Department of Climate Change, Energy, the Environment and Water

Introduction to Low Carbon Concrete

Low Carbon Concrete Accelerator (LOCCA) Program

18/08/2026 and 27/08/2026

NSW GOVERNMENT



The Department of Climate Change, Energy, the Environment and Water acknowledges that it stands on Aboriginal land.

We acknowledge the Traditional Custodians of the land and water, and we show our respect for Elders past and present.

We do this through thoughtful and collaborative approaches to our work, seeking to demonstrate our ongoing commitment to providing places in which Aboriginal people are included socially, culturally and economically.

Artist and designer Nikita Ridgeway from Aboriginal design agency – Boss Lady Creative Designs, created the People and Community symbol.

Housekeeping

Polls:
- Poll questions that will appear on your screen during the session.
- Select your answer and close the pop-up when you're finished.

Questions:
- Feel free to post questions in the chat at any time. We'll aim to answer them at the end of the session.
- If we don't get to them, we'll follow up afterwards.

Engage with us:
- Your participation and feedback help us improve the program.
- Let us know what's working well, what could be better, and if we're putting you to sleep!

This session is being recorded 

Overview of session

Learning outcomes

- What low carbon concrete (LCC) is and why it is important
- The environmental impact of concrete and the role of LCC in reducing embodied carbon
- How do suppliers reduce the impact of their concrete
- Common applications of LCC and key considerations for its use
- The benefits, limitations, and fundamental principles of LCC
- An overview of the resources, tools, and guidance available to support implementation through the LOCCA Program

Session content

- Overview of the LOCCA Program
  - Purpose of the program and how councils are supported
  - Resources, tools and workstreams developed for councils
- Reducing upfront carbon: embodied carbon, policy and avoid, switch, improve
- Introduction to LCC: concrete, its impact and how to reduce it
- Where LCC can be used, and its benefits and limitations
- Myth busting: durability, appearance, cost, constructability, specifications
- Supplier capability, EPDs, and what councils can do next

Audience

- Council staff involved in planning, design, procurement, project delivery, sustainability, asset management and maintenance

LOCCA for councils in the Hunter region

The Low Carbon Concrete Accelerator (LOCCA) is a capability building program to support councils and their value chains to report on, pilot and implement LCC in projects, policies and strategies.



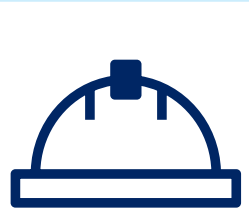
Leadership



Procurement



Sustainable Design



Implementation (Construction)



Planning Approvals

Recap



27 July – 11 Aug

Your council has confirmed partipation in the program.

Kick off session were held to introduce the program and gain an understanding of your council's current position

Your council is currently responding to an RFI so we can target our support

18 Aug - TODAY

Session that forms the basis for the program



Poll Question #1

How familiar are you with Low Carbon Concrete (LCC)?

(Single choice)

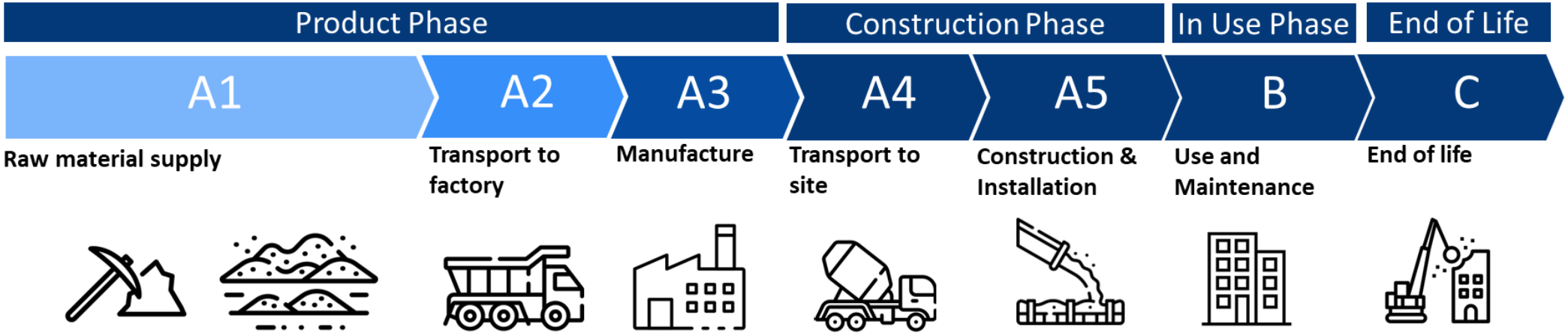
- Never heard of it
- Heard of it but know very little
- Some understanding
- Comfortable explaining it to others
- Have specified or used it on projects

Reducing Upfront Carbon in Infrastructure

1


A New York City every 35 days
Buildings and infrastructure are directly responsible for one third of Australia’s total carbon emissions
© Dan Freeman

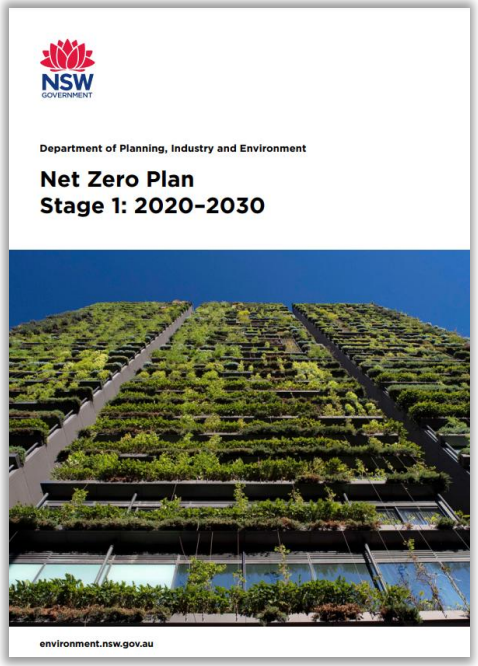
What is embodied carbon?

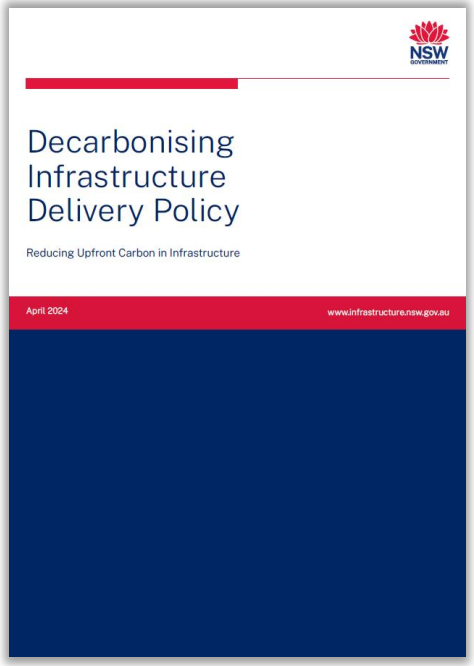


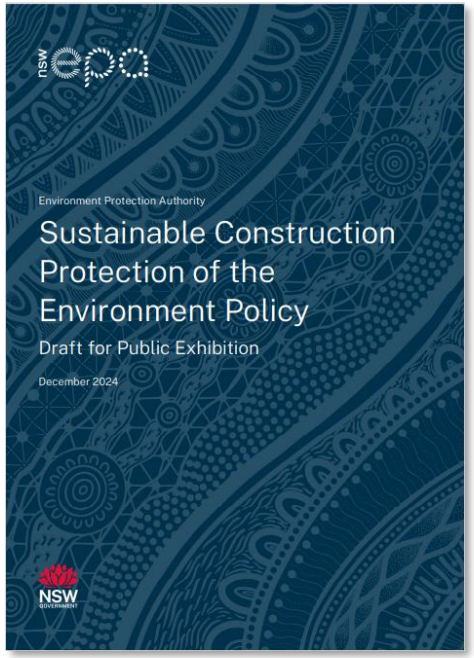
Source: Arup

Decarbonising Infrastructure Delivery Policy

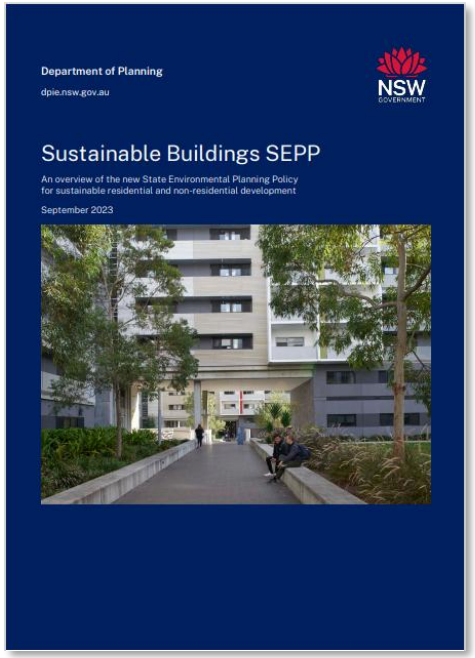
New South Wales State Government Policy











What are Opportunities for Councils?

Policy Momentum
Developers/ LGAs/ councils are expected to act

- Net Zero strategies are rapidly expanding to include Scope 3 emissions (this is where a councils concrete use is)
- Private sector is increasingly expected to measure, manage, and reduce emissions
- Councils play a critical role in driving and enforcing the use of LCC to support developers and LGAs

Strategic & Legislative Foundations
Already exist



Local Government Act

- Requires councils to maintain a long-term Resourcing Strategy to deliver community priorities
- Provides a pathway to embed low carbon materials into asset planning, funding, and delivery



Environmental Planning & Assessment Act 1979

- Enables councils to consider environmental impacts and emissions reduction in decision-making
- Allows councils to apply conditions of consent to reduce carbon impacts

The opportunity now is to build capability and confidently act!

How to reduce carbon on your project?

INSW Decarbonising Infrastructure Delivery Policy - *INSW Fact Sheets and Info Packs*

Avoid

Avoid building a new asset. Test whether the work is needed at all.

- Is there genuine demand for the service?
- Could digital or policy options meet the same need?
- Can existing assets be reused or extended?

Switch

Switch from business as usual. Rethink scope, design and materials.

- Can the need be met by re-using what already exists?
- If a new build is required, can low-carbon materials be used?

Improve

Improve delivery. Use techniques that cut resource use and emissions.

- Which methods improve efficiency in manufacture, transport and design?
- How can low-carbon delivery be built into the contract?

Hierarchy of decision making

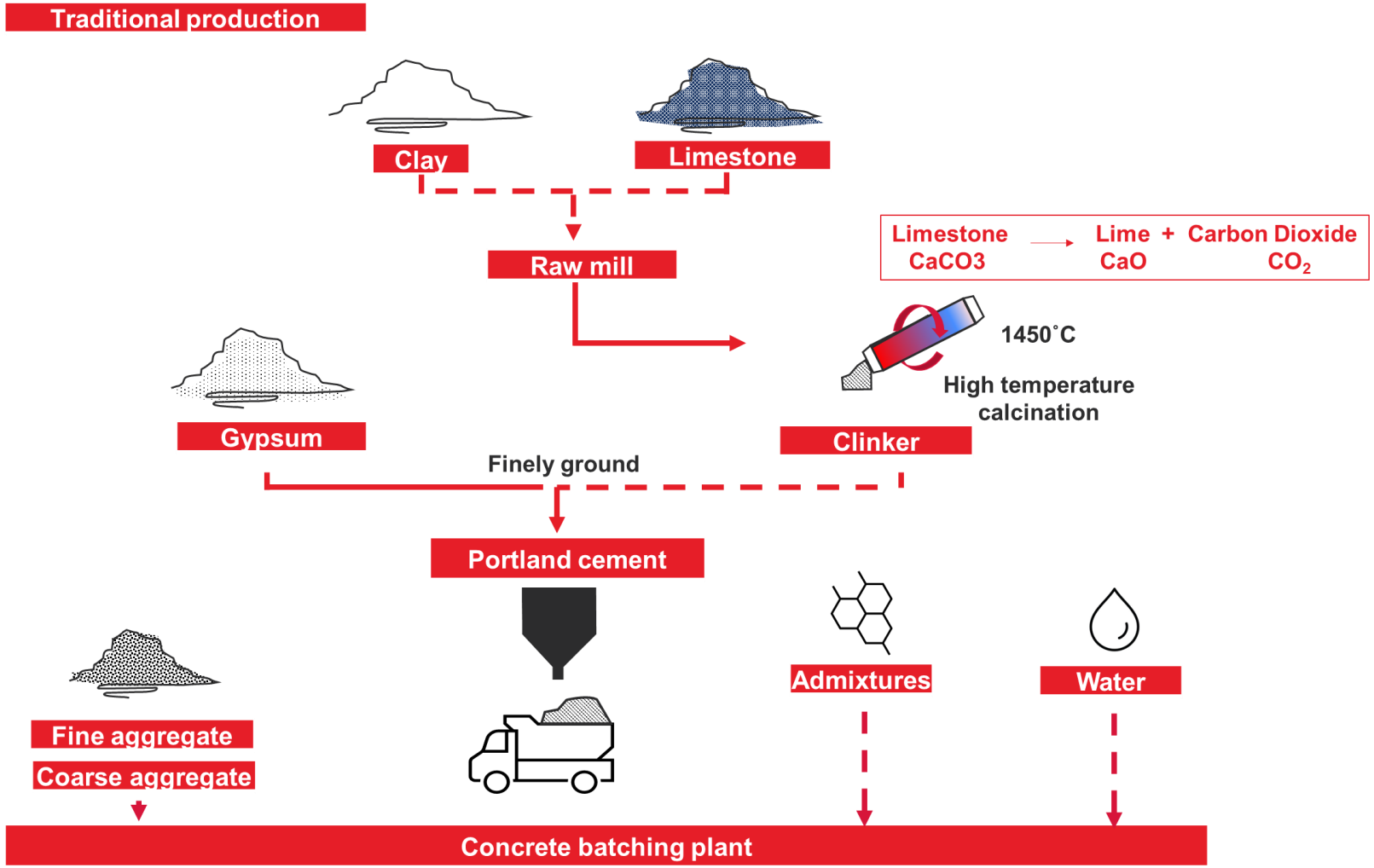
Decreasing ability to reduce upfront carbon in infrastructure projects

Low-carbon concrete is one of these opportunities within Switch. Important to recognise it sits within a broader approach to reducing emissions.

Introduction to Low Carbon Concrete (LCC)

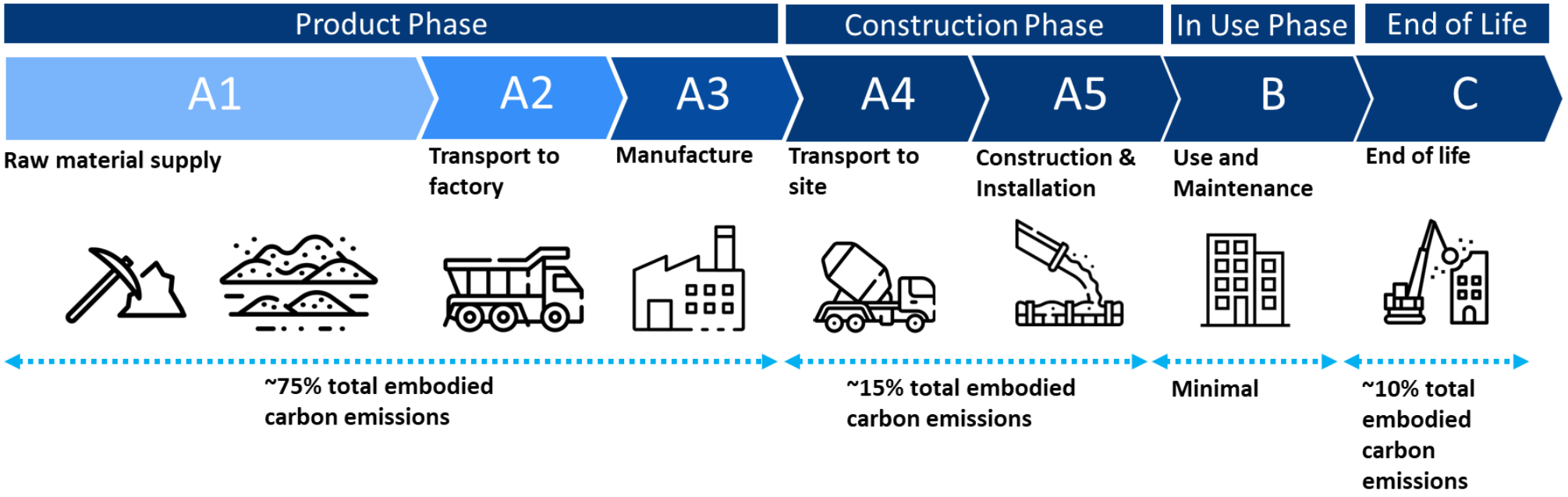
2

What is concrete?



Source: Arup

What is the impact of concrete?



Source: Arup



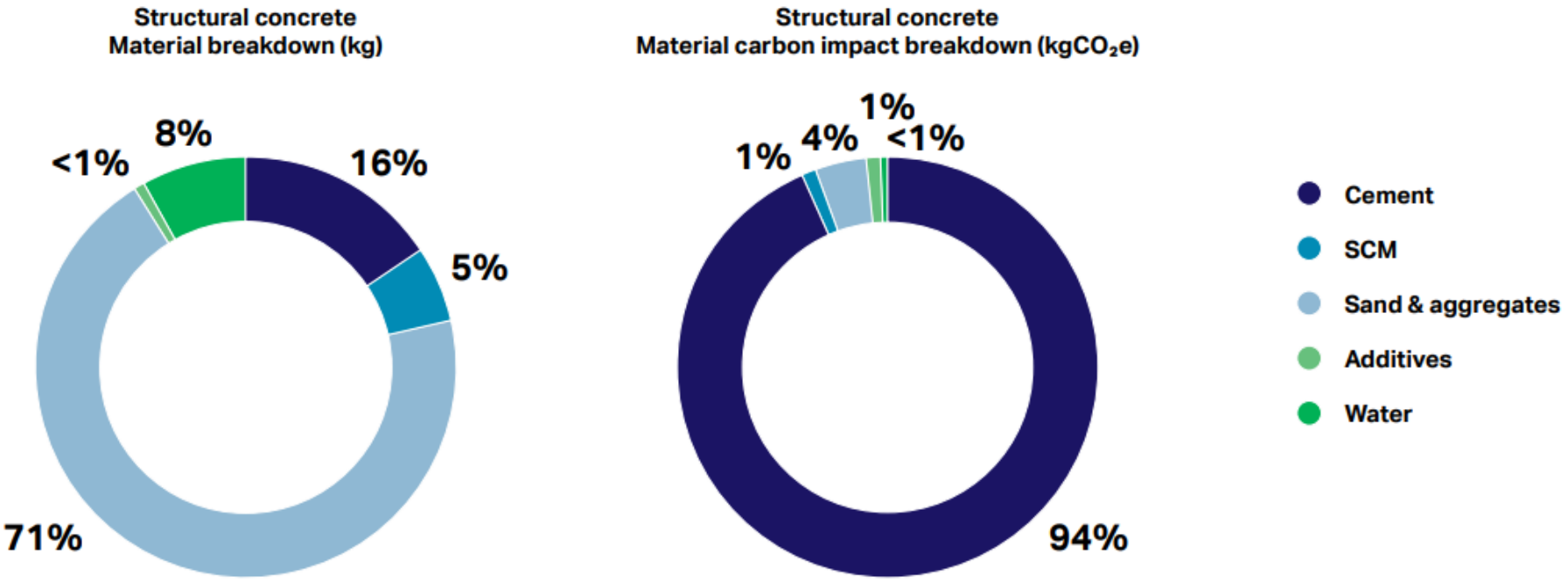
Poll Question #2

Which constituent material contributes the most embodied carbon for a typical concrete mix?

(Single choice)

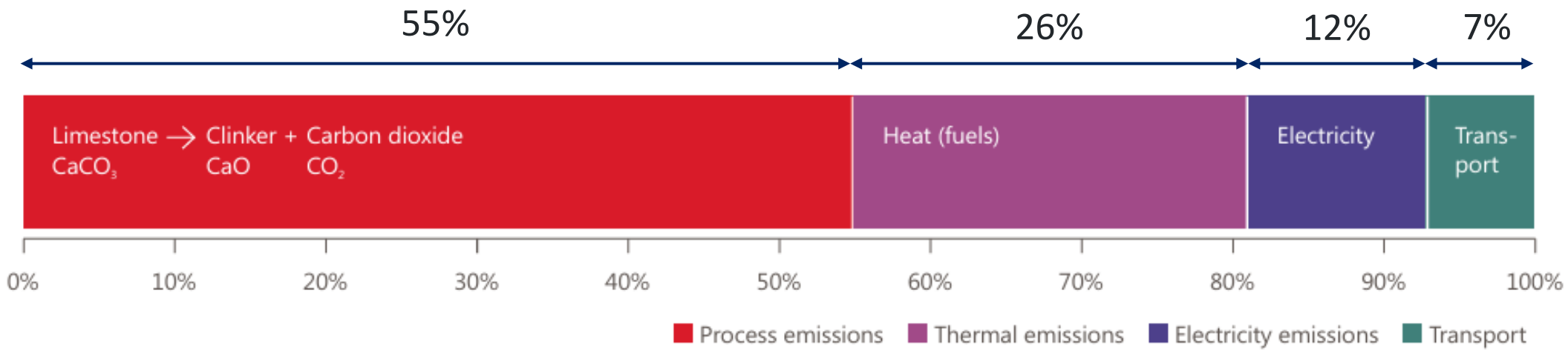
- Admixtures
- Cement
- Coarse Aggregate - Gravel
- Fine Aggregate - Sand
- Water

What is the impact of concrete?



Source: WBCSD Net-zero buildings - Halving construction emissions today

What is the impact of cement production?



Source: Full_Report_Decarbonisation_Pathways_web_single_page.pdf

What is low carbon concrete?

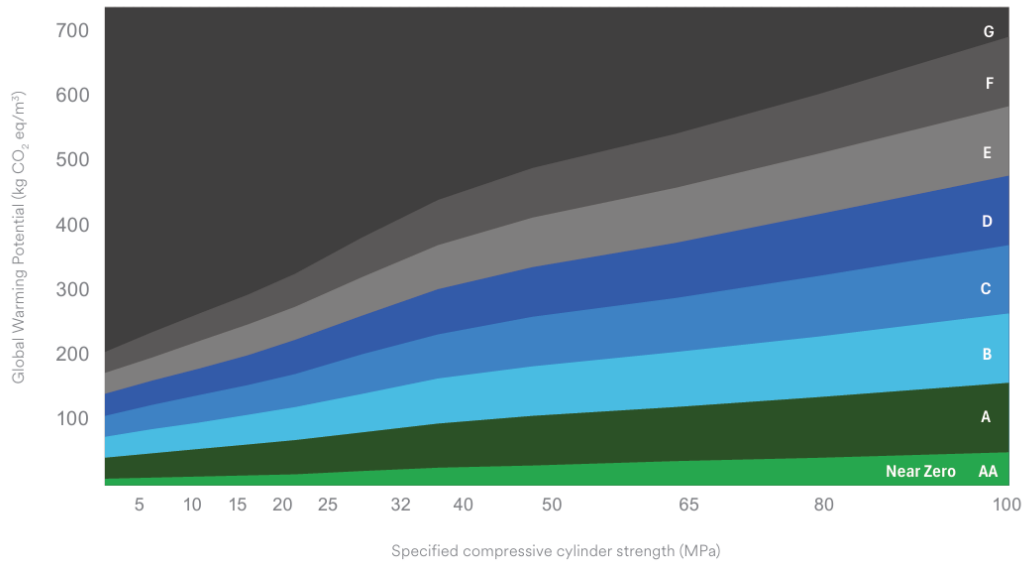
A low carbon product is a product with a lower carbon footprint relative to their equivalents in the market.

Low carbon concrete is designed to reduce its carbon footprint and environmental impact compared to traditional concrete.

Low carbon concrete should have the lowest embodied carbon available for the application while still meeting all specified technical and performance requirements. This includes AS 1379 to ensure compliance with the design of concrete structures regarding service life, as outlined in AS 3600, AS 5100.5, and any government standards used for concrete structures.

MECLA's guide to low-carbon concrete - Version 2.0

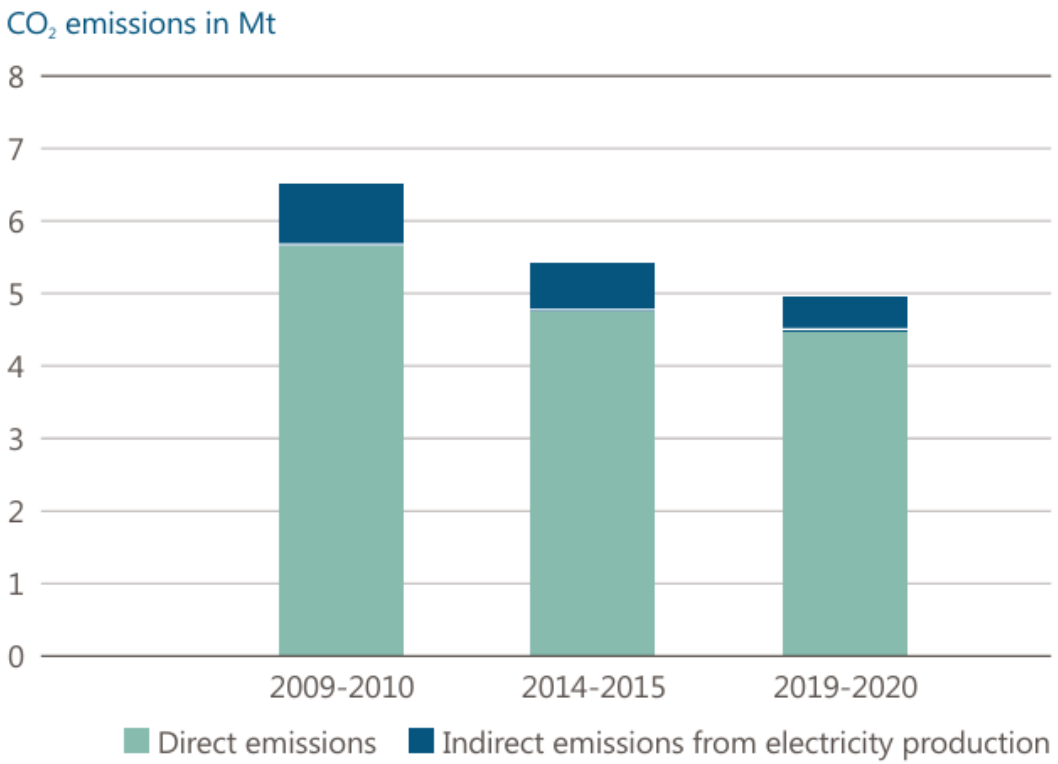
Figure 2 – Australian Adoption of Global Ratings for Low Carbon and Near Zero Emissions Concrete©



	Specified Concrete Cylinder Strength (MPa)										
	5	10	15	20	25	32	40	50	65	80	100
Top of band F	213	243	272	302	335	390	450	500	552	615	703
Top of band E	180	205	230	255	283	330	380	422	468	521	596
Top of band D	147	167	188	208	231	269	310	345	383	426	488
Top of band C	114	130	146	161	179	209	241	268	298	332	380
Top of band B	81	92	103	115	127	148	171	190	212	237	272
Top of band A	48	55	61	68	75	87	101	113	127	143	164
Top of band AA	15	17	19	21	23	27	32	36	42	48	56

CCAA_Australian Adoption of GCCA Global Ratings for Concrete

Have emissions reduced for the Australian cement industry?



25% lower

CO_2 emissions from the Australian cement industry than 20 years ago

Internal factors

- Modernised production and kilns; less efficient wet-kiln processes closed
- Almost 20% less energy per tonne of cement since 1999-2000
- 18% alternative fuel usage
- Around 40% biomass in alternative fuels
- Reduced electrical energy consumption

External factors

- Imports supplementing domestic clinker production
- Growing share of renewable energy in the power grids

Source: Full_Report_Decarbonisation_Pathways_web_single_page.pdf



Poll Question #3

Which of the following can help reduce the carbon footprint of a concrete mix?

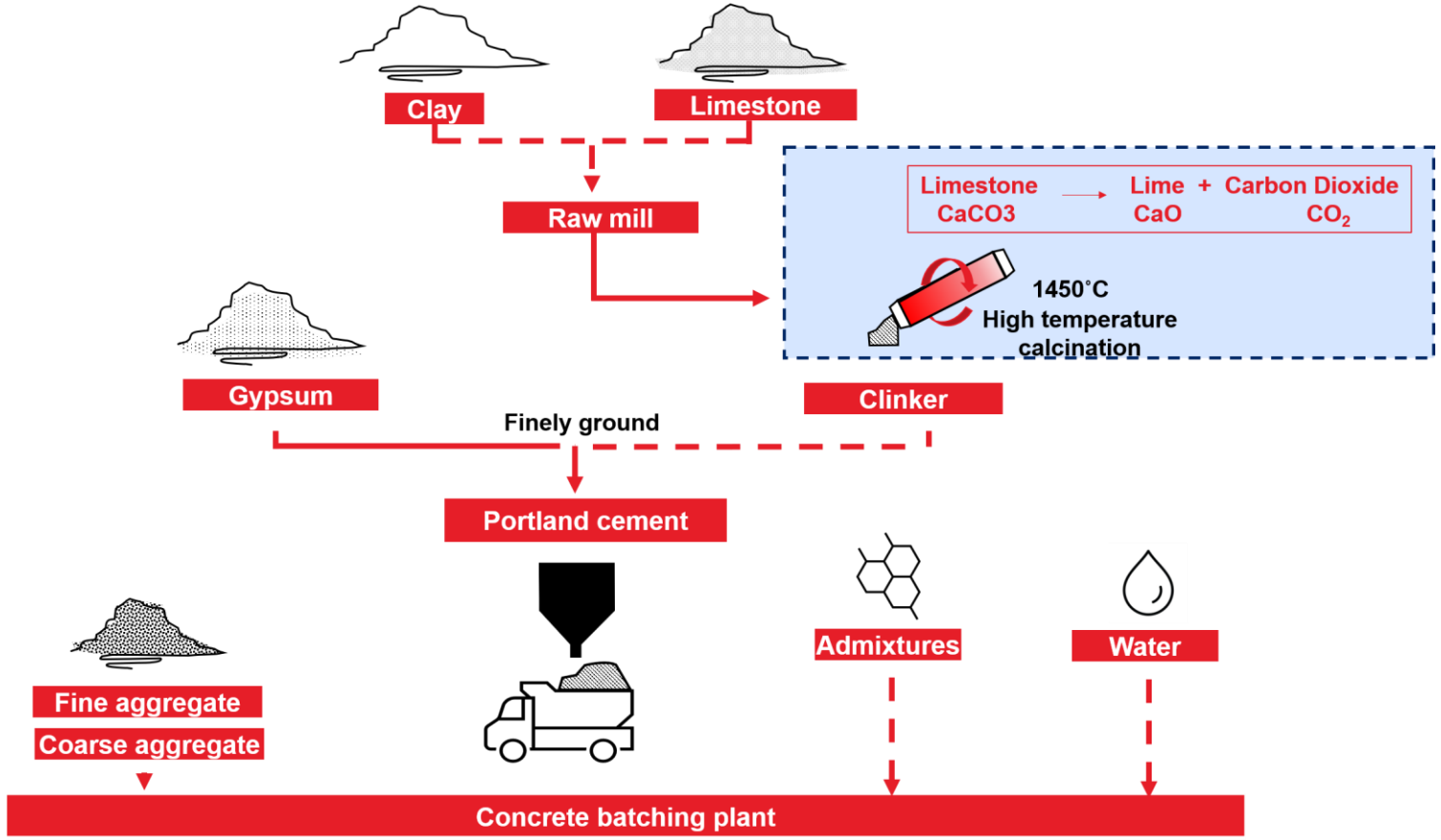
(Multiple choice – select all that apply)

- Supplementary cementitious materials (SCMs) such as fly ash or slag
- Alternative cement types
- Alternative fuels in cement manufacturing
- Increased use of recycled materials
- Optimised mix designs
- Carbon capture and storage

How can we reduce the impact of concrete?

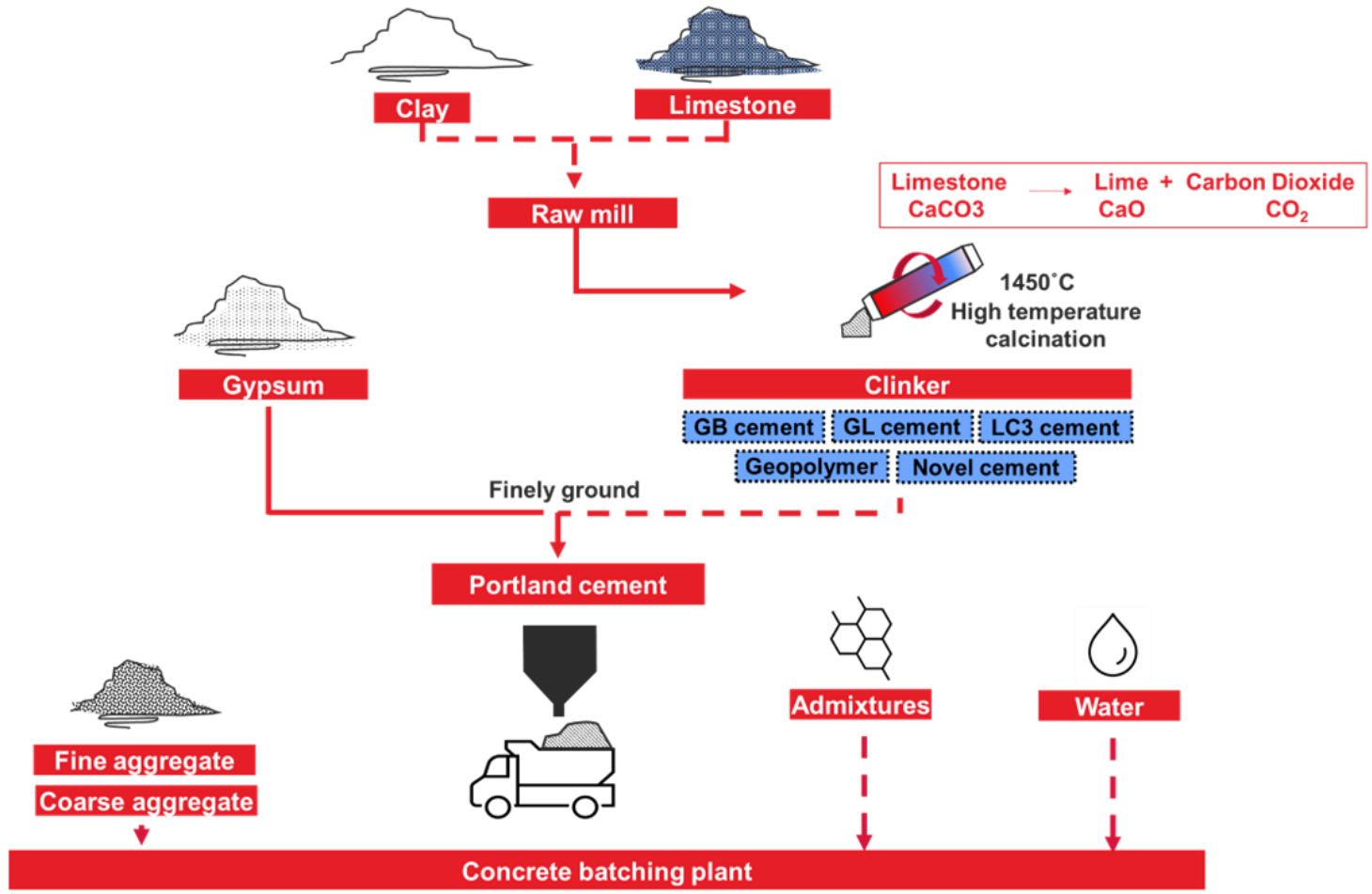
Reduce CO_2 from clinker production/ Use of alternative fuel

- Renewable energy integration
- Alternative fuels in cement kilns
- Electrification of cement kilns
- Green hydrogen
- Carbon capture, utilisation and storage



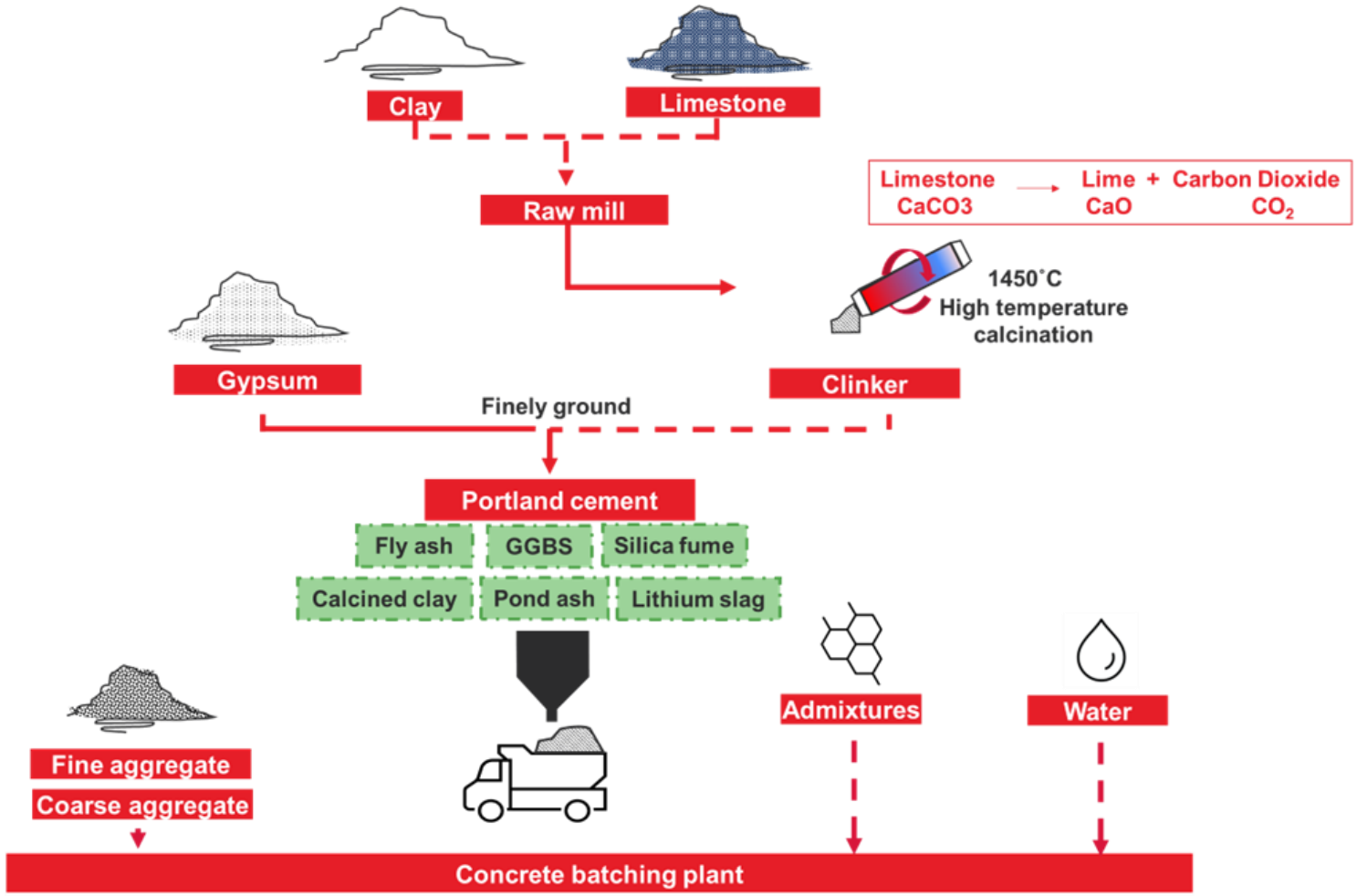
How can we reduce the impact of concrete?

Reduce clinker in cement



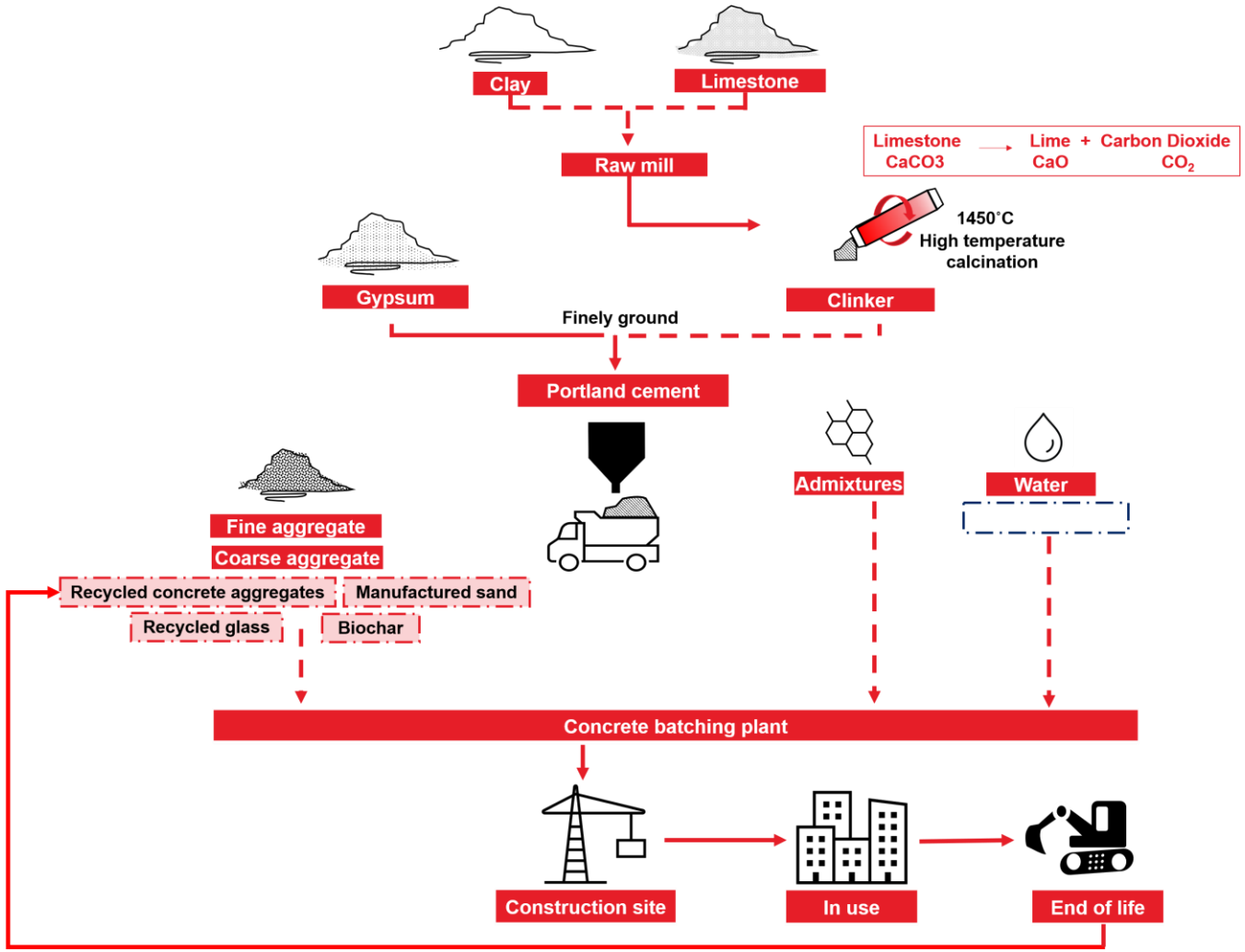
How can we reduce the impact of concrete?

Reduce or substitute cement in concrete



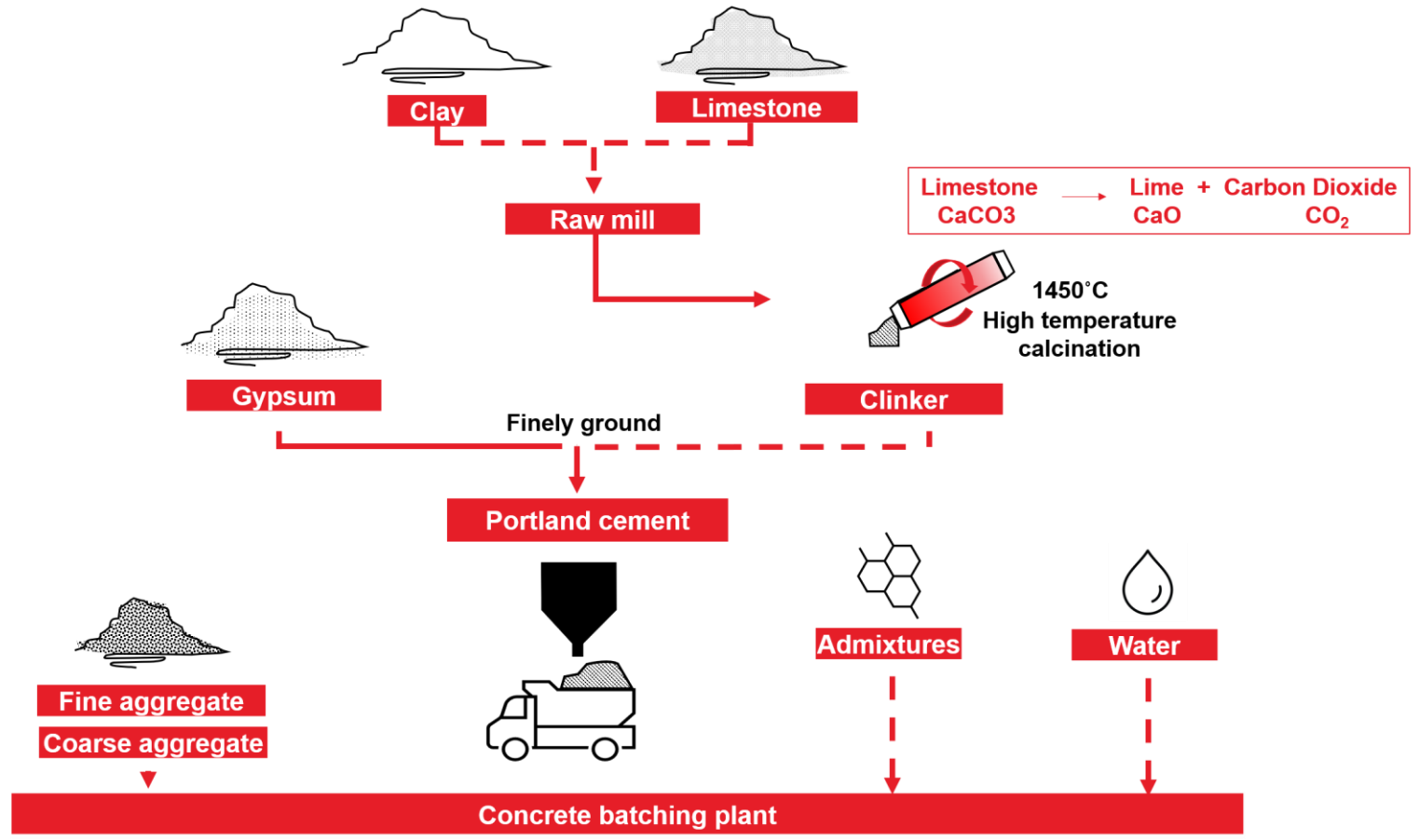
How can we reduce the impact of concrete?

Use recycled materials in concrete



How can we reduce the impact of concrete?

Considering beyond the concrete mix



Reduce concrete in structures

More efficient use/reuse of structures

What properties do LCC materials have?

	Fly ash	Blast furnace slag (GGBS)	Silica fume
Embodied carbon	↓	↓	↓
Australian standards	AS/NZS 3582.1:2016	AS 3582.2:2016	AS/NZS 3582.3:2016
Availability	Current	Current	Current
Cost	→ /↑	→ / ↑	↑
Workability	Needs higher slump	Needs higher slump	Needs higher slump
Compressive strength			
Early age strength	Reduced	Reduced	Improved
Long term strength	Improved	Improved	Improved
Durability			
Chloride resistance	Improved	Improved	Improved
Sulphate resistance	Improved	Improved	Improved
Carbonation resistance	Reduced	Reduced	Improved
AAR/ ASR resistance	Improved	Improved	Improved
Shrinkage	Depends on the mix design - adjustable with the optimisation of the mix design		

What properties do recycled materials have?

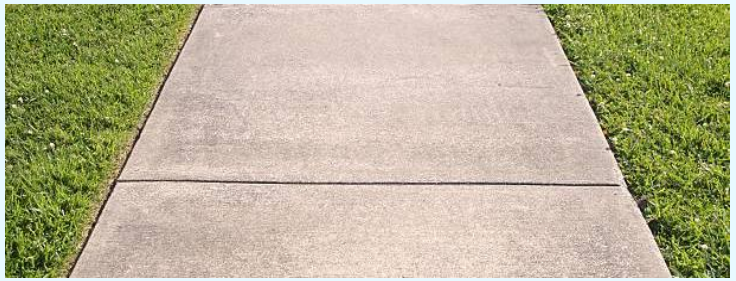
	Manufactured sand	Recycled concrete aggregates	Recycled glass
Availability	Current	Current	Current
Cost	↓	→/ ↓	→/ ↓
Optimum replacement	20-100% by mass	20-50% by mass	20% by mass
Workability	Similar	Increases water absorption	H&S implications
Compressive strength	Similar	Reduced	Similar
Durability	Depends on the mix design - adjustable with the optimisation of the mix design		

To manage performance impacts, replacement levels for a number of these materials need to be limited.

Where can I use low carbon concrete?

Most common applications for councils

Shared user paths, footpaths, hardstands



Kerbs, gutters and channels



Stormwater/ drainage pits and pipes



Culverts



Retaining walls and noise walls



Buildings – piles, slabs, columns, beams



Tunnel segments

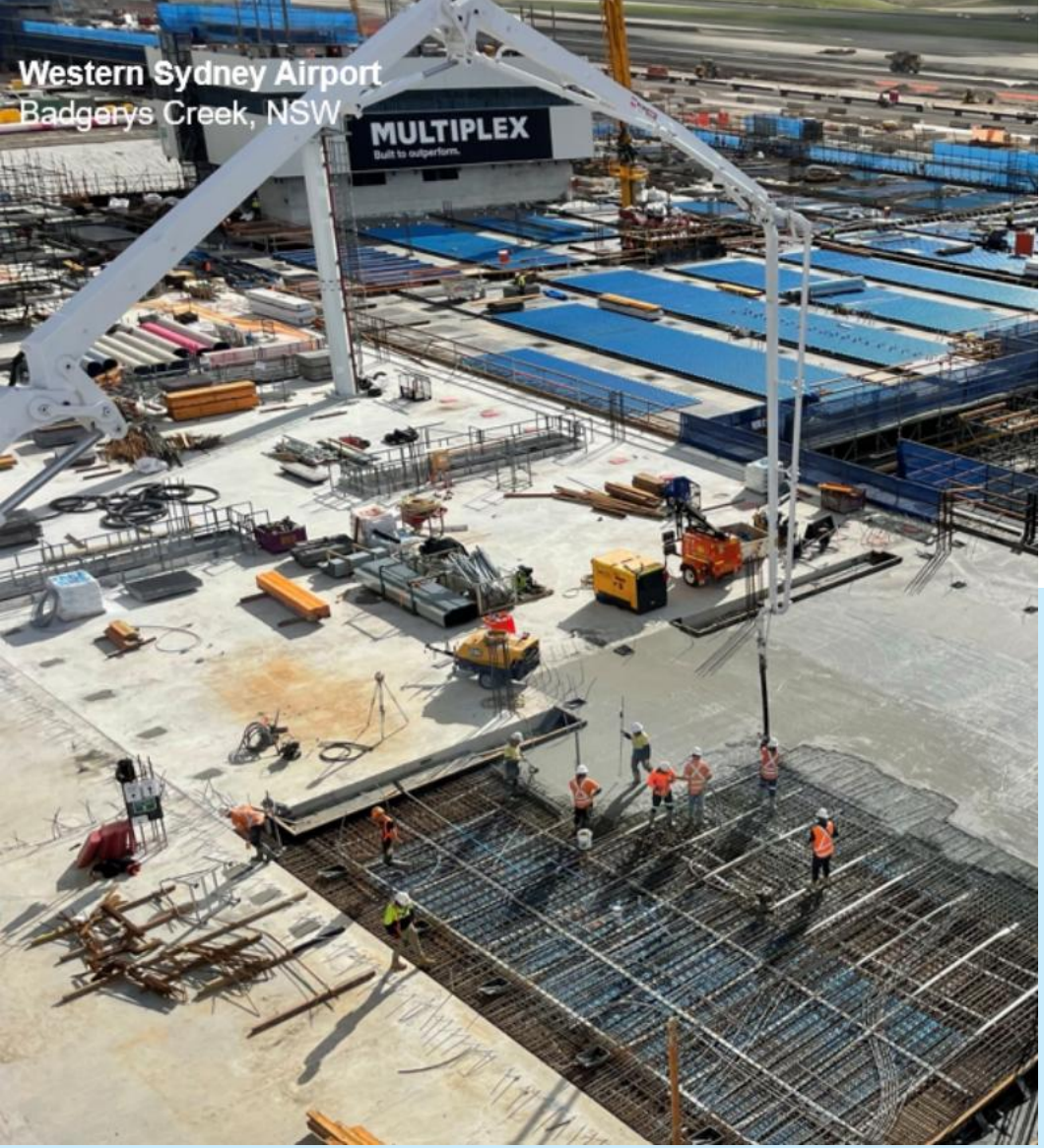


Bridges - piles, piers, bridge decks, crossheads



Maritime





Poll Question #4

Low carbon concrete has been used across Sydney Metro and Western Sydney Airport

Guess the percentage of cement replacement used in concrete at Western Sydney Airport

- *10%*
- *25%*
- *50%*
- *65%*
- *90%*

Poll Question #5



Guess the supplementary cementitious material used in concrete for Sea Cliff Bridge

- *Blast furnace slag*
- *Fly ash*
- *Silica fume*
- *They didn't use any*

Poll Question #6

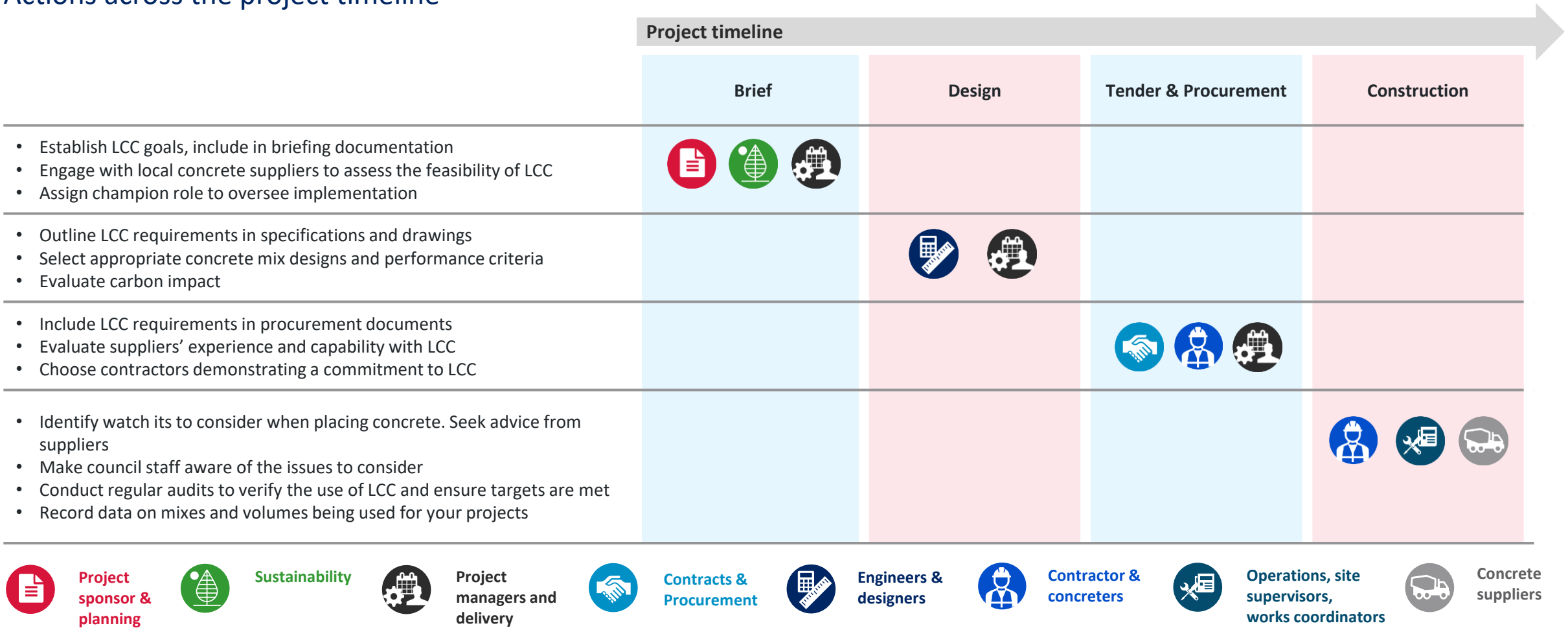


Guess the carbon saving compared to the BAU mix for a footpath in Broadmeadows with City of Newcastle

(Word cloud)

How to implement low carbon concrete

Actions across the project timeline





Poll Question #7

What is the main reasons you would consider using Low Carbon Concrete (LCC)?

(Multiple choice - Choose up to three)

- To reduce carbon emissions
- To meet sustainability targets
- To improve performance and durability of the asset
- To support local manufacturing
- To reduce virgin material use and waste
- I want to innovate and demonstrate leadership in construction
- I want to learn about emerging technologies

What are the benefits of low carbon concrete?

No impact to long term cost

No impact on project schedule for most of the council applications

Reduction in environmental impact

Improved durability
(increased useful life)

- Reduced permeability and porosity
- Enhanced performance to chloride ingress
- Enhanced sulfate resistance
- Mitigation of Alkali-Silica Reaction (ASR)
- Reduced heat of hydration
- *It can increase carbonation*



Poll Question #8

What is your biggest concern about specifying Low Carbon Concrete (LCC)?

(Word cloud)

If it can be used anywhere* why don't we?



Lack of knowledge across the industry and previous experience causing resistance to change



Can have an increased upfront cost



Experience of contractor and ensuring constructability



Barriers in specifications



Typically, limited supply with smaller suppliers and in more regional areas

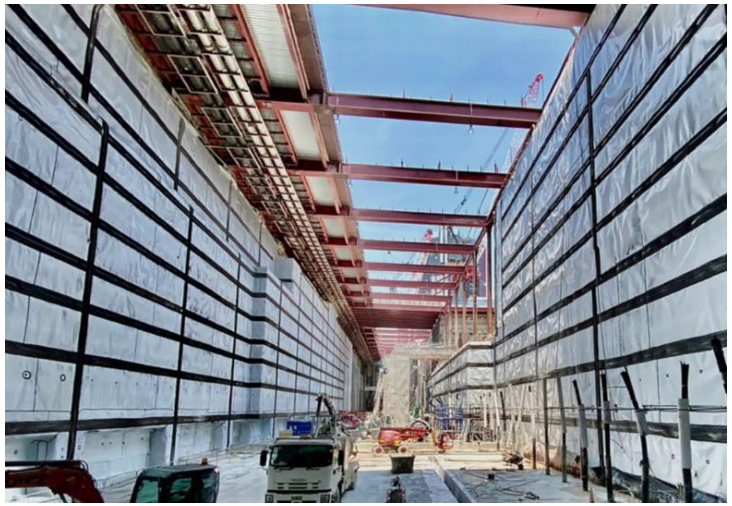
Based on what is practical, while still meeting the same technical and performance requirements

Myth Busting

3

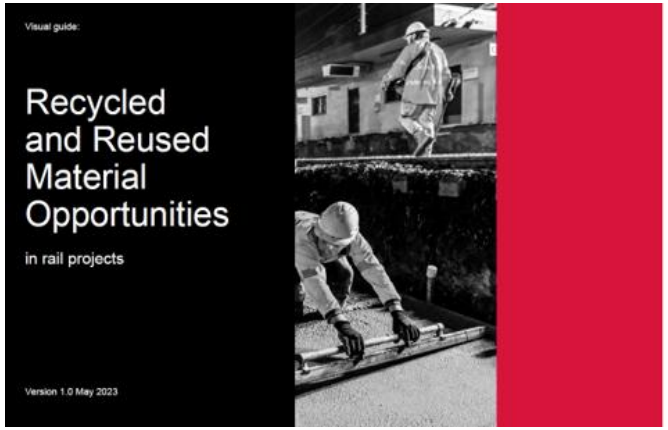
Will it impact concrete strength and performance?

The same strength and performance can be achieved



Major road infrastructure – Sydney Metro

- Minimum 35% reduction in cement content
- Higher SCM replacement levels:
  - Larger elements (≥70% slag or ≥50% fly ash)
  - Smaller elements (≥55% slag or ≥30% fly ash)



Major rail infrastructure – Precast drainage pits/ Concrete pipes

- BAU limit of 25% SCMs
- Preferred target: 60% SCMs



High-rise structural components (columns, beams, slabs) – One Sydney Harbour Barangaroo South R3 Towers

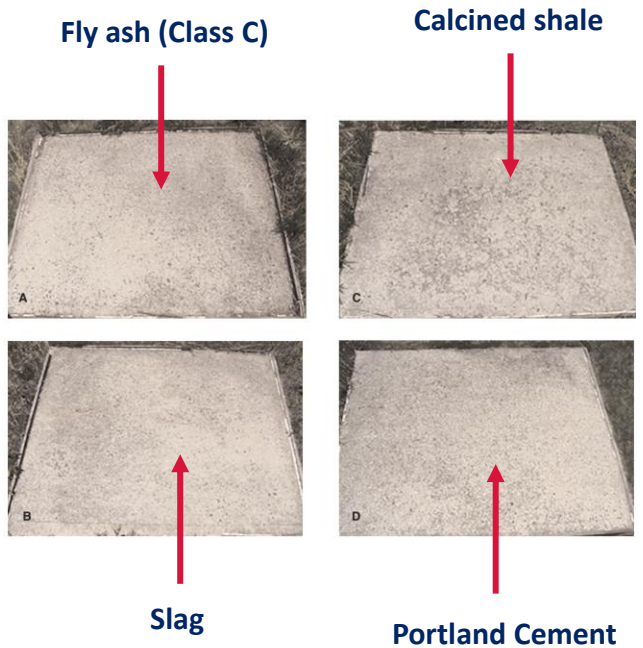
- Minimum 30% carbon reduction
- Achieved 50% carbon reduction

Do fly ash and slag affect the appearance of concrete?

Concrete with **fly ash** and **slag** remain within grey concrete tones. The colour of a mix depends on SCM type, replacement level, source of material, water, admixtures, curing and finishing

Samples or trials pours can be used if a specific colour is required





After 30 years

Fly ash mixes

- Often slightly darker grey or tan, depending on fly ash source

Slag / GGBS mixes

- Often lighter, brighter grey with higher reflectivity

Can LCC be recycled at the end of life?

In Australia, concrete with fly ash and slag is crushed and reused like conventional concrete under Australian Standards, TfNSW Standards and NSW EPA orders



Regulatory compliance of SCMs in concrete

- All supplementary cementitious materials (SCMs) used in concrete must comply with the relevant AS/NZS 3582 series standards.

Applicable Standards:
- AS/NZS 3582.1 – Fly Ash
- AS 3582.2 – Ground Granulated Blast Furnace Slag (GGBFS)
- AS/NZS 3582.3 – Amorphous Silica
- AS 3582.4 – Manufactured Pozzolans

- Concrete containing SCMs is acceptable provided the SCMs comply with the applicable AS/NZS 3582 standards.



Recycled crushed aggregates (RCA)

- AS 2758.1 applies the same requirements to RCA as natural aggregates and does not distinguish between concrete with or without SCMs.

- RCA, including material from SCM containing concrete, is permitted provided it complies with AS 2758.1.



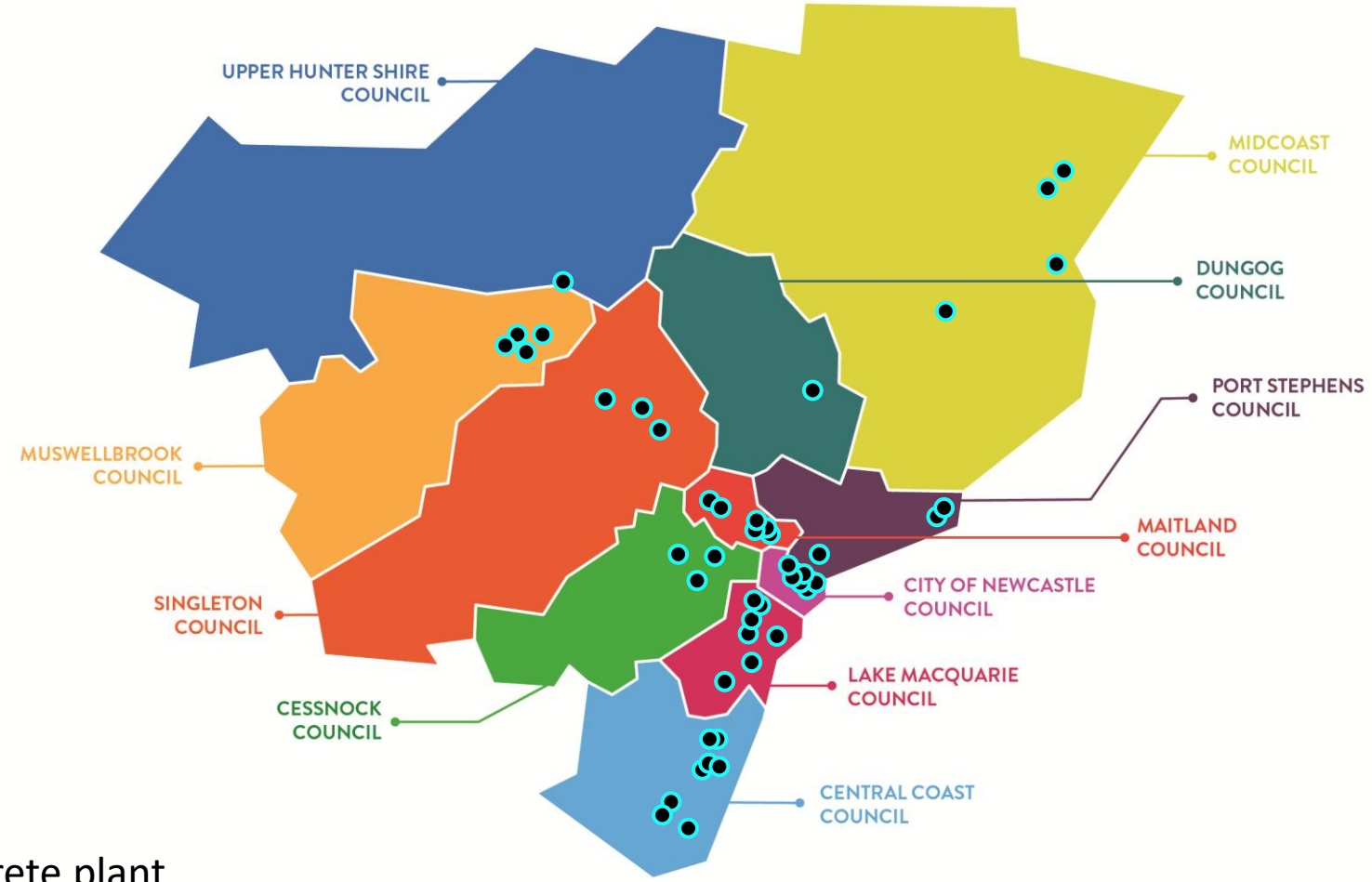
NSW Recovered Aggregate Order and Exemption 2014

- Applies to processed concrete used as RCA and sets contamination limits for construction use.

- Does not differentiate between concrete containing SCMs and conventional concrete.

- RCA is acceptable for use when it complies with the Order and Exemption requirements.

Is low carbon concrete available?



● Location of concrete plant

What information should I ask from a supplier?

Material Composition and Performance

- Cementitious material content
- Recycled materials
- Additives and admixtures
- Concrete performance

Supply Chain and Availability

- Availability and lead times
- Supplier partnerships

Pricing and Cost Implications

- Cost comparisons

Operational Considerations

- Batching and delivery

Environmental Data

- Embodied carbon data

Cost

4

What is the cost of low carbon concrete?

What influences cost?

- Targeted embodied carbon reduction
- SCM replacement level
- Early-age strength requirements
- Use of high-performance admixtures and activators

Indicative cost impact

Up to 40% SCM replacement

Typically cost neutral / minimal cost uplift

Greater than 50% SCM replacement

Typically 5% cost uplift

High SCM with equivalent early-age strength

Typically 10-20% cost uplift

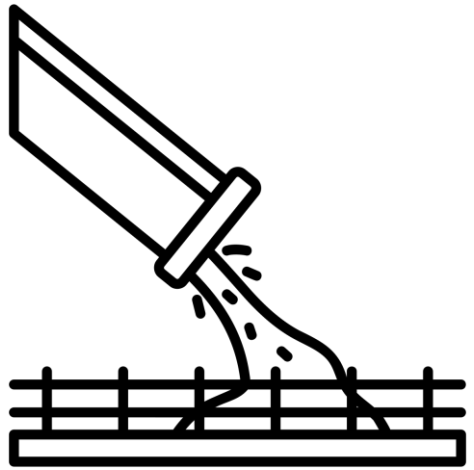
Additional admixtures or activators may be required

Site and Constructability Considerations

5

What are the impacts of using low carbon concrete on site?

- Workability and slump variations
- Setting time and early strength gain
- Handling and pumping
- Placing
- Curing
- Finishing
- Impact on formwork
- Training and communication



Advancements in concrete technology address the perceived performance differences noted above and have significantly reduced performance gaps. Always consult your concrete supplier for project specific guidance.

Pouring concrete

The same steps apply to both traditional concrete and LCC, and following them is good practice

Site Preparation
01

A dry base can pull moisture from the concrete, reducing hydration and weakening the slab

On-site coordination
02

Good communication prevents delays and ensures smooth concrete placement

Discharge Set-up
03

Proper chute setup allows safe and efficient concrete placement

Concrete testing
04

Confirms the mix meets specifications and has the correct consistency

Concrete Placement & Distribution
05

Even placement helps ensure proper compaction through placement and screeding, helping secure slab quality

Level & Screed
06

Establishes correct height and profile for the footpath

Surface closing (Bull Float)
07

Prevents defects and allows proper hydration of the concrete surface. Reduces premature volume loss that can also lead to early-age cracking

Edge finishing
08

Creates clean, compact edges and improves durability

Surface Finishing
09

Creates a safe, consistent walking surface

Curing
10

Proper curing improves strength, reduces cracking, and increases durability

11 **Post-pour Review & Control** - Accurate records and routine performance confirmation support transparency and help link future outcomes back to the materials used, building confidence and organisational learning over time

Source: MECLA Whitepaper on Reducing Embodied Carbon in Data Centre Delivery v3.pdf

Standards & Specifications

6



Poll Question #9

Do Australian Standards allow the use of Low Carbon Concrete (LCC)?

(Single choice)

- Yes
- I think so
- No
- Not sure which standards apply

What standards, certifications, and regulations are relevant to low carbon concrete?

Relevant standards and specifications

AS 1379	Specification and supply of concrete
AS 3582.1	Supplementary cementitious materials for use with portland and blended cement, Part 1: Fly ash
AS 3582.2	Supplementary cementitious materials, Part 2: Slag — ground granulated blast-furnace
AS/NZS 3582.3	Supplementary cementitious materials, Part 3: Amorphous silica
AS 3582.4	Supplementary cementitious materials, Part 4: Pozzolans — manufactured
AS 3600	Concrete structures **(Revision in Progress)**
AS 3972	General purpose and blended cements **(Revision in Progress)**
AS 5100.5	Bridge design, Part 5: Concrete
AS 5100.10	Ultra-high performance concrete **(Under development)**
SA TS 199	Design of geopolymer and alkali-activated binder concrete structures
B80	Concrete work for bridges
R53	Concrete for general works

What the standards say about SCMs

AS 3600 – 50-year design life

- Does not mandate specific requirements for concrete mix, cement content or SCM content
- Does not impose limits on SCM usage

AS 5100:2017 – 100-year design life

- The 2024 amendment requires a minimum of 25% SCM in all exposure classes
- 100% GP cement concrete requires approval from the relevant authority

TfNSW B80 – 100-year design life

- Permits ternary SCM blends for ASR and enhanced durability in aggressive environments.
- Allows up to 65% slag in severe exposure conditions.
- Promotes the use of SCMs to reduce heat of hydration and thermal cracking.

Carbon Impact

7

How do I measure the impact of a concrete mix?

Most accurate — **Least accurate**



This aligns to the INSW carbon data hierarchy

Option 1: Use of EPDs or PCFs

Information required:

- Verified Environmental Product Declaration (EPD) or Product Carbon Footprint (PCF)
- Total concrete volume procured
- Optional: concrete mix design details

Option 2: Use of concrete mix design

The INSW Embodied Carbon Databook can be utilised.

Information required:

- Concrete mix design details
- Total concrete volume procured

Option 3: Use of industry average data

Transport for New South Wales have developed an Engineering Cost and Carbon Library (ECCL)

Information required:

Total concrete volume procured

Note: it is recommended that the most up to date data is accessed through the TfNSW Sustainable Infrastructure Program site

Larger suppliers are likely to have EPDs, smaller suppliers you will likely need to use option 2

What does this all mean for council?



Session recap

- Councils have an important role in creating demand for lower-carbon materials through their specifications and procurement processes.
- Small changes in concrete requirements can deliver meaningful reductions in embodied carbon.
- Low-carbon concrete should still meet the required performance, durability and safety requirements for the application.
- Early engagement with suppliers and contractors helps identify practical lower-carbon options.

Today's focus was understanding LCC, next we'll focus on implementing it



Poll Question #10

After today's session, do you feel more confident to consider Low Carbon Concrete on future projects?

(Single choice)

- Not confident
- Slightly confident
- Moderately confident
- Confident
- Very confident
- I’m overwhelmed, give me some time

LOCCA Program Resources

9

Five workstreams to support councils to deliver LCC

01 Leadership

Enable leadership alignment to support the adoption of LCC across council projects and policies

Roles in council to involve: Executive and senior leadership

LOCCA activities:

- *Join regional working groups to align approaches across councils and suppliers*
- *For piloting and implementation set up a council working group*

Engage with design consultants where applicable

02 Sustainable Design

Support councils to reduce embodied carbon while maintaining performance and durability

Roles in council to involve: Design Engineers, Project Managers, Sustainability Officers, Asset Managers

LOCCA activities:

- *Attend a "Assessing the Carbon Impact of Concrete" Capability Building Session*
- *Attend a "Specifying Low Carbon Concrete" Capability Building Session*

Workshop with developers in LGA

03 Planning Approvals

Enable planning approval teams to confidently support LCC through approval processes

Roles in council to involve: Strategic Planners, Statutory Planners, Development Engineers, Subdivision Engineers, Infrastructure and Approvals Teams

LOCCA activities:

- *Attend a "Enabling Low Carbon Concrete in Planning" Capability Building Session*

Engage with local suppliers and contractors

04 Procurement

Enable councils to confidently procure LCC

Roles in council to involve: Procurement Officers, Contract Managers, Project Managers

LOCCA activities:

- *Attend a "Procuring Low Carbon Concrete" Capability Building Session*

Engage with contractors

05 Implementation

Support delivery of LCC through practical construction guidance, and collaboration

Roles in council to involve: Project Managers, Construction Supervisors, Works and Operations Teams, Asset Managers

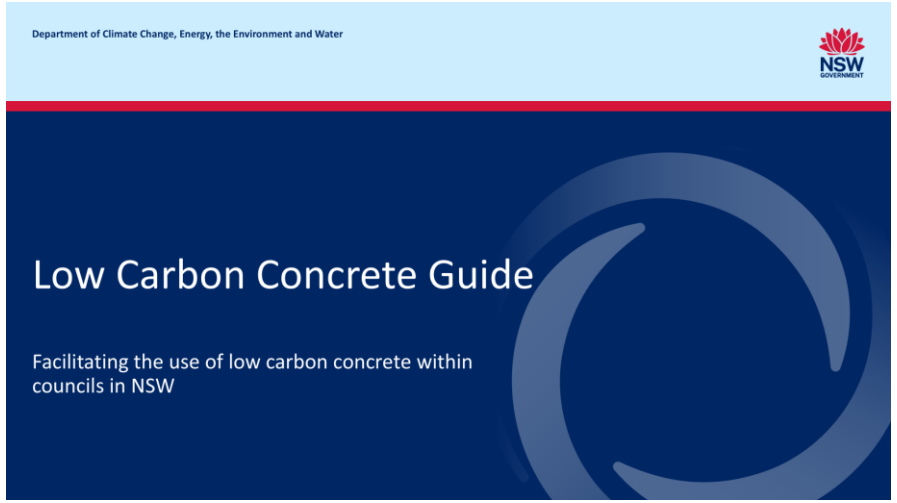
LOCCA activities:

- *Attend a "Using Low Carbon Concrete on Site" Capability Building Session*
- *Potential for a site visit, demo pour or similar*

Next capability building sessions

	Session	Target Audience
01	**Procuring Low Carbon Concrete**	Procurement Officers, Contract Managers, Project Managers
02	**Measuring and Reporting Emissions of Concrete**	Design Engineers, Sustainability Officers
03	**Specifying Low Carbon Concrete**	Design Engineers, Project Managers, Asset Managers
04	**Using Low Carbon Concrete on Site**	Project Managers, Construction Supervisors, Works and Operations Teams, Asset Managers
05	**Enabling Low Carbon Concrete in Planning Approvals**	Strategic Planners, Statutory Planners, Development Engineers, Subdivision Engineers, Infrastructure and Approvals Teams

LOCCA resources



Procurement

- LCC Procurement Checklist
- Policy update guide

Sustainable design

- LCC Carbon Accounting Guide
- LCC Specification guide for council projects

Implementation

- LCC Comparison
- Verification and quality control checklist
- LCC Frequently Asked Questions (FAQ)
- LCC Project Data Capture Template
- LCC myth busting factsheet
- Prioritisation framework

Planning approvals

- Planning approvals guide

Resources will be available at: [Low Carbon Concrete Accelerator Program (LOCCA) - Hunter Joint Organisation]

Additional resources



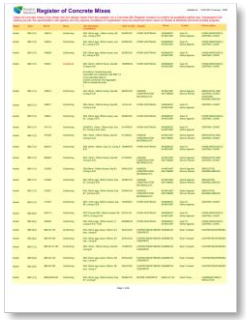
Delivering Low-Carbon Concrete in Practice



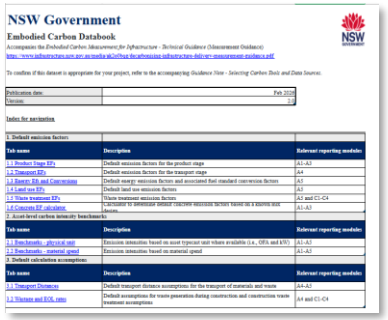
A Guide to Low Carbon Concrete in Australia



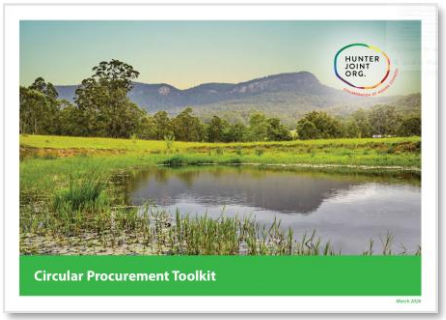
Australian adoption of the GCCA Global Ratings



TfNSW Register of Concrete Mixes



NSW Embodied Carbon Databook



Hunter JO Circular Procurement Toolkit