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ECONOMIC IMPACT ANALYSIS OF THE SECONDARY LEAD SMELTERS NESHAP -- FINAL

Economic Impact Analysis of the Secondary Lead Smelters NESHAP -- Final

Emissions Standards Division

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This report is issued by the Emission Standards Division of the Office of Air Quality Planning and Standards of the Environmental Protection Agency. It presents technical data on the National Emission Standard for Hazardous Air Pollutants (NESHAP), which is of interest to a limited number of readers. It should be read in conjunction with the *Industry Profile for the Secondary Lead Smelters NESHAP* (June 1994). Both the *Economic Impact Analysis* and the *Industry Profile* are in the public docket for the NESHAP proposal. Copies of these reports and other material supporting the proposal are in Docket A-92-43 at EPA's Air and Radiation Docket and Information Center, Waterside Mall, Room M1500, Central Mall, 401 M. Street SW, Washington, D.C. 20460. The EPA may charge a reasonable fee for copying. Copies are also available through the National Technical Information Services, 5285 Port Royal Road, Springfield, Virginia 22161. Federal employees, current contractors and grantees, and non-profit organizations may obtain copies from the Library Services Office (MD-35), U.S. Environmental Protection Agency; Research Triangle Park, N.C. 27711; phone (919)541-2777.

TABLE OF CONTENTS

TABLE OF CONTENTS
(Continued)

LIST OF TABLES

LIST OF FIGURES

1.0 INTRODUCTION

1.1 SCOPE

This report evaluates the economic impacts of a proposed National Emissions Standard for Hazardous Air Pollutants (NESHAP) for secondary lead smelters. The report seeks mainly to determine a) the market response to the regulation — specifically, impacts on industry-wide output, employment, and revenue; and b) the ability of each impacted facility to absorb annual control costs and obtain financing for capital control costs.

The NESHAP applies to, and therefore the analysis in this report is conducted for, all 23 secondary lead smelters in the U.S. Fifteen of these facilities are estimated to emit more than 25 short tons (about 22.7 metric tons) per year of hazardous air pollutants (HAPs) and are therefore classified as "major sources" of HAP emissions. The other eight facilities are classified as "area sources" because they are estimated to emit fewer than 25 short tons of HAPs per year.

Five control options are evaluated. Control Option 1 consists of various Maximum Achievable Control Technology (MACT) floor requirements, as well as requirements for recordkeeping and reporting. Control Option 2 has the same requirements as Control Option 1 but goes "above" the MACT floor by requiring a temperature of 1600°F rather than 1300°F for blast-furnace afterburners. (If a facility does not operate a blast furnace, there is no difference between Control Option 1 and Control Option 2.) Control Options 3 through 5 add monitoring to the requirements of Control Option 1. Control Option 3 adds to Control Option 1 the requirement of continuous opacity monitoring (COM) for baghouses. Control Option 4 adds to Control Option 3 the requirement of continuous emissions monitoring (CEM) for total hydrocarbons (THC). Control Option 5 adds to Control Option 4 the requirement of CEM for hydrochloric acid (HCl).

Much of the information needed to perform the analysis was available from publicly available sources, including publications of the U.S. Bureau of Mines and the trade literature, particularly American Metal Market. However, as the U.S. secondary lead industry is relatively small and most of the firms are privately owned, there still were data gaps after reviewing the publicly available information. Consequently, a telephone survey was initiated. Three firms representing four facilities (two major sources, two area sources) participated in the survey. Also responding to the survey were the U.S. Bureau of Mines, a representative of an industry trade group, and a lead industry consultant/analyst.

1.2 ORGANIZATION

In Section 1.3, which follows, the findings of the economic impact analysis are summarized. Background information is provided in Section 2.0. This includes information on the impacted companies and facilities in Section 2.1 and a summary of control costs in Section 2.2. In Section 3.0, some theoretical concepts are discussed and the methodology for the analysis is laid out. The price elasticity of supply, which is needed to calculate industry-wide impacts, is estimated in Section 4.0. Economic impacts are calculated and evaluated in Section 5.0. Industry-wide impacts are addressed in Section 5.1 and per-facility impacts are addressed in Section 5.2. Impacts on small businesses are assessed in Section 5.3, as a Regulatory Flexibility Analysis is conducted. In Section 5.4, the economic impacts are summarized, industry-wide and per-facility impacts are reconciled, and implications of the impacts are discussed.

1.3 SUMMARY

Lead is an internationally traded commodity whose price is determined by global market factors. Consequently, U.S. lead producers have little control over price — they are essentially price-takers. Recognizing that if any price increase is achieved in an attempt to recover control costs, it is likely to be minimal, the economic impact analysis assumes that no price increase will be achieved and control costs will have to be absorbed. This will reduce net income in an industry that appears to be currently (December 1993) just about breaking even.

Depending on the price elasticity of supply (a measure of the responsiveness of quantity supplied to a change in price), annual industry-wide output is estimated to decline by 1,127-1,948 metric tons under Control Option 1, the least stringent control option, ranging up to 3,155-5,453 metric tons under Control Option 5, the most stringent control option. The upper end of the range under Control Option 5, 5,453 metric tons, represents only 0.61 percent of baseline production. Industry-wide employment and revenue impacts are likewise minimal.

In the per-facility analysis, four active (i.e., currently operating) major sources and one active area source are "significantly impacted" by the NESHAP. This means that, at the facility level, total annualized control costs exceed 0.25 ¢/lb and/or, at the company level, capital control costs are more than five percent of baseline total assets and post-regulation total liabilities would exceed two-thirds of baseline total assets if the capital control costs are financed with debt. Two major sources are significantly impacted under all five control options (though the impacts increase in significance as the control options become more stringent), one is significantly impacted under Control Option 2, and one is significantly impacted under Control Option 5. The area source is significantly impacted under Control Options 2, 4, and 5.

Under current market conditions in the U.S., none of these facilities are likely to close as a consequence, however. The impacts of total annualized control costs are all less than 1 ¢/lb. In comparison, the price of lead has risen by 2 or 3 ¢/lb in the past several months, and lead supplies are "tight." If price turns back down, though, a closure or two is possible. The most likely candidates for closure are the two major sources that are significantly impacted under all five control options. This is because both are very possibly "marginal" — i.e., among the industry's highest-cost producers — in the baseline. The likelihood of either facility closing of course increases as the control options become more stringent.

By making marginal facilities even more marginal, the NESHAP could also contribute to a closure or two if new secondary lead capacity comes on stream in the U.S. GNB, RSR, and Asarco have all indicated an interest in building a new secondary lead facility, though their plans are all indefinite. The replacement of relatively small facilities by larger, more efficient facilities has perhaps been the dominant trend in the U.S. secondary lead industry since the 1970s. Over 100 facilities, mostly small, have closed since 1975. If new capacity comes on stream, it is likely to be at the expense of some existing capacity. The NESHAP may influence which existing facilities are marginal and therefore most vulnerable to closure.

The NESHAP will also give all seven of the secondary lead smelters in the U.S. that are shut down (four major sources, three area sources) an additional incentive not to reopen. The incentive not to reopen is greatest for facilities that are "significantly impacted" (three under Control Option 1, three under Control Option 2, four under

Control Option 3, six under Control Option 4, and all seven under Control Option 5), and increases as the control options become more stringent.

The NESHAP impacts small companies, defined as having 500 or fewer employees, disproportionately. While the number of significantly impacted smelters owned by small companies ranges from five under Control Option 1 to 10 under Control Option 5, only one smelter owned by a company that is not small is significantly impacted (under Control Options 2, 4, and 5). Small companies are disproportionately impacted by the NESHAP for two main reasons: 1) they tend to own smaller facilities, which do not benefit from the economies of scale inherent in the control costs (i.e., per-unit control costs tend to decrease as facility size increases), and 2) they have fewer capital resources. It is also possible that, because of their greater resources, larger companies have been able to control their operations more tightly in the baseline. This would make it easier, and less costly, to comply with the NESHAP.

2.0 BACKGROUND

2.1 IMPACTED COMPANIES AND FACILITIES

The NESHAP will impact all 23 of the secondary lead facilities in the U.S. These facilities are listed in Table 1. As the table indicates, seven facilities are large, 13 are medium-sized, and three are small. Only 16 of the 23 facilities are currently active; the other seven, including all three small facilities, are presently shut down.*

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* For purposes of this analysis, a secondary lead smelter is considered "shut down" if its operating equipment has not been sold. Such a facility has the potential to restart. If a facility's operating equipment has been sold, it does not have the potential to restart and is considered "closed." Such facilities are not included in the analysis.

TABLE 1. THE U.S. SECONDARY LEAD INDUSTRY, DECEMBER 1993

Company	Facility		
	Location	Size[a]	Status
Delatte Metals, Inc.	Ponchatoula, LA	Small	Shut down
East Penn Manufacturing Co.	Lyon Station, PA	Medium	Active
Exide Corp.	Muncie, IN	Medium	Active
	Reading, PA	Medium	Active
General Smelting & Refining Co.	College Grove, TN	Medium	Active
GNB Battery Technologies[b]	Columbus, GA	Medium	Active
	Frisco, TX	Medium	Active
	Vernon, CA	Large	Active
Gopher Smelting & Refining, Inc.	Eagan, MN	Large	Active
Gulf Coast Recycling Inc.	Tampa, FL	Medium	Active
Master Metals Inc.	Cleveland, OH	Small	Shut down
PBX Inc.	Norwalk, OH	Medium	Shut down
Refined Metals Corp.	Beech Grove, IN	Medium	Shut down
	Memphis, TN	Medium	Shut down
Ross Metals, Inc.	Rossville, TN	Small	Shut down
RSR Corp.	City of Industry, CA	Large	Active
	Indianapolis, IN	Large	Active
	Middletown, NY	Large	Active
Sanders Lead Co.	Troy, AL	Large[c]	Active
Schuylkill Metals Corp.	Baton Rouge, LA	Large[d]	Active
	Forest City, MO	Medium	Active
Tejas Resources Inc.	Terrell, TX	Medium	Shut down
The Doe Run Co.	Boss, MO	Medium	Active

[a]Small = annual production capacity less than 20,000 metric tons, medium = 20,000-75,000 metric tons, large = greater than 75,000 metric tons.
[b]Before October 1993, GNB Inc.
[c]Capacity is nominally "large," but early in 1993 production was cut in half. It is not known if the cutback is temporary or permanent. (Source: American Metal Market, May 12, 1993, page 2.)
[d]Capacity is nominally "large," but in May 1993 output was cut by 23 percent. The company hoped that the cutback would be temporary. (Source: American Metal Market, May 12, 1993, page 2.)

The 23 facilities are owned by 16 firms. GNB and RSR have the most facilities — three each. GNB and Doe Run are both subsidiaries of publicly held companies. GNB's parent is Pacific Dunlop Limited, a highly diversified, multinational company with headquarters in Australia (based on the exchange rate on August 2, 1993, Pacific Dunlop's sales in the fiscal year ended June 30, 1992 translated to U.S. $4.0 billion). Doe Run is a subsidiary of Fluor Corporation (sales in the fiscal year ended October 31, 1991 were $6.7 billion), which is concentrated in engineering services, construction, and coal production more than in lead production. Fluor has declared its intent to divest Doe Run.[1] All other secondary lead smelters in the U.S. are owned by private companies. Typically these companies are closely held (e.g., by several officers).

Of the 23 total facilities, 15 are major sources of HAP emissions and eight are area sources. However, only 11 major sources and five area sources are currently active. Four major sources and three area sources are shut down.

Three firms — East Penn, Exide, and GNB — are integrated downstream into battery manufacture (i.e., their secondary lead output is captively consumed in the manufacture of batteries). This is an important variable in the U.S. secondary lead industry. Competition for spent batteries, which account for about 85 percent of all lead scrap, is intense.* The battery distribution networks of integrated producers give them an advantage in collecting spent batteries. Spent batteries can be collected at the

* Lead scrap is the most important input in secondary lead production. Some other important inputs include coke, natural gas, electricity, alloying metals such as antimony, and labor.

retail outlets (e.g., auto parts stores, car dealerships, service stations, discount stores) where new batteries are delivered. Through important accounts such as Pep Boys and Wal-Mart, GNB, for example, encourages consumers to trade in used batteries when purchasing new ones.[2] Exide recently entered into an agreement to recycle spent batteries collected by Montgomery Ward (342 stores nationwide), which is paying consumers one dollar per battery.[3]

For integrated producers, battery production and secondary lead smelting can be a "closed loop." For example, one truck can deliver new batteries to retail outlets, pick up spent batteries at these outlets (which may acquire the spent batteries either by offering consumers payment for them, or as a consequence of state laws requiring retailers to accept spent batteries from consumers when new ones are purchased), deliver the spent batteries to a secondary lead smelter, and transport lead that has been recycled at the smelter to a battery production facility.

GNB acknowledges that its integrated approach, which it calls "Total Battery Management" ("manufacturing and distribution of new lead-acid batteries, responsible collection, storage and transportation of spent batteries, safe reclamation of battery materials and use of the materials in new batteries"), gives it a "significant marketing edge."[4,5] The U.S. Bureau of Mines (BOM) offers that "the integrated producer with a retail collection system has more control over secondary scrap supply than a nonintegrated producer and is therefore better able to influence the price he pays for lead scrap feedstock."[6]

Traditionally scrap dealers/battery haulers have been the major suppliers of lead scrap to secondary lead smelters. More and more, however, battery manufacturers have been controlling the flow of lead scrap for recycling.* This applies to both integrated and nonintegrated battery manufacturers. Both have special access to spent batteries, and both, because they consume lead, have a vested interest in seeing that batteries are recycled. While integrated battery producers wish to ensure a flow of lead scrap to their own lead smelting operations, nonintegrated battery producers will direct shipments of lead scrap to independent secondary lead smelters. Often this is done under a "tolling" arrangement, whereby the provider of lead scrap (i.e., the battery producer) retains title to the lead and pays a fee to the smelter to have it processed (recycled).

An implication of the increasing dominance of battery producers in the market for spent batteries is that it is important for nonintegrated secondary lead smelters to have connections with battery producers. Otherwise the supply of lead scrap can be inadequate. RSR, in particular, is regarded to have strong connections with battery manufacturers.[7] Therefore, despite not being integrated, it is considered to be well positioned in "battery loops." The number-one secondary lead producer in the U.S., RSR buys spent batteries in all 50 states, handling about one-third of all batteries scrapped in the country.[8,9]

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* The increasing importance of battery producers and the declining importance of scrap dealers/battery haulers in the market for spent batteries has several causes, including 1) increasing aggressiveness by battery producers, 2) new state laws that encourage or require consumers to return spent batteries to retail outlets that sell new batteries, and 3) growing reluctance by scrap dealers/battery haulers to participate owing to potential Superfund liability at battery-breaking sites.

In August 1993, RSR reached an agreement to be the lead investor in the purchase of a 110,000-metric-ton-per-year secondary lead business in England and France.[10] As a result, the company will become the first to have secondary lead operations in both the U.S. and Europe.

Doe Run is unique as the only U.S. producer of both secondary lead and primary lead. Aside from Doe Run and the three producers integrated into battery manufacture, U.S. secondary lead producers are typically not significantly diversified away from secondary lead.

2.2 CONTROL COSTS

Capital control costs and total annualized control costs are presented in Tables 2 and 3, respectively. Due to confidentiality, the facility names are not disclosed. A code scheme is used instead.

Capital costs reflect the up-front costs of pollution control equipment. Total annualized cost is the sum of annual operating and maintenance (O&M) costs and annualized capital costs. Capital costs are annualized using the "capital recovery factor" based on a 7 percent discount rate and a useful life that varies depending on the type of equipment.

Industry-wide capital costs range from $1.4 million under Control Option 1 to $9.0 million under Control Option 5. Industry-wide total annualized costs range from $2.0 million under Control Option 1 to $5.4 million under Control Option 5. See Section 1.1 for a description of the control options.

3.0 THEORY AND METHODOLOGY

3.1 INDUSTRY-WIDE IMPACTS

3.1.1 Market Framework

3.1.1.1 Basic Model. Figure 1 presents a framework for understanding the U.S. lead market. The figure shows that there are three sources of supply: domestic primary

TABLE 2. CAPITAL CONTROL COSTS

Facility	Major or area source?	Control Option 1	Control Option 2	Control Option 3	Control Option 4	Control Option 5
2	M	$47,000	$610,000	$125,200	$268,800	$395,700
3	M	$54,000	$54,000	$132,200	$275,800	$402,700
4	A	$0	$0	$39,100	$182,700	$309,600
5	M	$310,000	$310,000	$349,100	$492,700	$619,600
6	A	$47,000	$610,000	$125,200	$268,800	$395,700
8	A	$0	$0	$39,100	$182,700	$309,600
9	M	$280,000	$280,000	$319,100	$462,700	$589,600
10	M	$0	$0	$78,200	$221,800	$348,700
12	A	$0	$0	$39,100	$182,700	$309,600
13	M	$110,000	$110,000	$188,200	$331,800	$458,700
14	M	$0	$0	$78,200	$221,800	$348,700
15	M	$150,000	$150,000	$189,100	$332,700	$459,600
16	M	$0	$250,000	$39,100	$182,700	$309,600
17	M	$0	$0	$39,100	$182,700	$309,600
19	M	$0	$0	$78,200	$221,800	$348,700
20	A	$0	$0	$78,200	$221,800	$348,700
22	A	$0	$0	$39,100	$182,700	$309,600
23	A	$0	$0	$78,200	$221,800	$348,700
25	M	$260,000	$260,000	$299,100	$442,700	$569,600
26	M	$54,000	$54,000	$132,200	$275,800	$402,700
27	M	$0	$360,000	$39,100	$182,700	$309,600
28	M	$54,000	$54,000	$132,200	$275,800	$402,700
29	A	$0	$0	$78,200	$221,800	$348,700
Total		$1,366,000	$3,102,000	$2,734,500	$6,037,300	$8,956,000

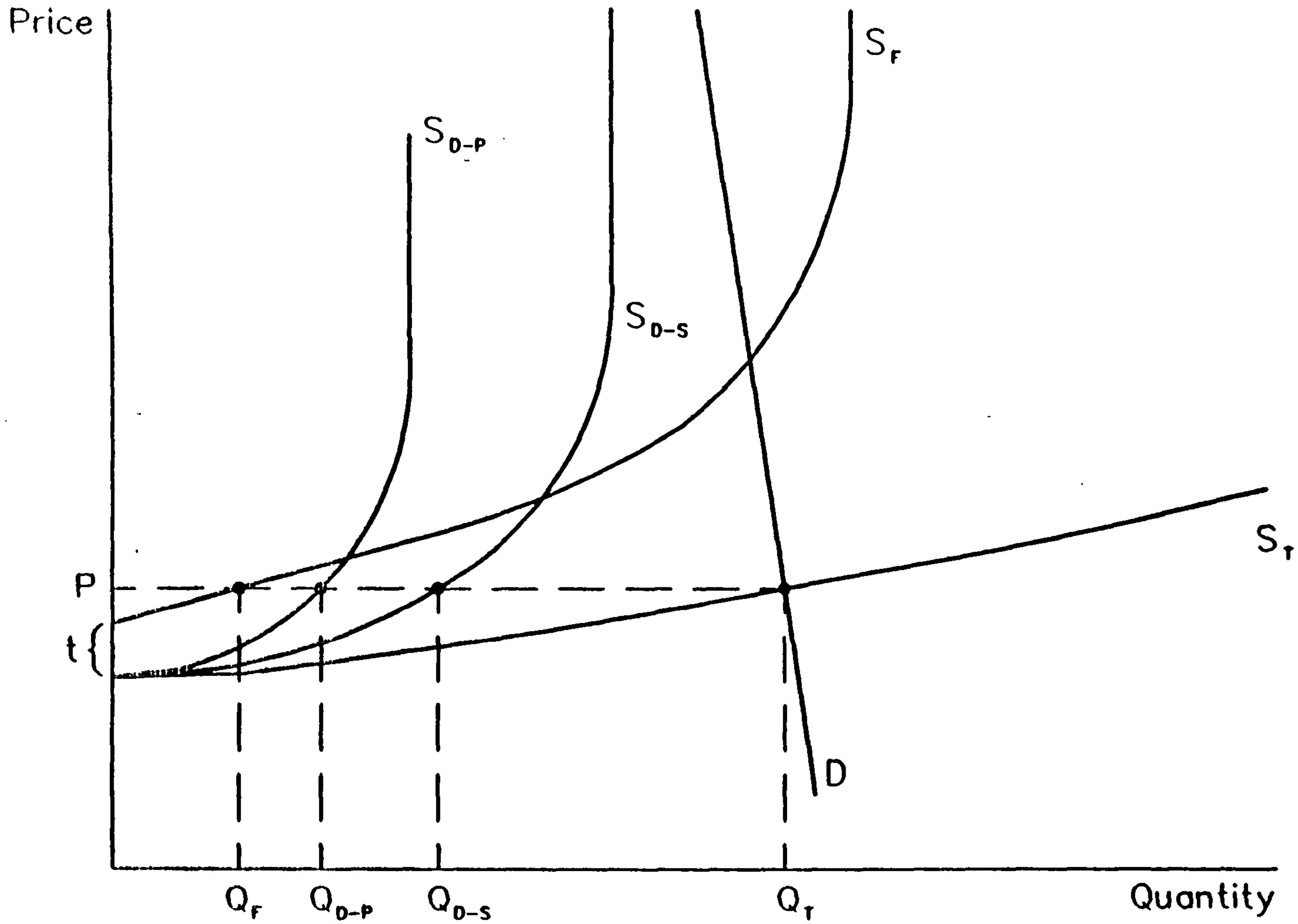
Control Option 1	MACT floor
Control Option 2	Above the MACT floor
Control Option 3	MACT floor + COM
Control Option 4	MACT floor + COM + THC CEM
Control Option 5	MACT floor + COM + THC CEM + HCl CEM

TABLE 3. TOTAL ANNUALIZED CONTROL COSTS

Facility	Major or area source?	Control Option 1	Control Option 2	Control Option 3	Control Option 4	Control Option 5
2	M	$88,000	$340,000	$121,000	$185,600	$245,900
3	M	$63,000	$63,000	$96,000	$160,600	$220,900
4	A	$56,000	$56,000	$72,500	$137,100	$197,400
5	M	$190,000	$350,000	$206,500	$271,100	$331,400
6	A	$58,000	$290,000	$91,000	$155,600	$215,900
8	A	$46,000	$46,000	$62,500	$127,100	$187,400
9	M	$220,000	$410,000	$236,500	$301,100	$361,400
10	M	$91,000	$91,000	$124,000	$188,600	$248,900
12	A	$46,000	$46,000	$62,500	$127,100	$187,400
13	M	$78,000	$78,000	$111,000	$175,600	$235,900
14	M	$90,000	$90,000	$123,000	$187,600	$247,900
15	M	$87,000	$87,000	$103,500	$168,100	$228,400
16	M	$46,000	$100,000	$62,500	$127,100	$187,400
17	M	$77,000	$77,000	$93,500	$158,100	$218,400
19	M	$46,000	$46,000	$79,000	$143,600	$203,900
20	A	$46,000	$46,000	$79,000	$143,600	$203,900
22	A	$51,000	$51,000	$67,500	$132,100	$192,400
23	A	$46,000	$46,000	$79,000	$143,600	$203,900
25	M	$230,000	$350,000	$246,500	$311,100	$371,400
26	M	$63,000	$63,000	$96,000	$160,600	$220,900
27	M	$140,000	$220,000	$156,500	$221,100	$281,400
28	M	$52,000	$52,000	$85,000	$149,600	$209,900
29	A	$46,000	$46,000	$79,000	$143,600	$203,900
Total		$1,956,000	$3,044,000	$2,533,500	$4,019,300	$5,406,200

Control Option 1 MACT floor
Control Option 2 Above the MACT floor
Control Option 3 Mact floor + COM
Control Option 4 MACT floor + COM + THC CEM
Control Option 5 MACT floor + COM + THC CEM + HCl CEM

FIGURE 1. CONCEPTUAL FRAMEWORK FOR THE U.S. LEAD MARKET



lead (S_{D-P}), domestic secondary lead (S_{D-S}), and foreign lead (S_F). All three sources of supply are shown in the figure to diminish in price elasticity (a measure of the responsiveness of quantity supplied to a change in price) and approach perfect price inelasticity as quantity increases. This is because primary lead is subject to natural-resource constraints, and secondary lead is constrained by the finite amount of recyclable lead available. Domestic secondary lead and domestic primary lead are assumed in Figure 1 to have similar fixed costs; hence, S_{D-S} and S_{D-P} start at the same point on the price axis. Foreign lead is assumed to have a transportation cost disadvantage "t."

The total supply of lead in the U.S., S_T, is derived by summing S_{D-P}, S_{D-S}, and S_F horizontally. Note that S_T is more elastic than any of its three components individually. The market clears at the intersection of S_T and demand (D). At the market-clearing price, P, quantity supplied is distributed among the three sources of supply as Q_F, Q_{D-P}, and Q_{D-S}. They add up to total quantity supplied, Q_T.

3.1.1.2 Price Elasticities of S_F and S_{D-P}. Although S_F and S_{D-P} will by necessity eventually approach the vertical, and therefore perfect price inelasticity, there is good reason to believe that they are highly elastic in their current ranges (i.e., around Q_F for S_F, and around Q_{D-P} for S_{D-P}). To begin, the U.S. Bureau of Mines indicated in the telephone survey that if, hypothetically, U.S. secondary lead producers were to attempt to increase prices by, say, ½ or 1 ¢/lb, it is a "safe assumption" that foreign lead and domestic primary lead would "flood the market."[11] Another respondent in the telephone survey, a representative of an industry trade group, said that in response to an attempt by domestic secondary lead producers to increase prices, "it is assumed that at some point lead imports would increase."[12] A

1992 study of the U.S. lead industry described the supply of foreign lead as "typically ... highly elastic because of large foreign reserves."[13]

The ready availability of foreign lead and perhaps domestic primary lead, and the substitutability of both of these sources of lead and domestic secondary lead, also point to high price elasticities for S_F and S_{D-P}. The ready availability of foreign lead is immediately suggested by the current record-high world stocks. Stocks of lead on the London Metal Exchange (LME), the world's clearing-house for lead and many other metals, stood at 262,250 metric tons on July 13, 1993, compared to, for example, 126,350 metric tons on January 2, 1992.[14,15] There is also substantial excess world capacity. Excluding the U.S., world primary lead capacity exceeded production by 1.75 million metric tons (4 million metric tons of capacity vs. 2.25 million metric tons produced) in 1989.[16] Perhaps some of the idle world capacity could be activated for export to the U.S. if prices of lead in the U.S. were to increase. (Caveat: Outside the U.S., lead is mined primarily as a byproduct of zinc or silver. Therefore, activating the idle capacity would depend greatly on the profitability of these other metals.)

Further, foreign secondary lead producers have recently become more aggressive in exporting to the U.S. In the first 11 months of 1992, U.S. imports of refined lead were 173,672 metric tons (112,800 metric tons, or 65%, of which were from Canada), compared to 116,473 metric tons in all of 1991.[17] Particular inroads were made by Mexico and Peru. From 1991 to the first 11 months of 1992, Mexico's exports to the U.S. increased from 22,614 to 51,778 metric tons, while Peru's increased from 500 to 8,997 metric tons. Mineroperu, the Peruvian mining company, has indicated its aim to increase exports to the U.S. by 20 to 30 percent in 1993.[18]

Importantly, Mexico and Peru have been able to ship to the southwestern U.S. at a premium over the LME spot price of only 2 cents per pound.[19]* In contrast, in 1993, Asarco's announced (published) premium over the LME spot price has ranged from 4.25 ¢/lb for the period January through May to 7.0 ¢/lb in November, and RSR's "four-corners" premium, based on both spot and forward LME prices, has ranged from 5.0 ¢/lb for January-May to 7.75 ¢/lb in November. (Asarco and RSR are, respectively, the top primary lead and secondary lead producers in the U.S. Their premiums are consistently published and therefore are benchmarks for the U.S. lead industry.) Clearly, lead from Mexico and Peru is very price-competitive.

Although foreign secondary lead producers are generally less efficient than U.S. producers, they tend to have lower overall costs owing to lower labor costs and less-stringent environmental regulations.[20,21] A respondent in the telephone survey gave the example that in the U.S. market, the Taiwanese are able to sell secondary lead for less than U.S. producers despite procuring spent batteries in the U.S. and shipping them back to Taiwan for processing.[22]

It should be mentioned that foreign secondary lead producers are not immune to two of the biggest current pressures on U.S. secondary lead producers: low lead prices and environmental control costs. In August 1993, Immsa, one of the two Mexican producers of refined lead (51,000 metric tons in 1992), indicated that it intends to shut down its smelting and refining operations sometime in 1994.[23,24] Low lead prices and environmental considerations were cited.

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* A "spot" price is for immediate delivery of a product. A "forward" price, in contrast, is for delivery of a product at some future date.

The company will continue to mine lead and have its concentrates tolled by the other Mexican lead smelter and refiner, Penoles, however. Also, due to low lead prices and the recent appreciation of the yen, MIM Holdings (Australia) and its Japanese partners have put on hold plans to develop in Japan a lead smelter with an annual capacity of 60,000 metric tons.[25] The smelter was originally scheduled to start up in the fall of 1995.

Lead may also be readily available from domestic primary sources. A respondent in the telephone survey said that domestic primary mines currently have excess capacity that could be activated.[26] The Missouri mines, for example, are presently significantly curtailed. In the first five months of 1993, U.S. lead mine production was down 19,000 metric tons, or 11 percent, from the same period in 1992.[27]

That S_F and S_{D-P} are highly price-elastic is also suggested by the substitutability of foreign lead, domestic primary lead, and domestic secondary lead. This is because pure lead and antimonial lead, the alloy commonly used in lead-acid batteries, are commodities. The specifications for pure lead and antimonial lead are standardized, and they can be met by any of the three sources of supply — domestic secondary, domestic primary, or foreign. Furthermore, when a customer has a special request (and there are about 300 common alloys of lead), the order can generally be filled from any of the three sources. Mexican lead, for example, is high-quality (highly refined), and good-quality lead is also available on the LME (though LME lead is usually of lower quality than U.S. and Mexican lead).[28] While not all LME lead is U.S. battery-grade, most is believed to be.[29]

Secondary lead smelters are differentiated from primary lead smelters in that they alloy with antimony much more. The secondaries do not have market power over antimonial lead, however, because the primaries are able to produce it, if requested. Moreover, the battery manufacturers can purchase pure lead and alloy it with antimony themselves, if they wish.[30]

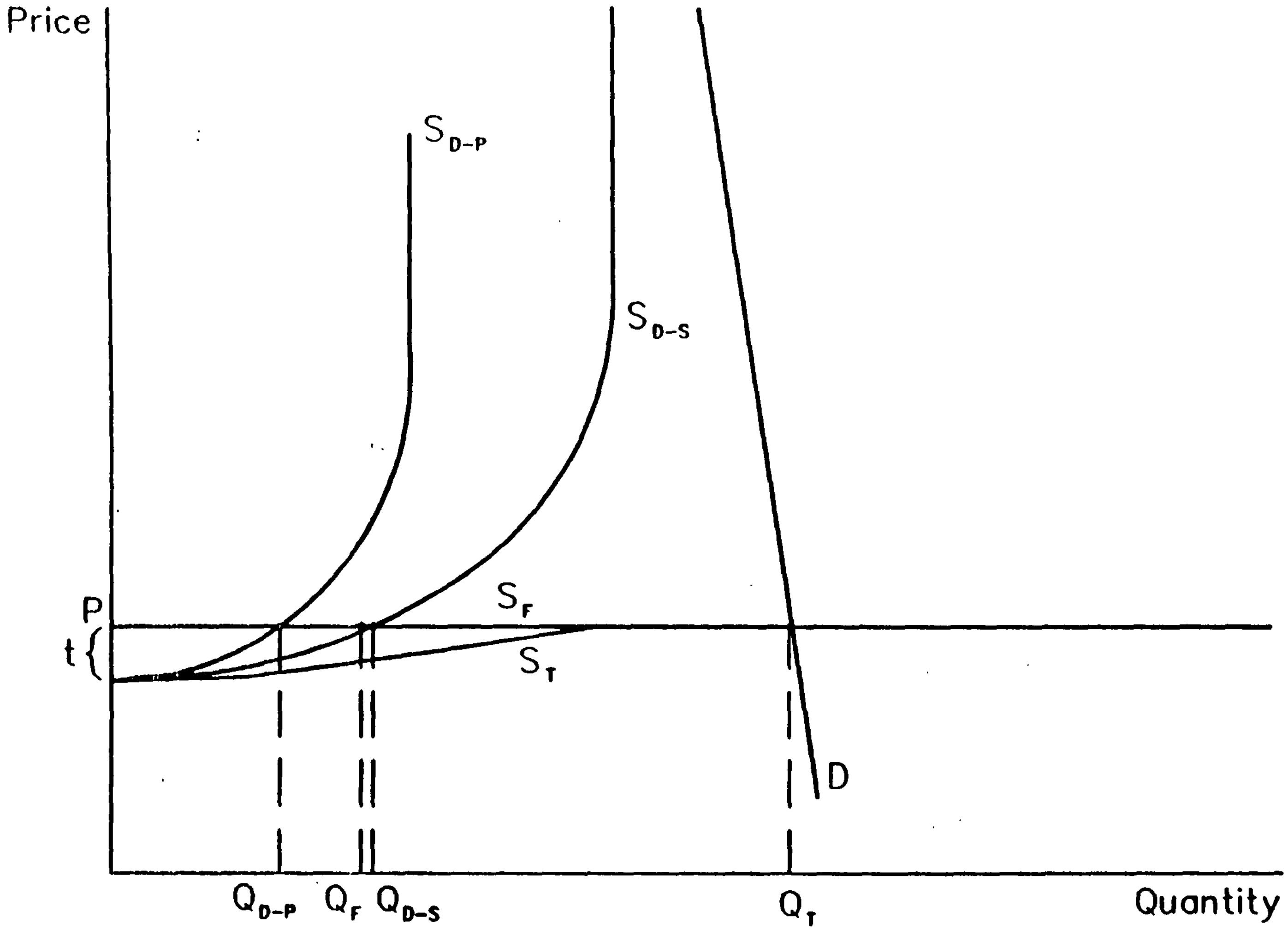
The value added by antimonial lead to pure lead is minimal. One secondary smelter's antimonial lead is typically 1¼ percent antimony in content and is not sold at a premium over pure lead.[31] Some of the smelter's antimonial lead is up to six percent antimony in content, but still is sold for only ¼-½ ¢/lb more than pure lead.

Recently, with the growth of waterless or "maintenance-free" batteries, calcium has been replacing antimony in the lead alloy used in some of the plates. However, like antimonial lead, calcium lead is basically a commodity. One secondary lead smelter responding in the telephone survey said that while calcium alloys generally add 1.5-2.5 ¢/lb to pure lead, "these are common alloys today and can hardly be classified as specialty products."[32]

Finally, the substitutability of primary and secondary lead is underscored by the fact that primary and secondary lead producers sometimes arrange to ship out of each others' stockpiles (presumably to save shipping costs).[33] (This practice is more common among secondary lead producers, though.)

3.1.1.3 Alternative Model. A highly price-elastic S_F or S_{D-P} has significant implications for the model developed in Figure 1. Figure 2 demonstrates the case of perfectly elastic S_F. Price is now constrained to the level at which foreign producers are willing to supply any quantity. Importantly, S_T is perfectly elastic after it reaches the price level. If instead of S_F, S_{D-P} had been assigned perfect elasticity in Figure 2, S_T would still have been perfectly elastic, though in this case the perfect elasticity would have begun on the price axis at the point from which S_{D-P} emanates. (Note: Because S_F is perfectly

FIGURE 2. CONCEPTUAL FRAMEWORK FOR THE U.S. LEAD MARKET, ASSUMING PERFECTLY ELASTIC FOREIGN SUPPLY (S_F)



elastic, it may not be immediately apparent, unlike in Figure 1, how Q_F is determined in Figure 2. It is determined as Q_T minus Q_{D-S} minus Q_{D-P}.)

As a rule, it takes only one perfectly elastic source of supply to impart perfect elasticity to total supply. As a corollary to this rule, it takes only one highly elastic source of supply to impart high elasticity to total supply. Therefore, if either S_F or S_{D-P} is highly elastic, S_T is highly elastic.

The different implications of the models in Figure 1 and Figure 2 for the impacts of the NESHAP on the U.S. lead market will be seen in Section 3.1.3.

3.1.2 Price Elasticity of Demand

The demand for lead in the U.S. was shown in Figures 1 and 2 to be fairly steeply sloped, reflecting that it is relatively price-inelastic. The price elasticity of demand indicates the responsiveness of quantity demanded to a change in price. It is measured as the percent change in quantity demanded divided by the percent change in price. Demand is relatively price-inelastic — the case for lead — when the absolute value of the percent change in quantity demanded is less than the absolute value of the percent change in price. This is reflected in an elasticity measurement between zero and -1.0.

In a study in the early 1980s, the price elasticity of U.S. demand for lead in storage batteries, which currently account for about 80 percent of U.S. secondary lead consumption, was estimated at -0.23.[34] This represents high inelasticity. The U.S. demand for lead is highly inelastic for three main reasons. First, there are few substitutes for lead, in part because many nonessential uses of lead have been weeded out by regulations in recent years. In addition, there are presently no commercially successful substitutes for lead-acid storage batteries. Alternative materials to lead have proven to be more costly and to have less-favorable recycling economics. Secondly, demand for lead's primary end use, storage batteries, is highly inelastic, largely because storage batteries comprise a very small portion of total cost in their applications (e.g., the cost of an automotive battery is a small fraction of the total cost of owning and operating an automobile). Thirdly, many battery manufacturers need not be particularly sensitive to the price of lead because they have sales contracts allowing pass-alongs on their lead costs.[35]

3.1.3 Market Response

The effects on the U.S. lead market of the NESHAP's control costs, which cause domestic secondary supply, S_{D-S}, to shift up and to the left, are shown in Figure 3 for the model introduced in Figure 1 and in Figure 4 for the model introduced in Figure 2. The shift in S_{D-S} to S_{D-S}' is the same in Figure 3 and Figure 4. The vertical distance between S_{D-S}' and S_{D-S} represents average unit control costs for U.S. secondary lead smelters. It is assumed that unit control costs are constant over all output levels. Hence the vertical shift in S_{D-S} to S_{D-S}' is uniform, i.e., the vertical distance between S_{D-S} and S_{D-S}' is constant over all output levels.

In Figure 3, because S_{D-P} and S_F are unchanged, the shift in S_T (to S_T') is less pronounced than the shift in S_{D-S} to S_{D-S}'. (S_T' equals the horizontal sum of S_{D-P}, S_{D-S}', and S_F.) Consequently, the increase in price, from P to P', falls short of unit control costs. Due to the relatively small price increase, the decrease in total quantity supplied (and quantity demanded), from Q_T to Q_T', is muted. The output mix changes significantly, however. While Q_{D-S} decreases appreciably to Q_{D-S}', Q_{D-P} and Q_F gain in the market. As long as S_{D-P} and S_F are not perfectly inelastic, the contributions of Q_{D-P} and Q_F to total quantity supplied will

FIGURE 3. THE EFFECTS ON THE U.S. LEAD MARKET OF CONTROL COSTS ON SECONDARY LEAD PRODUCERS

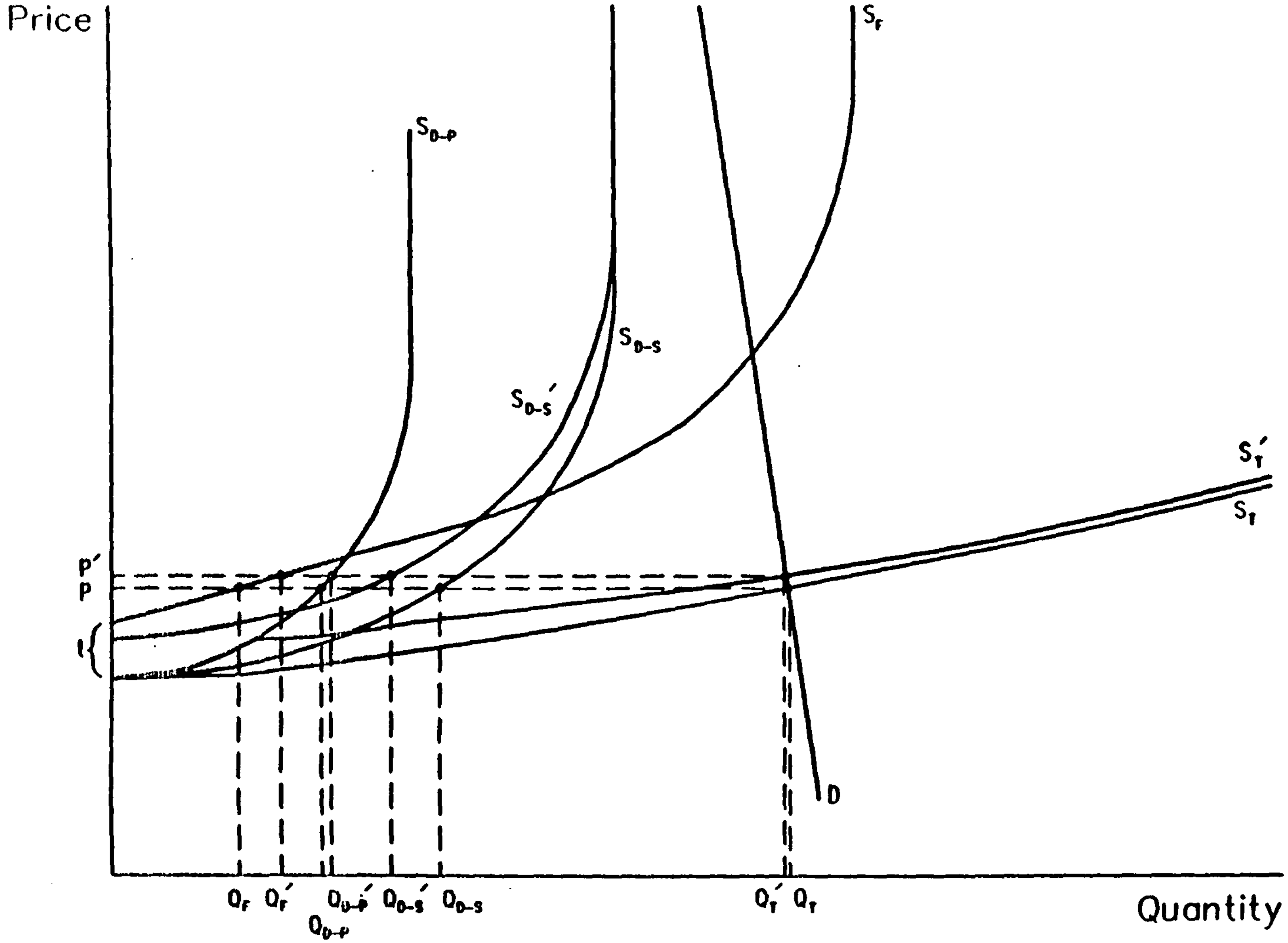
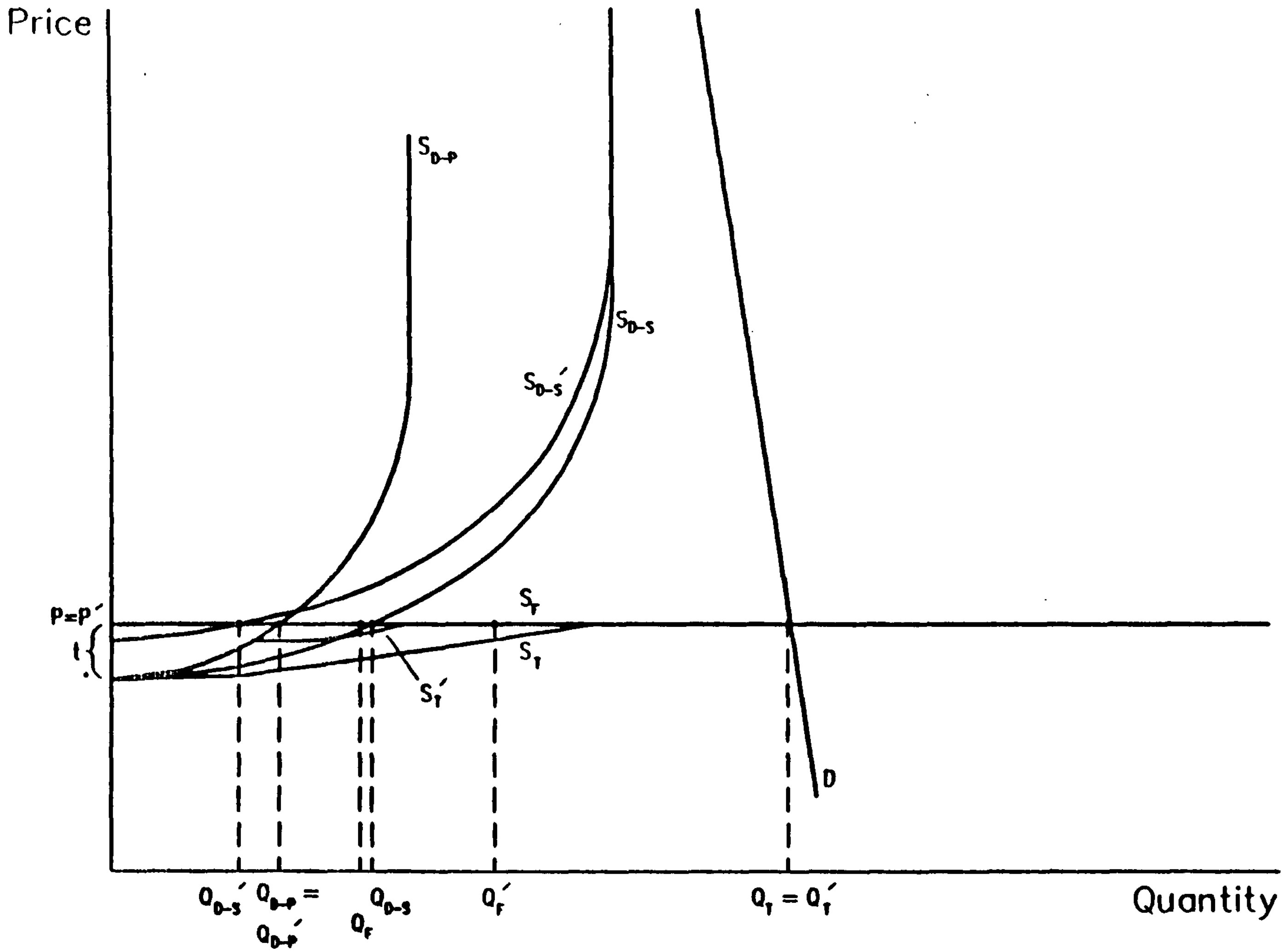


FIGURE 4. THE EFFECTS ON THE U.S. LEAD MARKET OF CONTROL COSTS ON SECONDARY LEAD PRODUCERS, ASSUMING PERFECTLY ELASTIC FOREIGN SUPPLY (S_F)



increase in response to the regulation, and $Q_{D\text{-}S}$ will decrease by more than the decrease in total quantity supplied (Q_T minus Q_T').

In Figure 4, as a result of the shift in $S_{D\text{-}S}$ to $S_{D\text{-}S}'$, S_T shifts to S_T', but this has no effect on S_T beyond the point at which it reaches the price level P. Beyond this point, S_T remains perfectly elastic. As a result, there is no change in price ($P' = P$), and control costs must be fully absorbed by secondary lead producers. With no upward shift in S_T where it intersects demand, there is also no change in total quantity supplied (and quantity demanded). However, the redistributive effects are greater than in Figure 3. Although $Q_{D\text{-}P}$ does not change (because there is no change in price), $Q_{D\text{-}S}$ falls by more and Q_F increases by more than in Figure 3.

While in Figure 3 the price effect is muted, in Figure 4 there is no price effect at all. The weight of anecdotal evidence, both from responses to the telephone survey and from the trade literature, suggests that if any price increase is achieved, it will be minimal. It is even very possible that no price increase will take place. U.S. lead producers have little control over price. Lead is an internationally traded commodity whose price is determined by global supply and demand, which are mostly external to the U.S. In 1990, for example, U.S. supply of refined lead, both primary and secondary, was about 22 percent of global supply, while U.S. demand was about 22 percent, as well, of global demand.[36] In this global context, the lead market is highly competitive. U.S. producers act as price-takers, constrained to set prices that do not exceed the price of lead in Europe (the LME price) plus the cost of moving lead from Europe to the U.S. (the basis for the U.S. producer premiums over the LME price).

Neither the LME price nor the U.S. producer premiums, the constituents of P (and P′) in Figure 4, are likely to be significantly impacted by the NESHAP. The LME price is not likely to be significantly affected because it is influenced by lead supplies from all over the world, of which U.S. secondary lead is only one component (15.5% in 1990). The U.S. producer premiums — which reflect withdrawal fees from LME warehouses in Europe, ocean freight from Europe to the U.S., the cost of insurance, tariffs, the cost of delivery in the U.S., and a small "grade premium" to ensure that LME lead is U.S. battery-grade — are not likely to budge because none of their determinants will be affected by the regulation.[37] The premiums are not arbitrary; rather, they are disciplined by arbitrage in a competitive market. If U.S. producers were to attempt to increase their premiums, lead traders could make a profit by arranging to have lead delivered to U.S. buyers from LME stocks in Europe. Mexican lead — which has been selling in the U.S. for only 2-3 ¢/lb above the LME price — might also be available.[38] It is telling that if foreign lead can be delivered in the U.S. more cheaply than domestic lead, U.S. producers are willing to purchase it and sell it at a profit, even if this cannibalizes their own production.[39]

Finally, Asarco, a primary lead producer, is considered to be the U.S. price leader (i.e., it takes the lead in establishing a premium over the LME price).[40] This suggests further that U.S. secondary lead producers would not be able to increase their premiums, as primary lead is not subject to the NESHAP.

It can be concluded that S_F and/or S_{D-P} are sufficiently elastic that if U.S. secondary lead producers can achieve a price increase, it will be negligible. Therefore, Figure 4, which posits no price increase, will be the model for assessing industry-wide impacts. At a minimum, this will result in conservative (worst-case) output and employment impacts. However, the impact calculations are liable to also be more accurate than calculations based on some kind of price increase.

3.1.4 Methodology

The most important consequence of the model in Figure 4 is that there is no price increase in the U.S. lead market. So, no "market price increase" is estimated in the economic impact analysis.* A second important consequence is that there is no change in total supply in the U.S. lead market. This is because S_T does not shift up at the point where it intersects demand (D). Because, as a result, no change in quantity demanded — dictated by the price elasticity of demand — is traced along D, the price elasticity of demand has no influence on Q_T or on the changes in any of the components of Q_T, such as Q_{D-S}.

Instead, the change in U.S. secondary lead output, from Q_{D-S} to Q_{D-S}' in Figure 4, is a function of the magnitude of control costs and the price elasticity of supply. The magnitude of control costs is reflected in the magnitude of the shift in S_{D-S} to S_{D-S}', while the price elasticity of supply is reflected in the slope of S_{D-S} (and S_{D-S}'). Accordingly, using regression analysis, the price elasticity of supply is estimated in Section 4.0. Then, in Section 5.1, after calculating the shift in S_{D-S} to S_{D-S}', the industry-wide change in output is estimated. Impacts on industry-wide employment and revenue are in turn estimated from the change in output.

* The "market price increase," defined as the average industry-wide price increase, is typically estimated in analyses of the economic impacts of regulations.

3.2 PER-FACILITY IMPACTS

Without a price increase, control costs cannot be passed along to customers. Furthermore, there is limited downward flexibility in the cost of lead scrap. This makes it uncertain that control costs can be passed back to scrap suppliers. Therefore, it is assumed that control costs will have to be absorbed. A calculation of the resultant percent reduction in net income is not meaningful because the U.S. secondary lead industry appears to be currently (December 1993) only just about breaking even. (Earlier in 1993, when the price of lead was lower, the industry was probably losing money.) Instead, in Section 5.2.2.2, for all 23 secondary lead facilities in the U.S., the per-pound impact of total annualized control costs is calculated. This represents the amount per pound by which net income will decline as a result of the NESHAP. The possibility that any facility may not be able to sustain the impact and therefore is at risk of closure is evaluated. Although discussed, the impacts calculated in Section 5.2.2.2 are not disclosed so that the facility identities are not revealed. This is necessary to protect confidentiality.

In Section 5.2.3, for all companies that own one or more of the 23 secondary lead facilities in the U.S., the availability of capital to finance capital control costs is assessed by calculating the ratio of capital control costs to baseline total assets and by comparing post-NESHAP total liabilities — assuming debt is issued to finance capital control costs — to baseline total assets. The possibility that any company may not be able to obtain capital and therefore one or more of its facilities is at risk of closure is evaluated. Again, the calculations are not disclosed to protect confidentiality.

4.0 ESTIMATION OF THE PRICE ELASTICITY OF SUPPLY

The price elasticity of supply (ϵ) indicates the responsiveness along a supply curve of quantity supplied to a change in price. It is measured as the percent change in quantity supplied divided by the percent change in price. For a normal upward-sloped supply curve, there is a positive relationship between the change in quantity supplied and the change in price, and $\epsilon \geq 0$. If $\epsilon < 1$, supply is considered to be relatively price-inelastic. Conversely, supply is relatively price-elastic if $\epsilon > 1$.

As was seen in Figure 4, the impact of the NESHAP on U.S. secondary lead output (Q_{D-S}) is determined by the change in the point at which the shifting industry supply curve (S_{D-S}) intersects the unchanged price level. The extent to which Q_{D-S} declines will depend both on the magnitude of control costs and on ϵ. The magnitude of control costs is reflected in the magnitude of the shift in S_{D-S} to S_{D-S}', while ϵ is reflected in the slope of S_{D-S} (and S_{D-S}'). The greater are control costs (i.e., the greater is the shift in S_{D-S}), and the more S_{D-S} is price-elastic (i.e., the lower the slope of S_{D-S}), the greater will be the decline in Q_{D-S}.

The price elasticity of supply is therefore a necessary input for determining the impact of the NESHAP on Q_{D-S} (and, in turn, industry-wide employment and revenue). There is no known estimate, such as in the economics literature, of ϵ for the U.S. secondary lead industry. However, ϵ can be estimated by regressing the natural log of price, as an independent variable, against the natural log of quantity supplied (output), as the dependent variable. The price elasticity of supply is represented in this framework by the coefficient obtained for the natural log of price.

There are of course factors other than price that influence supply. For example, technology and the costs of inputs (e.g., labor, raw materials, energy, capital) influence the willingness and/or ability of firms to produce. The supply curve is normally presented as the relationship between price and quantity supplied. A change in price therefore results in a movement along the supply curve. Changes in other factors such as technology and the costs of inputs, on the other hand, result in a shift in the supply curve.

In determining the influence of price on quantity supplied, and in turn estimating ϵ, it is important to control for the other factors that significantly influence quantity supplied. Otherwise the influence of price and the estimate for ϵ may be distorted.

The regression model used to estimate ϵ is specified in Table 4. In addition to the price of lead, four other independent variables — the cost of lead scrap, the producer price index (PPI) for secondary nonferrous metals, a dummy variable indicating whether or not state battery recycling laws were in place, and a time trend — were included for their influence on U.S. secondary lead production, the dependent variable. The variables were entered in the regression as a time series from 1970 to 1991. The values of the variables are given in Appendix A.

Normally, price is determined by the interaction of supply and demand and therefore a two-stage regression is required to estimate the supply function. In the case of secondary lead, however, U.S. supply has minimal influence on price. This is because the market for lead is global, and global supply and demand dictate price. For example, even though total U.S. output of refined lead fell by about 36,000 metric tons in 1992 (primary lead output was off about 41,000 metric tons from 1991 while secondary lead output increased by about 5,000 metric tons) in the face of relatively stagnant U.S. demand, the price of lead plummeted largely due to heavy shipments from the former East Bloc and weak worldwide demand, especially in Europe.[41] This means

TABLE 4. REGRESSION MODEL

Variable[a]	Variable description	Source	Expected sign of the coefficient ("+" or "-")
Dependent variable:			
Secondary lead production	Natural log of U.S. secondary lead production, in metric tons.	U.S. Department of the Interior, Bureau of Mines	N.A.
Independent variables:			
Price of lead	Natural log of the real spot price of lead, in ¢/lb, on the London Metal Exchange (LME).	U.S. Department of the Interior, Bureau of Mines	+
Cost of lead scrap	Natural log of the real dealer's buying price, in ¢/lb, for heavy soft scrap lead.[b]	"Metal Statistics" (annual), Diversified Publishing Group, New York, NY	-
PPI for secondary nonferrous metals	Natural log of the real producer price index (PPI) for secondary nonferrous metals.	U.S. Department of Labor, Bureau of Labor Statistics	-

TABLE 4. (CONTINUED)

Variable[a]	Variable description	Source	Expected sign of the coefficient ("+" or "-")
State battery recycling laws	Dummy variable indicating whether or not state battery recycling laws are in place (no = 0, yes = 1).	Battery Council International, Chicago, IL	+
Time trend	Series of increasing integers representing the passage of time (1970 = 1, 1971 = 2, ... 1991 = 22).		?

[a]See Appendix A for values.
[b]New York prices 1970-1986, Chicago prices 1987-1991. Chicago prices adjusted to New York basis based on the relationship between the two bases in 1986, the year in which the two series overlap.

N.A. Not applicable.

Note: All "real" variables are adjusted to 1982 dollars using the producer price index for finished goods. Source: U.S. Department of Commerce, Bureau of the Census, "Statistical Abstract of the United States 1992."

that the price of lead in the U.S. is determined exogenously, not by the interaction of domestic supply and demand, and the U.S. secondary lead industry (not just the individual producers) can be modeled as facing perfectly elastic demand. As a result, it is possible to estimate U.S. secondary lead supply, S_{D-S}, with a one-stage regression.

4.1 INDEPENDENT VARIABLES

The price of lead is represented in the model by the spot price on the LME. This is more appropriate than the U.S. quoted price (e.g., "North American Producer Price") because the actual transaction price in the U.S. is closely linked to the LME price, differing only by the relatively constant cost of transporting lead from Europe to the U.S. The U.S. quoted price, on the other hand, is a list price off of which varying discounts are allowed. The relationship between the price of lead and U.S. secondary lead production (i.e., the sign of the coefficient for the price of lead) was, of course, expected to be positive, in accordance with an upward-sloped supply curve.

The cost of lead scrap, on the other hand, was expected to have a negative effect on U.S. secondary lead production. The higher the cost of a factor input, the less the willingness to produce, ceteris paribus. This is manifested in a shift in the supply curve to the left when the cost of a factor input increases, and a shift to the right when the cost of a factor input decreases. However, it was recognized that this relationship is liable to be obscured in the regression model. While the cost of lead scrap can have an independent <u>negative</u> influence on secondary lead production, secondary lead production can have an independent <u>positive</u> influence on the cost of lead scrap. For example, if production increases independently, say because demand increases or the cost of energy decreases, the price of lead scrap, the supply of which is limited, is likely to be bid up. This applies to the market for lead scrap because no industry, other than perhaps the disposal industry, competes with the secondary lead industry for lead scrap. As a result, the secondary lead industry has significant buying power over lead scrap. This would not apply to an input such as unskilled labor, for which all industries compete.

The PPI for secondary nonferrous metals was included to capture the costs of factor inputs other than scrap. Because, in the long run at least, cost changes tend to be reflected in price changes, it was reasoned that the PPI is correlated with the generic costs, such as the costs of labor and energy, incurred by all secondary nonferrous metal producers, including secondary lead producers. As a representative of the costs of factor inputs, the PPI was expected to be negatively correlated with secondary lead production. Separate independent variables representing the costs of labor, natural gas, and electricity were tried in the regression equation. Although collectively they had more explanatory power (higher R-squared) than the PPI, they were not used because in most of the runs, the coefficients for two of the three variables had the unexpected (and presumably wrong) sign.

Since 1989, states have been active in passing laws promoting lead-acid battery recycling. These laws typically include "take-back provisions" that require retailers to accept spent batteries from consumers, and battery manufacturers to accept spent batteries from retailers, when new batteries are purchased.[42] This has no doubt positively influenced the battery recycling rate and therefore secondary lead production. Nine states were first to enact battery recycling laws in 1989; by the end of 1992, 37 had done so.[43] In order to account for this development, a dummy variable indicating whether or not battery recycling laws were in place was used in the regression equation. The variable's value is zero for all years prior to 1989, and one for 1989-1991. The expected correlation with secondary lead production was positive.

The final independent variable is a time trend. It runs in increments of one, from one to 22, for the period 1970-1991. This variable was included to capture in particular the cumulative effects of two forces: regulatory (e.g., environmental, safety and health) compliance costs and technological improvements. While regulatory compliance costs shift the supply curve to the left and therefore tend to have a negative effect on output, technological improvements shift the supply curve to the right and therefore tend to have a positive effect on output. Since it is not known which of these forces has been stronger in the past two decades, it was not known what sign to expect for the time trend variable.

4.2 REGRESSION RESULTS

The key results of the regression analysis are summarized in Table 5. In the first run, supply is estimated to be very price-inelastic, as ϵ is only 0.143. However, this estimate cannot be taken with much confidence because its T-statistic is only 0.571. There is also a potential autocorrelation problem as the Durbin-Watson statistic is only 0.662. (Autocorrelation is indicated by a Durbin-Watson statistic less than 2.) Note, though, that all independent variables have the expected sign.

The second run yields improvements. The price elasticity of supply is now 0.548 and is significant at the 99 percent confidence level (T-statistic = 2.941). The predictive power of the model improves as the adjusted R-squared increases to 0.722. The Durbin-Watson statistic also improves, though 0.922 may still indicate an autocorrelation problem. The time trend has turned out to

TABLE 5. RESULTS OF THE REGRESSION ANALYSIS

	Independent variable coefficients (T-statistics in parentheses)								
	Price of lead	Cost of lead scrap	PPI for secondary nonferrous metals	State battery recycling laws	Time trend	Durbin-Watson statistic	Adjusted R-squared	F-statistic	Mean square error
Run 1	0.143 (0.571)	0.134 (0.800)	-0.388 (-1.029)	0.387 (4.866)		0.662	0.569	7.941	0.013
Run 2	0.548 (2.941)	-0.078 (-0.626)	-0.294 (-0.968)		0.025 (6.781)	0.922	0.722	14.626	0.008
Run 3	0.317 (1.948)	0.061 (0.566)	-0.237 (-0.981)	0.206 (3.336)	0.018 (5.100)	0.964	0.826	20.901	0.005

be significant (T-statistic = 6.781) and the coefficient is positive. This suggests that technological improvements (including the replacement of old plants with new ones) have compensated for regulatory compliance costs over the past two decades. This was perhaps suggested when a respondent in the telephone survey said that recent process changes, including the installation of environmental controls, have improved its efficiency.[44] Note that the sign for the cost of lead scrap has changed. This probably reflects, as discussed earlier, the reverse positive effect of secondary lead production on the cost of lead scrap.

The third run includes the dummy variable for state battery recycling laws and the time trend together, and both are significant. The price elasticity of supply, 0.317, is still significant, now at the 93 percent confidence level. The explanatory power of the model is good, as the adjusted R-squared is 0.826.

The price elasticities of supply obtained in the second and third runs are both considered to be reasonable. Their indication of relative inelasticity is consistent with the observation that industry supply has been less variable than price over the past two decades (though at the facility level supply has been volatile as, for example, many small facilities have shut down to be replaced by larger facilities). Both of these estimates for ϵ will be used in Section 5.1 to calculate industry-wide impacts. This will not only result in a range of industry-wide impacts, but will also allow for the sensitivity of the impacts to a change in ϵ to be tested. The price elasticity of supply of 0.548 will yield larger impacts than the price elasticity of supply of 0.317.

5.0 ECONOMIC IMPACTS

5.1 INDUSTRY-WIDE

As discussed in Section 3.1.4, industry-wide impacts are calculated assuming that the NESHAP does not have an effect on the price of lead. Figure 5 shows that, as a result, the change in U.S. secondary lead output, from Q_1 to Q_2, is equal to the horizontal shift in the industry supply curve, S_{D-S}, to S_{D-S}', represented at the unchanged price level $P_1 = P_2$ as $\overline{AB}$. The horizontal shift in S_{D-S} in turn depends on 1) the magnitude of control costs, which is reflected in the vertical shift in S_{D-S}, and 2) the price elasticity of supply (ϵ), which is related to the slope of S_{D-S} (and S_{D-S}'). (Note: S_{D-S} and S_{D-S}' are shown for simplicity to be linear. In reality, if they are constant-elasticity functions and $\epsilon < 1$, they will be concave-upward.)

$\overline{AB}$, or the change in Q, can be represented by the horizontal displacement between A and C, the point directly below B on S_{D-S}. Recall from Section 4.0 that ϵ is measured for a supply curve as the percent change in quantity supplied divided by the percent change in price:

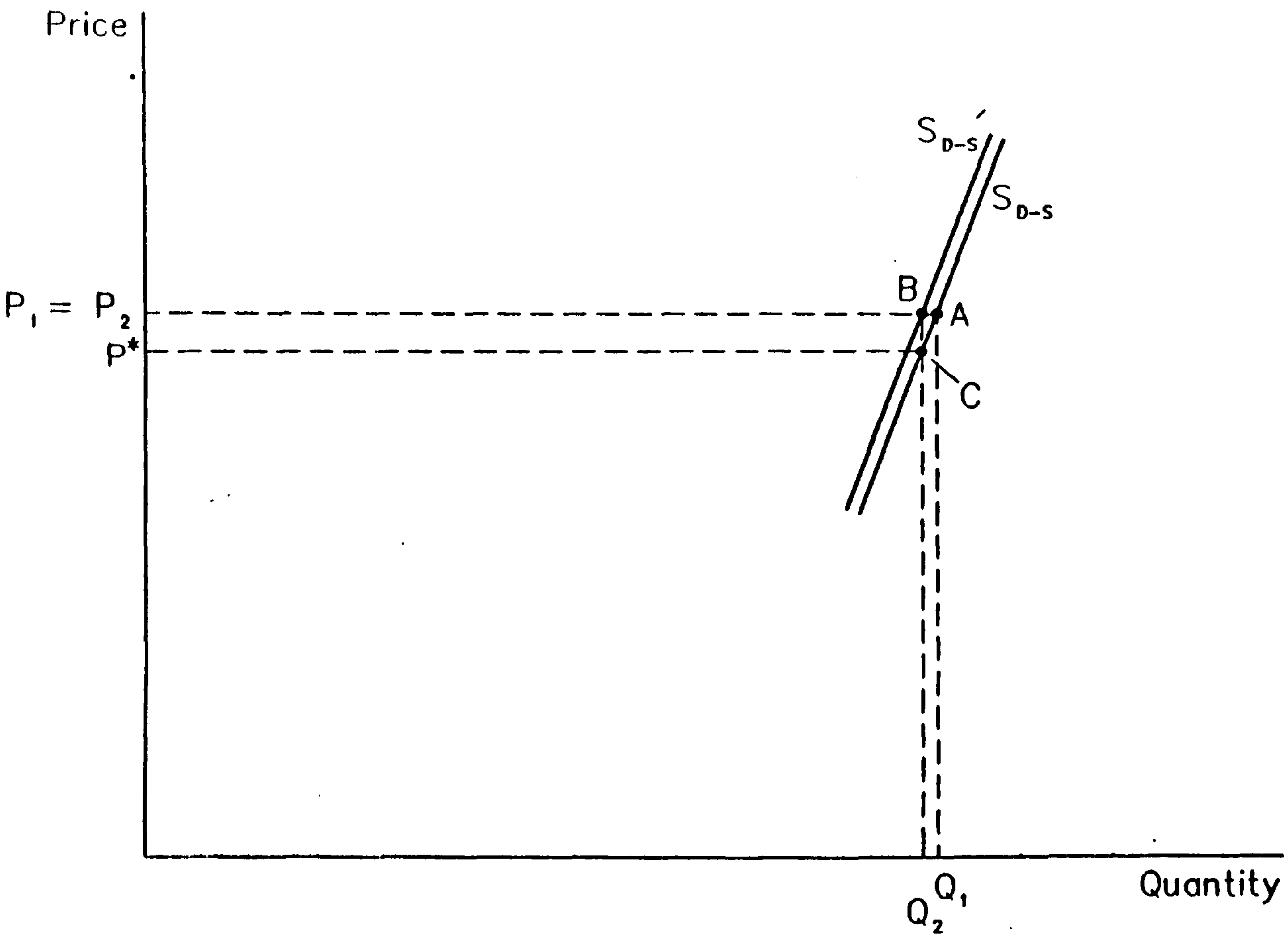
$$\epsilon = \%\Delta Q / \%\Delta P$$

This can of course be rearranged as:

$$\%\Delta Q = \epsilon \times \%\Delta P$$

For segment $\overline{AC}$ of S_{D-S}, this can be expressed as:

FIGURE 5. THE EFFECT OF CONTROL COSTS ON U.S. SECONDARY LEAD PRODUCTION IF PRICE DOES NOT CHANGE ($P_1 = P_2$)



$$(Q_2-Q_1)/Q_1 = \epsilon \times (P^*-P_1)/P_1 \ *$$

All but Q_2 in this equation are already known. Two alternative estimates of ϵ, 0.548 and 0.317, were offered in Section 4.0. Q_1, as represented by U.S. secondary lead output in the most recent year, 1992, is 888,500 metric tons. P_1 is established as 25 ¢/lb, the approximate current (November 1993) net price of lead in the U.S.[45] Finally, P^* equals P_1 minus $\overline{BC}$, where, assuming that unit control costs are constant over all output levels (i.e., the vertical shift in S_{D-S} is uniform), $\overline{BC}$ is equal to the vertical distance between S_{D-S} and S_{D-S}' above the baseline equilibrium, A, which is the average industry-wide unit (per-pound) control cost. The average industry-wide unit control cost is calculated as industry-wide total annualized control costs — $1,956,000 under Control Option 1, $3,044,000 under Control Option 2, $2,533,500 under Control Option 3, $4,019,300 under Control Option 4, and $5,406,200 under Control Option 5 (see Table 2) — divided by 1992 production, 1.959 billion pounds (888,500 metric tons x 2,204.62 lbs/metric ton). This comes to 0.10 ¢/lb under Control Option 1, 0.16 ¢/lb under Control Option 2, 0.13 ¢/lb under Control Option 3, 0.21 ¢/lb under Control Option 4, and 0.28 ¢/lb under Control Option 5. P^* is therefore 25.00 ¢/lb minus 0.10 ¢/lb = 24.90 ¢/lb under Control Option 1, 25.00 ¢/lb minus 0.16 ¢/lb = 24.84 ¢/lb under Control Option 2, 25.00 ¢/lb minus 0.13 ¢/lb = 24.87 ¢/lb under Control Option 3, 25.00 ¢/lb minus 0.21 ¢/lb = 24.79 ¢/lb under Control Option 4, and 25.00 ¢/lb minus 0.28 ¢/lb = 24.72 ¢/lb under Control Option 5.

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* P^* will never actually be realized. It is only an analytical construct that permits solving for $\%\Delta Q$ along S_{D-S}.

With these inputs it is possible to solve for Q_2 and, in turn, the change in annual industry-wide output (Q_1 minus Q_2). The results are shown in Table 6. Under the least stringent Control Option, 1, industry-wide output falls by an amount ranging from 1,127 to 1,948 metric tons, depending on ϵ. Under the most stringent Control Option, 5, industry-wide output falls by an amount ranging from 3,155 to 5,453 metric tons, again depending on ϵ. Even under Control Option 5, the impacts are not considered to be significant. At the most ($\epsilon = 0.548$), output would decline by only 0.61 percent. There is sufficient unused capacity in the U.S. secondary lead industry (capacity utilization in early 1993 was about 89%) that the decline in output should not have an effect on the battery recycling rate.[46] Ensuring that there is adequate battery recycling capacity is an important component of EPA's overall "lead strategy," "both to prevent batteries from being discarded in the environment, and to reduce the need to mine and smelt new lead."[47]

The impacts in Table 6 represent permanent changes in U.S. secondary lead output. However, as Figure 3 made clear, the total quantity of lead supplied to the U.S. market (Q_T) will not decline by nearly as much (and will not decline at all if, as in Figure 4, foreign lead supply and/or domestic primary lead supply are perfectly price-elastic). The quantity supplied of foreign lead (Q_F) and domestic primary lead (Q_{D-P}) will increase to largely offset the decrease in U.S. secondary lead output (Q_{D-S}). The extent to which foreign lead and domestic primary lead increase their shares of the U.S. lead market will depend on their price elasticities of supply. In the short run, foreign lead is likely to gain more market share — the record-high stocks of foreign lead (e.g., in LME warehouses in Europe) suggest that its supply is highly elastic. In the long run, foreign lead may also be the main beneficiary

TABLE 6. ESTIMATED ANNUAL INDUSTRY-WIDE OUTPUT IMPACTS

		Price elasticity of supply (ϵ) = 0.548			Price elasticity of supply (ϵ) = 0.317		
	Baseline output (Q_1), in metric tons	Post-regulation output (Q_2), in metric tons	Change in output, in metric tons	Percent change in output	Post-regulation output (Q_2), in metric tons	Change in output, in metric tons	Percent change in output
Control Option 1	888,500	886,552	-1,948	-0.22%	887,373	-1,127	-0.13%
Control Option 2	888,500	885,384	-3,116	-0.35%	886,697	-1,803	-0.20%
Control Option 3	888,500	885,968	-2,532	-0.28%	887,035	-1,465	-0.16%
Control Option 4	888,500	884,410	-4,090	-0.46%	886,134	-2,366	-0.27%
Control Option 5	888,500	883,047	-5,453	-0.61%	885,345	-3,155	-0.36%

if 1) foreign producers continue to become more aggressive in the U.S., 2) the general trend toward lower trade barriers (e.g., NAFTA) continues, and 3) the domestic primary lead industry is itself more strictly regulated.

In 1991, total employment at U.S. secondary lead smelters and refineries was estimated to be 1,700.[48] Assuming that employment is proportionate to output (i.e., a fixed labor-output ratio), the industry-wide employment impact under the least stringent Control Option, 1, ranges from -2 to -4, depending on ϵ. Under the most stringent Control Option, 5, the range is -6 to -10, again depending on ϵ. These impacts are less than one percent and are considered minimal.

Revenue equals output times price. With no change in price, the percent change in revenue is equal to the percent change in output. This is shown in Table 6. At the most (Control Option 5, $\epsilon = 0.548$), industry-wide revenue declines only by 0.61 percent.

5.2 PER-FACILITY

5.2.1 Baseline Risk

Irrespective of the NESHAP, there is tremendous risk in the U.S. secondary lead industry. This has been reflected in a staggering rate of attrition over the past two decades or so. Compared to the 16 secondary lead smelters currently in operation, there were 103 in 1980 and 156 in 1975.[49] Nevertheless, output increased from 675,578 metric tons in 1980 to 888,500 metric tons in 1992. Clearly, the average facility size has increased substantially, and small smelters have been the main victims of the industry shake-up.

The closure of so many small secondary lead smelters in the 1980s is attributable to two main forces: competition for a limited supply of lead scrap and the costs of pollution controls.[50] Previously, small, decentralized smelters enjoyed transportation advantages from being near customers and sources of inputs. However, these advantages have come to be outweighed by the costs of pollution controls, which have been proportionately higher — i.e., higher per unit of output — for small facilities than for large facilities (this is an example of an "economy of scale").[51]

The industry is apparently not done restructuring. Thus far in 1993, five relatively small (two "small" and three "medium") smelters have shut down, and two nonintegrated, regional smelters have cut back production. William Woodbury, the former lead specialist for the U.S. Bureau of Mines, says "you're going to see the big companies getting bigger. Market ups and downs are hard on smaller companies, but the battery manufacturers want to deal with the smelters that are more or less impervious to the market."[52] The smaller smelters are disadvantaged because, lacking scale economies, they are likely to be less efficient; because they generally have less clout with the battery manufacturers in procuring spent batteries; and because they generally have less access to capital.[53]

Smelters that are not well positioned in a battery recycling loop, either because they are not integrated into battery manufacture or because they do not have good connections with the battery manufacturers, are also generally disadvantaged. Lead scrap supplies for such smelters can be uncertain.

5.2.2 Cost Absorption

Without a price increase, control costs cannot be passed along to customers. Furthermore, although there may be some downward potential for the cost of lead scrap, it is limited.[54] This makes it uncertain that control costs can be passed back to scrap suppliers.

Like the market for lead, the market for lead scrap is not closed — there are export outlets. In 1992, the U.S. exported about 60,000 metric tons of lead scrap.[55] Already there is significant incentive to export lead scrap because potential Superfund liability in the U.S. can be avoided and because many countries have less-stringent battery recycling laws than the U.S. Because of the reduced risk, one scrap broker describes exporting lead scrap to Canada as a "marketing tool" for procuring scrap.[56] The availability of export outlets limits downward flexibility in the cost of lead scrap. In April 1993, a metals trader said that spent battery prices (about 6 ¢/lb on average) were "just high enough to forestall any significant return to the export market."[57]

The U.S. lead scrap market is not disciplined just by foreign trade — it has an internal disciplining mechanism as well. A certain minimum amount must be paid for lead scrap in order to cover the costs of the successive stages in its collection and shipment. The lower the price, the less the incentive of agents in the recycling chain — consumers, retail outlets, scrap dealers/battery haulers, et. al. — to move lead scrap along for recycling (though battery manufacturers, who as explained in Section 2.1 are more and more controlling the flow of lead scrap for recycling, may not be dissuaded from moving lead scrap along for recycling because, as consumers of lead, they have a vested interest in seeing that lead scrap is recycled). For example, retailers will have less incentive to offer payment or a discount to consumers for their used batteries or to even accept them at all. Scrap dealers may hold on to inventories, hoping for price to rebound. Also, with the risk of Superfund liability at battery-breaking sites, scrap dealers may refuse to handle lead scrap if it is not sufficiently remunerative. In May 1993, one secondary lead smelter responding in the telephone survey said that its cost of lead scrap — from 6 to 8 ¢/lb for delivered spent batteries, depending on where they are collected — is probably close to the threshold at which middlemen in the recycling chain have sufficient monetary incentive to participate.[58]

Seen another way, relatively low lead scrap prices can prompt secondary lead smelters to tighten their "catchment areas," or the areas in which they buy lead scrap (because it is not worth incurring the high transportation costs of going afar for spent batteries).[59] This can leave pockets of uncollected batteries.

In summary, if the price of lead scrap is too low, the flow of lead scrap to secondary lead smelters, i.e., the whole lead recycling chain, can be disrupted.

Without being able to pass control costs along to customers, and with an uncertain prospect that they can be passed back to scrap suppliers, it is assumed that control costs will have to be absorbed. This will reduce net income in an industry that appears to be currently (December 1993) only just about breaking even.

5.2.2.1 Baseline Profitability. That the U.S. secondary lead industry is apparently just about breaking even can be appreciated by comparing costs and price. It has been estimated that it costs secondary lead producers between 23 and 27 cents to make a pound of lead (it is believed that this accounts only for operating costs, not for capital costs, which are represented in the income statement by depreciation).[60] This comprises 12 ¢/lb for lead scrap (based on 6 ¢/lb for spent batteries, which are about half lead in content) and 11-15 ¢/lb for processing (this ignores the small credits that some smelters get from recovering plastic and/or sulfuric acid). In mid-1993, lead scrap supplies began to ease somewhat in response to several factors, including production cutbacks in the U.S. and Canada, hot weather (which influences the rate at which automobile batteries wear out), and the release of scrap supplies by dealers who had been holding out in hopes of an increase in the price of lead.[61] As a result, the cost of spent batteries in the eastern U.S. has fallen to 5-6 ¢/lb on a picked-up basis.[62] (In the western U.S., cost has remained fairly steady at 5½-6 ¢/lb on a delivered basis.) Even in the case of 5 ¢/lb picked-up, and assuming ½ ¢/lb for delivery, the cost of lead scrap is 11 ¢/lb (5½ ¢/lb x 2), which with processing costs yields a total operating cost of 22-26 ¢/lb.

Meanwhile, in November 1993, lead was selling in the U.S. for about 25 ¢/lb.[63] This price — which reflects an LME spot price of about 18 ¢/lb ($395-400 per metric ton) and a premium over the LME spot price of 7 ¢/lb, as announced by Asarco — falls within the range of total operating cost, suggesting that the U.S. secondary lead industry is just about breaking even.

Although as a whole the U.S. secondary lead industry is just about breaking even, some facilities are probably making a profit. Just a few months ago, in the spring and summer of 1993, the price of lead in the U.S. was only about 22 or 23 ¢/lb.[64] At that time, the industry was probably losing money. Yet, one respondent in the telephone survey said that a few "big, modern" facilities might be making a small profit.[65] Additionally, a positive return can be had from tolling, which is becoming more customary as the battery producers increasingly control the lead scrap market. Tolling offers a positive return, albeit perhaps a small one, because generally a mark-up over processing costs is charged. Facilities that do a lot of tolling may be making a small profit.

Although price has rebounded by two or three ¢/lb since the summer, it is still a far cry from the price a little over a year ago. Compared to about 18 ¢/lb in November 1993, the LME spot price of lead was 30 ¢/lb in September 1992. By the start of 1993, it had plummeted to 18.9 ¢/lb. Later in 1993 it reached its lowest real (i.e., adjusted for inflation) level in history. The main causes of the drop in price were increased exports from the former East Bloc, China, and North Korea, and slack demand worldwide, especially in Europe. Net lead exports to the West from the former East Bloc (particularly Eastern Europe, Russia, and Kazakhstan), China, and North Korea were 155,000-160,000 metric tons in 1992, up from only 60,000-65,000 metric tons in 1991.[66] This increase more or less accounted for the world production surplus in 1992. The International Lead and Zinc Study Group projects that exports to the West will again be "high" in 1993.[67] Meanwhile, in the first six months of 1993, European lead consumption was down 5.5 percent from the same period in 1992.[68]

Profit margins have been squeezed over the past year because the cost of lead scrap has not fallen in step with the price of lead. There has been a relative scrap shortage, in part due to the absence of extreme weather fluctuations (which can cause automotive batteries to expire). Excess capacity in the U.S. secondary lead industry, at least vis-a-vis the limited supply of lead scrap, has also helped to prevent scrap costs from falling.[69]

While the U.S. secondary lead industry as a whole may be currently breaking even, some facilities may be losing money. Moreover, for much of 1993, before the recent upturn in price, the majority of facilities in the industry may have been losing money. Firms cannot stay unprofitable indefinitely. In the long run, an adequate return on investment must be generated in order to justify staying in business. In theory, the rate of return cannot fall short of the rate of return on the best alternative investment. Otherwise, operations will be terminated and capital will be redeployed to the alternative investment.

In the short run, however, firms may continue to operate despite negative returns. In practice, this may be because an adequate long-run return is still expected (or hoped for). In theory, rather than close, it makes sense (i.e., it is profit-maximizing) to stay in business as long as variable costs do not exceed revenue. Fixed costs do not factor into this equation because they are, by definition, incurred whether or not operations are maintained. Relative to the option of shutting down temporarily (temporary shutdowns are common in the U.S. secondary lead industry), it makes sense to stay in operation as long as variable costs do not exceed revenue by more than the costs to shut down and later restart.

5.2.2.2 Calculations. Per-pound impacts of full-cost absorption were calculated by dividing total annualized control costs by annual production, in pounds. Facility production data are not known; therefore, production was approximated by multiplying production capacity by the average industry capacity utilization rate. This assumes uniform capacity utilization from facility to facility. To the extent that capacity utilization is below the industry average, the calculated impacts are understated; to the extent that capacity utilization is above the industry average, the calculated impacts are overstated. The production estimates for Sanders Lead Company and for the Schuylkill Metals Corp. facility in Baton Rouge, La. reflect the cutbacks earlier this year (see Table 1). If production were to be restored to the previous level, the impacts would be lower than calculated. For the seven facilities that are shut down (see Table 1), production is assumed to be at full capacity. The impacts for these facilities apply only if the facilities are restarted.

Impact calculations for major sources are summarized in Table 7. A threshold of 0.25 ¢/lb, about one percent of baseline operating costs, is used to indicate a "significant impact." This is conservative, considering that a five percent threshold — approximately 1.25 ¢/lb in this case — is typically used in regulatory impact studies. In addition, 0.25 ¢/lb represents only about two percent of the much more significant 12 ¢/lb drop in the LME price since September 1992, which, because there has been little compensating decrease in the cost of lead scrap, has hit the bottom line like a cost increase. However, a conservative threshold is preferred, considering that the current economic environment is disinflationary and that, with the numerous facility closures over the past couple decades, the U.S. secondary lead industry has demonstrated its sensitivity to pressures on profitability.

The number of major sources that are significantly impacted ranges from four under Control Option 1 to seven under Control Option 5. Some of these facilities are inactive, i.e., shut down. For these facilities (and for the inactive facilities that are not significantly impacted, as well) it can be said that the incremental costs of the NESHAP will give them an additional incentive not to reopen.

Two active major sources are significantly impacted under all five control options. A third active major source is significantly impacted under Control Option 2, while a fourth active major source is significantly impacted under Control Option 5. (Though significant, the impacts are all less than 1 ¢/lb.) Under current market conditions in the U.S., with price having rebounded by 2 or 3 ¢/lb since the summer, none of these facilities are likely to close as a

TABLE 7. NUMBER OF MAJOR SOURCES WITH A PER-POUND IMPACT OF TOTAL ANNUALIZED CONTROL COSTS EXCEEDING 0.25 CENTS

	Active	Inactive	Total
Control Option 1	2	2	4
Control Option 2	3	2	5
Control Option 3	2	3	5
Control Option 4	2	4	6
Control Option 5	3	4	7

consequence. Demand has picked up and lead supplies are said to be "tight."[70] If price turns back down, however, a closure or two is possible. The most likely candidates are the two facilities that are significantly impacted under all five control options. This is because both are very possibly "marginal" — i.e., among the industry's highest-cost producers — in the baseline. The likelihood of either facility closing of course increases as the control options become more stringent. The other two facilities are less likely to close because they are less likely to be marginal in the baseline and because their impacts are only marginally above 0.25 ¢/lb.

Several area sources are also significantly impacted: one under Control Option 1, two under Control Option 2, one under Control Option 3, three under Control Option 4, and four under Control Option 5. All but one of these facilities are shut down. These facilities will be less likely to reopen as a result of the NESHAP. The other facility is significantly impacted under Control Options 2, 4, and 5 (though the impacts are less than 1 ¢/lb). It could conceivably have to close if the market turns back down. One argument against closure, though, is that the facility will reportedly be overhauled and expanded.[71] Perhaps the NESHAP would not derail such major plans.

5.2.3 <u>Capital Availability</u>

The ability to finance capital control costs was assessed by comparing the capital control costs to baseline capital structure (i.e., liabilities and equity in relation to assets). For the publicly owned companies, GNB and Doe Run, information on capital structure was available from public financial statements (e.g., annual reports). For most of the private companies, information on capital structure was available from Dun & Bradstreet Information Services (Murray Hill, NJ). The analysis was conducted at the company level, not the facility level. This is because capital activities such as borrowing are conducted by the parent company, not an operating facility. Similarly, the capacity to borrow is a function of the parent company's finances, not an individual facility's. For companies that operate more than one impacted facility, the per-facility capital control costs were aggregated.

The analysis was triggered by calculating the ratio of capital control costs to baseline total assets. This ratio measures the percent impact on company-wide total resource requirements. Alternatively, it measures the percentage point increase in the share of baseline assets that total liabilities would comprise if debt is issued to finance the capital investment. (Normally for an investment in pollution controls, if external financing is needed, it is assumed that debt, not equity, is issued because the investment does not add to the firm's productive capacity.) For example, if total liabilities to assets is 50 percent in the baseline, a five percent ratio would indicate that total liabilities to baseline assets increases to 55 percent.

A ratio exceeding five percent was taken to indicate a significant impact on a company's balance sheet. If the ratio exceeded five percent, it was in turn judged that capital may be difficult to obtain if post-NESHAP total liabilities — assuming capital control costs are financed with debt — would exceed two-thirds of baseline total assets. Generally, the higher the ratio of liabilities to assets (i.e., the greater the "financial leverage"), the more difficult it is to obtain financing because the risk of default is greater.

Under Control Options 4 and 5, two facilities may have difficulty obtaining capital. While one is a major source and one is an area source, both are shut down. Therefore, under Control Options 4 and 5, difficulty in obtaining capital could prevent the facilities from reopening.

The case for two other facilities is ambiguous because no up-to-date information on capital structure is available. The ratio of capital control costs to baseline total assets exceeds five percent under Control Option 5 for the first facility and under Control Options 4 and 5 for the second facility. Whether it may in turn be difficult under these control options to obtain capital cannot be said without knowledge of baseline capital structure. The first facility is a major source that is shut down. The second facility is a major source that is in operation. This facility is one of the two facilities that was found in Section 5.2.2.2 to be significantly impacted by total annualized control costs (> 0.25 ¢/lb) under all five control options.

5.3 SMALL BUSINESSES

In accordance with the Regulatory Flexibility Act of 1980, it is necessary to perform a Regulatory Flexibility Analysis (RFA) if a proposed rule (in this case the NESHAP) will have "a significant economic impact on a substantial number of small entities." The EPA's "Revised Guidelines for Implementing the Regulatory Flexibility Act" (1992) interpret this broadly by considering <u>any</u> economic impact to be significant and <u>any</u> number of small entities to be substantial.

The chief emphases of an RFA are to distinguish economic impacts on small entities from economic impacts on other entities and to consider alternative regulatory options that may minimize the impacts on small entities (while still achieving the statutory objectives). Five regulatory options have been established for the NESHAP. They are the five control options described in Section 1.1.

It is of course necessary to define a "small entity." For the present NESHAP, a "small entity" can be equated with a “small business” because no small government jurisdictions or small not-for-profit organizations are affected. The U.S. Small Business Administration (SBA) definition for a small business in SIC 3341, Secondary Smelting and Refining of Nonferrous Metals, is 500 employees or fewer. Granted, SBA’s definitions were established primarily to give small businesses a fair share in the awarding of government contracts, not to accommodate regulatory impact analysis. Nevertheless, the SBA definition seems very appropriate for the U.S. secondary lead industry. Five companies in the industry have more than 500 employees: East Penn Manufacturing Company, Exide Corporation, Fluor Corporation (the parent of The Doe Run Company), Pacific Dunlop Limited (the parent of GNB Battery Technologies), and RSR Corporation. All enjoy market advantages due to scale or structure. RSR is the largest secondary lead producer in the U.S. and is regarded to have strong connections with battery manufacturers. East Penn, Exide, and GNB are all vertically integrated into battery manufacture. This makes it easier to procure lead scrap, which, as explained in Section 2.1, is important for success in the U.S. secondary lead industry. Doe Run is horizontally integrated in that it produces both secondary lead and primary lead. This may afford the opportunity to shift production between primary lead and secondary lead depending on comparative market conditions, and may also make it possible to offer customers a wider range of lead products. As multibillion-dollar public companies, Fluor and Pacific Dunlop no doubt have better access to capital than the other U.S. secondary lead producers.

In contrast, none of the U.S. secondary lead producers with 500 or fewer employees are vertically or horizontally integrated. And none are the subsidiary of a significantly larger organization. Thus, the 500-employees threshold conveniently bifurcates the U.S. secondary lead industry. The spirit of the Regulatory Flexibility Act's purpose for distinguishing relatively small businesses is met as above the threshold the businesses have distinct market advantages and below the threshold the businesses are "generally ... independently owned and operated and not dominant in (their) field."

While five companies in the U.S. secondary lead industry are "not small" (more than 500 employees), 11 are "small" (500 or fewer employees). The five companies that are not small own 10 of the 23 secondary lead smelters in the U.S., and 10 of the 16 that are presently active (i.e., not shut down). The 11 small companies own 13 smelters, six of which are active.

All 11 small companies are impacted by the NESHAP. Six of these companies own the seven smelters that are shut down. Because of its incremental costs, the NESHAP will give these smelters an additional incentive not to reopen. The other five small companies own six active smelters. The NESHAP imposes control costs on all secondary lead smelters in the U.S., including these six smelters. As discussed in Sections 3.1.3 and 5.2.2, control costs will have to be absorbed because neither a compensating increase in the price of lead nor decrease in the cost of lead scrap is likely.

Furthermore, as demonstrated in Table 8, of the 13 secondary lead smelters owned by small companies, the number that are "significantly impacted" by the NESHAP ranges from 5 under Control Option 1 to 10 under Control Option 5. In contrast, only one secondary lead smelter owned by a company that is not small is significantly impacted (under Control Options 2, 4, and 5). As set forth in Sections 5.2.2.2 and 5.2.3, a facility is "significantly impacted" by the NESHAP if, at the facility level, total annualized control costs

TABLE 8. NUMBER OF SIGNIFICANTLY IMPACTED FACILITIES

Facility type	Control Option 1	Control Option 2	Control Option 3	Control Option 4	Control Option 5
Owned by a "small" company					
Active					
Major source	2	3	2	2	3
Area source	-	-	-	-	-
Total	2	3	2	2	3
Shut down					
Major source	2	2	3	4	4
Area source	1	1	1	2	3
Total	3	3	4	6	7
Total	5	6	6	8	10
Owned by a company that is "not small"					
Active					
Major source	-	-	-	-	-
Area source	-	1	-	1	1
Total	-	1	-	1	1
Shut down					
Major source	-	-	-	-	-
Area source	-	-	-	-	-
Total	-	-	-	-	-
Total	-	1	-	1	1
Total	5	7	6	9	11

exceed 0.25 ¢/lb (about 1% of baseline operating costs) and/or, at the company level, capital control costs are more than five percent of baseline total assets and post-regulation total liabilities would exceed two-thirds of baseline total assets if the capital control costs are financed with debt.

Small companies are disproportionately impacted by the NESHAP for two main reasons: 1) they tend to own smaller facilities, which do not benefit from the economies of scale inherent in the control costs (i.e., per-unit control costs tend to decrease as facility size increases), and 2) they have fewer capital resources. It is also possible that, because of their greater resources, larger companies have been able to control their operations more tightly in the baseline. This would make it easier, and less costly, to comply with the NESHAP.

The impacts of the NESHAP on active facilities are of more concern than the impacts on facilities that are shut down. This is because the facilities that are shut down may not reopen, regardless of the NESHAP. From the standpoint of active facilities, the impacts of the NESHAP on small businesses are minimized under Control Options 1, 3, and 4 because only two active facilities owned by small companies (both major sources) are significantly impacted. In contrast, under Control Options 2 and 5, three such facilities are significantly impacted. The impacts are lowest under Control Option 1 because control costs are lowest. Control costs are slightly higher under Control Option 3, and then again higher under Control Option 4.

As discussed in Section 5.3, the facilities that are significantly impacted by the NESHAP are not likely to close as a consequence under current lead market conditions. If the price of lead turns back down or if new secondary lead capacity comes on stream in the U.S., however, one or two significantly impacted facilities may have to close. For the reasons discussed in Section 5.2.2.2, the most likely candidates for closure are the two facilities discussed above that are significantly impacted even under Control Options 1, 3, and 4.

5.4 SUMMARY AND CONCLUSIONS

Four active (i.e., currently operating) major sources and one active area source are "significantly impacted" by the NESHAP. This means that, at the facility level, total annualized control costs exceed 0.25 ¢/lb and/or, at the company level, capital control costs are more than five percent of baseline total assets and post-regulation total liabilities would exceed two-thirds of baseline total assets if the capital control costs are financed with debt. Two major sources are significantly impacted under all five control options (though the impacts increase in significance as the control options become more stringent), one is significantly impacted under Control Option 2, and one is significantly impacted under Control Option 5. The area source is significantly impacted under Control Options 2, 4, and 5.

Seven secondary lead smelters (four major sources, three area sources) in the U.S. are currently shut down. Because the NESHAP imposes incremental costs, all will have an additional incentive not to reopen, especially those that are "significantly impacted" — three under Control Option 1, three under Control Option 2, four under Control Option 3, six under Control Option 4, and all seven under Control Option 5.

The NESHAP impacts small companies, defined as having 500 or fewer employees, disproportionately. While the number of significantly impacted smelters owned by small companies ranges from five under Control Option 1 to 10 under Control Option 5, only one smelter owned by a company that is not small is significantly impacted (under Control Options 2, 4, and 5).

Under current market conditions in the U.S., with price having rebounded by 2 or 3 ¢/lb in the past several months and with lead supplies "tight," none of the four active major sources and one active area source that are significantly impacted by the NESHAP are likely to close as a consequence. If price turns back down, however, a closure or two is possible. The most likely candidates for closure are the two facilities that are significantly impacted under all five control options.

The economic impacts of the NESHAP are therefore contingent on the course of the price of lead. Ultimately the price of lead is determined by the interaction of global supply and demand. The past year has been characterized by world production in excess of world consumption and therefore a depressed price. There are signs, though, that price may rebound (indeed, at the time of writing, early December 1993, the LME spot price, which was in the range of $395-400/metric ton in November, was on the rise). To correct excess supply (manifested in the U.S. secondary lead industry primarily as excess demand for lead scrap), capacity is being rationalized worldwide, including in the U.S. (to wit the five secondary lead smelter shutdowns in 1993). As evidence, "Western-World" lead (primary and secondary) production is projected to decline in 1993 by three percent from 1992.[72] Moreover, exports from the former East Bloc, China, and North Korea — which soared in 1992, single-handedly accounting for the world production surplus, and which are believed to be similarly high in 1993 — are forecast by the International Lead and Zinc Study Group (ILZSG) to decline in 1994.[73] The ILZSG also expects the demand for lead in Europe to turn around in 1994, permitting a "limited recovery" of +3 percent in worldwide demand.[74]

Although the price outlook may be generally sanguine, there is downside potential (forecasting commodity prices is never unambiguous). For one, there still is excess world supply.[75] This means that further capacity rationalizations and/or an increase in demand are needed to bring the world market into balance. Secondly, it is not for sure that the recent price recovery in the U.S. is permanent. The fall is perennially when the demand for lead from battery manufacturers is highest, as battery production is stepped up in anticipation of winter demand (battery replacements are highest in the winter). Therefore, it is possible that the recent price increase has been at least in part seasonal.

In addition to the price of lead, there is another contingency that bears on the economic impacts of the NESHAP. This is the possibility that new secondary lead capacity will come on stream in the U.S. The U.S. has been characterized in recent years by excess demand for lead scrap. In the wake of recent shutdowns (e.g., five in 1993), the U.S. secondary lead industry is in better supply-demand balance. (Early in 1993, before two of the year's shutdowns, the industry's estimated capacity utilization rate was 89%.) If substantial new capacity comes on stream, though, the industry will again have excess capacity. This could adversely affect profitability by depressing price and by increasing the demand for, and therefore the cost of, lead scrap. In turn, marginal producers could be forced out of the industry. The facilities that are significantly impacted by the NESHAP, particularly the two facilities that are significantly impacted under all five control options, might be particularly vulnerable.

As recently as a few months ago, GNB and RSR ostensibly each had plans (the plans were announced to the public) to build a large smelter in the southeastern U.S.[76,77] Combined annual capacity of the two plants would be close to 200,000 metric tons. The companies' commitments to these plans are questionable, however. In November 1993, GNB said its plans to build a facility in Waynesboro, Ga. are "on hold indefinitely."[78] While RSR did announce in November 1993 that a site (in Montmorenci, S.C.) had been selected, in August it had said it was taking a "short respite" from its plans.[79, 80] Even if RSR proceeds with its plans, operating permits must still be obtained. This suggests that start-up is several years away. Asarco, the primary lead producer, is considering entering the secondary lead business by also building a secondary lead smelter in the Southeast.[81] No decision has been made, though.[82]

If price turns back down and/or new capacity comes on stream, and as a result the NESHAP contributes to a closure or two in the U.S. secondary lead industry, the output lost at these one or two facilities would exceed the industry-wide output loss estimated in Section 5.1 — 1,127-1,948 metric tons under Control Option 1, ranging up to 3,155-5,453 metric tons under Control Option 5. Surviving facilities, if not new facilities, can be expected to make up the difference. Secondary lead smelters can alter production levels fairly easily. One smelter responding in the telephone survey said that it could double its current capacity (which is already "large") at very little capital cost.[83]

The employment impact at these one or two facilities would also exceed the industry-wide employment loss — 2-4 under Control Option 1, ranging up to 6-10 under Control Option 5. Again, however, expansions or start-ups should generate new employment to make up the difference.

Finally, the U.S. secondary lead industry would be more concentrated after a closure or two. This should not significantly affect competition, however, because the lead market is global.

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APPENDIX A

INPUTS TO THE REGRESSION ANALYSIS

TABLE A-1. INPUTS TO THE REGRESSION ANALYSIS

	U.S. secondary lead production (metric tons)	LME spot price of lead (¢/lb)	Price of heavy soft scrap lead (¢/lb)		Producer Price Index (PPI) for secondary nonferrous metals	Producer Price Index (PPI) for all finished goods*
			Chicago basis	New York basis		
1970	541,943	13.8		7.13	51.5	2.545
1971	541,405	11.5		4.36	45.0	2.469
1972	559,368	13.7		5.65	45.0	2.392
1973	593,559	19.5		7.66	55.9	2.193
1974	633,853	26.8		11.44	85.5	1.901
1975	597,342	18.7		8.94	71.7	1.718
1976	659,132	20.5		12.35	74.8	1.645
1977	757,592	28.0		13.91	83.2	1.546
1978	769,236	29.9		19.23	88.3	1.433
1979	801,368	54.5		33.33	114.7	1.289
1980	675,578	41.2		23.25	123.0	1.136
1981	641,105	33.3		16.50	113.8	1.041
1982	571,276	24.7		11.77	100.0	1.000
1983	503,501	19.3		9.34	105.4	0.984
1984	633,374	20.1		9.52	103.5	0.964
1985	615,695	17.8		7.11	92.4	0.955
1986	624,769	18.4	7.25	5.58	91.0	0.969
1987	710,067	27.0	14.50		107.7	0.949
1988	736,401	29.7	15.57		128.2	0.926

TABLE A-1. (Continued)

	U.S. secondary lead production (metric tons)	LME spot price of lead (¢/lb)	Price of heavy soft scrap lead (¢/lb): Chicago basis	New York basis	Producer Price Index (PPI) for secondary nonferrous metals	Producer Price Index (PPI) for all finished goods*
1989	891,341	30.6	14.63		131.0	0.880
1990	922,911	37.1	16.80		125.6	0.839
1991	883,700	25.3	12.23		108.7	0.822

*Used to adjust all monetary inputs to 1982 dollars.

Sources: see Table 4.

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16. ABSTRACT

Under the authority of the 1990 Clean Air Act Amendments, a National Emission Standard for Hazardous Air Pollutants (NESHAP) is proposed to control emissions from Secondary Lead Smelters. This document presents the economic impacts and small business impacts associated with alternative regulatory options proposed in the NESHAP.

17. KEY WORDS AND DOCUMENT ANALYSIS

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