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Air

Economic Impact Analysis for the Brick and Structural Clay Products Manufacturing NESHAP: Final Rule

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U.S. Environmental Protection Agency
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This report contains portions of the economic impact analysis report that are related to the industry profile.

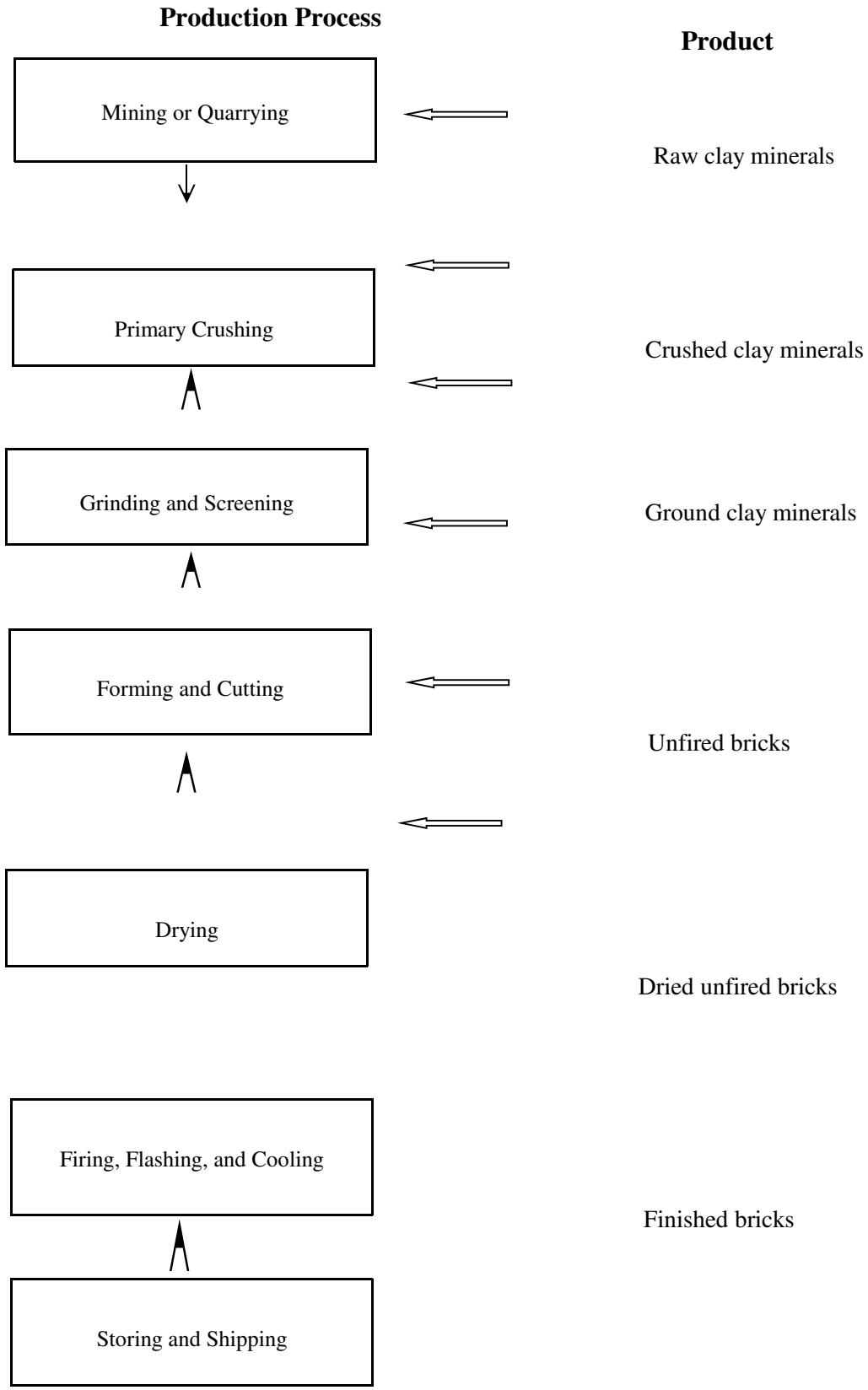

Figure 2-1. Brick and Structural Clay Products Manufacturing Process

Source: U.S. Environmental Protection Agency. 1997. *Emission Factor Documentation for AP-42, Section 11.3*, "Brick and Structural Clay Products Manufacturing: Final Report."

A detailed discussion of the production process below focuses on brick manufacturing, as structural clay products typically are produced in a similar manner. The primary difference in the production processes of bricks and structural clay products is how the prepared clay minerals are shaped and sized. Information in this section was taken from EPA's Emission Factor Documentation on Brick and Structural Clay Products Manufacturing (1997).

Production of brick begins with the mining of raw material, such as common clay and shale. This is the most common type of clay used in the production of BSCP. Producers of BSCP acquire their raw material either by mining it themselves or by purchasing it from local mineral processing plants. Often, a company owns a mining pit as well as facilities at which BSCP are produced. After the material is mined or purchased, it is fed into a crusher for initial size reduction. The material next passes through grinders to produce a finely ground material. This product is then screened for size and oversized material is returned to the grinders. The finely ground material is next conveyed to the mill room where it is formed into bricks.

The following processes exist to shape bricks:

1. stiff mud extrusion,
2. soft mud press process, and
3. dry press process.

Most brick is formed through the stiff mud extrusion process. This process begins with the use of a pug mill. In the mill, finely ground clay minerals are mixed with water and are then transferred into a vacuum chamber. Producers at this point can introduce additives, such as barium carbonate, to prevent sulfates present in the clay minerals from rising to the surface of the bricks. Next, air is removed from the material in the chamber, and the material is extruded through dies. Surface treatments can be introduced at this point to add specific color or texture to the product. Some of these surface treatments include manganese dioxide, iron oxide, and iron chromite. The extruded column of material is then cut into individual bricks using a wire-cutting machine. The bricks are set onto kiln cars and proceed to the dryers, which are typically heated to 204 degrees Celsius.

The soft mud process is used to produce bricks when clay is too wet for extrusion. In this process, finely ground clay minerals are blended with water and then formed into bricks using molds. The bricks are dried before proceeding to the kilns. In the dry press process, clay is mixed with a small amount of water and steel molds are used to shape the individual bricks. Pressure of 500 to 1,500 pounds per square inch is then applied to the molds to bond the material into bricks. These bricks then proceed to the dryers.

From the dryer, the bricks enter the kiln for firing. There are several steps to firing the bricks in the kiln. These steps are the evaporation of free water, dehydration, oxidization, vitrification, and flashing. Flashing refers to the process of introducing uncombusted fuel into the kiln atmosphere in order to add color to the surface of the bricks. Most kilns are fired

with natural gas, although coal, sawdust, fuel oil, and landfill gas are also used. Once the bricks have been fired, they are then cooled to ambient temperatures before they leave the kiln. This completes the process of brick manufacturing.

2.1.2 Emissions from the Brick and Structural Clay Product Facilities

Production of BSCP requires a number of steps that result in the emissions of HAPs and other pollutants. These pollutants include particulate matter (PM), sulfur dioxide (SO_2), nitrogen oxides (NO_x), carbon monoxide (CO), carbon dioxide (CO_2), volatile organic compounds (VOCs), and HAPs including HCl, HF, and HAP metals. The grinding and screening operations and kilns emit PM emissions. Kiln fuel combustion and some dryer combustion also result in emissions of SO_x, NO_x, CO, and CO_2. However, the primary source of SO_2 emissions from the kilns is the raw material, which contains sulfur compounds. These sulfur compounds form SO_2 when the raw material is fired. Similarly, the kilns release HF and HCl due to the presence of fluoride and chloride compounds in the raw material.

2.1.3 Costs of Production

This section discusses the costs of producing BSCP. There are several types of production costs such as:

capital expenditures, including the costs of equipment and its installation;

energy costs, which are the costs of electricity and fuels used in the production of BSCP;

labor costs, including the costs associated with employees wages and benefits; and

the cost of materials, which are the costs of tangible inputs such as clay minerals, parts, and additives.

Tables 2-1 and 2-2 show the historical production cost data for the brick and structural clay tile industry (SIC 3251) and the other structural clay product industry (SIC 3259) that were gathered from the U.S. Census Bureau.

Table 2-1. Production Costs for the Brick and Structural Clay Tile Industry (SIC 3251) (10^6)

Year	Labor Costs	Material Costs	Energy Costs	Capital Expenditures	Value of Shipments
1992	$213.9	$229.5	$142.7	$42.9	$1,116.0
1993	$229.3	$280.0	$157.3	$56.1	$1,199.1
1994	$233.9	$312.2	$151.2	$63.8	$1,319.1
1995	$235.2	$300.8	$139.8	$77.1	$1,283.3
1996	$246.7	$304.0	$160.3	$132.9	$1,421.9
1997	$262.2	$282.0	$175.6	$72.1	$1,452.2
Avg.	$236.9	$288.0	$154.5	$74.2	$1,298.6

Source: U.S. Department of Commerce, Bureau of the Census. 1999. *1997 Economic Census, Manufacturing Industry Series*, "Brick and Structural Clay Tile Manufacturing."

U.S. Department of Commerce, Bureau of the Census. 1998. *1996 Annual Survey of Manufactures*, M96(AS)-1 Statistics for Industry Groups and Industries.

U.S. Department of Commerce, Bureau of the Census. 1996. *1994 Annual Survey of Manufactures*, M94(AS)-1 Statistics for Industry Groups and Industries.

U.S. Department of Commerce, Bureau of the Census. 1995. *1993 Annual Survey of Manufactures*, M93(AS)-1 Statistics for Industry Groups and Industries.

Similar trends can be seen in the production costs across both SIC codes. For both the brick and structural clay tile industry (SIC 3251) and the other structural clay products industry (SIC 3259), the cost of materials accounts for the largest share of the value of shipments (VOS). For SIC 3251, cost of materials were equal to about $288 million on average, or 22 percent of the brick and structural clay tile industry's (SIC 3251) VOS. For SIC 3259, material costs on average were almost $38 million, or 27 percent of the industry's (SIC 3259) VOS. Labor costs represent the next largest share of the VOS for both markets, approximately 20 percent, and energy costs are approximately 11 percent of their VOS. Capital expenditures represent the smallest share of VOS for both SIC 3251 and SIC 3259.

Table 2-2. Production Costs for the Other Structural Clay Products Industry (SIC 3259) (10^6)

Year	Labor Costs	Material Costs	Energy Costs	Capital Expenditures	Value of Shipments
1992	$23.5	$34.3	$15.0	$5.4	$125.8
1993	$25.2	$30.6	$17.0	$6.8	$118.3
1994	$28.7	$41.5	$15.5	$4.0	$142.1
1995	$29.7	$43.2	$16.3	$4.4	$150.4
1996	$37.6	$52.3	$21.7	$4.2	$177.5
1997	$22.9	$25.9	$8.9	$4.9	$118.3
Avg.	$28.0	$38.0	$15.7	$5.0	$138.7

Source: U.S. Department of Commerce, Bureau of the Census. 1999. *1997 Economic Census, Manufacturing Industry Series*, "Other Structural Clay Product Manufacturing."

U.S. Department of Commerce, Bureau of the Census. *1996 Annual Survey of Manufactures*, M96(AS)-1 Statistics for Industry Groups and Industries.

U.S. Department of Commerce, Bureau of the Census. *1994 Annual Survey of Manufactures*, M94(AS)-1 Statistics for Industry Groups and Industries.

U.S. Department of Commerce, Bureau of the Census. *1993 Annual Survey of Manufactures*, M93(AS)-1 Statistics for Industry Groups and Industries.

Upon examination of both tables, the data clearly show that the size of the brick and structural clay tile industry is much larger than the other structural clay products industry. In fact, the value of shipments for the brick and structural tile industry (SIC 3251) is almost ten times greater than the value of shipments for the other structural clay products industry (SIC 3259).

2.1.4 Value of Clay Minerals

The most common raw materials used to produce BSCP are common clay and shale. Fire clay, kaolin, and other materials are also used, but to a lesser degree. The average value per metric ton of common clay and shale over the years 1993 to 1997 was $5.64. For fire clay, the average value over the same time period was $21.64 and for kaolin, it was $114.42. Based on the differences in the average values across these clay types, it is clear why

common clay and shale would be used as an input since it is suitable for BSCP. It is a relatively cheaper input that possesses the necessary attributes to produce BSCP.

Table 2-3 shows the difference in values of common clay and shale, fire clay, and kaolin produced and sold in the U.S. for the years 1993 through 1997. The production-weighted average price for clay minerals used in BSCP is also derived. Since the weighted average prices are relatively low, it is clear that common clay and shale is more heavily relied upon relative to fire clay and kaolin for production of BSCP. In fact, on average over this time period, 98 percent of the clay minerals used in BSCP were common clay and shale (Virta, 1999).

Table 2-3. Price Value of Clay Minerals Used in BSCP: 1993 - 1997 ($/metric ton)

Clay Minerals	1993	1994	1995	1996	1997	Avg.
Common Clay & Shale	$5.42	$5.31	$5.90	$5.50	$6.08	$5.64
Fire Clay	$25.05	$25.44	$21.96	$21.19	$14.56	$21.64
Kaolin	$108.38	$116.31	$117.09	$119.83	$110.52	$114.42
Weighted Average[a]	$7.23	$6.97	$7.82	$7.34	$6.47[b]	$6.97

Notes: [a]Weighted average reflects the production-weighted prices for clay minerals used to produce BSCP.

[b]Production-weighted average price for the year 1997 does not include fire clay because quantity of this clay mineral used in BSCP was not available for this year.

Source: Virta, Robert. 1999. "Clays," *In: Minerals Yearbook, Metals and Minerals 1997: Volume 1.* U.S. Geological Survey. U.S. Government Printing Office.

Virta, Robert. 1998. "Clays," *In: Minerals Yearbook, Metals and Minerals 1996: Volume 1.* U.S. Geological Survey. U.S. Government Printing Office.

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Virta, Robert. 1996. "Clays," *In: Minerals Yearbook, Metals and Minerals 1994: Volume 1.* U.S. Geological Survey. U.S. Government Printing Office.

The value of common clay and shale remained relatively constant, although it did reach a peak price of $6.08 per metric ton in 1997. Contrary to the behavior of the value of common clay and shale, both fire clay and kaolin sharply dropped in value in 1997. In fact, fire clay shows a general declining trend over the years 1993 to 1997 while kaolin steadily increased in value until it reached a peak of $119.83 in 1996. It then sharply fell in value in 1997.

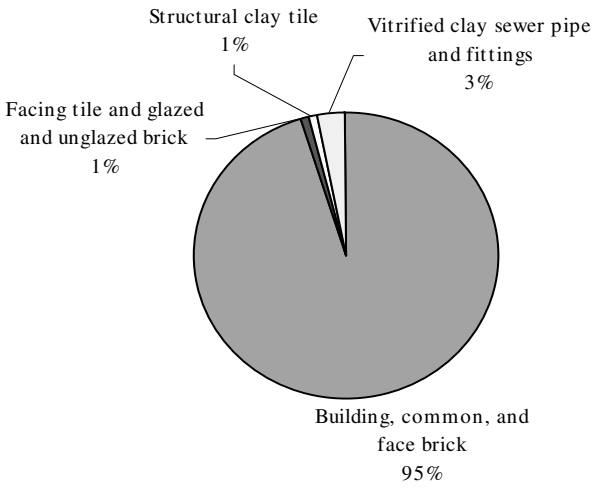
2.2 Uses, Consumers, and Substitutes

Clay minerals are the main input used to produce BSCP. These products are then used by the construction industry to build several different types of structures, including homes, buildings, and office facilities. The following section describes the uses, consumers, and substitutes of BSCP. In Section 2.2.1, the various uses for BSCP are described. Section 2.2.2 identifies the intermediate and final consumers of bricks and structural clay products. Last, the different products that can act as substitutes for bricks and structural products are described in Section 2.2.3.

2.2.1 Uses of Brick and Structural Clay Products

Bricks and structural clay products are used as inputs to the production of buildings, homes, and structures. Building, face, and common bricks are used to erect the walls of structures, while glazed bricks are used for flooring. Other structural clay products, such as clay pipe, structural clay tile, chimney pipe, flue linings, and drain, sewer, and roof tile are used in the installation of plumbing systems, fireplaces, and roofs. Brick and structural clay products have a variety of characteristics desirable in building materials. They are durable, resistant to fire, weather, and pests, and require little maintenance. Use of bricks enhances the resale value of homes and is considered energy efficient since they absorb heat and slow down heat transfer. In the summer a brick exterior retards the absorption of heat and in the winter, the exterior retains heat indoors (Brick Industry Association, 1999).

Census Data provide the 1997 values of select BSCP produced by SICs 3251 and 3259. As Figure 2-2 shows, the value of common, building, and face brick represents 95 percent ($1.34 billion) of the value of shipments for selected products in the brick, structural clay tile, and structural clay products industries. The rest of the end uses represented here, facing tile, glazed and unglazed brick, structural clay tile, and vitrified clay sewer pipe and fittings, together comprise only 5 percent of the value of shipments. This distribution is perhaps explained by the fact that there are a number of less expensive



1997 Value of Shipments = $1.41 Billion

Figure 2-2. Distribution of BSCP Shipments by End Use: 1997

Source: U.S. Department of Commerce, Bureau of the Census. 1998. *Current Industrial Reports for Clay Construction Products - Summary 1997.*

products that compete with structural clay products, such as concrete and PVC pipes and asphalt roofing materials. Structural clay products are, for the most part, specialty items in many parts of the country. It is important to note that the above pie chart represents *selected* BSCP in both SICs 3251 and 3259. The value of shipments of these products, $1.41 billion, is therefore less than the sum of the value of shipments for the entire BSCP industry ($1.57 billion).

2.2.2 Consumers of Brick and Structural Clay Products

The immediate purchasers of these products are construction companies who use them as inputs to the production of homes, buildings, and structures. Construction companies or contractors may also buy these products to specifically install plumbing systems, fireplaces, and new roofs and floors to existing structures. Consumers then purchase the homes, structures, and buildings produced by construction companies, or they hire contractors to make improvements to existing structures using structural clay products. These consumers therefore have an indirect demand for BSCP. However, if they build homes or make improvements themselves, then consumers directly demand these products.

2.2.3 Substitutes for Brick and Structural Clay Products

Aside from brick, there are a number of alternative building materials that can be used for the exterior walls of buildings, homes, and structures. Common alternatives are stucco, wood, hardboard, and aluminum and vinyl siding. There are certain advantages and disadvantages to using these materials instead of brick.

Stucco is made from sand, Portland cement, and water and is extremely durable. It is applied in three coats with pigment mixed in so that painting is not necessary. While stucco can create an extremely strong and long-lasting exterior, it can be difficult to apply and is subject to cracking if applied incorrectly. Wood is the oldest siding material used to build exterior walls for homes and buildings. It comes in a variety of forms including shingles, panels, and natural logs. When used for exterior walls, wood can be left as is, or can be painted over therefore offering flexibility in its appearance. It is organic which makes it an attractive option, however exposure to severe weather can result in wood rot and decay. In addition, wood is vulnerable to pests, such as termites, that can damage the structure of homes. Hardboard is a wood composite made by mixing wood fiber and a natural or chemical binder and pressing the mixture into panels or lap siding. Hardboard siding is coated with a water resistant primer and is painted. Aluminum and vinyl siding are simple exterior materials to care for, as they are nailed to the exterior of structures. These sidings do not need to be painted and can be easily cleaned by washing with water (Better Business Bureau, 2000).

There are also alternatives to roofing tiles and glazed brick for roofing and flooring applications. Roofing tile is one option for roofing, however wood shingles, asphalt, and metal can also be used. One of the characteristics common to roofing tile, asphalt, and metal is that they are all fireproof. Wood shingles are not as common as they once were because they do not possess this quality. Alternatives to clay tiles for flooring are wood, marble, vinyl, and linoleum. These options vary by price, quality, and appearance. Marble, clay tile, and hardwood floors are relatively sturdy, and therefore more expensive than vinyl and linoleum.

2.3 Industry Organization

This report addresses the economic impacts of pollution control requirements on facilities that produce bricks and structural clay products. Because there are costs associated with the control of HAPs, it is important to determine how the industry may be affected. This section provides a description of the industry's organization at both the facility-level and company-level. Section 2.3.1 first provides an overview of the market structure of the BSCP manufacturing industry. Section 2.3.2 characterizes the manufacturing facilities in this industry, while the parent companies of these facilities are described in Section 2.3.3. Last, Section 2.3.4 provides data on domestic production, foreign trade, and apparent consumption of bricks and structural clay products.

2.3.1 Market Structure

Market structure is of interest because it determines the behavior of producers and consumers in the industry. In perfectly competitive industries, no producer or consumer is able to influence the price of the product sold. In addition, producers are unable to affect the price of inputs purchased for use in production. This condition is most likely to hold if the industry has a large number of buyers and sellers, the products sold and inputs used in production are homogeneous, and entry and exit of firms is unrestricted. Entry and exit of firms are unrestricted for most industries, except in cases where the government regulates who is able to produce output, where one firm holds a patent on a product, where one firm owns the entire stock of a critical input, or where a single firm is able to supply the entire market. In industries that are not perfectly competitive, producer and/or consumer behavior can have an effect on price.

Concentration ratios (CRs) and the Herfindahl-Hirschman index (HHIs) can provide some insight into the competitiveness of an industry. The U.S. Department of Commerce reports these ratios and indices for the four-digit SIC code level for 1992, the most recent year available. Table 2-4 provides the four- and eight-firm concentration ratios (CR4 and CR8, respectively), and the Herfindahl-Hirschman index for both the brick and structural clay tile industry (SIC 3251) and for the other structural clay products industry (SIC 3259). For SIC 3251, the CR4 was 34 percent, and the CR8 was 52 percent. For SIC 3259, the CR4 was 35 percent and the CR8 was 60 percent.

The criteria for evaluating the HHIs are based on the 1992 Department of Justice's Horizontal Merger Guidelines. According to these criteria, industries with HHIs below 1,000 are considered unconcentrated (i.e., more competitive), those with HHIs between 1,000 and 1,800 are considered moderately concentrated (i.e., moderately competitive), and those with HHIs above 1,800 are considered highly concentrated (i.e., less competitive). In general, firms in less concentrated industries are more likely to be price takers, while those in more concentrated industries have more ability to influence market prices. Based on these criteria, both the brick and structural clay tile industry and the other structural clay products industry can be modeled as perfectly competitive for the purpose of this EIA.

Table 2-4. Market Concentration Measures for the Brick and Structural Clay Tile Industry (SIC 3251) and the Other Structural Clay Products Industry (SIC 3259)

SIC Code	Value of Shipments (10^6)	CR4	CR8	HHI
3251	$1,452.19	34%	52%	433
3259	$118.35	35%	60%	560

Note: CR4 and CR8 are the concentration ratios of the top 4 and 8 firms in the industry (by sales), respectively. HHI refers to the Herfindahl-Hirschman Index which is the sum of squared market shares for each company in a given industry.

Source: U.S. Department of Commerce, Bureau of the Census. 1999. *1992 Concentration Ratios in Manufacturing*. <http://www.census.gov/epcd/www/concentration.html>.

2.3.2 Manufacturing Facilities

As of 1996, there were 189 facilities producing bricks and structural clay products in the United States. Of these facilities, 164 were brick producers, 19 were structural clay product producers, and 6 produce both product types. Regardless of the type of product the facility produces, it can be classified as either one of two types of producers: a non-integrated producer or an integrated producer. Non-integrated BSCP producers purchase clay mineral inputs to use in production and then complete the manufacture of the final products. Integrated producers of BSCP are vertically integrated, which means they mine their own clay mineral inputs to use in the production of their final products.

The size of facilities depends on whether they are non-integrated or integrated producers. Plants that perform their own mining operations tend to be larger in size than those that purchase their inputs from a minerals processing plant. Even if facilities are non-integrated producers, it is likely that they are located near sources of clay minerals so that the transportation cost of this essential input remains low. Thus the locations of the 189 facilities are determined by the location of common clay and shale deposits. These facilities are located across 39 states with the highest concentrations in Ohio, with 22 facilities, North Carolina with 20 facilities, Texas with 18 facilities, and Alabama with 11 facilities (see Figure 2-3).

2.3.3 Firm Characteristics

The Agency identified 90 ultimate parent companies that owned and operated the 189 potentially affected facilities within this source category during 1996. Sales and employment data were obtained for these owning entities from either their survey response or one of the following secondary sources:

- American Business Directory (American Business Information, 1999),
- Dun & Bradstreet Market Identifiers (Dun & Bradstreet, 1999),
- Gale Group Company Intelligence (Gale Group, 1999),
- Hoover's Online (Hoover's, 2001),
- The Handbook of Texas Online (1999), or
- Standard & Poor's Register-Corporate (Standard & Poor's Corp., 1998)

Appendix A provides a listing of the companies identified by the Agency that own the potentially affected facilities within this source category.

Annual sales and employment data were available for 86 of the 90 companies (96 percent). The average (median) sales of companies reporting data were $124.5 million ($8.0 million). This includes revenue from operations other than BSCP manufacturing. The average (median) employment for these companies was 987 (92) workers. As of 1998, the top four companies in annual sales are:

- Hanson, PLC - $3.0 billion with 27,000 employees,
- Certainteed Corporation - $1.6 billion with 6,950 employees,
- Wienerberger Baustoffindustrie AG - $1.5 billion with 10,370 employees, and
- Texas Industries, Incorporated - $1.2 billion with 4,100 employees.

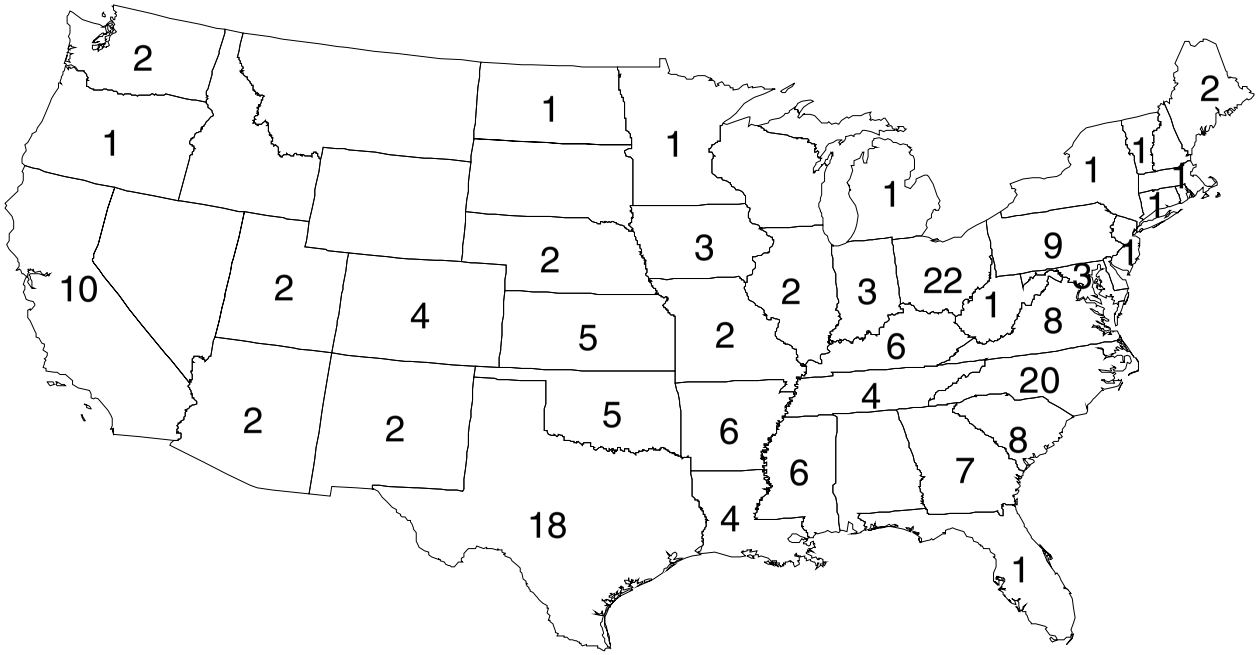


Figure 2-3. Location of Brick and Structural Clay Product Facilities

2.3.4 Small Business Annual Sales

EIA estimated revenues derived from company survey responses were used to represent annual sales for small businesses when these estimated revenues were greater than the annual sales reported in publicly available company profiles, or when annual sales figures were not available[1]. By definition, company sales are at least equal to the sum of the revenues generated at its facilities. Therefore, in the cases where annual sales were less than the EIA estimated revenues for the small firms, EPA chose to rely upon revenue estimates based on company survey responses. Sales may be under-reported in the secondary sources listed above because they represent the annual sales of a subsidiary or branch of a company or because these providing organizations generated their sales estimates. Additionally, relying on estimated revenues instead of potentially under-reported company sales data makes consistent the results across the facility-level economic impacts model (in Section 4) and the small business cost-to-sales ratio screening analysis (in Section 5). Of the 77 small businesses, 36 had estimated revenues in excess of their publicly available sales data and an additional 3 small companies had no available sales data. Table 2-5 provides comparative statistics on company sales and their estimated revenues for this subset of small companies.

Table 2-5. Summary Statistics for Small Company Sales Data: 1999

	Publicly Reported Sales (10^6/yr)	**EIA Estimated Revenues (10^6/yr)**
Companies (#)	36	39
Average	5.7	10.0
Median	4.2	6.1
Minimum	1.0	1.1
Maximum	22.0	48.2

Note: The summary statistics calculated for annual sales from publicly available sources excludes three companies that were included in the summary statistics for annual estimated revenues because no annual sales data were reported.

Table 2-6 presents a frequency distribution of the discrepancy between annual sales and estimated annual revenues for the small companies with identified data discrepancies. It is clear that for a large share of these firms, the discrepancy between reported sales and EIA estimated revenues are rather large. In fact, over 35 percent of the 36 companies have estimated revenues that are over 100 percent greater than the reported annual sales. The

[1] Company revenues were estimated by multiplying baseline price by reported production totals of their brick and structural clay product facilities.

magnitude of the discrepancy supports a replacement of the annual sales data with EIA estimated annual revenues, at least for the small companies, whose sole business it is to produce and sell brick and structural clay products.

Table 2-6. Summary of Discrepancy Between Annual Sales and Estimated Annual Revenues for Small Companies: 1999

Discrepancy Size	Number of Firms	Share of Firms	Average Annual Sales (10^6)
< 5 %	1	3 %	$4.5
5 - 10 %	4	11 %	$6.8
10 - 20 %	4	11 %	$6.4
20 - 50 %	9	25 %	$3.7
50 - 100 %	5	14 %	$8.2
> 100 %	13	36 %	$5.8

2.3.5 Market Data and Trends

This section presents historical market data for select BSCP. Historical market data include U.S. volumes for manufacturers' shipments, foreign trade, and apparent consumption. Data were obtained from various years of *Current Industrial Reports* published by the U.S. Bureau of the Census. Table 2-7 provides data for common, building, and face bricks, and structural clay tile, while Table 2-8 presents data for facing tile, glazed and unglazed brick, and vitrified clay and sewer pipe.

As shown in Table 2-7, the brick market shows an overall increasing trend in the quantity of shipments, exports, imports, as well as apparent consumption. This is evident from an examination of the average annual growth rates. The average annual growth rate of brick shipments from 1993 to 1997 was 4.3 percent. For brick imports, the rate is 24.2 percent, much larger relative to the average annual growth rates of shipments, exports, or apparent consumption.

This high average annual growth rate is due to the large increases in imports over the time period presented. Specifically, the imports of bricks increased significantly from about 9 million bricks in 1994 to 16.9 million bricks in 1995. Imports then increased to over 20 million bricks in 1996. Brick exports have remained between 42 and 43 million until the year 1997, when exports peaked at a quantity of 46.5 million.

As shown earlier in Figure 2-2, the market for other structural clay products is much smaller than the brick market, however it still represents an important sector of the BSCP

industry. As Table 2-8 shows, the average annual growth rate of select structural clay products is approximately -3.3 percent for the years 1993 to 1997, which is very close to the average annual growth rate for apparent consumption of these same products (-3.4 percent). While shipments and consumption decline over the time period examined, the average annual growth rate of exports is extremely high at 236.9 percent. While this growth rate looks large, it is relatively small in absolute terms. This average growth rate is due, in particular, to a large increase in exports of vitrified sewer pipe from 1993 to 1994. In 1993, 287 short tons were exported from the U.S. and in 1994, exports dramatically rose to 3,187 short tons. This is the main cause of such a large average annual growth rate of exports over the time period represented here. Imports of structural clay products were small, never exceeding 1 thousand short tons in any year between 1993 and 1997.

To determine how significant international trade of bricks and structural clay products is, foreign trade concentration ratios are calculated. Foreign trade concentration ratios demonstrate what share of domestically produced BSCP is exported and what share of apparent consumption is imported. Table 2-9 presents the concentration ratios for brick and structural clay tile and it shows that foreign trade of these products is small relative to the amounts produced and consumed domestically. Of the total quantity produced, only six-tenths of a percent is exported on average. The share of bricks and structural clay tile consumed from abroad is even less at 0.2 percent.

Table 2-7. Historical Data for Brick and Structural Clay Tile (10^3 bricks[a]): 1993 - 1997

Year	Shipment of Bricks	Exports	Imports	Apparent Consumption[b]
1993	6,623,300	42,643	10,170	6,590,827
1994	7,200,000	43,733	8,967	7,165,234
1995	7,243,900	43,627	16,867	7,217,140
1996	7,426,400	42,759	20,629	7,404,270
1997	7,837,600	46,518	20,267	7,811,349
Average Annual Growth Rates				
1993 - 1997	4.34%	2.28%	24.21%	4.38%

Note: [a]Bricks are 2-1/4 inch by 3-5/8 inch by 7-5/8 inch brick equivalent.
[b]Apparent Consumption = Shipments of Bricks - Exports + Imports
Source: Same data sources as those used for Table 2-6 below.

Table 2-8. Historical Data for Select Structural Clay Products (short tons): 1993 - 1997

Year	Shipments of Select SCP[a]	Exports	Imports	Apparent Consumption[b]
1993	62,552	287	615	62,880
1994	53,959	3,187	915	51,687
1995	51,738	1,543	388	50,583
1996	47,943	1,610	345	46,678
1997	53,750	1,334	888	53,304
Average Annual Growth Rates				
1993 - 1997	-3.27%	236.88%	34.40%	-3.37%

Note: [a]SCP refers to structural clay products.
[b]Apparent Consumption = Shipments of Select SCP - Exports + Imports
Source: U.S. Department of Commerce, Bureau of the Census. 1998. *Current Industrial Reports for Clay Construction Products - Summary 1997*. <http://www.census.gov:80/cir/www/mq32d.html>
U.S. Department of Commerce, Bureau of the Census. 1996. *Current Industrial Reports for Clay Construction Products - Summary 1995*. <http://www.census.gov:80/cir/www/mq32d.html>
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Table 2-10 presents the foreign trade concentration ratios for facing tile, glazed and unglazed brick, and vitrified clay and sewer pipe. The ratios for this market segment are low, but not as low as those calculated for brick and structural clay tile. In this case, 3 percent of domestically produced structural clay products is exported and approximately 1 percent of domestic consumption is supplied from abroad. These calculated ratios shown in Tables 2-9 and 2-10 provide evidence of the minimal foreign trade of BSCP relative to the quantities produced and consumed domestically.

Table 2-9. Foreign Trade Concentration Ratios of Brick and Structural Clay Tile: 1993 - 1997

Year	Exports/Production	Imports/Apparent Consumption
1993	0.64%	0.15%
1994	0.61%	0.13%
1995	0.60%	0.23%
1996	0.58%	0.28%
1997	0.59%	0.26%
Average	0.60%	0.21%

Source: U.S. Department of Commerce, Bureau of the Census. 1998. *Current Industrial Reports for Clay Construction Products - Summary 1997.* <http://www.census.gov:80/cir/www/mq32d.html>
U.S. Department of Commerce, Bureau of the Census. 1996. *Current Industrial Reports for Clay Construction Products - Summary 1995.* <http://www.census.gov:80/cir/www/mq32d.html>
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Table 2-10. Foreign Trade Concentration Ratios of Select Structural Clay Products: 1993 - 1997

Year	Exports/Production	Imports/Apparent Consumption
1993	0.46%	0.98%
1994	5.91%	1.77%
1995	2.98%	0.77%
1996	3.36%	0.74%
1997	2.48%	1.67%
Average	3.04%	1.18%

Source: U.S. Department of Commerce, Bureau of the Census. 1998. *Current Industrial Reports for Clay Construction Products - Summary 1997.* <http://www.census.gov:80/cir/www/mq32d.html>
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