Global Cement and Concrete Association

CONCRETE FUTURE

The GCCA 2050 Cement and Concrete Industry Roadmap for Net Zero Concrete

ROADMAP OVERVIEW DOCUMENT

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OUR CONCRETE FUTURE

Our 'Concrete Future' sets out the positive vision for how the cement and concrete industry will play a major role in building the sustainable world of tomorrow. Over the past 100 years, concrete has revolutionised the global built environment. It is the vital building material that has shaped our modern world. As we face the important challenges for future generations, addressing the need for sustainable communities and prosperity, including key infrastructure, homes, clean water and providing resilient communities as our climate changes, as well as supporting the transition to low carbon energy concrete, we are working towards building a brighter world.

Our Concrete Future highlights the commitment of our essential global industry, envisioning a net zero world and our contribution towards it, as well as the comprehensive work to decarbonise already underway.

Today, our member companies are already involved in a circular economy revolution, touching every part of the lifecycle of our product – the manufacture of cement, the cleaner energy we are already using, as well as the more efficient use, reuse and recycling of concrete.

Our concrete net zero future can be achieved on known technologies, but we are not resting, we are striving to innovate at every stage of the whole life of concrete. Each company is embarking on exciting technological pathways, but through the strength of collaboration we hope to make the journey more streamlined. We are proud of our two world-class global innovation programmes under our Innovandi platform.

To build the Concrete Future requires the collective action of all our member companies, but we cannot achieve it alone. It also requires the input, support and action of others. We call on policymakers, governments, investors, researchers, innovators, customers, end users and financial institutions, to play their part. Here we outline the collective endeavour which will guide us to a net zero future for society's critical building material and for the world.

OUR COMMITMENT AND PATHWAY TO BUILDING A NET ZERO WORLD

The GCCA 2050 Cement and Concrete Industry Roadmap for Net Zero Concrete is the collective commitment of the world's leading cement and concrete companies to fully contribute to building the sustainable world of tomorrow.

Our roadmap sets out a net zero pathway to help limit global warming to 1.5°C. The sector is committed to producing net zero concrete by 2050 and is committed to acting now.

The industry has already made progress with proportionate[01] reductions of CO_2 emissions in cement production of 20% over the last three decades. **This roadmap highlights a significant acceleration of decarbonisation measures achieving the same reduction in only a decade. It outlines a proportionate[01] reduction in CO_2 emissions of 25% associated with concrete by 2030** from today (2020) as a key milestone on the way to achieving full decarbonisation by the mid-century. The roadmap actions between now and 2030 will prevent almost 5 billion tonnes of CO_2 emissions from entering the atmosphere compared to a business-as-usual scenario.

Our roadmap represents a decisive moment for our industry and the world, demonstrating that it is possible, and setting out an achievable net zero pathway for the world's most used human-made material. GCCA members pledge to achieve the roadmap aims, contributing in line with their position in the cement and concrete value chain.

The roadmap sets out the levers and milestones needed to achieve net zero across the whole lifecycle from cradle to cradle. It highlights the actions from the industry already underway and those it will undertake in the months and years ahead, as well as the important contributions from designers, contractors, developers and clients in the use of concrete in the built environment, and those from policymakers.

We will succeed with the right policy support in place to shape demand for low carbon products (economic viability), enabling a transition of the sector and making full use of circular (economy) opportunities, as well as supporting the development and implementation of innovations and key infrastructure.

The roadmap outlines this collective endeavour and our **'Concrete Future'** which will guide us to a net zero future for society's critical building material and for the world.

01 / proportionate relates to per unit of product

Net zero is used throughout this document with respect to the industry and its products and relates to reduction of CO_2 emissions, across the whole life cycle, to zero. Carbon capture by our industry at our industrial plants is included amongst our actions to reduce carbon emissions to zero. Offsetting measures such as planting of trees or other nature based solutions are not included in the calculations to get to net zero. These offsetting measures are seen in some countries and regions as significant contributors to climate mitigation, but at a global level are not accepted within net zero definitions.

Carbon neutral was used in the GCCA 2020 climate ambition statement and has the same meaning as net zero as defined above.

Concrete refers to all cement-based products including mortar, render, cement-based plasters and precast cement-based products such as masonry units and cladding products.

OUR MEMBERS OPERATE IN ALMOST EVERY COUNTRY OF THE WORLD

About the Global Cement and Concrete Association

The GCCA is the trusted, authoritative platform and voice for the cement and concrete sector across the world. Our members are producers of Portland cement clinker and other natural cementitious clinkers used in the manufacture of cement around the globe.

GCCA members account for 80% of the global cement industry volume outside of China, and also includes several large Chinese manufacturers.

Our vision
Our vision sees a world where concrete supports global sustainable economic, social and environmental development priorities; and where it is valued as an essential material to deliver a sustainable future for the built environment.

Our mission
Our mission is to position concrete to meet the world's needs for a material that can build and support growing, modern, sustainable and resilient communities.

Our Members
- Asia Cement Corporation
- Breedon Group
- Buzzi Unicem S.p.A.
- Cementir Holding S.p.A.
- Cementos Argos S.A.
- Cementos Moctezuma
- Cementos Molins S.A.
- Cementos Progreso
- Cementos Pacasmayo S.A.A
- CEMEX
- China National Building Materials
- CIMSA CIMENTO
- CRH Group Services Ltd
- Dangote Group
- Dalmia Cement
- Grupo Cementos de Chihuahua S.A.B
- HeidelbergCement
- Holcim Group
- JK Cement Ltd
- JSW Cement
- Nesher Israel Cement Enterprises Ltd.
- Medcem Madencilik
- Orient Cement Ltd
- Schwenk Zement KG
- SECIL
- Shree Cement Ltd
- Siam Cement Group (SCG)
- Siam City Cement Ltd
- Taiheiyo Cement
- Taiwan Cement Corporation
- Titan Cement Group
- Ultratech Cement Ltd
- Unión Andina de Cementos S.A.A (UNACEM)
- Vassiliko Cement Works Public Company Ltd
- Vicat S.A
- Votorantim Cimentos
- West China Cement
- YTL Cement Bhd

Our Affiliates
- Asociación de Productores de Cemento (ASOCEM) – Peru
- Associção Brasiliera de Cimento Portland (ABC/SNIP) – Brazil
- Betonhuis – Netherlands
- Federation of the European Precast Concrete industry (BIBM)
- Cámara Nacional del Cemento (CANACEM) – Mexico
- European Cement Association (CEMBUREAU)
- Cement Concrete & Aggregates (CCA) – Australia
- Cement Association of Canada (CAC)
- Cement Industry Federation (CIF) – Australia
- Cement Manufacturers Association (CMA) – India
- Cement Manufacturers Ireland (CMI/IBEC)
- Concrete NZ – New Zealand
- European Ready Mixed Concrete Organisation (ERMCO)
- European Federation Concrete Admixtures (EFCA)
- Federacion Interamericana del Cemento (FICEM) – Colombia
- Federacion Iberoamericana del Hormigon Premezclado (FIHP) – Colombia
- Japan Cement Association (JCA)
- Korea Cement Association (KCA)
- Mineral Products Association (MPA) – United Kingdom
- National Ready Mixed Concrete Association (NRMCA) – USA
- Portland Cement Association (PCA) – USA
- The Spanish Cement Association (Oficemen) – Spain
- Association of German Cement Manufacturers (VDZ) – Germany

CEMENT AND CONCRETE AROUND THE WORLD

Over the past 100 years, concrete has revolutionised the global built environment. All over the world, concrete structures are key to providing housing for an ever-increasing population, enabling transport on land, at sea and in the air, supporting energy generation as well as industry and providing protection.

In 2020

14.0 billion m³

2020 volume of concrete globally

40%

The percentage of total concrete production for residential market

4.2 billion tonnes

2020 cement production globally

$440 billion

The global cement and concrete products market value in 2020

By 2050

9.8 billion

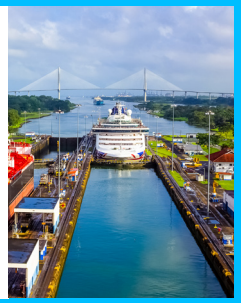
Estimated world's population by 2050

68%

Percentage of population living in cities

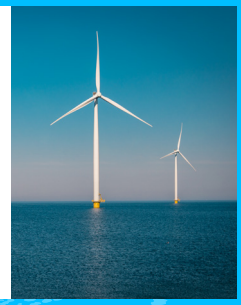
Panama Canal

By shortening shipping routes, the canal has avoided an incredible 650 million tonnes of CO_2 emissions.[01]



Offshore wind power in Europe

Offshore wind will play a key role in Europe's new power mix. Concrete foundations help anchor increasingly large wind turbines to the seabed.

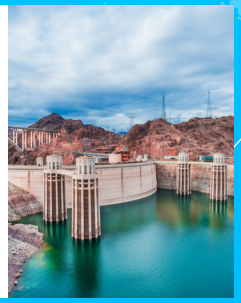


Housing in expanding cities

Every year, China starts building about 15 million new homes, more than five times the amount in America and Europe combined.[02]

Durable concrete

The Hoover Dam built in 1935 still protects downstream communities, produces green energy and provides water storage and irrigation.



Sustainable materials in India

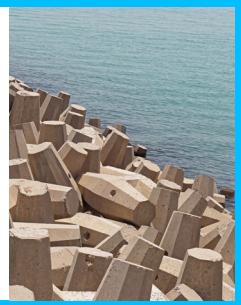
Concrete offers a durable and sustainable alternative to traditionally manufactured bricks, preserving the topsoil and limiting local air pollution.

Formalising housing in South Africa

Initiatives help residents in informal settlements across South Africa by providing, durable, safe, low-cost housing.[03]

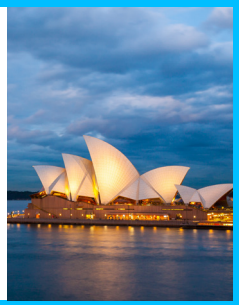
Kuwait sea defences

Concrete structures protect coastlines against the erosive force and power of waves.



Sydney Opera House

The iconic Sydney Opera House is an excellent example of what can be achieved with concrete in terms of design and engineering.



1 https://oceanconference.un.org/commitments/?id=16622
2 https://www.economist.com/finance-and-economics/2021/01/25/can-chinas-long-property-boom-hold
3 https://www.dezeen.com/2017/12/28/empower-shack-urban-think-tank-low-cost-housing-khayelitsha-south-africa/

CONCRETE SUSTAINABILITY

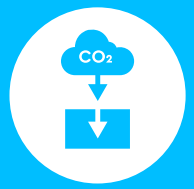
Just a few of the incredible performance benefits of concrete.

Concrete is not only the world's most used building material, it is the world's most used material in general after water – for a reason. It is abundant, affordable, locally available and can be used in innumerable ways.

Concrete's remarkable properties make it a vital element in both limiting the scope, and combating the effects of climate change – enabling the development of sustainable and resilient building and communities around the world.

Availability

The availability of concrete as an abundant, local and cost-effective building material means the sustainability of concrete – its durability, flexibility, resilience, etc. – can be enjoyed in both developed and emerging economies.



Carbon Uptake

Concrete reabsorbs a significant amount of CO_2 over its lifetime in a process known as carbon uptake or recarbonation.

Circular Economy

The industry utilises recycled/secondary aggregates and cementitious industrial by-products in concrete and alternative fuels/raw materials in cement kilns. Concrete buildings are long-lasting and can be re-used or adapted and re-purposed.

Design for Disassembly

Certain concrete buildings can be designed and built for easy disassembly as to enable the reuse of its component parts in other construction projects, reducing use of raw materials and lowering waste.

Disaster Resilience

Concrete stays standing more often than alternative building materials in the face of disaster, reducing the need for reconstruction and enabling communities to recover more quickly.

Durability

Concrete buildings last longer and require less maintenance. They better survive disasters and can be reused many times over in their lifetime, meaning less demolition and reconstruction.

Fire Resistance

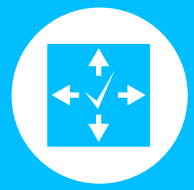
Concrete's resistance to fire improves the safety of occupants, fire fighters and neighbours during fire events, and minimises damage, so buildings can return to use quickly, boosting community resilience.

Passive Cooling using Thermal Mass

Due to its ability to absorb and store heat, concrete can be used to passively heat or cool buildings, reducing the energy consumed by heating or air conditioning as well as reducing the risk of overheating.

Strength

Society expects the built environment – buildings, bridges and other infrastructure – to be enduring and safe – safety is the first priority. Concrete is well known for its attributes of strength, durability, resilience and safety – concrete for example does not burn.



Structure as Finish

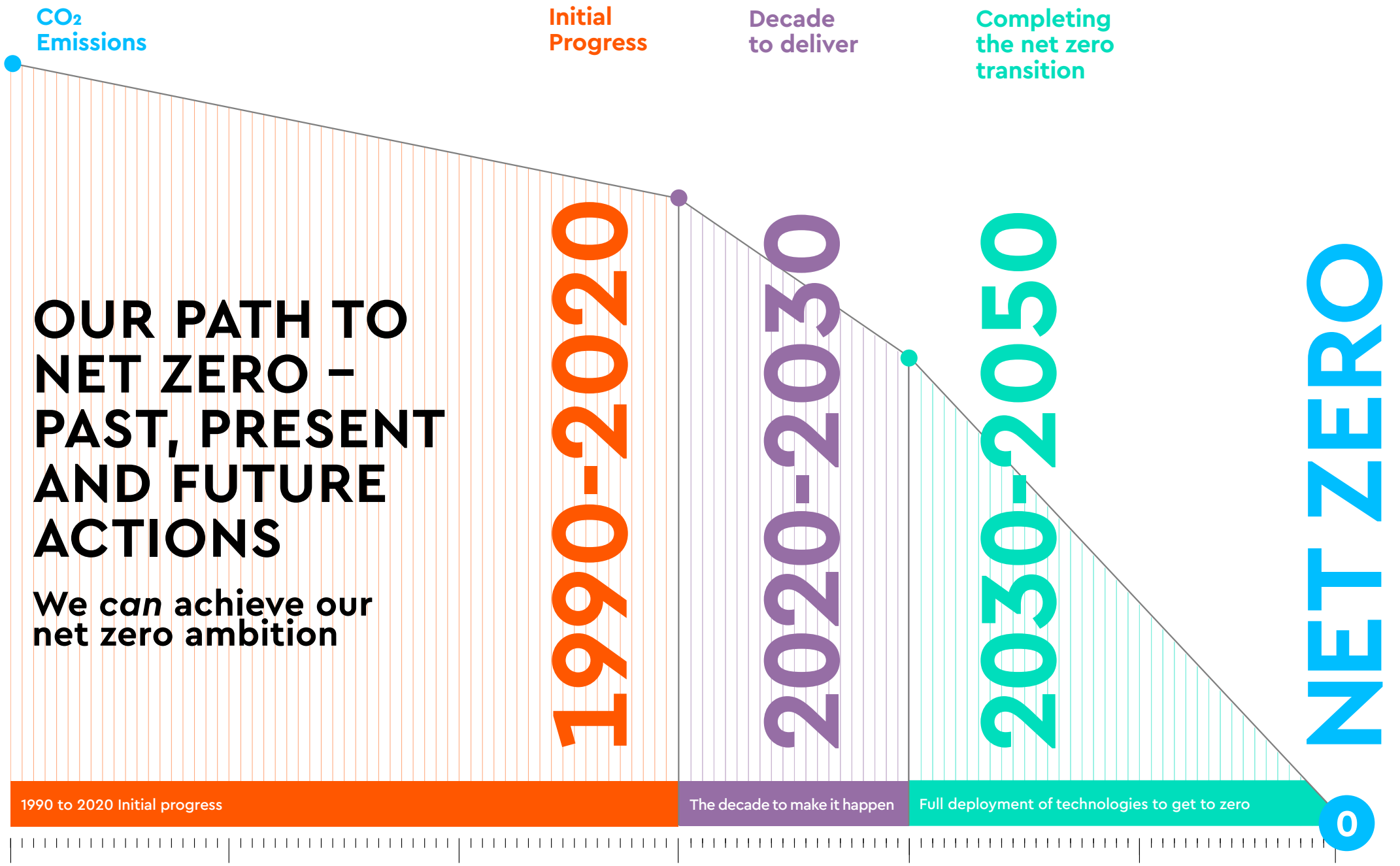
Concrete as a finished surface (e.g. ceiling, wall or floor) lowers material usage in construction and future maintenance needs. And it needn't be dull: concrete can come in a huge range of colours and textures!

Versatility

Concrete is a hugely versatile material, allowing structural designers enormous scope to meet and optimise application requirements with concrete in the most sustainable manner.

Wide Range of Placements

The huge variety of concrete placement techniques allows the use of concrete in a wide range of applications, enabling designers and contractors to choose the optimum technique to deliver efficient projects.



OUR PATH TO NET ZERO – PAST, PRESENT AND FUTURE ACTIONS

We *can* achieve our net zero ambition

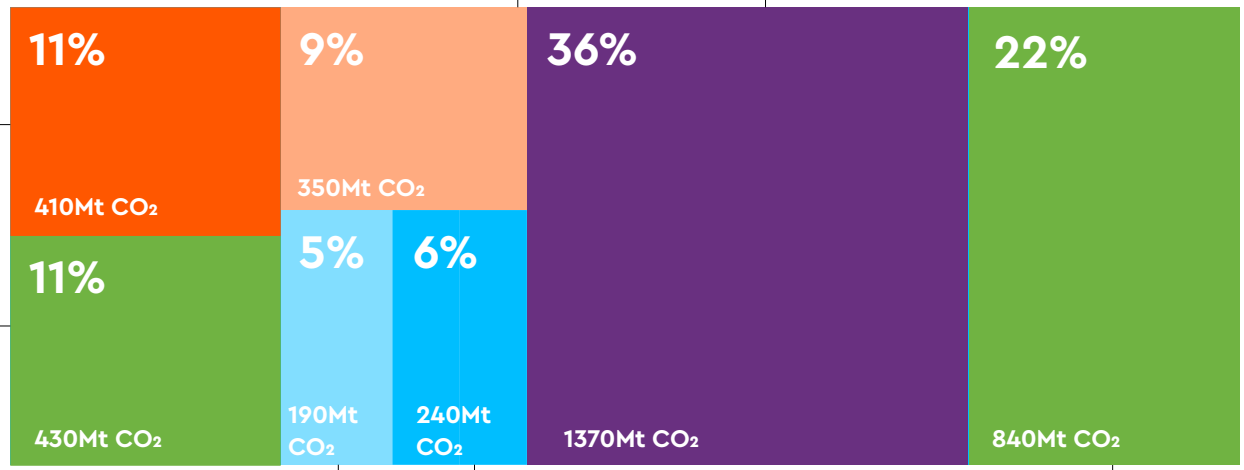
ACTIONS TO A NET ZERO FUTURE

Savings in clinker production
- thermal efficiency
- savings from waste fuels ("alternative fuels")
- use of decarbonated raw materials
- use of hydrogen as a fuel

Savings in cement and binders
- Portland clinker cement substitution. Also expressed through clinker binder ratio
- alternatives to Portland clinker cements

Carbon capture and utilisation/storage
- carbon capture at cement plants

PERCENTAGE CONTRIBUTION TO NET ZERO AND CO_2 EMISSION SAVINGS IN 2050



Efficiency in concrete production
- optimised mix design
- optimisation of constituents
- continue to industrialise manufacturing
- quality control

Decarbonisation of electricity
- decarbonisation of electricity used at both cement plants and in concrete production

CO_2 sink: recarbonation
- natural uptake of CO_2 in concrete – a carbon sink

Efficiency in design and construction
- client brief to designers to enable optimisation
- design optimisation
- construction site efficiencies
- re-use and lifetime extension

1920–2020

INITIAL PROGRESS

1990 TO 2020 - INITIAL PROGRESS

The cement industry was the first sector to monitor and publicly report its CO_2 emissions on a global level. We have done so for the past 20 years and transparently continue to do so today. Over the past three decades, our industry has reduced its emissions proportionately by around a fifth, predominantly by clinker substitution and fuel side measures. The reductions represent the efforts of producers right across the world.

Concrete production has also been advanced in the past three decades. Investment in mixing equipment, control and quality systems and new admixtures are amongst the developments which have enabled concrete manufacturers to produce concrete more efficiently. There has also been a steady shift in some emerging economies from producing concrete on small project sites using bagged cement to utilising factory production of ready mixed or precast concrete. In developed economies digitisation is now being introduced. Amongst the benefits of all these advancements is a reduction of CO_2 footprint for equivalent performing concretes.

2020–2030

THE DECADE TO MAKE IT HAPPEN

The LEILAC I (Low Emissions Intensity Lime And Cement) pilot.

2020 TO 2030 - THE DECADE TO MAKE IT HAPPEN

In this key decade, we will accelerate our CO_2 reductions through the following actions and initiatives:

- increased clinker substitution – including fly ash, calcined clays, ground granulated blast-furnace slag (ggbs), and ground limestone.
- fossil fuel reductions and increased use of alternative fuels
- improved efficiency in concrete production
- improved efficiency in the design of concrete projects and use of concrete during construction, including recycling
- investment in technology and innovation
- CCUS technology and infrastructure development

In addition, we will strive for and collaborate in establishing a policy framework to achieve net zero concrete.

2030 CO_2 REDUCTION MILESTONES:

(Compared with 2020 Baseline)

Concrete

25%

CO_2 reduction per m^3 of concrete by 2030

Cement

20%

CO_2 reduction per tonne of cement by 2030

2020 TO 2030 - THE DECADE TO MAKE IT HAPPEN

A comprehensive policy framework will need to be developed in this important decade, in order to achieve the shared goal of net zero concrete.

We will accelerate reductions over the course of this critical decade. With respect to clinker substitution – increased use of fly ash and ground granulated blast-furnace slag (ggbs) will still play an important role in this decade; ground limestone, recycled concrete fines and introduction of calcined clays and other new promising materials will also play an increasing role.

Further reductions will mean limiting fossil-fuel use at every point in supply and production chains, as well as repurposing society's waste as a smart and greener alternative. We are making progress on this important energy transition which, at the scale of the sector, is substantial.

Additionally, it is critical that in this decade we bring forward the required breakthrough technologies to be ready for commercial scale deployment by the end of it. Investing now in technologies and innovation that will come on stream in later years.

Our members are investing and researching into alternatives to Portland clinker cements. Whilst these may contribute to CO_2 reductions, they will likely have a limited role because of the lack of raw material at the required scale.

Carbon Capture Utilisation and Storage (CCUS) is an essential component of our Roadmap. CCUS pilots already have substantial momentum with live projects and announcements picking up pace in North America, China, India and Europe. This technology works, so we need to work with stakeholders such as policymakers and the investment community to help develop, de-risk and deploy the technology and infrastructure over this time to help transform the industry worldwide.

Whilst by no means straightforward, there are also relatively easier wins in the concrete production and concrete design and construction phases. Indeed not all changes require investment, and some can even reduce costs – reducing the quantities of raw materials through improved design processes, use of reprocessed and recycled material, through re-use of elements, and extending the lifetime of whole projects. Design efficiency and utilising the benefits and versatility of concrete can result in less material being used. This means viewing concrete and cement not only as products to be produced, but as crucial components in a circular economy.

A comprehensive policy framework will need to be developed in this important decade, in order to achieve the shared goal of net zero concrete. This will need to be a joint endeavour by industry, policymakers and governments.

2030 MILESTONE: CARBON CAPTURE PROGRESS

Carbon capture technology is applied at industrial scale in

10 plants

to contribute to delivering net zero concrete

2030–2050

FULL DEPLOYMENT OF TECHNOLOGIES TO GET TO ZERO

2030 TO 2050 - FULL DEPLOYMENT OF TECHNOLOGIES TO GET TO ZERO

Deployment of carbon capture technology at full scale during cement manufacturing could fully eliminate its process emissions and potentially result in the future delivery of carbon negative concrete for our world.

In this period, we will continue to build on the progress in the previous decade.

Clinker substitution will continue. Whilst recognising that supplies of fly ash and ggbs will likely decline, ground limestone and calcined clay will increase in availability and be deployed as a key tool.

Even into the 2030s there will still be scope for the further use of alternative fuels to drive down CO_2 emissions.

Alternatives to Portland clinker cements may also play a role in decarbonisation, albeit limited, perhaps around a 5% of the market.

Ultimately, our process emissions mean that whilst we will do all we can to reduce them, CO_2 will need to be captured, re-used if possible, or stored. Having established by 2030 the capability and commercial case, and with infrastructure development in place, we will be at the start of deployment of CCUS at scale to ensure that we can achieve net zero by 2050.

Deployment of carbon capture technology at full scale during cement manufacturing could fully eliminate its process emissions. This, in conjunction with biomass and recarbonation could potentially result in the future delivery of carbon negative concrete for our world.

Additionally, our members' investment, collaboration and focused work on innovation through our Innovandi programmes could also unleash new technologies in our mission to decarbonise. For example, green/clean hydrogen and kiln electrification are forecast to play a role from 2040.

UNLOCKING A NET ZERO FUTURE – THE ROLE OF PUBLIC POLICY

Public policy will play a central role in the ability of the industry and the wider value chain to decarbonise cement and concrete over their lifecycle. A comprehensive policy framework will need to be developed. This will be a joint endeavour by industry, policymakers and governments, to:

- **make low-carbon cement manufacturing investable**
- **stimulate demand for low-carbon concrete products**
- **create the infrastructure needed for a circular and net zero manufacturing environment.**

Some specific policies to achieve the above outcomes and support transition to net zero concrete are listed here.

- Use appropriate carbon pricing mechanisms to create a level playing field on carbon costs and avoid carbon leakage through adequate carbon pricing mechanisms.
- Unlock the full circular economy potential of the cement and concrete value chain by prioritising the use of, and improving access to waste and by-products as alternative fuels and materials; a ban on landfill, promoting the collection, sorting, pre-treatment, recovery, recycling and co-processing of waste.
- Through changes to standards and public procurement policy accelerate the adoption of low carbon cements and concrete products, that utilise cements with new chemistries and compositions.
- Support R&D and innovation through public funding and risk sharing investment mechanisms. Provide incentives for the creation of climate innovation hubs which foster the participation of all relevant stakeholder groups.
- Support carbon capture utilisation and storage, providing fair recognition of all carbon capture technologies with adapted carbon accounting and supporting the provision of, and access to transport and storage infrastructure.
- Boost the supply, distribution, availability and affordability of renewable energy.
- Recognise in national greenhouse gas accounting and in lifecycle analysis the natural CO_2 uptake in concrete over its lifetime and at end of life (recarbonation) as a permanent CO_2 sink and facilitate access to concrete demolition waste to enable the industry to maximise CO_2 uptake (recarbonation).
- Set ambitious standards for energy performance of buildings that are demanding and sophisticated enough to take into account the benefits of properties such as thermal mass.
- Adopt material/technology neutrality and CO_2 lifecycle performance in construction regulations and standards, as well as in public procurement, to optimise sustainable outcomes.
- Tackle (non-regulatory) systemic barriers to enable the optimisation of concrete design and construction and prioritisation of CO_2 performance alongside other objectives at the procurement, design and construction stages.

Global Cement and Concrete Association

CONCRETE FUTURE

We are fully committed to working together, and with partners, to achieving our net zero destination.