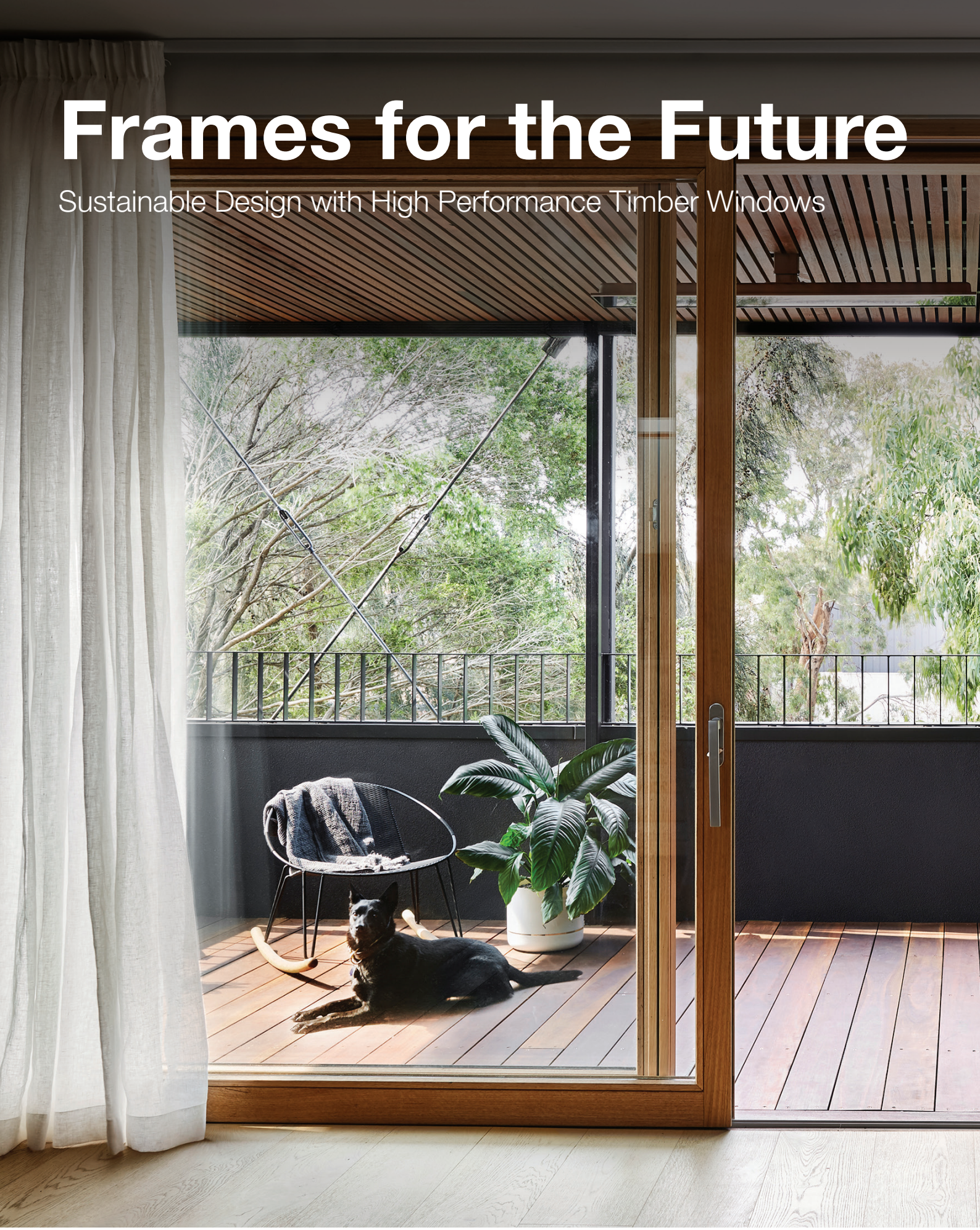
Frames for the Future

Sustainable Design with High Performance Timber Windows



BINQ®
World Standard

Introduction

On the surface, windows are used to fulfil two basic functions: provide daylighting and ventilation. It is well-established that health, comfort, and productivity are improved in well-ventilated indoor environments with access to natural light. However, there is more to window design than first appears – they are also critical to a home's thermal performance.

Up to 40% of a home's heating energy can be lost, and up to 87% of its heat gained, through windows.[1] Excess heat loss or gain due to poor window design has significant consequences for thermal comfort. In the winter, spaces can become too cold, while in the summer, spaces can become too warm – both scenarios increasing the reliance on mechanical heating and cooling to maintain comfortable indoor temperatures. The energy used to offset heat loss and gains is costing Australians every year in high energy bills and poor building performance.

Aluminium frames are often the cause of the problem. A popular window framing material, aluminum is an excellent thermal conductor, efficiently transferring heat from the outside to inside and vice versa. Recognising the issues with standard aluminium, manufacturers introduced thermally broken aluminium windows, which provide better insulation performance. But often a far superior, versatile and sustainable option is overlooked: timber windows.

This whitepaper takes a closer look at the impact of window design on energy efficiency and analyses the benefits of using timber windows in the sustainable homes of tomorrow.

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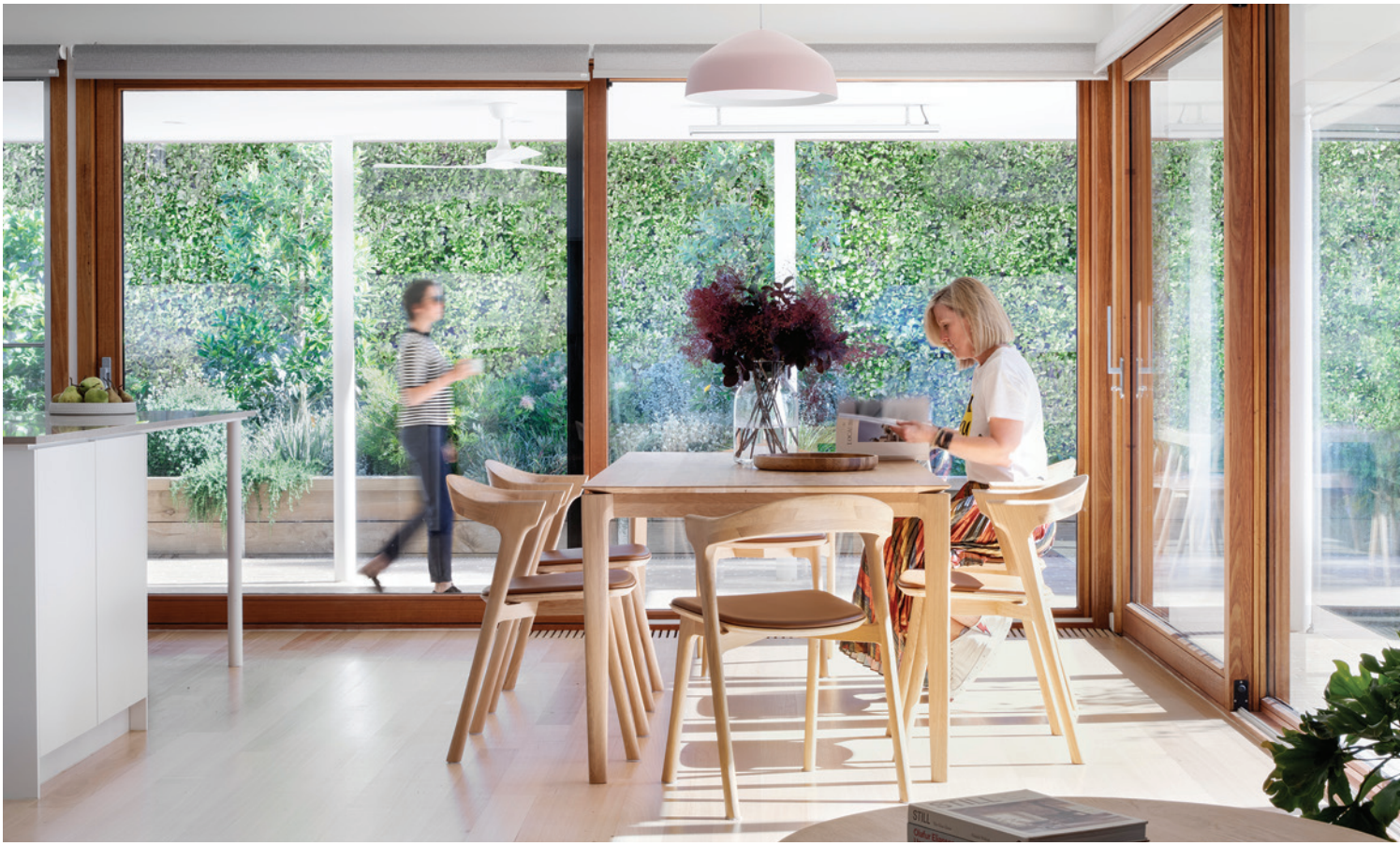


Windows and energy efficiency

Window systems are comprised of several key components: glass panes, structural frames, spacers, and sealants. In recent years, the variety of glass types, coatings and frames available for use in window systems has increased significantly. The range of materials, profiles and design options available provides the ability to control the amount of solar heat and energy that passes through the window system, which in turn affects thermal comfort within an indoor space.

Window design and the cost of heating and cooling are closely related. An energy-efficient window system minimises heat gain during the summer, and prevents heat loss during the winter, thus reducing peak heating and cooling loads at any given time of year. According to the National Institute of Building Sciences, optimum window design and glazing specification has the potential to reduce energy consumption from 10%–50% below accepted practice in most climates.[2]

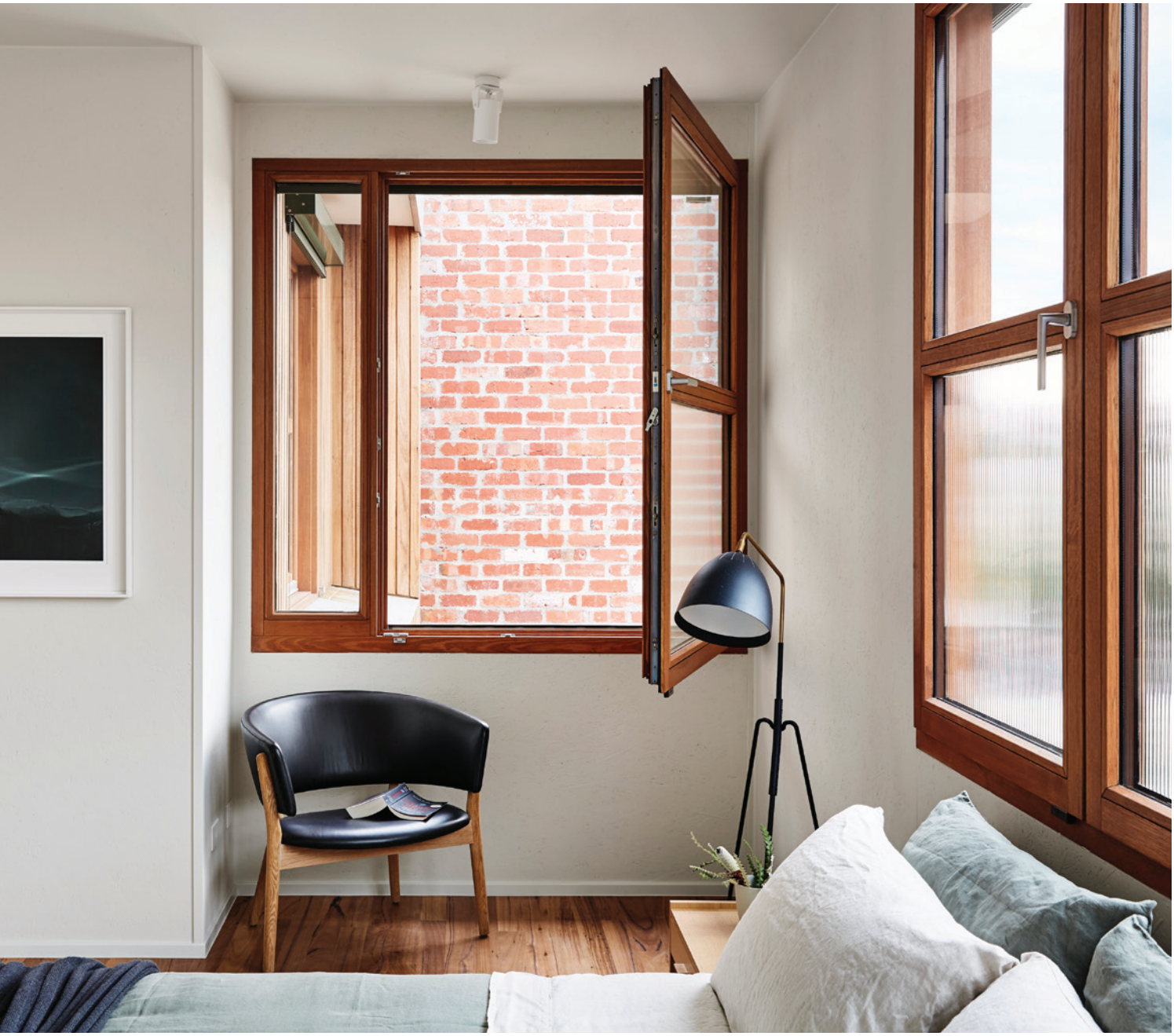
Heating and cooling loads that are too high require a larger air-conditioning system to compensate. The heating load refers to the amount of heat energy required for a space to maintain an indoor temperature within an acceptable range. Conversely, the cooling load is the amount of heat energy that needs to be removed from a space via cooling. Lower thermal loads indicates that a dwelling will require less heating and cooling energy to maintain comfortable indoor conditions, leading to savings in energy costs.

Key design considerations

A well-designed and specified window, positioned in the right areas, can help maintain comfortable indoor temperatures all-year round, with minimal input from heating or cooling sources. It is important to note that windows alone do not determine the thermal performance of a building envelope. Other influential factors include the specific site conditions, such as the building use type, the local climate and building orientation, and passive design features such as thermal mass, insulation and weather sealing.

The thermal performance of windows is largely determined by the unit design, the framing materials used, and the type of glass selected for the unit. Different combinations of framing materials and glass will deliver different levels of performance in terms of thermal comfort and natural light control. The size and number of openings, as well as any building features that provide shading or over shadowing, are also relevant.

Thermal performance must be balanced with other architectural and user requirements. For example, windows may be required to provide privacy, prevent glare or enable a wide view of the outside. In other applications, acoustic control is a high priority. Condensation management and protection against weather elements are also generally important for most projects.



Defining ‘good’ thermal performance

As we are focusing on thermal performance, we need to establish what ‘good’ performance means in the context of window design. The two most important measures for this purpose are U-Value and Solar Heat Gain Coefficient:

- **U-Value (Uw)** is the measure of the insulating capacity of the window system. It is used to represent how quickly heat from hot air (as opposed to direct sunlight) will transfer through the unit. The lower the U-Value, the better the unit is at preventing heat energy from escaping or entering the building.
- **Solar Heat Gain Coefficient (SHGC)** measures the amount of heat from direct sunlight that flows through the window unit. Windows with a poor SHGC value will allow buildings to more readily collect solar heat. The lower the SHGC value, the lower the amount of solar heat that is transmitted into the building.

There is no single combination of U-Value or SHGC that is ideal for all applications. However, in general, a low U-Value is desirable for most climates. The best double-glazed windows have a U-Value of about 2.7, but triple-glazed windows can have U-Values as low as 1.7.[3] Windows with a high SHGC of at least 0.39 can help heat a house, whereas windows with a low SHGC of 0.30 or lower, can help prevent a house from overheating.[4] The local climate and building regulations will determine the level of SHGC performance that is required on a project-by-project basis.

Why framing matters

Window frames have a significant impact on thermal performance because heat energy can be lost or gained through the frame. Different types of frames allow different levels of heat gain and loss. Below are several common frame types:

Aluminium. One of the most common framing materials, aluminium is typically specified due to its lightweight, strength and durability properties, and is available in a variety of powder-coated and anodised finishes. Standard aluminium frames tend to have high U-Values because aluminium is an effective thermal conductor, meaning that building designs must account for the heat loss and gain that may occur through the frame.

Thermally broken aluminium. A thermally broken aluminium has similar properties as a standard aluminum frame, except it includes a reinforced polyamide strip fixed between the inside and outside aluminium profiles that acts as an insulated barrier. The polyamide strip is a material of low thermal conductivity, so it prevents heat transfer through the frame. While a significant improvement in terms of thermal performance over the standard, the thermal break does not necessarily eliminate heat transfer.

Timber. Timber has a low thermal conductivity rating, which means it has excellent insulation properties. The natural insulation is provided by air pockets within the material's cellular structure. In this respect, timber performs 15 times better than masonry, 400 times better than steel, and 1,770 times better than aluminum.[5]

Below is Table 1 highlighting the superior thermal performance of timber-framed window units in comparison to standard aluminium. Note that the type of glass (e.g. low-emissivity glass, single, double, or triple glazing, and the use of tints or coatings) plays an important role in window performance, so careful glass specification will be critical in meeting specific thermal requirements on a project-by-project basis.

Table 1. Common window types: Aluminium vs timber windows

Window type	Uw	SHGC
Aluminium frame, single glazed with 3mm clear glass	6.9	0.77
Timber or uPVC frame, single glazed with 3mm clear glass	5.5	0.69
Aluminium frame, double glazed with 3mm clear glass/6mm air gap/3mm clear glass	4.2	0.69
Timber or uPVC frame, double glazed with 3mm clear glass/6mm air gap/3mm clear glass	3.0	0.61

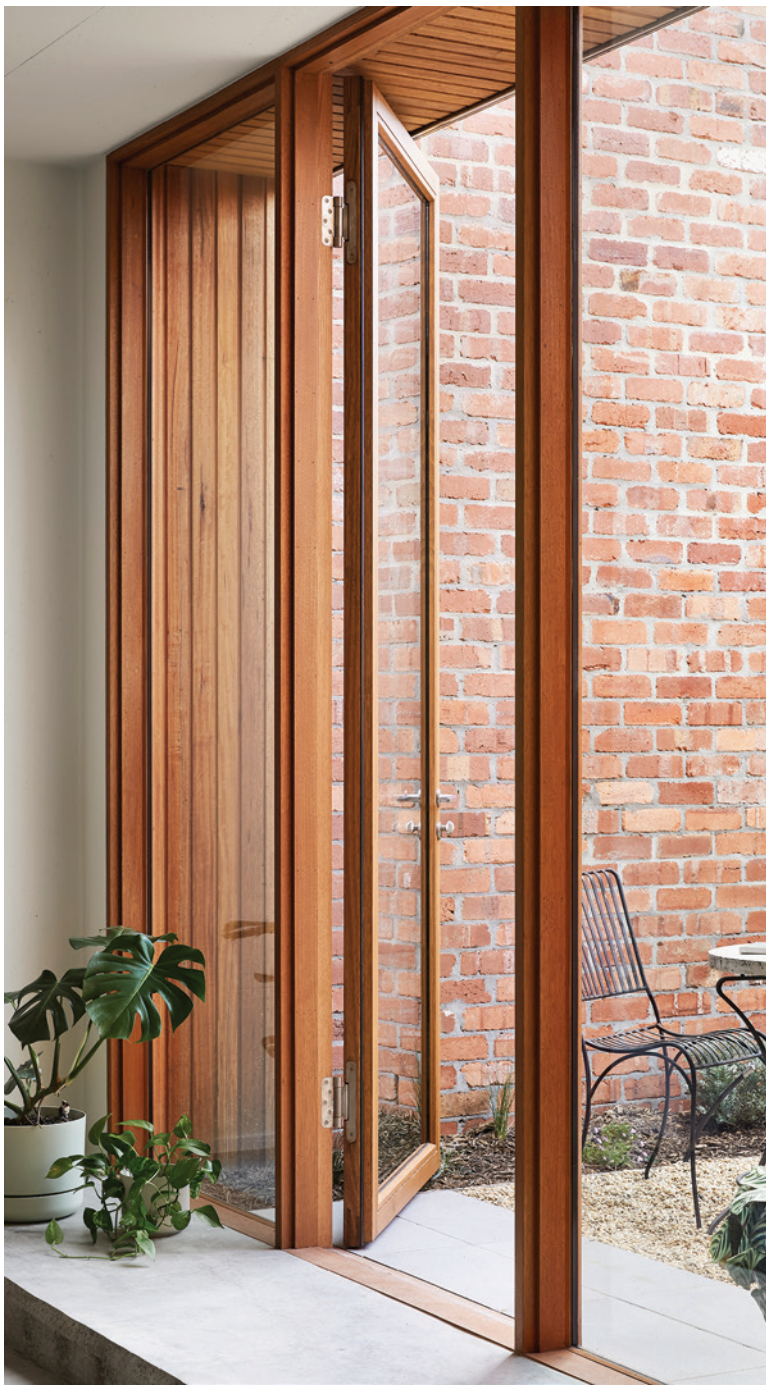
Source: https://www.yourhome.gov.au/passive-design/glazing

Leading high performance timber window systems offer even greater performance when paired with thermally-efficient glazing. Table 2 provides the performance values of two such models.

Table 2. Thermal performance of high performance timber windows

Window type	Uw	SHGC
BINQ Azione Series (40mm profile)	1.7	0.378
BINQ Archetto Series (68mm profile)	1.1	0.258

Source: https://www.binq.com.au



Why choose high performance timber windows over aluminium?

All natural

Timber is an organic material composed of cellulose fibers (which are strong in tension) embedded in a matrix of lignin that resists compression. In addition to being thermally efficient, it offers reliable strength, performance and longevity, having been used in building applications for centuries. As it is all natural, it is also non-toxic (provided it is finished with non-toxic surface treatments) and conducive to health and wellbeing.

Aesthetics and design flexibility

The aesthetics of timber are highly prized in residential applications and deliver a refined and timeless finish. Providing natural warmth and character, each timber product has unique grain patterns that cannot be emulated by other materials. Timber windows can be painted and varnished to achieve a specific look, while the various options in size and scale expand design possibilities.

Costs over lifetime

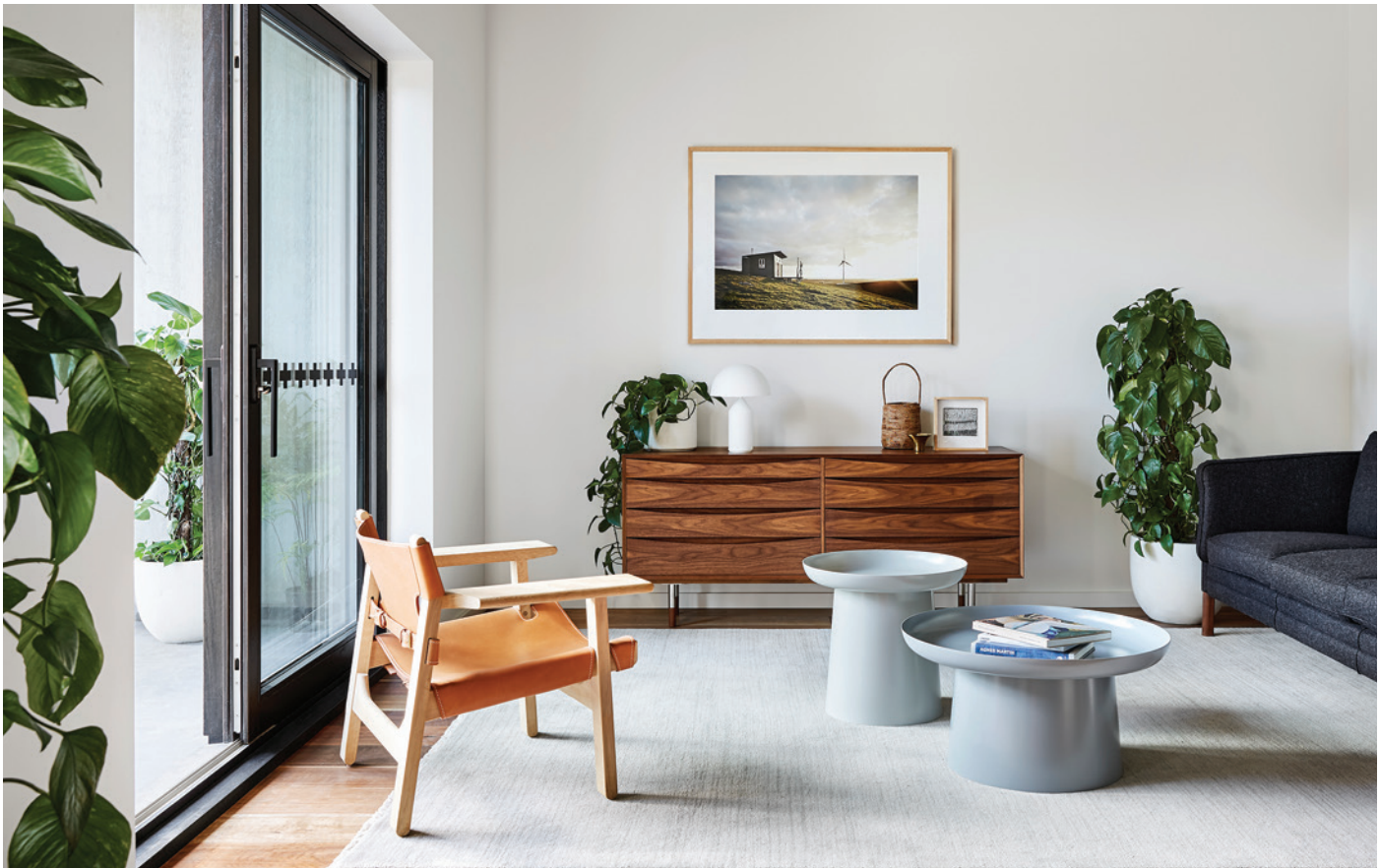
Timber often costs more upfront, but the cost is more than offset by three factors: longevity, energy savings and added value. Its superior thermal performance will deliver significant energy savings over its life when compared to standard aluminium windows. While thermally broken aluminium windows are more efficient than standard, they are generally closer in initial price to timber windows. Furthermore, aluminium will corrode over time even though it purports to require low maintenance. If properly maintained, timber can last for decades.

Sustainability

Due to the built environment's massive environmental impact, it is important to consider the environmental factors that go into building materials. A holistic approach is needed, covering a life cycle analysis of the material, its carbon footprint, what happens to it at the end of its life and how it contributes to energy-efficient buildings that minimise energy consumption.

According to all of these factors, timber is clearly the most sustainable, eco-friendly option. It is renewable, recyclable, waste efficient, biodegradable and non-toxic. It helps turn buildings into carbon sinks as timber stores the CO_2 taken up from the air by trees that are harvested. Using timber also avoids the greenhouse gas emissions from steel production. The embodied emissions in aluminium (358 MJ/kg) are significantly higher than those in timber products (26.9 MJ/kg in kiln-dried hardwood and 19.0 MJ/kg in kiln-dried softwood).[6]

Architects, designers and specifiers can reduce the built environment's impact further by specifying local timber products sourced from sustainable forestry practices. Timber that carries official certification ensures that the product meets environmental standards and does not contribute to deforestation.



The Archetto Series from BINQ

European Designed, Australian Made, World Standard

Offering the highest possible thermal efficiency, BINQ's Archetto Series are the best performing timber windows manufactured in Australia. With thick 68mm slimline timber profiles and coming standard with double glazing or triple glazing, these products are truly world standard, achieving U-Values as low as 1.1 and a SHGC as low as 0.258.

The thick timber profiles maximise the glazing rebate to a standard of 28mm, or up to 32mm for Passive House requirements. The timber is locally sourced and made from either Victorian Ash to achieve BAL 19 certification or Blackbutt to achieve BAL 29 certification, making them ideally suited to Australia's harsh climatic environment.

The size and scale of these high performance timber windows is endless, giving designers the ultimate flexibility in their design. The Archetto series uses heavy duty, high security hardware imported from Italy and Germany, which is engineered to carry heavy weights, allowing for expansive design by large-scale openings.

Many high performance European windows meet stringent standards established by the Passivhause Institute in Germany. The Archetto series combines the style and innovation of European design with the durability and environmental sustainability of local Australian manufacturing.

About BINQ

Established in 2009, BINQ is a privately-owned Australian company whose influence comes from traveling the globe researching the most advanced window systems, machinery and manufacturing techniques from Europe. Now a national, recognised brand with expansive business operations, the company offers a high quality range of European-designed and engineered high performance timber window and door systems manufactured in Australia.

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References

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All information provided correct as of October 2021

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