BY THE COMPTROLLER GENERAL

Report To The Congress

OF THE UNITED STATES

The United States Refining Policy In A Changing World Oil Environment

This study addresses the implications of international and domestic factors affecting the U.S. refining industry. GAO has made observations in this report about the impacts of those factors as they affect the domestic refining industry, international markets, regulatory actions, and the national security.

Growing U.S. demand for refined products, considered in light of already idle excess refining capacity in the rest of the free world, uncertain supplies of crude oil, a rapidly diminishing sweet crude resource base, and downstream expansion plans of oil-producing nations raises serious questions about the future of the U.S. domestic refining industry.

Utilization of the U.S. refining capacity will ultimately depend on the continued availability of adequate supplies of crude--an uncertain prospect at best.

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

This report addresses the implications of international and domestic factors affecting the United States refining industry. It considers such matters as the control of domestic crude price under The Entitlement Program, the small refinery bias, the availability of domestic and imported crude supplies, environmental and other regulations, and other factors affecting refinery capacity issues. Producer-nation control of crude supplies, foreign refining capacity and supplier-nation downstream developments are also addressed.

This analysis represents our continuing effort to develop an analytical framework within which to examine energy issues. We believe that our observations, which are based upon the analysis contained in the report, will be helpful in assisting Congress in its examination of existing and proposed policies affecting the U.S. refining industry. It also represents an expanded discussion of certain issues posed in our recent report entitled "U.S. Refining Capacity: How Much Is Enough?" (EMD-78-77, Jan. 15, 1979).

Copies of this report are being sent to the Director, Office of Management and Budget; the Chairmen of the energy-related congressional committees, and the Secretary of Energy.

ACTING Comptroller General
of the United States

petroleum legislation
oil resource
oil importing
crude oil
petroleum prod.

D I G E S T

The U.S. refining industry has traditionally operated at about 88 to 92 percent of capacity while tariffs and controlled U.S. prices have provided protection against the entry of foreign products. But in a world where available crude supplies are expected to become tighter and oil producing nations are expected to expand their refining capacity and link sale of products to crude sales, expansion plans for additional U.S. refining capacity are uncertain.

It will be increasingly difficult to continue to provide protection against foreign competition for the U.S. refining industry. Moreover, since almost one-third of Caribbean and European refining capacity, much of it owned by U.S. companies, lies idle, reliance on products refined in those centers may be construed as an alternative to large capital outlays to add to domestic capacity.

In any case, utilization of U.S. refining capacity will ultimately depend on the continued availability of adequate supplies of crude--an uncertain prospect, at best.

This analysis does not purport to be our last word, nor does it make explicit recommendations for a major new national refining policy. Rather, GAO undertook the task in order to clarify and clearly present major refining issues facing this Nation as GAO sees them. As a result of its study, GAO has made the following observations:

DOMESTIC

--The future of domestic refining capacity will depend on the perception of opportunities to make a profit, which will relate to a

range of factors including transportation costs, efficiency of operation, levels of demand, levels of subsidies, tariffs, and other Government policies--but the central controlling factor will ultimately be the availability of adequate crude supplies, from whatever source.

--Federal policies affecting investments in the oil industry would be best directed toward encouraging expansion of domestic hydrocarbon supplies to feed existing refineries than the construction of additional distillation capacity, which will, in the absence of increased availability of domestic supply, depend on insecure sources for crude.

--To the extent that capital investment in new refinery capacity is encouraged by U.S. policy, efforts should encourage the development of additional conversion capacity to refine heavy sour crudes as light sweet crudes, traditionally relied on, become less available.

NATIONAL SECURITY

--U.S. refining capacity already exceeds domestic oil production and that available from reserve drawdown. Consequently, without a commensurate increase in the availability of domestic supplies, increases in domestic refining capacity can make no significant contribution to national security. Further, U.S. policies insulating domestic refineries from most foreign competition in domestic markets encourage expansion of capacity which is not justifiable solely on national security grounds.

--However, increased reliance on foreign refinery products poses a different set of national security problems than does reliance on foreign crude supplies.

INTERNATIONAL

--In an oil-short world, there is little likelihood of a foreign competitive threat to domestic refiners who process mainly domestic crude oil. The United States has adequate refinery capacity to process its current and projected crude production.

--Free world oversupply of refining capacity will persist through the few remaining years of increasing world crude oil production and thereafter.

--Increases in the refining capacities of oil-producing nations are likely to build pressures on many oil import-dependent nations to accept an increasing proportion of refined products in their import mix at the expense of reduced utilization of their own refineries.

--As world crude markets tighten, expansion of U.S. refining capacity will be limited by the ability of the United States to obtain crude supplies. Failure of the Nation to obtain desired levels of crude supplies will make it increasingly necessary to import products refined in Europe and the Caribbean and, ultimately, from the expanded refineries of oil-producing countries.

REGULATORY

--In many cases, regulatory bias favoring small refineries has encouraged the construction of small, inefficient refineries and the extended use of obsolete refineries. While in some regions of the country small refineries are vital to supply small regional market needs, GAO doubts that the program, as it has been constituted, is beneficial on a macroeconomic basis.

--Current U.S. policies encourage imports of foreign crude. They have also encouraged construction of small and inefficient refineries.

--Termination of crude oil price controls would: eliminate most of the protection from foreign competition now enjoyed by U.S. refiners, and would particularly affect (1) small refineries, (2) competition at the refinery level in the domestic market, and (3) any significant expansion of U.S. refinery capacity.

GAO has undertaken to carry out this analysis as part of its continuing effort to develop an analytical framework within which to discuss national energy policies and the important issues which affect them. GAO believes the principal and inevitable implication that might be drawn from this study is the glaring vulnerability of the United States to external forces beyond its control that will drive its energy future and dramatically affect not only energy matters but the economy itself. Of course, there is a need to focus on policies and initiatives the U.S. Government should pursue in matters affecting foreign oil supplies and prices. However, if we are to mitigate the effects of these forces on the quality of our lives and our economic viability, we need an all-out national effort and program to: (1) increase efficiency of our use of energy and develop acceptable conservation programs; (2) develop ways to make more use of domestic energy resources (such as coal) in an evironmentally acceptable and safe way; and (3) develop alternative energy sources and technologies with particular emphasis on an ultimate move to renewable, inexhaustible sources of energy. Absent such moves, the United States will remain a nation dependent on insecure supplies and unstable prices, and be subject to the full range of vagaries that that implies.

AGENCY COMMENTS

The Department of Energy is in general agreement with the thrust of the report and stated that it makes a significant contribution to discussion of the international and national security aspects of the issues.

The Department was concerned, however, that the report did not adequately consider certain subsidiary issues. The Department's comments are summarized on pages 22 and 23 and are incorporated as appendix I.

Contents

ABBREVIATIONS

B/CD	Barrels per calendar day
DOE	Department of Energy
EEC	European Economic Community
EPA	Environmental Protection Agency
IEA	International Energy Agency
MMBPD	Million barrels per day
OPEC	Organization of Petroleum Exporting Countries

CHAPTER 1

INTRODUCTION

Until the 1970s the United States was largely self-sufficient in petroleum refining capacity with the exception of heavy fuel oil needs for the East Coast, which depended extensively on refineries in the Caribbean area. Since 1970, however, profound changes have taken place in both the domestic and international petroleum industries which have, and are continuing to have, important impacts on the U.S. refining industry and its future processing capacity. In turn, these changed conditions have serious implications for current U.S. refining policies, and raise important issues that should be addressed by the Congress and other U.S. energy policymakers.

Among the more important domestic factors affecting refining capacity are

--the continued growth in petroleum demand, the decline (except for short-term relief provided by Alaskan North Slope production) in domestic petroleum production,

--the continuing and growing dependence on foreign oil imports,

--changes in the sources and quality of crude oil feedstocks to U.S. refineries,

--the effectiveness of Federal regulatory policies and regulations which seek to assure competition within the industry,

--changes in the product mix and qualities required to meet environmental standards and siting problems, and finally

--the uncertainties of long-term crude oil supply.

Important international factors include (1) the control of crude oil supplies and prices by the Organization of Petroleum Exporting Countries (OPEC); (2) its growing influence on international petroleum markets; (3) the large excess refining capacity in West Europe, the Caribbean, and other world refining and export centers; (4) the refinery expansion and product export plans of the major petroleum exporting nations; (5) and their plans to tie crude oil exports to the acceptance of product exports.

An important national concern is whether or not the petroleum industry can continue to provide adequate and dependable supplies of petroleum products in the quantities and qualities required to meet the national security, economic performance, quality-of-life, and other goals and objectives of the Nation under competitive conditions and at reasonable prices to consumers.

The most immediate main domestic refining issues facing this Nation relate to the adequacy of capacity throughout the country and whether or not present Federal policies affecting U.S. refining capacity should be changed. If they are not changed, what are the implications for the U.S. refining industry of a "status quo" policy? If changes are made, what are the probable impacts if they result in

--a more highly regulated or tightly controlled industry or

--a decontrolled or "free market" with reduced or eliminated economic support of the domestic industry?

BACKGROUND

Petroleum has been the main energy source for the United States in the post-World War II period, supplying 40 percent or more of the Nation's total energy needs since 1950, as well as virtually all transportation sector needs. By 1977, petroleum demand amounted to 18.4 million barrels per day (MMBPD) or 48 percent of all energy consumed (38.1 MMBPD of oil equivalent). Until 1967, domestic petroleum production capacity was sufficient to meet the Nation's petroleum supply needs and imports were relied upon as a matter of choice for only about 20 percent of total petroleum supplies. By 1977, net dependence on foreign crude oil and products imports had risen to 8.6 MMBPD or 48 percent of U.S. petroleum consumption. 1/ Despite national policies which call for conservation and the development of alternate domestic energy sources, increases in petroleum demand and declining domestic oil production are expected to continue leading to further increases in U.S. dependence on foreign oil imports. By 1985, domestic petroleum products consumption is expected to be in the range of 20 to 23 MMBPD, with total oil imports rising to 12 and 13 MMBPD. 2/

Until the early 1970s, the nature of the U.S. petroleum refining industry and the national policies affecting its

(GAO note: See End notes for reference data on p. 25.)

role in meeting the Nation's energy needs had evolved largely in response to domestic requirements and considerations. The industry existed in a protected environment. Government policy insulated it from foreign competition, and the domestic crude oil resource base guaranteed access to crude oil sufficient to meet most needs. Over the last 8 years, international events and factors have assumed greater importance. Prior to 1970, domestic refiners received most of their supplies of crude oil from domestic sources and processed mostly light, sweet crudes in more costly conversion refineries to meet the high U.S. market demand for gasoline and other light products. In contrast, Caribbean, West European, and most other foreign refining centers processed predominantly heavier, sour crudes in less costly straight distillation refineries to produce mainly fuel oils to satisfy their market or export demands. For example, in 1976 the average product yield pattern of U.S. refineries was approximately 45 percent gasoline, 22 percent distillate, 10 percent residual fuel oil, and 23 percent other products. 3/ In contrast, yields in various foreign refining centers range from 10 to 23 percent gasoline, 11 to 30 percent distillate, 35 to 60 percent residual fuel oil, and 14 to 21 percent other products. 4/ Thus, foreign refineries could efficiently and economically serve the domestic market for fuel oil, particularly the East Coast market. This market accounts for 65 percent of total domestic residual fuel oil consumption and absorbs nearly 90 percent of all residual fuel oil imports, largely from Caribbean sources.

The Mandatory Oil Import Program, established in 1959, placed a volumetric quota on imports of crude oil and most petroleum products. An important exception was made in 1965 for residual fuel oil imports to the East Coast. This policy not only encouraged residual fuel oil imports but provided a strong incentive for the construction of offshore refineries processing relatively cheap foreign crudes to supply those exempted imports for the U.S. market.

Between 1966 and 1973, the United States became increasingly dependent on imported residual fuel oil. In 1977, residual fuel imports, even though reduced from the 1973 peak, still averaged 1.3 MMBPD or more than 60 percent of the 2.2 MMBPD of all products imported. While all products imported supplied only 12 percent of domestic consumption, residual fuel oil imports mainly from the Caribbean provided nearly half the U.S. consumption of that fuel in 1977. 5/

On the other hand, the oil import quota system initially worked effectively to limit the importation of crude oil and products other than residual fuel oil and provided protection to the existing domestic refining industry. Refinery allocations for the lower cost foreign crudes were based on individual refiners' import history or refinery input of previous periods, adjusted on a sliding scale to favor the smaller refiners in order to maintain their competitive position in the industry.

By the late 1960s, it was becoming increasingly clear that U.S. crude production capacity had peaked and was declining, and that increasing demands by U.S. refiners for crude would soon exceed domestic production capacity. With imports quantitatively restricted, crude supply could not be assured for refinery expansion, and the rapid growth in refinery capacity which had characterized the late 1960s came to an end. By 1972, prior to the Arab embargo, shortages in refining capacity had grown to the point that the Government was forced to grant special import licenses for heating oil. On May 1, 1973, the Government terminated the Mandatory Oil Import Program, thus granting U.S. refiners access to foreign crude supplies. To preclude reliance on foreign products rather than crude imports, refined products were charged a fee of 63 cents per barrel, while the crude oil import fee was set at 21 cents. In addition, new domestic refining capacity was exempted from paying even the 21-cent crude import fee for a period of 5 years after construction. These actions gave preference to foreign crude imports while protecting against foreign refinery competition. Almost immediately, the largest expansion of refining capacity the United States had ever seen was set in motion.

The decline in domestic crude production and the growing dependence on foreign oil which has characterized the 1970s sharply increased the impact of international factors on the U.S. refining industry and on Government policy. The policies currently in effect were adopted largely in response to international events. The most important is the emergence of OPEC since 1970, and its success in wresting control of the world crude oil export market from the international oil companies that had previously controlled it. Since the Arab oil embargo of 1973-74, OPEC countries have exercised almost absolute control over their own oil resources and the pricing of their exports, upon which so much of the world economy is dependent. OPEC's quadrupling of crude oil prices in 1973-74 was a major contributor to a worldwide economic recession. The recession caused a temporary reduction in world petroleum demand and subsequent lower rates of growth in demand that

led to the idling of nearly one-third of the refining capacity in West Europe, the Caribbean, and other foreign refining centers, assuring a surfeit of world refining capacity for many years to come.

The OPEC nations have not only established control over marketing of their own crude oil, but in some cases are taking steps to expand into downstream activities by building or acquiring their own refining capacity. Moreover, some voices have been raised in OPEC councils calling for the coupling of crude oil exports with acceptance of their surplus refined products. Thus, OPEC may add a new dimension to the world refining scene which could affect the U.S. refining industry and shape the policies that influence it.

Meanwhile, there is a growing consensus that a worldwide crude oil supply/demand imbalance in the latter half of the next decade will recreate for the world refining industry the dilemma which faced U.S. refiners when U.S crude oil production capacity began to decline 10 years ago. The United States was forced to turn to more abundant foreign crude oil supplies to fill the gap. The world does not now have such an alternative: In 1978, total free world refining capacity stood at about 63 MMBPD, some 12.5 million barrels in excess of requirements. If, as some experts predict, free world crude oil supply peaks within a decade at some 70 MMBPD, then comparatively little additional refining capacity will be needed to process limited total available supply. Just with the continuation of current actual annual net refining capacity increases, the world would have a total capacity of some 73 MMBPD by 1985, almost enough to handle the potential crude oil production peak. As the conviction grows among refiners that crude supply for refineries coming on stream in 1985 or beyond cannot be assured, free world refinery expansion should slowly grind to a halt, just as it did in the United States in the early 1970s. The only exception (which by its existence exerts an even earlier brake on commercial refinery expansion) would be new refineries built by the wealthier oil producing nations, which have both the capital for construction and the assured supply of crude oil that can guarantee profitable operation for the life of the plant.

PURPOSE OF REVIEW

The purpose of this report is to:

--Identify the significant international conditions having important implications for U.S. refining capacity and policies related thereto.

--Analyze those important international factors and domestic actions that affect U.S. refining capacity and assess their probable impacts on the industry.

--Define the major policy issues affecting domestic refining capacity and assess the probable impact of potential changes in policies and programs on the domestic refining industry and its ability to meet the Nation's energy demands.

We undertook this analysis following our publication of the report entitled "U.S. Refining Capacity: How Much Is Enough? (EMD-78-77, Jan. 15, 1979). That report recommended that 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.

Though it is our understanding that the Secretary has indeed undertaken to have such studies done, the keen interest manifested in discussions with staff members of several congressional committees about U.S. refining policies led us to make an effort to continue developing an analytical framework within which the Congress may examine existing and proposed policies and the major issues associated with them.

This analysis does not purport to be our last word, nor does it make explicit recommendations for a major new national refining policy. Rather, we undertook the task in order to clarify and clearly present major refining issues facing this nation as we see them.

CHAPTER 2

IMPLICATIONS OF DOMESTIC FACTORS FOR U.S. REFINING CAPACITY

Before 1959, U.S. refining capacity was normally built and expanded by the private sector on a free market economic basis. Since then, the size and configuration of the domestic refining industry and the economic conditions under which it operates have been heavily influenced by past and current Federal petroleum pricing, allocation, import, tariff, and environmental regulations.

DOMESTIC CAPACITY AND NEEDS

For the next two decades a supply interruption, for whatever reason, poses a major threat to our national security. From a military or defense standpoint, the United States still has sufficient domestic petroleum production capacity and reserves to support military operations in an emergency, but not nearly enough to sustain the general economy. Given the political instability existing in, and the military vulnerability of, many of the major oil-producing regions and countries, very large and severe supply interruptions can occur that could not be made up by increasing oil production in other producing areas. Such circumstances would result in critical worldwide crude shortages and idle large portions of both domestic and foreign refinery capacity (not to mention other sectors of the economy). Self-sufficiency in refining capacity would be relatively meaningless, except to the extent it could operate on domestic crude oil production and strategic and commercial oil reserves or stocks. U.S. national and international contingency planning requires reduced consumption in the event of a major oil supply interruption, which would more than offset increased military needs should an oil shortage be accompanied by a military crisis. Therefore, refinery capacity required for emergencies is less than that needed under normal circumstances, and may be much less, depending on the length and severity of the interruption and the level of military involvement in the crisis. Requirements for refinery capacity during emergency conditions should be determined with these considerations in mind, as well as crude oil availability.

As of January 1, 1978, the combined operable crude oil throughput capacity of the 302 U.S. refineries (not including the four Puerto Rico and Virgin Islands refineries, which have

a combined capacity of nearly 1 MMBCD) was about 17,048,000 barrels per calendar day (B/CD), an increase of 650,000 B/CD over that of January 1, 1977. 6/ Since 1960, domestic refineries (plus the natural gas liquids production of natural gas processing plants) have supplied between 83 and 92 percent of all the petroleum products consumed in the United States. During 1977, U.S. refineries alone supplied 16.2 million barrels per day of refined products or 88 percent of total domestic demand. This is about the same percentage as existed prior to 1970, but 5 percent higher than it was in 1973. 6/

On a regional basis, only the East Coast has a shortage of refining capacity, and it has been dependent on Gulf Coast and foreign refineries (mostly Caribbean) for most of its products during modern times. In 1977 the East Coast had only 10.6 percent of domestic refining capacity, which supplied only about 25 percent of its refined products demand. The Gulf Coast, with 44 percent of total domestic capacity is a surplus area, while on the West Coast and in mid-Continent areas, refining capacity is roughly in balance with demand.

A Department of Energy (DOE) report issued in June 1978 7/ indicates that the refining industry had "firm" plans to expand existing total operable refining capacity by 1.65 MMBPD to 18.7 MMBPD, which would provide about 17.4 MMBPD of refined products at sustainable rates of operation.

Including products obtained from natural gas liquids which do not require refinery distillation capacity, a total output of nearly 19 MMBPD would be available, exclusive of U.S.-owned refineries in the Caribbean. If, as predicted, demand ranges from 20 to 23 MMBPD by 1985, then the probable refining capacity by 1982, together with other domestic product sources, would have the capability of meeting from 85 to 98 percent of demand. These levels would compare favorably with those existing during the last 20 years. Thus, for the near term at least, the domestic industry appears to be willing and able to maintain capacity at least equal to historical ratios between demand and domestic product output capacity. The investment estimated for this projected expansion is in the order of $5 billion. However, Government policies to cut consumption, environmental regulations and siting problems, the Clean Air Act Amendments of 1977, and long-term uncertainties about crude supplies have acted to slow and, in some cases, stop major U.S. refinery projects once listed as "firm" by DOE.

On a qualitative basis, there is concern that domestic refiners are not now constructing or planning adequate sour crude (crude having greater than 0.5 percent sulfur content by weight) processing capacity. Instead, they are continuing to rely very heavily on sweet crude imports to produce low-sulfur products. Yet, limitations on both domestic and foreign reserves and production of sweet crudes are such that refiners increasingly will be forced to process sour crudes in the future.

In 1964 essentially two-thirds of U.S. proved oil reserves and production were of sweet crudes. Now, only 42 percent of U.S. proved oil reserves are sweet, and production is increasingly dependent upon sour crudes. Only 15 percent of the OPEC countries' crude oil reserves are sweet, and the U.S. relies on OPEC for about 80 percent of its sweet crude imports. In 1977, 55 percent of the 6.6 MMBPD of crude oil imported by the U.S. was sweet.

Since 1973, U.S. refiners have increased their conversion capability to handle sour crudes from 41.6 to 47.6 percent of operating crude oil capacity. Conversions are expected to continue, but DOE concluded in a December 1977 report 8/ that the rate of conversions of U.S. refineries needs to be roughly three times greater than the rate achieved in the past 4 or 5 years. The reasons for the inadequate rate of conversion to process sour crudes are largely financial. Processing sour crudes incurs investment and operating costs of from $1.20 to $2.00 per barrel more than the cost of processing sweet crudes, depending on the size of the refinery. Small refiners (15,000 B/CD or less) are at the greatest disadvantage, and most either cannot handle sour crude in their facilities or have very limited desulfurization capacity. Up to this time, DOE pricing regulations have not permitted passthrough and recovery of costs related to changes in feedstock quality or for capital investments in costly desulfurization facilities. Other factors, such as the price differential between low and high sulfur crude have an important effect on investment decisions about desulfurization equipment. Currently, the administration is in the process of modifying the regulations to permit passthrough of certain capital costs for upgrading refinery conversion capacity.

The need for U.S. refineries to convert to desulfurization processes is more due to the growing reliance on sour crude supplies than to environmental regulations which mandate or limit the sulfur content of fuels. Environmental regulations though do cause some shift in the consumption of fuels by sulfur content.

Environmental Protection Agency (EPA) regulations that require reduced levels of exhaust pollutants have led to the development of catalytic, anti-pollution devices which require the use of unleaded gasoline. The production of unleaded gasoline, gallon for gallon, requires up to 2 percent more crude oil than does the production of leaded gasoline.

The mandated replacement of leaded gasoline by unleaded will require additional distillation capacity just to meet the same level of total gasoline output. In order to meet minimum octane requirements for the vehicle fleet without adding lead to the gasoline, extensive and costly octane upgrading facilities must be added to existing refineries. The spot shortages of unleaded gasoline experienced in late 1978 are early manifestations of this problem, which is likely to become more acute at least, in the short term, as newer cars replace older ones at a faster rate than new refining capacity comes on line.

REGULATORY POLICIES AND PROGRAMS

Federal regulatory activities affect nearly every aspect of the domestic refining industry. Pricing and allocation regulations affect its crude oil supply, processing capacity and configuration, and product slate and quality. Environmental requirements for low sulfur fuels and unleaded gasoline, to meet air quality standards, require costly investment in both distillation and high conversion processing capacity. Air quality and coastal zone management laws and regulations affect the siting of new refineries and the expansion of capacity at existing ones. Pricing and taxation (existing or potential new crude oil equalization and user taxes) especially affect the economics of the entire industry and its competitive structure.

Since 1973, the Federal regulatory programs having the most important and pervasive effect upon domestic refining capacity have been price controls and the Crude Oil Entitlements Program, established in November 1974 and now administered by DOE. One purpose of the Emergency Petroleum Allocation Act of 1973 was to assure the competitive position of independent and small refiners in the domestic industry. In 1973, OPEC had just raised world crude oil prices to about twice that of federally controlled domestic crude oil prices; and there was concern that the major company refineries which had access to large supplies of lower cost domestic crude would have a great competitive advantage over small and independent refiners dependent on imports. Under

the program, DOE computes the prices paid by all refineries for both foreign and domestic crudes and provides "entitlements" (cash payments) to those refiners which cannot buy a pro rata share of lower cost, price-controlled domestic crude. The entitlements are designed to equalize the average crude costs to all refiners whether they use imported or domestic feed stocks. The act also provides a sliding-scale "small refiner bias" granting small refiners (those having less than 175,000 B/CD total capacity) a larger share of entitlements to offset the advantages of scale of larger refineries. This added benefit has averaged about 50 to 60 cents per barrel of total throughput and ranges from 6 cents to $1.89 per barrel, depending on the size of the refinery, with the smallest ones (less than 10,000 B/CD capacity) getting the greatest benefits.

The general effect of price controls and the entitlements program has been to give domestic refiners a large competitive advantage over foreign refiners. The entitlement program ensures that all refiners, large and small, share equally in that advantage. Currently, the domestic refiners' average crude oil acquisition cost is $1.50 to $2.00 per barrel less than that of foreign refiners. Initially, Caribbean refiners and East Coast fuel oil importers, in particular, were at a competitive disadvantage. The program was subsequently changed to provide "reverse entitlements" to residual fuel oil importers (originally, it was 30 percent equivalent crude oil entitlement for residual fuel oil; now it is 50 percent) and penalties for domestic refiners selling excessive quantities of residual fuel oil (a provision since eliminated).

Despite such modifications, price controls and the entitlements program together with the continuing crude oil product import fee differential have provided U.S. refiners a great incentive to import and process crude oil rather than refined products. Prior to 1973, crude oil and products imports were roughly in balance, but in 1977 crude oil imports were three times those of products. Thus, the program has encouraged U.S. refinery capacity expansion and assured high levels of refinery utilization in the United States.

The entitlements program has been responsible for maintaining the economic viability of the small refiner. In fact, it has caused a proliferation of small, inefficient refineries operating largely on the more costly sweet crudes, much of which is imported. (Since 1970, imports of sweet crudes have nearly quadrupled, from about 1.0 MMBPD to 3.7 MMBPD in 1977. Sour crude imports have increased at an even faster

rate, 0.3 MMBPD in 1970 to 2.8 MMBPD in 1977.) DOE has recently proposed a rule to reduce the "small refiner bias" benefits by more than half. Small refiners claim this would put them out of business, but DOE maintains that they have been greatly over-compensated under the present rules. Irrespective of the outcome, the capacity of the refinery industry will be affected by changes in, or uncertainties about, the future of the entitlements program.

Another important effect of the entitlements program lies in the fact that the protection afforded domestic refiners acts to stimulate consumption of petroleum products (and new refining capacity) by using controlled domestic crude oil prices to average down the cost of oil in the United States. However, until the recent round of foreign price increases, that cost differential was being narrowed and was expected to disappear altogether in a few years, absent additional sharp price increases by OPEC.

The administration is committed to eliminating the differential by raising U.S. crude prices to world levels in order to encourage conservation and the development of alternate domestic energy resources. Several actions, such as the proposed windfall profits tax, the proposed Crude Oil Equalization Tax (which failed to pass the Congress in the last session), the President's crude oil price decontrol program, higher oil import fees, and user's taxes, can be considered as means to accomplish price equalization. Obviously, equalization would destroy much of the protection from world competition that the U.S. refining industry now enjoys as well as the competitive viability of most small refiners, unless some substitute protection or subsidy were to be provided.

Environmental standards, regulations, and objectives also affect U.S. refining capacity. The impacts of air quality standards which limit the lead content of gasoline and sulfur content of fuel oils have already been discussed. Beyond these, the Clean Air Act of 1970 and subsequent amendments preclude construction of any facility in non-attainment areas (regions where pollution exceeds minimum air quality standards) unless an offset is found. The Coastal Zone Management Act of 1972 permits States to promulgate coastal zone management regulations to protect these areas from adverse industrial development, a provision being used to prohibit refinery construction in certain coastal areas (e.g. California and Delaware). These environmental considerations are expected to further limit the siting and construction of new refineries and the expansion of existing ones.

CHAPTER 3

IMPLICATIONS OF INTERNATIONAL FACTORS FOR U.S. REFINING CAPACITY

In the future, international factors can be expected to have an even greater influence on U.S. refining policies than in the past. The rise of OPEC and its control of the world crude oil export market, its move to expand downstream into the refining and marketing of products, the impending crude oil production shortfall (especially the more rapid diminution of light sweet crude reserves), and excessive world refining capacity are among the most important of these international factors.

CAPACITY AND NEEDS

As of January 1, 1978, operable free world crude oil refining capacity amounted to an estimated 63.4-million B/CD. 9/ Excluding the United States, free world capacity was about 45.4 million B/CD. 1/ Five major export refining centers (the Caribbean/Bahamas, Rotterdam and Italy in West Europe, the Middle East, and Singapore) accounted for about 86 percent of all free world petroleum product exports in 1977, even though they had only about 22 percent of free world refining capacity.

In the past 4 years, these export centers have operated at only about 65 percent of combined capacity. The reason for this very low utilization rate is that most of the free world refineries now operating were constructed or were under construction during the period before the huge OPEC crude oil price increases during and after the Arab oil embargo of October 1973. At that time, expectations were that the 6- to 7-percent annual rate of growth in free world petroleum demand that had prevailed since 1950 would continue unabated. Since 1974, however, growth rate in demand has slowed to about half this rate, and most forecasters expect it to remain at or below this level in the future.

Although the rate of refinery expansion has now diminished, additions since 1975 (some of them begun before the embargo) have still almost matched the slower rate of growth in oil consumption during 1976-78. Most excess distillation capacity is in West Europe and the Caribbean, export centers that are of particular importance to the United States. In 1977 Caribbean refiners had about 1.3 million B/CD of unused capacity, largely due to the loss of U.S. markets.

The United States has never been a very significant importer of products from West Europe. (Only 8 percent of its total refined product imports came from Europe in 1977). In the face of a surplus capacity of more than 7.2 million B/CD, European refiners have taken 1.6 million B/CD out of service. Furthermore, the European Economic Community (EEC) is now considering a plan to shut down another 1.2 million B/CD in EEC countries. Despite these actions, excess capacity in the existing major export refining centers is expected to continue for the next 10 years or so. In 1985 it will probably be in the range of 3 to 4 million B/CD. With the low consumption growth rates generally forecast for the future, it would take 4 years for free world refinery demand to reach an efficient 87 to 88 percent of refining capacity if all expansion were to cease immediately--an improbable prospect.

Despite the anticipated continuing surplus of total free world refinery capacity, certain major crude oil exporting countries--notably OPEC members--plan to build large new export refineries in their own countries by the early 1980s. The Middle East countries of Saudi Arabia, Iran, Iraq, and the United Arab Emirates have announced or indicated that they plan to construct almost 2 million B/CD of new capacity. Iran's plans are now, of course, uncertain. African countries have expanded their refining capacity by about 1 million B/CD in the last decade and are planning an equal expansion by 1985. Non-OPEC crude oil exporters also are planning to increase their refining and products export capacity. Mexico also has announced plans and is in the process of expanding its refining capacity by about 1 million B/CD by 1982, most of which will be for export. It should be recognized however, that not all refinery additions are to serve export markets. Oil consumption in oil-producing nations is growing at a much faster rate than in other free world nations. For example, demand increases in the Middle East absorbed about 66 percent of all refinery capacity added between 1967 and 1978, while in Africa, in the same period, demand increases absorbed about 55 percent of refinery expansion.

In summary, indications are that the existing free world surplus of refining capacity will persist at least through 1985 because of planned expansions and a relatively low rate of increase in free world petroleum demand. Most forecasters of world petroleum supplies expect free world crude oil production to peak at about 70 to 75 MMBPD by the 1990s. As demand approaches production capacity, the expansion of consuming nation refining capacity should end.

But there will be no guarantee that then existing capacity will be fully utilized if producing nations continue to expand their refining capacity despite a constant or declining supply of crude. Likely, there will be a shift of refining operations to those countries having crude supplies. In order for the United States to acquire crude imports, it will probably have no choice but to accept a greater proportion of imported refined products. However undesirable that may be on other grounds, it may be a much less expensive means of obtaining needed products than the building of expensive new domestic capacity subject to uncertain crude supplies.

Europe's refineries are not now adequately equipped to produce fuels having qualities adequate to meet U.S. low-sulfur fuel-oil and unleaded gasoline needs. European refiners are currently expanding their catalytic cracking capacity at a rapid pace to enable them to produce greater quantities of light products for their own markets. The use of modern fluid and thermal catalytic cracking technologies can (1) increase gasoline yields by 100 to 200 percent for the typical European refinery not now so equipped and (2) permit a greater production of low-sulfur fuels.

Caribbean refiners were deeply affected by U.S. regulations mandating sharply lower sulfur content of residual fuel oils to meet EPA air quality standards in their principal U.S. markets. They responded by making large and costly conversions of their refineries to meet growing U.S. demand for low-sulfur fuels in the late 1960s. Between 1965 and 1975, they added 1.6 million B/CD of new conversion capacity primarily to meet U.S. product quality requirements. Such conversion activities will enhance foreign refinery export center capability to meet the qualitative requirements of the U.S. markets and enable them to compete for a larger share of that market.

AVAILABILITY AND TERMS OF ACCESS TO CRUDE OIL

The announced plans of major oil exporting countries, OPEC and non-OPEC alike, to expand their downstream operations (transportation, refining, petrochemicals, gas liquids, etc.) could affect plans for future U.S. refining capacity expansion and access to crude supplies, especially light sweet crudes.

The move by the major OPEC oil exporters (e.g., Saudi Arabia, Iraq, Kuwait, and United Arab Emirates) into all phases of downstream operations has already begun. On a purely economic basis, investment in export-oriented refining capacity does not make commercial sense, particularly in the short term. These activities are highly capital intensive, and require high technologies and technical and managerial skills that are now in short supply in these countries. Such steps are ill-timed since there already is so much excess idle world refining capacity. OPEC nations recognize these facts but dismiss arguments against such investments, considering them a part of the short-term costs of acquiring the technologies and know-how to widen their industrial and economic development and enhance their long-term economic, social, and political interests. They want a greater share of the value added by the processing of their crude oil and other raw materials and believe they can only achieve this goal by acquiring the industrial base and developing the technological skills they do not now possess. OPEC members account for more than 60 percent of the free world's crude oil supply but have less than 8 percent of its refining capacity.

OPEC nations have tremendous leverage because they control crude oil supplies and can use their position to ensure efficient utilization of their refineries. They can simply link the exports of products to crude supply sales. Some OPEC nations have already announced this intention. Saudi Arabia, the largest and most important exporter, has curtailed the amount of light crude oil it will export and has said it will use its light oils for two of its three planned 250,000-B/CD export refineries, expected to be completed after 1982. The national oil companies of the OPEC countries currently market directly about 25 percent of total OPEC crude oil and refined products entering world trade.

Non-OPEC countries having exportable surpluses of oil (e.g., Mexico, Norway, Peru, Syria) have all followed OPEC pricing practices and also plan to expand their refining capacity and export of products. Mexico, a potentially large exporter to the United States, is carrying out plans to expand refining capacity. Pemex, the Mexican national oil company, plans to raise crude oil production from 1.2 to 2.2 MMBPD by 1982. Concurrently, refining capacity is to be expanded from 1.38 to 2.32 million B/CD. Thus, Pemex plans call for exports to be comprised primarily of refined products.

The clear implication of these international factors is that, increasingly, those who depend on imported petroleum

supplies (e.g., the United States, Japan, West Europe) must be prepared to accept a larger share of refined products in their oil imports. Oil importers who continue to expand refining capacity may run the risk of having it operate at inefficient low levels of utilization. Exporting countries having large investments in refining capacity can be expected to limit crude instead of products exports.

DEPENDENCE ON FOREIGN REFINERIES

Current prospects are for a continued decline, or at best, only a modest improvement in domestic oil production. U.S. refining capacity now greatly exceeds domestic crude production and is expected to remain adequate to process all available domestic crude oil for as long as that crude is competitive in the U.S. market. The United States increased dependence on foreign refining capacity has significant implications for the Nation, but the risks associated with the various world refining centers are not equal and are mitigated by the hard fact that insecure crude oil sources must be relied upon no matter where the refineries are located.

Caribbean area export refineries were developed almost exclusively to serve the U.S. East Coast residual fuel oil market and have a long history of uninterrupted supply. The Caribbean is as militarily secure as the U.S. Gulf Coast, but internal political considerations could conceivably pose some risks, as does the decline in area oil production and the processing of growing quantities of crude from other world-producing sources. Because the United States lacks the necessary low-sulfur fuel oil refining capacity and is dependent on Caribbean refineries to meet this need, it will likely be necessary to use Caribbean refineries to process crude oil from the U.S. strategic petroleum reserve during a crude oil supply interruption.

West European refineries offer a tempting near-time potential source to alleviate some shortages in U.S. clean products demand, but growing dependence on imports from this area would, under some circumstances, pose difficult security problems. Even in peacetime, in the event of a world oil supply interruption or severe shortage for any reason, a serious problem could arise concerning the willingness of West European governments to permit their refined products to go to the United States, International Energy Agency (IEA) sharing agreements notwithstanding.

In wartime, dependence on European refineries would pose military risks since they would be more vulnerable to damage by hostile enemy action than domestic refineries. Furthermore, dependence on European refineries would require inefficient use of naval forces to both safeguard tanker movements of crude to Europe and subsequently, product movements to the United States.

Refineries located in oil producing and exporting regions, such as the Middle East and Africa, are subject to the same wartime security risks as is crude oil supply from these areas. Loss of crude supply because of hostile action would imply that output from such refineries would also be unavailable to U.S. markets. However, producing countries which have made large investments in refining capacity may find this potential loss to be a mitigating factor in any decision to reduce or cut off supplies in peacetime if such reduction would adversely affect their own refinery output and, therefore, the economic return on their investment.

CHAPTER 4

OBSERVATIONS AND AGENCY COMMENTS

We have concluded from this analysis that refining issues, just as energy issues in general, are certainly not easy to resolve, and that the resolution of one problem is inextricably interrelated and interdependent with the need to resolve several other problems and may indeed even create several other problems in the process of resolving them. For each issue, there are a variety of answers for which supporting arguments can be made with equal vigor and rectitude. Were they easy to answer, likely there would be no argument about them. The answers, of course, depend on philosophy and, ultimately, economics. We make no recommendations as to how these questions might be resolved. We have though, made the following observations as a result of our analysis.

DOMESTIC

--The future of domestic refining capacity will depend on the perception of opportunities to make a profit which will relate to a range of factors including transportation costs, efficiency of operation, levels of demand, levels of subsidies, tariffs, and other Government policies. But the central controlling factor will ultimately be the availability of adequate crude supplies, from whatever source.

--Federal policies affecting investments in the oil industry would be best directed toward encouraging expansion of domestic hydrocarbon supplies to feed existing refineries than the construction of additional distillation capacity, which will, in the absence of increased availability of domestic supply, depend on insecure sources for crude.

--To the extent that capital investment in new refinery capacity is encouraged by U.S. policy, efforts should encourage the development of additional conversion capacity to refine heavy sour crudes as light sweet crudes, traditionally relied, on become less available.

NATIONAL SECURITY

--U.S. refining capacity already exceeds domestic oil production and that available from reserve drawdown. Consequently, without a commensurate increase in the availability of domestic supplies, increases in domestic refining capacity can make no significant contribution to national security. Further, U.S. policies insulating domestic refineries from most foreign competition in domestic markets encourage expansion of capacity which is not justifiable solely on national security grounds.

--However, increased reliance on foreign refinery products poses a different set of national security problems than does reliance on foreign crude supplies.

INTERNATIONAL

--In an oil-short world, there is little likelihood of a foreign competitive threat to domestic refiners who process mainly domestic crude oil. The United States has adequate refinery capacity to process its current and projected crude production.

--Free world oversupply of refining capacity will persist through the few remaining years of increasing world crude oil production and thereafter.

--Increases in the refining capacities of oil-producing nations are likely to build pressures on many oil import-dependent nations to accept an increasing proportion of refined products in their import mix at the expense of reduced utilization of their own refineries.

--As world crude markets tighten, expansion of U.S. refining capacity will be limited by the ability of the U.S. to obtain crude supplies. Failure of the U.S. to obtain desired levels of crude supplies will make it increasingly necessary to import products refined in Europe and the Caribbean and, ultimately, from the expanded refineries of oil-producing countries.

REGULATORY

--In many cases, regulatory bias favoring small refineries has encouraged the construction of small inefficient refineries and the extended use of obsolete refineries. While in some regions of the country small refineries are vital to supply small regional market needs, we doubt that the program, as it has been constituted, is beneficial on a macroeconomic basis.

--Current U.S. policies encourage imports of foreign crude. They have also encouraged construction of small and inefficient refineries.

--Termination of crude oil price controls would: eliminate most of the protection from foreign competition now enjoyed by U.S. refiners, and would particularly affect (1) small refineries, (2) competition at the refinery level in the domestic market, and (3) any significant expansion of U.S. refinery capacity.

We have undertaken to carry out this analysis as part of our continuing effort to develop an analytical framework within which to discuss national energy policies and the important issues which affect them. We believe the principal and inevitable implication that might be drawn from this study is the glaring vulnerability of the United States to external forces beyond its control that will drive its energy future and dramatically affect not only energy matters but the economy itself. Of course, there is a need to focus on policies and initiatives the U.S. Government should pursue in matters affecting foreign oil supplies and prices. However, if we are to mitigate the effects of these forces on the quality of our lives and our economic viability, we need an all out national effort and program to: (1) increase efficiency of our use of energy and develop acceptable conservation programs; (2) develop ways to make more use of domestic energy resources (such as coal) in an environmentally acceptable and safe way; and (3) develop alternative energy sources and technologies with particular emphasis on an ultimate move to renewable, inexhaustible sources of energy. Absent such moves, the United States will remain a nation dependent on insecure supplies and unstable prices, and be subject to the full range of vagaries that that implies.

DOE COMMENTS

DOE is in general agreement with the thrust of the report and believes it makes a significant contribution to the discussion of U.S. refinery policy, especially the international and national security aspects of the issue. However, DOE believes that the report gives inadequate consideration of the following issues:

--The effects of removal of protection on individual U.S. domestic refiners.

--The consequences of removal of U.S. refinery protection while foreign governments continue to protect or subsidize their own refinery operations.

--The relative economics in terms of balance of payments, national income, employment, etc., of importing refined products versus crude oil.

We recognize that these are indeed important issues viewed from the perspective of the relative economics of imported crude versus refined products and the desirability of competition among refineries and policies which address those issues. Satisfactory resolution of those issues, however, will not abnegate the basic and, we believe, primary point made by this report: that adequate quantities of crude oil supplies to feed U.S. refineries cannot be assured over the long term and that condition is likely to lead to the necessity of acquiring increased quantities of products refined abroad.

With the exception of the next to last paragraph of DOE's comments, our final report reflects those concerns expressed.

Regarding DOE's comment on constraints on all refineries as a consequence of constraints on the availability of world crude supplies, it is possible to postulate a circumstance under which a crude supply interruption may take place which affects either U.S. refineries or European refineries, but not both at the same time. (A selective embargo, for example, in response to U.S. initiatives in the Middle East.) However, if there is a more general widespread crude shortage, all non-OPEC or import-dependent countries' refineries would indeed be seriously affected.

APPENDIX I

Department of Energy
Washington, D.C. 20545

May 9, 1979

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

Dear Mr. Peach:

We appreciate the opportunity to review and comment on the GAO draft report entitled "The United States Refining Policy In A Changing World Oil Environment."

The draft report makes a significant contribution to the discussion of U.S. refinery policy, especially the international and national security aspects of the issue. DOE has investigated similar refining industry issues with similar results and we are currently in the midst of a very comprehensive refinery policy study.

In general we agree with the thrust of the report and that it correctly identifies many of the major refinery issues facing the U.S. refining industry. However, the report gave inadequate consideration to the following issues:

- o the effects of the removal of protection on individual U.S. domestic refiners;
- o the consequences of removal of U.S. refinery protection while foreign governments continue to protect or subsidize their own refinery operations; and
- o the relative economics in terms of balance of payments, national income, employment, etc., of importing refined products versus crude oil.

The following comments are offered for consideration in preparation of the final report.

Refinery conversions from low sulfur crude oil to high sulfur, heavier crude have been hindered by DOE price controls as discussed on page 15. However, the size of the price differential between low and high-sulfur crude oil has also played a large role in investment decisions about desulfurization equipment.

(See GAO note, p. 24.)

Mr. J. Dexter Peach, Director

The threat of OPEC expansion into refining for export appears to be mildly overstated (pages 9, 25-27). While certainly a possibility, this event appears uneconomic as the draft accurately points out.

The either/or tradeoff suggested on page 31, paragraph 2, is not valid. The choice is not greater refinery capacity versus greater domestic production. Whether or not the U.S. petroleum industry expands domestic refinery capacity will have little to do with its incentive or ability to develop additional domestic production.

In addition, on page 32, paragraph 1, the possibility that importing product may pose additional and/or different potential vulnerabilities for U.S. national security is ignored. Importers of product, for example, may have less flexibility in finding replacement supplies than domestic refiners who have some leeway in finding alternative sources of imported crude to run in their refineries.

It also appears to be an inconsistency with respect to European and Caribbean refiners in the argument presented on page 33, paragraph 3. It is clear that refineries in OPEC countries will not be crude constrained. But it seems logical that if U.S. refiners were constrained by the availability of world crude supplies, European and Caribbean refineries would also be operating under similar constraints.

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

Sincerely,

Donald C. Gestiehr
Director
GAO Liaison

GAO note: Page references in this appendix refer to the draft report and do not necessarily agree with the page numbers of this final report.

END NOTES

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