Australian Cement Industry Decarbonisation Pathway

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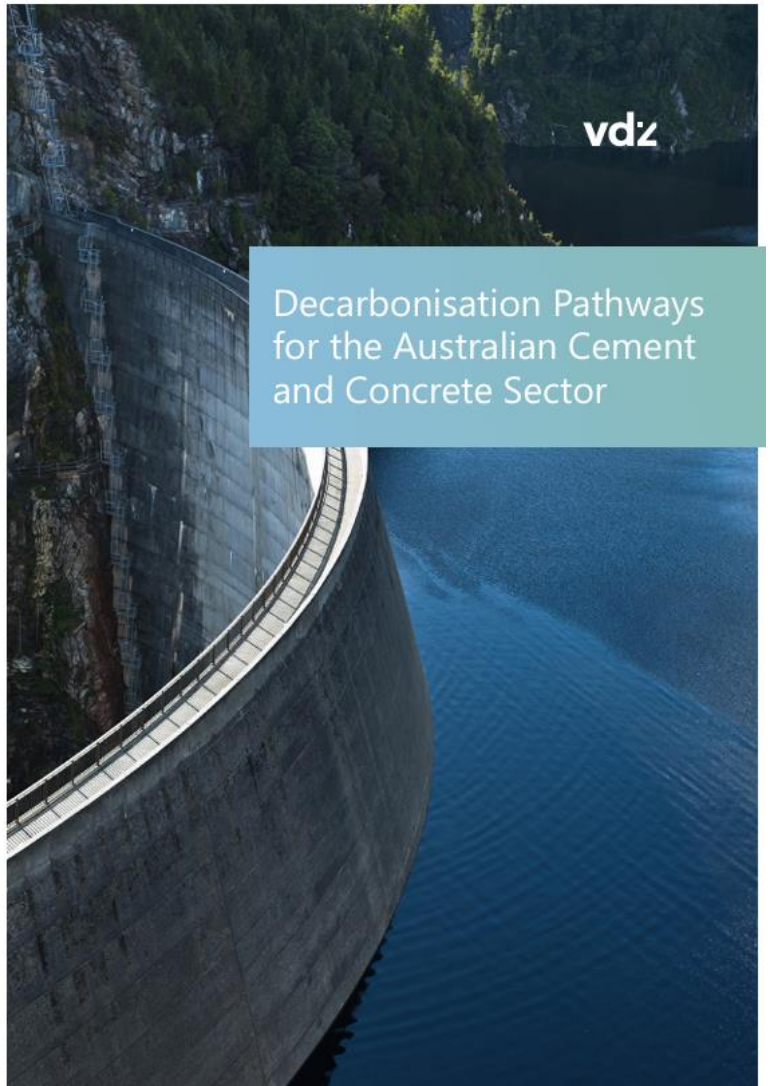
Overview

- Introduction to VDZ Decarbonisation Pathways for the Australian Cement and Concrete Sector
- The Challenge
- Levers for Decarbonation
  - Innovation in Construction and Design
  - Innovation in Concrete
  - Clinker efficient cements, SCM’s and new binders
  - Fuel and electrical energy efficiency in clinker production
  - Recarbonation
  - Carbon Capture
  - Thermal Mass

Introduction to VDZ Decarbonisation Pathways for the Australian Cement and Concrete Sector

- Independent Report
- Published 2021
- Financial and in-kind contributions from:
  - Cement Industry Federation
  - Cement Concrete & Aggregates Australia
  - Smartcrete CRC
  - Race for 2030 CRC



- Levers for Decarbonation
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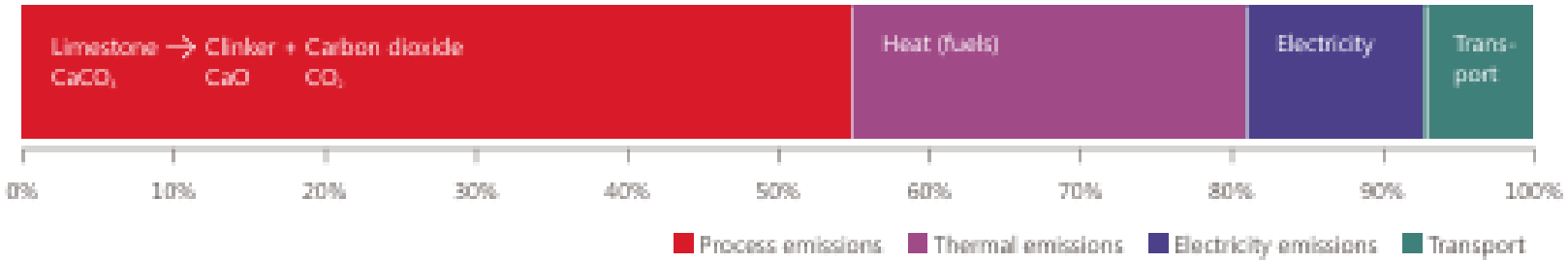
Introduction to VDZ Decarbonisation Pathways for the Australian Cement and Concrete Sector

Figure 2: Today's CO_2 emission profile of the Australian Cement and Concrete Industry

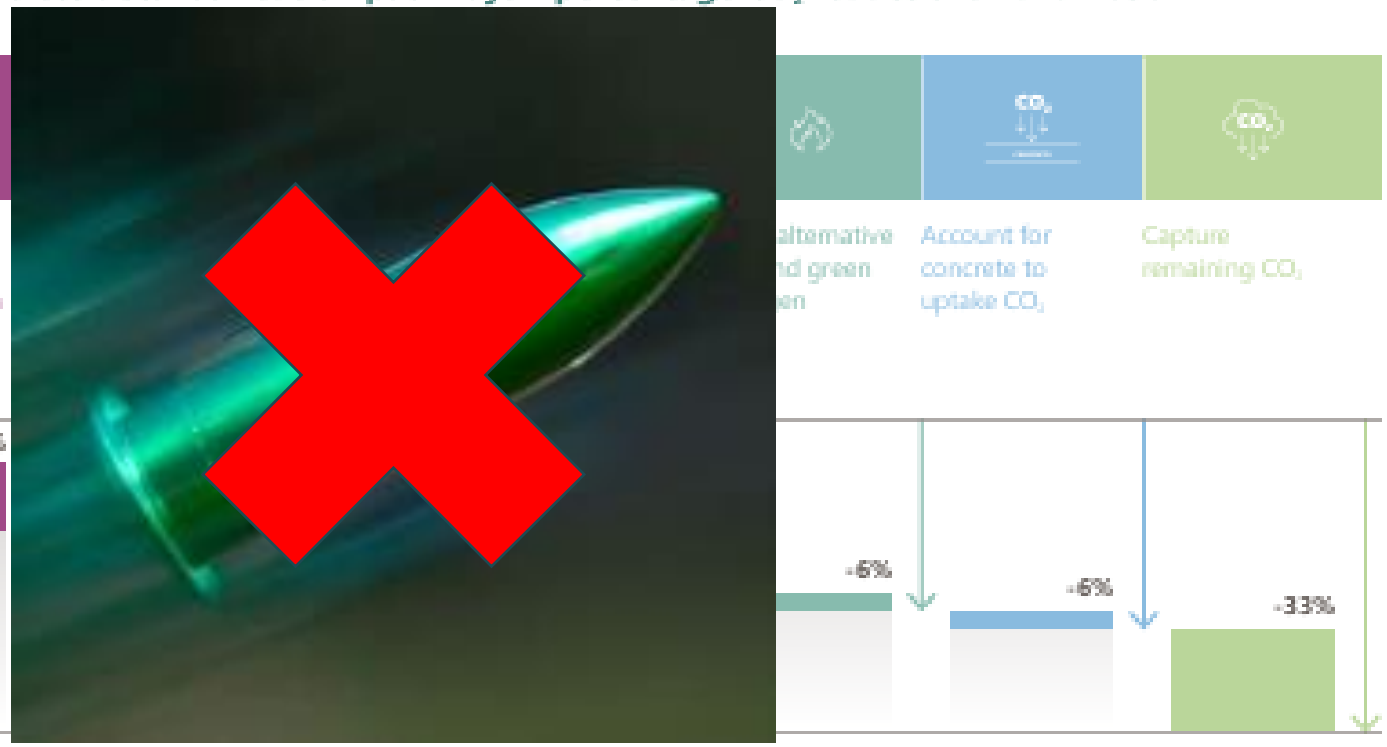


$$CaCO_3 \xrightarrow{heat} CaO + CO_2$$

$$\text{(1 Calcium \& 1 Carbon \& 3 Oxygen)} \xrightarrow{heat} \text{(1 Calcium \& 1 Oxygen) + } \underline{\textbf{(1 Carbon \& 2 Oxygen)}}$$

Introduction to VDZ Decarbonisation Pathways for the Australian Cement and Concrete Sector

Figure 1: Cement and concrete decarbonisation pathways – percentage CO_2 reductions 2020-2050



The Challenge

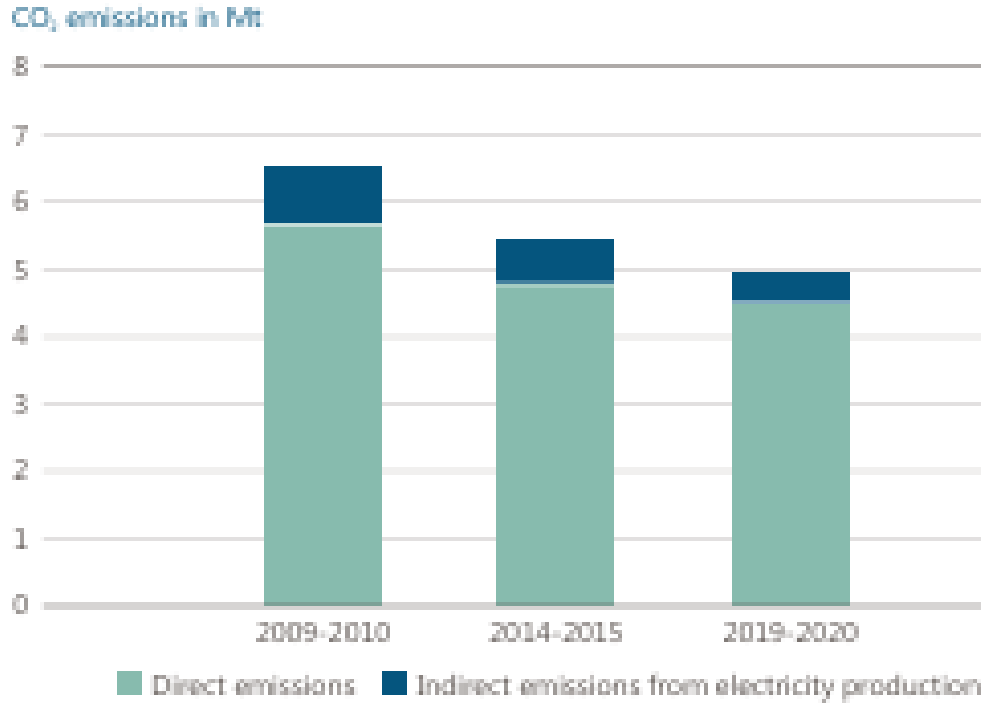
- “After water, concrete (including cement) is the most used material in the world and will continue to be absolutely crucial in supporting a modern world.”
- “…no viable replacement of clinker-based cement currently exists to satisfy the global demand of infrastructure and construction. Even over the long term, cement – and its main constituent clinker – will continue to be indispensable. Levers for Decarbonation”
- “…clinker is of particular importance against the fact that the demand for construction is expected to grow in Australia by almost 40 per cent by 2050, which is mirrored by the expected population growth and future infrastructure investment plans”

- 2019-20 – 11.7 million tonne of cement used in Australia

Prior Progress thru-2020

- 30% Improvement in thermal efficiency
- 18% Replacement of fossil fuels
- 40% Biomass in alternative fuels
- 38% reduction in clinker content of concrete

Figure 4: CO_2 emissions from the Australian cement industry



Levers for Decarbonation

Innovation in Construction and Design

- Structural optimisation – build more with less
- Improved design assumptions and methods – Reduce reliance on cookie cutter or prescriptive approach to design. Building Information Modelling (BIM) supports this pathway.
- New and improved construction technologies
- Lifetime extension repair and reuse

"Where we're going we don't need roads" Doc Brown, Back to the Future

Dematerialisation!

Levers for Decarbonation
Innovation in Concrete

- Use of supplementary cementitious materials (SCMs)
- Reduction of binder content – **PERFORMANCE over PRESCRIPTION**
- Avoidance of waste in concrete production
- Magnesia based cements [1]

[1] – not referenced in Decarbonation Pathways document

Levers for Decarbonation
Clinker efficient cements, SCMs and new binders

- Availability of SCMs in 2050
  - GGBFS from steel may be limited
  - Flyash production will decrease but large stockpiles exist
    - *Extra processing*
    - *Quality?*
  - Limestone mineral addition 20% (+?)
  - Calcined Clays
  - Other SCMs like natural pozzolana, lithium waste

Levers for Decarbonation

Fuel & electrical energy efficiency in clinker production

- Fuel efficiency – Energy demand has reduced from 4700MJ/t of clinker to 3445MJ/t clinker
- Thermal efficiency through advanced sensors and artificial intelligence
- Electrical energy efficiency

Levers for Decarbonation

Recarbonation, Carbon Capture and Thermal Mass

- Calcium Hydroxide is produced during cement hydration
- Calcium Hydroxide reacts with Carbon Dioxide in the air to ‘reform’ Calcium Carbonate
- Between 20-43% of process emissions ‘reabsorbed’ back into concrete
- Carbon Capture Use and Storage has a number of research avenues currently being investigated.
- “Usage” more critical than “Storage” in CCUS.
- Concrete can operate as a thermal mass and reduce heating and cooling energy usage in buildings. Not currently being looked at.

Review

- The Challenge – Cement is really good at what it does and we use a lot of it!
- The construction industry in Australia needs to decarbonise whilst it is still growing
- Levers for Decarbonation
  - Innovation in Construction and Design
  - Innovation in Concrete
  - Clinker efficient cements, SCM's and new binders
  - Fuel and electrical energy efficiency in clinker production
  - Recarbonation
  - Carbon Capture (Use and Storage)
  - Thermal Mass

Thank you!

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