Petroleum Inventories and Storage Capacity

A Report of the National Petroleum Council

June 1984

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Theodore A. Burtis, Chairman, Committee on Petroleum Inventories and Storage Capacity

June 1984

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Introduction

At the request of the Secretary of Energy, the National Petroleum Council (NPC) undertook to update Volume II, *Inventory and Storage*, of its six-volume 1979 report, *Petroleum Storage & Transportation Capacities*. The Secretary's request specified that:

> Your new study should update the analysis of the minimum operating levels for crude oil, motor gasoline, distillate fuel oil, and residual oil, as well as update the estimates of total storage capacity and the quantity of crude oil and refined petroleum products available for use. Other aspects of the overall U.S. petroleum inventory and storage system should be discussed as appropriate. [See Appendix A for the Secretary's request letter, a description of the NPC, and the membership roster of the Council.]

In response to the Secretary's request, the NPC established the Committee on Petroleum Inventories and Storage Capacity, chaired by Mr. T. A. Burtis, Chairman of the Board and Chief Executive Officer, Sun Company, Inc. Mr. J. Erich Evered, Administrator, Energy Information Administration (EIA), was designated Government Cochairman of the Committee by the Secretary of Energy. The Committee was assisted by a Coordinating Subcommittee and one Task Group. (See Appendix B for the membership rosters of the Committee and subgroups.)

Since 1948, the NPC has performed nine inventory studies to assist the federal government in emergency preparedness planning. The primary objectives of these studies have been to assess how much petroleum in the primary distribution system would be available in an emergency, as well as to determine the total storage capacity of that system. The 1974 and 1979 studies, in addition, estimated the minimum operating inventory for crude oil and certain petroleum products—i.e., the inventory level below which operating problems and shortages would start to appear in a defined distribution system.

The 1979 report also presented the Council's first estimates of storage capacity in the secondary distribution system and tertiary storage segment. These, though, were order of magnitude estimates only. This study examines the secondary and tertiary sectors in much greater detail, both because of the magnitude of their storage and because of their close relationship to the primary system. As in past NPC studies, however, the primary system remains the principal focus.

To develop the data on the primary distribution system for this report, the NPC surveyed the companies that report primary inventory data to the EIA. An independent public accounting firm, Price Waterhouse, was contracted by the NPC to receive and tabulate the survey results. (See Appendix C for the survey methodology, Appendix D for a copy of the survey questionnaire, and Appendix E for the tabulated survey returns.) In addition to data on storage and inventory, the survey also collected data on the use of the petroleum futures markets. (See Appendix F for an overview of the impact of

the petroleum futures markets.) The survey results, highlighted in the Executive Summary, are discussed in detail in Chapter Two, "Analysis of the Petroleum Distribution Systems, 1978-1983."

Seasonal- and sector-related petroleum demands vary by region. Thus, the primary system data were collected by Petroleum Administration for Defense Districts (PADDs), and by subPADDs in PADD I. In contrast, the supply and distribution systems are nationally integrated and flexible. Even there, however, PADD V functions largely independently from PADDs I-IV; therefore, PADD V data are presented separately. Figure 1 shows the five PADD districts.

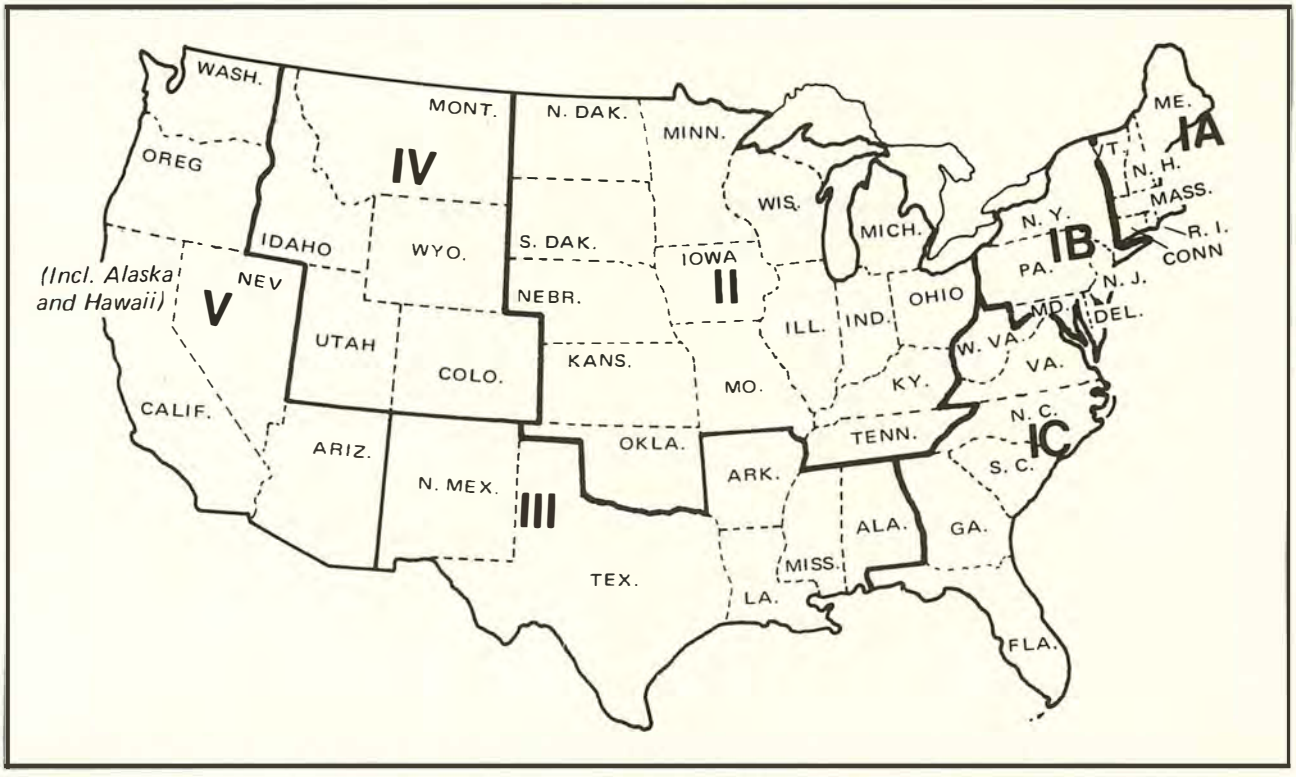

Figure 1. Petroleum Administration for Defense Districts (PADDs).

The survey of the primary system did not include the Strategic Petroleum Reserve (SPR) (see Appendix G). Nor did the survey cover crude oil and products located in U.S. possessions and territories and in transshipment facilities in the Caribbean (see Appendix H). Also, the survey totals cited in this study do not include *all* petroleum products. The survey covered crude oil and the principal fuel products only.

The report also contains historical information on refining-capacity utilization (see Appendix I) and petroleum demand (see Appendix J).

The methodologies used in deriving the estimates for the secondary distribution system and the tertiary storage segment are presented in Appendices K and L, respectively. Data on the bulk plant sector of the secondary system were obtained by surveying a sample of bulk plant operators. The results of the survey were received, tabulated, and extrapolated to totals for the entire bulk plant operator population by Price Waterhouse, the public accounting firm that handled the primary survey. Data on the retail outlet sector of the secondary system were developed from published literature and discussions with industry representatives. Storage capacities and inventory in the tertiary segment were estimated by using published data, surveys, and interviews with industry representatives and analysts.

Appendices K and L cover the methodologies in some detail to allow the reader to form an independent appreciation for the level of accuracy of these estimates. They may also provide a starting point for further study, should it be deemed desirable. In the analyses of the secondary distribution system and the tertiary storage segment, PADD V data are presented separately from PADD I-IV data, where possible.

Executive Summary

Primary Distribution System

The objectives of the primary distribution system analysis were to estimate the minimum operating inventory for crude oil and the principal petroleum products, to analyze the volumes of inventory that the system held on September 30, 1982, and March 31, 1983, and to determine the amount of storage capacity in the system. The data resulting from the 1983 NPC Survey of Petroleum Inventories and Storage Capacities in the Primary Distribution System show that both the minimum operating inventories and the volumes of inventory held in the system have declined since the 1979 NPC study. These decreases are due to the lower levels of consumption of petroleum products, which have caused structural changes in the distribution system and have affected the minimum operating inventory, and also to higher raw material and operating costs, which result in higher costs of storing products, and therefore lower inventory levels.

Minimum Operating Inventory

Minimum operating inventory is defined as the inventory level below which operating problems and shortages would begin to appear in a defined distribution system. Reductions in the minimum operating inventories in the primary distribution system are attributed principally to structural changes: in response to lower demand, refineries, pipelines, and tankage have been taken out of the distribution system. The NPC estimates of the 1979 and 1983 minimum operating inventories for crude oil and the principal petroleum products are compared below:

NPC MINIMUM OPERATING INVENTORY ESTIMATES FOR THE PRIMARY DISTRIBUTION SYSTEM (Millions of Barrels)

	1983			Decrease in Total U.S., 1979-1983
	PADDs I-IV	PADD V	Total	
Crude Oil*	215	70	285	5
Motor Gasoline	176	24	200	10
Kerosine	5	‡	5	5
Kero-Jet Fuel	20	5	25	
Distillate Fuel Oil	97	8	105	20
Residual Fuel Oil	34	6	40	20
Total†	**547**	**113**	**660**	**60**

*Excludes SPR. Alaskan crude oil in transit by water is included in PADD V, to be consistent with the EIA reporting system.
†Totals include crude oil and surveyed petroleum products only.
‡Less than 0.5 million barrels.

This report presents no estimate of a total minimum operating inventory for all petroleum products. It is important to note that the NPC minimum operating inventory total of 660 million barrels represents the sum of only those products included in this survey. EIA publications include categories for "other oils" and "unfinished oils." The products in these categories, because of their diverse nature and uses, were considered outside of this study's scope.

Total Inventory and Inventory Above Minimum

Total levels of inventories held in the primary system have also been reduced since the 1979 study, as can be seen below:

INVENTORY OF CRUDE OIL AND THE PRINCIPAL PETROLEUM PRODUCTS IN THE PRIMARY DISTRIBUTION SYSTEM
(Millions of Barrels)

	March 31, 1983			Change from
	PADDs I-IV	PADD V	Total	March 31, 1978
Crude Oil*	258	86	344	- 1
Motor Gasoline	197	26	223	-37
Kerosine	9	‡	9	- 3
Kero-Jet Fuel	28	6	35	+ 9
Distillate Fuel Oil	107	11	118	-20
Residual Fuel Oil	37	9	46	-16
Total†	**637**	**139**	**775**	**- 68**

*Excludes SPR and 11 million barrels of lease stocks adjustment. Alaskan crude oil in transit by water is included in PADD V, to be consistent with the EIA reporting system.

†Totals include crude oil and surveyed petroleum products only. Totals may not add due to independent rounding.

‡Less than 0.5 million barrels.

The major reason for this reduction is lower consumption of petroleum products, caused by higher prices, conservation, and lower economic activity. Other factors that have led to decreased inventory levels are reduced petroleum imports, the perceived security of world oil supply, the higher cost of storing petroleum, and lower refinery utilization.

The NPC also examined how the concept of days' supply of inventory might provide a misleading picture of inventory levels. Minimum operating inventory levels do not decline proportionally with demand. Moreover, minimum operating inventories are not available for use without the occurrence of shortages. Therefore, days' supply of inventory calculations based on total inventory do not present a valid indication of the adequacy of inventory levels. A better way to judge the adequacy of inventory levels is to look at accessibility; i.e., how much of that inventory above the minimum required to run the system is accessible:

$$\frac{\text{total inventory} - \text{minimum operating inventory}}{\text{current demand}} = \begin{array}{l}\text{days' supply of}\\ \text{inventory above}\\ \text{minimum}\end{array}$$

With this method, March 31, 1983, data for gasoline would indicate that there was 3.4 days' supply, rather than 32.8 days' supply, the figure derived from the total inventory calculation:

$$\frac{223 \text{ MMB} - 200 \text{ MMB} = 23 \text{ MMB}}{6.8 \text{ MMB/D}} = \begin{array}{l}\text{3.4 days' supply}\\ \text{of inventory above}\\ \text{minimum}^1\end{array}$$

$$\frac{223 \text{ MMB}}{6.8 \text{ MMB/D}} = \begin{array}{l}\text{32.8 days' supply}\\ \text{of total inventory}\end{array}$$

[1]MMB = million barrels; MMB/D = million barrels per day.

Using both of these methods, the following table compares the days' supply of inventory for March 31, 1978 with the days' supply of inventory for March 31, 1983. The days' supply of primary inventory above minimum, clearly a lower number than days' supply of total inventory, is a more realistic measure of available supply. However, a seemingly low number of days' supply above minimum should not cause concern in times of normal operations. The flexibility of the supply and distribution systems, together with ample crude oil supply, refining capacity, and transportation facilities, ensures the ability of the systems to meet product demand over time.

DAYS' SUPPLY OF INVENTORY IN THE PRIMARY DISTRIBUTION SYSTEM

	March 31, 1978		March 31, 1983	
	Total Inventory	Inventory Above Minimum*	Total Inventory	Inventory Above Minimum†
Crude Oil‡	24.3	3.9	32.0	6.3
Motor Gasoline	35.6	6.8	32.8	3.4
Distillate Fuel Oil	33.6	3.1	40.7	4.5

*The NPC's 1979 estimate.
†The NPC's 1983 estimate.
‡Excludes SPR, which on March 31, 1983, held 312 million barrels, or 149 days' supply of crude oil imports.

Although total inventories have decreased since 1978, the available inventory above minimum (in terms of days' supply) is not much changed from the 1978 level. The potential drawdown of inventory in the secondary distribution system and tertiary storage segment provides additional flexibility in times of tight supply.

In addition, approximately 75 percent of the crude oil supplied to refineries in 1983 was from domestic sources, as compared with approximately 60 percent in 1978. Thus, in the event of a supply disruption, the majority of the crude oil inputs to refineries would continue, ensuring uninterrupted, if somewhat reduced, product supply. The SPR stocks are also intended for use in times of severe oil supply disruption.

Storage Capacity

The primary system survey examined the total storage capacity in operation for crude oil and the principal products. Results indicate negligible change since 1979. Though crude oil tankage has increased, product storage capacity has actually decreased. Crude oil tankage has increased principally because of the addition of Gulf Coast offshore oil transfer facilities. Product tankage has decreased for the following reasons:

- Reductions in crude oil and product demand have caused refinery and terminal shutdowns and tankage consolidation.
- Tankage that was not retrofitted to meet environmental regulations has been removed from the systems.
- Tankage has physically deteriorated.

Tankage idle but available within 90 days, tankage in operation, and tankage under construction together constitute the total tankage available to the system. The shell capacity of these categories of tankage is presented in the following tables.

SHELL CAPACITY OF TANKAGE IN OPERATION AND TANKAGE UNDER CONSTRUCTION IN THE PRIMARY DISTRIBUTION SYSTEM (Millions of Barrels)

	March 31, 1978		March 31, 1983	
	Tankage in Operation	Tankage Under Construction*	Tankage in Operation	Tankage Under Construction
Crude Oil†	462*	12	499	10
Motor Gasoline	464	5	456	3
Kerosine	86	1	21	1
Kero-Jet Fuel			68	‡
Distillate Fuel Oil	336	3	295	1
Residual Fuel Oil	156	1	143	4
Total§	**1,504**	**22**	**1,482**	**19**

*Data for September 30, 1978.

†Excludes SPR. Also excludes all lease stock tankage in 1978 and a portion of the lease stock tankage in 1983. Lease stock inventory volumes were 12 million barrels in 1983 and 10 million barrels in 1978.

‡Less than 0.5 million barrels.

§Totals include tankage for crude oil and surveyed petroleum products only.

POTENTIALLY AVAILABLE TANKAGE IN THE PRIMARY DISTRIBUTION SYSTEM AS OF MARCH 31, 1983, THAT IS IDLE BUT CAN BE REACTIVATED WITHIN 90 DAYS (Millions of Barrels)

	Meets Environmental Regulations	Requires Environmental Waivers
Crude Oil	13	3
Motor Gasoline	7	‡
Kerosine	1	‡
Kero-Jet Fuel	3	‡
Distillate Fuel Oil	17	1
Residual Fuel Oil	12	1
Total*	**53**	**6**

*Totals include tankage for crude oil and petroleum products surveyed only. Totals may not add due to independent rounding.

‡Less than 0.5 million barrels.

Some of the idle tankage can be restored to service, but much of it is scattered in small volumes across the nation. Relying on any substantial part of this tankage for emergency preparedness planning is not realistic.

The table below shows the percentage utilization of tank capacity over the 35-year span of the NPC series of inventory reports. Over this period, inventory in tankage has averaged about 46 percent of storage capacity. Although tanks do fluctuate between the minimum and maximum operating levels during the operating cycle, the average has varied little over time.

PERCENTAGE UTILIZATION OF TANK CAPACITY IN THE PRIMARY DISTRIBUTION SYSTEM, 1948-1983

NPC Survey Date	Inventory as a Percentage of Tank Capacity
March 31, 1948	42
June 30, 1950	45
March 31, 1952	45
March 31, 1954	48
March 31, 1957	45
September 30, 1962	50
September 30, 1969	53
September 30, 1973	48
September 30, 1978	48
March 31, 1983	40

The 8 percent decrease in tank utilization between 1978 and 1983 may reflect the impact of:

- Declining demand for petroleum
- Increased spare refining capacity
- Higher costs of holding inventories.

It is likely that some storage capacity reported in the 1983 survey will be deactivated. This will tend to return the percentage utilization figure closer to the 46 percent historical average.

In the course of this study, the following topics, not examined in the 1979 report, were identified as factors to be considered in the analysis of inventories and storage capacity in the primary system: refinery utilization, the availability of naphtha-type jet fuel, and the impact of the SPR on private inventory levels. These topics are briefly discussed below. The petroleum futures markets, which were also identified as a factor, are discussed in a later section.

The NPC sought to quantify the changes in primary system stock levels caused by spare refining capacity, which allows refiners more flexibility to change product yields seasonally. The survey results were inadequate to quantify the impact of spare refining capacity on inventory levels. The NPC believes, however, that spare refining capacity is a factor in the observed decrease in inventory levels.

Because of the strategic nature of naphtha-type jet fuel, stocks normally in storage and stocks of components that could immediately be made available as naphtha-type jet fuel were also surveyed. The survey results show that, on March 31, 1983, the normal stocks of naphtha-type jet fuel could have been doubled by blending gasoline and kerosine/kero-jet fuel components in storage into finished naphtha-type jet fuel. But, given a fixed amount of crude oil, this increase in the production of naphtha-type jet fuel could not occur without a reduction in the production of gasoline and kerosine/kero-jet fuel.

The survey also asked respondents if the existence of the SPR contributed to a decrease in stock levels. With only one exception, responses indicated that the SPR did not affect a company's inventory levels.

The primary distribution system has changed considerably since the 1979 report. Refineries have closed, refinery capacity utilization is lower, and storage capacity has been removed from the system, thereby reducing the system's minimum operating inventory requirements. These changes have been caused by reduced demand for petroleum products, which, coupled with the high cost of storing product and the perceived security of crude and product supply, has also reduced the levels of inventories maintained in the primary distribution system.

Secondary Distribution System and Tertiary Storage Segment

This report presents a much more accurate estimate of the magnitude of storage capacity and inventory in the secondary distribution system and tertiary storage segment than was possible in the 1979 study. However, the NPC has more confidence in the storage capacity estimates than in those of inventory, and considers estimates by sector (e.g., bulk plants, residential) more reliable than those by region. In addition, the data resulting from this study define the inventories and storage capacities as of a specific date—March 31, 1983. The inventories doubtlessly have changed and will continue to do so as the system reacts to variations in supply, demand, prices, and other economic factors.

Secondary Distribution System

Storage capacities in the secondary distribution system consist of:

- **Bulk Plants**—storage facilities that have a total storage capacity of less than 50,000 barrels and do not receive petroleum products by barge, ship, or pipeline
- **Retail Motor Fuel Outlets**—service stations, truck stops, etc.

Bulk Plants

A sample of 2,088 bulk plant operators was surveyed to determine their storage capacities and inventory as of March 31, 1983. The results of the survey indicate that approximately 18,000 companies own and/or operate bulk plants in the United States. The storage and inventory estimates are as follows:

ESTIMATED STORAGE CAPACITY AND INVENTORY AT BULK PLANTS AS OF MARCH 31, 1983 (Millions of Barrels)

	Capacity	Inventory
Motor Gasoline	22	9
Kerosine	4	1
Diesel/ Distillate Fuel Oil	37	8
Residual Fuel Oil	6	2
Total*	**69**	**20**

*Totals include surveyed petroleum products only.

Retail Outlets

Data from several sources were analyzed to determine the number of retail motor fuel outlets in the United States as well as their storage capacity and inventories. It was determined that, as of March 31, 1983, there were approximately 210,000 retail outlets with an average estimated storage capacity of

16,800 gallons (400 barrels) and an inventory of 5,600 gallons (133 barrels). The total storage capacity at retail outlets, as of March 31, 1983, is estimated to have been 84 million barrels, with inventories at about 28 million barrels. These estimates are shown below:

ESTIMATED STORAGE CAPACITY AND INVENTORY AT RETAIL MOTOR FUEL OUTLETS AS OF MARCH 31, 1983 (Millions of Barrels)

	Capacity	Inventory
Motor Gasoline	79	26
Diesel/ Distillate Fuel Oil	5	2
Total*	**84**	**28**

*Totals include surveyed petroleum products only.

Estimated storage capacity and inventory in the secondary distribution system are shown below:

ESTIMATED TOTAL STORAGE CAPACITY AND INVENTORY IN THE SECONDARY DISTRIBUTION SYSTEM AS OF MARCH 31, 1983 (Millions of Barrels)

	Capacity	Inventory
Motor Gasoline	101	35
Kerosine	4	1
Diesel/ Distillate Fuel Oil	42	10
Residual Fuel Oil	6	2
Total*	**153**	**48**

*Totals include surveyed petroleum products only.

Tertiary Storage Segment

For the purposes of this study, the tertiary storage segment (the end-users) is divided into seven sectors. Storage capacity and inventory in the tertiary segment, as of March 31, 1983, were estimated to be as follows:

ESTIMATED STORAGE CAPACITY AND INVENTORY IN THE TERTIARY STORAGE SEGMENT AS OF MARCH 31, 1983 (Millions of Barrels)

	Capacity	Inventory
Sector		
Agricultural	41	14
Commercial	37	8
Electric Utilities	213	91
Industrial	61	17
Military/Government	56	23
Residential	100	55
Transportation	134	61
Total*	**642**	**269**
Product		
Motor Gasoline	103	42
Kerosine, Diesel, and Distillate Fuel Oil	282	131
Kero-Jet Fuel	21	11
Residual Fuel Oil	237	86
Total*†	**642**	**269**

*Totals may not add due to independent rounding.
†Totals include surveyed petroleum products only.

Petroleum Futures

A concern exists that, in the event of a supply shortage, some companies may rely on the futures market for delivery of "wet barrels" (the physical commodity), only to find that the "wet barrels" may not be available. Most participants in the market fulfill their contractual obligation to buy or sell through an opposite, offsetting transaction, rather than by delivering or taking delivery of "wet barrels." The results of the NPC survey of the primary distribution system and bulk plant operators suggest that, at this time, petroleum futures do not significantly affect the level of inventories.

System Dynamics

The petroleum distribution systems are a complex, integrated network of production, refining, storage, and transportation facilities. As a basis for studying the dynamics of this network, the NPC estimated total storage capacity and inventories for principal products and crude oil in the primary and secondary systems and the tertiary segment, for March 31, 1983. The findings are summarized in the table on the following page.

The secondary and tertiary inventories act as a buffer between primary inventories and end-use. Under normal conditions, these inventories represent a substantial safety cushion—in addition to that provided by primary inventories—for each product. This cushion is difficult to quantify, though, because

ESTIMATED STORAGE CAPACITY AND INVENTORY IN THE PETROLEUM DISTRIBUTION SYSTEMS AS OF MARCH 31, 1983
(Millions of Barrels)

	Primary		Secondary		Tertiary		Total	
	Cap.	Inv.	Cap.	Inv.	Cap.	Inv.	Cap.	Inv.
Motor Gasoline	456	223	101	35	103	42	660	300
Kerosine	21	9	4	1	*	*	25	10
Kero-Jet Fuel	68	35	-	-	21	11	89	46
Distillate Fuel Oil	295	118	42	10	282	131	619	259
Residual Fuel Oil	143	46	6	2	237	86	386	134
Total†	**984**	**431**	**153**	**48**	**642**	**269**	**1,779**	**748**
Crude Oil	499	313‡	-	-	-	-	499	313‡

*Included in distillate fuel oil for the tertiary storage segment.

†Totals include surveyed petroleum products only. These inventory levels and utilization of storage capacity represent satisfactory levels under normal operating conditions. Totals may not add due to independent rounding.

‡Excludes 31 million barrels of Alaskan North Slope crude oil in transit.

it was not possible to determine minimum operating inventories for the secondary system and tertiary segment. Moreover, the concept of minimum operating inventory as applied to the tertiary segment is somewhat different from the concept as applied to secondary and primary systems. Nevertheless, some minimum volume of inventory is necessary to keep the tertiary segment operating. It is believed that minimum operating inventory for a given product in the secondary and tertiary sectors is a smaller fraction of storage capacity than in the primary system because there is less unavailable inventory, such as pipeline fill, than in the primary system. Also, the size of receipts and deliveries of product is considerably smaller than in the primary system (in the secondary system deliveries are made by truck, whereas deliveries in the primary system are by barge, pipeline, and tanker).

Motor gasoline is used here to demonstrate the dynamic nature of the petroleum distribution systems. The table on the next page assumes that, for gasoline, minimum operating inventories in the secondary and tertiary sectors are 20 percent of capacity (a figure felt to be reasonable by the NPC). Note that these figures show an additional cushion of 15 million barrels of gasoline in the secondary system and 22 million barrels of gasoline in the tertiary segment. Hence, in this example, the combined secondary and tertiary reserves above minimum operating inventory are even greater than the 23 million barrels of cushion provided by the primary system alone. It should be recognized, however, that secondary and tertiary inventories are less flexible than primary inventory in their ability to redirect products to other consumer sectors or geographic areas. Similiar calculations for distillate fuel oil and residual fuel oil show even greater cushions for these products in the secondary and tertiary sectors.

Normally, inventories in the secondary system and tertiary segment represent additional volumes that can be used to maintain continuous supply of products for consumption. However, circumstances such as expectation of either a near-term substantial price increase or a crude oil shortage can cause very rapid increases in call for product. These increases, in turn, could disrupt the systems.

In the case of gasoline, a rapid surge in product call by the tertiary segment to fill the 61 million barrels of unused storage capacity could, potentially, drain both the secondary system of its 15 million barrels of gasoline above the assumed minimum operating inventory and the primary system of its 23 million barrels of gasoline above the minimum operating inventory. A surge in call by the secondary system, which has 66 million barrels of unused gasoline storage capacity, could also drain the primary system

MOTOR GASOLINE
AS OF MARCH 31, 1983
(Millions of Barrels)

	Primary System
Inventories Above Minimum Operating Inventory	23

	Secondary System	Tertiary Segment
Shell Capacity	101	103
Inventory	35	42
Minimum Operating Inventory*	20	20
Inventory Above Minimum Operating Inventory	15	22
Unused Shell Capacity†	66	61

*Assumed to be 20 percent of shell capacity.
†Shell capacity less inventory.

of its supply cushion. Similar examples extracted from the survey data for distillate and residual fuel oils would appear even more extreme, but it should be noted that, as of March 31, 1983, inventories of these heating fuels were expected to be low, and unused tankage capacity high.

Sudden product calls such as illustrated above are possible and could disrupt supply. However, several factors tend to mitigate the importance of sudden product calls and diminish the likelihood of disruption:

- The demand surge described above would not be a *consumption* surge. It is simply a *transfer* of products from the primary system to the secondary system and/or the tertiary segment.
- Holders of secondary and tertiary inventories would not necessarily experience a demand surge for all products in all geographic areas at the same time. For example, seasonality of product demand would probably result in less surge for heating oil in spring than in fall. Many electric utilities and industrial users have oil storage but burn natural gas, and would not necessarily want to fill their storage as long as gas was available.
- Refineries continually replenish the primary system. In addition, spare refining capacity of at least 1 to 2 million barrels per day and yield flexibility make it possible to increase production of finished products in response to a demand surge. The crude oil cushion above minimum operating inventory in the primary segment suggests capability for rapid response of such spare refining capacity.
- Space must be reserved for tank tops, safety allowances, and operating flexibility, which vary by sector. Thus, filling the entire shell capacity is impossible, and the unused capacity would have to be discounted by some amount.

The data resulting from this study define the inventories and storage capacities as of a specific date—March 31, 1983. The inventories doubtlessly have changed and will continue to do so as the system reacts to variations in supply, demand, prices, and other economic factors. This should be considered as one evaluates the study results.

The petroleum distribution systems are flexible and dynamic, changing to meet different supply situations and demand requirements. As has been demonstrated by the industry over time, this capability has enabled the industry to minimize the effect of supply disruptions.

Chapter One:

Overview of the Petroleum Distribution Systems and the Function of Inventory and Storage Capacity

The U.S. petroleum distribution systems are composed of networks of terminals, refineries, pipelines, tankers, barges, tank cars, tank trucks, and other storage facilities. These elements function to move crude oil from its source, convert it into consumer products, and deliver those products to consumers' facilities for their use. All of these elements incorporate storage to hold inventory. As an introduction to the analysis of changes in the petroleum distribution system presented in Chapter Two, this chapter presents an overview of the petroleum distribution systems and the function of inventory and storage capacity within those systems.

The Petroleum Distribution Systems

As shown in Figures 2 and 3, the petroleum distribution systems are composed of the primary distribution system, the secondary distribution system, and the tertiary storage segment. The primary system gathers crude oil, transports it to refineries, refines it into products, and delivers those products in bulk to the secondary distribution system. (In some cases, deliveries are directly to the storage of large end-users, i.e., tertiary storage.) The secondary system distributes these bulk quantities in smaller lots to the receiving tanks of the end-users. The tertiary segment is the storage capacity and inventory held by all end-users. The gasoline stored in the tank of the family car is a common example. The inventory behavior of the secondary system and tertiary segment significantly affects the primary system's ability to operate smoothly. Each of these systems is described in more detail in the following sections.

Primary Distribution System

Crude Oil

For domestic crude oil, the primary crude oil distribution system begins with a lease tank in which oil from a producing well is accumulated. Small pipeline-gathering systems, tank cars, tank trucks, and barges collect the crude oil from these lease tanks and deliver it into intermediate storage for further movement to refining facilities or directly to refineries.

Crude oil from foreign sources enters the primary system via tankers at marine terminals and refineries or, in Canada's case, via pipeline and overland. Export of domestic crude oil is restricted by law.

Major crude oil pipeline systems traverse the United States, linking gathering systems in producing areas to storage terminals and refineries. Large-diameter pipelines, called trunklines, move large volumes of oil between major points or to terminals. Trunklines are generally routed through focal points, or hubs, where a number of pipelines converge. At such points, transfers of crude oil to carriers with other destinations may be made. Examples of such locations are Midland and Odessa, in western Texas; Longview, in eastern Texas; Cushing, Oklahoma; Fort Laramie and Guernsey, Wyoming; and Patoka, Illinois. Such

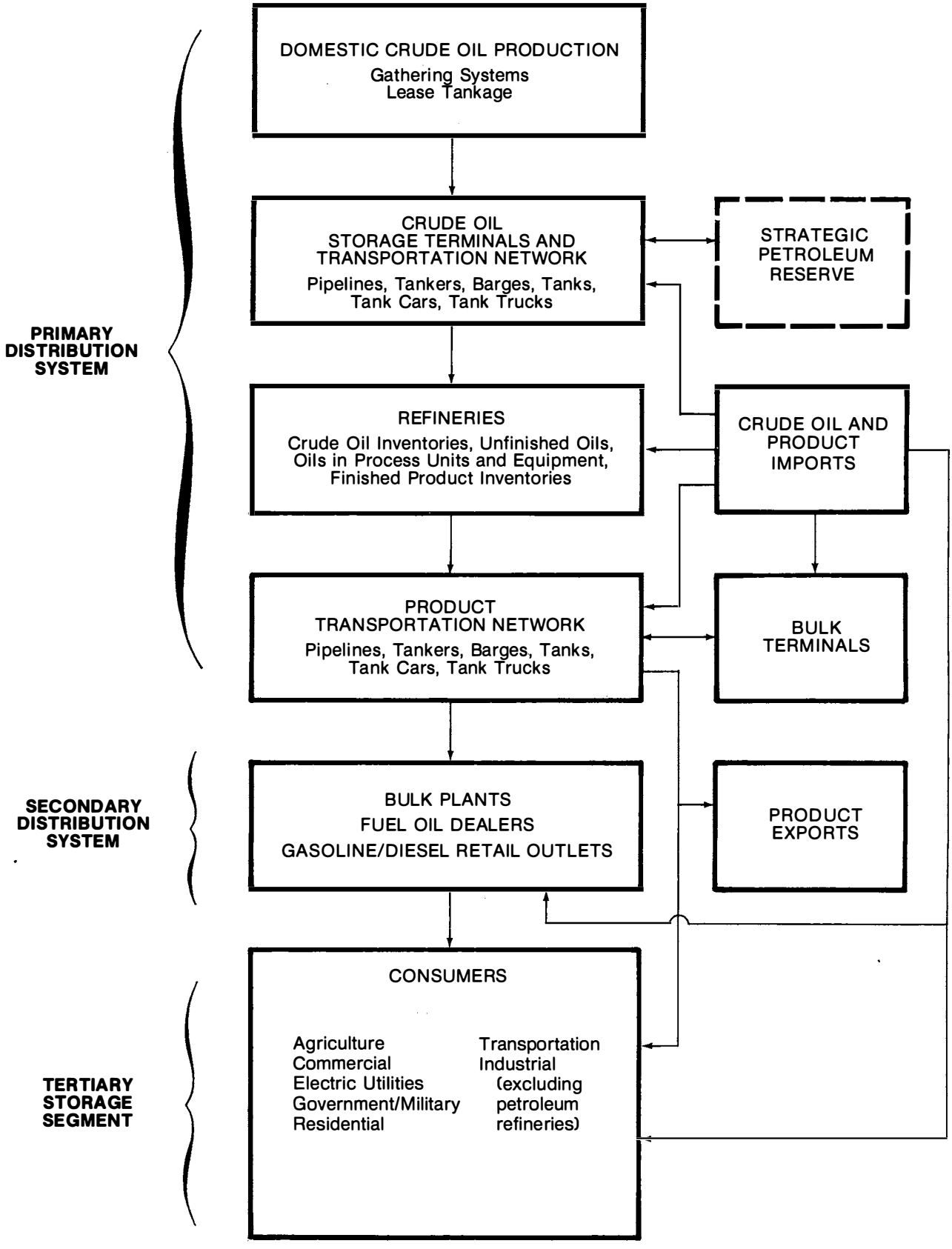

Figure 2. The Petroleum Distribution Systems.

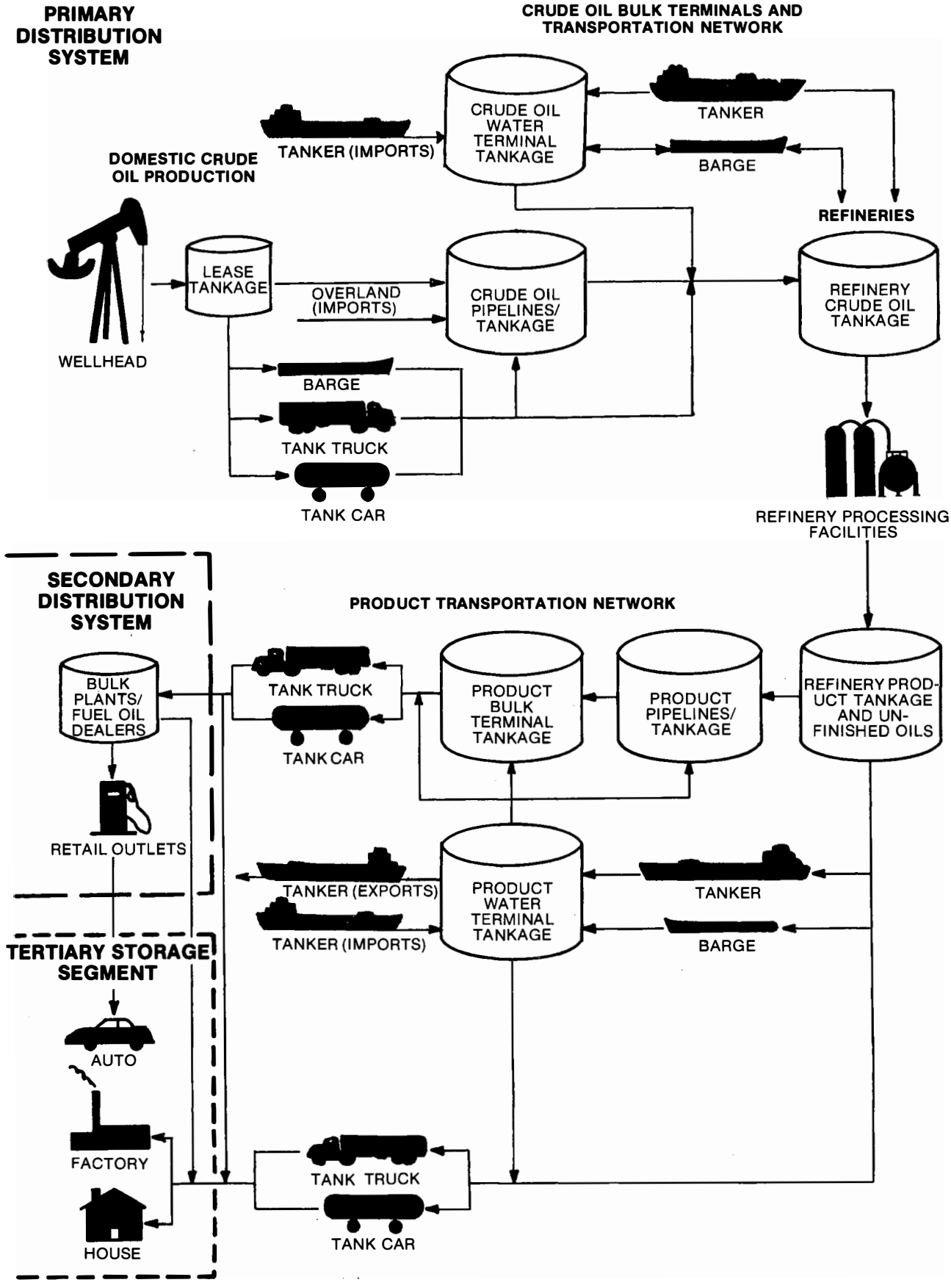

Figure 3. Simplified Diagram of the Petroleum Distribution System.

locations require a large storage capacity to accommodate crude oil from numerous producing regions, and to permit the segregation, batching, and storing that support the continuous movement of oil through the system. From these locations, smaller branches then move the crude oil to refineries.

A great deal of storage capacity is also needed at marine terminals to permit prompt discharge of cargo. This storage requirement applies also to refineries that accept marine shipments directly.

Because quality among crude oils varies substantially, they are generally segregated prior to transport. Segregation requirements, determined by quality characteristics that include sulfur content, specific gravity, asphalt content, pour point, and suitability for lube oil manufacturing, are usually dictated by the particular needs of the refineries being served. Tankage is required at refineries to receive and hold crude oil supplies, by grade, prior to processing.

Crude oil stored by the U.S. government in the SPR enters through the primary distribution system and, in the event of a drawdown, will again move through the primary system. (Appendix G summarizes the SPR's role.) There is also a significant volume of storage in the Caribbean at tanker transshipment terminals and at the refineries of several U.S. oil companies. (Appendix H discusses these facilities in more detail.)

Products

Once delivered to a refinery, crude oil is converted to various products, including motor gasoline, kerosine, jet fuel, distillate fuel oil, and residual fuel oil. Tankage is required at refineries to receive and hold both unfinished oils and finished product inventories.

Finished products exit the refinery through the primary product distribution system, which consists of facilities similar to those in the crude oil distribution system, such as product pipelines, barges and tankers, and bulk terminals to store product for further distribution. Imports and exports of products also flow through the primary product distribution system.

While products are still in refinery tanks, there is usually a choice as to the location to which the products may move and the mode of transport. Once a product is on its way, it is committed to the geographic area to which it is directed, although some delivery options remain. For example, the Colonial Pipeline, which extends from the Houston-Beaumont, Texas, area to the New York Harbor area, passes through the Baton Rouge, Atlanta, Greensboro, Richmond, Washington, Baltimore, and Philadelphia areas. Products can be delivered at numerous locations along its route. Storage capacity for each of the products carried is provided at shipper bulk terminals also located along the route.

The terminus of the primary product distribution system is usually a bulk terminal—a nonconsumer facility that, by the EIA's definition, has storage capacity of 50,000 barrels or more or that receives products directly by barge, tanker, or pipeline. Products leave the primary system from these bulk terminals and, at this point, the ability to divert a product to a different geographic location becomes much more limited.

The Function of Inventory and Storage Capacity

Primary Distribution System

The function of inventory and storage capacity in the primary petroleum distribution system is best understood by examining the following categories, each of which plays an important role in the operation of the overall system (see Figure 4):

- Unavailable inventory
- Working inventory
- Minimum operating inventory
- Operating space
- Maximum operating inventory
- Contingency space
- Unavailable space.

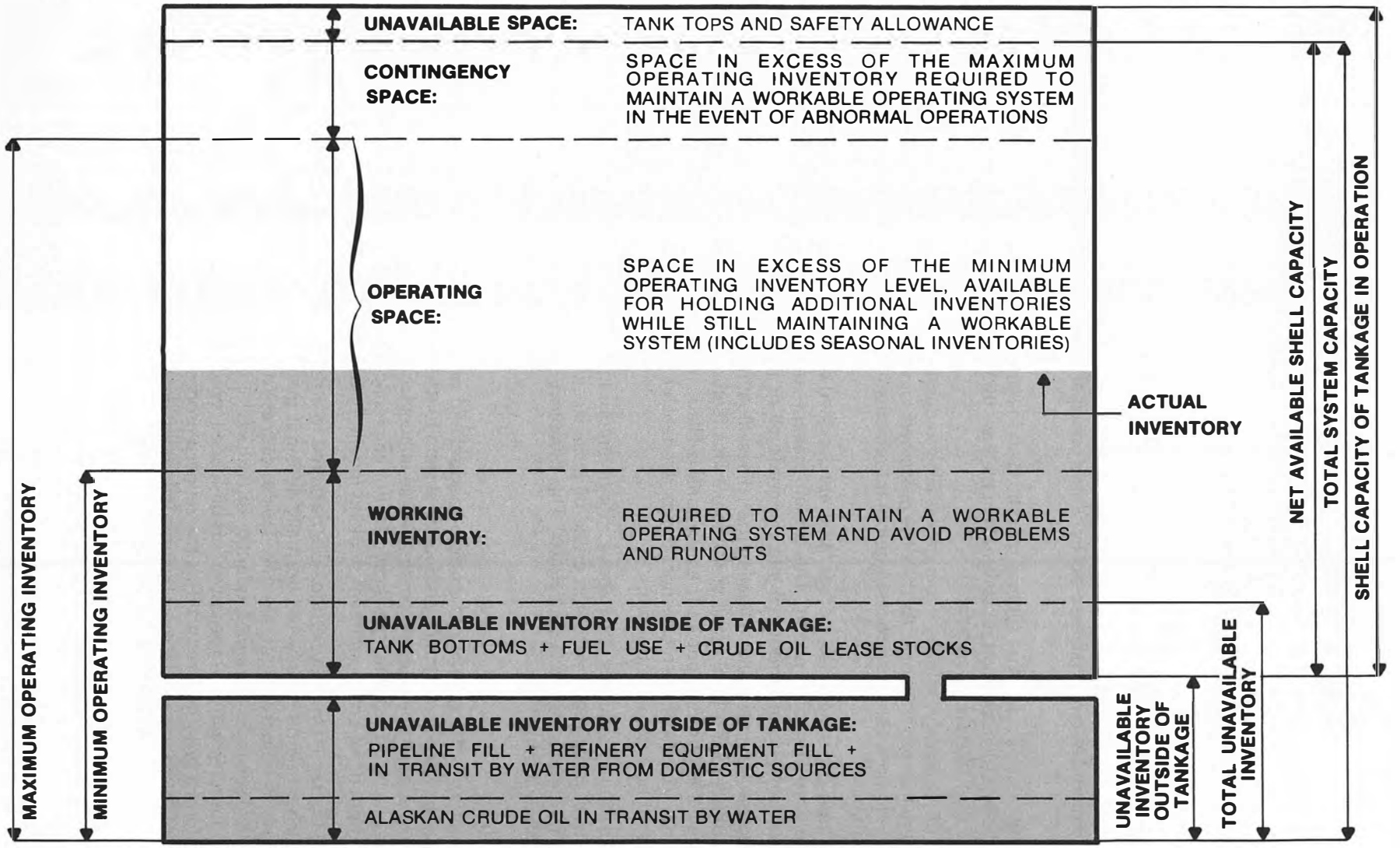

Figure 4. Simplified Diagram of Terms Describing Petroleum Inventories and Storage Capacities in the Primary Distribution System.

Unavailable inventory (equipment fill and tank bottoms) and working inventory (inventory above unavailable necessary to support the operating cycle) together constitute what is called the minimum operating inventory. The space available for maximum operating inventory is the total capacity of the system less the unavailable space (tank tops and safety allowance) and the contingency space (the empty space reserved to allow for smooth operation when inventories approach upper levels). The function and definition of unavailable inventory, working inventory, minimum operating inventory, operating space, and maximum operating inventory are discussed in greater detail in this section.

Unavailable Inventory

Unavailable inventory is the volume of oil contained in pipelines, refinery equipment, and tank bottoms and is consequently unavailable without shutting down part of the system. It also includes inventory in transit to and from domestic sources by truck, tank car, barge, or tanker, as well as fuel set aside for use within the system and as crude oil lease stocks. Three principal components of this inventory category are:

- **Pipeline Fill**—Initially, pipeline systems must be filled to operate. Subsequently, an equivalent volume of crude oil or product must remain in the line, unavailable for consumption, as long as the line is in normal operation.
- **Refinery Fill**—Similarly, refinery equipment is filled to design levels with crude oil and various unfinished petroleum fractions. As the oil is processed, new oil is added. Consequently, the inventory volume within the process equipment remains unavailable as long as the refinery is in operation.
- **Tank Bottoms**—In most cases, storage tanks are designed so that they cannot be totally emptied by the normal suction piping. This design prevents residue and water, which settle at the bottom, from being introduced into the crude oil or product streams.

  Some tanks are equipped with a floating roof. These floating-roof tanks are designed so that the roof adjusts to the level of oil in the tank. This feature prevents air from entering the tank as the oil is pumped out and, as the tank is filled, minimizes hydrocarbon emissions from the tank. A tank of this type is not permitted to reach a level that would allow the floating roof legs to touch the tank bottom.

Neither the inventory volumes cited above, nor inventory in transit by water, rail, and truck, nor fuel set aside for use within the system, nor crude oil lease stocks, can ever be used unless the facility or transportation mode concerned is shut down. This inventory is not available to the consumer and is thus classified "unavailable."

Working Inventory

Working inventory is the quantity of crude oil and refined products, above the unavailable inventory, that is needed to keep the primary distribution system functioning normally. It is the additional inventory necessary to support the operating cycle, handle unavoidable operating interruptions, and facilitate the blending of products to their final specifications. For all practical purposes, working inventory is also unavailable. Descriptions of components of working inventory are given below.

- **Operating Cycles**—Typically, crude oil is delivered to a refinery by pipeline or tanker. The rate at which crude oil is delivered normally does not match the rate at which it is refined. For example, a refinery might take ten days to process the cargo that a tanker has taken two days to discharge. A varying quantity of crude oil inventory is held as a result of this imbalance. Immediately after the tanker has off-loaded, crude oil inventory in tankage is high. The inventory is gradually reduced as the refinery processes the crude oil and awaits the next delivery. Storage capacity must be provided for the maximum crude oil delivery, although actual inventories will average substantially less than capacity.

  Product deliveries from a refinery operate similarly. Products manufactured in a refinery generally accumulate at rates slower than the outbound transportation facilities require. So sufficient working inventory must be on hand at all times to meet transportation system needs. For example, barge shipments of products from a refinery generally require that sufficient inventory be on hand to load a barge in less than a day. Batch shipments into pipelines are a

similar example. Inventory will therefore be lowest just after a shipment, and then will gradually increase as the next shipment is accumulated from refinery production.

- **System Interruptions**—Delivery of crude oil to a refinery and shipment of products are subject to interruptions due to unavoidable but recurring events. Inventory of both crude oil and products is held to protect against the consequences of these interruptions. For example, to protect against an immediate crude oil runout caused by a pipeline shutdown or a tanker delay, some additional crude oil will always be held in the refinery. This inventory is held not only because economics dictate continuous refinery operations, but also because it is operationally undesirable to shut down a refinery instantly and sufficient oil must be on hand to provide for a safe and orderly shutdown. In addition, in the event of a refinery shutdown, sufficient inventory of finished product is required to continue to supply customers until the refinery is back in operation.
- **Blending of Products**—Various unfinished products must be accumulated until sufficient quantities are available for blending in specific proportions to make finished products, such as different grades of gasoline and fuel oils.

Minimum Operating Inventory

Minimum operating inventory is the level of inventory that is necessary to maintain smooth operations and avoid runouts and below which operating problems and shortages would begin to appear in a defined distribution system. It is composed of unavailable inventory and working inventory and is normally not available for sale. The minimum operating inventory is a concept, not a precisely measurable quantity, that can be estimated more accurately for a company than for the industry as a whole.

A company's minimum operating inventory is a function of many factors, including the location of both its supply and demand, the level of its demand, the availability of transportation and refining facilities, the mode of transportation, and the availability, size, and location of tankage. Its actual inventory may, at times, fall below the minimum operating level. In such a circumstance, a company may be able to avoid serious problems by special purchases of supply or by a last-minute exchange with another company, but only if these additional supplies are available. In the course of normal operations, companies do not plan on drawing down stocks below minimum operating inventories, due to the costs and risks involved.

Estimating the minimum operating inventory on an industry-wide basis requires a complex and very difficult judgment. Merely totalling the minimum operating inventories for all companies, at a given time, may not truly represent the minimum operating inventory for the industry, because it is unlikely that all operators will reach their minimum operating levels simultaneously. Thus, one or more companies can incur shortages and runouts before the estimated minimum operating inventory for the total industry is reached.

Operating Space

Although there are many purposes for maintaining certain inventory levels within the "operating space," this discussion will focus on two primary elements:

- **Seasonal Demand**—Consumption of gasoline is greatest in summer months; consumption of heating oil is greatest in winter months. During a given season, refineries generally cannot change the mix of gasoline and heating oil sufficiently to balance production with demand. As a result, excess distillate fuel oil production in the summer may be held for winter demand, and excess gasoline production in the winter may be held for summer demand. This inventory is held in both the primary and secondary distribution systems to supply the shortfall between production capacity and peak demand. The amount of this inventory varies with individual company demand requirements and business expectations.
- **Planned Maintenance Periods**—Periodically, companies shut down a refinery for maintenance. To permit regular deliveries to customers during the shutdown, product inventories must be built up ahead of time. Since crude oil will continue to be delivered to the refinery while it is shut down, inventories at the refinery will increase during the shutdown period.

Other factors affecting inventory levels within the operating space are price expectations and perceived security of supply.

Maximum Operating Inventory

Maximum operating inventory is the maximum quantity of petroleum that could be stored in a defined distribution system and still maintain a workable operating system. The empty tank space above maximum operating inventory is the unavailable space (tank tops and safety allowance) and contingency space required for periods of high inventories (see Figure 4). This space is used to smooth out the operating cycles and to permit inventory buildups during interruptions of refinery or other distribution facility operations. For example, if a product pipeline system fed by a refinery fails and the refinery tankage is full, the refinery runs the risk of shutdown. Contingency space reduces that risk. Like minimum operating inventory, maximum operating inventory is a concept, not a precisely measurable quantity.

Secondary Distribution System

The secondary distribution system receives products from the primary system and delivers those products in smaller quantities to consumers. It is composed of bulk plants (nonconsumer facilities that have less than 50,000 barrels of storage capacity and are served only by tank car or truck), tankage at individual truck and automobile retail motor fuel outlets, and all retail fuel oil dealers not selling directly from primary distribution system storage outlets (see Figures 2 and 3).

It is estimated that there are about 18,000 companies operating bulk plants and about 210,000 retail outlets in the secondary distribution system. Bulk plant operators are those companies that store and resell petroleum products wholesale and/or retail. Retail motor fuel outlets consist of service stations, truck stops, convenience stores, car washes, and automotive service facilities that dispense gasoline, diesel, and small amounts of kerosine to consumers. While the storage capacity and inventory at each of the distribution points in the secondary distribution system are considerably smaller than that of the distribution points in the primary system, in total the secondary tank capacities and inventories are large.

The components of inventory and storage capacity in the secondary distribution system function and are managed in essentially the same way as those of the primary system. Factors such as unavailable inventory, working inventory, and minimum and maximum operating inventory are common to both systems, although the factors are considerably different in relative volume. The principal difference is that operating space in the secondary system is a greater percentage of shell capacity than in the primary system.

Operating problems for the secondary distribution system can occur for a variety of reasons. Refinery operating problems, large unforeseen withdrawals by some companies in the secondary system or the tertiary segment, and severe weather conditions are examples of causes of operating problems at the secondary level. The impact of supply disruptions caused by these factors on an individual secondary system company or service station may be less severe than on a primary system company, because alternate sources of supply can frequently be arranged. In the secondary distribution system, these operating problems generally do not affect consumers because of the many secondary system operators available to meet consumer demand.

Tertiary Storage Segment

The tertiary storage segment includes storage capacity and inventory of products held by end-users. Common examples include diesel fuel in tanks on farms for use in agricultural equipment; residual fuel oil in storage facilities for large office/apartment complexes, electric utility generating locations, or heavy industrial complexes; motor gasoline in private vehicles and government motor pool storage locations or vehicles, or for use with military support equipment; distillate fuel oil in home-heating storage tanks; and kerosine-type jet fuel for commercial jets in on-board storage or in tanks at airports.

The amount of storage capacity in the tertiary segment is very large, with some inventories varying seasonally. Once products have moved into the tertiary storage segment, there is generally little ability to relocate them.

Petroleum products can move into the tertiary storage segment from either the primary or secondary distribution systems. Gasoline for use in automobiles, for example, almost always comes from the

secondary distribution system (i.e., from retail service stations) although a number of the automobiles in commercial and industrial fleets may rely on the storage of the company that owns the fleet and, hence, be served from within the tertiary segment itself. Fuels used in the industrial sector may come either from the secondary distribution system via jobbers/distributors or, as in the case of some larger manufacturing facilities, by pipeline or barge directly from the primary system. Major commercial airports are commonly supplied directly from the primary system, although numerous smaller airports are supplied by jobbers/distributors.

For the purposes of this study, the tertiary segment has been divided into seven sectors of consumers, or end-users:

- Agricultural
- Commercial
- Electric Utilities
- Industrial
- Military/Government
- Residential
- Transportation.

The size of storage facilities varies greatly among these categories. Stocks on hand remain relatively constant all year for certain end-users but vary dramatically for others. For instance, the electric utility sector maintains very large storage facilities and inventories of residual fuel oil for use in power generation on a year-round basis. The agricultural sector (farms) maintains almost no inventory of diesel fuel during winter but has high inventory levels at the start of the planting and harvesting seasons.

Chapter Two:

Analysis of Changes in the Petroleum Distribution Systems, 1978-1983

Introduction

The U.S. petroleum industry has experienced significant economic and structural changes since the previous NPC report. Changes in product demand and crude oil and product prices have influenced the amount of inventory held in the primary and secondary distribution systems as well as in the tertiary segment. Decreased demand has caused, and is continuing to cause, fundamental structural changes in the U.S. refining, supply, and distribution systems, at both the primary and secondary levels. The NPC 1983 estimated minimum operating inventory levels have been reduced from the 1979 levels to reflect these changes. The structural changes have also affected the maximum operating inventory levels, although the Council has not estimated these upper limits.

This chapter examines historical data that reflect demand and economic changes in the industry over the 1978-1982 period and changes in the minimum operating, maximum operating, and total inventory levels; in total storage capacity; and in tankage utilization.

Final annual data for year 1983 were not available at the time this report was completed. A review of preliminary 1983 data indicates that final 1983 data would not change any of this study's conclusions.

Historical Data Affecting Petroleum Industry Operations, 1978-1982

Petroleum Product Demand, 1978-1982[1]

The decline in U.S. petroleum demand in the 1978-1982 period has been significant for most products, as indicated in Table 1. That overall trend continued through mid-year 1983. The decline occurred as higher prices encouraged fuel conservation and switching to other fuels, the economic recession reduced industrial consumption of all fuels, and federal conservation requirements, such as improved fuel efficiency for new car fleets, lowered fuel usage.

[1]In this report, *petroleum demand* is defined as withdrawals from primary stocks. *Consumption* is defined as the utilization of the product by an end-user.

TABLE 1

U.S. PETROLEUM PRODUCT DEMAND, 1978-1982
(Millions of Barrels per Day)

	1978	1979	1980	1981	1982	Percentage Decrease, 1978-1982*
Motor Gasoline	7.4	7.0	6.6	6.6	6.5	12
Kerosine	0.2	0.2	0.2	0.1	0.1	26
Kero-Jet Fuel	0.9	0.9	0.9	0.8	0.8	6
Distillate Fuel Oil	3.4	3.3	2.9	2.8	2.7	22
Residual Fuel Oil	3.0	2.8	2.5	2.1	1.7	43
Other	3.9	4.3	4.1	3.6	3.4	13
Total†	**18.8**	**18.5**	**17.1**	**16.1**	**15.3**	**19**

*Calculated on an unrounded basis.
†Totals may not add due to independent rounding.

Source: Energy Information Administration, *Petroleum Supply Annual*, 1981 and 1982; and *Petroleum Statement, Annual*, 1978-1980.

Influence of Prices on Demand

The price of crude oil and petroleum products rose dramatically from 1978 to 1981, but has since decreased slightly (see Table 2). In the 1978-1979 period, the Iranian revolution reduced Iranian oil production and caused a shortfall in world oil supplies. The subsequent Iran-Iraq war continued to limit production from those countries. The official price for Arabian Light, one of the benchmark crude oils, increased from $12.70 per barrel in 1978 to $34.00 per barrel in 1981, but subsequently decreased to

TABLE 2

U.S. PETROLEUM PRICES—ANNUAL AVERAGE, 1978-1982

	1978	1979	1980	1981	1982	Percentage Increase, 1978-1982
U.S. Refiner Crude Oil Acquisition Cost ($/bbl)	12.46	17.72	28.07	35.24	31.87	156
New York Harbor Regular Gasoline (¢/gal.)	42.8	85.4	92.4	98.9	90.9	112
New York Harbor #2 Distillate Fuel Oil (¢/gal.)	37.1	74.8	78.9	96.1	90.9	145
New York Harbor 1% Sulfur, Low Pour Residual Fuel Oil ($/bbl)	12.57	20.83	24.85	30.65	28.19	124

Source: Crude oil acquisition cost: Energy Information Administration, *Monthly Energy Review*, June 1983. Others: *Platt's Oil Price Handbook and Oilmanac*, annual issues.

$29.00 per barrel in early 1983. In 1978, domestic crude oil and gasoline prices were subject to federal price controls, which held them below then-current world prices. Although U.S. petroleum prices were permitted to phase up to world levels commencing in 1979, complete decontrol did not occur until January 1981. Data indicating general levels of U.S. crude oil and wholesale product prices since the 1979 NPC study are shown in Table 2. These higher costs for oil encouraged conservation of petroleum fuels in all sectors, as shown in Table 3.

As the price of petroleum products rose, consumers switched to more economic fuels. In the residential and commercial sector, consumers switched from oil to natural gas and electricity. Industrial users conserved on all fuels and also switched from oil to natural gas, coal, and electricity. The recent recession further reduced the demand for all energy. Table 4 illustrates the shift in U.S. demand for energy, by type, since 1978.

Impact of Government Actions on Demand

The demand for some fuels was also affected by regulatory constraints on the normal demand for products. As an example of a direct effect on consumption, gasoline demand declined partially because of government new car mileage requirements. These requirements increased the average miles per gallon (mpg) of the car fleet from 14.1 mpg in 1978 to 16.3 mpg in 1982. Part of the demand reduction, however, was due to a decrease in the average miles driven per car.

Structural Changes in the Petroleum Industry

Analysts disagree as to how much of the U.S. petroleum demand decline is structurally permanent and how much is caused by cyclical events, such as the economic recession and the impact of temporary government programs. Nevertheless, declining demand has caused structural changes in U.S. refining, supply, and distribution patterns. Due to decreased demand for petroleum products, the United States has an excess of refining, pipeline, and tankage capacity.

U.S. crude oil refinery runs declined by 3.0 million barrels per day to 11.8 million barrels per day between 1978 and 1982. U.S. operable refining capacity, however, continued to increase, peaking at 18.6 million barrels per day in January 1981, but subsequently declined to 16.8 million barrels per day by January 1983. However, the actual operating capacity in January 1983 was only 14.9 million barrels per day (see Appendix I). The volume of crude oil and petroleum products transported by pipeline decreased from 586 billion ton-miles to 564 billion ton-miles over the 1978-1981 period (1981 is the last year for which data are available). As discussed later in this chapter, tankage utilization decreased by 8 percent over the 1978-1983 period.

As product demand declined, individual companies at the primary level sought ways to reduce inventory requirements and to shut down unneeded or underutilized facilities. Commonly used options included supply and distribution exchange agreements and terminal throughput agreements. Exchange agreements allow the parties to the exchange to phase out marginal facilities (in order to increase the utilization of tankage at more economic locations) or to more readily gain entry into new markets. For example, a California company, wishing to access eastern markets, could contract a Pennsylvania firm to store and deliver product there. In exchange, the California company would perform the same service in the west for its eastern counterpart. In the case of throughput agreements, two or more companies may have terminals in the same location. As demand declines, one of the companies may decide to close its terminal and pay another company for the use of its facilities. In other cases, companies may decide to withdraw from markets in which the demand has declined to the point that operations are uneconomic. In various parts of the country, for example, several companies have withdrawn from the retail gasoline business. As these withdrawals occur, some tankage is no longer used and the utilization of the remaining companies' tankage increases.

At the secondary level, there has been a reduction in the number of jobbers/distributors and fuel oil dealers as the consumption of petroleum products has decreased. Some went out of business; some merged with other companies. The number of service stations also decreased substantially as a result of reduced consumption; the trend is towards fewer, though larger volume, outlets.

At the tertiary level, the movement toward greater efficiency in all sectors has decreased total energy use. These changes in the refining, supply and distribution, marketing, and end use of refined products have led to changes in the management of inventory throughout the distribution systems.

TABLE 3

U.S. PETROLEUM DEMAND BY SECTOR, 1978-1982
(Millions of Barrels per Day)

	1978		1979		1980		1981		1982		Percentage Decrease,
	Quantity	%	Quantity	%	Quantity	%	Quantity	%	Quantity	%	1978-1982
Industrial (Includes Agriculture)	4.9	26	5.4	29	4.8	28	4.3	27	4.0	26	18
Residential/ Commercial	2.1	11	1.7	9	1.5	9	1.3	8	1.3	8	38
Transportation	10.1	54	10.0	54	9.5	56	9.5	59	9.3	61	8
Electricity Generation	1.7	9	1.4	8	1.2	7	1.0	6	0.7	5	59
Total*	**18.8**	**100**	**18.5**	**100**	**17.1**	**100**	**16.1**	**100**	**15.3**	**100**	**19**

*Totals may not add due to independent rounding.

Source: Energy Information Administration, *Monthly Energy Review*, June 1983. Quantities calculated using conversion factors provided by the EIA.

TABLE 4

U.S. ENERGY DEMAND BY TYPE OF ENERGY, 1978-1982
(Millions of Barrels of Oil Equivalent per Day)

	1978		1979		1980		1981		1982		Percentage Change,
	Quantity	%	Quantity	%	Quantity	%	Quantity	%	Quantity	%	1978-1982
Oil	18.8	48	18.5	47	17.1	45	16.1	43	15.3	43	-19
Natural Gas*	10.0	26	10.3	26	10.1	27	9.9	27	9.1	26	- 9
Coal*	6.9	18	7.5	19	7.7	20	8.0	22	7.6	22	+10
Nuclear*	1.5	4	1.4	4	1.4	4	1.5	4	1.5	4	0
Other*	1.7	4	1.6	4	1.6	4	1.6	4	1.8	5	+6
Total†	38.9	100	39.3	100	37.7	100	36.9	100	35.3	100	- 9

*Converted from quadrillion BTU using factor of 5.5 million BTU per barrel.

†Totals may not add due to independent rounding.

Source: Energy Information Administration, *Monthly Energy Review*, June 1983.

Primary Distribution System Analysis

Minimum Operating Inventory Levels in the Primary System, 1979 and 1983

Definition

The industry-wide minimum operating inventory is the inventory level below which operating problems and shortages would begin to appear in a defined distribution system. (See Chapter One for a description of inventory terms.) Minimum operating inventory includes pipeline fill, tank bottoms, and other unavailable inventory, plus the amount of working inventory needed to keep the distribution system operating without supply disruptions. Much of this working inventory is in the unavailable category. Thus, as demand for a product declines, its minimum operating inventory would not be expected to decline proportionally. Unavailable inventory will decline only if demand has been reduced to the extent that some refineries and pipelines no longer need to operate and are removed from the system, and/or tankage utilization has become so low that some tankage is idle. Inventory held above minimum will vary more proportionally with changes in demand, price, interest rates, and security of supply.

Changes in the Minimum Operating Inventory Levels, 1979 and 1983

The estimated minimum operating inventory levels for crude oil and the petroleum products surveyed in this study are lower than those reported in the 1979 study, as shown in Table 5. These reductions in minimum operating inventory levels are largely attributable to a decline in demand for petroleum products fostered by a decrease in general economic growth, a significant increase in the price of petroleum, and consumer conservation practices and fuel switching. The decline in demand for petroleum products has caused, and is continuing to cause, fundamental structural changes in the refining, supply, and distribution patterns of the U.S. petroleum industry. These industry changes appear to be dynamic, as product demand patterns are still changing. As a result, minimum operating inventory is a dynamic, rather than a static, figure that will continue to change in response to factors affecting the industry.

It is important to note that the NPC minimum operating inventory total of 660 million barrels represents the sum of only those products included in its survey. EIA publications include categories for "other oils" and "unfinished oils." The products in these categories, because of their diverse nature and uses, were

TABLE 5

NPC MINIMUM OPERATING INVENTORY ESTIMATES FOR THE PRIMARY DISTRIBUTION SYSTEM (Million of Barrels)

	1983			Decrease in Total U.S., 1979-1983
	PADDs I-IV	PADD V	Total	
Crude Oil*	215	70	285	5
Motor Gasoline	176	24	200	10
Kerosine	5	‡	5	5
Kero-Jet Fuel	20	5	25	
Distillate Fuel Oil	97	8	105	20
Residual Fuel Oil	34	6	40	20
Total†	**547**	**113**	**660**	**60**

*Excludes SPR. Alaskan crude oil in transit by water is included in PADD V, to be consistent with the EIA reporting system.
†Totals include crude oil and surveyed petroleum products only.
‡Less than 0.5 million barrels.

considered outside of this study's scope. Consequently, this report presents no estimate of a total minimum operating inventory for all petroleum products.

The EIA's *Weekly Petroleum Status Report* publishes an "observed minimum" (the lowest end-of-month total petroleum inventory level during the recent 36-month period) for comparison with the current total petroleum inventories it reports weekly. The current "observed minimum" is 1,057.9 million barrels, which occured in April 1983. Data users are cautioned that the NPC's estimated minimum operating inventories for crude oil and selected products can be compared meaningfully only with the EIA's inventories for the same commodities.

Methodology Used in Estimating the 1983 Minimum Operating Inventory Levels

As in previous NPC estimates of the minimum operating inventory levels, the 1983 estimates were developed through a decision-making process. In order to arrive at a consensus, individual judgments were discussed in the context of operating experience and relevant data. The data used were: (1) the sum of the individual company minimum operating inventories as reported in the 1983 NPC survey, (2) the industry-wide estimates of minimum operating inventory levels as reported in the 1983 NPC survey,[2] and (3) historical inventory data. The NPC survey data are reported in Appendix E; the historical inventory data are shown in Appendix J.

The historical inventory data provide a means of testing the reasonableness of the previous minimum operating inventory levels by determining whether any spot shortages or distribution problems occurred when stocks were above or below the 1979 NPC minimum operating inventory levels. Those problems can then be explained in the context of the minimum operating inventory changes since that last study.

Crude Oil. Total crude oil inventories have been above the minimum operating inventory level at all times since the last survey and no significant physical shortages have developed (despite the worldwide shortfall following the outbreak of the Iran-Iraq war in 1978). Therefore, no physical test of the 1979 minimum operating inventory has occurred. Both the sum of the individual company responses, when adjusted for unreported crude oil lease stocks and Alaskan crude oil in transit by water, and the average of industry-wide estimates, when compared with similar data from the 1979 survey, suggest a modest reduction in the crude oil minimum operating inventory estimate: from 290 million barrels in 1979 to 285 million barrels in 1983.

The 1983 minimum operating inventory estimate includes 30 million barrels of Alaskan crude oil in transit by water, the majority of which was not included in the 1979 estimate. The addition of 41 million barrels of crude oil storage capacity since 1978 would also tend to increase the minimum operating inventory estimate. These increases, however, are believed to have been more than offset by the effect of refinery closures, the reduced quantities of imported crude oil processed, and reduced refinery runs. Imported crude oil generally moves in batch sizes five to ten times greater than domestic crude oil and hence has a larger effect on the working inventory component of minimum operating inventory.

Motor Gasoline. At the national level, motor gasoline inventories have not dipped below the 1979 estimate of minimum operating inventory. However, gasoline inventories came close to the minimum operating inventory in the spring of 1982 and again in 1983. At those times, some companies announced temporary localized allocations of motor gasoline at the primary distribution level. It appears now that these allocations did not reflect a real shortage. Rather, they reflected a rapid drawdown into the secondary and tertiary sectors, where price increases were expected. No significant regional shortages developed in the primary distribution system. Because of this experience and in response to the survey results, the minimum operating inventory for motor gasoline has been reduced from 210 million barrels to 200 million barrels.

Kerosine and Kerosine-Type Jet Fuel. On a national level, the actual inventories of kerosine and kerosine-type jet fuel have not fallen below the minimum operating inventory levels established in the 1979 study. No actual shortages of these products were known to exist during the 1978-1983 period. Hence, no critical test of the 1979 minimum operating inventory figures has occurred. Based on this operating experience and the decreased sum of the individual company minimum operating inventories,

[2]These estimates were used for general reference only, as only a few estimates were reported.

the NPC's previous estimate of the kerosine and kerosine-type jet fuel minimum operating level has been decreased from 35 million barrels to 30 million barrels.

Distillate Fuel Oil. Distillate fuel oil inventories fell well below the minimum operating levels in the spring of 1982 and the spring of 1983. Spot shortages occurred in the spring of 1982 because April was an unseasonably cold month. In 1983, inventories were tight, but widespread shortages did not occur. Inventories actually fell slightly below the 1983 minimum operating inventory estimate level, but only when the demand was low after the heating season. The sum of the individual company minimum operating inventories and the fact that inventories have been below the minimum operating inventory without widespread shortages support the Council's reduction of the minimum operating inventory estimates from 125 million barrels to 105 million barrels.

Residual Fuel Oil. The residual fuel oil market is still undergoing significant changes that affect working inventory requirements. Therefore, the residual fuel oil minimum operating inventory estimate deserves less confidence than that of the other products. Residual fuel oil inventories have been below the 1979 estimate of minimum operating inventory for most of 1982 and 1983. Shortages have not occurred; however, the market has been very tight, with inventories at about 45 million barrels. The strong reliance on residual fuel oil imports and the significant reduction in residual fuel oil demand due to decreased economic activity and fuel switching support the large reduction in minimum operating inventory for residual fuel oil from 60 million barrels to 40 million barrels. A change in the level of either economic activity or imports could have an impact on the minimum operating inventory level for residual fuel oil.

Days' Supply of Inventory Calculations

The NPC also examined how the concept of days' supply of inventory might provide a misleading picture of inventory levels. Minimum operating inventory levels do not decline proportionally with demand. Moreover, minimum operating inventories are not available for use without causing shortages. Therefore, days' supply of inventory calculations based on total inventory do not present a valid indication of the adequacy of inventory levels. A better way to judge the adequacy of inventory levels is to look at how much inventory is accessible above the minimum required to run the system:

$$\frac{\text{total inventory} - \text{minimum operating inventory}}{\text{current demand}} = \begin{array}{l}\text{days' supply of}\\ \text{inventory above}\\ \text{minimum}\end{array}$$

By using this method, March 31, 1983, data for gasoline would indicate 3.4 days' supply of that product, as displayed below, compared to 32.8 days' supply when calculated on the basis of total inventory.

$$\frac{223\ \text{MMB} - 200\ \text{MMB} = 23\ \text{MMB}}{6.8\ \text{MMB/D}} = \begin{array}{l}\text{3.4 days' supply}\\ \text{of inventory above}\\ \text{minimum}\end{array}$$

$$\frac{223\ \text{MMB}}{6.8\ \text{MMB/D}} = \begin{array}{l}\text{32.8 days' supply}\\ \text{of total inventory}\end{array}$$

Table 6 compares the days' supply of inventory for March 31, 1978, with March 31, 1983, when calculated on the basis of total inventory and on inventory above minimum. Clearly, the days' supply of inventory above minimum is a lower number than days' supply of total inventory. The former is more indicative of available supply, however, and is therefore more useful for emergency preparedness planning. A seemingly low number of days' supply above minimum should not be of concern in times of normal operations. The flexibility inherent in the petroleum supply and distribution systems, together with ample crude oil supply, refining capacity, and transportation facilities, ensure the ability of the systems to meet product demand over time. While total inventories have decreased since 1978, the amount of inventory above minimum (in terms of days' supply) is generally consistent with the 1978 level. The potential drawdown of inventory held by the secondary and tertiary storage systems provides additional flexibility in times of tight supply.

In addition, approximately 75 percent of the crude oil supplied to refineries in 1983 was from domestic sources, versus 60 percent in 1978. Even if foreign crude oil supply was disrupted, the majority of the

TABLE 6

DAYS' SUPPLY OF INVENTORY IN THE PRIMARY DISTRIBUTION SYSTEM

	March 31, 1978		March 31, 1983	
	Total Inventory*	Inventory Above Minimum†	Total Inventory*	Inventory Above Minimum ‡
Crude Oil§	24.3	3.9	32.0	6.3
Gasoline	35.6	6.8	32.8	3.4
Distillate Fuel Oil	33.6	3.1	40.7	4.5

*EIA data.
†The NPC's 1979 estimate.
‡The NPC's 1983 estimate.
§Excludes SPR, which on March 31, 1983, held 312 million barrels, or 149 days' supply of crude oil imports.

crude oil inputs to refineries would be unaffected, ensuring uninterrupted, if somewhat reduced, product supply. The SPR stocks are also intended for use in times of severe oil supply disruption.

Total Inventory Levels in the Primary System, 1979 and 1983

The total inventory level of crude oil plus the principal products has decreased since the previous study, as shown in Table 7. The aggregate amount of inventory actually held above minimum operating inventory levels has remained relatively constant.

In the primary system, the amount of inventory held above minimum operating inventory is largely determined by the level of product demand, price expectations, the cost of storing products and crude oil, and the perceived security of crude oil and product supply, as well as by the seasonal storage and maintenance factors discussed in Chapter One.

Product Demand

The most obvious reason for reducing stocks held above minimum operating inventory is lower product demand. For example, if a company determines that it is desirable to hold seven days' supply above minimum operating inventory, its inventory requirement falls by 70 thousand barrels if demand declines from 60 thousand barrels per day to 50 thousand barrels per day.

In addition, the products historically exhibiting the greatest seasonality of demand (distillate fuel oil and residual fuel oil) are becoming less seasonal. As seasonality declines, less product must be held in inventory to ensure supplies during peak periods of demand. Demand and inventory levels for the surveyed products for the years 1978 to 1983 are found in Appendix J. The figures show the reductions in the seasonality of these products.

Effect of Price Expectations

As noted above, inventory held above minimum is stored primarily to meet demand. In a free-market environment, a company's expectations regarding future petroleum prices also influence the level of its inventory held. For example, lower worldwide demand experienced in late 1982 and early 1983 created significant downward price expectations in the spring of 1983; accordingly, companies were lowering their overall inventory levels.

Cost of Storing Product

The higher prices of oil and levels of interest rates since 1978 have made the cost of holding inventory very high. The estimated cost of holding one gallon of gasoline in inventory was about 4¢ per gallon

TABLE 7

TOTAL INVENTORY OF CRUDE OIL AND THE PRINCIPAL PRODUCTS IN THE PRIMARY DISTRIBUTION SYSTEM (Millions of Barrels)

	March 31, 1978*			March 31, 1983		
	PADDs I-IV	PADD V	Total	PADDs I-IV	PADD V	Total
Crude Oil†	279.7	65.7	345.5	258.2	86.1	344.3
Motor Gasoline	235.7	23.9	259.6	197.3	25.8	223.0
Kerosine	11.5	0.4	11.9	8.8	0.3	9.1
Kero-Jet Fuel	19.5	6.7	26.2	28.3	6.4	34.7
Distillate Fuel Oil	126.3	11.5	137.8	107.0	11.1	118.1
Residual Fuel Oil	48.9	13.4	62.4	37.4	8.9	46.3
Total‡	**721.6**	**121.7**	**843.3**	**636.9**	**138.6**	**775.4**
	September 30, 1978*			**September 30, 1982**		
	PADDs I-IV	**PADD V**	**Total**	**PADDs I-IV**	**PADD V**	**Total**
Crude Oil†	265.5	55.7	321.2	258.4	82.3	340.7
Motor Gasoline	191.0	25.5	216.5	205.9	27.7	233.6
Kerosine	15.9	0.3	16.1	9.6	0.2	9.8
Kero-Jet Fuel	22.6	6.8	29.3	27.2	6.2	33.3
Distillate Fuel Oil	209.7	10.9	220.7	151.1	10.1	161.2
Residual Fuel Oil	68.1	13.2	81.3	51.4	10.4	61.8
Total‡	**772.7**	**112.4**	**885.1**	**703.6**	**136.9**	**840.5**

*Data on inventories in 1978 differ from those published in the NPC's 1979 report. They were changed to reflect final EIA data and to make them comparable to 1982-1983 data. Motor gasoline stocks data represent finished motor gasoline and motor gasoline blending components. Aviation gasoline is excluded.

†Excludes SPR and 11 million barrels of lease stocks adjustment in 1983. Alaskan crude oil in transit by water is included in PADD V.

‡Totals may not add due to independent rounding. Totals include crude oil and petroleum products surveyed only.

Source: Data reported to EIA on Forms EIA-810-813 in 1983, Forms EIA-87-90 in 1982, and Forms FEA-P320-P323 in 1978.

per year in 1978; 19¢ per gallon per year in 1981; and 14¢ per gallon per year in 1982. As shown in Table 8, the estimated total annual holding and tankage cost of gasoline has doubled from 1978 through 1982. Thus, firms in the petroleum industry tried to manage their inventories so that no more than the required levels were held.

TABLE 8

ESTIMATED GASOLINE STORAGE COST

	1978	1981	1982
Product Value (¢/gal.)*	42.3	98.9	90.0
Interest Rate (%)†	9.06	18.87	14.86
Holding Cost (¢/gal./yr)	4	19	14
Tankage Cost (¢/gal./yr)‡	6	7	7
Total Storage Cost (¢/gal./yr)	**10**	**26**	**21**

*Data taken from *Platt's Oil Price Handbook and Oilmanac*, 1983.
†Average prime rate for year, as cited in *The Federal Reserve Board Bulletin.*
‡Estimated cost of commercial storage space.

Security of World Crude Oil and Product Supply

Perceived security of world crude oil and product supply is another factor in determining how much inventory is held above minimum operating inventory levels. Today's concerns about short-term security of supply have eased significantly since the 1979 NPC report, principally because the world crude oil supply, which was tight in 1978, is now in oversupply due to increases in non-OPEC production and reduced worldwide petroleum demand. OPEC production of crude oil and natural gas liquids in 1982 was 19.8 million barrels per day, down 35 percent from 1978, while non-OPEC production increased 18 percent, to 22.2 million barrels per day. The dependence of the United States on net petroleum imports (excluding SPR fill) fell from 43 percent in 1978 to 27 percent in 1982. While imports are currently low compared with 1978 levels, many forecasters predict that U.S. import requirements will, over the longer term, increase again.

Strategic Petroleum Reserve. The SPR held 312 million barrels of crude oil as of March 31, 1983. That reserve is held by the U.S. government to reduce major adverse effects on the national economy and, for national emergencies, to provide supplies to help offset future crude oil disruptions. The SPR drawdown and distribution capability is currently 1.7 million barrels per day. Upon completion of Phase II, the SPR will be able to sustain a drawdown and distribution rate of 3.5 million barrels per day. The SPR may be regarded by some as providing security of supply. However, with only one exception, individual refiners responded to the NPC survey that they do not allow for the SPR when determining their individual inventory levels (see Appendix E).

Spare Refining Capacity. Another type of security of product supply is provided by low refinery utilization. A disruption in one refinery's operations can be offset by increased throughput in other refineries. Total refinery runs can be raised fairly rapidly to respond to low industry inventory situations, provided crude oil is available. Low refinery utilization also allows refiners more flexibility to change product yields seasonally. In 1978, refiners had to run refineries at high utilization levels to meet gasoline demand year-round. Beginning in the summer of 1978, distillate inventory had to be built up to ensure adequate winter supplies. Because of the decline in demand and the reduced seasonality of gasoline and distillate fuel oil, refiners have a greater ability to adjust crude oil runs and shift yields to meet seasonal demands, rather than having to hold high product inventories. The results of the 1983 NPC survey indicate, however,

that current inventory levels are not greatly influenced by spare refining capacity. (See Appendix I for a historical perspective on refining capacity utilization.)

Petroleum Futures Markets. Petroleum futures (as traded on the New York Mercantile Exchange, the Chicago Board of Trade, and the London International Petroleum Exchange) may be perceived by some companies as a way to reduce inventory and ensure supplies. The results of the 1983 NPC survey of the primary distribution system suggest that, at present, petroleum futures do not significantly affect the level of inventories held in the primary system (see Appendix E). However, a concern exists that, in the event of a supply shortage, some companies may rely on the futures markets for delivery of "wet barrels" (the physical commodity), only to find that the "wet barrels" may not be available. Most participants in the market fulfill their contractual obligations to buy or sell through an opposite, offsetting transaction, rather than by delivering or taking delivery of "wet barrels." Thus, the buying company may have financial security, but no guaranteed delivery of the needed crude oil or products at the specified time.

Naphtha-Type Jet Fuel. The stock level of naphtha-type jet fuel understates the potential availability of that fuel. In the 1983 NPC survey, data were requested regarding normally dedicated stocks in storage on March 31, 1983, and stocks that could have been dedicated immediately with little or no processing other than mechanical blending. Industry reported that 6.8 million barrels of naphtha-type jet fuel were held. Additionally, 6.8 million barrels of unfinished oils, blending components, special naphthas, and naphtha of less than 400°F end-point could have been dedicated immediately to the production of naphtha-type jet fuel, thereby doubling the available stocks (see Appendix E). Given a fixed amount of crude oil, however, this increase in the production of jet fuel would reduce the production of gasoline, kerosine/kero-jet fuel, and other products.

Maximum Operating Inventory in the Primary Distribution System

The maximum operating inventory is the maximum quantity that could be stored in a defined distribution system while still maintaining a workable operating system.

The NPC recognizes that the limits of the industry-wide maximum operating inventories have not been tested in the same sense as have the minimum operating inventories. Therefore, the NPC does not believe that it can estimate valid limits for maximum operating inventories on an industry-wide basis. Further, the NPC is concerned that a quantification of the maximum limits would imply the same degree of confidence as is inherent in the estimation of the minimum limits.

The survey results of the sum of the individual company maximum operating inventory levels and the industry-wide estimates are shown in Appendix E. The NPC urges caution in the interpretation of these data. Consideration of these data should take into account facility location and access to transportation networks, refining centers, and markets, which affect the upper limits of petroleum industry operations.

Total Storage Capacity in the Primary Distribution System

The total capacity of tankage in operation and tankage under construction in 1978 and 1983 are shown in Table 9. The grand total for both categories of storage capacity for crude oil and the products surveyed has declined by about 1 percent since the previous report. However, tankage for crude oil has increased by 8 percent during that same period. The closing of a number of refineries since that time decreased crude oil tankage. But that decrease was more than offset by the activation of the Louisiana Offshore Oil Port and other refining and storage facilities. In addition, concerns for security of supply during the early part of this period may have prompted companies to construct crude oil tankage or to convert product tankage into crude oil tankage.

Tankage for motor gasoline and kerosine remained fairly constant from 1978 to 1983. Tankage for distillate and residual fuel oils declined significantly over the 1978-1983 period, due primarily to decreased consumption and seasonality of demand.

The total tankage on March 31, 1983, was less than that on September 30, 1978, for three primary reasons: the reduction in crude oil and product demand, causing refinery and terminal shutdowns and tankage consolidation; the deletion from service of tankage that was not retrofitted to meet environmental regulations; and the physical deterioration of tankage. To bring some of that tankage back into service, environmental regulations would have to be waived or tankage systems would have to be updated.

TABLE 9

SHELL CAPACITY OF TANKAGE IN OPERATION AND TANKAGE UNDER CONSTRUCTION IN THE PRIMARY DISTRIBUTION SYSTEM (Millions of Barrels)

	March 31, 1978		March 31, 1983	
	Tankage in Operation	Tankage Under Construction*	Tankage in Operation	Tankage Under Construction
Crude Oil†	462*	12	499	10
Motor Gasoline	464	5	456	3
Kerosine	86	1	21	1
Kero-Jet Fuel			68	‡
Distillate Fuel Oil	336	3	295	1
Residual Fuel Oil	156	1	143	4
Total§	**1,504**	**22**	**1,482**	**19**

*Data for September 30, 1978.

†Excludes SPR. Also excludes all lease stocks tankage in 1978 and a portion of the lease stocks tankage in 1983. Reported lease stocks inventory volumes were 12 million barrels in 1983 and 10 million barrels in 1978.

‡Less than 0.5 million barrels.

§Totals include tankage for crude oil and petroleum products surveyed only.

Tankage idle but available within 90 days' notice is shown in Table 10. This tankage, the tankage in operation, and tankage under construction together provide an estimate of the total tankage available to the system.

TABLE 10

POTENTIALLY AVAILABLE TANKAGE IN THE PRIMARY DISTRIBUTION SYSTEM AS OF MARCH 31, 1983, THAT IS IDLE BUT CAN BE REACTIVATED WITHIN 90 DAYS (Millions of Barrels)

	Meets Environmental Regulations	Requires Environmental Waivers
Crude Oil	13	3
Motor Gasoline	7	‡
Kerosine	1	‡
Kero-Jet Fuel	3	‡
Distillate Fuel Oil	17	1
Residual Fuel Oil	12	1
Total*	**53**	**6**

*Totals include tankage for crude oil and petroleum products surveyed only. Totals may not add due to independent rounding.

‡Less than 0.5 million barrels.

Although the idle tankage can be restored to service, much of it is dispersed in relatively small volumes across the nation. Therefore, relying on any substantial part of this tankage for emergency preparedness planning is not practical.

Table 11 compares the percentage utilization of tank capacity over the 35-year history of the NPC inventory reports. Inventory in tankage has averaged about 46 percent of storage capacity over the period. During the operating cycle, tanks do fluctuate between the minimum and maximum operating levels. However, the average has varied little.

TABLE 11

PERCENTAGE UTILIZATION OF TANK CAPACITY IN THE PRIMARY DISTRIBUTION SYSTEM, 1948-1983

NPC Survey Date	Inventory as a Percentage of Tank Capacity
March 31, 1948	42
June 30, 1950	45
March 31, 1952	45
March 31, 1954	48
March 31, 1957	45
September 30, 1962	50
September 30, 1969	53
September 30, 1973	48
September 30, 1978	48
March 31, 1983	40

The 8 percent decrease in tank utilization from 1978 to 1983 may reflect the impact of declining demand for petroleum, increased spare refining capacity, and higher costs of holding inventories. Some of the storage capacity reported in the 1983 survey will likely be deactivated, which will tend to return the utilization figure closer to the 46 percent historical average.

Secondary Distribution System and Tertiary Storage Segment Analyses

This report represents a much more accurate estimate of the magnitude of storage capacity and inventory in the secondary distribution system and tertiary storage segment than was possible in the 1979 study. However, the NPC has more confidence in the storage capacity estimates than in those of inventory, and considers estimates by sector more reliable than those by region.

In addition, the data resulting from this study define the inventories and storage capacities as of a specific date—March 31, 1983. The inventories doubtlessly have changed and will continue to do so as the system reacts to variations in supply, prices, and other economic factors.

Secondary Distribution System Analysis

Petroleum products generally flow from the primary system to the secondary system. Figure 2 in Chapter One presents a simplified diagram of the product flow.

The secondary system is composed of bulk plants and retail motor fuel outlets such as gasoline service stations, convenience stores, and truck stops. The products considered in this discussion of the secondary distribution system are the same as those examined in the primary system. (Crude oil is neither stored nor handled in the secondary distribution system.) The methodologies employed to determine storage capacity and inventories are found in Appendix K.

Bulk Plants

A large part of the storage capacity and inventory in the secondary distribution system is contained in bulk plants, which, in the United States, are operated by approximately 18,000 companies. These facilities may be owned and operated by either refiner/marketers or independent jobbers/distributors. Many bulk plant operators also own and operate service stations. Based on the results of the NPC analysis of the survey results, it is estimated that, on March 31, 1983, storage capacity of bulk plants totaled 69 million barrels while inventories were 20 million barrels. Estimated storage capacity and inventory at bulk plants are shown in Table 12.

TABLE 12

ESTIMATED STORAGE CAPACITY AND INVENTORY AT BULK PLANTS AS OF MARCH 31, 1983 (Millions of Barrels)

	Capacity	Inventory
Motor Gasoline	22	9
Kerosine	4	1
Diesel/Distillate Fuel Oil	37	8
Residual Fuel Oil	6	2
Total*	**69**	**20**

*Totals include surveyed petroleum products only.

Much of the product that moves from the primary system into retail outlets and the tertiary segment does so after first being moved into storage at bulk plants. The volume of product being handled in this manner will vary, according to seasonal demand patterns, geographic area, and product. For example, distillate fuel oil for residential heating is generally moved by truck transport from primary storage into bulk plants, allowing the bulk plant operator to deliver smaller quantities to the consumer. Generally, more distillate fuel oil will be held in bulk plants immediately preceding and during the heating season. Considerations such as inventory carrying costs, perceptions of the security of supply, and price expectations will influence the operations of bulk plants. Many owners of bulk plants also own retail outlets and, after weighing these considerations, have the option of transferring product from the primary system into either type of facility.

The results of the petroleum futures section of the NPC 1983 Survey of Storage Capacity and Inventory in the Secondary Distribution System reinforce the findings of the primary system survey that futures markets do not affect inventory levels. Of the companies that responded to the survey, only 18 have traded on one of the futures markets. Price hedging was the principal reason cited for trading, with potential profits through speculation second, and additional flexibility ranked only third.

Retail Outlets

For motor fuel, there were approximately 210,000 outlets in the United States on March 31, 1983, with an average storage capacity of 16,800 gallons (400 barrels). Accordingly, these outlets have a calculated combined storage capacity of 84 million barrels. On average, storage tanks at service stations are believed to be about one-third full. Therefore, for the March 31, 1983, study date, motor fuel inventories at retail outlets are estimated to be 28 million barrels.

Petroleum products other than motor gasoline are now stored and sold at some retail outlets. Diesel fuel and kerosine are two such products. Diesel fuel capacity at these outlets is approximately 6 percent of the total storage. The amount of storage dedicated to kerosine at these outlets is not significant. Estimated storage capacity and inventory at retail motor fuel outlets are shown in Table 13.

TABLE 13

ESTIMATED STORAGE CAPACITY AND INVENTORY AT RETAIL MOTOR FUEL OUTLETS AS OF MARCH 31, 1983 (Millions of Barrels)

	Capacity			Inventory		
	PADDs I-IV	PADD V	Total	PADDs I-IV	PADD V	Total
Motor Gasoline	66	13	79	22	4	26
Diesel Fuel	4	1	5	1	‡	2
Total*	**70**	**14**	**84**	**23**	**5**	**28**

*Totals include surveyed petroleum products only. Totals may not add due to independent rounding.
‡Less than 0.5 million barrels.

Tertiary Storage Segment Analysis

The tertiary segment of the petroleum distribution system is composed of the storage and inventory held by the end-users of petroleum products (see Figures 2 and 3). The products considered in this discussion are the same as those considered in the primary distribution system.

The tertiary segment is composed of several different sectors, each of which is discussed below. Wherever possible, a discussion of recent trends in each sector is included. In most cases it was not possible to distinguish between storage for kerosine and that for diesel/distillate fuel oil. The data for these products are therefore presented in aggregate. In addition, data for storage and inventory are divided between PADDs I-IV and PADD V, wherever possible. It should be noted that the breakdown among products is generally less accurate than the aggregate data, and that there is less confidence in the precision of the estimates of the regional segregations than in the U.S. totals.

Table 14 summarizes the findings of the tertiary analysis. The individual methodologies used to derive these data are discussed below and in more detail in Appendix L.

Agricultural Sector

Definition. The agricultural sector includes all farms, ranches, and similar entities in the United States. Petroleum storage for this sector includes motor gasoline and diesel fuel used in vehicles and equipment. Distillate fuel oil for residential heating on farms is included in the residential sector analysis.

Description and Trends. Over the long term, there has been a trend toward fewer, though higher acreage, farms. Between 1978 and 1982, however, the number of farms and the total acreage devoted to agriculture have remained fairly constant. Between 1978 and 1982, the number of farms remained approximately 2.4 million; the average farm size was about 430 acres.

Larger farms have lower petroleum storage capacity per acre than smaller farms. Therefore, the long-term trend toward fewer and larger farms would suggest a reduction in storage. However, because of the 1973 and 1979 supply disruptions, this trend has flattened and farmers have increased their storage. Consequently, storage capacity has not changed significantly since 1978.

Agricultural demand tends to be lower in the winter season and higher during planting and harvesting seasons. Agricultural inventories reflect this cycle.

Storage capacity and inventories in the agricultural sector are shown in Table 15.

Commercial Sector

Definition. The commercial sector includes the storage capacity and inventory necessary for the heating requirements of commercial establishments such as office buildings, nursing homes, banks, shopping centers,

TABLE 14

ESTIMATED STORAGE CAPACITY AND INVENTORY IN THE TERTIARY STORAGE SEGMENT AS OF MARCH 31, 1983 (Millions of Barrels)

	Capacity	Inventory
Sector		
Agricultural	41	14
Commercial	37	8
Electric Utilities	213	91
Industrial	61	17
Military/Government	56	23
Residential	100	55
Transportation*	134*	61*
Total†	**642**	**269**
Product		
Motor Gasoline	103	42
Kerosine, Diesel, and Distillate Fuel Oil	282	131
Kero-Jet Fuel	21	11
Residual Fuel Oil	237	86
Total†‡	**642**	**269**

*Includes on-board and fixed storage capacity and inventory for cars, trucks, buses, railroads, and aviation, but excludes payload storage (i.e., storage capacity and inventory for product transported, not that used to power transportation vehicle) of railroads, tank trucks, and marine vessels.

†Totals may not add due to independent rounding.

‡Totals include surveyed petroleum products only.

TABLE 15

AGRICULTURAL SECTOR ESTIMATED STORAGE CAPACITY AND INVENTORY AS OF MARCH 31, 1983 (Millions of Barrels)

	Capacity	Inventory
Motor Gasoline	19	7
Diesel/Distillate Fuel Oil	22	8
Total*	**41**	**14**

*Totals may not add due to independent rounding.

Source: NPC estimate. (See Appendix L for methodology.)

real estate offices, car dealerships, and apartment complexes with more than four units. It excludes commercial transportation (see the Transportation Sector section), residential heating (see the Residential Sector section), industrial manufacturing facilities (see the Industrial Sector section), and public schools (see the Military/Government Sector section).

Description and Trends. The commercial sector storage capacity is estimated to be 37 million barrels. In the commercial sector, many divergent trends have occurred between 1978 and 1983, such as the 6.4 percent real increase in gross national product (GNP), the increase in the number of large shopping centers, and the trend away from oil heating. However, it is estimated that tankage capacity and oil inventory exhibited no significant change over this period.

Storage capacity and inventories in the commercial sector are shown in Table 16.

TABLE 16

COMMERCIAL SECTOR
ESTIMATED STORAGE CAPACITY AND INVENTORY
AS OF MARCH 31, 1983
(Millions of Barrels)

	Capacity	Inventory
Kerosine	1	‡
Distillate Fuel Oil	21	5
Residual Fuel Oil	15	3
Total	**37**	**8**

‡Less than 0.5 million barrels.

Source: NPC estimate. (See Appendix L for methodology.)

Electric Utility Sector

Definition. The electric utility sector includes storage capacity and inventory of distillates and residual fuel oil at electric utility plants.

Description and Trends. Fuel switching in the electric utility sector has reduced the sector's oil demand by 60 percent from 1978 to 1982, but oil inventories at electric utilities have not dropped over that time. Many utilities have continued to maintain large inventories as a supplement to their prime fuel supplies or to meet peak electricity demand requirements. Accordingly, it is believed that the storage capacity has remained essentially the same since 1978 because very little tankage has been taken out of service.

Storage capacity and inventories in the electric utility sector are shown in Table 17.

Industrial Sector

Definition. The industrial sector is composed of plants and factories, but excludes retail and service enterprises (see Commercial Sector section). For this study's purposes, petroleum refineries and electric utilities are not included in the industrial sector since fuel for refinery use is part of the primary system and utilities are reported in the Electric Utility Sector section.

Description and Trends. Industry maintains storage and inventory of petroleum products primarily for space or process heating, to power machinery, and, in some cases, most notably in the chemical industry, to provide raw material for manufacturing processes. The products covered in this study (motor gasoline, kerosine, distillate fuel oil, and residual fuel oil) account for approximately 20 percent of total industrial petroleum derived energy usage on a BTU basis. The remaining 80 percent includes such non-fuel products as petrochemical feedstocks, liquified petroleum gas, asphalt, and lubricating oils.

TABLE 17

ELECTRIC UTILITY SECTOR
ESTIMATED STORAGE CAPACITY AND INVENTORY
AS OF MARCH 31, 1983
(Millions of Barrels)

	Capacity	Inventory
Distillate Fuel Oil	36	22
Residual Fuel Oil	177	70
Total*	**213**	**91**

*Totals may not add due to independent rounding.

Source: NPC estimate. (See Appendix L for methodology.)

Of the products in this study, kerosine and distillate and residual fuel oils account for about 99 percent of the industrial sector's storage capacity and inventory. Small amounts of motor gasoline are also held for such purposes as fueling small machinery or generators.

The petrochemical industry uses as feedstocks some liquid hydrocarbons that may also be used as blending components for finished products (for example, naphtha may be used as a feedstock or as a gasoline blending component). The storage capacity and inventory of these feedstocks are outside the scope of this study; only finished products used for fuel by industry are considered. It should be pointed out, however, that an increase in demand for these feedstocks will reduce the blending components available for finished fuel products.

In the industrial sector, there is a great deal of storage capacity relative to demand. Industrial petroleum demand declined from 1978 to 1982. While some of this decrease stems from plant closings in energy-intensive industries (which removes some tankage from service), much is the result of intensive conservation efforts and fuel switching. However, additional tankage was installed during this period as a result of concern over security of supply. Due to these offsetting factors, it is believed that storage capacity has not changed significantly since 1978.

In the short run, inventories exhibit a close relationship to demand. Reduced petroleum demand in the industrial sector, together with the perception of the relative security of petroleum supply, supports the belief that stocks are lower than in 1978.

Storage capacity and inventories in the industrial sector are shown in Table 18.

Military/Government Sector

Definition. The military/government sector includes federal, state, and local governments and all branches of the U.S. military located in the United States.

Description and Trends. Of the 56 million barrels of storage capacity in this sector, 39 million barrels are held by the U.S. military. The reported capacity includes storage held by both the Defense Fuel Supply Center and the armed forces. The trend in U.S. military storage represents a reduction of about 5 percent, or 2 million barrels between 1978 and 1983. Mainly, this reduction reflects the closing of some military installations.

Of the remaining military/government storage, 12 million barrels represent local government capacity for heating schools and municipal buildings and for fueling police cars and other municipal cars and trucks. State and federal government storage capacity is 4 million barrels for heating and 2 million barrels, for transportation. Based on the 1983 analysis, there appears to have been no significant change in storage capacity during the last five years.

Storage capacity and inventories in the military/government sector are shown in Table 19.

TABLE 18

INDUSTRIAL SECTOR
ESTIMATED STORAGE CAPACITY AND INVENTORY
AS OF MARCH 31, 1983
(Millions of Barrels)

	Capacity	Inventory
Motor Gasoline	‡	‡
Distillate Fuel Oil/Kerosine	30	9
Residual Fuel Oil	31	8
Total	**61**	**17**

‡Less than 0.5 million barrels.

Source: NPC estimate. (See Appendix L for methodology.)

TABLE 19

MILITARY/GOVERNMENT SECTOR
ESTIMATED STORAGE CAPACITY AND INVENTORY
AS OF MARCH 31, 1983
(Millions of Barrels)

	Military*	Government†	Total§
Capacity			
Motor Gasoline	1	6	8
Kero-Jet Fuel	10	‡	11
Distillate Fuel Oil	24	4	29
Residual Fuel Oil	3	7	9
Total§	**39**	**18**	**56**
Inventory			
Motor Gasoline	1	3	4
Kero-Jet Fuel	5	‡	5
Distillate Fuel Oil	9	2	10
Residual Fuel Oil	1	2	3
Total§	**16**	**7**	**23**

*Actual March 31, 1983, data from Defense Fuel Supply Center. (See Appendix L for methodology.)

†NPC estimate. (See Appendix L for methodology.)

‡Less than 0.5 million barrels.

§Totals may not add due to independent rounding.

Residential Sector

Definition. Storage for residential heating fuel includes tankage for single family homes (including farmhouses) and multifamily dwellings of up to four units. Storage for large apartment buildings is part of the commercial sector.

Description and Trends. Total residential fuel consumption has declined between 1978 and 1982. Several factors have contributed to this reduction in demand. Conservation by consumers and conversion from oil to gas or other energy sources are the most significant factors. More efficient burners, added insulation, lowered thermostat settings, and supplementary heat sources such as wood stoves and nonvented kerosine heaters have all contributed to reduced distillate fuel oil consumption.

As of March 31, 1983, an estimated 15.4 million household units were heated with oil, about 2 million of which use oil heat as a supplement to other systems.[3]

It is estimated that there are approximately 12 million fuel storage tanks in the residential sector. The apparent inconsistency with the estimate of 15.4 million household units being heated with oil is due to the fact that small multifamily units are included in the residential sector. Many of these units share a single fuel oil tank. Fuel storage tanks in use range from 55-gallon drums to 2,000-gallon tanks, with most tanks in the 250- to 800-gallon range. As of March 31, 1983, the average was 360 gallons per tank. This average compares to the 1979 NPC estimated average of about 390 gallons.

Storage capacity and inventories in the residential sector are shown in Table 20.

TABLE 20

RESIDENTIAL SECTOR
ESTIMATED STORAGE CAPACITY AND INVENTORY
AS OF MARCH 31, 1983
(Millions of Barrels)

	Capacity	Inventory
Distillate Fuel Oil	100	55

Source: NPC estimate. (See Appendix L for methodology.)

Transportation Sector

Definition. The transportation sector includes fixed storage for railroad, bus, truck, aviation, marine, and taxicab fleets, as well as on-board storage for the fuel consumed in these vehicles and private automobiles. For this study, the payload storage capacity of vehicles that transport petroleum, such as tank trucks, tank cars, and barges, is excluded because these are transportation media and do not constitute storage for end use by the transportation sector.

Description and Trends. Each element of the transportation sector is sensitive to overall economic conditions. In common with most tertiary storage sectors, the transportation sector has tended to increase its fixed storage due to the supply uncertainties over the last decade. While concern over security of supply has eased, this tank capacity has not been taken out of service.

Table 21 summarizes storage capacity and inventories for each part of the transportation sector. On-board storage in cars and trucks, which was estimated to be 77 million barrels in the 1979 NPC study, increased to 90 million barrels in 1983. The increase is primarily the result of an increase in the total number of vehicles, particularly medium trucks.

[3]Energy Information Administration, "Energy Consumption Survey: Consumption and Expenditures, April 1980-March 1981. Part 2: Regional Data," June 1983.

TABLE 21

TRANSPORTATION SECTOR
ESTIMATED STORAGE CAPACITY AND INVENTORY
AS OF MARCH 31, 1983
(Millions of Barrels)

	Capacity	Inventory
Subsector		
Railroad	12	7
Aviation	10	6
Marine	11	5
Marine Pleasure Craft	6	2
Motor Vehicle Fleet*	96	42
Total†	**134**	**61**
Product		
Gasoline	75	30
Kerosine and Diesel	44	23
Kero-Jet	10	6
Residual Fuel Oil	5	2
Total†	**134**	**61**

*Includes fixed and on-board storage for buses, private vehicles, taxicabs, and trucks.

†Totals may not add due to independent rounding.

Appendices

Appendix A:

Study Request Letter and Description and Membership of the National Petroleum Council

THE SECRETARY OF ENERGY
WASHINGTON, D.C. 20585

November 3, 1982

Mr. John F. Bookout
Chairman
National Petroleum Council
1625 K Street, N.W.
Washington, D. C. 20006

Dear Mr. Bookout:

The National Petroleum Council (NPC) is currently working on two important studies at my request. The first concerns Third World Petroleum Development and the second is an update of the Council's 1976 study on Enhanced Oil Recovery. I would also like the Council's advice on several aspects of the nation's petroleum inventory and storage system.

In 1979, the NPC conducted a study of inventories and storage capacities. The principal objectives of that study were to analyze current inventories, estimate minimum operating inventory levels, and determine the total storage capacity of the primary petroleum distribution system. Since the report was based on 1978 data and since the United States (U.S.) petroleum situation has significantly changed in the past few years, an update of that report is deemed necessary at this time.

I, therefore, request the NPC to undertake a comprehensive study that will update the 1979 report. In particular, your new study should update the analysis of the minimum operating levels for crude oil, motor gasoline, distillate fuel oil, and residual oil, as well as update the estimates of total storage capacity and the quantity of crude oil and refined products available for use. Other aspects of the overall U.S. petroleum inventory and storage system should be discussed as appropriate.

For the purposes of this study, I will designate J. Erich Evered, Administrator, Energy Information Administration, to represent me and to provide the necessary coordination between the Department of Energy and the National Petroleum Council.

Sincerely,

James B. Edwards

James B. Edwards

Background Information on the National Petroleum Council

In May 1946, the President stated in a letter to the Secretary of the Interior that he had been impressed by the contribution made through government/industry cooperation to the success of the World War II petroleum program. He felt that it would be beneficial if this close relationship were to be continued and suggested that the Secretary of the Interior establish an industry organization to advise the Secretary on oil and natural gas matters.

Pursuant to this request, Interior Secretary J. A. Krug established the National Petroleum Council on June 18, 1946. In October 1977, the Department of Energy was established and the Council's functions were transferred to the new department.

The purpose of the NPC is solely to advise, inform, and make recommendations to the Secretary of Energy on any matter, requested by him, relating to petroleum or the petroleum industry. Matters which the Secretary of Energy would like to have considered by the Council are submitted as a request in the form of a letter outlining the nature and scope of the study. The request is then referred to the NPC Agenda Committee, which makes a recommendation to the Council. The Council reserves the right to decide whether or not it will consider any matter referred to it.

Examples of recent major studies undertaken by the NPC at the request of the Department of the Interior and the Department of Energy include:

- *U.S. Energy Outlook* (1971, 1972)
- *Potential for Energy Conservation in the United States: 1974-1978* (1974)
- *Potential for Energy Conservation in the United States: 1978-1985* (1975)
- *Ocean Petroleum Resources* (1975)
- *Petroleum Storage for National Security* (1975)
- *Materials and Manpower Requirements* (1974, 1979)
- *Petroleum Storage & Transportation Capacities* (1974, 1979)
- *Refinery Flexibility* (1979, 1980)
- *Unconventional Gas Sources* (1980)
- *Emergency Preparedness for Interruption of Petroleum Imports into the United States* (1981)
- *U.S. Arctic Oil & Gas* (1981)
- *Environmental Conservation—The Oil and Gas Industries* (1982)
- *Third World Petroleum Development: A Statement of Principles* (1982)
- *Enhanced Oil Recovery* (1976, 1984)

The NPC does not concern itself with trade practices, nor does it engage in any of the usual trade association activities. The Council is subject to the provisions of the Federal Advisory Committee Act of 1972.

Members of the National Petroleum Council are appointed by the Secretary of Energy and represent all segments of petroleum interests. The NPC is headed by a Chairman and a Vice Chairman, who are elected by the Council. The Council is supported entirely by voluntary contributions from its members.

National Petroleum Council
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1984

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Riverside, Connecticut

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ZAH, Peterson, Chairman
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ZARROW, Henry, President
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Delta Drilling Company

Appendix B:
Committee and Subgroup Rosters

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Petroleum Inventories and Storage Capacity

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Industries, Inc.

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Energy Analyst
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Petroleum Inventories and Storage Capacity

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Tesoro Petroleum Corporation

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Chief Executive Officer
The Standard Oil Company (Ohio)

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Coordinating Subcommittee
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Committee on
Petroleum Inventories and Storage Capacity

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Office of Oil and Gas
Energy Information Administration
U.S. Department of Energy

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Corporate Regulatory Analysis
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Joan Walsh Cassedy
Consultant
National Petroleum Council

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76 Division
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Roger A. Compton, Coordinator
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Donald M. Crann, Manager
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Farmland Industries, Inc.

Edward N. Krapels
Research Associate
Johns Hopkins School of
Advanced International Studies

John G. McDonald
Senior Vice President
Petroleum Products & Refining
The Standard Oil Company (Ohio)

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Strategic Planning
Supply Department
Standard Oil Company (Indiana)

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Vice President—Operations
Colonial Pipeline Company

D. M. Prenowitz
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Shell Oil Company

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Supply and Distribution
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R. N. Yammie
Vice President
Supply and Transportation
Marathon Petroleum Company

Karl Zentner
Senior Coordinator
Arco Petroleum Products Company

Coordinating Subcommittee

Special Assistants

James M. Diehl, Chief
Data Quality Section
Petroleum Supply Division
Energy Information Administration
U.S. Department of Energy

Nancy J. Kirkendall
Office of Statistical Standards
Energy Information Administration
U.S. Department of Energy

David L. McColloch
Office of Energy Emergencies
U.S. Department of Energy

George R. Naniche
Economics Department
The Standard Oil Company
of California

National Petroleum Council
Secondary and Tertiary Storage Task Group
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Committee on
Petroleum Inventories and Storage Capacity

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Supply and Transportation
Marathon Petroleum Company

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Data Quality Section
Data Analysis and Support Branch
Petroleum Supply Division
Energy Information Administration
U.S. Department of Energy

Assistant to the Chairman
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Financial Analyst
Corporate Funds Division
Marathon Oil Company

Secretary
Benjamin A. Oliver, Jr.
Assistant Committee Coordinator
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Vice President
Weber Oil Company

Secondary and Tertiary Storage Task Group

Special Assistants

James A. Aleveras
Coordinator, Operations Planning
Marketing Department
Chevron U.S.A. Inc.

Gary Arthur
Assistant to the Vice President
Supply and Distribution
Ashland Oil, Inc.

Appendix C:
Primary System Survey Methodology

Objective

The National Petroleum Council's 1983 Survey of Petroleum Inventories and Storage Capacities in the United States was designed to determine:

- How much of the U.S. petroleum inventory is required for normal operation of the primary petroleum distribution system and is therefore not available for delivery to consumers
- The total primary storage capacity and tankage utilization
- The impact of the following factors on primary inventories: spare refining capacity, the Strategic Petroleum Reserve, and the petroleum futures markets.

Scope of the Survey

To be consistent with inventory information provided monthly to the Energy Information Administration (EIA), the nine questionnaires in the survey conform with EIA product definitions, with the exception of that for motor gasoline (see product definitions in Appendix M).

Data for crude oil and certain refined products (motor gasoline, kerosine, kerosine-type jet fuel, distillate fuel oil, and residual fuel oil) were requested, with some data also solicited for naphtha-type jet fuel.

To better define the seasonal change in inventories and to reflect seasonal shifts in tank utilization, two reporting dates, September 30, 1982, and March 31, 1983, were chosen for the refined products. Only one reporting date was selected for crude oil and naphtha-type jet fuel, because of their relative lack of seasonality.

The survey covered the 50 states and the District of Columbia, but excluded all U.S. territories, possessions, and the Hawaiian Foreign Trade Zone.

Descriptions of Questionnaires

The inventory information was requested by Petroleum Administration for Defense Districts (PADDs), with PADD I subdivided into three parts: New England (IA), Central Atlantic (IB), and Lower Atlantic (IC) states. The estimates of the respondents' minimum and maximum operating inventories and related questions were requested by broad geographic region, i.e., PADDs I-IV aggregated and PADD V.

Questionnaires 1-6 are similar to those utilized in the 1979 NPC survey except:

- Bureau of Mines refinery district detail was eliminated.
- Aviation gasoline was eliminated from the gasoline category because its volume was considered insignificant, while kerosine and kerosine-type jet fuel data were collected separately.

- Detailed information was requested on idle tankage.
- Information on the impact of spare refining capacity on stocks was collected.
- Data on Alaskan crude oil in transit by water were requested as a separate item.
- Data on lease stocks were collected.

On Questionnaires 1-6 respondents were requested to:

- Submit inventory information on crude oil and the refined products [including detailed information on unavailable inventories both in tankage (e.g., tank bottoms) and outside of tankage (e.g., pipeline fill)]
- Estimate their minimum and maximum operating inventories
- Provide data on:
  - — Active shell capacity of tankage in operation
  - — Shell capacity of idle tankage that would be available for service within 90 days following little or no maintenance work and within existing environmental constraints
  - — Shell capacity of idle tankage that would require environmental waiver or modification to be available for service within 90 days
- Report tankage under construction
- Estimate the impact of spare refining capacity on stocks
- State the amount by which their inventories exceeded their estimated minimum operating inventories and what portion of that amount was seasonal inventory, inventory held in anticipation of planned maintenance, and normal operating inventory.

Questionnaire 7 requested respondents who analyze industry inventory levels to provide estimates of minimum and maximum operating inventories for crude oil and the surveyed refined products for PADDs I-IV, PADD V, and the total United States.

Part I of Questionnaire 8 collected selected information on naphtha-type jet fuel because of its strategic nature. This questionnaire solicited inventory information previously reported to EIA as well as information regarding the industry's ability to make additional naphtha-type jet fuel available for immediate use. Part II of this questionnaire asked if the existence of the Strategic Petroleum Reserve has contributed to a decrease in the respondent's inventory holding practices.

Questionnaire 9 collected information regarding the respondents' participation in the petroleum futures markets in an attempt to determine if the use of these markets has affected industry inventory holding practices.

Questionnaires 8 and 9 were not part of the 1979 NPC survey.

Respondents to the Survey

The survey was sent to refiners, bulk terminal operators, product pipeline operators, and holders of crude oil stocks that were required to file EIA Forms 810, 811, 812, and 813 as of March 1983 or the counterpart forms that were in place in September 1982. On January 1, 1983, the EIA increased its list of operators required to complete the monthly surveys, adding 150 bulk terminal operators, 15 pipeline operators, and 30 holders of crude oil stocks, thereby increasing the potential reporting population for the NPC survey between the September 30, 1982, and March 31, 1983, dates. Although EIA receives data from each unit of a company, the NPC collected information on a company-wide basis, requesting that each company consolidate into a single report all of the data that its units reported separately to EIA.

Distribution and Receipt of Questionnaires

The questionnaires were mailed by the NPC on June 7, 1983. The independent public accounting firm of Price Waterhouse was contracted by the NPC to receive and tabulate the survey responses. Price Waterhouse tabulated all responses received through August 30, 1983, and transmitted the aggregated

results to the NPC on September 13, 1983. In keeping with its contract with the NPC, Price Waterhouse did not release any individual company data to the NPC, the Department of Energy, or any other organization.

Validation of Individual Company Responses

A series of edit checks was employed to ensure that appropriate questionnaire line items were completed, questionnaire arithmetical integrity was maintained, and questionnaire responses were reasonable.

If any of the responding companies' data failed the edit checks, Price Waterhouse contacted the company to discuss the data and made changes where appropriate. In situations in which responses to questionnaires were incomplete or obviously incorrect and the respondent failed to provide Price Waterhouse with the appropriate information, the questionnaire response was not included in the results of the survey. In addition, data previously submitted to the EIA by the NPC respondents that correspond to Line 1 of Questionnaires 1-6 and Section 1, Part A, Column 1 of Questionnaire 8 were provided by the EIA to Price Waterhouse via the NPC, with the permission of the companies concerned, in order to serve as a check of the reasonableness of the inventory data submitted on the survey.

Results of the Survey

Of the 505 companies on the Department of Energy mailing list, 461 companies to which it was applicable received the NPC survey, of which 250, or 54 percent, responded to one or more of the questionnaires. Of the 250 responses, 23 were not usable. The 54 percent response rate is comparable to the 55 percent response to the 1979 NPC survey.

Of greater significance, however, is the coverage when computed on a volumetric basis, as displayed in Table C-1. As shown in Table C-1, the response coverage by category for March 31, 1983, ranged from a high of 93 percent for crude oil to a low of 58 percent for residual fuel oil. These 1983 survey responses are less than those received from the 1979 NPC survey, as shown in Figure C-1.

The Council evaluated these levels of response to determine whether they were adequate for use in formulating conclusions based upon the survey results. The Council concluded that the coverage was sufficiently high to permit analysis of the results as reasonably representative of the manner in which inventory and tank capacity is managed by the primary distribution system. Therefore, responses to the NPC for key inventory and tankage items were adjusted upward by dividing by the volumetric percentage coverage, so that the individual line items were representative of the EIA universe. For example, the sum of the motor gasoline responses for the individual company minimum operating inventory as of March 31, 1983, was 154,126 thousand barrels. To adjust to the universe, one divides 154,126 thousand by 85.1 percent, which yields 181,121 thousand barrels. For crude oil, however, certain modifications to EIA data on crude oil lease stocks and Alaskan crude oil in transit by water were made prior to the adjustment in order to ensure a consistency with Line Item 1 on Questionnaires 1-6.

Procedures Used in Analyzing the Survey Data

The NPC estimates of minimum operating inventory, discussed in Chapter Two, were developed through a decision-making process. In order to arrive at a consensus, individual judgments were discussed with the aid of operating experience and relevant statistical data. The statistical data used are: (1) the sum of the individual company minimum operating inventories as reported in the 1983 NPC survey; (2) the industry-wide estimates of minimum operating inventory levels as reported in the 1983 NPC survey;[1] and (3) historical inventory data. The NPC survey data are reported in Appendix E; the historical inventory data are shown in Appendix I.

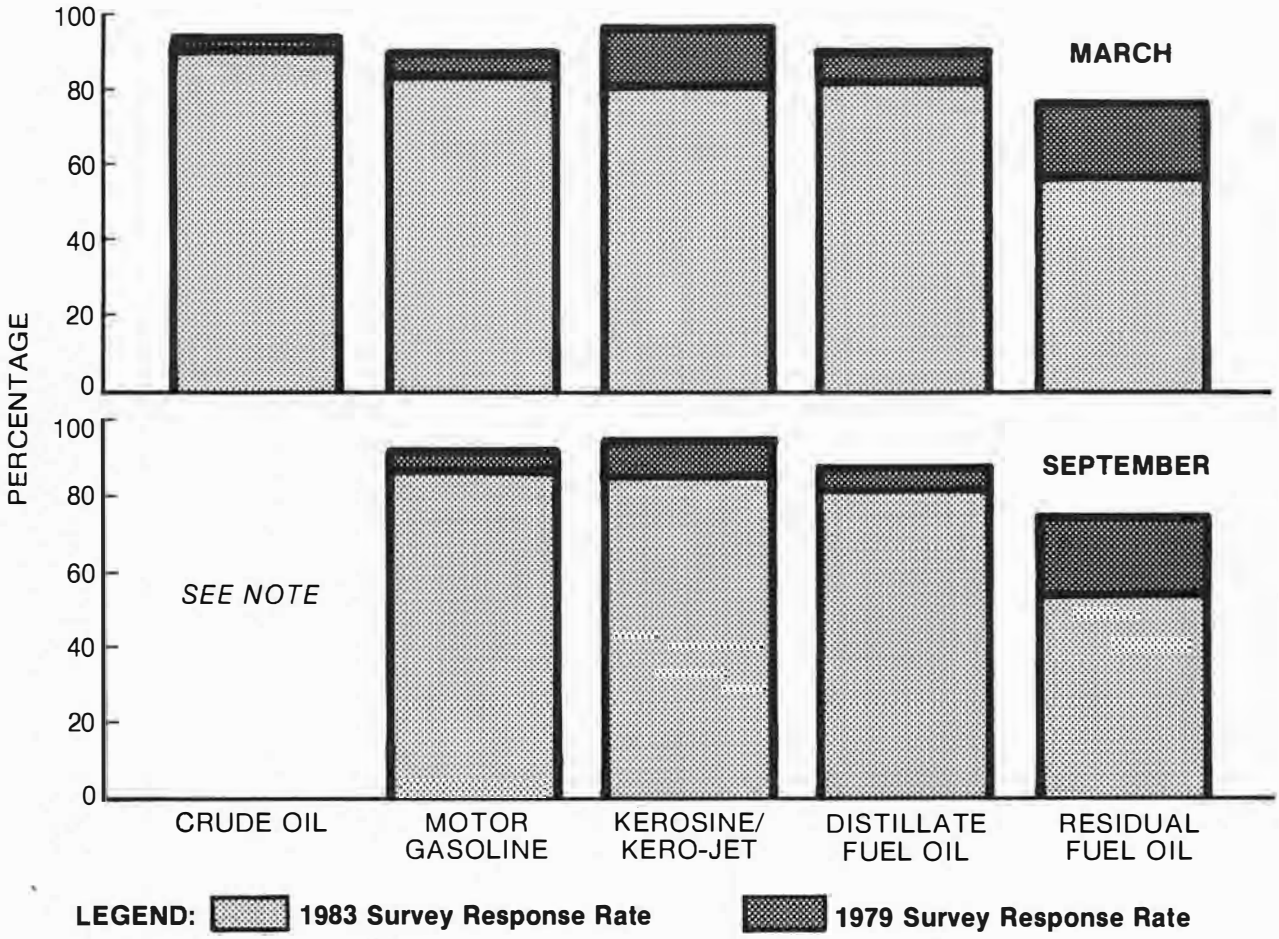
The Council's conclusions regarding the impact on private primary inventories of spare refining capacity, the Strategic Petroleum Reserve, and the petroleum futures markets were developed from the sum of the responses to the NPC survey.

[1]These estimates were used for general reference only, as only a few estimates were reported.

TABLE C-1

NPC SURVEY RESPONSES AS A PERCENTAGE OF INVENTORY REPORTED TO THE EIA

	NPC (Thousands of Barrels)			EIA (Thousands of Barrels)			Percentage		
	PADDs I-IV	PADD V	Total U.S.	PADDs I-IV	PADD V	Total U.S.	PADDs I-IV	PADD V	Total U.S.
September 30, 1982									
Motor Gasoline	175,997	27,822	203,819	205,918	27,704	233,622	85.5	100.4	87.2
Kerosine	7,054	242	7,296	9,626	209	9,835	73.3	115.8	74.2
Kero-Jet Fuel	22,213	5,933	28,146	27,153	6,174	33,327	81.8	96.1	84.5
Distillate Fuel Oil	121,363	9,894	131,257	151,086	10,110	161,196	80.3	97.9	81.4
Residual Fuel Oil	24,388	8,999	33,387	51,400	10,418	61,818	47.4	86.4	54.0
March 31, 1983									
Crude Oil	238,763	51,989	290,752	258,201	54,954	313,155	94.6	94.6	92.8
Motor Gasoline	165,609	24,192	189,801	197,284	25,761	223,045	83.9	93.9	85.1
Kerosine	6,577	341	8,760	8,760	339	9,099	75.1	100.6	76.0
Kero-Jet Fuel	22,287	6,209	28,496	28,271	6,414	34,685	78.8	96.8	82.2
Distillate Fuel Oil	86,923	10,200	97,123	106,991	11,129	118,120	81.2	91.7	82.2
Residual Fuel Oil	18,929	7,795	26,724	37,366	8,927	46,293	50.7	87.3	57.7
Naphtha-Type Jet Fuel	3,345	1,122	4,467	5,076	1,794	6,870	65.9	62.5	65.0



NOTE: Crude oil responses are for September in the 1979 survey, and March in the 1983 survey.

Figure C-1. Survey Response Rates, 1979-1983.

Appendix D:

NPC 1983 Survey of Petroleum Inventories and Storage Capacities

Price Waterhouse

OFFICE OF GOVERNMENT SERVICES

1801 K STREET, N.W.
WASHINGTON, DC 20006
202 296-0800

NATIONAL PETROLEUM COUNCIL
1983 SURVEY OF PETROLEUM INVENTORIES AND STORAGE CAPACITIES IN THE UNITED STATES

We have been engaged by the National Petroleum Council to receive and process the responses to this survey of petroleum inventories and storage capacities. Upon receiving the survey responses, Price Waterhouse will review them for reasonableness and completeness. The name and address of your company contact are requested in case clarification of your response is necessary during this process. After the initial review, company identifications will be removed and individual responses will be coded. Thereafter, data transcription and processing will be by code number only so that data cannot be associated with an individual company.

Individual company data will not be released to industry or government representatives. Price Waterhouse will provide data to the National Petroleum Council only in an aggregated form, and then only when sufficient responses have been obtained to preclude disclosure of individual company data. The original data forms will be destroyed at the completion of the study.

Price Waterhouse

NATIONAL PETROLEUM COUNCIL
1983 SURVEY OF
PETROLEUM INVENTORIES
AND STORAGE CAPACITIES
IN THE UNITED STATES

Reporting Company: _____

Address: _____

_____

_____ Zip Code: _____

Person in reporting company to be contacted if questions arise:

_____

Phone: (____) _____

Code: _____
(Price Waterhouse Use Only)

Please check for each questionnaire that you have provided data:

____ Questionnaire No. 1	____ Questionnaire No. 4	____ Questionnaire No. 7
____ Questionnaire No. 2	____ Questionnaire No. 5	____ Questionnaire No. 8
____ Questionnaire No. 3	____ Questionnaire No. 6	____ Questionnaire No. 9

Please return this booklet by July 8, 1983, to:

Price Waterhouse
OGS, Suite 701
1801 K Street, N.W.
Washington, D.C. 20006

INTRODUCTION

At the request of the U.S. Department of Energy (DOE), the National Petroleum Council has agreed to update its 1979 study of petroleum inventories and storage capacities in the United States. The study has two primary objectives:

1) To determine how much of the U.S. petroleum inventory reported monthly to the Department of Energy is required for normal operation of the petroleum distribution system itself and is therefore not available for delivery to consumers.

2) To determine the total primary storage capacity and that portion required for normal industry operations.

The enclosed questionnaires are designed to provide the National Petroleum Council with the information it requires to respond to DOE's request. These questionnaires request information on primary inventories and storage capacities relating to crude oil and the principal refined products. Most of the inventory data being requested have already been reported to DOE by your company. These data will provide a measure of the response to the survey and assist you in remaining within the scope of the instructions for the questionnaires.

The National Petroleum Council has retained the services of the certified public accounting firm of Price Waterhouse to collect and aggregate the data reported in this survey. Individual company data will not be released to industry or government representatives. Price Waterhouse will provide data to the National Petroleum Council only in an aggregated form, and then only when sufficient responses have been obtained to preclude disclosure of individual company data. The original data forms will be destroyed at the completion of the study. A statement from Price Waterhouse regarding its data collection and processing methodology is enclosed with this mailing.

GENERAL INSTRUCTIONS

1. Reporting of Data

a. Report all figures in **thousands** of 42-gallon barrels.

b. Report on a company-wide basis; i.e., submit only one response for your company's primary operations. (See enclosed list of locations for which you submit monthly reports to DOE.)

c. Report information in a manner consistent with your Petroleum Supply Reporting System (PSRS) reports filed with DOE on current forms EIA-810 (Monthly Refinery Report), EIA-811 (Monthly Bulk Terminal Report), EIA-812 (Monthly Product Pipeline Report), EIA-813 (Monthly Crude Oil Report), and the counterpart forms that were in use on September 30, 1982. That is,

—Report on a custody basis regardless of ownership of the inventories or facilities.

—In the case of jointly owned tankage or pipelines, data should be provided by the operator.

—Report inventories less basic sediment and water (BS&W) corrected to 60°F.

d. Definitions—The definitions for crude oil and petroleum products that should be used in the survey must be consistent with those of DOE's Petroleum Supply Reporting System, except for the definition of motor gasoline, for which respondents to this survey should aggregate finished leaded gasoline (Product Code 132 in PSRS—includes leaded gasohol), finished unleaded gasoline (Product Code 133 in PSRS—includes unleaded gasohol), and motor gasoline blending components (Product Code 134 in PSRS).

e. Crude oil data—Report as of March 31, 1983. Only one reporting date for crude oil has been chosen because crude oil inventories are not seasonal.

f. Refined product data—Report refined product stocks only for locations that were reported to DOE on September 30, 1982, and March 31, 1983, in your regular **monthly** reports to DOE as described under (c) above. Two reporting dates for the principal products have been chosen to better define the seasonal changes in inventories, and to reflect seasonal shifts in tank utilization.

Report for the following principal products:

—Motor gasoline, including blending components

—Kerosine

—Kerosine-type jet fuel

—Distillate fuel oil, including No. 4 fuel oil

—Residual fuel oil

More limited data are to be reported for naphtha-type jet fuel. Due to the nature of the product and its strategic importance in national defense, information is needed on minimum operating inventories and on the volume of additional supplies that might be made available to satisfy a rapid increase in demand.

2. Report by Petroleum Administration for Defense Districts (PADDs)

a. Data for Puerto Rico, the U.S. Virgin Islands, Guam, and the Hawaiian Foreign Trade Zone **should not be reported,** except for Alaskan crude oil in transit by water to the above locations (see line item instructions for Line 15).

b. Information will be collected on a PADD basis, with PADD I subdivided into three areas for all refined products. PADD I is **not** subdivided for crude oil. Respondents should use the table below to determine the PADD classification for each state in which they have operations.

c. Data for crude oil are also reported on a Total U.S. basis as well as by PADD to provide for reporting of Alaskan crude oil in transit by water.

d. Respondents with operations in the New England, Central Atlantic, and Lower Atlantic states should submit their data as PADD IA, PADD IB, and PADD IC, respectively.

e. State/PADD classifications:

PADD I

New England (PADD IA)
- Connecticut
- Maine
- Massachusetts
- New Hampshire
- Rhode Island
- Vermont

Central Atlantic (PADD IB)
- Delaware
- District of Columbia
- Maryland
- New Jersey
- New York
- Pennsylvania

Lower Atlantic (PADD IC)
- Florida
- Georgia
- North Carolina
- South Carolina
- Virginia
- West Virginia

PADD II

- Illinois
- Indiana
- Iowa
- Kansas
- Kentucky
- Michigan
- Minnesota
- Missouri
- Nebraska
- North Dakota
- Ohio
- Oklahoma
- South Dakota
- Tennessee
- Wisconsin

PADD III

- Alabama
- Arkansas
- Louisiana
- Mississippi
- New Mexico
- Texas

PADD IV

- Colorado
- Idaho
- Montana
- Utah
- Wyoming

PADD V

- Alaska
- Arizona
- California
- Hawaii, excluding Foreign Trade Zone
- Nevada
- Oregon
- Washington

3. Do not report data in the shaded areas of Questionnaires 1–7.

4. Completing Questionnaires 1–6

Specific line item instructions are provided for these questionnaires, beginning on Page 5.

5. Completing Questionnaire 7

It is possible that the sum of the companies' assessments of their own minimum and maximum operating inventories (Lines 2 and 21 on Questionnaires 1–6) will not accurately reflect the entire petroleum industry's minimum or maximum operating inventory. If your company analyzes industry levels, provide your estimate of the minimum and maximum operating inventories of the U.S. petroleum industry. Enter estimates for PADDs I–IV, PADD V, and Total U.S., if available. If your company does not have some of the estimates requested in this questionnaire, leave those sections blank.

(Refer to specific instructions on the face of the questionnaire.)

6. Completing Questionnaire 8

Because of the strategic nature of naphtha-type jet fuel, DOE requires certain limited information about this petroleum product.

The information requested concerning the Strategic Petroleum Reserve will help the National Petroleum Council's Committee on Petroleum Inventories and Storage Capacity to better understand changes in U.S. petroleum inventories.

(Refer to specific instructions on the face of the questionnaire.)

7. Completing Questionnaire 9

The petroleum futures markets are increasing in prominence and may have a significant influence on such operating decisions as refinery runs, pipeline movements, and inventory management. This questionnaire attempts to ascertain the possible impact of futures markets on inventories.

8. Other Instructions

a. Disregard those questionnaires in the survey booklet that are not applicable to your company's operations, but return the booklet intact.

b. Complete the cover page, leaving the code line blank, and send the completed questionnaire in the envelope provided by July 8, 1983, to:

Price Waterhouse
OGS, Suite 701
1801 K Street, N.W.
Washington, D.C. 20006

c. Any questions regarding this questionnaire should be addressed to:

Joan Walsh Cassedy
Committee Coordinator
National Petroleum Council
1625 K Street, N.W.
Washington, D.C. 20006
(202) 393-6100

An extra copy of this questionnaire is enclosed for your convenience.

Line 1. Total Inventory Reported to the Department of Energy

For crude oil, aggregate by PADD the inventories you report on Forms EIA-810 and EIA-813 as of March 31, 1983, except Alaskan crude oil in transit by water (Product Code 092 on Form EIA-813), which should **not** be included in this line entry.

For refined products, aggregate by PADD (sub-PADD in PADD I) the inventories you report on Forms EIA-810, 811, and 812 as of March 31, 1983, and the counterpart forms that were in use on September 30, 1982. Do **not** report data for U.S. territories and possessions.

Line 2. Minimum Operating Inventory

Data related to minimum operating inventory should be reported using your best estimates. These estimates should be on a custody basis and, therefore, **consistent with the number you report as actual inventory.** Do not include Alaskan crude oil in transit by water in your minimum operating inventory estimates. Data relating to minimum operating inventory are to be reported on a "system basis" for each product; that is, only in columns labeled Total PADDS I–IV, PADD V, and Total U.S., as specified on each questionnaire.

Runouts and shortages are likely to occur if inventory falls below the minimum operating level. This inventory is not available for consumer use because it is either "unavailable" or "required working" inventory.

"Unavailable" inventory includes:

— Pipeline fill (Line 7)
— Refinery lines and operating equipment fill (Line 8)
— Oil in transit by water from domestic sources (ex Alaska) (Line 9)
— Tank bottoms (Line 11)
— Plant fuel and pipeline prime mover fuel (Line 12)
— Lease stocks (Line 13)
— Alaskan crude oil in transit (Line 15).

"Required working" inventory includes stocks necessary to:

— Facilitate blending to meet product specifications
— Support the normal operating cycle of shipments/receipts (e.g., pipeline tenders)
— Handle unavoidable but recurring emergencies (e.g., pipeline failure, extreme weather conditions that affect waterborne movements).

The minimum operating inventory for a single company is a function of numerous factors, including the location of both its supply and demand, the current level of demand, the availability of transportation and refining facilities (e.g., refinery closures), the modes of transportation available (e.g., pipeline transportation cycles), the location of tankage (e.g., bulk terminal closures), and the cost of capital.

Line 3. Difference (Line 1 Minus Line 2) or Total Inventory Minus Minimum Operating Inventory

A positive difference would indicate that you had oil in storage above that needed to meet minimum operating requirements. A negative difference would indicate that you were below the minimum level and, hence, incurring operating problems. This difference may be zero, indicating that actual inventory was the amount needed to meet minimum operating needs.

Positive differences should be accounted for in Lines 4, 5, and 6, below.

Line 4. Seasonal Inventory

The amount on Line 3 that is seasonal inventory; that is, inventory that is not immediately needed to support current demand levels, but is maintained in anticipation of higher (seasonal) demand levels that cannot be met with then-current manufacturing or transportation capabilities. Seasonal inventories need not be stored in swing tankage.

Line 5. In Anticipation of Planned Maintenance

The various functions performed within the supply system extensively utilize sophisticated mechanical equipment. Such equipment must be refurbished regularly. Accordingly, companies generally plan for and manage stock levels in order to ensure continued supply to meet demand while equipment is under maintenance. Respondents should enter the amount of any stocks so dedicated as of the reporting dates for the various products.

Line 6. Normal Operating Inventory

The inventory considered by your company to be held as part of the normal operating inventory, either due to specific operating directives or changes in demand, production, or facilities. This inventory has not been allowed for in your minimum operating inventory (Line 2).

Line 7. Pipeline Fill

Inventory located between the shipping and receiving tanks on a pipeline system.

Line 8. Refinery Lines and Operating Equipment Fill

Inventory within the refinery lines and operating equipment (excluding tanks) that is required for the refinery processing system to function normally.

Line 9. In Transit by Water from Domestic Sources (Excluding Crude Oil from Alaska), Including Domesticized Foreign Oils in Transit

Include all stocks reported on Line 1 that were in transit by water to bulk terminals and refineries, excluding crude oil in transit by water from Alaska reported on Form EIA-813. Include stocks of domestic origin, and stocks of foreign origin that have entered through U.S. Customs—i.e., domesticized foreign oils.

In-transit inventory should only be reported in the same amounts and on the same basis as reported to DOE.

Line 10. Subtotal: Unavailable Inventory Outside of Tankage

This line is the sum of the data on Lines 7, 8, and 9.

Line 11. Tank Bottoms

Inventory that falls below the normal suction line of the tank. For floating roof tanks, the amount required to keep the legs of the roof from touching the tank bottom.

Line 12. Plant Fuel and Pipeline Prime Mover Fuel

Stocks set aside as plant fuel or pipeline prime mover fuel.

Line 13. Lease Stocks (Complete on Questionnaire 1 Only)

Include all lease stocks reported on Line 1 (Product Code 057 on Form EIA-813).

Line 14. Total

This line is the sum of the data on Lines 10, 11, 12, and 13.

Line 15. Alaskan Crude Oil In Transit by Water (Complete on Questionnaire 1 Only)

Include all stocks of Alaskan crude oil in transit by water that you reported to DOE on Form EIA-813 (Product Code 092) as of March 31, 1983. These stocks are not to be included in Lines 1, 2, and 21 (see line item instructions for Lines 1, 2, and 21).

Although Form EIA-813 requests this information on a U.S. basis only, please report on this line not only the amount reported to EIA for the Total U.S., but also your best estimate of the intended destination, differentiating between PADDs I-IV and PADD V.

Please include in your estimate for PADDs I-IV the volume of Alaskan crude oil in transit to Puerto Rico and the Virgin Islands, and in your estimate for PADD V the volume in transit to the Hawaiian Foreign Trade Zone and Guam.

Line 16. Shell Capacity of Tankage in Operation

The design capacity of operating tanks located at refineries, bulk terminals, pipeline tank farms, and producer leases. Include capacity of swing tankage; ensure that swing tankage is included in only one product or crude oil category for each date. Tankage that was idle—for reasons other than programmed maintenance with plans for immediate return to service—on September 30, 1982, and/or March 31, 1983 (in the case of refined products) or March 31, 1983 (in the case of crude oil) should not be reported on this line.

Line 17. Tank Tops and Safety Allowance

The portion of the shell capacity at the top of the tank that is not utilized for oil storage. This includes the safety allowance that is needed to protect personnel and property from damage that could result from thermal expansion and/or overfilling the tanks.

Line 18. Subtotal: Net Available Shell Capacity

This line is the difference between Lines 16 and 17.

Line 19. Unavailable Inventory Outside of Tankage

Repeat the data that were reported on Line 10. **Do not** include the data reported on Line 15, which will be handled separately by the NPC.

Line 20. Total Operating System Capacity

This line is the sum of Lines 18 and 19.

Line 21. Maximum Operating Inventory

Report your best estimates of your maximum operating inventory. These estimates should be on a custody basis and, therefore, **consistent with the number you report as actual inventory.** Do not include Alaskan crude oil in transit by water in your maximum operating inventory estimates. Report maximum operating inventory on a "system basis" for each product; that is, only in columns labeled Total PADDs I-IV, PADD V, and Total U.S., as specified on each questionnaire.

If inventory were to go above this level, there would not be enough empty space in the system to allow it to keep operating without a slowdown or interruption in the system. Space above this level is not available for storage because it is needed to maintain a workable operating system.

The maximum operating inventory represents the maximum quantity that could be stored in the assigned tankage and in other parts of the system such as pipelines, refinery lines, or in transit (unavailable inventory outside of tankage, Line 10) while still maintaining a workable operating system.

Line 22. Shell Capacity of Idle Tankage

The design capacity of tankage that was idle on March 31, 1983, for reasons other than programmed maintenance with plans for immediate return to service (included in Line 16). Line 22 tankage would be available for service within 90 days following little or no maintenance work (for example, cleaning, painting), and within existing environmental constraints.

Capacity should be reported in the same service as at the time of idling.

Line 23. Shell Capacity of Idle Tankage (Environmentally Restricted)

The design capacity of tankage that was idle on March 31, 1983, and would require environmental waiver or modification to be available for service within 90 days. Capacity should be reported in the same service as at the time of idling.

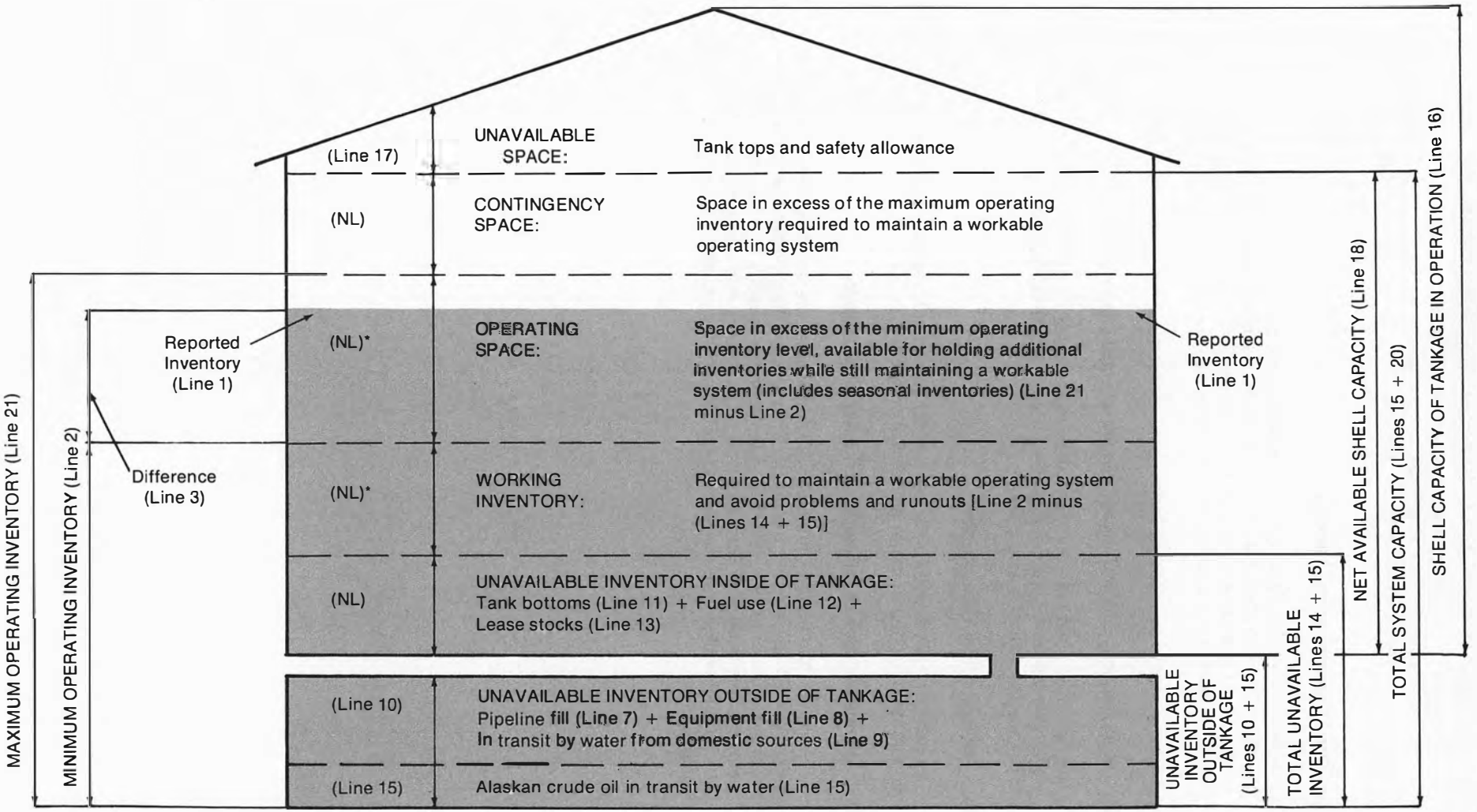
Line 24. Tankage Under Construction

The design shell capacity of tankage under construction (ground has been broken and the construction contract signed or major equipment ordered).

Line 25. Change in Stock Level Due to Spare Refining Capacity

Estimate the additional volume of seasonal stocks (see line item instructions for Line 4) that would be required if spare refining capacity did not exist. Respondents who do not adjust their seasonal stock requirements as a result of spare refining capacity are requested to **enter zero rather than leave this line blank.** For Questionnaire 1, this volume may be negative [indicate with ( )] for refiners who have increased crude oil stocks relative to refined product stocks because spare refining capacity is available.

SCHEMATIC OF TERMS DESCRIBING PETROLEUM INVENTORIES AND STORAGE CAPACITIES REQUESTED IN NPC QUESTIONNAIRES 1–7



*NL: No line referenced in the questionnaires

NATIONAL PETROLEUM COUNCIL
1983 SURVEY OF PETROLEUM INVENTORIES AND STORAGE CAPACITIES IN THE UNITED STATES

CRUDE OIL

Page 1 of 1
QUESTIONNAIRE NO. 1

As of March 31, 1983
(Report All Figures in **Thousands of Barrels**)

DESCRIPTION	(1) PADD I	(2) PADD II	(3) PADD III	(4) PADD IV	(5) Total PADDS I-IV	(6) PADD V	(7) Total U.S.
(Deal only with those end-of-the-month stocks reported to the Department of Energy on Forms EIA-810 and EIA-813).	(1,000 bbl)	(1,000 bbl)	(1,000 bbl)	(1,000 bbl)	(1,000 bbl)	(1,000 bbl)	(1,000 bbl)
A. CRUDE OIL INVENTORY							
1. Total inventory reported to the Department of Energy							
2. Minimum operating inventory							
3. Difference (Line 1 minus 2)							
If not zero, estimate what volume was:							
4. Seasonal inventory							
5. In anticipation of planned maintenance							
6. Normal operating inventory							
Memo Item: Unavailable inventory							
7. Pipeline fill							
8. Refinery lines and operating equipment fill							
9. Oil in transit by water from domestic sources (ex Alaska)							
10. Subtotal: Unavailable inventory outside of tankage (Lines 7, 8, and 9)							
11. Tank bottoms							
12. Plant fuel and pipeline prime mover fuel							
13. Lease stocks							
14. Total (Lines 10, 11, 12, and 13)							
15. Alaskan crude oil in transit by water							
B. STORAGE CAPACITY ASSIGNED TO CRUDE OIL							
16. Shell capacity of tankage in operation							
17. Tank tops and safety allowance							
18. Subtotal: Net available shell capacity (Line 16 minus 17)							
19. Unavailable inventory outside of tankage (from Line 10 above)							
20. Total operating system capacity (Lines 18 and 19)							
21. Maximum operating inventory							
C. IDLE BUT USABLE CAPACITY/NEW CAPACITY							
22. Shell capacity of idle tankage							
23. Shell capacity of idle tankage (environmentally restricted)							
24. Tankage under construction							
D. OTHER							
25. Change in stock level due to spare refining capacity							

Code: _____
(Price Waterhouse Use Only)

NATIONAL PETROLEUM COUNCIL
1983 SURVEY OF PETROLEUM INVENTORIES AND STORAGE CAPACITIES IN THE UNITED STATES

MOTOR GASOLINE, INCLUDING BLENDING COMPONENTS

Page 1 of 2
QUESTIONNAIRE NO. 2

As of September 30, 1982, and March 31, 1983
(Report All Figures in **Thousands of Barrels**)

DESCRIPTION	(1) PADD IA		(2) PADD IB		(3) PADD IC		(4) PADD II	
(Deal only with those end-of-the-month stocks reported to the Department of Energy on Forms EIA-810, EIA-811, and EIA-812).	Sept. 30 (1,000 bbl)	Mar. 31 (1,000 bbl)	Sept. 30 (1,000 bbl)	Mar. 31 (1,000 bbl)	Sept. 30 (1,000 bbl)	Mar. 31 (1,000 bbl)	Sept. 30 (1,000 bbl)	Mar. 31 (1,000 bbl)
A. MOTOR GASOLINE INVENTORY, INCLUDING BLENDING COMPONENTS								
1. Total inventory reported to the Department of Energy								
2. Minimum operating inventory								
3. Difference (Line 1 minus 2)								
If not zero, estimate what volume was:								
4. Seasonal inventory								
5. In anticipation of planned maintenance								
6. Normal operating inventory								
Memo Item: Unavailable inventory								
7. Pipeline fill								
8. Refinery lines and operating equipment fill								
9. Oil in transit by water from domestic sources (ex Alaska)								
10. Subtotal: Unavailable inventory outside of tankage (Lines 7, 8, and 9)								
11. Tank bottoms								
12. Plant fuel and pipeline prime mover fuel								
13. Lease stocks								
14. Total (Lines 10, 11, 12, and 13)								
15. Alaskan crude oil in transit by water								
B. STORAGE CAPACITY ASSIGNED TO MOTOR GASOLINE, INCLUDING BLENDING COMPONENTS								
16. Shell capacity of tankage in operation								
17. Tank tops and safety allowance								
18. Subtotal: Net available shell capacity (Line 16 minus 17)								
19. Unavailable inventory outside of tankage (from Line 10 above)								
20. Total operating system capacity (Lines 18 and 19)								
21. Maximum operating inventory								
C. IDLE BUT USABLE CAPACITY/NEW CAPACITY								
22. Shell capacity of idle tankage								
23. Shell capacity of idle tankage (environmentally restricted)								
24. Tankage under construction								
D. OTHER								
25. Change in stock level due to spare refining capacity								

Code: _____
(Price Waterhouse Use Only)

NATIONAL PETROLEUM COUNCIL
1983 SURVEY OF PETROLEUM INVENTORIES AND STORAGE CAPACITIES IN THE UNITED STATES

MOTOR GASOLINE, INCLUDING BLENDING COMPONENTS

QUESTIONNAIRE NO. 2

As of September 30, 1982, and March 31, 1983
(Report All Figures in **Thousands of Barrels**)

DESCRIPTION	(5) PADD III		(6) PADD IV		(7) Total PADDS I-IV		(8) PADD V	
(Deal only with those end-of-the-month stocks reported to the Department of Energy on Forms EIA-810, EIA-811, and EIA-812).	Sept. 30 (1,000 bbl)	Mar. 31 (1,000 bbl)	Sept. 30 (1,000 bbl)	Mar. 31 (1,000 bbl)	Sept. 30 (1,000 bbl)	Mar. 31 (1,000 bbl)	Sept. 30 (1,000 bbl)	Mar. 31 (1,000 bbl)
A. MOTOR GASOLINE INVENTORY, INCLUDING BLENDING COMPONENTS								
1. Total inventory reported to the Department of Energy								
2. Minimum operating inventory								
3. Difference (Line 1 minus 2)								
If not zero, estimate what volume was:								
4. Seasonal inventory								
5. In anticipation of planned maintenance								
6. Normal operating inventory								
Memo Item: Unavailable inventory								
7. Pipeline fill								
8. Refinery lines and operating equipment fill								
9. Oil in transit by water from domestic sources (ex Alaska)								
10. Subtotal: Unavailable inventory outside of tankage (Lines 7, 8, and 9)								
11. Tank bottoms								
12. Plant fuel and pipeline prime mover fuel								
13. Lease stocks								
14. Total (Lines 10, 11, 12, and 13)								
15. Alaskan crude oil in transit by water								
B. STORAGE CAPACITY ASSIGNED TO MOTOR GASOLINE, INCLUDING BLENDING COMPONENTS								
16. Shell capacity of tankage in operation								
17. Tank tops and safety allowance								
18. Subtotal: Net available shell capacity (Line 16 minus 17)								
19. Unavailable inventory outside of tankage (from Line 10 above)								
20. Total operating system capacity (Lines 18 and 19)								
21. Maximum operating inventory								
C. IDLE BUT USABLE CAPACITY/NEW CAPACITY								
22. Shell capacity of idle tankage								
23. Shell capacity of idle tankage (environmentally restricted)								
24. Tankage under construction								
D. OTHER								
25. Change in stock level due to spare refining capacity								

Code: _____
(Price Waterhouse Use Only)

NATIONAL PETROLEUM COUNCIL
1983 SURVEY OF PETROLEUM STORAGE CAPACITIES AND INVENTORY AVAILABILITY IN THE UNITED STATES

KEROSINE

Page 1 of 2
QUESTIONNAIRE NO. 3

As of September 30, 1982, and March 31, 1983
(Report All Figures in **Thousands of Barrels**)

DESCRIPTION	(1) PADD IA		(2) PADD IB		(3) PADD IC		(4) PADD II	
(Deal only with those end-of-the-month stocks reported to the Department of Energy on Forms EIA-810, EIA-811, and EIA-812).	Sept. 30 (1,000 bbl)	Mar. 31 (1,000 bbl)	Sept. 30 (1,000 bbl)	Mar. 31 (1,000 bbl)	Sept. 30 (1,000 bbl)	Mar. 31 (1,000 bbl)	Sept. 30 (1,000 bbl)	Mar. 31 (1,000 bbl)
A. KEROSINE INVENTORY								
1. Total inventory reported to the Department of Energy								
2. Minimum operating inventory								
3. Difference (Line 1 minus 2)								
If not zero, estimate what volume was:								
4. Seasonal inventory								
5. In anticipation of planned maintenance								
6. Normal operating inventory								
Memo Item: Unavailable inventory								
7. Pipeline fill								
8. Refinery lines and operating equipment fill								
9. Oil in transit by water from domestic sources (ex Alaska)								
10. Subtotal: Unavailable inventory outside of tankage (Lines 7, 8, and 9)								
11. Tank bottoms								
12. Plant fuel and pipeline prime mover fuel								
13. Lease stocks								
14. Total (Lines 10, 11, 12, and 13)								
15. Alaskan crude oil in transit by water								
B. STORAGE CAPACITY ASSIGNED TO KEROSINE								
16. Shell capacity of tankage in operation								
17. Tank tops and safety allowance								
18. Subtotal: Net available shell capacity (Line 16 minus 17)								
19. Unavailable inventory outside of tankage (from Line 10 above)								
20. Total operating system capacity (Lines 18 and 19)								
21. Maximum operating inventory								
C. IDLE BUT USABLE CAPACITY/NEW CAPACITY								
22. Shell capacity of idle tankage								
23. Shell capacity of idle tankage (environmentally restricted)								
24. Tankage under construction								
D. OTHER								
25. Change in stock level due to spare refining capacity								

Code: _____
(Price Waterhouse Use Only)

NATIONAL PETROLEUM COUNCIL
1983 SURVEY OF PETROLEUM STORAGE CAPACITY AND INVENTORY AVAILABILITY IN THE UNITED STATES

KEROSINE

QUESTIONNAIRE NO. 3

As of September 30, 1982, and March 31, 1983
(Report All Figures in **Thousands of Barrels**)

DESCRIPTION	(5) PADD III		(6) PADD IV		(7) Total PADDS I-IV		(8) PADD V	
(Deal only with those end-of-the-month stocks reported to the Department of Energy on Forms EIA-810, EIA-811, and EIA-812).	Sept. 30 (1,000 bbl)	Mar. 31 (1,000 bbl)	Sept. 30 (1,000 bbl)	Mar. 31 (1,000 bbl)	Sept. 30 (1,000 bbl)	Mar. 31 (1,000 bbl)	Sept. 30 (1,000 bbl)	Mar. 31 (1,000 bbl)
A. KEROSINE INVENTORY								
1. Total inventory reported to the Department of Energy								
2. Minimum operating inventory								
3. Difference (Line 1 minus 2)								
If not zero, estimate what volume was:								
4. Seasonal inventory								
5. In anticipation of planned maintenance								
6. Normal operating inventory								
Memo Item: Unavailable inventory								
7. Pipeline fill								
8. Refinery lines and operating equipment fill								
9. Oil in transit by water from domestic sources (ex Alaska)								
10. Subtotal: Unavailable inventory outside of tankage (Lines 7, 8, and 9)								
11. Tank bottoms								
12. Plant fuel and pipeline prime mover fuel								
13. Lease stocks								
14. Total (Lines 10, 11, 12, and 13)								
15. Alaskan crude oil in transit by water								
B. STORAGE CAPACITY ASSIGNED TO KEROSINE								
16. Shell capacity of tankage in operation								
17. Tank tops and safety allowance								
18. Subtotal: Net available shell capacity (Line 16 minus 17)								
19. Unavailable inventory outside of tankage (from Line 10 above)								
20. Total operating system capacity (Lines 18 and 19)								
21. Maximum operating inventory								
C. IDLE BUT USABLE CAPACITY/NEW CAPACITY								
22. Shell capacity of idle tankage								
23. Shell capacity of idle tankage (environmentally restricted)								
24. Tankage under construction								
D. OTHER								
25. Change in stock level due to spare refining capacity								

Code: _____
(Price Waterhouse Use Only)

NATIONAL PETROLEUM COUNCIL
1983 SURVEY OF PETROLEUM INVENTORIES AND STORAGE CAPACITIES IN THE UNITED STATES

KEROSINE-TYPE JET FUEL

Page 1 of 2
QUESTIONNAIRE NO. 4

As of September 30, 1982, and March 31, 1983
(Report All Figures in **Thousands of Barrels**)

DESCRIPTION	(1) PADD IA		(2) PADD IB		(3) PADD IC		(4) PADD II	
(Deal only with those end-of-the-month stocks reported to the Department of Energy on Forms EIA-810, EIA-811, and EIA-812).	Sept. 30 (1,000 bbl)	Mar. 31 (1,000 bbl)	Sept. 30 (1,000 bbl)	Mar. 31 (1,000 bbl)	Sept. 30 (1,000 bbl)	Mar. 31 (1,000 bbl)	Sept. 30 (1,000 bbl)	Mar. 31 (1,000 bbl)
A. KEROSINE-TYPE JET FUEL INVENTORY								
1. Total inventory reported to the Department of Energy								
2. Minimum operating inventory								
3. Difference (Line 1 minus 2)								
If not zero, estimate what volume was:								
4. Seasonal inventory								
5. In anticipation of planned maintenance								
6. Normal operating inventory								
Memo Item: Unavailable inventory								
7. Pipeline fill								
8. Refinery lines and operating equipment fill								
9. Oil in transit by water from domestic sources (ex Alaska)								
10. Subtotal: Unavailable inventory outside of tankage (Lines 7, 8, and 9)								
11. Tank bottoms								
12. Plant fuel and pipeline prime mover fuel								
13. Lease stocks								
14. Total (Lines 10, 11, 12, and 13)								
15. Alaskan crude oil in transit by water								
B. STORAGE CAPACITY ASSIGNED TO KEROSINE-TYPE JET FUEL								
16. Shell capacity of tankage in operation								
17. Tank tops and safety allowance								
18. Subtotal: Net available shell capacity (Line 16 minus 17)								
19. Unavailable inventory outside of tankage (from Line 10 above)								
20. Total operating system capacity (Lines 18 and 19)								
21. Maximum operating inventory								
C. IDLE BUT USABLE CAPACITY/NEW CAPACITY								
22. Shell capacity of idle tankage								
23. Shell capacity of idle tankage (environmentally restricted)								
24. Tankage under construction								
D. OTHER								
25. Change in stock level due to spare refining capacity								

Code: _____
(Price Waterhouse Use Only)

NATIONAL PETROLEUM COUNCIL
1983 SURVEY OF PETROLEUM INVENTORIES AND STORAGE CAPACITIES IN THE UNITED STATES

KEROSINE-TYPE JET FUEL

QUESTIONNAIRE NO. 4

As of September 30, 1982, and March 31, 1983
(Report All Figures in **Thousands of Barrels**)

DESCRIPTION	(5) PADD III		(6) PADD IV		(7) PADDS I-IV		(8) PADD V	
(Deal only with those end-of-the-month stocks reported to the Department of Energy on Forms EIA-810, EIA-811, and EIA-812).	Sept. 30 (1,000 bbl)	Mar. 31 (1,000 bbl)	Sept. 30 (1,000 bbl)	Mar. 31 (1,000 bbl)	Sept. 30 (1,000 bbl)	Mar. 31 (1,000 bbl)	Sept. 30 (1,000 bbl)	Mar. 31 (1,000 bbl)
A. KEROSINE-TYPE JET FUEL INVENTORY								
1. Total inventory reported to the Department of Energy								
2. Minimum operating inventory								
3. Difference (Line 1 minus 2)								
If not zero, estimate what volume was:								
4. Seasonal inventory								
5. In anticipation of planned maintenance								
6. Normal operating inventory								
Memo Item: Unavailable inventory								
7. Pipeline fill								
8. Refinery lines and operating equipment fill								
9. Oil in transit by water from domestic sources (ex Alaska)								
10. Subtotal: Unavailable inventory outside of tankage (Lines 7, 8, and 9)								
11. Tank bottoms								
12. Plant fuel and pipeline prime mover fuel								
13. Lease stocks								
14. Total (Lines 10, 11, 12, and 13)								
15. Alaskan crude oil in transit by water								
B. STORAGE CAPACITY ASSIGNED TO KEROSINE-TYPE JET FUEL								
16. Shell capacity of tankage in operation								
17. Tank tops and safety allowance								
18. Subtotal: Net available shell capacity (Line 16 minus 17)								
19. Unavailable inventory outside of tankage (from Line 10 above)								
20. Total operating system capacity (Lines 18 and 19)								
21. Maximum operating inventory								
C. IDLE BUT USABLE CAPACITY/NEW CAPACITY								
22. Shell capacity of idle tankage								
23. Shell capacity of idle tankage (environmentally restricted)								
24. Tankage under construction								
D. OTHER								
25. Change in stock level due to spare refining capacity								

Code: _____
(Price Waterhouse Use Only)

NATIONAL PETROLEUM COUNCIL
1983 SURVEY OF PETROLEUM INVENTORIES AND STORAGE CAPACITIES IN THE UNITED STATES

DISTILLATE FUEL OIL, INCLUDING NO. 4 FUEL OIL

QUESTIONNAIRE NO. 5

As of September 30, 1982, and March 31, 1983
(Report All Figures in **Thousands of Barrels**)

DESCRIPTION	(1) PADD IA		(2) PADD IB		(3) PADD IC		(4) PADD II	
(Deal only with those end-of-the-month stocks reported to the Department of Energy on Forms EIA-810, EIA-811, and EIA-812).	Sept. 30 (1,000 bbl)	Mar. 31 (1,000 bbl)	Sept. 30 (1,000 bbl)	Mar. 31 (1,000 bbl)	Sept. 30 (1,000 bbl)	Mar. 31 (1,000 bbl)	Sept. 30 (1,000 bbl)	Mar. 31 (1,000 bbl)
A. DISTILLATE FUEL OIL INVENTORY								
1. Total inventory reported to the Department of Energy								
2. Minimum operating inventory								
3. Difference (Line 1 minus 2)								
If not zero, estimate what volume was:								
4. Seasonal inventory								
5. In anticipation of planned maintenance								
6. Normal operating inventory								
Memo Item: Unavailable inventory								
7. Pipeline fill								
8. Refinery lines and operating equipment fill								
9. Oil in transit by water from domestic sources (ex Alaska)								
10. Subtotal: Unavailable inventory outside of tankage (Lines 7, 8, and 9)								
11. Tank bottoms								
12. Plant fuel and pipeline prime mover fuel								
13. Lease stocks								
14. Total (Lines 10, 11, 12, and 13)								
15. Alaskan crude oil in transit by water								
B. STORAGE CAPACITY ASSIGNED TO DISTILLATE FUEL OIL								
16. Shell capacity of tankage in operation								
17. Tank tops and safety allowance								
18. Subtotal: Net available shell capacity (Line 16 minus 17)								
19. Unavailable inventory outside of tankage (from Line 10 above)								
20. Total operating system capacity (Lines 18 and 19)								
21. Maximum operating inventory								
C. IDLE BUT USABLE CAPACITY/NEW CAPACITY								
22. Shell capacity of idle tankage								
23. Shell capacity of idle tankage (environmentally restricted)								
24. Tankage under construction								
D. OTHER								
25. Change in stock level due to spare refining capacity								

Code: _____
(Price Waterhouse Use Only)

NATIONAL PETROLEUM COUNCIL
1983 SURVEY OF PETROLEUM INVENTORIES AND STORAGE CAPACITIES IN THE UNITED STATES

DISTILLATE FUEL OIL, INCLUDING NO. 4 FUEL OIL

QUESTIONNAIRE NO. 5

As of September 30, 1982, and March 31, 1983
(Report All Figures in **Thousands of Barrels**)

DESCRIPTION	(5) PADD III		(6) PADD IV		(7) PADDS I-IV		(8) PADD V	
(Deal only with those end-of-the-month stocks reported to the Department of Energy on Forms EIA-810, EIA-811, and EIA-812).	Sept. 30 (1,000 bbl)	Mar. 31 (1,000 bbl)	Sept. 30 (1,000 bbl)	Mar. 31 (1,000 bbl)	Sept. 30 (1,000 bbl)	Mar. 31 (1,000 bbl)	Sept. 30 (1,000 bbl)	Mar. 31 (1,000 bbl)
A. DISTILLATE FUEL OIL INVENTORY								
1. Total inventory reported to the Department of Energy								
2. Minimum operating inventory								
3. Difference (Line 1 minus 2)								
If not zero, estimate what volume was:								
4. Seasonal inventory								
5. In anticipation of planned maintenance								
6. Normal operating inventory								
Memo Item: Unavailable inventory								
7. Pipeline fill								
8. Refinery lines and operating equipment fill								
9. Oil in transit by water from domestic sources (ex Alaska)								
10. Subtotal: Unavailable inventory outside of tankage (Lines 7, 8, and 9)								
11. Tank bottoms								
12. Plant fuel and pipeline prime mover fuel								
13. Lease stocks								
14. Total (Lines 10, 11, 12, and 13)								
15. Alaskan crude oil in transit by water								
B. STORAGE CAPACITY ASSIGNED TO DISTILLATE FUEL OIL								
16. Shell capacity of tankage in operation								
17. Tank tops and safety allowance								
18. Subtotal: Net available shell capacity (Line 16 minus 17)								
19. Unavailable inventory outside of tankage (from Line 10 above)								
20. Total operating system capacity (Lines 18 and 19)								
21. Maximum operating inventory								
C. IDLE BUT USABLE CAPACITY/NEW CAPACITY								
22. Shell capacity of idle tankage								
23. Shell capacity of idle tankage (environmentally restricted)								
24. Tankage under construction								
D. OTHER								
25. Change in stock level due to spare refining capacity								

Code: _____
(Price Waterhouse Use Only)

NATIONAL PETROLEUM COUNCIL
1983 SURVEY OF PETROLEUM INVENTORIES AND STORAGE CAPACITIES IN THE UNITED STATES

RESIDUAL FUEL OIL

Page 1 of 2
QUESTIONNAIRE NO. 6

As of September 30, 1982, and March 31, 1983
(Report All Figures in **Thousands of Barrels**)

DESCRIPTION	(1) PADD IA		(2) PADD IB		(3) PADD IC		(4) PADD II	
(Deal only with those end-of-the-month stocks reported to the Department of Energy on Forms EIA-810, EIA-811, and EIA-812).	Sept. 30 (1,000 bbl)	Mar. 31 (1,000 bbl)	Sept. 30 (1,000 bbl)	Mar. 31 (1,000 bbl)	Sept. 30 (1,000 bbl)	Mar. 31 (1,000 bbl)	Sept. 30 (1,000 bbl)	Mar. 31 (1,000 bbl)
A. RESIDUAL FUEL OIL INVENTORY								
1. Total inventory reported to the Department of Energy								
2. Minimum operating inventory								
3. Difference (Line 1 minus 2)								
If not zero, estimate what volume was:								
4. Seasonal inventory								
5. In anticipation of planned maintenance								
6. Normal operating inventory								
Memo Item: Unavailable inventory								
7. Pipeline fill								
8. Refinery lines and operating equipment fill								
9. Oil in transit by water from domestic sources (ex Alaska)								
10. Subtotal: Unavailable inventory outside of tankage (Lines 7, 8, and 9)								
11. Tank bottoms								
12. Plant fuel and pipeline prime mover fuel								
13. Lease stocks								
14. Total (Lines 10, 11, 12, and 13)								
15. Alaskan crude oil in transit by water								
B. STORAGE CAPACITY ASSIGNED TO RESIDUAL FUEL OIL								
16. Shell capacity of tankage in operation								
17. Tank tops and safety allowance								
18. Subtotal: Net available shell capacity (Line 16 minus 17)								
19. Unavailable inventory outside of tankage (from Line 10 above)								
20. Total operating system capacity (Lines 18 and 19)								
21. Maximum operating inventory								
C. IDLE BUT USABLE CAPACITY/NEW CAPACITY								
22. Shell capacity of idle tankage								
23. Shell capacity of idle tankage (environmentally restricted)								
24. Tankage under construction								
D. OTHER								
25. Change in stock level due to spare refining capacity								

NATIONAL PETROLEUM COUNCIL
1983 SURVEY OF PETROLEUM INVENTORIES AND STORAGE CAPACITIES IN THE UNITED STATES

RESIDUAL FUEL OIL

QUESTIONNAIRE NO. 6

As of September 30, 1982, and March 31, 1983
(Report All Figures in **Thousands of Barrels**)

DESCRIPTION	(5) PADD III		(6) PADD IV		(7) PADDS I-IV		(8) PADD V	
(Deal only with those end-of-the-month stocks reported to the Department of Energy on Forms EIA-810, EIA-811, and EIA-812).	Sept. 30 (1,000 bbl)	Mar. 31 (1,000 bbl)	Sept. 30 (1,000 bbl)	Mar. 31 (1,000 bbl)	Sept. 30 (1,000 bbl)	Mar. 31 (1,000 bbl)	Sept. 30 (1,000 bbl)	Mar. 31 (1,000 bbl)
A. RESIDUAL FUEL OIL INVENTORY								
1. Total inventory reported to the Department of Energy								
2. Minimum operating inventory								
3. Difference (Line 1 minus 2)								
If not zero, estimate what volume was:								
4. Seasonal inventory								
5. In anticipation of planned maintenance								
6. Normal operating inventory								
Memo Item: Unavailable inventory								
7. Pipeline fill								
8. Refinery lines and operating equipment fill								
9. Oil in transit by water from domestic sources (ex Alaska)								
10. Subtotal: Unavailable inventory outside of tankage (Lines 7, 8, and 9)								
11. Tank bottoms								
12. Plant fuel and pipeline prime mover fuel								
13. Lease stocks								
14. Total (Lines 10, 11, 12, and 13)								
15. Alaskan crude oil in transit by water								
B. STORAGE CAPACITY ASSIGNED TO RESIDUAL FUEL OIL								
16. Shell capacity of tankage in operation								
17. Tank tops and safety allowance								
18. Subtotal: Net available shell capacity (Line 16 minus 17)								
19. Unavailable inventory outside of tankage (from Line 10 above)								
20. Total operating system capacity (Lines 18 and 19)								
21. Maximum operating inventory								
C. IDLE BUT USABLE CAPACITY/NEW CAPACITY								
22. Shell capacity of idle tankage								
23. Shell capacity of idle tankage (environmentally restricted)								
24. Tankage under construction								
D. OTHER								
25. Change in stock level due to spare refining capacity								

Code _____
(Price Waterhouse Use Only)

NATIONAL PETROLEUM COUNCIL
1983 SURVEY OF PETROLEUM INVENTORIES AND STORAGE CAPACITIES IN THE UNITED STATES

Page 1 of 1
QUESTIONNAIRE 7

ESTIMATED MINIMUM AND MAXIMUM OPERATING INVENTORIES FOR THE ENTIRE U.S. PETROLEUM INDUSTRY

Complete this questionnaire only if your company analyzes industry inventory levels. (See NOTE, below.)

As of September 30, 1982, and March 31, 1983
(Report All Figures in **Thousands of Barrels**)

	Estimated Operating Inventories for the Entire U.S. Petroleum Industry											
	Minimum (1,000 bbl)						Maximum (1,000 bbl)					
	September 30, 1982			March 31, 1983			September 30, 1982			March 31, 1983		
	PADDS I-IV	PADD V	TOTAL U.S.	PADDS I-IV	PADD V	TOTAL U.S.	PADDS I-IV	PADD V	TOTAL U.S.	PADDS I-IV	PADD V	TOTAL U.S.
1. Crude oil												
2. Motor gasoline, including blending components												
3. Kerosine												
Kerosine-type jet fuel												
Total												
4. Distillate fuel oil, including No. 4 fuel oil												
5. Residual fuel oil												
6. Naphtha-type jet fuel												

NOTE: It is possible that the sum of the companies' assessments of their own minimum and maximum operating inventories (Lines 2 and 21 on Questionnaires 1–6) will not accurately reflect the entire petroleum industry's minimum or maximum operating inventory. If your company analyzes industry levels, provide your estimate of the minimum and maximum operating inventories of the U.S. petroleum industry. Enter estimates for PADDS I-IV, PADD V, and Total U.S. If your company does not have certain of the estimates requested in this questionnaire, leave those sections blank. If your company only performs this analysis for Total U.S., complete only those columns.

Code: _____
(Price Waterhouse Use Only)

NATIONAL PETROLEUM COUNCIL
1983 SURVEY OF PETROLEUM INVENTORIES AND STORAGE CAPACITIES IN THE UNITED STATES

As of March 31, 1983
(Report All Figures in **Thousands of Barrels**)

SECTION 1. NAPHTHA-TYPE JET FUEL

	(1) Normally Dedicated Stocks in Storage	(2) Stocks Which Could Have Been Dedicated
PART A. STOCKS		
PADD IA		
PADD IB		
PADD IC		
PADD II		
PADD III		
PADD IV		
PADD V		

PART B. MINIMUM OPERATING INVENTORY	
PADDS I-IV	
PADD V	
PART C. DESIGN CAPACITY	
PADDS I-IV	
PADD V	

Report in PART A, Column 1, stocks previously reported to DOE. This should include both specification product and any components dedicated as of March 31, 1983, and reported as naphtha-type jet fuel to DOE. (See line item instructions for Line 1 for Questionnaires 1–6). Include in Column 2 any inventory on hand (including line fill) as of March 31, 1983, categorized as unfinished oils, blending components, special naphthas, naphtha less than 400°F end-point (see DOE Form EIA-810) which your company could have made available (stocks which could have been dedicated from other products) immediately for use as naphtha-type jet fuel and not reported in Column 1. Amounts entered represent product which would meet specification with little or no processing other than mechanical blending. Do not include stocks if facility management processes (i.e., cleaning tankage) would have been required prior to your company's being able to make the product available.

Report in PART B the amount calculated in accordance with line item instructions for Line 2 for Questionnaires 1–6.

Report in PART C the design capacity normally dedicated to production, distribution, and storage of naphtha-type jet fuel consistent with Lines 18–20 in Questionnaires 1–6.

SECTION II. IMPACT OF THE STRATEGIC PETROLEUM RESERVE ON PRIVATE INVENTORY LEVELS

Total industry inventories of refined products and crude oil are currently below historical levels. Has the existence of the Strategic Petroleum Reserve contributed to a decrease in your inventories? If yes, please provide an estimate of the amount, expressed as a percentage of your total crude oil stocks as of March 31, 1983 (Questionnaire 1, Column 7).

Yes _____—_____% No _____

If no, please provide your company's principal reasons:

_____

_____

_____

_____

Code: _____
(Price Waterhouse Use Only)

NATIONAL PETROLEUM COUNCIL
1983 SURVEY OF PETROLEUM INVENTORIES AND STORAGE CAPACITIES IN THE UNITED STATES

PETROLEUM FUTURES

The petroleum futures markets are increasing in prominence. Originally, non-oil futures markets (e.g., wheat, corn) were created as a hedge against price fluctuations. However, it appears that the petroleum futures markets may also have a significant influence on such operating decisions as refinery runs, pipeline movements, and inventory management. This questionnaire attempts to ascertain the possible impact of petroleum futures markets on U.S. inventories.

1) Has your firm traded in the petroleum futures markets?

_____ Yes
_____ No

If your answer is No, please go to Questions 4 and 5.

2) Which oil futures have you traded?

_____ #2 Fuel Oil/Gasoil
_____ Motor Gasoline
_____ Crude Oil

3) As a percentage of your March 31, 1983, inventories, what is the maximum open interest you have had in each commodity during the last 12 months?

#2 Fuel Oil _____% Motor Gasoline _____% Crude Oil _____%

How many contracts does this represent?

#2 Fuel Oil _____ Motor Gasoline _____ Crude Oil _____

4) If you have traded or anticipate trading in the petroleum futures market, which of the following best describes the reason? Please list in order of importance (1 through 7, with 1 being the principal reason).

_____ Physical Inventory
_____ Supplemental Outlet for Products
_____ Supplemental Source of Products
_____ Potential Profits Through Speculation
_____ Hedge Against Price Fluctuations
_____ Additional Flexibility
_____ Other

5) Has there been or do you visualize a change in your physical inventory policy or physical inventory levels due to the presence of the petroleum futures markets?

_____ Yes
_____ No

Code: _____
(Price Waterhouse Use Only)

Appendix E:

Primary System Survey Data

NATIONAL PETROLEUM COUNCIL
1983 SURVEY OF PETROLEUM INVENTORIES AND STORAGE CAPACITIES IN THE UNITED STATES

CRUDE OIL

As of March 31, 1983
(Thousands of Barrels)

INVENTORY AND STORAGE CAPACITY	PADD I	PADD II	PADD III	PADD IV	Total PADDs I-IV	PADD V	Total U.S.	
							NPC Total	Adjusted NPC Total
A. CRUDE OIL INVENTORY								
1. Total inventory reported by DOE	15,075	78,640	147,611	16,875	258,201	54,954	313,155	***
a. Total inventory reported to NPC	13,993	76,199	133,752	14,819	238,763	51,989	290,752	313,155
b. Percentage of line one	92.8	96.9	90.6	87.8	92.5	94.6	92.8	***
2. Minimum operating inventory					170,794	34,331	205,125	220,930
3. Difference (Line 1 minus 2)					67,969	17,658	85,627	92,225
If not zero, estimate what volume was:								
4. Seasonal inventory					783	10	793	854
5. In anticipation of planned maintenance					130	667	797	858
6. Normal operating inventory					67,056	16,628	83,684	90,132
Memo Item: Unavailable inventory								
7. Pipeline fill	110	26,177	38,064	4,174	68,525	12,404	80,929	***
8. Refinery lines and operating equipment fill	169	307	618	34	1,128	192	1,320	***
9. Oil in transit by water from domestic sources (ex Alaska)	125	424	580	0	1,129	590	1,719	***
10. Subtotal: Unavailable inventory outside of tankage (Lines 7, 8, and 9)	404	26,908	39,262	4,208	70,782	13,186	83,968	90,438
11. Tank bottoms	2,677	9,242	20,333	1,422	33,674	7,632	41,306	***
12. Plant fuel and pipeline prime mover fuel	5	0	0	9	14	32	46	***
13. Lease stocks	32	2,330	6,352	866	9,580	1,457	11,037	***
14. Total (Lines 10, 11, 12, and 13)	3,118	38,480	65,947	6,505	114,050	22,307	136,357	146,864
15. Alaskan crude oil in transit by water					25,114	6,052	31,166	31,218**
B. STORAGE CAPACITY ASSIGNED TO CRUDE OIL								
16. Shell capacity of tankage in operation	26,731	99,996	228,430	19,450	374,607	88,256	462,863	498,528
17. Tank tops and safety allowance	1,797	6,339	19,414	970	28,520	6,503	35,023	37,722
18. Subtotal: Net available shell capacity (Line 16 minus 17)	24,934	93,657	209,016	18,480	346,087	81,753	427,840	460,806
19. Unavailable inventory outside of tankage (from Line 10 above)	404	26,908	39,262	4,208	70,782	13,186	83,968	90,438
20. Total operating system capacity (Lines 18 and 19)	25,338	120,565	248,278	22,688	416,869	94,939	511,808	551,244
21. Maximum operating inventory					354,872	70,908	425,780	458,587*
C. IDLE BUT USABLE CAPACITY/NEW CAPACITY								
22. Shell capacity of idle tankage	77	4,368	5,547	39	10,031	1,642	11,673	12,572
23. Shell capacity of idle tankage (environmentally restricted)	0	221	1,544	0	1,765	1,311	3,076	3,313
24. Tankage under construction	0	281	8,202	48	8,531	779	9,310	10,027
D. OTHER								
25. Change in stock level due to spare refining capacity					1,116	0	1,116	***

* Excludes Alaskan crude oil in transit, see line 15.
** As reported to EIA.
*** Not applicable

NATIONAL PETROLEUM COUNCIL
1983 SURVEY OF PETROLEUM INVENTORIES AND STORAGE CAPACITIES IN THE UNITED STATES

MOTOR GASOLINE, INCLUDING BLENDING COMPONENTS

As of September 30, 1982
(Thousands of Barrels)

INVENTORY AND STORAGE CAPACITY	PADD IA	PADD IB	PADD IC	Total PADD I	PADD II	PADD III	PADD IV	Total PADDs I-IV	PADD V	Total U.S. NPC Total	Total U.S. Adjusted NPC Total
A. MOTOR GASOLINE INVENTORY, INCLUDING BLENDING COMPONENTS											
1. Total inventory reported by DOE				63,461	69,288	67,451	5,718	205,918	27,704	233,622	***
a. Total inventory reported to NPC	4,958	25,892	23,684	54,534	58,466	58,061	4,936	175,997	27,822	203,819	233,622
b. Percentage of line one				85.9	84.4	86.1	86.3	85.5	100.4	87.2	***
2. Minimum operating inventory								134,167	20,202	154,369	176,941
3. Difference (Line 1 minus 2)								41,830	7,620	49,450	56,681
If not zero, estimate what volume was:											
4. Seasonal inventory								2,656	282	2,938	3,368
5. In anticipation of planned maintenance								2,528	0	2,528	2,898
6. Normal operating inventory								34,162	7,054	41,216	47,243
Memo Item: Unavailable inventory											
7. Pipeline fill	60	2,507	6,063	8,630	9,159	11,118	895	29,802	1,395	31,197	***
8. Refinery lines and operating equipment fill	0	72	29	101	149	279	33	562	227	789	***
9. Oil in transit by water from domestic sources (ex Alaska)	505	500	251	1,256	229	197	0	1,682	205	1,887	***
10. Subtotal: Unavailable inventory outside of tankage (Lines 7, 8, and 9)	565	3,079	6,343	9,987	9,537	11,594	928	32,046	1,827	33,873	38,826
11. Tank bottoms	710	3,907	2,049	6,666	8,084	8,796	829	24,375	4,792	29,167	***
12. Plant fuel and pipeline prime mover fuel	0	0	5	5	0	0	10	15	0	15	***
13. Lease stocks											
14. Total (Lines 10, 11, 12, and 13)	1,275	6,986	8,397	16,658	17,621	20,390	1,767	56,436	6,619	63,055	72,275
15. Alaskan crude oil in transit by water											
B. STORAGE CAPACITY ASSIGNED TO MOTOR GASOLINE, INCLUDING BLENDING COMPONENTS											
16. Shell capacity of tankage in operation	9,333	53,353	43,420	106,106	106,700	104,281	11,986	329,073	57,561	386,634	443,169
17. Tank tops and safety allowance	619	4,201	2,383	7,203	7,400	8,177	767	23,547	4,841	28,388	32,539
18. Subtotal: Net available shell capacity (Line 16 minus 17)	8,714	49,152	41,037	98,903	99,300	96,104	11,219	305,526	52,720	358,246	410,630
19. Unavailable inventory outside of tankage (from Line 10 above)	565	3,079	6,343	9,987	9,537	11,594	928	32,046	1,827	33,873	38,826
20. Total operating system capacity (Lines 18 and 19)	9,279	52,231	47,380	108,890	108,837	107,698	12,147	337,572	54,547	392,119	449,456
21. Maximum operating inventory								289,846	48,672	338,518	388,017
C. IDLE BUT USABLE CAPACITY/NEW CAPACITY											
22. Shell capacity of idle tankage											
23. Shell capacity of idle tankage (environmentally restricted)											
24. Tankage under construction											
D. OTHER											
25. Change in stock level due to spare refining capacity								0	0	0	0

*** Not applicable

NATIONAL PETROLEUM COUNCIL
1983 SURVEY OF PETROLEUM INVENTORIES AND STORAGE CAPACITIES IN THE UNITED STATES

MOTOR GASOLINE, INCLUDING BLENDING COMPONENTS

As of March 31, 1983
(Thousands of Barrels)

INVENTORY AND STORAGE CAPACITY	PADD IA	PADD IB	PADD IC	Total PADD I	PADD II	PADD III	PADD IV	Total PADDs I-IV	PADD V	Total U.S. NPC Total	Total U.S. Adjusted NPC Total
A. MOTOR GASOLINE INVENTORY, INCLUDING BLENDING COMPONENTS											
1. Total inventory reported by DOE				55,298	68,304	65,400	8,282	197,284	25,761	223,045	***
a. Total inventory reported to NPC	3,644	22,584	21,294	47,522	56,412	54,692	6,983	165,609	24,192	189,801	223,045
b. Percentage of line one				85.9	82.6	83.6	84.3	83.9	93.9	85.1	***
2. Minimum operating inventory								133,875	20,251	154,126	181,121
3. Difference (Line 1 minus 2)								31,734	3,941	35,675	41,924
If not zero, estimate what volume was:											
4. Seasonal inventory								2,710	318	3,028	3,558
5. In anticipation of planned maintenance								474	30	504	592
6. Normal operating inventory								25,915	3,593	29,508	34,676
Memo Item: Unavailable inventory											
7. Pipeline fill	78	2,138	6,971	9,187	10,265	10,121	875	30,448	1,177	31,625	***
8. Refinery lines and operating equipment fill	0	69	29	98	133	283	33	547	227	774	***
9. Oil in transit by water from domestic sources (ex Alaska)	296	814	304	1,414	445	236	0	2,095	339	2,434	***
10. Subtotal: Unavailable inventory outside of tankage (Lines 7, 8, and 9)	374	3,021	7,304	10,699	10,843	10,640	908	33,090	1,743	34,833	40,934
11. Tank bottoms	688	3,925	2,088	6,701	8,691	8,401	911	24,704	4,710	29,414	***
12. Plant fuel and pipeline prime mover fuel	0	0	5	5	0	0	10	15	0	15	***
13. Lease stocks											
14. Total (Lines 10, 11, 12, and 13)	1,062	6,946	9,397	17,405	19,534	19,041	1,829	57,809	6,453	64,262	75,518
15. Alaskan crude oil in transit by water											
B. STORAGE CAPACITY ASSIGNED TO MOTOR GASOLINE, INCLUDING BLENDING COMPONENTS											
16. Shell capacity of tankage in operation	9,044	53,364	43,844	106,252	107,918	104,781	12,048	330,999	57,404	388,403	456,433
17. Tank tops and safety allowance	608	4,238	2,416	7,262	7,537	8,281	767	23,847	4,875	28,722	33,753
18. Subtotal: Net available shell capacity (Line 16 minus 17)	8,436	49,126	41,428	98,990	100,381	96,500	11,281	307,152	52,529	359,681	422,680
19. Unavailable inventory outside of tankage (from Line 10 above)	374	3,021	7,304	10,699	10,843	10,640	908	33,090	1,743	34,833	40,934
20. Total operating system capacity (Lines 18 and 19)	8,810	52,147	48,732	109,689	111,224	107,140	12,189	340,242	54,272	394,514	463,614
21. Maximum operating inventory								285,809	48,008	333,817	392,286
C. IDLE BUT USABLE CAPACITY/NEW CAPACITY											
22. Shell capacity of idle tankage	94	659	228	981	2,254	1,926	74	5,235	736	5,971	7,017
23. Shell capacity of idle tankage (environmentally restricted)	0	0	85	85	65	50	0	200	16	216	254
24. Tankage under construction	0	0	0	0	145	2,137	0	2,282	301	2,583	3,035
D. OTHER											
25. Change in stock level due to spare refining capacity								0	0	0	0

*** Not applicable

NATIONAL PETROLEUM COUNCIL
1983 SURVEY OF PETROLEUM STORAGE CAPACITIES AND INVENTORY AVAILABILITY IN THE UNITED STATES

KEROSINE

As of September 30, 1982
(Thousands of Barrels)

INVENTORY AND STORAGE CAPACITY	PADD IA	PADD IB	PADD IC	Total PADD I	PADD II	PADD III	PADD IV	Total PADDs I-IV	PADD V	Total U.S. NPC Total	Total U.S. Adjusted NPC Total
A. KEROSINE INVENTORY											
1. Total inventory reported by DOE				4,294	2,877	2,404	54	9,629	209	9,838	***
a. Total inventory reported to NPC	277	1,259	1,161	2,697	2,372	1,948	37	7,054	242	7,296	9,838
b. Percentage of line one				62.8	82.4	81.1	68.5	73.3	115.8	74.2	***
2. Minimum operating inventory								3,952	134	4,086	5,508
3. Difference (Line 1 minus 2)								3,102	108	3,210	4,327
If not zero, estimate what volume was:											
4. Seasonal inventory								0	0	0	0
5. In anticipation of planned maintenance								9	0	9	12
6. Normal operating inventory								0	40	40	54
Memo Item: Unavailable inventory											
7. Pipeline fill	8	117	161	286	182	195	0	663	0	663	***
8. Refinery lines and operating equipment fill	0	5	1	6	5	18	2	31	2	33	***
9. Oil in transit by water from domestic sources (ex Alaska)	1	14	9	24	5	1	0	30	0	30	***
10. Subtotal: Unavailable inventory outside of tankage (Lines 7, 8, and 9)	9	136	171	316	192	214	2	724	2	726	979
11. Tank bottoms	26	157	109	292	267	316	4	879	41	920	***
12. Plant fuel and pipeline prime mover fuel	0	0	0	0	0	0	0	0	0	0	***
13. Lease stocks											
14. Total (Lines 10, 11, 12, and 13)	35	293	280	608	459	530	6	1,603	43	1,646	2,219
15. Alaskan crude oil in transit by water											
B. STORAGE CAPACITY ASSIGNED TO KEROSINE											
16. Shell capacity of tankage in operation	726	3,039	2,820	6,585	4,521	4,708	114	15,928	487	16,415	22,127
17. Tank tops and safety allowance	38	160	176	374	244	217	8	843	26	869	1,171
18. Subtotal: Net available shell capacity (Line 16 minus 17)	688	2,879	2,644	6,211	4,277	4,491	106	15,085	461	15,546	20,956
19. Unavailable inventory outside of tankage (from Line 10 above)	9	136	171	316	192	214	2	724	2	726	979
20. Total operating system capacity (Lines 18 and 19)	697	3,015	2,815	6,527	4,469	4,705	108	15,809	463	16,272	21,935
21. Maximum operating inventory								13,935	385	14,320	19,303
C. IDLE BUT USABLE CAPACITY/NEW CAPACITY											
22. Shell capacity of idle tankage											
23. Shell capacity of idle tankage (environmentally restricted)											
24. Tankage under construction											
D. OTHER											
25. Change in stock level due to spare refining capacity								0	0	0	0

*** Not applicable

NATIONAL PETROLEUM COUNCIL
1983 SURVEY OF PETROLEUM STORAGE CAPACITY
AND INVENTORY AVAILABILITY IN THE UNITED STATES

KEROSINE

As of March 31, 1983
(Thousands of Barrels)

INVENTORY AND STORAGE CAPACITY	PADD IA	PADD IB	PADD IC	Total PADD I	PADD II	PADD III	PADD IV	Total PADDs I-IV	PADD V	Total U.S. NPC Total	Total U.S. Adjusted NPC Total
A. KEROSINE INVENTORY											
1. Total inventory reported by DOE				3,719	2,504	2,498	39	8,760	339	9,099	***
a. Total inventory reported to NPC	160	1,251	986	2,397	2,024	2,124	32	6,577	341	6,918	9,099
b. Percentage of line one				64.5	80.8	85.0	82.1	75.1	100.6	76.0	***
2. Minimum operating inventory								3,985	148	4,133	5,436
3. Difference (Line 1 minus 2)								2,592	193	2,785	3,663
If not zero, estimate what volume was:											
4. Seasonal inventory								0	0	0	0
5. In anticipation of planned maintenance								9	0	9	12
6. Normal operating inventory								0	85	85	112
Memo Item: Unavailable inventory											
7. Pipeline fill	7	175	156	338	73	218	0	629	1	630	***
8. Refinery lines and operating equipment fill	0	5	1	6	5	18	2	31	2	33	***
9. Oil in transit by water from domestic sources (ex Alaska)	1	7	9	17	2	1	0	20	0	20	***
10. Subtotal: Unavailable inventory outside of tankage (Lines 7, 8, and 9)	8	187	166	361	80	237	2	680	3	683	898
11. Tank bottoms	24	158	98	280	265	320	4	869	58	927	***
12. Plant fuel and pipeline prime mover fuel	0	0	0	0	0	0	0	0	0	0	***
13. Lease stocks											
14. Total (Lines 10, 11, 12, and 13)	32	345	264	641	345	557	6	1,549	61	1,610	2,118
15. Alaskan crude oil in transit by water											
B. STORAGE CAPACITY ASSIGNED TO KEROSINE											
16. Shell capacity of tankage in operation	589	3,073	2,546	6,208	4,339	4,833	111	15,491	688	16,179	21,280
17. Tank tops and safety allowance	34	166	149	349	236	230	7	822	40	862	1,134
18. Subtotal: Net available shell capacity (Line 16 minus 17)	555	2,907	2,397	5,859	4,103	4,603	104	14,669	648	15,317	20,146
19. Unavailable inventory outside of tankage (from Line 10 above)	8	187	166	361	80	237	2	680	3	683	898
20. Total operating system capacity (Lines 18 and 19)	563	3,094	2,563	6,220	4,183	4,840	106	15,349	651	16,000	21,044
21. Maximum operating inventory								12,990	556	13,546	17,817
C. IDLE BUT USABLE CAPACITY/NEW CAPACITY											
22. Shell capacity of idle tankage	0	58	5	63	303	560	3	929	0	929	1,222
23. Shell capacity of idle tankage (environmentally restricted)						0	0	0	10	10	13
24. Tankage under construction						450	0	450	20	470	618
D. OTHER											
25. Change in stock level due to spare refining capacity								0	0	0	0

*** Not applicable

NATIONAL PETROLEUM COUNCIL
1983 SURVEY OF PETROLEUM INVENTORIES AND STORAGE CAPACITIES IN THE UNITED STATES

KEROSINE-TYPE JET FUEL

As of September 30, 1982
(Thousands of Barrels)

INVENTORY AND STORAGE CAPACITY	PADD IA	PADD IB	PADD IC	Total PADD I	PADD II	PADD III	PADD IV	Total PADDs I-IV	PADD V	Total U.S. NPC Total	Total U.S. Adjusted NPC Total
A. KEROSINE-TYPE JET FUEL INVENTORY											
1. Total inventory reported by DOE				9,037	7,830	9,554	732	27,153	6,174	33,327	***
a. Total inventory reported to NPC	854	3,560	3,253	7,667	6,958	7,013	575	22,213	5,933	28,146	33,327
b. Percentage of line one				84.8	88.9	73.4	78.6	81.8	96.1	84.5	***
2. Minimum operating inventory								16,204	3,908	20,112	23,814
3. Difference (Line 1 minus 2)								6,009	2,025	8,034	9,513
If not zero, estimate what volume was:											
4. Seasonal inventory								80	50	130	154
5. In anticipation of planned maintenance								0	0	0	0
6. Normal operating inventory								5,929	1,586	7,515	8,898
Memo Item: Unavailable inventory											
7. Pipeline fill	48	386	444	878	773	1,621	61	3,333	300	3,633	***
8. Refinery lines and operating equipment fill	0	6	2	8	9	32	9	58	26	84	***
9. Oil in transit by water from domestic sources (ex Alaska)	92	9	46	147	72	25	0	244	0	244	***
10. Subtotal: Unavailable inventory outside of tankage (Lines 7, 8, and 9)	140	401	492	1,033	854	1,678	70	3,635	326	3,836	4,690
11. Tank bottoms	69	447	141	657	1,054	1,140	70	2,921	915	3,836	***
12. Plant fuel and pipeline prime mover fuel	0	0	0	0	0	0	0	0	2	2	***
13. Lease stocks											
14. Total (Lines 10, 11, 12, and 13)	209	848	633	1,690	1,908	2,818	140	6,556	1,243	7,799	9,235
15. Alaskan crude oil in transit by water											
B. STORAGE CAPACITY ASSIGNED TO KEROSINE-TYPE JET FUEL											
16. Shell capacity of tankage in operation	1,262	7,755	5,063	14,080	14,111	14,217	995	43,403	12,091	55,494	65,709
17. Tank tops and safety allowance	66	443	209	718	684	949	46	2,397	690	3,087	3,655
18. Subtotal: Net available shell capacity (Line 16 minus 17)	1,196	7,312	4,854	13,362	13,427	13,268	949	41,006	11,401	52,407	62,054
19. Unavailable inventory outside of tankage (from Line 10 above)	140	401	492	1,033	854	1,678	70	3,635	326	3,961	4,690
20. Total operating system capacity (Lines 18 and 19)	1,336	7,713	5,346	14,395	14,281	14,946	1,019	44,641	11,727	56,368	66,744
21. Maximum operating inventory								38,220	10,035	48,255	57,138
C. IDLE BUT USABLE CAPACITY/NEW CAPACITY											
22. Shell capacity of idle tankage											
23. Shell capacity of idle tankage (environmentally restricted)											
24. Tankage under construction											
D. OTHER											
25. Change in stock level due to spare refining capacity								0	0	0	0

*** Not applicable

NATIONAL PETROLEUM COUNCIL
1983 SURVEY OF PETROLEUM INVENTORIES AND STORAGE CAPACITIES IN THE UNITED STATES

KEROSINE-TYPE JET FUEL

As of March 31, 1983
(Thousands of Barrels)

INVENTORY AND STORAGE CAPACITY	PADD IA	PADD IB	PADD IC	Total PADD I	PADD II	PADD III	PADD IV	Total PADDs I-IV	PADD V	Total U.S. NPC Total	Total U.S. Adjusted NPC Total
A. KEROSINE-TYPE JET FUEL INVENTORY											
1. Total inventory reported by DOE				8,917	6,910	11,670	774	28,271	6,414	34,685	***
a. Total inventory reported to NPC	665	3,043	3,134	6,842	5,872	9,017	556	22,287	6,209	28,496	34,685
b. Percentage of line one				76.7	85.0	77.3	71.8	78.8	96.8	82.2	***
2. Minimum operating inventory								18,590	3,880	22,470	27,350
3. Difference (Line 1 minus 2)								3,697	2,329	6,026	7,335
If not zero, estimate what volume was:											
4. Seasonal inventory								276	31	307	374
5. In anticipation of planned maintenance								0	0	0	0
6. Normal operating inventory								3,421	2,064	5,485	6,676
Memo Item: Unavailable inventory											
7. Pipeline fill	27	476	812	1,315	788	3,468	122	5,693	330	6,023	***
8. Refinery lines and operating equipment fill	0	8	0	8	9	103	9	129	26	155	***
9. Oil in transit by water from domestic sources (ex Alaska)	60	244	18	322	35	80	0	437	20	457	***
10. Subtotal: Unavailable inventory outside of tankage (Lines 7, 8, and 9)	87	728	830	1,645	832	3,651	131	6,259	376	6,635	8,076
11. Tank bottoms	68	442	137	647	970	1,055	69	2,741	896	3,637	***
12. Plant fuel and pipeline prime mover fuel	0	0	0	0	0	0	0	0	0	0	***
13. Lease stocks											
14. Total (Lines 10, 11, 12, and 13)	155	1,170	967	2,292	1,802	4,706	200	9,000	1,272	10,272	12,503
15. Alaskan crude oil in transit by water											
B. STORAGE CAPACITY ASSIGNED TO KEROSINE-TYPE JET FUEL											
16. Shell capacity of tankage in operation	1,262	7,643	5,005	13,910	14,121	14,803	970	43,804	11,907	55,711	67,811
17. Tank tops and safety allowance	66	438	205	709	683	975	45	2,412	691	3,103	3,777
18. Subtotal: Net available shell capacity (Line 16 minus 17)	1,196	7,205	4,800	13,201	13,438	13,828	925	41,392	11,216	52,608	64,034
19. Unavailable inventory outside of tankage (from Line 10 above)	87	728	830	1,645	832	3,651	131	6,259	376	6,635	8,076
20. Total operating system capacity (Lines 18 and 19)	1,283	7,933	5,630	14,846	14,270	17,479	1,056	47,651	11,592	59,243	72,110
21. Maximum operating inventory								40,449	10,102	50,551	61,530
C. IDLE BUT USABLE CAPACITY/NEW CAPACITY											
22. Shell capacity of idle tankage	23	0	136	159	1,345	856	20	2,380	187	2,567	3,125
23. Shell capacity of idle tankage (environmentally restricted)	0	0	26	26	0	0	0	26	0	26	32
24. Tankage under construction	0	0	0	0	0	0	0	0	30	30	37
D. OTHER											
25. Change in stock level due to spare refining capacity								0	0	0	0

*** Not applicable

NATIONAL PETROLEUM COUNCIL
1983 SURVEY OF PETROLEUM INVENTORIES AND STORAGE CAPACITIES IN THE UNITED STATES

DISTILLATE FUEL OIL, INCLUDING NO. 4 FUEL OIL

As of September 30, 1982
(Thousands of Barrels)

INVENTORY AND STORAGE CAPACITY	PADD IA	PADD IB	PADD IC	Total PADD I	PADD II	PADD III	PADD IV	Total PADDs I-IV	PADD V	Total U.S.	
										NPC Total	Adjusted NPC Total
A. DISTILLATE FUEL OIL INVENTORY											
1. Total inventory reported by DOE				67,950	45,569	34,033	3,534	151,086	10,110	161,196	***
a. Total inventory reported to NPC	10,882	30,263	13,403	54,548	37,176	26,561	3,078	121,363	9,894	131,257	161,196
b. Percentage of line one				80.3	81.6	78.0	87.1	80.3	97.9	81.4	***
2. Minimum operating inventory								66,286	5,899	72,185	88,650
3. Difference (Line 1 minus 2)								55,077	3,995	59,072	72,546
If not zero, estimate what volume was:											
4. Seasonal inventory								18,505	677	19,182	23,557
5. In anticipation of planned maintenance								47	0	47	58
6. Normal operating inventory								32,699	3,129	35,828	44,000
Memo Item: Unavailable inventory											
7. Pipeline fill	117	1,040	3,838	4,995	4,730	5,351	306	15,382	453	15,835	***
8. Refinery lines and operating equipment fill	0	62	6	68	59	185	28	340	66	406	***
9. Oil in transit by water from domestic sources (ex Alaska)	252	153	77	482	40	37	0	559	0	559	***
10. Subtotal: Unavailable inventory outside of tankage (Lines 7, 8, and 9)	369	1,255	3,921	5,545	4,829	5,573	334	16,281	519	16,800	20,632
11. Tank bottoms	1,016	2,658	818	4,492	3,770	3,394	235	11,891	1,266	13,157	***
12. Plant fuel and pipeline prime mover fuel	0	0	2	2	0	39	0	41	8	49	***
13. Lease stocks											
14. Total (Lines 10, 11, 12, and 13)	1,385	3,913	4,741	10,039	8,599	9,006	569	28,213	1,793	30,006	36,850
15. Alaskan crude oil in transit by water											
B. STORAGE CAPACITY ASSIGNED TO DISTILLATE FUEL OIL											
16. Shell capacity of tankage in operation	20,279	59,824	24,271	104,374	69,335	46,514	4,403	224,626	20,810	245,436	301,419
17. Tank tops and safety allowance	882	3,713	1,221	5,816	3,554	3,286	239	12,895	1,354	14,249	17,499
18. Subtotal: Net available shell capacity (Line 16 minus 17)	19,397	56,111	23,050	98,558	65,781	43,228	4,164	211,731	19,456	231,187	283,920
19. Unavailable inventory outside of tankage (from Line 10 above)	369	1,255	3,921	5,545	4,829	5,573	334	16,281	519	16,800	20,632
20. Total operating system capacity (Lines 18 and 19)	19,766	57,366	26,971	104,103	70,610	48,801	4,498	228,012	19,975	247,987	304,552
21. Maximum operating inventory								199,517	18,018	217,535	267,154
C. IDLE BUT USABLE CAPACITY/NEW CAPACITY											
22. Shell capacity of idle tankage											
23. Shell capacity of idle tankage (environmentally restricted)											
24. Tankage under construction											
D. OTHER											
25. Change in stock level due to spare refining capacity								0	0	0	0

*** Not applicable

NATIONAL PETROLEUM COUNCIL
1983 SURVEY OF PETROLEUM INVENTORIES
AND STORAGE CAPACITIES IN THE UNITED STATES

DISTILLATE FUEL OIL, INCLUDING NO. 4 FUEL OIL

As of March 31, 1983
(Thousands of Barrels)

INVENTORY AND STORAGE CAPACITY	PADD IA	PADD IB	PADD IC	Total PADD I	PADD II	PADD III	PADD IV	Total PADDs I-IV	PADD V	Total U.S. NPC Total	Total U.S. Adjusted NPC Total
A. DISTILLATE FUEL OIL INVENTORY											
1. Total inventory reported by DOE				37,973	39,037	26,701	3,280	106,991	11,129	118,120	***
a. Total inventory reported to NPC	4,168	15,851	9,415	29,434	32,807	22,075	2,607	86,923	10,200	97,123	118,120
b. Percentage of line one				77.5	84.0	82.7	79.5	81.2	91.7	82.2	***
2. Minimum operating inventory								64,681	6,023	70,704	85,989
3. Difference (Line 1 minus 2)								22,242	4,177	26,419	32,131
If not zero, estimate what volume was:											
4. Seasonal inventory								1,885	958	2,843	3,458
5. In anticipation of planned maintenance								60	0	60	73
6. Normal operating inventory								17,286	2,894	20,180	24,543
Memo Item: Unavailable inventory											
7. Pipeline fill	105	1,504	2,721	4,330	4,377	4,360	316	13,383	548	13,931	***
8. Refinery lines and operating equipment fill	0	94	6	100	59	175	28	362	70	432	***
9. Oil in transit by water from domestic sources (ex Alaska)	50	422	14	486	183	49	0	718	0	718	***
10. Subtotal: Unavailable inventory outside of tankage (Lines 7, 8, and 9)	155	2,020	2,741	4,916	4,619	4,584	344	14,463	618	15,081	18,341
11. Tank bottoms	954	2,458	787	4,199	3,803	3,186	234	11,422	1,271	12,693	***
12. Plant fuel and pipeline prime mover fuel	0	0	1	1	0	39	0	40	10	50	***
13. Lease stocks											
14. Total (Lines 10, 11, 12, and 13)	1,109	4,478	3,529	9,116	8,422	7,809	578	25,925	1,899	27,824	33,839
15. Alaskan crude oil in transit by water											
B. STORAGE CAPACITY ASSIGNED TO DISTILLATE FUEL OIL											
16. Shell capacity of tankage in operation	19,216	55,855	23,327	98,398	69,439	48,680	4,390	220,907	21,955	242,862	295,366
17. Tank tops and safety allowance	797	3,376	1,166	5,339	3,565	3,422	241	12,567	1,409	13,976	16,997
18. Subtotal: Net available shell capacity (Line 16 minus 17)	18,419	52,479	22,161	93,059	65,874	45,258	4,149	208,340	20,546	228,886	278,369
19. Unavailable inventory outside of tankage (from Line 10 above)	155	2,020	2,741	4,916	4,619	4,584	344	14,463	618	15,081	18,341
20. Total operating system capacity (Lines 18 and 19)	18,574	54,499	24,902	97,975	70,493	49,842	4,493	222,803	21,164	243,967	296,710
21. Maximum operating inventory								193,339	18,944	212,283	258,176
C. IDLE BUT USABLE CAPACITY/NEW CAPACITY											
22. Shell capacity of idle tankage	1,994	1,147	465	3,606	8,690	662	2	12,960	1,121	14,081	17,125
23. Shell capacity of idle tankage (environmentally restricted)	42	930	3	975	39	110	0	1,124	40	1,164	1,416
24. Tankage under construction	0	0	42	42	80	464	20	606	103	709	862
D. OTHER											
25. Change in stock level due to spare refining capacity								0	0	0	0

*** Not applicable

NATIONAL PETROLEUM COUNCIL
1983 SURVEY OF PETROLEUM INVENTORIES AND STORAGE CAPACITIES IN THE UNITED STATES

RESIDUAL FUEL OIL

As of September 30, 1982
(Thousands of Barrels)

INVENTORY AND STORAGE CAPACITY	PADD IA	PADD IB	PADD IC	Total PADD I	PADD II	PADD III	PADD IV	Total PADDs I-IV	PADD V	Total U.S. NPC Total	Total U.S. Adjusted NPC Total
A. RESIDUAL FUEL OIL INVENTORY											
1. Total inventory reported by DOE				28,985	5,738	16,226	451	51,400	10,418	61,818	***
a. Total inventory reported to NPC	1,617	7,055	4,092	12,764	3,031	8,275	318	24,388	8,999	33,387	61,818
b. Percentage of line one				44.0	52.8	51.0	70.5	47.4	86.4	54.0	***
2. Minimum operating inventory								13,468	3,564	17,032	31,536
3. Difference (Line 1 minus 2)								10,920	5,435	16,355	30,282
If not zero, estimate what volume was:											
4. Seasonal inventory								2,127	3	2,130	3,944
5. In anticipation of planned maintenance								227	569	796	1,474
6. Normal operating inventory								8,284	4,268	12,552	23,241
Memo Item: Unavailable inventory											
7. Pipeline fill	2	3	4	9	2	1	1	13	28	41	***
8. Refinery lines and operating equipment fill	0	15	0	15	14	70	8	107	52	159	***
9. Oil in transit by water from domestic sources (ex Alaska)	48	57	0	105	48	15	0	168	0	168	***
10. Subtotal: Unavailable inventory outside of tankage (Lines 7, 8, and 9)	50	75	4	129	64	86	9	288	80	368	681
11. Tank bottoms	266	837	333	1,436	452	1,352	44	3,284	1,093	4,377	***
12. Plant fuel and pipeline prime mover fuel	0	159	12	171	31	204	20	426	50	476	***
13. Lease stocks											
14. Total (Lines 10, 11, 12, and 13)	316	1,071	349	1,736	547	1,642	73	3,998	1,223	5,221	9,667
15. Alaskan crude oil in transit by water											
B. STORAGE CAPACITY ASSIGNED TO RESIDUAL FUEL OIL											
16. Shell capacity of tankage in operation	4,589	15,811	11,216	31,616	9,939	19,304	1,092	61,951	24,615	86,566	160,282
17. Tank tops and safety allowance	187	1,342	641	2,170	452	1,492	55	4,169	1,520	5,689	10,533
18. Subtotal: Net available shell capacity (Line 16 minus 17)	4,402	14,469	10,575	29,446	9,487	17,812	1,037	57,782	23,095	80,877	149,749
19. Unavailable inventory outside of tankage (from Line 10 above)	50	75	4	129	64	86	9	288	80	368	681
20. Total operating system capacity (Lines 18 and 19)	4,452	14,544	10,579	29,575	9,551	17,898	1,046	58,070	23,175	81,245	150,430
21. Maximum operating inventory								51,012	17,902	68,914	127,598
C. IDLE BUT USABLE CAPACITY/NEW CAPACITY											
22. Shell capacity of idle tankage											
23. Shell capacity of idle tankage (environmentally restricted)											
24. Tankage under construction											
D. OTHER											
25. Change in stock level due to spare refining capacity								0	0	0	0

*** Not applicable

NATIONAL PETROLEUM COUNCIL
1983 SURVEY OF PETROLEUM INVENTORIES
AND STORAGE CAPACITIES IN THE UNITED STATES

RESIDUAL FUEL OIL

As of March 31, 1983
(Thousands of Barrels)

INVENTORY AND STORAGE CAPACITY	PADD IA	PADD IB	PADD IC	Total PADD I	PADD II	PADD III	PADD IV	Total PADDs I-IV	PADD V	Total U.S.	
										NPC Total	Adjusted NPC Total
A. RESIDUAL FUEL OIL INVENTORY											
1. Total inventory reported by DOE				20,589	3,588	12,753	436	37,366	8,927	46,293	***
a. Total inventory reported to NPC	1,448	4,479	2,510	8,437	2,325	7,771	396	18,929	7,795	26,724	46,293
b. Percentage of line one				41.0	64.8	60.9	90.8	50.7	87.3	57.7	***
2. Minimum operating inventory								11,568	3,706	15,274	26,459
3. Difference (Line 1 minus 2)								7,361	4,089	11,450	19,834
If not zero, estimate what volume was:											
4. Seasonal inventory								448	1	449	778
5. In anticipation of planned maintenance								149	494	643	1,114
6. Normal operating inventory								5,373	3,506	8,879	15,381
Memo Item: Unavailable inventory											
7. Pipeline fill	2	3	4	9	2	1	1	13	33	46	***
8. Refinery lines and operating equipment fill	0	15	0	15	14	71	8	108	53	161	***
9. Oil in transit by water from domestic sources (ex Alaska)	0	142	0	142	51	55	0	248	0	248	***
10. Subtotal: Unavailable inventory outside of tankage (Lines 7, 8, and 9)	2	160	4	166	67	127	9	369	86	455	788
11. Tank bottoms	274	761	327	1,362	430	1,386	42	3,220	1,147	4,367	***
12. Plant fuel and pipeline prime mover fuel	0	183	12	195	61	152	20	428	56	484	***
13. Lease stocks											
14. Total (Lines 10, 11, 12, and 13)	276	1,104	343	1,723	558	1,665	71	4,017	1,289	5,306	9,191
15. Alaskan crude oil in transit by water											
B. STORAGE CAPACITY ASSIGNED TO RESIDUAL FUEL OIL											
16. Shell capacity of tankage in operation	4,704	15,066	10,446	30,216	9,503	19,805	949	60,473	22,342	82,815	143,457
17. Tank tops and safety allowance	197	1,274	554	2,025	426	1,613	42	4,106	1,388	5,494	9,517
18. Subtotal: Net available shell capacity (Line 16 minus 17)	4,507	13,792	9,892	28,191	9,077	18,192	907	56,367	20,954	77,321	133,940
19. Unavailable inventory outside of tankage (from Line 10 above)	2	160	4	166	67	127	9	369	86	455	788
20. Total operating system capacity (Lines 18 and 19)	4,509	13,952	9,896	28,357	9,144	18,319	916	56,736	21,040	77,776	134,728
21. Maximum operating inventory								44,584	17,720	62,304	107,927
C. IDLE BUT USABLE CAPACITY/NEW CAPACITY											
22. Shell capacity of idle tankage	261	878	804	1,943	1,340	705	174	4,162	3,021	7,183	12,443
23. Shell capacity of idle tankage (environmentally restricted)	0	0	0	0	6	160	0	166	257	423	733
24. Tankage under construction	0	0	308	308	0	1,000	5	1,313	800	2,113	3,660
D. OTHER											
25. Change in stock level due to spare refining capacity								0	0	0	0

*** Not applicable

NATIONAL PETROLEUM COUNCIL
1983 SURVEY OF PETROLEUM INVENTORIES AND STORAGE CAPACITIES IN THE UNITED STATES

NAPHTHA-TYPE JET FUEL

As of March 31, 1983
(Thousands of Barrels)

INVENTORY AND STORAGE CAPACITY	PADD IA	PADD IB	PADD IC	Total PADD I	PADD II	PADD III	PADD IV	Total PADDs I-IV	PADD V	Total U.S. NPC Total	Total U.S. Adjusted NPC Total
PART A. INVENTORY											
1. Dedicated inventory reported to the Department of Energy[1]	79	424	32	535	1,780	2,418	343	5,076	1,794	6,870	***
2. Dedicated inventory reported to the NPC	64	437	0	501	1,275	1,245	324	3,345	1,122	4,467	6,870
3. Line 2 as a percentage of Line 1	81.0	103.1	0	93.6	71.6	51.5	94.5	65.9	62.5	65.0	***
4. Minimum Operating Inventory[2]								1,718	442	2,160	3,322
5. Difference[3]								1,627	680	2,307	3,548
6. Unavailable inventory[4]											
7. Memo Item: Stocks which could have been dedicated[5]	28	295	59	382	395	2,580	141	3,498	906	4,404	6,773
PART B. DESIGN CAPACITY[6]								4,866	1,847	6,713	10,324

[1]Includes both specification product and any components dedicated as of March 31, 1983, and reported as naphtha-type jet fuel to DOE.
[2]Consistent with the line item instructions for Line 2 on Questionnaires 1–6.
[3]Reason for positive difference not surveyed.
[4]Not surveyed.
[5]Includes any inventory on hand (including line fill) as of March 31, 1983, categorized as unfinished oils, blending components, special naphthas, naphtha less than 400°F endpoint (see DOE Form EIA-810) which the company could have made available (stocks which could have been dedicated from other products) immediately for use as naphtha-type jet fuel and not reported in Line 2. Amounts entered represent product which would meet specification with little or no processing other than mechanical blending. Does not include stocks if facility management processes (i.e., cleaning tankage) would have been required prior to making the product available.
[6]The design capacity normally dedicated to production, distribution, and storage of naphtha-type jet fuel consistent with Lines 18–20 on Questionnaires 1–6. Includes net available shell capacity of tankage in operation plus unavailable inventory outside of tankage.

IMPACT OF THE STRATEGIC PETROLEUM RESERVE ON PRIVATE INVENTORY LEVELS

Total industry inventories of refined products and crude oil are currently below historical levels. Has the existence of the Strategic Petroleum Reserve contributed to a decrease in your inventories? If yes, please provide an estimate of the amount, expressed as a percentage of your total crude oil stocks as of March 31, 1983 (Questionnaire 1, Column 7).

Yes 1 – —% No 71

*** Not applicable

NATIONAL PETROLEUM COUNCIL
1983 SURVEY OF PETROLEUM INVENTORIES
AND STORAGE CAPACITIES IN THE UNITED STATES

PETROLEUM FUTURES

1) Has your firm traded in the petroleum futures markets?

26 Yes
117 No

2) Which oil futures have you traded?

23 #2 Fuel Oil/Gasoil
16 Motor Gasoline
5 Crude Oil

3) As a percentage of your March 31, 1983, inventories, what is the maximum open interest you have had in each commodity during the last 12 months?

Average response: #2 Fuel Oil 42% Motor Gasoline 15% Crude Oil 67%

How many contracts does this represent?

Average response: #2 Fuel Oil 443 Motor Gasoline 266 Crude Oil 166

4) If you have traded or anticipate trading in the petroleum futures market, which of the following best describes the reason? Please list in order of importance (1 through 7, with 1 being the principal reason).

Weighted Response:	
Physical Inventory	3
Supplemental Outlet for Products	6
Supplemental Source of Products	4
Potential Profits Through Speculation	5
Hedge Against Price Fluctuations	1
Additional Flexibility	2
Other	7

5) Has there been or do you visualize a change in your physical inventory policy or physical inventory levels due to the presence of the petroleum futures markets?

17 Yes
117 No

NATIONAL PETROLEUM COUNCIL
1983 SURVEY OF PETROLEUM INVENTORIES AND STORAGE CAPACITIES IN THE UNITED STATES

ESTIMATED MINIMUM AND MAXIMUM OPERATING INVENTORIES FOR THE ENTIRE U.S. PETROLEUM INDUSTRY

As of September 30, 1982, and March 31, 1983
(Thousands of Barrels)

	Minimum						Maximum					
	September 30, 1982			March 31, 1983			September 30, 1982			March 31, 1983		
	PADDs I-IV	PADD V	TOTAL U.S.	PADDs I-IV	PADD V	TOTAL U.S.	PADDs I-IV	PADD V	TOTAL U.S.	PADDs I-IV	PADD V	TOTAL U.S.
CRUDE OIL:												
Highest Estimate				235,000	75,000	310,000				340,000	110,000	540,000
Lowest Estimate				220,000	60,000	260,000				310,000	90,000	400,000
Average				**229,333**	**70,000**	**289,714**				**325,000**	**100,000**	**447,500**
No. of Cos. Reporting				3	3	7				2	2	4
GASOLINE (MOTOR AND AVIATION):												
Highest Estimate	190,000	25,500	210,000	190,000	24,700	210,000	320,000	40,000	409,000	320,000	40,000	424,000
Lowest Estimate	170,000	20,000	190,000	180,000	20,000	190,000	230,000	30,000	260,000	240,000	30,000	280,000
Average	**178,200**	**21,375**	**197,912**	**182,525**	**21,175**	**202,100**	**263,333**	**36,667**	**321,800**	**271,667**	**36,667**	**329,800**
No. of Cos. Reporting	4	4	6	4	4	8	3	3	5	3	3	5
KEROSINE, INCLUDES KERO-TYPE JET FUEL:												
Highest Estimate	30,000	5,900	35,000	27,200	6,000	40,000	69,000	11,000	80,000	69,000	11,000	80,000
Lowest Estimate	24,900	5,000	30,000	24,900	5,000	30,000	43,000	7,000	50,000	38,000	7,000	45,000
Average	**27,933**	**5,333**	**33,760**	**25,700**	**5,367**	**33,640**	**56,000**	**9,000**	**65,000**	**53,500**	**9,000**	**67,667**
No. of Cos. Reporting	3	3	5	3	3	5	2	2	3	2	2	3
DISTILLATE FUEL OIL, INCL. NO. 4 FUEL OIL:												
Highest Estimate	150,000	10,500	160,000	105,300	10,300	115,600	270,000	30,000	290,000	260,000	20,000	280,000
Lowest Estimate	100,000	8,000	100,000	91,000	8,000	100,000	180,000	12,000	200,000	168,000	12,000	180,000
Average	**128,400**	**9,625**	**132,137**	**97,825**	**9,325**	**104,200**	**221,000**	**20,667**	**242,000**	**214,000**	**16,000**	**228,750**
No. of Cos. Reporting	4	4	8	4	4	8	3	3	5	2	2	4
RESIDUAL FUEL OIL:												
Highest Estimate	37,300	8,000	45,300	35,000	8,000	45,000	90,000	20,000	115,000	90,000	20,000	110,000
Lowest Estimate	35,000	8,000	30,000	32,000	8,000	30,000	73,000	12,000	85,000	70,000	10,000	60,000
Average	**36,433**	**8,000**	**42,217**	**33,500**	**8,000**	**40,643**	**81,500**	**16,000**	**103,333**	**80,000**	**15,000**	**80,000**
No. of Cos. Reporting	3	3	6	3	3	7	2	2	3	2	2	4
NAPHTHA-TYPE JET FUEL:												
Highest Estimate	5,100	1,500	6,600	4,900	1,400	6,300	10,000	2,000	12,000	10,000	2,000	12,000
Lowest Estimate	4,000	1,000	2,000	4,000	1,000	2,000	6,000	2,000	6,000	6,000	2,000	6,000
Average	**4,367**	**1,167**	**4,720**	**4,300**	**1,133**	**4,660**	**8,000**	**2,000**	**8,667**	**8,000**	**2,000**	**8,667**
No. of Cos. Reporting	3	3	5	3	3	5	2	2	3	2	2	3

NOTE: The totals may not add, as each cell represents an individual estimate. In some cases, the averages will not add due to the different number of estimates in each cell that have been used to calculate the averages.

Appendix F:
The Impact of Petroleum Futures Markets on Inventory Levels

The petroleum futures markets are a relatively new phenomenon in commodities trading. Commodities futures, primarily agricultural products, have been traded for over a century, providing an opportunity to spread financial and supply risk in a cyclical product or to make a gain from speculation in the product.

Ownership of a commodity does not change hands at the time that a futures contract is entered into. A futures contract is a legally binding promise to deliver or take delivery, in the future, of a specific quantity and quality of a commodity at a specific price, time, and location.

Futures contracts are bought and sold with a commitment for delivery of a physical product during a specific month in the future, up to 18 months ahead. Very few petroleum futures contracts are actually delivered as "wet barrels" (the physical commodity). In 1982, about two percent of all trades were delivered. Most participants in the markets fulfill their obligations to buy or sell under the contract through an opposite, offsetting transaction in the futures market, rather than delivering or taking delivery of "wet barrels."

There are four requirements for any successful commodities futures market:

- Fluctuating prices
- The desire of market participants to arrange in advance for the purchase or sale of the product at a known price and time prior to its actual distribution or consumption
- A level of fungibility (standardization of product quality)
- A large number of buyers and sellers participating in the market.

Two early 1970s attempts to establish petroleum futures markets failed because one or more of these requirements was not met. The 1974 introduction of a crude oil contract by the New York Cotton Exchange failed largely due to problems with quality standardization. The No. 6 residual fuel oil contract introduced in 1978 by the New York Mercantile Exchange (NYMEX) also failed.

The No. 2 distillate fuel oil contract introduced by the NYMEX in 1978, however, has grown steadily in volume traded. In 1981, NYMEX introduced a futures contract for leaded motor gasoline and the International Petroleum Exchange (IPE) in London began an energy futures contract for a distillate fuel oil (gasoil). In late 1982, the Chicago Board of Trade (CBOT) introduced a futures contract for unleaded gasoline. Trading of contracts in crude oil began in 1983 on the three exchanges. Table F-1 summarizes the petroleum commodities traded on the various exchanges and the starting dates of their trading.

The terms of all futures contracts, except price, are determined by the rules of the commodity exchange with, in the United States, the approval of the Commodity Futures Trading Commission. These terms include contract unit, quality specifications, and delivery location. For petroleum futures, the contract unit is the same for all exchanges, 1,000 barrels, except on the IPE, where the gasoil contract unit is 100 metric tons (approximately 746 barrels). Quality specifications and delivery points for each product vary among the exchanges.

TABLE F-1

STARTING DATES OF PETROLEUM COMMODITY TRADING

	NYMEX*	CBOT†	IPE‡
No. 2 Fuel Oil	Nov. 1978	Apr. 1983	Apr. 1981
Regular Leaded Gasoline	Oct. 1981	-	-
Regular Unleaded Gasoline	-	Dec. 1982	-
Crude Oil	Apr. 1983	Apr. 1983	Nov. 1983

*New York Mercantile Exchange.
†Chicago Board of Trade.
‡International Petroleum Exchange (London).

TABLE F-2

NYMEX REGULAR LEADED GASOLINE POSITIONS AS OF MARCH 25, 1983

	Open Interest*				
	Long		Short		
	Number of Contracts	Number of Firms	Number of Contracts	Number of Firms	Total Accounts†
Reportable‡					
Hedgers					
Refiners	1,569	4	765	4	N/A
Resellers	3,953	16	4,442	21	N/A
End Users	483	5	404	7	N/A
Total Hedgers	6,005	25	5,611	32	44
Speculators	1,444	19	1,206	16	28
Total Reportable	7,449	44	6,817	42	72
Non-Reportable§	3,120		3,752		
Total Open Interest	**10,569**		**10,569**		

*Number of contracts outstanding at the end of a trading day.
†The sum of the longs and shorts is larger than the total accounts because some accounts are buying (long) and selling (short) at the same time. N/A = not available.
‡Holders of 25 contracts (1,000 barrels per contract) or more.
§Fewer than 25 contracts. Estimated by NYMEX to be 60 percent speculators, 40 percent hedgers. Only brokers have access to this information.

Source: NYMEX

There are two types of futures traders—speculators and hedgers. Hedgers are usually involved in producing, marketing, or consuming the product covered by the contract. They use the futures market to gain protection from sudden price fluctuations in the physical product that could reduce inventory values or increase the cost of future product acquisition. Thus they use futures to reduce risk, not to make a profit on the futures themselves.

Speculators are generally not in the business of buying or selling the product involved. They enter into futures contracts for the express purpose of making a profit on their transactions. The speculators provide the large numbers of buyers and sellers necessary for an effective market and facilitate the transfer of risk from the hedgers.

Most oil companies active in the futures market operate as hedgers, to reduce their business risk, rather than as speculators for financial gain. Tables F-2 and F-3 present the positions for regular leaded gasoline and No. 2 fuel oil held by speculators and hedgers on the NYMEX as of March 25, 1983.

To better understand the extent of involvement in the petroleum futures market by different segments of the oil industry, the NPC surveyed the primary distribution system companies and bulk plant operators. Appendices E and K present the results of the surveys. The NPC cautions the reader, however, that the crude oil results are misleading because trading in crude oil futures contracts began only a few days before the survey date.

This survey was conducted because the NPC was concerned that, in the event of a petroleum supply shortage, many companies holding contracts for crude oil or products may hold those contracts, wanting

TABLE F-3

NYMEX NO. 2 FUEL OIL POSITIONS AS OF MARCH 25, 1983

	Open Interest*				
	Long		Short		
	Number of Contracts	Number of Firms	Number of Contracts	Number of Firms	Total Accounts†
Reportable‡					
Hedgers					
Refiners	3,133	12	2,647	13	N/A
Resellers	4,170	21	6,896	30	N/A
End Users	740	7	921	10	N/A
Total Hedgers	8,043	40	10,464	53	67
Speculators	5,988	49	6,105	64	97
Total Reportable	14,031	89	16,569	117	164
Non-Reportable§	7,246		4,708		
Total Open Interest	**21,277**		**21,277**		

*Number of contracts outstanding at the end of a trading day.

†The sum of the longs and shorts is larger than the total accounts because some accounts are buying (long) and selling (short) at the same time. N/A = not available.

‡Holders of 25 contracts (1,000 barrels per contract) or more.

§Fewer than 25 contracts. Estimated by NYMEX to be 60 percent speculators, 40 percent hedgers. Only brokers have access to this information.

Source: NYMEX

delivery of "wet barrels," only to find that the barrels may not be available. The companies may have financial security, but no physical delivery of needed crude oil or products.

Most companies stated that the futures markets did not affect their inventory levels. As expected, the reason given most often by companies in the primary distribution system for participating in the futures markets was price hedging. Second, they cited additional flexibility, and third, physical inventory.

The results of the futures portion of the 1983 NPC survey on storage capacity and inventory in the secondary distribution system reinforce the finding in the primary system analysis that futures markets do not have an effect on inventory levels. As in the primary system, the secondary system companies most often reported price hedging as their reason for participating in the futures markets. However, profit from speculation was second and additional flexibility third.

Glossary of Futures Terms

CBOT—Chicago Board of Trade.

clearinghouse—subsidiary of a futures exchange which interposes itself between every trade so as to become a party to every contract. Acts as central business office and credit corporation for the exchange. Guarantees performance of all contracts and manages the delivery process.

close a position (to)—to cancel a long or short position through a sale or purchase.

Commodity Futures Trading Commission (CFTC)—Federal agency authorized to regulate futures trading in all commodities.

delivery area—the points specified in an exchange's rules as to where delivery of the physical commodity can be made.

delivery month—the month in which delivery against a futures contract takes place.

futures contract—an agreement to make or accept delivery of a standardized amount of a commodity, of a standardized quality, during a specific month. Futures contracts are traded on an organized central exchange, at prices set by public auction. They are subject to all terms and conditions included in the rules of an exchange. By closing a position before the delivery month, delivery can be avoided.

hedge—the establishment of an opposite position in the futures market from that held in the physical market as a protection against the possibility of adverse price fluctuations.

IPE—International Petroleum Exchange (London).

last trading day—the day when futures trading ceases for a particular delivery month. For products, it is generally the last business day of the month preceding the delivery month.

long—a person who has bought futures. A long hedge is a buyer's hedge. A long position is one in which a person has committed to buy futures.

margin—good faith money deposited by buyers and sellers of futures contracts, to ensure performance of the terms of the contract. Minimum margins are set by the exchange's rules.

NYMEX—New York Mercantile Exchange.

open interest—contracts outstanding at the end of a trading day.

position—a market commitment. A buyer of futures has a long position and a seller of futures has a short position.

short—a person who has sold futures. A short hedge is a seller's hedge. A short position is one initiated by the sale of futures.

speculator—a trader who is not a hedger. One who assumes risk in order to make a profit through a favorable price move.

volume—the number of transactions occurring during a specific period of time. Equal to the number of purchases or sales of contracts made during the period.

"wet barrels"—physical barrels.

Appendix G:
The Strategic Petroleum Reserve

The Strategic Petroleum Reserve Program was created by the Energy Policy and Conservation Act (P.L. 94-163), enacted on December 22, 1975. In the aftermath of the 1973-1974 Arab oil embargo, Congress declared it to be U.S. policy that a reserve of up to one billion barrels of crude oil and/or petroleum products be established to reduce the impact of disruptions in petroleum supplies or to carry out the obligations of the United States under the International Energy Program.

The Strategic Petroleum Reserve (SPR) may not be drawn down unless the President determines that a national energy supply shortage exists that is, or is likely to be, of significant scope and duration; is of an emergency nature; may cause major adverse impact on national safety and the national economy; and results, or is likely to result, from an interruption in imported petroleum supplies, sabotage, or an act of God.

The Energy Policy and Conservation Act required submission to the Congress of an SPR plan to detail the proposals for designing, constructing, and filling the Reserve. The SPR Plan, submitted on February 16, 1977, and effective on April 18, 1977, discusses the development and implementation of the Reserve.

The schedule for filling the Reserve was accelerated by SPR Plan Amendment No. 1, submitted to the Congress on May 25, 1977. Amendment No. 2 to the SPR Plan, submitted May 18, 1978, authorized an increase in the SPR size from 500 million barrels to one billion barrels of stored oil and detailed plans for government storage of 750 million barrels. On October 31, 1979, the Distribution Plan for the SPR, Plan Amendment No. 3, was submitted to Congress. This amendment was replaced on December 1, 1982, when a new "Drawdown" (Distribution) Plan (Amendment No. 4) for the use of the SPR was transmitted to Congress. This plan, required under the Energy Emergency Preparedness Act of 1982, provides for primary use of market procedures for the drawdown, sale, and distribution of crude oil from the SPR.

The SPR program consists of the development of six crude oil storage sites and one marine terminal on the Gulf Coast of the United States. The SPR storage sites are interconnected to three major interstate crude oil distribution networks, the Seaway, Texoma, and Capline pipeline systems, and associated marine terminals.

The first 750 million barrel storage capacity of the SPR is currently being developed in three phases. Phase I consists of the conversion of five sites with existing storage capacity of approximately 260 million barrels, one in Texas and four in Louisiana, plus a Department of Energy marine terminal facility at St. James, Louisiana. The Phase I sites are Bryan Mound in Texas, and Bayou Choctaw, West Hackberry, Sulphur Mines, and Weeks Island in Louisiana.

Phase II consists of the expansion of three Phase I sites to increase the SPR storage capacity by 290 million barrels. The Bryan Mound site is being expanded by 120 million barrels and the West Hackberry

site is being expanded by 160 million barrels, both by leaching (solution mining) new caverns. A further 10-million-barrel capacity will be added to Phase II through acquisition of an additional existing storage cavern at Bayou Choctaw.

Phase III, consisting of approximately 200 million barrels, will involve the further expansion of existing sites and the development of a new 140 million barrel site located at Big Hill, Texas.

As of March 31, 1983, the SPR inventory was 312 million barrels of crude oil in storage, an increase of 223 million barrels over the July 30, 1979, level reported in the previous NPC study. The SPR drawdown and distribution capability at that time was 1.7 million barrels per day. Upon completion of Phase II, as described in the plan and subsequent amendments, the SPR will be able to sustain a drawdown and distribution rate of up to 3.5 million barrels per day.

Appendix H:
Caribbean Facilities

There is a significant volume of storage in the Caribbean associated with both tanker transshipment terminals and refining operations in Puerto Rico and the Virgin Islands. This storage capacity was not included in the NPC's 1983 Survey of Petroleum Inventories and Storage Capacities in the United States.

Tanker transshipment terminals provide deepwater facilities into which supertankers off-load. These terminals are needed because most U.S. ports have insufficient water depth for fully loaded supertankers. Arriving ships discharge their cargo into storage at the deepwater terminal; the terminal then reloads the cargo into smaller tankers, which can off-load at U.S. ports. The total storage capacity of these transshipment terminals is estimated to be about 30-40 million barrels.

Crude oil and fuel product storage capacity in U.S. company refineries in Puerto Rico and the Virgin Islands amounts to another 45 million barrels.[1]

In total, there are about 80 million barrels of storage in the facilities described above. Some terminals or refineries may have excess storage capacity due to lower crude oil and product demand, but this excess capacity is not constant. Further, the tanker transshipment terminals in the Caribbean are not under U.S. control nor do they service the U.S. market exclusively, so their usefulness in times of emergency cannot be assured. While the other facilities are within U.S. territories and possessions, their value for emergency storage will depend upon the nature of the supply interruption that occurs and its effect on the operations of the individual terminals or refineries, which are factors beyond the scope of this report.

[1]Data from Energy Information Administration Form EIA-820.

Appendix I:
Historical Perspective on Refining Capacity Utilization

As indicated in Table I-1, refining operations in the United States have undergone significant change since the 1979 NPC study. The number of operable U.S. refineries and their crude oil distillation capacity increased from 1978 until 1980; since that time, a substantial number of refineries have been shut down. In spite of this substantial reduction in refining capacity, operable refinery utilization has remained below historical levels, with year-average 1982 utilization at the 70 percent level, versus 88 percent in 1978.

TABLE I-1

OPERABLE U.S. REFINING CAPACITY TRENDS

Year	Number of Refineries at Year End*	Crude Oil Distillation Capacity at Year End* (MB/D)†	Average Utilization‡ (%)
1978	311	17.4	88
1979	319	18.0	85
1980	324	18.6	76
1981	301	17.9	69
1982	258	16.9	70

*Annual Energy Information Administration (EIA) Refinery Capacity Surveys.
†Thousands of barrels per day.
‡EIA *Petroleum Supply Monthly* and EIA *Weekly Petroleum Status Report.*

The EIA's definition of operable capacity includes capacity that has been shut down but can be placed in operation within 90 days. As a result of some concern that this definition overstates the capacity in actual use, and thereby understates its utilization, EIA published not only operable capacity, but also idle capacity and operating capacity in use, beginning in January 1983. The companies' monthly utilization rates for 1983 on both an operating and operable basis are shown in Table I-2.

TABLE I-2

U.S. REFINERS' MONTHLY UTILIZATION RATES, JANUARY–JUNE 1983

Month	Gross Inputs To Stills (MB/D)*	Operable Capacity (MB/D)*	Operable Utilization (%)	Operating Capacity (MB/D)*	Operating Utilization (%)
Jan.	11,423	16,825	67.9	14,899	76.7
Feb.	11,000	16,823	65.4	14,413	76.3
Mar.	11,118	16,848	66.0	14,556	76.4
Apr.	11,664	16,832	69.3	14,622	79.8
May	12,060	16,837	71.6	14,589	82.7
June	12,606	16,819	74.9	14,670	85.9

*Thousands of barrels per day.

Source: EIA, *Petroleum Supply Monthly*, March-August 1983.

It is believed that refiners may be relying on spare refining capacity and the flexibility it offers as a substitute for holding higher inventory levels. The NPC survey results to Line Item 25 on Questionnaires I-6, however, indicate that current inventory levels are not influenced by the spare refining capacity. (See Appendix E for the survey results.)

Appendix J:

Demand and Primary Inventory Levels, 1978-1983

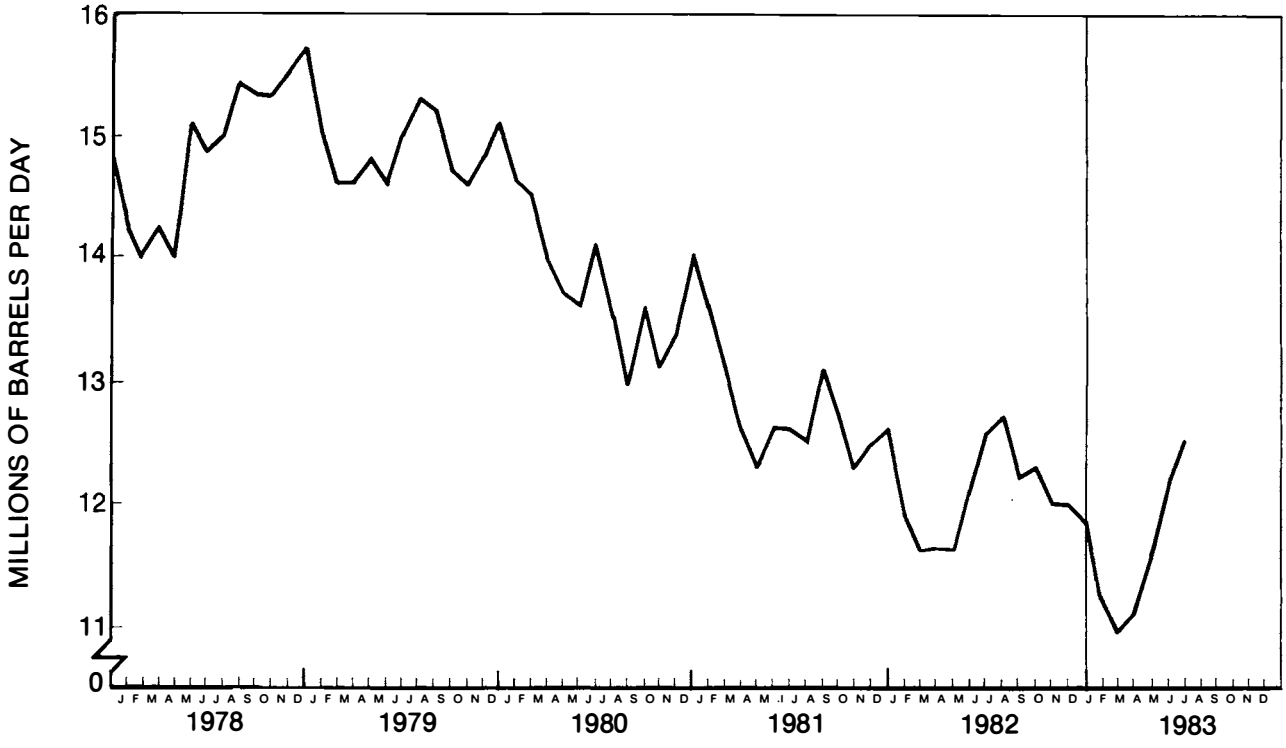


Figure J-1. Demand on Primary System for Crude Oil—Total U.S. (Millions of Barrels per Day).*

*Demand for crude oil is defined as the sum of refinery inputs, crude oil used directly as fuel oil, crude oil losses, and exports.

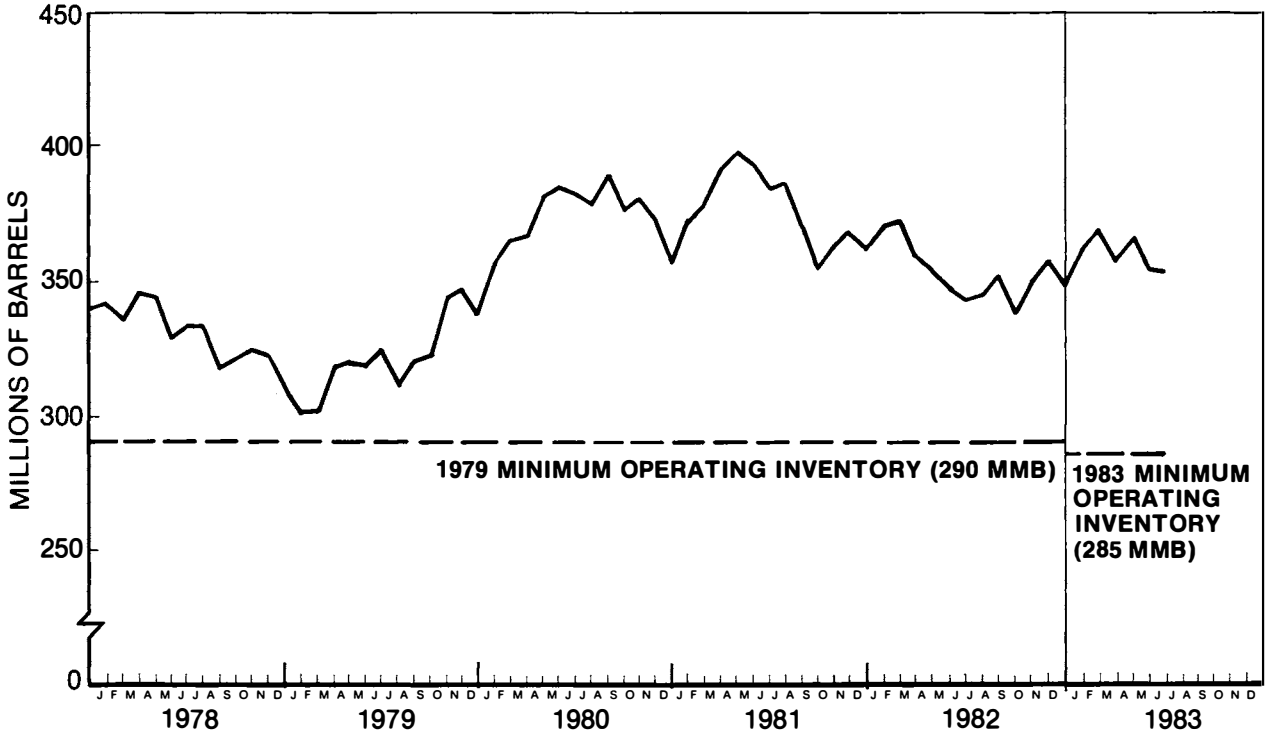


Figure J-2. Stocks of Crude Oil—Total U.S., Excluding SPR (Millions of Barrels).

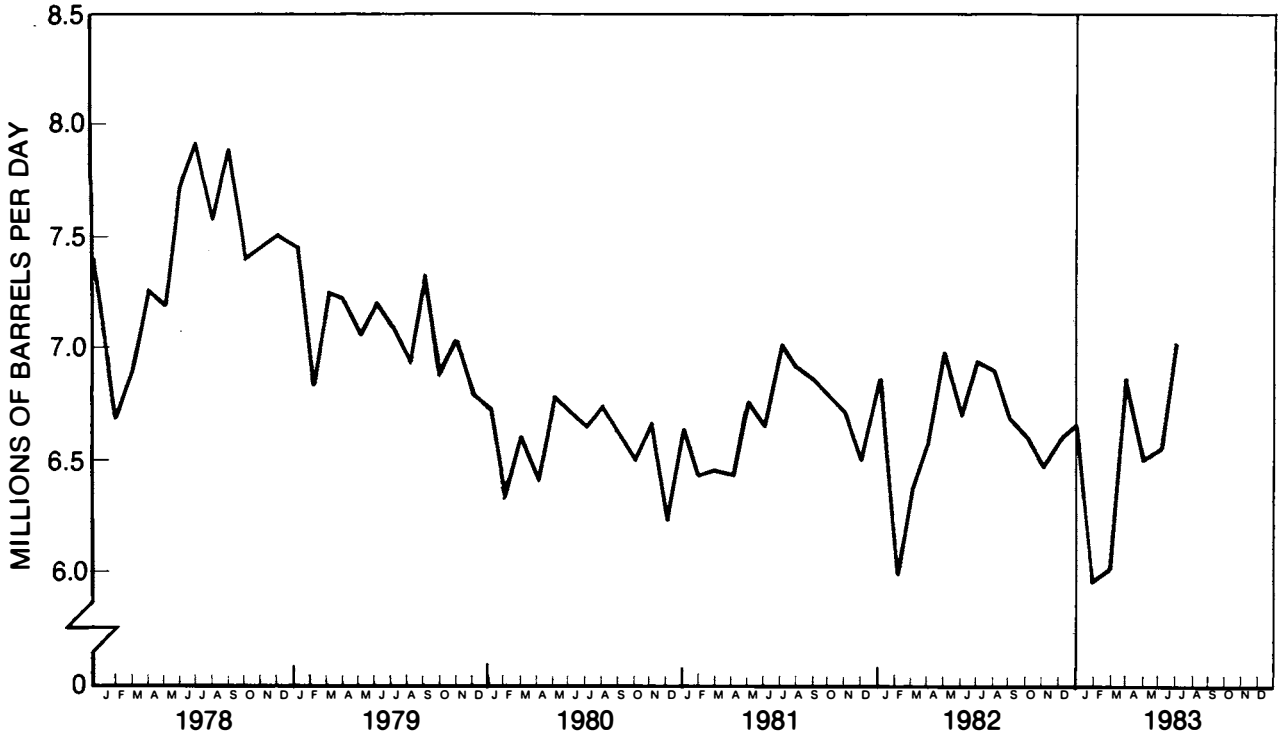


Figure J-3. Demand on Primary System for Motor Gasoline—Total U.S.
(Millions of Barrels per Day).

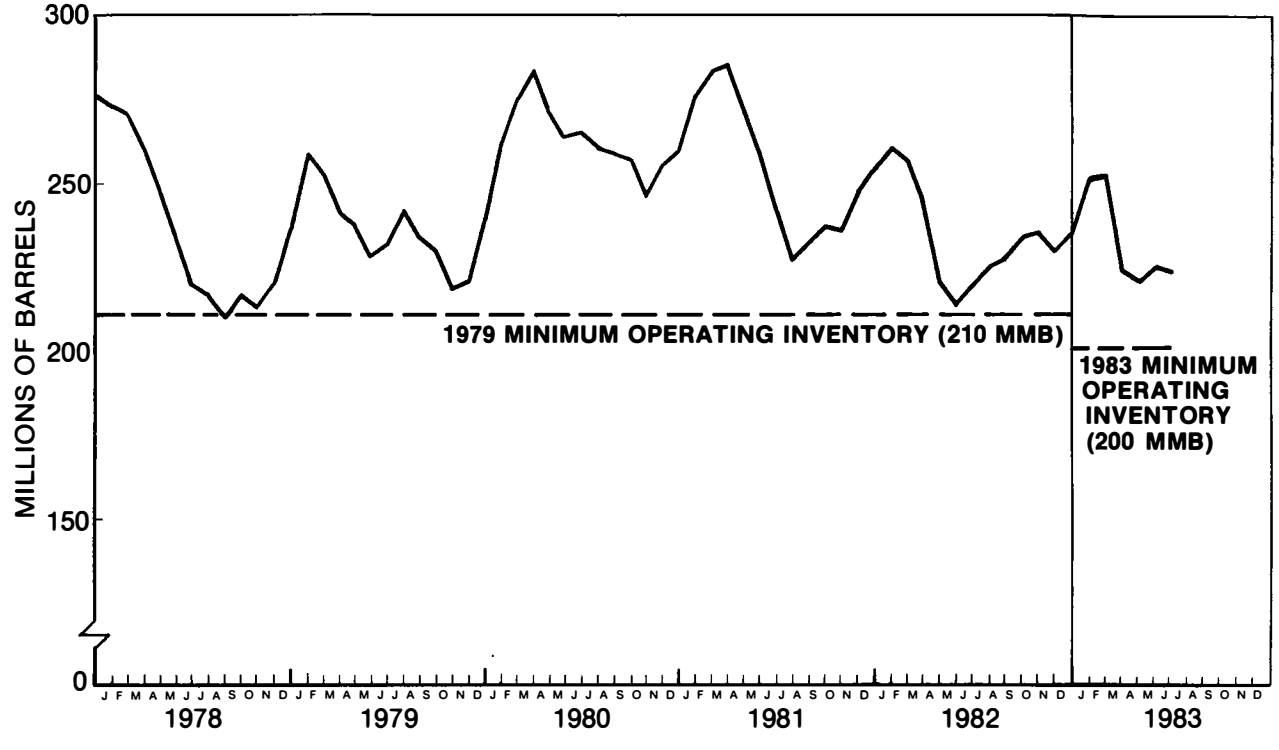


Figure J-4. Stocks of Motor Gasoline—Total U.S.
(Millions of Barrels).

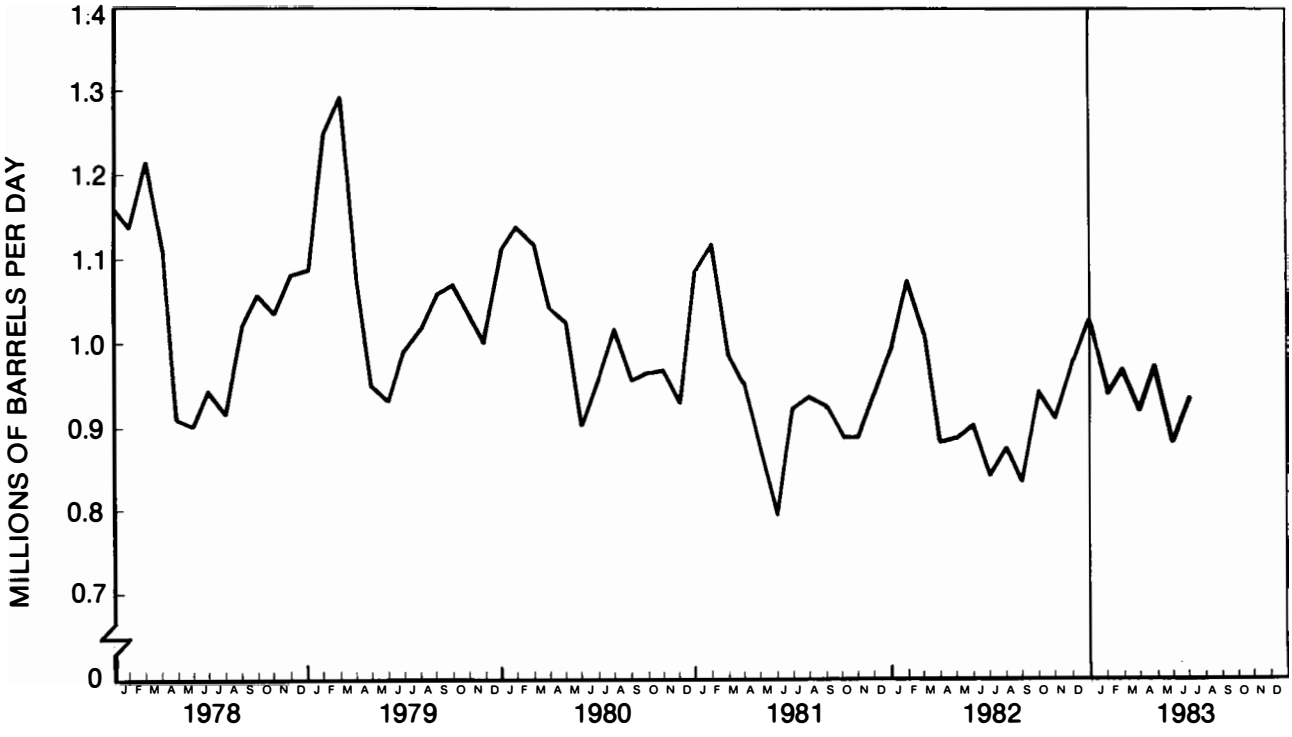


Figure J-5. Demand on Primary System for Kerosine and Kerosine-Type Jet Fuel—Total U.S. (Millions of Barrels per Day).

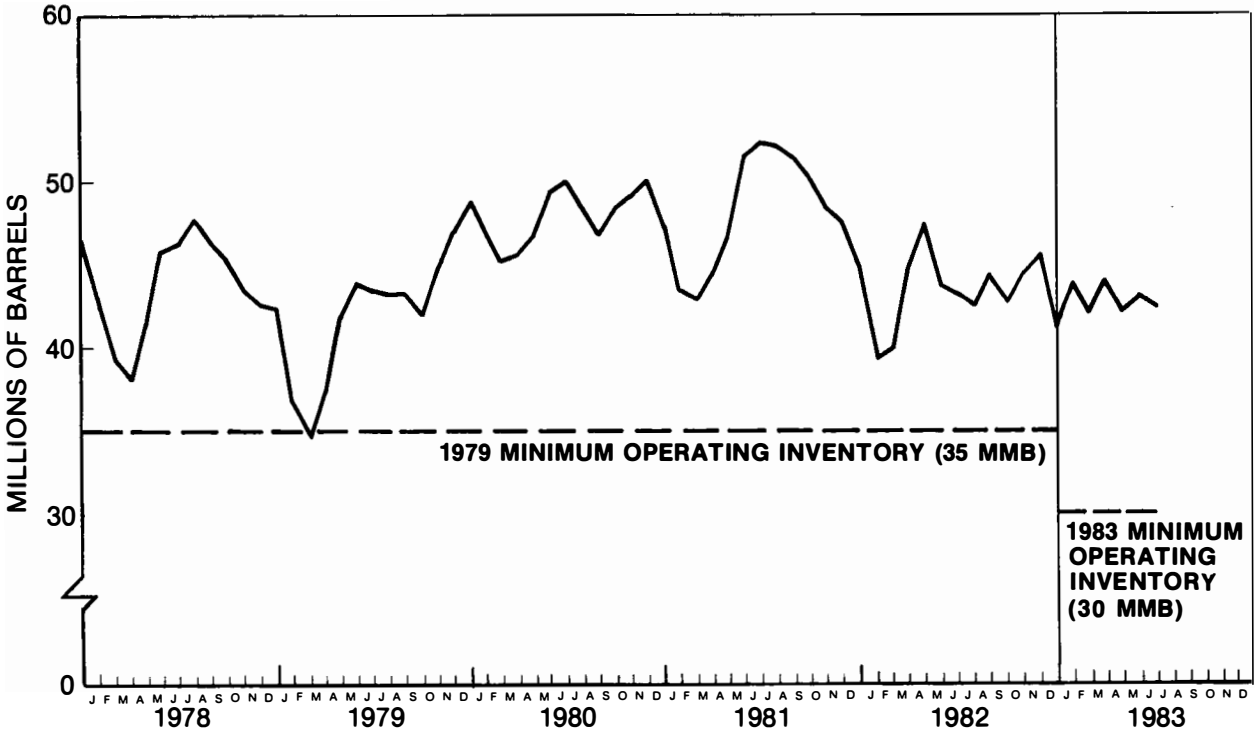


Figure J-6. Stocks of Kerosine and Kerosine-Type Jet Fuel—Total U.S. (Millions of Barrels).

Figure J-7. Demand on Primary System for Distillate Fuel Oil—Total U.S.
(Millions of Barrels per Day).

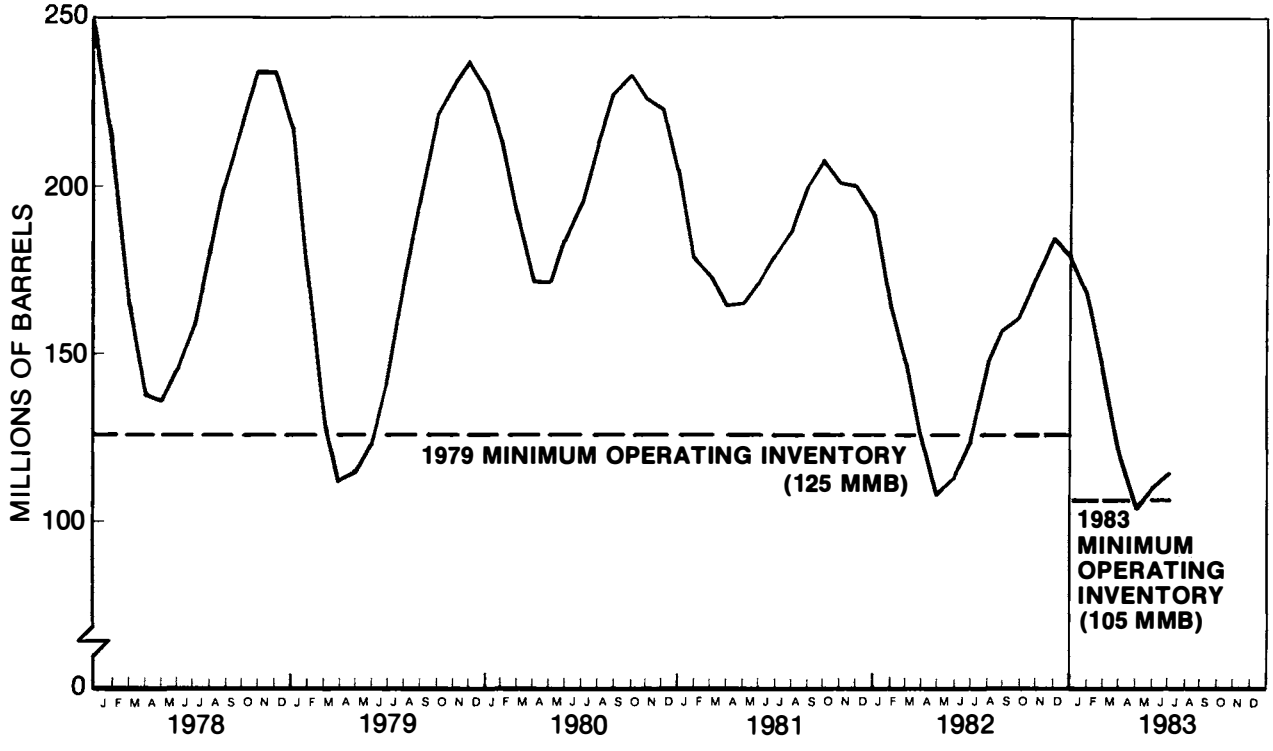


Figure J-8. Stocks of Distillate Fuel Oil—Total U.S.
(Millions of Barrels).

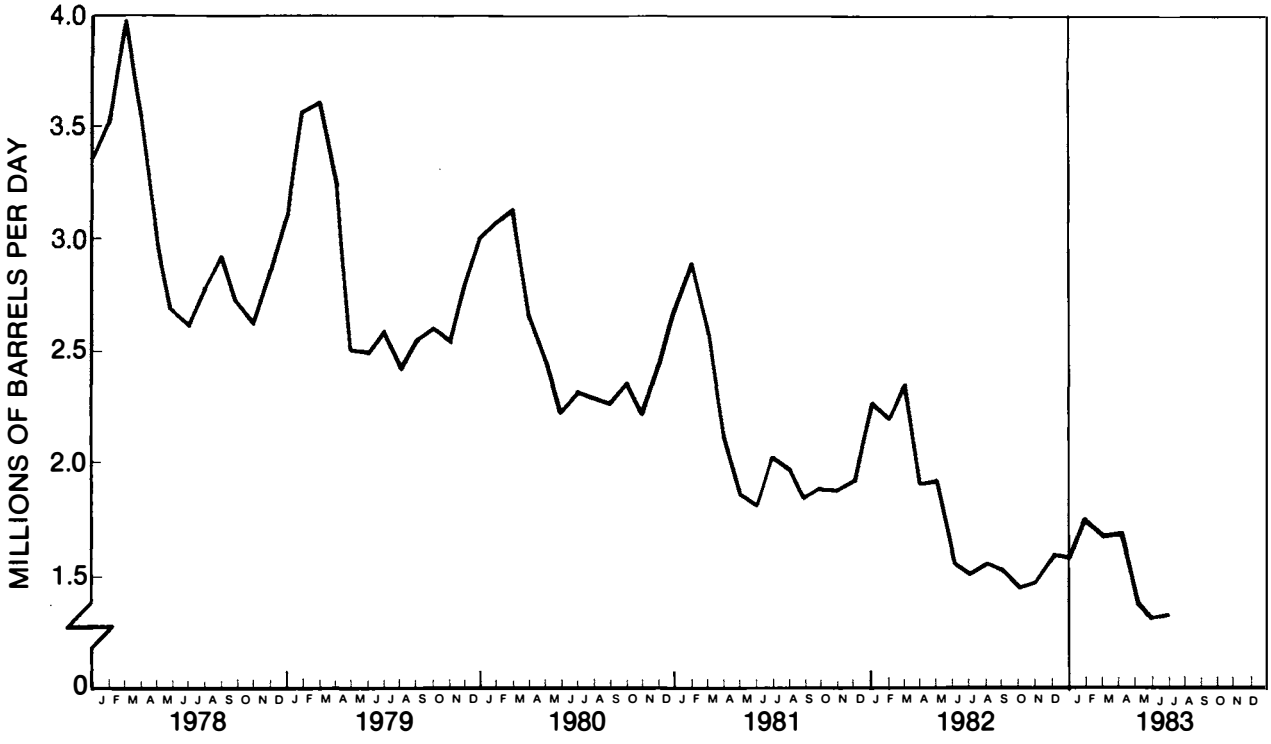


Figure J-9. Demand on Primary System for Residual Fuel Oil—Total U.S.
(Millions of Barrels per Day).

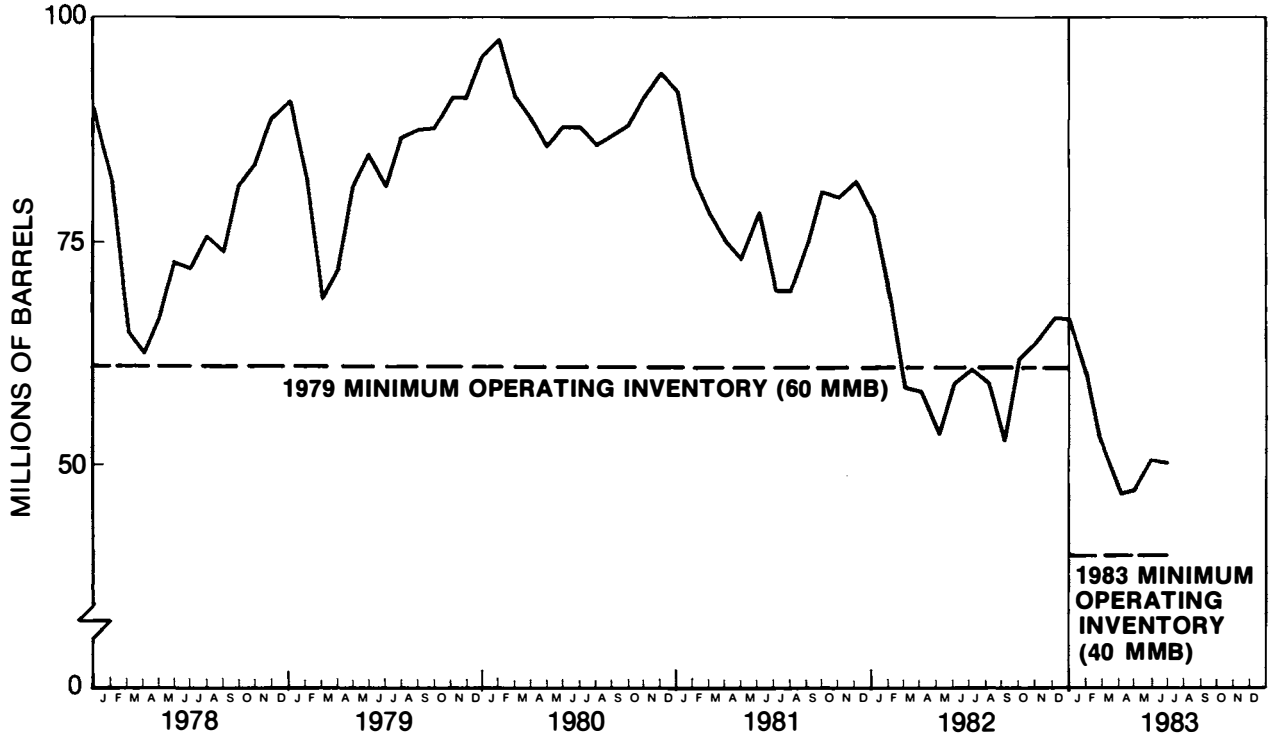


Figure J-10. Stocks of Residual Fuel Oil—Total U.S.
(Millions of Barrels).

Appendix K:

Methodologies for Determining Petroleum Inventories and Storage Capacity in the Secondary Petroleum Distribution System

Introduction

The secondary distribution system is composed of two sectors: bulk plants and retail motor fuel outlets. Different methodologies were used to estimate the storage capacity and inventories in each of these sectors. A stratified random sample of bulk plant operators was surveyed to determine their storage capacity and inventories as of March 31, 1983. Estimates for the total population were projected from these data. The storage capacity and inventories at retail motor fuel outlets were estimated based on published literature and discussions with industry experts. These methodologies are described below.

Bulk Plants

Objective

The National Petroleum Council's 1983 Survey of Petroleum Inventories and Storage Capacity in the Secondary Distribution System in the United States was designed to determine:

- The total storage capacity for selected petroleum products in bulk plants on March 31, 1983
- The amount of motor gasoline and distillate storage that was switchable between those products
- The total level of inventory of selected refined petroleum products in bulk plants as of March 31, 1983
- The impact of the petroleum futures market on inventories and storage capacity in bulk plants.

Scope of the Survey

The survey collected storage capacity and inventory data for motor gasoline, kerosine, distillate fuel oil, and residual fuel oil for March 31, 1983. That date was selected to be consistent with the primary system survey. The survey covered the 50 states and the District of Columbia, but excluded all U.S. territories and possessions and the Hawaiian Foreign Trade Zone. Storage of motor gasoline at retail outlets was excluded from the survey.

Description of the Questionnaires

The questionnaire consisted of two parts: Part One, storage and inventory; and Part Two, petroleum futures. Part One of the questionnaire asked only three questions:

- Total fixed storage capacity by product
- Amount of storage capacity of motor gasoline, distillate fuel oil, and kerosine storage that can be switched without modification to tankage
- Inventory by product as of March 31, 1983.

The futures questionnaire was identical to that in the primary system survey, except for Question 4, which was revised to request only the three major reasons for the company's participation in the petroleum futures markets, rather than a ranking of the seven reasons given.

The inventory and capacity information was requested by the Petroleum Administration for Defense District (PADD) for companies that operate in more than one PADD. A survey without PADD divisions was sent to companies that operate in only one PADD. As in the primary survey, PADD I was divided into three regions: New England (IA), Central Atlantic (IB), and Lower Atlantic (IC) states. The futures information was requested companywide. A copy of the questionnaire is found at the end of this appendix.

The Survey Population

There were 2,088 questionnaires sent. The population included the companies in the primary distribution system that held the products surveyed as well as a stratified random sampling of the nonprimary companies.

The population for the survey was determined from the EIA-764, Petroleum Product Sales Identification Survey. To develop a list of resellers of gasoline and sellers and resellers of distillate and residual fuel oils, the EIA-764 survey was mailed, in May 1982, to approximately 60,000 names and addresses. The sales data from the EIA-764 were augmented by storage data from a previous EIA survey, the EIA-402. The EIA-402, Fuel Oil Identification Survey, was mailed by EIA in 1979. In addition to sales data, it also collected total storage capacity for motor gasoline, distillate fuel oil, and residual fuel oil.

The EIA-764 survey results were used to identify firms that were on the list more than once (duplicates), and firms that were out of business, did not resell the products surveyed, or for whom the survey forms were undeliverable by the post office. After this screening, 36,031 names and addresses remained on the list.

Stratification Design

The 36,031 names and addresses for this survey were stratified for processing and estimation based on the following:

- Companies that operate in both the primary distribution system and the secondary distribution system were separated from firms that operate only in the secondary distribution system.
- Companies that were known to operate in more than one PADD were separated from companies that were known to operate in only one PADD.
- Companies that were "large," according to available data, were separated from those that were "small."
- Companies for which no volumetric data were available (e.g., nonrespondents to the EIA-764) were separated from the companies for which volumetric data were available.

Each company was assigned to a strata. The strata were assigned processing codes, which are summarized in Table K-1. All companies that operate in more than one PADD, operate in the primary sector, or that were designated as "large," received a survey form. The others were randomly sampled. The extent of followup of the nonrespondents varied by strata, depending upon the expected contribution to the overall PADD estimates and the expected variation of the storage capacity within each group. A description of the makeup of each stratum is as follows:

Code PR: Priority, Primary

This stratum is comprised of companies in the primary distribution system that were thought to have very large storage capacity. They received extensive followup.

Code A: Multi-PADD, Primary

This stratum is comprised of the companies in the primary distribution system that operate in more than one PADD, except for those large enough to be assigned to PR.

TABLE K-1

SUMMARY OF STRATIFICATION DESIGN

Process Codes	PADD	Description	Number in Population	Number in Survey	Response Rate (Percent)
PR	Priority	Primary*	77	77	84
A	Multi-PADD		73	73	74
B	IA	Primary	27	27	33
C	IB	Primary	61	61	44
D	IC	Primary	15	15	53
E	II	Primary	49	49	41
F	III	Primary	66	66	41
G	IV	Primary	6	6	67
H	V	Primary	32	32	19
J	Multi-PADD	Large	183	183	66
K	Multi-PADD	Small	598	598	34
L	IA	Large	41	41	51
M	IB	Large	58	58	67
N	IC	Large	53	53	66
O	II	Large	69	69	67
P	III	Large	56	56	59
Q	IV	Large	22	22	64
R	V	Large	41	41	73
S	IA	Small-sample	2,087	41	85
T	IB	Small-sample	3,273	66	82
U	IC	Small-sample	2,742	55	62
V	II	Small-sample	9,128	90	73
W	III	Small-sample	2,845	57	67
X	IV	Small-sample	913	37	70
Y	V	Small-sample	1,363	45	73
Z	Miscellaneous	NPC-identified	54	54	48
Z1	Miscellaneous	Nonrespondent	12,099	116	72

*Companies operating in the primary distribution system.

Codes B-H: Single PADD, Primary

These strata are comprised of all companies in the primary distribution system that operate in a single PADD, except for those large enough to be assigned code PR. Each PADD was assigned a unique processing code.

Codes J-K: Multi-PADD, Not Primary

These two strata are comprised of all companies that were not in the primary distribution system, but were known to operate in more than one PADD. The J code was assigned to the "large" companies and the K code was assigned to the "small" companies.

Codes L-R: Large, Single PADD, Not Primary

These strata are comprised of all "large" companies that were not in the primary distribution system and were known to operate in only one PADD. The definition of "large" varied from PADD to PADD.

Codes S-Y: Small, Single PADD, Not Primary

These strata are comprised of all "small" companies that were not in the primary distribution system, were to operate in only one PADD, and were not included among codes L-R above. A random sample was selected from the small companies in each PADD.

Code Z: No Volumetric Data Available, Not Primary, NPC Identified

The companies for which there were no volumetric data available were separated into two groups, depending on whether or not they were independently identified as having substantial storage in some state via a separate survey conducted by the NPC. This survey is described below.

The 22 largest refiners/marketers were asked by the NPC staff, in mid-1983, to identify the companies with the largest bulk plant storage capacity, by state. The NPC-identified companies that had volumetric data from the EIA-764, and that confirmed that they were large, were included in one of the strata identified above.

The NPC-identified companies for which no volumetric data were available from the EIA-764 all received the secondary survey. This group includes two separate subgroups: those companies that were on the EIA list, but had no data; and those companies that were not on the EIA list. The NPC prepared a separate mailing for this later group. Both of these subgroups were assigned processing code Z.

Code Z1: No Volumetric Data Available, Not Primary

There were an additional 12,099 companies from the EIA list that had no volumetric data and were not identified through the NPC survey. A simple random sample of these companies was selected to respond to the secondary survey. These companies received extensive nonresponse followup. They were assigned code Z1.

Estimation Procedures

The U.S. total for a stratum was estimated as the average of the reported data multiplied by the estimated number of companies in the stratum with storage capacity.

Pooling is used in two places: when calculating the estimates of the number of firms with storage, and when estimating the size of the average firm for each product. In the first instance, similar strata are pooled to achieve a more accurate ratio of the number of firms with storage to the number of total responses. The ratio for the entire pool is used for each stratum in the pool to estimate the number of firms with storage in that stratum. In the second instance, the estimated size of the average firm for each product reflects the pooling. This provides additional assurance of confidentiality.

The U.S. total estimates can be viewed as the sum of the responses and of the estimates of the nonrespondents and those not surveyed. The respondents were assumed to resemble the nonrespondents and those not surveyed in terms of their average size and of the percentage that have storage capacity. The estimate for the nonrespondents was distributed by PADD according to the percentage of the sales for the aggregate of the nonrespondents in that PADD. The sales data available for distillate fuel oil, residual fuel oil, and motor gasoline on the EIA-764 survey were used to determine the appropriate percentages. Although volumetric sales and storage have been shown to be uncorrelated, it was assumed that the sales data provided information concerning the PADDs in which the nonresponding companies operated. Since no EIA data were available on kerosine sales, the estimated kerosine storage for the nonrespondents was distributed among PADDs based on the PADD breakdown of the respondents.

The estimates for the nonrespondents and those not surveyed in strata Z and Z1 were distributed based on the PADD breakdown of the responding small single-PADD firms.

Results of the Survey

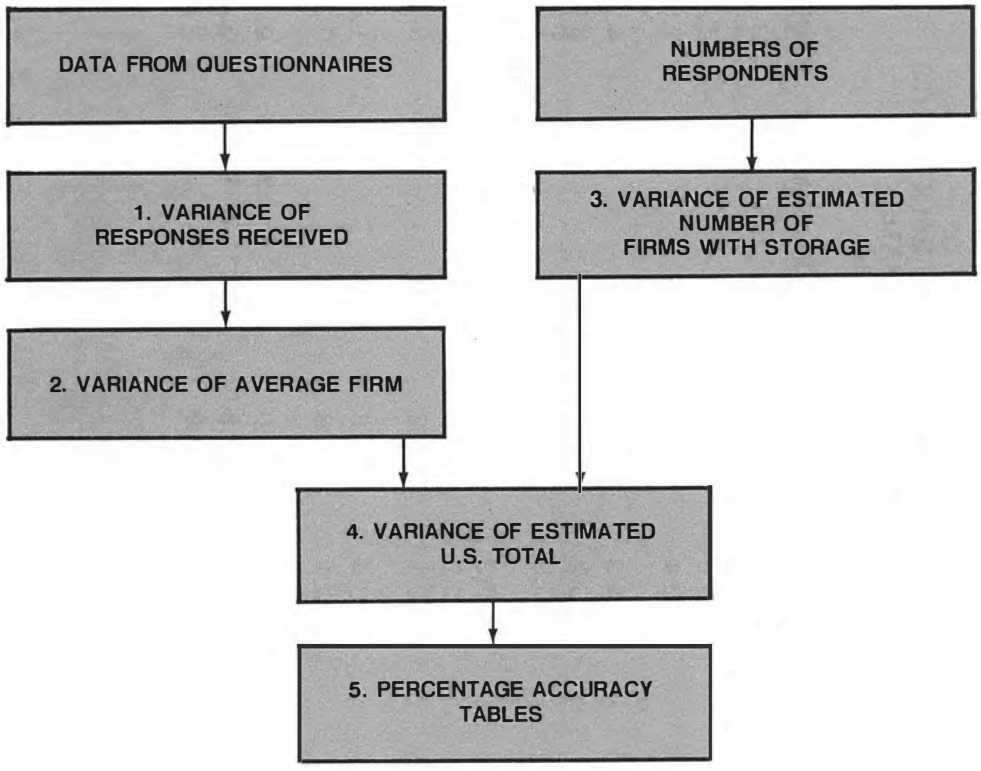
Of the 2,088 companies surveyed, 55.3 percent responded. Analysis was performed on the accuracy of the estimates. No efforts were made to audit the accuracy of the survey responses.

As anticipated at the outset of this survey, the projections have varying degrees of reliability. The national level estimates of storage capacity for motor gasoline, diesel/distillate fuel oil, kerosine, and residual fuel oil are accurate, at a 95 percent confidence level, to within 8, 36, 17, and 21 percent, respectively, of the actual values. The PADD level estimates range from being quite useful (the estimate of storage capacity of motor gasoline in PADD II is accurate to within 15 percent) to being unreliable (the estimate of storage capacity of diesel/distillate fuel oil in PADD IV is only accurate, with 95 percent confidence, to 209 percent of the actual level). In general, estimates at the PADD level for either primary or non-primary firms are unreliable. Aggregating up to the total PADD estimate or the national estimate produces increasingly reliable projections.

The results of the survey, confidence levels, and response rates by stratum and the results of the secondary system petroleum futures survey are shown on Tables K-2, K-3, K-4, and K-5.

Calculations of Variances and Percentage Accuracy Tables

The methodology used in calculating the accuracy of the estimates is described in the flowchart and the explanations below:



1. **Variance of Responses Received**—This number is calculated from the data base and is not included in the report.

   Formula: $X^2/N - AVG^2$; where X = data in individual company file, N = number of firms with storage of any product, and AVG = sum of responses received divided by N.

2. **Variance of Average Firm**—This number is used in further calculations. It is not included in the report.

   Formula: V/N; where V = variance of responses received (#1 above), and N = number of firms with storage of any product.

3. **Variance of Estimated Number of Firms with Storage**—This number is not included in the report. The value is a variance of numbers of responding firms, not data.

   Formula: $N^{2*}VP$; where N = number of firms with storage of any product, and VP = pooled variance of the number of respondees with storage.

TABLE K-2

NPC 1983 SURVEY OF STORAGE AND INVENTORY IN BULK PLANTS SUMMARY OF ESTIMATES (Millions of Barrels)

		PADD IA	PADD IB	PADD IC	PADD II	PADD III	PADD IV	PADD V	Total
	Storage	1.1	3.1	2.7	8.2	3.7	1.2	1.8	21.8
Motor Gasoline	Switchable	0.8	2.1	1.9	6.0	2.2	0.7	1.3	15.0
	Inventory	0.4	1.3	1.0	3.1	1.6	0.5	0.7	8.7
Diesel/Distillate	Storage	4.3	11.1	2.8	9.4	4.2	1.4	3.5	36.6
Fuel Oil	Switchable	3.2	5.9	2.0	5.9	3.0	0.8	2.2	23.0
	Inventory	0.9	1.8	0.5	2.6	1.2	0.4	0.9	8.4
	Storage	0.3	1.0	1.1	1.1	0.3	*	0.2	4.0
Kerosine	Switchable	0.2	0.8	0.8	0.9	0.2	*	0.2	3.2
	Inventory	0.1	0.2	0.3	0.4	0.1	*	0.1	1.2
Residual Fuel	Storage	0.4	1.8	0.6	1.6	1.0	0.2	0.5	6.1
Oil	Inventory	0.1	0.6	0.1	0.4	0.3	0.1	0.1	1.8
	Storage	**6.1**	**17.0**	**7.2**	**20.3**	**9.1**	**2.9**	**5.9**	**68.5**
Total	**Switchable**	**4.2**	**8.8**	**4.7**	**12.8**	**5.4**	**1.6**	**3.7**	**41.3**
	Inventory	**1.5**	**3.9**	**2.0**	**6.5**	**3.3**	**1.0**	**1.9**	**20.0**

*Less than .05 million barrels.

TABLE K-3

NPC 1983 SURVEY OF STORAGE AND INVENTORY IN BULK PLANTS SUMMARY OF PERCENTAGE ACCURACIES AT 95 PERCENT CONFIDENCE LEVEL*

		PADD IA	PADD IB	PADD IC	PADD II	PADD III	PADD IV	PADD V	Total
Motor Gasoline	Storage	29.2	25.6	18.1	14.9	20.0	30.9	28.5	8.5
	Switchable	26.9	28.0	15.5	16.7	17.7	15.8	17.3	8.7
	Inventory	33.5	31.0	18.0	17.0	19.7	25.5	23.9	9.2
Diesel/Distillate Fuel Oil	Storage	120.9	70.2	124.0	55.9	90.3	208.8	133.4	35.8
	Switchable	71.4	33.0	24.1	20.8	24.5	14.7	30.4	14.9
	Inventory	54.7	39.2	37.1	24.1	39.2	24.9	46.8	15.1
Kerosine	Storage	69.7	40.9	26.1	30.6	47.2	79.4	112.6	17.3
	Switchable	70.5	47.7	31.5	28.5	47.7	23.1	114.9	19.1
	Inventory	74.0	35.4	37.6	31.3	66.9	67.0	130.5	21.1
Residual Fuel Oil	Storage	52.7	38.1	55.5	56.0	42.7	60.7	47.5	21.4
	Inventory	61.8	50.3	52.6	48.0	39.7	66.8	345.1	34.6

*These tables can be read as: "These estimates are accurate to within _____ percent of the total in 95 percent of the cases." The formula used to calculate the confidence levels is ([SQRT (Variance of Total)]/Total) *1.96.

TABLE K-4

RATES OF RESPONSE BY STRATUM

Stratum	Not Applicable	Refused to Respond	Duplicate	Firms With Some Storage	Total Responses Received*	Total Surveys Sent	Response Rate (Percent)
PR	40	3	2	23	65	77	84
A	37	1	3	14	54	73	74
B	6	0	0	3	9	27	33
C	8	0	1	18	27	61	44
D	5	0	0	3	8	15	53
E	13	0	3	4	20	49	41
F	20	0	2	5	27	66	41
G	2	0	0	2	4	6	67
H	5	0	0	1	6	32	19
B-H	59	0	6	36	101	256	39
J	79	13	3	38	120	183	66
K	50	0	4	148	202	598	34
L	4	2	2	15	21	41	51
M	11	4	9	19	39	58	67
N	12	3	1	22	35	53	66
O	14	4	4	28	46	69	67
P	13	1	2	18	33	56	59
Q	2	3	1	11	14	22	64
R	14	2	1	15	30	41	73
L-R	70	19	20	128	218	340	64
S	20	0	1	14	35	41	85
T	29	2	1	24	54	66	82
U	7	2	0	27	34	55	62
V	16	7	3	47	66	90	73
W	10	1	0	28	38	57	67
X	6	2	0	20	26	37	70
Y	10	2	2	21	33	45	73
S-Y	98	16	7	181	286	391	73
Z	3	5	4	19	26	54	48
Z1	62	3	1	20	83	116	72
TOTAL	**498**	**60**	**50**	**607**	**1,155**	**2,088**	**55**

*(Number of firms responding not applicable) + (Number of firms providing data); excludes firms refusing to respond.

TABLE K-5

RESULTS OF THE FUTURES SURVEY

Of the 607 firms who responded to the secondary survey and who had some secondary storage, 585 responded to the futures survey. A tabulation of these responses is as follows:

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PETROLEUM FUTURES

The petroleum futures markets are increasing in prominence. Originally, non-oil futures markets (e.g., wheat and corn) were created as a hedge against price fluctuations. However, it appears that the petroleum futures markets may also have a significant influence on operating decisions such as inventory management. The following questionnaire attempts to ascertain the possible impact of petroleum futures markets on inventories.

1) Does your firm currently trade in petroleum futures markets?

18 Yes **557** No

If your answer is No, please go to Question 5.

2) Which oil futures have you traded? *(Number of times chosen)*

#2 Fuel Oil **15** Motor Gasoline **11** Crude Oil **3**

3) As a percentage of your monthly requirements, what is the maximum open interest you have ever had in each commodity? *(No useful information provided)*

#2 Fuel Oil___% Motor Gasoline___% Crude Oil___%

How many contracts does this represent?

#2 Fuel Oil_____ Motor Gasoline_____ Crude Oil_____

4) If you are currently trading, which of the following describes why? Please list in order of preference (1 through 3, with 1 being the main reason). *(Ranked in the order of the number of times chosen)*

_____ Inventory Management
_____ Supplemental Outlet for Products
3rd Supplemental Source of Products
2nd Potential Profits Through Speculation
1st Hedge Against Price Fluctuations
3rd Additional Flexibility
_____ Other

5) Has there been or do you visualize a change in your inventory policy or inventory levels due to the presence of the petroleum futures markets?

45 Yes **522** No

4. **Variance of Estimated U.S. Total**—These are the values from which the accuracy of the national estimates can be judged. The numbers are not included in the report.

   Formula: $(VA*K) + (AVG^2*K) + (VA*M^2)$; where VA = variance of the average firm (#2 above), K = variance of estimated number of firms with storage (#3 above), AVG = sum of responses received divided by the number of responses, M = estimated number of nonrespondents with some storage (estimated number of firms with storage − number of respondees with storage).

5. **Percentage Accuracy**—This value gives an understandable measure of the accuracy of the national estimates. The numbers should be interpreted as saying "These estimates are accurate to within ____ percent of the total in 95 percent of the cases," with the percentage accuracy number inserted in the blank. A summary of percentage accuracies is presented in Table K-3.

   Formula: (Square root of VE/E)* 196; where VE = variance of estimated U.S. total (#4 above) and E = estimated U.S. total.

Retail Motor Fuel Outlets

The methodology utilized to estimate the total storage capacity and inventory contained in retail motor fuel outlets in the United States involved estimation of the total number of such outlets, followed by independent assessment of the average storage capacity and inventory at these outlets. These assessments were based on data obtained by independent survey, research of trade articles and discussions held with representatives of various petroleum trade associations, refiners, marketers, jobbers, and firms in related industries. Where practical, independent sources were used to test the reasonableness and accuracy of each element used in the final storage capacity and inventory estimation.

Number of Retail Outlets

Several sources, both public and private, were used by the NPC to estimate the total number of retail outlets in the United States. The estimate of outlets is the result of a consensus reached after evaluation of all available data sources.

A telephone survey of representatives of industry and trade associations was conducted for the NPC by the Southeastern Independent Oil Marketers Association (SEIOMA). This survey, which included contact with 211 firms or associations, estimated total retail outlets in four categories—major metropolitan area service stations; other metropolitan and rural area service stations; convenience stores; and other, smaller outlets such as car and implement dealers. As shown in Table K-6, results of that survey indicated total U.S. retail outlets to number 207,600, with the total storage capacity (which will be discussed later) of 86 million barrels.

In 1982, a detailed study was conducted by Marketing Corporations of America (MCA)[1] to determine a marketing plan for a new product and to develop data on the number of underground tanks in use in the United States. This information was based on detailed interviews with oil company representatives, reports prepared by tank manufacturers, research of hundreds of articles, and review of federal and state level data. Although incidental to the primary objective of the study, MCA estimated that there were 229,000 retail outlets in the United States during 1980, with a total storage capacity of approximately 80 million barrels. Adjusting that estimate downward to reflect estimated closures through year-end 1982 resulted in an adjusted MCA-study-based estimate of 209,000 outlets. The average storage capacity per outlet, determined using the MCA study, was estimated to be approximately 14.8 thousand gallons.

Finally, in September 1983, Lundberg Associates published the results of a study they had conducted to determine the total 1982 retail outlet count. The study indicated that there were 211,000 retail outlets in existence but did not address storage capacity.

[1]Made available to the NPC by Hunter Environmental Services.

TABLE K-6

ESTIMATED NUMBER OF RETAIL MOTOR GASOLINE OUTLETS AND STORAGE CAPACITY*

	Number of Stations	Average Storage per Station (Gallons)	Total Storage (Thousands of Barrels)
Major Metropolitan Area Stations	63,000	28,000	42
Rural and Other Metropolitan Service Stations	57,600	14,500	20
Convenience Stores	37,000	24,000	21
Car Dealers, Implement Dealers, Small Stores	50,000	2,500	3
Total	**207,600**	**17,500**	**86**

*May and June 1983 phone survey of 211 firms.

These estimates are compared in Table K-7. After considering these data, which were developed independently by three different techniques, the NPC reached the conclusion that there were 210,000 retail outlets at year-end 1982.

TABLE K-7

ESTIMATED NUMBER OF RETAIL OUTLETS, 1982

	Number of Outlets
SEIOMA	207,000
MCA*	209,000
Lundberg	211,000

NPC Consensus: 210,000 outlets

*Adjusted to 1982 from 1980 estimate of 229,000.

Average Storage

The average storage capacity per retail outlet was estimated by the NPC to be 16,800 gallons per retail outlet. (This average capacity per retail outlet was estimated by the NPC by considering the results of the SEIOMA and MCA surveys and the average storage capacity of the retail outlets owned by the companies represented on the study committee.) Based on the estimated number of retail outlets derived above, this yields a total storage capacity of 84 million barrels.

The estimated PADD distribution of retail outlet storage capacity was derived in a similar manner. The SEIOMA survey of 211 firms indicated average storage capacity per outlet in PADDs I-IV to be approximately 15,300 gallons per outlet. PADD V outlets were estimated to have storage capacity of 31,000

gallons per outlet. These preliminary results were tested by followup discussions with each of the companies represented on the study committee. Based on these discussions, the NPC concluded that these estimates were reasonable. The large difference between the PADD I-IV estimates and the PADD V estimates is indicative of the fact that PADD I-IV outlets include more small, rural outlets, while PADD V outlets are larger and concentrated more in urban areas.

Inventory

The average inventory contained in retail outlets in the United States was estimated by the NPC to be 33 percent of available storage capacity, or about 28 million barrels. The estimate is based on the SEIOMA survey and on conversations held with several company representatives on the study committee, which indicated normal inventories varied through a range of approximately 30 to 45 percent.

Many outlets now sell products other than motor gasoline. Diesel fuel and kerosine are two such products that occupy a percentage of the gasoline outlet storage. The NPC believes that the amount of storage dedicated to kerosine is insignificant. Diesel fuel storage is greater and is estimated to occupy approximately 6 percent of the retail outlet storage capacity.

Table K-8 presents a summary of estimated retail outlet storage capacity and inventories.

TABLE K-8

RETAIL MOTOR FUEL OUTLETS
ESTIMATED STORAGE CAPACITY AND INVENTORY
AS OF MARCH 31, 1983
(Millions of Barrels)

	Capacity			Inventory*		
	PADDs I-IV	PADD V	Total	PADDs I-IV	PADD V	Total
Motor Gasoline	66	13	79	22	4	26
Diesel Fuel	4	1	5	1	‡	2
Total	**70**	**14**	**84**	**23**	**5**	**28**

*Totals may not add due to independent rounding.
‡Less than 0.5 million barrels.

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Please note any changes to the above information:

Company Name: _____

Address: _____

_____

_____ Zip Code: _____

Name of the person completing the questionnaires, to be contacted by Price Waterhouse only in the event that questions arise:

_____

Phone: (_____) _____

Please report on a company-wide basis; if you are a subsidiary, send this form to your parent company. To prevent duplication of reporting, list on the back of this sheet the companies for which you are reporting. If your company does not operate in the secondary petroleum distribution system (see definition on reverse) or if this is a duplicate survey, please mark the appropriate box below and return the survey to Price Waterhouse.

☐ Not applicable ☐ Duplicate

Please return this survey by December 9, 1983, to:

Price Waterhouse
Suite 701
1801 K Street, N.W.
Washington, D.C. 20006

If you have questions regarding this survey, please call (collect) Mr. B.A. Oliver at the National Petroleum Council office, (202) 393-6100.

The following definitions apply to this survey:

Reportable Storage—This survey is based on **custody of inventory** in tankage. If you have custody of any of the products covered by the survey (motor gasoline, diesel/distillate fuel oil, kerosine, and residual fuel oil), report the storage capacity in which that inventory is held plus operable, associated tankage not currently in service. Tankage not currently in service should be reported in the product category of its last use.

Secondary Distribution System—Includes bulk plants and facilities of resellers of petroleum products, such as jobbers and fuel oil dealers. Inventory and storage capacity at gasoline service stations are **not** covered by this survey.

Bulk Plants—A nonconsumer facility used for storage and/or marketing of petroleum products that has total storage capacity of less than 2.1 million gallons (50,000 barrels) and does **not** receive petroleum products by barge, ship, or pipeline. Include any tanks not currently in service; such tankage should be reported in the product category of its last use.

Petroleum Futures—If your company completed the petroleum futures questionnaire in the NPC survey of the primary system, please mark the questionnaire as such and return it. Do not submit this questionnaire twice.

Petroleum Administration for Defense Districts (PADDs)—Please report your inventory and storage capacity by PADD. The states are grouped by PADD below:

PADD IA

Connecticut
Maine
Massachusetts
New Hampshire
Rhode Island
Vermont

PADD IB

Delaware
District of Columbia
Maryland
New Jersey
New York
Pennsylvania

PADD IC

Florida
Georgia
North Carolina
South Carolina
Virginia
West Virginia

PADD II

Illinois
Indiana
Iowa
Kansas
Kentucky
Michigan
Minnesota
Missouri
Nebraska
North Dakota
Ohio
Oklahoma
South Dakota
Tennessee
Wisconsin

PADD III

Alabama
Arkansas
Louisiana
Mississippi
New Mexico
Texas

PADD IV

Colorado
Idaho
Montana
Utah
Wyoming

PADD V

Alaska
Arizona
California
Hawaii, excluding Foreign Trade Zone
Nevada
Oregon
Washington

Please list the states in which you have storage:

_____ _____ _____

_____ _____ _____

_____ _____ _____

Companies for which you are reporting:

_____ _____ _____

_____ _____ _____

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STORAGE CAPACITY/INVENTORY

Please provide the following information as of March 31, 1983:

1. Total storage capacity (excluding service stations, C-stores, truckstops, and any other retail motor fuel outlet tankage).

   In most cases, this will be your bulk plant storage capacity only.

PRODUCT	PADD IA (Gallons)	PADD IB (Gallons)	PADD IC (Gallons)	PADD II (Gallons)	PADD III	PADD IV	PADD V
MOTOR GASOLINE							
DIESEL/ DISTILLATE FUEL OIL							
KEROSINE							
RESIDUAL FUEL OIL							

2. Amount of capacity in Question 1 that can be switched to one of the other products without modifications.

   Example: If your distillate storage could be used for gasoline storage without modification of the tankage, that amount would be entered in the Diesel/Distillate Fuel Oil column.

MOTOR GASOLINE							
DIESEL/ DISTILLATE FUEL OIL							
KEROSINE							
RESIDUAL FUEL OIL							

3. The total amount of your inventories in the storage capacity reported in Question 1 as of March 31, 1983.*

MOTOR GASOLINE							
DIESEL/ DISTILLATE FUEL OIL							
KEROSINE							
RESIDUAL FUEL OIL							

*If your exact inventory level cannot be provided, please estimate the level of your inventories on March 31, 1983, as a percentage of total storage capacity for each product category reported in Question 1:

Percentage of Capacity:

MOTOR GASOLINE	%	%	%	%	%	%	%
DIESEL/ DISTILLATE FUEL OIL	%	%	%	%	%	%	%
KEROSINE	%	%	%	%	%	%	%
RESIDUAL FUEL OIL	%	%	%	%	%	%	%

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SECONDARY PETROLEUM DISTRIBUTION SYSTEM

PETROLEUM FUTURES

The petroleum futures markets are increasing in prominence. Originally, non-oil futures markets (e.g., wheat and corn) were created as a hedge against price fluctuations. However, it appears that the petroleum futures markets may also have a significant influence on operating decisions such as inventory management. This questionnaire attempts to ascertain the possible impact of petroleum futures markets on inventories.

1) Does your firm currently trade in petroleum futures markets?

___Yes ___No

If your answer is No, please go to Question 5.

2) Which oil futures have you traded?

#2 Fuel Oil____ Motor Gasoline____ Crude Oil____

3) As a percentage of your monthly requirements, what is the maximum open interest you have ever had in each commodity?

#2 Fuel Oil____% Motor Gasoline____% Crude Oil____%

How many contracts does this represent?

#2 Fuel Oil____ Motor Gasoline____ Crude Oil____

4) If you are currently trading, which of the following describes why? Please list in order of preference (1 through 3, with 1 being the main reason).

___Inventory Management
___Supplemental Outlet for Products
___Supplemental Source of Products
___Potential Profits Through Speculation
___Hedge Against Price Fluctuations
___Additional Flexibility
___Other

5) Has there been or do you visualize a change in your inventory policy or inventory levels due to the presence of the petroleum futures markets?

___Yes ___No

Appendix L:

Methodologies for Determining Petroleum Inventories and Storage Capacity in the Tertiary Storage Segment

Introduction

In the tertiary storage segment, as with the primary and secondary distribution systems, the NPC estimated the total storage capacity and inventory held by end-users on or around March 31, 1983. The task was more difficult than for the primary system, which the NPC had analyzed nine times since 1948. Consequently, the Council has more confidence in the results of the primary system analysis than in those of the tertiary segment analysis.

This report does present a much more accurate estimate of the magnitude of storage capacity and inventory in the tertiary storage segment than was possible in the 1979 NPC study. However, the Council has more confidence in the storage capacity estimates than in those of inventory, and considers estimates by sector (e.g., industrial, residential) more reliable than those by region.

In addition, the data resulting from this study define the inventories and storage capacities as of a specific date—March 31, 1983. The inventories doubtlessly have changed and will continue to do so as the system reacts to variations in supply, demand, prices, and other economic factors.

For the purpose of this analysis, the tertiary storage segment was divided into the following sectors:

- Agricultural
- Commercial
- Electric Utilities
- Industrial
- Military/Government
- Residential
- Transportation.

For each sector, published data were used where available. If the data were insufficient, the storage capacity and inventories were estimated using a variety of methodologies, judgments, and discussions with sector representatives.

The NPC's methodology in deriving its estimates is presented below for each sector. In all sectors, only the principal fuel products (motor gasoline, kerosine, kerosine-type jet fuel, diesel fuel, distillate fuel oil, and residual fuel oil) are included in the estimates.

Agricultural Sector

Definition

The agricultural sector includes all farms, ranches, and similar entities in the United States. Petroleum storage for this sector includes motor gasoline and diesel fuel used in farm vehicles and equipment. Distillate fuel oil for residential heating on farms and ranches is included in the residential sector.

Data Sources

The Bureau of the Census conducted a survey in the second quarter of 1980 (hereafter referred to as the "Census of Agriculture survey") that provided storage capacity and inventory levels for farms in the 48 contiguous states.[1] The results of this survey were compared to a survey conducted by the State Farm Magazine Bureau in the first quarter of 1982 (hereafter referred to as the "State Farm Magazine Bureau survey").[2]

The Census of Agriculture surveyed 33,800 farmers and received a response rate of 81 percent. The State Farm Magazine Bureau surveyed 10,000 farmers, but received a lower response rate, 36 percent. Moreover, the State Farm Magazine Bureau's respondents were larger in terms of average acreage and income than the average U.S. farmer as reported by the Department of Agriculture. Despite these drawbacks, the more recent State Farm Magazine Bureau survey is useful in assessing changes in market conditions between 1980 and 1982.

Methodology

Published agricultural statistics indicate that the average farm size has been stable at about 430 acres since 1978.[3] The Census of Agriculture survey average acreage was 438, while the State Farm Magazine Bureau survey respondents averaged 617 acres. The State Farm Magazine Bureau survey results were therefore adjusted by size category to equal the lower, 438 acre average farm in a distribution provided in the *Statistical Abstract of the United States 1982-1983.*[4] This distribution was applied to the State Farm Magazine Bureau responses. (For example, if farms in the 10-49 acre category were 12 percent of the raw responses, but 19 percent of the adjusted distribution, the total storage capacity of farms in the 10-49 acre category was adjusted upward by .19/.12, or 58 percent. An analogous reduction was made in the larger acreage categories.) The result of this process was an average gasoline and diesel storage per farm for the adjusted sample. These numbers were multiplied by the total U.S. farm count to calculate aggregate storage capacity.

The Census of Agriculture survey results were based on a farm count of 2,256,000. Since the total number of farms in the United States is higher—2,437,000 in 1982—the results were adjusted upward to the higher total.[5]

The adjustments described above resulted in the comparison of the data from the two surveys shown in Table L-1.

Storage Capacity

While the two surveys had major methodological differences, the adjusted results were similar. The State Farm Magazine Bureau survey results were higher, consistent with expectations that farmers had added tankage after the 1979 petroleum disruption. Weighing the greater response rate of the Census of Agriculture survey against the more recent information of the State Farm Magazine Bureau survey, total storage capacity as of March 31, 1983, was estimated to be 41 million barrels, as shown in Table L-2.[6]

---

[1]U.S. Department of Commerce, *1978 Census of Agriculture*, Volume 5, Part 9, "1979 Farm Energy Survey," September 1982.

[2]State Farm Magazine Bureau, *1982 Automotive, Petroleum, TBA Survey*, Chicago, Illinois, 1982.

[3]U.S. Department of Agriculture, *Agricultural Statistics 1982*, 1982.

[4]U.S. Department of Commerce, *Statistical Abstract of the United States 1982-1983.*

[5]See footnote 3.

[6]The higher State Farm Magazine Bureau survey number was used for the diesel storage capacity estimate. Motor gasoline storage capacity was estimated as the average of the two surveys. It is believed that less gasoline is being delivered to farms since the time of the surveys due to lower self-service retail station prices.

TABLE L-1

COMPARISON OF AGRICULTURAL SECTOR SURVEY RESULTS

	Adjusted Data from Census of Agriculture	Adjusted Data from State Farm Magazine Bureau
Storage Capacity per Farm (Gallons)		
Motor Gasoline	314	351
Diesel Fuel	356	372
Total	**670**	**723**
Aggregate Storage (Millions of Barrels)		
Motor Gasoline	18.2	20.4
Diesel Fuel	20.7	21.6
Total	**38.9**	**42.0**

TABLE L-2

AGRICULTURAL SECTOR
ESTIMATED STORAGE CAPACITY AND INVENTORY
AS OF MARCH 31, 1983
(Millions of Barrels)

	PADDs I-IV	PADD V	Total
Capacity			
Motor Gasoline	16.8	2.5	19.3
Diesel and Distillate Fuel Oil	18.8	2.8	21.6
Total	**35.6**	**5.3**	**40.9**
Inventory			
Motor Gasoline	5.8	0.9	6.7
Diesel and Distillate Fuel Oil	6.6	1.0	7.6
Total	**12.4**	**1.9**	**14.3**

Inventory

Inventories as of December 31, 1979, were estimated in the Census of Agriculture survey to be 47 percent of gasoline storage capacity and 53 percent of diesel storage capacity. Because supply uncertainty had decreased by March 1983, a lower estimate of inventory on hand was deemed appropriate. Based on data provided by several agricultural fuel marketers, inventory was estimated to be 35 percent of capacity, or a total inventory of 14 million barrels, on March 31, 1983, as shown in Table L-2.

Inventories in the agricultural sector can be expected to fluctuate seasonally and geographically. Higher inventories are necessary right before planting and harvesting periods, while much lower stocks are held during the winter months.

PADD Estimates

The 41 million barrels of storage capacity and 14 million barrels of inventory were distributed between PADDs I-IV and PADD V based on their proportions in the Census of Agriculture survey. This distribution is shown in Table L-2.

Commercial Sector

Definition

The commercial sector includes nonmanufacturing establishments such as office buildings, apartment buildings of over four units, motels, restaurants, wholesale and retail businesses, hospitals, and other health and private educational institutions.

Methodology

Capacity and inventory data for the commercial sector are not regularly collected. The procedure employed to estimate commercial storage capacity and inventories is briefly described below.

The total U.S. commercial sector demand for key petroleum products was determined. A days' supply of capacity estimate, i.e., the ratio of storage capacity to daily average demand, was then calculated using demand and storage capacity data from a small sample of commercial users. Total storage capacity was derived by multiplying the commercial sector's daily average demand by the days' supply of capacity estimate.

Daily Average Demand for Petroleum Products

Demand for key petroleum products, storage capacity, and inventory in the commercial sector are shown in Table L-3. The oil demand includes the oil equivalent demand of commercial users who have dual-firing (oil/gas) capabilities. These commercial users typically use gas, but are included because they also have oil storage capacity.

Storage Capacity

A variety of commercial users was sampled to obtain their annual consumption and storage capacity. The sample included both oil-only and dual-fired users. These data are presented in Table L-4. As shown in the notes to this table, the ratio of storage capacity to daily average demand for this sample is approximately 90 days; thus, the average daily demand was multiplied by 90 to derive the storage capacity of the commercial sector.

Inventory

In order to estimate oil inventory on hand as of March 31, 1983, near the end of the heating season, a sample of 135 oil-only commercial users was used. Their tanks ranged from 25 to 60 percent full, with the mean about one-third full. It was assumed that oil inventory in the dual-firing portion of the commercial sector was negligible, because oil was not economic compared with gas at the time of the survey and gas supply was readily available.

PADD Estimates

To distribute the storage capacity and inventory estimates between PADDs I-IV and PADD V, it was assumed that the share of storage capacity and inventories in the commercial sector in PADD V was the same as the PADD V share of U.S. total demand in the commercial sector. Thus, it is estimated that there were 2.8 million barrels of storage capacity and 0.95 million barrels of inventory in the commercial sector in PADD V as of March 31, 1983.

TABLE L-3

COMMERCIAL SECTOR
1982 DEMAND AND ESTIMATED STORAGE CAPACITY AND INVENTORY
AS OF MARCH 31, 1983

	1982 Demand (MB/D*)†	Capacity (Millions of Barrels)§		
		PADDs I-IV	PADD V¶	Total
Kerosine	15	0.9	0.1	1.0
Distillate Fuel Oil	230	19.5	1.5	21.0
Residual Fuel Oil	165	13.8	1.2	15.0
Total	**410**	**34.2**	**2.8**	**37.0**
		Inventory (Millions of Barrels)**		
		PADDs I-IV	**PADD V**	**Total**
Kerosine		‡	‡	‡
Distillate Fuel Oil		4.5	0.5	5.0
Residual Fuel Oil		2.6	0.4	3.0
Total		**7.1**	**0.9**	**8.0**

*MB/D = thousands of barrels.

†Average 1982 oil demand in the commercial sector from EIA, *Petroleum Supply Annual*, 1982. Government demand was excluded to avoid double counting (see the Military/Government Sector section). Includes oil equivalent 1982 gas demand at dual-fired facilities (69 thousand barrels per day distillate fuel oil and 60 thousand barrels per day residual fuel oil) from American Gas Association, *Gas Energy Review*, "Analysis of Commercial Gas Markets," January 1983, and discussions with AGA representatives.

§Based on 90 days' supply of capacity.

¶Estimate based on the PADD proportion of 1981 demand mix.

**Estimated to be one-third of storage capacity at oil-burning facilities only. Dual-fired facilities were assumed to hold negligible petroleum inventory.

‡Less than 0.5 million barrels.

TABLE L-4

COMMERCIAL HEATING OIL CUSTOMERS

Regions	Number of Users Sampled*	Total Annual Demand† (Thousands of Gallons)	Total Storage Capacity (Thousands of Gallons)	Storage Capacity Expressed in Days' Supply‡
Connecticut/ New York†	9	109	23	78
Detroit/ Cleveland	12	450	120	97
Chicago	135	540	125	85
Pacific Northwest	25	58	15	95
Total	**181**	**1,157**	**283**	**90**

*Includes a mix of oil-only and dual-fired users.

†Includes oil equivalent demand of dual-fired users.

‡Storage capacity divided by daily demand (annual demand/365 days).

Electric Utility Sector

Definition

The electric utility sector includes electric utility power plants.

Methodology

To estimate storage capacity and inventory in the electric utility sector, two sources of data were used—the 1983 *Petroleum Marketers' Handbook* and the Energy Information Administration (EIA) data on the March 1983 inventories at electric utilities. *Oil Buyer's Guide* publishes the *Petroleum Marketers' Handbook* annually. The 1983 edition contained data on the storage capacities for 86 electric utility companies, with the information provided by state, company, and product. These data were verified by checking several of these utilities directly and determining their storage capacity as of the end of March 1983. Storage capacity data were also checked with the New England Energy Power Pool; the New York Power Pool; the Pennsylvania, New Jersey, Maryland Power Pool; and the Southeast Reliability Council. The comparison of the data sources indicated that the storage capacities were equivalent in aggregate and varied little for individual companies.

A capacity utilization ratio was determined by dividing the total storage capacity of the companies covered in the *Petroleum Marketers' Handbook* into the total inventories, less those in central storage, reported to the EIA by the 86 companies. The capacity utilization ratio was assumed to be representative of all utilities in all regions of the United States and was divided into the total inventories, less those in central storage, for PADDs I-IV and PADD V to estimate total storage capacity for these geographic regions. Inventories in central storage are those held for utilities by primary system companies and are included in the primary system data.

The final inventory data for March 1983 were obtained from the EIA's electric power data base and were adjusted by the EIA to reflect only those inventories held at utilities. Telephone conversations with representatives of the electric utility companies, which accounted for 79 percent of the inventories reported in central storage at the end of March 1983, verified that these inventories were included in inventories held in the primary distribution system. It was assumed that the remaining 21 percent held by other companies was included in the primary distribution system also.

Estimated storage capacity and inventory for the electric utility sector are presented in Table L-5.

TABLE L-5

ELECTRIC UTILITY SECTOR
ESTIMATED STORAGE CAPACITY AND INVENTORY
AS OF MARCH 31, 1983
(Millions of Barrels)

	PADDs I-IV	PADD V	Total
Capacity			
Distillate Fuel Oil	28.2	7.4	35.6
Residual Fuel Oil	127.5	49.5	177.0
Total	**155.7**	**56.9**	**212.6**
Inventory			
Distillate Fuel Oil	18.6	2.9	21.5
Residual Fuel Oil	48.0	21.5	69.5
Total	**66.6**	**24.4**	**91.0**

Utility inventory practices vary by region. In certain areas, such as Hawaii, Illinois, and most of the East Coast states, utilities consume oil on a regular basis and their inventory levels average 25-45 days of peak demand, depending upon state regulatory requirements or their own fuel purchasing strategy.

In other areas, such as Texas and California, utilities have been burning natural gas rather than oil, due to its price advantage. These utilities have been maintaining oil inventories above those that appear to be required for their present short-term consumption (often as much as 50-80 percent of storage capacity) in anticipation of switching back to oil if the price differential between oil and gas changes to favor oil.

There is a trend in the utility industry toward shorter term oil contracts. This trend should slightly increase the level of oil inventories held during certain time periods by certain oil-using utilities. However, changes from oil to coal and other fuels should more than offset any future increase in inventory levels expected from these changes in contracting practices.

Industrial Sector

Definition

The industrial sector includes manufacturing plants and factories, and construction and off-highway nontransportation equipment and vehicles (e.g., for the logging and mining industries). While petroleum refining is traditionally considered part of the industrial sector, it is excluded from this analysis because refinery fuel stocks are reported in the primary distribution system. This sector also excludes retail and service enterprises (see the Commercial Sector section) and electric utilities.

Methodology

Total storage capacity and inventory in the industrial sector were estimated using published data and information obtained from approximately 50 industrial consumers. The basic methodology employed was to determine the average daily demand for petroleum products adjusted for reduced plant utilization, estimate the days' supply of storage capacity and inventory, and then multiply those estimates by the demand data.

Demand

Distillate Fuel Oil and Residual Fuel Oil

There are two components to the demand estimate for distillate and residual fuel oils:

- **Actual Petroleum Demand by Industry Published by the EIA**—For the purposes of this analysis, the following EIA categories of users were considered part of the industrial sector:
  - — Industrial
  - — Off-highway diesel use (distillate fuel oil only)—defined by EIA as "fueling engines which require diesel fuel, but are not used for transportation, such as construction, logging and road building equipment."
  - — All other.
- **Natural Gas Demand Switchable to Petroleum**—American Gas Association data were used to determine the volume of gas demand in 1982 that could have been switched to petroleum demand. This demand is included because facilities that could switch to petroleum demand have oil storage capacity in place in the event it is needed. The data for both types of fuel demand, as of March 31, 1983, are presented below:

	Distillate Fuel Oil	Residual Fuel Oil
Oil Demand (MB/D*)†	351	349
Oil-Equivalent Gas‡	447	558
Total Industrial Consumption (MB/D)	**798**	**907**

*MB/D = thousands of barrels per day.
†EIA, *Petroleum Supply Annual*, 1982.
‡American Gas Association.

Kerosine

Data from EIA's 1982 *Petroleum Supply Annual* for the "Industrial" and "All Other" categories were used. No oil equivalent gas demand was included because it was assumed that the amount of kerosine that could displace natural gas demand is insignificant. Industrial kerosine demand is estimated to have been 64 thousand barrels per day as of March 31, 1983.

Motor Gasoline

For the purposes of this study, industrial gasoline consumption is estimated to be 75 percent of the Department of Transportation's reported volume of industrial, construction, and commercial demand as reported by the Federal Highway Administration in *Highway Statistics, 1982*. Using these data, industrial gasoline consumption is estimated to have been 10 thousand barrels per day as of March 31, 1983.

Plant Utilization Adjustment

In 1982, manufacturing plant utilization was 71 percent,[7] compared to a practical maximum of 85 percent. Because storage capacity is generally built to accommodate product requirements at full capacity, an upward adjustment (plant utilization adjustment) of 15 percent was made to the demand data. Fifteen percent was used instead of 20 percent, the percentage change of 85 percent over 71 percent, to compensate for capacity closed in 1983, which may still be counted as active capacity.

Storage Capacity

Contacts with industrial sector consumers revealed that, on average, industry had storage capacity sufficient to hold 30 days' oil demand in the event natural gas was unavailable. There is quite a variance in these data, as facilities with lower petroleum use maintain less storage capacity relative to demand than facilities with substantial oil demand.

The demand data for each product were multiplied by the plant utilization adjustment of 15 percent and the 30 days' supply of storage capacity estimate. These calculations are presented below:

	Potential Consumption (MB/D)	×	Plant Utilization Adjustment	×	Days' Supply	=	Total Storage Capacity (MB)
Motor Gasoline	10		1.15		30		345
Distillate Fuel Oil	798		1.15		30		27,531
Kerosine	64		1.15		30		2,208
Residual Fuel Oil	907		1.15		30		31,292
Total	**1,779**						**61,376**

Inventory

The demand data discussed above were multiplied by a days' supply of inventory estimate to develop the total inventory estimate. The plant utilization adjustment was not applied because it was assumed that the level of inventory held was based on actual demand and that March 1983 demand closely approximated the 1982 EIA data. In an informal survey, industrial sector consumers reported that, on average, about 15 days' supply of inventory is held. For the distillate and residual fuel oils, an additional five days' supply of inventory was also included, to reflect inventory held by firms with dual-firing capacity. The inventory calculations are presented at the top of the next page.

[7]Source: Federal Reserve Board.

	Potential Consumption (MB/D)	×	Days' Supply	=	Inventory (MB)
Gasoline	10		15		150
Distillate Fuel Oil					
Actual	351		15		5,265
Oil-Equivalent Gas	447		5		2,235
Subtotal Distillate	798				7,500
Kerosine	64		15		960
Residual Fuel Oil					
Actual	349		15		5,235
Oil-Equivalent Gas	558		5		2,790
Subtotal Residual	907				8,025
Total Above Products					**16,635**

Table L-6 summarizes estimated storage capacity and inventory in the industrial sector. PADD estimates were not developed due to lack of available information.

TABLE L-6

INDUSTRIAL SECTOR
ESTIMATED STORAGE CAPACITY AND INVENTORY
AS OF MARCH 31, 1983
(Millions of Barrels)

	Capacity	Inventory
Motor Gasoline	0.3	0.2
Distillate Fuel Oil	27.5	7.5
Kerosine	2.2	1.0
Residual Fuel Oil	31.3	8.0
Total	**61.3**	**16.7**

Military/Government Sector

Definition

The military/government sector includes federal, state, and local governments and all branches of the U.S. military service located in the United States, but excludes municipal utilities.

Methodology

The Defense Fuel Supply Center provided the actual data for military storage capacity and inventory as of March 31, 1983. No data were available for federal, state, and local governments. An estimating approach was employed to determine storage capacity and inventory in this sector.

First, the petroleum demand by major product for each individual federal, state, and local government subsector was determined. Next, data for a sample of selected government units were obtained to determine their storage capacity and demand for various petroleum products. The ratio of storage capacity to average daily demand calculated from the sample was used to estimate the storage capacity of the total federal, state, and local government sector. Finally, the oil inventory held by the government sector was estimated as a percentage of that capacity.

Demand

Estimates of petroleum product demand by major product are summarized in Table L-7. Actual demand data were reported by the EIA for military and civilian federal government activities. However, these data did not segregate fuel oils belonging to federal, state, and local governments into distillates and residuals. The demand was estimated by product as shown in Table L-7.

TABLE L-7

MILITARY/GOVERNMENT SECTOR
1982 PETROLEUM PRODUCT DEMAND
(Thousands of Barrels per Day)

	Military	Federal Gov.*	State Gov.	Local Gov.	Gov. Total	Military/ Government Total
Motor Gasoline	6.2	12.0	35.8†	82.2†	130.0	136.2
Jet Fuel	140.4	3.1	1	N.A.‡	4.1	144.5
Kerosine	0.0	0.0	0.0	0.0	0.0	0.0
Distillate Fuel Oil	41.6	5	8.8	32.8§	46.6§	88.2
Residual Fuel Oil	21.4	8	13.9	52.6§	74.5§	95.9
Total	**209.6**	**28.1**	**59.5**	**167.6**	**255.2**	**464.8**

*The federal government use is from the EIA federal agency quarterly energy use reports, FY 1982. Distillate fuel oil/residual fuel oil is estimated.

†Based on vehicles (cars, buses, and trucks) owned by state and local governments and assumes that fuel consumption per vehicle is the same as the U.S. average. Source: Motor Vehicle Manufacturers of America, *Motor Vehicle Facts & Figures*, 1983.

‡N.A. = Not Available.

§Based on the ratio of state and local government employees to federal government employees multiplied by federal government demand. These estimates were adjusted upward by a factor of 2 for local and 1.35 for state governments to reflect consumption by schools as explained in the Military/Government Sector Demand section.

Estimates of state and local government demand were derived from a variety of sources. Motor gasoline demand was calculated by assuming that cars, buses, and trucks owned by state and local governments[8] use the same amount of fuel per year as the national average.[9] The split between state and local fleets for cars and trucks was estimated to be 35/65, the ratio of state employees to local government employees excluding teachers.[10] All school buses were assigned to the local government subsector. Distillate and residual fuel oils demand by state and local governments, mainly for space heating requirements, was based on the ratio of state and local government employees[11] (including teachers and an estimated number of students) to federal civilian employees, multiplied by federal government demand. These state and local government data were adjusted upward by a factor of 1.35 for state governments and 2 for local governments to account for the larger schoolroom space heating requirements in school buildings. The higher factor used for local governments reflects a higher ratio of teachers (35 percent of local employees) than for state employees (12 percent of state employees) as shown in Table L-8.

[8]Motor Vehicle Manufacturers of America, *Motor Vehicle Facts and Figures*, 1983, p. 49.

[9]Ibid. p. 52.

[10]*Statistical Abstract of the U.S.*, 1981, Table 507, p. 306.

[11]Ibid.

TABLE L-8

LOCAL, STATE, AND CIVILIAN FEDERAL GOVERNMENT EMPLOYEES, 1980*
(Thousands)

	Local	State	Civilian Federal	Total
Total Employees	9,562	3,753	5,216	18,531
Teachers	3,352	467	-	3,819
Employees (excluding teachers)	6,210	3,286	5,216	14,712

*Data taken from *Statistical Abstract of the U.S.*, 1981, p. 306, Table 507.

Storage Capacity

To develop the storage capacity estimates for the government subsector, individual state and local governments were contacted to determine their days' supply of storage capacity. The ratios provided were in the range of 53 to 97 days, as shown in Table L-9.

TABLE L-9

SAMPLE OF GOVERNMENT USERS
DAYS' SUPPLY OF STORAGE CAPACITY

Government Unit	Fuel	Days' Supply of Storage Capacity
Oregon State	Motor Gasoline*	53
	Fuel Oil†	59
New Jersey State	Motor Gasoline‡	71
Clifton, New Jersey	Motor Gasoline§	41
	Heating Oil¶	97

*460,000-gallon shell capacity divided by average daily demand (annual demand of 3.15 million gallons/365 days).
†936,000-gallon shell capacity divided by average daily demand (annual demand of 5.755 million gallons/365 days).
‡165,000-gallon shell capacity divided by average daily demand (annual demand of 847,997 gallons/365 days).
§675-barrel shell capacity divided by average daily demand (annual demand of 255,000 gallons/365 days/42 gallon/barrel).
¶4,700-barrel shell capacity divided by average daily demand (annual demand of 740,000 gallons/365 days/42 gallon/barrel).

On average, the ratios were higher for heating oils than for motor gasoline due to the more pronounced seasonal fluctuation in demand for heating oils. More storage capacity is needed for heating oil to accommodate peak demands in the winter. Therefore, for seasonal products such as distillate and residual fuel oils, a ratio of 90 days was used for the storage capacity calculation, while for products with less seasonality (motor gasoline and kero-jet), a ratio of 60 days was used.

In the case of state and local governments, the storage capacity estimate for motor gasoline was adjusted downward by 20 percent to account for fueling of government vehicles at service stations.

The actual military storage capacity data and government estimates are shown in Table L-10.

It was assumed that for the less seasonal products (motor gasoline and kero-jet), government inventories were equal to 50 percent of storage capacity. For seasonal products (distillate and residual fuel oils), it was assumed that the inventories on March 31, 1983, toward the end of the heating season, represented only one-third of tank capacity. The actual military inventory data and government estimates are shown in Table L-11.

TABLE L-10

MILITARY/GOVERNMENT SECTOR
STORAGE CAPACITY AS OF MARCH 31, 1983
(Millions of Barrels)

	Military*†	Estimated Government‡				Military/ Government Total
		Federal	State	Local	Total	
Motor Gasoline	1.4	0.7	1.7§	3.9§	6.3	7.7
Kero-Jet	10.4	0.2	0.1	0	0.3	10.7
Distillate Fuel Oil	24.4	0.5	0.8	3.0	4.3	28.7
Residual Fuel Oil	2.7	0.7	1.2	4.7	6.6	9.3
Total	**38.9**	**2.1**	**3.8**	**11.6**	**17.5**	**56.4**

*Actual storage capacity as reported to the NPC by Defense Fuel Supply Center. The NPC estimated the products' storage capacity based on the Defense Fuel Supply Center reported inventories of those products.

†Excludes on-board storage capacity of military vehicles, vessels, and aircraft.

‡Storage capacity was calculated from the days' supply of capacity estimates shown in Table L-9 using 60 days for motor gasoline and kero-jet and 90 days for distillate and residual fuel oils.

§Capacity was further adjusted downward by 20 percent to account for government vehicle fueling at commercial service stations.

TABLE L-11

MILITARY/GOVERNMENT SECTOR
INVENTORY AS OF MARCH 31, 1983
(Millions of Barrels)

	Military*†	Estimated Government‡				Military/ Government Total
		Federal	State	Local	Total	
Motor Gasoline	1.0	0.4	0.9	2.0	3.3	4.3
Kero-Jet	5.0	0.1	0.05	-	0.2	5.2
Distillate Fuel Oil	8.8	0.2	0.3	1.0	1.5	10.3
Residual Fuel Oil	0.9	0.2	0.4	1.6	2.2	3.1
Total	**15.7**	**0.9**	**1.65**	**4.6**	**7.15**	**22.9**

*Actual March 31, 1983, inventory as reported to the NPC by the Defense Fuel Supply Center.

†Excludes on-board inventory of military vehicles, vessels, and aircraft.

‡Estimated inventory was calculated at one-half of storage capacity for motor gasoline and kero-jet and one-third of capacity for distillate and residual fuel oils.

PADD Estimates

No PADD data are available for the military storage capacity and inventory. For the government subsector, it was assumed that PADDs I-IV and PADD V storage capacities and inventories were about 85 percent and 15 percent of the U.S. total, respectively, which is their proportion of the total U.S. population.

Residential Sector

Definition

The residential sector includes single family homes (including farmhouses) and multifamily dwellings of up to four units. Larger apartment buildings are part of the commercial sector.

Methodology

The March 31, 1983, storage capacity and inventory estimates for the residential sector were based on EIA April 1980-March 1981 demand data adjusted for recent trends in energy consumption in that sector.

Demand

Due to the price increases since the 1973-1974 period, many oil burning units were replaced with natural gas and electrical units. Also, the efficiency of many oil burning units has been upgraded. Other factors contributing to the decrease in residential oil demand are improvements in insulation and weatherization of dwellings, lower temperature settings in the winter, and higher settings in the summer. The use of renewable fuels, such as wood and solar energy, have also contributed to a drop in heating oil use in the residential sector.

At the same time, however, there has been a rapid increase in the use of nonvented kerosine space heaters. It is estimated that over two million units were in use in 1983. These kerosine units are used principally as a supplemental heat source in homes, allowing the main heating unit to be turned off or operated at a lower temperature setting.

It is estimated that there were 15 million households using either fuel oil or kerosine for heating in March 1983. Of these, approximately 2 million use distillate fuel oil or kerosine as a supplemental heat source only, relying on other fuels for their principal source of heating.[12]

Storage Capacity

To store fuel for these household units, it is estimated that there are approximately 11.8 million fuel storage tanks in use. The number of households is greater than the number of tanks because many small multifamily dwellings are served by only one tank. Residential tanks vary in size from 55-gallon drums mounted on a stand outside the residence to 2,000-gallon underground storage tanks. Most of the tanks currently in service are in the 250 to 800-gallon capacity range. It is estimated that the average size of the storage tank in residential use on March 31, 1983, was 360 gallons.[13] This compared with an estimated average of about 390 gallons reported in the 1979 NPC report. Thus, the total storage capacity in the residential sector as of March 31, 1983, was estimated to be about 100 million barrels, as shown in Table L-12.

TABLE L-12

RESIDENTIAL SECTOR
ESTIMATED STORAGE CAPACITY AND INVENTORY
AS OF MARCH 31, 1983
(Millions of Barrels)

	Capacity	Inventory
Distillate Fuel Oil	100	55

[12]DOE/EIA-0321/2 Residential Energy Consumption Survey; Consumption and Expenditures, April 1980 through March 1981, adjusted by the NPC.

[13]Calculated from DOE/EIA-0321/2 Residential Energy Consumption Survey; Consumption and Expenditures, April 1980 through March 1981.

Inventory

The amount of heating oil and kerosine stored in the residential sector varies during the year as demand for the fuel follows the weather pattern. More fuel oil is stored and used in colder periods, with a decrease during the warmer summer months. Based on a telephone survey of six fuel oil dealers, it is estimated that the average residential oil storage tank was filled to 55 percent of capacity on March 31, 1983, representing 55 million barrels of distillate fuel oil inventory on that date, as shown in Table L-12.

Transportation Sector

Definition

For the purposes of this study, the transportation sector includes the following categories: railroad, bus, trucking, aviation, marine, marine pleasure craft, taxicab, and personal vehicles. This analysis includes fixed and on-board storage, but excludes payload storage. The volume of payload storage in the transportation sector is estimated in the notes at the end of this sector's analysis.

Methodology

Each transportation mode was researched independently and is reviewed separately. With the exception of railroads, limited data are published regarding the total storage capacity or average inventory level for any of the transportation modes. Therefore, most of the data were gathered from trade associations representing the various transportation modes. The capacities and inventories estimated for this sector are summarized in Tables L-13 and L-14, respectively.

Railroad Transportation

The estimated storage capacity and inventory for the railroad subsector was derived from information provided by the Association of American Railroads (AAR). The AAR publications used included: the 1983 edition of "Railroad Facts" and "North American Railway Energy Management and Conservation Report on Energy Issues," which contains the results of a survey conducted by the AAR in 1982. The AAR's Universal Machine Language Equipment Register (UMLER) data base was also used in developing the following estimates. The AAR estimated average inventory for railroad fixed tankage to be 60

TABLE L-13

TRANSPORTATION SECTOR
ESTIMATED STORAGE CAPACITY
AS OF MARCH 31, 1983
(Millions of Barrels)

Transportation Mode	Motor Gasoline	Kerosine and No. 2 Diesel	Kero-Jet	Residual Fuel Oil	Total
Railroad	-	11.5	-	-	11.5
Bus	-	0.9	-	-	0.9
Truck	-	4.7	-	-	4.7
Aviation	-	-	9.9	-	9.9
Marine	-	6.2	-	4.5	10.7
Marine Pleasure Craft	5.0	0.6	-	-	5.6
Taxicab	0.3	-	-	-	0.3
Motor Vehicle	69.9	20.3	-	-	90.2
Total	**75.2**	**44.2**	**9.9**	**4.5**	**133.8**

TABLE L-14

TRANSPORTATION SECTOR
ESTIMATED INVENTORY
AS OF MARCH 31, 1983
(Millions of Barrels)

Transportation Mode	Motor Gasoline	Kerosine and No. 2 Diesel	Kero-Jet	Residual Fuel Oil	Total*
Railroad	-	6.7	-	-	6.7
Bus	-	0.4	-	-	0.4
Truck	-	2.6	-	-	2.6
Aviation	-	-	5.5	-	5.5
Marine	-	3.1	-	2.2	5.3
Marine Pleasure Craft	1.5	0.2	-	-	1.7
Taxicab	0.1	-	-	-	0.1
Motor Vehicle	28.7	10.0	-	-	38.7
Total*	**30.3**	**23.0**	**5.5**	**2.2**	**61.1**

*Totals may not add due to independent rounding.

percent of capacity. In "North American Railway Energy Management and Conservation Report on Energy Issues," on-board inventory for locomotive tanks was estimated to be 50 percent of storage capacity, as shown in Table L-15.

TABLE L-15

RAILROAD TRANSPORTATION
ESTIMATED STORAGE CAPACITY AND INVENTORY
AS OF MARCH 31, 1983
(Thousands of Barrels)

	Capacity	Inventory
Fixed Storage Tankage	9,619	5,771
On-Board Locomotive Tanks*	1,929	965
Total	**11,548**	**6,736**

*Based on 27,000 locomotives in service at the close of 1981, with an average capacity of 3,000 gallons.

Bus Transportation

For the purpose of this analysis, the bus transportation subsector is grouped into three primary systems—those receiving federal funding, private bus companies, and school buses. Diesel fuel is used in virtually all buses included in both the federally funded and private bus systems. The school bus segment is primarily gasoline-powered and is not included in this segment of the report; its capacity is included in the military/government portion of the report as part of the local government sector. The data in this analysis include only fixed tankage and do not include on-board storage capacity, which is included with the motor vehicle estimates.

The bus systems receiving federal funding are represented by the American Public Transit Association (APTA). APTA conducted a 1978 survey that is believed to be fairly representative of 1983 storage capacity in this portion of the bus transportation subsector. To update the figures, the capacity increases scheduled at the time of the survey and an APTA estimated growth factor of 10 percent have been added to the 1978 data. The private bus companies are represented by the American Bus Association (ABA). The ABA conducted a survey of its membership during the fall of 1983. For both public and private bus systems, inventories are estimated at 50 percent of capacity, as shown in Table L-16.

TABLE L-16

BUS TRANSPORTATION
ESTIMATED FIXED STORAGE CAPACITY AND INVENTORY
AS OF MARCH 31, 1983
(Thousands of Barrels)

	Capacity		Inventory	
	Kerosine	Diesel	Kerosine	Diesel
Public Bus Systems (APTA)	88	264	44	132
Private Bus Systems (ABA)	-	543	-	271
Total	**88**	**807**	**44**	**403**

Truck Transportation

The trucking subsector is composed of several types of operators, including common carriers, private fleets, owner/operators, and leasing companies. Some companies maintain their own storage capacity, some fuel at truck stops, and others supply their requirements through a combination of truck stops, purchases from others, and their own storage facilities. The storage capacity at truck stops is part of the secondary distribution system and is included in that section of the report. To determine the remainder of the storage capacity and inventory, the following organizations were contacted:

- American Trucking Association
- National Tank Truck Carriers Association
- National Association of Truck Stop Operators
- Transportation Research & Marketing (trucking industry consultant)
- Energy Information Administration
- Motor Vehicle Manufacturers Association.

Based on information from the groups above, it is estimated that 60 percent of the taxable diesel fuel is marketed through truck stops; the balance is supplied through storage owned by the trucking industry. The EIA reports that taxable "on highway" diesel fuel demand in 1982 was 926 thousand barrels per day, including an estimated 11 thousand barrels per day used by automobiles and light trucks. Forty percent of the demand, 336 thousand barrels per day, was delivered through storage owned by the trucking industry.

Several types of companies in the trucking industry (including leasing companies, common carriers, and private fleets) were contacted to determine the relationship between a company's volume of fuel requirements and its storage capacity. The storage capacity for these companies generally represented 7 to 25 days of fuel required, with 14 as an average. Thus, total storage capacity in the trucking subsector as of March 31, 1983, is estimated to have been 4.7 million barrels (336 barrels per day demand x 14 days' supply of capacity). Inventory in the trucking subsector as of March 31, 1983, is estimated to average 50 percent of storage capacity, or 2.35 million barrels.

Air Transportation

The air transportation subsector includes commercial airlines and airports, general aviation (nonscheduled) aircraft and airports, and helicopters. Storage capacity and inventory for military use is not included in this analysis because it is included in the military/government sector analysis.

Several organizations were contacted in the course of this study, including the following:

- Air Transport Association of America
- Aircraft Owners and Pilots Association
- Airport Operators Council International
- American Association of Airport Executives
- Federal Aviation Administration
- General Aviation Manufacturers Association
- General Research Corporation
- National Air Transportation Association
- National Business Aircraft Corporation
- Regional Airline Association.

Storage capacity and inventory at airports may be owned by the airport, the fixed base operators (aircraft fueling service companies), the kero-jet fuel suppliers, major oil companies, individual airlines, or by a combination of the above. No data exist regarding the number of airports in the United States that have kero-jet fuel storage. The Federal Aviation Administration (FAA) stated that any airport with a runway of 5,000 feet or longer would probably service jet aircraft and therefore maintain storage for kero-jet fuel. The FAA reports that there were 1,385 airports in this category within the United States as of August 1983, of which 681 were airports handling scheduled commercial aviation.

The Air Transport Association of America (ATAA) conducted a survey of the 237 largest of the 681 airports handling commercial aviation in the United States and listed the 1982 kero-jet fuel consumption by airport. The NPC then surveyed the 50 largest of these airports for their storage capacity (excluding the capacity owned by companies in the primary distribution system). The ATAA survey showed that the 50 largest airports accounted for 86 percent of the 1982 total consumption for the 237 locations affected. It was then assumed that the storage capacity obtained in the survey of these 50 airports would also represent 86 percent of the total storage capacity in airports handling commercial aviation.

Based on discussions with the organizations listed above, it was assumed that the 444 commercial airports not included in the above-mentioned surveys each maintained about 20 thousand gallons of storage capacity for kero-jet fuel. A recent Department of Defense survey revealed that airlines maintain fixed inventories at almost 57 percent of storage capacity and this percentage was used in estimating inventory in storage at all commercial aviation airports.

The FAA reported that there were 704 general aviation facilities, i.e., airports that do not service commercially scheduled aircraft, in August 1983. Based on discussions with the organizations listed above, it was assumed that each location maintained about 10,000 gallons of storage capacity, which was filled to 50 percent of capacity, on average.

With respect to on-board storage, it was reported that 8,300 smaller turboprop and turbojet aircraft were operational in 1983, each with an estimated average storage capacity of 900 gallons.[14] Additionally, 3,900 turbine helicopters were in service in 1983 with an average capacity of 150 gallons.[15] It was assumed that on-board inventory was 50 percent of storage capacity at any given time.

The storage capacity in the U.S. commercial fleet was determined by using a listing provided by Pratt and Whitney of the U.S. commercial fleet and the storage capacities of each type of airplane. It was assumed that on-board inventory was 50 percent of storage capacity at any given time.

[14]General Aviation Manufacturers Association.

[15]Ibid.

Table L-17 shows the estimated storage capacity and inventory maintained within the air transportation subsector.

TABLE L-17

AIR TRANSPORTATION
ESTIMATED STORAGE CAPACITY AND INVENTORY
AS OF MARCH 31, 1983

	Capacity (Thousands of Barrels)	Average Inventory to Capacity (Percent)	Inventory (Thousands of Barrels)
Commercial Aviation Airports			
237 largest	8,396	57	4,786
444 (@ 20,000 Gal.)	211	57	120
General Aviation Airports			
704 (@ 10,000 Gal.)	168	50	84
Turboprops/Turbojets General Aviation and Small Commercial			
8,300 (@ 900 Gal.)	178	50	89
Turbo Helicopters			
3,900 (@ 150 Gal.)	14	50	7
U.S. Commercial Fleet			
3,022*	906*	50	453
Total	**9,873**		**5,539**

*Pratt & Whitney, "Air Transport Association of America," U.S. International Commercial Jet Transport Fleets, March 1983.

Marine Transportation

The marine transportation subsector includes all ships and vessels engaged in trade or commerce. For the purposes of this analysis, the ships and vessels were divided into two basic categories, petroleum carriers and nonpetroleum carriers, with subcategories within each by type of transport. The volumes cited are on-board bunker storage capacity and inventory only.

The information presented below was compiled with the assistance of the U.S. Coast Guard, American Waterway Operators, the Army Corp of Engineers, and in discussions with numerous owner/operators, brokers, trade associations, and other data-collecting agencies. The methodology used to estimate the storage capacity for each subcategory is shown in the notes to Table L-18. For the estimated average inventory of the total commercial marine transportation subsector, it was assumed that inventory, on average, represented 50 percent of storage capacity.

Marine Pleasure Craft

The National Marine Manufacturers Association reports that there were 9.1 million pleasure boats registered in the United States at year-end 1982, of which 8.6 million craft maintained on-board storage

TABLE L-18

MARINE TRANSPORTATION
NUMBER OF VESSELS AND
ESTIMATED BUNKER STORAGE CAPACITY AND INVENTORY
AS OF MARCH 31, 1983

Vessel Classification	Number of Vessels	Bunker Storage (Thousands of Barrels) Capacity			Inventory*
		No.2 Fuel	Residual Fuel Oil	Total	
Petroleum Carriers†					
U.S. Flag Ocean Tankers	247	78	3,839	3,917	N/A
U.S. Flag Lake Vessels					
Tankers	6	6	6	12	N/A
Barges	16	7	-	7	N/A
Tugs	127	42	-	42	N/A
U.S. Coastal Barges‡	122	2	-	2	N/A
Inland Waterway Barges§	3,610	19	-	19	N/A
Towboats¶	4,693	2,723	-	2,723	N/A
Non-Petroleum Carriers					
U.S. Flag Ocean Drybulk/ Container Ships**	20	6	274	280	N/A
U.S. Flag Lake Drybulk Carriers††					
Operating	62	124	124	248	N/A
In Temporary Lay-Up	19	19	57	76	N/A
Laid-Up Over 1 Year	57	-	228	228	N/A
Offshore‡‡	2,800	3,166	-	3,166	N/A
Total	**11,779**	**6,192**	**4,528**	**10,720**	**5,360**

*N/A = Not Available.

†Approved for petroleum service; excludes liquified petroleum gas carriers.

‡Vessels average over 19,000 barrels each. It has been assumed that each vessel is fitted with at least 500 gallons of fuel for pump engines/machinery.

§2,591 barges are 195 feet or longer and 454 are 150-195 feet long. The total of 3,045 represents 84.3 percent of the fleet. Each barge is equipped with at least one pump engine. A number of the smaller barges are outfitted with pump engines as well. Therefore, it is assumed reasonable to include 90 percent of the barge fleet, with an average of 250 gallons of on-board storage for pump engines, in the estimate of inland waterway barge storage capacity. (3,610 vessels x 0.9 x 250 gallons/42 = 19,340 barrels)

¶The American Waterways Operators Shipyard Conference reports that there are 4,693 towboats with a total of 7,146,576 horsepower, or approximately 1,500 horsepower per boat. Using the assumption of one gallon per day per horsepower of demand and 16 days' supply of demand, total bunker storage would approximate 2,722,505 barrels.

**The Maritime Administration estimates that there are approximately 20 drybulk carriers operating at approximately 14,000 barrel bunkers each.

††Industry sources indicate bunker capacity on each ship to be approximately 4,000 barrels.

‡‡Boats, tugs, and other equipment used in supplying materials for offshore production facilities; data supplied by Fleet Data Service, Houston, Texas.

for fuel, including portable tankage used in the smallest of craft. Due to the seasonality of recreational boating, fuel demand and inventory held vary widely. Therefore, on-board inventory is estimated by the NPC to average 30 percent, as shown in Table L-19.

TABLE L-19

MARINE PLEASURE CRAFT
ESTIMATED ON-BOARD STORAGE CAPACITY AND INVENTORY
AS OF MARCH 31, 1983

Type of Craft	1982 Registrations (Millions)	Average Tank Capacity (Gallons)	Capacity (Thousands of Barrels)	Inventory (Thousands of Barrels)*
Outboard Motor (Gasoline Engine)	7.2	12	2,057	N/A
Stern Driven (Gasoline Engine)	0.9	50	1,071	N/A
Cruiser and Auxiliary Craft				
(Gasoline Engine)	0.4	200	1,905	N/A
(Diesel Engine)	0.1	250	595	N/A
Total			**5,628**	**1,689**

*N/A = Not Available.

Taxicab Transportation

The taxicab subsector includes the for-hire automobile fleet for passenger transportation. The International Taxicab Association (ITA) estimates that there are approximately 4,500 cab companies operating in the United States today. In 1981, the ITA surveyed approximately 3,000 of these taxicab companies, including virtually all of the larger companies. The results of the survey indicate that 40 percent, or 1,200, of these companies maintained their own fueling facility, while the balance fueled at service stations. Of the remaining 1,500 companies, the NPC estimates that only 20 percent, or 300, have storage capacity for fueling. The average storage capacity for the 1,500 companies that fuel their own fleet is estimated to be 8,000 gallons, or a total of 12 million gallons (286,000 barrels). The average fixed inventory is estimated by the Council to be 50 percent, or 143,000 barrels.

Motor Vehicle Fleet

The motor vehicle subsector includes private passenger vehicles, motorcycles, buses, taxicabs, and trucks. On-board storage capacity and inventory only are included in this analysis; the fixed storage capacity and inventory used to service the motor vehicle fleets fueling requirements is included in other analyses.

The EIA, Federal Highway Administration (FHWA), R. L. Polk, Motor Vehicle Manufacturers Association of America (MVMAA), and others were consulted in the compilation of the following information. Polk reports that 1982 auto registrations totalled 106.9 million vehicles. This figure differs from the Department of Transportation reported total registrations because it excludes double registrations that occur primarily as a result of an individual's relocation from one state to another. Based on production figures reported by the MVMAA, it is estimated that 2 percent of the automobile fleet is diesel-powered. Industry representatives estimate that, on average, inventory in automobiles is about 40 percent of tank capacity. The average automobile tank is 19.9 gallons.

Motorcycle registrations totalled nearly 5.8 million in 1982. A survey of various motorcycle models revealed a range of tank capacities from 3 to 7 gallons per vehicle with an average capacity of 4.5 gallons. Inventory in motorcycles is estimated to be 50 percent of tank capacity.

Polk reports that 1982 bus registrations totalled 107,000 (commercial) and 433,000 (school); the average tank capacity was estimated by APTA to be 125 gallons for commercial and 35 gallons for school buses. Industry sources estimate that 25 percent of commercial buses are kerosine-powered (primarily municipal buses); the balance use diesel fuel. It is also estimated that 95 percent of the school buses in service are gasoline-powered.

The FHWA reported that 1982 registrations of light, medium, and heavy trucks were 28.2 million, 6.9 million, and 1.8 million, respectively. Although these data are not presented by fuel type, industry sources indicate that it is reasonable to assume that 5 percent of the light trucks registered are diesel-powered, while 60 percent of the medium and 100 percent of the heavy trucks are diesel-powered. Based on industry estimates, the assumption was also made that the average inventory held on-board at any given time is 40 percent for light trucks and 50 percent for both medium and heavy trucks, as shown in Table L-20.

TABLE L-20

MOTOR VEHICLE FLEET
ESTIMATED ON-BOARD STORAGE CAPACITY AND INVENTORY
AS OF MARCH 31, 1983

	Registered 1982 Vehicles	Average Tank Capacity (Gallons)	Total Tank Capacity (Thousands of Barrels)				Estimated Inventory (Thousands of Barrels)
			Motor Gasoline	No.2 Diesel	Kero-sine	Total	
Automobiles	106,867,000*†	19.9§	49,621	1,013	-	50,634	20,253
Motorcycles	5,779,000*	4.5	619	-	-	619	310
Buses							
Commercial	107,315†	125.0¶	-	240	79	319	160
School	432,813†	35.0¶	343	18	-	361	180
Trucks							
Light	28,172,497‡	20.0§	12,745	671	-	13,416	5,366
Medium	6,904,005‡	100.0§	6,575	9,863	-	16,438	8,219
Heavy	1,762,638‡	200.0§	-	8,394	-	8,394	4,197
Total			**69,903**	**20,199**	**79**	**90,181**	**38,685**

*Motor Vehicle Manufacturers Association.
†R. L. Polk.
‡Federal Highway Administration.
§DOE/EIA—0328 Residential Energy Consumption Survey, February 1983. The automobile fleet average is 7.2 years.
¶American Public Transit Association.

Notes to Transportation Sector Analysis

Not included in the analysis above is the payload capacity in trailers, tankwagons, railcars, barges, and tankers. These capacities are listed on Table L-21 and were not included in the transportation sector analysis because transportation media do not constitute storage for end use by the transportation sector. It should be noted that, as is the case with all equipment, it is impossible to achieve 100 percent utilization of the payload capacity at any given time.

TABLE L-21
TRANSPORTATION FLEET PAYLOAD CAPACITY
(Millions of Barrels)

Tankcars	65.8
Tank Trucks	10.1
Tankwagons	2.5
Barges/Tankers*	174.4
Total	**252.8**

*In addition to the bunker storage capacity shown on Table L-18, petroleum carriers have an estimated cargo capacity of 174.3 million barrels, as detailed below:

Vessel Classification	Petroleum Cargo Capacity (Millions of Barrels)
U.S. Flag Ocean Tankers	113.0
U.S. Flag Lake Vessels	
Tankers	0.4
Barges	0.6
U.S. Coastal Barges	2.4
Inland Waterway Barges	58.0
	174.4

Appendix M:
Glossary

aviation gasoline—all special grades of gasoline for use in aviation reciprocating engines, as given in ASTM Specification D910 and Military Specification MIL-G-5572. Includes all refinery products within the gasoline range that are to be marketed straight or in blends as aviation gasoline without further processing; i.e., any refinery operation except mechanical blending. Also includes finished components in the gasoline range that will be used for blending or compounding into aviation gasoline.

Alaskan crude oil in transit by water—crude oil cargoes in transit by tanker from Alaskan loading ports to other states, Puerto Rico, the Virgin Islands, Guam, and the Hawaiian Foreign Trade Zone. Includes crude oil shipped from all sources in Alaska, including Cook Inlet and Valdez.

barrel—the standard unit of measurement of liquids in the petroleum industry, containing 42 U.S. standard gallons at 60°F.

basic sediment and water (BS&W)—bottoms, sediments, and water that collect at the bottom of storage tanks.

bulk plant—a nonconsumer facility used for storage and/or marketing of petroleum products that has total storage capacity of less than 50,000 barrels and does *not* receive petroleum products by barge, tanker, or pipeline.

bulk terminal—a nonconsumer facility used for storage and/or marketing of petroleum products that has total storage capacity of 50,000 barrels or more *or* receives petroleum products by barge, tanker, or pipeline.

clean products—motor gasoline, kerosine, jet fuel, and distillate fuel oil.

consumption—the utilization of a product by an end-user.

contingency space—space in excess of the maximum operating inventory, exclusive of the unavailable space, that is required to maintain a workable operating system. This space is only used in times of abnormal operations, such as equipment failure (see Figure 4).

crude oil—technically defined as a mixture of hydrocarbons that exists in natural underground reservoirs and remains liquid at atmospheric pressure after passing through surface separating facilities. Statistically defined to also include lease condensate (see definition) and small amounts of nonhydrocarbons produced with the oil. Unfinished oils (see definition) and natural gas liquids produced at natural gas processing plants and mixed with crude oil are excluded.

demand—the withdrawal of stocks from the primary distribution system.

distillate fuel oil (general)—a general classification for one of the petroleum fractions that is used primarily for space heating, on-highway and off-highway diesel engine fuel (including railroad engine fuel and fuel for agriculture machinery), and electric power generation. Included are products known

as No. 1 and No. 2 heating oil conforming to ASTM Specification D396 and diesel fuel conforming to ASTM Specification D975 for No. 1-D and No. 2-D.

distillate fuel oil (No. 4 fuel oil)—a fuel oil for commercial burner installations not equipped with preheating facilities; extensively used in industrial plants. This grade is a blend of distillate fuel oil and residual fuel oil stocks that conforms to ASTM Specification D396 or Federal Specification VV-F-815C for this grade. Also included is No. 4-D, a fuel oil for low-speed and medium-speed diesel engines that conforms to ASTM Specification D975.

fixed storage—storage capacity that is held at a central location for eventual consumption by an end-user, such as jet fuel storage tanks at an airport.

futures—for the purpose of this report, refers to futures trading of No. 2 fuel oil/gas oil, motor gasoline, and crude oil on the New York Mercantile Exchange, the Chicago Board of Trade, and the London International Petroleum Exchange. (See futures glossary in Appendix F.)

idle tankage—tankage that was idle on March 31, 1983, for reasons other than programmed maintenance, but that could be available for service within 90 days following little or no maintenance work.

idle tankage (environmentally restricted)—tankage that was idle on March 31, 1983, but that would require environmental waiver or modification to be available for service within 90 days.

in-transit inventory—inventory that is being transported between domestic storage locations at a given point in time.

inventories—liquid barrels of crude oil and certain refined petroleum products located within the customs territory of the United States (excluding Puerto Rico) that are stored in the primary and secondary distribution systems and the tertiary storage segment. Does not include inventories in U.S. territories and possessions.

kerosine (non-aviation use)—a petroleum product used in space heaters, cook stoves, and water heaters, also suitable for use as an illuminant when burned in wick lamps. Included are the two classifications recognized by ASTM D3699: No. 1-K and No. 2-K, and all grades of kerosine called range or stove oil that have properties similar to No. 1 fuel oil.

kerosine-type jet fuel—a relatively low-freezing-point petroleum product of the kerosine type used primarily for commercial turbojet and turboprop aircraft engines. Covered by ASTM Specification D1655 and Military Specification MIL-T-5624L (Grades JP-5 and JP-8).

lease condensate—a natural gas liquid recovered from gas well gas (associated and non-associated) in lease separators or field facilities. Consists primarily of pentanes and heavier hydrocarbons and is included with crude oil in this report.

lease stocks—crude oil stocks held in storage on producing properties.

maximum operating inventory—the maximum quantity that could be stored in a defined distribution system while still maintaining a workable operating system (see Figure 4).

minimum operating inventory—the inventory level below which operating problems and shortages would begin to appear in a defined distribution system. Includes "unavailable" inventory as well as "required working" inventory necessary to maintain normal operations; does not include seasonal inventory (see Figure 4).

motor gasoline—a complex mixture of relatively volatile hydrocarbons, with or without small quantities of additives, that have been blended to form a fuel suitable for use in spark-ignition engines. Consists of finished leaded gasoline (including leaded gasohol), finished unleaded gasoline (including unleaded gasohol), and motor gasoline blending components. Specifications for motor gasoline are given in ASTM Specification D439 and Federal Specification VV-G-1690B.

naphtha-type jet fuel—a fuel in the heavy naphtha boiling range meeting Military Specification MIL-T-5624L (Grade JP-4). Used for turbojet and turboprop aircraft engines, primarily by the military; excludes ram-jet and petroleum rocket fuels.

net available shell capacity—the total shell capacity of tankage less the unavailable space for tank tops and safety allowance (see Figure 4).

on-board storage—the storage capacity that is used to fuel the engine of any transportation mode, such as the gasoline tank in an automobile and diesel tanks on trucks.

operable capacity (refineries)—the maximum amount of input that can be processed by a crude oil distillation unit in a 24-hour period, making allowances for processing limitations due to types and grades of inputs, limitations of downstream facilities, scheduled and unscheduled downtimes, and environmental constraints. Includes any shutdown capacity that could be placed in operation within 90 days.

operating cycle—the cyclic process of delivering oil from supply tank(s) at one location in the distribution system to another tank(s) in the system to meet demand for that oil at the receiving location. The volume and frequency of the cycle are a function of many factors, including the location of both supply and demand, the level of demand, the availability of transportation and refinery facilities, the mode of transportation, and the availability and size of tankage.

operating space—space in the primary storage system in excess of the minimum operating inventory, available for holding additional inventories while still maintaining a workable system. Includes seasonal inventories and inventory build-up for planned maintenance (see Figure 4).

PADDs (Petroleum Administration for Defense Districts)—a geographic aggregation of the 50 states and the District of Columbia into five districts originally designed by the Petroleum Administration for Defense in 1950 for purposes of administration (see Figure 1). PADD I has been divided into three sub-PADDs: IA, IB, and IC.

payload capacity—the cargo capacity of any transportation mode used to transport petroleum, such as barges, tank cars, and tank trucks.

petroleum products—a generic term used to describe products obtained from distilling and processing crude oil, unfinished oils, natural gas liquids, blend stocks, and other miscellaneous hydrocarbon compounds. Includes all gasoline, jet fuels, kerosine, distillate fuel oil, residual fuel oil, liquified petroleum gases, petrochemical feedstocks, lubricants, paraffin wax, petroleum coke, asphalt, and many other miscellaneous products. Under some statistical classifications, petroleum products may refer to all petroleum, excluding only crude oil and lease condensate.

pipeline fill—inventory in a pipeline between the shipping and receiving tanks in the pipeline system.

primary distribution system—the system of tanks, caverns, terminals, pipelines, tankers, barges, tank cars, tank trucks, and refineries that receive, transport, and refine crude oil into products for delivery to bulk distribution terminals, the secondary distribution system, or certain end-users. Does not include the Strategic Petroleum Reserve (see Figures 2 and 3).

residual fuel oil—the topped crude oil of refinery operation, which includes No. 5 and No. 6 fuel oils as defined in ASTM Specification D396 and Federal Specification VV-F-815C; Navy Special fuel oil as defined in Military Specification MIL-F-859E including Amendment 2 (NATO Symbol F-77); and Bunker C fuel oil. Residual fuel oil is used for the production of electric power, space heating, vessel bunkering, and various industrial purposes. Includes imported crude oil to be burned as a fuel.

seasonal inventory—inventory that is not immediately needed to support current demand levels, but is maintained in anticipation of higher (seasonal) demand levels that cannot be met with then-current manufacturing or transportation capabilities.

secondary distribution system—includes nonconsumer bulk plants and facilities of resellers of petroleum products, such as gasoline service stations, jobbers, and fuel oil dealers (see Figures 2 and 3).

Strategic Petroleum Reserve (SPR)—a federal program created by the Energy Policy and Conservation Act of 1975 to establish a reserve of up to one billion barrels of crude oil and/or petroleum products in order to reduce the impact of disruptions in petroleum supplies and to carry out the obligations of the United States under the International Energy Program (see Appendix G).

shell capacity of tankage—the design capacity of the tank (see Figure 4).

stocks—see definition of inventories.

swing tankage—tankage that is used to store different products at different times of the year.

tank bottoms—inventory that falls below the normal suction line of the tank. For floating-roof tanks, the amount required to keep the legs of the roof from touching the tank bottom. The inventory in tank bottoms (including BS&W) is unavailable (see Figure 4).

tankage under construction—shell capacity under construction (ground has been broken, the construction contract signed, and major equipment ordered).

tertiary storage segment—inventory and storage capacity of products at the consumer level (see Figures 2 and 3).

total system capacity—the sum of net available shell capacity, storage caverns, and unavailable inventory outside of tankage (defined as pipeline fill, inventory in refinery lines, operating equipment, and in-transit from domestic sources excluding Alaskan crude oil in transit by water). In the case of crude oil inventories, producers' lease tankage is also included in total system capacity if stocks are routinely reported to the Department of Energy.

unavailable inventory—includes inventory in tank bottoms, pipelines, refinery pipelines, and operating equipment; quantities set aside as plant fuel or pipeline prime mover fuel; and oil in transit by truck, tank car, barge, and tanker from domestic sources.

unavailable space—top portion of a tank that is not available to store inventory but is required for design or safety considerations; e.g., to allow for thermal expansion (see Figure 4).

unfinished oils—mixture or combination of partially processed petroleum oils or any components thereof that are to be further processed; i.e., any refinery operation except mechanical blending.

wet barrel delivery—futures market delivery mechanism involving the physical transfer of the commodity during the delivery month.

working inventory—that portion of the minimum operating inventory required over and above the unavailable inventory required to keep the distribution system functioning normally without operating problems and run-outs. Includes the volumes needed to support the normal operating cycle of shipments and receipts as levels rise and fall in each tank when oil is delivered or removed. Also includes the volume needed to handle unavoidable but recurring operating interruptions and schedule changes, and volumes needed to facilitate blending of final product to required specification. Does not include seasonal inventory or stocks held for planned maintenance (see Figure 4).

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