RAISING THE BAR

Glazing Performance for Residential Buildings Under the National Construction Code Energy Reforms

GLASSWORKS

INTRODUCTION

Celebrated for its aesthetic appeal and ability to provide a connection to the outdoors, glass is among the most prominent materials in modern residential architecture, yet one that tends to be overlooked in the budget. In fact, Australian glass processor Glassworks estimates that approximately 70% of residential builds settle for single-glazed windows and doors – a startling fact considering that over 80% of heat is gained and 40% is lost through windows alone. There is a clear need for adequate education on the importance of glass in building design given its impact on building energy efficiency and performance.

Recognising the need for reform in building insulation to reduce greenhouse gas (GHG) emissions, regulators are undertaking a significant overhaul of the National Construction Code (NCC) in 2022 to stipulate more stringent requirements on residential building materials such as floors, walls and especially glazing.[1] The result? Homes with energy performance equivalent to a 7 star NatHERS (Nationwide House Energy Rating Scheme) Energy Rating where single glazing will be seldom used and more low-E Insulating Glass Units (IGUs) in thermally-conductive framing systems will assist in the pursuit of a more 'passive' overall design.

While this push for more energy-efficient window systems will require a greater investment in glazing, among other materials, the ongoing payoff of lower energy consumption and thermal comfort is not to be underestimated.

This whitepaper addresses the role of glazing in passive temperature control and lighting and highlights how some advanced low-E coated IGUs are already leaps and bounds ahead of the new NCC requirements.

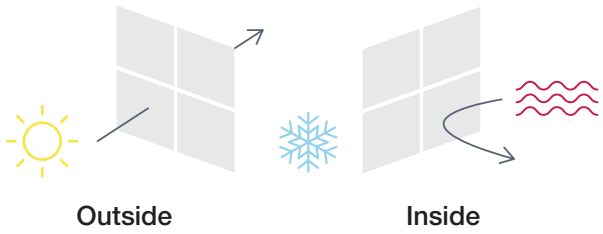
"Passive design is a concrete way to reduce energy consumption and increase thermal comfort."

PERFORMANCE FACTORS FOR GLAZING

When considering wall-glazing design, designers need to be familiar with several concepts, technical terms and performance measurements. First is **passive heating and cooling**, which refers to an approach to solar design that seeks to use the sun's energy for the heating and cooling of living spaces through carefully managed sun exposure. Passive design is a concrete way to reduce energy consumption and increase thermal comfort.

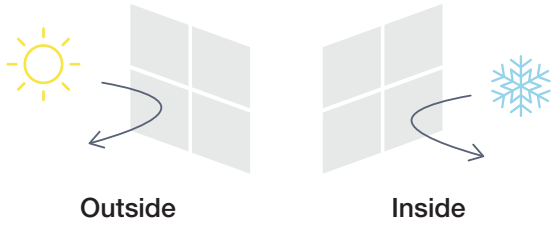
"Passive heating" aims to capture the sun's heat within the building's elements, and gradually release that heat when the sun is absent while maintaining a comfortable interior temperature.[2] Glass and the building's thermal mass work in combination to absorb, store and distribute solar heat.

Winter example



"Passive cooling" works by implementing design solutions that reduce unwanted heat gain during the day, so minimal air-conditioning is required to cool a room.[3] This is achieved through heat gain prevention, that is preventing heat from entering the interior, or by removing heat from the building via natural cooling processes.

Summer example



The challenge is allowing the greatest amount of light in, while rejecting excess solar heat gain through the glass. The NCC measures a window's thermal performance in terms of U-Value and Solar Heat Gain Co-Efficient (SHGC). Visible Light Transmission (or VLT) is the measurement for natural light transmission. These measurements are explained below:

- **U-Value** measures the amount of heat transferred through a window. The lower the value, the higher the window's insulation performance.
- **SHGC** measures how much solar radiation passes through the window. Windows with poor SHGC allow buildings to collect solar heat more readily.
- **VLT** is the measurement of the amount of visible light waves that transmit through a material. The higher the VLT value, the more light is entering.

The next question is what environmental and design factors impact glazing selection. Below are several factors outlined in more detail.

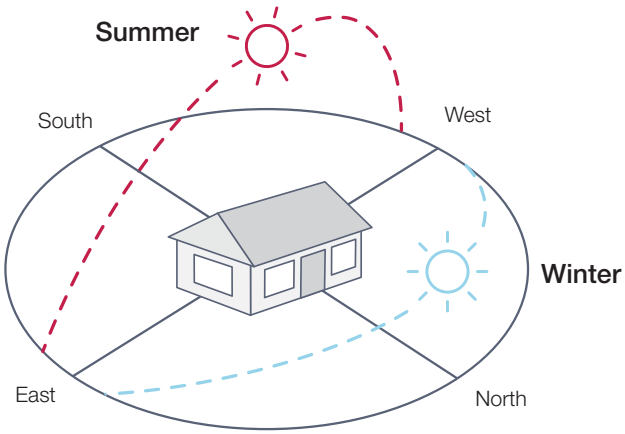
Climate

Different climatic conditions have different performance demands. In warmer climates, the priority is to keep solar radiation and ultraviolet light out, while retaining the coolness of air-conditioned air indoors. Compare this to cooler climates, which typically demand windows and glazing to maximise desirable solar heat gain for most of the year, while insulating against excess heat loss. Mixed climates require a balance.

Building Orientation

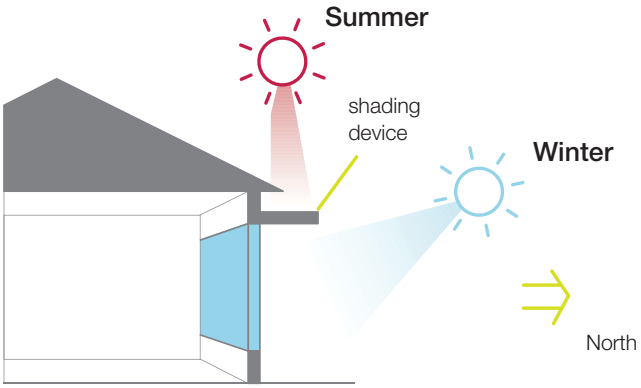
North-elevated windows receive sun in winter and little sun in summer. East and west facing windows can be a major source of heat gain during summer. For east and north-east facing windows, this occurs predominantly in the morning, west and north-west facing windows more so in the afternoon. South-facing windows receive little to no sunlight in summer and almost none in winter.

Summer vs Winter Sun
(credit: https://www.sustainability.vic.gov.au)



Building Considerations

The use of shading devices, eaves, pergolas and verandahs all impact the amount of sun a window receives during the day. In addition, building elements such as ventilation, wall insulation and other building materials can impact a building's overall thermal performance.



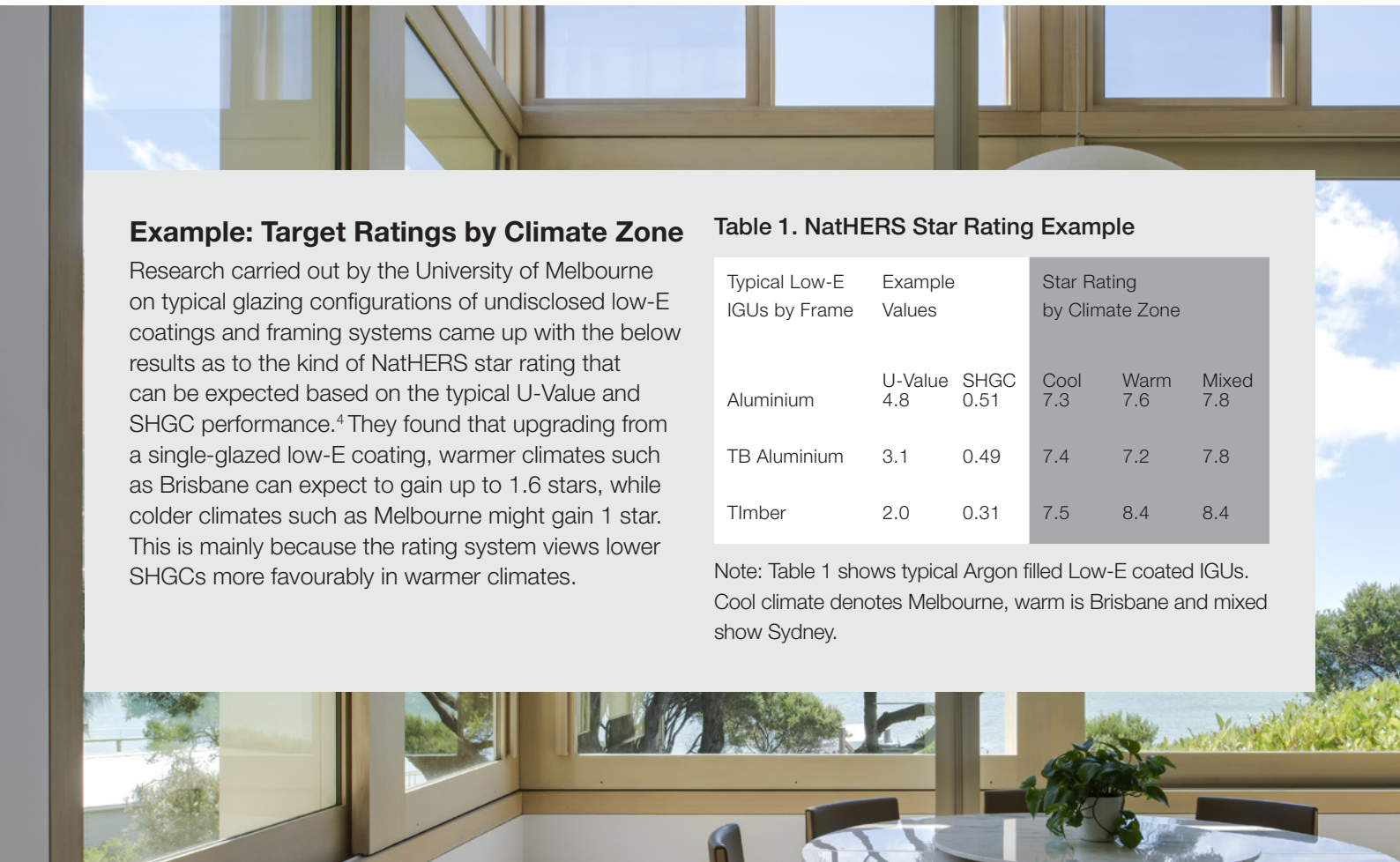
Shade North Facing Windows
(credit: https://www.sustainability.vic.gov.au)

FROM 6 TO 7 STARS: THE IMPACT OF NCC 2022

NCC reforms have been made to increase thermal performance requirements for homes from the current 6 star NatHERS equivalent, to an equivalent of 7 stars under the NatHERS for residential buildings under Class 1, Class 2 sole-occupancy units (SOUs) and Class 4 parts of buildings.

Residential Performance Requirements

Achieving 7 Star NatHERS ratings will require a combination of approaches to improve passive heating and cooling depending on climate zone. Given that window selection is the greatest influencing factor on the whole-of-house performance, substantially improved glazing, typically low-E IGUs with low conductance framing (timber/uPVC/TB Alum) will now be required as a minimum, along with other insulation improvements such as walls and flooring.



Example: Target Ratings by Climate Zone

Research carried out by the University of Melbourne on typical glazing configurations of undisclosed low-E coatings and framing systems came up with the below results as to the kind of NatHERS star rating that can be expected based on the typical U-Value and SHGC performance.[4] They found that upgrading from a single-glazed low-E coating, warmer climates such as Brisbane can expect to gain up to 1.6 stars, while colder climates such as Melbourne might gain 1 star. This is mainly because the rating system views lower SHGCs more favourably in warmer climates.

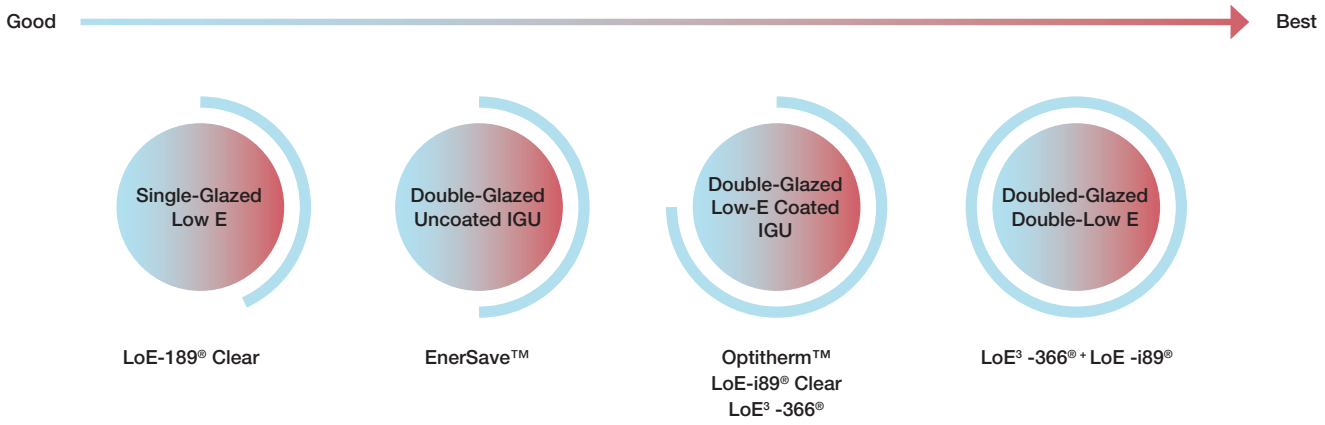
Table 1. NatHERS Star Rating Example

Typical Low-E IGUs by Frame	Example Values		Star Rating by Climate Zone		
	U-Value	SHGC	Cool	Warm	Mixed
Aluminium	4.8	0.51	7.3	7.6	7.8
TB Aluminium	3.1	0.49	7.4	7.2	7.8
TImber	2.0	0.31	7.5	8.4	8.4

Note: Table 1 shows typical Argon filled Low-E coated IGUs. Cool climate denotes Melbourne, warm is Brisbane and mixed show Sydney.

Advanced Low-E coatings are already one step ahead

Based on the new more stringent requirements, it is predicted that usage of low-E coated IGUs will increase by 150 to 200% and single glazing will no longer be a viable option for most homes. Glassworks has been pushing performance glazing since long before it became a requirement, with a portfolio of low-E glass and IGUs that cover all possible Australian climates and performance levels ahead of the NCC changes. Some examples from good to best are given below.



Please refer to the complete **Performance Data sheet** to view the entire IGU range and detailed performance data associated with each make-up.

Whole window performance

The whole window performance (glass and frame) goes towards the NCC thermal efficiency rating and can differ greatly depending on products specified. To reach a 7 star NatHERS energy rating equivalent, aim for a U-Value of below 5 and an SHGC of under 0.50 as a minimum. Glass suppliers such as Glassworks report verified data such as U-Value, SHGC and VLT on their standalone glazing products (please refer to the company's Product Performance document for comprehensive performance data on the Glassworks range).

However, as glazing performance measured in the NCC takes into account the window as a whole, this only tells half the story. The Window Energy Rating Scheme (WERS) is a database containing the performance data of various glazing products together with various framing systems – which also differ in performance – to give a standardised whole window value.

Organised by window fabricator rather than glass producer, not every imaginable make-up is contained within but it is the surest way to find a window or door which satisfies the glazing performance requirement of a project. Architects and builders can also turn to Glassworks for additional verified window calculations and advice on a project basis.

Below are some modest window examples taken from WERS based on 1000x1000mm.

Ultra-clear low-E for cool climates

LoE-i89® single glazed

Glass: 6mm LoE-i89 clear*
System: Capral aluminium hinged door
U-Value: 4. 4 | SHGC: 0. 47

Note: By specifying LoE-i89 as an IGU with 6mm clear on room side, the U-Value and SHGC drop considerably.

Optitherm® IGU

IGU: 6mm clear / 10mm Argon / 6mm Low-E
System: Capral aluminium awning
U-Value: 3.2 | SHGC: 0.47

Neutral coloured low-E for mixed to warm climates

LoE 3-366® IGU

IGU: 4mm Low-E / 8mm Argon / 4mm Clear
System: Darley aluminium awning
U-Value: 3.7 | SHGC: 0.2

About Glassworks

Glassworks is an Australian-owned glass processing operation that utilises the best technology and machinery from around the world to provide innovative, customised glass solutions to the Asia Pacific region with over 90% of all materials sourced locally.

Committed to innovation in design and glass that contributes to a buildings' overall sustainability performance, the company's main areas of focus are performance driven glass and decorative glass with processing capabilities such as laminating, toughening and customisation.

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REFERENCES

1 Murray, Duncan. “A big week for energy efficiency standards in Australia.” The Fifth Estate. https://thefifthestate.com.au/innovation/residential-2/a-big-week-for-energy-efficiency-standards-in-australia (accessed 7 February 2022).

2 Australian Government. “Passive solar heating.” YourHome. https://www.yourhome.gov.au/passive-design/passive-solar-heating (accessed 7 February 2022).

3 Australian Government. “Passive cooling.” YourHome. https://www.yourhome.gov.au/passive-design/passive-cooling (accessed 7 February 2022).

4 Harris, Russell. NCC 2022 6 to 7-Star Impact Analysis (AGWA, 2021).

All information provided correct as of March 2022

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