Summer 1979

Staff Report. California Assembly Committee on Fuel Scarcity

California Assembly Committee on Fuel Scarcity

STAFF REPORT

California Assembly Committee On Fuel Scarcity

Summer 1979

MEL LEVINE
CHAIRMAN

Daniel Boatwright
Victor Calvo
Robert C. Frazee
Carol Hallett
Walter M. Ingalls
Henry J. Mello
Paul Priolo
Maxine Waters

Committee Staff

Brian H. Sway
Consultant

Andrew Gunther

Judy Sarantis
Secretary

STAFF REPORT

CALIFORNIA
ASSEMBLY COMMITTEE
ON FUEL SCARCITY

SUMMER 1979

MEL LEVINE
CHAIRMAN

DANIEL BOATWRIGHT
VICTOR CALVO
ROBERT C. FRAZEE
CAROL HALLETT
WALTER M. INGALLS
HENRY J. MELLO
PAUL PRIOLO
MAXINE WATERS

COMMITTEE STAFF

BRIAN H. SWAY
CONSULTANT

ANDREW GUNTHER

JUDY SARANTIS
SECRETARY

TABLE OF CONTENTS

ACKNOWLEDGMENTS

This report could not have been produced without the assistance of a number of individuals. The Committee staff is particularly indebted to:

Steve Lewis, Analyst
Assembly Office of Research

Richard Simpson, Public Finance Specialist
Senate Office of Research

Keith Felte, Data Processing Manager
Assembly Committee on Rules

Pauline Sweezy, Chief Economist
Department of Finance

V. John White, Consultant
Assembly Committee on Resources, Land Use and Energy Committee

In addition, the Committee staff wishes to thank:

Matthew Brady, Legal Counsel
Dale Rodman, Assessments Division
California Energy Resources, Conservation and Development Commission

Thomas Willoughby, Chief Consultant
Assembly Committee on Resources, Land Use and Energy

Timothy Davis, Chief Consultant
Roxanne Scott, Consultant
Senate Committee on Energy and Public Utilities

Tom Greene, General Counsel
Office of the Auditor General

D. J. Smith, Principal Consultant
Assembly Committee on Transportation

I. INTRODUCTION/SUMMARY

On May 9, 1979, Speaker McCarthy created the Assembly Committee on Fuel Scarcity to examine shortages of refined petroleum products which had begun to disrupt the social and economic well being of Californians. In announcing the creation of this special legislative committee, the Speaker explained:

> "Millions of Californians are confused and angry. They are victims of a chaotic fuel supply situation they do not understand...(and) they are entitled to answers..."

This report summarizes the Committee's efforts, as of July 1979, to fulfill this charge.

An exhaustive analysis by the Committee of all aspects of the fuel scarcity situation proved infeasible. The complexity of this problem has resulted in an ever-increasing web of related issues for the Committee to consider. Events of a global, national, regional, state and facility-by-facility nature are involved. The Committee's staff therefore approached the investigation by focusing on three fundamental areas of inquiry: 1) crude oil supplies; 2) refinery capabilities and performance; and 3) demand for gasoline.

Staff focused on these three areas, rather than others, after a preliminary analysis indicated that they include the basic aspects of the fuel scarcity subject which are unique to California. Several important factors not treated herein include the intricate and ever-changing federal allocation and

price control programs, the state's utilization of its "set aside" in the federal allocation program, the Governor's odd-even program, competing intrastate demands between farmers and truckers for diesel fuel which emerged in late June, and the number of retail service station closings in California.

In spite of this focused approach, there are still many questions which remain unanswered and no single cause or factor completely explains why California has experienced a fuel scarcity. It is unlikely that any one explanation will ever satisfactorily answer the question "What went wrong?" for those who have had to sit in gasoline lines.

Mr. Charles Warren, the Special Emissary of the President to California on fuel issues, indicated in testimony to the Committee that the shortfall of allocated gasoline in California had reached 70,000 b/d in May, 1979, when compared to May 1978. This figure excludes 1979 gasoline demand in excess of 1978 levels. As it is difficult at best to estimate what that additional increment of demand actually was (distinguishing tank-topping, industrial stockpiling, and general panic buying from natural increases in consumption), the true extent of the California shortage is unknown.

However, the Committee investigation has resulted in the isolation of significant trends which contributed to the overall fuel scarcity problem. Aspects of crude oil supplies, refining and demand, all appeared to have had an effect upon the overall situation.

Trends the Committee has identified include:

- CRUDE OIL SUPPLIES. First quarter 1979 California crude oil supplies remained at levels similar to those at the end of 1978. Imports of foreign crude oil into California for the first quarter of 1979 actually increased over year-end 1978 levels. The Iranian crisis therefore did not result in reduced imports into California during the first quarter of 1979.

  On the national level, 1979 imports and domestic production have declined from 1978 year-end levels. While the reduction in imports appears to be a consequence of the Iranian revolution's impact on the world crude oil market, the drop in domestic production is unexplained. In addition, crude oil stocks which were drawn down substantially in 1978 have been increasing since the beginning of 1979.

- REFINING. In 1979 United States refineries have been utilized at rates below 1978 year-end levels. West Coast refining capacity, of which California refineries comprise 80%, has operated at monthly utilization rates

ranging between 81 and 85% during 1979.

California gasoline production dropped 21% between December 1978 and March 1979, while residual fuel oil production increased. Gasoline inventories were more heavily utilized in this period, but it does not appear that minimum operating levels were reached on an industry-wide basis.

Heavy crude oil, thought by some to have only recently arrived on the California market, has long been used by California refineries. Since the completion of the Trans-Alaskan Pipeline, in the summer of 1977, heavy crude oil has comprised a major portion of California refinery inputs. Though great uncertainty is voiced by industry representatives about the ability of California refineries to process heavy crude oil, several large California refineries are relying predominately on heavy crude oils for their refinery feedstocks.

Federal price and State environmental regulations have been represented as major obstacles preventing the industry from modifying refineries to more efficiently utilize heavy crude oils. However, a number of California refiners, particularly smaller independent companies, have begun to modify and expand their facilities to allow for more efficient utilization of heavy crude oils.

- DEMAND FOR REFINED PETROLEUM PRODUCTS.

  Purchases of gasoline by the ultimate consumer are not recorded or compiled by any central organization. Demand is evaluated by measurements of taxable distributions, i.e., the tax per volume of refined petroleum products transferred from the refinery to the first purchaser in the distribution system. While the recorded distributions for January and February 1979 were unusually high, distributions for March and April declined significantly to levels .6, and .3 percent above 1978 levels. May 1979 distributions were 2.8% less than those in May 1978.

  Growth in the California economy, population, registered vehicles, and outstanding drivers' licenses at rates in excess of national levels could easily account for the increased distributions in March and April. In addition, there are indications that commercial purchasers (vehicle fleet operators) took notice of the Iranian situation earlier than other consumers and increased the frequency and quantity of their fuel purchases, which could account for a significant portion of the increased distributions in January and February.

Of great significance to an understanding of the fuel scarcity is the fact that California is the major gasoline supplier for much of PADD 5. Increases in gasoline exports to other states, combined with reduced imports into California from the Gulf Coast, further aggravated the California fuel scarcity.

II. CRUDE OIL SUPPLIES

- Total California crude oil receipts through March 1979 remained relatively constant. Foreign crude oil receipts actually increased slightly during the same period.

- 1979 United States crude oil imports and production declined from 1978 year-end levels.

  --imports of Iranian crude oil have been reduced

  --existing contracts for imports of foreign crude oil were broken and supplies diverted for sale on the world spot market

  --the decrease in domestic crude oil production is unexplained

- United States 1979 crude oil stocks have been increasing over year-end 1978 levels. West Coast 1979 crude oil stocks have also increased.

Measurement of crude oil supplies has three integral components: 1) foreign imports; 2) domestic production; and 3) stocks. Crude oils from particular countries and regions

differ in specific gravity, metals content, and other qualitative aspects which are very significant to the purchaser. These qualitative differences are not recorded in published data, but must be kept in mind when discussing crude oil supplies.

Stocks include storage in refinery tanks, cargos in tankers, ships, tank trucks, railroad tank cars and pipelines. The level of stocks can fluctuate in relation to pending changes in demand, seasons, crude oil prices, production estimates, economic, and political climates among other factors.

A. Crude Oil Imports

Free world crude oil production is approximately 47 million b/d of which 63% is produced by countries belonging to the Organization of Petroleum Exporting Countries (OPEC). The United States, which consumes 30% of world production, produces 8 - 9 million b/d and imports the remainder of its crude oil supplies.[1/]

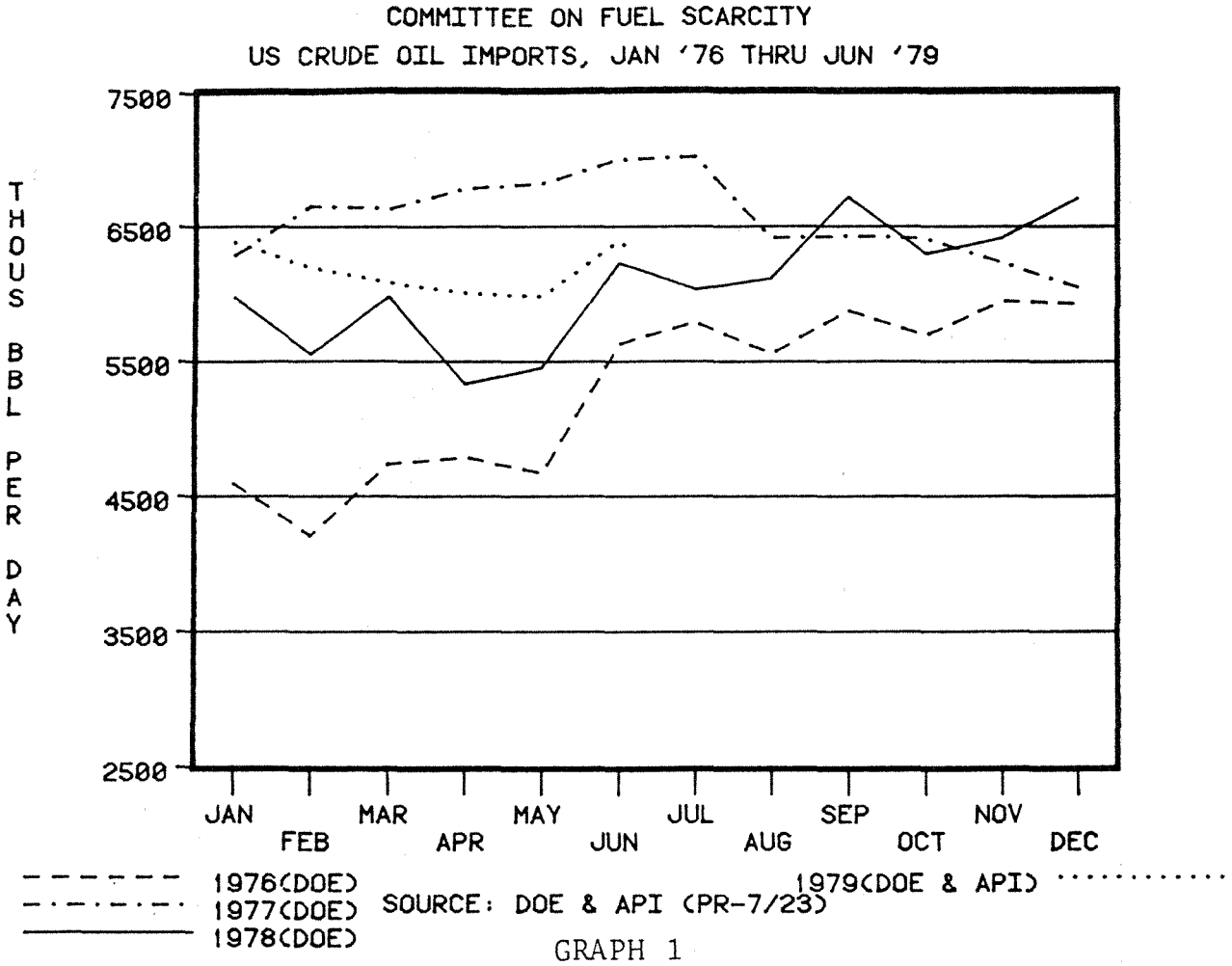
First quarter 1979 United States imports of foreign crude oil averaged 6.2 million b/d. America is dependent on OPEC for the majority of this imported crude oil, and this reliance has steadily increased since 1973. In 1973, crude oil purchased from OPEC comprised 71% of total United States foreign imports. By 1978, this figure had increased to 82%. The sources of imported crude oil most important to the United States in 1978 were Saudi Arabia (15%), Nigeria (12%), and Venezuela (11%). These supply arrangements are in contrast to those of 1973 when Venezuela was the largest United States supplier (27%), followed by Canada (20%) and Saudi Arabia (12%).[2/]

Until December 1978, Iran was the second largest producer of crude oil in the world. Iran provided 11% of the United States foreign crude oil imports in 1978, 8% in 1977, and 7% in 1973.[3/] Although this reliance made the United States very vulnerable to supply interruptions, other European and Asian countries were even more dependent upon Iranian oil. Japan, which imports virtually all of its crude oil, received 17% of its 1977 crude oil imports from Iran.[4/]

The revolution in Iran has had a significant effect upon the world petroleum market. Iranian oil production had reached levels as high as six million b/d in early 1978, and accounted for 13% of 1978 Free World oil production. However, by October 1978 the country's political instability began to undermine its crude oil production. Strikes and slowdowns by oil field workers resulted in reduced production, and in late December, Iranian exports ceased completely. Production resumed after 69 days, but only at a rate of 3.5 - 4 million b/d.

The full and continuing primary and secondary impacts of the Iranian reduction and recent OPEC sanctions on United States imports are not clear. As has been widely reported in the media, foreign crude oil imports into the United States, excluding imports to the Strategic Petroleum Reserve, have declined since the curtailment of Iranian oil production in December 1978 and this trend continued after the subsequent resumption of limited production. However, this decline during the first five months of 1979 was from record-setting import levels experienced during the last quarter of 1978. To put this

decrease in perspective: in December, 1978, the United States imported 6.7 million b/d, whereas by May 1979, this had dropped by 800,000 b/d to 5.9 million b/d. However, when the first six months in 1979 are compared to the same period in 1978, crude oil imports actually increased 420,000 b/d or 7.3%.(See Graph 1) 5/



GRAPH 1

A further aspect that clouds the crude oil imports picture, and has nearly gone unreported, is the United States government's continuing efforts to increase the volume of crude oil in the Strategic Petroleum Reserve (SPR). From December 1, 1978

through March 1979, the United States added approximately 22,685,000 million barrels of foreign imported crude oil to the SPR.[6/] This is considered more fully in the discussion of crude oil stocks.

The net decrease in Iranian crude oil production has had the effect of reorganizing the world crude oil market. The world market went from a condition of surplus to one of deficit, forcing those countries which were especially dependent upon Iranian crude oil to become intensively competitive in the world crude oil market. Before the revolution in Iran, much of the world's crude oil production was under long-term contract. Crude oil production in surplus to these contracts was sold on what is called the "spot market".

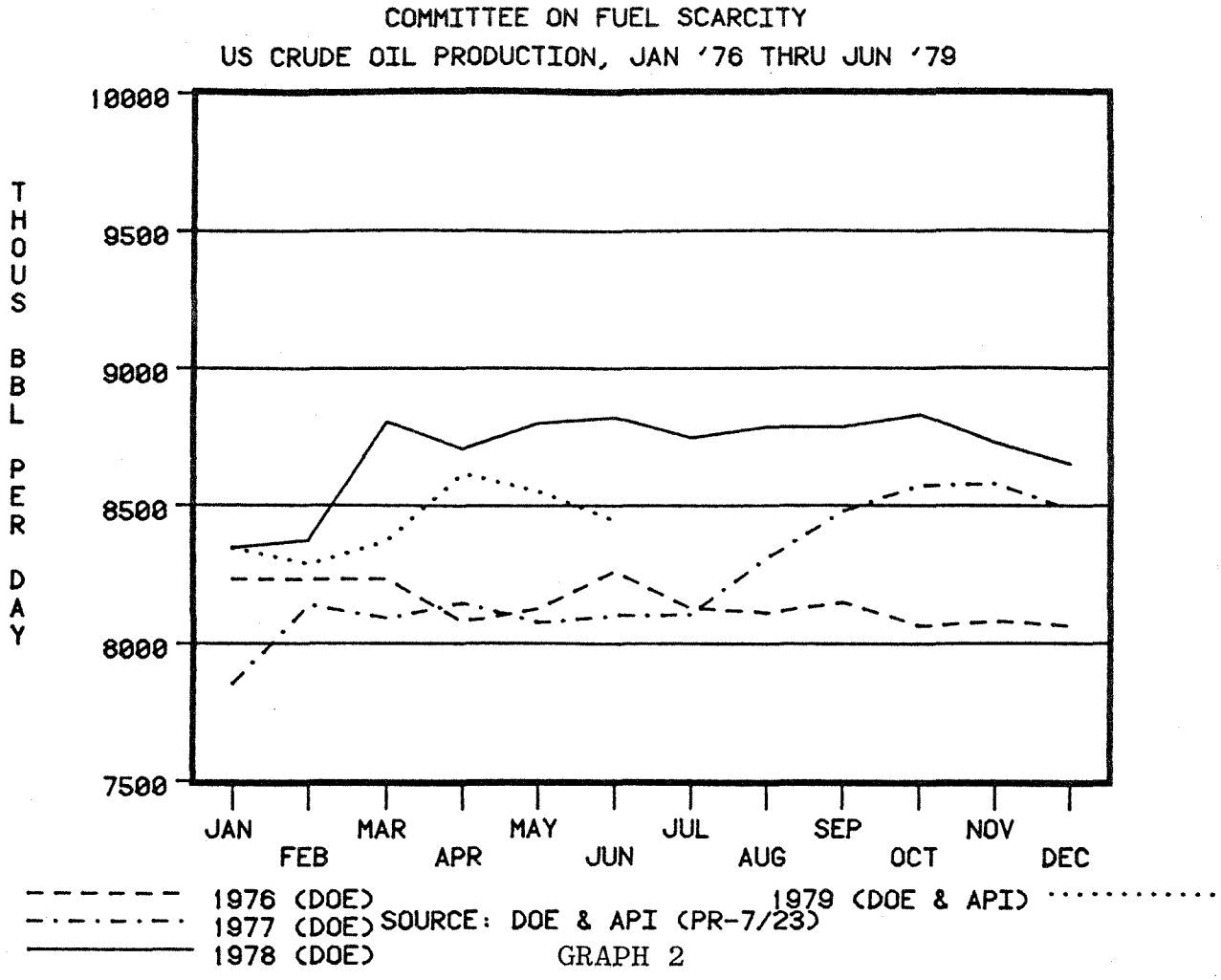
The spot market has operated as a mechanism for producers to sell supplies in surplus of contractual obligations. This market mechanism has long been used by the petroleum industry as a price indicator. When crude oil supplies are tight, price escalates. Inversely, when there is a surplus, price decreases.

Since December, 1978, there has been a drastic rearrangement in supplier-purchaser contractual relations. With the curtailment of Iranian exports, the spot market initially dried up. When the National Iranian Oil Company resumed production, although at reduced levels, they began canceling old contracts and allocating their production to the spot market. Because overall world supplies were tight, Iran was able to obtain significantly-higher prices for its crude oil. Other producing nations quickly followed suit.

Purchasers with cancelled contracts came under extraordinary pressure to compete on the spot market for the newly-freed crude oil supplies. The economic success producers experienced in resorting to the spot market encouraged further reallocation, and thus traditional supplier-purchaser relations have been upset and world crude oil production redistributed. Countries bidding actively on the spot market have purchased previously-contracted supplies, generating shortages elsewhere while pushing up prices. Japan has become an aggressive purchaser and has been successful in obtaining supplies of Indonesian crude oil.

B. Domestic Production

Whereas some OPEC and other producing countries temporarily increased production during the height of the Iranian shutdown, United States production in the first six months of 1979 actually decreased. In the first six months of 1978, domestic crude oil production averaged 8,643,000 b/d.[7/] By comparison, in the first six months of 1979, preliminary figures indicate the United States produced an average of 8,436,000 b/d of crude oil.[8/] This 207,000 b/d average shortfall is the equivalent to the loss of 37,467,000 barrels of crude oil production. (See Graph 2)



GRAPH 2

This difference appears to be due to a steady decline in domestic crude production during the fourth quarter of 1978 and the first quarter of 1979. From October 1978 to March 1979, domestic crude production dropped 5%, or 461,000 b/d.[9/] By comparison, the General Accounting Office estimated the United States crude shortfall due to Iran to be 500,000 b/d.[10/]

According to testimony presented to the Committee from Chevron U.S.A., decreasing domestic production, on the order of 2% each year, must be expected as our oil fields become older

and less productive.[11/] However, a substantive explanation for the more pronounced decline noted above has not been brought to light by the Committee's investigation. This drop in domestic crude oil production must be considered a significant factor of the national condition of fuel scarcity.

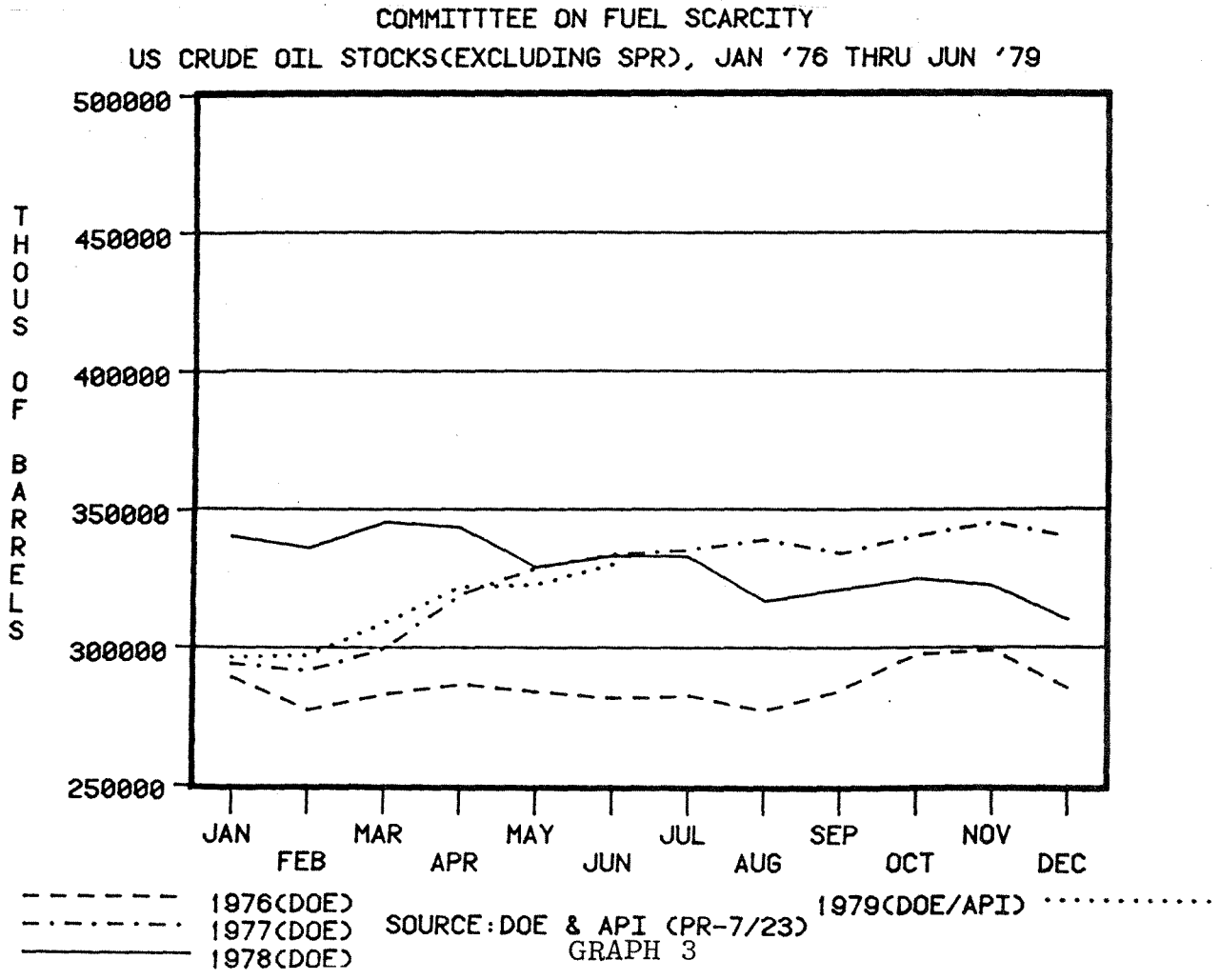
Some attempts to explain this situation, offered in the media, have included inclement weather and mechanical failures. In testimony to the Committee, Chevron U.S.A. stated that domestic production cannot be accelerated on short notice as was the production of other countries. However, preliminary data from the American Petroleum Institute indicates that following a marked decline in domestic production between October 1978 and February 1979, production increased 249,000 b/d (3%) from March to April, and then decreased through May and June.[12/] (See Graph 2) The United States was the only other oil-producing country besides Iran to show a crude production decrease in the first quarter of 1979.[13/]

C. Crude Oil Stocks

Inventories of crude oil available to the refiners are known as stocks. In addition to crude oil at the refinery and in terminal storage tanks, companies consider all crude oil being transported in pipelines, tankers, rail tank cars, and truck tank cars as stocks. Many firms have predetermined volumes called minimum operating levels (MOLs). If stocks fall below the MOL, refiners believe their operations may be subject to interruptions by delivery delays, spot shortages, or other similar events. Such interruptions could in turn affect wholesale and retail operations.

Crude oil stocks therefore have a critical role in the operations of the petroleum market. In analysis and commentary on the current crisis, there has been a tendency to make comparisons of United States stock levels as reported in December 1978 and December 1977. Such an analysis indicates a 9% decline which, it has been suggested, left the United States unusually vulnerable.[14/]

However, such a comparison fails to take into account the fact that stocks were abnormally high in late 1977 and early 1978. (See Graph 3) Throughout 1977, crude oil stocks continually increased, as a substantial OPEC price increase had been anticipated by year's end. This price increase had not materialized by early spring 1978, and so crude oil stocks declined throughout the balance of the year, resulting in the above-mentioned lower levels in December 1978.

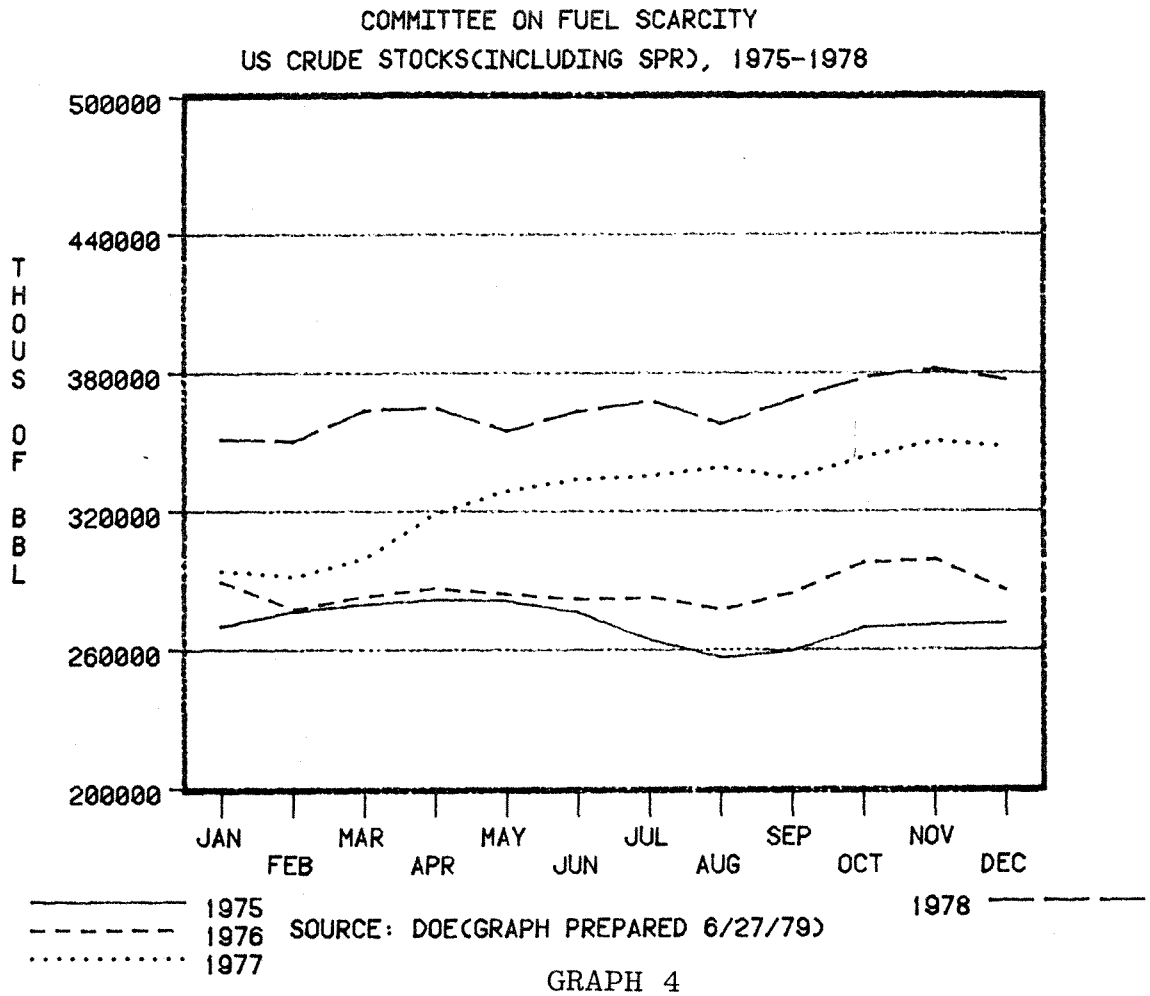


GRAPH 3

Through the first part of 1979, a concerted effort seems to have been made to increase crude oil stocks, while at the same time a national crude oil shortage was being stressed. (See Graph 3) It appears that stocks were lower than normal in the beginning of 1979 due to last year's draw down. And even with that draw down, crude stocks at the beginning of 1979 were higher than at the beginning of 1977 and 1976. The Committee is unable to ascertain if these additions to crude oil stocks, above levels of prior years, during a time of product scarcity, were necessary.

Since October 1977, the Department of Energy has been adding crude oil to the Strategic Petroleum Reserve (SPR). At the end of 1978, the SPR stood at 66,860,000 bbl., and by March 1979 it had climbed to 82,501,000 bbl. Measurements of crude stocks, including the SPR, show the highest inventory levels ever by the end of 1978. (See Graph 4) However, as the Department of Energy had not installed pumping equipment, these crude oil stocks could not be utilized during the peak of the crisis.

Most of the crude oil being used to create the SPR is imported crude oil. It is unclear how much of the fuel scarcity condition may have been alleviated through temporarily redirecting these imports, but the refining and distribution of this crude and additional industry crude directed to inventories would certainly have had a positive effect upon fuel availability. 15/



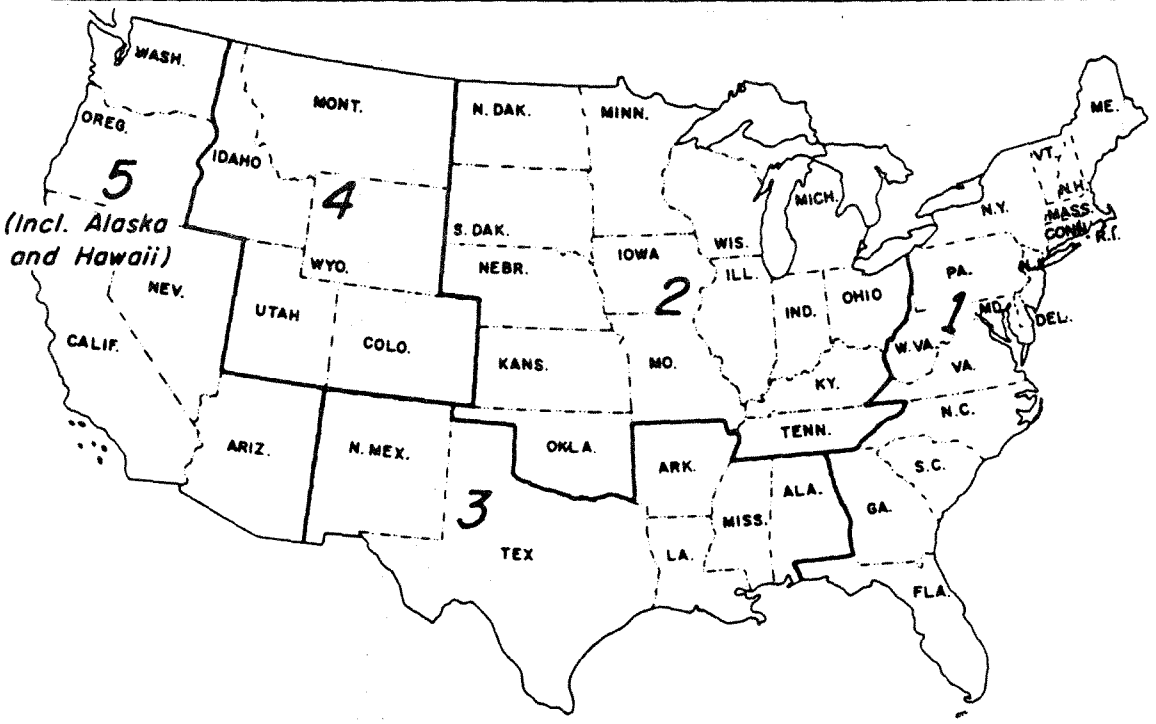
GRAPH 4

D. The California and the PADD 5 Crude Oil Supply Perspective

California and United States supply trends have not followed the same course in recent years. The United States is divided into five Petroleum Administration Defense Districts (PADDs). (See Figure 1) These districts are drawn on a geographical basis and California is contained within PADD 5. In addition to California, PADD 5 includes the states of Alaska, Washington, Oregon, Nevada, Arizona, and Hawaii.

FIGURE 1

PETROLEUM ADMINISTRATION FOR DEFENSE (PAD) DISTRICTS

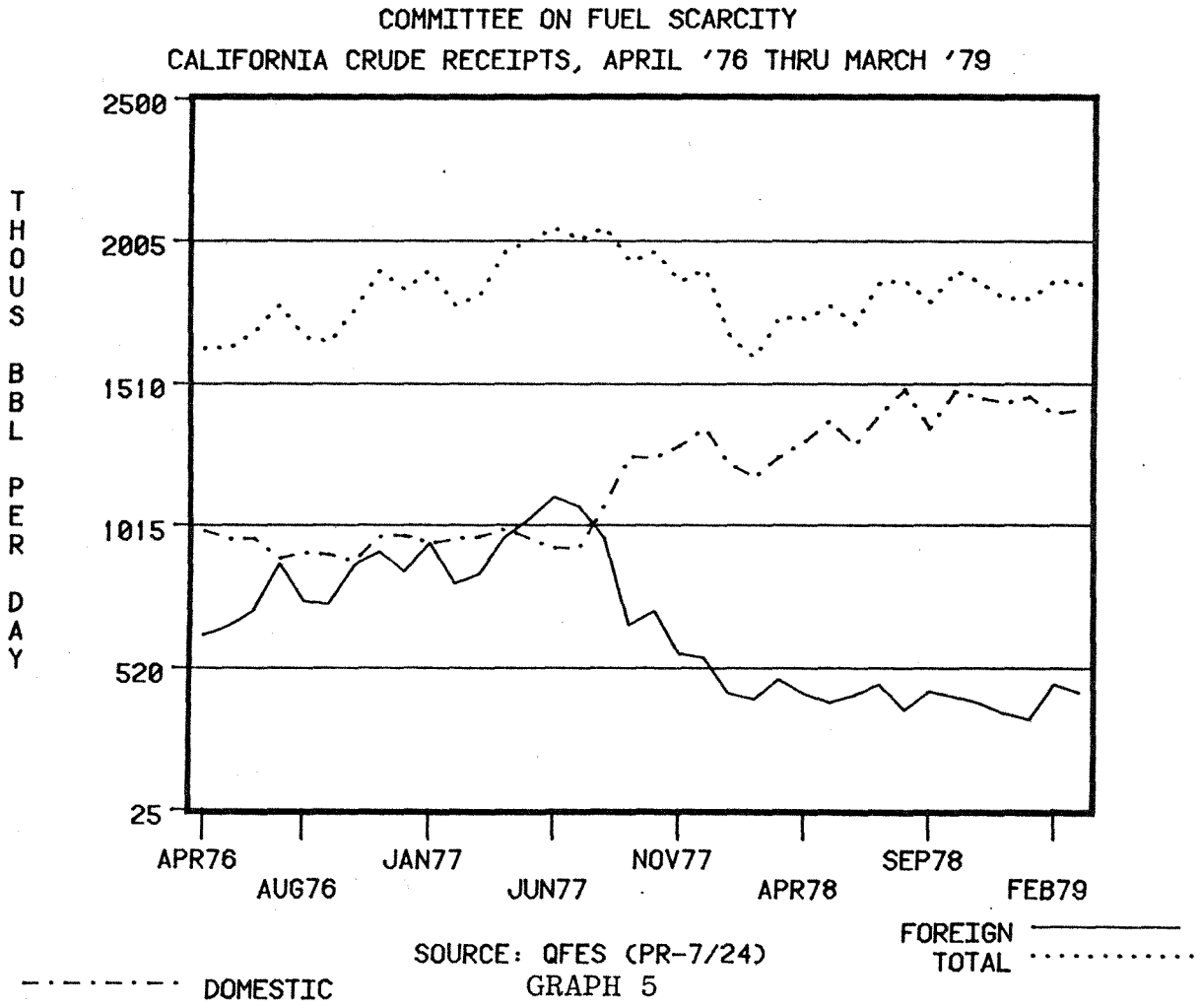


Source: Department of Energy

The geological separation by the Rockies of PADD 5 from the rest of the United States is more than a convenient demarcation. Very little in the way of crude oil flows over the Rockies either into or out of PADD 5 by railcar, truck or pipeline.

Due to this physical separation, California - PADD 5 supply trends have not followed the same course as those of United States in recent years. Until mid-summer 1977, and the arrival of Alaskan North Slope crude oil, the West Coast was heavily dependent on foreign imports, California production and small amounts of Southern Alaskan production.

In December 1976, California total crude oil receipts averaged 1,834,000 b/d. Of the total, domestic crude oil receipts averaged 980,870 b/d or 53%, while foreign imports, primarily receipts from Indonesia and the Middle East, averaged 853,452 b/d or 47%. However, this trend has changed significantly in the last two years. By December 1978, domestic receipts, including 581,032 b/d of Alaskan North Slope crude oil, had grown to comprise 80% of total receipts, averaging 1,442,000 b/d, while foreign receipts dipped to only 20% of the 1,805,000 b/d total, averaging 363,000 b/d.[16/] In contrast to the nation as a whole, California and PADD 5 are now dependent on domestic production for the majority of their crude supplies. (See Graph 5)



GRAPH 5

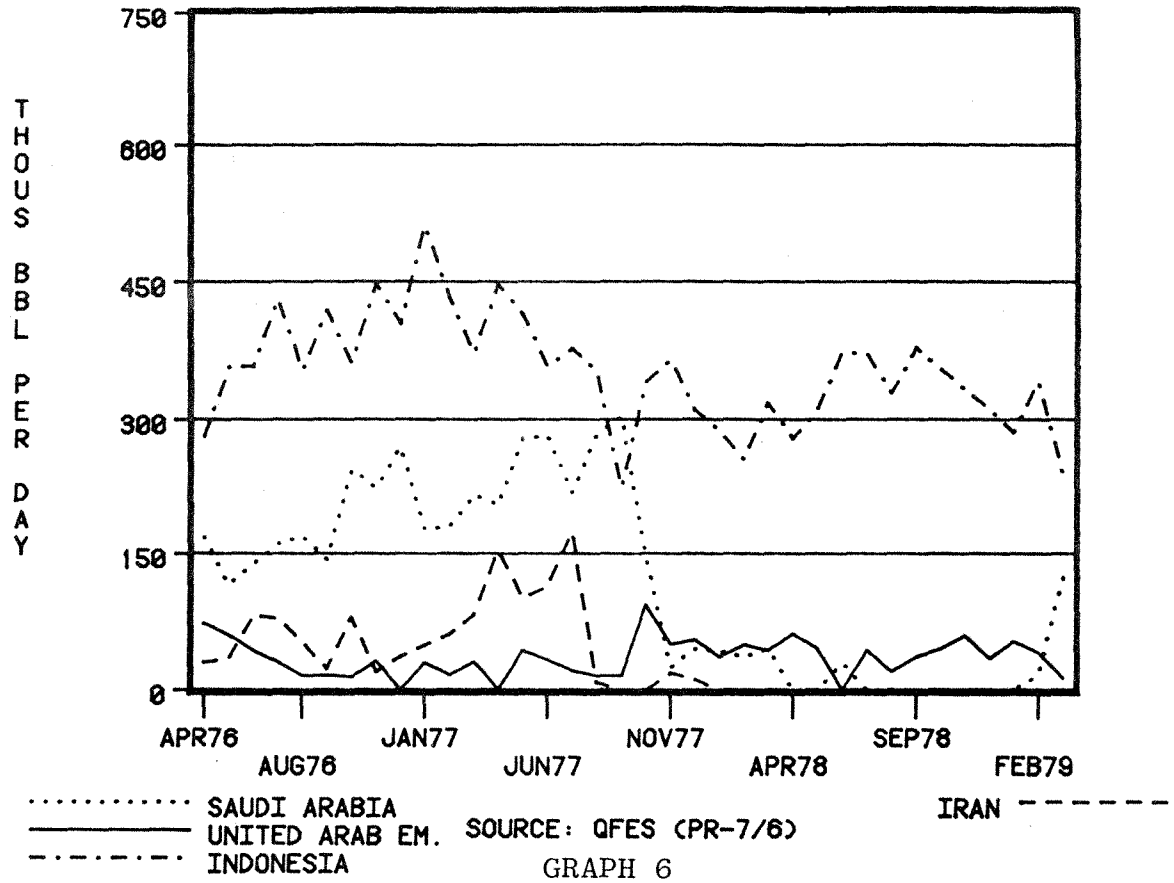
In light of the transition from light imports to heavy domestic crude oils in 1977, the Iranian revolution appears to have had a minimal direct effect upon California receipts of crude oil. Since November 1977, this state has not received any Iranian oil, and Indonesia has been our primary source of imported foreign crude oil. (See Graph 6) Although imports from Indonesia declined in the first quarter of 1979, this decrease in volume was more than offset by increased imports of Saudi Arabian crude. As a result, total receipts of foreign crude in California for the first quarter of 1979 actually increased by 19,000 b/d over fourth quarter 1978 levels.[17/] This trend is in marked contrast to the national decline of imports.

These figures indicate that, at least for the first quarter of 1979, there was not a crude oil shortage in California due to a decrease of foreign imports. Overall in California, from September 1978 through the first quarter of 1979, total crude oil receipts were relatively constant. (See Graph 7)

Crude oil stocks in California and PADD 5 have followed national trends more closely than have crude oil imports. California crude oil stocks rose through 1977, followed by a draw down in 1978. (See Graph 8) This trend is also seen in PADD 5 figures. (See Graph 9) As of June 1979, preliminary data indicates that PADD 5 crude oil stocks were very close to 1978 levels. California refinery crude oil stocks hit a low point in February 1979 and increased through March.

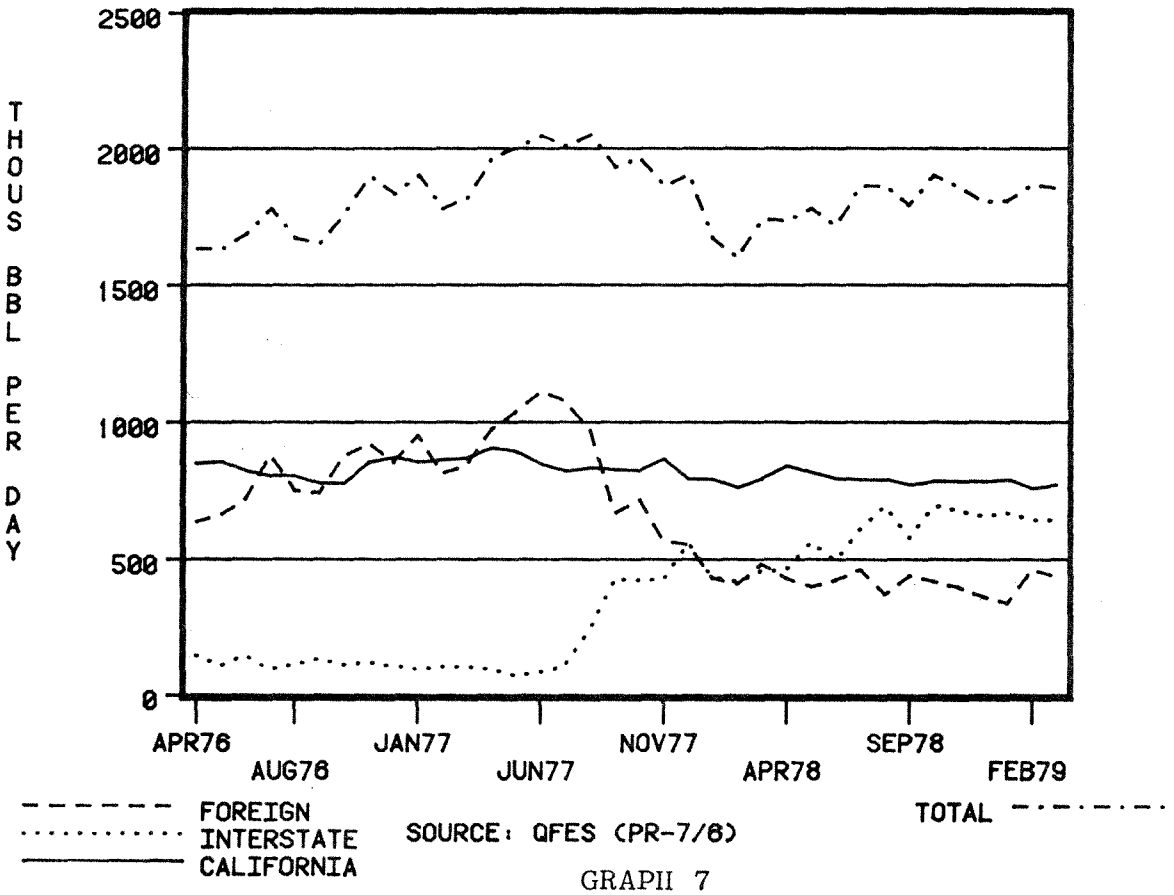
COMMITTEE ON FUEL SCARCITY

SELECTED FOREIGN CRUDE RECEIPTS IN CALIF., APRIL '76 THRU MARCH '79

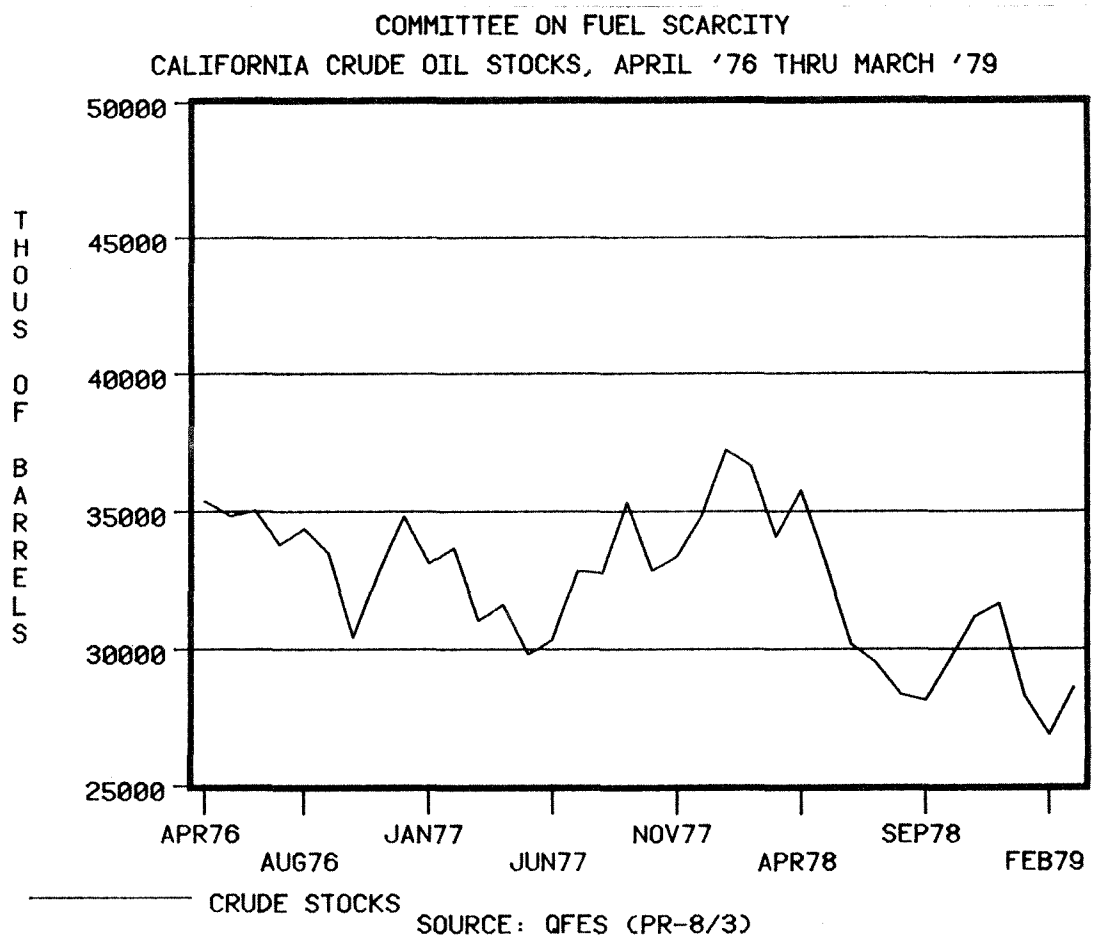


GRAPH 6

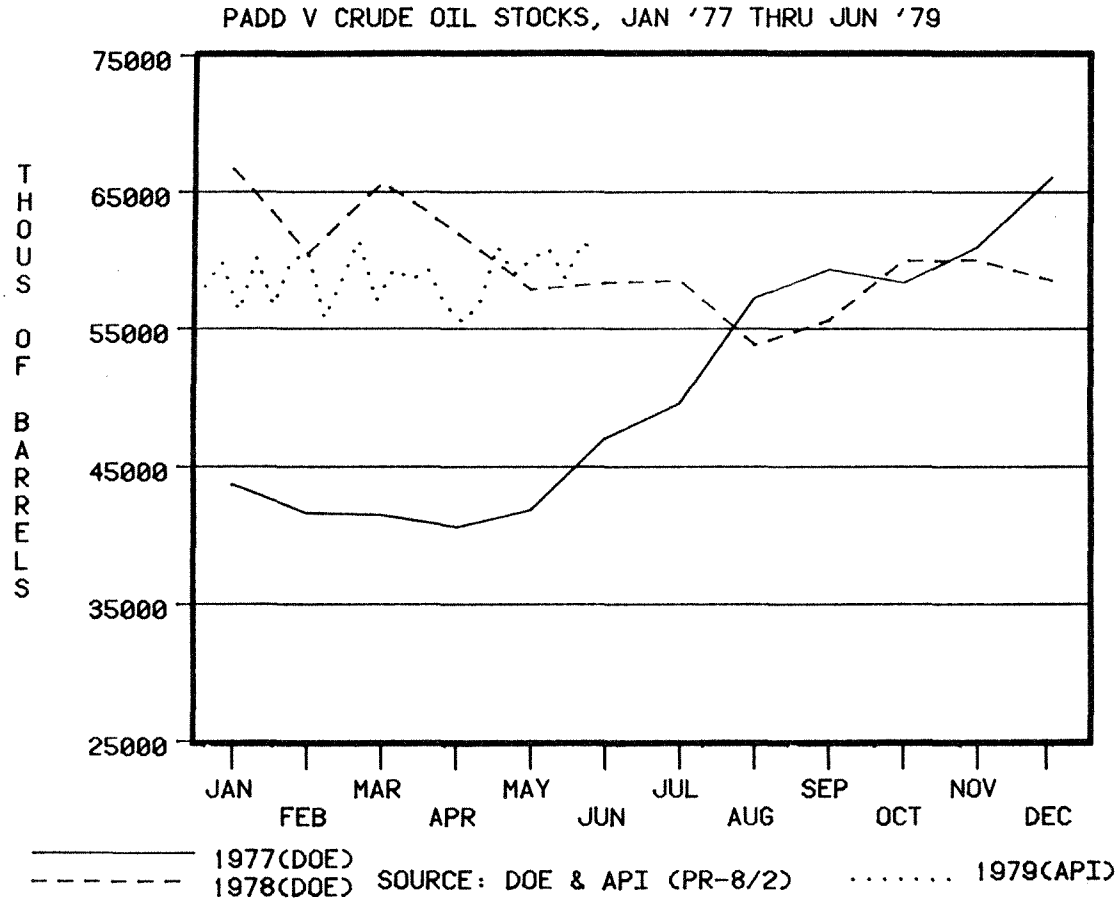
CALIFORNIA CRUDE RECEIPTS, APRIL '76 THRU MARCH '79



GRAPH 7



GRAPH 8



GRAPH 9

E. Summary

Preliminary analysis of data indicates the Iranian shortfall, and subsequent rearrangement of world crude oil supplier-purchaser relationships, did not reduce California crude oil supplies through the first quarter of 1979. Foreign imports of crude oil into California were up slightly while domestic receipts of crude oil were down.

Iran and the United States were the only oil-producing nations to show a decrease in crude oil production in the first part of 1979. The reasons for the decline in United States crude oil production are not clear.

California crude oil stocks dipped to low levels in February 1979 and showed signs of being rebuilt in March of 1979. Preliminary data indicates that June 1979 West Coast crude oil stocks were at approximately the same levels as 1978. Nationally, crude oil stocks have been increasing through the first six months of 1979.

III. REFINING

- Refining of heavy crude oil requires special refining components. The utilization rates of such equipment are not published and therefore the efficiency of these units cannot be assessed with available data.

- California refineries have been processing heavy domestic crude oil for many years and large volumes of Alaskan North Slope crude oil since 1977.

- Although there are complaints about government regulations interfering with refinery expansions and modifications to be able to process heavy crude oil, there have been permits issued and projects initiated for such work. It is unclear to what extent government policies are inhibiting additional refinery retrofits or if other economic and strategic reasons are responsible.

- California gasoline production dropped 21% between December 1978 and March 1979, while residual fuel oil production increased. There is no thorough explanation for this shift in refined product outputs.

- While industry gasoline stocks were drawn down substantially in the first quarter of 1979, it does not appear they were at minimum levels. Gasoline stock levels in PADD 5 did not drop below 1978 levels.

The adequacy of California's refinery capacity has emerged as the area of greatest uncertainty in the Committee's hearings and staff investigation to date. The Committee sought answers to the following questions:

1) Are the types and capacities of California's refineries adequate to meet demand?

2) Are existing California refineries being utilized to the fullest extent possible?

3) To what extent are California refineries equipped to process crude oils available now and likely to be in the future?

There are 40 crude oil refineries in California with a reported capacity of 2,400,000 b/d. Eight of the largest oil companies in the state have 12 refineries with 1,751,000 b/d capacity or 73% of California's total refinery capacity.[18/] These large refineries produce the majority of the state's gasoline.

The isolation of PADD 5, described in the above discussion of crude oil supplies, is particularly relevant in understanding the California - PADD 5 refinery picture. California refining capacity makes up 80% of the total PADD 5 refining capacity.[19/]

A. The Refining Process

Each refinery is unique and varies in its ability to refine different types of "feedstocks" (inputs), to produce specific "product slates" (outputs), and in maintenance requirements. Utilization of refineries is therefore a function of many variables including among others the complexity of the refinery, products desired, types and quality of crude oil

refined, and operable condition of refinery equipment.

Capacity ratings reported to government regulatory agencies involve the "upstream" capacity, which is the amount of crude oil fed into the refinery's primary distillation unit(s) at the beginning of the refining process. Upstream refining is the initial distillation of crude oil whereby it is separated into its natural components.

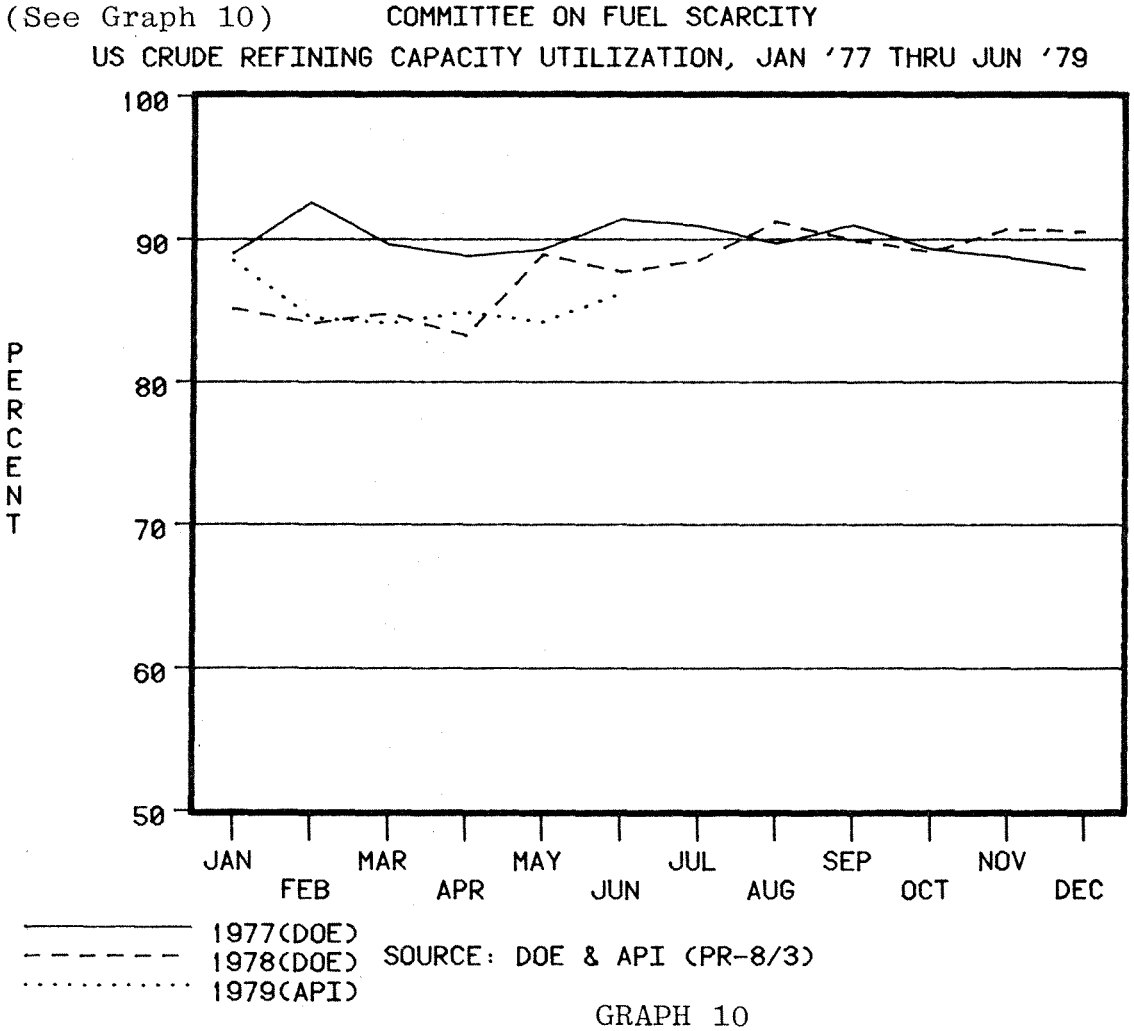
Often unmentioned in discussion of refinery capabilities is the capacity of the refinery's "downstream" equipment. Such equipment includes cokers, catalytic reformers, and catalytic hydrocrackers. For California, these operations involve the most important aspects of refining operations: the second-stage of the refinery process which upgrades distillates into products which meet set specifications, produces more gasoline from lower-grade distillates, and radically alters residual product from the primary distillation process into middle distillates and light products.

Downstream equipment is not totally reliant on the upstream refining capabilities at a given refinery. Distillates can be purchased on the open market, and processed in downstream equipment independent of upstream refinery apparatus. Testimony received by the Committee indicates that the downstream capacity of many California refineries have not been designed to receive and process the full volume of output from the initial distillation units.

B. Utilization Rates

Utilization rates usually refer to the amount of crude processed by a refinery's upstream components and is expressed as a percentage of the "name-plate" or maximum potential. Industry witnesses indicated that a utilization rate of 95% name-plate capacity represents maximum use of a refinery. American Petroleum Institute statistics indicate that since 1976, the highest single utilization of operable upstream refinery capacity for the United States in any given month was 92.7%. In 1976, the United States' percentage of operable capacity utilized was 89%, in 1977 - 89.9%, and in 1978 it dropped to an average of 88%.[20/] For the first six months of this year, United States refinery utilization averaged 84.6%.[21/]

(See Graph 10)



GRAPH 10

PADD 5 data from the American Petroleum Institute indicate a decline in refinery utilization in the second quarter of 1979. The average utilization rates reported for April were 84%, 81% in May, 82.9% in June, and 85.4% as of the first week in July.[22/] By contrast, other PAD Districts reported higher utilization rates. The West Coast refining sector is therefore operating at 15-20% below its rated upstream name-plate capacity.

Whereas the American Petroleum Institute and Federal Department of Energy collect information on percent utilization of capacity, completely unreported is the utilization of downstream refinery units. This secondary refinery capability is the essential element in the refining of heavier crude oils (Alaskan and California crude oil) into desirable light products.

In testimony to the Committee, it was reported that downstream capacity is being utilized at rates which in some cases exceed 110% of normal capacity. This is possible as normal capacity is not necessarily equal to maximum capacity. Even though upstream refining capacity may not be totally utilized, the volume of unfinished products produced by initial distillation which needs additional refining may well exceed downstream capacity. As mentioned above, these secondary processing units can also process middle distillates and residual oil obtained from other sources.

The depth and complexity of refinery operations makes an assessment of utilization rates and efficiency of operations very difficult. This is especially true when attempting to

assess if the refining industry is fully utilizing available downstream equipment. Operation of refinery components are varied by the industry to produce a particular product slate. Variations in product output observed in California in the first quarter of 1979 indicate that changes in utilization are occurring. However, the lack of reported information concerning downstream equipment leaves many questions unanswered.

C. Feedstocks (Crude Input to Refineries)

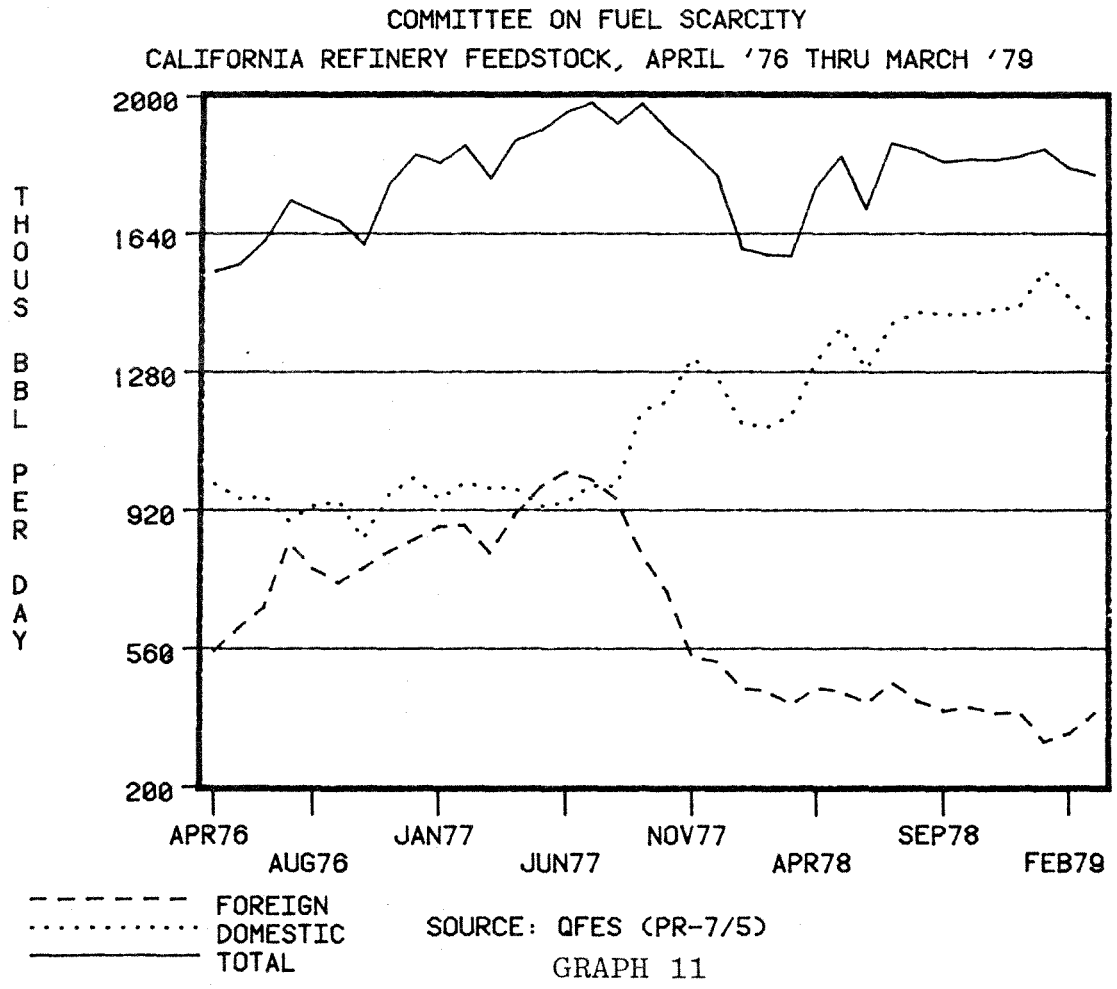
The issue of quality differences between types of crude oils has been pointed to as a factor affecting product output. Feedstock quality, in addition to refinery hardware and operating efficiency, is an essential factor influencing refinery product slates, and was repeatedly emphasized by many of the Committee's witnesses.

Basically, crude oil is a mixture of hydrocarbon molecules. Impurities such as metalics, sulfur and parafin, which are often associated with crude oil deposits, make each type of crude oil unique. All of these factors are closely considered when refineries are initially designed or later modified. Refiners are thus anxious to obtain crude feedstocks which complement their refinery design and thus permit maximum efficiency of operations. The limits to which refineries can process crude oils they were not designed for varies on a facility-by-facility basis.

In general terms, California has had two types of crude oil available to it: A) light (high specific gravity) crude oil such as most Saudi Arabian and Indonesian crudes which are conducive to less complex refining processes; and B) heavy (low specific gravity) crude oil such as most Californian and Alaskan North Slope crude oils which require more complex down-stream refining processes including reforming, coking, and catalytic cracking. Simple distillation of a barrel of light Indonesian crude oil gives substantially more light product than a barrel of heavier Alaskan North Slope crude oil. This basic difference represents how critical crude quality is in the refining process.

By late 1976, the mix of California's refinery feed-stocks averaged approximately 50% domestic crude oil and 50% foreign crude oil. However, with the arrival of Alaskan North Slope crude oil into California in April of 1977, foreign crudes (specifically Saudi Arabian) came to represent a smaller fraction of refinery feedstocks. (See Graph 11) California refineries began utilizing large quantities of heavy domestic crude in 1977 and recent changes in crude oil inputs have been comparatively minor.

The flexibility of individual California refineries to process different mixes of crude oil has been represented to be quite small. Alarmingly, the Committee has received testimony that California refineries have been designed to operate utilizing lighter crude oils heretofore obtained from foreign sources, and have difficulty in refining the larger proportions of heavy crude oils now available from California and Alaska.



GRAPH 11

Given recent developments on the world crude oil market, it appears that refinery feedstocks in California will never again have a high percentage of light foreign crudes due to the keen competition for light foreign crude oils on the world market and America's desire to stimulate domestic oil production. This means that California refiners will be forced to meet future demand with relatively heavy crude oil feedstocks. This transition, it is said, will have to entail the modification and expansion of downstream refinery capabilities in PADD 5 to allow for efficient utilization of heavy crude oil supplies.

Complicating this entire refinery issue still further is the growing demand for unleaded gasoline. Each year the automobile fleet is requiring more unleaded gasoline as new cars replace older vehicles which used leaded gasoline. Production of unleaded gasoline adds pressure upon already-strained refinery capacity. It takes more refining time and therefore more capacity to produce a given amount of unleaded as opposed to leaded gasoline. Demand for unleaded fuel is anticipated to peak in the mid 1980's when the federal mileage standards are met.

In testimony to the Committee, the industry made repeated statements that environmental regulations and Department of Energy pricing regulations have inhibited their investments in the highly-technical and expensive downstream refining equipment that would allow them to better utilize heavy domestic crude oil.

However, there have been many applications and approvals for additions to California's refinery inventory both in terms of refining modifications and construction of new refineries. At least nine refinery expansions and four new refineries have been approved in the last two years. (See Figure 2)

FIGURE 2

APPROVED REFINERY MODIFICATIONS/EXPANSIONS

IN CALIFORNIA (77/78)

Company	Refinery Location	From (B/CD)	To (B/CD)	Increased Capacity B/CD
ARCO	Carson	180,000	180,000	-0-
Beacon Oil Co.	Hanford	12,300	14,000	1,700
Champlin Petroleum	Wilmington	30,600	50,000	19,400
Fletcher Oil and Refining	Carson	20,000	30,000	10,000
Kern County Refinery	Bakersfield	15,900	28,000	12,100
Mohawk Petroleum	Bakersfield	22,100	33,000	10,900
Newhall Refining	Newhall	11,500	17,500	6,000
UCO	Martinez	-0-	10,000	10,000
Gibson	Bakersfield	-0-	5,000	5,000
USA Petroleum	Ventura	19,000	30,000	11,000
Progress Refinery	Kern	-0-	5,000	5,000
Golden Eagle Refining	Carson	16,500	41,000	24,500
Coastal	Kern	-0-	10,000	10,000
			TOTAL:	125,600

(5% increase in state capacity)

B/CD = Barrels per calendar day

SOURCE: The Oil and Gas Journal - March 20, 1978 and California Air Resources Board, Authority to Construct Applications

The statement that government red tape is inhibiting investments in refinery capacity to handle heavy crude oil is also confusing in light of existing refinery operations. Texaco indicated in their testimony to the Committee that their Wilmington refinery "basically runs on heavy sour crudes". Similarly, Exxon testified that their Benicia refinery operated entirely on Alaskan North Slope crude oil. Several other companies indicated they had either just completed or were currently contemplating refinery modifications.[23/]

D. Refined Petroleum Product Output

Production of refined petroleum products is a very complicated and flexible procedure involving variation of certain parameters according to the dictates of engineering and business. The parameters include such factors as crude feedstocks, refinery capabilities, and storage capacity. Engineering concerns involve repairs and maintenance of equipment, and the technical operations of refineries. Business concerns involve adjusting product slates to meet changing market strategies, scheduling "down time", setting product inventories and rates of production for various products.

The Committee staff has focused upon trends in production rates, product inventories, and refinery down time to highlight factors in production that have contributed to fuel scarcity in California.

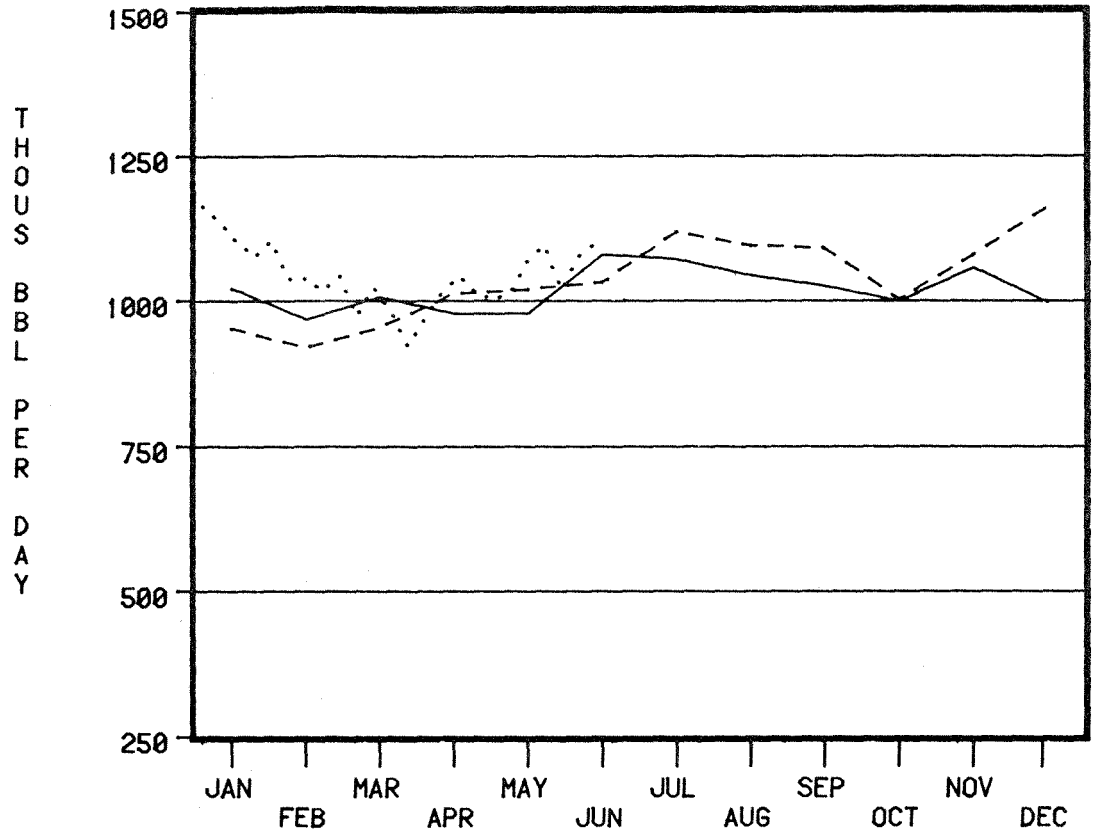
The most alarming trend is that gasoline production in PADD 5 and California was severely depressed during the first months of 1979. (See Graphs 12 and 13) Gasoline production in California dropped 21% (199,935 b/d) from December 1978 to March 1979, from 958,096 b/d to 758,161 b/d.[24/] This drop seems unexplainable in the face of crude supplies and market conditions. California data for periods beyond the first quarter 1979 is not available to determine if this trend has continued.

However, preliminary data for the second quarter of 1979 from the American Petroleum Institute for PADD 5 indicates that while production increased slightly in the second quarter of 1979, it was still below December 1978 levels. In the first two weeks of July 1979, gasoline production in PADD 5 was up to 1,090,000 b/d, but this figure was still 6% below the 1,163,000 b/d produced in December 1978.[25/]

It is interesting to note that the depression in gasoline output has been accompanied by an increase in residual fuel oil production. (See Graphs 13 and 14) In March 1979, residual fuel oil production in California was at an all-time high of 516,290 b/d.[26/] A similar increase is seen in PADD 5 residual fuel oil production, as preliminary statistics show a 31% rise from early February to late March (487,000 b/d to 639,000 b/d). During the second quarter, the PADD 5 data indicate that residual fuel oil production dropped back to lower levels. By May residual fuel oil production averaged 470,000 b/d.[27/]

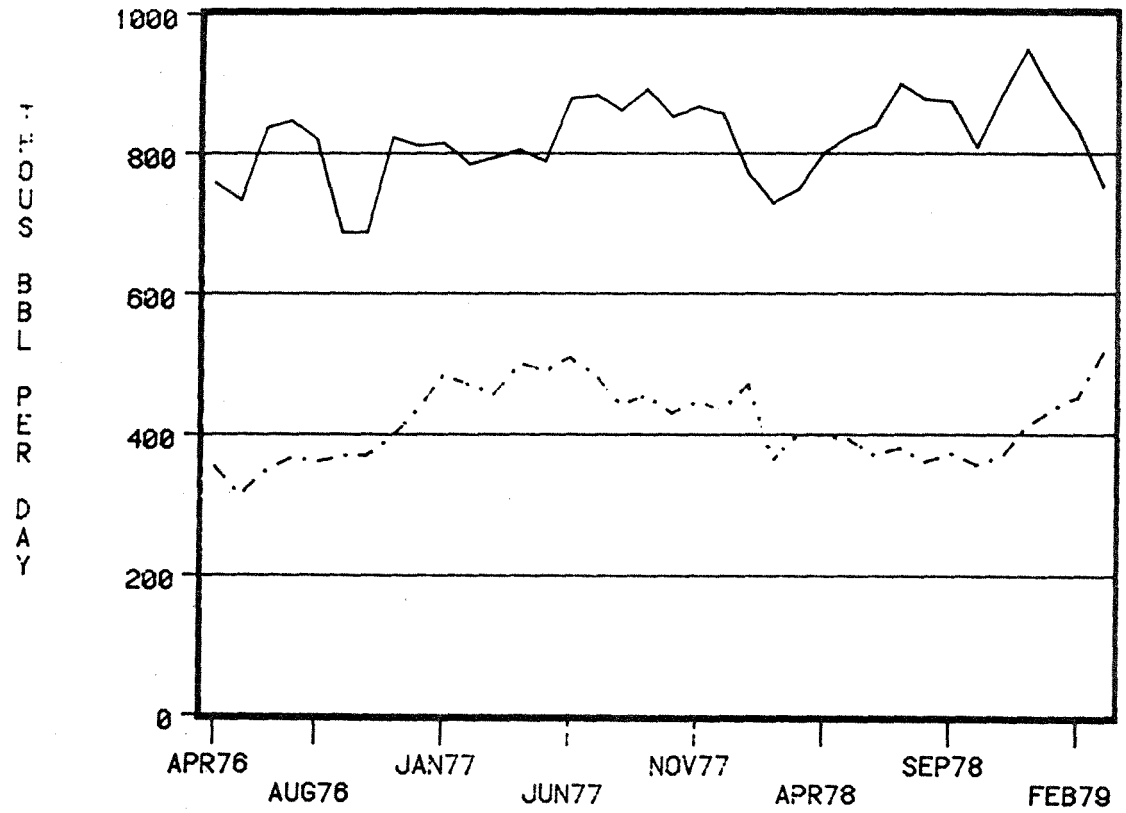
COMMITTEE ON FUEL SCARCITY

PAD V GASOLINE PRODUCTION, JAN '77 THRU JUN '79

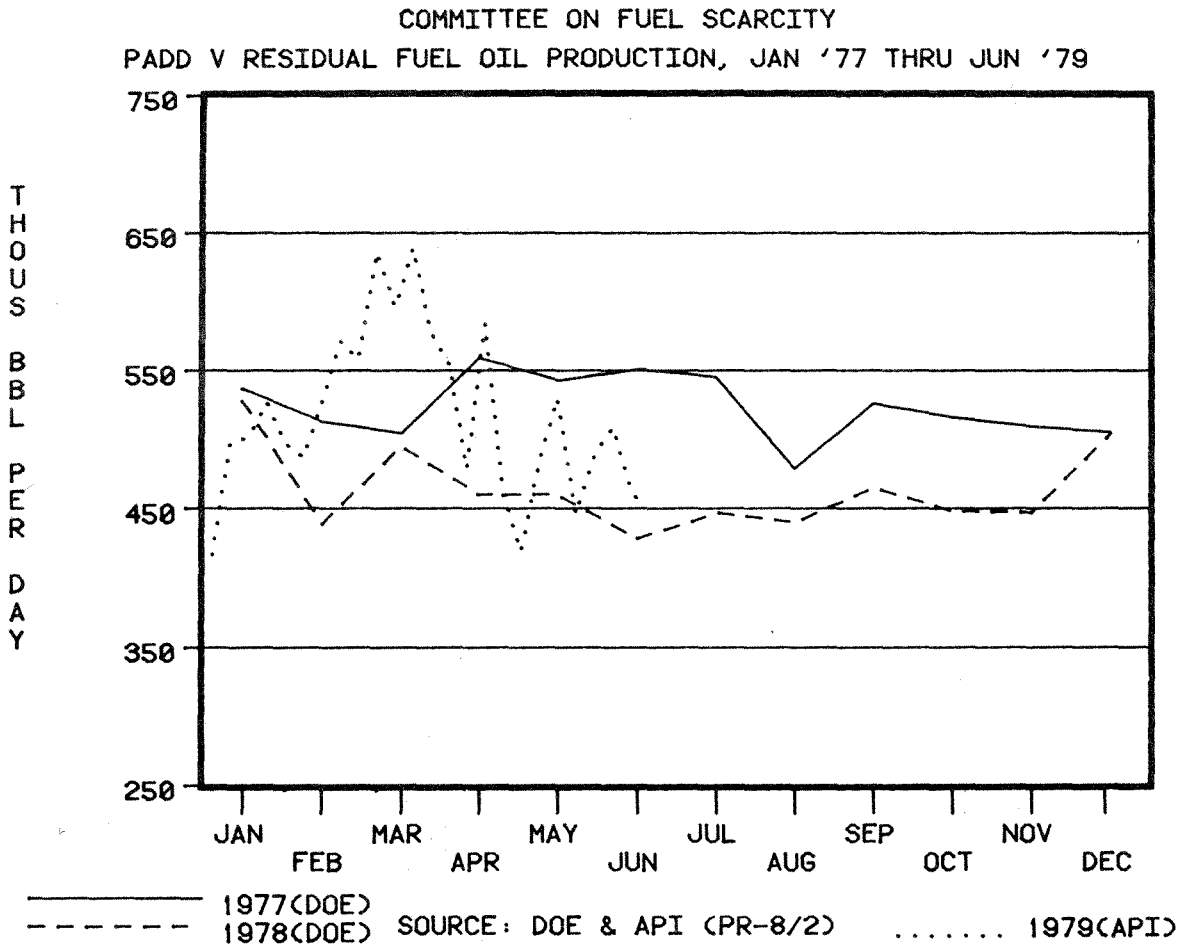


GRAPH 12

GASOLINE & RESIDUAL FUEL OIL PRODUCTION IN CALIF., 4/76 THRU 3/79



GRAPH 13



GRAPH 14

As was mentioned above, a complex array of factors determines what production from refineries will be during any given time period. Whatever the reason, the trends discussed above indicate that at the time when it would be expected that refineries would be producing more gasoline to ease the fuel scarcity in California, just the opposite was occurring.

One particular factor which may account for some of this shift in products is the number of refinery shutdowns for maintenance and emergency repairs. Witnesses from major oil companies testified that many of the region's larger refineries have been partially or totally out of service during

portions of the first five months of 1979. Much of this refinery down time is attributable to "turnarounds", i.e., installation of new equipment and routine maintenance.

Due to the significant proportion of total California capacity that major refineries represent, down time at any one refinery can have a significant impact on refined product availability. This is especially true for gasoline, as gasoline capacity in California is primarily concentrated in relatively few large refineries. The trends in production discussed above may have been in part the result of down time at certain refineries. For example, Chevron's catalytic cracker at Richmond was shut down from February 16 through April 23, cutting gasoline production by some 28,000 b/d.[28/] Other shut downs have occurred elsewhere in the state and in PADD 5.[29/]

The frequency and timing of company "turnarounds" has been questioned. In interviews between Committee staff and the Oil, Chemical and Atomic Workers Union, the beliefs of experienced refinery workers were conveyed to the Committee staff that refinery down time was becoming increasingly more frequent than in previous years. They maintain companies appear to have stepped up the frequency and thoroughness of their maintenance programs in what the Union believes is marked contrast to past practices of utilizing refineries and their equipment for much longer time periods between repairs.

The implication of this discussion to the fuel scarcity situation is obvious. The statements made by the Oil, Chemical and Atomic Workers Union have been disputed by industry officials.

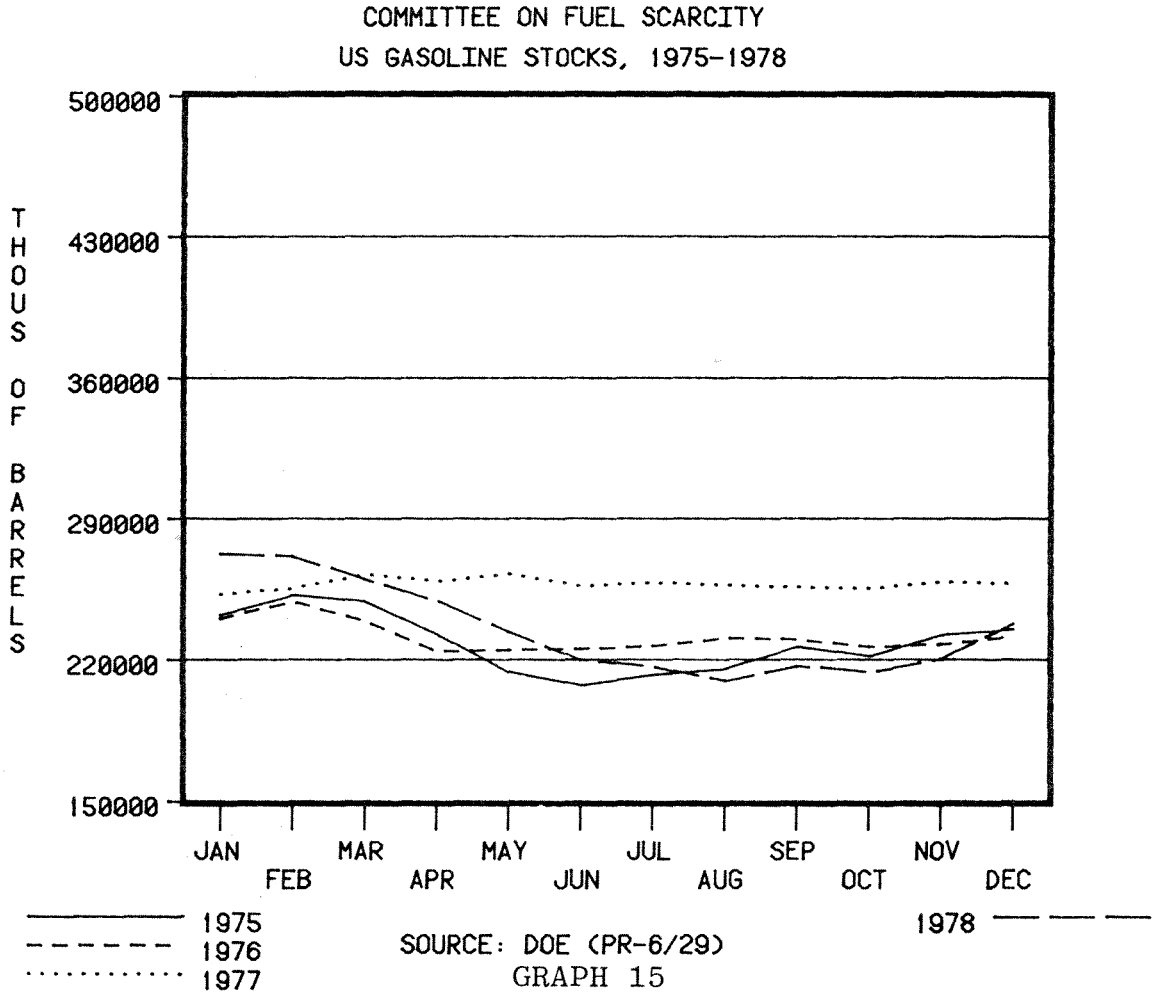
Testimony before the Committee by company representatives indicated that additional shutdowns had been planned for the spring of 1979 and were intentionally postponed to continue producing gasoline without interruptions. These witnesses stated that these actions had been taken in an effort to avoid additional gasoline shortages due to routine maintenance.

It was suggested to the Committee that another reason for the shift in products may have been increased demand for heating oil due to the long winter. Such a market situation would cause refiners to shift product slates to produce heavier products (heating oils) at the expense of lighter products (gasoline). The contribution to such a program that would be required of West Coast refineries, however, is unclear. In testimony before the Committee, Mr. Douglas Robinson, Deputy Administrator, Economic Regulatory Administration of the Department of Energy, indicated that the federal government was not looking to PADD 5 refineries for assistance in this year's effort to build up heating oil stocks for next winter.

In addition to trends in production and refinery down time, some interesting trends can be observed in gasoline inventory levels. As mentioned earlier, product inventories are an integral part of understanding how the industry adjusts production.

Nationally, gasoline stocks were at a very high level in 1977, and a substantial draw down occurred in 1978. (See Graph 15) This is similar to the trends observed in crude stocks.

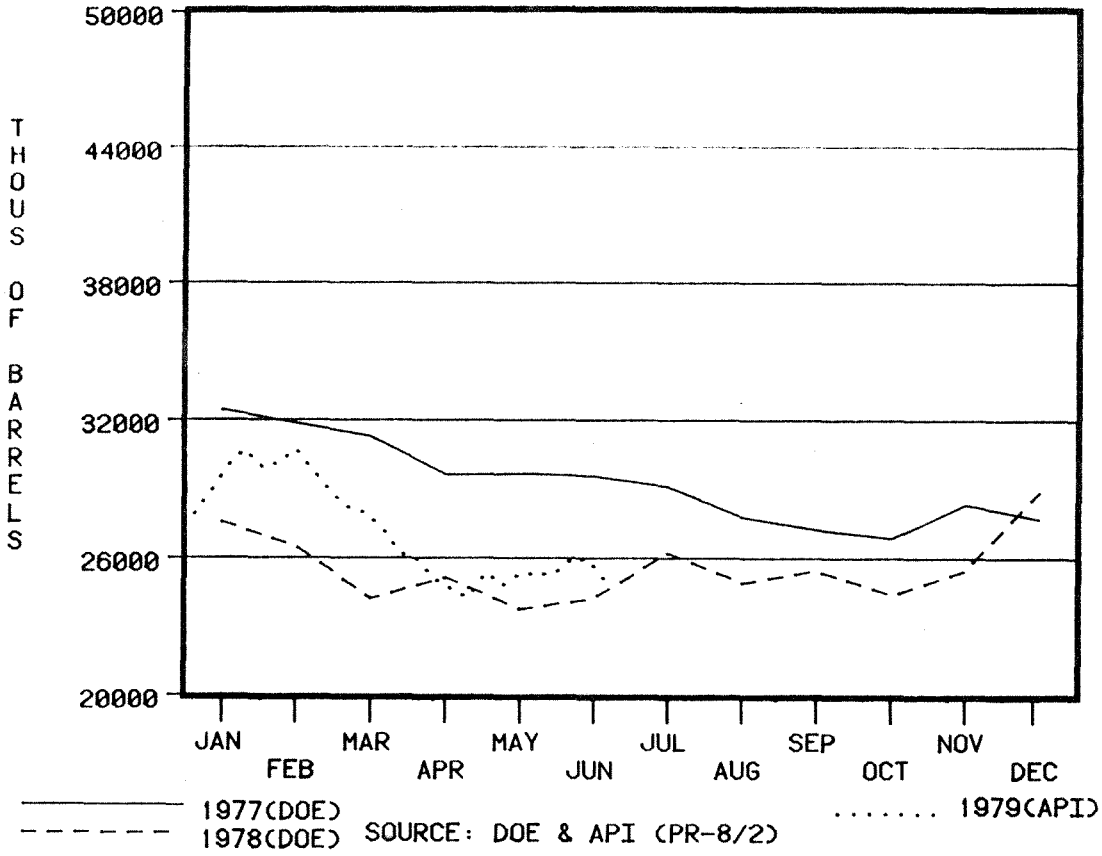
PADD 5 and California gasoline stocks were drawn down throughout 1977. However, stocks began to climb again in late 1978 and continued to do so until early 1979. (See Graphs 16 and 17)



GRAPH 15

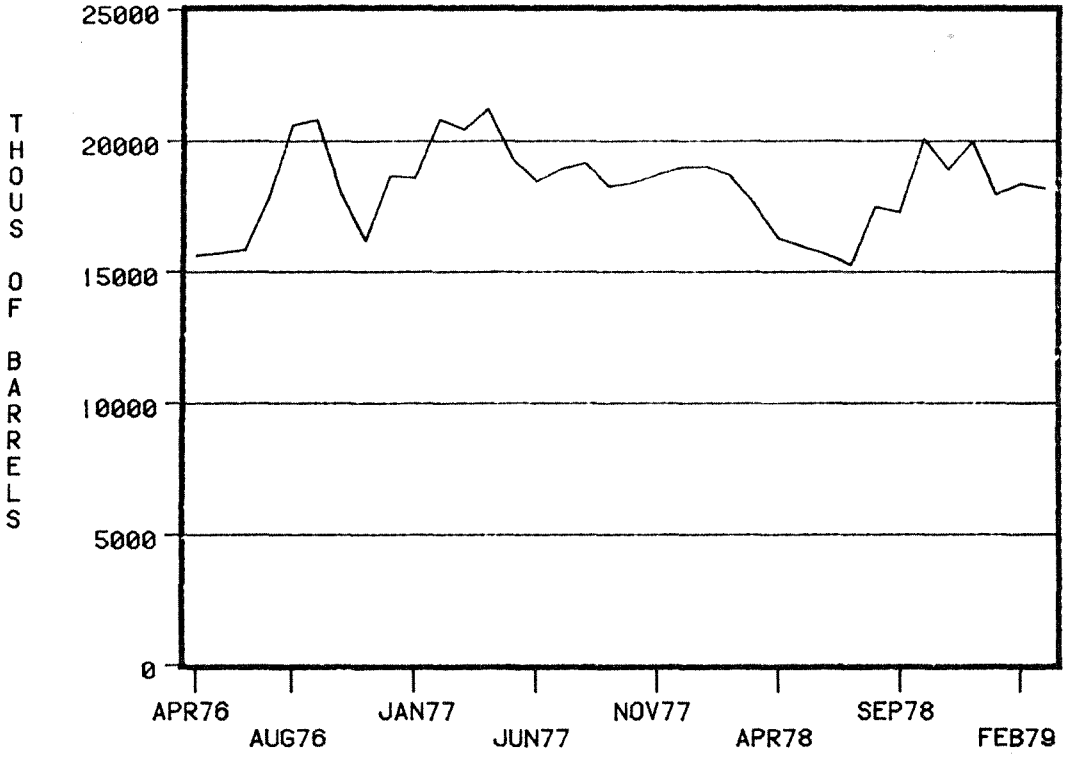
COMMITTEE ON FUEL SCARCITY

PADD V GASOLINE STOCKS, JAN '77 THRU JUN '79



GRAPH 16

CALIFORNIA GASOLINE STOCKS, APRIL '76 THRU MARCH '79



SOURCE: QFES (PR-7/5)

GAS STOCKS ————

GRAPH 17

In 1979, gasoline inventories have shown a marked decrease in PADD 5. Stocks dropped from 30,693,000 barrels in late January to 24,257,000 barrels by late April, a drop of 21%.[30/] However, this trend was not as pronounced in California through March. (See Graph 17)

As was mentioned in the discussion of crude stocks, companies have minimum operating levels (MOLs) below which stocks are not drawn down to insure continuous operation of facilities. This is also true for product inventories, and according to the American Petroleum Institute, approximately 35% of the industry's total inventories of gasoline are thereby rendered unavailable.[31/]

It is not clear at this time if the draw down of gasoline inventories observed in PADD 5 in the beginning of 1979 represents a drop approaching MOL. This seems highly unlikely, as even with the draw down, stocks never dropped below their 1978 levels. (See Graph 16) Information supplied to the Committee by Atlantic Richfield Company (ARCO) indicates that ARCO reached MOL for gasoline in early May 1979. Similar data from other major companies, though promised to Committee by the Company's Sacramento representative, has not been forthcoming. American Petroleum Institute preliminary data seems to indicate on a national and regional level that gasoline stocks have not been utilized on an industry-wide basis to MOLs (the greatest extent possible) in 1979.[32/] Draw down to MOLs would have certainly resulted in increased fuel availability.

E. Summary

The issue of refinery capability and utilization has emerged as the least certain aspect of the Committee investigation. Utilization rates of upstream components are low on the West Coast, which may be due to reliance upon heavy domestic crude oils. Utilization rates of downstream equipment are not available, and it is thus difficult to assess how efficiently heavy crude oil is being refined in California.

Industry spokesmen have indicated refinery expansions and modifications to allow for more efficient utilization of heavy crude oil have been inhibited by government regulations. While this may be true, empirical evidence, including large volumes of heavy crude oil currently being refined in California refineries and numerous applications for refinery modifications and expansions, raises questions concerning this assertion. A better understanding of other economic and strategic factors that may be involved in such investment decisions is necessary. These issues will undoubtedly play an important part in California's energy future.

Decreased gasoline production by California refineries in the beginning of 1979 must have contributed to the gasoline crisis. The reason for this decline is unclear, but refinery down time and record levels of residual fuel oil production on the West Coast in the spring of 1979 may have contributed to this situation. Cautious distribution of gasoline inventories may have also contributed to the fuel scarcity.

It is incumbent on the Legislature to determine the degree to which environmental and price control regulations are factors which inhibit investment in modification and expansion of California refineries, or whether there are other stronger influences such as corporate marketing strategies, tax provisions, economic or strategic factors which are influencing the decision not to invest in California refinery capacity.

This issue is of particular importance to California's energy future and to the Legislature as it is a long-term problem which must be understood and solved soon if we are to utilize our petroleum resources efficiently in the future.

IV. DEMAND FOR GASOLINE

- "Conspicuous consumption" by Californians does not appear to be "the" cause of fuel scarcity.

- Figures on increased gasoline demand in 1979, while high in January and February, dropped significantly in March and April. May 1979 demand measurements were below 1978 levels.

- Significant increases in industrial gasoline purchases early in the year appear to have made a substantial contribution to the shortfall for private consumers in May.

- Economic growth, population growth, and increases in the number of registered vehicles and outstanding drivers' licenses have contributed to increased gasoline demand in California.

- Increased gasoline exports to other western states and decreased imports of gasoline from the Gulf Coast and the North West appear to have made a major contribution to the fuel scarcity situation.

The third area the Committee staff has explored is that of demand for refined petroleum products. In the round of accusations of "who" is responsible for the current shortage, the finger has been pointed at the California motorist. Officials of the federal government and industry have inferred that Californians brought the fuel crunch upon themselves through excessive consumption.

In testimony, the Committee was told by major oil company witnesses that demand for gasoline by consumers had increased drastically, making it difficult for the industry to keep pace. These witnesses expressed the belief that the tight world market for crude oil in 1979, combined with heavy demand for refined products, were the largest contributing factors to the fuel scarcity.

A. Distribution as Measurement of Demand

So-called "demand" is not measured by the amount of fuel consumed by the end user, i.e., the motorist. Instead, distribution of petroleum products from the primary storage of refiners to the next level in the distribution chain is recorded as the indicator of demand. Therefore, demand figures are not measures of actual consumption by end users, but indicate only how much of a given product has been distributed. Since complete statistics on petroleum products are not kept or required by government agencies once they leave the refinery, little is known of the size of the inventory that may be contained in pipelines, tankers, distribution storage tanks, tank cars,

tank trucks, service station tanks, and other bulk storage facilities.

Keeping in mind that demand measurements are only the distribution of products, examination of gasoline distribution data compiled by the State Board of Equalization indicate that in January and February, 1979, distributions were 7.6% higher than for the same period last year. However, in March and April, 1979, distributions leveled off and were only .45% above last year's levels. In May, distributions were 2.8% less than 1978 levels (due in part to the federal allocation program). (See Figure 3) With the uncertain storage capacity in the distribution system mentioned above, it is possible that end gasoline consumption, by California motorists, might not have increased at anywhere near the rates publicized in January and February.

FIGURE 3

Gasoline Distributions: 1979

Millions of Gallons

	1979	1978	Percent change from same month, 1978
January	965.2	907.9	6.3
February	941.8	863.7	9.0
March	1,004.8	999.1	0.6
April	962.0	959.5	0.3
May	998.4	1,027.3	(2.8)
Five months	4,872.2	4,757.5	2.4

SOURCE: State of California, Board of Equalization

B. Factors Affecting Demand

Demand for gasoline, while increasing throughout the nation in the past few years, has been climbing in our State at a rate above the national average. However, direct comparisons of demand levels between states is misleading, given the strong correlation between gasoline consumption and economic activity. California's economic growth has meant that individuals and businesses have purchased more vehicles and taken more trips for work and pleasure.

Wage and salary employment in California were up 7.3% in 1978, compared to a 4.3% nationwide increase. Similarly, personal income in the state rose 13.9% last year, while nationally it increased only 11.7%.[33/]

In addition to this increase in economic growth, California demographics show two unique features that have not been examined in the round of accusations. Total population in California increased 1.9% from July 1, 1977 to July 1, 1978, while the national increase was only 0.8% over the same time period.[34/] Moreover, the number of outstanding drivers' licenses in California increased by 2.9% in 1978, a rate of growth faster than the growth in population.[35/] Such demographic trends may have a significant impact on gasoline usage.

And yet, Californians use fewer gallons per vehicle than the average American motorist. California was also below the national average for gallons consumed per capita in 1976 and 1977 and 37th among states in monthly per-vehicle gasoline consumption (63 gallons).[36/] The only West Coast states with lower per-vehicle consumption rates are Colorado and Hawaii.[37/]

C. Stockpiling

In the first few weeks of the gas crisis there is no doubt that California consumers intensified their own problem by "tank topping". Industry officials have pointed out that the average size of credit card purchases decreased as consumers insured their tanks were full. There were numerous reports of individuals storing large quantities of gasoline for private use. There is no way to determine how much of the demand for gasoline in California during this time period was the result of such panic buying.

However, motorists were not the only sector guilty of so-called "tank topping". It is likely that every link in the distribution system (pipeline companies, wholesalers, jobbers - retail outlets) accelerated their purchases. It was particularly evident that industrial/commerical demand for gasoline increased long before consumers began to worry about fuel scarcity.

Mr. Frank P. Alcock, past President of the Purchasing Management Association of Los Angeles (a commercial buyers' organization), informed the Committee that a "commodity alert" was issued to members of the Association in late 1978. This alert, a verbal notification, informed members of possible shortages in fuels and petrochemical supplies.

The Los Angeles Times reported that many businesses with large vehicle fleets which need gasoline began increasing stocks as early as late 1978 at the first signs of trouble in Iran.

According to the Times,

> In the first four months of (1979), jobbers and refiners who buy from Shell and sell to commercial accounts generated 74% increased demand in Southern California and a 55% jump in the San Francisco area over the same period last year. 38/

The article also discussed similar trends for other major suppliers.

While such a prudent business practice is understandable, this source of demand seems to have been overlooked in many analyses of the fuel scarcity situation. However, due to a lack of recorded data concerning gasoline storage beyond the refinery gate, the contribution of accelerated business purchases to the overall shortage cannot be accurately assessed. And yet, the sporadic increases in distribution in January and February can be attributed, at least in part, to precautionary industrial/commercial purchases. In the same Los Angeles Times article, a Chevron executive said that his company could have had a 95-100% allocation in May 1979 without the increase in industrial demand during the first part of the year. 39/

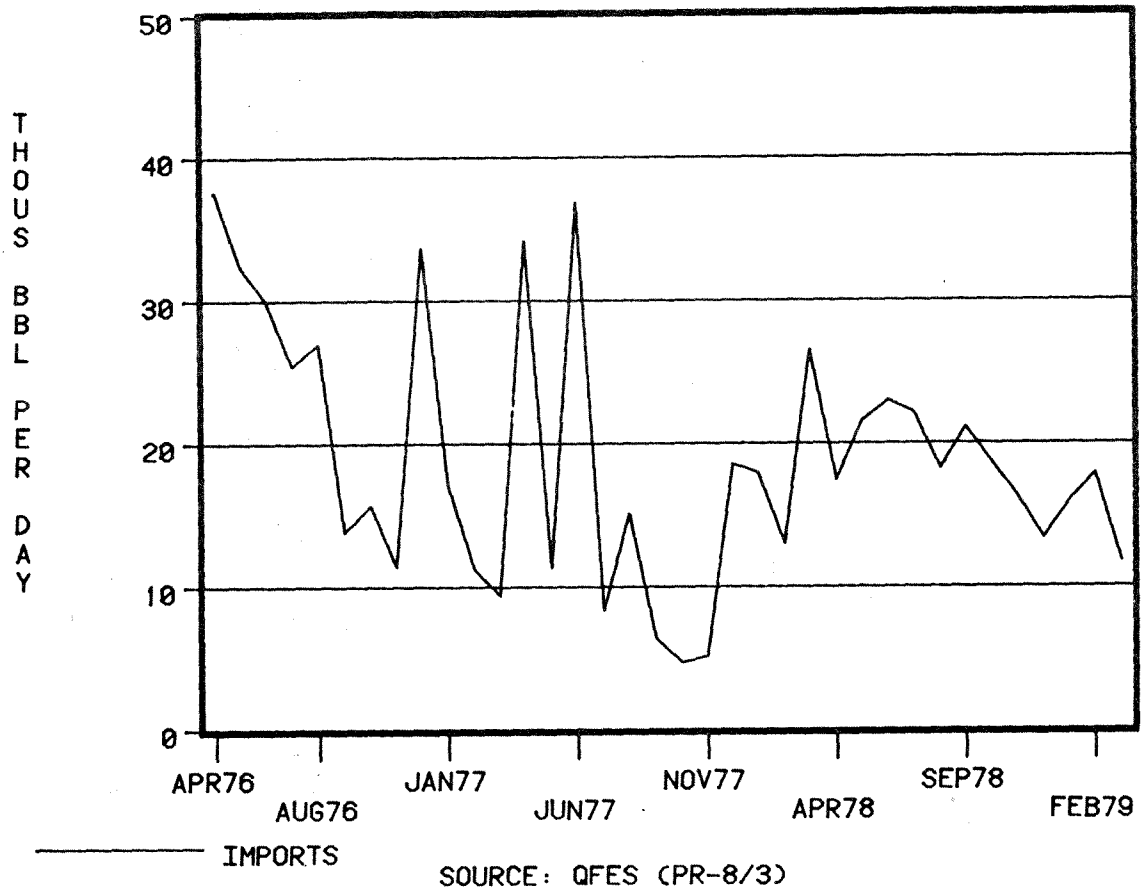
D. Interstate Imports and Exports of Gasoline

Still another critical element affecting overall California supplies of refined products is the role California refineries play in meeting the demand of other western states for refined products.

Although California must import gasoline to meet its own needs, it is a net exporter of gasoline. (See Graphs 18 and 19)

COMMITTEE ON FUEL SCARCITY

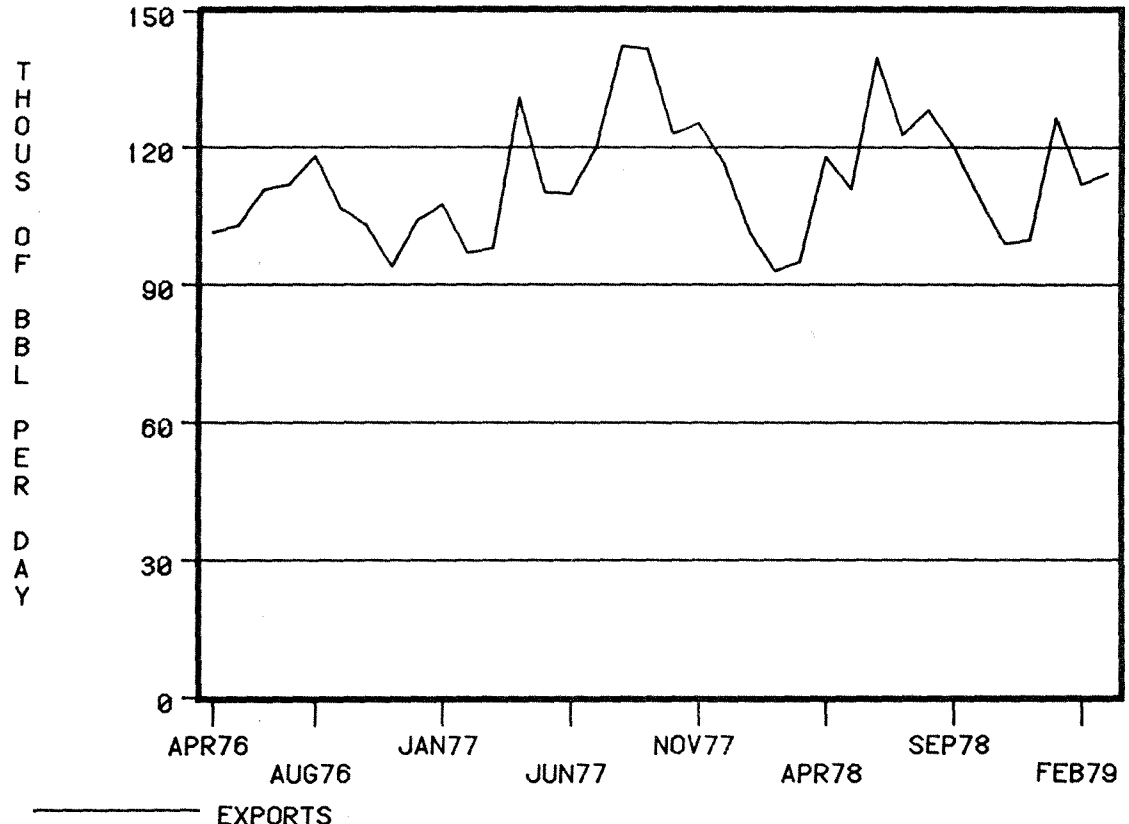
CALIFORNIA GASOLINE IMPORTS, APRIL '76 THRU MARCH '79



SOURCE: QFES (PR-8/3)

GRAPH 18

GASOLINE EXPORTS IN CALIFORNIA, APRIL '76 THRU MARCH '79



SOURCE: QFES: (PR-7/11)

GRAPH 19

In the first quarter of 1979, imports declined while the rate of exports increased. California exported 21,144 b/d more gasoline in the first quarter of 1979 than in the same period in 1978. However, gasoline imports were 4,188 b/d less than the 1978 rate. When combined, these changes result in a net decrease of 25,332 bbl/day of gasoline in California during the first quarter of 1979 when compared to the same time period last year.[40]

In testimony to the Committee, Mr. Douglas Robinson, of the Department of Energy, stated that this figure could be as high as 80,000 b/d. The majority of these imports are from the Gulf Coast, and it has been suggested to the Committee that this area was more severely effected by the national drop in foreign imports of crude oil. With less crude available on the Gulf Coast, less gasoline would be available for export to the West Coast.[41]

E. Transportation Patterns

Short fuel supplies, long service station lines, and high prices have had a great influence on transportation patterns. There have been increases reported in carpooling (15% since April), bus use (14% over pre-shortage levels), and commuter train patronage.[42] CalTrans reports decreases in peak commuter hour freeway driving in Southern California.

According to CalTrans, freeway traffic flow in Los Angeles began to gradually decline in early April with significant reduction being reported by the first week of May. Unfortunately, drivers have begun to resume their former habits. CalTrans reports that average daily traffic had been reduced as much as 14% during the week of May 7-11 (odd-even was instituted May 9th) and was still 2% lower during the week of June 18-22.

PERCENTAGE WEEKLY CHANGES IN
AVERAGE DAILY TRAFFIC ON
THE 42 MILE DOWNTOWN LOS ANGELES FREEWAY LOOP

	WEEK	DIFFERENCE
April	2 - 6	-0-
	9 - 13	-0-
	16 - 20	-2
	23 - 27	-3
	30 - May 4	-5
May	7 - 11	-14
	14 - 18	-13
	21 - 25	-10
	28 - June 1	-10
June	4 - 8	-5
	11 - 15	-2
	18 - 22	-2

SOURCE: CalTrans, Office of Traffic

F. Summary

Excessive demand for refined petroleum products by California motorists does not appear to have been "the" cause of the gasoline crisis. While in January and February 1979 demand for gasoline (which is a measure of distributions by refineries, not consumption by end users) was up significantly over last year's levels, by March and April it was back to only slightly above 1978 figures. In May 1979, gasoline demand was actually lower than last year. Economic growth and increases larger than the national average in the number of registered vehicles, population, and outstanding drivers' licenses, indicate that accelerated demand for gasoline in this state should be expected, and is not "conspicuous consumption".

While the long lines at the pumps may have been due in part to tank topping by consumers, the level of gasoline purchases by industrial users early in the year undoubtedly were significant contributors to the severe fuel scarcity situation in May. Moreover, California is the major gasoline supplier for much of PADD 5, and an increased level of gasoline exports, combined with reduced imports, further exacerbated the scarcity situation. To simply point a finger at the California public, as did many federal and industry officials, is not a valid explanation for the fuel scarcity in California.

APPENDIX A

SOURCES OF INFORMATION

The Committee has obtained its information through testimony provided at six Committee hearings, and limited data obtained from the American Petroleum Institute, the federal Department of Energy, and the California Energy Commission.

There are significant limitations to the data the Committee has obtained from these sources. Information supplied to the Committee by the state Energy Commission on a statewide basis is unavailable after the first quarter of 1979. State statute requires companies to report data to the Commission once a quarter, and there is a time lag between the closing of the reporting period and the compilation of the data by the Commission.

United States Department of Energy data, available only through March 1979, is published on a national and regional basis. Although data is reported to the Department of Energy on a company-by-company and statewide basis, it is considered proprietary and has been denied to the Committee. Committee staff are continuing their efforts to obtain this data.

The American Petroleum Institute (API), an industry trade association, is the only available data source updated on a regular and timely basis through weekly and monthly publications. API cautions that its data is preliminary and it defers to Department of Energy (DOE) statistics whenever possible. DOE data has thus been utilized in this report whenever possible.

In addition to data collection and analysis, the Committee staff has interviewed representatives of the Department

of Energy, the State Energy Commission, Department of Finance, refiners, labor unions involved in the petroleum industry, wholesalers and marketers of both crude oil and refined petroleum products, other petroleum industry analysts, congressional staffs, United States and State Department of Justice investigators, refinery engineers, and research consultants throughout the country.

APPENDIX B

EXPLANATION OF GRAPHICS

Graphs utilized in this report were prepared using Tektronix computer equipment at the Senate Office of Research. The date of preparation is included on each graph (PR-date).

The sources of data utilized in preparation of each graph are as follows:

Graphs 1, 2, and 3: Department of Energy (DOE), Monthly Energy Review, June, 1979, and American Petroleum Institute (API), Monthly Statistical Bulletins, April-June, 1979.

Graphs 4, 15: DOE, Monthly Petroleum Statements, 1975 - 1978.

Graphs 5, 6, and 7: California Energy Commission (CEC), Quarterly Fuels and Energy Summary (QFES), Origin of Crude Oil Receipts Report (Form OR-02). The figures for domestic receipts in Graph 5 represent the sum of Interstate and Intrastate receipts of crude oil from form OR-02.

Graph 8: CEC, QFES, Refinery Stocks Report (Form OR-06) and Oil Production Report (OP-01). Crude stocks data represents the sum of crude oil stocks from form OR-06, and crude stocks on lease, in pipelines, and at tank farms from form OP-01.

Graphs 9, 12, 14 and 16: DOE, Monthly Petroleum Statements, 1977 - 1978, and API, Weekly Statistical Bulletins, 1979. Note that the line labeled "1979" on these four graphs represents weekly data and the monthly demarcations on the horizontal axis are therefore approximate references to the

corresponding month on the "1979" line. While the use of weekly data unfortunately results in the greater variations observed in the "1979" line, this was necessary as API weekly statistics are the only recent data available for PADD 5. The lines labeled "1977" and "1978" represent official DOE statistics.

Graph 11: CEC, QFES, Feedstock Report (Form OR-01).

Graph 13: CEC, QFES, Refinery Output Report (Form OR-04).

Graphs 17, 18, and 19: CEC, QFES, Finished Product Supply and Distribution Report, (Form OM-01). Gas stocks data represents the sum of the beginning storage statistics for premium, regular, low lead/unleaded, and unspecified gasoline. Gas Imports data represents the sum of the above categories for interstate receipts and foreign import receipts. Gas export data represents the sum of the above categories for interstate sales and foreign sales.

FOOTNOTES

1. American Petroleum Institute (API), discussion with Washington, D.C. analysts, July 17, 1979.

2. API, Monthly Statistical Bulletin (MSB), December 1978.

3. Ibid., and discussion with API analysts, July 17, 1979.

4. API, discussion with Washington, D.C. analysts, July 17, 1979.

5. Department of Energy (DOE), Monthly Energy Review, June 1979, p. 28. API, MSB, June, 1979.

6. DOE, loc. cit.

7. Ibid.

8. API, MSB, April-June, 1979. DOE, loc. cit.

9. DOE, loc. cit.

10. General Accounting Office, Analysis of the Energy and Economic Effects of the Iranian Oil Shortfall (EMD 79-38), March 5, 1979.

11. Testimony to the Committee on Fuel Scarcity - May 14, 1979, Edward Cahill, Chevron, USA.

12. DOE, loc. cit., and API, MSB, April-June, 1979.

13. DOE, Inside DOE, April 16, 1979, p. 8.

14. DOE, Monthly Energy Review, June 1979, p. 28.

15. Ibid.

16. California Energy Commission (CEC), Quarterly Fuels and Energy Summary, (QFES), Origin of Crude Oil Receipts (OR-02).

17. Ibid.

18. International Petroleum Encyclopedia, The Petroleum Publishing Co., Tulsa, 1978.

19. Ibid.

20. API, MSB, December 1978.

21. API, MSB, June 1979.

22. API, MSB, April-June, and Weekly Statistical Bulletin (WSB), July 6, 1979.

23. Mr. T. M. Tepper, Texaco, Inc., testimony before the Committee, May 30, 1979. Mr. Joe T. McMillan, Exxon, USA, testimony before the Committee, June 13, 1979.

24. CEC, QFES, Refinery Output Report (OR-04).

25. API, WSB, July 6 and 13, 1979; DOE, Monthly Petroleum Statement, December 1978.

26. CEC, QFES, loc. cit.

27. API, WSB, February 9, March 23, and May, 1979.

28. Sacramento Bee, May 29, 1979.

29. Testimony to this point was made by Exxon, Shell and Chevron, USA.

30. API, WSB, January 26, and April 27, 1979.

31. API, WSB, definitional notes.

32. API, WSB, July 1979.

33. Department of Finance, Division of Financial and Economic Research.

34. Ibid.

35. Department of Motor Vehicles.

36. Richard Maullin, Chairman, CEC, testimony before the Joint Committee on the State's Economy, May 22, 1979, and DOE Presentation to the United States Senate Subcommittee on Energy Regulation of the Committee on Energy and Natural Resources, February 28, 1979.

37. DOE, loc. cit.

38. Los Angeles Times, May 20, 1979.

39. Ibid.

40. CEC, QFES, Finished Product Supply and Distribution (OR-04), Interstate Sales and Receipts of Finished Products.

41. Mr. Douglas Robinson, Deputy Administrator, Department of Energy, Testimony before the Committee, May 18, 1979.

42. CalTrans, Office of Traffic - July 1979.