Decarbonisation Pledge

The contribution
of the precast concrete industry
to a decarbonised built environment

By BIBM – the Federation of the European Precast Concrete industry

Why this document?

Reducing the environmental impact of buildings and infrastructures throughout their whole life cycle is our shared objective. There is now a strong recognition by all stakeholders of the importance of reducing carbon emissions in the construction sector. Our industry must respond to today's challenges related to climate change and the energy crisis. Providing sustainable and affordable buildings is the way forward, and special focus must be given to circular and decarbonised solutions for the built environment. The European Commission's "Green Deal" calls for a climate-neutral and circular economy, requiring the full mobilisation of the industry, and in this regard all parties must take responsibility for their actions.

The European Commission's **"GREEN DEAL"** calls for a climate-neutral and circular economy

The decarbonisation efforts of our industry coupled with the remarkable properties of precast concrete, are significantly contributing to the mitigation of climate change. Moreover, many advantages of precast concrete, such as durability, affordability, resilience, versatility, low maintenance, fast assembly and circularity potential enable the development of sustainable structures and infrastructure. This can be assessed, for example, by using Level(s) – the European Commission's first-ever framework to improve the sustainability of buildings.

In this document, we explore the present and future decarbonisation opportunities of the sector:

- The Carbon footprint reduction linked with the optimisation of precast concrete construction works;
- The use of circular economy principles to reduce carbon footprint;
- The role of precast concrete manufacturers and the involvement of the value chain;
- The needs in terms of legislative framework moving forward.

WITH THIS PLEDGE, WE WANT TO:

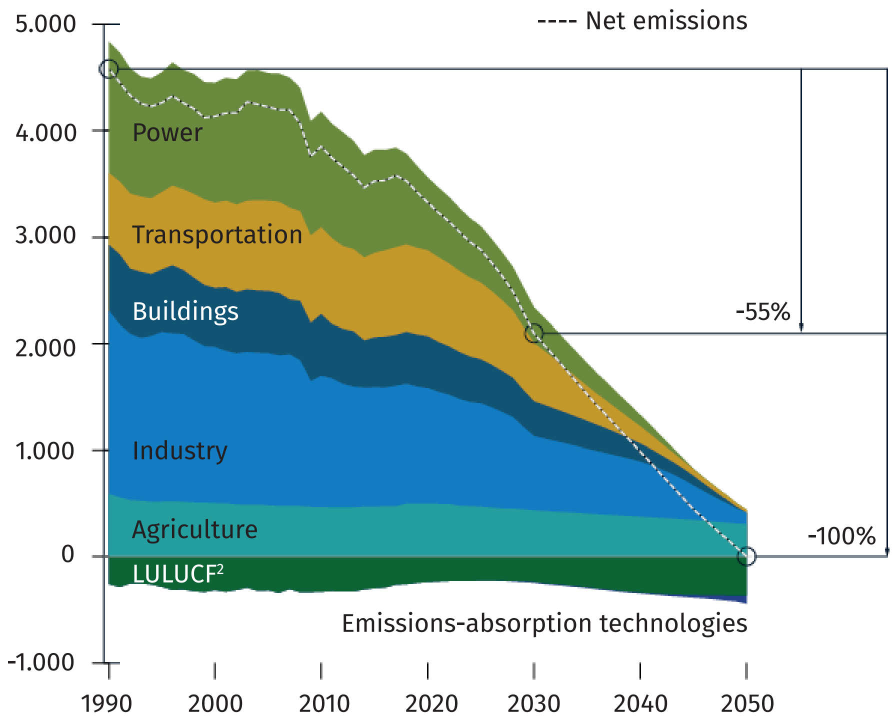
- Contribute to the global efforts to mitigate climate change by encouraging the adoption of sustainable practices and clean energy strategies;
- Foster collaboration among different stakeholders, including governments, businesses, NGOs, and communities, to create partnerships that collectively work towards decarbonisation;
- Contribute to the policy-making processes at various levels by encouraging the development and implementation of supportive policies, regulations, and incentives for decarbonisation efforts;
- Raise public awareness about the urgency of addressing climate change and engage individuals and communities in the transition to a low carbon future;
- Demonstrate the leadership of the precast concrete sector in addressing climate change and inspire others to act.

Net-zero Timeline at Global and European Level

Policies combatting climate change in the modern sense started in the 1960s, with the motivation to reduce the side effects and its expansion. Since such environmental issues are not only limited to national territories, global actions are being taken in order to have a common approach to a common problem. In this sense, environmental policy includes the involvement of many different local and global initiatives.

Total emissons per sector in cost-optimal pathway for EU-27[1]

megatons of carbon dioxide equivalent



[1]Excluding international aviation and shipping.
[2]Land use, land-use change, and forestry entails all forms in which atmospheric CO_2 can be captured or realesed as carbon in vegetation and soils in terrestrial ecosystems.

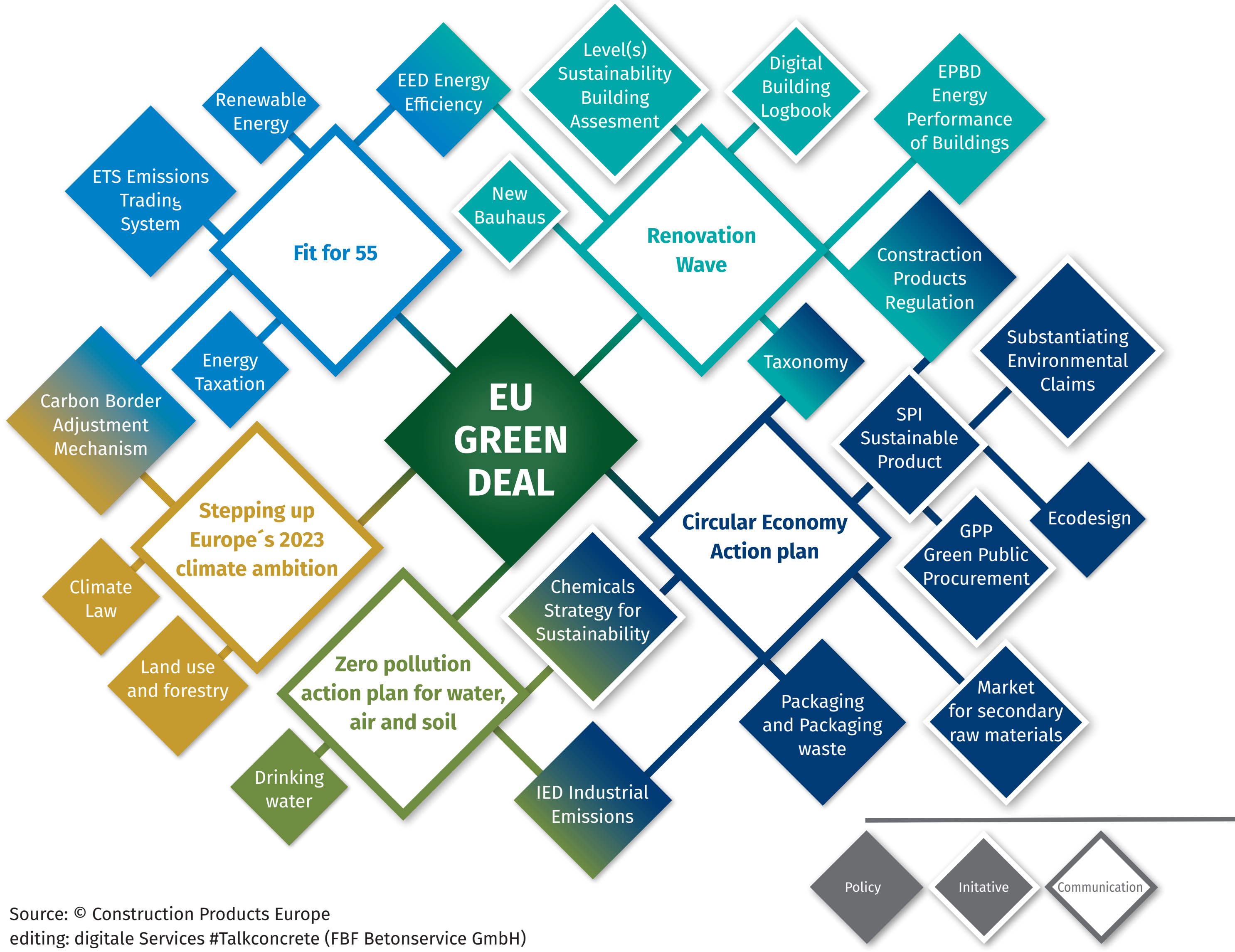
Source: © UNFCCC; McKinsey analysis
editing: digitale Services #Talkconcrete (FBF Betonservice GmbH)

KEY DATES

1997 Adoption of the Kyoto Protocol by the United Nations Framework Convention on Climate Change (UNFCCC), setting binding emission reduction targets for industrialised countries.

2015 Adoption of the Paris Agreement at the United Nations Climate Change Conference (COP21), which sets the goal of limiting global warming to well below 2 degrees Celsius above pre-industrial levels whilst pursuing efforts to limit the temperature increase to 1.5 degrees Celsius. The EU and its member states ratified the agreement.

2019 Launch of the European Green Deal, a set of policy initiatives by the European Commission aimed at making the European Union climate-neutral by 2050.



Source: © Construction Products Europe
editing: digitale Services #Talkconcrete (FBF Betonservice GmbH)

KEY EU GREEN-DEAL RELATED POLICES

2020 The New Circular Economy Action Plan (CEAP) has announced initiatives along the entire life cycle of products.

2021 The European Climate Law sets the goal of achieving climate neutrality by 2050 into law and includes a binding intermediate target of reducing GHG emissions by at least 55% by 2030 compared to 1990 levels.

The Fit for 55 Package includes a broad range of legislative proposals covering various sectors including energy, transportation, buildings, and agriculture.

2021 The Sustainable Carbon Cycles Communication sets out an action plan on how to develop sustainable solutions to increase carbon removals.

2023 The EU-wide whole-life caron roadmap outlines how all builing-related emissions can be mitigated by 2050.

Decarbonisation of precast concrete construction works

Achieving net zero carbon in buildings means having a net balance of zero CO_2eq emissions throughout the whole life cycle, from the extraction of raw materials, through manufacturing and transport, during the use phase and at the end-of-life. The European precast concrete industry's ambition is to reach this net-zero balance by 2050. First, by reducing emissions as much as possible during the whole life cycle (from conception to end-of-life) through a combination of actions from the whole value chain. Once emissions are minimised through mitigation strategies, it is necessary to phase out the remaining emissions with removal strategies.

The final objective is to lower the overall carbon footprint of concrete works (CO_2eq/m²/year). Precast concrete manufacturers have two tools at their disposal for achieving this:

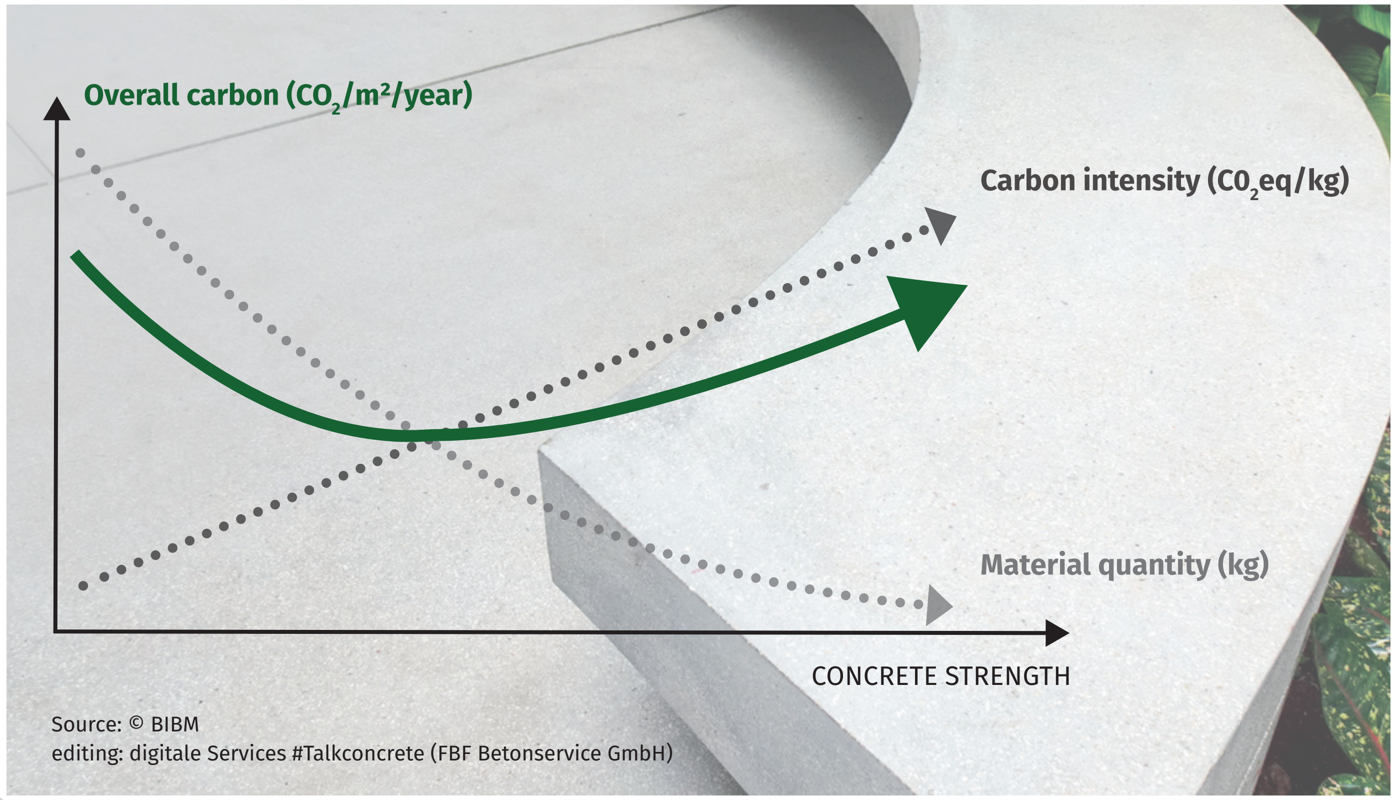
- Using concrete with a lower carbon content (CO_2eq/kg);
- Optimising the design to use less material (kg).

To achieve the desired technical functionality of a construction work, it is necessary to optimise the relationship between these two tools. Using lower-carbon concrete for a given design is only one part of the overall strategy, as comparable or even superior performance can be achieved by using concrete with a higher specific carbon content but in lower quantities.

Cement manufacturing generally contributes to around 80% of the total carbon footprint of concrete. For that reason, reducing the carbon profile of cement is necessary to achieve low-carbon concrete. In this case as well, the concrete performance needs to be taken into account. Ultimately, the objective is to achieve a low-carbon concrete work, with low-carbon cement and low-carbon concrete being the means.

Optimised concrete structures –

reducing the overall carbon emissions by m² of built structure and per year

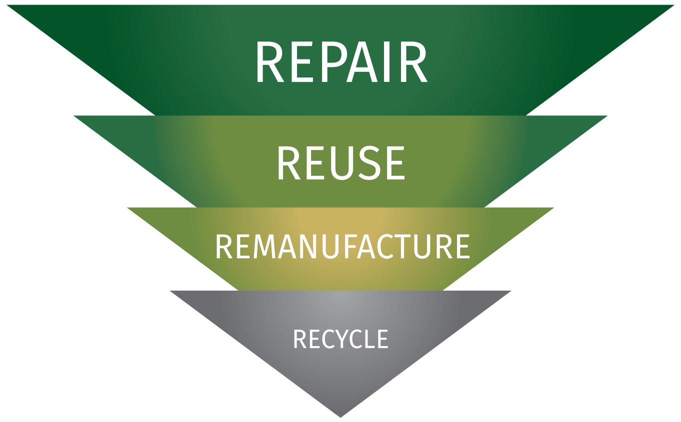


Source: © BIBM
editing: digitale Services #Talkconcrete (FBF Betonservice GmbH)

Using circularity to reduce the whole-life carbon

It has become evident that the global economic model – the linear sequence of "extract-manufacture-consume-dispose" – is not sustainable. Rather, the solution is transitioning towards a circular economic model in which the value of resources is maintained as long as possible, and thus the waste generated is reduced. This is the main objective of the Circular Economy Package approved by the European Union in 2015 and it is one of the main elements of the European Green Deal.

The main purpose of applying a circular economy model is to decouple economic growth from resource use and to finally reduce the environmental burdens. The volatility of prices and availability raw materials, as well as the increasing effects of climate change, also encourage the promotion and implementation of efficient and sustainable use of our natural resources. It follows that, applying circular economy principles to the design, manufacturing, use, and end-of-life of precast concrete construction works can play a positive role in their carbon profile. Precast concrete elements as industrial products are manufactured under tight quality controls, which leads to optimising the use of material, minimising waste at source, and facilitating its subsequent management. Precast concrete construction presents multiple advantages to meet the main principles of the circular economy by adopting some of the following routes: repair, reuse, remanufacture and/or recycling.



REPAIR

Unlike some consumer goods, precast concrete manufacturers focus on durability and the extension of product lifespans, which is a key aspect of the circular economy. Therefore, precast concrete elements are also designed in a modular way, with parts that can be extracted and replaced in case of damage. Additionally, if needed, the service life of precast elements can be extended through repair before their reuse.

REUSE

Reuse involves transferring a precast product from a construction work that has reached the end of its service life into a new one. This is feasible when the precast product has not yet reached its design service life. In this case, the associated impacts, such as embodied carbon, can be offset over a new life cycle. Various precast concrete products, such as wall elements, road barriers, paving blocks, or roofing tiles, can be easily reused to fulfil the same function or serve a new purpose. Furthermore, the industrialisation of processes, digitalisation, and the design of connections facilitate the disassembly of elements and their subsequent management.

REMANUFACTURE

Remanufacturing involves selecting and dismantling precast products or components that have already been used. They are cleaned, repaired and combined to manufacture a new product that can serve the same or different purposes in a new construction work. Similar considerations as for reuse apply in this context.

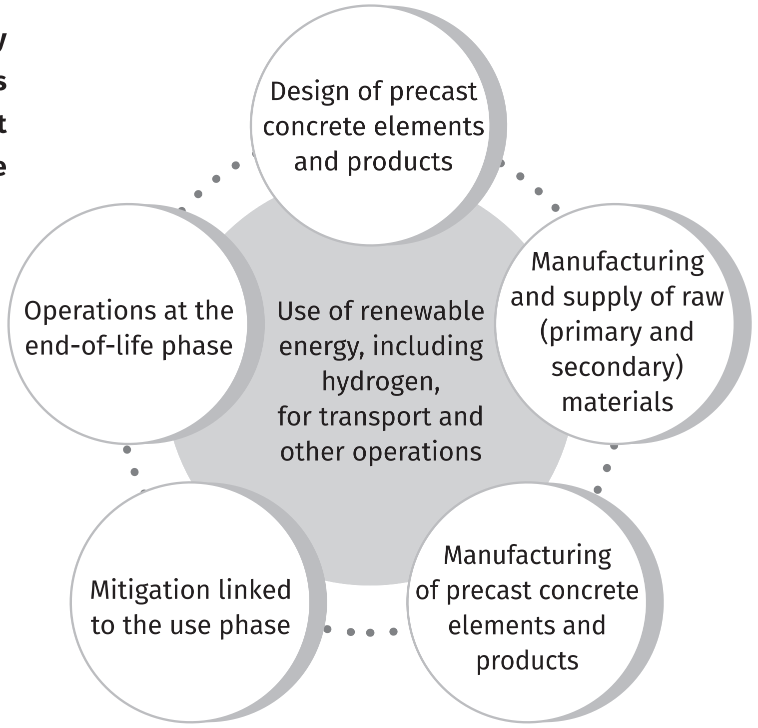
RECYCLE

Finally, recycling should be considered the last option from a circularity perspective, as it involves a greater transformation of the elements (such as energy consumption). However, recycling has greater applicability within construction products. Recycling in precast concrete can be observed in two different ways: first, by recovering all the concrete waste generated in the production process to achieve lean production; second, by using recycled aggregates from external sources such as construction and demolition waste (see the EU-funded research project VEEP, www.veep-project.eu).

A value-chain approach

Decarbonising precast concrete works is possible by optimising the design, mix and transportation across the supply chain. It can be achieved using different strategies within the sector, involving all actors in the value chain throughout the whole life cycle:

1. Design of precast concrete elements and products
2. Manufacturing and supply of raw (primary and secondary) materials;
3. Manufacturing of precast concrete elements and products;
4. Mitigation linked to the use phase;
5. Operations at the end-of-life phase;
6. Use of renewable energy, including hydrogen, for transport and other operations.



1. Design of precast concrete elements and products

Buildings and civil engineering works designed today need to be built to last, and be able to adapt to changing user needs; they should be demountable, reusable and ultimately recyclable in order to reduce CO_2 emissions. An advanced design of precast concrete products could lead to a reduction in the specific CO_2 emissions of the final structure (e.g., CO_2/m²/year). Current and future developments in this field focus on:

- Optimisation of structural elements: place concrete and reinforcement only where needed;
- Lighter concrete structures: use of lighter concrete, including reinforcement, would reduce the self-weight of the structure, transportation costs, and environmental impact while increasing material efficiency;
- Use modern digital tools (optimisation and design software such as BIM – Building Information Modelling) with the aim of maximising output with the minimum carbon profile;
- Design precast concrete structures for disassembly and reuse.

2. Manufacturing and supply of raw (primary and secondary) materials

For the decarbonisation strategy to be effective, there is a need for the contribution and commitment of material suppliers, in particular cement manufacturers:

- Increasing the demand for low- and zero-carbon cement;
- Reducing the clinker/cement ratio by increasing the use of alternative binders;
- Utilising cement-reducing admixtures that reduce the amount of cement per m³ of concrete or allow for the use of low-clinker cements;
- Developing new binders as an alternative to clinker as binding agent;
- Investing in carbon capture, utilisation and storage (CCUS) technologies;
- Using less CO_2-intensive reinforcement, such as steel with lower CO_2 emissions or alternative reinforcement;
- Using CO_2-encapsulating aggregates, which have a negative CO_2 balance.

3. Manufacturing of precast concrete elements and products

Another source of CO_2 reduction can be achieved in precast concrete plants themselves:

- Concrete optimisation – using concrete formulations that reduce the use of cement (e.g., through specific admixtures) and/or changing to other types of cements with less clinker (and therefore more SCMs[1]);
- Prestressing – increasing the use of prestressed products, which generally have a better CO_2 profile (thinner sections, longer spans);
- Using higher strength concrete – products made of higher strength concrete generally have a better CO_2 profile for a given function;
- Increase energy efficiency in manufacturing operations.
- BIM/Digital fabrication – promoting the increased use of IT solutions to optimise internal processes;
- CO_2 injection at curing – storing CO_2 in finished precast concrete elements;
- Granulometry – optimise the choice and ratio of fine and coarse aggregates to improve compaction;
- Electrification of precast plants – increase use with green energy sources.

4. Mitigation linked to the use phase

Further emission reductions can be achieved during the use of precast concrete products:

- Thermal mass – by functioning like a battery, the utilisation of thermal mass (passively or actively) reduces the energy required to maintain a comfortable indoor environment;
- Low maintenance – reducing maintenance operations means less energy is needed to maintain the functionality of a construction work;
- Long service life – doubling the service life of a construction work roughly reduces the CO_2 emissions of the final structure by 50% (expressed as CO_2/m²/year);
- Energy grids integration – actively utilising the thermal mass of concrete in conjunction with energy grids helps reduce energy consumption.

5. Operations at the end-of-life phase

At their end-of-life, precast concrete products can contribute to further reducing the carbon footprint of construction works:

- Disassemble and reuse – increase the service life of elements by giving them a second life;
- Recycling into secondary aggregates for concrete and other purposes;
- Enhanced carbonation – it is possible to inject carbon into crushed concrete to store it permanently.

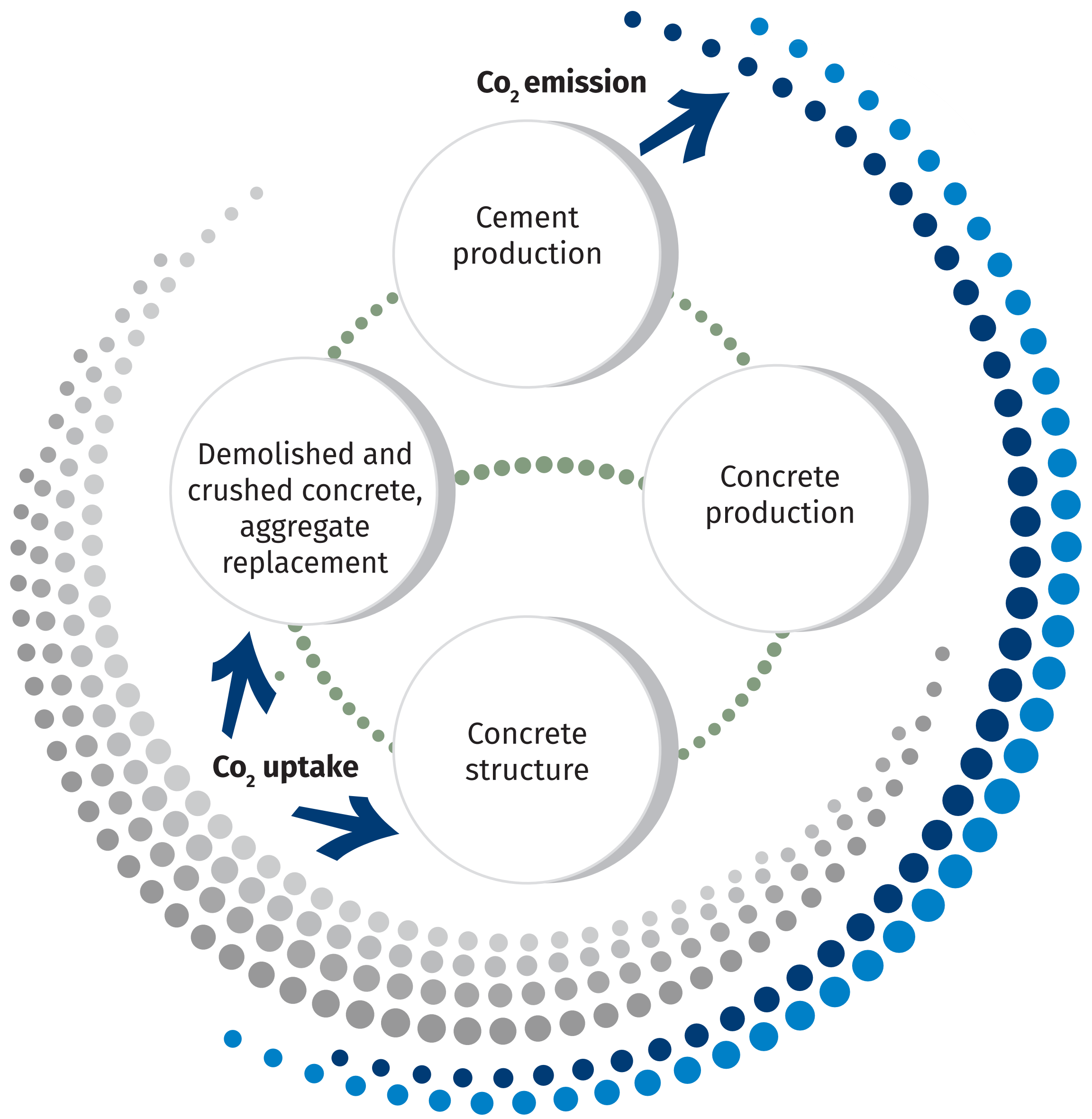
6. Use of renewable energy, including hydrogen, for transport and other operations

Further reductions can be achieved through associated operations like logistics. Although often precast manufacturers do not have direct control, they can have a positive impact by promoting these practices within their suppliers.

[1] Supplementary Cementitious Materials

The role of carbonation

Carbonation is a natural phenomenon that occurs in concrete during its lifespan (including the end-of-life phase), where a portion of the carbon emitted during cement manufacturing is absorbed and permanently bound in the concrete (mineralisation). The amount of carbon reabsorbed depends on various factors such as the type of element, type of cement, and exposure conditions. This can be quantified using the standard EN 16757. Unlike what was previously discussed, this is a given parameter, depending on the design, the exposure and the characteristics of concrete. However, it should be considered when assessing the overall carbon profile of a precast concrete work throughout its whole life cycle, and its quantity should be taken into account for a fair and comprehensive assessment.



CO_2 cycle in concrete; Source: © EN 16757
editing: digitale Services #Talkconcrete (FBF Betonservice GmbH)

Standardisation work

AVAILABLE STANDARDS

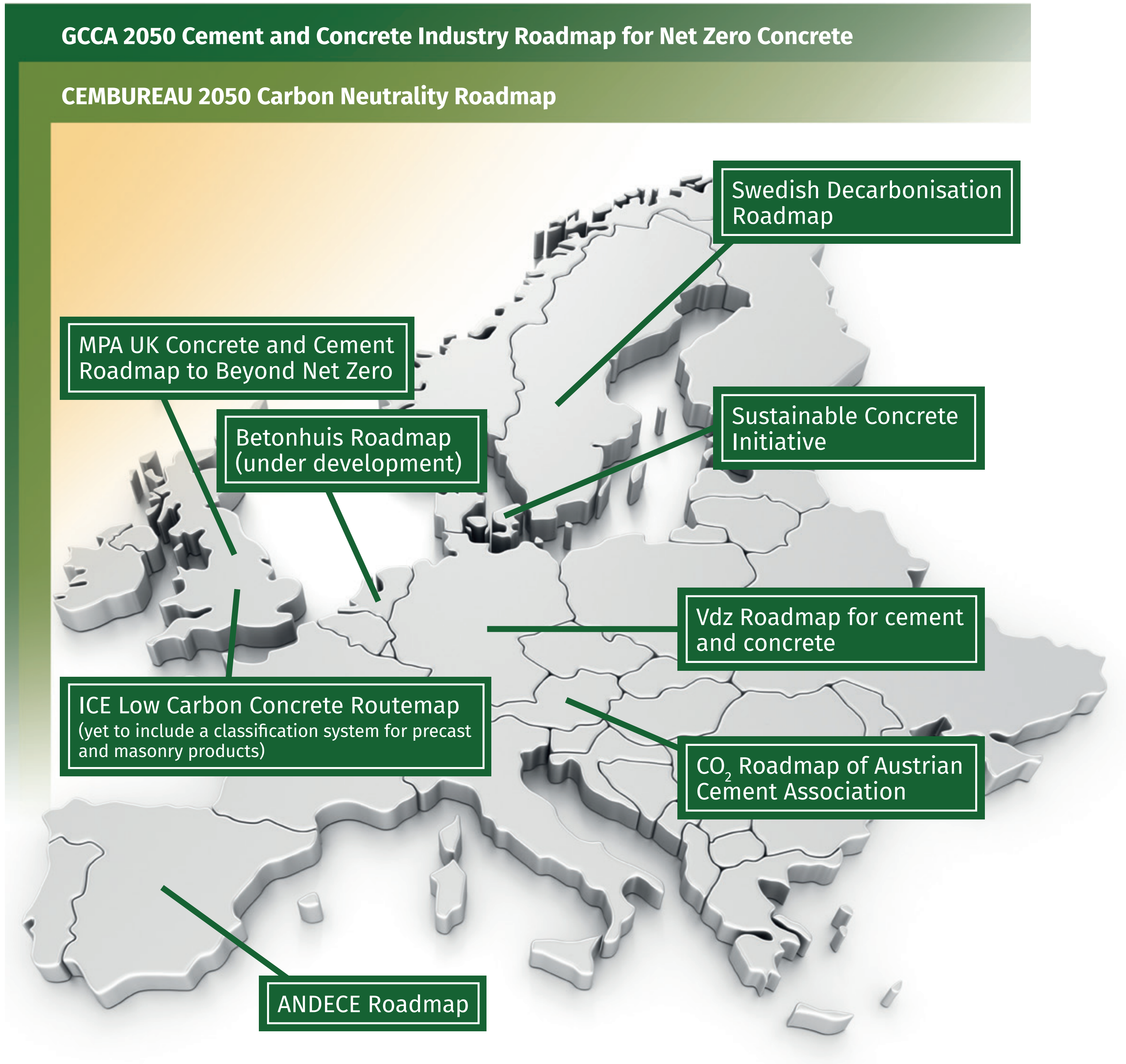
- EN 15978:2012 – Sustainability of construction works – Assessment of environmental performance of buidings – Calculation method;
- EN 17472:2022 – Sustainability of construction works – Assessment of environmental performance of civil engineering works – Calculation method;
- EN 15804:2012+A2:2019 – Sustainability of construction works – Environmental product declarations – Core rules for the product category of construction products;
- EN 16757:2022 – Sustainability of construction works – Environmental product declarations – Product Category Rules for concrete and concrete elements.

STANDARDS UNDER DEVELOPMENT

- CEN/TR – Sustainable construction with concrete Part 1 – Practical guidance;
- CEN/TR – Sustainable building with concrete Part 2 – Further potential for optimisation;
- Informative annex to the revised EN 206 on options to declare environmental properties of "low carbon concrete".

Roadmaps available

BIBM is not the only organisation that has a vision towards the decarbonisation of the concrete sector. There are other initiatives at the national, European and global level aimed at this, which positively influence each other to achieve the net-zero objective.



On the electronic version of the BIBM Pledge available on www.bibm.eu, hyperlinks to the different roadmaps are provided.

Map of current decarbonisation activities in Europe – Source: © BIBM
editing: digitale Services #Talkconcrete (FBF Betonservice GmbH)

An enabling policy framework

Cooperation between stakeholders and policy makers is a key factor in achieving the common objective of the decarbonisation of the built environment. BIBM sees the following approach as enabling the transition towards carbon neutrality in Europe.

Cooperation is a
KEY FACTOR

1. A supportive regulatory and policy framework needs to be established in order to set targets that enable all construction solutions to contribute to a decarbonised built environment.

2. Permanently stored carbon in construction materials (through processes such as mineralisation) should be taken into account when assessing the carbon balance throughout the whole life cycle by:
   a. Recognising both in greenhouse gas accounting and life-cycle analysis, the natural CO_2 uptake of concrete over its lifetime and at end of life (carbonation) as a permanent CO_2 sink;
   b. Recognising the effects of enhanced carbonation (during manufacturing or at the end of life) and support its technological development.

3. Support carbon capture utilisation and storage (CCUS) technologies as both mitigation and removal strategies

4. European policy should ensure material neutrality by:
   a. Targeting a decarbonised built environment without any preference for specific technologies or solutions;
   b. Adopting material/technology neutrality and CO_2 life cycle performance in construction regulations and standards, as well as in public procurement, to optimise sustainable outcomes.

5. Encourage the development of new net-zero technologies by:
   a. Setting clear and stable performance goals;
   b. Providing a scientific-based framework;
   c. Establishing appropriate funding schemes.

6. Use an accurate scientific basis to assess the whole-life carbon of construction works, including durability, circular potential, service life and maintenance CO_2 costs.

7. Set standards for energy performance of buildings that are broad enough to consider the benefits of properties such as thermal mass.

8. Address (non-regulatory) systemic barriers to enable the optimisation of concrete design and construction and prioritise CO_2 performance.

9. Enhance the industrialisation of the construction sector to reduce waste in production and construction.

10. Phase out landfill and incineration as acceptable end-of-life of construction products.

Conclusions

Concrete is the most widely used construction material in the world, and the possibilities for improvement are vast (such as achieving more function with less material, using alternative binders instead of cement, reusing existing structures, etc.). Therefore, even small improvements in terms of carbon emissions have huge global impact. With this pledge, we aim to demonstrate the commitment of the precast concrete industry to achieve a sustainable and low-carbon society, based on minimising all environmental impact during the whole life of our products.

Decarbonisation shall be achieved at the level of the construction work during the whole life cycle. Components (including precast concrete elements and structures) should be designed and optimised with this final objective in mind, applying a life-cycle assessment. The application of circular economy principles can contribute to the decarbonisation objective, in particular the longevity and resilience of concrete as a building material. When designed and specified correctly, it reduces material consumption, and contributes to reducing carbon emissions. The precast concrete industry is becoming more resource-efficient and environmentally aware as it adopts sustainable development principles. A value-chain approach is needed to tackle this challenge in a complex industrial sector like construction. Starting from designers, through manufacturing and operation, until the end of life, all actors can have a positive contribution to the common objective.

Working towards improving precast concrete must go hand in hand with cooperation and engagement from policy makers. Specific policy requests to achieve the outcomes set out above and support the transition to net-zero concrete can be found in our pledge. As a sector, we firmly believe that by working collaboratively we can deliver a sustainable and low carbon construction sector which is fit for the future.

OUR AIM

To demonstrate the commitment of the precast concrete industry to achieve a sustainable and low-carbon society, based on minimising all environmental impact during the whole life of our products.

Think Concrete, Go Precast

**The Federation of
the European Precast Concrete industry**

Rue d'Arlon, 55
B-1040 Brussels
Belgium

info@bibm.eu
www.bibm.eu

EU Transparency Register n. 07055806769-32

DIGITAL VERSION

available on the
BIBM website