Fact sheet

Keeping heat in: Insulation

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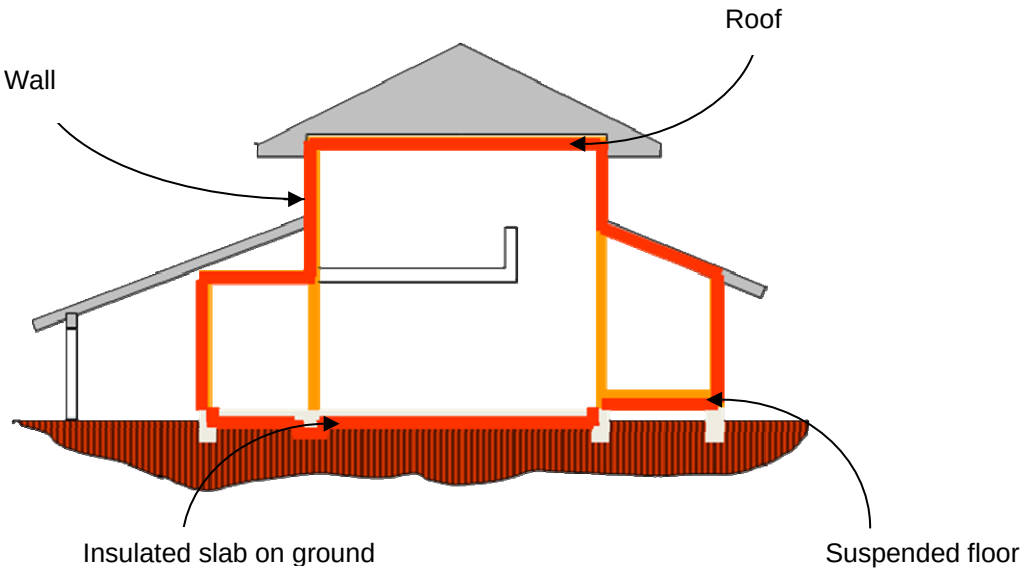
Insulation acts in two ways – in winter, it's like a blanket keeping your home warm, and in summer, it's like the walls of a chilly bin, keeping your home cool. Having a well-insulated home means that when you heat (or cool), it's your house that gets the benefit. Heating or cooling an un-insulated house is like trying to fill a bath with water, but not putting in the plug.

As insulated surfaces are warmer, condensation is less likely to form on them. As a result, an insulated house will have less mould and mildew, and be a less appealing environment for allergy-aggravating dust mites.

Insulating the thermal envelope

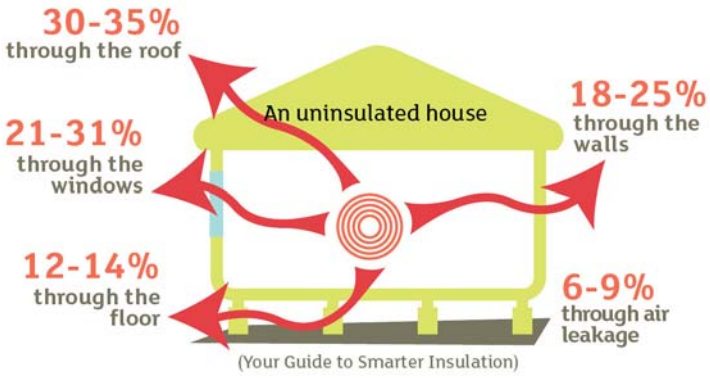
The thermal envelope is the insulation barrier between the heated and unheated spaces. It is the invisible wrap which protects the inside of the home from the outside climate. Ideally it should be continuous, have no gaps and have a minimum of weak points. (Weak points in your thermal envelope are things like windows, doors, skylights, ceiling fans, downlights and chimneys)



When thinking about insulation, it's important that you think of **all** the following areas:

- ceiling
- under the floor
- walls - **i**t's always worth insulating an exterior wall if you're relining or recladding.
- windows

Houses built before 1979 are unlikely to have any insulation, unless it has been subsequently added, and houses built before 2007 have much lower levels of insulation than necessary to keep most homes comfortable. In insulated houses without double glazing, windows are the main area where heat is lost from the home.



What is an R-value?

Insulation generally works by trapping air which is the most effective method and/or reflecting heat. Materials that provide good heat insulation are lightweight because they contain large amounts of tiny pockets of still air.

The 'R-value' measures how good the insulation material is at containing heat. The higher the R-value on an insulation product, the more it slows down the transfer of heat and the more effective it will be. Generally, the R-value of insulation gets higher as the product gets thicker. For example an R3.0 product has greater thickness than a R1.0 product of the same type. However, using R-values helps you to compare the effectiveness of different types of insulation.

You should also note that insulation needs to be properly installed to reach its R-value and work effectively.

DIY tips: Checking out your ceiling cavity

If you have had electricians in, or someone installing a ducted system (e.g. a heat transfer or ventilation system), chances are they have moved any insulation that is up there already. And there may be obvious things like ducting coming loose which you can fix easily yourself.

Here's a list of the things to look for in your ceiling:

- **Ceiling hatch – is it insulated?** If the rest of the ceiling is insulated but your hatch isn't, it will act as a chimney for heat to escape. It's easy to insulate the hatch yourself, by taping the insulation onto the top of the hatch so it stays on, even when you move the hatch.
- **Has any insulation been piled up somewhere? Are there bare areas with no insulation?** Move any piled up insulation back into place, trying to make it fit closely to the wooden rafters and next pieces of insulation. However, if there have been downlights installed in your ceiling, those areas might be bare for a reason – insulation mustn't be placed over downlights as it could catch fire.
- **Is ducting in the ceiling connected?** If it has come adrift, tape it back together again with duct tape.
- **Do you have a leak in your roof? Can you see holes or damp patches?** Sometimes the nails pop up on corrugated iron roofs, and you can see this easily from inside the cavity.
- **Is there building paper between your roof surface and the framing?** (e.g. corrugated iron or tiles) If there isn't, next time you re-roof, make sure the roofer installs building paper to help keep your ceiling cavity drier.

Types of insulation

Glass wool/Fibreglass (e.g. Pink Batts, Bradford Gold) 	▪ Widely available from your local hardware store or through professional installers. ▪ A range of R-value products suitable for ceilings, walls and under-floor, including high R-values ("Ultra" type products). ▪ Some products are Environmental Choice certified and have high rates of recycled glass content. ▪ Suitable for installation in new builds or renovations. ▪ Available as batts and as blankets. ▪ Fibres can irritate installers, and it is not easy to install in ceilings with very low roofs or under-floors where access is very difficult. ▪ Must be properly installed to perform well and doesn't perform when wet (fix that leaky roof!). ▪ Early installations (e.g. those done in the 70s and 80s) may well have slumped and are of a very thin product – these need topping up or replacing. ▪ Long lasting product - current products have an expected 50 year life.
Wool (e.g. EcoInsulation, Terra Lana, Latitude, Rockwool, Woolcote) 	▪ Widely available from hardware stores or through professional installers. ▪ A range of R-value products suitable for ceilings, walls and under-floor. Slightly lower R-values than fibreglass for same thickness of material. Often available mixed with polyester. ▪ Some products have a high proportion of recycled fibre. ▪ Chemical treatment protects from fire and pests. ▪ Suitable for installation in new builds or renovations. ▪ Available as batts and blankets, or as loose fill. ▪ Not easy to install in ceilings with very low roofs or under-floors where access is very difficult. ▪ Long term durability/life expectancy not known.

Polyester (e.g. Autex Greenstuf, Novatherm, Eco Insulation, Cocoon) 	▪ Widely available from hardware stores or through professional installers. ▪ A range of R-value products suitable for ceilings, walls and under-floor. Slightly lower R-values than fibreglass for same thickness of material. ▪ Some products are Environmental Choice certified and have high recycled content. ▪ Suitable for installation in new builds or renovations. ▪ Available as batts and as blankets. ▪ Not easy to install in ceilings with very low roofs or under-floors where access is very difficult. ▪ Stable, long life product although prone to compression damage if stored inappropriately before installation.
Polystyrene (e.g. Expol, Retrotherm, Poly Palace, Styrofoam) 	▪ Widely available from hardware stores or through professional installers. ▪ A range of R-value products suitable for ceilings, walls and under-floor, although in retrofit situations mainly used under-floor. Slightly higher R-values than fibreglass for same thickness of material. ▪ Available as sheets, beads or less commonly embedded in structural elements. ▪ Current products are CFC free but some early products used CFCs so care with their disposal is needed. Some products have high recycled content. ▪ Stable and long lived, although can be vulnerable to damage if exposed. Some shrinkage can occur over time which can affect friction fittings (e.g. in floors).
Straw	▪ Specialist installation required for straw bale construction – used for wall insulation as a structural element in new homes. ▪ Very high R-values can be achieved. ▪ Renewable product. ▪ Chemical treatment protects from fire and pests. ▪ Durability is affected by extreme sensitivity to moisture, and protection from moisture during construction is critical.
Cellulose/Macerated Paper (e.g. Insulfluff)	▪ Specialist installation required for blown-in fibre into ceilings. ▪ Has been used in ceilings where access for installation of

	insulation is difficult. Initial R-values can be similar to fibreglass, but deteriorate over time. ▪ Chemical treatment protects from fire and pests. ▪ Some products contain high recycled content. ▪ Lower cost product than other forms of insulation, but has a shorter life as it is prone to slumpage and moisture penetration over time. ▪ Older installations (e.g. from 70s and 80s) are likely to be ineffective now. ▪ Unsafe for use where downlights have been installed as can create a fire risk. Consequently, this product is not recommended.
Polymer (e.g. AirCell, Silverzone) 	▪ Available for DIY or by specialist installers. ▪ Used in ceilings and under-floors. Claimed R-values are higher than installations in place, and no independent information available on performance as yet. Available as foil backed rolls for under-floor installations. ▪ Can sometimes be installed in situations where other insulation is difficult (lower under-floors). ▪ Durability information not available but probably a stable, long-lived product.
Hardened U/F foam (e.g. Airfoam)	▪ Available for installation by specialist installers for retrofits into wall cavities as a blown-in ▪ foam. ▪ Not at all suitable for brick construction as blocks drainage cavity needed to prevent your walls rotting. ▪ Higher R-values than fibreglass. ▪ Lack of information on long term durability and impact on weathertightness of New Zealand houses. ▪ A 2010 BRANZ study found the installed R-value was less than claimed, the product was prone to cracking shrinkage and voids, and moisture management could be a problem.

Metallic foil (e.g. Silversark, Sisalation)	▪ Available for DIY for by specialist installers. ▪ Low R-value product. ▪ Used in new homes and retrofitted to suspended floors. ▪ Prone to deterioration and physical damage leading to poor performance over time. Also has risk of electrocution with installation (stapling). Consequently

	this widely-used product is not recommended. ▪ Older installations (more than 5 years old) should be replaced with a better performing product.
Aerated concrete	▪ A specialist installation product mainly used in new installations of walls and floors as blocks and pre-formed panels. A pumped-in product is available for retrofitting under-floors. ▪ Low R-values (0.7 per 100mm) ▪ Expected to be durable for the life of the building.
Insulated concrete	▪ A specialist installation product for walls of new buildings. ▪ R-value depends on the thickness of the insulation – can be higher than fibreglass. ▪ Available as blocks and pre-formed panels, normally with polystyrene as the insulation. ▪ As it is an insulated thermal mass, it can be used for heat storage. ▪ Expected to be durable for the life of the building.
Polythene	▪ This is not an insulation product, but is often a key part of an under-floor insulation installation as it acts as a vapour barrier for moisture coming off the ground. ▪ Unless your under-floor has very significant ventilation (for example, a pole house) or is built on very dry land, a vapour barrier is recommended. ▪ Some under-floor insulation products claim they also perform as a vapour barrier; however, research indicates that a separate vapour barrier is still required.

Questions to ask when considering insulation options:

1. How durable is the product? Does it break down after a number of years? How long does it provide the quoted R-value? (Insulation is required to last "not less than 50yrs" under Clause B2 "Durability" of the Building Code.)
2. Is formaldehyde (a known carcinogen) released from the product, for how long, and what are the health problems with this, particularly for sensitive people?
3. Are there problems with water (liquid or vapour) getting into the timber framing during or after the installation process that will increase the moisture content of the timber?
4. For houses where there is a ventilated cavity (typically brick veneer, where the cavity is there to stop water going from the brick veneer to the timber framing) how does the foam prevent the water (vapour and/or liquid) travelling into the timber?
5. How much does the product shrink on drying/curing? Small gaps around insulation severely compromise its R-value.
6. What guarantee is there that the cavity will not be overfilled, with resulting damage to the lining or cladding?
7. How long does the product take to dry/cure?
8. Does the product have any adverse effect on the electrical wiring, plumbing, and other services installed in the wall cavity?
9. Should you wish to install more electrical outlets or plumbing, will the new services have to be surface-mounted or is there some way of concealing them?
10. Have the R-values of your product been independently certified?
11. Are your installers and the products you use approved by EECA for the Warm Up New Zealand: Heat Smart programme?

DIY tips: Installing your own insulation

If you plan to install insulation yourself, here are some important points:

1. **Install the highest R-value possible:** Different materials (e.g. wool, polyester, fibreglass) of the same thickness will have different R-values. The Building Code recommends minimum R-values for new homes based on climate zone (visit www.dbh.govt.nz). These are minimum values only and we strongly recommend you exceed these if possible -- you won't regret it!
2. **Use a tested product:** There have been problems with insulation not meeting its claimed R-value, so it's wise to check that the product you use has been tested or certified by an accredited testing laboratory. A BRANZ appraisal, for example, indicates the product meets its performance claims (visit www.branz.co.nz/). Opus International is another laboratory conducting appraisals.
3. **Install it correctly:** This is important! There should be no gaps between insulation and framing members, or in joins between pieces of insulation. You can download -- free! -- the NZ Standard NZS4246:2006 'Installing insulation' from www.energywise.govt.nz/sites/all/files/installing-insulation-in-residential-buildings-07.pdf . This authoritative, clear, practical guide contains all you need to know with helpful detail. The essential messages are summarised in Section 3: snug fit, no gaps, no folds, no compression, keep it dry, ensure it stays in place.
4. **There must be a 25mm air gap** between the top of ceiling insulation and the underside of the roof or its underlay. This is to ensure condensation cannot track onto the insulation. If this happens severe damage to the building can result. Don't let any installer tell you otherwise!
5. **Don't cover downlights unless they are IC rated**: Because the incandescent or halogen bulbs used in downlights run very hot, fire is a very real possibility. Safety regulations mandate a 150mm un-insulated gap around the downlights, and downlight cans should never be covered unless they are IC rated. See Factsheet on Downlights.

For more information:

- See Fact sheets on
  - Keeping heat in: Overview
  - Keeping heat in: Double glazing
  - Keeping heat in: Draught proofing
  - Downlights
- To access Government assistance to get your house insulated through the Warm Up New Zealand: Heat Smart scheme, go to www.energywise.govt.nz/funding-available/index.html.
- Access NZ standard **NZS4246:2006 'Installing insulation'** from www.energywise.govt.nz/sites/all/files/installing-insulation-in-residential-buildings-07.pdf .
- Find the latest minimum standards for insulation levels at www.dbh.govt.nz/quick-energy-guide
- Here are some websites with useful information on improving the thermal performance of your house:
  - www.energywise.govt.nz/how-to-be-energy-efficient/building-and-renovatingThis is the Energy Efficiency and Conservation Authority site with everything about energy efficiency.
  - www.smarterhomes.org.nz/design/insulation and www.smarterhomes.org.nz/materials/insulation-materials. These are a good introduction to the theory and practice of insulation..
  - www.consumerbuild.org.nz/publish/materials/materials-insulation.php – this website from Consumer New Zealand has lots of information for builders and renovators.