

Aluminium

Aluminium is mainly used in New Zealand homes as the raw material for window frames. Aluminium is also sometimes used for roof and wall cladding. Its use as a balustrading system is increasing.

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Extraction and manufacture															
Impact of extraction	<p>Bauxite mining has significant visual impact and run-off must be contained on site. There is also potential for damage to local ecosystems during raw material extraction. Is the bauxite sourced from a mine that has in place environmental control and a land rehabilitation programme?</p> <p>Bauxite supplied to NZ is taken from tropical rainforest areas.</p> <p>A large amount of raw material is needed to produce a small amount of final product – the ratio is about 6 to 1.</p>														
Energy use	<p>Embodied energy quotes¹ for aluminium are:</p> <table border="0"> <tr> <td>Virgin:</td> <td>194 MJ/kg</td> </tr> <tr> <td>Extruded:</td> <td>204 MJ/kg</td> </tr> <tr> <td>Extruded anodized:</td> <td>230 MJ/kg</td> </tr> <tr> <td>Extruded factory painted:</td> <td>220 MJ/kg</td> </tr> <tr> <td>Recycled:</td> <td>9 MJ/kg</td> </tr> <tr> <td>Recycled, extruded:</td> <td>14.6 MJ/kg</td> </tr> <tr> <td>Recycled, factory painted:</td> <td>22 MJ/kg</td> </tr> </table> <p>On average it takes some 15.7 kWh of electricity to produce one kilogram of aluminium from alumina (13.1 for NZ smelter).</p>	Virgin:	194 MJ/kg	Extruded:	204 MJ/kg	Extruded anodized:	230 MJ/kg	Extruded factory painted:	220 MJ/kg	Recycled:	9 MJ/kg	Recycled, extruded:	14.6 MJ/kg	Recycled, factory painted:	22 MJ/kg
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By-products/emissions	<p>Processing of bauxite into aluminium results in large quantities of waste (called “red mud”). Manufacturers claim that the residue, while highly alkaline and containing traces of heavy metals and other hazardous substances, is chemically stable and non-toxic. Refining of bauxite for New Zealand production is carried out in Australia.</p> <p>A by-product of the smelting process (called “potliner”) contains fluoride and chlorine and must be disposed of as hazardous waste.</p> <p>Most IAI (International Aluminium Institute) member smelters have equipment that removes 96-99 % of all fluoride emissions from the pots and re-uses them. Current average emission levels to atmosphere are around 1.1kg (0.5kg for the new modern plants) of fluoride per tonne of aluminium (3.9 kg per tonne in 1974).</p>														
Sourcing															
Material sources	<p>Raw aluminium is manufactured in New Zealand (Bluff) from imported refined raw materials (Weipa open cast mine in Australia). Window sections are extruded in Auckland and Hamilton, and assembled locally. Cladding planks are extruded in Auckland. Flat cladding panels are made in Auckland or imported. Roofing profiles are rolled in main centres throughout New Zealand.</p>														
Availability	<p>Aluminium building components are readily available throughout New Zealand.</p>														
Cost	<p>Up-front costs are higher than for comparable steel wall and roof cladding. Uncoated wall and roof cladding material can be used in marine environments without an applied coating.</p> <p>Aluminium windows and doors are generally cheaper than timber or PVC.</p>														

Transport to site	Aluminium is typically light to transport. Components such as windows can be bulky, but are generally assembled locally.
Construction/installation	
Health and safety during construction/installation	There are no currently known health and safety issues.
Ease of construction/installation	Aluminium is relatively lightweight and easy to handle.
Adaptability	Installed aluminium products are easy to moderately easy to replace.
Performance	
Health and safety during life of building	Aluminium is inert and not subject to off-gassing. It is suitable for roof water catchment. Some concerns have been raised overseas of a possible Alzheimer's link but evidence is not compelling.
Structural capability	Aluminium has a low to medium strength-to-weight ratio.
Expected durability (assuming correct installation and maintenance)	25-40 years serviceable life for aluminium windows Profiled aluminium cladding should last more than 50 years depending on cleaning and environment. Aluminium is more durable than steel in similar environments, particularly when used without a paint coating.
Maintenance rating	Low to medium for cladding – but this depends on the environment, coating, and frequency of cleaning
Moisture resistance	Aluminium is impermeable to moisture.
Rot, mould and corrosion	Pinhole corrosion can occur in damp conditions if aluminium is unprotected or dirty or bird droppings are not removed by rain washing.
Thermal performance	No thermal insulation or thermal mass is provided – the rate of heat transfer is high. The thermal performance of aluminium window sections can be substantially improved by the use of a thermal break in the frame section to restrict heat loss.
Sound insulation	Negligible – thin material can vibrate and assist sound transfer.
Fire performance	Aluminium won't burn, but will melt in a hot fire.
Waste disposal/recycling/re-use	
Re-use	Aluminium windows and cladding in good condition can be re-used.
Recycling	Painted and pure aluminium can be recycled. Recovery of embodied energy is high when recycling – recycling aluminium requires less than 20% of the energy of refining bauxite. Anodised and some aluminium alloys cannot be readily recycled.
Waste disposal	Aluminium should be recycled where possible.

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 Philosophy in Architecture, Wellington, 2010.)