Cement Industry Federation

SUBMISSION

Advice on opportunities to reduce greenhouse gas emissions of Victorian Government infrastructure

14 May 2023

1. INTRODUCTION

Thank you for the opportunity to provide comment on the *Advice on opportunities to reduce greenhouse gas emissions of Victorian Government infrastructure.*

The Cement Industry Federation (**CIF**) is the peak national body representing all Australian integrated cement manufacturers and comprises the three major Australian cement producers - Adbri Ltd, Boral Cement Ltd and Cement Australia Pty Ltd.

Australian cement production is a **critical manufacturing industry of national importance**, supporting over 1,200 employees directly in high paid positions as well as hundreds of apprentices, contractors and transport operators. The cement, lime[1] and concrete value chain supports over 15,000 jobs in Australia.

2. SUMMARY OF KEY POINTS

- Cement, the key ingredient in concrete, is a critical input into Australian infrastructure projects such as roads, bridges, dams, buildings – and will remain so for the foreseeable future.
- Pathways to decarbonise cement and concrete manufacturing by 2050 have been identified, including pathways for key elements of the full value chain to also contribute to emission reductions.
- There are three key levers available now to cement manufactures to reduce emissions – energy efficiency, clinker substitution and fuel substitution (alternative fuels).
- The final lever, carbon capture, use and storage (CCUS), will also be critical once the technology readiness levels of the process – as well as the required transport infrastructure mature, which will most likely be post 2030.
- From a use perspective, clinker substitution offers immediate emissions reduction opportunities. However, existing standards and specifications currently limit the levels of clinker substitution and therefore emissions reduction opportunities for the most specified cement type (Type General Purpose).
- Standards, Codes and Specifications for cement, SCMs and concrete will need to be reviewed and updated where necessary to fully realise the emissions reduction potential of clinker substitution and the introduction of new, lower carbon cements.
- An increased focus on sustainability from a whole of life (WOL) perspective, particularly in terms of public procurement, will result in increased demand for these products with significant emissions reduction potential.
- Recarbonation, the re-uptake of carbon dioxide by cement and concrete, is an important decarbonisation pathway that is currently being modelled for Australian conditions.

3. CEMENT PRODUCTION

Cement is a critical ingredient in concrete, one of the most used materials in the world and essential for the built environment as we know it. Australian cement production is closely linked to population growth – With strong growth, the demand for cement increases.

Portland cement is manufactured in Australia from local sources of limestone using state-of-the-art pre-calciner technology. Limestone is crushed and blended with minerals such as shale, iron ore and sand. The resultant raw mix, or 'meal', is then sent to a precalciner where it reaches temperatures of up to 860 C, before entering a rotating kiln where it is further heated to 1,450 C.

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[1] CIF members also produce lime, either in conjunction with clinker and cement or at stand-alone facilities

At these temperatures the mix undergoes a sintering process as it passes through the rotating kiln, partially melting and forming nodules of clinker. The clinker is then cooled and stored before being sent to the grinding mill, where it is blended with gypsum and other materials (such as unburnt limestone, fly ash and blast furnace slag) – depending on the type of cement required.

The resulting cement products are then distributed (via road, rail or sea) to customers around the country.

Cement Types

The current Australian cement standard AS 3972-2010 defines 3 types of cement:

- **General purpose cement (Type GP)**: is mainly based on Portland cement clinker and calcium sulfate (gypsum). The use of mineral additions, for example limestone, is allowed up to a content of 7.5 per cent.

- **Blended cement (Type GP)**: which contains Portland cement clinker, calcium sulfate (gypsum) and at least 7.5 per cent of GGBFS, fly ash and/or amorphous silica alone or in combination. The use of amorphous silica is limited to 10 per cent.

- **General purpose limestone cement (Type GL)**: with a limestone content up to 20 per cent. Further mineral additions are also allowed as part of the limestone content (up to 5 per cent).

Additional properties of those cement types can also be specified, which results in special purpose cements with properties such as high early strength (Type HE), low heat (Type LH), sulfate resistance (Type SR) or limited shrinkage (Type SL).

SCMs must comply with the same standards as concrete additions (AS 3582.1 for fly ash, AS 3582.2 for GGBFS, AS 3582.3 for amorphous silica). Limestone to be used as SCMs in cement is defined in the cement standard AS 3972.

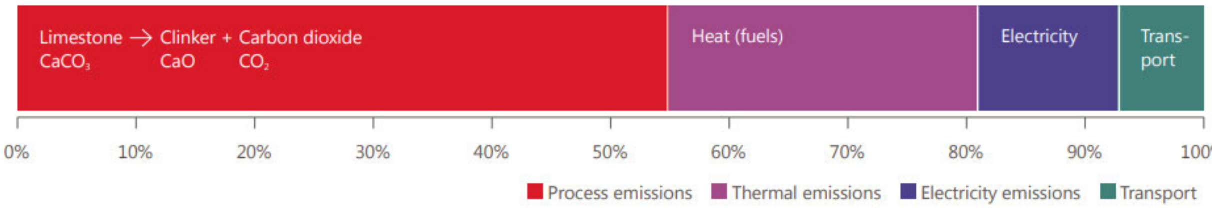
The most used cement type in Australia is General Purpose cement (Type GP), followed by General Blended (Type GB). General Limestone cement (Type GL) is not yet used at scale in Australia.

4. CEMENT AND CONCRETE EMISSIONS PROFILE

Process emissions resulting from the calcination of limestone to produce clinker, the main ingredient in Portland Cement, are unavoidable.

There are three main sources of carbon-dioxide emissions from the traditional cement manufacturing process - process emissions, direct thermal energy-related emissions and indirect electricity-related emissions (Figure 1).

Figure 1: Typical emissions profile of Australian cement and concrete production



Approximately 55 per cent of per cent of carbon dioxide emissions occur as unavoidable process emissions which result from the necessary conversion of calcium carbonate to calcium oxide. Calcium carbonate is present in the principal raw material used in cement manufacture, limestone.

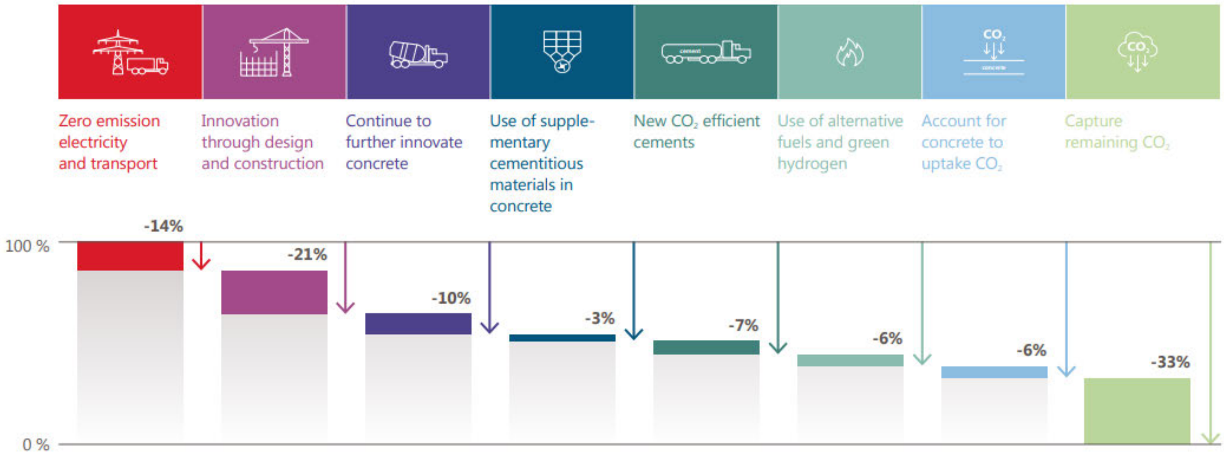
5. CEMENT AND CONCRETE DECARBONISATION PATHWAYS

VDZ, a world-renowned cement and concrete research centre, was commissioned to undertake a study to better understand the technologies and practices necessary to decarbonise Australian cement and concrete.

The report identified eight decarbonisation pathways and key research requirements for the Australian cement and concrete industry to meet its declared ambition to deliver net zero carbon cement & concrete by 2050 (Figure 2), namely:

- Zero emissions electricity and transport
- Innovation through design and construction
- Innovation in concrete
- Use of SCMs in concrete
- Clinker substitution (new CO_2 efficient cements)
- Alternative fuels and green hydrogen
- Recarbonation
- Carbon Capture, Use and Storage

Figure 2: Identified decarbonisation pathways for cement and concrete



Importantly, the VDZ report demonstrated that a decarbonised cement and concrete sector is possible through concerted action across the full cement and concrete value chain – including the design and use phase.

Clinker substitution and the development of new, lower carbon cements are examples of decarbonisation pathways available now, while other pathways such as zero emissions electricity/transport and CCUS will be available as technology and markets mature.

6. CLINKER SUBSTITUTION

Clinker substitution is a key decarbonisation pathway available now.

Clinker ground with 4 to 5 per cent gypsum develops the useful cementitious quality of reacting and hardening when mixed with water. There are other mineral compounds that also have these hydraulic properties when mixed and ground with clinker and gypsum. These mineral compounds can be used as clinker substitutes known as a supplementary cementitious materials (SCMs).

Due to the fact these compounds are pre-calcined by other industrial processes the avoided process emissions and combustion fuel used in the kiln make SCMs one of the most attractive greenhouse gas reduction options in cement manufacturing.

Materials which can substitute clinker in cement and concrete can be naturally occurring (limestone) or manufactured as a by-product or waste stream of other industries (fly ash, blast furnace slag).

SCMs have been used in cement and concrete manufacture for many years. They contribute to performance with the added benefit of offsetting emissions associated with clinker. However, several factors can limit the use of SCMs in cement production, including:

- Availability of SCMs
- National standards and building codes and
- Market acceptance

Notwithstanding cement standards, market acceptance can also be a limiting factor in the use of SCMs. Government agencies, responsible for large infrastructure projects, often require design specifications which hinder the optimal use of SCMs.

<u>SCM Availability</u>

SCMs in use today, both in cement and concrete, are primarily industrial by-products such as fly ash (from coal fired power generation) and ground granulated blast furnace slag (GGBFS). Limestone that has not been calcined (heated) can also be used.

As the Australian economy decarbonises out to 2050, it is possible that the by-products from steel and coal fired power generation will decline, therefore limiting access to key SCMs. While Australia has significant stockpiles of fly ash, it is not currently suitable for use as an SCM in cement and concrete production and will require significant investment in technology and processes to make it available at scale.

Limestone is abundantly available in Australia and will continue to be so for many years.

Future sources of SCMs, such as calcined clay and by-products from lithium production for example, are being actively investigated and will be critical as the demand for lower carbon cement and concrete increases into the future.

<u>National standards and building codes</u>

Standards, Codes and Specifications for cement, SCMs and concrete need to be reviewed and updated where necessary to fully realise the emissions reduction potential of clinker substitution.

This will require the modification of existing cement types (i.e., Type GP, Type GB and Type GL) as well as the introduction of new, low carbon cement types (i.e., to allow for new SCMS such as calcined clay, as well as higher limestone cements).

For example, a reduction in clinker content to produce a lower carbon Type GP cement can be obtained by increasing the maximum mineral addition (limestone content) from 7.5 per cent to 10 per cent. This is currently being considered as part of a review of the Australian cement standard - AS 3972 – and will require the support of all stakeholders.

Overall, the proposed changes to the cement standards will increase the potential for significant emissions reductions – conservatively estimated at between 5 and 10 per cent per annum.

Other Codes and Specifications, such as those used by infrastructure authorities as well as state and local governments, should also be reviewed and updated along the same lines.

<u>Market acceptance</u>

Simply producing clinker-efficient cement and concretes will not solve the problem if there is little demand for the products. There will need to be a transition from product push to market pull, which will require close cooperation and ongoing exchange of knowledge along the entire cement and concrete value chain.

Public procurement can play a key leadership role here given public investment provides a major part of infrastructure spending, and since state regulator´s standards will continue to determine how the majority of cement and concrete is specified.

There are already examples of strong action in this area, as evidenced by the Office of Projects Victoria Sustainable investment Guidelines, which provide guidance on how to embed sustainability into infrastructure projects across all stages of the investment lifecycle.

In general, stakeholders will be looking to governments and regulators taking leadership in procurement processes with a strong focus on embodied carbon and the production and supply of lower carbon cement and concrete.

7. RECARBONATION

Another important decarbonisation pathway identified by VDZ, and currently the focus of international research and action, is recarbonation.

It is well known that plants absorb carbon dioxide by photosynthesis and therefore forests act as a global sink for carbon dioxide. It is far less well known that cement (the key ingredient of concrete) in our built environment, in our cities and infrastructure, also absorbs carbon dioxide.

The International Panel on Climate Change's (IPCC) Sixth Assessment Report (2021) noted carbonation as a sink associated with cement and concrete production. The IPCC report also noted that the uptake of CO_2 in cement and concrete infrastructure (carbonation) offsets between 20-43 per cent of the carbonate emissions from current cement production (process emissions).

Further research has been commissioned to model the uptake of carbon dioxide in cement and concrete in Australia through a project being funded by the SmartCrete CRC. The project, along with similar research projects from a number of other countries, will feed into the IPCC process, as well as national inventories, through the relevant national and global associations.

Recarbonation occurs during the lifetime of concrete structures and continues into the end-of-life stage. As such, the emissions reductions associated with recarbonation in cement and concrete, once modelled, should be accounted for during any project sustainability assessment.

FURTHER COMMENTS

Thank you for the opportunity to provide the above comments. For further information relating to this submission please contact [redacted], using the details below.

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