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Revision of EU Ecolabel criteria for Hard Coverings

Technical Report v.2.0: Draft criteria proposals.

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1 EXECUTIVE SUMMARY

This short summary brings together some key points about the project that should be borne in mind as well as a summary of the criteria proposals presented in this document.

Timeline

The EU Ecolabel criteria for hard coverings (HC) set out in Decision 2009/607/EC are now 9 years old and, via Commission Decision (EU) 2017/2076, have had their validity prolonged until 30 June 2021. As the last remaining Decision that still precedes the EU Ecolabel Regulation (EC) No 66/2010, its revision is overdue. The first Ad-Hoc Working Group (AHWG) meeting is scheduled as three separate webinars on the 10, 12 and 14 December 2018 for concrete products, ceramic products and natural/agglomerated stone products respectively. Assuming no delays, new criteria are expected to be officially published in the second half of 2020.

Scope and uptake

The scope of the existing criteria extend to floor and wall coverings made of natural stone, agglomerated stone, fired clay, ceramics and concrete. Moderate uptake of the criteria has been achieved with ceramic tiles (especially in Italy, where producers offer a range of high quality ceramic tile and slab products for export). With natural stone, only one quarry in Europe (in Spain) has been willing and able to demonstrate compliance with the applicable quarry scoring matrix. The authors are not aware of any current or expired EU Ecolabel licenses for agglomerated stone, clay or concrete-based products.

Potential scope expansion

In this report, the potential expansion of the product group to include kitchen countertops, roofing tiles and masonry units is considered. There are arguments for and against the expansion to these product categories. Although there may be some differences in the parameters that need to be respected in the production processes, they are fundamentally produced in the same way and are made of the exact same materials as the sub-products already covered in the scope for floor and wall tiles. The final decision on whether to include them or not will ultimately depend on stakeholder feedback.

The potential expansion to plasterboard was also considered but was not followed up due to time constraints and a lack of external input from the industry. Whether or not plasterboard will be reconsidered will also depend on stakeholder feedback.

Market considerations

The products covered by the existing EU Ecolabel hard coverings scope are dominated by business-to-business (B2B) sales and this factor, coupled with the well-coordinated efforts of CEN-TC 350 have led to a substantial uptake of Environmental Product Declarations (EPDs) for these type of products. With the recent trend towards producing sectorial EPDs, where average data can be weighted over a large number of producers and product types, it can be said that around 70% of all ceramic production in the EU will soon be covered by sectorial EPDs.

Part of the reason for the successful uptake of EPDs is their recognition in Green Building Assessment (GBA) schemes such as BREEAM and LEED. The authors believe that the EU Ecolabel for hard coverings, as a Type I ecolabel covering a number of different construction products, and being based on criteria that target the main hotspots of LCA impacts, is also worthy of recognition by these same schemes and this will continue to be discussed as the project progresses.

Another part of the reason for the successful uptake of EPDs, in Italy in particular, is the recognition of EPDs and type I ecolabels when setting legislation supporting minimum environmental criteria for "*internal furniture, building and textile products*". A minimum environmental requirement of an EPD (specific or sectorial) or an EU Ecolabel is defined. Sectorial EPDs are much more economical when large groups of companies pool their data together. While it can be argued if a sectorial EPD should be recognised at all, let alone be considered as comparable to a product specific EPD or an EU Ecolabel product, this effect only serves to highlight the potential positive influence of GPP criteria on projects when regional or national public procurement legislation pushes for Ecolabels or EPDs.

A general shift towards a scoring approach for hard covering products

In the existing criteria, a scoring matrix was already present but only for natural stone quarries. In principal the idea is interesting and represents a move away from the rigid pass-fail approach that is normally employed. If applied to the entire criteria, it could give potential applicants an idea of how far away they might be from being able to obtain the EU Ecolabel, to identify one or more ways in which they could bridge the gap or to simply measure their own progress using these metrics without having to involve any LCA experts.

Particular effort has been made to set the criteria to focus on requirements and information that potential applicants already have or should be able to obtain. The only upstream requirements are on criteria linked to quarries for natural stone and cement for concrete. These could not be ignored because they are involved with significant LCA hotspots.

As a cautionary note, some EUEB members have requested that scoring should be supported by some mandatory requirements to act as a "*safety net*'' to prevent the possibility of an EU Ecolabel product being associated with very poor performance in one or two environmental aspects. This feedback has generally been taken into account and mandatory requirements are set together with potential ways in which an applicant can achieve points. Two common aspects that are promoted for all the sub-products, without making them mandatory, are EMAS certification and the installation of onsite CHP.

As a general rule, the points are based on quantitative data that is linked to maximum points for an arbitrary best practice threshold or are based on optional requirements where a yes achieves full points or a no achieves zero points.

Changes to the natural stone product criteria

The scoring matrix for the quarry has been removed due to the following points:

- Concern about the highly dynamic nature and dependence on the choice of sampling point for dust emissions to air and noise.
- Doubts about the relevance of water recycling ratio since the authors understand that water is recycled in a closed loop and only evaporative losses and losses in separated wet sludge are topped up (so a default ratio of 100% according to the method in the existing criteria is the norm).
- Leading from the water recycling practice, suspended solid emissions become irrelevant or highly intermittent and carrying also solids from diffuse sources (due to fact that water emissions are either zero or in overflow conditions due to rainfall.
- The weighting factors generally cannot be controlled by the quarry operator (e.g. population density of the surrounding population) and greatly influence the final score.

The highly dynamic, and difficult to verify, requirements relating to dust emissions, suspended solid emissions and noise have been converted into more tangible good management practices (for water and air) and the noise requirement has been set to a fixed maximum during working hours. There are no more weighting factors in the proposal. Mandatory requirements (and optional points) are set for the quarry impact ratio and the material efficiency due to their continued importance on land use impacts and resource efficiency. These are numbers which the quarry operator should be able to calculate as they are closely related to the core business.

Changes to the agglomerated stone product criteria

During the initial research period the JRC was unable to visit a production facility or establish dialogue with relevant experts. Consequently, there is some uncertainty associated with the relevance and ambition level of both the existing and proposed criteria. A decision needs to be made about whether cement-based agglomerated stone products should be covered by the EU Ecolabel or not. If so, then some sort of requirement on the cement binder would need to be proposed.

Due to a lack of information, the air emission limits have been maintained as they were although desk-based research has suggested that it would be possible to push for recycled/secondary material content (up to 40 points) and for a reduction in the organic binder content on a w/w basis (up to 25 points). Regarding specific energy consumption, there is very little data published and so further input will be needed. A tighter limit of 1.1 MJ/kg has been proposed with a view to prompting discussion on this matter. Independent of the specific energy consumption, recognition of efforts by potential applicants who need heat energy for their process and who manage to obtain it more efficiently is promoted by awarding points for the installation of CHP units onsite. Further points are available should the CHP unit be fed with biomass or waste fuels and/or from the renewables share of purchased electricity. The approach has been applied to all the sub-products and, if deemed suitable for all, could be moved to the horizontal criteria.

Changes to the ceramic product criteria

Specific energy consumption data and air emissions from the BREF Document published in 2007 for ceramics (specifically those data regarding floor and wall tile production) have been cross-checked against the current EU Ecolabel requirements. A direct comparison was complicated by the different units used (BREF focuses on mg/Nm^3 and EU Ecolabel focuses on mg/m^2). In the context of the BREF data from 2007, most of the requirements in the EU Ecolabel appear to be of a reasonable ambition level.

While it is unclear how much energy consumption and air emissions have improved in the last 10 years, a new type of ceramic tile product has emerged, the thin format tile. Thin format tiles can be as thin as 3mm, a significant decrease compared to the standard thickness of 10-12mm. Consequently, it has to be decided what to do with the units used for requirements relating to energy consumption (MJ/kg, which penalises thinner tiles) and air emission (mg/m^2, which favours thinner tiles). In the proposed criteria, two units have been proposed so that readers can see how they compare. One possible approach could be to set the units in a way that standard tiles can meet but which always favour thinner tiles, in order to recognise their superior material efficiency. This is a matter for in-depth stakeholder discussion.

With regards to points, the most important aspects are recognised as air emissions and specific energy consumption, although the advanced reuse of process waste solids and further reductions in specific freshwater consumption are fully encouraged too.

Changes to the concrete-based product criteria

Both the concrete paving blocks and the cement-based terrazzo tiles are made with the same production technology, namely dry-cast concrete using vibro-compression. Clear lines need to be drawn between cement-based terrazzo tile and cement-based agglomerated stone but this will require clarification from industry and relevant CEN/TC members. In this first proposal, the same criteria for terrazzo tiles and concrete paving blocks, flags and kerb units apply.

A significant number of potential new EU Ecolabel criteria arose during the background research carried out. Some potential criteria such as an optional award of points for high albedo concretes or the use of alternative fuels in cement kilns were not brought forward from the Background Report into the first draft proposal in this Technical Report due uncertainties about the delivery of environmental benefits. For example, there is still some uncertainty if surface albedo at the global level is actually an issue of environmental concern. With regards to alternative fuels, not all alternative fuels are equal and it may be challenging to estimate the calorific value input of alternative fuels in cases where they are heterogeneous by nature and variable from batch to batch delivered to site.

Still, there are a number of new criteria that are presented for stakeholder feedback and which apply at the level of the cement producer (i.e. clinker factor and gross CO2 emissions) or the concrete producer (recycled/secondary material content, plant energy consumption, photocatalytic surfaces and permeable pavements).

Restructuring of criteria

In Decision 2009/607/EC, the criteria were generally structured in the same sequence as a product life cycle, starting with raw material extraction, the processing, then the use phase. Sub-products were either natural or processed and the latter were either fired or hardened. From the perspective of a potential reader who is only interested in what criteria are relevant for e.g. ceramics, the document was not reader-friendly. Consequently, the criteria have been restructured as follows:

- Horizontal criteria for all sub-products;
- Specific criteria for natural stone;
- Specific criteria for agglomerated stone;
- Specific criteria for ceramic-based products, and
- Specific criteria for concrete-based products.

2 INTRODUCTION

The EU Ecolabel promotes the production and consumption of products with a reduced environmental impact along the life cycle and is awarded only to the best (environmental) performing products in the market.

The entire life cycle of the product, from the extraction of raw materials through to production, packaging, distribution, use and disposal is considered. The EU Ecolabel may define criteria that address environmental impacts from any of these lifecycle phases, with the aim being to target those areas of most significant impact preferentially. The criteria development process involves scientists, non-governmental organisations (NGOs), member state representatives, and industry stakeholders. The overall ambition level for criteria should aim to target 10% to 20% of the most environmentally friendly products currently on the market.

Since the life cycle of each product and service is different, the criteria are tailored to address the unique characteristics of each product type. They are revised to reflect upon technical innovation such as alternative materials or production processes, reductions in emissions and market advances. The development and revision processes are carried out in accordance with the EU Ecolabel Regulation (EC) No 66/2010. An important part of the process for developing or revising EU Ecolabel criteria is the involvement of stakeholders through publication of and consultation on draft technical reports and criteria proposals. This is achieved by working group meetings and written consultation processes managed via the BATIS online platform.

The overall aim of this project is to update existing criteria for hard coverings (Commission Decision 2009/607/EC). The project performs an evaluation of the existing criteria for the product group by identifying which are still relevant and those who need revision, addressing existing concerns. It also examines whether any new criteria need to be introduced for areas of concern. The key factors to consider in this respect are:

- New technological development: either step-wise evolution of existing processes or completely new processes that become available, are economically viable and could mitigate environmental impacts;
- Stricter legal requirements: which may render existing EU Ecolabel criteria obsolete or of low ambition, or which may oblige the introduction of new restrictions;
- Developments in other ISO 14024 Type I ecolabels: to align where possible and where a clear rationale can be established;
- Published papers about LCA and non-LCA impacts with relevant processes and products: to help ensure that proposed criteria focus mainly on the environmental hotspots of the hard covering production.

This Technical Report aims to provide the background information and rationale for the revision of the EU Ecolabel criteria for the hard coverings product group. The study has been carried by the Joint Research Centre (JRC Seville). The work is being developed for the European Commission's Directorate General for the Environment.

2.1 The criteria revision process

This project is intended to follow the standard procedure for the revision of EU Ecolabel criteria. A general illustration of the standard procedure is illustrated in Figure 1. The current stage in the process is highlighted in the red box.

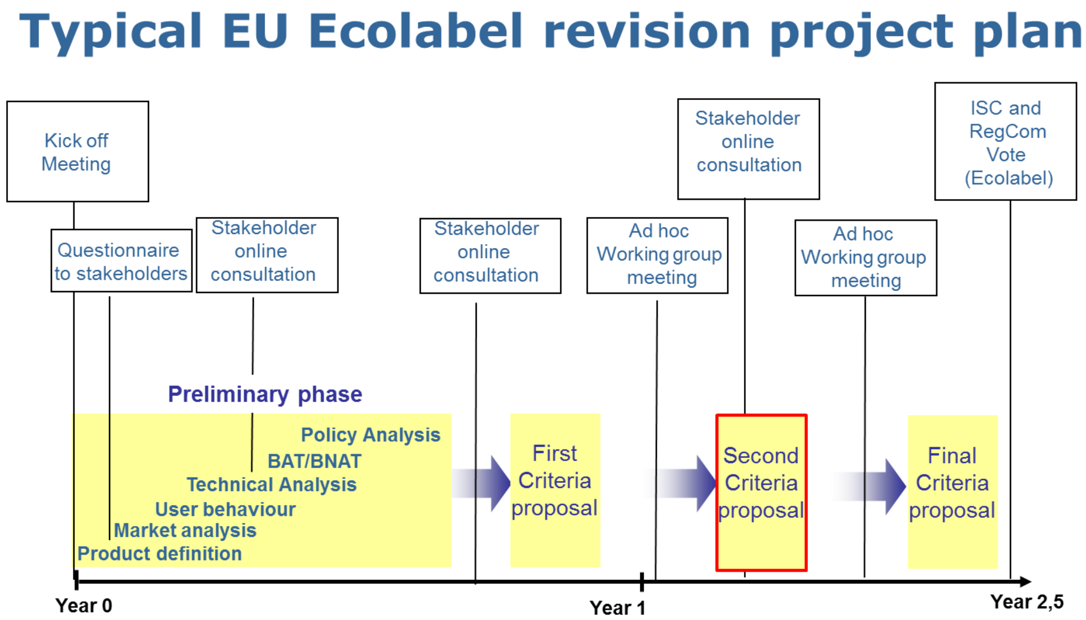

Figure 1. Overview of the typical EU Ecolabel revision process

The information obtained during the preliminary phase of the revision process has been included in the Preliminary Report (PR) published along with the 1st technical report, in the BATIS online platform and the JRC website. The PR, together with the existing Decision 2009/607/EC for EU Ecolabel hard coverings, constitute the basis of the 1st revised criteria proposal published in TR v1.0. Both documents (PR and TR v1.0) then served as a basis for discussions with stakeholders in the first ad-hoc working group (AHWG) meeting held in December 2018.

This report (TR v2.0) now builds upon stakeholder feedback to TR v1.0 and any further research conducted by the JRC since the 1st AHWG meeting. The criteria proposals have been updated and re-evaluated in TR v2.0 and the main changes between v1.0 and v2.0 are described at the beginning of each chapter. Tables comparing the criteria at different stages of the project are also provided for ease of reference.

Several iterations of the criteria are anticipated before they will be finally voted and these will be reflected in subsequent version of this Technical Report. An html version of the Technical Report v2.0 will also be uploaded to the BATIS online platform prior to the 2nd AHWG meeting where registered stakeholders can upload their comments at any point up until around one month after the meeting. Feedback received before, during and after the 2st AHWG meeting will then be considered when drafting the final Technical Report v3.0.

Throughout the project, updates will be presented to the EU Ecolabelling Board when the board periodically meets in Brussels (3 times per year).

After the stakeholder consultation process has finalised, the proposed revisions will be subjected to internal consultation with other DGs of the Commission and then formally voted by members of the EU Ecolabelling Board. Subject to a positive vote, the criteria will be presented in the legal text format of a Commission Decision and subject to the scrutiny of the European Council and the European Parliament and translated into all of the official languages of the European Union.

2.2 Summary of preliminary report

This section summarises the main conclusions of the PRs. The full text documents can be found on the BATIS platform and also at the project website:

http://susproc.jrc.ec.europa.eu/Hard_coverings/documents.html

2.2.1 Legal and Policy context

There are a number of relevant EU policy tools, Regulations and Directives that apply to this sector specifically and in an overarching manner as well. Arguably the most relevant is the Industrial Emissions Directive 2010/75/EU which defines best available techniques for major industrial sectors and sets requirements relating to emissions from the production site and sometimes on energy supply or consumption (this Directive is directly relevant to ceramic and cement production).

The use of secondary or recycled materials, and the reduction of waste production onsite are relevant to all sectors in different ways and are in line with the general aims of the Waste Framework Directive (2008/98/EC) and the EU Action Plan for the Circular Economy (COM(2015) 614).

As construction products, all are required to respect the harmonised requirements for the marketing of construction products as per Regulation (EU) No 305/2011. However, it is understood that these requirements would not apply to any products for use as kitchen countertops, since they would be considered as "*furniture*", which has no CE marking requirements, instead of construction products.

2.2.2 Market analysis

Market dimensions

The products covered in the current scope form part of major industrial sectors. The basic level relevant PRODCOM codes assessed are:

- 08.11 Quarrying of ornamental and building stone, limestone, gypsum, chalk and slate.
- 23.31 Manufacture of ceramic tiles and flags
- 23.32 Manufacture of bricks, tiles and construction products, in baked clay
- 23.51 Manufacture of cement
- 26.61 Manufacture of concrete products for construction purposes

Natural stone production in Europe is dominated by Italy, Spain and Portugal, who together account for around two thirds of the total EU production of around 20 Mt.

With ceramics, production data is reported in m^2 and EU production in 2016 was around 1350 Mm^2. Spain and Italy are the two dominant producers in the EU, together accounting for over two thirds of total EU production. The Spanish and Italian sectors are characterised by production clusters, with the vast majority of producers concentrated into region districts (i.e. Castellon in Spain and Sassuolo in Italy).

~~The agglomerated stone market in the EU was reported to be 17 Mm^2 in 2014 and is experiencing rapid growth worldwide (expected to be 24.5 Mm^2 in the EU in 2019).~~

The production of concrete tiles and flags in the EU is dominated by Germany, Poland and the UK, who together account for around 50% of total European production volume and value.

In general, all of these products have experienced a slump in production at the European level due to the economic crisis. Ceramics and natural stone are the sectors with greatest potential growth for exports out of the EU while concrete products in particular are limited to regional markets, even with cement supply (except in cases of white cement, which is a relatively niche product of potential relevance to this product group).

Environmental marketing strategies

In terms of other ecolabel schemes, an analysis of potentially relevant ISO 14024 Type I ecolabels revealed that these types of product are not covered by the main European ecolabel schemes (i.e. Blue Angel and Nordic ecolabel) but that outside of Europe there are a number of possible overlaps. The main examples are:

- The Korean Ecolabel (KEITI) with criteria for blocks, tiles, panels, recycled construction materials, aggregate and fine powder.
- Good Environmental Choice Australia (GECA) for cement, concrete and concrete-products as well as "hard surfacing".
- Environmental Choice New Zealand (ECNZ) of Portland cement and Portland cement blends and for ready-mixed concrete, pre-cast concrete, concrete products and dry-bagged mortars.
- Floor score (seeming global and operated by an independent party) which relates to VOC emissions for flooring materials.

It is worth mentioning some industry-led initiatives that attempt to define some level of environmental reporting and sustainability. In terms of environmental reporting, CEN/TC 350 has led the development of Product Category Rules for construction products in general, resulting in the publication of the standard EN 15804. This standard has set the platform for carrying out Environmental Product Declarations (EPDs) for this type of products. While the number of product specific EPDs remains relatively small, there are some "sectorial" EPDs which claim to cover large parts of entire sectors at the national or international level. This is the case for Portland cement as well as ceramic tile producers in Germany, Italy and shortly, Spain.

In terms of sustainability initiatives at international level, the concrete industry have developed an early version of the Concrete Sustainability Council Certification System (version 1.0 ready in December 2017) and the ceramics industry are currently finalising an ISO standard on specifications for sustainable ceramic tiles.

Green Building Assessment schemes are a major demand-side influence on the sector and the current recognition of EPDs by LEED and BREEAM is considered to be helping drive the uptake of EPDs.

2.2.3 Technical analysis

The quarrying of ornamental or dimension stone has two broad techniques: dynamic splitting (using explosives for hard stone like granite) and cutting (wet or dry, for soft stone like marble). The processing of these blocks into natural stone tile or slab products involves further cutting (exact technique dependent again on stone type) and surface finishing (generally polishing but other techniques may be used to increase surface roughness as well). Resins may be used to treat stone surfaces in order to prevent water penetration and/or to achieve high gloss finishes.

~~With agglomerated stones, crushed rock (typically granite, marble or quartz) is set in a polyester or epoxy resin under vacuum in a mould under carefully controlled temperatures. The resultant slabs are then shipped to final producers who cut the pieces to shape for customers. Cutting to standard formats may also be carried out at the same site where slab production occurs.~~

Ceramic tile production involves the grinding (wet or dry) of clay and other raw materials like feldspars and quartz to optimise the behaviour of the green (unfired) body in the kiln and the final properties of the fired ceramic product. Atomisation of ground raw materials (i.e. spray drying) is a specialised operation that results in particles with good mechanical behaviour in the pressing and shaping operations. Due to economies of scale, only the largest ceramic producers will tend to have their own atomisation plant. Others will simply purchase atomised raw material to begin with. Ceramic tiles may be decorated, glazed or unglazed and may be fired once or twice, depending on the kiln technology onsite and the interaction between the glazing formulation and the "green" ceramic body. Firing temperatures of 1050 to 1300°C are typically required to produce the ceramic tile. The tile surface may then be cut, rectified, polished and optionally coated with a resin or wax, for the same reasons as this treatment may be applied to natural stone. Major innovations in this sector during the last 10 years have been the adaptation of production processes to facilitate large format and thin tiles and digital printing.

The concrete production technology for concrete paving blocks, flags and kerb units generally uses the dry-cast technology due to its improved economics over "wet" pre-cast techniques. This involves the mixing of a low or zero slump concrete (coarse aggregates, fine aggregates, filler, pigments, cement and water) which is dosed to a mould before it is vibrated to remove any entrained air and pressed under vibration. The production process is rapid (over the order of minutes) and the final product requires at least 24 hours to cure under controlled temperature conditions (normally 20 to 40°C) before it will have sufficient strength for handling and shipment. It is worth mentioning the production process of cement, the fundamental ingredient in concrete, which is a mixture of limestone (ca. 80%) and clay that is ground and fired at 1450°C in a rotary kiln to produce reactive clinker mineral phases. The clinker is then ground together with a minor amount calcium sulfate (normally gypsum and < 5% by weight) which acts as a set regulator when the cement will be mixed with water.

2.2.4 Life Cycle Assessment

The nature of the hard covering product group means that life cycle impacts will always be concentrated in the raw material supply and production stages.

With natural stone tiles and slabs, the impacts due to the quarrying operation are highly significant, arguably more so than the actual production of the final product. A similar case exists for concrete products, where it is the production of cement that dominates more life cycle impact categories. The challenge here is to decide how best to reflect this in the approach to EU Ecolabel criteria. There is no incentive for the quarry operator or cement producer to even share certain data with their customers because they are not likely to be aware of or interested in the EU Ecolabel.

So is there some scope for these upstream actors in the supply chain to somehow be recognised by the EU Ecolabel?

With ceramic tile production, virtually all of the life cycle impacts are dominated by the kiln although there are important impacts associated with the atomisation of powder and the production of frits and glazes by upstream suppliers as well.

With agglomerated stone, the supplier has more scope with the choice of raw materials and the promotion of recycled or secondary materials is considered as a particularly interesting way to reduce life cycle impacts. Likewise, the reduction of the resin content and a shift from a fossil-based to a bio-based resin could be relevant. However, more specific information about the production process is needed and there is almost no LCA literature available about this type of products.

3 REVISION OF SCOPE

Current definition and scope in Decision 2009/607/EC
The product group 'hard coverings' shall comprise — for internal/external use, without any relevant structural function — natural stones, agglomerated stones, concrete paving units, terrazzo tiles, ceramic tiles and clay tiles. For hard coverings, the criteria can be applied both to floor and wall coverings, if the production process is identical and uses the same materials and manufacturing methods.
Proposed definition and scope for TR v1.0
The product group 'hard coverings' shall comprise floor coverings and wall coverings, for internal or external use and without any relevant loadbearing function for building structures. *Hard coverings shall be made of either: natural stone, agglomerated stone, unreinforced concrete, terrazzo tiles, ceramic tiles or clay pavers.*
Proposed definition and scope for TR v2.0
The product group 'hard coverings' shall comprise floor tile, wall tile, roof tile, masonry unit, brick, block, paver, table-top and kitchen countertop products for internal or external use and without any relevant loadbearing function for building structures. The scope extends to such products made of natural stone, unreinforced precast concrete, ceramics or fired clay.

Rationale:

Clarification about relevant structural function

The term "*without any relevant structural function*" has been replaced with "*without any relevant loadbearing function for building structures*" in order to be more precise about what exactly should be understood by structural function. It is obvious that all floor coverings and some wall coverings will transfer loads from one place to another within a structure during their normal use as part of a larger pavement or building structure, for example when people walk on floors, vehicles drive over pavements and items or shelves are hung from wall coverings. It has to be clear that none of these situations is considered as a "*relevant structural function*".

If kitchen countertops are to be included in the scope (CEN/TC 246 seems to be relevant for this), the proposed wording would also clarify that supporting the load of items placed on the countertop is definitely not considered as a "*structural loadbearing function at building level*". Likewise, if roofing tiles (CEN/TC 128) are included, it would be understood that these materials do not bear any load from the building structure.

Expansion of the scope to masonry units

Masonry units are generally used in non-structural applications in buildings and can be made of clay, aggregate concrete, autoclaved aerated concrete, 'manufactured stone' or natural stone (all recognised by the EN 771 series of standards). It could be argued that these products do not fit so well within the scope in the sense that it is rare that the ever end up facing the user under normal conditions (usually they would be plastered over.

<u>Expansion of the scope to include kitchen countertops</u>

During the revision process for EU Ecolabel furniture, it was requested if criteria for kitchen countertops could be included within the scope. At the time it was decided that it would not be feasible to add criteria specifically for materials that would not otherwise be included in the furniture scope (e.g. ceramic tiles, concrete, natural stone). The existing scope made specific reference to floor covering and wall covering, but in reality kitchen countertops are not intended to cover either.

The other materials covered in the hard covering product group scope are highly relevant to kitchen countertop producers. Including kitchen countertops in scope would offer a more direct route to customers in a product groups that tends to be dominated by B2B dynamics. ~~Furthermore, it would greatly increase the potential market, especially considering agglomerated stone, where "*furniture*" products account for about two thirds of the total agglomerated stone demand (around 47 Mm^2 in 2014). The same predominance of agglomerated stone demand being higher for kitchen countertops than in floor or wall tiles is the same in all difference global regions.~~

Outcomes from and after the 1st AHWG meeting

The proposed expansion of the scope to include table-tops, kitchen countertops, masonry units and roof tiles was broadly accepted. However, caution was also urged about the choice of functional unit for the new products included in the scope, which should be in line with how production volumes are quantified by producers.

Expansion to include plasterboard was specifically not accepted by one stakeholder. In the case of plasterboard, the JRC can accept that this product is significantly different to the others in the sense that it is a composite material (cardboard and gypsum) and is in general "softer" than these other "hard" products.

One stakeholder representing the concrete sector expressed their concerns about the whole idea of the EU Ecolabel being applied to what was essentially a B2B product.

Further research:

One aspect that was considered was the potential confusion with the term terrazzo tiles, since these appear to refer to precast concrete products (i.e. cement as the binder) but which, according to market data, can also refer to resin bound terrazzo (e.g. epoxy-terrazzo). To avoid such confusion, it is recommended that any cement-based terrazzo tiles simply be included under the precast concrete section.

4 REVISION OF PRODUCT DEFINITIONS

Current assessment and verification
The specific assessment and verification requirements are indicated within each criterion. *This group can be divided into 'natural products' and 'processed products'.* *'Natural products' includes the natural stones, that, as defined by CEN TC 246 are pieces of naturally occurring rock, and include marble, granite and other natural stones.* *'Other' natural stones refer to natural stones whose technical characteristics are on the whole different from those of marble and granite as defined by CEN/TC 246/N.237 EN 12670 'Natural stones — Terminology'. Generally, such stones do not readily take a mirror polish and are not always extracted by blocks: sandstone, quartzite, slate, tuff, schist.* *The group of 'processed products' can be further divided into hardened and fired products. Hardened products are agglomerated stones, concrete paving units and terrazzo tiles. Fired products are ceramic tiles and clay tiles.* *'Agglomerated stones' are industrial products manufactured from a mixture of aggregates, mainly from natural stone grit, and a binder as defined by JWG 229/246 EN 14618. The grit is normally composed of marble and granite quarry granulate and the binder is made from artificial components as unsaturated polyester resin or hydraulic cement. This group includes also artificial stones and compacted marble.* *'Concrete paving units' are products for outer floor-coverings obtained by mixing sands, gravel, cement, inorganic pigments and additives, and vibro-compression as defined by CEN/TC 178. This group also includes concrete flags and concrete tiles.* *'Terrazzo tiles' are a suitably compacted element of uniform shape and thickness, which meets specific geometrical requirements as defined by CEN/TC 229. The tiles are single or dual-layered. The single-layered are tiles completely made of granulates or chipping of a suitable aggregate, embedded in grey and white cement and water. The dual-layered tiles are terrazzo tiles made up of the first face or wear layer (with single-layered composition) and a second layer, known as backing or base concrete layer, whose surface is not exposed during normal use and which may be partially removed.* *'Ceramic tiles' are thin slabs from clays and/or other inorganic raw materials, such as feldspar and quartz as defined by CEN/TC 67. They are usually shaped by extruding or pressing at room temperature, dried and subsequently fired at temperatures sufficient to develop the required properties. Tiles can be glazed or unglazed, are non-combustible and generally unaffected by light.* *'Clay tiles' are units which satisfy certain shape and dimensional requirements, used for the surface course of pavements and manufactured predominantly from clay or other materials, with or without additions as defined by CEN 178.* *Where appropriate, test methods other than those indicated for each criterion may be used if their equivalence is accepted by the competent body assessing the application.* *Where possible, testing should be performed by appropriately accredited laboratories or laboratories that meet the general requirements expressed in standard EN ISO 17025.* *Where appropriate, competent bodies may require supporting documentation and may carry out independent verifications.* *The competent bodies are recommended to take into account the implementation of recognised environmental management schemes, such as EMAS, ISO 14001 when assessing applications and monitoring compliance with the criteria (note: it is not required to implement such management schemes).*
Proposed definition and scope for TR v1.0
The product group 'hard coverings' shall comprise floor coverings and wall coverings, for internal or external use and without any relevant loadbearing function for building structures. *Hard coverings shall be made of either: natural stone, agglomerated stone, unreinforced*

concrete, terrazzo tiles, ceramic tiles or clay pavers.

'Agglomerated stone products', according to EN 14618:2009, means industrial products mainly made of hydraulic cement, resin or a mixture of both, stones and other additions. They are industrially manufactured in geometrical shapes at fixed plants by moulding techniques. They are put on the market in the form of rough blocks, rough slabs, slabs, tiles, dimensional stone works, and any other cut to size products. The term 'agglomerated stone' is considered as synonymous with 'engineered stone' and 'manufactured stone'.

'Ceramic tile products', as defined by CEN/TC 67, means thin slabs made from clays and/or other inorganic raw materials, such as feldspar and quartz, which are usually shaped by extrusion or dry-pressing techniques, dried and subsequently fired at temperatures sufficient to develop the required properties. Tiles can be glazed or unglazed, are non-combustible and generally unaffected by light.

'Çlay pavers', as defined by EN 1344:2013, means pavers and accessories manufactured from clay for interior or exterior use that will be subjected to pedestrian and vehicular traffic and used in the flexible form of construction (pavers laid with narrow sand-filled joints on a sand bed) or in the rigid form of construction (pavers laid with cementitious mortar joints on a similar mortar bed, itself placed on a rigid base). It does not include clay floor tiles or masonry units.

'Concrete paving blocks', as defined by EN 1338, means precast, unreinforced cement bound concrete blocks and complimentary fittings for pedestrian use, vehicular use and roof coverings. These products are manufactured by mixing sands, gravel, cement, inorganic pigments and additives, and vibro-compression as defined by CEN/TC 178. This group also includes concrete paving flags and kerb units, as defined in EN 1339 and EN 1340 respectively.

'Natural stone' is defined by CEN TC 246 as pieces of naturally occurring rock, and include marble, granite and other natural stones.

'Other' natural stones refer to natural stones whose technical characteristics are on the whole different from those of marble and granite as defined by CEN/TC 246/N.237 EN 12670 'Natural stones — Terminology'. Generally, such stones do not readily take a mirror polish and are not always extracted by blocks: sandstone, quartzite, slate, tuff, schist.

'Terrazzo tiles' are suitably compacted elements of uniform shape and thickness formed via a vibro-compression similar technique and which meet specific geometrical requirements as defined by EN 13748. The tiles may be single or dual-layered. The single-layered are tiles completely made of granulates or chipping of a suitable aggregate, embedded in grey or white cement and water. The dual-layered tiles made up of the first face or wear layer (with single-layered composition) and a second layer, known as backing or base concrete layer, whose surface is not exposed during normal use and which may be partially removed.

Proposed definition and scope for TR v2.0

The following definitions shall apply:

~~*'Agglomerated stone products'*, according to EN 14618:2009, means industrial products mainly made of hydraulic cement, resin or a mixture of both, stones and other additions. They are industrially manufactured in geometrical shapes at fixed plants by moulding techniques. They are put on the market in the form of rough blocks, rough slabs, slabs, tiles, dimensional stone works, and any other cut to size products. The term 'agglomerated stone' is considered as synonymous with 'engineered stone' and 'manufactured stone'.~~

~~*'Terrazzo tiles'* are suitably compacted elements of uniform shape and thickness formed via a vibro-compression similar technique and which meet specific geometrical requirements as defined by EN 13748. The tiles may be single or dual-layered. The single-layered are tiles completely made of granulates or chipping of a suitable aggregate, embedded in grey or white cement and water. The dual-layered tiles made up of the first face or wear layer (with single-layered~~

~~composition) and a second layer, known as backing or base concrete layer, whose surface is not exposed during normal use and which may be partially removed.~~

'*Aggregate Concrete Masonry units*', as defined by EN 771-3, means masonry units manufactured from cementitious binder, aggregates and water and which may contain admixtures and additions and colouring pigments and other materials incorporated or applied during or subsequent to unit manufacture and which are suitable for all forms of walling, including single leaf, external leaf to chimneys, cavity wall, partitions, retaining, and basement. They can provide fire protection, thermal insulation, sound insulation and sound absorption.

'Ceramic tile products', as defined by CEN/TC 67, means thin slabs made from clays and/or other inorganic raw materials, such as feldspar and quartz, which are usually shaped by extrusion or dry-pressing techniques, dried and subsequently fired at temperatures sufficient to develop the required properties. Tiles can be glazed or unglazed, are non-combustible and generally unaffected by light. For the purposes of the EU Ecolabel criteria, the term ceramic tile shall also include thin format pieces and large format pieces which may be used in table-tops or kitchen countertops.

'*Clay masonry units*', as defined in EN 771-1, means masonry units masonry unit made from clay or other argillaceous materials with or without sand, fuel or other additives fired at a sufficiently high temperature to achieve a ceramic bond and for which the main intended uses are protected masonry (masonry which is protected against water penetration and is not in contact with soil and ground water) or unprotected masonry structure (masonry which may be exposed to rain, freeze/thaw and/or may be in contact with soil and ground water without a suitable protection). Examples include facing and rendered masonry, loadbearing or non-loadbearing masonry structures, including internal linings and partitions, for building and civil engineering).

'Çlay pavers', as defined by EN 1344, means pavers and accessories manufactured from clay for interior or exterior use that will be subjected to pedestrian and vehicular traffic and used in the flexible form of construction (pavers laid with narrow sand-filled joints on a sand bed) or in the rigid form of construction (pavers laid with cementitious mortar joints on a similar mortar bed, itself placed on a rigid base). It does not include clay floor tiles or masonry units.

'*Clay roofing tiles*', as defined by EN 1304, means products for discontinuous laying on pitched roofs, and for wall cladding, which are manufactured by shaping (extrusion and/or pressing), drying and firing of the prepared clay, with or without additives and where all or part of their surface can be covered with an engobe or glaze.

'Concrete paving blocks', as defined by EN 1338, means precast, unreinforced cement bound concrete blocks and complimentary fittings for pedestrian use, vehicular use and roof coverings. These products are manufactured by mixing sands, gravel, cement, inorganic pigments and additives, and vibro-compression as defined by CEN/TC 178. This group also includes concrete paving flags, kerb units and terrazzo tiles, as defined in EN 1339, EN 1340 and EN 13748 respectively.

'*Natural stone masonry units*', as defined by EN 771-6, means masonry units manufactured from natural stone the width of which is equal to or greater than 80 mm, for which the main intended uses are common, facing or exposed masonry units in loadbearing or non-loadbearing building and civil engineering applications. These units are suitable for all forms of coursed or random masonry walling, including single leaf, cavity, partition, retaining and the external masonry to chimneys. They can provide fire protection, thermal insulation, sound insulation and sound absorption.

'Natural stone products', as defined by EN 12670, means worked pieces of naturally occurring used in building and for monuments. Naturally occurring rock includes marble, granite and other natural stones defined in EN 12670. The term '*other natural stones*' refers to natural stones whose technical characteristics are on the whole different from those of marble and granite as defined by EN 12670 "*Natural stone — Terminology*". Generally, such stones do not readily take a mirror polish and are not always extracted by blocks: sandstone, quartzite, slate, tuff, schist.

Rationale:

A number of changes have taken place between the existing text in Decision 2009/607/EC, the proposal in TR v1.0 and the proposal in TR v2.0. The listing of definitions in the framework of the Annex of the legal text is normal practice but it needs to be clearly stated that the list refers to a series of definitions. This was not the case in Decision 2009/607/EC or in the proposal in TR v1.0. In fact, in TR v1.0, the scope text (which will appear in the Act of the legal text) was combined with the definitions. Now the text has been separated again. Some specific changes regarding the definitions are described below.

'Clay tiles" becomes "clay pavers"

The existing definition referred to 'clay tiles' as per CEN/TC 178 but when checking the relevant standards covered by that technical group, the only one relating to clay products was EN 1344, which is specifically about clay pavers (i.e. floor covering) and not clay tiles (i.e. floor and wall coverings). So this has been corrected.

If there is a relevant market segment relating to clay wall coverings that should be included in the scope, stakeholders should inform the JRC.

The difference between terrazzo tiles and agglomerated stone

As explained in the rationale for the scope text, there is a grey area with terrazzo tiles, in the sense that they may be cement-based (i.e. concrete) or resin-based (i.e. agglomerated stone). This is not helped by the non-standard use of these terms when advertising products on the market.

Request for stakeholder input

Further feedback and cross-checking needed from industry stakeholders to check about terminology, especially related to large and thin format ceramic tiles, to roofing tiles made of concrete or natural stone and to masonry units of all materials.

5 REVISION OF EXISTING CRITERIA

5.1 Criteria structure

Within the product group scope there are three main sub-products and the criteria have been structured in such a way that the criteria relating to a particular sub-product can easily be identified and read:

1. **Natural stone products** (blocks are cut from a quarry and sold to processors who convert the blocks into finished products).
2. **Agglomerated stone products** (marble or quartz powder is mixed with resins under vacuum and pressure in a patented process to produce blocks and slabs that may be sold to processors or finished at the same site).
3. **Ceramic tiles** (clay and other raw materials are extracted from quarries before being pressed or extruded into specific shapes, treated with glazes and possibly being printed before firing at high temperatures (1050 to 1300°C) into solid and durable products.
4. **Concrete products** (aggregates are extracted from quarries and mixed with cement and water before being moulded and pressed into products of a specific shape before curing. The cement production process has higher environmental impacts due to the calcination of limestone and clay at high temperatures (1450°C) in a rotary kiln.

The criteria are set up to be read horizontally at first and then vertically, depending upon which sub-product is of relevance.

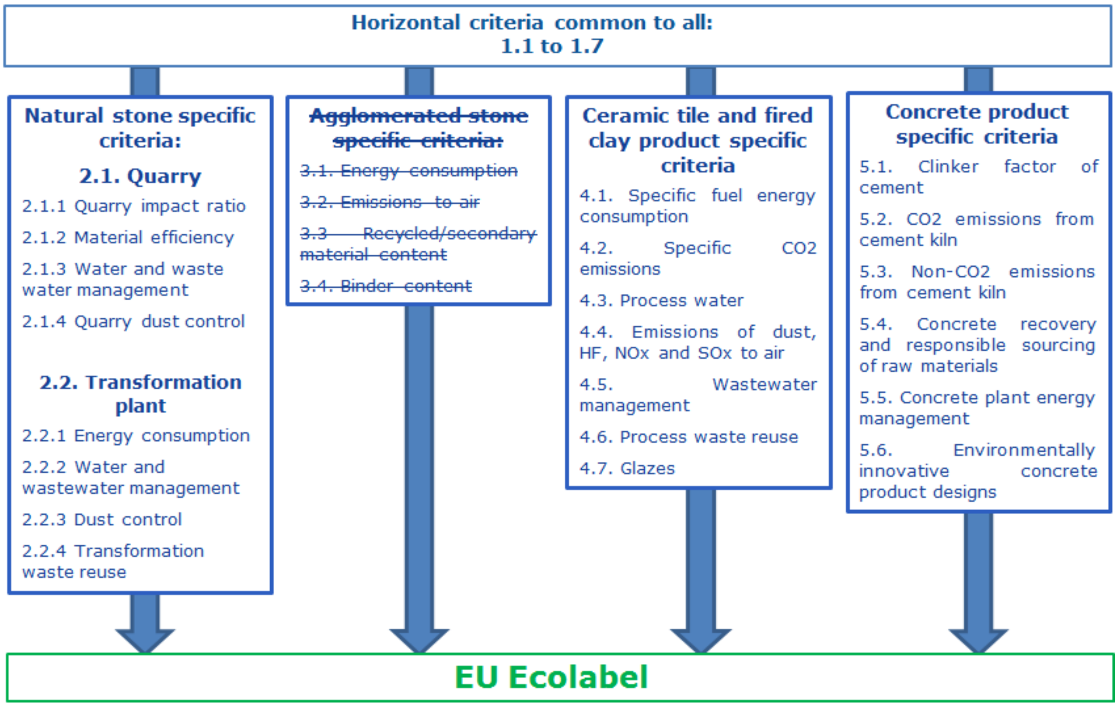

Figure 2. Criteria structure for the four sub-products currently included in the scope.

Some criteria rely on the upstream supply chain (i.e. the quarry for natural stone products and the cement supplier for concrete products and terrazzo tiles). In these cases, there is no obvious incentive for the suppliers to make any effort to comply so the possibility of a B2B type EU Ecolabel might be potentially interesting.

5.2 Criteria proposals

CRITERIA 1: Horizontal criteria for all sub-products

1.1 – Environmental Management System

Existing criterion
No existing criterion
TR v1.0 proposed criterion:——1.1. Quality management and environmental management
Mandatory requirement *The applicant shall have a documented Environmental Management System in place.* ***EU Ecolabel points*** *The applicant shall have a documented environmental management system according to ISO 14001 in place and certified by an accredited organization (2 points).* *or* *The applicant shall have a documented environmental management system according to the EU Eco-Management and Audit Scheme (EMAS) in place and certified by an accredited organization (5 points).* ***Assessment and verification**:* *The applicant shall provide a declaration of compliance with the mandatory requirement of this criterion, supported by a copy of their own Environment Management System documentation.* *Where points are claimed for ISO 14001 or EMAS certification, the applicant shall provide a copy of the ISO 14001 or EMAS certificate, as appropriate, and provide the Competent Body with the details of the organization which carried out the accreditation.* *In cases where an applicant has both ISO 14001 and EMAS certification, only the points for the EMAS certification shall be awarded.*
TR v2.0 proposed criterion:-Environmental Management System
Note: This criterion is optional only and applies to the production facility or facilities of the applicant where the EU Ecolabel product is produced. **EU Ecolabel points** Points shall be awarded for applicants that have a documented environmental management system in place according to ISO 14001 and certified by an accredited organization (3 points). or Points shall be awarded for applicants that have a documented environmental management system in place according to the EU Eco-Management and Audit Scheme (EMAS) and certified by an accredited organization (5 points). ***Assessment and verification**:* *The applicant shall provide a copy of the ISO 14001 or EMAS certificate, as*

appropriate, and provide the competent body with the details of the organization which carried out the accreditation.

In cases where an applicant has both ISO 14001 and EMAS certification, only the points for the EMAS certification shall be awarded.

Rationale:

An Environmental Management System is considered as a fundamental requirement to ensure that an organization has established some environmental goals and is taking measures to assess and reduce the environmental impact of its activities. Such a philosophy fits perfectly well with any company that may be interested in applying for the EU Ecolabel and can provide a framework for how to gather necessary data that would be relevant to certain EU Ecolabel criteria.

For companies that have made the effort to achieve external certification, bonus points are awarded for ISO 14001 and EMAS certification. For sake of clarity and comparison some of the key differences between EMAS and ISO 14001 are summarized below.

Table 1. A comparison of EMAS and ISO 14001[1].

Elements	EMAS	ISO 14001
General aspects		
Legal status	European Regulation (EC) No 1221/2009.	International commercial standard under private law.
Participation	Voluntary.	Voluntary.
Geographical outreach	Globally applicable.	Globally applicable.
Focus and objective	Focus on continual improvement of environmental performance of the organization.	Focus on continual improvement of Environmental Management System.
Planning		
Environmental aspects	Comprehensive initial environmental review of the current status of activities, products and services.	Requires only a procedure to identify environmental aspects. Initial review is recommended, but not required.
Legal compliance	Proof of full legal compliance is required.	Only commitment to comply with applicable legal requirements. No compliance audit.
Employee involvement	Active involvement of employees and their representatives.	Not required (ISO 14001 and EMAS both foresee training for employees).
Suppliers and contractors	Influence over suppliers and contractors is required.	Relevant procedures are communicated to suppliers and contractors.
External communication	Open dialogue with external stakeholders is required. External reporting is required on the basis of a regularly published environmental statement.	Dialogue with external stakeholders not required. External reporting is not required.

[1] From the EMAS factsheet, published by the European Commission in December 2011.

Checking		
Internal environmental auditing	Environmental Management System audit. Performance audit to evaluate environmental performance. Environmental compliance audit.	Includes only the Environmental Management System audit of the requirements of the standard.
Verifier/Auditor	Environmental verifiers are accredited/licensed and supervised by governmental bodies. Independence of the environmental verifier is required.	Certification bodies are accredited through a national Accreditation body. Independence of the auditor is recommended.
Audits	Inspection of documents and site visits to be carried out according to Regulation. Check for improvement of environmental performance. Data from environmental statement needs to be validated.	No certification rules in standard (other standards for auditing and certification). Check of Environmental Management System performance, but no frequency specified or required.
Derogations for SMEs	Extension of verification intervals from three to four years. Updated environmental statement needs to be validated only every two years (instead of every year). Environmental verifier takes into account special characteristics of SMEs.	No derogations foreseen.
Official registration by authorities	Publically accessible register records each organization. Each registered organization receives a registration number.	No official register.
Logo	Yes.	No.

Outcomes from and after the 1st AHWG meeting

Despite the above mentioned differences between ISO 14001 and EMAS, some stakeholders wanted the gap in terms of points awarded to be narrowed (in TR v1.0 it was 2 points for ISO 14001 and 5 points for EMAS).

An important legal concern was raised during the 1st AHWG about potential problems if an EMS is made mandatory under a label (e.g. the EU Ecolabel) and if that label is then specified in a Public Procurement tender.

Looking at Article 43 of the Public Procurement Directive, it says that any label has to be related to the product (i.e. not the organisation or site). The legal text is reproduced below for convenience:

Article 43
Labels

1. Where contracting authorities intend to purchase works, supplies or services with specific environmental, social or other characteristics they may, in the technical specifications, the award criteria or the contract performance conditions, require a specific label as means of proof that the works, services or supplies correspond to the required characteristics, provided that all of the following conditions are fulfilled:

(a) the ***label requirements only concern criteria which are linked to the subject-matter of the contract*** *and are appropriate to define characteristics of the works, supplies or services that are the subject-matter of the contract;*

(b) the label requirements are based on objectively verifiable and non-discriminatory criteria;

(c) the labels are established in an open and transparent procedure in which all relevant stakeholders, including government bodies, consumers, social partners, manufacturers, distributors and non-governmental organisations, may participate;

(d) the labels are accessible to all interested parties;

(e) the label requirements are set by a third party over which the economic operator applying for the label cannot exercise a decisive influence.

Where contracting authorities do not require the works, supplies or services to meet all of the label requirements, they shall indicate which label requirements are referred to.

Contracting authorities requiring a specific label shall accept all labels that confirm that the works, supplies or services meet equivalent label requirements.

Where an economic operator had demonstrably no possibility of obtaining the specific label indicated by the contracting authority or an equivalent label within the relevant time limits for reasons that are not attributable to that economic operator, the contracting authority shall accept other appropriate means of proof, which may include a technical dossier from the manufacturer, provided that the economic operator concerned proves that the works, supplies or services to be provided by it fulfil the requirements of the specific label or the specific requirements indicated by the contracting authority.

2. Where a label fulfils the conditions provided in points (b), (c), (d) and (e) of paragraph 1 but also sets out requirements not linked to the subject-matter of the contract, contracting authorities shall not require the label as such but may define the technical specification by reference to those of the detailed specifications of that label, or, where necessary, parts thereof, that are linked to the subject-matter of the contract and are appropriate to define characteristics of this subject-matter.

The main concern is linked to the text highlighted in part a) – i.e. for cases where the EMS might not be considered as relevant enough for the subject matter of the contract. For example, the subject matter may be one specific ceramic tile product but the EMS may apply to an entire international organisation.

Further research:

Ecolabel bonus points are kept for those applicants that can demonstrate to have a documented environmental management system. The gap between ISO 14001 and EMAS has been narrowed (now 3 points and 5 points instead of 2 points and 5 points for ISO 14001 and EMAS respectively).

ISO 14001:2015 and EMAS have many similarities, such as the focus on monitoring environmental indicators to assess environmental performance and the use of auditing to monitor environmental processes for conformance and improvement. Both support continual improvement of environmental performance. While both give requirements for environmental management, and many of the benefits are the same for that reason, there are some differences between them. The biggest difference when comparing the requirements is that EMAS has a stricter interpretation of how environmental processes are to be planned and managed. For instance, ISO 14001:2015 requires the identification of environmental aspects and impacts, while EMAS requires the carrying out of a comprehensive initial environmental review of the processes. Likewise, ISO 14001 requires the definition of an external legal reporting system based on the needs of external parties (such as legal agencies), while EMAS requires external reporting through a regularly published environmental statement.

1.2 – Industrial and construction mineral extraction

Existing criterion 1 Raw material extraction
1.2. Extraction management (for all hard covering products) *The raw materials used in the production of hard coverings shall comply with the following requirements for the related extraction activities:* *The applicant shall provide a technical report including the following documents:* - the authorisation for the extraction activity; - the environmental recovery plan and/or environmental impact assessment report; - the map indicating the location of the quarry; - the declaration of conformity to Council Directive 92/43/EEC (habitats) and Council Directive 79/409/EEC (birds). In areas outside the Community, a similar technical report is required to demonstrate compliance with the UN conservation on biological diversity (1992) and provide information on any national biodiversity strategy and action plan, if available. ***Assessment and verification***: *The applicant shall provide the related data and documents including a map of the area. If the extraction activity is not directly managed by the producers, the documentation shall always be requested to the extractor(s).*
TR v1.0 proposed criterion:–1.2. Industrial and construction mineral extraction
Mandatory requirement The extraction of industrial and construction minerals (for example limestone, clay, aggregates, ornamental or dimension stone etc.) for to manufacture any EU Ecolabel hard covering product shall respect the following requirements, as appropriate. Extraction activity carried out within the EU: - If they are extracted from Natura 2000 network areas, composed of Special Protection Areas under Directive 2009/147/EC on the conservation of wild birds, and Special Areas of Conservation under Directive 92/43/EEC on the conservation of natural habitats and wild fauna and flora, extraction activities have been assessed and authorised in accordance with the provisions of Article 6 of Directive 92/43/EEC and taking into account the EC Guidance document on non-energy mineral extraction and Natura 2000. Extraction activity carried out outside the EU: - If they are extracted from areas officially nominated as candidates for or adopted as Areas of Special Conservation Interest, part of the Emerald network pursuant to Recommendation No. 16 (1989) and Resolution No. 3 (1996) of the Standing Committee of the Convention of the Conservation of the European Wildlife and Natural Habitats (Bern Convention), or protected areas designated as such under the national legislation of the sourcing / exporting countries, the extraction activities have been assessed and authorised in accordance with provisions that provide assurances equivalent to Directives 2009/147/EC and 92/43/EEC. ***Assessment and verification:*** *In case industrial or construction mineral extraction activities have been carried out in*

Natura 2000 network areas (in the EU), the Emerald network or protected areas designated as such under the national legislation of the sourcing/exporting countries (outside the EU), the applicant shall provide a declaration of compliance with this requirement issued by the competent authorities or a copy of their authorisation issued by the competent authorities.

TR v2.0 proposed criterion: 1.2. Industrial and construction mineral extraction

Mandatory requirement

The extraction of industrial and construction minerals (for example limestone, clay, aggregates, ornamental or dimension stone etc.) for the manufacture of any EU Ecolabel hard covering product shall only come from sites which are covered by the following documentation:

- the authorisation for the extraction activity;
- a map indicating the location of the quarry;
- the rehabilitation management plan and/or environmental impact assessment report;
- a declaration of conformity with EU Regulation No 1143/2014 of the European Parliament and of the Council of 22 October 2014 on the prevention and management of the introduction and spread of invasive alien species.
- a declaration of conformity with Council Directive 92/43/EEC (habitats) and Council Directive 79/409/EEC (birds)*'**.

*In cases where extraction sites are located in Natura 2000 network areas, composed of Special Protection Areas under Directive 2009/147/EC on the conservation of wild birds, and Special Areas of Conservation under Directive 92/43/EEC on the conservation of natural habitats and wild fauna and flora, extraction activities shall have been assessed and authorised in accordance with the provisions of Article 6 of Directive 92/43/EEC and have taken into account the EC Guidance document on non-energy mineral extraction and Natura 2000.

**In cases where extraction sites are located outside the EU, if they are extracted from areas officially nominated as candidates for or adopted as Areas of Special Conservation Interest, part of the Emerald network pursuant to Recommendation No. 16 (1989) and Resolution No. 3 (1996) of the Standing Committee of the Convention of the Conservation of the European Wildlife and Natural Habitats (Bern Convention), or protected areas designated as such under the national legislation of the sourcing / exporting countries, the extraction activities have been assessed and authorised in accordance with provisions that provide assurances equivalent to Directives 2009/147/EC and 92/43/EEC.

Assessment and verification:

The applicant shall provide a declaration of compliance with this requirement issued by the issued by the competent authorities or a copy of their authorisation issued by the competent authorities.

The rehabilitation management plan shall include the objectives for the rehabilitation of the quarry, the conceptual final landform design, including the proposed post quarry land use; details on the implementation of an effective revegetation program and details of an effective monitoring programme to assess performance of the rehabilitated areas.

In case industrial or construction mineral extraction activities have been carried out in Natura 2000 network areas (in the EU), the Emerald network or protected *areas designated as such under the national legislation of the sourcing/exporting countries (outside the EU), the applicant shall provide a declaration of compliance with this requirement issued by the competent authorities or a copy of their authorisation issued by the competent authorities.*

Rationale:

Following consultation with Commission colleagues, it was agreed that the requirements relating to the extraction of industrial or construction minerals for EU Ecolabel hard coverings should generally follow the same wording as that which was voted for EU Ecolabel Soil Improvers and Growing Media (Decision (EU) 2015/2099).

The term "*industrial and construction mineral extraction*" is preferred instead of "*raw materials*", with the former being in line with the terminology used in the BAT Reference Document for the management of waste from extractive industries published by the Commission in 2018.

Outcomes from and after the 1st AHWG meeting

During the meeting it was explained that requirements that apply when extraction occurs on a Natura 2000 site occur have been copied from text previously agreed in Decision (EU) 2015/2099 for EU Ecolabel Soil Improvers and Growing Media. However, it was also admitted by JRC that the other requirements for non-Natura 2000 sites had been mistakenly deleted.

A request to add a reference to a reference to Regulation (EU) No 1143/2014 of the European Parliament and of the Council of 22 October 2014 on the prevention and management of the introduction and spread of invasive alien species, relevant for refurbishing quarries, in addition to compliance with the Birds and Habitats Directive and other documents that are required in the existing criteria for EU Ecolabel hard coverings.

Further research:

<u>*Rehabilitation management plans*</u>

Raw material extraction is one of the most critical environmental impacts for hard coverings. It should be ensured that appropriate measures are taken to minimise biodiversity losses and ensure appropriate recovery of the areas where extraction activities take place. These can only be verified by providing full documentation of the extraction activity including the environmental recovery plan and the environmental impact assessment report. It was considered that the term "*rehabilitation management plan*" would be a better term than "*environmental recovery plan*".

The rehabilitation management plan must state the objectives for the rehabilitation of the quarry. A conceptual final landform design, including the proposed post quarry land use should be included and specific details on the implementation of an effective revegetation program should be provided. Rehabilitation may be progressive or only at the end of the quarry life. In all quarries some degree of progressive rehabilitation should be possible. An effective monitoring programme is essential for assessing the performance of the rehabilitated areas. The rehabilitation management plan should be designed to reach the following main objectives:

- Achievement of acceptable land use suitability (post quarrying) – Rehabilitation will aim to create a stable landform with land capability and/or agricultural suitability similar to that prior to quarry activities, unless other beneficial land uses are pre-determined and agreed. This will be achieved by setting clear rehabilitation criteria and outlining the monitoring requirements that assess whether or not these criteria are being accomplished.
- Creation of stable landform – Disturbed land will be rehabilitated to a condition that is self-sustaining, or one where maintenance requirements are consistent with the agreed post-quarry land use.
- Preservation of downstream water quality –Current and future water quality will be maintained at levels that are acceptable for users downstream of the site.

In order to achieve this, it is necessary to coordinate a practical approach that could include among others:

- Conducting proven and resilient revegetation techniques that acknowledge altered landform and soil conditions;
- Undertaking effective soil management techniques including stripping, stockpiling, respreading and appropriate weed control; and
- Establishing a monitoring program that can determined whether the rehabilitated areas are moving towards a successful outcome.

Alien and invasive species

The rehabilitation and revegetation programmes should take into account the Regulation (EU) No 1143/2014 of the European Parliament and of the Council of 22 October 2014 on the prevention and management of the introduction and spread of invasive alien species. Therefore a requirement to declare compliance with the regulation has been included.

According to the European Commission, Invasive Alien Species (IAS) "*are animals and plants that are introduced accidently or deliberately into a natural environment where they are not normally found, whose introduction or spread has been found to threaten or adversely impact upon biodiversity and related ecosystem services.*"

IASs are considered the second largest threat to global biodiversity and quarrying can lead to their spreading. Quarry sites run the risk of becoming colonised by IAS. The ability of an IAS to easily adapt to its surroundings, grow and spread rapidly and, in some instances, prevent the development of native species, meaning that they can easily colonise quarry environments and have a negative impact on native biodiversity. Many invasive species that grow in aggregate quarries produce a lot of seeds that are exported via the aggregate material. Once dispersed on construction sites IAS can easily spread further into natural ecosystems and damage them. Alongside ecological damages, IAS are a potential hazard for infrastructure, and can cause economic damages to roads, pipes, etc.

The Quarry Life Award

This is an initiative led by Heidelberg cement (not a dimension stone producer) but it details many aspects of quarry biodiversity that are also relevant to dimension stone quarries.

Biodiversity Management Plans, which map the various different habitat types in the site and define measures to take for their future rehabilitation or continued preservation, are required for quarries located within 1km of Natura 2000 areas. A number of biodiversity indicators are also defined, which either focus on habitats or species.

Table 2. Quarry Life Award biodiversity indicators

	Title	Description
Habitat	Habitats	Number of habitats per extraction site / area of the extraction (ha)
	After-use	Area of the extraction site with after-use nature conservation (ha) / area of the extraction site (ha) with after-use cultivated landscape (ha) / area of the extraction site (ha)
	Wanderbiotopes	Area of the wanderbiotopes in an extraction site (ha) / area of the extraction site (ha)
Species	Plant species density	Number of the plant species in the extraction site / area of the extraction site (ha)
	Relative plant species diversity	Number of the plant species in the extraction site / number of the plant species in the surroundings
	Animal species density	Number of selected animal groups in the extraction site / area of the extraction site (ha)
	Relative animal species diversity	Number of selected animal groups in the extraction site / number of selected animal groups in the surroundings

Other indicators relating to endangered species are also mentioned, but the description was not so clear. The different habitats described by the Quarry Life Award are illustrated below.

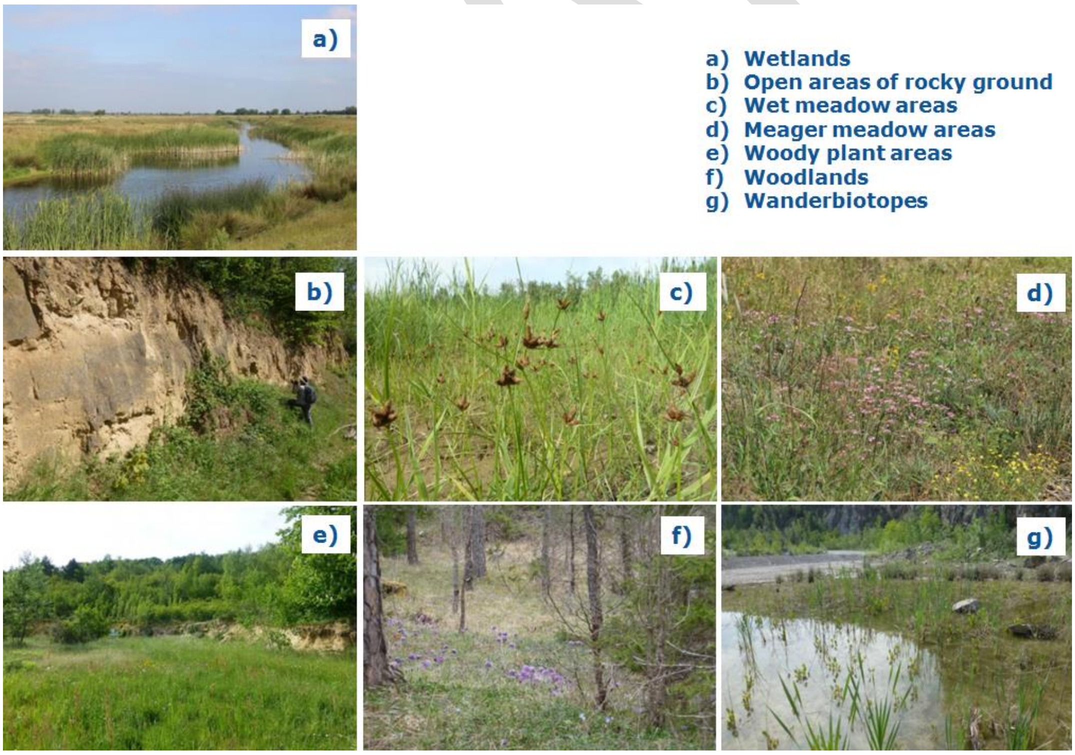

Figure 3. Different habitats defined by Quarry Life Award.

Wetlands are characterized by reeds and other plants that flourish in permanently saturated soils with or without permanent standing water on the surface (drier wetlands may end up being considered as wet meadows). They provide important habitat for many insect species and specific bird species. Although not intuitively associated with biodiversity, vertical rocky areas can provide important nesting sites for bird species such as eagle owls, jackdaws and kestrels and crevices in both horizontal areas of protosoil and vertical rocky areas provide valuable habitats for many insect species. Meager meadow areas are of particular value in drier climates where only specialized plants and herbs can flourish. Woody plant areas and woodlands provide valuable habitat and microclimates for many insect species and species that feed on those insects and also provide fruits for bird species or other grazing animals. Wanderbiotopes is term apparently coined to characterize the dynamically changing habitat structures caused by extraction activity (new vertical and horizontal surfaces exposed, changes in water runoff behavior and collection and so on). The presence of water seems vital for these types of habitat to be of potential value to biodiversity.

1.3 – Hazardous substance restrictions

Existing criterion 2.1. Absence of risk phrases in raw materials
No substances or preparations that are assigned, or may be assigned at the time of application, any of the following risk phrases (or combinations thereof): *— R45 (may cause cancer),* *— R46 (may cause heritable genetic damage),* *— R49 (may cause cancer by inhalation),* *— R50 (very toxic to aquatic organisms),* *— R51 (toxic to aquatic organisms),* *— R52 (harmful to aquatic organisms),* *— R53 (may cause long-term adverse effects in the aquatic environment),* *— R54 (toxic to flora),* *— R55 (toxic to fauna),* *— R56 (toxic to soil organisms),* *— R57 (toxic to bees),* *— R58 (may cause long-term adverse effects in the environment),* *— R59 (dangerous for the ozone layer),* *— R60 (may impair fertility),* *— R61 (may cause harm to the unborn child),* *— R62 (possible risk of impaired fertility),* *— R63 (possible risk of harm to the unborn child),* *— R68 (possible risk of irreversible effects),* *as laid down in Council Directive 67/548/EEC (Dangerous Substances Directive), and considering Directive 1999/45/EC of the European Parliament and of the Council (Dangerous Preparations Directive), may be added to the raw materials.* *Alternatively, classification may be considered according to Regulation (EC) No 1272/2008 of the European Parliament and of the Council. In this case no substances or preparations may be added to the raw materials that are assigned, or may be assigned at the time of application, with and of the following hazard statements (or combinations thereof): H350, H340, H350i, H400, H410, H411, H412, H413, EUH059, H360F, H360D, H361f, H361d, H360FD, H361fd, H360Fd, H360Df, H341.* *Due to the environmental advantages of the recycling of materials, these criteria do not apply to the quota of closed-loop recycled materials [4] used by the process and as defined in Appendix A2. Assessment and verification: in terms of chemical and mineralogical analysis, the material formulation shall be provided by the applicant together with a declaration of compliance with the abovementioned criteria.* *(4). Close loop recycling' means recycling a waste product into the same product. For secondary material arising from a manufacturing process (such as leftovers or remnants), 'closed loop recycling' means that the materials are used again in the same process.* *A2 Raw materials selection* *'Closed loop recycling' means recycling a waste product into the same kind of product; for 'secondary material' arising from a manufacturing process (such as leftovers or remnants), 'closed loop recycling' means that the materials are used again in the same process.*
TR v1.0 proposed criterion:-1.3. Hazardous substance restrictions

Mandatory requirement

a) Restrictions on Substances of Very High Concern (SVHC)

The product shall not contain substances that have been identified according to the procedure described in Article 59(1) of Regulation (EC) No 1907/2006 and included in the Candidate List for Substances of Very High Concern in concentrations greater than 0.10 % (weight by weight). No derogation from this requirement shall be granted.

Assessment and verification:

The applicant shall provide a declaration that the product does not contain any SVHC in concentrations greater than 0.10 % (weight by weight). The declaration shall be supported by safety data sheets of process chemicals used or appropriate declarations from chemical or material suppliers.

The list of substances identified as SVHC and included in the candidate list in accordance with Article 59(1) of Regulation (EC) No 1907/2006 can be found here:

http://echa.europa.eu/chem_data/authorisation_process/candidate_list_table_en.asp.

Reference to the list shall be made on the date of application.

Mandatory requirement

b) Classification, Labelling and Packaging (CLP) restrictions

Unless derogated in Table X, the product shall not contain substances or mixtures in concentrations greater than 0.10 % (weight by weight) that are classified with any of the following hazard statements in accordance with Regulation (EC) No 1272/2008:

- Group 1 hazards: Category 1A or 1B carcinogenic, mutagenic and/or toxic for reproduction (CMR): H340, H350, H350i, H360, H360F, H360D, H360FD, H360Fd, H360Df.

- Group 2 hazards: Category 2 CMR: H341, H351, H361, H361f, H361d, H361fd, H362; Category 1 aquatic toxicity: H400, H410; Category 1 and 2 acute toxicity: H300, H310, H330; Category 1 aspiration toxicity: H304; Category 1 specific target organ toxicity (STOT): H370, H372.

- Group 3 hazards: Category 2, 3 and 4 aquatic toxicity: H411, H412, H413; Category 3 acute toxicity: H301, H311, H331; Category 2 STOT: H371, H373.

The use of substances or mixtures that are chemically modified during the production process so that any relevant restricted CLP hazard no longer applies shall be exempted from the above requirement.

Table X. Derogations to the CLP hazard restrictions and applicable conditions

Substance / mixture type	Applicability	Derogated classification(s)	Derogation conditions
Titanium dioxide	All materials within scope	H350i	TiO2 is naturally occurring as an impurity in raw materials used and is present in concentrations less than 2.0% (w/w) of the product.
Titanium dioxide	Products with photocatalytic properties	H350i	TiO2 is intentionally added for the purpose of imparting photocatalytic properties to the product surface, which shall be demonstrated via testing according to ISO 22197-1 or equivalent methods.

Assessment and verification:

The applicant shall provide a list of all relevant chemicals used in their production process together with the relevant safety data sheet or chemical supplier declaration.

Any chemicals containing substances or mixtures with restricted CLP classifications shall be highlighted. The approximate dosing rate of the chemical, together with the concentration of the restricted substance or mixture in that chemical (as provided in the safety data sheet or supplier declaration) and an assumed retention factor of 100 %, shall be used to estimate the quantity of the restricted substance or mixture remaining in the final product.

Justifications for any deviation from a retention factor of 100 % or for chemical modification of a restricted hazardous substance or mixture must be provided in writing to the competent body.

For any restricted substances or mixtures that exceed 0.10 % (weight by weight) of the final hard covering product but are derogated, proof of compliance with the relevant derogation conditions must be provided.

TR v2.0 proposed criterion:-1.3. Hazardous substance restrictions

Mandatory requirement

a) Restrictions on Substances of Very High Concern (SVHCs)

The product shall not contain substances that have been identified according to the procedure described in Article 59(1) of Regulation (EC) No 1907/2006 and included in the Candidate List for Substances of Very High Concern in concentrations greater than 0.10 % (weight by weight). No derogation from this requirement shall be granted.

Assessment and verification:

The applicant shall provide a declaration that the product does not contain any SVHC in concentrations greater than 0.10 % (weight by weight). The declaration shall be supported by safety data sheets of process chemicals used or appropriate declarations from chemical or material suppliers.

The list of substances identified as SVHCs and included in the candidate list in accordance with Article 59(1) of Regulation (EC) No 1907/2006 can be found here:

http://echa.europa.eu/chem_data/authorisation_process/candidate_list_table_en.asp.

Reference to the list shall be made on the date of application.

Mandatory requirement

b) Classification, Labelling and Packaging (CLP) restrictions

Unless derogated in Table X, the product shall not contain substances or mixtures in concentrations greater than 0.10 % (weight by weight) that are classified with any of the following hazard statements in accordance with Regulation (EC) No 1272/2008:

- Group 1 hazards: Category 1A or 1B carcinogenic, mutagenic and/or toxic for reproduction (CMR): H340, H350, H350i, H360, H360F, H360D, H360FD, H360Fd, H360Df.

- Group 2 hazards: Category 2 CMR: H341, H351, H361, H361f, H361d, H361fd, H362; Category 1 aquatic toxicity: H400, H410; Category 1 and 2 acute toxicity: H300, H310, H330; Category 1 aspiration toxicity: H304; Category 1 specific target organ toxicity (STOT): H370, H372.

- Group 3 hazards: Category 2, 3 and 4 aquatic toxicity: H411, H412, H413; Category 3 acute toxicity: H301, H311, H331; Category 2 STOT: H371, H373.

The use of substances or mixtures that are chemically modified during the production process so that any relevant restricted CLP hazard no longer applies shall be exempted from the above requirement.

Table X. Derogations to the CLP hazard restrictions and applicable conditions

Substance / mixture type	Applicability	Derogated classification(s)	Derogation conditions
Titanium dioxide	All materials within scope	H350i	That TiO2 is not intentionally added to the product but is present because it is a naturally occurring impurity in raw materials used. The maximum TiO2 content (expressed as TiO2) in the final product shall be 2.0% (w/w) of the product.
Crystalline silica	All materials within scope	H372, H373 (STOT RE 1 & 2)	The applicant shall provide a declaration of compliance with any relevant instructions for safe handling and dosing specified in the safety data sheet or supplier declaration. Factory cutting operations shall be carried out use wet process tools or dry processes where a vacuum hood is in place to collect dust. Safety instructions regarding exposure to dust during any cutting operations carried out by installers shall be provided with the product

Assessment and verification:

The applicant shall provide a list of all relevant chemicals used in their production process together with the relevant safety data sheet or chemical supplier declaration.

Any chemicals containing substances or mixtures with restricted CLP classifications shall be highlighted. The approximate dosing rate of the chemical, together with the concentration of the restricted substance or mixture in that chemical (as provided in the safety data sheet or supplier declaration) and an assumed retention factor of 100 %, shall be used to estimate the quantity of the restricted substance or mixture remaining in the final product.

Justifications for any deviation from a retention factor of 100 % or for chemical modification of a restricted hazardous substance or mixture must be provided in writing to the competent body.

For any restricted substances or mixtures that exceed 0.10 % (weight by weight) of the final hard covering product, a relevant derogation must be in place and proof of compliance with any relevant derogation conditions must be provided.

Rationale:

The structure of the horizontal hazardous substance criteria follows the general recommendations of the EU Ecolabel Chemicals Task Force. The wording of the current proposal is based predominantly on the most recently voted product group which is an article (Graphic paper, Tissue paper and Tissue paper products, voted in June 2018).

Legal background

The existing EU Ecolabel criteria for the product group "Hard Coverings" were published in 2009, specifically in Commission Decision 2009/607/EC. This was prior to the publication of the revised EU Ecolabel Regulation in 2010.

Article 6(6) of EU Ecolabel Regulation (EC) No 66/2010 makes specific provision for a horizontal approach to hazardous substance restrictions for all product groups.

- Article 6(6): "The EU Ecolabel may not be awarded to goods containing substances or preparations/mixtures meeting the criteria for classification as toxic, hazardous to the environment, carcinogenic, mutagenic or toxic for reproduction (CMR), in accordance with Regulation (EC) No 1272/2008 of the European Parliament and of the Council of 16 December 2008 on classification, labelling and packaging of substances and mixtures nor to goods containing substances referred to in Article 57 of Regulation (EC) No 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorization and Restriction of Chemicals (REACH)".

Nevertheless, the EU Ecolabel Regulation also recognizes also that in certain circumstances the restriction of some substances may not be technically or environmentally justifiable. Therefore, Article 6(7) of the Regulation states that:

- Article 6(7): "For specific categories of goods containing substances referred to in paragraph 6, and only in the event that it is not technically feasible to substitute them as such, or via the use of alternative materials or designs, or in the case of products which have a significantly higher overall environment performance compared with other goods of the same category, the Commission may adopt measures to grant derogations from paragraph 6. No derogation shall be given concerning substances that meet the criteria of Article 57 of Regulation (EC) No 1907/2006 and that are identified according to the procedure described in Article 59(1) of that Regulation, present in mixtures, in an article or in any homogeneous part of a complex article in concentrations higher than 0,1% (weight by weight).".

The term "*containing*" is highlighted above because legal clarity was needed regarding what particular content can be considered as relevant. In principle, contained could be considered as the presence of just one molecule of a particular restricted hazardous substance. An EU Ecolabel Chemicals Task Force was convened and it was agreed that for the purposes of interpreting Articles 6(6) and 6(7), the term "*containing*" should be considered as equating to a content exceeding 0.10% (weight by weight) of the entire product or its homogenous part. The concentration 0.10% was used instead of the 0.1% mentioned in REACH because it reduces the potential for convenient rounding down of concentrations.

As a general rule for applying the 0.10% rule, it is proposed to consider all the products covered by this product group as simple articles. Even though some products may not be homogenous (e.g. dual layered concrete pavers, dual layer terrazzo tiles or glazed ceramics) such a proposal is considered reasonable since these heterogeneous areas are bonded in such a way that they cannot be mechanically separated by simple means.

SVHC restrictions

Since Article 6(7) prevents any derogation of SVHCs above 0.1% and the Chemicals Task Force agreed that "contained" means greater than 0.10% by weight, it can be concluded that any products considered to "contain" any SHVC cannot qualify for the EU Ecolabel.

The 0.10% limit is particularly useful for SVHC declarations since it aligns perfectly with communication requirements that are stipulated in the REACH Regulation (specifically in Articles 7(2) and 33 of REACH).

Article 7(2) requires importers or producers to notify ECHA if an SVHC is present in articles they import or produce in concentrations exceeding 0.1% (w/w) and add up in total to more than 1 tonne of a particular SVHC per actor per year.

Article 33 is even more relevant, since any recipient (i.e. a business to business transaction) or consumer (business to consumer transaction) must, upon request, be informed within 45 days of the presence of any SVHC present in the article(s) they have purchased if the concentration of the SVHC exceeds 0.1% (w/w). The weak point of Article 33 is that this communication requirement is only triggered by a specific request and only if the answer is positive (i.e. that there is an SVHC present >0.1%). There is no obligation to respond if no SVHC is present >0.1% w/w, even if it is simply to confirm that there is no issue.

CLP restrictions

There is no longer any reference to risk phases (e.g. R45, R50 etc.) when mentioning the classification of substances and mixtures because these were linked to the Dangerous Substances Directive (67/548/EEC) which was repealed by the CLP Regulation as of June 2015. Instead, reference is exclusively made to hazard statements and classes (e.g. H350, H400 etc.).

The term "*toxic, hazardous to the environment, carcinogenic, mutagenic or toxic for reproduction (CMR)*" from Article 6(6) was translated into specific CLP hazard categories by the EU Ecolabel Chemicals Task Force and resulted in the Group 1, Group 2 and Group 3 hazards as listed in the criterion proposal.

Depending on the nature of the product group and its normal use, the potential to also restrict category 1 skin sensitizers (H317) or category 1 respiratory sensitizers (H334) may be considered. These particular hazards do not seem relevant to hard coverings and so H317 and H334 are not listed in the proposed CLP criterion.

Unfortunately REACH does not make any provision for communication requirements about non-SVHC substances in articles like hard coverings and the CLP Regulation is focussed on labelling of substances and mixtures, not articles. Consequently, in order to demonstrate compliance with the CLP restriction criteria, the EU Ecolabel applicant has to be aware of all of the chemical substances or mixtures that have been used during the processing of the hard covering product. The following pieces of information are needed:

- List of chemical substances or mixtures used.
- Safety data sheets or relevant supplier declarations.
- Information about dosing rates and chemistry of any reactions that take place.

Armed with the above information, each chemical product can then be cross-checked against the following flow chart:

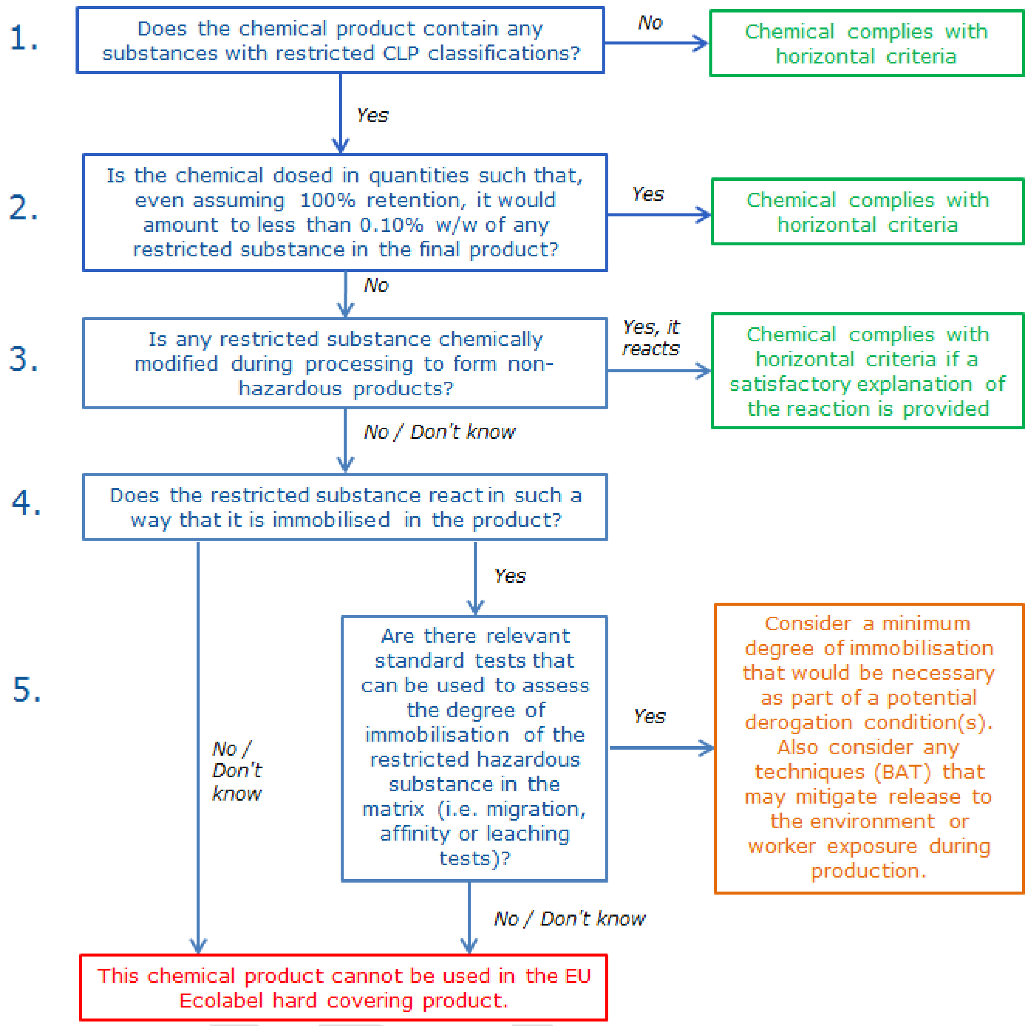

Figure 4. Flow chart for checking compliance with CLP restrictions.

According to the flow chart above, the easiest means to demonstrate compliance is simply not to use chemicals containing hazardous substances in the first place.

When considering whether or not it is technically feasible to substitute the chemical or not, consideration has to be given to the functionality that the chemical imparts (e.g. brightness, gloss, scratch resistance etc.). If less hazardous alternatives do exist, then a case has to be made for why the more hazardous chemical is used. Maybe it is more efficient, maybe its performance is better proven or similar reasons.

If the quantities of the restricted hazardous substance(s) involved are small then applicants should check their dosing rates and calculate if its use can be justified based on the fact that it would account for less than 0.10% of the final product weight.

The last chance for justifying the use of a chemical containing restricted hazardous substances without any specific derogation is to assess whether or not the substance reacts in such a way as to no longer be hazardous. Reactivity should be considered in terms of chemical reaction instead of physical immobilisation. For example, a monomer reacting to form a polymer is a clear example of a relevant chemical reaction but the depositing of a pigment in a coloured matrix is simply immobilisation, and thus not a relevant reaction.

Finally, if a restricted hazardous substance cannot comply with the previous four steps but its use is considered essential for specific products or desirable product functionalities, then a derogation request should be made to the JRC.

Any derogation request should explain clearly what substance(s) are involved, their CLP classification(s), why they should be derogated and suggested conditions that could be attached to any such derogation (e.g. worker exposure control, maximum dosing rate, minimum functionality or minimum immobilisation achieved etc.).

Derogation for Titanium Dioxide (TiO2)

Although this material has not been officially reclassified as H350i (carcinogenic via the inhalation route), the derogation is proposed anyway so that stakeholder opinions can be gathered in case the reclassification should happen. Even though TiO2 is expected to be well immobilised in all hard covering products, it is not expected to be chemically modified, which would otherwise exempt it from the requirements of the horizontal CLP restrictions for EU Ecolabel products.

Feedback from the Italian Ceramics association (Confindustria Ceramica) confirmed that raw material contents of TiO2 in Italian clays ranged from 0.16 to 0.38% w/w, i.e. always above the 0.1% threshold for the horizontal hazardous substance criteria. The same group also presented substantial arguments about why the reclassification of TiO2 might be based on flawed evidence although such matters are generally beyond the scope of the EU Ecolabel project.

Outcomes from and after the 1st AHWG meeting

A number of comments were received from stakeholders. First of all, a minor correction was made to the step-wise flow diagram, with one step being removed that is not directly relevant to the assessment and verification process (it is actually a step that the JRC and stakeholders should only consider during the criteria development process when considering derogation requests).

Split views were expressed regarding TiO2 derogations. Industry stakeholders were in favour of derogations (both for TiO2 as impurities and as an intentionally added ingredient in photocatalytically active products). Some Member State representatives and NGOs were against derogation for TiO2 in principle. The JRC considered that a derogation for TiO2 as impurities would be reasonable, considering the average TiO2 content that can naturally occur in clays.

The potential need for a derogation for crystalline silica was expressed by a representative of the ceramic tile industry. The JRC has inserted a draft derogation in TR v2.0 for further consideration by stakeholders at the 2nd AHWG meeting.

Further research:

Crystalline silica

It seems that there is no REACH registration duty for crystalline silica due to the fact that there is an exemption for registration of any "*minerals which occur in nature, if they are not chemically modified*".

A review and hazard assessment of the health effects of respirable crystalline silica concluded with the recommendation that the fine fractions of crystalline silica and cristobalite should be classified as STOT RE 1 (H372). Such a classification is linked to occupational health experience with workers that have been affected by silicosis.

The RE part of STOT RE 1 stands for Repeated Exposure, meaning that this is an issue that will be specific for factory workers and installers that are potentially exposed to airborne crystalline silica particles during each work day.

1.4 – VOC emissions

Existing criterion 2.3. Limitation of the presence of asbestos and polyester resins in the materials
No existing criterion.
TR v1.0 proposed criterion:—1.5. VOC (Volatile Organic Compound) emissions
Mandatory requirement   *The applicant shall declare if the final product surface has been treated with any waxes, adhesives, coatings, resins or similar surface treatment chemicals.*   *In cases where treatment has been carried out, safety data sheets or supplier declarations for the waxes, adhesives or resins used shall be provided together with the approximate dosing rate used and an estimate of the total quantity of the resin or wax remaining in the final product.*   *No formaldehyde-based resins are permitted.*   *In cases where the VOC content of the wax or resin used exceeds 5% and the total quantity of wax or resin on the final product accounts for more than 1% of the final product weight, VOC emissions of the final product shall also be tested.*   ***EU Ecolabel points***   *Up to a maximum of 5 points shall be awarded for applicants that can demonstrate compliance with the following aspects:*   • *Where the wax or resin used is less than 1% by weight of the final product (2 points).*   • *Where the wax or resin used has a VOC content less than 5% by weight (3 points).*   • *Where the results of a chamber test according to EN 16516 or ISO 16000 show that after 28 days the air concentration is: ≤ 0.01 mg/m3 formaldehyde; ≤ 0.3 mg/m3 TVOC, ≤ 0.1 mg/m3 TSVOC and ≤0.001 mg/m3 category 1A and 1B carcinogens (excluding formaldehyde); styrene 450 µg/m3 (5 points).*   • *Where no final surface treatment with VOCs has been applied (5 points).*   ***Assessment and verification**:*   *The applicant shall provide a declaration of the use or non-use of surface treatment chemicals used during product finishing operations.*   *In cases where such chemicals have been used, the safety data sheet or supplier declarations shall be provided regarding the VOC content. Furthermore, the applicant shall provide an estimate of the quantity of surface treatment chemicals used in the finishing operations (in g or ml per m^2) and how much remains in the final product (% w/w).*   *In cases where a VOC emission test is required, or where the applicant voluntarily wishes to obtain the extra 5 points for compliance with this requirement, the applicant shall provide a declaration of compliance, supported by a test report carried out according to EN 16516 or the ISO 16000 series or standards. If compliance with the chamber concentration limits specified at 28 days can be met at any other time between 3 and 28 days, the chamber test may be stopped prematurely.*   *A maximum of 5 points can be awarded under this criterion.*
TR v2.0 proposed criterion:—1.4. VOC (Volatile Organic Compound) emissions
Mandatory requirement   The applicant shall declare if the final product surface has been treated with any

waxes, adhesives, coatings, resins or similar surface treatment chemicals.

In cases where treatment has been carried out, safety data sheets or supplier declarations for the waxes, adhesives or resins used shall be provided together with the approximate dosing rate used and an estimate of the total quantity of the resin or wax remaining in the final product.

No formaldehyde-based resins are permitted.

EU Ecolabel points

A total of 5 points shall be awarded for applicants that can demonstrate compliance with either of the following aspects:

- Where the results of a chamber test according to EN 16516 or ISO 16000 show that after 28 days the air concentration is: ≤ 0.01 mg/m^3 formaldehyde; ≤ 0.3 mg/m^3 TVOC, ≤ 0.1 mg/m^3 TSVOC and ≤0.001 mg/m^3 category 1A and 1B carcinogens (excluding formaldehyde); styrene < 250$\mu g/m^3$.
- Where no final surface treatment with VOCs has been applied.

***Assessment and verification**:*

The applicant shall provide a declaration of the use or non-use of surface treatment chemicals used during product finishing operations.

In cases where such chemicals have been used, the safety data sheet or supplier declarations shall be provided regarding the VOC content.

In cases where a VOC emission test is required, or where the applicant voluntarily wishes to obtain the extra 5 points for compliance with this requirement, the applicant shall provide a declaration of compliance, supported by a test report carried out according to EN 16516 or the ISO 16000 series or standards. If compliance with the chamber concentration limits specified at 28 days can be met at any other time between 3 and 28 days, the chamber test may be stopped prematurely.

Rationale:

The overall objectives of this criterion are:

- to recognize the potential use of surface treatment agents on many of the hard covering products covered with the product group scope,
- to prevent the use of formaldehyde-based resins,
- to reward applicants that either do not use surface treatment agents or who use them in such a way that does not result in major VOC emissions from the product.

The emission of VOCs is a serious environmental concern. From the broader environmental perspective, VOCs react with nitrogen oxides in the presence of sunlight to form harmful ground level ozone and ozone is well known to contribute to smog formation. Elevated ground level ozone and smog are well known to exacerbate asthma and other respiratory conditions.

From a product-specific perspective, the products covered by the EU Ecolabel hard coverings product group (e.g. natural stone, ceramics and concrete) are not considered to generate significant VOC emissions. However, in order to improve certain technical properties of the products, such as scratch resistance, stain resistance or water repellency, these products may be treated with waxes, resins or other surface treatment chemicals which may (or may not) have a significant VOC content.

Green Building Assessment schemes recognize the importance of VOC emissions from interior building products on indoor air quality. For example, the BREEAM International New Construction (Version sd233 1.0) offers up to 5 credits for flooring and wall materials (amongst others). The LEED v.4 criteria for building design and construction offer up to 3 credits for low emitting materials under its Indoor Environmental Quality criteria.

The main minimum requirement for the criteria is to basically know and declare any surface treatment chemicals have been used. An EU Ecolabel applicant will already have this information after demonstrating compliance with the horizontal CLP criterion (1.3b). The other minimum requirement is that any resins used must not be formaldehyde-based. Formaldehyde is now classified as a category 1 carcinogen and even if free-formaldehyde is consumed during the resin polymerization, small but continual amounts of free-formaldehyde can be released during the product use stage when the resin comes into contact with moisture or atmospheric humidity.

Depending on the VOC concentration and quantity of surface treatment chemical applied, VOC emission testing of the product is either voluntary or mandatory. The emission limits stated in the criteria are aligned with the exemplary performance level of BREEAM for building materials. One additional emission limit added is that of styrene, which could be significant in cases where polyester resins are used and which is highly relevant to agglomerated stone products.

Outcomes from and after the 1st AHWG meeting

Support was expressed about the VOC emission approach by industrial stakeholders, which can be considered as relevant especially due to certain surface treatments. One stakeholder shared their own personal experience with purchasing hard coverings in Belgium, where products with a VOC label (according to a French initiative) were available. So it is considered to be an important aspect for consumers. Even ceramic, natural stone and concrete type products were using the VOC label. JRC acknowledged that this would be a relevant area in which to conduct further research, especially due to the ongoing evolution of different schemes (e.g. AgBB in Germany, ANSIS in France and other requirements cherry-picked by GBAs). Other colleagues in JRC have also tried to look at harmonizing what can be considered as acceptable VOC emission limits. It was pointed out that care should be taken if the VOC emissions are to target the surface treatment only or also the entire binder (in cases where a VOC containing binder is used, as is the case in agglomerated stone). JRC acknowledged the point and would either adapt the horizontal approach or insert a new specific approach for agglomerated stone relating to VOC in the binder for the next version.

Another industry stakeholder highlighted some misleading wording in the assessment and verification text (specifically the word "*extra*") which suggests that more than 5 points could be achieved is carrying out a chamber test. JRC clarified that this was not the intention and that no more than 5 points could be obtained under any circumstances and that the wording would be adapted accordingly to minimise the potential for confusion. Another clarification requested was that the 5% VOC by weight should be clearly expressed as a % of the chemical formulation. JRC agreed to modify the text in this way.

In written feedback, one stakeholder requested that the awarding of intermediate points for the use of low quantities or low VOC content surface treatments was a way of potentially confusing the issue, since these practices could not be guaranteed to result in a low VOC emission product. It was suggested to delete them and simply award 5 points for the non-use of VOC containing surface treatment agents or, in cases when they are used, that VOC emissions from the final product are tested.

Further research:

Styrene maximum limit value.

Over the last couple of years, the World Health Organization (WHO) together with the European Commission and experts from the ECA group has been working towards the development of guideline values for indoor air concentrations of priority chemical compound, the development of common procedures of testing, analysis and evaluation with the possibility of one emission test being sufficient to allow labelling in accordance with the different schemes. Within this frame, a European Working Group, so-called EU-LCI Working Group, derive and recommend EU-wide harmonised based reference values for the assessment of product emissions, based on the so-called "*Lowest Concentration of Interest*" (LCI) concept.

EU LCI values have been published for around 100 different VOCs, which are broadly grouped into the following categories: (i) aromatic hydrocarbons; (ii) saturated aliphatic hydrocarbons; (iii) terpenes; (iv) aliphatic alcohols; (v) aromatic alcohols; (vi) glycols, glycoethers; (vii) aldehydes; (viii) ketones; (ix) acids; (x) esters; (xi) chlorinated hydrocarbons and (xii) others.

Based on the values proposed in the latest EU-LCI list (2018) the initial proposed value of 450μg/m^3 has been further reduced to 250μg/m^3.

1.5 – Fitness for use

Existing criterion for fitness for use: 8 – Fitness for use
The product shall be fit for use. This evidence may include data from appropriate ISO, CEN or equivalent test methods, such as national or in-house test procedures. *An indication of the kind of use for which the product is fit for use has to be clearly specified: wall, floor or wall/floor if suitable for both purposes.* ***Assessment and verification**:* *Details of the test procedures and results shall be provided, together with a declaration that the product is fit for use based on all other information about the best application by the end-user. According to Directive 89/106/EEC a product is presumed to be fit for use if it conforms to a harmonised standard, a European technical approval or a non-harmonised technical specification recognised at Community level. The EC conformity mark 'CE' for construction products provides producers with an attestation of conformity easily recognisable and may be considered as sufficient in this context.*
TR v1.0 proposed criterion:-1.5. Fitness for use
Mandatory requirement *The applicant shall have a quality control and quality assessment procedure in place to ensure that products are fit for use. Where relevant, evidence demonstrating fitness for use may be provided. Any such evidence provided should be based on test results according to appropriate ISO or EN standards or equivalent test methods. An indicative list of potentially relevant standards is included below.* ***Assessment and verification:*** *The applicant shall provide a declaration of compliance with the criterion, supported by a description of their in-house quality control and quality assessment procedures.* *In cases where test data according to EN or ISO standards, or equivalent methods is considered necessary, an indicative list of potentially relevant standards is indicated below:* - *Natural stone: EN1341, EN1342, EN1343, EN1467, EN1468, EN1469, EN12057, EN12058 or EN12059;* - *Cement-based terrazzo tiles: EN13748* - *Agglomerated stone: EN15285, EN15286, EN 15388 or EN16954* - *Clay pavers and ceramic tiles: EN1344, EN13006 or EN 14411* *Concrete paving blocks, flags and kerb units: EN1338, EN1339 or EN1340*
TR v2.0 proposed criterion:-1.5. Fitness for use
Mandatory requirement The applicant shall have a quality control and quality assessment procedure in place to ensure that products are fit for use. Where relevant, evidence demonstrating fitness for use may be provided. Any such evidence should be based on test results according to appropriate ISO or EN standards or equivalent test methods. An indicative list of potentially relevant standards is provided below. ***Assessment and verification:*** *The applicant shall provide a declaration of compliance with the criterion, supported by a description of their in-house quality control and quality assessment procedures.*

In cases where test data according to EN or ISO standards, or equivalent methods is considered necessary, an indicative list of potentially relevant standards is indicated below:

- Natural Stone products: EN771-6, EN1341, EN1342, EN1343, EN1467, EN1468, EN 1469, EN12057, EN12058 or EN12059;
- Cement-based terrazzo tiles: EN13748
- Agglomerated stone: EN15285, EN15286, EN 15388 or EN16954
- Clay masonry units, pavers and ceramic tiles: EN 771-1, EN1344, EN13006 or EN 14411
- Concrete masonry units, paving blocks, flags and kerb units: EN771-3, EN771-4, EN1338, EN1339 or EN1340

Rationale:

These environmental criteria take the whole product life cycle into account from the extraction of the raw materials, to production, packaging and transport, right through to use and disposal/recycling. Fitness-for-use criteria also guarantee good product performance (of course with the caveats of correct installation and use). The main purpose of the requirement on fitness for use is to make sure that products are sold that are correctly marked with whatever relevant performance class(es) they conform with, which will help ensure the customer about their correct installation and use, which will reduce the risk of wasted materials and premature end-of-life.

The highest environmental impacts caused by hard coverings are due to their raw material extraction and production stages. These impacts, especially those on the resource consumption, can be minimized provided that the service life of the product is extended. To guarantee a long durability of the finished products a design for fitness for use is needed. This criterion aims at ensuring these characteristics in the EU Ecolabel products.

Hard coverings are products are extremely durable, resulting in a long life expectancy. According to a study of Life Expectancy of Home Components prepared by the National Association of Home Builders (NAHB), the average life span of different coverings varies between 75 and more than 100 years. Despite the long life, the use stage causes negligible environmental impacts. This is due to the fact that the maintenance of hard coverings is quite simple and usually is limited to maintenance to seal the surface for natural stone products and cleaning operations, although it depends on the type of flooring, material and application (domestic, office, etc.).

EN standards and test methods are available for demonstrating appropriate levels of performance. The full titles of the standards are included here for reference.

Natural stone products

EN 1341, Natural stone — Slabs of natural stone for external paving.— Requirements

EN 1342 Sets of natural stone for external paving - Requirements and test methods

EN 1343 Kerbs of natural stone for external paving - Requirements and test methods

EN 1467, Natural stone — Rough blocks — Requirements

EN 1468, Natural stone — Rough slabs — Requirements

EN 1469, Natural stone products — Slabs for cladding — Requirements

EN 12057, Natural stone products — Modular tiles — Requirements

EN 12058, Natural stone products — Slabs for floors and stairs — Requirements

EN 12059, Natural stone products — Dimensional stone work — Requirements

Cement-based terrazzo tiles

EN 13748 — Terrazzo tiles - Part 1: Terrazzo tiles for internal use

EN 13748— Terrazzo tiles - Part 2: Terrazzo tiles for external use

Agglomerated stone

EN15285 — Agglomerated stone — Modular tiles for flooring and stairs (internal and external)

EN15286 — Agglomerated stone —Slabs and tiles for wall finishes (internal and external)

EN 15388 — Agglomerated stones — Slabs and cut to size products for vanity and kitchen tops

EN 16954— Agglomerated stone — Slabs and cut-to-size products for flooring and stairs (internal and external)

Clay and ceramic tiles

EN 1304 — Clay roofing tiles and fittings - Product definitions and specifications

EN13006 – Ceramic tiles – Definitions, classification, characteristics and marking

EN14411 — Ceramic tiles - Definition, classification, characteristics, assessment and verification of constancy of performance and marking

Concrete blocks, flags and tiles

EN1338 — Concrete paving blocks - Requirements and test methods

EN1339 —Concrete paving flags - Requirements and test methods

EN 1340 – Concrete kerb units – Requirements and test methods

Outcomes from and after the 1st AHWG meeting

One stakeholder stated that the fitness for use standards are important and that a minimum strength requirement should be set for products to help ensure their long lifetime. The JRC responded by saying that more important than high strength is the appropriate performance class for the use environment in question.

Since the manufacturer cannot know the intended use environment for all their sold products, setting a minimum strength requirement for all EU Ecolabel products, regardless of intended use, may be counter-productive. For example, higher strength concrete paving slabs may be good in highly trafficked areas but would represent an excessive use of cement in quiet pedestrian pavements.

Another stakeholder commented that fitness for use if a technical issue more than an environmental one. The JRC only partly agreed, stating that products which are fit for use and that have the performance class properly communicated will have an increased opportunity to be procured and installed adequately, thus improving their potential useable lifetime.

Further research:

No further research was carried out for this criterion between TR v1.0 and TR v2.0.

1.6 – Consumer information

Existing criterion for consumer information: 9 – consumer information

The product shall be sold with relevant user information, which provides advice on the product's proper and best general and technical use as well as its maintenance. It shall bear the following information on the packaging and/or on documentation accompanying the product:

(a) information that the product has been awarded the Community eco-label together with a brief yet specific explanation as to what this means in addition to the general information provided by box 2 of the logo;

(b) recommendations for the use and maintenance of the product. This information should highlight all relevant instructions particularly referring to the maintenance and use of products. As appropriate, reference should be made to the features of the product's use under difficult climatic or other conditions, for example, frost resistance/ water absorption, stain resistance, resistance to chemicals, necessary preparation of the underlying surface, cleaning instructions and recommended types of cleaning agents and cleaning intervals. The information should also include any possible indication on the product's potential life expectancy in technical terms, either as an average or as a range value;

(c) an indication of the route of recycling or disposal;

(d) information on the Community eco-label and its related product groups, including the following text (or equivalent):'for more information visit the EU eco-label website: http://www.ecolabel.eu'.

***Assessment and verification**:*

The applicant shall provide a sample of the packaging and/or texts enclosed.

TR v1.0 proposed criterion:-1.5. Fitness for use

Mandatory requirement

The product shall be sold with relevant user information, which provides advice on the product's proper and best general and technical use as well as its maintenance. It shall bear the following information on the packaging and/or on documentation accompanying the product:

- *(a) Recommendations for correct use and storage so as to maximise the product lifetime (e.g., whether the product needs coating or sealing, etc). As appropriate, reference should be made to the features of the product's use under difficult climatic or other conditions, for example, frost resistance/water absorption, stain resistance, resistance to chemicals, necessary preparation of the underlying surface, cleaning instructions and recommended types of cleaning agents and cleaning intervals. The information should also include any possible indication on the product's potential life expectancy in technical terms, either as an average or as a range value;*
- *(b) Installation instructions including recommended techniques and materials. These instructions must not specify nor require the use of any component that does not comply with the materials requirements of this criterion.*
- *(c) Maintenance instructions, if required. Maintenance instructions must not specify nor require the use of any chemical or coating limited by any part of this criterion.*
- *(d) Recycling or environmentally preferable disposal instructions for the product end-of-life.*

Assessment and verification:

The applicant should provide a sample of the packaging and/or texts enclosed.

TR v2.0 proposed criterion: 1.6. Consumer information

Mandatory requirement

The product shall be sold with relevant user information, which provides advice on the product's proper installation, appropriate use environment and correct maintenance. It shall bear the following information on the packaging and/or on documentation accompanying the product:

(e) Recommendations for correct use and storage so as to maximise the product lifetime (e.g., whether the product needs coating or sealing, etc.). As appropriate, reference should be made to the features of the product's use under difficult climatic or other conditions, for example, frost resistance/water absorption, stain resistance, resistance to chemicals, necessary preparation of the underlying surface, cleaning instructions and recommended types of cleaning agents and cleaning intervals. The information should also include any possible indication on the product's potential life expectancy in technical terms, either as an average or as a range value;

(f) Installation instructions including recommended techniques and materials. These instructions must not specify nor require the use of any component that does not comply with the materials requirements of this criterion.

(g) Maintenance instructions, if required. Maintenance instructions must not specify nor require the use of any chemical or coating limited by any part of this criterion.

(h) Recycling or environmentally preferable disposal instructions for the product end-of-life.

Assessment and verification:

The applicant should provide a sample of the packaging and/or texts enclosed.

Rationale:

The information requested to comply with this criteria is focused to the product itself, no more reference to the eco-label community, as this information is already provided to the consumer with the logo (see criterion 1.7). The information provided should cover the whole use life cycle: use and storage, installation and maintenance, and recycling and disposal.

The information given to the consumers can play an important role in the overall environmental performance of the product. In this sense, if the supplier, installers and consumers follow these recommendations an outstanding performance of the product is expected fulfilling both technical and environmental expectations.

A revision of other national schemes confirms this relevance. In general consumer information is based on the installation of the product including the recommended base or underlay, type of area to use the product or the moisture and temperature limits and on its maintenance including the cleaning agents and methods and the recommendations to extend the life of the product and finally recommendations.

Outcomes from and after the 1st AHWG meeting

Several points were raised by consumers about this point during the written feedback period. It was consider important to not try to state the estimated useful life of the product although it was considered necessary to communicate which life cycle stages the criteria for that sub-product focus on the most.

It was also suggested that the product score appear on the label, although this would first need to be consulted with the EU Ecolabelling Board

1.7 – Information appearing on the EU ecolabel

Existing criterion for consumer information: 10 – Information appearing on the ecolabel

Box 2 of the eco-label shall contain the following text:

***Natural products**:*

— reduced impact of extraction on habitats and natural resources,

— limited emission from finishing operations,

— improved consumer information and waste management.

Processed products:

— reduced energy consumption of production processes,

— reduced emissions to air and water,

— improved consumer information and waste management.

***Assessment and verification**:*

The applicant shall provide a sample of the packaging and/or texts enclosed.

TR v1.0 proposed criterion:-1.9. Information appearing on the ecolabel

The applicant shall follow the instructions on how to properly use the EU Ecolabel logo provided in the EU Ecolabel Logo Guidelines:

http://ec.europa.eu/environment/ecolabel/documents/logo_guidelines.pdf

If the optional label with text box is used, it shall contain the following three statements, as appropriate

For natural stone products:

- *From limited landscape impact quarries;*
- *Material efficient extraction and processing operations;*
- *Reduced emissions to water and air.*

For agglomerated stone products:

- *Energy efficient production process;*
- *Reduced emissions to air;*
- *Maximum binder content xx% / minimum recycled or secondary material content yy% (as appropriate).*

For ceramic products:

- *Energy efficient production process;*
- *Reduced emissions to air;*
- *Material efficient product (in case of thin format tiles < 10mm thick or tiles with a high recycled content > 10%) / Material efficient production process (in all other cases).*

For concrete products:

- *Reduced CO2 footprint cement*
- *Reduced air emissions*
- *Minimum recycled or secondary material content xx% / energy efficient production / anti-NOx surface / permeable paving (as appropriate)*

Assessment and verification:

The applicant shall provide a declaration of compliance with this criterion, supported by an image of the product packaging that clearly shows the label, the registration/licence number and, where relevant, the statements that can be displayed together with the label.

TR v2.0 proposed criterion:—1.7. Information appearing on the EU ecolabel

The applicant shall follow the instructions on how to properly use the EU Ecolabel logo provided in the EU Ecolabel Logo Guidelines:

http://ec.europa.eu/environment/ecolabel/documents/logo_guidelines.pdf
If the optional label with text box is used, it shall contain up to three of the following statements, as appropriate

For natural stone products:

- Sourced from responsibly managed quarries;
- Reduced dust emissions from quarry and transformation plant;
- Closed loop wastewater recycling at quarry and transformation plant;
- Material efficient production process.

~~For agglomerated stone products:~~

- ~~Energy efficient production process;~~
- ~~Reduced emissions to air;~~
- ~~Maximum binder content xx% / minimum recycled or secondary material content yy% (as appropriate).~~

For ceramic and fired clay products:

- Energy efficient and low CO2 production process;
- Reduced emissions to air;
- Material efficient product* / Material efficient production process**.

**applies to all thin format tiles <6mm thick, to any other tiles or fired clay products with recycled content ≥20% or to any other tiles or fired clay products with a void content ≥25%, ** applies to all other cases.*

For concrete products:

- Low CO2 cement
- Reduced air emissions
- Material efficient product* / Material efficient production process**

**applies to any precast concrete products with a recycled content ≥20% or a void content ≥25%in cases, ** applies to all other cases*

Assessment and verification:

The applicant shall provide a declaration of compliance with this criterion, supported by an image of the product packaging that clearly shows the label, the registration/licence number and, where relevant, the statements that can be displayed together with the label.

Rationale:

According to Article 8 (3b) of the EU Ecolabel Regulation 66/2010, for each product group, three key environmental characteristics of the ecolabelled product may be displayed in the optional label with text box. The guidelines for the use of the optional label with text box can be found in the "*Guidelines for the use of the EU Ecolabel logo*" on the Commission website.

Information given to the consumers also ensures that end-users adopt an environmentally friendlier behavior, since the customer who is interested in buying the EU ecolabel products is generally interested in knowing the environmental performance of the products s/he buys. For this reason, a requirement about the logo and the number certification shall be included.

The information to be displayed is the same for all different hard covering products and provides an accurate reflection of the key issues addressed in the technical criteria, it also includes information on the restriction of hazardous substances.

Also instructions on the use of logo and license number are included.

Outcomes from and after the 1st AHWG meeting

A proposal was made for information appearing on the EU Ecolabel of ceramic tile products by an industrial stakeholder regarding the material efficient claims for thin format tiles and any tiles with a recycled content of 10%. The JRC decided to raise the recycled content for such a statement to 20%.

Further research

The requirements for criterion 1.7 are still very much open since first it will be necessary to decide on the criteria and only then on the final information to be displayed on the label.

CRITERIA 2: Natural stone

LCA hotspots of natural stone products

As a simple snapshot, the natural stone EPD data below demonstrates that the main sources of impacts (ca. 70% for five impact categories) are from the raw material production (A1) and manufacturing (A3) processes covered by the A1-A3 values. Other potentially relevant impact categories that could be of particular relevance are abiotic depletion potential and water consumption.

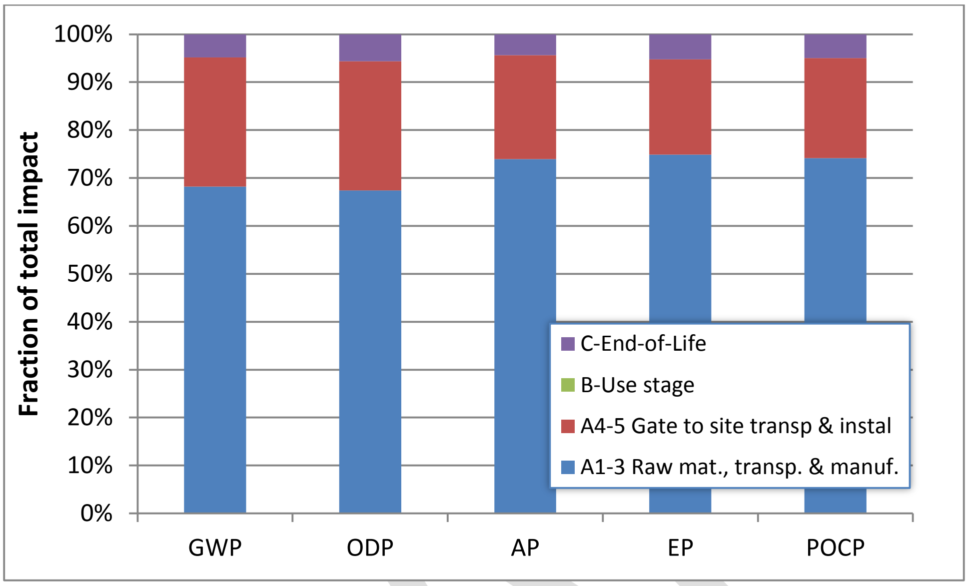

Figure 5. Split of LCA impacts between modules A (A1-A3 and A4-A5), B and C (Oppdal, 2015).

Consequently, it is justifiable to set criteria relating to the production stage, both at the quarry where the raw material (ornamental or dimension stone) is extracted (A1) and the processing plant, where blocks are processed into natural stone products (such as slabs and tiles) (A3).

Main changes from Decision 2009/607/EC to TR v1.0

In technical report v.1.0, a completely new approach for natural stone was proposed based on a horizontally and vertically structured set of criteria with a combination of mandatory and optional elements. This approach aims to recognise the different ways in which the environmental impacts of quarrying and processing plant operations can be minimised and uses a combination of mandatory requirements and award points to attempt to find the right balance between guaranteeing environmental benefits, encouraging natural stone producers to improve and rewarding those that already comply with good practice.

The number and subject matter of criteria proposals made in TR v1.0 were very different to those established in Decision 2009/607/EC. The scoring matrix for quarrying operations has been removed and each individual criterion has been considered on its own merits. In all cases, the weighing factors related to the proximity of population centres and original soil classification have been removed, since the quarry operator has no influence over these parameters (poor steerability).

The water recycling ratio and the water quality criteria have been replaced by a list of good practices that cover broader issues relating to water and wastewater management at the quarry. In general, the water recycling ratio is 100% since the loop is closed although there will be losses due to evaporation and in moist sludge removed from site.

The quarry impact ratio was maintained, but the term "*active dump*" has been replaced by "*extractive waste deposition area*" and "*by-products deposition area*" in line with the terminology used in the recent BREF document on mining waste. An additional element known as the quarry visual impact was also introduced, which intended to align with the approach used in the GECA scheme.

The "*natural resource waste*" criterion was renamed as "*material efficiency*" and was reconfigured completely to reward both the efficiency of blocks of dimension or ornamental stone from the quarry as well as the use of by-products.

The air quality criterion has been changed from a quantitative assessment of dust at point sources (in reality the sources are diffuse and highly variable in both time and space) to a list of good practices that should be implemented onsite.

The noise criterion was also adapted from a fixed limit to a requirement to have a noise management plan, although working time noise limits of 80dB (A) in cases where residential populations are located within a 5km radius.

Regarding criteria that apply to the transformation plant, emissions of certain pollutants to water, the water recycling ratio and emissions to air were all grouped together in a single table. The emissions to air requirements were removed because, considered how the transformation plants operate, there appears to be no centralized chimney where air emissions can be continuously monitored. The water recycling ratio was removed since it is common practice to have a ratio of nearly 100% at the transformation plant. The criteria on emissions to water were maintained, but only in cases where the applicant is responsible for the final discharge of the effluent to local watercourses. Cadmium and lead do not seem to be relevant pollutants based on the sawing media used and so no longer needed to be tested. However, testing for COD, due to potential grease from lubricants was additionally required.

A new criterion relating to energy management has been introduced for the transformation plant and the use of renewable electricity is strongly encouraged via the award of points. Another new criterion is on recycling of process waste, which was only required previously for ceramic, agglomerated stone and concrete products in Decision 2009/607/EC. At least 70% reuse is required and higher rates are rewarded with points.

Table 3. Natural stone criteria in Decision 2009/607/EC and TR v1.0.

Decision 2009/607/EC (all mandatory)	Technical Report v1.0
5. Waste management (description of procedures in place for waste recycling and disposal).	1.1. Environmental Management System (mandatory to have one, optionally up to 5 points awarded, if it is third party certified)
1.2. Extraction management	1.2. Industrial and construction mineral extraction (mandatory)
2.1. Raw materials selection (restricted risk phrases)	1.3. Hazardous substance restrictions (mandatory)
2.3. Asbestos	1.4. Asbestos (mandatory)
	1.5. VOC emissions (mandatory and optional elements for which up to 5 points can be awarded)
7. Packaging (≥70% recycled content in any paperboard packaging).	1.6. Business to consumer packaging (mandatory)
8. Fitness for use	1.7. Fitness for use (mandatory)
9. Consumer Information	1.8. Consumer information (mandatory)
10. Information appearing on the EU Ecolabel.	1.9. Information appearing on the ecolabel (mandatory)
L1. Water recycling ratio	2.1.3. Water and wastewater management (mandatory if wet processes used)
L5. Water quality	
L2. Quarry impact ratio	2.1.1. Quarry landscape impact ratio (mandatory) and optionally up to 10 points.
L3 Natural resource waste	2.1.2. Material efficiency (mandatory) and optionally up to 20 points.
L4. Air quality	2.1.4. Air pollution minimisation (mandatory)
L6. Noise	2.1.5. Noise control (mandatory)
3. Finishing operations (for natural products only). Limits set for PM, styrene, water recycling ratio, TSS, Cd, Cr(VI), Fe and Pb	2.2.2. Emissions to water (TSS, COD, Cr(VI) and Fe).
	2.2.1. Energy consumption (mandatory) and optionally up to 30 points.
	2.2.3. Recycling of waste from processing operations (mandatory) and optionally up to 20 points.

Main changes from Decision TR v1.0 to TR v2.0

The criteria for natural stone in TR v1.0 and TR v2.0 are summarized below.

Table 4. Natural stone criteria in TR v1.0 and TR v.2.0.

Technical Report v1.0	Technical Report v2.0
1.1. Environmental Management System (mandatory to have one, optionally up to 5 points awarded, if it is third party certified)	1.1. Environmental Management System (optionally up to 5 points, if it is third party certified)
1.2. Industrial and construction mineral extraction (mandatory)	1.2. Industrial and construction mineral extraction (mandatory)
1.3. Hazardous substance restrictions (mandatory)	1.3. Hazardous substance restrictions (mandatory)
1.4. Asbestos (mandatory)	
1.5. VOC emissions (mandatory and optional elements for which up to 5 points can be awarded)	1.5. VOC emissions (mandatory and optionally 5 points can be awarded)
1.6. Business to consumer packaging (mandatory)	
1.7. Fitness for use (mandatory)	1.7. Fitness for use (mandatory)
1.8. Consumer information (mandatory)	1.8. Consumer information (mandatory)
1.9. Information appearing on the ecolabel (mandatory)	1.9. Information appearing on the ecolabel (mandatory)
2.1.3. Water and wastewater management (mandatory if wet processes used) and optionally up to 5 points.	2.1.3. Water and wastewater management (mandatory).
2.1.1. Quarry landscape impact ratio (mandatory) and optionally up to 10 points.	2.1.1. Quarry landscape impact ratio (mandatory) and optionally up to 30 points.
2.1.2. Material efficiency (mandatory) and optionally up to 20 points.	2.1.2. Material efficiency (mandatory) and optionally up to 30 points.
2.1.4. Air pollution minimisation (mandatory)	2.1.4. Quarry dust control (mandatory)
2.1.5. Noise control (mandatory)	
2.2.1. Energy consumption (mandatory) and optionally up to 30 points.	2.2.1. Energy consumption (mandatory) and optionally up to 20 points.
2.2.2. Emissions to water (TSS, COD, Cr(VI) and Fe) (conditionally mandatory).	2.2.2. Emissions to water (TSS, COD) (mandatory). Optionally up to 10 points.
2.2.3. Recycling of waste from processing operations (mandatory) and optionally up to 20 points.	2.2.3. Recycling of waste from processing operations (mandatory) and optionally up to 20 points.

Following stakeholder feedback to the proposals in TR v1.0 and further research, a number of modifications have been made in TR v2.0. The asbestos and packaging criteria have been removed due to their low relevance and low effect on the total environmental impact of ceramic products. The known presence of asbestos fibres in quantities exceeding 0.10% w/w would effectively disqualify the product from the EU Ecolabel according to criterion 1.3.

The water and wastewater management criterion is essentially the same although it is now mandatory in all cases because even if dry processes are used, water will still be needed for dust control. The optional 5 points for the non-use of flocculants has been removed.

The quarry landscape impact ratio has changed considerably. The visual impact element has been removed due to a lack of available data to justify any particular ambition level and also because of its subjectivity, both based on focal point chosen and range of colour contrasts possible. New elements have been added where increased vegetated areas and/or land used for the generation of renewable energy is rewarded.

The material efficiency criterion is essentially unchanged except for the insertion of an exemption the mandatory minimum of 0.25 for slate, which has a particularly low block extraction efficiency due to its laminar nature (although this can be compensated for by a high reuse of by-products).

The requirements for the water and wastewater management criterion at the quarry have been nuanced slightly depending on whether or not the cutting processes are of the wet-type. The quarry dust control list of good practices has been extended based on finding from further research. Finally, the noise criterion has been removed due to its limited perceived benefit.

The energy consumption criterion for the natural stone transformation plant has been reworded to better align with a similar criterion set out by the Natural Stone Council in the US.

The water and wastewater management criteria at the transformation plant have also been modified, both in response to stakeholder feedback about the need for even third party waste water treatment plant operators to declare on effluent quality and on broader aspects, such as rainwater collection systems, which can be optionally awarded points.

Regarding the reuse of process waste from natural stone transformation plants, a distinction has been made between process scrap (pieces of hard rock easier to reuse as coarse aggregate) and sludge (not so easy to reuse, especially if flocculants have been used as sedimentation aids). The reuse up to 100% of both is encouraged by points but a minimum is only stated for process scrap.

Criteria applicability and scoring matrix

A combination of mandatory criteria and opportunities to gain EU Ecolabel points are detailed in this section for natural stone products.

Table 5. Natural stone-specific criteria structure and scoring system

Proposed criteria	Mandatory element?	Optional element	Points
1.1. Environmental Management System	No	Yes	Up to 5
1.2. Industrial and construction mineral extraction	Yes	No	0
1.3. Hazardous substance restrictions	Yes	No	0
1.4. VOC emissions	Yes	Yes	Up to 5 points
1.5. Fitness for use	Yes	No	0
1.6. Consumer information	Yes	No	0
1.7. Information appearing on the ecolabel	Yes	No	0
2.1 Quarry			
2.1.1. Quarry landscape impact ratio.	Yes	Yes	30
2.1.2. Material efficiency.	Yes	Yes	30
2.1.3. Water and wastewater management.	Yes	No	0
2.1.4. Quarry dust control	Yes	No	0
MINIMUM points needed for stone block			**30**
2.2. Transformation plant			
2.2.1. Energy consumption	Yes	Yes	20
2.2.2. Emissions to water	Yes	Yes	10
2.2.3. Recycling of waste from processing operations	Yes	Yes	20
TOTAL points available for stone tile or slab			**120**
MINIMUM points needed for stone tile or slab			**60**

Up to 60 points are under the direct control of the quarry operator and 60 points under the direct control of the operator of the transformation plant. In cases where a final transformed product is to be licensed, a total of 60 points (50% of the total) is needed. In cases where dimension or ornamental stone blocks produced from the quarry are to be licensed, a total of 30 points (50% of the quarry points) is needed.

2.1 – Quarry requirements

2.1.1 – Quarry Landscape Impact Ratio

Existing criterion 1. Raw material extraction: 1.1. Extraction management (for natural products only; I2 Quarry Impact Ratio)

1.1. Extraction management (for natural products only)

General requirements

The raw material extraction management for natural stones shall be 'scored' according to a matrix of six main indicators.

The total score shall be based on the sum of individual scores given for each indicator, multiplied by a corrective weighting (W). Quarries must obtain a weighted score of at least 19 points to be eligible for the eco-label award. In addition, the score for each indicator must be higher or lower than the threshold specified, as appropriate.

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Matrix for scoring raw material extraction management for natural stones

Indicator	Notes	Score				
		5 (excellent)	3 (good)	1 (sufficient)	Threshold	Relative weights
I.2. Quarry impact ratio	$\frac{m2\ affected\ area\ (quarry\ front\ +\ acti}{m2\ authorised\ area}$ [%]	<15	15-30	31-50	>50	W1, W2 (*)

****W1. Soil protection:** (weightings: 0,3 — 0,8, see table) — for quarry impact ratio (I.2) and water quality (I.5) indicators, three different values of weights are considered, as a function of land use potentialities (see Technical appendix — A1 for details):*

Soil protection	Classes I-II	Classes III-IV-V	Classes VI-VII-VIII
Weight	0.3	0.5	0.8

***Assessment and verification:** the applicant shall provide appropriate documentation, including a map, of the land capability classification of the quarry site.*

A1 W1. Soil protection/land capability classification

According to the European Soil Bureau's indication, land is graded on the basis of its potentialities and the severity of its limitations for crop growth into eight capability classes. An indicative description of the classes is as follows:

- Class I soils have slight limitations that restrict their use,
- Class II soils have moderate limitations that reduce the choice of plants or require moderate conservation practices,
- Class III soils have severe limitations that reduce the choice of plants or require special conservation practices, or both,
- Class IV soils have very severe limitations that restrict the choice of plants or require very careful management, or both,
- Class V soils have little or no hazard of erosion but have other limitations, impractical to remove, that limit their use mainly to pasture, range, forest

land, or wildlife food and cover,

- Class VI soils have severe limitations that make them generally unsuited to cultivation and that limit their use mainly to pasture, range, forest land, or wildlife food and cover,
- Class VII soils have very severe limitations that make them unsuited to cultivation and that restrict their use mainly to grazing, forest land, or wildlife,
- Class VIII soils and miscellaneous areas have limitations that preclude their use for commercial plant production and limit their use to recreation, wildlife, or water supply or for aesthetic purposes.

****W2. Population density of settlements*** which lie within a 5 km radius (distance) from the quarry site: (weightings: 0,5 —0,9, see table) quarry impact ratio (I.2), air quality (I.4), water quality (I.5) and noise (I.6) indicators are weighted in function of three density ranges:*

Population density	<100 hab /km^2	20 to 100 hab/km^2	<20 hab/km^2
Weight	0.5 (0.6)	0.7 (0.84)	0.9

__Assessment and verification__: the applicant shall provide a map and appropriate documentation to verify the population density of settlements lying within 5 km radius (distance) from the quarry border (authorised area). In the case of existing quarries and expanding settlements in the area concerned, the weight factor indicated in brackets shall be used. This does not refer to major extensions of the already authorised area of such quarries (> 75 %).

__Assessment and verification:__

The applicant shall provide the calculation of their total 'score' (weighted accordingly), and related data for each of the six indicators (showing, amongst others, that each score is above the minimum score, if one is given) according to the matrix overleaf and to the associated instructions in the Technical appendix — A3. The applicant shall also provide appropriate documentation and/or declarations that prove compliance with all of the abovementioned criteria.

TR v1.0 proposed criterion:-2.1.1. Quarry landscape impact ratio

The applicant shall identify the quarry from which the dimension stone or ornamental stone blocks have been procured. The impact of the quarry on the landscape shall be evaluated according to the following metrics:

$$quarry\ footprint\ ratio = \frac{\boldsymbol{QF_S\ (m^2) + EWDA\ (m^2) + BPDA(m^2)}}{\boldsymbol{total\ authorized\ area\ (m^2)}}$$

Where:

- QFs is the active quarry front as observed from a satellite view.

- EWDA is the Extractive Waste Deposition Area, including the Extractive Waste Facility.

- BPDA is the By-Products Deposition Area occupied for storage of materials that may, in principle, qualify as by-products/products.

Authorized Area is the total surface area authorized in the permit for extraction activity.

$$quarry\ visual\ impact = \frac{\boldsymbol{QF_V\ (m^2)}}{\boldsymbol{QF_S\ (m^2)}}$$

Where:

QF_V is the vertical profile surface area of the active quarry front. Any active quarry surface that is underground shall not be counted towards QF_V but will be counted towards QF_S.

EU Ecolabel points

Points shall be awarded for applicants that can prove the following

- Quarry footprint ratio of less than 0.6 and as low as 0.2 (Up to 5 points)
- Quarry visual impact of less than XX and as low as 0 (Up to 5 points).
- Demonstrate progressive rehabilitation activities during the operational phase (5 points).

Assessment and verification:

The applicant shall provide declare the quarry from which the material used to produce the EU Ecolabel natural stone tiles or slabs has been sourced, supported by delivery invoices.

Furthermore, a declaration from the quarry operator shall be provided together with documentation including maps or satellite images in which the QF_S, EDWA, BPDA and the authorized area are outlines and estimations of the surface area of each provided.

The quarry operator shall also declare a value for the QF_V value, which shall only count vertically exposed rock that has been cut and which is included in the same area as the QF_S. The estimation of QFV shall be supported by photographic evidence.

Any points shall be awarded in proportion to how closely the result reaches the minimum threshold value (e.g. quarry footprint ratio of 0.51 = 0 points, quarry impact ratio of 0.2 = 5 points).

TR v2.0 proposed criterion:-2.1.1. Quarry landscape impact ratio

Mandatory requirement

The applicant shall identify the quarry from which the dimension stone or ornamental stone blocks have been procured. The impact of the quarry on the landscape shall be evaluated according to the following metrics:

$$quarry\ footprint\ ratio = \frac{\boldsymbol{QF_S}\,(\boldsymbol{m^2}) + \boldsymbol{EWDA}\,(\boldsymbol{m^2}) + \boldsymbol{BPDA}(\boldsymbol{m^2})}{\boldsymbol{total\ authorized\ area}\,(\boldsymbol{m^2})}$$

Where:

- QFs is the active Quarry Front area.

- EWDA is the Extractive Waste Deposition Area, including the extractive waste facility.

- BPDA is the By-Products Deposition Area occupied for storage of materials that may, in principle, qualify as by-products/products.

- Authorized Area is the total surface area authorized in the permit for extraction activity.

$$Quarry\ beneficial\ land\ use\ ratio = \frac{\boldsymbol{BA}\,(\boldsymbol{m^2}) + \boldsymbol{REA}\,(\boldsymbol{m^2})}{\boldsymbol{total\ authorized\ area}\,(\boldsymbol{m^2})}$$

Where:

- BA is the Biodiverse Area; where (i) topsoil and vegetation cover or wetlands/engineered reed-beds have been established using native species as part of progressive rehabilitation and/or (ii) where topsoil and vegetation has simply not been disturbed in the first place and is not isolated in pockets within the quarry.

- REA is the Renewable Energy Area, where land has been occupied for the generation of electricity via solar, hydroelectric, wind or biomass energy.

- Authorized Area is the total surface area authorized in the permit for extraction activity.

All areas shall be estimated based on satellite imagery that is not older than 12 months prior to the date of application for or renewal of the EU Ecolabel license.

EU Ecolabel points

Points shall be awarded for applicants that can prove the following

- Quarry footprint ratio of less than 0.6 and as low as 0.2 (up to 10 points).
- Demonstrate that up to 40% of the quarry site has established vegetation cover (undisturbed or rehabilitated) or is being used for the generation of renewable energy (up to 20 points).

***Assessment and verification*:**

A declaration from the quarry operator shall be provided, together with documentation including maps or satellite images in which the QF_S, EDWA, BPDA, BA, REA and the authorized area are outlined, and estimations of the surface area of each provided.

In cases where the applicant is not the quarry operator, the applicant shall declare the quarry from which the material used to produce the EU Ecolabel natural stone tiles or slabs has been sourced, supported by delivery invoices and a relevant declaration from the quarry operator regarding the QF_S, EDWA, BPDA, BA, REA and the authorized surface areas.

Any points shall be awarded in proportion to how closely the result reaches the minimum threshold value (e.g. quarry footprint ratio of ≥0.60 = 0 points; quarry footprint ratio of ≤0.20 = 10 points) or the maximum threshold value (e.g. 0% of quarry site with established vegetation cover or being used for renewable energy generation = 0 points; ≥40% of quarry site with established vegetation cover or being used for renewable energy generation = 20 points), as appropriate.

Rationale:

What is the criterion trying to achieve?

Quarrying is an inherently invasive process that can endanger human health and uses processes that could harm the environment, creating particular potential risks to water, air, soil and fauna and flora and drastically affect the landscape both within the quarry and the surrounding area. The effects of this damage can continue for years after a quarry has closed, especially due to erosion processes and inhospitable habitats for flora and fauna. However, at the same time, the landscape alteration also creates opportunities for specific habitat creation or the generation of renewable energy.

The main purpose of this criterion is to recognise the efforts of quarries that:

- To stockpile extractive waste and by-products in such a way that occupies less land surface area;

- To encourage the use of extractive waste and by-products in the local area as road base and for the construction of access ramps and barriers;
- To indirectly encourage quarry operators to find markets for extractive waste and by-products off-site;
- To indirectly encourage more efficient extraction practices;
- Reward underground extraction activities, which avoid or drastically reduce impacts on flora and fauna at the ground surface;
- Reward progressive rehabilitation activities during the operational period in order to reduce the risk of erosion;
- Reward the use of potentially large areas of land for the generation of renewable energy in cases where climatic conditions and surrounding topography is adequate.

Different types of quarry

It is difficult to define a fixed ambition level for the quarry footprint ratio because there is a lack of published data regarding such metrics and the type of rock and strata ultimately defines the architecture of the quarry, which will have a major influence on these metrics. In general, marble, granite and massive limestone quarries have a high-step architecture, where the primary cut is approximately 8 metres high. Quarries for sandstone and slate, where smaller sized blocks are extracted, will have low-step architecture.

Ideally, an open cast quarry looks almost like an amphitheatre, where production can take place simultaneously on several levels. Some of the best planned quarries for large granite and marble deposits approximate this situation, with a high yield per area and volume of extracted rock. A "*good*" situation in an efficient quarry could be an annual production of 1000 – 2000 m^3 of commercial blocks per hectare. However, in many cases the deposits are narrow, inclined and/or occur beneath layers of non-exploitable rocks. A steeply inclined slate or marble deposit, for instance, causes a trench or well-shaped quarry layout, which have a lower productivity. The productivity is also depending on the internal structures of the rocks – e.g. cutting angles.

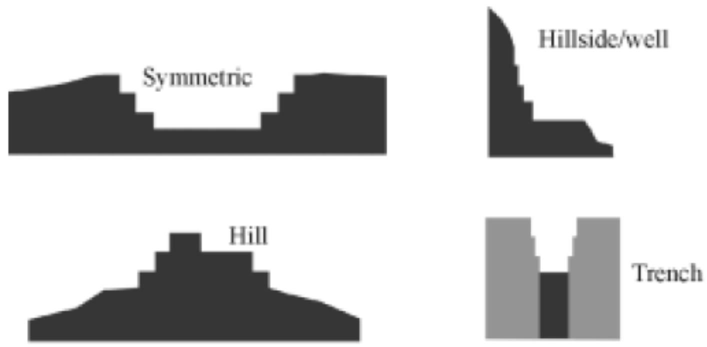

Figure 6. Different open quarries structures (Schematic view. Source: Arvantides et al)

In recent years, technological developments in quarrying equipment (particularly with chain saw and diamond wire cutting techniques) has made large scaled underground operations economically viable, especially for soft rocks such as marble. Underground quarrying has several advantages, of which less impact on the local surface environment is perhaps the most important one. The possibility of selective quarrying, leaving the poorest rock quality in pillars, is also important.

Furthermore, local morphological conditions (steep terrain) and the occurrence of overburden, also favours underground operations.

Generally, underground quarrying produces less waste-rock than open-cast quarrying. The disadvantages (or rather challenges) of underground operations mainly relate to their higher cost, especially in the early stage of opening. A good knowledge of site specific conditions (e.g. deposit type, deposit size, rock characteristics and quality) is even more crucial with underground extraction activities. In addition, stress monitoring of fractures and the stability of pillars and walls is of even greater importance for safe operation. Underground quarrying has proven to be economically viable only for soft rocks to date (e.g. marble, limestone and slate). Approximately 30% of the marble production in the Carrara Basin occurs, at present, underground. For granite and other hard rocks, the technology still needs improvement.

A rehabilitation/restoration plan is a mandatory requirement (see Criterion 1.2) but, as stated in the soon to be published BAT Reference Document on the management of waste from the extractive industries, if the progressive restoration is carried out during the operational phase adverse environmental effects are minimized. For example, if the extractive waste facility is progressively revegetated erosion is reduced. The same logic for mining waste also applies to extraction of ornamental or dimension stone.

For clarity, the definition of an Extractive Waste Facility, for the purposes of these proposed EU Ecolabel criteria, should be considered as the same as that provided in Directive 2006/21/EC, which states:

"'waste facility' means any area designated for the accumulation or deposit of extractive waste, whether in a solid or liquid state or in solution or suspension, for the following time-periods:

—no time-period for Category A waste facilities and facilities for waste characterised as hazardous in the waste management plan;

—a period of more than six months for facilities for hazardous waste generated unexpectedly;

—a period of more than one year for facilities for non-hazardous non-inert waste;

—a period of more than three years for facilities for unpolluted soil, non-hazardous prospecting waste, waste resulting from the extraction, treatment and storage of peat and inert waste.

Such facilities are deemed to include any dam or other structure serving to contain, retain, confine or otherwise support such a facility, and also to include, but not be limited to, heaps and ponds, but excluding excavation voids into which waste is replaced, after extraction of the mineral, for rehabilitation and construction purposes;"

The criterion is established in such a way that a responsible use of the land, regardless of the nature of the material or the typology of the quarry, is rewarded. No minimum level is set but all beneficial use of quarry land is rewarded with points and any reduction of the quarry footprint ration below 60% is rewarded. A greater weight is given the beneficial quarry land use since this is associated with greater direct environmental benefits than simply not having such large extractive waste and by-product deposition areas.

Outcomes from and after the 1st AHWG meeting:

It was requested that the optional requirement "*Progressive rehabilitation activities during operational phase*" should be made mandatory and a list of examples of good practice be provided (specifically mentioned were wastewater treatment areas based on biological processes and the establishment of biodiversity areas that contain local species of trees, herbs and animals.

However, it is important to recognise that progressive rehabilitation activities cannot always be carried out to the same extent on different quarries, it will depend on the type of quarry, the work-plan for extraction, surrounding topography, local microclimate and soil type. Therefore, the TR v2.0 proposal rewards progressive rehabilitation without making it mandatory and also rewards the non-disturbance of surface land in the first place at the dimension stone quarry site.

Further research:

What do other schemes say about visual impact and quarry footprint ratios?

The Fair Stone international standard for the natural stone industry (4th edition, 2010) does not set any specific requirements for the quarry footprint ratio during operation but have the following relevant general criteria:

"25.2. The company initiates rehabilitation of abandoned quarry areas as soon as possible.

25.3. The company protects the topsoil and subsoil. Soil resources need to be protected from erosion and either reused on restoration areas as soon as possible or stored for a transitional period to avoid damage or loss.

25.5. The company implements and carries out production policies that prevent and/or mitigate negative impacts on neighbourhood, flora and fauna."

The 2018 draft version of hard surfacing criteria set by Good Environmental Choice Australia (GECA) state the following;

"3.1.8. Visual Impact. Criterion 11: Where the mine or quarry is located within 5 km of a Populated Area, the visual impact of the operation must not exceed 30 as defined in Appendix 3 of this standard.

APPENDIX 3 – CALCULATION OF THE VISUAL IMPACT.

The calculation of the Visual Impact of Mines and Quarries for the purpose of this standard is based on the calculation described in the Technical Appendix A1.9 of the EU Commission Decision 2002/272/EC.

The calculation of visual impact lies in tracing cross sections passing through the quarry front and other external "visual points", which are important to determine the visual impact (for example either from nearby towns or from frequented places or major roads, etc.). The calculation of the final score, measured as a percentage, shall be taken from the highest value of originally calculated values (worst case situation). A short explanation for the finally chosen "visual point" should be submitted to the Competent Body. From each visual point (P), the "bottom radius" is traced, tangent to the topographic surface and intercepting the lowest point of the "visible quarry area". The visible quarry area is regarded as the area where the excavation is carried out or where there is an active dump. Already rehabilitated areas (both in front area and dumps) need not be considered. From the same visual point a second radius (called "top radius") is traced, intercepting the highest point of the quarry front. The top radius and bottom radius allow the identification on the section of the quarry of the limits of the height of the visible front (the vertical distance from top to bottom radius matching the front). The calculation could be made on the basis of the quarry project. These geometric data are put into the following formula and the result is the quotient of visual impact of the quarry affecting a specific visual point.

$$x\,(\%) = \frac{h^2}{(L\ x\ tan30°)^2}\ x\ 100\%$$

h = vertical height of front visible from visual point P (metres); L = horizontal distance between the worst visual point P and the front tan30° = tangent of the average angle of the human eye vision cone; x% = Percent of visual impact

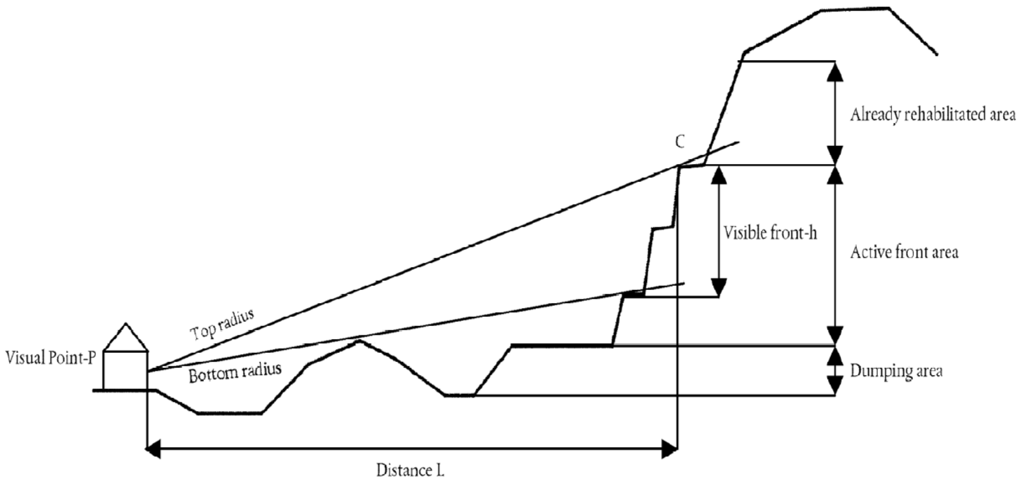

Figure 7. Graphical definition of the visual impact indicator in Decision 2002/272/EC and GECA criteria.

The Natural Stone Council (NSC) standard 373 – sustainability assessment for natural dimension stone, does not have any mandatory or optional criteria that address the aspect of quarry footprint ratio or visual impact.

The GECA criterion shows a very similar approach to visual impact indicator that was published in 2002 for the EU Ecolabel criteria for hard coverings.

One potential criticism of the visual impact approach mentioned above is the fact that the result is very much dependent on the choice of viewing point. Dentoni and Massacci (2012) concluded that the above approach to visual impact does not capture the impacts in terms of the breadth of the quarry altered landscape or the chromatic contrast between the quarry and the surrounding area. Other authors have also highlighted the importance of the chromatic difference between the quarry site and the surrounding area (Pinto et al., 2002; Bishop, 2003; Degan et al., 2014).

In the 2009 EU Ecolabel criteria, the quarry impact ratio aimed to look at the area affected by the quarry front and the "*active dump*" as a function of the total quarry area. The current approach is similar to the 2009 criteria but now makes it clearer how this should be calculated (i.e. from a satellite view). This way underground extraction of dimension stone is clearly favored as is any underground or compact storage of by-products and extraction waste.

A closer look at progressive rehabilitation options in quarries

The term rehabilitation encompasses any measures taken to repair disturbed or degraded land and return it to a stable and nonpolluting state; suited to the proposed future use of the land. Progressive rehabilitation refers to the rehabilitation of worked out, or surplus areas in a quarry while extractive operations continue at the same site. It helps to minimise the visual impact of a quarry and control dust, erosion, and the invasion of weeds. It also assists in fostering good community relations.

Rehabilitation works may be considerably more efficient if carried out while the necessary machinery is onsite and operating, rather than having machinery transported back to a site. As new quarry sections are opened, worked out areas could be progressively rehabilitated to avoid increasing the total disturbed area of a quarry. Overburden and topsoil can be stripped from areas being opened up and placed directly onto worked out areas which are being rehabilitated. This will avoid double handling of materials and prevent degradation of the topsoil

Unless preventative measures are implemented, erosion will continue long after extractive activities have ceased. Poor drainage can damage rehabilitation work. The best erosion prevention at a site is the establishment of vegetation on a stable landform. However, while vegetation is becoming established, it may be necessary to employ other erosion prevention techniques.

Recommended practices include:

- To slow down surface runoff retain drainage controls, like diversion drains, contour banks and rock filters upslope of the area being rehabilitated.
- Leave surfaces in a rough or uneven state. Rough surfaces will capture more water and allow rainfall to infiltrate rather than flow away. It may be beneficial to retain any sediment ponds onsite with the owner's consent. However, ponds will need to be periodically cleaned out for the first year or so.
- Apply surface mulches around growing seedlings on steep batters to reduce erosion, weed establishment and to conserve soil moisture and add nutrients to the soil.

Revegetation (i.e. establishing a self-sustaining cover of vegetation) is the best way to stabilise disturbed sites in the long term. Revegetation also minimises the visual impact of quarries. Generally, the vegetation type which existed before the disturbance, or a similar vegetation type will regenerate most successfully.

A closer look at the quarry footprint ratio

The proposal in TR 2.0 is based on how the quarry site is distributed as perceived from a satellite view. The exact outline of the quarry site boundary would need to match any operating permits issued by public authorities. Within the site boundary, it would then be up to the applicant (or quarry operator, if different) to indicate which areas on the site are being used for active quarry fronts (QF), by-product deposition areas (BPDA) and extractive waste deposition areas (EWDA). An example of how this could be split up is shown below.

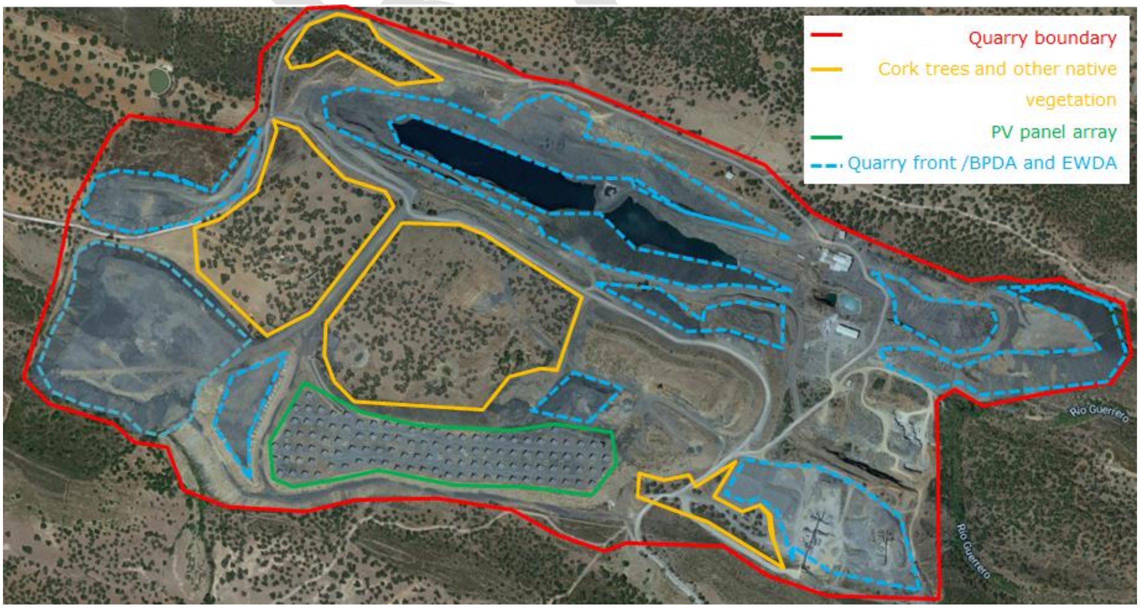

Figure 8. Overview of opencast slate and granite quarry in Spain.

The above site (site quarry boundary is a speculative estimate only) shows that the quarry footprint ratio would be calculated by dividing the total area within the dashed blue shapes by the total area within the red shape.

It is also interesting to note that this particular site has significant areas with established vegetation cover and even a photovoltaic panel array. The quarry footprint ratio could be used not only to limit the areas occupied by extractive waste and by-products but also to reward the beneficial use of unused land onsite (e.g. vegetation cover and renewable energy generation). It is also worth noting that roads, access ramps and areas for the circulation of heavy machinery are not counted as occupied areas, so the use of extractive waste as road base would be promoted by this criterion.

2.1.2 – Material efficiency

Existing criterion quality management and environmental management practices

1. Raw material extraction

1.1. Extraction management (for natural products only)

General requirements

The raw material extraction management for natural stones shall be 'scored' according to a matrix of six main indicators.

The total score shall be based on the sum of individual scores given for each indicator, multiplied by a corrective weighting (W). Quarries must obtain a weighted score of at least 19 points to be eligible for the eco-label award. In addition, the score for each indicator must be higher or lower than the threshold specified, as appropriate.

Here only copy of the relevant part

Matrix for scoring raw material extraction management for natural stones

Indicator	Notes	Score				
		5 (excellent)	3 (good)	1 (sufficient)	Threshold	Relative weights
I.3. Natural resource waste	$\frac{m3\ usable\ material}{m3\ extracted\ material}$ [%]	>50	50-35	34-25	<25	-

TR v1.0 proposed criterion:-2.1.2. Material efficiency

<u>Mandatory requirement</u>

The quarry operator shall, for the most recent calendar year provide data relating to the extraction activities and provide the following information:

- **A:** Total quantity of material extracted (m^3).
- **B:** Yield of saleable blocks sold (m^3).
- **C:** Total quantity of extractive waste and materials that qualify as by-products (i.e. irregular blocks, stones and fine fraction) that is sold or used internally for useful purposes by replacing other materials which otherwise would have been used to fulfil that particular function (m^3).
- **D:** Total quantity of extractive waste and materials that qualify as by-products (i.e.

irregular blocks, stones and fine fraction) that is stored from excavation that are stored or deposited onsite (m^3).

In cases were data is available in tonnes, it should be converted to m^3 using a fixed bulk density factor for the rock material being extracted.

a) Extraction efficiency ratio

Mandatory requirement

The minimum extraction efficiency ratio that must be achieved is 0.25, calculated as:

$$extraction\ efficency\ ratio = \frac{\boldsymbol{B}}{\mathbf{A}}$$

EU Ecolabel points

Points shall be awarded for applicants that can demonstrate a higher extraction ratio up to best practice target of 0.50. (Up to 10 points).

b) Useful by-product/waste ratio

No minimum ratio is set. The ratio shall be calculated as:

$$Useful\ by - product/waste\ ratio = \frac{\boldsymbol{C}}{\mathbf{C} + \mathbf{D}}$$

EU Ecolabel points

Points shall be awarded for applicants that can demonstrate a higher useful by-product/waste ratio up to a best practice target of 0.60. (Up to 10 points).

Assessment and verification:

The applicant shall provide a declaration of compliance with the mandatory requirements of this criterion, supported by a declaration from the quarry operator. The quarry operator should provide values of A, B, C and D, expressed in m , to allow the calculation of the extraction efficiency ratio and useful by-product/waste ratio. For calculation purposes, it should be assumed that A-B = C+D. For any material calculated under C that was sold, invoices of the material delivery to the other sites shall be provided.

a) Points shall be awarded in proportion to how closely the data reaches the maximum value (e.g. extraction efficiency ratio of 0.25 = 0 points and of 0.50 = 10 points).

b) Points shall be awarded in proportion to how closely the data reaches the maximum value (e.g. secondary material reuse ratio of 0.00 = 0 points and 0.60 = 10 points).

TR v2.0 proposed criterion:-2.1.2. Material efficiency

Mandatory requirement

The quarry operator shall, for the most recent calendar year or rolling 12 month period, provide data relating to the extraction activities and provide the following information:

- **A:** Total quantity of material extracted (m^3).
- **B:** Yield of saleable blocks sold and/or, in cases of integrated production, transferred to the transformation plant (m^3).
- **C:** Total quantity of extractive waste and materials from the quarry that qualify as by-products (i.e. irregular blocks, stones and fine fraction) that is sold or used internally for useful purposes by replacing other materials which otherwise would

have been used to fulfil that particular function (m^3).

- **D:** Total quantity of extractive waste transferred to the extractive waste deposition area or landfill and materials from the quarry that qualify as by-products stored in the by-products deposition area that is stored or deposited onsite (m^3).

In cases where data is available in tonnes, it should be converted to m^3 using a fixed bulk density factor for the rock material being extracted.

a) Extraction efficiency ratio

With the exception of slate, the extraction efficiency ratio shall be at least 0.25, and in all cases shall be calculated as follows:

$$extraction\ efficency\ ratio = \frac{\boldsymbol{B}}{\mathbf{A}}$$

EU Ecolabel points

Points shall be awarded for applicants that can demonstrate a higher extraction ratio up to an environmental excellence threshold of 0.50. (Up to 20 points).

b) Useful by-product ratio

The useful by-product ratio shall be calculated as:

$$Useful\ by-product\ ratio = \frac{\boldsymbol{C}}{\mathbf{C+D}}$$

EU Ecolabel points

Points shall be awarded for applicants that can demonstrate a higher useful by-product ratio up to a best practice target of 0.60. (Up to 10 points).

Assessment and verification:

A declaration from the quarry operator shall be provided that states the values of A, B, C and D, expressed in m^3 and calculating extraction efficiency ratio and useful by-product ratio.

In cases where the applicant is not the quarry operator, the applicant shall declare the quarry from which the material used to produce the EU Ecolabel natural stone tiles or slabs has been sourced, supported by delivery invoices and a relevant declaration from the quarry operator regarding values A, B, C and D.

For calculation purposes, it should be assumed that A-B = C+D. For any material calculated under C that was sold, invoices of the material delivery to the other sites shall be provided.

a) Points shall be awarded in proportion to how closely the data reaches the maximum value (e.g. extraction efficiency ratio of 0.00 = 0 points and of 0.50 = 20 points).

b) Points shall be awarded in proportion to how closely the data reaches the maximum value (e.g. useful by-product ratio of 0.00 = 0 points and 0.60 = 10 points).

Rationale:

The extraction efficiency is arguably the most important indicator relating to a quarry for ornamental stone or dimension stone. From a life cycle perspective, the functional unit will undoubtedly be the tonnes or m^3 output of saleable blocks. A better extraction efficiency implies a reduced production of by-products and extractive waste, meaning that less area of the quarry will be taken up by these materials, thus improving the quarry footprint ratio.

From an economical perspective, the value of saleable blocks dominates the quarry output. Marble from the Carrara region, which can be considered to be at the top end of the market, can be worth over 1600 €/m^3 while irregular blocks are not generally economical to transport (7€/m^3) and extractive waste has no significant market value at all. With Gneiss rock, regular blocks may command prices of around 265 €/m^3, and similar values for irregular blocks and extractive waste as for marble (Bianco, 2018).

There is generally no economic incentive for quarry operators to find some useful application for extractive waste or by-products beyond their site. The mass deposition of these materials onsite will have a negative effect on the quarry footprint ratio but the use of these materials onsite for a "*useful purpose*" can deliver the twin environmental benefits of reducing land occupation of by-product or extractive waste material and avoiding the need for other materials to achieve that particular "*useful purpose*".

Some examples of useful purposes may include the construction of access ramps or road bases for the access of vehicles and heavy machinery to certain parts of the quarry, the construction of berms for the onsite storage of fine extraction waste to reduce the possibility of fine material being blown off-site of the construction of safety barriers for road edges. However, it would not be considered acceptable for a quarry operator to pile the by-product or extractive waste in a heap and claim that this heap is somehow providing a useful purpose.

Due to the difficulties of finding external markets and demand for by-products and extractive waste for ornamental and dimension stone quarries, no minimum requirement is set for the useful/by-product/waste ratio but any acceptable internal use or external sale is still encouraged via the awarding of points.

Outcomes from and after the 1st AHWG meeting:

No stakeholders offered any comments on this criterion during the 1st AHWG meeting or during the submission period for written comments. During one site visit to a slate quarry, it was explained that the extraction efficiency was very low (1-3%) because the purity demands from consumers for slate roof tiles were very high. The slightest visible spot of pyrite impurities on the tile would lead to it being rejected. However, there is a significant demand for crushed slate aggregate for landscaping purposes that helps compensate for the poor extraction efficiency.

To account for these situations, it was decided that no minimum should be set for extraction efficiency to account for similar cases at different quarries. The number of points associated with the extraction efficiency criterion has been increased in order to better highlight its importance from an environmental perspective.

In any case, it is clear that the quarry operator has a vested economical interest to maximize the extraction efficiency of dimension stone as it will always have a higher intrinsic value than crushed aggregate.

Further research and main changes from TR v.1.0 to v2.0

According to the European Environment Agency (EEA, 2016), around 4-5% of average domestic material consumption in the EU28 is due to the direct or indirect consumption of marble, granite and sandstone. However, none of the national material efficiency programmes aimed to improve the extraction efficiency or by-product reuse efficiency associated with dimension stone production.

A closer look at quarry extraction efficiency

Although extraction efficiency will also be affected by the characteristics of each site (e.g. level of overburden, fissures etc.), it is worth mentioning here the different techniques that can be applied to the extraction of dimension stone at the quarry and their potential effect on extraction efficiency.

Table 6. Comparison of waste production by different extraction methods (Esmailzadeh et al., 2018).

Method	Relative waste generation	Brief description of technique
Plug and feather	High	Holes are bored at regular intervals along the area to be cut. Deeper holes that are closer together improve the ease of extraction. Two metal plugs are placed in the holes and struck via a metal "feather" (a long pole that pushes in-between the plugs) using a sledgehammer or hydraulic hammer, causing expansion and crack propagation from the borehole.
Blasting	High	Holes are bored in the vertical and horizontal axis and explosive charges are placed inside. Care needs to be taken to use the minimum amount of explosive necessary and for forces to act in the desired direction in order to minimise damage to the neighbouring rock.
Expanding materials	Low-medium	Holes are bored along the area to be cut and filled with a material that will hydrate upon reaction with water to create an expansive force (much better control offered than blasting).
Diamond cutting wire	Seldom	A diamond wire is looped through horizontal and vertical holes that coincide. The cutting action is controlled by a drive that pulls the wire in the vertical and horizontal axis. The wire needs to be cooled by water.

Significant differences exist for soft rock extraction (such as marble) depending on the extraction technique used. Dambov et al., (2013) reporting that marble extraction efficiency in Macedonia varied according to the technique used as follows:

- 0 to 2.5% for extraction by drilling, blasting and cutting
- 2.5 to 10% for extraction by cutting with a diamond wire saw and cutting machine
- 10 to 40% for extraction with a cutting machine
- >40% for cutting machines "in city".

When rock is suitably soft, it is clear that the diamond wire cutting technique is most efficient. Placing a minimum requirement on extraction efficiency of dimension stone ensures that certain extraction techniques cannot be used.

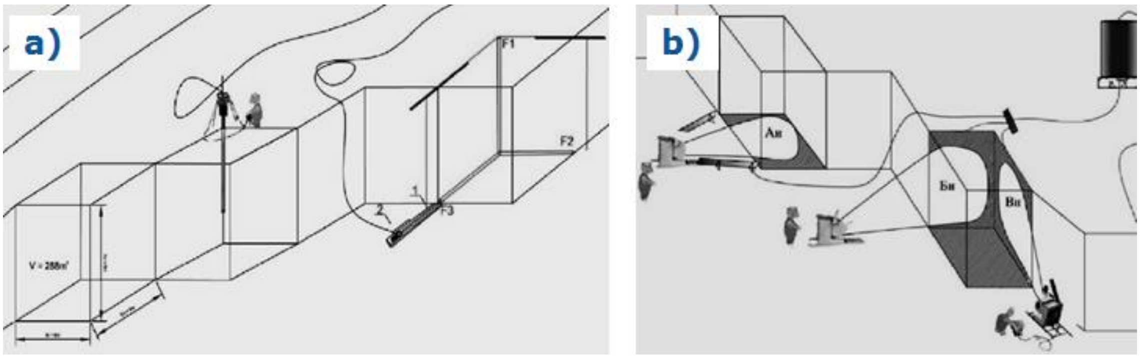

Figure 9. Illustration of diamond wire cutting a) drilling horizontal and vertical holes for wire loop placement, b) diamond wire loops cutting in action (Dambov et al., 2013).

According to Bianco (2018), the following techniques can be applied to the cutting of hard (H) and soft (S) rocks.

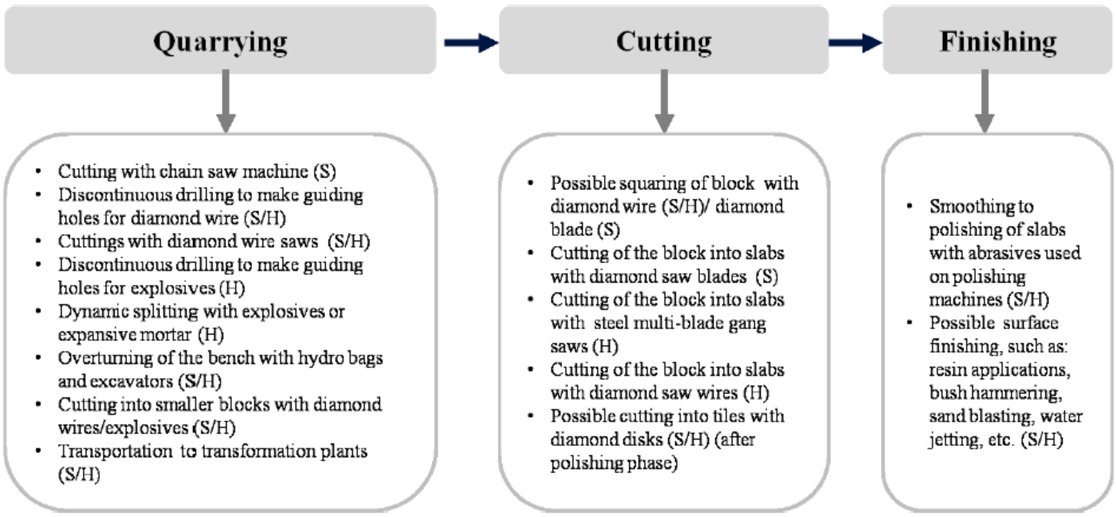

Figure 10. Different cutting technologies applied for natural stone extraction from the quarry (left hand side). Source: Bianco, 2018.

Many cutting techniques can be applied to either hard or soft rocks although chain saw cutting can only be used on soft rocks (e.g. marble) and the use of explosives and dynamic splitting (with explosives or expansive mortars) is only used with hard rocks (e.g. granite).

A closer look at quarry waste reuse potential

The reuse of extractive waste generated in dimension stone quarries has historically been poor and continues to leave much room for improvement today. Dino et al., (2017) estimate that 3.0 million m^3 of waste are generated each year in the Carrara basin but only 0.5 million m^3 is actually sold and/or converted in secondary raw materials, despite the fact that the waste is high purity $CaCO_3$ with potential reuse in the asphalt, paper, paint, plastic and rubber sectors.

Marras et al., (2010) showed that marble fines from filter press sludge after quarry and transformation plant wastewater treatment was fine for use up to 10% of total raw material mass in the firing of clay bricks. Medina et al., (2017) showed that granite sludge could be used as a supplementary cementitious material, substituting 10 or 20% of the cement clinker content while still meeting the relevant technical requirements for Type II/A and Type IV/A cements despite potential concern about the relatively high alkali (Na and K) content in the sludge and the inconclusive results about whether the sludge exhibited pozzolanic activity or not.

In a comprehensive review of the potential reuse of dimension stone waste in concrete, Rana et al., (2016) concluded that the reuse potential was highest for the substitution of coarse aggregates (100%), then fine aggregates (5 to 100% depending on the type of waste) and then cement replacement (up to 20% for quarry dust).

2.1.3 – Water and wastewater management

Existing criterion water efficiency

1. Raw material extraction

1.1. Extraction management (for natural products only)

General requirements

The raw material extraction management for natural stones shall be 'scored' according to a matrix of six main indicators.

The total score shall be based on the sum of individual scores given for each indicator, multiplied by a corrective weighting (W). Quarries must obtain a weighted score of at least 19 points to be eligible for the eco-label award. In addition, the score for each indicator must be higher or lower than the threshold specified, as appropriate.

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Matrix for scoring raw material extraction management for natural stones

Indicator	Notes	Score				
		5 (excellent)	3 (good)	1 (sufficient)	Threshold	Relative weights
I.1 Water recycling ratio	$\frac{Waste\ Water\ Recycled}{TotalWater\ Leaving\ the\ Process} * 100$ See Technical appendix - A3	<80	80-70	69-65	<65	W3 (*)

(*) W3 (weightings: 0,5) — If the quarry interferes with surface water bodies (average flow < 5 m 3 /s) there is a weight of 0,5 on both the indicators about water recycling ratio (I.1) and water quality (I.5).

<u>Assessment and verification</u>: the applicant shall provide appropriate documentation to show whether or not there is any interference between the quarry and the surface water body.

<u>Assessment and verification:</u>

The applicant shall provide the calculation of their total 'score' (weighted accordingly), and related data for each of the six indicators (showing, amongst others, that each score is above the minimum score, if one is given) according to the matrix overleaf and to the associated instructions in the Technical appendix — A3. The applicant shall also provide appropriate documentation and/or declarations that prove compliance with all of the abovementioned criteria.

A 3: Water recycling ratio

The calculation of the water recycling ratio shall be consistent with the following formula based on the flows highlighted in Figure A1.

$$Recycling\ ratio = \frac{Waste\ Water\ Recycled}{Total\ Water\ Leaving\ the\ Process} * 100 = \frac{R}{W1} * 100$$

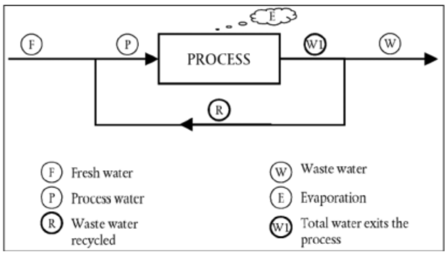

Figure A1: Water flow scheme that shall be used to calculate water recycling ratio (1)

For waste water is meant only the water used in processing plants, not comprehensive of the fresh water coming from rain and subsoil water.

TR v1.0 proposed criterion:-2.1.3. Water and wastewater management

Mandatory requirement

Note: This requirement only applies in cases where wet stone cutting techniques are used in the extraction phase.

The applicant shall provide a description of water use in quarrying operations including strategies and methods for recirculation and reuse of water. The following conditions shall be met:

- Water used by the cutting equipment shall be stored in an impermeable container (for example a tank, lined pond or an excavated pond set in impermeable rock).
- The site shall make provisions for the opportune collection of water run-off to compensate for water lost in wet sludge and evaporation.
- The site shall make provisions for the diversion of water run-off via a drainage network to prevent the surface flow of rainwater across the working area carrying suspended solid loads into the impermeable container which supplies water to the cutting equipment.
- The separation of solids from cutting wastewater shall be achieved by sedimentation systems, retention basins, cyclone separators inclined plate clarifiers, filter presses or any combination thereof. Clarified water shall be returned to the impermeable container which supplies the cutting equipment.
- Settled sludge shall be dewatered prior to: internal use for useful purposes, external use for useful purposes or transport offsite to a suitable waste disposal facility.

EU Ecolabel points

The non-use of organic flocculants in the solids separation process or the use of readily biodegradable organic flocculants (5 points).

Assessment and verification:

The applicant shall provide a declaration of compliance with this criterion, supported by a declaration from the quarry operator and relevant documentation. The documentation should include details of the water management system, sludge separation and sludge disposal operations and destinations.

TR v2.0 proposed criterion:-2.1.3. Water and wastewater management

Mandatory requirement

The applicant shall provide a description of water use in quarrying operations including strategies and methods for collection, recirculation and reuse of water.

In general:

- The site shall make provisions for the opportune collection of storm water run-off to compensate for water lost in wet sludge and evaporation.
- The site shall make provisions for the diversion of storm water run-off via a drainage network to prevent the surface flow of rainwater across the working area carrying suspended solid loads into the impermeable ponds which supplies water to the cutting equipment or into natural watercourses.

In cases where wet cutting techniques are used:

- Water for use by wet cutting equipment shall be stored in an impermeable container (for example a tank, lined pond or an excavated pond set in impermeable rock).
- The separation of solids from cutting wastewater shall be achieved by sedimentation systems, retention basins, cyclone separators inclined plate clarifiers, filter presses or any combination thereof. Clarified water shall be returned to the impermeable pond or container which supplies the cutting equipment.
- Settled sludge shall be dewatered prior to: internal use for useful purposes, external use for useful purposes or transport offsite to a suitable waste disposal facility.

Assessment and verification:

The quarry operator shall provide a declaration of compliance with this criterion, supported by relevant documentation describing how water is used onsite and providing details of the water management system, sludge separation and sludge disposal operations and destinations.

In cases where the applicant is not the quarry operator, the applicant shall declare the quarry from which the material used to produce the EU Ecolabel natural stone tiles or slabs has been sourced, supported by delivery invoices and a relevant declaration from the quarry operator regarding water use and the water management system at the quarry site.

Rationale:

Water is used to dissipate the heat produced by the stone cutting process. It is still the most economical method so long as water supply is not an issue (i.e. not in arid climates and in high-altitude quarry sites).

Why no longer any requirement for water recycling ratio proposed?

During discussions with experts, it was revealed that the reuse of water for stone cutting in the extraction phase was the norm and that, as a general rule, all of the settled water was reused, which would mean a recycling ratio of 100%. The only losses from the system were due to possible seepage into the ground via cracks in basins or ponds, via evaporation and via wet sludge.

By requiring that all supernatant water after solids separation is returned to the container which supplies water to the cutting equipment, a recycling ratio of 100% is essentially being requested.

Why the specific general requirements?

The general requirements apply to all quarries, whether they use dry cutting or wet cutting techniques. In both cases, water is needed (e.g. for dust suppression in dry techniques, for actual cutting in wet techniques).

It is important to specify that the water container is impermeable. The main justification is that no matter how well wastewater is recycled or recirculated, the specific consumption rate of water can increase significantly due to losses via infiltration from the container or basin to the surrounding ground area.

Secondly, it is important to make the optimum use of water run-off so that it can top up the container to compensate for evaporative losses and water lost as moisture content in removed sludge. However, uncontrolled inflow of water run-off must be avoided because this could result in significant suspended solid loads being carried into the water that supplies the cutting equipment or into natural watercourses.

About wastewater treatment

Another important aspect is to require some minimum treatment of the wastewater from cutting equipment before it is returned – otherwise the solids load and other pollutants will just gradually build up if water is to be recirculated.

Methods for the recirculation and reuse not only lessen the environmental impacts of production but also lead to cost savings. According to the Natural Stone Council (NSC, 2011) solids separation (i.e. primary water treatment) and reuse of clarified water at the quarry or processing facility can be accomplished by a number of ways: filter presses, cyclone separators, sedimentation systems, retention basins, and combinations of these systems.

The selection of the most appropriate option depends on several factors such as, site topography, local climate, water demand, available footprint as well as water and solid loading rates to be processed. Quarries with high water demand use settlement ponds to supply the needed water as well as to provide a sufficient storage area for effluent. If space is limited or other obstacles exist, filter presses, inclined plate clarifiers, or cyclone separators (hydrocyclones) may be the best option for filtration followed by storage in a tank or basin. These machines utilize a much smaller footprint than a series of ponds or basins and avoid the need for excavation as they are installed on the ground surface.

The use/non-use of flocculants

The suspended solids in wastewater from stone cutting operations generally have the same surface charge, which reduces the possibility of them colliding and sticking together. Since sedimentation rates are a function of particle size, the use of flocculants can greatly accelerate sedimentation processes by providing opposite surface charges which attract suspended solids into larger agglomerations.

There are two main types of flocculants: inorganic and organic. The inorganic type is typically alum ($Al_2(SO_4)_3$) or ferric ($FeCl_3$) and they react in water in normal pH ranges to precipitate as $Al(OH)_3$ and $Fe(OH)_3$ respectively. The new solids and their surface charges can, when dosed optimally, optimise the solids settling rate. The organic flocculants are typically based on polyamide polyelectrolytes that are available with cationic and/or anionic surface groups.

During site visits it was not possible to establish what flocculants were being used but operators were complaining about the stickiness imparted to the sludge in cases were the sludge was being used as a filler/binder of loose aggregates for site roads. While this property was potentially useful for reducing dust emission from vehicle movements when dry, it was problematic when a sticky, cohesive mass is formed when wet, affecting vehicle traction.

In conclusion, the use of inorganic flocculants significantly increases the quantity of sludge. With organic flocculants, it is recommended to only use those organic flocculants that are readily biodegradable, to minimise the possible deterioration of nearby surface water, which follows the same logic as BAT Conclusion 42(e) of the

BAT Reference Document for the management of waste from the extractive industries.

Outcomes from and after the 1st AHWG meeting

No discussion about this criterion took place in the meeting. In later discussions during site visits to quarries, it was evident that all quarries using wet cutting techniques had some form of water recirculation in place although the collection and storage basins where generally very rudimentary in their design, often simply using natural depressions in the ground to collect and store the water.

Depending on the surrounding topography, there could be a zero risk or a high risk of suspended solids carryover into natural watercourses. In all sites, there will be a significant risk of suspended solids carryover into the site basin.

Further research:

No particularly insightful articles or web sites were found that offered more specific details of the water cycle during the wet cutting of dimension stone blocks at the quarry. Any stakeholder input on this area would be most welcome.

One example of the water cycle during wet cutting of marble in the Carrara region is shown below.

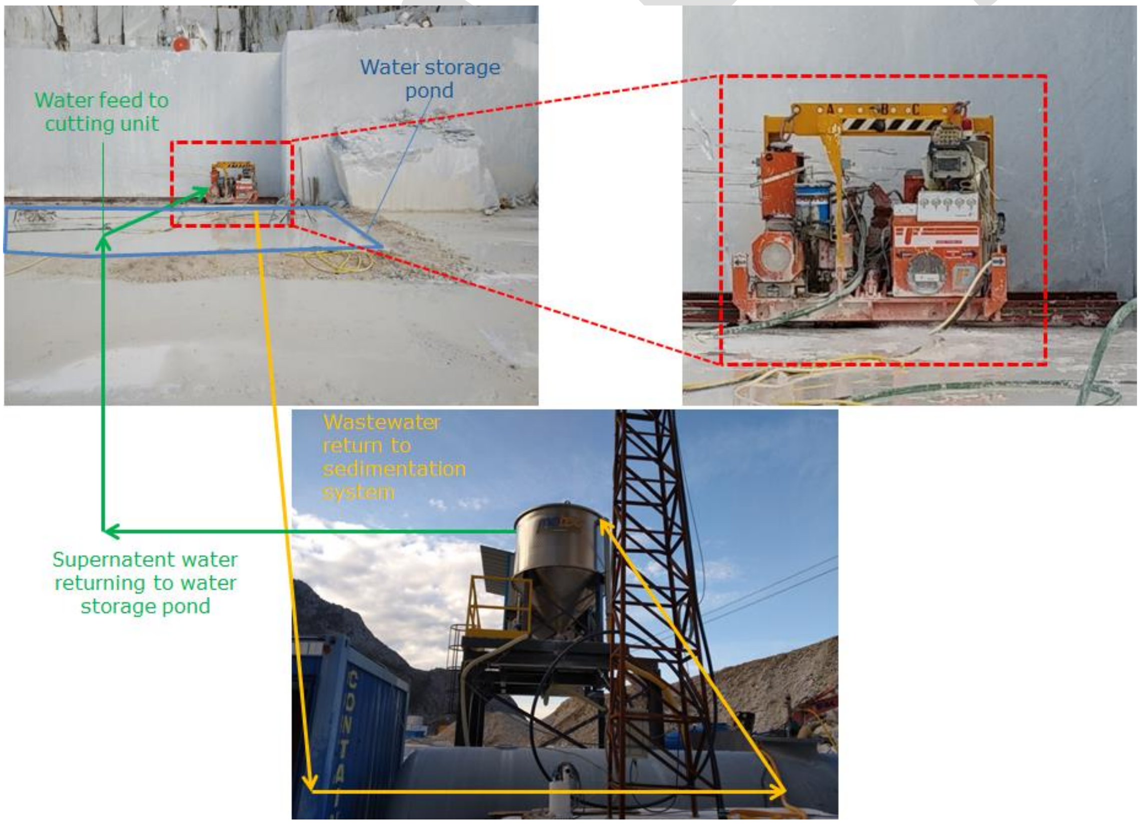

Figure 11. Example of water recirculation system at a marble quarry.

What do other schemes say?

The Fair Stone international standard for the natural stone industry (4th edition, 2010) sets the following requirements for water:

"25.4. The company protects ground water and surface water and avoids any contamination during quarry operation or after-use.

27.1. A study on how to save water and other consumables, and how to recycle waste water must be undertaken and documented.

27.2. The company must take appropriate measures to ensure economical use of electrical energy and water. All staff must know how to save energy and water.

27.3. The company uses quarrying and production methods that minimize water consumption."

The 2018 draft version of hard surfacing criteria set by Good Environmental Choice Australia (GECA) state the following;

"3.1.1. Water Resource Use. Criterion 4: The quarry or mine pit must not interfere with a confined aquifer. Water may be drawn from confined aquifers provided that the bore is sealed and the flow rate is measured. Bore use must not be continued if the flow rate decreases by greater than 20 % of the initial rate, averaged over a five year period (or in case records are not dated as far back, a shorter period may be sufficient to calculate the initial flowrate). If a flow rate measurement followed by a consecutive measurement shows a flow rate below 80% of the initial flow rate; bore use shall be discontinued. Test pumping to monitor flow rates may be carried out to establish whether the rate improves again in which case the bore may be reopened.

Surface water must not be used if the water body is located within, or is directly connected to a:

- National Park,
- Drinking water catchment area,
- Ramsar Wetland
- Area identified by the EPBC Act as containing threatened species or ecological communities.

For areas outside Australia, reference to national classification frameworks comparable to the EPBC Act must be provided.

Quarrying and mining operations must be able to demonstrate procedures or measures to minimise the impact of water use. This may include, but is not limited to, water recycling, rainwater collection and settling ponds.

Water released off-site directly from quarrying and mining operations must not exceed 5 L/m3 of extracted material. This limit does not include natural runoff from the site during rain events or water consumed in closed loop recycling systems. Suppliers are requested to obtain and provide data on water release from the main quarrying operation for the purpose of refining this criterion in future versions of the standard."

3.1.6. Water Emissions: criterion 9: Suspended solids in effluent water must shall be less than 30 mg/L, where the operation discharges to surface waters that interact with a:

- National Park
- Drinking water catchment area
- Ramsar Wetland
- Area identified by the EPBC Act as containing threatened species or ecological communities. For such areas, suspended solids in effluent water shall not exceed 40 mg/L.

The test method must be in line with ISO 5667-17 or equivalent."

The Natural Stone Council (NSC) standard 373 – sustainability assessment for natural dimension stone, has two mandatory requirements and four optional requirements relating to water and wastewater:

- **5.1. Water inventory (mandatory):** The facility operator shall develop and maintain an annual inventory of water use including the quantity of water used on an annual basis, organized by water source (e.g., municipal potable, direct rainwater captured for reuse, on-site wells, or reclaimed grey water. Water used as a result of both manufacturing and non-manufacturing operations shall be included.

- **5.2.1. Recycled water (mandatory):** A minimum of 25% of the water accounted for in the inventory for fabrication or quarry operations shall be captured and recycled.
- **5.2.2. Recycled water (optional):** minimum of a) 26% to 90% of the water accounted for in the inventory for processing or quarry operations are captured and recycled. (1 point); or b) More than 90% of the water accounted for in the inventory for processing or quarry operations is captured and recycled. (2 points total)
- **5.3.1. Enhanced water treatment (optional):** Demonstrate on-site systems that result in enhanced treatment of discharge water. Enhanced treatment shall be demonstrated by one of the following: a) Management of wastewater on-site resulting in no direct discharge of water (e.g., seepage ponds) (1 point); or b) Quality of discharged water, either to POTW or directly to the environment, is demonstrated to meet State drinking water standards (1 point); or c) Where no permits or regulations are applicable, the facility operators demonstrate that the quality of water discharged to the environment from their facility meets the US EPA's NPDES (National Pollutant Discharge Elimination System) requirements. (1 point). Facility Operators that do not utilize water in their manufacturing operations shall qualify for 1 point under this criterion.
- **5.3.2. Enhanced sludge treatment (optional):** The facility operator shall demonstrate operation of a sludge management system that diverts a minimum of 50% of annual sludge produced by operations from traditional disposal methods by landfill or incineration, in favor of environmentally acceptable reuse applications (e.g., agricultural use). To qualify for this criterion, the facility operator shall provide documentation of the diversion, including a description of the end disposal method. (1 point)

The GECA criteria are very similar to the EU Ecolabel criteria set out in Decision 2009/607/EC. However, the meaningful measurement of suspended solid concentrations in runoff has been questioned since most quarries do not have any intentional runoff at all (the water recycling system is closed). It is also difficult to try and estimate a water release rate (GECA sets a limit of 5 L/m3). Depending on how exactly the number is calculated, it could also include water lost in wet sludge transported offsite, as water evaporated from drying sludge or evaporating from the surface pond. It is not clear either if inflows of storm water to the retention pond would be counted as "*free water*" or not.

The above reasons also apply as complicating factors when attempting to carry out any water inventory or water recycling rate with the NSC criteria.

The Fair Stone requirements are only vague criteria that would need to be further explained in some detail to be able to be assessed and verified by competent bodies.

2.1.4 – Quarry dust control

Existing criterion 1. Raw material extraction: 1.1. Extraction management (for natural products only; I4 Air quality

1.1. Extraction management (for natural products only)

General requirements

The raw material extraction management for natural stones shall be 'scored' according to a matrix of six main indicators.

The total score shall be based on the sum of individual scores given for each indicator, multiplied by a corrective weighting (W). Quarries must obtain a weighted score of at least 19 points to be eligible for the eco-label award. In addition, the score for each indicator must be higher or lower than the threshold specified, as appropriate.

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Matrix for scoring raw material extraction management for natural stones

Indicator	Notes	Score				
		5 (excellent)	3 (good)	1 (sufficient)	Threshold	Relative weights
I.4 Air quality	Yearly limit value measured along the border of quarry area. PM 10 suspended particles [μg/Nm3] Testing method EN 12341	<20	20-100	101-150	>150	W2 (*)

***(*) W2. Population density of settlements** which lie within a 5 km radius (distance) from the quarry site: (weightings: 0,5 —0,9, see table) quarry impact ratio (I.2), air quality (I.4), water quality (I.5) and noise (I.6) indicators are weighted in function of three density ranges:*

Population density	<100 hab /km^2	20 to 100 hab/km^2	<20 hab/km^2
Weight	0.5 (0.6)	0.7 (0.84)	0.9

***<u>Assessment and verification</u>**: the applicant shall provide a map and appropriate documentation to verify the population density of settlements lying within 5 km radius (distance) from the quarry border (authorised area). In the case of existing quarries and expanding settlements in the area concerned, the weight factor indicated in brackets shall be used. This does not refer to major extensions of the already authorised area of such quarries (> 75 %).*

<u>Assessment and verification:</u>

The applicant shall provide the calculation of their total 'score' (weighted accordingly), and related data for each of the six indicators (showing, amongst others, that each score is above the minimum score, if one is given) according to the matrix overleaf and to the associated instructions in the Technical appendix — A3. The applicant shall also provide appropriate documentation and/or declarations that prove compliance with all of the abovementioned criteria.

TR v1.0 proposed criterion:-2.1.4. Air pollution minimisation
<u>Mandatory requirement</u>

The applicant shall:

- focus dust control water sprays close to any dry cutting activities or other activities that are likely to generate significant quantities of dust.
- regularly assess meteorological and air quality monitoring data and have a plan developed for the relocation/modification/stoppage of operations onsite to prevent or minimise dust emissions to air during normal and adverse weather conditions;
- to include wind protection systems in the quarry design that aim to reduce wind speed and thus minimise dust emissions and soil erosion onsite (e.g. wind fences or windbreaks consisting of one or more rows of plants along the border of the extractive waste deposition area, including the extractive waste facility and/or extractive was handling area).

Assessment and verification:

The applicant shall provide a declaration of compliance with this criterion, supported by a declaration from the quarry operator and relevant documentation.

TR v2.0 proposed criterion:-2.1.4. Quarry dust control

Mandatory requirement

The applicant shall demonstrate operational and site features that have been implemented at the quarry site for dust control. Features will vary from site to site but should include the following aspects, where relevant:

- the employment of dust suppression water sprays or vacuum hoods linked to dust filter bags/electrostatic precipitators for any dry cutting, crushing or other activities that are likely to generate significant quantities of dust.
- regularly assess meteorological and air quality monitoring data and have a plan developed for the relocation/modification/stoppage of operations onsite to prevent or minimise dust emissions to air during normal and adverse weather conditions;
- to include wind protection features in the quarry design that aim to reduce wind speed and thus minimise dust emissions and soil erosion onsite (e.g. wind fences or windbreaks consisting of one or more rows of plants along the border of the extractive waste deposition area, including the extractive waste facility and/or extractive waste handling area).
- in cases where wet cutting operations are carried out, enclosed storage of dried wastewater sludge prior to sale, shipment to landfill or use for useful purposes onsite.
- cover the most heavily used road areas with concrete or asphalt paving.
- provision of appropriate training to employees about good practice for dust control and provision of adequate personal protective equipment to employees and visitors.

Assessment and verification:

The quarry operator shall provide a declaration of compliance with this criterion, supported by relevant documentation and a description of the dust control features implemented at the quarry site.

In cases where the applicant is not the quarry operator, the applicant shall declare the quarry from which the material used to produce the EU Ecolabel natural stone tiles or slabs has been sourced, supported by delivery invoices and a relevant declaration from the quarry operator regarding dust control at *the quarry site.*

Rationale:

Why no longer monitoring for PM emissions

Monitoring of dust emissions is much more practical in chimneys, where all dust emissions are channelled through a central point and where air flow rates are well controlled.

When any attempt to quantify diffuse emissions of dust in an outdoor environment is made, it is virtually impossible to obtain what could be considered as a representative sample. This is due to facts such as: air flow rates and directions are highly variable but the sampling point is fixed; the source of dust emissions onsite is highly variable in both time and specific location; impossibility to distinguish dust from neighbouring sites and dust from monitored site.

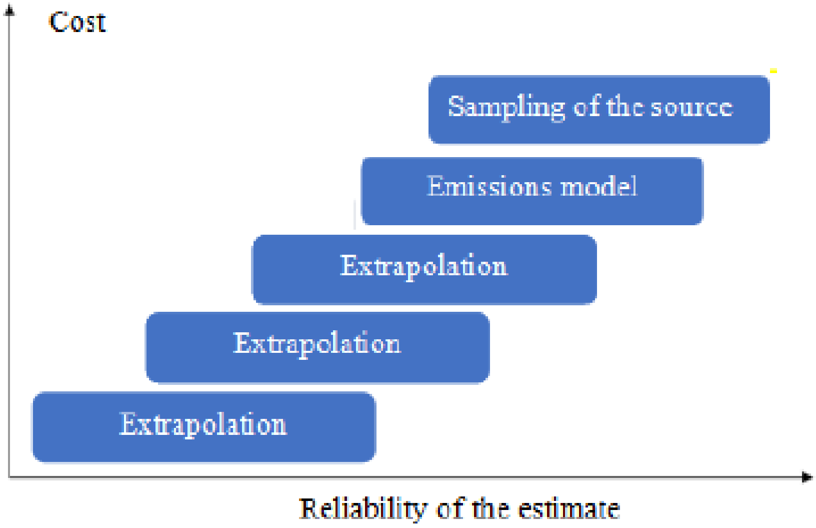


Figure 12. Cost and reliability relationship for estimating dust emissions (Source: INECC-SEMARNAT, 2005).

As indicated above, sampling is required in order to have the best estimate of actual dust emissions, but this entails a significant cost and the results are not guaranteed to be simply due to activities carried out at the quarry site.

The need for measures to minimise dust emissions

The minimisation of dust emissions is a key environmental issue and operational plans and equipment should be designed to reduce dust emissions both for worker health and safety and local residents.

Dust is managed on site through a variety of potential control measures. The exact combination of measures required at a site can vary widely, and depends on the production and shipping rates, size of the site, and distance to neighbouring residents. Therefore the criterion does not require a specific technique or measure to be implemented but the assessment and implementation of the most convenient techniques to minimise the air quality impacts.

Practical mitigation measures and best management practices must be implemented to prevent or mitigate impacts on the air quality within the local areas. Examples of potential control measures can include:

- Spraying, washing, vacuum sweeping and paving of haul roads, parking areas, entrances and exits.
- Reducing haul trips and limiting speeds on unpaved roads.
- Wetting material prior to processing or loading.
- Covering stock piles, conveyor belts, and loads in trucks.
- Locating stock piles in locations that limit their exposure to wind.
- Scheduling loading, unloading and blasting activities on days when there is less wind
- Proper loading of trucks.
- Lowering the drop distances at transfer points.
- Minimising the area of disturbance and progressively revegetating disturbed areas as soon as possible to reduce erosion and minimize dust.

Additionally, education, awareness and training of staff on dust prevention, control measures, monitoring and reporting are important in reducing dust emissions at a quarry operation.

Outcomes from and after the 1st AHWG meeting

No comments were received from stakeholders during the meeting, where the JRC explained that it did not make sense to try to set quantitative limits on diffuse sources of dust, which may come from the same quarry or from neighboring quarries. Instead it was considered most appropriate to tackle dust emissions via the implementation of good management techniques that will minimize the potential for dust emission at the point sources of major dust emissions.

Further research:

What do other schemes say about dust/air pollution?

The Fair Stone international standard for the natural stone industry (4th edition, 2010) sets the following requirements for silica dust and mineral dust:

- 9.1. The employer shall take all possible measures in order to eliminate exposure or reduce the concentration of silica dust in the workplace.
- 9.2. Introduce technical measures such as wet processing or dust extraction and take organizational measures e.g. segregate areas with a higher level of concentration from those with a lower level, minimize periods/levels of exposure.
- 9.3. Dry dust shall be extracted by vacuum dust collectors wherever possible.
- 9.4. Regular cleaning of machinery, cabins and rooms in order to avoid dust accumulation is essential.
- 9.5. To avoid the spread of dust, use water or a vacuum cleaner. Avoid using a broom.
- 9.6. In case of wet drilling or sawing, water quantity has to be sufficient and water feed shall be initiated before processing.
- 9.7. The workforce should be informed about the risks of silica dust and the suitable prevention measures in order to create awareness.

The Natural Stone Council (NSC) standard 373 – sustainability assessment for natural dimension stone, only makes a very general reference that dust control measures should be included in the site management plan for quarries (under the required criterion 7.1 for site management plan).

The 2018 draft version of hard surfacing criteria set by Good Environmental Choice Australia (GECA) state the following;

"*3.1.5. Dust emissions: Criterion 8. The PM10 dust emissions to air shall be less than 100 μg/Nm^3 where the main mine or quarry is located within 5 km of a: Populated Area; National Park; Drinking water catchment area; Ramsar Wetland or an Area identified by the EPBC Act as containing threatened species or ecological communities*".

The measurement of dust in the GECA criterion is to be according to EN 12341 or equivalent method.

Overall, the Fair Stone, NSC and GECA approaches are completely different. The GECA approach most closely relates to the EU Ecolabel approach set out in Decision 2009/607/EC, while the Fair Stone requirement states specific measures and the NSC criteria are very general.

Sources of dust from quarry extraction activities

Although speaking about mineral extraction sites in general rather than dimension stone quarries, Petavratzi et al., (2005) made the following general classification of different potential sources of dust emission.

Table 7. Dust sources from mineral extraction sites

Operation / equipment	Emission mechanism	Relative potential contribution to total site dust levels	Primary source	Secondary source
Drilling & blasting	Air flush from drilling and from force of blast	Small	+	-
Loading and dumping	Dropping material from height	Moderate	-	+
Draglines	Dropping material from heights	Large	-	+
Crushing and preparation	Impact, abrasion and dropping from heights	Large	+	-
Conveyors	Dropping from heights	Small	0	-
Haulage roads	Raised by tyres, exhaust and cooling fans	Large	0	+
Storage piles	Wind blow, high wind speeds	Small	0	-

"+" indicates a major source, "-" indicates a minor source and "0" indicates a negligible source

The operations in the above table related to quarrying for coarse aggregate by the blasting method. Specifically for dimension stone quarrying, the cutting operation (especially dry methods) should be inserted in the table above and will be more relevant than blasting. With the arguable exception of haulage roads, all of these sources of dust emission can be actively managed by the quarry operator.

In cases where granite or other silica based rocks are being quarried, the potential health effects of dust emissions on site workers become much more severe due to the threat of silicosis.

Good practice for dust control

Dust control can incorporate a number of different strategies that can broadly be split into prevention, removal and suppression.

Prevention of dust emission in the first place is the preferred solution and can be achieved by employing techniques that produce less dust. When the generation of dust cannot be reduced *per se*, the next best approach is to remove dust particulates from the air via some sort of collection mechanism before correctly disposing of the collected dust. In cases where dust is not collected, its dispersion can at least be minimized via the use of water sprays so that dust concentrations remain concentrated in a small area.

Techniques can be either dry or wet. Dry techniques will tend to be favored in dry climates or sites where access to water is expensive or technically challenging. Dry techniques have a higher installation and operating cost but are less prone to failure and require less maintenance.

Both point sources and diffuse sources of dust emission will be present at or near the quarry site. Both types of emission can be controlled by implementing certain good management techniques. The specific variation of the technique (e.g. wet or dry) will primarily depend on factors such as the climate and the nature of the rock being extracted.

Dumping

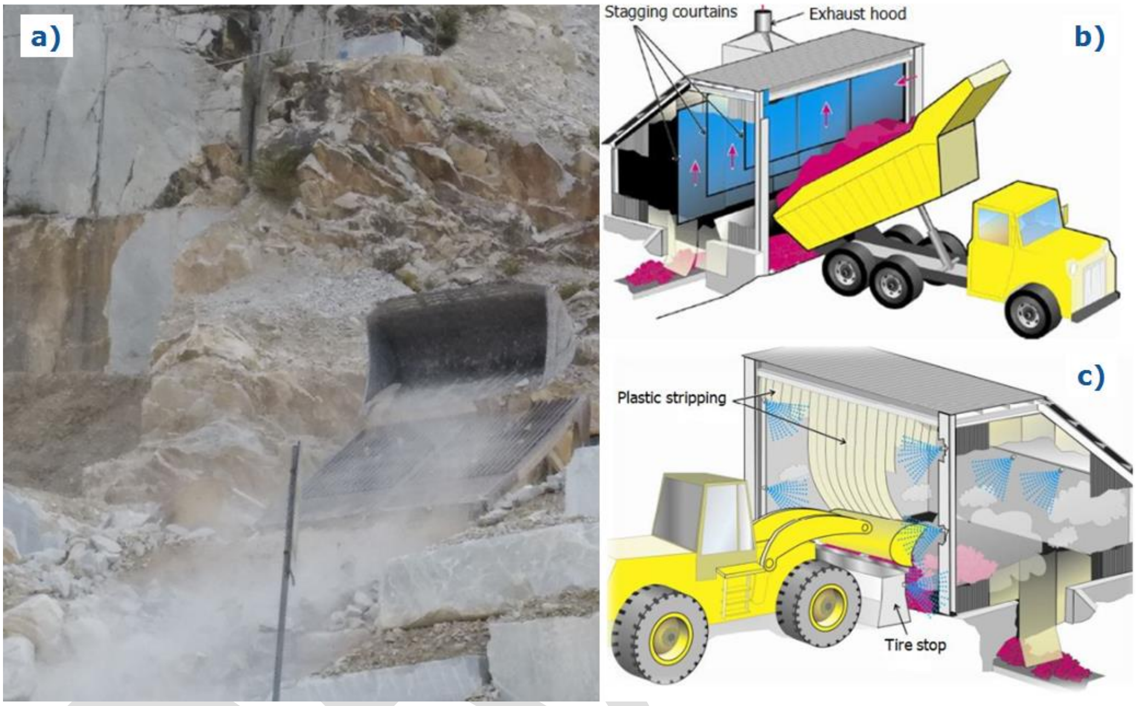


Figure 13. Examples of dust emission from screening at the quarry a) no dust control; b) dry dust control and c) wet dust control (Images for b) and c) taken from NIOSH, 2012).

Dumping of materials over a screen is a very basic process where waste material is passed by gravity over a slanted grid with fixed spaces than only permit the passage of material of a certain degree of fineness. The finer material can be periodically collected while the coarser material falls into the extractive waste deposition area. Although these operations are only carried out periodically, they result in plumes of dust in cases when the material is dry. Placing a temporary cover structure over the screen can facilitate a major reduction in dust emissions, using either dry or wet methods. Dust control systems can be set to be automatically initiated by movement sensors.

Crushing

For irregular blocks and pieces that are considered as by-products or extractive waste from extraction activities for dimension stone, there may be a market for such material if it can be crushed into standard gradations.

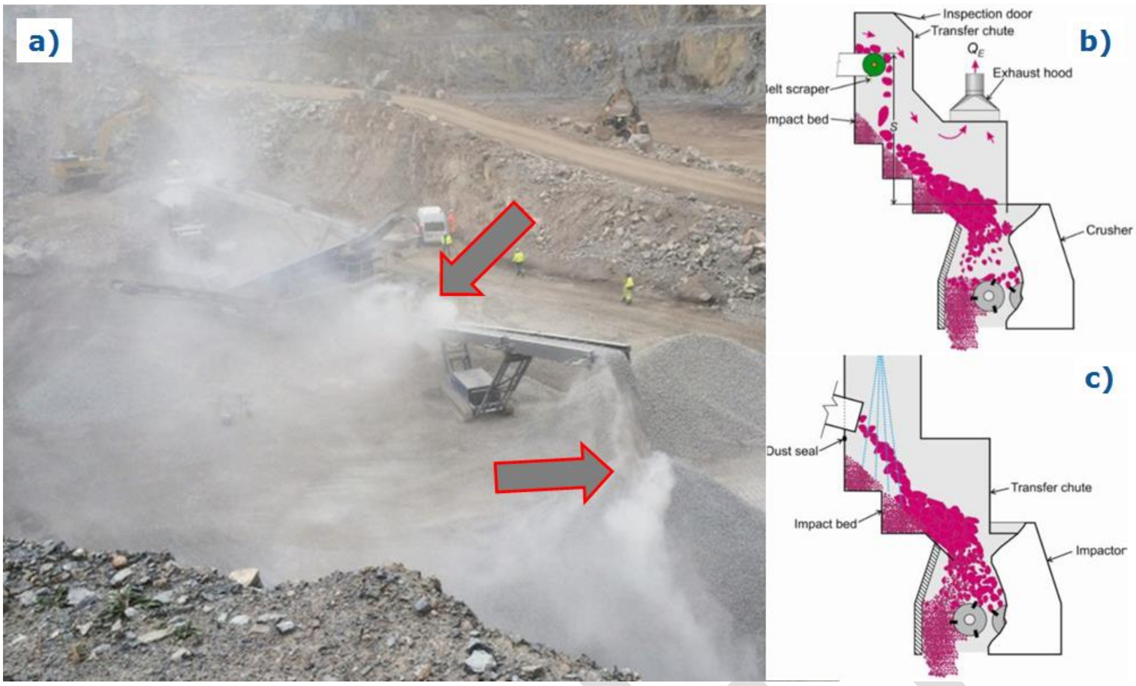


Figure 14. Examples of dust emission from crushing at the quarry a) no dust control; b) dry dust control and c) wet dust control (Images for b) and c) taken from NIOSH, 2012).

Crushing operations not only produce dust during the crushing operation but also during the subsequent stockpiling of material if the height difference between the conveyor belt and the top of the stockpile is significant enough. The potential for dust emission will also depend on weather conditions at the moment, the moisture content of the crushed material and the fineness to which the stockpiled material has been crushed.

Diffuse emissions of dust

Fines deposited onsite from any source can and pass to the air again as soon as a sufficient mechanical action is applied. The finer and drier the dust particle, the less significant the mechanical action required is and the further the particle can be transported.

According to Organiscak and Reed (2006), fugitive emissions of particulate matter are dominated (78 to 97%) by the movement of trucks onsite.

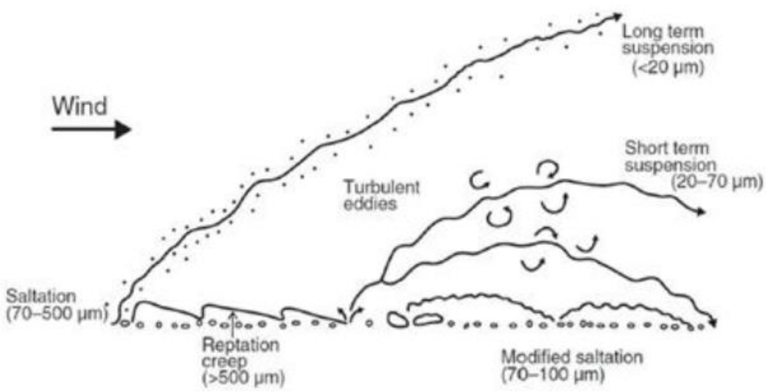


Figure 15. Dust particle transmission mechanisms of relevance to trucks on unpaved roads at quarry sites (from Neuman and Nickling, 2009).

Irrigation of unpaved roads is only a temporary solution and serious consideration should be given to the paving of the most commonly used haulage roads. Apart from fewer dust emissions, other advantages delivered by paved roads include:

- Improved visibility for drivers.
- Better traction for vehicle tyres (safer maneuvering and quicker transit possible).
- Better protection of the road base.
- Smoother road surface reduces rolling resistance (fuel savings for vehicles and less wear and tear on vehicle suspension and tyres).

Wind erosion from stockpiles

The wind erosion potential of material in a particular stockpile will mainly depend on its dryness and fineness. The higher the wind erosion potential, the lower the wind speed required to generate a given degree of dust emissions from the stockpile.

A variety of approaches can be taken to reduce dust emissions which can broadly be split as follows:

- Reduce the erosion potential of the stockpile (e.g. moisten the surface layer with water, establish vegetation cover by seeding).
- Reduce the velocity of wind reaching the surface area (e.g. construct wind breaks around the stockpile and fence off open areas).
- Prevent the wind coming into contact with the stockpile surface area (e.g. cover with tarpaulins, store fines in enclosed silos prior to transport offsite, deposit in inert landfills).

2.1.5 – Noise control

Existing criterion for noise: 1- Raw material extraction, 1.1. Extraction management (for natural products only), I6 Noise

1. Raw material extraction

1.1. Extraction management (for natural products only)

General requirements

The raw material extraction management for natural stones shall be 'scored' according to a matrix of six main indicators.

The total score shall be based on the sum of individual scores given for each indicator, multiplied by a corrective weighting (W). Quarries must obtain a weighted score of at least 19 points to be eligible for the eco-label award. In addition, the score for each indicator must be higher or lower than the threshold specified, as appropriate.

Matrix for scoring raw material extraction management for natural stones

Indicator	Notes	Score				
		5 (excellent)	3 (good)	1 (sufficient)	Threshold	Relative weights
I.6 Noise	Measured along the border of quarry area (dB(A)) Testing method ISO 1996-1	<30	30-55	56-60	>60	W2 (*)

*(*) **W2. Population density of settlements** which lie within a 5 km radius (distance) from the quarry site: (weightings: 0,5 —0,9, see table) quarry impact ratio (I.2), air quality (I.4), water quality (I.5) and noise (I.6) indicators are weighted in function of three density ranges:*

Population density	<100 hab /km^2	20 to 100 hab/km^2	<20 hab/km^2
Weight	0.5 (0.6)	0.7 (0.84)	0.9

***Assessment and verification**: the applicant shall provide a map and appropriate documentation to verify the population density of settlements lying within 5 km radius (distance) from the quarry border (authorised area). In the case of existing quarries and expanding settlements in the area concerned, the weight factor indicated in brackets shall be used. This does not refer to major extensions of the already authorised area of such quarries (> 75 %).*

Assessment and verification:

The applicant shall provide the calculation of their total 'score' (weighted accordingly), and related data for each of the six indicators (showing, amongst others, that each score is above the minimum score, if one is given) according to the matrix overleaf and to the associated instructions in the Technical appendix — A1. The applicant shall also provide appropriate documentation and/or declarations that prove compliance with all of the abovementioned criteria.

A 1: I.6. Noise

This indicator considers the noise level recorded along the border of the quarry area. Non-impulsive noises are to be measured. The calculation of I.6 consists in the measurement of the noise using the

test method reported in ISO 1996-1.
TR v1.0 proposed criterion:-2.1.5. Noise control
Mandatory requirement The applicant shall provide a noise management plan which, as a minimum, covers the following aspects: • A map of the site with agreed monitoring points and whether the monitoring is to be continuous or during random periods by the competent authority. • Identification of the main sources of noise and an estimate of the average and maximum dB(A) during working hours on site or in specific parts of the site. • Identification of any measures taken to reduce noise emission. • Provision of adequate ear protection for all employees and visitors. In cases where there is a residential population within a 5km distance of the quarry site the noise level from the operation must not exceed an average of 80dB(A) during working hours, measured at the perimeter of the quarry. ***Assessment and verification:*** *The applicant should provide a map and appropriate documentation to verify the conditions in which the noise is measured.*
TR v2.0 proposed criterion:-2.1.5. Noise control
Proposed to remove this criterion

Rationale:

Noise is a serious issue during the production of natural stone, both at the quarry site and the transformation plant. In both sites the cutting operations will generate significant noise. At the quarry site, the use of heavy machinery will generate high levels of noise and in the extraction of hard rock, explosive charges may be inserted into drilled holes. With the latter activity, vibration is as much a concern as actual noise.

Quarry activities do not take place at night time for safety reasons, so the disturbance of resident sleep cannot be an issue. The potential health effects on workers can be controlled by the correct use of ear protection.

Trying to set quantitative limits on noise from a quarry activity is a challenging task due to the fact that the noise is highly intermittent and measured levels at a fixed point will depend not only on the activities onsite, but also on wind, traffic passing the site and noise from neighbouring quarries. This last aspect in particular can be significant since it is not uncommon to have dozens of quarries operating side-by-side in the same site. On hillside quarries, there will be a lot less noise from passing trucks in a site near the top of the hill than in a site near the bottom of the hill, because all trucks will be using a common same access road. Finally, controlling the noise level below a certain point at one fixed point on a site does not necessarily mean that it is controlled at other important points on or near the same site.

For these reasons, it is proposed to remove the criterion on noise.

Outcomes from and after the 1st AHWG meeting

One stakeholder asked either to revise the criterion and make it more stringent or to remove it because the current proposed threshold of 80 dB(A) has no added value. JRC agreed that in this case, it would make more sense to remove the criterion.

Further research:

Further research was split into two areas: (i) noise exposure to residents and (ii) noise exposure to workers.

Noise exposure to residents:

In Europe, the Environmental Noise Directive (2002/49/EC) relating to the assessment and management of environmental noise is the main instrument to identify noise pollution levels and to trigger the necessary action both at Member State and at EU level. It focuses on three action areas:

- the determination of exposure to environmental noise
- ensuring that information on environmental noise and its effects is made available to the public. It requires the requires MS to prepare and publish, every 5 years, noise maps and noise management action plans for large population areas (>100,000 inhabitants)
- preventing and reducing environmental noise where necessary and preserving environmental noise quality where it is good

The Directive applies to noise to which humans are exposed but does not apply to noise that is caused by the exposed person himself, noise from domestic activities, noise created by neighbours, noise at work places or noise inside means of transport or due to military activities in military areas. It is important to note, however, that the Directive does not set limit or target values, nor does it prescribe the measures to be included in the action plans, thus leaving those issues at the discretion of the competent Member State authorities.

The European Union's Seventh Environment Action Programme (7th EAP) sets the objective that by 2020 noise pollution in the EU will have significantly decreased, moving closer to World Health Organization (WHO) recommended levels. The WHO recommends that for a good night's sleep, continuous background noise should stay below 30 dB and individual noises should not exceed 45dB.

Overall, policy efforts to limit noise exposure to residents do not tend to influence natural stone extraction activities because the population centres near quarries are not sufficiently large, because extraction activities do not take place at night and because the dominant source of background environmental noise for residents is in fact road traffic.

Noise exposure to quarry workers:

The primary source of noise from quarrying is from heavy machinery, cutting operations, deposition/screening of by-products/extractive wastes and breaking up of larger irregular blocks into smaller, more manageable pieces. The truck traffic carrying staff and materials or equipment to be delivered or collected is also a significant source of noise.

The impacts of noise on humans are highly dependent on the noise frequency, site topography, ground cover of the surrounding site, and climatic conditions. Topographic barriers can shield target areas or reflect noise waves in a different direction.

An important factor in determining a person's tolerance to a new noise is the ambient (background) noise to which one has adjusted. In general, the more a new noise exceeds the existing background noise level, the less acceptable the new noise will be. In an urban or industrial environment, background noise may mask noise from a quarry operation, whereas the same level of noise in a rural area or quiet, residential neighbourhood may be more noticeable to people.

The impacts of noise can be mitigated through various engineering techniques:

- Landscaping, berms, and stockpiles can be constructed to form sound barriers.
- Noisy equipment (such as crushers) can be enclosed in sound-deadening structures.
- Conveyors can be used instead of trucks for onsite movement of materials.
- Noisy operations can be scheduled or limited to certain times of the day.
- The proper location of access roads, the use of acceleration and deceleration lanes, and careful routing of trucks can help reduce truck noise.
- Workers can be protected from noise through the use of enclosed, air-conditioned cabs on equipment and, where necessary, the use of hearing protectors.

Directive 2003/10/EC established the regulation for the Control of Noise at Work Regulations 2005. The main requirements are triggered by four "*action levels*":

- lower limit for daily personal noise exposures of 80 dB(A);
- upper limit for daily personal noise exposure of 85 dB(A);
- lower limit for peak noise exposure of 135 dB(C) and
- upper limit for peak noise exposure of 137 dB(C).

There are also daily exposure and peak exposure limits of 87 dB(A) and 140 dB(C) respectively, which take into account the effect of wearing hearing protection and which the regulations do not allow to be exceeded. These regulations are concerned with the protection of people at work, and do not, therefore, deal with exposure to noise for the public.

In the Carrara site, where there are almost 200 individual quarries in operation, it was explained that permits for extraction activities are based on noise limits during working hours of three general classes: <80dB(A); 80-85dB(A) and >85dB(A). The criterion addresses the fact that noise is an inherent impact from the quarrying activities but it can be mitigated through different techniques depending also on the location of the quarry. Therefore a conditional maximum value is established that aligns with the lower limit that was mentioned during initial discussions with experts.

Studies involving the monitoring of worker noise exposures, characterizing equipment sound levels and dominant noise sources, evaluating engineering noise controls, analyzing hearing protection device (HPD) effectiveness, and testing of improved sound level monitoring techniques specifically for mining systems, are being conducted Bauer et al., (2006) and Sunita et al., (2017).

Sunita et at., (2017) recorded the noise produced during blasting and crushing activities for 10 days. the noise levels during blasting ranged between 102.8 and 130.8 dB. The noise levels were also recorded during crushing activities. The reading ranged between 97.0 and 116.2dB.

<u>*What do other schemes say about noise?*</u>

The Fair Stone international standard for the natural stone industry (4th edition, 2010) sets the following requirements for noise and vibration:

- 10.1. Noise measurements should be used to identify the areas with noise risks. Noise zones must be clearly marked.
- 10.2. Introduce technical measures such as low noise blades for circular saws and noise absorbers or take organizational steps e.g. segregate areas with a higher noise level from those with a lower level, minimize periods/levels of exposure.
- 10.3. The installation of a new production line, new production methods or the redesign of workplaces, has to be planned in such a way that noise and vibration are minimized.
- 10.4. Workers should be informed about the risks of noise and vibration as well as suitable prevention measures in order to create awareness.
- 10.5. Drivers' seats of your mobile equipment (e.g. forklifts, trucks, excavators) have to be maintained properly or exchanged for new seats with good vibration absorbing performance.

The Natural Stone Council (NSC) standard 373 – sustainability assessment for natural dimension stone, does not state any specific requirements on noise.

The 2018 draft version of hard surfacing criteria set by Good Environmental Choice Australia (GECA) state the following;

"*3.1.7. Noise: Criterion 10. Where the main mine or quarry is located within 5km of a Populated Area, the noise level from the operation shall not exceed 70 dB(A), measured at the perimeter of the mine or quarry.*"

For the purposes of the standard, a populated area is considered as any area with a habitant density of more than 50 habitants per square kilometre (>50 hab/km^2). The measurement of noise levels is to be carried out according to ISO 1996.

Overall, the Fair Stone, NSC and GECA approaches are completely different. The GECA approach most closely relates to the EU Ecolabel approach set out in Decision 2009/607/EC, while the Fair Stone requirement is focused on health and safety requirements that should be common practice in Europe already.

2.2 – Transformation plant requirements

Processing operations on natural products where dimension stone blocks are transformed into slabs and tiles shall be assessed according to the following requirements:

2.2.1 – Energy consumption

Existing criterion for energy consumption
New criterion
TR v1.0 proposed criterion:-2.2.1. Energy consumption
Mandatory requirements The applicant shall assess and document the electricity consumption (kWh) and fuel consumption (L diesel, etc.) of the process plant equipment (including for lifts and trucks used for onsite transport) for a defined period of 12 months. The total production during the same 12 months shall be expressed in terms of kg of final product sold. **EU Ecolabel points** Points shall be awarded for applicants that can demonstrate the following aspects: - Up to 30 points can be awarded in proportion to how much of the energy consumed is from renewable sources (i.e. 0 points for 0% renewable electricity, 30 points for 60% renewable electricity). ***Assessment and verification:*** *The applicant shall provide a declaration of compliance with the mandatory requirement for energy consumption and any relevant declaration regarding the onsite CHP and renewable energy sources and use of electric vehicles.* *For continuously operating production, data shall be collected over a 12 month period. In cases where production is non-continuous, the production period shall be mentioned and should not be less than 30 days.*
TR v2.0 proposed criterion:-2.2.1. Energy consumption
Mandatory requirements The applicant shall complete an inventory of energy use for the transformation plant. The inventory shall detail the type and quantity of energy consumed (e.g. diesel, grid electricity) and break down the consumption into fuel and electricity and, depending on the precise set-up of the transformation plant, into specific operations. The energy inventory shall cover a 12 month period and, during that same period, the total product output shall be estimated both in terms of mass (kg or tonne) and surface area (m^2). **EU Ecolabel points** Points shall be awarded for applicants that can demonstrate the following aspects: - Up to 20 points can be awarded in proportion to how much of the electricity consumed is from renewable sources (i.e. 0 points for 0% renewable electricity, 20 points for 100% renewable electricity).

Assessment and verification:

The applicant shall provide an energy inventory for transformation plants for a period of at least 12 months prior to the date of award of the EU Ecolabel license and shall commit to maintaining such an inventory up to date during the validity of the EU Ecolabel license.

In cases where points are claimed for renewable electricity, the applicant shall provide a declaration from the grid electricity supplier, indicating the nature of the energy source(s) associated with the contracted tariff and the percentage of electricity supplied that is from a renewable source. In cases where guarantee of origin certificates are purchased to increase the renewables share, the applicant shall provide appropriate documentation to ensure that the guarantee of origin certificates have been purchased in accordance with the Principles and Rules of Operation of the European Energy Certificate System.

Rationale:

The processing of blocks of ornamental or dimension stone into natural stone slabs or tiles requires a significant amount of energy for squaring and cutting of blocks and polishing of slab or tile surfaces. There are significant environmental and financial benefits from ensuring that the use of energy is optimised.

Energy consumption during cutting

There are a number of different cutting techniques available such as: diamond mono-wire; diamond mono-blade; giant disk saw; steel grid gang saw; diamond blade multi-saw; diamond blade multi-wire and diamond disk. The choice of which technique is most appropriate will largely be determined by the type of rock to be cut, the slab dimensions that need to be cut (i.e. standard or custom) and, in the case of more recent techniques, if it is economical for the operator to upgrade to the newer technique.

Energy consumption during finishing

The degree of surface finishing required depends not only on the final product specifications that must be met but also on the effect of the cutting technique on the rock surface. In this sense, gang saw cutting of hard stone will produce a rougher surface than say, diamond saw blade cutting of soft stone, and the former will require much more polishing than the latter to meet the same surface smoothness.

The simplest surface finishing operation is polishing although, depending on the surface characteristics that are desired, other techniques such as bush hammering, flaming, waterjet or sand blasting may be used to impart a certain texture or roughness.

Another potential treatment of blocks and slabs is impregnation with an epoxy or polyester resin in order to maximise the yield from fragile or partially fractured slabs and ensure that they will be protected from water infiltration. The resin treatment process involves drying the slab at a moderately elevated temperature (ca. 35°C), applying the resin and then drying again at a similar temperature to allow the resin to cure. This process could take a few hours.

Due to the great variety of cutting and finishing techniques that can be used and the general lack of specific energy consumption data, it was decided to not set any specific process energy requirement for natural stone slab and tile products. Nonetheless, it is recognised that energy consumption in the processing plant is an important issue and so applicants should be monitoring energy consumption closely. Such monitoring should undoubtedly already be a part of any Environmental Management System in place in the organization.

Points are available for any applicant that can demonstrate a share of renewables (onsite or via supplier) in the electricity they use. Unlike ceramic tile or concrete production, the potential use for waste heat from any onsite CHP was not considered as particularly relevant for ornamental and dimensional stone processing operations.

Outcomes from and after the 1st AHWG meeting

One stakeholder commented that the points awarded for renewable energy share should be stretched up to 100% compared to the TR v1.0 proposal, which had maximum points being awarded for 30% renewable energy use.

The JRC agreed in principle and wanted to change the range from 0 to 30% to 0 to 100%. It was considered important to keep the renewable electricity lower level at 0% in order to encourage any improvement in renewable electricity share.

Further research

What do other schemes say?

The Fair Stone international standard for the natural stone industry (4th edition, 2010) sets the following requirements that relate to energy consumption in stone processing factories:

- 26.1. A study on how to save water and other consumables, and how to recycle waste water must be undertaken and documented.
- 26.2. The company must take appropriate measures to ensure economical use of electrical energy and water. All staff must know how to save energy and water.
- 26.4. Use only energy-efficient equipment and lighting systems.
- 26.5. Machinery and equipment must be maintained regularly to stay energy efficient.

The Natural Stone Council (NSC) standard 373 – sustainability assessment for natural dimension stone has more concrete requirements relating to energy in natural stone manufacturing facilities.

Table 8. NSC 373 criteria on energy for natural stone transformation/production

Criterion title	Criterion text
10.1 Energy Inventory (M)	The facility operator shall complete an inventory of energy use including the quantity and type of energy consumed (e.g., diesel, local power grid) organized by location or function (e.g., power use by building, equipment). Inventory shall include both electricity and fuel usage and identify factors important to consumption (e.g., number of tons shipped, hours of operation, etc). Energy consumption shall be reported in energy consumed per unit processed (e.g., KWh per ton of dimension stone produced), and a total energy consumption for the facility operations (i.e., combined energy from all sources) shall be calculated.
10.2.1 Energy Management (M)	The facility operator shall establish and implement a program to systematically improve energy consumption and associated greenhouse gas emissions. The quarry or processing facility shall measure and track energy consumption by energy source and purpose of consumption, identify opportunities and methods for reducing energy use, establish target goals, quantify changes, and monitor progress. This program shall cover but not be limited to the following topics: 1) Equipment operation and maintenance (e.g., minimizing idle times, improved maintenance, replacement of inefficient equipment); 2) Transportation and logistics (e.g.,

	maximizing shipping loads, utilizing advanced logistics); and 3) Office and administration energy and lighting. This program shall track progress towards established goals on a rolling 5-year period based on percentage reduction, and shall be reported publicly (e.g., corporate sustainability report, website posting). Alternatively, this criterion shall be met if the facility operator has earned Energy Star Challenge recognition, or international equivalent.
10.2.2 Total energy reduction (O) (max. 3 points)	The facility operator shall demonstrate, over a 6-year timeframe, the successful reduction of total energy use (i.e., combined energy from all sources). Points shall be earned for the following reductions: a) Achieved reduction of 10 - 20% of energy inventory (1 point); b) Achieved reduction of 21 - 40% of energy inventory (2 points total); or c) Achieved reduction of greater than 40% of energy inventory (3 points total). All reductions shall be measured relative to total energy (e.g., KWh/ton of stone), as determined in section 10.1, and shall be measured and documented to receive credit. Achieved reductions shall be calculated by comparing the total energy consumption for the most recent completed year to that of the baseline year, and calculating the percent of total energy reduction achieved. The baseline year shall be the year 6 years prior, providing that a complete inventory meeting the requirements of section 10.1 exists for that year. Otherwise, the baseline shall be the most recent year for which a complete energy inventory meeting section 10.1 exists. Under no circumstances shall energy data from more than 6 years prior be used as a baseline in this criterion.
10.3 Carbon Management (O) (2 points)	The facility operator shall perform a carbon footprint analysis of its operations. Boundaries of the analysis shall include the manufacturing and transportation stages of the product life-cycle, as well as all stages upstream including materials extraction and processing and energy generation. Analysis shall include carbon emissions associated with all of the following: – Manufacturing processes directly related to stone production; – On-site and off-site transportation during production; and – Off-site support and administrative processes. To qualify, carbon footprint shall have been performed in the last 3 years and shall be documented in a report meeting the specifications of ISO 14064. Carbon footprint shall be performed using any commercially available software package or by a credible, qualified third party. (2 points)
10.4 Renewable and alternative energy sourcing (O) (2 points)	The facility operator shall demonstrate the use of renewable energy in its operations. Renewable energy sources include energy derived from water, wind, and solar sources, as well as the use of renewable fuels such as biodiesel and those derived from sources such as switch grass. a) 1-10% of total energy use derived from renewable sources (1 point); or b) 11-100% of total energy use derived from renewable sources (2 points total). All contributions of renewable energy are measured relative to total energy use for entire operation, as determined in section 10.1, and shall be measured and documented to receive credit.

M = Mandatory, O = Optional

The 2018 draft version of hard surfacing criteria set by Good Environmental Choice Australia (GECA) state the following;

"6*.1. Direct energy consumption: Criterion 23. Energy consumption during the production of certified products shall not exceed the limits specified in Table 7 when calculated using the method and figures given in Appendix B. Applicants shall undertake an energy audit including all energy flows in the production process for the purpose of informing future energy efficiency improvements and refining this criterion in future versions of the standard.*

…Flamed natural products: 65 MJ/m^2".

"*6.2. Energy Management: Criterion 24: In order to reduce energy consumption during installation, dimensional stone producers shall be able to provide stone to the exact thickness required for each order (± 2 mm).*

For processes involving firing…..,"

Overall, the Fair Stone, NSC and GECA approaches to criteria on energy consumption are completely different, but each scheme does at least have an approach in place. The EU Ecolabel previously had no criterion relating to energy consumption during natural stone production.

A logical starting point would appear to be the mandatory NSC requirement on an energy inventory and so this has been inserted as a mandatory requirement for the EU Ecolabel. The simplest point, in terms of assessment and verification, would be to reward those processors with a higher % of renewable electricity and/or onsite renewables. Every producer has the option to increase their share of renewable electricity either via onsite generation (directly with wind turbines or solar panels or indirectly by purchased green electricity from suppliers).

2.2.2 – Water and wastewater management

Existing criterion for emissions to water : 3. Finishing operations (for natural products only)

Part of current Criterion 3 : Finishing operations (for natural products only)

Finishing operations on natural products shall be made according to the following requirements:

Parameter	*Limit (to pass)*	*Test method*
~~*Particulate emission to air*~~	~~*PM10 < 150 µg/Nm³*~~	~~*EN 12341*~~
~~*Styrene emission to air*~~	~~*< 210 mg/Nm³*~~	
~~*Water recycling ratio*~~	~~$= \frac{\text{waste water recycled}}{\text{total water leaving process}} \cdot 100 \geq 90\%$~~	~~*Technical appendix A3*~~
Suspended solid emission to water	*< 40 mg/l*	*ISO 5667-17*
~~*Cd emission to water*~~	~~*< 0,015*~~	~~*ISO 8288*~~
Cr(VI) emission to water	*< 0,15 mg/l*	*ISO 11083*
Fe emission to water	*< 1,5 mg/l*	*ISO 6332*
~~*Pb emission to water*~~	~~*< 0,15 mg/l*~~	~~*ISO 8288*~~

Assessment and verification:

The applicant shall provide the corresponding analysis and test reports for each emission parameter measured at all emission points. Where no test method is specified, or is mentioned as being for use in verification or monitoring, competent bodies should rely as appropriate on declarations and documentation provided by the applicant and/or independent verifications

TR v1.0 proposed criterion:-2.2.2. Emissions to water

Mandatory requirement

Effluent water discharged to the environment from processing operations must not exceed the following limits. These limits apply after waste water treatment, whether on-site or off-site.

Parameter	**Limit (mg/l)**
Total Suspended Solids (TSS)	35
COD (mg/l O_2)	100
Cr(VI)	<0.15 mg/l
Fe	<1.5 mg/l

If the settled wastewater is discharged to a municipal sewage works or other third party operated treatment plant, the applicant shall be exempted from demonstrating compliance with the emission limits defined above.

Assessment and verification:

The applicant shall provide a declaration of compliance with the mandatory requirements of this criterion, clearly state if process wastewater is discharged to local watercourses or to the sewerage network.

In cases where treated process wastewater is discharged to local watercourses and it is not possible to provide specific data for a production line or product, the applicant shall refer to data for the entire plant and provide test reports based on weekly analysis of the discharged wastewater according to the standard test methods defined above or equivalent in-house laboratory methods. Less frequent testing may be permitted in cases where the operating permit sets less frequent testing requirements.

TR v2.0 proposed criterion:-2.2.2. Water and wastewater management

Mandatory requirement

The applicant shall provide a description of water use in the natural stone transformation plant, including strategies and methods for collection, recirculation and reuse of water.

The recovery of solids from wastewater from cutting operations must be carried out onsite using sedimentation and/or filtration principles. Any clarified waste water after solids removal that is discharged to local watercourses must not exceed the following limits:

Parameter	Limit
Total Suspended Solids (TSS)	35 mg/L
Chemical Oxygen Demand (COD)	100 mg/L
Cr(VI)	<0.15 mg/L
Fe	<1.5 mg/L

If the settled wastewater is discharged to a municipal sewage works or other third party operated treatment plant, the applicant shall be exempted from demonstrating compliance with the emission limits defined above, but the third party wastewater treatment operator shall declare compliance with the limits for TSS and COD.

EU Ecolabel points

Points shall be awarded for applicants that can demonstrate the following aspects:

- The reuse of treated waste water for all cutting operations and dust control purposes (up to 5 points).
- The installation of a rainwater collection system to collect and store rainwater that lands on impermeable areas on site (5 points).

Assessment and verification:

The applicant shall provide a declaration describing the use of water onsite and the wastewater collection network and treatment system. The declaration shall also state if effluent waste water is reused, discharged to local watercourses *and/or discharged to the sewerage network.*

In cases where treated process wastewater is discharged to local watercourses and it is not possible to provide specific data for a production line or product, the applicant shall refer to data for the entire plant and provide test reports based on weekly analysis of the discharged wastewater according to the standard test methods defined above or equivalent in-house laboratory methods. Less frequent testing may be permitted in cases where the operating permit sets less frequent testing requirements.

Rationale:

<u>*Sources of wastewater.*</u>

Wastewater is produced by any one of several processing operations which require water, for example:

- Cutting: Water can be used for cooling, for transport of abrasive particles or used under high pressure to directly deliver the cutting action itself, for example in CNC (Computer Numerically Controlled) drills.
- Finishing: Polishing is generally carried out in contact with water in order to carry loose fines away before the might impede the polishing action.
- Dust control: especially from cleaning of floor surfaces and vehicles tyres.

The main pollutant resulting from these operations are solid particles from the rock and from cutting blade teeth, diamond wire or polishing media. Solids separation (i.e. primary water treatment) at the transformation plant is different than the quarry in the sense that there is always much less available footprint at the transformation plant than the quarry. Consequently, more intensive solids separation techniques such as inclined plate clarifiers and/or flocculant dosing are more likely to be employed. The separated sludge is highly likely to be dewatered to reduce the sludge volume prior to collection and transport offsite, thus also reducing disposal costs.

<u>*Why no limits for emission of Cd and Pb to wastewater?*</u>

The authors are not aware of any potential sources of Pb and Cd and suspect that this was carried over from the equivalent criteria for ceramic tiles, where Pb and Cd could be provided via certain glaze formulations.

<u>*Why a limit for COD emissions?*</u>

The stone cutting and finishing operations involve a lot of moving parts which need to be lubricated and grease can be expected to be transmitted to the wastewater. Since the COD is associated with dissolved organics or fats, oils and grease that will float (i.e. not generally settling with suspended solids) it was considered relevant to propose this type of emission testing, in cases where wastewater is discharged directly to local watercourses. In general, the two most common pollutants that are to be tested from most wastewater discharges are suspended solids and COD (or some proxy measure of COD like Total Organic Carbon, TOC).

Outcomes from and after the 1st AHWG meeting

No comments were raised during the stakeholder meeting regarding this criterion. During the period for written feedback, one comment was received stating that the criterion should apply equally regardless of whether the effluent is sent to a third party wastewater treatment plant or discharged to local water courses.

In response to this comment, the revised proposal now maintains some commitment, even from the third party wastewater treatment plant operator, for control on TSS and COD, because they will normally have to measure this anyway. However, the JRC did not consider it appropriate to ask the third party wastewater treatment plant operator to declare on Cr(VI) and Fe emissions for a number of reasons. The two most obvious reasons would be: (i) any Fe and Cr(VI) would be greatly diluted by other influents to the plant from other sources and (ii) these tests are not routine and would increase costs and assessment and verification efforts.

Further research:

What do other schemes say?

The Fair Stone international standard for the natural stone industry (4th edition, 2010) sets the following requirements that relate to energy consumption in stone processing factories:

- 25.6. Waste water and waste materials are disposed of properly so that they might not endanger workers and inhabitants close by.
- 26.1. A study on how to save water and other consumables, and how to recycle waste water must be undertaken and documented.
- 26.2. The company must take appropriate measures to ensure economical use of electrical energy and water. All staff must know how to save energy and water.
- 26.3. The company uses production methods that minimize water consumption.

The Natural Stone Council (NSC) standard 373 – sustainability assessment for natural dimension stone has more concrete requirements relating to energy in natural stone manufacturing facilities.

Table 9. NSC 373 criteria on water for natural stone transformation/production

Criterion title	Criterion text
5.1 Water Inventory (M)	The facility operator shall develop and maintain an annual inventory of water use including the quantity of water used on an annual basis, organized by water source (e.g., municipal potable, direct rainwater captured for reuse, on-site wells, or reclaimed grey water. Water used as a result of both manufacturing and non-manufacturing operations shall be included.
5.2.1 Recycled water (M)	A minimum of 25% of the water accounted for in the inventory for fabrication or quarry operations shall be captured and recycled.
5.2.2 Recycled water (O) (max. 2 points)	A minimum of a) 26% to 90% of the water accounted for in the inventory for processing or quarry operations are captured and recycled. (1 point); or b) More than 90% of the water accounted for in the inventory for processing or quarry operations is captured and recycled. (2 points total)
5.3.1 Enhanced water treatment (O) (1 point)	Demonstrate on-site systems that result in enhanced treatment of discharge water. Enhanced treatment shall be demonstrated by one of the following: a) Management of wastewater on-site resulting in no direct discharge of water (e.g., seepage ponds) (1 point); or b) Quality of discharged water, either to POTW or directly to the environment, is demonstrated to meet State drinking water standards (1 point); or c) Where no permits or regulations are applicable, the facility operators demonstrate that the quality of water discharged to the environment from their facility meets the US EPA's NPDES (National Pollutant Discharge Elimination System) requirements. (1 point) Facility Operators that do not utilize water in their manufacturing operations shall qualify for 1 point under this criterion.
5.3.3 Water Reuse (O) (2 points)	The facility operator shall document as compared to the annual water inventory (see 5.1) for both manufacturing and non-manufacturing operations, that at least 25% of input water is sourced from rainwater, grey water, or other source that is non-potable. (1 point)

M = Mandatory, O = Optional

The 2018 draft version of hard surfacing criteria set by Good Environmental Choice Australia (GECA) state the following:

"*5.1 Water Emissions: Criterion 21: Effluent waters discharged to the environment from processing or finishing operations shall not exceed the following limits. These limits apply after water treatment either on- or off-site. Municipal sewage treatment plant emission levels may be used if waste water is discharged directly to the sewer by permit from the relevant local authority.*

Suspended solids 40 mg/L; Cadmium 0.015 mg/L; Chromium (VI) 0.15 mg/L); Iron 1.5 mg/L and Lead 0.15 mg/L.

The waste water produced by the processes included in the production chain shall reach a recycling ratio of at least 90 %. The recycling ratio shall be calculated as the ratio between the waste water recycled or recovered (by applying a combination of process optimisation measures and process waste water treatment systems, internally or externally at the plant), and the total water that leaves the process."

Overall, the Fair Stone requirements on water and wastewater management were very vague, whereas the NSC and GECA requirements were much more specific. In both NSC and GECA, emphasis is placed on the recycling of waste water, so this approach should be taken forward into the new proposal for EU Ecolabel criteria.

In terms of pollutants in discharged waste water, the GECA criteria appear to be a modelled directly on the older EU Ecolabel criteria. However, as mentioned above, many of the pollutants listed do not make sense for a natural stone transformation plant.

The NSC criteria also introduce an interesting optional requirement relating to rainwater harvesting that would be interesting to promote for the EU Ecolabel as well, especially considering the increasingly unpredictable swings in climate reported in many parts of Europe from longer drought periods to more intense storm events. In both extremes of weather period, a rainwater collection and storage capacity would be beneficial. For example, in a prolonged drought period, the previously collected rainwater would be used and would reduce the abstraction requirement from the local watercourse, which may already be under water stress. During heavy storm periods, any storm water hitting impermeable areas such as roofs or paved areas would be diverted to storage tanks onsite instead of contributing to the peak runoff flowing downstream, thus reducing flood risks downstream.

2.2.3 - Dust control

Existing criterion: 3. Finishing operations (for natural products only)

Part of current Criterion 3 : Finishing operations (for natural products only)

Finishing operations on natural products shall be made according to the following requirements:

Parameter	Limit (to pass)	Test method
Particulate emission to air	*PM10 < 150 µg/Nm^3*	*EN 12341*
Styrene emission to air	*< 210 mg/Nm^3*	
~~*Water recycling ratio*~~	~~$= \frac{\text{waste water recycled}}{\text{total water leaving process}} \cdot 100 \geq 90\%$~~	~~*Technical appendix A3*~~
~~*Suspended solid emission to water*~~	~~*< 40 mg/l*~~	~~*ISO 5667-17*~~
~~*Cd emission to water*~~	~~*< 0,015*~~	~~*ISO 8288*~~
~~*Cr(VI) emission to water*~~	~~*< 0,15 mg/l*~~	~~*ISO 11083*~~
~~*Fe emission to water*~~	~~*< 1,5 mg/l*~~	~~*ISO 6332*~~
~~*Pb emission to water*~~	~~*< 0,15 mg/l*~~	~~*ISO 8288*~~

***Assessment and verification**:*

The applicant shall provide the corresponding analysis and test reports for each emission parameter measured at all emission points. Where no test method is specified, or is mentioned as being for use in verification or monitoring, competent bodies should rely as appropriate on declarations and documentation provided by the applicant and/or independent verifications

TR v1.0 proposed criterion:-2.2.3. Dust control

No proposal made for dust emissions or styrene emissions from natural stone processing plants.

TR v2.0 proposed criterion:-2.2.3. Dust control

Mandatory requirement

The applicant shall demonstrate features and operations that have been implemented at the transformation plant for dust control. Features will vary from site to site but should include the following aspects, where relevant:

- the employment of dust suppression water sprays or vacuum hoods linked to dust filter bags/electrostatic precipitators for any dry cutting or shaping activities that are likely to generate significant quantities of dust.
- To regularly clean indoor floor areas of dust using either water sprays on surfaces that drain to a water treatment system onsite or the use of a vacuum device for

dry dust removal (sweeping of dry dust should not be carried out).

- The storage of any settled solids in enclosed containers prior to their shipment off-site, regardless of whether it is for reuse or disposal to landfill.
- cover the most heavily used road areas with concrete or asphalt paving.
- provision of appropriate training to employees about good practice for dust control and provision of adequate personal protective equipment to employees and visitors.

Assessment and verification:

The applicant shall provide a declaration of compliance with this criterion, supported by relevant documentation and a description of the dust control features implemented at the quarry site.

In cases where the applicant is not the quarry operator, the applicant shall declare the quarry from which the material used to produce the EU Ecolabel natural stone tiles or slabs has been sourced, supported by delivery invoices and a relevant declaration from the quarry operator regarding dust control at the quarry site.

Rationale:

Much of the rationale stated in section 2.1.4 for quarry dust control also applies to the transformation plant dust control. Although a transformation plant represents a much more controlled environment than a quarry, operations are still quite manual and are carried out sometimes in enclosed spaces but often in open warehouses. Due to the highly variable nature of operations and the much smaller scale compared to ceramic or cement production facilities, dust emissions are highly variable, both in time and location.

Consequently, instead of setting a fixed concentration on dust in air (difficult to measure from diffuse sources instead of point sources), it was considered more pragmatic to define a series of practices that could be made mandatory for the purposes of obtaining the EU Ecolabel.

Outcomes from and after the 1st AHWG meeting

No comments were raised at the meeting or received in written form in the subsequent period for written comments. However, experience from sites visits showed the different extents to which dust control is actually being achieved in transformation plants and, especially in the case of siliceous rocks, dust control at the transformation plant should be a high priority both for worker safety and the potential pollution of surrounding areas with wind-blown dust.

Further research:

What do other schemes say?

The Fair Stone international standard for the natural stone industry (4th edition, 2010) sets the following requirements that relate to dust control in stone processing factories:

- 9.1. The employer shall take all possible measures in order to eliminate exposure or reduce the concentration of silica dust in the workplace.

- 9.2. Introduce technical measures such as wet processing or dust extraction and take organizational measures e.g. segregate areas with a higher level of concentration from those with a lower level, minimize periods/levels of exposure.
- 9.3. Dry dust shall be extracted by vacuum dust collectors wherever possible.
- 9.4. Regular cleaning of machinery, cabins and rooms in order to avoid dust accumulation is essential.
- 9.5. To avoid the spread of dust, use water or a vacuum cleaner. Avoid using a broom.
- 9.6. In case of wet drilling or sawing, water quantity has to be sufficient and water feed shall be initiated before processing.
- 9.7. The workforce should be informed about the risks of silica dust and the suitable prevention measures in order to create awareness.

The Natural Stone Council (NSC) standard 373 – sustainability assessment for natural dimension stone, only makes a very general reference that dust control measures should be included in the site management plan for fabrication facilities (under the required criterion 7.1 for site management plan).

The 2018 draft version of hard surfacing criteria set by Good Environmental Choice Australia (GECA) state the following;

"5.2. Air emissions: Criterion 22. Air emissions for each material type are to be measured as follows: …..Natural Products – finishing stage: 300 mg/m^2.

If the finishing operation for natural stone products is conducted at a different site from the extraction operation, a human health risk assessment must be undertaken to identify the nature and possible risks of particulate emissions associated with finishing operations. Where finishing operations for natural stones are conducted on the same site as extraction operations, Section 3.1.5 shall apply as the air emission requirement.".

Overall, the Fair Stone, NSC and GECA approaches are completely different. The GECA approach most closely relates to the EU Ecolabel approach set out in Decision 2009/607/EC (although they have copied the limits for agglomerated stone in mg/m^2 instead of the limit for natural stone finishing operations, in ug/Nm^3), while the Fair Stone requirement states specific measures more focused on worker safety and the NSC criteria are very general.

2.2.4 – Transformation waste reuse

Existing criterion 5.2. Recovery of waste (*for processed products only*)
The applicant shall provide an appropriate documentation on the procedures adopted for the recycle of the by-products originated from the process. The applicant shall provide a report including the following information: *— kind and quantity of waste recovered,* *— kind of disposal,* *— information about the reuse (internally or externally to the production process) of waste and secondary materials in the production of new products.* *At least 85 % (by weight) of the total waste generated by the process or the processes (2) shall be recovered according to the general terms and definitions established by Council Directive 75/442/EEC (3).* *Assessment and verification: the applicant shall provide appropriate documentation based on, for example, mass balance sheets and/or environmental reporting systems showing the rates of recovery achieved whether externally or internally, for example, by means of recycling, reuse or reclamation/regeneration.* *(2) Process wastes do not include maintenance wastes, organic wastes and urban wastes produced by auxiliary and office activities.* *(3) OJ L 194, 25.7.1975, p. 39.* *(4) OJ L 40, 11.2.1989, p. 12.*
TR v1.0 proposed criterion:–2.2.3 Recycling of waste from processing operations
Mandatory requirement At least 70% by mass of the process waste* generated from natural stone processing operations onsite shall be diverted from landfill. *i.e. sludge from polishing and other finishing operations, cutting operations, broken specimens and off-cuts from squaring, rectification and any customized shaping. **EU Ecolabel points** Points shall be awarded for applicants that can demonstrate higher reuse rates of process waste up a maximum of 90% reuse by mass (up to 20 points). ***Assessment and verification:*** *The applicant shall provide a declaration of compliance with the mandatory requirement of this criterion, supported by a calculation of total production process waste (in kg or t). Details about the destination of these process wastes shall also be provided with clarifications about whether it is external use in another process or sent to landfill. For any external use or landfill disposal, shipment notes shall be presented.* *In case it is not possible to provide specific data for a production line or product, the applicant shall refer to data for the entire plant.* *Points shall be awarded in proportion to how closely the data reaches the maximum benchmark set (e.g. process waste reuse rate of 70% = 0 points and 90% = 20 points).*

TR v2.0 proposed criterion:-2.2.4 Transformation waste reuse
Mandatory requirement The applicant shall complete an inventory of process waste production for the transformation plant. The inventory shall detail the type and quantity of waste produced (e.g. process scrap* and sludge). The process waste inventory shall cover a 12 month period and, during that same period, the total product output shall be estimated both in terms of mass (kg or tonne) and surface area (m^2). At least 80% by mass of the process scrap* generated from natural stone processing operations onsite shall be reused in other applications or stored onsite in preparation for future sale. **fragments, trimmings and dust from transformation operations at the transformation plant.* **EU Ecolabel points** Points shall be awarded for applicants that can demonstrate higher reuse rates of process scrap up a maximum of 100% reuse by mass (up to 10 points). Points shall be awarded for applicants that can demonstrate any diversion of process sludge** up to a maximum of 100% (up to 10 points). ***settled solids recovered from the onsite treatment of waste water from cutting and polishing operations* ***Assessment and verification:*** *The applicant shall provide a waste inventory for the transformation plant for a period of at least 12 months prior to the date of award of the EU Ecolabel license and shall commit to maintaining such an inventory up to date during the validity of the EU Ecolabel license.* *The applicant shall provide a declaration of compliance with the mandatory requirement of this criterion, supported by a calculation of total production process scrap (in kg or t). Details about the destination of these process wastes shall also be provided with clarifications about whether it is external use in another process or sent to landfill. For any external use or landfill disposal, shipment notes shall be presented.* *In case it is not possible to provide specific data for a production line or product, the applicant shall refer to data for the entire plant.* *Points shall be awarded in proportion to how closely the data reaches the maximum benchmark set (e.g. process waste reuse rate of 80% = 0 points and 100% = 10 points; process sludge diversion from landfill of 0% = 0 points and 100% = 10 points).*

Rationale:

The processing stage involves splitting blocks into slabs and treating their surfaces. Cutting is performed by either: (i) the action of metal gang saws and the forced horizontal movement of abrasive pulp (rock dust, grit, and lime) or (ii) diamond wire looms, with water spraying for dust suppression. At this stage, approximately 25% of each of the cut blocks is converted into waste. The exact figure varies by technique used, the thickness of the cutting media (thinner cutting media produce less relative waste) and the desired thickness of the slabs (thicker slabs produce less relative waste).

Solid wastes generated by cutting and polishing operations are removed by cooling water and rinsing water respectively. These wastewater streams may be combined into a single sedimentation tank or be treated separately for discharge according to its composition: waste with grit, produced by cutting with traditional looms; and waste without grit, produced by cutting with diamond wires and from polishing.

Given the costs of the potential transportation of this this waste and discharge and the environmental impact that can be caused by the large volume produced, studies have been performed examining its potential reuse in civil construction. In its natural state, after dewatering, the waste sludge has a moisture level between 20 and 30%.

Marras et al., (2010) showed that marble fines from filter press sludge after quarry and transformation plant wastewater treatment was fine for use up to 10% of total raw material mass in the firing of clay bricks. Medina et al., (2017) showed that granite sludge could be used as a supplementary cementitious material, substituting 10 or 20% of the cement clinker content while still meeting the relevant technical requirements for Type II/A and Type IV/A cements despite potential concern about the relatively high alkali (Na and K) content in the sludge and the inconclusive results about whether the sludge exhibited pozzolanic activity or not.

In a comprehensive review of the potential reuse of dimension stone waste in concrete, Rana et al., (2016) concluded that the reuse potential was highest for the substitution of coarse aggregates (100%), then fine aggregates (5 to 100% depending on the type of waste) and then cement replacement (up to 20% for quarry dust).

Use of flocculants

The use of a flocculant can increase sedimentation rates and result in a smaller footprint wastewater treatment plant onsite or improved suspended solid removal. However, the flocculant will also increase the quantity of sludge generated, especially if inorganic ferric chloride or alum sulphate are used, which react in water streams to form $Fe(OH)_3$ and $Al(OH)_3$ precipitates respectively. Organic flocculants may be particularly effective but could compromise the potential to reuse the sludge in certain applications, particularly in blended cements, where any organic matter can have a drastic and unpredictable effect on cement setting behaviour.

During the site visit to Carrara, the use of flocculants was common practice in process wastewater treatment, although the operators were not aware of the type of flocculant that was being used. Regardless of the type of flocculant used, its presence in the settled sludge may complicate its potential reuse or at least the market value of the waste material.

Unlike ceramic tile production, there is no real opportunity for the process waste to be reincorporated into the natural stone production process, although some sludges, if of a sufficiently high purity, may be suitable in the fabrication of agglomerated stone products.

The normal practice is that a plant may process blocks from a large number of quarries, resulting in a high heterogeneity of the process waste.

Some more details about resin impregnation to reduce material waste

Generally, the systems commonly used in marble processing are not satisfactory for granite processing lines. Granite is much harder, with microscopic fissures and a different absorption rate. No polyester resin would have the capability to deeply penetrate in the very thin cracks of the granite stone, harden up and give a sufficient strength to the material but epoxy resins have shown the capability to fill all of the pits and micro-fissures present in the granite. Additionally, its long hardening time allows the glue to penetrate deeply into the stone before the complete curing will occur. Before being treated, the surface of a granite slab has to be honed; to allow the surface of the material to evenly absorb the resin. This process requires special convection ovens or two to three days in favorable dry working conditions. After being mixed in the right ratio (either using a scale or an automatic mixing dispenser), the resin is then spread on the whole surface. After the system is completely cured (usually it takes up to 24 hours, depending on the system and the equipment used) the slab is ready to be polished. During the polishing process, the first steps are focused on removing all excess resin poured on top of the slab, leaving only the resin that has filled into the cracks or the pits. In this way, the epoxy resin will not form a film on top of the granite, and it will be present only in the interspaces and in the micro-fissures

The use of the sludge from natural stone processing may be used in road base or backfill. With higher value applications, it is not yet clear if levels sludge from marble processing would be pure enough for recycling in the paper or food sectors.

Outcomes from and after the 1st AHWG meeting

No comments were raised at the meeting or received in written form in the subsequent period for written comments. However, a review of other environmentally relevant schemes for natural stone products resulted in a new proposal for this criterion being brought forward in TR v2.0.

Further research:

What do other schemes say?

The Fair Stone international standard for the natural stone industry (4th edition, 2010) sets the following requirements that relate to waste management in stone processing factories:

- 25.1. A study on how to reduce and recycle waste must be undertaken and documented.
- 25.2. Minimise production of waste, use all possibilities of waste separation or recycling and ensure the responsible disposal based on principles of sustainability.
- 25.3. Used cleaning rags are collected in flame-resistant containers with a lid.
- 25.4. Waste must be disposed of at regular intervals.
- 25.5. Combustible waste, debris, and rubble must be collected and promptly removed from the workplace.
- 25.6. Waste water and waste materials are disposed of properly so that they might not endanger workers and inhabitants close by.

The Natural Stone Council (NSC) standard 373 – sustainability assessment for natural dimension stone, only a number of references to criteria on waste management.

Table 10. NSC 373 criteria on energy for natural stone transformation/production

Criterion title	Criterion text
5.2.3 Enhanced sludge treatment (O)	The facility operator shall demonstrate operation of a sludge management system that diverts a minimum of 50% of annual sludge produced by operations from traditional disposal methods by landfill or incineration, in favor of environmentally acceptable reuse applications (e.g., agricultural use). To qualify for this criterion, the facility operator shall provide documentation of the diversion, including a description of the end disposal method. (1 point)
11.1 Inventory of excess process materials and solid waste (M)	The facility operator shall create and maintain an inventory of excess materials generated by its operations. The inventory shall characterize the nature of the excess materials (e.g., sludge, fines, cuttings), the annual quantity generated (estimated or measured), the source of the excess materials (e.g., cutting operations, rejects), the percent or quantity reclaimed or recycled, and the disposal, storage, or reclaim method. In addition, the inventory shall also track general solid waste and recyclables generated on-site, characterizing the nature and annual quantity of the waste, the percent recycled or reclaimed, and the method of reclaim or disposal.
11.2 Excess process material and waste management program (M)	The facility operator shall establish and implement a program to track and manage excess process material and to systematically reduce or eliminate waste. Specifically, the program shall track and measure the amount of excess process material and solid waste produced by source and type, identify opportunities and methods for reducing generation rates, establish target goals, quantify changes in generation rates (normalized by production volume), and monitor progress of program efforts. At a minimum, the program shall address each of the following: a) Material yield improvement; b) Management of stone excess material from dimensional stone production; c) Alternative uses for processing excess material; d) Management of solid waste including collection, separation, disposal and/or recycling; e) Reuse, recycling or reclaim of goods used in processing; and f) Office waste reduction. This program shall track progress towards established goals on a rolling 6-year period for both solid waste and excess process material. Progress shall be estimated or measured based on percentage reduction in generation rates (per unit of dimension stone produced), and be reported publicly (e.g., corporate sustainability report, website posting). If estimated, the facility operator shall provide method of estimation and documented data on which the estimation is based to receive credit.
11.3 Demonstrated process reduction of excess process materials (O)	The facility operator shall demonstrate, over a 6-year timeframe, the successful reduction of excess process material generated per unit processed. Methods for reducing such materials shall include but are not limited to, process modification, operational changes, efficient use of materials, and use of more sustainable materials (estimated or measured as ton of scrap per unit of dimension stone produced). a) Achieved reduction of 10 - 24% of excess process material inventory (1 point); b) Achieved reduction of 25 - 50% of excess process material inventory (2 points total); or c) Achieved reduction of greater than 50% of excess process material inventory (3 points total). All reductions shall be measured relative to total excess process material (e.g., ton of excess material/ton of stone product produced), as determined in section 11.1 and shall be measured or estimated to receive credit. If estimated, operator shall provide method of estimation and documented data on which the estimation is based to receive credit. Achieved reductions shall be calculated by comparing the total excess material for the most recent completed year to that of the baseline year, and calculating the percent of total excess material reduction achieved. The baseline year shall be the year 6 years prior, providing that a complete inventory meeting the requirements of section 11.1 exists for that year. Otherwise, the baseline shall be the most recent year for which a complete inventory meeting section 11.1 exists. Under no circumstances shall data from more than 6 years prior be used as a baseline in this criterion.
11.4 Demonstrated	The facility operator shall demonstrate, over a 6-year timeframe, the successful reduction of solid waste generated per unit processed. Methods for reducing waste

solid waste production (O)	include but are not limited to process modification, operational changes, efficient use of materials, and use of more sustainable materials (measured as lbs of solid waste per unit produced). a) Achieved reduction of 25 - 60% of solid waste inventory (1 points total); or b) Achieved reduction of greater than 60% of solid waste inventory (2 points total). Reductions shall be measured relative to the inventory as determined in section 11.1, and shall be measured or estimated. If estimated, the facility operator shall provide method of estimation and documented data on which the estimation is based to receive credit. Alternatively, for the purposes of this credit, a facility shall use as a baseline a solid waste inventory from a previous year, provided that the inventory meets the requirements of section 11.1, goes back no further than 6 years, and shall be properly documented. In such cases, credits shall be awarded for achieved reductions against the past inventory (see Foreword).

M = Mandatory, O = Optional

The 2018 draft version of hard surfacing criteria set by Good Environmental Choice Australia (GECA) state the following;

"6.3. Waste Management. Criterion 25: Manufacturers shall be able to demonstrate the following elements, as minimum, in a waste management program covering all operational sites:

• Functioning procedures for diverting recyclable and reusable materials from the waste stream.

• Functioning procedures for the recovery of waste materials for other purposes.

• Contracts with registered hazardous waste contractors, where hazardous waste is generated by the process.

• Waste recovery or diversion from landfill, where technically possible."

The NSC criteria make an interesting distinction between process scrap and process sludge. Such a distinction seems justifiable because the materials are significantly different due to their particle size ranges. The larger scrap materials can be crushed to specific size fractions prior to reuse as coarse aggregate but the sludge may be difficult to reuse if flocculants have been used. Consequently, even just a low reuse percentage of process sludge should be encouraged while some mandatory requirement is needed for the process scrap reuse.

CRITERIA 3: Agglomerated stone criteria

Due to a general lack of detailed information in the literature about market data, process technologies, chemical additives, product variations and environmental information such as specific energy consumption of the production process, agglomerated stone products are proposed to be removed from the product group scope for EU Ecolabel hard coverings.

Should suitable information become available in due course, it would be possible to consider agglomerated stone products within the scope of EU Ecolabel furniture in the future.

LCA hotspots of agglomerated stone products

As a simple snapshot of the typical LCA impacts of an "engineered stone" product (synonymous with the term agglomerated stone when organic binders are used), is shown below.

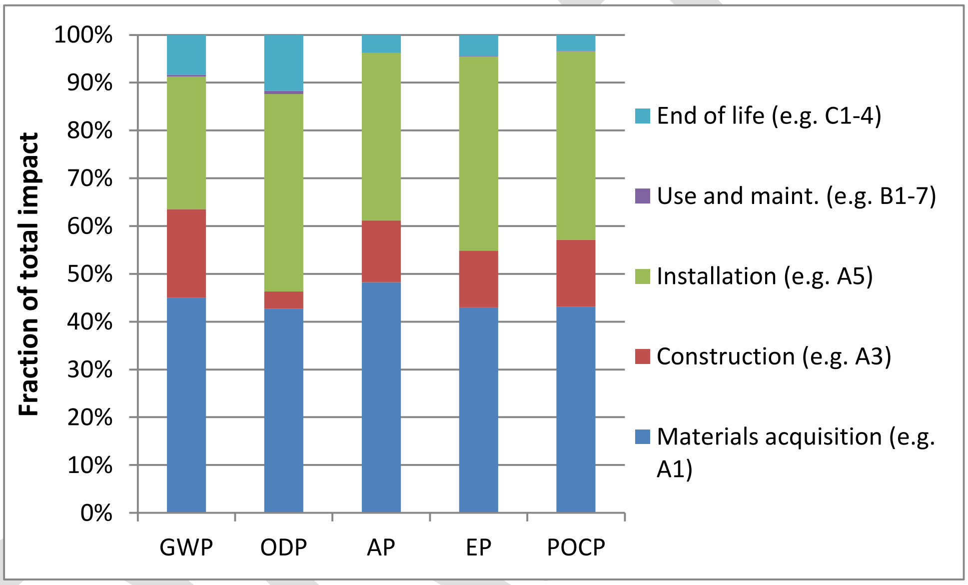


Figure 16. Split of LCA impacts between different life cycle stages of an "engineered stone" product (Corian Quartz)

Only a few EPDs for engineered stone products have been published online and this particular example does not follow the EN 15804 framework because it is an American product. Nevertheless, it is possible to approximate which EN 15804 modules the American life cycle stages correspond to when reading their descriptions:

- **Material acquisition (and pre-processing):** This stage includes the extraction of materials from nature, processing required to create the raw materials used in surfaces production, and transportation of the materials to the construction stage. Any processing of secondary materials used in surfaces production is also included.
- **Construction:** During construction, raw materials for the countertop are processed into slab. The stage also includes production and inbound transport of packaging materials.
- **Installation:** The installation stage starts with the transportation of the slab to a warehouse, distributor, and/or fabricator. The fabricator, who is responsible for customizing the slab, is assumed to travel to the installation site to take initial measurements. These measurements are used to customize the slab back at the

fabrication facility. Since Corian® Quartz is used for more than residential countertops, a 10% scrap rate is assumed. Lastly, the customized slab is transported to the installation site and installed with Corian® joint adhesive.

- **Use and maintenance:** Use includes product maintenance—typically cleaning with tap water and soap—over the 10-year timeframe. No sealing or additional maintenance is needed.
- **End-of-Life:** The end-of-life stage includes the disposal of the surface, as well as the disposal of packaging from installation. Corian® Quartz is assumed to be disposed entirely to landfill or incinerated.

The so called A1-A3 stages account for 45 to 65% of the total impacts for each impact category, which is a reasonable justification for setting EU Ecolabel requirements at the production stage. It is interesting to note how significant the LCA impacts are at the installation stage because the nature of the "engineered stone" material (uniform microstructure and relative ease of shaping/cutting) these product lend themselves well to cutting **after** the slab has been finished. These customisation procedures are assumed to result in 10% of the material being scraped at this stage. This scrap rate and the need for a specialised joint adhesive are no doubt the main reasons behind the significant influence of the installation stage on LCA impacts.

Comparison of existing and proposed criteria

The criteria specifically for ceramic tiles set out in Decision 2009/607/EC and the current proposals are compared below. A combination of mandatory criteria and opportunities to gain EU Ecolabel points are detailed in this section for agglomerated stone products.

Table 11. Agglomerated stone-specific criteria structure and scoring system

Proposed criteria	Decision 2009/607/EC	Proposed criteria details	
		Mandatory?	Points?
1.1. Environmental Management System	No	Yes	5
1.5. VOC emissions	No	Yes	5
3.1 Energy consumption	Yes	Yes	25
3.2 Emissions to air	Yes	Yes	-
3.3 Recycled/secondary material content	No	No	40
3.4 Binder content	Yes	Yes	25
TOTAL points available in proposed criteria			**100**
MINIMUM points needed in proposed criteria			**50**

3.1 – Energy consumption

Existing criterion for energy consumption: 4.1: Energy consumption, (a) Process energy requirement (PER) limit
4.1. The energy consumption shall be calculated as process energy requirement (PER) for agglomerated stones and terrazzo tiles. (b) Energy requirement for firing (ERF) limit The process energy requirement (PER) for agglomerated stones and terrazzo tiles manufacturing processes shall not exceed the following levels:

	Requirement (MJ/kg)	Test method
Agglomerated stone	1.6	Technical appendix — A4

Note: requirement expressed in MJ per kg of final product ready to be sold.

Assessment and verification:

The applicant shall calculate the PER according to the Technical appendix — A4 instructions and provide the related results and supporting documentation.

A4 Energy consumption calculation (PER, ERF)

When providing a calculation of process energy requirement (PER) or energy requirement for firing (ERF), the correct energy carriers shall be taken into account for the entire plant or for the firing stage only. Gross calorific values (high heat value) of fuels shall be used to convert energy units to MJ (Table A1). In case of use of other fuels, the calorific value used for the calculation shall be mentioned. Electricity means net imported electricity coming from the grid and internal generation of electricity measured as electric power.

Evaluation of PER for agglomerated stone production shall consider all energy flows entering the production plant both as fuels and electricity.

~~*Evaluation of PER for terrazzo tiles production must consider all energy flows entering the production plant both as fuels and electricity.*~~

~~*Evaluation of ERF for ceramic tile production shall consider all energy flows entering all the kilns as fuels for the firing stage.*~~

~~*Evaluation of ERF for clay tile production shall consider all energy flows entering all the kilns as fuels for the firing stage.*~~

~~*Evaluation of PER for cement production shall consider all energy flows entering the production system both as fuels and electricity.*~~

Table A1

Table for calculation of PER or ERF (see text for explanations)

Production period	Days	From	To	
Production (kg)				
Fuel	Quantity	Units	Conversion factor	Energy (MJ)
Natural gas		kg	54,1	
Natural gas		Nm^3	38,8	
Butane		kg	49,3	
Kerosene		kg	46,5	
Gasoline		kg	52,7	
Diesel		kg	44,6	
Gas oil		kg	45,2	
Heavy fuel oil		kg	42,7	
Dry steam coal		kg	30,6	
Anthracite		kg	29,7	
Charcoal		kg	33,7	
Industrial coke		kg	27,9	
Electricity (from net)		kg	3,6	
			Total energy	
Specific energy consumption (MJ/kg of product)				

~~**TR v1.0 proposed criterion: 3.1. Energy consumption**~~

~~**Mandatory requirement**~~

~~The specific energy consumption for agglomerated stone production shall not exceed 1.1 MJ/kg.~~

~~**EU Ecolabel points**~~

~~Points shall be awarded for applicants that can demonstrate the following~~

~~aspects:~~

- ~~Installation of onsite CHP (10 points)~~
- ~~Up to 15 points can be awarded in proportion to how much of the supplied electricity is from renewable sources (i.e. 0 points for 0% renewable electricity, 15 points for 20% renewable electricity).~~

~~***Assessment and verification***~~

~~*The applicant shall provide a declaration of compliance with the mandatory requirement for energy consumption and any relevant declaration regarding the onsite CHP and renewable energy sources and use of electric vehicles.*~~

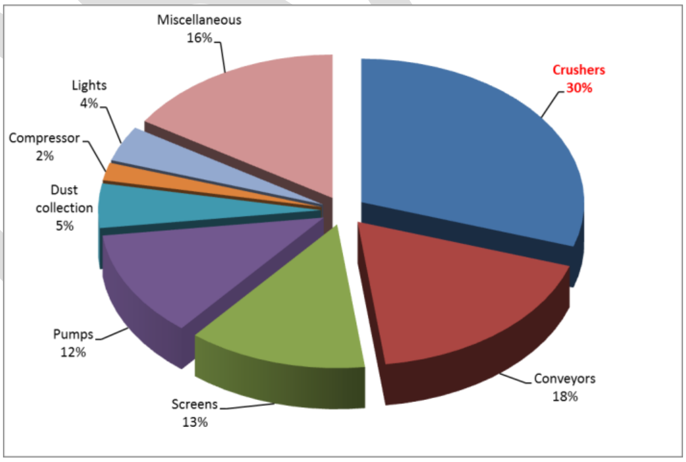
~~*For continuously operating, the production period should be 12 months. In cases where production is non-continuous, the production period shall be mentioned and should not be less than 30 days.*~~

TR v2.0 proposed criterion: 3.1. Energy consumption
Proposed to remove as no longer within product group scope

~~**Rationale:**~~

~~A great amount of energy is consumed and dissipated during the entire manufacturing process from crushing the natural stone to the required size to the compacting and hardening processes and final polishing. The manufacturing process is highly standardised and no major changes in the production technologies have occurred however progress and improvements in the already existing technologies processes led to a decrease in energy consumptions.~~

~~The first step to prepare the mixture is to crush the aggregate to the desired size. The crushing facility consists of feeders, crushers, conveyors and screens. Figure 17 shows that the crushers are the largest electricity end-use, followed by the conveyors and screens.~~



~~**Figure 17. Electric energy use breakdown in a crushing facility**~~

~~Crushers mechanically break the stone into smaller pieces. Reduction in size is generally accomplished in several crushing stages, as there are practical limitations on the ratio of size reduction through a single stage. Crusher selection is based on rock type, required size reduction, output rock shape and production rate. A significant number of facilities have older crushers with inefficient controls that~~

present a significant potential for increasing production efficiencies. System optimisation in terms of number of crushing stages, use premium efficiency motors and cogged V-belts (savings can range from 5 to 15%) maximum load capacity, elimination of the re-circulating load circuits or simply shut off the equipment when not needed results in crushing facility optimization and energy savings.

3.2 – Emissions to air

Existing criterion 4.3 Emissions to air

(a) Agglomerated stones

The emissions to air for the following parameters for the whole manufacturing process shall not exceed the following:

Parameter	*Limit (mg/m²)*	*Test method*
Particulate matter (dust)	*300*	*EN 13284-1*
Nitrogen oxides (as NOx)	*1200*	*EN 14792*
Sulphur dioxide (SO2)	*850*	*EN 14791*
Styrene	*2000*	*-*

***Assessment and verification**:*
The applicant shall provide appropriate documentation and test reports for each emission parameter mentioned above, following the indications of the Technical appendix — A6. Where no testing method is specified, or is mentioned as being for use in verification or monitoring, competent bodies should rely, as appropriate, on declarations and documentation provided by the applicant and/or independent verifications.

A6 Emissions to air (for processed products only)

The air pollutant emission factors shall be calculated as follows:

- *the concentration in the exhaust gas emitted to the environment of each parameter considered in the tables shall be calculated,*
- *the measurements used for the calculation must be made following the testing methods indicated in the tables,*
- *the samplings shall be representative of the considered production.*

TR v1.0 proposed criterion: 3.2. Emissions to air

Mandatory requirement

The emissions to air in the following parameters for the entire manufacturing process shall not exceed the following values

Parameter	Limit (mg/m²)
Particulate matter (dust)	300
Styrene	2000
Nitrogen oxides (as NOx)	1200
Sulphur dioxide (SO2)	850

Assessment and verification

The applicant shall provide a declaration of compliance with the mandatory

~~*requirements of this criterion, supported by site data in mg/Nm³ and expressed as an annual average value calculated from daily average values. The data shall have been generated via continuous monitoring according to EN 13284-1 for dust, EN 14792 for NOx and EN 14791 for SO_2.*~~ ~~*The air pollutant emission factors shall be calculated as follows:*~~ - ~~*the concentration in the exhaust gas emitted to the environment of each parameter considered in the tables shall be calculated,*~~ - ~~*the measurements used for the calculation must be made following the testing methods indicated in the tables,*~~ - ~~*the samplings shall be representative of the considered production.*~~
TR v2.0 proposed criterion: 3.2. Emissions to air
Proposed to remove as no longer within product group scope

~~**Rationale:**~~

~~Dust is generated also during the manufacturing process, both in the mixture preparation and in the finishing operations. Finishing operations, specifically, are mostly performed wet, creating mainly sludge. The main concern, during the manufacturing process, is the emission to air of toxic substances, such as those used in the resins preparations (e.g. styrene, formaldehyde and other VOC), and CO_2 .~~

~~The mixture used to manufacture agglomerated stone contains resins, therefore VOC emissions should be also considered (see Chapter 1. Criterion 1.5). VOC emissions from polyester resin operations occur when the cross-linking agent (monomer) contained in the liquid resin evaporated from fresh resin surfaces into air during application curing. Styrene and methyl methacrylate are by far the principle and the most common monomers used in cross linking agents. Since emissions result from evaporation of monomer from the uncured resin, they depend upon the amount of resin surface exposed to the air and the duration of exposure. Thus the potential for emissions varies with the manner in which the resin is mixed, applied, handled, and cured among the different fabrication processes. Thus, the emission potential in closed moulding operations is considerably low compared with atomisation operations, because of the lower monomer content in the casting resins and of the enclosed nature of the mouldings.~~

~~3.3 – Recycled/secondary material content~~

~~**Existing criterion**~~
~~*No existing criterion*~~
~~**TR v1.0 proposed criterion: 3.3. Recycled/secondary material content**~~
~~**Mandatory requirement**~~ ~~The applicant shall assess and document the regional availability of recycled or secondary aggregates, including fillers.~~ ~~**EU Ecolabel points**~~ ~~Points shall be awarded for applicants that can demonstrate the incorporation of recycled/secondary materials into the agglomerated stone product up to 40%~~

~~w/w content (Up to 40 points).~~ ~~The incorporation of returned or rejected agglomerated stone product into new product shall not be considered as recycled content if it is going back into the same process that generated it.~~ ~~***Assessment and verification:***~~ ~~*The applicant shall provide a declaration of compliance with the mandatory requirement of this criterion, supported by a copy of their company policy for the identification of potential sources of recycled materials.*~~ ~~*An inventory of all sold or stored agglomerated stone production, existing raw materials in stock and raw material deliveries (virgin, secondary and recycled origin) to the manufacturing plant shall be provided, supported by production reports for a period of 12 months.*~~ ~~*In cases of manufacturing plants that only produce one type of product and specification, results should be averaged across the entire production. Where the EU Ecolabel products are produced in specific batches only, any secondary or recycled materials should be allocated according to batch mix compositions used.*~~
TR v2.0 proposed criterion: 3.3. Recycled/secondary material content
Proposed to remove as no longer within product group scope

~~**Rationale:**~~

~~*What is meant exactly by "recycled material"?*~~

~~The ISO 14021 definition of the term "recycled content" and related terms are as follows:~~

- ~~**Recycled content**: Proportion, by mass, of recycled material in a product or packaging. Only pre-consumer and post-consumer materials shall be considered as recycled content, consistent with the following usage of terms.~~
- ~~**Pre-consumer material**: Material diverted from the waste stream during a manufacturing process. Excluded is reutilization of materials such as rework, regrind or scrap generated in a process and capable of being reclaimed within the same process that generated it.~~
- ~~**Post-consumer material**: Material generated by households or by commercial, industrial and institutional facilities in their role as end-users of the product which can no longer be used for its intended purpose. This includes returns of material from the distribution chain.~~
- ~~**Recycled material**: Material that has been reprocessed from recovered [reclaimed] material by means of a manufacturing process and made into a final product or into a component for incorporation into a product.~~
- ~~**Recovered [reclaimed] material**: Material that would have otherwise been disposed of as waste or used for energy recovery, but has instead been collected and recovered [reclaimed] as a material input, in lieu of new primary material, for a recycling or a manufacturing process.~~

~~So unless the agglomerated stone product has previously been transferred to other actors in the distribution chain, it cannot be considered as recycled content when it comes back to the concrete factory. Especially in the case of fresh concrete returns or reject batches, this would normally be considered as being a waste of the production process.~~

~~Within the agglomerated stone manufacture sector there is the common practice to use, in the mixture, a fair amount of pre-consumer recycled materials, intended as derivate and by-products of natural stones quarrying operations; secondly, the recurrence of high ratios of natural stones' gravel in the mixture to which correspond a general low use of artificial binding agents, both resins and cement.~~

~~There are commercial products with high content of recycled content, from 5 % up to 30% in weight. These products qualify for LEED (*Materials – Resources (MR) Credit 4: Recycled content)* which requires materials with recycled content such that the sum of post-consumer recycled content plus 1 /2 of the pre-consumer content constitutes at least 10% or 20%, based on cost, of the total value of the materials in the project. The minimum percentage materials recycled for each point threshold is as follows:~~

~~3.4 - Binder content~~

Existing criterion 2.3. Limitation of the presence of asbestos and polyester resins in the materials
~~*No asbestos shall be present in the raw materials used for natural and processed products, as laid down in Council Directive 76/769/EEC (2).*~~ *The use of polyester resins in the production shall be limited by 10 % of the total weight of raw materials.* *Assessment and verification: in terms of chemical and mineralogical analysis, the material formulation shall be provided by the applicant together with a declaration of compliance with the abovementioned requirements.*
~~TR v1.0 proposed criterion: 3.4. Binder content~~
~~Mandatory requirement~~ ~~The use of polyester, epoxy or other resins in the production shall be limited to 10% of the total weight of raw materials.~~ **~~EU Ecolabel points~~** - Where the content of resin used is less than 10% by weight of the final product, towards a benchmark of 5% (up to 20 points). - Where the resin used is at least 10% bio-based or from recycled plastics (5 points). ***~~Assessment and verification~~***: ~~*The applicant shall provide a declaration of compliance with the mandatory requirements of the criterion, supported by a calculation of the total use of resin binder(s) as a function of total raw material consumption.*~~ ~~*In case it is not possible to provide specific data for a production line or product, the applicant shall refer to data for the entire plant.*~~ ~~*Points shall be awarded in proportion to how closely the data reaches the maximum benchmark set (e.g. a resin use rate of 10% = 0 points and a resin use rate of 5% = 15 points).*~~
TR v2.0 proposed criterion: 3.4. Binder content
Proposed to remove as no longer within product group scope

Rationale:

The binder as defined in EN 14618 is an organic or inorganic chemical product used to bind via an irreversible process the aggregates and the filler in an agglomerated stone. A typical agglomerated stone material will consist of 85 -93% stone aggregates by weight and 15-7% resin. Different types of resins are used by different manufacturers, the most common types are:

- Hydraulic cement (see criterion 5)
- Unsaturated polyester resins that is usually a polyester, epoxy or acrylic type thermoset organic resin and, in any case, a petrochemical polymer, with an amount of synthetic diluents such as styrene, toluene, Xylene, etc., and other additives,

The nature and content of binder have a large influence on the mixture. For example, the use of polymeric resins as binding agents, instead of hydraulic cement, results in the weight percentage of natural stones' gravel in the mixture being significantly higher (from 76-78% with cement to 90-96% with resin). There are also documents in the state of the art which describe the use of resins that are less aggressive with the environment, or in which the reactive solvent which usually contains said resin is removed. Polyester resins free of reactive diluents (without styrene) with satisfactory physico-mechanical properties have been successfully prepared by the reaction between an epoxidized triglyceride and at least one carboxylic anhydride and in which the necessary triglycerides can be obtained starting from vegetable or animal fats (Consentino, 2012). However, this would require to have the process infrastructure suitable epoxidizing the fatty acids Furthermore, the catalytic system needed for polymerizing this resin is completely different from the systems which are used today, which would make it necessary to make substantial mechanical changes in the already implemented processes, with the economic investment this involves, and eliminating the possibility of being able to reuse current systems

In recent years, an important part of research has been focused to searching for components which come from renewable and/or recycled raw materials that are more environmentally friendly and make the overall process cleaner and more efficient, and at the same time allow manufacturing a material with excellent mechanical and aesthetic features. In this respect, major advancements have been done in the use of bio-resins made from renewable plant sources (for instance from no-food vegetable oil produce no volatile emissions to the atmosphere). Bio-based resins (or bioresins) offer comparable mechanicals to petro-based resins, thus introduce sustainable materials reducing the dependence on petroleum based products and expanding options for end-of-life recycling and reuse. Products manufactured with bioresins have the potential compliance with initiatives such as LEED program which encourages use of recycled or bio-based materials (LEED BD+C: New construction. Materials and Resources (MR) Credit: Building product disclosure and optimization – sourcing of raw materials).

CRITERIA 4: Ceramic criteria

Summary of preliminary report of specific relevance to the ceramic sector

Legal and policy context

All ceramic products used in the construction sector are regulated by the Construction Products Regulation (EU) No 305/2011 and should carry a CE marking unless they are used in furniture applications, such as kitchen countertops, table-tops or for other non-construction related purposes.

The fact that unused ceramic tile production capacity in China exceeds the entire EU ceramic production capacity and the led to the introduction of anti-dumping duties of 26.3% to 67.7% for specific Chinese producers that co-operated in sampling data and 69.7% for all other Chinese producers of ceramic tiles via Commission Implementing Regulation (EC) No 917/2011. It was decided to continue the anti-dumping measures via Commission Implementing Regulation (EC) No 2017/2179 with the same duties of 69.7% for Chinese producers in general and lower rates of 13.9% to 36.5% for co-operative Chinese producers. Some of the most relevant data provided in Regulation (EC) No 2017/2179 to justify this decision was as follows:

- From 2011 to 2014, Chinese ceramic tile production capacity increased from 10.8 to 17 billion m^2
- During the same period actual Chinese production increased from 8.7 to 11.1 billion m^2.
- Consequently, the spare production capacity in China increased from 20% to 35%.
- The spare capacity in China was estimated at 5.9 billion m^2, more than six times higher than the estimated total ceramic tile consumption in the EU (879 million m^2).
- The average price in the Union market (USD 0.46/kg) is still significantly higher than the Chinese export price (USD 0.34/kg).

As stated in Annex I to the Industrial Emissions Directive (IED) 2010/75/EU, the manufacturing of ceramic products by firing (in particular roofing tiles, bricks, refractory bricks, tiles, stoneware or porcelain) in facilities with a production capacity exceeding 75 tonnes/day and/or with a kiln capacity exceeding $4m^3$ and setting density exceeding 300 kg/m^3, falls within the scope of the IED. The IED aims to define best available techniques (BAT) and set monitoring requirements and relevant upper limits on emissions and energy consumption associated with manufacturing processes. These requirements are the formally adopted as BAT conclusions in a Commission Implementing Decision. No BAT Conclusions have been adopted yet for the ceramics sector yet (expected around 2024).

The latest relevant document relating to BAT for ceramic manufacturing was published in 2007 under the old Integrated Pollution Prevention and Control (IPPC) Directive (96/61/EC). While useful data is presented in the BAT reference document, it does not set any standard monitoring requirements or upper emission limits that must be respected in operating permits.

Ceramic manufacturing at a scale above the same threshold as mentioned above for the IED is also regulated by the EU Emissions Trading System (ETS) established in Directive 2003/87/EC and recently amended by Directive (EU) 2018/410.

It is also necessary for ceramic production facilities that exceed the common production capacity threshold for the IED and ETS to report on the release or off-site transfer of defined pollutants and hazardous wastes in accordance with Regulation (EC) No 166/2006 on the establishment of a European Pollutant Release and Transfer Register (E-PRTR). Emissions must be reported to Member State competent authorities if they exceed thresholds defined in Annex II to the E-PRTR. The most relevant thresholds are:

- Particulate Matter (PM): >50 000 kg/yr
- Nitrogen oxides (NOx/NO_2): >100 000 kg/yr
- Nitrous Oxide (N_2O): >10 000 kg/yr
- Ammonia (NH_3): >10 000 kg.yr
- Sulphur oxides (SOx/SO_2): >150 000 kg/yr

The only information that needs to be reported is the quantity of emissions in kg/yr. Data relating to production volume during the same period is purely optional and is not normally reported.

Market data

The main PRODCOM codes for sold production (NACE Rev. 2) of relevance to ceramic products were identified as:

- 23.31.10.00 - Ceramic tiles and flags
- 23.31.10.10 - Unglazed ceramic mosaic tiles, cubes and similar articles, with a surface area < 49 cm²
- 23.31.10.20 - Glazed ceramic mosaic tiles, cubes and similar articles, with a surface area < 49 cm²
- 23.31.10.30 - Unglazed ceramic double tiles of the Spaltplatten type
- 23.31.10.50 - Unglazed ceramic and stoneware flags and paving, hearth or wall tiles; unglazed ceramic and stoneware mosaic cubes and the like, whether or not on a backing
- 23.31.10.57 - Earthenware or fine pottery and other unglazed ceramic flags and paving, hearth or wall tiles (excluding of siliceous fossil meals or similar siliceous earths, refractory ceramic goods, articles of stoneware, double tiles of the ''Spaltplatten'' type, tiles made into stands, ornamental articles and tiles specifically manufactured for stoves)
- 23.31.10.71 - Glazed ceramic double tiles of the spaltplatten type
- 23.31.10.75 - Glazed earthenware or fine pottery ceramic flags and paving, hearth or wall tiles, with a face of > 90 cm²
- 23.31.10.79 - Glazed ceramic flags and paving, hearth or wall tiles excluding double tiles of the spaltplatten type, stoneware, earthenware or fine pottery flags, paving or tiles with a face of not > 90 cm²
- 23.32.11.10 - Non-refractory clay building bricks (excluding of siliceous fossil meals or earths)
- 23.32.11.30 - Non-refractory clay flooring blocks, support or filler tiles and the like (excluding of siliceous fossil meals or earths)
- 23.32.12.50 - Non-refractory clay roofing tiles
- 23.32.12.70 - Non-refractory clay constructional products (including chimneypots, cowls, chimney liners and flue-blocks, architectural ornaments, ventilator grills, clay-lath; excluding pipes, guttering and the like)

The first nine codes in the list above can be considered to correspond to ceramic tiles that are included within the scope of EU Ecolabel hard coverings. Unfortunately, none of these nine Eurostat PRODCOM codes listed above for ceramic tiles were consistently reported during the period 2007 to 2019. For example, codes 23.31.10.30 and 23.31.10.57 were no longer reported after 2010.

Code 23.31.10.50 was only reported between 2011 and 2016. For 2017 and 2018, all the other codes disappeared and were replaced by a new single code (23.31.10.00). For consistency, the EU28 trend data is reported from 2007 to 2016 only and, when looking at Member State specific data, the latest data from 2018 is used.

The last four codes in the list above can be considered to correspond to the brick and roof tile sector. In principle all four codes could be covered by the scope of EU Ecolabel hard coverings. Code 23.32.12.30 can be considered to correspond mainly to clay masonry units and code 23.32.12.50 to roofing tiles.

Because the different PRODCOM codes have different production volume indicators (e.g. m^2 for ceramic tiles, m^3 for clay bricks, p/st for roofing tiles and kg for clay flooring blocks and filling tiles) the sold production volume data are presented as normalised decimals relative to 2007 sold production volume for that same category.

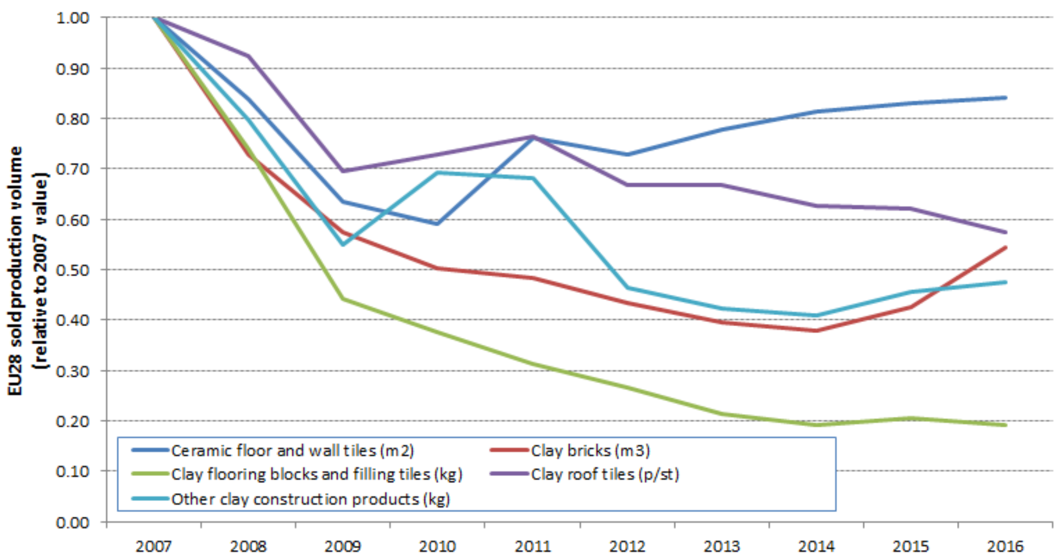


Figure 18. Trends in EU28 sold production volume of relevant ceramic hard covering products.

The data presented in for ceramic floor and wall tiles was the sum of seven PRODCOM codes (23.31.10.10; 23.31.10.20; 23.31.10.30; 23.31.10.50; 23.31.10.57; 23.31.10.71; 23.31.10.75 and 23.31.10.79). Other codes for the data trends presented above were: clay bricks (23.32.11.10); clay flooring blocks and filling tiles (23.32.11.30); clay roof tiles (23.32.11.50) and other clay construction products (23.32.11.70).

The segregated data for ceramic brick and roof tile production show that all sub-sectors were hit very hard by the global economic crisis (drops of 30-55% in sold production volume between 2007 and 2009) and have since shown widely varying degrees of recovery (clay roof tiles and clay flooring blocks and filling tiles continued in a gradual decline between 2009 and 2016, while clay bricks and other construction products showed an modest recovery between 2014 and 2016). However, in all cases the 2016 values for all of these sub-sectors where still at least 40% lower than 2007 sold production volumes.

Since 2009 the sold production volumes have continued to show a gradual decline, reaching a new low point in 2016 that was 62% below 2007 sold production volume levels. In 2018, the total EU28 sold production volume and production values were:

- Clay bricks: 44 million m^3 and 3 566€ million (76 €/m^3)
- Clay flooring blocks and filling tiles: 1.1 million t and 99€ million (90€/t)
- Clay roofing tiles: 2 781 million p/st and 2 098€ million (0.75€/piece)
- Other clay construction products: 0.16 million t and 99€ million (619€/t)

It is not possible to do a general comparison of unit cost prices due to the different units involved. However, a comparison could be made with the larger scale standard piece production of clay flooring blocks and filling tiles (e.g. masonry units) and the more niche segment of other clay construction products, where the niche segment was 10 times less in volume and almost 7 times more expensive per tonne.

The data for ceramic floor and wall tiles shows a similar, but less severe drop in sold production volume during the global economic crisis (40% decrease from 2007 to 2010). In contrast to the brick and tile sub-sectors, the wall and tile market has subsequently recovered to the extent that 2016 sold production levels were only 15% lower than 2007 level. In 2016, EU28 sold production volume was around 760 million m^2 and EU28 sold production value was €6,100 million at an average unit cost of 8.0 €/m^2.

A closer look at the most recent Member State level data for the production ceramic tiles is presented in Table 12 below. The data is ordered in terms of PRODVAL for each product category and the top 5 ranked Member States in terms of PRODVAL (highest € first), PRODQNT (highest m^2 first) and unit cost (lowest €/t first) are highlighted in red.

Table 12. 2018 PRODCOM data for ceramic tile, masonry unit and roofing tile production in Europe at Member State level

23311000 - Ceramic tiles and flags				23321130 – Clay flooring blocks and filler tiles					23321250 – Clay roofing tiles		
	PDVAL (€ Mil)	PDQNT (m2)	€/m2		PDVAL (€ Mil)	PDQNT (t)	€/t		PDVAL (€ Mil)	PDQNT (p/st)	€/p/st
IT	4,692.1 (46.6%)	434,713,328 (34.6%)	10.8	IT	29.4 (29.6%)	401,222 (36.9%)	73	DE	680.4 (32.4%)	597,682,000 (21.5%)	1.14
ES	3,217.4 (32.0%)	513,163,000 (40.9%)	6.3	ES	13.3 (13.4%)	259,396 (23.8%)	51	FR	626.0 (29.8%)	690,554,152 (24.8%)	0.91
PO	591.8 (5.9%)	110,705,000 (8.8%)	5.3	DE	9.9 (10.0%)	47,046 (4.3%)	211	IT	125.1 (6.0%)	371,664,135 (13.4%)	0.34
DE	510.5 (5.1%)	47,463,813 (3.8%)	10.8	AT	9.7 (9.8%)	46,641 (4.3%)	207	UK	117.6 (5.6%)	224,311,187 (8.1%)	0.52
FR	149.3 (1.5%)	17,754,207 (1.4%)	8.4	PO	5.2 (5.3%)	49,997 (4.6%)	104	PO	100.9 (4.8%)	132,466,000 (4.8%)	0.76
UK	106.9 (1.1%)	9,306,689 (0.7%)	11.5	FR	4.2 (4.3%)	12,371 (1.1%)	341	ES	71.7 (3.4%)	195,176,000 (7.0%)	0.37
BG	104.8 (1.0%)	28,209,195 (2.2%)	3.7	UK	0.73 (0.7%)	523 (<0.1%)	1403	PT	47.6 (2.3%)	113,324,297 (4.1%)	0.42
RO	35.1 (0.35%)	6,260,131 (0.5%)	5.6	FI	0.35 (0.4%)	153 (<0.1%)	2285	HR	26.2 (1.2%)	44,541,000 (1.6%)	0.59
HR	3.2 (<0.1%)	844,988 (<0.1%)	3.7	DK	0.09 (<0.1%)	3 (<0.1%)	29151	EL	14.4 (0.7%)	43,478,657 (1.6%)	0.33
EE	0.2 (<0.1%)	20,000 (<0.1%)	10.2	BE	undeclared	undeclared	n/a	DK	10.5 (0.5%)	9,519,098 (0.3%)	1.10
AT	undeclared	undeclared	n/a	HU	undeclared	undeclared	n/a	AT	undeclared	undeclared	n/a
BE	undeclared	undeclared	n/a	LV	undeclared	undeclared	n/a	BE	undeclared	undeclared	n/a
CZ	undeclared	undeclared	n/a	NL	undeclared	undeclared	n/a	CZ	undeclared	undeclared	n/a
EL	undeclared	undeclared	n/a	PT	undeclared	undeclared	n/a	HU	undeclared	undeclared	n/a
HU	undeclared	undeclared	n/a	RO	undeclared	undeclared	n/a	NL	undeclared	undeclared	n/a
IE	undeclared	undeclared	n/a	SE	undeclared	undeclared	n/a	RO	undeclared	undeclared	n/a
LT	undeclared	undeclared	n/a	SK	undeclared	1,412 (0.1%)	n/a	SE	undeclared	undeclared	n/a
NL	undeclared	undeclared	n/a					SI	undeclared	undeclared	n/a
PT	undeclared	undeclared	n/a								
SI	undeclared	undeclared	n/a								
SK	undeclared	undeclared	n/a								
EU28	**10062.7**	**1,255,097,850**	**8.0**	**EU28**	**99.3**	**1,088,934**	**91.2**	**EU28**	**2,098**	**2,781,213,233**	**0.75**

For ceramic floor and wall tiles, the data presented above show that ES and IT are by far the two most significant Member States in terms of EU28 sold production volume (>75% of EU total) and value (>75% of EU total). The next two most significant Member States were PO and DE. The unit costs in the two biggest producers (ES and IT) are high enough to imply that economies of scale, at least at Member State level, do not apply to ceramic tile production. The significant difference (>40%) in unit cost between IT and ES may simply be due to the marketing efforts of IT to focus on high quality products and especially with white ceramic tiles. By far the cheapest unit costs were associated with BG and HR (followed by PO and RO), which may be related to lower labour costs.

For clay flooring blocks and filler tiles, the data show that IT and ES also dominate EU28 production volume (>60% of EU total) and value (>40% of EU total). The next most important Members States were DE, AT and PO, each with around 4% of total EU production volume. The wide variation in unit cost values suggests that the products included in this PRODCOM code could have widely varying unit costs when expressed as €/t. However, even with this assumption, there seems to be some error in the data reporting for production quantities (especially for DK), with perhaps m^2 of facing area being mixed up with the correct PRODCOM unit of kg.

With clay roofing tiles, DE and FR are by a distance the two most significant producers in terms of EU28 sold production volume (>45% of EU total) and value (>60% of EU total). It is interesting to note that the unit costs were significantly higher (double or triple) in DE and FR than in other significant producers such as IT, ES, PT and the UK.

LCA hotspots of ceramic tile products

As a simple snapshot of the typical LCA impacts of ceramic tile products, data from a sectorial EPD covering a total of 84 plants in Italy that represent over 82% of Italian ceramic tile production is presented below.

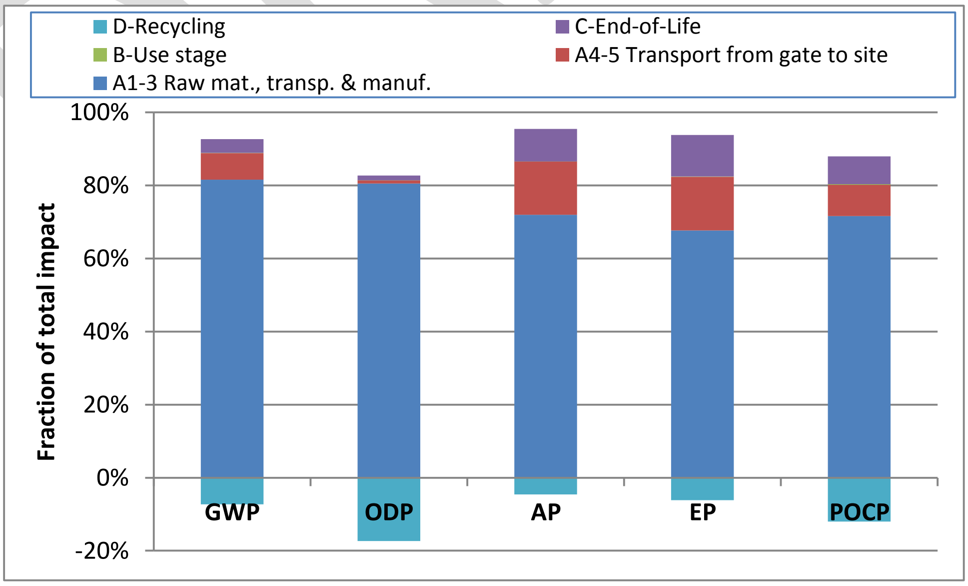


Figure 19. Split of LCA impacts between modules A (A1-A3 and A4-A5), B, C and D (Confindustria Ceramica, 2016).

According to interpretation of the LCA data by the owners/authors of the Italian sectorial EPD, energy use (especially within life cycle stages A1-A3) dominates the GWP impacts (70%) and has a significant influence on POCP (46%), ODP (33%) and EP (20%). The emissions of acidic gases such as SO2, NOx and HF will without a doubt be the dominant influences on AP impacts.

Main changes from Decision 2009/607/EC to TR v1.0

The number and subject matter of criteria proposals made in TR v1.0 were very similar to those established in Decision 2009/607/EC. The only new criterion was the horizontal one relating to VOC emissions.

Many of the criteria in TR v1.0 continued the same ambition level as the equivalent criteria in Decision 2009/607/EC via mandatory limits but also offered the possibility to gain points in proportion to how much better the performance was compared to the mandatory limit.

Table 13. Ceramic criteria in Decision 2009/607/EC and TR v1.0.

Decision 2009/607/EC (all mandatory)	Technical Report v1.0
5. Waste management (description of procedures in place for waste recycling and disposal).	1.1. Environmental Management System (mandatory to have one, optionally up to 5 points awarded, if it is third party certified)
1.2. Extraction management	1.2. Industrial and construction mineral extraction (mandatory)
2.1. Raw materials selection (restricted risk phrases)	1.3. Hazardous substance restrictions (mandatory)
2.3. Asbestos	1.4. Asbestos (mandatory)
	1.5. VOC emissions (mandatory and optional elements for which up to 5 points can be awarded)
7. Packaging (≥70% recycled content in any paperboard packaging).	1.6. Business to consumer packaging (mandatory)
8. Fitness for use	1.7. Fitness for use (mandatory)
9. Consumer Information	1.8. Consumer information (mandatory)
10. Information appearing on the EU Ecolabel.	1.9. Information appearing on the ecolabel (mandatory)
4.1(b) Energy requirement for firing (ERF)	4.1. Specific kiln energy consumption (mandatory) and up to 25 points can be awarded
4.2(a) Water consumption and use ≤1 L/kg product and recycling ration of >90%	4.2. Specific freshwater consumption limit (mandatory) and option to gain up to 10 points
4.3.(b) Emissions to air (PM, HF, NOx and SO2)	4.3. Emissions to air limits (mandatory) and option to gain up to 30 points
4.4. Emissions to water	4.4. Waste water management (mandatory) and option to gain up to 5 points
4.5. Process waste reuse ≥85%	4.5. Process waste reuse (mandatory) ≥85% and option to gain up to 10 points
4.6. Glazes (leaching limits of Pb, Cd and Sb)	4.6. leaching limits of Pb and Cd (mandatory) up to 10 points for low Pb and Cd content

Main changes from Decision TR v1.0 to TR v2.0

The criteria relevant for ceramic products in TR v1.0 and TR v2.0 are summarized in the table below.

Table 14. Ceramic criteria in TR v1.0 and TR v.2.0.

Technical Report v1.0	Technical Report v2.0
1.1. Environmental Management System (mandatory to have one, optionally up to 5 points awarded, if it is third party certified)	1.1. Environmental Management System (optionally up to 5 points, if it is third party certified)
1.2. Industrial and construction mineral extraction (mandatory)	1.2. Industrial and construction mineral extraction (mandatory)
1.3. Hazardous substance restrictions (mandatory)	1.3. Hazardous substance restrictions (mandatory)
1.4. Asbestos (mandatory)	
1.5. VOC emissions (mandatory and optional elements for which up to 5 points can be awarded)	1.5. VOC emissions (mandatory and optional elements for which up to 5 points can be awarded)
1.6. Business to consumer packaging (mandatory)	
1.7. Fitness for use (mandatory)	1.7. Fitness for use (mandatory)
1.8. Consumer information (mandatory)	1.8. Consumer information (mandatory)
1.9. Information appearing on the ecolabel (mandatory)	1.9. Information appearing on the ecolabel (mandatory)
4.1. Specific kiln energy consumption (mandatory) and up to 25 points can be awarded	4.1. Specific kiln energy consumption (mandatory) and up to 25 points can be awarded
	4.2. Specific CO_2 emissions (mandatory) and up to 25 points can be awarded
4.2. Specific freshwater consumption limit (mandatory) and option to gain up to 10 points	4.3. Process water (mandatory)
4.3. Emissions to air limits (mandatory) and option to gain up to 30 points	4.4. Emissions to air limits (mandatory) and option to gain up to 40 points
4.4. Waste water management (mandatory) and option to gain up to 5 points	4.5. Waste water management (mandatory): **JRC proposal to remove**
4.5. Process waste reuse (mandatory) ≥85% and option to gain up to 10 points	4.6. Process waste reuse (mandatory) ≥90% and option to gain up to 10 points
4.6. leaching limits of Pb and Cd (mandatory) up to 10 points for low Pb and Cd content	4.7. Low Pb and Cd content in glaze formulation (mandatory).

Following stakeholder feedback to the proposals in TR v1.0 and further research, a number of modifications have been made in TR v2.0. The asbestos and packaging criteria have been removed due to their low relevance and low effect on the total environmental impact of ceramic products. The deliberate use of asbestos fibres is not only irrelevant to ceramics but would be effectively banned by criterion 1.3.

The criterion on kiln thermal energy requirement has been substantially reworked, nuancing values for different types of ceramic or fired clay product and presenting two options for readers to consider, one that continues to focus only on kiln fuel energy consumption and another that covers the significant fuel energy consumption in the spray-drying and ceramic body drying stages as well. A new criterion has been proposed specifically relating to CO_2 emissions, due to the fact that this is a high-profile environmental issue in the ceramic sector and it now also may address process emissions of carbonates in raw materials.

The criteria on process water and wastewater have been reworded to recognize the possibility of zero liquid discharge systems used in the ceramic sector. The prevalence of such systems among existing EU Ecolabel license holders has prompted the JRC to proposal the removal of the criterion on wastewater altogether.

The criterion on emissions to air has been substantially reworked, with a closer look at clean gas data presented in the BREF document (BREF, 2007) and data from existing EU Ecolabel license holders.

Finally, the criterion on Pb and Cd migration has been adapted, moving away from any requirements on migration and instead focussing on the Pb and Cd content of the glaze formulation used.

Overview of scoring system for ceramic hard coverings in TR v2.0

To obtain the EU Ecolabel for ceramic or fired clay products, it will be necessary to comply with all relevant mandatory requirements and to obtain at least 55 points from the optional criteria. This amount equates to 50% of the total points that are available for ceramic and fired clay products in the scope.

All 110 of the points can be considered to be under the direct control of the applicant, perhaps with the exception of energy consumed and CO2 emitted during spray drying in cases where spray-dried powder is purchased from third parties and the more comprehensive option for energy and CO2 criteria is applied.

Table 15. Ceramic-specific criteria structure and scoring system

Proposed criteria	Mandatory element?	Optional element	Points
1.1. Environmental Management System	No	Yes	Up to 5
1.2. Industrial and construction mineral extraction	Yes	No	0
1.3. Hazardous substance restrictions	Yes	No	0
1.4. VOC emissions	Yes	Yes	Up to 5 points
1.5. Fitness for use	Yes	No	0
1.6. Consumer information	Yes	No	0
1.7. Information appearing on the ecolabel	Yes	No	0
4.1. Specific kiln energy consumption	Yes, upper limits	No	Up to 25
4.2. Specific CO2 emissions	Yes, upper limits	No	Up to 25
4.3. Process water	Yes, upper limits	No	0
4.4. Emissions of dust, HF, NOx and SOx to air	Yes, upper limits	No	Up to 40
4.5. Waste water management: **JRC proposal to remove**	Yes, upper limits	No	0
4.6. Process waste reuse	Yes, lower limit	No	Up to 10
4.7. Glazes	Yes	No	0
TOTAL points available in proposed criteria			**110**
MINIMUM points needed in proposed criteria			**55**

4.1 – Specific fuel energy consumption

Existing criterion for energy consumption: 4.1. Energy consumption, (b) Energy requirement for firing (ERF) limit

4.1. The energy consumption calculated as energy requirement for firing (ERF) ceramic tiles and clay tiles shall not exceed the following limit.

(b) Energy requirement for firing (ERF) limit

The energy requirement for firing (ERF) stages for ceramic tiles and clay tiles shall not exceed the following requirements:

	Requirement (MJ/kg)	Test method
Ceramic and clay tiles	3.5	Technical appendix — A4

Note: requirement expressed in MJ per kg of final product ready to be sold.

Assessment and verification:

The applicant shall calculate the ERF according to the Technical appendix — A4 instructions and provide the related results and supporting documentation.

A4 Energy consumption calculation (PER, ERF)

When providing a calculation of process energy requirement (PER) or energy requirement for firing (ERF), the correct energy carriers shall be taken into account for the entire plant or for the firing stage only. Gross calorific values (high heat value) of fuels shall be used to convert energy units to MJ (Table A1). In case of use of other fuels, the calorific value used for the calculation shall be mentioned. Electricity means net imported electricity coming from the grid and internal generation of electricity measured as electric power.

~~*Evaluation of PER for agglomerated stone production shall consider all energy flows entering the production plant both as fuels and electricity.*~~

~~*Evaluation of PER for terrazzo tiles production must consider all energy flows entering the production plant both as fuels and electricity.*~~

Evaluation of ERF for ceramic tile production shall consider all energy flows entering all the kilns as fuels for the firing stage.

~~*Evaluation of ERF for clay tile production shall consider all energy flows entering all the kilns as fuels for the firing stage.*~~

~~*Evaluation of PER for cement production shall consider all energy flows entering the production system both as fuels and electricity.*~~

Table A1

Table for calculation of PER or ERF (see text for explanations)

Production period	*Days*	*From*	*To*	
Production (kg)				
Fuel	*Quantity*	*Units*	*Conversion factor*	*Energy (MJ)*
Natural gas		*kg*	*54,1*	
Natural gas		*Nm^3*	*38,8*	
Butane		*kg*	*49,3*	
Kerosene		*kg*	*46,5*	
Gasoline		*kg*	*52,7*	
Diesel		*kg*	*44,6*	
Gas oil		*kg*	*45,2*	
Heavy fuel oil		*kg*	*42,7*	
Dry steam coal		*kg*	*30,6*	
Anthracite		*kg*	*29,7*	
Charcoal		*kg*	*33,7*	

Industrial coke		*kg*	*27,9*	
Electricity (from net)		*kg*	*3,6*	
			Total energy	
Specific energy consumption (MJ/kg of product)				

TR v1.0 proposed criterion: 4.1. Specific kiln energy consumption

Mandatory requirement

The specific energy consumption for ceramic tile production shall not exceed 3.5 MJ/kg or, for tiles <10mm thick, 70 MJ/m^2.

EU Ecolabel points

Points shall be awarded for applicants that can demonstrate the following aspects:

- Non-use of coal, petroleum coke, light fuel oil and heavy fuel oil for kiln firing (2 points).
- Installation of onsite CHP (3 points).
- Meeting up to 10% of total fuel requirement for kiln firing via gas, liquid or solid fuels from renewable sources (up to 5 points).
- Reduction of specific kiln firing energy production towards a best practice of 1.9 MJ/kg (up to 15 points).

Assessment and verification

The applicant shall provide a declaration of compliance with the mandatory requirement for specific kiln firing energy consumption and any relevant declaration regarding the non-use of fuel oils in kiln firing, onsite CHP and renewable energy sources.

The applicant shall calculate all inputs of fuel to the kiln system. The total thermal energy of the fuel input (in MJ) shall be calculated by multiplying the mass of fuel consumed in a defined production period (in kg, t, L or Nm3) by a specific or generic calorific value for the same fuel (in MJ/kg, t, L or Nm3).

The specific thermal energy consumption (MJ/t) shall be determined by dividing the total fuel input (MJ) by the total ceramic tile output (in kg or m^2, as appropriate) during the same production period.

For continuously operating kilns, the production period should be 12 months. In cases where production is non-continuous, the production period shall be mentioned and should not be less than 30 days.

In cases where points are awarded for renewable fuels or lower kiln energy consumption, these shall be awarded in proportion to the maximum benchmark set (i.e. for renewable fuels: 0% = 0 points and 10% = 5 points; for specific kiln energy consumption: 3.5 MJ/kg = 0 points and 1.9 MJ/kg = 15 points).

TR v2.0 proposed criterion: 4.1.

Option 1: Specific fuel consumption for firing kilns

Option 2: Specific fuel consumption for drying and firing stages

Option 1 (kiln fuel only)	Option 2 (kiln and dryer fuel)
Coal, petroleum coke, light fuel oil and heavy fuel oil shall not be used in kilns. The specific fuel energy consumption for firing kilns during the production of any	Coal, petroleum coke, light fuel oil and heavy fuel oil shall not be used in dryers or kilns. The specific fuel energy consumption

particular ceramic product (tiles) or fired clay product (brick, block, roof tile or masonry unit) shall not exceed the following relevant limit listed in the middle column of table below.

Up to 25 points shall be awarded in proportion to where the actual specific fuel consumption for firing kilns lies relative to the relevant values listed in the middle column and the right hand column.

Product type	Mandatory upper limit	Environmental excellence threshold
ceramic tiles ≥6mm thick	3.5 MJ/kg	2.2 MJ/kg
ceramic tiles <6mm thick	75 MJ/m^2	50 MJ/m^2
Fired clay brick, paving block and roof tile	3.0 MJ/kg	2.0 MJ/kg
Fired clay masonry unit	1.9 MJ/kg	1.0 MJ/kg

Assessment and verification

The applicant shall provide a declaration of compliance with the mandatory requirement for specific kiln firing energy consumption, supported by calculations of fuel consumption and production over the defined production period.

For continuous production campaigns, data should be representative of a 12 month period. For shorter production campaigns, the actual production period(s) shall be stated and site readings should represent at least 80% of the production campaign.

Volumetric or mass inputs of fuel to the kiln system shall be taken from site readings and converted into units of MJ by multiplying the volume/mass of fuel consumed over the defined production period (in kg, t, L or Nm^3) by a specific or generic calorific value for the same fuel (in MJ/kg, MJ/t, MJ/L or MJ/Nm^3).

The specific thermal energy consumption (MJ/t) shall be determined by dividing the total fuel input (MJ) by the total product output (in kg or m^2, as appropriate) during the same production

score for firing and drying stages of the relevant ceramic or fired clay product shall not exceed 1.0, when calculated according to the relevant reference value(s) and equation(s) below.

Up to 25 points shall be awarded in proportion to how closely the score approximates 0.50.

Product type	Reference value
Spray-dried powder	1.8 MJ/kg powder*
ceramic tiles ≥6mm thick	4.0 MJ/kg
ceramic tiles <6mm thick	86 MJ/m^2
Fired clay brick, paving block and roof tile	3.5 MJ/kg
Fired clay masonry unit	2.2 MJ/kg

**includes any residual moisture content, which would typically be 5-7%*

For ceramic tile products where onsite produced or purchased spray-dried powder is used, the score shall be calculated as follows:

$$Fuel_{score} = 0.35(SDP) + 0.65(KD)$$

Where:

- $Fuel_{score}$ is the overall score for specific fuel consumption in the production of ceramic tiles.

- SDP is the score for spray-dried powder production (actual value divided by the relevant reference value)

- KD is the score for fuel consumption in the kiln and green body dryer (actual value divided by reference value)

For all other products where spray dried powder is not used, the score shall be calculated as follows:

$$Fuel_{score} = KD$$

Where:

- $Fuel_{score}$ is the overall score for specific fuel consumption in the production of ceramic tile or fired clay product.

- KD is the score for fuel consumption in the kiln and green body dryer (actual value divided by reference value)

Assessment and verification

The applicant shall declare the $Fuel_{score}$ value for the relevant product(s), supported by calculations according to

period. *The number of points awarded shall be calculated as zero in cases where the actual value is equal to the mandatory limit and as 25 in cases where the actual value is equal to or lower than the environmental excellence threshold.* *Actual values in-between the mandatory and environmental excellence thresholds shall be awarded points in proportion to where they lie to the two aforementioned reference points.*	*the relevant equation above and by the underlying site data for fuel consumption and production over the defined production period.* *For continuous production campaigns, data should be representative of a 12 month period. For shorter production campaigns, the actual production period(s) shall be stated and site readings should represent at least 80% of the production campaign.* *Volumetric or mass inputs of fuel to the kiln and dryer systems shall be taken from site readings and converted into units of MJ by multiplying the volume/mass of fuel consumed over the defined production period (in kg, t, L or Nm^3) by a specific or generic calorific value for the same fuel (in MJ/kg, MJ/t, MJ/L or MJ/Nm^3).* *In cases where fuel used to generate heat for drying operations is fed to a cogeneration system, the electricity generated by the system during the defined production period (measured in kWh and converted into MJ) should be subtracted from the total dryer fuel consumption reading.* *The specific thermal energy consumption (MJ/t) shall be determined by dividing the total fuel input (MJ) by the total product output (in kg or m^2, as appropriate) during the same production period.* *The number of points awarded shall be calculated as zero in cases where the actual score is equal to the mandatory limit of 1.00, and 25 in cases where the actual score is equal to or lower than 0.60.* *Actual values in-between 1.00 and 0.60 shall be awarded points in proportion to where they lie to the two aforementioned reference points.*

Rationale:

<u>*Information from the BREF Document for ceramics*</u>

The energy consumption during kiln firing (1.9 – 4.8 MJ/kg) is the single largest energy consuming process during ceramic tile production. Spray drying is also a significant source of energy consumption (1.1 – 2.2 MJ/kg). However, since spray drying is not carried out by all ceramic tile producers, but is instead produced by specialised, large-scale atomisation plants, it is not something that will always be under the direct control of the ceramic tile producer (only the largest ceramic tile producers will have their own atomisation plant). Consequently, mandatory energy requirements are restricted to those for kiln firing, which should always be under the direct control of any potential EU Ecolabel applicant.

The production of ceramic floor and wall tiles requires firing at temperatures of around 1050 to 1300°C depending on the mineral composition of the green body and the final desired products of the tile. Tiles may be glazed or unglazed and may be fired in single or double stage process. In the double firing process, the first firing is commonly referred to as "*biscuit firing*" and this takes place before the glazing operation. The type of kiln technology employed is either a tunnel kiln or a roller hearth kiln. Whether tiles are glazed or not, whether the firing is single or double stage, the final desired water absorption of the tile and the choice of kiln technology can greatly influence the specific energy consumption requirement.

Table 16. Operating data of tunnel kilns and roller hearth kilns (Source: BREF, 2007)

		Tunnel kiln with biscuit firing	Roller hearth kiln		Tunnel kiln	Roller hearth kiln	
			Final firing	Single firing	Unglazed	Unglazed	Glazed
Product type		Tiles with higher water absorption			Tiles with lower water absorption		
Throughput	t/h	2.8	1.2	1.6	1.2	2.1	2.1
Kiln length	m	120	60	80	130	80	60
Cross-section	m^2	1.5 – 2.0	0.8 – 1.2	0.5 – 1.0	1.5 – 2.0	1.2	0.8 – 1.0
Setting density	kg/m^3	500 - 700	10 - 30	10 – 30	700-1000	20 - 30	20 - 30
Firing temp.	°C	1100	1250	1300	1200	1220	1230
Specific energy requirement	kJ/kg	3500	2900	2200	3900	2900	2500
Flue-gas volume flow	m^3/h	15000	10000	13000	15000	10000	13000
Flue-gas temp.	°C	180	160	200	220	160	160

Some data ranges provided for kilns producing wall and floor tiles in BREF (2007) was as follows:

- Double-pass tunnel kiln: 5920 – 7300 kJ/kg
- Single-pass tunnel kiln: 5420 – 6300 kJ/kg
- Double-pass roller hearth kiln: 3400 – 4620 kJ/kg
- Single-pass roller hearth kiln: 1900 – 4800 kJ/kg

In the context of the numbers above, the EU Ecolabel reference value of 3500 kJ/kg (i.e. 3.5 MJ/kg) seems appropriate for allowing both single and double-pass roller heath kilns to comply, although only allowing the very best double-pass systems to be compliant. Tunnel kiln technology does not appear to be sufficiently energy efficient by some margin.

Outcomes from and after the 1st AHWG meeting

Regarding distinctions for thin format ceramic tiles

It was generally agreed that kiln energy consumption is the dominant life cycle hotspot of environmental impacts associated with ceramic production. Concern was expressed about how exactly to define the specific consumption unit (i.e. m^2 or kg). The limit of 3.5 MJ/kg for firing energy was originally set for tiles that were around

10mm thick, which was the most common thickness over 10 years ago. However, since then the range of thicknesses has begun to vary a lot, especially towards the thinner end of the spectrum, where tiles as thin as 3mm may now be produced. Overall, the thickness may vary from 3-30mm.

Taking a 10mm thick tile as a reference point, and assuming an average ceramic tile density of 20 kg/m^2, a requirement of 3.5 MJ/kg would translate into 70 MJ/m^2. It could be logically assumed that as the tile becomes thinner, the energy requirement (at least in terms of MJ/m^2) goes down. However, any reduction in energy required, especially due to the fact that less material needs to be sintered, is minor due to the fact that only a small fraction of the total energy consumed in kilns is due to the physico-chemical reactions of the ceramic body (approximately 3% according to Figure 21 in the next sub-section). At the same time, the tile will have dropped in specific density in kg/m^2 by a much larger amount (e.g. 10mm to 8mm is a drop of 20%, 8mm to 4mm is 50%) Consequently, as tiles get thinner, the specific energy consumption in terms of MJ/kg gets considerably bigger. So the question put to stakeholders was where to draw the line for thin format tiles exactly?

One industry stakeholder requested that thin format tiles should be considered as tiles < 6mm thick (as opposed to the initial distinction of <10 mm thick) and that a specific kiln energy consumption limit for these thin tiles should be set at 75 MJ/m^2 instead of 70 MJ/m^2.

JRC asked how exactly the specific energy consumption values were calculated by existing license holders although no specific feedback has been received so far. Consequently it remains unclear if values are simply weighted averages of production runs for specific kilns, weighted averages of specific kilns for the whole year or the weighted average of the whole factory for the whole year.

Regarding other sources of energy consumption in the process

In discussions with a stakeholder sub-group following the 1st AHWG meeting, the relative importance of other energy demanding processes was raised by the JRC. Overall, it seemed that a general rule of thumb for a ceramic and fired clay products included in the scope for EU Ecolabel hard coverings is that total energy consumption is split into: 90% fuel and 10% electricity. Consequently it was agreed that the energy criterion could continue to focus only on fuel consumption.

The relative importance of fuel consumption in spray dryers and in green body dryers before firing was also questioned by the JRC. To obtain a better idea of the significance of fuel consumption in these processes (and if they were strongly inter-related with each other in terms of waste heat flows) the JRC proposed to set up a data gathering questionnaire (see Appendix I).

Regarding different values for other products included in the scope

It seems that all EU Ecolabel licenses to date for ceramic products relate to ceramic floor and wall tiles and that the specific energy consumption value set out in Decision 2009/607/EC was specifically tailored for these products. However, it is also clear that the scope of Decision 2009/607/EC also refers to fired clay tiles and blocks and that different specific energy consumption values may be applicable.

Industry stakeholders confirmed that the use of a single specific energy consumption value for all the fired clay and ceramic products included in the scope does not make sense. Further research should therefore be conducted to better nuance these values, for example for thicker and thinner format tiles, for masonry units and for roofing tiles. The aforementioned data gathering questionnaire aims to gather data for these different product types (see Appendix I).

Further research and main changes

Recap of the different production process variations for ceramic floor and wall tiles

It is worth summarizing the main production processes for ceramic floor and wall tiles and their variations so that an overall view of fuel consumption can be provided.

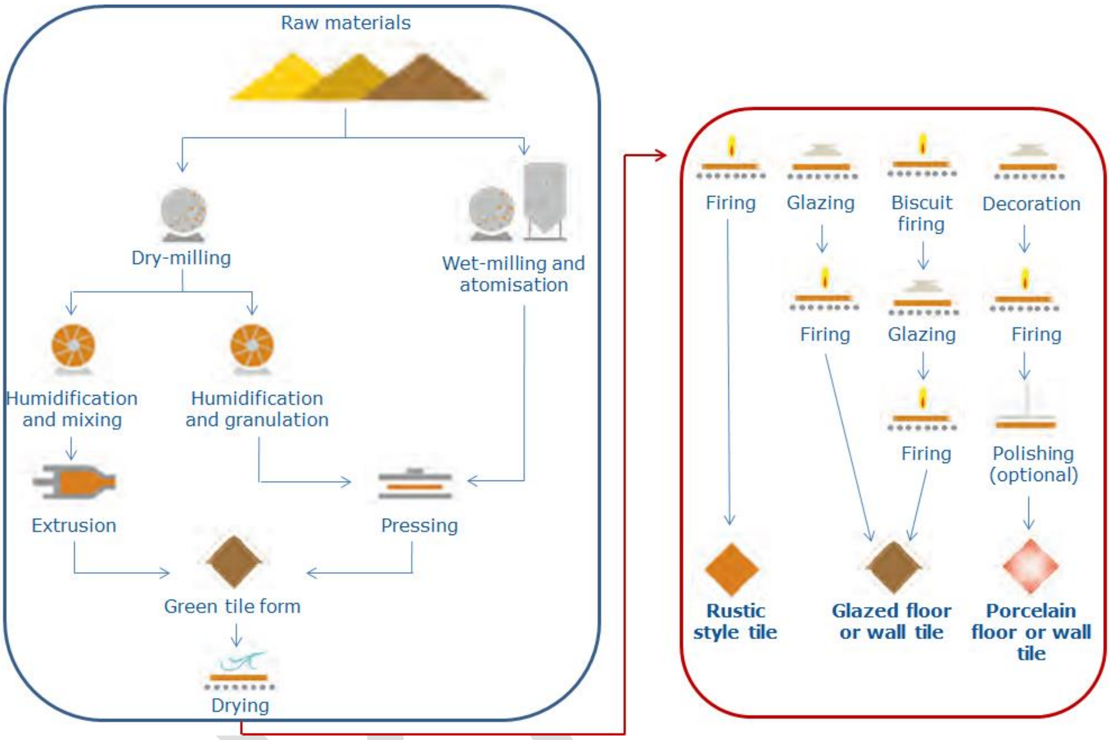


Figure 20. Illustration of different production processes for ceramic tiles

The individual process step images used in Figure 20 above are taken from AVEN (2011). The most common ceramic floor/wall tile production route is the single firing one (Ros-Dosda et al., 2018). According to EN 14411, tiles shaped by extrusion are classified as Group A types and tiles shaped by dry-pressing are classified as Group B types. The type of green body shaping technology used onsite (extrusion or dry-pressing) ultimately determines what milling method to use (wet or dry).

Wet-milling is generally associated with spray-drying. This preparation route is more energy intensive but offers the advantage of producing more spherical particles which are more flowable and better fill press dies and moulds. This results in a greater uniformity of "*green*" bodies, both within a single piece and between different pieces. Consequently, dimensional consistency is greater and there will be fewer reject pieces and fewer losses during rectification.

The dry-milling route is normally associated with shaping via extrusion. However, a considerable amount of water needs to be introduced to dry milled powder in order to form a cohesive mix with a typical moisture content of 5 to 7% if it is to form granules and to pressing. This extra moisture will need to be removed via extra thermal energy in the drying stage before it is fired in the kiln.

Broadly speaking, there are three main types of ceramic tile product:

- Unglazed tiles (rustic style)

- Glazed tiles (either via single or double firing processes)
- Porcelain stoneware tiles

Unglazed tiles will tend to be more porous and have an aesthetic that is determined by the colours of the raw materials used. Porosity in the tile surface can facilitate the accumulation of dirt, complicate cleaning operations and present concerns about freeze-thaw damage in certain use environments. Glazed or decorated tiles can provide a broad range of different aesthetics and physical characteristics of the tile surfaces. Porcelain stoneware tiles are distinguished by an especially low water absorption (<0.5% on average according to EN 10545-3).

Fuel consumption for ceramic floor and wall tile production

The production of ceramic floor and wall tiles is an energy intensive process with considerable room for optimization via the recovery of waste heat. A typical Sankey diagram of the process shows that only around 15% of the total thermal energy entering the kiln is actually used to provoke the necessary physico-chemical transformations to form the ceramic product.

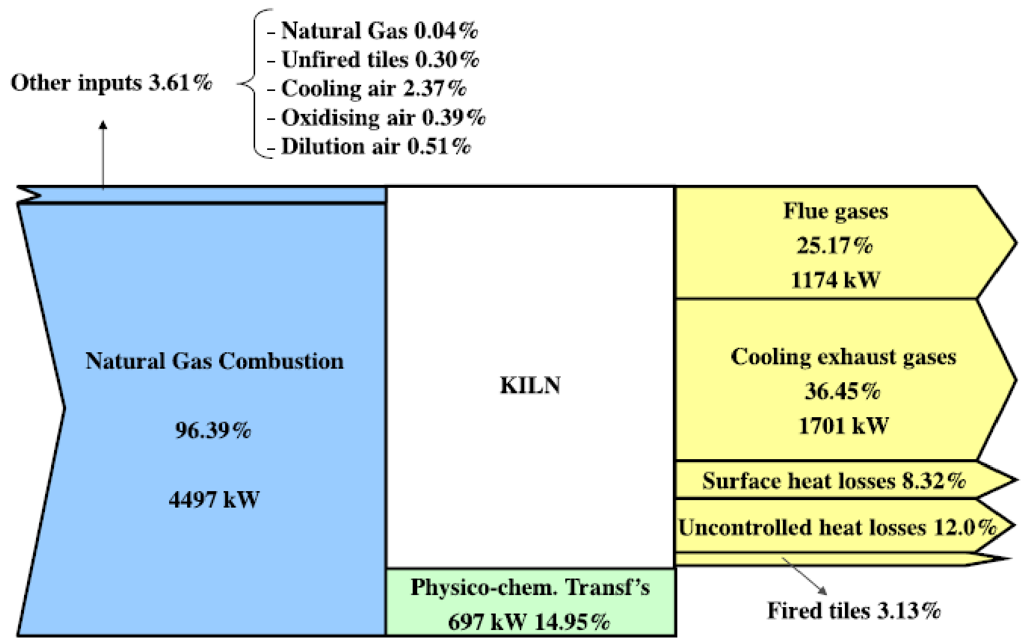


Figure 21. Energy Sankey diagram for ceramic tile production (Source: Mezquita et al., 2019)

Approximately 60% of all thermal energy entering the kiln leaves as exhaust gases, from which a fraction can be recovered either for preheating combustion air and/or oxidizing air. Beyond the kiln system, recovered heat could be used for onsite spray drying operations (where relevant) and for drying of green ceramic bodies.

The JRC prepared an excel spreadsheet for the purposes of a data gathering exercise for both specific energy consumption at the level of the product (via fuels fed to the kiln only) and for emissions to air at the level of the factory (it was considered unrealistic to gather data at the level of the product given the way in which gases are treated in centralized processes).

Unfortunately no responses were received from stakeholders. This prompted the JRC to consult other sources of data:

- The draft ISO 17889-1 standard: which sets the most ambitious levels for "*specific fuel consumption for firing of kilns*" as **80 MJ/m²** and **4 MJ/kg** depending on the choice of functional unit.
- Anonymous data ranges from existing license holders (n=50). Considering the maximum and minimum values of these ranges only, the following data distribution was found: Maximum = **3.46 MJ/kg**; 3rd quartile value = **2.80 MJ/kg**; Median = **2.42 MJ/kg**; 1st quartile value = **2.2 MJ/kg** and minimum = **1.11 MJ/kg**. The average value was close to the median (**2.48 MJ/kg**).
- Data from a cumulative cost assessment (CCA) of the European ceramics industry published by DG GROW (CEPS, 2017): which reports wide ranges of natural gas intensities from 0.3 to 4.8 MWh/t between the years 2006 and 2015, these ranges translate into **1.1 to 17.3 MJ/kg**.

It is worth noting that the ambition level for ISO 17889-1 is intended to apply to ceramic floor and wall tiles only and that all current EU Ecolabel licenses are assumed to be associated only with ceramic floor and wall tile products. The data reported in the CCA are specifically for ceramic floor and wall tiles, but the report also provides data for the brick and (roof) tile sector, which is presented later in this section. First of all, it is worth comparing the data for ceramic floor and wall tiles from the three sources listed above on the same graph.

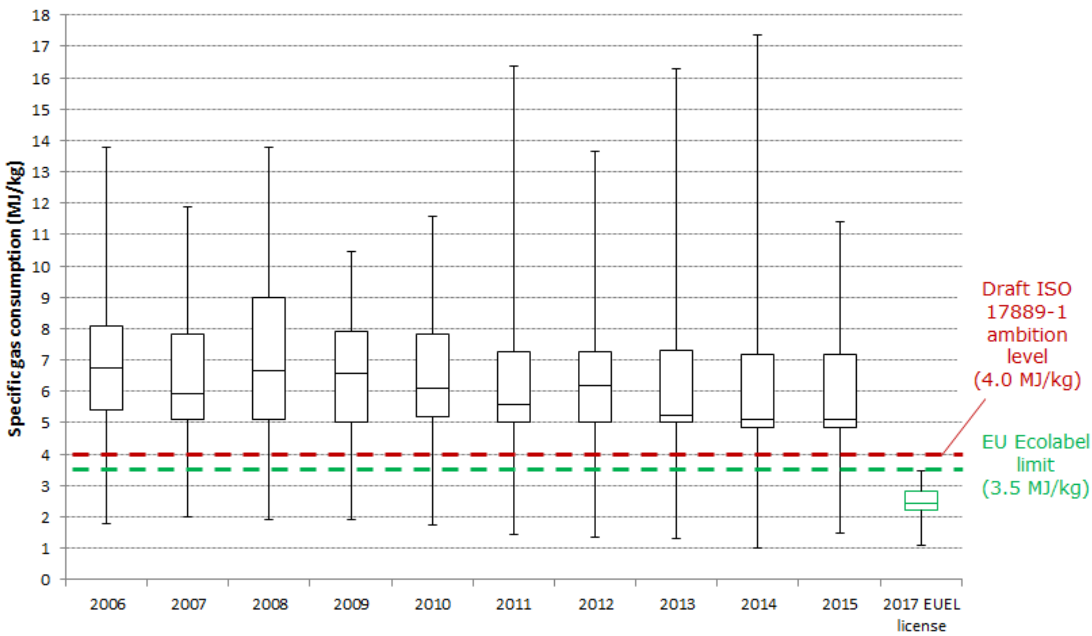


Figure 22. Specific gas consumption for ceramic floor and wall tile production

The data in the Figure above for 2006 to 2015 were the results of a questionnaire exercise carried out by CEPS, Economisti Associata and Ecorys on behalf of DG GROW (CEPS, 2017). It is supposed that the boxplots represent the data received as follows:

- Upper error bar indicates maximum value received.
- Upper line of box represents the 3rd quartile value (i.e. 75% of all values are below this threshold).
- The line inside the box represents the median value (i.e. 50% of all values are below this threshold).

- Lower line of box represents the 1st quartile value (i.e. 25% of all values are below this threshold).
- Lower error bar indicates minimum value received.

For ceramic floor and wall tiles, a total of 16 responses were received and units were expressed as MWh/t of production. These results were converted from MWh/t into MJ/kg by multiplying by 3.6 (3600 MJ/MWh and 1t/1000kg).

When compared to the draft ISO 17889-1 maximum ambition level and the maximum EU Ecolabel limit, the values collected by CEPS seem very high. The CEPS data is centered from 5 to 7.5 MJ/kg level while the actual EU Ecolabel license data is centered from 2.2 to 2.8 MJ/kg, less than half of the equivalent CEPS values.

The CEPS data appears to have been reported at company level whereas the EU Ecolabel data only focuses on the kiln. Consequently, any gas consumed by drying units (for powdered raw materials or for ceramic bodies) will not be counted in the EU Ecolabel data, but would be counted in the CEPS data.

Nevertheless, for the vast majority of ceramic tile producers gas consumption in dryers should not be as high as gas consumption in the kiln. The BREF document (BREF, 2007) states that kiln firing (**1.9–4.8 MJ/kg**) is the largest energy consuming process during ceramic tile production, followed by spray drying when relevant (**1.1–2.2 MJ/kg**). Mezquita et al. (2014) stated that the an average thermal energy requirement for ceramic tile manufacturing was around 4.6 MJ/kg, which would typically be split as 55% kiln firing (**2.53 MJ/kg**), 36% spray drying (**1.66 MJ/kg**) and 9% drying of ceramic bodies (0.41 MJ/kg).

The significance of the spray drying on gas consumption and the fact that this is not included in the EU Ecolabel criteria explains why the EU Ecolabel ambition levels look a lot stricter than the CEPS data presented above in Figure 22. Some of the variation in specific gas consumption data may be associated with factories or companies that produce spray-dried atomised powder onsite (higher specific consumption) and those that buy the already-atomised powder (lower specific consumption) for sale to third parties although this depends on exactly how the data gathering exercise was conducted by CEPS.

The main reason for the wide difference in performance is likely to be due to the varying degrees of:

- heat recovery that are achieved (higher recovery means lower specific gas consumption);
- average operating capacity as a % of maximum (closer to 100% means lower specific gas consumption);
- around the clock operation (closer to 24 hours per day / 7 days per week means lower specific gas consumption).

The only factor that can be directly controlled by the producer is the installation of heat recovery equipment. The other two factors listed above depend on demand-side signals and commercial strategies at the sectorial level.

Overall, the data consulted for ceramic floor and wall tiles suggests that the existing limit of 3.5 MJ/kg is sufficiently ambitious. However, a closer look at the EU Ecolabel data (only maximum and minimum values reported for each product, not the average) revealed that, taking each minimum and maximum values as individual data points, the spread of data would be: Maximum 3.46 MJ/kg; Top 75% 2.8 MJ/kg; Top 50% 2.42 MJ/kg; Top 25% 2.2 MJ/kg and Top value 1.11 MJ/kg. A top 25% (i.e. 1st quartile) value is considered as an appropriate threshold for environmental excellence.

Fuel consumption for brick and (roof) tile production

In a similar manner to ceramic floor and wall tiles, the production of fired clay bricks, blocks and roof tiles is an energy intensive process with considerable room for optimization via the recovery of waste heat. A typical Sankey diagram of the process shows that heat recovery from the kiln is a highly significant part of the total energy used in the drying process.

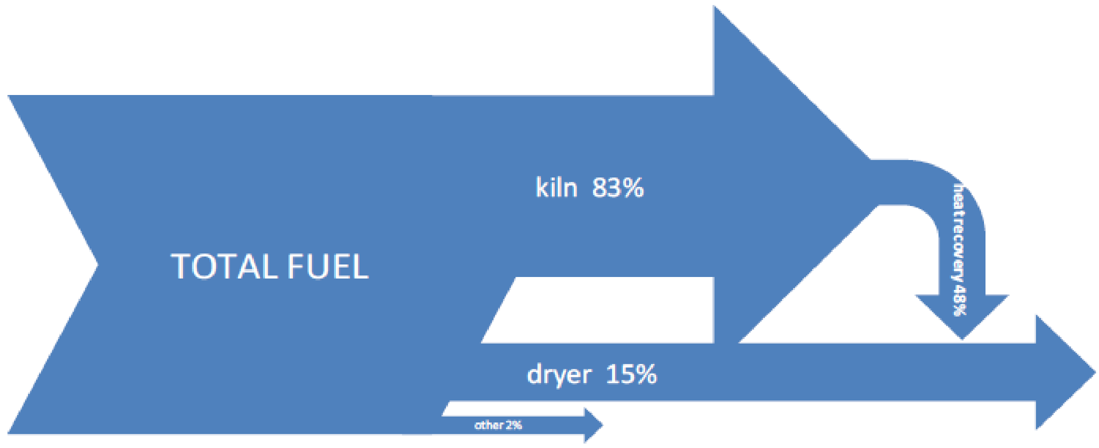


Figure 23. Sankey diagram for fuel energy brick production (Source: Carbon Trust, 2010)

The purpose of the dryer is to reduce to moisture content of the green clay forms to between 0 and 1% in order to prevent cracking when it is fired in the kiln. Consequently, the energy required in the dryer will vary as a function of the ingoing moisture content of the green forms and their ambient temperature.

From the Sankey diagram above, it is clear that the heat recovered from the kiln is not sufficient to account for the full thermal energy requirements of the dryer. The potential for heat recovery from the kiln will depend on other losses from the kiln.

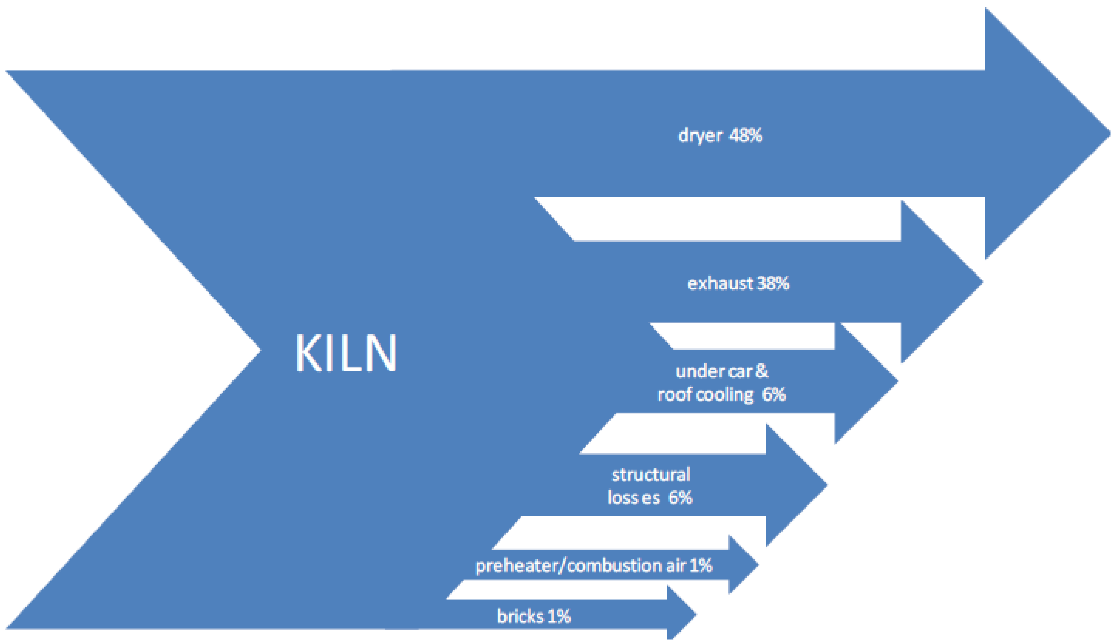


Figure 24. Sankey diagram for fuel energy flows from the kiln in brick production (Source: Carbon Trust, 2010)

According to the Sankey diagram above, only a very small amount of the thermal energy is transferred to the bricks themselves (ca. 1%) while around 50% of thermal energy is lost in exhaust gases and via the kiln structure. It is evident that kilns with higher heat losses from kilns will have higher gas consumption in the dryer(s) and kilns with lower heat losses from the kilns will have lower gas consumption rates in the dryer(s). **By having a criterion only focused on kiln gas consumption, it would be possible that more efficient kiln-dryer systems are not sufficiently recognized. Consequently, it is proposed that gas consumption data should look at the kiln-dryer system and not just the kiln alone.**

The JRC consulted gas consumption data presented in the CEPS report for brick and tile production as well (a total of 23 companies responded to the CEPS survey, see data below). One of the main purposes of this was to determine if different specific kiln energy consumption values can be justified for brick and (roof) tile products.

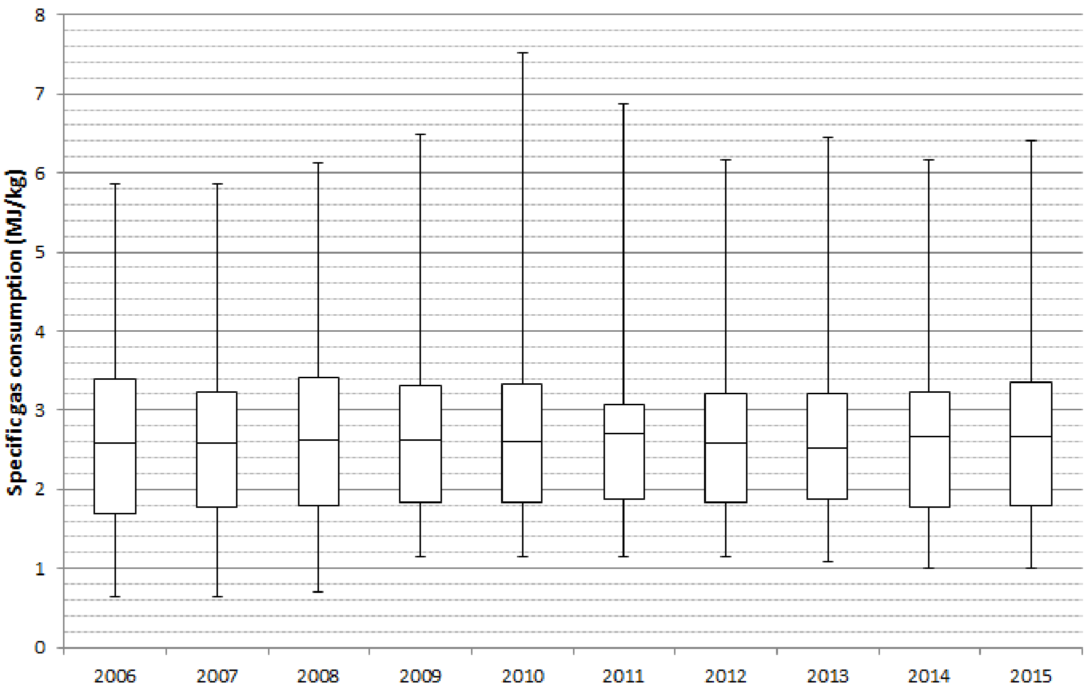


Figure 25. Specific gas consumption for ceramic brick and (roof) tile production

In general, the specific gas consumption values are much lower than the equivalent data for ceramic floor and wall tiles. The following observations can be made:

- Maximum values ranged from around 5.8 to 7.5 MJ/kg for brick and tile, much lower than floor and wall tile (10.5 to 17 MJ/kg).
- The data was centered (i.e. 1st to 3rd quartiles) around **1.8-3.4 MJ/kg** for brick and tile, again much lower than floor and wall tile (5.0 to 7.5 MJ/kg).
- The lowest values ranged from 0.6 to 1.2 MJ/kg, again much lower than floor and wall tile (1.0 to 2.0 MJ/kg).

Overall, the CEPS data clearly indicate that a lower specific energy consumption limit should be set for brick (median 2.65 MJ/kg) and ceramic tile type products (median 5.1 MJ/kg). Unfortunately the CEPS data do not describe any split between gas consumption in dryers and kilns. Furthermore, the data from the brick and tile sector is not broken down into the type of product required, so the data ranges are likely to be dominated by the most commonly produced product in the sector, which will be facing bricks.

Data from 2007 regarding 73 brick kilns in UK revealed the following cumulative distribution of specific fuel energy consumption:

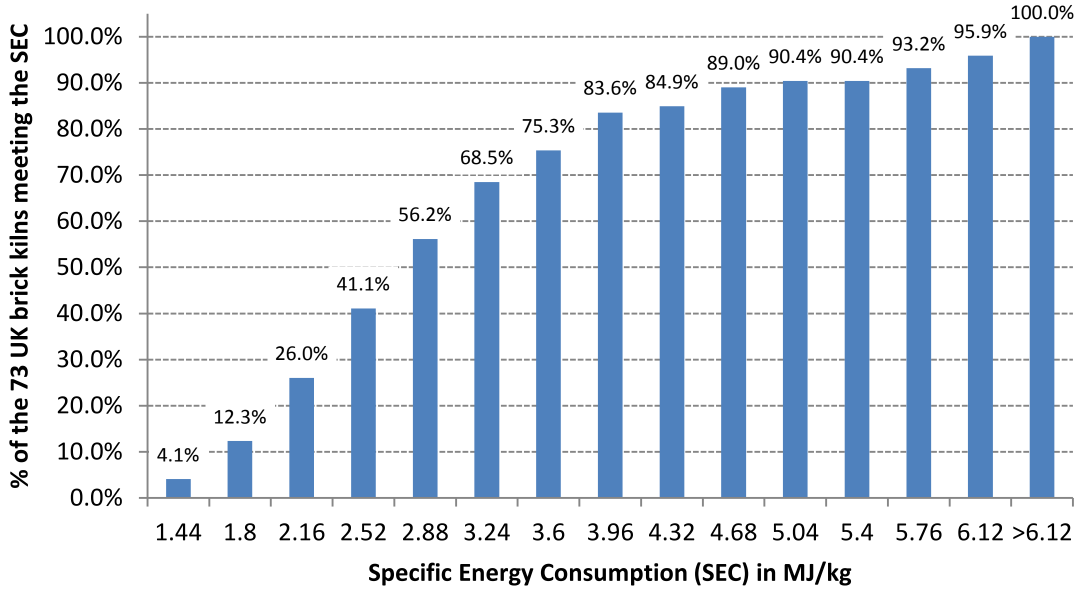


Figure 26. Specific energy consumption values for brick production in the UK (Source: Carbon Trust, 2010)

Looking at the data for UK brick kilns, a third quartile value that would serve as a basis for a mandatory upper limit for EU Ecolabel criteria would be around **3.6 MJ/kg** and a threshold for environmental excellence, corresponding to the top 25% of products, could be around **2.1 MJ/kg**. However, it must be stated that these data are at the level of the facility and should only serve as a broader indication of particular product level requirements. The same sort of data could be expected to apply to fired clay paving blocks given the similarities in these types of product and how densely they can be loaded on kiln cars.

A more focused set of data is reported in section 3.3.1.2 of the BREF document (BREF, 2007), specific gas consumption values of **1.02-1.87 MJ/kg** for masonry units, **2.87 MJ/kg** for facing bricks and **1.97-2.93 MJ/kg** for roof tiles were reported by the Austrian Member of the Technical Working Group. The values depend on the final required density of the product (higher density means higher firing temperatures) and organic content (higher organic content could reduce fuel requirement but may affect product density).

A report published by the UK Carbon Trust (CT, 2010) looked at three different brick kilns and reported the following data:

- Extruded brick process (using a green brick with a 15% moisture content dried to 1% and firing at 1060°C for 52 hours): 73 kWh/t electricity and 691 kWh/t gas, or **2.49 MJ gas/kg** of brick production.
- Extruded brick process (using a green brick with a 15% moisture content dried to 0% and firing at 1000°C for 75 hours): 161 kWh/t electricity and 596 kWh/t gas, or **2.15 MJ gas/kg** of brick production.

- Soft-mud process (using a green brick with a moisture content of 26% dried to 2% and firing at 1030°C for 140 hours): 57 kWh/t electricity and 657 kWh/t gas, or **2.37 MJ gas /kg** of brick production.

The Brick Sustainability Report (BDA, 2017) stated an average specific energy consumption of between 727 and 763 kWh/t for the years 2011 to 2016. These values were the sum of electricity and fuel consumption. Applying a fuel of thumb assumption that 90% of the total energy consumption is via fuels, and converting the units into MJ/kg, the values would be **2.35 to 2.47 MJ/kg** for brick production (drying and firing).

One aspect that influences the specific fuel energy consumption but which cannot be directly controlled in continuously operating kilns is the loading capacity which the kiln is run at (this will be influenced by stock levels and the variations in product demand). Example data from a real-life tunnel kiln producing bricks in the UK is reproduced below (Carbon Trust, 2010):

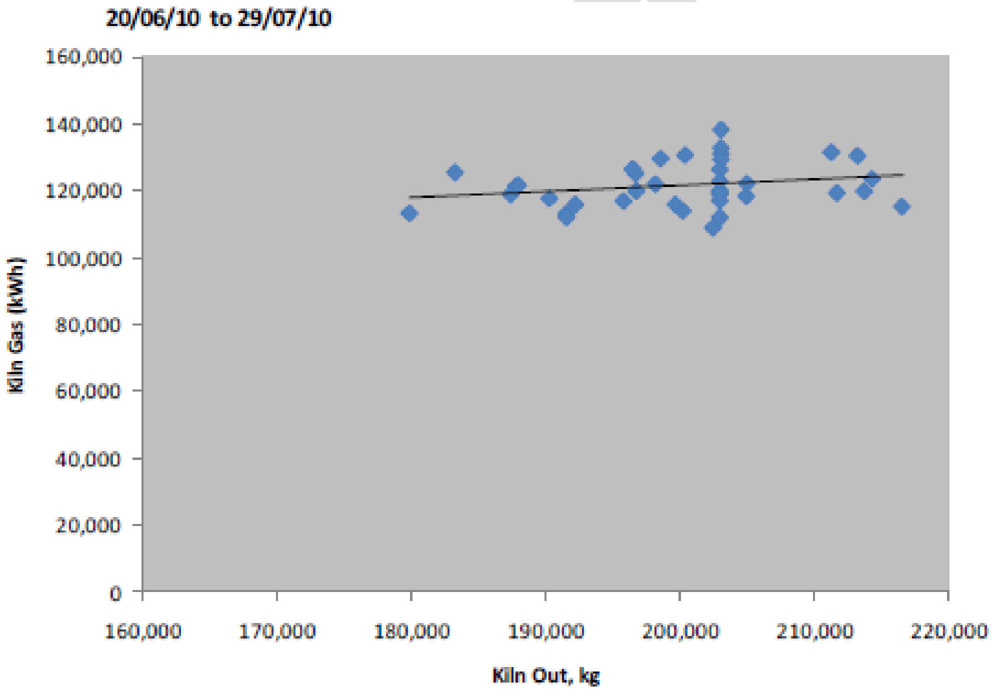


Figure 27. Kiln gas consumption as a variation with kiln output.

The data presented above show no a very modest increase in kiln gas consumption when the kiln output ranges from 180,000 to 215,000 kg. This data implies that the main losses of thermal energy from the kiln are almost independent of the loading rate. The modest increase can be expected simply due to the energy required for the heating of green ceramic bodies and to make the mineralogical transformations take place. However, as seen in Figure 24 above, the heat transferred to bricks was only a small proportion of the total heat energy consumption in the first place.

Especially with roller hearth kilns, it is important to note that larger scale ovens are only rarely switched off (e.g. for annual maintenance works) due to the challenges of start-up and the time it takes to achieve a steady-state operation. Instead, the oven is also maintained at a baseline temperature and has firing sections where higher temperatures are applied that depend on the mineral composition of the tile and the final properties that are desired.

These points above lead to the conclusion that specific fuel energy consumption will be lowest in kiln/dryer systems that run closer to their maximum capacity.

Focus only on fuel consumption in the kiln or in the drying process(es) as well?

The focus of the current energy criterion for ceramic hard coverings is entirely on the kiln (i.e. ignoring everything in the left hand side of Figure 20). However, Mezquita et al., (2014) stated that around 45% of total fuel consumption for the production of ceramic tiles could be attributed to drying processes (36% due to spray drying and 9% due to ceramic body drying). A look at tunnel kiln data reported by the Carbon Trust (2010), it is clear that dryers can be and are configured in different ways to take different amounts of waste heat from the kiln.

By having a criterion on the EU Ecolabel that is focused purely on thermal energy consumption in the kiln, it could be argued that ignoring thermal energy consumption in spray-drying and green body drying stages would not be in line with Article 6(3)a of the EU Ecolabel Regulation, which states:

"*3. EU Ecolabel criteria shall be determined on a scientific basis considering the whole life cycle of products. In determining such criteria, the following shall be considered:*

(a) the most significant environmental impacts, in particular the impact on climate change, the impact on nature and biodiversity, energy and resource consumption, generation of waste, emissions to all environmental media, pollution through physical effects and use and release of hazardous substances;"

Furthermore, looking only at the kiln fuel consumption may penalise those production processes where a larger amount of kiln waste heat is used in dryers in comparison to production processes where fuel is fired directly into dryers.

Consequently, the JRC has decided to make a proposal for how a criterion on thermal energy consumption in the production of ceramic tiles and fired clay products could look. However, such a proposal needs to be supported by data that are representative of thermal energy consumption of this broader focus (i.e. spray-drying, dryer and kiln).

The data from CEPS (2014) can be considered to be more representative of the combined production process, although caution is urged when interpreting that data because the wide range of results (see Figure 22 and Figure 25) could be due to some facilities producing an excess of spray-dried powder for use in other sites (i.e. higher gas consumption) and other facilities buying the already spray-dried powder (i.e. lower gas consumption).

Spray drying typically involves a wet-milled powder of 30-40% moisture content (60-70% solids content) being dried to granules of 5.5 to 7% moisture content by coming into contact with hot air at a temperature of 350 to 450°C (BREF, 2007). When looking at 12 Spanish production facilities, Monfort et al., (2010) reported average specific energy consumptions of 476 ± 19 kWh/t dry solids or 510 ± 23 kWh/t spray dried powder. The minimum and maximum values found were 387 and 621 kWh/t spray dried powder respectively. Converting to MJ/kg, the thermal energy consumption values reported by Monfort et al., (2010) are **1.71 MJ/kg** spray dried powder on average with lowest and highest values of **1.4 and 2.2 MJ/kg** respectively. This compares well to the ranges of **1.1 to 2.2 MJ/kg** reported in the BREF Document (BREF, 2007) although it is not clear if the BREF ranges refer to kg of dried material or kg of dry solids.

The broader proposal also permits the rewarding of cogeneration systems that supply heat to dryers because electricity is generated by the hot combustion gases before most of the same heat is used to dry the wet material.

Stakeholders confirmed that the production of spray-dried powder (only associated with ceramic tile production) is more economical in larger scale, centralized units. This means that smaller producers, or even different sites of the same company, will not produce the spray-dried powder onsite. Consequently, the criterion needs to have a separate approach for spray-dried powder, where specific fuel consumption values for spray dryer units provided by suppliers can be used. In order to improve the consistency of data collected, it was considered necessary to try to explain in as much detail as possible how to estimate the specific fuel consumption (partly in the assessment and verification text and partly in the User Manual).

A consideration of Combined Heat and Power (CHP) units in the ceramic sector

The advantage of the option 2 criterion proposal for the energy criterion is that is allows for the possibility to reward and incentivize the use of CHP units for the cogeneration of heat and power. According to Cerame-Unie (2013) there were around 250 CHP units installed in the European ceramic sector in 2012, with an average installed capacity of 3MW (the largest one being 15MW and many units having a capacity <1MW). Overall, it was stated that installed capacity was around 700MW and that 3000 GWh/yr (or 10800 TJ/yr) of electricity was generated (Batier, 2013).

Option 1 does not recognize CHP units because the heat they can provide after electricity generation is only hot enough to assist in drying operations and the focus of the criterion in option 1 is purely on fuel consumption in the kiln.

Option 2 captures the full potential use of CHP in the relevant ceramic sectors because it can also be reflected in the score for third party producers of spray dried powder.

4.2 – Specific CO2 emissions

Existing criterion:

No existing criterion

TR v1.0 proposed criterion:

No proposal made

TR v2.0 proposed criterion: 4.2. CO2 emissions

Option 1: Specific CO2 emissions from kiln fuel

Option 2: Specific CO2 emissions from kiln fuel, dryer fuel and material decarbonation

Option 1 (kiln fuel only, with mandatory elements)

The specific CO2 emission associated with fuel consumption for kiln firing during the production of the relevant ceramic or fired clay product shall not exceed the following relevant limits listed in the middle column of table below.

Up to 15 points shall be awarded in proportion to where the actual specific fuel consumption for kiln firing lies relative to the relevant values listed in the middle column and the right hand column.

Product type	Mandatory upper limit	Environmental excellence threshold
ceramic tiles ≥6mm thick	196 $kgCO_2/t$	123 kgCO2/t
ceramic tiles <6mm thick	4.2 $kgCO2/m^2$	2.8 $kgCO2/m^2$
Fired clay brick, paving block and roof tile	168 kgCO2/t	112 kgCO2/t
Fired clay masonry unit	107 kgCO2/t	56 kgCO2/t

Assessment and verification

The applicant shall provide a declaration of compliance with the mandatory requirement for specific kiln firing energy consumption.

Fuel CO2 emissions shall be based on the specific fuel consumption values (MJ/t or MJ/m²) declared under criterion 4.1. Specific fuel consumption values shall be converted into specific

Option 2 (kiln and dryer fuel plus process emissions)

The CO2 emission score associated with fuel consumption and process emissions for firing and drying stages of the relevant ceramic or fired clay product shall not exceed 1.0, when calculated according to the relevant reference value(s) and equation(s) below.

Up to 25 points shall be awarded in proportion to how closely the score approximates 0.50.

Product type	Reference value
Spray-dried powder	101 $kgCO_2/t$ powder*
ceramic tiles ≥6mm thick	274 $kgCO_2/t$ product
ceramic tiles <6mm thick	5.8 $kgCO_2/m^2$ product
Fired clay brick, paving block and roof tile	246 $kgCO_2/t$ product
Fired clay masonry unit	173 $kgCO_2/t$ product

**includes any residual moisture content, which would typically be 5-7%*

For ceramic tile products where onsite produced or purchased spray-dried powder is used, the score shall be calculated as follows:

$$CO2_{score} = 0.35(SDP) + 0.65(KD)$$

Where:

- $CO2_{score}$ is the overall score for specific fuel and process emissions of CO2 in the production of ceramic tiles.

- SDP is the score for specific fuel emissions of CO2 from spray-dried powder production (actual value divided by the relevant reference

CO_2 emission values ($kgCO_2/t$ or $kgCO_2/m^2$) by multiplying by the appropriate standard carbon emission factor(s) listed in Annex VI of Regulation (EC) No 601/2012 for the fuel(s) used. The applicant may use alternative calculation factors in accordance with Articles 30 to 39 of the same Regulation. *The number of points awarded shall be calculated as zero in cases where the actual value is equal to the mandatory limit and as 15 in cases where the actual value is equal to or lower than the environmental excellence threshold.* *Actual values in-between the mandatory and environmental excellence thresholds shall be awarded points in proportion to where they lie between the two aforementioned reference points.*	value). - KD is the score for specific fuel and process emissions of CO2 from the kiln and specific fuel emissions of CO2 from the green body dryer (actual value divided by reference value). For all other products where spray dried powder is not used, the score shall be calculated as follows: $CO2_{score} = KD$ Where: - $CO2_{score}$ is the overall score for specific fuel and process emissions of CO2 in the production of ceramic tile or fired clay product. - KD is the score for specific fuel and process emissions of CO2 from the kiln and specific fuel emissions from the green body dryer (actual value divided by reference value). ***<u>Assessment and verification</u>*** *The applicant shall declare the $CO2_{score}$ value for the relevant product(s), supported by calculations according to the relevant equation above.* *Fuel CO2 emissions shall be based on the specific fuel consumption values (MJ/t or MJ/m^2) declared under criterion 4.1. Specific fuel consumption values shall be converted into specific CO_2 emission values ($kgCO_2/t$ or $kgCO_2/m^2$) by multiplying by the appropriate standard carbon emission factor(s) listed in Annex VI of Regulation (EC) No 601/2012 for the fuel(s) used. The applicant may use alternative calculation factors in accordance with Articles 30 to 39 of the same Regulation.* *Process CO_2 emissions shall be calculated based on the average carbonate (CO_3) content of the raw material mix used. The carbonate value (in kg/t) shall be converted to process CO2 emissions by multiplying by a factor of 44/60.* *The number of points awarded shall be calculated as zero in cases where the actual score is equal to the mandatory*

	limit of 1.00, and 25 in cases where the actual score is equal to or lower than 0.50. *Actual values in-between 1.00 and 0.50 shall be awarded points in proportion to where they lie between the two aforementioned reference points.*

Rationale and discussion:

Emissions of CO2 have been at the very top of the scientific and political agenda for climate change for well over a decade and will continue to be so (EC, 2018b). This priority focus has led to the European ceramics sector publishing its own roadmap to 2050 (Cerame-Unie, 2012), with a strong focus on the options available to reduce CO2 emissions from the sector.

Currently there are different mandatory and voluntary policies being applied to the ceramic sector (and other energy intensive sectors) to manage CO2 emissions.

At the most focused end of the policy spectrum is the mandatory reporting of CO2 emissions under the Emissions Trading Scheme (ETS), where only emissions from the site are included (i.e. not those from grid electricity or raw material production).

At the broader end of the policy spectrum are the Product Category Rules that are defined for voluntary Environmental Product Declarations, where all sorts of variables that influence the final CO2 "*footprint*" of the product can be considered (e.g. assumptions about electricity grid factors, assumptions about transport of raw materials, assumptions about embodied carbon in raw materials etc.).

All large scale ceramic tile and fired clay product producers are obliged to report on emissions of CO2 under the more focused ETS calculations. The coverage of EPD style calculations is less clear, although sectoral average EPDs for ceramic floor and wall tiles have been published by the German, Italian and Spanish sectors (covering over 75% of European ceramic tile production) the coverage of other relevant fired-clay products by EPDs is not so clear.

Overall, thanks both to the mandatory requirements of the ETS and the voluntary requirements of EPDs, the ceramic sector is well-placed to assess and verify any requirements relating to CO2 emissions that could be set under EU Ecolabel criteria. In fact, it seems strange that the existing EU Ecolabel criteria did not consider CO2 emissions as one of its criteria already.

The proposal for CO_2 emissions can be tailored to suit which option is decided upon for criterion 4.1 (i.e. option 1 or option 2) and this is why there are also two options for the CO2 criterion.

The limits for CO_2 emissions have been translated into units of $kgCO_2/t$ or m^2 product from the fuel energy reference values in criterion 4.1 (in MJ/kg or m^2 product) by multiplying by a carbon emission factor of 56.1 tCO_2/TJ (equivalent to 56.1 $kgCO_2/GJ$ and 56.1 gCO_2/MJ), which is typical of natural gas. It is also worth mentioning that an extra 50 $kgCO_2/t$ product has been added to the reference values for fired products to account for process emissions (see further research section for more background on this aspect). This extra allowance was also factored in for the reference value for thin tiles that is expressed in $kgCO_2/m^2$ product.

Table 17. Translation of energy reference values into CO2 reference values

Product type	Criterion 4.1 reference value	Multiplying by 56.1 gCO2/MJ and then both sides by 1000 (i.e. g→kg and kg→t)	Adding 50 kgCO2/t for process emissions
Spray-dried powder	1.8 MJ/kg powder*	101 $kgCO_2/t$ powder*	101 $kgCO_2/t$ powder**
ceramic tiles ≥6mm thick	4.0 MJ/kg	224 $kgCO_2/t$ product	274 $kgCO_2/t$ product
ceramic tiles <6mm thick	86 MJ/m^2	4.82 $kgCO_2/m^2$ product	5.82 $kgCO_2/m^2$ product†
Fired clay brick, paving block and roof tile	3.5 MJ/kg	196 $kgCO_2/t$ product	246 $kgCO_2/t$ product
Fired clay masonry unit	2.2 MJ/kg	123 $kgCO_2/t$ product	173 $kgCO_2/t$ product

**includes any residual moisture content, which would typically be 5-7%*

***no process emissions assumed during spray drying since temperatures are too low to cause mineral decarbonation.*

†assuming a tile density of 20kg/m^2, 50kgCO_2/t tile would be equivalent to 50kgCO_2/50m^2, or 1kgCO_2/m^2

Outcomes from and after the 1st AHWG meeting

Given the fact that most ceramic producers will need to report on CO_2 emissions under the ETS, JRC asked why no interest had been expressed in expressing the specific energy requirement in terms of kg CO_2/kg or m^2 of product (can be calculated by multiplying the gas meter reading by the calorific value and carbon factor provided by the gas supplier or by using default values in Regulation (EC) No 601/2012). Industry stakeholders confirmed that this could be done, but that it would not be any simpler to obtain than the specific kiln energy consumption rate because industry associations only have data for CO_2 emissions at the level of the facility (not at the level of the product) and because the emissions would also include CO_2 emissions from onsite dryers.

However, it was admitted that looking at CO_2 emissions would generally follow the same approach being promoted in the draft ISO 17889-1 standard for sustainable ceramic tiles. Industry stakeholders emphasized that they did not wish to see the EU Ecolabel become a type of EPD+ scheme because of the many different ways in which EPD numbers can be manipulated (e.g. convenient selection of primary and secondary data, assumptions for transport etc.) and because it would require companies to contract LCA experts. Consequently, if any criterion on CO_2 is to be inserted, it should be focused on energy use at the site and not the CO_2 footprint of the product.

In terms of how a possible criterion for CO_2 and energy could work together, JRC stated that a criterion on energy could be split into two parts, one on total fuel energy in MJ/kg or m^2 and the other on kg CO_{2eq}/kg or m^2. That way both energy efficiency and the use of biomass-based fuels would be recognized. After the meeting, JRC also committed to investigating the potential significance of "*process*" emissions of CO_2 from the decarbonation of carbonates in the raw materials.

Further research and main changes

Almost 19 Mt of CO_2 was estimated to be emitted from the European sectors for the production of brick and tile, of ceramic floor and wall tile and of refractories. These emissions were split as follows:

- 66% due to fuel consumption
- 18% due to electricity production

- 16% due to process emissions

Emissions of CO_2 due to fuel combustion can be simply estimated by multiplying the specific fuel consumption values in units of MJ/kg or MJ/m^2 (already required for the existing criterion) by a carbon emission factor. Standard carbon emission factors and net calorific values have been defined for many fuels in Annex VI of Regulation (EU) No 601/2012. Specific values can also be used if acceptable data are provided by the fuel supplier. Some examples of standard carbon emission factors are provided below, together with net calorific values.

Table 18. Selected fuel emission factors and calorific values from Regulation 601/2012

Fuel type	Emission factor (t CO2/TJ)	Net calorific value (TJ/Gg)
Anthracite (coal)	98,3	26,7
Other bituminous coal	94,6	25,8
Sub-bituminous coal	96,1	18,9
Lignite	101,0	11,9
Liquified petroleum gas	63,1	47,3
Natural gas	56,1	48,0
Landfill gas	-	50,4
Sludge gas	-	50,4

The main fuel used by the ceramic sector in general is natural gas. Compared to other fossil fuels, it has the lowest carbon emission factor. Consequently the shift from fuels like coal and fuel oil to natural gas has helped the ceramic sector reduce its specific CO_2 emissions already.

By setting reference values based on fuel energy requirements (in MJ/kg) and linking this them to the carbon emission factor of natural gas (in kg CO_2/MJ), the EU Ecolabel criterion would encourage both improved energy efficiency and the use of biogas derived from non-fossil sources, such as sludge and landfills. However, it is claimed that biogas is currently 2-3 times more expensive than natural gas.

Emissions of CO_2 for electricity might become complicated to calculate when grid factors for electricity are involved. When CHP is involved, the calculations of CO2 emissions associated with electricity become more complicated. Furthermore, with grid electricity there is limited "*steerability*" for potential EU Ecolabel applicants and license holders. Consequently, it is proposed not to include CO_2 emissions from electricity consumption in the proposal.

Process emissions of CO_2 are related to the thermal decomposition of carbonate minerals in the raw materials. Carbonate content can be assumed to be mostly broken down into CO_2 plus the residual oxide under the normal processing conditions of ceramic or fired clay production. Carbonate content is an important parameter to monitor and must be tightly restricted for low porosity products such as porcelain tiles. Monfort et al., (2010) presented results of CO_2 emissions associated with 4 different products (see below).

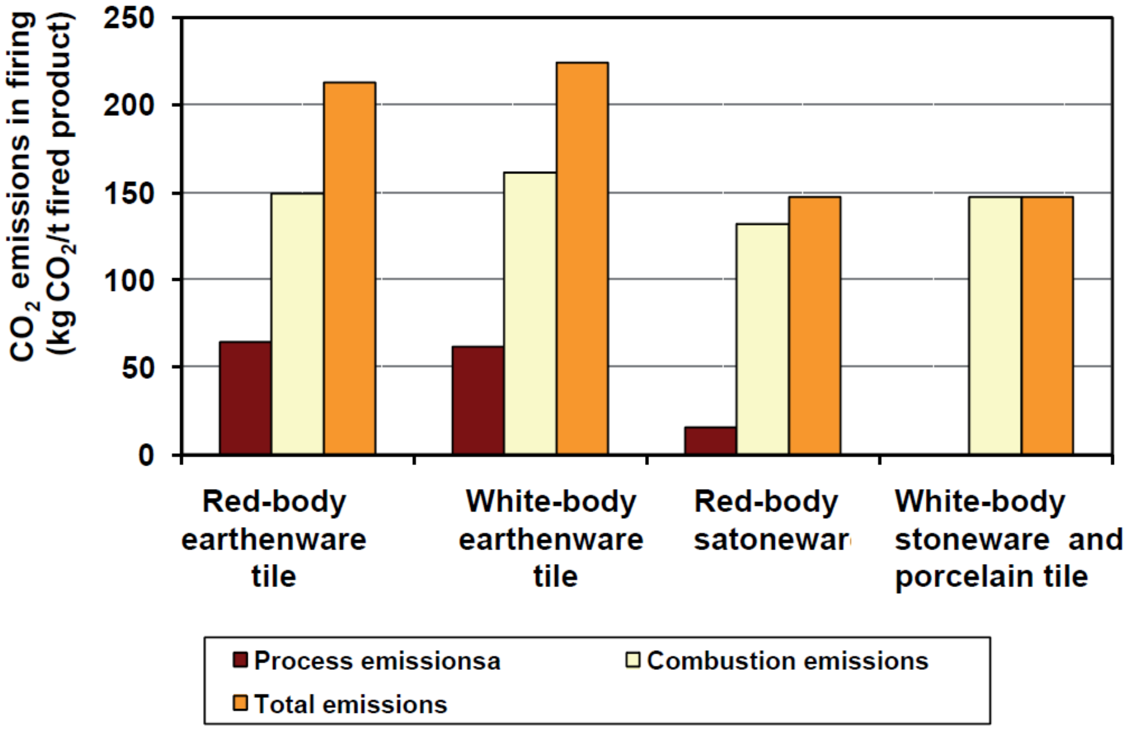


Figure 28. CO2 emissions for production of different ceramic tile products (Source: Monfort et al., 2010)

When looking only at fuel combustion in the kiln and process emissions, the graph above shows that decarbonation can vary from 0% to over 25% of total kiln CO2 emissions. The relevant data were:

- Red-body earthenware: carbonate content 13.1%; process emissions 64 kgCO_2/t
- White-body earthenware: carbonate content 12.5%; process emissions 61 kgCO_2/t
- Red-body stoneware: carbonate content 3.3%; process emissions 15 kgCO_2/t
- White-body porcelain and stoneware: carbonate content <0.5%; process emissions <1 kgCO_2/t

The same study also showed that CO_2 emissions from the spray dryer accounted for 27-36% of total fuel and process emissions and that CO_2 emissions from green body dryers accounted for 6-9% of total fuel and process emissions.

Therefore, as with the specific fuel energy criterion 4.1, any proposal for a CO_2 criterion should consider thresholds that account for specific fuel consumption in dryer(s) and in the kiln. In addition to this, the CO_2 criterion should also take into account the potential carbonate content of the raw material used. For fuel consumption reference emissions, it would seem reasonable to assume that all fuel used was natural gas, thus penalising the use of other fossil fuels and incentivising the use of renewable fuels.

Points for discussion
Opinions on option 1 and 2? **Any standard method for determining carbonate content in clays to refer to?** **Opinions on the thresholds proposed?**

4.3 – Process water

Existing criterion: 4.2. Water consumption and use

(a) The water consumption at the manufacturing stage, from raw material preparation to firing operations, for the fired products shall not exceed the following requirement:

(litres/kg of product)

Parameter	Requirement
Fresh water specific consumption (Cw_{p-a})	1

Assessment and verification: the applicant shall provide the calculation of fresh water specific consumption as indicated in the Technical appendix — A5. For fresh water, only groundwater, shallow water or water from the aqueduct should be considered.

A5 Water consumption calculation

The fresh water specific consumption shall be calculated as follows:

$Cw_{p-a} = (W_p + W_a)/P_t$

Cw_{p-a} = fresh water specific consumption. The results are expressed in m^3/tonnes, equivalent to l/kg;

Pt = total stored production in tonnes;

Wp = water from wells and intended for exclusive industrial use (excluding water form wells for domestic use, irrigation and any other non-industrial use), in m 3 ;

Wa = water from aqueduct and intended for exclusive industrial use (excluding water form aqueduct for domestic use, irrigation and any other non-industrial use) in m 3 .

The system boundaries are intended from raw materials to firing operation.

(b) The waste water produced by the processes included in the production chain shall reach a recycling ratio of at least 90 %. The recycling ratio shall be calculated as the ratio between the waste water recycled or recovered by applying a combination of process optimisation measures and process waste water treatment systems, internally or externally at the plant, and the total water that leaves the process, as defined in the Technical appendix — A3.

Assessment and verification: the applicant shall provide the calculation of the recycling ratio including raw data on total wastewater produced, water recycled and the quantity and source of fresh water used in the process.

A3 Water recycling ratio

The calculation of the water recycling ratio shall be consistent with the following formula based on the flows highlighted in Figure A1.

$$\text{Recycling ratio} = \frac{\text{Waste water recycled}}{\text{Total water exists the process}} \cdot 100 = \frac{R}{WI} \cdot 100$$

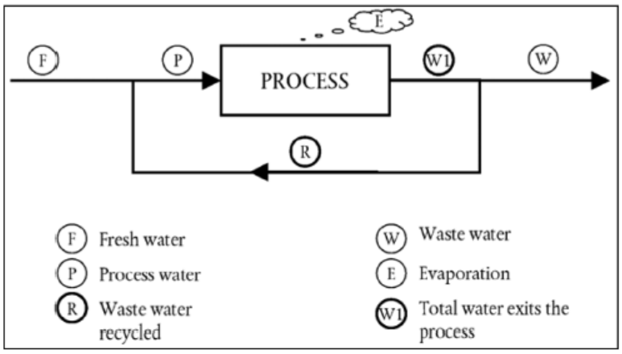


Figure A1: Water flow scheme that shall be used to calculate water recycling ratio ([1])

TR v1.0 proposed criterion: 4.2. Specific freshwater consumption

Mandatory requirement

The specific freshwater consumption, from grinding of raw material, spray drying, shaping, glazing and firing processes shall not exceed 1.0 L/kg or 20.0 L/m2.

For plants where grinding and spray drying operations are not carried out because spray dried material is purchased, the specific water consumption shall not exceed 0.5 L/kg or 10.0 L/m2.

EU Ecolabel points

Points shall be awarded in proportion to how much the applicant can reduce the specific freshwater consumption to 50% of the applicable limit (up to 10 points).

Assessment and verification:

The applicant shall provide a declaration of compliance with the mandatory requirement, supported by the total freshwater consumption data (in L or m3) for the most recent calendar year or 12 month period and the total ceramic tile production data (in kg or m2) for the same period.

In case it is not possible to provide specific data for a production line or product, the applicant shall refer to data for the entire plant.

Water consumption due to toilets, canteens and other activities not directly relevant to tile production should be metered separately and not be included in the calculation.

Points shall be awarded in proportion to how closely the data reaches the maximum benchmark set (e.g. for plants where grinding and spray drying is carried out: 1.0 L/kg = 0 points

TR v2.0 proposed criterion: 4.3. Process water

Mandatory requirement

The facility producing the ceramic tile or fired clay product shall either:

- Have a closed loop wastewater recycling system for process wastewater that facilitates zero liquid discharge.
- Be able to demonstrate that specific freshwater consumption that is less than or equal to the limits defined below.

Product type	Including spray drying?*	Consumption limit
Thin format ceramic tiles (≤ 6mm thickness)	Yes	20.0 L/m^2
	No	10.0 L/m^2
All other ceramic tile and fired clay products	Yes	1.0 L/kg
	No	0.5 L/kg

**Spray drying water consumption is only relevant to ceramic tile production and values should be included if the spray dryer is operated by the applicant or if the spray dried powder supplier provides this data.*

Assessment and verification:

The applicant shall provide a declaration of compliance with the mandatory requirement, stating by which means they comply.

In cases where a zero liquid discharge system is in place for recycling process wastewater, they shall provide a brief description of the system and its main operating parameters.

In cases where such a system is not in place, total process water consumption data (in L or m^3) and the total ceramic tile or fired clay product output data (in kg or m^2) shall be provided for the most recent calendar year or rolling 12 month period.

In case it is not possible to provide specific data for a production line or product, the applicant shall refer to data for the entire plant.

Water consumption due to toilets, canteens and other activities not directly relevant to the production process should be metered separately and not be included in the calculation.

Rationale:

The importance of specific water consumption

According to the European Environment Agency, a total of 36 river basins in Europe, covering 19% of Europe's territory, suffered from water scarcity in the summer of 2015. An arbitrary definition of a water scare region is when more than 20% of the natural freshwater resources are abstracted for human activities (i.e. agriculture, power generation, manufacturing, service industries and urban consumption). The total abstraction of water for human activities as a fraction of the total available freshwater resources is expressed as the Water Exploitation Index (WEI).

Water scarcity, that is to say WEI, is measured at the level of the river basin by the European Environment Agency. It is interesting to consider the data for the river basins in which the two dominant ceramic producing regions in Europe are located: Castellón in Spain and Sassuolo in Italy.

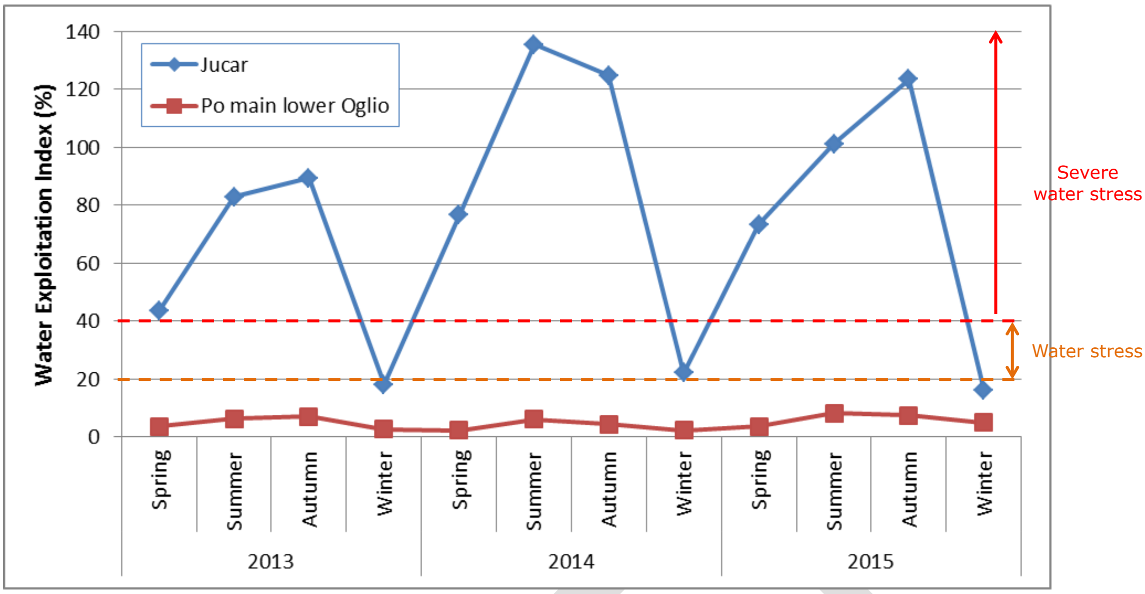


Figure 29. Trends in water stress in the Castellon and Sassuolo district river basins (Jucar and Po respectively). Source: EEA.

The data in Figure 29 show that the Jucar basin has been almost continually classified as being under water stress during the last 3 years, even during winter periods when demand for irrigation water for agriculture is greatly reduced. In some cases the human abstraction of freshwater actually exceeded 100%, which is either a methodological flaw or represents the tapping into not normally available freshwater reserves such as deep aquifers. In either case, the numbers serve to highlight the importance of efficient water consumption in the Castellon region, via ceramic tile production or any other water demanding activity.

On the other hand, the Po (main lower Oglio) river basin in which the Sassuolo ceramic cluster is located does not suffer from any obvious water stress. Even in this case, water recycling is important in order to lower costs associated with water abstraction and wastewater discharge.

Ceramic tile production requires a significant quantity of water for wet grinding, to prepare clay and glaze slips, to obtain the correct plasticity of clay bodies prior to pressing or extrusion and for general washing and cooling purposes.

Two separate limits have been specified depending on what processes are carried out at the applicant's plant. In cases where grinding and spray drying of raw materials is not carried out, because they instead purchase the spray dried material, there is a significantly reduced water demand. According to some industry stakeholders, this could be reflected by a 50% reduction in specific freshwater consumption rates.

Why no longer any requirement for water recycling ratio proposed?

One of the concerns about the water recycling ratio is that it will be easier to meet a high recycling ratio when large amounts of water are consumed in the first place. By having a fixed requirement on specific freshwater consumption only, potential applicants have a more flexible choice: either use dry processes in the first place or use wetter processes and recycle the water in an efficient manner. To illustrate this point, the dry and wet grinding processes can be considered.

The grinding stage consumes a significant quantity of water. Even with dry grinding, it is necessary to soak the ground powder to a moisture content of 7-12% prior to optimised drying of the moistened granules, which will carry a moisture content of around 6-7%. Wet grinding is generally considered to consume around 4 times as much water (wet ground raw materials will have a moisture content of 42-50%) which is then dried to a moisture content of 5-6%. Consequently, there is a much higher quantity of water available for recycling when wet grinding processes are used.

Alignment with draft ISO 17889-1 standard

The draft ISO 17889-1 standard for sustainable ceramic tiles sets a criterion for "*specific freshwater consumption*" and makes a distinction in values depending on whether the product unit is m^2 or kg. In total, 4 different limits are set:

- <20 L/m^2 or <1000 L/t;
- 20-24 L/m^2 or 1000-1200 L/t;
- 24-28 L/m^2 or 1200-1400 L/t and
- >28 L/m^2 or >1400 L/t;

The EU Ecolabel proposal aligns with this most ambitious level of the ISO 17889-1 draft standard (<20 L/m^2 or <1000 L/t).

Outcomes from and after the 1st AHWG meeting

When discussing potential criteria for wastewater emissions, representatives of the ceramic tile industry stated that many producers had already moved to zero liquid discharge systems, rendering such a criterion obsolete. In such systems, process wastewater is reused to wet ingoing raw materials after having undergone some primary purification treatment such as sedimentation. This also justified the removal of the water recycling ratio criterion.

The use of closed loop wastewater recycling systems will have an enormous benefit on specific water consumption and so it was considered as a simpler but justifiable alternative to reporting on specific water consumption.

This trend was confirmed for the ceramic tile sector in Europe but it was not clear how applicable it would be to the brick, block and roof-tile sector, so further research would needed.

Further research and main changes

Overall, closed loop process wastewater recycling will greatly reduce total water consumption. However, it may also lead to different interpretations of how to calculate specific water consumption. The draft ISO 17889-1 standard uses the term "*specific freshwater consumption*". Should recycled process wastewater be considered as freshwater? Is freshwater consumption simply calculated as the water that needs to be paid for (i.e. metered supply from mains or from nearby abstraction site). This could explain the broad variation in specific water consumption data (believed to be all related to ceramic tile production) that was shared in anonymous format and which is graphically illustrated below.

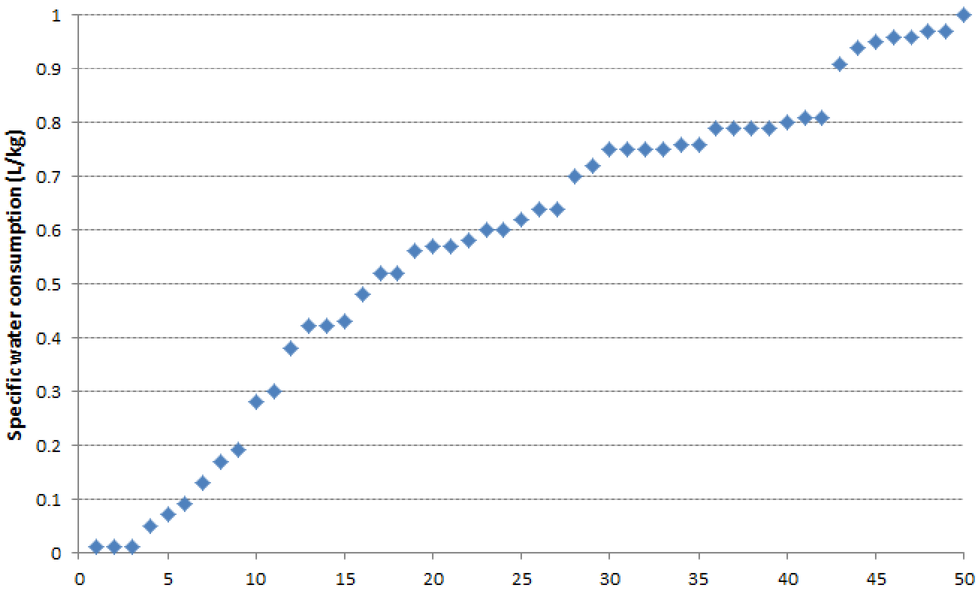


Figure 30. Anonymised data reported by existing EU Ecolabel license holders

Specific water consumption values range from 0.01 to 1.0 L/kg, a factor of 100 difference that surely cannot be accounted for by differences in process techniques alone (e.g. dry milling versus met milling and dry-pressing versus extrusion).

In terms of other fired clay products, data from the 2016 Brick Sustainability Report (BDA, 2016) suggests that a normal range of specific water consumption for brick production would be 125 to 200 L/t (see below).

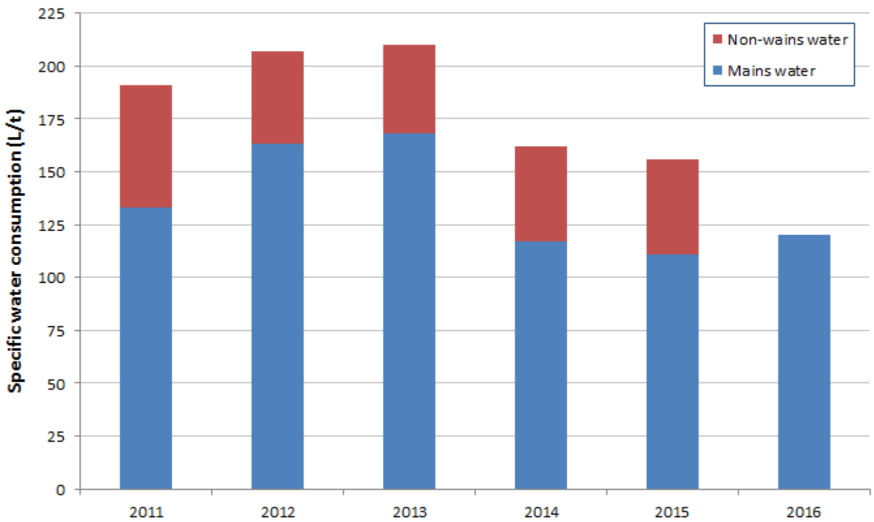


Figure 31. Trend in specific water consumption for the UK brick industry.

The value range for brick production is equivalent to 120 to 200 L/t (or 0.12 to 0.20 L/kg), which is considerably lower than the values reported for ceramic tile production. This could be considered surprising since bricks tend to be produced via the wet extrusion process, which results in green bodies with significantly higher water contents (e.g. 15-25%) than ceramic tiles (e.g. 5-7%).

In any case, based on this data, it is not considered necessary to define a separate higher specific water consumption threshold for other fired clay products.

Points for discussion
Due to the very wide range of specific water consumption values reported by license holders (factor of 100 difference), it seems obvious that the calculation has been interpreted differently by different companies. Is it correct to account returned process water as newly consumed water or not?   **Should a separate value be set for the brick, block and roof tile sector? Current limits seem very high compared to UK average data.**

4.4 – Emissions of dust, HF, NOx and SOx to air

Existing criterion: 4.3. Emissions to air, (b) Ceramic tiles

The total emissions to air of particulates for pressing, glazing and spray drying ('cold emissions') shall not exceed 5 g/m^2.

Assessment and verification: the applicant shall provide appropriate documentation and test reports, following the indications of the Technical appendix — A6.

The emissions to air for the firing stage only shall not exceed the following:

Parameters	*Limit value (mg/m2)*	*Test method*
Particulate matter (dust)	*200*	*EN 13284-1*
Fluorides (as HF)	*200*	*ISO 15713*
Nitrogen oxides (as NOx)	*2500*	*EN 14792*
Sulphur dioxide (SO2) *Sulphur content in raw material is ≤ 0.25%*	*1500*	*EN 14791*
Sulphur dioxide (SO2) *Sulphur content in raw material is > 0.25%*	*5000*	*EN 14791*

Assessment and verification: the applicant shall provide appropriate documentation and test reports for each emission parameter mentioned above, following the indications of the Technical appendix — A6.

A6 Emissions to air (for processed products only)
The air pollutant emission factors shall be calculated as follows:
— the concentration in the exhaust gas emitted to the environment of each parameter considered in the tables shall be
calculated,
— the measurements used for the calculation must be made following the testing methods indicated in the tables,
— the samplings shall be representative of the considered production.

TR v1.0 proposed criterion: 4.3. Emissions to air

Mandatory requirement

The following emissions to air limits shall be respected.

Parameters		Limit value	Test method
Particulate matter (dust) from cold processes in ceramic production.		0.125 g/kg	EN 13284-1
Particulate matter (dust) from glaze application and kiln firing.		0.2 g/m^2* or 0.01 g/kg**	EN 13284-1
Fluorides (as HF) from firing		0.2 g/m^2* or 0.01 g/kg**	ISO 15713
Nitrogen oxides (as NOx)		2.5 g/m^2* or 0.125 g/kg**	EN 14792
Sulphur dioxide (SO2)	If S content of clay is < 0.125%	0.75 g/m^2* or 0.0375 g/kg**	EN 14791
	If S content of clay is 0.125% < 0.25%	1.5 g/m^2* or 0.075 g/kg**	
	If S content of clay is ≥ 0.25%	3.0 g/m^2* or 0.15 g/kg**	

**for ceramic tile of 10mm thickness or more. **for tile formats of thickness less than 10mm.*

EU Ecolabel points

Points shall be awarded for applicants that can demonstrate the following aspects:

- Reduction of dust emissions from the kiln towards a best practice limit of 0.1g/m2 for tiles that are ≥10 mm thick, or 0.005 g/kg for tiles < 10 mm thick (up to 10 points).
- Reduction of HF emissions towards a best practice limit of 0.1g/m2 for tiles that are ≥10 mm thick, or 0.005 g/kg for tiles < 10 mm thick (up to 10 points).
- Reduction of SO2 emissions towards a best practice limit of 0.4g/m2 for tiles that are ≥10 mm thick, or 0.02 g/kg for tiles < 10 mm thick (up to 10 points).

Assessment and verification

The applicant shall provide a declaration of compliance with the mandatory requirements of this criterion, supported by site data in mg/Nm^3 and expressed as an annual average value calculated from daily average values. The data shall have been generated via continuous or periodic monitoring according to EN 13284-1 or -2 for dust, EN 14792 for NOx and EN 14791 for SO_2.

To convert exhaust gas monitoring results from mg/Nm^3 into g/t of clinker, it is necessary to multiply by the specific gas flow volume (Nm^3/t ceramic tile). One Nm^3 refers to one m^3 of dry gas under standard conditions of 273K, 101.3 kPa and 10% O_2 content.

For continuously operating kilns, the production period should be 12 months. In cases where production is non-continuous, the production period shall be mentioned and should not be less than 30 days.

Points shall be awarded in proportion to how closely the data reaches the maximum benchmark set (e.g. for dust from kiln firing: 0.2g/m2 = 0 points and 0.1g/m2 = 10 points).

TR v2.0 proposed criterion: 4.4. Emissions of dust, HF, NOx and SOx to air

The specific dust, HF, NOx and SOx emissions to air associated with the production of ceramic tile and fired clay products shall not exceed the following relevant limits listed in the column titled mandatory limits in the table below.

A total of up to 40 points shall be awarded in proportion to where the actual specific emissions of dust, HF, NOx and SOx relative to the relevant mandatory limit and threshold of environmental excellence set out in the table below.

Product type	Emission parameter	Mandatory limit	Environmental excellence threshold	Test method	Points available
ceramic tiles <6mm thick	Dust (cold)	3000 mg/m² or 150 mg/kg	1300 mg/m²	EN 13284-1	Up to 5
	Dust (kiln)	200 mg/m²	80 mg/m²	EN 13284-1	Up to 5
	HF	200 mg/m²	70 mg/m²	ISO 15713	Up to 10
	NOx (as NO_2)	2500 mg/m²	1750 mg/m²	EN 14792	Up to 10
	SOx (as SO_2)	*1500 mg/m² or **4000 mg/m²	1150 mg/m²	EN 14791	Up to 10
ceramic tiles ≥6mm thick and fired clay brick, block and roof tile products	Dust (cold)	150 mg/kg	650 mg/kg	EN 13284-1	Up to 5
	Dust (kiln)	10 mg/kg	4 mg/kg	EN 13284-1	Up to 5
	HF	10 mg/kg	3.5 mg/kg	ISO 15713	Up to 10
	NOx (as NO_2)	125 mg/kg	85 mg/kg	EN 14792	Up to 10
	SOx (as SO_2)	*75 mg/kg or **200 mg/kg	55 mg/kg	EN 14791	Up to 10

**when S content of raw material is ≤ 0.25% by weight*

***when S content of raw material is > 0.25% by weight*

Assessment and verification

The applicant shall provide a declaration of compliance with the mandatory requirements of this criterion, supported by site data in mg/Nm³ and expressed as an annual average value calculated from daily average values. The data shall have been generated via continuous or periodic monitoring according to EN 13284-1 or -2 for dust, EN 14792 for NOx and EN 14791 for SO_2. In cases of periodic monitoring, at least three samples shall be taken during stable running of the kiln for production runs of the EU Ecolabel product(s).

The higher mandatory threshold for SOx emissions can only be applied if the applicant submits a test report of the raw material mix demonstrating that the S content is higher than 0.25% by weight (as S).

To convert exhaust gas monitoring results from mg/Nm³ into mg/m² of ceramic tile of mg/kg of ceramic or fired clay product, it is necessary to multiply by the specific gas flow volume (Nm³/m² or kg product). One Nm³ refers to one m³ of dry gas under standard conditions of 273K, 101.3 kPa and 18% O_2 content.

For continuous production campaigns, data should be representative of a 12 month period. For shorter production campaigns, the actual production period(s) shall be stated and site data should represent at least 80% of the production campaign.

In case it is not possible to provide specific data for a production line or product, the applicant shall refer to data for the entire plant.

The number of points awarded shall be calculated as zero in cases where the actual value is equal to the mandatory limit and as 15 in cases where the actual value is equal to or lower than the environmental excellence threshold.

Actual values in-between the mandatory and environmental excellence thresholds

shall be awarded points in proportion to where they lie between the two aforementioned reference points.

General points for discussion about air emissions
More information is needed about how exactly emissions are calculated, both for partial and full production cycle facilities. **How is S content estimated in the raw material? What method?** **Is it normal practice to continually monitor dust, HF, NOx and SO2 emissions from ceramic kilns?** **How best to look at dust emissions (especially for ceramic tiles): cold process limit and kiln gas limit? Or partial production cycle limit and full production cycle limit?** **Do the NOx limits account for emissions from any combined heat and power facilities and/or spray dryers onsite? If so, how to allocate emissions, if possible?** **If biomass is used in onsite dryers and/or CHP, how much are NOx and SO2 emissions affected?** **How common is intermittent production in the ceramic sector?**

Rationale:

The existing emission to air limit values set out in Decision 2009/607/EC and taken forward to the proposal in TR v1.0 have been considered in light of the data from the following further research into the sources below:

- The Reference document for BAT in the ceramics sector (BREF, 2007);
- The draft ISO 17889-1 standard for sustainable ceramic tiles;
- The European Pollutant Release and Transfer Register (E-PRTR);
- The academic literature;
- Responses to a questionnaire designed by the JRC and distributed to stakeholders;
- Anonymised data from existing EU Ecolabel license holders

The E-PRTR did not provide any useful data due to (i) the fact that total emissions to air are only reported if they are above a defined threshold; (ii) that only around 2% of ceramic/fired clay facilities with emissions logged in the register provided actual production data (it is only optional to report production data according to Annex III of Regulation (EC) No 166/2006) and (iii) when production volume is provided, the units are not specified (e.g. kg, t, m^2, m^3).

No responses were received to the JRC questionnaire (see Appendix II) and only a very limited amount of useful data was found in the academic literature.

Consequently, the main influencing factors on the choice of EU Ecolabel limits for emissions to air are the 2007 BREF document, the draft ISO 17889-1 standard and anonymised data relating to existing EU Ecolabel licenses.

EU Ecolabel limits in the context of BREF and ISO 17889-1

A comparison of the emission to air limits for dust, HF, SOx and NOx for the BREF, ISO 17889-1 and EU Ecolabel criteria (Decision 2009/607/EC) for ceramics is presented below. Conversion of EU Ecolabel and BREF data to units of mg/kg allows for a comparison with each other and with the draft ISO 17889-1 standard.

Table 19. EU Ecolabel emission to air limits compared to BREF and ISO 17889-1

	EU Ecolabel		ISO 17889-1 (most ambitious level only)		BREF Document	
	mg/m^2	mg/kg*	mg/m^2	mg/kg	mg/m^3	mg/kg†
Dust (cold)	5000	250	5000**	250**	1 to 20	n/a
Dust (kiln)	200	10	1250**	60**	1 to 20	5 to 100
Kiln HF	200	10	200	10	1 to 10	5 to 50
Kiln NOx (as NO2)	2500	125	n/a	n/a	250 (if <1300 °C) 500 (if >1300 °C)	1250 (if <1300 °C) 2500 (if >1300 °C)
Kiln SOx (as SO2)	1500 or 5000	75 to 250	n/a	n/a	500 (if S ≤0.25%) 2000 (if S >0.25%)	2500 (if S ≤0.25%) 10000 (if S >0.25%)

**estimated by converting values from mg/m2 to mg/kg using an assumed tile density of 20kg/m2*

***ISO 17889-1 does not split dust emissions by "cold" and "kiln" but instead by "full" and "partial" production cycles. Shaping would be a "cold" emission but is also included in the "partial" cycle.*

†estimated by converting values from mg/m3 to mg/kg using an assumed specific kiln air flow rate of 5 m3/kg (normal specific flow rates seem to range from 3-6 Nm3/kg).

The BREF limits (in were taken from sections 5.1.3, 5.1.4 and 5.2.5 of the BREF Document and assumed specific air flow rates of 3-6 Nm3/kg product for both tunnel and roller hearth kilns were considered based on data presented in Table 2.2 and Table 3.28 of the same document.

According to the numbers presented above, the EU ecolabel limit for dust emissions appears ambitious in the context of BREF but a like-for-like comparison cannot be done with ISO 17889-1 due to the way dust emission counting is split up. It is assumed that these values can be applied to fired clay brick, block and roof tile production as well. Cold process emissions of dust from clay brick, block and roof tile production are likely to be much lower due to the use of wet extrusion shaping instead of dry pressing and due to a lower likelihood of glazing/decoration.

The EU Ecolabel emission limit for HF is identical to that for sustainable ceramic tiles in ISO 17889-1 and appears relatively ambitious in the context of the BREF ranges. It is assumed that this value can carry over to fired clay brick, block and roof tile production.

The EU Ecolabel limit for NOx does not distinguish between higher or lower firing temperatures while the BREF limits do (factor of 2 difference). It is not clear if the EU Ecolabel limit also includes NOx emissions from any onsite spray-driers. The EU Ecolabel limit appears unambitious if the firing temperature is <1300 °C but further clarification is needed on exactly how the number is determined by applicants and license holders. ISO 17889-1 has no limit set for NOx emissions.

Regarding SOx emissions, the EU Ecolabel approach mirrors very closely the approach set out by BREF and also appears suitably more ambitious. ISO 17889-1 has no limit set for SOx emissions.

Anonymised data from EU Ecolabel license holders

Any data provided from license holders can help inform if the existing limits are particularly challenging or not. Furthermore, the spread of the data can help determine what a good limit would be for setting a threshold of environmental excellence where maximum EU Ecolabel points could be awarded. The anonymised data obtained for dust, HF, NOx and SOx emissions where analysed in the further research section and led to the latest JRC proposals for TR v.2.0. A comparison of the latest proposals with Decision 2009/607/EC and TR v.1.0 is provided below for reference.

Table 20. Comparison of existing limits and TR v.1.0/v.2.0 proposals.

Parameter	Proposed mandatory limit			Proposed threshold of environmental excellence	
	Decision 2009/607/EC	TR v.1.0	TR v.2.0	TR v.1.0	TR v.2.0
Dust (cold processes)	5000 mg/m²	125 mg/kg	3000 mg/m² 150 mg/kg	-	1300 mg/m²
Dust (kiln)	200 mg/m²	200 mg/m²	200 mg/m²	100 mg/m²	80 mg/m²
HF	200 mg/m²	200 mg/m²	200 mg/m²	100 mg/m²	70 mg/m²
NOx (as NO_2)	2500 mg/m²	2500 mg/m²	2500 mg/m²	-	1750 mg/m²
SOx (as SO_2)	1500 mg/m² or 5000 mg/m²	750, 1500 or 3000 mg/m²	1500 mg/m² or 4000 mg/m²	1150 mg/m²	1150 mg/m²

Regarding the mandatory limits, the units for "*cold*" process emissions were changed from mg/m² to mg/kg since it was considered a much more practical unit to work with. Cold processes such as milling and spray-drying, which are the predominant sources of cold emissions, are operated based on kg throughput. Only when the ware is shaped and decorated/glazed would the m² of the throughput be known. In TR v2.0, the option to report emissions in either /kg or /m² is provided and the limit has been adjusted following an analysis of data (in mg/m²) for EU Ecolabel license holders (see further research section). The conclusions in mg/m² were converted to mg/kg by multiplying by an assumed tile density of 20 kg/m².

Regarding the thresholds for environmental excellence, because this is a new concept compared to Decision 2009/607/EC, all the values proposed are highlighted in red. In TR v.1.0, the values proposed were arbitrarily chosen whereas the values in TR v.2.0 have been proposed following an analysis of data for EU Ecolabel license holders (see further research section).

Outcomes from and after the 1st AHWG meeting

No significant changes to the existing criteria on emissions of dust, HF, NOx and SO_2 to air were proposed by the JRC at the first AHWG meeting and so not much discussion took place.

However, the JRC did raise concerns about the large ranges of emission data reported by BREF and the importance of the taking into account the % O_2 content when considering the concentrations (in mg/Nm³) reported by the BREF data. Due to the fact that EU Ecolabel criteria are normalized to the unit of production and not the volume of air, it is not so important to specify the % O2 concentration when calculating the total emissions of dust/HF/NOx/SO2. It is simply necessary to know (i) the total volume of air exiting the chimney during a given period of time; (ii) the average concentration of the pollutants in that same air and (iii) the production volume during that same time.

The JRC also asked why emissions of SO2 and HF were so dependent on the raw material composition if flue gas abatement techniques are able to remove >90% of these pollutants. It was also asked if such emission data can easily be assigned to specific products or production lines if kiln exhaust gases are passed through centralized flue gas abatement systems.

A discrepancy in the application of BREF monitoring techniques became apparent between the two main EU producers (ES and IT) where continuous monitoring for SO2 emissions is mandatory in ES but not in IT is the fuel used is natural gas. The justification for non-monitoring of SO2 in IT seems unusual given the sensitivity of SO2 emissions to the S content in the raw material. Regardless, SO2 monitoring is required for all EU Ecolabel license holders, in whatever Member State. It was confirmed that the IT license holders conducted three periodic analyses of the flue gas per year. It was also clarified that the correct measurement should be SOx (as SO2).

The JRC considered it necessary to conduct a data gathering exercise to gather data on emissions to air in order to better understand the type of data that can be gathered (a joint exercise with the questionnaire on specific fuel energy consumption – see exemplar of questionnaire in Appendix II). Unfortunately no responses were received to the questionnaire (one industry representative said that they would instead wait for the BREF exercise to begin before providing data). However, anonymized data for some existing EU Ecolabel license holders was provided (see further research section). The draft ISO 17889-1 standard would also be consulted to better inform about what is an appropriate level of ambition.

Further research

Sources and nature of dust, HF, NOx and SOx emissions to air

The emissions of air are influenced by different factors due to the physicochemical environment of the production process, whether it is integrated with onsite spray dryers and cogeneration (CHP) plants and whether the production process runs intermittently or continuously. Emissions of dust, HF and SOx can only occur when material is actively passing through the kiln, levels of HF and SOx are especially sensitive to the F and S contents in the raw material and NOx emissions are especially sensitive to firing temperature.

Dust

The BREF data (see Table 3.28 of BREF, 2007) about dust emissions implies that if emissions of dust are uncontrolled, they could amount to a total of 60 to 100 g/kg of product (i.e. 6 to 10% of the total material input). The most significant losses are associated with the "*cold process*" body preparation (55 to 90 g/kg), which is associated with the spray-drying plant for ceramic tile production and which, as mentioned earlier, is often owned and operated by third parties. Only a relatively small amount of dust emissions (around 1.5% of uncontrolled emissions) would be associated with the processes that are common to all ceramic tile producers (i.e. shaping, glaze preparation/application and firing). Such significant loss of material from cold processes can be reduced by 99% via the implementation of dust control techniques for dryers such as cyclones which return fines to the process and cascade type bed adsorbers, filters or dry or wet flue gas scrubbing which collect fines separately.

HF

The source of fluoride emissions is the raw material, which contains traces of fluoride as it can substitute for hydroxyl groups in clay minerals and depends greatly on the geological history of the clay deposit (e.g. marine sediment, alluvial sediment etc.). Emissions of HF are only relevant at the firing stage because a high temperature is required to release fluorides from clay minerals. For a given fluoride content in the raw material, a number of factors influence the potential for HF emissions:

- Temperature: mineral-F is released as HF at temperatures around 550 to 700°C and CaF2 hydrolyses to HF + CaO at temperatures exceeding 900°C.
- Moisture content: the main reactions for HF formation require the presence of moisture.
- Setting and specific surface area of the ware to be fired: this will increase or decrease the rate of diffusion of H2O into the ware and HF out of the ware.
- Glazing: acting as a physical barrier to HF emission from the glazed surface area in any firing after glazing application.

NOx

Wide ranges of NOx emissions concentration can occur in raw gas from ceramic kilns (e.g. 5 to 150 mg/m3) as shown in Table 3.27 of the BREF document (BREF, 2007). The concentration will depend on specific air flow rates (e.g. 3 to 6 Nm3/kg), maximum kiln firing temperatures, burner technology and any nitrogen content in fuels, additives or raw materials. Kiln temperature and specific air flow rate are the main factors influencing NOx emissions though. The thermal reaction between N_2 and O_2 from the combustion air in the regions close to the flame:

- $N_2 + O \rightarrow NO + N$
- $N + O_2 \rightarrow NO + O$
- $N + OH \rightarrow NO + H$

Thermal NOx formation becomes significant when the flame temperature and the excess oxygen in the combustion air.

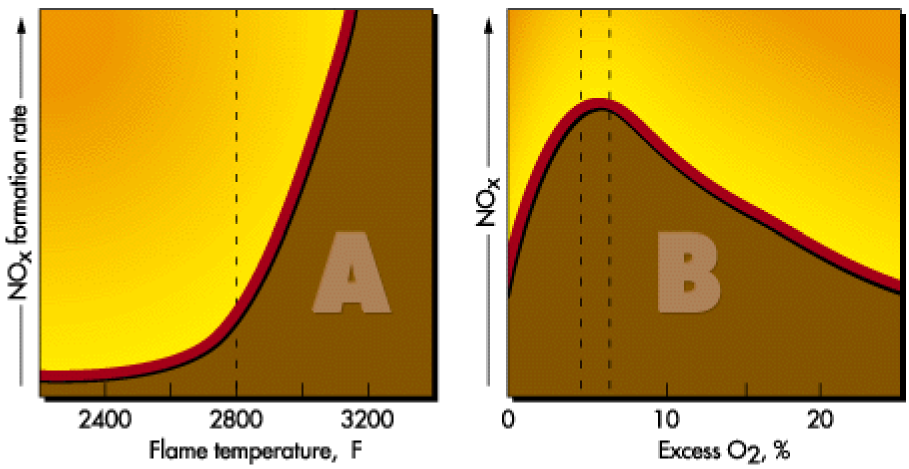


Figure 32. NOx formation as a function of flame temperature and excess O2 (Source: Alentecnic).

The data above clearly show that as the flame temperature rises above 1300°C, and especially from 1500°C (2800 F) onwards, thermal NOx formation increases. For a given situation, the potential for thermal NOx formation is highest when the excess oxygen content is 5-7% (i.e. 25-45% excess air). A lower oxygen excess starves the NOx formation reaction of oxygen while oxygen levels above 7% lower the flame temperature. Care should be taken with the substitution of natural gas for any other fuels with a careful consideration of their nitrogen content, since this could result in a significant increase in NOx emissions from the kiln.

SOx

Table 3.27 of the BREF document (BREF, 2007) shows that SO2 has the largest range of raw gas concentrations (1 to 300 mg/m3) of all the pollutants listed. Specific air flow rate variation (3 to 6 Nm3/kg) is only a factor of 2, which does not come close to accounting for the factor of 300 variation in SOx emissions. The two main reasons for this variability is the difference in S content of raw material and the S content of fuels. Since natural gas is the main fuel used in the ceramic industry and is virtually free of S, the variation will mainly be due to S content in the raw materials.

It should be noted that the BREF document reported S contents in (brick) clay ranging from less than 0.01% S to as high as 2.05% S (i.e. from <100 mg/kg to around 20000 mg/kg). This corresponds to a factor of 200 difference. The split between high and low S content raw materials in the general BAT conclusions (see section 5.1.4 of BREF, 2007) seems quite arbitrary (i.e. above or below 0.25%) considering that in reality the range is from <0.01% to 2.05% for European (brick) clays. Sulphur containing impurities in clay may be pyrite (FeS) and, to a lesser extent, as Ca or Mg sulphates.

A look at clean gas data in the BREF document for ceramics

Only data from 2 of the 9 ceramic sub-sectors covered by the BREF document were considered: (i) bricks and roof tiles and (ii) wall and floor tiles. The table below represents a summary of the clean gas concentrations (and some specific air emission values) for the production of different fired clay and ceramic products that are covered by the scope of the EU Ecolabel hard coverings product group.

Table 21. A summary of relevant air emission data (clean gas only) from the BREF document (BREF, 2007).

		Fired clay brick, block and roof tiles					Ceramic tile
		Porous clay blocks (n =?)	Masonry bricks (n=10)	Clinker brick and roof tile (n=5)	Clay blocks (n=4)	Facing bricks (n=4)	Wall and floor tiles (n=?)
Dust	Avg. mg/Nm^3	11.6	7.59	7.16	42.25	8.75	n/a
	Range mg/Nm^3	n/a	0.9 to 27	1.2 to 18	3 to 71	4 to 14	n/a
	Avg. mg/kg	**17.6**	**n/a**	**n/a**	**n/a**	**n/a**	**150 to 380 (cold) and 10-20 (kiln)**
HF	Avg. mg/Nm^3	2.7	1.2	2.74	3	1.9	n/a
	Range mg/Nm^3	n/a	0.1 to 3	0.5 to 4.5	1 to 6	0.1 to 6	n/a
	Avg. mg/kg	**4.1**	**n/a**	**n/a**	**n/a**	**n/a**	**10 to 50**
SOx as SO2	Avg. mg/Nm^3	26.1	31.4	11.0	1931	211	n/a
	Range mg/Nm^3	n/a	1.2 to 178	1.6 to 20	1336 to 2295	10 to 635	n/a
	Avg. mg/kg	**39.6**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a***
NOx as NO2	Avg. mg/Nm^3	121	81.7	66.1	27.3	62	n/a
	Range mg/Nm^3	n/a	18 to 187	26.8 to 107.3	21 to 36	19 to 98	n/a
	Avg. mg/kg	**184**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a***

**BREF only reported data ranges for unclean gas of 5 to 150 mg/m^3 NOx (as NO_2) and 1 to 300 mg/m^3 of SOx (as SO_2).*

The data summarised above specifically came from tables 3.5, 3.6, 3.7, 3.8, 3.9, 3.27 and 3.28 of the BREF document (BREF, 2007). While the BREF data serves to demonstrate that clean gas concentrations of NOx, SO2 and HF vary widely, it is not so helpful for the purposes of putting the EU Ecolabel reference values in context because (i) they BREF data is only rarely converted into specific emissions and (ii) the EU Ecolabel limits are set in units of mg/m2 and not mg/kg of product (even though a rule of thumb conversion can be applied, it is not ideal).

To convert BREF clean gas concentrations (mg/Nm^3) into specific emissions (mg/m^2 or mg/kg); it is necessary to multiply by a specific airflow rate in terms of Nm^3/m^2 of product or Nm^3/kg of product. A specific air flow rate range of **3-6 Nm^3/kg** product was stated for the kiln firing process (presumably for roller hearth kilns since this was regarding ceramic wall and floor tile production only).

It was not clear what the specific air flow rate would be for tunnel kilns due to the wide range of throughput rates, setting densities and firing times used. Data from table 2.2 of the BREF document (BREF, 2007) showed data ranges for throughput rate and airflow rate, if the fastest throughput rates are assumed to be associated with the highest airflow rates (and the slowest with the lowest) then the following specific airflow rates may apply for tunnel kilns:

- Facing bricks and clay pavers: 1 to 15 t/h at 5000-20000 m^3/h translating into **1.3 to 5 m^3/kg**.
- Clay blocks: 3 to 15 t/h at 10000 to 50000 m^3/h translating into **3.3 m^3/kg**.
- Horizontally perforated clay blocks: 3 to 15 t/h at 10000 to 50000 m^3/h translating into **3.3 m^3/kg**.
- Roof tiles: 3 to 6 t/h at 10000 to 40000 m^3/h translating into **3.3 to 6.6 m^3/kg**.

When specific emission data are reported by BREF, they are as mg/kg or g/kg, which complicates comparison with the existing emission limits in mg/m2 for ceramic (wall and floor tiles) and for clay tiles in Decision 2009/607/EC. A general rule to switch between units is to multiply by an assumed density of 20 kg/m^2.

A look at the draft ISO 17889-1 standard for sustainable ceramic tiles

The emission to air limits proposed in the draft ISO 17889-1 standard are split into four levels of ambition, with the mandatory limit applying under the "*100%*" column and the most ambitious limit appearing under the "*130%*" column.

Table 22. Draft values proposed for dust emissions in ISO 17889-1

Emission parameter	Unit, appolicability	100%**	110%**	120%**	130%**
Dust	g/m^2, full cycle*	7.5-10g/m^2	6.0-7.5g/m^2	5.0-6.0g/m^2	≤5.0g/m^2
	g/m^2, partial cycle*	1.9-2.5g/m^2	1.5-1.9g/m^2	1.25-1.5g/m^2	≤1.25g/m^2
	g/t, full cycle*	375-500g/t	300-375g/t	250-300g/t	≤250g/t
	g/t, partial cycle	95-125g/t	75-95g/t	60-75g/t	≤60g/t
HF	g/m^2	1.0-2.0g/m^2	0.6-1.0g/m^2	0.2-0.6g/m^2	≤0.2g/m^2
HF	g/t	50-100g/t	30-50g/t	10-30g/t	≤10g/t
NOx		n/a	n/a	n/a	n/a
SOx		n/a	n/a	n/a	n/a

**Full cycle includes blending, milling and spray-drying as well as subsequent shaping and firing. Partial cycle includes only shaping and firing.*

***Ambition level increases going from 100% to 130%*

Limits have been set for dust and HF emissions but not NOx and SOx emissions. For both dust and HF emissions, limits are expressed as both mg/m^2 and mg/kg. When comparing the values above, it is clear that an average density of 20 kg/m^2 (or 0.02 t/m^2) has been assumed because for each value, the translation from g/m^2 to g/t is to effectively multiply by a factor of 50 (i.e. $\frac{X\ g/m^2}{0.02\ t/m^2} = 50X\ g/t$).

One interesting aspect is the split in ambition level for dust emissions, with a higher value applying for sites that incorporate the "*full production cycle*" (i.e. including blending, milling and spray drying) and a lower value for sites that buy the spray dried powder, hence only incorporating a "*partial production cycle*" (i.e. shaping and firing). Such a split is highly relevant due to the fact that dust emissions predominate in the powder preparation stages. The EU Ecolabel makes a similar but slightly different type of split for "*cold processes*" and for "*kiln firing*" emissions.

Looking at the highest ambition level, the ISO 17889-1 split is effectively 3.75 g/m^2 for blending, milling and spray-drying and 1.25 g/m^2 for shaping, decoration/glazing and firing. Compared to the existing EU Ecolabel criteria (5 g/m^2 and 0.2 g/m^2), the values in ISO 17889-1 seem ambitious for cold processes but not at all for kiln emissions, despite the fact that total emissions are similar (5.0 versus 5.2 g/m^2). A logical explanation for this would be that the comparison of "*hot*" and "*cold*" dust emissions is not a fair one, since both approaches are probably looking at shaping in a different way: the EU Ecolabel would be including it as a cold process (so cold process emission threshold is higher) while the draft ISO 17889-1 would not include shaping with the "cold processes" in cases where only a partial production cycle takes place (instead it is included with the "hot" processes, making it less ambitious than the EU Ecolabel).

The ISO 17889-1 criteria also allow dust emissions to be expressed as g/t, which could help ease the calculation for cases where an excess of spray-dried powder onsite (for sale to other sites) needs to be factored into the specific dust emission calculations.

No split in HF emissions for "partial production cycle" and "full production cycle" is made because these emissions occur at temperatures that can only be achieved in the kiln, and kiln firing is common to all production sites.

Compared to the existing EU Ecolabel criteria (200 mg/m^2), only the most ambitious value in ISO 17889-1 is comparable (the exact same value).

Relevant data presented in the academic literature

A very interesting study that investigated the actual air emissions from ceramic kilns (for HF, HCl, SOx and NOx) was conducted by Monfort et al., (2011), who collected actual emission data in mg/m^3, compared it to current BREF recommended limits and then transformed it into specific emissions in mg/m^2 and mg/kg to permit a comparison of the same emissions with the EU Ecolabel limits.

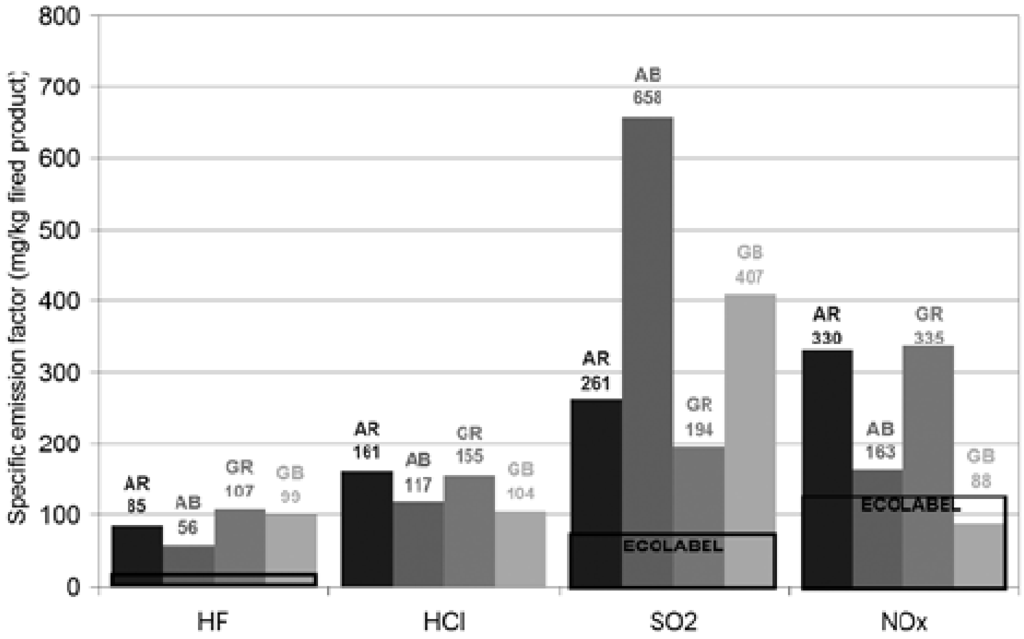


Figure 33. Comparison of median specific acidic gas emission factors from 4 ceramic tile products with EU Ecolabel thresholds (Source: Monfort et al., 2011).

The data presented above, considered to be representative of the Spanish ceramic tiles sector, appear to be based on raw gas concentrations, that is to say, before any flue gas abatement has been applied. The data serve to highlight the need for a consistent 90% reduction in HF emissions, up to 90% reduction in SOx emissions and up to 70% reduction in NOx emissions so that clean gas concentrations would be sufficiently low for the tiles are to be able to meet the requirements for the EU Ecolabel.

A look at EU Ecolabel license holder data

Data provided by CBs in anonymised format for dust, HF, NOx and SOx emissions have been compiled and plotted in ascending order so that the distribution of data points can be clearly observed. The existing EU Ecolabel limit (in mg/m^2) is plotted on the graph for reference and the median value is identified in order to propose that value as a threshold for environmental excellence for that particular emission.

To minimize the potential for confusion, it is proposed to report all results in units of mg/m^2 and propose them for thin ceramic tiles (<6mm thick). For thicker ceramic tiles and other tiles and fired clay products, values in mg/m^2 can be expressed as mg/kg (equivalent to g/t) simply by dividing by 20kg/m^2 ($\frac{X\ mg/m^2}{20\ kg/m^2} = 0.05X\ mg/kg$).

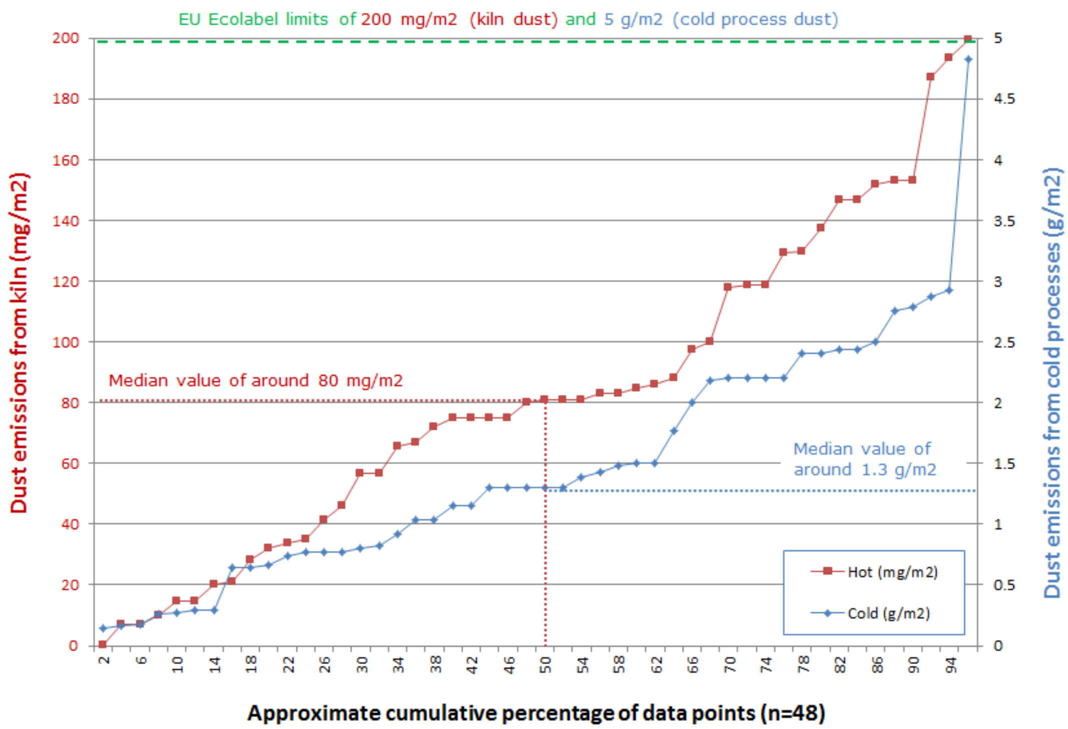


Figure 34. Specific dust emissions reported by existing EU Ecolabel license holders

From the data presented it is evident that almost all license holders easily complied with the limit for cold emissions. Almost 90% of the data reported for the cold process dust emissions was less than half of the 5 g/m^2 limit set and only one data point was greater than 3 g/m^2. This justifies lowering the upper limit from 5 to 3 g/m^2. A median value of around 1.3 g/m^2 for cold dust emissions was identified and has been proposed as a threshold for environmental excellence.

For kiln dust emissions, the vast majority of points were less than 80% of the limit, however it is not proposed to lower the upper limit. A median value of around 80 mg/m^2 for cold dust emissions was identified and has been proposed as a threshold for environmental excellence.

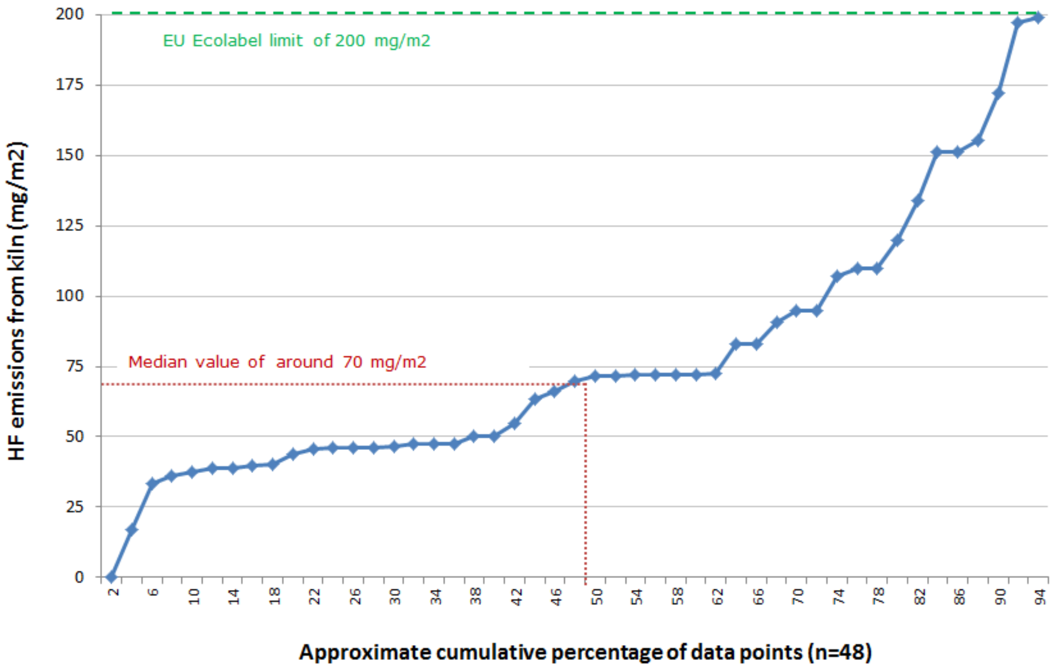


Figure 35. Specific HF emissions reported by EU Ecolabel license holders

For HF emissions, the vast majority of points were less than 75% of the limit. However, it is not proposed to lower the upper limit. A median value of around 70 mg/m^2 for HF emissions was identified and has been proposed as a threshold for environmental excellence. This would translate into 3.5 mg/kg.

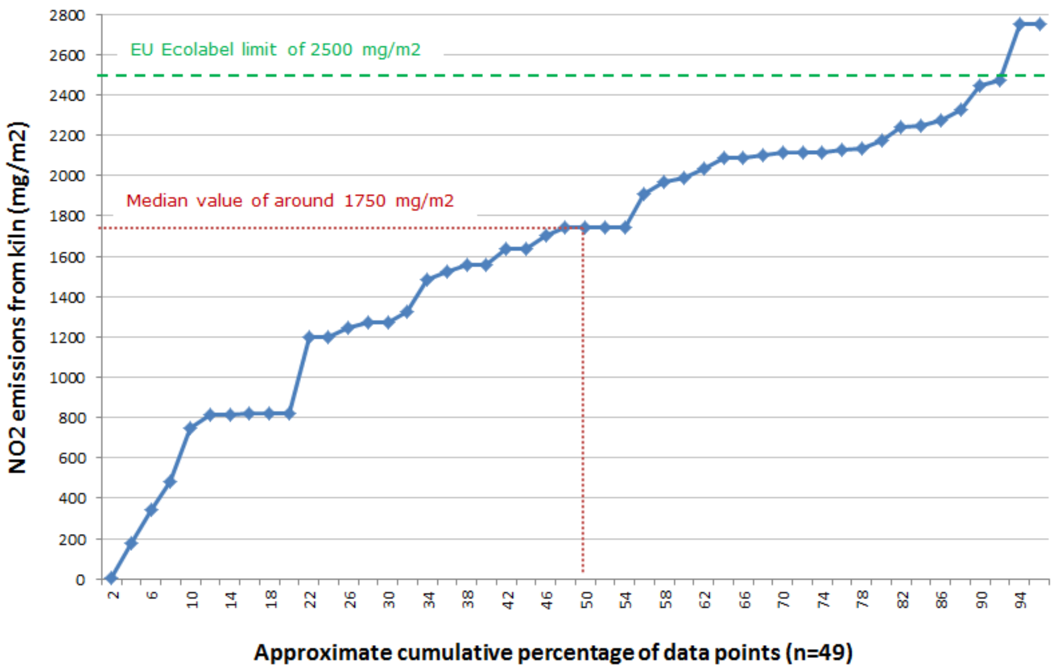


Figure 36. Specific NOx (as NO2) emissions reported by EU Ecolabel license holders

Perhaps confusingly, two data points for specific NOx emissions exceeded the EU Ecolabel limit. Compared to dust and HF emissions, the limit for NOx in general appears more challenging. Most data lies within the 1200 to 2200 mg/m^2 range and one data point appears to be nearly zero, which seems highly unusual. It is not proposed to lower the upper limit for NOx emissions. A median value of around 1750 mg/m^2 for NOx emissions was identified and has been proposed as a threshold for environmental excellence. This would translate into around 85 mg/kg.

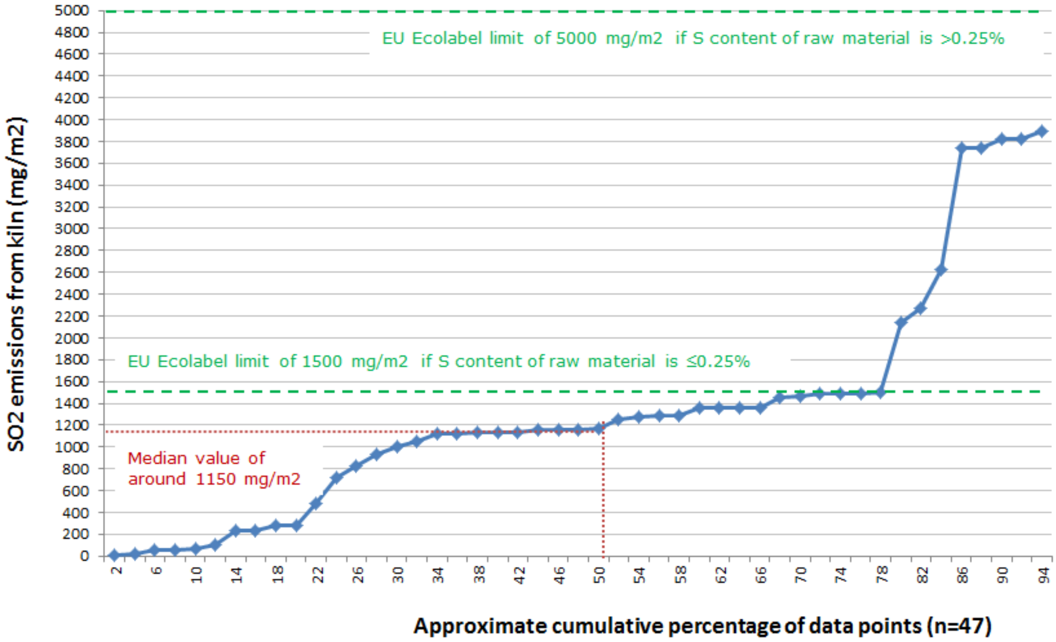


Figure 37. Specific SOx (as SO2) emissions reported by EU Ecolabel license holders

The data for S emissions are more difficult to interpret because there are two limits set in the EU Ecolabel depending on the S content of the raw material. While it is self-evident that the 8 data points that exceed 1500 mgSO_2/m^2 product must be associated with higher S contents in the raw material, it is not clear what S contents were associated with the other data points.

In any case, it seems that the level set for higher S content raw materials could be lowered from 5000 to 4000 mg/m^2. The limit of 1500 mg/m^2 for lower S content raw material seems ambitious enough already. A median value of around 1150 mg/m^2 for SOx emissions was identified and has been proposed as a threshold for environmental excellence. This would translate into around 55 mg/kg.

4.5 – Wastewater management

Existing criterion: 4.4. Emissions to water

After waste water treatment, whether onsite or off-site, the following parameters shall not exceed the following limits:

Parameter	Limit	Test methods
Suspended solid emission to water	40 mg/l	ISO 5667-17
Cd emission to water	0,015 mg/l	ISO 8288
Cr(VI) emission to water	0,15 mg/l	ISO 11083
Fe emission to water(1)	1,5 mg/l	ISO 6332
Pb emission to water	0,15 mg/l	ISO 8288
(1) The 'Fe' parameter is applicable to all the processed products 'with the exclusion of ceramic tiles'.		

Assessment and verification: the applicant shall provide appropriate documentation and test reports showing compliance with this criterion.

TR v1.0 proposed criterion: 4.4. Waste water management

Mandatory requirement

Wastewater shall be treated onsite via sedimentation to recover sludge for potential reuse and shall not be mixed with wastewater from toilets, canteens and any other non-process related inputs of wastewater.

In cases where process wastewater is discharged to local watercourses, the applicant must demonstrate compliance with the following limits:

Parameter	**Limit**	**Test methods**
Suspended solid emission to water	40 mg/l	ISO 5667-17
Cd emission to water	0,015 mg/l	ISO 8288
Cr(VI) emission to water	0,15 mg/l	ISO 11083
Pb emission to water	0,15 mg/l	ISO 8288

If the settled wastewater is discharged to a municipal sewage works or other third party operated treatment plant, the applicant shall be exempted from demonstrating compliance with the emission limits defined above.

EU Ecolabel points

5 points shall be awarded if the applicant does not use glazes at all or, in cases where glazes are used, the applicant can demonstrate that wastewater from the glazing process is collected and treated separately to facilitate glaze recovery.

Assessment and verification:

The applicant shall provide a declaration of compliance with the mandatory requirements of this criterion, clearly state if process wastewater is discharged to local watercourses or to the sewerage network and provide details about any glazing process wastewater handling.

In cases where treated process wastewater is discharged to local watercourses and it is not possible to provide specific data for a production line or product, the applicant shall refer to data for the entire plant and provide test reports based on weekly analysis of the discharged wastewater according to the standard test *methods defined above or equivalent in-house laboratory methods.*

Less frequent testing may be permitted in cases where the operating permit sets less frequent testing.

TR v2.0 proposed criterion: 4.5. Waste water management

Process wastewater from the production of ceramic tiles or fired clay bricks, blocks and roof tiles shall either:

- Be treated onsite to remove suspended solids, with treated wastewater being returned to the production process as part of a zero liquid discharge system;
- Be treated onsite to remove suspended solids (or not treated at all) prior to wastewater being sent to a third-party operated treatment works;
- Be treated onsite to remove suspended solids prior to wastewater being discharged to local watercourses.

In cases where options 2 or 3 apply, the applicant or the third party wastewater treatment plant operator, as appropriate, must demonstrate compliance with the following limits for final treated effluent.

Parameter	Limit	Test methods
Suspended solids	40 mg/l	ISO 5667-17
Cadmium	0,015 mg/l	ISO 8288
Lead	0,15 mg/l	ISO 8288

Assessment and verification:

The applicant shall provide a declaration of compliance, specifying which option applies to the production site.

In cases where a zero liquid discharge system is in place for recycling process wastewater, they shall provide a brief description of the system and its main operating parameters.

In cases where the treated or untreated wastewater is sent to a third party operated treatment plant, the operator of the plant shall declare the average concentrations of suspended solids, cadmium and lead in the final treated effluent and provide test reports based on weekly analysis of the discharged wastewater according to the standard test methods defined above or equivalent in-house laboratory methods. Less frequent testing may be permitted in cases where the operating permit sets less frequent testing.

In cases where process wastewater is treated onsite and effluent is discharged to the local watercourse, the applicant shall declare the average concentrations of suspended solids, cadmium and lead in the final treated effluent and provide test reports based on weekly analysis of the discharged wastewater according to the standard test methods defined above or equivalent in-house laboratory methods. Less frequent testing may be permitted in cases where the operating permit sets less frequent testing.

Rationale:

It is expected that all ceramic production plants will have some type of onsite wastewater treatment in order to remove the suspended inorganic particles carried in process wastewater although it is possible that smaller producers operating in clusters may discharge to a common wastewater treatment plant. Even after the solids have been settled and recovered as a dewatered sludge, it is likely that the process water will be recycled to a significant degree (this was confirmed at the 1st AHWG meeting). When wastewater recycling is effectively 100%, there is no need to test the effluent because it is not actually being discharged to the environment, hence the provision of option 1 in the TR v2.0 proposal.

The criteria set out in Decision 2009/607/EC imply that test data is required for suspended solids, Cd and Pb in final treated effluent. This is fine so long as it is the same applicant that has control over the wastewater treatment system and has full access to obtain samples (i.e. option 3).

However, when the wastewater goes to a third party operated treatment plant, the applicant has no control on removal performance or any means to obtain final effluent data. The potential influence of other wastewaters received from other sources cannot be isolated either. In any case, analytical results of the final effluent shall be required in line with the operating permit of the wastewater treatment plant. If the operating permit does not require testing of Cd or Pb, then the applicant shall need to pay for one-off testing of the final effluent for these metals.

Outcomes from and after the 1st AHWG meeting

Industry representatives for ceramic tile producers stated that in Italy and Spain, it was common practice to have zero liquid discharge wastewater treatment systems. Consequently the wastewater criterion could be completely irrelevant to some producers. It was also confirmed that Cr(VI) is not relevant to the ceramic sector, neither in wastewater or sludge.

Further research

The only further research conducted was an analysis of data from existing EU Ecolabel license holders. Of the 50 data sets gathered, only 1 actually included analytical results for process wastewater. This serves to highlight the low relevance of this criterion to the overall environmental impact of ceramic tile production.

Points for discussion
Due to the low apparent relevance of wastewater discharge from ceramic tile and (presumably) fired clay brick, block and roof tile production, the JRC would provisionally propose to remove this criterion. Opinions?

4.6 – Process waste reuse

Existing criterion: 5.2. Recovery of waste (*for processed products only*)
The applicant shall provide an appropriate documentation on the procedures adopted for the recycle of the by-products originated from the process. The applicant shall provide a report including the following information: *— kind and quantity of waste recovered,* *— kind of disposal,* *— information about the reuse (internally or externally to the production process) of waste and secondary materials in the production of new products.* *At least 85 % (by weight) of the total waste generated by the process or the processes (2) shall be recovered according to the general terms and definitions established by Council Directive 75/442/EEC (3).* *Assessment and verification: the applicant shall provide appropriate documentation based on, for example, mass balance sheets and/or environmental reporting systems showing the rates of recovery achieved whether externally or internally, for example, by means of recycling, reuse or reclamation/regeneration.* *(2) Process wastes do not include maintenance wastes, organic wastes and urban wastes produced by auxiliary and office activities.* *(3) OJ L 194, 25.7.1975, p. 39.* *(4) OJ L 40, 11.2.1989, p. 12.*
TR v1.0 proposed criterion: 4.5. Process waste reuse
Mandatory requirement At least 85% by mass of the process waste* generated in ceramic tile production shall be reincorporated into the ceramic production process onsite, be reincorporated into ceramic production processes by third parties offsite or be reused in other production processes. *i.e. sludge from grinding, body preparation and glaze preparation, reject/broken material from shaping, drying, firing, rectification and surface finishing operations and residues from exhaust gas abatement systems such as separated dust/ashes, gas scrubbing residues and peelings from cascade adsorber bed materials. **EU Ecolabel points** Points shall be awarded for applicants that can demonstrate higher reuse rates of process waste up a maximum of 95% reuse (up to 10 points). **Assessment and verification:** *The applicant shall provide a declaration of compliance with the mandatory requirement of this criterion, supported by a calculation of total production process waste (in kg or t), split between sludge, reject/broken material and gas treatment residues for the most recent calendar year or 12 month period. Details about the destination of these process wastes shall also be provided with clarifications about whether it is internal reuse in ceramic production, external reuse in ceramic production, external reuse in another process or sent to landfill. For any external reuse or landfill disposal, shipment notes shall be presented.* *In case it is not possible to provide specific data for a production line or product,*

the applicant shall refer to data for the entire plant.

Points shall be awarded in proportion to how closely the data reaches the maximum benchmark set (e.g. process waste reuse rate of 85% = 0 points and 95% = 10 points).

TR v2.0 proposed criterion: 4.. Process waste reuse

Mandatory requirement

At least 90% by mass of the process waste generated in ceramic tile production shall be reincorporated into the ceramic production process onsite, be reincorporated into ceramic production processes by third parties offsite or be reused in other production processes.

Process waste shall be considered as sludge/dry solids from grinding, body preparation and glaze preparation, reject/broken material from shaping, drying, firing, rectification and surface finishing operations and residues from exhaust gas abatement systems such as separated dust/ashes, gas scrubbing residues and peelings from cascade adsorber bed materials.

EU Ecolabel points

Points shall be awarded for applicants that can demonstrate higher reuse rates of process waste up a maximum of 100% reuse (up to 10 points).

Assessment and verification:

The applicant shall provide a declaration of compliance with the mandatory requirement of this criterion, supported by a calculation of total production process waste (in kg or t), split between sludges, reject/broken material and gas treatment residues for the most recent calendar year or 12 month period. Details about the destination of these process wastes shall also be provided with clarifications about whether it is internal reuse in ceramic production, external reuse in ceramic production, external reuse in another process or sent to landfill. For any external reuse or landfill disposal, shipment notes shall be presented.

In case it is not possible to provide specific data for a production line or product, the applicant shall refer to data for the entire plant.

Points shall be awarded in proportion to how closely the data reaches the maximum benchmark set (e.g. process waste reuse rate of 85% = 0 points and 95% = 10 points).

Rationale and discussion:

Process waste from ceramic production has a high potential to be reused within the same process. In particular, sludge and dust from "*cold processes*" can be directly returned to wet grinding processes of new raw materials or dried first before being incorporated into dry grinding processes.

Allowance has to be made for the external reuse of these materials since some ceramic tile producers simply buy spray dried material and so do not have a significant material grinding capacity onsite.

In terms of onsite reuse, sludge production has been estimated to be in the range of 0.09 to 0.15 kg/m^2 which, if completely reincorporated to the production of ceramic tiles of 20kg/m^2 density, would amount to approximately 0.4 to 1.0% of the total produced ceramic tile mass (BREF, 2007). Such small additions are not expected to have any adverse effect on the predictability of raw body physical properties.

Unfired reject material can easily be reincorporated into the ceramic tile production process as well as small amounts of fired materials. Due to the toughness of fired material, it may be considered as a very useful secondary aggregate in road base or non-structural concrete.

Wastes from flue gas treatment will be more difficult to find reuse applications for. However, in cases where SO_2 emissions are a concern and hydrated lime is used in gas scrubbed, the generated flue gas desulphurisation residue can potentially be used in other industries such as plasterboard and cement production.

Points for discussion about material efficiency in the production process
Opinions about the approach proposed? **Any recent data from industry about this aspect to share?**

Outcomes from and after the 1st AHWG meeting

No comments were received regarding this criterion during or after the meeting.

Further research and main changes

An analysis of data relating to existing EU Ecolabel license holders is presented below.

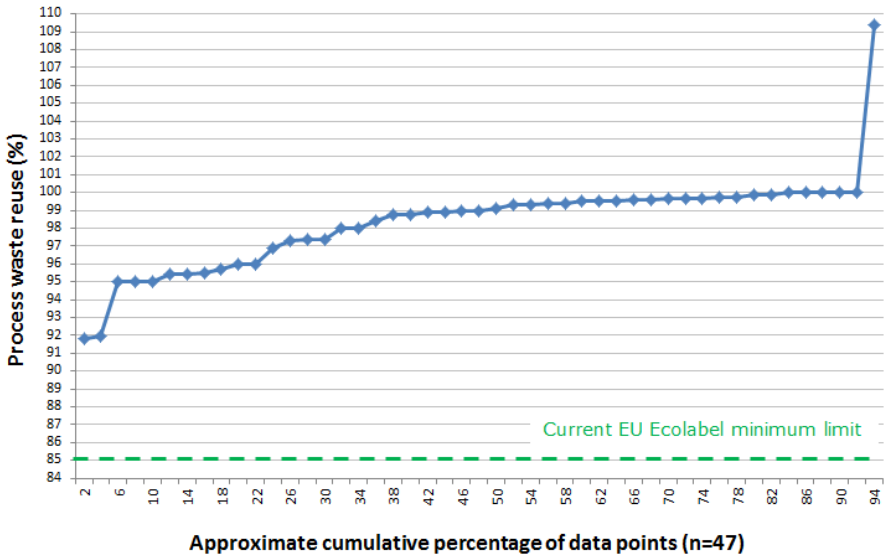


Figure 38. Process reuse rates reported by existing EU Ecolabel license holders

Apart from one outlier where process reuse somehow exceeds 100% (109.4% to be precise), the data provided show that ceramic tile producers are easily complying with the 85% reuse rate requirement for process waste. Consequently, it was deemed suitable to raise the minimum requirement to 90% and offer 10 points for reaching a maximum of 100% waste reuse.

4.7 – Glazes

Existing criteria:

2.2. Limitation of the presence of some substances in the additives

6.1. Release of dangerous substances (glazed tiles only)

2.2. Limitation of the presence of some substances in the additives

Where lead, cadmium and antimony (or any of their compounds) are used in the glazes, their content shall not exceed the following specific limits:

(% in weight of the glazes ([1]))

Parameter	Limit
Lead	0,5
Cadmium	0,1
Antimony	0,25

([1]) Glazes are all the substances applied on the tiles surface between the tile shaping and the firing stage

Assessment and verification: in terms of chemical and mineralogical analysis, the material formulation shall be provided by the applicant together with a declaration of compliance with the abovementioned limits.

6.1. Release of dangerous substances (glazed tiles only)

In order to control the potential release of dangerous substances in the use phase and at the end of the glazed tile's life, the products shall be verified according to the EN ISO 10545-15 test. The following limits shall not be exceeded:

Parameter	Limit (mg/m^2)	Testing method
Pb	80	EN ISO 10545-15
Cd	7	EN ISO 10545-15

Assessment and verification: the applicant shall provide an analysis and test reports with regard to the emission parameters mentioned above. This shall include a declaration of conformity of the product with the requirements of Council Directive 89/106/EEC (4) and with relevant harmonised standards created by CEN once published in the *Official Journal of the European Union*.

TR v1.0 proposed criterion: 4.6. Glaze (for glazed tiles only)

Mandatory requirement

The migration of Pb and Cd from glazed ceramic tiles or kitchen counter-tops shall not exceed 8 mg/m2 or 0.7 mg/m2 respectively when tested according to EN ISO 10545-15.

EU Ecolabel points

In cases where ceramic tiles are unglazed or where the glaze formulation contains less than 0.1% Pb and less than 0.1% Cd, 10 points shall be awarded.

Assessment and verification:

The applicant shall provide a declaration of compliance with the mandatory requirement of this criterion. Where tiles are glazed, the declaration shall be

supported by test results according to EN ISO 10545-15.
TR v2.0 proposed criterion: 4.7. Lead and cadmium restrictions (for glazed and decorated tiles only)
Mandatory requirement In cases where ceramic tiles are glazed or decorated, the glaze formulation shall contain less than 0.10% wt. Pb and less than 0.10% wt. Cd. ***Assessment and verification:*** *The applicant shall provide a declaration of compliance with the mandatory requirement of this criterion, supported by a relevant declaration or safety data sheet from the glaze supplier.*

Rationale:

Requirements on the migration of Pb and Cd from glazed tiles have been removed since they imply a significant assessment and verification cost and are only intended to apply when used as food contact materials. Ceramic wall and floor tiles are unlikely to be considered as food contact materials unless larger format pieces are used as table tops or kitchen countertops. However, the producer cannot realistically know how these larger format pieces would be used or marketed by their customers. The limits for migration are still under consideration (see further research section) but are likely to be tightened significantly. Setting any requirement for the EU Ecolabel criteria could end up being unreasonably ambitious or embarrassing unambitious, depending on the final outcome of the consultation process on food migration limits.

Outcomes from and after the 1st AHWG meeting:

With glazes, it was requested to remove any requirements on Pb and Cd migration since this is purely for food contact purposes and is considered as an unnecessary and expensive test to carry out. The current discussions on migration thresholds are looking at very tight limits that essentially make the exposure of these heavy metals to users less than the potential intake from the food itself.

In general, kitchen countertops could be considered as food contact materials, but this final use is not often known by the producer, who sells the large format thin tiles to a business that will provide tiles for a variety of end uses.

The main source of Cd and Pb is in the frits, most producers of which are based in Castellon, Spain. Discussions with these producers revealed that Cd and Pb based frits are very rare today and only used when very specific colours are required. One final point was to potentially reconsider the use of the terms "*glazed/unglazed*" due to technological evolution in the production process - a better distinction may be "*decorated/undecorated*".

Further research:

Legal background to requirements on Pb and Cd migration

Article 2(4) of Council Directive 84/500/EEC set requirements for the leaching limits of Pb (0.8 mg/dm^2 or 80 mg/m^2) and Cd (0.07 mg/dm^2 or 7 mg/m^2) for different ceramic articles intended to come into contact with foodstuff. More specifically, Article 2(4) refers to migration limits of 0.8 mg/dm^2 (i.e. 80 mg/m^2) for Pb and

0.07 mg/dm^2 (i.e. 7 mg/m^2) for Cd for "*Articles which cannot be filled…*". These limits can be considered to relate to ceramic countertops in kitchens and a wide variety of different types of ceramic tableware. Details of the migration test were set out in Annex I to Council Directive 84/500/EEC which, in the case of a flat ceramic tile, entails the immersion of the specimen in a solution of 4% (v/v) acetic acid at 22°C for a period of 24 hours (in total darkness when Cd migration is to be measured). After the test period, the acid is tested for Pb or Cd by atomic absorption spectrophotometry.

The same procedure and limits have been incorporated into EN ISO 10545-15: Ceramic tiles – Part 15: Determination of lead and cadmium given off by glazed tiles.

As permitted under Article 5 of Regulation 1935/2004, the Commission is currently considering the downward revision of allowable Pb migration limits and to check if migration limits for other metals may be relevant to consider, based on potential adverse exposure to users of ceramics intended to come into contact with foodstuffs.

The JRC have conducted research about the adequacy of the original leaching method and found that it was in general suitable as an estimate of potential migration of Pb and Cd to food but that the migration test should be conducted three times in succession (3 x 24 hours) and the results of the third test used (JRC, 2017).

There is no lower safe exposure limit for Pb and so a conservative approach has been proposed (not yet finalised) where food DSVs (Discussion Starting Values) would be matched with the Drinking Water Directive (98/83/EC) limits for Pb and Cd. Such a proposal would lower the food DSV value from 4mg Pb/kg food to 10µg Pb/kg food (a factor of 400 reduction for Pb) and from 0.3mg Cd/kg food to 5µg Cd/kg food (a factor of 60 reduction for Cd).

Use of lead in ceramic glazes

The use of lead oxide in silicate glaze compositions imparts a number of desirable physical properties to the glaze such as: lower fusion point and reduced surface tension which in turn permits the formulation of a broad range of compositions that are capable of delivering chemically durable and smooth surfaces with high brilliance which are highly resistant to devitrification and with the ability to heal defects in the clay surface (Lehman, 2002).

According to the Glass Manufacturing BREF (BREF, 2013) a typical low melting point frit could consist of 50% by weight red lead (Pb_3O_4), with the remainder being due to quartz (ca. 20%), zinc oxide (ca. 15% and boric acid (ca. 15%).

Adverse health effects of lead

Even if lead in the final ceramic product is well immobilised and not likely to migrate into foodstuffs during the use phase, the very creation of demand for lead glazes drives a production process, from mining through smelting and frit production to glaze formation and firing where larger or smaller amounts of lead are emitted to the environment. At the End of Life of the glazed ceramic tile, it is also possible that emissions of lead may be possible via leaching or inhalation of crushed tile dust or via emission to exhaust gases should old tiles end up in municipal solid waste incinerators.

Some of the health impacts associated with exposure to lead stated by the World Health Organisation are staggering, for example in 2016, it was estimated that lead exposure was responsible for 540,000 deaths and 13.9 million years of healthy life lost. The effect of lead exposure is especially pronounced on children, due to their increased specific uptake of lead (x4-5) compared to adults under the same exposure conditions.

Development of lead-free ceramic glazes

Research into low-lead or lead-free glazes were prompted by lead shortages during World War II and later due to health and environmental concerns about lead exposure. Two possible alternatives are (Lehman, 2002):

- Zinc/Strontium-based glazes: although these glazes can fire well, they do not deliver great colour development.
- Alkali borosilicate (ABS) based glazes: the use of approximately 10% B_2O_3 and 10% $(Li,Na,K)_2O$ by weight is required although higher firing temperatures are required and defect rates are higher.

It must be highlighted that these alternative glazes have been presented for use in the production of ceramic tableware and it is not sure how they would carry over to the process for floor and wall tile manufacture.

Analysis of data provided from EU Ecolabel license holders

Of the 50 data sets provided, only 13 provided numerical results (expressed as below prescribed limits, not as concrete values). It is assumed that the other 37 data sets covered unglazed products or did not use glazes containing Pb or Cd.

CRITERIA 5: Concrete criteria

Summary of preliminary research of specific relevance to the concrete sector

Legal and policy context

All pre-cast concrete products used in the construction sector are regulated by the Construction Products Regulation (EU) No 305/2011 and should carry a CE marking unless they are used in non-construction applications, such as benches or other street furniture. In terms of EN standards applicable to the final precast concrete product the most relevant are:

- EN 13369: Common rules for precast concrete products.
- EN 1338: Concrete paving blocks – Requirements and test methods
- EN 1339: Concrete paving flags – Requirements and test methods
- EN 1340: Concrete kerb units – Requirements and test methods
- EN 771-3: Specification for masonry units. Aggregate concrete masonry units (dense and light-weight aggregates)

These standards define minimum performance requirements and distinctions between difference levels of performance class for the relevant product type. For cement, the fundamental ingredient of concrete, the most relevant standard is EN 197-1, which defines the 27 different classes of Portland cement, and also the EN 196 series of standards which focus only specific chemical and physical properties of cement.

Cement production is regulated under the Industrial Emissions Directive (IED) 2010/75/EU, which aims to define industry best available techniques (BAT) and set mandatory upper limits on emissions from priority industrial activities. The BAT conclusions for the production of cement, formally adopted via Commission Implementing Decision 2013/163/EU, apply to any rotary kilns with a production capacity exceeding 500 tonnes of cement clinker per day or to other kiln technologies with production capacity exceeding 50 tonnes of cement clinker per day. Although exemptions for certain site-specific circumstances may apply, the following concentration limits in kiln gas emissions must be considered by Member State authorities by March 2017 when updating operating permits:

- Particulate Matter (PM): <10-20 mg/Nm^3
- Nitrogen oxides (NOx/NO_2): <200-450 or 400-800 mg/Nm^3
- Sulphur oxides (SOx/SO_2): <50-400 mg/Nm^3
- Ammonia (NH3): <30-50 mg/Nm^3 (only if SNCR technique used)
- Hydrochloric acid (HCl): <10 mg/Nm^3
- Hydrofluoric acid (HF): <1 mg/Nm^3
- Mercury (Hg): <0.05 mg/Nm^3
- Sum of Cadmium and Thallium (Cd and Tl): <0.05 mg/Nm^3
- Sum of other heavy metals (As, Sb, Pb, Cr, Co, Cu, Mn, Ni, V): <0.5 mg/Nm^3
- Dioxins (PCDD/F): <0.05-0.1 ng PCDD/F I-TEQ/Nm^3

Greenhouse gas emissions associated with cement production are regulated by the Emissions Trading System (ETS) established in Directive 2003/87/EC and recently amended by Directive (EU) 2018/410. Emissions accounting applies to installations exceeding the same thresholds of production as stated in the previous paragraph for the IED Directive.

It is also necessary for cement production facilities that exceed the common production capacity threshold for the IED and ETS to report on the release or off-site transfer of defined pollutants and hazardous wastes in accordance with Regulation (EC) No 166/2006 on the establishment of a European Pollutant Release and Transfer Register (E-PRTR). Emissions must be reported to Member State competent authorities if they exceed thresholds defined in Annex II to the E-PRTR. The most relevant thresholds are:

- Particulate Matter (PM): >50 000 kg/yr
- Nitrogen oxides (NOx/NO_2): >100 000 kg/yr
- Nitrous Oxide (N_2O): >10 000 kg/yr
- Ammonia (NH_3): >10 000 kg.yr
- Sulphur oxides (SOx/SO_2): >150 000 kg/yr

The only information that needs to be reported is the quantity of emissions in kg/yr. Data relating to production volume during the same period is purely optional and is not normally reported.

Market data

The main PRODCOM codes for sold production (NACE Rev. 2) of relevance to precast concrete products were identified as:

- 23.61.11.50: Tiles, flagstones and similar articles of cement, concrete or artificial stone (excluding building blocks and bricks).
- 23.61.11.30: Building blocks and bricks of cement, concrete or artificial stone
- 23.61.12.00: Prefabricated structural components for building or civil engineering, of cement, concrete or artificial stone
- 23.61.20.00: Prefabricated buildings of concrete
- 23.69.19.30: Pipes of cement, concrete or artificial stone
- 23.69.19.80: Articles of cement, concrete or artificial stone for non-constructional purposes (including vases, flower pots, architectural or garden ornaments, statues and ornamental goods.

Of these codes, the first two in the list can be considered to definitely fall within the scope for EU Ecolabel hard coverings. In 2017, these two codes account for approximately 60% of the total production volume of the six codes listed above.

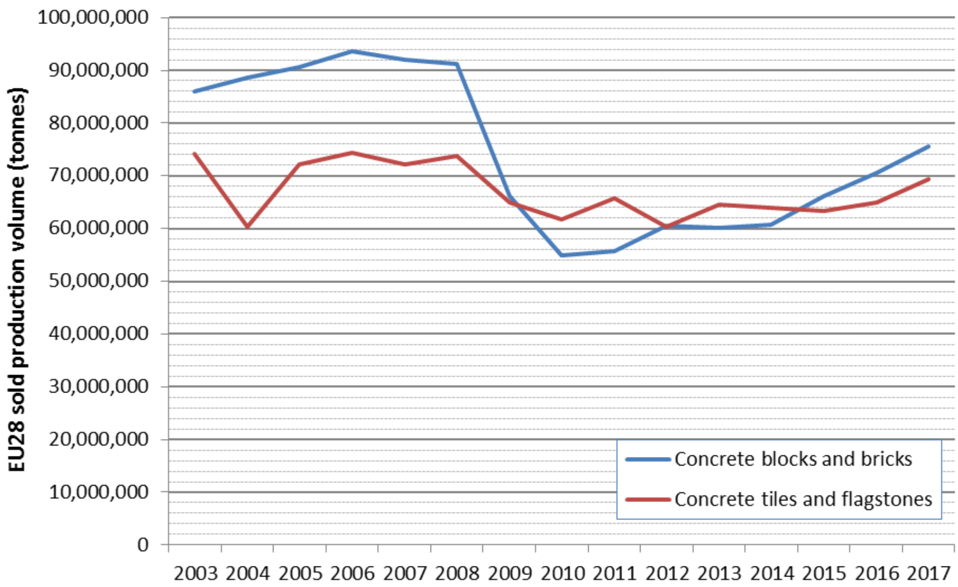


Figure 39. Trends in EU28 sold production of relevant concrete hard covering products

It is clear from the data for concrete bricks and blocks that this product category was hit hard by the global economic crisis, with sold production dropping by around 40% during the 2008 to 2010 period. Since 2011 there has been a gradual but steady recovery in sold production, although the 2017 sold production volume is still around 20% lower than the 2008 level. In 2017 sold production value in the EU28 was €3800 million.

The data for concrete tiles and flagstones shows a similar trend but the drop caused by the global economic crisis was less significant (around 16%) and sold production in 2017 is around 5% below the 2008 level. In 2017 sold production value in the EU28 was €5500 million.

Both the concrete tiles and flagstones and the bricks and blocks are examples of high bulk and relatively low value products. Consequently, the markets tend to be more regional and this was reflected by the fact that production data is reported in all EU Member States except CY, MT and LX. Member State level data is presented in Table 23 below. The data are presented two halves, one for concrete building blocks and bricks (on the left) and one for concrete tiles and flagstones (on the right). The data is ordered in terms of PRODVAL for each product category and the top 5 ranked Member States in terms of PRODVAL (highest €), PRODQNT (highest tonnes) and unit cost (lowest €/t) are highlighted in red.

Table 23. 2017 PRODCOM data for certain precast concrete products (top 5 for PDVAL, PDQNT and €/t in red)

23611130 - Building blocks and bricks of cement, concrete or artificial stone							23611150 - Tiles, flagstones and similar articles of cement, concrete or artificial stone (excluding building blocks and bricks)						
	PDVAL (€ Mil)	Ranking	PDQNT (t)	Ranking	€/t	Ranking		PDVAL (€ Mil)	Ranking	PDQNT (t)	Ranking	€/t	Ranking
UK	784	1 of 26 (20.0%)	22052	1 of 25 (28.5%)	35.6	3 of 25	DE	1446	1 of 26 (26.5%)	19473	1 of 26 (28.2%)	74.3	13 of 26
DE	639	2 of 26 (16.3%)	confidential	n/a	n/a	n/a	UK	812	2 of 26 (14.9%)	7205	2 of 26 (10.4%)	112.8	22 of 26
FR	544	3 of 26 (13.9%)	11247	2 of 25 (14.6%)	48.4	10 of 25	SE	644	3 of 26 (11.8%)	3105	3 of 26 (4.5%)	207.5	26 of 26
NL	433	4 of 26 (11.0%)	5022	4 of 25 (6.5%)	86.2	18 of 25	PO	544	4 of 26 (10.0%)	13498	4 of 26 (19.5%)	40.3	4 of 26
PO	385	5 of 26 (9.8%)	7794	3 of 25 (10.1%)	49.4	11 of 25	IT	364	5 of 26 (6.7%)	4731	5 of 26 (6.8%)	77.1	17 of 26
IT	218	6 of 26 (5.6%)	3497	5 of 25 (4.5%)	62.5	14 of 25	NL	244	6 of 26 (4.5%)	2200	6 of 26 (3.2%)	111.0	21 of 26
IE	159	7 of 26 (4.1%)	3333	6 of 25 (4.3%)	47.9	8 of 25	AT	222	7 of 26 (4.1%)	1548	7 of 26 (2.2%)	143.6	24 of 26
RO	110	8 of 26 (2.8%)	2514	7 of 25 (3.3%)	43.7	5 of 25	BE	184	8 of 26 (3.4%)	1914	8 of 26 (2.8%)	96.1	19 of 26
CZ	91.2	9 of 26 (2.3%)	1305	10 of 25 (1.7%)	69.8	15 of 25	FR	178	9 of 26 (3.3%)	1984	9 of 26 (2.9%)	89.6	18 of 26
BE	71.9	10 of 26 (1.8%)	1542	9 of 25 (2.0%)	46.6	6 of 25	CZ	163	10 of 26 (3.0%)	2816	10 of 26 (4.1%)	58.1	8 of 26
SK	70.4	11 of 26 (1.8%)	728	13 of 25 (0.9%)	96.7	19 of 25	DK	122	11 of 26 (2.2%)	1615	11 of 26 (2.3%)	75.4	14 of 26
ES	67.8	12 of 26 (1.7%)	1763	8 of 25 (2.3%)	38.5	4 of 25	PT	94.2	12 of 26 (1.7%)	676	12 of 26 (1.0%)	139.3	23 of 26
SE	62.1	13 of 26 (1.6%)	277	18 of 25 (0.4%)	223.7	25 of 25	ES	92.5	13 of 26 (1.7%)	1204	13 of 26 (1.7%)	76.8	16 of 26
AT	61.4	14 of 26 (1.6%)	431	16 of 25 (0.6%)	142.5	23 of 25	RO	71.7	14 of 26 (1.3%)	1092	14 of 26 (1.6%)	65.6	11 of 26
HU	51.2	15 of 26 (1.3%)	885	11 of 25 (1.1%)	57.8	13 of 25	HU	54.7	15 of 26 (1.0%)	1282	15 of 26 (1.9%)	42.6	5 of 26
FI*	48.7	16 of 26 (1.2%)	458	15 of 25 (0.6%)	106.1	20 of 25	IE	44.9	16 of 26 (0.8%)	1738	16 of 26 (2.5%)	25.8	1 of 26
EE	30.3	17 of 26 (0.8%)	627	14 of 25 (0.8%)	48.3	9 of 25	NO	40.1	17 of 26 (0.7%)	362	17 of 26 (0.5%)	110.7	20 of 26
PT	23.0	18 of 26 (0.6%)	783	12 of 25 (1.0%)	29.3	1 of 25	SK	38.7	18 of 26 (0.7%)	599	18 of 26 (0.9%)	64.7	9 of 26
DK	22.8	19 of 26 (0.6%)	202	19 of 25 (0.3%)	112.7	21 of 25	BG	29.7	19 of 26 (0.5%)	458	19 of 26 (0.7%)	64.7	10 of 26
LT	13.7	20 of 26 (0.3%)	399	17 of 25 (0.5%)	34.2	2 of 25	LT	27.1	20 of 26 (0.5%)	755	20 of 26 (1.1%)	35.9	3 of 26
BG*	10.3	21 of 26 (0.3%)	129	20 of 25 (0.2%)	79.7	17 of 25	SI	21.1	21 of 26 (0.4%)	278	21 of 26 (0.4%)	75.9	15 of 26
SI	9.3	22 of 26 (0.2%)	78	22 of 25 (0.1%)	118.0	22 of 25	HR	17.3	22 of 26 (0.3%)	254	22 of 26 (0.4%)	67.9	12 of 26
NO	4.6	23 of 26 (0.1%)	21	25 of 25 (0.0%)	218.8	24 of 25	FI	15.4	23 of 26 (0.3%)	80	25 of 26 (0.1%)	191.8	25 of 26
EL	3.9	24 of 26 (0.1%)	83	21 of 25 (0.1%)	46.9	7 of 25	LV	13.2	24 of 26 (0.2%)	286	24 of 26 (0.4%)	46.0	6 of 26
HR	3.4	25 of 26 (0.1%)	68	23 of 25 (0.1%)	49.9	12 of 25	EE	8.7	25 of 26 (0.2%)	272	23 of 26 (0.4%)	31.9	2 of 26
LV	2.9	26 of 26 (0.1%)	38	24 of 25 (0.0%)	75.7	16 of 25	EL	4.6	26 of 26 (0.1%)	81	26 of 26 (0.1%)	56.9	7 of 26
EU28	**3920**	**n/a**	**77266**	**n/a**	**50.7**	**n/a**	**EU28**	**5459**	**n/a**	**69157**	**n/a**	**78.9**	**n/a**

**data for BG and FI building bricks and blocks was from 2016*

The data in Table 23 show that concrete tiles and flagstones have a significantly higher average unit cost (78.9 €/t) than concrete bricks and blocks (50.7 €/t). However, in both of these product categories, there exists a wide variation in unit costs at Member State level (from 29 to 224 €/t for bricks and blocks and from 26 to 208€/tonne for tiles and flagstones).

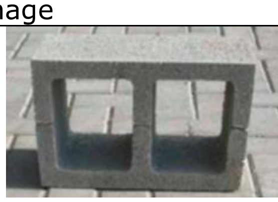
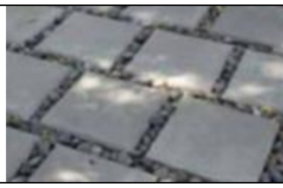
Unit costs in SE, NO and FI were consistently high for both product categories, perhaps being related to higher labour costs.

There was no direct relationship (at Member State level) with quantity of production and unit cost, implying that this is not a sector where large scale production delivers lower unit production costs or, more likely, that production is not highly centralised in the first place, even in countries with large production volumes overall. Member States with the lowest unit costs (e.g. IE, PT, LT, EE, PO, ES, RO and HU) can be considered to be associated with lower than EU average labour costs, supporting the idea that this is an important cost element to be taken into account.

LCA hotspots of dry-cast and pre-cast products

According to evidence in the LCA literature, the dominant source of environmental impacts of dry-cast and pre-cast concrete products is cement. Although the precise content of cement in relevant concrete products can vary significantly depending on the strength performance class in question (e.g. from 150 to 450 kg/m^3), even at the lower cement contents, raw material manufacture (i.e. cement) remains the dominant source of impacts. For example, an EPD published by one American company includes the following 4 relevant concrete products with the mix recipes as follows:

Table 24. Examples of different mix recipes for concrete products within the proposed scope (Source: HBF, 2018).

Mix recipe	Image
1m^3 of 200mm Hollow Concrete Masonry Unit: 146kg water; 250kg Portland cement; 1000kg crushed coarse aggregate; 1150kg crushed fine aggregate; 250kg natural fine aggregate	
1m^3 of 200mm Solid Concrete Masonry Unit: 120kg water; 140kg Portland cement; 850kg crushed coarse aggregate; 1410kg crushed fine aggregate; 250kg natural fine aggregate	
1m^3 of 80mm grey rectangular concrete paver: 136kg water; 422kg Portland cement; 782kg crushed coarse aggregate; 843kg crushed fine aggregate; 0kg natural fine aggregate	
1m^3 of 50mm Grey roof tiles: 108kg water; 424kg Portland cement; 790kg crushed coarse aggregate; 841kg crushed fine aggregate; 0kg natural fine aggregate	

Despite the significant variations in cement content and aggregate types used, the impacts due to raw material extraction (A1) are consistently more important than impacts during concrete processing (A3).

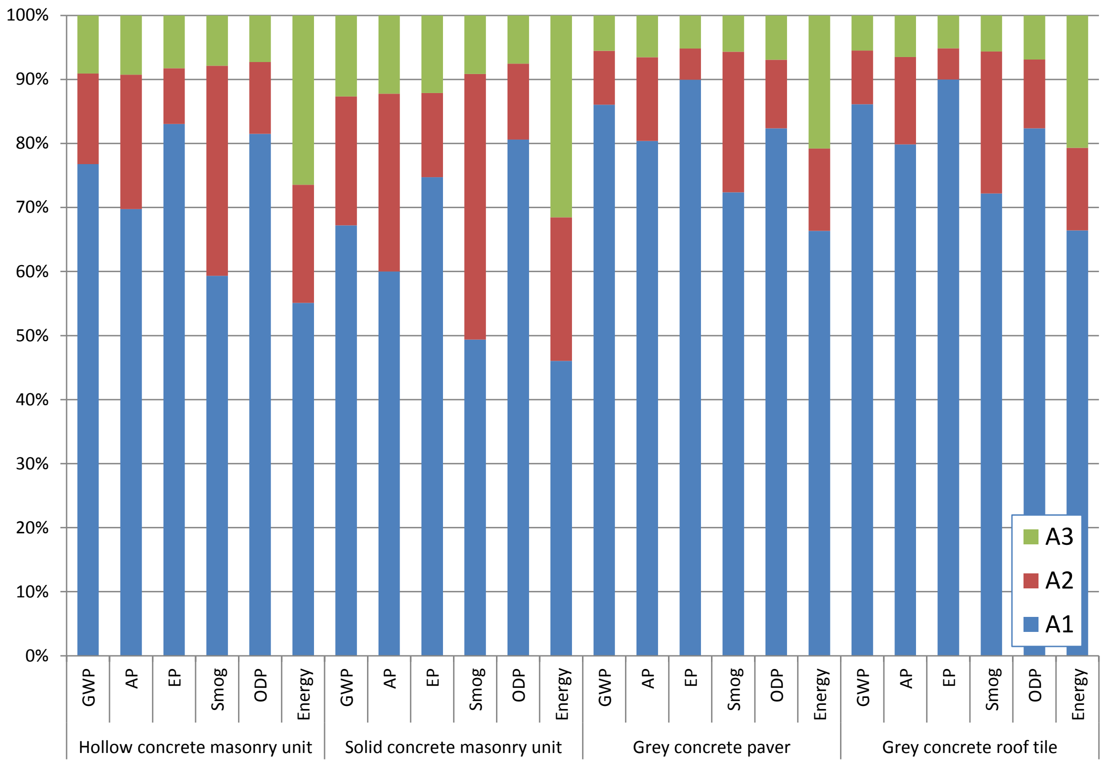


Figure 40. A1, A2 and A3 impacts for manufacture of 5 different concrete products.

Due to the dominance of A1 stages, it is justifiable that EU Ecolabel criteria should pay particular attention to the raw materials used. The relative influences of aggregates and cement on the overall impacts of concrete have been examined by many authors in the LCA literature. There is a broad consensus that impacts due to cement are far higher, despite the fact that aggregates are present in levels up to 10 times higher than cement in the concrete mix recipe.

Marceau et al., (2007) showed that for concrete masonry units, the average total embodied energy was 1.01 GJ, with 69% being due to the cement production, 14% due to curing operations and less than 4% due to aggregates – despite the fact that cement accounted for only 8.7% of the concrete mass and aggregates, 75.3% of the concrete mass.

In a similar manner, Flowers and Sanjayan (2007) reported that cement accounted for 74 to 81% of CO2 emissions and aggregates for 13 to 20% of emissions. The same authors also showed that the emissions associated with cement could be reduced by 13-15% when replacing 25% of the cement with coal fly ash, or be reduced by 40% when replacing 40% of the cement by blast furnace slag.

Higher performance concrete, for example higher strength or frost-resistant concrete will tend to have a higher cement content and a lower water to cement ratio. Across all of the main types of concrete relevant to the hard coverings scope, the cement content may vary from 150 to 450 kg/m^3 concrete. This variation in cement content emphasises the difficulty of trying to set any reasonable benchmarks in terms of embodied energy of CO2 footprint at the level of the concrete product.

It is considered more appropriate to set requirements at the level of the cement used, since it can be safely assumed that concrete producers have an economic interest to lower the quantity of cement in their products to the lowest practical level.

Considering that environmental benefits in cement can be achieved in different ways (e.g. efficient clinker production and/or blending of clinker with supplementary cementitious materials), a flexible approach is proposed in which points can be achieved in different ways for the cement component of concrete.

Such a flexible approach is also important due to the fact that concrete producers only have a relatively limited number of economically competitive cement suppliers to choose from in their regions.

Main changes from Decision 2009/607/EC to TR v1.0

The criteria relevant for concrete in Decision 2009/607/EC and Technical Report v1.0 are summarized in Table 25 below. The criteria from Decision 2009/607/EC are not presented in order but instead beside whatever criteria are most relevant in the TR v1.0, whose order is actually respected. This way it should be easier to visualize which criteria are new or modified and which old ones have been deleted.

Table 25. Concrete criteria in Decision 2009/607/EC and TR v1.0.

Decision 2009/607/EC (all mandatory)	Technical Report v1.0
5. Waste management (description of procedures in place for waste recycling and disposal).	1.1. Environmental Management System (mandatory to have one, optionally up to 5 points awarded, if it is third party certified)
1.2. Extraction management	1.2. Industrial and construction mineral extraction (mandatory)
2.1. Raw materials selection (restricted risk phrases)	1.3. Hazardous substance restrictions (mandatory)
2.3. Asbestos	1.4. Asbestos (mandatory)
	1.5. VOC emissions (mandatory and optional elements for which up to 5 points can be awarded)
7. Packaging (≥70% recycled content in any paperboard packaging).	1.6. Business to consumer packaging (mandatory)
8. Fitness for use	1.7. Fitness for use (mandatory)
9. Consumer Information	1.8. Consumer information (mandatory)
10. Information appearing on the EU Ecolabel.	1.9. Information appearing on the ecolabel (mandatory)
	5.1. Clinker factor of cement (mandatory to report, up to 25 points if factor is ≤ 0.50)
4.5. Cement process air emissions (dust 65g/t; SO2 350g/t; NOx 900g/t)	5.2. Non-CO2 emissions from cement production (mandatory, dust ≤37g/t; NOx ≤943 or 1656g/t; SO2 ≤736g/t)
	5.3. CO2 emissions from clinker/white cement production (mandatory, ≤900 kg CO2/t grey clinker or ≤1100 kg CO2/t white cement; optionally up to 25 points if emissions are as low as 600kg CO2/t clinker or cement).
4.5. Cement process energy requirement (3800 MJ/t)	5.4. Cement kiln thermal efficiency (mandatory ≤3800 MJ/t grey clinker or ≤6000 MJ/t white cement).
5.2. Recovery of waste (≥85% recovery).	5.5. Recycled and secondary materials at the concrete plant (mandatory to recover aggregate from waste concrete batches, optionally up to 25

	points for having up to 50% aggregates from secondary/recycled sources)
4.1a) Process Energy Requirement for terrazzo tiles (1.3 MJ/kg)	5.6. Concrete plant process energy consumption (mandatory to report specific fuel and electricity consumption, optional points for use of onsite CHP (up to 10 points) and renewable electricity (up to 15 points).
	5.7. Photocatalytic surfaces (optional, up to 10 points for surfaces that show a NOx reduction of 40% under standard laboratory conditions).
	5.8. Permeable paving (optional, up to 10 points for blocks with void areas ≥5% or which drains at an infiltration rate of ≥400mm/hour).
4.3d) Concrete plant emissions to air (dust 300mg/m2; NOx 2000mg/m2; SO2 1500mg/m2)	
4.4. Emissions to water from concrete plant (suspended solids 40mg/l; Cd 0.015mg/l; Cr(VI) 0.15mg/l; Fe 1.5mg/l; Pb 0.15mg/l)	

In TR v1.0, a completely new approach for concrete was proposed based on a horizontally and vertically structured set of criteria with a combination of mandatory and optional elements. This approach aims to recognise the different ways in which the environmental impacts of cement and concrete production can be minimised.

A number of criteria from the 2009 Decision were not brought forward because they were not considered relevant enough. For example, emissions to air from the concrete plant are insignificant when compared to those from the manufacture the cement. Emissions to water are simply not a major environmental impact from concrete production, and almost all facilities in Europe are connected to mains sewers.

Some criteria from 2009 were modified to varying degrees in TR v1.0. A relatively minor modification was the introduction of a separate threshold for the specific thermal energy consumption for white cement manufacture. A more significant modification was the minimum recovery of 85% of production waste being indirectly incorporated into the optional criterion on an Environmental Management System and the mandatory element of the criterion on recycled/secondary aggregates.

A number of new criteria were presented in TR v.1.0. At the cement production stage, proposals were made for criteria on the clinker factor (i.e. how much cement clinker is "*diluted*" with other, less polluting materials) and on specific CO2 emissions, since this is a highly relevant environmental issue for the industry. At the concrete production stage, proposals were made for criteria that reward the use of recycled/secondary aggregates without making it mandatory and also for concrete products with specific features that deliver environmental benefits, namely photocatalytically active surfaces and permeable properties. The VOC emission of concrete, although not a commonly considered issue was introduced in the horizontal criteria due to the growing interest in this field from Green Building Assessment schemes and other initiatives.

Main changes from Decision TR v1.0 to TR v2.0

The criteria relevant for concrete in TR v1.0 and TR v2.0 are summarized in Table 26 below.

Table 26. Concrete criteria in TR v1.0 and TR v.2.0.

Technical Report v1.0	Technical Report v2.0
1.1. Environmental Management System (mandatory to have one, optionally up to 5 points awarded, if it is third party certified)	1.1. Environmental Management System (optionally up to 5 points, if it is third party certified)
1.2. Industrial and construction mineral extraction (mandatory)	1.2. Industrial and construction mineral extraction (mandatory)
1.3. Hazardous substance restrictions (mandatory)	1.3. Hazardous substance restrictions (mandatory)
1.4. Asbestos (mandatory)	
1.5. VOC emissions (mandatory and optional elements for which up to 5 points can be awarded)	1.5. VOC emissions (mandatory and optional elements for which up to 5 points can be awarded)
1.6. Business to consumer packaging (mandatory)	
1.7. Fitness for use (mandatory)	1.7. Fitness for use (mandatory)
1.8. Consumer information (mandatory)	1.8. Consumer information (mandatory)
1.9. Information appearing on the ecolabel (mandatory)	1.9. Information appearing on the ecolabel (mandatory)
5.1. Clinker factor of cement (mandatory to report, up to 25 points if factor is ≤ 0.50)	5.1. Clinker factor of cement (mandatory to report, up to 25 points if factor is ≤ 0.50)
5.2. Non-CO2 emissions from cement production (mandatory, dust ≤37g/t; NOx ≤943 or 1656g/t; SO2 ≤736g/t)	5.2. Non-CO2 emissions from cement production (mandatory, dust ≤37g/t; NOx ≤943 or 1656g/t; SO2 ≤736g/t)
5.3. CO2 emissions from clinker/white cement production (mandatory, ≤900 kg CO2/t grey clinker or ≤1100 kg CO2/t white cement; optionally up to 25 points if emissions are as low as 600kg CO2/t clinker or cement).	5.3. Net CO2 emissions from clinker/white cement production (mandatory, ≤795 kg CO2/t grey clinker or ≤1230 kg CO2/t white cement; optionally up to 25 points in proportion to how close the best practice benchmarks of 659 kgCO2/t grey clinker and 835 kgCO2/t white clinker respectively).
5.4. Cement kiln thermal efficiency (mandatory ≤3800 MJ/t grey clinker or ≤6000 MJ/t white cement).	
5.5. Recycled and secondary materials at the concrete plant (mandatory to recover aggregate from waste concrete batches, optionally up to 25 points for having up to 50% aggregates from secondary/recycled sources)	5.5. Recycled and secondary materials at the concrete plant (mandatory to recover aggregate from waste concrete batches, optionally up to 25 points for having up to 50% aggregates from secondary/recycled sources)
5.6. Concrete plant process energy consumption (mandatory to report specific fuel and electricity consumption, optional points for use of onsite CHP (up to 10 points) and renewable electricity (up to 15 points).	5.6. Concrete plant process energy consumption (mandatory to report specific fuel and electricity consumption, optional points for use of onsite CHP (up to 10) and renewable electricity (up to 15).
5.7. Photocatalytic surfaces (optional, up to 10 points for surfaces that show a NOx reduction of 40% under standard laboratory conditions).	
5.8. Permeable paving (optional, up to 10 points for blocks with void areas ≥5% or which drains at an infiltration rate of ≥400mm/hour).	5.8. Permeable paving (optional, up to 10 points for blocks with void areas ≥5% or which drains at an infiltration rate of ≥400mm/hour).

Following stakeholder feedback to the proposals in TR v1.0 and further research, a number of modifications have been made in TR v2.0. The asbestos and packaging criteria have been removed due to their low relevance (especially to concrete products) and low effect on the total environmental impact. The deliberate use of asbestos fibres would be effectively banned by criterion 1.3 in any case.

The criterion on kiln thermal energy requirement has been removed since it was agreed that this is effectively covered by the criterion on CO2 emissions for cement clinker production.

Due to political concerns expressed at the EU Ecolabelling Board meeting, it was decided to not promote the intentional use of TiO2 in photocatalytically active hard covering products (including concrete). Although the scale and importance of the direct and indirect adverse health effects of NOx in the urban atmosphere are well understood (WHO 2003; EC 2013; EEA, 2016; EEA, 2018, Deziel, 2018, Serpone, 2018), the reaction mechanisms of NO and NO2 emissions to the atmosphere are complex (Reeves et al., 2002). Hard coverings in exterior applications would come into contact with both UV radiation and the main source of NOx emissions, which is vehicle exhaust gases (EEA, 2018). However, variable performance under different environmental conditions (Murata et al., 2000; Staub de Melo and Triches, 2012), potential reversible reactions (Ndour et al., 2009; Monge et al., 2010; Mothes et al., 2016) and, when trying to minimise the potential for reversible reactions by regular washing with water, possible new concerns about the acidification of concrete surfaces when NO3- products of NOx oxidation form HNO3 acid upon contact with water (Yang et al., 2018) imply that there are several technical aspects that still need to be resolved before such products can deliver a consistent and predictable pollution abatement performance.

Other criteria have been modified in line with feedback from the 1st stakeholder meeting and supporting rationale from further research that is provided throughout the next sub-sections of this chapter.

Overview of scoring system for concrete in TR v2.0

To obtain the EU Ecolabel for concrete products, it will be necessary to comply with all relevant mandatory requirements and to obtain at least 55 points from the optional criteria. This amount equates to 50% of the total points that are available for most precast concrete products in the scope.

An additional 10 points is also potentially available for innovative concrete paving products that are designed to facilitate runoff drainage at source and another 10 points is available for those paving products that are especially material efficient in their design.

Ignoring the points for innovative products, 65 of the 110 points are linked to cement production and 45 of the 110 points are linked to the concrete plant.

Table 27. Concrete-specific criteria structure and scoring system

Proposed criteria	Mandatory element?	Optional element	Points
1.1. Environmental Management System	No	Yes	Up to 5
1.2. Industrial and construction mineral extraction	Yes	No	0
1.3. Hazardous substance restrictions	Yes	No	0
1.4. VOC emissions	Yes, declare	Yes	Up to 5 points
1.5. Fitness for use	Yes	No	0
1.6. Consumer information	Yes	No	0
1.7. Information appearing on the ecolabel	Yes	No	0
5.1. Clinker factor of cement	Yes, reporting	Yes	Up to 25
5.2. CO2 emissions from the cement kiln	Yes, upper limits	Yes	Up to 25
5.3. Non-CO2 emissions to air from the cement kiln	Yes, upper limits	Yes	Up to 15
5.4. Concrete recovery and responsible sourcing of raw materials	Yes, systems in place	Yes	Up to 25
5.5. Concrete plant energy management	Yes, reporting	Yes	Up to 10
5.6. Permeable and material efficient pavements *(Innovative products)*	No	Yes	Up to 20 points
TOTAL points available in proposed criteria			**110 + 20**
MINIMUM points needed in proposed criteria			**55**

5.1 – Clinker factor of cement

Existing criterion
No existing criterion

TR v1.0 proposed criterion 5.1: Clinker factor of cement

Mandatory requirement

A clinker factor for the cement or cements used shall be provided by the cement supplier.

In cases where more than one cement is used in the concrete product(s) that are to be EU Ecolabelled (e.g. in dual layered products) a weighted average clinker factor shall be calculated based on the average masses of each cement used in the concrete.

EU Ecolabel points

Up to 25 points can be awarded in proportion to how low the clinker factor is between a reference point of 1.00 for no points and 0.50 for maximum points.

Assessment and verification:

The applicant shall provide a declaration of compliance which states the relevant clinker factor. The cement supplier shall provide a declaration of the clinker factor in writing to the applicant and/or Competent Body. The clinker factor shall be calculated by estimating the kg of Portland cement clinker present in 1t of the cement product and dividing the kg of clinker by 1000kg.

In cases where packaged cement is delivered and no specific declaration is provided by the cement supplier, the following assumptions can be made for the cement clinker factor:

EN 197-1 Code	Factor assumed	EN 197-1 Code	Factor assumed
CEM I	0.97	CEM II/A-L	0.87
CEM II/A-S	0.87	CEM II/B-L	0.72
CEM II/B-S	0.72	CEM II/A-LL	0.87
CEM II/A-D	0.92	CEM II/B-LL	0.72
CEM II/A-P	0.87	CEM II/A-M	0.84
CEM II/B-P	0.72	CEM II/B-M	0.72
CEM II/A-Q	0.87	CEM III/A	0.50
CEM II/B-Q	0.72	CEM III/B	0.28
CEM II/A-V	0.87	CEM III/C	0.12
CEM II/B-V	0.72	CEM IV/A	0.77
CEM II/A-W	0.87	CEM IV/B	0.55
CEM II/B-W	0.72	CEM V/A	0.76
CEM II/A-T	0.87	CEM V/B	0.60
CEM II/B-T	0.72		

TR v2.0 proposed criterion 5.1: Clinker factor of cement

Mandatory requirement

A clinker factor for the cement used shall be provided by the applicant that expresses the % weight of the cement, in decimal format, that is composed of cement clinker.

EU Ecolabel points

Up to 25 points can be awarded in proportion to where the clinker factor of the cement lies between 1.00 and the threshold for environmental excellence of 0.50 (0 points if the factor is equal to 1.00 and 25 points if the factor is 0.50 or lower).

Assessment and verification:

The applicant shall provide a declaration of the cement clinker factor. The declaration shall be supported by relevant declarations or information from their cement supplier, which state either a specific clinker factor or at least define the EN 197-1 class of the cement(s) supplied.

In cases where no specific clinker factor is mentioned but the EN 197-1 class is defined, the following assumptions can be made for the cement clinker factor:

EN 197-1 Code	Factor assumed	EN 197-1 Code	Factor assumed
CEM I	0.96	CEM II/A-L	0.83
CEM II/A-S	0.83	CEM II/B-L	0.68
CEM II/B-S	0.68	CEM II/A-LL	0.83
CEM II/A-D	0.88	CEM II/B-LL	0.68
CEM II/A-P	0.83	CEM II/A-M	0.80
CEM II/B-P	0.68	CEM II/B-M	0.68
CEM II/A-Q	0.83	CEM III/A	0.47
CEM II/B-Q	0.68	CEM III/B	0.25
CEM II/A-V	0.83	CEM III/C	0.09
CEM II/B-V	0.68	CEM IV/A	0.73
CEM II/A-W	0.83	CEM IV/B	0.52
CEM II/B-W	0.68	CEM V/A	0.72
CEM II/A-T	0.83	CEM V/B	0.57
CEM II/B-T	0.68		

In cases where more than one cement is used in the concrete product(s) that are to be EU Ecolabelled (e.g. in dual layered terrazzo tile products) the applicant shall calculate the points that would apply to each cement as if it was the only cement used, then calculate a weighted average points total based on the relative use of each cement in the EU Ecolabel concrete production line

Rationale:

<u>The importance of the clinker factor</u>

The clinker factor is basically a measure of how much Portland cement clinker is present in the Portland cement. The three main clinker phases (tri-calcium silicate, di-calcium silicate and tri-calcium aluminate – or C3S, C2S and C3A for short) are responsible for the cementitious behavior of Portland cement.

These vital clinker phases can only be formed via the high temperatures generated in the cement kiln (i.e. around 1450°C in the kiln) which results in environmental impacts due to the high fuel energy consumption requirements.

Furthermore, due to the high calcium content in the clinker phases, this requires the use of limestone (i.e. $CaCO_3$) raw material which decarbonates in the kiln, releasing substantial amounts of process CO_2, on top of the emissions due to fuel combustion.

In a "*pure*" Portland cement (i.e. CEM I according to EN 197-1), the only material that is ground together with clinker is calcium sulfate in the form of gypsum or anhydrite in order to control the setting and hydration reactions of the clinker phases once they come into contact with water. A typical content of gypsum or hemihydrate is from 3-5%, which would result in a cement with a "*clinker factor*" of 0.97-0.95.

Decades of research (Malhotra and Kumar Mehta, 1996; Siddique and Khan, 2011; Thomas, 2017) have shown that a number of other materials, herein referred to as supplementary cementitious materials (SCMs), can be blended with clinker to produce blended cements that have equivalent or sometimes superior properties to those of a pure, CEM I type cement. The main SCMs are defined by EN 197-1 and represent a mixture of industrial by-products and natural materials that may or may not need to be processed prior to blending with clinker.

- Industrial by-products: blast furnace slag (from iron production); silica fume (from silicon metal production); coal fly ash (from coal combustion).
- Natural materials: natural pozzolana (e.g. volcanic ashes) calcined pozzolana (e.g. kaolin clay calcined at 500-700°C), burnt shale and limestone (the latter is essentially "free" since it can be sourced from the same quarry as the raw meal).

From a practical and market-based perspective, all of these materials have considerable environmental benefits (especially those which are industrial by-products) and economic benefits (especially limestone obtained from the same quarry operated by the cement producer). BAT 8 in the BAT Conclusions for the production of cement, set out in Commission Implementing Decision 2013/163/EU, states the following:

"*8. In order to reduce primary energy consumption, BAT is to consider the reduction of the clinker content of cement and cement products.*"

Data from EPDs published by CEMBUREAU for "*average*" CEM I, CEM II and CEM III produced in several European countries illustrates very clearly the influence of clinker factor on the life cycle environmental impacts when looking at the cradle-to-gate life cycle stages. The average clinker factors were 0.925, 0.76 and 0.44 for CEM I, CEM II and CEM III EPDs respectively.

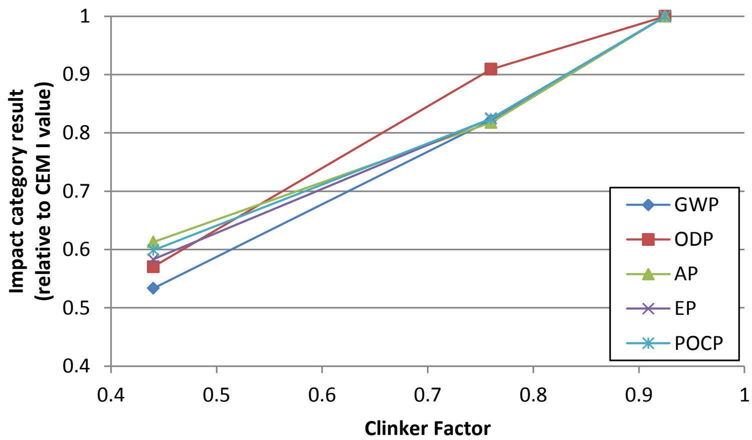


Figure 41. Influence of clinker factor on EPD impact category results (Sources: CEMBUREAU 2015a, b and c).

For the sake of comparing numbers that vary widely in scale between different impact categories, all results for CEM I in Figure 41 have been normalized to 1.00 and the CEM II and CEM III data expressed as a decimal of the CEM I data. A clear proportional relationship between the clinker factor and the environmental impacts can be seen, although there are only 3 points on the line, the R^2 values for best fit linear trendlines were all 0.97 or higher.

With the notable exception of limestone, the choice of SCM will be influenced by regional availability, material quality and market fluctuations in SCM prices. Consequently, the EU Ecolabel criteria seek to reward any blended cements in a manner that is proportional to how well they manage to reduce their clinker factor, without preferring or prioritizing one type of SCM over another.

Data available from "Getting the Numbers Right" (GNR) database

Although the GNR database reports on clinker factors and counts both own produced clinker as well as clinker purchased from other sites. The formula used for calculating the clinker factor (CF) in the GNR reporting format is as follows:

$$CF = \frac{Total\ clinker\ consumed}{Own\ clinker\ consumed + (gypsum, limestone, CKD\&SCMs\ in\ blending) + bought\ clinker\ consumed}$$

**where CKD stands for Cement Kiln Dust and SCM stands for Supplementary Cementitious Material (e.g. coal fly ash etc.).*

Table 28. Clinker factors reported in the GNR database* (GNR, 2018)

Region	2012	2013	2014	2015	2016
Africa	78%	77%	76%	77%	77%
Asia (n.e.c.) + Oceania	81%	80%	80%	80%	80%
Brazil	68%	69%	69%	69%	71%
Central America	73%	74%	74%	74%	73%
China + Korea + Japan	77%	77%	77%	77%	77%
CIS	79%	80%	80%	82%	82%
Europe	75%	76%	76%	76%	76%
India	71%	71%	70%	69%	70%
Middle East	83%	84%	84%	84%	85%
North America	91%	91%	90%	90%	89%
South America ex. Brazil	70%	70%	68%	69%	66%

**Data from indicator "92AGWce – Clinker to cement equivalent ratio – Weighted average – Grey and White clinker in Portland and blended cements (%).*

The weighted average clinker factors vary from as low as 0.66 (i.e. 66%) in South America (excl. Brazil) to 0.89 in North America. Europe is somewhere towards the middle of this range with a 0.76 clinker factor. The average European cement would therefore have achieved around 12 points out of 25 for the EU Ecolabel clinker factor criterion.

Future trends in the clinker factor in Europe

In terms of future prospects, CEMBUREAU estimate that the European cement sector could achieve a sectorial average clinker factor of 0.70 by 2050 (CEMBUREAU, 2013) (i.e. only minor and incremental progress from today). Two particularly important SCMs are blast furnace slag (from steel production) and coal fly ash (from coal combustion). Any decreases in European steel production will make it more costly for European cement producers to obtain blast furnace slag. Coal combustion is likely to decrease in Europe due to efforts to decarbonize the energy sector, resulting in less fly ash being available for EU cement production. Furthermore, NO_x emission abatement from coal combustion plants by treatment via selective reduction with ammonia dosing may pose a threat to the consistency of fly ash quality when ammonia slip occurs. The projected decreases in availability of these coal fly ash and blast furnace slag will need to be compensated by increased use of other SCMs such as limestone and calcined clays.

Ambition level in proposed approach

This criterion proposal is new to the EU Ecolabel and so stakeholder feedback is particularly important. Even though the weighted average clinker factor in European Portland cement is already 0.76, no mandatory threshold was set for the clinker factor. This is in recognition that a low clinker factor is just one way (albeit a very important one) to reduce the environmental impact of Portland cement. It is also possible to produce high clinker factor cements with low emissions to air, and these higher clinker factor cements may deliver certain technical properties that lower clinker factor cements cannot meet (e.g. brightness of white cements) or that would require a larger quantity of low clinker factor cement to be met (e.g. minimum early age strength development of concrete).

In the latter case, the low dose of cement may be because the concrete producer has their own supply of SCMs and wishes to blend them onsite prior to concrete production. The criteria have been set up so that even if a concrete producer loses points by using cement with a high clinker factor, he can obtain extra points by demonstrating a higher use of secondary or recycled materials in his concrete mix (see criterion 5.4).

For these reasons, it is considered most suitable to allow for higher clinker factor cements but to reward those cements which achieve lower clinker factors in proportion to the actual clinker factor towards an arbitrary best practice benchmark of 0.50.

Dosing and blending systems in cement production

For EU Ecolabel, a similar formula to that used in the GNR database described above can be used to calculate the clinker factor, although it is unimportant whether any distinction is made between own produced and bought clinker.

It must be appreciated that a single cement factory may produce multiple different cement products, even if it would only produce one clinker - the distinction in cement products comes from blending of the clinker with other materials in different combinations after the clinker has cooled. Consequently, the clinker factor must be calculated at the level of individual cement products rather than the entire facility.

The cement blending process may be simple or complex, depending on how many materials are to be blended and at what point. In any case, it is always possible to make a reasonable estimate of the clinker factor by monitoring the mass flows of clinker in and cement out. Accurate monitoring of the mass flows of key non-clinker materials is fundamental to ensuring predictable performance of each cement batch.

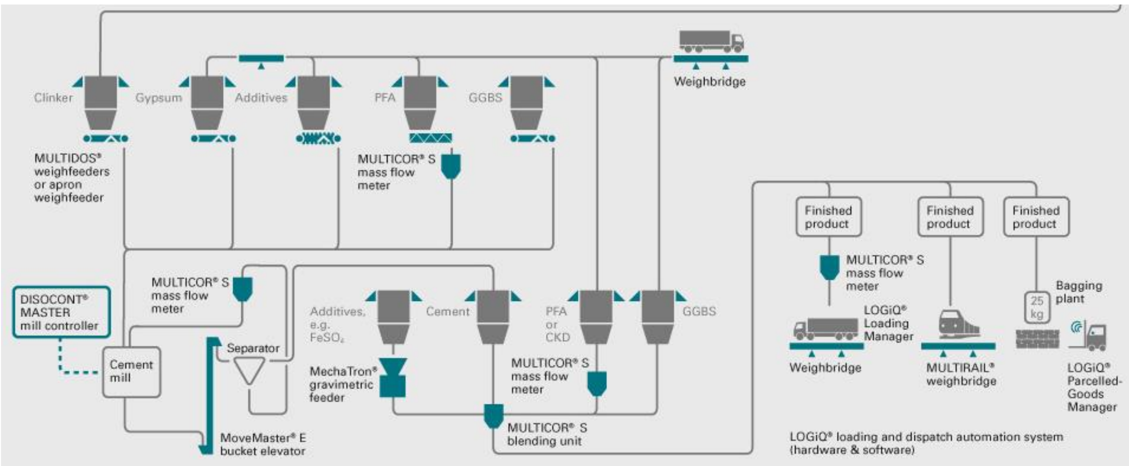


Figure 42. Cement blending process diagram (Source: [SchenkProcess]).

The process diagram in Figure 42 shows that the combination of cement clinker with other materials may be carried out prior to milling with gypsum, which results in a homogenous material, or that it may be blended later with SCMs of sufficient fineness in a simple blending unit. The return of fines from the milling operation to the system may complicate the mass balance process if these returns are not metered.

Alternative verification via EN 197-1 cement class

There may be cases where a concrete manufacturer is unable obtain information about the clinker factor of the cement they use. The precise clinker factor is generally considered as commercially sensitive information by cement producers. In such cases, an alternative means of estimating the clinker factor is provided via the code that should be displayed on packaging of any CE marked Portland cement.

The codes listed in the criterion indicate which type or types of SCM have been used and the range of SCM content that is present in accordance with table 1 of EN 197-1. The estimated clinker factor is simply based on the medium point of the range of added SCM covered by that code. For example, if code CEM II/A-S corresponds to clinker blended with 6-20% of blast furnace slag. If the middle percentage is taken (i.e. 13%) this would correspond to an estimated clinker factor of 0.87. Adding in the assumed average gypsum content of 4% (this same assumption applies to all Portland cement classes with more than 50% clinker) would result in a final clinker factor of 0.83.

Due to the fact that gypsum is added to regulate the setting behaviour of one of the clinker constituents (i.e. C3A) for cements with clinker factors less than 0.60, a slightly lower gypsum addition of 3% has been assumed (i.e. for CEM III/A, B and C, for CEM IV/B and CEM V/B).

Table 29. Different classes of Portland cement according to EN 197-1

Type	Code	From kiln	From other sources (supplementary cementitious materials (SCMs))									Other minor constituents
		Clinker	Blast furnace slag	Silica fume	Pozzolana		Fly ash		Burnt shale	Limestone		
					natural	natural calcined	siliceous	calcareous				
		K	S	D	P	Q	V	W	T	L	LL	
CEM I	CEMI I	95-100	-	-	-	-	-	-	-	-	-	0-5
CEM II	CEM II/A-S	80-94	6-20	-	-	-	-	-	-	-	-	0-5
	CEM II/B-S	65-79	21-35	-	-	-	-	-	-	-	-	0-5
	CEM II/A-D	90-94	-	6-10	-	-	-	-	-	-	-	0-5
	CEM II/A-P	80-94	-	-	6-20	-	-	-	-	-	-	0-5
	CEM II/B-P	65-79	-	-	21-35	-	-	-	-	-	-	0-5
	CEM II/A-Q	80-94	-	-	-	6-20	-	-	-	-	-	0-5
	CEM II/B-Q	65-79	-	-	-	21-35	-	-	-	-	-	0-5
	CEM II/A-V	80-94	-	-	-	-	6-20	-	-	-	-	0-5
	CEM II/B-V	65-79	-	-	-	-	21-35	-	-	-	-	0-5
	CEM II/A-W	80-94	-	-	-	-	-	6-20	-	-	-	0-5
	CEM II/B-W	65-79	-	-	-	-	-	21-35	-	-	-	0-5
	CEM II/A-T	80-94	-	-	-	-	-	-	6-20	-	-	0-5
	CEM II/B-T	65-79	-	-	-	-	-	-	21-35	-	-	0-5
	CEM II/A-L	80-94	-	-	-	-	-	-	-	6-20	-	0-5
	CEM II/B-L	65-79	-	-	-	-	-	-	-	21-35	-	0-5
	CEM II/A-LL	80-94	-	-	-	-	-	-	-	-	6-20	0-5
	CEM II/B-LL	65-79	-	-	-	-	-	-	-	-	21-35	0-5
	CEM II/A-M	80-88	< --12-20-- >									0-5
	CEM II/B-M	65-79	< --21-35-- >									0-5
CEM III	CEM III/A	35-64	36-65	-	-	-	-	-	-	-	-	0-5
	CEM III/B	20-34	66-80	-	-	-	-	-	-	-	-	0-5
	CEM III/C	5-19	81-95	-	-	-	-	-	-	-	-	0-5
CEM IV	CEM IV/A	65-89	-	< ---------------------11-35-------------------- >					-	-	-	0-5
	CEM IV/B	45-64	-	< --------------------36-55--------------------- >					-	-	-	0-5
CEM V	CEM V/A	40-64	18-30	-	< ----------18-30--------- >			-	-	-	-	0-5
	CEM V/B	20-38	31-49	-	< -----------31-49---------- >			-	-	-	-	0-5

Verification of clinker factor via testing of the cement product?

Standard procedures (EN 196-4) have been developed for quantifying the content of certain SCMs in blended cement via a selective dissolution procedure and could be used as a last recourse in cases where the cement clinker factor is disputed. However, while these methods are valid for almost all cement classes defined in EN 197-1, it must be noted that those containing burnt shale (CEM II/A-T and B-T or calcareous fly ash (CEM II/A-W and B-W) cannot be properly quantified because they consist of several different minerals, some of which will react under the conditions of the test and some not.

Outcomes from and after the 1st AHWG meeting

One industrial stakeholder stated that the clinker factor is considered as a commercially sensitive piece of information. For example, the Concrete Sustainability Initiative is only allowed to published highly aggregated clinker factor data and only then with a one year time lag. Consequently, it is foreseen that the industry would not be comfortable sharing this data with Competent Bodies, even with the existing confidentiality agreements that EU Ecolabel Competent Bodies use. The JRC asked if simply providing information about which of the Portland cement 27 classes defined in EN 197-1, which narrows the possible clinker factor down to a certain range, would be considered as acceptable for the industry to share. In principle this would be okay (because it is also information that is shared with customers) but would need to be checked with members to see if it could raise any anti-trust concerns.

Further research:

The clinker factor criterion has been maintained due to its importance as a strategy for cement producers to lower the environmental impact of their cement products in a simple manner and that this information can be generally understood by concrete producers.

The clinker factors to be assumed for the different EN 197-1 classes have been revised downwards by 0.03 or 0.04 to account for the 3 or 4% gypsum content that can be assumed in all Portland cements. A 3% gypsum content was assumed for any cements with clinker factors of 0.60 or less and 4% for clinker factors greater than 0.60. This arbitrary distinction is justified because the gypsum addition is related to the quantity of clinker phases present, so higher clinker factor cements would tend to have higher gypsum contents.

The wording of the final paragraph of the assessment and verification text has been adjusted to better match equivalent wording used in the CO_2 criterion.

5.2 – CO_2 emissions from the cement kiln

Existing criterion:

No existing criterion on CO2 emissions.

TR v1.0 proposed criterion 5.3: Gross CO2 emissions from grey clinker/white cement production

Mandatory requirement

In accordance with the methodology defined by the Getting the Numbers Right (GNR) initiative, the gross CO_2 emissions shall comply with the relevant limits defined below:

- Grey cement: 900 kg CO2/t grey cement clinker.
- White cement: 1100 kg CO2/t white cement.

EU Ecolabel points

Points shall be awarded for applicants that can demonstrate the following aspects:

- Reduction of CO2 emissions from a grey cement kiln towards a best practice limit of 600 kg CO2/t grey cement clinker.
- Reduction of CO2 emissions from a white cement kiln towards a best practice limit of 600 kg CO2/t white cement.

Assessment and verification:

The applicant shall provide a declaration of compliance from their cement supplier(s) with the mandatory requirement of this criterion supported by a statement of the calculated gross CO2 emission in accordance with the latest GNR reporting methodology.

TR v2.0 proposed criterion 5.2: Net CO2 emissions from cement clinker/alternative cement production

Mandatory requirement

In accordance with the methodology defined by the Getting the Numbers Right (GNR) initiative, the net CO_2 emissions shall comply with the relevant limits defined below:

- Grey clinker: 795 kg CO2/t grey clinker.
- White clinker: 1230 kg CO2/t white clinker.
- Alternative cement: 795 kg CO2/t alternative cement.

EU Ecolabel points

Up to 25 points can be awarded in proportion to where the specific net CO2 emission lies between the relevant mandatory threshold listed above (0 points if equal to the mandatory level) and the relevant thresholds for environmental excellence defined below (25 points if equal to or less than the relevant threshold below):

- Reduction of CO2 emissions from a grey clinker kiln towards an environmental excellence threshold of 659 kg CO2/t grey clinker.
- Reduction of CO2 emissions from a white clinker kiln towards an environmental

excellence threshold of 835 kg CO_2/t white clinker.

- Reduction of CO_2 emissions from alternative cement constituents towards an environmental excellence threshold of 659 kg CO_2/t alternative cement.

Assessment and verification:

The applicant shall provide a declaration of compliance from their cement supplier(s) with the mandatory requirement of this criterion supported by a statement of the calculated net CO_2 emission in accordance with the latest GNR reporting methodology.

Alternative cements shall be considered as cements that do not contain any Portland cement clinker phases (e.g. alkali-activated cements and geopolymers based entirely on materials such as coal fly ash, blast furnace slag or metakaolin). In lieu of net CO_2 emissions from the cement kiln, alternative cements should have a carbon footprint calculated using emission factors associated with the constituent ingredients such as sodium hydroxide, sodium silicate, sodium sulphate and metakoalin. In the absence of specific emission factors from material suppliers, the following generic emission factors from a life cycle inventory database should be used.

The total CO_2 associated with one tonne of the alternative cement will then be compared against the relevant mandatory limit and environmental excellence threshold.

In cases where more than one cement is used in the production of EU Ecolabel certified concrete products (e.g. dual layered terrazzo tiles), the applicant shall calculate the points that would apply to each cement as if it was the only cement used, then calculate a weighted average points total based on the relative use of each cement in the EU Ecolabel concrete production line.

Rationale:

Data available from "Getting the Numbers Right" (GNR) database

The GNR database is a voluntary project previously managed by the Cement Sustainability Initiative (CSI) and now by the Global Cement and Concrete Association (GCCA). Interested stakeholders submit data via standard web-based reports which are verified and logged in a global database. In 2016, a total of 849 individual cement facilities submitted data covering 807 million tonnes of cement production, representing approximately 19% of global production. The degree of industry coverage varies depending on the geographical region.

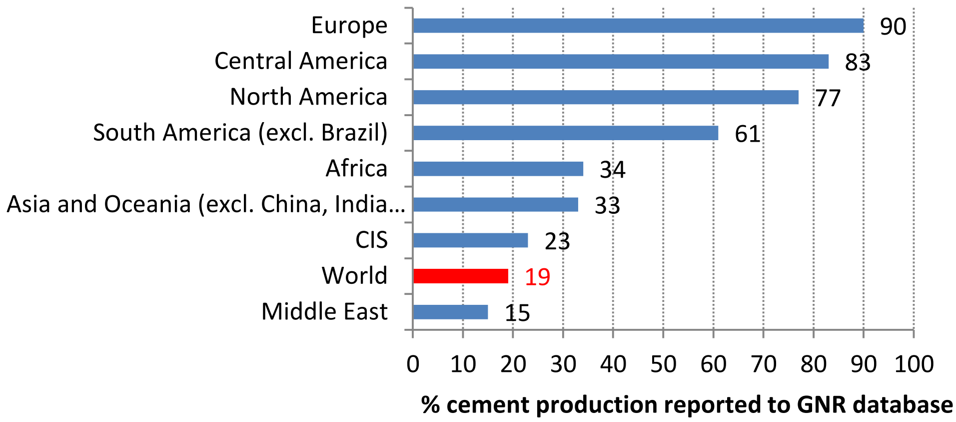


Figure 43. Variation in GNR data reported by geographical region.

The low global average of 19% cement production is due to low levels of reporting in China and India, which are the two dominant global producers of Portland cement (China with approximately 70% and India with around 8% of total global production) (CEMBUREAU, 2017).

Despite the low global average, it is clear that data from Europe can be considered as highly relevant for the European cement sector due to the fact that 90% of European cement production capacity is reporting to the database. This high extent of coverage also acts as a justification for any EU Ecolabel criteria on CO2 to align with the same calculation and reporting format as is already required for the GNR database.

The need to align with an existing calculation method

Emissions of CO2 are at the very top of the scientific and political agenda for climate change. The cement industry is commonly cited as being responsible for some 5-8% of global anthropogenic CO2 emissions. This has resulted in a variety of different mandatory and voluntary policies being applied to the cement sector (and other energy intensive sectors) to manage CO2 emissions.

At the most focused end of the policy spectrum is the mandatory reporting of CO2 emissions under the Emissions Trading Scheme (ETS), where only emissions from the site are included (i.e. not those from grid electricity). At the broader end of the policy spectrum are the Product Category Rules that are defined for Environmental Product Declarations, where all sorts of variables that influence the final CO2 "footprint" of the product can be considered (e.g. assumptions about electricity grid factors, assumptions about transport of raw materials, assumptions about embodied carbon in raw materials etc.).

In terms of market coverage, the more focused ETS calculations will cover essentially 100% of the EU cement market, while the coverage of EPD style calculations is less clear, although sectoral average EPDs have been published by CEMBUREAU for representative CEM I, CEM II and CEM III type Portland cements.

With the EU Ecolabel, it is important to avoid inventing yet another way to calculate CO2 emissions if possible. The approach to calculating CO2 emissions for the GNR database was considered to be suitable since around 90% of EU cement production capacity is already reporting to this database and it is possible to analyse the data for the purpose of setting benchmarks. One major advantage of the GNR database is that it does not include grid electricity, which would lead to further stakeholder debate regarding assumptions for grid factors.

Gross or net CO2 emissions according to GNR reporting?

The glossary of terms for the GNR database states the following:

- "Gross CO2 emissions: direct CO2 emissions (excluding on-site electricity production) minus emissions from biomass fuel sources."
- "Net CO2 emissions: gross CO2 emissions minus emissions from alternative fossil fuels."

The term "*alternative fossil fuel*" sounds odd, and is possibly a typographical error. The term "*alternative fuel*" is further defined as:

- "Fuels used for fossil fuel substitution in clinker production. Alternative fuels are derived from waste (excluding biomass waste)."

Analysis of the GNR database will look at both gross and net emissions in order to see how big the difference is in data ranges. The advantage of going for gross emissions would be that it does not put pressure on cement producers to use alternative fuels, but is more focused on the energy efficiency of the kiln. The advantage of setting requirements on net emissions is that it would incentivize cement producers to increase the use of alternative fuels but also reward those producers with efficient kilns.

It is presumed that emission factors for fuels shall be used in accordance with Annex VI to Commission Regulation (EC) No 601/2012 of 21 June 2012 on the monitoring and reporting of greenhouse gas emissions.

Choice of functional unit for CO2 emissions from the GNR database.

Data is publically available for CO2 emissions expressed as:

- kgCO_2/t grey clinker (gross and net),
- kgCO_2/t white cement (gross only),
- kgCO_2/t grey and white cement equivalent (gross and net), and
- kgCO_2/t cementitious (gross and net).

The GNR database glossary defines these terms as follows:

- "Clinker: intermediate product in cement manufacturing. Clinker is the result of calcination of raw materials in the kiln."
- "Cement: finished product of the cement plant obtained by grinding the clinker and adding various components (gypsum, limestone etc.)."
- "Cementitious products: all clinker volumes produced by a company for cement making or direct clinker sale, plus gypsum, limestone, CKD, and all clinker substitutes consumed for blending, plus all cement substitutes produced. Clinker bought from third parties for the production of cement is excluded."

Considering the GNR definitions, CO2 emission values expressed as "*per tonne cement*" could be misleading since this includes the potential use of SCMs. The use of SCMs (i.e. the clinker factor) will vary widely between cement products and affect the CO2 emission value of the cement. However, the CO2 emission values of cements are not expressed as a function of their clinker factor in the GNR database.

The same concern applies to "*cementitious products*" but is even greater because there is room for additional variation caused by the production of cement substitutes and the purchase of third party clinker.

Consequently, it was concluded that an analysis of the data for clinker production would be the most appropriate approach for the purposes of setting benchmarks for EU Ecolabel criteria.

Table 30. Trends in weighted average CO2 emissions in EU 28 reported in the public version of the GNR database

YEAR	kgCO2/t grey cement clinker			kgCO2/t white cement
	Gross (59cAG)	Net (71AG)	Gross – Net (59cAG – 71AG)	Gross (59cAWcm)
1990	**911**	**903**	**8**	**997**
2000	**881**	**854**	**27**	**993**
2005	**865**	**828**	**37**	**997**
2006	**863**	**823**	**43**	**947**
2007	**868**	**824**	**44**	**992**
2008	**863**	**814**	**49**	**938**
2009	**854**	**791**	**63**	**967**
2010	**856**	**785**	**71**	**1 001**
2011	**847**	**772**	**75**	**1 031**
2012	**841**	**764**	**77**	**1 103**
2013	**829**	**753**	**76**	**1 042**
2014	**829**	**749**	**80**	**1 061**
2015	**825**	**740**	**85**	**1 075**
2016	**821**	**730**	**91**	**1 071**

Comparing the gross and net values for grey clinker, the net values are always lower thanks to a certain amount of alternative fuel combustion. The difference between net and gross weighted averages is an indirect indicator of the relative importance of alternative fuel combustion in the EU28. There is a continual increase in the significance of alternative fuel consumption that is especially noted by the data changes between 1990 and 2005, between 2008 and 2010 and between 2013 and 2016.

Unfortunately no net or gross data is reported for white clinker or white cement in the public version of the GNR database (first and third quartile values were requested, and are presented further below). However, gross data was available for white cement in the public database and is presented above.

Comparing the trends in time, it can be seen that specific CO2 emissions of grey clinker production decreased by around 10% between 1990 and 2016 while the white cement specific emissions increased by around 7% over the same period.

Clearly there are different market tendencies for grey clinker and white cement that are having different effects on specific CO2 emission trends. One of the differences is that we are comparing grey "*clinker*" with white "*cement*". White cement will consist of white clinker plus any supplementary cementitious materials. Consequently it was necessary to ask the GCCA for the white clinker data.

White cement specificities

Compared to grey cement, white cement is a relatively niche market, with some 3 Mt of production (Saunders, 2014) in EU28 countries compared to 121 Mt of grey cement clinker (GNR, 2018). In fact, significant white cement production is only noted in Spain, Denmark, Portugal and Germany.

White cement can be considered as a value added product that is used when concrete with a high surface reflectivity is required. Although the production process for white cement is generally the same as that for grey cement, there are strict requirements on the iron content of raw materials (each 0.1% increase in iron oxide can reduce cement reflectivity by 2.5%). In order to minimize any potential oxidation of iron impurities, higher kiln temperatures and more rapid clinker cooling techniques tend to be used, which decrease the energy efficiency of the process and lead to higher specific CO2 emissions. This is well reflected by the higher specific thermal energy consumption required for white cement production shown below.

Table 31. Comparison of specific thermal energy consumption and gross CO2 emissions for grey clinker and white cement production (Source: GNR database)

	Thermal energy consumption - Weighted average | excluding drying of fuels		% difference for white cement versus grey clinker	59cAG - Gross CO2 emissions - Weighted average | excluding CO2 from on-site power generation - Grey clinker (kg CO2 / t clinker)		% difference for white cement versus grey clinker
	MJ/t grey clinker (25aAG)	MJ/t white cement (25 aAWK)		kg/t grey clinker (59cAG)	kg/t white cement (59cAWcm)	
1990	4,078	6,163	51.2%	911	997	9.4%
2000	3,727	6,160	65.3%	881	993	12.8%
2005	3,695	6,011	62.7%	865	997	15.2%
2006	3,686	5,665	53.7%	863	947	9.7%
2007	3,728	5,961	59.9%	868	992	14.3%
2008	3,725	5,582	49.8%	863	938	8.6%
2009	3,713	5,866	58.0%	854	967	13.2%
2010	3,714	6,084	63.8%	856	1,001	17.0%
2011	3,731	6,239	67.2%	847	1,031	21.6%
2012	3,740	6,694	79.0%	841	1,103	31.2%
2013	3,716	6,214	67.2%	829	1,042	25.6%
2014	3,704	6,363	71.8%	829	1,061	28.0%
2015	3,687	6,326	71.6%	825	1,075	30.3%
2016	3,685	6,352	72.4%	821	1,071	30.6%

The data in Table 31 show that the thermal energy requirements for white cement production are substantially higher (+50 to +75%) than those for grey clinker production. This difference has remained relatively constant during the last 30 years in Europe. However, the relative difference in gross CO2 emissions is much less significant (+8 to +30%) but still notable. These trends point towards the use of less CO2 intensive fuels that must be used in white cement production.

White cement is important for aesthetic purposes, especially in terrazzo tile facing layers, and also important due to potential indirect environmental benefits depending on how and where they are installed: for example, higher albedo (more reflective) surfaces could lower interior or exterior lighting requirements for a fixed luminance level or reduce in the urban heat island effect in warm climates.

For the aforementioned reasons, it is considered acceptable to set a separate ambition level for white cement in the EU Ecolabel criteria.

Outcomes from and after 1st AHWG meeting

Stakeholders generally agreed that a criterion on CO2 emissions was important but that the exact thresholds to set would need to be considered carefully. It was recommended to request cumulative distribution curves of the GNR data for specific CO2 emissions and that even though not available in the publicly available database, it should be possible to obtain the data for white clinker as well (net and gross emissions).

It was recommended to set CO2 limits based on net emissions rather than gross emissions because that way, the use of alternative fuels is indirectly incentivized (which is something that EU cement producers have improved in dramatically during the last decade).

It was also commented that the initially proposed best practice threshold (now termed as a threshold of environmental excellence to avoid any confusion with mandatory BAT Conclusions published in Commission Implementing Decision 2013/163/EU) of 600 kgCO2/t clinker was too ambitious, since the emissions due to decarbonisation of CaCO3 in the raw meal alone would typically amount to around 530-540 kgCO2/t clinker. JRC agreed to request the cumulative data for net emissions relating to grey and white clinkers and to adapt the thresholds according to the data distributions therein.

Further research was requested into setting specifications for alternative cements, in particular geopolymer-type cements. JRC responded by saying that although such cements are not commonly available on the market, they do not have any actual cement clinker content. The main source of carbon emissions would be associated with the embodied carbon in raw materials and activators.

Further research:

Upon request, a cumulative distribution of the gross and net CO2 emission data for grey clinker production was provided by the GCCA. The cumulative distribution curve permits the identification of different percentile values.

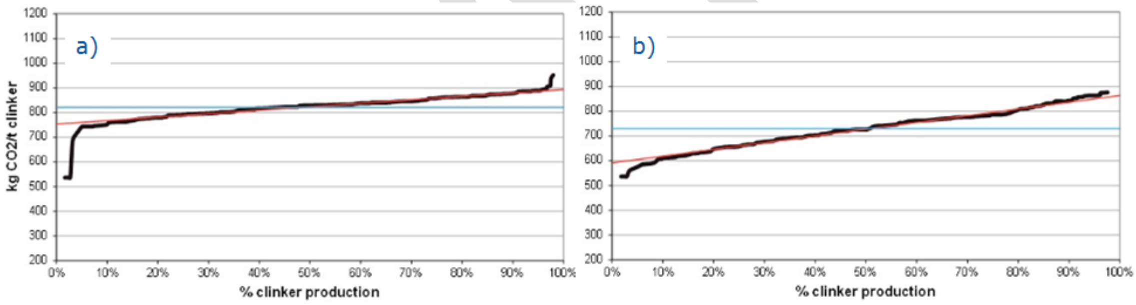


Figure 44. Cumulative distributions of a) gross and b) net CO2 emissions for grey clinker production in the EU28 in 2016 (Source GNR database).

Applying a best fit linear regression line to the data in Figure 44 (red line) allowed benchmark data to be derived. The GCCA also provided benchmark data about white clinker production, although the cumulative distribution curves were not shared. Regardless, the information provided for white clinker stated the main information needed, namely the 1st and 3rd quartile values.

Table 32. CO2 benchmarks for EU28 grey cement clinker production in 2016

	Grey cement clinker		White cement clinker	
	Gross CO2	Net CO2	Gross CO2	Net CO2
Top 25% (1st quartile)	788 kg/t	659 kg/t	1000 kg/t	835 kg/t
Weighted average ± 1 St.Dev*	821 ±104 kg/t	730 ±126 kg/t	-	-
Top 75% (3rd quartile)	858 kg/t	795 kg/t	1270 kg/t	1230 kg/t

The mandatory minimum EU Ecolabel requirement has been arbitrarily set for a value that corresponds to the 3^{rd} quartile (i.e. top 75%) and points are awarded up to a maximum in cases where CO2 emissions are equal to or lower than the 1^{st} quartile (top 25%) benchmark value. For specific net CO2 emission values in between, EU Ecolabel points would be awarded in proportion to where the lie relative to the 1^{st} and 3^{rd} quartile values.

In terms of what are appropriate generic carbon footprints to state for sodium hydroxide, sodium silicate, sodium sulphate and metakaolin it would be necessary to review the existing life cycle inventories (LCIs) of the main LCA tools that are currently available. Some initial values are included in the table below to prompt discussion.

Table 33. Carbon footprints for commonly used activators/raw materials used in alternative cements

Substance	Product category and production method	Database and impact category	Impact category and value
Sodium hydroxide	50% in H2O, mercury cell, at plant	Ecoinvent ReCiPe 1.08 Midpoint (H) - Climate change, default, excl biogenic carbon [kg CO2-Equiv.]	1.08 [kg CO2-Equiv.]
	50% in H2O, diaphragm cell, at plant		1.22 [kg CO2-Equiv.]
	from chlorine-alkali electrolysis, diaphragm	Gabi ReCiPe 1.08 Midpoint (H) - Climate change, default, excl biogenic carbon [kg CO2-Equiv.]	1.41 [kg CO2-Equiv.]
Sodium silicate	sodium silicate, furnace process, pieces, at plant	Ecoinvent ReCiPe 1.08 Midpoint (H) - Climate change, default, excl biogenic carbon	0.842 [kg CO2-Equiv.]
	sodium silicate, furnace liquor, 37% in H2O, at plant		1.1 [kg CO2-Equiv.]
	hydrothermal liquor, 48% in H2O, at plant		0.747 [kg CO2-Equiv.]
	spray powder 80%, at plant		1.59 [kg CO2-Equiv.]
Sodium sulphate	from Mannheim process, at plant	Ecoinvent ReCiPe 1.08 Midpoint (H) - Climate change, default, excl biogenic carbon	0.472 [kg CO2-Equiv.]
	from natural sources, at plant		0.132 [kg CO2-Equiv.]
Metakoalin	As described by Dumani and Mapiravana, 2018	ReCiPe 1.08 Midpoint (H) - Climate change, default, excl biogenic carbon	0.313 to 0.423 [kg CO2-Equiv.]

5.3 – Non-CO2 emissions from the cement kiln

Existing criteria: 4.5 Cement (part relevant)

4.5 Cement

The use of raw materials for cement production shall be consistent with extraction management for processed products requirements (criterion 1.2).

Those producers who use cement in the production process shall comply with the following requirements:

~~— cement included in any product shall be produced using not more than 3 800 MJ/t of process energy requirement (PER), calculated as explained in the Technical appendix — A4,~~

— the cement included in any product shall be produced respecting the following air emission limits:

Parameter	Current limit (g/t)	Test methods
Dust	65	EN 13284-1
SO2	350	EN 14791
NO_x	900	EN 14792

Assessment and verification: the applicant shall provide the relevant test reports and documentation related to the PER and the air emissions deriving from the cement production.

TR v1.0 proposed criterion 5.2: Non-CO2 emissions to air from the cement kiln

Mandatory requirement

The following non-CO_2 emissions to air from the cement kiln shall be continuously monitored and comply with relevant limits for the parameters defined below:

Parameter	Specific emission (g/t clinker*)
Dust	≤ 37
NO_x	≤ 943 or 1656**
SO_x (as SO_2)	≤ 736

** g/t clinker limits were translated from mg/Nm3 data by multiplying by a factor of 2.3 Nm3/t clinker*

*** higher limit applies to Lepol kilns, long rotary kilns or white cement production*

Assessment and verification:

The applicant shall provide a declaration of compliance with the mandatory requirements of this criterion, supported by site data in mg/Nm^3 and expressed as an annual average value calculated from daily average values. The data shall have been generated via continuous monitoring according to EN 13284-1 for dust, EN 14792 for NOx and EN 14791 for SO_2.

To convert exhaust gas monitoring results from mg/Nm^3 into g/t of clinker, it is necessary to multiply by the specific gas flow volume (Nm^3/t clinker). One Nm^3 refers to one m^3 of dry gas under standard conditions of 273K, 101.3 kPa and 10% O_2 content.

For continuously operating kilns, the production period should be 12 months. In cases where production is non-continuous, the production period shall be mentioned and should not be less than 30 days.

TR v.2.0 proposed criterion 5.3: Non-CO2 emissions from the cement kiln

Mandatory requirement

The following non-CO_2 emissions to air from the cement kiln shall be continuously monitored and comply with specific emission limits for the parameters defined below:

Parameter	Mandatory specific emission limit (indicative exhaust gas concentration)*
Dust	≤ 34.5 g/t clinker (15mg/Nm3)*
NO_x	≤ 1472 g/t clinker (640 mg/Nm3)*
SO_x (as SO_2)	≤ 460 g/t clinker (200mg/Nm3)*

** g/t clinker limits were translated from mg/Nm3 data by multiplying by a factor of 2.3 Nm3/t clinker*

EU Ecolabel points

Up to 15 points (5 points for dust emissions, 5 points for NOx emissions and 5 points for SO2 emissions) can be awarded in proportion to where the specific emissions (expressed as g/t clinker) lie between the mandatory thresholds above (0 points if equal to the mandatory limit) and the relevant thresholds for environmental excellence defined below (5 points each if equal to or less than the relevant threshold below):

Parameter	Environmental excellence threshold (indicative exhaust gas concentration)*
Dust	≤ 11.5 g/t clinker (5mg/Nm3)*
NO_x	≤ 920 g/t clinker (400 mg/Nm3)*
SO_x (as SO_2)	≤ 130 g/t clinker (50mg/Nm3)*

** g/t clinker limits were translated from mg/Nm3 data by multiplying by a factor of 2.3 Nm3/t clinker*

Assessment and verification:

The applicant shall provide a declaration of compliance with the mandatory requirements of this criterion from their cement supplier. Where a claim for EU Ecolabel points is made, site data for emissions from the cement kiln, in mg/Nm^3 and expressed as an annual average value calculated from daily average values, shall be provided by the cement supplier. The site data shall have been generated via continuous monitoring according to EN 13284-1 for dust, EN 14792 for NOx and EN 14791 for SO_2.

To convert exhaust gas monitoring results from mg/Nm^3 into g/t of clinker, it is necessary to multiply by the specific kiln gas flow volume (Nm^3/t clinker) reported by the cement producer. Typical specific gas flow volumes for cement kilns range from 1700 to 2500 Nm^3/t clinker. One Nm^3 refers to one m^3 of dry gas under standard conditions of 273K, 101.3 kPa and 10% O_2 content.

For continuously operating kilns, the production period should be 12 months. In cases where production is non-continuous, the production period shall be stated and should not be less than 30 days.

Rationale and discussion:

Existing criterion in Decision 2009/607/EC

Requirements for non-CO2 emissions to air (dust, SO2 and NOx) from cement production were set in the existing Decision for Hard Coverings. The requirements cover the same three parameters and refer to the same three standards for the measurement technique.

Due to the fact that there are no existing hard covering licenses for cement-based products, it is not possible to know if any one of the existing criteria for cement were problematic in terms of setting unrealistic ambition levels.

Feedback from industry experts identified that criterion 4.3(d) in Decision 2009/607/EC must be a mistake and should not be included. This was because there is no significant thermal process involved in dry-cast or pre-cast concrete plants and consequently no significant emissions of NOx and SOx occur. Furthermore, the choice of unit in criterion 4.3(d) is highly questionable (mg/m^2) since the thickness of concrete products will vary significantly between pavers, flags and tiles.

The requirements in existing criterion 4.5 make more sense. This is because by far the most important source of dust, NOx and SO_2 emissions is the cement kiln and not the concrete plant. The choice of unit (g/t cement produced) makes sense since it is linked directly to the productivity of the cement producing facility.

Context for setting ambition levels

Since the EU Ecolabel criteria for hard coverings was published in Commission Decision 2009/607/EC, the BAT Reference Document (BREF, 2013b) and BAT Conclusions (Decision 2013/163/EU) have been released, which set requirements for Portland cement production.

More recently, emission data has been published by CEMBUREAU in their 2017 activity report, covering more than 250 kilns. Now it is possible to put the existing numbers stated in the Decision 2009/607/EC in the context of a much broader data gathering exercise and decide whether or not the EU Ecolabel thresholds are of a suitable ambition level or not. In principle, the same logic will be applied to the ambition level for dust, NOx and SO2 emissions as has been applied to the CO2 emissions, that is to say:

- that the mandatory requirement will be to fall within the top 75% of the reporting kilns (or within 75% of the upper AEL defined in BAT Conclusions).
- that maximum points can be achieved by complying with the top 25% of reporting kilns.

In cases where it is not possible to accurately identify 3rd quartile values, the mandatory EU Ecolabel requirement will be set to align with 75% of the upper AEL defined in the BAT Conclusions.

General requirements of the BAT Conclusions for dust, NOx and SO2 emissions

Cement kilns operating in compliance with the BAT Conclusions (Decision 2013/163/EU) are required to continuously monitor emissions of dust, NOx and SOx (as SO2) from the kilns (specifically in BAT 5d). Other gas streams may be combined with kiln exhaust gas, particularly gases from milling processes, for combined dust control. Upper emission limits that must be complied with are defined in units of mg/Nm^3.

In section 1.3.4 of the BAT Reference Document it is stated that typical kiln exhaust gas volume flow rates are in the range of 1700 to 2500 Nm^3/t clinker. Consequently, it is possible to approximately convert the values stated in the BAT Conclusions in mg/Nm^3 to g/t clinker as follows:

$$Measured\ emission\ (mg.Nm^{-3})\ x\ \frac{1700\ to\ 2500\ Nm^3}{1\ tonne\ clinker} x\ \frac{1g}{1000mg} = Specific\ emission\ (g.t^{-1}\ clinker)$$

Or, to simplify:

$$Measured\ emission\ (mg.Nm^{-3})x\ 1.7\ to\ 2.5 = Specific\ emission\ (g.t^{-1}\ clinker)$$

Although it is understood that each kiln will have its own specific air flow rate (typically ranging from 1700 to 2500 Nm3/t clinker), a single conversion factor of 2.3 (i.e. 2300 Nm3/t clinker) has been used when converting the ambition levels derived from the BAT Conclusions into EU Ecolabel criteria. So the conversion operation becomes:

$$Measured\ emission\ (mg.Nm^{-3})x\ 2.3 = Specific\ emission\ (g.t^{-1}\ clinker)$$

5.3.1 – BAT for dust emissions and EU industry data

BAT 17 states the following:

"*In order to reduce dust emissions from the flue-gases of cooling and milling processes, BAT is to use dry flue-gas cleaning with a filter.*

The BAT-AEL for dust emissions from flue-gases of kiln firing processes is <10–20 mg/Nm^3, as the daily average value. When applying fabric filters or new or upgraded ESPs, the lower level is achieved."

The following applicable techniques are then described:

Technique and description	*Applicability*
*a**) Electrostatic precipitators:** Electrostatic precipitators (ESPs) generate an electrostatic field across the path of particulate matter in the air stream. The particles become negatively charged and migrate towards positively charged collection plates. The collection plates are rapped or vibrated periodically, dislodging the material so that it falls into collection hoppers below. It is important that ESP rapping cycles be optimised to minimise particulate re-entrainment and thereby minimise the potential to affect plume visibility.* *ESPs are characterised by their ability to operate under conditions of high temperatures (up to approximately 400°C) and high humidity. The major disadvantages of this technique are their decreased efficiency with an insulating layer and a build-up of material that may be generated with high chlorine and sulphur inputs. For the overall performance of ESPs, it is important to avoid CO trips.* *Even though there are no technical restrictions on the applicability of ESPs in the various processes in the cement industry, they are not often chosen for cement mill dedusting because of the investment costs and the efficiency (relatively high emissions) during start-ups and shutdowns*	*Applicable to all kiln systems*
***b) Fabric filters:** Fabric filters are efficient dust collectors. The basic principle of fabric filtration is to use a fabric membrane which is permeable to gas but which will retain the dust. Basically, the filter medium is arranged geometrically. Initially, dust is deposited both on the surface fibres and within the depth of the fabric, but as the surface layer builds up, the dust itself becomes the dominating filter medium. Off-gas can flow either from the inside of the bag outwards or vice versa. As the dust cake thickens, the resistance to gas flow increases. Periodic cleaning of the filter medium is therefore necessary to control the gas pressure drop across the filter. The fabric filter should have multiple compartments which can be individually isolated in case of bag failure and there should be sufficient of these to allow adequate performance to be maintained if a compartment is taken off line. There should be 'burst bag detectors' in each compartment to indicate the need for maintenance when this happens. Filter bags are available in a range of woven and non-woven fabrics. Modern synthetic fabrics can operate at quite high temperatures of up to 280°C.* *The performance of fabric filters is mainly influenced by different parameters, such as compatibility of the filter medium with the characteristics of the flue-gas and the dust,*	

suitable properties for thermal, physical and chemical resistance, such as hydrolysis, acid, alkali, and oxidation and process temperature. Moisture and temperature of the flue-gases have to be taken into consideration during the selection of the technique.	
c) Hybrid filters: *Hybrid filters are the combination of ESPs and fabric filters in the same device. They generally result from the conversion of existing ESPs. They allow the partial reuse of the old equipment*	

BAT 17 basically states that any cement plant that has installed fabric filters or new or upgraded electrostatic precipitators should be able to comply with the lower limit of 10 mg/Nm^3. The EU industry data reported below show the actual values being reported.

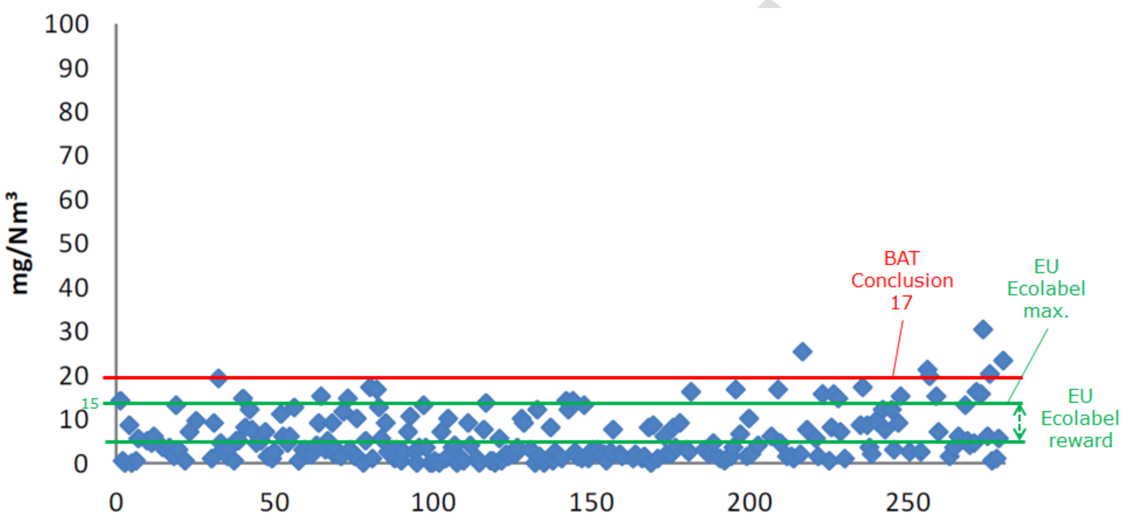


Figure 45. Comparison of EU Ecolabel and BAT ambition levels with 2015 industry data for dust emissions (Source: CEMBUREAU 2017 Activity Report).

The data in Figure 45 show that all but 5 of the 250+ cement production facilities covered (ca. 2%) exceeded the upper AEL for BAT Conclusion 17 in 2015 (20 mg/Nm^3).

With the more stringent upper limit (15 mg/Nm^3) proposed for EU Ecolabel cement criteria, an additional 28 mills (ca. 13%) would have problems meeting the limit, at least based on this data presented from 2015.

Many mills seem to be achieving near zero dust emissions. Due to the difficulty to distinguish between the points on the graph, a reasonable approach would be to set the requirements as a function of the upper BAT AEL of 20 mg/Nm^3. So this would mean the following:

- Mandatory requirement of dust emissions being ≤ 15 mg/Nm^3 (or 34.5 g/t clinker).
- Maximum points when dust emissions are ≤ 5 mg/Nm^3 (or 11.5 g/t clinker)
- Points awarded in proportion to where site specific emissions lie between 5 and 15 mg/Nm^3 (or between 11.5 and 34.5 g/t clinker).

5.3.2 – BAT for NOx emissions and EU industry data

BAT 19 states the following:

"In order to reduce the emissions of NOx from the flue-gases of kiln firing and/or preheating/precalcining processes, BAT is to use one or a combination of the following techniques:"

Technique and description	Applicability
a***) I. Flame cooling:*** *The addition of water to the fuel or directly to the flame by using different injection methods, such as injection of one fluid (liquid) or two fluids (liquid and compressed air or solids) or the use of liquid/solid wastes with a high water content reduces the temperature and increases the concentration of hydroxyl radicals. This can have a positive effect on NOx reduction in the burning zone*	*Applicable to all types of kilns used for cement manufacturing. The degree of applicability can be limited by product quality requirements and potential impacts on process stability.*
a) II. Low NOx burners: *Designs of low NOx burners (indirect firing) vary in detail but essentially the fuel and air are injected into the kiln through concentric tubes. The primary air proportion is reduced to some 6 – 10 % of that required for stoichiometric combustion (typically 10 – 15 % in traditional burners). Axial air is injected at high momentum in the outer channel. The coal may be blown through the centre pipe or the middle channel. A third channel is used for swirl air, its swirl being induced by vanes at, or behind, the outlet of the firing pipe. The net effect of this burner design is to produce very early ignition, especially of the volatile compounds in the fuel, in an oxygen-deficient atmosphere, and this will tend to reduce the formation of NOx.* *The application of low NOx burners is not always followed by a reduction of NOx emissions. The set-up of the burner has to be optimised.*	*Applicable to all rotary kilns, in the main kiln as well as in the precalciner*
a) III. Mid-kiln firing: *In long wet and long dry kilns, the creation of a reducing zone by firing lump fuel can reduce NO x emissions. As long kilns usually have no access to a temperature zone of about 900 – 1 000 °C, mid-kiln firing systems can be installed in order to be able to use waste fuels that cannot pass the main burner (for example tyres). The rate of the burning of fuels can be critical. If it is too slow, reducing conditions can occur in the burning zone, which may severely affect product quality. If it is too high, the kiln chain section can be overheated – resulting in the chains being burned out. A temperature range of less than 1 100 °C excludes the use of hazardous waste with a chlorine content of greater than 1 %.*	*Generally applicable to long rotary kilns*
a) IV. Addition of mineralisers to improve the burnability of the raw meal (mineralized clinker): *The addition of mineralisers, such as fluorine, to the raw material is a technique to adjust the clinker quality and allow the sintering zone temperature to be reduced. By reducing/lowering the burning temperature, NOx formation is also reduced.*	*Generally applicable to rotary kilns subject to final product quality requirements*
a) V. Process optimisation: *Optimisation of the process, such as smoothing and optimising the kiln operation and firing conditions, optimising the kiln operation control and/or homogenisation of the fuel feedings, can be applied for reducing NOx emissions. General primary optimisation measures/techniques, such as process control measures/techniques, an improved indirect firing technique, optimised cooler connections and fuel selection, and optimised oxygen levels have been applied.*	*Generally applicable to all kilns*
b) Staged combustion (conventional or waste fuels), also in combination with a precalciner and the use of optimized fuel mix: *Staged combustion is applied at cement kilns with an especially designed precalciner. The first combustion stage takes place in the rotary kiln under optimum conditions for the clinker burning process. The second combustion stage is a burner at the kiln inlet, which produces a reducing atmosphere that decomposes a portion of the nitrogen oxides generated in the sintering zone. The high temperature in this zone is particularly favourable for the reaction which reconverts the NOx to elementary nitrogen. In the third combustion stage, the calcining fuel is fed into the calciner with an amount of tertiary air, producing a reducing atmosphere there, too. This system reduces the generation of NOx from the fuel, and also decreases the NOx coming out of the kiln. In the fourth and final combustion stage, the remaining tertiary air is fed into the system as 'top air' for residual combustion*	*In general, can only be applied in kilns equipped with a precalciner. Substantial plant modifications are necessary in cyclone preheater systems without a precalciner. In kilns without precalciner, lump fuels firing might have a positive effect on NOx reduction depending on the ability to produce a controlled reduction atmosphere and to control the related CO*

	emissions
c) Selective non-catalytic reduction (SNCR): *Selective non-catalytic reduction (SNCR) involves injecting ammonia water (up to 25 % NH3), ammonia precursor compounds or urea solution into the combustion gas to reduce NO to N2. The reaction has an optimum effect in a temperature window of about 830 to 1050 °C, and sufficient retention time must be provided for the injected agents to react with NO.*	*In principle, applicable to rotary cement kilns. The injection zones vary with the type of kiln process. In long wet and long dry process kilns it may be difficult to obtain the right temperature and retention time needed. See also BAT 20*
d) Selective catalytic reduction (SCR): *SCR reduces NO and NO2 to N2 with the help of NH3 and a catalyst at a temperature range of about 300 – 400 °C. This technique is widely used for NOx abatement in other industries (coal fired power stations, waste incinerators). In the cement industry, basically two systems are considered: low dust configuration between a dedusting unit and stack, and a high dust configuration between a preheater and a dedusting unit. Low dust flue-gas systems require the reheating of the flue-gases after dedusting, which may cause additional energy costs and pressure losses. High dust systems are considered preferable for technical and economical reasons. These systems do not require reheating, because the waste gas temperature at the outlet of the preheater system is usually in the right temperature range for SCR operation.*	*Applicability is subject to appropriate catalyst and process development in the cement industry*

Considering the range of primary techniques (i.e. reduce the formation of NOx in the first place) and secondary techniques (i.e. remove NOx from the exhaust gas), Table 2 of BAT 19 sets the following limits for NOx emissions:

- <200 to 450 mg/Nm^3 for preheater kilns (daily average values)[2,3]
- 400 to 800 mg/Nm^3 for lepol and long rotary kilns (daily average values)[4]

Apart from the primary and secondary NOx reduction techniques mentioned above in the BAT Conclusions, other factors such as the maximum kiln temperature needed (higher for white cement) and the N content of the fuel(s) used will affect NOx emissions. The EU industry data reported below show the actual values being reported in 2015.

[2] The upper level of the BAT-AEL range is 500 mg/Nm3, if the initial NOx level after primary techniques is > 1 000 mg/Nm3.

[3] Existing kiln system design, fuel mix properties including waste and raw material burnability (e.g. special cement or white cement clinker) can influence the ability to be within the range. Levels below 350 mg/Nm3 are achieved at kilns with favourable conditions when using SNCR. In 2008, the lower value of 200 mg/Nm3 has been reported as a monthly average for three plants (easy burning mix used) using SNCR.

[4] Depending on initial levels and NH3 slip.

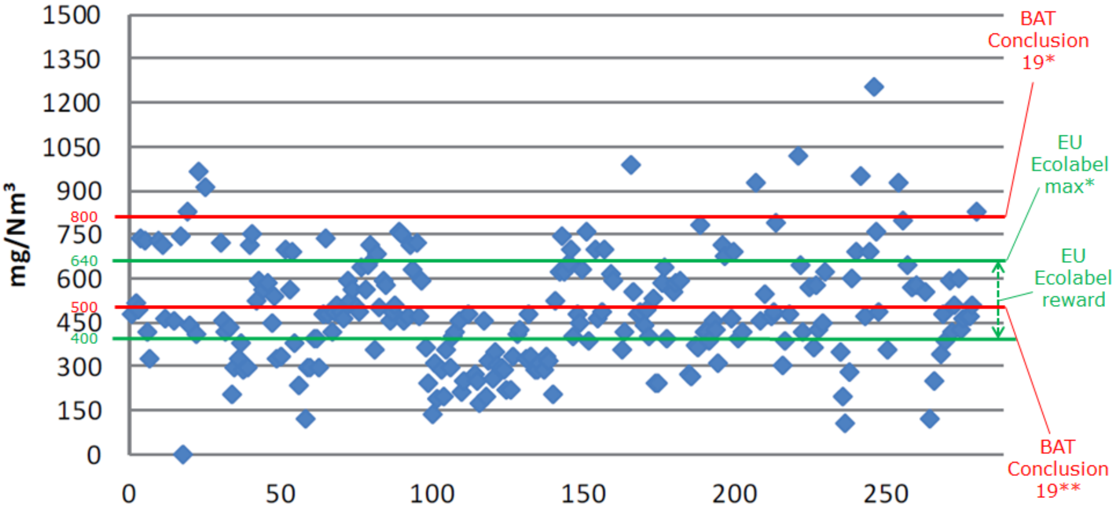


Figure 46. Comparison of EU Ecolabel and BAT ambition levels with 2015 industry data for NOx emissions (*denotes BAT upper limits for Lepol kilns and long kilns, **denotes upper limits for all other kilns and normal cements).

The data for the NOx emissions is more complicated because the BAT Conclusions set two upper AELs, with a higher limit allowed for Lepol kilns and long rotary kilns (800 mg/Nm^3) and another limit for all other kilns (450-500 mg/Nm^3). The data presented in Figure 46 unfortunately does not identify which points correspond to Lepol and long dry kilns, to those producing white cement or those burning alternative fuels with a notable N content.

Consequently, it was decided to set the EU Ecolabel ambition level by treating the data in Figure 46 as a single data set. Approximately 42 of the kilns (ca. 17%) would not meet the proposed mandatory EU Ecolabel limit of 640 mg/Nm3. An environmental excellence limit of 400 mg/Nm3 is proposed to distinguish kilns that have made particular efforts to reduce NOx emissions. Any kiln that has emissions equal to or below 400 mg/Nm3 would therefore achieve maximum points. According to the data in Figure 46, approximately 64 of the kilns (ca. 26%) would be able to meet this definition of environmental excellence with regards to NOx emissions. Any plants with NOx emission data lying within the range of 400 to 640 mg/Nm3 would receive EU Ecolabel points in proportion to where the lie within that range.

5.3.3 – BAT for SOx emissions and EU industry data

BAT 21 states the following:

"In order to reduce/minimise the emissions of SOx from the flue-gases of kiln firing and/or preheating/precalcining processes, BAT is to use one of the following techniques:"

Technique and description	***Applicability***
*a**) Absorbent addition:*** *Absorbent is either added to the raw materials (e.g. hydrated lime addition) or injected into the gas stream (e.g. hydrated or slaked lime (Ca(OH)2), quicklime (CaO), activated fly ash with a high CaO content or sodium bicarbonate (NaHCO3)).* *Hydrated lime can be charged into the raw mill together with the raw material constituents or directly added to the kiln feed. The addition of hydrated lime*	*Absorbent addition is, in principle, applicable to all kiln systems, although it is mostly used in suspension preheaters. Lime addition to the kiln feed reduces the*

offers the advantage that the calcium-bearing additive forms reaction products that can be directly incorporated into the clinker-burning process. *Absorbent injection into the gas stream can be applied in a dry or wet form (semi- dry scrubbing). The absorbent is injected into the flue-gas path at temperatures close to the water dew point, which results in more favourable conditions for SO2 capture. In cement kiln systems, this temperature range is usually reached in the area between the raw mill and the dust collector*	*quality of the granules/ nodules and causes flow problems in Lepol kilns. For preheater kilns it has been found that direct injection of slaked lime into the flue-gas is less efficient than adding slaked lime to the kiln feed*
b) Wet scrubber: *The wet scrubber is the most commonly used technique for flue-gas desulphurisation in coal-fired power plants. For cement manufacturing processes, the wet process for reducing SO2 emissions is an established technique. Wet scrubbing is based on the following chemical reaction:* *SO2 + ½ O2 + 2 H2O + CaCO3 ←→ CaSO4.2H2O + CO2* *SOx are absorbed by a liquid/slurry which is sprayed in a spray tower. The absorbent is generally calcium carbonate. Wet scrubbing systems provide the highest removal efficiencies for soluble acid gases of all flue-gas desulphurisation (FGD) methods with the lowest excess stoichiometric factors and the lowest solid waste production rate. The technique requires certain amounts of water with a consequent need for waste water treatment*	*Applicable to all cement kiln types with appropriate (sufficient) SO2 levels for manufacturing the gypsum*

BAT 21 sets the following BET AEL range:

- <50 to 400 mg/Nm3 (daily average values expressed as SO2).

CEMBUREAU data for SO2 emissions in 2015

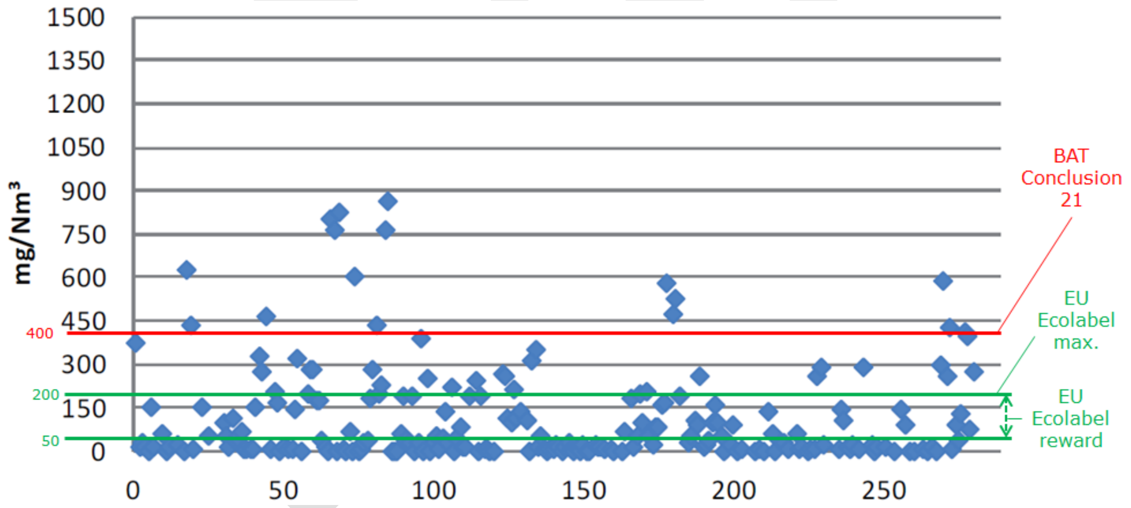


Figure 47. Comparison of EU Ecolabel and BAT ambition levels with 2015 industry data for SO2 emissions.

The data in Figure 47 show that all but 15 of the 250+ kilns covered (ca. 6%) exceeded the upper AEL for BAT Conclusion 21 in 2015 (400 mg/Nm^3). If the mandatory EU Ecolabel limit for SO2 emissions was lowered to 75% of the upper AEL (i.e. to 300 mg/Nm3), an additional 5 mills (ca. 2%) would be cut off, at least based on this data presented from 2015.

In order to better align the mandatory EU Ecolabel limit with the 3rd quartile performance for SO2 emissions, it is now proposed to lower the limit for SO2 to 200 mg/Nm3, which would cut off approximately 50 of the 250+ kilns (i.e. 20%).

Looking at the data, it is clear that there are many mills able to achieve very low SO2 emissions, which will most likely be due to the use of very low sulphur content fuels. Consequently the environmental excellence threshold, where maximum points can be attained, is set at 50 mg/Nm3. Due to the scale of the graph and the size of the data points, it is difficult to see how many kilns fall below 50 mg/Nm3 but it is estimated that at least 25% of the kilns could meet this level.

While these kilns should be rewarded, it is worth mentioning that kilns with notable sulphur emissions may also have some merit of their own. In cases where sulphur emissions are due to burning of certain alternative fuels, sulphur emissions are simply transferred from either the landfill (where they would arise as sulphides) or waste incinerators (where an inorganic air pollution control residue would be produced that requires disposal). Incinerating such waste in a cement kiln effectively prevents ash generation because any mineral content is incorporated into the clinker or into flue gas desulphurization residue, which can be used as a partial gypsum substitute in cement blending at the same site where it is produced.

<u>General comments regarding non-CO2 emissions for cement production</u>

The proposal in TR 2.0 is based on the same emissions that criteria were set for in Decision 2009/607/EC and is based on the units (g/t). For clarity it is stated that we are talking about tonnes of clinker and not tonnes of cement. Because the ambition level is based on reported data in units of mg/Nm3, the criteria mention both the requirement (in g/t) and how that number was arrived at by conversion from mg/Nm3. The A summary of how the proposals have evolved (in this proposal, in the TR v1.0 proposal and in Decision 2009/607/EC), see the table below.

Table 34. Comparison of existing and proposed mandatory limits for dust, NOx and SO2 emissions from cement production.

	Dust	NOx	SO2
Decision 2009/607/EC	**65 g/t**	**900 g/t**	**350 g/t**
TR v1.0	**37 g/t*** *(16 mg/Nm3)*	**943 or** 1656 g/t*** *(400 or 720 mg/Nm3)*	**736 g/t*** *(320 mg/Nm3)*
	-43% compared to 2009	+4.8% or +84%	+110% compared to 2009
TR v2.0	**34.5 g/t*** *(15 mg/Nm3)*	**1472 g/t*** *(640 mg/Nm3)*	**460 g/t*** *(200 mg/Nm3)*
	-47% compared to 2009 -6.7% compared to TR1.0	+63.5% compared to 2009 -6.7% compared to TR1.0	+31.4% compared to 2009 -37.5% compared to TR1.0

* g/t calculated by multiplying limits in mg/Nm3 by a factor of 2.3.
** Higher limits applicable to Lepol kilns, long dry kilns and white cement production.

Any strict comparison with the limits set out in Decision 2009/607/EC should be treated with caution since it was not explicitly stated in that Decision whether or not the g/t related to tonnes of cement product (i.e. clinker plus any blended supplementary cementitious materials) or simply as tonnes of cement clinker. If considered as tonnes of cement, the ambition level of Decision 2009/607/EC could potentially be much lower than is assumed in the table above if the units were meant to be g/t cement (it would depend on the clinker factor).

The emissions of dust, NO2/NOx and SOx/SO2 need to be continuously monitored by European producers and reported to competent authorities as per operating permits in accordance with the IED. However, it is not certain whether or not cement producers are willing to provide average data to customers or EU Ecolabel competent authorities on a voluntary basis. For this reason, the mandatory requirement is simply a declaration saying whether or not the average emissions are below the defined limits or not. The mandatory limit for the EU Ecolabel is consistently more ambitious than mandatory legal limit (i.e. the upper AELs defined in Decision 2013/163/EU). In cases where EU Ecolabel points are to be awarded, it will be necessary for the cement supplier to declare the average emissions to either the EU Ecolabel applicant or to the competent authority assessing the EU Ecolabel application and be willing to provide supporting documentation upon request.

Points for discussion about non-CO2 emissions to air from the cement kiln
Is information on dust, NOx and SO2 emissions readily communicated by cement companies to their customers? (Data must be reported to competent authorities under BREF operating permits). Can white cement producers in Europe meet the mandatory limit of 640 mg/Nm3 of NOx (or 1472 g/t white cement clinker)? Or would some sort of derogation be needed?

5.4 – Concrete recovery and responsible sourcing of raw materials

Existing criterion:
No existing criterion
TR v1.0 proposed criterion 5.5: Recycled and secondary materials at the concrete plant
Mandatory requirements The applicant shall assess and document the regional availability of recycled or secondary aggregates, including fillers. The applicant shall have procedures in place for the recovery of aggregates from batches of returned or rejected concrete batches. **EU Ecolabel points** Points shall be awarded for applicants that can demonstrate the incorporation of recycled/secondary materials into the concrete product up to 50% w/w content (Up to 25 points). The incorporation of returned or rejected concrete into new concrete shall not be considered as recycled content if it is going back into the same process that generated it. ***Assessment and verification:*** *The applicant shall provide a declaration of compliance with the mandatory requirements of the criteria, supported by a copy of their company policy for the identification of potential sources of secondary or recycled materials for use as aggregates, fillers or supplementary cementitious materials.* *An inventory of all sold or stored concrete production, existing raw materials in stock and raw material deliveries to the concrete plant shall be provided, supported by production reports and delivery invoices for a defined production period.* *In cases of concrete plants that only produce one type of concrete product and to only one specification, the results should be averaged across the entire production. Where the EU Ecolabel concrete products are produced in specific batches, any secondary or recycled materials should be allocated according to batch mix compositions used.* *Points shall be awarded in proportion to how closely the data reaches the maximum benchmark set (e.g. recycled/secondary material content of 0% = 0 points and 50% = 25 points).*
TR v2.0 proposed criterion 5.4: Concrete recovery and responsible sourcing of raw materials
Mandatory requirements The applicant shall have procedures in place for any batches of returned or rejected concrete in which all returned/rejected material is either: - Recycled directly into new concrete batches which are cast prior to the returned/rejected concrete hardening; - Recycled as aggregate in new batches after returned/rejected concrete hardening: - Recycled offsite either prior to or after hardening as part of a contractual arrangement with a third party. **EU Ecolabel points** Points shall be awarded for applicants that can demonstrate the incorporation of recycled/secondary materials into the EU Ecolabel concrete product up to 30% w/w content (Up to 15 points). Points shall be awarded for the proportion of aggregates (up to 5 points) and of cement (up to 5 points) used at the concrete production facility that is certified as responsibly sourced by an appropriate third party certification scheme.

Assessment and verification:

Compliance with the mandatory aspects of this criterion can be demonstrated via a silver, gold or platinum certificate awarded by the Concrete Sustainability Council (CSC) to the concrete producer in accordance with version 2.0 of the CSC technical manual. Alternatively the applicant shall provide a declaration of compliance with the mandatory requirements of the criteria, supported by a copy of their company policy for the handling of returned or rejected concrete and, where relevant, any third party agreements relating to the recovery of returned/rejected concrete.

For the award of EU Ecolabel points relating to secondary and/or recycled aggregate content, the applicant shall provide an inventory of raw material inputs (cement, aggregates, filler, supplementary cementitious materials and water) and concrete production output at the facility level, supported by delivery invoices and production reports. Inputs of aggregates shall be highlighted and identified as being from either virgin (CSC certified and non-certified), secondary or recycled material streams. If data is represented in volume (e.g. m3) instead of weight, it should be converted to weight by multiplying by an appropriate density factor (e.g. kg/m3).

The incorporation of returned or rejected concrete into new concrete shall not be considered as recycled content if it is going back into the same process that generated it.

From the facility level data, the applicant shall quantify how much concrete production is to be subject to the EU Ecolabel and the estimated allocation of virgin, secondary and recycled aggregates to that same concrete production. The % content of secondary/recycled aggregates for the EU Ecolabel concrete shall be calculated as:

$$= \frac{SA\,(kg) + RA\,(kg)}{VA\,(kg) + SA\,(kg) + RA\,(kg)}$$

Where: SA = Secondary Aggregate; RA = Recycled Aggregate and VA = Virgin Aggregate

Points shall be awarded in proportion to how closely the data reaches the maximum benchmark set (e.g. recycled/secondary material content of 0% = 0 points and ≥30% = 15 points).

For the award of EU Ecolabel points relating to responsible sourcing of virgin aggregates and/or cement, the applicant shall provide an inventory of raw material inputs for a 12 month period, highlighting the incoming virgin aggregate and cement materials that are certified as bronze, silver, gold or platinum according to the CSC or equivalent certification systems. Points shall be awarded in proportion to the % of total cement and the % of total virgin aggregates that are certified as responsibly sourced (e.g. 80% of cement being CSC certified = 4 points, 30% of virgin aggregates being CSC certified = 1.5 points).

Rationale:

The mandatory requirements are largely inspired by criterion E7.04 (Responsible processing of returned concrete) set out in version 2.0 of the Concrete Sustainability Council's (CSCs) technical manual. These mandatory requirements for the EU Ecolabel are prerequisites for any concrete producer that wishes to obtain the silver, gold or platinum CSC certification.

Compliance with these mandatory EU Ecolabel requirements can nonetheless be met independently of CSC certification, and for this reason the underlying requirements are also stated in the assessment and verification text.

What is meant exactly by "recycled aggregate"?

The ISO 14021 definition of the term "recycled content" and related terms are as follows:

- **Recycled content**: Proportion, by mass, of recycled material in a product or packaging. Only pre-consumer and post-consumer materials shall be considered as recycled content, consistent with the following usage of terms.
- **Pre-consumer material**: Material diverted from the waste stream during a manufacturing process. Excluded is reutilization of materials such as rework, regrind or scrap generated in a process and capable of being reclaimed within the same process that generated it.
- **Post-consumer material**: Material generated by households or by commercial, industrial and institutional facilities in their role as end-users of the product which can no longer be used for its intended purpose. This includes returns of material from the distribution chain.
- **Recycled material**: Material that has been reprocessed from recovered [reclaimed] material by means of a manufacturing process and made into a final product or into a component for incorporation into a product.
- **Recovered [reclaimed] material**: Material that would have otherwise been disposed of as waste or used for energy recovery, but has instead been collected and recovered [reclaimed] as a material input, in lieu of new primary material, for a recycling or a manufacturing process.

So unless the concrete has previously been transferred to other actors (and thus other processes or activities) in the distribution chain, it cannot be considered as recycled content when it comes back to the concrete factory. In the case of fresh concrete returns, if it were to be reincorporated directly back into the concrete mix, it should not be considered as recycled content. However, if the concrete was hardened and then crushed into aggregate before going into any new concrete mix, it could be argued that it is recovered material or recycled material, depending on which actors in the supply chain it is handled by.

What is meant by "secondary material"?

The ISO 14021 definition for recycled content and recycled material does seem to cover materials such as blast furnace slag, silica fume and coal fly ash. However, it is possible that they may be considered as industrial by-products rather than waste, which would complicate their recognition as recycled materials.

Consequently, the term "*secondary material*" has also been used in order to avoid any confusion about whether these commonly used materials should be counted as contributing to points in the EU Ecolabel criteria. Potential confusion may stem from Article 5 of the Waste Framework Directive (2008/98/EC) when a "*waste*" is no longer considered as a waste but instead as a "*by-product*" when:

- Further use of the substance or object is certain;
- The substance or object can be used directly without any further processing other than normal industrial practice;
- The substance or object is produced as an integral part of a production process; and
- Further use is lawful, i.e. the substance or object fulfils all relevant product, environmental and health protection requirements for the specific use and will not lead to overall adverse environmental or human health impacts.

Considering recycled and secondary aggregates from an LCA and LCC perspective

When assessing the environmental impacts of concrete production from an LCA perspective, aggregates are a relatively minor contribution to most impacts. It has also been argued that the normal abiotic depletion LCA impact category is not suitable for considering the impacts of aggregate use because, when global resources are considered, the impact is negligible because sand and gravel reserves are vast.

Furthermore, due to the high bulk mass and low value, transport costs for aggregates are highly significant (truck haul for 30 miles can double the cost of the aggregate to the end user (Robinson and Brown, (2002)) and aggregates do not tend to travel far unless rail or barge transport links are convenient. Consequently, it would be much more relevant to consider abiotic depletion potential at the regional level (Habert et al., 2010), where the impacts would undoubtedly be far more significant.

The benefits of using recycled aggregates are significant when considering the consequential impacts of reduced land use (via avoided landfill and reduced quarrying) (Blengini and Garbarino, 2010) and potentially reduced transport emissions. Another important aspect is that, especially in developed areas, recycled aggregates tend to be available in the local environments where construction activities are taking place and may even be reincorporated into the same project where demolition activity precedes new construction on the same site.

In cases where recycled aggregates are available, but require longer transport distances than natural aggregates, there is a trade-off in environmental impacts. Blengini and Garbarino (2010) estimated that the use of recycled aggregates (when compared to natural aggregates) can remain environmentally beneficial up until the point when the transport distance for recycled aggregates becomes 2-3 times longer than for natural aggregates.

EU policy promoting recycled content and secondary aggregates and fillers

Two of the main types of recycled aggregate relevant to concrete production are recycled concrete aggregate (RCA) and crushed brick waste, which is produced by processing waste concrete from construction and demolition waste (CDW). As one of the most voluminous waste streams in the EU, accounting for some 25-30% of all EU waste, the Waste Framework Directive (WFD) has identified the recycling of CDW as a priority area. Specifically under Article 11(2) of the WFD, Member States are required to achieve a minimum of 70% of non-hazardous CDW recycling by 2020.

Although backfilling is permitted to count towards the 70% target, higher value recycling applications possible, such as use in non-structural or structural concrete. Data reported back in 2011 revealed that there was considerable scope to improve the handling of CDW by moving away from backfilling and towards recycling.

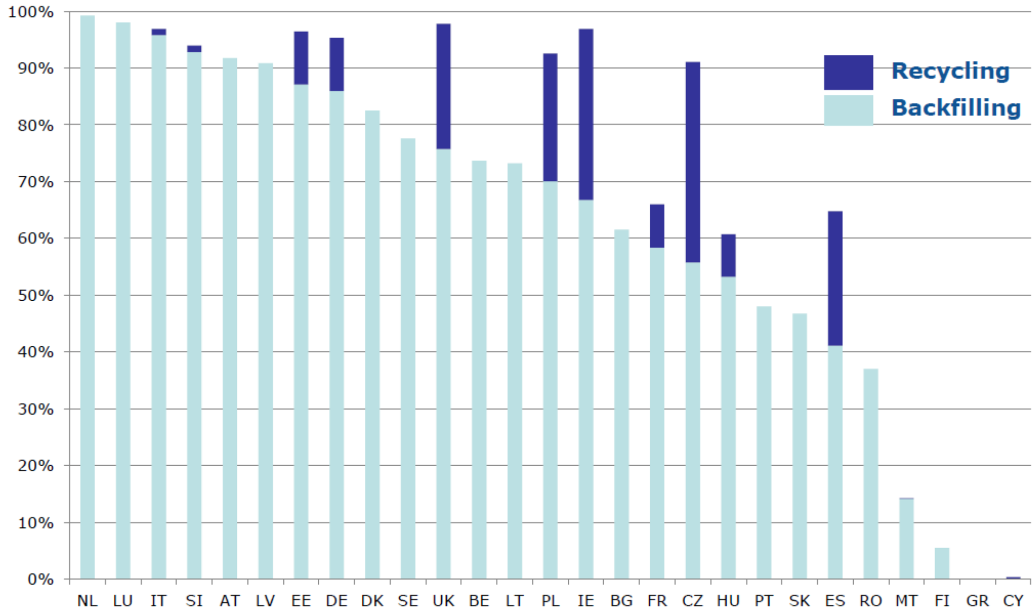


Figure 48. CDW backfilling and recycling in 2011 (Source: DG ENV).

Based on the data above, it is clear that only a handful of Member States were implementing CDW recycling in 2011. The leading Member States in CDW were clearly IE, the UK, the CZ, ES and PO. The Commission has since published an EU CDW protocol (EC, 2016) and guidelines (EC, 2018) to encourage better uptake of CDW recycling and increase awareness of higher value reuse and recycling opportunities compared to simple backfilling.

There is no harmonised approach to the regulation of CDW in Member States, which in turn leads to a wide range in performance. It is generally understood that CDW does not travel far, since the materials are generally of low bulk value. Selective demolition of gypsum plasterboard is one sensible approach due to the higher added value of gypsum and the fact that the sulphate present in gypsum is undesirable in any waste that would be sent to landfill (possible anaerobic biodegradation to sulphide gases) or in recycled aggregates used in concrete (as it could adversely affect the Portland cement hydration chemistry).

A large volume of research has been published regarding the use of recycled aggregates in concrete products. Structural engineers are reluctant to use recycled aggregates in structural concrete due to concerns about consistency of technical properties, especially the fact that recycled aggregates tend to be weaker than natural ones and that they will show a higher, and more variable water absorption. Poon et al., (2002) explained that any concerns about recycled aggregate in structural concrete do not extend to mechanically moulded concrete bricks and blocks. The authors demonstrated that up to 100% of the natural aggregate could be replaced by recycled aggregate of a suitable size distribution with only a minor decrease in compressive strength, a minor reduction in density, a minor increase in drying shrinkage and a notable increase in skid resistance. With both masonry unit bricks and paving blocks, the same authors showed that a 50% replacement of natural aggregates by recycled aggregates improved all physical properties.

Outcomes from and after 1st AHWG meeting

During the stakeholder meeting, caution was urged about promoting secondary and recycled aggregate contents too much in TR v1.0. Such bias could potentially lead to perverse outcomes in cases where recycled or secondary aggregates from significantly more remote sources are favored over more local virgin aggregates.

The limitations of high recycled/secondary aggregate content in reinforced and structural concrete were emphasized by industry stakeholders. However, the JRC pointed out that structural concrete products do not fall within the scope of the EU Ecolabel for hard coverings and that concerns with precast concrete products should be less significant.

One proposal received in subsequent written feedback was to re-title the criterion as "*responsible sourcing*" of aggregates and to include some recognition of responsibly sourced virgin aggregates, which was not promoted in the TR v.1.0 proposal. JRC agreed in principle to investigate this option.

Further research:

Following up from the feedback received, the latest version of the CSC Technical Manual (v.2.0) was consulted in order to identify possible synergies between CSC certification and the EU Ecolabel and to better understand how responsible sourcing might be recognized.

In terms of responsible sourcing, the CSC criteria are now recognized by several Green Building Assessment schemes. BREEAM recognizes bronze, silver and gold certification under its "Mat 03" indicator for responsible sourcing.

Table 1: BREEAM recognised RSCS, EMS and their associated summary scores levels

RSCS/EMS Scheme (or other recognised source)	Label(s)/Version(s) of the scheme	Additional requirement to be specified[4]	RSCS summary score level for use in BREEAM assessments
BES 6001 Framework Standard for Responsible Sourcing	All	n/a	5 (Baseline score[3])
CARES Sustainable Constructional Steel Scheme	All	n/a	5
Concrete Sustainability Council (CSC)	Certified concrete (bronze, silver, gold and platinum levels)	n/a	5
Eco Reinforcement Responsible Sourcing Standard, Steel Products for the Reinforcement of Concrete	All	n/a	5
FSC	'FSC 100%'	n/a	7
	'FSC Mix' 'FSC Recycled'	n/a	5
PEFC	'PEFC Certified' 'PEFC Recycled'	n/a	5
SFI	'SFI Certified Chain of Custody, Promoting Sustainable Forestry'	Certified forest content = 100% of total	6
	'SFI Certified Chain of Custody, Promoting Sustainable Forestry'	Recycled timber/fibre content = 0% of total	5
Construction products/materials reused in-situ or within the same construction site, with only minor processing that does not alter the nature of the construction product/material (e.g. cleaning, cutting, fixing to other construction products).	n/a	n/a	10
Environmental Management Systems (EMS) (certified)	Key Process[1] and supply chain[2] extraction process. See Table 2 below.	n/a	2
	Key Process[1]. See Table 2 below.	n/a	1

Figure 49. Recognition of CSC certification by BREEAM (snapshot from BREEAM guidance note GN18, v3.1).

It can be seen that BREEAM recognizes the CSC certification for concrete on a similar level as it does for FSC and PEFC with wood.

The CSC is also currently recognized by the DGNB scheme based in Germany, specifically under criterion ENV 1.3 (sustainable resource extraction) and in the US, the CSC has been recognized by the infrastructure certification system, Envision (specifically under credit RA 1.2 "sustainable procurement practices").

Although the total number of points associated with this criterion has been maintained (25 points), it has now been split into 15 points for recycled content and 10 points for responsibly sourced raw materials instead of being entirely for recycled and secondary materials. The optional requirements for EU Ecolabel points relating to responsibly sourced materials (cement and aggregates) have been proposed in such a way as to align with the responsible sourcing initiative of the CSC.

5.5 – Concrete plant energy management

Existing criterion: 4.1 (a) Process energy requirement (PER) limit

The process energy requirement (PER) for agglomerated stones and terrazzo tiles manufacturing processes shall not exceed the following levels:

	Requirement (MJ/kg)	Test method
~~Agglomerated stones~~	~~1,6~~	~~Appendix A4~~
Terrazzo tiles	1,3	Appendix A14

Note: all the requirements are expressed in MJ per kg of final product ready to be sold. This criterion does not apply to concrete paving units.

Assessment and verification: the applicant shall calculate the PER according to the Technical appendix — A4 instructions and provide the related results and supporting documentation.

A4 Energy consumption calculation (PER, ~~ERF~~)

When providing a calculation of process energy requirement (PER) or energy requirement for firing (ERF), the correct energy carriers shall be taken into account for the entire plant or for the firing stage only. Gross calorific values (high heat value) of fuels shall be used to convert energy units to MJ (Table A1). In case of use of other fuels, the calorific value used for the calculation shall be mentioned. Electricity means net imported electricity coming from the grid and internal generation of electricity measured as electric power.

~~*Evaluation of PER for agglomerated stone production shall consider all energy flows entering the production plant both as fuels and electricity.*~~

Evaluation of PER for terrazzo tiles production must consider all energy flows entering the production plant both as fuels and electricity.

~~*Evaluation of ERF for ceramic tile production shall consider all energy flows entering all the kilns as fuels for the firing stage.*~~

~~*Evaluation of ERF for clay tile production shall consider all energy flows entering all the kilns as fuels for the firing stage.*~~

~~*Evaluation of PER for cement production shall consider all energy flows entering the production system both as fuels and electricity.*~~

Table A1

Table for calculation of PER or ERF (see text for explanations)

Production period	*Days*	*From*	*To*	
Production (kg)				
Fuel	*Quantity*	*Units*	*Conversion factor*	*Energy (MJ)*
Natural gas		*kg*	*54,1*	
Natural gas		*Nm^3*	*38,8*	
Butane		*kg*	*49,3*	
Kerosene		*kg*	*46,5*	
Gasoline		*kg*	*52,7*	
Diesel		*kg*	*44,6*	
Gas oil		*kg*	*45,2*	
Heavy fuel oil		*kg*	*42,7*	
Dry steam coal		*kg*	*30,6*	
Anthracite		*kg*	*29,7*	
Charcoal		*kg*	*33,7*	
Industrial coke		*kg*	*27,9*	
Electricity (from net)		*kg*	*3,6*	
			Total energy	
Specific energy consumption (MJ/kg of product)				

TR v1.0 proposed criterion 5.6: Concrete plant energy management

Mandatory requirements

The applicant shall assess and document the electricity consumption (kWh) and fuel consumption (L diesel, m3 natural gas etc.) of the concrete process plant equipment (including forklifts and trucks used for onsite transport) for the full calendar year or rolling 12 period.

The total concrete production during the same 12 month period shall be expressed in terms of m^3.

Both the specific electricity consumption (MJ/m^3 concrete) and specific fuel consumption (MJ/m^3 concrete) shall be reported. Conversion of kWh to MJ shall be carried out by multiplying the kWh value by 3.6 MJ/kWh.

EU Ecolabel points

Points shall be awarded to applicants that have installed onsite CHP units that can meet up to a maximum of 50% of the process electricity (up to 10 points).

Points shall be awarded to applicants that can demonstrate that the electricity used in the concrete plant is from renewable sources up to a maximum of 90% (up to 15 points).

Assessment and verification:

The applicant shall provide a declaration of compliance with the mandatory requirements of the criterion, supported by calculations of electricity and fuel consumption, as well as production capacity during the same 12 month period.

Points shall be awarded in proportion to how closely the data reaches the maximum benchmark set (e.g. CHP electricity 0% of process electricity = 0 points; CHP electricity 50% of process electricity = 10 points; renewable energy share of 0% = 0 points; renewable energy share of 90% = 15 points).

TR v2.0 proposed criterion 5.5: Concrete plant energy management

Mandatory requirements

The applicant shall assess and document the electricity consumption (kWh) and fuel consumption (MJ) of the concrete process plant equipment (including forklifts and trucks used for onsite transport) for the full calendar year or a rolling 12 month period.

The total concrete production during the same 12 month period shall be expressed in terms of m^3.

Both the specific electricity consumption (kWh/m^3 concrete) and specific fuel consumption (MJ/m^3 concrete) shall be reported. Conversion of kWh to MJ shall be carried out by multiplying the kWh value by 3.6 MJ/kWh.

EU Ecolabel points

Points shall be awarded to applicants that can demonstrate that the energy (fuel + electricity) used in the concrete plant is from renewable sources up to a maximum of 100% (up to 25 points).

Assessment and verification:

The applicant shall provide a declaration of compliance with the mandatory requirements of the criterion, supported by calculations of electricity and fuel consumption, as well as production volume during the same 12 month period.

For electricity consumption, the applicant shall declare if any electricity is generated onsite and any relevant share of renewables that applies. The applicant shall also provide documentation from the grid electricity supplier that *describes the average energy mix involved with the grid electricity supplied.*

For fuel consumption, the applicant shall provide a breakdown of the different fuels used on the site, estimating the quantities consumed (e.g. L diesel, m^3 natural gas, kg biomass) in the 12 month period and convert them into MJ by multiplying by the default net calorific values provided in Annex VI of Regulation (EU) 601/2012 or using specific net calorific values provided by fuel suppliers. Any fuels which are renewable or have a % renewable content shall be highlighted in the list and accounted for in the renewable energy calculation.

Points shall be awarded in proportion to how closely the energy data (i.e. fuel + electricity) reaches the maximum benchmark set (e.g. renewable energy share of 0% = 0 points; renewable energy share of 100% = 25 points).

Rationale:

<u>Why focus on energy consumption at the concrete plant?</u>

Although the energy footprint of concrete is dominated by cement manufacture, it is necessary that the EU Ecolabel criteria focus on some aspects that can be directly controlled by the potential EU Ecolabel applicant, i.e. the pre-cast or dry-cast concrete producer.

The type of information would fit well with any environmental management system which the applicant may have implemented and which could obtain points under the optional criterion 1.1.

<u>Why promote higher renewable energy?</u>

The Renewable Energy Directive has recently been recast and sets a target of an average renewable energy share of 27% by 2030. A criterion on renewable energy is appropriate since the applicant has a much better control over their fuel choice and especially their electricity supply.

Outcomes from and after 1st AHWG meeting

On stakeholder stated that the promotion of onsite CHP might not be such a good idea since concrete plants do not consume large amounts of heat. JRC generally accepted the point about the overall scale of heat consumption but believed that the ratio of heat to electricity consumption was such that CHP becomes interesting. The data presented in Table 36 supported the position of the JRC and are retained for reference in the next section.

It was commented that the requirements for concrete plant energy consumption seemed disproportionate. Earlier research by the Concrete Sustainability Council (CSC) reached the conclusion that energy use in the concrete plant (albeit in ready mix applications) is not significant, being as low as 1% of the total product CO2 footprint. JRC emphasised that there is a significant difference in energy profiles for ready mix and precast concrete production.

JRC pointed out that the example of ready mix concrete (i.e. large batches prepared in trucks that are poured in place on construction sites) is simply not relevant to the scope for EU Ecolabel hard covering products, which are all pre-cast or dry-cast products formed in dedicated factories. When looking at primary data reported by pre-cast concrete plants in the US, energy consumption at the concrete plant was much more significant (see analysis in Table 35 in the next section).

Further research:

Following up from the feedback received, it was decided to take a closer look at the energy consumption data presented in the study by Marceau et al., (2007) for the production of ready mix concrete, precast concrete and concrete masonry units.

One important difference between ready mix applications (where stakeholders claimed concrete plant energy consumption is insignificant, being around 1% of the total) and precast applications, is that energy is required for the moulding and curing operations in the latter. So it is especially important to consider how significant (or not) is the energy consumption associated with the moulding and curing operations.

With masonry concrete production, the curing temperature can vary from ambient temperature (longer time required) to as high as 90°C for accelerated curing. Accelerated curing can reduce yard storage time from 7 days to 1 day before the units are strong enough for shipment.

Table 35. A look at the significance of concrete plant energy consumption.

		Masonry (data from 13 plants)	**Pre-cast (data from 15 plants)**	**Ready mix 3**
	28d compressive strength	**Unspecified**	**50 MPa**	**20 MPa**
Unit weight		2380 kg/m3	2290 kg/m3	2320 kg/m3
Representative mix (kg/100 units† or kg/m3 concrete)	Cement	159 kg/100 units	504 kg/m3 concrete	223 kg/m3 concrete
	Water	109 kg/100 units	178 kg/m3 concrete	141 kg/m3 concrete
	Coarse aggregate	473 kg/100 units	1050 kg/m3 concrete	1127 kg/m3 concrete
	Fine aggregate	1081 kg/100 units	555 kg/m3 concrete	831 kg/m3 concrete
Concrete plant energy (GJ/100 units† or GJ/m3 concrete) (% of total plant energy)	Vehicles (fuel)	0.0793 GJ/100 units 24.4 %	0.2648 GJ/m3 32.3%	0.0067 GJ/m3 15.6%
	Curing (fuel)	0.2019 GJ/100 units 62.2%	0.3584 GJ/m3 43.7%	0.0213 GJ/m3 49.8%
	Heating + other (fuel)		0.0590 GJ/m3 7.2%	
	Plant (electricity)	0.0433 GJ/100 units 13.3%	0.1371 GJ/m3 16.7%	0.01481 GJ/m3 34.6%
	Plant total	**0.3245 GJ/100 units 100%**	**0.8193 GJ/m3 100%**	**0.0428 GJ/m3 100%**
	Fuel : elec. ratio	86.7 : 13.3 (6.5 : 1)	83.3 : 16.7 (5 : 1)	65.4 : 34.6 (1.9 : 1)
Embodied energy* (GJ/100 units† or m3 concrete)	Cement	0.691 GJ/100 units	2.19 GJ/m3	Not specified
	Aggregates	0.038 GJ/100 units	0.04 GJ/m3	
Sum of embodied energy and plant energy		**1.01 GJ/100 units**	**3.15 GJ/m3**	**1.13 GJ/m3**
Plant energy as % of total embodied energy		**32.1%††**	**26.0%††**	**3.8%**

*Ignoring transportation of materials to concrete plant.
†100 units refers to 100 concrete masonry units of 200x200x400mm. Typically 131 such units would be produced from 1m3 of concrete.
††Number not explicitly stated in the report, but deduced by calculation using values in the table above.

The main conclusion that can be drawn from the table above is shown in the last row, where it can be clearly observed that concrete plant energy consumption is much more important in concrete plants producing pre-cast concrete than in ready mix concrete (26.0% and 32.1% versus just 3.8%).

It is also clear that concrete plant energy consumption becomes less significant as the cement content increases (i.e. increasing cement content from 208 to 504 kg/m3 reduced the significance of concrete plant energy consumption from 32.1 to 26.0%.

Another interesting finding from Table 35 is the ratio between fuel and electricity use in the concrete plant. In the plants that are most relevant to the hard covering scope (i.e. masonry unit and pre-cast plants) total concrete plant energy demand was dominated by fuel used (5-6 times higher than electricity). However, this ratio may change significantly in the future (almost towards parity) as plant vehicles shift from combustion engine-based to electric-motor-based vehicles.

The closer that fuel and electricity consumption becomes, the interesting becomes any potential investment in Combined Heat and Power plants (CHP). With CHP systems, it is important that the heat demand occurs at the same time as electricity is required. This would generally be the case in concrete plants since electricity is only required when concrete is being produced and the dominant heat demand would be to produce steam for curing chambers for that same recently produced concrete.

From the data gathered by Marceau et al., (2007), the dominant fuel used for steam production was natural gas.

<u>Why onsite CHP could be beneficial for precast concrete production?</u>

The installation of onsite CHP brings clear environmental benefits for any industry where the waste heat from the CHP unit can be beneficially reused. As a general rule of thumb, grid electricity can be considered to represent no more than a 40% efficient conversion of primary energy into useful energy (i.e. electricity) due to losses of heat and transmission losses across the grid. However, CHP can generally be considered as an 80% efficient conversion of primary energy into useful energy (i.e. electricity plus heat) because the demand for the heat is located near the CHP unit.

The potential for CHP is maximised when onsite heat demand matches or exceeds onsite electricity demand onsite by at least a factor of 2. Some typical process operating data for concrete production plants by Marceau et al., (2007) is presented below.

Table 36. Example of specific energy inputs in pre-cast concrete production (Marceau et al., 2007)

Concrete Masonry Unit production		
Energy carrier	**Used for**	**Quantity (KJ/100 units)**
No 1, 2 and 4 diesel	Light trucks e.g. fork lift, loaders etc.	79,310 (24.4%)
Natural gas	Kiln and industrial boiler: for steam and vapour	201,890 (62.2%)
Electricity	Throughout plant	43,270 (13.3%)
Precast concrete		
Energy carrier	**Used for**	**Quantity (kJ/m3)**
Gasoline	Light trucks e.g. fork lift, loaders etc.	32,470 (4.0%)
No 1, 2 and 4 diesel	Light trucks e.g. fork lift, loaders etc.	92,550 (11.3%)
No 1, 2 and 4 fuel oil	Light trucks e.g. fork lift, loaders etc. Industrial boiler for steam curing.	139,790 (17.1%) 8,920 (1.1%)
Kerosene	Portable building heater.	750 (0.09%)
Natural gas	Industrial boiler for steam curing. Building heating.	297,340 (36.3%) 52,470 (6.4%)
LPG	Industrial boiler for steam curing. Various manufacturing equipment.	52,100 (6.4%) 5,790 (0.7%)
Electricity	Throughout plant	137,110 (16.7%)

The data in Table 36 confirms that onsite CHP units could be beneficial for both concrete masonry unit production and pre-cast concrete product where the heat:electricity ratios (ignoring vehicle fuels) are around 4.7 and 3.0 respectively.

5.6 – Environmentally innovative concrete product designs

Existing criterion:
No existing criterion
TR v1.0 proposed criterion 5.8: Permeable pavements
EU Ecolabel points Points shall be awarded for concrete tiles and flags which are designed to have: • a void area of more than 5%, or • where installation guides are provided using specified joint filling aggregates, standard infiltration rates of at ≥ 400 mm/hour can be achieved. ***Assessment and verification:*** *The applicant shall provide a declaration stating whether or not this criterion is relevant to their product(s) that will apply for the EU Ecolabel.* *In cases where this criterion is relevant, the applicant shall provide test reports according to BS 7533-13, BS DD 229:1996 or similar standards.* *A maximum total of 10 points shall be awarded in proportion to how closely the data reaches the maximum benchmarks set:* • i.e. void area 0% = 0 points and a void area of ≥5% = 10 points or, • i.e. 400 mm/hr = 0 points and 2000 mm/h =10 points.
TR v2.0 proposed criterion 5.6: Environmentally innovative concrete product designs
This criterion is optional and recognises certain innovative design features of concrete hard covering products as specified below that bring direct or indirect environmental benefits. **EU Ecolabel points** 1. Freely draining concrete paving – up to 10 points shall be awarded to precast concrete tiles and flagstones that are designed to be pervious to moisture or that are permeable via void spaces at joints when installed in accordance with producer specifications (infiltration rate of 400 to ≥2000 mm/h). 2. Material efficient precast concrete masonry units – up to 10 points shall be awarded to concrete masonry units with void space in the product form (from 20% to ≥80% of total volume). 3. Grass/turf open pavers – 10 points shall be awarded to concrete paving units that are designed with void spaces to be filled with topsoil/sand/gravel and be seeded with grass that can fit into permeable paving designs. ***Assessment and verification:*** *The applicant shall provide a declaration stating whether or not this criterion is relevant to their product(s) that will apply for the EU Ecolabel.* *1. In cases where the freely draining concrete paving criterion is relevant, the applicant shall provide test reports according to BS 7533-13, BS DD 229:1996 or similar standards. Points shall be awarded in proportion to how the infiltration rate data lies between the lower level (0 points if rate = 400 mm/h) and the upper level (10 points if rate ≥2000 mm/h).* *2. In cases where the material efficient precast concrete unit criterion is relevant,*

the applicant shall provide a declaration of the % void content of the form by providing the dimensions of the product form in such detail that the total volume and the void volume can be calculated. Points shall be awarded in proportion to how the void space data lies between the lower level (0 points if void space = 20% of total volume) and the upper level (10 points if void space ≥80% of total volume). *3. In cases where the grass/turf open paver criterion is relevant, the applicant shall provide technical drawings of the concrete forms, images of real-life installations complete with vegetated surfaces and detailed installation instructions about how the products should be filled and seeded.*

Points for discussion
Opinions about this approach? Any appropriate standard methods for assessing infiltration rates in the laboratory? Other innovative concrete products that could be included here? (thermal insulation or acoustic insulation, avoiding the need for extra heating/cooling costs or the need for acoustic insulation materials)?

Rationale and discussion:

Why are freely draining concrete paving units worth recognising?

Paved surfaces are beneficial in the sense that they provide flat and solid surfaces that facilitate the continued optimum movement of pedestrians and vehicles and which are designed to drain well during and after rainfall. The classical design of paving systems is to be impermeable to water and to be sloped in order to quickly divert rainwater to drainage systems. As urbanisation has increased, so too has the extent of impermeable paving. During storm events in any particular river catchment, water that hits an impermeable area is rapidly conveyed via the drainage system to the river whereas storm water hitting a greenfield site infiltrates into the ground and, only once the ground is saturated, it would flow across the vegetated surface towards the river or be trapped in natural depressions in the surface topography. The result is that for a given storm event, there is a higher and more concentrated peak flow in watercourses fed by impermeable areas compared to those fed by greenfield areas.

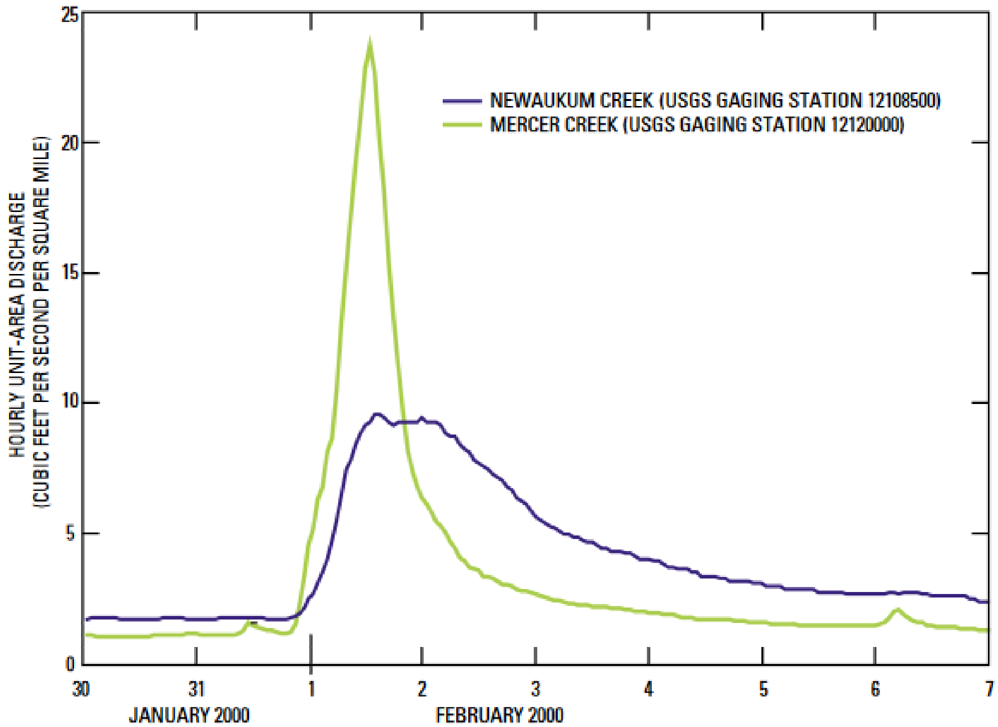


Figure 50. Specific runoff rates in an urban stream (green) and a rural stream (purple) that are located in the same area (Konrad, 2003).

Even though the rainfall event on the 1st February shown in **Figure 50** was essentially the same for both stream catchments, the urban stream shows a much higher (x2.5) peak runoff rate. Furthermore, almost all of the storm runoff has passed from the urban area to the stream within one day whereas this process takes more than 5 days in the rural area. The two runoff behaviours indicate that watercourses in urban areas are much more susceptible to the phenomenon of flash flooding simply due to the increase in speed with which stormwater reaches the watercourse.

So it is clear that impermeable pavements play an important role in the rapid conveyance of stormwater to watercourses. To design and construct paved areas that deliver more gradual runoff in a similar (or better) manner when compared to a greenfield site, permeable paving is one of a number of options possible, all of which fall under the concept of sustainable (urban) drainage systems (SUDS for short).

Apart from elevated risks of flash flooding, impermeable paving reduces the possibility of recharging of groundwater aquifers. Permeable pavements can be designed for full, partial or zero infiltration, depending on what is most appropriate for the local area, by adjusting the broader paving system design and underlying base layers that are installed.

Focusing purely on the top paving layer, there are two broad types of permeable paving:

i. impermeable blocks with larger joints or large void spaces that are to be filled with aggregates of a well-defined granulometry, and

ii. concrete blocks that are permeable on the surface of the block itself (i.e. pervious concrete).

With the first option, in order to ensure the permeability of the filled joints, it is necessary to fill joints with aggregates with a very low fines content, to ensure that voids between coarse aggregates are not filled by small aggregates. Larger joint areas between blocks will also enhance permeability.

With the second option, for pervious concrete, it is also important to restrict the fines content in aggregates as well as the cement content. Ranges of mix compositions (aggregate, cement and water) that have been used in academic research have been summarised by Chandrappa and Biligiri, (2016). With correct compositional control, pervious concrete with an interconnected void content of 15-35% can be produced (Kia et al., 2017).

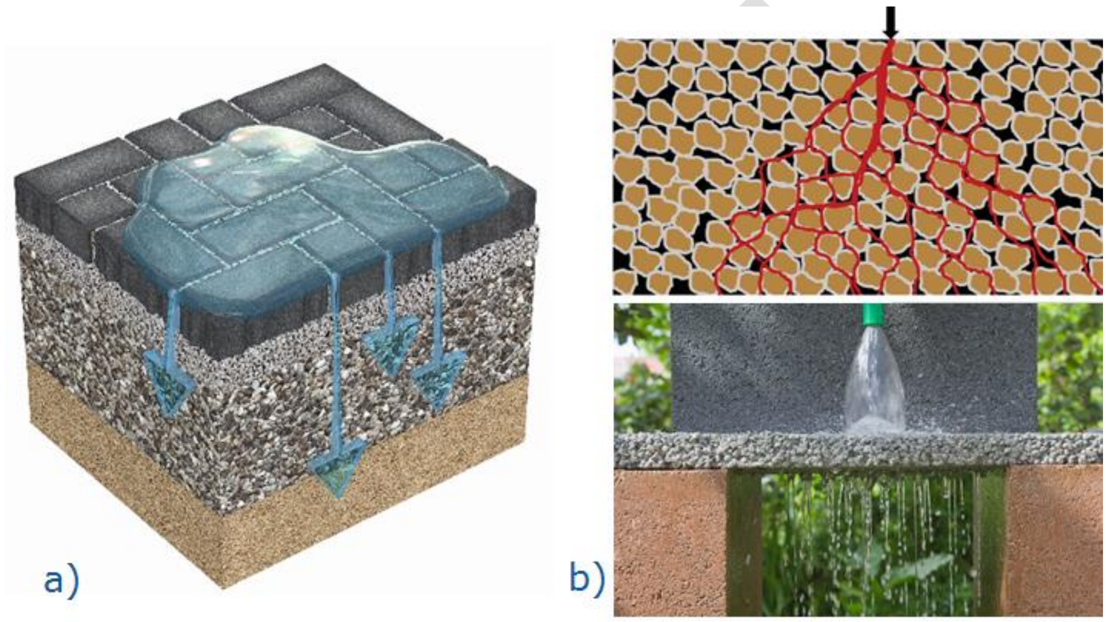


Figure 51. Drainage mechanisms in a) paving with permeable joints and b) pervious concrete blocks (Source of image a) Marshalls, image b) Kia et al., 2017).

It is worth noting that permeable paving is recognised by a number of green building assessment schemes. Points can be awarded under credit 6 (Stormwater Management) of LEED for reducing the runoff rate by at least 25% (credit 6.1) and removing at least 80% of total suspended solids and 40% of total phosphorus (credit 6.2). The BREEAM scheme has a requirement related to surface runoff rates (Pol. 03), HQE rewards building plot designs with fewer impermeable areas (criterion 5.2.1) and that limit rainwater discharge into combined sewers (criterion 5.3.3).

If claims for permeable paving are to be recognised, it is important to consider exactly how the claims should be assessed and verified. Although results will also depend on the correct specification of joint filler and underlying base materials, one simple and reproducible test is to measure the infiltration rate of water (in mm/h) under standard conditions. It is unclear if there is a harmonised European standard for this type of test but one example used in the UK is BS DD 229:1996 (Method for determination of the relative hydraulic conductivity of permeable surfacings). With impermeable pavers that are interlocked with permeable joints and spacings, a simple specification would be to specify the permeable area as a fraction of the total area.

Why are material efficient concrete masonry units worth recognising?

The compressive strength of concrete tends to greatly exceed its minimum requirement when used in structural applications. So in applications which are not part of loadbearing building structures, which is where the scope for EU Ecolabel hard coverings becomes relevant, the safety margin is even wider.

This wide safety margin has led to innovation in the design of concrete masonry unit forms, by introducing large void spaces that do not compromise on compressive strength requirements but which do increase the material efficiency of the product and reduce raw material costs. These forms with incorporated voids allow for blocks to be larger while still remaining light enough for manual placement onsite. Some examples of the forms that are used are shown below.

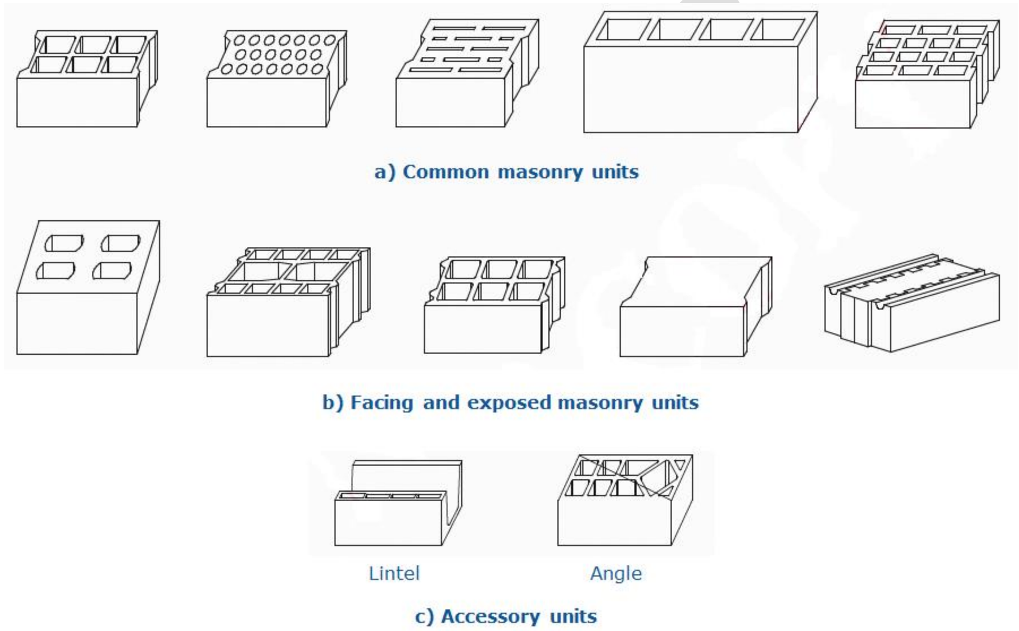


Figure 52. Examples of different concrete masonry unit forms (Source: EN 771-3)

It can be seen that there are a wide range of forms possible, each with their own particular % void content in the form. The image above should also help clarify that <u>void content in the form</u> should not be confused with <u>pore volume within the concrete material itself</u> caused by entrapped air bubbles or evaporated pockets of water.

The direct environmental benefits associated with material efficient concrete masonry units include less consumption of aggregates and cement per unit volume. Indirect environmental benefits could relate to lower loads on foundations/floor slabs or, depending on how the blocks are placed together and incorporated into the broader design, the potential for passive ventilation in the wall.

Why are grass/turf open paving concrete paving units worth recognising?

These types of products have found particular interest in areas such as driveways and car parks, where a stable ground surface is needed for vehicle traction and ride-ability on a continual or periodic basis. These products have some significant environmental advantages, the importance of each varying depending on the site-specific situation:

- Help reduce soil erosion due to both the vegetation cover.
- Help reduce soil erosion by winds even in cases when vegetation cover is minimal.
- Help reduce soil erosion by wind and rain especially on sloping surfaces.
- Help reduce erosion, rutting and soil compaction by the concrete surface supporting vehicle loads and transferring them over broader areas.
- Permit the free drainage of the surface towards greenfield site levels.
- Permit the establishment of a vegetation cover for aesthetic benefits.
- Save on concrete for a given m^2 of ground surface area covered.
- When vegetated, help reduce urban heat island effects.

In wetter climates, these products offer an optimal compromise between green space and outdoor paved areas in cases where soil erosion, drainage or the need for occasional or permanent heavy use of the area applies. The more occasional the use, or the lighter the use volume in general, the more suitable the vegetated option becomes. Non-vegetated options are also possible in cases of heavy and permanent vehicle use and/or insufficient moisture. As a general rule of thumb, a surface will need to receive at least 5 hours of sunlight a day for grass to flourish (ICPI, 2006). Some images of the grass/turf pavers are provided below.

Figure 53. Examples of grass/turf open pavers (Sources: ICPI, 2006; Eagle Bay Pavers and Unilock).

The possible uses of these products include: parking lots (especially overspill parking), emergency and fire lane access, driveways, access roads to remote infrastructure, drainage channels, erosion control, riverbank stabilization, walkways, flooring for barns and picnic areas.

According to the ICPI, these types of products can potentially be recognised by LEED under the criteria summarised below.

Table 37. Potential recognition of grass/turf open pavers by LEED (Source: ICPI, 2014)

LEED Credit Category	Available	Potential Points Using Segmental Concrete Pavement
Integrative Process	1-5	1-5
Sustainable Sites	10	
Open Space		1
Rainwater Management		3
Heat Island Reduction		2
Water Efficiency	11	
Outdoor water use		Prerequisite (no points)
Materials & Resources	13	
Building Product Disclosure and Optimization– Environmental Product Declarations		1
Building Product Disclosure and Optimization– Sourcing of Raw Materials		1
Building Product Disclosure and Optimization– Material Ingredients		3
Construction and Demolition Waste Management		2
Innovation	6	6
Regional priority	4	4
Range of potential points	45 – 50	25 – 30

From the table above it is clear that the rainwater management and heat island reduction benefits are recognised. Although LEED does not recognise the grass grown in grass paver voids as a vegetated area, it is still possible to obtain one credit for the open space category by potentially providing surfaces for outdoor social activities and recreation.

The potential credits relating to materials and resources are more related to producer management systems and the choice of whether or not to incorporate recycled aggregates into the products.

6 IMPACTS OF CHANGE OF CRITERIA

This section consists of a summary of the main general changes proposed for the revised criteria and potential implications for current license holders and possible applicants.

In relation to the **scope** there are two main aspects proposed:

- Enlargement of the scope with the inclusion of kitchen countertops, table-tops, masonry units and roofing tiles.

- The removal from the scope of agglomerated stone products.

The enlargement of the scope has a number of benefits. First of all, it extends the coverage of the EU Ecolabel to products that have markets worth billions of euros per year at the EU28 level.

The removal of agglomerated stone products is unfortunate because they are a particularly relevant material for the kitchen countertops included in the new expanded scope, but the removal has been due to the lack of data provided. One last call will be made at the 2nd AHWG meeting for any agglomerated stone producers that would be willing to apply for the EU Ecolabel and actively collaborate in the development of criteria, using the TR v1.0 proposals as a starting point.

In relation to the **criteria**

The natural stone criteria have been adapted to focus much more on good practice at the quarry and less on rigid quantitative emissions which sound good in theory but are not so meaningful in practice (measuring diffuse emissions at a point source). The criteria have been influenced by other initiatives such as the National Stone Council in the US, GECA in Australia and Fair Stone in Germany.

The ceramic criteria have been re-evaluated following a more exhaustive analysis of the BREF document published in 2007, the latest draft ISO 17889-1 standard published in 2018 and anonymous data from existing license holders. The ambition level of thresholds of environmental excellence is much better justified although further data input is welcomed. In particular, the NOx data should be carefully analysed. In terms of points, importance has been taken away from water related criteria and given to energy and air emission related criteria. An expansion of the scope for energy consumption is also proposal, to account for the significant energy consumption during spray drying and ceramic body drying. This way a more holistic approach can be taken to energy consumption.

For cement and concrete criteria, the authors have attempted to focus on parameters that are already widely used and reported by industry and which do not require the definition of, or reference to, any LCA rules.

For all types of material covered by the product group scope, greater emphasis has been placed on the reuse of process waste and process by-products as well as the potential recognition of recycled content.

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8 TABLE OF COMMENTS

8.1 General

Comments received in written form	JRC Dir. B response
SCOPE	
We support the scope extension to kitchen counters, masonry units and roofing tiles for the reasons described in the Technical report. However, we would not support the inclusion of plasterboard because this type of product is too different from products already covered by the Ecolabel in terms of composition (they include cardboard and sometimes polystyrene) and installation (they require a metallic frame).	**Accepted.** The expansion of the scope remains in the TR v2.0 proposals but without plasterboard.
We agree with the option: "The product group 'hard coverings' shall comprise floor coverings and wall coverings, for internal or external use and without any relevant loadbearing function for building structures" if it includes more items of the hard coverings'	**Acknowledged.**
We can support the suggested scope expansions. But it is important to ensure that if new product shall be included, that the ecolabel requirements can separate the market, hence ensuring that it is possible to set requirements which have an environmental impact.	**Accepted.** In particular, research into trying to distinguish between the specific energy consumption (and associated CO2 emissions) of the variety of different ceramic and fired clay products has been carried out.
Construction products are mainly business-to-business products whose environmental impact has to be taken into account in the buildings system through LCA. We are not in favour of Ecolabel for construction products, and especially for cement and concrete.	**Acknowledged.** The JRC wishes to take the opportunity to explain that the different purposes of the EU Ecolabel and EPDs and that both have a place in the market for green products, even in B2B sectors. EPDs aim to give precise quantitative information about specific LCA impacts so that larger scale LCAs (e.g. at building level) can be carried out. EPDs can also help a particular producer monitor progress in their numbers on a year-by-year basis. However, there is no guarantee that any of the numbers associated in a particular EPD are good or bad. The EU Ecolabel aims to distinguish products of environmental excellence based on a compliance with criteria that will set quantitative limits on the parts of the production process that can be assessed and verified and that are generally associated with the main LCA hot-spots of the product. Compliant products can be considered as having a good environmental profile.

	The EU Ecolabel will, in the future serve as a good basis for the development of any simple Green Public Procurement criteria as well.
It is proposed to expand the scope to masonry units. In that case, different units and the capacity to integrate data later in the building assessment need to be carefully considered. *The criteria need to clearly differentiate the different units used by the various materials under scope. Hard coverings are generally expressed on m2 for calculating environmental impacts, while clay and concrete masonry units are usually expressed on m3 or kg.* *Appropriate differentiation of units for different materials is needed in order to enable data integration the whole building assessment.☐French EPD "Fiche de declaration environmmentale et sanitaire » for clay tiles*	**Acknowledged.** This is a valid point. The appropriate functional unit should ultimately be decided by potential applicants, since they will need to report the data in the first place. Further discussion is welcomed at the 2nd AHWG meeting. Currently there are diverging approaches for ceramic tile and fired clay products depending on the specific nature of the product (m2 and kg).
SCORING APPROACH	
We support the scoring approach with the bonus points, provided that mandatory criteria remain high enough. We therefore support performance criteria rather than 'management criteria" (for instance, we prefer to define quantitative thresholds for the recycled content rather than a documentation of the availability of recycled material).☐We also should avoid the case where an applicant could obtain the license if he is neglecting one environmental dimension. The certification threshold could be raised to 60 or 70 points.	**Acknowledged.** The JRC welcomes further discussion on the scoring thresholds from all stakeholders once the criteria can be agreed on. Regarding the documentation of available recycled material, this was actually an alignment with one of the requirements of the Concrete Sustainability Council. It is important to not introduce mandatory requirements on recycled content because whether or not it delivers an environmental benefit will depend on how far away it was sourced from compared to equivalent virgin material.
While we can support the point system in principle, we think that the complexity of the criteria proposal has reduced transparency the benefits delivered by the EU Ecolabel for hard coverings, undermining communication and promotion of the label.☐Key criteria for biodiversity protection and indoor air quality should be strict and mandatory.☐ Set mandatory requirements for key criteria which will be better communicated to the final user.	**Accepted.** The VOC criterion has now been reworded and is simply now between the non-use of VOC containing surface treatments or compliance with VOC emissions from final product testing. Regarding extraction sites for all raw materials (including dimension stone quarries) a rehabilitation plan is now mandatory again and progressive rehabilitation (or non-disturbance in the first place) of land on quarry sites is being strongly encouraged with award points.
In principle we can support a scoring system. But a scoring system shall ensure an overall good environmental performance of a product and enable the applicant to choose different approaches to achieve further improvements. For the products included in these criteria we do not at this point see the relevance of a scoring system. We are of the opinion that prescriptive criteria or criteria based on points go against LCA at the level of the building, and do not allow for any performance-based competition with other product types.	**Rejected.** The JRC wishes to emphasise here that the purpose of the EU Ecolabel is not to plug directly into an LCA (that is the purpose of EPDs). Instead its aim is to distinguish best performance within a certain type of product (e.g. concrete tiles), but not to form the basis for deciding if a concrete floor tile is better than a textile, ceramic or wooden floor tile for example, which is something that an LCA exercise could be used for.

The revision of the EU Ecolabel criteria introduces the adoption of a scoring system with a minimum threshold of 50 points out of 100. *A minimum entry threshold set at 50 points may not be very representative of the excellent products. The entry threshold, if maintained, should be restricted by raising the entry threshold.*	**Further discussion needed.** The exact threshold for points depends on the original ambition level of the criteria. For example, if the limit set in the criterion is easy to comply with, a high score should be needed, but if it is difficult to comply with the minimum requirement, a lower score could be justified. Each criterion where points are available should be discussed individually as far as possible.
We agree with the proposal of obligatory and mandatory criteria together with the scoring system. We consider important that the EU Ecolabel is moving towards a "blend" with other building sustainable tools. However, we have doubt how a Ecolabel awarded firm with a high scoring point can benefit from this on the market if this result does not appear nowhere.(i.e criteria 1.9)	**Acknowledged.** It is worth discussing this at the EUEB level to check if the score can be included in information appearing with the EU Ecolabel. Even if it cannot, there should be no obstacle to them communicating this information elsewhere on their packaging or marketing information. The JRC agrees that some form to communicate the score is essential in order to encourage license holders to improve their score.
OTHER	
We agree that the EU Ecolabel should be recognised by Green building Assessment (GBA) –). However, to be relevant in the GBA scheme, the EU Ecolabel shall answer to all the credit scoring relevant for that system for hard covering products. We recommend that the report clearly highlights those improvements achieved by ecolabel criteria which will comply with GBA requirements (e.g. waste recycling). There should be a stronger life cycle thinking approach (e.g. taking into consideration those aspects that will be evaluated in the final building), and not only a focus on the final product. *We propose to use the sub-categories and disclose the validation of the LEED requirements in the EU Ecolabel documentation. Some examples of aspects which should be further developed are:* *Pollution prevention of construction activities. Create and implement an erosion and sedimentation control (ESC) plan for all construction activities associated with the project. As part of the ESC plan, the Ecolabel can steer improvements if there are mandatory criteria on waste recycling from processing operations of natural stone. At the moment this is only optional in criterion 2.2.3, which just establish as mandatory diverting divert waste from landfill.* *- Stormwater design: quantity control . Implement a stormwater management plan that results in a 25% decrease in the rate and volume of stormwater runoff from the 2-year 24-hour design storms.*	**Acknowledged but rejected.** In principal this is a reasonable point but while some synergies can be found (e.g. with VOC emissions for all products and verified claims of recycled content for concrete), in general the hard covering product producer has no control over how exactly their product will be used or how a building or paved area will be designed and constructed. One For example it is not the producer of the permeable paving (the potential EU Ecolabel applicant) who has any control over how a particular development site will handle rainwater, that is determined by the designer of the development site. It is hoped that discussions with representatives of GBA schemes will help shed light on the best synergy between the EU Ecolabel criteria and GBAs.

- Potential technologies & Strategies Design the project site to maintain natural stormwater flows by promoting infiltration. Specify vegetated roofs, permeable pavement and other measures to minimize impermeable surfaces. Reuse stormwater for non-potable uses such as landscape irrigation, toilet and urinal flushing, and custodial uses.	

8.2 Horizontal criteria

Comments received in written form	JRC Dir. B response
1.1 Environmental Management System	
The criterion 1.1 gives the first view of a management system at the level of the plant. However, we miss requirements to provide information on GHG emissions per functional units. Such criteria are will be consistent with EU low carbon strategies to fight climate change. *EPDs provide information on GHG emissions, which is needed for Green Building Assessment.* *Add new criteria based on ISO 14064: 2019 to provide direct and indirect GHG emissions.* *At the product level, the GHG emission shall be divided by the quantity of annual product referred to the market unit (m2, m3, and others)*	**Acknowledged:** The reporting of GHG emissions varies among the different sectors covered by the hard coverings product group. While it is common to estimate GHG emissions in the cement and ceramic facilities, it is not common practice to estimate such emissions in dimension stone quarries, natural stone transformation plants or in precast concrete plants. Due to other comments received, it was decided to make EMS optional only and so any requirements associated with the EMS would become optional only as well. Doing a full carbon footprint would be costly and would be something that is essentially done anyway if an EPD is to be conducted. However, recognising the importance of carbon emissions, specific criteria have been proposed for the most carbon intensive aspects covered by the hard covering scope (i.e. cement production and ceramic production). Limits have been defined per kg of cement and per kg or m2 of ceramic tile.
We agree with the new proposal but it should be specified in the manual that "JRC clarified that wherever an EU Ecolabel product is produced, it should somehow be covered by the EMS, so if the license is for a single site only, the EMS only needs to apply to that site.	**Rejected.** Although this is a valid point, for simplicity it was decided to make the EMS criterion purely optional.
We believe that waste management is well tackle within an Environmental management system, on the contrary as far as we know the energy management is not well addressed, even so, we do not believe that an energy management system should be a mandatory criteria.	**Accepted.** The EMS is now purely optional.

We can support that ISO 14001 are treated equal in regards to points.	**Partly accepted.** The gap between ISO 14001 and EMAS has now been closed in terms of points awarded (gap is 2 points now instead of 3) but not completely as was requested.
1.2 Raw material extraction management activities	
The existing criterion requiring the technical report including the environmental recovery plan and environmental impact assessment report should be maintained. Declaration of conformity with the Birds and Habitats Directives should also be provided to the Ecolabel Competent Body. *Raw material extraction is one of the most critical environmental impacts for hard coverings. It should be ensured that appropriate measures are taken to minimise biodiversity losses and ensure appropriate recovery of the areas where extraction activities take place. These can only be verified by providing full documentation of the extraction activity including the environmental recovery plan and the environmental impact assessment report.* *Keep current criterion and add a reference to Regulation (EU) No 1143/2014 of the European Parliament and of the Council of 22 October 2014 on the prevention and management of the introduction and spread of invasive alien species, relevant for refurbishing quarries, in addition to compliance with the Birds and Habitats Directive.*	**Accepted.** It was already mentioned by the JRC that the TR v1.0 proposal was not optimal and would be revised to better reflect the existing criterion. The new proposal now captures all of the elements covered by the existing criterion and introduces a new requirement regarded invasive and alien species. Furthermore, the requirement for non-EU extraction sites that may be in protected areas has been explained in some more detail.
We agree with the new proposal	**Accepted in principle.** However, due to other stakeholder feedback, the proposal has now been modified.
1.3 Hazardous substance restrictions	
The stepwise process listed looks workable for applicants and CB´s, but the step-wise process is not the same as the flowchart at the same slide? The flowchart will not work in the application process.	**Accepted.** The step-wise figure has now been modified accordingly (the box about less hazardous alternatives has been removed). Indeed, that particular box would apply only when someone is thinking about whether or not a derogation request would be relevant.
Are there any foreseen derogation requests (i.e. for hazardous substances not chemically modified and potentially present in the product >0.1% w/w)? Possible issues may be borates, crystalline silica, heavy metal fluxing agents and colorants in glazes and titanium dioxide pigments… *how do these compare in terms of % of total product weight? Crystalline silica is*	**Further discussion needed:** It still needs to be clarified if silica dust should be classified or not (both as a raw material and as a component of a mixture or article). In case it could be classified, a derogation would then be needed. A proposed derogation has been inserted for crystalline silica to prompt further discussion.

present in ceramic tiles in > 0.1% w/w. in any case silica comes with clays, which are excluded from registration in REACH due to their natural origin. In any case if has to be ensure that clarified Crystalline silica comply with the established criteria otherwise any ceramic tile will qualify for Ecolabel.	
We have a strong opposition to the derogation granted to allow use of Titanium Dioxide for products with photocatalytic properties. *The EU Ecolabel should not allow intentional use of TiO2.*	**Accepted.** Photocatalytic surfaces are a clear environmental feature that has been developed in the ceramic and concrete sector. The JRC sees the case of use of TiO2 as scientifically justified from an environmental perspective, with the pros outweighing the cons. The role of poor air quality in urban environments and the central role of NOx in human health effects have been widely investigated and linked to clean air objectives of the Commission. However, due to stakeholder opposition predominating in feedback, the derogation for intentionally added TiO2 in photocatalytically active products has been removed.
We support BEUC's position regarding the restriction of titanium dioxide and the absence of derogation	
We find unacceptable that Commission services say in an official report that substantial arguments from industry can justify that the reclassification of TiO2 might be done on flawed evidence. This statement is questioning the Commission scientific bodies and processes and the work of ECHA in this process. Moreover, this statement raises further controversies as industry is spending millions to avoid this reclassification.☐	**Rejected.** The reference to flawed evidence in this comment has been taken out of context and insinuated as being the JRCs opinion, which it is not. The correct context was that the JRC has been contacted by the Italian ceramics association, who presented their arguments to the JRC that the whole TiO2 reclassification exercise might be based on flawed evidence. The Technical Report simply referred to this exchange as a matter of fact occurrence and no more. In fact, the JRC did not expand upon these arguments and stated in the same sentence that such discussions are beyond the scope and responsibility of this particular EU Ecolabel project, effectively admitting that it is a discussion for the relevant Commission scientific bodies. Regardless, now that intentionally added TiO2 is not derogated in the latest proposal, there should be no more room for perceived controversy here.
The TiO2 is present as impurity in all the raw materials or as an additive used to confer photocatalytic properties to the ceramic products. The exemption for TiO2 is requested.	**Accepted:** for derogation of TiO2 impurities. **Rejected:** for derogation of intentionally added TiO2, it appears that the final decision will depend on political opinions more than scientific ones.
In the current criterion proposal: "The product shall not contain substances that have been identified according to the procedure described in Article 59(1) of Regulation (EC) No 1907/2006 and included in the Candidate List for Substances of Very High Concern in concentrations greater than 0.10 %" which is aligned with Wooden Floor Covering referential. However, in the Lubricant criteria, SVHC were restricted to 0,01% (10-fold factor difference). How does the JRC explain this difference?	**Response:** This difference exists because the higher limit refers to products that are "articles" whereas the lower limit refers to product groups that are "mixtures". Such a distinction in thresholds based on the intrinsic nature of the product is in line with the recommendations of the EU Ecolabel Chemicals Task Force.

1.4 Asbestos	
Asbestos is already classified under hazard class H350 and H 372 under CLP with the limitation of 0.1% by weight of the product and therefore already included in criterion 1.3. *Is suggested to delate this specific criteria.*	**Accepted.** The JRC agrees that the criterion on Asbestos could be removed.
We agree. Asbestos is not used in the ceramic industry.	**Accepted.** The JRC agrees that the criterion on Asbestos could be removed.
1. 5 VOC emissions	
The indoor air quality is an important issue as recent studies shows that people live more than 90% of their life indoor and the air can be even much polluted than outdoor. Criterion on VOCs should be further enhanced in the scoring system by raising the value of the absence of VOCs.	**Acknowledged but rejected.** The importance of VOCs is a serious issue in general. The main aim of the criterion here is to discourage the use of VOC containing surface treatments and finishes and recognise the inherent environmental benefits of these products to a minor extent. It is also important from a strategic perspective since it would align well with some Green Building Assessment schemes. However, adding more points here would mean points are being taken away from other criteria. If agglomerated stone was to be included in the scope again, it could be justifiable to have higher points for that particular sub-product, because VOC emissions is a larger potential issue there (organic resin binder used) than with concrete, ceramic tiles and natural stone.
The VOC emissions are relevant as additives for surface treatment and could release during the use phase. *The criteria proposal establishes different ambition levels to obtain points progressively following increased substitution of VOCs. The proposal lacks transparency for the end user on an important criteria to clearly communicate benefits of the EU Ecolabel for improved air quality.* *Compliance with the two options provided for obtaining points will not be difficult. The EU Ecolabel should set strict mandatory limits on VOC content.* *Substitute the point system for VOCs and set a mandatory requirement on no VOC use or strict low emissions of VOC.* *Delete* *- Where the wax or resin used is less than 1% by weight of the final product (2 points).* *- Where the wax or resin used has a VOC content less than 5% by weight*	**Accepted.** The changes suggested have been incorporated into the TR v2.0 proposal. The issue is also simplified by the current exclusion of agglomerated stone products from the scope.

(3 points). *The EU Ecolabel for hard coverings should have a clear communication about strict limitation of emissions thus contributing to indoor air quality*	
Experience shows that safety data sheets are not always available in the local language, reducing transparency and access to the information of the end user. It should be required that safety data sheets are provided in the final user language.	**Further discussion needed.** It is not clear if this comment is considering the "*user*" as the final consumer (commercial sensitivity) or as the potential EU Ecolabel applicant? In any case, it might present an additional administrative burden and delay the application process and/or the assessment and verification process. While it is realistic to expect a safety data sheet in the official languages of major EU Member States, it may be more challenging in cases where the chemical is marketed in or imported into smaller countries.
We agree with the approach, since is similar to other international systems.	**Acknowledged.**
There is currently an on-going harmonization process at the European level on VOC labelling for products impacting the indoor air quality (floor covering, paints, furniture, etc.). The JRC should ensure that the Hard covering criteria are aligned with this framework.	**Accepted.** Further research will be needed to make sure that any VOC emission limits from the final product are in line with other relevant schemes and/or the latest version of EU LCI values published.
1.6 Business to consumer packaging	
We do not think that the ambition level delivered is comparable in both cases. *The EU Ecolabel should set mandatory requirements on packaging recycled content.* *Packaging should also be reusable and recyclable. However, it is necessary to provide guidance for how this can be assessed.* *Finally, take back systems to achieve zero landfill of materials should be incentivised (NSF landfill free label can be helpful as a reference for waste management GUID-445 Landfill Free-2016.pdf)* *Consider take back systems.* *To be consistent with circular economy policies☐prEN45554 General methods for the assessment of the ability to repair, reuse and upgrade energy-related products (CEN generic standard)☐and prEN 45555 for recyclability*	**Rejected.** The packaging criterion is not an LCA hotspot and has been removed in order to simplify the criteria. The problem with packaging take back systems is that it will depend on the relevant supply chain. For example, how would this work if the products are sold via an independent retailer? The EN 45554 and EN 45555 standards are still under development but if we understand correctly, these standards are more relevant to products that are more complex than those of hard coverings.

Not clear the term "reusable". It should be specified	**Acknowledged but rejected.** Although no longer relevant because the packaging criterion has been removed in the latest proposal, the term "reusable" is used in Directive 94/62/EC on packaging and packaging waste. In any case, a relevant definition would be: ***"reusable packaging' shall mean packaging which has been conceived, designed and placed on the market to accomplish within its lifecycle multiple trips or rotations by being refilled or reused for the same purpose for which it was conceived;"***
Recycled or reused materials seem more environmentally friendly than those that only are intended to be recycled or reused.	**Acknowledged but rejected.** Because no longer relevant because the packaging criterion has been removed in the latest proposal
We agree with the proposal since most of the Italian EU Ecolabel awarded firms use these materials for packaging, archiving high % of recycling.	**Acknowledged.** Good to know that the original criterion can be met for ceramic products, but it is unsure how the concrete and natural stone products can meet the requirement. Due to its low relevance from an LCA perspective and a desire to simplify the EU Ecolabel criteria where practical, the packaging criterion has been removed.
1.7 Fitness for use	
Fitness for use is important for these products. In the slide from the AHWG it is indicated that no limits are set. To our knowledge limits are set in the relevant EN standards, eg EN 13748, 4.2.4 mechanical strength. The parameters are important to ensure a long life time.	**Acknowledged but rejected.** In the webinar, the point that was made by JRC was that the EU Ecolabel criteria should recognise these standards in fitness for use requirements but should not try to quantify certain performances because these standards include a wide range of performance classes for different use environments. For example, setting high strength requirements in concrete pavers is good in heavily trafficked environments but a waste of cement in quiet pedestrian areas. For the practical impossibility of knowing what use environment the customer intends to use the hard covering product, it is considered more important that the appropriate labelling and product class is communicated to customers so they can be better informed about the suitability of the product for their intentions.
A reference to compliance with the relevant product standard is convenient.	**Acknowledged.**
1.8 Consumer information	
We agree with the new proposal in line with costumers/consumers needs. *However, the scoring system information of the Ecolabel awarded firm should appear on the label. Thus encouraging companies to achieve a better environmental performance and consumers to choose a better product in terms of environmental performance.*	**Acknowledged but to be discussed further.** A very logical comment. It would need to be discussed an approved at the EUEB level whether or not any score should appear on the actual label itself, or simply be a piece of information that can be communicated outside of the label.

We do not see the need to include information on the product's potential life expectancy in technical terms, either as an average or as a range value, nor regarding store.	**Accepted.** The actual lifetime of a hard covering is highly dependent on its use environment and correct installation, which is beyond the control of the EU Ecolabel license holder.
We think it is necessary to clearly communicate to the consumer which life cycle stages are covered or excluded from the Ecolabel scope. For this product category, the European ecolabel mainly covers the raw materials' extraction and manufacturing. We don't want consumer to think that because they bought an ecolabel material, their building will automatically be sustainable. Similarly to guidelines provided for Detergents, we would like to indicate on the packaging that the product's final sustainable performance in the building will depend of its installation and building daily management.	**Accepted in principle.** Suggestions will come to the fore during later discussion with other stakeholders.
1.9 Information appearing on the ecolabel	
For ceramic products we propose the following rewording for the last key environmental characteristic: *"Material efficient product (in case of thin format tiles* ***< 6 mm thick*** *or tiles with a high recycled content > 10%) / Material efficient production process (in all other cases)."* *Traditional porcelain tiles are 8-11 mm thick, traditional wall tiles are 8-9/10 mm thick, therefore if 10 mm is set as a threshold for thin tiles, an important amount of traditional ceramic tiles will be included as thin tiles, which will be a wrong approach. Therefore we propose to change it 6 mm.*	**Accepted.** This suggestion is now included in the TR v2.0 proposal for further stakeholder response. A higher threshold for recycled content was inserted (20% instead of 10%).
OTHER	
It seems that the installation phase has a relatively high contribution to the overall environmental impact (due to waste generated during installation and the use of a joint adhesive). Could the JRC consider a criterion to foster product that generate less waste during installation or needed less joint? The horizontal criterion on substance only covers the health dimension of adhesives, not the environmental impact.	**Acknowledged but rejected:** The comments are sensible, but it is not clear how exactly the EU Ecolabel could influence installers. The only way to reduce joint adhesive is to use bigger pieces, but this introduces other inconveniences such as handling problems, more cutting operations and the need to use thinner tiles which are less suitable for floor applications. It is a complicated area to try and control.

8.3 Natural stone

2.1.1 Quarry landscape impact ratio	
The two first options will be of easy compliance by industry as they reflect business as usual. It is requested to delete: *Quarry footprint ratio of less than 0.6 and as low as 0.2 (Up to 5 points)* *Quarry visual impact of less than XX and as low as 0 (Up to 5 points).* *The EU Ecolabel should rather set criteria to steer environmental innovation and improvements. Use criteria based on environmental innovations and improvements* *The third proposal should be made mandatory. However, it is necessary to clarify what can be understood by "progressive rehabilitation activities". A list should be provided as example* *Clarify the criterion by adding a list of "progressive rehabilitation activities". Some examples of good practices for refurbishing quarries:☐1) use as water waste treatment area based on biological process (e.g. filtering garden)☐2) installing a biodiversity area managed to reintroduce local species of trees, herbs, and animals.*	The first part of the quarry footprint ratio is directly taken from the existing criteria and, since only one quarry in the EU currently is associated with the EU Ecolabel license (3 licensed products using material from the same quarry in Galicia, Spain), it is not clear if 0.60 is simply business as usual or not, much more data would be necessary. The beneficial use of quarry land for establishing or maintaining biodiversity, or for generating renewable energy has now been proposed. No minimum requirement is set so that all steps to improve biodiversity are recognised (maximising steerability for the quarry operator at potentially any site). The importance of biodiversity (and other beneficial land uses) is reflected by the number of points associated (20). The key to establishing biodiversity is considered as the establishment of vegetation cover with native species (exactly how much is possible will depend on site specifics and the microclimate). While a restoration plan can be made mandatory (see criterion 1.2), progressive rehabilitation arguably should not always be mandatory because its potential is highly dependent on the quarry architecture, operational management, etc. Therefore, the criterion acknowledges the fact that environmental effects are minimized if the restoration is progressively carried out during the operational phase by awarding bonus points for establishing areas that are biodiverse or that enable biodiversity to be established. Some examples of good practice with progressive rehabilitation have been inserted in the TR.
We are interested by the source data for the calculation of the landscape impact ratio (report, study, etc.) to help us assess whether the new formulae are more relevant compared to the current ones (especially for underground mines).	The quarry footprint ratio criteria and ambition level actually comes straight from the 2009 Decision (was previously part of the quarry matrix). The second aspect, the visual impact ratio, was proposed mainly to reward underground quarrying operations, which avoid above ground land use impacts. However, due to a lack of data available relating to vertical quarry front areas, it has now been removed from the proposal because a suitable ambition level could

	not be justified.
2.2.1 Energy consumption	
The criterion is not consistent with the EU objectives for renewable electricity. Use of renewable electricity produced on-site should be encouraged. The proposed scoring system should be more ambitious. *Proposal☐0 renewable energy 0 point 10% 5 points 20% 10 points 50% 25 points*	**Accepted in principle**, but not on the requirement for renewable energy to be on-site only. This approach has been taken now in TR v2.0 for the natural stone transformation plant criteria but not for agglomerated stone, because in TR v2.0, it was proposed to discontinue with criteria for agglomerated stone.
2.2.2 Emissions to water	
The absence of discharged water quality thresholds for plants when it is discharged to municipal sewage works or other third party operated treatment plant seems not conservative enough. *We think that industrials should be held accountable for their own effluents. We should ensure that their effluent quality will not interfere with the proper functioning of the water treatment plant.*	The JRC understand that if the process wastewater is not discharged directly to a local watercourse but to a municipal sewage works or other third party operated treatment plant, the applicant has no control on removal performance or means to obtain final effluent data. The wastewater will be so heavily diluted by effluents from other sources that analysing data at the discharge end of the third party wastewater treatment may be meaningless. However, the third party wastewater treatment plant will have its own final effluent requirements to meet in accordance with regional regulations, these normally apply only to suspended solids, COD or BOD and nitrogen. So it is considered reasonable to request a declaration from the third party treatment plant operator on TSS and COD at least.

8.4 Agglomerated stone

3.1 Energy consumption	
The criterion is not consistent with the EU objectives for renewable energy. Use of renewable electricity produced on-site should be encouraged *Proposal☐0 renewable electricity 0 point,☐20% 5 points,☐50% 15 points,☐100% 25 points*	**Accepted in principle**, but not on the requirement for renewable energy to be on-site only. This approach has been taken now in TR v2.0 for the natural stone transformation plant criteria but not for agglomerated stone, because in TR v2.0, it was proposed to discontinue with criteria for agglomerated stone.
3.3 Recycled/secondary material content	

We support a minimal recycled content in the mandatory criterion because we feel that the "documentation of the availability of recycled material" is not sufficient. The optional criterion with Ecolabel points could be translated into a mandatory requirement and a more ambitious threshold used to get bonus points. We however acknowledge that the recycled materials should be sourced locally to avoid trade-off linked to long transport distances ("trade-off starts when transport distance for recycled aggregates becomes 2-3 times longer than for natural aggregates", as per the Technical report).	**Rejected.** There is a conflict in this comment where on the one hand a mandatory minimum recycled content is requested and on the other, the avoidance of using recycled materials sourced from too far away is acknowledged. The agglomerated stone industry has the potential to use crushed rock that is deliberately quarried or is sourced from irregular blocks from natural stone quarries. In one case it is a virgin raw material and the other it is a secondary material. During the data gathering exercise, the JRC did not receive any feedback about recycled/secondary material content in agglomerated stone, although it was understood that up to 50% is possible with some commercially marketed products. In TR v2.0, no proposal is brought forward for agglomerated stone products since it was proposed to discontinue with this sub-product.

8.5 Ceramic and fired clay products

General	
Second thoughts are needed on the proposal to establish different thresholds and measurement units for thin tiles.	**Acknowledged.** In line with other feedback received, we now distinguish thin format tiles as having a thickness of ≤6mm (as opposed to the initially proposed distinction of ≤10mm). The proposals for energy, CO2 and water consumption are specifically defined in functional units of MJ, kg or L per m2 for thin format tiles and in units of MJ, kg or L per kg for all other formats covered by the scope.
Thinner tiles can have a better performance from the natural resources point of view, but it does not make thinner tiles better than all other tiles. Natural resources are one of the aspects to analyse within a whole life cycle analysis, but many others count; therefore, if a product performs well for one aspect does not make it the best ever, since a complete analysis of the impacts needs to be done. On top of that, thin tiles are products that fit well for wall tiles, since not enough breaking strength is achieved to be used for flooring. This point is important to avoid misunderstanding among users.	**Accepted.** Thin format tiles cannot be used for all of the product functions covered by the hard covering scope. We now have a proposal that makes a clearer distinction between thin format and other tiles, largely inspired by the approach in ISO 17889-1.

Each type of tile needs to achieve the adequate performance for its intended used.	
4.1 Specific kiln energy consumption	
We agree with the mandatory requirement that incentives the Non-use of coal, petroleum coke, light fuel oil and heavy fuel oil for kiln firing. *We will confront with the Italian Ceramic sector with raw data to verify the feasibility of the following proposal" Reduction of specific kiln firing energy production towards a best practice of 1.9 MJ/kg (up to 15 points)"since this score has a big weight on the general scoring system proposed.*	**Accepted.** The non-use of certain fuels in kiln firing has been maintained in the new proposals. **Acknowledged.** We have tried to gather data about energy consumption in ceramic production from stakeholders but without success. But we have been able to use data associated with EU Ecolabel licenses to help better justify our choice of limits.
We suggest to add a point for renewable energy consumption. .	**Need for clarification.** Just one point? For how much renewable energy exactly? The ceramic sector is fuel dominant, so the purchasing of renewable electricity can only bring limited benefits. The use of bio-based fuels is still quite far from being cost-competitive with natural gas and it is uncertain if impurities in these bio-based fuels would adversely impact the process or products.
Regulation 601/2012 is a right reference for calorific values	**Acknowledged.**
CHP is not applicable to kilns, therefore any reference to CHP on this criteria makes no sense and should be deleted; we suggest include instead a point for those installations consuming renewable electricity. Default position is that it should not be included since the primary purpose is electricity generation but perhaps the ETS approach has a different way of interpreting this? The primary purpose of and industrial CHP is not electricity generation but heat generation, electricity generation is a co-product, anyway in any case CHP is not applicable to ceramic kilns.	**Accepted.** A new proposal has been provided in TR v2.0 that does not oblige or directly reward the use of CHP but does indirectly reward it in the sense that generated electricity can be substracted from the total fuel energy consumption.
70 MJ/m2 is rather ambitious it can be raised to 75 MJ/m2 for tiles < 6mm thick (10 mm is not the right threshold).	**Accepted.** The 70 MJ/m2 was proposed by the Italian association and is in line with a recent draft ISO 17889-1 standard for sustainable ceramic tiles but now it has been replaced by 75 MJ/m2 for tiles <6mm thick, with producers needing to lower their actual consumption to 50 MJ/m2 if they wish to obtain maximum points.
The ambition level for specific kiln energy consumption (3.5 MJ/kg) is still ambitious.	**Accepted.** The threshold has been maintained and a threshold of environmental excellence inserted of 2.2 MJ/kg.
No need for clarification on scope of kiln firing needed	**Rejected.** Perhaps not for competent bodies that are experts, but heat flows may be complicated when dryers do not have any significant dedicated burners and in reality a lot of the fuel entering the kiln is used to indirectly heat the

	dryer.
Maximum points for energy consumption should be greater than for other criteria, since energy consumptions is the most relevant in the impacts.	**Acknowledged.** However, care needs to be taken that the ambition level is appropriate for all criteria with points but especially those with more points.
Ceramic tiles products barely can comply with the criterion of 1.9 MJ / kg. The data proposed seems to derives from the preliminary data reported in BREF 2007 related to roller kilns reported for years in which (1997-1998) the production was characterized by large production of lots and by the presence of single firing that required lower cooking temperatures.	**Acknowledged.** It is correct that this is where the 1.9 MJ/kg figure came from. After looking at anonymous EU Ecolabel license holder data, it seems that the 1^{st} quartile value was 2.2 MJ/kg, which could be considered as a suitable threshold for environmental excellence (i.e. for full points).
It is requested to raise the assigned value of 15 points to consumption equal to or less than 3 MJ/kg	**Rejected.** This value does not appear to be sufficiently ambitious, more than 75% of current EU Ecolabel ceramic tiles could be assumed to get full points here. The threshold from maximum points has been raised from 1.9 MJ/kg to 2.2 MJ/kg. Further data is requested if this threshold should be higher.
It is recorded how the market is asking for increasingly customized productions, thus causing a fragmentation of the production lots and consequent an increase in specific energy consumption.	**Acknowledged.** The JRC can accept the point in principle, but would like to know better just how sensitive is the specific kiln energy consumption to the size of the production lot? This was one of the main reasons why a data gathering exercise was carried out but no data was received.
From the analysis of the environmental permits in Italy emerges that the average value of total consumption of natural gas for full cycles is 4.3 MJ/kg (5.8 MJ/kg if there is a production of spray dry for third party) and 3.1 MJ/kg for partial cycle (without the production of spray dry).	**Acknowledged.** Thank you for providing this average data. Would it be possible to see the raw data behind these averages? It is important to define the scope for the EU Ecolabel criteria, which is currently limited to the kiln only and not the spray drier (i.e. the partial cycle). So the average value of 3.1 MJ/kg is actually lower than the EU Ecolabel mandatory requirement, but much higher than the best practice for maximum points of 1.9 MJ/kg. This suggests that the current approach is not unreasonable.
In Italy company can't comply with the criteria of the 10% of fuel from renewable sources.	**Acknowledged.** This was an optional requirement only, for obtaining up to 5 points but has now been removed to better focus the criterion on specific energy consumption.
4.2 Specific freshwater consumption	
We are in line with the Italian Ceramic tiles association to maintain the old criteria that encourage firms to recycle water (R>90%) giving a high scoring point such as 10 points	**Rejected.** Based on other feedback received during the meeting, it was explained that ceramic tile producers now operate closed wastewater circuits (i.e. 100% recycling of wastewater). If this is the standard practice in Europe, this could be considered as a non-criterion in the sense that it does not distinguish any particular producer from others in terms of environmental impacts. Instead we have now moved to a criterion relating to specific freshwater

	consumption that is in line with the draft ISO 17889-1 standard for sustainable ceramic tiles. No points are associated with this criterion now as they have been shifted to the larger environmental impact associated with specific energy consumption, CO2 emissions and other emissions to air.
Should harvested rainwater be specifically exempted from the freshwater calculation or can it already be assumed to be excluded based on the current criterion formulation? *In our opinion any specification helps for a harmonized application of the criteria around the EU.*	**Acknowledged.** In principle, the JRC is of the opinion that any freshwater consumption should only be counted from abstracted water (i.e. from mains, from boreholes or from surface water courses). Any rainwater captured on site for use would not pass through these meters. However, this would need to be discussed and agreed with stakeholders.
Should the applicant be given a choice between the L/m2 or L/kg unit or should the former apply to standard thickness tiles (e.g. ≥10mm) and the latter to thinner format tiles (e.g. <10mm)? *Not sure about the two options given, more information on it has to be gathered from our members, in any case the threshold for thin tiles should be 6 mm.*	**Further discussion needed** at the 2nd AHWG meeting although the 6mm distinction has already been accepted.
Water is an important resource and one of the key materials used for the production of ceramic tiles.☐ We suggest that water recycling ratio (R> 90%) is maintained by assigning a scoring system of 10 points.	**Rejected.** Based on other feedback about the closure of wastewater circuits, it appears that this this a non-criterion now. However, a criterion on process water use has been maintained in the TR v2.0 proposal.
The current proposal does not take into account the production where spry dry is produced for third parties where higher consumptions occur.	**Acknowledged.** The distinction between full and partial cycles (i.e. with or without spray-drying) has been made in line with the approach of the raft ISO 17889-1 standard.
The current proposal does not take into account the production where spry dry is produced for third parties where higher consumptions occurs.☐	**Acknowledged and further discussion welcomed.** The specific freshwater consumption limits differ by a factor of 2 depending on whether spray drying is carried out onsite or not (in-line with the draft ISO 17889-1 standard). However, it is important that the consumption of water for spray drying can be metered separately to the water consumed for ceramic body preparation, otherwise it could be complicated to know how exactly to subtract the water consumed for exported spray dried powder.
4.3 Emissions to air	
The monitoring of the pollutants is not in a continuous way but discontinuous.	**Accepted.** We would like to know the frequency of measurements applied under IT and ES permits.
In ceramic BREF the limit values are referred to 18% O2, and in Spain too.	**Accepted.**
Shaping is "cold process", on the contrary spray drying is not "cold process" since combustion exists.	**Acknowledged but further discussion needed.** This is understandable in principle, but how are dust emissions handled on sites with spray dryers? Is it

	mixed with kiln gases or with cold process gases?
In the ceramic sector the non continual production in not normal, just during the crisis some plants were running with non-continual production.	**Accepted but further discussion welcomed.** How much does continuity of production rates (as a % of full capacity or time of steady conditions) can affect the specific kiln energy consumption (and other non-raw material related emissions like NO_x and CO_2).
The limit values for different pollutants are very stringent, and it is one of the obstacles for ceramic tile producers to apply for Ecolabel. The threshold for thin tiles should be 6mm.	**Acknowledged.** The JRC can accept the point in principle, but would like to know better just how stringent are the limits? The mandatory parts seem to be relatively close to the BREF approaches and the draft ISO 17889-1 standard. Doubts about the appropriateness of the environmental excellence threshold was one of the main reasons why a data gathering exercise was carried out but no data was received. So any data that could be provided to help inform discussions would be much appreciated. The threshold of 6mm has been included in the proposal.
HF emission limit ambition level is too stringent	
NOx limit values on Ecolabel are very demanding for the industry, this is one of the obstacles for its expansion	**Acknowledged.** The JRC can accept the point in principle, but data to support this opinion would be necessary, especially since clean gas values for NO_x from ceramic tile production did not appear to be presented in the 2007 BREF document. An analysis of current anonymous EU Ecolabel license holder data suggests that this might be an issue but a broader data set would be necessary to justify any increase in the limit.
NOx emissions from CHP associated to spray dryers are not an actual problem for the industry.	**Acknowledged**.
No biomass-based CHP exists in the Spanish ceramic industry.	**Acknowledged**.
SO2 is not monitored for CHP.	**Acknowledged**.
No additional contaminants (e.g. HCl) are necessary to be introduced	**Acknowledged.** This would be in line with the general REFIT conclusions to not increase criteria complexity unless some other emission can be flagged up as a major potential environmental impact.
The emissions into the air of NOx and SO2 occurring during the firing stage comes from raw materials and combustion. As N and S compounds naturally occur in the raw materials for ceramic production the companies can only control the combustion phase. The best available technique for ceramic tiles for the fuel used into the firing stage is the use of natural gas that contain the lowest 10 content of S compared to other kind of fuels. ☐The Region Emilia	**Rejected.** The exemption for S emission monitoring just because of the fuel used implies that S emissions due to S content in the raw material is negligible. However, this logic is not in line with the BREF approach to setting significantly different limits of SO_x emission depending on whether the S content is less than or greater than 0.25% as S. At the same point, a wide range of S content in (brick) clays was also reported by BREF (0.01% to 2.05%). So the justification of

Romagna (Italy) in his specification regarding the air threshold associated to BAT indicate that the use of natural gas in the firing stage is a presumption of compliance with the limits of SO2 and therefore no monitoring are needed if only this fuel is used. A similar solution shall be adopted in the revision of Ecolabel criteria for NOx and SO2.□We request an exemption for the monitoring of NOx and SO2 where natural gas as fuel is used.	no monitoring for S based on the fact that natural gas is the kiln fuel does not appear justifiable for EU Ecolabel criteria. For different reasons, exemption from monitoring NOx emissions because natural gas is used as a fuel is not acceptable either. The reason this time is not related to the potential N content in raw materials but instead to the formation of thermal NOx due to the presence of N2 and O2 in combustion air. Thermal NOx formation is especially important at temperatures exceeding 1200°C, which can be achieved in the kiln.
It is required to maintain the 18% oxygen reference. A value equal to 10% would penalize the ceramic productions whose oxygen contents during the firing stage is much higher.	**Accepted.**
4.4 Wastewater management	
A scoring point shall be giving to Wastewater treated onsite to incentive the recycle of water with the hard covering production.	**Rejected.** During the 1^{st} AHWG webinars it was mentioned by industry stakeholders that ceramic tile production is generally using closed loop waste water systems already (see next two comments below). Instead, greater points have been allocated to the specific energy consumption, associated CO2 emissions and other emissions to air.
The actual situation on ceramic sector regarding wastewater treatment is that most of the plants don´t make any discharge to sewage; commonly 100% of waste water is reused. We do not believe that the approach of using or not using glazes is not the right one, since the use of glazes is not a driver to make a good or bad wastewater management.	**Accepted.** A different approach to the waste water criterion has been applied now in TR v2.0 that does not make a distinction for separate flow of glazing waste water.
According to feedback provided by the Italian ceramic producers, Italian manufacturers use water in closed loops, which reduced the adverse impact on water streams. We could have a mandatory criterion on closed loop water use since it seems to be the standard for the industry and would require limited effort for the industrials to comply with this requirement.	**Acknowledged.** The recognition of closed loop waste water systems has now been introduced. Since the feedback is specific to ceramic tile production, an alternative approach remains for brick and roofing tile production, which may have different approaches to waste water management.
The number of points allocated to waste water management is lower than those allocated for air emission. We encourage the JRC to associate more points to water management as it is considered a hotspot for the product category.	**Rejected.** Ceramic tile manufacturers generally use water in closed loops already. While this should be recognised, it appears to be an environmental issue that has largely been resolved. Points should therefore focus on those areas where environmental issues can be improved still (i.e. energy consumption and emissions to air).
We request to enhance the recovery (internal / external) of waste water by providing a scoring of 10 points in order to promote virtuous productions that does not discharge downstream water from the manufacturing process.	
We do not believe that the approach of using or not using glazes is not the right	**Acknowledged.** The proposal in TR v1.0 was in line with upcoming trends

one, since the use of glazes is not a driver to make a good or bad wastewater management.	reported in the 2007 BREF document. However, it seems that the closing of waste water cycles has rendered this potentially good practice as pointless.
The optimization of this resource via internal or external recycle must be awarded.	Point accepted, this comment appears to support the current proposal for criterion 4.5.
4.6 Glazes	
We would delete criteria on glazes, lately the process of glazing is less important since other type of decorations are rising, such as digital printing. We suggest to delete this criteria.	**Further discussion needed.** As long as glazed tiles still represent a significant enough market share, we should maintain some criterion on glaze. It has been proposed to only allow glazes that are not based on Pb or Cd.
We suggest that the criteria will be eliminated as the matter of materials and objects in contact with food (MOCA) is already regulated under Directive 84/500/CEE.	**Accepted.** JRC agrees with this in principle and has removed the migration requirement in the TR v2.0 proposals.
Other	
As the extraction of raw materials is a secondary environmental hotspot for ceramic products (impact on ecosystems), we support a criterion regarding the presence of a rehabilitation plan for quarries (similar to natural stone products)	**Accepted.** This has been reintroduced for all hard covering products in the horizontal criterion 1.2.

8.6 Concrete products

General	
To our opinion, criteria 5.1, 5.3 & 5.4 are overlapping.	**Partially accepted.** The overlap between 5.3 (CO_2/t clinker) and 5.4 (MJ/t clinker) is evident and it makes more sense to continue with criterion 5.3 (broader coverage) and remove criterion 5.4 (narrower focus). The overlap with criterion 5.1 is not so strong though because 5.1 assesses how the environmental impact of cement can be reduced by substituting clinker for other materials whereas 5.3 focuses on lower CO_2 emissions to make the clinker in the first place. For any one particular cement product, either strategy (or both) could be used to reduce its environmental impact.
5.1 Clinker factor	
If the aim of 5.1 is to reduce embodied CO_2, this is covered by 5.3, and 5.1 is redundant.	**Rejected.** This is part of the aim of criterion 5.1. but it is also proposed to be there in order to recognise the environmental benefits of a cement which might have to use a clinker with a relatively high CO_2 content, but only in reduced quantities in

	the cement.
5.2 Non CO2 emissions	
We find that criteria 5.2 is already covered by the implementation of IED requirements by cement producers in the EU. BAT for cement plants are strict and challenging.	**Acknowledged.** Previous experience with other product groups that are covered by the IED (e.g. Pulp and Paper) has revealed that simple compliance with the IED requirements is a basic legal requirement and thus of no value in demonstrating that a particular clinker or cement can be distinguished as being of good or excellent environmental performance, which is the core purpose of the EU Ecolabel. Consequently, it is necessary for the EU Ecolabel to act as a target for those cement producers that wish to distinguish themselves from mere regulatory compliance with IED emissions.
It is also requested to clarify the reference to the conversion from mg / Nm3 to g / t for the clinker (p.82 of the study).	**Misplaced comment? (Appeared in ceramic chapter).** In that case, the conversion from mg/Nm3 to g/t clinker was by multiplying by an assumed specific air flow rate of 2300 Nm3/t clinker. The BREF Document quotes specific air flow rates ranging from 1700 to 2500 Nm3/t.
5.3 CO2 emissions	
Cement plants do not (cannot) publicly disclose CO2/t clinker per plant so this criterion is impossible to apply. The alternative is to disclosure through EPDs at the level of cement, not clinker, which are not available for many types of cement today.	**Acknowledged.** Strange that public disclosure is banned (by whom?). In any case, the JRC wishes to emphasise that data relating to any application for the EU Ecolabel are not publically declared and is covered by a confidentiality agreement between the applicant and the Member State competent authority that will process the application.
If CO2 criteria are applied, they should be on the basis of net emissions, not gross, in order to incentivise use of alternative fuels. A best practice could be the EU ETS benchmark.	**Partially accepted.** CO2 emission limits are now expressed as net emissions. Thresholds have been defined in line with the 1st and 3rd quartiles of EU28 data available from the GNR database rather than the EU ETS benchmark.
JRC sets benchmark for both grey and white cement at 600kg CO2/t clinker, while white cement gross CO2 emissions are much higher than grey (c.a. 200kg CO2/t clinker more).	**Accepted.** This became evident when obtaining the values from the GNR database (e.g. mandatory level 795kgCO2 and 1230kgCO2 for grey clinker and white clinker respectively.
We support the alternative proposal to criterion 5.3 of setting CO2 requirements on the concrete and its performance level.	**Accepted in principle but rejected in practice.** In principle the JRC are not opposed to this, quite the opposite. However, in order for such an approach to be properly done, it will be necessary to know much, much more about the ranges of cement contents in concretes of different performance classes (e.g. EN 1339 breaking load 30, 70, 110, 300) and product types (e.g. masonry units, paving blocks/flags/kerbs and roofing tiles). Any co-operation in gathering this type of information would be much appreciated. If such data cannot be gathered, a requirement at the level of the cement used (i.e. the current proposal) is the most practical alternative.

5.5 Recycled and secondary materials	
Criterion 5.5 should be replaced with responsible sourcing.	**Accepted.** Consultation with the Concrete Sustainability Council has been carried out with a view to finding an acceptable wording and approach. The incorporation of recycled content is still associated with EU Ecolabel points, even though it is accepted that this might not always be the best environmental solution (depends on relative local availability of virgin and recycled materials).
On 5.5 "Recycled material and secondary material at the concrete plant": *o We agree with the mandatory part ("assess and documents").* *o We find that the potential effect on LCA results of using recycled aggregates is correctly discussed.* *o Regarding the points to be given for reaching up to 50% recycled content, this will be difficult to reach due to supply issues and also limits in concrete standards.* *An alternative could be to set a low (e.g. 5%) recycled aggregate content for all concrete produced, average over a year.* *Another alternative would be to set a demanding recycled aggregate requirement only for specific low-strength, unreinforced concrete (in line with national rules).*	**Acknowledged and further discussion welcomed.** The JRC understands that recycled aggregate content is ambitious but wishes to emphasise the voluntary nature of the 50% threshold and the fact that points are awarded for any recycled content in proportion to where it lies on the 0% to 50% scale. Nonetheless, the upper limit for maximum points has now been lowered to 30%. None of the concrete products that could qualify for the EU Ecolabel in this particular product group would be expected to be reinforced or perform any loadbearing function of a building structure. Consequently these two important limitations to the use of recycled aggregate content in concrete (i.e. placement concerns when rebar is used and design uncertainty with structural concrete pours) are not applicable.
We can also support a greater promotion of secondary/recycled material content in products like concreate and agglomerated stone.	**Acknowledged.** However, care needs to be taken to avoid situations where secondary/recycled materials from far away sites are promoted over locally available virgin aggregate.
5.8 Permeable pavements	
It seems strange to apply such a criterion to an ecolabel at the level of a paving unit, when the drainage potential will depend on the entire designed system, not just the paving unit. This is where again a system-approach rather than a product-approach would make more sense.	**Acknowledged.** JRC accepts the point in principle but wishes to state that it is simply not feasible for the EU Ecolabel to extend to the system level for individual installations and projects, due to the excessive assessment and verification costs this would entail. Other benefits such as material efficient products and grass pavers are also being promoted as these products already are distinguishing themselves from other concrete products from an environmental perspective and the EU Ecolabel should recognise that.
Other	
We identify that criteria on water are missing, considering that water resource depletion is an environmental hotspot for the product category.	**Rejected.** The JRC questions this statement, both at the level of the LCA results (i.e. what functional unit was used, were impacts normalized etc.) and the actual scope for water reduction that exists in the concrete industry (water is an essential ingredient in concrete, accounting for up to 10% by mass of the concrete).

9 APPENDIX I. Data gathering questionnaire for ceramics

Introductory text The EU Ecolabel criteria for Hard Coverings, originally published in 2009 in Commission Decision 2009/607/EC, include ceramic floor and wall tiles and paving blocks in their scope. The EU Ecolabel criteria are now being revised and the scope will also include roofing tiles, masonry units and kitchen countertops in addition to ceramic floor and wall tiles and paving blocks. We are looking for data about energy consumption (i.e. rows 14 to 24) and/or emissions to air (i.e. dust, SO2, NOx and HF in rows 32 to 74). Even if data is only available for some emissions to air (e.g. only dust and NOx), it would still be welcome. It is necessary to better nuance the EU Ecolabel criteria for energy consumption since only a single pass-fail value of 3.5 MJ/kg is set for all ceramic products in the scope, regardless of the nature of the ceramic product, the firing temperature or the kiln type. Since the **kiln thermal energy data** is highly specific to the details of the process and is monitored at kiln level and in real time, it is hoped that multiple data sets can be reported for each ceramic production facility (i.e. different data for different kilns on the same site, different data when the maximum firing temperature is changed in the same kiln, different data when the thickness of the fired body changes etc.). This is in contrast to **emission to air data**, which is much more difficult to disaggregate because centralised kiln exhaust gas treatment systems are used. Additional data for different products/kilns/facilities can be submitted in columns G, H etc. simply by copy and pasting column F.	
Cells filled in green should be answered as far as possible. Cells filled in orange are optional. Cells filled in red should not be filled in.	*The cells were conditionally formatted to change colour depending on what options were chosen from drop down menus at previous questions*
Contact email address	
Reference code (for cases where data submissions from different sources are compiled prior to being submitted and more than one submission is associated with the same contact email)	
1. Thermal energy consumption in kilns: *this data should be specific to one kiln and one specific type of ceramic product as far as is possible. Data for different products fired under different conditions in the same kiln can be submitted separately and data for the same product, same kiln but different year can also be submitted separately if significantly different.*	
1.1. What type of kiln technology does the energy data refer to?	
1.1.1. If other, was chosen, please specify here in your own words.	
1.2. What type of ceramic product is being produced?	
1.2.1. If floor or wall tiles are produced, what is the specific thickness/range of thicknesses of the product covered by the reporting data (in mm)?	
1.3. What is the specific density of the ceramic product (**in kg/m2 area covered**)?	
1.4. What is the maximum kiln firing temperature for the product(s) (**in °C**)?	
1.5. Is waste heat from the kiln or any afterburner integrated with the ceramic product drying section (directly or indirectly)?	
1.6. Is waste heat from the kiln, ceramic product drying section or any afterburner integrated with any onsite spray dryers for raw materials?	
1.7. Is waste heat used for any other purposes? If so, please describe briefly.	
1.8. What is the specific fuel consumption of the kiln section for ceramic bodies (**in MJ/kg ceramic product**)?	
1.9. Year that data was collected in:	

2. Emission to air data from kilns: *this data may be averaged across the operation of different kilns on the same site and the production of different ceramic products on that site.*	
2.1. Please describe the main **category of ceramic products** produced at the facility?	
2.2. Emission data is based on the operation of **how many kilns** at the facility?	
2.3. What is/are the **main kiln technology / technologies** used facility?	
2.3.1. If other was selected, please describe the kiln technology in your own words here:	
2.4. **Please describe the exhaust gas abatement system used onsite.** For consistency between different responses, please use the following terminology as far as possible: Cyclone/centrifgual dust separators; bag filters; sintered lamellar filters; wet dust separators; electrostatic precipitators; cascade-type packed adsorbers; module adsorber systems; dry flue gas scrubbing systems (+ scrubbing agent used); wet flue gas scrubbing systems (+ scrubbing agent used);	
2.5. Were emissions of dust from the kiln measured?	
2.5.1. Please state the average dust concentration in the exhaust gas exciting the chimney stack (**in mg/Nm3**):	
2.5.1.1. The average value reported above is:	
2.5.2. Please state the average volume flow rate of the chimney stack (**in Nm3/h**):	
2.5.3. Please state the operation time of the chimney stack (**in h/year**):	
2.5.4. Please state the annual ceramic production (**in m2/year**):	
2.5.5. Please state the annual ceramic production (**in kg/year**):	
2.5.6. Average exhaust gas O2 content (**%**)	
2.5.7. Year that data was collected in:	
Your automatically estimated specific dust emission is (in mg/kg):	**#DIV/0!**
Your automatically estimated specific dust emission is (in mg/m2):	**#DIV/0!**
2.6. Were emissions of SO2 measured?	
2.6.1. What is the average S content of the raw material mix used to prepare ceramic bodies (in % S)?	
2.6.2. Please state the average SO2 concentration in the exhaust gas exciting the chimney stack (**in mg/Nm3**):	
2.6.2.1. The average value reported above is:	
2.6.3. Please state the average volume flow rate of the chimney stack (**in Nm3/h**):	
2.6.4. Please state the operation time of the chimney stack (**in h/year**):	
2.6.5. Please state the annual ceramic production (**in m2/year**):	
2.6.6. Please state the annual ceramic production (**in kg/year**):	
2.6.7. Average exhaust gas O2 content (**%**)	
2.6.8. Year that data was collected in:	
Your automatically estimated specific SO2 emission is (in mg/kg):	**#DIV/0!**

Your automatically calculated specific SO2 emission is (in mg/m2):	#DIV/0!
2.7. Were emissions of NOx measured?	
2.7.1. Please state the average NO2 concentration in the exhaust gas exciting the chimney stack (**in mg/Nm3**):	
2.7.1.1. The average value reported above is:	
2.7.2. Please state the average volume flow rate of the chimney stack (**in Nm3/h**):	
2.7.3. Please state the operation time of the chimney stack (**in h/year**):	
2.7.4. Please state the annual ceramic production (**in m2/year**):	
2.7.5. Please state the annual ceramic production (**in kg/year**):	
2.7.6. Average exhaust gas O2 content (**%**)	
2.7.7. Year that data was collected in:	
Your automatically estimated specific NOx emission is (in mg/kg):	#DIV/0!
Your automatically calculated specific NOx emission is (in mg/m2):	#DIV/0!
2.8. Were emissions of HF measured?	
2.8.1. What is the average F content of the raw material mix used to prepare ceramic bodies (in % F)?	
2.8.2. Please state the average HF concentration in the exhaust gas exciting the chimney stack (**in mg/Nm3**):	
2.8.2.1. The average value reported above is:	
2.6.3. Please state the average volume flow rate of the chimney stack (**in Nm3/h**):	
2.6.4. Please state the operation time of the chimney stack (**in h/year**):	
2.6.5. Please state the annual ceramic production (**in m2/year**):	
2.6.6. Please state the annual ceramic production (**in kg/year**):	
2.6.7. Average exhaust gas O2 content (**%**)	
2.6.8. Year that data was collected in:	
Your automatically estimated specific HF emission is (in mg/kg):	#DIV/0!
Your automatically calculated specific HF emission is (in mg/m2):	#DIV/0!

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