Oxygenate Supply/Demand Balances in the Short-Term Integrated Forecasting Model

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Related EIA Short-Term Forecast Analysis Products

- Supporting Data for this Analysis Report
- Areas Participating in Oxygenated Gasoline Program
- Areas Participating in Reformulated Gasoline Program
- Demand, Supply, and Price Outlook for Reformulated Motor Gasoline, 1995

Introduction

The blending of oxygenates, such as fuel ethanol and methyl tertiary butyl ether (MTBE), into motor gasoline has increased dramatically in the last few years because of the oxygenated and reformulated gasoline programs.[(1)] Because of the significant role oxygenates now have in petroleum product markets, the *Short-Term Integrated Forecasting System (STIFS)* was revised to include supply and demand balances for fuel ethanol and MTBE. The *STIFS* model is used for producing forecasts in the *Short-Term Energy Outlook*. A review of the historical data sources and forecasting methodology for oxygenate production, imports, inventories, and demand is presented in this report.

Fuel ethanol and MTBE usage has grown steadily since the early 1980's in response to octane demand resulting initially from the phaseout of lead from gasoline and later from rising demand for premium gasoline. Federal and local tax incentives for blending renewable fuels into motor gasoline have contributed to the growth in demand for fuel ethanol.[(2)] The oxygenated and reformulated gasoline programs stimulated a dramatic increase in oxygenate demand and production capacity between 1991 and 1995 (Table 1). Oxygenates now account for over 4 percent of the finished motor gasoline pool.

[Monthly ethanol and MTBE Production Data]

Table 1. U.S. Oxygenate Capacity and Production
(Thousand barrels per calendar day)

	Oxygenate Production Capacity			
	Ethanol	MTBE	TAME	ETBE
January 1, 1991	82.6	122.5	0.5	0.0
January 1, 1992	93.5	135.1	3.7	0.0
January 1, 1993	90.1	170.2	5.0	10.3
January 1, 1994	90.7	223.2	14.5	0.8
January 1, 1995	103.6	250.9	18.1	4.0
	Annual Average Production			
	Ethanol	MTBE		
1990	49	84		
1991	56	101		
1992	70	101		
1993	75	136		
1994	83	144		
1995	88	163		
1996	63	185		
1997	83	198		

Notes:

- EIA stopped collecting oxygenate production capacity data after January 1, 1995. This information was first collected by EIA to monitor the transition of reformulated motor gasoline into the market.
- TAME (tertiary amyl methyl ether) and ETBE (ethyl tertiary butyl ether) production numbers are withheld by EIA to avoid disclosure of individual company data.

Sources:

- Capacities from Energy Information Administration, *Petroleum Supply Annual*, Volume 1, Table 50.
- Ethanol and MTBE production for 1992 to current from Energy Information Administration, *EIA-819M Monthly Oxygenate Telephone Report*, Tables B2 and B3.
- Ethanol production for 1990 and 1991 estimated from Federal Highway Administration, "Gasohol Sales By State," *Highway Statistics Summary to 1995*, Table MF-233GLA.
- MTBE production estimates for 1990 and 1991 supplied by DeWitt and Co., Inc.

Oxygenate Demand

The recent growth in oxygenate blending into motor gasoline has been demand-driven because of the minimum oxygen content mandates in the oxygenated and reformulated gasoline programs. Oxygenated gasoline must contain a minimum 2.7 percent oxygen by weight while reformulated gasoline requires a minimum 2.0 percent oxygen by weight. Supply and demand projections for fuel ethanol and MTBE begin with estimates of total oxygenate demand.

Total oxygenate demand forecasts are based on estimated market shares for the following types of motor gasoline:

- Oxygenated motor gasoline
- Reformulated motor gasoline (RFG)
- Oxygenated program reformulated motor gasoline (OPRG)
- Gasohol and conventional motor gasoline octane demand

Estimates of market shares for the regulated gasolines (oxygenated motor gasoline, RFG, and OPRG) generally begin with estimates of the fraction of the U.S. population that reside in each control area that require one of the regulated gasolines. Calculated population shares must then be corrected to arrive at motor gasoline demand shares because per capita gasoline demand varies throughout the country. For example, the District of Columbia contains 0.20 percent of the U.S. population but represents only 0.15 percent of the U.S. retail motor gasoline market. Wyoming, on the other hand, has a retail gasoline market share that is over 1.5 times its population share. Population share correction factors were estimated for each State using motor gasoline demand shares calculated from Federal Highway Administration (FHWA) 1995 motor gasoline sales data.[3] Finally, estimated control area motor gasoline demand shares are then adjusted for spill over (delivery of regulated motor gasoline to areas that do not require it).[4] Table 2 provides a sample of this estimation method for RFG in mandated areas.

[Population Correction Factors]

Table 2. Estimated RFG Demand Share - Mandated RFG Areas, January 1998				
Control Area	**Estimated Population 7/1/96** (thousands)	**U.S. Population Share**	**Population Correction Factor**	**Estimated Gasoline Demand Share**
Baltimore, MD	2,436	0.0092	0.942	0.0087
Chicago-Gary-Lake Co., IL-IN-WI	8,275	0.0312	0.889	0.0277
Hartford, CT	1,862	0.0070	0.865	0.0061
Houston-Galveston-Brazoria, TX	4,253	0.0160	1.037	0.0166
Los Angeles-Anaheim-Riverside, CA	15,495	0.0584	0.912	0.0533
Milwaukee-Racine, WI	1,784	0.0067	1.004	0.0068
New York City, NY-NJ-CT	18,373	0.0693	0.779	0.0540
Philadelphia, PA-NJ-DE-MD	6,092	0.0230	0.903	0.0207
Sacramento, CA	2,073	0.0078	0.912	0.0071
San Diego, CA	2,655	0.0100	0.912	0.0091
Total unadjusted share of total U.S. motor gasoline retail market				0.210
Correction for spill over				x 1.02
Total adjusted share of total U.S. motor gasoline retail market				0.214

Notes:

- Population correction factor = State gasoline demand share (1995) / State population share (1996). Multiple state control areas are population weighted.
- Estimated gasoline demand share = U.S. population share (1996) x Population correction factor.
- Estimated total U.S. population (July 1, 1996) = 265,283,783.

Sources:

- Population: U.S. Census Bureau. See also EIA, Areas Participating in Reformulated Gasoline Program, *April 1998* (HTML file, 22 KB)
- State Gasoline Demands: Federal Highway Administration, *Highway Statistics 1995*, "Monthly Gasoline Reported by States" (Table MF-33GA). Annual data were used to calculate demand shares and no attempt was made to account for seasonality in State per capita demands.

Regulated gasoline demand shares are converted to monthly volumes using the forecast of refinery output of motor gasoline generated by the *STIFS* model.[5] Because there is about a one month lag between production of finished motor gasoline at refineries and retail sale, demand shares are lagged one month to convert them to production shares. In other words, while 11.8 percent of the motor gasoline sold at retail outlets in January 1998 should be Oxygenated or OPRG, refineries are expected to produce these grades of regulated gasolines in December 1997.

Because fuel ethanol and MTBE have different oxygen contents, volumetric oxygenate demands are usually presented on an MTBE-equivalent basis. About 2 gallons of MTBE have the same oxygen content as 1 gallon of ethanol.[6] Oxygenated motor gasoline and OPRG are assumed to contain 15.2 percent MTBE by volume, and RFG is assumed to require 11.7 percent MTBE by volume.[7] Given estimates of total refinery production of motor gasoline, regulated gasoline production shares, and required oxygenate content, oxygenate demand for blending into regulated motor gasoline can be derived.

Continued demand for ethanol in gasohol blending, and demand for MTBE as an octane blendstock in conventional gasoline, is added to the demand for oxygenates in regulated motor gasolines to arrive at total oxygenate demand. A simple forecast of continued demand for oxygenates in gasohol and octane blending of an average 70 thousand barrels per day MTBE-equivalent volume during the summer months and an average 40 thousand barrels per day during the winter is assumed.

The sum of oxygenate demand for regulated motor gasolines, gasohol, and octane blending equals total oxygenate demand:

$$OZTCPUS = [0.152 * (OXFRAC + OPFRAC) + 0.117 * RFFRAC] * MGROPUS + OZTCPAD$$

where,

OZTCPUS = Total oxygenate demand, million barrels per day MTBE-equivalent volume
OPFRAC = Oxygenated program RFG production share, fraction
OXFRAC = Oxygenated gasoline production share, fraction
RFFRAC = Reformulated gasoline production share, fraction
MGROPUS = Refinery output of finished motor gasoline, million barrels per day
OZTCPAD = Oxygenate demand for gasohol and octane blending, million barrels per day MTBE-equivalent volume (30 to 80 thousand barrels per day assumed)

Note: Regulated gasoline production shares = demand shares lagged one month.

Total oxygenate demand is then disaggregated into ethanol and MTBE (and other ethers) demands based on the assumption that ethanol demand is supply-driven and that MTBE satisfies the remaining demand.

Fuel Ethanol Supply and Demand Balance

The *STIFS* fuel ethanol balance involves the following 5 variables:

- EOPRPUS = Fuel ethanol plant production

- EOFPPUS = Fuel ethanol field production
- EONIPUS = Fuel ethanol net imports
- EOPSPUS = Fuel ethanol end-of-month stocks
- EOTCPUS = Fuel ethanol product supplied (demand)

The EIA began collecting monthly ethanol plant production and end-of-month inventory statistics beginning January 1992, and monthly fuel ethanol imports in January 1993 (Table 3). Fuel ethanol demand for gasoline blending, EOTCPUS, is calculated from a material balance around plant production, imports, and stock change:[8]

EOTCPUS = EOPRPUS + EONIPUS - d(EOPSPUS)

Most fuel ethanol blending into motor gasoline takes place at terminals and racks (often referred to as "splash" blending) that are not included in EIA surveys. Fuel ethanol splash blending is classified as field production in the EIA *Petroleum Supply Monthly* and is obtained from the following identity:

EOFPPUS = EOTCPUS - Refinery Inputs of Fuel Ethanol

Refinery inputs of fuel ethanol are not explicitly identified in EIA publications. However, total field production of fuel ethanol can be calculated from the *Petroleum Supply Monthly* using the identity:

EOFPPUS = MBFPPUS + MGFPPUS

where,
MBFPPUS = Field production of motor gasoline blend components
MGFPPUS = Field production of finished motor gasoline
There are several other sources for fuel ethanol supply statistics that may be used to supplement EIA survey data (Table 3).

[Monthly Ethanol Data]

Table 3. Fuel Ethanol Annual Statistics
All units in thousand barrels per day, except stocks are million barrels

	Production		Exports	Imports		End-of-Year Stocks	Demand	Imputed Demand	
Source:	**ATF**	**EIA**	**ATF**	**ATF**	**EIA**	**EIA**	**FHWA**	**ATF**	**EIA**
1997	-	83	-	-	0	2,889	-	-	81
1996	-	63	-	-	1	2,065	70	-	64
1995	-	88	-	-	1	2,186	79	-	90
1994	-	83	-	-	1	2,393	68	-	83
1993	-	75	-	-	1	2,114	64	-	75
1992	62	70	0.4	2.4	-	1,791	58	64	68
1991	55	-	2.8	0.8	-	-	56	53	-
1990	70	-	8.6	1.0	-	-	49	62	-
1989	46	-	0.7	1.5	-	-	45	47	-
1988	51	-	0.8	0.6	-	-	53	51	-
1987	49	-	1.2	1.3	-	-	52	49	-
1986	60	-	0.2	6.5	-	-	51	66	-
1985	48	-	0.2	5.2	-	-	51	53	-

Notes:
FHWA fuel ethanol demand based on estimate of ethanol contained in gasohol sales reported by States
Imputed demand = production + imports - exports - stock build
ATF imputed demand assumes no stock change
EIA imputed demand assumes no exports (or stock change in 1990 and 1992)

Sources:

ATF	Bureau of Alcohol, Tobacco, and Firearms, *Monthly Distilled Spirits Report*, Report Symbol 76 and *Alcohol Fuels Report*, internal quarterly report.
EIA	Production and 1992 stocks: Energy Information Administration, *EIA-819M Monthly Oxygenate Telephone Report*, Table B2 Imports and stocks: Energy Information Administration, *Petroleum Supply Annual*, Tables 20 and 30, respectively.
FHWA	Federal Highway Administration, *Highway Statistics Summary to 1995*, "Gasohol Sales by State, 1980-1992" (Table MF-233GLA), and Estimated Use of Gasohol, 1993-1995 (Table MF-233E); *Highway Statistics 1996*, "Estimated Use of Gasohol" (Table MF-33E).

However, because of the lack of monthly data for some of the series, some simplifying assumptions are made for the *STIFS* historical database:

- End-of-month stocks are assumed to be constant at 1 million barrels for all months before January 1992.
- Net imports = 0, for all months before January 1993.
- Refinery inputs of ethanol = 0, for all months before January 1993.

Given these assumptions, fuel ethanol demand equals fuel ethanol plant production. Although fuel ethanol demand calculated from gasohol sales reported by the Federal Highway Administration (FHWA) from State reports of excise tax receipts may be understated, comparison to demand imputed from Bureau of Alcohol, Tobacco, and Firearms (ATF) and EIA data indicate reasonable closeness. Because the FHWA data are available on a monthly basis, these data were used for fuel ethanol production/demand history before January 1992.

The *Short-Term Energy Outlook's* forecast for ethanol production is assumed to remain flat at 90 thousand barrels per day over the forecast period. Net imports are assumed to be 0, and inventories are assumed to remain constant at the most recent level reported in the *Petroleum Supply Monthly*. Thus, fuel ethanol demand for the forecast period equals fuel ethanol production. Refinery inputs are assumed to average 30 thousand barrels per day, and field production 60 thousand barrels per day.

MTBE Supply and Demand Balance

The *STIFS* balance for MTBE and other ethers involves the following 4 variables:

- MTPRPUS = MTBE production
- MTNIPUS = MTBE net imports
- MTPSPUS = MTBE end-of-month stocks
- MTTCPUS = MTBE product supplied (demand)

EIA began collecting MTBE data at the same time as the fuel ethanol data (Table 4). The MTBE data do not include a difference between plant production and field production as in the fuel ethanol balance.

[Monthly MTBE Data]

Table 4. EIA MTBE Annual Statistics All units in thousand barrels per day, except stocks are million barrels						
	1997	**1996**	**1995**	**1994**	**1993**	**1992**
Plant Production	198	185	163	142	136	101
Gross Imports	59	48	45	39	20	-
Gross Exports	12	12	7	11	-	-
Net Imports	47	36	39	28	-	-
End-of-Year Stocks	8,228	10,008	8,702	13,769	10,035	13,818
Imputed Demand	249	218	215	160	161	106

Sources:

- MTBE plant production and 1992 stocks: Energy Information Administration, *EIA-819M Monthly Oxygenate Telephone Report*, Table B3.
- Gross imports, gross exports, and stocks: Energy Information Administration, *Petroleum Supply Annual*, Tables 20, 27, and 30, respectively. Exports are reported in Table 27 as "Other Hydrocarbons/Oxygenates" and may include exports of ethanol and other ethers.

MTBE supply history before January 1992 is more scant than that for fuel ethanol. Monthly gross imports for 1992 and gross exports for 1992 and 1993 were obtained from the *Oil Market Listener*.[9] Estimates of annual average MTBE production, gross imports and gross exports for 1985 through 1991 were provided by DeWitt and Company, Inc. The annual average production data were disaggregated into monthly volumes by fitting a cubic spline curve. MTBE net imports are assumed to average 3 thousand barrels per day in 1991, and 0 for all months before January 1991. MTBE stocks are assumed to remain constant at 1 million barrels for all months before December 1990, and then increase steadily at about 1 million barrels per month through January 1992.

Historical MTBE demand is calculated from a material balance around production, net imports (imports - exports), and stock change:

MTTCPUS = MTPRPUS + MTNIPUS - d(MTPSPUS)

The MTBE demand forecast is derived from the difference between estimated total oxygenate demand and assumed ethanol demand (converted to MTBE-equivalent volume):

MTTCPUS = OZTCPUS - 2.0 * EOTCPUS

MTBE net imports are assumed to remain constant at 40 thousand barrels per day over the forecast period. An MTBE production forecast is assumed, and adjusted to produce a reasonable stock path. These exogenously specified production and stock numbers may be converted to estimated regression equations once a consistent production/stock history is accumulated.

Refinery Balances

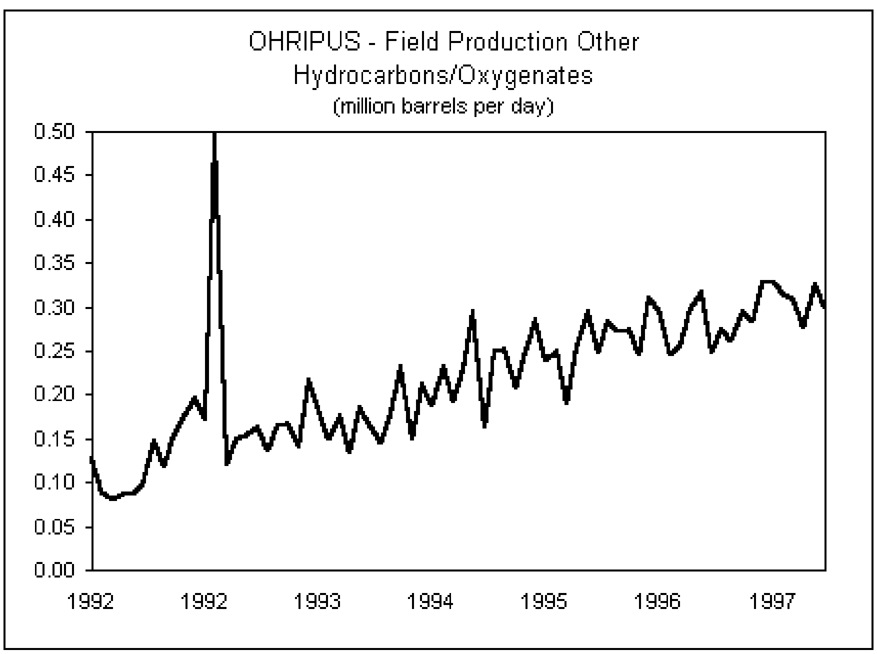
The MTBE and fuel ethanol balances are converted into aggregates that correspond to volumes reported in the *Petroleum Supply Monthly* and the *Short-Term Energy Outlook*.

Field Production: Field production of other hydrocarbons/oxygenates is one of 6 categories of field production reported in the *Petroleum Supply Monthly* and modeled in *STIFS* (other categories include crude oil, pentanes plus, liquefied petroleum gases, motor gasoline blend components, and finished motor gasoline). All MTBE production and a small volume of ethanol blended into motor gasoline at refineries are included in the category field production of other hydrocarbons/oxygenates.

Field production of other hydrocarbons/oxygenates (OHRIPUS) is estimated in the *STIFS* model as a linear function of MTBE production (MTPRPUS), a dummy variable representing January 1993 (when new MTBE inventory survey data was incorporated into the *Petroleum Supply Monthly*), and monthly dummies:

OHRIPUS = OHRI_B0
+ OHRI_MT * MTPRPUS
+ OHRI_D9301 * D9301
+ monthly dummy variables

[Regression Results, Table A1]
[Graph of OHRIPUS]
[Monthly Regression Data]

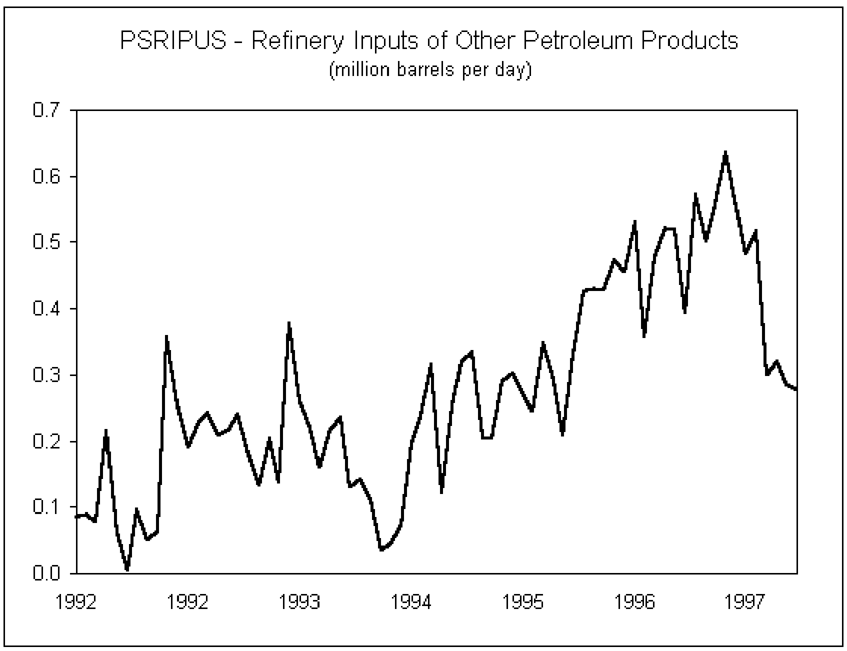


Refinery Inputs: Six categories of refinery inputs are modeled in *STIFS*: crude oil, pentanes plus, liquefied petroleum gases, unfinished oils, aviation gas blending components, and "other" petroleum products. The "other" petroleum products category includes other hydrocarbons/oxygenates and motor gasoline blending components.

Refinery inputs of other petroleum products (PSRIPUS) is estimated as a function of MTBE demand (MTTCPUS), field production of motor gasoline blend components (MBFPPUS), a dummy variable to capture the months Oct. 1996 and Dec. 1996 through May 1997 when imports and refinery inputs were unusually high, and monthly dummies:

PSRIPUS = PSRI_B0
+ PSRI_MB * MBFPPUS
+ PSRI_MT * MTTCPUS
+ PSRI_DY * DY9697
+ monthly dummy variables

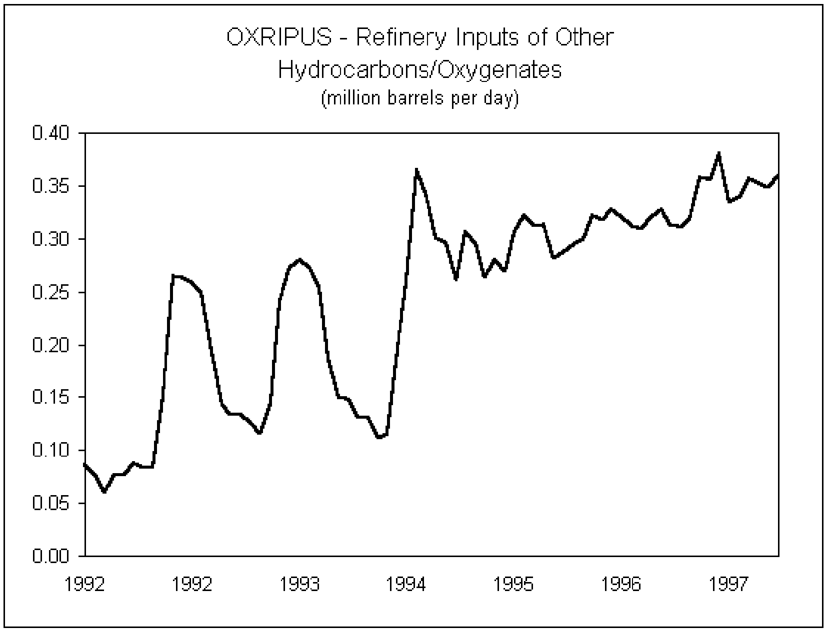
[Regression Results, Table A2]
[Graph of PSRIPUS]
[Monthly Regression Data]



The *STIFS* model also includes an estimating equation for the subcategory refinery inputs of other hydrocarbons/oxygenates (OXRIPUS), which is estimated as a function of MTBE demand (MTTCPUS) and monthly dummies:

OXRIPUS = OXRI_B0
+ OXRI_MT * MTTCPUS
+ monthly dummy variables

[Regression Results, Table A3]
[Graph of OXRIPUS]
[Monthly Regression Data]



Inventories: Inventories of MTBE (MTPSPUS) and fuel ethanol (EOPSPUS) are aggregated into total oxygenate stocks (OXPSPUS). Also included in this category are stocks of other oxygenates such as methanol, tertiary butyl alcohol (TBA), and other ethers, which are assumed to remain constant at 700 thousand barrels through the forecast period:

OXPSPUS = EOPSPUS + MTPSPUS + 0.700

Total oxygenate stocks are then added to stocks of other hydrocarbons/hydrogen to yield total stocks of other hydrocarbons/hydrogen/oxygenates (OHPSPUS). Stocks of other hydrocarbons/hydrogen are assumed to remain constant at 50 thousand barrels through the forecast period:

OHPSPUS = OXPSPUS + 0.050

End Notes

(1) For reviews of the oxygenated and reformulated motor gasoline program requirements and oxygenate supply and demand issues refer to these other analyses published by the Energy Information Administration:

- "1995 Reformulated Gasoline Market Affected Refiners Differently," *Petroleum Marketing Monthly*, DOE/EIA-0380(96/01) (Washington, DC, January 1996), pp. xiii-xxxi.

- "Demand, Supply, and Price Outlook for Reformulated Motor Gasoline, 1995," *Short-Term Energy Outlook Annual Supplement 1994*, DOE/EIA-0202(94) (Washington, DC, August 1994), pp. 3-20.
- "The Economics of the Clean Air Act Amendments of 1990: Review of the 1992-1993 Oxygenated Motor Gasoline Season," *Petroleum Supply Monthly*, DOE/EIA-0109(93/07) (Washington, DC, July 1993), pp. xiii-xxv.
- "Demand, Supply, and Price Outlook for Oxygenated Gasoline," *Short-Term Energy Outlook Annual Supplement 1992*, DOE/EIA-0202(92) (Washington, DC, June 1992), pp. 3-10.

(2) The Energy Tax Act of 1978 exempted all retail sales of gasoline blended with at least 10 volume percent alcohol (produced from biomass) from the then 4 cents/gallon Federal excise tax. The 1980 Winfall profits Tax Act added an alcohol blender's tax credit of 40 cents/gallon on fuel alcohol as an alternative to the retail tax credit. The Surface Transportation Act of 1982 increased the excise tax exemption to 5 cents/gallon and the blender's tax credit to 50 cents/gallon. The Tax Reform Act of 1985 increased the tax exemptions to 6 and 60 cents/gallon. The Miscellaneous Tax and Budget Reduction Act of 1990 cut the tax exemption to 5.4 and 54 cents/gallon. The Energy Policy Act of 1992 expanded the definition of gasohol. Before January 1, 1993, a tax exemption was not allowed for gasoline with less than 10 percent fuel alcohol by volume. After January 1, 1993, there are three tax exeption rates: 5.4/54 cents/gallon for gasohol containing at least 10 volume percent alcohol; 4.158/41.58 cents/gallon for gasohol with at least 7.7 but less than 10 volume percent alcohol; and 3.078/30.78 cents/gallon for gasohol with at least 5.7 but less than 7.7 volume percent alcohol.

For State tax exemptions refer to Federal Highway Administration, *Highway Statistics*, Section I, Table MF-121T.

(3) An equivalent description of this method is that the fraction of a State's population that resides in a control area is multiplied by the State's share of the U.S. retail gasoline market.

(4) Earlier estimates of the correction factor included the expected effects of reduced automobile fuel efficiency and price elasticity of demand. These corrections are not required when gasoline demand shares are estimated using 1995 or later gasoline demand data, which should include these effects.

(5) For analysis of forecasting model and regression results for refinery output of motor gasoline, refer to: Energy Information Administration, *Short-Term Energy Outlook Model Documentation*.

(6) The volumetric ratio between MTBE and ethanol may vary by &#plusmn;0.05 depending on the assumed ethanol and MTBE product purities.

(7) These percentages may change by as much as &#plusmn;0.5 percent absolute (i.e., MTBE in oxygenated gasoline may range from 14.7 to 15.7 volume percent) depending on the density of the motor gasoline, the purity of the oxygenate, and the assumed average oxygen content.

(8) EIA reports only gross imports of fuel ethanol in the *Petroleum Supply Monthly* (Table 33). Net imports are assumed to equal gross imports in the *STIFS* historical database (i.e., gross exports are assumed to be zero).

(9) Energy Information Ltd., "US MTBE Imports Remain Strong While Stocks Rebuild With End of Oxy Season," *Oil Market Listener* (San Francisco, CA, April 6, 1994) p. 2.

Appendix. Regression Results

Table A1. Field Production Other Hydrocarbons/Oxygenates (million barrels per day)

Equation	DF Model	DF Error	SSE	MSE	Root MSE	R-Square	Adj R-Sq	Durbin-Watson
OHRIPUS	14	56	0.06820	0.0012178	0.03490	0.828	0.788	1.93

Parameter	Estimate	Approx. Std. Err.	'T' Ratio	Independent Variable
OHRI_B0	-0.047963	0.02469	-1.94	Constant Coefficient
OHRI_MT	1.726869	0.12456	13.9	MTPRPUS, MTBE production
OHRI_D9301	0.320144	0.03833	8.35	D9301 = 1 if January 1993, 0 otherwise
OHRI_E1	0.024326	0.02216	1.10	JAN = 1 if January, 0 otherwise
OHRI_E2	-0.002370	0.02119	-0.11	FEB = 1 if February, 0 otherwise
OHRI_E3	0.000512	0.02124	0.02	MAR = 1 if March, 0 otherwise
OHRI_E4	-0.007310	0.02114	-0.35	APR = 1 if April, 0 otherwise
OHRI_E5	-0.015904	0.02113	-0.75	MAY = 1 if May, 0 otherwise
OHRI_E6	-0.019539	0.02113	-0.92	JUN = 1 if June, 0 otherwise
OHRI_E7	0.001694	0.02118	0.08	JUL = 1 if July, 0 otherwise
OHRI_E8	-0.008982	0.02115	-0.42	AUG = 1 if August, 0 otherwise
OHRI_E9	-0.015690	0.02116	-0.74	SEP = 1 if September, 0 otherwise
OHRI_E10	-0.009161	0.02118	-0.43	OCT = 1 if October, 0 otherwise
OHRI_E11	-0.003124	0.02207	-0.14	NOV = 1 if November, 0 otherwise
Method of estimation: Ordinary least squares Estimation period: January 1992 through October 1997				

Table A2. Refinery Inputs "Other" Petroleum Liquids (million barrels per day)

Equation	DF Model	DF Error	SSE	MSE	Root MSE	R-Square	Adj R-Sq	Durbin-Watson
PSRIPUS	15	55	0.43809	0.0079653	0.08925	0.738	0.671	1.26

Parameter	Estimate	Approx. Std. Err.	'T' Ratio	Independent Variable
PSRI_BO	-0.116219	0.04749	-2.45	Constant Coefficient
PSRI_MB	0.417911	0.26202	1.59	MBFPPUS, field production motor gasoline blend components
PSRI_MT	1.626040	0.18066	9.00	MTTCPUS, MTBE demand
PSRI_DY	0.174293	0.03900	4.47	DY9697 = 1 if Oct 1997 or Dec 1997 - Mar 1998
PSRI_E2	0.103094	0.05164	2.00	FEB = 1 if February, 0 otherwise
PSRI_E3	0.147015	0.05203	2.83	MAR = 1 if March, 0 otherwise
PSRI_E4	0.148479	0.05240	2.83	APR = 1 if April, 0 otherwise
PSRI_E5	0.115947	0.05318	2.18	MAY = 1 if May, 0 otherwise
PSRI_E6	0.131098	0.05390	2.43	JUN = 1 if June, 0 otherwise
PSRI_E7	0.162030	0.05457	2.97	JUL = 1 if July, 0 otherwise
PSRI_E8	0.177580	0.05590	3.18	AUG = 1 if August, 0 otherwise
PSRI_E9	-0.009130	0.05426	-0.17	SEP = 1 if September, 0 otherwise
PSRI_E10	0.048537	0.05275	0.92	OCT = 1 if October, 0 otherwise
PSRI_E11	0.053504	0.05634	0.95	NOV = 1 if November, 0 otherwise
PSRI_E12	0.025127	0.05656	0.44	DEC = 1 if December, 0 otherwise
Method of estimation: Ordinary least squares Estimation period: January 1992 through October 1997				

Table A3. Refinery Inputs Oxygenates (million barrels per day)

Equation	DF Model	DF Error	SSE	MSE	Root MSE	R-Square	Adj R-Sq	Durbin-Watson
OXRIPUS	13	57	0.07464	0.0013095	0.03619	0.876	0.850	1.62

Parameter	Estimate	Approx. Std. Err.	'T' Ratio	Independent Variable
OXRI_B0	0.025888	0.01909	1.36	Constant Coefficient
OXRI_MT	1.250655	0.06835	18.3	MTTCPUS, MTBE demand
OXRI_E2	-0.011611	0.02090	-0.56	FEB = 1 if February, 0 otherwise
OXRI_E3	-0.008702	0.02098	-0.41	MAR = 1 if March, 0 otherwise
OXRI_E4	-0.011842	0.02091	-0.57	APR = 1 if April, 0 otherwise
OXRI_E5	-0.020854	0.02090	-1.00	MAY = 1 if May, 0 otherwise
OXRI_E6	-0.010917	0.02092	-0.52	JUN = 1 if June, 0 otherwise
OXRI_E7	0.007517	0.02104	0.36	JUL = 1 if July, 0 otherwise
OXRI_E8	-0.002976	0.02097	-0.14	AUG = 1 if August, 0 otherwise
OXRI_E9	-0.034592	0.02106	-1.64	SEP = 1 if September, 0 otherwise
OXRI_E10	-0.021436	0.02125	-1.01	OCT = 1 if October, 0 otherwise
OXRI_E11	-0.025004	0.02241	-1.12	NOV = 1 if November, 0 otherwise
OXRI_E12	-0.023332	0.02232	-1.05	DEC = 1 if December, 0 otherwise
Method of estimation: Ordinary least squares Estimation period: January 1992 through October 1997				

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