UNSW SYDNEY | Australia's Global University

Welcome

Research Capabilities on Concrete Decarbonisation

Dr Ali Kashani
ali.kashani@unsw.edu.au

UNSW Decarbonised Concrete Team

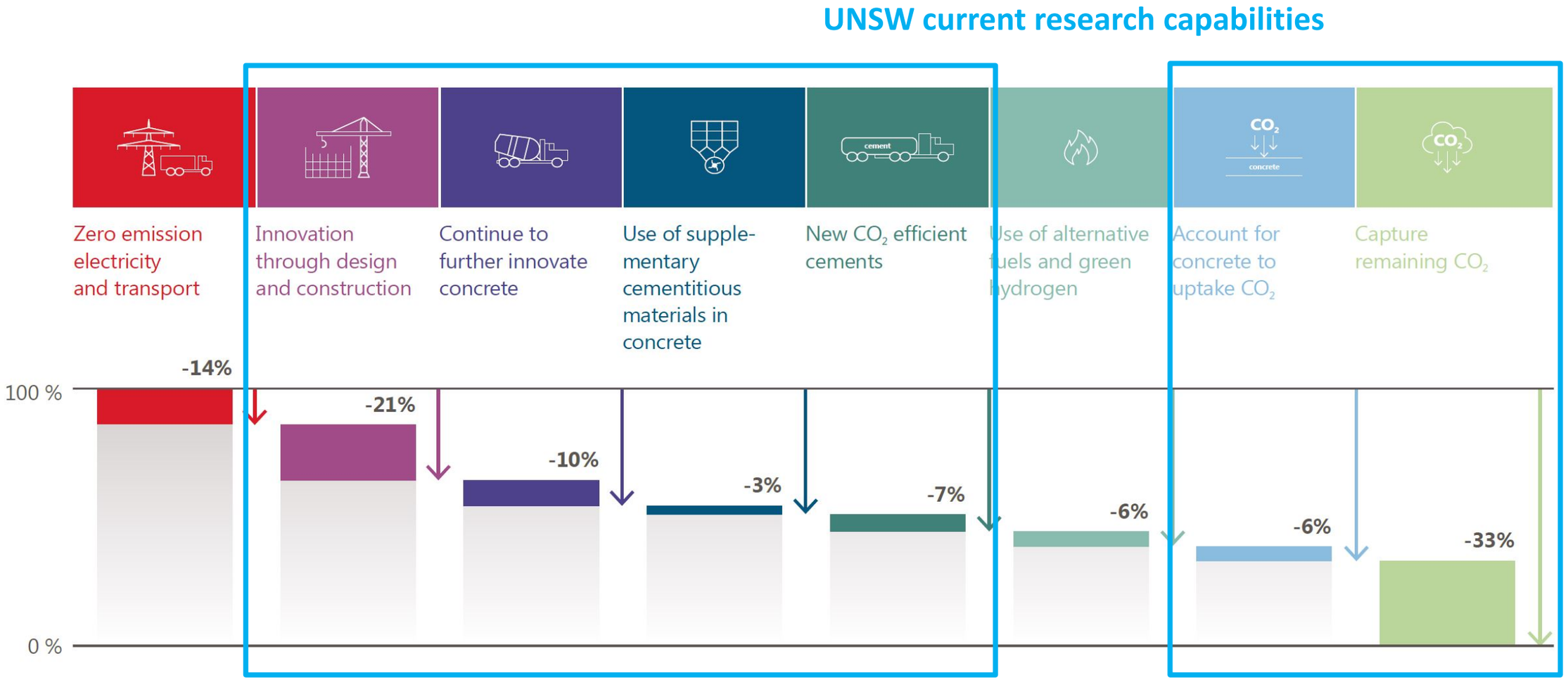
Prof. Stephen Foster (Dean of Engineering)

Dr Ali Kashani

Dr Ailar Hajimohammadi

Dr Taehwan Kim

Cement and Concrete Decarbonisation Pathways



Ways to achieving a low carbon building industry

Dematerialisation:	Higher strength, higher performance materials, additive manufacturing; efficiency gains.
Substitution:	Replacement of a higher embodied carbon material with a lower one that gives the same or improved performance.
Capture:	Carbon capture and utilisation.

Utilising recycled glass as binder & aggregate

Use of supple-mentary cementitious materials in concrete

New CO_2 efficient cements

Green concrete with recycled glass as cement and aggregate replacement

Glass as aggregates and SCM in cement-based precast concrete

- Mix designs
- Mechanical properties & durability
- ASR

(Kashani et al.)

Next generation sustainable concrete: trialling recycled glass in geopolymer concrete

Glass as aggregates/SCM in geopolymer concrete

- Mix designs
- Mechanical properties & durability
- Develop specifications

(Hajimohammadi et al.)

The reuse of glass from waste photovoltaic modules

Glass as aggregates/ SCM in cement concrete

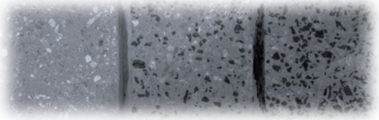
- Impact of impurities
- Mechanical properties & durability

(Hajimohammadi et al.)

Implementation of recycled rubber for acoustic applications

- Elasticity, damping, ductility and desirable freeze and thaw characteristics
- Better noise attenuation
- Lightweight
- Less carbon footprint

(Hajimohammadi et al.)

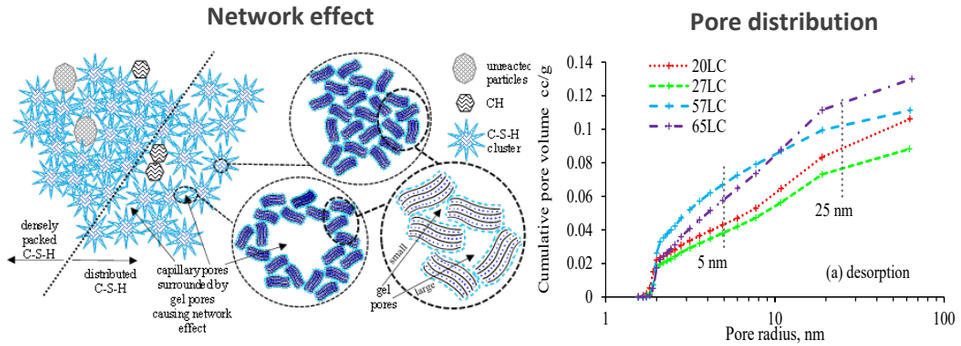


TyreStewardship AUSTRALIA

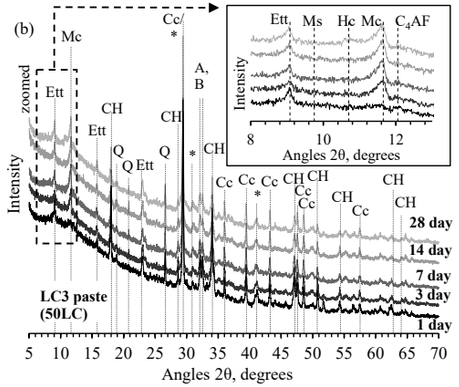
Advanced Infrastructural Materials Laboratory

(Taehwan Kim et. al)

❑ Shrinkage, Creep, and Restrained Early Cracking of Low Carbon Concrete (LC3 cement/Fly ash/Slag)



Gel and capillary pore distribution



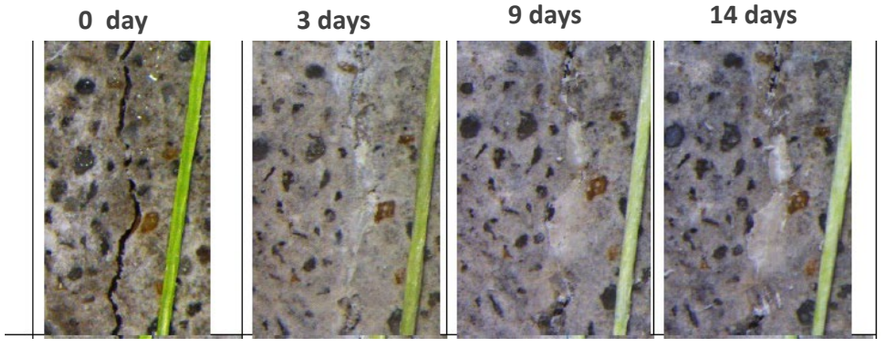
Phase identification and hydration process

Restrained ring test

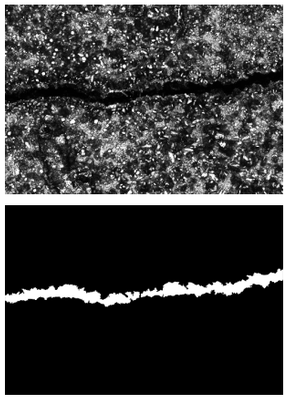
Autogenous shrinkage, Drying shrinkage

Tensile creep

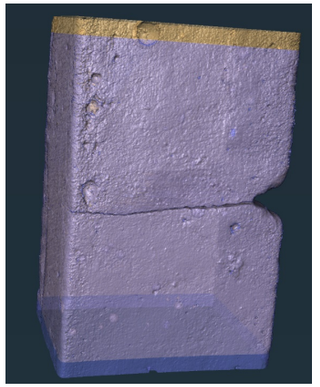
❑ Self-Healing Capacity and Corrosion of Low Carbon Concrete (LC3 cement/Fly ash/Slag)

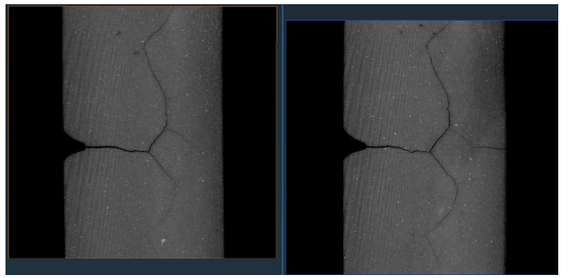


Crack healing of 60% slag concrete



Digitizing of crack width using confocal microscope



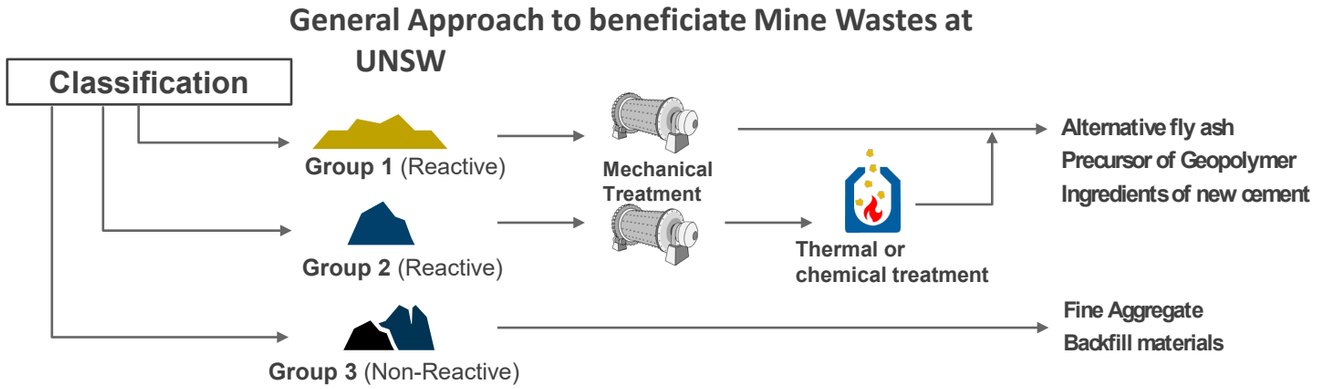


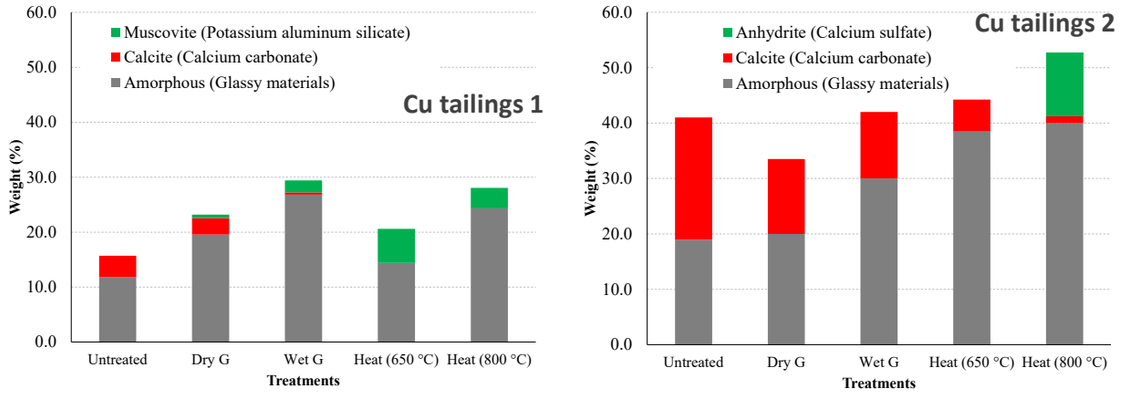
3D evolution of crack healing (X-ray μCT

Advanced Infrastructural Materials Laboratory

(Taehwan Kim et. al)

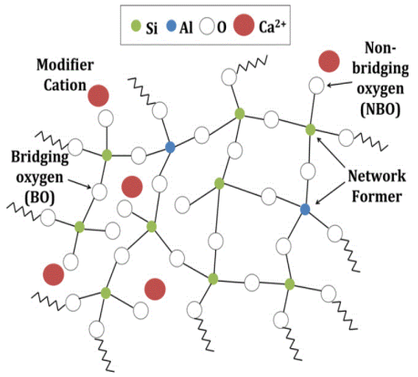
❑ Beneficiation of Mine Wastes and Exploring alternative SCMs





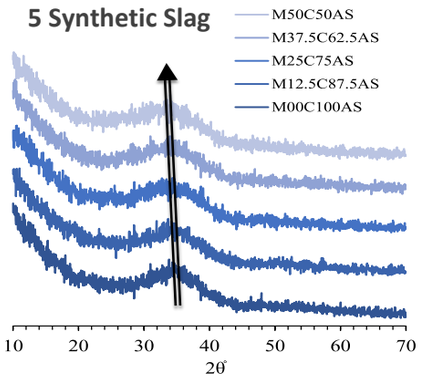
Mineralogical changes after different mechanical/thermal treatments

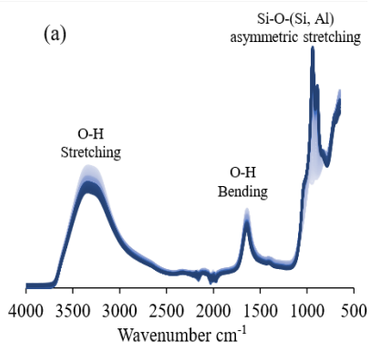
❑ Reaction Kinetics and Rheology and Structural build-up of Geopolymer



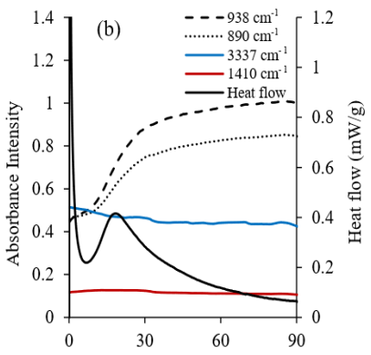
Newlands K. et. al., 2016

Synthesis of Chemically Controlled Slag → Study the Reaction kinetics

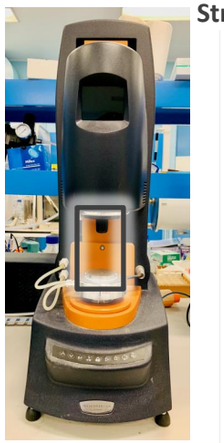




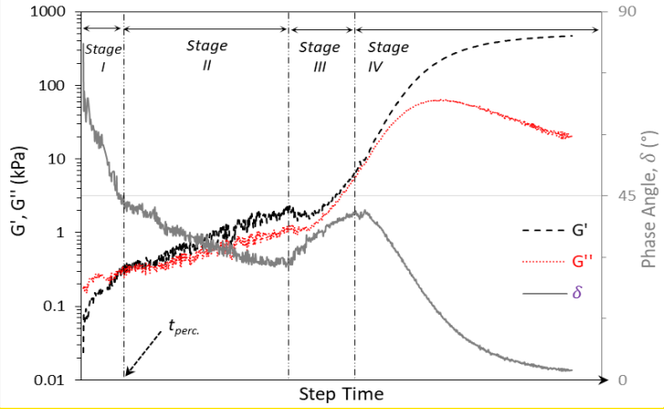
In-situ FTIR



In-situ FTIR + Heat Evolution



Structural Build-up (hardening behaviour) of geopolymer



Low Carbon Cements and Alternative Binder Concrete

(Steve Foster et. al.)

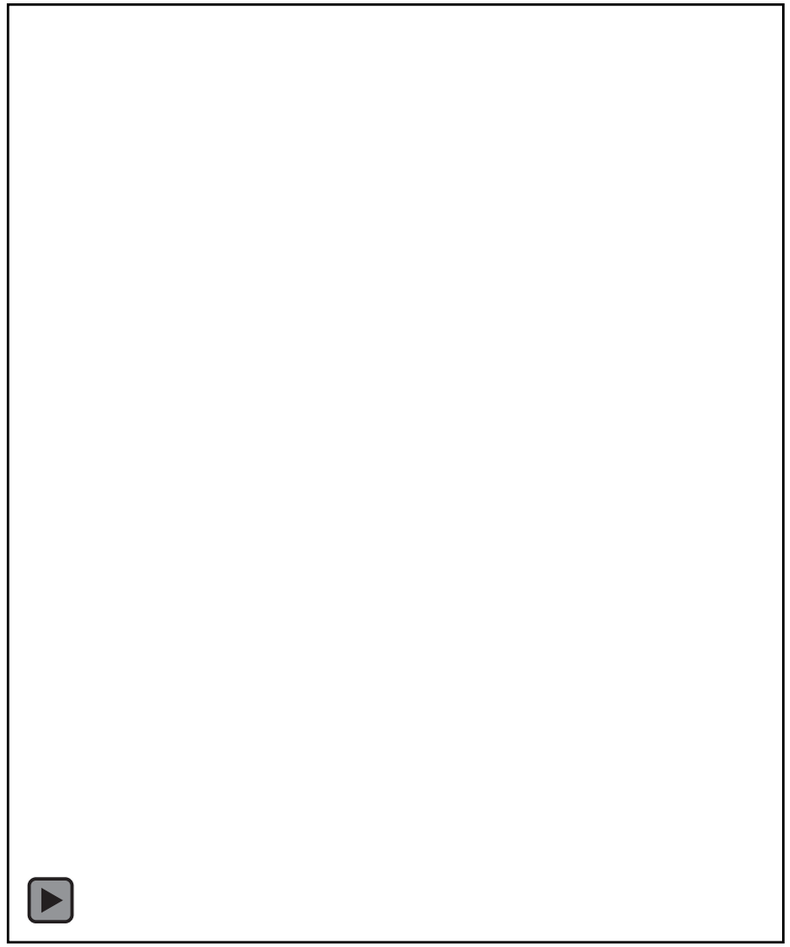
High Density Breakwater Armour Units

City of Sydney Pavement Trial

Digital Concrete (3D printing)

Ali Kashani

Innovation
through design
and construction



Carbon Capture & Utilisation in Concrete

Ali Kashani

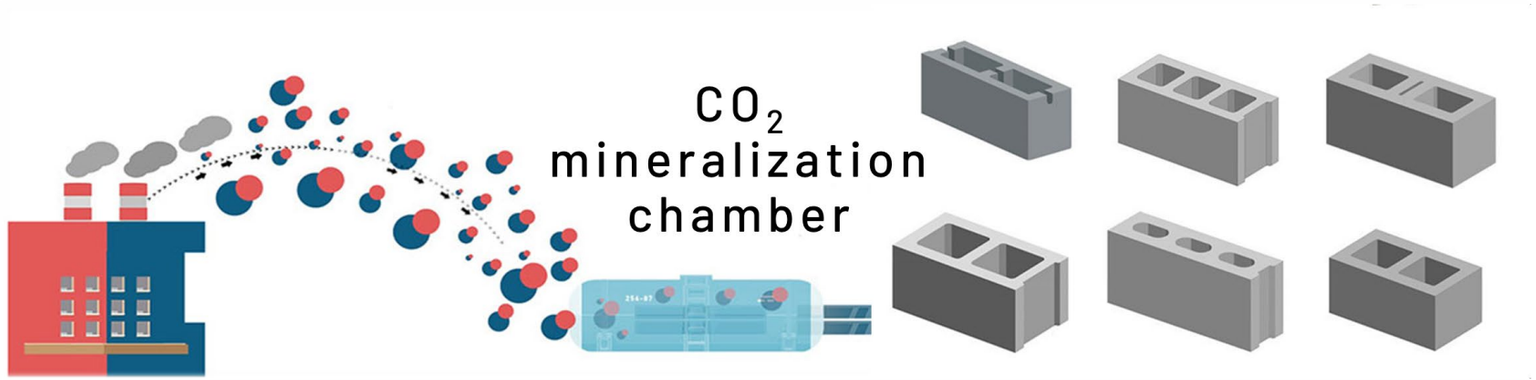
Account for concrete to uptake CO_2

Capture remaining CO_2

SINKRETE

Made with CO_2

A sustainable and low-carbon technology that recycles CO2 into construction materials

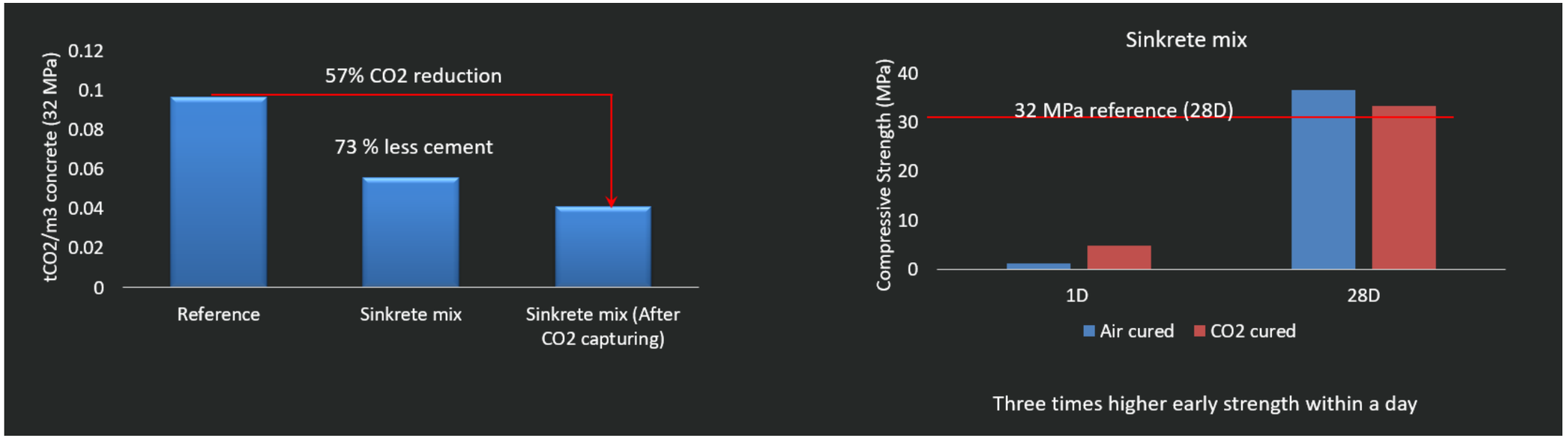


UNSW SYDNEY

Sinkrete Performance and Applications

Account for concrete to uptake CO_2

Capture remaining CO_2



Precast concrete

Fibre cement board

Plaster board

Masonry

AAC blocks

“We can only achieve net-zero cement and concrete industry by 2050 through collaborative efforts of all stakeholders”

Questions