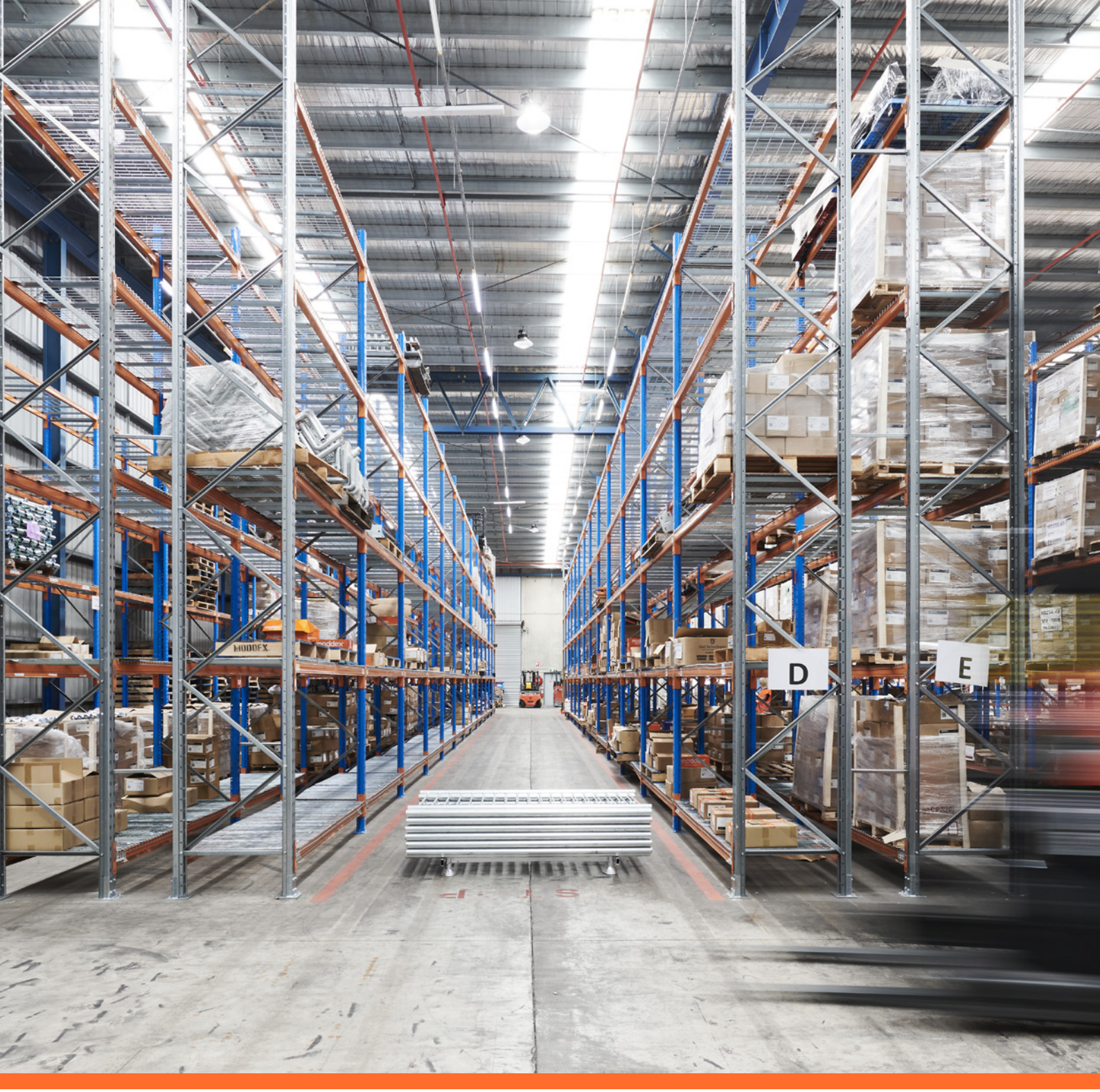


# Lower-Carbon Aluminium in Architecture & Design

Understanding Its Potential for Reducing Embodied Carbon

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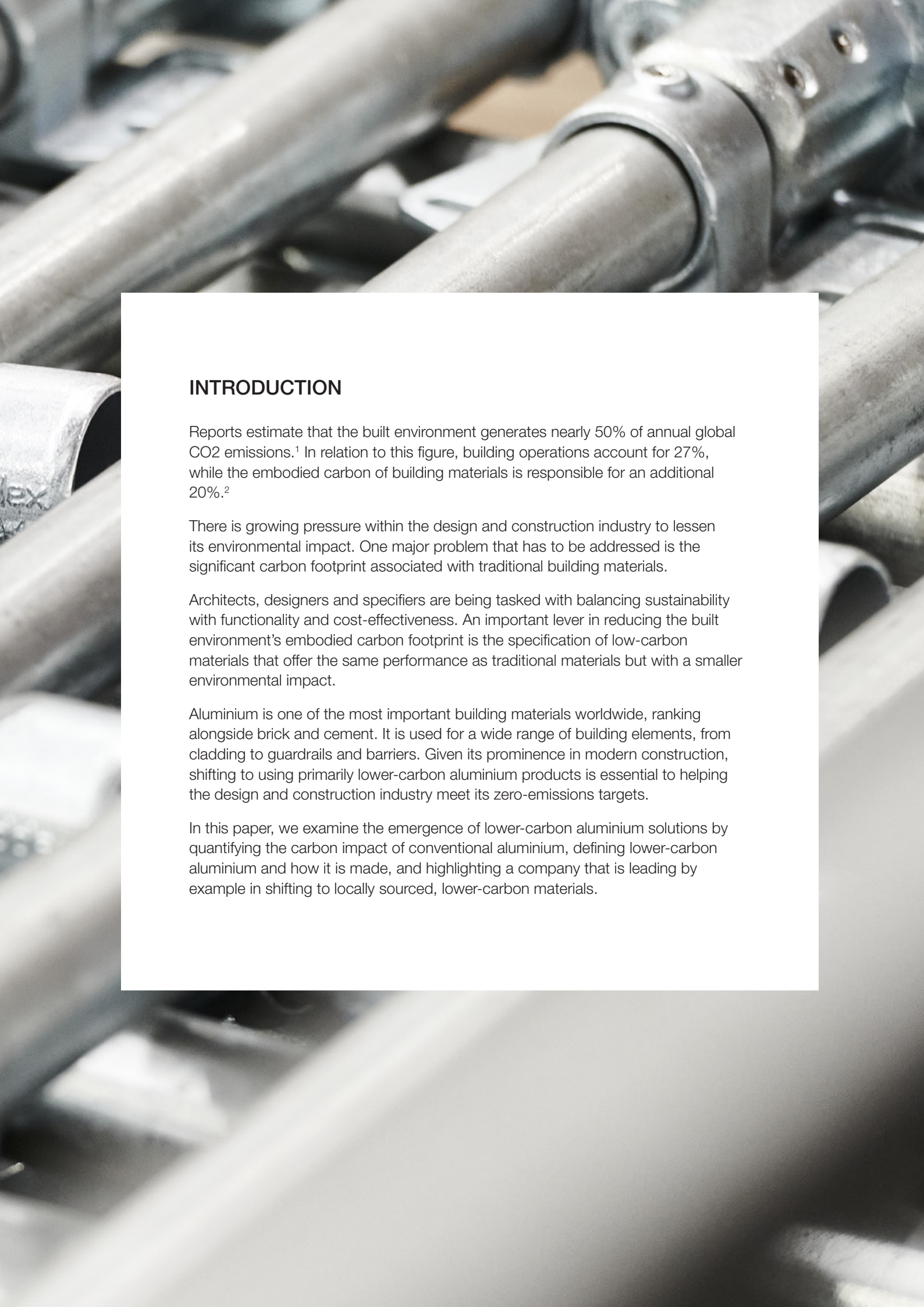

## INTRODUCTION

Reports estimate that the built environment generates nearly 50% of annual global CO2 emissions.[1] In relation to this figure, building operations account for 27%, while the embodied carbon of building materials is responsible for an additional 20%.[2]

There is growing pressure within the design and construction industry to lessen its environmental impact. One major problem that has to be addressed is the significant carbon footprint associated with traditional building materials.

Architects, designers and specifiers are being tasked with balancing sustainability with functionality and cost-effectiveness. An important lever in reducing the built environment's embodied carbon footprint is the specification of low-carbon materials that offer the same performance as traditional materials but with a smaller environmental impact.

Aluminium is one of the most important building materials worldwide, ranking alongside brick and cement. It is used for a wide range of building elements, from cladding to guardrails and barriers. Given its prominence in modern construction, shifting to using primarily lower-carbon aluminium products is essential to helping the design and construction industry meet its zero-emissions targets.

In this paper, we examine the emergence of lower-carbon aluminium solutions by quantifying the carbon impact of conventional aluminium, defining lower-carbon aluminium and how it is made, and highlighting a company that is leading by example in shifting to locally sourced, lower-carbon materials.

## WHAT IS THE CARBON EMISSIONS FOOTPRINT OF ALUMINIUM?

Aluminium is found in abundant quantities in the rocks and soil of Earth, but it is not found in its pure form and must be extracted from compounds. This requires an energy-intensive process of smelting and refining that uses a massive amount of electricity. Many countries rely on fossil-fuel-based power sources to produce this energy.

Due to increasing production, the total direct emissions from the global aluminium sector have stayed at high levels over the last decade. This is happening at the same time that the emissions intensity of the production of aluminium has been gradually decreasing, on average by 1.7% year, primarily due to a decline in the energy intensity of alumina production.[3]

According to the International Energy Agency, aluminium production emitted nearly 270 Mt of direct CO2 emissions in 2022, which amounts to about 3% of the world's direct industrial CO2 emissions.[4] The electricity generated during the aluminium smelting process accounts for about 60% of the greenhouse gas emissions produced by the aluminium industry.[5]

Various reports note that the global average carbon emissions for a kilogram of aluminium are 12.46kg CO2e/kgAl.[6] In Australia, where we primarily rely on coal-fired power generation, locally produced aluminium would likely have an emissions intensity in this range.[7] Aluminium smelters in Australia account for almost 10% of the country's total electricity grid capacity and 6.5% of its total carbon emissions.[8]

Decarbonising the power sources used by the aluminium industry would be a crucial step to lowering the sector's carbon footprint. While it is the heavy consumption of energy that creates the overwhelming majority of carbon emissions, there are other significant emissions and pollution created by the smelting and refining process, such as fluoride emissions, sulfur dioxide and other particulate matter.

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## WHAT IS "LOWER-CARBON" ALUMINIUM?

What do we mean when we talk about "lower-carbon" aluminium? In the aluminium industry, lower-carbon aluminium is now a recognised term, though it is sometimes defined in slightly different ways by various stakeholders.

The term is often used to characterise two types of aluminium: primary aluminium with a carbon intensity lower than the global average (12.46kg CO2e/kgAl) and secondary aluminium that is made using a high proportion of scrap from end-of-life products.[9] Aluminium with carbon emissions significantly lower than the global average is becoming increasingly available locally and worldwide.

Current market lower-carbon products are much more likely to be virgin aluminium produced with renewable energy. By using renewable energy sources, aluminium's footprint can be reduced on average to approximately 6-4.0kg CO2e/kgAl, according to the Materials and Embodied Carbon Leaders' Alliance.[10] By using recycled post-consumer scrap content, this can be lowered even further.


## HOW IS LOWER-CARBON ALUMINIUM MADE?

Any attempt to create aluminium with a lower carbon footprint must directly address the electricity supply needed for the smelting process, which separates aluminium from its oxide, alumina. Today, renewable energy sources like solar, wind, and hydropower are used to produce lower-carbon primary aluminium.

Another significant area for decarbonisation is the direct emissions associated with the processing of aluminium. Manufacturers like Tomago Aluminium focus on emission and pollution control measures to ensure the aluminium smelting process is clean and unobtrusive.

For example, aluminium smelter emissions pass through ducting to treatment plants where fluorides, fume and dust are adsorbed onto fresh alumina particles that are then captured in large filter bags.[11] This is known as the “dry scrubber” process, which contributes to why Tomago’s emissions are among the lowest recorded by any aluminium smelter in the world.[12]

Increasing scrap recovery would decrease the requirement for primary aluminium and the corresponding carbon emissions. According to a World Economic Forum report, about seven million tonnes of aluminium are not recycled annually.[13] If 95% of this material could be recovered, the demand for primary aluminium would be reduced by 15%, saving 250 million tonnes of CO2 emissions annually.[14]

Scrap aluminium can be remelted and recycled into new products. Recycling aluminium reduces emissions and uses 95% less energy than producing it from ore. Capral and Rio Tinto are leading the Australian market in this area, with closed-loop recycling agreements in place to deliver locally produced primary aluminium billet containing a minimum of 20% recycled content sourced directly from Capral’s manufacturing sites.[15]

## BENEFITS OF LOWER-CARBON ALUMINIUM

Lower-carbon aluminium has lower embodied emissions while maintaining the same technical characteristics as primary aluminium made with conventional energy sources. As it has the same workability, strength, and durability as conventional aluminium, it can be easily incorporated into all current applications, ranging from structural elements to lightweight cladding systems.

By simply replacing conventional aluminium with lower-carbon aluminium when designing and constructing buildings, more sustainable outcomes can be achieved.

Case studies, for instance, demonstrate that substituting primary aluminium for low-carbon aluminium in the building's components of a large educational facility could cut the building's embodied carbon by 18% and its greenhouse gas emissions by 23%.[16] In commercial buildings with traditional structures, replacing aluminium parts with low-carbon aluminium can reduce carbon emissions by approximately 7%.[17]

Selecting lower-carbon aluminium is crucial for reasons other than environmental preservation, like corporate responsibility, compliance, and cost efficiency. Projects that put sustainability first and incorporate lower-carbon aluminium into their structures show that they care about the environment. The use of lower-carbon aluminium also contributes to credits under internationally recognised sustainable building certification schemes such as GreenStar.


# Shifting to locally sourced lower-carbon aluminium: How Moddex is leading by example

Leading producer of prefabricated modular handrail and balustrade systems, Moddex, has made the switch to locally sourced, lower-carbon aluminium from Capral Aluminium, marking a significant step towards sustainability.

This decision highlights Moddex's commitment to environmental responsibility and aligns its operations with the critical goal of decarbonising the built environment. It also helps its clients meet the increasingly stringent sustainability requirements of commercial, industrial and infrastructure projects.

Moddex's transition to lower-carbon aluminium significantly reduces the environmental impact of its products. Capral Aluminium's LocAl® Green boasts carbon emissions of just 8kg CO2e/kg Al, with LocAl® Super Green achieving an even lower footprint at 4kg CO2e/kg Al. These figures position them among the lowest-carbon aluminium options available globally. While being more sustainable, this new aluminium material performs on par with or better than conventional options.

Recently, LocAl® Capral was also certified for the extrusion, warehousing, and distribution of aluminium goods and services against the Chain of Custody (CoC) V2 and the Aluminium Stewardship Initiative (ASI) Performance Standard V3. The 26 facilities owned by Capral, including mills, distribution centers, and trade centers that are spread across all of Australia, are all covered by the certifications. These certifications attest to Capral's dedication to responsible production, manufacturing, and handling of aluminium products.

In terms of Moddex's sustainability journey, the adoption of these lower-carbon aluminium products is a significant turning point. Moddex acknowledges the well-known advantages of aluminium, such as its strength, light weight, resistance to corrosion, and durability, but it is also taking active steps to reduce the environmental impact of the production process.

An important lever in reducing the built environment's embodied carbon footprint is the specification of low-carbon materials that offer the same performance as traditional materials but with a smaller environmental impact.

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All information provided correct as of August 2024

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