THE SUSTAINABLE BUILT ENVIRONMENT AGENDA: CONTRIBUTION FROM CEMENT AND CONCRETE

I. The context

In the European Union, 220 million building units or 85% of the building stock was built before 2001 and 9 out of 10 of the buildings that exist today will still be here by 2050. These buildings are not energy-efficient (represent 40% of total energy consumption) and are carbon intensive (36% of GHG emissions from energy).

The European Union has set itself a GHG emission reduction target of 55% by 2030. This requires a reduction of GHG emissions from buildings by 60% and a reduction of final energy consumption by 14%. To achieve these targets, 35 million building units need to be renovated by 2030. It is important to emphasize that buildings with a long durability and high resilience, like concrete-based ones, are particularly useful in this respect because they can be renovated instead of having to be demolished and reconstructed with much higher impacts and cost in the majority of cases.

The renovation wave will be characterized by a greening of the building stock, will focus on improving the quality of life for citizens and have a significant impact on job creation.

Concrete is one of the building materials that will play an essential role in the renovation wave and the transition to a sustainable built environment. Through this paper, the European cement industry sets out how it undertakes action, throughout the value chain, to offer a sustainable product to the customer.

II. A variety of building materials to achieve our goals

The built environment will always consist of a variety of building materials, each of them providing different strengths and characteristics when it comes to durability, versatility, thermal mass, resilience and sustainability. The interplay and complementary use of these materials is a design choice made by different actors in the construction value chain. All of these actors, including up to the end-user of a building (owner or tenant), are increasingly sensitive to the reduction of energy and carbon intensity in the built environment.

Policymakers and legislators have an essential role to play in elaborating the performance criteria every building material needs to comply with. In executing this task, policymakers are held to an obligation of **material neutrality** and should shy away from expressing a preference of one building material over another without sound, science-based arguments. It would not be correct, for instance, to single out "*bio-based building materials*" as more environment-friendly than "*fossil fuel-based building materials*". Such preference expressed by policymakers risks to ignore the need for full and comparable life cycle analyses with due attention to whole and particularly end-of-life emissions, biodiversity impacts and the inclusion of sustainable availability of raw materials, finally leading to less environmentally-friendly solutions.

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In this context, we are proud to present how concrete can contribute to a sustainable built environment but we fully acknowledge the credentials of other building materials. In the end, the construction industry needs to bring sustainable, safe and affordable products to the end-user and it is up to policymakers to create a fair and facilitating regulatory framework to help that marketing process. We are convinced that public procurement rules and financial incentives can further this “bringing to market” process.

Standards play an essential role in facilitating the “bringing to market” of products but also in ensuring a smooth operation of the internal market and of the free movement provisions in particular. The path to decarbonization of the cement and concrete industry requires timely and swift adoption of standards that accompany the push of low carbon products into the market. CEMBUREAU is pleased to see that a thorough revision of the standardization process has been initiated where the roles of the European Commission and the standardization bodies, respectively, are clarified. The legal aspects of the standardization process should indeed fall with the European Commission but the technical elaboration should remain with the standardization body CEN which should be at the heart of the process as the only body to develop harmonised standards.

It is further of utmost importance to put in place a coherent and consistent regulatory framework. Most construction products, including cement, are covered by the Construction Products Regulation (CPR) and cement companies comply with REACH and Classification, Labelling, Packaging (CLP) requirements. Environmental Product Declarations (EPD’s) have incentivised the offer of sustainable products to the construction market by encouraging the demand for and supply of products with a lower life-cycle negative impact on the environment for the building (design, construction, operation, renovation & deconstruction) of construction works. Cement EPDs have been instrumental in providing the environmental input to pilot projects of the EU Commissions Building Level(s) approach. We therefore strongly believe that EPDs should be reinforced through the implementation of building life cycle assessment using Level(s). All these elements need to be taken into account in discussing the scope of new legislation such as eco-design rules.

III. How concrete can contribute

1. Greening the built environment

The main responsibility of the cement industry is to design more sustainable cement and concrete allowing emissions to be reduced over the lifetime of a built structure without losing its essential properties of safety, thermal mass, durability or resilience needed for its applications. This requires action along the cement-concrete value chain, covering embedded and operational emissions as well as end-of life and after-life emissions. The industry is already putting on the market low-carbon concretes with less carbon emissions compared to standard concrete and intends to accelerate its efforts. In its **Carbon Neutrality Roadmap 2050**, CEMBUREAU has identified the CO_2 reduction pathways for each of the five stages of its value chain (the “5 C’s”: clinker ⇨ cement ⇨ concrete ⇨ construction ⇨ carbonation). The industry’s aim for 2030 is a 30% gross emissions reduction on cement and a 40% reduction in concrete.

a. Embedded emissions reduction

The cement sector is fully aware of the CO_2 and energy-intensity of its manufacturing process whereby two thirds of its emissions are process-related and one third are combustion emissions. With the clinker production process being the most CO_2 intensive due to the chemical transformation of limestone into lime, a very substantial part of CO_2 emission reductions (42%) will need to come from **carbon capture and storage or use**. The industry is engaged in pilot and demonstrator plants with the first carbon-free cement plant coming on stream by 2030. Access to CO_2 pipeline and storage infrastructure is a necessary precondition for the further roll-out of this technology.

Further CO_2 reductions at the manufacturing stage are to be expected from a **substitution of clinker by alternative materials and an increased use of alternative fuels** to fire the kiln, thus reducing the recourse to primary fossil fuels. Currently, alternative fuels sourced from a variety of waste streams represent 50% of the fuel needs on average in the European cement sector. The targets set in the Carbon Neutrality Roadmap is to increase the alternative fuel use to 60% by 2030 and to 95% by 2050.

It is important to emphasize that most of the CO_2 emissions of cement applications through their life cycle are originated in clinker production, making their reduction the key decarbonising factor. This usually leads to very low unit emissions in specific final applications through their whole value chain.

The cement industry is also using large quantities of water, especially in the limestone quarries and is keen to engage in any forthcoming policy discussion on water use and treatment in industrial installations.

b. Activated thermal efficiency in buildings through concrete

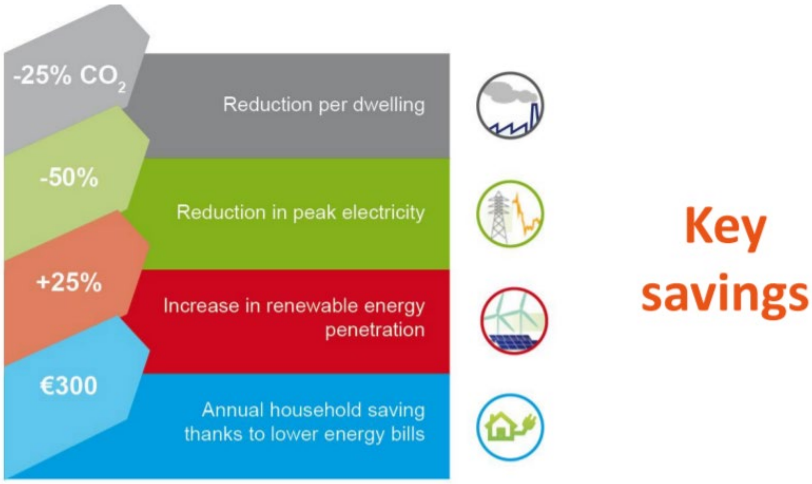
Buildings are moving from being highly energy-demanding and unresponsive elements in an overall ecosystem to becoming highly efficient micro energy-hubs, consuming, producing, storing and supplying energy, making the overall system more flexible and efficient. Technological solutions exist that implement demand response in existing buildings at a district level. Thermal inertia of existing buildings is one of the key variables used when designing these new solutions but it is essential to increase the use of thermal mass of existing buildings under renovation schemes.

One of the inherent qualities of concrete is precisely this ability to store energy, which is later released. This "**thermal mass**" is a material-inherent property, i.e., it comes for free, in any concrete structure[1]. It avoids overheating in buildings and keeps temperatures comfortable. Thermal mass has traditionally been used to improve the energy efficiency of buildings and provide a stable indoor temperature.

An untapped potential achieved through the activation of concrete's thermal mass through pipes embedded in the concrete is the capacity offered by the built structure to provide flexibility in energy grids and boost the uptake of renewable energy. This active cooling can use energy during periods when there is low demand for electricity, for example during the night, and reduce the need for energy at peak times, which helps balance the electricity grid and can boost the uptake of fluctuating renewable energy sources.

[1] For a more detailed analysis, see "Concrete for energy-efficient buildings. The benefits of Thermal mass", European Concrete Platform, April 2007.

This can lead[2] to the following key savings:



c. Circular concrete

In its new Circular Economy Action Plan[3], the European Commission observes that the amount of waste generated in the EU is not going down. It stagnates at around 2.5 billion tonnes annually which equals 5 tonnes per capita a year. More than one third of all waste generated in the EU is construction and demolition waste. Concrete makes up a third of that waste.

Therefore, it is of prime importance for the cement industry to keep construction and demolition waste away from landfilling. A point of specific relevance for the renovation wave agenda is that waste from renovation, which will amount to significant quantities, is currently not counted as demolition waste but should not be overlooked in policy approaches.

The cement sector strongly supports the circular economy agenda set forth by the European Commission for a sustainable built environment which hinges on material efficiency, an adherence to the waste hierarchy and a close attention to life-cycle assessment.

- ✓ Waste prevention through durability: the highest rank in the waste hierarchy is reserved for adaptability of the products which do not even reach the status of waste. The long lifetime of concrete makes it a perfect building material for the adaptation of built assets in line with the circular economy principles for building design; concrete buildings can be re-purposed (e.g., from commercial to residential) or adapted (e.g., through floor extensions) during their lifetime.

- ✓ Preparing for re-use: a concrete frame and many concrete elements can be designed to last over 100 years which is often much longer than the life cycle of the overall building. Applying material efficiency principles, the pathway to carbon neutrality in the built environment by 2050 will require a thinking beyond the life cycle of the original building whereby building elements and/or the concrete frame can be reused in a future life cycle.

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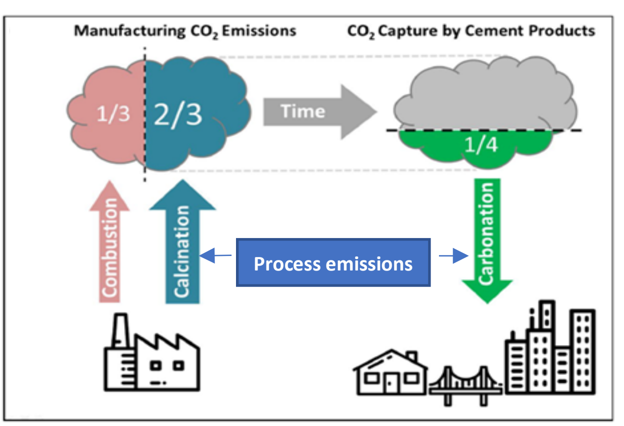
2 See RENEWABLE ENERGY IN BUILDINGS - Unleashing the potential of thermal mass for electricity grid flexibility

3 “A new Circular Economy Action plan. For a cleaner and more competitive Europe”, COM(2020)98final.

- ✓ Recycling concrete: concrete can be 100% recycled after demolition. Recycled aggregates from demolition concrete can be used for the production of new concrete which results in a closed-loop recycling. It is important, however, to proceed to a case-by-case assessment in order to determine the most sustainable (environmentally and economically) option in case of recycling. Demolished concrete can also be used in unbound applications such as road base which is an open-loop type of recycling. It would be wrong to label open-loop recycling as downcycling as it tends to ignore that the use for a road-base application nearby a demolition site may be a more sustainable option than transporting the recycled aggregates for use in new concrete, especially since also the quality of C&DW material can vary widely. However, the cement industry highlights the need to promote segregation of C&D waste at source, or as close to source as possible, to enable the highest possible degree of recycling possible. This is done more successfully in some Member States than others.

- ✓ Concrete (re)carbonates/built environment as a carbon sink: during the manufacturing of cement, the calcination reaction breaks down limestone into calcium oxide and carbon dioxide, thus resulting in a CO_2 intensive manufacturing process (see above). However, unknown to many is that this calcination process naturally reverses in concrete in use as time goes by whereby concrete reabsorbs CO_2 from the atmosphere and mineralizes it. This (re)carbonation process occurs in all concrete structures – buildings, pavements, dams, bridges – throughout their lifetime and in the end-of-life, as crushed concrete for recycling. Concrete carbonation has been recognized in the Sixth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) in the summer of 2021, thus paving the way for an uptake in international CO_2 accounting.



2. Creating local, lasting and good quality jobs

In the post-COVID era, close attention is paid to the need for local supply chains and reduced dependency on third countries for raw material supply. The cement industry sources its raw materials from quarries that are located close to the 200 plants spread across Europe and provides employment to local communities across Europe. Concrete mixing plants are partly vertically integrated in cement companies but for a large part also small- and medium-size enterprises totalling more than 11,500 ready-mix plants.

Quite often, several members of the same family, and even of consecutive generations, from cities nearby and with long lasting and good quality jobs (expert workers), are working in a cement factory. In addition, the focus on digitalization of the construction value chain will require new skills and training of the workforce increasing even more the jobs quality required.

3. Improving lives and nature

The construction value chain is largely focusing on building sustainably, at a reasonable cost and securing the safety of people and nature while providing the necessary comfort.

a. Concrete protects

Safety of the built environment, our homes and the infrastructure and nature around us, is always a top priority in construction. Over the past decades, humanity has witnessed changing weather conditions with more severe thunderstorms, flooding, and unusual temperature changes over very short periods of time. Many of these weather events affected people's homes, be it through incoming water, fires or structural damage. Protection of nature also comes on top of the agenda with attention for coastal and rivers protection, flood prevention or focus on landslide stabilisation.

The choice of building materials plays an important role in addressing these challenges. In the case of fire, it is crucial for the structural integrity of a built structure to be maintained when exposed to intense heat and flames. Saving lives will not only depend on allowing the time for people to escape from the building but also on the integrity of a built structure under fire. Concrete allows a building to maintain its structural integrity due to its components (limestone, clay, gypsum, and aggregates) being chemically inert and non-combustible. Statistics show that the leading cause of death and the major cause of injuries in fires is the inhalation of toxic smoke[4]. In this context, it is relevant to mention that, when concrete is subjected to fire, it does not emit toxic fumes, nor does it produce smoke.

In addition, as has been demonstrated frequently, concrete also stands up very well against hurricanes, tornadoes, and floods. The durability and resilience of concrete play a key role in addressing erosion, natural disasters, and extreme weather conditions. In short, concrete does not rot or burn.

b. Concrete provides comfort

The thermal mass properties of concrete, referred to above, allow the temperature in homes to be kept at a constant level year-round and further a high level of indoor air quality. Another characteristic of concrete is its capacity to absorb sound which is not only a stress relieving factor for life in residential properties but also an effective means of blocking out outside noise (loading trucks; railway or road noise) in industrial business areas. In addition, concrete does not emit harmful volatile organic compounds (VOCs). As time goes by, the integrity of concrete is also important in many types of infrastructures keeping comfort, for instance, in urban areas or pavements. All this makes concrete buildings a peaceful environment to live in.

[4] Source: Fire Safe Europe, Classification system for smoke toxicity of fire-exposed construction products, Technical document, p. 5.

c. *Concrete is affordable*

In the European Union, 1 out of 10 households spend 40% or more of their disposable income on housing. A large part of the costs is energy-related with operational energy representing almost 85% of the total energy used over the life cycle of a building. The suggested inclusion of buildings in an ETS-like system under the “Fit for 55” package is said to increase energy spending by 50% for the lowest income households due to emission costs in residential buildings. Potential annual carbon costs per household from residential buildings can amount to EUR 429 annually[5].

In addition to public financing efforts to help families to weather these additional costs, appropriate attention should be given to the energy-efficiency of building materials. As stated above, much of the energy savings come from thermal mass turning concrete into one of the most efficient and cost-effective building materials. The energy savings can reduce heating and cooling bills and help support social equity through ensuring more affordable housing costs.

Noteworthy is also the relatively modest insurance cost for concrete buildings during the construction and operational phases due to the non-combustible nature of the material and its capacity to withstand long periods of wet weather as it is not susceptible to rot and is termite resistant.

Concrete is one of the cheapest industrial materials used by mankind (less than 5 cents of Euro per kg). It is impossible to find in the world alternative materials at such price and in the sufficient amounts needed to properly protect people and nature and to enhance the standard of living.

Finally, the durability and longevity of concrete structures make maintenance cost over the lifecycle low.

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[5] “Cost for households of the inclusion of transport and residential buildings in the EU ETS”, Polish Economic Institute, ERSCT, Cambridge Econometrics, June 2021, p. 4.

ITEM	POLICY REQUEST
Material neutrality	The legislator can prescribe science-based targets or objectives to be reached by construction materials but should not express a preference for one building material over another.
Coherent & consistent regulatory framework	In developing a sustainable product policy, including the scope of eco-design rules, account should be taken of existing rules (CPR; EPD's; CLP; REACH) that already ensure compliance and facilitate the bringing to market of products. Further attention needs to be paid to flexibility and faster implementation of cement and concrete standards.
Biodiversity	Ensure that protection of biodiversity goes hand in hand with measures taken to combat global warming.
Embedded emissions	Public financing support for carbon capture and use, including CO_2 pipeline and storage infrastructure and allowing capturing installations to deduct CO_2 from its emissions provided CO_2 is not released by that entity into the atmosphere.
	Ensure continued access to waste, including biomass waste, as an alternative fuel used in cement kilns in replacement of fossil fuels.
Energy efficiency/Thermal energy	EPBD revision: recognize activation of thermal energy as complementary to passive thermal inertia / Add a reference to "available structural storage capacity" in Annex I EPBD.
	Develop energy performance calculation models to consider the dynamic use of thermal energy in a load shifting context; promote interoperability between buildings and energy markets to deploy active demand response; provide end-users with incentives for energy storage.
(Multi-)life cycle thinking	The energy and CO_2 performance of building materials needs to be assessed against the whole life and after life of a built structure, including embedded, transport, operational and end-of-life emissions.
	Re-use of structural frames in a new building should be encouraged in a multi-life cycle approach in order to further enhance durability.
Recycling	Encourage, on the basis of a case-by-case sustainability assessment, all types of recycling (open- and closed-loop, including the use of recycled concrete paste as CO2 sink) in order to opt for the most environment friendly and economically feasible application. Encourage better segregation of C&D waste at or close to source.
	Phase-out landfilling of construction and demolition waste.
	Target setting for recycled content needs to take into account (local) availability of secondary resources compared to demand.
Recarbonation	Based on scientific calculations, include recarbonation in the National Inventory Reporting of carbon dioxide emissions ad removals to the UNFCCC.
Design for deconstruction	In order to reap the full benefits of recycling and LCA thinking, it is crucial to start designing buildings today with an eye to their deconstruction at end-of-life, allowing for an easy separation and therefore higher quality recycling of the different building materials.
Standardisation	A clarification of the role of standardization bodies and the European Commission in the standardization process is essential to allow a fast adoption of standards facilitating the bringing to market of low carbon products.