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1980 Motor Gasoline Supply and Demand

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1980 Motor Gasoline Supply and Demand

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- Imports will provide about 300 MB/D of the total gasoline supply in 1980. January through August 1978 imports averaged 193 MB/D.

- Effects of increased automobile fleet efficiency appear to lead to conservation of between 430,000 and 730,000 barrels per day of motor gasoline below the demand levels which would be estimated from recent trends.

- Retail motor gasoline prices were assumed to remain constant in real terms over the forecast period. This, in fact, has been the case for the last four years.

The conclusions of this analysis can be stated in summary form. For 1980 motor gasoline consumption is projected to range from 7.58 MMB/D to 7.96 MMB/D depending on the level of economic activity and the extent of improvement in the fuel efficiency of the automobile fleet. Recent data indicate that automobiles do not perform as well on the road as they do in the Environmental Protection Agency (EPA) gasoline economy tests. Accordingly, a range of measures of fuel efficiency or what we will generally refer to as conservation, are presented below. Depending on the state of the economy, low levels of conservation assumed here indicate a range of 1980 consumption levels which vary from 7.88 to 7.96 MMB/D. With high conservation the levels are from 7.58 to 7.66 MMB/D.

One recent economic projection ("Recession Ahead: New Forecast Summary" by Otto Eckstein, Data Resources, Inc. published November 3, 1978) based on recent Administration actions taken to strengthen the value of the dollar, is for lower economic growth than even the low level represented by the pessimistic growth case in this analysis. Hence, there is perhaps some justification for concentrating on the pessimistic case. For that case, gasoline consumption is projected to be between 7.58 and 7.88 MMB/D with alternative conservation assumptions.

With 1980 consumption of motor gasoline at these projected levels, the refining industry will have to take certain actions to increase supplies, particularly to offset the effects of the sharp phase-down of octane-increasing lead additives. Under authority of the Clean Air Act, the EPA has ruled that lead must be phased out of use. However, as a result of the specific appeals by refiners the EPA has somewhat relaxed its schedule at different points in time while maintaining the end schedule target of .5 grams of lead per gallon by October 1979. This target level refers to total gasoline sold divided by total lead used. Thus, while the EPA is expected to permit lead to be added to the clear (free of additives) gasoline pool at the rate of about 1.2 grams per gallon through most of 1979, the industry will be required to reduce that level to about 0.5 grams per gallon by October. This action puts pressure on downstream refinery units which make high octane clear pool gasoline. The estimated effect of this phase-down is a reduction of possible gasoline output by about 500 thousand barrels per day in 1980.

The refining industry may increase gasoline supplies by increasing capacity utilization rates of downstream units 2/ to levels that are higher than the normal industry practice, using manganese additives in leaded grades as permitted by the EPA, and somewhat reducing the octane rating of some or all of the gasoline grades they produce.

2/ Such as alkylation, reforming, and cracking which upgrade the octane quality of blending components for gasoline after the initial distillation process.

INTRODUCTION

Three major factors have caused the U.S. refining industry to face complex choices concerning its capability to supply acceptable motor fuels at acceptable prices in the near term: 1) uncertain, but possibly increasing demand for all gasoline, 2) reduction in the levels or elimination of octane additives allowable in gasoline, and 3) considerable shifts from previous trends in the U.S. automobile fleet efficiency and octane requirements. This work was undertaken to help understand the range of uncertainty which these three often offsetting occurrences have on total gasoline consumption and the demands to be placed on octane-enhancing refinery unit operations. The analysis uses two analytical tools available to the EIA: the Short-Term Petroleum Product Demand Forecasting Model (STPPDFM) for projections of motor gasoline demand through 1980 and the Refinery and Petrochemical Modeling System (RPMS) for projections of domestic refineries' motor gasoline supply capability through 1980. In this analysis the STPPDFM is used to estimate future motor gasoline demand based on alternate assumptions about economic growth and automobile fuel efficiencies. Next, the refinery model is used to evaluate the capability of domestic refiners to supply the projected demand levels. While not attempting to specify what steps the refining industry would take to ensure adequate supplies, or in what order, the analysis does describe several important options available to the industry to extend supplies.

DEMAND ASSUMPTIONS AND PROJECTIONS

The evaluation of motor gasoline demand through 1980 presented in this Analysis Memorandum is based on, (1) demand projections derived from the Department of Energy's Short-Term Petroleum Product Demand Forecasting Model (STPPDFM), and (2) conservation impacts due to new vehicle fuel efficiency standards derived from the Light Duty Vehicle Fuel Consumption Model (LDVFCM). This section provides brief descriptions of these two models, major assumptions of the analysis, and major results.

Demands are estimated under the assumptions of, (1) three levels of macroeconomic growth, and (2) two levels of conservation due to new vehicle fuel efficiency standards. This results in a range of demand estimates which cover reasonable limits for future levels of gasoline demand.

Short-Term Petroleum Product Demand Forecasting Model (STPPDFM)

The STPPDFM is an econometric model which estimates demands for eight refined petroleum products quarterly for a three year horizon in each of the five Petroleum Administration for Defense Districts. The model consists of equations for each product which relate the demand for that product to key economic and weather variables shown to influence demand. In the current model version, these relations have been statistically estimated based on historical data for the period 1970 through 1976. As an example, the key variables identified in the gasoline demand equation are:

- U.S. population (a proxy for the number of potential drivers)
- real national income
- product price (regular leaded gasoline at full service outlets)

By using projections of future levels for these variables in the demand equations, the model generates estimates of future petroleum product demands. For this analysis, projections of most future macroeconomic activity were obtained from Data Resources, Inc. (DRI). These include real national income, GNP price deflator, product prices, index of national electric power generation, index of national chemical industry output, and federal goverment purchases for national defense. These variables for the most part are required for the non-gasoline product projections.

DRI's projections for each of these variables are determined as part of their macroeconomic simulations of the United States. These simulations, run monthly for short-term projections and quarterly for long-term projections, are based on alternative assumptions about future economic prospects. The population projection is not influenced by the economic environment.

Economic Assumptions

Projections of the demand for motor gasoline used in this analysis are based upon three macroeconomic scenarios ranging from optimistic to pessimistic for future economic growth. 3/ The principal energy demand factors imbedded in these forecasts are listed in Table 1.

For this analysis the assumption was made that product prices would remain constant in real terms. The assumption that prices will rise only in accordance with the rate of inflation appears within the bounds of recent historical

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3/ DRI's OPTIM0525, CONTROL0524 and PESSIM0524, respectively.

TABLE 1

PRINCIPAL ASSUMPTIONS UNDERLYING THE PETROLEUM PRODUCT DEMAND FORECASTS

	1978	1979	1980
Real GNP: Annual Growth rate (%)			
OPTIM	4.4	4.0	5.0
CONTROL	4.0	3.6	4.8
PESSIM	3.1	2.6	4.8
GNP Deflator (inflation rate in %) a/			
OPTIM	6.2	5.6	6.0
CONTROL	6.6	6.2	6.5
PESSIM	6.9	7.0	7.4
Real National Income (growth rate in %) a/			
OPTIM	5.4	4.0	5.2
CONTROL	5.0	2.7	5.0
PESSIM	3.8	1.5	5.1
Index of Chemical Industry Activity b/			
OPTIM	1.92	2.10	2.30
CONTROL	1.92	2.04	2.23
PESSIM	1.88	1.98	2.17

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a/ Measured from mid-year to mid-year.

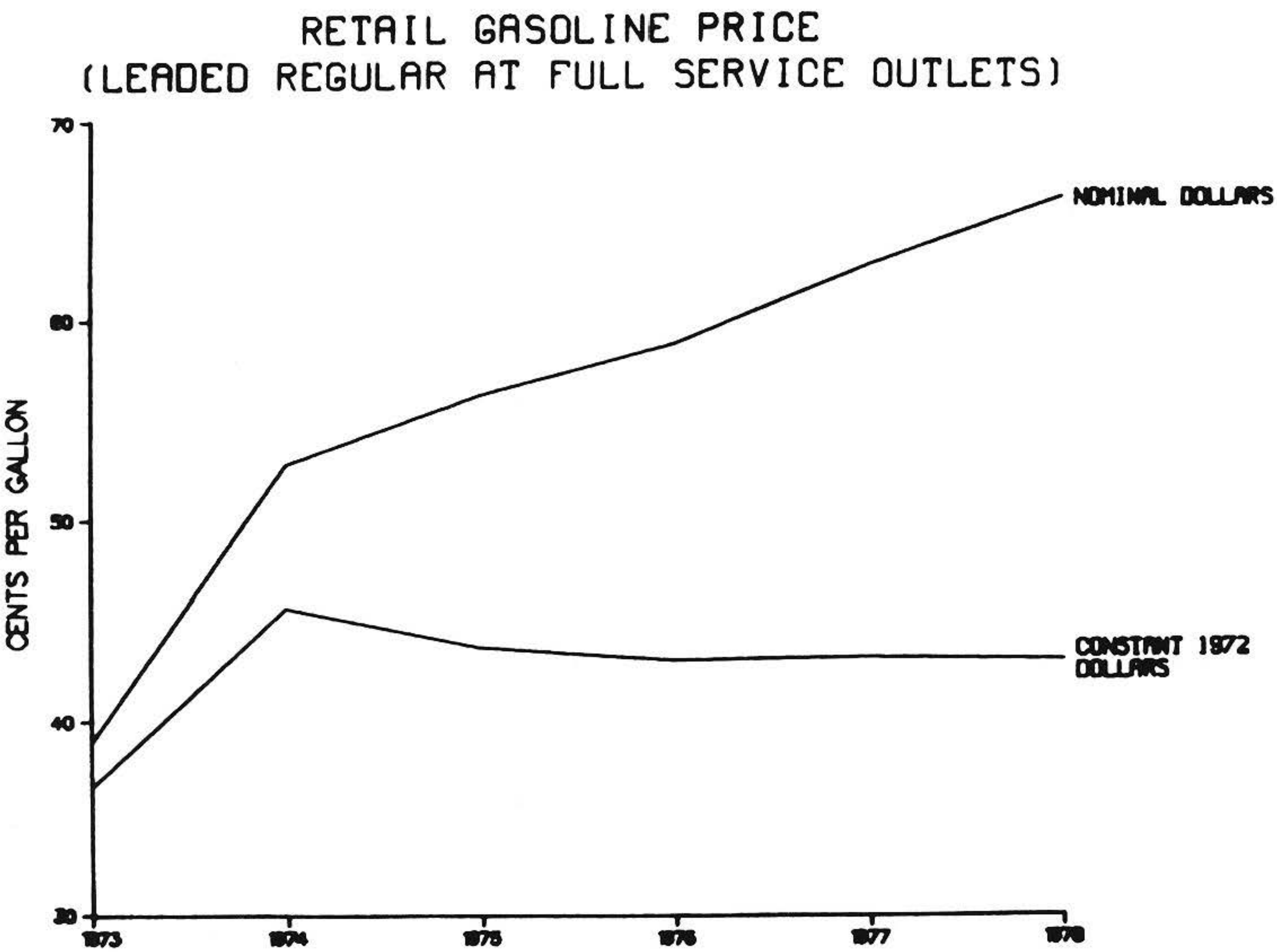
b/ Mid-year value.

observations. For example, Figure 1 shows recent trends for the price of leaded regular gasoline at full service outlets. This shows relatively constant real prices over the last four years. There is a possibility of modest price increases in the price of gasoline over the next few years due to the recent DOE "tilt" proposal which allows refiners to allocate increased production costs to gasoline prices on a greater than pro rata volumetric basis and also allows retailers to increase prices.

Conservation Estimates

The estimates obtained from the STPPDFM do not capture structural changes in demand which were not observed during the period over which the model was estimated. Such a structural change is expected to occur due to the mandated new car efficiency standards set forth in the Energy Policy and Conservation Act. These standards will lead to gradually, but significantly increasing automobile fleet efficiencies that are not embodied in the econometric estimates of the STPPDFM. Over the period of time the STPPDFM was estimated, the automobile fleet efficiency

FIGURE 1



SOURCE: DOE Monthly Energy Review. 1978 point estimated from data for the first three quarters.

	Nominal	Constant (72)
1973	39.0	36.7
1974	52.8	45.7
1975	56.2	43.7
1976	58.7	43.1
1977	62.6	43.2
1978	66.0	43.1

was essentially constant at approximately 13.6 miles per gallon. To correct for this limitation, the demand forecasts produced by the STPPDFM are adjusted downward by estimates of conservation obtained from the Light Duty Vehicle Fuel Consumption Model (LDVFCM). 4/

The LDVFCM is a structural model which derives fuel consumption from past and projected characteristics of the vehicle fleet. These characteristics are: annual new vehicle registrations, scrappage rates, vehicle miles traveled per vintage car year, new vehicle average fuel economies as determined through EPA test procedures, and on-road miles per gallon (mpg) discount factors which account for in-use driving conditions, thereby reducing fuel economy below the EPA test value. Through a series of accounting computations, the fleet vehicle miles traveled, the mpg of the fleet, and the fleet fuel consumption are derived. In addition, estimates of dieselization (the increasing use of diesel fuel in passenger cars and light duty trucks) are also obtained. The LDVFCM estimates the

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4/ For a description of the model see Light Duty Vehicle Fuel Consumption Model, April 28, 1978, Energy and Environmental Analysis, Inc.

consumption of motor gasoline and diesel fuel by passenger cars and light trucks and vans. These vehicles are subject to the standards set forth in the Energy Policy and Conservation Act.

The procedure for adjusting the demand forecasts provided by the STPPDFM is to run the LDVFCM under two scenarios. One scenario simulates the conditions of the STPPDFM where total fleet efficiency is held constant at 13.6 mpg. The other scenario is run under the assumption that new vehicle fuel efficiency standards are met, implying an increase of overall vehicle fleet efficiency over time. The difference in total fuel consumption between these two scenarios is an estimate of the conservation savings due to the new vehicle fuel efficiency standards. These savings are then subtracted from the demand forecasts derived from the STPPDFM. In 1980 these conservation savings amount to between 430,000 and 730,000 barrels per day, depending on the on-the-road efficiency assumptions described in the next section. Increased diesel fuel use between the two runs of the LDVFCM are also subtracted from the gasoline requirements but are added to the distillate estimates from the STPPDFM. In 1980, this increased diesel use is relatively insignificant, on the order of 35,000 barrels per day.

EPA Test Vs. On-Road New Vehicle Fuel Economy

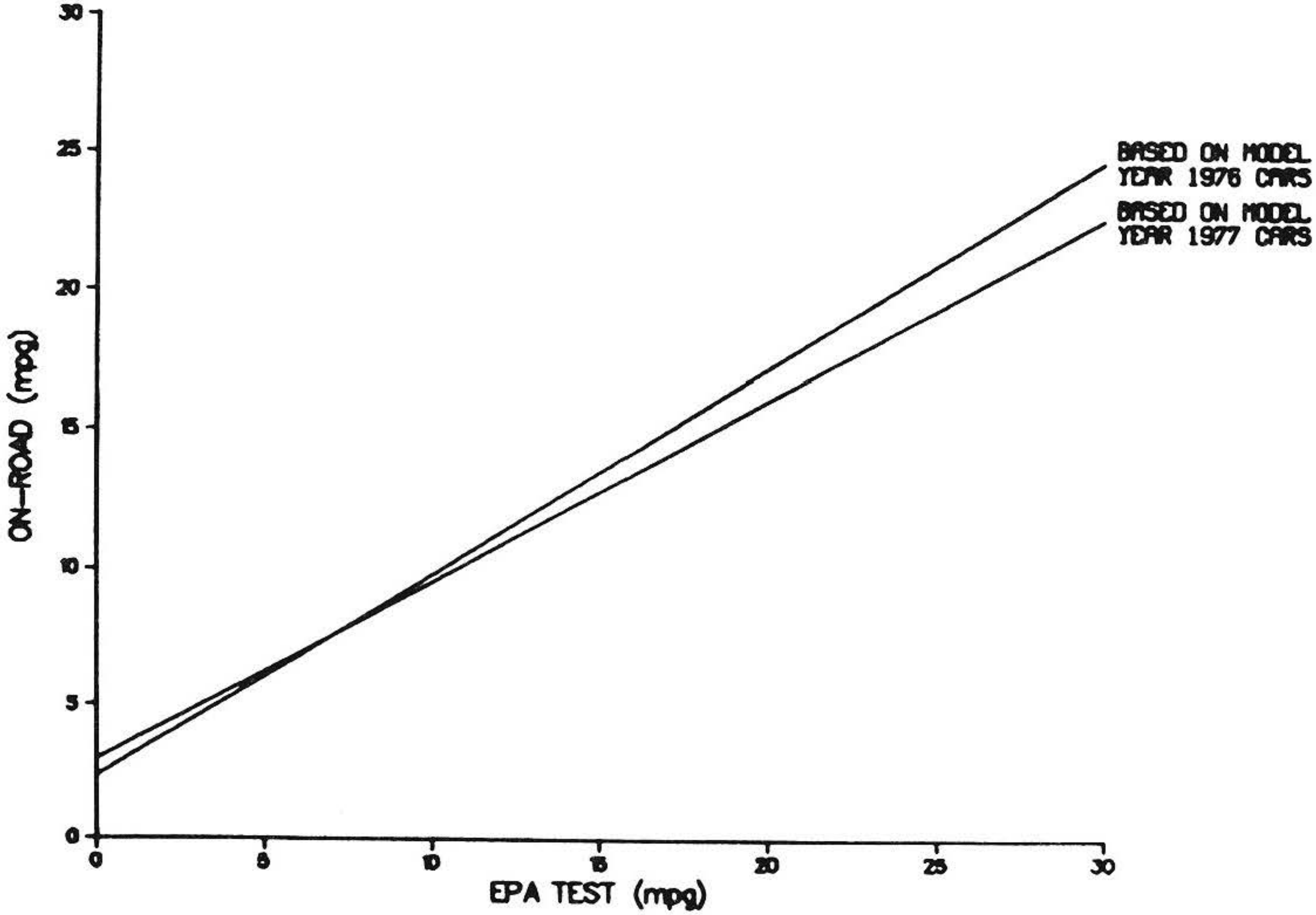
The existing and future relationship between EPA test and on-road fuel economy of new vehicles is a factor that introduces a significant amount of uncertainty into the estimation of energy consumption in the transportation sector. The LDVFCM calculates energy consumption under the assumption that there will be a degradation between fuel economy tests on new vehicles and actual on-road experience. Based on the evidence to date, there is a significant difference between on-road performance and the EPA test results. 5/ However, there is uncertainty as to the precise amount of this degradation. For this analysis, degradation relationships determined from experience on selected samples of model year 1976 and 1977 automobiles were used. Figure 2 shows a graph of these two relationships. As an example, 1976 vehicles with EPA test results of 25.0 mpg are estimated to perform at 20.8 mpg and 1977 vehicles at 19.2 mpg. The test results are based on records from large automobile fleets. 6/

5/ See McNutt, Barry et.al., A Comparison of Fuel Economy Results from EPA Tests and Actual In-Use Experience, 1974-1977 Model Year Cars, February, 1978.

6/ The 1976 relationship is based on observations of 138 different car model/engine type combinations while that for the 1977 automobiles covered 58 combinations. The estimated relationships are:
Model Year 1976: On-road mpg = 0.74 x EPA Test mpg + 2.32
Model Year 1977: On-road mpg = 0.65 x EPA Test mpg + 2.98.

FIGURE 2

DEGRADATION RELATIONSHIPS BETWEEN EPA TEST
AND ON-ROAD FUEL ECONOMY



If it is assumed that total vehicle miles are insensitive to the severity of this degradation, then significant variations in vehicle fuel consumption will occur when different degradation relationships are used in the LDVFCM.

Demand Projections

Table 2 shows the range of motor gasoline demand forecasts for the three macroeconomic and two conservation scenarios assuming constant real prices. The first and last values in each column represent the extreme cases in each year. Optimistic macroeconomic assumptions combined with low conservation estimates produce the high end of the range, while pessimistic macroeconomic assumptions combined with high conservation savings produce the low end of the range. Figure 3 shows a graph of these demand projections, as well as the historical data for the period 1972 to 1978.

Table 3 presents the conservation and dieselization estimates derived from the LDVFCM which were used to adjust the demand forecasts produced by the STPPDFM.

TABLE 2

MOTOR GASOLINE DEMAND ESTIMATES
1978-1980
(MB/D)

Macroeconomic Forecast/Level of Conservation:	Actual	Estimated		
	1977 a/	1978 b/	1979	1980
OPTIM				
Low Conservation	7176	7395	7769	7962
High Conservation	7176	7395	7509	7662
CONTROL				
Low Conservation	7176	7395	7740	7928
High Conservation	7176	7395	7480	7628
PESSIM				
Low Conservation	7176	7395	7697	7884
High Conservation	7176	7395	7437	7584

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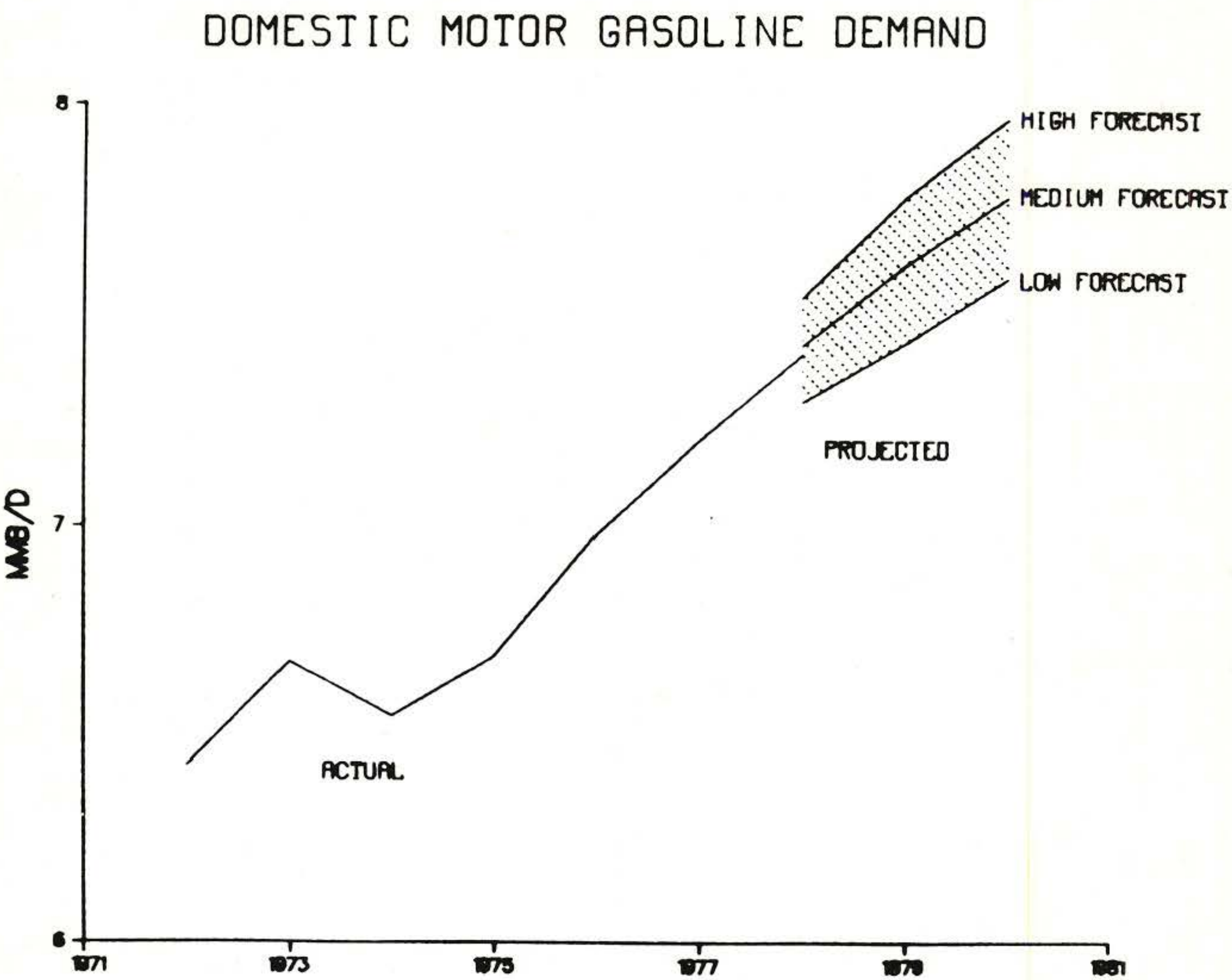
a/ Source: Monthly Energy Review, EIA.

b/ Based on 10 months preliminary data from EIA. See footnote to Figure 3 for a further explanation.

FIGURE 3



* Actual data were taken from the DOE Monthly Energy Review. The 1978 point was estimated from data for the first three quarters by proportionment to comparable 1977 data as follows:

MB/D	1977	1978
3 Quarters	7,157	7,375
Full Year	7,176	7,395 (est.)
Ratio	1.003	(same)

TABLE 3

RANGE OF MOTOR GASOLINE CONSERVATION ESTIMATES
1979-1980
(MB/D)

	1979	1980
Current Estimates a/		
Low Conservation b/	250	430
High Conservation c/	510	730
Increased Distillate Consumption Due to Dieselization	15	35

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a/ These estimates differ from those used in the EIA Analysis Memorandum (AM/ES/78-19) "Motor Gasoline Supply and Demand through 1980," August 1978. The earlier conservation estimates correspond to the high conservation case, but were based on higher automobile sales and projected higher average new car EPA-test mileage.

b/ Based on the relationship between EPA-test and on-road fuel economy developed from the experience of 1977 model year automobiles.

c/ Based on the relationship between EPA-test and on-road fuel economy developed from the experience of 1976 model year automobiles.

SUPPLY ASSUMPTIONS

The supply analysis evaluates the ability of the domestic refining industry to meet the projected demands for leaded and unleaded gasoline in 1980. In this analysis, a composite U.S. refinery model was used to estimate the potential supply of motor gasoline, given the constraints of projected demands, capacities, product qualities and EPA lead level restrictions.

This methodology develops estimates of refining capacity requirements for supplying the forecast demand for motor gasoline given different assumptions on refinery operating conditions. These estimates of capacity requirements are then compared with projections of available refining capacity. Any potential capacity shortfalls are subsequently identified and used to estimate potential gasoline supply under each set of assumptions.

This section first provides a brief description of the gasoline production processes. Next, gasoline production as impacted by the restrictions proposed by the Environmental Protection Agency on the use of octane boosting additives is discussed. And finally, a brief description of the model which was used to analyze domestic refining activities, and specific assumptions made are presented.

Gasoline supply estimates from alternate refinery simulations are presented in the following section on the 1980 supply and demand balance. That section also presents a discussion of the potential supply enhancements resulting from adjustments to refinery capacity utilization rates, use of allowed octane boosting additives, and a certain amount of octane quality reduction. The base case described here is not presented, however, as a "most likely" situation, but rather as a logical departure point for evaluating the potential contribution to gasoline supply of several production strategies which may be pursued by the refining industry.

Refining Capacity Requirements

Gasoline demand can be satisfied by domestic refinery output, imports, and, in the short-run, by inventory drawdowns. This analysis initially assumes a restrictive production environment. Imports are assumed constant at a relatively high but feasible level and inventories are not built up or drawn down on an annual basis.

1. Gasoline Manufacturing Processes - A refinery consists of a number of processes for separating, changing and blending crude oil components. As described below, principal refinery processing operations which yield outputs blended to make gasoline include crude oil distillation, catalytic cracking, hydrocracking, catalytic reforming, alkylation, and isomerization. The available capacity of these and other processing

units 7/, the rates and conditions at which they are operated, and the quality of crude oils processed essentially determine the refinery yield of gasoline.

- Crude Distillation - Components of crude oil are separated based on their boiling points, which can range to well over 1000 degrees Fahrenheit. Light components of crude (which may be blended or further processed to make gasoline and are sometimes referred to as naphthas) have lower boiling points (100-400 degrees). High API gravity crudes generally have a higher percentage of low boiling point components and have a higher gasoline yield potential.

- Catalytic Cracking - This is the primary method for increasing the yield of gasoline from crude. In this process the large molecules of distillate oils (generally 550 to over 700 degrees boiling range) are "cracked" into smaller molecules. The process yields gasoline and naphthas, some of which are ready for final blending.

- Hydrocracking - Again cracking of large molecules is the objective, only in this process, hydrogen must be present. Unlike catalytic cracking, a wide range of feedstocks can be used in this process (from middle distillates to heavy oils) and it does not produce a high yield of low utility, high boiling by-products. The process yields gasoline and naphthas. Hydrocracking is a relatively expensive process in terms of both capital and operating costs and its use is not as widespread as that of catalytic cracking.

7/ Other gasoline producing equipment include cokers and polymerization units.

- Catalytic Reforming - This is the primary method for increasing the octane quality of potential gasoline blend stocks. Naphtha not suitable for finished product (principally low octane components) are chemically changed in order to improve their octane characteristics. The high octane material from this process is called reformate. Important determinants of the reformate yield are the conditions--pressure, temperature, etc., (referred to as the severity of operation)--under which the reaction is carried out. Increasing severity increases the octane number of the reformate, but lowers yield by converting some of the charge stocks to gas.

- Alkylation - The alkylation process combines light, selected by-products of the catalytic cracking process (butylene and propylene) with isobutane to synthesize high octane gasoline blendstocks called alkylates. Like hydrocracking, the alkylation process is relatively expensive compared to other refinery processes for manufacture of high quality gasoline blendstocks.

- Isomerization - In this process, low octane normal butanes, pentanes or hexanes are converted into high octane isomers. Isomerization is a relatively expensive process compared to catalytic reforming, and like alkylation its utility may be limited by feedstock availability.

Finally the many gasoline component streams are blended, either in-line, in the piping network within the refinery or in tank farms neighboring the plant. The objective here is to combine the various blend stocks from the processes mentioned above in the proportion which satisfies all product quality specifications. These include most importantly, research and motor octane number and vapor pressure.

Additional factors affecting the refinery yield of gasoline are the restrictions on octane improvement additives used in the blending phase, such as tetra-ethyl lead (TEL) and MMT (a manganese compound used by the industry to boost gasoline octane ratings).

2. Regulatory Environment Concerning Gasoline Additives - Since 1975 American auto manufacturers have equipped most passenger cars with catalytic converters in order to reduce harmful emissions. Tetra-ethyl lead deactivates the catalyst in the converters, raising the level of harmful emissions. Hence, these automobiles must use unleaded fuel. As the demand for unleaded gasoline increases, the octane requirements for gasoline blending components will also increase (in order to compensate for the loss of incremental octane rating formerly supplied by lead additives).

The octane requirements of gasoline blending components will be further increased by two recent decisions by the EPA. First, the use of MMT for gasoline octane improvement is prohibited in unleaded grades, effective September 1978, again because of the possibility of catalyst deactivation in vehicles equipped with converters. Second, the EPA has established an October 1, 1979, phasedown schedule of 0.5 grams per gallon (g/gal.) as the maximum lead concentration allowed in the U.S. gasoline pool (total lead used divided by total gasoline produced).

This phasedown forces refiners to reduce the average lead level level of their leaded gasoline earlier than would be accomplished by "natural phasedown" (a consequence of the increasing share of unleaded gasoline in the overall gasoline pool because of the replacements of older cars by new cars using lead-free gasoline). Consequently, the clear octane quality of leaded gasoline blending stocks must increase to compensate for this loss of lead. Currently and into early 1979, according to the EPA phasedown schedule, the maximum lead content in gasoline should be .8 g/gal. However, EPA has temporarily waived this requirement for many refiners. Refiners granted waivers account for about 80 percent of U.S. domestic gasoline production capacity. Small refiners are granted additional exemptions from the lead level requirements. Thus, the level of lead in motor gasoline is expected to average 1.2 grams per gallon in 1979 and 0.59 grams per gallon in 1980 unless further waivers are granted.

3. Refinery Model and Assumptions - As indicated in the previous section, the petroleum industry will need to increase its yield of high clear octane gasoline blending components significantly by 1980 in response to increased demand for unleaded fuel and restrictions on additives.

A model of the aggregate U.S. refining industry was used for the analysis. The model was constructed with technical data on refinery operations from the Bonner and Moore Refinery and Petrochemical Modeling System (RPMS). The RPMS model is a comprehensive simulation of refinery operations in which crude distillation, downstream unit operations and product blending are mathematically represented. The model treats the United States as a composite of all refineries, simulating actual operations by selecting a least cost method of converting crude oils to finished petroleum products using existing refinery facilities, or by constructing new capacity.

The RPMS data base consists of individual crude assays, process yield correlations, refinery capacity and configuration data, investment data and operating costs. RPMS investment data represents current Gulf Coast construction costs for each type of refinery processing unit.

The RPMS model was formulated to reflect assumptions concerning future product demand, product imports, refinery unit capacities and operating rates, and use of octane boosting additives. Capacities are set at projected levels for all refinery processing units except catalytic reformers, in which the model allows additional "investment" to meet increased demands for high octane components. As lead is removed from gasoline, octane ratings can be maintained only by upgrading relatively low quality blendstocks by more intensive processing, primarily catalytic reforming.

Specific assumptions made in this analysis include the following:

- Future gasoline demands - High and low demand projections as presented in the first section of this paper. Other product demands were not varied but held at the midrange level as forecast by the STPPDFM in percentage yield terms.
- Gasoline imports - Imports are assumed to be available at an average 300 thousand barrels per day (MB/D), with 60 MB/D being unleaded regular gasoline and 240 MB/D being leaded regular gasoline.
- Capacities of refinery processing units - Capacities for crude distillation and other major gasoline producing units are shown below. The data has been compiled using actual data submitted to the Department of Energy for the 17 largest gasoline refiners and published data for the remaining refiners.

	1980 Capacity Thousand Barrels Per Stream Day
Crude Distillation	18,117
Catalytic Reforming	4,084
Catalytic Cracking	5,232
Hydrocracking	895
Alkylation	936
Isomerization	179

Of the total available catalytic reforming capacity, 309 MB/D in 1978 and 374 MB/D in 1980 were estimated to be dedicated to the production of aromatic petrochemicals.

- Capacity Utilization Rate - Downstream refinery units were initially assumed to be operated at 92 percent capacity utilization. The utilization rates were subsequently varied to 94 percent as a means of increasing gasoline supplies. Crude distillation capacity is specified not to exceed 91 percent.

- Use of lead and MMT - Average lead level in 1980 is evaluated at the EPA October 1979 phasedown level of 0.5 grams per gallon and alternatively at 1.2 grams lead (in the event that the EPA would grant additional waivers). Because of the small refiner exemptions, the effective concentration is 0.59 at the 0.5 grams level. Use of MMT in leaded gasoline only is evaluated as an alternative to increase gasoline supplies.

- Octane boost available from lead and MMT - The current source of data concerning the octane boost available from various MMT manganese concentrations is the Ethyl Corporation, the sole manufacturer of MMT. Estimates from EPA based on Ethyl Corp. data indicated that a manganese concentration of 0.024 g/gal would provide 0.26 RON and 0.26 MON octane increase in the leaded premium and regular grades. 8/

  The lead/octane representation in the RPMS model is also from the Ethyl Corporation. The model fully tracks the nonlinearities associated with gasoline octane blending. Because of changes in the composition of gasoline in the different cases, the assumed pool octane response is automatically recalculated by the model for the new blend. A representative approximation to the lead response curves is presented in the following table:

8/ RON refers to Research Octane Number, a laboratory rating, and MON refers to Motor Octane Number, a rating of actual engine anti-knock performance. (R+M)/2 refers to the average of RON and MON.

Lead Octane Response

Concentration grams lead/gallon	Octane Boost a/ Premium RON	Premium MON	Regular RON	Regular MON
0 (clear)	0	0	0	0
0.5	3.1	6.0	3.5	4.0
1.0	5.2	8.5	6.1	6.1
1.5	6.6	9.9	7.7	7.4
2.0	7.5	11.1	8.7	8.4
3.0	8.9	12.6	10.2	9.7

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a/ See footnote on page 27.

- Market Shares of Gasoline Grades and Octane Specifications - The market shares of the various grades of gasoline assumed in the study are shown below. Imports from abroad were assumed to be 20 percent unleaded regular and 80 percent leaded regular gasoline, so refinery production shares for unleaded grades were adjusted upward accordingly. Gasoline specifications other than octane (vapor pressure, boiling point, volatility, etc.,) were set at current industry averages.

1980 Market Shares of Gasoline

	Base a/ Assumption	Alternate b/ Assumption
Unleaded Regular	50%	34%
Unleaded Premium	Negligible	18%
Leaded Regular	42%	44%
Leaded Premium	8%	4%

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a/ Estimated by EPA, based on Ethyl Corp. data.

b/ This assumption is discussed in the following text.

The RON (Research Octane Number) and MON (Motor Octane Number) quality specification were set as follows:

	Gasoline Octane Specification			
	Base Assumption		Alternate Assumption	
	RON	MON	RON	MON
Unleaded Regular	92.3	84.0	91.5	82.5
Unleaded Premium	--	--	93.4	86.0
Leaded Regular	93.4	86.0	93.4	86.0
Leaded Premium	98.9	91.5	98.9	91.5

The base assumptions on grade split and qualities have been used in earlier analyses and have been estimated by the EPA.

In the alternate assumption, leaded premium sales are assumed to be reduced from 8 percent of the total to 4, with 2 percent going to leaded regular sales and the other 2 percent to unleaded premium. The unleaded premium pump octane quality is assumed to be equal to that of leaded regular and the unleaded regular pump octane is reduced to the EPA minimum of 87 (R+M)/2 from the current quality of about 88.2 (R+M)/2. The unleaded gasoline pool is assumed to be about one-third unleaded premium and two-thirds unleaded regular. This assumption, in effect, can be considered a possible marketing strategy which could reduce overall octane demand.

1980 MOTOR GASOLINE SUPPLY AND DEMAND BALANCE

This section presents estimates of potential gasoline supply which would be available in 1980, given alternate assumptions regarding refinery utilization rates, use of octane boosting additives, and product quality. The analysis, however, assumes the refining industry will take all steps necessary to ensure an adequate supply in 1980. Accordingly, intermediate supply estimates are presented only to facilitate evaluation of the potential impact of the supply enhancing measures considered here. No conclusions should be drawn from non-balancing supply and demand estimates other than as provided in this analysis.

The most significant limitation on gasoline supplies in 1980 will be the ability of domestic refiners to produce sufficient quantities of high octane gasoline to replace octane boosting capability formerly provided by lead and MMT additives. The critical refinery process for increasing octane is the catalytic reforming. The catalytic reforming process yields high octane streams called reformates, which are blended to make gasoline or processed further to yield aromatics which are used as feed-stocks by the petrochemical industry. The amount of reforming capacity needed as other options available to refiners were varied, was obtained from the alternate RPMS model simulations. Subsequently, required reforming capacities were compared to available capacities to determine the range of potential gasoline production under the various alternatives. This was accomplished by comparing incremental gasoline production and incremental reforming capacity availability established in each simulation. Estimated gasoline production levels obtained in this manner are presented in Table 4 for six cases representing different combinations of options available to U.S. refiners to increase the gasoline yield. Tables 5 illustrates the octane ratings obtained under the different case restrictions. In Table 6 potential gasoline production is added to imports to yield potential total supply, which is then compared with forecast demand.

The data in Table 4 indicate that the domestic refinery gasoline production capability ranges from 7,160 MB/D to a maximum of 7,662 MB/D and varies with assumptions regarding refinery capacity utilization, use of MMT in leaded grades, the option of slight octane reduction in leaded grades, introduction of two grades of unleaded gasoline to reduce the unleaded octane requirements, and finally use of estimated 1979 levels of lead in the gasoline pool. Case A shows the most restrictive set of assumptions modeled. Cases B-F show alternative combinations and magnitudes and their incremental supplies over those of Case A.

The combinations of the factors varied in this analysis and their respective magnitudes should not be interpreted as the sole set of supply alternatives. These cases are merely representative of the spectrum of possibilities, and are used to demonstrate the relationships between motor gasoline supply and the options varied. Similarly, the refining industry may not be compelled to invoke the measures presented in either the exact combinations or magnitudes as represented by the six cases in Table 4.

Table 5 identifies the pool octane ratings that correspond to the six cases presented in Table 4, showing the effect of the various options choosen. Pool octane ratings would vary as combinations and magnitudes of options varied.

TABLE 4

1980 DOMESTIC MOTOR GASOLINE PRODUCTION ALTERNATIVES

	Case A	Case B	Case C	Case D	Case E	Case F
Estimated Gasoline Production, MB/D	7,160	7,265	7,284	7,454	7,662	7,662
Options Varied						
Capacity Utilization Percent	92	94	92	94	94	92
MMT in Leaded Grades	NO	NO	YES	YES	YES	NO
Octane Shaving in Leaded Grades	NO	NO	YES	YES	YES	NO
Two Grades of Unleaded (reduction in pool octane)	NO	NO	NO	NO	YES	NO
Pool Lead Average, g/gal	0.59	0.59	0.59	0.59	0.59	1.20

TABLE 5

OCTANE RATINGS OF PRODUCTION ALTERNATIVES

	Case A	Case B	Case C	Case D	Case E	Case F
Pool Average Pump Octane Produced (R+M/2)	90.0	90.0	89.76	89.71	89.26	90.11
Pool Average Clear Octane Produced (R+M/2)	86.90	86.66	86.66	86.65	86.28	85.54

TABLE 6

1980 MOTOR GASOLINE SUPPLY/DEMAND BALANCE

Supply/Demand (MB/D)	Case A	Case B	Case C	Case D	Case E	Case F
Estimated Production (From Table 4)	7160	7265	7284	7454	7662	7662
Imports	300	300	300	300	300	300
Total Supply	7460	7565	7584	7754	7962	7962
Low Demand	7584	7584	7584	7584	7584	7584
High Demand	7962	7962	7962	7962	7962	7962

CONCLUSION

In this analysis no attempt has been made to identify the most probable course for the economy or to predict the actions of either the Environmental Protection Agency or the refining industry in general. The analysis, however, has included a range of demands which should encompass the actual 1980 levels, and has evaluated the capability of the refining industry to satisfy the range of demand projections. While some adjustments by the industry will be required to satisfy even the low demand level in 1980, the high range of demand projections can only be satisfied with a combination of product imports and major adjustments by U.S. refiners.

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3. Two Grades of Unleaded - As the need to increase the clear octane rating of the gasoline pool increases because of lead phasedown and the increasing share of unleaded in the pool, some refiners may decide to redistribute the use of their clear octane capability by eliminating their leaded premium gasoline production and instead providing one grade of leaded gasoline and two grades of unleaded. The variations in the grade split and qualities occasioned by this scenario were discussed in an earlier section. This scenario is evaluated in Case E of Table 4 and indicates that over 200 MB/D additional gasoline supply may be provided by reducing the leaded premium sales and introducing two grades of unleaded gasoline.

4. Continuation of EPA Lead Phasedown Waivers - As indicated in Case F, about 500 MB/D gasoline supply may be obtained over Case A levels by assuming a continuation of the EPA lead phasedown waivers as in 1978 and 1979. Until recently, the EPA lead phasedown had been discussed in the context of a decrease in the rate of growth of gasoline consumption in the 1978-1980 period eventually leading to a leveling off in the overall consumption. However, the current analysis was performed against a background of sharp upward revisions of the 1980 motor gasoline demand.