eco intelligent growth
cradle of the circular economy

Environmental and Circular Analysis of Spanish Ceramic Tiles

Relevant information for architects, designers and other technical professionals

GENERALITAT VALENCIANA
Conselleria de Hacienda y Modelo Económico

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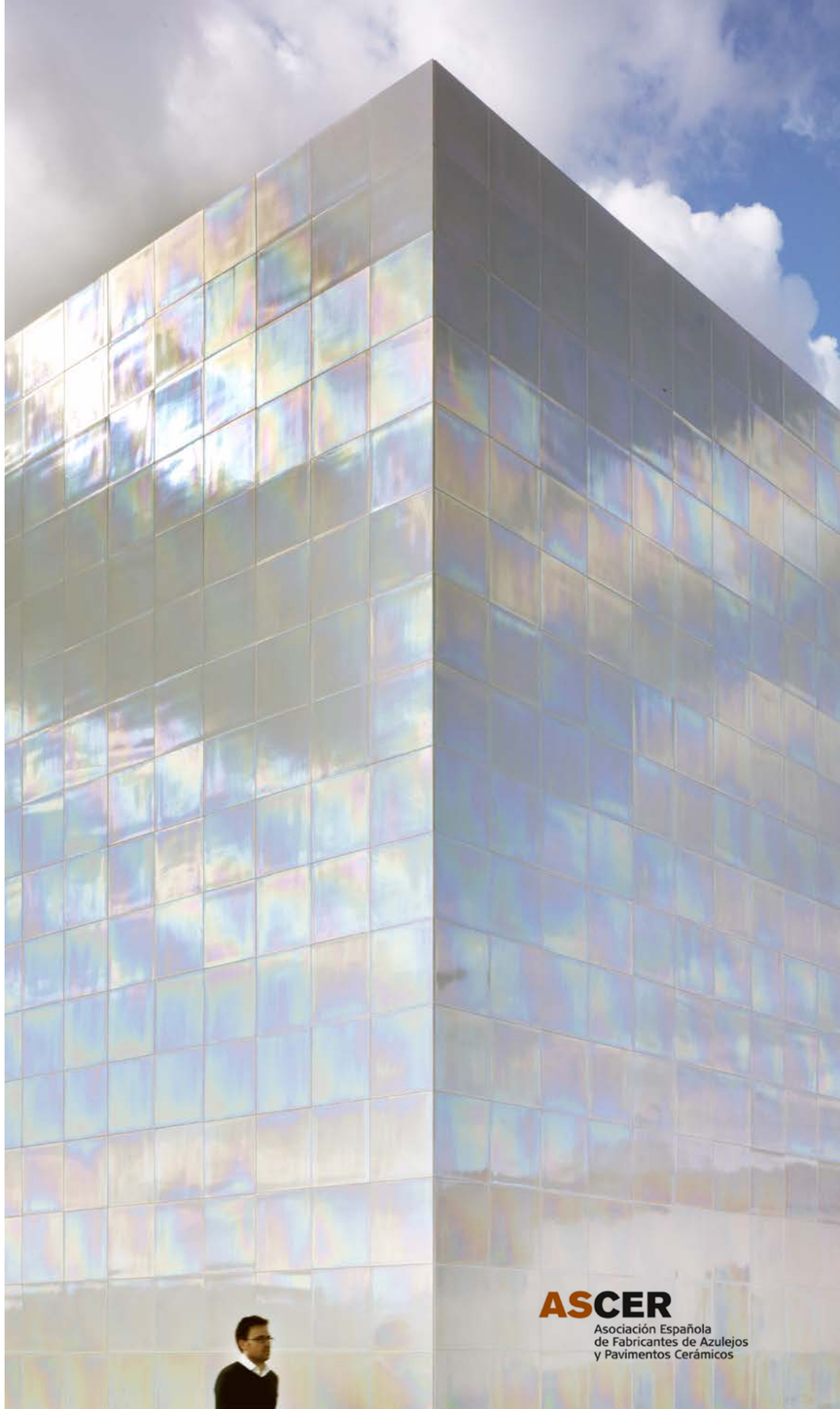

1. Introduction

This report has been developed with the aim of positioning the Spanish ceramic tile sector in the international market from the perspective of a circular economy, considering aspects of its impact on indoor air quality and its carbon cycle.

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A literature review for the Spanish and international ceramic tile industry has been carried out, analysing different aspects of the ceramic tile:

- The material's intrinsic characteristics;
- The carbon cycle of the ceramic tile and an analysis of the life cycle of the material compared to other types of flooring;
- The contribution of ceramic tiles to sustainable building programmes;
- The positioning of ceramic tiles in product certification programmes;
- Alignment of the Spanish ceramic tile industry with the 2030 Agenda for Sustainable Development.

This analysis reflects the commitment of the Spanish ceramic tile sector industry's commitment to be aligned with the paradigm shift towards a circular economy with a positive social, economic, and environmental impact.

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The Spanish ceramic tile industry and its environmental performance

137
companies

16,100
occupied

€3,842M
total sales

€2,941M
(76%) exports

187
countries

2020 Data

Determined to adapt its production processes to achieve net zero greenhouse gas emissions by 2050, the ceramic tile sector has been making technological and innovative improvements to its production processes to achieve results that go beyond reducing its carbon footprint. Its goal is also to optimise processes in other areas, such as raw materials and water management.

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Carbon footprint reduction

For decades, the Spanish ceramic tile industry has been adopting energy efficiency measures and the best available technologies to reduce the sector's carbon footprint and decrease CO2 emissions. The most representative measures adopted include:

- **Waste heat recovery,**
- **Replacement with more efficient burners in furnaces and the consequent reduction of gas consumption,**
- **High efficiency furnaces,**
- **High efficiency cogeneration systems,**
- **Use of natural gas (cleanest fuel currently available).**

Due to constant application of innovative technological improvements in energy efficiency, the total CO2 emissions of the ceramic tile industry per tonne of fired product have been cut by 60% since 1980.

Reuse of production process waste

In the product process, the use of recycled material is encouraged, turning remnants into raw material for new products to cut down on waste. The sector manages to reuse an estimated 100% of the clay waste before it is fired and an effort is made to recover as much of the fired pottery as possible to lower the environmental impact of using virgin raw materials.

Water consumption and management

The sector makes efficient use of water resources to minimise water consumption per square metre of product manufactured. A total 80% of raw water consumption is for atomisers, where it is almost completely evaporated in the process. The remaining 20% of water consumption is part of a closed cycle in the production process, in which all wastewater is recycled and reused. This means that the wastewater discharge in the ceramic tile production process is equal to zero.

Environmental Product Declaration (EPD)

The Spanish ceramic tile industry has pioneered the development of a sectoral EPD for ceramic tiles at the European level, on the basis of a representative sample of Spanish tile production. The Spanish Association of Ceramic Tile Manufacturers (ASCER, as per the Spanish acronym) spearheaded this sectoral eco-label, which was developed in 2019. A significant number of ceramic tile manufacturers have also developed EPD's for their products.

High efficiency furnaces

100% (approx.) of raw materials are prepared with heat from cogeneration

100% of waste from the production process is recycled

Reduction of raw material use

100% recycling and recovery of wastewater

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Characteristics of ceramic tiles

Natural, plastic-free and free of toxic substances

Mostly composed of inorganic minerals, water and fire, and free from VOCs.

Local

The raw material (clay) is abundantly found in nature, often locally.

Hygienic, anti-allergic and aseptic

Waterproof, harmless, odourless and allergen-free material.

Easy maintenance

Easy to clean, without the use of harsh chemicals, enhancing indoor air quality.

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Flame retardant

Material naturally flame retardant and free of toxic fume emissions when exposed to fire.

Resistant and durable

Resistant to high and low temperatures, to water and humidity and to contact with aggressive chemicals. It is long-lasting.

Energy efficient

It provides with an insulation layer protection and ventilation of the building envelope provides acoustic insulation and thermal conductivity and inertia.

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2. The different scenarios for the future of ceramic tiles

The European Union wants to be climate neutral by 2050 and one of its first goals to do so is to reduce greenhouse gas emissions by 55% by 2030.

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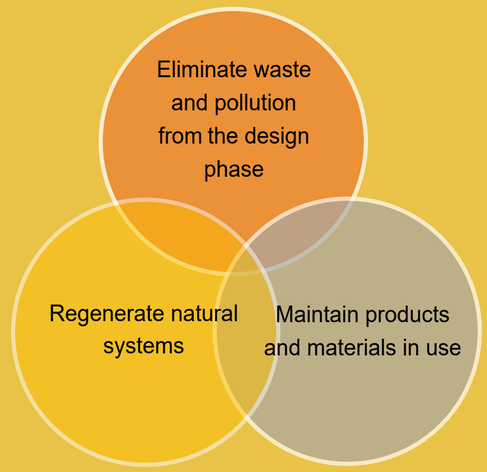
In 2020 the European Commission defined an action plan for the circular economy to promote circular products and processes and to identify strategic sectors for their implementation. One of the sectors identified was the building and construction sector, as it is responsible for more than 35% of carbon dioxide (CO_2) emissions in Europe. Consequently, new construction and renovation projects will have to prioritise environmental criteria to meet the targets set by the European Union.

As for Spain, it has also established its own Circular Economy strategy under the European precepts: "Spain Circular 2030" (EEEC in its Spanish acronym), which establishes the necessary actions to implement circularity and lays the foundations to promote a new production and consumption model at a national level.

In general terms, the circular economy establishes a more sustainable model of production and consumption, based on the following principles:



In other words, the circular model seeks to design durable products, where materials and resources remain in use for as long as possible. In addition, it aims to minimise waste generated and increase materials reuse, recovery and recycling strategies. Therefore, when a product ends its life cycle, it can be used as a nutrient or raw material in the life cycle of another product.

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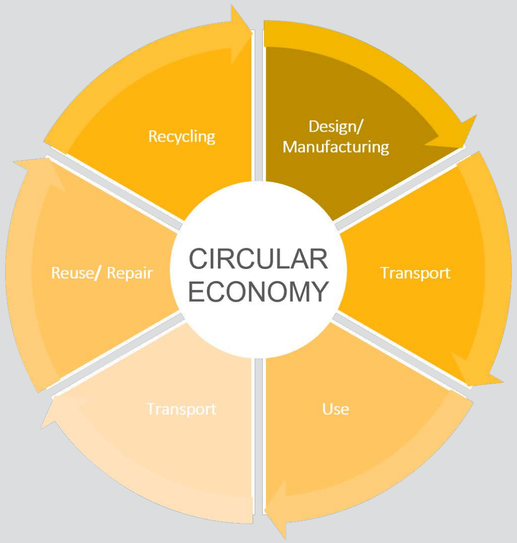
The potential of ceramic tiles in a circular economy



In this context, ceramic tile is a product aligned with European and national objectives, thanks to its circularity potential and its ability to reduce negative environmental impacts. Made from 100% natural raw materials and found in abundance in nature, this material has a percentage of recycled raw materials in new products, it is designed to be durable and can be recovered at the end of its useful life, making it a raw material for other products, as long as the necessary conditions are provided to do so. It is also fire retardant and resistant to chemical abrasion, and therefore has the potential to accompany buildings throughout their life cycle.

The fact that it is a durable material and has a long-life span, estimated at 50 years, means that ceramic tiles are replaced less often. This characteristic contributes to reducing the use of virgin raw materials and the greenhouse gas emissions associated with their manufacture.

It should be noted that the quality and quantity of ceramic material that can be recovered will depend on how efficiently it is collected, sorted and separated from other construction waste, dust and residues. High sulphate or lime contents from other building materials may impede their possible reuse. Therefore, implementing measures to improve the separation when a building is demolished and consolidating a by-product market are key to exploiting the circularity potential of ceramic tiles, as well as to increasing the circularity potential of the whole construction sector.

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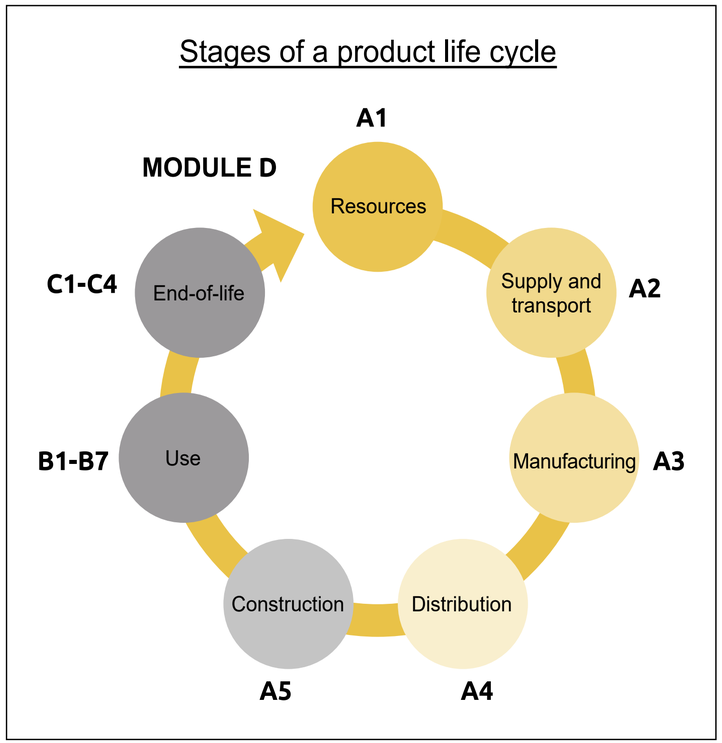
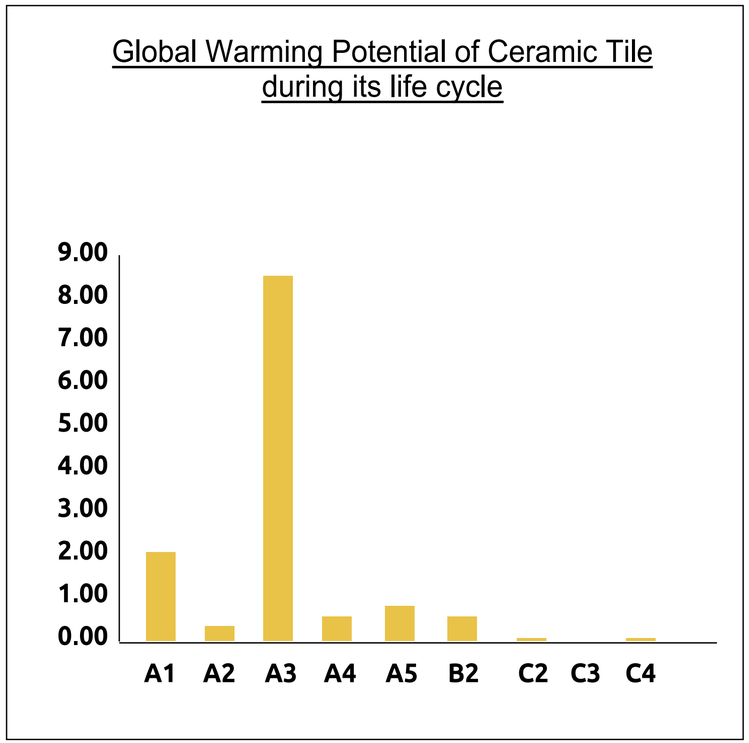
Hotspots





A **hotspots** analysis makes it possible to assess the points that are of particular concern for human and environmental health during the different stages of a product's life cycle.
The chart to the left, developed on the basis of the sectoral EPD for Spanish ceramic tiles, illustrates the global warming potential of the product in each of the stages of its life cycle. The following page describes the origin of the greenhouse gas (GHG) emissions of these stages.

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Extraction of raw materials, Transport and Manufacture of the product (A1- A3)

This phase concentrates the highest environmental impacts and energy consumption of the entire ceramic tile life cycle.

17% of the total GHG emissions of the tile life cycle are produced in the raw material extraction phase (A1).

90% of the CO2 emissions of the product manufacturing phase (A3) come mainly from the combustion of natural gas in the equipment for firing the pieces (furnaces) and the drying of raw materials and shaped pieces.

Distribution and Installation (A4-A5)

Emissions in the finished product transport phase (A4) are due to the export of ceramic tiles, as only 35% of their total production is marketed in Spain.

The impact in the installation phase (A5) is associated with the use of mortars or glues for laying the product, which also hinder the recovery of the tile at the end of its life cycle.

Use (B1- B7)

CO2 emissions generated depend exclusively on the use and frequency of cleaning.

During the tile lifetime, virtually no maintenance is required.

End-of-life (C1- C4)

The environmental impact is directly related to the type of treatment it receives.

Its most frequent destination today is the landfill, with the rest of construction waste.

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Emission reduction strategies in the ceramics sector

The ceramics industry has been working for decades to reduce the environmental impact of its products. During this time, it has managed to reduce CO2 emissions per square metre produced by 60% compared to those emitted by the sector in the 1980s, and total CO2 emissions by 24% compared to the 1990s. All this progress has been possible thanks to the energy efficiency measures rolled out by the industry.

To meet the European Union's targets, the future production must be aligned with the use of 100% renewable fuels. Under this premise, some of the alternatives proposed for the ceramic tile sector are:

- **Replacing natural gas used in the cooking and drying process with low-carbon fuels.** Fuels such as green hydrogen or biofuels are one of the options most widely considered for the future, as their implementation would require less transformation of the equipment than if the entire production system were to be electrified. Biomethane obtained from biogas has a number of advantages, as the same circuits used for natural gas could be used and the production process would not require any adaptation. However, it is not yet considered a realistic option in the short term, due to its lack of availability, limited production capacity and lack of sufficient political impetus for its deployment nationally.

- **Increasing the deployment of on-site renewables for self-generation of energy to cover the whole process' electricity requirements**. A short-term option would be to purchase electricity from 100% certified renewable sources.

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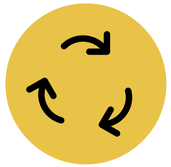
Benchmark of future ceramic tile scenarios

For the benchmark, three scenarios have been defined and compared with the initial Life Cycle Assessment based on the Sectoral EPD on the Spanish ceramic tile sector.

Scenario A

Energy optimisation measures in the manufacturing process. Ideal scenario, where all the energy consumed will come from renewable sources.



Scenario B

Optimisation measures for materials and their flows. Theoretical scenario.

Scenario C

Decarbonisation and energy efficiency measures combined with more circular use of materials. Most realistic scenario, combining a moderate implementation of the previous scenarios.

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	Scenario 0 Current situation	Scenario A Energy efficiency and renewable energies	Scenario B Circularity strategy	Scenario C Combined practices
Actions implemented in the energy demand of the manufacturing process	• Energy demand as described by the sectoral EPD. • The main energy source is natural gas. It is mainly used for atomisation, drying and firing. • The Spanish electricity mix of 2017 is applied for electricity consumption.	• 7% of recycled material is taken to enter the life cycle together with virgin materials. • An estimated 75% of waste generated during the life cycle is recycled. • Tile waste is landfilled as inert material.	Same conditions as Scenario 0.	• Replacing 10% of natural gas consumption with biomethane. • Replacing the electricity used with electricity from renewable sources. • 10% energy savings due to technological improvements and energy efficiency measures.
Actions implemented in the consumption and flow of materials	• 7% of recycled material is considered to enter the life cycle together with virgin materials. • An estimated 75% of waste generated during the life cycle is recycled. • Tile waste is landfilled as inert material.	Same conditions as Scenario 0.	• Replacement of 100% virgin materials with recycled materials. A cost has been quantified for transforming materials to be reintroduced into the cycle and their transport. • Replacement of 50% of the materials used in the glaze with recycled material. • Replacement of the packaging film and strapping with recycled paper packaging and polyethylene-free adhesive. • Returnable cardboard box system. • Recovery of 80% of the product at the end of its life cycle. • 95% recycling efficiency of all packaging used during the process.	• Input of 50% of the material of the substrate of recycled origin. Transport of raw materials adapted accordingly. • Substitution of films and strapping used for packaging with recycled paper packaging. • 20% recovery of the product at the end of its life cycle.

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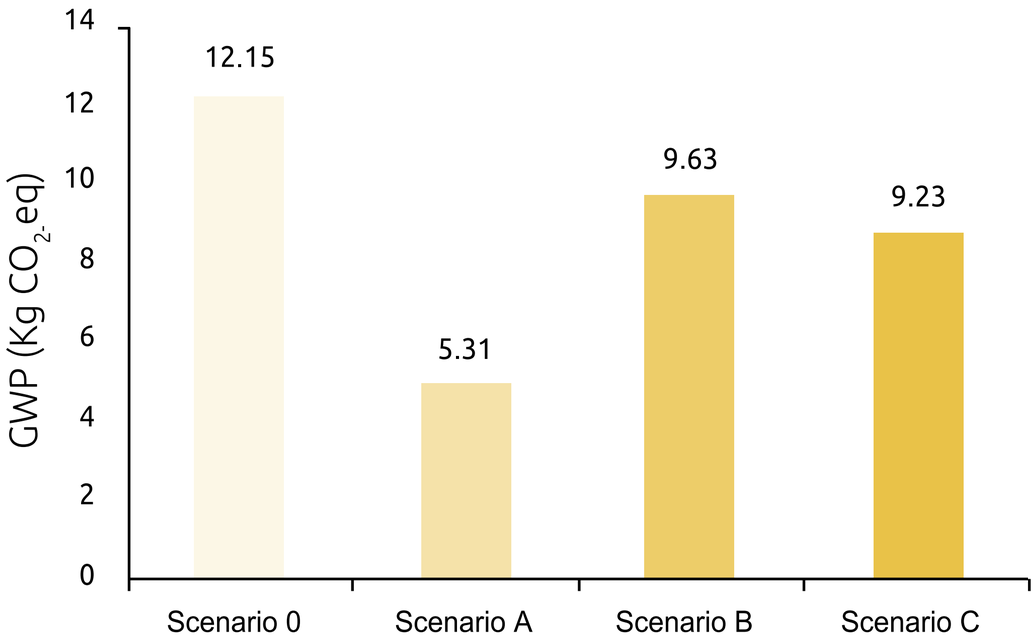
Results and interpretation



The graph shows the results for each scenario after modifying the different parameters.

- **0** Current situation
- **A** Energy efficiency and renewable energies
- **B** Circularity strategy
- **C** Combined practices

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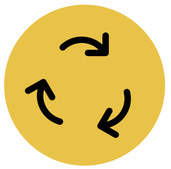
Scenario	A1 kg co_2 eq	A2 kg co_2 eq	A3 kg co_2 eq	A4-A5 kg co_2 eq	B1-B7 kg co_2 eq	C2-C4 kg co_2 eq	MODULE D kg co_2 eq	TOTAL
Scenario 0	2.07	0.30	8.32	0.94	0.52	0.11	-0.26	12.15
Scenario A	2.07	0.30	1.63	0.94	0.52	0.11	-0.26	5.31
Scenario B	0.68	0.13	8.32	0.91	0.52	0.11	-1.05	9.63
Scenario C	1.05	0.19	6.92	0.94	0.52	0.11	-0.50	9.23

Comparing the results of the global warming potential in the different scenarios, one may see that:

- **Scenario A**: by optimising energy in the production phase, the global warming potential of ceramic tiles is reduced by 56%. The elimination of emissions associated with manufacturing is not total, given that there are emissions due to the clay decarbonation and the use of packaging used in this stage, among others.



- **Scenario B**: by applying strategies based on the use of materials, a 21% reduction in CO2eq. emissions is achieved. This decrease is mainly due to strategies applied at the beginning and end of the life cycle. In this stage, more environmental benefits are also achieved at the end of the tile's lifecycle, by recovering part of the material and optimising the recycling processes of the whole process.

- **Scenario C**: 24% reduction of the product's carbon footprint, mainly due to the substitution of 10% of natural gas with biomethane, the optimisation of the manufacturing phase by applying energy savings of 10% and the use of 50% recycled material in the production of the tile support. Glazed materials have been kept 100% virgin. This scenario could be applied with most of the techniques and technologies currently available.

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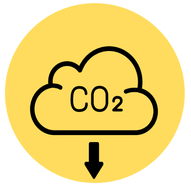
Conclusions of the benchmark of future ceramic tile scenarios

The ceramic tile industry is a sector committed to reducing the environmental impact of its products and is workinh hard to do this. But to achieve the European Union's target of reducing CO2 emissions by 2050, it will need to combine several strategies that focus not only on the product's manufacturing stage, but also on the entire tile's lifecycle.



Reduction of CO_2 eq. emissions

The study shows the need to decarbonise ceramic tiles, mainly in terms of energy, but it also yields a very positive vision in terms of reducing the environmental impact generated, by merely increasing the percentage of recycled material or applying improvements to the recycling and recovery of materials. Likewise, increasing the consumption of ceramic tiles nationally would enable the environmental footprint to be reduced during the product's distribution.
In terms of energy, it will be necessary to continue implementing strategies to improve the energy efficiency of its processes, reduce energy demand, use renewable energies and improve existing facilities and technologies.

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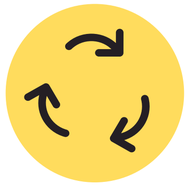
100% recycling

Focusing on the tile's value chain and the entire lifecycle, it will be needed to enhance tile cyclability. To obtain results similar to those in this study, an ecosystem will have to be generated that includes all the relevant actors in the sector, such as producers, manufacturers, suppliers, customers, collectors and governments, and a long-term commitment strategy developed among them. Action should be taken both in the extraction and acquisition of raw materials and in the correct management of the waste generated during the production process and subsequent recovery of the ceramic material at the end of its life cycle.



Great circularity potential

The collaboration of all actors involved is crucial to decarbonise the sector and enhance the product's circularity. The benefits will be multiple and on a large scale.

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3. Ranking of floorings in the construction sector

The impact of materials used in the construction sector varies greatly depending on the type of product.

People spend on average 90% of their time indoors, so the use of healthy materials is essential to safeguarding their health. In addition, many studies directly relate the health of spaces to workers' productivity.

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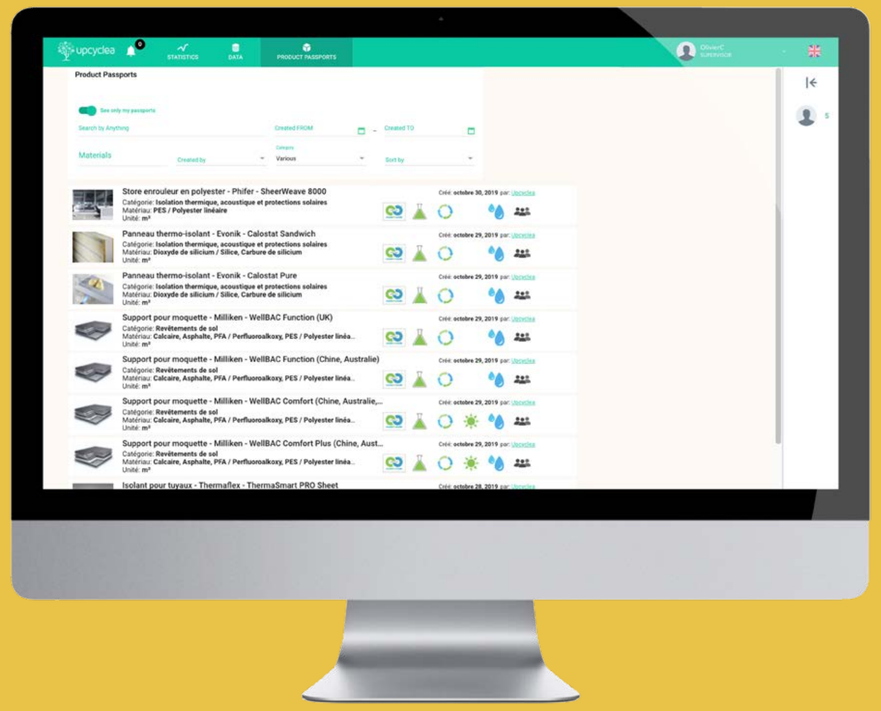
It is clear that the technical characteristics of products and their price are of the utmost importance when choosing them, but it is also of utmost importance to assess the carbon footprint of their life cycle, their circularity potential and their toxicity.

To gain this global vision of products, the use of tools such as the Materials Passport is essential, since it can compare all these impacts between materials and products and can facilitate informed decision making.

Material Passport

The Material Passport is the product's ID or, in other words, a digital duplicate of the product used in a building. Its function is to provide the description of products used in a building and to ensure they can be traced.

It provides all the information on the composition, the proportion of recycled and new materials, their possible future uses, and their environmental and social impacts.



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Analysed Material Passports

The circular passports of the different materials covered by this study were compared to check the total impact of 1m2 of ceramic tile, carpet, wood and vinyl.
For the comparison, product passports from myUpcyclea platform were used, all of which are Cradle to Cradle Certified® and/or considered high-end. Below is an overview of the types of materials compared:

Ceramic tile

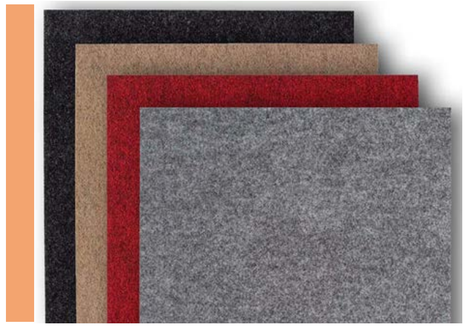
Category: **Floor covering**
Material: **Clay, Feldspar, Common Ceramics, Alluvial Sands, Water**
Unit: **m² / Version: 2021**

Vinyl tile

Category: **Floor covering** Material: **PVC / Polyvinyl Chloride, Calcium Carbonate, Treatments** Unit: **m² / Version: 2021**

Wooden floors (parquet)

Category: **Floor covering**
Material: **Solid raw wood Oak, Solid raw wood Pine.**
Unit: **m² / Version: 2020**



Carpet

Category: **Floor covering**
Material: **Polymers (plastics and elastomers), PA 6 / Nylon 6, Carbonate.**
Unit: **m² / Version: 2021**

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Benchmarks

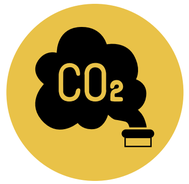
Knowing which products are used in a project and how they are installed is essential to assess the health of a space and its circularity potential. The Material Passport of myUpcyclea platform allows the products installed in a building to be assessed using 3 indicators:

Material health

The material health indicator is based on the toxicity analysis of products used in buildings. The analysis is performed according to the basic health criteria of Cradle to Cradle Certified® programme. Products with higher quality information receive a higher rating, promoting transparency.

Circularity

The indicator considers both the previous life of the materials integrated into the products considered, as well as the next possible uses of these products. It also considers the disassemblability of the products with respect to the building.



Carbon footprint

The carbon footprint measures the greenhouse gas emissions associated with the manufacturing stage of products and materials used in buildings.

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These indicators are generated once the Material Passports are assigned to a specific building, with their respective quantities and indications of rotation cycles and degrees of retrievability of each product or construction system. The final result is the Circular Signature of the building, or digital inventory of the building, which reflects the results of these indicators and allows the traceability of the materials applied, enabling their correct management in the future.

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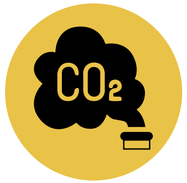
Comparison of floorings

The results obtained from the Material Passports have been used to compare floorings, as well as other indicators that provide a broader overview of the advantages and disadvantages of each product. The parameters taken into consideration were the following:

Durability

Potential product lifetime, directly linked to its environmental impact and its circularity. The longer a material lasts, the lower its environmental impact.



Environmental Impact

Carbon footprint calculated for each material over its entire life cycle.

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Cyclability potential

Analysis of the potential of each material to be cyclable, in accordance with the principles of Circular Economy.

Toxicity

Material free of substances toxic to human and environmental health, a key parameter for a material to be circular.

Use Phase

Advantages and disadvantages that the product presents during its use and installation phase. (Aesthetic characteristics of each coating not taken into account).

Cost

Decisive factor in the choice of a construction material. The combination of this parameter with environmental criteria can be useful when choosing healthier alternatives within a given budget.

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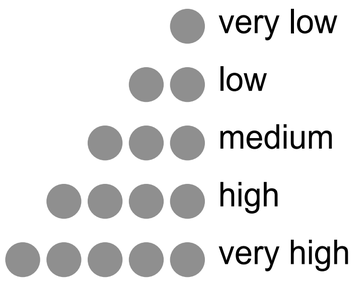
Flooring comparison results

For each criterion, scores are awarded from 1 to 5, depending on whether the materials meet the criteria to a greater or lesser extent. The criteria used to award scores for each indicator to each of the materials analysed are detailed in the methodological notes section of the annexes.

Criteria	Ceramic tile	Vinyl tile	Wooden floors	Wall-to-wall carpet
Durability	●●●●●	●	●●	●
Environmental impact	●●	●●●●●	●	●●●
Circularity	●●●	●●●	●●●●	●●●●●
Toxicity	●	●●●●	●	●●
Use	●●●●	●●●●	●●●	●●●
Cost (€)	●●	●●	●●●●●	●●●●



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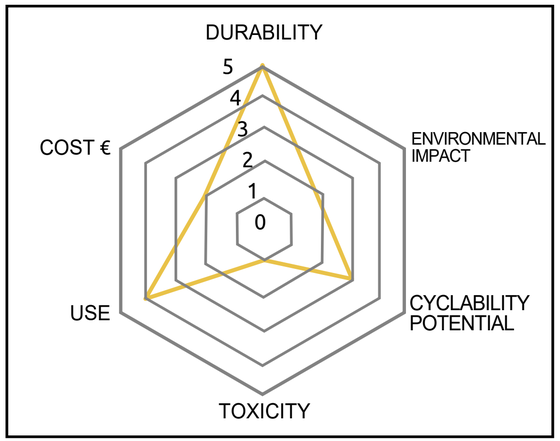
Interpretation of results

Ceramic tile



ADVANTAGES

- **Possibility of customisation**: different thicknesses, sizes, formats and finishes that even imitate other materials.
- **Free of toxic emissions**: material naturally free of VOC emissions.
- **Resistant and durable material:** of the four flooring alternatives, it has the longest life cycle. This influences its environmental impact, because if the time factor is taken into account, during the lifetime of a tile, there can be up to 4 or 5 life cycles of other materials with their corresponding greenhouse emissions.
- **Easy to clean and low maintenance:** low maintenance with water and detergent. Non-staining and resistant material.
- **Provides thermal inertia:** inherent characteristic of the material.
- **Circularity potential:** long useful life. Remains in circulation, or in use, for a long period of time.
- **Suitable for reuse and recycling:** if properly separated from other construction waste, it can be used as a by-product, e.g. as aggregate for concrete or as a substrate for plants. As it does not contain toxic materials harmful to human health that can be released during use, it also fulfils a prerequisite for being cyclable.

DISADVANTAGES

- **Material perceived as cold.**
- **Application with mortars and glues:** makes it difficult to recover the material and increases its negative impact if they are materials that are not free of toxic substances. However, healthier glue and mortar alternatives can be used or dry laying can be prioritised.

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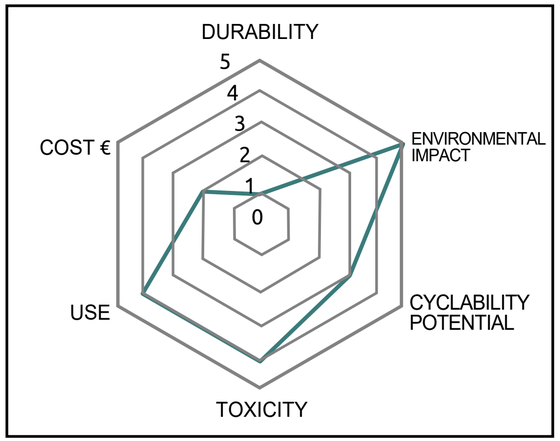
Vinyl tile (LVT)



ADVANTAGES

- **Possibility of customisation:** different thicknesses, sizes, formats and finishes that can imitate other materials.
- **Easy to clean and maintain material**: easy to clean.
- **Easy to install:** easy to install, without the need for building works.
- **Economical material:** it is usually the most economical of the four covering materials studied.

DISADVANTAGES

- **Potential toxicity to people and the environment:** it is made of PVC, a material composed of substances that are highly harmful to the environment and to people's health, such as vinyl chloride, ethylene dichloride and dioxins.
- **Not resistant to more aggressive detergents:** it can be damaged by the use of certain cleaning products.
- **Unrecyclability:** its cyclability potential is affected, as vinyl material is generally not recyclable due to its chemical composition.
- **No points for sustainable construction certifications:** it is very difficult to obtain points for using this material as flooring.

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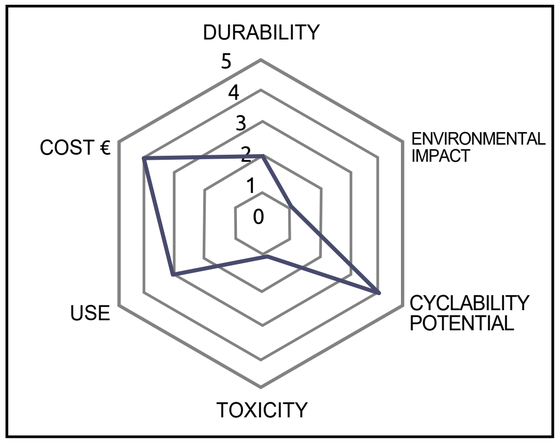
Wooden floors (parquet)



ADVANTAGES

- **Natural material with low toxicity, depending on the type of treatment it receives:** it can vary according to the type of glues and varnishes applied to it.
- **Provides comfort and hygiene**: it is pleasant to the touch and does not accumulate dust mites or allergens.
- **Natural insulation against cold and heat.**
- **Suitable for reuse and recycling.**
- **Recyclable and CO2 sink:** it has great environmental advantages over other coverings. It is a recyclable material and if it comes from sustainable forest management it can also be considered renewable. In addition, its capacity as a CO2 sink makes it a material with the potential for reducing the greenhouse effect.

DISADVANTAGES

- **Low possibility of customisation:** especially if it is natural.
- **Delicate material and difficult to maintain:** its maintenance requires care with specific products. Floors can last a long time, but this durability is directly related to the type of maintenance provided.
- **Vulnerable to physical, chemical and/or biological impacts:** very vulnerable to knocks, scratches, chemicals, humidity, sun exposure and insects.
- **High price:** the more wood it has, the higher the cost. Within the comparison, it is the product with the highest cost.

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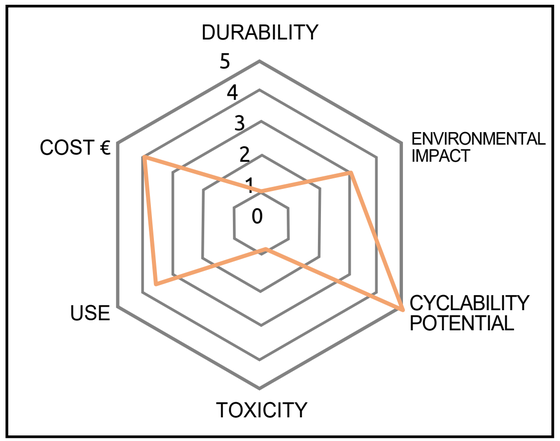
Wall-to-wall carpet



ADVANTAGES

- **Possibility of customisation:** different sizes, formats and prints.
- **Provides a feeling of warmth and comfort:** for winter it is presented as the most comforting alternative of all. However, in summer it can contribute to increase the feeling of warmth in rooms.
- **Easy installation:** easy to install, without the need for building works.
- **Insulating and anti-slip properties:** it acts as a shock absorber for knocks and falls.

DISADVANTAGES

- **Accumulates dust mites and allergens in its use phase:** requires a lot of maintenance and cleaning.
- **Can cause mould:** retains moisture and excess moisture can lead to mould growth.
- **Vulnerability to chemicals, stains, moisture and fire:** non-flammable material and difficult to clean.
- **May be composed of materials with negative impact on human health and the environment:** if they are made of natural fibres, such as cotton, wool or jute, it is possible for their materials to be reused or recycled. However, if they are made of cheaper materials such as polypropylene, polyester or nylon, their potential for cyclability is reduced due to the environmental and human health impact. Polyester, for example, can generate microplastics from wear and tear and is not a readily biodegradable product.

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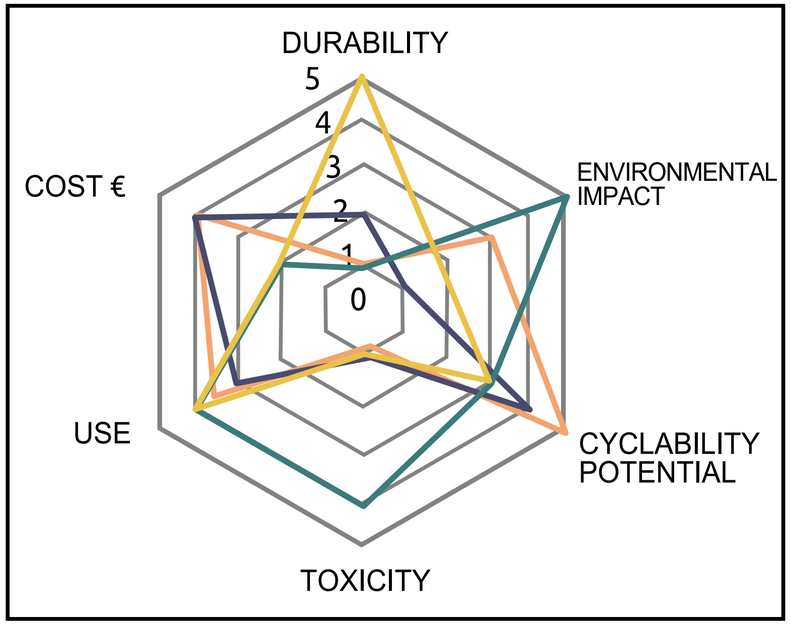
Flooring ranking conclusions



Each of the floorings analysed has advantages and disadvantages in the different criteria analysed, but it is up to the professional to guide its clients in the prioritisation of one criterion or another.

When choosing a covering material for a construction site, aesthetic and economic criteria are generally prioritised over others. This trend is beginning to change due to the regulations imposed by Europe, which aim to decarbonise the construction sector and implement the circular economy to reduce its negative impact and promote the regeneration of ecosystems. In this context, the criteria for choosing one type of coating or another must be changed to address all the challenges posed by the construction sector.

Opting for healthy and sustainable options, even though they may mean a higher cost or a different aesthetic, anticipates the future demands and legal requirements of the sector. Sustainable products with low environmental impacts present a secure long-term value and create healthy spaces that people can live in for a long time.

Choosing durable, non-toxic materials with a low environmental impact during their life cycle is a timeless decision.

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4. Ceramic tiles in green building certifications

Reflecting society's increased awareness and sensitivity to living and working in healthier and more sustainable spaces, there is a growing demand for and supply of spaces with green building certifications.

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There is currently a wide variety of green building certifications for different types of buildings (residential, offices, retail, renovation, new construction, etc.).

Green building programmes such as LEED, BREEAM®, VERDE, DGNB, have a more global approach, analysing multiple aspects of building sustainability. Other certifications are focused on more specific environmental aspects, like energy efficiency, such as the Passivhaus standard. There are also those that focus on improving the health and well-being of building occupants, such as the WELL™ certification. All these standards are promoted by institutes and private non-profit organisations.

The European Commission has also promoted the Level(s) initiative to create a common framework for the design of circular and sustainable buildings. This initiative, together with the Circular Economy, is likely to have a major impact on the future development of sustainable construction.

This chapter explains how ceramic tiles can contribute to meeting the requirements of the different certification schemes.

Circularity in green building certifications

Circular Economy creates a more sustainable model, guaranteeing the preservation of natural resources, avoiding waste generation and helping in the fight against climate change. It has to become a framework for future product development and is widely supported by the European Union through the European Green Deal and other initiatives. To ensure the construction of future-proof spaces, products should be used that are aligned with the Circular Economy.

In recent years, benchmark standards such as LEED or BREEAM® are developing new programmes to adapt and also include circularity criteria. Although these criteria are not included in the current guidelines, they are beginning to be valued as innovation credits.

Other more recently developed programmes, such as Level(s), already contemplate circularity from their initial design.

LEED

One of the most widely used and recognised certification programmes in the world. It creates a framework for designing and building different typologies of spaces (neighbourhoods, schools, housing, new buildings, Core & Shell, data centres, logistics buildings, hospitals, etc.). The use of ceramic products in LEED projects can help to obtain scores in different areas of analysis:

Heat island reduction

Analyses overheating in built-up areas with detrimental effects on microclimate and species habitat.

The use of light coloured ceramic roof and floor tiles with a high Solar Reflection Index (SRI) contributes to mitigating the Heat Island Effect.

Minimum Energy Performance & Optimization of Energy Performance

In addition to being a mandatory prerequisite, this is the credit that awards the highest scores in the certification.

The use of ceramic tiles in the building envelope can help to improve the energy performance of the building. Ceramic is a material with high thermal inertia, which helps delay energy loss and regulate indoor temperatures, which can be advantageous in climates with large thermal variations. Its use in ventilated façades, with insulation, can eliminate thermal bridges in the envelope, reducing the building's energy demand. Using systems with radiant ceramic tiles, raised ceramic floors for flat roofs or solar protection with ceramic lattices can also help reduce the building's energy demand.

Building Life-Cycle Impact Reduction

Aims to promote reuse and optimise the environmental performance of products and materials used in the building.

Ceramic tiles, with their high durability and low wear and tear, are materials that can be used in full building envelope or interior finishing renovations, specially large format minimum thickness tiles. When carrying out a Life Cycle Assessment (LCA) of the building, ceramic products, due to their high durability, can contribute to reducing the related environmental impacts.

Construction and demolition waste management

Rewards those projects that minimise waste generated on site and the waste produced that is sent to recycling plants, preventing it from ending up in landfills or incinerators.

Ceramic tiles are fireproof materials and are easy to recycle to obtain new aggregates that can be used as raw material for other products, such as conglomerates for roads, etc.

Building Product Disclosure and Optimization - Environmental Product Declarations (EPD)

Promotes the use of products and materials that have information available on the environmental impacts associated with their life cycle, and rewards the use of those that are better.

Many ceramic tiles have an EPD verified by a third party (Type III), which makes it easy to prove compliance with this credit. The Spanish ceramic tile sector also has a sectoral EPD promoted by ASCER.

Building Product Disclosure and Optimization - Sourcing of Raw Materials

Promotes the use of products with a better environmental, social and economic impact throughout their life cycle, rewarding the use of products that come from responsible sources, with the following criteria:

1. Products that have public information on the raw materials used and their origin, preferably verified by an independent third party, such as Global Reporting Initiative (GRI), UN Global Compact or ISO 26000;

2. Use of products with raw materials with relevant environmental characteristics, such as Extended Product Responsibility, pre- and/or post-consumer recycled material, reused materials, etc.

Transparency about where raw materials come from is an increasingly widespread practice in the industry and many manufacturers make this information on their products publicly available.

Building Product Disclosure and Optimization - Material Ingredients

Promotes the use of products and materials that make, publish and/or third party verify the chemical composition of products, to minimise the presence of hazardous substances in buildings.

Ceramic tile manufacturers, generally upon request, have ingredient inventories, REACH declarations and other tools to be able to meet this credit.

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Low-Emitting Materials

Promotes the use of products that do not emit pollutants (VOCs that deteriorate indoor air quality.

Ceramic tiles, in all their applications, meet the requirements defined in this credit since LEED system considers them to be non-emissive, VOC-free materials. In addition, the ceramics sector has developed comprehensive solutions, with mortars, grouts and other materials that comply with the LEED-defined limits.

Circular products

Rewards the implementation of innovative strategies through voluntary Innovation Credits or Pilot Credits. There is currently a Pilot Circular Products credit.

The Spanish ceramic tile sector is implementing strategies to improve the circularity of its products. Waste recycling is very high in ceramic tile manufacture, so compliance with the Zero Waste Manufacturing requirement can be easily documented.

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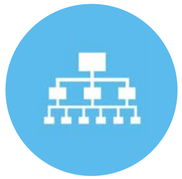
BREEAM® ES

This certification was created by the Building Research Establishment (BRE) in the UK in 1990. It is present in more than 90 countries with more than 500,000 certified buildings. There are different versions adapted to different countries' language and regulations. The use of ceramic tiles in projects can help to obtain points in the different areas analysed in the BREEAM_ES Housing and New Construction guide:



Life cycle cost and service life planning

Encourages calculating the life cycle cost of the building to improve its design, operation and maintenance. To this end, it proposes analysing information on investment costs to promote a sustainable economy.

Ceramic materials’ greater durability than alternative materials significantly reduces the environmental impact and costs associated with their use and maintenance.

Commissioning and handover

Promotes proper planning of the delivery and commissioning of the facilities, including the envelope. In relation to the thermal envelope, the continuity of insulation, thermal bridging and possible air leakage are assessed through an air permeability test and a post-construction thermographic inspection.

The ceramic ventilated façade can help to meet the requirements of this credit, as it offers resistance to humidity, water and large thermal variations.

Indoor air quality

Encourages a healthy indoor space through different strategies. One of them requires low product emission levels and measuring formaldehyde and total VOCs is required post construction.

Ceramic tiles are free of formaldehyde and VOC emissions, so their use contributes to achieving the aim of these requirements. In addition, there are comprehensive solutions with low-emission auxiliary materials that ensure the entire system's compliance.

Thermal comfort

Promotes buildings that guarantee their occupants' thermal comfort.

The thermal properties of ceramic tiles, in combination with inertia heat distribution systems such as radiant floors, walls or ceilings, can contribute to improving spaces' thermal comfort. The high thermal inertia of ceramic tiles allows heat to be transferred uniformly over the surface, for a stable temperature over time.

Acoustic performance

Ensures that the building's acoustic efficiency meets the appropriate standards according to its use.

Ceramic floor tiles are compatible with technical flooring systems and raised floors, so anti-impact sheets, which contribute to spaces' acoustic efficiency, can be installed.

Reduction of energy use and carbon emissions

Promotes buildings with minimum energy demand, to reduce primary energy consumption and CO2 emissions.

The use of ceramic tiles in solutions such as ventilated façades, solar protection, raised ceramic floors for roofs, among others, improves energy use mainly due to their characteristic thermal inertia. In addition, ceramic tiles do not require the use of energy in their maintenance, meaning high energy savings in their use phase.

Life cycle impacts

Encourages an analysis of the building's life cycle and the specification of building materials with a limited environmental impact throughout the building life cycle.

Ceramic tiles show the best results out of the different types of flooring found on the market in the impacts of Global Warming Potential (GWP), Acidification (AP), Abiotic Resource Depletion (ADP), Eutrophication (EP) and Tropospheric Ozone Formation, mainly due to its high durability (50 years).

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Responsible sourcing of construction products

Encourages the use of reused or recycled materials, the application of the Environmental Management System (EMS), or the BES6001 Framework Standard for Responsible Sourcing.

Transparency about where raw materials are from is an increasingly widespread practice in the sector and many manufacturers make this information on their products public.

Designing for durability and resilience or impact reduction focused design

Encourages the protection of building elements and landscaping to minimise the frequency of replacement.

The high durability and resilience of ceramic tiles is a proven fact. The use of ceramic flooring for high traffic areas ensures that floors are durable and easy to clean.

Construction waste management

Promotes effective and appropriate management of construction waste.

Ceramic tiles can be easily separated on site for reuse or recycling. Even if there are traces of mortar or glue, they can be recycled to obtain new aggregates that will be raw material for other types of materials, such as conglomerates for roads, among others.

WELL Building Standard™

This standard focuses on the health and well-being of people in buildings through a holistic vision, considering the design, construction and occupation of space. It is promoted by the International Well Building Institute (IWBI) and has different assessment and certification schemes depending on the building's typology and use.

Fundamental air quality (mandatory)

Requires acceptable air quality levels. Air quality is affected by exposure to air pollutants such as VOCs, ozone, microparticles, carbon monoxide and others.

Ceramic materials are inert products and do not emit VOCs during their use phase. The mortars, sealants and adhesives required for installation must be taken into account. Lime-based mortars, sealants and adhesives for ceramic products with low levels of VOC emissions are currently available on the market.

Enhanced air quality

Provides improved levels of air quality that have been linked to improved human health and performance according to the WHO, Cal/EPA and OEHHA.

In this credit, ceramic tiles may be important as they are non-emissive and therefore contribute to indoor air quality. The use of photocatalytic ceramics and other innovations for bacteria, mould and dirt control are also of note.

Quality monitoring and awareness

Promotes ongoing measurement of pollutants to educate and empower occupants with regard to environmental quality.

New ceramic technologies improve air quality and therefore can be part of environmental quality education and awareness. Ceramic tiles, as non-emissive products, if installed with appropriate materials, have a positive impact on indoor air quality.

Radiant thermal comfort

Requires projects to use radiant systems and independently controlled ventilation systems.

Ceramic tiles have great thermal properties and advantages over other materials, especially when used in combination with inertial distribution systems, such as radiant floors, walls or ceilings. Ceramic tiles' high thermal inertia allows heat to be transferred evenly over the surface, for a stable temperature over time.

Sound barriers

Guarantees adequate acoustic comfort in spaces by installing suitable sound barriers.

Ceramic finishes, due to their high density and compactness, work very well for acoustic treatment in the low frequency range (below 85 Hz). These ceramic finishes must be accompanied by acoustic insulation to configure an element that functions as a suitable acoustic barrier at different frequencies.

Impact noise management

Requires projects to manage background noise levels through resilient flooring design and other impact noise mitigation techniques.

Ceramic tiles are compatible with technical and raised floor systems, so anti-impact sheeting can be installed. Noise reduction is strongly influenced by the type of installation (bonded or floating tile) and by the materials coupled to the tiles.

In-place management

Minimises exposure to certain chemicals by limiting the presence of halogenated flame retardants (HFRs, per- and polyfluoroalkyl substances (PFAS and ortho-phthalates.

Ceramic tiles help to meet this credit, as they are naturally flame retardant materials, so flame retardants are unnecessary.

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Volatile compound reduction

Seeks to minimise the impact of Volatile Organic Compounds emitted by products on indoor air quality.

Ceramic tiles are naturally VOC-free products, so they automatically meet this credit.

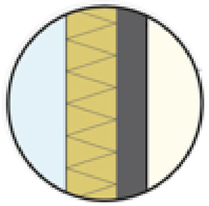
Restorative spaces

Supports access to spaces that promote the relief of mental fatigue and stress through an indoor or outdoor environment with certain characteristics, including the incorporation of materials with colours, textures and shapes that promote wellbeing.

Ceramic tiles have a wide range of customisation possibilities, allowing designs, colours, textures and shapes that imitate natural patterns and promote people's wellbeing.

Passivhaus

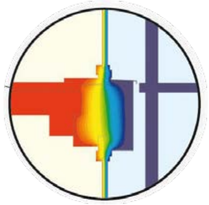
This standard is considered the most demanding energy efficiency standard in the world. It focuses on minimising building's energy consumption while maintaining high levels of indoor comfort. It is based on exhaustive procedures while drawing up the project and in its execution to guarantee that the performance of the constructed building matches the theoretical design values. The use of ceramic products in projects can help to achieve a Passivhaus certified building:



High thermal insulation and thermal inertia

Makes achieving an envelope with very low thermal transmittance possible.

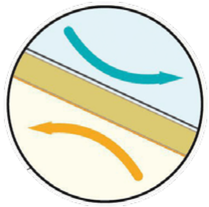
Although ceramic does not have a particularly low thermal transmittance it is a material with high thermal inertia. The use of ceramic tiles in interior and exterior envelope finishes help delay energy losses and regulate the interior temperature, which is particularly relevant for climates with large thermal variations. Furthermore, its high thermal inertia means it works very well in combination with radiant distribution air-conditioning systems, such as radiant floors, ceilings and walls, for an even and slow distribution of heat in interiors.



Thermal bridge free design

Thermal bridges are points in the envelope where the thermal transmittance is higher, resulting in considerable losses of energy.

Vertical ceramic finishes, both interior and exterior, are light enough to be installed without a load-bearing substructure, which usually causes thermal bridges that reduce the bulding envelope's efficiency. When these ceramic finishes are integrated into ventilated façades that do require a supporting substructure, this can be done with specific structural solutions that almost completely reduce these thermal bridges: fibreglass clips, thermal isolation clips or galvanised steel stud systems placed on the insulation and attached to the facing with point anchorages that barely break the building's thermal barrier.



Airtightness

Airtightness to outside air must be ensured for a building with maximum energy efficiency, i.e. to minimise infiltration.

Ceramic finishes, due to their composition and surface treatment, are usually airtight materials that can help create a building’s pressurised barrier. To achieve this effect, using large ceramic elements that minimise the presence of joints in their cut is preferable. The joints must be airtight and this type of solution should be accompanied by products and solutions that promote airtightness.

5. Ceramic tiles in product certification

Product certification provides proof that a manufacturer produces products that meet certain quality, safety and environmental requirements. Having the accreditation of a certifying body sets the product apart and generates more trust in the brand and the quality it represents.

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When a manufacturer opts for product certification, it shows its commitment to information transparency in the construction materials industry and allows professionals and consumers to make decisions based on verified information.

To assess the product certification requirements for ceramic tiles, the most recognised and widely implemented standards worldwide have been reviewed: Cradle to Cradle Certified®, EU Ecolabel, Greenguard Certification and Indoor Air Quality Product Performance Standard for Building Interiors.

All these product certifications are recognised and can give points in different green building certification programmes.

Cradle to Cradle Certified®

This is an internationally recognised multi-attribute programme developed by the Cradle to Cradle Products Innovation Institute. It assesses products and their manufacturing process under the perspectives of health, circularity and corporate responsibility. It is preferred in public procurement programmes and awards points in the main green building certifications, such as LEED, BREEAM® and DGNB.

C2C Certified® assesses the product in five categories: Material Health, Product Circularity, Clean Air and Climate Protection, Water and Soil Management and Social Justice. Each of the categories can be rated Bronze, Silver, Gold and Platinum and the overall certification matches the lowest score in any of the categories.

Material health

Assesses the impact of product ingredients on human health and the environment.

Being a natural material composed of inorganic minerals and water and fired at high temperatures, ceramic tiles are free of VOC emissions, toxicity and any restricted substances in the programme. The possible concentrations of heavy metals in glazes, stains and frits are analysed on a case-by-case basis. However, the Spanish ceramic tile industry complies with the highest standards on the use of toxic substances in its products' finishes.

Product circularity

Assesses product design so that they can be degraded (biological nutrients or recycled (technical nutrients in continuous cycles.

The sector has high rates of raw material recyclability in the production process and ceramic tiles can be easily reused or recycled at the end of their useful life. Managing this material at the end of its useful life will depend mainly on whether it is free of glues and mortars. If reuse is not possible, it can be used as a raw material for other types of materials, such as conglomerates for roads, etc.

Clean air & climate protection

Assesses the use of energy resources with which the product is manufactured and their respective GHG emissions.

The industry is committed to energy efficiency measures and the optimisation of fuel use in the manufacture of ceramic tiles. In addition, many manufacturers have Environmental Product Declarations (EPD), which contributes to the scoring of this requirement.

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Water and soil stewardship

Assesses whether processes are designed to consider water and soil as valuable resources for all.

The sector treats and recovers practically 100% of the water that remains in the production cycle, generating zero negative impact on soil and no water pollution.

Social Fairness

Measures the company's performance in relation to its commitment to human rights and potential risks.

Companies will demonstrate that they foster a work environment that is diverse, inclusive and committed to social equity.
In this case, each manufacturer in the ceramic tile sector must prove that it meets this requirement.

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EU Ecolabel

Certification programme developed by the European Commission to recognise sustainably designed products. It aims to promote innovation, circular economy and the contribution towards climate neutrality in the European Union by 2050. Ceramic tiles are assessed within the "hard coverings" category, formulated to meet the most relevant criteria of the main international green building programmes applied in Europe, such as LEED, BREEAM®, HQE, DGNB and VERDE.

The criteria assessed consider the main environmental impacts generated throughout the products' lifecycle. The "hard coverings" product category includes mandatory criteria and optional criteria that together can reach a maximum score of 100, with a minimum acceptable score of 50.

General Criteria

Compliance with the general criteria is related to the regulatory compliance of the European Parliament, local regulations of the manufacturer's activities related to the product to be certified and specific EU Ecolabel certification guidelines. The following topics are analysed:

- **Industrial and construction mineral extraction,**
- **Restricted substances,**
- **VOC emissions,**
- **Fitness for use,**
- **User information.**

As these are basic and essential criteria for certification, both the ceramic tiles and the manufacturer seeking certification of its product are considered to comply or broadly comply with each of them.

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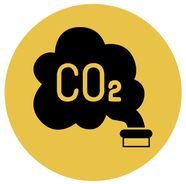
Specific Criteria

Fuel consumption for drying and firing - up to 20 points

Establishes restrictions on the use of fossil fuels such as petroleum coke, light fuel oil and heavy fuel oil, as well as limits on the consumption of other fuels.

The Spanish ceramic tile sector has been using natural gas as a fuel since 1985 and has high efficiency kilns and cogeneration energy systems to reduce use.



CO2 emissions - up to 25 points

Sets limits for CO2 emissions associated with combustion and drying and firing processes.

Measures to adopt high-efficiency furnaces, high-efficiency cogeneration and the use of cleaner fuels facilitate compliance with this criterion.

Process water consumption

Requires a complete closed-loop wastewater recycling system, eliminating liquid discharge.

The sector already has a system to treat and recover 100% of the water that has not evaporated in the production process.

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Emissions of dust, HF, NOx and Sox to air - up to 40 points

Sets limits and evaluates measures to reduce dust emissions from specific operations.

The ceramic tile industry conforms to stringent standards requiring the minimisation of dust emissions associated with its production processes.

Wastewater management

Requires wastewater from the manufacturing process to be treated on site and reused or discharged safely locally.

As explained above, the sector already has a system for treating and recovering 100% of the not evaporated water not evaporated in the production process, for 'zero waste'.

Reuse of process waste - up to 10 points

Analyses the type and quantity of waste generated during the production process. At least 90% of the waste must be reincorporated into production processes.

The ceramic tile industry already reuses 100% of the waste from unfired clays and a large part of the waste from fired clays and also recovers sludge and dust from the production process.

Glazes and inks

Analyses the formulation of the glaze or ink applied to the ceramic tile and limits are set for heavy metal content.

The industry has been working to reduce the use of lead and cadmium in glaze and ink formulations for years, so these metals are already only found in small amounts.

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GREENGUARD® Certification

Certification programme promoted by UL, a multinational consulting and certification company that evaluates products to verify that they meet rigorous safety and quality standards. It aims to recognise products that help reduce indoor air pollution and the risk of chemical exposure and is recognised by green building programmes such as LEED v4, WELL™ , BREEAM®.

Ceramic tile is tested under the 'Building Materials and Interior Finishes' category, where it is assessed for levels of Volatile Organic Compound (VOC) emissions, carcinogens and reproductive toxins. The programme is divided into two levels of certification, GREENGUARD and GREENGUARD Gold, the difference being basically the limits and timing of these chemicals' emissions.

GREENGUARD

- Evaluates the product against a range of over 75,000 chemicals, including VOCs, carcinogens and reproductive toxins.
- There must be a VOC emissions test in which the emission limit values established by the programme for the 168-hour (7-day) period are met.

GREENGUARD GOLD

- It includes health-based criteria for additional chemicals and also requires lower levels of total VOC emissions to help ensure that products are acceptable for use in environments such as schools and medical facilities.
- There must be a VOC emissions test in which the emission limit values established by the programme are met in a period between 168 hours (7 days) and 336 hours (14 days). Compliance may be achieved at time points shorter than 336 hours, provided that it is shown that emissions have already peaked. All products must meet GREENGUARD requirements before being eligible for GREENGUARD Gold.

The natural raw material composition of the ceramic tiles, coupled with the neutrality of VOC emissions, means that this material easily meets this certification’s strictest criteria. The main focus is on the use of heavy metals in glazed and decorated products.

Indoor Air Quality Product Performance Standard for Building Interiors

This is a standard developed by SCS Global Services and assesses the extent to which building materials and indoor furniture affect indoor air quality (IAQ). It aims to promote safe and healthy spaces for people and to provide transparency and credibility to manufacturers who strive for products that contribute to indoor air quality. The standard is recognised by green building programmes such as LEED v4, WELL™, BREEAM® CHPS and Green Globes.

Within the analysis of the impact of building materials on indoor air quality, ceramic tiles are covered by two different SCS Global Services certifications: the FloorScore® and the Indoor AdvantageTM Gold - Building Materials, both based on the CDPH/EHLB (California Department of Public Health / Environmental Health Laboratory Branch) Standard Method V1.2.

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FloorScore®

Evaluates VOC emissions from indoor flooring based on the CDPH/EHLB Standard Method V1.2 for office and classroom settings.

Indoor Advantage™ Gold – Building Materials

Evaluates VOC emissions from indoor building materials based on the V1.2 CDPH/EHLB Standard Method V1.2 for office, classroom and/or residential settings.

Since ceramic products are naturally VOC-free materials, the evaluation according to both certifications' criteria is quite plausible. In recognition of this intrinsic characteristic of ceramics, both FloorScore® and Indoor AdvantageTM Gold require a VOC emission test every four years for this material, instead of two years as for the others.

The differentiating factor for these certifications lies in the analysis of the manufacturer's quality control and in the on-site audit of the manufacturing process of the product to be certified.

6. Aligning the Spanish ceramics industry with the UN 2030 Agenda

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Good health and well-being

The material is naturally free of toxicity and VOCs emissions. It does not transmit odours and its waterproof and innocuous nature makes it more hygienic, anti-allergic and aseptic.

Clean water and sanitation

Resource used as raw material, coolant and cleaning agent in the ceramic tile manufacturing process. 100% of the waste water is reused, achieving the zero waste goal.

Affordable and clean energy

The natural gas used as a transition fuel, the commitment to renewable energies and high-efficiency cogeneration of energy result in the constant reduction of global greenhouse gas emissions in the industry.

Decent work and economic growth

Almost 90% of the industry's workforce is on indefinite term contracts and there are few temp jobs. For every direct job generated, 2.8 additional jobs are provided to the Spanish economy.

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Industry, Innovation and Infrastructure

Commitment to technology and R&D&I-based projects, in addition to ongoing investment in sectoral projects promoted by specialised institutions.

Responsible production and consumption

Reintroduction of nearly 100% of the waste generated in the manufacturing process, enabling the recovery of the remaining waste and reducing the need for virgin raw materials. Its durability and long life cycle delays replacement and reduces unnecessary consumption.

Climate action

60% fewer emissions in the Spanish ceramics sector than in 1980, mainly thanks to the adoption of natural gas as a fuel and cogeneration. In addition, innovations to use as little material as possible while maintaining the same characteristics (thin large tiles).

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Methodological notes

Benchmark study of future scenarios

To undertake this study, the Life Cycle Assessment (LCA) carried out for the production of 1m2 of ceramic tile covered by the Environmental Product Declaration for the Spanish ceramic tile sector, valid until 2024, was used.

As a starting point, scenario 0 was established, which contains the initial LCA data, and the rest of the scenarios were built on this basis. The models for the different scenarios were created with Simapro 9.1 software and the parameters were modified according to the conditions described in each scenario. This makes it possible to obtain their greenhouse gas emissions equivalents and gives an idea of which strategy generates the greatest CO2 savings for the sector and, therefore, allows reaching the objectives proposed by the European Union sooner.

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Benchmark study of coverings in the construction sector

The criteria for assigning points for each indicator are shown below:

SCORING CRITERIA

Estimated useful life (years)	Score	Carbon footprint (Kg de CO2eq)	Score	Circularity (%)	Score	Cost (€/m2)	Score
Between 10-15	1	Between 0-5	1	Between 0-20%	1	Between 0-30	1
Between 16-20	2	Between 6-10	2	Between 21-40%	2	Between 31-55	2
Between 21-25	3	Between 11-15	3	Between 41-60%	3	Between 56-80	3
Between 26-30	4	Between 16-20	4	Between 61-80%	4	Between 81-100	4
Over 30	5	Over 20	5	Over 80%	5	Over 100	5

SCORING BY FLOOR TYPE

Material	Estimated useful life (years)	Score	Carbon footprint (tn CO2 eq/tn product)	Score	Circularity (%)	Score	Cost (€/m2)	Score
Ceramic tile	50	5	0.613	2	41	3	37.00	2
Vinyl tile (LVT)	15	1	2.68	5	60	3	33.00	2
Carpet	10	1	1.50	3	93	5	95.00	4
Wood	20	2	0.242	1	70	4	118.00	5

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Glossary of acronyms and terms

Life Cycle Assessment: Life Cycle Assessment (LCA) is a tool to systematically assess the environmental aspects of a product or service system at all the stages of its life cycle.

Best Available Technology (BAT): The best available technology to achieve a high overall level of environmental protection, developed on a scale that allows implementation in the relevant activity under economically feasible conditions.

Volatile Organic Compounds (VOCs): Hydrocarbons that occur in a gaseous state at normal ambient temperature or are highly volatile at normal ambient temperature. They are classified into three levels of risk to human health and the environment, ranging from extremely hazardous to low impact. They can enter the human body through the respiratory tract or the skin and bioaccumulate in the body. Their health effects are reflected in respiratory problems, eye and throat irritation, dizziness, irritability, concentration difficulties, etc. In the long term, they may cause kidney, liver or central nervous system damage or even have a carcinogenic effect.

Environmental Product Declaration (EPD): Ecolabel type III, according to ISO 14020. It provides quantified, relevant, objective and verified information on the environmental impacts of a product throughout its Life Cycle Assessment (LCA).

Greenhouse gases (GHG): Gaseous components of the atmosphere, natural or anthropogenic, that absorb and emit radiation through the atmosphere and clouds, causing the greenhouse effect. The primary greenhouse gases in the earth's atmosphere are water vapour (H2O), carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O) and ozone (O3). In addition to CO2, N2O and CH4 added by human activity, the atmosphere contains a number of greenhouse gases of entirely anthropogenic origin, such as halocarbons or other substances containing chlorine and bromine, together with sulphur hexafluoridee
(SF6), lhydrofluorocarbons (HFC) and perfluorocarbons (PFCs).

REACH: Registration, Evaluation, Authorisation and Restriction of Chemicals is a European Community Regulation of 18 December 2006.

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