CEMENT INDUSTRY FEDERATION

CIF Submission to the

Productivity Commission’s Inquiry into

Opportunities in the Circular Economy

ABN: 59 008 468 639

Australia's Cement Industry

INTRODUCTION

The Cement Industry Federation (CIF) appreciates the opportunity to provide comment on the Productivity Commission's call for submissions on Opportunities in the circular economy.

The CIF is the 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.

Together these companies account for 100 per cent of integrated clinker, cement and production in Australia.

Cement is the key ingredient in concrete, which is a critical input for Australia's residential and commercial construction industry, as well as for our major infrastructure projects.

This submission contains specific comments on issues relevant to the Australian integrated cement manufacturing industry and should be read in conjunction with the submission from Cement, Concrete and Aggregates Australia (CCAA), which discusses circularity issues in relation to the heavy construction materials industry.

ADBRI BORAL CEMENT AUSTRALIA

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CEMENT AND CIRCULARITY

Cement is a key ingredient in concrete, one of the most widely used building materials in the world, and it is a vital commodity essential to the success of the Australian economy. It is a critical input for Australia's residential and commercial construction industry, as well as for our major infrastructure projects.

Globally, the cement industry accounts for around 7 per cent of global carbon dioxide emissions. This is due to the unavoidable emission of carbon dioxide during the chemical process of converting limestone into lime ($CaCO_3$ + heat à CaO and CO_2), as well as the energy requirements of the process to achieve the required temperatures (1,450oC).

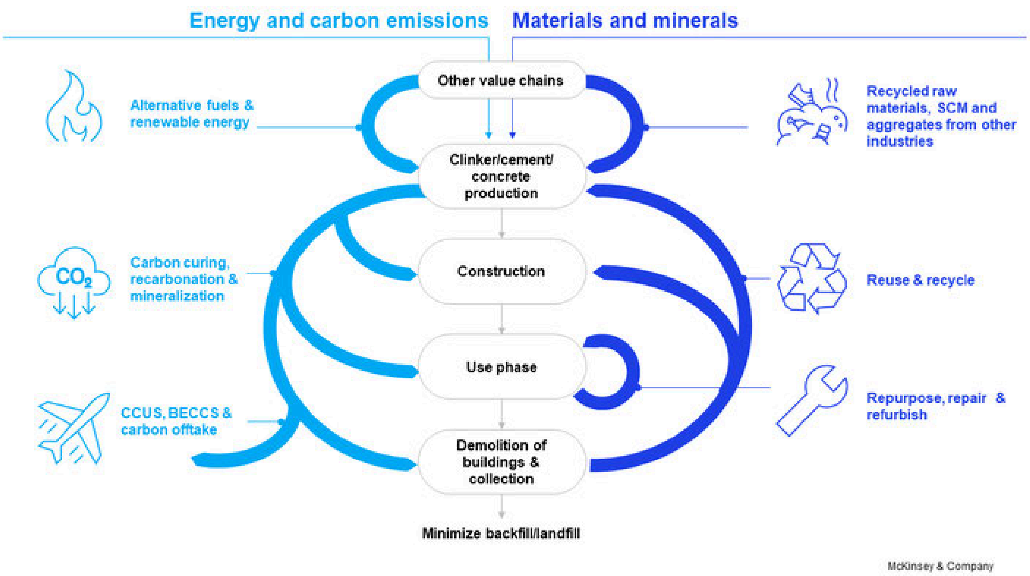
This is why cement manufacturing is recognised as a hard-to-abate sector.

Circularity is a key principle that has been the focus of Australian cement manufacturers for several decades through well-established industry practices such as the recirculation of materials or minerals from waste and the recirculation of energy using alternative fuels (often referred to as coprocessing) – see **Figure 1**.

While Australian cement manufacturers are actively working to increase the use of alternative fuels and raw materials, they are also investing into new areas of circularity including renewable energy as well as capturing and reusing emissions (for example through direct injection of carbon dioxide into concrete and mineralisation in aggregates further down the supply chain).

Industry performance and ambitions are in alignment with existing jurisdictional policies in this space. Governments and key departments can assist further by actively supporting industry circular economy initiatives, removing barriers and minimising red tape wherever possible.

Figure 1: Summary of circularity solutions in the built environment and infrastructure [1]



[1] Circularity: A key enabler to reach net-zero in cement and concrete, Nov 2024, World Economic Forum

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CEMENT MANUFACTURE

Cement manufacturing involves the calcination (heating) of limestone in a kiln to produce clinker, which is then ground and mixed with gypsum to produce what is known as Portland cement (cement). Raw materials required for the process include limestone, sand, iron ore, shales, and clays (Figure 2).

Clinker production is emissions intensive due to the calcination of limestone, which results in unavoidable process emissions. As such, clinker substitution with supplementary cementitious materials (such as fly ash and blast furnace slag) is a key decarbonisation pathway available now that also includes a circularity component (see Section 4).

Clinker production is also an energy intensive process that requires kiln temperatures of up to 1,450 degrees Celsius. The energy required by Australian manufacturers is predominantly derived from conventional sources such as coal and gas, as well as an increasing amount of alternative fuels and raw materials (AFRs).

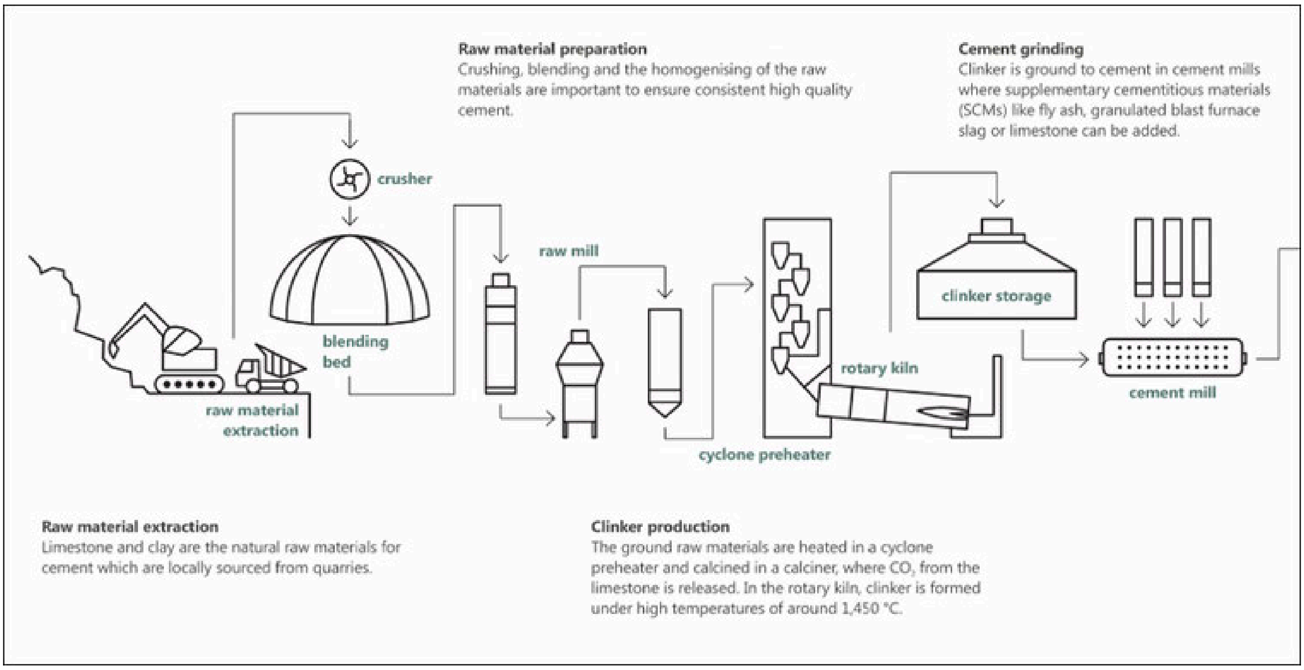
In 2022-23 Australian cement producers consumed around 21 PJ of thermal energy, of which approximately 55 per cent came from coal, 20 per cent from natural gas and 1 per cent from diesel oil and other fuels.

The remaining 24 per cent was derived from alternative fuels (such as demolition wood waste, solvents, used oil, spent pot liner and carbon powders).

Cement manufacture is becoming increasingly important in terms of resource recovery and reuse innovation. Manufacturers are looking to build on the well-established economic benefits of AFRs, towards the environmentally sound disposal of waste and the reduction of greenhouse gas emissions (see Section 5).

Carbon curing (concrete), mineralisation (aggregates) and recarbonation are all pathways for the reuse of carbon dioxide – either obtained through direct capture from industrial processes or naturally from the atmosphere (see Section 6).

Figure 2: Cement manufacturing process summary



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CLINKER SUBSTITUTION

Clinker, when 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 reduced raw material and natural resource consumptions, coupled with avoided process emissions and combustion fuels used in the kiln, make SCMs one of the most attractive greenhouse gas reduction options in cement manufacturing.

Materials which can substitute for clinker in cement and concrete can be naturally occurring (limestone) or manufactured as an industrial by-product 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.

Several factors can limit the use of SCMs in cement production, including:

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

SCM Availability

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.

National Standards and Building Codes

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 and, as a result, the increased use of SCMs.

This will require the modification of existing cement types (i.e., Type General Purpose, Type General Blend and Type General Limestone) 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.

Market Acceptance

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.

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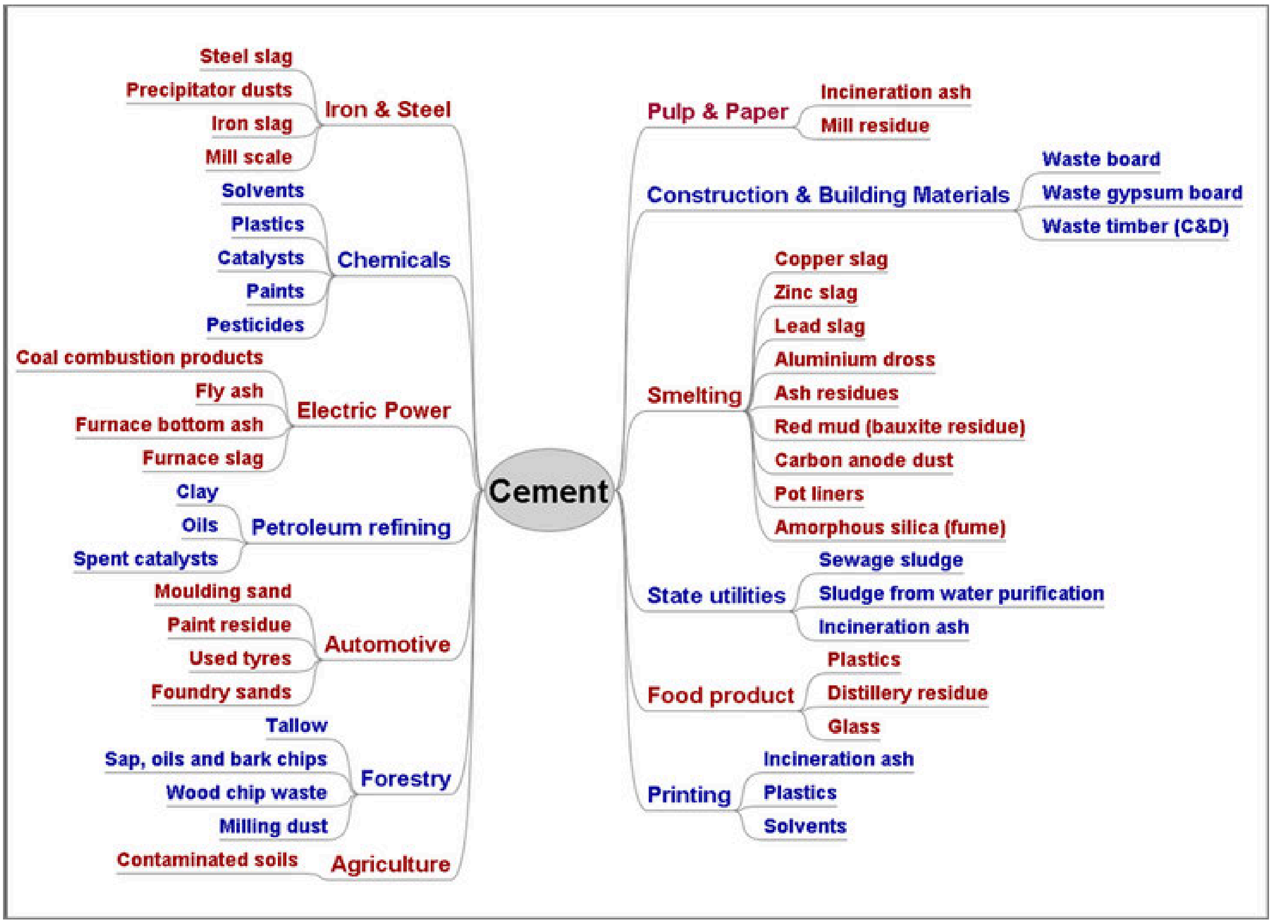
RESOURCE RECOVERY

The cement industry, both globally and in Australia, has been using secondary materials as a resource for well over 40 years through a process known as co-processing. Co-processing is the use of by-products as a raw material to replace natural mineral resources (material recycling), and/or as an energy source to replace fossil fuels such as coal or gas (energy recovery).

Cement kilns are ideally suited to the safe recovery of energy and co-processing of a range AFRs – including certain types of hazardous secondary materials that can have very limited disposal options. The high-temperature sintering process and alkaline conditions lead to the absorption of combustion products and heavy metals into the clinker.

The use of AFRs therefore can assist in diverting a range of secondary materials – including hazardous wastes – from landfill or incineration[2]. Examples of secondary material opportunities for the cement industry are shown in Figure 3.

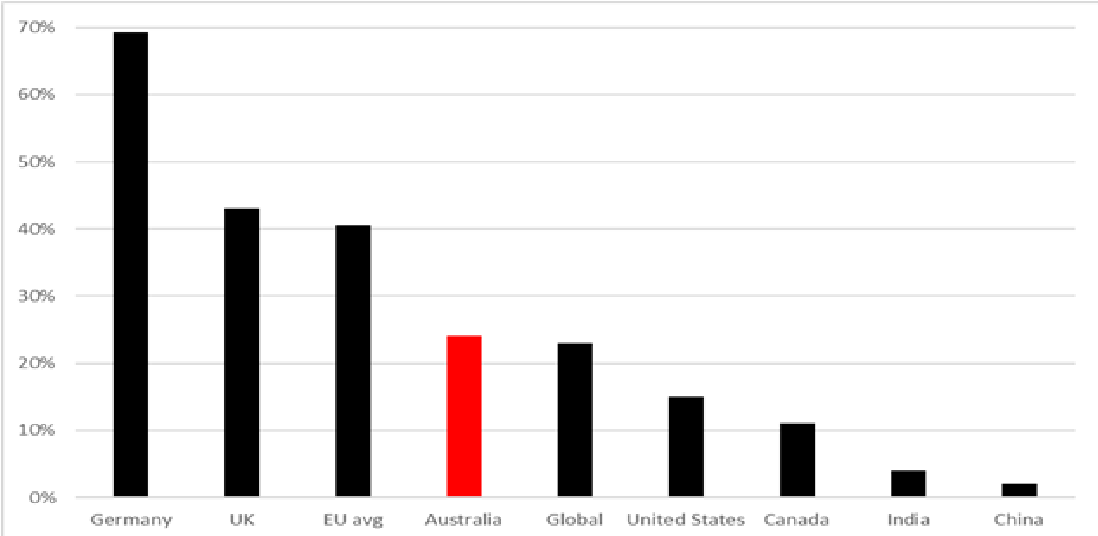
Figure 3: Secondary/By-Product Material Opportunities for the Cement Industry



[2] Cement kilns typically operate at temperatures over 1,450 degrees C (up to 2,000 degrees C at the flame). Other waste-to-energy options (i.e. municipal waste incinerators) generally operate at lower temperatures (~850-1,000oC).

While the Australian cement industry has made significant progress in the uptake of AFRs to-date (with around 24 per cent of alternative fuel usage reported in 2022-23 – Figure 4), there is considerable scope for further increased use of AFRs if certain barriers, regulatory or otherwise, can be identified and addressed.

Figure 4: Examples of AFR usage as a percentage of energy consumption



Increasing the safe use of AFRs in cement manufacturing is dependent on several factors including:

- waste definitions
- the waste hierarchy
- availability
- regulatory limitations
- community engagement and awareness
- investment requirements for on-site storage and handling systems
- transport.

Waste Definitions

When does a waste cease to be a waste? There are cases where a waste material, for example a recycled liquid fuel, is still considered to be a waste despite having gone through a refining process.

Consideration should be given to developing consistent regulatory approaches and definitions of 'end-of-waste', including guidelines (or standards) for materials that have been sufficiently processed to be considered a genuine alternative energy source or raw material, rather than a waste. Such an approach has the potential to significantly increase the uptake of such materials.

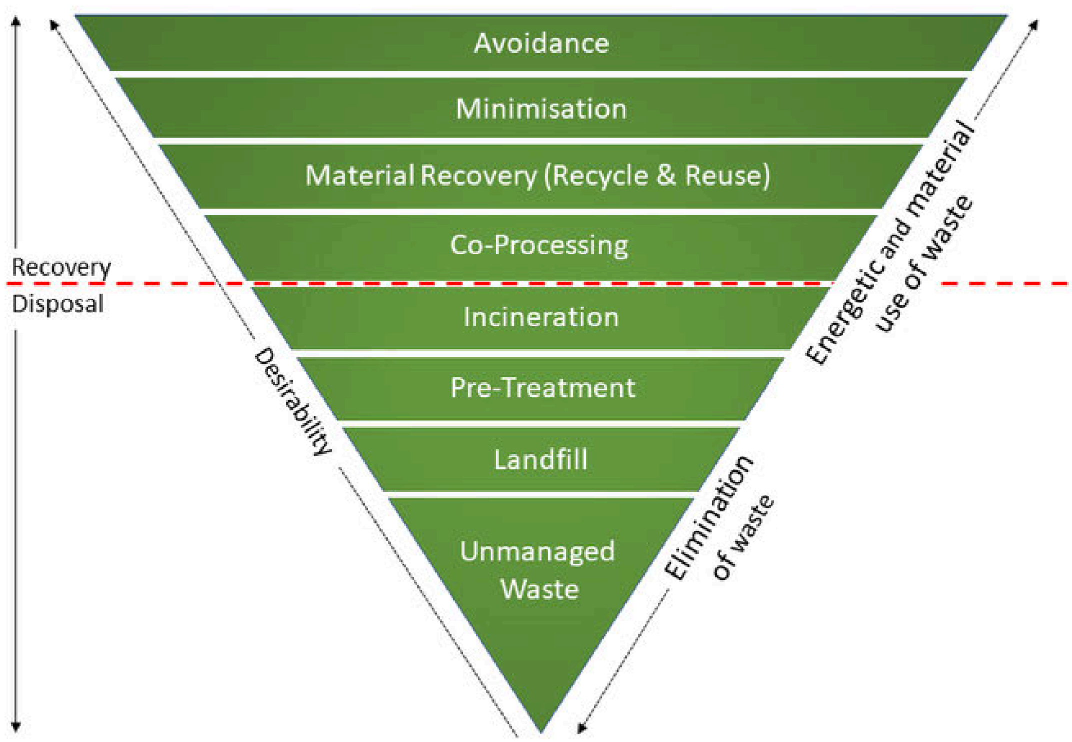
Where circular economy initiatives are supported in one jurisdiction there should be a simplified pathway to expand this across state and territory systems and waste versus product regulatory frameworks.

Waste Management Hierarchy

The coprocessing of alternative fuels and raw materials (AFRs) in cement manufacturing is a safe, proven method for the utilisation of secondary materials (not otherwise reusable or recyclable) that is ecologically sound and benefits both industry and society alike.

From a waste hierarchy perspective, coprocessing should be considered as the next best option after material recovery as AFRs in can provide both material and energy components (Figure 5).

Figure 5: Waste Management Hierarchy including co-processing



Availability

The availability of suitable secondary materials in sufficient quantity is one of many factors that need to be considered by cement manufacturers as they seek to reduce their reliance on naturally occurring primary materials and fossil fuels such as coal and gas.

In 2020-21, Australia generated an estimated 75.8 million tonnes of waste, of which 45.4 million tonnes (63.1%) was recovered[3]. While this is progress, there is still some way to go towards meeting Australia's target of 80 per cent average resource recovery rate by 2030.

Improving the recovery rate, coupled with improvements in waste collection and separation, has the potential to increase the amount and quality of secondary materials available to cement manufacturers as AFRs.

This could be achieved through government programs or increased expectations and standards, as well as supportive frameworks for cross industry materials reuse without excessive regulatory barriers to circularity where initiatives can demonstrate end of waste criteria.

In addition, programs and measures that impact on the availability of AFRs should be avoided. For example, Product Stewardship programs have the potential to be ineffective and costly if not designed correctly, mainly because they tend to lack flexibility. Such programs have the potential to impact the availability and affordability of waste materials.

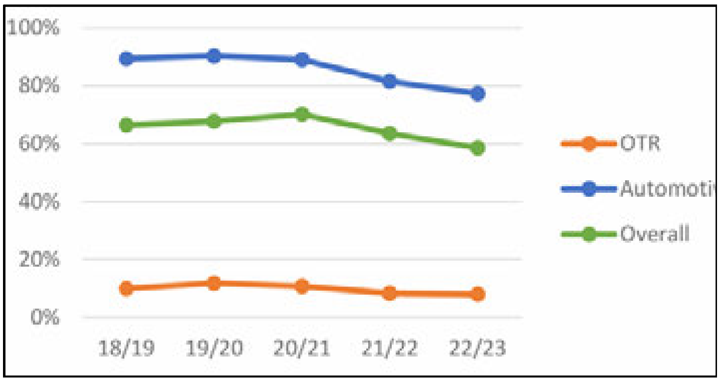
The National Tyre Product Stewardship Scheme (TSS) is a prime example of a program put in place to find alternative reuse options for waste tyres, but with limited success regarding the recovery, suitability and availability of waste material for reuse within Australia.

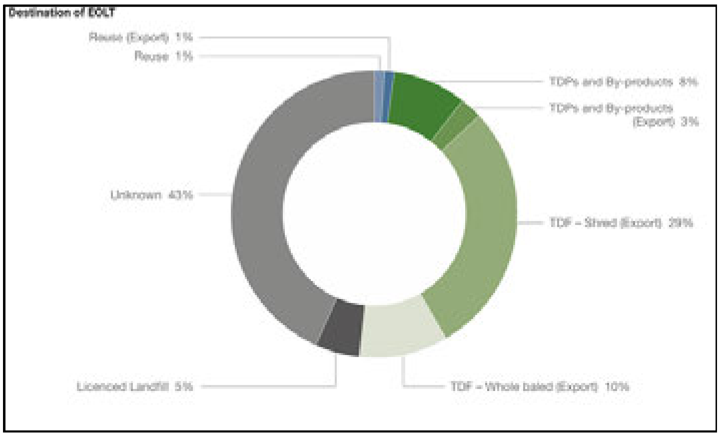
Of the estimated 545,000 tonnes of used tyres generated in Australia in 2022-23, only around 58 per cent were recovered for use in domestic and international markets. Around 225,000 tonnes of waste tyres were not recovered.[4]

In general, waste tyre recovery rates have been declining over recent years. Historically, it has been reported that almost 40 per cent of Australia's collected tyres ended up as tyre-derived fuel (TDF). However, in terms of known destinations none of this TDF was utilised in Australian manufacturing – it was all exported (Figure 6).

If the TSS is to be effective in reducing the environmental harm associated with the large number of landfilled and stockpiled tyres, significantly more focus needs to be applied to diverting this resource towards not only recycling, but also domestic material/energy recovery.

Figure 6: Waste Tyre Recovery Rates [4] & Destination of End-of-life Tyres [5]





[3] National Waste Policy Action Plan, Progress Summary Report 2023
[4] Australian Tyre Consumption and Recovery – 2022-23
[5] Tyre Stewardship Australia – Annual Report 2018-19

Regulatory Processes

Regulatory processes, both at federal and state level, can add to the complexity and timeliness of AFR projects. Reforms should focus on ensuring appropriate, more aligned and consistent environmental licensing for the industry without further regulatory burden.

This should recognise and not inhibit receiving and utilising suitable secondary materials as a product (not a waste) when used as a replacement or supplement in the manufacturing process.

A flexible, adaptive and fit-for-purpose regulatory framework with a focus on protecting human health and the environment is critical. Such an approach should also seek to streamline approval processes and minimise project approval times wherever possible.

Active steps should be taken to identify, remove and avoid regulatory duplication across federal, state, territory, and local governments - for example aiming for interjurisdictional cooperation and alignment such that multiple agencies are not regulating the same matter.

Community Awareness & Engagment

All Governments have a role in partnering with industry to communicate the benefits of diverting suitable wastes from landfill for the safe recovery of energy and materials – including for use as an AFR in cement manufacturing.

Also, in terms of resource recovery in general, for both recycling and reuse, there is a fundamental requirement for improvements in the quality of the recovered material – which is often reduced through contamination (e.g. glass).

A strong focus on education of the general community and improved training of those involved in resource recovery has the potential to significantly improve the quality of existing and future waste streams.

Capital Investment

The upfront capital investment required for facilities to receive, store and feed suitable AFR materials into the process can be significant. Addressing issues around resource availability, transport costs and regulatory burden would assist in improving the business case for AFR projects.

Innovative funding models could also assist in getting projects off the ground. Non-regulatory programs and measures could be considered by state and federal governments aimed at identifying and providing incentives to encourage investment in suitable, long-term material recycling and reuse projects.

These could include grant and funding support programs specifically aimed at incentivising major recycling and reuse projects that would increase the capacity of Australia’s domestic waste processing industry – including for energy recovery.

Such an approach would complement existing and proposed actions to increase the domestic handling of waste in Australia.

Transport

Low value industrial by-products are rarely generated close to an integrated cement manufacturing facility and therefore must be transported long distances.

As such, Transport costs can therefore be a deciding factor when considering an AFR for use in a cement kiln that could be addressed through improved transport infrastructure and access to freight network links.

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CAPTURING AND STORING CARBON

Carbon Curing

Curing is an important process in concrete manufacture that controls moisture loss. It not only increases the strength of the concrete, it also makes it more durable, less permeable to water, and more resistant to cracking, freezing, and thawing.

The curing of concrete elements by diffusing carbon dioxide into it under controlled pressure and temperature is becoming one of the popular methods of accelerated curing. The process allows the carbon dioxide to diffuse into the concrete and undergo carbonation. The carbonation results in thermodynamically stable calcium carbonate products.

Mineralisation

Mineralisation (sometimes referred to as enhanced mineral carbonation) is the process of accelerating the natural process of mineral carbonation. This process replicates a range of natural geochemical processes, such as weathering and hydrothermal processes to reduce carbon dioxide in the atmosphere.[6]

This process can also be used to increase the recycling of concrete waste in added-value products and applied to the development of aggregates for use in concrete.[7]

Recarbonation

Another important decarbonisation pathway 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 CO2 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 method development process, as well as national carbon accounting frameworks, through the relevant national and global associations.

[6] https://www.csiro.au/en/news/All/Articles/2024/February/mineral-carbonation
[7] Carbonation of Recycled Concrete Aggregates for New Concrete and Concrete Fines to Make Cement-Free Hollow Blocks

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CIRCULAR ECONOMY SUCCESS STORIES

Australian integrated cement manufacturers are committed to reducing waste within their processes and supply chains as part of a circular economy approach. They are also actively seeking to increase the use of AFRs within their operations – both for their material as well as energy content.

This is a win for the environment: the safe use of AFRs reduces the reliance on traditional fossil fuels and associated greenhouse gas emissions. Certain AFRs have also been shown to reduce raw material and natural resource consumption as well as combustion-related emissions (such as airborne nitrous oxide).

It's a win for the community: the unique process environment allows for the utilisation of a wide variety of wastes and industrial by-products – reducing the amount of waste deposited in landfills and contributing to the circular economy in general.

It's a win for industry: the ability to operate with a mix of fossil fuels (coal or gas), waste materials and industrial by-products reduces environmental emissions, improves resource efficiency and provides security of supply.

As stated above, CIF members have been actively engaged in using AFRs for several decades. Some examples of recent CIF member activity in this area include:

- Adbri has introduced efficiencies into their processes to reduce production-related environmental impacts, with a 32 per cent reduction in process waste to landfill (over 2019 baseline) reported in 2023. Process waste includes cement kiln dust, lime kiln dust and off-specification kiln materials, produced at their major lime and clinker production sites[8].

- Using circular economy principles, Boral currently processes more than 2m tonnes of construction and demolition waste material annually, otherwise destined for landfill, back into the construction process as new material[9].

[8] Adbri 2023 Sustainability Report
[9] 2023 Boral Annual Report

- In 2023 Geocycle, a wholly owned subsidiary of the Cement Australia Group, used around 25,036kL of industrial waste (otherwise destined for landfill) to produce approximately 39,399kL of alternative fuel replacement. This subsequently displaced at least 39,419 tonnes of coal and saved around 21,627 tonnes of carbon dioxide from going into the atmosphere[10].
- Adbri's Birkenhead cement facility has embraced alternative fuels and reducing the impact on the environment. Since 2003 over 1,000,000 tonnes of Refuse Derived Fuel (RDF) has been used in the kilns from waste processed from construction, commercial and industrial activities. This has reduced the facility's natural gas usage by over 35 per cent and diverts over 200,000 tonnes of waste from landfill each year[11].
- In 2023, Boral utilised around 155,000 tonnes of alternative raw materials to reduce cement manufacturing process emissions.

SUMMARY AND FURTHER CONTACT

For further information relating to this submission please contact Ms Margie Thomson, Chief Executive Officer, using the details below.

Margie Thomson
Chief Executive Officer,
Cement Industry Federation

[10] Sometimes the best thing we can leave behind for the future generation is .....Nothing | Cement Australia
[11] Environment - Adbri