Glass

Silica sand, the main ingredient, is mixed with lime and soda and heated to approximately 1500 °C using fossil fuels. The molten glass is passed over a bed of molten tin (at 1000ºC) and then cooled in a controlled manner to form a continuous sheet. Float glass is normally manufactured in thicknesses from 2 – 25 mm. Several other additives are put into the mix (magnesium and aluminium oxide) to help melting and make it run properly, and other oxides are added for colour. Float glass technology is continuing to develop with the refinement of the process to reduce energy use and by-products.

Approximately 95 million metric tonnes of silica sand is mined each year, the majority of this in the United States. Float glass can be:

- polished
- toughened
- laminated
- coated
- tinted
- manufactured into components such as insulating glass units (IGUs, ommonly called double or triple glazing).

These processes provide sheet glass with widely differing properties suitable for a wide variety of end uses.

Recycled glass use is increasing, but specialist glasses are not recycled (for example, toughened or laminated).

Extraction and manufacture	
Impact of extraction	A raw material for glass is silica sand. It is typically extracted from natural sand features such as dunes and beaches, which means there's potential for damage to local ecosystems.
Energy use	Significant amounts of energy are required in glass manufacture and in recycling. Recovery of embodied energy during recycling is low. Embodied energy of glass is quoted[1] as: • float glass – 15.9 MJ/kg • toughened glass – 27 MJ/kg
By-products/emissions	Manufacturing 1000 kg of glass can generate up to 200 kg of mining waste and 14 kg of air pollutants. Glass furnaces discharge dust, sulphur dioxide, chlorine and fluorine to the atmosphere.
Sourcing	
Material sources	Glass is fully imported.
Availability	Clear and tinted glass is readily available in most parts of New Zealand. Specialised glass may be available ex-stock or imported to order.
Cost	Cost varies significantly with thickness and glass type – float glass is a lower cost product.
Transport to site	The distance of the building site from a port will influence delivery costs. Bulk glass is heavy to transport – larger single sheets are difficult to transport without specialist vehicles. Glass requires careful handling during transport to reduce risk of breakage.

Construction/installation	
Health and safety during construction/installation	Glass is inert, non-toxic and not prone to off-gassing volatile materials. Glass can be hazardous to installers if broken and is classified by Building Code clause F2 as a hazardous building material – see NZS 4223 Part 3 for safety glazing requirements.
Ease of construction/ installation	Float and laminated glass are fragile to install and transport.
Adaptability	Older glass is difficult to re-cut without breaking. Laminated glass is difficult to cut while toughened glass cannot be re-cut.
Performance	
Health and safety during life of building	Glass is inert, non-toxic and not prone to off-gassing volatile materials. Glass is suitable for roof water catchment Glass can be hazardous to building occupants if broken.
Structural capability	Glass is generally used as a non-structural element. Glass has high compression strength but performs poorly in tension.
Expected durability (assuming correct installation and maintenance)	100+ years
Maintenance rating	Glass requires regular cleaning.
Moisture resistance	Glass is generally unaffected by moisture unless it gets between stored panes in a stack, but can be affected by alkaline runoff from cement plaster, uncured concrete, or mortar.
Rot, mould and corrosion	Not affected
Thermal performance	Single panes don't contribute significantly to a wall system's thermal insulation. Thermal insulation can be improved by specifying: • insulating glass units (IGUs) • gas rather than air filling of IGUs – argon is a gas that works best with a 10-12 mm thick gap between panes • timber, uPVC or fibreglass frames, or aluminium frames that incorporate a thermal break • glass with a low emittance (low-E), a spectrally selective coating • glass that permits the entry of infrared wavelengths allowing exposed interior thermal mass surfaces to be heated. Glass does not add to a building's thermal mass.
Sound insulation	Sound insulation increases with glass thickness. Sound insulation can be improved with laminated glass using different thicknesses of glass, having one pane installed on an angle and lining the reveal with a sound absorbing material
Fire performance	Limited to use of wired glass and special laminates in tested steel-framed glazed panels.

Waste disposal/recycling/re-use	
Re-use	Limited
Recycling	Most glass can be recycled – used in the manufacture of fibreglass insulation. Crushed (colour-sorted) glass (cullet) can be used as a raw material for the manufacture of new glass containers. Waste glass has been used in highway construction overseas as an aggregate substitute.
Waste disposal	Some glass can be re-used.

1. Embodied energy figures taken from work © J. Andrew Alcorn, 2010. (Alcorn, J. Andrew, *Global Sustainability and the New Zealand House*, a thesis submitted to Victoria University of Wellington in fulfilment of the requirements for the degree of Doctor of Philosophyin Architecture, Wellington, 2010.)