TECHNICAL BRIEFING – GLASS & ENERGY MANAGEMENT: REDUCING BUILDING ENERGY COSTS

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Introduction
This paper focuses on energy issues and design strategies to reduce energy use and improve greenhouse gas savings.
The façade performance is an important decision in the overall building operation cost. High performance solar control or insulating glass can deliver energy savings for the life of the building and may determine the building's future energy rating.

Key themes discussed in this paper:

- **Lifecycle and environment payback** Through daylight and passive solar design, glass can pay back its embodied energy.
- **Glass cost verses the building cost**

Often the higher cost of performance glass is off-set by reductions in mechanical plant cost. In residential construction the glass cost does not significantly affect housing affordability.

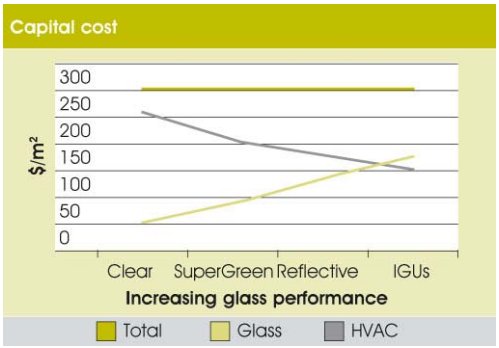
- **Glass selection and reduced operation cost** The correct glass selection reduces building operation costs through energy saving and provides a lifetime payback.
- **Energy regulations and glass performance**

Both commercial and residential building energy regulations recognise the importance of glazing performance and its economic payback, and have therefore recommended levels of performance that reduce building energy consumption.

Lifecycle
Glass is a material that allows passive day-lighting and heating. Used correctly, it can also assist with cooling through the stack effect. These attributes 'pay back' the embodied energy in the manufacture of glass.

The value of a well-designed glazing system reduces building operation lifecycle costs. The value of day-lighting is a significant area for reductions in building energy use and can be measured in terms of the cost of artificial lighting. It is generally accepted that natural light is beneficial to people's health and well-being and can be the foundation for a productive working environment.

Capital cost



The chart shows how the investment in a high performance glass (solar and thermal insulation) reduces the capital cost of the heating and air-conditioning plant (HVAC) by reducing the building's heating and cooling loads. Running costs are reduced and savings continue for the life of the building, (source Lincoln Scott, Feb 1995).

Operation cost
The selection of a glass with the most appropriate solar control (solar heat gain coefficient) and insulation (U Value) can significantly reduce energy costs for heating and air-conditioning. This is achieved by placing less loading on the plant and installing a smaller air-conditioning plant. A better performing building envelope is achieved with higher performance glass. The additional cost of this glass is often offset by a reduction in the air-conditioning plant cost.

Energy codes and glass
Reducing energy consumption in every aspect of our lives is high on the national agenda. Buildings, in which we live and work, consume approximately 50% of energy with correlating greenhouse gas emissions. In response to this, the Australian government has developed mandatory minimum Energy Efficiency Measures in the Building Code of Australia (BCA). These regulations cover both residential and commercial construction types.

Energy use modelling has shown that the selection and placement of glazing is one of the most critical elements in designing for energy efficiency. In large commercial and apartment buildings where the roof is a smaller proportion of the building envelope, treatment of glazing is the most important design consideration. Selecting the right glass allows designers to maximise light, while insulating against heat loss and selectively shielding unwanted heat gain. Choosing the right balance of these factors during the design phase will provide a comfortable, healthy and energy efficient environment for the life of the building.

The BCA is a performance-based code, offering a number of paths to compliance and sets out the performance that a building has to achieve. In terms of glazing, the key focus is on minimising the rate of summertime heat gain and winter heat loss (the emphasis will shift depending on the climate). The requirements will also vary depending on the nature and type of heating and cooling systems employed, if at all.

Glazing performance is measured in terms of U Value (for conduction) and Solar Heat Gain Coefficient (SHGC), and is based on National Fenestration Rating Council (NFRC100-2001) conditions. All Viridian glass performance data presented in our catalogues is assessed under NFRC 100-2001 environmental conditions. Care should be exercised when selecting performance data to ensure that it meets these criteria.

The code also allows for a dual approach to calculating glazing system performance - either by reference to published 'window system' (glass plus frame) data, or by aggregation of the glass performance data and a frame adjustment (for conductance). The performance data presented in this catalogue is glass only. A simple tool to allow glass and frame aggregation is available at www.agga.org.au

The deemed to satisfy provisions of the BCA provide a simplified method of compliance. Glazing requirements in each climate zone are a function of floor area, conductance and solar radiation of the glazing system, orientation, shading devices and window area. The code recognises high performance glazing through maximising allowable window sizes

Generally in Australia, southern locations will often require products with high performance thermal insulation (lower U Values), while in a northern location, solar radiation (lower SHGC value) will usually be the critical component. Viridian offers a range of products that can meet these various requirements. A simple chart reference indicating the relative performance by product for daylight transmission, thermal insulation (conductance) and solar control is shown in the glass performance data tables.

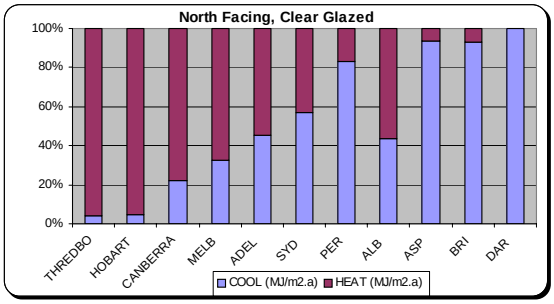
Tropical (emphasis on cooling)	Temperate (cooling and heating)	Cold (emphasis on heating)
Zone 1	Zone 4	Zone 6
Zone 2	Zone 5	Zone 7
Zone 3		Zone 8

Guide to glass products in meeting energy efficiency requirements

The products listed are recommended for windows in houses for each of the climate zones. We cannot provide any assurance relating to the end result of the house energy rating by using these products as performance of other building materials, orientation, floor area, number and size of window on each elevation and the type of frame can all impact on the rating. They are simply our suggestions of products that will have a positive impact in improving window performance and the energy efficiency of the house.

Products have been chosen for north, south, east and west elevations. Orientation of the house between these four points may vary the type of glass required.

For more assistance in determining a climate zone refer to the Building Code of Austalia, Volume 2, Figure 1.1.4 - Climate Zones for Thermal Design and Table 1.1.2 – Climate Zones for Thermal Design / Various Locations. The 8 climate zones are based on research which showed the proportion of energy used either for heating or cooling as shown in the following chart for a typical north facing house glazed in clear glass.



The dark colour is the percentage of energy used for heating and the light colour the energy used for cooling. For example, in Melbourne, almost 80% of energy is used for heating and a little more than 20% for air conditioning, while in Brisbane more than 90% is for cooling and less than 10% for heating. This means in Melbourne we will be more concerned with choosing glass that will minimise heat loss and in Brisbane, products that will reduce heat gain.

Regulations and rating software also provide allowance for greater glass areas if the design allows for heat from the sun to gain access through north facing windows in the winter months in most climate zones. However this usually necessitates provision of shading, more than likely in the region of 600mm to 1100mm to protect north facing windows during summer months. The suggestions on the following page for north facing windows are divided into shaded and unshaded. If windows are unshaded a low – medium performance solar control glass is suggested in the interest of occupant comfort, however, this can have a negative impact on the house rating as it reduces the gain of “free heat” from low winter sun.

The next table has grouped the zones based on the chart above. It needs to be remembered that actual requirements in the software are based on postcodes so these can only be generalised suggestions with no knowledge of the actual conditions of the house under consideration. Also the product choices have been restricted to the “residential glass range”.

	North Elevation - Shaded	North Elevation - Unshaded	West Elevation	South Elevation	East Elevation
Cooling Zones Zones 1, 2 & 3					
Good	Clear Float	ComforTone	ComforTone	ComforTone	ComforTone
Better	C/Plus Neutral	C/Plus Neutral	C/Plus Neutral	C/Plus Neutral	C/Plus Neutral
Best	Clear IGU	C/Plus Toned	C/Plus Toned	C/Plus Toned	C/Plus Toned
Cooling /Heating Zones Zones 4 & 5					
Good	Clear Float	ComforTone	ComforTone	C/Plus Clear or Neutral	ComforTone
Better	C/Plus Clear	C/Plus Neutral	C/Plus Toned	Clear IGU	C/Plus Toned
Best	Clear IGU	C/Plus Toned	Toned IGU	Clear Low E IGU	Toned IGU
Heating Zones Zones 6 & 7					
Good	C/Plus Clear	C/Plus Neutral	C/Plus Neutral	C/Plus Clear or Neutral	C/Plus Neutral
Better	Clear IGU	C/Plus Toned	C/Plus Toned	Clear IGU	C/Plus Toned
Best	Clear Low E IGU	Toned IGU	Toned IGU	Clear Low E IGU	Toned IGU
Zone 8					
Good	Clear IGU	Toned IGU	ComforTone IGU	Clear IGU	ComforTone IGU
Better			E/Grn IGU		E/Grn IGU
Best	Clear Low E IGU	Toned Low E IGU	E/Grn Low E IGU	Clear Low E IGU	E/Grn Low E IGU

Viridian New World Glass

CSR

- Toned – Viridian **VFloat**™ Grey, Green or Bronze toned glass
- CPlus Clear – Viridian **ComfortPlus**™ Clear
- CPlus Neutral – Viridian **ComfortPlus**™ Neutral
- CPlus Toned – Viridian **ComfortPlus**™ Grey or Green
- Clear IGU – Viridian **ThermoTech**™ using clear glass
- Clear Low E IGU - Viridian **ThermoTech**™ U Plus using clear glass and Viridian **EnergyTech**™ Low E
- ComforTone IGU - Viridian **ThermoTech**™ using Viridian **VFloat**™ Grey, Green or Bronze toned glass and clear glass
- **SuperGreen** IGU - Viridian **ThermoTech**™ using Viridian **Supergreen**™ glass and clear glass
- **SuperGreen** Low E IGU - Viridian **ThermoTech**™ U Plus using Viridian **SuperGreen**™ glass and Viridian **EnergyTech**™ Low E

Further information
Please visit viridianglass.com or freecall 1800 810 403

The performance data for Viridian glass is derived using the International Glass data base and software developed by Lawrence Berkley University. The international standard of measurement used is NFRC 100-2001 conditions.

The combination of the SHGC and U Value determines the performance of the glass and its energy contribution. The building structure, glass framing system and orientation will all contribute to determining the overall environmental performance of the façade and the building. It should be noted that performance data presented in this guide is for glass only and a window rating or assessment is required.

Not all manufacturers' data is calculated using NFRC 100-2001 conditions; in particular some countries have different conditions that will impact on the glass performance.

The BCA energy efficiency requirements are evolving in stringency and application. The information on glazing requirements has been paraphrased from the ABCB publication: Regulatory *Proposal – Energy Efficiency Measures for Class 5 to 9 Buildings BCA Volume One, November 2004.*