

SECTION SEVEN

NATIONAL AND REGIONAL EMPLOYMENT IMPACTS AND TOTAL OUTPUT LOSSES

This section of the EA assesses the regional and national employment impacts of the Final Pharmaceutical Industry Effluent Guidelines, both separately and together with the impacts from the MACT standards rule. It also discusses output losses to the national economy induced by revenue losses in the pharmaceutical industry. Only BAT, BPT, and PSES options are discussed here;¹ Section Five discusses impacts from NSPS and PSNS options.

EPA examines national-level employment losses and gains that will occur throughout the economy in response to the reallocation of expenditures caused by implementation of the Final Pharmaceutical Industry Effluent Guidelines, both separately and together with the impacts of the MACT standards rule. EPA also examines the losses of employment in the national-level economy that result from employment losses due to postcompliance facility closures and firm failures in the pharmaceutical industry. Additionally, since employment losses from closures and failures could overstate or understate employment losses based on reductions in output, EPA estimates direct losses to the pharmaceutical industry based on output losses (assuming no costs can be passed on to consumers). These losses are tempered by gains within that industry (due to direct hiring of pollution control equipment operators within the industry), so in this analysis EPA also calculates a net direct loss (or gain) of employment. Finally, EPA examines regional-level losses to determine impacts on communities.

Pollution control expenditures divert investment away from production by pharmaceutical establishments, which leads to direct employment losses and to a reduction in pharmaceutical production. These losses are offset by gains in employment and production in the firms that manufacture the pollution control equipment and by gains in employment related to installing and operating the equipment. A portion of these gains will most likely occur in the pharmaceutical industry itself (labor to operate pollution control equipment). These gains and losses can be measured using input-output (I-O) analysis.

¹ There are no costs associated with Best Conventional Pollutant Control Technology (BCT).

To compute either regional- or national-level employment changes, output effects or direct employment losses such as facility closures must be considered. Output loss, as defined for the purposes of I-O analysis, is measured as the total production loss multiplied by the unit price of that production, or the gross revenue loss to the industry. Pharmaceutical industry investments in compliance equipment and the costs of operating the equipment translate directly into output losses in the pharmaceutical industry (assuming none of these costs is passed through to customers); that is, the costs of compliance equal the output losses, which is consistent with economic theory under a zero cost passthrough scenario (with a perfectly elastic demand curve, the supply curve shifts down by the total incremental unit cost of compliance leading to reduced production and revenues). Declines in production at pharmaceutical establishments affect the revenues of input industries (industries that supply goods and services to the pharmaceutical industry), which further results in employment declines. These shifts, in turn, eventually result in a reduction of household consumption by workers in both the pharmaceutical industry and input industries, decreasing demand for consumer products at the national level.

Firsthand impacts, in this case those on the pharmaceutical industry, are known as direct effects, impacts that continue to resonate through the economy are known as indirect effects (effects on input industries), and effects on consumer demand are known as induced effects. Such effects are tracked both nationally and regionally in massive I-O tables prepared by the U.S. Department of Commerce's Bureau of Economic Analysis (BEA). For every dollar spent in a "spending industry" (or for every employment change in the directly affected industry), these tables identify the portion spent (or every employment change) in contributing or vendor industries and the portion spent by consumers (or employment change as a result of a change in consumption).²

For example, as a result of the Final Pharmaceutical Industry Effluent Guidelines, a pharmaceutical facility might purchase equipment to meet the effluent guidelines equivalent to BAT-A/C. One piece of this equipment could be a tank to hold wastewater. To make the tank, the manufacturer would purchase stainless steel. The steel manufacturer would purchase iron ore, coke, energy sources, and other commodities. Thus a portion of a dollar spent by the pharmaceutical industry becomes a smaller portion of a dollar spent by the tank manufacturer, and a smaller portion of a dollar spent by the steel manufacturer, and so on. These

² Direct employment effects such as employment losses from postcompliance facility closures or firm failures also can be used to derive national- and regional-level impacts using direct-effect multipliers.

iterations are captured in BEA's I-O tables and summarized as regional and national multipliers for output (revenues). BEA also has determined average wages and the proportion of output in each industry that goes to employee earnings and, as a result, the number of employees or full-time equivalents (FTEs)³ associated with each \$1 million change in output. I-O analysis provides a straightforward framework as long as the direct effects to the industry are small and certain limiting assumptions about technology are valid (e.g., constant returns to scale and fixed input ratios).

As noted above, I-O analysis uses the multipliers derived by BEA to determine both output and employment effects. There are national-level multipliers and regional-level multipliers. National-level multipliers used here include final-demand output multipliers (which are used to estimate total U.S. economy effects when output changes in a specific industry), final-demand employment multipliers (which are used to estimate the change in total U.S. employment when output changes in a specific industry), and direct-effect employment multipliers (which are used to estimate the change in U.S. employment given a change in employment in a specific industry). The regional multipliers used here are direct-effect employment multipliers (which are used to estimate a state-wide change in employment given a change in employment in a specific industry in a specific state). All of these multipliers will be discussed in more detail below.

The analysis of employment and output losses (as well as related impacts) is divided into two parts. Section 7.1 analyzes the national-level impacts of the Final Pharmaceutical Industry Effluent Guidelines on both labor and output using both direct output effects and direct employment effects. It also discusses the net, direct impacts on the pharmaceutical industry based on reductions in production resulting from compliance costs and the impacts of output and employment from the combined Pharmaceutical Industry Effluent Guidelines and MACT standards rule. Section 7.2 examines the regional impacts associated with employment losses resulting from facility closures and/or firm failures.

³ One FTE = 2,080 labor hours = 1 person-year of employment.

7.1 NATIONAL-LEVEL OUTPUT AND EMPLOYMENT IMPACTS

7.1.1 Introduction

To comply with the Final Pharmaceutical Industry Effluent Guidelines, facilities might need to install and operate pollution control systems. The costs for these systems reduce output and employment in the pharmaceutical industry and increase output and employment in the sectors that manufacture, install, and operate pollution control equipment.

Despite the fact that employment losses and gains associated with pollution control expenditures tend to act as counterbalances, there are differences in the national-level economy under baseline and postcompliance scenarios. Because industries vary in the effect they have on the national-level economy and their labor intensity, output and employment losses may or may not exceed output and employment gains, leading to either small net losses or small net gains.

7.1.2 Methodology for Estimating National-Level Output and Employment Impacts

EPA estimates two categories of national-level impacts associated with the Final Pharmaceutical Industry Effluent Guidelines: impacts on output in the economy as a whole (in dollars) and impacts on national employment (in FTEs). Also discussed in this section is the method for determining direct employment losses occurring in the pharmaceutical industry alone, based on changes in output in the industry. These losses are compared to the employment losses attributable to facility closures or firm failures, which can be either smaller or larger than output-induced losses. Finally, this section discusses the method used to estimate output and employment gains and losses associated with the MACT standards rule and the combined rules.

7.1.2.1 National-Level Output Losses and Gains

The loss in national-level output associated with output loss in the pharmaceutical industry is estimated using the pretax capital and O&M costs of compliance. The pretax costs are used because I-O multipliers are based on changes in revenues, which are pretax numbers.

BEA industry 29.0100, which corresponds to SIC 283 (drugs), is the detailed industry category that most closely matches the portion of the pharmaceutical industry affected by the Final Pharmaceutical Industry Effluent Guidelines. The national-level output multiplier estimated by BEA for this industry grouping is 2.3882.⁴ This multiplier represents the total dollar change in national output for all industries for each dollar change in the output of the pharmaceutical industry. Using the BEA multiplier and the output loss to the industry (equivalent to the pretax compliance costs to the industry, as discussed above), EPA estimates losses throughout the national economy in the following way:

$$\text{Pretax Compliance Cost for Option} \times 2.3882 = \text{National-Level Output Loss for Option}$$

EPA also estimates the output gains in the economy using the following output multipliers⁵ for the pollution control industries:

- For capital material costs:

BAT and BPT: BEA Industry 42.0800 (pipes, valves, and pipe fittings); BEA Industry 49.0100 (pumps and compressors); BEA Industry 49.0700 (general industrial machinery and equipment); BEA Industry 36.1100 (concrete products, except block and brick); and BEA Industry 40.0600 (fabricated plate work),⁶ with a weighted output multiplier of

⁴ U.S. Department of Commerce, 1992. Table A-2.4—Total Multipliers, by Industry Aggregation, for Output, Earnings, and Employment. *Regional Input-Output Modeling System (RIMS II)*. Washington, DC: BEA, Regional Analysis Division, (RIMS II National Multipliers).

⁵ *Ibid.*

⁶ Includes tanks.

2.9487.⁷ Capital material costs are assumed to be 90 percent of the total capital costs estimated for each option.

PSES: BEA Industry 42.0800 (pipes, valves, and pipe fittings); BEA Industry 49.0100 (pumps and compressors); BEA Industry 49.0700 (general industrial machinery and equipment); BEA Industry 40.0600 (fabricated plate work);⁸ BEA Industry 40.0300 (heating equipment, except electrical and warm air furnaces); and BEA Industry 40.0400 (fabricated structural metal), with a weighted output multiplier of 2.9724.⁹ Capital material costs are assumed to be 90 percent of the total capital costs estimated for each option.

- For installation costs (BAT, BPT, and PSES): BEA Industry 11.0000 (construction — new and maintenance and repair), with a multiplier of 3.1957. Installation costs are assumed to be 10 percent of total capital costs.
- For operating costs (BAT, BPT, and PSES): (1) Labor: BEA Industry 29.0100 (drugs), with a multiplier of 2.3882 (assumes that operators for pollution control equipment will be hired by the affected industry); (2) Materials: BEA Industry 27.0406 (chemical and chemical preparations, not elsewhere classified) with a multiplier of 2.9083; (3) Energy: BEA Industry 68.0100 (electric services [utilities]), with a multiplier of 2.2370. Labor, materials, and energy shares vary among options as discussed below.

Gains are calculated using the costs assigned to a cost component (e.g., materials cost x 2.9083 = national-level output gain associated with the materials portion of O&M cost). Labor, materials, and energy

⁷ The weighted multiplier for BAT/BPT is developed assuming that 20 percent of capital costs is piping, 10 percent is pumps, 10 percent is general industrial machinery (filter press), 35 percent is concrete, and 25 percent is tanks. These breakdowns, as well as those discussed in the bullets later in this section, are estimated on the basis of assumptions developed by EPA's technical contractor (Tim Brenza, Eastern Research Group, Inc., Industry Categories for Multipliers. Memorandum to Record, January 29, 1998). These same assumptions are applied to the development of the employment multiplier breakdown discussed later.

⁸ Includes tanks.

⁹ The weighted multiplier for PSES is developed assuming that 50 percent of capital costs is piping, 4 percent is pumps, 1 percent is general industrial machinery, 20 percent is tanks, 10 percent is heating equipment, and 15 percent is fabricated structural metal. These breakdowns, as well as those discussed in the following bullets, are estimated on the basis of assumptions developed by EPA's technical contractor (Tim Brenza, Eastern Research Group, Inc., Industry Categories for Multipliers. Memorandum to Record, January 29, 1998). These same assumptions are applied to the development of the employment multiplier breakdown discussed later.

shares for all options have been estimated separately in cost models and vary according to option.¹⁰ EPA calculates output gains for the remaining options similarly using their respective labor, materials, and energy costs. When all the gains associated with pollution control industries are aggregated, EPA can estimate the total output gains attributable to the Final Pharmaceutical Industry Effluent Guidelines. To determine a net loss or gain, EPA then compares the losses and gains in the economy.

7.1.2.2 National-Level Employment Losses and Gains

In calculating national-level employment impacts, the Agency first uses a similar approach to that used to calculate output effects. Based on pharmaceutical industry output, BEA (RIMS II National Multipliers) has estimated a final-demand multiplier for national-level employment of 19.5. This number represents the total change in the number of jobs in all industries nationally for each \$1 million change in output delivered to final demand by the pharmaceutical industry.¹¹ Therefore, to calculate employment impacts, EPA divides the output loss of the pharmaceutical industry, measured as the annual pretax compliance cost, by \$1 million and multiplies this figure by BEA's employment multiplier.¹²

Another estimate of impact on employment can be achieved by using total postcompliance closures/failures and the associated employment losses, multiplied by the national-level, direct-effect employment multiplier of 5.0798. These two types of losses (output and closure-related losses) overlap (that is, the larger of the two losses includes the smaller of the two losses), but they correspond to different driving factors. Closures/failures are driven by individual facility or firm financial situations, but are not directly related to market conditions, whereas output-related losses do reflect market conditions but would not reflect conditions at individual firms or facilities.

¹⁰ Cost breakdowns for labor, materials and energy were developed by EPA's technical contractor; Tim Brenza, Eastern Research Group, Inc. Cost Breakdowns for Labor, Materials and Energy. Memorandum to Record, May 29, 1998.

¹¹ Employment impacts calculated using a final-demand multiplier include direct, indirect, and induced effects.

¹² Losses are inflated to 1992 dollars because BEA's national multipliers are based on 1992 data. EPA uses *Engineering News Record*, 1997. "Construction Cost Index," March 31, for inflating.

Output-based losses can be thought of as longer-term losses associated with longer-term market equilibrium, whereas losses associated with closures and failures can be considered the more immediate impact of the rule before market equilibrium is achieved. Thus output-based losses may be greater than or less than the losses estimated on the basis of closures and failures, which means that nonclosing facilities might gain or lose production and employment depending on how many facilities close. If no facilities close, nonclosing facilities might lose some production and employment. If many facilities close, nonclosing facilities might actually gain production and employment if closure losses “overshoot” the expected losses at market equilibrium. Note, however, that both the output-based employment effects and the closure/failure employment effects derived here are worst-case impacts within the pharmaceutical industry since EPA assumes the industry cannot pass through the costs of compliance to consumers.

Employment gains are estimated using the final-demand multipliers for each of the pollution control industries listed above. These multipliers are:

- For capital material costs:

BAT and BPT: BEA Industry 42.0800 (pipes, valves, and pipe fittings); BEA Industry 49.0100 (pumps and compressors); BEA Industry 49.0700 (general industrial machinery and equipment); BEA Industry 36.1100 (concrete products, except block and brick); and BEA Industry 40.0600 (fabricated plate work),¹³ with a weighted employment multiplier of 31.35.¹⁴

PSES: BEA Industry 42.0800 (pipes, valves, and pipe fittings); BEA Industry 49.0100 (pumps and compressors); BEA Industry 49.0700 (general industrial machinery and equipment); BEA Industry 40.0600 (fabricated plate work);¹⁵ BEA Industry 40.0300 (heating equipment, except electrical and warm air furnaces); and BEA Industry 40.0400 (fabricated structural metal), with a weighted employment multiplier of 30.32.¹⁶

- For installation costs (BAT, BPT, and PSES): BEA Industry 11.0000 (construction — new and maintenance and repair), with a multiplier of 21.5.

¹³ Includes tanks.

¹⁴ Weighting is the same as that used for the output gains analysis.

¹⁵ Includes tanks.

¹⁶ Weighting is the same as that used for the output gains analysis.

- For operating costs (**BAT**, **BPT**, and **PSES**): (1) Labor: BEA Industry 29.0100 (drugs), with a multiplier of 19.5 (assumes that operators for pollution control equipment will be hired by the affected industry); (2) Materials: BEA Industry 27.0406 (chemicals and chemical preparations, not elsewhere classified) with a multiplier of 23.7; and (3) Energy: BEA Industry 68.0100 (electric services [utilities]), with a multiplier of 15.8.

EPA computes employment gains by multiplying the appropriate industry shares of the pollution control costs times the appropriate multiplier. After aggregating all gains, EPA compares national-level losses and gains to compute the net employment change resulting from the Final Pharmaceutical Industry Effluent Guidelines. This net change can then be compared to national-level employment to gauge the magnitude of employment impacts on the national economy.

7.1.2.3 Total Direct Employment Losses in the Pharmaceutical Industry

As noted above, the employment losses from closures/failures might understate direct employment losses in the pharmaceutical industry. Therefore, EPA also must determine whether employment losses from nonclosing facilities occur, or whether some employment (and production) gains accrue to nonclosing facilities. EPA thus conducts another employment loss analysis that allows net losses to be computed. This analysis is based on output effects assuming no cost passthrough to consumers and gains in labor associated with operating pollution control equipment. The analysis uses total output losses associated with the selected options scenario to reflect the reduction in output that would affect employment in the pharmaceutical industry alone. EPA then computes the direct employment losses in the pharmaceutical industry alone. As with the national-level analysis described above, employment losses in the industry might be offset by employment gains, because it is likely pharmaceutical facilities will hire or transfer workers from productive operations to operate the pollution control equipment installed.

This output loss, which was converted to total employment losses using the BEA multiplier of 19.5 FTEs per \$1 million change in the output for the pharmaceutical industry, includes all direct, indirect, and induced employment effects specifically related to changes in output in the pharmaceutical industry alone. To estimate direct losses only (losses only in the pharmaceutical industry), EPA multiplies total net employment losses by the inverse of the national-level direct-effect employment multiplier (5.0798). The direct-effect multiplier represents the change in total (direct, indirect, and induced) employment for each unit change in direct employment; its inverse, therefore, represents the direct employment change portion of total

employment impacts. Direct losses can be compared to total industry baseline employment to gauge the magnitude of employment impacts within the industry. They also can be compared to losses associated with facility closures/firm failures to determine how many employees, if any, are lost at nonclosing facilities after accounting for potential gains.

Employment losses associated with failures/closures are estimated using the Section 308 Survey data on facility-level employment. For every closure or closure/failure, EPA assumes the entire employment at a facility is lost. For firm failures where the facility or facilities are considered financially viable, EPA assumes 10 percent of total firm employment is lost (i.e., the facilities are sold, but some administrative employment is lost due to acquisition and/or merger).

The direct employment losses, however, are only a fraction of the employment losses that might affect the national economy; as discussed earlier, there are indirect and induced losses of employment also to consider. These indirect and induced losses can be estimated using the national-level BEA direct-effect multipliers. The national-level direct-effect multiplier for the pharmaceutical industry is 5.0798. The calculation for determining the total, national-level employment loss based on closures/failures is:

Direct Employment Loss x Direct Effect Multipliers = Total Direct, Indirect, and Induced Losses.

7.1.2.4 Output and Employment Effects Associated with the Combined Rules

Using the same methodology as described above, and assuming that the breakdowns and multipliers are identical to those used for PSES-A/C (the technologies likely to be used for achieving PSES-A/C and the MACT standards rule are very similar) and the costs associated with the MACT standards rule, EPA calculates the output and employment losses and gains associated with MACT standard costs for wastewater emission controls and total MACT standard costs for the facilities in the Final Pharmaceutical Industry Effluent Guidelines analysis. These impacts are then summed with impacts from the Final Pharmaceutical Industry Effluent Guidelines to estimate the impacts from both rules combined.

7.1.3 National-Level Output and Employment Impacts

7.1.3.1 National-Level Output Losses From the Final Pharmaceutical Industry Effluent Guidelines

Table 7-1 shows the total gross, national-level, worst-case output losses associated with the Final Pharmaceutical Industry Effluent Guidelines. Using the output multiplier of 2.3882, national-level output losses are estimated to range from \$0 to \$86 million per year, depending on the option, with total losses under the selected options estimated to be \$118 million.

Table 7-2 shows the total gross national-level output gains associated with purchasing, installing, and operating pollution control equipment. The national-level output gains for each option are estimated to range from \$0 to \$100 million per year, with a total output gain of \$136 million for all selected options. The net annual gains in national-level output for each option are estimated to range from \$0 million to \$13 million per year, depending on the option, with total net gains estimated to be \$18 million (see Table 7-3).

7.1.3.2 National-Level Employment Losses/Gains from the Final Pharmaceutical Industry Effluent Guidelines

Table 7-4 presents the national-level employment losses associated with the lost pharmaceutical industry output. EPA converts the industry output losses into millions of 1992 dollars¹⁷ and multiplies these losses by the employment multipliers to determine total annual employment losses of 0 to 742 FTEs, depending on the option. The total output-based loss over the entire U.S. economy for all selected options is estimated to be 1,014 FTEs. The total number of employment losses associated with closures/failures is estimated to be 139 FTEs.¹⁸ When indirect and induced losses are added to these direct losses, losses in the economy from closures/failures total 706 FTEs. The output-based loss includes these 706 FTEs.

¹⁷ BEA's RIMS II National Multipliers are based on 1992 data and thus, all 1990 dollars must be inflated when compared to the total employment losses in the economy associated with closures/failures.

¹⁸ These losses stem from one facility failure and closure (94 FTEs), three firm failures (combined 25 FTEs), and one facility closure (20 FTEs) which closes only under Baseline 3 when total MACT costs are included.

Table 7-1

Annual National-Level Output Losses (millions of 1990 dollars)

Selected Option	Total Estimated Ouput Loss in the Pharmaceutical Industry	Output Multiplier	National-Level Output Losses
BPT-A/C	\$2.02	2.3882	\$4.82
BPT-B/D	\$1.12	2.3882	\$2.68
BAT-A/C	\$2.93	2.3882	\$6.99
PSES-A/C	\$36.13	2.3882	\$86.29
PSES-B/D	\$7.17	2.3882	\$17.12
Total of Selected Options	\$49.36		\$117.89

Source: Output loss is pretax annualized cost of capital and O&M costs shown in Table 4-3 in Section 4. Output multiplier is from U.S. Department of Commerce, 1992. Table A-2.4--Total multipliers, by Industry Aggregation, for Output, Earnings and Employment. Regional Input-Output Modeling System (RIMS II). BEA, Regional Analysis Division.

Table 7-2

Annual National-Level Output Gains (millions of 1990 dollars)

Item	BPT-A/C	BPT-B/D	BAT-A/C	PSES-A/C	PSES-B/D	Total
Total Capital Cost (Annualized Over 16 Years at 7%)	\$0.26	\$0.19	\$0.59	\$8.56	\$2.34	\$11.93
Capital Materials Cost	\$0.23	\$0.17	\$0.53	\$7.70	\$2.10	\$10.74
Capital Materials Multiplier	2.9487	2.9487	2.9487	2.9724	2.9724	
Output Gain (Capital Materials)	\$0.68	\$0.50	\$1.56	\$22.90	\$6.25	\$31.90
Installation Cost	\$0.03	\$0.02	\$0.06	\$0.86	\$0.23	\$1.19
Installation Cost Multiplier	3.1957	3.1957	3.1957	3.1957	3.1957	
Output Gain (Installation)	\$0.08	\$0.06	\$0.19	\$2.74	\$0.75	\$3.81
Total O&M Cost	\$1.76	\$0.93	\$2.34	\$27.57	\$4.83	\$37.43
Labor Share	\$1.04	\$0.69	\$0.97	\$11.55	\$0.88	\$15.13
Labor Multiplier	2.3882	2.3882	2.3882	2.3882	2.3882	
Output Gain (Labor)	\$2.49	\$1.65	\$2.31	\$27.58	\$2.10	\$36.14
Materials Share	\$0.60	\$0.18	\$1.15	\$15.66	\$3.92	\$21.51
Materials Multiplier	2.9083	2.9083	2.9083	2.9083	2.9083	
Output Gain (Materials)	\$1.74	\$0.52	\$3.35	\$45.55	\$11.39	\$62.56
Energy Share	\$0.12	\$0.06	\$0.21	\$0.36	\$0.04	\$0.79
Energy Multiplier	2.2370	2.2370	2.2370	2.2370	2.2370	
Output Gain (Energy)	\$0.27	\$0.14	\$0.48	\$0.80	\$0.08	\$1.77
Total Output Gain	\$5.26	\$2.87	\$7.90	\$99.57	\$20.56	\$136.17

Source: Capital and O&M costs are from EPA's Development Document. Multipliers are derived as discussed in the text of this report and obtained from BEA table.

Table 7-3

Net Annual National-Level Output Losses Associated with the Final Pharmaceutical Industry Effluent Guidelines (millions of 1990 dollars)

Selected Option	Total Annual Loss	Total Annual Gain	Net GAIN in National-Level Output
BPT-A/C	\$4.82	\$5.26	\$0.44
BPT-B/D	\$2.68	\$2.87	\$0.20
BAT-A/C	\$6.99	\$7.90	\$0.91
PSES-A/C	\$86.29	\$99.57	\$13.28
PSES-B/D	\$17.12	\$20.56	\$3.45
Total of Selected Options	\$117.89	\$136.17	\$18.28

Source: Tables 7-1 and 7-2.

Table 7-4

National-Level Employment Losses (FTEs)

Selected Option	Total Annual Output Loss in the Pharmaceutical Industry (\$ MM 1990)	Loss in 1992 Dollars (\$ MM 1992)	Output Employment Multiplier	Total Output-Based FTE Loss	Employment Losses Based on Facility Closures/Firm Failures	Direct Effect Employment Multiplier	Total Closure/Failure-Based FTE Loss
BPT-A/C	\$2.02	\$2.12	19.5	41	0	5.0798	0
BPT-B/D	\$1.12	\$1.18	19.5	23	0	5.0798	0
BAT-A/C	\$2.93	\$3.08	19.5	60	0	5.0798	0
PSES-A/C	\$36.13	\$38.06	19.5	742	138	5.0798	701
PSES-B/D	\$7.17	\$7.55	19.5	147	1	5.0798	5
Total Selected Options	\$49.36	\$52.00		1,014	139		706

Source: Table 7-1; Employment multipliers are from U.S. Department of Commerce, 1992. Table A-2.4--Total Multipliers, by Industry Aggregation, for Output, Earnings and Employment. Regional Input-Output Modeling System (RIMS II). BEA, Regional Analysis Division.

1990 dollars are inflated to 1992 dollars using the Engineering News Record's Construction Cost Index (0.9568).

Table 7-5 presents the national-level employment gains associated with the output gains in the pollution control industries. These gains range from 0 to 900 FTEs, depending on option, with total gains estimated to be 1,232 FTEs.

As Table 7-6 shows, net employment gains range from 0 to 158 FTEs, depending on option. The total net gain in national-level employment based on output is 218 FTEs for all selected options. (A gain of 526 FTEs would be computed if national-level losses are estimated solely on the basis of closures/failures.)

7.1.3.3 Direct Employment Losses in the Pharmaceutical Industry from the Effluent Guidelines

As noted above, the losses associated with postcompliance facility closures or firm failures could overstate or understate longer-term losses in the pharmaceutical industry. The actual output loss, calculated for the pharmaceutical industry using pretax annual costs of compliance, totals \$52 million annually for all selected options (1992 dollars) or less than 1 percent of the \$56.7 billion in pharmaceutical revenues in 1990.¹⁹ This output loss would result in a nationwide employment loss of 1,014 FTEs associated with output losses occurring strictly in the pharmaceutical industry, based on the final-demand employment multiplier of 19.5 FTEs per \$1 million output change (see Table 7-4 and Table 7-7).

These numbers, however, include the direct, indirect, and induced employment losses, (see beginning of Section Seven for definition) as well as losses that might be offset by gains within the pharmaceutical industry. Employment gains (direct, indirect, and induced) expected due to the need to operate the pollution control equipment, as shown in Table 7-5, are estimated to be 0 to 237 FTEs, for a total of 311 FTEs over the selected options. Assuming pharmaceutical firms will choose to transfer employees from productive operations or hire new employees to operate the pollution control equipment rather than contract for these services from other industries, 100 percent of these employment gains will be felt in the pharmaceutical industry itself (see Table 7-7). Thus the total net loss associated with pharmaceutical facilities (and still including direct, indirect, and induced losses) ranges from 0 to 505 FTEs, depending on option, and totals 703 FTEs over all selected options (i.e., 1,014 FTEs lost – 311 FTEs gained = 703 FTEs lost). Given this total net loss in employment, the inverse of the direct-effect multiplier (i.e., 1/multiplier) can be used to

¹⁹ U.S. Bureau of the Census. 1997. *Statistical Abstract of the United States: 1997*. Washington, DC: U.S. Government Printing Office.

Table 7-5

National-Level Employment Gains (FTEs) (millions of 1992 dollars)

Item	BPT-A/C	BPT-B/D	BAT-A/C	PSES-A/C	PSES-B/D	Total
Total Capital Cost (Annualized Over 16 Years at 7%)	\$0.27	\$0.20	\$0.62	\$9.02	\$2.46	\$12.57
Capital Materials Cost	\$0.24	\$0.18	\$0.56	\$8.12	\$2.21	\$11.31
Capital Materials Employment Multiplier	31.35	31.35	31.35	30.32	30.32	
Employment Gain (Capital Materials)	8	6	18	246	67	344
Installation Cost	\$0.03	\$0.02	\$0.06	\$0.90	\$0.25	\$1.26
Installation Cost Employment Multiplier	21.5	21.5	21.5	21.5	21.5	
Employment Gain (Installation)	1	0	1	19	5	27
Total O&M Cost	\$1.85	\$0.98	\$2.46	\$29.05	\$5.09	\$39.43
Labor Share	\$1.10	\$0.73	\$1.02	\$12.17	\$0.93	\$15.94
Labor Employment Multiplier	19.5	19.5	19.5	19.5	19.5	
Employment Gain (Labor)	21	14	20	237	18	311
Materials Share	\$0.63	\$0.19	\$1.22	\$16.50	\$4.13	\$22.66
Materials Employment Multiplier	23.7	23.7	23.7	23.7	23.7	
Employment Gain (Materials)	15	4	29	391	98	537
Energy Share	\$0.13	\$0.06	\$0.00	\$0.38	\$0.04	\$0.83
Energy Employment Multiplier	15.8	15.8	15.8	15.8	15.8	
Employment Gain (Energy)	2	1	4	6	1	13
Total Employment Gain	47	26	71	900	189	1,232

Source: Capital and O&M costs are from EPA's Development Document. Multipliers are derived as discussed in the text of this report and obtained from BEA tables.

Table 7-6

**Net Annual National-Level Employment Losses Associated with the
Final Pharmaceutical Industry Effluent Guidelines (FTEs)**

Selected Option	Total Annual Losses Based on Output	Total Annual Gain	Net GAIN in National-Level Employment Based on Output
BPT-A/C	41	47	5
BPT-B/D	23	26	3
BAT-A/C	60	71	11
PSES-A/C	742	900	158
PSES-B/D	147	189	42
Total of Selected Options	1,014	1,232	218

Source: Tables 7-4 and 7-5.

Table 7-7

Direct Employment Losses in the Pharmaceutical Industry (FTEs)

Selected Option	Total FTE Loss	Total FTE Gain	Net Total FTE LOSS	Net Direct FTE LOSS	Percent of Industry Employment
BPT-A/C	41	21	20	4	0.00%
BPT-B/D	23	14	9	2	0.00%
BAT-A/C	60	20	40	8	0.00%
PSES-A/C	742	237	505	99	0.05%
PSES-B/D	147	18	129	25	0.01%
Total of Selected Options	1,014	311	703	138	0.08%

Source: Tables 7-4 and 7-5. Industry employment from Section 308 survey.

calculate the direct employment losses. The direct-effect multiplier for the pharmaceutical industry is 5.0798, which means that for every direct job loss, there are an additional 4.0798 indirect and induced job losses.²⁰ Thus, the direct component of the net losses calculated is estimated to be 138 FTEs for all selected options, which is 0.08 percent of the estimated 184,000 FTEs (Section 308 Survey) employed in the affected portion of the pharmaceutical industry. This number is almost identical to the closure/failure-related losses estimated (139 FTEs), so any employment losses or gains occurring among nonclosing facilities will be negligible, assuming zero cost passthrough.

7.1.3.4 National-level Output and Employment Losses and Gains from Final Pharmaceutical Industry Effluent Guidelines and MACT Standards Rule

Table 7-8 presents the output and employment gains expected from the MACT standards rule. Output gains associated with the MACT standards rule for wastewater emission controls and total MACT standards requirements (for facilities in the Final Pharmaceutical Industry Effluent Guidelines analysis) were estimated to be \$24 and \$112 million with employment gains of 227 and 1,017 FTEs, respectively. Table 7-9 presents the output and employment losses and net output and employment gains from the MACT standards rule and the combined rules. The net gain in national-level output associated with total MACT standards requirements is estimated to be \$16 million and, when combined with the \$18 million net gain associated with the selected effluent guideline options, the total net gain in national-level output for the combined rules becomes \$34 million. The net gain in national-level employment associated with total MACT standards requirements is estimated to be 189 FTEs, yielding a net employment gain of 407 FTEs for the combined rules.

Table 7-10 presents direct output-related employment losses in the pharmaceutical industry for MACT standards rule. The annual postcompliance production loss associated with the total costs of the MACT standards rule for facilities in the Final Pharmaceutical Industry Effluent Guidelines analysis, as measured by annualized pretax costs of compliance, is estimated to be \$42 million in 1992 dollars.²¹ Multiplying this production loss by the final-demand employment multiplier of 19.5 yields a total loss of 828

²⁰ RIMS II National Multipliers.

²¹ BEA's RIMS II National Multipliers are based on 1992 data and thus, all 1990 dollars must be inflated when compared to the total employment losses in the economy associated with closures/failures.

Table 7-8

Annual National-Level Output and Employment Gains for MACT standards

Item	Output Gains (millions of 1990 dollars)		Employment Gains (FTEs) (millions of 1992 dollars)	
	MACT standards for wastewater emission controls	Total MACT standards	MACT standards for wastewater emission controls	Total MACT standards
Total Capital Cost (Annualized Over 16 Years at 7%)	\$3.27	\$10.88	\$3.45	\$11.47
Capital Materials Cost	\$2.94	\$9.80	\$3.10	\$10.32
Capital Materials Multiplier	2.9724	2.9724	30.32	30.32
Output/Employment Gain (Capital Materials)	\$8.75	\$29.12	94	313
Installation Cost	\$0.33	\$1.09	\$0.34	\$1.15
Installation Cost Multiplier	3.1957	3.1957	21.5	21.5
Output/Employment Gain (Installation)	\$1.05	\$3.48	7	25
Total O&M Cost	\$5.44	\$29.44	\$5.73	\$31.01
Labor Share *	\$2.18	\$11.81	\$2.30	\$12.44
Labor Multiplier	2.3882	2.3882	19.5	19.5
Output/Employment Gain (Labor)	\$5.21	\$28.19	45	243
Materials Share *	\$3.19	\$17.25	\$3.36	\$18.17
Materials Multiplier	2.9083	2.9083	23.7	23.7
Output/Employment Gain (Materials)	\$9.27	\$50.17	80	431
Energy Share *	\$0.07	\$0.38	\$0.07	\$0.40
Energy Multiplier	2.2370	2.2370	15.8	15.8
Output/Employment Gain (Energy)	\$0.16	\$0.86	1	6
Total Output/Employment Gain	\$24.44	\$111.82	227	1,017

Source: Capital and O&M costs are from EPA's Development Document. Multipliers are derived as discussed in the text of this report and obtained from BEA table.

* Labor, materials, and energy shares of O&M are assumed to be equivalent to PSES-A/C percentages.

Table 7-9

Net Annual National-Level Output and Employment Losses Associated with Final Pharmaceutical Industry Effluent Guidelines and MACT standards

Rule	National-Level Output (millions of 1990 dollars)			National-Level Employment (FTEs)		
	Total Annual Loss	Total Annual Gain	Net GAIN in National-Level Output	Total Annual Loss	Total Annual Gain	Net GAIN in National-Level Employment
Total selected effluent guidelines options	\$117.89	\$136.17	\$18.28	1,014	1,232	218
MACT standards for wastewater emission controls	\$20.81	\$24.44	\$3.63	179	227	48
Total MACT standards	\$96.30	\$111.82	\$15.52	828	1,017	189
Total combined rules	\$214.19	\$247.99	\$33.80	1,842	2,249	407

Source: Table 7-8 and Table 4-4 (applying multipliers as in Tables 7-1 and 7-4) for MACT standards rule and Table 7-2 and 7-5 for the Final Pharmaceutical Industry Effluent Guidelines.

Table 7-10

Direct Employment Losses in the Pharmacaetical Industry for MACT standards (FTEs)*

Rule	Annual Postcompliance Production Loss (\$ MM 1990)	Output Loss in 1992 Dollars (\$ MM 1992)	Final-Demand Employment Multiplier	Total FTE Loss	Total FTE Gain	Net Total FTE LOSS	Net Direct FTE LOSS	Percent of Industry Employment
Total selected effluent guidelines options	\$49.36	\$52.00	19.5	1,014	311	703	138	0.08%
MACT standards for wastewater emission control	\$8.71	\$9.18	19.5	179	45	134	26	0.01%
Total MACT standards	\$40.33	\$42.48	19.5	828	243	586	115	0.06%
Total combined rules	\$89.69	\$94.48	19.5	1,842	553	1,289	254	0.14%

Source: Table 7-9 for MACT standards rule and Table 7-1 and 7-7 for Final Pharmaceutical Industry Effluent Guidelines.

* Refer to text for explanation of MACT standards costs.

FTEs. Assuming that 40 percent of the MACT standards O&M cost goes to labor (which is the same assumption used for PSES-A/C, because the MACT standards rule is associated with the same technology on which PSES-A/C is based) and assuming 100 percent of these labor gains occur in the pharmaceutical industry (because workers are assumed to be transferred from productive operations to operate pollution control equipment), then the total employment gain associated with the labor to operate pollution control equipment resulting from the MACT standards rule is 243 FTEs (see Table 7-8). Comparing total gains and losses yields a total net loss of 586 FTEs for the MACT standards rule, which includes all direct, indirect, and induced losses. Multiplying this loss by the inverse of the direct-effect multiplier (i.e., 1/multiplier) yields a net direct employment loss of 115 FTEs, which is only 0.06% of total industry employment. Thus, direct net employment losses for both rules combined totals 254 FTEs, (138 from the Final Pharmaceutical Industry Effluent Guidelines and 115 from MACT standards rule, with rounding, or 0.14% of total industry employment. Closing firms/facilities are associated with employment losses totaling 139 FTEs. Thus nonclosing facilities might experience very small employment impacts (about 0.4 FTE per facility per year on average) from the combined rules, assuming zero cost passthrough.

7.2 REGIONAL EMPLOYMENT IMPACTS

7.2.1 Regional Analysis Methodology

The employment losses of concern in the regional-level analysis consist of two components: (1) employee layoffs associated with the facility closures and (2) employee layoffs associated with firm failures. (The output-based losses among nonclosing facilities calculated to occur are very small and will not have any effect on any one community). As discussed above, Section 308 Survey data on annual employment hours is used to calculate direct employment losses associated with facility closures/failures resulting from the Final Pharmaceutical Industry Effluent Guidelines on an FTE basis.

These losses are the direct employment losses associated with the Final Pharmaceutical Industry Effluent Guidelines that might have a significant impact on a region's economy. As in the case at the national level, direct losses can lead to indirect and induced losses at the regional level, which can be estimated using BEA regional direct-effect multipliers for the affected states in which closing/failing facilities or firms are

located. Note, however, that because these multipliers are derived for an entire state, they will most likely overstate the impacts within a smaller region (e.g., county or metropolitan statistical area [MSA]).

The direct-effect multiplier shows the number of total jobs lost in all industries given one job lost in the subject industry. For example, BEA tables show that one job lost in the pharmaceutical industry in the state of California will result in a total of 5.8464 jobs lost in all industries throughout the state. Thus the calculation is:

$$\text{Direct Employment Loss} \times \text{Direct-Effect Multiplier} = \text{Total Direct, Indirect, and Induced Losses}$$

The significance to the community of employment losses is measured by their impact on the community's overall level of employment. Data necessary to determine the community impact include the community's total labor force and employment rate. The community employment information used in this analysis is from the Census Bureau's web page,²² as estimated by the Bureau of Labor Statistics. For the purposes of this analysis, the community is defined as the MSA (if urban) or county (if rural) in which the facility is located and is assumed to represent the labor market area within which residents could reasonably commute to work. EPA evaluates the percentage increase in the unemployment rate (measured as 1 percent, for example, if the unemployment rate changes from 5 percent to 6 percent), to determine the severity of impact. The change in the unemployment rate is computed as:

$$\text{Current Unemployment Rate} - [(\text{Current Unemployment} + \text{Postcompliance Employment Losses}) / \text{Labor Force}]$$

Because the closures/failures are occurring among firms and facilities not affected by statistical weighting, the employment losses represented by these closures/failures will most likely occur only in the communities in which the affected facilities are located.

7.2.2 Results of the Regional Analysis

The largest employment loss associated with any one facility closure/failure occurs in a large urban area. The direct employment loss is 94 FTEs, and when indirect and induced effects are taken into account

²² [Http://www.census.gov/datamap/www/index.html](http://www.census.gov/datamap/www/index.html).

for that state, the total loss becomes 395 FTEs. The county in which this facility is located has a labor force of approximately 400,000 with an unemployment rate of about 8 percent (1994 data, the most recent available).²³ The facility closure/failure would cause the unemployment rate to increase by only 0.1 percent. EPA concludes that the impact this facility closure/failure would have on this region's economy is negligible.

The most significant percentage change in regional employment patterns resulting from a facility closure occurs in a rural area with a very small county labor force. This closure leads to a direct employment loss of 20 FTEs, and when accounting for indirect and induced losses in that state, the total employment loss is 66 FTEs.²⁴ Although this region experiences the most significant employment impact from a closing/failing facility, the increase in the county unemployment rate due to this closure/failure is still less than 0.4 percent, which EPA considers minimal. Given these findings and given that all other firm failures result in changes in the unemployment rate of substantially less than 0.4 percent, none of the selected options (either with or without MACT standards costs) would have a noticeable economic impact on the affected communities.

²³ [Http://www.census.gov](http://www.census.gov). *Op. cit.*

²⁴ These employment losses occur only under Baseline 3 when total MACT standards costs are included.