Greenhouse Gas Emissions and Ceramic Tile Production

A Cradle to Cradle focus on Sustainable Ceramics

By Pete Brown - Founder, Bedrock Tiles

Gotham Hotel, Manchester - 40% Recycled Content

Aquashard Restaurant, The Shard - 40% Recycled Content / 7mm Thick Tiles

Selfridges, Manchester - 49% Recycled Content

www.bedrock-tiles.com | 01604 330003 | office@bedrock-tiles.com
What I have found out so far......

........is that I have only just scratched the surface!
Here is what I know, here’s what I can share

When we need to think about a product for a project, what do we do to find the answers fast about something so important and that is to ask some one you know and trust to have the answers, simple right. Someone recently asked me about the GHG emissions for my ranges and indeed my industry. I wasn’t too sure on the specific detail so decided to get on top of what’s happening within our industry, thank you Asif for prompting this along.

I know we are sustainable as a company because of our working practices and that our ranges boast exceptional properties in order to achieve BRE or SKA rated projects but admittedly, I just didn’t know the bigger picture!

Being a self proclaimed sustainable promoter, I swiftly embarked on a study to further my knowledge and understand how we, as a company and overall as an industry can, and are making strides to reduce carbon output, in line with the global and EU targets of net-zero by 2050.

Pete Brown, Founder.
The Ultimate Goals!

To reduce Greenhouse Gas Emissions by 2030 to the tune of: 55% reduction against the levels released in 1990.

To reduce Greenhouse Gas Emissions by 2050 to the tune of achieving net-zero emissions against the levels released in 1990 and becoming climate-neutral.

We will always have emissions but it’s how we manage those into the future and that is why you are investing important time into reading this study!
This is a Cradle to Cradle view of a life cycle.
How can we measure or capture information about the energy being used and the impact on the environment in the PRODUCTS WE SPECIFY for the projects we design?
Certification of course!

…………..Yes…………..

Which ones?

I’ve found that EPD Certificates are a good starting place
What do they look like, who issues them and can I get them?

EPD Certificates are voluntary and their assessment can be conducted internally or by use of an independent assessor.

Most factories that I researched use independent, external assessors.

The EPD Process follows the entire lifecycle of the product.
Stage 1: Resources

Quarry

Mineral Extraction: logged and monitored to government

Transport between quarry to factory – Distances measured

Fuel used for moving the materials to the Mineral Purification department are logged

Stored in mineral warehouses on the factory premises
Stage 2: Processing

This atomizer below is designed to mill the powders efficiently in water to create the granules needed to produce 'technically' perfect tiles.

A lot of tile sludge is created and removed sustainably during this process.

Following the atomization, the Spray Dryer will dry out and create the right balance of first choice, atomized minerals ready for the next process. This Spray Dryer featured in this image below enables this factory to make electricity savings of up to 50%, and gas savings of 10-15%.

I’ll come to how the energy is measured for each of the processes in the LCA later, this is about production now.
Stage 3: Manufacturing

Here the presses are shown, these machines define the shape, size and surface texture of the tiles we use and specify!

They mechanically press at approx. 7,5 Tons!
Stage 3: Manufacturing

**Nu-Skool!**

Modern advances in technology see the next step in the manufacturing stage is the decoration, or ‘creation’ as I like to call it, of the style of tile and its looks. Inks used are regulated to current EU requirements for sustainable use and disposal.

**Old Skool!**

These are how we used to apply colour or pattern to the tiles surface, each of these Roto-Glaze machines has slightly different colour paint in them. If you’re having a really varied stone effect look, the tile would potentially roll under up to 25 of these paint-heavy machines!
Stage 3: Manufacturing

The factory produces incredibly accurate print replication and then prints over an area so that the likely hood of seeing two tiles that look the same, installed next to each other is extremely remote.
Another example of the incredible detail that modern porcelain tile ink-jet production can achieve!
The firing process involves industrial kilns that are between 100 – 200m long and control temperatures of between 600 – 1600°C.

The heat is captured from the kiln and reused in the drying processes from the previous atomization stage, also the heat is used for heating to the overall premises including offices etc.

The kilns are refurbished and repaired annually to ensure they maintain efficiency and comply to strict EU emission reduction programmes such as the EU-ETS – we’ll discuss this scheme a little later.
All tiles are mechanically finished, this could be rectification which is a process of trimming the tiles to ensure they are all of a consistent ‘rectified’ size.

Some tiles are polished which involved buffering the porcelain extensively until it polishes up.

In the penultimate part of the production it is critical that every single tile undergoes a strict and rigorous quality control and testing checks.

From these checks the technical datasheet for the range is formed and thus bases the information contained in the EPD certificate.
Here is an example of a technical data sheet

<table>
<thead>
<tr>
<th>CHARACTERISTICS</th>
<th>DECLARED VALUES</th>
<th>TEST METHOD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Physical Dimensions</strong></td>
<td></td>
<td></td>
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<tr>
<td>Length and Width</td>
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<td></td>
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<tr>
<td>Maximum deviation for manufacturing</td>
<td>± 0.2%</td>
<td>ISO 10545-2</td>
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<tr>
<td>size</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum deviation for average size</td>
<td>± 0.3%</td>
<td>ISO 10545-2</td>
</tr>
<tr>
<td>Thickness - Maximum deviation</td>
<td>± 2%</td>
<td>ISO 10545-2</td>
</tr>
<tr>
<td>Rectilinearity - Maximum deviation</td>
<td>± 0.3%</td>
<td>ISO 10545-2</td>
</tr>
<tr>
<td>Orthogonality - Maximum deviation</td>
<td>± 0.2%</td>
<td>ISO 10545-2</td>
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<tr>
<td>Surface Flatness</td>
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<tr>
<td>Maximum central curving</td>
<td>± 0.3%</td>
<td>ISO 10545-2</td>
</tr>
<tr>
<td>Maximum lateral curving</td>
<td>± 0.3%</td>
<td>ISO 10545-2</td>
</tr>
<tr>
<td>Maximum bending</td>
<td>± 0.3%</td>
<td>ISO 10545-2</td>
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<tr>
<td><strong>Physical Properties</strong></td>
<td></td>
<td></td>
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<tr>
<td>Water Absorption</td>
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<tr>
<td>Rupture Load (N)</td>
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<tr>
<td>Density &lt; 7.5 mm</td>
<td>&gt; 2000 N</td>
<td>ISO 10545-4</td>
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<tr>
<td>Density &gt; 7.5 mm</td>
<td>&gt; 1500 N</td>
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<td>ISO 10545-7</td>
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<tr>
<td>Crasing Resistance (Glazed)</td>
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<td>ISO 10545-11</td>
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<tr>
<td>Resistance to Frost</td>
<td>Without visible defects</td>
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<td>Anti-slip Resistance</td>
<td>R9</td>
<td>DIN 31130</td>
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<td>Anti-slip Resistance</td>
<td>A</td>
<td>DIN 51097</td>
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<tr>
<td>Binding Strength - Tabled Values</td>
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<tr>
<td>Cement-based Adhesive</td>
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<tr>
<td>Spread Adhesive</td>
<td>≥ 1 N/mm²</td>
<td>NP EN 12004:2004</td>
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<tr>
<td>Resin-Reactive Adhesive</td>
<td>≥ 2 N/mm²</td>
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<td>Mortar</td>
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<td>Min. Type 4</td>
<td>ISO 10545-14</td>
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<tr>
<td>Resistance to High Concentrations of Acids and Alkalis</td>
<td>UMA</td>
<td>ISO 10545-13</td>
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<td>UA</td>
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<td>Release of Dangerous Substances</td>
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<td>PHD</td>
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<tr>
<td>Lead</td>
<td>PHD</td>
<td>ISO 10545-15</td>
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<tr>
<td>Reaction to Fire</td>
<td>Class A₁₂</td>
<td>Decision 90/603/CE</td>
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</tbody>
</table>

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Packaging

From pallets to cardboard packaging for the tiles through to the various other items required to bind and secure the products ready for transport, all items are sustainably sourced, fully recyclable and come with offsetting schemes to allow for regeneration.
Stage 4: Distribution

Transport happens for all products. The distances calculated differ with each EPD certificate I researched but are easily picked out when you investigate them. The certificates often class distribution measurement as:

1. National
2. Europe
3. Rest of World

We operate a groupage method, this involved consolidation of industry orders to ensure trucks are both using the most of their space, inclusive of double stacking and to ensure the management of emissions for importing within our industry.

Delivery within the UK can now be monitored by use and request of vehicles that are FORS rated. FORS looks at the operations and efficiencies of fleets operating across the UK.

What is Euro VI fuel?

European emission standards regulate gasoline and diesel vehicles separately. Considering first the standards for diesel vehicles (see Table 1), Euro 6 is a significant advancement over Euro 5 with regard to NOx limits. The NOx limit declines from 0.18 g/km to 0.08 g/km, a reduction of 56%.
Stage 5: Construction and use of the product

Consider the adhesives used in the project: This is a study not a sales pitch but we would recommend Kerakoll Bio-gel as a revolutionary new material!

The grout being used is also critical, here’s a great look at the choices of colour available in highly sustainable grout – never compromise your creativity!

Bedrock Tiles will write an M40 / NBS specification for any and all projects we work with you on.

They specifically note the grout and adhesive best suited for sustainable architecture

This service is free of charge and takes 24-48hrs!
Myth Buster!

When porcelain or ceramic tiles are installed they omit...

NO

V.O.C’s
Stage 5: Use / Life Span

Life • Use • Purpose!

Project: Aldwych One, London
Client: Fabled Studio, London
Contractor: WFC
Completed: 2019
EPD Certificate: Yes
Recycled Content: 40% +
Life • Use • Purpose!

The expected ‘Life Span’ of a building changes from report to report but there is a pattern between the respective producers which translates to:

- 1. UK - 60 years
- 2. Italy - 60 years
- 3. Portugal - 60 years
- 4. Spain - 50 years

Provided the tiles are installed correctly, all factories state in their EPD certificatess that their product will last for that life span!
Project: Vodafone ‘Commercial’ Rollout
Client: CMI Workplace, London
Contractor: Overbury
Completed: 2016 – Present
EPD Certificate: Yes
Recycled Content: 70%
Stage 6: End of Life

At the end of the product's life, can it be recycled again, if **not** your product is classed as Cradle to Grave.

If your product **can** be reused after being removed from a demolished building then it achieves [Cradle to Cradle](#).

Porcelain and Ceramic tiles are all reusable and predominantly reused for motorway aggregate or to be milled into powders for use in carbon neutral, cement production.
What percentage of tiles are reused after their life ends?

The breakdown of the waste processing for ceramic/porcelain tiles, using a metric of 1m² is calculated to be approximately:

70% = Reuse, recovery and recycling.

30% = Controlled landfill.
Cradle to Cradle Assessment

When we complete the full cycle of life for a product, we can then truly measure its impact. What this means is that as we look to improve all areas of production, we can prioritise the heaviest levels of emission output to reduce them faster!

You’ll see the production phase is referenced with a letter for example, A1 refers to ‘Raw Materials’. These references are listed on the chart vertically on the left.

Running horizontally from left to right are the situations that the process of production affects, these are listed at the bottom of the chart but the next page explains it all in more detail.

Extract from a Spanish producers EPD certificate
Cradle to Cradle – Breakdown of Environmental Impact for each stage of the Life Cycle

We are making good progress, we established what the emissions are per m2 of porcelain tile on the previous page, now we must see what impact that has on the environment.

The environment is like the human mind, very complex, very integrated and had mood swings. We can look at what our goals are within the overall carbon reduction schemes and address those.

This graph shows the impact to each part of the environment, for example if you needed to see what stage of the life-span of a tile is the greatest for the Global Warming Potential then you can see it is the A3 (manufacturing) phase so to reduce the GWP, we would refine the production methods.
Further in-depth data for sustainable analysis

The reports continue to generate specific data on the use of renewable energy resource use and exact information on output flows and waste categories across the life span of the tile, so we can manage the emission or fossil reduction goals properly into the future.
**Extra data available:**

At the beginning of this report I mentioned that I’d only just scratched the surface, well, this is because for each module of assessment through the production, such as A1 or A3, there are measurements or assumptions applied in order to gain the overall phase’s, respective emission outputs.

Rather than making this report to unbearable to read, they’re available upon request. They’re quite in-depth and informative but not incorporable at this level.
The European Reference Life-Cycle Database (ELCD) has been developed by the European Commission’s Joint Research Centre (DG JRC) and provides core Life Cycle Inventory (LCI) data from front-running EU-level business associations and, where not available, other sources. Within the ELCD, several energy-related data are provided, being energy a major input for almost all the environmental analyses of products or processes. This study presents a comprehensive analysis of LCI and other potential sources to be used as data providers, in order to assure the quality of the ELCD. Therefore, an analysis of the quality of energy data for European markets that are available in 3rd party life cycle databases and from authoritative sources that are, or could be, used to improve the ELCD has been carried out. This work has been carried out by the Energy Systems Analysis (ASE) Unit of CIEMAT (Public Research Centre for Energy, Environment and Technology, Madrid, Spain), through a service contract (Service Contract Number 387533) awarded by the European Commission – Joint Research Centre – Institute for Environment and Sustainability (Tender Number IES/H/2011/01/13/NC)

**European Reference Life-Cycle Database**

**Environmental Impact Indicators**

As referenced in EPD Certificates

**Ecoinvent v2.0**

The ecoinvent database is the world's leading LCI database which delivers both in terms of transparency and consistency. The ecoinvent database provides well documented process data for thousands of products, helping you make truly informed choices about their environmental impact.

https://www.ecoinvent.org

ecoinvent
The scheme allows larger emitting companies to buy allocations from lesser emitting companies in order to manage the overall reduction of emissions by 2050.

The Ceramics industry as mentioned is collaborating as groups and organisations in order to massively reduce the emissions created within ceramic production. We are ahead of our requirements in reducing our emissions output as a sector and continue to developing newer and greener methods of manufacturing.
Italian Mafia!

The Confindustria Ceramica is a group of factories that subscribe to a member group of 76 prominent and leading manufacturers.

At least 20 of our factories belong to this group and only a handful have proceeded to create their own, stand alone EPD Certificate for their individual operations.

These handful of people are now regarded by Bedrock as industry heroes and will enjoy the benefits of Bedrock promoting their ranges as priority to reward the progress, they have made to push forward the message about climate change and the need to work harder at emission reduction!

Here’s what they say on their site:

*The Italian ceramic industry’s world leadership position is therefore not limited to production but includes to a commitment to achieving extremely low levels of environmental impact and fully respecting the ecological equilibrium.*
Technology Advancements

Thin Tiles/Slabs

3mm / 5mm / 6mm / 7mm

Zabeel House, Great Eastern Street, London
40% recycled Content, 3200x1600mm 6mm Thick Porcelain Slab

Aquashard Restaurant, Level 32, London
40% recycled Content, 1500x750mm 6mm Thick Porcelain Slab Tiles

The Blade, Commercial Offices, Reading
40% recycled Content, 1200x600mm 10mm Thick Porcelain Tiles
How and Why are Thin Porcelain Tiles a good thing?

Thin porcelain tiles are making big waves within our industry at the moment and we feel this style of porcelain will become more popular in the future.

**Why use Thin tiles?**

**Environment** - Thin tiles are great for the environment, they boasts in the majority of cases up to 30-70% less material than a regular porcelain tile. Thin porcelain tiles use less energy and production requirements therefore making the thin tiles more environmentally friendly in a LCA perspective.

**Weight** - Being of a light weight nature, thin tiles can be specified as large format tiles for use on the wall, this before could not be easily achieved before.

**Speed / Cost** - Should a project be running behind schedule, you can over tile an area with thin tiles, reducing the time needed to strip off the previous finish and make good ahead of the new tiles being installed which would ultimately saving both time and money.
Great, now - How can I apply my sustainable tiles to my projects?
SKA – Measures the sustainability and efficiency of commercial refurbishments

SKA M13 Hard wall covering criteria, the following criteria applies for the wall ceramic tiles:

- wall tile (ceramic, glass, clay, stone, porcelain), are manufactured with at least 50% recycled content, measured by mass;
- have a Cradle to Cradle Silver certification or above;
- have an EU Ecolabel;
- are supplied with an environmental product declaration, written in accordance with ISO 14025 standards.

Achieving the 50% recycled content may be challenging but there are other options to meet the SKA criteria, such as having **EPD accreditation**, EU Ecolabel or Cradle to Cradle Silver certification or above.

Bedrock Has Collections that can achieve:
- Wall tiles with up to 61% (Ceramic)
- Floor and Wall Tiles up to 100% recycled content (Porcelain)

Our key factories, produce Bedrock Tiles’ key ranges are EPD certified in addition to offering high recycled content levels.
BREEAM – Measures the sustainability and efficiency of public and any new building scheme

To achieve an ‘BREEAM A+’ your tiles must achieve 40% or higher in recycled content

<table>
<thead>
<tr>
<th>Product Description</th>
<th>Element number</th>
<th>BRE Summary rating</th>
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<tbody>
<tr>
<td>Cement based terrazzo tiles.</td>
<td>821580007</td>
<td>E</td>
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<tr>
<td>Ceramic floor tiles.</td>
<td>821580001</td>
<td>B</td>
</tr>
<tr>
<td>Porcelain Floor Tile (40% recycled content) 11mm thick, ISO13006 Type B1A</td>
<td>1021580001</td>
<td>A+</td>
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<td>1021580002</td>
<td>A+</td>
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<tr>
<td>Resin based terrazzo/agglomerated stone/composite tiles (10% resin content).</td>
<td>8215800018</td>
<td>D</td>
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</table>
Leadership in Energy and Environmental Design (LEED) is a voluntary environmental certification system developed by the US Green Building Council in 2000. It covers design, construction, operation and maintenance.

LEED is the young upstart with around 9,000 certified buildings with only 100 registered in the UK. LEED, developed by the US Green Building Council (USGBC), took the structure and topics from BREEAM and adapted them to the US market.

Leadership in Energy and Environmental Design (LEED) is a voluntary environmental certification system developed by the U.S. Green Building Council in 2000.

It covers design, construction, operation and maintenance.

LEED is a competitor to the BREEAM environmental assessment method, developed in the UK.

There are more than 110,000 certified buildings, most of them in the UK.
What you have just experienced is what I’ve learnt about the carbon emissions and greenhouse gas so far that’s created by our industry......

I plan to review this every 2-5 years dependant on any major changes that develop......

As you see from our ongoing work and research, we’re not hanging around to be sustainable – Bedrock Tiles are committed to being the leading supplier of ecologically sound, porcelain and ceramic tiles!
## Our ranges that have above 40% content or are produced with an EPD Certificate

<table>
<thead>
<tr>
<th>Bedrock Range Name</th>
<th>Our Code</th>
<th>EPD Certificate</th>
<th>Country of Origin</th>
<th>Material Type</th>
<th>Recycled Content</th>
<th>Use</th>
<th>Clients that specified the range</th>
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<td>Eco Tiles</td>
<td>BHGF</td>
<td>Yes</td>
<td>Italy</td>
<td>Porcelain</td>
<td>100% / 80% / 70%</td>
<td>All Sectors</td>
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<td>BUOP</td>
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<td>HS2 / Network Rail / Birmingham City University everywhere!</td>
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<td>Spain</td>
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</tr>
<tr>
<td>Botanical</td>
<td>BTNC</td>
<td>Yes</td>
<td>Spain</td>
<td>Ceramic</td>
<td>61%</td>
<td>All Sectors</td>
<td></td>
</tr>
</tbody>
</table>
And the list goes on.........and on........and on..................

You can always check into our website where you’ll find these and many more eco-focused collections.

Like all good businesses we strive to continue our search for new, cool, specifiable and technically brilliant material so keep tuned to find out more.

Thank you for your interest in how sustainability is making strides through our TILES’ life cycle from............

Cradle to Cradle.
Further Actions to develop your sustainable development

• Book a CPD through Bedrock to share the knowledge you’ve learnt here with your extended team at your practice or studio.

• Arrange samples from Bedrock so you know that sustainability has been discussed and the appropriate samples are on their way.

• Challenge your contractors, clients, suppliers to ensure that everyone is sustainably-conscious as much as possible throughout the entire construction process.

• Keep believing, keep promoting and never stop the drive for a more sustainable future. We owe it to our kids, let’s get in the game!