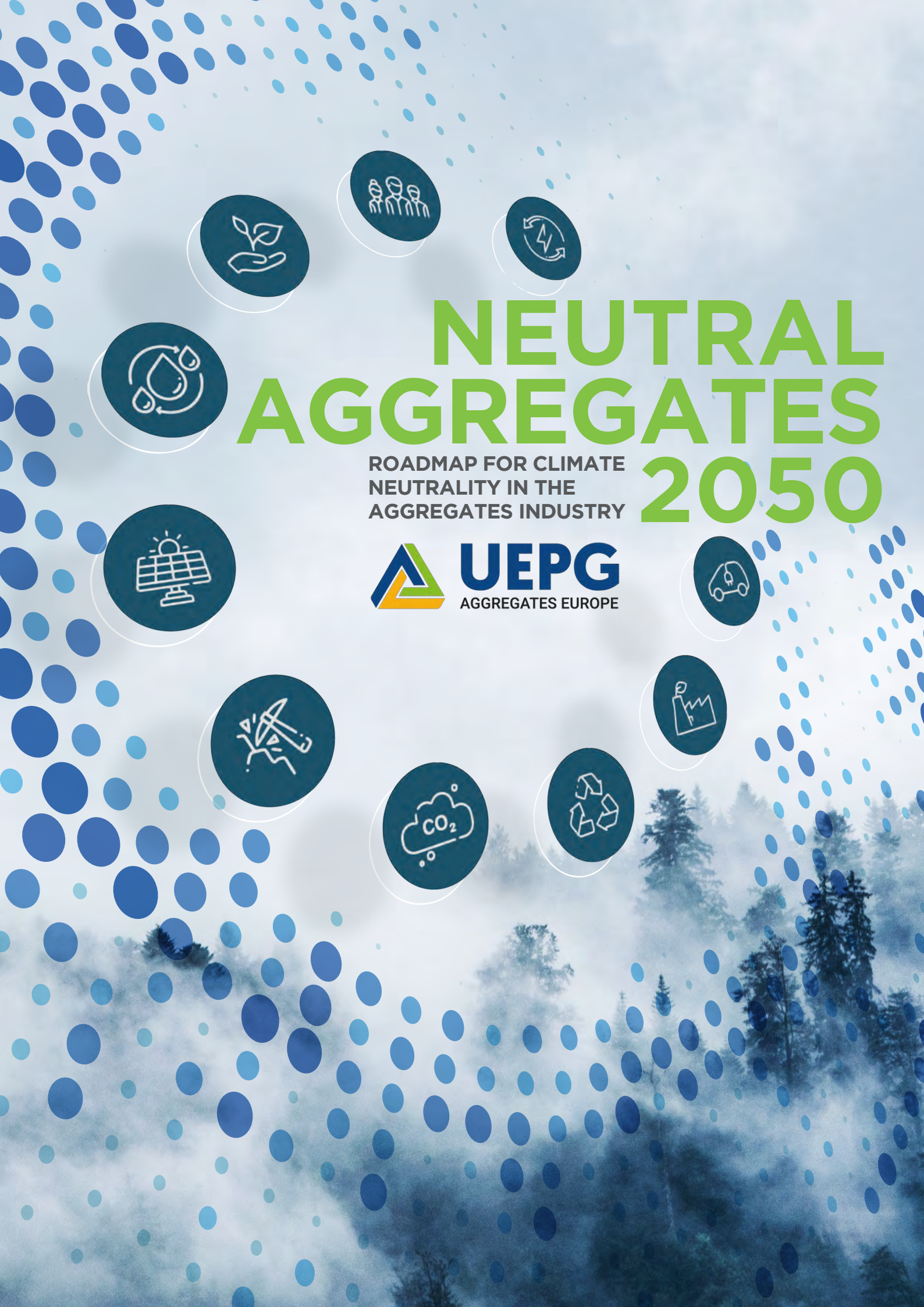
NEUTRAL AGGREGATES 2050

ROADMAP FOR CLIMATE NEUTRALITY IN THE AGGREGATES INDUSTRY

UEPG
AGGREGATES EUROPE



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Aggregates Europe – UEPG
Economic Committee
Climate Change Adaptation and Mitigation Task Force
Chairman and Coordinator of the document: César Luaces Frades

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02 Letter from the President. Our commitment to Carbon Neutrality and the Green Deal

Antonis Antoniou Latouros
President of Aggregates Europe – UEPG

Aggregates Europe – UEPG represents the by far largest non-energy extractive industry with 26,000 extraction sites across Europe operated by 15,000 companies (mostly SMEs) and delivering about 3 billion tons a year of natural, recycled, and manufactured aggregates.

Aggregates – an essential ally for EU climate neutrality

After water, aggregates which are produced from igneous, metamorphic, and sedimentary rocks, are the most used material on planet Earth. Aggregates – sand, gravel, and crushed rock – are also the main product used in the construction and infrastructure sectors.

Aggregates production shows low CO_2 emissions. The available and reliable sources of life cycle assessment and Environmental Product Declaration – EPD that have been analysed for aggregates extraction sites show an average value of about 5 kg CO_2-eq/t of aggregates, from pit (cradle) to gate. Local supply is key for our industry to minimise CO_2 emissions related to the transport of our products to the market.

Aggregates have high durability which means the product is in use for many years, preventing waste generation and the need for demolition and replacement is greatly reduced, contributing to the first principle of circular economy. And due to their nature, they are almost 100% recyclable, so the CO_2 emissions of a ton of aggregates per year of use are negligible.

Our huge network of sites and our essential products have great potential to contribute, to climate change adaptation and mitigation, to many other European policies, in particular to the EU's new growth strategy, the European Green Deal and, more precisely, to the Green Deal Industrial Plan. If responsibly managed aggregates extraction sites can evolve to reach carbon neutrality by 2050 reducing the CO_2 footprint of aggregates covering the production, distribution, and lifespan.

Even if aggregates are not seen as critical, they are undoubtedly essential and instrumental to ensure the success of European policies by contributing to greener energy supply and use, to the decarbonisation of electricity and fuels, to European prevention, mitigation and adaptation to the effects of climate change, fostering biodiversity and rehabilitation for net positive impact adapted to climate change, keeping the circular economy in function, bringing the future closer with R&D&I, digitisation and new technologies, and building the foundations of the growth of the EU sustainable economy.

A key and indisputable fact is that the decarbonisation of the aggregates sector depends on numerous external factors, such as the decarbonisation of the electricity grid and viable technological solutions for transport and mobile machinery. But just as important are the steps the sector can take in the meantime to contribute to the transition by increasing efficiency.

Therefore, as our industry is essentially composed of SMEs, public policy will play a key role in our ability to decarbonise throughout our life cycle. It will be necessary to develop a comprehensive policy framework such as the recently announced Green Deal Industrial Plan that provides a predictable and simplified regulatory environment, with realistic and achievable targets matched to the availability and affordability of technologies, as well as speeding up access to finance, and enhancing skills.

With the EU Green Deal and its renovation wave and other EU policies like RePowerEU or the Green Deal Industrial Plan, requiring massive amounts of primary and secondary construction raw materials, the question is not whether we need aggregates but rather where and how to source them from in the most sustainable way to contribute to our main markets, including Ready-Mix Concrete, Mortar, Precast concrete, and Asphalt to progress in its decarbonisation.

With this voluntary approach, Aggregates Europe – UEPG wants to send a clear signal to the European Institutions, Member States, our companies and our customers in the building construction and infrastructure industries of our commitment to the future of Europe through this world-first *Roadmap for Climate Neutrality in the Aggregates Industry – Climate Neutral Aggregates 2050* produced by our Climate Change Adaptation and Mitigation Task Force, which places our industry as an indispensable part of the solution.

03 Executive summary

Aggregates Europe – UEPG *Roadmap for Climate Neutrality in the Aggregates Industry - Neutral Aggregates 2050* presents, for the first time, the industry's key role in climate change adaptation and mitigation.

The Roadmap provides a comprehensive response to all climate-related EU regulatory and non-regulatory policies, measuring the impact of Europe's top ambition for a decarbonised Industry by 2050 on the aggregates sector. The adaptation of the World Bank's Climate-Smart Mining Building Blocks to the position of Aggregates Europe – UEPG in relation to the aggregates industry shows a full alignment between the approaches of the two institutions.

Aggregates (i.e., sand, gravel, and crushed rock) are essential for the realisation of the EU Green Deal objectives, including the climate change mitigation and adaptation strategy. They are abundant (although currently ever more inaccessible due to lengthy and unfit-for-purpose permitting procedures), inert, highly durable, 100% recyclable and low-cost products. These exceptional characteristics of aggregates make them a strategic product to contribute to climate change prevention and mitigation through the construction of sustainable and resilient infrastructure and buildings in Europe.

Thanks to the high durability, the life cycle of aggregates in the phase of use contributes to the first principle of the 'waste hierarchy' of the EU Waste Framework Directive, preventing waste generation and the need for demolition and replacement is greatly reduced. In addition to that, the availability of construction and demolition waste generated yearly and suitable for recycling is proportionally low, compared to the total needs of aggregates.

According to available and reliable sources of life cycle assessment and Environmental Product Declaration – EPD of aggregates quarries, from cradle to gate (raw material extraction, internal transport and aggregates manufacturing (A1+A2+A3)), **the carbon footprint is estimated to an average value of about 5 kg CO_2-eq/t of aggregates**.

Finally, and in addition to the aforementioned average value, the downstream transport of aggregates to the first user is evaluated by UNPG (Deloitte) at about 4 CO_2-eq/t. Unless extended railway and/or maritime transport infrastructure is in place, because of their bulky nature and their low cost, local supply of aggregates is crucial in order to guarantee the environmental and economic sustainability of the Industry.

The SWOT analysis of the aggregates industry shows a balanced situation that needs strong political action to overcome threats and weaknesses and maximise strengths and opportunities.

Aggregates prove to be essential and instrumental to ensure the success of European policies by contributing to greener energy supply and use, to the decarbonisation of electricity and fuels, to the prevention of and adaptation to the effects of climate change, fostering biodiversity and rehabilitation for net positive impact adapted to climate change, keeping the circular economy in function, bringing the future closer with R&D&i, digitisation and new technologies, and building the foundations of Europe's sustainable growth and ecological transition.

The aggregates industry´s contribution to net zero target by 2050 can be structured by areas and actions that enable potential significant reductions in CO_2 emissions.

Our *Roadmap* to carbon neutrality by 2050 has been based on the following assumptions: the decarbonisation of electricity and transportation as well as the sufficient supply of green fuels, including hydrogen.

Furthermore, given that the aggregates industry is essentially composed of SMEs, public policy will play a key role in our ability to decarbonise throughout our life cycle. Hence, there is the need for a comprehensive policy framework, providing a predictable and simplified regulatory environment, with realistic and achievable targets matched to the availability and affordability of technologies, as well as speeding up access to finance, and enhancing skills. In that direction, the supply of all raw materials should be addressed both at national and EU level.

A work plan for Aggregates Europe – UEPG and which requires collaboration, synergies, and unity of action with other actors such as customers, suppliers and others, is proposed.

Our Roadmap recommends the decarbonisation of the aggregates industry by 2050 in four phases:

1st Phase: 1990 – 2023: Inertial individual progress.
2nd Phase: 2023 – 2030: Initial progress.
3rd Phase: 2030 – 2040: Deployment of technologies and actions.
4th Phase: 2040 – 2050: Completing the carbon neutrality transition.

A set of KPIs is proposed for tracking the progress of the aggregates industry and for prioritising actions towards future targets. The Roadmap concludes with recommendations for aggregates associations, companies, and sites as well as a reference to the contribution of aggregates to the Sustainable Development Goals - SDGs.

Annex I lists climate change-related EU initiatives affecting the aggregates industry, Annex II compiles carbon neutrality projects related to aggregates, Annex III provides some definitions, Annex IV explains the relationship between ISO 14060 and GHG standards, and Annex V lists all the bibliographic references used.

04 EU Policies on climate change mitigation and adaptation

All the European industries are critical to the Union's economy, its resilience, and its economic, social, and environmental sustainability. However, they face key challenges: a strong global competition and the need to decarbonise and to be as environmentally friendly as possible. Industries need to transform and evolve. All of them are being required to achieve climate neutrality, near zero waste, zero pollution and zero landfill by 2050 at the latest.

Raw materials are critically important for implementing the *2030 Agenda for Sustainable Development*, securing the transition to green energy technologies, ensuring growth and sustainable consumption, and assuring access to clean and efficient consumer technologies as mentioned in the *EU's Raw Materials Initiative*. The extractive sector and the mineral processing sector are vital to guarantee the sustainable supply of European raw materials. The aggregates industry is, by far, the largest part of the non-energy extractive sector in Europe.

Aggregates life cycle

Accelerating the twin green and digital transitions will be key to achieve lasting and robust growth, always in line with the EU's new growth strategy, the European Green Deal and, more precisely, the *Green Deal Industrial* Plan aimed to enhance the competitiveness of Europe's net-zero industry and support the fast transition to climate neutrality by providing a more supportive environment for the scaling up of the EU's manufacturing capacity for the net-zero technologies and products required to meet Europe's ambitious climate targets.

Implications of the EU's Climate Neutrality by 2050

The four axes of the transformation of our EU economy into a carbon-neutral system are based on the evolution of:

- The financial system towards a sustainable economy (Taxonomy).
- The market value chains, the economy and its sectors.
- The legislation and progressive regulation.
- The education system in terms of embedding sustainability into education.

In the short and medium term, the sum of these principles and the interaction between them will produce a competitive acceleration effect towards a low-carbon economy that will drag along the set of companies and, in particular, SMEs that take part in the value chains of all economic sectors. To achieve this, the calculation of the Organisational Carbon Footprint, a disaggregated inventory of emissions and a plan to reduce and offset them will be required to articulate this transformation.

Very soon, the typology of companies that will have to calculate and publish their carbon footprint together with a GHG emissions reduction plan will be established properly, by the corporate sustainability reporting directive (CSRD), the corporate sustainability due diligence directive (CSDD) and the European sustainability reporting standards (ESRS).

Green procurement plans assembled by the different European & national administrations are establishing that tendered contracts should progressively include an awarding system that values the enrolment of organisations in the Carbon Footprint Register, the offsetting policies adopted, and the established carbon dioxide absorption projects.

The calculation of the carbon footprint is also part of the information that must be provided for the environmental assessment of those plans and projects that must undergo the environmental assessment procedure in order to be authorised.

RePower EU reinforces the need to carry out emission reduction plans based on emission inventories that allow businesses related to the construction sector to compete under better conditions.

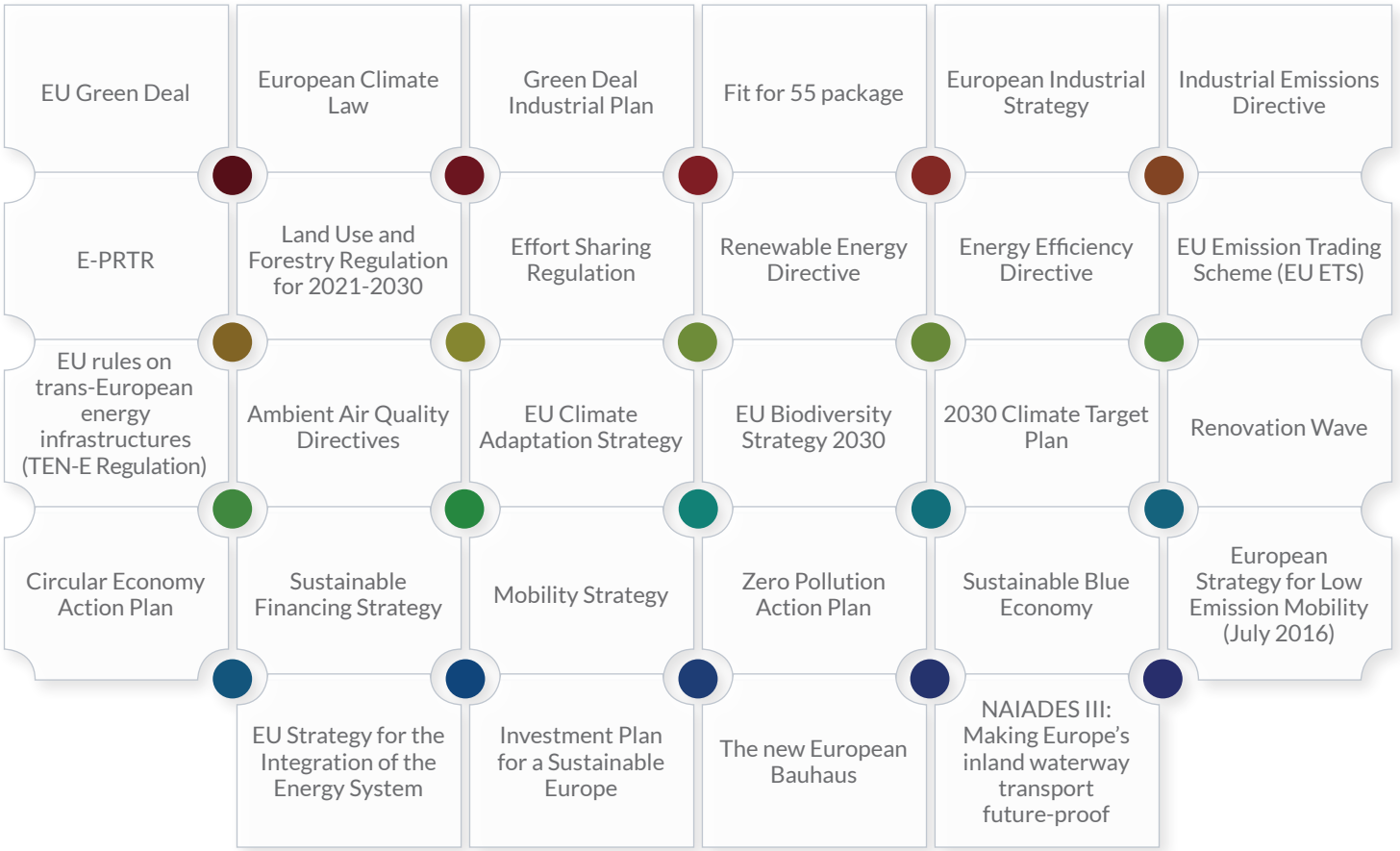
Thus, it is necessary to address decarbonisation under competitiveness criteria.

The economy as a whole is forced to activate GHG reduction plans based on inventories that allow steady progress towards a scenario of low emissions and climate neutrality, greater efficiency in processes, greater energy independence and lower energy costs.

At present, the most important companies in the majority of the relevant sectors have established, whether in full or partially, emission inventories and reduction plans, which include the data of their value chain.

Hence, decarbonisation is not only a necessity but also a differentiating and competitiveness element that needs to be integrated into the aggregates companies' competitive strategies in the coming years.

EU climate change initiatives related to the aggregates industry



The Annex I includes a list with the references of the main climate change-related EU initiatives affecting the aggregates industry.

05 Aggregates: an essential product for the EU climate change mitigation and adaptation strategy

Aggregates sustainability

After water, the igneous, metamorphic, and sedimentary rocks to produce aggregates are the world's most used raw material. Aggregates – sand, gravel, and crushed rock – are also the main product used in the construction and infrastructure sectors.

Aggregates can be produced from several tens of different rock types. This fact gives a very wide geographical distribution to the aggregates quarry network and allows a local supply while minimising the negative environmental effects and emissions produced by the transportation of the product. Aggregates are very abundant, inert, highly durable products, 100% recyclable whether they have been used with or without binders. They are also low-cost products.

Due to the huge volume of aggregates required in the EU, more than 3 billion tons a year, we are an essential player in sustainable building techniques, leading to a smarter, more energy-efficient, more reusable, and recyclable building sector environment.

The aggregates industry is a driving force already contributing to climate neutrality. Especially with regards to an efficient operation of circular economy, aggregates can be recycled at the end-of-life of any built structure. Our companies play a key role in the management of construction and demolition waste (CDW) and crushing of concrete waste (around 80% of aggregates per m^3) is already contributing to re-absorb CO_2 through re-carbonation at the time of recycling into new aggregates. Indeed, carbonation is increased when some types of aggregates, especially artificial and alkaline ones like concrete, are crushed for reuse at the end of their life cycle and during any secondary use. And, in contexts of alteration of certain minerals (high temperature, water circulation, etc.), natural rocks such as basalts and ultrabasic rocks capture CO_2 by carbonation[2]:

To sum up, aggregates are 100% recyclable within proper building or infrastructure demolition management.

These exceptional characteristics of aggregates make them a strategic product to contribute to climate change prevention and mitigation through the construction of sustainable and resilient infrastructure and buildings in Europe.

[2] BRGM – rapport RP-54781-FR juin 2006 Carbonatation minérale.

Contribution of aggregates to the EU climate change mitigation and adaptation strategy

The contribution of aggregates to concrete's and masonry's thermal performance properties is critical. This supports the construction of highly energy-efficient buildings and infrastructures. Thermal mass is, in fact, a property of concrete and masonry that allows heat to be absorbed, stored, and slowly released afterwards. Concrete buildings with high thermal mass generally have lower energy requirements and emissions from heating and cooling. Similarly, the properties of aggregates in road mixtures could be exploited to produce geothermal energy. In that sense, several experiments are in progress.

06 Aggregates production process and CO_2 emissions

At present, there are no national roadmaps on climate change adaptation and mitigation for aggregates and hardly any examples from businesses.

Aggregates are final and also intermediate products characterised by a life cycle inventory (ICV) or environmental product declaration (EPD) in LCA format.

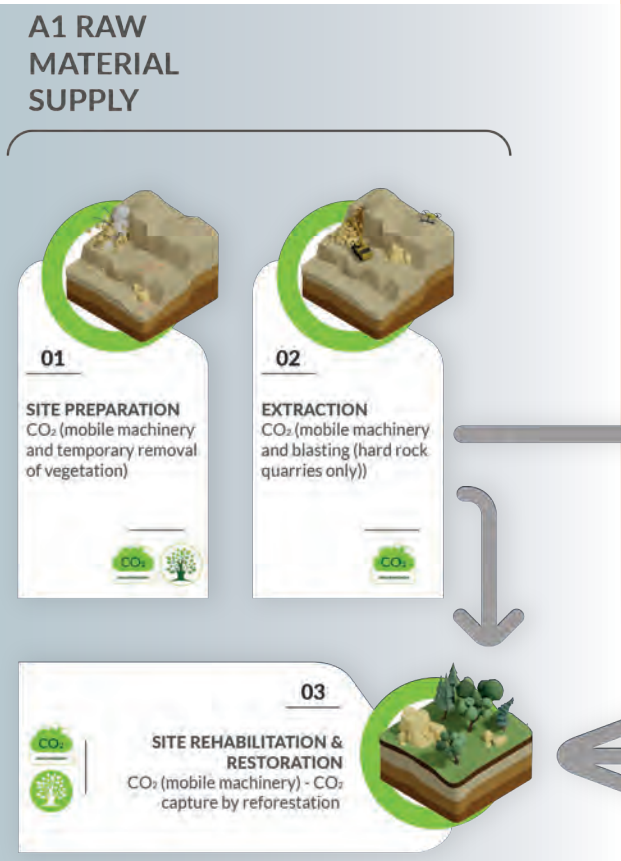
Some countries (e.g., France, Spain, Sweden) have worked in depth on the development of Environmental Product Declarations – EPDs and carbon footprint for aggregates.

Sustainable aggregates for climate neutrality. Spanish Aggregates Federation 2022

A1 RAW MATERIAL SUPPLY

The land included in an authorised quarry perimeter represents a carbon capital that extraction reduces, and that rehabilitation will more or less quickly recover, or even increase depending on the approved restoration project. Indeed, it should be noted that, in addition to the CO_2-eq emissions from the industrial activity of aggregates production linked to the GHG Inventory, there is another impact due to the alteration of the vegetation cover and soil that occurs progressively during the extraction phases of the site and which, on the other hand, is reversed with the rehabilitation activities, the restitution of organic soil and its revegetation.

Obviously, this is linked to the initial state of the affected land, the management of the rehabilitation phases, the type of plant species used and their evolution over time. With proper management, it is possible to achieve final states whose CO_2-eq capture capacity may be higher than the initial state. Next steps 1 to 8 are related to GHG Inventory: Balance sheet of CO_2-eq emissions of the aggregates production process (except biomass emissions and carbon capture), while steps 1 and 8 are also in addition related to long-term quarry footprint evolution of CO_2-eq emissions and capture according to the changes in land use.



1 – Site preparation

The first stage of the production process is the clearance of a site, eventually after vegetation cleaning, stripping soils, and the removal of the overburden to access those parts of the deposit which are suitable for aggregates production. This is done by heavy diesel mobile machinery. The temporary removal of pre-existing vegetation reduces the capacity of the site as CO_2 sink until rehabilitation and restoration occur. This step causes a GHG emission categorised in direct emissions 1.5, emissions related to biomass, soils and forests.

2 – Extraction

Hard rock: Secondly comes the process of extracting the hard rock, through the drilling of blast holes (diesel machine) and the use of explosives and blasting devices specifically designed to control and minimise vibrations.

Sand and gravel or soft rock deposits: In the case of sand and gravel pits, and sometimes in soft rock, extraction is done directly by mechanical diesel equipment such as backhoes and loaders or, if the deposit is below the water table[3] o marine extraction, with draglines or dredges.

3 – Site rehabilitation and restoration

The last stage of the production process is the restoration of the quarries. Once the extraction at a particular quarry point has been completed, mobile diesel machinery carries this task out. Planting of new plant species enhances the quarry's capability to capture CO_2.

This stage induces progressive GHG capture, whose quantification and timing not only remain difficult to identify precisely but are linked to the know-how of the operators and the maintenance of the rehabilitated areas.

[3] According to national legislation and to the permits granted.

Aggregates production process and CO_2 emissions

A2 RAW MATERIAL TRANSPORT

4 – Handling, loading and internal transport

Usually, hauling, and internal transport of operations are performed with mobile equipment such as the above-mentioned, but also with rigid or articulated dumper trucks (powered by diesel engines). In other cases, the material may be transported by conveyor belts (powered by electric engines) or a combination of both.

A3 AGGREGATES PRODUCTION

5 – Treatment processing plant

In the treatment plant (stationary or mobile) crushing, grinding, and classification by different screening techniques take place. Washing happens in specific cases where the deposits have numerous impurities, such as clay. Here, the material classification may be done by hydraulic means, followed by sludge treatment stages. The energy used in the treatment plant is electrical but may have been generated on site by diesel generators. Only when the quarry produces mortar there may be a thermal drying stage, even though it is uncommon[4].

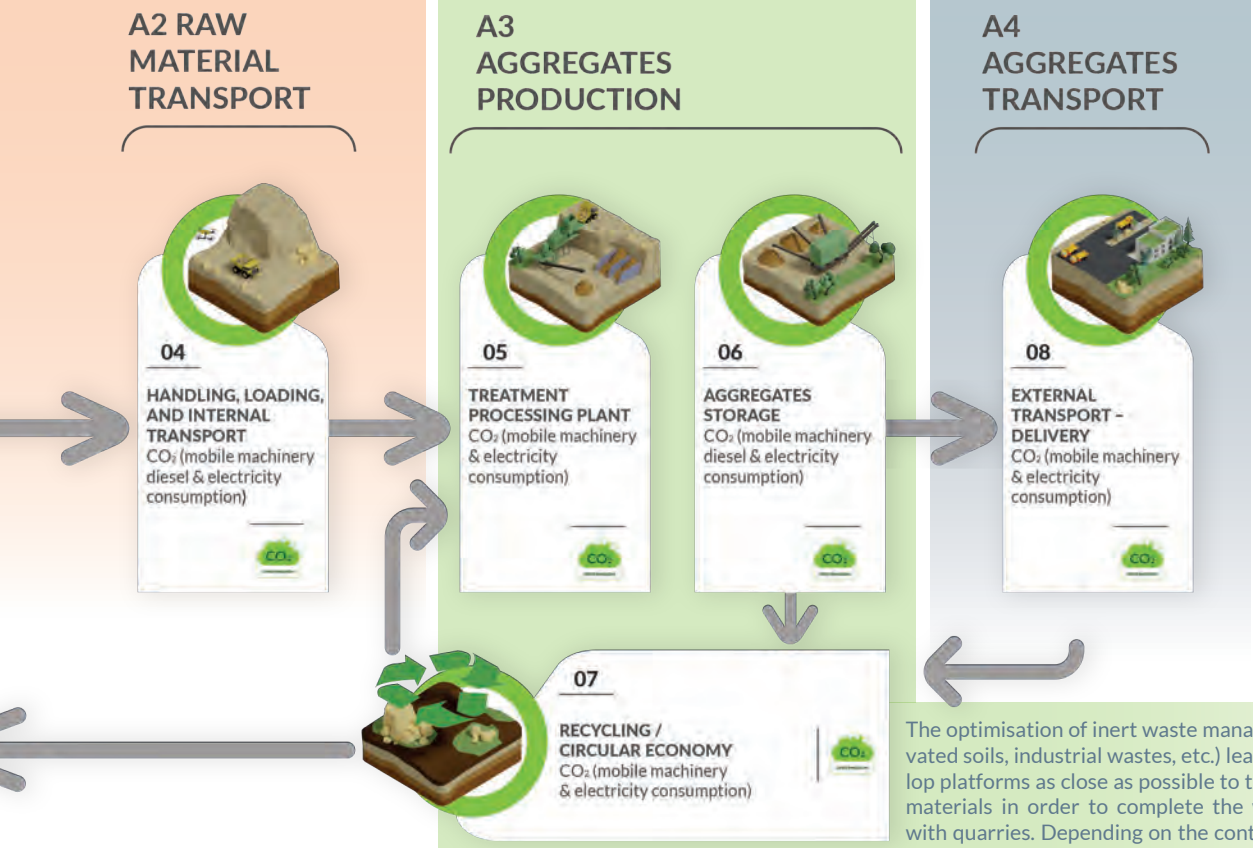
6 – Aggregates storage

The produced aggregates are stored outdoors in stockpiles or indoor in silos. Loading for external transport can either be conducted by automatic means (automatic silo unloading or stockpiles belt loading) powered by electricity or by diesel wheel loaders.

A4 AGGREGATES TRANSPORT

8 – External transport and delivery

The dispatch of the product is carried out through systems of delivery notes and weighing of the aggregates sent to the market on weighbridges. Aggregates are essentially shipped to the market by lorry (>95%), although in countries that have the appropriate logistics infrastructure, and depending on the location of the site and markets, they can be transported by mixed means combining lorry, ship, and rail. In countries with access to marine resources, marine dredged aggregate is transported to wharves by ship for onward transport by lorry, ship, or rail.



7 – Recycling / Circular Economy

Increasingly, the production of natural aggregates is been carried out simultaneously on site with the reception of external inert excavated soils (for site restoration) and CDW to be treated to obtain recycled aggregates. In cases where it is combined with the exploitation and production of natural aggregates, the same treatment plant can be used with some modifications, or another plant, fixed or mobile, can be installed.

The optimisation of inert waste management (deconstruction, excavated soils, industrial wastes, etc.) leads aggregates players to develop platforms as close as possible to the sources of these secondary materials in order to complete the waste management networks with quarries. Depending on the context (country, regulations, geology, urban density, multimodal infrastructure, etc.), these platforms are called upon to play a progressively important role in the decarbonisation of construction materials:

- Collect and sort, to produce natural and recycled aggregates as close as possible to the markets.
- Recover excavated soil into fertile land for the transformation of cities (with the addition of organic waste), into raw soil for low-energy construction materials (mixture of subsoil, straw, sand, etc.).
- Mass transport of non-recyclable waste to quarries.
- In those cases, platforms must be designed to manage often large stocks with very versatile methods and equipment (machinery with multiple tools, mobile screening, crushing units, etc.)

[4] Dry processing techniques are being developed to reduce the water samples: high-energy screening, addition of lime, etc. Sand resulting from dry treatment with lime is considered, within the meaning of the standard, as natural sand by France (Aggregates Standardisation Commission). The use of lime in an alternative dry treatment (a few % maximum) to neutralise clay fines is not synonymous with increasing the carbon balance of the aggregates since it makes it possible to avoid consuming energy in the pumps noting that lime captures CO_2 from the atmosphere and completely recarbonates.

07 Life cycle of Aggregates – Our value chain

Thanks to the high durability, the life cycle of aggregates contributes to the first principle of the 'waste hierarchy' of the EU Waste Framework Directive, preventing waste generation and the need for replacement. As a result, compared to the majority of other goods and materials, there is a low need for recycling aggregates.

In addition, aggregates are 100% recyclable, thus, the CO_2 emissions of a ton of aggregates per year of use are negligible.

Life cycle of natural aggregates

Natural aggregates production – 1 day production + storage (from days to months)

External transport / delivery – 1 day

Integration in construction products – < 1 week

- Cement based (ready-mixed concrete/mortar/precast concrete)
- Bituminous based mixtures

Unbound aggregates– 1 day (bases/subbases/armourstone/railway ballast/other uses)

Construction Phase – 1 to few days (if storage on site)

- Buildings
- Civil works

Use phase – from >10 years to > 200 years. Average >100 years

- Durability
- Energy efficiency

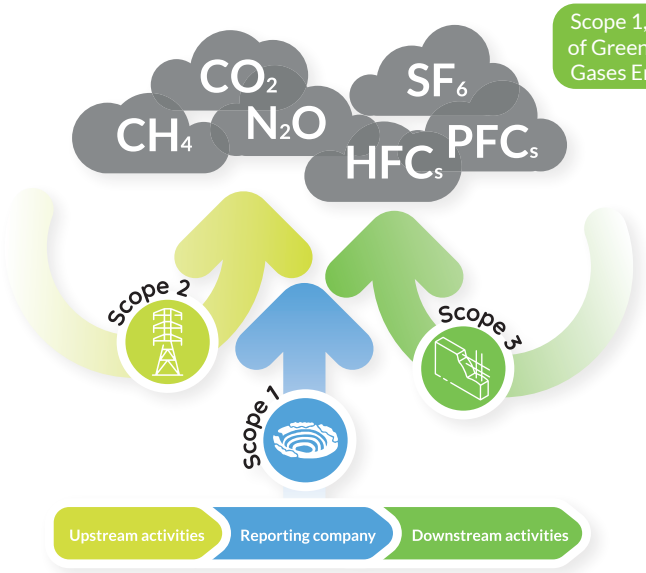
Demolition phase – 1 to 2 months

Recycling / valorisation of C&DW and of industrial wastes – 1 day production + storage (from days to months)

- Adjustement of need of new natural aggregates, having a direct impact on the whole CO_2 emissions to satisfy the total demand of aggregates
- Recarbonation of recycled and artificial wastes / new products
- Use of fine materials as CO_2 sinks

08 The GHG emissions categories for aggregates

The ISO 14060 family standards provides clarity and consistency for quantifying, monitoring, reporting, and validating or verifying GHG emissions and to guide actors towards an increasingly low-carbon economy. The second edition of ISO 14064-1:2018 standard revises the definition of GHG and leave the 3 scopes to list the emission items into six categories. This change is a response to a growing number of organizations that are recognising the importance and significance of indirect emissions and are developing GHG inventories that include more types of indirect emissions across the value chain.



Category 1: GHG direct emissions (idem scope 1)	• 1.1 Stationary combustion sources (Boiler fuels) • 1.2 Mobile sources of combustion (Construction machinery, cars) • 1.3 Non-energy processes (Decarbonation) • 1.4 Fugitive emissions (Coolant leakage) • 1.5 Biomass (soils, wood) (Deforestation, direct land change of use)
Category 2: Indirect emissions related to energy (idem scope 2)	• 2.1 Electricity consumption (generation of electricity by a power plant not included in the scope of the organisation) • 2.2 Energy consumption other than electricity (turbine or boiler outside the perimeter)
Category 3: Indirect emissions associated with transport	• 3.1 Upstream transport (Internal transport between the deposit and the treatment processing plant) • 3.2 Downstream transport (External transport of aggregates to the first user) • 3.3 Home-to-work transport (transport to work for site employees) • 3.4 Movement of visitors and customers (School children, controls, external visitors, administration, customers, etc.) • 3.5 Business trips (Meetings, training, etc.)
Category 4: Indirect emissions associated with purchased products	• 4.1 Purchases of goods (Supplies, goods required for the production) • 4.2 Capital assets (Vehicles, machinery, IT equipment, buildings and other infrastructure) • 4.3 Wastes management (Collection and treatment of wastes and effluent from the perimeter of the organisation) • 4.4 Upstream leased assets (Production, use, maintenance, end of life of goods which are rented by the site to third parties) • 4.5 Purchases of services (Activities giving rise to the production of a service - banks, consultancy, technical studies, etc. - purchased by the site)
Category 5: Indirect emissions associated with sold products	• 5.1 Use of sold products (Production of energy and materials consumed throughout their duration of life by the products sold during the reporting year by the site) • 5.2 Downstream leased assets (Production, use, maintenance, end of life of goods - vehicles, machinery, buildings, etc. - which belong to the quarry and are rented to third parties who are the users) • 5.3 End of life of sold products (Collection and treatment - recycling, etc. - at the end of the life of products sold during the reporting year by the site) • 5.4 Financial investment (Activities and projects financed by the site)
Category 6: Other indirect emissions	• 6.1 Other emissions (Sources of indirect emissions resulting from the activities of the quarry, and which cannot be counted in one of the previous items)

GHG emissions categories for aggregates. Source UNPG

09 European aggregates carbon balance – Baseline scenario

More than 98% of the CO_2 equivalent emissions are CO_2.

The Green House Gases recognised in international agreements are carbon dioxide (CO_2), methane, nitrous oxide and four fluorinated gases; the most widely used, CO_2, has become the baseline (expressed in CO_2 equivalent - CO_2-eq) into which the other gases are converted on the basis of their global warming potential.

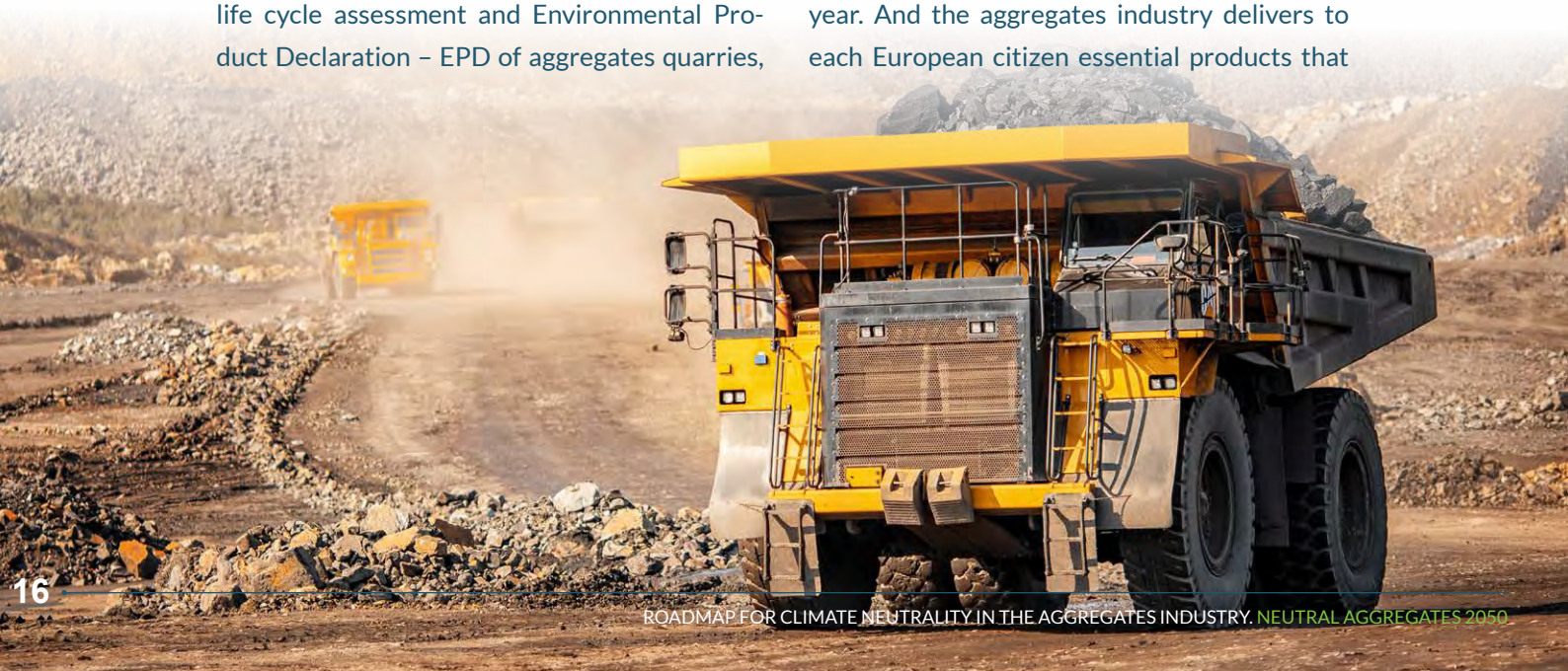
In an average aggregates site, emissions of methane, nitrous oxide, and fluorinated compounds are negligible because they are extremely low.

CO_2 emissions from raw material supply and transport and aggregates manufacturing (A1+A2+A3).

According to available and reliable sources of life cycle assessment and Environmental Product Declaration – EPD of aggregates quarries, from cradle to gate (raw material extraction, internal transport and aggregates manufacturing (A1+A2+A3)), **the carbon footprint is estimated to an average value of 4.7 kg CO_2-eq/t of aggregates**. More specifically, average value for hard rock aggregates is 4.8 kg CO_2-eq/t, while for sand and gravel the corresponding value is 4.6 kg CO_2-eq/t. The variability of the results does not allow us to conclude as a general rule that aggregates from sand and gravel pits always have a lower CO_2 footprint than those from hard rock quarries, as it depends on the many particular circumstances of each site.

Applying the obtained values to the 3.078 billion tonnes of aggregates supplied each year (2021), it can be estimated that the aggregates sector (EU + UK + EFTA) annually produces about 14.5 million tonnes of CO_2-eq, which is 0.35% of EU emissions reported by EEA (2018).

Given that our industry supplies each European citizen with an average of 5.8 tonnes per year, this results in 27.3 kg CO_2-eq/inhabitant per year. And the aggregates industry delivers to each European citizen essential products that

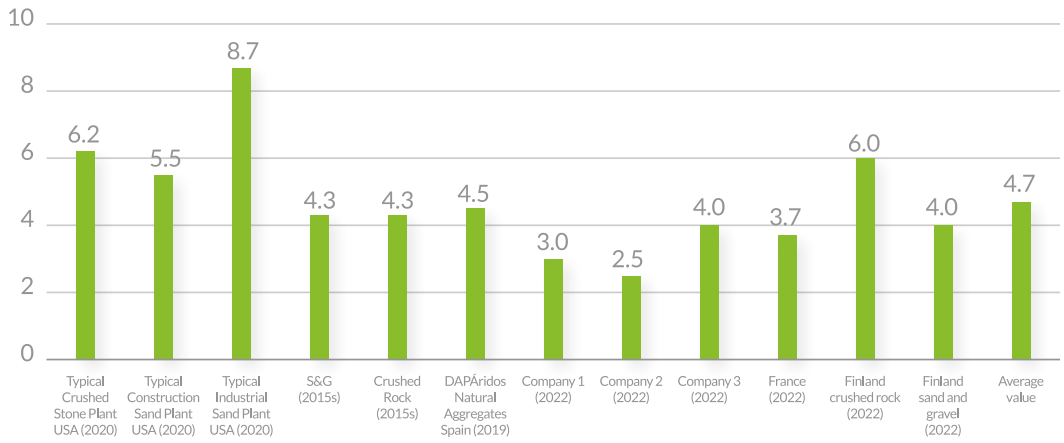


make it possible to benefit of houses, schools, hospitals, museums, shops, cinemas, sport stadiums, etc. Everything around them.

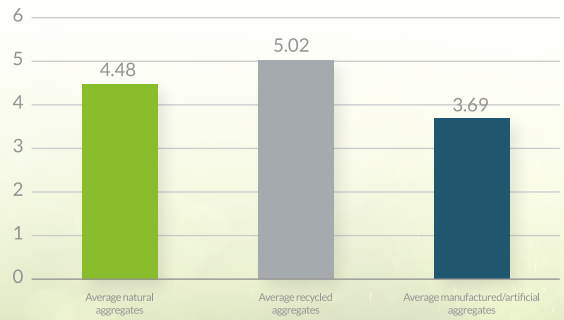
When compared to the emissions of a single trip from Paris to Brussels for one passenger we find the following: 69 kg CO_2-eq by plane (+152%), 59 kg CO_2-eq by gasoline car (+116%), 52 kg CO_2-eq by diesel car (+90%).

Another example would be a smartphone: it generates 95 kg CO_2-eq/unit (+247%) during its production, and a daily citizen's electrical and electronic equipment (EEE) consumption is estimated at an average of 940 kg CO_2-eq/year (+3,333%) for a single household.

CO_2 equivalent emissions for aggregates . Various sources (kg CO_2-eq/t of aggregates)



CO_2 equivalent emissions for natural, recycled, and artificial aggregates.
Source EPD Spanish Aggregates Federation
(kg CO_2-eq/t of aggregates)

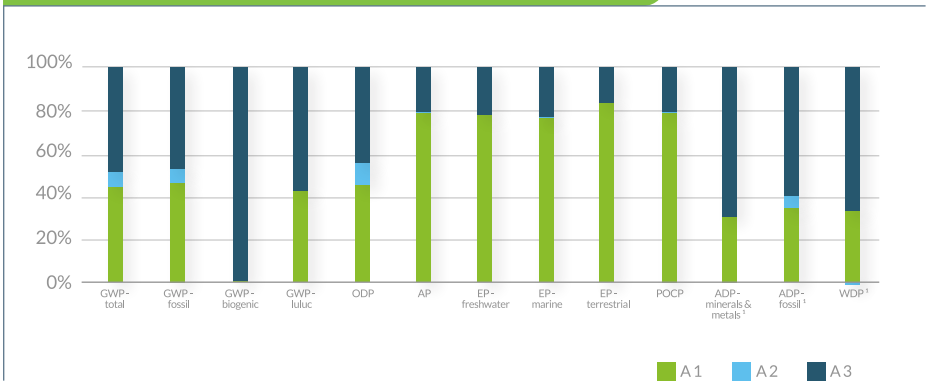


The comparison of the values obtained for natural, recycled and artificial aggregates in the Spanish EPD[5] based on 2019 data and with an identical methodology that allows for a homogeneous contrast shows that, on the one hand, all three cases have low values and, on the other hand, that artificial aggregates are at the bottom of the scale, while recycled aggregates are at the top as they are penalised by the transport of CDWs to the treatment plant.

[5] Calculated according to the GlobalEPD EN 15804, with 400 Spanish sites.

Given the currently known CO_2-eq values, scaling up the circular economy to reasonably possible and feasible values (different for each geographical local area in Europe) will have a minimal impact on climate neutrality in terms of CO_2-eq emissions. For example, in the hypothesis of reaching a 15% substitution of natural aggregates by recycled aggregates (currently 9.4%) and 2.5% for manufactured aggregates, (2.1% at present), emissions would increase by 0.61% in kg CO_2-eq for the total aggregates produced (EU+UK+EFTA).

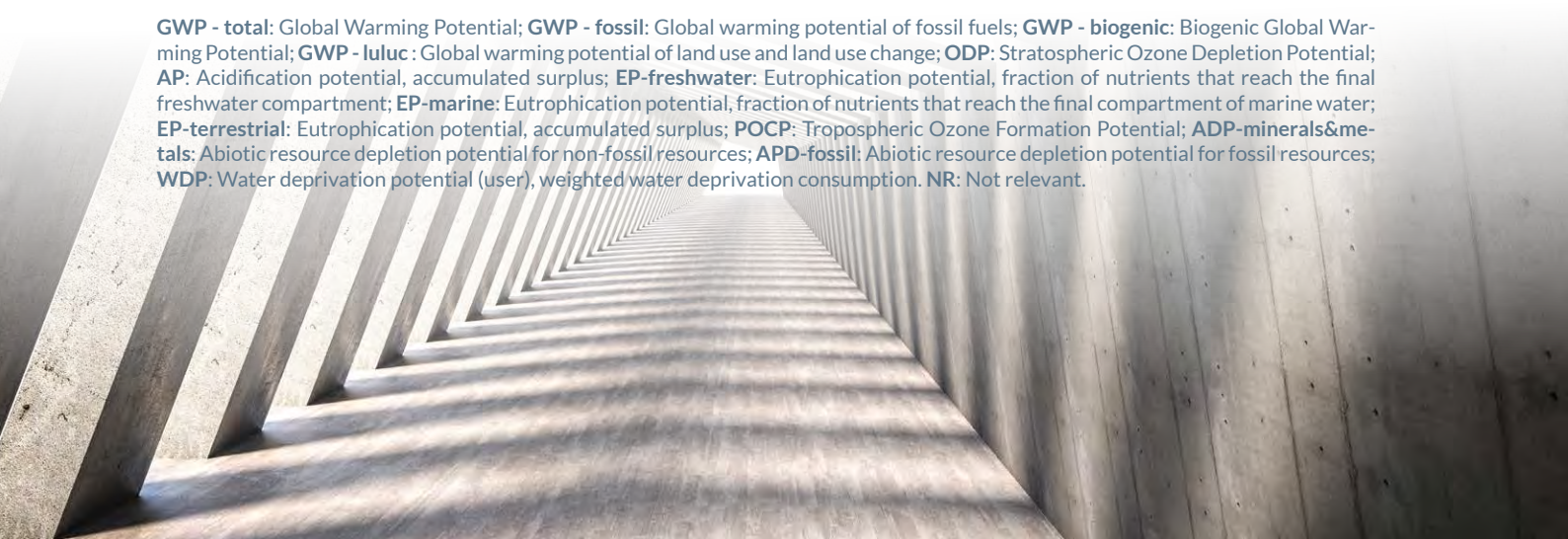
Distribution of each EDP parameter among the different stages of the natural aggregates production process. Source Spanish EPD



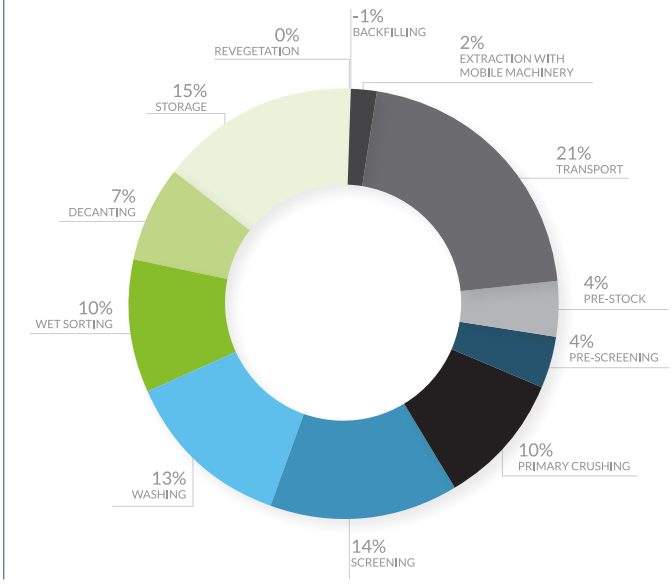
Values of each EDP parameter among the different stages of the natural aggregates production process. Source Spanish EPD

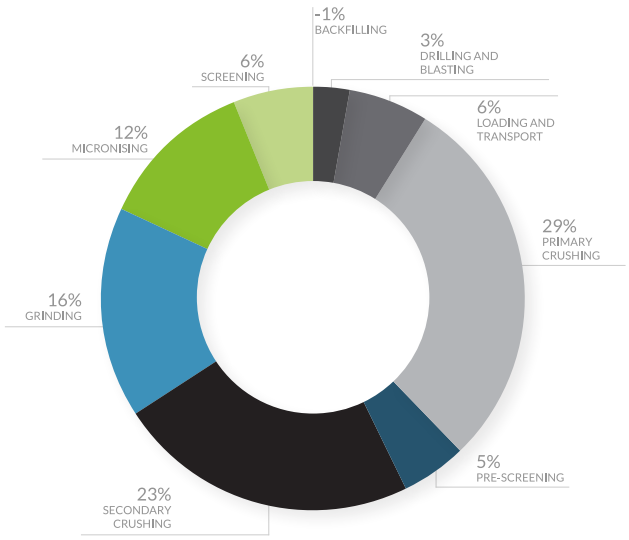
PARAMETER	UNITS	A1	A2	A3	A1+A2+A3
GWP – total	kg CO_2-eq.	2.03E+00	2.90E-01	2.16E+00	4.48E+00
GWP – fossil	kg CO_2-eq.	2.03E+00	2.90E-01	2.03E+00	4.35E+00
GWP – biogenic	kg CO_2-eq.	1.87E-03	1.70E-05	1.25E-01	1.27E-01
GWP – luluc	kg CO_2-eq.	1.37E-03	2.35E-06	1.80E-03	3.17E-03
ODP	kg CFC 11 eq.	3.33E-07	6.89E-08	3.22E-07	7.24E-07
AP	mol H+ eq.	6.20E-02	5.76E-04	1.59E-02	7.85E-02
EP – freshwater	kg PO_4^{3-} eq.	9.33E-03	5.69E-05	2.61E-03	1.20E-02
EP – marine	kg N eq.	2.10E-02	9.56E-05	6.22E-03	2.73E-02
EP – terrestrial	mol N eq.	3.08E-01	1.06E-03	5.92E-02	3.69E-01
POCP	kg NMVOC eq.	6.21E-02	3.75E-04	1.62E-02	7.87E-02
ADP – minerals & metals [1]	kg Sb eq.	8.96E-07	1.26E-08	2.03E-06	2.94E-06
ADP – fossil [1]	MJ	2.54E+01	4.11E+00	4.32E+01	7.27E+01
WDP [1]	m^3	3.53E+00	-6.92E-04	7.03E+00	1.06E+01

GWP - total: Global Warming Potential; **GWP - fossil**: Global warming potential of fossil fuels; **GWP - biogenic**: Biogenic Global Warming Potential; **GWP - luluc** : Global warming potential of land use and land use change; **ODP**: Stratospheric Ozone Depletion Potential; **AP**: Acidification potential, accumulated surplus; **EP-freshwater**: Eutrophication potential, fraction of nutrients that reach the final freshwater compartment; **EP-marine**: Eutrophication potential, fraction of nutrients that reach the final compartment of marine water; **EP-terrestrial**: Eutrophication potential, accumulated surplus; **POCP**: Tropospheric Ozone Formation Potential; **ADP-minerals&metals**: Abiotic resource depletion potential for non-fossil resources; **APD-fossil**: Abiotic resource depletion potential for fossil resources; **WDP**: Water deprivation potential (user), weighted water deprivation consumption. **NR**: Not relevant.



Distribution of CO_2 equivalent emissions from sand and gravel (kg CO_2-eq/t of aggregates). Source EDP Spanish Aggregates Federation





Distribution of CO_2 equivalent emissions from crushed rock (kg CO_2-eq/t of aggregates). Source EDP Spanish Aggregates Federation

CO_2 emissions from downstream transport of aggregates to the first user (A4)

In addition to the above value of 4.7 kg CO_2-eq/t, the downstream transport of aggregates to the first user is evaluated by UNPG (Deloitte)[6] at 4.2 kg CO_2-eq/t.

Unless extended railway and/or maritime transport[7] infrastructure is in place, because of their bulky nature and their low cost, local supply of aggregates is crucial in order to guarantee the environmental and economic sustainability of the Industry.

Considering that aggregates are, after water, the most consumed product in the world, and therefore in Europe at just over 3 billion tons per year, it is critical that public policies support the proximity of quarries to consumption centres, or enable sustainable modes such as rail, for long-distance supply to minimise transport distances and reduce CO_2 emissions in the construction industry.

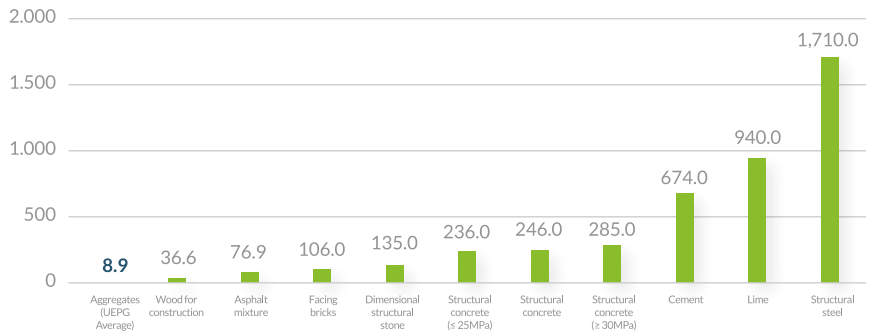
The importance of the transport of products in the carbon footprint of aggregates can also be expressed by the fact that quarries allow the mineral resources present in the territories to be extracted as close as possible to their market. For example, using the UNPG (Deloitte) spreadsheet it is possible to simulate that an additional distance of 10 km would represent a 16% increase in the carbon footprint of the transport by lorry.

[6] See reference 31, in Annex IV.
[7] For example, rock transported from Somerset and East Midlands in England into London and South East England.

Comparison of CO_2-eq/t emissions (A1 to A4) of aggregates with other products used in the construction industry

According to UNPG and Deloitte, aggregates have, by far, the lowest CO_2-eq/t emissions (A1 to A4) when compared to other products used in the construction industry.

Kilograms of CO_2 equivalent emissions per ton for different products, including average transport. Source UEPG from different sources (UNPG, Deloitte, UEPG, and other sources)[8]



[8] Comparative Analysis of the Global Warming Potential (GWP) of Structural Stone, Concrete and Steel Construction Materials. Kerr, J. et al. (2022); Declaraciones Ambientales de producto de hormigones. ANEFHOP. (2022); Environmental Product Declaration. TARMAC (2016); CEMBUREAU (2020) + 7 kg CO_2-eq / t for cement transport. Eula (2015)

10 Aggregates industry and carbon neutrality – SWOT analysis

Strengths

- An essential and strategic product indispensable for climate change adaptation / prevention / mitigation and to achieve the EU goals.
- A low carbon intensity industry (production and transport), with very small CO_2 emissions per tonne and total emissions compared to overall emissions and to other sectors.
- A production of huge volumes of products with low surface occupation, low cost, and high quality and durability.
- EU domestically sourced production leading to low geopolitical dependency and supply risk, together with short transport distances.
- Massive amount of client industries (GDP impact, employment impact, ...) and enormous diversity of uses that favours the establishment of other industries in the territory, contributing to the establishment of value chains to avoid the relocation of companies, as well as to promote the EU's industrialisation and job creation objectives.
- Environmental capacity and behaviour of the EU Aggregates companies:
  - Biodiversity enhancement, green infrastructure and connectivity and ecosystem services, including carbon storage and sequestration.
  - Sustainability policies.
  - Circularity leadership.
  - High resource efficiency (Low waste production on site and mostly inert).
- Big network of 26,000 sites across the EU. Good neighbour policies to help citizens fight floods, snowfalls, fires, and waste management derived from these phenomena, water reserves, etc.
- Rehabilitation and restoration contribute to adaptation (i.e., water storage and flood management or fire prevention).
- Good EU and national Aggregates Associations that can help all companies and, in particular, SMEs towards the change that is required.
  - High lobby capacity to explain the issues to policymakers.
  - High prescription capacity towards members.

Weaknesses

- Size of companies – small number of major/ international companies and large number of SMEs. Particular issues for SMEs include:
  - Capital costs of investments to decrease specific energy consumption o for lower carbon technologies will be significant, leading to the need for economic support for the change.
  - Lack of internal technical expertise and external support.
- Low awareness of the companies on the need to adapt their processes and technologies to lower CO_2 emissions.
- Low economic margins for the huge investments that will be needed.
- Low capacity of adaptation compared with the evolution of targets coming from decarbonation policies.
- Need for adaptation and preparation of the workforce in the face of new technologies and policies to operate and maintain upgraded facilities.
- A suitably sized aggregates market is needed to run sites at optimal capacity to deliver maximum energy performance.
- Social impacts and negative image of quarries.

Opportunities

- Local supply. Aggregates km 0.
  - Better permitting (extractive and land use planning).
  - Close to the destination of use.
  - Strategical management perspective.
- New aggregates markets, key for climate change effects mitigation:
  - Energy efficiency rehabilitation and improvement in buildings.
  - Sustainable mobility (underground and suburban networks, parking areas, etc.).
  - Creation of intermodal connections and logistical nodes.
  - Freight rail network improvement, which is several times more efficient and has a level of greenhouse gas emissions five times lower than other modes.
  - Water management (regulation, distribution, loss reduction (26%), sewerage and wastewater treatment).
  - Coastal and river flood protection.
  - Water scarcity and desertification combating (erosion control and irrigation).
  - Development of a renewable energy network and other infrastructures for required for decarbonisation (carbon capture).
  - Circular economy (green points, transfer stations, treatment plants and energy recovery infrastructures).
  - Inclusive and sustainable urban planning (railway closures, high traffic streets, by-passes), etc.
- Evolution of the production to achieve even "Better" aggregates:
  - Higher durability.
  - Increased performance.
  - Lower environmental footprint.
- Circular economy:
  - The capacity of the industry to manage recycled and artificial aggregates.
  - Other waste management capacity.
  - Recovery of poor excavated soil to generate fertile one for the transformation of cities (with the addition of organic waste), or for other uses such as the production of energy-efficient building materials (mixture of subsoil, straw, sand, etc.).

- Renewable energy self-supply.
- E-mobility.
- Digitisation oriented to climate change mitigation and adaptation.
- Site rehabilitation as a carbon sink.
- Biodiversity and ecosystem services.
- Recarbonation (Quarry / Stocks / Built environment – buildings and infrastructures – recycled concrete materials).
- Quarry water supply for human consumption.
- Prevention and mitigation of floods, fires, etc.

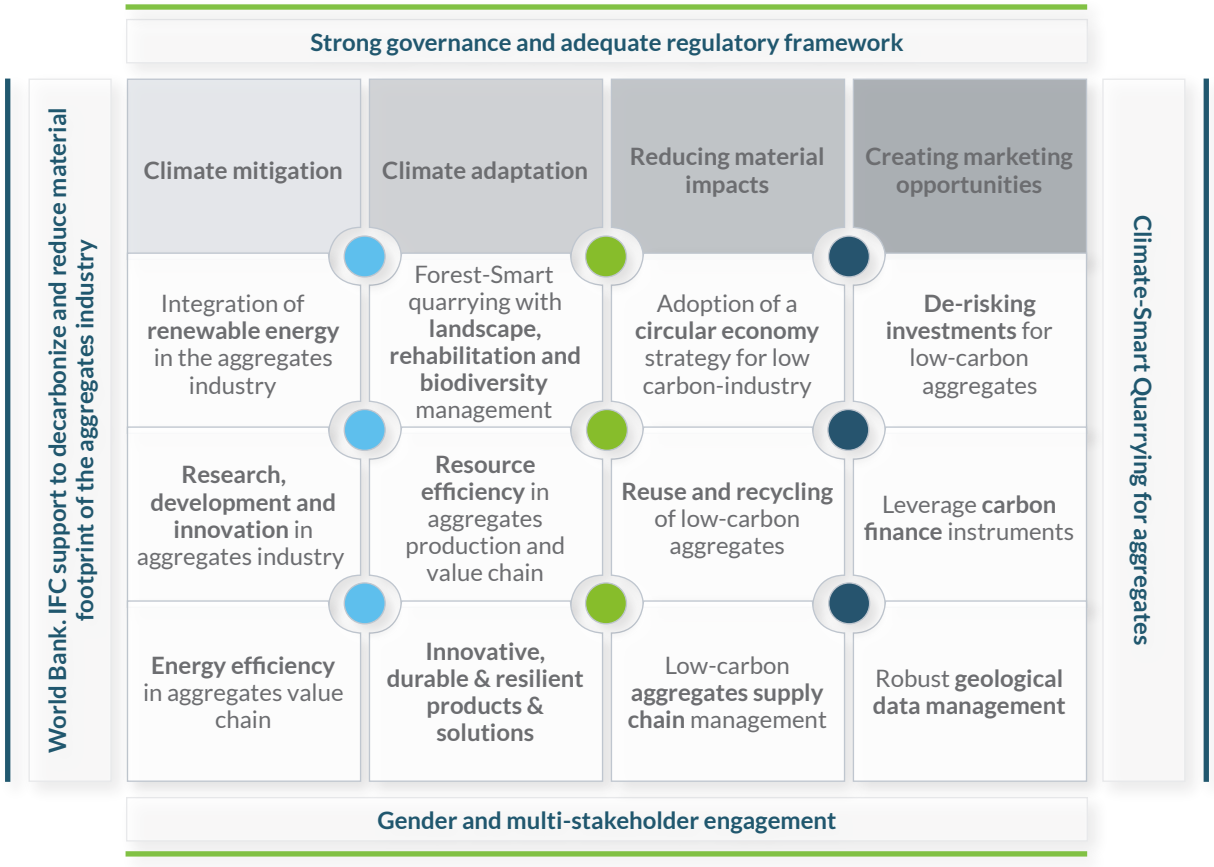
Threats

- New regulations and policies (EU / National / Local) that could result in:
  - New unrealistic requirements for the industry (IED, New targets for Nk2, Water, Air, Soil, ...) and projects (new sites, renovation, or enlargement).
  - New policy targets (constantly evolving to become more restrictive).
  - Planning and permitting requiring zero emissions rather than considering 'transition' to net zero target by 2050 and time taken for the development, availability, and affordability of low carbon technologies.
  - New taxation policies for natural aggregates.
  - Potential new land restrictions.
  - Reinforced environmental requirements may, in some cases, increase the energy consumption.
- Availability and cost of technologies.
- Increased cost of supplies and energy.
- 'New' competitor products (self-proclaimed greener products).
  - Wood.
  - New sourced aggregates (CO_2 captured based, natural aggregates from other extractive industries, ...).
  - Etc.
- Challenges for our key markets: cement/lime-based (concrete, mortar, precast, ...) and bituminous mixtures leading to:
  - Costs increase of the products containing aggregates.
  - Unfair competition due to imported, cheaper, high-carbon products .
  - Potential new issues of EU cement/lime-based producers (affecting investments in their aggregates divisions).
  - Etc.
- Speed of the transformation process (ambitious short-term goals).
- Zero-emission areas in cities that hinder transport.
- Taxonomy, if the extractive industry is nor properly considered.
- Need of changing the transport fleets to make them less CO_2 emitting and more efficient.
- Potential land conflicts between aggregates sites and new renewable energy sites.
- Climate change demonstrations against large infrastructure projects (Communication issues).
- Large-lasting permits for the introduction of low carbon new technologies (i.e., installation of renewables on sites).
- Lack of alternative to fossil-fuelled (diesel) heavy machinery – lorries on-site and for transport to markets.

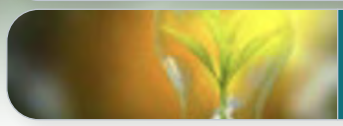
11 Why are aggregates essential for carbon neutrality? What can we do?

The World Bank's Climate-Smart Mining Building Blocks adapted to the aggregates industry by Aggregates Europe – UEPG shows full alignment between the approaches of the two institutions.

Climate-Smart Mining Building Blocks. Source World Bank and Aggregates Europe – UEPG



Reducing CO_2 footprint of aggregates (production + distribution + lifespan)



Contributing to greener energy supply and use. Decarbonisation of electricity and fuels

Contributing to prevention and adaptation to the effects of climate change

Fostering biodiversity and rehabilitation for net positive impact adapted to climate change, environment management and eco innovation

Keeping the circular economy in function

Bringing the future closer with digitisation and new technologies

Contributing to the ecological transition

Promoting aggregates industry R&D&i – Innovating for neutrality

Main contributions of the aggregates industry to climate neutrality in Europe. Source Aggregates Europe – UEPG

Reducing the CO_2 footprint of aggregates (production + distribution + lifespan)

Although the CO_2 emissions per tonne of aggregates are very low, further reducing its carbon footprint is a priority. To achieve this, the aggregates industry is able to:

- Aggregates companies
- Aggregates associations
- Public administrations
- Client industries
- Suppliers
- Accademia, Technological Centres, etc.
- Environmental NGOs

	Aggregates companies	Aggregates associations	Public administrations	Client industries	Suppliers	Accademia, Technological Centres, etc.	Environmental NGOs
Include the CO_2 emissions dimension when designing new sites.	✓						
Work in a sustainable way to maintain a network of sites that provide local access to resources, thus reducing transport distances. Local supply is a key issue. Access to local resources by land-use planning and permitting procedures. Guaranteeing the supply of local aggregates to meet the needs arising from the prevention and mitigation of climate change effects.	✓						
Progressively introduce low-carbon technologies in aggregates production when developed, available and affordable. Process improvements to minimise CO_2 generation by combustion (Electrification, Hydrogen, etc.). Taking benefit from lower CO_2 equipment and technologies delivered by machinery and goods suppliers.	✓				✓		
Apply smart design to the sites to minimise the energy requirements in the process (short transport distances, use of gravity, substitution of mobile equipment by conveyor belts, etc.).	✓				✓	✓	
Enhance blasting practices to reduce electrical energy consumption in the treatment plant.	✓				✓		
Increase efficiency in aggregates production (energy, water, management of the geological deposit, etc.).	✓				✓		
Improve equipment maintenance in order to increase its lifetime as well as reduce the equipment's replacement needs and therefore its associated CO_2 footprint.	✓				✓		
Develop a Life Cycle Analysis and Environmental Product Declarations (EPD) and make aggregates carbon calculations available to customers.	✓						
Further develop "Greener aggregates": higher durability, lower content of unwanted substances, better performance, etc.	✓						
Improve logistics systems for intermodal means of transport (bulking logistics platforms that combine trucks, rail, ships, etc.).		✓	✓				
Deliver aggregates for green construction.	✓						
Demonstrate how the new projects will contribute to mitigation and adaptation to climate change.	✓			✓			
Develop a collaboration roadmap that provides formal opportunities to our client industries to develop greener and lower-carbon new products, services, and solutions.	✓			✓			
Contribute to recarbonation of products (ready-mix concrete, precast concrete, mortar or even some natural/artificial aggregates) by research[9] and promotion of: • Accelerated carbonation of materials and products derived from carbonates, the capture of high industrial quality CO_2 released in manufacturing and its incorporation into products and applications. • Natural aggregates such as basalt when crushed can also be re-carbonated when exposed to certain temperature and pressure conditions.	✓			✓			

[9] The use of "carbonatable" products or those which capture CO_2 to mitigate the effects of climate change, such as calcification of acidified lakes and oceans or the use of these materials to capture CO_2 in industrial and civil applications (i.e., carbonation of buildings, agricultural products, soils, and asphalt in the road network, etc.).

Contributing to greener energy supply and use. Decarbonisation of electricity and fuels

The following actions will lead to an intense CO_2 reduction of aggregates global energy demand:

Energy switching

Switching the current energy sources and diverse self-consumption supplies to renewable sources in aggregates sites and treatment processing plants (wind turbines, photovoltaic solar panels, biofuels, gravity, geothermal and, when available, hydrogen, etc.). Increasing renewable energy usage and machinery electrification will contribute to the decarbonisation objectives. This could supply the electrical facility's power, plant lighting, and equipment such as truck wash stations. Potential deployment of these technologies in aggregates sites is highly dependent on local conditions like the availability of local renewable sources, electricity prices, site size, political context, permitting and economic incentives. Permitting for on-site renewable energy deployment should be simplified and facilitated.	✓				✓		
Reducing indirect emissions by contracting electricity supply from decarbonised sources.	✓				✓		
Gradually substituting the current fleet of mobile equipment (in-house machinery and external-fleet lorries) and engines by new ones with lower energy consumption, higher efficiency, hybrid, and lower emissions or by other powered by new energy sources like eco-fuels, electricity, or hydrogen engines as these become commercially available and affordable. Truck and mobile equipment manufacturers are conducting extensive research on industrial-scale vehicles, including hybrid (electricity, eco-fuel, and hydrogen) vehicles. Besides, full-electrically powered conveyances are also being tested. According to estimates, all material and fuel transportation will be carbon neutral by 2050.	✓				✓		
Developing new, both site and plant designs, to reduce diesel-powered haulage and install conveyors to transport the material instead of mobile equipment, when possible.	✓				✓		

Energy efficiency

The production of aggregates is energy intensive, and companies work permanently to optimise their processes to become more efficient, due to the high energy costs. These are the actions to be potentially achieved:

Undertake energy audits to increase energy efficiency in the different stages of the aggregates production process.	⚒						
Develop digital monitoring of energy use at each stage of the processes will lead to improved flow and consumption optimisation.	⚒						
Enhance energy facilities to better dimension them and therefore avoid losses.	⚒						
Deploy existing state-of-the-art technologies in new aggregates plants and retrofit existing facilities to improve energy performance levels when economically possible.	⚒				🏭		
Train drivers of mobile equipment on efficient driving, as well as all the other workers in the efficient use of energy.	⚒						
Reduce the energy footprint of aggregates and those products where aggregates are incorporated, in collaboration with client industries.	⚒			🚚			
Optimise consumption by working with mobile equipment and processing plant manufacturers to determine the right size of mobile fleets and of the treatment facilities based on actual needs.	⚒				🏭		
Implement state-of-the-art emission monitoring equipment and real-time fleet management software.	⚒				🏭		
Improve insulation (double pane windows, roofing, and walls materials, etc.) of the buildings in the site (offices, changing rooms, canteens, workshops, laboratories, etc.) to reduce heating and cooling energy needed.	⚒						
Use techniques like thermography to find energy or heat leaks, ensuring that the machine is working as efficiently as possible.	⚒						
Transforming traditional lighting systems into low-energy LED ones.	⚒				🏭		
Manage the site to benefit of the availability of electricity supply to maximise renewable sourced.	⚒						
Site election as close as possible to the market, to minimise external transport distances.	⚒						

Contributing to prevention and adaptation to the effects of climate change

Tomorrow's human-built environment will have sustainability at its core. Structures, both building, and infrastructures must be resilient, safe, durable, and affordable (social pillar); they must meet the pursuit of carbon and energy efficiency; and construction and renovation must remain a key driver of economy growth and jobs, as strongly emphasized in the renovation initiative launched under the Green Deal.

Aggregates' properties remain unchanged under all kinds of environmental conditions, adverse weather conditions and extreme natural phenomena such as floods, storms, hurricanes or even fires.

Aggregates transfer all their positive properties of strength like fire resistance, durability, or many others to the products in which they are incorporated, such as ready-mixed concrete, precast concrete, mortars, surface layers, bases and subbases of infrastructure, railway ballast, armourstones, etc.

As a consequence, aggregates are a strategic industry for the supply of high quality and massively needed primary and secondary affordable raw materials essential for construction to contribute to climate change prevention and adaptation (Renovation Wave) in:

Design and construction of sustainable buildings and infrastructures as aggregates are efficient, 100% recyclable and highly durable products. Aggregates perform an important role in the development of adaptability and disassembly techniques.	⚒			🚚			
In addition to providing many of the essential properties of concrete, precast concrete and mortar, aggregates contribute to diluting and substantially lowering the CO_2 in concrete, as they account for 80% by weight.	⚒			🚚			
With the evolution of low-CO_2 cements, aggregates will continue to play a key role in providing the essential properties to concrete, precast concrete and mortar.	⚒			🚚			
Because the use of aggregates improves concrete's thermal mass properties, which can reduce the energy required for this purpose, rehabilitation, and improvement of energy efficiency for heating and cooling in buildings during their working life. This energy reduction will save CO_2 indirectly until the energy supply is completely decarbonised.	⚒			🚚			
All transportation infrastructures including roads, bridges, subways, light rail systems, airports, ports, sidewalks, and bike trails. The aggregates industry can contribute to road improvements which will help to reduce CO_2 emissions. Proper road maintenance and improvements, such as more efficient intermodal hubs to help reducing emissions.	⚒			🚚			

Development of the renewable energy network especially on- and off-shore wind, tidal, hydraulic, and photovoltaic: • Windmill turbines require substantial foundations and other associated structural and geotechnical engineering considerations. One 2 MW onshore windmill turbine need a foundation of more than 400 tons of aggregates for the concrete and other relevant amount for their new service roads and for the foundations of the distribution grid towers between new renewable infrastructure and the pre-existing grid. Building a 2 MW offshore wind turbine requires about 10,000 tonnes of aggregates. • Solar power plants (photovoltaic) require smaller foundations for each solar panel. But because the number of solar panels required to achieve the power of an equivalent windmill is much higher, the total concrete and aggregates requirements are comparable. Aggregates are also needed for the construction of solar thermal plants. • Dams for hydroelectric power generation are entirely made of concrete, and then contain massive amounts of aggregates. The same goes for the structures for tidal power stations (tidal stream generators, tidal barrages o lagoons, dynamic tidal power, etc. • Nuclear fission technologies, as referred in Net Zero Industry Act requires aggregates. • Aggregates, as the main constituent of concrete, are also key to geothermal energy.	✓			✓			
Sustainable mobility (underground and suburban networks, parking lots, etc.).	✓			✓			
Creation of intermodal connections and logistical nodes.	✓			✓			
Resilient infrastructure (roads, railways, housing) against extreme weather conditions (droughts, floods, storms).	✓			✓			
Adaptation to river floods and rising sea levels (extraction sites as retention areas, dikes, dams, beach refurbishment). Aggregates are essential for coastal and river flood protection.	✓			✓			
Contribute to rivers' free flow by preventing flooding through organised and approved dredging operations to keep the river channel clear of sediment accumulations, protecting its banks from erosion with armourstones, creating buffer zones for flood dissipation, and offering extraction sites near rivers as retention areas to reduce the effects of flooding.	✓			✓			
Fight water scarcity, droughts, and desertification (erosion control and irrigation).	✓			✓			
Improve the freight rail network, which is five times more energy-efficient than other modes and has a lower level of greenhouse gases emissions.	✓			✓			
Water management (regulation, distribution, loss reduction, sewerage, and wastewater treatment).	✓			✓			
Build a circular economy network (green points, transfer stations, treatment plants and energy recovery infrastructures).	✓			✓			
Develop inclusive and sustainable urban planning (railway closures, high traffic streets, by-passes), etc.	✓			✓			
Carbon capture, utilisation and storage (CCUS) infrastructure.	✓			✓			

Fostering biodiversity and rehabilitation for net positive impact adapted to climate change, environmental management and eco innovation

Multiple impacts on biodiversity are expected as a result of climate change.

The European aggregates industry can prove positive synergies between biodiversity conservation policies and climate change mitigation and adaptation policies, since it is recognised by far as the leader of the extractive industry regarding biodiversity management and sites rehabilitation, and one of the main players in environmental management and eco innovation.

As an example, the biomass found in the soil (topsoil, wetlands) and on the ground (vegetation) of quarries in France represents a carbon stock estimated at 22.6 million tons of CO_2-eq, and the procedures used for rehabilitation are seen to get improved over time.

Therefore, we can help to support ecosystems' integrity and resilience, conservation, and promote the connectivity and permeability of natural regions.

The aggregates industry is essential for Europe to reach the net zero target by 2050 by:

Implementing biodiversity management plans in aggregates sites, oriented to the priority objectives of the European Strategy on Biodiversity 2030, with ecological connectivity and with green infrastructure, halting biodiversity loss. A biodiversity indicator reporting system is currently under development. Besides, a management tool to measure our net biodiversity gain will be disseminated and promoted too.	✓						✓
Aligning biodiversity management and rehabilitation plans to contribute to protected, prioritised, and endangered species and habitats to fight against invasive alien species, thus actively contributing to climate change mitigation and adaptation.	✓						✓
Improving aggregates site ecological restoration programs to increase biological diversity and its ecosystem services (pollinators), including nature-based solutions and carbon sink-oriented restorations (sites for CO_2 capture), and water storage (flood management and water supply). As well as preventing desertification, land degradation and loss of biodiversity. This will help to achieve climate mitigation and adaptation EU goals and nature restoration and green connectivity strategies.	✓						✓
Anticipating the carbon trajectory of each quarry based on land management, rehabilitation of the site and possible arrangements with stakeholders.	✓						✓
Orienting the site's rehabilitation as a carbon sink and biodiversity asset through delivering multiple ecosystem services.	✓						✓
As a member of Aggregates Europe – UEPG adhering to the European strategy on pollinators.	✓	✓					
Fostering reforestation (contributing to EU reforestation and rewilding strategies).	✓						✓
Improving air quality emissions management (noise, particles, vibrations, ...).	✓						
Efficiently managing water (groundwater and surface water), in terms of consumption, quality, recycling, etc., by: • Reducing specific water consumption per ton of aggregates (90 l/t). • Minimising water withdrawal and water discharges. • Achieving that the 100% of water discharged meets water quality standards.	✓						
Investing in technologies to reduce aggregates' production environmental footprint on soil, air, water, etc.	✓				✓		

Keeping circular economy in function

The main contribution of aggregates to the circular economy is their high durability. This maximises the first principle of waste management: the prevention of waste generation.

As a 100% recyclable and infinitely recyclable product, natural aggregates have a non-ending life within the construction cycle.

Nevertheless, as observed in practice and confirmed by all rigorous studies, the capacity of recycled and secondary aggregates to cover a part of the total demand of aggregates is limited and varies from country to country, so that in the best-case scenario natural aggregates consumption will continue to cover approximately 85% of this total demand. CO_2-eq emissions from recycled aggregates are similar or even higher than those from natural aggregates. So, aggregates from secondary sources can provide some emissions benefits, but only if the material is locally available, with a quality that meets the technical requirements for its use and can also be locally used or even on-site reused.

Then, again, aggregates are key to contribute to the net zero target by expanding the quarries activities to the management of construction and demolition waste, industrial waste and / or non-hazardous waste by:

Installing recycling plants in aggregates sites.	⚒				🏭		
Adapting site production processes to the manufacture of recycled and / or artificial products or even to process new aggregates.	⚒				🏭		
Adapting the extractive sites for excavated soils, CDW management, or other waste management.	⚒				🏭		
Collaborating with client industries to generate best practices across aggregates downstream product lines to maximise aggregates use efficiency.	⚒			🚚			
Improving the quarry deposit and the treatment plant management to minimise the generation of extractive waste.	⚒				🏭		
Developing site methodologies to maximise the use of waste material that would have otherwise gone to landfill.	⚒						
Valorising non-recyclable low quality CDW for site rehabilitation (backfilling).	⚒						
Identifying and developing by-products for other uses.	⚒			🚚			
Recovering poor excavated soil to generate fertile one for the transformation of cities (with the addition of organic waste), or for other uses such as the production of energy-efficient building materials (mixture of subsoil, straw, sand, etc.).	⚒						
Implementing policies of agreements for active collaboration between aggregates and CDW management companies to promote operational synergies.	⚒			🚚			
Developing R&D&I to increase the durability, quality and recyclability of aggregates and their products.	⚒			🚚			

Bringing the future closer with digitisation and new technologies

The aggregates industry demands evolvement to take full advantage of the synergies and opportunities of new technological developments and the development of advanced data management, sensors, artificial intelligence, and robotics solutions in order to implement the following challenges:

Improvement of the extractive project and also the production process to maximise resource efficiency by increasing the extraction capacity of all the raw materials from the deposit.	●				●		
Improvement of rocks, minerals, and products control by enhancing technologies and digitisation processes to obtain safer, more durable, and more advanced materials and products.	●				●	●	
Adoption of new technologies for new aggregates deposits investigation.	●				●	●	
Minimisation of the extractive waste generated at various stages of the production process.	●					●	
Optimisation of the covered distances by each mobile equipment (internal and external transport) by analysing and automating the internal truck loading circuit, reducing machinery movements, and externally managing and optimising the distances travelled by the truck fleet.	●				●		
Improvement of the coordination of operations to increase efficiency.	●						
Reduction of energy consumption in the different phases of the extractive process and the overall consumption.	●						
Remote / autonomous operation of equipment (mobile and fixed).	●						
Supply-demand alignment: Just In Time management of the production.	●						
Use of decision-making tools.	●				●	●	
Automation of the entire process and integrated management, including KPIs.	●				●		
Automation and integration of logistics procedures for storage, loading and dispatch of aggregates.	●				●		
Use of predictive maintenance systems to improve efficiency of processes.	●						
In this specific case, digitisation applied to aggregates as a product would: • Create the Digital Product Passport (DPP) one of the pillars of the proposed Eco-design for Sustainable Product Regulation (ESPR). • Enable builders to receive and deliver the exact aggregates required on site. • Help contractors and purchasers of the building/infrastructure to enable the carbon footprint to be determined. • Help clients to improve aggregates grading and optimise admixtures.	●			●			

Contributing to the ecological transition

The aggregates industry is a relevant performer when generating economic activity in the European Union, anchoring other industrial activities around it, creating quality employment and, therefore, fixing the population in rural or peri-urban areas. All this contributes to territorial balance maintenance, which is very important for climate neutrality.

The aggregates industry supply of more than 3 billion tonnes each year for a wide range of applications is an essential contribution to the Green Industrial Deal goals and the competitiveness of the EU's industry and economy.

The European Industrial Strategy states that, as the whole European industry moves towards climate neutrality, there is a risk that the dependence on fossil fuels will be replaced by the dependence on non-energy raw materials. Access to resources is fundamental to all EU industries and central to Europe's ambition of delivering the Green Deal and ensuring the digital transformation of the EU economy.

Indeed, all raw materials (not just critical raw materials) are the first of six strategic areas defined by the European Commission for EU industry.

In line with this EC strategy, the aggregates industry can:

Continue to work to improve the permitting process and ensure its predictability.		●					
Commit to maintain high environmental standards.	●	●					
Apply EU principles for sustainable raw materials.	●						
Invest under the Recovery and Resilience Facility.	●						
Develop research and innovation for raw materials under Horizon Europe.	●	●				●	
Build strategic international aggregates partnerships, such as the Global Aggregates Information Network, to secure a diverse and sustainable supply of essential raw materials.		●					
Implement further "product as a service" business model to encourage the recycling and reuse of raw materials.	●			●			
Track raw materials through technology, harmonised data requirements.	●						
Evaluate the economic impact of climate change on aggregates companies.	●						
Take actions to assess and then improve the competitiveness of the aggregates industry.		●					
Enhance the added value of aggregates as a strategic product to achieve the net zero target in relation to other self-proclaimed greener products.		●					

Promoting aggregates industry R&D&i – Innovating for neutrality

The aggregates industry has the ambition to prove that it is a leading supplier of green construction solutions for buildings and infrastructures.

To achieve this, our industry is developing R&D&I projects at the EU and national level to:

Meet the future demand of aggregates to ensure a sustainable supply for climate protection and climate change adaption in Europe, especially including the renewable energy infrastructure.	⚒						
Increase efficiency of aggregates production (energy, resource, water, explosives, supplies, etc.).	⚒				🏭		
Develop low carbon technologies for aggregates production together with equipment manufacturers and other suppliers.	⚒				🏭	🏛	
Achieve a greener energy supply and machinery affordable to SMEs.	⚒				🏭		
Develop renewable energy production on site.	⚒						
Foster circular economy.	⚒						
Minimise CO_2 and environmental footprint of the aggregates industry.	⚒				🏭		
Put digitisation in the core of the activity as lever to achieve net zero target by 2050.	⚒				🏭		
Increase the durability and resilience of aggregates to deliver climate proof infrastructure.	⚒			🚚		🏛	

A list of projects is included in Annex II.

Some R&D&I aggregates projects related with carbon neutrality

DIGIECOQUARRY
INNOVATIVE DIGITAL SUSTAINABLE AGGREGATES SYSTEMS

R8TATE
CIRCULAR ECOLOGICAL ESSENTIAL & CRITICAL RAW MATERIALS

carbon8

Blue Planet™

12 Contribution to carbon neutrality

The aggregates industry´s contribution to carbon neutrality by 2050 can be structured by areas and actions that enable significant reductions in CO_2 emissions.

An assessment of the average status for 2023 and 2050 is made (from - non initiated to - achieved).

And the interactions of the aggregates industry required with client industries, suppliers, environmental NGOs public administrations, Accademia, technological centres, etc., and aggregates associations are pointed out.

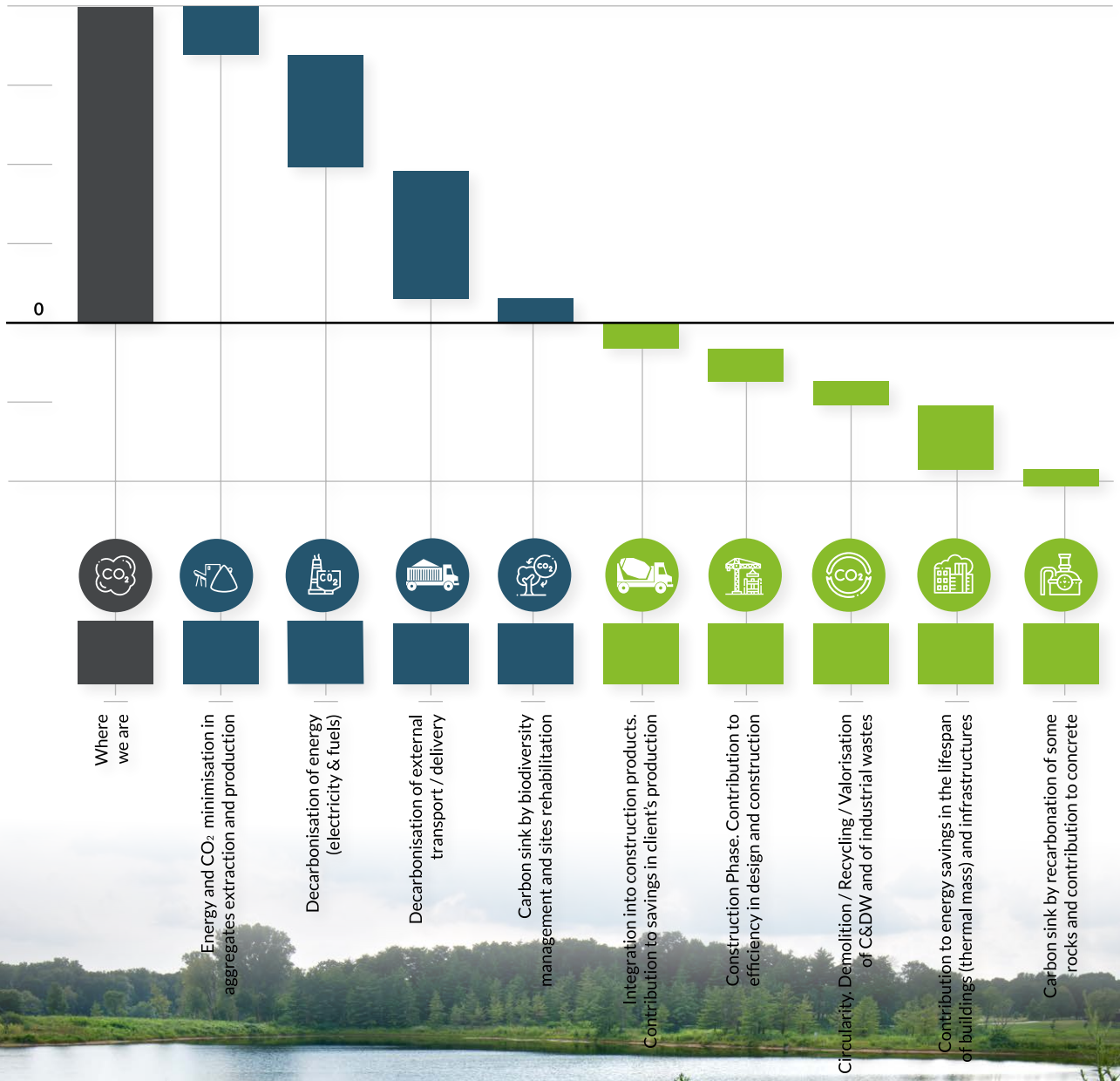
Because the aggregates industry is a complex activity, to properly shape our approach and our model to the net zero target by 2050, we have made a number of considered assumptions[11]:

- The electricity grid will be almost decarbonised by 2050.
- Transport will be almost decarbonised by 2050.
- There will be sufficient zero-carbon fuels including hydrogen for aggregates production.

Areas and actions that will allow a progressive significant reduction of CO_2 emissions in the aggregates industry	LEADER	INTERACTION WITH OTHER GROUPS	SITUATION 2023	SITUATION BY 2050
Energy and CO_2 minimisation in aggregates extraction and production				
Decarbonisation of energy (electricity & fuels)				
Decarbonisation of external transport / delivery				
Integration into construction products. Contribution to savings in client's production				
Construction Phase. Contribution to efficiency in design and construction				
Circularity. Demolition / Recycling / Valorisation of C&DW and of industrial waste				
Contribution to energy savings in the lifespan of buildings (thermal mass) and infrastructures				
Carbon sink through biodiversity management and sites rehabilitation				
Carbon sink through recarbonation of some rocks and contribution to concrete				

[11] See reference Nº 16 in Annex IV (MPA)

Contribution of the aggregates industry to achieve Net Zero



13 What do we need in public policies? - Priorities for the aggregates industry

How can public policies support this transformation?

Public policies will play a central role in the ability of the aggregates industry and the value chain to decarbonise over its life cycle. A comprehensive policy framework will need to be developed.

The Green Deal Industrial Plan is based on four pillars: a predictable and simplified regulatory environment, speeding up access to finance, enhancing skills, and open trade for resilient supply chains. It has to provide a regulatory framework suited for net-zero industrial capacity and its quick deployment, ensuring simplified and fast-track permitting, promoting European strategic projects, and developing standards to support the scale-up of technologies across the Single Market.

Public policies needed to achieve net zero in the aggregates industry

Transversal policies for a fair policy framework	Construction products policies	Aggregates specific policies
Establish long-term strategies and objectives.	Encourage and recognise EPD and LCA systems based on a full life cycle approach from cradle to grave.	Adopt policies to ensure local access to resources to reduce transport distances by integrating the nature and geographical location of aggregates deposits into a concerted regional planning to favour a reduction in climate impact due to the increase of transport distances. Local supply is a key issue to minimise the impacts of transportation. Then, review and adapt the land-use planning policies to allow a long-term strategy.
Maintain regulatory coherence and stability.	Focus on maximising the different properties of building materials like their durability, recyclability, thermal inertia, or re-carbonation potential.	Adopt flexible and simple permitting procedures (also for renewable energy infrastructure on site).
Set realistic CO_2 reduction policies and targets, reflecting the period of the 'transition to net zero' and adapted to the availability and maturity of technologies which have to be widely available on the market and not in experimental stages.	Continue to prioritise technical construction properties (stability, fire protection and environmental compatibility of a structure) when selecting the appropriate building material in the future.	Streamline the access to additional primary and secondary raw materials to build the essential and adapted infrastructure.
Improve governmental and EU support for the transformation of the aggregates sites and their machinery and equipment, as this is an industry essentially composed of SMEs, where investments have a specific medium and, above all, long term timetable.	Promote climate-friendly planning of construction projects, employing digital methods such as Building Information Modelling (BIM).	Develop a fair level playing field with aggregates from other non-EU countries.
Develop policies that support the industry transition, particularly given their role of delivering low-carbon infrastructure.	Strengthen and establish, in collaboration with industry, building regulations and specifications aimed to achieve carbon neutrality of the built environment over its entire life cycle, including during the use phase and at the end of life of residential, non- residential, and infrastructure applications.	
Adopt material and technology neutrality in construction, in construction products regulations, standards, in the industry and in green public procurement.	Enhance the development and deployment of low-carbon solutions in the construction sector that consider a life cycle approach, by including them in public procurement policies.	
Create institutional frameworks for industry-scale technology initiatives (managing and implementing projects, financing mechanisms, partnership rules and governance models). Collaborate with other stakeholders, to promote cooperation among countries and their public and private sectors to pool funding and knowledge.	Require the development of infrastructure projects to be accompanied by construction materials resource assessments and supply audits to provide greater visibility of construction material needs.	
Reform the electricity market design, to make industries and consumers benefit from the lower costs of renewables.		
Support programmes to develop the needed skills for a people-centred green transition, with a view to launch upgrading and retraining programmes in strategic sectors such as raw materials.		

Key issues

1. The aggregates industry and public administrations should cooperate and work closely together to find ways to enable its evolution and progress towards the common goal of climate neutrality.

2. A fair transition to zero net emissions must preserve the competitiveness and employment of the aggregates industry.

3. Long-term and sound structural policies are needed to support the investments necessary to achieve climate neutrality in a largely SME-based but highly capital-intensive industry.

4. The achievement of the aggregates industry's climate neutrality objectives will be linked to the success of cross-cutting energy decarbonisation public policies and to the availability and affordability of emission-neutral technologies, within sufficient timeframes to allow their progressive deployment on quarries.

Infrastructures policies

- Create the infrastructure for a circular and carbon-neutral environment.
- Boost the supply, distribution, availability, and affordability of renewable energy (electricity, hydrogen, etc.)
- Improve the infrastructure for bulk material transport to minimise road transportation impact.

Public awareness policies

- Promote public policies to foster the awareness of the raw materials industry.
- Recognise the aggregates industry's role as a net and relevant contributor to climate change mitigation and adaptation.
- Natural recarbonation recognition for the entire life cycle.
- Develop a clear scheme of carbon removal certificates.
- Reach a new consensus in the politics, economics, science, and civil society area on the development of a climate-neutral technology mix for the future.

Technological policies

- Incorporate into the EU R&D&i system the most relevant needs for climate change impact.
- Boost the development of industrial vehicles (trucks, mobile machinery, etc.) powered by renewable energy sources and make them available and affordable.
- Deploy low-carbon operating standards adapted to aggregates.
- Set ambitious standards for buildings' energy performance. Encourage and promote digitisation.
- Support collaborative research programmes or networks among companies, equipment suppliers, research institutes and governments to pool R&D and demonstration resources, and public-private partnerships on emissions reductions.
- Adapt underground mining techniques to aggregates, not always technically possible, much more complex, and costly to operate, but with the advantages of much less disturbance to soil and vegetation and being able to be closer to market in complex environments, reducing transport emissions.

Financial policies

- Speed up investment and financing for clean tech innovation, production, and deployment by making available EU and national public funds and private finance to meet investment needs.
- Improve Sustainable Finance to include investments in adapting our built environment to climate change. In particular, integrate aggregates under EU Taxonomy Compass.
- Support R&D&i and innovation through public funding and risk sharing investment mechanisms.
- Promote tax exemptions to encourage the use of green energy in industrial processes (Energy Taxation Directive) or indirect cost compensation mechanisms.
- Make economic incentives open to all types of technology.
- Comprehensive policy package along the entire aggregates value chain to provide the right incentives and create an environment in which the industry can be geared to the needs of climate neutrality.
- Mitigate risks through investment mechanisms that use private funding for low-carbon innovative technologies and through promotion of private-public partnerships.
- Promote alternative sources of funding for innovative low-carbon technologies in the aggregates industry, including export credit agencies and multilateral development banks.

Aggregates Europe - UEPG internal actions

Aggregates Europe - UEPG Climate Change Adaptation and Mitigation TF will develop the following actions:

- Deliver this Roadmap for climate neutrality in the aggregates industry – Neutral aggregates 2050.
- Coordinate Aggregates Europe – UEPG Committees, TFs and WGs to achieve a smart Aggregates Europe – UEPG approach and give support in the different topics, when needed.
- Interact with policy makers & stakeholders, explaining the case of the industry, the efforts made by the sector and the companies to adapt to climate change EU and national policies and the challenges they face. This will be achieved by:
  - Requesting the accomplishment of the suitable public policies to achieve this transformation (see clause 13 above).
  - Permanently analysing the industry situation.
  - Evaluating the policy and action plan effectiveness.
  - Delivering a suitable communication strategy.
  - Assuming a transparent and fair lobby action.
- Elaborate and disseminate brochures and documents in close collaboration with Aggregates Europe – UEPG PR and Communication TF:
  - To carry out continuous information and communication activities about climate change.
  - To integrate actions on climate change in Aggregates Europe – UEPG PR and Communication strategy.
  - To collect and disseminate information and good practices to Aggregates Europe – UEPG members and to their companies.
- Develop/adapt and apply methods and tools for the aggregates industry to evaluate impacts, vulnerability, and readjustment to climate change.
- Make actions taken by the aggregates industry, both individually and by the sector as a whole, more visible to society.
- Ask for governmental/EU support to transform sites and machines, in an SMEs industry where investment has specific long-term schedule.

Collaboration, synergies, and unity of action

To achieve the above actions, a collaborative network to identify and maximise synergies has to be further developed with:

Collaborative network to achieve net zero in the aggregates industry

Aggregates industry	• UEPG Member associations (UNPG; MPA; FdA; ...) • Aggregates companies
Clients	• Cement; Mortar; RMx Concrete; Precast Concrete; Asphalt mixtures • Construction industry
Other extractive industries	• NEEIP, ERMA, EIT RM, ...
Other sectors	• Identify other with similar issues (as partners for negotiations)
Suppliers	• Machinery; Explosives; Energy; ...

Interactions with Aggregates Europe – UEPG committees, TFs and WGs

Because climate change is a cross-cutting issue affecting most of Aggregates Europe's Committees, TFs and WGs, the Climate Change Adaptation and Mitigation Task Force is, and will be, in permanent coordination with all of them, informing about the latest issues, asking for particular expertise on certain topics, supplying global knowledge and the general Aggregates Europe – UEPG approach to climate change, and finally, reporting when necessary or required.

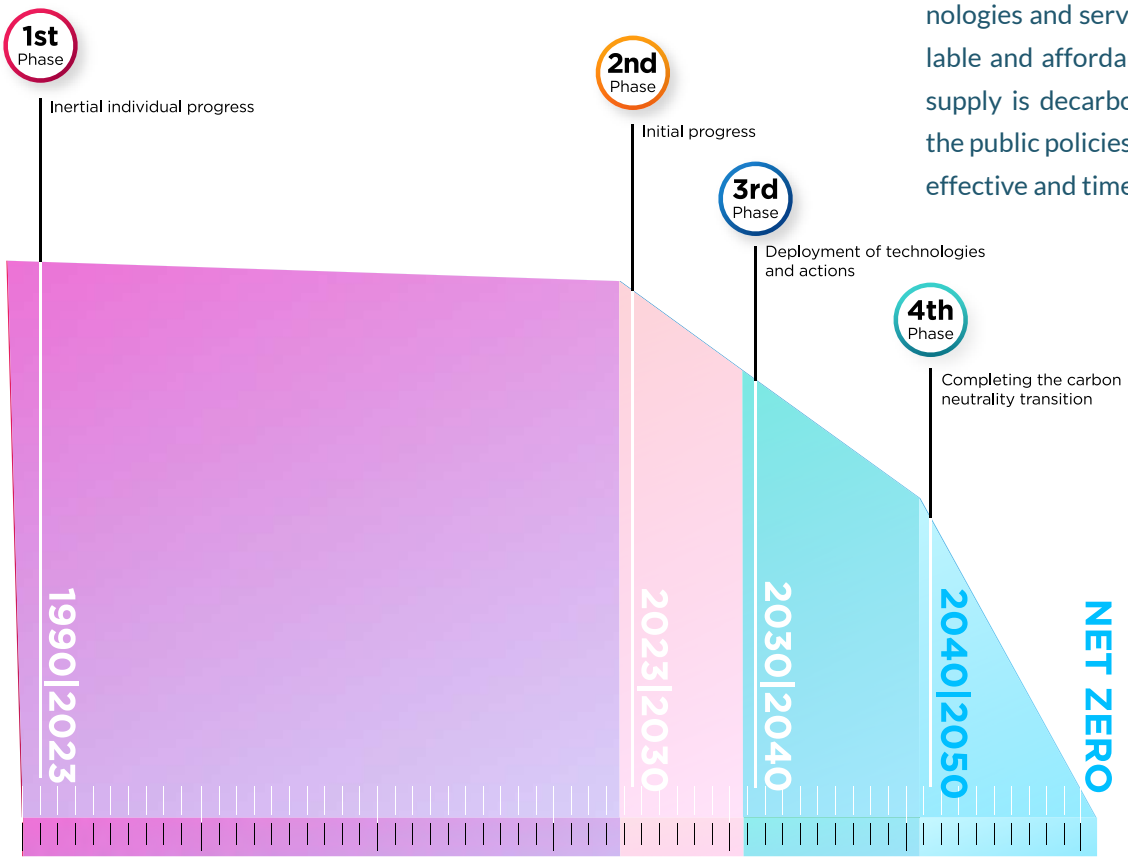
14 Timeline

The schedule of Neutral Aggregates 2050 is shown in the next graphic where the expected evolution of the industry is divided into four phases:

- 1st Phase: **1990 – 2023: Inertial individual progress**. Reduction leaded by the slow development of greener energy supply sources and the optimisation of other processes.
- 2nd Phase: **2023 – 2030: Initial progress**. Raising awareness, dissemination, and adoption of initial measures. Development of carbon neutrality policies in the national associations and in the aggregates companies. Adoption of initial technologies when proven available, widespread, and affordable.
- 3rd Phase: **2030 – 2040: Deployment of technologies and actions**. Progressive and programmed implementation of actions and new technologies as they become proven, available, widespread, and affordable.
- 4th Phase: **2040 – 2050: Completing the carbon neutrality transition**. Last phase of progressive and programmed full implementation of actions and new technologies as they become proven, available, widespread, and affordable. Achievement of net zero target.

As explained, the evolution of the aggregates industry will only be possible if green technologies and services are available and affordable, if energy supply is decarbonised, and if the public policies required are effective and timely in place.

Intended evolution of CO_2 emissions per ton of aggregates if the framework conditions are met



15 Key Performance Indicators

Monitoring the performance in CO_2 reduction with a simple set of KPIs is the first step in understanding the potential for improvement. It is key for tracking the progress of the aggregates industry and prioritising actions towards future targets.

Data collection and reporting systems combined with transparent monitoring and verification procedures, facilitate accurate information to industry stakeholders, policy makers, scientists, and analysts.

- Deployment of Neutral Aggregates 2050 Roadmaps with emission reduction targets aligned to science-based targets (% of member associations; % of companies; % of aggregates sites).
- Deployment of site action plans (% of aggregates sites).
- Zero CO_2 electricity emissions (% of total supplied).
- On-site Renewable Energy Generation (% of sites).
- On-site Renewable Energy Generation (% of total electricity consumption).
- Use of lower carbon alternative fuels (eco-fuels) to replace fossil fuels (% of total consumption).
- Total specific net CO_2 Emissions (kg CO_2-eq/t).
- On-site Transport Carbon Intensity (kg CO_2-eq/t).
- Off-site Transport Carbon Intensity (kg CO_2-eq/t).

16 Recommendations to aggregates associations

Aggregates Europe – UEPG's members national associations have to take the lead to achieve the neutrality objective of this industry by 2050 by:

- Disseminating the relevance of achieving the net zero target by 2050.
- Developing a national Neutral Aggregates 2050 strategy aligned with Aggregates Europe – UEPG.
- Interacting with Authorities asking for the implementation of all the public policies needed and already defined in clause 13, including public support (legislative, economic incentives, etc.), CO_2 reduction technologies and equipment substitution.
- Promoting and supporting aggregates companies to progressively adapt all their sites to these sectoral strategies.
- Acting constantly so that territorial policies guarantee local access to mineral resources as close as possible to the market and promoting the adaptation of the land-use planning policies, so they allow platforms in urban and peri-urban areas to recover inert waste from industries and deconstruction. Local supply is a key issue to minimise impacts of aggregates transportation.
- Developing alliances with other industrial players to provide heavy transport infrastructure (railways, waterways, river-sea ports, port facilities) as an alternative / complement to road transportation.
- Collaborating with the national associations of cement, ready-mix concrete, precast concrete, mortar, asphalt, etc. By shaping common strategies in terms of CO_2 reduction and searching synergies.
- Promoting and facilitating carbon footprint analysis, energy audits, EPDs, etc. for the companies.
- Proposing renewable energy introduction on sites (for self-consumption or external consumption).
- Closely interacting with machinery, energy, explosives, consumables, and other suppliers to communicate the industry needs and closely follow these technologies' evolution.
- Promoting R&D&I projects on CO_2 reduction.
- Encouraging aggregates companies to develop a system for the decarbonisation of their processes with emission reduction targets (with or without certification) based on EN ISO 14064-1.

Spanish EPD for natural aggregates. Source Spanish Federación de Áridos

17 Recommendations to aggregates companies & sites

It is essential that all the aggregates companies, independently of their size, realise that it would be key for their own business and survival to achieve carbon neutrality by 2050. This requires a tailor-made strategy for each company with clear targets defined at short, medium, and long term.

Technological innovations (equipment efficiency, renewable energies, etc.) are not enough to achieve decarbonisation. Aggregates companies must therefore understand the local evolution of their territories in order to adapt their products to demand:

- Stay as close as possible to the markets.
- Be attentive to changes in sustainable construction methods.
- Be cooperative in identifying and implementing carbon-free solutions with local actors.
- Develop rehabilitation (phasing, soil quality, type of habitats/crops/plantings, etc.) of sites so that the long-term evolution of the quarry shows a net carbon gain.

In clause 11, many actions to achieve carbon neutrality by 2050 are proposed. Actions to be implemented by the companies are identified with the symbol (⚒). Please read this clause carefully and based on it, design the particular roadmap for the company, adapting it to the specific characteristics of the company (structure, size, economic and technical resources, etc.) and the aggregate sites on which it operates. The strategic orientation of actions and investment decisions towards the objective of climate neutrality in 2050 will be decisive for the sustainable and appropriate programming of the company's progressive evolution and transformation.

18 Aggregates and the Sustainable Development Goals for the long-term EU Strategy

The aggregates industry daily contributes to the achievement of the UN Sustainable Development Goals – SDGs by supplying aggregates for the construction of housing, offices, shopping centres, essential infrastructures for transport, telecommunications, drinking and waste water management, energy generation and distribution, food production and distribution, education (schools and universities), health (primary care centres and hospitals), justice (courts), sports (stadiums, race tracks, gymnasiums), as well as the preservation of cultural heritage and a long etcetera.

Until recently, SDGs have been the benchmark and should remain so, but integrated and oriented towards the green transition of the economy.

SDG and the extractive industry.
Source: European Commission

At the local level, raw materials are used for local construction projects and specifically, aggregates companies provide local and good quality employment and contribute with their taxes.

When responsibly managed, aggregates sites have minimal impact on the environment, including the landscape, surface and groundwater, air, and soil, and can provide a range of new environmental services, ranging from flood water management to biodiversity enhancement.

For many countries where depopulation of rural areas is a strategic challenge, our industry is an essential player as a generator of wealth and good quality employment.

Despite this, there is a lack of knowledge and recognition from society and governments of the essential nature and importance of the use of aggregates to cover the daily needs of citizens, as their supply is taken for granted.

This is why it is essential to show how aggregates contribute to the ecological transition of the economy and to the SDGs achievement.

The aggregates industry contributes to 16 of the 17 SDGs, with a particularly important contribution to:

- SDG 8. Promote inclusive and sustainable economic growth, employment, and decent work for all.
- SDG 12. Ensure sustainable consumption and production patterns.
- SDG 13. Take urgent action to combat climate change and its impacts.
- SDG 11. Make cities inclusive, safe, resilient, and sustainable.
- SDG 9. Build resilient infrastructure, promote sustainable industrialisation, and foster innovation.
- SDG 15. Sustainably manage forests, combat desertification, halt and reverse land degradation, halt biodiversity loss.

Neutral Aggregates 2050 will drive this decisive contribution to the planet sustainability and the industry should be proud of this, as few activities are as cross-cutting and have the capacity to contribute to the well-being of humanity.

Annex I

Climate change-related EU initiatives affecting the aggregates industry

General framework (2019-2024)

EU Green Deal - https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal_en
The European Green Deal is a set of policy initiatives launched by the European Commission with the overarching aim of making Europe climate neutral in 2050 mainly by cutting emissions, investing in green technologies, and protecting the natural environment. An impact assessed plan will also be presented to increase the EU's greenhouse gas emission reductions target for 2030 to at least 50%.

Legislation

European Climate Law - https://climate.ec.europa.eu/eu-action/european-green-deal/european-climate-law_en
The European Climate Law is a project to legislate the Green Deal application by applying, amongst others, control, and monitoring policies of member states on the application of their carbon neutrality policy. A provisional agreement on the Regulation on the Climate Law was concluded in April 2021 thus legislating the 2030 and 2050 targets.
Industrial Emissions Directive - https://ec.europa.eu/environment/industry/stationary/ied/legislation.htm
The Industrial Emissions Directive or IED is the main EU instrument regulating pollutant emissions from industrial installations. The IED is based on 5 pillars: (1) an integrated approach, (2) use of best available techniques, (3) flexibility, (4) inspections and (5) public participation.
E-PRTR - https://ec.europa.eu/environment/industry/stationary/eper/legislation.htm
The European Pollutant Release and Transfer Register (E-PRTR) is the Europe-wide register that provides easily accessible key environmental data from industrial facilities in European Union Member States and in Iceland, Liechtenstein, and Norway.
Land use and forestry regulation for 2021-2030 - https://ec.europa.eu/clima/policies/forests/lulucf_en
EU Member States must ensure that accounted greenhouse gas emissions from land use, land use change or forestry are balanced by at least an equivalent accounted removal of CO_2 from the atmosphere in the period 2021 to 2030 through action in the sector. This is known as the "no debit" rule.
Effort Sharing Regulation - https://ec.europa.eu/clima/policies/effort/regulation_en
The European Commission adopted a series of legislative proposals setting out how it intends to achieve climate neutrality in the EU. The package proposes to review several pieces of EU climate legislation, including the EU ETS, Effort Sharing Regulation allowing to EU members along with Iceland, Norway, and Liechtenstein to bank, borrow, buy, and sell annual emissions. Thus, giving Member States the flexibility to deal with annual fluctuations in emissions due to weather or economic conditions.
Renewable Energy Directive - https://ec.europa.eu/energy/topics/renewable-energy/directive-targets-and-rules/renewable-energy-directive_en
The Renewable Energy Directive is the legal framework for the development of renewable energy across all EU economy sectors . The energy sector is responsible for more than 75% of the EU's greenhouse gas emissions. The European Commission therefore proposes to increase the share of renewable energies to 40% by 2030.
Energy Efficiency Directive - https://ec.europa.eu/energy/topics/energy-efficiency/targets-directive-and-rules/energy-efficiency-directive_en
Set of guidelines addressed by the Commission to the Member States to achieve Green Deal objectives in terms of energy efficiency. The proposal nearly doubles the annual energy savings obligation. EU countries must achieve new savings each year of 1.5% of final energy consumption from 2024 to 2030, up from the current level of 0.8%.
EU Emission Trading System (EU ETS) - https://ec.europa.eu/clima/policies/ets_en
Set up in 2005, the EU ETS is the world's first international emissions trading system. It works on the 'cap and trade' principle. A cap is set on the total amount of certain greenhouse gases that can be emitted by the installations covered by the system. The cap is reduced over time so that total emissions fall.
CO_2 emission standards for heavy-duty vehicles - https://eur-lex.europa.eu/eli/reg/2019/1242/oj
Regulation that contributes to achieving the Union's target of reducing its greenhouse gas emissions by 30 % below 2005 levels in 2030 by setting CO_2 emission performance requirements for new heavy-duty vehicles whereby the specific CO_2 emissions of the Union fleet of new heavy-duty vehicles shall be reduced compared to the reference CO_2 emissions (under revision procedure).**EU rules on trans-European energy infrastructure (TEN-E Regulation)** - https://ec.europa.eu/info/news/reviewing-eu-rules-trans-european-energy-infrastructure-2020-may-18_en
The TEN-E Regulation currently in force, lays down rules for the timely development and interoperability of cross-border energy infrastructure [TEN-E] networks to achieve the EU's energy policy objectives. Its key objective is to timely implement projects of common interest (known as "PCIs"), which interconnect the energy markets across Europe. This document also informs on the different consultations with the public and stakeholders that happened during the summer of 2020.
Ambient Air Quality Directives - https://ec.europa.eu/environment/air/quality/existing_leg.htm
A new directive including the content of previous legislations counting elements such as air quality objectives for PM2.5 (fine particles), legislations about arsenic, cadmium, mercury, nickel, and polycyclic aromatic hydrocarbons in ambient air, or time extensions of three years (PM10) or up to five years (NO2, benzene) for complying with limit values.

Strategies

EU Strategy on Climate Adaptation - https://ec.europa.eu/clima/policies/adaptation/what_en
Strategy set by the Commission to adapt to the unavoidable impacts of Climate Change. It has four principal objectives: to make adaptation smarter, swifter and more systemic, and to step up international action on adaptation to climate change.

The 2030 EU Biodiversity Strategy - https://ec.europa.eu/environment/strategy/biodiversity-strategy-2030_en
The biodiversity strategy aims to put Europe's biodiversity on a recovery path by 2030 for the benefit of people, climate, and the planet. Establishing a larger EU-wide network of protected areas on land and sea, the EU will enlarge existing Natura 2000 areas, with strict protection for areas of very high biodiversity and climate value.
2030 Climate Target Plan - https://ec.europa.eu/clima/policies/eu-climate-action/2030_ctp_en
With the 2030 Climate Target Plan, the Commission proposes to raise the EU's ambition on reducing greenhouse gas emissions to at least 55% below 1990 levels by 2030. This is a substantial increase compared to the existing target of at least 40%.
Fit for 55 Package - https://ec.europa.eu/commission/presscorner/detail/en/IP_21_3541
F for 55 Package is an article that summarises the application of the Green Deal, the 55% carbon emission reduction target by 2030 and carbon neutrality by 2050. The Commission is presenting the legislative tools to deliver on the targets agreed in the European Climate Law and fundamentally transform our economy and society for a fair, green, and prosperous future.
Renovation Wave Strategy - https://ec.europa.eu/commission/presscorner/detail/en/ip_20_1835
Is a press release describing the Renovation Wave Strategy. The Commission aims to at least double renovation rates in the next ten years and make sure renovations lead to higher energy and resource efficiency. By 2030, 35 million buildings could be renovated and up to 160,000 additional green jobs created in the construction sector.
European Industrial Strategy - https://ec.europa.eu/info/strategy/priorities-2019-2024/europe-fit-digital-age/european-industrial-strategy_en
It affirms the Commission's positions on its European industrial strategy by drawing lessons from the COVID-19 pandemic. The Commission stresses the resilience of the European single market and stresses the need to strengthen the autonomy of the European market.
Circular Economy Action Plan-e https://ec.europa.eu/environment/strategy/circular-economy-action-plan_en
The European Commission adopted the new circular economy action plan (CEAP) in March 2020. The measures that will be introduced under the new action plan aim to make sustainable products the norm in the EU, focusing on the sectors that use most resources and where the potential for circularity is high such as: electronics and ICT, batteries and vehicles, packaging, plastics, textiles, construction and buildings, food, water, and nutrients. They also aim on leading the global efforts on circular economy.
Sustainable Finance Strategy - https://ec.europa.eu/info/publications/210706-sustainable-finance-strategy_en
The European Commission adopted an ambitious and comprehensive package of measures to help improving the money-flow towards financing the transition to a sustainable economy. It aims to support the financing of the transition to a sustainable economy by proposing action in four areas: transition finance, inclusiveness, resilience and contribution of the financial system and global ambition.
Mobility Strategy - https://ec.europa.eu/transport/themes/mobilitystrategy_en
The European Commission presented its strategy for a carbon neutral mobility across Europe. Their goal is to achieve zero-emission for all vehicles by 2050 including cars, vans, buses as well as new heavy-duty vehicles, aircrafts, and marine vessels. They also aim at doubling the rail freight and are planning to implement a fully operational, multimodal Trans-European Transport Network (TEN-T) for sustainable and smart transport with high-speed connectivity.
Zero Pollution Action Plan - https://ec.europa.eu/environment/strategy/zero-pollution-action-plan_en
The zero-pollution vision for 2050 is for air, water, and soil pollution to be reduced to levels no longer considered harmful to health and natural ecosystems, that respect the boundaries with which our planet can cope, thereby creating a toxic-free environment. This is translated into key 2030 targets to speed up reducing pollution at source. These targets include air pollution, chemicals, circular economy, industrial emissions, marine and coastal environment, nature and biodiversity, noise pollution, plastic production, and a sustainable use of soil, water, and land.
Sustainable Blue Economy - https://ec.europa.eu/oceans-and-fisheries/ocean/blue-economy/sustainable-blue-economy_en
The strategic plan for a sustainable blue economy aims to define Europe's future economy by developing a more circular and greener approach to maritime sectors. The strategy highlights the crucial role of the oceans in the fight against global warming as one of the main climate regulators on Earth.
European Strategy for Low-Emissions Mobility - https://ec.europa.eu/clima/policies/transport_en#tab-0-0
The European Strategy for Low-Emissions Mobility is based on three main policies: The efficiency increasement of the transport system, a full-scale deployment of zero-emission vehicles and low-emission alternative energy for transport. The strategy integrates a broader set of measures to support Europe's transition to a low-carbon economy and supports jobs, growth, investment, and innovation.
EU Strategy for Energy System Integration - https://ec.europa.eu/energy/sites/ener/files/energy_system_integration_strategy_.pdf
The EU Strategy for Energy System Integration aiming to link different energy carriers, infrastructure, and consumption sectors together to boost renewables and reduce carbon emissions. The strategy intends to achieve deep decarbonisation at the "lowest possible costs" by reducing waste and using the relative strengths of different energy carriers.
Sustainable Europe Investment Plan - https://ec.europa.eu/commission/presscorner/detail/en/fs_20_48
The Sustainable Europe Investment Plan (also known as European Green Deal Investment Plan - EGDIP) aims to mobilise through the budget of the European Union (EU) and the associated instruments at least €1 trillion of private and public sustainable investments over a decade. The Investment Plan is a comprehensive framework that aims to become a bridge between policy objectives and the available private financial resources . This framework targets climate, environmental and social investments as far as they are related to the sustainable transition.
New European Bauhaus - https://ec.europa.eu/commission/presscorner/detail/en/IP_21_111
The New European Bauhaus is an environmental, economic, and cultural project, aiming to combine design, sustainability, accessibility, affordability, and investment to help deliver the European Green Deal. As one element of the design phase the Commission will launch, the first edition of the New European Bauhaus prize.
NAIADES III: Boosting future-proof European inland waterway transport - https://ec.europa.eu/transport/sites/default/files/com20210324-naiades.pdf
NAIADES III constitute the next step for European inland shipping. It outlines the direction and planned actions that will solidify inland shipping's role in Europe's economy moving forward and the realisation of the European Green Deal.

Funding

Just Transition Mechanism - https://cinea.ec.europa.eu/just-transition-mechanism_en
The Just Transition Mechanism (JTM) is a key tool to ensure that the transition towards a climate-neutral economy happens in a fair way, leaving no one behind. It provides targeted support to help mobilise at least €150 billion over the period 2021-2027 in the most affected regions, to alleviate the socio-economic impact of the transition.
Horizon Europe - https://ec.europa.eu/info/research-and-innovation/funding/funding-opportunities/funding-programmes-and-open-calls/horizon-europe_en
Horizon Europe is the EU's key funding program for research and innovation with a budget of €95.5 billion. It tackles climate change, helps to achieve the UN's Sustainable Development Goals, and boosts the EU's competitiveness and growth. The program facilitates collaboration and strengthens the impact of research and innovation in developing, supporting, and implementing EU policies while tackling global challenges. It supports creation and better dissemination of excellent knowledge and technologies.

Annex II

Carbon neutrality projects related to aggregates

- **AGGREGACO$_2$**. The project aims to capture and use the CO_2 generated in industrial processes related to refining to produce a carbon negative aggregate that can be used in the construction industry. https://www.aggregaco2.com/en/
- **Carbon 8**. Engineering the conditions of exposure to CO_2 can dramatically speed up the carbonation reaction, and an economically viable form of carbon capture and use. https://www.carbon8.co.uk
- **Blue Planet's mineralization technology**. It is a scalable method for capturing and permanently sequestering billions of tonnes of CO_2. This process can use dilute CO_2 from any source, at any concentration, and turn it into valuable building materials to enable carbon capture at a profit. Each tonne of the resulting aggregate permanently mineralizes 440 kg of CO_2, preventing it from ever leaking or accumulating in the atmosphere. https://www.blueplanetsystems.com
- **Fast Carb**. It is the outcome of the coming together of two observations. First, the production of cement is a major source of global CO_2 emissions, accounting for 5-7% of the total. Approximately two-thirds of these emissions are due to the decarbonation of limestone during the manufacture of Portland cement. The reversal of this process occurs naturally and is referred to as the carbonation of concrete. However, natural carbonation is a very slow process. www.fastcarb.fr
- **DIGIECOQUARRY**. The project aims to design, develop, and validate an Innovative Quarrying System (IQS) comprising sensors, processes, tools and methods for data capture, processing and sharing to provide integrated digitalised, automatic, and real-time process control for aggregates quarries. This will translate into maximised sustainability and resource efficiency in the quarry operations by reducing emissions, improving the management of water, energy, and other materials, reducing waste generation, and fostering a sustainable supply of aggregates. https://digiecoquarry.eu
- **ROTATE**. The project aims to minimise the environmental footprint of the extractive industry (emissions, water consumption, energy, wastes, biodiversity management, etc.) and to develop sustainable processes to foster CO_2 reduction. https://rotateproject.eu

Annex III

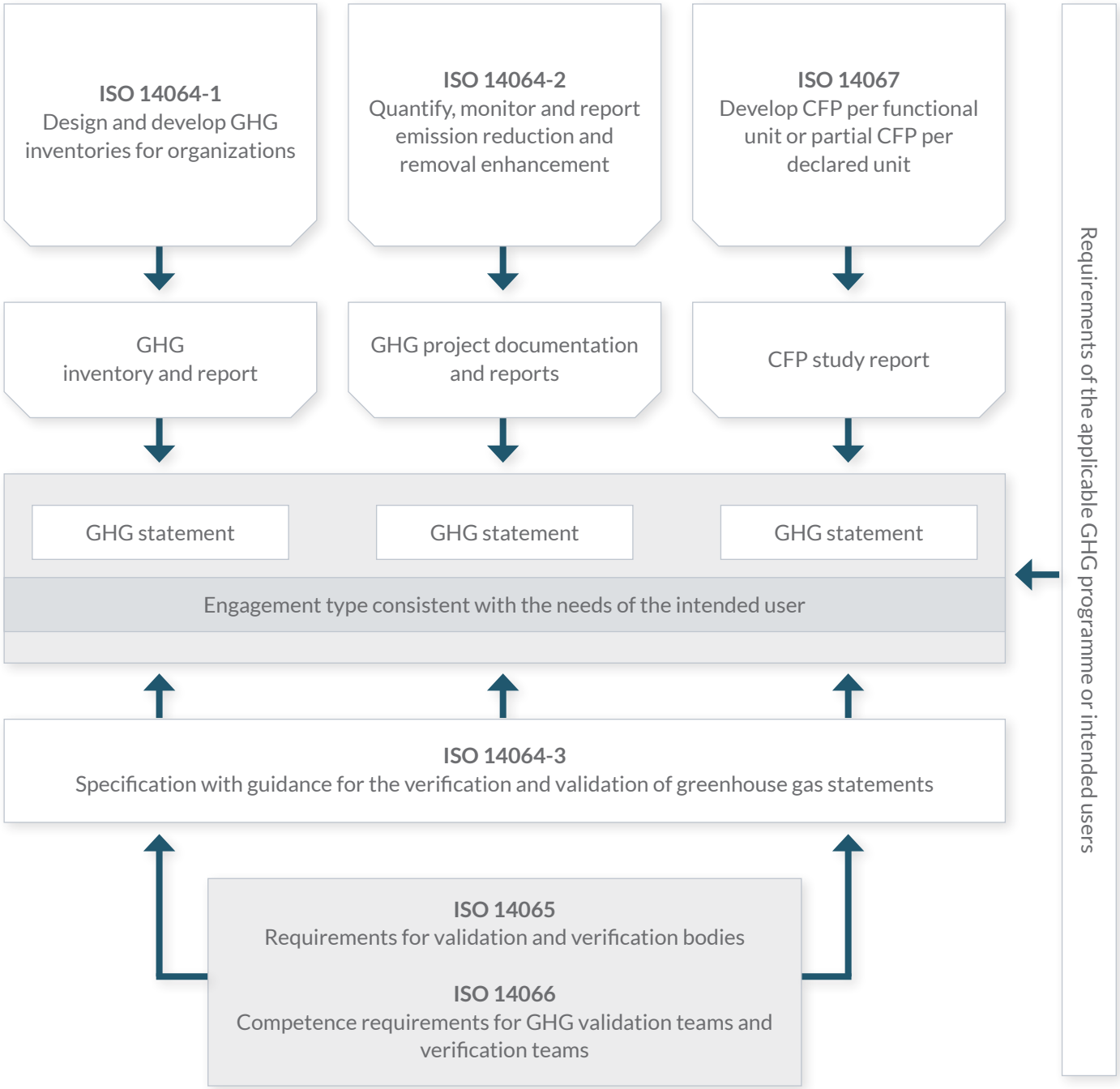
Definitions

- **Net zero** refers to the target of negating greenhouse gas emissions based on human activity until elimination by abating emissions and offsetting the residuals from the atmosphere. It relates to the reduction targets of CO_2 equivalent emissions, across the whole life cycle, to zero.
- **Carbon neutrality** means that an organisation has achieved net zero emissions. This is done by reducing its carbon footprint, such as using renewable energy sources and other carbon-reducing tactics and offsetting any residual carbon footprint. The main difference is that net zero refers to the goal of eliminating GHG emissions, while carbon neutrality is the end-state achieved by reducing emissions and offsetting the residuals. Achieving carbon neutrality means that organisations take action to reduce their climate impact and invest in emissions-reducing projects[12].
- **CO_2-eq** means carbon dioxide equivalent, or CO_2 equivalent, abbreviated as CO_2-eq is a metric measure used to compare the emissions from various greenhouse gases on the basis of their global-warming potential (GWP), by converting amounts of other gases to the equivalent amount of carbon dioxide with the same global warming potential.
- **Global-warming potential**, abbreviated as **GWP**, is a term used to describe the relative potency, molecule for molecule, of a greenhouse gas, taking account of how long it remains active in the atmosphere. The global-warming potentials (GWPs) currently used are those calculated over 100 years. Carbon dioxide is taken as the gas of reference and given a 100-year GWP of 1.
- **GHG inventory** consists in counting the emissions of the industry in the perimeter over which it exercises its control. The carbon inventory is easy to calculate, but it does not include the emissions related to the manufacture of extra-perimeter products like imported goods.
- **GHG footprint** is the sum of the emissions produced within the controlled perimeter with those linked to goods outside this perimeter, from which the emissions linked to any products exported from the same perimeter. This footprint thus makes it possible to calculate the full carbon impact of the activity, considering the impacts that are not directly controlled by the activity. Life Cycle Assessment (LCA): is a multi-step and multi-criteria environmental assessment method that quantifies the impacts of a product, service, process, or structure on the entire its life cycle: from the extraction of raw materials to its end-of-life processing. One of the criteria naturally includes energy named "climate change" reported in weight of CO_2, although it should be noted that the values cannot be directly compared with that of a carbon footprint since the methodologies are different.

[12] Source: www.net0.com

Annex IV

Relation between ISO 14060 and GHG standards



Annex V

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