



Key Window Material Considerations

A Closer Look at Timber and Aluminium
Framing Options



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Introduction

As the world shifts towards more environmentally sustainable models of construction, the residential sector is no exception. In Australia, new homes are being assessed and graded under the Nationwide House Energy Rating Scheme (NatHERS), which measures a home's energy efficiency to generate a star rating. There are a range of factors that impact a home's performance in this regard – some less obvious than you might think.

Windows and doors are not active users of energy, but they allow the transfer of energy which can severely impact a building's heating and/or cooling load. Design, composition and technology in a window system all combine to determine the window's durability, aesthetics, and functionality, but frame material is one of the key factors influencing the windows overall energy performance.

In this whitepaper, we compare the two most common window materials – timber and aluminium – and determine which option is superior for modern construction under three criteria: lifespan and maintenance, thermal performance and sustainability.



7 stars is on its way

The NatHERS gives homes a star rating out of 10 based on how its building design addresses energy efficiency. The Scheme provides a 'measuring tape' for energy efficiency, encouraging Australians to design and build homes that are more comfortable to live in and reduce energy consumption. Currently, the National Construction Code (NCC) requires new homes and some renovations to existing homes to meet a minimum 6-star energy rating.

There are several elements that affect a home's NatHERS rating. Such elements include the orientation and aspect of the home (i.e. whether the building is north-facing and maximises natural lighting, and passive heating and

cooling), insulation, building materials, and design and construction features such as double-glazed windows and thermal mass.

In one of its more significant updates, the latest three-year review of the NCC includes a proposal to raise the minimum NatHERS rating from 6 to 7 stars. Against the backdrop of soaring fossil fuel prices and greater public demand for climate change action, it is only inevitable that NatHERS ratings will continue to increase and improve. This puts pressure on the residential building industry to come up with more effective products to achieve this rating for every new build.

How window design affects energy efficiency

Windows are comprised of two key elements: framing and glazing. These components impact the energy efficiency of a building design through two key mechanisms: conduction and solar heat gain.¹

- **Conduction** refers to the rate of non-solar heat that is lost or gained through the window unit and is expressed as the 'U-Value'. The lower the U-Value, the greater the window's resistance to heat flow.
- **Solar heat gain** is how readily heat from sunlight flows through the window unit and is expressed by the solar heat gain coefficient (SHGC). The lower a window's SHGC (between 0 to 1), the less solar heat it transmits.

Up to 40% of a home's heating energy and up to 87% of its heat gained is through windows.² A window's energy efficiency is significantly influenced by the framing material, which contributes 10% to 30% of the unit's insulation.³ It is important to compliment highly insulative glazing with frames that reduce rapid heat transfer.

The choice of frame materials, the glazing or glass features, gas fills and spacers, and the type of operation all influence the overall energy-related properties of the window. Window frames can be made from a variety of materials, with aluminium and timber among the most popular. Each option offers different performance advantages in terms of durability, maintenance and energy efficiency, which we explore in further detail below.

Comparing aluminum vs timber window options

Lifespan and ease of maintenance

Aluminium is a popular framing material due to its light weight and strength profile. Aluminium weighs only one third of a piece of steel of the same size and shape while offering a similar level of structural strength. Its lightweight properties mean it is easy to handle, and it can be formed into complex shapes. It is also durable and corrosion resistant due to the thin, hard film of aluminum oxide that forms on its surface.

While aluminium windows are commonly marketed as requiring 'zero' maintenance, this is not actually the case. Depending upon use, all aluminium doors and windows will require some periodic maintenance over time. While it is naturally resistant to corrosion, aluminium is nevertheless susceptible in very aggressive atmospheres, such as those found near the sea. Cleaning aluminium window frames, sills and tracks is an important step in preventing corrosion from occurring.

One of the many reasons people consider timber windows is due to their unique, natural beauty and reliable performance properties. However, there is a common misconception that timber requires a high degree of maintenance to ensure it looks and performs at its best for a long period of time. Both timber and aluminium can be maintained to increase their lifespan, but timber has the ability to be rejuvenated. In many cases, simply repainting a timber frame every five years is enough to make them as good as new.

The periodic maintenance task on timber doors and windows is generally contained to the bottom section only, not the entire window. The maintenance cycle of timber doors and windows is significantly influenced by the coating type (painting vs staining), window design (a good design will reduce maintenance), and window exposure to the elements (shading through eaves or natural shading from vegetation can reduce maintenance frequency). Leading manufacturers offer pre-finished units for ease of installation and maintenance.

The durability and service life of timber products can be enhanced by treating the wood with preservatives. This is a cost-efficient and reliable method of protecting the timber from insects or decay (e.g. by using anti-fungal primer treatments). A variety of treatments are available depending on the environmental conditions the timber will be subject to during its lifespan.

Thermal performance

Aluminium is a good heat conductor so a significant amount of heat can pass through the frame. This characteristic means that you can lose heat through the window frame in winter, and gain unwanted heat through the frame in summer. Both effects increase a home's

dependence on artificial heating and cooling throughout the year. In technical terms, aluminium window frames generally have a high U-Value, representing its lesser ability to insulate in comparison to other materials.

Due to its thermal properties, aluminium windows are predisposed to condensation. Without an insulating barrier, aluminium framing can lose heat when outside temperatures drop. This causes the interior surface of the frame to become as cold as the exterior, which, when in contact with the warmer indoor environment, creates the ideal conditions for condensation. Uncontrolled condensation can cause issues with mould and mildew and can also cause damage to building structures.

Thermal breaks have been recently introduced to address the poor thermal performance of standard aluminium frames. They consist of a structural insulator between the inner and outer frames that is made from timber or plastic (usually a polyamide such as nylon) to prevent the efficient transfer of heat energy through the frame.

Even so, the thermal performance of timber framing far surpasses that of aluminium framing, thermally broken or not. Timber is a poor conductor of heat and acts as a natural insulator. As the material minimises uncontrolled heat transfer through the frame, timber-framed windows will keep your home warmer in the winter and cooler in the summer. Importantly, timber's insulating properties and thermal resistance help designers meet mandatory energy efficiency regulations with greater ease.

Table 1. Comparing thermal values of window units

Default windows in NatHERS*

Type	Glazing	U-Value
Aluminium Group A single glazing	Clear	6.7
Timber Group A single glazing	Clear	5.4
Aluminium thermally broken Group A double glazing air fill	Clear/air fill/clear	3.6
Timber Group A double glazing air fill	Clear/air fill/clear	3

*Based on 2019 NatHERS values.⁴

BINQ timber window systems

Type	Glazing	U-Value
BINQ's Archetto Series (triple glazed low-e)	Clear/air fill/clear/argon fill/clear low E	1
BINQ's Archetto Series (double glazed low-e)	Clear/argon fill/clear low E	1.4
BINQ's Azione Series (double glazed low-e)	Clear/argon fill/clear low E	1.7

Sustainability

The choice of materials is one of the most important levers in changing the amount of embodied energy in a building. In this respect, timber is far superior to aluminium. According to the YourHome government website, the embodied energy of kiln-dried hardwood is 26.9 MJ/kg whereas aluminium is 358 MJ/kg.⁵

A cradle-to-gate assessment of aluminium-framed window products highlights why its carbon footprint outstrips that of timber. While aluminium is lightweight and may have lower transport emissions than timber, the complex process of bauxite extraction and refinement is energy intensive and has significant environmental impacts.⁶

In comparison, timber is a renewable material and can be sourced sustainably from certified sustainable forest managements. The use of timber in construction can also turn buildings into carbon sinks. As they grow, trees capture CO₂ taken from the air, which continues to be stored in timber building products produced from

harvested wood. Due to its eco-friendly properties, timber can be used to maximise energy ratings and carbon credits under sustainable building certification schemes such as Green Star.

Timber is a resilient material that can provide decades of use, which makes it suitable for recycling and reuse. After its initial use, timber can be recovered and turned into other building products or recycled into other bio-based materials such as particle board, wood pellets or chips. Where reuse is not possible, wood waste can be burned and turned into bio-energy.

To its credit, aluminium is also a highly recoverable material that can be infinitely recycled without any loss of quality.⁷ However, the majority of aluminium around the world is still in its first use. With the growing demand for aluminium, there is not enough aluminium scraps to produce recycled material. Accordingly, the industry relies heavily on primary aluminium production and thus must work to negate the emissions and pollution associated with that process.



High-Performance Timber Windows by BINQ

BINQ High-Performance Timber Windows and Doors provide luxury, comfort and performance all in one. Made from select grade timber and sourced from a local supply chain, the company's quality assurance process of their timber is rigorous, ensuring that only the finest lengths of timber progress to the production floor.

Some of the most advanced machinery available allows BINQ a high degree of precision with their joinery, and allows the company to be highly automated and fast track the production process, while maintaining a high standard of workmanship.

The BINQ range of timber windows includes the **Archetto** series, which is crafted from thick 68mm timber profiles, which provide highly thermal efficient options. Within limiting hardware restrictions, the size and scale of these products are endless, allowing you the ultimate flexibility in your design.

For Australian-designed window systems with some European flare, the **Azione** series is the ideal choice. Crafted from 40mm timber profiles, and featuring enhanced sealing systems, which surpass any other of their kind, the Azione series offers some of the best thermal values with premium aesthetics in a range of window and door options.

BINQ offers pre-finished timber products based on the latest in European design, engineering and manufacturing techniques. European standards are among the highest in the world when it comes to the thermal performance of homes. All the products that BINQ offers must meet their core values of product creation which include:

- Superior quality
- High-performance on a global scale
- Aesthetically appealing
- Efficient to manufacture locally
- Ability to source at least 50% of the raw materials from local suppliers
- Positive impact on the environment

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References

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