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BY THE COMPTROLLER GENERAL

Report To The Congress

OF THE UNITED STATES

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U.S. Refining Capacity: How Much Is Enough?

From 83 to 92 percent of the Nation's petroleum products have been provided from U.S.-based refineries. Between now and 1985, the U.S. refining industry is planning capacity additions which should maintain this position. Whether or not refinery additions should take place will involve domestic and international trade-offs. This report discusses petroleum product demand, industry expansion plans, and Federal policies affecting those plans.

The Department of Energy has initiated a study to identify future U.S. refining capacity needs. As a part of this study, the Secretary of Energy should:

--Analyze implications of alternative levels of U.S. refining capacity.

--Determine U.S. refining capacity needs in view of these implications.

--Determine what additional incentives or disincentives, if any, would be needed to bring about the development of this optimum capacity.

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report

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COMPTROLLER GENERAL OF THE UNITED STATES
WASHINGTON, D.C. 20548

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To the President of the Senate and the
Speaker of the House of Representatives

This report discusses the need for the Department of Energy to specifically define refining capacity needs after evaluating the domestic and international trade-offs involved. It reviews the following domestic factors: (1) concern for air quality and related air quality regulations, (2) multiple use of the coastal zone under the Coastal Zone Management Act, (3) pricing and allocation regulations, (4) gasoline lead content restrictions, (5) environmental and technological requirements for desulfurization equipment, and (6) the Crude Oil Entitlements Program.

We made our review pursuant to the Budget and Accounting Act of 1921 (31 U.S.C. 53), and the Accounting and Auditing Act of 1950 (31 U.S.C. 67).

We are sending copies of this report to the Director, Office of Management and Budget; the Secretaries of Energy and Commerce; the Administrator, Environmental Protection Agency; and interested congressional committees.

Comptroller General
of the United States

COMPTROLLER GENERAL'S
REPORT TO THE CONGRESS

U.S. REFINING CAPACITY: HOW MUCH IS ENOUGH?

D I G E S T

Regardless of efforts to reduce consumption of oil in the United States, oil will remain an important domestic energy source until the Nation is able to shift to renewable and essentially inexhaustible sources.

All studies GAO has seen conclude that oil consumption in the United States will grow through 1985, even though estimates vary as to the growth rate. The National Energy Plan offered two consumption extremes by 1985--a low of 18.2 million barrels per day if the plan had been enacted as proposed and a high of 22.8 million if no action were taken.

In an earlier report, GAO concluded the administration overstated the Nation's ability to develop and use other sources of energy by the oil equivalent of 3.9 million barrels per day. Even if the plan had been enacted as proposed, 1985 petroleum product consumption will be closer to the administration's high demand estimate.

A fundamental question the Nation now faces is how much domestic refining capacity to maintain.

The United States historically has provided between 83 and 92 percent of its total refining needs--16.2 million barrels.per day in 1977. Most of the rest is imported from Caribbean countries and Canada.

The U.S. refining industry currently is planning capacity increases to meet almost 100 percent of the administration's 1985 low-demand estimate and about 85 percent of the administration's high-demand estimate. Whether planned capacity increases will or should occur as proposed depends on several factors and uncertainties.

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There are national security and economic advantages in encouraging domestic refining capacity, which must be weighed against the disadvantages. For instance, if the United States increases its dependence on foreign refineries to supply petroleum products, it could become subject to an even less desirable product embargo. Increased domestic refining capacity will also contribute to domestic employment and the economy.

The main disadvantages of continuing this historical relationship between domestically refined and imported products include environmental impacts and international considerations, such as the potential costs of unused capacity if exporters refuse to provide or reduce production of crude oil. There is considerable potential to increase the Nation's product imports to help meet 1985 requirements and avoid increasing domestic environmental impacts.

The Caribbean area probably will continue to be the major exporter of petroleum products to the United States in 1985. Other areas also have potential to increase product exports to the Nation: European refineries may have a surplus capacity of 2.4 million barrels per day by 1985; Africa and the Middle East also may have surplus capacity for product exports.

DOMESTIC FACTORS AFFECTING FUTURE REFINING CAPACITY

Because refineries are sources of air pollution, concern for air quality is probably the key domestic issue affecting future refining capacity. Over 80 percent of existing refining capacity is located in areas which are in violation of air quality standards for one or more pollutants. After July 1, 1979, no new industrial plant can be built in these areas unless the State has adopted and the Environmental Protection Agency has approved an air pollution control plan that will assure full compliance with air quality standards by a specified date. It is apparent that new or expanded refinery construction in many areas may be restricted

until substantial improvements are made in air quality.

Other factors affecting future U.S. refinery capacity are:

--The Coastal Zone Management Act. This provides incentives for each State to develop a federally approved plan for multiple use of its coastal zone. Although planning is only in the early stages, constraints on the location of refineries in the coastal zone are being considered by some States.

--Pricing and allocation regulations. Petroleum industry officials claim that the Federal Government has created a web of complicated regulations which restrain domestic refinery expansion. This assessment was corroborated by the December 1976 Presidential task force report which called for the elimination of product price and allocation regulations for refiners and resellers. The administration is considering whether to submit a gasoline decontrol proposal for congressional approval in 1979.

--Gasoline lead content restrictions. The Environmental Protection Agency is requiring (1) reductions in the lead content of gasoline and (2) unleaded gasoline to be supplied by large service stations. Additional modern catalytic reforming equipment will be needed, and 1.5 to 2.0 percent additional crude oil must be used in the refining process although there will be some increase in liquid propane gas. Two estimates of capital needed between 1974-75 and 1985 to install facilities to make unleaded gasoline are $3.2 and $5.7 billion.

--Environmental and technological requirements for desulfurization equipment. In order to meet State environmental standards and to be able to process future domestic and imported high-sulfur crude, many U.S. refiners will need additional desulfurization and sulfur recovery

equipment. This additional capacity will require higher capital investment and operating costs.

--The Department of Energy's Entitlements Program. The Department of Energy established its Entitlements Program to foster competition in the refining industry and generally to equalize the costs of foreign and lower priced domestic crude oil to U.S. refiners. However, a segment of this program encourages construction of small but relatively inefficient and inflexible refineries by permitting small refiners to purchase crude oil at a price lower than the cost of oil to others.

CONCLUSIONS AND RECOMMENDATIONS

After reviewing domestic programs and policies and international considerations, we believe that the Department of Energy has not comprehensively evaluated the tradeoffs necessary to establish a definitive U.S. refining policy. However, the Department of Energy recently initiated a study to identify future U.S. refining capacity needs.

As part of this study, GAO recommends that the Secretary of Energy:

--Analyze the international and domestic implications of alternative levels of U.S. refining capacity and determine the criteria for Government involvement in effecting any desired levels. This analysis should include an evaluation of the environmental, economic, national security, and technical trade-offs necessary to meet various domestic capacity levels.

--Based on the above trade-off analysis, determine future U.S. refining capacity needs considering such factors as the optimum mix of refinery sizes necessary to insure desired levels of U.S. petroleum products and the optimum relationship with U.S. petroleum product consumption.

--Consistent with the trade-off analysis, determine the policies and actions, if

any, necessary to influence attainment of optimum domestic capacity, and submit such documentation and analysis to the appropriate congressional energy committees. The submission should include a detailed analysis of the advantages and disadvantages of using incentive versus disincentive alternatives to meet the desired capacity needs. It should also include an analysis of the probable marketplace reactions to (1) existing and (2) fewer Government regulations. In addition, the submission should include any needed legislative proposals and milestones upon which to judge the effectiveness of such policies and actions in meeting the needs and in the event that progress is not being made, a determination of what additional incentives or disincentives are needed.

AGENCY COMMENTS

Copies of the draft report were sent to the Department of Energy, Environmental Protection Agency, and Department of Commerce. The Department of Commerce had no major problems with the report and provided only informal technical comments, which were incorporated in the text.

Department of Energy

In July 1978 the Department said the report contained useful information on the U.S. refinery situation, particularly on the trade-offs between increased refinery capacity and other energy-related goals. However, it questioned the practicality of preparing a cost/benefit analysis of U.S. refining capacity needs.

In November 1978 the Department provided additional comments to our report. It stated that contracts are currently being prepared and efforts are underway which will provide information and data required to develop a definitive refinery policy. Overall, these efforts would appear to be a first step toward implementing the recommendations in the report.

Environmental Protection Agency

The Agency said that the report will make a significant contribution to discussion of U.S. refining capacity issues. However, the Agency believes several sections should be clarified, which has been done.

The Agency does not expect air quality standards to significantly constrain future increases in domestic refining capacity. However, the Agency is studying the issue. Until the Environmental Protection Agency provides evidence to the contrary, GAO will continue to believe that if present air quality standards and laws are enforced as written, new or expanded refinery construction in many areas may be restricted until substantial improvements are made in air quality.

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ABBREVIATIONS

DOE	Department of Energy
EPA	Environmental Protection Agency
GAO	General Accounting Office
PAD	Petroleum Administration for Defense

CHAPTER 1

INTRODUCTION

For at least 20 years until 1970, the United States enjoyed an abundance of energy which supplied goods and services unequaled in any other country. During this period, petroleum consumption increased from 6.5 million to 14.7 million barrels per day while the Nation's dependence on petroleum to meet its energy needs increased from 40 to 44 percent. By 1970 U.S. crude oil production had peaked at 9.6 million barrels per day, but domestic consumption continued to grow at about 5 percent a year. Thus, in 1977, petroleum consumption increased to 18.4 million barrels per day while domestic crude oil production averaged 8.2 million barrels per day, resulting in crude oil imports of 6.5 million barrels per day. 1/

Factors contributing to increased petroleum product use were the

--initially low crude oil costs;

--environmental objections to burning coal;

--decrease in natural gas availability; and

--increased gasoline demand.

The quadrupling of world crude oil prices during the 1973-74 Arab oil embargo--from $3 to $11 a barrel--demonstrated that the relatively low energy prices, which had prevailed for two decades, would no longer remain. 2/ It also caused the Nation to realize that domestic production was declining and petroleum shortages would have to be borne by the consumer either through increased prices, voluntary conservation, or reduced availability of desired products, such as gasoline and home heating oil.

Government action in response to domestic shortages of crude oil and petroleum products resulted in new programs and regulations intended to stimulate production, foster conservation, restrict imports, and otherwise insure against future shortages. Reducing oil imports is a primary goal of the administration. The administration believes that the oil exporting countries will not be able to satisfy all the increases in demand expected to occur in the United States and other

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Note: Numbered footnotes to chapter 1 are on page 6.

countries throughout the 1980s. 3/ The Congress recently passed the National Energy Act, which is designed to help reduce oil imports.

Despite the concern for future crude oil supply, until the United States is able to shift to renewable and essentially inexhaustible sources of energy, oil will remain an important domestic energy source. It is within this context that the oil industry must plan its activities to meet future consumption patterns. This report concentrates on refining--the segment of the oil industry which transforms crude oil into products needed by various consumers.

PETROLEUM REFINING

Crude oil, as it is extracted from the ground, must be altered and separated--or refined--before it can be used. Of the several known refining processes, the major ones are separation, conversion, and treating. 4/

Separation involves boiling the crude oil and permitting it to vaporize and condense at different temperatures. This process yields petroleum products that are more or less determined depending on the type of crude oil.

The conversion process alters the chemical structure of crude oil and results in an increased yield and quality of certain products, such as gasoline. There are several conversion processes, but the basic ones are cracking and polymerization. Cracking is the process of breaking down large complex molecules into smaller ones, while polymerization--generally the reverse of cracking--consists of linking two or more small molecules together. By using cracking conversion methods, refiners can obtain 25 to 60 percent more gasoline than with separation methods. 5/

Treating crude oil essentially removes undesired impurities such as sulfur, vanadium, nickel, iron, oxygen compounds, and nitrogen compounds. Sulfur and sulfur compounds, the most significant contaminants, are usually removed through various processes known as hydroprocessing. This involves mixing the petroleum with hydrogen and heating it in the presence of a catalyst to produce hydrogen sulfide. The hydrogen sulfide is later removed and sent to a sulfur recovery unit and the unused hydrogen is separated and recycled. 6/

U.S. refineries produce gasoline, jet fuels, kerosene, diesel fuel, and fuel oils as their principal products. They also produce lubricants, waxes, solvents, asphalt oil, and petrochemical raw materials for products such as plastics, synthetic rubber, and synthetic fibers. The proportions of

the principal products vary with the refinery design, location, and time of year. For example, refineries in the northeastern United States maximize gasoline production during the summer and maximize heating oil during the winter. 7/ The following tabulation classifies the most familiar petroleum products in descending order--from lightest to heaviest finished products.

Fractions	Finished products
Liquid refinery gases	Butane Propane
Light ends	Dry cleaning solvent Paint solvent Gasolines
Distillates	Kerosenes Jet fuels Heating oil Diesel fuel
Lube distillates	Lubricating oils Waxes
Residuals	Navy special fuel oil Nos. 4, 5, and 6 fuel oils
Bottoms	Asphalt Coke

ADEQUATE REFINING CAPACITY: HOW MUCH IS ENOUGH?

As of January 1, 1978, there were 302 refineries in the United States*, providing a combined capacity of 17.0 million barrels of oil per day. 8/ During 1977 these refineries supplied an average of 16.2 million barrels per day or about 88 percent of the total U.S. demand for petroleum products. As shown in the following table, this was consistent with the percentage of domestic consumption since 1960. 9/

*This does not include four refineries in Puerto Rico and the Virgin Islands, which are considered part of the Caribbean exporting capacity.

Table 1

U.S. Petroleum Product Supply and Demand

Year	Domestic demand	Products imported	Domestic supply (note a)	Domestic supply as percent of domestic demand
	-----(million barrels per day)------			
1960	9.8	0.8	9.0	92
1965	11.5	1.2	10.3	89
1970	14.7	2.1	12.6	86
1971	15.2	2.3	13.0	85
1972	16.4	2.5	13.8	85
1973	17.3	3.0	14.3	83
1974	16.6	2.6	14.0	84
1975	16.3	1.9	14.4	88
1976	17.4	2.0	15.4	89
1977	18.4	2.2	16.2	88

a/Includes natural gas liquids, only a portion of which is sent to refineries for gasoline production.

A fundamental question that must be faced now is what constitutes adequate U.S. refining capacity. Whether the United States should continue its historical relationship between domestically refined and imported products, or alter the ratio to either encourage or discourage domestic refining capacity involves trade-offs between the advantages and disadvantages of alternate courses of action. For example, maintaining high capacity levels has several disadvantages, including air quality and land use impacts, as well as potential costs of unused capacity if exporters refuse to provide or reduce production of crude oil. Also, encouraging U.S. capacity would not help to relieve the current excess refining capacity problem in Europe. These disadvantages are discussed in more detail throughout the report. On the other hand, there are national security and economic advantages in encouraging U.S. capacity which must be weighed against the disadvantages. For instance, if the United States increases its dependence on foreign refineries to supply petroleum

products, it could become subject to an even less desirable product embargo.

Domestic refining capacity also contributes to domestic employment, not only in the plants themselves but also in related support industries. The Department of Energy (DOE) estimates that for every million barrels per day of refining capacity exported, 31,500 permanent jobs are lost, and another 12,000 refinery construction jobs are lost for 3 years.

PURPOSE AND SCOPE OF REPORT

This report synthesizes existing literature and information on U.S. refineries, and addresses the subjects of petroleum product demand, industry plans for capacity expansion, and Federal policies which affect those plans. It also identifies the principal problems and trade-offs associated with the formulation of a U.S. refining policy.

The sources of information include the Federal Trade Commission, the Congressional Research Service, the Congressional Budget Office, the Departments of Energy* and the Interior, the Environmental Protection Agency, and the Central Intelligence Agency. We also included data obtained from major and independent refineries, petroleum industry trade associations, and members of academia.

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*The Department of Energy Organization Act (Public Law 95-91) transferred the functions of the Federal Energy Administration, Energy Research and Development Administration, Federal Power Commission, and certain energy-related activities of other agencies to DOE. This was effective on October 1, 1977. For simplicity, statements made and data published under the former agency name are attributed to DOE.

FOOTNOTE REFERENCES (Chapter 1)

1/ Derived from: Federal Energy Administration, Energy in Focus: Basic Data (Washington: U.S. Government Printing Office, 1977) pp. IC and IIB; and United States Department of Energy, August 1978 Monthly Energy Review (Washington: U.S. Department of Energy, 1978) pp. 10 and 12.

2/ Federal Energy Administration, Project Independence Report (Washington: U.S. Government Printing Office, 1974) p. 285.

3/ Executive Office of the President, The National Energy Plan (Washington: U.S. Government Printing Office, 1977) p. VII.

4/ American Petroleum Institute, Facts About Oil (Washington: American Petroleum Institute, 1977) p. 23.

5/ Ibid., p. 24.

6/ United States Department of Energy, Trends in Desulfurization Capabilities, Processing Technologies, and the Availability of Crude Oils (Washington: U.S. Department of Energy, 1977) p. 10.

7/ Science and Public Policy Program, University of Oklahoma, Energy Alternatives: A Comparative Analysis (Washington: U.S. Government Printing Office, 1975) pp. 3 to 25.

8/ United States Department of Energy, Energy Information Administration, Petroleum Refineries in the United States and Puerto Rico, January 1, 1978. (Washington: U.S. Department of Energy, 1978) p. 3.

9/ Derived from: Federal Energy Administration, Future Refinery Capacity Needs, Construction Incentives, and Processing Configurations (Washington: Federal Energy Administration, 1977) p. II-3; and United States Department of Energy, August 1978 Monthly Energy Review (Washington: U.S. Department of Energy, 1978) pp. 10 and 12.

CHAPTER 2

U.S. CONSUMPTION AND IMPORTS OF PETROLEUM PRODUCTS

Except for 1974 and 1975--the immediate aftermath of the Arab oil embargo--U.S. consumption of petroleum products has steadily increased over time. In fact, consumption nearly doubled between 1960 and 1977--from 9.8 to 18.4 million barrels per day. Various major forecasts of 1985 consumption expect the trend to continue although they do not agree at what rate. Historically, U.S. refineries have supplied 83 to 92 percent of this consumption, with the remainder being imported primarily from the Caribbean.

This chapter examines past and future oil consumption. It discusses the administration's projections with and without the proposed National Energy Plan and recent congressional action on the plan. It also discusses prospects for increased product imports from the Caribbean and other countries.

PAST AND FUTURE CONSUMPTION

The Nation consumes more gasoline than any other refined product. During 1972-77, U.S. consumption of major petroleum products, by percentages is shown as follows. 1/

Table 1

U.S. Consumption of Petroleum Products, 1972-1977

Refined product	Percent of consumption
Gasoline	40
Distillate fuel oil	18
Residual fuel	16
Natural gas liquids	8
Jet fuel	6
All others	12

Note: Numbered footnotes to chapter 2 are on pages 16 and 17.

Future product consumption depends on a number of uncertain variables, such as availability and price of crude oil, economic growth, and Government policies. Since the 1973-74 embargo, private industry and Government have given increased attention to projecting these variables as a basis for energy planning. We examined 12 such projections of potential oil consumption in 1985. They were all prepared in 1976 and 1977 and represent a cross-section of private and public sources. Five were by Government agencies, four by petroleum refining companies, two by energy consulting firms, and one by a bank.

As shown in table 2, these forecasts of consumption generally range from 18.2 to 22.8 million barrels per day. 2/

Table 2

U.S. Refined Product Consumption in 1985

Source	Forecast (million barrels per day)
The administration, assuming enactment of National Energy Plan, April 1977	18.2
International Trade Commission, September 1977	19.2
Chevron, October 1977	20.6
Gulf, March 1977	20.8
Petroleum Industry Research Foundation, Inc., October 1977	21.1
Petroleum Economics, Ltd., June 1978	21.6
Bankers Trust Company, 1976	21.7
Shell, September 1976	21.9
Exxon, January 1977	22.0
Central Intelligence Agency, April 1977 (note a)	22.2
Congressional Research Service, June 1977	22.7
The administration, assuming National Energy Plan not enacted, April 1977	22.8

a/Estimate ranges from 22.2 to 25.0 million barrels per day.

The two extreme estimates were prepared by the administration in connection with the National Energy Plan. Table 3 compares these two estimates. 3/

Table 3

Refined Product Consumption in 1985

(million barrels per day)

Source of refining supply	With plan	Without plan	Increase (decrease) with plan
Domestic	10.6	10.4	0.2
Refining gains (note a)	0.6	0.9	(0.3)
Imports	7.0	11.5	(4.5)
Total	18.2	b/22.8	(4.6)

a/Refinery processing gains occur because petroleum products, such as gasoline, are larger in volume than crude from which they are derived.

b/Assumes compliance with automobile efficiency standards under current law, and reduced driving as a result of higher gasoline prices. Without these assumptions, consumption would be 25.0 million barrels per day.

THE NATIONAL ENERGY PLAN: EFFECTS ON CONSUMPTION

The primary purpose of the proposed National Energy Plan was to reduce dependence on imported oil and, thereby, reduce vulnerability to interruption or reduction of foreign oil supplies. To reduce dependence on imports, the plan proposed a variety of legislative, administrative, and budgetary actions designed to

--lower the growth rate of total energy consumption and make the U.S. stock of capital goods more energy efficient,

--shift industrial and utility consumption from oil and natural gas to coal and other more abundant resources, and

--advance the development of new energy sources for the long-term future.

In a July 1977 report to the Congress, 4/ we concluded that even with enactment of its plan, the administration

overestimated the 1985 domestic supply of coal, natural gas, and nuclear power, as well as the Nation's ability to switch from oil and gas to coal as follows.

Table 4

National Energy Plan 1985

Overestimate of Domestic Energy Supply

	Million barrels per day oil equivalent
Coal	2.3
Natural gas	1.0
Nuclear power	0.6
Total	3.9

Because the administration overestimated domestic supplies of oil*, gas, coal, and nuclear power, we estimated that 1985 oil imports would be about 12.0 to 13.0 million barrels per day, or 5.5 to 6.5 million barrels per day more than the administration's plan indicates. The 3.9-million-barrel-per-day overestimate of gas, coal, and nuclear power implies a higher future consumption of petroleum than the administration estimated. Therefore, even if the plan had been enacted as proposed, we believe 1985 petroleum consumption will be closer to the administration's high demand estimate of 22.8 million barrels per day.

National Energy Act

In November 1978 the President signed five separate acts, hereafter referred to as the National Energy Act of 1978 (Public Laws 95-617 to 621)--the result of about 1-1/2 years' congressional deliberation over the administration's National Energy Plan. The act includes the following measures designed to reduce consumption of petroleum products:

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*In a later report to the Congress (EMD-78-5, Oct. 14, 1977), we concluded that domestic oil production was also overestimated by 1.6 to 2.6 million barrels per day.

--In the transportation sector, which consumes about half of U.S. petroleum products, (1) a graduated excise tax on gas-guzzling cars that fall substantially below federally mandated fleetwide mileage standards for each year and (2) additional tax programs to reduce demand.

--In the residential and commercial sector, which uses distillates to heat homes and businesses, a reduction in wasted energy in buildings and appliances through incentives, regulations, and tax credits for conservation measures.

--In the industrial sector, which uses residual fuel as a boiler fuel, conservation measures and the switching to coal and other fuels through a regulatory program to require the use of coal.

Two key measures of the National Energy Plan which would have affected petroleum consumption were not passed--the crude oil equalization and oil- and gas-users taxes. As a result of these and other changes, DOE estimates 1985 oil import savings from the act will be 2.4 to 3.0 million barrels per day--a reduction of 1.6 to 2.2 million barrels per day 1985 oil equivalent savings from the administration's estimate of savings if its plan had been enacted. This reduction in oil savings further reinforces our conclusion that 1985 petroleum consumption will be closer to 22.8 million barrels per day.

PETROLEUM PRODUCT IMPORTS

We had estimated earlier 5/ that even with the administration's plan, oil imports will increase to about 12.0 to 13.0 million barrels per day by 1985; we did not estimate how much would be product and how much would be crude oil imports. This depends, in large part, on the factors and uncertainties affecting future U.S. refining capacity discussed in the next chapter.

The greatest level of reliance on product imports, in percentage terms, came in 1973; the lowest level of reliance on imports was in 1960. In 1977 product imports provided almost 12 percent of consumption, or about 2.2 million barrels per day.

Although the United States imports all major types of refined products to some extent, most of its imports are residual fuel oil. In 1977 residual fuel imports supplied almost half of domestic residual fuel oil consumed and constituted over 60 percent of all products imported.

Most of the Nation's imports in that year were from the Caribbean and Canada, as shown on the following table. 6/

Table 5

Source of Petroleum Product Imports

(thousand barrels per day)

Caribbean	
Venezuela	438
Virgin Islands	466
Netherlands Antilles	214
Trinidad	155
Bahamas	167
Puerto Rico	105
Panama	5
Total Caribbean area	1,550
Non-Caribbean	
Canada	238
Europe	175
Africa	71
Others	142
Total non-Caribbean area	626
Total product imports	2,176

Caribbean area

The Caribbean is the largest source of U.S. product imports, providing over 70 percent of 1977 product imports. Venezuela provided almost 30 percent of the Nation's total Caribbean imports.

The refining capacity of the Caribbean area is 4.6 million barrels per day, 3.1 million barrels per day of which is available for export. One study estimates the Caribbean

export capacity will increase moderately (about 0.2 million barrels per day) by 1985. 7/ The Caribbean imports about 39 percent of its supply of crude oil from eastern hemisphere crude sources. 8/

During February 1977 in congressional hearings, questions were raised about the security of the Caribbean area as the Nation's main source of petroleum product imports. As a result of these hearings, DOE reevaluated the Nation's dependence on the Caribbean area. DOE believes that Caribbean-area refineries are a safe source of refined petroleum products. It stated in its March 1978 amendment to the Strategic Petroleum Reserve plan that the national security agencies believe there is a very low probability that any non-U.S. Caribbean refiner would refuse to furnish products to the United States if the refiners have a continuing crude oil supply. 9/ Further, Caribbean refineries have been designed and built to supply the U.S. market. Thus, the Caribbean position as a major exporter of petroleum products to the United States probably will continue.

Other sources of products

Canada is the next largest source of U.S. product imports, supplying 0.2 million barrels per day in 1977. In that year, Canadian refining capacity was 2.1 million barrels per day. Canada is reducing its crude oil exports to the United States, but its policies and potential for increasing product exports are uncertain at this time. In April 1978 we were advised by an official of DOE's Office of Oil and Gas that, in his view, major increases in product exports from Canada are unlikely.

Excess refining capacity in Europe, however, is a major problem. In the past year, most European refineries have been operating at less than 65 percent capacity, and refiners' financial losses have been increasing. In 1977 European refining capacity was about 20.7 million barrels per day. To cut losses, European refiners have taken out of service 1.6 million barrels per day of capacity. Officials within the European Economic Community have stated that another 1.2 million barrels per day will have to be shut down. The Community also has sought to delay any new refinery construction. Unused capacity in Europe could further increase as the Middle East expands its ability to export products to serve European and other markets.

It appears that considerable potential exists for the United States to increase product imports from Europe. U.S. imports of European petroleum products were only 0.2 million barrels per day in 1977. A recent study by Petroleum Economics

Limited, states that western European refineries may have 2.4 million barrels per day surplus capacity by 1985. 10/ However, it also states that there may be problems meeting the type and quality of petroleum products required by the United States. For example, European refineries may not be able to meet U.S. lead content standards for gasoline. The study concludes that if Europe is to provide increased levels of products to the United States, it is likely that firm contracts between U.S. importers and European refiners would be required.

Africa and the Middle East also may have some surplus capacity for product exports in the future. Although the United States imported only 71,000 barrels per day from Africa in 1977, African refining capacity has increased 150 percent between 1967 and 1977, from less than 0.6 to 1.5 million barrels per day.

Like Africa, the Middle East exports negligible amounts of products to the United States. However, several Middle East countries are planning to build more refining capacity. While some additions will be used to meet local demand, a portion will be available for export. If Middle East producers tie the export of crude oil to the acceptance of refined products, the United States might import more Middle East products, which could result in unused domestic refining capacity.

In summary, there is considerable potential to increase product imports to help meet U.S. product requirements in 1985. The Caribbean area will probably continue to be the major exporter of petroleum products to the United States. Potential also exists to increase product imports from other areas. The extent of the Nation's future reliance on product imports will depend, in large part, on U.S. policies and programs affecting domestic refining capacity and international considerations, such as the potential costs of unused capacity if exporters refuse to provide or reduce production of crude oil.

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CHAPTER 3

DOMESTIC FACTORS AFFECTING FUTURE U.S. REFINING CAPACITY

Domestic refineries supplied from 83 to 92 percent of the refined products consumed between 1960 and 1977. It appears that sufficient domestic refining capacity is being planned to meet almost 100 percent of the administration's 1985 low-demand estimate and about 85 percent of the administration's high-demand estimate (18.2 and 22.8 million barrels per day, respectively). In this chapter, we discuss the current and projected growth of domestic refining capacity and domestic factors which could affect those projections.

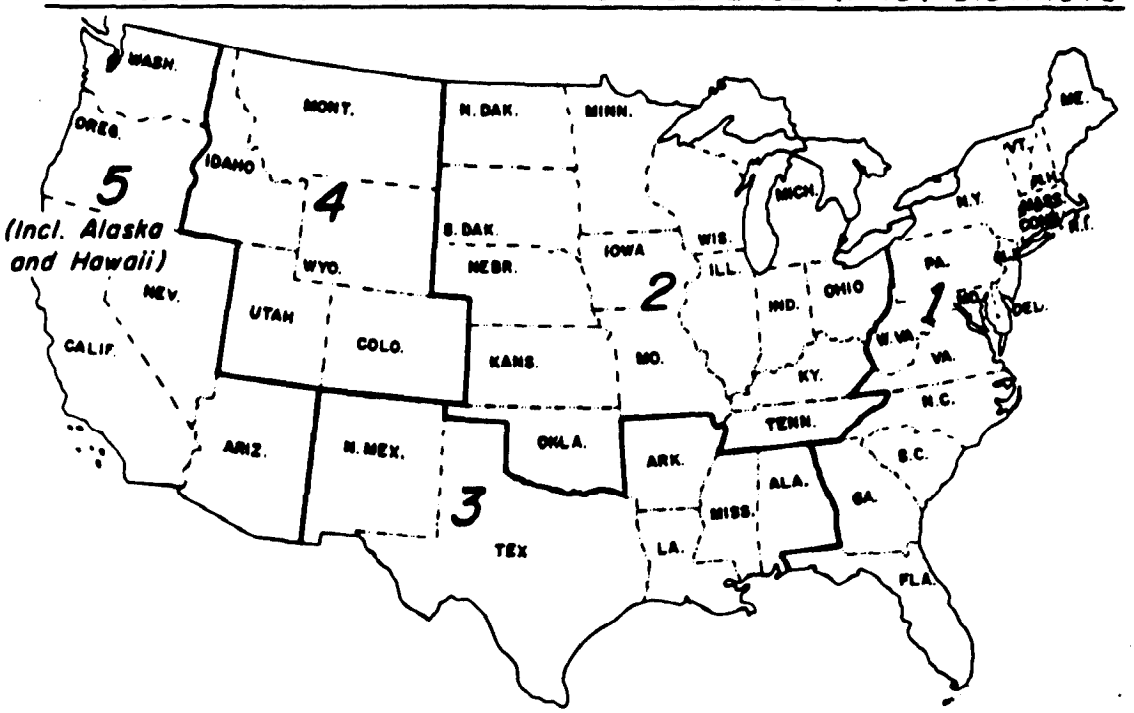
DOMESTIC REFINING CAPACITY

U.S. refineries are located in Petroleum Administration for Defense (PAD) Districts as shown on the following map. 1/ Currently, 43 percent of U.S. refining capacity is located in the Gulf Coast area, PAD District III. Since 1960 its capacity growth rate has been about 4 percent a year. In comparison, the East Coast area, PAD District I, currently has 11 percent of domestic capacity and an annual growth rate of less than 1 percent since 1960. The East Coast has a comparatively high petroleum product demand but, in 1977, supplied only 25 percent of its products. Most of its products are obtained from Gulf Coast and Caribbean refineries.

Note: Numbered footnotes to chapter 3 are on pages 31 and 32.

Figure 1

PETROLEUM ADMINISTRATION FOR DEFENSE (PAD) DISTRICTS



Based mainly on a review of industry plans for expansion, DOE issued a June 1977 report projecting that refining capacity will increase to over 18.6 million barrels per day by January 1982. 2/ One month later, DOE issued another report on U.S. refining needs which stated that even if some of the projects scheduled to come on stream between 1977 and 1982 fail to materialize, the addition of as little as 1.0 million barrels per day would meet the low 1985 demand projection of 18.2 million barrels per day, assuming enactment of the National Energy Plan. 3/

Using DOE's capacity projection of 18.6 million barrels per day, we calculated that products available for consumption in 1982 would approximate 19.2 million barrels per day. Because we believe 1985 demand will be closer to 22.8 million barrels per day, we estimate 19.4 million barrels per day will be needed by 1985 if the United States is to refine about 85 percent of its oil product consumption. Thus, if industry plans are completed as proposed, only an additional 0.2 million barrels per day would be needed between 1982 and 1985.

There is no guarantee, however, that industry expansion projects will be completed as planned. There are a number of domestic factors which affect future overall refining capacity

and the Nation's ability to process high-sulfur, heavy crude oil to meet demand for specific products, such as unleaded gasoline.

DOMESTIC FACTORS AFFECTING FUTURE CAPACITY

Key domestic factors which affect the Nation's 1985 domestic refining capacity are:

--Pricing and allocation regulations.

--Air quality standards.

--The Coastal Zone Management Act.

--Gasoline lead content restrictions.

--Environmental and technological requirements for desulfurization equipment.

Other domestic factors which affect or have the potential to affect 1985 U.S. refining capacity are DOE's Entitlements Program and oil and gas taxes in the proposed National Energy Plan, which could be reintroduced in the Congress.

Pricing and allocation regulations

Petroleum industry officials claim that the Federal Government, through its regulatory activities, has created a web of complicated regulations that are restraining domestic refinery expansion. This assessment was corroborated by a December 1976 Presidential task force report on regulatory reform. 4/ The report called for the elimination of DOE product price and allocation regulations for refiners and resellers. The report states that (1) present product supply conditions are adequate and (2) such regulations are unnecessary and discourage the construction of new refinery capacity.

One aspect of the regulations is a controversial cost passthrough requirement. Under this requirement, certain costs, such as changes in raw material quality and capital needs, are not recognized as recoverable costs. For example, high-sulfur crude oil, although less expensive, costs $1 to $2 per barrel more to refine than low-sulfur oil. 5/ According to industry testimony, if a refiner invests in facilities to run less expensive high-sulfur crude, he is not allowed, under Federal passthrough controls, to recover the investment cost of the new facilities. 6/ In addition, the refiner must reduce his product prices by the amount of his raw material

savings. Thus, there is no economic incentive for refiners to invest capital in desulfurization equipment. This regulation may become a greater problem as high-sulfur crude oil becomes an increasing percentage of domestic production. However, the elimination of price controls or this regulation could resolve the current disincentive to invest in desulfurization equipment.

The previous administration, in line with the Presidential task force report recommendation, proposed the decontrol of gasoline prices*, but before the proposal was considered by the Congress, it was withdrawn for further study by the current administration. In November 1978 DOE issued a draft environmental impact statement on its gasoline decontrol proposal. The administration is considering whether to submit a gasoline decontrol proposal to the Congress in 1979. The refining industry claims that this would eliminate cost pass-through problems and provide an incentive for refinery expansion without greatly increasing the price of gasoline.

Environmental concerns

The size and configuration of the U.S. refining industry can be seriously affected by various environmental concerns and laws. DOE reported in June 1977 that 13 projects on the East Coast, which would have added 1.7 million barrels per day to capacity, have not been constructed due to citizen and group environmental opposition. 7/ It should be noted that three of the projects would not have been proposed if others had been built. A listing of these projects is shown in appendix I. One of the more difficult issues involves striking a proper balance between the Nation's energy needs and its need to protect the health and environment of its citizens. The major environmental issues which affect future refining capacity are:

--Air quality standards and implementation of the Coastal Zone Management Act, which affect the location of new refinery capacity.

--Environmental Protection Agency (EPA) lead standards to help control automobile emissions, which affect the amount of crude oil input to the refining process.

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*Gasoline, which comprises about half of the U.S. refinery output, is the only major refined product under price control.

--The ability of U.S. refineries to process increasing amounts of high-sulfur, heavy crude oil to meet technical and environmental standards.

Air quality standards

Refineries are contributors to an area's "smog" problem. Refineries emit hydrocarbons which react with nitrogen dioxide and sunlight to form ozone, a photochemical oxidant. The ozone effects on humans include eye irritation and lung inflammation. Ozone concentrations found in urban air aggravate the breathing of individuals with respiratory problems and increase susceptibility to bacterial infection.

The Clean Air Act, as amended (42 U.S.C. 7401 et seq.), was passed to protect and enhance the Nation's air resources so as to promote the public health and welfare. The act precludes construction or expansion of any facility that emits a pollutant in a nonattainment area--a region where air quality standards have not been met for one or more pollutants--unless an offset is found for the new source of pollution. The offset provision permits a new source of pollution in a nonattainment area until July 1, 1979, and then, only if the new source's emissions are controlled to the greatest degree possible and are more than offset by a reduction in emissions from existing facilities in the area. Thereafter, no new industrial plants can be built unless the State has adopted, and EPA has approved, an air pollution control plan that will assure full compliance with air quality standards by 1982 (1987 for photochemical oxidants and carbon monoxide).

The widespread number of nonattainment areas has caused concern regarding the ability of several industries to expand, including the refining industry. Currently, over 80 percent of domestic refining capacity is in nonattainment areas. Under the current offset provision, if a company is allowed to construct or expand a refinery in a nonattainment area, it has to more than offset the new pollutants by reducing the emissions from either its own facilities in the area or possibly those of other companies. It is apparent that if present Federal air quality standards and laws are enforced as written, new or expanded refinery construction in many areas may be restricted until substantial improvements are made in air quality.

Coastal Zone Management Act

U.S. coastal zones*, including the Great Lakes, contain some of the Nation's most valuable assets. Consequently, they have been subjected to increasing and competing demands. For instance, 60 percent of U.S. refining capacity is concentrated in the four coastal States of Texas, Louisiana, California, and New Jersey. Therefore, the Coastal Zone Management Act of 1972, as amended (Public Law 92-583), was passed to provide States with incentives to use their coastal resources wisely. 8/

Although only a few States have federally approved coastal zone management plans, the impact of the act is already being experienced by refiners. California, based on the implementation of its federally approved plan, disallowed a receiving and separation facility in Santa Barbara County. The State wanted the facility to locate in a developed area which the company believed was too expensive. A compromise was later reached, however, when California allowed an existing coastal facility to be expanded. Delaware recently submitted its draft coastal zone plan for Federal review. The plan would prohibit the siting of any heavy industry, including refineries, in part of the coastal zone. An official of the National Oceanic and Atmospheric Administration's Office of Coastal Zone Management told us in February 1978 that a general policy is emerging to encourage future development primarily in those areas which have already experienced some development.

Lead content in gasoline

Under the authority of the Clean Air Act, EPA regulates fuel and fuel additives which endanger the public health or which interfere with the performance of anti-pollution control devices. Lead can impede the effectiveness of anti-pollution control devices, and atmospheric lead is known to be a danger to human health. As a result, EPA now requires large service stations to supply unleaded gasoline to prevent interference with anti-pollution control devices in newer automobiles. EPA has also required a reduction in the lead content of gasoline from an average of 1.7 grams a gallon to 0.8 grams a gallon by

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*The coastal zone includes the coastal waters and the adjacent shorelands. The zone stretches inland only as far as necessary to control shorelands whose uses have a direct and significant impact on the coastal waters. The zone typically includes beaches; marshes; estuaries; sand dunes; and industrial, commercial, and residential complexes.

January 1, 1978, and to 0.5 grams a gallon by October 1, 1979, to protect human health. It has, however, extended the January 1978 deadline for some refiners who were unable to meet the standard but were continuing to make good faith efforts to achieve it.

In order to provide unleaded gasoline with octane ratings required by U.S. automobiles, 1.5 to 2.0 percent additional crude oil must be used in the refining process. Based on 1977 consumption of gasoline, about 145,000 barrels per day of refining distillation capacity will have to be added, although there will be some increase in liquid propane gas.

To meet future increasing demand for unleaded gasoline, modern catalytic reforming equipment will be needed. A May 1976 EPA contract study by Arthur D. Little, Inc., estimated that the refining industry will need to invest $5.7 billion (1975 dollars) from 1975 to 1985 to put in facilities to make unleaded gasoline. 9/ Fifty-six percent, or $3.2 billion, will be for new construction; 44 percent, or $2.5 billion, will be for upgrading existing refineries. In an April 1976 EPA contract study, Turner, Mason, and Solomon, Inc., estimated a lower figure--$3.2 billion (1974 dollars)--from 1974 to 1985 to meet both unleaded gasoline and lead phasedown requirements. 10/

High-sulfur crude oil

To meet EPA and sometimes more stringent State sulfur dioxide emission standards, refined petroleum products are restricted in sulfur content. For instance, in California and Hawaii the sulfur content of most fuel oil is limited to 0.5 percent. Some sections of California have a 0.25 percent limit.

Of the 247 Air Quality Control regions of the Nation, only 44, or about 18 percent, are nonattainment for sulfur dioxide. Thus, sulfur dioxide standards are not expected to be a major factor which could limit the siting options for new refineries. However, because new domestic crude oil produced from Alaska and future crude oil imports are expected to have a high sulfur content, sulfur content standards may have a greater impact on the amount and type of future refinery expansion.

In addition, most of this crude oil is expected to be heavier in density and yield higher percentages of heavy petroleum products, such as residual fuel and asphalt. Thus, to meet future demand for lighter products, such as gasoline and jet fuel, and to meet sulfur standards, existing refineries will need additional capacity. An industry official told us

that about 2.0 million barrels per day of current U.S. capacity must be modernized and another 2.0 million barrels per day of incremental refining capacity must be built to process high-sulfur crude oil to meet projected demand for products in the mid-1980s. Desulfurization and sulfur recovery capacity requires 2-1/2 years lead time in comparison with a new refinery, which requires about 4 years lead time. Thus, plans made today to process heavy, high-sulfur crude oil will not result in additional capacity before the early 1980s.

But this additional capacity will involve higher capital investment and operating costs. In 1976 EPA estimated that operating costs of desulfurization would be 17 cents a barrel for a 100,000-barrel-per-day refinery which processes high-sulfur, light imported crude oil. 11/ In a later study, however, DOE reported that to build and operate a 250,000-barrel-per-day refinery handling crude oil of similar quality, about $2,300 investment and $0.44 operating costs per barrel would be incurred to remove the sulfur. 12/ A similar size refinery handling low-sulfur, light crude would cost $1,400 and $0.20, respectively. For a small refiner operating a 15,000-barrel-per-day plant, the costs would be about double. In summary, it generally costs twice as much to process high-sulfur crude as to process low-sulfur crude. Further, it costs the small refiner about twice as much per barrel as the large refiner for desulfurization.

Entitlements Program

The Emergency Petroleum Allocation Act of 1973 (Public Law 93-159) mandated that DOE provide for a competitive petroleum industry by preserving the competitive viability of independent and small refiners. Concern was expressed that independent and small refiners may not be able to compete with oil companies with access to domestic crude oil controlled at prices below imported oil.

In response to this mandate, DOE established the Crude Oil Entitlements Program in November 1974 generally to equalize the costs of foreign and lower-priced domestic crude oil to all refiners. The program also provided additional benefits to small refiners (processing 175,000 barrels per day or less) to offset any advantages large refineries might have due to economies of scale. This adjustment allows small refiners to acquire oil, on the average, for 54 cents a barrel less

than the cost of oil to other refiners after entitlements.* The adjustment is commonly referred to as the small refiner bias.

Further, the Entitlements Program placed the Caribbean refineries outside Puerto Rico and the Virgin Islands at a competitive disadvantage. Because these refineries had to buy crude oil at higher world levels, they were unable to compete with U.S. refineries. To offset this disadvantage, DOE, in February 1976, initiated a residual fuel oil program commonly referred to as "reverse entitlements." This program was designed to (1) improve the competitiveness of certain Caribbean refineries that sell products to the East Coast and (2) insure the financial viability of those U.S. marketers that depend on Caribbean-refined products.

Under this program, domestic refineries were penalized 50 percent of the benefits they receive under the Entitlements Program for every barrel of residual fuel they sell on the East Coast in excess of 5,000 barrels per day. In addition, DOE allowed East Coast residual fuel oil importers a 30-percent equivalent product entitlement benefit.

According to DOE and the refiners we contacted, the program has created strong disincentives for sales of domestically refined residual fuel oil to the East Coast. Furthermore, because the program discriminates against domestic refiners not benefiting from the Entitlements Program, they are encouraged to use their residual oil for lesser value uses, such as feedstock for asphalt and paving products. Although DOE recognized the problems created by the program, in May 1978 it proposed an increase from the current 30-percent equivalent entitlement benefit to a 100-percent entitlement benefit for East Coast residual fuel importers. In July 1978 hearings were held. DOE's proposed change was preempted, however, by an amendment to its appropriation for fiscal year 1979. This amendment and subsequent regulatory changes by DOE resulted in (1) elimination of U.S. refiners' penalty for selling residual fuel to the East Coast except for refiners which ship products in foreign flag vessels between U.S. ports and (2) an increase from the current 30-percent equivalent entitlement benefit to a 50-percent entitlement benefit for East Coast and Michigan residual fuel importers. The new

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*The benefit for small refiners can range from $0.06 to $1.89 a barrel depending on the size of the small refinery. For example, very small refineries processing 10,000 barrels per day or less receive the greatest cost reduction.

regulations are in effect from July 1, 1978, through June 30, 1979. These new actions will help to eliminate some of the problems associated with reverse entitlements.

The National Energy Plan stated that by 1981, when the crude oil equalization tax was proposed to be fully in effect, the Entitlements Program would be terminated, and certain regulatory activities could be phased out. Whether in fact this would happen, if the tax were enacted, is questionable in view of recent events. For example, as of July 1, 1978, entitlement benefits are to be provided to refiners who process shale oil and liquid petroleum substitutes from coal, tar sands, biomass, and solid waste. Further, DOE is studying a crude oil pricing system which would abolish crude oil ceiling prices and only require entitlement obligations. Thus, the future direction of the Entitlements Program is uncertain. Its relationship to (1) any reintroduction of the crude oil equalization tax, (2) crude oil price controls, and (3) the need for a small refiner bias is unknown at this time, adding to the uncertain investment climate for U.S. refiners today.

Oil and gas taxes

The proposed National Energy Plan created substantial uncertainties for refiners. It proposed major changes in the prices they pay for their primary input--crude oil--and possible restrictions on the prices they could charge for refined products. The two measures were referred to as (1) the crude oil equalization tax and (2) the oil- and gas-users tax. The Congress excluded these measures from the approved National Energy Act. However, because these mechanisms may be reintroduced in the Congress, we are discussing their potential impact on U.S. refining capacity.

Crude oil equalization tax

The feature of the plan which would have most significantly affected refiners was the crude oil equalization tax. Basically, to encourage conservation, the tax would increase the price of most domestic crude oil to that charged by the rest of the world. The tax on "old" oil was intended to be imposed in three stages (at the beginning of 1978, 1979, and 1980) to raise current prices paid by consumers to the 1977 world price plus domestic inflation. The tax would be applied to "new" oil at one time--the beginning of 1980. Thereafter, the tax would be increased with the world price. However, if the world price rises significantly faster than the rate of domestic inflation, authority would exist to limit increases in the tax. 13/

The exact effect of the equalization tax depends on a number of variables which cannot be forecast precisely such

as domestic inflation, increases in world oil prices, and the volume of oil imports. However, our analysis of the administration's estimates shows that the tax would raise the average price of domestic and imported crude oil from about $10.80 a barrel to $13.50 a barrel (both in 1977 dollars), an increase of almost 25 percent.

Critical to refiners' financial health is the question of how much of this tax they can pass through to consumers of refined products. This passthrough ability may be affected both by the market for such products and by Government controls. Estimates of the industry's ability to pass through those increased costs vary greatly.

--The Congressional Budget Office estimates 90 percent.

--The administration estimates 67 percent.

--F. Eberstadt & Co., a stock brokerage firm, estimates 50 percent. 14/

According to administration estimates, 1976 industry after-tax profits were $7.5 billion. The administration further estimated that the equalization tax in fiscal year 1980 would amount to about $12.0 billion. If the industry absorbs $1.2 billion of the tax as increased costs--Congressional Budget Office's 10-percent estimate--profits would be about $0.6 billion less than in 1976, a decrease of 8 percent. If the industry absorbs $6 billion--Eberstadt's 50-percent estimate--the loss in profit would be $3.1 billion, or 42 percent. Both estimates assume that the industry faces a 48-percent marginal tax rate.

Because even the smallest of these estimates would result in a sizable reduction in industry profits, it is important to be able to gauge the passthrough accurately. The administration's estimate was based on a comparison of wholesale prices at New York for five European-refined products, with comparable wholesale product prices in this country if the equalization tax were enacted. The administration concluded that the "pressure of world markets" would require refiners to absorb one-third of the tax.

However, we believe the administration's analysis has weaknesses:

--The "spot price" data used may not accurately reflect long-term trends, and data for only 1 month were used.

--The analysis did not address whether European refineries have the potential to restrain U.S. prices, nor whether

European-refined products meet the quality requirements of this country. For example, unleaded gasoline is not currently made in Europe.

The Congressional Budget Office and Eberstadt estimates both appear better grounded. They examine underlying pricing patterns for various refined products and also differentiate among various regions of the country. A key difference between them is how much of the tax refiners will be able to pass through on gasoline as distinguished from residual fuel oil and other products.

The wide divergence among two generally creditable analyses suggests that

--the equalization tax might have serious adverse financial impacts on domestic refiners and

--the administration needs to devote further study to this issue prior to any reintroduction of a crude oil equalization tax.

Oil- and gas-users tax

Another National Energy Plan feature of potential importance to refiners was the proposed oil- and gas-users tax. This tax was designed to increase the cost of oil and natural gas relative to the price of coal, and thereby encourage existing and prospective industrial and utility consumers to switch to coal. 15/

Refineries consume vast amounts of oil and gas, and this tax, as originally proposed, would also have affected refiners' costs. Before it was eliminated from the National Energy Act, however, both House and Senate versions of the bill made oil and gas exempt from taxation if the use of other fuels (1) would affect the manufacturing process or (2) is precluded by Federal or State air pollution regulations. The House version also provided an exemption (1) when the use of other fuels is not economically and environmentally feasible or (2) for any facility that was in existence or under construction on April 20, 1977.

Notwithstanding these exemptions, about one-fifth of the oil and gas consumption of a typical refinery could have been subject to the tax because the fuels are used for purposes other than for process heat. Moreover, because the exemptions were conditioned upon a showing of economic or environmental infeasibility, or violation of air pollution regulations, it could have taken considerable time for DOE and the courts to fully define the conditions qualifying a user for an exemption.

Accordingly, this tax, if reintroduced to the Congress, would create uncertainty for refiners and, together with the crude oil equalization tax, may adversely affect refinery expansion and modernization plans.

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In summary, after reviewing domestic programs and policies and international considerations, we question whether, under present U.S. policy, U.S. refineries will be able to maintain the historical relationship between domestically refined and imported products. It should be noted that the administration has not decided whether the historical relationships are the targets it should be trying to maintain. We believe that DOE has not comprehensively evaluated the environmental, technical, economic, national security, and other trade-offs necessary to establish a definitive U.S. refining policy. However, DOE recently initiated a study to identify future U.S. refining capacity needs.

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CHAPTER 4

CONCLUSIONS AND RECOMMENDATIONS

Between 1960 and 1977 petroleum product consumption in the United States increased from 9.8 to 18.4 million barrels per day. Domestic refining capacity kept pace during these years, supplying between 83 and 92 percent of all petroleum products consumed in this country. The question to be faced now is whether the United States should continue to maintain its historical relationship between domestically refined and imported products. This would require increases in U.S. refining capacity.

All studies we have seen conclude that U.S. refined product consumption will grow through 1985, even though estimates vary as to the expected growth rate. The National Energy Plan offered two extremes of what consumption might be in 1985--a low of 18.2 million barrels per day if the plan had been enacted and a high of 22.8 if it were not. In an earlier GAO report, we estimate that the administration overstated the Nation's ability to develop and use nonpetroleum sources of energy by the oil equivalent of 3.9 million barrels per day. This overestimate implies higher petroleum consumption. Therefore, even if the plan had been enacted as proposed, we believe 1985 petroleum consumption will be closer to 22.8 million barrels per day. The National Energy Act passed by the Congress is estimated to save 2.4 to 3.0 million barrels per day in 1985--a reduction of 1.6 to 2.2 million barrels per day 1985 oil equivalent savings from the administration's estimate of savings if its plan had been enacted. This reduction in oil savings further reinforces our conclusion concerning 1985 petroleum consumption.

The U.S. refining industry is currently planning capacity increases to meet almost 100 percent of the administration's 1985 low demand estimate and about 85 percent of the administration's high demand estimate. Whether planned capacity increases will or should occur as proposed, however, involves trade-offs among alternative courses of action.

Maintaining high domestic refining capacity levels has several disadvantages, including air quality and land use impacts, as well as international considerations, such as the potential costs of unused capacity if exporters refuse to provide or reduce production of crude oil. On the other hand, there are national security and economic advantages in encouraging U.S. capacity which must be weighed against the disadvantages.

Potential exists to increase the Nation's product imports to help meet 1985 product requirements and avoid increasing domestic environmental impacts. One study estimates Caribbean refining capacity will increase moderately. The Caribbean area will probably continue to be the major exporter of petroleum products to the United States in 1985.

Other areas also have potential to increase product exports to the United States and must be considered in relationship to future U.S. refining capacity. Currently, Europe has excess refining capacity. Africa and the Middle East also may have surplus capacity for product exports. If Middle East oil-producing countries tie the export of crude oil to the acceptance of refined products, the United States might import more Middle East products. These international considerations must be considered in the formation of any U.S. refining policy.

Legislation designed to encourage U.S. refining capacity growth was to be prepared in 1977, but it was not introduced because of congressional deliberations over the proposed National Energy Plan. However, refinery legislation may be considered by the 96th Congress. The Senate Energy and Natural Resources Committee, in its March 1978 report to the Senate Budget Committee, stated that the legislation could include up to $250 million in new budget authority and $500 million in loan guarantees in fiscal year 1979 to encourage both construction of new refining capacity and renovation of existing capacity to handle lower quality crude oil.

Although the legislation is not yet available for review, it would appear to deal mainly with only one issue relating to U.S. refining capacity growth--capital availability. We believe that other issues, such as the international and environmental implications of U.S. refining capacity growth, also need to be considered.

Probably the most important domestic issue is the concern for clean air. Over 80 percent of existing refining capacity is located in areas which are in violation of air quality standards for one or more pollutants. After July 1, 1979, no new industrial plant can be built in these areas unless the State has adopted and EPA has approved an air pollution control plan that will assure full compliance with air quality standards by a specified date. It is apparent that if present Federal air quality standards and laws are enforced as written, new or expanded refinery construction in many areas may be restricted until substantial improvements are made in air quality.

Other domestic factors affecting future U.S. refining capacity include

--potential constraints on the location of refineries in coastal zone areas;

--Federal pricing and allocation regulations, such as price controls on gasoline and restrictions on the costs that refiners can pass through to consumers;

--gasoline lead content restrictions which increase the need for modern catalytic reforming equipment and require between 1.5 and 2.0 percent more crude oil to produce the same amount of gasoline;

--environmental standards which restrict the sulfur content of petroleum products and which may require the modernization of 2 million barrels per day of existing capacity and another 2 million barrels per day of additional refining capacity by the mid-1980s; and

--the small refiner bias of the DOE Entitlements Program, which encourages the construction of small, inefficient refineries.

In addition, reintroduction in the Congress of the crude oil equalization tax and/or oil- and gas-users tax from the National Energy Plan has the potential to affect future U.S. refining capacity. If enacted, these taxes would increase the cost of crude oil and natural gas to refiners.

In summary, after reviewing domestic programs and policies and international considerations, we question whether, under present U.S. policy, U.S. refineries will be able to maintain the historical relationship between domestically refined and imported products. The administration has not decided whether the historical relationship should be maintained. We believe that DOE has not comprehensively evaluated the environmental, technical, economic, national security, and other trade-offs necessary to establish a definitive U.S. refining policy. However, DOE recently initiated a study to identify future U.S. refining capacity needs.

RECOMMENDATIONS

As a part of the study, we recommend that the Secretary of Energy:

--Analyze the international and domestic implications of alternative levels of U.S. refining capacity and determine the criteria for Government involvement in effecting any desired levels. This analysis should include an evaluation of the environmental, economic, national

security, and technical trade-offs necessary to meet various domestic capacity levels.

--Based on the above trade-off analysis, determine future U.S. refining capacity needs considering such factors as the optimum mix of refinery sizes necessary to insure desired levels of U.S. petroleum products and the optimum relationship with U.S. petroleum product consumption.

--Consistent with the trade-off analysis, determine the policies and actions, if any, necessary to influence attainment of optimum domestic capacity and submit such documentation and analysis to the appropriate congressional energy committees. The submission should include a detailed analysis of the advantages and disadvantages of using incentive versus disincentive alternatives to meet the desired capacity needs. It should also include an analysis of the probable marketplace reactions to (1) existing and (2) fewer Government regulations. In addition, the submission should include any needed legislative proposals and milestones upon which to judge the effectiveness of such policies and actions in meeting the needs and, in the event that progress is not being made, a determination of what additional incentives or disincentives are needed.

CHAPTER 5

AGENCY COMMENTS

We sent a draft of this report to DOE, EPA, and the Department of Commerce. The Department of Commerce had no major problems with the section of the report dealing with its Coastal Zone Management Program and provided only informal technical comments, which were incorporated in the report. DOE and EPA comments are included as appendices II, III and IV.

DOE COMMENTS

By letter dated July 24, 1978, DOE stated that our report contained useful information on the U.S. refinery situation, particularly on the trade-offs between increased refinery capacity and other energy-related goals. However, DOE believed that the argument for increasing U.S. refinery capacity was not well supported.

It is not our intention to argue for or against increased U.S. refining capacity. Our report reviews domestic programs and policies and international considerations, and recommends that DOE determine future U.S. refining capacity needs after evaluating the trade-offs involved.

DOE, in initially commenting on our recommendation that the Secretary of Energy analyze the international and domestic implications of alternative levels of U.S. refining capacity needs, stated that this may appear to be prudent advice, but a more in-depth observation reveals the fact that supply/demand outlook has been difficult, if not totally impractical to predict, for the past decade. Further, given the kind of specificity DOE believed was required, it questioned the practicability of performing intricate cost/benefit analyses. DOE stated it does not believe one would elaborate much further the trade-offs covered in our report. As an alternative to the analysis we recommended, DOE offered the rationale that has been the basis for its present refinery capacity policy. According to DOE, Government policy has been to provide incentives (by way of import fees) to encourage new capacity to be located domestically. In later comments, however, it appears that DOE changed its position concerning the need for a study of U.S. refining needs.

The remainder of DOE's comments dealt with our treatment of international issues. DOE claimed that the report did not take into account that during an embargo, U.S. product demands would be reduced and thus, the need for U.S. refining capacity would be reduced. DOE further stated that the real threat to the United States and other industrial countries is not an

embargo, but a significant cutback by major oil producers. In such an event, DOE stated there would be significant unused refining capacity in the United States and in the rest of the world. We believe our draft report recognized that during an embargo or production cutback, unused capacity would exist. We pointed out that one of the disadvantages of increasing U.S. refining capacity is the potential cost of unused capacity if exporters decline to provide crude oil.

In a letter dated November 1, 1978, DOE provided additional comments on our report. The Department stated that further information and work related to policy issues has been updated and that a coordinated and carefully articulated DOE policy is needed to guide regulatory changes, identify necessary and appropriate legislative proposals, and provide the refining industry with an indication of the future refinery investment climate. DOE stated that contracts are currently being prepared and efforts are underway which will provide information and data required to develop a definitive refinery policy.

DOE acknowledged that domestic refinery operations are affected by several and sometimes conflicting DOE programs such as the small refiner bias, crude oil allocations, and oil import fees. The Department expects many of these programs to change in some fashion during the next 9 months and new programs affecting domestic refineries will be legislated.

Specifically, DOE pointed out several issues that it believes require resolution. These relate to (1) whether national security or economic benefits of import tariffs justify higher petroleum product prices, (2) the capability of the refinery industry to adjust to both changes in the characteristics of crude oil and product demands, (3) trade-offs between environmental regulation and expanding refinery capacity, and (4) the extent to which competition in the refinery industry may be restrained.

Overall, DOE's efforts would appear to be a first step toward implementing the recommendations in our report; nevertheless, we continue to believe that DOE should determine future U.S. refining capacity needs and determine what additional incentives and disincentives, if any, are needed. In addition, the stated actions did not specifically address the inter-relationship between domestic refinery policy and the international refinery situation. As pointed out in our report, Europe presently has excess refinery capacity and, in our opinion, this situation cannot be ignored in arriving at a domestic refining policy. Such a policy should also consider the impacts of major refinery growth within Middle Eastern countries. DOE's response fails to address these matters, as well as national security implications of a potential

product embargo, if the Nation becomes more dependent on product imports.

EPA COMMENTS

EPA stated that our draft report reflects a good deal of thought and hard work, and the final report will undoubtedly make a significant contribution to the discussion of the issue of refining capacity. However, EPA mentioned several sections which it believes require clarification.

EPA stated that the projects listed as not being constructed on the East Coast due to environmental opposition were canceled as a result of citizen opposition, not EPA action. We have made that clarification to the report. Further, EPA stated that the projects listed are duplicative because many of the projects would not have been proposed if others had been built. We have clarified this in the report.

EPA showed concern with our draft in that EPA does not expect air quality standards to significantly constrain future increases in domestic refining capacity. However, EPA did state that it is studying the issue and should have the results of the study this fall. EPA told us informally in November 1978 that the study would be completed in the spring of 1979. We have provided substantial reasons for our position, and until EPA provides evidence to the contrary, we will continue to believe that if present air quality standards and laws are enforced as written, new or expanded refinery construction in many areas may be restricted until substantial improvements are made in air quality.

We revised our report to reflect EPA's concern that we clearly distinguish between (1) the EPA requirement that large service stations must supply an unleaded grade of gasoline to prevent interference with the catalytic converter and (2) the EPA lead phasedown program to reduce the concentration of lead particulates in the ambient air. We also included the estimate mentioned by EPA of the industry capital cost to meet unleaded gasoline and lead phasedown requirements.

EPA stated that much of the additional crude oil processed to provide unleaded gasoline is converted to liquid propane gas--a useful clean energy supply source--and that from a balance-of-payments viewpoint, the United States substitutes increased crude oil imports for decreased liquid propane gas imports. Although some processes may result in an increase in liquid propane gas, the fact remains that not all of that additional crude oil required for unleaded gasoline is converted to liquid propane gas. However, we modified our draft to include this comment.

Finally, we incorporated EPA's comment concerning the price differential between high- and low-sulfur crude oil in the absence of price regulation.

REFINERIES PLANNED BUT NOT CONSTRUCTED

DUE TO OPPOSITION ON ENVIRONMENTAL GROUNDS

Company	Location	Size (barrels per day)	Year of final action-blocking project
Shell Oil Company	Delaware Bay, Del.	150,000	1972
Fuels Desulfurization (note a)	Riverhead, Long Island, N.Y.	200,000	1970
Maine Clean Fuels (note a)	South Portland, Me.	200,000	1971
Maine Clean Fuels (note a)	Searsport, Me.	200,000	1971
Georgia Refining (note a)	Brunswick, Ga.	200,000	1972
Northeast Petroleum	Tiverton, R.I.	65,000	1971
Supermarine, Inc.	Hoboken, N.J.	100,000	1972
Commerce Oil	Jamestown Island, R.I.--Narragansett Bay	50,000	(undated)
Steuart Petroleum	Piney Point, Md.	100,000	1974
Olympic Oil Refineries	Durham, N.H.	400,000	1974
C.H. Sprague & Son	Newington, N.H.	50,000	1974
Belcher Oil Company	Manatee County, Fla.	200,000	1974
In-O-Ven	New London, Conn.	400,000	1977

a/Maine Clean Fuels and Georgia Refining Company are subsidiaries of Fuels Desulfurization; the refiner in question is the same in each case. The capacity in barrels per day is not additive, but the incidents are independent and additive.

Source: Federal Energy Administration, Trends in Refinery Capacity and Utilization, p. 13.

APPENDIX II

Department of Energy
Washington, D.C. 20545

July 24, 1978

Mr. Monte Canfield, Jr.
Director, Energy and Minerals Division
U. S. General Accounting Office
Washington, D. C. 20548

Dear Mr. Canfield:

We appreciate the opportunity to review and comment on the GAO draft report entitled "U. S. Refining Capacity: Will There be Enough?." Our views with respect to the text of the report and recommendations made by GAO are discussed below.

This GAO report contains useful information on the U. S. refinery situation, particularly on the trade-offs between increased refinery capacity and other energy-related goals, mechanisms and procedures. But, we believe that the argument for increasing U. S. refinery capacity is not well supported.

In the Conclusions and Recommendations section, GAO has criticized the lack of a well-defined refinery policy by the Department of Energy and recommends that detailed benefit analyses be performed to establish definitive policy.

[See GAO note on p. 44.]

This may appear to be prudent advice, but a more in-depth observation reveals the fact that supply/demand outlook has been difficult, if not totally impractical, to predict for the past decade. Currently, we are unable to predict petroleum product demand to an accuracy of one million barrels per day 10 years into the future.

[See GAO note on p. 44.]

Given the kind of specificity that is required in order to perform intricate cost benefit analyses, we question the practicability of conducting such an exercise. As an alternative, we would offer the rationale that has been the basis for our present refinery capacity policy.

APPENDIX II

The following facts are pertinent in establishing a general policy concerning refinery capacity:

1. Under about any set of assumptions, it is conceded that additional refinery capacity will be needed to supply future domestic petroleum product requirements.

2. There is clearly an economic stimulation for the Nation when constructing additional refinery capacity.

3. The U. S. security position is improved as we become more capable of refining our total product requirement.

4. The east coast is extremely deficit in refinery capacity which causes inefficiencies and higher petroleum product cost for that area of the Nation.

5. Environmental degradation is reduced to insignificant levels under present environmental regulations when new capacity is installed. There may even be an improvement in the environmental quality of a locality due to the bias in certain trade-off provisions which new refiners are obligated to obtain.

6. Establishing a level of protection for domestic refiners that would result in domestic construction at the expense of shutting down foreign refineries would be an economic waste and would require extreme fees and/or incentives. But, to encourage new capacity to be constructed domestically in lieu of new capacity in foreign areas requires a very modest level of domestic protection.

Because of these facts, it has been Government policy to provide incentives (by way of import fees) to encourage new capacity to be located domestically. The present protection afforded domestic refiners is not of such a magnitude to cause a shut down of foreign capacity, but, on the other hand, considerable new capacity has been constructed domestically in the past 5 years. This trend is monitored and if it were to change, modest adjustments could be made in the level of protection.

Also, additional refinery capacity is expensive. Recommendations to construct sufficient new refinery capacity to meet an arbitrarily selected percentage of total consumption would involve a substantial risk of expensive overinsurance.

APPENDIX II

Regarding U. S. dependence on foreign refineries during an embargo, the report does not take into account that U. S. product demands would be reduced during such an embargo as would crude oil needs. Thus, the "sufficient" capacity would also be reduced.

As pointed out in the report, most U. S. product imports are residual fuel oil from Venezuela and the rest of the Caribbean, areas not likely to be embargoed. To the extent that these refineries might also be subject to embargo, so would substitute capacity if situated in the United States. In an embargo, we will try to negotiate for oil from non-embargoing suppliers regardless of the percent of our refinery capacity and the percent of refinery capacity should not facilite or make more difficult this negotiation.

The real threat to the U. S. and other industrial countries is not an embargo, but a significant cutback by major oil producers. In such an event, there would be significant unutilized refinery capacity, both in the U. S. and the rest of the world. The use of Europe's surplus refinery capacity to provide U. S. products is a common and relatively inexpensive phenomenon even without a supply interruption. Europe's current problems in meeting U. S. low-sulfur fuel oil and unleaded gasoline needs would probably not be a major constraint by the early 1980's, when new U. S. refineries could potentially be brought into operation.

While DOE could undertake the analysis GAO calls for, we do not believe such an analysis would produce a percentage of consumption figure that would reflect "security" and become the goal for domestic refinery capacity. Nor do we believe that one would elaborate much further the trade-offs that are covered in the GAO report. Consequently, we question the utility of the proposal recommended.

Comments of lesser significance have been furnished to members of your staff.

Sincerely,

Fred L. Hiser, Director
Division of GAO Liaison

GAO note: The deleted comments relate to matters which were discussed in the draft report but omitted in this final report.

Department of Energy
Washington, D.C. 20545

November 1, 1978

Mr. J. Dexter Peach, Director
Energy and Minerals Division
U. S. General Accounting Office
Washington, D.C. 20548

Dear Mr. Peach:

Please refer to Fred L. Hiser's July 24, 1978 letter to Mr. Canfield regarding our review and comments on the GAO draft report entitled "U. S. Refining Capacity: Will There Be Enough?".

Since Mr. Hiser's letter, further information and work relating to policy issues has been updated and is discussed below.

Domestic refinery operations are affected by several and sometimes conflicting Department of Energy (DOE) programs, e.g., small refiner bias, the crude oil allocation program, and oil import fees. Many of these programs are being amended or will be changed in some fashion during the next nine months. Further, new programs affecting domestic refineries will be proposed for legislative action early in the 96th Congress. A coordinated and carefully articulated DOE policy is needed to guide regulatory changes, identify necessary and appropriate legislative proposals, and provide the refining industry with an indication of the future refinery investment climate.

Several issues require resolution:

(1) The DOE must decide whether the national security or economic benefits of an import tariff on imported petroleum products justify the higher prices consumers would then pay for these products.

(2) If the characteristics of available crude input to domestic refineries are likely to change over the next several years, and if domestic refiners are not expected to be able to reconfigure their refineries to accommodate this new crude stream to projected product demand specifications, then the DOE should consider policies to remedy this situation.

APPENDIX III

(3) If new or expanded refining capacity would economically come on stream except for binding environmental controls and requirements, the DOE should weigh the benefits of environmental regulations against costs of reduced levels of domestic refining capacity and suggest relevant policy initiatives.

(4) Finally, if certain aspects of the domestic petroleum market are restraining competition in the industry such as pipeline control, environmental regulations or downstream subsidization, the DOE should consider alternatives to overcome these anti-competitive effects.

Contracts are currently being prepared and efforts are underway which will provide DOE with the information and data required to develop a definitive refinery policy.

We would be pleased to provide any additional information that is desired in this matter.

Sincerely yours,

Donald C. Gestiehr
Acting Director
GAO Liaison

APPENDIX IV

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON D C 20460

19 JUL 1978

OFFICE OF
PLANNING AND MANAGEMENT

Mr. Henry Eschwege, Director
Community and Economic Development Division
United States General Accounting Office
Washington, D.C. 20548

Dear Mr. Eschwege:

We have reviewed your draft report entitled "U.S. Refining Capacity: Will There Be Enough?", paying particular attention to pages 29 to 33 as you suggested. The draft clearly reflects a good deal of thought and hard work and the final report will undoubtedly make a significant contribution to the discussion of this issue. There are, of course, a number of sections in the draft which need clarification.

Page 29 mentions that 13 potential refinery expansion projects have not been constructed on the East Coast due to environmental opposition. It should be noted that none of the listed projects were cancelled due to Federal restrictions or objections. In all cases the environmental opposition was comprised of local ad hoc groups which succeeded in defeating the proposed construction programs. Moreover, the list is "duplicative" because many of the projects would not have been proposed if others had been built. Hence, it is misleading to suggest the lack of construction is due to EPA action.

The extent to which refinery construction in non-attainment areas will be constrained in the future is unclear at present, as the draft indicates. We have a major study of this issue underway, the results of which should be available this fall. At present, we believe that most States will be able to demonstrate attainability of the air quality standards in the required time-frame while accommodating growth, including refinery construction. Consequently, we do not expect air quality standards to significantly constrain future increases in domestic refining capacity.

The discussion regarding lead content in gasoline does not adequately distinguish between: (1) the EPA requirement that large service stations must supply an unleaded grade of gasoline to prevent interference with the catalytic converter, and (2) the EPA lead phasedown program to reduce the concentration of lead particulates in the ambient air. There are many variations among the estimates of cost and energy penalties due to lead removal. The one noted in the GAO study is on the high side. Turner, Mason and Solomon, Inc., in an April 1976 study for EPA, estimated that the

APPENDIX IV

industry would need to invest $3.2 billion (1974 dollars) from 1974 to 1985 to meet not only the unleaded requirements but also lead phasedown requirements. Also much of the additional crude oil processed to provide unleaded gasoline is converted into LPG -- a useful clean energy supply source. From a balance of payments viewpoint, the U.S. substitutes increased crude oil imports for decreased LPG imports.

The high sulfur crude oil discussion notes correctly the increased capital and operating costs associated with processing greater quantitites of high sulfur crude oil. The discussion should also note that the world price of high sulfur crude is sufficiently below that of low sulfur crude that in the absence of price controls additional processing costs would not have a significant effect on refining profitability. The discussion also correctly notes that high sulfur crude oils produce lower yields of gasoline. The significance of this is unclear, however, because gasoline consumption is expected to level off in the early 1980s while the total amount of crude processed will continue to increase.

Thank you for the opportunity to comment on the draft report. The Agency is most anxious to continue to participate in the development of a national energy program that appropriately balances the many domestic and international trade-offs involved.

Sincerely yours,

for William Drayton, Jr.

William Drayton, Jr.
Assistant Administrator
for Planning and Management

APPENDIX V

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