COB Friday 30 October.

All interested parties are invited to attend a public workshop on Monday 12 October at 3:30-5:00pm AEST, with additional meetings being held throughout the month.

If you would like to attend the public meeting, please register here.

Please direct any questions regarding the consultation process to Julianne Tice at consultation@eec.org.au.

# 2 Summary of Potential Solutions and Consultation Questions

This report sets out a range of potential solutions to improve the safety and quality of insulation installations. These potential solutions are delivered in four broad streams:

- Training and accreditation;
- New buildings and major renovations (building permit required);
- Retrofits (no building permit required); and
- Moving beyond an insulation-only approach

**The potential solutions presented in this report are intended to spark conversation and feedback and are not yet 'recommendations'. We seek your views on these potential solutions, and whether there are other options that we should consider as we develop the final recommendations that will be presented to the insulation industry and the state and federal governments in late 2020.**

These potential solutions are set out in more detail in Section 9 of this report.

## 2.1 Training and accreditation

**Potential Solution 1: Improve training and accreditation processes for insulation installers**

Governments and industry could work together to either refine and expand the existing training and accreditation system for insulation installers, or develop a new training and accreditation program that could include four qualifications:

1. Basic training (and potentially accreditation) for people that install insulation into new build construction projects, covering the basics insulation installation;
2. Training (and potentially accreditation) for people that retrofit insulation into existing buildings, which would need to have more extensive safety training, including confined spaces, hazardous materials and electrical safety;
3. Training (and potentially accreditation) for pumped insulation, spray foams and polystyrene beads; and
4. Advanced insulation training and/or certification for the people that:
    - Sign off that insulation has been installed in accordance with relevant building codes and standards (new build and retrofit); and
    - Quote and specify insulation measures for retrofits. Accordingly, it would need to cover health and safety, product selection and integration of insulation into buildings.

A key lesson from local and global experience is that the take up of training and accreditation may be limited without strong drivers, such as demand from industry and/or government.

## 2.2 Installation of insulation in new buildings and major renovations

**Potential Solution 2: Update and harmonise training and quality control processes**

Insulation manufacturers, distributors and installers could consider harmonising the training and quality-control processes that they use, to support Potential Solution 1. While some

elements of training and quality-control processes are product-specific, there may be options for more national harmonisation in training, potentially using the same training and accreditation systems that could be developed for insulation retrofit installers.

**Potential Solution 3: Consider on a state-by-state basis whether someone with an appropriate training or certification in advanced insulation should be required to be involved in insulation installation.**

In some states, a significant number of insulation installations are undertaken be non-specialist installers (e.g. Queensland). One option to ensure that insulation has been appropriately installed is to require that at least one person with appropriate skills is involved in the process of insulation installation. Due to the differences between jurisdictions, this issue may need to be considered on a state-by-state basis.

**Potential Solution 4: Determine how to ensure that building inspectors can assess the quality of insulation installation**

It is currently difficult for building inspectors to determine the quality of insulation installation, which could be remedied through either a shift in the timing of building inspections, or a requirement for builders or insulation providers to provide date-stamped and geo-located photos of completed installation.

## 2.3 Installation of insulation in building retrofits.

**Potential Solution 5: Develop national guidelines and documents to support insulation installation**

In order to reduce costs and support national harmonisation, governments and industry could work together to develop a national set of simple model guidelines and documents to support insulation installation, including:

- **'Pre-Installation Assessment' processes and documents**

  A Pre-Installation Assessment involves visiting a site to assess the safety issues associated with the site and identify the suitable products for retrofit;

- **'Pre-Start Checklist' processes and documents**

  On the day of the installation, all staff that will be involved in the installation process should complete a Pre-Start Checklist that includes checking off on any of the safety issues that were identified in the Pre-Installation Assessment;

- **Guidelines for insulation installation**

  Guidelines for installation should build off existing work, including *AS 3999-2015 Thermal insulation of dwellings – bulk insulation – installation requirements*;

- **Methods for documenting completed installation**

  There are multiple options for rapidly documenting completed installation, including taking photographs of the installed insulation;

- **Quality assurance processes and documents**

  A relevant manager should either visit the site or view photographs to confirm that the installation was undertaken in accordance with relevant standards.

**Potential Solution 6: Develop a national list of products that have been verified to meet *AS/NZS 4859.1:2018 Materials for the thermal insulation of buildings***

Governments and industry could work together to develop and maintain this list, with installers on government supported- programs only use verified products from the list.

**Potential Solution 7: Create drivers for insulation installers to take up training, quality control processes and accredited products**

Governments could individually or collectively consider how to drive the take up of training, quality control processes and accredited products. Two potential options are:

- Introduce legislation to mandate training, quality control processes and accredited products for all insulation retrofits; or
- Provide significant incentives for insulation retrofits, and require the use of training, quality control processes and accredited products to access to these incentives.

**Potential Solution 8: Pre-approve insulation installation companies for government programs**

Where governments programs support the installation of insulation, they could develop lists of pre-approved insulation installation companies and require these companies to:

- Use trained and accredited installers;
- Use pre-accredited products;
- Undertake a Pre-Installation Assessment;
- Undertake a Pre-Start Checklist;
- Install measures in accordance with relevant guidelines and safety procedures;
- Document the installed measures;
- Conduct an in-house quality assurance process; and
- Provide a guarantee of the quality of insulation materials and installation.

This option would work in conjunction with options 1, 2, 3 and 4.

**Potential Solution 9: Include independent audits for insulation installations completed under government programs**

Where government programs support the installation of insulation, they should undertake or contract independent providers to conduct spot-audits on a sample of installations (e.g. five per cent of installations).

## 2.4 Moving beyond an insulation-only approach

**Potential Solution 10: Undertake further analysis on options for integrated building envelopes**

Maximising the benefits of insulation in both new builds and retrofits will need insulation to be integrated with other elements of a building's thermal envelope, air tightness and ventilation systems. Further work is required to:

- Communicate the need for, and benefits of, integrated building upgrades; and
- Identify options to foster a market for more integrated buildings and develop an industry that is capable of delivering building retrofits at scale.

## 2.5 Consultation questions

- Do the potential solutions set out above address the key safety and quality issues associated with insulation installation? If not, what is missing?
- Are the above options reasonable stipulations for industry? If not, what would you recommend in their place? And would your alternatives adequately address the risks involved in insulation installation?
- Do the above options involve governments in a constructive way to enable the roll out of healthy, comfortable buildings across Australia?
    - If not, what else should be considered?
    - What solutions for quality control don't require mandates or incentives?
- Would your organisation support the potential solutions identified in this consultation document and commit to realising them? If not, why not?

Please send any responses to consultation questions to consultation@eec.org.au.

# 3. The function and benefits of insulation

The comfort and functionality of a building involves a number of factors, including:

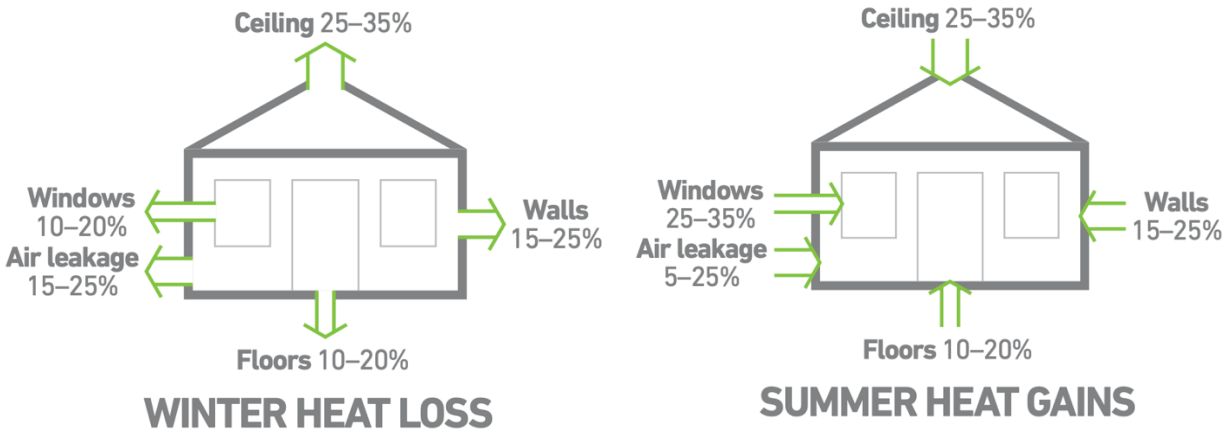
- Temperature;
- Air movement and quality (e.g. carbon dioxide levels); and
- Moisture and the presence or absence of mould.

Insulating materials play a key function in maintaining a safe and comfortable indoor temperature, but can also influence air movement, air quality, moisture and the presence and absence of mould.

## 3.1 Thermal properties of insulation

In terms of temperature, typical representations of uninsulated homes suggest that around 30 per cent of heat is lost or gained through ceilings, 20 per cent through walls, 20 per cent through floors and about 20 per cent through air leakage (Figure 1). However, precise figures will vary, and in particular heat loss and gain through air leakage can be much higher than 20 per cent.

**Figure 1 Typical heat losses and gains from an uninsulated house**




Source: Sustainability Victoria 2016 *Cavity Wall Insulation Retrofit Trial,* Sustainability Victoria, Melbourne.

Insulating materials work by reducing the flow of heat through a material. This is typically referred to as either:

- R-value – a measure of how much an insulation structure will resist the flow of thermal energy over a two-dimensional surface. Insulation products are typically rated based on their R-Value.
- U-value – a measure of how much an insulation structure will conduct heat, the inverse of R-value.

Most insulating materials function by trapping small pockets of air in relatively non-conductive material. A variety of materials are used for insulating buildings in Australia, which are set out in Table 1.

**Table 1. Common insulating materials in Australia**

| | Type of insulation | Description | Function |
|---|---|---|---|
| **Fibrous** | Glasswool – Batt | Fibres of glass are formed into batts. Non-combustible. | Ceiling<br>Underfloor<br>Wall - new or reno |
| | Glasswool – Granulated | Fibreglass is granulated into a loose fill that can be blown or pumped into a space | Wall - retrofit Ceiling |
| | Mineralwool – Batt | Fibres of minerals formed into batts. | Ceiling<br>Underfloor<br>Wall - new or reno |
| | Polyester – Batt | Polyethylene terephthalate (PET) fibres are spun and formed into batts | Underfloor<br>Ceiling<br>Wall – new or reno |
| | Cellulose – blown | A type of blown insulation made from recycled paper and treated with fire and pest retardants. | Ceiling<br>Wall – retrofit |
| **Foam board** | Expanded Polystyrene (EPS) panel (open cell) | Polystyrene is expanded and then cut into rigid boards. EPS is often coated with foil to increase its R-value | Ceiling<br>Underfloor<br>Wall - new or reno |
| | EPS beads | Small EPS balls are coated with a binding agent and pumped into a wall, forming a semi rigid space. No longer in use due to low melting point. | Wall – retrofit<br>Ceiling |
| | Extruded Polystyrene (XPS) panel (closed cell) | Polystyrene is extruded and then cut into a rigid board. | |
| | PIR board | A rigid insulation board made of closed cell, rigid foam. | Wall<br>Ceiling<br>Underfloor |
| **Thermoset** | Phenolic board stock | Rigid insulation boards made of closed cell phenolic resin with a surface acting agent. Provides protection against moisture. | Wall – new or reno<br>Ceiling– new or reno<br>Underfloor– new or reno |
| **Spray foam** | Open cell polyurethane foam | Cells are filled with air, creating a lower-density foam | Wall – retrofit<br>Underfloor<br>Sealing |
| | Closed cell polyurethane foam | High-density cells are formed around a gas, creating a dense foam | Wall – retrofit<br>Underfloor<br>Sealing |
| | Urea Formaldehyde | A resin and hardener are pumped into a space (e.g. wall cavity) and expand to form a rigid foam. Has been phased out for use in buildings. | Wall – retrofit<br>Underfloor<br>Sealing |

| | | | |
|---|---|---|---|
| **Panel** | Structural Insulated Panels (SIPs) | Prefabricated insulated panels made from foam insulation sandwiched between structural board which comprise a structural element to the home. | Wall – new or reno<br>Ceiling– new or reno<br>Underfloor– new or reno |
| | External Insulated Façade Systems (EIFS) | Prefabricated insulated panels with external coating or barrier. Acts as both air sealing and insulation. | Wall – new or reno<br>Roof |
| **Foil** | Reflective Foil Laminates (RFL) | Foil insulation is typically a highly reflective material (e.g. aluminium) combined with other materials. It works by reflecting radiant heat. | The use of RFL is changing significantly, but can be used under rooves, in walls or underfloor. |

### Common insulation forms

In addition to being categories by its materials, insulation can be categorised by its form.

**Blanket**

Blanket insulation includes fiberglass and mineralwool batts that are rolled out into a space, such as roof cavities, underfloor spaces and open walls. Blanket insulation needs to be laid in contact with the surface that is being insulated.

**Foam board**

Foam board can be used in any application in a home (walls, underneath roofs, floors and underneath foundations), although it is typically not used for ceiling insulation or retrofitting enclosed spaces (e.g. wall cavities). When installed continuously with gaps sealed with spray foam, foam boards can also provide draught sealing.

**Loose-fill**

Loose-fill insulation includes cellulose, fiberglass and rockwool that has been granulated and can be blown into place. This type of insulation can be blown into an open space much like blanket insulation, but it is also suitable for filling enclosed spaces, including existing (uninsulated) wall cavities, sealed attic spaces and other hard-to-reach places.

**Spray foam**

Spray foam acts as both an insulation and an air and moisture barrier, and is sometimes used simply for draught sealing. Foams can be sprayed in place, injected, or poured, which makes it suitable for new and already enclosed walls cavities and underfloor installations.

**Structural Insulated Panels (SIPs)**

SIPs are composite panels that provide both insulation and structural components in homes, and can be used in cavities, ceilings and floors. While SIPs are still relatively uncommon in Australia, they have become increasingly common in other jurisdictions.

**Foil**

Foils can be either used in their own (e.g. in sarking) or integrated into products such as foam boards. Unintegrated foil products have electrical safety risks and are very rarely used in building retrofits.

## 3.2 The thermal interaction of insulation with other building elements

Insulating materials are a critical component of a system to keep a building comfortable. However, insulating materials are only one part of a structure (e.g. a wall), and the overall thermal property of a structure is affected by multiple factors. For example:

**Gaps in insulation materials**

In most buildings insulation doesn't form a continuous surface, and is interrupted by materials such as wooden joists. Wooden joists are not very thermally conductive in themselves, however if there are significant gaps in insulation (e.g. insulation hasn't been installed up to the edges of joists and cover top plates) it can significantly reduce the overall R-value of a structure.

**Thermal bridging**

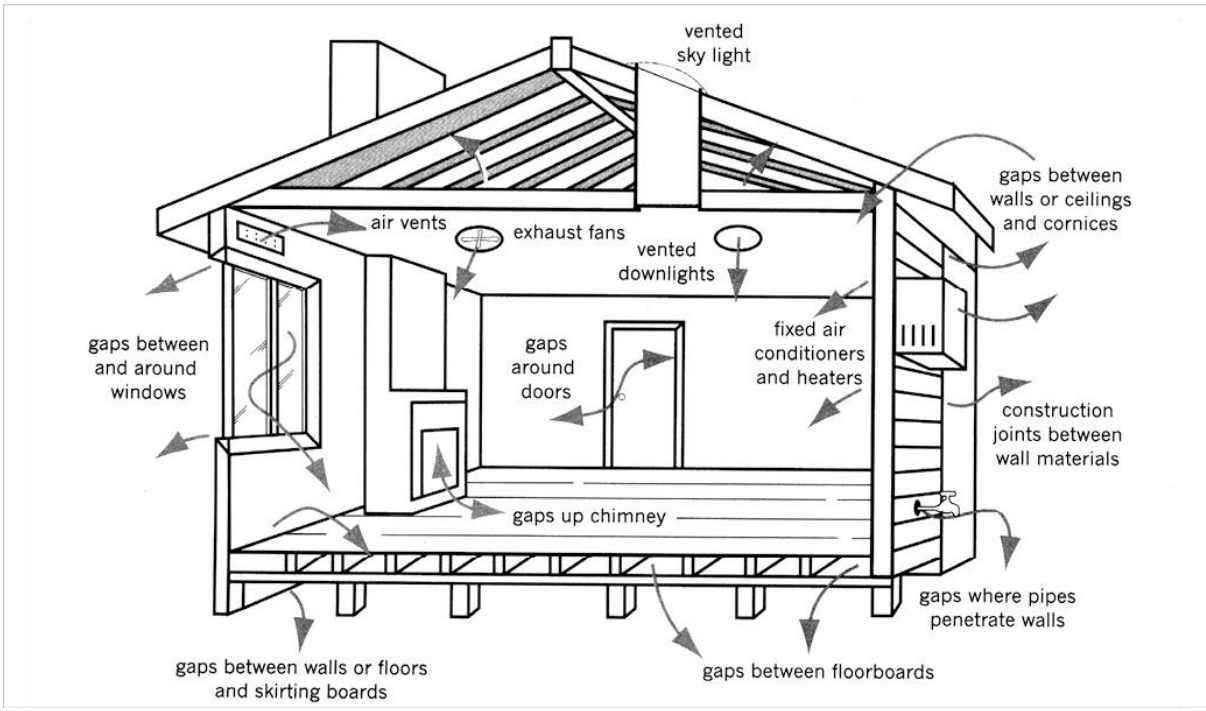
As noted above, in most buildings insulation doesn't form a continuous surface, and is often broken by materials such as wooden studs. Some level of thermal bridging is normal, and while wood is a form of thermal bridging that reduces the overall R value of a structure, it is a relatively poor conductor of heat. However, if an insulated surface is pierced by very thermally conductive materials, such as steel, it can dramatically reduce the R-value of the surface.

**Air leaks**

Even if a room is surrounded by a good insulating layer on all surfaces, if air can easily move in or out of the space it undermines the impact of insulation. Sources of air leakage can also enable vapour and moisture to enter a home which can then cause issues such as mould and mildew. Common sources of air leakage in a home are shown in figure 2.

In effect, a whole building is a thermal structure, that includes ceilings, walls, floors, windows, doors and ventilation systems. The performance of a building depends on every element in the system – even if a ceiling is well insulated, a building can be very cold in winter and hot in summer if its walls and floors are uninsulated, it has single-glazed windows, and/or has a high rate of air leakage. Building renovations and retrofits are therefore viewed as a holistic system in terms of a 'building envelope', which can be defined as the barrier where the thermal and air barriers of a building meet.

**Figure 2 Common sources of air leakage in a home**




Source: YourHome: *Sealing your home.* https://www.yourhome.gov.au/passive-design/sealing-your-home

## 3.3 Air tightness, ventilation and moisture control

As noted above, the impact of insulation can be undermined by unintended air leaks. However, excessive air tightness can result in poor air quality, including high levels of carbon dioxide. Modern building practices combine minimising unindented air leaks with designing effective ventilation systems, such as mechanical fans in bathrooms, to ensure an appropriate level of airflow through a building. This approach can be strengthened by using heat-recovery ventilation systems that extract heat (or cool) from outgoing air and use it to heat (or cool) incoming air. This approach is often referred to as:

*Seal it tight, ventilate right*

Ventilation strategies also have a critical impact on moisture control. Moisture build-up on surfaces in buildings (e.g. on drywall) can lead to mould problems which both damage the building and have health impacts. However, moisture build up on surfaces is also affected by the thermal envelope of a building. Warm air can carry quite high levels of moisture. When warm moist air comes into contact with colder surfaces, it results in condensation.

Correctly designed and installed insulation measures can help to reduce condensation. For example, in cold climates installing insulation in walls can help reduce the build-up of moisture on drywall. However, installing insulation materials without addressing other elements of a building's design can also exacerbate condensation issues. For example, installing thick ceiling insulation can lower the temperature of a roof, increasing condensation in the roof cavity if it is tightly sealed. In this instance, installing insulation in a ceiling should be combined with strategies to ensure that moisture can exit the roof space.

This means that good integrated design and construction are important to maximise the benefits of insulation, for both thermal performance, air quality and building longevity, whether this is part of a new build, major renovation or retrofit.

## 3.4 The benefits of insulation

Insulation is an essential component of a healthy, comfortable building. In both commercial and residential buildings, ensuring an adequate level of insulation can result in lower heating and cooling bills, reduced prevalence of illness and death, and increased thermal comfort. The benefits of insulation extend far beyond the individual household, providing benefits for regional electricity grids, local pollution and greenhouse gas emissions.

Studies indicate that insulation levels in both new and existing buildings in Australia are significantly below the ideal cost-benefit level. An ABS survey from 2011 suggested that 14 per cent of homes had no ceiling insulation and the presence of insulation was unknown in a further 17 per cent of households.[1] The proportion of homes lacking insulation in their walls and underfloor is likely significantly higher. Given that almost all buildings constructed after 2011 include insulation, the proportion of partially- or fully-uninsulated houses is likely to have declined but still remain significant.

### Health and Social benefits

Hayes et al conclude that *"housing, health, and energy efficiency are closely intertwined",* and that improving household energy efficiency can deliver significant improvements in occupant health outcomes, with particularly significant benefits in reducing asthma, respiratory illness, and cardiovascular disease. [2]

In addition to health benefits, insulation upgrades also deliver emotional and social benefits. Studies of insulation retrofits in social housing in the UK found that that tenants reported improved thermal comfort, health and wellbeing, including improved mental health, social interaction, family relations and nutrition.[3, 4] Studies in New Zealand have found that insulation retrofits delivered significant improvements in self-reported heath measures, reduced general practitioner visits, hospitalisations and days missed from work or school. [5, 6]

It is estimated that around 3,000 Australians die during periods of hot and cold weather each year, and Melbourne, Sydney and Brisbane have cold-associated mortality rates that are far

[1] https://www.abs.gov.au/ausstats/abs@.nsf/Lookup/4602.0.55.001Main+Features3Mar+2011

[2] Hayes, S., Kubes, C., & Gerbode, C. (2020). *Making health count: Monetizing the health benefits of in-home services delivered by energy efficiency programs*. American Council for an Energy Efficient Economy: Washington, DC. Page iv.

[3] Lilley, S., Davidson, G., & Alwan, Z. (2017). ExternalWall Insulation (EWI): Engaging social tenants in energy efficiency retrofitting in the North East of England. *Buildings*, *7*(4). https://doi.org/10.3390/buildings7040102

[4] Gilbertson, J., Stevens, M., Stiell, B., & Thorogood, N. (2006). Home is where the hearth is: Grant recipients' views of England's Home Energy Efficiency Scheme (Warm Front). *Social Science and Medicine*, *63*(4), 946–956. https://doi.org/10.1016/j.socscimed.2006.02.021. Page 946.

[5] Chapman, R., Howden-Chapman, P., Viggers, H., O'Dea, D., & Kennedy, M. (2009). Retrofitting houses with insulation: A cost-benefit analysis of a randomised community trial. *Journal of Epidemiology and Community Health*, *63*(4), 271–277. https://doi.org/10.1136/jech.2007.070037.

[6] Howden-Chapman, P., Matheson, A., Crane, J., Viggers, H., Cunningham, M., Blakely, T., Cunningham, C., Woodward, A., Saville-Smith, K., O'Dea, D., Kennedy, M., Baker, M., Waipara, N., Chapman, R., & Davie, G. (2007). Effect of insulating existing houses on health inequality: Cluster randomised study in the community. *British Medical Journal*, *334*(7591), 460–464. https://doi.org/10.1136/bmj.39070.573032.80. Page 460.

higher than Stockholm in Sweden.[7] As Australians spend much of their lives indoors, the poor thermal quality of our homes is considered a critical factor in Australia's high temperature-related mortality rates.[8] In one health district in Melbourne, 78 per cent elderly patients presenting with hypothermia had developed it indoors.[9]

Improving the insulation of our buildings wouldn't just reduce cold-associated morbidity and mortality - Morshed et al estimate that bringing the entire building stock of Melbourne up to a minimum of 5.4-star NatHERS rating would reduce deaths in heatwaves by 90 per cent.[10] With climate projections suggesting increased periods of hot weather, ensuring that building can maintain safe and comfortable temperatures during heatwaves will be critical.

## Environmental benefits

Improving the levels of insulation in new and existing building in Australia would deliver significant greenhouse gas emissions reductions through the reduction in energy use and fossil-fuel extraction and combustion, with one study estimating that insulation could reduce Australia's emissions by 7.1 million tonnes of $CO_2e$.[11, 12] The impact of insulation on reduced energy demand can also impact on local air pollution. Reductions in the extraction and combustion of coal and gas reduce particulate matter, sulphur dioxide, nitrogen oxides and mercury pollution as well as greenhouse gas emissions associated with coal mining and fossil fuel-generated electricity.[13]

## Economic benefits

The total economic benefit of insulation is a combination of their health, social and productivity benefits.

The most obvious economic and social benefit of insulation in buildings is reduced energy bills. Studies on a major retrofit program in New Zealand found that homes with upgraded insulation had energy bills that were 13.2 per cent lower than the control group.[14]

However, multiple studies suggest that the health and social benefits of insulation are far larger than the bill-savings. Returning to Chapman et al study from New Zealand, the authors estimated that total discounted benefits of insulation retrofits due to reduced general

---

[7] Gasparrini, A., Guo, Y., & Hashizume, M. (2015). Mortality risk attributable to high and low ambient temperature: a multicountry observational study. *The Lancet*, *386*(1), 369–375. https://doi.org/10.1016/S0140-6736(14)62114-0

[8] Australian Department of Agriculture, Water and the Environment. (n.d.). *Indoor air.* https://www.environment.gov.au/protection/air-quality/indoor-air

[9] Forcey, D., Fitzgerald, M., Burggraf, M., Nagalingam, V. and Ananda-Rajah, M.2020 "'Cold and lonely': emergency presentations of patients with hypothermia to a large Australian health network", *Internal Medicine Journal,* 50, pp54-60

[10] Morshed, A. Sanjayan, J., Zou, P. Srewart, M. and Wilson, J. 2016 "Modelling the correlation between building energy ratings and heat-related mortality and morbidity," *Sustainable Cities and Society,* 22, pp29-39

[11] ASBEC & ClimateWorks Australia. (2018). The bottom line: The household impacts of delaying improved energy requirements in the Building Code. In *Building Code Energy Performance Trajectory Project*.

[12] Energy Efficient Strategies (2012). *The value of insulation based residential energy savings measures in Australia*. http://icanz.org.au/wp-content/uploads/2013/04/The-Value-of-Insulation-Based-Residential-Energy-Savings-Measures.pdf

[13] Nishioka, Y., Levy, J. I., Norris, G. A., Wilson, A., Hofstetter, P., & Spengler, J. D. (2002). Integrating risk assessment and life cycle assessment: A case study of insulation. *Risk Analysis*, *22*(5), 1003–1017. https://doi.org/10.1111/1539-6924.00266

[14] Chapman, R., Howden-Chapman, P., Viggers, H., O'Dea, D., & Kennedy, M. (2009). Retrofitting houses with insulation: A cost-benefit analysis of a randomised community trial. *Journal of Epidemiology and Community Health*, *63*(4), 271–277. https://doi.org/10.1136/jech.2007.070037. P271.

practitioner visits, hospitalisations and days missed from work or school resulted in financial savings in the order of "one and a half to two times the magnitude of the cost".[15]

A second study from New Zealand suggested that the each dollar that had been spent on their insulation retrofit program delivered a benefit-cost ratio of 3.6 to 1 for retrofits to the homes of the general population, and a ratio of 7 to 1 for retrofits to the homes of low-income households.[16,17]

Extending beyond the household, insulation also delivers benefit to electricity networks, by reducing peak demand and therefore reducing the need for expenditure on networks.[18, 19]

Finally, insulation installation is jobs-rich. The International Energy Agency estimates that energy efficiency upgrades to buildings deliver approximately 6.5 to 15 jobs per million USD of expenditure, making public investment in energy efficiency retrofits well suited to stimulus programs.[20]

[15] Chapman *et al.* (2009). Retrofitting houses with insulation: A cost-benefit analysis of a randomised community trial.

[16] Preval, N., Keall, M., Telfar-barnard, L., Grimes, A., & Howden-chapman, P. (2017). Impact of improved insulation and heating on mortality risk of older cohort members with prior cardiovascular or respiratory hospitalisations. *British Medical Journal*, 7(1), 1–8. https://doi.org/10.1136/bmjopen-2017-018079

[17] Grimes, A., Denne, T., Howden-chapman, P., Arnold, R., Telfar-barnard, L., Preval, N., & Young, C. (2012). *Cost Benefit Analysis of the Warm Up New Zealand : Heat Smart Programme Ministry of Economic Development*. *June*.

[18] ASBEC, & ClimateWorks Australia. (2018). The bottom line: The household impacts of delaying improved energy requirements in the Building Code. In *Building Code Energy Performance Trajectory Project*.

[19] Energy Efficient Strategies. (2012). *The value of insulation based residential energy savings measures in Austral*. http://icanz.org.au/wp-content/uploads/2013/04/The-Value-of-Insulation-Based-Residential-Energy-Savings-Measures.pdf

[20] International Energy Agency 2020 *Sustainable Recovery,* IEA Paris.

# 4. The insulation process and industry

The supply chain for insulation involves the following steps:

- Manufacturing insulation products;
- Distribution and sales of the insulation product via the manufacturer, specialist distributor and/or retailer; and
- Installation of product into a building via one of four broad routes:
    - Construction of new buildings;
    - Renovation of an existing building (requires building permit);
    - Retrofit of an existing building (no permit required); and
    - Do-it-yourself (DIY) installation. While many households undertake DIY installation, this is not covered in this report.

## 4.1 Construction of new buildings

New buildings are designed and constructed via a relatively regulated process. This process is described in more detail in Section 5, but involves:

- A building is designed by an architect, building designer or experienced builder. While many buildings use model plans, rather than bespoke design, these model plans were originally designed by one or more experts. These plans either use design features to achieve energy efficiency outcomes, or their energy performance is modelled using software;
- A building surveyor or other party reviews the plans and either approves them or seeks amendments to ensure that they line up with the requirements of the National Construction Code (NCC);
- A builder or site supervisor oversees the construction of the building and coordinates the multiple trades involved in its construction, including licensed carpenters, licensed roof plumbers, licensed plumbers and general labourers; and
- A building surveyor or similar verifies that the building has been constructed to code. In some jurisdictions regulators also undertake spot-checks.

Insulation is generally installed in new buildings by one of two broad groups:

- **Insulation specialists employed by insulation manufacturers and distributors**

  Some large insulation manufacturing companies and some insulation distributors, which supply products from one or more manufacturers, employ staff or contractors that visit construction sites specifically to install insulation. Insulation specialists are normally trained to install particular insulation products; and

- **Workers that don't specialise in insulation**

  On the remainder of construction sites, especially those run by smaller construction firms, insulation is installed by a person who is undertaking multiple tasks, such as both plastering and insulation. Interviewees suggested that generalist installers of insulation are most likely to be either plasterers, carpenters or general labourers, but

they could come from a variety of trades. While some of these people are well-trained in insulation installation, this is not guaranteed due to their diversity of backgrounds.

ICANZ estimates that there are around 700-1,500 people working as insulation specialists in Australia, and potentially around 2,500 to 3,500 non-specialists that install insulation on a part-time basis.[21] The Australian Government estimates that there are around 4,200 workers employed as 'building insulation installers', noting that this occupation code (ANZSCO ID 821411) is wider than just insulation, and also includes window films.[22]

Interviewees suggested that insulation specialists likely installed insulation in around 75 per cent of new homes in Australia, particularly homes constructed by volume builders, while non-specialists were likely to install insulation in less than 25 per cent of homes. One interviewee suggested that this proportion varies by state, with non-specialists installing insulation in less than 10 per cent of new homes in Western Australia but around 40 per cent of new homes in Queensland.

Finally, the process of insulation installation in new buildings is relatively safe and straightforward, as:

- The absence of plasterboard makes it relatively straightforward to install insulation in walls, ceilings and under floors;
- Ceiling insulation is often (but not always) installed from underneath and underfloor insulation is often (but not always) installed from above, reducing the risks associated with working at heights and working in an enclosed space; and
- Wiring in the building is typically not live when insulation is installed.

## 4.2 Major renovations

Major renovations that require a building permit are similar to the construction of new buildings, in that the process involves:

- Design of the renovation by a specialist that can consider the overall performance of a building;
- Review of the design by specialists;
- Construction by a multi-disciplinary team; and
- Independent review of the completed renovation.

However, there are a number of differences between new builds and renovations that are relevant for insulation. These include:

- A new building is a 'blank slate' and the construction firm can control a large number of features of the building. In contrast, in a renovation a number of existing features of the building may be difficult or expensive to change. For example, when an extension is added to a building it is relatively simple to ensure that any new walls are properly insulated, but far more complicated to install insulation in existing walls. Elements that are difficult or expensive to retrofit include:

[21] Dennis D'Arcy 2020 Personal communication
[22] https://joboutlook.gov.au/occupations/building-insulation-installers?occupationCode=821411

    - Installing insulation into walls;
    - Installing airtight and vapour permeable barriers; and
    - Optimising multiple features of a house to achieve good air-tightness and effective ventilation at modest cost;
- From a safety perspective, renovating a building can involve more hazards such as wiring that is not compliant with the latest safety standards, or needing to access restricted spaces; and
- Renovations tend to be undertaken by smaller construction teams, including workers that don't specialise in insulation.

There are no estimates of the mix of insulation specialists and non-specialists in building renovations, although the bespoke nature of renovations means that non-specialists are more likely to be involved than in new buildings.

## 4.3 Retrofits

'Retrofits' of existing buildings are upgrades that don't require a building permit. Currently, upgrades of building's thermal shell, air tightness and ventilation systems tend to be undertaken as a series of separate actions that aren't coordinated by a building expert. Typically, a building's owner or manager will engage a number of separate companies to undertake projects which could include some or all of the following:

- Installing or topping up ceiling insulation, often but not always by a company that specialises in insulation;
- Installing underfloor insulation;
- Retrofitting wall insulation (typically undertaken by pumping rockwool or EPS beads into a wall cavity, or alternatively removing parts of the wall to install batts);
- Retrofitting more efficient glazing;
- Draught-sealing (can be one or more projects); and
- Improving ventilation (can be one or more projects).

While single-technology retrofits can deliver significant benefits to homes, the lack of expert integration between various upgrades can significantly undermine their effectiveness, and cause significant problems which are discussed in Section 4.

Insulation retrofits generally consist of at least two visits to a building:

- An individual with more experience in insulation visits the property to assess the site and develop a quotation for the insulation upgrade. This individual sometimes assesses a range of features of the site, including safety issues; and
- If the quote is accepted, a team of installers visit the site with the specified insulation materials and conduct the installation.

# 5. Key challenges for insulation

## 5.1 Risks for insulation performance and building occupants

To maximise the benefits of insulation, it needs to be part of an integrated design for a building, and it also needs to be installed correctly. Some of the risks associated with insulation performance and impacts on building occupants include:

**Insufficient insulation**

Building designers can specify insufficient insulation levels in building plans. Almost all homes in Australia that were built prior to the introduction of minimum insulation standards have insufficient insulation, which has a major impact on occupant health and wellbeing.

**Gaps in insulation**

Insulation needs to form as continuous a barrier as possible to be fully effective. Excessive gaps can emerge at three stages:

- **Design and overall construction** – designers and builders can create buildings with areas that are either uninsulated (e.g. skylights), or extremely difficult to insulate (e.g. the corners of some wall frames).
- **Incorrect installation** – installers can fail to correctly install insulation and leave unnecessary gaps (e.g. not putting insulation between joists in ceilings); and
- **Disturbing insulation** – trades such as electricians often move insulation in order to undertake their work, and if it isn't put back correctly this can create gaps. They may also crawl on top of ceiling insulation while doing work in the roof space, which can disturb and compress insulation, rendering it less effective.

**Thermal bridging**

Thermal bridging is typically caused by poor decisions at the design phase of a building (e.g. using metal frames that touch both internal and external surfaces of external walls) although it can be introduced in the installation phase if installers use metal fastenings that fully penetrate the insulation material. In addition to undermining the thermal benefits of insulation, thermal bridging can cause significant moisture issues by introducing condensation on small parts of a surface (e.g. where metal studs meet plasterboard).

**Condensation**

As part of an appropriate sealing and ventilation strategy, insulation can help to reduce condensation and associated issues with mould and air quality. For example, retrofitting cavity wall insulation can significantly reduce the build-up of condensation on drywall.

However, in some situations the installation of insulation can exacerbate condensation and mould issues unless it is combined with ventilation strategies. For example, increasing the thickness of ceiling insulation can lower the temperature in a roof cavity, and in tightly sealed roof cavities this can increase the build-up of moisture.

**Fire risks**

Many insulation products are extremely resilient to heat (e.g. rockwool) or are safe if they are properly designed and integrated into a building's structure. However, some insulation products (e.g. polystyrene) are flammable if they are used in the wrong context. Proper

selection of products and proper integration of products into building design can eliminate the risks associated with flammable insulation products.

However, even non-combustible insulation products can create fire risks if they trap heat from equipment such as luminaires and fans, which can then ignite materials such as joists in ceilings. This risk can be mitigated by leaving appropriate gaps between insulation and high temperature equipment, such as fans and downlights.

**Electrical issues**

Most insulation products are non-conductive and do not impact on electrical safety. However, issues can be created by two types of insulation product:

- EPS beads and adhesives can lead to the degradation of some forms of wiring if are in contact; and
- Foils, sarking and staples are conductive and can create electrical hazards if they come into contact with exposed electrical wires.

## 5.2 Role of installers

Some of the issues identified in section 5.1 are largely caused by errors in building or retrofit design, and installers are rarely in a position to correct design errors. In particular:

- Insufficient insulation in a building is generally a problem in the design phase;
- Some gaps in insulation are caused at the design phase;
- Thermal bridging is largely caused by poor decisions in design; and
- Condensation issues are largely caused by poor decisions in the design of a building's construction, renovation or retrofit.

However, insulation installers can influence the following:

- **Gaps in insulation:** Installers can influence whether insulation covers as much of a surface as possible.
- **Compression:** Installers can overly compress insulation, which reduces the amount of air in it and undermines its effectiveness.
- **Thermal bridging:** While installers are rarely responsible for the most egregious forms of thermal bridging, some fasteners used in insulation can create thermal bridges.
- **Fire risks:** Installers are responsible for minimising fire risks by creating appropriate spaces around lights, fans and other equipment.
- **Some condensation issues:** Installers need to ensure that batts are not in contact with the underside of sarking or other roofing materials.
- **Some ventilation issues:** Installers of air-tight insulation materials (e.g. foams) need to have the appropriate skills to avoid creating condensation issues.

## 5.3 Risks during the insulation of installation

The process of installing insulation products is relatively safe compared to many other construction activities, as insulation materials are relatively light, non-toxic and can be cut and installed without the use of power tools. However, like any activity, there are safety issues associated with installing insulation. These include:

**Working at heights**

Installers potentially risk injuries from falling if they are working at heights, which is especially an issue when installing ceiling insulation. In retrofits, ceiling insulation is generally installed by installers entering the roof space from either inside the home or by removing part of the roofing, and installers often need to balance on joists. In new construction ceiling insulation is generally installed from underneath, which may somewhat reduce height that workers are operating from, but it is sometimes installed from above.

**Working in restricted spaces**

Insulation installers often need to work in restricted spaces, such as roof cavities and the crawlspace under houses. This presents safety issues, including difficulties in quickly exiting an area if there are problems. This is especially an issue for retrofitting underfloor insulation and ceiling insulation.

**Overheating**

The temperature in a roof cavity can easily exceed 40 degrees on a hot day, which presents significant health hazards. Overheating is a particular risk for retrofitting ceiling insulation, although it is a risk that can be easily mitigated by not working in roof cavities during hot weather.

**Hazardous materials**

Roof cavities and crawlspaces under houses can contain a variety of potentially hazardous materials, including mould and, in some cases, asbestos.

**Electrical safety**

Installers can come into contact with live wires, especially if they are retrofitting insulation into a roof cavity. Generally, wiring in a new construction is compliant with modern safety standards, is not live and presents a low safety risk. Electrical safety issues are significantly higher for renovations and retrofits because:

- Wiring may have been installed prior to the introduction of modern safety standards and features such as Residual Current Devices;
- Wiring may have degraded or been tampered with by unqualified people; and
- Even if the electricity is switched off at the mains, lives wires from the electricity network or onsite solar PV can enter the house through the roof cavity.

Even given these risks, most insulation products are extremely safe to retrofit. Foil insulation, however, presents a significant safety risk if it is installed incorrectly. Three of the four deaths associated with the Australian Government's Home Insulation Program were due to inexperienced installers working with foil insulation.

# 6. Current Australian policy and programs

There are currently a range of policies and programs in Australia that encourage the safe and quality installation of insulation.

- General rules that are not specific to insulation:
    - Workplace health and safety laws and electrical safety laws; and
    - Commonwealth, state and territory consumer protection laws.
- Voluntary standards:
    - Voluntary standards for insulation materials; and
    - Voluntary standards for the process of installing bulk insulation.
- A range of training and accreditation programs for insulation installers; and
- The National Construction Code (NCC) and associated state and territory regulations and compliance mechanisms.

## 6.1 Workplace health and safety laws and electrical safety laws

State and territory workplace health and safety laws require employers to provide safe workplaces and require employees to follow safe work practices. Relevant acts include:

- *Work Health and Safety Act 2011 (NSW);*
- *Occupational Health and Safety Act 2004 (Vic); and*
- *Workplace Health and Safety Act 1995* (Qld).

States and territories also have legislation that set out specific requirements around electrical safety, such as the *Electrical Safety Act 2002* (Qld). It is notable that the three companies that employed insulation installers that were electrocuted during the Australian Home Insulation Program were fined at least $100,000 each for failing to meet their duties under the *Electrical Safety Act 2002* (Qld), with one also fined for breach of the *Workplace Health and Safety Act 1995* (Qld).

This means that the employers of insulation installers are already required to provide safe workplaces, particularly in regards to electrical safety. However, the level of explicit guidance as to *what constitutes a safe workplace or work-practice* varies between sectors.

In addition to general requirements, individuals that work on construction sites (new build or renovation) are required to undergo basic safety training to obtain a ‘white card’.

## 6.2 Fair trading and consumer protection laws

Commonwealth, state and territory laws, such as Australian Consumer Law and Fair Trading Act 2012, provide a framework that places some requirements on companies to deliver fair services. Amongst other requirements, these laws require the provision of clear and fair contracts and a requirement to deliver the services that were quoted or provide a refund. This legislation does provide some protection for consumers, but since many consumers lack sufficient knowledge of insulation installation, they may not understand or demand their rights in this matter.

## 6.3 Standards for products

Standards Australia has developed a standard for insulation materials *AS/NZS 4859.1:2018 – Materials for the thermal insulation of buildings. AS/NZS 4859.1:2018* sets out quite comprehensive details on the desired features for insulation. The National Construction Code requires products to be in accordance with *AS/NZS 4859.1:2018* but there are no requirements in relation to materials used in retrofits.

## 6.4 Standard for Bulk Thermal Insulation - Installation

Standards Australia has developed a standard for the installation of bulk thermal insulation - *AS 3999:2015*. This standard has been upgraded three times since the Royal Commission in the Home Insulation Program to take account of the lessons from recent insulation programs and new technology developments.

*AS 3999:2015* set outs the process for the safe and effective installation of bulk insulation, and is relatively comprehensive, running at 118 pages. Recommendations in the standard include:

- Before bulk insulation is installed in a dwelling, there should be a pre-installation inspection. This inspection should include actions such as:
    - Assess electrical safety;
    - Assess the presence of electrical elements (e.g. wires and luminaires) to minimise heat build-up;
    - Assess impediments to installing insulation;
    - Assess potential condensation issues, including potential contact between bulk insulation and existing building membranes; and
    - Specify the works that will be carried out on the site, including the installation of insulation, the need for special equipment such as barriers around luminaires and measures to address condensation.
- During insulation, care should be made to address issues such as:
    - Minimising gaps between insulation;
    - Ensuring that insulation isn't compressed; and
    - Leaving space between insulation and external walls, to allow external walls to breath.
- Installers should address safety issues through measures such as:
    - Carrying out an assessment of the electrical risks on a site prior to installation; and
    - Switching off power to the work area where possible.

However, compliance with the standard is currently entirely voluntary in insulation retrofits, and interviewees expressed the view that a large number of insulation installations, especially retrofits, are not carried out in accordance with the standard. The cost of obtaining a copy of the standard may also be an impediment to people reading and understanding it, although the ICANZ Insulation Handbook, which references the standard, can be freely download.

## 6.5 Training and accreditation for installers

Several organisations have developed formal and informal training around insulation products and installation processes, including:

- Some insulation installer companies;
- The manufacturers of insulation products; and
- Industry associations.

### Batt insulation training

There is also a series of relevant formal training units that cover the installation of batt insulation products:

- CPCCOHS2001A Apply OHS requirements policies and procedures in the construction industry
- CPCCCM1015A Carry out Measurements and Calculations
- CPCCCM2010B Work Safely at Heights
- CPCCPB3014 Install bulk insulation and pliable membrane products
- CPCCPB3027 Install ceiling insulation.

These units could theoretically be delivered by any Registered Training Organisation (RTO) that has the capacity to deliver it. However, in practice the only organisation that is currently delivering this training is the Association of Wall and Ceiling Industries Australia and New Zealand (AWCI). The training is delivered over two days through in-person training in small groups (15-25), which provides a high level of guidance. However, there are only a few courses run each year and the requirement to attend in person creates significant barriers for potential attendees, including costs, travel and time away from work. AWCI estimate that around 200 people have completed the training over the past eight years.

### Batt insulation accreditation

The Clean Energy Council (CEC) runs an accreditation program for batt insulation installers that is built off the AWCI training. To gain provisional accreditation, an installer has to submit:

- Statement of Attainment from the course provider;
- Certificate of Currency for Public Liability Insurance of at least $5 million;
- Current Working at Heights certification; and
- Current White Card (construction induction).

Once the installer has provisional accreditation, they can secure full accreditation by undertaking seven insulation installations and submitting evidence of their work, specifically 3 wall batt installations, 3 ceiling batt insulations and 1 floor batt installation. This evidence is currently reviewed by AWCI. To maintain accreditation, installers must pay $150 a year and submit three practical assessments.

Very few people have completed or maintained CEC Insulation Installer accreditation. Only 73 individuals have applied for provisional accreditation, and of these only 27 have gone on to secure full accreditation. The vast majority of people have let their provisional and full

accreditations expire – only two people have ever renewed their accreditation. Accordingly, on 1 September 2020 there were only 16 people with current full accreditation.

With ICANZ estimating that each year between 3,200 and 5,000 people undertake paid insulation work on either a part-time or full-time basis, this means that less than 0.5 per cent of installers have current CEC Insulation Installer accreditation.

The number of people obtaining and maintaining accreditation could potentially be increased by improving the convenience and lowering the costs of training and accreditation. However, the largest barrier to the uptake of this accreditation is likely to be the limited drivers for individuals to gain accreditation. While some insulation installer companies put their staff through the CEC Insulation Accreditation program as a way of differentiating their services, accreditation does not appear to be essential to operate in the market.

It appears likely that a significant proportion of insulation installers will only be driven to take up accreditation if:

- Accreditation is mandatory for insulation installation (either just retrofit, or both retrofit and new build); or
- Governments provide incentives for insulation retrofits and make access to that incentive contingent on using trained installers. To be effective at driving the uptake of accreditation, insulation incentives will need to be significant and in place for several years. Experience in Australia and overseas shows that short-term insulation programs that require accreditation will not drive significant uptake of accreditation.

### Spray insulation and pumped insulation

Training for batt insulation will not provide people with the relevant skills for either spray insulation (i.e. expanding foams) or pumping insulation into walls. While one organisation previously provided training in foam insulation in Australia, this is no longer available.

Pumped and spray insulation are the most cost-effective way to retrofit insulation into many walls in Australia. A training program specifically for spray and pumped insulation could be considered, noting that additional training would be required for specific insulation products and installation systems.

## 6.6 National Construction Code

In most jurisdictions National Construction Code (NCC) sets out specific requirements for insulation, ventilation and air tightness for most types of building, and in NSW the requirements are set out under the Building Sustainability Index (BASIX). There are multiple steps to ensuring that a building meets these requirements:

- The design of a building is documented and, in some cases its energy performance is modelled in software to produce a performance rating, such as the Nationwide Home Energy Rating Scheme (NatHERS). This design has to be reviewed and approved by building surveyors and or other parties;
- An independent surveyor or building assessor examines the building at several stages, typically:
    - Before the foundation is laid;
    - After the foundation is laid;
    - After the frame is complete; and
    - After construction is completed.

This means that, while the building assessor has a responsibility to assess if a building is insulated in accordance with the NCC, in practice this is very difficult for insulation in walls and some other parts of a building. Insulation is typically added to a building after the frame has been assessed and is then hidden behind plasterboard prior to the completion of the home. As a result, many building assessors rely on signed statements from builders that insulation has been installed as specified in the plan.

In contrast, in most states in the US home inspections involve an assessment just before the plasterboard is installed. While this inspection is timed largely so that building inspectors can examine electrical works and plumbing, it also allows the assessment of insulation.

The difficulties in assessing insulation (and electrical and plumbing work) at the final inspection is a serious shortcoming with the building inspection process in Australia that needs to be addressed. Options to improve the ability for buildings inspectors to assess insulation include:

- Building inspectors use tools such as heat cameras during their final building inspection. This may be less effective if heating systems aren't working and/or the inspection takes place on a day with mild weather; or
- Builders or another part takes photos of installed insulation prior to plasterboard installation, and make them available to the building inspector; or
- Building inspectors undertake an additional inspection before plasterboard is installed. This would also enable them to inspect electrical and plumbing work.

## 6.7 Specific requirements by states and territories

South Australia requires anyone who installs insulation in a new home, renovation or retrofit to have a builder's license that permits them to install insulation. To obtain this condition on their builder's license, individuals must be able to reference both the relevant sections of the NCC and the insulation standards.

# 7. International case studies

Australia will need to design an approach to insulation that considers our specific circumstances, including the structure and capabilities of our construction industry, the types of buildings in Australia, our regulatory systems and our governance structures.

However, Australia can learn a great deal from other countries. Rather than conduct a shallow survey of many countries, the Project Team conducted in-depth analysis of four countries – Germany, Ireland, New Zealand and the United States of America. These countries were selected based on recommendations from global experts, similarities to Australia and availability of key information in English.

Each country that we studied had a unique approach to insulation installation, which built on that country's culture, traditions, construction systems, regulatory frameworks and experience with insulation. Nevertheless, there are a number of key themes that emerged from all case-studies:

- Governments in every country considered insulation a critical part of healthy homes and had taken policy measures to address this. All countries had both:
    - Minimum insulation standards for new homes; and
    - Generous grants for insulation retrofits, even in countries with a strong public acceptance of the benefits well-insulated homes (e.g. Germany).
- While every case-study country was taking strong action to drive insulation retrofits, they also saw the challenge of improving existing buildings as a long-term commitment. This is a significant contrast to Australia's problematic HIP, which had attempted to deliver an extraordinary number of insulation upgrades in a few years;
- The generosity of insulation grants in these countries meant that a large proportion of insulation retrofits were channelled through grant programs. These grant programs all involved much greater controls on safety and quality than the requirements on unsubsidised retrofits, and typically included:
    1. Requirements for companies and/or installers to have accreditation. Accreditation for processes should generally be targeted at companies, and accreditation for skills should generally be targeted at individuals;
    2. Requirements for installers to use approved products and processes; and
    3. Risk-based auditing of a sample of retrofits.
- Germany, Ireland and the US all went through a phase of encouraging insulation without properly taking into account ventilation and moisture control, which resulted in significant problems with condensation and indoor air quality. These countries have subsequently developed a more integrated approach to improving the thermal properties and air quality of buildings.

  Many buildings in Australia and New Zealand currently suffer significant condensation and air quality problems because they lack sufficient insulation. In learning from Germany, Ireland and the US, Australia can move directly to taking an integrated approach to buildings that considers insulation, air tightness and ventilation.

## 7.1 Germany

Germany has a long tradition of skilled craftspeople that were historically associated with guilds. Craftspeople in a particular discipline (e.g. carpentry) rise through the ranks of apprentice *(Lehrling*), journeyman (*Geselle*) and, eventually, mastercraftsman *(Meister*). Some types of businesses, such as construction companies, need to employ at one least *Meister* in the relevant discipline.

While there are clear parallels between German 'crafts' and Australians 'trades', there are significant cultural and practical differences, including longer training periods. The designation of *Meister* is highly valued and the risk of losing this designation is taken very seriously. Accordingly, much of the German building regulatory system is based around *Meister* and other accredited people personally signing off that building elements meet the relevant standards, in conjunction with a relatively low rate of independent audits.

The relevant signatories for new buildings and external cladding are *Meister* builders. For cavity wall insulation, installation and signoff is generally carried out by an 'industrial installer' who has received accredited training, often from a manufacturer.

### New construction and major renovation

Building codes in Germany are set by the 16 state governments (*Länder*) and vary between states. However, the German government, in consultation with the 16 states, sets national rules for the energy efficiency of homes in every state through the national Building Energy Act 2020 (*Gebäudeenergiegesetz 2020*).

State governments manage compliance with their building codes, including reviewing the plans for each new development to see if they meet the requirements of the Building Energy Act. Unlike Australia, where every building needs to be assessed during and after completion by private building inspectors, German state governments send independent public inspectors to assess potentially as few as one per cent of new constructions.

The German Government also offers attractive loans and grants through the KfW (state-owned bank) to encourage new buildings and renovations to go significantly beyond the requirements in the Energy Code, and there are additional compliance mechanisms in place to ensure that public funds are well spent.

To secure these incentives, developers must provide their retrofit plans to the KfW. These plans need to be signed off by an Energy Rater *(Energieberater)* – an *Energieberater* is not a particular profession – rather it is a *Meister*, architect, engineer, craftsperson or similar who has undertaken additional training in energy and been registered on a central government platform as an *Energieberater*. The KfW also undertakes independent inspections of less than 1 per cent of projects to assess if they have complied with their submitted designs.

### Retrofits

The German Government also offers attractive incentives for upgrading the thermal shell of buildings. As with incentive for new buildings, to be eligible for these incentives, plans need to be signed off by an *Energieberater*.

In addition to incentives for specific upgrade measures, the German government provides subsidies for holistic home retrofit designs, also known as a 'building retrofit passport'. A building energy passport is far more than just an energy efficiency rating – instead an

*Energieberater* provides detailed specifications for an integrated energy efficiency retrofit that considers insulation, air tightness, ventilation, heating, cooling and hot water. This plan is detailed and actionable, providing quite specific details on what should be installed (e.g. the type and thickness of insulation) and the sequencing of measures.

To give an indication of the level of thoroughness of a building energy passport, the full unsubsidised cost of a passport would be around AUD 2,500, although the German government covers up to 80 per cent of the cost of a building retrofit passport.

### Implications for Australia

Some German measures would be hard to rapidly introduce in Australia due to their reliance on highly-trained tradespeople and professionals. However, there are three take-away measures:

- Testing and certification of products will become increasingly important as buildings move towards pre-fabricated components;
- More training and accreditation are critical as we move towards high-performance buildings, including for the installation of insulation; and
- Australia will need highly skilled individuals to design and deliver integrated building retrofits, whether those skills are held by builders, architects or dedicated energy professionals similar to the *Energieberater*. As one interviewee noted *"Homeowners may only upgrade their homes once in their life, why would we expect them to become experts in retrofitting if they are only doing it once?"*

## 7.2 Republic of Ireland

Ireland's system for quality control of insulation is built around three elements:

- Certification for insulation products, and associated certification for the companies that install these products;
- Standards for new buildings and renovations; and
- Generous grants for insulation retrofits that are accompanied by requirements to use certified products and installers and undertake a home energy efficiency rating.

### Accreditation for products, companies and experts

The National Standards Authority of Ireland (www.nsai.ie) has a branch (*NSAI Agrément*) that oversees standards for 'new and innovative' building products and processes, including thermal insulation, wall membranes and window systems. NSAI Agrément standards for products also set out the standards for the installation of those specific products to ensure that they remain certified, including how to address ventilation issues.

In relation to insulation, *NSAI Agrément* certifies:

- Cavity wall insulation – generally pumped insulation;
- External insulation - pre-fabricated panels of multiple materials fitted to the outside of buildings; and
- Installers of specific products - e.g. some installers are specifically certified to use the Korefill Cavity Wall Insulation system. Interviewees indicated that manufacturers of these products will provide training for installers to provide quality control.

*NSAI Agrément* also certifies:

- Air tightness testers (testing is required for new construction);
- Thermal modellers (modelling is required for new construction); and
- People that can validate that ventilation systems have been appropriately installed, balanced and commissioned (validation is required for new construction).

In addition, the Sustainable Energy Authority of Ireland (SEAI) trains and accredits Building Energy Raters (BER) that develop energy ratings for buildings.

### New construction and major renovation

The design and construction of buildings is regulated under the *Building Control Acts* 1990 to 2014. As part of this system, buildings need to meet specific energy efficiency requirements, including the use of appropriately certified products. As noted above, new buildings and major renovations are also tested, including tests for air tightness and ventilation systems.

### Retrofits

NSAI and SAI Global have developed a '*Code practice for the energy efficient retrofit of dwellings'* (Standard Recommendation SR 54:2014&A1:2019) which sets out comprehensive advice for the retrofit of dwellings including insulation, air tightness, ventilation, heating, hot-water systems and lighting. This document provides technical guidance on energy efficiency

retrofits, and is intended for 'designers, specifiers, installers and property managers working on energy efficient retrofit projects for dwellings'. This code of practice is entirely voluntary unless projects are supported by government grants.

The Sustainable Energy Authority of Ireland (SEAI – www.seai.ie) offers a range of generous grants to encourage and support people to undertake energy retrofits. The Better Energy Home (BEH) grants include:

- Attic insulation – grants of €400 (approximately AUD 650)
- Cavity wall insulation - grants of €400 (approx. AUD 650)
- External wall insulation in a detached house - grants of €6,000 (approx. AUD 9,800)
- Heat Pump for space heating (air to air) – grants of €600 (approx. AUD 980)

If homeowners complete three upgrades, they get an additional grant of €300, and if they complete four upgrades their grant will be increase by a further €100. If homeowners are on social security, they can be eligible for completely free upgrades.

Due to the generosity of these grants, a large proportion of insulation retrofits in Ireland take advantage of these grants, which enables the Irish Government to put additional controls on the quality of installation. These additional conditions include:

- Requirements to use appropriately certified materials. For example, cavity wall insulation must be *NSAI Agrément* certified cavity wall insulation.
- Requirements to use an SEAI Registered Contractor for the relevant work. For example, contractors carrying out cavity wall insulation must be on the directory for *NSAI Agrément* 'Registered Blow Cavity Wall Installation Companies'.
- Contractors must comply with all relevant Health and Safety legislation, including the *Safety, Health and Welfare at Work Act 2005*. There are additional requirements around matters such as electrical works, where non-compliant 'earthing and bonding' must be rectified to the applicable National Rules for Electrical Installations 2008 before grant-funded works are started.
- The contractor must carry out a pre-works assessment before works commence, which includes an assessment of 'ventilation provision'. Depending on the current condition of the dwelling and the works that are planned, some upgrades to the ventilation systems may be required. One interviewee highlighted the importance of the pre-works assessment.
- Materials must be installed in accordance with specifications that are specific to that material (e.g. cavity wall insulation or ceiling insulation). These specifications are set out in SEIA 2019 *Domestic Technical Standards and Specifications*, SEAI, Dublin. In the case of cavity wall insulation, for example, the specification requires:
    - Walls must be surveyed before installation by a trained surveyor. Any defects recorded in the survey must be rectified before works can commence;
    - Cavity filling with EPS balls should not be undertaken where unprotected PVC-sheathed electrical cables are passing through the cavity; and
    - Cavity wall insulation must achieve a U-value of at least 0.35 $W/m^2K$.

- Manufacturers, system suppliers and/or contractors must issue a guarantee to the customer.
- The impact of the upgrade must be assessed by a registered 'Building Energy Rating (BER) Assessor'. The assessment must be conducted in accordance with a range of guidelines, including the most pessimistic default settings in calculations unless the BER Assessor has been provided with relevant information and certificates for the products that have been used.
- SEAI conducts random checks of insulation installation. Spot checks typically take place during the installation of insulation, rather than afterwards, due to the complexity of assessing the quality of cavity wall insulation after it is completed. While there are benefits in conducting an assessment during the installation process, it does make it significantly less effective at ensuring compliance, as installers will know which upgrades will be monitored and which will not.

### Implications for Australia

- As with Germany, Irish programs suggest that testing and certification of products will become increasingly important as buildings move towards pre-fabricated components;
- As with Germany, Ireland has invested considerable efforts to create an industry that can deliver integrated energy efficiency retrofits;
- Australia could learn from the way that Ireland has used the relationships between insulation manufacturers and insulation installers to ensure that installers are trained in installing products and motivated to deliver quality outcomes; and
- Australian policy makers could examine the Better Energy Home grants documentation to develop requirements for insulation installers for local programs.

## 7.3 United States of America

In the US, state governments are responsible for many matters relating to buildings, including standards associated with new construction and programs to encourage retrofits. However, there is a level of national or regional coordination provided by various bodies.

**New Buildings and major renovations**

Building codes requirements in the US vary by state and city but are generally based on model codes, primarily the International Building Code (IBC) which is developed by the International Code Council (ICC). While the IBC has been adopted by a small number of jurisdictions, including Abu Dhabi and Colombia, it is heavily driven by US requirements, and all eighteen of the ICC's directors are based in the US.[23]

US jurisdictions generally use a combination of two model codes to set their requirements for energy efficiency:

- The ICC's International Energy Conservation Code; and
- The American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) *Standard 90.1 for the Energy Efficient Design of New Buildings Except Low-Rise Residential Buildings* (i.e. commercial buildings and apartments).

Model codes are generally updated around every three years, but states and local governments are not required to adopt the latest version of a model code as soon as it is updated, and so there are a variety of vintages of model codes in operation around the US.

States and local governments are responsible for compliance with their building codes. As in Australia, building inspectors are required to assess that new buildings are compliant with the code. However, unlike Australia, most jurisdictions require a building inspection before drywall (plasterboard) is installed so that inspectors can properly assess electrical works, plumbing and insulation. Interviewees from the US noted that the requirement to have inspections prior to the installation of drywall was primarily to inspect electrical works, and that insulation was rarely assessed in detail. However, major defects in insulation would be far more likely to be picked up if buildings were inspected prior to drywall installation.

### Retrofits

If building owners upgrade the insulation in their home without any grant from government or utilities, there are no specific training or process requirements that insulation installers are required to meet beyond general occupational health and safety and consumer protection requirements.

However, over the several decades there have been a variety of national, state, utility and local programs to encourage energy efficiency retrofits in buildings. For example, following the Global Financial Crisis, the Obama Administration invested USD 11 billion in stimulus for building upgrades between 2009 and 2011.[24] These programs have typically imposed a range of certification and quality requirements on insulation upgrades.

[23] Confirmed on 28 August 2020

[24] International Energy Agency 2020, *Energy efficiency and economic stimulus*, IEA, Paris.

The US Department of Energy, in cooperation with the US Environmental Protection agency runs a national program called Home Performance with ENERGY STAR (https://www.energystar.gov/campaign/improvements) which encourages and supports households to have an integrated energy efficiency retrofit to their home. These integrated retrofits consider a broad range of issues such as insulation, air sealing, ventilation, windows, air conditioning, hot water and appliances. The program includes:

- Mandatory certification for some categories of expert;
- A process for a 'home performance assessment' which leads to a relatively comprehensive set of 'home improvement recommendations';
- A system for assurance quality of the installations performed by vetted contractors; and
- Standards around how upgrades are conducted.

This program in effect establishes a bar for integrated energy efficiency retrofits. The roll-out of this program is undertaken by 'sponsors', which can be national, state and local agencies or utilities. Sponsors recruit and train contracts in local areas, promote this approach (in some cases including subsidies) and evaluate upgrades after they have been installed in order to provide quality control.

The Building Performance Institute (BPI) (www.bpi.org) has established a suite of training and accreditation programs for building performance specialists, which is one of several certification types that program sponsors may require. Training and accreditation includes:

- Building Analysts, who can conduct whole-of-home energy audits and make tailored recommendations to improve buildings based on building physics;
- Crew Leaders, who have the ability to oversee energy efficiency upgrades; and
- Retrofit Installer Technicians, who can install insulation, air sealing, duct sealing, ventilation and other elements of a building upgrade.

The Building Analyst certification is competency-based, which means that while training may be valuable, is not mandatory. Instead, certification is based on passing:

- An online examination that consists of 100 multiple-choice questions derived from the ANSI/BPI-1200-S-2017 Standard Practice for Basic Analysis of Buildings; and
- A field test that consists of health and safety inspections of equipment within the home, including carbon monoxide testing of gas-fuelled equipment, and administering a blower door test to measure air leakage within the home.

Although the Building Analyst accreditation is considered one of the BPI's entry-level accreditations, Building Analysts perform quite comprehensive audits that include:

1. A basic visual inspection of electrical systems within the home, especially electrical boxes and wiring within the roof space;
2. A visual inspection of any health and safety issues within or outside the home – existing or potential – including, but not limited to gutters and water diversion outside the home, cracks in walls or ceiling indicating compromised structural integrity, mould or mildew as a result of moisture issues or improper ventilation;

3. Testing gas lines inside and outside the home for gas leaks;
4. Testing ventilating fans, including ensuring they vent to outside the home and measuring their airflow;
5. Testing combustion (gas-fuelled) equipment (generally hot water heaters, ducted gas furnaces, and ovens) for carbon monoxide generation and proper venting;
6. Measuring ceiling, wall and underfloor insulation (where possible) to later prescribe recommendations for top-ups;
7. Visual inspection of the roof space to check for unsealed downlights and other bypasses for significant air leaks and unsafe insulation practices such as covering downlights or wires; and
8. Performing blower door tests to determine airflow throughout the home to later prescribe an appropriate level of air sealing.

After a Building Analyst assesses a home, they present their initial findings to the homeowner and then use modelling software to come up with specific, actionable recommendations including specific insulation top-up amounts, levels of draught sealing, HVAC and lighting upgrades to present the homeowner with a holistic retrofit picture including costs.

In some cases, the analyst may refer the homeowner to a specific company that is capable of completing the retrofit work, or they may be employed by a company that is capable of doing this work. Homeowners may then qualify for rebates on the retrofit work through the Home Performance with Energy Star program, which the company will assist with.

### Implications for Australia

- Australian policy makers could consider how to give Australian building inspectors the same ability to assess the quality of buildings as their counterparts in the US. In the US building inspections are conducted before drywall (plasterboard) is installed, which enables US building inspectors to easily assess electrical works, plumbing and insulation. Options include changing the timing of building inspections in Australia or requiring builders to provide building inspectors with comprehensive photographs of buildings prior to the installation of plasterboard.
- The US Home Performance with ENERGY STAR demonstrates one potential approach for a national program to improve the quality of insulation installation and building retrofits, which includes:
    - National collaboration to develop standards and certification for building energy efficiency retrofits; and
    - State and local governments and utilities providing funds to roll out this approach at a local level.
- The Building Performance Institute does not have a single accreditation system, rather it has a range of accreditations in the design and installation of energy efficiency retrofit measures in homes. In Australia, a single insulation installer accreditation will deliver significant benefits, but the benefits would be significantly greater if insulation installer accreditation was split into several levels and accompanied by a range of other accreditation programs, particularly in the design of home energy retrofits.

## 7.4 New Zealand

Construction work in New Zealand is regulated under the *Building Act 2004*, whether it requires building consent or not. However, in practice the construction of new buildings and major renovations are regulated significantly more than maintenance and retrofits.

Like the US, New Zealand doesn't require training or accreditation for the retrofit of insulation unless it is supported by government funding. However, New Zealand has had a major and very generous incentive program for retrofitting insulation into the homes of low-income and vulnerable households, which is currently called *'Warmer Kiwi Homes', which is associated with* quite significant processes for quality control.

### Warmer Kiwi Homes

Warmer Kiwi Homes is a retrofit program administered by the Energy Efficiency and Conservation Authority (EECA) in New Zealand. The program offers significant subsidies for the installation of insulation, moisture barriers and heating systems in low-income homes. Prior to the COVID-19 pandemic, the program was offering grants that covered an average of 67 per cent of the cost of upgrades. In response to COVID-19, grants have been increased and now cover around 90 per cent of the cost of a retrofit.

The precursor to Warmer Kiwi Homes started in 2009, and the program has been extended, refunded and rebranded several times. A recent evaluation found that the program's health, economic and manufacturing benefits resulted in a benefit-cost ratio of:

- 3.6 to 1 for the general population; and
- 6 to 1 for low income households.[25, 26]

The success of the program is likely in part attributable to the fact that it has been operating for over a decade, which has allowed EECA to iterate the program design. The program has well-established quality-control process that includes:

- A panel of vetted installation companies;
- Requirements to use accredited insulation products;
- Requirements for companies to follow processes in insulation installation; and
- Independent audits of approximately 5 per cent of retrofits.

A key component of the Warmer Kiwi Homes program is that it has a pre-approved panel of insulation providers that service each region of New Zealand. In order to join the panel, installer companies need to show evidence of a history of insulation installation and their documented quality control processes. EECA expects installer companies to have health and safety processes in place in line with the general provisions of the New Zealand *Health and Safety at Work Act 2015*, and does not require specific certifications around health and safety.

[25] Preval, N., Keall, M., Telfar-barnard, L., Grimes, A., & Howden-chapman, P. (2017). Impact of improved insulation and heating on mortality risk of older cohort members with prior cardiovascular or respiratory hospitalisations. *British Medical Journal*, *7*(1), 1–8. https://doi.org/10.1136/bmjopen-2017-018079

[26] Grimes, A., Denne, T., Howden-chapman, P., Arnold, R., Telfar-barnard, L., Preval, N., & Young, C. (2012). *Cost Benefit Analysis of the Warm Up New Zealand: Heat Smart Programme Ministry of Economic Development*. *June*.

EECA does not require individual installers to take particular training courses or become certified – instead it expects installer companies to appropriately train their staff. The stability and generosity of the Warmer Kiwi Homes program provides a strong incentive for insulation installer companies to ensure that they can continue to participate in the program. Accordingly, many installer companies have had a long relationship with the program.

The main component of EECA's quality assurance process is a set of quite specific processes that installer companies need to follow in order to receive payment. These processes are set in the EECA 2020 *Warmer Kiwi Homes Service Provider (Insulation) Program Guidelines – v3.0*, and include:

**Pre-installation -** the service provider must visit the property to:

- Complete a site-specific health and safety assessment, including the identification of any risks on the site. The service provider must keep a copy of the site-specific health and safety assessment; and
- Assess the site to determine whether it is eligible for the program, determine what energy efficiency measures to install and identify any specific issues for the site (e.g. the number of light fittings that will need to be worked around).

**Installation** - on the day of the installation the service provider must:

- Complete a 'pre-start assessment', where the staff involved in the installation must review risks and controls identified in the site-specific health and safety assessment, and discuss the method and sequence of work for install; and
- Install the insulation in line with a range of documents, including:
    - The Warmer Kiwi Homes quality and audit manual;
    - *NZS4246:2016 Energy efficiency – installing insulation in residential buildings;*
    - The New Zealand Building Code; and
    - Electrical (Safety) Regulations 2010.

**Quality control and audit** – there are two separate processes:

- The service provider company itself must carry out quality assurance processes on every installation, including signing and dating a post-installation audit that declares that the installation meets all the requirements. This is a critical step, as individual insulation installers may have a much weaker incentive for quality control than service provider companies that are seeking a long-term source of revenue.
- EECA has a long-term contract with an independent audit company, which carries out independent inspections on around 5 per cent of installations.

### Implications for Australia

- New Zealand's 'Warmer Kiwi Homes' sets out a model for quality control processes that Australian governments could use as the base for their quality control processes. Australian governments may want to consider additional safety measures, specifically requiring all insulation installers that participate in government-funded programs to have undergone basic health and safety training.

# 8. Potential solutions to enhance insulation installation in Australia

This section sets out potential solutions to improve the safety and quality of insulation installations. These potential solutions are delivered in four broad streams:

- Training and accreditation;
- New buildings and major renovations (building permit required);
- Retrofits (no building permit required); and
- Moving beyond an insulation-only approach

The potential solutions are intended to spark conversation and feedback and are not recommendations. We seek your views on these options, and whether there are other options that we should consider as we develop the final options in this report.

In addition, we note that realising the full benefits of insulation will require integrated design that considers the whole thermal envelope (including glazing and minimising thermal bridging), air tightness and systems for heating, cooling and ventilation. Insulation installers are generally not responsible for overall building design and addressing these broader issues will require a range of other measures. While this report is focussed on improving the safety and quality of the insulation installation process, we have also set out options further work to develop recommendations to improve integrated building design and construction.

## Training and accreditation

### Potential solution 1

All insulation should be installed by people with basic training in safety and insulation installation. However, further training is required for people that installed various forms of pumped and injected insulation, as this is associated with a range of other risks that need to be controlled. In addition, a much higher level of competency is required by the people that specify the insulation that should in installed in a retrofit and inspect the installation to ensure that it has been done in line with standards.

Splitting insulation installer training (and potentially accreditation) programs into various sections and levels would have a number of benefits. Many installers are only in the industry for a short period of time and, while all installers should have basic training, they may be loath to undertake training that is excess to requirements. Far more skills are required for the people that specify insulation and lead installation teams, and having higher levels of accreditation may encourage people to see a career path in insulation.

A series of insulation installer accreditations could potentially be built off existing programs, such as the CEC Insulation Accreditation scheme.

**Potential Solution 1: Improve training and accreditation processes for insulation installers**

Governments and industry could work together to either refine and expand the existing training and accreditation system for insulation installers, or develop a new training and accreditation program that could include four qualifications:

1. Basic training (and potentially accreditation) for people that install insulation into new build construction projects, covering the basics insulation installation;

2. Training (and potentially accreditation) for people that retrofit insulation into existing buildings, which would need to have more extensive safety training, including confined spaces, hazardous materials and electrical safety;
3. Training (and potentially accreditation) for pumped insulation, spray foams and Expanded Polystyrene beads;
4. Advanced insulation training and/or certification for the people that:
    - Sign off that insulation has been installed in accordance with relevant building codes and standards (new build and retrofit); and
    - Quote and specify insulation measures for retrofits. Accordingly this training and/or certification would need to cover health and safety, product selection and integration of insulation into buildings.

A key lesson from local and global experience is that the take up of training and accreditation may be limited without strong drivers, such as demand from industry and/or government.

To give a sense of comparison compared to current training and accreditation schemes, the competency units required for the CEC's current Insulation Accreditation scheme (CPCCOHS2001A, CPCCCM1015A, CPCCCM2010B, CPCCPB3014 and CPCCPB3027) would be the same as, or similar to, the competency units required for the proposed second tier of accreditation (retrofitting insulation).

## Installation of insulation in new buildings and major renovations

### Potential Solutions 2 and 3

Insulation installations in new buildings are undertaken by a mix of people that specialise in insulation installation and people that undertake other roles on building sites (e.g. carpenters and plasterers). Some companies that specialise in insulation installation companies already have some form of training and quality-control processes in place, but the precise form of these processes varies significantly.

**Potential Solution 2: Update and harmonise specialist training and quality control processes**

Insulation manufacturers, distributors and installers could consider harmonising the training and quality-control processes that they use, to support Potential Solution 1. While some elements of training and quality-control processes are product-specific, there may be options for more national harmonisation in training, potentially using the same training and accreditation systems that could be developed for insulation retrofit installers.

The remaining insulation installations in new buildings and major renovations are delivered by a large number of non-specialists. It is potentially difficult to ensure that everyone in this category has appropriate training, due to the diversity of backgrounds. However, jurisdictions could consider, on either a national or jurisdictional basis, whether to require that someone with appropriate training is involved in the installation process.

**Potential Solution 3: Consider on a state-by-state basis whether someone with an appropriate training or certification in advanced insulation should be required to be involved in insulation installation.**

In some states, a significant number of insulation installations are undertaken be non-specialist installers (e.g. Queensland). One option to ensure that insulation has been appropriately installed is to require that at least one person with appropriate skills is involved in the process of insulation installation. Due to the differences between jurisdictions, this issue may need to be considered on a state-by-state basis.

### Possible solution 4

Even if insulation installers are well-trained, poor quality installation can occur by individuals cutting corners or other trades (e.g. electricians) disturbing completed insulation installations. While additional training for trades such as electricians may be beneficial in reducing the level of disturbance, the most efficient option for complementing training for insulation installers may be ensuring that building inspectors are able to assess whether insulation is installed correctly and has not been disturbed. While thermal imaging could be used in some conditions to assess the condition of insulation, advice from experts was that it may not work well in unoccupied buildings in spring and autumn.

**Potential Solution 4: Determine how to ensure that building inspectors can assess the quality of insulation installation**

It is currently difficult for building inspectors to determine the quality of insulation installation, which could be remedied through either a shift in the timing of building inspections, or a requirement for builders or insulation providers to provide date-stamped and geo-located photos of completed installation.

## Installation of insulation in retrofits

### Potential Solution 5

A variety of insulation programs around the world, such as Warmer Kiwi Homes, provide guidelines and documents to support insulation installation. Developing a set of national model guidelines and documents would support governments and industry to improve the safety and quality of insulation installation, regardless of whether they adopt a voluntary, incentivised or mandatory approach to using these guidelines and documents.

These documents could be built off existing documents, such as *AS 3999-2015 Thermal insulation of dwellings – bulk insulation – installation requirements.* However, AS 3999-2015 is not a particularly accessible document. In addition to the recent video guides produced by ICANZ, key elements of the standard could be turned into simple user-friendly guides and documents.

**Potential Solution 5: Develop national guidelines and documents to support insulation installation**

In order to reduce costs and support national harmonisation, governments and industry could work together to develop a national set of simple model guidelines and documents to support insulation installation, including:

- **'Pre-Installation Assessment' processes and documents**

  A Pre-Installation Assessment involves visiting a site to assess the safety issues associated with the site and identify the suitable products for retrofit;

- **'Pre-Start Checklist' processes and documents**

  On the day of the installation, all staff that will be involved in the installation process should complete a Pre-Start Checklist that includes checking off on any of the safety issues that were identified in the Pre-Installation Assessment;

- **Guidelines for insulation installation**

  Guidelines for installation should build off existing work, including *AS 3999-2015 Thermal insulation of dwellings – bulk insulation – installation requirements*;

- **Methods for documenting completed installation**

  There are multiple options for rapidly documenting completed installation, including taking photographs of the installed insulation;

- **Quality assurance processes and documents**

  A relevant manager should either visit the site or view photographs to confirm that the installation was undertaken in accordance with relevant standards.

### Potential Solution 6

There is an existing standard for insulation materials, *AS/NZS 4859.1:2018 – Materials for the thermal insulation of buildings.* However, materials do not need to be tested against the standard to be sold in Australia.

Governments could collaborate with industry to develop tests for products to ensure that they meet relevant standards and put them on a regularly-updated list of products that have been tested to meet the standard. Governments could potentially use this list of eligible products if they provide incentives for insulation, resulting in national harmonisation of incentive schemes.

The experience from overseas is that the processes of verifying whether insulation products meet relevant standards become significantly more important once complex composite products start to become common in the market, such as Structural Insulated Panels.

**Potential Solution 6: Develop a national list of products that have been verified to meet *AS/NZS 4859.1:2002 Materials for the thermal insulation of buildings***

Governments and industry could work together to develop and maintain this list, with installers on government supported- programs only use verified products from the list.

### Potential Solution 7

Individuals and companies will only adopt training and quality-control processes if they see an incentive to do so. There are currently a number of high-quality insulation companies that have adopted training and quality-control processes as differentiators in the market, but wider uptake has, to date, been extremely low.

For example, the CEC's 'Accredited Insulation Installer' program commenced in 2014. Over the last 6 years less than 27 people have been fully accredited under this program, which is potentially less than 0.5 per cent of the people currently working in insulation installation. While there are potential options to improve this program, the main reason for the lack of demand for the accreditation is the fact that there is almost no demand for accredited installers.

Wider take up of training and accreditation in insulation retrofits will be unlikely unless governments either:

- Mandate training and quality-control processes for all insulation retrofits services. This route will require legislative change and was not chosen by any of the case-study countries that we examined for this project (Germany, Ireland, the United States and New Zealand);

  *Or*

- Run significant and long-term incentive programs for insulation retrofit, and require training, accreditation and quality-control processes for participants in this program. These grants programs will need to be substantial and stable enough to provide an incentive for a significant proportion of insulation installers to invest in the training and processes required to participate in the program. It is notable that this was the approach taken by all the countries that we examined as part of this project, because driving uptake of insulation was seen as a critical to deliver policy goals associated with health, well-being, social welfare and greenhouse gas emission reduction.

**Potential Solution 7: Create drivers for insulation installers to take up training, quality control processes and accredited products**

Governments could individually or collectively consider how to drive the take up of training, quality control processes and accredited products. Two potential options are:

- Introduce legislation to mandate training, quality control processes and accredited products for all insulation retrofits, regardless of support from government; or
- Provide significant incentives for insulation retrofits, and require the use of training, quality control processes and accredited products to access to these incentives.

Potential Solutions 8 and 9

In Germany, Ireland, the US and New Zealand, government programs that provide grants for the retrofit of insulation all require insulation installers to conduct installations in accordance with mandated processes. It is clearly in governments' interest to ensure good outcomes from any retrofit that they support but, equally importantly, this provides governments with an opportunity to support the development of a more effective insulation retrofit industry.

**Potential Solution 8: Pre-approve insulation installation companies for government programs**

Where governments programs support the installation of insulation, they could develop lists of pre-approved insulation installation companies and require these companies to:

- Use trained and accredited installers;
- Use pre-accredited products;
- Undertake a Pre-Installation Assessment;
- Undertake a Pre-Start Checklist;
- Install measures in accordance with relevant guidelines and safety procedures;
- Document the installed measures;
- Conduct an in-house quality assurance process; and
- Provide a guarantee of the quality of insulation materials and installation.

This option would work in conjunction with options 1, 2, 3 and 4.

In Germany, Ireland, the US and New Zealand, government programs that provide grants for the retrofit of insulation all involve independent spot checks of insulation installation.

**Potential Solution 9: Include independent audits for insulation installations completed under government programs**

Where government programs support the installation of insulation, they should undertake or contract independent providers to conduct spot-audits on a sample of installations (e.g. five per cent of installations).

## Moving beyond an insulation-only approach

To deliver truly safe and comfortable buildings, insulation materials needs to integrated with a range of other measures, including other thermal elements (e.g. windows), airtightness, and heating, cooling and ventilation systems.

Ensuring that insulation is installed safely and with quality will contribute towards high-performing buildings, but is only part of this process. Other critical steps in delivering high-performing buildings include:

- Developing an integrated design for a new, renovated or retrofitted building; and
- Project managing the construction, renovation or retrofit.

There are already a series of processes in place to integrate a range of elements in the construction of new buildings and renovation of existing building - enhancing these existing processes should be able to deliver high-performing buildings. For example:

- Buildings are currently designed by architects, building designers or similar experts, sometimes with input from energy specialists. This process could be enhanced through additional training for existing professions and injecting more support from experts in building physics into the design process; and
- There are already individuals that coordinate construction projects and independent building assessors examine the final building. This process could be enhanced through additional training for key parties and potentially more rigorous testing of building performance, such as through blower-door testing.

There are far greater challenges facing the retrofit of existing buildings. Generally, homeowners and building managers, who typically lack expertise in building physics, coordinate retrofits themselves by engaging a series of disparate service providers. As a result of the lack of either an integrated design or integrated installation of multiple measures to improve the performance of building measures, retrofits are often partial and significantly less effective.

The project team interviewed experts in Germany, Ireland and the United States and found that all three countries had made significant efforts over the last two decades to develop experts and industries that could deliver integrated building retrofits at scale. If we want to ensure that all Australians live in safe, comfortable homes, governments and industry will need to work together to develop a strategy to deliver integrated building retrofits in this country.

### Option 10: Undertake further analysis on options for integrated building envelopes

Maximising the benefits of insulation in both new builds and retrofits will need insulation to be integrated with other elements of a building's thermal envelope, air tightness and ventilation systems. Further work is required to:

- Communicate the need for, and benefits of, integrated building upgrades; and
- Identify options to foster a market for more integrated buildings and develop an industry that is capable of delivering building retrofits at scale.

# 9. Next steps

Throughout October the EEC and ASBEC will conduct a series of workshops that will discuss the content of this consultation paper, and the options for consideration. This consultation process will inform final recommendations for government and industry.

Following this consultation, the project team will finalise a report with recommendations for government and industry by the end of 2020.

In early 2021 meetings will be held with both the insulation industry and government to facilitate the uptake of the recommendations from the final report.

## Consultation questions

- Do the potential solutions set out above address the key safety and quality issues associated with insulation installation? If not, what is missing?
- Are the above options reasonable stipulations for industry? If not, what would you recommend in their place? And would your alternatives adequately address the risks involved in insulation installation?
- Do the above options involve governments in a constructive way to enable the roll out of healthy, comfortable buildings across Australia?
    - If not, what else should be considered?
    - What solutions for quality control don't require mandates or incentives?
- Would your organisation support the potential solutions identified in this consultation document and commit to realising them? If not, why not?

Please send any written feedback to consultation@eec.org.au by COB Friday 30 October.

## Consultation process

All interested parties are invited to attend a public workshop on Monday 12 October at 3:30-5:00pm AEST, with additional meetings being held throughout the month.

If you would like to attend the public meeting, please register here.

Please direct any questions regarding the consultation process to Julianne Tice at consultation@eec.org.au.