UNLOCKING LOW-CARBON **CONCRETE FOR INFRASTRUCTURE**

INSIGHTS FROM WESTERN AUSTRALIA'S CIRCULAR-ECONOMY APPROACH, SHOWING HOW MATERIALS, VALIDATION AND COLLABORATION ARE MOVING LOW-CARBON CONCRETE FROM INNOVATION TO IMPLEMENTATION.

Images: Daniel Carson, DC Images Photography

Precast has long been an ideal solution, capable of catering for projects of all sizes.

Australia's infrastructure pipeline is expanding, but so too is the pressure to reduce embodied carbon across major projects. Concrete remains essential to delivery, however, its reliance on Portland cement continues to drive emissions at a scale the industry can no longer ignore.

Far from simply mitigating the issue of emission-heavy concrete, Western Australian business and National Precast Member Permacast made a strategic pivot to low-carbon concrete, and the results have proved significant.

The company has assessed that the emissions problem is unavoidable through conventional means and predict that regulatory and market pressures are only likely to increase. Observing that large volumes of industrial by-products generated in the region are currently being exported or discarded, Permacast believed it could transform WA's industrial waste streams into a strategic asset and competitive advantage.

Earlier this year, Permacast published its white paper detailing its pursuit of low-carbon high-performance green concrete. Its mission is to be seen as a leading innovator in the space and are now even advocating for policy change. Its journey and approach are well-worth understanding.

BETWEEN INNOVATION AND UPTAKE

For contractors, asset owners and engineers, the barrier is not innovation. It is certainty.

Low-carbon mixes must demonstrate structural performance, durability in demanding environments, compliance with existing specifications and consistency at scale.

Without this, uptake remains limited, particularly in infrastructure where long asset life and risk management are critical.

Despite growing policy interest, the absence of clear mandates and consistent procurement pathways continues to slow adoption. Industry conservatism, combined with fragmented standards and validation approaches reinforce reliance on traditional materials.

Above: The reduction of clinker content while maintaining structural integrity has emerged as a desired solution.

WHAT IS WORKING IN PRACTICE

Advances in high-recycled-content concrete are beginning to address these challenges by combining sustainability with proven performance.

In Western Australia, locally sourced industrial by-products from mining, construction and processing industries are being incorporated into concrete mixes as supplementary cementitious materials. These materials reduce clinker content while maintaining structural integrity.

Recent developments have demonstrated clinker replacement levels of around 30 to 40 per cent, with early results indicating embodied carbon reductions in the order of 20 to 25 per cent, depending on the mix design and application.

This is a critical shift. The conversation is moving away from future potential and towards what can be delivered today using locally available resources.

VALIDATION IN REAL INFRASTRUCTURE

Demonstrating performance in real infrastructure applications is essential to building industry confidence.

Low-carbon precast elements, including noise wall panels, are now being developed and tested using high-replacement mixes. These solutions demonstrate how low-carbon alternatives can meet standard infrastructure requirements while reducing reliance on traditional cement.

Performance testing has shown that these mixes can meet, and in some cases exceed, expected benchmarks. Compressive strengths have surpassed design requirements at 28 days, confirming their suitability for structural applications.

Equally important is constructability. These elements are being designed for integration into existing project workflows, allowing adoption without disruption to established construction practices.

Validation remains a central focus. Testing is being undertaken in line with recognised Australian Standards, including AS 1379, alongside relevant state infrastructure specifications. Durability, workability and long-term performance are all being assessed to ensure suitability for infrastructure use.

In parallel, Environmental Product Declarations and Life Cycle Assessments are providing greater transparency around embodied carbon outcomes, supporting more informed decision-making by asset owners and government agencies. These outcomes reinforce the technical findings presented in Permacast's White Paper, which highlights the role of locally sourced materials and validated performance in accelerating adoption.

TURNING CAPABILITY INTO ADOPTION

Western Australia is uniquely positioned to lead the transition to low-carbon concrete through a circular economy approach.

The state's abundance of industrial by-products, including materials derived from the lithium industry, presents a significant opportunity to reduce emissions while strengthening local supply chains. Using these materials locally can reduce transport impacts, improve resource efficiency, and support more resilient infrastructure delivery.

However, technical capability alone will not drive change.

Widespread adoption will depend on stronger alignment between industry and government, early engagement with asset owners and specifiers, pilot projects that demonstrate performance at scale, as well as procurement frameworks that support performance-based specifications.

Image: National Precast

National Precast CEO Cadell Taye.

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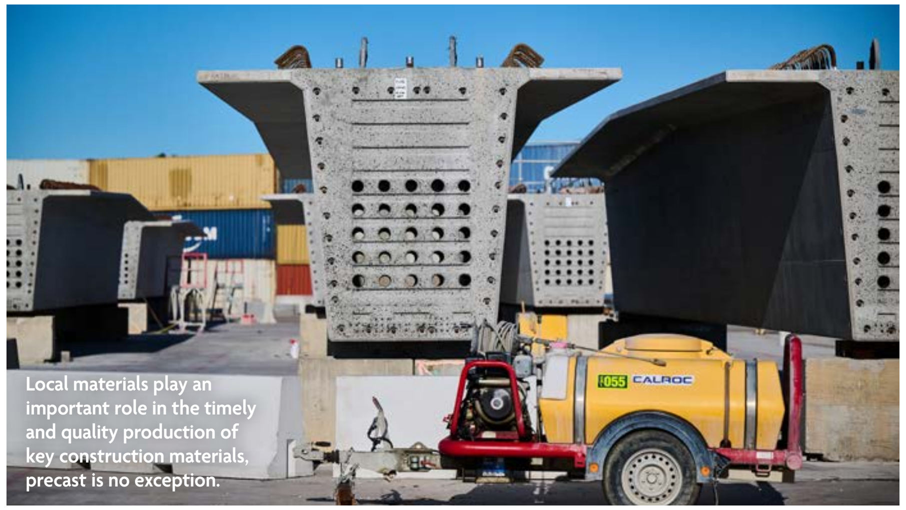

Local materials play an important role in the timely and quality production of key construction materials, precast is no exception.

The pathway forward is clear. Low-carbon concrete is no longer an emerging concept. It is a viable, tested solution that can be deployed in infrastructure today.

The next step is for procurement, policy and project delivery frameworks to catch up. By embedding performance-based approaches and recognising validated low-carbon alternatives, the infrastructure sector can accelerate adoption without increasing risk.

The opportunity now is for industry and government to move beyond pilot projects and embed low-carbon concrete into standard specifications, ensuring it becomes a normal part of infrastructure delivery rather than an exception. ■