Concrete New Zealand Incorporated

*Submission to*

# NZ Infrastructure Commission
# *Te Waihanga*

*on*

## Testing our thinking - Developing an enduring National Infrastructure Plan

10 December 2024

10 December 2024

New Zealand Infrastructure Commission
Level 7, The Todd Building
95 Customhouse Quay
WELLINGTON 6011

Dear Sir/Madam

**SUBMISSION TO TESTING OUR THINKING - DEVELOPING AN ENDURING NATIONAL INFRASTRUCTURE PLAN**

The concrete industry welcomes the opportunity to contribute to the discussion about the **National Infrastructure Plan** (the Plan) and supports its objectives of addressing long-term infrastructure challenges, enhancing resilience, and achieving sustainability goals. Concrete plays a vital role in New Zealand's infrastructure, offering resilience, efficiency, and alignment with environmental and economic imperatives. With the right settings in place, that role could increase in support of a growing economy.

## INTRODUCTION

**Concrete NZ** is the voice of the cement and concrete industry, representing more than 500 corporates and individuals, including more than 200 concrete producers. The industry spans cement manufacture, ready-mixed concrete, masonry, precast components including pipes and culverts, and experts in structural design and construction with concrete. More than 11,000 people are employed by the industry, which contributes more than $1.25 bn to GDP (March 2023, in March 2023 prices).

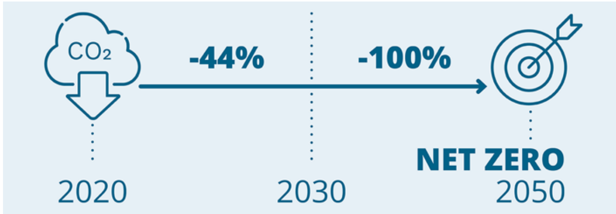
This document constitutes Concrete NZ’s submission on the consultation relating to “Testing our thinking - Developing an enduring National Infrastructure Plan”.

## PART A:  CEMENT AND CONCRETE INDUSTRY CONTEXT

As a critical construction material, concrete delivers resilient buildings and infrastructure, including bridges, tunnels, clean water, clean and renewable energy, and resilience to natural hazards, including mitigating the effects of climate change.

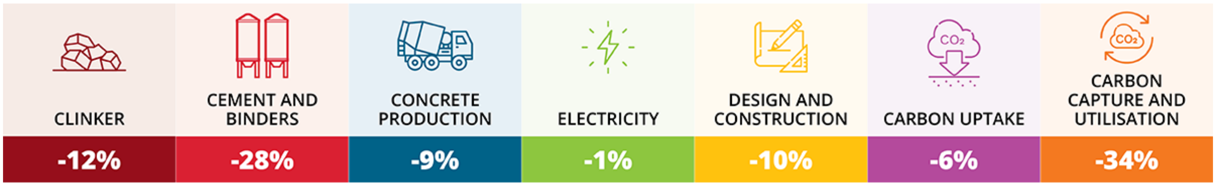
Concrete is strong, durable and versatile – it can be formed into almost any shape. Compared with other building materials, concrete offers better fire safety, flood resilience, greater noise reduction, and more efficient heating and cooling. It can be reused, repurposed and recycled at the end of life of a building or other structure. For many applications there is no alternative to concrete.

The New Zealand cement and concrete industry has committed itself to a decarbonisation Roadmap, containing two main emissions reduction milestones as per the graphic to the right.




The industry's 2030 goal will contribute more than 400,000 tons of $CO_2$ emissions reductions annually to the government's overall goal.

Implementation of the Roadmap is already underway. Concrete NZ reports on progress via its sustainability reporting as well as regular stocktakes for the industry. The Roadmap lists seven key "levers" for cement and concrete industry decarbonisation (percentages refer to net emissions reductions by 2050 relative to a 2020 baseline):




In August 2024—based on the findings of the Roadmap project—a research project funded by BRANZ (through the Building Research Levy), MBIE's Building Innovation Partnership and Concrete NZ has started work with stakeholders to maintain the positive momentum and enable the transformation of the cement and concrete industry towards Net Zero Carbon by 2050.

Concrete already appears in resilient and affordable infrastructure throughout New Zealand, delivering long-term societal and environmental benefits to communities. With recent investments in low-carbon concrete supply chains, the material can be delivered with reduced embodied emissions today.

Roads are an area in which concrete can add significant value. Infometric's November 2024 report "The Case for Concrete Roads", highlights the benefits of concrete roads, including cost-efficiency, de-risking oil price volatility, and lower whole-of-life embodied emissions versus asphalt.



https://cdn.ymaws.com/concretenz.org.nz/resource/resmgr/docs/cnz/c_roadmap_concrete.pdf

https://static.infometrics.co.nz/Content/Consulting/c_concrete_road_2024_full.pdf

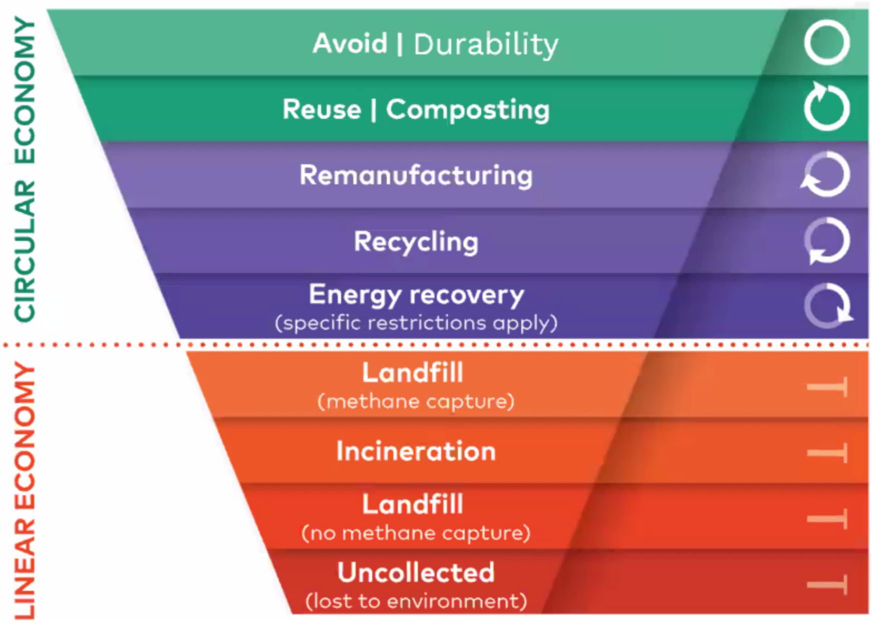
**PART B: GENERAL COMMENTS**

- Concrete NZ supports the "*need to build low-emission infrastructure more quickly than we do now*" (page 61). Mandating the performance-based specification of low-carbon concrete in any future projects would achieve emissions-reductions without adding unnecessary cost[1], while incentivising the concrete industry to seek out more efficient ways to compete on the grounds of embodied carbon as well as traditional concrete performance metrics.

- Regarding the following paragraph (page 61):

  *"We also need to reduce the emissions we generate when we build and maintain infrastructure. This is challenging as infrastructure construction materials,* ***like concrete and steel, are often carbon intensive*** *and there aren't many alternatives. Our best chance for reducing the emissions created during the life of our infrastructure is often to get more use out of the infrastructure we've already got so we don't need to build more."*

  Given that infrastructure is always a long-term investment, providing services to communities for decades to come, Concrete NZ stresses the importance of operationalising the Circular Economy hierarchy—and especially its ultimate target of durability—to prioritise action. Concrete NZ supports the general sentiment of extending the life of existing infrastructure and highlights the excellent repairability and multi-generational resilience of concrete structures.[2]



*(source: thinkstep-anz webinar on Circular Economy principles)*

---

[1] As of 2024, most low carbon concrete mixes incur no or very limited additional cost. Earliest consultation with potential suppliers is advised.

[2] https://www.concreteconstruction.net/how-to/repair/the-repairability-of-concrete_o

However, on the topic of being 'carbon intensive', Concrete NZ would like to emphasise that concrete is not a carbon intensive material over whole-of-life. On the contrary, its upfront embodied fossil emissions may rival biogenic alternatives, due to the extremely low embodied energy per cubic metre of concrete.[3] This is especially relevant to long-lived infrastructure investments.

In addition, the cement and concrete industry is following through with our Net Zero Carbon Concrete Industry by 2050 roadmap, implementing measures to achieving the referenced targets for 2030 and 2050, providing an even more carbon-efficient material for a sustainable built environment. Even today, low-carbon mix options are available in Aotearoa New Zealand.

Lastly, going beyond carbon, the UN as well as prominent leaders in the IPCC, United Nations Environment Programme (UNEP), and climate science[4,5,6] highlight the importance of not considering climate in isolation of other environmental metrics like biodiversity and freshwater use. Concrete excels on most other life-cycle environmental impact indicators compared to other major building materials used for structural purposes.[7] In addition, it is naturally rot, pest and fire resistant without chemical treatment.

---

[3] Substantiated by various publicly available EPDs; not linking to specific ones for neutrality of sources.
[4] United Nations on Biodiversity
[5] Sir Robert Watson on Biodiversity and Climate
[6] Planetary Boundaries Model
[7] Study comparing various materials on their environmental impacts on structural parameters

## PART C: DETAILED SUBMISSIONS

Concrete NZ focuses its submission on the following key topics. More comprehensive explanations and references to most topics are provided within the subsequent text.

### 1. Addressing Infrastructure Challenges

*[Reference to Section 1, Question 1]*

New Zealand faces critical challenges in ensuring its infrastructure meets the demands of a changing climate, population shifts, and the need for decarbonisation. Concrete's durability and resilience make it a cornerstone for addressing these challenges. Its minimal lifecycle maintenance costs and ability to withstand climate stressors ensure long-term value for infrastructure investments. The Plan's focus on sustainability, resilience, and efficiency is well-founded, but greater emphasis on materials with proven performance, like concrete, will enhance these outcomes.

### 2. Te ao Māori perspectives and principles

*[Reference to Section 1, Question 2]*

Concrete NZ supports the statement that te ao Māori principles, such as kaitiakitanga (guardianship) and manaakitanga (care and respect), strengthen the Plan by promoting sustainable and intergenerational infrastructure planning. Concrete aligns with these principles through its durability, efficient use of resources—requiring minimal energy, freshwater, and land per unit—and its potential for recycling and reuse, supporting a circular economy. Additionally, the concrete industry is a significant employer of Māori, with 25.6% of its workforce identifying as Māori, reinforcing its role in advancing community and economic wellbeing.

### 3. Managing Uncertainty in Planning

*[Reference to Section 2, Question 3]*

Infrastructure planning must contend with uncertainties such as climate change, population dynamics, and economic shifts. Concrete addresses these uncertainties through its resilient supply chain, which is less vulnerable to disruptions, and its durability, ensuring long-lasting structures that can adapt to changing demands. The Plan should incorporate flexible policies and robust scenario modelling to support materials and designs that endure diverse future scenarios.

## 4. Are we focusing on the right problems?

*[Reference to Section 4, Question 5]*

The National Infrastructure Plan rightly focuses on critical issues such as climate resilience, efficient resource use, and long-term infrastructure sustainability. However, from a concrete industry perspective, some additional considerations could strengthen the Plan's outcomes. The following section C4 dedicates a short paragraph to each of those items.

## 5. Recognition of Carbonation in Cement as a Valid Carbon Removal Method

*[General remark on the recognition of material characteristics]*

The natural process of carbonation in hardened concrete, which sequesters $CO_2$, should be recognised as a legitimate and permanent form of carbon removal in infrastructure LCAs. This process is recognised by the United Nation's IPCC and aligns with international carbon accounting standards and contributes to non-forestry carbon removals.

## C1. Addressing Infrastructure Challenges

The most critical infrastructure challenges for New Zealand over the next 30 years align with the National Infrastructure Plan and the concrete industry's goals of net zero carbon concrete by 2050 and a 44% emission reduction by 2030.

a) Decarbonisation materials

As the concrete industry is committed to significantly reducing emissions, the infrastructure plan must support the adoption of low-carbon materials and technologies. This includes:

- Adopting performance-based specifications for low-carbon concrete procurement across all infrastructure projects.
- Promoting the use of reduced embodied carbon cement, supplementary cementitious materials (SCMs) and alternative binders.
- Increasing knowledge about the characteristics of low carbon concrete and how it can be efficiently implemented into all infrastructure projects, highlighting advantages in durability, resilience, and low embodied whole-of-life emissions.
- Note that low carbon concrete will tend to lead to enhanced durability owing to their more refined hydration species.

b) Climate resilience and adaptation

New Zealand's exposure to natural hazards and climate change impacts requires infrastructure that is resilient to sea-level rise, increased flooding, and extreme weather events. Infrastructure built with durable, low-carbon concrete can offer long-term benefits in minimising maintenance costs and reducing lifecycle emissions.

At the same time, the concrete material supply chain features reduced vulnerability to natural hazards like wildfires, minimising supply risks and supply chain environmental impacts.

c) Lifecycle management and asset renewal

A significant portion of New Zealand's infrastructure is aging. Improved asset management strategies are necessary to maintain and upgrade existing infrastructure, reducing waste and embodied carbon through optimized material reuse and refurbishment.

To improve asset quality and minimise maintenance expenses in the future, adopting concrete roads—especially in heavy-duty areas—should be promoted. A recent [Infometrics report](https://www.infometrics.co.nz/article/2024-11-media-release-concrete-roads-more-sustainable) highlighted the whole-of-life benefits of concrete roads versus asphalt roads. In short, they are 17% cheaper over their lifetime and reduce the cost and frequency of road maintenance.

d) Efficient use of resources and circular economy principles

The construction industry must transition to a circular economy, minimising waste and maximising the reuse of materials.

The highest principle of a circular economy is durability. Concrete—including and particularly low carbon concrete—should therefore be specified and employed in infrastructure projects throughout Aotearoa New Zealand.

Manufacturing low-carbon cement in New Zealand highlights another two important features of a circular economy: energy recovery and mineral recycling. In Portland, Whangarei, the use of waste tyres and waste timber for "co-processing" delivers tangible emissions reductions consistent with these two principles.

Policies should promote the use of recycled crushed concrete as aggregate in new concrete mixes when and where applicable. Regional availability of crushing facilities as well as transport distances play an integral role in the potential positive contribution of this activity.

Lastly, policies should recognise concrete's unique ability to absorb atmospheric carbon dioxide as part of the natural (re)carbonation process of hydrated cement, even if it is buried underground and used as filler material in large-scale infrastructure projects.



https://www.infometrics.co.nz/article/2024-11-media-release-concrete-roads-more-sustainable

e) Alignment of Investment and Capability Development

Addressing these challenges requires sustained investment in infrastructure that aligns with national decarbonisation goals. In addition, building a skilled workforce with expertise in sustainable construction and asset management is essential to execute projects effectively and deliver on climate goals.

The National Infrastructure Plan provides an opportunity to embed these priorities into New Zealand's infrastructure strategy, ensuring the nation meets both its decarbonisation targets and its resilience needs while delivering economic and social benefits. Collaboration with sectors like the concrete industry, which plays a foundational role in infrastructure, will be critical to achieving these objectives.

## C3. Managing Uncertainty in Planning

The main sources of uncertainty in infrastructure planning include climate change impacts, population shifts, technological advancements, and economic fluctuations. These uncertainties challenge long-term planning and capital investment prioritisation.

Concrete addresses these uncertainties through its resilient supply chain, which requires minimal land, water, and energy, ensuring stable production even under environmental and economic stress. Its durability enables the construction of strong, long-lasting structures that can adapt to climate challenges. Incorporating concrete into infrastructure planning, alongside flexible policies and robust scenario modelling, can mitigate uncertainties and ensure investments remain relevant and effective over time. The industry's roadmap to deliver Net Zero Carbon Concrete underlines its ability to deliver positive outcomes while staying in line with long-term greenhouse gas emission targets.

## C4. Are we focusing on the right problems?

The National Infrastructure Plan rightly focuses on critical issues such as climate resilience, efficient resource use, and long-term infrastructure sustainability. However, from a concrete industry perspective, some additional considerations could strengthen the Plan's outcomes.

a) Material durability and lifecycle benefits

While durability is highlighted, the unique advantages of concrete, such as its minimal lifecycle maintenance and inherent resilience to climate stressors, warrant greater emphasis. This ensures infrastructure investments are cost-effective and sustainable over decades.

b) Potential of materials to decarbonise

The Plan references present-day material perceptions with regards to embodied emissions. However, major industries—including cement and concrete—have committed and are implementing solutions to decarbonise their value chains. These plans as well as current investments in asset decarbonisation have to be considered by a long-term forward looking strategy like the Plan.

c) Localised supply chains and resource efficiency

Concrete's efficient use of land, water, and energy should be a central consideration, especially given New Zealand's vulnerability to global supply chain disruptions. Supporting local production reduces environmental impact and enhances project delivery reliability.

d) Planetary boundaries

While climate change is undoubtedly a major challenge, other environmental impact indicators are closely linked to climate performance as well as ecosystem stability while not being measured in "radiative forcing". We strongly suggest to consider a broader range of environmental impact metrics like biodiversity loss, freshwater withdrawals and land use when choosing materials.

e) Carbon reduction and circular economy

The Plan could expand its focus on materials that contribute directly to decarbonisation goals. Concrete, through its ability to sequester $CO_2$ via natural recarbonation, offers untapped potential in achieving emissions targets while aligning with circular economy principles. This last point will be elaborated on in section C5 of this document.

By addressing these areas, the Plan can better support resilient, sustainable infrastructure aligned with New Zealand's environmental and economic objectives.

## C5. Carbonation of Hydrated Cement—A Source of Permanent Carbon Removal

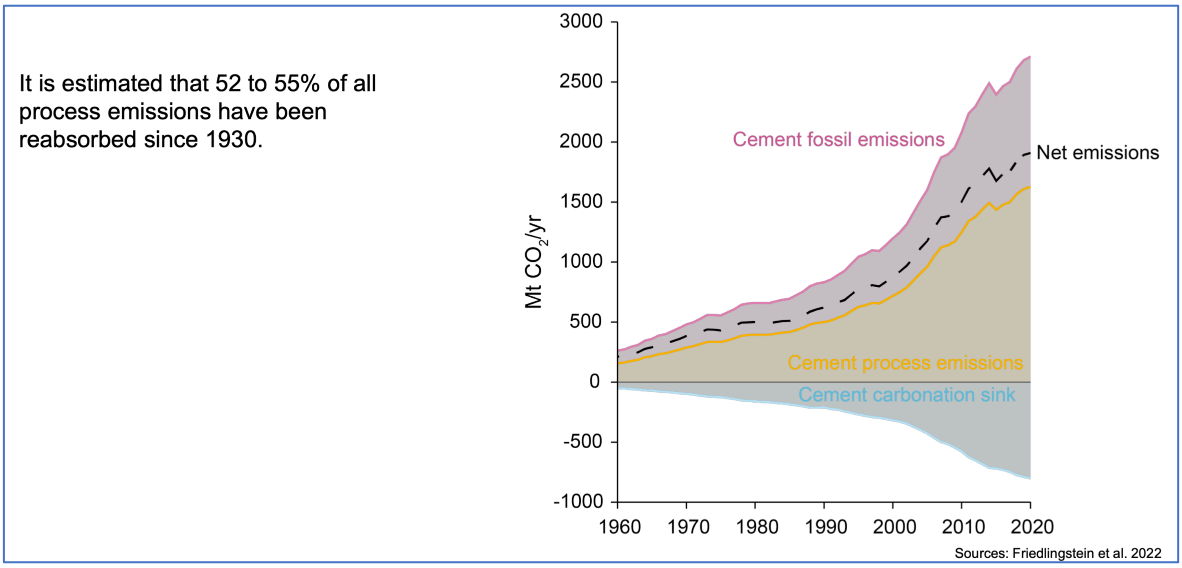



***Figure 1:*** Cement carbonation on a global scale by [Cyril Brunner, ETH Zurich]

Exposed surfaces of hardened concrete absorb atmospheric $CO_2$ in a natural process that the IPCC recognised in its 6th Assessment Report (AR6), published in sections in 2021 and 2022.[8] This report states that carbon uptake or "recarbonation" is significant and includes it as a removal in the overall emission balance.[9]

The difference between biogenic sequestration in timber and carbonation in concrete is well-explained in this presentation to the 80th LCA Forum held by Dr Cyril Brunner: video & presentation.

Furthermore, the Lifecycle Product Category Rules for cement and building lime as per EN 16908:2017+A1:2022 recognise carbonation: "Carbonation contributes to a reduced GWP impact of cement products over their whole life."[10] ISO 21930:2017, the international standard about sustainability in buildings and civil engineering works reads: "Environmental impacts considered during the production, use and end-of-life stages shall include carbonation."[11]

A paper titled "Carbonation as a method to improve climate performance for cement based material" discusses various aspects of carbonation, including a potential integration into the EU ETS through the EU Effort Sharing Regulation (ESR), which also accepts forestry offsets (as of 2019, this was not implemented).[12]

---

https://video.ethz.ch/events/lca/2022/spring/80th/9b530597-8f79-4140-8aba-3cb4a2981e00.html

[8] IPCC 6th Assessment Report

[9] Full IPCC AR6 WGI Report page 688: "The uptake of $CO_2$ in cement infrastructure (carbonation) offsets about one half of the carbonate emissions from current cement production (*Friedlingstein et al., 2020*)."

[10] EN 16908:2017+A1:2022

[11] ISO 21930:2017

[12] Carbonation as a method to improve climate performance for cement based material

Lastly, a 2023 report conducted by the Joint Research Centre, the European Commission's science and knowledge service, has extensive coverage of carbonation as an example of 'CCU':[13]

> *Recarbonation is a naturally occurring process in which cement in concrete re-absorbs $CO_2$. Since carbonation reverses the calcium carbonate's calcination, which is necessary in the current Portland clinker production process, one may consider that the $CO_2$ captured by carbonation was actually released during clinker production, even though the $CO_2$ molecules captured may have different origins. In theory, all $CO_2$ emissions from calcination can be offset by carbonation, however the two processes take place at different time: Calcination takes place in the production phase of clinker; carbonation takes place over the lifetime of the concrete and its cement. Research indicates that 23% to 30% of annual process emissions by the cement industry are captured annually by the carbonation of the cement stock in-use [IVL, 2018; Cao et al., 2020]. This process can be stimulated by increasing the surface area (thus by separating and grinding cement paste from concrete) and by increasing the $CO_2$ content and temperature of contact gases. Doing so increases $CO_2$ capture to half of $CO_2$ process emissions from limestone calcination. Furthermore, the carbonated material can be used as a clinker replacement in cement or as an additive in concrete [Cembureau, 2020c].*
>
> *This process has only recently been referred to carbon accounting as a carbon mitigation measure [IPCC, 2021]. Assuming a conservative capture rate of 20% of emissions annually and assuming a decrease of clinker-to-cement ratio in the coming decades, global recarbonation is forecasted to lay at 242 MtCO2 in 2050 [GCCA, 2021]. This process is however already accounted for by the industry in its quest to net-zero cement [Heidelberg Cement, 2020; Holcim, 2021].*

Carbonation is scientifically robust, additional, and permanent. Concrete NZ suggests recognising and quantifying this additional source of carbon removal in infrastructure LCAs by accounting for its sequestration effect during the use phase (B) and the end-of-life phase (C) of concrete structures.

**PART D: CLOSING REMARKS**

Concrete NZ thanks the New Zealand Infrastructure Commission for the opportunity to provide feedback. After all, while the cement and concrete industry is responsible for less than two percent of New Zealand's gross greenhouse gas emissions, it plays a significant part to deliver resilient infrastructure for a changing climate, and in the construction of renewable electricity generation. The industry has demonstrated its commitment towards becoming net zero by investing in technologies and low-carbon supplementary material supply chains. Now, the Roadmap and follow-up research project are aimed to lay the foundation for further emissions reductions. Despite the

[13] JRC Technical Report – Decarbonisation Options for the Cement Industry; page 59

concrete industry's modest contribution to New Zealand's overall emissions, every step helps and should be explicitly recognised in the National Infrastructure Plan.

Yours faithfully

[redacted]

[redacted]
CHIEF EXECUTIVE