

**The Impact of Environmental  
Compliance Costs on  
U.S. Refining Profitability  
1995-2001**

May 2003

**Energy Information Administration**  
Office of Energy Markets and End Use  
U.S. Department of Energy  
Washington, D.C. 20585

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## Preface

This report assesses the effects of pollution abatement requirements on the financial performance of U.S. petroleum refining and marketing operations during the 1995 to 2001 period. This study is a follow-up to the October 1997 publication entitled *The Impact of Environmental Compliance Costs on U.S. Refining Profitability*, that focused on the financial impacts of U.S. refining pollution abatement investment requirements in the 1988 to 1995 period. This analysis draws heavily on financial and operating data from the Energy Information Administration's Financial Reporting System (FRS). Pursuant to Section 205(h) of the Department of Energy Organization Act, which established the FRS, the Energy Information Administration, through its Form EIA-28, collects financial information and other measures of energy-related business efforts and results for major energy companies. Since the FRS data are collected on a uniform, segmented basis, the comparability of information across energy lines of business is unique to this reporting system. In 2001, thirty companies filed Form EIA-28. Also essential to the analysis are data on pollution abatement costs and capital expenditures collected and published separately by the Bureau of the Census and the American Petroleum Institute. The information in this report is intended for use by the U.S. Congress, Government agencies, industry analysts, and the general public.

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## Introduction and Summary

Following the sharp decline in profitability during the 1988 to 1995 period, U.S. petroleum refining and marketing operations experienced an upswing in profitability during 1996-2001, along with an increase in capital expenditures. A 1997 Energy Information Administration (EIA) report, *The Impact of Environmental Compliance Costs on U.S. Refining Profitability*<sup>1</sup> (October 1997), analyzed the sources of the 1988-1995 reduction in profitability, with particular attention to the impacts of the costs of environmental compliance.

This study is a follow-up to the 1997 report and analyzes the sources of increased profitability in U.S. refining/marketing, including the role of the costs of compliance with environmental laws and their implementation. The primary focus is on the 1996 to 2001 period, but the report also presents data for the 1988 to 1995 period of the 1997 study.

The analysis presented in this report utilizes a financial reporting framework and draws on government and industry data sources. The results are for the major energy companies<sup>2</sup> (the “majors”) reporting to the EIA’s Financial Reporting System (FRS) (described below). For these companies, the results in this report indicate that:

- The upswing in U.S. refining/marketing profitability in the 1995 to 2001 period was mainly due to an increase in the spread between refined product prices and the cost of raw material inputs to refineries (the “gross refining margin”) and also due to reductions by the majors in their operating costs relative to the scale of operations.
- Relative to the scale of operations, environmentally related operating costs, including depreciation expenses, declined. The share of environmentally related assets, based on value, in U.S. refining operations also declined.
- The impact of environmental requirements on refining/marketing return on investment (ROI)<sup>3</sup> appeared to remain substantial. Calculations of ROI excluding environmental effects show that actual ROI was 42 percent lower than the ROI excluding the financial effects of environmental compliance, on average, over the period 1996 to 2001. In 1991 to 1995 the comparable reduction in ROI was 69 percent. In 1988 to 1990, prior to the implementation of the Clean Air Act Amendments of 1990, the comparable reduction was 32 percent.

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<sup>1</sup> For the full text of the report please refer to [http://www.eia.doe.gov/emeu/perfpro/ref\\_pi/contents.html](http://www.eia.doe.gov/emeu/perfpro/ref_pi/contents.html).

<sup>2</sup> A “major energy producing” company must meet at least one of the following criteria: control at least 1 percent of U.S. crude oil production (or reserves), control at least 1 percent of U.S. natural gas production (or reserves), or control at least 1 percent of U.S. crude oil distillation capacity or product sales. See <http://www.eia.doe.gov/emeu/perfpro/appenda.html#criteria> for more discussion of this point.

<sup>3</sup> ROI is net income contributed by the FRS companies' U.S. refining/marketing line of business (excluding unallocated items, mainly interest expense) as a percent of net fixed assets (net property, plant, and equipment plus investments and advances) in U.S. refining and marketing.

This analysis draws on data from the EIA's FRS.<sup>4</sup> The FRS is an annual survey that collects, through Form EIA-28, financial and associated operating information from U.S.-based major energy producing companies. In 2001 there were 30 such companies, 21 of which owned refineries in the United States. The data are reported on a line-of-business basis, including the U.S. petroleum refining and marketing line of business.

The FRS companies occupy a major part of the U.S. refining industry. For example, in 2001, the FRS companies' share of U.S. refined product output was 85 percent.<sup>5</sup> However, the FRS does not collect financial data on environmental compliance. Instead, the American Petroleum Institute collected U.S. refiners' environmental operating costs and capital expenditures and published aggregate data for the industry, for 1990 through 2001.<sup>6</sup> Operating costs and capital expenditures for the industry for 1988 and 1989 were estimated.<sup>7</sup> Environmental capital expenditures and operating costs are prorated for the FRS companies on the basis of their share of total U.S. crude distillation capacity.

## Key Findings

### The Profitability of the Majors' U.S. Petroleum Refining/Marketing Operations Rose Sharply in Recent Years

The profitability of the FRS companies' U.S. petroleum refining/marketing operations rose from near zero in 1995 to over 14 percent in 2001 (Figure 1). Profitability of this line of business is measured by return on investment (ROI): net income contributed by the FRS companies' U.S. refining/marketing line of business (excluding unallocated items, mainly interest expense) as a percent of net fixed assets (net property, plant, and equipment plus investments and advances) in U.S. refining and marketing. The higher ROI for U.S. refining/marketing in recent years is in strong contrast to the results for the prior seven years. In the earlier period, the profitability of U.S. refining and marketing plunged from a peak of 15 percent in 1988 to an average of only 2 percent in the 1992 to 1995 period.

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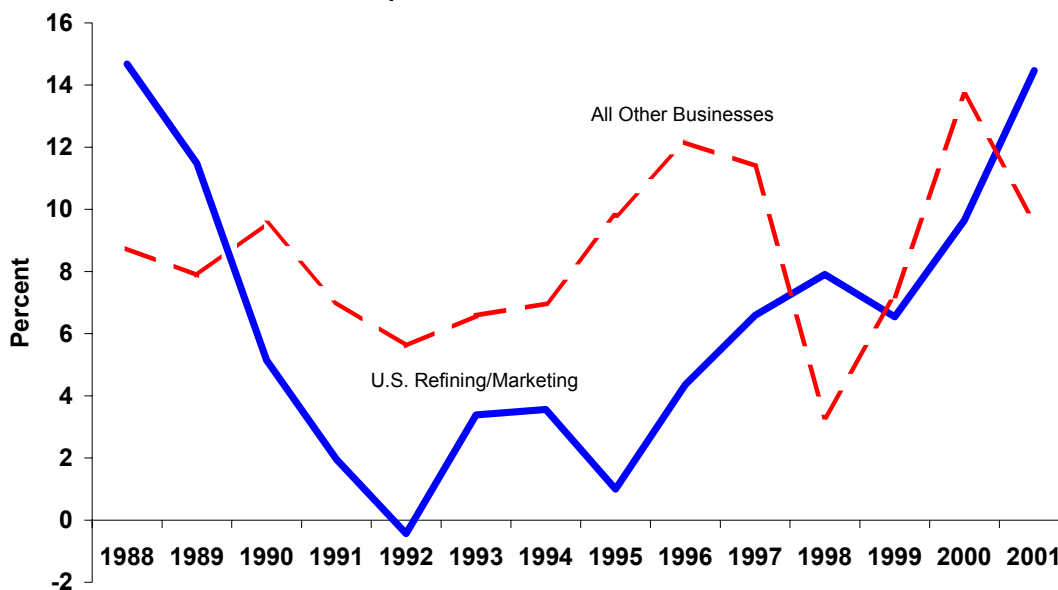
<sup>4</sup> The FRS data and associated analyses of financial developments in energy markets are reported annually, most recently in Energy Information Administration, *Performance Profiles of Major Energy Producers 2001*, DOE/EIA-0206(01)(Washington, DC, January 2003), which can be found at <http://www.eia.doe.gov/emeu/perfpro/index.html>.

<sup>5</sup> See Energy Information Administration, *Performance Profiles of Major Energy Producers 2001*, DOE/EIA-0206(2001), pp. 4 and 5. Note that data revisions have lowered the FRS share of U.S. refinery capacity in 2001 from 92 percent to 85 percent.

<sup>6</sup> Data for the 1990 to 1996 period are from American Petroleum Institute, *Petroleum Industry Environmental Performance* (Washington, DC, May 1997), pp. 47-48 and data for the 1997 to 2001 period are from American Petroleum Institute, *U.S. Oil and Natural Gas Industry's Environmental Expenditures* (Washington, DC, February 2003), p. 9.

<sup>7</sup> The earlier study utilized environmental cost and expenditure data from U.S. Bureau of the Census, *Pollution Abatement Costs and Expenditures: 1994*, MA200(94)-1(Washington, DC, 1996), pp. 6-7, available at <http://www.census.gov/econ/www/mu1100.html>, and earlier editions of the Census report. However, after 1994, Census only published data for 1999. Since the American Petroleum Institute data are continuous over the 1990 to 2001 period, they were utilized for this study. Estimates of costs and expenditures were made by applying the ratio of the American Petroleum Institute series to the corresponding Census series for the 1990 to 1994 overlap period to the Census values for 1988 and 1989.

**Figure 1. Return on Investment in U.S. Refining/Marketing and Other Lines of Business for FRS Companies, 1988-2001**



Note: Return on investment (ROI) = net income (excluding unallocated items) as a percent of net property, plant, and equipment and investments and advances.

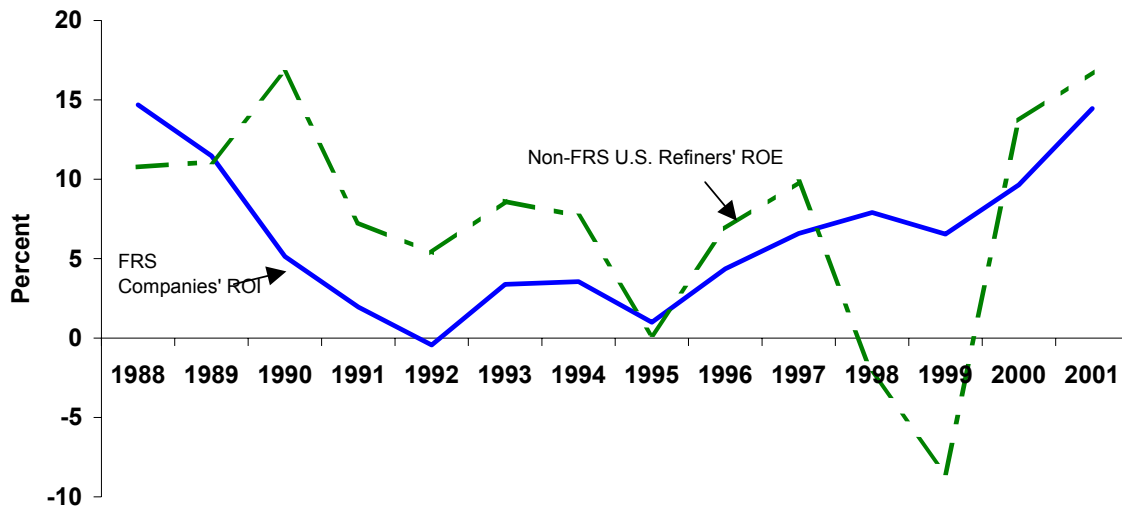
Source: Energy Information Administration, Form EIA-28 (Financial Reporting System).

Figure 1 also shows the ROI for all of the other FRS companies' lines of business on a combined basis. Over the 1998 to 2001 period, the U.S. refining/marketing line of business outperformed the majors' other businesses, on average. In the prior seven years, the profitability of the majors' U.S. refining/marketing business was well below that of their other businesses overall.

Other U.S. refiners besides the majors also experienced an upswing in profitability after 1995, following a steep decline in profitability. The measure for other refiners, shown in Figure 2, is return on equity (net income as a percent of shareholders' equity, shareholders' equity being the net book value of ownership), a commonly used measure of a corporation's profitability. This measure is used because the ROI for U.S. refining/marketing, which is computed from the FRS data, is not available for non-FRS companies. Since other refiners tend to be specialized, the return on equity measure of profitability tends to wholly reflect the results of their petroleum refining and marketing activity.

What factors accounted for the recovery in U.S. petroleum refining and marketing in recent years?

**Figure 2. U.S. Refining/Marketing Return on Investment for FRS Companies and Return on Equity for Non-FRS Refiners, 1998-2001**



Note: Return on investment (ROI) = net income as a percent of net property, plant, and equipment and investments and advances.

Return on equity (ROE) = net income as a percent of stockholders' equity. The negative ROE values for non-FRS refiners is mainly due to Pennzoil-Quaker. Excluding its values would result in ROE values of -1.3% and 5.9% in 1998 and 1999, respectively. ROE is used since ROI is not available for non-FRS refiners.

Sources: **FRS Companies:** Energy Information Administration, Form EIA-28 (Financial Reporting System). **Non-FRS Refiners:** Compustat PC Plus, a service of Standard and Poor's.

## Behind the Upswing: Margins and Profitability

The net refined product margin (net margin) is the gross refining margin (refined product revenues less purchases of raw material inputs to refining and refined product purchases) minus out-of-pocket operating costs per barrel of refined products sold. The net margin represents the before-tax cash earnings from production and sale of refined products and excludes ancillary activities such as non-fuel sales from convenience stores. The net margin is an important determinant of short-term decisions in refining operations. Basically, for a given scale and configuration of a refinery, output will tend to be expanded as long as the added output adds to cash earnings.

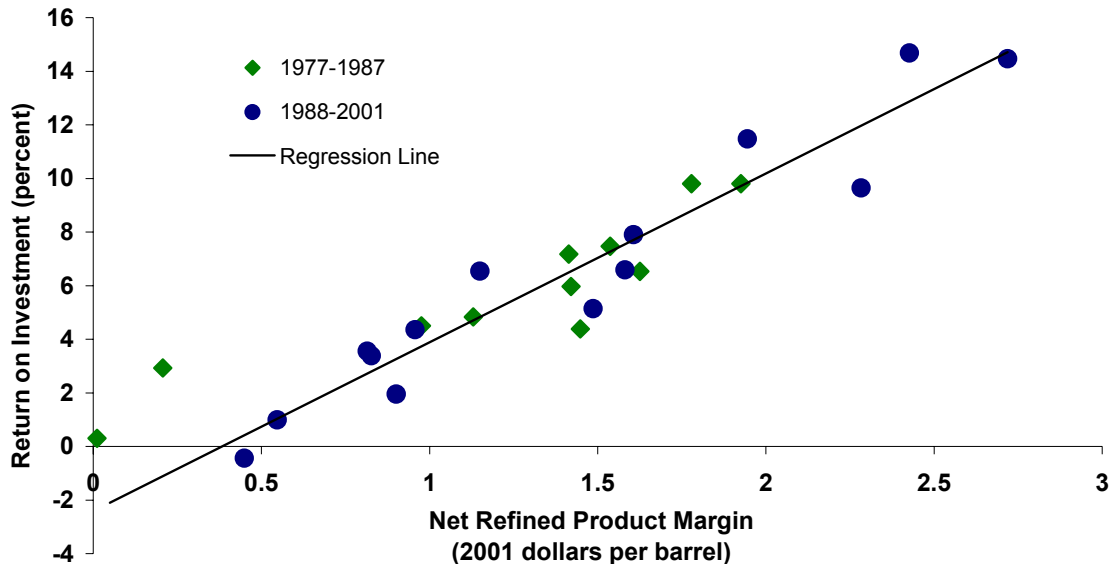
The net margin is also closely related to refining/marketing profitability. Figure 3 shows that when cash earnings per barrel sold (adjusted for inflation) are high, so is refining/marketing profitability. The correlation between profitability (measured by ROI) and the net refined product margin is 0.93,<sup>8</sup> which is highly significant by the usual statistical conventions.

<sup>8</sup> The results from the regression of ROI for domestic refining/marketing on the net margin (in 2001 dollars) for all FRS refiners (i.e., those FRS companies having non-zero values for beginning and/or ending refining capacity) for the years 1977 through 2001 are as follows: Multiple R = 0.934; R square = 0.872; Adjusted R square = 0.867; Standard error of the regression = 1.440; and observations = 25. The estimated equation is:

Domestic refining/marketing ROI = -1.156 (0.651) + 5.514 (0.440) \* Net margin, where the standard errors of the estimated coefficients are in parentheses.



**Figure 3. U.S. Refining/Marketing Return on Investment and Net Refined Product Margin for FRS Companies, 1977-2001**



Source: Energy Information Administration, Form EIA-28 (Financial Reporting System).

The strong, positive relationship between domestic refining/marketing profitability and the net refined product margin provides an avenue by which to investigate the changes in domestic refining/marketing profitability by examining the changes in the components of the relatively more straightforward net refined product margin.<sup>9</sup>

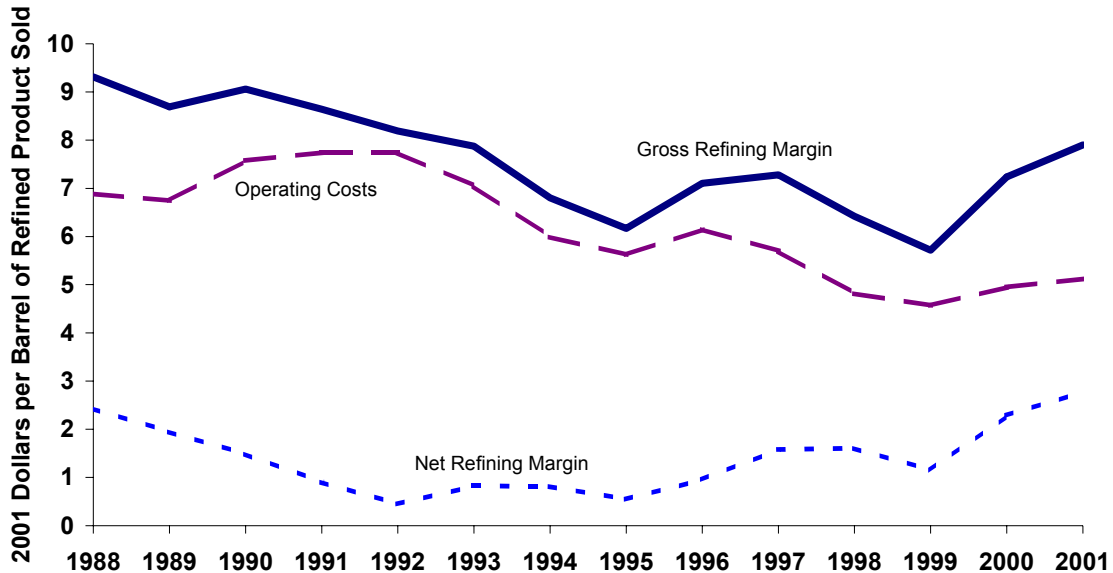
### The Gross Refining Margin

The gross refining margin increased between 1995 and 2001 (Figure 4) as relatively low product stocks, particularly in 2000 and 2001,<sup>10</sup> put upward pressure on product prices. Overall, average refined product prices received by the majors increased 25 percent over the 1995 to 2001 period (Table 1). The price rise was led by distillate and motor gasoline, while the relatively lower value products registered a less steep rise.

<sup>9</sup> The net margin is used as a proxy for profitability here because of the greater expository value of the net margin. That is, estimation of the effects of environmental legislation through examination of the changes in the components of the net margin is a far more straightforward proposition than is an examination of the changes in the components of profitability due to a myriad of complex factors, chiefly tax laws.

<sup>10</sup> See Energy Information Administration, *Performance Profiles of Major Energy Producers 2000*, DOE/EIA-0206(2000) (Washington, DC, January 2002), Figure 16; and *Performance Profiles of Major Energy Producers 2001*, DOE/EIA-0206(2001) (Washington, DC, January 2003), Figure 16.

**Figure 4. U.S. Refining/Marketing Margins and Operating Costs for FRS Companies, 1988-2001**



Note: The FRS gross refining margin is refined product revenues less raw material cost and product purchases divided by refined product sales volume. Net margin = gross margin less operating costs.

Source: Energy Information Administration, Form EIA-28 (Financial Reporting System).

At the same time, the growing sophistication of the FRS refineries<sup>11</sup> allowed the companies to benefit from generally increasing price differences between light and heavy crude oil (Figure 5), which diminished the upward pressure on the average price paid for raw materials (and thereby lifted refining margins).

The majors' gross refining margin increased by \$1.68 per barrel (2001 dollars) between 1995 and 2001 (Table 1). Partly offsetting this result was a 49-percent increase in energy costs for refining operations, mainly reflecting an even steeper rise in U.S. natural gas prices over the period.

### Operating Costs

On the cost side, the declining ROI of the FRS refiners during the early 1990's provided an incentive to attempt to reduce their operating costs. Efforts were apparently effective, as operating costs were reduced between 1995 and 2001 (Figure 4). Apart from energy costs, the majors reduced the overall costs of operating their refineries and marketing networks by 20 percent between 1995 and 2001.

The largest relative reduction was in environmental operating costs. Environmental operating costs are the out-of-pocket expenses for prevention, control, abatement or

<sup>11</sup> See, Energy Information Administration, Update of Tables and Figures from *U.S. Petroleum Refining and Gasoline Marketing Industry* (Washington, DC, June 2002), Table 6. Internet-only product, which is located at <http://www.eia.doe.gov/emeu/finance/usi&to/downstream/update/index.html>.

**Table 1. Components of the Gross Refining Margin and Average Refined Product Revenues for FRS Companies, 1988, 1995, and 2001**  
(2001 dollars per barrel of refined product sold)

	1988	1995	2001	percent change 1995-2001
Average Refined Product Revenues	29.36	27.04	33.88	25.3
Raw material Acquisition Costs and Refined Product Purchases	20.05	20.87	26.04	24.8
Gross Margin	9.31	6.17	7.85	27.2
Energy Costs	1.45	0.92	1.37	49.3
Marketing Costs	2.14	1.95	1.59	-18.6
Environmental Operating Costs	0.36	0.49	0.34	-29.8
Other Refining Costs	2.94	2.26	1.82	-19.4
Net Refining Margin	2.43	0.55	2.72	397.0
<b>Average Refined Product Revenues</b>				
Motor Gasoline	33.59	30.26	36.96	22.1
Distillate	27.59	24.70	32.96	33.4
Other Products	23.20	23.17	26.30	13.5
All Refined Products	29.36	27.04	33.88	25.3

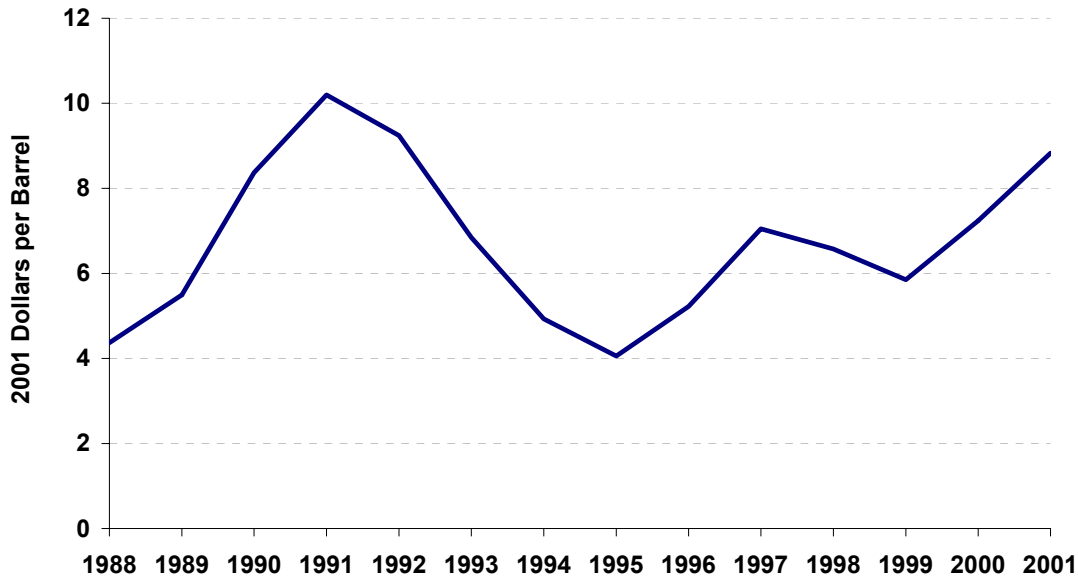
Source: Energy Information Administration, Form EIA-28 (Financial Reporting System).

elimination of environmental pollution. For refiners, the costs include the costs of meeting the motor fuel standards of the Clean Air Act Amendments of 1990. These standards mandated production of oxygenated gasoline by 1992, reformulated gasoline by 1995 (with more stringent emission requirements for reformulated gasoline in 2000), and production of low-sulfur diesel fuel by October 1993.

Environmental operating costs were 30 percent less in 2001 than in 1995, a drop of \$0.15 per barrel of refined product sold (2001 dollars) (Table 1). This decline follows the 35-percent rise in environmental operating costs in the 1988 to 1995 period of the earlier study. The recent reduction probably reflects not only general cost-cutting but also efficiency gains. Lower costs were achieved as familiarity and expertise with the production of the new reformulated fuels accumulated and as the scale of reformulated fuel production grew over the period.

The largest total reduction in operating costs was achieved in refinery operations, excluding environmental costs. The majors were able to reduce these costs by \$0.44 per barrel of refined product sold (2001 dollars) between 1995 and 2001, a 19-percent decline. Cost-cutting efforts tended to be broad-based and in the case of refiners included inventory management. In the second half of the 1990's, refiners adopted "just-in-time" inventory practices that reduced their stock of petroleum on hand and, thereby, their costs of holding petroleum stocks.

**Figure 5. Price Difference between Light Crude Oil and Heavy Crude Oil, 1988 - 2001**



Note: Light crude oil is defined here as having an API gravity of 40.1 or greater and heavy crude oil is defined as having an API gravity of 20.1 or less.

Source: Energy Information Administration, *Petroleum Marketing Monthly*, DOE/EIA-0380, Tables 27 and 28.

The reduction in marketing costs between 1995 and 2001 totaled \$0.36 per barrel of refined product sold (2001 dollars), a 19-percent decline. The majors pursued a variety of cost-cutting strategies, but they generally retrenched their gasoline marketing operations,<sup>12</sup> made greater use of lower-cost distribution channels (and less use of higher-cost distribution channels), or both.<sup>13</sup> Higher-cost distribution channels sell motor gasoline through company-operated and dealer-operated branded retail outlets. Alternatively, lower-cost distribution channels sell motor gasoline through wholesale and direct sales. Thus, restructuring increased use of lower-cost motor gasoline distribution channels and increased the productivity of direct-supplied FRS branded retail outlets.

Based on the analysis of the net refining margin presented in this section, it appears that lower environmental operating costs after 1995 were a contributor, but not the major

<sup>12</sup> Retrenchment refers to the majors exiting areas of the country in which their refining/marketing operations were lagging the operations of other companies. Although this strategy implies that the number of directly supplied branded outlets of the majors will decline, it does not necessarily imply that the use of directly supplied outlets also declines. Although this outcome is possible, the company could simply increase its reliance on high-volume outlets, resulting in little apparent change in the amount of motor gasoline sold through directly supplied outlets, which decline in number.

<sup>13</sup> For example, see Energy Information Administration, *Restructuring: The Changing Face of Motor Gasoline Marketing* (DOE/EIA, September 2001). This is an Internet-only report and is located at <http://www.eia.doe.gov/emeu/finance/sptopics/downstrm00/index.html>. See also Energy Information Administration, *Performance Profiles of Major Energy Producers 2000*, DOE/EIA-0206(2000) (Washington, DC, January 2002), p. 42. (This report is available on the Internet at <http://tonto.eia.doe.gov/FTP/ROOT/financial/020600.pdf>.)

contributor, to the growth in profitability of the majors' U.S. refining/marketing operations. However, operating costs are only part of the total impact on profitability of environmental requirements. Depreciation charges and the share of the investment base attributable to environmental requirements are also part of the ROI calculation. These latter components of profitability depend on the path of capital expenditures, both environmentally related and otherwise. The next section reviews capital expenditures and their effects on depreciation charges and the environmentally related investment base.

## **Recent Surge in Refining Investment Led by Mergers and Acquisitions**

### **Overall Capital Expenditures**

After reaching a 1990's peak of \$6.1 billion (2001 dollars) in 1992, the majors' capital expenditures for U.S. refining operations steadily declined until 1997, hitting \$2.0 billion (2001 dollars) in that year. Since 1997, the majors' capital expenditures surged dramatically, reaching \$12.1 billion in 2001 (Figure 6). The sharp upswing in spending is largely traceable to mergers and acquisitions in 1998, 2000, and 2001. Table 2 lists the mergers and acquisitions that had an effect on capital expenditures in those years. Most of the transactions were between the majors.

Companies that EIA added to the FRS respondent group (starting with the 1998 reporting year) were especially active in mergers and acquisitions. The companies added in 1998 (the "entrants") included CITGO Petroleum, Equilon Enterprises (part of Chevron Texaco in 2001), Lyondell-CITGO Refining, Motiva Enterprises, Premcor (formerly named Clark Refining and Marketing), Tesoro Petroleum, Tosco (acquired by Phillips Petroleum in 2001), Ultramar Diamond Shamrock (acquired by Valero Energy in 2001), Valero Energy, and Williams Companies.<sup>14</sup>

These companies grew to prominence in U.S. petroleum refining beginning in the mid-1990's, as the established majors (the "incumbents") restructured their downstream petroleum operations. The restructurings often involved sales of refining assets by the incumbents to the entrants. Also, refining and marketing assets were sometimes reorganized into joint ventures operated apart from the joint venture partners. For example, Equilon Enterprises, a joint venture between Shell Oil and Texaco (and later absorbed into Shell Oil when Chevron and Texaco merged in 2001)<sup>15</sup> and Motiva

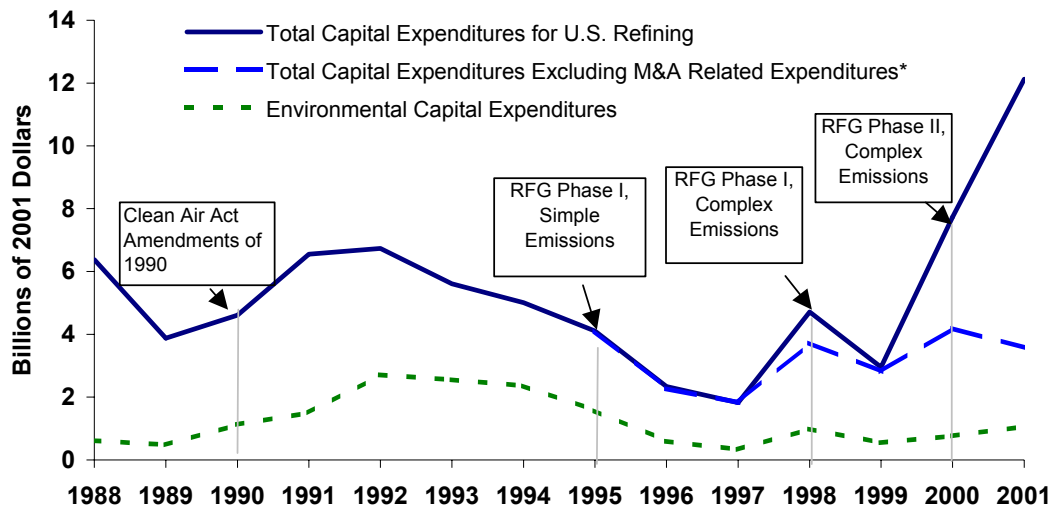
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<sup>14</sup> For a more extensive examination of this group of refiners and their substantial growth, see Energy Information Administration, *Performance Profiles of Major Energy Producers 1997*, DOE/EIA-0206(97) (Washington, DC, January 1999), pp. 60-64. (This report is available on the Internet at <http://tonto.eia.doe.gov/FTP/ROOT/financial/020697.pdf>.)

<sup>15</sup> The U.S. Federal Trade Commission required that Texaco's share of the Equilon and Motiva joint ventures be divested prior to approving Chevron's merger with Texaco. Shell ultimately purchased Texaco's share of the Equilon venture and both Shell and Saudi Aramco purchased Texaco's share of Motiva. The result was that Shell was the sole owner of Equilon (which was included with other assets in what is now known as Shell Products US) and Shell and Saudi Aramco are equal partners in Motiva.

Enterprises, a joint venture between Shell Oil, Texaco, and Saudi Aramco, were part of the restructurings.

**Figure 6. U.S. Refining Capital Expenditures for FRS Companies, 1988-2001**



\*: Note that total capital expenditures excluding M&A related expenditures only cover the period 1995 through 2001. Sources: U.S. refining capital expenditures - Energy Information Administration, Form EIA-28 (Financial Reporting System) Environmental capital expenditures - 1990-1996: American Petroleum Institute, *Petroleum Industry Environmental Performance* (Washington, DC, May 1997), pp. 47-48. 1997-2001: American Petroleum Institute, *U.S. Oil and Natural Gas Industry's Environmental Expenditures* (Washington, DC, February 2003), p. 9. FRS environmental capital expenditures are prorated by share of U.S. crude distillation capacity.

The addition of the entrants was largely responsible for the jump in capital expenditures between 1997 and 1998, even apart from mergers and acquisitions. Excluding mergers and acquisitions, capital expenditures increased from \$2.0 billion (2001 dollars) in 1997 to \$3.5 billion (2001 dollars) in 1998 (Figure 6), of which the addition of the entrants to the FRS respondent group accounted for 95 percent.<sup>16</sup> Capital expenditures, excluding mergers and acquisitions, have been essentially flat between 1998 and 2001, averaging \$3.6 billion (2001 dollars).

### Environmentally Related Capital Expenditures

Environmentally related capital expenditures also peaked, declined, and rose during the 1990's, largely to comply with the Clean Air Act Amendments of 1990. The Clean Air Act Amendments of 1990 required production of oxygenated gasoline by late 1992, lower sulfur diesel fuels by late 1993, and reformulated gasoline by January 1, 1995. In the 1988 to 1989 period, prior to the Clean Air Act Amendments of 1990, environmentally related capital expenditures by the majors for their U.S. refining operations averaged \$0.5 billion (2001 dollars) annually. Thereafter, largely in response to the Clean Air Act Amendments

<sup>16</sup> Energy Information Administration, Form EIA-28 (Financial Reporting System) and company public disclosures.

**Table 2. Mergers, Acquisitions, and Related Transactions by FRS Companies in U.S. Refining, 1998, 2000, and 2001**

Year and Acquiring Company	Acquisition
<b>Mergers and Acquisitions between FRS Companies</b>	
<b>1998</b>	
Valero Energy	Mobil's Paulsboro, New Jersey refinery
Tesoro Petroleum	Shell Oil's Anacortes, Washington refinery
Premcor	BP's Lima, Ohio refinery
<b>2000</b>	
BP	Atlantic Richfield Company (ARCO)
Valero Energy	Exxon Mobil's Benicia, California refinery
Tosco	BP's Alliance, Louisiana refinery
Ultramar Diamond Shamrock	Tosco's Avon, California refinery
Tosco	Equilon's Wood River, Illinois refinery
<b>2001</b>	
Phillips Petroleum	Tosco
Valero Energy	Ultramar Diamond Shamrock
Tesoro Petroleum	BP's Mandan, North Dakota and Salt Lake City, Utah refineries and associated facilities
Valero Energy	El Paso's Corpus Christi refinery
<b>Other Acquisitions by FRS Companies</b>	
<b>1998</b>	
Tesoro Petroleum	Broken Hill Proprietary's Ewa Beach, Hawaii refinery
<b>2001</b>	
Valero Energy	Huntway Refining Co.

Sources: Company annual reports to shareholders and press releases.

of 1990, environmentally related capital expenditures rose steeply, peaking at \$2.7 billion (2001 dollars) in 1992. Expenditures remained well above \$2 billion for each of the next two years. In 1995, the year in which reformulated gasoline was required by the implementation of the Clean Air Act Amendments of 1990 to be supplied to designated areas, environmentally related capital expenditures were \$1.6 billion (2001 dollars). After refiners passed the reformulated gasoline milestone, environmentally related capital expenditures plunged to \$0.3 billion (2001 dollars) in 1997, less than what was being spent annually in the 1988 to 1989 period.

In 1998, the majors' environmentally related capital expenditures for U.S. refining rose to \$1.0 billion. About 70 percent of the rise was due to the addition of the entrants to the FRS group. However, the incumbents hiked their environmentally related capital expenditures by over 60 percent in 1998. The Phase I complex emissions regulations for reformulated gasoline, which went into effect in that year, were the likely cause of this increase in outlays. Phase II of these regulations became effective in 2000. Accordingly,

the majors' environmentally related capital expenditures for U.S. refining were up 41 percent in 2000 and 39 percent in 2001.

Although the majors' environmentally related capital expenditures for U.S. refining totaled \$1.0 billion in 2001, this was a considerable decline from the levels of the 1991 to 1995 period, adjusted for inflation. The decline in environmentally related capital expenditures is even more dramatic when viewed in the context of the majors' total capital expenditures for U.S. refining operations. As a share of total capital expenditures, the majors' environmentally related capital expenditures rose from 10 percent in 1988 to nearly 50 percent in the 1993 to 1994 period (Figure 7). Since then, the share has steadily declined, hitting only 9 percent in 2000 and 2001. Much of the fall in the share was because of the impact of heavy merger and acquisition activity in recent years on overall capital expenditures for U.S. refining. But even in 1997, before most of the heightened merger and acquisition activity, the share was down to 18 percent.

### **Effects on Profitability**

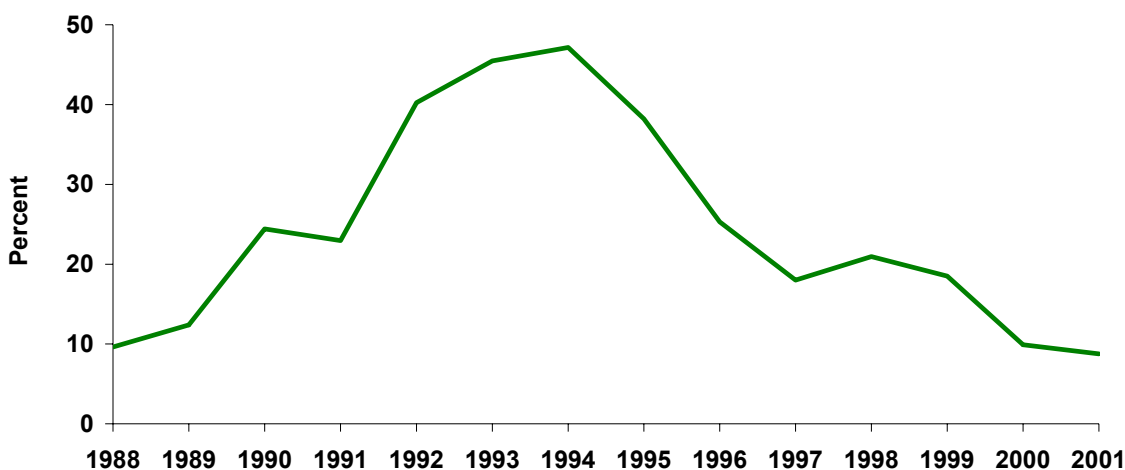
The lower level of environmentally related capital expenditures after 1995 had two effects on the profitability of the majors' U.S. refining/marketing operations. First, depreciation expenses for environmentally related assets tended to decline. Estimated environmentally related depreciation expenses declined from \$745 million (2001 dollars) in 1995 to \$673 million in 2001. When measured relative to the volume of refined product sales, depreciation charges for environmentally related assets fell by 42 percent over the same period (Table 3). In terms of direct impact on U.S. refining/marketing profitability, environmentally related depreciation expenses fell from 1.4 percent, relative to the U.S. refining/marketing investment base, in 1995, to 0.9 percent in 2001.

Second, the share of fixed assets accounted for by environmental investments declined after 1995. Environmental investments incur expenses (i.e., for operation and depreciation) but do not produce revenues directly. Consequently, when the share of environmental investments in a company's overall investment base increases, the rate of return is negatively affected. Conversely, when the environmentally related share falls, profitability tends to rise, other things being equal. When the majors' environmentally related capital expenditures surged in the first half of the 1990's, the environmentally related share of U.S. refining fixed assets more than doubled, from 8 percent in 1988 to 17 percent in 1995. Since then, the share declined steadily, to 12 percent in 2001.

In that environmental compliance incurs operating costs, depreciation expenses, and investments that do not add to the bottom line, the changes since 1995 noted above should have reduced the negative impact of environmental compliance on U.S. refining/marketing profitability. As reported in the next section, this is indeed the case, but the overall impact on profitability was still greater than before the Clean Air Act Amendments of 1990.



**Figure 7. Environmental Capital Expenditures as a Share of U.S. Refining Capital Expenditures for FRS Companies, 1988-2001**



Sources: U.S.refining capital expenditures - Energy Information Administration, Form EIA-28 (Financial Reporting System) Environmental capital expenditures - **1988-1989**: American Petroleum Institute, *Petroleum Industry Environmental Performance* (Washington, DC, May 1997), pp. 47-48 and U.S. Department of Commerce, Bureau of the Census, *Pollution Abatement Costs and Expenditures* (various issues) (Washington, D.C.). (Estimates of expenditures were made by applying the ratio of the American Petroleum Institute series to the corresponding Census series for the 1990-1994 overlap period to the Census values for 1988 and 1989.) **1990-1996**: American Petroleum Institute, *Petroleum Industry Environmental Performance* (Washington, DC, May 1997), pp. 47-48. **1997-2001**: American Petroleum Institute, U.S. Oil and Natural Gas Industry's Environmental Expenditures (Washington, DC, February 2003), p. 9. FRS environmental capital expenditures are prorated by share of U.S. crude distillation capacity.

## **Impacts of Environmental Requirements on Refining/Marketing Profitability, though Reduced, Remain Sizable**

To estimate the impact of environmental requirements on the profitability of the majors' U.S. refining/marketing operations, actual profitability will be compared to profitability excluding the financial effects of environmental requirements.

In the previous two sections of this report, the financial effects of environmental requirements were presented: namely, environmentally related operating costs, environmentally related depreciation charges, and the share of net fixed assets attributable to environmental requirements. The ratio of income, excluding environmentally related operating costs and depreciation, to net fixed assets excluding the part of the investment base attributable to environmental requirements, is an accounting measure of profitability that excludes the financial effects of environmental requirements. It should be noted that this measure does not include any estimates of the impacts on energy market dynamics (including 9/11) that might have occurred in the absence of environmental requirements on the U.S. refining industry.

The measure of profitability used to estimate the impacts of environmental requirements is the operating return on investment (operating ROI) for the majors' U.S. refining/marketing line of business, as reported on Form EIA-28. Operating ROI is the ratio of the majors' annual U.S. refining/marketing operating income (i.e., revenues minus operating expenses) to the value of net property, plant, and equipment allocated to

**Table 3. Components of U.S. Refining/ Marketing Operating Return on Investment for FRS Companies, 1988, 1995, and 2001**

	1988	1995	2001
	millions of 2001 dollars		
Environmental Depreciation Expense	293	745	673
Environmental Operating Costs	1,890	2,186	3,057
	2001 dollars per barrel of refined product sales		
Environmental Depreciation Expense	0.04	0.13	0.08
Environmental Operating Costs	0.36	0.49	0.34
	percent share of U.S. refining/marketing net PP&E		
Environmental Depreciation Expense	0.6	1.4	0.9
Environmental Operating Costs	3.9	4.4	4.3
Environmental Share of U.S. Refining/ Marketing net PP&E (percent)	7.6	17.5	11.6

Note: net PP&E = net property, plant, and equipment.

Sources: Energy Information Administration, Form EIA-28 (Financial Reporting System); American Petroleum Institute, *Petroleum Industry Environmental Performance* (Washington, DC, May 1997); American Petroleum Institute, *U.S. Oil and Natural Gas Industry's Environmental Expenditures* (Washington, DC, February 2003).

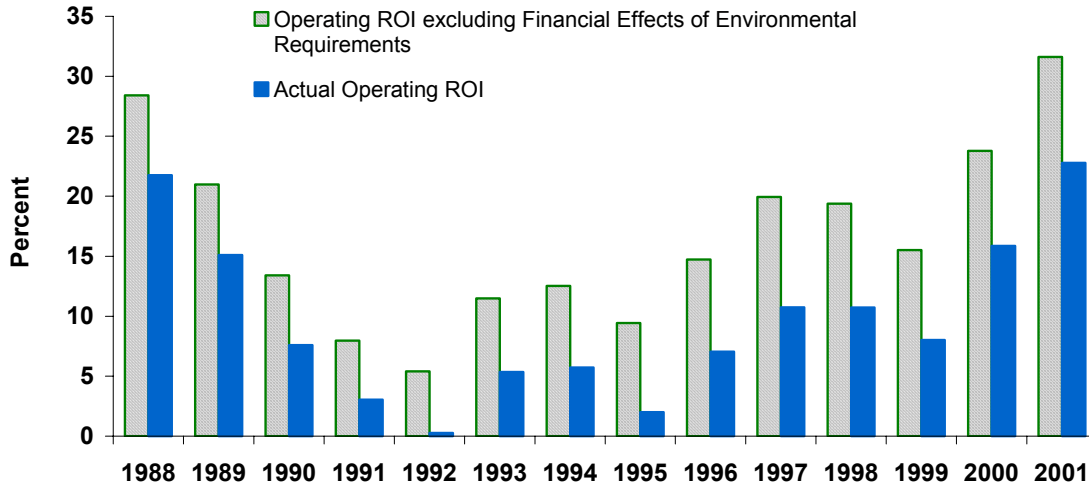
U.S. refining and marketing operations.<sup>17</sup> This measure correlates strongly with ROI based on net income (ROI is shown in Figure 1). Using operating ROI has the advantage of not having to estimate environmentally related effects on affiliate income, income taxes, and gains/losses from asset sales.

Two adjustments are made to calculate operating ROI exclusive of the financial effects of environmental requirements. First, environmentally related operating costs and depreciation charges are excluded from operating income. Second, net property, plant, and equipment attributable to environmental requirements is excluded from the investment base. Operating ROI with these adjustments and actual ROI are shown in Figure 8.

The impact of environmental requirements on the profitability of the majors' U.S. refining/marketing operations appeared to remain substantial after 1995. Actual operating ROI averaged 58 percent of the value of operating ROI excluding the effects of environmental requirements, over the 1996 to 2001 period (Table 4). That is, actual profitability was 42 percent below the estimated level of profitability without environmental compliance. The estimated impact for the 1996 to 2001 period is less than the 69-percent reduction in profitability over the 1991 to 1995 period, which was when U.S. refiners' environmentally related capital expenditures nearly tripled in order to meet environmental requirements, particularly the requirements of the Clean Air Act Amendments of 1990. However, the 42-percent reduction in profitability in the 1996 to

<sup>17</sup> Stated differently, net income is operating income plus income from unconsolidated affiliates plus gains on asset sales minus income taxes.

**Figure 8. Operating Return on Investment in U.S. Refining/Marketing for FRS Companies, 1988-2001**



Note: Operating Return on Investment (Actual Operating ROI) = operating income as a percent of net property, plant, and equipment (PP&E). Operating ROI excluding financial effects of environmental requirements = operating income less environmental operating costs less environmental depreciation expenses as a percent of net PP&E less environmental net PP&E.  
 Sources: Energy Information Administration, Form EIA-28 (Financial Reporting System); American Petroleum Institute, *Petroleum Industry Environmental Performance* (Washington, DC, May 1997); American Petroleum Institute, *U.S. Oil and Natural Gas Industry's Environmental Expenditures* (Washington, DC, February 2003).

2001 period exceeds the 32-percent reduction in profitability attributable to environmental compliance in the 1988 to 1990 period prior to the implementation of the Clean Air Act Amendments of 1990.

**Table 4. U.S. Refining/ Marketing Operating Return on Investment for FRS Companies, 1988- 2001**  
(percent)

<b>Year</b>	<b>Actual Operating ROI</b>	<b>Operating ROI less Environmental Effects</b>	<b>Operating ROI less Environmental Effects Minus Actual Operating ROI</b>	<b>Actual ROI as a Percent of ROI less Environmental Effects</b>
1988	21.8	28.4	6.6	76.6
1989	15.1	21.0	5.9	72.0
1990	7.6	13.4	5.8	56.6
1991	3.0	8.0	4.9	38.2
1992	0.3	5.4	5.1	4.9
1993	5.4	11.5	6.1	46.6
1994	5.7	12.5	6.8	45.7
1995	2.0	9.4	7.4	21.3
1996	7.0	14.7	7.7	47.8
1997	10.7	19.9	9.2	53.8
1998	10.7	19.4	8.7	55.3
1999	8.0	15.5	7.5	51.7
2000	15.9	23.8	7.9	66.7
2001	22.8	31.6	8.8	72.0
<b>Averages</b>				
1988-1990	14.8	20.9	6.1	68.4
1991-1995	3.3	9.4	6.1	31.3
1996-2001	12.5	20.8	8.3	57.9

Note: The earlier study utilized environmental cost and expenditure data from U.S. Bureau of the Census, Pollution Abatement Costs and Expenditures: 1994, MA200(94)-1(Washington, DC, 1996), pp. 6-7, available at <http://www.census.gov/econ/www/mu1100.html>, and earlier editions of the Census report. However, after 1994, Census only published data for 1999. Since the American Petroleum Institute data are continuous over the 1990 to 2001 period, they were utilized for this study. Estimates of costs and expenditures were made by applying the ratio of the American Petroleum Institute series to the corresponding Census series for the 1990-1994 overlap period to the Census values for 1988 and 1989.

Sources: Energy Information Administration, Form EIA-28 (Financial Reporting System); American Petroleum Institute, *Petroleum Industry Environmental Performance* (Washington, DC, May 1997); American Petroleum Institute, *U.S. Oil and Natural Gas Industry's Environmental Expenditures* (Washington, DC, February 2003).

## Appendix

By request of EIA's Analysis Review Board, data that are available prior to 1988 for the figures in the report are in the following tables.

**Table A1. Data for Figure 1: Return on Investment in U.S. Refining/Marketing and Other Lines of Business for FRS Companies**

(percent)

Year	ROI for U.S. Refining/Marketing	ROI for All Other Businesses
1977	7.2	12.2
1978	7.5	12.1
1979	9.8	16.5
1980	9.8	16.8
1981	4.4	14.5
1982	6.0	9.7
1983	4.8	9.7
1984	0.3	10.0
1985	6.5	9.2
1986	4.5	5.4
1987	2.9	7.8
1988	14.7	8.7
1989	11.5	7.9
1990	5.1	9.6
1991	2.0	7.0
1992	-0.4	5.6
1993	3.4	6.6
1994	3.6	7.0
1995	1.0	9.8
1996	4.4	12.2
1997	6.6	11.4
1998	7.9	3.3
1999	6.5	7.2
2000	9.6	13.7
2001	14.5	9.6

Source: Energy Information Administration, Form EIA-28 (Financial Reporting System)

**Table A2. Data for Figure 4: U.S. Refining/Marketing Margins and Operating Costs for FRS Companies**  
(2001 Dollars per Barrel of Refined Product Sold)

<b>Year</b>	<b>Gross Refining Margin</b>	<b>Operating Costs</b>	<b>Net Refining Margin</b>
1977	8.35	6.94	1.41
1978	8.70	7.16	1.54
1979	8.84	7.06	1.78
1980	11.06	9.13	1.93
1981	11.86	10.42	1.45
1982	11.72	10.30	1.42
1983	10.52	9.39	1.13
1984	9.05	9.04	0.01
1985	10.81	9.19	1.63
1986	9.08	8.10	0.98
1987	7.48	7.27	0.21
1988	9.31	6.89	2.43
1989	8.69	6.74	1.94
1990	9.06	7.58	1.49
1991	8.64	7.74	0.90
1992	8.19	7.74	0.45
1993	7.87	7.05	0.83
1994	6.80	5.99	0.81
1995	6.17	5.62	0.55
1996	7.10	6.15	0.96
1997	7.28	5.70	1.58
1998	6.42	4.81	1.61
1999	5.72	4.57	1.15
2000	7.24	4.95	2.29
2001	7.90	5.12	2.78

Source: Energy Information Administration, Form EIA-28 (Financial Reporting System)

**Table A3. Data for Figure 5: Price Difference between Light Crude Oil and Heavy Crude Oil**  
(2001 Dollars per Barrel)

<b>Year</b>	<b>Difference between all countries crude w/API gravity of 20.1 or less and 40.1 or more</b>
1978	4.94
1979	14.98
1980	23.91
1981	20.83
1982	19.18
1983	12.87
1984	7.02
1985	5.50
1986	5.52
1987	3.65
1988	4.37
1989	5.50
1990	8.37
1991	10.19
1992	9.24
1993	6.84
1994	4.93
1995	4.06
1996	5.22
1997	7.05
1998	6.57
1999	5.85
2000	7.24
2001	8.83

Source: Energy Information Administration, *Petroleum Marketing Monthly*, DOE/EIA-0380, Tables 27 and 28.

**Table A4. Data for Figure 6: U.S. Refining Capital Expenditures for FRS Companies**  
(\$2001 billion)

Year	FRS Total Capital Expenditures for U.S. Refining	FRS Share of Environmental Expenditures (based on API)	FRS Share of Environmental Expenditures (based on Census)
1974	13.9		3.2
1975	13.8		3.1
1976	11.9		2.1
1977	5.9		1.5
1978	7.1		1.5
1979	9.4		1.4
1980	9.0		1.1
1981	12.0		1.0
1982	12.9		1.1
1983	8.9		0.7
1984	8.2		0.4
1985	4.9		0.4
1986	3.5		0.5
1987	3.6		0.5
1988	6.4	0.6	0.5
1989	3.9	0.5	0.3
1990	4.6	1.1	0.7
1991	6.5	1.5	0.9
1992	6.7	2.7	1.7
1993	5.6	2.6	1.5
1994	5.0	2.4	1.4
1995	4.1	1.6	
1996	2.3	0.6	
1997	1.8	0.3	
1998	4.7	1.0	
1999	3.0	0.5	
2000	7.7	0.8	
2001	12.1	1.1	

Sources: U.S.refining capital expenditures - Energy Information Administration, Form EIA-28 (Financial Reporting System)

Environmental capital expenditures - **1990-1996:** American Petroleum Institute, Petroleum Industry Environmental Performance (Washington, DC, May 1997), pp. 47-48. **1997-2001:** American Petroleum Institute, U.S. Oil and Natural Gas Industry's Environmental Expenditures (Washington, DC, February 2003), p. 9. FRS environmental capital expenditures are prorated by share of U.S. crude distillation capacity. **1974-1994:** U.S. Bureau of the Census, Pollution Abatement Costs and Expenditures: 1994, MA200(94)-1(Washington, DC, 1996), pp. 6-7, available at <http://www.census.gov/econ/www/mu1100.html>, and earlier editions of the Census report. Since the American Petroleum Institute data are continuous over the 1990-2001 period, they were utilized for this study. Estimates of costs and expenditures were made by applying the ratio of the American Petroleum Institute series to the corresponding Census series for the 1990-1994 overlap period to the Census values for 1988 and 1989.