Glazing
Cool temperate

This fact sheet deals specifically with glazing solutions for cool temperate climates. Cool temperate climates are climates in which a typical house uses:

> More than 70 percent of its total space-conditioning energy for heating in winter and

> Less than 30 percent for cooling in summer.

For a general introduction to glass and windows and climate types [See: Glass and Windows]

For information on WERS and generic window types [See: How to Use WERS]

DESIGN GUIDELINES

Windows with the lowest predicted annual heating energy requirement under WERS will be of greatest benefit in heating climates. These windows insulate well (have a low U-value) and admit maximum free solar heating (have a high solar heat gain coefficient).

North facing glazing is ideal for cool temperate climates. It allows maximum solar access in winter and can be easily shaded in summer.

In cool temperate climates:

> Maximise north facing glazing with solar exposure (especially in living areas). [See: Passive Solar Heating]

> Minimise east & west facing glazing.

> Use adjustable shading.

> Minimise south facing glazing.

> Use insulating glass and frames and/or snug fitting insulating drapes with sealed pelmets.

East and west-facing windows will contribute to overheating in summer if not well shaded. Glazing with a low solar heat gain coefficient can be used to counter this but will reduce beneficial winter heat gains while still allowing winter heat loss.

An ideal solution is to use smaller insulating glass units on east and west facades to reduce heat loss in winter. High solar heat gain coefficient glazing can be used to maximise solar gains in winter. Summer heat gain can then be controlled with adjustable external shading. [See: Shading].

Winter heat loss can be further reduced with internal insulating treatments such as snug fitting insulating drapes with sealed pelmets or insulating blinds.

Large areas of south facing glass will allow heat loss but do not allow compensating solar heat gain and should be avoided. Moderate south facing glass areas are required for cross ventilation and day lighting.

From the WERS table of 27 generic windows:

> window types WIN06 to WIN14 have the best heating energy reduction performance. These are generally insulating glass units, with clear glazing, gas fills, low-emissivity (low-e) coatings and thermally improved frames.

> WIN14 provides almost a 42 percent reduction in heating energy under WERS.

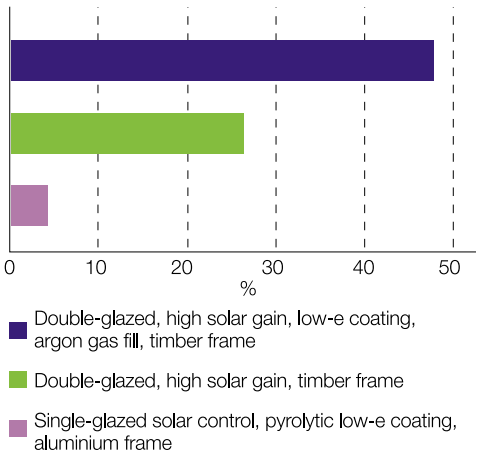
> WIN19 to WIN27 also provide acceptable heating performance but are more appropriate in hot climates. [See: How to Use WERS]

ANNUAL ENERGY SAVINGS

The following graph compares the performance of three advanced window types to typical clear, single-glazed aluminium-frame windows in heating climates. These are expressed as indicative savings on heating energy bills. In an ideal situation, replacing conventional windows with the most energy-efficient windows in the graph below can halve annual heating energy.

However, actual savings will depend heavily on the size of the area glazed, the type of window coverings used and the extent to which other passive design principles have been employed. These factors have far greater combined impact on overall glazing performance than the frame and glass type

Reduction in heating energy (%) compared to using 3mm single clear glass in aluminium frame, in WERS HEATING climate.



Overall glazing performance is dependent on a combination of passive design features as well as the performance of the glass. The comparisons above were made using the NatHERS building energy simulation program for a particular house type and orientation.

NatHERS assumes that a house is maintained within typical, thermal comfort ranges.

In reality, the actual amount of energy that homeowners purchase depends on individual preferences, the design and orientation of the home, the total area of glazing; insulation levels and the efficiency of heating and cooling systems. For more details on NatHERS.
[See: Rating Tools]

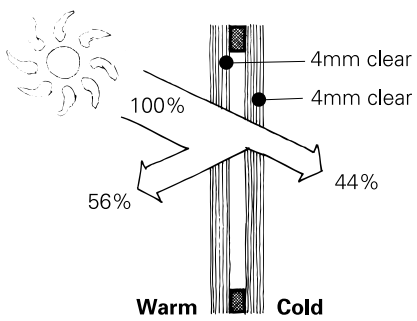
In a cool temperate climate, well-chosen and located windows can reduce annual energy use and improve comfort. A house with a suitable area of north oriented and appropriately shaded energy-efficient windows can out-perform the same house fitted with smaller conventional windows. This is due to a combination of solar heat gain through the windows and their insulative properties. This assumes that the house has adequate thermal mass to store the extra solar heat gained.

Even with advanced glazing and framing systems, glass areas remains the single greatest source of heat loss and heat gain in a home.

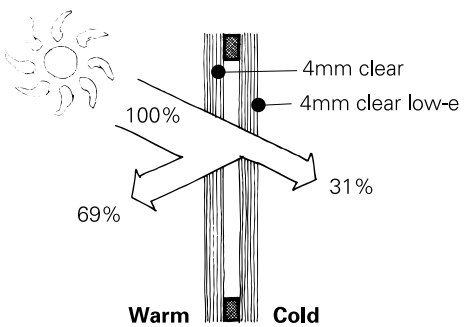
Advanced glazing solutions can only be effective when used in accordance with the principles set out in other Passive Design fact sheets. [See: Orientation; Passive Cooling; Passive Solar Heating; Insulation Overview; Shading; Thermal Mass].

The diagrams below show how insulating glass units trap heat inside the house. Even more heat can be trapped by using low-e glass in the insulating units.

Insulating glass unit



Insulating glass unit with low-e



CONSUMER CASE STUDIES

Arthur Langtip – Corio, Victoria

"We prefer natural light and lots of it – also the house is completely air conditioned and that got us thinking about energy efficient high performance windows.

Arthur's house before the renovations.

The brick veneer home is over fifty years old and is in the Geelong suburb of Corio. Three big front windows face due west and the original single glazed windows were unshaded and provided little barrier to solar energy in summer. They also lost a lot of heat in winter.

Arthur first installed a reverse cycle air conditioner to deal with the resulting summer heat and winter cold but, in light of the running costs, decided the best solution was to double-glaze the whole house to reduce his energy bills.

New windows were installed throughout the house with aluminium frames and double glazed insulating units. The windows on the north, south and east elevations have a 5mm outer pane and 3mm inner pane of clear float glass with an 8mm airspace. On the western elevation, 5mm green toned float glass was used for the outer pane.

The windows were manufactured to the stringent requirements of "AS2047 – Windows in buildings". This standard requires windows to be tested for air infiltration, which can be a significant cause of heat loss from inside a building.

The primary concern was to reduce heat loss from inside the house and reduce the cost of running a ducted air conditioning unit.

The clear double glazed windows reduced the U-value of the windows from about 5.5 for the old single glazed windows to 3.2. Heat loss through the windows was reduced by approximately 42 percent. Low-e glass in the interior pane would have reduced heat loss by up to 60 percent.

The western windows with the green toned solar control glass have a U-value of 3.2 and a low solar heat gain coefficient of 0.5. Heat gain in the summer months is reduced, improving comfort and reducing cooling bills. External shading devices would yield significant additional benefits.

Green toned glass also helps to reduce glare and cut down on some of the UV and visible light that fades furnishings. From the outside during the day, the toned glass looks great, while from inside the daylight looks perfectly normal.

Heat loss through all windows was reduced and the clear north facing windows allow the sun to provide "free" heat in the winter months. Arthur has found that the reverse cycle unit is needed far less often in both winter and summer. Shading the windows in summer could eliminate the need for air-conditioning entirely.

"From outside, I think the new windows make a huge difference by modernising the whole home and have surely added appreciably to its value."

The back of the house looks out over a big reserve with an athletics track and a large secondary school which together produce varying levels of noisy activity, including a public address system on sports days. The new windows have greatly reduced noise from the reserve.

The windows have an Outdoor-Indoor Transmission Class (OITC) rating of approximately 31dB. For comparison, the OITC of typical 3mm single-glazed windows with poor sealing is 22dB. An increase in OITC of 10dB means that the perceived noise is halved, so it is clear that these high performance windows provide dramatically improved sound insulation.

North, south and east windows are estimated to have a WERS 4 star heating rating while the windows on the west are estimated to have a 4 star WERS cooling rating.

Barry & Jenny Cameron – Canberra, ACT

"I wanted to get as much sun as possible into the bedrooms and bathrooms in the morning, and sun in the living rooms during the day."

For Barry and Jenny living in an inner Canberra suburb, lots of sunlight made sense. The big family house, now three renovations old, is part two storey and has a floor plan that resembles a small 'h'.

The well-treed block faces north with a view towards Black Mountain and south to a nature reserve. It presents a beautiful bushland outlook.

Even with Canberra's hot, dry summers to contend with, Barry's main concern was to keep the house warm in winter. He decided that double-glazing was the way to go, but with a lot of big windows he was concerned about the price.

After checking the cost of standard sized double glazed windows, Barry was surprised by their affordability and installed some in his first renovation. After a number of winters with double glazing, there was no hesitation when the time came for renovation number two.

In the third renovation, Barry has installed low-emissivity double-glazing in timber frames on all his north-west facing windows. The outer pane is clear and the inner is high solar transmission low-e glass. These windows are ideally suited to the cold Canberra winter.

Low-e glass reduces U-values even further than ordinary clear double glazing making the unit's insulation performance almost equivalent to a triple glazed, air filled unit. If these windows had used Argon gas instead of air between the panes, heat loss would have been even further reduced.

The use of clear glass, particularly on the north elevation, allows maximum winter sun penetration and "free" solar heating. Additionally, the glass significantly reduces the penetration of ultra violet light and reduces fading of furnishings.

The windows have light transmission in excess of 60 percent, minimising use of artificial lighting and maximizing outlook to the excellent views.

The north-west windows are estimated to achieve a WERS rating of 4.5 stars for a heating climate.

Ken and Marie Gent – Dingley, Victoria

"Our new house is on a rise overlooking the Kingswood Golf Course so our big double-glazed windows make the most of the beautiful views."

Ken and Marie designed their house themselves. The two storey rendered brick construction covers forty-two squares and is located in Dingley, an eastern suburb of Melbourne. Although the house faces east, it has particularly large windows to the west in order to capitalise on the all-round views.

The eaveless style chosen for the house provides no shading to windows. With east and west aspect, this created summer overheating and winter heat loss challenges right from the outset.

Hydronic heating and reverse cycle air-conditioning were installed throughout the large house making energy costs a big liability. Loss of heat through the frames and large areas of glass would add to heating bills and heat gain through the large unshaded glass areas would make the air-conditioner run overtime.

After conversations with his window supplier, Ken chose double-glazing units in all windows to reduce winter heat loss. He is extremely happy with the result.

The frames are a composite assembly of aluminium and timber with an insulation performance similar to aluminium frames with a thermal break and close to that of timber frames.

Glass on all elevations is clear float glass with an 8mm sealed airspace between the two panes. This is sufficient, when combined with the high performance seals used in the window frames, to provide a U-value of 3.1.

The WERS rating for these windows is 4 stars in terms of reducing heating energy required.

Glare from the low setting west sun was a problem. To counteract this, Ken and Marie were advised by their window supplier to install internal roller blinds featuring a fine open weave material. These blinds overcome any discomfort in summer while still retaining the views.

Unfortunately, internal blinds do not prevent solar heat gains. These can only be reduced by fitting external shading devices. Use of a medium performance solar control glass for the outer panes on the western side would have solved the glare problem and made a marginal reduction in the solar heat gains.

Considering the size of the home, Ken confesses that he has been pleasantly surprised at the comparatively low heating costs. He attributes these savings jointly to the hydronic heating and the insulating quality of the double-glazed windows.

Dingley is quite close to Moorabbin Airport where small aircraft are continually taking off and landing, and although the double glazed windows were not selected for noise reduction reasons, the results have been more than gratifying. These windows would not normally be specified for noise reduction – thicker glass panes would be preferred – but even so noise has been noticeably reduced.

Whilst advanced glazing solutions have helped to reduce summer overheating and winter heat loss, appropriate shading of the windows and a reduction in their size would reduce or eliminate the need for air-conditioning and significantly reduce heating costs in Melbourne's climate.

ADDITIONAL KEY REFERENCES

WERS Manual, www.wers.net
www.awa.org.au
www.efficientwindows.org

Principal authors:
AGGA and Dr. Peter Lyons.

Additional comments:
Chris Reardon.