Methodology for the free allocation of emission allowances in the EU ETS post 2012

Sector report for the ceramics industry

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Disclaimer and acknowledgements

Disclaimer

The views expressed in this study represent only the views of the authors and not those of the European Commission. The focus of this study is on preparing a first blueprint of an allocation methodology for free allocation of emission allowances under the EU Emission Trading Scheme for the period 2013 – 2020 for installations in the ceramic industry. The report should be read in conjunction with the report on the project approach and general issues. This sector report has been written by Ecofys.

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1 Introduction

The ceramic manufacturing industry produces ceramic products, which are inorganic materials (with possibly some organic content) made up of non-metallic compounds and made permanent by a firing process. In addition to clay based materials, today ceramics include a multitude of products with a small fraction of clay or none at all.

In order to acquire information on the ceramic manufacturing industry, Ecofys has been in contact with the Cerame Unie which is an umbrella organization of eight ceramics sector organization. Ecofys has been in contact with three of these organizations: the European Tiles & Bricks Producers' Federation (TBE), the European Ceramic Tile Manufacturers' Federation (CET), the European Refractories Producers Federation (PRE).

Table 1 provides an overview of the classification of the ceramic industry in relevant activity classifications. The ceramic industry is associated with one category of activities in the Annex I to original[1] and amended[2] Greenhouse Gas Emission Allowance Trading Directive, which will be referred to as the Directive. In the NACE Rev. 1.1, classification of economic activities, the sector is associated with eight four-digit codes.

Table 1 Classification of the ceramic industry in the categories of activities of the Annex I of the Directive and in the NACE Rev. 1.1 classification of economic activities

Category of activities according to Annex I to the original Directive	**NACE Rev. 1.1 code**	**Description (NACE Rev. 1.1)**
Installations for the manufacture of ceramic products by firing, in particular roofing tiles, bricks, refractory bricks, tiles, stoneware or porcelain, with a production capacity exceeding 75 tonnes per day, and/or with a kiln capacity exceeding 4 m^3 and with a setting density per kiln exceeding 300 kg/m^3		
Category of activities according to Annex I to the amended Directive		
Manufacture of ceramic products by firing, in particular roofing tiles, bricks, refractory bricks, tiles, stoneware or porcelain, with a production capacity exceeding 75 tonnes per day	26.21	Manufacture of ceramic household and ornamental articles
	26.22	Manufacture of ceramic sanitary fixtures
	26.23	Manufacture of ceramic insulators and insulating fittings

[1] Directive 2003/87/EC
[2] Directive 2009/29/EC amending Directive 2003/87/EC

Continuation Table 1

Manufacture of ceramic products by firing, in particular roofing tiles, bricks, refractory bricks, tiles, stoneware or porcelain, with a production capacity exceeding 75 tonnes per day	26.24	Manufacture of other technical ceramic products
	26.25	Manufacture of other ceramic products
	26.26	Manufacture of refractory ceramic products
	26.30	Manufacture of ceramic tiles and flags
	26.40	Manufacture of bricks, tiles and construction products, in baked clay

There are currently 1097 open accounts in EU27 registered in the Community Independent Transaction Log (CITL) that are specified in the original Annex I category of activities associated with the ceramic manufacturing industry (CITL, 2009a). As a result of the change in definition of ceramic installations in Annex I this number will increase to around 2000 (Cerame Unie, 2009c). No information is available on the number of ceramic producing installations that are not covered by the ETS, because of their limited size. Many ceramic installations have annual emissions below 25 kt CO_2 and could be opted-out out by Member States in the next EU ETS trading phase, e.g. regarding bricks and roof tile production, 90% of installations in Spain and 60% of installations in France have annual emissions below 25 kt CO_2 (TBE, 2009a). Table 2 shows the distribution of installations included in the ETS producing ceramic products per MS and Norway.

Table 2 Number of installations producing ceramic products per country (CITL, 2009a)

Country	No. of installations	Country	No. of installations
Austria	33	Italy	35
Belgium	34	Latvia	6
Bulgaria	21	Lithuania	8
Cyprus	8	Netherlands	42
Czech Republic	64	Norway	3
Denmark	25	Poland	50
Estonia	2	Portugal	70
Finland	4	Romania	32
France	51	Slovakia	11
Germany	138	Slovenia	9
Greece	45	Spain	287
Hungary	43	Sweden	5
Ireland	3	United Kingdom	70

Table 3 lists the allocated allowances and verified EU27 emissions of greenhouse gasses (GHGs) of the ceramics industry from 2005 onwards. According to estimates of Cerame Unie (2009c) as of 2013 the total emissions for ceramic installations in the ETS will increase to around 26.5 Mt CO_2 eq. Information on which emissions are included and how they were determined can be found in the guidelines for monitoring and reporting of GHG emissions[3]; in particular Annex X: 'Activity-specific guidelines for installations for the manufacture of ceramic products…'

Table 3 Allocated allowances and estimated EU emissions of greenhouse gasses (GHGs) for the ceramic sector from 2005 onwards (CITL, 2009a,b)

	'Ceramic products by firing'	
Year	**Allocated allowances ($Mt CO_2$ eq.)**	**Verified emissions ($Mt CO_2$ eq.)**
2005	18.0	14.7
2006	18.1	14.9
2007	18.3	14.8
2008	18.1	13.0

[3] Commission Decision 2007/589/EC

2 Production process and GHG emissions

The manufacture of ceramic products takes place in different types of kilns, with a wide range of raw materials and in numerous shapes, sizes and colours. The general process of manufacturing ceramic products, however, is rather uniform, and largely independent of the materials used and the final product (BREF Ceramics, 2007).

Figure 1 shows schematically the typical process and possible or necessary supply and disposal facilities.

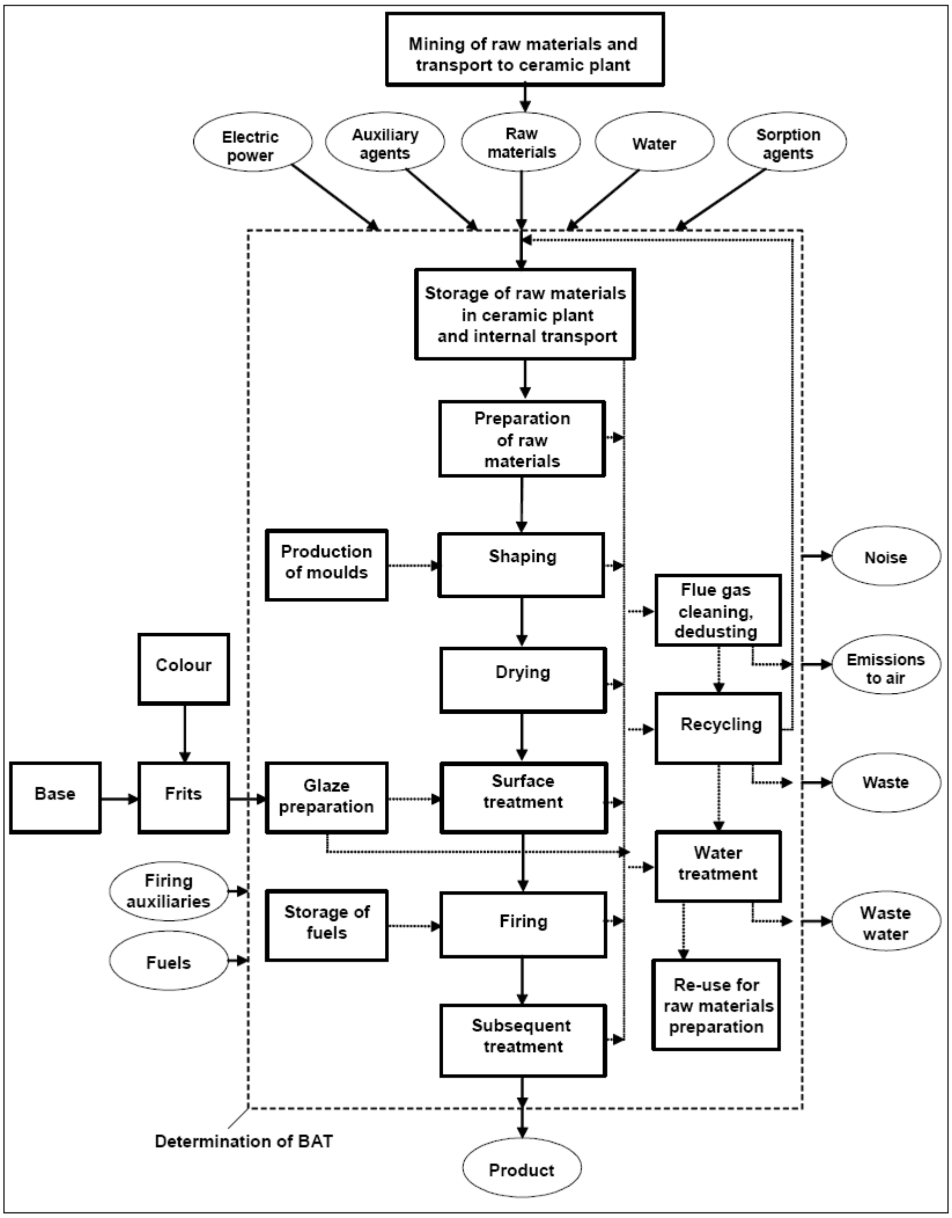

Figure 1 Stages in the manufacture of ceramic products (BREF Ceramics, 2007)

The following main process steps can be distinguished (Enviros Consulting Limited, 2006):

1. Raw material preparation
2. Component mixing
3. Forming and shaping of ware
4. Drying of ware
5. Firing of ware
6. Product finishing
7. Addition of auxiliary materials

In general, raw materials are mixed and cast, pressed or extruded into shape. Water is regularly used for a thorough mixing and shaping. This water is evaporated in dryers and the products are either placed by hand in the kiln (especially in the case of periodically operated kilns) or placed onto carriages that are transferred through continuously operated kilns (BREF Ceramics, 2007).

Over 70% of the emissions from the ceramic manufacturing industry are created in the firing process (Ceram data in BREF Ceramics, 2007). Carbon dioxide arises from the combustion of fuel in the kiln, from calcinations of limestone or dolomite in the raw material and from limestone, which is used to reduce air pollutants (Enviros Consulting Limited, 2006). Process emissions are dependent on the mineral composition of the raw materials, which in most cases consists mainly of the locally available clay. Process emissions vary between product groups, mostly due to the mineral composition of the clay and the raw material mix.

Table 4 shows the specific energy consumption in the ceramics industry in Europe:

Table 4 Specific energy consumption in the ceramics industry in Europe in 2003 (BREF Ceramics, 2007)

Sector	**Specific energy consumption (GJ/t)**
Bricks and roof tiles	2.31
Wall and floor tiles	5.60[1]
Refractory products	5.57
Sanitary ware	21.87
Vitrified clay pipes	5.23
Table- and ornamental ware	45.18
Technical ceramics	50.39

[1] Cerame Unie indicated that this figure only includes drying and firing

The fuels employed in the drying and firing operations are mainly natural gas, liquefied petroleum gas (propane and butane) and fuel oil extra light (EL). Heavy fuel oil, liquefied natural gas (LNG), biogas/biomass, electricity and solid fuels (e.g. coal, petroleum coke) can also play a role as energy sources for burners. The use of heavy fuel oil, coal and petroleum coke is limited mainly to brickworks (BREF Ceramics, 2007).

3 Benchmarking methodology

3.1 Background

The ceramics industry produces a large variety of different products for different applications. PRODCOM 2007 lists 17 six-digit and 48 eight-digit ceramic products (see appendix A). The reference document on best available techniques distinguishes nine sub-sectors of ceramic products (BREF Ceramics, 2007; pp. 6):

1. bricks and roof tiles
2. wall and floor tiles
3. refractory products
4. expanded clay aggregates
5. vitrified clay pipes
6. table- and ornamental ware
7. sanitary ware
8. technical ceramics
9. inorganic bonded adhesive

The energy consumption associated with product group was estimated using EU15 production data and the specific energy consumption in the year 2000 as reported in the reference document on best available techniques (BREF Ceramics ,2007) (see Table 5).

Table 5 Estimation of share of energy consumption of sub-sectors for EU15 in the year 2000 (BREF Ceramics, 2007)

Sub-sector	Production (Mt)	Specific energy consumption (GJ/t)	Energy consumption (TJ)	Relative share of energy consumption
Bricks and roof tiles	55	238	130.9	38%
Wall and floor tiles	25	5.74[1]	143.5	42%
Refractory products	4.5	5.41	24.345	7%
Sanitary ware	0.5	20.88	10.44	3%
Vitrified clay pipes	0.7	6.10	4.27	1%
Table- and ornamental ware	0.5	43.46	21.73	6%
Technical ceramics	0.15	34.72	5,208	2%
Expanded clay aggregates (2002)	3.0			
Inorganic bonded abrasives (2003)	0.04			
Total			**340**	**100%**

[1] Cerame Unie indicated that this figure only includes drying and firing

Based on the estimated shares of energy consumption as given in Table 5, and discussion with Cerame Unie (TBE, 2009a), the first three groups in this list are expected to account for close to 80% of the emissions of the total ceramic manufacturing sector. The first two groups, bricks and roof tiles and wall and floor tiles, together account for about two-thirds of emissions, wall and floor tiles accounting for a slightly larger share (TBE, 2009a). The emissions from the refractory industry covered by the ETS account for about 5% of total ceramic industry emissions covered by the ETS (Cerame Unie, 2009d). Note that these shares of emissions are estimates for the total European ceramic industry. Shares of emissions within framework of the EU-ETS may differ because of opt-out of small installations

In section 4.4.3 of the report on the project approach and general issues, we discuss the issue of product differentiation and give some guidance on how many products to distinguish. Criteria to distinguish products as proposed in that section are related to the amount of emissions associated with a certain product, the difference in emission intensity compared to other products, the number of installations that produce a product, the existence of a clear product differentiation and whether a product is sold as an intermediate product. In case of the ceramic sector, we found that that there was a need to provide some additional guidance on product differentiation based on physical properties.

There are different considerations that play a role when distinguishing products. Apart from the ones described in section 4.4.3 of the report on the project approach and general issues and the ones that will not be take into account in accordance with the principles as laid down in section 4.4 of the report on the project approach and general issues (e.g. production technology, raw material input), we encountered three arguments to distinguish products within groups that can be distinguished based on the general type of application (e.g. bricks versus floor tiles): difference in material characteristics (e.g. density, frost resistance), difference in specific application, and appearance (shape and aesthetics). Although we acknowledge differences in the specific application of products, we aim to use that argument only in an indirect way, since in our line of thought it should be covered by the other two: the material characteristics and appearance make a product more suitable for a particular application.

We choose only to take differences in material characteristics and difference in appearance in account if they make a product more suitable for a particular application in terms of technical requirements. Consequently, we will not distinguish products on the basis of aesthetical differences. That way, products with a similar quality, but higher carbon intensity because of an aesthetic feature will be more expensive to produce, thereby providing an incentive to produce products with lower carbon intensity.

In the following sections, product differentiation following the approach described above will be discussed for the main subsectors.

3.2 Bricks and roof tiles

The products produced by bricks and roof tiles manufacturers can be grouped in different ways. Table 6 gives an overview of different ways of distinguishing main product groups. In the text below, the main product groups according to the grouping used by TBE will be discussed in more detail. Unless noted otherwise, information was provided by TBE.

Table 6 Overview of ways to distinguish main product groups

BREF Ceramics (2007)	TBE	PRODCOM 2007[1]
Building bricks	Clay blocks Facing bricks	26.40.11.10
Roof tiles	Roof tiles	26.40.11.30
Paving bricks	Pavers	26.40.11.30
Chimney bricks	Ceramic accessories	26.40.12.70

[1]See appendix A for descriptions

Clay blocks

A clay block is a perforated component intended for use in masonry construction made from clay or other argillaceous materials with or without sand, or other additives fired at a sufficiently high temperature to achieve a ceramic bond. These products are only used for applications, where they are protected against water penetration and include all wall or structural clay masonry units that are not used as facing bricks. A distinction is made between two main geometrical configurations: blocks with horizontal perforation and blocks with vertical perforation.

Specification for masonry units-Part 1 Clay masonry units EN 771-1 April 2003 distinguishes the following types of masonry units:

A) LD Units: comprising clay masonry units with a gross density of less than or equal to 1000 kg/m^3 for use in protected masonry (called ”Clay blocs LD”)

B) HD Units: Comprising

B.1: All clay masonry units for use in unprotected masonry (called “Facing Bricks”)

B.2: clay masonry units with a gross density of greater than 1000kg/m^3 for use in protected masonry. (called “HD Clay blocs”)

A further division can be made in the following product categories:

- Lightweight clay blocks: with excellent insulation and high porosity, low compressive strength (normally <10 N/mm^2) gross dry density < 1000 kg/m^3 (LD category according to EN 771-1). These clay blocks are usually applied for monolithic external walls. Such lightweight clay blocks are used for protected masonry (e.g. external rendering). High porosity can be caused by the presence of poreforming agents present in the clay, e.g. carbonaceous shale, or by additives to enhance the porosity, e.g. sawdust and cellulose fibres. Apart from increasing the porosity of blocks lightness can also be achieved by geometry (big holes, very thin shells, and webs). Blocks that are lightweight because of their geometry are used for infill masonry and are typical for southern Europe. Blocks that are lightweight because of added biogenic material are used for highly thermal insulating masonry and are typical for central and eastern Europe. The use of biogenic poreformers leads to lower specific fossil fuel consumption, because of the energy input associated with these additives.

- Ordinary clay blocks: With a low porosity. These blocks belong either to the LD or HD category according to EN 771-1 and are generally used in walls with external or internal additional insulation.
- Heavy clay blocks: with high mechanical resistance, high compressive strength (normally > 10 N/mm^2), high thermal capacity, high acoustic insulation); either infill blocks or perforated blocks with a low percentage of voids, no poreforming agents, gross dry density > 1000 kg/m^3 (HD according to EN 771-1). These clay blocks are usually applied for the inner leaf in cavity wall constructions with facing bricks for the outer leaf and also for internal partition walls (acoustic performance).
- Floor slabs and floor blocks: clay blocks used in conjunction with beams in compliance with EN 15037-1 and/or cast-in-situ concrete (topping) for the construction of beam-and-block floor systems. Also, clay floor slabs with infill blocks for beam and block floor systems in many different sizes and shapes according to EN 15037-2.
- Roof boarding sarking: clay units used for the massive underconstruction of clay roofs.

Facing bricks

Facing bricks are used for the outer leaf of buildings with cavity walls. Such facing bricks are used for unprotected masonry and therefore need to be frost-resistant. They also play an important role in the aesthetics of the building (architectural styles, colour combinations etc.). Facing Bricks exist in different colours, which results in a significantly different energy consumption and fuel CO_2 emission due to different firing temperatures and in a different process CO_2 emission due to different carbon and different lime (CaO) content in the clay as well as significantly different iron or to lime (Fe_2O_3/CaO) ratios. These different colours are closely related to local availability of raw materials (types of clays), local wishes and building traditions from planners and costumers. Four basic colours can be distinguished: red, yellow, white and blue.

- Red, rosé and yellow colours and other shades: the Fe_20_3/CaO-ratio in the raw materials mix can vary significantly, usually with a higher $CaCO_3$ content for rosé or yellow colours. Firing temperatures also vary significantly between 1000 and 1150°C, strongly influenced by both the iron (Fe_2O_3) and the lime ($CaCO_3$) content. A higher carbon and/or lime content results in higher energy consumption and higher specific CO_2 output. To produce a specific locally requested colour can therefore result in a significantly higher process CO_2 output of up to approx. +100 kg process CO_2/ton and to a significantly higher energy consumption of approx. +10 Nm^3 gas/1000 bricks or approximately +47 kWh/ton compared to "standard" bricks.
- White colours: firing temperature between 1150°C and 1200°C with approx. +30 Nm^3 gas/1000 bricks or +120 kWh/ton in comparison to red bricks.
- Blue colours: braised facing bricks, fired in high reduced atmosphere and significantly higher temperature; mostly in intermittent chamber kilns with higher specific energy consumption (approximately +60 Nm^3/1000 bricks or +250 kWh/ton in comparison to plain red bricks).

Pavers

In general the features that are mentioned above to distinguish between the various types of facing bricks will also apply to pavers. Pavers have a significantly different product performance; they have a higher compressive strength, a lower porosity, lower water absorption and higher abrasion resistance. To be frost resistant pavers are usually fired at higher temperatures resulting into approximately +30 Nm^3 gas /1000WF or 130 kWh/ton compared to fired facing bricks. Pavers exist in different colours such as red, yellow, and blue braised.

Roof tiles

In EN 1304:2005 requirements for clay roofing tiles and fittings for pitched roof coverings and wall cladding and lining, the following types of tiles are defined:

A) Special tiles: tiles made to shapes that vary from tile to tile for aesthetic reasons.
B) Interlocking tiles with sidelock and/or headlock: tiles pressed in moulds in different sizes from approx. 8 pieces/m^2 to 25 pieces/m^2:
    - B.1 large sized interlocking tiles < 12 pieces/m^2
    - B.2 medium sized interlocking tiles: 12-17 pieces/m^2
    - B.3 small sized interlocking tiles: > 17 pieces/m^2
C) Plain tiles: tiles usually with a flat surface that can be slightly cross cambered and/or longitudinally cambered and which have no interlocking system;
D) Overlapping tiles: tiles which have no side or headlock and are profiled in an "S" shape.
E) Over and under tiles: tiles with the shape of a gutter whose design makes it possible either to fix them with variable headlaps or where their headlap is fixed due to the presence of lugs on the tiles. They are made with their edges either parallel or forming a cone;
F) Clay roofing fittings: products that are complementary to the tiles have complex shapes and have a technical function.

Roof tiles are produced with three purposes in mind:

1. Roof-covering with weathering protection. The diversity of climatic conditions throughout Europe explains the diversity of roof tile characteristics according to the regional requirements. The major climatic aggression to which roof tiles are exposed is frost. The recent European standardisation for CE marking fixed a common method to measure frost resistance all over Europe, but allowed for each Member State to fix the minimum requirement for its domestic market. These minimum requirements throughout Europe (50 freeze-thaw cycles in the South of Europe, 150 cycles in the North). Frost resistance is directly connected to firing temperature of the tiles and hence to energy consumption and CO_2 emissions. Roof tiles close to the seaside have to resist aggression by saline atmospheres. Increasing this specific quality also depends on increasing the firing temperature.

   In the South of Europe roofs are low pitched. Therefore roof tiles have a highly curved design to drain rainwater coming in short but with heavy showers. Roof tiles are either Roman tiles (the traditional type) or curved interlocking tiles reproducing the aspect of Roman tiles, usually with big sizes (<15 pieces/m^2). In the North of Europe, roofs have a high pitch. Therefore roof tiles are plain tiles (the traditional type), or interlocking tiles with shapes varying from curved to totally flat.

2. Aesthetics of the building i.e. architectural styles with different colours, shapes, dimensions
3. Renovation and maintenance purposes i.e. repair of old and protected historic buildings with existing or new roof tile shapes. Roughly half of the market for roof tiles is for repair - therefore old shapes and colours have to be produced beside newer models. Many urban planning regulations also impose the use of "historical" types of roof tiles even for new buildings.

The quality standards and different colours are materialized during the firing process of the roof tiles with the support of refractory firing accessories such as U- or H-setters. The relation between the weight of the refractory support (cassettes) and the weight of the roof tiles significantly influence the energy consumption and consequently the emissions. Glazed roof tiles are better protected against damage in the kiln when H-cassettes are used, but the use of these H-cassettes leads to lower setting density and higher specific emissions.

Ceramic accessories
The following products can be considered to be accessories that can not be included in any of the other groups based on their specific application and shape:

- Cladding products: the increased use of thermal insulation placed on the outside of building walls and frame construction buildings has led manufacturers of clay products to develop cladding elements which are able to protect the specific thermal insulation used and the outer coating. Several solutions based on fired clay products are available on the market.
- Flue blocks for chimneys: flue blocks are fired clay components that can be used to put up chimneys. The product is mainly used in France and Italy.
- Very long bricks (also known as storey-height bricks)
- Clay shells for beams and lintels: Shells for beams of beam and block floor systems and for lintels. These shells are filled with either reinforced or prestressed concrete.

Final proposal for products to be distinguished

Having looked at the information send to us by TBE, taking into account the existence of product classifications and following our approach described in section 3.1, we propose distinguishing the following product groups:

- Clay blocks: two products groups: LD units (<1000 kg/m^3) and HD units (>1000 kg/m^3) used for protected masonry based on EN 771-1; This differentiation is justified based on the different material properties of the product groups, most notably porosity, which make them better suited for particular applications. No classification was found to distinguish more products. Also, we do not distinguish product based on a difference in application only.

- Facing bricks: one product group; HD units (>1000 kg/m^3) used for unprotected masonry based on EN 771-1. We propose not to distinguish types of bricks based on colour in accordance with our approach not to distinguish products based on aesthetics differences alone (see section 3.1). Another reason not to distinguish types of bricks based on colour is that no unambiguous product classification exists that takes into account difference on colour.
- Pavers: one product group. As for bricks, we propose not to distinguish types of pavers based on colour.
- Roof tiles: In accordance with our approach not to distinguish products based on aesthetics differences alone (see section 3.1), we propose not to distinguish types of roof tiles based on colour or shape of roof tile due to roof pitch. A differentiation based on frost resistance and resistance to saline atmospheres could be justified since these features of roof tiles can be regarded as material characteristics that make a product more suitable for a particular application in terms of technical requirements. Differentiation can be based on classes and types of tiles as defined in EN 1304:2005. We propose to regard clay roofing fittings (defined in EN 1304:2005) as speciality products since they have very specific shapes needed for specific applications. (see below).
- A speciality group including ceramics accessories (cladding products, flue blocks for chimneys, very long bricks, clay shells for beams and lintels) and clay roof fittings. These products are in this group since they have very specific shapes needed for specific applications.

The availability of more information could lead to the insight that it would be appropriate to distinguish more products or that there are products within the first four product groups that should be regarded as specialties. It is stressed that the present differentiation of product groups follows from the approach as described in section 3.1.

3.3 Wall and floor tiles

The description below is based on information from Cerame Unie (2009b). The European Standard that defines and gives terms, requirements and marking criteria for ceramic tiles (produced by extrusion and dust pressing techniques) is EN 14411 "Ceramic tiles – Definitions, classification, characteristics and marking".

This standard defines "ceramic tiles" as follows: *Thin slabs made from clays and/or other inorganic raw materials, generally used as coverings for floor and walls, usually shaped by extruding (A) or pressing (B) at room temperature but may be formed by other processes (C), then dried and subsequently fired at temperatures sufficient to develop the required properties, tiles can be glazed (GL) or unglazed (UGL) and are incombustible and unaffected by light.*

Ceramic tiles can be divided into groups according to their method of manufacture and their water absorption:

Methods of manufacture:

- A Extruded tiles
- B Dry-pressed tiles

Water absorption (E):

- Group I: Tiles of low water absorption ($E \leq 3\%$)
  - a) $E \leq 0,5$ %
  - b) $0.5\% \leq E \leq 3\%$
- Group II: Tiles of medium water absorption ($3\% \leq E \leq 10\%$)
  - a) $3\% \leq E \leq 6\%$
  - b) $6\% \leq E \leq 10\%$
- Group III: Tiles of high water absorption ($E \geq 10\%$)

The majority of the European wall and floor tile production is shaped by dry-pressing. Dry-pressed tiles can be divided in wall tiles and floor tiles by considering differences in water absorption: larger than 10% for wall tiles[4] (Group III) and smaller than 10% for floor tiles (Groups I and II). The characteristic of the water absorption or porosity of the ceramic tiles provides information on the mechanical resistance of the tiles: the lower the water absorption or porosity of the tile, the higher is its mechanical resistance. The main properties of wall and floor tiles that distinguish them from one another are:

Wall tiles:

- Thickness < 10 mm; water absorption between 11-15%; breaking strength 300-1200N; not frost resistant.
- Wall tiles can only be used as coverings for internal walls.

Floor tiles:

- Thickness > 8 mm; water absorption between 0.1- 6%; breaking strength 1000-5000N; those with low water absorption are frost resistant.
- Floor tiles can be used as a covering for internal and external walls, internal or external floor, and special uses, since they have better technical properties. Floor tiles that have lower water absorption can be used for external uses, and the ones that have medium water absorption only can be used for internal residential and commercial floorings.

In manufacturing plants of wall and floor tiles different types of products are manufactured at the same time, and no information on energy consumption per type of tile is available. As a consequence, no information on energy consumption and CO_2 emissions per type of product is available at installation level. However, it is known from a technical point of view that wall tiles consume more energy in the firing stage than floor tiles:

- Although the production of wall tiles requires lower temperatures and the firing cycle can be shorter, the raw materials contain more carbonates than those used for floor tiles: on average 10% for porous wall tiles and 1% for vitrified floor tiles (Timellini

[4] Although this distinction related to water absorption is considered to be a general rule, in some cases ceramic tiles with water absorption >10% are also adequate for flooring.

& Blasco-Fuentes, 1993). Since the decomposition of carbonates is an endothermic reaction, it leads to an increased need for energy input.

- The average density of floor tiles in the furnace is higher than that of wall tiles. Therefore, during firing, a smaller share of energy is wasted per tonne product to heat the kiln interior (walls and furniture such as kiln cars).
- The higher content of carbonates also leads to higher process emissions: process emissions for wall tiles usually represent about 25% of total emissions, while for floor tiles this share is about 5-10%.

Apart from the end-products discussed above, the production of dry-pressed ceramic tiles also entails an intermediate sold product: spray dried powder which is obtained in the first step of the manufacturing process. There are no codified standards for this product. At European level there is no information available on the CO_2 emissions per process step. However, based on data of the most significant Italian plants in terms of energy requirements (BREF Ceramics, 2007) and an estimation of the Spanish National Association of Manufacturers following an internal survey (Cerame Unie, 2009d), the emissions from spray drying are considered to account for about 30% of the total emissions due to dry-pressed ceramic tile production, using natural gas consumption data. Spray dried powder production may involve cogeneration, which is commonly done by using the exhaust gases in natural gas turbines.

Extruded tiles are rustic tiles and are thicker than dry-pressed tiles. They are normally used as flooring in terraces and balconies, but can also be used in industrial areas. Energy consumption for extruded tiles is 2 to 3 times as high as for dry-pressed ones. Extruded ceramic tiles account for about 5% of the total emissions from ceramic tiles production (Cerame Unie, 2009d).

Final proposal for products to be distinguished

For wall and floor tiles there is a clear product classification. Dry-pressed wall tiles and dry-pressed floor tiles are distinguished based on a difference in water absorption which are material characteristics. Based on Cerame Unie (2009b) we conclude that these two products would account for the great majority of the emissions from ceramic tile production.

As explained in the previous section, the production of wall and floor tiles also entails the production of an intermediate sold product: spray dried powder. Following the principle to use separate benchmarks for intermediate products (see section 4.4 of the report on the project approach and general issues), we propose not to include the production of spray dried powder in the end-product benchmark(s) for ceramic tiles and to consider it as a separate product.

Apart from the production of dry-pressed tiles, the subsector wall tiles and floor tiles also covers the production of extruded tiles. The difference between dry-pressed tiles and tiles is amongst others related to process technology. Distinguishing extruded tiles as a separate product based on the difference in process technology employed would however not be in line with the principles laid down in section 4.4 of the report on the project approach and general issues. Another difference between extruded tiles and dry-pressed tiles is thickness: extruded tiles are thicker than dry-pressed tiles. However, since we consider thickness to be an aesthetic feature, distinguishing extruded tiles as a separate product group based on a difference in thickness would not be in line with the approach to distinguish products as outlined in section 3.1. One argument to define extruded tiles as a separate product is that some extruded products -such as angles, pieces for stairs, and all types of peaces- can not be produced by dry-pressing (Cerame Unie, 2009b).

Regardless of the discussion in the previous paragraph, we propose to consider extruded tiles as a separate product group, since the production of extruded tiles does not require spray dried powder production, whereas the production of dry-pressed tiles does. As a consequence, a single benchmark for dry-pressed tile production and extruded tiles production would not be appropriate: for dry-pressed tiles the benchmark would account for part of the production process to come to an end-product, whereas for extruded tiles it would account for the whole production process. Because of the small amount of emissions associated with the production of extruded tiles (5% of the total emissions from ceramic tiles production) and the limited amount of data available, we propose to group extruded tiles together with specialty products.

3.4 Refractory products

The refractory industry is characterized by a very wide variety of products with different shapes and technical characteristics required for the different applications in which these products are used. Refractory products are used in all industrial processes where temperatures exceed 600°C. PRODCOM 2007 lists 3 six-digit and 10 eight-digit refractory products. In terms of 6-digit PRODCOM 2007 codes, the refractory industry produces the following products:

- PRODCOM 26.26.11: Bricks, blocks, tiles and other ceramic goods of siliceous fossil meals (for example, kieselguhr, tripolite or diatomite) or of similar siliceous earths
- PRODCOM 26.26.12: Refractory bricks, blocks, tiles and similar refractory ceramic constructional goods, other than those of siliceous fossil meals or similar siliceous earths.
- PRODCOM 26.26.14: Other refractory ceramic goods (for example, retorts, crucibles, muffles, nozzles, plugs, supports, cupels, tubes, pipes, sheaths and rods), other than those of siliceous fossil meals or of similar siliceous earths.

The products in the latter group are diverse in terms of their shape which is generally a more complex shape than the products in the other two groups. They will therefore typically have a lower setting density resulting in higher energy consumption and higher emissions.

A classification between low-heat resistant and high-heat resistant products is based on the ISO standard R836 from 1968, which was revised in 2001 (ISO 836:2001). This standard on “terminology for refractories” is based on the German standard DIN 51060 and defines the following categories:

- Heat resistant products: firing temperature < 1500°C
- Refractory products: firing temperature > 1500°C
- Highly refractory products: firing temperature > 1800°C

Final proposal for products to be distinguished

For refractory products there are clear product classifications based on the Combined Nomenclature/PRODCOM and on the firing temperature. We propose to distinguish three product groups:

- PRODCOM 26.26.11 and 26.26.12: High-heat resistant products: firing temperature >1500°C (based on ISO 836:2001)
- PRODCOM 26.26.11 and 26.26.12: Low-heat resistant products: firing temperature <1500°C (based on ISO 836:2001)
- PRODCOM 26.26.14: Other refractory ceramic goods.

The differentiation between the first two groups is based on a difference in material characteristics and that of the latter product group on a difference in shape. Table 7 provides an overview of the emissions, number of installations and production volumes for the first two product groups which together account for 70%-80% of total refractory emissions (PRE, 2009). When interpreting this table, note that some installations produce both high-heat and low-heat resistant products. No data was available for the third product group.

Table 7 Emissions, number of installations, and production volumes from high-heat and low-heat resistant products. Figures are estimates by Cerame Unie (2009d) and are representative for the situation in 2008.

	Emissions (Mt CO_2-eq)	**No. of installations**	**Production (Mt)**
High-heat resistant products	0.2	40	0.4
Low-heat resistant products	0.4	60	1.5

3.5 Other products

Because of the great diversity of products in the remaining groups in combination with the limited amount of emissions associated with them with respect to the emission of total ceramic manufacturing industry and with respect to the emissions of industry as a whole, we will not discuss these groups in detail and consider them as one group.

3.6 Overview of proposal of products to be distinguished

In order to summarize our proposal for products to be distinguished, Table 8 gives an overview of the products distinguished in different sub-sectors together with available estimates of shares of emissions and number of installations

Table 8 Overview of proposal for products to be distinguished

Product	Definition	Share of emissions w.r.t. total ceramic industry[1,2]	No. of installations
Bricks and roof tiles		*30%*	
- Low-density clay blocks	PRODCOM: - 26.40.11.10 EN 771-1: - Density: <1000 kg/m^3		
- High-density clay blocks	PRODCOM: - 26.40.11.10 EN 771-1: - Density: >1000 kg/m^3 - Unprotected masonry		
- Facing bricks	PRODCOM: - 26.40.11.10 EN 771-1: - Density: >1000 kg/m^3 - Protected masonry		
- Pavers	PRODCOM: - 26.40.11.30		
- Roof tiles[3]	PRODCOM: - 26.40.12.50 EN 1304:2005: - All groups except for clay roof fittings		
Wall and floor tiles		*35%*	
- Wall tiles	*PRODCOM:* - *26.30.10* EN 14411: - Dry-pressed - Water absorption: >10%	Together with floor tiles: 22%	

Continuation Table 8

- Floor tiles	*PRODCOM:* *- 26.30.10* EN 14411: - Dry-pressed - Water absorption: <10%	Together with wall tiles:22%	
- Spray dried powder	Unclear whether standards are available, benchmark refers to 0% humidity	11%	
Refractory products		*5%*	
- High-heat resistant products	PRODCOM: - 26.26.11 - 26.26.12 ISO 836:2001: - Firing temp.: >1500°C	1%	40
- Low-heat resistant products	PRODCOM: - 26.26.11 - 26.26.12 ISO 836:2001: - Firing temp.: <1500°C	2%	20
Specialty products	*PRODCOM:* *- 26.21* *- 26.22* *- 26.23* *- 26.24* *- 26.25* *- 26.26.14* *- 26.30.10* (EN 14411: B) *- 26.40.12.70* *- 26.40.13.00*		

[1] Shares of emissions are rough estimates for total European ceramic industry. For further explanations we refer to the sector descriptions given in this Chapter. Shares of emissions within framework of the EU-ETS may differ because of opt-out of small installations

[2] Sum of estimates of emissions of products considered in a sub-sector may not be equal to that of the sub-sector (in italics), since products covered by a sub-sector may be grouped together with specialty products.

[3] Differentiation based on difference in frost resistance and resistance to saline atmospheres could be justified using EN 1304:2005 to define classes and types of roof tiles.

4 Benchmark values

In this chapter benchmark values for different sub-sectors are proposed. As a result of data collection and analysis of the respective sector organizations, a considerable amount of information needed to construct benchmark curves has become available. Nevertheless, none of the benchmark values proposed was determined completely in accordance the approach proposed on the basis of our interpretation of amended Directive text (see section 4.4 of the report on the project approach and general issues). Consequently, all values should be regarded as preliminary.

4.1 Bricks and roof tiles

TBE has collected data from 80-90% of installations (small, medium and large sites) in 18 Member States[5], together accounting for 80-90% of total sub-sector emissions (TBE, 2009a). The data set provided by TBE includes both process and fuel emissions only for 2007, as data for 2008 are not available yet. The sample covers only single-product installations, as for installations producing more than one product it is not possible to allocate emissions to each product. Moreover, the sample does not cover at all or only partially those countries (excl. Cyprus, Malta, Greece, Poland, Hungary) where specific emissions are expected to be higher due to the different fuel mix. Using the collected data, TBE was able to construct benchmark curves for three product groups: clay blocks, facing bricks and roof tiles.

TBE provided the graphs for each product category excluding the best and worst 10% installations of the available sample, since having considered the above, they regard these curves to give a more representative picture of the whole European industry. We note that the exclusion of the best and worst 10% installations is not in line with Article 10a (2) of the amended Directive stating that the starting point for benchmarks shall be the average performance of the 10% most efficient installations, nor with our proposed approach to take into account the presence of data outliers (see section 4.4.1 of the report on the project approach and general issues).

The respective curves are presented in Figure 2, 3 and 4. The figures show the curves differentiating process emissions and emissions due to the use of fuels. Note that the curve for clay blocks also includes emissions from biomass origin which are not included in the EU ETS and therefore should be left out. As noted in section 3.2, the use of biogenic poreformers leads to lower specific fossil fuel consumption, because of the energy input associated with these additives.

[5] Austria, Belgium, Czech Republic, Germany, Denmark, Finland, France, Hungary, Italy, the Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden and the UK.

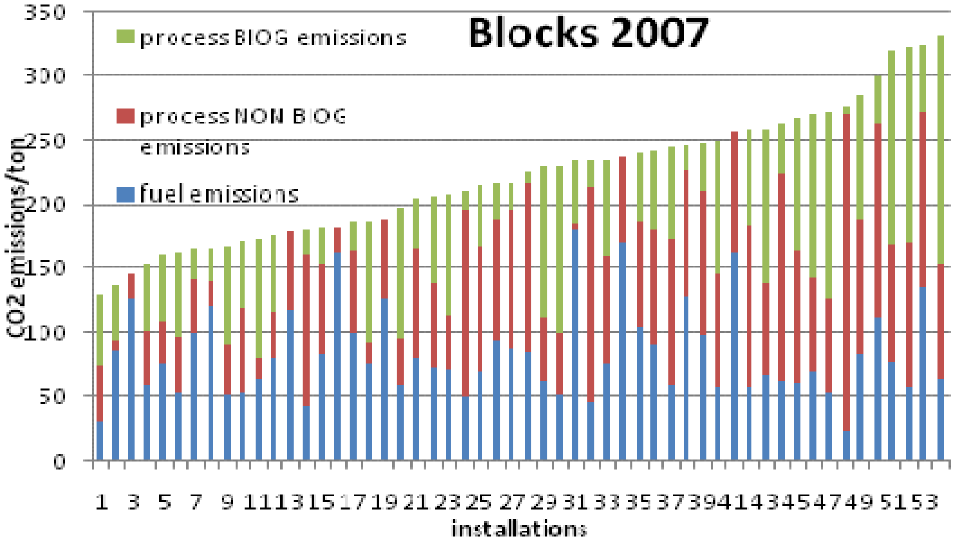

Figure 2 Part of benchmark curve for clay blocks; 10th to 90th percentile (TBE, 2009c)

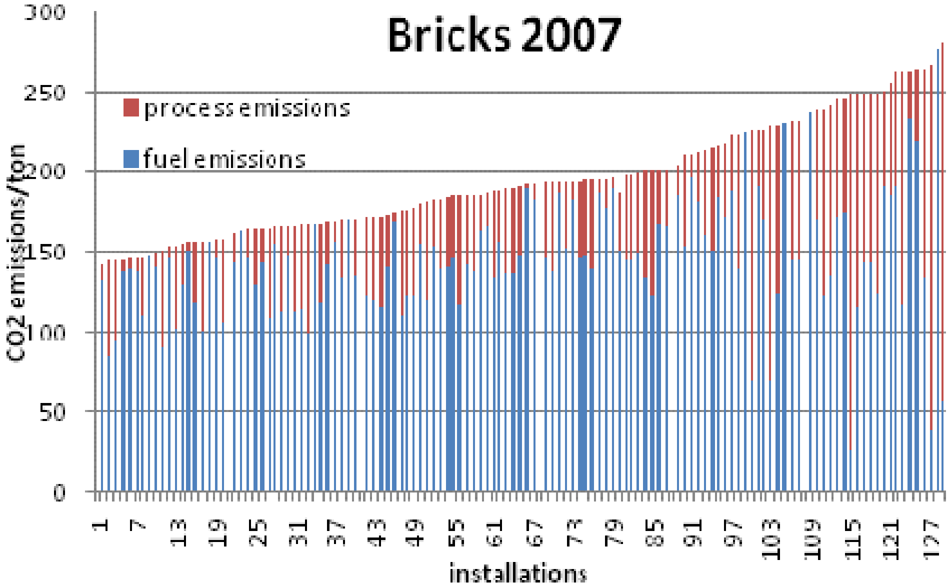

Figure 3 Part of benchmark curve for facing bricks; 10th to 90th percentile (TBE, 2009c)

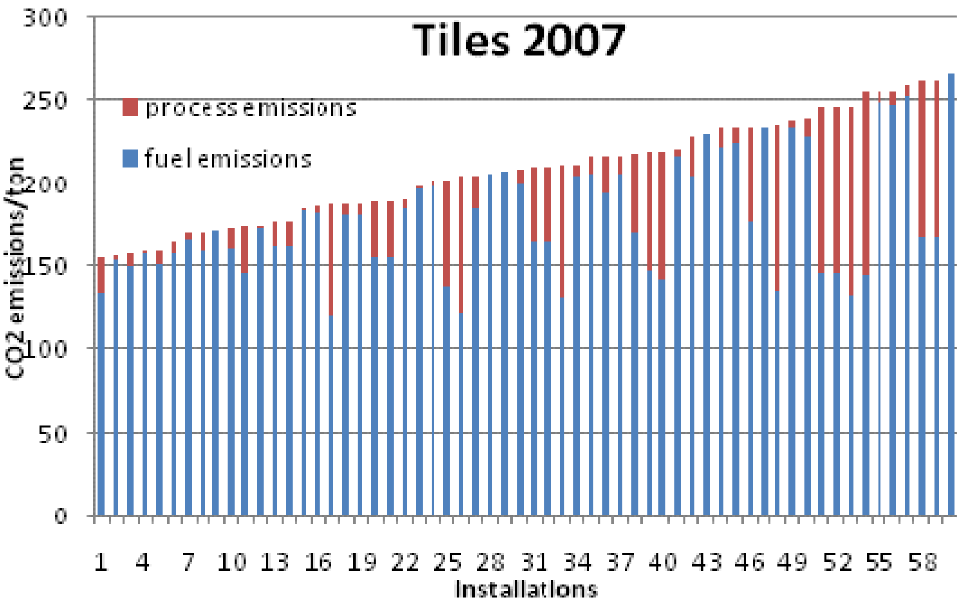

Figure 4 Part of benchmark curve for roofing tiles bricks; 10th to 90th percentile (TBE, 2009c)

In the absence of benchmark curves in line with the methodology described in section 4.4.1 of the report on the project approach and general issues, indicative benchmark values have been estimated using graphs of linearizations based on data points between the 10th and 90th percentile as provided by TBE (see Appendix B).[6] Indicative benchmark values are given in Table 9 together with characteristics of the provided curves.

Table 9 Characteristics of benchmark curves and benchmark values

Product group	Sample size[1]	Range[1]	Average[1]	Benchmark based on linearizations (kg CO_2/t product)
Clay blocks[2]	54	129 – 331	222	114
Facing bricks	129	142 - 282	195	133
Roof tiles	60	155 - 266	209	151

[1] Excludes best and worst 10% installations
[2] Specific emissions include process emissions from biogenic origin which should be excluded as they are not covered by EU ETS

As was noted in section 3.2, instead of defining one product group for clay blocks, we defined two. Also, we indicated that a further differentiation of the product group roof tiles could be made. As at this time we cannot assess the difference in emission intensity between different types of clay blocks and different types of roof tiles. Moreover, the homogeneous benchmark curves do not indicate a need for differentiation. We therefore propose a single benchmark value for clay blocks (114 kg CO_2/t clay block) and a single benchmark value for roof tiles (151 kg CO_2/t roof tile).

[6] The slope of a linearization was graphically determined and using this slope, the emission factor that the line would indicate at the 5th percentile was calculated and taken as an indicative benchmark value. Since the slopes of the linearizations were determined graphically, the resulting value is subject to measurement errors. The total errors is believed to be in the order of 0.001 t CO_2/t- product

Apart from clay blocks, facing bricks and roof tiles, we proposed to distinguish the product groups pavers and specialty products. At the time of writing this report, we do not have data available on pavers. Based on the relatively small difference in the benchmark specific emissions resulting from the curves for products that do not have process emissions from biomass origin (facing bricks and roof tiles), it may be expected that the benchmark specific emission for pavers would not differ substantially from the benchmark values for these products. On the other hand, in a study for DTI on benchmarking of the UK ceramic industry, Enviros Consulting Limited (2006) proposed a value for benchmark specific energy consumption for pavers that was 1.5 times as high as the one for common facing and engineering bricks. Nevertheless, due to the lack of available information, we propose to take the same benchmark value for pavers as for bricks (133 kg CO_2/t product). We stress that this value should be regarded as preliminary as its basis is rather weak and that there is a clear need for further data collection.

Benchmarking for the specialty group as a whole is not considered to be appropriate because of the diversity of products. We therefore propose to use a fall-back approach to come to an allocation for this group of products (see section 5 of the report on the project approach and general issues).

Overall, the availability of more information could lead to the assessment that it would be appropriate to distinguish more products based on difference in benchmark emission intensity and on considerations related to the discussion in section 3.2.

Figures 2 to 4 show that the share of process emissions in the total emissions can differ substantially from installation to installation (e.g. in the UK it varies from about 3 to 75% according to the chemistry of your clay (TBE, 2009c)). In order to further show the relative impact of process and fuel related emissions, Figure 5 and Figure 6 show curves for each type of emissions separately for all products. Curves of process emissions for each product group specifically are included in appendix B.

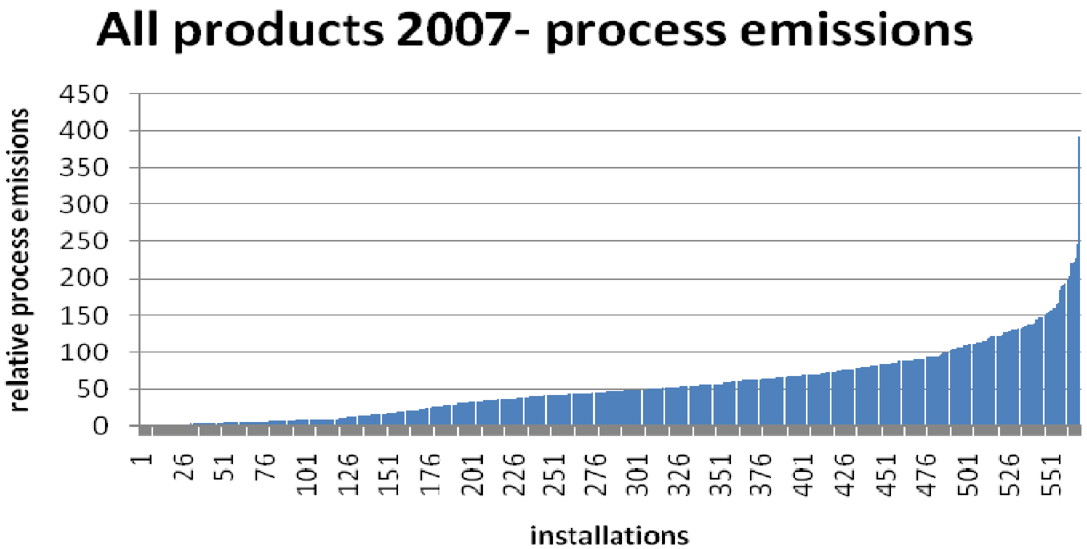

Figure 5 Full benchmark curves of specific process emissions for all products (TBE, 2009b)

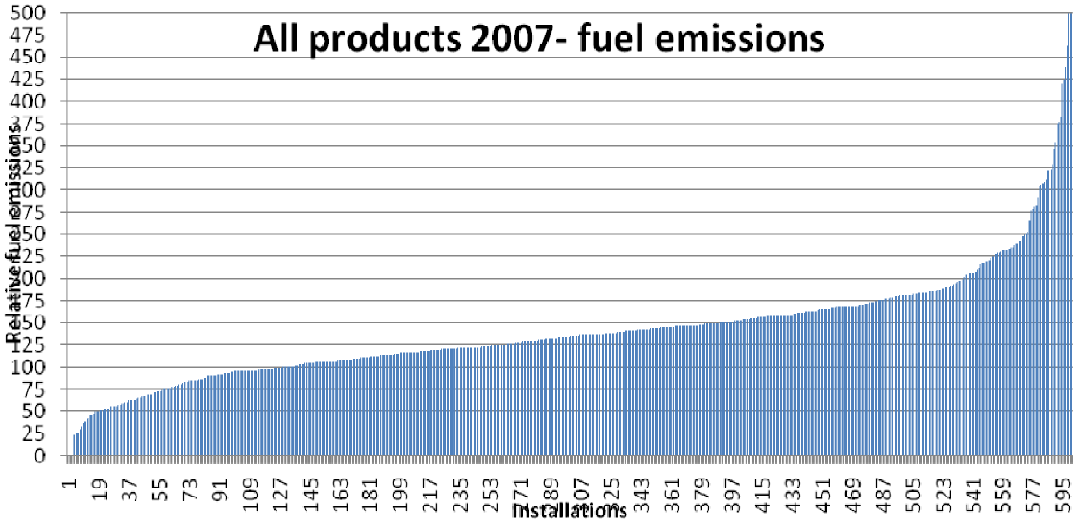

Figure 6 Full benchmark curves of specific fuel related emissions for all products (TBE, 2009b)

4.2 Wall and floor tiles

Presently, there is a lack of information regarding the specific emissions per type of product. There are two main reasons for this situation: firstly, most of the installations are not currently covered by EU ETS, and thus no historical information on emissions exists. Secondly, multiple products are produced on the same site, which makes it difficult to allocate the amount of emissions from the production of each product.

Taking into account the lack of information regarding the specific energy consumption per type of product, we will use literature values to come to benchmark values. To this end values for the production of dry-pressed tiles from Enviros Consulting Limited (2006) and the the reference document on best available techniques (BREF Ceramics, 2007) are summarized in Table 10. In addition the table shows the energy requirement for firing stages for ceramic tiles for the award of the Community Eco-label (EC, 2009).

Table 10 Specific energy consumption for dry-pressed wall and floor tile production according to Enviros Consulting Limited (2006) and the reference document on best available techniques (BREF Ceramics, 2007), and energy requirements for the award of the Community Eco-label (EC, 2009).

	Enviros Consulting Limited (2006)	**BREF Ceramics (2007)[2]**	**Community eco-label (EC, 2009)**
Spray drying (kJ/kg)		980 - 2200	
Drying (kJ/kg)	7744	250 - 750	
Firing (kJ/kg)		1900[3] – 7300	3,500
Total (kJ/kg)	7744[1]	3130 – 10250[4]	

[1] Value reported by Enviros Consulting Limited (2006) is representative of UK industry in 2002 and is limited to wall tile production (Enviros Consulting Limited, 2006, pp. 12)
[2] Based on Italian data only, where the Italian ceramic tile industry is one of the most efficient in the EU (CET, 2009)
[3] Refers to one step of a double firing process (the first step for the production of the intermediate product called "biscuit" and the second step for the "vitrification" of this biscuit (CET, 2009)
[4] The total range as given based on the reference document on best available techniques was obtained by adding all low end values and all high and values and is not representative for the actual total range.

We propose to base the benchmark for spray drying on the lower end value as reported by the reference document on best available techniques (BREF Ceramics, 2007). Considering the emission factor for natural gas (56.1 kg CO_2/GJ (IPCC,1997)), the corresponding specific emission factor for spray drying can be determined to be 55.0 kg CO_2/t spray dried powder produced.

For dry-pressed wall and floor tile production (excl. spray drying), we propose to base the benchmark on the lower end value energy consumption for the drying stage as reported in the reference document on best available techniques (BREF Ceramics, 2007). For the firing stage we opt to use the energy requirement for the award of the Community eco-label (EC, 2009) instead of the lower end value reported in the reference document on best available techniques (BREF Ceramics, 2007), since that value refers to one step of a double firing process and is therefore not regarded to be representative for an efficient firing process to produce a common tile. Using an emission factor for natural gas of 56.1 kg CO_2/GJ (IPCC, 1997), the specific emission factor due to fuel consumption for dry-pressed wall and floor tile production (excl. spray drying), can be determined to be 210.4 kg CO_2/t tiles produced.

Specific process emissions as proposed by Enviros Consulting Limited (2006) and CET (2009) are shown in Table 11. CET obtained its reported value using Annex X to the guidelines for monitoring and reporting of GHG emissions[7]. In that Annex two different methods are defined to determine process emissions, the one applicable to wall and floor tiles production being the one based on carbon inputs ("Calculation method A") (CET, 2009). We propose to use the resulting value in determining the benchmark.

Table 11 Process emission factors for wall and floor tile production according to Enviros Consulting Limited (2006) and CET (2009)

	Enviros Consulting Limited (2006)	CET (2009)
Process emissions (kg CO_2/t product)	139	96.42

Summarizing the above, the proposed benchmark values based on BAT data are presented in the table below. Note that the value for spray dried powder is calculated on the basis of tonnes of tiles produced. When using the benchmark to come to an allocation, the weight of spray dried powder would therefore need to be corrected for water content.

Table 12 Overview of product benchmarks

Product	Benchmark value (kg CO_2/t product)
Dry-pressed wall and floor tiles (excl. spray drying)	300.0
Spray dried powder (0% humidity)	55.0

There are indications that wall tiles and floor tiles differ both in fuel emission intensity and process emission intensity, but at this stage not enough information is available to be able to

[7] Commission Decision 2007/589/EC

assess whether or not benchmarks for wall and floor tiles would differ from one to another by more than 20% in order to justify the definition of different benchmarks. In light of this situation, CET is internally preparing a data collection exercise and developing a methodology to acquire information about the emission intensity of both products. More accurate information on specific emissions may therefore become available in the near future. This information could lead to the assessment that separate benchmarks for wall tiles and floor tiles would be appropriate based on differences in emission intensity.

For the production of extruded tiles no best practice value could be found. Also, the production volume of extruded tiles is considered to be small compared to that of dry-pressed tiles. We therefore propose to use a fall-back approach to come to an allocation for this group of products (see section 5 of the report on the project approach and general issues).

4.3 Refractory products

PRE has collected data from 15 installations producing high-heat resistant products and 25 installations producing low-heat resistant products. These installations cover approximately 40% of the total number of installations and account for about 60% of total emissions from refractory production. The data reflect the situation for the year 2007 or 2008. No differentiation was made between different types of kilns. The benchmark curves for high- and low-heat resistant products are shown in Figure 7. From the curves it can be seen that there are no outliers on the left side of the curve.

The average performance of the 10% most efficient installations based on a discrete number of installations was determined to be:

- 335 kg CO_2/t for high-heat resistant products
- 225 kg CO_2/t for low-heat resistant products

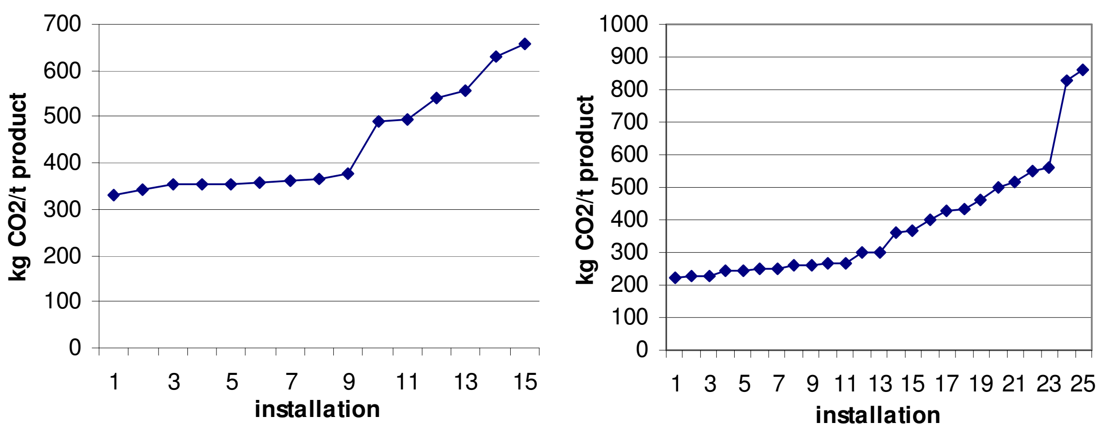

Figure 7 Benchmark curve for high-heat resistant products (left) and low-heat resistant products (right)

Benchmarking for the remaining product group covered by PRODCOM 26.26.14 is not considered to be appropriate because of the diversity of products. We therefore propose to use a fall-back approach to come to an allocation for this group of products (see section 5 of the report on the project approach and general issues).

4.4 Other products

Because of the diversity of products in the remaining product group, benchmarking for this group as a whole is considered to be appropriate. We therefore propose to use a fall-back approach to come to an allocation for this group of products (see section 5 of the report on the project approach and general issues).

4.5 Overview of proposal for benchmark values

Table 13 gives an overview of the benchmark values for the products distinguished in different sub-sectors. For product definition and available estimates of shares of emissions and number of installations the reader is referred to section 3.6

Table 13 Overview of preliminary benchmark values

Product	**Benchmark value (t CO_2/t-product)**
Bricks and roof tiles	
- Low-density clay blocks	0.114
- High-density clay blocks	0.114
- Facing bricks	0.133
- Pavers	0.133
- Roof tiles	0.151
Wall and floor tiles	
- Wall tiles	0.300
- Floor tiles	0.300
- Spray dried powder	0.055
Refractory products	
- High-heat resistant products	0.335
- Low-heat resistant products	0.225
Specialty products	*Covered by a fall-back approach (see Chapter 5 of the report on the project approach and general issues).*

5 Additional steps required

Bricks and roof tiles

- TBE has collected data from 80-90% of installations (small, medium and large sites) in 18 MS. Since the benchmark should be based on the average performance of the 10% most efficient installations in a sector or subsector in the Community (Art. 10a (2) of the amended Directive), additional installations should be included in the curves.
- Benchmarks should be based on 2007-2008 performance (Art. 10a (2) of the amended Directive). The present benchmark curves only include 2007 data, so 2008 data would still need to be considered.
- Benchmarks should be based on the 10% most efficient installations in a sector or subsector performance (Art. 10a (2) of the amended Directive). The present benchmark curves exclude the best and worst 10% installations. These installations should however be included in the curves.
- Using the complete curve as a staring point, the presence and exclusion of data outliers should be considered.
- A benchmark curve for clay blocks excluding biogenic process emissions should be constructed.
- Differentiation of benchmark values for different products in the product groups roof tiles and clay blocks could be considered.
- When the steps above have been completed, the preliminary benchmark values reported in the present report need to be reassessed.
- In the present proposal a single benchmark value for roof tiles and facing bricks is proposed. After reassessment of benchmark values, it needs to be assessed whether or not this grouping of values is appropriate.
- In the present proposal, the benchmark value for roof tiles and facing bricks is also proposed for pavers. Further data collection is needed in order to be able assess whether or not this choice is appropriate.

Wall and floor tiles

- CET is internally preparing a data collection exercise and developing a methodology to acquire information about the emission intensity of both products. More accurate information on specific emissions may therefore become available in the near future. Based on this information, the proposed values need to be reassessed.
- It should be assessed how spray dried powder can be defined using standards available within the sector.

Refractory products

- PRE has collected data from 40% of the installations that produce refractory products. Since the benchmark should be based on the average performance of the 10% most efficient installations in a sector or subsector in the Community (Art. 10a (2) of the amended Directive), additional installations should be included in the curves.

6 Stakeholder comments

The European Tiles & Bricks Producers' Federation (TBE), the European Ceramic Tile Manufacturers' Federation (CET), the European Refractories Producers Federation (PRE) commented on a first draft report discussed with the sector before summer 2009 (Cerame Unie, 2009c). Some of these comments have been addressed in the text of this report. A summary of the comments can be found below. In order to make this summary, we (Ecofys) made a selection of the text as provided to us by the sector organizations.

TBE

- We propose to apply – if any – the benchmark approach only to “standard products”, which will represent approx. 80% of the total production; special products should be treated with alternative systems
- Such special products could e.g. be special colour facing bricks (e.g. white or blue braised), clay roof tiles accessories or highly insulating clay blocks produced with biogenic additives, which cannot be dealt with properly by fuel benchmarks
- Our industry should receive between 15 and 21 benchmarks to properly cover the large variety of different products
- Should this request for a greater number of benchmarks not be acceptable, we would like to recommend an alternative approach based on the current Belgian and Dutch CO_2 external auditing schemes. These installation specific schemes take into account the improvement potential of each installation, which is determined by a third party
- Benchmarks – if any- should be based on the maximum available number of installations in the EU
- The principle that the number of benchmarks of a sector should be related to its share of emissions in the ETS undermines the level playing field across the sectors, resulting in an unfair burden for those sectors, like the clay bricks and roof tiles industry, which are characterized by high product variety but have a limited share of emissions in the whole ETS and favoring other sectors, like cement and steel industries.

CET

- The actual situation in manufacturing plants of wall and floor tiles is that different types of products (wall, floor, porcelain, red body tiles, white body tiles…) are manufactured at the same time, and no information on energy consumption per type of tile is available, and thus no information on CO_2 emissions per type of product. Although no information on energy consumption per type of tile is available at installation level, it is known from a technical point of view that wall tiles consume more energy in the firing stage than floor tiles mainly for the following reasons (Ecofys: see section 3.3 for a summary of these reasons):
- CET would like clearly state that its aim is to have two different benchmarks for final product, one for wall tiles and one for floor tiles, since the amount of CO_2 emissions to produce each type of product is different, but at this stage we do not have yet enough information to propose different values for each benchmark.

- We considered that only one benchmark for spray dried powder shall be defined for the total production of powder, regardless of whether the powder is consumed in the installation where it has been produced or not. This way there is a level playing field for all installation around EU producing powder.
- Extruded tiles are rustic tiles much thicker than dry-pressed ones, normally used as flooring in terraces and balconies, but also can be used in industrial areas. The energy consumption for extruded tiles is usually 2 or 3 times for dry-pressed tiles, so it is the extremely important to foresee a different treatment for this type of products in the benchmarking exercise.

PRE

- Given the wide variety of product applications, many products are special products for which no benchmark would be appropriate. These products, such as retorts, crucibles, muffles, nozzles, plugs, supports, tubes, pipes, sheaths and rods, are all classified by CN 6903 (or PRODCOM 26.26.14). PRE has always advocated that these products should not be benchmarked but should receive a fall-back position. Therefore PRE fully supports the statement written in the first draft report: "As stated above, certain refractory products may have an emission intensity that differs by at least more than 20% from this benchmark. For those products, the fall-back approach is envisioned."
- PRE has organised a data collection on the CO_2 emissions (kg/ton of product) for the benchmarkable refractory products (CN 6901 and 6902 or PRODCOM 26.26.11 and 26.26.12). Based on the results received so far, PRE concludes that the refractory industry would need two benchmarks, one benchmark for high heat resistant products used in high temperature applications and one for low heat resistant products used in low temperature applications.

7 References

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TBE (2009c), Benchmark curves and additional information send in September 2009.

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Appendix A: PRODCOM List 2007

PRODCOM 2007 code	Description
26211130	Porcelain or china tableware and kitchenware (excluding electro-thermic apparatus, coffee or spice mills with metal working parts)
26211150	Household and toilet articles, n.e.c., of porcelain or china
26211210	Ceramic tableware, other household articles : common pottery
26211230	Ceramic tableware, other household articles : stoneware
26211250	Ceramic tableware, other household articles : earthenware or fine pottery
26211290	Ceramic tableware, other household articles : others
26211330	Statuettes and other ornamental articles, of porcelain or china
26211350	Ceramic statuettes and other ornamental articles
26221030	Ceramic sinks... and other sanitary fixtures, of porcelain or china
26221050	Ceramic sinks, wash basins, baths... and other sanitary fixtures, n.e.c.
26231033	Ceramic electrical insulators (excluding with metallic parts)
26231035	Ceramic electrical insulators for overhead power transmission or traction lines (including with metallic parts) (excluding lightning arresters)
26231039	Ceramic electrical insulators (including with metallic parts) (excluding for overhead power transmission or traction lines, lightning arresters)
26231053	Ceramic insulating fittings for electrical machines, appliances or equipment; containing ≥ 80 % by weight of metallic oxides
26231055	Ceramic insulating fittings for electrical machines, appliances or equipment (excluding fittings containing ≥ 80% by weight of metallic oxides)
26241100	Ceramic wares for laboratory, chemical, technical use, of porcelain or china
26241200	Ceramic wares for laboratory, chemical, technical use, other material than porcelain or china
26251100	Ceramic (agricultural) troughs, tubs...; ceramic pot, jars..., n.e.c.
26251230	Other ceramic articles of porcelain/china including non-refractory firebrick cheeks, parts of stoves/fireplaces, flower-pots, handles and knobs, signs/motifs for shops, radiator humidifiers
26251255	Other ceramic articles (common pottery) including heating apparatus, non-refractory firebrick cheeks, stoves/fireplaces parts, flower-pots, handles/knobs, shopssigns, radiator humidifiers
26251259	Ceramic articles, n.e.c. : other than porcelain or common pottery
26261100	Ceramic goods of siliceous fossil meals or earths including bricks, blocks, slabs, panels, tiles, hollow bricks, cylinder shells and pipes excluding filter plates containing kieselguhr and quartz
26261210	Refractory ceramic constructional goods containing >50% of MgO, CaO or Cr_2O_3 including bricks, blocks and tiles excluding goods of siliceous fossil meals or earths, tubing and piping
26261233	Refractory bricks, blocks..., weight > 50% Al2O3 and/or SiO_2: ≥ 93% silica (SiO_2)

Continuation

PRODCOM 2007 code	Description
26261235	Refractory bricks, blocks, tiles and similar refractory ceramic onstructional goods containing, by weight, > 7% but < 45% alumina, but > 50% by weight combined with silica
26261237	Refractory bricks, blocks..., weight > 50% Al_2O_3 and/or SiO_2: others
26261290	Refractory bricks, blocks, tiles, etc, n.e.c.
26261300	Refractory cements, mortars, concretes and similar compositions (including refractory plastics, ramming mixes, gunning mixes) (excluding carbonaceous pastes)
26261410	Articles containing magnesite, dolomite or chromite (including bricks and other shapes, touchstones for testing precious metal, paving blocks and slabs) (excluding refractory goods)
26261430	Refractory ceramic goods, n.e.c., by weight > 25% graphite or other forms of carbon
26261455	Refractory ceramic goods, n.e.c., alumina or silica or mixture > 50% : alumina < 45%
26261459	Refractory ceramic goods, n.e.c., alumina or silica or mixture > 50% : alumina ≥ 45%
26261490	Refractory ceramic goods, n.e.c.
26301010	Unglazed ceramic mosaic tiles, cubes and similar articles, with a surface area < 49 cm²
26301020	Glazed ceramic mosaic tiles, cubes and similar articles, with a surface area < 49 m²
26301030	Unglazed ceramic double tiles of the Spaltplatten type
26301053	Unglazed stoneware flags and paving, hearth or wall tiles (excluding double tiles of the Spaltplatten type)
26301055	Unglazed earthenware or fine pottery flags and paving, hearth or wall tiles (excluding double tiles of the Spaltplatten type)
26301059	Unglazed ceramic flags and paving, hearth or wall tiles (excluding stoneware, earthenware or fine pottery, double tiles of the Spaltplatten type)
26301071	Glazed ceramic double tiles of the Spaltplatten type
26301073	Glazed stoneware flags and paving, hearth or wall tiles, with a face of > 90 cm²
26301075	Glazed earthenware or fine pottery ceramic flags and paving, hearth or wall tiles, with a face of > 90 cm²
26301079	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
26401110	Non-refractory clay building bricks (excluding of siliceous fossil meals or earths)
26401130	Non-refractory clay flooring blocks, support or filler tiles and the like (excluding of siliceous fossil meals or earths)
26401250	Non-refractory clay roofing tiles
26401270	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)
26401300	Ceramic pipes, conduits, guttering and pipe fittings: drain pipes and guttering with fittings

Appendix B: Additional benchmark curves

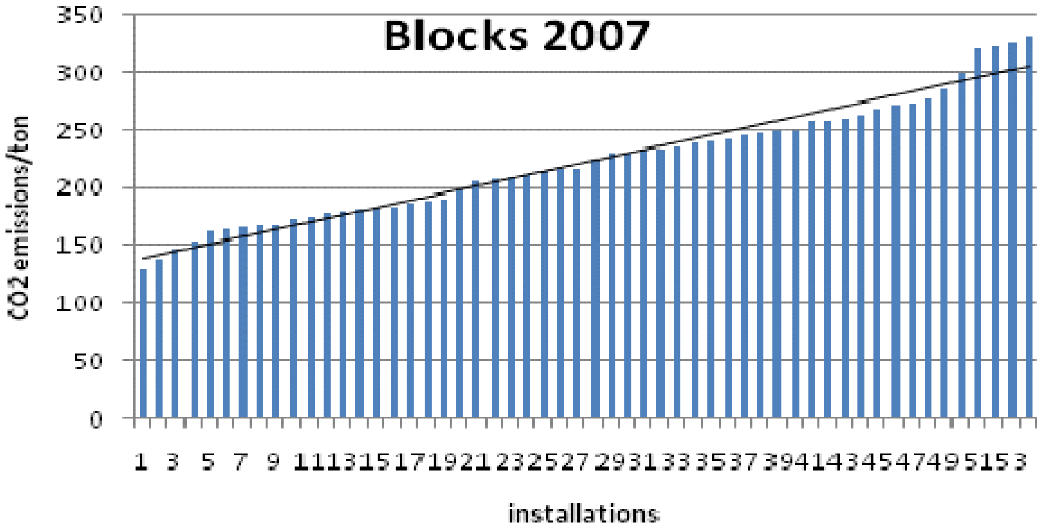

Figure 8 Part of benchmark curve for clay blocks including process emissions and emissions due to fuel use; 10th to 90th percentile; and linearization based on data points between the 10th and 90th percentile (TBE, 2009c)

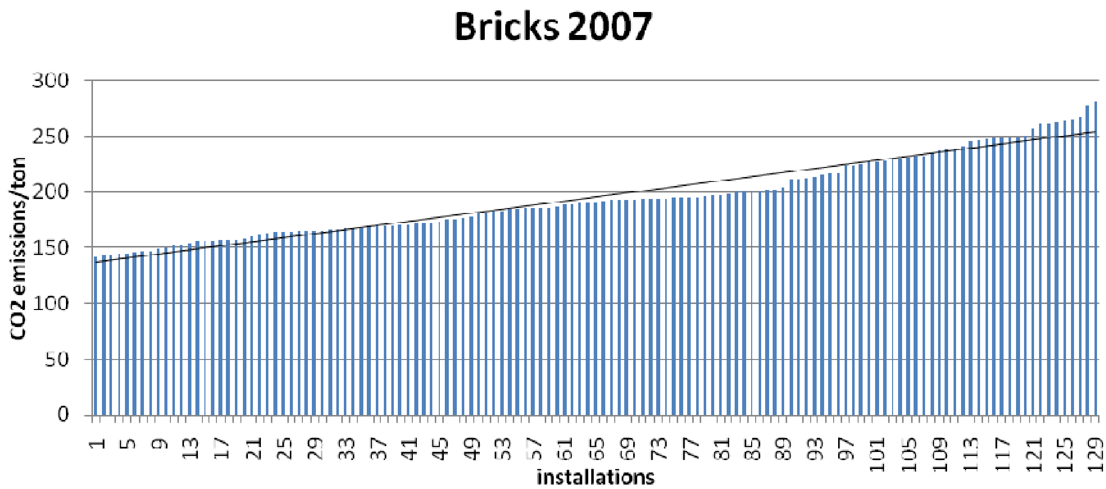

Figure 9 Part of benchmark curve for facing bricks including process emissions and emissions due to fuel use; 10th to 90th percentile; and linearization based on data points between the 10th and 90th percentile (TBE, 2009c)

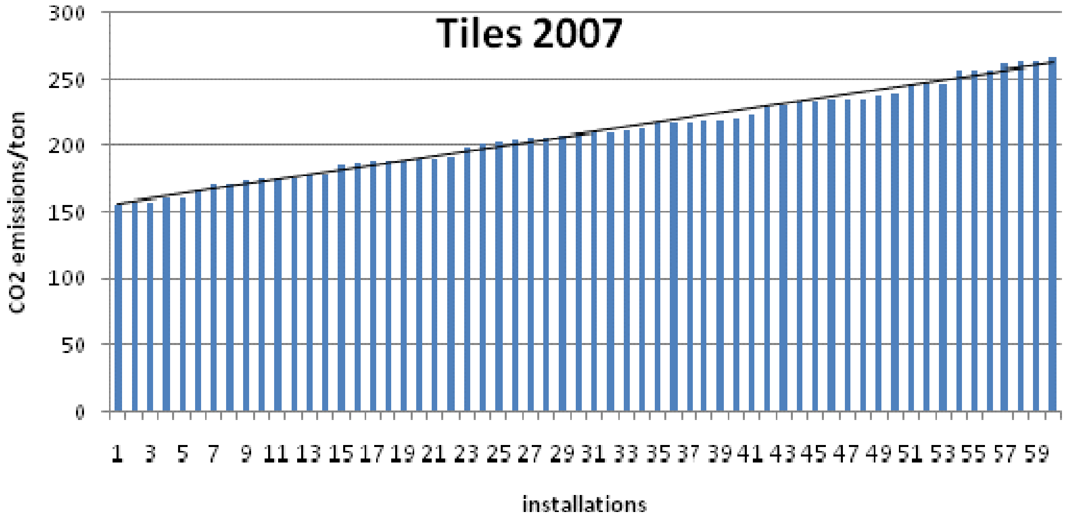

Figure 10 Part of benchmark curve for roofing tiles including process emissions and emissions due to fuel use; 10th to 90th percentile; and linearization based on data points between the 10th and 90th percentile (TBE, 2009c)

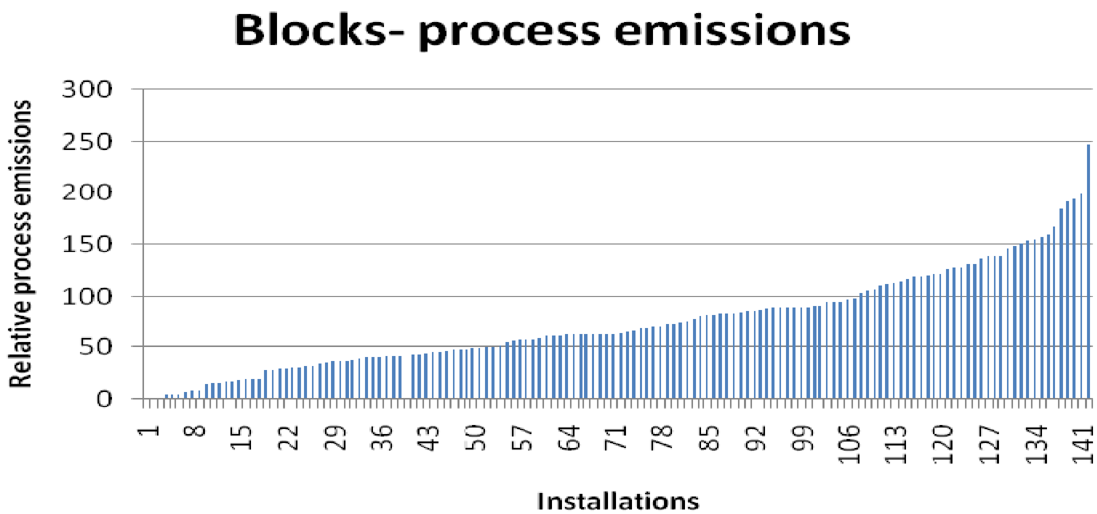

Figure 11 Full benchmark curve for clay blocks including process emissions only (TBE, 2009b)

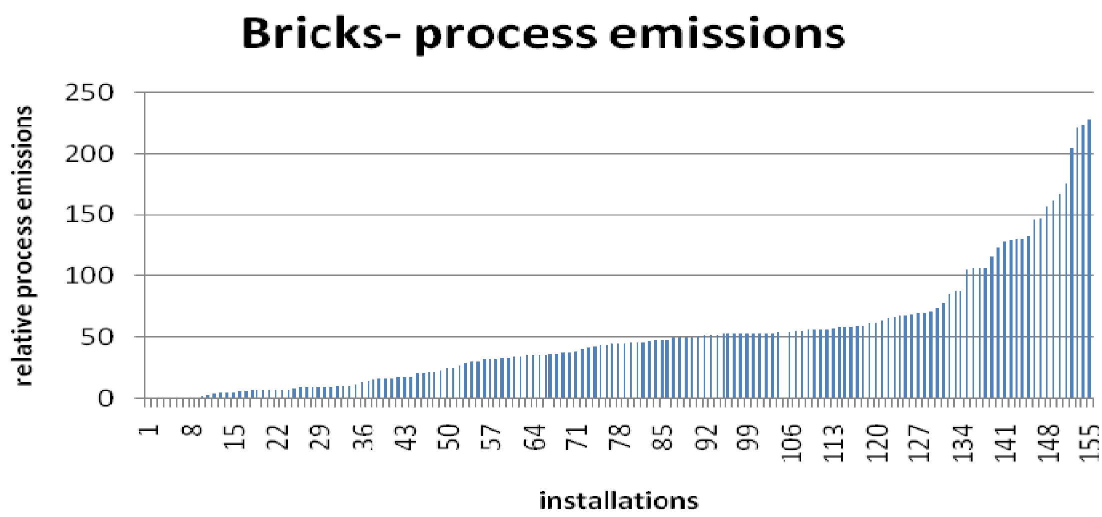

Figure 12 Full benchmark curve for facing bricks including process emissions only (TBE, 2009b)

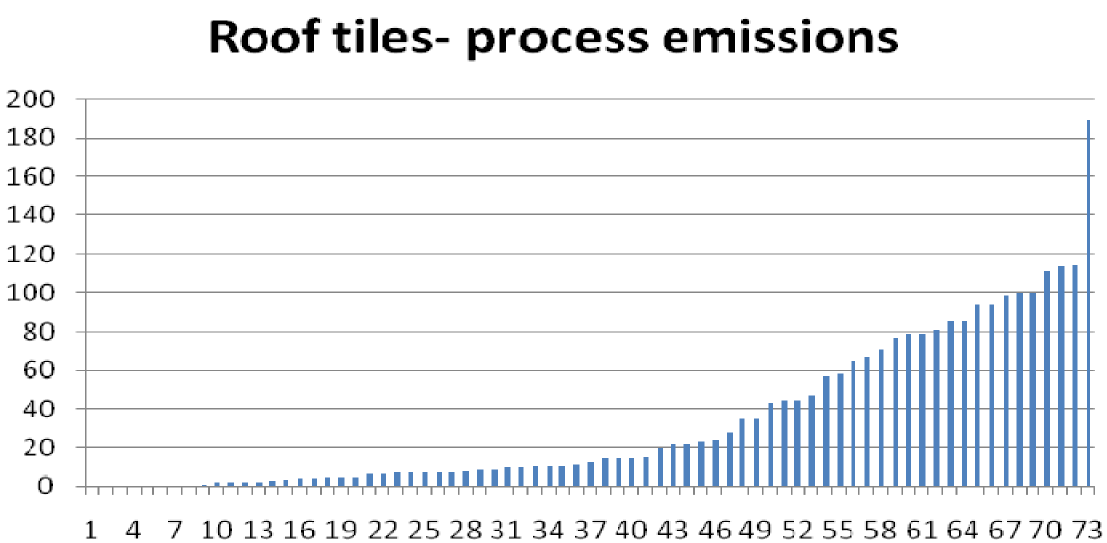

Figure 13 Full benchmark curve for roof tiles including process emissions only (TBE, 2009b)