THE IMPORTANCE OF AIRTIGHTNESS IN THE ENERGY EFFICIENCY EQUATION – and how to achieve it.

SIGA 1966 Stick with us.®

Introduction

The current debate around climate change and the contribution of humans to this phenomenon will rage on unresolved for decades. There is a fundamental lack of agreement between those that agree and those that don't. The reason is quite simple. The issue centres on the difficulty in scientifically quantifying the amount by which human activity is causing a detrimental impact. Regardless of this, governments worldwide, not just in Australia, are spending billions of taxpayer dollars on schemes, many of which are highly questionable; to show that they are a part of the 'solution'. The question is whether this massive utilisation of scarce financial resources and its huge opportunity cost to the taxpayers is an equitable one.

The Argument

The path travelled by many governments is to facilitate an environment that generates punitive measures against consumers in the hope that they will cut back on resource usage. South Australia is perhaps a case in point where power bills have more than quadrupled to the point that it has the most expensive power prices in Australia. How does this help its people? Energy security and cost effective power is of vital importance to all citizens who need business to thrive so they can be employed and ensure a successful economic cycle continues.

An alternative path is to legislate for the ethical stewardship of the consumption of our natural resources instead. We know from much research including that by the CSIRO that heating and cooling our homes and offices accounts for up to 50% of power consumption. We also know that up to 40% of energy used to condition internal habitable space is wasted as a result of air leakage. The explosion in 'green eco wash' in the building industry appears to have had little impact on this debate.

According to Joseph Lstiburek Ph.D., P.Eng., Fellow ASHRAE and esteemed Building Science Expert, **"Many green buildings don't save energy**. Why? They have too much glass, they are over ventilated, *they are leaky to air*, they are fraught with thermal bridges and they rely on gimmicks rather than physics".

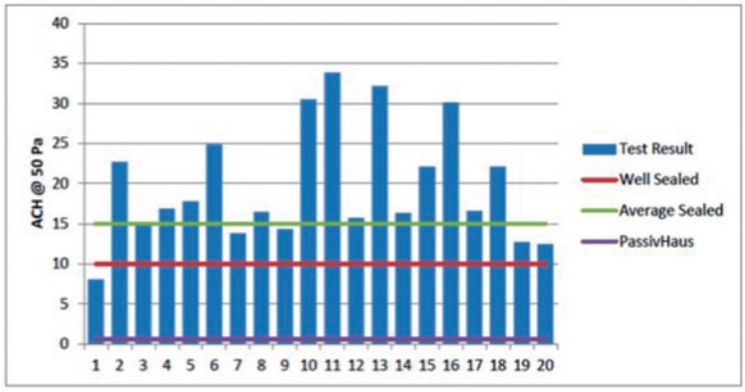


Figure 5-9 Pressure test results at 50 pascals for 20 sample houses in Melbourne

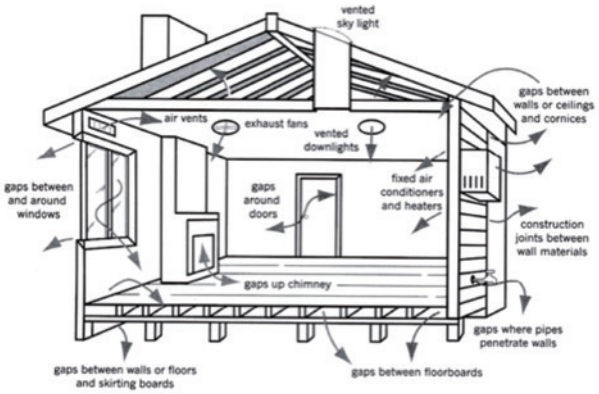
Architects and Building designers can effectively control all the four negatives above. It's the 'leaky to air' bit that is of interest here. Let's hypothesise that within a decade, we could move all new build building envelopes from an average 15-19 ACH (CSIRO study-Melb residential homes and 2016 test with NatHERS) to a mandated 5ACH/50Pa. The corresponding reduction in base load required would see a significant reduction in scarce resource demand and CO2 emissions. The cost to achieve this very positive result…certainly not in the billions, nor even the millions. The cost to the average residential home at $400k shouldn't be more than 5%.

Much of the developed world has moved to mandate standards for airtightness recognising that governments have to lead because if the market left to its own devices, will build for the cheapest dollar cost it can. That is a given.

So why in 2017, are we in Australia still debating the issue of whether airtightness is required or even important! It's been nearly a decade since there has been any meaningful overhaul of mandatory Energy Efficiency requirements for our buildings. However the ABCB, the body responsible for developing our Building Code finally has airtightness in its sights signalling 2019 as a watershed year for potentially recognising that Airtightness is crucial to the energy efficiency of our buildings.

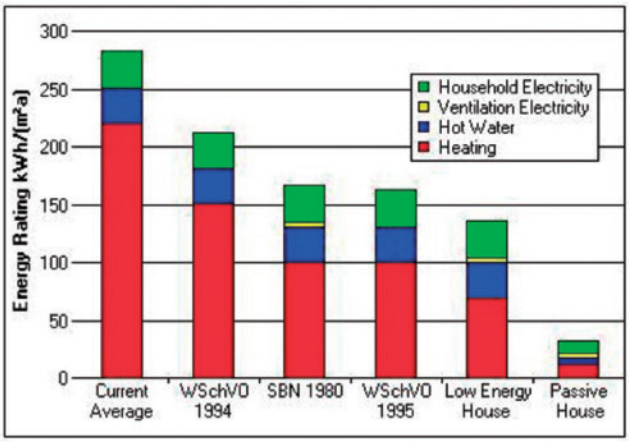
Achieving Airtightness

Airtightness is a vital component in the energy efficiency equation. Indeed not only that; it also contributes to a better level of healthy indoor air quality and protects the structure from attack by moisture related problems. The 'leaky building syndrome' in New Zealand has ruined lives and cost millions of dollars to 'fix'. In Australia, evidence is emerging of endemic failure of building structures within the next 10 years because of poor workmanship; the main consequence of this being moisture and water damage. Moisture ingression leads to the development of mildew and mould and becomes a health problem contributing in part to allergy and asthma development, if unchecked.



So controlling air leakage is vitally important for the proper performance and integrity of the building envelope. Insulate all you like but if your envelope is leaky, insulation will fail in its required performance. Numerous studies confirm that up to 40% of energy used to condition the internal building space is wasted as a result of air leakage.

Architects and Building designers know that Air leakage is the uncontrolled movement of air through the structure primarily through sub-floors, windows, doors and ceiling space, as shown in the simplified diagram (seav-common leakage points). Multi-story towers have their own unique issues, however the major problem with all leaky envelopes is that due to high air infiltration and exfiltration, they are hard to keep heated or cooled. Resource demand is therefore higher than it needs to be.



High Performance (Low Energy) and Passive Haus building principles champion airtightness measured in ACH at a level of 50pascals (Pa). These buildings typically use between 60-80% less energy to heat and cool than a non-airtight (normally built) structure. Real life examples show that a High Performance Build Energy Efficient home will be up to five time more energy efficient than a conventional build.

According to the Franhofer Institute of Construction physics, Stuttgart; "**it takes the same amount of energy to condition a leaky home of 80m2 as an airtight home of 400m^2**". That's a factor of 5. The magnitude of the reduction in resource demand from the hypothesised 15ACH to 5ACH can now been seen. A recent build by Pure Eco Homes, a leading Low Energy home builder in Melbourne achieved 1.36ACH using a standard method of construction with a standard timber frame with the 'SIGA Airtightness System' specified by Architect Edmund Yang of Identity Architecture. While most passive houses are unlikely to get to above 15 SQ here, this particular home was 55 SQ.

Measuring the Airtightness of an Envelope

The airtightness of the building envelope is measured by performing a blower door test. A pressurisation and a de-pressurization run are conducted and the readings are averaged to provide a final ACH number. To be of value this test should be combined with a thermography camera to show up areas of leakage which must then be rectified.

Application

There is no point in trying to invent a square wheel when a round one exists! And yet many are still trying to experiment with all sorts of different models! This is the situation that exists in Australia. The methods of achieving airtightness and weather tightness are widely known in Europe, USA, Canada and other developed parts of the world. The system for achieving this is proven.

Modus operandi

There are two very important components in the quest for airtightness. The vapour permeable and semi permeable membranes and the highly specialised tapes used in sealing to the structure. Diffusion of vapour is extremely important because of the tightness of the envelope and the membranes and tapes used must be vapour permeable at differing levels to this activity and having due regard for the build location climate. It is vitally important to ensure the diffusion of vapour is expelled from the frame cavity through differing conditions across the year.

The Structure Wrap – The external face of the structure's frame (assume it is timber for the purposes of this discussion) needs to be wrapped with a permeable monolithic weather resistive barrier. It may typically have an Sd value of 0.05 and must not retard the diffusion of vapour through to the outside. (Sd is the dimension for the diffusion resistance of a component to water vapour - described as air layer thickness for this application).

The membrane must be sealed to the base, for example the slab, so that it forms an airtight weather tight seal. This seal must be carried through to all openings through the membrane, e.g. perimeters of windows and doors, and penetrations. A high quality water resistive barrier (WRB) will do a superb job of protecting the structure, while helping as a first line of defence in achieving the airtight construction we are seeking, at the same time allowing any moisture in the wall cavities to escape. A monolithic WRB will move moisture through at a molecular level and at a faster rate than the traditional 'Sisalation' micropore wall wrap commonly use. Additionally there is a high probability these pores will get blocked during the construction process and cause a failure of even this limited function. The result is damage to the frame. This sisalation should not be used to wrap a frame, even though our code allows it!

The internal face of the structure should be wrapped as a minimum in a semi permeable diffusion vapour control membrane and should possess different properties to the external WRB. It may have a Sd value of 5 upwards (in other words a Fixed Sd membrane) and should allow easy passage for vapour diffusion through to the inside, from the frame cavity. Ideally, it may also be restrictive in allowing it back out into the structure cavity where it could do damage.

An advance on the fixed Sd membrane is the Diffusion Vapour Variable control membrane (so called 'Intelligent' membrane). The VVC membrane is relatively vapour closed when air is relatively dry but becomes increasing vapour open when exposed to humid air. (Open in humid conditions, closed in Dry conditions). During winter heating, the water vapour on the structure's internal (humid) side wants to move through the VVC membrane material to the air on the dry side. The diffusion vapour drive is to the outside. A VVCM does not open up in summer or close down in winter as some sales personnel and suppliers will tell you and they are not always clear about how, when and why the materials change permeability in service. However what happens when there is a rapidly induced change?

A Variable Vapour Control Membrane is not really 'intelligent' as claimed, Why? Because it doesn't sense moisture. Nor is it capable of detecting which side the moisture is on. As it get progressively wet with moisture from its environment, it undergoes a physical change opening up at the molecular level to allow a greater number of water molecules migrate through at a faster rate. The problem with allowing a state of open vapour diffusion through to the frame cavity at the wrong time, (when it is winter conditions on the outside and it should be in retarding mode) is that it can result in damaging excess moisture condensing on the frame.

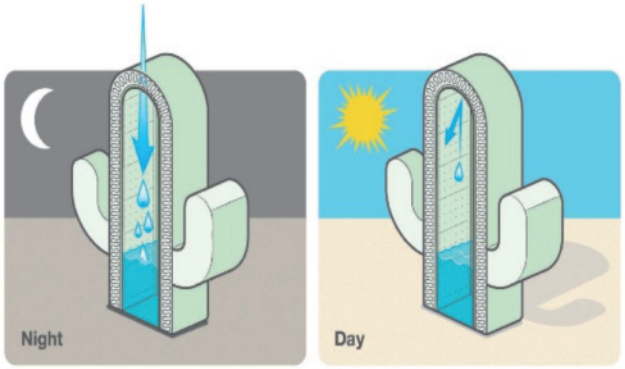
For example, set in winter, an ‘induced’ change may result from a classroom of 25 energised children that suddenly arrives, with the ability to generate a large amount of humidity in a very short period of time! Or a newly plastered interior or a newly screeded heated flooring system. These activities create potential to generate massive amounts of humidity into the air. The so called ‘intelligent’ VVCM opens up and allows vapour diffusion into the frame cavity to its single Sd value.

Due to the winter temperature in the frame cavity, this results in condensation within the frame. The same may result in public buildings with transient populations or intense activity areas or pool areas or flat roofs which frequently have no ventilated rear cavity area. If this is happens often enough, the end result is structural damage. Research by the Aachen Institute of Building Damage Research and Applied building Physics found that because of their inability to sense which side the moisture is on, Variable Vapour Control membranes opened up with ‘induced’ changes, resulting is structural damage.

What’s the Ideal Vapour Diffusible Membrane?

It would possess the ability to sense moisture and which side it is on and thereby react earlier. Preferably it will possess differing Sd levels – one for the diffusion seeking to enter from the frame cavity and a different more retarding Sd for diffusion seeking to leave the internal area into the frame cavity, which we know is something to be actively retarded.

Retarding diffusion to the outside limits the concentration of vapour in the frame cavity, thereby facilitating it to dry out rather than cause damage. In the event of an induced vapour overload, the different Sd value on the inside will not allow diffusion to occur at the same rate as it entered from the frame cavity. As we have seen, unretarded diffusion could have damaging consequences for the structure if it occurred over a period of time because of the accumulation of moisture. So what we are seeking is ‘one directional transport’ of vapour diffusion with a 2 dimensional Sd value membrane. Sounds like science fiction.



SIGA looked to the humble Cactus to understand how this could occur. The Cactus allows moisture in through the night but not out during the blazing hot desert day.

In effect one directional moisture transport!

This formed the basis for the multi-year development of the world’s first Hygrobrid® Technology Vapour Control Membrane. It is called **Majrex®**.

Testing conducted by the TUD proved that Majrex® with Hygrobrid® technology significantly reduces moisture development in the structure compared with conventional variable vapour control membranes, and the diffusion of any moisture that is in the structure to the outside is faster. Hygrobrid® allows Majrex® to react faster but Majrex® also has 2 dimensional Sd construction. The inside skin possesses a more retarding Sd value when compared to the outside skin of the membrane which is more vapour diffusion open.

Majrex® has scored another world first. It is the only Vapour Control membrane to be awarded component certification by the Passive House Institute. This is the ultimate accolade for such a membrane, and one of the toughest to obtain.

About SIGA

SIGA is a world class leading manufacturer, unique in the Airtightness product industry. Since 1966, it is the only manufacturer to research, develop and manufacture its highly specialised products at its purpose built facilities in Ruswil and Schachen, Switzerland. It holds numerous patents on its developments. A culture of not outsourcing means it arguably maintains the highest level of quality control in the industry.

SIGA has developed an airtightness weathertight system which consists of highly specialised diffusible membrane structure wraps and sealing tapes which have been durability tested to last 50+ years. Additionally they are VOC free with no off-gassing No off-gassing is vital for internal air quality but it also means that there is no embrittling of tapes and a virtually unlimited shelf life, superb quality and stickability from -40°C to +100°C.

Energy efficiency experts acknowledge that this system is the most successful method of achieving airtightness in a structure. Of course a good system needs to be installed correctly to function successfully. That's why SIGA undertake to assist all users with training in the various aspects of system installation on site.

A Simplified Easily Installed System - Instead of a myriad of products, SIGA has thoughtfully developed its product line up limiting it to just a handful with multi-application capabilities. The clear benefit is easy comprehension and application on site, for it is here that the battle for world class airtightness will be won or lost.

One example is sealing of penetrations. Some systems advocate the use of *EPDM rubber gourmets to fit around penetrations. EPDM contains a fossil fuel base, and will deteriorate over time.

Imagine a tradesperson on the roof sealing penetrations who finds that he has run out of the specified grommet size. What does he do? Run down to the local hardware store? This is not possible currently in Australia and would anyway result in wasted travel time. The usual trade response is to 'make do'. Those in the construction industry know well what that means. A sub-optimal solution usually results.

The SIGA solution is typically simple. SIGA *Rissan* is an armoured and elasticated tape for internal use and especially designed to be capable of being melded around penetrations no matter how large or small for a permanent airtight seal. SIGA *Wigluv* its external equivalent, is similarly capable of sealing penetrations, stitching the external membrane overlaps and sealing the window perimeters airtight and watertight.

Vapour diffusible membranes are robust and come with overlap guidelines and measure squares. There is one for the roof (*Majcoat*), one for the walls (*Majvest*) and two choices for the internal walls – *Majpell* a fixed Sd cost effective solution and the now famous *Majrex* Hygrobrid® membrane.

SUMMARY

Suggesting that buildings must be allowed to 'breathe' is a throwback to the Victorian age. An energy-efficient home must be as airtight as possible. Current 6 star homes have an average 15ACH... a travesty for the owner and the environment. An Airtight (High Performance low energy) home will be up to 5 times more energy efficient than a standard leaky home according to the Franhofer Institute of Construction Physics. A handful of basic components working in synergy are needed to make this happen.

A high quality airtight building envelope system like SIGA membranes and tapes to wrap the structure, high quality double glazing made from a material that mitigates thermal bridging such as uPVC, mitigating structural thermal bridging and an Energy Recovery System (ERV) or HRV system that will perform the dual tasks of ventilation and energy recovery. More humid areas may require moisture management on board.

Mechanical ventilation is important because the tighter a structure gets past 5ACH, the requirement for mechanical ventilation becomes a necessity to ensure a healthy internal air quality. Healthy internal environments maintaining around 50% humidity is an ideal requirement for a human, and deadly for mould, mildew and other bugs and viruses that cause illness.

The principles of High Performance (low energy) and Passive House champion Airtightness. Once the building envelope has been wrapped and or prior to handover, a blower door test is conducted to determine where there are leakage areas in the building fabric. Using a thermography camera, leakage in reference colours is identified easily. Essentially, using depressurisation and pressurisation runs of the structure, readings measured in ACH air changes per hour are taken and averaged. So a blower door test is critical to final evaluation of a build. The airtightness, energy recovery and minimised thermal bridging results in a build that maintains a very stable consistent temperature throughout the home with greatly reduced requirements for heating-cooling loads.

Architects and Building Designers are now in the driving seat to effect real and meaningful change to the energy efficiency of buildings in Australia.

Those interested in specifying Airtightness for Commercial or Residential applications only need to specify "The SIGA Airtightness System".

The builder contacts SIGA and we will assist and train the builder to implement the system for ultimate effectiveness. We are also pleased to come to your offices and demonstrate the system with our portable demonstration unit.

Edward Mazria is correct in his statement that you control the global thermostat.

'Product' pages and applications below. You may also call our SIGA Experts who will be pleased to assist and recommend the appropriate combinations for you.

www.zeroemissionsbuildingproducts.com.au Tel: (03) 8742 7995 Mob: 0468 459 659

Zero Emissions is the Official distributor and educator for SIGA products in Australia.

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OTHER SIGA PRODUCTS MAKING UP THE AIRTIGHTNESS SYSTEM

EXTERNAL

Majvest

Europe's leading external weatherproof membrane provides for permanently airtight and weathertight facades on the exterior. Majvest is highly tear-proof and flexible, so it is easy and secure to lay. The material is permeable and permanently protects the internal wall construction from condensation build-up.

Majcoat

Europe's leading external weatherproof roof membrane. The driving rain-proof and diffusion-open breathable membrane Majcoat is specified for creating a permanently windtight building envelope.

Wigluv

Europe's leading external façade sealing tape and the optimum solution for permanently windtight sealing of breathable membranes and facade membranes, for overlaps, penetrations and bonding the membrane to the concrete slab edge on the outside.

Fentrim F

The black, fleece-backed flashing tape Fentrim F is the ideal flashing solution for jobsite conditions where mixed substrates are present. The aggressive acrylic adhesive bonds in the most difficult temperature conditions. A tear-proof, split-release liner allows fast and error-free results...every time. Fentrim F removes the need for custom made flashings. It reduces cost from damage on site and delays due to incorrect manufacture.

Fentrim 2

The black coloured, single-sided high-performance adhesive tape Fentrim 2 is the optimal solution for permanent windtight and driving-rain proof bonding of window and door frames in solid construction on the outside. A perforated edge zone provides perfect keying in for final coating like render, acratex or similar trowelled finishes.

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ZERO EMISSIONS PLANET™

INTERNAL

Majpell

Europe's leading all-purpose, easy to apply vapour control layer Majpell covers not less than three different applications: between and above-rafter insulation and roof renovation from the outside and provides for permanently airtight building envelopes for roof, wall and ceiling structures in the interior.

Rissan

A specialised armoured tape with elastic properties allowing it to be melded tightly around circular penetrations such as pipes or cables, vapour control layers and wood-based panels. These areas are tricky and potential high leakage risks that can be easily, quickly and durably sealed airtight with the single-sided high-performance adhesive tape Rissan.

Sicrall

The single-sided high-performance adhesive tape Sicrall 60 is specified for permanent airtight sealing of vapour control layer overlaps in the interior. Also butt-joints between wood-based panels (e.g. OSB) can be easily, quickly and reliably sealed with Sicrall 60 to make them airtight.

Corvum

The single-sided high-performance pre-folded tape Corvum is the perfect solution for easy, quick and permanently airtight sealing troublesome right angle joins. The pre-fold is unique to SIGA. Use Corvum pre-folded 12/48 for sealing door and window frames to the internal membrane and in reveal frame corners. In addition, the tape is invisible behind cladding because it is precisely pre-folded. This makes application quick and easy. Use Corvum pre-folded 30/30 for permanent airtight sealing of purlins, joists, corners and skylights on the inside. Corvum can be easily, quickly and reliably applied.

50+ YEARS DURABILITY TESTED

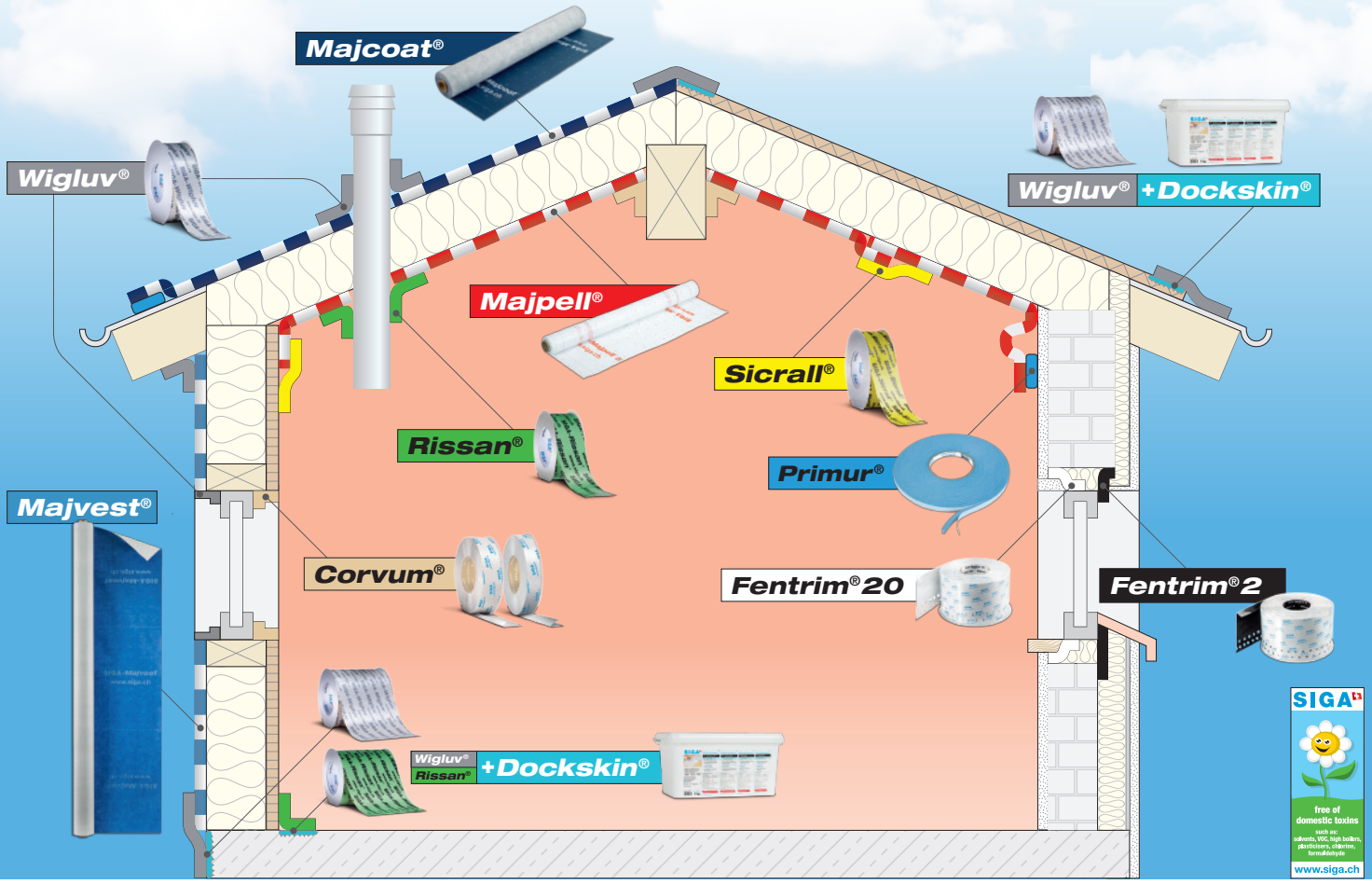
Please visit **www.zeroemissionsbuildingproducts.com.au** or **http://www.siga.ch/en/company.html** for further information on SIGA's superlative Airtightness Range of VOC free products.

Call our SIGA Experts who will be pleased to assist you. **P: 03 8742 7995 M: 0468 459 659**

SIGA house-tight

air and windtightness system free of domestic toxins

✓ permanently reduce your energy consumption ✓ no drafts ✓ no building damage



The right SIGA highperformance adhesive ... / ... for different substrates	Twinet®	Rissan® 60	Rissan® 100 & 150	Sicrall® 60 & 170	Corvum® 30/30 & 12/48	Primur® Cartridge/Tubular bag	Primur® Roll	Wigluv® black	Wigluv® 60 & 20/40	Wigluv® 100 & 150	Fentrim® 20 & Fentrim® IS 20	Fentrim® 2 & Fentrim® IS 2	Fentrim® 20 50/85	Fentrim® 2 50/85
Wood	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Hard wood-based panels	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Softboards										✓*		✓*		✓*
Gypsum plaster boards/gypsum fibre boards		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Cement fibre boards							✓	✓	✓	✓		✓		✓
Concrete, masonry, plaster			✓*			✓	✓	✓*		✓*	✓	✓	✓	✓
Bituminous sheeting in the base area			✓				✓			✓	✓	✓	✓	✓
Rigid insulation (EPS/XPS/PU)			✓							✓	✓	✓	✓	✓
Metal	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓
Hard plastics	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓

The right SIGA highperformance adhesive ... / ... for different types of membranes	Twinet®	Rissan® 60	Rissan® 100 & 150	Sicrall® 60 & 170	Corvum® 30/30 & 12/48	Primur® Cartridge/Tubular bag	Primur® Roll	Wigluv® black	Wigluv® 60 & 20/40	Wigluv® 100 & 150	Fentrim® 20 & Fentrim® IS 20	Fentrim® 2 & Fentrim® IS 2	Fentrim® 20 50/85	Fentrim® 2 50/85
Vapour control layers/ diffusion retarder membranes • Smooth to slightly rough PE/PA/PO/PP membranes • Kraft papers • Aluminium sheeting	✓	✓	✓	✓	✓	✓	✓				✓		✓	
Vapour control layers/diffusion retarder membranes for aboverafter insulation and roof renovations • Smooth to slightly rough PE/PA/PO/PP membranes	✓					✓	✓		✓	✓				
Breathable membranes/roof underlay membranes and roof membranes (does not apply to bitumen and PVC membranes)							✓		✓	✓				
Facade membranes							✓	✓	✓	✓		✓		✓

* must be reinforced with high-performance primer **SIGA-*Dockskin***®
If necessary, strengthen all above mentioned substrates with high performance primer **SIGA-*Dockskin***®.

Get your professional knowledge at www.siga.ch

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