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2d Session }

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THE PROSPECTS FOR GASOLINE
AVAILABILITY: 1974

A BACKGROUND PAPER

PREPARED BY THE

CONGRESSIONAL RESEARCH SERVICE

AT THE REQUEST OF

HENRY M. JACKSON, Chairman

COMMITTEE ON INTERIOR AND

INSULAR AFFAIRS

UNITED STATES SENATE

PURSUANT TO

S. Res. 45

THE NATIONAL FUELS AND ENERGY
POLICY STUDY

Serial No. 93-41 (92-76)

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SENATE RESOLUTION 45

NATIONAL FUELS AND ENERGY POLICY STUDY

This publication is a background document for the National Fuels and Energy Policy Study authorized by Senate Resolution 45, introduced by Senators Jennings Randolph and Henry M. Jackson on February 4, 1971, and considered, amended, and agreed to by the Senate on May 3, 1971.

The resolution authorized the Senate Interior and Insular Affairs Committee, and ex-officio members of the Committees on Commerce and on Public Works and the Joint Committee on Atomic Energy, to make a full and complete investigation and study of National Fuels and Energy Policies.

Subsequently, on March 1, 1974, in the furtherance of the purposes of Senate Resolution 45 (92d Congress), the Senate approved the addition of ex-officio members from the Committees on Finance, on Foreign Relations, on Government Operations, and on Labor and Public Welfare, also.

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MEMORANDUM OF THE CHAIRMAN

To Members and Ex-Officio Members of the Senate Committee on Interior and Insular Affairs Study of National Fuels and Energy Policy Pursuant to Senate Resolution 45:

In the winter of 1973-74, the Nation experienced its first peacetime gasoline shortages. These shortages were due to a combination of factors: unprecedented growth in demand; the Arab production cuts and embargo; mismanagement of stocks; and poor planning on the part of industry and Government. The results of the shortage were long gas lines, higher prices at the pump, curtailments in travel, economic dislocations, and serious inconvenience for the American consumer.

The experiences of this past winter have left the American people concerned and uncertain about the likelihood of future shortages. Clearly no one wants to risk a repetition of last winter's experience. But unless the public has some understanding of the gasoline supply situation anticipated for 1974, they cannot be expected to make appropriate adjustments in their consumption.

For this reason, I requested the Congressional Research Service of the Library of Congress to prepare a report on the projected availability of gasoline for the balance of 1974 and beyond. I have directed that this report by David Lindahl of the Environmental Policy Division, Congressional Research Service, Library of Congress, be published as a committee print for the use of the Senate's National Fuels and Energy Policy Study.

Also included in the print as Appendixes are two related documents. One is a post-embargo supply-demand outlook prepared by the Federal Energy Office. The other is a brief report on the gasoline supply picture for the second and third quarters prepared by the Petroleum Industry Research Foundation.

Publication of these documents is being undertaken as part of the committee's continuing effort to assure the availability of current, accurate information on critical energy problems.

HENRY M. JACKSON, *Chairman.*

LETTER OF TRANSMITTAL

THE LIBRARY OF CONGRESS,
CONGRESSIONAL RESEARCH SERVICE,
Washington, D.C., June 20, 1974.

Hon. HENRY M. JACKSON,
Chairman, Committee on Interior and Insular Affairs,
U.S. Senate, Washington, D.C.

DEAR CHAIRMAN JACKSON: I am pleased to transmit herewith a report entitled, "The Prospects for Gasoline Availability: 1974," prepared at your request by Mr. David M. Lindahl, Analyst, Environmental Policy Division.

We shall be pleased to continue to assist you in carrying out the National Fuels and Energy Policy Study.

Sincerely yours,

LESTER S. JAYSON, *Director.*

THE PROSPECTS FOR GASOLINE AVAILABILITY: 1974

Prepared by
DAVID M. LINDAHL, Analyst
Environmental Policy Division
Library of Congress
at the Request of
HENRY M. JACKSON, Chairman
Committee on Interior and Insular Affairs
United States Senate

June 1974

THE REPORT OF THE COMMISSIONER OF THE GENERAL LAND OFFICE

FOR THE YEAR 1871

IN RESPONSE TO A RESOLUTION OF THE HOUSE OF COMMONS

PASSED ON THE 12TH MARCH 1871

BY THE COMMISSIONER

OF THE GENERAL LAND OFFICE

AND BY THE SECRETARY OF THE LAND OFFICE

IN ANSWER TO A RESOLUTION OF THE HOUSE OF COMMONS

PASSED ON THE 12TH MARCH 1871

LONDON

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INTRODUCTION

On October 17, 1973, the member states of the Organization of Arab Petroleum Exporting Countries (OAPEC) announced an oil production cut of 25% effective November 1973, and embargoed direct and indirect sales to the United States and the Netherlands. The announced purpose of the embargo was to force Israel, through the United States, to relinquish occupied territories captured in the 1967 war.

At that time, the United States received approximately 17% of its oil (including petroleum products refined in Europe, Canada, and the Caribbean from Arab crude oil) from the participants in the embargo. The embargo did not immediately affect the United States because Arab oil in transit continued to be delivered through December. By January, those deliveries plus a small amount of "leakage" had effectively ceased, and the embargo began to cause shortages of most petroleum products. These losses of crude oil were offset to some extent by increased production from Iran, Nigeria, and Venezuela that amounted to 800,000 barrels per day (b/d), much of which was imported to the United States.* Despite those gains, crude oil imports in February 1974 were 58% less than they were in October 1973.**

To maintain basic industries and to ensure adequate stocks of heating oil for the winter of 1973-74, the Administration ordered increases in heating oil production at the expense of gasoline. This action reduced the

* U.S., Congress. Joint Economic Committee, A Reappraisal of U.S. Policy, Committee Print, 93d Cong., 2d sess., March 8, 1974, p. 33.

** U.S., Federal Energy Office, Monthly Energy Indicators, March 1974, p. 1.

gasoline supply to levels considerably below demand. By the time priority users were supplied, less gasoline was available to the general public. These shortages combined with inadequate distribution, panic buying, and the general confusion resulting from local "rationing" plans produced long lines at gasoline stations by February when the psychological effect of the embargo was at its peak.

In addition to its embargo and the production cuts, OAPEC also tripled its prices, as did most other oil exporting countries. Gasoline prices in Europe, which is 85% dependent upon OAPEC for its petroleum, were allowed to rise and consumption dropped enough so that after a period of adjustment, few shortages occurred at gasoline stations there.

The full impact of the price increase has yet to be felt in the United States. Now that oil shipments from the Middle East have resumed, it seems likely that there will be continued upward pressure on gasoline prices at the pump in the United States, a condition which is attracting the attention of many Members of Congress.

Shortages of petroleum products in the United States would very likely have occurred even without the Arab Oil Embargo. Gasoline was in short supply in the summer of 1973 and probably would not have been available in sufficient quantities to forestall shortages in the summer of 1974. The embargo dramatized the trend, developing since the mid-1960's, of declining domestic production and increasing demand. The embargo, in effect suddenly telescoped the future into the present.

The full effect of the embargo is difficult to determine precisely. The Federal Energy Office has estimated that during the first quarter of 1974,

supply (16.4 million barrels per day) fell short of demand (19.1 mb/d) by 2.7 mb/d of unconstrained demand.* Through conservation measures, the net shortage was held to about 1 mb/d. Unless Arab oil production is increased over the September 1973 levels, it is unlikely that the unconstrained demand for gasoline in the United States can be met.

The purpose of this report is to present an overview of current thinking on these problems of supply and demand for gasoline in the United States with special attention to prospects for this summer. The report first focuses on factors behind the rapid increase in demand for gasoline over recent years. It discusses several developments which have decreased demand. The report then examines developments that have either increased or decreased gasoline supplies. It concludes with an assessment of gasoline availability for next summer and several comments on the impact of shortages.

* U.S., Federal Energy Office, Petroleum Situation Report, March 29, 1974, p. 1.

FACTORS INCREASING DEMAND

1. Population Growth

One basic factor behind the rapid increase in gasoline demand is the growth in population and in particular the number of registered drivers. In 1964 there were 96 million licensed drivers. By 1974 there were 123 million, an increase of 27 million drivers.* This increase is due largely to the "baby boom" of the early 1950's which has caused a surge in the number of licensed drivers in the 1970's. This trend is diminishing now that the growth in population is leveling off. The recent decline in the birthrate will have little effect on gasoline consumption for the next 15 years, however, because of the time it will take for the children born today to reach driving age.

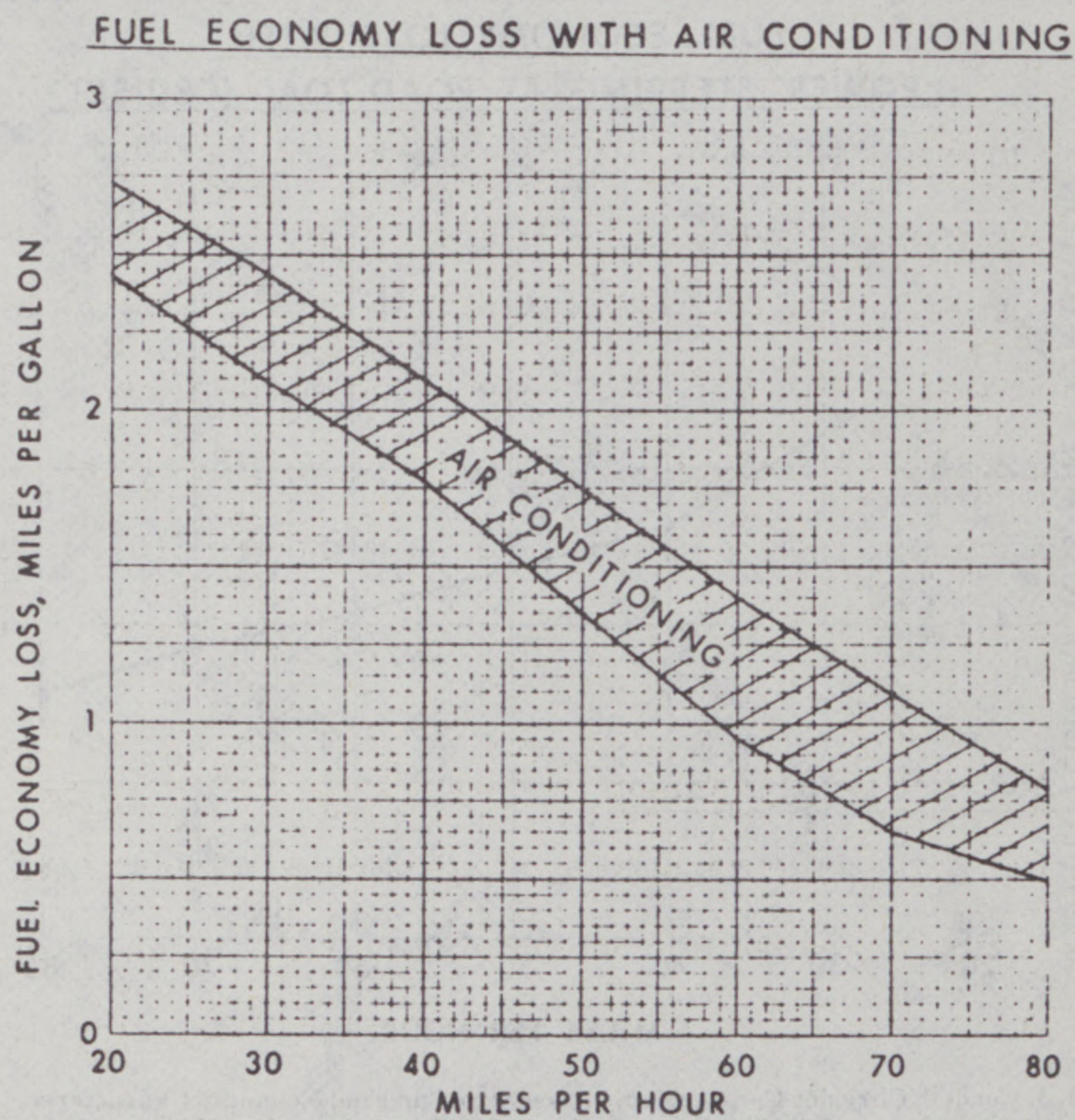
2. Optional Automotive Equipment

The addition of power-consuming accessories to new cars has been a major factor in the increased fuel consumption of American automobiles over the past decade. Air-conditioning is by far the most significant energy-consuming accessory. The fuel penalty imposed by air-conditioning is generally estimated at about 10% (Figure 1). Other accessories such as automatic transmission, power brakes and power steering can decrease mileage by another 3 to 4% (Figure 2).

In addition to the energy needed to operate them, these items add to the weight of the car which further decreases fuel economy (Figure 3). An

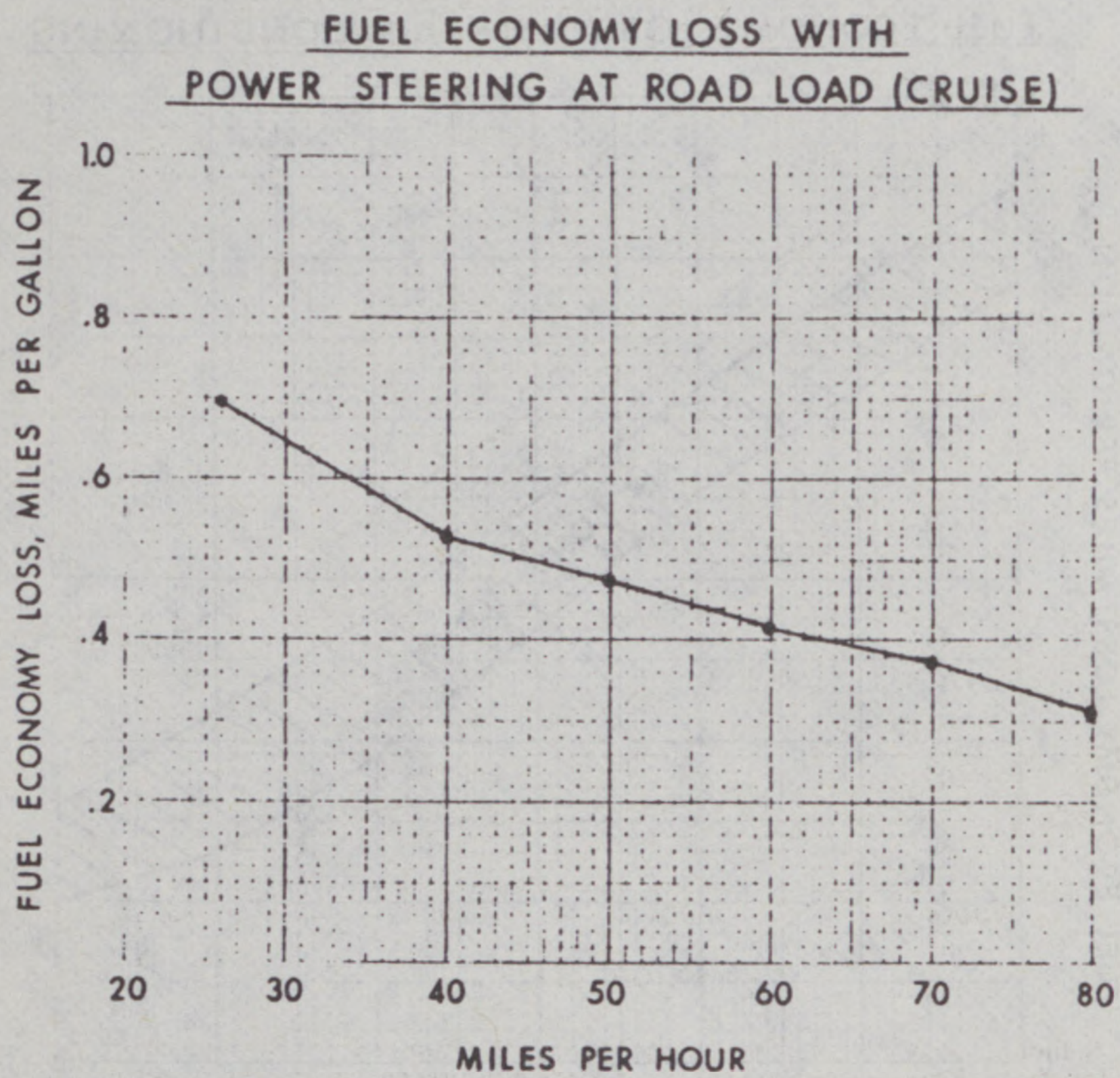
* Automobile Facts and Figures, Motor Vehicles Manufacturers Association. 1964 edition.

Figure 1



J. J. Cornell, Chrysler Corporation, "Passenger Car Fuel Economy Characteristics on Modern Superhighways", Paper 650862 presented at SAE meeting, Tulsa, Oklahoma, November 1965.

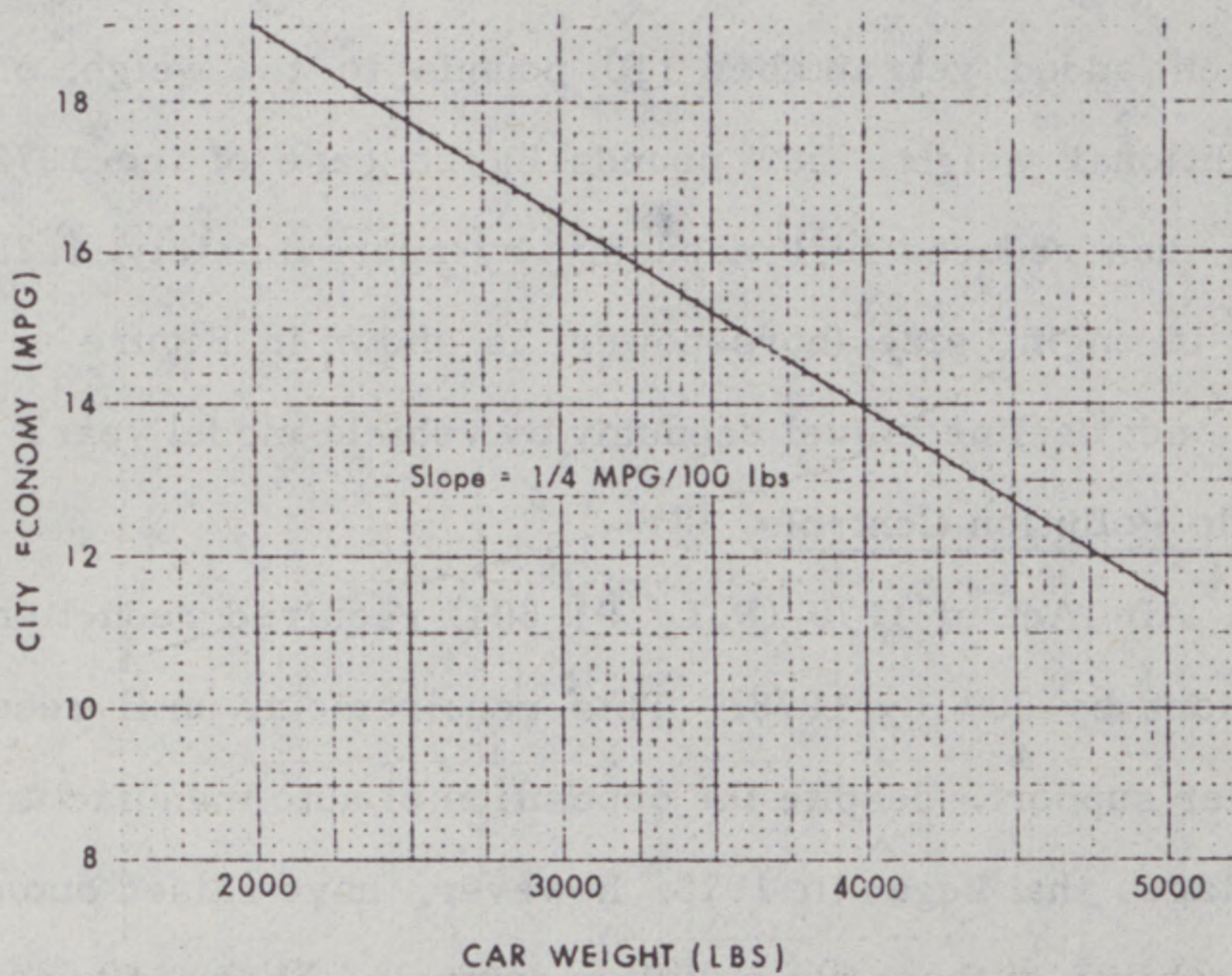
Figure 2



J. J. Cornell, Chrysler Corporation, "Passenger Car Fuel Economy Characteristics on Modern Superhighways", Paper 650862 presented at SAE meeting, Tulsa, Oklahoma, November 1965.

Figure 3

EFFECT OF CAR WEIGHT ON FUEL ECONOMY
(MILES PER GALLON) DURING CITY DRIVING



C. E. Scheffler, G. W. Neipoth, GM Corporation, "Customer Fuel Economy Estimated from Engineering Tests", Paper 650861 presented at SAE meeting, Tulsa, Oklahoma, November 1965.

increase of 400 pounds of car weight is estimated to impose a one-mile-per-gallon fuel penalty. Air pollution controls have also increased car weight and decreased fuel economy. To maintain performance levels while meeting emission standards, engine size has been increased, typically by 119 pounds for the 1973 model Chevrolet. This in turn required heavier construction which added yet another 110 pounds to the weight of the car. The total additional weight, 502 pounds in the case of the 1973 Chevrolet (Table 1), has reduced fuel economy by approximately 1.25 m.p.g.* The increase in engine size (horsepower) is shown in Figure 4. Figure 5 illustrates the net decline in fuel economy by vehicle model year.

3. Automobile Pollution Controls

The Clean Air Act of 1970 (P.L. 91-604) required reduction of automobile emissions by 90% by 1976. This requirement, until recently, had enjoyed popular support, despite the opposition of auto manufacturers. The gasoline shortages that began in 1973, however, have raised some question about the desirability of these air pollution controls. There is general agreement that the controls have achieved significant reductions in emission levels. The simple steps taken prior to 1971, such as crankcase blow-by control, evaporative controls, leaner mixture ratios, and minor engine modifications have improved burning efficiency and reduced hydrocarbon

* U.S. Congress. Senate. Committee on Commerce. Automotive research and development and fuel economy. Hearings, 93d Congress, 1st session. May 3, 4, 14, June 8, 14, and 21, 1973. Serial No. 93-41. 680 p. p. 557.

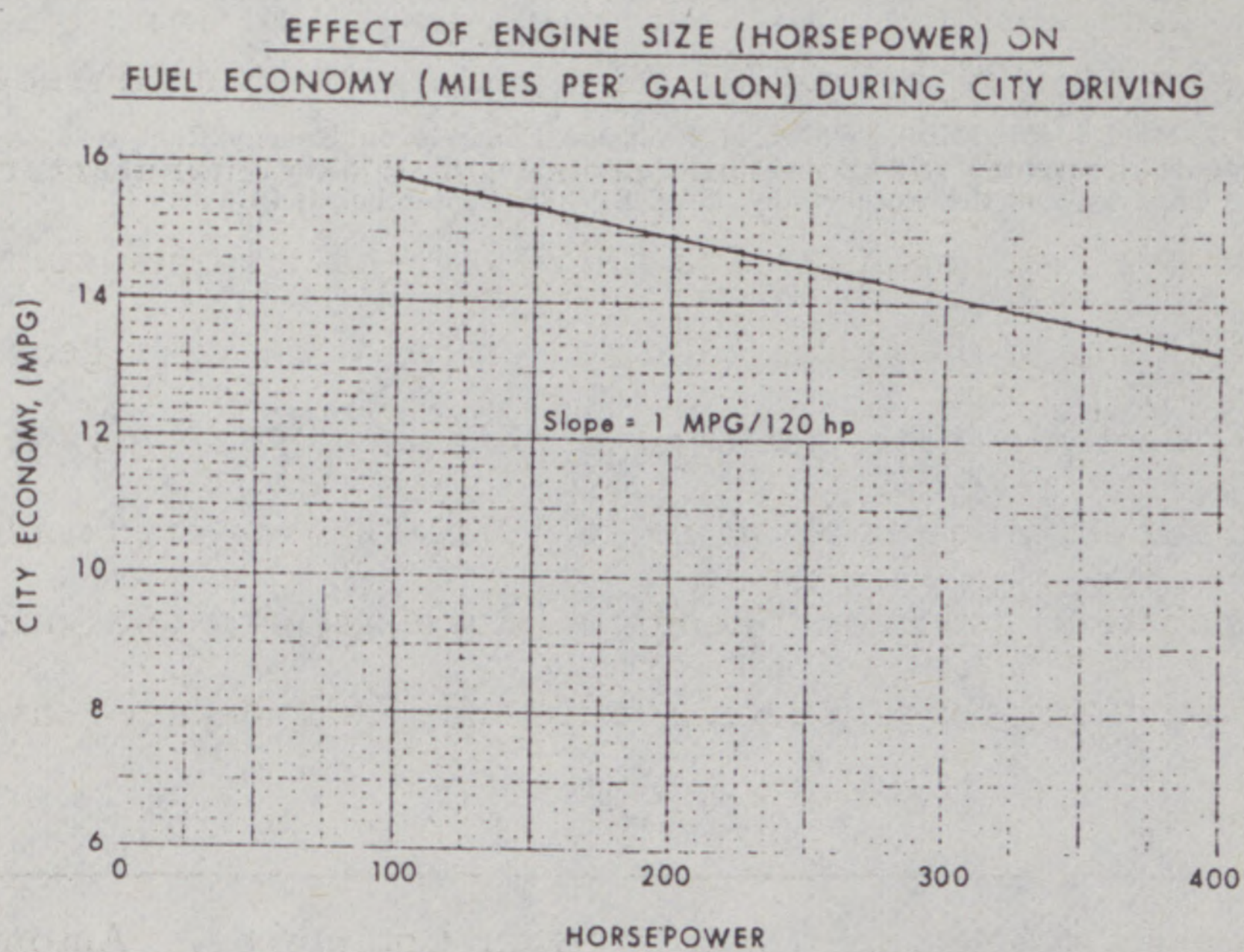
Table 1

Shipping Weight Changes--Full Size, V-8 Chevrolet 4-Door (1968-73)

	<i>Pounds</i>
Bumpers -----	118
Sideguard beams-----	40
Disc brakes and suspension-----	75
Power steering-----	40
Frame -----	56
Wheels and tires-----	54
Engine -----	119
	<hr/> 502

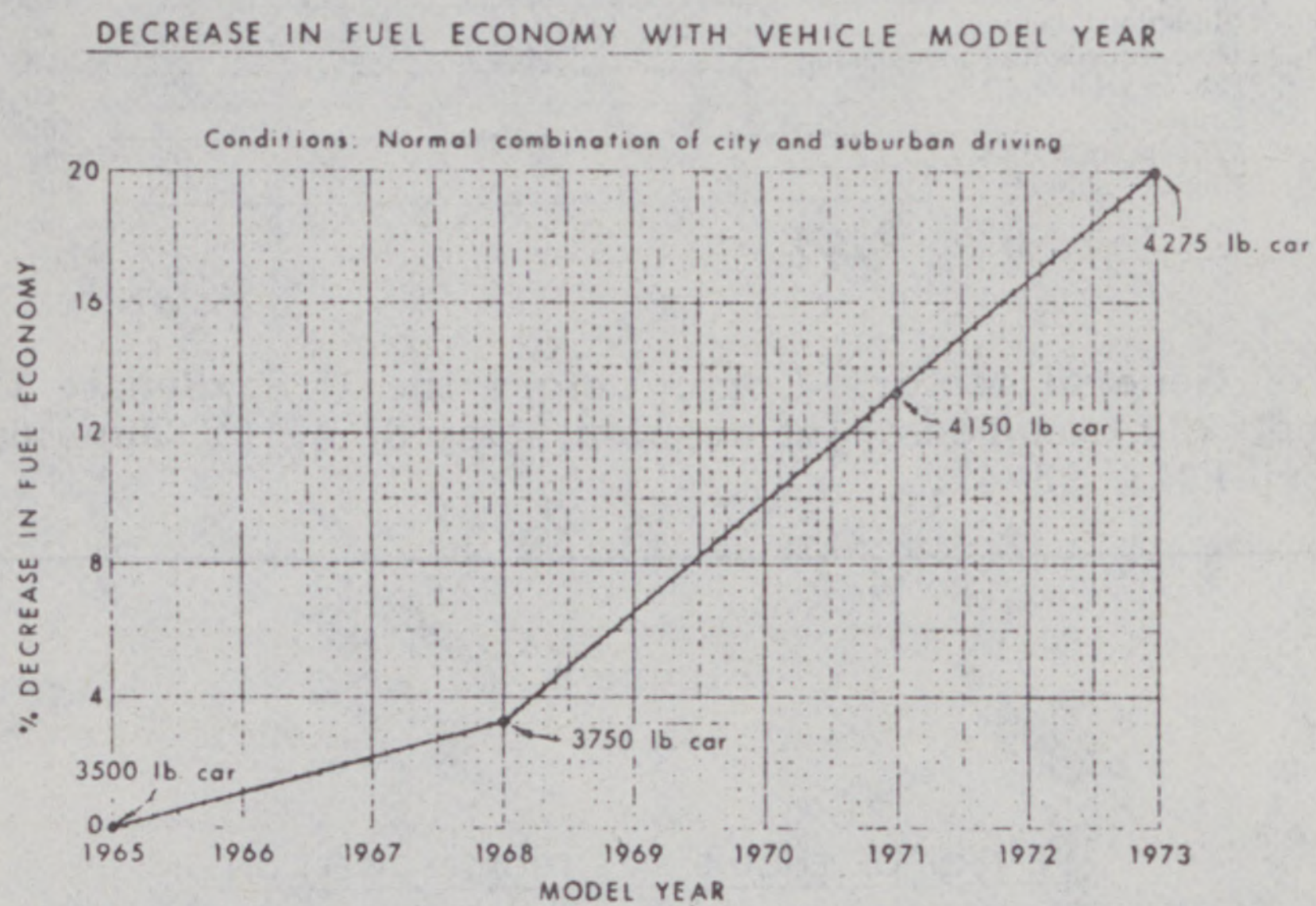
Statement of General Motors Corp. before the U.S. Senate Committee on Commerce, 93d Congress, 1st session, May 3, 4, 14, June 8, 14, and 21, 1973. Serial No. 93-41.

Figure 4



C. E. Scheffler, G. W. Neipoth, GM Corporation, "Customer Fuel Economy Estimated from Engineering Tests", Paper 650861 presented at SAE meeting, Tulsa, Oklahoma, November 1965.

Figure 5



H. C. MacDonald (Ford), "Effect of Emission Controls on Energy Requirements", presented at SAE meeting, Detroit, May 15, 1973 (to be published in "Energy and the Automobile", SAE SP-383, September 1, 1973).

emissions by 53% and carbon monoxide by 60%.* The cost of these modifications was small and did not adversely affect performance or economy.

Reduction in nitrogen oxides emissions from automobile engines, however, requires further modifications to be made. Because these emissions are directly related to engine temperatures, there was no way to reduce the emissions except by lowering combustion temperatures which lowers efficiency. Use of a lower compression ratio and exhaust gas recirculation system has reduced nitrogen oxide emissions by 54% but simultaneously imposed a penalty on fuel economy of 14-18% on cars over 4000 pounds (Figure 6). For cars under 4000 pounds, fuel economy improved slightly (approximately 2%) because of the improved fuel management systems used to meet the emission standards. The Environmental Protection Agency (EPA) reports that on a sales-weighted average basis, the total loss in fuel economy has been about 10% for 1973 and 1974 cars.**

Because of the seriousness of the gasoline shortage in early 1974, considerable interest developed in the disconnection of automotive pollution control equipment. A study recently conducted by EPA revealed that fuel savings of 5% could be achieved by such disconnections,*** but only when the work is done by competent technicians.

* David Gushee, Issue Brief: New Car Emission Controls, Congressional Research Service, January 10, 1974.

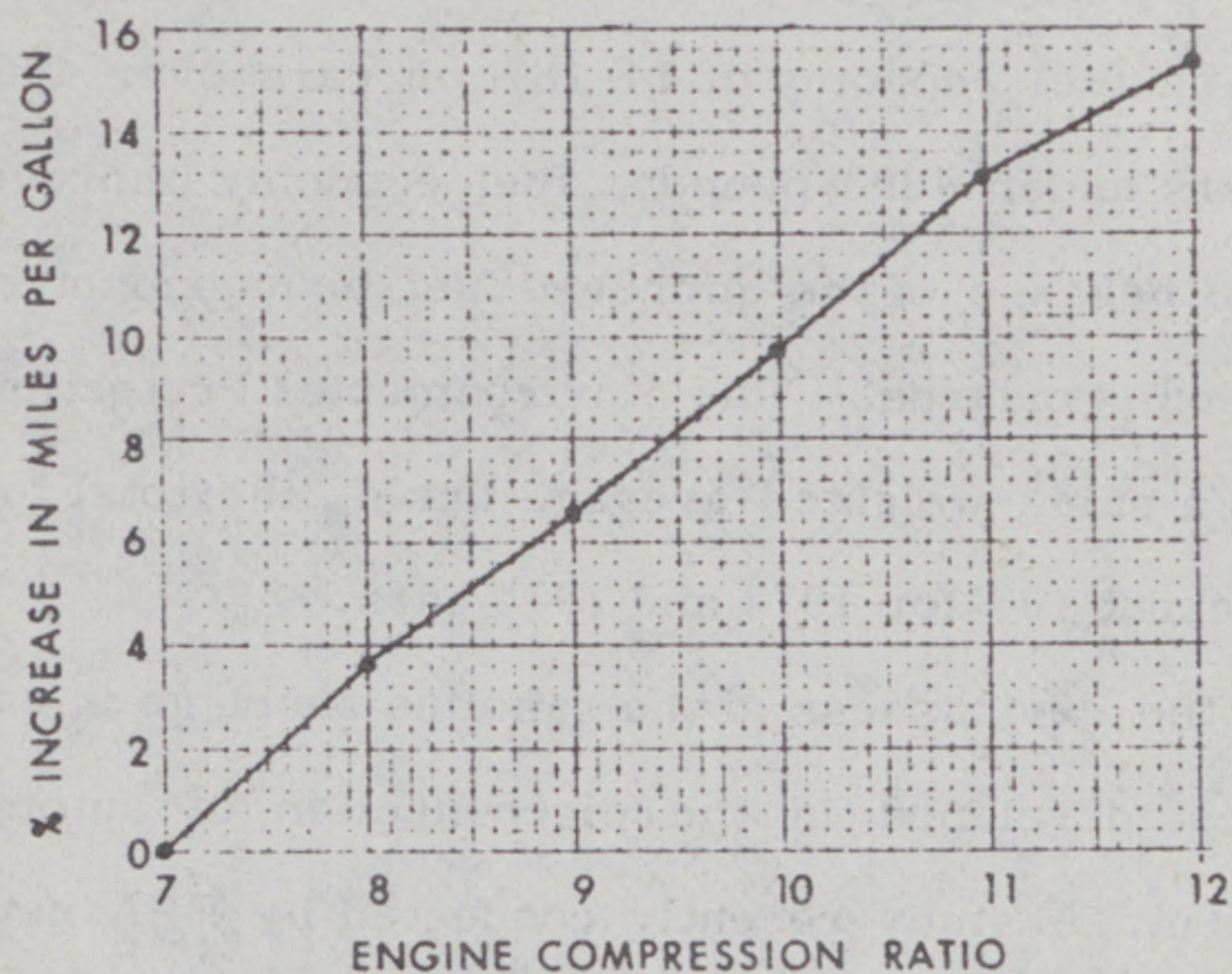
** Fact Sheet, Office of Air and Water Programs, Environmental Protection Agency, January 1974.

*** A Study in Fuel Economy Changes Resulting from Tampering with Emission Controls, Environmental Protection Agency, January 1974.

Figure 6

GENERAL EFFECT OF ENGINE COMPRESSION RATIO
ON FUEL ECONOMY

Example: If a vehicle obtained 15 miles per gallon with a 10 to 1 compression ratio engine, the same vehicle with an 8 to 1 compression ratio engine would get 14.1 miles per gallon.



M. M. Roensch, "The Automotive Engine—Today and Tomorrow", Paper 710845 presented at SAE meeting, St. Louis, Missouri, October 1971.

When EPA, as an experiment, had various garages remove emission controls from a sample group of cars, the alterations resulted in a fuel economy loss of 3.5%. In addition, the potential fuel savings would apply only to 1973-74 models because the earlier 1968-72 models were largely unaffected by the limited controls installed on them. Moreover, the 1975 models will be equipped with catalytic converters which do not reduce engine efficiency and consequently may produce fuel economy gains of 7-10% over the 1974 models.

FACTORS DECREASING DEMAND1. Price

The price stability of gasoline has long been taken for granted, subject to an occasional drop during a "gas war" but seldom rising. The average wholesale price of gasoline rose only from 11.38 cents per gallon in 1952 to 12.70 cents per gallon in 1972. In twenty years this increase was only 9.6% whereas the cost of living rose nearly 100% during the same period (Table 2 and Figure 6). There was no question that gasoline was a bargain and while there was a domestic surplus to market, the oil companies found it expedient to give prizes and trading stamps to encourage patronage. Many Americans built their lifestyles around the availability of cheap gasoline with the expectation that it would continue indefinitely. This assumption was shattered by the Arab Oil Embargo and the shortages and price increases that followed.

Prior to the embargo on October 1, the posted price of Saudi Arabian crude oil was \$3.01 per barrel (Table 3). That price, however, is used primarily to calculate taxes. The market price, for which the oil actually sold was \$2.37 per barrel. After the embargo was imposed and several price increases announced, the same oil was posted at \$11.65 per barrel and sold for \$7.61 per barrel. Adding tanker delivery costs of about \$1.50 per barrel made the total post-embargo price \$9.09 per barrel. Because this oil, even at the higher prices, was not available during the embargo, some oil from producing states not participating in the embargo (such as Iran and Nigeria) sold for prices in excess of \$20 per barrel on the spot

Table 2

U.S. Wholesale Prices of Gasoline

Year	Motor Gasoline ¢/Gal.		
1952	11.38	1973	¢/Gal.
1953	12.01	January	12.94
1954	11.66	February	13.26
1955	11.62	March	13.54
1956	11.75	April	13.75
1957	12.34	May	13.83
1958	11.74	June	14.50
1959	11.64	July	14.55
1960	11.61	August	14.55
1961	11.62	September	14.71
1962	11.52	October	15.51
1963	11.35	November	17.02
1964	11.27	December	18.47
1965	11.52	1974	
1966	11.59	January	20.40
1967	11.84	February	22.07
1968	11.55	March	24.34
1969	11.80		
1970	12.33		
1971	12.70		
1972	12.70		
1973	14.72		

Independent Petroleum Association of America, April 1973 Statistical Release:

Figure 6

UNITED STATES - AVERAGE PRICES
CRUDE OIL AND GASOLINE - 1962 TO 1973
(Current and Constant Values)

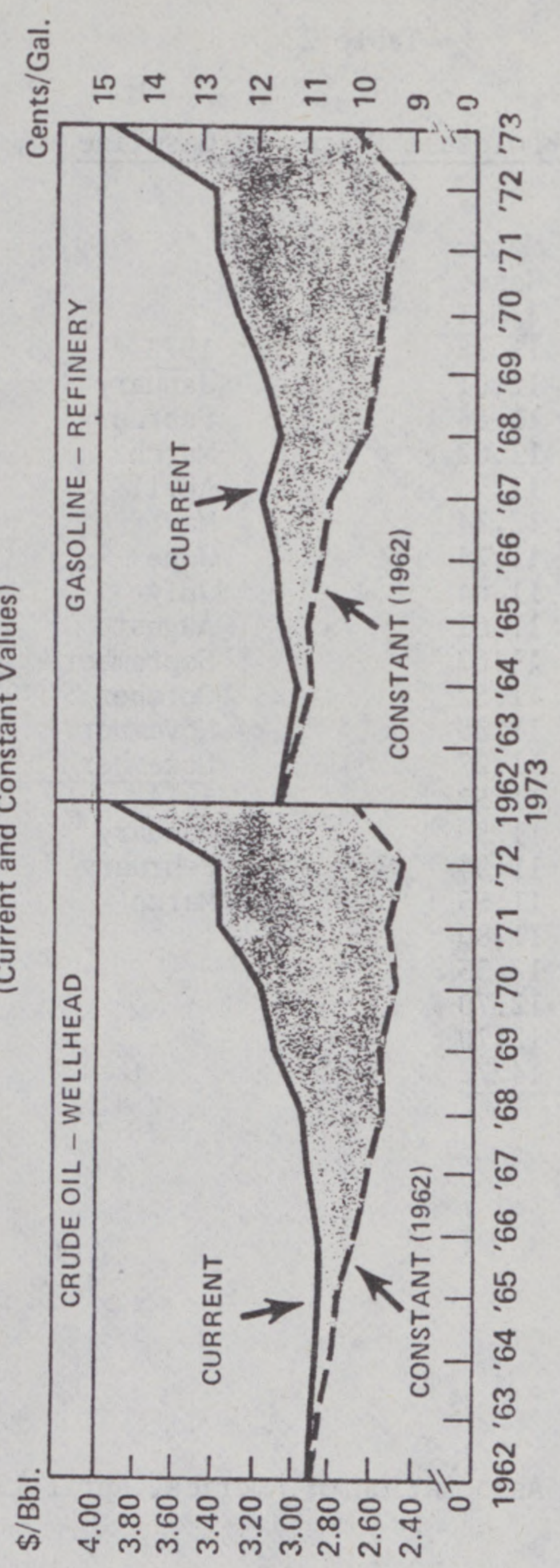


Table 3

Saudi Arabian Crude Oil Prices

	U.S. dollars per barrel				Present increase Jan. 1, 1974, over Jan. 1, 1973
	Jan. 1, 1973	Oct. 1, 1973	Nov. 1, 1973	Jan. 1, 1974	
Saudi Arabian 34° gravity oil: ¹					
1. Posted price.....	2.591	3.011	5.176	11.651	350
2. Royalty (12½ percent of 1).....	.324	.376	.647	1.456	-----
3. Production cost.....	.100	.100	.100	.100	-----
4. Profit for tax purposes (1) minus (2 plus 3).....	2.167	2.535	4.429	10.095	-----
5. Tax (55 percent of 4).....	1.192	1.394	2.436	5.552	-----
6. Government revenue (2 plus 5).....	1.516	1.770	3.083	7.008	362
7. Oil company cost (3 plus 6).....	1.616	1.870	3.183	7.108	340
8. Estimated oil company profit.....	.500	.500	.500	.500	-----
9. Estimated sales price (f.o.b.) (7 plus 8).....	2.116	2.370	3.683	7.608	260
10. Estimated transportation cost ² (to U.S. gulf coast).....	1.480	1.480	1.480	1.480	-----
11. Estimated sales price (c.i.f.) (to U.S. gulf coast).....	3.596	3.850	5.163	9.088	153

¹ Price increases shown are for Saudi Arabian light crude oil 34° API gravity. Saudi light is used as the benchmark for Persian Gulf crude because it is the largest single type of crude oil produced there and represents a good average between higher priced low-sulfur crude and lower priced heavier oil.

² Using tanker rates of Worldscale 100.

Source: Annual Report of the Council on International Economic Policy (ARCIEP), 1974.

market. The posted prices and actual costs of foreign and U.S. crude oil are shown in Table 4.

During the embargo, very little Arab oil reached the United States but high-priced oil from Venezuela and other sources did. The amount of gasoline produced from foreign crude or imported directly was less than 20% of the total U.S. gasoline supply, so the overall price impact was not as large as it was in countries heavily dependent on foreign oil. For those independent companies that rely largely upon foreign supply, however, the price squeeze was disastrous. Many firms that had built reputations on selling "gas for less" were selling regular gasoline for as much as 20 cents per gallon more than the major oil companies that they had traditionally undersold. A survey by the Society of Independent Gasoline Marketers of America found that independents were averaging 8.7 cents per gallon above neighboring major brand stations.*

Domestic crude oil, which was under price controls ("old oil"), became exceptionally inexpensive, compared to the world prices (Figures 7 and 8). Uncontrolled prices for domestic crude oil (i.e., "new oil") rose to \$10.35 per barrel, while old oil (71% of production) was held to \$5.25 per barrel (Figure 9). Because of this, the price of gasoline produced from domestic crude oil did not rise as much as that made from foreign crude oil. The major oil companies that were fortunate enough to have large supplies of domestic crude oil were able, therefore, to sell gasoline at prices lower than many independents.

* Independent Gas Stations Opening Sundays, Evenings; Washington Post, March 28, 1974.

Table 4

REPRESENTATIVE POSTED PRICES AND ACTUAL COST PER
BARREL OF FOREIGN CRUDES AND U.S. CRUDE
March, 1974

<u>Country</u>	<u>Posted Price</u>	<u>Actual Cost</u>	<u>Transport World Scale 100</u>	<u>Actual Cost Plus Transport</u>
Algeria	\$16.21	\$10.05	\$0.60	\$10.65
Canada	4.25	10.65*	0.20	10.85
Iran	11.87	7.25	1.50	8.75
Iraq	11.67	7.13	1.50	8.63
Kuwait	11.54	7.02	1.50	8.52
Libya	15.76	9.75	0.60	10.35
Nigeria	14.69	9.06	0.60	8.66
Qatar	12.01	7.60	1.50	9.10
Saudi Arabia	11.65	7.10	1.50	8.60
U.A. Emirates	12.63	7.72	1.50	9.22
Venezuela	14.87	10.10	0.25	10.35
U.S. Old Oil				5.25
U.S. New Oil				10.00 Est.
U.S. Composite				7.92**

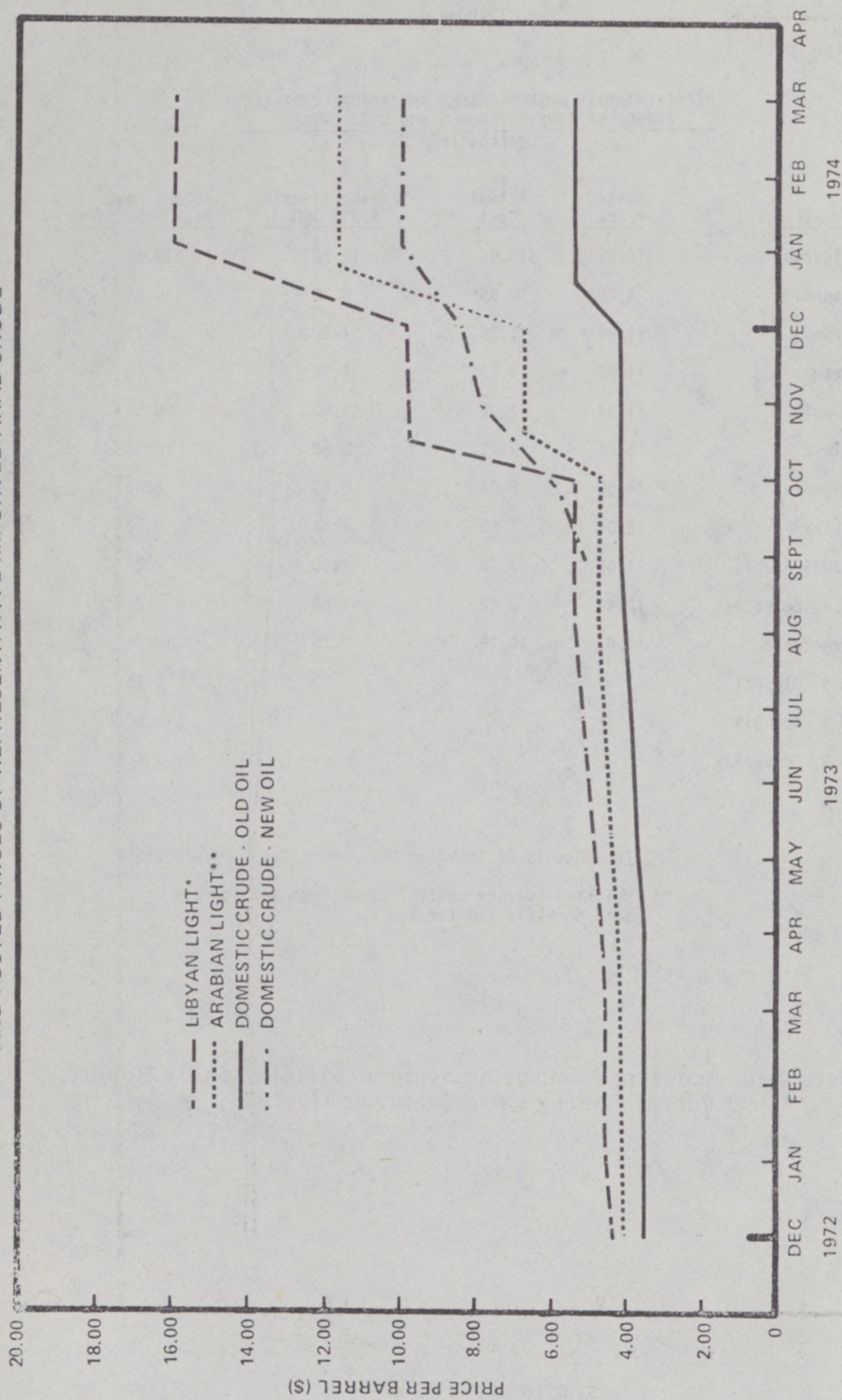
* Includes \$6.40 Canadian Government Tax

** Weighted average cost of crude from all sources both domestic and foreign

Petroleum Industry Monitoring System (PIMS) Monthly Report,
Federal Energy Office, March 31, 1974.

Figure 7

COMPARISON OF PRICES BETWEEN DOMESTIC CRUDE PETROLEUM
AND POSTED PRICES OF REPRESENTATIVE IMPORTED ARAB CRUDE



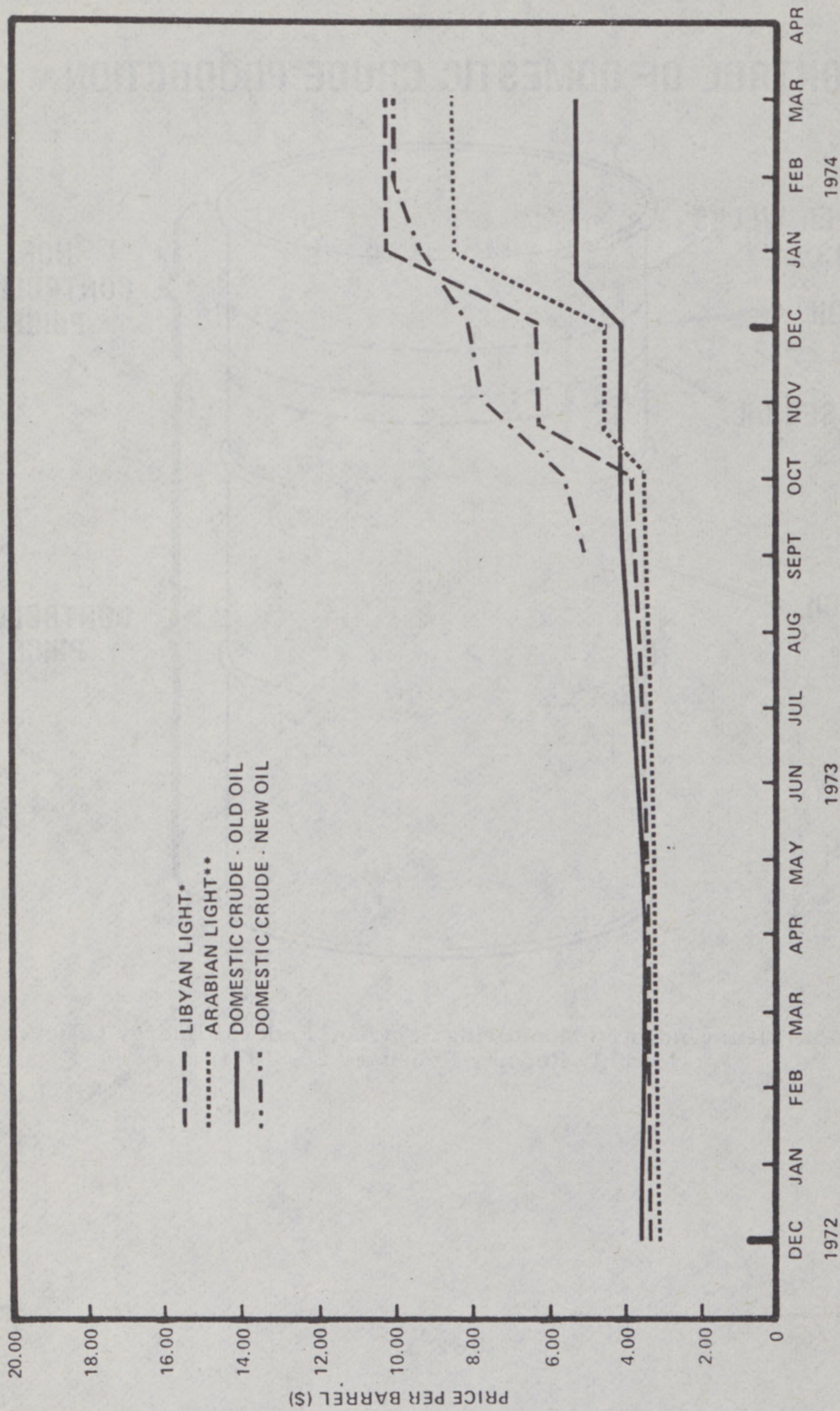
* INCLUDES FREIGHT WS 100 = \$0.60, FOB ATLANTIC PORTS

** INCLUDES FREIGHT WS 100 = \$1.50, FOB GULF PORTS

Petroleum Industry Monitoring Service, Federal Energy Office,
Monthly Report, March 31, 1974.

Figure 8

COMPARISON OF ACTUAL COSTS OF REPRESENTATIVE
FOREIGN CRUDE OILS AND U.S. CRUDE

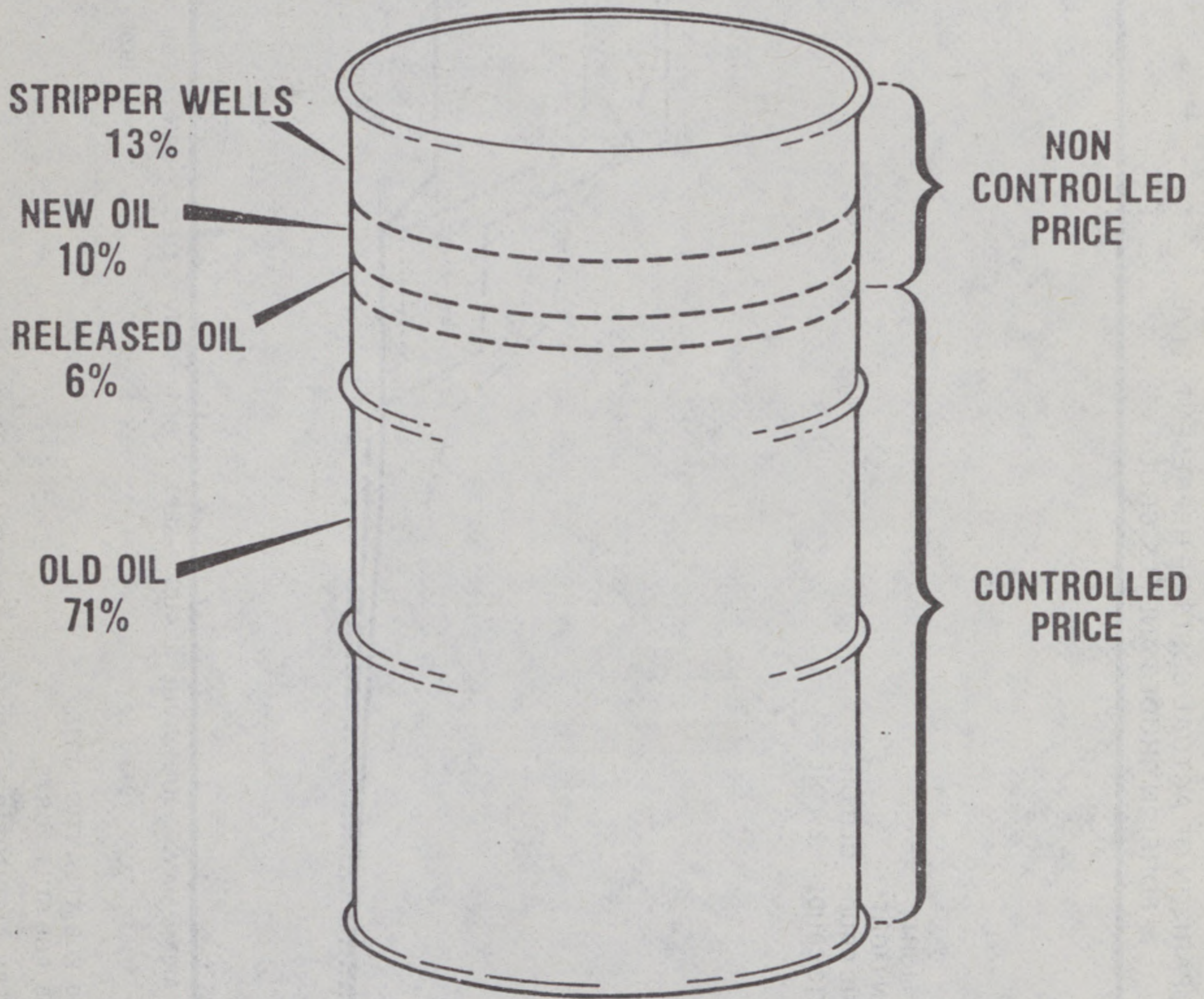


* INCLUDES FREIGHT WS 100 = \$0.60, FOB ATLANTIC PORTS

** INCLUDES FREIGHT WS 100 = \$1.50, FOB GULF PORTS

Petroleum Industry Monitoring Service, Federal Energy Office,
Monthly Report, March 31, 1974.

Figure 9

CONTROL OF DOMESTIC CRUDE PRODUCTION

Petroleum Industry Monitoring Service, Federal Energy Office,
Monthly Report, February 28, 1974.

During the months of January, February and March, when the shortage was most severe, these price differentials did not greatly affect sales because customers were happy to obtain gasoline regardless of price. Now that the supply of gasoline is not as restricted, however, it is likely that the price will again be a factor in determining place of purchase. Because of the higher prices of the independents who rely on foreign product, these stations are being forced by market pressures to serve as convenience stations, open during evenings and Sundays when the major brand stations are generally closed. The independents that obtain most of their gasoline from major refiners using domestic crude oil have generally been able to continue underselling the major brands, although the differential is not as great as it was before the embargo. Because the independent marketers have for the most part lost their price advantage, it is unlikely that they will continue to exert the same competitive influence on the industry that they did prior to the embargo. Unless shortages once again become severe, it is probable that their share of the gasoline retail market will decline and be recaptured by the major oil companies.

In addition to the higher costs brought about by rising prices of crude oil, the pump price of gasoline has risen because of the lower volume. To compensate dealers who were selling less gasoline than they did in 1972 because of the supply shortage, mandatory allocation regulations, and other conservation measures, the FEO on February 16, 1974, issued a regulation permitting independent retail gasoline dealers to increase their prices by one cent per gallon.* This was superseded on February 23 by an order allowing

* Gasoline Pricing Policy Information, Federal Energy Office, March 1974.

a two-cent increase to take effect on March 1, 1974. In addition, on February 25, 1974, FEO announced that refiners would be permitted to increase their prices by one cent per gallon as an incentive to produce gasoline, while lowering the price of distillates by two cents per gallon. These margin increases have forced gasoline prices upward, as shown in Tables 5 and 6, and in Figure 10.

Prices for both domestic and foreign oil rose steeply during the embargo. By the end of March 1974, the U.S. composite price was \$7.92 per barrel. It is possible, however, that oil prices have peaked temporarily with the ending of the embargo. Saudi Arabia's decision to increase production above pre-embargo levels may, in fact, lower world oil prices and domestic oil prices as well. There is little evidence so far to indicate that the demand for gasoline is elastic. While high prices have encouraged conservation, they do not appear to have affected basic demand by the public. Even though there probably is a price level which, if reached, would be high enough to reduce demand greatly, it does not appear that such demand elasticity would occur on a large scale at prices lower than 75 cents per gallon.

2. A Slowing Economy

Much of the increased demand for oil and its products, including gasoline, has resulted from economic expansion since 1970, although the economy was beginning to cool even before the oil embargo. In 1972 the GNP (in constant 1958 dollars) rose 6.1% and in 1973 by 5.9%*. In 1974, however, the

* Edward Green and Allen Sinai, Forecast Detail--The Effects of Energy, Data Resources Inc., November 16, 1973.

Table 5

AVERAGE MARGINS, SELLING PRICES AND PURCHASING PRICES OF
RETAIL OUTLETS

(Figures for Regular Gasoline in ¢/gal ex tax)

	<u>Selling Price</u>	<u>Purchase Price</u>	<u>Dealer Margin</u>
<u>Platt's Oilgram</u>			
<u>1973</u>			
January	25.31	18.46	6.85
February	24.81	18.09	6.72
March	25.94	18.75	7.19
April	26.32	19.02	7.30
May	26.49	19.21	7.28
June	26.78	19.22	7.56
July	26.82	19.22	7.60
August	26.81	19.21	7.60
September	26.74	19.13	7.61
<u>PIMS Survey</u>			
October	27.7	20.2	7.4
November	29.3	21.6	7.7
December	31.3	23.1	8.2
<u>1974</u>			
January	34.1	25.2	8.9
February	36.6	27.5	9.1
March	40.1	29.2	10.8

Petroleum Industry Monitoring Service (PIMS), Federal Energy Office,
March 31, 1974, p. 6.

Table 6

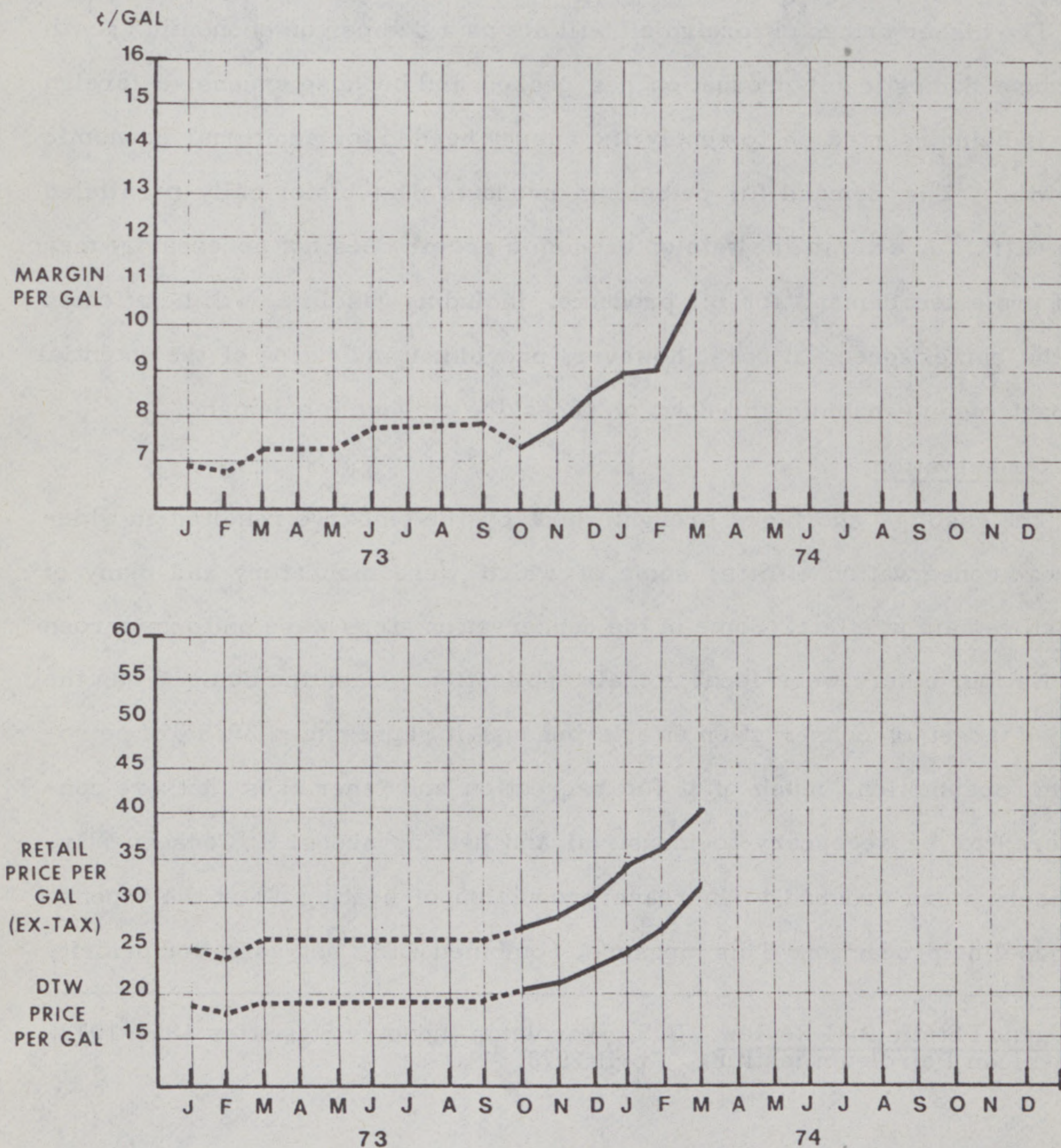
Gasoline prices

(Major-brand regular)				(Major-brand regular)			
	Price ex. tax 4-9-74	Pump price 4-9-74	Pump price 4-10-73		Price ex. tax 4-9-74	Pump price 4-9-74	Pump price 4-10-73
+ Albany	43.9	55.9	39.9	+ New York*	44.9	57.9	41.9
Albuquerque	37.9	48.9	37.9	Norfolk	33.2	46.2	36.9
- Amarillo	31.9	40.9	33.9	+ Okla. City	39.3	49.9	36.9
Atlanta	35.7	47.2	37.9	+ Omaha	42.4	54.9	39.9
+ Baltimore	40.9	53.9	38.9	+ Philadelphia	40.9	52.9	37.9
+ Birmingham	40.9	52.9	37.9	Phoenix	39.9	50.9	37.9
Boston*	35.7	47.2	37.9	+ Pittsburgh	40.9	52.9	37.9
+ Buffalo	43.9	55.9	39.9	Portland, Ore.	40.5	51.5	36.9
+ Charlotte	40.9	53.9	38.9	Salt Lake City	36.9	47.9	36.9
Cheyenne	38.9	49.9	39.9	- San Antonio	31.9	40.9	33.9
+ Chicago*	43.6	56.6	40.4	San Diego	39.2	50.2	36.9
+ Cleveland	41.9	52.9	37.9	San Francisco	40.2	51.2	36.9
- Corpus Christi	31.4	41.4	33.9	Seattle	38.4	51.4	37.9
- Dallas	32.4	41.4	33.9	Spokane	39.3	52.3	37.9
Denver	38.9	49.9	38.9	+ Springfield, Ill*	40.9	53.9	40.9
+ Des Moines	39.9	50.9	37.9	+ St. Louis	40.9	51.9	38.9
+ Detroit	40.5	53.5	39.9	Tampa	35.2	47.2	37.9
- Fort Worth	32.4	41.4	33.9	- Texarkana	31.9	40.9	32.9
- Houston	32.4	41.4	33.9	+ Tulsa	39.3	49.9	36.9
+ Indianapolis	42.9	54.9	37.9	+ Wichita	41.9	52.9	37.9
+ Jacksonville	40.9	52.9	37.9	- Wichita Falls	31.9	40.9	33.9
+ Kansas City	39.9	50.9	37.9	Week's avg.	38.78	50.05	37.56
+ Little Rock	38.4	49.9	36.9	Mar. avg.	36.93	48.20	37.30
+ Louisville	43.9	54.9	37.9	Feb. avg.	34.45	45.75	36.79
Los Angeles	39.7	50.7	35.9	1974 to date	35.66	46.92	
+ Memphis	39.9	50.9	37.9	1973 to date	25.63	36.87	
Miami	35.2	47.2	37.9				
+ Milwaukee	42.9	53.9	38.9				
+ Minn.-St. Paul	40.9	51.9	38.9				
Newark	37.2	48.2	38.9				
+ New Orleans	39.9	51.9	36.9				

+ Increase, - decrease from previous week. *Pump price includes local tax ranging from 0.5 to 2.0 cents/gal.

Figure 10

AVERAGE MARGINS, SELLING PRICES AND PURCHASING PRICES OF REGULAR GASOLINE



SOURCE:

..... PLATTS OILGRAM PRICE SERVICE

— PIMS

Petroleum Industry Monitoring Service, (PIMS) Federal Energy Office,
Monthly Report, March 31, 1974, p. 7.

forecast for real GNP growth was 2.6%. This was later lowered to 1.6% to account for the effects of the oil embargo. The growth forecast for 1974, therefore, is 4.3% lower than GNP growth during 1973.

The higher prices of foreign oil will act as a damper on economic growth because domestic oil production has peaked and because expensive foreign oil is being counted on to supply the energy needed for additional economic growth. The demand for petroleum products has historically paralleled the GNP. A drop in the rate of economic growth does not necessarily mean that projected demand for oil products, including gasoline, will be affected to the same degree. It does, however, provide an indication of the potential impact of an economic slowdown or recession on gasoline demand.

3. Conservation

The gasoline shortages brought about by the embargo resulted in widespread conservation efforts, some of which were mandatory and many of which remain in effect. Some of the conservation steps were uniform across the Nation, others were local in their application. Gasoline demand was the major target of conservation efforts because it represented 39.3% of petroleum consumption, much of it for recreation and other uses that are considered to be secondary to industrial and heating needs.* Consequently, refiners were ordered to increase production of heating oil at the expense of gasoline production. This measure, combined with a set-aside for priority

* Annual Statistical Review. U.S. Petroleum Industry Statistics 1956-1972, American Petroleum Institute, April 1973.

users, meant that gasoline deliveries to retailers declined 15-30%. Conservation then became a practical necessity to bring gasoline demand into line with sharply reduced supplies.

In a nationwide address on November 7, 1973, President Nixon announced several conservation actions that were designed to minimize the impact of the shortage. The measures that affected gasoline consumption directly were mostly voluntary and placed the responsibility on the States. The President did ask for a national 50 m.p.h. speed limit, claiming that the lower speed limit would save an estimated 150,000 barrels per day or 3% of demand.* The relationship of speed to gasoline consumption rates is shown in Tables 7 and 8. The other measures were voluntary and included the increased use of mass transit and carpools.

Until gasoline supply is once again adequate to meet demand, conservation will remain the only short-term alternative to economic dislocation and personal inconvenience. Even though the supply situation is improving, there will be the constant threat of a renewed embargo and the prospects of rising prices. The recent sales decline for large cars and the increase for small cars is a direct consequence of the gasoline shortage. The public is anxious to maintain its mobility at relatively low cost and this has greatly increased the attractiveness of the small car that can offer two to three times the gas mileage of a large car at some sacrifice of ride, quiet and safety in most cases. However, even if the shift from large cars to small ones is permanent, it will be approximately a decade before the

* Fact Sheet, President's Energy Emergency Address, November 7, 1973.

Table 7. Effect of Speed on Fuel Consumption Rates
(Without use of air conditioning)

Test Car Number and Net Weight (lbs.)	Miles Per Gallon At Selected Speeds					Percent Increase In Gasoline Consumption Caused By Increase In Speed ¹				
	30	40	50	60	70	30 to 40	40 to 50	50 to 60	60 to 70	50 to 70
1 (4,880)	17.12	17.20	16.11	14.92	13.13	-0.05	6.76	7.97	13.63	22.70
2 (3,500)	19.30	18.89	17.29	15.67	13.32	2.17	9.25	10.34	17.64	29.80
2A (3,500)	21.33	21.33	18.94	17.40	15.36	-0.01	12.64	8.85	13.28	23.31
3 (3,510)	23.67	24.59	20.46	14.83	13.42	-3.74	22.67	37.96	8.96	52.46
4 (3,975)	18.25	20.00	16.32	15.77	13.61	-8.75	22.55	3.49	15.87	19.91
5 (2,450)	31.45	35.19	33.05	30.78	22.82	-10.63	6.47	7.37	34.88	44.83
6 (3,820)	22.88	19.41	20.28	17.78	14.88	17.88	-4.29	14.06	19.49	36.29
7 (3,990)	15.61	14.89	16.98	13.67	11.08	1.81	-12.31	24.21	23.38	53.25
8 ² (2,050)	(24.79)	(27.22)	(26.80)	(24.11)	N.A.	-8.93	1.57	11.16	N.A.	N.A.
9 (2,290)	21.55	20.07	19.11	17.83	16.72	7.37	5.02	7.18	6.64	14.29
10 (2,400)	22.72	21.94	22.22	21.08	17.21	3.56	-0.13	5.41	22.49	29.11
11 (5,250)	18.33	19.28	15.62	14.22	12.74	-4.93	23.43	9.85	11.62	22.61
12 (4,530)	20.33	20.00	17.50	16.17	14.86	1.65	14.29	8.23	8.82	17.77
Average (Unweighted)	21.05	21.07	19.49	17.51	14.93	0.00	8.11	11.31	17.28	30.53

¹ Changes in this section marked with a minus (-) sign were decreases.

² Since vehicle #8 could not be operated satisfactorily at 70 miles per hour, its miles per gallon performances were omitted from the averages. They are, however, given in parentheses.

Table 8. Effect of Speed on Fuel Consumption Rates
(With air conditioning in use)

Test Car Number	Miles Per Gallon At Selected Speeds					Percent Increase In Gasoline Consumption Caused By Increase In Speed				
	30	40	50	60	70	30 to 40	40 to 50	50 to 60	60 to 70	50 to 70
1	16.29	16.56	15.56	14.42	12.74	-0.16	6.43	7.91	13.19	22.14
3	18.42	18.22	15.69	13.83	10.89	1.08	16.12	13.45	27.00	44.08
4	16.16	16.82	16.30	14.07	13.14	-3.92	3.19	15.85	7.08	24.05
6	21.04	17.41	17.22	17.33	13.42	20.86	1.10	-0.06	29.14	28.32
7	16.06	13.17	14.22	12.40	10.89	21.94	-7.38	14.68	13.87	30.58
9	18.55	18.29	17.78	17.33	16.26	1.42	2.87	2.60	6.58	9.35
10	22.77	21.93	20.42	18.67	16.92	3.83	7.39	9.37	10.34	20.69
11	17.17	18.39	14.53	12.43	10.89	-6.63	26.57	16.89	14.14	33.43
12	16.83	16.78	16.04	14.56	13.35	0.03	4.64	10.16	9.06	20.15
Average (Unweighted)	18.14	*17.51	16.42	15.00	13.17	3.60	6.64	9.47	13.90	24.68

The Effect of Speed on Automobile Gasoline Consumption Rates, Federal Highway Administration, Department of Transportation, October 1973, pages 43 and 44.

larger ones are phased out and the full conservation potential of the smaller cars is realized. Next to carpooling, perhaps the type of gasoline conservation that has the greatest potential is in personal driving habits and automobile maintenance. The following procedures have been recommended by the American Automobile Association to reduce gasoline consumption:

Maintenance and Car Care

1. GET A TUNE-UP—Have your ignition, carburetor, air cleaner and engine compression checked. A spark plug misfiring half the time drops your fuel economy. Slight variations in your ignition timing can cause a one mile per gallon loss.

2. HAVE YOUR TIRES PROPERLY INFLATED—For best gas mileage and for driving on long trips with heavy loads, inflate your tires three to four pounds above the recommended pressure. Under-inflated tires can increase the fuel consumption by as much as one mile per gallon.

3. CONSIDER BUYING RADIAL TIRES—Installation of radial tires, in addition to improving the handling characteristics of your car, will give you from 0.5 to 0.8 more miles per gallon.

4. MAKE SURE YOUR WHEELS ARE PROPERLY ALIGNED—Improper front wheel toe-in alignment can increase fuel use by 0.3 miles per gallon.

5. SEE THAT YOUR BRAKES ARE ADJUSTED PROPERLY—Dragging brakes can rob gasoline economy. Be sure they are releasing properly.

6. DON'T CARRY UNNECESSARY WEIGHT—For every additional 1,000 pounds, gas consumption can increase 1.5 to 2.5 miles per gallon.

7. CONSIDER INSTALLING AN ELECTRONIC IGNITION—This device produces a hotter spark and reduces fouling and misfire which can save up to 10 percent in gas consumption.

8. CONSIDER INSTALLING A MANIFOLD VACUUM MONITOR—This device can teach you good driving habits by visually indicating the vacuum pressure in the intake manifold. This vacuum is directly related to gas efficiency. By learning to achieve a high vacuum reading on the monitor at steady speeds, you can learn to increase your gas mileage.

9. USE GASOLINE OF THE PROPER OCTANE RATING—Using a gasoline of too low an octane rating for your car will produce a "ping" and waste power. Using a fuel of too high an octane rating will not produce more power, it will only increase your fuel costs.

10. CHANGE OIL AND OIL FILTER AT RECOMMENDED INTERVALS—Dirty oil can seriously damage engine parts, foul spark plugs and cause friction and wear that robs gas mileage.

11. USE GOOD OIL OF "SE" RATING—Do not use an oil of a viscosity higher than recommended by your owner's manual. Thicker oil increases internal engine friction and can affect economy.

*Good Driving Habits Conserve
Gasoline*

12. START AND STOP SLOWLY—Hot rod driving with rapid acceleration will increase fuel consumption by two miles per gallon in city traffic.

13. DRIVE AT SLOWER SPEEDS—As your speed increases, so does your car's wind resistance—a big factor in gasoline mileage. Driving at 50 miles per hour rather than at 70 can save you more than 30 percent in gas consumption.

14. DRIVE AT STEADY SPEEDS—Hold a steady foot on the accelerator as long as traffic conditions permit.

15. AVOID EXCESSIVE IDLING—A warm-up period is not necessary. Drive slowly the first few blocks after starting.

16. USE AS FEW ACCESSORIES AS POSSIBLE—The energy required to operate such accessories as air conditioners ultimately must come from the gasoline.

17. AVOID SHORT TRIP OPERATION—Short trips are costly in terms of gas mileage. A vehicle driven four miles will average about eight miles per gallon. The same vehicle driven 15 miles will average nearly 13 miles per gallon.

18. CONSOLIDATE YOUR DRIVING—Combine short trips such as your shopping and commuting trips to reduce the miles traveled for each action.

19. PRE-PLAN YOUR TRIPS—Calculate the shortest route to your destination taking into consideration that you get better mileage on the freeway than on arterial city streets.

20. CONSIDER THE IMPORTANCE OF ANY AUTO TRIP—Keep unnecessary auto trips to a minimum.

21. TIME YOUR APPROACH TO STOP LIGHTS—Stop-and-go driving significantly increases gas consumption. In addition to saving gas, timing your approaches saves wear on brake linings and gives your passengers a smoother ride.

Some Other Things to Consider

22. CONSIDER A CAR POOL—Explore the possibility of joining or starting a car pool for your daily commuting. A five-member car pool can save its members up to 80 percent in out-of-pocket expenses.

23. USE MASS TRANSIT WHEN POSSIBLE—Find out if a bus line serves your area and consider using it for commuting purposes. It can offer big savings in expenses if you have to pay for parking where you work.

24. CONSIDER A SMALLER CAR—When it comes time to purchase a new car, buy the smallest car that will suit your needs. Many compacts and sub-compacts offer big-car luxury and comfort at significant savings in fuel consumption.

25. KEEP RECORDS OF YOUR DRIVING EXPENSES—Checking mileage every time you get a tank of gas can help you to be more conscious of driving economy and will bring you cash savings.

A great deal can be done by municipal governments to assist drivers in conserving gasoline. Woodrow W. Rankin of Highway Users Federation for Safety and Mobility proposed the following measures to the Senate Commerce Committee:*

Programs to improve urban traffic flow merit consideration as fuel conservation measures. Each stop, involving slow-down, idling, and start-up, increases fuel consumption. In urban driving on nonaccess controlled highways, stops can easily reduce average speed 10 to 40 percent and double fuel consumption.¹⁴ Traffic control measures that minimize delays and expedite flow on urban arterials will not eliminate all the congestion and related inefficient fuel use. However, the measures can contribute to their reduction.

Freeways have a demonstrated capability to efficiently handle the major traffic flows of urban areas. An element of this efficiency is fuel economy. Studies have shown that fuel consumption for average urban freeway travel is about 20 percent less than fuel use for comparable travel on arterial streets.¹⁵

It is estimated¹⁶ that freeways currently carry about 18 percent of all urban travel. As completed freeway networks can be expected to carry at least 30 percent of the travel in urban areas, the provision of essential network links can be a worthwhile component of a community fuel conservation program. On a national basis, as the traffic capacity of freeway networks is increased, there could be an annual fuel saving of 97 million gallons for each one percent of total urban travel shifted from arterial streets to freeways.

* U.S. Congress. Senate. Committee on Commerce. Woodrow W. Rankin, Technical Notes: Highway Transportation Fuel Conservation, Highway Users' Federation for Safety and Mobility, in Truth in Energy and Carpooling, Hearings, July 23 and 26, 1973. Washington, U.S. Govt. Print. Off., 1973. 93d Congress, 1st session. Serial No. 93-44, p. 311.

FACTORS INCREASING SUPPLY

1. Increased Domestic Production

While conservation is essential in dealing with the immediate gasoline shortages, the long-term solution will depend upon increased domestic production. Petroleum output in the U.S. has declined since 1970 and the gap between supply and demand has been filled by substantially increased oil imports, from Canada, South America, and increasingly from the Middle East. Not only has domestic oil production declined, but so also has exploration activity, including the number of crew-months worked, the number of wells drilled, the number of wells completed, and the number of oil discoveries (Table 9 and Figure 11). This sustained decline in U.S. oil production is attributed primarily to the low costs and favorable tax treatment of extracting crude oil in foreign countries. However, sharply higher royalty payments to producing states, combined with a trend toward nationalization, have made foreign sources less attractive for new development.

Now that foreign oil is approximately twice as expensive as domestic oil, it may be possible to increase petroleum exploration and development. The United States, despite the large amount of petroleum produced, still has large reserves remaining. Some of these, such as the Outer Continental Shelf (OCS), have barely been tapped. The U.S. Geological Survey estimates that the U.S. OCS contains 65-130 billion barrels of oil* and 395-790 trillion cubic feet of natural gas. This is a large amount compared to current domestic production of 3.5 billion barrels per year. Furthermore, reserve

* Press Release, U.S. Geological Survey, March 26, 1974.

Table 9

EXPLORATION (Geophysical crew activity, acreage under lease, wildcat wells drilled)

Year	Crew months worked	Total acres leased Jan. 1 (Thousands)	Wildcat wells		
			Total	Dry	% Dry
1954	7,969	315,568	13,100	10,389	79.3
1955	8,240	N.A.	14,942	11,832	79.2
1956	7,857	383,863	16,207	13,118	80.9
1957	7,242	N.A.	14,714	11,904	80.9
1958	5,731	371,146	13,199	10,632	80.6
1959	5,696	382,607	13,191	10,577	80.2
1960	5,207	424,251	11,704	9,515	81.3
1961	5,024	416,871	10,992	9,022	82.1
1962	4,231	408,870	10,797	8,815	81.6
1963	4,174	387,457	10,664	8,686	81.5
1964	4,406	372,408	10,747	8,951	83.3
1965	4,471	375,306	9,466	8,005	84.6
1966	3,835	350,895	10,313	8,705	84.4
1967	3,496	333,858	8,878	7,360	82.9
1968	3,390	325,106	8,806	7,439	84.5
1969	3,259	332,005	9,701	8,001	82.5
1970	2,521	343,213	7,693	6,422	83.5
1971	2,757	332,647	6,922	5,834	84.3
1972	3,140	350,725	7,539	6,254	83.0
1973	N.A.	366,386	7,435	5,965	80.2

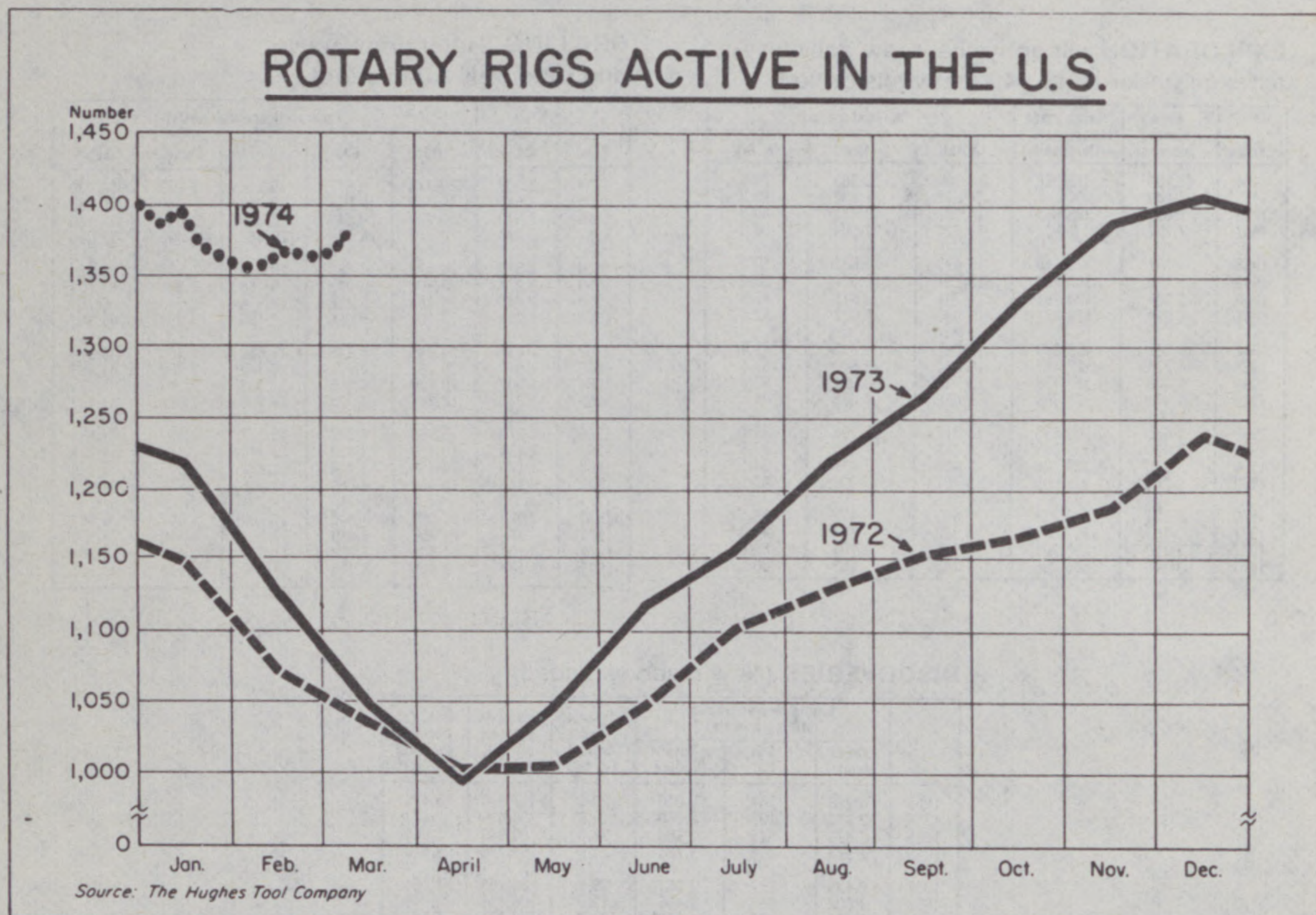
DRILLING (Rotary rigs active and total well completions)

Year	Rigs active	Total well completions				
		Oil	Gas	Dry	Service	Total
1954	2,509	29,773	3,977	19,168	1,012	53,930
1955	2,687	31,567	3,613	20,742	760	56,682
1956	2,619	30,730	4,543	21,838	1,049	58,160
1957	2,429	28,612	4,626	20,983	1,409	55,024
1958	1,923	24,578	4,803	19,043	1,615	50,039
1959	2,074	25,800	5,029	19,265	1,670	51,764
1960	1,746	21,186	5,258	17,574	2,733	46,751
1961	1,763	21,101	5,664	17,106	3,091	46,962
1962	1,637	21,249	5,848	16,682	2,400	46,179
1963	1,501	20,288	4,751	16,347	2,267	43,653
1964	1,502	20,620	4,855	17,488	2,273	45,236
1965	1,388	18,761	4,724	16,025	1,922	41,432
1966	1,270	16,780	4,377	15,227	1,497	37,881
1967	1,134	15,329	3,659	13,246	1,584	33,818
1968	1,170	14,331	3,456	12,812	2,315	32,914
1969	1,195	14,368	4,083	13,736	1,866	34,053
1970	1,028	13,020	3,840	11,260	1,347	29,467
1971	975	11,858	3,830	10,163	1,449	27,300
1972	1,107	11,306	4,928	11,057	1,464	28,755
1973	1,194	9,815	6,315	10,270	975	27,375

DISCOVERIES (New reserves added)

Year	Liquid Hydrocarbons (Million barrels)			Natural gas (Trillion cu. ft.)	Crude oil per new oil well (Barrels)	Nat. gas per new gas well (Mil. cu. ft.)
	Crude oil	Gas liq.	Total liquids			
1953	3,296	744	4,040	20.9	127,940	5,480
1954	2,873	107	2,980	9.6	96,496	2,423
1955	2,871	515	3,386	22.0	90,949	6,085
1956	2,974	810	3,784	24.8	96,778	5,470
1957	2,425	137	2,562	20.2	84,755	4,364
1958	2,608	858	3,466	19.0	106,111	3,946
1959	3,667	703	4,370	20.8	142,131	4,132
1960	2,365	725	3,090	14.2	111,630	2,696
1961	2,658	695	3,353	17.3	125,965	3,059
1962	2,181	733	2,914	19.6	102,640	3,359
1963	2,174	878	3,052	18.4	107,156	3,877
1964	2,665	609	3,274	20.4	129,243	4,212
1965	3,048	832	3,880	21.5	162,464	4,545
1966	2,964	894	3,858	20.4	176,638	4,650
1967	2,962	930	3,892	22.0	193,228	6,000
1968	2,455	686	3,141	13.8	171,306	3,998
1969	2,120	281	2,401	8.5	147,550	2,082
1970*	3,089	308	3,397	11.6	237,250	3,021
1971*	2,318	347	2,665	10.1	195,480	2,637
1972*	1,558	238	1,796	9.8	137,803	1,987

Figure 11



Petroleum Independent, March-April, 1974. p. 35.

estimates have traditionally been understated and it seems reasonable to expect that further exploration combined with higher prices will result in the discovery of additional reserves. An accelerated leasing program which is currently underway is certain to increase production of offshore oil within three years.

The large deposits of oil shale in Utah, Colorado, and Wyoming are known to contain vast quantities of oil. If oil prices remain high and if environmental problems can be overcome, it may be possible eventually to recover 3 million barrels per day from oil shale. Technological advances and high, stable prices may increase the amount recovered even further. Even though there are many problems associated with the extraction of this oil, it does represent a large and secure source of petroleum in the future.

The Alaskan North Slope contains over 10 billion barrels of proven economically recoverable reserves, and probably much more. The Naval Petroleum Reserve No. 4 has been explored only on a very limited scale, but there are strong indications that it contains as much oil as that already discovered on private North Slope holdings. By 1977 the Alaskan Pipeline should supply 2 million barrels of North Slope Oil daily to U.S. markets. If conservation continues and petroleum demand in 1977 is limited to 20 million barrels per day, the Alaskan oil would supply 10% of domestic demand and could substantially reduce the need for imported oil. If a second pipeline were built, that flow could be doubled to supply 20% of the demand.

Increased coal production could also have a significant impact on gasoline availability. To the extent that use of coal for generation of electricity

can relieve the pressure on petroleum products, more oil would be available for refining into gasoline. If technology and economics permit, liquid fuels may be made directly from coal. This type of conversion was used by the United States and Germany during World War II. South Africa currently uses an advanced form of this technology to produce synthetic crude oil (syn-crude) which meets a large percentage of its gasoline needs at relatively low prices. The United States is fortunate to have nearly one-third of the world's known coal reserves. If the conversion of coal into synthetic crude oil or directly into gasoline can be accomplished economically and without serious environmental degradation, the United States could have a plentiful and secure source of petroleum well into the next century.

2. Increased Imports

None of the possibilities for increased domestic production just mentioned, except for some offshore development and Naval Petroleum Reserve No. 1 (Elk Hills, California), are likely to affect the gasoline supply situation before 1977. Until then, demand and domestic supply can be balanced only through conservation and increased imports. As the Arab oil embargo has demonstrated, reliance on foreign oil can cause serious economic problems in the United States if the loss of imports cannot be offset through conservation and increased domestic production.

When the end of the embargo was announced, OAPEC indicated that it would not increase production above pre-war levels. Saudi Arabia, however, already has announced its intention to increase production to offset the continuing Libyan refusal to supply the United States with oil. The Saudis have

also indicated that they would increase their production to force world oil prices down to lessen the economic disruption caused by recent price increases. Since Saudi Arabia has 25% of the world's oil reserves, conservatively estimated at 137 billion barrels, it would not be difficult for Aramco (the Arabian American Oil Co., consortium of Exxon, Texaco, Mobil, and Standard of California) to increase its daily production of oil there from 8 million barrels to 11 million barrels within a year.* Such expansion of capacity was taking place before the embargo and work continued uninterrupted during the embargo. The Saudis, therefore, could significantly ease future crude oil shortages in this country, or make them worse, depending on their foreign policy.

3. Fuel Additives to Increase Economy of Use

The shortage of gasoline during the height of the embargo was over 15%. This stimulated interest in fuel additives to stretch the supply of gasoline. Surprisingly, one of the most effective additives is water. During World War II, it was discovered that water injected into a gasoline engine greatly increased performance. It has since been discovered that an automobile can be operated on an emulsified blend of 18% water and 82% gasoline.** Fuel economy with this mixture is reported to be higher than that obtained with gasoline alone. In addition, the water lowers the combustion temperatures, thereby reducing oxides of nitrogen in the exhaust, which

* Twentieth Century Petroleum Statistics 1973, Degolyer and MacNaughton, September 1, 1973, p. 1.

** "Oil and Water Alchemy," Time, February 11, 1974, p. 31.

some observers think could eliminate the need for pollution controls and associated energy penalties. Gasoline and water do not normally mix. To overcome this natural tendency, the gasoline and water are emulsified by ultrasonic vibrations. The U.S. Postal Service, in conjunction with the University of Oklahoma, has adapted part of its vehicle fleet to an experimental mixture of 87% gasoline and 13% water.* To date, this experiment has revealed that vehicles require only minor adjustment to the carburetors. A 70% gasoline-water combination is also being planned but would require carburetor modifications. The use of water as an additive is strictly experimental at present, but early indications are encouraging. If the emulsion proves stable and if the mixture could be marketed efficiently, the implications for improved fuel economy and reduced air pollution are great.

Another additive which offers considerable promise is methanol, which can be made from coal or from natural gas now being wasted in the Middle East. Methanol can be added directly to gasoline without being emulsified. Tests with a mixture of 15% methanol and 85% gasoline have shown mileage increases of 10% or more and over 50% reductions in exhaust emissions.** Methanol currently costs more than gasoline but only because it is made on a small scale for a limited market. If it were available in large quantities, it could be made at a price lower than that of gasoline. Natural gas can

* "But Vehicle Still Working...Water, Gas Mixed Up," Norman, Oklahoma Transcript, in Congressional Record, January 30, 1974, p. E290.

** "Methanol: A Versatile Fuel for Immediate Use," Science, December 28, 1973, pp. 1299-1304.

readily be transformed into methanol for shipment in conventional tankers. Methanol is under consideration as a means of importing natural gas to the United States from Algeria, Alaska, and other areas. In addition to converting all of this methanol to natural gas, it may have an important use as a gasoline supplement.

FACTORS DECREASING SUPPLY

1. Reduced Domestic Production

There are no guarantees that domestic production will rise in the near term. The price increases in domestic crude oil that resulted from the pressures of the Arab oil embargo have stimulated drilling activity in the United States, but so far this has not yet been translated into production. Domestic production, shown in Table 10 and Figure 12, has not risen despite the pressures of the embargo. Proven crude oil reserves (excluding Alaska), as shown in Table 11, have continued to drop steadily since 1966 when they were estimated at 31,452,000,000 barrels. Table 11 shows that the reserve/production ratio for domestic crude oil has also been dropping. This ratio indicates the balance between production and additions to reserves. If production exceeds the amount of new oil added to reserves, the R/P ratio drops, as it has since 1958.

The discovery of oil on the Alaskan North Slope added nearly 9.6 billion barrels to reserves in 1970. This resulted in higher proven reserves than at any other time in history. These reserves, however, are rapidly being drawn down by a high rate of consumption which is not being offset by new production. On January 1, 1973, the U.S. proven oil reserves totalled 36,339,408,000 barrels. One year later, the reserves had dropped to 35,299,839,000 barrels because production exceeded additions to reserves. It is unlikely that another discovery of North Slope size will be made. Intensive exploration and development of the North Slope and Outer Continental Shelves may produce enough new oil to arrest the decline in reserves. If

Table 10

CRUDE OIL

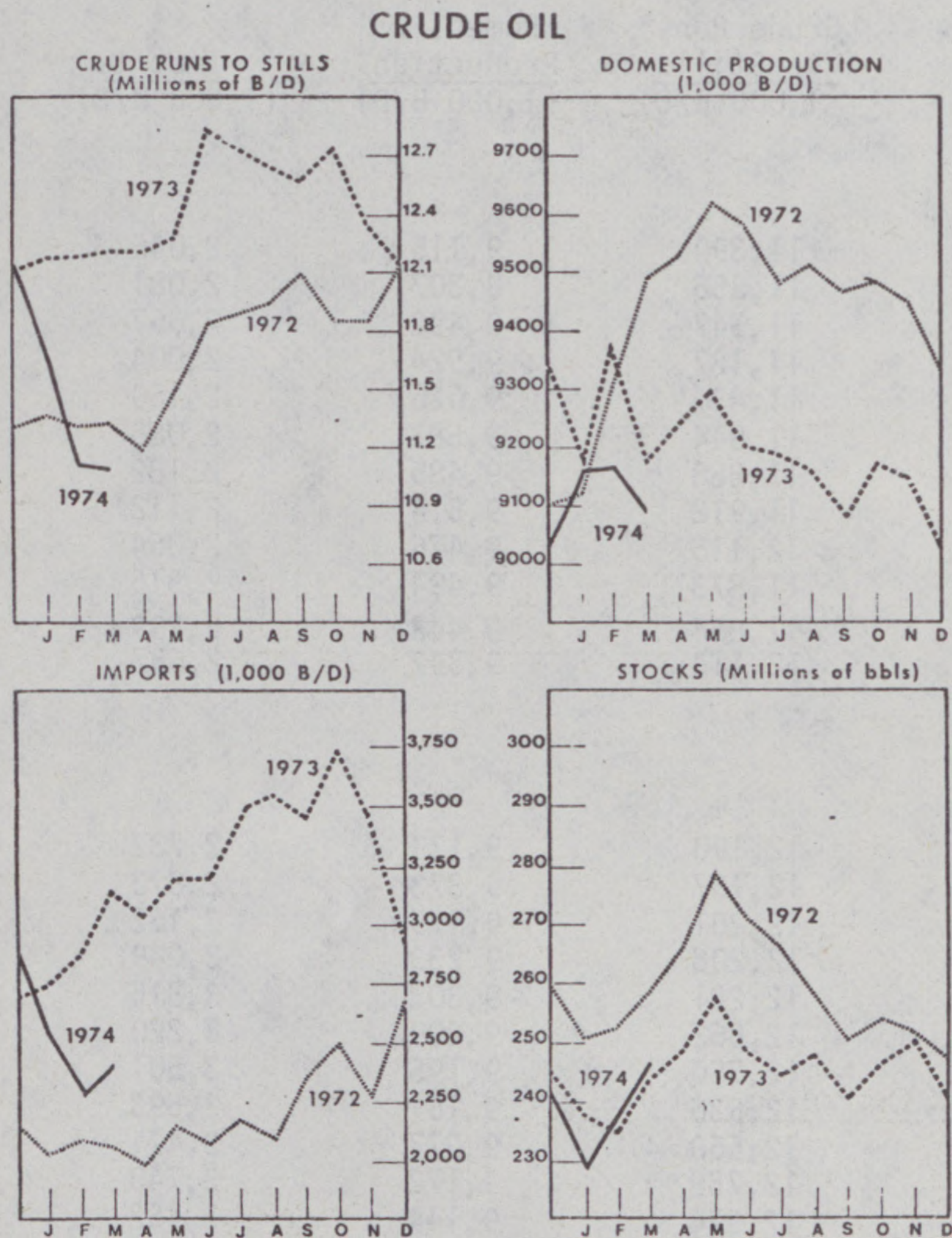
	Crude Runs* to Stills (1,000 B/D)	Domestic Production (1,000 B/D)	Imports (1,000 B/D)	Stocks (1,000 of BBLs)
<u>1972</u>				
January	11,390	9,115	2,046	251,012
February	11,358	9,307	2,081	252,945
March	11,347	9,492	2,067	258,902
April	11,187	9,524	2,004	266,636
May	11,480	9,626	2,160	279,490
June	11,844	9,587	2,085	271,381
July	11,888	9,485	2,182	265,843
August	11,918	9,514	2,112	257,976
September	12,115	9,476	2,364	250,802
October	11,873	9,494	2,516	253,748
November	11,854	9,442	2,299	251,306
December	12,113	9,347	2,667	246,395
<u>1973</u>				
January	12,190	9,179	2,732	237,469
February	12,187	9,373	2,873	235,362
March	12,201	9,175	3,162	244,131
April	12,208	9,233	3,049	248,783
May	12,281	9,303	3,215	257,867
June	12,862	9,209	3,220	248,857
July	12,750	9,195	3,501	243,673
August	12,636	9,161	3,593	248,314
September	12,560	9,077	3,471	241,276
October	12,758	9,172	3,740	246,297
November	12,374	9,144	3,452	249,998
December ^R	12,150	9,041	2,891	242,478
<u>1974</u>				
January	11,563	9,178	2,530	229,979
February	11,129	9,178	2,259	237,344
March	11,117	9,098	2,440	247,310

* Includes Lease Condensate

Source: Bureau of Mines

API data included from January through
March 21, 1974

Figure 12



Petroleum Industry Monitoring System, Federal Energy Office,
Monthly Report, March 31, 1974.

Table 11

PROVED RESERVES

(Liquid hydrocarbons and natural gas)

Dec. 31st	Liquid hydrocarbons (Million barrels)			Natural gas (Trillion cu. ft.)	Reserve/production ratio		
	Crude oil	Gas liquids	Total liquids		Crude oil	Total liquid	Nat. gas
1953	28,945	5,438	34,383	210.3	12.5	13.2	22.9
1954	29,561	5,244	34,805	210.6	13.1	13.6	22.5
1955	30,012	5,439	35,451	222.5	12.4	12.8	22.1
1956	30,435	5,902	36,337	236.5	11.9	12.5	21.8
1957	30,300	5,687	35,987	245.2	11.8	12.4	21.4
1958	30,536	6,204	36,740	252.8	12.9	13.5	22.1
1959	31,719	6,522	38,241	261.2	12.8	13.3	21.1
1960	31,613	6,816	38,429	262.3	12.8	13.2	20.1
1961	31,759	7,049	38,835	266.3	12.6	13.0	19.9
1962	31,389	7,312	38,701	272.3	12.3	12.8	20.0
1963	30,970	7,674	38,644	276.2	11.9	12.4	19.0
1964	30,991	7,747	38,738	281.3	11.7	12.2	18.3
1965	31,352	8,024	39,376	286.5	11.7	12.1	17.6
1966	31,452	8,329	39,781	289.3	11.0	11.5	16.5
1967	31,377	8,614	39,991	292.9	10.3	10.9	15.9
1968	30,707	8,598	39,305	287.4	9.8	10.3	14.8
1969	29,632	8,143	37,775	275.1	9.3	9.6	13.3
1970*	29,401	7,703	37,104	264.7	8.8	9.1	12.1
1971*	28,463	7,304	35,767	252.8	8.7	8.9	11.5
1972*	26,739	6,787	33,536	240.1	8.1	8.3	10.7

*Excludes 9.6 billion barrels of crude oil and 26 trillion cubic feet of natural gas added for Alaskan North Slope.

prices remain high enough to warrant secondary and tertiary recovery, additional oil will probably be produced from existing fields. In recent months the petroleum industry, particularly the independent producers, have encountered difficulty in obtaining tubular steel needed for drilling operations. The shortage of casing, tubing and drill pipe are curtailing drilling activity by 50% or more for many operators.*

2. Refining Capacity

The lifting of the Arab oil embargo will not automatically end the gasoline shortage in the United States. A problem that was apparent during the gasoline shortage last summer, but which was overshadowed by the embargo, is the inadequate refining capacity of the United States. The United States has a refining capacity of 14.1 million barrels per day but during the embargo was operating only 11.4 million barrels.** Even if the United States were able to import all the petroleum it needs to supplement domestic production for an unconstrained summer demand of 18 million barrels of gasoline per day, there would not be enough refining capacity to process that much crude oil. As a result it will be necessary to import more refined products, including gasoline, from foreign refineries. Unfortunately, most foreign refineries are designed for maximum fuel oil production and therefore produce relatively small amounts of gasoline. In the past, the United States has imported relatively small amounts of gasoline (less than 2% of

* "U. S. Tubular-goods Pinch Cutting Deep into Drilling," Oil and Gas Journal, April 1, 1974, pp. 31-35.

** Weekly Statistical Bulletin, American Petroleum Institute, February 15, 1974.

demand), but unless domestic refining capacity is enlarged, it will be necessary to increase that percentage.

Only two major refineries have been built in the United States since 1970 and none are currently under construction. Plans for a number of refineries were announced by the oil industry, but all of these have been shelved temporarily because of the uncertainties of crude supply and because of the difficulty in obtaining suitable sites. Some expansion of existing refineries has taken place, with a 6.2% (833,000 b/d) increase in capacity in the past year (Figure 13).^{*} New refineries, however, will be essential for the United States to become independent of foreign petroleum products.

3. Import Restrictions

The OAPEC embargo could be reimposed at any time and some countries, such as Libya, still refuse to ship oil to the United States. Even though some producers (Saudi Arabia) have expressed a willingness to increase production, other traditional suppliers (e.g. Venezuela) have cut back production, raised prices or announced nationalization plans. The end of the embargo, therefore, does not necessarily mean an end to oil import problems.

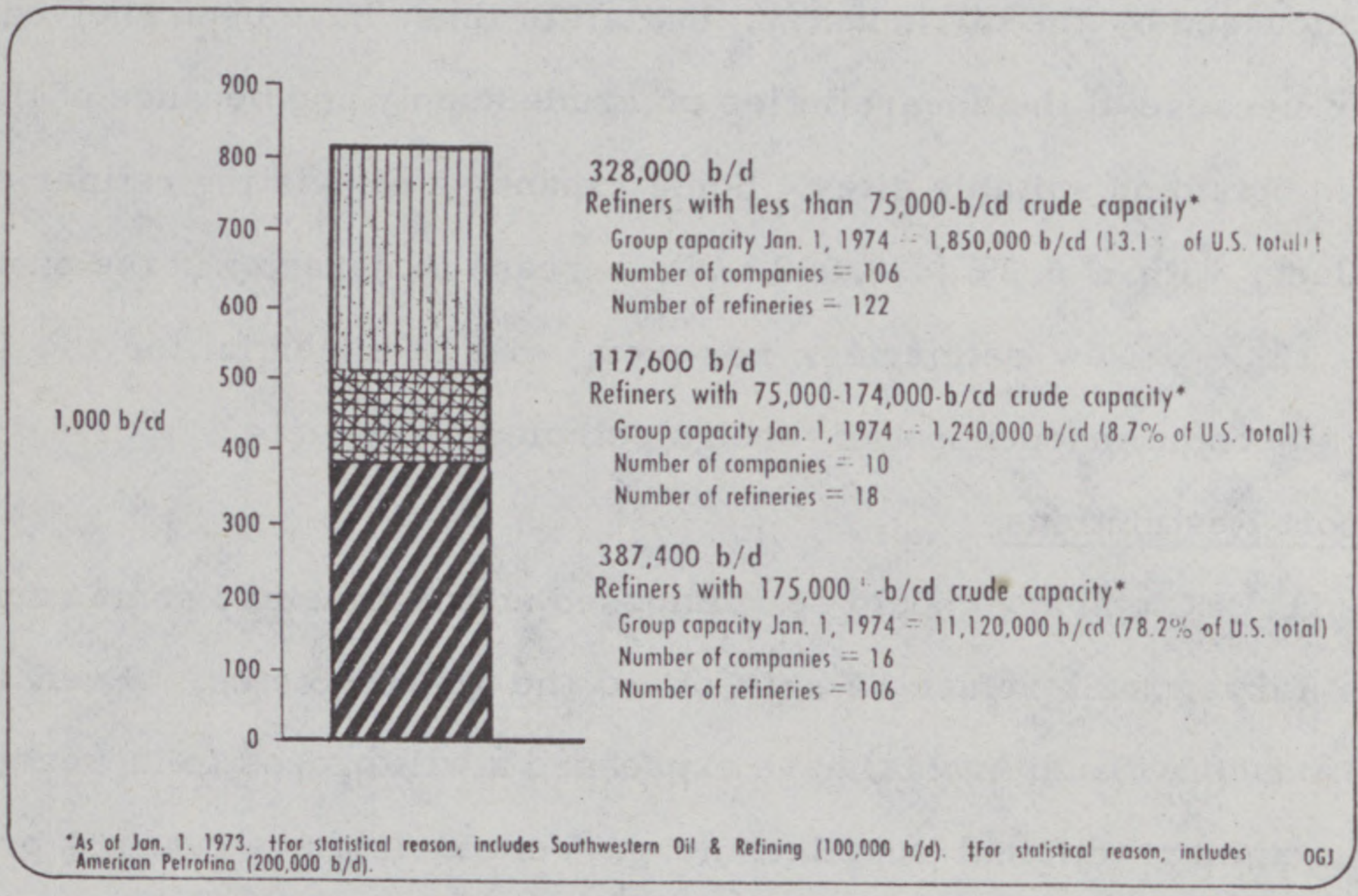
4. Crude Oil Allocation

The Emergency Petroleum Allocation Act of 1973 (P.L. 93-159) was enacted to ease the impact of petroleum shortages and to insure supplies for independent refiners and marketers. The allocation of petroleum products under this Act has been relatively successful, but the crude oil allocation program has encountered problems. The problems developed when FEO,

^{*} "A Close Look at Added New Refining Capacity in U.S.," Oil and Gas Journal, April 8, 1974, p. 33.

Figure 13

Who expanded capacity and how much in 1973



in order to equalize crude oil supplies, ordered refiners with more than a 76.6% ratio of oil supply to refining capacity to sell their excess to refiners who had less than 76.6%. This decision forced some oil companies to sell oil to larger companies that were actually in a much better crude position. Shell, Gulf and Mobil, for example, were required to sell a substantial amount of their imported oil, while some companies like Texaco were receiving oil because of the allocation formula (Table 12). In some cases, smaller refiners were forced to sell crude to the larger companies. Not only were importers required to sell to refiners operating at a lower percentage of capacity until all reached the same level, but they were also required to sell it on the basis of the importer's average cost of all crude. If a company imported oil at \$13 per barrel, it might be forced to sell it at a weighted price of \$8 per barrel. This situation acted as a strong disincentive to importation of crude oil, for it is more advantageous for an importer to refine crude oil abroad and to import the product the price of which can be passed through. By not importing crude oil, each refiner automatically increases the allocation that he can receive from those companies that are importing crude oil.

This situation has led many companies to limit their imports of crude oil to amounts less than those available even with the embargo. The declines in imports following FEO implementation of P. L. 93-159 on February 1, 1974, were approximately 1 million b/d of crude oil, from which 420,000

* "Sharing of Crude Oil has an Ironical Result," Washington Post, February 23, 1974.

Table 12

The Effect of Crude Oil Allocations on Major Oil Companies

Company	Net domestic oil production (thousands of bbl. per day)	Ratio of production to refining capacity (percent)	Allocation gain or loss (thousands of bbl.)
Exxon	970	83%	-102
Texaco	792	71	+1,623
Shell	638	60	-6,840
Gulf	561	68	-11,632
Standard (Ind.)	487	47	-4,780
Standard (Calif.)	462	48	-1,191
ARCO	437	56	+4,303
Mobil	394	42	-1,039
Getty	315	151	+3,453
Union	299	67	+93
Phillips	267	66	-3,932
Sun Oil	235	45	+501
Continental	220	67	-5,545
Cities Service	215	72	-2,009
Marathon	180	80	+2,036

Data: Petroleum Engineer

BUSINESS WEEK: February 16, 1974

b/d of gasoline would have been produced.* FEO has proposed rule changes that would eliminate allocation obligations for refiners with a capacity in excess of 75,000 b/d, while preserving it for refiners under that amount. Crude oil in excess of expected quantities could be imported without being subject to allocation.*

* Press Release, Federal Energy Office, February 28, 1974.

GASOLINE AVAILABILITY

The prospects for an adequate gasoline supply in the United States depend greatly on the factors mentioned earlier. Although not all of the problems mentioned will be solved by this summer, it does appear that serious gasoline shortages are not likely if:

- (1) Arab oil production and exports to the United States return to pre-war levels;
- (2) gasoline conservation measures remain in effect; and
- (3) cost increases can be recovered in the market price.

Arab crude oil began arriving in mid-April and by mid-May stocks should have been built up enough to preclude serious shortages later in the year if the embargo is not reimposed. In addition, gasoline yields from refining operations will probably average near 48% in the second and third quarters, which may increase gasoline supplies by 650,000 b/d over first quarter levels. A survey conducted by the Oil and Gas Journal indicates that gasoline supply in the second quarter will be comparable to the 1973 supply (Table 13). During the peak driving season of July, August, and September, supply may exceed the levels of 1973. What the peak summer demand will be remains to be seen. In the fourth quarter, gasoline supply will probably drop as the buildup of winter fuel oil stocks begins.

The Oil and Gas Journal's estimate is reinforced by the FEO projection of gasoline supply and demand. If high prices and conservation remain in effect (Table 14), supply is expected to be 1% (39,000 b/d) short of demand in the second quarter of 1974 and in balance in the third and fourth quarters.

Table 13

The brighter U.S. gasoline picture

This table reflects the supply-demand possibilities for gasoline in the U.S. this summer now that the Arab oil embargo is lifted. It is based on interviews with leading oil economists.

(1,000 b/d)				
	1st Q	2nd Q	3rd Q	4th Q
New-gasoline supply sources*				
Refinery runs	11,300	12,000	12,700	12,700
% yield of gasoline	44.5	47.0	47.7	42.0
Gasoline production	5,029	5,640	6,058	5,334
NGL input	810	810	790	790
Gasoline imports	140	150	150	120
Processing gains	187	200	210	200
Total new supply*	6,166	6,800	7,208	6,444
Gasoline demand possibilities				
Equals 1973 demand	6,350	6,819	6,966	6,579
Off 1% from 1973	6,287	6,751	6,896	6,513
Off 2% from 1973	6,224	6,683	6,826	6,447
Off 3% from 1973	6,161	6,614	6,752	6,382
Equals 1974 IPAA forecast	6,615	7,145	7,339	7,035

* New supply may be augmented by withdrawal from inventories.

OSJ

"U.S. Gasoline Outlook for Summer is Much Improved," Oil and Gas Journal,
March 25, 1974, p. 37.

Table 14

SHORTFALL
SELECTED SCENARIOS

Product	1974 Quarter	Embargo Lifted			
		Forecast w/ Unconstrained Demand		Forecast w/Price & Conservation Effects*	
		(MB/D)	(%)	(MB/D)	(%)
Motor Gasoline	2nd	276	4%	39	1%
	3rd	161	2	0	0
	4th	360	5	0	0
Distillate	2nd	0	0	0	0
	3rd	0	0	0	0
	4th	0	0	0	0
Residual	2nd	353	13	128	5
	3rd	18	1	0	0
	4th	154	5	0	0
Kerosine Jet	2nd	16	2	0	0
	3rd	0	0	0	0
	4th	0	0	0	0
TOTAL ALL PRODUCTS	2nd	1,109	6%	426	3%
	3rd	586	3	149	1
	4th	788	4	105	1

*In the aggregate there is a net surplus. The minor product imbalances can be accommodated by slight shifts in refinery operations.

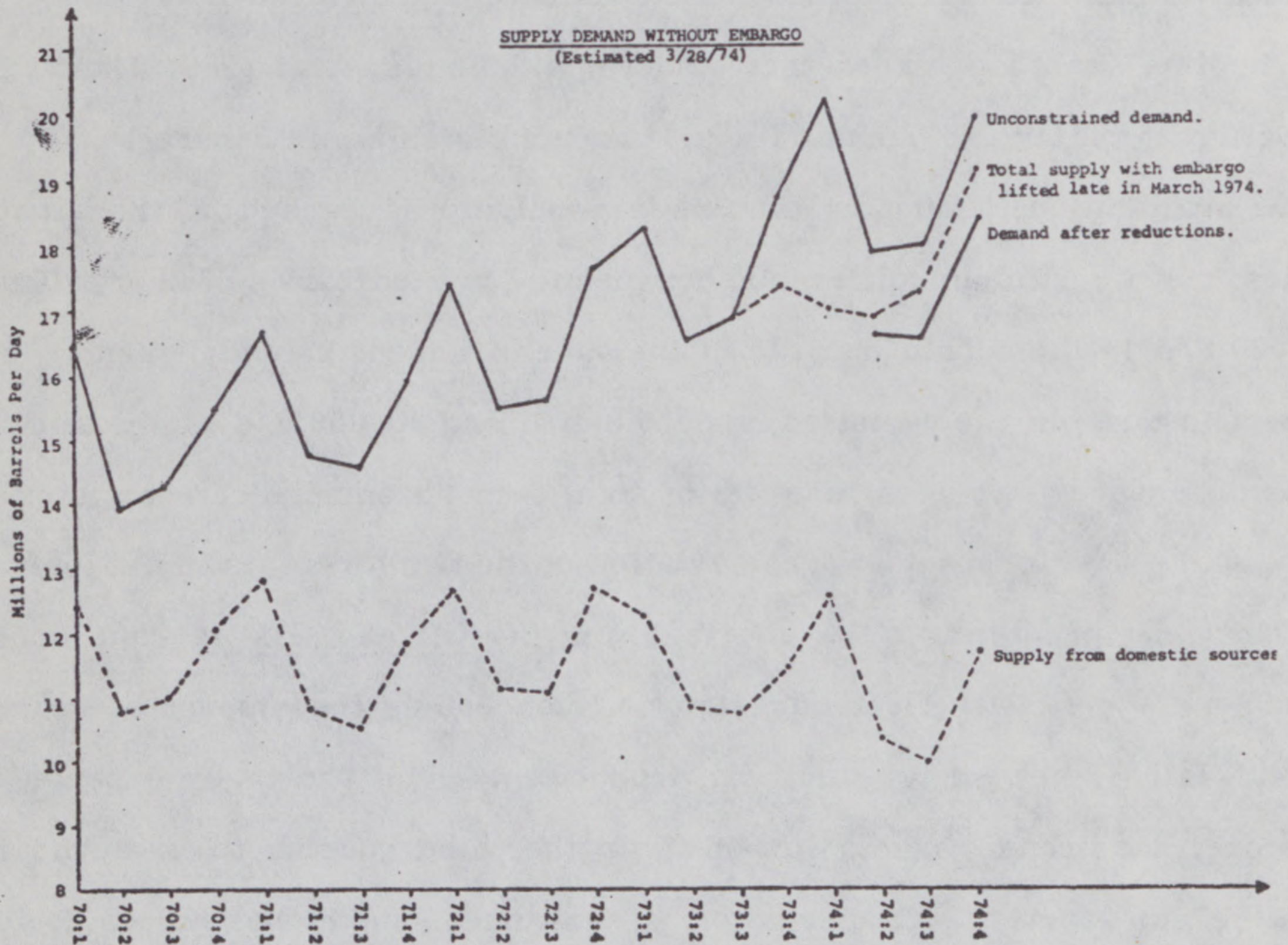
Petroleum Supply and Demand Forecasts Without an Embargo, Federal Energy Office Press Release, April 4, 1974.

If demand were unconstrained, however, the shortage might be 4% (276,000 b/d) in the second quarter, 2% (161,000 b/d) in the third, and 5% (360,000 b/d) in the fourth. This would be roughly the equivalent of the gasoline spot shortages that existed in the summer of 1973. The FEO projection of supply and demand for all products is shown in Figure 14.

All available data support the basic conclusions reached in these two studies. The maximum difference between the two estimates of shortfall is 231,000 b/d in the fourth quarter in the case of unconstrained demand. In the second quarter the variation is 69,000 b/d and 30,000 b/d in the third. These differences are less than 1% of total demand and indicate the similarity in the two forecasts. The deviation of the two forecasts in the fourth quarter (FEO predicting a 5% shortage and the Oil and Gas Journal forecasting a 9% deficit) reflect uncertainties concerning the amount of crude oil that will be needed for fuel oil production. The shortages expected, therefore, may range from a low of 2% in the third quarter to as much as 9% in the 4th quarter. Conservation, if continued, and higher prices could reduce those shortages to as little as zero in the third and fourth quarters.

Demand remains the key to the situation. In spite of the increased supplies available as a result of the lifting of the embargo, there will not be sufficient gasoline on hand to satisfy all of the potential demand for gasoline. Because of the continued tightness in supply, although much improved over the first quarter of 1973, the situation will require continuation of conservation measures adopted last winter. If the public returns to unrestrained driving, shortages could reoccur. The FEO Petroleum Situation Report of

Figure 14



Petroleum Supply and Demand Forecasts Without an Embargo, Federal Energy
Office Press Release, April 4, 1974.

April 5, 1974, indicates that such a trend is developing. Gasoline conservation for the first week in April was only 3.4% of unconstrained demand, compared to an average of 10% during the first quarter of 1974.

Even though it is possible that modest gasoline surpluses could develop in the third quarter, it is more likely that supply will be short of demand for the remainder of 1974. If demand exceeds supply by 0-5%, the effects will be minimal. If the unbalance is between 5 and 9% (the worst possible case in the Oil and Gas Journal forecast), spot shortages will be likely. The West Coast will probably experience the tightest situation because most gasoline imports arrive on the East Coast and very little of that is distributed that far west. Heavy military allocations and other priority uses may result in 20-25% shortages at the pumps in that area.* In general, the States that will be most affected are those that are either on the end of the distribution system or supplied primarily by independent marketers. Because of these distribution problems, the West Coast, the Upper Mid-West, New England, Florida, and Hawaii are the most likely to experience spot shortages. The current consensus in both industry and government is that gasoline supply is expected to be comparable to 1973 levels and that spot shortages will be infrequent if demand can be controlled.

* "U.S. Gasoline Outlook for Summer is Much Improved," Oil and Gas Journal, March 25, 1974, p. 38.

IMPACT OF THE SHORTAGES

1. Industry

The increasing availability of gasoline should preclude the possibility of large-scale employment disruptions. Unless the embargo is reimposed, most workers will probably have sufficient fuel for commuting to their jobs, but the cost of each trip will be much higher than it was before the embargo. The burden will fall most heavily on the lower income groups. The working group most affected by the higher prices and occasional shortages will be those workers who rely on mobility for their livelihood, such as migrant workers. These higher costs of worker transportation, plus higher costs of operating gasoline-powered farm equipment, ultimately will also be passed to the consumer through higher food prices.

The industry most likely to be affected by the moderate tightness of supply expected for the rest of 1974 is the tourist industry. It is unlikely that supply will support unconstrained demand during 1974. Short supplies of gasoline and uncertainty over its availability already have had a serious impact on the tourist industry. Tourists who would normally travel by automobile are concerned that gasoline supplies might be inadequate to enable them to reach their destinations and then to return. Some potential tourists are reluctant to attempt long trips for fear they might be stranded en route or might not be able to obtain emergency repair service. Gasoline price may also be a deterrent because it will represent a much larger percentage of total trip cost, especially for long trips to remote areas.

Because of these factors, many people will probably take their vacations nearer home than normal. This reduction in auto use will probably have an adverse impact on areas that depend heavily on tourists from out-of-State, and especially on those that are not near the major metropolitan centers.* This trend has been accelerated by government actions to limit the use of automobiles which makes touring difficult. These actions include 55 miles-per-hour speed limits which lengthen driving time, gasless Sundays that make weekend travel difficult, and odd-even purchase plans and reduced deliveries to service stations. In addition, there is little flexibility in travel patterns that would allow a shift away from automobiles to other commercial modes of transportation such as aircraft. In the case of a switch from automobiles to airplanes, even if ridership were increased by 50%, it would only absorb 10% of the leisure trips currently made by automobile.**

States such as Florida have been particularly hard hit by the loss of revenue from what is normally a \$5.6 billion-a-year industry.*** Tourists supply 15% of Florida's income and make it the largest industry in that State. Most tourists travel to Florida by automobile. Because of the gasoline uncertainties this winter, many of these tourists stayed home. The result was a decline in attendance of up to 40% at some attractions, with similar declines in hotel bookings, restaurant business, and other parts of the

* Eric Zausner, Assistant Administrator, FEO, statement before the House Select Committee on Small Business. Hearings on the Impact of the Energy Crisis on Tourism, March 15, 1974.

** Ibid.

*** Senator Edward J. Gurney, opening statement before the Permanent Subcommittee on Investigations, March 6, 1974.

industry. Many of these businesses have consequently been forced to lay off employees. Moreover, small business enterprises, such as motels and restaurants, and other "Mom and Pop" enterprises do not enjoy the economic protection of diversification or strong financial backing available to large companies during difficult periods and so are at higher risk of business failure.

Florida is not the only State with this sort of problem. Tourism is a major industry in many States, adding over \$60 billion to the U.S. economy each year and supporting over 3 million jobs.* Even though the industry is highly dependent upon the use of gasoline by tourists, only 2.1% of the annual domestic consumption of gasoline is used in vacation travel by automobile. The improved gasoline situation should considerably ease the pressure on the tourist industry, although a full return to extended long trips is not likely.

2. Consumers

By far the greatest burden of the gasoline shortage falls directly on the individual car owners. They were the ones who had to wait in long lines to obtain gasoline left over after the needs of priority users had been met. They were also the ones who made most of the effort to conserve gasoline when the shortage was most severe.

The combined effect of short supplies and extensive conservation can be seen in Table 13, which shows the decline in gasoline consumption during

* The Importance of Tourism to the U.S. Economy, Special Travel Industry Council on Energy Conservation, March 1974, p. 5.

Table 13

MARCH 19, 1974

TABLE HF-336-03-19-74 COMPARISON OF GROSS GALLONS OF MOTOR GASOLINE SOLD BY MONTH AND YEAR FROM AVAILABLE STATES

STATE	NOV. 73 (48 STATES)		CAL. YR. CUMUL.		DEC. 73 (42 STATES)		CAL. YR. CUMUL.		JAN. 74 (20 STATES)		CAL. YR. CUMUL.	
	AMOUNT 1000 GAL.	PERCENT CHANGE	AMOUNT 1000 GAL.	PERCENT CHANGE	AMOUNT 1000 GAL.	PERCENT CHANGE	AMOUNT 1000 GAL.	PERCENT CHANGE	AMOUNT 1000 GAL.	PERCENT CHANGE	AMOUNT 1000 GAL.	PERCENT CHANGE
ALABAMA	163,648	7.1	1,733,840	5.4	153,729	3.2	1,387,560	5.2	134,464	0.0	154,476	0.0
ALASKA	13,090	-2.3	136,855	-12.1								
ARIZONA	94,745	9.1	1,100,662	6.3	105,702	4.6	1,206,364	8.0				
ARKANSAS	96,923	6.7	1,083,026	5.3	92,841	-2.9	1,175,867	4.6	78,210	-3.7	78,210	-3.7
CALIFORNIA	848,127	2.9	9,523,640	3.8	815,506	-4.5	10,339,146	3.1				
COLORADO	105,288	7.6	1,258,128	5.1	104,711	1.1	1,362,839	4.8				
CONNECTICUT	111,210	-9	1,257,244	2.8	104,297	-10.0	1,361,541	1.7	101,344	-7.7	101,344	-7.7
DELAWARE	19,227	-21.2	279,739	4.7	27,842	18.0	307,581	5.8	20,143	-11.2	20,143	-11.2
DIST. OF COLUM.	21,366	-7	238,000	7.5	19,510	-9.7	257,510	5.9	16,353	-8.0	16,353	-8.0
FLORIDA	358,893	9.3	4,031,875	11.6	347,237	1.0	4,379,112	10.7	330,377	-9.1	330,377	-9.1
GEORGIA	229,572	3.8	2,614,106	6.9	224,520	-3.4	2,838,626	6.0				
HAWAII	21,356	-2.8	262,203	7.0	24,697	-4	286,900	6.3				
IDaho	36,205	4.7	450,966	5.1	34,973	-2.3	485,939	4.6				
ILLINOIS	402,373	.6	4,758,739	4.9								
INDIANA	100,267	-56.0	2,519,163	-8	356,193	51.2	2,875,356	3.7	207,451	-10.7	207,451	-10.7
IOWA	157,273	9.7	1,700,458	12.8								
KANSAS	94,343	205.9	1,258,009	7.8	117,907	-40.3	1,375,916	.8				
KENTUCKY	138,495	3.8	1,570,202	5.1								
LOUISIANA	155,550	-4.7	1,642,055	4.3	147,998	14.5	1,790,053	5.1	131,843	1.8	131,843	1.8
MAINE	43,099	.6	479,490	3.8	39,102	-7.3	537,592	2.9	35,591	-11.4	35,591	-11.4
MARYLAND	154,511	2.9	1,733,002	5.3	140,382	-6.7	1,873,384	4.3	134,774	-19.6	134,774	-19.6
MASSACHUSETTS	196,185	.5	2,297,351	4.7	182,442	-8.8	2,389,793	3.5				
MICHIGAN	397,052	-0.0	4,316,345	2.8	385,601	-6	4,701,946	2.5				
MINNESOTA	181,811	5.4	1,968,723	3.1	165,712	-3.6	2,133,935	2.6				
MISSISSIPPI	102,936	9.1	1,129,613	3.2	101,183	-4.7	1,230,796	2.5	86,393	-12.5	86,393	-12.5
MISSOURI	237,745	2.9	2,511,085	2.5	231,213	6.1	2,742,298	2.8	198,929	-10.4	198,929	-10.4
MONTANA	40,313	48.1	402,214	.5	70,113	72.4	472,327	7.1				
NEBRASKA	68,206	2.7	829,592	2.2	81,206	5.6	910,798	2.5	57,645	-12.2	57,645	-12.2
NEVADA	31,065	7.1	365,244	6.5	27,749	-2.9	392,993	5.8				
NEW HAMPSHIRE	31,873	.8	374,336	3.9	29,424	-7.2	403,760	3.0	27,550	-13.5	27,550	-13.5
NEW JERSEY	239,445	11.8	3,003,682	4.7	263,161	-17.3	3,266,843	2.4				
NEW MEXICO	55,649	8.4	646,154	7.1	55,755	-9.9	701,909	5.5				
NEW YORK	371,616	-23.2	5,628,300	1.3	693,024	35.9	6,321,324	4.3				
N. CAROLINA	227,156	5.2	2,613,999	4.7	227,545	-7.6	2,861,544	3.6				
N. DAKOTA	36,523	15.0	405,541	4.6	31,524	4.8	437,065	4.6	24,398	-14.6	24,398	-14.6
OHIO	435,172	3.2	4,774,172	5.4	417,284	-2.0	5,191,456	4.8				
OKLAHOMA	146,229	9.8	1,599,230	4.3								
OREGON	96,166	23.6	1,154,931	6.1	88,910	-16.7	1,243,841	4.1				
PENNSYLVANIA												
PUERTO RICO	25,753	-22.4	350,214	1.5	30,890	-13.8	381,104	0.0				
S. CAROLINA	119,134	.3	1,376,503	5.9	114,089	-7.5	1,490,592	4.8	108,872	-7.8	108,872	-7.8
S. DAKOTA	39,478	-9.3	438,103	1.3	40,790	8.3	478,893	1.9	37,444	14.4	37,444	14.4
TENNESSEE	197,614	11.8	2,075,894	8.0	184,437	5.8	2,260,331	7.8				
TEXAS	611,586	7.7	6,757,951	5.9	597,179	2.2	7,355,130	5.6				
UTAH	19,705	-9	228,970	2.2	17,168	-12.3	246,138	1.1				
VERMONT	208,039	5.3	2,331,986	7.2	190,617	-5.1	2,522,603	6.2	174,076	-4.5	174,076	-4.5
VIRGINIA	107,896	-19.5	1,558,184	2.8	155,426	22.2	1,713,610	4.3	118,127	5.9	118,127	5.9
WASHINGTON	65,192	4.0	720,829	7.8								
WEST VIRGINIA	155,654	-13.4	2,017,353	2.0	193,850	9.8	2,211,203	2.6	160,120	-5.6	160,120	-5.6
WISCONSIN												
WYOMING												
TOTAL	7,801,101	1.0	91,457,901	4.8	7,431,939	1.9	88,403,527	4.4	2,221,043	-7.3	2,221,043	-7.3

THE DATA SHOWN ARE COMPARABLE TO THE GASOLINE PORTION OF THE FIRST COLUMN ON FHWA TABLE HF-2. EXCLUDES TO THE EXTENT INFORMATION IS AVAILABLE: EXPORTS, MILITARY USE, TRANSFERS BETWEEN DEALERS, AND ALL SPECIAL FUELS (DIESEL AND LIQUEFIED PETROLEUM GASES, PRIMARILY). CURRENT CUMULATIVE FIGURES INCLUDE ANY REVISIONS THAT HAVE BEEN MADE IN PRIOR MONTHLY DATA. PERCENTAGE COMPARISONS ARE WITH THE COMPARABLE PERIOD OF THE PRIOR CALENDAR YEAR. FOR INFORMATION CALL KENT BRAMLETT, 202-426-0187.

Press Release, Department of Transportation,
Federal Highway Administration, April 1, 1974.

the first three months of the embargo. Most of these conservation measures will remain in effect.

The most immediate impact of the gasoline shortage will be price. Initially, the foreign price increases for crude oil did not affect gasoline prices much because of the large percentage of domestic oil used in U.S. refineries. However, the domestic price has begun to rise toward foreign levels. The price for old oil (71% of production) was frozen at \$5.25 per barrel, but new oil prices were allowed to rise to more than \$10 per barrel, roughly three times the price that prevailed before the embargo. A tripling of oil prices does not necessarily mean that retail gasoline prices will also triple, because most of the retail price includes refining and transportation costs, dealers' profit margin, and taxes. The actual increase in retail price caused by higher crude oil prices was about 12 cents per gallon. Additional price increases resulted from actions by FEO to compensate station owners for lost income due to lower sales and restricted operations. Additional world price increases are possible at the rate of world inflation, which is presently 12%, although Saudi Arabia has shown some willingness to lower prices. World oil prices will probably stabilize at a level between \$8 and \$10 per barrel, seasonally adjusted for inflation. This would mean that prices will probably rise about 1 cent per month in the absence of other inflationary pressures. By the end of summer 1974, therefore, the average price per gallon of regular gasoline may well be close to 60 cents per gallon and possibly more in some areas.

The need for rationing has diminished with the increasing supply of gasoline. The projected shortages are not large enough to warrant a formal rationing system, although future supply constraints may once again raise the prospect. Two types of rationing have been proposed, formal coupon rationing and a tax rebate system. Both of these were summarized by the Joint Economic Committee in the following excerpt from "A Reappraisal of U.S. Energy Policy."*

On December 27, 1973, the Federal Energy Administrator announced the design of a rationing system to be prepared for implementation on or after March 1, 1974. The system would provide monthly coupon allotments to all drivers over 18. The allotment per driver would depend to some degree on locally available transportation alternatives. Coupons could be sold legally to provide an incentive to conserve fuel at all levels of consumption and also to accommodate greater-than-average individual needs (at increased cost). If the number of coupons exactly covered available retail supply, then the coupon price would increase the total price of gas to the market-clearing level. Without more accurate information than now exists on inventories and refinery output, however, it will be difficult for the Government to determine how many coupons to issue.

An increase in the gasoline tax with quarterly rebates would be equally as effective and equitable as a coupon rationing system, while avoiding the bother of exchanging coupons and the need to suppress coupon counterfeiting. If rebates to all drivers were uniform, for instance, a person consuming an average amount of gas would be fully compensated for the new tax; if he chose to drive less, he could easily spend his rebate on something else. Rebates could be differentiated, if desired, to improve equity among different groups of people. One problem with this option is choosing the right tax level to prevent run-outs at gas stations. Legislation would have to permit some executive discretion to vary the size of the tax analogous to authority needed under coupon rationing to set the number of coupons to be issued in any period.

The gasoline shortages that developed in February 1974 were due only in part to the Arab oil embargo. February gasoline stocks and production were within 1% of the 1973 levels.** In addition, gasoline imports were

* A Reappraisal of U.S. Energy Policy, a report of the Joint Economic Committee, March 8, 1974, p. 11.

** Weekly Statistical Bulletins, February 8, 15, and 22, and March 1, 1974, American Petroleum Institute.

substantially larger in February 1974 than in the same month in 1973. The shortage at the pumps, however, was real because of several factors. First, the FEO ordered reductions of up to 15% in gasoline deliveries to service stations as a conservation move. Second, many large-volume users, such as farmers, overbought in anticipation of continuing shortages in the spring, which diverted gasoline from the retail market.* Third, inequities in the gasoline allocations because of uneven population growth had not yet been worked out, and consequently some areas received proportionately less gasoline than others. Fourth, many motorists panicked at the thought of limited mobility and were continually "topping off" their tanks. In addition to lengthening the lines, this meant that more gasoline that would otherwise have been for sale at the pump was being hoarded in the gasoline tanks of motorists. The effects of this mobile storage were temporary and limited, for the most part, to February, because the capacity for hoarding was soon reached. Fifth, limitations on maximum purchases virtually assured long lines by forcing motorists to return more often for fuel. Sixth, many station owners attempted to serve only their regular clientele by limiting their operations to one hour or less per day in many cases. Under these circumstances, shortages and long lines were inevitable.

In the absence of a national program to reduce gasoline lines created by "topping off", many local and State governments resorted to variations of the "Oregon Plan". This system limited purchases to alternate days, based on the last number of each license plate. The principal benefit of such a plan

* The 5-Month Oil Embargo, The Washington Post, March 25, 1974.

appears to have been a psychological one which may have encouraged gasoline conservation by forcing motorists to plan trips and gasoline purchases beforehand rather than making them spontaneously. There is little evidence, however, that odd-even plans by themselves reduced waiting lines to any degree. The plans that were successful involved requirements that tanks be less than half full to qualify for a purchase which was then not limited in any way. The experience of February 1974 revealed quite clearly that the best way to reduce lines is by reducing the number of gasoline purchases, which can be done by opening stations for longer periods or by staggering their hours of operation, requiring half-empty tanks to qualify for purchase, and elimination of limitations on the amount sold to each qualified customer.

Even though the end of the embargo has improved the supply situation, motorists will still not be free of limitations on the use of their automobiles. Adequate gasoline for commuting and shopping should be available, but most of the conservation measures brought about by the crisis last winter will remain in effect.

The gasoline supply for vacation travel may be subject to spot shortages, depending upon the degree to which vacationing by automobile will be inhibited by fear of shortage. The gasoline that is available will cost approximately 20 cents per gallon more than it did a year ago, and this may be a deterrent to the planning of long trips for many families.

SUMMARY

For the past year, gasoline shortages have been a chronic problem in the United States. The Arab oil embargo seriously compounded this problem by sharply limiting the amount of crude oil available to the United States. Even without the embargo, however, gasoline shortages would have been likely if not severe. Population growth, the increased use of energy-consuming options on new cars, and automobile pollution controls have acted together to increase the demand for gasoline. Rising prices and conservation efforts have offset this increase to some extent, but not enough to prevent recurrence of spot shortages. Domestic oil production has been declining for several years and does not appear likely to increase significantly for at least three years, at which time additional oil from the Alaskan North Slope and the Outer Continental Shelf may be available. To meet the excess demand, increased imports of both crude oil and gasoline will probably be necessary. Limited refining capacity, however, will restrict the amount of crude oil that can be processed domestically. Because of these factors, gasoline supplies will continue to be short of demand by several percentage points.

Efforts to deal with petroleum shortages have had serious implications for the individual motorist. Governmental action to increase the supply of heating oil led to cutbacks in gasoline production. Limited service station hours, panic buying, and local "rationing" plans made gasoline purchases difficult. Combined with higher prices and lower speed limits, these gasoline supply uncertainties discouraged many motorists from embarking on

extended automobile trips. As a result, the tourist industry, in particular, has been seriously affected in many areas. The prospects for gasoline availability are much improved since the lifting of the embargo, and the impact of the shortages may be lessened to some extent. Some tightness of supply can be expected, however, for the remainder of 1974 and possibly for the two succeeding years.

APPENDIXES

APPENDIX I

The Outlook for Gasoline in the
2nd and 3rd Quarter 1974

ALPHABET

TABLE

OF THE
ALPHABET



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THE OUTLOOK FOR GASOLINE IN THE
2ND AND 3RD QUARTER 1974

May, 1974

Summary

Following the end of the Arab oil embargo and absent any new restrictions on oil imports, no significant shortage of gasoline will occur during the remainder of 1974 if demand from May through September -- the peak consuming period -- does not increase by much more than 2 1/2% above a year ago. The sharp increases in gasoline prices since last October and existing mandatory and voluntary conservation measures make it plausible that the growth rate over the next six months will be kept within this limit. However, if gasoline demand were to return to the historic growth rates of recent years which ranged from 4.5% to 6%, available supplies would be clearly inadequate and a substantial gasoline shortage could be expected to develop.

The assumptions for this projection are summarized in the table on the next page and are discussed in the text following the table.

Table I

U.S. Gasoline Supply/Demand Second-Third
Quarter 1974
(000 b/d)

	<u>2nd Quarter</u>	<u>3rd Quarter</u>
Crude Runs	12,000	12,800
Unfinished Oils	<u>170</u>	<u>170</u>
Runs	12,170	12,970
Gasoline Yield %	(47.5)	(47.5)
Refinery Output	5,780	6,160
NGL Blends	775	800
Net Imports	<u>200</u>	<u>200</u>
Supply	6,755	7,160
Demand	6,850	7,100
Stock Change (000 b/d)	(-95)	(+60)
Stocks End Quarter million barrels	(217.4)	(223)

Assumptions

(1) Crude Oil Supplies

Our analysis assumes that following the end of the Arab oil embargo at the end of March crude oil imports will average 3.2 million b/d for the second quarter as a whole, almost 700,000 b/d higher than projected under a continuation of the embargo. For the 3rd quarter we project a

crude oil import level close to 4 million b/d. The availability of these import volumes are based on the assumption that after April Arab crude oil export levels will exceed the last pre-embargo month (September 1973) while the output of non-Arab oil exporters will continue to rise above last year. At the same time world oil demand which apparently was down 5-10% in the first Quarter of 1974 compared to a year ago, is expected to remain relatively weak throughout the remainder of the year because of a combination of economic declines in several major importing countries and the increase in the cost of oil. Domestic crude oil production is expected to maintain its first-quarter level of about 9 million b/d throughout the period. This should enable U.S. refineries to raise average crude oil utilization from about 80% in the 1st Quarter to 86% in the 2nd Quarter and at least 91% in the 3rd Quarter. It would also permit an increase in crude oil inventories by the end of September to well above a year ago.

(2) Gasoline Supplies

The estimated gasoline yields of 47.5% for both Quarters represent no technical problems for the industry. In fact, if circumstances warrant it, these yields could probably be increased at least one full point which would increase supplies by 1.8%.

The level of 200,000 b/d of gasoline imports is more speculative. This relates less to its potential availability than to its price. Physically, this volume is probably available for importation into the U.S. but, for a variety of reasons, its cost may be considerably

above that of domestic gasoline bought under term-contracts. Currently, the difference is 12-15¢ per gallon. Since the end of the crude oil shortage can be expected to bring about a return of competition into the domestic market, marketers may well be reluctant to buy foreign gasoline at those higher prices. However, a somewhat smaller volume of imports than projected could probably be offset by a slight increase in the gasoline yield of domestic refineries and, thus, not affect the total volume of available gasoline.

(3) Demand for Gasoline

Prior to the embargo gasoline demand had been projected to increase by more than 5% in 1974, or about the same as in the first 10 months of 1973. However, the sharp increase in prices have quite naturally rendered these projections obsolete. Yet the suddenness and steepness of these price increases -- about 35% at the retail level since last October -- have made it exceedingly difficult to project with any degree of certainty just what the new level of gasoline demand will be.

There is a wide divergence in estimates of the short run price elasticity of gasoline. Recent analysis by both the Federal Energy Office as well as by Dr. H. S. Houthakker and P. K. Verleger, Jr., suggest an elasticity of about $-.15$. This level of responsiveness to change in price would result in virtually no growth in gasoline

demand. Such a scenario certainly seems possible.* During the month of April demand appears to have been down approximately 4% from year-ago levels. Probably not all of the decline was due to physical constraints which had eased considerably from those prevailing in the first Quarter of 1974.

However, our analysis assumes a somewhat higher level of demand than a year ago. Table I projects that gasoline demand will increase 0.7% in the entire second Quarter (which could amount to 2% for the May-June period) and 2.1% in the 3rd Quarter. Yet even at these assumed higher levels of demand, inventories -- measured in both absolute terms and relative terms (days/supply ratios) -- show an improvement over comparable periods in 1973 and 1972 - as illustrated in the following table. However, it can be calculated from the table that any demand increase in excess of 3% in the 3rd Quarter would reduce the ratio of inventory to demand below the comparable Days Supply of 1973 when gasoline was beginning to be tight.

*Particularly if we also consider mandatory conservation measures not related to price, such as maintenance and enforcement of the 55 mph speed limit which could save 150,000 barrels per day.

Table II

Gasoline Inventories And Demand
(million bbls)

	<u>Inventories</u>	
	<u>End of 2nd Quarter</u>	<u>End of 3rd Quarter</u>
1974 (est.)	217	223
1973	208	210
1972	200	199

	<u>Demand</u> (000 b/d)	
	<u>2nd Quarter</u>	<u>3rd Quarter</u>
1974 (est.)	6,850	7,100
1973	6,805	6,955
1972	6,516	6,690

	<u>Days Supply*</u>	
1974 (est.)	31.7	31.4
1973	30.6	30.2
1972	30.7	29.7

*Defined here as end quarter inventories divided by average quarter demand.

4th Quarter Supplies

No separate calculation of supply and demand was made for the 4th Quarter 1974. But since gasoline demand during that period is seasonally significantly below that of the 3rd Quarter, it is reasonable to assume that if the 3rd Quarter ends with the inventory figure shown in our table and no new restrictions are imposed on crude oil imports, gasoline supplies will be adequate in the 4th Quarter of 1974.

APPENDIX II

National Petroleum Supply and Demand
1974

Post-Embargo

NATIONAL PETROLEUM SUPPLY AND DEMAND

1974

POST-EMBARGO

TECHNICAL REPORT

74-2

F.E.O. - E.A.T.R. - 74-2

FEDERAL ENERGY OFFICE

OFFICE OF QUANTITATIVE METHODS

APRIL 26, 1974

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Appendices

A - The Simulation Model

B - Input Data Files

I. INTRODUCTION

The purpose of this report is to document the procedures and assumptions used by the Federal Energy Office during the first three months of 1974 to forecast the supply and demand for petroleum products during 1974. The basic forecasting methodology and its initial data inputs were reported in: National Petroleum Supply and Demand, 1974, Technical Report 74-1, Office of Energy Analysis, FEO, January 2, 1974. Changes have been made in methodology and supporting data since Technical Report 74-1 was published in January. Most of these changes separately constitute only minor amendments to the forecasting model. The changes in the model are addressed to the following concerns.

- the need to provide forecasts for additional scenarios;
- the availability of more current data, and
- the benefit of an expanding community of offered constructive suggestions for changes in the model as first published.

In addition, certain portions of the forecasting process which were done manually have been automated. The conduct of this exercise necessitated some changes in the model as presented in January as certain computations could only be reproduced approximately.

The presentation of the model here is motivated by the fact that although most of the changes since January have been minor, taken together they represent a sufficient difference in substance that Technical Report 74-1 no longer adequately documents the basis for current forecasts. It should be noted that this report is not intended to present a new generation of forecasting model. An inspection of the current model reveals that a more durable forecasting tool would necessitate a more explicit representation of the structure of relationships which underlie the supply and demand for petroleum products. There is strong evidence that the events of the past six months have significantly altered the marketplace for energy in general and petroleum products in particular. Research which seeks to understand and represent these changes is underway. In order to remain a viable tool for policy analysis, the forecasting model will evolve in a manner so as to depend less upon historical usage patterns and more upon current and explicit structural relationships. This evolution will be documented in future technical reports.

This report is outlined as follows: Section II presents an overview of how the forecasts are conducted. Section III outlines the assumptions underlying the estimation of petroleum product supply. Section IV outlines the assumptions and estimating relationships for petroleum product demand. Section V presents the results of implementing the forecasting model under two scenarios which take the lifted embargo into account and distinguish between two estimates of demand. Appendices present an outline of the simulation model itself and the data files which support the forecasts presented in Section V.

II. OVERVIEW OF THE PROCEDURE

The supply/demand estimation procedure consists of three main components: a forecast of demand or consumption, a forecast of domestic crude production as well as crude and product imports, and the simulation of industry operations and inventory policies.

The focus of the forecast is on the monthly national aggregates for supply and demand. The primary historical data base is the monthly report of the Bureau of Mines which summarizes the industry operations and the disappearance of products from primary stocks^{1/}. The latter statistics are referred to as domestic demand in popular usage. Due to supply constraints or the confounding of inventory accumulation in secondary stocks, these primary stock disappearance data are subject to criticism but remain the best proxy for actual consumption. In this context, the basic demand estimates of Section IV are properly interpreted as consumption forecasts under the assumption of no major shift in the recent historical relationships between supply and demand. In particular, the secondary economic effects of the embargo are not intended to be accounted for in the basic forecast. This is the proper reference point for planning purposes and provides the base against which demand reductions are measured.

Essentially, the model accepts an estimate of demand and estimates of new supplies of crude, NGL, and product. The yearly pattern of available product supplies or short-term changes in the general level of product supplies can be changed by setting parameters within the model which establish seasonal inventory profiles and minimum inventory levels. Once the available supply is determined by the model, supply is compared to demand. If demand is greater, the difference is computed and expressed as a percentage of demand (the shortfall). If supply is greater, the difference is added to inventory and the shortfall shown as 0%. For supply, detail is maintained which accounts for domestic production, inventory changes, and imports.

^{1/} Monthly Petroleum Statement, Bureau of Mines, Division of Fossil Fuels.

III. ESTIMATION OF SUPPLY

The determination of supply includes estimates of domestic crude and natural gas liquids (NGL) production, blending ratio for NGL, changes in the inventory of unfinished oils and imports of crude and products.

For most of the petroleum products, actual beginning inventories are used for April. For crude, unfinished oils, motor gasoline, distillate fuel, residual fuel, kerosine jet fuel, and naphtha jet fuel, these inventory numbers are taken from the American Petroleum Institute (API) weekly report of March 29, 1974. For the remaining petroleum products, estimates are used.

A. Supply Forecast for Domestic Crude Oil Production and NGL

The forecasts of quarterly domestic crude and NGL production were made by the Bureau of Mines. The forecasts of monthly domestic crude production were taken from the quarterly forecasts by scaling the values according to the profile of average domestic crude runs to still for 1971 to 1972. The BOM quarterly forecast for Natural Gas Liquids is apportioned in the same manner.

Monthly Supply of Raw Materials (Thousands of Barrels/Day)

<u>Date</u>	<u>Domestic Crude Forecast</u>	<u>Domestic NGL Forecast</u>
74:1	9022.93	1755.76
74:2	9032.59	1758.42
74:3	8993.49	1750.81
74:4	9007.11	1797.43
74:5	8913.27	1778.70
74:6	9139.62	1823.87
74:7	9083.75	1813.71
74:8	8970.13	1791.02
74:9	8826.12	1762.27
74:10	8941.63	1804.40
74:11	8857.57	1787.44
74:12	8900.80	1796.16

B. Blending of NGL

The blending transactions for NGL were based on the average of similar transactions for 1971 and 1972 for the production of motor gasoline, LPG and Ethane -- the primary component of "other" products^{2/}.

Quarterly Blending of NGL
(Thousands of Barrels/Day)

	<u>71:1</u>	<u>71:2</u>	<u>71:3</u>	<u>71:4</u>	<u>72:1</u>	<u>72:2</u>	<u>72:3</u>	<u>72:4</u>
Motor Gas	730.0	661.0	699.0	770.0	767.0	728.0	750.0	822.0
LPG	697.0	735.0	712.0	670.0	679.0	739.0	710.0	668.0
Ethane	<u>207.0</u>	<u>220.0</u>	<u>234.0</u>	<u>238.0</u>	<u>262.0</u>	<u>264.0</u>	<u>281.0</u>	<u>292.0</u>
TOTAL NGL	<u>1719.0</u>	<u>1714.0</u>	<u>1736.0</u>	<u>1774.0</u>	<u>1782.0</u>	<u>1811.0</u>	<u>1818.0</u>	<u>1851.0</u>

For each series the average was taken and the blending ratios were taken as the ratios of these averages to their sum.

	<u>Mean</u>	<u>Standard Deviation</u>	<u>Blend Ratios</u>
Motor Gas	740.875	48.71	0.438
LPG	701.250	27.65	0.414
Ethane	249.75	29.79	<u>0.148</u>
			<u>1.000</u>

C. Inventory of Unfinished Oils

The inventory of unfinished oils is determined exogenously and is not affected by the decision rules in the model. The monthly profile of unfinished oil inventory is assumed to follow the average pattern of the months between September 1971 and August 1973.

^{2/} Blending includes blending and transfers.

Monthly Ending Inventory
for Unfinished Oils

74:4	105.9
74:5	107.4
74:6	108.8
74:7	105.9
74:8	101.9
74:9	102.7
74:10	103.4
74:11	102.5
74:12	97.7

D. Imports

The expectations with respect to import levels, given that the embargo was lifted in the latter part of March, can only be offered as the result of informed judgment. The following estimates, broken out by source, were made by the Office of Oil and Gas.

TABLE III-0

Embargo Lifted in Latter Part of March 1974
 Arab Production Restored to September 1973 Level
 with Continued Improvement Through the Year

<u>Imports</u>	<u>April 1974</u>	<u>May 1974</u>	<u>June 1974</u>	<u>3rd Qtr 1974</u>	<u>4th Qtr 1974</u>
Crude Oil	2,495	3,500	3,600	3,800	4,000
Unfinished Oil	110	110	130	140	160
NGL	<u>110</u>	<u>110</u>	<u>115</u>	<u>120</u>	<u>130</u>
Sub-Total	2,715	3,720	3,845	4,060	4,290
Motor Gasoline	145	145	180	200	190
Dist. F.O. (Incl. #4)	295	295	320	340	340
Residual F.O.	1,670	1,670	2,000	2,100	2,200
Naphtha Jet	10	10	10	10	10
Kero Jet	160	160	180	180	180
LPG	120	120	120	120	120
Other	<u>45</u>	<u>45</u>	<u>55</u>	<u>60</u>	<u>80</u>
Sub-Total	2,445	2,445	2,865	3,010	3,120
TOTAL IMPORTS	<u>5,160</u>	<u>6,165</u>	<u>6,710</u>	<u>7,070</u>	<u>7,410</u>

SOURCE: Office of Oil & Gas.

TABLE III-1

Embargo Lifted in Latter Part of March 1974
Arab Production Restored to September 1973 Level
Crude Oil Allocation Program Changed

	1972	CRUDE OIL IMPORTS (Thousands of Barrels/Day)							
		73:1	73:2	73:3	73:4	74:1	74:2	74:3	74:4
North America	854	1,076	1,039	978	944	825	950	1,000	1,050
Caribbean & South America	299	329	437	507	530	550	350	350	350
Europe	1	0	0	0	0	0	0	0	0
West Africa	259	440	467	509	520	530	570	580	600
South East Asia	166	167	205	224	250	260	220	240	250
Iran	136	115	207	231	250	260	390	370	350
OAPEC	502	796	803	1,074	800	0	718	1,260	1,400
TOTAL	2,217	2,923	3,158	3,523	3,361	2,425	3,198	3,800	4,000

SOURCE: 1972 to 73:3 - BOM.
73:4 to 74:4 - Office of Oil and Gas.

TABLE III-2

Embargo Lifted in Latter Part of March 1974
Arab Production Restored to September 1973 Level

	MOTOR GAS (Thousands of Barrels/Day)								
1972	73:1	73:2	73:3	73:4	74:1	74:2	74:3	74:4	
North America	1	2	26	10	6	12	22	74:4	12
Caribbean & South America	65	61	64	101	107	99	123	146	166
Europe	1	11	18	24	19	10	22	32	12
West Africa	0	0	0	0	0	0	0	0	0
South East Asia	0	0	0	2	0	0	0	0	0
Iran	0	0	0	2	0	0	0	0	0
OAPEC	0	0	5	0	0	0	0	0	0
TOTAL	67	74	113	139	127	115	157	200	190

SOURCE: 1972 to 73:3 - BOM.
73:4 to 74:4 - Office of Oil and Gas.

TABLE III-3

EMBARGO LIFTED IN LATTER PART OF MARCH 1974
Arab Production Restored to September 1973 Levels

		DISTILLATE OIL (Thousands of Barrels/Day)							
	1972	73:1	73:2	73:3	73:4	74:1	74:2	74:3	74:4
North America	6	9	10	3	13	10	10	10	10
Caribbean & South America	149	312	168	223	334	310	243	260	250
Europe	22	198	47	66	79	20	50	60	70
West Africa	0	0	0	0	0	0	0	0	0
South East Asia	0	0	0	0	0	0	0	0	0
Iran	0	1	0	0	0	0	0	0	0
OAPEC	3	13	9	2	0	0	0	10	10
TOTAL	180	533	234	301	426	340	303	340	340

SOURCE: 1972 to 73:3 - BOM.
73:4 to 74:4 - Office of Oil and Gas.

TABLE III-4

Embargo Lifted in Latter Part of March 1974
Arab Production Restored to September 1973 Level

	RESIDUAL OIL (Thousands of Barrels/Day)								
	1972	73:1	73:2	73:3	73:4	74:1	74:2	74:3	74:4
North America	83	73	112	93	74	40	80	130	150
Caribbean & South America	1,467	1,792	1,389	1,398	1,635	1,528	1,565	1,785	1,845
Europe	145	143	138	153	105	80	100	160	180
West Africa	10	20	13	8	21	15	15	15	15
South East Asia	3	5	6	33	10	17	20	10	10
Iran	1	0	0	0	0	0	0	0	0
OAPEC	33	45	50	76	8	0	0	0	0
TOTAL	1,742	2,078	1,708	1,761	1,853	1,680	1,780	2,100	2,200

SOURCE: 1972 to 73:3 - BOM.
73:4 to 74:4 - Office of Oil and Gas.

TABLE III-5

Embargo Lifted in Latter Part of March 1974
Arab Production Restored to September 1973 Level

	JET FUEL (Thousands of Barrels/Day)								
	<u>1972</u>	<u>73:1</u>	<u>73:2</u>	<u>73:3</u>	<u>73:4</u>	<u>74:1</u>	<u>74:2</u>	<u>74:3</u>	<u>74:4</u>
North America	4	5	10	9	6	2	4	6	6
Caribbean & South America	150	140	132	164	113	126	134	143	145
Europe	6	2	8	4	7	2	6	8	6
West Africa	0	0	0	0	0	0	0	0	0
South East Asia	17	37	16	26	28	21	21	21	21
Iran	4	8	1	5	9	9	9	9	9
OAPEC	<u>13</u>	<u>9</u>	<u>5</u>	<u>6</u>	<u>5</u>	<u>0</u>	<u>3</u>	<u>3</u>	<u>3</u>
TOTAL	<u>194</u>	<u>201</u>	<u>172</u>	<u>213</u>	<u>168</u>	<u>160</u>	<u>177</u>	<u>190</u>	<u>190</u>
Kero-Jet					160	150	167	180	180
Nap-Jet					8	10	10	10	10

SOURCE: 1972 to 73:3 - BOM.

73:4 - API.

74:1 to 74:4 - Office of Oil and Gas.

TABLE III-6

Embargo Lifted in Latter Part of March 1974
Arab Production Restored to September 1973 Level

	LPG (Thousands of Barrels/Day)								
	<u>1972</u>	<u>73:1</u>	<u>73:2</u>	<u>73:3</u>	<u>73:4</u>	<u>74:1</u>	<u>74:2</u>	<u>74:3</u>	<u>74:4</u>
North America	76	133	65	54	60	85	85	85	85
Caribbean & South America	11	45	23	37	35	35	34	34	34
Europe	1	1	1	7	0	0	0	0	0
West Africa	0	0	0	0	0	0	0	0	0
South East Asia	0	0	1	0	0	0	0	0	0
Iran	0	0	0	0	0	0	0	0	0
OAPEC	1	1	3	5	2	0	1	1	1
TOTAL	<u>89</u>	<u>180</u>	<u>93</u>	<u>103</u>	<u>97</u>	<u>120</u>	<u>120</u>	<u>120</u>	<u>120</u>

SOURCE: 1972 to 73:3 - BOM.
73:4 to 74:4 - Office of Oil and Gas.

TABLE III-7

Embargo Lifted in Latter Part of March 1974
Arab Production Restored to September 1973 Level

	1972	73:1	73:2	73:3	73:4	74:1	74:2	74:3	74:4
North America	105	131	121	112	120	120	120	130	140
Caribbean & South America	125	114	120	159	146	128	135	158	185
Europe	6	4	1	17	10	10	10	15	20
West Africa	0	0	0	0	0	0	0	0	0
South East Asia	2	0	0	10	0	0	0	0	0
Iran	1	1	2	0	2	2	2	2	2
OAPEC	14	9	32	11	0	0	10	15	23
TOTAL	253	259	276	309	278	260	277	320	370
NGL					100	110	112	120	130
Unfinished Oils					145	110	117	140	160
Miscellaneous					33	40	48	60	80

SOURCE: 1972 to 73:3 - BOM.

73:4 - API.

74:1 to 74:4 - Office of Oil and Gas.

IV. FORECASTING DEMAND

The disappearance of products from primary inventories is reported as domestic demand and the national aggregates appear each month in the authoritative Bureau of Mines Monthly Petroleum Statement. Although confounded by secondary inventory adjustments, these statistics represent the best available proxy for actual consumption and forecasts of this consumption are what is intended by the informal usage of the terms "demand estimates".

For the purposes of planning, estimates are required of the consumption levels that would take place if the prevailing trends of supply and demand were not dramatically altered. Variations in weather, economic activity or seasonality should be accounted for, but major shifts in the structure of the market are described external to the historic data base when possible.

This section describes the demand estimates constructed and used by FEO in the preparation of the forecast scenarios presented in Section V. Ideally, these demand estimates should be causal, structural relationships where a change in the exogenous variables will explain the change in consumption. In some instances, such as degree days with respect to distillate consumption a plausible argument of this type can be made. Frequently, however, the explanatory variables are better interpreted as proxies for the true causal relationship. Hence, these intuitively appealing functions should be good predictors given minor changes in the variables but major structural shifts must be supported by additional analysis.

Elementary single equation models were constructed for each product using standard least squares or first order autocorrelation techniques. Where possible, the exogenous variables were forecasted using a comprehensive macroeconomic model employed for conditions prior to the oil embargo^{3/}. The important degree day profile was assumed to follow the pattern of a normal winter.

Although the models could be improved with further study, it should be noted that the monthly demand forecasts are not dramatically different than those produced by equations with time trends and seasonal dummies. It is not surprising that a wide range of estimation procedures, when formally related to the data base, produce similar short-term forecasts.

The consumption estimates obtained from the basic models were augmented to include exports (at the level of the most recent four quarters), additional requirements of the Department of Defense due to losses of foreign sources, and certain judgments resulting from the evaluation of experts. In each case, these components of the demand forecast are identified.

^{3/} The Data Resources, Inc. (DRI) Model using Control Forecast 10/24, implying a real GNP growth of 2.6% at annual rates.

Most of the exogenous variables used are well known and intuitive. Two deserve some brief comment. An important determinate of the demand for certain products is the weather. To a certain extent, the impact of variations in the weather can be accounted for by variables which represent the season (so-called seasonal dummies). However, a variable was introduced which could account for continuous and specific differences in weather (i.e., a mild winter versus a severe winter). This variable is called "degree day", an index (aggregated across states and weighted with respect to the states' relative usage of the appropriate product type) of the deviation of temperature from the comfort norm. Time series data supporting this index were provided by the Department of Commerce, National Oceanic and Atmospheric Administration. For the forecasts into 1974, normal weather was assumed.

In two instances, motor gasoline and liquefied gases, the use of ordinary least squares provided evidence of significant autocorrelation of the error terms of the estimating equations. To compensate for this an autoregressive transformation of the regression equation was performed. The corrective factor in the forecasting equation associated with the *Rho* term is included to achieve the appropriate adjustment

The estimating equations presented here are essentially the same as those presented in Technical Report 74-1. However, there are differences. Many of these differences are attributable to changes associated with automating a number of operations which were originally carried out manually. During the automation process, a number of transaction errors and inconsistencies in the time periods considered were corrected. The net effect of these changes is small. One change has led to a systematic difference. The personal income projection for (originally) the last quarter of 1973 and for 1974 was constructed inadvertently in part from a different source than the DRI Control Forecast 10/24. In order for all the macroeconomic variables to be related to a coherent forecasting structure, the DRI Control Forecast 10/24 personal income time series was used in the forecasting equations presented here. As it happens, this time series forecasts a slightly lower time path for personal income. As a result, the demand projections depending upon this variable are slightly lower when compared to those in Technical Report 74-1. The difference is small, usually far less than 1%.

In the single case of kerosine type jet fuel, a substantial change was made in the forecasting equation. Inspection revealed that the functional form used in Technical Report 74-1 was highly sensitive to the manner in which the personal income and the seasonal variables were included. A simpler functional form was substituted which related fuel usage to ton-miles and revenue-miles flown. Variations due to the season or to the overall level of economic activity were taken into account in the estimation of the ton-mile and revenue-mile variables.

A final remark is appropriate with respect to the usage of the term "demand". With respect to the jargon of economics, the forecasting equations are not demand equations. A demand equation describes the quantity per time period which buyers would absorb, given marked price and other relevant decision variables. A demand equation is often called a structural equation which, in combination with other structural equations (notably supply equations), can be used to determine both the price and quantity which would prevail in the market at equilibrium. The forecasting equations offered here estimate the equilibrium quantity directly. As a result, they are related to what are often called reduced form equations. In fact, no structural hypothesis about the determinates of supply and demand in the market for the various petroleum products is being offered in this report. As a result, the "demand" forecast is in fact a forecast of market consumption.

A. Demand Forecast for Motor Gasoline

The forecasts of the monthly (quarterly) domestic demand for motor gasoline are based on the following equation:

$$\begin{aligned}
 \text{DMD291GASMTNRS} = & 59.418 - 114.69 * \text{PMRGASNS} \\
 & (5.26220)^{a/} \quad (-2.70527) \\
 & + .00095993 * \text{PYNMNSHH} - .011088 * \text{DDNMWT} \\
 & (5.88119) \quad (-4.02857) \\
 & - 4.2310 * \text{SEASONM02} + 2.5410 * \text{SEASONM03} \\
 & (-1.92947) \quad (1.49715) \\
 & - 5.0821 * \text{SEASONM09} + 4.8020 * \text{SEASONM12} \\
 & (-2.44418) \quad (2.04327) \\
 & + .51089 * \text{DMD291GASMTNRS} \quad (-12) \\
 & (-4.69341) \\
 & (\text{RHOGAS}^{K1}) * (\text{GASACT} - \text{GASSTAR}) \\
 & (2.73478)
 \end{aligned}$$

a/ The numbers in parentheses are t-statistics.

$R^2 = .9660$; $DW = 2.1666$; $SE = 3.88266$; $RHOGAS = 0.312165$; where
 DMD291GASMTNRS $\equiv$ domestic total demand for gasoline, millions of barrels per month, PMRGASNS $\equiv$ monthly average price (in dollars per gallon) at 55 cities for major brandname, regular gasoline excluding taxes; PYNMNSHH $\equiv$ monthly total personal income millions of current dollars, not seasonally adjusted; DDNMWT $\equiv$ national monthly degree days; GASACT $\equiv$ actual domestic monthly total demand for motor gasoline in July 1973; GASSTAR $\equiv$ the forecast from the above equation omitting $(\text{RHOGAS}^{K1}) * (\text{GASACT} - \text{GASSTAR})$ for July 1973; $K1 = 6, 7, \dots, 17$ for January through December respectively; SEASONM02, SEASONM03, SEASONM09, and SEASONM12 are seasonal dummy variables for February, March, September, and December respectively.

To convert the forecast values for DMD291GASMTNRS to thousands of barrels per day, the forecast values are multiplied by 1000 and divided by the number of days in the given month.

To convert from monthly to quarterly values for total gasoline demand, the three monthly values in each quarter are averaged.

Monthly Demand, Motor Gas (Thousands of Barrels/Day)					Quarterly Demand, Motor Gas (Thousands of Barrels/Day)	
	Base Model	Exports	Military	Total		
74:1	6,248	2	17	6,267		
74:2	6,668	2	17	6,687		
74:3	6,693	2	17	6,712	74:I	6,555
74:4	6,902	4	17	6,923		
74:5	7,809	4	17	7,110		
74:6	7,346	4	17	7,367	74:II	7,133
74:7	7,271	2	17	7,290		
74:8	7,337	2	17	7,356	74:III	7,276
74:9	7,162	2	17	7,181		
74:10	7,148	2	17	7,167	74:IV	7,156
74:11	7,196	2	17	7,215		
74:12	7,066	2	17	7,085		

It should be noted that the forecast for PYNMNSHH is derived from a macroeconomic model (from the Control 10/24 simulation of the Data Resources, Inc. eight quarter model). DDNMWT is forecast as a 15 year average (1958 to 1972) of the historical values of DDNMWT; PMRGASNS is assumed to remain constant at a value of .30. The values of these variables over the forecast period are given below:

	74:1	74:2	74:3	74:4	74:5	74:6	74:7	74:8	74:9	74:10	74:11	74:12
PMRGASNS (\$/Gal.)	\$.30	\$.30	\$.30	\$.30	\$.30	\$.30	\$.30	\$.30	\$.30	\$.30	\$.30	\$.30
PYNMNSHH (Mils. of Current \$)	\$88,371	\$88,525	\$89,800	\$90,701	\$91,469	\$92,850	\$93,007	\$93,359	\$95,217	\$97,233	\$98,148	\$98,933
DDNMWT (15 Yr. Nat'l Avg.)	1177.7	1004.1	849.5	475	220.3	44.9	9.9	18.6	102.6	347.7	667.3	1042.3
GASACT-GASSTAR	-0.44	-0.44	-0.44	-0.44	-0.44	-0.44	-0.44	-0.44	-0.44	-0.44	-0.44	-0.44
K1	6	7	8	9	10	11	12	13	14	15	16	17

NOTE: Estimation Period: 66:1 to 73:7 for initial ordinary least squares regression.
66:2 to 73:7 for autocorrelation-corrected regression.

B. Demand Forecast for Aviation Gasoline

The forecasts of the monthly (quarterly) domestic demand for aviation gasoline are based on the following equation:

$$\begin{aligned} \text{DMD291GASAVNS} = & 8.0027 + .00004409 * \text{PYNMNSHH} \\ & (4.42716) \quad (2.02243) \\ & - .00027596 * \text{DDNMWT} - 0.03409 * \text{TIME} \\ & (-3.59753) \quad (-3.21016) \\ & + .31531 * \text{DMD291GASAVNS} (-12) \\ & (3.18226) \end{aligned}$$

$\bar{R}^2 = .8733$; $DW = 1.80$; $SE = .252689$; where DMD291GASAVNS $\equiv$ domestic total demand for gasoline, millions of barrels per month, not seasonally adjusted; PYNMNSHH $\equiv$ monthly total personal income, millions of current dollars, not seasonally adjusted; DDNMWT $\equiv$ national monthly degree days; TIME $\equiv$ a linear time trend.

To convert the forecast for DMD291GASAVNS to thousands of barrels per day, the forecast values are multiplied by 1000 and divided by the number of days in the given month.

To convert from monthly values to quarterly values for total aviation gasoline demand, the three monthly values in each quarter are averaged.

Monthly Demand, Average Gas (Thousands of Barrels/Day)		Quarterly Demand, Average Gas (Thousands of Barrels/Day)	
	Base Model		
74:1	28		
74:2	32		
74:3	32	74:I	31
74:4	36		
74:5	40	74:II	40
74:6	42		
74:7	39	74:III	40
74:8	40		
74:9	41	74:IV	36
74:10	41		
74:11	36		
74:12	31		

It should be noted that DDNMWT is forecast as a 15 year average (1958 to 1972) of the historical values of DDNMWT. The forecast for PYNMNSHH is derived from a macroeconomic model (from the Control 10/24 simulation of the Data Resources, Inc. eight quarter model). The values of these variables over the forecast period are given below:

	74:1	74:2	74:3	74:4	74:5	74:6	74:7	74:8	74:9	74:10	74:11	74:12
DDNMWT (15 Yr. Nat'l Avg.)	1177.7	1004.1	849.5	475	220.3	44.9	9.9	18.6	102.6	347.7	667.3	1042.3
PYNMNSHH (Mils. of Current \$)	\$88,371	\$88,525	\$89,800	\$90,701	\$91,469	\$92,850	\$93,007	\$93,359	\$95,217	\$97,233	\$98,148	\$98,933
TIME	325	326	327	328	329	330	331	332	333	334	335	336

NOTE: Estimation Period: 66:2 to 73:6

C. Demand Forecast for Distillate Oil

The forecasts of the monthly (quarterly) demand for distillate fuel are based on the following equation:

$$\begin{aligned} \text{DMD291DFNS} = & 12.294 + .00036228 * \text{PYNMNSHH} \\ & (6.93173) (10.1312) \\ & + 0.0000000033 * \text{BNMINTERP} * \text{DDNMWT} \\ & (12.6486) \\ & + .30357 * \text{DMD291DFNS} (-12) \\ & (5.52326) \end{aligned}$$

$\bar{R}^2 = .9739$; $DW = 1.8901$; $SE = 3.64352$; where DMD291DFNS $\equiv$ domestic total demand for distillate fuel oil, millions of barrels per month, not seasonally adjusted; PYNMNSHH $\equiv$ monthly total personal income, millions of current dollars, not seasonally adjusted; DDNMWT $\equiv$ national monthly degree days; BNMINTERP $\equiv$ number of burner tips in use at end of month.

To convert the forecast for DMD291DFNS to thousands of barrels per day, the forecast values are multiplied by 1000 and divided by the number of days in the given month.

To convert from monthly values to quarterly values for total distillate fuel demand, the three monthly values in each quarter are averaged.

Monthly Demand, Distillate (Thousands of Barrels/Day)							Quarterly Demand, Distillate (Thousands of Barrels/Day)	
	Base Model	Exports	Estimated Gas Impact*	Military	Seasonal Peaking Adjustment**	Total		
74:1	4,201	6	40	60	104	4,411		
74:2	4,308	6	40	60	107	4,521		
74:3	3,551	6	40	60	89	3,746	74:I	4,226
74:4	2,941	6	0	60	-107	2,900		
74:5	2,557	6	0	60	-94	2,529	74:II	2,573
74:6	2,324	6	0	60	-99	2,291		
74:7	2,203	2	0	60	0	2,265	74:III	2,305
74:8	2,136	2	0	60	0	2,198		
74:9	2,390	2	0	60	0	2,452	74:IV	3,611
74:10	2,817	4	40	60	0	2,921		
74:11	3,538	4	40	60	0	3,642		
74:12	4,165	4	40	60	0	4,269		

*These estimates include 40,000 bbl/day of demand due to natural gas curtailments. Estimates indicate that the gas curtailment impact may run as high as 300,000 bbl/day, approximately 100,000 bbl/day of which is not accounted for by the initial forecast. Accordingly, 40,000 bbl/day has been added to the demand for distillate fuel oil and 60,000 bbl/day to the demand for residual fuel oil.

**These adjustments were made, based on the opinion of the analysts, to compensate for consistent underprediction in the first quarter and overprediction in the second quarter.

It should be noted that DDNMWT is forecast as a 15 year average (1958 to 1972) of the historical values of DDNMWT. BNMINTERP is estimated as a function of itself lagged one period and subsequently these estimates are used in forecasting the series over the 74:1 to 74:12 interval. The forecast for PYNMNSHH is derived from a macro-economic model (from the Control 10/24 simulation of the Data Resources, Inc. eight quarter model). The values of these variables, over the forecast period, are given below:

	74:1	74:2	74:3	74:4	74:5	74:6	74:7	74:8	74:9	74:10	74:11	74:12
DDNMWT (15 Yr. Nat'l Avg.)	1,177.7	1,004.1	849.5	475	220.3	44.9	9.9	18.6	102.6	347.7	.667.3	1,042.3
BNMINTERP (Thou. of Units)	12,107.96	12,129.83	12,151.72	12,173.64	12,195.59	12,217.58	12,239.61	12,261.69	12,283.81	12,306.00	12,328.24	12,350.54
PYNMNSHH (Mils. of Current \$)	\$88,371	\$88,525	\$89,800	\$90,701	\$91,469	\$92,850	\$93,007	\$93,359	\$95,217	\$97,233	\$98,148	\$98,933

NOTE: Estimation Period: 61:2 to 71:12

D. Demand Forecast for Residual Oil

The forecasts of the monthly (quarterly) domestic demand for residual fuel oil are based on the following equation:

$$\begin{aligned}
 \text{DMD291RFNS} = & 46.553 - .0011030 * \text{PYNMNSHH} \\
 & (5.20719) \quad (-2.99734) \\
 & + .020325 * \text{DDNMWT} + .0068356 * \text{DDNMWT} * \text{JFRB491RES} \\
 & (7.38340) \quad (3.01072) \\
 & + .00095742 * \text{PYNMNSHH} * \text{JFRB491IND} \\
 & (4.92319) \\
 & + .24170 * \text{SEASONM05} + 4.0976 * \text{SEASONM06} \\
 & (.171626) \quad (2.59862) \\
 & + 4.8586 * \text{SEASONM07} + 4.9215 * \text{SEASONM08} \\
 & (3.01799) \quad (3.02434) \\
 & + 1.8832 * \text{SEASONM09} \\
 & (1.21763)
 \end{aligned}$$

$R^2 = .9401$; $DW = 2.0301$; $SE = 3.88620$; where DMD291RFNS $\equiv$ domestic total demand for residual fuel oil, millions of barrels per month, not seasonally adjusted; PYNMNSHH $\equiv$ monthly total personal income, millions of current dollars, not seasonally adjusted; DDNMWT $\equiv$ national monthly degree days; JFRB491RES $\equiv$ FRB index of electric power production for residential use; JFRB491IND $\equiv$ FRB index of electric power production for industrial use; SEASONM05, SEASONM06, SEASONM07, SEASONM08, and SEASONM09 are seasonal dummy variables for May, June, July, August, and September respectively.

To convert the forecast for DMD291RFNS to thousands of barrels per day, the forecast values are multiplied by 1000 and divided by the number of days in the given month.

To convert from monthly values to quarterly values for residual fuel oil demand, the three monthly values in each quarter are averaged.

Monthly Demand, Residual (Thousands of Barrels/Day)							Quarterly Demand, Residual (Thousands of Barrels/Day)	
	Base Model	Exports	Estimated* Gas Impact	Military	Adjustment **	Total		
74:1	3,475	31	60	36	-150	3,452		
74:2	3,786	31	60	36	-159	3,754		
74:3	3,298	31	60	36	-138	3,287	74:I	3,498
74:4	3,001	29	0	36	0	3,066		
74:5	2,648	29	0	36	0	2,713	74:II	2,855
74:6	2,723	29	0	36	0	2,788		
74:7	2,621	34	0	36	0	2,691	74:III	2,751
74:8	2,609	34	0	36	0	2,679		
74:9	2,811	34	0	36	0	2,881	74:IV	3,350
74:10	2,955	37	60	36	-132	2,956		
74:11	3,452	37	60	36	-153	3,432		
74:12	3,694	37	60	36	-165	3,662		

*These estimates include 60,000 bbl/day of demand due to natural gas curtailments. Estimates indicate that the gas curtailment impact may run as high as 300,000 bbl/day, approximately 100,000 bbl/day of which is not accounted for by the initial forecast. Accordingly, 60,000 bbl/day has been added to the demand for residual fuel and 40,000 bbl/day to the demand for distillate fuel oil.

**These adjustments were made, based on the opinion of the analysts, to compensate for consistent over prediction in the first quarter and fourth quarter.

It should be noted that DDNMWT is forecast as a 15 year average (1958 to 1972) of the historical values for DDNMWT. The forecast for PYNMNSHH is derived from a macroeconomic model (from the Control 10/24 simulation of the Data Resources, Inc. eight quarter model). JFRB491RES and JFRB491IND are forecast by a separate set of equations. The value of these variables, over the forecast period, are given below:

	74:1	74:2	74:3	74:4	74:5	74:6	74:7	74:8	74:9	74:10	74:11	74:12
DDNMWT (15 Yr. Nat'l Avg.)	1,177.7	1,004.1	849.5	475	220.3	44.9	9.9	18.6	102.6	347.7	667.3	1,042.3
JFRB491RES	1.815	1.830	1.850	1.852	1.871	1.883	1.941	1.923	1.931	1.959	1.962	1.971
JFRB491IND	1.420	1.465	1.474	1.472	1.472	1.485	1.484	1.474	1.508	1.510	1.519	1.498
PYNMNSHH (Mils. of Current \$)	\$88,371	\$88,525	\$89,800	\$90,701	\$91,469	\$92,850	\$93,007	\$93,359	\$95,217	\$97,233	\$98,148	\$98,933

NOTE: Estimation Period: 61:1 to 73:7

E. Demand Forecast for Jet Fuel - Kerosine Type

The forecasts for the monthly (quarterly) domestic demand for jet fuel - kerosine type are based on the the following equation:

$$\begin{aligned} \text{DMD291JETKRS} &= -1.25081 \\ &\quad (-1.31605) \\ &\quad + .0458812 * \text{QE\&F451DNS} \\ &\quad \quad (4.87912) \\ &\quad + .112701 * \text{QMLS451DNS} \\ &\quad \quad (6.10127) \end{aligned}$$

$R^2 = .8731$; DW = 1.3311; SF = 1.60008; where DMD291JETKRS $\equiv$ domestic total demand for kerosine type jet fuel, millions of barrels per month, not seasonally adjusted; QE&F451DNS $\equiv$ express and freight ton-miles flown by scheduled domestic trunk lines, not seasonally adjusted; QMLS451DNS $\equiv$ revenue-miles flown by scheduled domestic trunk lines, not seasonally adjusted.

To convert the forecast for DMD291JETKRS to thousands of barrels per day, the forecast values are multiplied by 1000 and divided by the number of days in the given month.

To convert from monthly values to quarterly values for kerosine type jet fuel demand, the three monthly values in each quarter are averaged.

Monthly Demand, Jet-Kero (Thousands of Barrels/Day)					Quarterly Demand, Jet-Kero (Thousands of Barrels/Day)	
	Base Model	Exports	Military	Total		
74:1	814.4	1	26	841.4		
74:2	858.1	1	26	885.1		
74:3	849.2	1	26	876.2	74:I	867.6
74:4	857.6	4	26	887.6		
74:5	865.0	4	26	895.0	74:II	901.9
74:6	893.1	4	26	923.1		
74:7	844.6	0	26	870.6	74:III	896.5
74:8	873.0	0	26	899.0		
74:9	893.9	0	26	920.9	74:IV	916.8
74:10	891.1	0	26	917.1		
74:11	897.9	0	26	924.9		
74:12	883.5	0	26	909.5		

QE&F451DNS and QMLS451DNS are forecast by a separate set of equations. The values of these variables over the forecast period are given below:

	74:1	74:2	74:3	74:4	74:5	74:6	74:7	74:8	74:9	74:10	74:11	74:12
QE&F451DNS (Mils. of Miles)	187.3	184.7	210.1	201.0	217.3	215.9	199.4	214.4	216.3	221.8	221.1	219.6
QMLS451DNS (Mils. of Miles)	158.9	149.1	159.1	157.5	160.6	161.0	162.2	164.0	161.0	165.9	160.1	164.7

NOTE: Estimation Period 66:1 to 73:6

F. Demand Forecast for Jet Fuel - Naphtha Type

The forecasts of the monthly (quarterly) domestic demand for jet fuel - naphtha type are based on the following equation:

$$\text{DMD291JETNPNS} = (\text{DMD291JETNPNS} (-12) * (1 + .05))$$

where DMD291JETNPNS $\equiv$ domestic monthly total demand for jet fuel - naphtha type . It was assumed to increase by five percent over last year, month by month.

To convert the forecast for DMD291JETNPNS to thousands of barrels per day, the forecast values are multiplied by 1000 and divided by the number of days in the given month.

To convert from monthly values to quarterly values for naphtha type jet fuel demand, the three monthly values in each quarter are averaged.

Monthly Demand, Jet-Naphtha (Thousands of Barrels/Day)					Quarterly Demand, Jet-Naphtha (Thousands of Barrels/Day)	
	Base Model	Exports	Military	Total		
74:1	206	6	156	368		
74:2	199	6	156	361		
74:3	199	6	156	361	74:I	363
74:4	260	1	156	417		
74:5	231	1	156	388	74:II	399
74:6	235	1	156	392		
74:7	208	2	156	366	74:III	395
74:8	243	2	156	401		
74:9	260	2	156	418	74:IV	427
74:10	282	2	156	440		
74:11	288	2	156	446		
74:12	235	2	156	393		

G. Demand Forecast for Petrochemical Feedstocks

The forecasts of the monthly (quarterly) domestic demand for petrochemical feedstock are based on the following equation:

$$\begin{aligned} \text{DMD291PETRONS} = & .54995 + .00009518 * \text{PYNMNSHH} \\ & (1.66048) (7.38349) \\ & + .22330 * \text{DMD291PETRONS} (-12) \\ & (2.48313) \end{aligned}$$

$R^2 = .8801$; $DW = 1.7960$; $SE = .523409$; where DMD291PETRONS $\equiv$ domestic total demand for petrochemical feedstocks, millions of barrels per month, not seasonally adjusted; PYNMNSHH $\equiv$ monthly total personal income, millions of current dollars, not seasonally adjusted.

To convert the forecast of DMD291PETRONS to thousands of barrels per day, the forecast values are multiplied by 1000 and divided by the number of days in the given month.

To convert from monthly values to quarterly values for petrochemical feedstocks demand, the three monthly values in each quarter were averaged.

Monthly Demand, Petrochemical (Thousands of Barrels/Day)					Quarterly Demand, Petrochemical (Thousands of Barrels/Day)	
	Base Model	Exports	Smoothing Error*	Total		
74:1	370	11	0	381		
74:2	399	11	-20	390		
74:3	371	11	9	391	74:I	387
74:4	390	13	-11	392		
74:5	373	13	7	393	74:II	394
74:6	392	13	-9	396		
74:7	382	8	16	406	74:III	406
74:8	385	8	10	403		
74:9	404	8	-4	408	74:IV	410
74:10	401	15	-4	412		
74:11	415	15	-20	410		
74:12	407	15	-13	409		

*No rationale could be provided for the monthly variations. These are presumed to be spurious effects of the poor equation.

It should be noted that the forecast for PYNMNSHH is derived from a macroeconomic model (from the Control 10/24 simulation of the Data Resources, Inc. eight quarter model). Its values, over the forecast period, are given below:

	74:1	74:2	73:3	74:4	74:5	74:6	74:7	74:8	74:9	74:10	74:11	74:12
PYNMNSHH (Mlls. of Current \$)	\$88,371	\$88,525	\$89,800	\$90,701	\$91,469	\$92,850	\$93,007	\$93,359	\$95,217	\$97,233	\$98,148	\$98,933

NOTE: Estimation Period: 66:2 to 73:7

H. Demand Forecast for Liquefied Gases

The forecasts of the monthly (quarterly) domestic demand for liquefied gases are based on the following equation:

$$\begin{aligned} \text{DMD291LIQGASNS} = & -1.0417 + .0060598 * \text{DDNMWT} \\ & (-0.300991) \quad (4.11148) \\ & + 7.1578 * \text{JFRB28} + .68081 * \text{DMD291LIQGASNS} (-12) \\ & (2.52202) \quad (7.61227) \\ & - (\text{RHOLG}^{K2}) * (\text{LGACT} - \text{LGSTAR}) \\ & (5.05396) \end{aligned}$$

$\bar{R}^2 = .9254$; $\text{DW} = 2.0077$; $\text{SE} = 2.0528$; $\text{RHOLG} = .54556$; where DMD291LIQGASNS = domestic total demand for liquefied gases, millions of barrels per month, not seasonally adjusted; DDNMWT = national monthly degree days; JFRB28 = FRB production index of chemicals and products; $\text{DMD291LIQGASNS} (-12)$ = domestic total demand for liquefied gases, lagged 12 months; LGACT = actual domestic monthly demand for liquefied gases in September 197; LGSTAR = the forecast from the above equation omitting $(\text{RHOLG}^{K2}) * (\text{LGACT} - \text{LGSTAR})$ for September 1973; $K2 = 4, 5, \dots, 15$ for January through December 1974 respectively.

To convert the forecast values for DMD291LIQGASNS to thousands of barrels per day, the forecast values are multiplied by 1000 and divided by the number of days in the given month.

To convert from monthly to quarterly values for total liquefied gases demand, the three monthly values in each quarter are averaged.

Monthly Demand, Liquefied Gases (Thousands of Barrels/Day)				Quarterly Demand, Liquefied Gases (Thousands of Barrels/Day)	
	Base Model	Exports	Total		
74:1	1,703	35	1,738		
74:2	1,631	35	1,666		
74:3	1,229	35	1,264	74:I	1,556
74:4	1,103	25	1,128		
74:5	1,025	25	1,050	74:II	1,041
74:6	920	25	945		
74:7	882	31	913	74:III	1,018
74:8	1,015	31	1,046		
74:9	1,065	31	1,096	74:IV	1,508
74:10	1,246	37	1,283		
74:11	1,495	37	1,532		
74:12	1,672	37	1,709		

It should be noted that the forecast for JFRB28 is derived from a macroeconomic model (from the Control 10/24 simulation of the Data Resources, Inc. eight quarter model). DDNMWT is forecast as a 15 year average (1958 to 1972) of the historical values of DDNMWT . The values of the variables, over the forecast period, are given below:

	74:1	74:2	74:3	74:4	74:5	74:6	74:7	74:8	74:9	74:10	74:11	74:12
DDNMWT (15 Yr. Nat'l Avg.)	1,177.7	1,004.1	849.5	475	220.3	44.9	9.9	18.6	102.6	347.7	667.3	1,042.3
JFRB28	1.554	1.590	1.595	1.596	1.601	1.606	1.618	1.623	1.628	1.642	1.647	1.652
LGACT-LGSTAR	-.662	-.622	-.622	-.622	-.622	-.622	-.622	-.622	-.622	-.622	-.622	-.622
K2	4	5	6	7	8	9	10	11	12	13	14	15

NOTE: Estimation Period: 66:1 to 73:9 for initial, ordinary least squares regression.
66:2 to 73:9 for autocorrelation-corrected regression.

I. Demand Forecast for Other Products

The forecasts of the monthly (quarterly) domestic demand for other petroleum products are based on the following equation:

$$\begin{aligned}
 \text{DMD2910THERNS} = & 20.696 + .00038762 * \text{PYNMNSHH} \\
 & (10.0344) (15.9209) \\
 & + .0066722 * \text{DDNMWT} - 3.8517 * \text{SEASONM02} \\
 & (5.16042) (-4.64130) \\
 & + 7.0046 * \text{SEASONM05} + 11.779 * \text{SEASONM06} \\
 & (6.09395) (8.84515) \\
 & + 16.232 * \text{SEASONM07} + 18.164 * \text{SEASONM08} \\
 & (11.8552) (12.9766) \\
 & + 14.046 * \text{SEASONM09} + 11.789 * \text{SEASONM10} \\
 & (10.6004) (10.7728) \\
 & + 2.8132 * \text{SEASONM11} \\
 & (3.15003)
 \end{aligned}$$

$R^2 = .9234$; $DW = 1.8990$; $SE = 1.75175$; where DMD2910THERNS $\equiv$ domestic total demand for other petroleum products, millions of barrels per month, not seasonally adjusted; PYNMNSHH $\equiv$ monthly total personal income, millions of current dollars, not seasonally adjusted; DDNMWT $\equiv$ national monthly degree days; SEASONM02, SEASONM05, SEASONM06, SEASONM07, SEASONM08, SEASONM09, SEASONM10, and SEASONM11 are seasonal dummy variables for February, May, June, July, August, September, October, and November respectively.

To convert the forecast values for DMD2910THERNS to thousands of barrels per day, the forecast values are multiplied by 1000 and divided by the number of days in the given month.

To convert from monthly values to quarterly values for other petroleum products demand, the three monthly values in each quarter are averaged.

Monthly Demand, Other Products (Thousands of Barrels/Day)				Quarterly Demand, Other Products (Thousands of Barrels/Day)	
	Base Model	Exports	Total		
74:1	2,026	139	2,165		
74:2	2,066	139	2,205		
74:3	1,973	139	2,112	74:I	2,161
74:4	1,967	159	2,126		
74:5	2,085	159	2,244	74:II	2,274
74:6	2,292	159	2,451		
74:7	2,356	144	2,500	74:III	2,541
74:8	2,425	144	2,569		
74:9	2,411	144	2,555	74:IV	2,367
74:10	2,339	144	2,483		
74:11	2,200	144	2,344		
74:12	2,129	144	2,273		

It should be noted that DDNMWT is forecast as a 15 year average (1958 to 1972) of the historical values of DDNMWT. The forecast for PYNMNSHH is derived from a macroeconomic model (from the Control 10/24 simulation of the Data Resources, Inc. eight quarter model). The values of these variables, over the forecast period, are given below:

	74:1	74:2	74:3	74:4	74:5	74:6	74:7	74:8	74:9	74:10	74:11	74:12
DDNMWT (15 Yr. Nat'l Avg.)	1,177.7	1,004.1	849.5	475	220.3	44.9	9.9	18.6	102.6	347.7	667.3	1,042.3
PYNMNSHH (Mils. of Current \$)	\$86,371	\$88,525	\$89,800	\$90,701	\$91,469	\$92,850	\$93,007	\$93,359	\$95,217	\$97,233	\$98,148	\$98,933

NOTE: Estimation Period: 68:2 to 73:7

A number of the explanatory variables in the forecasting equations were also estimated. The estimating procedures are discussed below.

-- Forecasts for the exogenous variables in the petroleum demand equations:

PYNMNSHH $\equiv$ monthly total personal income, millions of current dollars, not seasonally adjusted.

The twelve monthly values for PYNMNSHH in 1972 were summed and then in turn, each monthly value was computed as a fraction of the year total. These month-to-year total fractions were applied against annualized personal income figures which had been forecast by the DRI Control 10/24 simulation.

BNMINTERP $\equiv$ number of burner tips in use at end of month, thousands of units.

From the original, annual series for number of burner tips, a monthly linear interpolation was performed to obtain monthly values. Using these past monthly values, BNMINTERP was regressed against a constant and itself lagged one period. The resultant parameter estimates were employed in estimating this series over the forecast interval.

JFRB491RES $\equiv$ FRB index of electric power production for residential use.

For the period 1960 to 1970, last month-of-the-year values were obtained for the above FRB index and for another series, JFRB491&G (FRB production index, electrical utilities). JFRB491RES (as an annual construction) was subsequently regressed over the historical interval against a constant, JFRB491&G (as an annual construction), and C58, annual total personal consumption expenditures in 1958 dollars.

For 1971 to 1972, values were computed for JFRB491RES as a fraction of its year end equivalent. For each month in this period of two years, these fractions were averaged.

Annualized values of JFRB491&G and C58 (both forecast by DRI Control 10/24) were used to estimate the JFRB491RES annual construction. The month-to-year end fractional averages mentioned above were then applied against the annualized, predicted JFRB491RES values to obtain monthly estimates for JFRB491RES over the forecast interval.

JFRB491IND $\equiv$ FRB index of electric power production for industrial use.

The same method described in JFRB491RES above was used to predict JFRB491IND. The only difference was that a constant and an annualized GNP58 (GNP in 1958 dollars) were used as regressors in the equation.

QE&F451DNS $\equiv$ express and freight ton-miles flown by scheduled domestic trunk lines, not seasonally adjusted.

QE&F451DNS was estimated as a function of a constant, national income in 1958 dollars, itself lagged 12 months, and eleven seasonal dummies. To forecast with this equation, the components of the variable national income in 1958 dollars were taken from DRI Control 10/24.

QMLS451DNS $\equiv$ revenue-miles flown by scheduled domestic trunk lines, not seasonally adjusted.

QMLS451DNS was estimated in the same fashion as QE&F451DNS except that its equation used personal income in 1958 dollars instead of national income. The constant, the twelve month lag, and the eleven seasonal dummies were used as the other regressors.

JFRB28 $\equiv$ FRB production index of chemicals and products.

Quarterly estimates of JFRB28 were obtained from the DRI Control 10/24 solution and subsequently these quarterly numbers were distributed with respect to a monthly time variable to obtain the monthly forecast estimates of JFRB28.

V. IMPLEMENTING THE MODEL: THE EMBARGO LIFTED

The model is implemented for two scenarios differentiated with respect to the assumptions made about the level of demand. These differences are enumerated below. The lifting of the embargo brings no guarantee of an elimination of petroleum shortages. The formal removal of the embargo must be accompanied by an increase in Arab production if higher import levels are to resume. If Arab production immediately returns to the levels of September 1973 and continues to increase for the future, imports should approximate those depicted in Section III and could be fully felt in the United States within 30 to 90 days.

The evaluation of the adequacy of these higher imports requires the careful analysis of the estimates of the demand for the various petroleum products. The forecasts of past consumption trends, adjusted for weather and other factors, as presented in Section IV, indicate the level of demand that would have occurred without the many changes of the past months. These estimates, when combined with additional military requirements, are referred to as unconstrained demand. Historical consumption data and the demand forecast are presented in Table V-2. Product shortfalls are calculated by comparing the estimates of unconstrained demand to estimates of product availability. For the total of all products shortfalls for unconstrained demand of 4%, 3.1% and 4.1% are projected for the second, third and fourth quarters. The product detail is summarized in Table V-1. It should be noted that in both the unconstrained demand case and the constrained demand case (explained later in this report), the model operates under a drawdown constraint for the nation's inventory of crude oil; this minimum crude inventory level is assumed to be 237 million barrels.

These estimates do not take into account the increases in prices which have occurred since October 1973 or the impact of successful conservation efforts which are likely to continue. Therefore, these first shortfall estimates must be viewed as the conservative statement of what would occur if no allocation actions or conservation programs were implemented. The recent rise in prices will reduce the demand for petroleum products. A second scenario was constructed to account for price increases and other factors which would curtail demand. The quantification of these effects over the short run is complicated by the lack of a history including price changes of the current magnitudes. In addition, price effects reinforce major conservation efforts but the savings are not additive. However, some estimates of price responsiveness have been made, and an indication of the magnitude of short term demand reductions can be obtained by applying these estimates to recent price changes. When combined with the mandatory conservation efforts which are not subsumed by the effect of higher prices, significant demand reductions can be identified. Estimated reductions in demand for each product are summarized in Table V-3. A comparison of constrained demand to estimates of available product show modest and rapidly falling product shortfalls. These shortfalls of 2%, 1%, and 1% are projected for the second, third, and fourth quarters if historic refinery yield patterns are maintained.

TABLE V-1

Shortfall
Selected Scenarios

Product	1974 Quarter	Embargo Lifted			
		Forecast w/ Unconstrained Demand		Forecast w/Price & Conservation Effects*	
		(MB/D)	(%)	(MB/D)	(%)
Motor Gasoline	2nd	84	1%	0	0%
	3rd	161	2	0	0
	4th	360	5	0	0
Distillate	2nd	0	0	0	0
	3rd	0	0	0	0
	4th	0	0	0	0
Residual	2nd	301	10	0	0
	3rd	18	1	0	0
	4th	154	5	0	0
Kerosine Jet	2nd	0	0	0	0
	3rd	0	0	0	0
	4th	0	0	0	0
TOTAL ALL PRODUCTS	2nd	778	4%	299	2%
	3rd	585	3	149	1
	4th	789	4	105	1

*In the aggregate there is a net surplus. The minor product imbalances can be accommodated by slight shifts in refinery operations. These figures differ from estimates published in April 4, 1974 due to updating initial inventory levels.

TABLE V-2

Historical and Forecasted Domestic Demand and Growth Rates
(Millions of Barrels per Day)
(Average of Last Three Quarters of Each Year)

	1970	1971	1972	1973	Projected	
					1974*	1974**
Gasoline - Mils. B/D (% Change)	5.92	6.17 (4%)	6.54 (6%)	6.78 (4%)	7.17 (6%)	6.81 (Nil)
Distillate - Mils. B/D (% Change)	2.21	2.33 (5%)	2.63 (13%)	2.82 (7%)	2.77 (-2%)	2.52 (-11%)
Residual - Mils. B/D (% Change)	1.98	2.14 (8%)	2.41 (13%)	2.66 (10%)	2.91 (10%)	2.66 (Nil)
Kerosine Jet - Mils. B/D (% Change)	.72	.75 (4%)	.79 (5%)	.82 (4%)	.88 (7%)	.84 (2%)
ALL PRODUCTS - Mils. B/D (% Change)	14.23	14.86 (4%)	16.11 (8%)	16.93 (5%)	17.80 (5%)	16.80 (-1%)

* Unconstrained demand inclusive of exports and additional military requirements.

** Constrained demand due to price, conservation and other effects, without inclusion of exports and additional military requirements.

TABLE V-3

Demand Changes^{a/}
(Thousands of Barrels Per Day)

	2nd Quarter 1974	3rd Quarter 1974	4th Quarter 1974
Gasoline ^{b/}	-370	-380	-390
Distillate ^{c/}	-170	-170	-560
Residual ^{d/}	-290	-290	-410
Kerosine Jet ^{e/}	-70	-70	-70
Liquefied Gases ^{f/}	-10	-4	0
Remaining Products ^{g/}	-230	-220	-200
ALL PRODUCT TOTAL ^{h/}	<u>-1,140</u>	<u>-1,134</u>	<u>-1,630</u>

a/ Military demand due to the embargo has been netted out of the demand for each product in each quarter. In addition, a small adjustment was uniformly made to each product demand to account for changes in the overall level of economic activity.

b/ Estimates of price elasticity by Verleger and Sheehan in "A Study of the Quarterly Demand for Gasoline and Impacts of Alternative Gasoline Taxes", Data Resources, Inc., December 1973, vary from -.12 to -.16. This is consistent with the implied elasticity of -.16 in the Technical Report 74-1 of the Federal Energy Office. Elasticities rise over time. A representative time path for these elasticities is assumed to be -.15, -.18, and -.21 for the second through fourth quarters respectively. Prices are now assumed to be 30% higher compared with pre-embargo prices.

c/ Conservation during winter months. The price effects reflect elasticities of -.09 and -.12 for the second and third quarters with a price increase of 45% over pre-embargo prices.

TABLE V-3

(Continued)

FOOTNOTES (Continued)

- d/ Oil to coal switch. Wheeling of base load. Heating reductions and daylight saving in winter. Air conditioning in summer. In addition, there have been large reported conservation efforts by industry and very large price increases. The structure of the market is such that these effects are difficult to separate. The reductions shown indicate estimates of the aggregate impact.
- e/ Assumes price elasticities of $-.06$, $-.07$, and $-.08$ and a price increase of 75% over pre-embargo prices.
- f/ Assumes price elasticities of $-.04$, $-.04$, and $-.05$ and a price increase of 20% over pre-embargo prices.
- g/ Assumes a price increase over pre-embargo prices: of 30% for naphtha jet with price elasticities of $-.06$, $-.07$, and $-.08$; of 20% for petrochemical feedstocks with price elasticities of $-.12$, $-.14$, and $-.16$; of 45% for all other products with a price elasticity of $-.05$ for each quarter.
- h/ For distillate and residual more than one influence accounts for the demand reduction. While informed sources agreed on the approximate level of total demand reductions, no consensus could be achieved for each influence separately. As a result, no further breakout has been attempted.

A. Scenario #1

1. Demand

Unconstrained

The demand for petroleum products is that given by the forecasting equations of Section IV including military demand due to the embargo and exports. This level of "demand" is an estimate of that quantity of product which would have passed through the market if pre-embargo historical patterns are forecast into 1974.

2. Supply

Embargo lifted the latter part of March 1974:

- Historical import patterns as given in Section III;
- Maintenance of historical levels of petroleum product inventories;
- Minimum inventory bound for crude oil stocks held constant at 237.0 million barrels.
- Beginning inventories use API March 29 actuals, supplemented by estimates.

3. Explanation of Output Table for Petroleum Model

a. "DEMAND" for a particular product pertains to the forecast demand for that product, given a set of demand assumptions (i.e., unconstrained or constrained demand).

b. "YIELD" for a particular product pertains to the percentage of total crude runs used to produce that product. For example, in April 1974, 45.7% of 11,795.3 (total crude runs) leads to motor gasoline production of 5,390.5.

c. "PRDCTN" for a particular product pertains to the volume of production of that product in a given time period.

d. "BLEND" for a particular product pertains to the natural gas liquids blending transactions for that product. Refer to the section in this report entitled "Blending of NGL" for a more detailed explanation of how these figures were derived.

e. "IMPORT" for a particular product pertains to expected level of imports for that same product. Refer to the "Imports" section of this report for a more detailed explanation.

f. "BG INV" for a particular product pertains to the beginning inventory for that product in a given time period. For the initial period over which the model is run, this inventory figure is in most cases a recent, actual figure coming from API (refer to earlier section "Estimation of Supply"). For the subsequent periods over which the model is run, the beginning inventory figure is calculated according to inventory assumptions specified by the user of the model. In both the unconstrained and constrained demand scenarios, the only inventory assumptions (i.e., restrictions) are that (1) crude inventories cannot fall below 237.0 million barrels and (2) product inventories fluctuate with respect to historical, seasonal patterns.

g. "CHANGE" for a particular product pertains to the forecast inventory change for a given product.

h. "SUPPLY" for a particular product pertains to the disappearance from primary product stocks figure that the model calculates.

i. "SHORT" for a particular product pertains to the forecast shortage of that product.

j. "PCT" for a particular product pertains to the percentage shortage forecast for a given product.

FED SCENARIO BALANCE FOR 8 PRODUCTS
OVER 5 PERIODS

	APR74	MAY74	JUN74	3Q74	4Q74
CRUDE					
PRDCTN	9007.0	8913.0	9139.0	8960.0	8900.0
IMPORT	2495.0	3500.0	3600.0	3800.0	4000.0
BG INV	245.1	237.0	237.0	237.0	254.1
CHANGE	-270.0	0.0	0.0	186.3	265.4
UNFIN					
IMPORT	110.0	110.0	130.0	140.0	160.0
BG INV	103.3	105.9	107.4	108.8	102.7
CHANGE	86.7	48.4	46.7	-66.3	-55.4

RUNS	11795.3	12474.6	12822.3	12780.0	12850.0
NGL	1907.0	1888.0	1938.0	1918.0	1940.0

	APR74	MAY74	JUN74	3Q74	4Q74
MOGAS					
DEMAND	6923.2	7110.2	7366.7	7275.9	7155.7
YIELD	45.70	46.50	46.60	47.40	45.90
PRDCTN	5390.5	5800.7	5975.2	6057.7	5898.2
BLEND	835.3	826.9	848.8	840.1	849.7
IMPORT	145.0	145.0	180.0	200.0	190.0
BG INV	226.9	210.3	200.5	196.6	195.0
CHANGE	-552.5	-317.0	-130.0	-17.4	142.4
SUPPLY	6923.2	7089.6	7134.1	7115.2	6795.5
SHORT	0.0	20.6	232.6	160.7	360.2
PCT	0.00	0.29	3.16	2.21	5.03

	APR74	MAY74	JUN74	3Q74	4Q74
DIST					
DEMAND	2900.0	2528.6	2290.6	2305.0	3610.7
YIELD	22.00	21.80	22.00	21.40	22.30
PRDCTN	2595.0	2719.5	2820.9	2734.9	2865.6
BLEND	0.0	0.0	0.0	0.0	0.0
IMPORT	295.0	295.0	320.0	340.0	340.0
BG INV	132.2	131.9	147.0	172.5	243.3
CHANGE	-10.0	485.9	850.3	769.9	-405.2
SUPPLY	2900.0	2528.6	2290.6	2305.0	3610.7
SHORT	0.0	0.0	0.0	0.0	0.0
PCT	0.00	0.00	0.00	0.00	0.00

	APR74	MAY74	JUN74	3Q74	4Q74
RESID					
DEMAND	3065.7	2712.6	2788.1	2750.5	3350.0
YIELD	6.80	6.40	6.10	5.90	7.10
PRDCTN	802.1	798.4	782.2	754.0	912.4
BLEND	0.0	0.0	0.0	0.0	0.0
IMPORT	1670.0	1670.0	2000.0	2100.0	2200.0
BG INV	44.0	40.2	43.1	45.9	57.1
CHANGE	-126.7	93.5	93.3	121.7	-83.7
SUPPLY	2598.7	2374.8	2688.8	2732.3	3196.0
SHORT	467.0	337.8	99.3	18.2	154.0
PCT	15.23	12.45	3.56	0.66	4.60

KERJET	APR74	MAY74	JUN74	3Q74	4Q74
DEMAND	888.0	895.0	923.0	896.0	917.0
YIELD	6.10	5.90	5.50	5.70	5.70
PRDCTN	719.5	736.0	705.2	728.5	732.5
BLEND	0.0	0.0	0.0	0.0	0.0
IMPORT	160.0	160.0	180.0	180.0	180.0
BG INV	24.4	24.1	24.2	23.0	24.2
CHANGE	-8.5	1.0	-37.8	12.5	-4.5
SUPPLY	888.0	895.0	923.0	896.0	917.0
SHORT	0.0	0.0	0.0	0.0	0.0
PCT	0.00	0.00	0.00	0.00	0.00

NAPJET	APR74	MAY74	JUN74	3Q74	4Q74
DEMAND	417.3	387.9	391.9	395.0	426.6
YIELD	1.50	1.50	1.50	1.50	1.50
PRDCTN	176.9	187.1	192.3	191.7	192.8
BLEND	0.0	0.0	0.0	0.0	0.0
IMPORT	10.0	10.0	10.0	10.0	10.0
BG INV	7.1	5.8	5.5	5.2	6.3
CHANGE	-43.3	-9.7	-10.0	12.0	2.2
SUPPLY	230.3	206.8	212.3	189.7	200.6
SHORT	187.0	181.1	179.6	205.3	226.0
PCT	44.82	46.69	45.82	51.96	52.98

PETCHM	APR74	MAY74	JUN74	3Q74	4Q74
DEMAND	392.0	393.0	395.8	405.7	410.0
YIELD	3.10	2.70	2.70	2.70	2.80
PRDCTN	365.7	336.8	346.2	345.1	359.8
BLEND	0.0	0.0	0.0	0.0	0.0
IMPORT	5.0	5.0	5.0	5.0	5.0
BG INV	3.1	2.8	2.8	2.8	3.0
CHANGE	-10.0	0.0	0.0	2.2	3.3
SUPPLY	380.7	341.8	351.2	347.9	361.5
SHORT	11.3	51.2	44.6	57.8	48.5
PCT	2.89	13.02	11.27	14.25	11.82

LIQGAS	APR74	MAY74	JUN74	3Q74	4Q74
DEMAND	1127.5	1050.4	944.8	1018.3	1507.7
YIELD	3.00	3.10	2.90	2.80	2.70
PRDCTN	353.9	386.7	371.8	357.8	347.0
BLEND	789.5	781.6	802.3	794.1	803.2
IMPORT	120.0	120.0	120.0	120.0	120.0
BG INV	62.5	69.4	80.3	90.8	114.1
CHANGE	230.0	351.6	349.4	253.6	-237.6
SUPPLY	1033.4	936.7	944.8	1018.3	1507.7
SHORT	94.1	113.7	0.0	0.0	0.0
PCT	8.35	10.82	0.00	0.00	0.00

OTHER	APR74	MAY74	JUN74	3Q74	4Q74
DEMAND	2162.8	2284.2	2493.1	2581.3	2402.5
YIELD	15.20	15.40	16.00	16.10	15.60
PRDCTN	1792.9	1921.1	2051.6	2057.6	2004.6
BLEND	282.2	279.4	286.8	283.9	287.1
IMPORT	40.0	40.0	50.0	55.0	75.0
BG INV	84.5	92.1	90.7	88.0	84.1
CHANGE	253.3	-43.7	-91.5	-42.4	-35.8
SUPPLY	1861.8	2284.2	2479.9	2438.8	2402.5
SHORT	301.0	0.0	13.2	142.5	0.0
PCT	13.92	0.00	0.53	5.52	0.00

TOTPRD	APR74	MAY74	JUN74	3Q74	4Q74
DEMAND	17876.5	17361.9	17594.0	17627.7	19780.2
YIELD	103.40	103.30	103.30	103.50	103.60
PRDCTN	12196.4	12886.3	13245.5	13227.3	13312.6
BLEND	1907.0	1908.0	1938.0	1918.0	1940.0
IMPORT	2445.0	2445.0	2865.0	3010.0	3120.0
BG INV	584.7	576.7	594.1	624.8	727.1
CHANGE	-267.6	561.7	1023.7	1112.1	-618.9
SUPPLY	16816.0	16657.6	17024.7	17043.2	18991.5
SHORT	1060.5	704.3	569.3	584.5	788.7
PCT	5.93	4.06	3.24	3.32	3.99

#ET=4:36.0 APPROX CRU= 00061

B. Scenario #21. DemandConstrained

Unconstrained demand is reduced by the amounts given in Table V-3.

2. Supply

Embargo lifted the latter part of March 1974:

- Historical import patterns as given in Section III;
- Maintenance of historical levels of petroleum product inventories;
- Minimum inventory bound for crude oil stocks held constant at 237.0 million barrels;
- Beginning inventories use API March 29 actuals, supplemented by estimates.

FED SCENARIO BALANCE FOR 8 PRODUCTS
OVER 5 PERIODS

CRUDE	APR74	MAY74	JUN74	3Q74	4Q74
PRDCTN	9007.0	8913.0	9139.0	8960.0	8900.0
IMPORT	2495.0	3500.0	3600.0	3800.0	4000.0
BG INV	245.1	237.0	237.0	237.0	254.1
CHANGE	-270.0	0.0	0.0	186.3	265.4
UNFIN					
IMPORT	110.0	110.0	130.0	140.0	160.0
BG INV	103.3	105.9	107.4	108.8	102.7
CHANGE	86.7	48.4	46.7	-66.3	-55.4

RUNS	11795.3	12474.6	12822.3	12780.0	12850.0
NGL	1907.0	1888.0	1938.0	1918.0	1940.0

MOGAS	APR74	MAY74	JUN74	3Q74	4Q74
DEMAND	6560.2	6737.8	6981.5	6897.4	6761.8
YIELD	45.70	46.50	46.60	47.40	45.90
PRDCTN	5390.5	5800.7	5975.2	6057.7	5898.2
BLEND	835.3	826.9	848.8	840.1	849.7
IMPORT	145.0	145.0	180.0	200.0	190.0
BG INV	226.9	221.2	222.3	223.0	241.4
CHANGE	-189.5	34.8	22.6	200.4	176.1
SUPPLY	6560.2	6737.8	6981.5	6897.4	6761.8
SHORT	0.0	0.0	0.0	0.0	0.0
PCT	0.00	0.00	0.00	0.00	0.00

DIST	APR74	MAY74	JUN74	3Q74	4Q74
DEMAND	2710.5	2356.0	2128.9	2133.2	3050.0
YIELD	22.00	21.80	22.00	21.40	22.30
PRDCTN	2595.0	2719.5	2820.9	2734.9	2865.6
BLEND	0.0	0.0	0.0	0.0	0.0
IMPORT	295.0	295.0	320.0	340.0	340.0
BG INV	132.2	137.6	158.0	188.4	275.0
CHANGE	179.5	658.5	1012.0	941.7	155.5
SUPPLY	2710.5	2356.0	2128.9	2133.2	3050.0
SHORT	0.0	0.0	0.0	0.0	0.0
PCT	0.00	0.00	0.00	0.00	0.00

RESID	APR74	MAY74	JUN74	3Q74	4Q74
DEMAND	2779.7	2426.6	2502.1	2464.5	2939.0
YIELD	6.80	6.40	6.10	5.90	7.10
PRDCTN	802.1	798.4	782.2	754.0	912.4
BLEND	0.0	0.0	0.0	0.0	0.0
IMPORT	1670.0	1670.0	2000.0	2100.0	2200.0
BG INV	44.0	40.2	43.1	51.5	87.3
CHANGE	-126.7	93.5	280.1	389.5	173.4
SUPPLY	2598.7	2374.8	2502.1	2464.5	2939.0
SHORT	181.0	51.8	0.0	0.0	0.0
PCT	6.51	2.13	0.00	0.00	0.00

KERJET	APR74	MAY74	JUN74	3Q74	4Q74
DEMAND	818.8	825.5	852.1	828.0	846.6
YIELD	6.10	5.90	5.50	5.70	5.70
PRDCTN	719.5	736.0	705.2	728.5	732.5
BLEND	0.0	0.0	0.0	0.0	0.0
IMPORT	160.0	160.0	180.0	180.0	180.0
BG INV	24.4	26.2	28.4	29.4	36.8
CHANGE	60.7	70.5	33.1	80.5	65.9
SUPPLY	818.8	825.5	852.1	828.0	846.6
SHORT	0.0	0.0	0.0	0.0	0.0
PCT	0.00	0.00	0.00	0.00	0.00

NAPJET	APR74	MAY74	JUN74	3Q74	4Q74
DEMAND	255.3	226.5	230.5	235.0	266.9
YIELD	1.50	1.50	1.50	1.50	1.50
PRDCTN	176.9	187.1	192.3	191.7	192.8
BLEND	0.0	0.0	0.0	0.0	0.0
IMPORT	10.0	10.0	10.0	10.0	10.0
BG INV	7.1	5.8	5.5	5.2	6.3
CHANGE	-43.3	-9.7	-10.0	12.0	2.2
SUPPLY	230.3	206.8	212.3	189.7	200.6
SHORT	25.0	19.7	18.2	45.3	66.3
PCT	9.81	8.70	7.88	19.26	24.85

PETCHM	APR74	MAY74	JUN74	3Q74	4Q74
DEMAND	380.6	381.6	384.3	396.0	401.1
YIELD	3.10	2.70	2.70	2.70	2.80
PRDCTN	365.7	336.8	346.2	345.1	359.8
BLEND	0.0	0.0	0.0	0.0	0.0
IMPORT	5.0	5.0	5.0	5.0	5.0
BG INV	3.1	2.8	2.8	2.8	3.0
CHANGE	-9.9	-0.1	0.0	2.2	3.3
SUPPLY	380.6	341.9	351.2	347.9	361.5
SHORT	0.0	39.7	33.1	48.1	39.6
PCT	0.00	10.41	8.61	12.15	9.86

LIQGAS	APR74	MAY74	JUN74	3Q74	4Q74
DEMAND	1112.7	1036.6	932.4	1014.4	1508.0
YIELD	3.00	3.10	2.90	2.80	2.70
PRDCTN	353.9	386.7	371.8	357.8	347.0
BLEND	789.5	781.6	802.3	794.1	803.2
IMPORT	120.0	120.0	120.0	120.0	120.0
BG INV	62.5	69.4	80.3	91.2	114.8
CHANGE	230.0	351.6	361.8	257.5	-237.9
SUPPLY	1033.4	936.7	932.4	1014.4	1508.0
SHORT	79.3	99.9	0.0	0.0	0.0
PCT	7.13	9.63	0.00	0.00	0.00

OTHER	APR74	MAY74	JUN74	3Q74	4Q74
DEMAND	2112.8	2221.2	2424.3	2534.1	2372.9
YIELD	15.20	15.40	16.00	16.10	15.60
PRDCTN	1792.9	1921.1	2051.6	2057.6	2004.6
BLEND	282.2	279.4	286.8	283.9	287.1
IMPORT	40.0	40.0	50.0	55.0	75.0
BG INV	84.5	92.1	92.7	91.6	84.1
CHANGE	253.3	19.3	-35.9	-81.8	-6.2
SUPPLY	1861.8	2221.2	2424.3	2478.2	2372.9
SHORT	251.0	0.0	0.0	55.9	0.0
PCT	11.88	0.00	0.00	2.21	0.00

TOTPRD	APR74	MAY74	JUN74	3Q74	4Q74
DEMAND	16730.6	16211.8	16436.1	16502.6	18146.3
YIELD	103.40	103.30	103.30	103.50	103.60
PRDCTN	12196.4	12886.3	13245.5	13227.3	13312.6
BLEND	1907.0	1888.0	1938.0	1918.0	1940.0
IMPORT	2445.0	2445.0	2865.0	3010.0	3120.0
BG INV	584.7	595.3	633.1	683.0	848.8
CHANGE	354.1	1218.6	1663.6	1802.0	332.2
SUPPLY	16194.3	16000.7	16384.8	16353.3	18040.4
SHORT	536.3	211.1	51.3	149.3	105.9
PCT	3.21	1.30	0.31	0.90	0.58

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APPENDIX ATHE SIMULATION MODEL

Given the independent supply and demand component estimations, the simple national model computes the required inventory adjustments and product shortages over time^{1/}. The specific data inputs are described in the Appendix. Conceptually, the decision rules can be described in terms of the following variables:

D_t^i	demand for product i in period t
X_t^i	imports of product i in period t
I_t^i	beginning inventory of product i in period t
L_t^i	lower bound for I_{t+1}^i
Y_t^i	yield of product i in period t as a percentage of runs
R_t	crude runs to still and unfinished reruns in period t
U_t	upper bound for R_t
p_t^i	production of product i in period t
NGL_t	production of NGL in period t
B_t^i	blending ratio of product i in period t
S_t^i	shortage of product i in period t

^{1/} There are no stochastic estimates modeled explicitly. The optimizing model used for the regional estimates will be described in a subsequent report.

Using the convention that crude and unfinished oils are product $i = 1$, the shortage calculation proceeds as:

Step 1

Obtain P_t^i , U_t , L_t^i , Y_t^i , B_t^i , I_1^i , D_t^i for all i and t

Step 2

$$R_t = \text{Min} \{U_t, P_t^1 + X_t^1 - I_t^1 + L_t^1\}$$

Step 3

$$I_{t+1}^1 = I_t^1 - R_t + P_t^1 + X_t^1$$

Step 4

$$P_t^i = R_t Y_t^i + \text{NGL}_t^i B_t^i \quad (i = 2, \dots, n)$$

Step 5

$$S_t^i = \text{Max} \{0, D_t^i - P_t^i - X_t^i - I_t^i + L_t^i\} \quad (i = 2, \dots, n)$$

Step 6

$$I_{t+1}^i = I_t^i + P_t^i + X_t^i + S_t^i - D_t^i \quad (i = 2, \dots, n)$$

Steps 2-6 are repeated for each period^{2/}.

^{2/} Copies of the short FORTRAN program implementing this algorithm are available upon request.

APPENDIX B
Input Data Files

The basic input files for the two scenarios in Section V are presented in this Appendix. The format of this input file is described in the following table

Input Data Layout

<u>Identification</u>	<u>Raw Material Inputs (1-210)</u>	<u>Format</u>
A1	N Number of Products, M Number of Periods	(816)
B1	Days in Each Period	(8F6.0)
C1	Name of Period	(8A6)
D1	Goal for Crude Runs	(8F7.3)
E1	Crude Production	(8F7.3)
F1	Crude Imports	(8F7.3)
G1	First Period Beginning Crude Stock	(F7.3)
H1	Lower Bound on Crude Inventory (end)	(8F7.3)
I1	Unfinished Oil Imports	(8F7.3)
J1	First Period Beginning Unfinished Stock	(F7.3)
K1	Unfinished Oil Profile of Stock	(8F7.3)
L1	NGL Production Plus Imports	(8F7.3)

DATA FILEUnconstrained Demand

```

L
100 A1      8      5
110 B1  30.    31.    30.    92.    92.
120 C1 APR74 MAY74 JUN74 3074 4074
130 D1 12662.012532.012845.012780.012850.0
140 E1 9007.0 8913.0 9139.0 8960.0 8900.0
150 F1 2495.0 3500.0 3600.0 3800.0 4000.0
160 G1  245.1
170 H1  257.7  268.6  260.1  260.2  253.0
180 I1  110.0  110.0  130.0  140.0  160.0
190 J1  103.3
200 K1  105.9  107.4  108.8  102.7  97.6
210 K1 1907.0 1888.0 1938.0 1918.0 1940.0
220 A1 MOGAS
230 B1 6923.2 7110.2 7366.7 7275.9 7155.7
240 C1  226.9
250 D1  207.2  200.5  196.6  195.0  208.1
260 E1  0.438  0.438  0.438  0.438  0.438
270 F1  0.457  0.465  0.466  0.474  0.459
280 G1  145.0  145.0  180.0  200.0  190.0
290 A1 DIST
300 B1 2900.0 2528.6 2290.6 2305.0 3610.7
310 C1  132.2
320 D1  100.0  110.0  127.0  194.0  166.0
330 E1  0.000  0.000  0.000  0.000  0.000
340 F1  0.220  0.218  0.220  0.214  0.223
350 G1  295.0  295.0  320.0  340.0  340.0
360 A1 RESID
370 B1 3065.7 2712.6 2788.1 2750.5 3350.0
380 C1   44.0
390 D1   40.2   43.1   45.9   57.1   49.4
400 E1  0.000  0.000  0.000  0.000  0.000
410 F1  0.068  0.064  0.061  0.059  0.071
420 G1 1670.0 1670.0 2000.0 2100.0 2200.0

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DATA FILE
Unconstrained Demand
(Continued)

430	A1KERJET					
440	B1	888.0	895.0	923.0	896.0	917.0
450	C1	24.4				
460	D1	21.8	21.7	21.6	22.9	20.0
470	E1	0.000	0.000	0.000	0.000	0.000
480	F1	0.061	0.059	0.055	0.057	0.057
490	G1	160.0	160.0	180.0	180.0	180.0
500	A1NAPJET					
510	B1	417.3	387.9	391.9	395.0	426.6
520	C1	7.1				
530	D1	5.8	5.5	5.2	6.3	6.5
540	E1	0.000	0.000	0.000	0.000	0.000
550	F1	0.015	0.015	0.015	0.015	0.015
560	G1	10.0	10.0	10.0	10.0	10.0
570	A1PETCHM					
580	B1	392.0	393.0	395.8	405.7	410.0
590	C1	3.1				
600	D1	2.8	2.8	2.8	3.0	3.3
610	E1	0.000	0.000	0.000	0.000	0.000
620	F1	0.031	0.027	0.027	0.027	0.028
630	G1	5.0	5.0	5.0	5.0	5.0
640	A1LIQGAS					
650	B1	1127.5	1050.4	944.8	1018.3	1507.7
660	C1	62.5				
670	D1	69.4	80.3	89.5	109.5	85.0
680	E1	0.414	0.414	0.414	0.414	0.414
690	F1	0.030	0.031	0.029	0.028	0.027
700	G1	120.0	120.0	120.0	120.0	120.0
710	A1 OTHER					
720	B1	2162.8	2284.2	2493.1	2581.3	2402.5
730	C1	84.5				
740	D1	92.1	89.7	88.0	84.1	80.6
750	E1	0.148	0.148	0.148	0.148	0.148
760	F1	0.152	0.154	0.160	0.161	0.156
770	G1	40.0	40.0	50.0	55.0	75.0

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DATA FILEConstrained Demand

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100	A1	8	5			
110	B1	30.	31.	30.	92.	92.
120	C1	APR74	MAY74	JUN74	3Q74	4Q74
130	D1	12662.012532.012845.012780.012850.0				
140	E1	9007.0	8913.0	9139.0	8960.0	8900.0
150	F1	2495.0	3500.0	3600.0	3800.0	4000.0
160	G1	245.1				
170	H1	257.7	268.6	260.1	260.2	253.0
180	I1	110.0	110.0	130.0	140.0	160.0
190	J1	103.3				
200	K1	105.9	107.4	108.8	102.7	97.6
210	K1	1907.0	1888.0	1938.0	1918.0	1940.0
220	A1	MOGAS				
230	B1	6560.2	6737.8	6981.5	6897.4	6761.8
240	C1	226.9				
250	D1	207.2	200.5	196.6	195.0	208.1
260	E1	0.438	0.438	0.438	0.438	0.438
270	F1	0.457	0.465	0.466	0.474	0.459
280	G1	145.0	145.0	180.0	200.0	190.0
290	A1	DIST				
300	B1	2710.5	2356.0	2128.9	2133.2	3050.0
310	C1	132.2				
320	D1	100.0	110.0	127.0	194.0	166.0
330	E1	0.000	0.000	0.000	0.000	0.000
340	F1	0.220	0.218	0.220	0.214	0.223
350	G1	295.0	295.0	320.0	340.0	340.0
360	A1	RESID				
370	B1	2779.7	2426.6	2502.1	2464.5	2939.0
380	C1	44.0				
390	D1	40.2	43.1	45.9	57.1	49.4
400	E1	0.000	0.000	0.000	0.000	0.000
410	F1	0.068	0.064	0.061	0.059	0.071
420	G1	1670.0	1670.0	2000.0	2100.0	2200.0

DATA FILE
Constrained Demand
(Continued)

430	A1KERJET					
440	B1	818.8	825.5	852.1	828.0	846.6
450	C1	24.4				
460	D1	21.8	21.7	21.6	22.9	20.0
470	E1	0.000	0.000	0.000	0.000	0.000
480	F1	0.061	0.059	0.055	0.057	0.057
490	G1	160.0	160.0	180.0	180.0	180.0
500	A1NAPJET					
510	B1	255.3	226.5	230.5	235.0	266.9
520	C1	7.1				
530	D1	5.8	5.5	5.2	6.3	6.5
540	E1	0.000	0.000	0.000	0.000	0.000
550	F1	0.015	0.015	0.015	0.015	0.015
560	G1	10.0	10.0	10.0	10.0	10.0
570	A1PETCHM					
580	B1	380.6	381.6	384.3	396.0	401.1
590	C1	3.1				
600	D1	2.8	2.8	2.8	3.0	3.3
610	E1	0.000	0.000	0.000	0.000	0.000
620	F1	0.031	0.027	0.027	0.027	0.028
630	G1	5.0	5.0	5.0	5.0	5.0
640	A1LIQGAS					
650	B1	1112.7	1036.6	932.4	1014.4	1508.0
660	C1	62.5				
670	D1	69.4	80.3	89.5	109.5	95.0
680	E1	0.414	0.414	0.414	0.414	0.414
690	F1	0.030	0.031	0.029	0.028	0.027
700	G1	120.0	120.0	120.0	120.0	120.0
710	A1 OTHER					
720	B1	2112.8	2221.2	2424.3	2534.1	2372.9
730	C1	84.5				
740	D1	92.1	89.7	88.0	84.1	80.6
750	E1	0.148	0.148	0.148	0.148	0.148
760	F1	0.152	0.154	0.160	0.161	0.156
770	G1	40.0	40.0	50.0	55.0	75.0

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