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Air

# Economic Impact Analysis for the Final Vegetable Oil Processing NESHAP

## Final Report

# Economic Impact Analysis for the Proposed Vegetable Oil Processing NESHAP

U.S. Environmental Protection Agency
Office of Air Quality Planning and Standards
Innovative Strategies and Economics Group, MD-15
Research Triangle Park, NC 27711

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# LIST OF ACRONYMS

| | |
|---|---|
| 2SLS | two-stage least squares |
| AC | annualized capital investment |
| CBI | confidential business information |
| CSRs | cost-to-sales ratios |
| EIA | economic impact analysis |
| FTEs | full-time equivalents |
| GDP | gross domestic product |
| HAPs | hazardous air pollutants |
| HHIs | Herfindahl-Hirschman indexes |
| ISEG | Innovative Strategies and Economics Group |
| LP | lost production |
| LDAR | leak detection and repair |
| LPC | lost production costs (operating costs and foregone profits incurred while the plant is shut down to install capital) |
| MACT | maximum achievable control technology |
| MRR | monitoring, recordkeeping, and reporting costs |
| NAICS | North American Industry Classification System |
| NESHAP | National Emission Standard for Hazardous Air Pollutants |
| O&M | operating and maintenance costs |
| OAQPS | Office of Air Quality Planning and Standards |
| OLS | ordinary least squares |
| RFA | Regulatory Flexibility Act |
| SBA | Small Business Administration |

| | |
|---|---|
| SBREFA | Small Business Regulatory Enforcement Fairness Act of 1996 |
| SIC | Standard Industrial Classification |
| SRC | solvent recovery credit |
| tpd | tons per day |
| tpy | tons per year |
| USDA | U.S. Department of Agriculture |
| VOCs | volatile organic compounds |

# EXECUTIVE SUMMARY

This report analyzes the economic impacts of an air pollution regulation to reduce emissions of hexane, which is a solvent, generated in the production of crude vegetable oils and meals. Hexane is a hazardous air pollutant (HAP). This analysis presents the economic impacts of two regulatory alternatives. The first alternative is the MACT floor, and the EPA is promulgating this regulatory alternative. The economic impact results are also presented for an above-the-MACT-floor alternative, and these results are presents for comparison purposes only.

**How do emissions of HAPs occur in the production of vegetable oils and meals?**

Emissions of HAPs from the production of vegetable oil and meal originate from the transfer and storage of solvent (hexane); potential leaks of solvent from piping and tanks; process vents (solvent recovery section, meal dryer, and meal cooler); and solvent retained in the crude oil or meal after processing.

**Which markets are affected by the regulation?**

The affected markets are those for crude soybean oil and meal, crude cottonseed oil and meal, crude corn oil and corn germ meal, and other types of crude vegetable oil and meal. Other types include safflower, sunflower, flaxseed, canola, and peanut oils and meals. The markets for refined vegetables oils are not directly affected.

**Which producers will be affected?**

In 1995, the baseline year of the analysis, the affected producers are the 106 vegetable oil processing facilities that produce vegetable oil and meal using a solvent extraction process. Both new and existing producers will be affected. A total of 31 companies are identified as owners of these vegetable oil and meal plants.

**How many small businesses will be affected?**

Based on Small Business Administration (SBA) definitions, 15 small companies owned and operated 21 facilities, or 20 percent of all solvent extraction facilities in 1995.

**What are the compliance costs associated with the regulation?**

The costs that each facility will incur include capital costs; operating and maintenance costs; monitoring, recordkeeping, and reporting costs; and lost production costs (operating costs and lost profits incurred while process changes are implemented). On an annualized basis, the compliance costs for plants operating in 1995 and for three plants that began operation in 1996 were estimated at $12.3 million with the maximum achievable control technology (MACT) floor scenario and $204.6 million with the more stringent above-the-MACT-floor scenario.

**What are the expected emissions reductions as a result of the regulation?**

The U.S. Environmental Protection Agency (EPA) estimates that a 25 percent reduction in emissions will be achieved with the MACT floor scenario, and a 43 percent reduction in emissions will be achieved with the above-the-MACT-floor scenario.

**How large are the compliance costs relative to sales for the entire industry?**

Cost-to-sales ratios (CSRs) were calculated at the facility level by dividing the regulatory compliance costs by facility revenue. For the MACT floor scenario, 104 of the 106 facilities have CSRs below 1 percent, two have CSRs from 1 to 2 percent, and no facility has a CSR above 2 percent. For the above-the-floor scenario, 17 facilities have CSRs below 1 percent, 44 have CSRs from 1 to 2 percent, and 45 have CSRs above 2 percent.

**How do the compliance costs relative to sales compare for small businesses?**

Under the floor scenario, average CSRs are 0.30 percent for small companies and 0.04 percent for large companies. Under the above-the-floor scenario, average CSRs are 2.97 percent for small companies and 0.45 percent for large companies.

**What are the overall expected effects on prices, output, and revenues?**

Under the floor scenario, prices for individual vegetable oils and meals are expected to increase by one-half of 1 percent or less, output is expected to decline by approximately one-third of 1 percent or less, and revenues are expected to increase by one-tenth of 1 percent. Under the above-the-floor scenario, prices for vegetable oils and meals are expected to increase by 2 to 13 percent under the above-the-floor scenario, output is expected to decline by 1 to 6 percent, and revenues are expected to increase by 4 percent.

**What are the predicted effects of the regulation on employment in the industry?**

Employment is expected to decrease by 12 individuals under the floor scenario and by 350 individuals under the above-the-floor scenario.

**Are any facilities predicted to close under the regulation?**

No product-line or facility closures are predicted with the floor option. Six product-line closures and three facility closures are predicted with the above-the-floor option.

**Will this regulation pose a significant impact on a substantial number of small entities?**

No. Under the floor scenario with lost production costs, the screening analysis (CSRs) and the market impact analysis do not show a significant impact on a substantial number of small entities. The potential for negative impacts is greater under the above-the-floor scenario.

**How have economic conditions changed in the affected industries since 1995, the baseline year of the analysis?**

The markets for oilseeds, oils, and meals exhibit a great deal of volatility over time. Since 1995, the prices of the primary oilseeds and similar inputs used in the production of vegetable oils and meals generally increased, while the prices of crude vegetables and meals generally decreased. However, the magnitude of the compliance costs relative to sales did not increase substantially using 1999 data compared to using 1995 data. In 2000, economic conditions in these industries have generally improved.

# SECTION 1

# INTRODUCTION

The U.S. Environmental Protection Agency (referred to as EPA or the Agency) is developing an air pollution regulation for reducing emissions of hexane generated in the production of crude vegetable oils and related products. These products include crude soybean oil and meal, crude cottonseed oil and meal, crude corn oil and corn germ meal, and crude specialty vegetable oils and meals. The regulation does not apply to facilities that refine crude vegetable oil. EPA's Office of Air Quality Planning and Standards (OAQPS) is developing the National Emission Standard for Hazardous Air Pollutants (NESHAP) under Section 112 of the Clean Air Act Amendments of 1990 to limit these emissions. The Innovative Strategies and Economics Group (ISEG) has developed this economic impact analysis (EIA) to support the evaluation of impacts associated with the regulatory alternatives considered for this NESHAP. This report presents economic impacts of the maximum achievable control technology (MACT) floor regulatory alternative promulgated by the EPA and economic impacts for an above-the-MACT-floor regulatory alternative for comparison purposes.

## 1.1 Scope and Purpose

This report evaluates the economic impacts of pollution control requirements in the production of vegetable oils and related products that are designed to reduce releases of hazardous air pollutants (HAPs) into the atmosphere. The Clean Air Act's purpose is to protect and enhance the quality of the nation's air resources (Section 101(b)). Section 112 of the Clean Air Act Amendments of 1990 establishes the authority to set national emissions standards for 189 HAPs. Emissions of HAPs from the production of vegetable oil and meal originate from the transfer and storage of solvent (hexane); potential leaks of solvent from piping and tanks; process vents (solvent recovery section, meal dryer, and meal cooler); and solvent retained in the crude oil or meal after processing (Midwest Research Institute, 1995).

The NESHAP will apply to all existing and new major sources that manufacture vegetable oil and related products using solvent extraction processes.[1] A major source is defined as a stationary source or group of stationary sources located within a contiguous area and under common control that emits, or has the potential to emit, 10 tons or more of any one HAP or 25 tons or more of any combination of HAPs. In 1995, an estimated 106 processing facilities produce crude vegetable oil and related products in the United States using solvent extraction processes. Some of these facilities process multiple oilseed types (e.g., soybean, cottonseed, corn, safflower, sunflower, canola, peanut). Based on 1995 emissions data, EPA has determined that all of these facilities are major sources of HAPs.

To reduce emissions of HAPs, the Agency establishes MACT standards. The term "MACT floor" refers to the minimum control technology on which MACT standards can be based. For existing major sources, the MACT floor is the average emissions limitation achieved by the best performing 12 percent of sources (if there are 30 or more sources in the category or subcategory). The MACT can be more stringent than the floor, considering costs, nonair quality health and environmental impacts, and energy requirements. The estimated costs for individual plants to comply with the MACT are inputs into the economic impact analysis presented in this report.

This report analyzes the economic effects of the MACT standard on existing sources. The MACT standard is the same for both new and existing soybean plants, which contribute the majority of HAP releases, but slightly more stringent for new plants that process other oilseed types. However, the economic impacts of the regulation on new sources of all types are expected to be minimal. Newly installed equipment is expected to be already in compliance with the MACT standard and no add-on control equipment will be necessary. Therefore, this report does not explicitly analyze the impact of the regulation on new sources. However, because the baseline year of the analysis is 1995, this report describes changes in economic conditions of the affected industries since that time.

## 1.2 Organization of the Report

The remainder of this report is divided into five sections that describe the methodology and present results of this analysis:

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[1]Most vegetable oil production processes use solvent extraction. Mechanical extraction accounts for less than 6 percent of production of vegetable oils.

- Section 2 provides a summary profile of the production of crude vegetable oils and related products. It presents data on market volumes and prices, manufacturing plants, and the companies that own and operate these plants.
- Section 3 reviews the regulatory control options and associated costs of compliance. This section is based on EPA's engineering analysis conducted in support of the NESHAP.
- Section 4 details the methodology for assessing the economic impacts of the NESHAP and the results of the analysis, which include market, industry, and social cost impacts.
- Section 5 provides the Agency's analysis of the regulation's impact on small businesses.
- Section 6 describes the assumptions used in this analysis.

In addition to these sections, Appendix A describes the economic model used to predict the economic impacts of the NESHAP, Appendix B provides information on the elasticities of demand and supply used in the model, and Appendix C provides the results of sensitivity analyses on the model assumptions.

# SECTION 2

# INDUSTRY PROFILE

Most crude vegetable oil and related products are produced using solvent extraction processes (affected facilities), although a small proportion is still produced using mechanical or hydraulic extraction processes (unaffected facilities). The affected products produced by vegetable oil facilities are classified in the following North American Industry Classification System (NAICS) codes:

- NAICS 311221, Wet Corn Products and NAICS 311211 Flour and Other Grain Mill Products—corn oil and corn germ meal;
- NAICS 311222, Soybean Products—soybean oil and soybean meal; and
- NAICS 311223, Other Oilseed Products—oils and meals of cottonseed, canola, flaxseed, rice, safflower, sunflower, and other oilseeds.

In addition to these primary products, other minor products, such as hulls, linters, and lecithin, are produced as well.[1]

This section provides a summary profile of the vegetable oil and related products industries as background information for understanding the technical and economic aspects of the industries. Section 2.1 presents a brief overview of the production process. Section 2.2 provides market data on U.S. production, consumption, foreign trade, and prices. Section 2.3 describes the affected U.S. processing facilities and the companies that own them. Finally, Section 2.4 provides data on the consumers and uses of vegetable oils and related products.

## 2.1 Production

Figure 2-1 shows a simplified process diagram for vegetable oils and related products. Oilseeds, such as soybeans and cottonseed, or similar inputs, such as peanuts, rice, and corn

[1]These minor products are not described as part of this summary profile because available data are insufficient to characterize them.

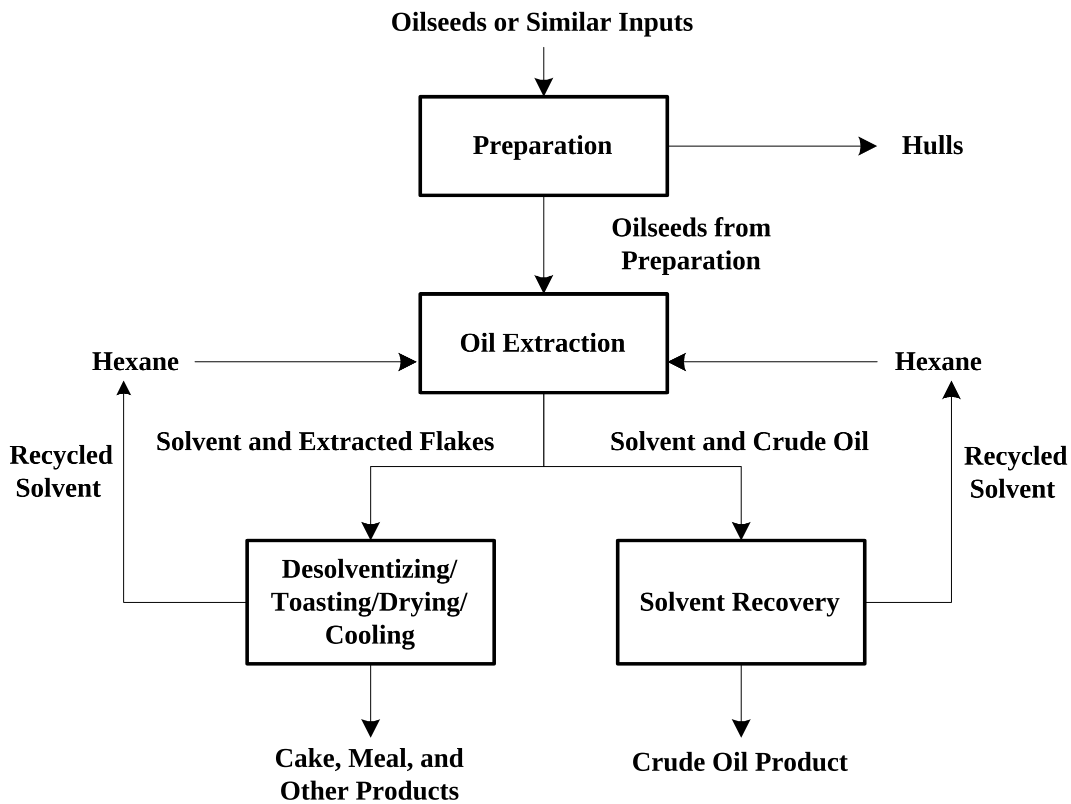


**Figure 2-1. Simplified Solvent Extraction Process for Vegetable Oils**

germ, are dehulled, cracked and flaked, and prepared for oil extraction. Hexane is added to dissolve the oil in the prepared oilseed or similar input and then recovered in a desolventizing (evaporation) process. Recovered hexane is then recycled for reuse in the process.

Crude oil products produced at these facilities are then transferred to a refining facility where they are prepared for human consumption. Meal products are either further processed into a variety of products for human consumption or prepared for use in animal feeds.

Based on the data, it appears that facilities produce relatively fixed proportions of their outputs to the oilseeds or similar inputs. Table 2-1 shows the average shares of oil production and meal production volumes relative to oilseed volumes based on U.S. Department of Agriculture (USDA) data for the years 1975 through 1996 and on the EPA facility database for 1995. Soybeans generate an average of 18.2 percent oil and 79.2 percent meal, with 2.6 percent shrink or waste by weight based on USDA data. These numbers are

**Table 2-1. Summary of Output Shares Relative to Input Volumes (short tons)**

| | Total Crushed Volume | Oil Product: Production Volume | Oil Product: Share (%) | Meal Product: Production Volume | Meal Product: Share (%) |
|---|---|---|---|---|---|
| USDA (1975 - 1996)[a] | | | | | |
| Soybean | | | | | |
| Mean | 29,991,290 | 5,472,871 | 18.2% | 23,740,258 | 79.2% |
| Standard deviation | 7,451,987 | 1,423,299 | 0.45% | 5,950,354 | 1.16% |
| Cottonseed | | | | | |
| Mean | 3,636,076 | 588,727 | 16.2% | 1,660,773 | 45.7% |
| Standard deviation | 482,524 | 94,383 | 0.96% | 281,226 | 2.65% |
| EPA Facility Database (1995)[b] | | | | | |
| Corn | 2,477,695 | 1,066,819 | 43.1% | 1,401,546 | 56.6% |
| Cottonseed | 3,794,066 | 622,308 | 16.4% | 1,744,562 | 46.0% |
| Soybean | 41,920,179 | 7,968,264 | 19.0% | 31,225,572 | 74.5% |
| All other | 2,601,092 | 1,026,335 | 39.5% | 1,497,886 | 57.6% |

[a] The USDA reports total crushed volumes based on a marketing year beginning September 1. These volumes have been adjusted to reflect a marketing year beginning October 1 to be consistent with reported oil and meal production.

[b] Oil and meal product quantities for seven facilities have been adjusted to be consistent with reported total crushed volumes.

Source: U.S. Department of Agriculture. 1997c. *Oil Crops Situation and Outlook Yearbook*. Washington, DC: Government Printing Office.

similar to the figures provided by David Ailor (1998) of the National Oilseed Processors Association (18.5 percent oil, 79 percent meal, 2.5 percent shrink and waste) and based on the EPA facility database (19.0 percent oil; 74.5 percent meal; and 6.5 percent shrink, waste, and hulls). Based on USDA data, cottonseed generated an average of 16.2 percent oil and 45.7 percent meal, with the remainder going to other products, and based on the EPA facility database, cottonseed generated an average of 16.4 percent oil and 46.0 percent meal. USDA does not report comparable figures for corn germ or the other oilseed types. However, based on the EPA facility database, corn germ is on average 43.1 percent oil and 56.6 percent meal. All other oilseeds are on average 39.5 percent oil and 57.6 percent meal.

Because the calculated percentages based on USDA data were fairly constant over time and because the major trade associations verified that these percentages remain constant, fixed production proportions are assumed in the EIA. Thus, predicted changes in oil and meal production due to the effects of the regulation were verified against these percentages as part of the EIA.

## 2.2 Market Data

This section presents baseline 1995 data for production, exports, imports, and apparent consumption of each of the three primary oil products and their associated meal products, as well as other vegetable oils and meals combined. Because the prices for these products are volatile, both historical and recent price data are included for the major outputs and the oilseed inputs.

### *2.2.1 Quantity Data*

Table 2-2 provides baseline 1995 data on production, exports, imports, and apparent consumption of corn oil, cottonseed oil, soybean oil, all other vegetable oils combined, corn germ meal, cottonseed meal, soybean meal, and all other meals combined, as reported by the USDA and Department of Commerce.

In 1995, soybean oil accounted for 74 percent of all vegetable oil production. Approximately 15 percent of soybean oil production was exported. Even greater percentages of the other oils were exported: 37 percent of corn oil, 23 percent of cottonseed oil, and 62 percent of all other vegetable oils combined. Small quantities of corn, cottonseed, and soybean oil were imported, but nearly half of all other vegetable oils combined were imported. Most of this quantity was canola oil, which is currently produced in only small quantities in the United States.

As with the oil products, soybean meal made up the majority of meal production, accounting for 92 percent of all meals combined in 1995. Approximately 19 percent of soybean meal was exported, compared to 5 percent of cottonseed meal and 13 percent of all other meals. Production and import data were unavailable for corn germ meal. The United States imports insignificant quantities of soybean and cottonseed meal but imports approximately half of all other meals (canola, flaxseed, and sunflower).

**Table 2-2. U.S. Inventories, Production, Foreign Trade, and Apparent Consumption of Vegetable Oils by Market: 1995 (short tons)**

| Market | Beginning Inventory | Production | Imports | Exports | Ending Inventory | Apparent Consumption[a] |
|---|---|---|---|---|---|---|
| Oil products | | | | | | |
| Corn oil | 45,091 | 1,121,703 | 4,495 | 415,270 | 98,203 | 657,816 |
| Cottonseed oil | 57,370 | 645,925 | 106 | 147,281 | 47,424 | 508,697 |
| Soybean oil | 527,616 | 7,818,128 | 13,616 | 1,143,544 | 704,447 | 6,511,369 |
| All other vegetable oils[b] | 135,042 | 1,015,792 | 529,125 | 632,625 | 146,792 | 900,542 |
| Total, oils | 765,118 | 10,601,548 | 547,341 | 2,338,719 | 996,865 | 8,578,423 |
| Meal products | | | | | | |
| Corn germ meal | NA | NA | NA | 61,950 | NA | NA |
| Cottonseed meal | 94,900 | 1,826,100 | 0 | 89,700 | 21,200 | 1,810,100 |
| Soybean meal | 241,117 | 33,340,037 | 65,405 | 6,491,570 | 290,100 | 26,864,889 |
| All other meals[c] | 16,512 | 1,091,571 | 936,570 | 138,469 | 16,512 | 1,889,673 |
| Total, meals | 352,529 | 36,257,708 | 1,001,975 | 6,781,688 | 327,812 | 30,564,662 |
| All other products[d] | NA | 3,781,800 | NA | NA | NA | NA |

[a] Apparent Consumption = Beginning Inventory + Production + Imports – Exports – Ending Inventory
[b] Includes canola, flaxseed, peanut, safflower, and sunflower volumes.
[c] Includes canola, flaxseed, and sunflower volumes.
[d] Includes cottonseed hulls, lecithin, cottonseed linters, and soybean hulls.

Sources: U.S. Department of Agriculture, Economic Research Service. Oil Crops Yearbook. [computer file]. Last updated January 1998.

U.S. Department of Commerce. 1996a. *1995 Current Industrial Reports—Fats and Oils: Oilseed Crushings*. M20J. Washington, DC: Government Printing Office.

U.S. Bureau of the Census. 1998a. U.S. Exports History: Historical Summary 1993-1997 on CD-ROM [machine readable data file]. Washington, DC: Bureau of the Census.

U.S. Bureau of the Census. 1998b. U.S. Imports History: Historical Summary 1993-1997 on CD-ROM [machine readable data file]. Washington, DC: Bureau of the Census.

All other vegetable oil products totaled 3.8 million tons in 1995. These include products such as hulls, lecithin, and cottonseed linters. Because of insufficient data, these products are not included in the EIA.

### *2.2.2 Baseline and Historical Price Data*

Historical price data for 1990 through 1999 for crude vegetable oils are presented in Table 2-3, with the 1995 baseline year of analysis in boldface. While the prices for corn, cottonseed, and soybean enter the model individually, the prices of canola, flaxseed, peanut, safflower, and sunflower are combined into a weighted average price for all other vegetable oils (see Table 4-1). Prices of oil tend to fluctuate greatly from year to year and appear to have peaked in 1994 for many of the oils and then fallen in 1995 and each year since then. The decrease in prices is attributable primarily to changes in the international markets for oil. In particular, crushing capacities in South America and Europe have expanded, thus reducing the demand for vegetable oil exports to these countries (USDA, 1999c).

Prices for oilseed meal and similar products are listed in Table 2-4 for 1990 through 1999, with the baseline 1995 data again in boldface. As with oil prices, these prices fluctuate greatly from year to year. For these products, prices appear to have peaked in 1993, fallen in 1994 and 1995, peaked again in 1996 and 1997, and then fallen drastically in 1998 and 1999. As with the prices for vegetable oils, these decreases are most likely attributable to a reduction in export demand for meals. Thus, for both vegetable oils and meals, prices received by vegetable oil processors were higher in 1995 than in recent years.

A large percentage of the costs of producing vegetable oils and meals is the cost of the raw agricultural inputs. In Table 2-5, their prices are presented for 1990 through 1999, with baseline 1995 data in boldface. Because these are agricultural commodities, acres planted and weather conditions influence the output in any given year; thus, prices tend to be volatile. In 1995, prices of oilseeds and similar inputs were substantially higher than in 1999 with the exception of cottonseed. Thus, while output prices for most vegetable oils and meals have fallen recently for most oilseed types, the cost of the primary input has fallen also. The situation for cottonseed is different than for the other oilseeds because cottonseed is being used increasingly as a dairy cow feed.

## Table 2-3. Prices of Vegetable Oils, 1990-1996 (cents/lb)

| | Corn | Cottonseed | Soybean | Canola[a] | Flaxseed | Peanut | Safflower | Sunflower |
|---|---|---|---|---|---|---|---|---|
| 1990 | 25.40 | 23.90 | 23.40 | 24.40 | 40.10 | 45.70 | 55.10 | 22.10 |
| 1991 | 28.40 | 20.70 | 20.30 | 21.30 | 34.50 | 38.06 | 49.20 | 23.40 |
| 1992 | 24.00 | 21.40 | 19.30 | 20.30 | 30.70 | 25.03 | 60.00 | 22.90 |
| 1993 | 21.80 | 26.00 | 22.70 | 23.70 | 31.70 | 34.10 | 70.00 | 26.80 |
| 1994 | 27.30 | 27.10 | 27.90 | 28.90 | 32.50 | 45.91 | 59.00 | 31.10 |
| **1995** | **26.60** | **26.80** | **26.80** | **27.80** | **35.00** | **41.57** | **59.00** | **28.90** |
| 1996 | 26.50 | 25.90 | 23.80 | 24.80 | 37.10 | 40.20 | 59.00 | 24.66 |
| 1997 | 24.85 | 26.51 | 23.27 | 24.27 | 36.25 | 47.20 | 59.00 | 23.45 |
| 1998 | 30.33 | 31.03 | 25.73 | 26.73 | 36.00 | 47.21 | 59.00 | 24.24 |
| 1999 | 23.36 | 23.95 | 17.60 | 18.60 | 36.00 | 38.25 | 59.00 | 19.00 |

[a] USDA does not report a crude canola oil price; thus, it was approximated as one cent per pound over the soybean oil price (Marine, 1999).

Sources: U.S. Department of Agriculture. 2000. *Agricultural Statistics 2000*. Washington, DC: Government Printing Office.

U.S. Department of Agriculture, Economic Research Service. 1999b. Oil Crops Yearbook. [computer file]. Last updated November 1999.

U.S. Department of Agriculture, Economic Research Service. 2000. Oil Crops Outlook. September 13, 2000.

U.S. Department of Agriculture. 1997a. *Agricultural Statistics 1997*. Washington, DC: Government Printing Office.

U.S. Department of Agriculture. 1992. *Agricultural Statistics 1992*. Washington, DC: Government Printing Office.

U.S. Department of Agriculture, Economic Research Service. 1998. Oil Crops Yearbook. [computer file]. Last updated January 1998.

## Table 2-4. Prices of Meal and Similar Products, 1990-1996 (cents/lb)

| | Corn Germ Meal[a] | Cottonseed | Soybean | Sunflower | Flaxseed | Peanut |
|---|---|---|---|---|---|---|
| 1990 | 4.76 | 7.79 | 9.08 | 4.57 | 6.63 | NA |
| 1991 | 5.09 | 6.74 | 9.21 | 4.36 | 6.37 | NA |
| 1992 | 5.18 | 7.23 | 9.38 | 3.96 | 6.40 | NA |
| 1993 | 4.39 | 8.29 | 9.94 | 4.51 | 7.03 | NA |
| 1994 | 4.48 | 7.53 | 9.13 | 4.37 | 6.00 | 8.40 |
| **1995** | **4.42** | **6.16** | **8.69** | **3.62** | **5.20** | **6.84** |
| 1996 | 5.82 | 10.01 | 12.33 | 6.33 | 8.28 | 10.04 |
| 1997 | 4.20 | 9.42 | 13.32 | 5.32 | 7.71 | 10.99 |
| 1998 | 3.25 | 6.22 | 8.14 | 3.74 | 5.15 | 9.36 |
| 1999 | 3.11 | 5.54 | 7.08 | 3.33 | 4.37 | 4.99 |

NA = Not available.

[a] Computed by adding $7 per short ton to reported corn gluten feed price (Brenner, 1999).

Sources: U.S. Department of Agriculture, Economic Research Service. 1997. Feed Yearbook. [computer file]. Last updated April 1997.

U.S. Department of Agriculture, Economic Research Service. 2000. Feed Yearbook. [computer file]. Last updated May 2000.

U.S. Department of Agriculture, Economic Research Service. 1998. Oil Crops Yearbook. [computer file]. Last updated January 1998.

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U.S. Department of Agriculture, Economic Research Service. 2000. Oil Crops Outlook. September 13, 2000.

U.S. Department of Agriculture, Economic Research Service. Oil Crops Outlook. September 13, 1999.

U.S. Department of Agriculture, Economic Research Service. Oil Crops Outlook. November 12, 1998.

**Table 2-5. Prices of Oilseeds: 1990-1996 (cents/lb)**

| | Corn Germ[a] | Cottonseed | Soybean | Peanuts | Sunflower | Flaxseed | Canola | Safflower | Rice |
|---|---|---|---|---|---|---|---|---|---|
| 1990 | 10.92 | 6.01 | 9.70 | NA | 11.53 | 12.25 | NA | NA | 6.90 |
| 1991 | 12.21 | 4.41 | 9.33 | NA | 10.19 | 7.31 | NA | NA | 7.34 |
| 1992 | 10.32 | 4.59 | 9.26 | NA | 9.10 | 6.71 | 9.84 | 13.10 | 7.03 |
| 1993 | 9.37 | 5.72 | 10.07 | NA | 11.63 | 7.59 | 10.57 | 14.83 | 5.98 |
| 1994 | 11.74 | 5.14 | 10.18 | NA | 12.97 | 8.03 | 11.03 | 14.80 | 8.22 |
| **1995** | **11.44** | **4.96** | **9.75** | **NA** | **10.83** | **9.02** | **11.10** | **14.60** | **7.62** |
| 1996 | 11.40 | 6.03 | 12.13 | NA | 12.37 | 10.62 | 12.30 | 16.93 | 9.59 |
| 1997 | 10.69 | 6.07 | 12.40 | NA | 11.39 | 10.87 | 11.83 | 16.30 | 9.99 |
| 1998 | 13.04 | 5.99 | 10.08 | NA | 12.51 | 10.47 | 10.63 | 14.60 | 9–10 |
| 1999 | 10.04 | 4.99 | 7.61 | NA | 9.15 | 7.82 | 8.65 | 13.87 | 9–10 |

NA = Not available.

[a] Corn germ price is computed as follows: 0.43 × corn oil price (Brenner, 1999).

Sources: U.S. Department of Agriculture. 1997a. *Agricultural Statistics 1997*. Washington, DC: Government Printing Office.

U.S. Department of Agriculture. 1992. *Agricultural Statistics 1992*. Washington, DC: Government Printing Office.

U.S. Department of Agriculture, Economic Research Service. 1998. Oil Crops Yearbook. [computer file]. Last updated January 1998.

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U.S. Department of Agriculture, National Agriculture Statistics Service. 2000. *Agricultural Prices: 1999 Summary*. Washington, DC: Government Printing Office.

U.S. Department of Agriculture, Economic Research Service. 1998. Rice Yearbook. [computer file]. Last updated November 1998.

U.S. Department of Agriculture, Economic Research Service. 2000. Oil Crops Outlook. September 13, 2000.

## 2.3 Affected Producers

The following section briefly describes vegetable oil processing facilities and the companies that own them. It also presents the information used to determine the proportion of products produced by affected solvent extraction facilities versus unaffected mechanical extraction facilities.

### *2.3.1 Manufacturing Facilities*

Tables 2-6(a) through 2-6(d) provide information on the facilities that produced crude vegetable oils and meals in the baseline year 1995 and that will be affected by the NESHAP. In addition, the tables indicate which facilities have closed since 1995 and list new facilities that have begun operations since 1995. All of these facilities use solvent extraction processes and are major sources of HAPs. The facilities are organized by the following product categories:

- corn oil (as represented by NAICS 311221 Wet Corn Products, and NAICS 311211 Flour and Other Grain Mill Products)—As shown in Table 2-6(a), six companies owned and operated eight facilities producing corn oil in 1995. In addition, one corn oil facility also produces safflower oil. Since 1995, one facility has closed.

- cottonseed oil (included in NAICS 311223 Other Oilseed Products)—As shown in Table 2-6(b), 12 companies owned and operated 25 cottonseed oil facilities in 1995. In addition, one cottonseed oil facility also produces safflower oil, two facilities also produce peanut oil, and one facility also produces corn oil. Since 1995, ten cottonseed oil facilities have closed or become dormant and three new facilities have opened.

- soybean oil (as represented by NAICS 311222 Soybean Products)—As shown in Table 2-6(c), 13 companies own and operate 62 soybean oil facilities. Since 1995, four soybean oil facilities have closed or become dormant and nine new soybean oil facilities have opened.

- minor vegetable oils (included in NAICS 311223 Other Oilseed Products)—This classification includes all other producers of vegetable oils, including canola, flaxseed, peanut, rice, safflower, and sunflower oils. As shown in Table 2-6(d), six companies owned and operated 11 facilities. Five of these facilities produce more than one type of vegetable oil product. Since 1995, two facilities have ceased operations.

## Table 2-6(a). Solvent Extraction Corn Oil Manufacturing Facilities and Locations: 1995

| Company Name | Facility Name | Facility Location | | Other Types Produced |
|---|---|---|---|---|
| Archer Daniels Midland | Archer Daniels Midland Co. | Clinton | IA | |
| | Archer Daniels Midland Co. | Decatur | IL | |
| Bunge Corporation | Bunge Corp.[a] | Danville | IL | |
| Cargill Incorporated | Cargill Inc. | Eddyville | IA | |
| | Cargill Inc. | Memphis | TN | |
| CPC International | CPC International | Bedford Park | IL | |
| Mitsubishi Corporation | California Oils | Richmond | CA | Safflower |
| Tate and Lyle PLC | A.E. Staley[b] | Loudon | TN | |

[a] Also produces corn oil using a mechanical extraction process.
[b] Dormant or closed after 1995.

Source: Ailor, David C., National Oilseed Processors Association. July 25, 2000. "Comments of the Vegetable Oil MACT Coalition on the National Emission Standards for Hazardous Air Pollutants: Solvent Extraction for Vegetable Oil Production, 40 C.F.R. Part 63 Subpart GGGG, Air Docket No. A-97-59." Memorandum.

National Cotton Council of America. July 25, 2000. "Comments of the National Cotton Council and National Cottonseed Products Association on the Proposed National Emission Standards for Hazardous Air Pollutants: Solvent Extraction for Vegetable Oil Production (65 FR 34252; May 26, 2000) (Air Docket No. A-97-59). Memorandum.

## Table 2-6(b). Solvent Extraction Cottonseed Oil Manufacturing Facilities and Locations: 1995

| Company Name | Facility Name | Facility Location | | Other Types Produced |
|---|---|---|---|---|
| Archer Daniels Midland | Southern Cotton Oil Co. | Memphis | TN | |
| | Southern Cotton Oil Co. | Port Gibson | MS | |
| | Southern Cotton Oil Co. | Lubbock | TX | Corn |
| | Southern Cotton Oil Co. | Levelland | TX | |
| | Southern Cotton Oil Co. | N Little Rock | AR | |
| | Southern Cotton Oil Co.[a] | Quanah | TX | Peanut |
| | Southern Cotton Oil | Sweetwater | TX | Peanut |
| Chickasha Cotton Oil Mill | Chickasha Cotton Oil[a] | Casa Grande | AZ | |
| | Clinton Cotton Oil Mill[a] | Clinton | OK | |
| | Lamesa Cotton Oil Mill | Lamesa | TX | |
| | Rio Grande Oil Mill[a] | Harlingen | TX | |
| Delta Oil Mill | Delta Oil Mill | Jonestown | MS | |
| Dunavant Enterprises | Anderson Clayton[a] | Phoenix | AZ | |
| | Anderson Clayton[a] | Chowchilla | CA | |
| Hartsville Oil Mill Incorporated | Hartsville Oil Mill | Darlington | SC | |
| J.G. Boswell | J.G. Boswell | Corcoran | CA | Safflower |
| Osceola Products | Osceola Products Co.[a] | Kennett | MO | |
| | Osceola Products Co.[a] | Osceola | AR | |
| Plains Cooperative Oil Mill Incorporated | Plains Co-op Oil Mill | Lubbock | TX | |
| Planter's Cotton Oil Mill | Planter's Cotton Oil Mill Inc. | Pine Bluff | AR | |
| Producers Cooperative Mill | Producers Cooperative Oil Mill | Oklahoma City | OK | |

(continued)

**Table 2-6(b). Solvent Extraction Cottonseed Oil Manufacturing Facilities and Locations: 1995 (Continued)**

| Company Name | Facility Name | Facility Location | | Other Types Produced |
|---|---|---|---|---|
| Valley Cooperative Mills | Valley Co-op Oil Mill | Harlingen | TX | |
| Yazoo Valley Oil Mill, Incorporated | Yazoo Valley Oil Mill[a] | Helena | AR | |
| | Yazoo Valley Oil Mill | Greenwood | MS | |
| | Yazoo Valley Oil Mill[a] | West Monroe | LA | |
| **New Facilities Opened Since 1995** | | | | |
| Alimenta | Alimenta | Vienna | GA | Peanut |
| Archer Daniels Midland | Southern Cotton Oil | Richmond | TX | |
| Chickasha Cotton Oil Mill | Chickasha Cotton Oil | Tifton | GA | |

[a] Dormant or closed after 1995.

Source: Ailor, David C., National Oilseed Processors Association. July 25, 2000. "Comments of the Vegetable Oil MACT Coalition on the National Emission Standards for Hazardous Air Pollutants: Solvent Extraction for Vegetable Oil Production, 40 C.F.R. Part 63 Subpart GGGG, Air Docket No. A-97-59." Memorandum.

National Cotton Council of America. July 25, 2000. "Comments of the National Cotton Council and National Cottonseed Products Association on the Proposed National Emission Standards for Hazardous Air Pollutants: Solvent Extraction for Vegetable Oil Production (65 FR 34252; May 26, 2000) (Air Docket No. A-97-59). Memorandum.

## Table 2-6(c). Solvent Extraction Soybean Oil Manufacturing Facilities and Locations: 1995

| Company Name | Facility Name | Facility Location | | Other Types Produced |
|---|---|---|---|---|
| Ag Processing | Ag Processing Inc. | Eagle Grove | IA | |
| | Ag Processing Inc. | Sergeant Bluff | IA | |
| | Ag Processing Inc. | Mason City | IA | |
| | Ag Processing Inc. | St Joseph | MO | |
| | Ag Processing Inc. | Manning | IA | |
| | Ag Processing Inc. | Dawson | MN | |
| | Ag Processing Inc. Assoc. | Sheldon | IA | |
| Archer Daniels Midland | Archer Daniels Midland Processing | Mankato | MN | |
| | Archer Daniels Midland Soybean Processing | Kansas City | MO | |
| | Archer Daniels Midland Co. | Des Moines | IA | |
| | Archer Daniels Midland Co.[a] | Decatur | IL | |
| | Archer Daniels Midland Co. | Lincoln | NE | |
| | Archer Daniels Midland Co. | Frankfort | IN | |
| | Archer Daniels Midland Co. | Mexico | MO | |
| | Archer Daniels Midland Co. | Fremont | NE | |
| | Archer Daniels Midland Co. | Kershaw | SC | |
| | Archer Daniels Midland Co.[b] | Clarksdale | MS | |
| | Archer Daniels Midland Co. | Fostoria | OH | |
| | Archer Daniels Midland Co. | Galesburg | IL | |
| | Archer Daniels Midland Co. | Fredonia | KS | |
| | Archer Daniels Midland Co. | Little Rock | AR | |
| | Archer Daniels Midland Co. | Taylorville | IL | |
| | Archer Daniels Midland Co. | Valdosta | GA | |

(continued)

## Table 2-6(c). Solvent Extraction Soybean Oil Manufacturing Facilities and Locations: 1995 (Continued)

| Company Name | Facility Name | Facility Location | | Other Types Produced |
|---|---|---|---|---|
| Bunge Corporation | Bunge Corp. | Decatur | AL | |
| | Bunge Corp. | Marks | MS | |
| | Bunge Corp. | Vicksburg | MS | |
| | Bunge Corp. | Cairo | IL | |
| | Bunge Corp. | Destrehan | LA | |
| | Bunge Corp. Soybean Processing | Emporia | KS | |
| | Bunge Corp. | Danville | IL | |
| Cargill Incorporated | Cargill Inc. | Fayetteville | NC | |
| | Cargill Inc. | Sidney | OH | |
| | Cargill Inc. | Sioux City | IA | |
| | Cargill Inc. | Raleigh | NC | |
| | Cargill Inc. | Guntersville | AL | |
| | Cargill Inc. | Des Moines | IA | |
| | Cargill Inc. | Chesapeake | VA | |
| | Cargill Inc. | Iowa Falls | IA | |
| | Cargill Inc. | Bloomington | IL | |
| | Cargill Inc. | Kansas City | MO | |
| | Cargill Inc. | Wichita | KS | |
| | Cargill Inc. | Gainesville | GA | |
| | Cargill Inc. | Cedar Rapids | IA | |
| | Cargill Inc. | Lafayette | IN | |
| | Cargill Inc. Protein Products | Cedar Rapids | IA | |

(continued)

## Table 2-6(c). Solvent Extraction Soybean Oil Manufacturing Facilities and Locations: 1995 (Continued)

| Company Name | Facility Name | Facility Location | | Other Types Produced |
|---|---|---|---|---|
| Central Soya Company | Central Soya Co. | Decatur | IN | |
| | Central Soya Co. | Gibson City | IL | |
| | Central Soya Co. | Bellevue | OH | |
| | Central Soya Co. | Delphos | OH | |
| | Central Soya Co. | Marion | OH | |
| Harvest States Cooperative | Honeymead Processing/Refining | Mankato | MN | |
| Moorman Manufacturing | Moorman Manufacturing Co.[c] | Quincy | IL | |
| | Quincy Soybean Co.[b] | Helena | AR | |
| | Quincy Soybean Co.[c] | Quincy | IL | |
| Owensboro Grain Company | Owensboro Grain Co. | Owensboro | KY | |
| Perdue Farms | Perdue Farms Inc. | Cofield | NC | |
| | Perdue Farms Inc. | Salisbury | MD | |
| Riceland Foods Incorporated | Riceland Foods Inc. | Stuttgart | AR | |
| Rose Acre Farm Incorporated | Rose Acre | Seymour | IN | |
| Southern Soya Corporation | Southern Soya Corp.[b] | Estill | SC | |
| Townsends | Townsends[b] | Millsboro | DE | |
| **New Facilities Opened Since 1995** | | | | |
| Ag Processing | Ag Processing | Hastings | NE | |
| Ag Processing | Ag Processing | Emmetsburg | IA | |
| Bunge Corporation | Bunge Corporation | Council Bluffs | IA | |
| Central Soya Company | Central Soya Co. | Morristown | IN | |
| Consolidated Grain and Barge | Consolidated Grain and Barge | Mt. Vernon | IN | |

(continued)

Table 2-6(c). Solvent Extraction Soybean Oil Manufacturing Facilities and Locations: 1995 (Continued)

| Company Name | Facility Name | Facility Location | | Other Types Produced |
|---|---|---|---|---|
| **New Facilities Opened Since 1995 (continued)** | | | | |
| CF Processing | CF Processing | Creston | IA | |
| Incobrasa | Incobrasa | Gilman | IL | |
| South Dakota Soybean Processors | South Dakota Soybean Processors | Volga | SD | |
| Zeeland Farm Soya | Zeeland Farm Soya | Zeeland | MI | |

[a] Two facilities are listed at this location.
[b] Dormant or closed since 1995.
[c] Currently owned by ADM.

Source: Ailor, David C., National Oilseed Processors Association. July 25, 2000. "Comments of the Vegetable Oil MACT Coalition on the National Emission Standards for Hazardous Air Pollutants: Solvent Extraction for Vegetable Oil Production, 40 C.F.R. Part 63 Subpart GGGG, Air Docket No. A-97-59." Memorandum.

National Cotton Council of America. July 25, 2000. "Comments of the National Cotton Council and National Cottonseed Products Association on the Proposed National Emission Standards for Hazardous Air Pollutants: Solvent Extraction for Vegetable Oil Production (65 FR 34252; May 26, 2000) (Air Docket No. A-97-59). Memorandum.

## Table 2-6(d). Solvent Extraction Other Vegetable Oil Manufacturing Facilities and Locations: 1995

| Company Name | Facility Name | Facility Location | | Types Produced |
|---|---|---|---|---|
| Archer Daniels Midland | Archer Daniels Midland Co. | Velva | ND | Canola |
| | Archer Daniels Midland Co.[a] | Augusta | GA | Canola and peanut |
| | Archer Daniels Midland Co. | Red Wing | MN | Flaxseed and sunflower |
| | Northern Sun | Enderlin | ND | Sunflower |
| | Northern Sun | Goodland | KS | Sunflower |
| Cargill Incorporated | Cargill Inc. | West Fargo | ND | Flaxseed, sunflower |
| | Stevens Industries | Dawson | GA | Canola and peanut |
| Lubrizol Corporation | SVO Specialty Products | Culbertson | MT | Canola, safflower, and sunflower |
| Oilseeds International | Oilseeds International[a] | Grimes | CA | Safflower |
| Rito Partnership | Rito Partnership[b] | Stuttgart | AR | Rice |
| Sessions Company | Sessions Company | Enterprise | AL | Peanut |

[a] Dormant or closed after 1995.

[b] The rice oil facility will not be subject to the regulation. However, its production volumes are included in the total for the other vegetable oil types to protect confidentiality.

Source: Ailor, David C., National Oilseed Processors Association. July 25, 2000. “Comments of the Vegetable Oil MACT Coalition on the National Emission Standards for Hazardous Air Pollutants: Solvent Extraction for Vegetable Oil Production, 40 C.F.R. Part 63 Subpart GGGG, Air Docket No. A-97-59.” Memorandum.

National Cotton Council of America. July 25, 2000. “Comments of the National Cotton Council and National Cottonseed Products Association on the Proposed National Emission Standards for Hazardous Air Pollutants: Solvent Extraction for Vegetable Oil Production (65 FR 34252; May 26, 2000) (Air Docket No. A-97-59). Memorandum.

Many cottonseed facilities in particular have ceased operations in the past few years because of changes in the market for cottonseed. The feed value of cottonseed has risen relative to the value of oil and meal products processed from cottonseed (USDA, 1997b). Thus, the price of cottonseed has risen, making cottonseed oil and meal production less profitable. Facilities owned by small businesses have been particularly affected; of the ten cottonseed facilities that have closed, seven are owned by small businesses. However, three new cottonseed facilities have also opened since 1995.

Sales and employment information is not included in Tables 2-6(a) through 2-6(d) because these data are confidential business information (CBI). For use in the EIA model, sales at the facility level were calculated by multiplying the quantities produced at each facility, which is CBI, by the average prices reported by USDA. Facility-level employment data were available directly as CBI.

In addition to these affected facilities, some facilities in the industry produce vegetable oil and meal products using mechanical extraction processes. Because of a lack of data on these unaffected facilities, they were modeled as one aggregate unaffected facility for each type of vegetable oil.

Table 2-7 presents the 1995 baseline data on affected and unaffected product volumes. These data are used to determine the production volume of the industry attributable to the representative unaffected facility. Total 1995 production volumes by type were obtained from the USDA (see Table 2-2). The volume produced by affected facilities was obtained by adding the production volumes of the affected facilities in the EPA facility database. The volume produced by unaffected facilities was obtained by subtracting affected facility volume from total volume reported by the USDA. For soybean oil and several of the individual all other oil and meal products, production volume in the EPA facility database exceeded USDA reported production. In these cases, the facility database volumes were used as the baseline market values rather than the USDA reported volumes. Because the soybean oil production volume in the EPA database was assumed to be the market volume, this analysis assumes there are no unaffected soybean facilities.[2]

[2]Because oil and meal are complementary outputs, this analysis also assumes that the soybean meal volume in the EPA database is the market volume. However, USDA reports a higher volume of soybean meal production than the EPA database.

## Table 2-7. Baseline Vegetable Oil Volumes and Shares by Market and Extraction Method: 1995 (short tons)

| Market | Total Volume | Solvent Extraction: Number of Facilities | Solvent Extraction: Volume | Solvent Extraction: Volume Share (%) | Mechanical Extraction: Number of Facilities[a] | Mechanical Extraction: Volume | Mechanical Extraction: Volume Share (%) |
|---|---|---|---|---|---|---|---|
| Oil products | | | | | | | |
| Corn oil | 1,121,703 | 9 | 1,066,819 | 95.1% | NA | 54,884 | 4.9% |
| Cottonseed oil | 645,925 | 25 | 622,308 | 96.3% | NA | 23,617 | 3.7% |
| Soybean oil | 7,968,264 | 62 | 7,968,264 | 100.0% | NA | 0 | 0.0% |
| All other vegetable oils[b] | 1,093,411 | 15 | 1,026,335 | 93.9% | NA | 67,076 | 6.1% |
| Total, oils | 10,829,303 | 106 | 10,683,726 | 98.7% | | 145,577 | 1.3% |
| Meal products | | | | | | | |
| Corn germ meal | 1,473,651 | 9 | 1,401,546 | 95.1% | NA | 72,105 | 4.9% |
| Cottonseed meal | 1,826,100 | 25 | 1,744,562 | 95.5% | NA | 81,538 | 4.5% |
| Soybean meal | 31,225,572[c] | 62 | 31,225,572 | 100.0% | NA | 0 | 0.0% |
| All other meals[b] | 1,583,559 | 15 | 1,497,886 | 94.6% | NA | 85,673 | 5.4% |
| Total, meals | 38,151,242 | 106 | 35,869,566 | 94.0% | NA | 2,281,676 | 6.0% |

[a] Modeled as a representative plant.
[b] Includes canola, flaxseed, peanut, rice, safflower, and sunflower volumes.
[c] In the economic impacts model, the volume of meal produced by solvent extraction plants was assumed to be the total market volume for consistency with soybean oil.

NA = not available.

Source: U.S. Department of Agriculture, Economic Research Service. 1998. Oil Crops Yearbook. [computer file]. Last updated January 1998.

### *2.3.2 Companies*

A total of 31 companies were identified as owners of vegetable oil manufacturing plants using the solvent extraction method in 1995. Table 2-8 lists these companies.[3] In addition to the number of facilities owned during 1995, information on sales and employment at the company level is included as well.[4] Archer Daniels Midland (31 facilities) and Cargill Incorporated (19 facilities) own the largest number of these facilities (47.2 percent of total solvent extraction facilities).

Firm size is likely to be a factor in the distribution of the impacts of the NESHAP on companies. Grouping the firms by size facilitates the analysis of small business impacts as required by the Regulatory Flexibility Act (RFA) of 1982 as amended by the Small Business Regulatory Enforcement Fairness Act of 1996 (SBREFA). Firms are grouped into small and large categories using Small Business Administration (SBA) general size standard definitions for NAICS codes. These size standards are provided either by number of employees or by annual receipt levels, depending on NAICS code. The SBA defines a small business for industries affected by this regulation as follows:

- Corn Oil (NAICS 311221)—fewer than 750 total employees and (NAICS 311211)—fewer than 500 employees;
- Cottonseed Oil (NAICS 311223)—fewer than 1,000 total employees;
- Soybean Oil (NAICS 311222)—fewer than 500 total employees; and
- All Other Vegetable Oils (NAICS 311223)—fewer than 1,000 total employees.

Based on these definitions, 15 companies can be classified as small businesses or potentially small. Two firms do not have employment data available and are included as potentially small businesses. As of 1995, these 15 companies owned and operated 21 facilities, or 20 percent of all solvent extraction facilities.

[3]In cases where sales and employment data were not available, the EPA facility information in the CBI file was used in the EIA based on the assumption that each company owns only the facilities identified therein.

[4]Sales and employment data were obtained from publicly available sources and reflect the most recently available information.

## Table 2-8. Sales and Employment Data for Solvent Extraction Vegetable Oil Companies Included in the 1995 Baseline

| Company Name | Organization Type | Number of Facilities | Sales ($ million) | Total Employment | Year Reported | Small Business |
|---|---|---|---|---|---|---|
| Ag Processing | Private | 7 | $1,370.0 | 3,000 | 1995 | No |
| Archer Daniels Midland Company | Public | 31 | $13,314.0 | 14,811 | 1996 | No |
| Bunge Corporation | Private | 8 | $2,570.0 | 3,000 | 1996 | No |
| Cargill Incorporated | Private | 19 | $62,570.0 | 73,000 | 1996 | No |
| Central Soya Company | Private | 5 | $1,000.0 | 1,200 | 1994 | No |
| Chickasha Cotton Oil Company | Private | 4 | $93.0 | 600 | 1995 | Yes |
| CPC International | Public | 1 | $9,844.0 | 55,300 | 1996 | No |
| Delta Oil Mill | Private | 1 | $22.5 | 90 | 1996 | Yes |
| Dunavant Enterprises[a] | Private | 2 | $720.0 | 2,000 | 1995 | No |
| Hartsville Oil Mill Incorporated | Private | 1 | $20.0 | 100 | 1996 | Yes |
| Harvest States Cooperative[b] | Private | 1 | $1,000.0 | 2,400 | 1996 | No |
| J.G. Boswell | Private | 1 | $80.0 | 1,000 | 1993 | Yes |
| Lubrizol Corporation[c] | Public | 1 | $1,600.0 | 4,358 | 1996 | No |
| Mitsubishi Corporation[d] | Foreign | 1 | $166,300.0 | 36,000 | 1996 | No |
| Moorman Manufacturing[e] | Private | 3 | $800.0 | 3,500 | 1996 | No |
| Oilseeds International | NA | 1 | NA | NA | NA | Yes |
| Osceola Products | Private | 2 | $438.0 | 189 | 1996 | Yes |
| Owensboro Grain Company | Private | 1 | $450.0 | 195 | 1996 | Yes |
| Perdue Farms | Private | 2 | $2,000.0 | 19,000 | 1996 | No |
| Plains Cooperative Oil Mill, Incorporated | Private | 1 | $128.0 | 108 | 1995 | Yes |
| Planter’s Cotton Oil Mill | Private | 1 | $35.0 | 100 | 1996 | Yes |
| Producers Cooperative Mill | Private | 1 | $35.0 | 100 | 1996 | Yes |
| Riceland Foods Incorporated | Private | 1 | $807.6 | 2,000 | 1996 | No |
| Rito Partnership | NA | 1 | NA | NA | NA | Yes |

(continued)

**Table 2-8. Sales and Employment Data for Solvent Extraction Vegetable Oil Companies Included in the 1995 Baseline (continued)**

| Company Name | Organization Type | Number of Facilities | Sales ($ million) | Total Employment | Year Reported | Small Business |
|---|---|---|---|---|---|---|
| Rose Acre Farm Incorporated | Private | 1 | $152.0 | 900 | 1996 | No |
| Sessions Company | Private | 1 | $30.0 | 100 | 1994 | Yes |
| Southern Soya Corporation | Private | 1 | NA | 89 | 1996 | Yes |
| Tate and Lyle PLC[f] | Foreign | 1 | $7,315.4 | 17,743 | 1996 | No |
| Townsends | Private | 1 | $270.0 | 3,000 | 1993 | No |
| Valley Cooperative Mills | Private | 1 | $32.0 | 100 | 1992 | Yes |
| Yazoo Valley Oil Mill, Incorporated | Private | 3 | $113.7 | 300 | 1996 | Yes |
| Total | | 106 | NA | NA | | 15 |

NA = not available

Note: The Small Business Administration (SBA) defines a small business for industries affected by this regulation as follows:
Corn Oil (NAICS 311221) = fewer than 750 total employees and 500 employees for NAICS 311211.
Cottonseed Oil (NAICS 311223) = fewer than 1,000 total employees.
Soybean Oil (NAICS 311222) = fewer than 500 total employees
All Other Vegetable Oils (NAICS 311223) = fewer than 1,000 total employees.

[a] Owns Anderson Clayton. Queensland Cotton Holdings Limited acquired Anderson Clayton in September 1997.
[b] Owns Honeymead Processing.
[c] Owns SVO Specialty Products.
[d] Owns California Oils.
[e] Owns Quincy Soybeans. Archer Daniels Midland Company acquired Moorman in late 1997.
[f] Owns A.E. Staley.

Sources: *1997 Directory of Corporate Affiliations*. 1997. Vol. 5: International Public and Private Companies. New Providence, RI: National Register Publishing.
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## 2.4 Consumption and Uses of Vegetable Oils and Meals

Vegetable oils are consumed in both edible and inedible products. Oilseed meal products are consumed both as products for human consumption and as animal feeds. This section describes consumption and uses of each type of product.

### *2.4.1 Vegetable Oil Consumption and Uses*

In Table 2-9, per capita consumption of corn, cottonseed, soybean, and other vegetable oils is provided for 1990 through 1999, with the baseline 1995 data in boldface. Per capita consumption of most vegetable oils has been relatively stable over this time period. However, soybean oil consumption has been steadily increasing at an average annual growth rate of 2 percent, and canola oil consumption more than doubled, with an average annual growth rate of 10 percent. Soybean oil consumption is by far the highest, at nearly 60 pounds per capita per year in 1999. Corn, cottonseed, and canola oil consumption quantities are each a few pounds per year, and flaxseed, peanut, safflower, and sunflower consumption quantities are for the most part each less than 1 pound per year.

In 1995, the baseline year of the analysis, approximately 71.2 percent of all fats and oils were consumed in edible products, and 28.8 percent were consumed in inedible products. As Figure 2-2 illustrates, the edible uses include baking and frying fats (28.5 percent), salad or cooking oil (31.9 percent), margarine (8.7 percent), and other edible products (2.0 percent). The most significant inedible product uses are animal feed (11.1 percent) and fatty acids (9.3 percent), but inedible product uses also include soap, paint and varnish, resins and plastics, lubricants, and other products.

The vegetable oils affected by the regulation make up an estimated 64 percent of the 21 billion pounds of consumption of all fats and oils. In terms of edible uses, these vegetable oils are often preferred to their substitutes because they have low saturated fat content. However, functional characteristics of the oils, such as melting behavior, crystal structure, resistance to oxidation, and flavor, affect preferences as well. Edible substitute products include coconut oil, palm oil, palm kernel oil, edible tallow, butter, and lard.

## Table 2-9. Per Capita Consumption of Vegetable Oils: 1990-1999 (lbs)

| Calendar Year | Corn | Cottonseed | Soybean | Canola | Flaxseed | Peanut | Safflower | Sunflower |
|---|---|---|---|---|---|---|---|---|
| 1990 | 4.26 | 3.17 | 48.88 | 2.21 | 0.67 | 0.79 | 0.39 | 0.73 |
| 1991 | 4.64 | 3.91 | 47.71 | 2.81 | 0.67 | 0.77 | 0.19 | 0.99 |
| 1992 | 4.76 | 4.16 | 49.08 | 3.37 | 0.62 | 0.82 | 0.10 | 1.36 |
| 1993 | 4.76 | 3.82 | 51.30 | 4.10 | 0.61 | 0.84 | 0.18 | 0.68 |
| 1994 | 4.76 | 3.50 | 49.90 | 4.49 | 0.64 | 0.75 | 0.17 | 0.54 |
| **1995** | **5.03** | **3.89** | **49.78** | **4.69** | **0.61** | **0.77** | **0.18** | **0.65** |
| 1996 | 5.06 | 3.81 | 51.72 | 4.51 | 0.59 | 0.73 | 0.11 | 0.67 |
| 1997 | 4.70 | 3.68 | 54.38 | 4.28 | 0.57 | 0.76 | 0.26 | 0.76 |
| 1998 | 4.74 | 3.53 | 57.08 | 4.59 | 0.57 | 0.79 | 0.28 | 0.75 |
| 1999 | 4.95 | 2.94 | 58.14 | 5.02 | 0.57 | 0.78 | 0.31 | 0.93 |
| Average Annual Growth Rate | 1.8% | –0.2% | 2.0% | 10.0% | –1.6% | 0.1% | 10.3% | 7.0% |

Note: In cases where monthly data were unavailable, the calendar year data were estimated based on marketing year month shares of the calendar year. For example, an estimate of a 1996 consumption quantity based on data reported for an October marketing year would be calculated as follows: (9/12) • 1995 marketing year quantity + (3/12) • 1996 marketing year quantity.

Sources: U.S. Department of Agriculture, Economic Research Service. 1998. Oil Crops Yearbook. [computer file]. Last updated January 1998.

U.S. Department of Agriculture, Economic Research Service. 1999b. Oil Crops Yearbook. [computer file]. Last updated November 1999.

U.S. Department of Agriculture, Economic Research Service. 2000. Oil Crops Outlook. September 13, 2000.

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U.S. Department of Agriculture, Economic Research Service. Oil Crops Outlook. November 12, 1998.

U.S. Department of Commerce, Bureau of the Census. National Monthly Population Estimates: 1980-2000. <http://www.census.gov/population/www/estimates/nation1htm>. Last updated November 2, 2000.

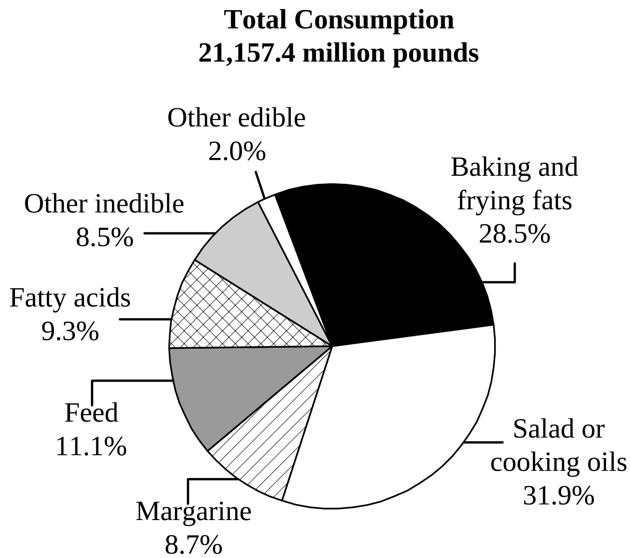


**Figure 2-2. U.S. Consumption of Fats and Oils by Use, 1995**

Source: U.S. Department of Commerce. 1996b. *1995 Current Industrial Reports—Fats and Oilseed Crushings, Production, Consumption, and Stocks*. M20K. Washington, DC: Government Printing Office.

In terms of inedible uses, these vegetable oils are used in smaller quantities than some of their more specialized substitutes. Inedible substitute products include both the edible substitute products listed above as well as the following oils that are used only in inedible products: linseed oil, tall oil, caster oil, tung oil, and inedible tallow.

### *2.4.2 Oilseed Meal Consumption and Uses*

In Table 2-10, per capita consumption of corn germ meal, cottonseed meal, soybean meal, and other meals is provided for 1990 through 1999, with baseline 1995 data in boldface. Most meal products are consumed in animal feed products, but an estimate of the proportion of these products used for animal feed versus human consumption is not available. Soybean products in particular are used in a variety of protein products (i.e., soy flour concentrates and isolates) in addition to animal feed products. Hence, the approximately 200 pounds per capita consumption

## Table 2-10. Per Capita Consumption of Meal Products 1990-1999 (lbs)

| | Corn Germ Meal | Cottonseed | Soybean | Canola | Flaxseed | Peanut | Sunflower |
|---|---|---|---|---|---|---|---|
| 1990 | NA | 10.32 | 181.23 | 2.97 | 1.05 | 1.16 | 2.49 |
| 1991 | NA | 14.73 | 182.54 | 4.28 | 1.00 | 1.47 | 3.01 |
| 1992 | NA | 13.12 | 183.89 | 5.06 | 0.90 | 1.67 | 3.81 |
| 1993 | NA | 11.22 | 190.05 | 7.10 | 0.86 | 1.33 | 3.21 |
| 1994 | NA | 11.10 | 200.32 | 8.26 | 0.84 | 1.32 | 3.06 |
| **1995** | **NA** | **13.84** | **204.58** | **9.09** | **0.93** | **1.61** | **4.49** |
| 1996 | NA | 12.05 | 203.65 | 9.43 | 0.84 | 1.41 | 3.59 |
| 1997 | NA | 12.39 | 207.98 | 11.28 | 1.31 | 1.01 | 3.60 |
| 1998 | NA | 11.22 | 217.99 | 12.60 | 1.33 | 0.81 | 4.11 |
| 1999 | NA | 8.92 | 225.69 | 13.52 | 1.28 | NA | 4.47 |
| Average Annual Growth Rate | NA | 0.1% | 2.5% | 19.0% | 2.7% | –2.5% | 8.6% |

Note: In cases where monthly data were unavailable, the calendar year data were estimated based on marketing year month shares of the calendar year. For example, an estimate of a 1996 consumption quantity based on data reported for an October marketing year would be calculated as follows: (9/12) • 1995 marketing year quantity + (3/12) • 1996 marketing year quantity.

NA = not available.

Sources: U.S. Department of Agriculture, Economic Research Service. 1998. Oil Crops Yearbook. [computer file]. Last updated January 1998.

U.S. Department of Agriculture, Economic Research Service. 1999b. Oil Crops Yearbook. [computer file]. Last updated November 1999.

U.S. Department of Agriculture. 1997a. *Agricultural Statistics 1997*. Washington, DC: Government Printing Office.

U.S. Department of Agriculture. 2000. *Agricultural Statistics 2000*. Washington, DC: Government Printing Office.

U.S. Department of Commerce, Bureau of the Census. National Monthly Population Estimates: 1980-2000. <http://www.census.gov/population/www/estimates/nation1.htm>. Last updated November 2, 2000.

per year of soybean meal is a combination of animal feed uses and human uses. The other meals, which account for anywhere from less than one pound per capita to a dozen pounds per capita, are used in a combination of animal feed and human uses as well. As shown, the average annual growth rates for meal products over this period are positive with the exception of peanut meal. Canola meal experienced the largest annual growth rate at 19 percent.

Of the processed feed uses, soybean meal has the largest portion of the market at 57.0 percent of all processed feeds (see Figure 2-3). Cottonseed meal makes up 6.3 percent, and other oilseed meals (linseed, peanut, sunflower, and canola) make up 4.4 percent. These products compete with animal proteins (6.9 percent) and other feed products (23.4 percent) such as millfeeds.

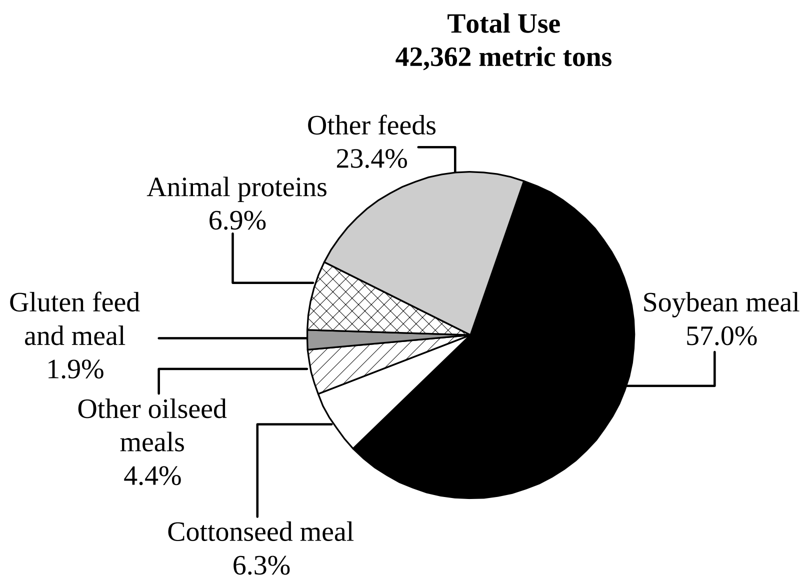


**Figure 2-3. U.S. Processed Feeds by Type, 1995**

Source: U.S. Department of Agriculture, Economic Research Service. 1997. Feed Yearbook. [computer file]. Last updated April 1997.

# SECTION 3

# ENGINEERING COST ANALYSIS

This section presents the Agency's estimates of the compliance costs associated with the NESHAP on the production of vegetable oils and meals. This regulation will affect all 106 facilities (baseline 1995) that use a solvent extraction process to extract oil from oilseeds or similar agricultural inputs (e.g., soybean, cottonseed, corn germ) because all are major sources of HAPs.[1] These 106 facilities operated 119 product lines during the 1995 to 1996 time period. The primary solvent used in the extraction process is a commercial grade hexane comprising 60 to 70 percent n-hexane (CAS No. 110-54-3), which is a HAP (Zukor and Riddle, 1998). The balance of the solvent composition is a blend of hexane isomers, which are volatile organic compounds (VOCs).

All vegetable oil facilities operate some type of solvent collection and recovery system. These systems collect solvent-laden process gas streams from a number of key process units such as the extractor, desolventizer-toaster, process evaporators, and distillation columns. The solvent collection and recovery system then routes the gathered process gas streams to a recovery device that is usually a packed-bed mineral oil scrubber. In addition to the collection and recovery system, source reduction techniques are used as well. By optimizing the system's performance, process solvent losses are minimized.

Hexane emissions in vegetable oil production facilities occur from the following ten general sources:

- the main vent (5 to 20 percent of emissions),
- the meal dryer vent and the meal cooler vent (10 to 30 percent of emissions combined),
- crude meal (10 to 40 percent of emissions),

[1]Three additional plants using solvent extraction processes come on line in 1996. The cost and emissions data in this section include data from these plants although they are not included in the 1995 baseline economic analysis.

- crude oil (5 to 15 percent of emissions),
- equipment leaks (1 to 25 percent of emissions),
- solvent storage tank leaks (1 to 5 percent of emissions),
- process wastewater collection (1 to 5 percent of emissions),
- facility startups and shutdowns (10 to 20 percent of emissions), and
- operational upsets (1 to 20 percent of emissions) (Zukor and Riddle, 1998).

As described in this section, the Agency estimated the compliance costs for each facility to install the necessary equipment and process controls that will reduce emissions and bring each facility into compliance with the NESHAP. The estimation of these costs is currently applied to existing facilities, although new sources may be considered later. Control options and costs are described in Section 3.1. National emissions reductions and compliance costs are described in Section 3.2.

## 3.1 Control Options and Costs

The NESHAP will limit the gallons of HAP loss per ton of seeds processed rather than establish regulatory requirements at each emission point. This approach allows industry the flexibility to implement the most cost-effective method to reduce overall HAP loss and minimizes the costs associated with monitoring, recordkeeping, reporting, and other administrative requirements for both industry and the regulatory agencies (Durham, 1998).

The remainder of this section describes the controls based on plant characteristics and then summarizes their associated costs. In addition to capital costs and operating and maintenance costs, this section describes monitoring, recordkeeping, and reporting costs and lost production costs.

### *3.1.1 Control Options*

Solvent losses vary among plants based primarily on the oilseed type, desolventizing method used, oilseed processing rate, and oilseed prepressing operations. To determine control options, plants were subcategorized into the following:

- “soybean” plants processing soybeans in both conventional and specialty desolventizers;
- “corn germ” plants processing corn germ with a wet or dry milling process;

- “large cottonseed” plants processing 120,000 tons or more of cottonseed per year as well as plants processing sunflower seed; and
- “small cottonseed” plants processing fewer than 120,000 tons of cottonseed per year as well as plants processing canola seed, flaxseed, peanuts, and safflower seed.

To develop model plants, the “soybean” plants were characterized as processing 2,200 tons of seed per day. “Large cottonseed” and “corn germ” plants were characterized as processing 1,100 tons of seed per day. “Small cottonseed” plants were characterized as processing 400 tons of seed per day. All but specialty soybean plants, which were assumed to operate 300 days per year, were assumed to operate 330 days per year.

Based on their needed emissions reductions to meet the MACT floor, plants were assigned to one of the following model plants:

- Model MACT Plant: 0 percent emissions reduction;
- Model Plant 1: 30 percent emissions reduction;
- Model Plant 2: 50 percent emissions reduction; and
- Model Plant 3: 70 percent emissions reduction.

One additional model plant was developed to represent soybean facilities operating a specialty desolventizer. This model plant was used only for calculating impacts for the “above-the-MACT-floor” option.

Of 119 facility product lines, 42 (35.2 percent) were assigned to the Model MACT Plant, 50 (42.0 percent) were assigned to Model Plant 1, 17 (14.3 percent) were assigned to Model Plant 2, and 10 (8.4 percent) were assigned to Model Plant 3 (Zukor and Snyder, 2000).[2] The control technologies assigned to each model plant are described in Table 3-1. These include, for example, installing additional trays in the desolventizer to increase residence time (Model Plants 1 and 2), installing an oil dryer in the oil distillation system (Model Plants 2 and 3), and implementing a leak detection and repair program for fugitive equipment leaks (Model Plant 3).

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[2]One facility combined reported solvent usage for three oilseed types and thus is treated as a single facility product line.

**Table 3-1. Summary of Control Technologies Assigned to Model Plants**

| Model Plant | Required Emissions Reduction to Meet MACT | Assigned Control Technologies |
|---|---|---|
| MACT Plant | 0% | None |
| Model Plant 1 | 30% | Install two additional trays in the desolventizer to provide increased residence time. |
| Model Plant 2 | 50% | Install two additional trays in the desolventizer to provide increased residence time.<br><br>Install an oil dryer in the oil distillation system to reduce the residual solvent content in the oil product.<br><br>Install a refrigerated condenser on the main vent to recover solvent vapors in the exhaust. |
| Model Plant 3 | 70% | Install a completely new, counter-current desolventizer.<br><br>Install an oil dryer in the oil distillation system to reduce the residual solvent content in the oil product.<br><br>Install a refrigerated condenser on the main vent to recover solvent vapors in the exhaust.<br><br>Vent standing and working losses from fixed-roof storage tanks to the existing solvent recovery system.<br><br>Implement a leak detection and repair (LDAR) program for fugitive equipment leaks. |

Source: Zukor, C. and J. Snyder, Alpha-Gamma Technologies, Inc. November 10, 2000. "Final Summary of Emission Reductions and Control Costs Associated with Achieving the MACT Floor and a Control Option Above the MACT Floor." Memorandum submitted to the Vegetable Oil NESHAP Project File.

In addition to these controls, the Agency also evaluated an above-the-MACT-floor option, which is more stringent than the MACT floor. For this option, plants would be required to install a fabric filter and catalytic incinerator to the combined exhaust from the meal dryer and cooler vents (Zukor and Snyder, 2000). The fabric filter is installed to remove excess particulate matter in the exhaust stream prior to entering the catalytic incinerator. The catalytic incinerator is capable of reducing the volume of HAP and VOC emissions in the exhaust stream by approximately 95 percent. These controls were assumed to be added on after the plant installed controls to achieve the MACT floor. Unlike the control technologies to achieve the MACT floor, no vegetable oil processing plants currently have a catalytic incinerator in place.

### *3.1.2 Control Costs*

Control costs were estimated for both the MACT floor and the above-the-MACT-floor options. Compliance costs to achieve the MACT floor include the following components:

- O&M: operating and maintenance costs;
- MRR: monitoring, recordkeeping, and reporting costs;
- AC: capital investment annualized over 15 years at 7 percent interest;
- SRC: solvent recovery credit (cost savings due to increased reuse of solvent); and
- LPC: lost production costs annualized over 15 years at 7 percent interest (operating costs and foregone profits incurred while the plant is shut down to install capital).

The estimated compliance costs for the model plants were scaled to reflect the processing rate of each affected facility. Table 3-2 presents the MACT floor estimated HAP emissions reductions, total capital investment costs, annual costs by type, and cost-effectiveness for each subcategory within each model plant. Soybean model plants range from 112 to 607 tons per year in HAP emissions reductions at an annual cost of $227,000 to $575,000 per year. Cost per ton emission reduction measures decrease from $2,026 per ton of HAP for Model Plant 1 to $948 per ton of HAP for Model Plant 3. Corn germ model plants range from 112 to 607 tons per year in HAP emissions reductions at an annual cost of $185,000 to $511,000 per year with associated cost per ton emission reduction measures of $1,649 to $842 per ton. Large cottonseed model plants range from 139 to 759 tons per year in HAP emissions reductions at an annual cost of $170,000 to $423,000 per year with associated cost per ton emission reduction measures of $1,222 to $558 per ton. Finally, small cottonseed model plants range from 71 to 386 tons per year in HAP emissions reductions at an annual cost of $115,000 to $286,000 per year with associated cost per ton emission reduction measures of $1,626 to $740 per ton. In all subcategories, plants requiring larger emissions reductions can achieve them at lower average cost (i.e., $/ton of HAPs) than plants requiring small emissions reductions.

**Table 3-2. Cost Estimates for MACT Floor Control Technologies for Each Model Plant (1995 dollars) (Continued)**

| Model Plant | HAP Emissions Reduction (tons/yr) | Total Capital Investment ($\$10^3$) | Annualized Costs ($\$10^3$/yr)[a] | | | | | | Cost Per Ton Emission Reduction ($/ton HAP) | Costs Apply to Emissions Reduction Range |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | O&M | MRR | AC | SRC | LPC | Total | | |
| **Model Plant 3** | | | | | | | | | | |
| Soybean | 607 | $2,771 | $237 | $40 | $305 | $185 | $178 | $575 | $948 | $\geq$60 percent |
| Corn Germ | 607 | $2,995 | $246 | $40 | $329 | $185 | $81 | $511 | $842 | |
| Large Cottonseed | 759 | $2,618 | $230 | $40 | $287 | $231 | $97 | $423 | $558 | |
| Small Cottonseed | 386 | $1,371 | $181 | $40 | $150 | $118 | $32 | $286 | $740 | |

[a] O&M—Operation and Maintenance Cost
AC—Annualized Capital Costs (15 years at 7%)
LPC—Annualized Lost Production Cost (15 years at 7%)
MRR—Monitoring, Recordkeeping and Reporting Costs
SRC—Solvent Recovery Credit (cost savings)
Total Annual Cost = O&M + MRR + AC – ( SRC) + LPC

Source: Zukor, C. and J. Snyder, Alpha-Gamma Technologies, Inc. November 10, 2000. "Final Summary of Emission Reductions and Control Costs Associated with Achieving the MACT Floor and a Control Option Above the MACT Floor." Memorandum submitted to the Vegetable Oil NESHAP Project File.

Table 3-2. Cost Estimates for MACT Floor Control Technologies for Each Model Plant (1995 dollars)

| Model Plant | HAP Emissions Reduction (tons/yr) | Total Capital Investment ($$10^3$) | Annualized Costs ($$10^3$/yr)[a] | | | | | | Cost Per Ton Emission Reduction ($/ton HAP) | Costs Apply to Emissions Reduction Range |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | O&M | MRR | AC | SRC | LPC | Total | | |
| **Model Plant 1** | | | | | | | | | | |
| Soybean | 112 | $600 | $56 | $40 | $66 | $34 | $99 | $227 | $2,026 | 1 to 39 percent |
| Corn Germ | 112 | $681 | $59 | $40 | $75 | $34 | $45 | $185 | $1,649 | |
| Large Cottonseed | 139 | $582 | $55 | $40 | $63 | $42 | $54 | $170 | $1,222 | |
| Small Cottonseed | 71 | $320 | $44 | $40 | $35 | $22 | $18 | $115 | $1,626 | |
| **Model Plant 2** | | | | | | | | | | |
| Soybean | 260 | $892 | $116 | $40 | $98 | $79 | $139 | $313 | $1,205 | 40 to 59 percent |
| Corn Germ | 260 | $951 | $119 | $40 | $104 | $79 | $63 | $247 | $952 | |
| Large Cottonseed | 325 | $805 | $113 | $40 | $89 | $99 | $76 | $219 | $673 | |
| Small Cottonseed | 166 | $463 | $100 | $40 | $51 | $51 | $25 | $165 | $994 | |

(continued)

Table 3-3 presents the above-the-MACT-floor estimated HAP emissions reductions, total capital investment costs, annual costs by type, and cost per ton emission reduction for each of the following types of plants: small cottonseed, large cottonseed and corn germ, conventional soybean, and specialty soybean. HAP emissions reductions range from 27 tons per year for small cottonseed plants to 566 tons per year for large-size specialty soybean (2,200 tons per day). Annualized costs for the above-the-MACT-floor scenario include operating and maintenance costs; annualized capital costs; monitoring, recordkeeping, and reporting costs; and lost production costs. The costs shown in Table 3-3 are incremental to the costs for the MACT floor. Lost production costs are assumed to be the same as those associated with the MACT floor controls. Because the add-on equipment incinerates rather than recovers solvent, no additional solvent recovery credits are associated with it. Annualized costs range from $762,000 per year for small cottonseed plants to $19,890,000 per plant for large-size specialty soybean plants (2,200 tons per day). Cost per ton emission reduction measures range from $15,293 per ton for large cottonseed and corn germ to $51,462 per ton for small-size specialty soybean plants (220 tons per day).

## 3.2 National Emissions Reductions and Compliance Costs

Under the NESHAP, the Agency estimates that a 25 percent reduction in emissions will be achieved with the MACT floor option and a 43 percent reduction in emissions will be achieved with the above-the-MACT-floor option (Table 3-4). With the MACT floor option, VOC emissions are expected to decline by 10,600 tons per year, and HAP emissions are expected to decline by 6,800 tons per year. With the above-the-MACT-floor option, VOC emissions are expected to decline by 18,300 tons per year, and HAP emissions are expected to decline by 11,700 tons per year.

Total annual compliance costs for plants operating in 1995 and for three plants that began operation in 1996 were estimated at $12.3 million with the MACT floor option and $204.6 million with the above-the-MACT-floor option. With the MACT floor option, cost per ton emission reduction measures are $1,200 per ton of VOC reductions and $1,800 per ton of HAP reductions. With the above-the-MACT-floor option, cost per ton emission reduction measures are $11,200 per ton of VOC reductions and $18,400 per ton of HAP reductions.

## Table 3-3. Incremental Cost Estimates for Above-the-MACT-Floor Control Technologies for Each Model Plant (1995 dollars)

| Model Plant | HAP Emission Reductions (tons/yr)[a] | Total Capital Investment ($10$^3$) | Annualized Costs ($10$^3$/yr)[b] | | | | | | Cost Per Ton Emission Reduction ($/ton HAP) |
|---|---|---|---|---|---|---|---|---|---|
| | | | O&M | MRR | AC | SRC | LPC | Total | |
| Small Cottonseed | 27 | $591 | $686 | $20 | $56 | $0 | $0 | $762 | $28,222 |
| Large Cottonseed and Corn Germ | 82 | $873 | $1,157 | $20 | $77 | $0 | $0 | $1,254 | $15,293 |
| Conventional Soybean | 56 | $1,163 | $1,754 | $20 | $98 | $0 | $0 | $1,872 | $33,429 |
| Specialty Soy: 220 tpd[c] | 39 | $1,295 | $1,880 | $20 | $107 | $0 | $0 | $2,007 | $51,462 |
| Specialty Soy: 770 tpd[c] | 185 | $4,532 | $6,580 | $20 | $375 | $0 | $0 | $6,975 | $37,703 |
| Specialty Soy: 2,200 tpd[c] | 566 | $12,948 | $18,800 | $20 | $1,070 | $0 | $0 | $19,890 | $35,141 |

[a] HAP emission reductions achieved by the catalytic incinerator are estimated as 95 percent of the remaining HAP emissions released from the combined meal dryer and cooler vents after applying MACT floor controls.

[b] O&M—Operation and Maintenance Cost
MRR—Monitoring, Recordkeeping, and Reporting Costs
AC—Annualized Capital Costs (15 years at 7%)
SRC—Solvent Recovery Credit (cost savings)
LPC—Annualized Lost Production Cost (15 years at 7%)
Total Annual Cost = O&M + MRR + AC – ( SRC) + LPC

[c] tpd—tons per day.

Source: Zukor, C. and J. Snyder, Alpha-Gamma Technologies, Inc. November 10, 2000. “Final Summary of Emission Reductions and Control Costs Associated with Achieving the MACT Floor and a Control Option Above the MACT Floor.” Memorandum to the Vegetable Oil NESHAP Project File.

**Table 3-4. Summary of National Emissions and Costs for the MACT Floor and Above-the-MACT-Floor Control Scenarios (1995 dollars)[a]**

| Control Option | Emissions Reductions (tons/yr) | | Overall Emissions Reduction (percent) | Total Annual Cost (million $) | Cost Per Ton Emission Reduction ($/ton) | |
|---|---|---|---|---|---|---|
| | VOC | HAP | | | VOC | HAP |
| MACT Floor | 10,600 tons | 6,800 tons | 25% | $12.3 | $1,200 | $1,800 |
| Above MACT Floor | 18,300 tons | 11,700 tons | 43% | $204.6 | $11,200 | $18,400 |

[a] Totals include all facilities operating in 1995 as well as three facilities that began operation in 1996.

Source: Zukor, C. and J. Snyder, Alpha-Gamma Technologies, Inc. November 10, 2000. "Final Summary of Emission Reductions and Control Costs Associated with Achieving the MACT Floor and a Control Option Above the MACT Floor." Memorandum submitted to the Vegetable Oil NESHAP Project File.

# SECTION 4

# ECONOMIC IMPACT ANALYSIS

The rule to control emissions of HAPs from vegetable oil and meal processing facilities will affect the entire U.S. industry directly (through imposition of compliance costs) or indirectly (through changes in market prices). Implementation of the rule will increase the costs of production at solvent extraction plants. As described in Section 3, these costs vary across facilities depending on their physical characteristics and baseline controls. The response of producers to these additional costs determines the economic impacts of the regulation. Specifically, the cost of the regulation may induce some owners to close their operations (entire facility or individual product lines) or to change their current operating rates. These choices affect, and in turn are affected by, the market price for vegetable oils and meals.

This section describes the data and approach used to estimate the economic impacts of the regulation for baseline year 1995. Section 4.1 presents the inputs for the economic analysis, including producer characterization, market characterization, and compliance costs of the regulation. Section 4.2 describes the approach to estimating the economic impacts on the industry, and Section 4.3 describes the assumptions of the model. Finally, Section 4.4 presents the results of the EIA.

## 4.1 Economic Analysis Inputs

Inputs to the economic analysis include a baseline characterization of vegetable oil and meal producers, their markets, and the estimated costs of complying with the regulation. Each input is described briefly below.

### *4.1.1 Producer Characterization*

The baseline characterization of vegetable oil and meal producers is based primarily on the facility responses to EPA's Section 114 questionnaires (hereafter called EPA's facility database). This information includes oilseed purchases, oil production, meal production, by-product production, capacity, number of employees, facility location, and company ownership. These facility-specific data on existing major sources were supplemented with secondary information on market volumes and market prices from the USDA and on trade from the U.S. International Trade Commissions. Using these data, the Agency developed product-specific cost equations for this analysis (described fully in Appendix A).

### *4.1.2 Vegetable Oil and Meal Markets*

Table 4-1 provides 1995 data on the U.S. vegetable oil and meal markets for use in this analysis. The market prices for each product were obtained from the USDA. Market output for each product is the sum of U.S. production and foreign imports. The affected portion of U.S. production of each product is the sum of the individual facility production levels taken from EPA's facility database, while the unaffected portion is derived as the difference between the reported U.S. production and affected production volumes (see Table 2-7). Foreign trade data on exports and imports of these products are from the U.S. International Trade Commission and the USDA.

### *4.1.3 Regulatory Control Costs*

As described in Section 3, the Agency developed compliance cost estimates for each of the vegetable oil and meal facilities affected by the regulation. Two control scenarios were considered and thus two sets of costs were developed. The scenarios are as follows:

- the MACT floor including lost production costs and
- the above-the-floor option including lost production costs.

The equipment needed to comply with the MACT floor is an upgrade of existing equipment at vegetable oil production facilities. In contrast, the equipment needed to comply with the above-the-floor option is additional equipment added on to the existing process after it is upgraded to the MACT floor.

Compliance costs are either fixed with regard to the level of production or vary with the level of production. The costs that are fixed include the following:

- annualized total capital investment (capital recovery)—costs to comply with the MACT floor as well as above-the-floor equipment costs are annualized over 15 years at 7 percent;
- the catalytic incinerator required for the above-the-floor option must be replaced every 2 years; thus, its cost is annualized over 2 years at 7 percent;

**Table 4-1. Summary of Baseline Vegetable Oil and Meal Values: 1995**

| | Baseline | |
|---|---|---|
| | **Oil Product** | **Meal Product** |
| **Corn** | | |
| Market Price ($/short ton) | $532.00 | $88.40 |
| Market Output (tpy) | 1,126,198 | 1,473,651 |
| Domestic Production | 1,121,703 | 1,473,651 |
| Solvent Extraction | 1,066,819 | 1,401,546 |
| Mechanical Extraction | 54,884 | 72,105 |
| Exports | 415,270 | 61,950 |
| Imports | 4,495 | 0 |
| **Cottonseed** | | |
| Market Price ($/short ton) | $536.00 | $123.20 |
| Market Output (tpy) | 646,031 | 1,826,100 |
| Domestic Production | 645,925 | 1,826,100 |
| Solvent Extraction | 622,308 | 1,744,562 |
| Mechanical Extraction | 23,617 | 81,538 |
| Exports | 147,281 | 89,700 |
| Imports | 106 | 0 |
| **Soybean** | | |
| Market Price ($/short ton) | $536.00 | $173.80 |
| Market Output (tpy) | 7,981,880 | 31,290,977 |
| Domestic Production | 7,968,264 | 31,225,572 |
| Solvent Extraction | 7,968,264 | 31,225,572 |
| Mechanical Extraction | 0 | 0 |
| Exports | 1,143,544 | 6,491,570 |
| Imports | 13,616 | 65,405 |
| **All Other** | | |
| Market Price ($/short ton) | $658.82 | $93.22 |
| Market Output (tpy) | 1,623,013 | 2,520,129 |
| Domestic Production | 1,093,411 | 1,583,559 |
| Solvent Extraction | 1,026,335 | 1,497,886 |
| Mechanical Extraction | 67,076 | 85,673 |
| Exports | 632,625 | 138,469 |
| Imports | 529,125 | 936,570 |

- monitoring, recordkeeping, and reporting—fixed cost per facility; and
- lost production costs.

The costs that vary with the level of production include

- operation and maintenance costs for the control equipment, less the cost savings from reduced solvent purchases.

Because costs were estimated at the facility level but each facility produces oil and meal jointly, compliance costs were allocated to each product at the facility based on assumptions described in Section 4.3. Once allocated to each product, compliance costs were divided by total production of each product at each affected facility to obtain a per-unit compliance cost or "cost shifter."

As one indicator of the impact of the regulation, cost-to-sales ratios (CSRs) were estimated at the facility level by dividing the regulatory compliance costs by facility revenue. Facility revenues were obtained by multiplying market prices as reported by the USDA by facility-level production. Table 4-2 presents facility-level CSRs for each of the two regulatory scenarios. For the MACT floor scenario with lost production costs, 104 of the 106 facilities have CSRs below 1 percent, two have CSRs from 1 to 2 percent, and no facility has a CSR above 2 percent. For the above-the-floor scenario with lost production costs, 17 facilities have CSRs below 1 percent, 44 have CSRs from 1 to 2 percent, and 45 have CSRs above 2 percent.

**Table 4-2. Distribution of Facility-Level Compliance Cost-to-Sales Ratios: 1995**

| | MACT Floor with LP[a] | | Above-the-Floor with LP[a] | |
|---|---|---|---|---|
| | **Number** | **Share** | **Number** | **Share** |
| 0–1% | 104 | 78.1% | 17 | 16.0% |
| 1–2% | 2 | 1.9% | 44 | 41.5% |
| >2% | 0 | 0.0% | 45 | 42.5% |
| TOTAL | 106 | 100.0% | 106 | 100.0% |

[a] LP represents lost production costs that may be incurred due to the downtime to install new capital equipment.

The Agency also evaluated whether these CSRs would change substantially using 1999 data because economic conditions in the industry are different than they were in 1995.

The compliance costs were projected to 1999 using the producer price index, revenues were calculated using 1999 market prices, and CSRs were then recomputed. Based on these calculations, only one facility switched from the 0–1 percent to 1–2 percent category, and all other facilities had increased CSRs of less than 0.1 percent. Thus, this analysis suggests that the results of the economic impact analysis would not differ substantially using more recent data.

The Agency also considered other potential indicator measures including the ratio of compliance costs to gross margins or profits for the industry. In general, reliable independently verifiable data are unavailable to compute these ratios for the industry, and the data that are available are severely limited. In particular, only three of the 31 affected companies are publicly traded and thus have publicly available financial statements. For these three companies, the cost-to-profit ratios of the regulation are substantially less than 1 percent.

## 4.2 Economic Impact Methodology

This section summarizes the Agency's economic approach to modeling the responses of vegetable oil and meal producers and markets to the imposition of the regulation. In conducting an economic analysis and determining the economic impacts, the analyst should recognize the alternatives available to each producer in response to the regulation and the context of these choices. The Agency evaluated the economic impacts of this NESHAP using a market-based approach that gives producers the choice of whether to continue producing these products and, if so, to determine the optimal level consistent with market signals.

The Agency's approach is soundly based on standard microeconomic theory, employs a comparative statics approach, and assumes certainty in relevant markets. Prices and quantities were determined in perfectly competitive markets for each vegetable oil and meal product. Production decisions involve whether a firm with plant and equipment already in place purchases inputs to produce outputs. These are called short-run decisions since the plant and equipment are fixed. A profit-maximizing firm will operate existing capital as long as the market price for its output exceeds its per-unit variable production costs. As long as the market price even marginally exceeds the average variable (operating) costs, the facility will cover not only the cost of its variable inputs but also part of its capital costs. In the short run, a profit-maximizing firm will not pass up an opportunity to recover part of its fixed investment in the plant and equipment.

The Agency developed cost curves for each product at solvent extraction facilities. Given the capital in place, each vegetable oil and meal product at an affected facility is characterized by an upward-sloping supply function, as shown in Figure 4-1. In this case, the supply function is that portion of the marginal cost curve bounded by zero and the technical capacity at the facility. The facility owner is willing to supply output according to this schedule as long as the market price is sufficiently high to cover average variable costs. If the market price falls below the average variable costs, then the firm's best response is to cease production because total revenue does not cover total variable costs of production.

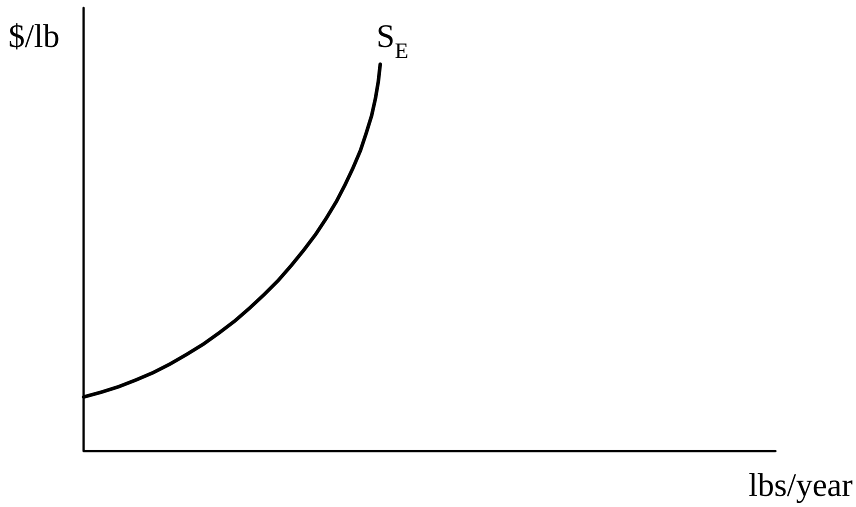
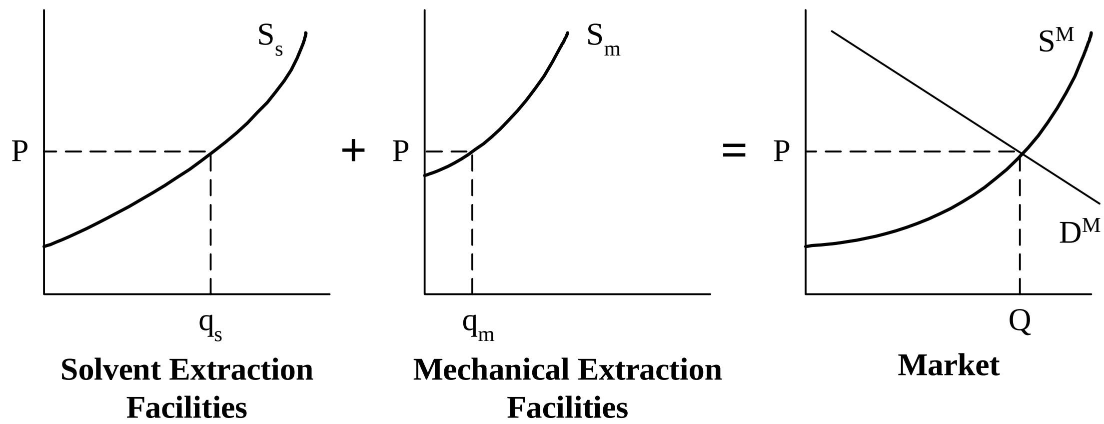
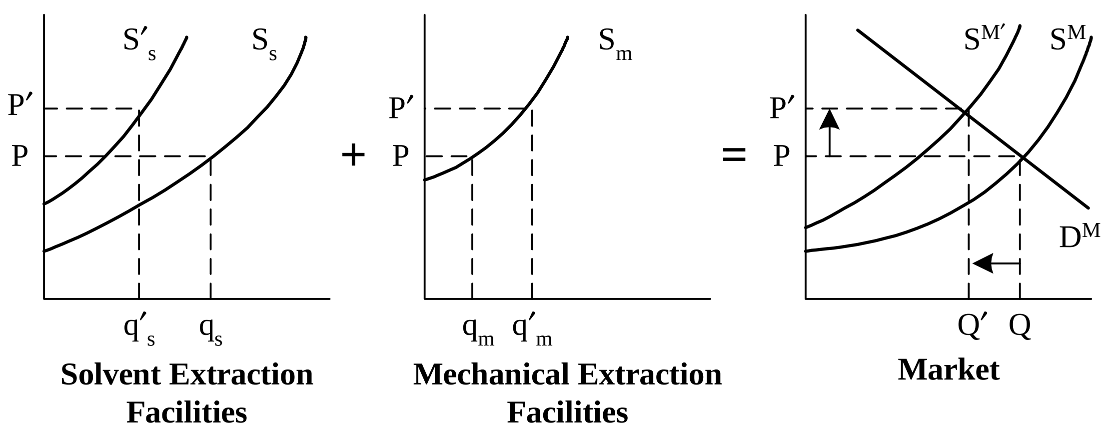



**Figure 4-1. Supply Curve for a Representative Affected Facility**

The individual facility-level supply decisions were aggregated to develop the market supply curve. This economic analysis assumes that prices for vegetable oils and meals are determined in perfectly competitive markets (i.e., individual facilities have negligible power over the market price of the products and thus take the prices as "given" by the market). As shown in Figure 4-2(a), under perfect competition, market prices and quantities are determined by the intersection of market supply and demand curves. The initial baseline scenario consists of a market price and quantity (P, Q) that are determined by the downward-sloping market demand curve ($D^M$) and the upward-sloping market supply curve ($S^M$) that reflects the sum of the individual supply curves of affected and unaffected facilities.




**a) Baseline Equilibrium**




**b) With Regulation Equilibrium**

**Figure 4-2. Market Equilibrium Without and With Regulation**

Now consider the effect of the regulatory control costs. These costs include the variable component consisting of the operating and maintenance costs and the nonvariable component consisting of the compliance capital equipment required for the regulatory option. Incorporating the regulatory control costs involves shifting upward the supply curve for each affected facility by the per-unit compliance cost. As a result of the upward shift in the supply curve for each affected facility, the market supply curve for each affected vegetable oil will shift upward to reflect the increased costs of production at solvent-extraction facilities.

The estimated per-unit annual compliance cost of the MACT standard was incorporated into the baseline market scenario as shown in Figure 4-2(b). In the baseline scenario without the standards, at the projected price, P, the industry would produce total output, Q, with solvent-extraction facilities producing the amount $q_s$ and mechanical extraction facilities accounting for Q minus $q_s$, or $q_m$. The regulation raises the average total cost (annual capital costs plus operating and maintenance) of solvent extraction facilities, causing their supply curves to shift upward from $S_s$ to $S_s'$ and the market supply curve to shift upward to $S^{M'}$. At the new equilibrium with the regulation, the market price increases from P to P′ and market output (as determined from the market demand curve, $D^M$) declines from Q to Q′. This reduction in market output is the net result of reductions at solvent extraction facilities and increases at mechanical extraction facilities.

To estimate the economic impacts of the regulation under this scenario, EPA operationalized the conceptual model described above in a Lotus 1-2-3 multiple spreadsheet model for each vegetable oil and meal market. Appendix A provides the details of the operational market model for this economic analysis. In summary, this model characterizes domestic and foreign producers and consumers of each product and their behavioral responses to the imposition of the regulatory compliance costs. These costs are expressed per pound of product for each facility and serve as the input to the market model, or the "cost shifters" of the baseline supply curves at the facility. Given these costs for directly affected facilities, the model determines a new equilibrium solution in a comparative static approach with higher market prices and reductions in output of each product.

## 4.3 Economic Model Assumptions

In developing and implementing the economic model, several assumptions were necessary. These assumptions are either numerical or operational. This section describes each type of assumption.

### *4.3.1 Operational Assumptions*

The operational assumptions of the model influence the structure and coverage of the model. They are as follows:

- The domestic markets for crude vegetable oils and meals are perfectly competitive.
- The U.S. may potentially influence the price of crude vegetable oils and meals in the world market (i.e., the U.S. is not a price-taker).
- Vegetable oils and meals are produced in fixed proportions relative to the oilseed inputs.
- The markets for by-products and co-products of the vegetable oil and meal production process will be unaffected by the regulation.
- The markets for specialty use products, which are primarily produced from crude meals, will be unaffected by the regulation.
- The baseline year for the analysis, which is 1995, is representative of a typical year for the industry.
- The markets for the other vegetable oils and meals (canola, flaxseed, peanut, safflower, and sunflower) are sufficiently similar that they can be combined.

In Section 6, each of these operational assumptions is explained further. In addition, the impact of each assumption on the results of the model is described. For example, if 1995 was a better than typical year for the industry, then the estimated percentage price effects would appear smaller for the baseline year than in a typical year. However, based on the estimates of the CSRs using 1999 data, as described in Section 4.1.3, the results of the model would likely not differ substantially using more recent data.

### *4.3.2 Numerical Assumptions*

The numerical assumptions of the economic model are the actual values used in developing the spreadsheet model. These include the demand, supply, and trade elasticities used in the model as well as the methods for allocating seed costs and compliance costs to the joint oil and meal products at each facility. These assumptions are described briefly below.

#### *4.3.2.1 Elasticity Assumptions*

In determining the elasticity values to use in the economic model, the Agency reviewed the economics literature and estimated econometric models. Appendix B describes each paper that cites relevant elasticity estimates and presents the results of the independent econometric estimates. The elasticities used in the model, which were obtained from both sources, are listed in Table 4-3 (see Section B.4 for a more complete description).

**Table 4-3. Elasticity Estimates Used in the Economic Impact Analysis**

| | Product | Elasticity Used for the EIA |
|---|---|---|
| Demand Elasticities | Corn oil | –0.39 |
| | Cottonseed oil | –0.65 |
| | Soybean oil | –0.34 |
| | All other oils | –0.33 |
| | Corn germ meal | –0.46 |
| | Cottonseed meal | –1.01 |
| | Soybean meal | –0.27 |
| | All other meals | –0.64 |
| Supply Elasticities | Corn oil | 0.44 |
| | Cottonseed oil | 0.44 |
| | Soybean oil | 0.44 |
| | All other oils | 0.44 |
| | Corn germ meal | 0.28 |
| | Cottonseed meal | 0.28 |
| | Soybean meal | 0.28 |
| | All other meals | 0.28 |
| Import Supply Elasticities | All products | 1.00 |
| Export Demand Elasticities | All products | –1.00 |

In general, the demand elasticities used in the model were obtained from the independent econometric estimates. The one exception is that the econometrically estimated cottonseed oil demand elasticity was outside the range of the econometric estimates; thus, an estimate from the literature was used. In the case of supply elasticities, the values used are based on estimates in the literature for soybean products.

To investigate the impacts of alternative elasticity values on the economic model results, EPA conducted a sensitivity analysis. The economic model was run using, in one case, the elasticity values expected to generate the greatest effects and, in the other case, the elasticity values expected to generate the smallest effects. These results are presented in

Appendix C. In general, the projected effects of the regulation are not particularly sensitive to changes in the elasticity values.

*4.3.2.2 Allocation of Compliance Costs to Oils and Meals*

Facility-level compliance costs were allocated to oil and meal products produced at the facility based on the relative shares of revenue generated by each product. First, facility-level revenues were calculated for oils and for meals and then expressed as a proportion relative to total revenue from both products. Then, facility-level compliance costs were then allocated to each product using these proportions.

This method is preferable to allocating compliance costs based on the proportion of the weight of the respective products relative to the weight of the oilseed input. This is because oil generates more revenue relative to its weight than meal. (For example, soybeans are approximately 20 percent oil and 80 percent meal by weight, but oil generates 45 percent and meal generates 55 percent of the revenue.) Thus, this method would allocate too much of the compliance costs to meal.

*4.3.2.3 Allocation of Seed Costs to Oils and Meals*

Similar to the issue with compliance costs, seed costs were allocated separately to vegetable oils and oilseed meals to facilitate construction of supply curves for each individual product. Seed costs were allocated to each product based on its proportion of revenue. First, facility-level revenues were calculated at each plant using market prices for oils and meals, and seed costs were calculated using market prices for oilseeds. The industry average percentage of the oilseed cost relative to total revenue (averaged over oilseed types) was used to allocate oilseed cost to each individual product. For cottonseed, the average proportion of cottonseed cost relative to total revenue is approximately 61 percent. Thus, it was assumed that 61 percent of the revenue generated from cottonseed oil is the cost of cottonseed used in its production, and 61 percent of the revenue generated from cottonseed meal is the cost of cottonseed used in its production. For soybeans, the average value is approximately 85 percent and for corn germ, the average value is approximately 77 percent. Since market prices are missing for most of the other types of oilseeds and oilseed products, 73 percent, which is the average of the soybean value and cottonseed value, was assumed.

## 4.4 Economic Impact Results

This section provides the economic impacts of the MACT regulation. The model results are summarized below as market-, industry-, and society-level impacts due to the regulation.

### *4.4.1 Market-Level Results*

Table 4-4 compares 1995 baseline values with the projected effects of the two regulatory scenarios for each of the eight vegetable oil and meal markets. Compliance costs are ten to 12 times larger for the above-the-floor option than the MACT floor option and therefore have much greater market-level effects. In all cases, the following changes occur:

- market price increases,
- production by domestic solvent extraction facilities decreases,
- production by domestic mechanical extraction facilities increases or remains unchanged,
- exports decrease, and
- imports increase.

Under the floor scenario, the size of the effects in percentage change terms is similar across all of the markets. Price increases for oils range from 0.16 percent for all other vegetable oils to 0.48 percent for cottonseed and corn oil. Output decreases range from 0.11 percent for all other vegetable oil to 0.35 percent for cottonseed oil. In the meal markets, price increases range from 0.10 percent for all other vegetable oils to 0.34 percent for corn germ meal. Output decreases range from 0.07 percent for all other vegetable meals to 0.27 percent for cottonseed meal.

### *4.4.2 Industry-Level Results*

Table 4-5 compares the 1995 baseline industry measures with the effects of the two regulatory scenarios for the total domestic industry, domestic solvent extraction facilities, and domestic mechanical extraction facilities. As with the market-level effects, effects are greater for the above-the-floor option compared to the floor option. The following general changes are projected to occur:

- industry revenues increase as a result of higher market prices that offset decreases in output,

## Table 4-4. Summary of Market-Level Impacts of Vegetable Oil Production NESHAP: 1995[a]

| Scenario: | | Floor with LP[b] | | Above-the-Floor with LP[b] | |
|---|---|---|---|---|---|
| Compliance Costs: | | $12,151 | | $203,704 | |
| | | Changes from Baseline | | | |
| | Baseline | Absolute | Percent | Absolute | Percent |
| **Corn Oil** | | | | | |
| Market Price ($/short ton) | $532.00 | $2.53 | 0.48% | $36.44 | 6.85% |
| Market Output (tpy) | 1,126,198 | –3,280 | –0.29% | –26,786 | –2.38% |
| Domestic Production | 1,121,703 | –3,301 | –0.29% | –27,094 | –2.42% |
| Solvent Extraction | 1,066,819 | –3,416 | –0.32% | –28,718 | –2.69% |
| Mech. Extraction | 54,884 | 115 | 0.21% | 1,624 | 2.96% |
| Exports | 415,270 | –1,966 | –0.47% | –26,623 | –6.41% |
| Imports | 4,495 | 21 | 0.48% | 308 | 6.85% |
| **Cottonseed Oil** | | | | | |
| Market Price ($/short ton) | $536.00 | $2.55 | 0.48% | $30.33 | 5.66% |
| Market Output (tpy) | 646,031 | –2,233 | –0.35% | –25,414 | –3.93% |
| Domestic Production | 645,925 | –2,234 | –0.35% | –25,420 | –3.94% |
| Solvent Extraction | 622,308 | –2,283 | –0.37% | –25,999 | –4.18% |
| Mech. Extraction | 23,617 | 49 | 0.21% | 579 | 2.45% |
| Exports | 147,281 | –697 | –0.47% | –7,887 | –5.36% |
| Imports | 106 | 1 | 0.48% | 6 | 5.66% |
| **Soybean Oil** | | | | | |
| Market Price ($/short ton) | $536.00 | $1.84 | 0.34% | $43.82 | 8.17% |
| Market Output (tpy) | 7,981,880 | –11,867 | –0.15% | –266,695 | –3.34% |
| Domestic Production | 7,968,264 | –11,914 | –0.15% | –267,808 | –3.36% |
| Solvent Extraction | 7,968,264 | –11,914 | –0.15% | –267,808 | –3.36% |
| Mech. Extraction | 0 | 0 | NA | 0 | NA |
| Exports | 1,143,544 | –3,905 | –0.34% | –86,417 | –7.56% |
| Imports | 13,616 | 47 | 0.34% | 1,113 | 8.17% |
| **All Other Vegetable Oils** | | | | | |
| Market Price ($/short ton) | $658.82 | $1.07 | 0.16% | $15.20 | 2.31% |
| Market Output (tpy) | 1,623,013 | –1,763 | –0.11% | –24,593 | –1.52% |
| Domestic Production | 1,093,411 | 2,622 | –0.24% | –36,798 | –3.37% |
| Solvent Extraction | 1,026,335 | –2,670 | –0.26% | –37,474 | –3.65% |
| Mech. Extraction | 67,076 | 48 | 0.07% | 676 | 1.01% |
| Exports | 632,625 | –1,025 | –0.16% | –14,263 | –2.25% |
| Imports | 529,125 | 859 | 0.16% | 12,205 | 2.31% |

(continued)

**Table 4-4. Summary of Market-Level Impacts of Vegetable Oil Production NESHAP: 1995[a] (Continued)**

| Scenario: | | Floor with LP[b] | | Above-the-Floor with LP[b] | |
|---|---|---|---|---|---|
| **Compliance Costs:** | | $12,151 | | $203,704 | |
| | | Changes from Baseline | | | |
| | **Baseline** | **Absolute** | **Percent** | **Absolute** | **Percent** |
| **Corn Germ Meal** | | | | | |
| Market Price ($/short ton) | $88.40 | $0.30 | 0.34% | $11.33 | 12.81% |
| Market Output (tpy) | 1,473,651 | –3,304 | –0.22% | –84,725 | –5.75% |
| Domestic Production | 1,473,651 | –3,304 | –0.22% | –84,725 | –5.75% |
| Solvent Extraction | 1,401,546 | 3,373 | –0.24% | –87,201 | –6.22% |
| Mech. Extraction | 72,105 | 69 | | 2,476 | |
| Exports | 61,950 | –212 | –0.34% | –7,036 | –11.36% |
| Imports | 0 | 0 | NA | 0 | NA |
| **Cottonseed Meal** | | | | | |
| Market Price ($/short ton) | $123.20 | $0.34 | 0.27% | $4.38 | 3.56% |
| Market Output (tpy) | 1,826,100 | –5,019 | –0.27% | –63,320 | –3.47% |
| Domestic Production | 1,826,100 | –5,019 | –0.27% | –63,320 | –3.47% |
| Solvent Extraction | 1,744,562 | –5,081 | –0.29% | –64,122 | –3.68% |
| Mech. Extraction | 81,538 | 62 | 0.08% | 802 | 0.98% |
| Exports | 89,700 | –244 | –0.27% | –3,082 | –3.44% |
| Imports | 0 | 0 | NA | 0 | NA |
| **Soybean Meal** | | | | | |
| Market Price ($/short ton) | $173.80 | $0.47 | 0.27% | $12.49 | 7.19% |
| Market Output (tpy) | 31,290,977 | –35,793 | –0.11% | –892,586 | –2.85% |
| Domestic Production | 31,225,572 | –35,970 | –0.12% | –897,287 | –2.87% |
| Solvent Extraction | 31,225,572 | –35,970 | –0.12% | –897,287 | –2.87% |
| Mechanical Extraction | 0 | 0 | NA | 0 | NA |
| Exports | 6,491,570 | –17,571 | –0.27% | –435,309 | –6.71% |
| Imports | 65,405 | 178 | 0.27% | 4,701 | 7.19% |
| **All Other Vegetable Oil Meals** | | | | | |
| Market Price ($/short ton) | $93.22 | $0.10 | 0.10% | $1.86 | 1.99% |
| Market Output (tpy) | 2,520,129 | –1,729 | –0.07% | –32,548 | –1.29% |
| Domestic Production | 1,583,559 | –2,704 | –0.17% | –51,186 | –3.23% |
| Solvent Extraction | 1,497,886 | –2,729 | –0.18% | –51,660 | –3.45% |
| Mechanical Extraction | 85,673 | 25 | 0.03% | 474 | 0.55% |
| Exports | 138,469 | –144 | –0.10% | –2,702 | –1.95% |
| Imports | 936,570 | 975 | 0.10% | 18,638 | 1.99% |

[a] Facilities that began operation in 1996 or later years are not included in the analysis.
[b] LP represents lost production costs that may be incurred due to the downtime to install new capital equipment.
NA = not available.

**Table 4-5. Summary of Industry-Level Impacts of Vegetable Oil Production NESHAP: 1995[a]**

| | | Floor with LP[b] | | Above-the-Floor with LP[b] | |
|---|---|---|---|---|---|
| | | Changes from Baseline | | | |
| | **Baseline** | **Absolute** | **Percent** | **Absolute** | **Percent** |
| **Total Industry** | | | | | |
| Revenues ($\$10^3$) | $11,963,996 | $17,728 | 0.1% | $447,584 | 3.7% |
| Costs ($\$10^3$) | $10,567,809 | –$6,394 | –0.1% | –$216,276 | –2.0% |
| Post-regulatory | $0 | $12,076 | NA | $163,977 | NA |
| Oil and Meal Production | $10,567,809 | –$18,470 | –0.2% | –$380,253 | –3.6% |
| Gross Profits ($\$10^3$) | $1,396,186 | $24,122 | 1.7% | $663,860 | 47.5% |
| Operating Entities | | | | | |
| Product-Line Closures | NA | 0 | NA | 6 | NA |
| Facility Closures | NA | 0 | NA | 3 | NA |
| Employment Loss | NA | –12 | NA | –350 | NA |
| **Solvent Extraction** | | | | | |
| Revenues ($\$10^3$) | $11,853,542 | $17,264 | 0.1% | $440,414 | 3.7% |
| Costs ($\$10^3$) | $10,482,567 | –$6,477 | –0.1% | –$217,808 | –2.1% |
| Post-regulatory | $0 | $12,076 | NA | $163,977 | NA |
| Production | $10,482,567 | –$18,554 | –0.2% | –$381,785 | –3.6% |
| Gross Profits ($\$10^3$) | $1,370,975 | $23,741 | 1.7% | $658,222 | 48.0% |
| Operating Entities | | | | | |
| Product Lines | 111 | 0 | 0.0% | 6 | 5.4% |
| Facilities | 106 | 0 | 0.0% | 3 | 2.8% |
| Employment | 5,673 | –12 | –0.2% | –350 | –6.2% |
| **Mechanical Extraction** | | | | | |
| Revenues ($\$10^3$) | $110,454 | $464 | 0.4% | $7,170 | 6.5% |
| Costs ($\$10^3$) | $85,242 | $84 | 0.1% | $1,532 | 1.8% |
| Post-regulatory | $0 | $0 | 0.0% | $0 | 0.0% |
| Production | $85,242 | $84 | 0.1% | $1,532 | 1.8% |
| Gross Profits ($\$10^3$) | $25,212 | $380 | 1.5% | $5,638 | 22.4% |
| Operating Entities | | | | | |
| Product Lines | NA | NA | NA | NA | NA |
| Facilities | NA | NA | NA | NA | NA |
| Employment | NA | NA | NA | NA | NA |

[a] Facilities that began operation in 1996 or later years are not included in the analysis.
[b] LP represents lost production costs that may be incurred due to the downtime to install new capital equipment.
NA = not available.

- net industry costs decrease,
- production costs decrease for solvent extraction facilities due to decreased production levels,
- production costs increase for mechanical extraction facilities due to increased production levels,
- gross industry profits increase (revenue less direct costs of production and compliance costs), and
- industry employment decreases due to decreased production levels and/or line closures.

No product-line or facility closures are predicted with the floor option, including lost production costs. Six product-line closures and three facility closures are predicted with the above-the-floor option. However, it should be noted that the estimates of facility and product-line closures are sensitive to the accuracy of the baseline characterization of facilities and the estimation of their costs to comply with the NESHAP.

Although total gross profits for solvent extraction facilities are projected to increase 1.7 percent under the floor option, some facilities are projected to experience decreased gross profits. Facilities with profit losses are those with higher than average variable production costs (labor, energy, and materials) and/or compliance costs relative to the facilities with profit gains. Facilities with profit gains benefit from increased market price and the ability to pass some of the regulatory costs on to consumers.

Table 4-6 separates the number of facilities projected to experience profit losses from those projected to experience profit gains. The factors differentiating facilities with profit losses and those with profit gains are as follows:

- profit losers have smaller capacity facilities (one-third of the size of profit gainers),
- profit losers have greater solvent loss ratios per ton of oilseed (two to four times greater than profit gainers), and
- profit losers have greater compliance costs per ton of oilseed (four times greater than profit gainers).

### *4.4.3 Social Costs of the Regulation*

The social costs of a regulation are traditionally measured as changes in both consumer and producer economic welfare (see Appendix A for a more complete discussion).

**Table 4-6. Summary of Distributional Industry Impacts of Vegetable Oil Production NESHAP: 1995[a]**

| | Floor with LP[b] | | | Above-the-Floor with LP[b] | | |
|---|---|---|---|---|---|---|
| | Solvent Extraction Facilities | | | | | |
| | With Profit Loss | With Profit Gain | Total | With Profit Loss | With Profit Gain | Total |
| Number | | | | | | |
| Facility Capacity (tpd) | 21 | 85 | 106 | 22 | 84 | 106 |
| Total | 11,362 | 161,841 | 173,203 | 13,610 | 159,593 | 173,203 |
| Average Per Facility | 541 | 1,904 | 1,634 | 619 | 1,900 | 1,634 |
| Annual Solvent Loss | | | | | | |
| Total ($10^3$ gallons) | 2,419 | 13,577 | 15,996 | 2,682 | 13,314 | 15,996 |
| Gallons per Ton of Oilseed | 0.84 | 0.28 | 0.31 | 0.84 | 0.28 | 0.31 |
| Incremental Compliance Costs | | | | | | |
| Total ($\$10^3$/yr) | $2,502 | $9,649 | $12,151 | $54,191 | $149,513 | $203,704 |
| Per ton of oilseed | $0.87 | $0.20 | $0.24 | $16.93 | $3.14 | $4.01 |
| Change in Gross Profits ($\$10^3$/yr)[c] | –$1,184 | $24,925 | $23,741 | –$16,885 | $675,106 | $658,222 |
| Change in Employment (FTEs)[d] | –7 | –5 | –12 | –213 | –137 | –350 |

[a] Facilities that began operation in 1996 or later years are not included in the analysis.
[b] LP represents lost production costs that may be incurred due to the downtime to install new capital equipment.
[c] Gross profits calculated as revenue less costs of production including oilseed costs.
[d] FTEs = Full-time equivalents.

The vegetable oil NESHAP directly affects consumers and producers of vegetable oils and meals. Consumers experience reductions in economic welfare (i.e., consumer surplus) due to increased market prices and decreased market quantity. Producers may experience either increases or decreases in economic welfare (i.e., producer surplus) as a result of increased market prices, decreased costs of production, and imposition of the compliance costs.

Table 4-7 compares the welfare effects of the NESHAP on domestic consumers, domestic producers, and foreign producers. Consumer surplus decreases in all eight

**Table 4-7. Distribution of the Social Costs Associated with the Vegetable Oil Production NESHAP: 1995[a]**

| | Floor with LP[b] | Above-the-Floor with LP[b] |
|---|---|---|
| **Social Cost Component** | **Change in Value ($10³)** | |
| Consumer Surplus | –$36,929 | –$842,168 |
| Corn Oil | –$2,845 | –$40,554 |
| Cottonseed Oil | –$1,644 | –$19,207 |
| Soybean Oil | –$14,649 | –$343,893 |
| All Other Vegetable Oils | –$1,734 | –$24,470 |
| Corn Germ Feed | –$446 | –$16,212 |
| Cottonseed Meal | –$613 | –$7,865 |
| Soybean Meal | –$14,752 | –$385,322 |
| All Other Vegetable Meals | –$244 | –$4,645 |
| Producer Surplus | $24,846 | $675,388 |
| Domestic Producers | $24,122 | $663,860 |
| Solvent Extraction | $23,741 | $658,222 |
| Mechanical Extraction | $380 | $5,638 |
| Foreign Producers | $725 | $11,528 |
| Social Costs of Regulation | –$12,083 | –$166,780 |

[a] Facilities that began operation in 1996 or later years are not included in the analysis.
[b] LP represents lost production costs that may be incurred due to the downtime to install new capital equipment.

vegetable oil and meal markets under both regulatory scenarios. Consumer surplus losses range from $36.9 million for the floor option to $842.2 million for the above-the-floor option including lost production costs. Domestic producer surplus increases under both regulatory scenarios, although, as noted in Section 4.4.2, some producers gain while others lose. Foreign producer surplus increases as a result of higher prices and increased imports. In total, the social costs of the regulation range from $12.1 million to $166.8 million.

## SECTION 5

## SMALL BUSINESS IMPACTS

This regulatory action will potentially affect owners of vegetable oil and meal processing facilities. Firms or individuals that own these facilities are legal business entities that have the capacity to conduct business transactions and make business decisions that affect the facility. The legal and financial responsibility for compliance with a regulatory action ultimately rests with these owners who must bear the financial consequences of their decisions. Environmental regulations like this rule affect all businesses, large and small, but small businesses may have special problems in complying with such regulations.

The RFA of 1980 requires that special consideration be given to small entities affected by federal regulation. The RFA was amended in 1996 by SBREFA to strengthen the RFA's analytical and procedural requirements.

This section identifies the small businesses that will be affected by this NESHAP and provides a screening-level analysis to assist in determining whether this rule imposes a significant impact on a substantial number of small businesses. The screening-level analysis described in this section is a "sales test," which computes the annualized compliance costs as a percentage of sales for each company.[1] In addition, this section provides information about the likely impact on small businesses after accounting for producer responses to the regulation and resulting changes in market prices and output for vegetable oils and meals. Information on cottonseed facilities is provided separately because they make up a disproportionate number of the facilities owned by small companies.

The SBA defines a small business involved in vegetable oil and meal processing as follows:

- Corn Oil (NAICS 311221)—fewer than 750 total employees;
- Corn Oil Dry Milling (NAICS 311211)—fewer than 500 total employees;

[1]Company-level sales figures used for this analysis were obtained from publicly available sources.

- Cottonseed Oil (NAICS 311223)—fewer than 1,000 total employees;
- Soybean Oil (NAICS 311222)—fewer than 500 total employees; and
- All Other Vegetable Oils (NAICS 311223)—fewer than 1,000 total employees.

Based on these definitions, 15 companies, which are listed in Table 5-1, can be classified as small or potentially small businesses. Two firms without available employment data are included as potentially small businesses. As of 1995, these 15 companies owned and operated 21 facilities, or 20 percent of all solvent extraction facilities.

For the purposes of assessing the impact of this rule on these small businesses, the Agency calculated the share of annual compliance cost relative to baseline sales for each company. For this screening-level analysis, annual compliance costs were defined as the engineering control costs imposed on these companies; thus, they do not reflect the changes in production expected to occur in response to imposition of these costs and the resulting market adjustments. Table 5-2 compares total compliance costs for small and large companies for each of the two scenarios. Small companies own 20 percent of the facilities and incur compliance costs of $2.2 million (18 percent) under the floor with lost production costs scenario and $21.1 million (10 percent) under the above-the-floor with lost production costs scenario.

Mean, minimum, and maximum CSRs under each scenario are presented in Table 5-3. Mean CSRs for all companies are 0.16 percent under the floor with lost production costs scenario and 1.62 percent under the above-the-floor with lost production costs scenario. Under the floor scenario, the mean CSR for small companies is 0.30 percent, ranging from a low of 0.03 to 0.61 percent, while the mean ratio is 0.04 percent for large companies. Under the above-the-floor scenario, the mean CSR for small companies is 2.97 percent, and the mean CSR for large companies is 0.45 percent. Table 5-4 presents the distribution of CSRs for small, large, and all companies combined for each of the scenarios. All large and small companies have CSRs less than 1 percent under the floor scenario. Under the above-the-floor scenario, 13 small companies and three large companies have CSRs above 1 percent.

## Table 5-1. Summary Data for Small Companies: 1995

| Company Name | Number of Affected Facilities | Sales ($ million) | Total Employment | Year Reported |
|---|---|---|---|---|
| Chickasha Cotton Oil Company | 4 | $93.0 | 600 | 1995 |
| Delta Oil Mill | 1 | $22.5 | 90 | 1996 |
| Hartsville Oil Mill Incorporated | 1 | $20.0 | 100 | 1996 |
| J.G. Boswell | 1 | $80.0 | 1,000 | 1993 |
| Oilseeds International | 1 | NA | NA | NA |
| Osceola Products | 2 | $50.0 | 170 | 1996 |
| Owensboro Grain Company | 1 | $450.0 | 195 | 1996 |
| Plains Cooperative Oil Mill, Inc. | 1 | $128.0 | 108 | 1995 |
| Planter's Cotton Oil Mill | 1 | $35.0 | 100 | 1996 |
| Producers Cooperative Mill | 1 | $35.0 | 100 | 1996 |
| Rito Partnership[a] | 1 | NA | NA | NA |
| Sessions Company | 1 | $30.0 | 100 | 1994 |
| Southern Soya Corporation | 1 | NA | 89 | 1996 |
| Valley Cooperative Mills | 1 | $32.0 | 100 | 1992 |
| Yazoo Valley Oil Mill, Inc. | 3 | $113.7 | 300 | 1996 |
| TOTAL | 21 | NA | NA | NA |

NA = Not available.

[a] Rito Partnership operates a rice oil facility that will not be subject to the regulation. It is included in the aggregate totals to maintain confidentiality in the tables that present production data.

Note: The Small Business Administration (SBA) defines a small business for industries affected by this regulation as follows:
Corn Oil (NAICS 311221) = fewer than 750 total employees
Corn Oil Dry Milling (NAICS 311211) = fewer than 500 total employees
Cottonseed Oil (NAICS 311223) = fewer than 1,000 total employees
Soybean Oil (NAICS 311222) = fewer than 500 total employees
All Other Vegetable Oils (NAICS 311223) = fewer than 1,000 total employees

Sources: Information Access Corporation. 1997 Business Index [computer file]. Foster City, CA: Information Access Corporation.
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## Table 5-2. Capacity and Compliance Cost Comparisons for Small and Large Companies: 1995

| | | | | Capacity (tons per day) | | Compliance Costs ($10^3$) | |
|---|---|---|---|---|---|---|---|
| **Company Size** | **Number of Companies** | **Number of Facilities** | **Share of Facilities** | **Total** | **Share** | **Floor with LP[a]** | **Above-the-Floor with LP** |
| Small | 15 | 21 | 19.8% | NR | NR | $2,153 | $21,089 |
| Large | 16 | 85 | 80.2% | NR | NR | $9,998 | $182,615 |
| TOTAL | 31 | 106 | 100.00% | 172,803 | 100.00% | $12,151 | $203,704 |

NR = Not reported to avoid disclosure of CBI.

[a] LP represents lost production costs that may be incurred due to the downtime to install new capital equipment.

## Table 5-3. Summary of Cost-to-Sales Ratios for the Vegetable Oil NESHAP: 1995 (%)

| | Scenario | | | | | |
|---|---|---|---|---|---|---|
| | Floor with LP[a] | | | Above-the-Floor with LP | | |
| **Company Size** | **Mean** | **Min** | **Max** | **Mean** | **Min** | **Max** |
| Small | 0.30 | 0.03 | 0.61 | 2.97 | 0.51 | 6.11 |
| Large | 0.04 | <0.01 | 0.11 | 0.45 | <0.01 | 1.30 |
| TOTAL | 0.16 | <0.01 | 0.61 | 1.62 | <0.01 | 6.11 |

[a] LP represents lost production costs that may be incurred due to the downtime to install new capital equipment.

## Table 5-4. Distribution of Cost-to-Sales Ratios for the Vegetable Oil NESHAP: 1995

| | Scenario | | | |
|---|---|---|---|---|
| | Floor with LP[a] | | Above-the-Floor with LP | |
| | Number | Share | Number | Share |
| **Small Companies** | | | | |
| 0-1% | 15 | 100.0% | 2 | 13.3% |
| 1-2% | 0 | 0.0% | 2 | 13.3% |
| >2% | 0 | 0.0% | 11 | 73.3% |
| TOTAL | 15 | 100.0% | 15 | 100.0% |
| **Large Companies** | | | | |
| 0-1% | 16 | 100.0% | 13 | 81.3% |
| 1-2% | 0 | 0.0% | 3 | 18.8% |
| >2% | 0 | 0.0% | 0 | 0.0% |
| TOTAL | 16 | 100.0% | 16 | 100.0% |
| **All Companies** | | | | |
| 0-1% | 31 | 100.0% | 15 | 48.4% |
| 1-2% | 0 | 0.0% | 5 | 16.1% |
| >2% | 0 | 0.0% | 11 | 35.5% |
| TOTAL | 31 | 100.0% | 31 | 100.0% |

[a] LP represents lost production costs that may be incurred due to the downtime to install new capital equipment.

Because small businesses affected by this regulation own many cottonseed processing facilities and several of these facilities have closed since the baseline year of analysis,[2] the Agency undertook additional analysis to determine whether companies that operate these facilities will experience significant economic impacts as a result of the regulation. CSRs were calculated both for the plants included in the 1995 baseline and then for currently operating plants using publicly available sales data. Under the floor with lost production costs scenario, the average CSR for small companies that owned cottonseed processing facilities in 1995 falls below 1 percent (0.31 percent) with a maximum value of 0.59 percent (see Tables 5-5 and 5-6). None of these companies have CSRs above 1 percent. However, under the above-the-floor with lost production costs scenario, the average CSR in 1995 is 2.9 percent with a maximum value of 4.3 percent. All ten companies have CSRs above 1 percent, eight of which are greater than 2 percent. Although ten cottonseed facilities have closed since 1995, excluding the compliance costs for facilities not currently operating does not significantly alter the analysis. The one exception is that two companies no longer operate any cottonseed facilities and therefore are not affected under the above-the-floor scenario.

CSRs for companies that own cottonseed facilities were also calculated using facility revenues as the denominator rather than publicly available company sales data. These facility CSRs exclude revenues that companies may generate from operations other than vegetable oil production. In this case, for the nine cottonseed processing facilities operating in 1995 and still currently operating that are owned by small businesses, the average facility-level CSR is 0.28 percent and ranges from 0.05 percent to 0.52 percent (see Table 5-7). Thus, the results are not substantially different using facility-level revenues instead of company sales. In addition, the facility CSRs for compliance cost data cottonseed facilities were recomputed using 1999 price data and projected to 1999 using the producer price index. The purpose of this analysis was to determine whether cottonseed facility CSRs would change substantially using more recent data. For the cottonseed processing facilities operating in 1995 and still operating currently that are owned by small businesses, the average facility-level CSR increased to only 0.33 percent with a range from 0.06 percent to 0.58 percent.

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[2]In 1995, 25 cottonseed facilities were operating. Since then, ten of these facilities have closed. Closures have been particularly high in this industry because cottonseed is being used increasingly as a dairy feed. The value of cottonseed as a feed product has risen relative to its value in producing oil and meal products (Wedegaertner, 1999). Hence, cottonseed oil and meal processing has become less profitable.

## Table 5-5. Summary of Company Cost-to-Sales Ratios for Companies That Own Cottonseed Facilities: 1995 (%)

| | Operating 1995[a] | | | | | | Currently Operating[b] | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Floor with LP[c] | | | Above-the-Floor with LP | | | Floor with LP | | | Above-the-Floor with LP | | |
| **Company Size** | **Mean** | **Min** | **Max** | **Mean** | **Min** | **Max** | **Mean** | **Min** | **Max** | **Mean** | **Min** | **Max** |
| Small | 0.31 | 0.03 | 0.59 | 2.91 | 1.01 | 4.32 | 0.22 | 0.03 | 0.51 | 2.35 | 0.86 | 4.32 |
| Large | 0.02 | 0.02 | 0.02 | 0.37 | 0.23 | 0.50 | 0.01 | <0.01 | 0.02 | 0.24 | <0.01 | 0.47 |
| TOTAL | 0.26 | 0.02 | 0.59 | 2.49 | 0.23 | 4.32 | 0.18 | <0.01 | 0.51 | 1.96 | <0.01 | 4.32 |

[a] Companies with cottonseed facilities operating in 1995.
[b] Companies with cottonseed facilities currently operating.
[c] LP represents lost production costs that may be incurred due to the downtime to install new capital equipment.

## Table 5-6. Distribution of Cost-to-Sales Ratios for Companies That Own Cottonseed Facilities: 1995

| | Operating 1995[a] | | | | Currently Operating[b] | | | |
|---|---|---|---|---|---|---|---|---|
| | Floor with LP[c] | | Above-the-Floor with LP | | Floor with LP | | Above-the-Floor with LP | |
| | Number | Share | Number | Share | Number | Share | Number | Share |
| **Small Companies** | | | | | | | | |
| 0-1% | 10 | 100.0% | 0 | 0.0% | 9 | 100.0% | 1 | 11.1% |
| 1-2% | 0 | 0.0% | 2 | 20.0% | 0 | 0.0% | 3 | 33.3% |
| >2% | 0 | 0.0% | 8 | 80.0% | 0 | 0.0% | 5 | 55.6% |
| TOTAL | 10 | 100.0% | 10 | 100.0% | 9 | 100.0% | 9 | 100.0% |
| **Large Companies** | | | | | | | | |
| 0-1% | 2 | 100.0% | 2 | 100.0% | 2 | 100.0% | 1 | 100.0% |
| 1-2% | 0 | 0.0% | 0 | 0.0% | 0 | 0.0% | 0 | 0.0% |
| >2% | 0 | 0.0% | 0 | 0.0% | 0 | 0.0% | 0 | 0.0% |
| TOTAL | 2 | 100.0% | 2 | 100.0% | 2 | 100.0% | 1 | 100.0% |
| **All Companies** | | | | | | | | |
| 0-1% | 12 | 100.0% | 2 | 16.7% | 11 | 100.0% | 2 | 27.3% |
| 1-2% | 0 | 0.0% | 2 | 16.7% | 0 | 0.0% | 3 | 27.3% |
| >2% | 0 | 0.0% | 8 | 66.7% | 0 | 0.0% | 5 | 45.5% |
| TOTAL | 12 | 100.0% | 12 | 100.0% | 11 | 100.0% | 10 | 100.0% |

[a] Companies with cottonseed facilities operating in 1995.
[b] Companies with cottonseed facilities currently operating.
[c] LP represents lost production costs that may be incurred due to the downtime to install new capital equipment.

## Table 5-7. Summary of Facility Cost-to-Sales Ratios for Cottonseed Facilities: 1995 (%)

| | Operating 1995[a] | | | Currently Operating[b] | | |
|---|---|---|---|---|---|---|
| | Floor with LP[c] | | | | | |
| **Company Size** | **Mean** | **Minimum** | **Maximum** | **Mean** | **Minimum** | **Maximum** |
| Small | 0.54 | 0.05 | 1.57 | 0.28 | 0.05 | 0.52 |
| Large | 0.25 | 0.07 | 0.64 | 0.20 | 0.07 | 0.52 |
| TOTAL | 0.43 | 0.05 | 1.57 | 0.25 | 0.05 | 0.52 |

[a] Facilities operating in 1995.
[b] Facilities currently operating.
[c] LP represents lost production costs that may be incurred due to the downtime to install new capital equipment.

In summary, the Agency's screening analysis does not suggest a significant negative impact on a substantial number of small companies under the MACT floor alternative promulgated by the EPA (this scenario includes lost production costs). The economic impacts model verifies that the effects of taking into account market adjustments are small. However, the potential for negative impacts is greater under the above-the-floor scenario.

Table 5-8 summarizes the economic impacts of the regulation on small companies. Gross profits are projected to increase by 0.2 percent for small companies under the floor with lost production costs scenario. The projected effects of the above-the-floor with lost production costs scenario are greater than the floor scenario, but no closures are expected under either of the scenarios.

## Table 5-8. Summary of Small Business Impacts of Vegetable Oil Production NESHAP: 1995

| | | Floor with LP[a] | | Above-the-Floor with LP[a] | |
|---|---|---|---|---|---|
| | | Changes From Baseline | | | |
| | Baseline | Absolute | Percent | Absolute | Percent |
| Revenues ($$10^3$) | $780,636 | –$793 | –0.1% | $13,629 | 1.7% |
| Costs ($$10^3$) | $665,767 | –$1,010 | –0.2% | –$7,777 | –1.2% |
| Post-regulatory | $0 | $2,131 | NA | $19,586 | NA |
| Production | $665,767 | –$3,141 | –0.5% | –$27,363 | –4.1% |
| Gross Profits ($$10^3$) | $114,869 | $217 | 0.2% | $21,405 | 18.6% |
| Operating Entities | | | | | |
| Product Lines | 21 | 0 | 0.0% | 0 | 0.0% |
| Facilities | 20 | 0 | 0.0% | 0 | 0.0% |
| Employment | NR | –6 | NR | –59 | NR |

NA = Not available.
NR = Not reported to avoid disclosure of CBI.

[a] LP represents lost production costs that may be incurred due to the downtime to install new capital equipment.

# SECTION 6

## ASSUMPTIONS AND LIMITATIONS OF THE ECONOMIC MODEL

In developing the economic model of the vegetable oil and meal markets, several assumptions were necessary to make the model operational. These assumptions are in addition to the numerical assumptions described in Section 4.3.2 (i.e., elasticity values and allocation of both seed costs and compliance costs to individual products). In this section, each operational assumption is listed and explained. Possible impacts and limitations of the model resulting from each assumption are then described.

**Assumption: The domestic markets for crude vegetable oils and meals are perfectly competitive.**

***Explanation:*** Assuming that the markets for crude vegetable oils and meals are perfectly competitive implies that individual producers cannot individually affect the prices they receive for their products. The measures available to determine whether a market is perfectly competitive are the four-firm concentration ratios (CR4) and the Herfindahl-Hirschman indexes (HHIs). The most recently available measures are based on SIC code-level data for 1992. Based on the 1992 data, the CR4s for vegetable oils range from a low of 62 percent for SIC 2074 (Cottonseed Oil Mills) to a high of 89 percent for SIC 2076 (Vegetable Oil Mills, Except Corn, Soybean, and Cottonseed). Similarly, the HHIs range from a low of 1,430 for SIC 2074 to a high of 2,119 for SIC 2076. These concentration measures considered in isolation imply that the vegetable oil industry is moderately imperfectly competitive. However, given the homogeneous nature of crude vegetable oils and meals and that there appear to be large economies of scale in their production, the assumption of perfect competition is appropriate.

***Possible impact:*** If the markets for crude vegetable oils and meals were in fact imperfectly competitive, implying that individual producers can exercise market power and thus affect the prices they receive for their products, the economic model would understate possible price increases due to the regulation and the social costs of the regulation. Under imperfect competition, producers would be able to pass along more of the costs of the regulation to consumers; thus, consumer surplus losses would be greater.

**Assumption: The U.S. is not a price-taker on the world market for crude vegetable oils and meals; that is, the U.S. may influence the price of these products on the world market.**

***Explanation:*** Assuming that the U.S. is not a price-taker on the world market for these products implies that the U.S. is "large" relative to the rest of the world. That is, the U.S. ships a sufficient quantity of these products that changes in the volume of products imported or exported may affect prices in the world market. Thus, producers in the U.S. have the opportunity to pass along some portion of the costs of the regulation to the consumers of crude vegetable oils and meals (i.e., to the facilities that further process the product for consumption by humans or animals).

***Possible impact:*** If the U.S. was instead a price-taker on the world market for crude vegetable oils and meals, producers in the U.S. would not be able to pass along the costs of the regulation to consumers of these products. If U.S. companies that export crude vegetable oils and meals attempted to raise prices as a result of the regulation, importing countries would instead purchase from countries other than the U.S. Likewise, U.S. companies would be unable to raise prices of these products domestically because consumers of crude vegetable oils and meals would instead import all these products at the lower world price. Thus, U.S. producers would have to fully absorb the costs of the regulation, and consumers would bear none of the costs of the regulation. The potential impact under this scenario on individual producers is estimated by the CSRs that are documented in Section 4.

**Assumption: Crude vegetable oils and meals are produced in fixed proportions relative to the oilseed inputs.**

***Explanation:*** Assuming that crude vegetable oils and meals are produced in fixed proportions implies that facilities cannot alter the ratio of oil to meal from a given oilseed in response to the regulation. This assumption is appropriate in light of our calculations using production data from the USDA and information provided by the trade associations (see Section 2.1).

***Possible impact:*** If, in fact, facilities could alter the proportion of oil to meal, then facilities could potentially alter the proportion in response to the regulation and thus could alleviate some of the burden of the regulation. In particular, a facility may choose to produce more of the product that generates higher revenues by weight (i.e., oil). However, it appears technically infeasible for facilities to alter the proportion.

**Assumption: The markets for by-products and co-products of the vegetable oil and meal production process will be unaffected by the regulation.**

***Explanation:*** Products such as cottonseed linters, hulls, and lecithin are produced either as by-products or co-products of the production process for vegetable oils and meals. These markets could be potentially affected by the regulation if the regulation changes the throughput of oilseeds in the production process. They are not modeled in this analysis because there is insufficient data to characterize their markets (e.g., prices and output at each facility), and they generate a relatively smaller share of revenue compared to oils and meals.

***Possible impact:*** Because the prices and output of by-products and co-products are assumed unchanged as a result of the regulation, the analysis may either understate or overstate changes to revenue and costs for individual facilities. It is expected that the net effects of these potential revenue and cost changes on individual facilities are minimal and would not significantly alter the primary conclusions of the EIA.

**Assumption: The markets for specialty use products, which are produced primarily from crude meal, will be unaffected by the regulation.**

***Explanation:*** Specialty use products that are produced by vegetable oil mills include products such as soy protein, tofu, and infant formula ingredients. The production processes for these products are proprietary to the plant producing them, and only a handful of plants produce each of these products. Thus, data to characterize these markets are unavailable.

***Possible impact:*** These specialty use products generate higher revenues than crude meal; thus, revenues are understated in the model for the plants that produce them. Therefore, the impacts of the regulation on these plants appear larger than they may be in actuality.

**Assumption: The baseline year of the analysis, which is 1995, is representative of a typical year for the industry.**

***Explanation:*** The engineering costs of the regulation are estimated for all facilities that produced crude vegetable oils and meals in 1995. In order for the economic model to be consistent, all costs, prices, and quantities must be denominated in the same year. In addition, for consistency between market-level data and facility-level data, both must be representative of the same year.

***Possible impact:*** If 1995 was a good year relative to typical conditions (i.e., with high output prices and low input prices), then the impacts of the regulation would appear to be smaller (in percentage terms) than they would be for a typical year.  As discussed in Section 2, the markets for vegetable oils and meals and for the oilseeds used in their production exhibit a great deal of volatility over time.  Based on price data for the 1990s, 1995 appears to have been a relatively good year for vegetable oil producers.  To evaluate whether the results of the economic model would differ substantially using more recent data, facility-level CSRs were calculated using 1999 data.  Based on these calculations, the CSRs increased by less than 0.1 percent except for one facility.  Thus, it appears that the results of a model using 1999 data would not differ substantially from the results using 1995 data.  It is likely that the projected percentage changes in the economic variables would increase slightly, but the overall economic effects of the MACT floor scenario would still be small.  According to a recent USDA publication, the economic conditions of the vegetable oil and meal industries have improved in 2000 (USDA, 2000).

**Assumption:  The markets for specialty oils and meals, which include canola, flaxseed, peanut, safflower, and sunflower, are sufficiently substitutable that they can be considered in the same market.**

***Explanation:***  Because relatively few facilities produce each of the specialty oils and meals, and because these products are grouped in the NAICS definitions, they are considered to be in a single market in the economic analysis.  The price in the model for the oilseed input and the oil and meal outputs are computed as weighted averages of the prices of the individual products.  By grouping these products into a single market, it is assumed that these products are highly substitutable for one another.

***Possible impact:***  The impacts of the regulation on speciality oils and meals may be potentially understated or overstated because they are grouped in the analysis.  However, the impacts on each as projected by the economic model are small.  There are only a handful of producers of each of these products, and data on prices of some of the products are not available; thus, it is not possible to model each market separately.

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## APPENDIX A

## ECONOMIC MODEL OF THE U.S. VEGETABLE OIL AND MEAL MARKETS

Implementation of the MACT standards will affect the costs of production in the U.S. vegetable oil industry for existing solvent extraction plants. Responses at the facility level to these additional costs collectively determine the market impacts of the regulation. Specifically, the cost of the regulation may induce some facilities to alter their current level of production or to close. These choices affect, and in turn are affected by, the market price for each product. The EIA employs standard concepts in microeconomics to model the supply of each product and the impacts of the regulation on production costs and the output decisions of facilities. The main elements are the following:

- characterize production of each product at the individual facility and market levels,
- characterize demand for each product, and
- develop the solution algorithm to determine the new post-regulatory equilibrium.

### A.1 Supply of Vegetable Oils and Related Products

Market supply of vegetable oil and related products ($Q^s$) can be expressed as the sum of domestic and foreign supply, or imports, that is,

$$Q^s = q^s + q^I \qquad \text{(A.1)}$$

where $q^s$ is the domestic supply of a particular product, which is the sum of production from solvent and mechanical extraction facilities, and $q^I$ is the foreign supply, or imports. Each of these supply components is described below.

#### *A.1.1 Solvent Extraction Facilities*

Individual supply functions were developed for each vegetable oil and related product at solvent extraction facilities. Producers of vegetable oils and related products have the ability to vary output in the face of production cost changes. Upward-sloping supply curves for vegetable oils and related products were developed to allow these facilities to respond in this manner to the imposition of regulatory costs. For this analysis, the generalized Leontief profit function was used to derive the supply curve for vegetable oils and related products at each facility. This functional form was appropriate given the fixed-proportion material input (oilseeds) and the variable-proportion inputs of chemicals, labor, electricity, and energy. By applying Hotelling's lemma to the generalized Leontief profit function, the following general form of the supply functions for each vegetable oil and related product was obtained:

$$q_j = \gamma_j + \frac{\beta}{2}\left[\frac{I_j}{p}\right]^{\frac{1}{2}} \qquad \text{(A.2)}$$

where p is the net market price for each product after subtracting the cost of the oilseed input, $I_j$ is the variable production cost variable (described below), $\gamma_j$ and $\beta$ are model parameters, and j indexes producers (i.e., individual solvent extraction facilities). The theoretical restrictions on the model parameters that ensure upward-sloping supply curves are $\gamma_j \geq 0$ and $\beta < 0$.

Figure A-1 illustrates the theoretical supply function represented by Eq. (A.2). As shown, the upward-sloping supply curve is specified over a productive range with a lower bound of zero that corresponds with a shutdown price equal to $\frac{\beta^2}{4\gamma_j^2} \cdot I_j$ and an upper bound given by the productive capacity of $q^M_j$ that is approximated by the supply parameter $\gamma_j$. The curvature of the supply function is determined by the $\beta$ parameter.

To obtain the empirical specification of Eq. (A.2), the variable production cost variable, $I_j$, was first constructed. It was calculated as a cost-share weighted index of regional- and state-level average hourly earnings ($w_j$), average fuel prices ($f_j$), and electricity prices ($e_j$).[1] The $I_j$ variable therefore varies across facilities because of all three variables (w,f,e). The cost shares used to weight the variable cost components vary by the four

[1]Chemicals are an input into vegetable oil and meal production but are not included here because they are an extremely small proportion of total production costs and because we expect little variation in costs across facilities.

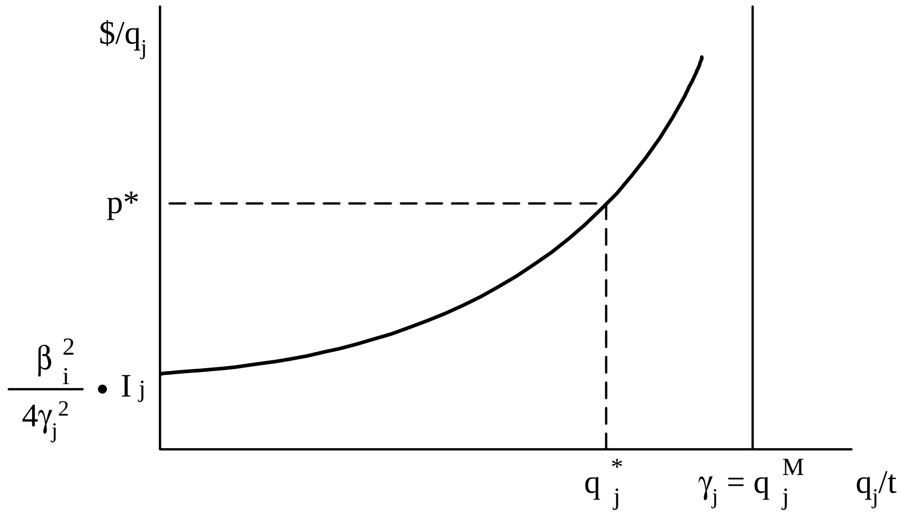



**Figure A-1. Theoretical Supply Function for Solvent Extraction Facilities**

vegetable oil product classifications—corn oil, cottonseed oil, soybean oil, and all other vegetable oils. These shares, which were computed from the U.S. Department of Commerce's *1992 Census of Manufactures*, are shown in Table A-1.

Regional- and state-level wage, fuel, and electricity variables were converted into indexes normalized to the median value of each variable. Table A-2 provides the normalized indexes used for each product by state. This conversion allows each variable to be measured in terms of a relative index for use in deriving the cost-share weighted variable production cost index. The facility-specific index was computed as follows:

$$I_j = S^L w_j + S^f f_j + S^e e_j$$

where $S^L$ is the cost share for labor, $S^f$ is the cost share for fuel, and $S^e$ is the cost share for energy used in the production of vegetable oils (from Table A-1).

Using these constructed values for $I_j$, the β parameter was computed by substituting an econometrically estimated or assumed market supply elasticity for a particular vegetable oil or related product (ξ), the average annual production level of solvent extraction facilities (q), the variable production cost index (I), and the market price of the product (p) into the following equation:

**Table A-1. Cost Shares of Variable Production Factors by Market**

| SIC | Market | Labor | Fuels | Electricity |
|---|---|---|---|---|
| 2046 | Corn oil | 36.4% | 35.8% | 27.9% |
| 2074 | Cottonseed oil | 50.7% | 13.9% | 35.3% |
| 2075 | Soybean oil | 44.3% | 33.2% | 22.5% |
| 2076 | Minor vegetable oils | 56.9% | 20.2% | 22.8% |

Sources: U.S. Department of Commerce, Bureau of the Census. 1995. *1992 Census of Manufactures, Industry Series—Fats and Oils*. MC92-1-20D. Washington, DC: Government Printing Office.

U.S. Department of Commerce, Bureau of the Census. 1995. *1992 Census of Manufactures, Industry Series—Grain Mill Products*. MC92-1-20D. Washington, DC: Government Printing Office.

$$\beta = -\xi 4 q \left[\frac{I}{p}\right]^{-\frac{1}{2}}. \qquad \text{(A.3)}$$

Baseline 1995 market prices and average annual production levels of each product were provided in Table 4-1. The β parameter for each product was then calculated by incorporating these values into Eq. (A.3).

**Supply Function Intercept.** The intercept of the supply function, $\gamma_j$, approximates the productive capacity and varies across products at each facility. This parameter does not influence the facility's production responsiveness to price changes as does the β parameter. Thus, the parameter $\gamma_j$ is used to calibrate the model so that each solvent extraction facility's supply equation is exact using the baseline production data for 1995.

**Regulatory Response.** The production decisions at solvent extraction facilities are affected by the total annual compliance costs, $c_j$, which are expressed per ton of product.[2] Each supply equation is directly affected by the regulatory control costs, which enter as a net

[2]Total annual compliance cost estimates, provided by EPA's engineering analysis, include capital costs, annual operating and maintenance costs, and applicable monitoring costs. These costs are estimated at the facility level and allocated to each product using revenue shares at each facility.

**Table A-2. Variable Cost Indexes by Region: 1995**

| State | Labor Index | Fuel Index | Electricity Index |
|---|---|---|---|
| AL | 0.79 | 0.77 | 0.93 |
| AR | 0.81 | 0.95 | 1.04 |
| AZ | 0.86 | 1.14 | 1.27 |
| CA | 1.20 | 1.03 | 1.60 |
| DE | 0.87 | 0.99 | 1.04 |
| GA | 0.90 | 1.01 | 1.03 |
| IA | 1.13 | 1.17 | 0.87 |
| IL | 1.10 | 1.21 | 1.17 |
| IN | 1.10 | 1.00 | 0.89 |
| KS | 1.03 | 1.01 | 1.11 |
| KY | 1.02 | 1.01 | 0.73 |
| LA | 0.83 | 0.85 | 0.95 |
| MD | 1.15 | 1.04 | 1.19 |
| MN | 1.05 | 1.04 | 0.99 |
| MO | 1.06 | 1.15 | 1.04 |
| MS | 0.72 | 0.92 | 1.01 |
| MT | 1.06 | 1.04 | 0.74 |
| NC | 0.87 | 0.98 | 1.11 |
| ND | 0.95 | 0.92 | 1.06 |
| NE | 0.98 | 1.16 | 0.90 |
| OH | 1.22 | 1.12 | 0.93 |
| OK | 0.79 | 0.81 | 0.92 |
| SC | 0.78 | 0.85 | 0.91 |
| TN | 1.05 | 0.90 | 1.02 |
| TX | 0.88 | 0.99 | 0.96 |
| VA | 1.04 | 0.83 | 0.94 |

Sources: U.S. Department of Labor, Bureau of Labor Statistics. BLS LABSTAT database. <http://www.bls.gov>. Data extracted on March 3, 1998.

U.S. Department of Energy, Energy Information Administration. State Energy Price and Expenditure Report 1994 [computer file]. <http://www.eia.doe.gov/emev/sep/states.html>. Last modified June 25, 1997.

price change (i.e., $p_j$ - $c_j$). Thus, the supply function for each existing facility from Eq. (A.2) becomes:

$$q_j^s = \gamma_j + \frac{\beta}{2}\left[\frac{I_j}{p_j - c_j}\right]^{\frac{1}{2}}. \tag{A.4}$$

The total annual compliance costs per ton were calculated given the annual production per facility and the regulatory cost estimates for each facility provided by the engineering analysis.

### *A.1.2 Mechanical Extraction Facilities*

Mechanical extraction facilities are not directly affected by the regulation and were modeled as a single representative supplier. Supply of vegetable oils and related products from these facilities ($q^m$) can be expressed by the following general formula for each product:

$$q^m = A^m [p]^{\xi} \tag{A.5}$$

where p is the market price for the product, $\xi$ is the domestic supply elasticity (see Appendix B), and $A^m$ is a multiplicative supply parameter that calibrates the supply equation for each product given data on price and the supply elasticity to replicate the observed 1995 level of production from these facilities.

### *A.1.3 Foreign Supply (Imports)*

Similar to mechanical extraction facilities, foreign producers are not directly affected by the regulation but are included in the model as a single representative supplier. Supply of vegetable oils and related products from foreign producers ($q^I$) can be expressed by the following general formula for each product:

$$q^I = A^I [p]^{\xi^I} \tag{A.6}$$

where p is the market price for the product, $\xi^I$ is the import supply elasticity (see Appendix B), and $A^I$ is a multiplicative supply parameter that calibrates the supply equation for each product given data on price and the foreign supply elasticity to replicate the observed 1995 level of imports.

## A.2 Demand for Vegetable Oils and Related Products

Market demand for vegetable oil and related products ($Q^d$) can be expressed as the sum of domestic and foreign demand as follows:

$$Q^d = q^d + q^x \qquad \text{(A.7)}$$

where $q^d$ is the domestic demand and $q^x$ is the foreign demand, or exports, as described below. Each of these demand components is described below.

### *A.2.1 Domestic Demand*

Domestic demand for vegetable oils and related products can be expressed by the following general formula for each product:

$$q^d = B^d [p]^{\eta^d} \qquad \text{(A.8)}$$

where p is the market price for the product, $\eta^d$ is the domestic demand elasticity (see Appendix B), and $B^d$ is a multiplicative demand parameter that calibrates the demand equation for each product given data on price and the domestic demand elasticity to replicate the observed 1995 level of domestic consumption.

### *A.2.2 Foreign Demand (Exports)*

Foreign demand, or exports, for vegetable oils and related products can be expressed by the following general formula for each product:

$$q^x = B^x [p]^{\eta^x} \qquad \text{(A.9)}$$

where p is the market price for the product, $\eta^x$ is the assumed export demand elasticity (see Appendix B), and $B^x$ is a multiplicative demand parameter that calibrates the foreign demand equation for each product given data on price and the foreign demand elasticity to replicate the observed 1995 level of exports.

## A.3 Post-Regulatory Market Equilibrium Determination

Facility responses and market adjustments can be conceptualized as an interactive feedback process. Facilities face increased production costs due to compliance, which causes facility-specific production responses (i.e., output reduction). The cumulative effect of these responses leads to an increase in the market price that all producers (affected and unaffected) and consumers face, which leads to further responses by producers (affected and unaffected) as well as consumers and thus new market prices, and so on. The new equilibrium after imposing the regulation is the result of a series of iterations between producer and consumer responses and market adjustments until a stable market price arises where total market supply equals total market demand (i.e., $Q^s = Q^d$).

This process for determining equilibrium price (and output) with the increased production cost is modeled as a Walrasian auctioneer. The auctioneer calls out a market price for each product and evaluates the reactions by all participants (producers and consumers), comparing total quantities supplied and demanded to determine the next price that will guide the market closer to equilibrium (i.e., where market supply equals market demand). Decision rules are established to ensure that the process will converge to an equilibrium, in addition to specifying the conditions for equilibrium. The result of this approach is a vector of prices with the regulation that equilibrates supply and demand for each product.

The algorithm for deriving the post-compliance equilibria in all markets can be generalized to five recursive steps:

1. Impose the control costs on each affected facility, thereby affecting their supply decisions.
2. Recalculate the market supply of each vegetable oil product.
3. Determine the new prices via the price revision rule for all product markets.
4. Recalculate the supply functions of all facilities with the new prices, resulting in a new market supply of each product. Evaluate market demand at the new prices.
5. Go to Step 3, resulting in new prices for each product. Repeat until equilibrium conditions are satisfied in all markets (i.e., the difference between supply and demand is arbitrarily small for each and every product).

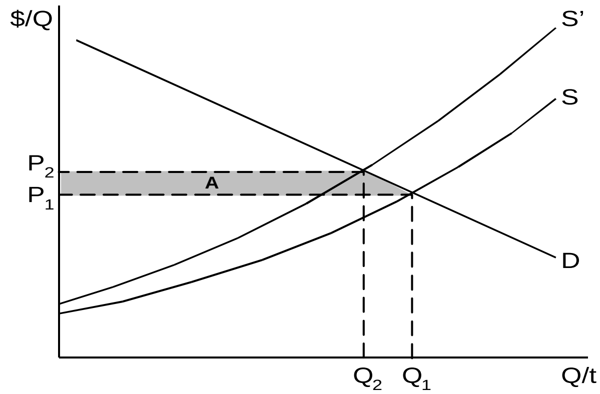
## A.4 Economic Welfare Impacts

The economic welfare implications of the market price and output changes of vegetable oils and related products with the regulations can be examined using two slightly different tactics, each giving a somewhat different insight but the same implications: changes in the net benefits of consumers and producers based on the price changes and changes in the total benefits and costs of these products based on the quantity changes. This analysis focuses on the first measure—the changes in the net benefits of consumers and producers. Figure A-2 depicts the change in economic welfare by first measuring the change in consumer surplus and then the change in producer surplus. In essence, the demand and supply curves previously used as predictive devices are now being used as a valuation tool.

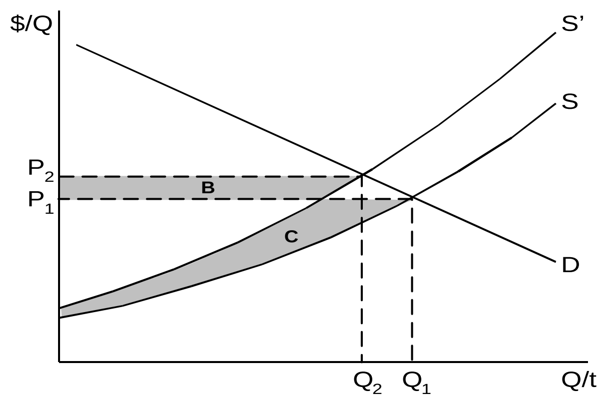
This method of estimating the change in economic welfare with the regulation divides society into consumers and producers. In a market environment, consumers and producers of the good or service derive welfare from a market transaction. The difference between the maximum price consumers are willing to pay for a good and the price they actually pay is referred to as "consumer surplus." Consumer surplus is measured as the area under the demand curve and above the price of the product. Similarly, the difference between the minimum price producers are willing to accept for a good and the price they actually receive is referred to as "producer surplus." Producer surplus is measured as the area above the supply curve and below the price of the product. These areas can be thought of as consumers' net benefits of consumption and producers' net benefits of production, respectively.

In Figure A-2, baseline equilibrium occurs at the intersection of the demand curve, D, and supply curve, S. Price is $P_1$ with quantity $Q_1$. The increased cost of production with the regulations will cause the market supply curve to shift upward to $S'$. The new equilibrium price of the product is $P_2$. With a higher price for the product there is less consumer welfare, all else being unchanged. In Figure A-2(a), area A represents the dollar value of the annual net loss in consumers' benefits with the increased price. The rectangular portion represents the loss in consumer surplus on the quantity still consumed, $Q_2$, while the triangular area represents the foregone surplus resulting from the reduced quantity consumed, $Q_1$–$Q_2$.

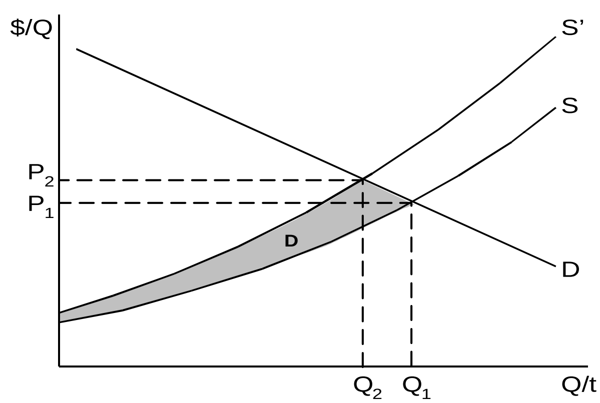
In addition to the changes in consumer welfare, there are also changes in producer welfare with the regulations. With the increase in market price, producers receive higher revenues on the quantity still purchased, $Q_2$. In Figure A-2(b), area B represents the increase in revenues due to this increase in price. The difference in the area under the supply curve up




**(a) Change in Consumer Surplus with Regulation**




**(b) Change in Producer Surplus with Regulation**




**(c) Net Change in Economic Welfare with Regulation**

**Figure A-2. Economic Welfare Changes with Regulation: Consumer and Producer Surplus**

to the original market price, area C, measures the loss in producer surplus, which includes the loss associated with the quantity no longer produced. The net change in producer welfare is represented by area B–C.

The change in economic welfare attributable to the compliance costs of the regulation is the sum of consumer and producer surplus changes, that is, – (A) + (B–C). Figure A-2(c) shows the net (negative) change in economic welfare associated with the regulation as area D. However, this analysis does not include the benefits that occur outside the market (i.e., the value of the reduced levels of air pollution with the regulation). Including this benefit may reduce the net cost of the regulation or even make it positive.

# APPENDIX B

# ESTIMATES OF THE DEMAND AND SUPPLY ELASTICITIES FOR VEGETABLE OILS AND MEALS

This appendix summarizes the demand and supply elasticities used in the economic impacts model. Because oils and meals for each of corn germ, cottonseed, soybean, and all other oilseeds combined are modeled individually, estimates of elasticities were required for each. In cases for which sufficient data were available, EPA estimated the elasticities; in other cases, the elasticities were obtained directly from the economics literature or assumed based on similar products' elasticities.

Section B.1 reviews previous elasticity estimates obtained from the economics literature. In Section B.2, the elasticity estimation procedure used by EPA is described. Section B.3 discusses the results of the estimation procedure. Finally, the elasticities used in the EIA are summarized in Section B.4.

## B.1 Review of Previous Elasticity Estimates

The economics literature provides seven sources of estimates of either the demand elasticities or the supply elasticities for particular vegetable oil or oilseed meal products. The relevant elasticity estimates from each source are summarized below in reverse chronological order.

***Ugarte (1999)***

In developing a national model of the agricultural sector, Ugarte used elasticity estimates for soybean products as inputs into the analysis. The elasticities used in his model are based on estimates in the literature. They are as follows:

- soybean meal demand –0.6
- soybean oil demand –0.1
- soybean meal export demand –0.85
- soybean oil export demand –0.75

### *Agriculture and Agri-Food Canada (1998)*

Under the direction of Professor Karl Meilke at the University of Guelph, Agriculture and Agri-Food Canada has estimated oil and meal demand elasticities for several countries. The model aggregates soybeans, canola, and sunflower into a single oilseed commodity for the purposes of the analysis. All equations were estimated by ordinary least squares. The years used in the analysis were not indicated in the report. Table B-1 provides the estimated demand elasticities for each commodity aggregate.

**Table B-1. Estimates of Oilseed Product Demand Elasticities from Agriculture and Agri-Food Canada**

| Product Aggregate | Elasticity |
|---|---|
| Oilseed oil | –0.30 |
| Oilseed meal | –0.12 |
| Oilseed oil stock | |
| Short-run | –0.80 |
| Long-run | –1.77 |
| Oilseed meal stock | |
| Short-run | –0.50 |
| Long-run | –0.50 |

Source: Agriculture and Agri-Food Canada. 1998. "An Evaluation of Oilseed Trade Liberalization." http://aceis.agr.ca/policy/epad/en...pubs/wp-tp/tms/98034tp/toc/toc.htm. September.

### *Baumel (1996)*

Baumel presents historical data on soybean processing margins and describes the impact of increasing margins on plant expansion by soybean processors. In describing the effects, he cites estimates of elasticities of demand for soymeal of –0.1 and for soybean oil of –0.26. However, he does not indicate the source for these estimates.

### *Chern, Loehman, and Yen (1995)*

The study conducted by Chern, Loehman, and Yen used annual observations for the time period 1950 to 1988 to estimate a system of demand equations for fats and oils that included variables to measure the effects of health information on consumer demand. The components of their system are butter, corn oil, cottonseed oil, lard, peanut oil, and soybean oil. Table B-2 provides the estimated demand elasticities for each; standard errors are not included because the authors did not report them.

**Table B-2. Estimates of Demand Elasticities for Fats and Oils from Chern, Loehman, and Yen Using Annual Data, 1950 to 1988**

| Product | Elasticity |
|---|---|
| Butter | –0.816 |
| Corn oil | –0.235 |
| Cottonseed oil | –0.646 |
| Lard | –0.263 |
| Peanut oil | –0.242 |
| Soybean oil | –0.292 |

Source: Chern, Wen S., Edna T. Loehman, and Steven T. Yen. 1995. "Information, Health Risk Beliefs, and the Demand for Fats and Oils." *The Review of Economics and Statistics* 77(3):555-64.

The elasticity estimates indicate that all fats and oil products are inelastic, and cottonseed oil is more elastic than corn oil, peanut oil, and soybean oil. While all of these results appear reasonable, the estimates of the cross-price elasticities and expenditure elasticities, which are not reported here, are not. For example, the expenditure elasticities for corn oil and peanut oil are negative, which would suggest that consumers reduce their purchases of these products as their income increases. Furthermore, we would expect vegetable oils to be substitutes for one another, yet cross-price elasticities suggest that many are complements (e.g., peanut oil and cottonseed oil).

***Lence, Hayes, and Meyers (1995)***

As part of a model to understand forward trading and storage of soybeans, Lence, Hayes, and Meyers estimated supply elasticities for soybean oil and meal. The data used to estimate the model are monthly observations for the period September 1965 through December 1986, and elasticities are evaluated at the sample means. The estimated supply elasticities from their "very-short-run" and "short-run" models are presented in Table B-3 along with their standard errors. In either case, the supply elasticities are very inelastic. In the “very-short-run” model, the elasticities for soybean oil and meal differ, but in the “short-run” model, they indicate the same supply price responsiveness for each. These differences likely occur because soybean meal is perishable and more costly to store than soybean oil; therefore, quantity supplied is less responsive to price changes in the very short run.

**Table B-3. Estimates of Supply Elasticities for Soybean Oil and Meal from Lence, Hayes, and Meyers Using Monthly Data, September 1965 to December 1986**

| Product | Very-Short-Run Supply Elasticity | Short-Run Supply Elasticity |
|---|---|---|
| Soybean oil | 0.42<br>(0.10) | 0.23<br>(0.09) |
| Soybean meal | 0.11<br>(0.04) | 0.23<br>(0.11) |

Note: Standard errors are indicated in parentheses.
Source: Lence, S.H., D.J. Hayes, and W.H. Meyers. 1995. “The Behavior of Forward-Looking Firms in the Very Short Run.” *American Journal of Agricultural Economics* 77(November):922-934.

### *Huang (1993)*

Huang used annual observations for the time period 1953 to 1990 to estimate elasticities for the fats and oils subgroup within a complete system of demand equations for food commodities. The components of the fats and oils subgroup were butter, margarine (which is produced using vegetable oils), and all other fats and oils. Table B-4 presents the estimated demand elasticities, standard errors, and percentages of each type in the total fats and oils consumer budget. All the elasticities indicate that demand is very inelastic for these products.

**Table B-4. Estimates of Demand Elasticities for Fats and Oils from Huang Using Annual Data, 1953 to 1990**

| Type of Product | Estimated Elasticity | Standard Error |
|---|---|---|
| Butter | –0.2428 | 0.1613 |
| Margarine | –0.0087 | 0.1470 |
| Other fats and oils | –0.1393 | 0.0650 |

Source: Huang, K.S. 1993. *U.S. Demand for Food: A Complete System of Price and Income Effects*. U.S. Department of Agriculture, Economic Research Service. Bulletin 1821.

### *Meyers et al. (1993)*

The model developed by Meyers et al. estimates supply and demand elasticities for a number of agricultural crops using annual data from 1965/1970 (the actual year depends on the crop) through 1992. They calculated elasticities at the average 1985 through 1989 prices and quantities. Among the commodities included in their analysis are soybean oil and meal. Table B-5 presents the estimated supply and demand elasticities; standard errors were not provided in the report and thus are not included here. The demand elasticities are nearly perfectly inelastic, indicating almost no change in purchases of soybean oil or meal in response to price changes. The supply elasticities are inelastic as well but larger in absolute value than the demand elasticities.

**Table B-5. Estimates of Demand and Supply Elasticities for Soybean Oil and Meal from Meyers et al. Using Annual Data, 1965/1970 to 1992**

| Product | Supply Elasticity | Demand Elasticity |
|---|---|---|
| Soybean oil | 0.660 | –0.061 |
| Soybean meal | 0.323 | –0.097 |

Source: Meyers, W.H., P. Westhoff, D.L. Stephens, B.L. Buhr, M.D. Helmar, and K.J. Stephens. January 1993. "FAPRI U.S. Agricultural Sector Elasticities Volume I: Crops." Center for Agricultural and Rural Development, Iowa State University, Ames, Iowa. Technical Report 92-TR 25.

*Yen and Chern (1992)*

The study conducted by Yen and Chern used annual observations for the time period 1950 to 1986 to estimate a system of demand equations for fats and oils using a demand system proposed by Lewbel while correcting for serial correlation of the errors. They included equations in their model for butter, coconut oil, corn oil, cottonseed oil, peanut oil, palm oil, lard, soybean oil, and tallow. Table B-6 provides the estimated demand elasticities for each; standard errors were not reported by the authors.

**Table B-6. Estimates of Demand Elasticities for Fats and Oils by Yen and Chern Using Annual Data, 1950 to 1986**

| Product | Elasticity |
|---|---|
| Butter | –0.6711 |
| Coconut oil | –0.3959 |
| Corn oil | –0.3063 |
| Cottonseed oil | –1.1185 |
| Peanut oil | –1.0145 |
| Palm oil | –1.5168 |
| Lard | –0.8620 |
| Soybean oil | –0.5523 |
| Tallow | –1.7380 |

Source: Yen, S.T., and W.S. Chern. 1992. "Flexible Demand Systems with Serially Correlated Errors: Fat and Oil Consumption in the United States." *American Journal of Agricultural Economics* 74(3):689-697.

## B.2 Overview of Elasticity Estimation Procedure

To obtain elasticity estimates, a simultaneous system of equations is required in which each equation is identified through the inclusions of exogenous variables to control for shifts in the supply and demand curves over time. A partial equilibrium market supply/demand model is specified as a system of interdependent equations in which the price and output of a product are simultaneously determined by the interaction of producers and consumers in the market. In simultaneous equation models, where variables in one equation feed back into variables in another equation, the error terms are correlated with the endogenous variables (price and output). In comparison, single-equation ordinary least squares (OLS) estimation of individual equations will lead to biased and inconsistent parameter estimates because it does not account for the correlation of the error term with the endogenous variables.

Exogenous variables influencing the demand for vegetable oils and oilseed meals include measures of general economic activity (such as U.S. gross domestic product [GDP]), population, and the prices of substitutes. Exogenous variables influencing the level of supply of vegetable oils and oilseed meals include measures of the change in the costs of production caused by changes in prices of key inputs like oilseeds, fuel, electricity, and labor.

The supply/demand system for each vegetable oil and oilseed meal at the wholesale level can be defined as follows:

$$Q_t^d = f(P_t, Z_t) + u_t \tag{B.1}$$

$$Q_t^s = g(P_t, W_t) + v_t \tag{B.2}$$

$$Q_t^d = Q_t^s \tag{B.3}$$

Eq. (B.1) shows per capita quantity demanded as a function of price, $P_t$; a vector of demand shifters, $Z_t$ (e.g., measures of economic activity and substitute prices); and an error term, $u_t$. Eq. (B.2) represents quantity supplied as a function of price and a vector of supply shifters, $W_t$ (e.g., input prices), and an error term, $v_t$, while Eq. (B.3) specifies the equilibrium condition that quantity supplied equals quantity demanded, creating a system of three equations with three endogenous variables. The interaction of the specified market forces solves this system, generating equilibrium values for the variables $P_t^*$ and $Q_t^*=Q_t^{d*}=Q_t^{s*}$.

To generate estimates separately of either the demand elasticities or the supply elasticities, the two-stage least squares (2SLS) regression procedure can also be used. The first stage of the 2SLS procedure involves regressing the observed price against the supply and demand “shifter” variables that are exogenous to the system. This first stage produces fitted (or predicted) values for the price variable that are, by definition, highly correlated with the true endogenous variable, the observed price, and uncorrelated with the error term. In the second stage, these fitted values are then employed as observations of the right-hand side price variable in the demand function. These fitted values are uncorrelated with the error term by construction and thus do not incur the endogeneity bias. By converting all variables into natural logarithms, each coefficient on the price variable yields an estimate of the constant elasticity of demand or supply for each vegetable oil or oilseed meal product. Elasticities estimated in this manner for vegetable oil and oilseed meals were used in the economic impacts model.

## B.3 Results of Elasticity Estimation

The data used in the elasticity estimation for vegetable oils and meals are annual time-series data covering the period 1984 through 1996 and were obtained primarily from USDA publications, including *Agricultural Statistics*, *Oil Crops Yearbook*, *Oil Crops Situation and Outlook*, and *Sugar and Sweetener Yearbook*.

### *B.3.1 Demand Equation Estimation*

Demand equations were estimated using a general specification where the per capita quantity consumed is expressed as a function of own-price, per capita income (for oil products but not meal products), price of the primary substitute, trend, and trend squared. Trend and trend squared were included as a general way to model the effects of changes in tastes and preferences for vegetable oils and oilseed meals. All variables were converted to natural logs, and all price and income variables were deflated by the implicit GDP deflator. The endogenous variables in the equations are per capita consumption, own-price, and the price of the primary substitute. The price of the primary substitute was included as an endogenous variable because oil products substitute readily for one another as do meal products; therefore, consumption of each is jointly determined with the price of its substitutes. The exogenous variables include per capita income, trend, and trend squared. The list of instruments includes these exogenous variables in addition to supply factors influencing the price of the product: the price of the oilseed input, wages at the three-digit SIC level, and the producer price index for fuel.

Using this model, reasonable estimates were obtained for cottonseed oil, cottonseed meal, soybean oil, and soybean meal. For corn oil, none of the regressors in the model are significant other than its price and trend. Dropping all of the other regressors in the model results in a reasonable estimate of the demand elasticity and a reasonable adjusted $R^2$. The results of these five models are provided in Table B-7.

Sufficient data were not available to estimate a demand equation for corn germ meal. Sufficient data were available to estimate demand for linseed oil, linseed meal, sunflower oil, and sunflower meal, but the data series are too volatile to obtain reasonable estimates. Thus,

## Table B-7. Results of Econometric Estimation of Oilseed Product Demand Equations

| | Corn Oil | Cottonseed Oil | Cottonseed Meal | Soybean Oil | Soybean Meal |
|---|---|---|---|---|---|
| **Dependent Variable—Regressor** | **Per Capita Corn Oil Consumption** | **Per Capita Cottonseed Oil Consumption** | **Per Capita Cottonseed Meal Consumption** | **Per Capita Soybean Oil Consumption** | **Per Capita Soybean Meal Consumption** |
| Intercept | 2.640 (4.38) | –14.249 (–1.37) | –2.682 (–0.43) | 3.927 (1.46) | 5.287 (33.95) |
| Price | –0.387 (–2.22) | –0.245 (–0.32) | –1.011 (–1.60) | –0.340 (–1.92) | –0.268 (–0.75) |
| Substitute price[a] | — | –3.635 (–1.32) | 1.517 (0.99) | 0.133 (0.19) | 0.178 (0.51) |
| Income | — | 0.537 (0.77) | — | 0.412 (2.07) | — |
| Trend | 0.016 (2.61) | 0.212 (2.80) | 0.032 (0.70) | 0.035 (1.80) | 0.021 (1.63) |
| Trend squared | — | –0.008 (–2.19) | –0.002 (–0.76) | –0.001 (–1.27) | 0.001 (0.07) |
| Adjusted $R^2$ | 0.722 | 0.7305 | 0.643 | 0.885 | 0.895 |
| Durbin-Watson | 2.753 | 2.050 | 2.527 | 2.001 | 2.282 |
| Observations | 13 | 13 | 13 | 13 | 13 |

Notes:
1. Numbers in parentheses are t-ratios (coefficient estimate divided by its standard error).
2. All variables are in natural logs.

[a] Substitute commodity prices used were as follows:
cottonseed oil equation: soybean oil
cottonseed meal equation: producer price index for animal feed
soybean oil equation: cottonseed oil
soybean meal equation: cottonseed meal

elasticities for corn germ meal and the other oilseed products were assumed based on the available estimates.

### *B.3.2 Supply Equation Estimation*

Supply equations were estimated using a general specification where quantity was expressed as a function of price, wages at the three-digit SIC level, the price of the oilseed input, and the price index for fuel. All variables were converted to natural logs, and all price variables were deflated by the implicit GDP deflator. The endogenous variables in the equations are price and quantity, and all others are assumed exogenous. The list of instruments includes these exogenous variables in addition to demand factors influencing the price of the product: income, price of substitutes, trend, and trend squared.

Reasonable estimates of the supply elasticities were not obtained and thus are not reported here. Supply of these products is most likely a more complicated process than can be represented by this simple model. In particular, inventories of products likely influence the supply response of producers. As a result, supply elasticity estimates used in the EIA were chosen based on values from the economics literature for soybean oil and meal.

## B.4 Results of Elasticity Estimation

Table B-8 summarizes the domestic demand and supply elasticities and the trade elasticities from the literature and from independent econometric estimates. In addition, the elasticities used in the EIA are indicated. Corn oil and soybean demand elasticities used in the EIA were obtained directly from the econometric estimates because they are similar to those reported in the literature. The cottonseed demand elasticity used in the EIA is the middle value of the econometrically estimated and reported values because the econometrically estimated elasticity fell outside the range of reported values. The demand elasticity for all other oils is a simple average of the three elasticities for the other oils. Cottonseed meal and soybean meal demand elasticities were obtained directly from the econometric estimates. The soybean meal estimate from the literature is similar to the econometric estimate, and no estimates for cottonseed meal were available from the literature. The demand elasticity used for corn germ meal and all other meals is a simple average of the cottonseed meal and soybean meal econometric estimates.

The supply elasticities for oils and meals are based on estimates in the literature for soybean oil and meal. For each of these products, two estimates were available; thus, the elasticities used in

## Table B-8. Summary of Elasticity Estimates for Vegetable Oils and Meals

| | Product | Literature Estimates | Econometric Estimates | Elasticity Used for the EIA |
|---|---|---|---|---|
| Demand Elasticities | Corn oil | –0.235, –0.306 | –0.387 | –0.39 |
| | Cottonseed oil | –0.646, –1.118 | –0.245 | –0.65 |
| | Soybean oil | -0.292, -0.610, -0552, -0.1[a] | –0.340 | –0.34 |
| | All other oils | –0.242 (peanut) –1.014 (peanut) | | –0.33[b] |
| | Corn germ meal | | | –0.46 |
| | Cottonseed meal | | –1.011 | –1.01 |
| | Soybean meal | –0.097, -0.6[a] | –0.268 | –0.27 |
| | All other meals | | | –0.64[c] |
| Supply Elasticities | Corn oil | | | 0.44[d] |
| | Cottonseed oil | | | 0.44[d] |
| | Soybean oil | 0.660, 0.230 | | 0.44[d] |
| | All other oils | | | 0.44[d] |
| | Corn germ meal | | | 0.28[e] |
| | Cottonseed meal | | | 0.28[e] |
| | Soybean meal | 0.323, 0.230 | | 0.28[e] |
| | All other meals | | | 0.28[e] |
| Import Supply Elasticities | All products | | | 1.00[f] |
| Export Demand Elasticities | All products | | | –1.00[f] |

[a] Value was used in a model developed by Ugarte but was not econometrically estimated.
[b] Average of corn oil, cottonseed oil, and soybean oil econometric estimates.
[c] Average of cottonseed meal and soybean meal econometric estimates.
[d] Midpoint of soybean oil supply elasticities from the literature.
[e] Midpoint of soybean meal supply elasticities from the literature.
[f] Value is assumed.

the EIA are an average of the elasticities from each source. For lack of other information, the soybean elasticities were used for the cottonseed, corn germ, and all other oils and meals as well.

In general, trade elasticities are expected to be more elastic than domestic supply and demand elasticities. Except for soybean oil and meal export demand, elasticity values are not available from either econometric estimates or the literature. For these soybean products, however, the values reported by Ugarte are assumed rather than econometrically estimated. Thus, the values of –1 and 1 are assumed for the export demand and import supply elasticities respectively for all vegetable oil and meal products.

## APPENDIX C

## ECONOMIC MODEL SENSITIVITY ANALYSIS

A sensitivity analysis was conducted to determine the effects of different demand and supply elasticity estimates under the MACT floor regulatory alternative promulgated by the EPA. This analysis assumes lost production costs. Table C-1 presents the sets of elasticities used in the analysis reported in Section 4 and for two sensitivity analyses. Sensitivity Analysis A uses the most inelastic demand elasticities and the most elastic supply elasticities from the literature (see Table B-6). These elasticities are expected to result in the greatest predicted changes in consumer and producer surplus and the greatest social costs of the regulation. Sensitivity Analysis B uses the most elastic demand elasticities and the most inelastic supply elasticities from the literature. Likewise, these elasticities are expected to result in the smallest predicted changes.

The following results are presented:

- market-level impacts of the NESHAP (Table C-2),
- industry-level impacts of the NESHAP (Table C-3),
- distribution of industry impacts of the NESHAP by profit losers and profit gainers (Table C-4),
- distribution of the social costs associated with the NESHAP (Table C-5), and
- small business impacts of the NESHAP (Table C-6).

In general, the projected effects of the regulation are not particularly sensitive to changes in the elasticity values. However, predicted price, output, trade, revenue, and consumer and producer surplus are greater under Sensitivity Analysis A relative to the base values and less under Sensitivity Analysis B.

## Table C-1. Summary of Market-Level Impacts of Vegetable Oil Production NESHAP: 1995

| | Primary | | Sensitivity Analysis A[a] | | Sensitivity Analysis B[b] | |
|---|---|---|---|---|---|---|
| | **Demand** | **Supply** | **Demand** | **Supply** | **Demand** | **Supply** |
| Oils | | | | | | |
| Corn | –0.39 | 0.44 | –0.235 | 0.66 | –0.39 | 0.23 |
| Cottonseed | –0.65 | 0.44 | –0.245 | 0.66 | –1.118 | 0.23 |
| Soybean | –0.34 | 0.44 | –2.92 | 0.66 | –0.61 | 0.23 |
| All Other | –0.46 | 0.44 | –0.257[c] | 0.66 | –1.044 | 0.23 |
| Meals | | | | | | |
| Corn Germ | –0.64[d] | 0.28 | –0.55[d] | 0.32 | –0.64[d] | 0.23 |
| Cottonseed | –1.01 | 0.28 | –1.01 | 0.32 | –1.01 | 0.23 |
| Soybean | –0.27 | 0.28 | –0.097 | 0.32 | –0.268 | 0.23 |
| All Other | –0.64[d] | 0.28 | –0.55[d] | 0.32 | –0.64[d] | 0.23 |

[a] Inelastic demand/elastic supply.
[b] Elastic demand/inelastic supply.
[c] Average of corn, cottonseed, soybean.
[d] Average of cottonseed, soybean.

## Table C-2.  Summary of Market-Level Impacts of Vegetable Oil Production NESHAP:  1995

| | | Inelastic Demand/ Elastic Supply | | Primary | | Elastic Demand/ Inelastic Supply | |
|---|---|---|---|---|---|---|---|
| | | Changes from Baseline | | | | | |
| **Scenario** | **Baseline** | **Absolute** | **Percent** | **Absolute** | **Percent** | **Absolute** | **Percent** |
| **Corn Oil** | | | | | | | |
| Market Price ($/short ton) | $532.00 | $3.40 | 0.64% | $2.53 | 0.48% | $1.65 | 0.31% |
| Market Output (tpy) | 1,126,198 | –3,705 | –0.33% | –3,280 | –0.29% | –2,141 | –0.19% |
| Domestic Production | 1,121,703 | –3,734 | –0.33% | –3,301 | –0.29% | –2,155 | –0.19% |
| Solvent Extraction | 1,066,819 | –3,965 | –0.37% | –3,416 | –0.32% | –2,194 | –0.21% |
| Mechanical Extraction | 54,884 | 232 | 0.42% | 115 | 0.21% | 39 | 0.07% |
| Exports | 415,270 | –2,640 | –0.64% | –1,966 | –0.47% | –1,282 | –0.31% |
| Imports | 4,495 | 29 | 0.64% | 21 | 0.48% | 14 | 0.31% |
| **Cottonseed Oil** | | | | | | | |
| Market Price ($/short ton) | $536.00 | $4.14 | 0.77% | $2.55 | 0.48% | $1.18 | 0.22% |
| Market Output (tpy) | 646,031 | –2,070 | –0.32% | –2,233 | –0.35% | –1,551 | –0.24% |
| Domestic Production | 645,925 | –2,071 | –0.32% | –2,234 | –0.35% | –1,552 | –0.24% |
| Solvent Extraction | 622,308 | –2,191 | –0.35% | –2,283 | –0.37% | –1,564 | –0.25% |
| Mechanical Extraction | 23,617 | 120 | 0.51% | 49 | 0.21% | 12 | 0.05% |
| Exports | 147,281 | –1,130 | –0.77% | –697 | –0.47% | –324 | –0.22% |
| Imports | 106 | 1 | 0.77% | 1 | 0.48% | 0 | 0.22% |
| **Soybean Oil** | | | | | | | |
| Market Price ($/short ton) | $536.00 | $2.29 | 0.43% | $1.84 | 0.34% | $0.94 | 0.17% |
| Market Output (tpy) | 7,981,880 | –13,370 | –0.17% | –11,867 | –0.15% | –9,285 | –0.12% |
| Domestic Production | 7,968,264 | –13,428 | –0.17% | –11,914 | –0.15% | –9,309 | –0.12% |
| Solvent Extraction | 7,968,264 | –13,428 | –0.17% | –11,914 | –0.15% | –9,309 | –0.12% |
| Mechanical Extraction | 0 | 0 | NA | 0 | NA | 0 | NA |
| Exports | 1,143,544 | –4,864 | –0.43% | –3,905 | –0.34% | –1,996 | –0.17% |
| Imports | 13,616 | 58 | 0.43% | 47 | 0.34% | 24 | 0.17% |

(continued)

Table C-2. Summary of Market-Level Impacts of Vegetable Oil Production NESHAP: 1995 (Continued)

| Scenario | Baseline | Inelastic Demand/ Elastic Supply | | Primary | | Elastic Demand/ Inelastic Supply | |
|---|---|---|---|---|---|---|---|
| | | Changes from Baseline | | | | | |
| | | Absolute | Percent | Absolute | Percent | Absolute | Percent |
| **All Other Vegetable Oils** | | | | | | | |
| Market Price ($/short ton) | $658.82 | $1.57 | 0.24% | $1.07 | 0.16% | $0.48 | 0.07% |
| Market Output (tpy) | 1,623,013 | –2,112 | –0.13% | –1,763 | –0.11% | –1,214 | –0.07% |
| Domestic Production | 1,093,411 | –3,374 | –0.31% | –2,622 | –0.24% | –1,600 | –0.15% |
| Solvent Extraction | 1,026,335 | –3,479 | –0.34% | –2,670 | –0.26% | –1,611 | –0.16% |
| Mechanical Extraction | 67,076 | 106 | 0.16% | 48 | 0.07% | 11 | 0.02% |
| Exports | 632,625 | –1,506 | –0.24% | –1,025 | –0.16% | –461 | –0.07% |
| Imports | 529,602 | 1,262 | 0.24% | 859 | 0.16% | 386 | 0.07% |
| **Corn Germ Meal** | | | | | | | |
| Market Price ($/short ton) | $88.40 | $0.36 | 0.41% | $0.30 | 0.34% | $0.26 | 0.30% |
| Market Output (tpy) | 1,473,651 | –3,447 | –0.23% | –3,304 | –0.22% | –2,868 | –0.19% |
| Domestic Production | 1,473,651 | –3,447 | –0.23% | –3,304 | –0.22% | –2,868 | –0.19% |
| Solvent Extraction | 1,401,546 | –3,542 | –0.25% | –3,373 | –0.24% | –2,918 | –0.21% |
| Mechanical Extraction | 72,105 | 95 | 0.00% | 69 | | 49 | 0.00% |
| Exports | 61,950 | –254 | –0.41% | –212 | –0.34% | –184 | –0.30% |
| Imports | 0 | 0 | NA | 0 | NA | 0 | NA |
| **Cottonseed Meal** | | | | | | | |
| Market Price ($/short ton) | $123.20 | $0.37 | 0.30% | $0.34 | 0.27% | $0.29 | 0.23% |
| Market Output (tpy) | 1,826,100 | –5,561 | –0.30% | –5,019 | –0.27% | –4,292 | –0.24% |
| Domestic Production | 1,826,100 | –5,561 | –0.30% | –5,019 | –0.27% | –4,292 | –0.24% |
| Solvent Extraction | 1,744,562 | –5,640 | –0.32% | –5,081 | –0.29% | –4,336 | –0.25% |
| Mechanical Extraction | 81,538 | 79 | 0.10% | 62 | 0.08% | 44 | 0.05% |
| Exports | 89,700 | –271 | –0.30% | –244 | –0.27% | –209 | –0.23% |
| Imports | 0 | 0 | NA | 0 | NA | 0 | NA |

(continued)

## Table C-2. Summary of Market-Level Impacts of Vegetable Oil Production NESHAP: 1995 (Continued)

| Scenario | Baseline | Inelastic Demand/ Elastic Supply | | Primary | | Elastic Demand/ Inelastic Supply | |
|---|---|---|---|---|---|---|---|
| | | Changes from Baseline | | | | | |
| | | Absolute | Percent | Absolute | Percent | Absolute | Percent |
| **Soybean Meal** | | | | | | | |
| Market Price ($/short ton) | $173.80 | $0.62 | 0.36% | $0.47 | 0.27% | $0.42 | 0.24% |
| Market Output (tpy) | 31,290,977 | –32,124 | –0.10% | –35,793 | –0.11% | –31,689 | –0.10% |
| Domestic Production | 31,225,572 | –32,359 | –0.10% | –35,970 | –0.12% | –31,846 | –0.10% |
| Solvent Extraction | 31,225,572 | –32,359 | –0.10% | –35,970 | –0.12% | –31,846 | –0.10% |
| Mechanical Extraction | 0 | 0 | NA | 0 | NA | 0 | NA |
| Exports | 6,491,570 | –23,210 | –0.36% | –17,571 | –0.27% | –15,509 | –0.24% |
| Imports | 65,405 | 235 | 0.36% | 178 | 0.27% | 157 | 0.24% |
| **All Other Vegetable Oil Meals** | | | | | | | |
| Market Price ($/short ton) | $93.22 | $0.12 | 0.13% | $0.10 | 0.10% | $0.08 | 0.09% |
| Market Output (tpy) | 2,520,129 | –1,810 | –0.07% | –1,729 | –0.07% | –1,459 | –0.06% |
| Domestic Production | 1,583,559 | –2,982 | –0.19% | –2,704 | –0.17% | –2,282 | –0.14% |
| Solvent Extraction | 1,497,886 | –3,017 | –0.20% | –2,729 | –0.18% | –2,299 | –0.15% |
| Mechanical Extraction | 85,673 | 34 | 0.04% | 25 | 0.03% | 17 | 0.02% |
| Exports | 138,469 | –173 | –0.12% | –144 | –0.10% | –122 | –0.09% |
| Imports | 936,570 | 1,172 | 0.13% | 975 | 0.10% | 823 | 0.09% |

NA = Not available.

## Table C-3. Summary of Industry-Level Impacts of Vegetable Oil Production NESHAP: 1995

| | | Inelastic Demand/ Elastic Supply | | Primary | | Elastic Demand/ Inelastic Supply | |
|---|---|---|---|---|---|---|---|
| | | Changes from Baseline | | | | | |
| Scenario | Baseline | Absolute | Percent | Absolute | Percent | Absolute | Percent |
| **Total Industry** | | | | | | | |
| Revenues ($$10^3$) | $11,963,996 | $27,959 | 0.2% | $17,728 | 0.1% | $10,048 | 0.1% |
| Costs ($$10^3$) | $10,698,845 | –$6,926 | –0.1% | –$6,394 | –0.1% | –$2,888 | –0.0% |
| Post-regulatory | $0 | $12,056 | NA | $12,076 | NA | $12,102 | NA |
| Oil and Meal Production | $10,698,845 | –$18,982 | –0.2% | –$18,470 | –0.2% | –$14,989 | –0.1% |
| Gross Profits ($$10^3$) | $1,265,151 | $34,885 | 2.8% | $24,122 | 1.7% | $12,936 | 0.8% |
| Operating Entities | | | | | | | |
| Product Line-Closures | NA | 0 | NA | 0 | NA | 0 | NA |
| Facility Closures | NA | 0 | NA | 0 | NA | 0 | NA |
| Employment Loss | NA | –15 | NA | –12 | NA | –6 | NA |
| **Solvent Extraction** | | | | | | | |
| Revenues ($$10^3$) | $11,853,542 | $27,222 | 0.2% | $17,264 | 0.1% | $9,802 | 0.1% |
| Costs ($$10^3$) | $10,611,376 | –$7,089 | –0.1% | –$6,477 | –0.1% | –$2,923 | –0.0% |
| Post-regulatory | $0 | $12,056 | NA | $12,076 | NA | $12,102 | NA |
| Production | $10,611,376 | –$19,145 | –0.2% | –$18,554 | –0.2% | –$15,025 | –0.1% |
| Gross Profits ($$10^3$) | $1,242,166 | $34,310 | 2.8% | $23,741 | 1.7% | $12,725 | 0.8% |
| Operating Entities | | | | | | | |
| Product Lines | 111 | 0 | 0.0% | 0 | 0.0% | 0 | NA |
| Facilities | 106 | 0 | 0.0% | 0 | 0.0% | 0 | NA |
| Employment | 5,673 | –15 | –0.3% | –12 | –0.2% | –6 | NA |

(continued)

## Table C-3 Summary of Industry-Level Impacts of Vegetable Oil Production NESHAP: 1995 (Continued)

| | | Inelastic Demand/ Elastic Supply | | Primary | | Elastic Demand/ Inelastic Supply | |
|---|---|---|---|---|---|---|---|
| | | Changes from Baseline | | | | | |
| **Scenario** | **Baseline** | **Absolute** | **Percent** | **Absolute** | **Percent** | **Absolute** | **Percent** |
| **Mechanical Extraction** | | | | | | | |
| Revenues ($\$10^3$) | $110,454 | $737 | 0.7% | $464 | 0.4% | $246 | 0.2% |
| Costs ($\$10^3$) | $87,469 | $162 | 0.2% | $84 | 0.1% | $36 | 0.0% |
| Post-regulatory | $0 | $0 | 0.0% | $0 | 0.0% | $0 | 0.0% |
| Production | $87,469 | $162 | 0.2% | $84 | 0.1% | $36 | 0.0% |
| Gross Profits ($\$10^3$) | $22,985 | $574 | 2.5% | $380 | 1.5% | $211 | 0.7% |
| Operating Entities | | | | | | | |
| Product Lines | NA | NA | NA | NA | NA | NA | NA |
| Facilities | NA | NA | NA | NA | NA | NA | NA |
| Employment | NA | NA | NA | NA | NA | NA | NA |

NA = Not available.

## Table C-4. Summary of Distributional Industry Impacts of the Vegetable Oil Production NESHAP: 1995

| | Floor | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Supply Elasticity | Inelastic Demand/Elastic Supply | | | Primary | | | Elastic Demand/Inelastic Supply | | |
| | Solvent Extraction Facilities | | | | | | | | |
| | With Profit Loss | With Profit Gain | Total | With Profit Loss | With Profit Gain | Total | With Profit Loss | With Profit Gain | Total |
| Number | 17 | 89 | 106 | 21 | 85 | 106 | 32 | 74 | 106 |
| Facility Capacity (tons per day) | | | | | | | | | |
| Total | 8,062 | 165,141 | 173,203 | 11,362 | 161,841 | 173,203 | 24,977 | 148,226 | 173,203 |
| Per Facility | 474 | 1,856 | 1,634 | 541 | 1,904 | 1,634 | 781 | 2,003 | 1,634 |
| Annual Solvent Loss | | | | | | | | | |
| Total ($10^3$ gallons) | 1,584 | 14,412 | 15,996 | 2,419 | 13,577 | 15,996 | 3,981 | 12,015 | 15,996 |
| Gallons per Ton of Oilseed | 0.86 | 0.29 | 0.31 | 0.84 | 0.28 | 0.31 | 0.70 | 0.27 | 0.31 |
| Incremental Compliance Costs | | | | | | | | | |
| Total (\$$10^3$/yr) | $1,867 | $10,284 | $12,151 | $2,502 | $9,649 | $12,151 | $3,808 | $8,343 | $12,151 |
| Per Ton of Oilseed | $1.01 | $0.21 | $0.24 | $0.87 | $0.20 | $0.24 | $0.67 | $0.19 | $0.24 |
| Change in Gross Profits (\$$10^3$/yr)[a] | –$1,038 | $35,349 | $34,310 | –$1,184 | $24,925 | $23,741 | –$1,473 | $14,198 | $12,725 |
| Change in Employment (FTEs)[b] | –8 | –7 | –15 | –7 | –5 | –12 | –3 | –3 | –6 |

[a] Gross profits calculated as revenue less costs of production including oilseed costs.
[b] FTEs = Full-time equivalents.

**Table C-5. Distribution of the Social Costs Associated with the Vegetable Oil Production NESHAP: 1995**

| | Floor with Lost Production Costs | | |
|---|---|---|---|
| | Inelastic Demand/Elastic Supply | Primary | Elastic Demand/Inelastic Supply |
| **Social Cost Component** | Change in Value ($\$10^3$) | | |
| Consumer Surplus | –$48,321 | –$36,929 | –$25,007 |
| Corn Oil | –$3,827 | –$2,845 | –$1,854 |
| Cottonseed Oil | –$2,673 | –$1,644 | –$763 |
| Soybean Oil | –$18,259 | –$14,649 | –$7,476 |
| All Other Vegetable Oils | –$2,548 | –$1,734 | –$779 |
| Corn Germ Feed | –$537 | –$446 | –$387 |
| Cottonseed Meal | –$680 | –$613 | –$524 |
| Soybean Meal | –$19,504 | –$14,752 | –$13,017 |
| All Other Vegetable Meals | –$294 | –$244 | –$206 |
| Producer Surplus | $35,915 | $24,846 | $13,314 |
| Domestic Producers | $34,885 | $23,122 | $12,936 |
| Solvent Extraction | $34,310 | $23,741 | $12,725 |
| Mechanical Extraction | $574 | $380 | $211 |
| Foreign Producers | $1,030 | $725 | $379 |
| Social Costs of Regulation | –$12,407 | -$12,083 | –$11,693 |

## Table C-6. Summary of Small Business Impacts of Vegetable Oil Production NESHAP: 1995

| | | Floor with Lost Production Costs | | | | | |
|---|---|---|---|---|---|---|---|
| | | Inelastic Demand/Elastic Supply | | Primary | | Elastic Demand/Inelastic Supply | |
| | | Changes from Baseline | | | | | |
| | Baseline | Absolute | Percent | Absolute | Percent | Absolute | Percent |
| Revenues ($\$10^3$) | $780,636 | -$396 | –0.1% | –$793 | –0.1% | –$739 | –0.1% |
| Costs ($\$10^3$) | $665,767 | –$1,507 | –0.2% | –$1,010 | –0.2% | –$185 | –0.1% |
| Post-regulatory | $0 | $2,126 | NA | $2,131 | NA | $2,139 | NA |
| Production | $665,767 | –$3,633 | –0.5% | –$3,141 | –0.5% | –$2,324 | –0.4% |
| Gross Profits ($\$10^3$) | $114,869 | $1,111 | 1.1% | $217 | 0.2% | –$554 | –0.4% |
| Operating Entities | | | | | | | |
| Product Lines | 21 | 0 | 0.0% | 0 | 0.0% | 0 | 0.0% |
| Facilities | 20 | 0 | 0.0% | 0 | 0.0% | 0 | 0.0% |
| Employment | NR | –7 | NR | –6 | NR | –2 | NR |

NA = Not available.
NR = Not reported to avoid disclosure of CBI.