CHART 9 - CHEVROLET OXIDES OF NITROGEN ENGINE OUT

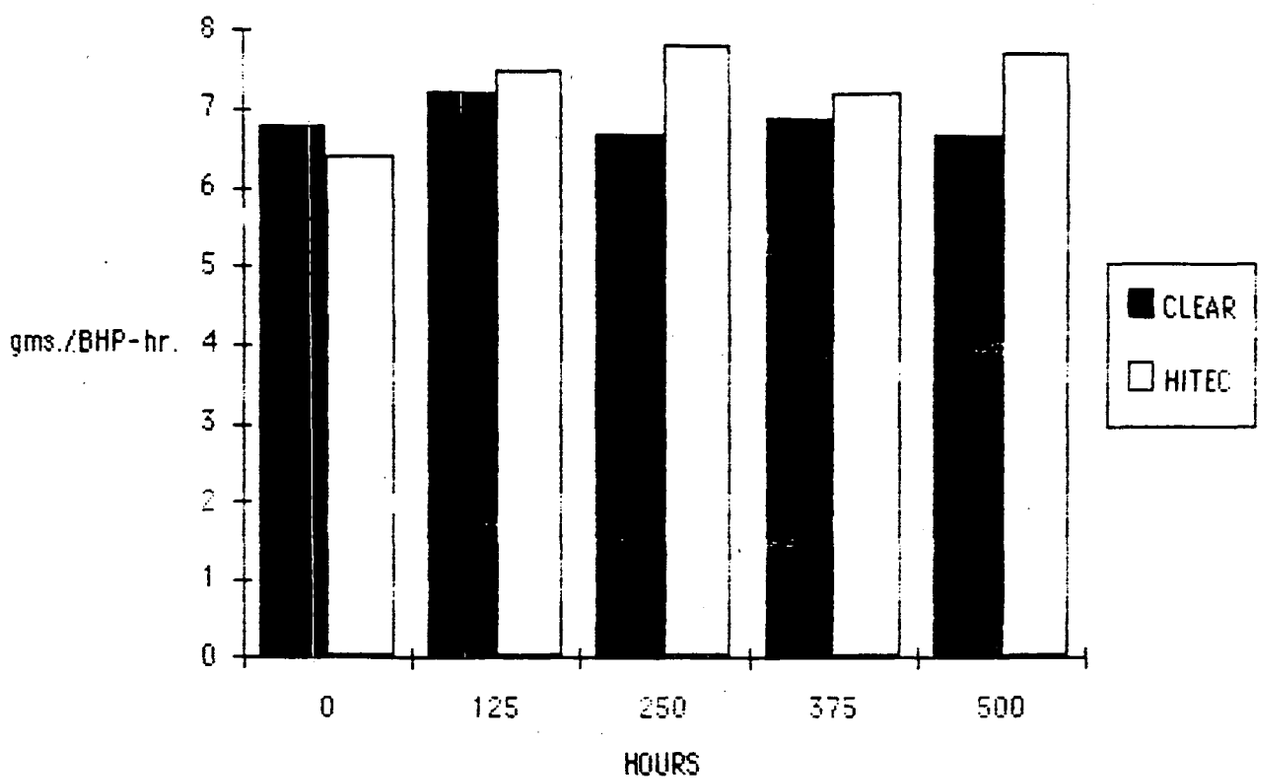

CHART 10 - FORD HYDROCARBONS ENGINE OUT

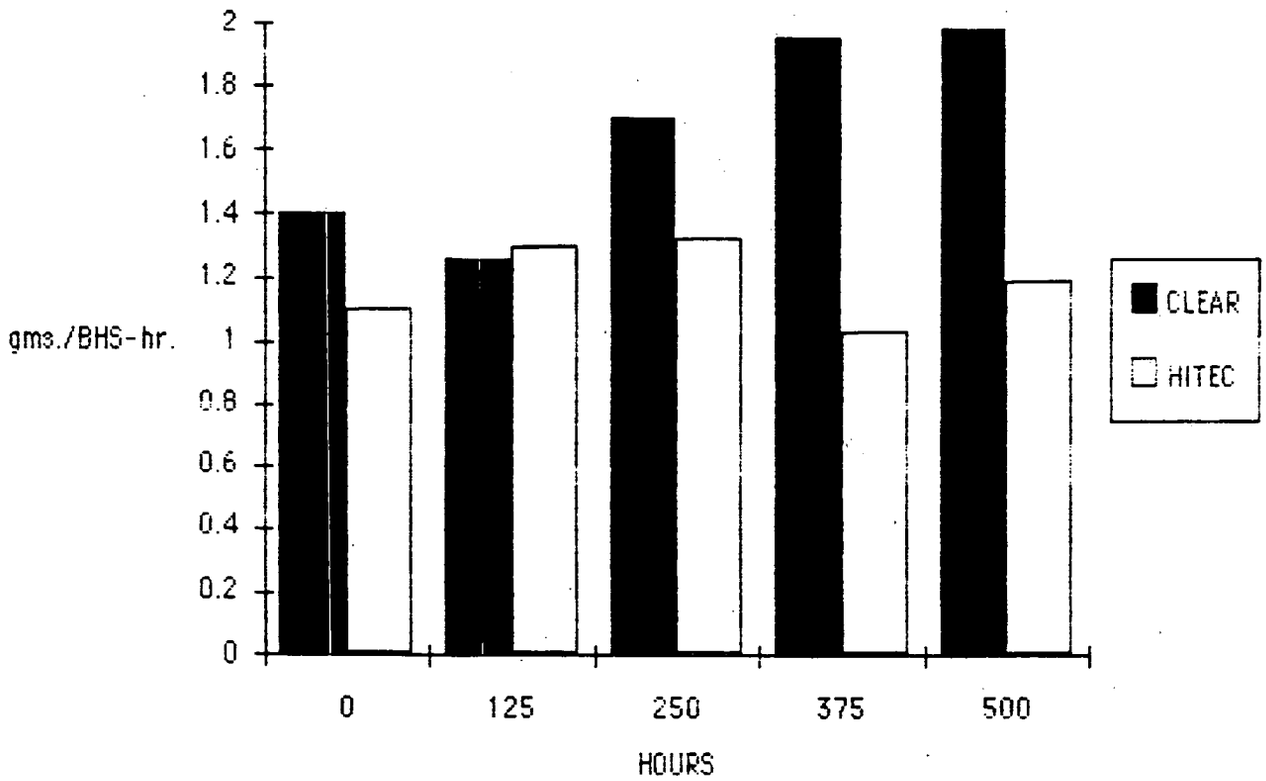

CHART 11 - FORD CARBON MONOXIDE ENGINE OUT

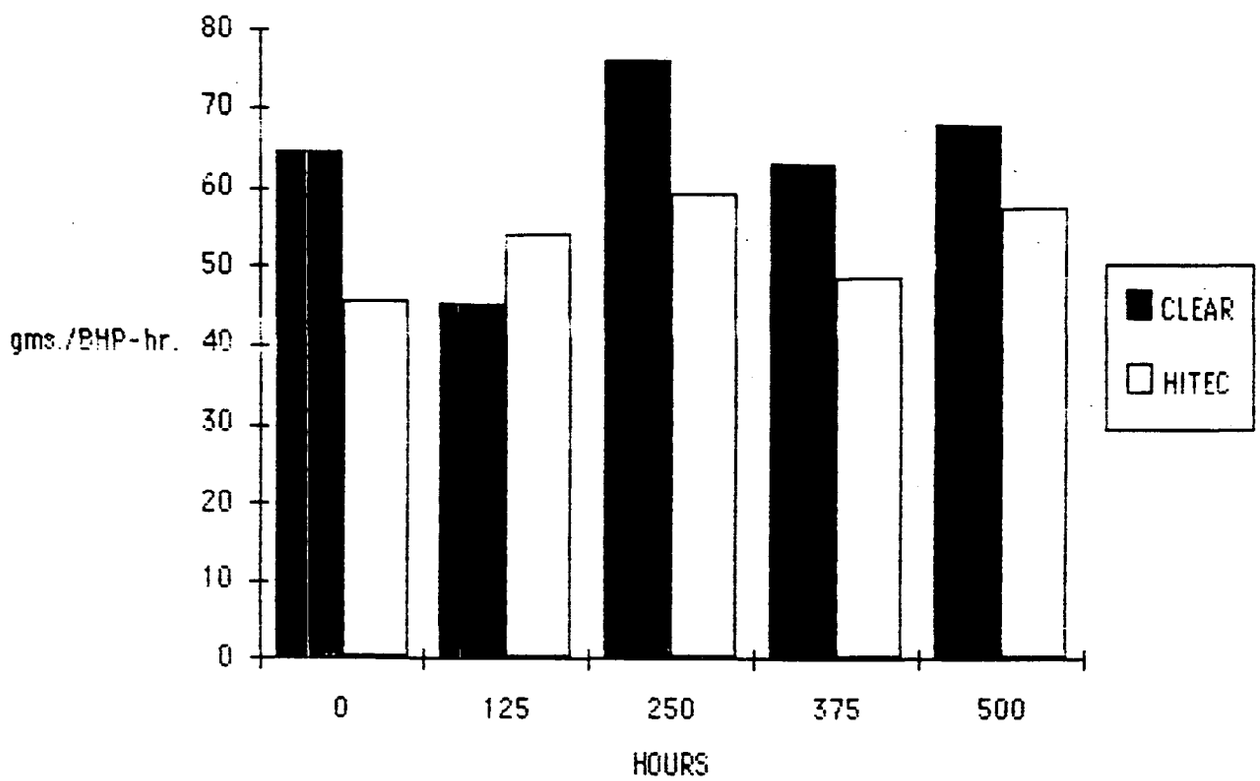

CHART 12 - FORD OXIDES OF NITROGEN ENGINE OUT

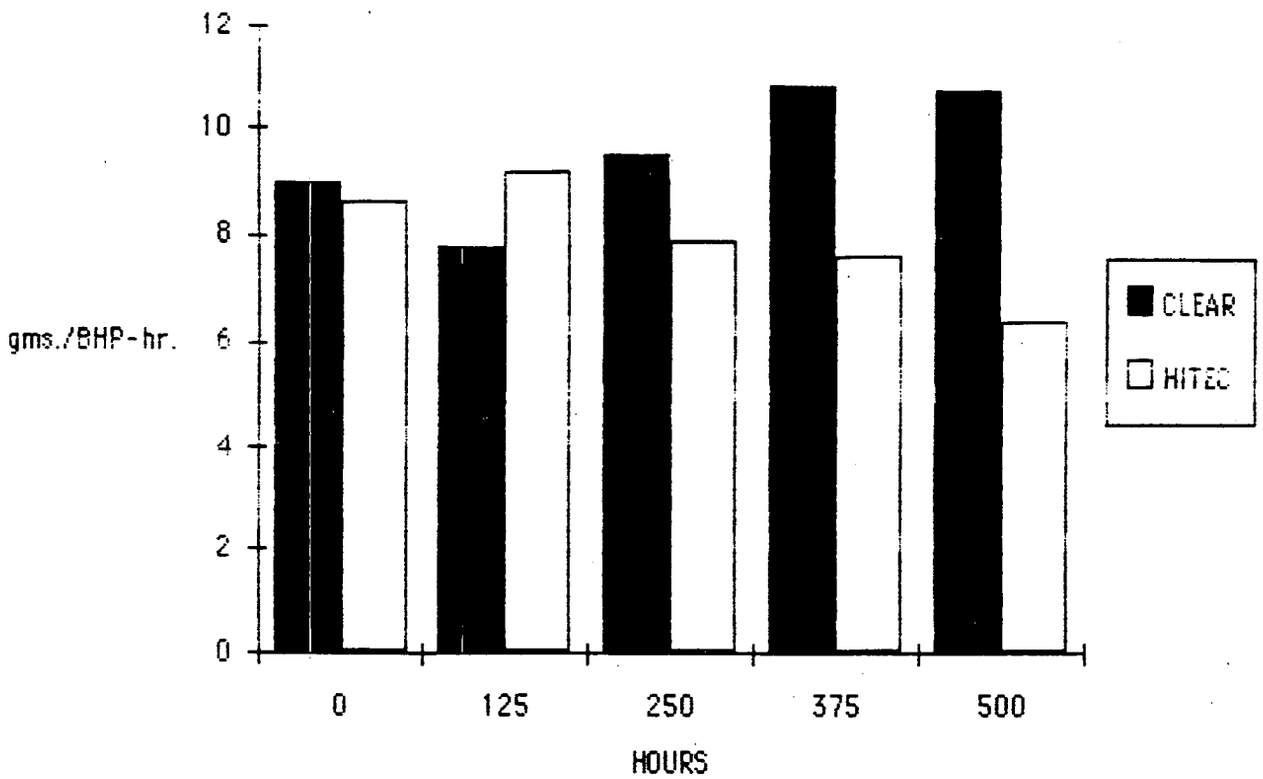

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TABLE A-1

BASIS AND ASSUMPTIONS

STUDY OF EFFECTS OF HITEC 3000 USE

- Use the Turner, Mason & Company (TM&C) linear programming (LP) model of PADD III conversion refineries. PADD III gasoline production is about 45% of total U.S. production.

- Run 1995 summer and winter cases with minimum and maximum opt in as estimated by DOE.

	% Reformulated/Oxygenated				
	Minimum		Maximum		Oxygen
	Summer	Winter	Summer	Winter	%
RFG @ 2.1% O_2	25.3	8.6	63.3	31.2	2.1
RFG @ 2.7% O_2	-	16.7	-	32.1	2.7
Oxygenated @ 2.7% O_2	-	20.0	-	4.6	2.7
Conventional	74.7	54.7	36.7	32.1	0.0
	100.0	100.0	100.0	100.0	-

- As specified by DOE, assume no growth in gasoline (or other products) demand from 1990 to 1995. This is a very conservative assumption.

- Assume octanes by grade are the same in 1995 as in 1990. Reformulated/ oxygenated gasoline is the same octane as the corresponding conventional gasoline.

- As specified by DOE, conservatively assume that the 1990 gasoline grade ratio applies to 1995 except for leaded gasoline. Prorate 1990 leaded gasoline to unleaded grades to maintain constant marketed pool octane number.

- Reid vapor pressure (RVP) for the summer cases reformulated gasoline will be set at EPA average limits of 8.0 psi for area C and 7.1 for area B. Conventional gasoline will be at Phase II levels of 9.0 and 7.8 psi less a compliance margin of 0.3 psi. Winter RVP will be set at 1990 levels. These will be averaged according the PADD III supply patterns.

- Benzene level in reformulated gasoline will be set at 0.95 volume % average as recommended in EPA's Reg-Neg process.

- Aromatics level in reformulated gasoline will be limited to an average of 25% with no compliance margin.

- Reformulated gasoline will have no increase in olefins, sulfur and T90 from 1990 levels.

- Conventional gasoline will have no increase in benzene, aromatics, olefins, sulfur and T90 from 1990 levels.

- Table A-2 shows the 1990 average supply and disposition of crude oil and petroleum products for the U.S. Corresponding information for PADD III is shown in Table A-3. The seasonality of PADD III refining production of major products is shown in Table A-4. PADD III production will be allocated between simple refineries and the IIIC model conversion refineries.

- Development of PADD III 1990 gasoline production ratios is presented in Tables A-5, A-6 and A-7.

- NIPER data for summer and winter gasolines are shown in Tables A-8 and A-9. Data from the comprehensive 1989 NPRA survey are shown in Table A-10. The NPRA survey represents actual production at the refineries included in the TM&C LP model of PADD III conversion refineries.

- The NIPER data presented in Table A-8 indicate that (R+M)/2 octane numbers increased slightly from 1989 to 1990. Adjust the PADD III survey data in Table A-10 as follows:

	1989 Survey	Increase	1990 Specifications
Unleaded Regular	87.2	0.2	87.4
Unleaded Midgrade	89.1*	0.1	89.2
Unleaded Premium	92.7	0.2	92.9

* Based on NIPER increase over unleaded regular.

Unleaded premium gasoline produced in PADD III has a higher octane number than the U.S. average because PADD III supplies gasoline to the East Coast where marketed premium gasoline octanes are higher than average. Winter gasolines have essentially the same octane numbers as summer gasolines, as shown in Tables A-8 and A-9.

- Use TM&C pricing based on recent history prior to the Persian Gulf war. Based on the consensus outlook of numerous forecasts, we selected a $20-per-barrel price for West Texas Intermediate crude.

- Assume the existing capacity plus current construction is adequate for the 1995 case exclusive of distillate desulfurization and gasoline reformulation processes.

- Allow investment over base for reformulated gasoline facilities with no HiTEC 3000; allow HiTEC 3000 with no further investment and no capital charge on reformulation processes.

- Adjust gasoline demand to account for the lower heat of combustion caused by introduction of oxygenates, lowering of aromatic content and lowering of gasoline 90% boiling point. Use an "R" factor that indicates gasoline requirements will go up 0.8% for every 1.0% decrease in the energy content of gasoline. This factor has been accepted by EPA in recent studies of vapor pressure reduction and other regulations.

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A-2

Table 3. U.S. Daily Average Supply and Disposition of Crude Oil and Petroleum Products, 1990 (Thousand Barrels per Day)

Commodity	Supply				Disposition				
	Field Production	Refinery Production	Imports	Unaccounted For Crude Oil[a]	Stock Change[b]	Crude Losses	Refinery Inputs	Exports	Products Supplied[c]
Crude Oil	7,355	–	5,894	259	-35	(s)	13,409	109	24
Natural Gas Liquids and LRGs	1,359	499	197	–	42	–	457	41	1,705
Pentanes Plus	309	–	9	–	-7	–	175	2	148
Liquefied Petroleum Gases	1,250	499	188	–	48	–	293	40	1,556
Ethane/Ethylene	477	16	7	–	-11	–	(s)	(s)	510
Propane/Propylene	474	404	115	–	48	–	(s)	28	917
Normal Butane/Butylene	149	67	50	–	7	–	137	12	110
Isobutane	151	11	16	–	5	–	155	0	19
Other Liquids	80	–	476	–	-11	–	713	0	-145
Other Hydrocarbons/Alcohol	80	–	(s)	–	2	–	78	0	0
Unfinished Oils	–	–	413	–	-21	–	607	0	-174
Motor Gasoline Blend. Comp.	–	–	62	–	7	–	27	0	28
Aviation Gasoline Blend. Comp.	–	–	0	–	(s)	–	(s)	0	(s)
Finished Petroleum Products	–	14,773	1,491	–	112	–	–	707	15,405
Finished Motor Gasoline	–	6,959	342	–	10	–	–	55	7,235
Leaded	–	369	1	–	-21	–	–	6	385
Unleaded	–	6,590	341	–	31	–	–	49	6,850
Finished Aviation Gasoline	–	23	(s)	–	-1	–	–	0	24
Jet Fuel	–	1,488	108	–	31	–	–	43	1,522
Naphtha-Type	–	178	8	–	-1	–	–	4	182
Kerosene-Type	–	1,311	100	–	31	–	–	39	1,340
Kerosene	–	45	5	–	1	–	–	5	43
Distillate Fuel Oil	–	2,925	278	–	73	–	–	109	3,021
Residual Fuel Oil	–	950	504	–	13	–	–	211	1,229
Naphtha for Petro. Feed. Use	–	138	46	–	-1	–	–	5	182
Other Oils for Petro. Feed. Use	–	287	109	–	(s)	–	–	21	355
Special Naphthas	–	85	11	–	(s)	–	–	10	58
Lubricants	–	168	12	–	-4	–	–	20	164
Waxes	–	17	1	–	(s)	–	–	2	16
Petroleum Coke	–	552	2	–	-4	–	–	220	339
Asphalt and Road Oil	–	449	32	–	-5	–	–	3	483
Still Gas	–	673	0	–	0	–	–	0	673
Miscellaneous Products	–	65	2	–	(s)	–	–	2	65
Total	8,994	15,272	8,019	259	107	(s)	14,589	857	16,889

[a] Unaccounted for crude oil represents the difference between the supply and disposition of crude oil.
[b] A negative number indicates a decrease in stocks and a positive number indicates an increase in stocks.
[c] Products supplied is equal to field production, plus refinery production, plus imports, plus unaccounted for crude oil, minus stock change, minus crude losses, minus refinery inputs, minus exports.
(s) = Less than 500 barrels per day.
LRG = Liquefied Refinery Gas.
Note: Totals may not equal sum of components due to independent rounding.
Sources: • Energy Information Administration (EIA) Forms EIA-810, "Monthly Refinery Report," EIA-811, "Monthly Bulk Terminal Report," EIA-812, "Monthly Product Pipeline Report," EIA-813, "Monthly Crude Oil Report," EIA-814, "Monthly Imports Report," EIA-816, "Monthly Natural Gas Liquids Report," and EIA-817, "Monthly Tanker and Barge Movement Report." • Domestic crude oil production from State conservation agencies and the Minerals Management Service of the U.S. Department of the Interior. • Export data from the Bureau of the Census and Form EIA-810, "Monthly Refinery Report."

A-3

Table 9. PAD District III—Daily Average Supply and Disposition of Crude Oil and Petroleum Products, 1990 (Thousand Barrels per Day)

Commodity	Supply					Disposition				
	Field Production	Refinery Production	Imports by PAD District of Entry[a]	Unaccounted For Crude Oil[b]	Net Receipts	Stock Change[c]	Crude Losses	Refinery Inputs	Exports	Products Supplied[d]
Crude Oil	3,340	–	3,887	223	-1,402	-13	(s)	6,050	0	0
Natural Gas Liquids and LRGs	1,046	291	65	–	-66	8	–	256	19	1,025
Pentanes Plus	191	–	1	–	-9	-3	–	98	1	86
Liquefied Petroleum Gases	855	291	65	–	-87	11	–	157	17	939
Ethane/Ethylene	364	11	3	–	45	-15	–	(s)	0	438
Propane/Propylene	304	224	25	–	-119	16	–	(s)	11	407
Normal Butane/Butylene	72	44	25	–	3	6	–	64	5	69
Isobutane	116	12	12	–	-17	4	–	93	0	25
Other Liquids	52	–	295	–	-19	-10	–	409	0	-71
Other Hydrocarbons/Alcohol	52	–	0	–	0	(s)	–	51	0	0
Unfinished Oils	–	–	285	–	-10	-18	–	387	0	-95
Motor Gasoline Blend. Comp.	–	–	10	–	-9	7	–	30	0	24
Aviation Gasoline Blend. Comp.	–	–	0	–	0	(s)	–	(s)	0	(s)
Finished Petroleum Products	–	6,754	216	–	-3,161	36	–	–	349	3,426
Finished Motor Gasoline	–	3,125	14	–	-1,899	10	–	–	43	1,187
Leaded	–	67	(s)	–	-10	-5	–	–	6	56
Unleaded	–	3,058	14	–	-1,889	15	–	–	37	1,131
Finished Aviation Gasoline	–	14	0	–	-7	(s)	–	–	0	7
Jet Fuel	–	746	17	–	-468	14	–	–	23	258
Naphtha-Type	–	97	0	–	-22	1	–	–	1	73
Kerosene-Type	–	649	17	–	-447	13	–	–	22	185
Kerosene	–	19	1	–	-12	(s)	–	–	5	3
Distillate Fuel Oil	–	1,304	2	–	-714	9	–	–	72	511
Residual Fuel Oil	–	366	29	–	-9	2	–	–	54	330
Petrochemical Feedstocks[o]	–	342	144	–	1	-1	–	–	17	470
Special Naphthas	–	33	7	–	-12	1	–	–	6	21
Lubricants	–	101	(s)	–	-22	-2	–	–	9	73
Waxes	–	10	(s)	–	(s)	(s)	–	–	1	9
Petroleum Coke	–	243	1	–	0	2	–	–	118	123
Asphalt and Road Oil	–	112	1	–	-18	-1	–	–	(s)	95
Still Gas	–	308	0	–	0	0	–	–	0	308
Miscellaneous Products	–	35	(s)	–	-2	(s)	–	–	1	33
Total	4,439	7,045	4,463	223	-4,677	19	(s)	6,724	367	4,380

[a] Represents the PAD District in which the material entered the United States and not necessarily where the crude oil or product is processed and/or consumed.
[b] Unaccounted for crude oil represents the difference between the supply and disposition of crude oil.
[c] A negative number indicates a decrease in stocks and a positive number indicates an increase in stocks.
[d] Products supplied is equal to field production, plus refinery production, plus imports, plus unaccounted for crude oil, plus net receipts, minus stock change, minus crude losses, minus refinery inputs, minus exports.
[o] Includes naphtha less than 401° F endpoint and other oils equal to or greater than 401° F endpoint.
(s) = Less than 500 barrels per day.
LRG = Liquefied Refinery Gas.
Note: Totals may not equal sum of components due to independent rounding.
Sources: • Energy Information Administration (EIA) Forms EIA-810, "Monthly Refinery Report," EIA-811, "Monthly Bulk Terminal Report," EIA-812, "Monthly Product Pipeline Report," EIA-813, "Monthly Crude Oil Report," EIA-814, "Monthly Imports Report," EIA-816, "Monthly Natural Gas Liquids Report," and EIA-817, "Monthly Tanker and Barge Movement Report." • Domestic crude oil production from State conservation agencies and the Minerals Management Service of the U.S. Department of the Interior. • Export data from the Bureau of the Census and Form EIA-810, "Monthly Refinery Report."

TABLE A-4

PADD III PRODUCTION OF MAJOR PRODUCTS

SUMMER[1] VERSUS ANNUAL AVERAGE

STUDY OF EFFECTS OF HiTEC 3000 USE

(% of annual)

	1987	1988	1989	1990	Average
Gasoline	102.4	100.5	103.4	101.7	102.0
Kerosene Jet Fuel	94.7	93.0	93.7	96.5	94.5
Distillate Fuel	94.7	97.7	97.4	101.0	97.7
Residual Fuel	98.6	98.7	93.9	97.0	97.1
Asphalt	126.9	119.7	117.7	118.6	120.7

[1] Second and third quarters.

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TABLE A-5

FIRST SALES OF MOTOR GASOLINE

BY GRADE

STUDY OF EFFECTS OF HiTEC 3000 USE

(%)

	PADD					
	I	II	III	IV	V	U.S.
1990						
Regular	0.2	3.4	2.3	22.1	15.4	4.8
Unleaded Regular	58.1	73.7	70.8	62.2	61.7	65.3
Unleaded Midgrade	14.5	8.8	10.4	2.4	1.8	9.6
Unleaded Premium	27.2	14.1	16.5	13.3	21.1	20.3

	U.S.					Outlook
	1986	1987	1988	1989	1990	1995
Regular	31.8	23.7	17.4	10.0	4.8	-
Unleaded Regular	50.9	55.9	58.6	59.8	65.3	68.6
Unleaded Midgrade*	-	-	-	6.7	9.6	10.1
UnleadedPremium	17.3	20.4	24.0	23.5	20.3	21.3

* Included in unleaded regular until 1989.
Source: *Petroleum Marketing Monthly*, Table 47, annual average.

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TABLE A-6

MOVEMENTS OF MOTOR GASOLINE

BETWEEN PADDS – 1990

STUDY OF EFFECTS OF HITEC 3000 USE

(MM barrels)

	Shipments from PADD					Total
Receipts	I	II	III	IV	V	Receipts
I	-	21.3	561.6	-	-	582.9
II	58.0	-	140.6	5.4	-	204.0
III	-	20.3	-	-	-	20.3
IV	-	10.7	-	-	-	10.7
V	-	-	11.3	10.6	-	21.9
Total Shipments	58.0	52.3	713.5	16.0	0	839.8
Total Receipts	582.9	204.0	20.3	10.7	21.9	839.8
Net Receipts						
MM Barrels	524.9	151.7	(693.2)	(5.3)	21.9	-
M Barrels/Day	1,438	416	(1,899)	(15)	60	-

Source: *Petroleum Supply Annual*, 1990, Table 32.

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TABLE A-7

PADD III GASOLINE PRODUCTION GRADE RATIO

STUDY OF EFFECTS OF HITEC 3000 USE

(%)

	1990						Outlook
	Destination PADD						
	I	II	III	V	Exported	Total	1995
Regular	0.2	3.4	2.3	15.4	-	1.5	-
Unleaded Regular	58.1	73.7	70.8	61.7	100.0	65.2	66.2
Unleaded Midgrade	14.5	8.8	10.4	1.8	-	12.0	12.2
Unleaded Premium	27.2	14.1	16.5	21.1	-	21.3	21.6
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0
PADD III Refinery Supply, MB/D	1,539	385	1,131	31	39	3,125	-

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TABLE A-8
SUMMER GASOLINE PROPERTIES(1)
U.S. AVERAGE(2)
STUDY OF EFFECTS OF HITEC 3000 USE

	1989	1990	Delta
UNLEADED REGULAR			
Gravity, °API	58.2	58.2	0.0
Sulfur, wt %	0.033	0.037	0.004
Benzene, vol %	1.76	1.73	(0.03)
Octane Number			
Research	91.9	92.0	0.1
Motor	82.5	82.8	0.3
(R+M)/2	87.2	87.4	0.2
RVP, psi	9.1	8.7	(0.4)
20 V/L, °F	137	140	3
Distillation, °F			
IBP	94	93	(1)
10%	123	125	2
50%	211	212	1
90%	343	346	3
EP	414	417	3
UNLEADED MIDGRADE			
Gravity, °API	57.1	57.4	0.3
Sulfur, wt %	0.029	0.028	(0.001)
Benzene, vol %	1.65	1.75	0.10
Octane Number			
Research	94.0	94.0	0.0
Motor	84.2	84.4	0.2
(R+M)/2	89.1	89.2	0.1
RVP, psi	9.2	8.7	(0.5)
20 V/L, °F	139	141	2
Distillation, °F			
IBP	93	93	0
10%	125	126	1
50%	219	216	(3)
90%	342	342	0
EP	416	415	(1)
UNLEADED PREMIUM			
Gravity, °API	55.3	55.5	0.2
Sulfur, wt %	0.011	0.013	0.002
Benzene, vol %	1.87	1.86	(0.01)
Octane Number			
Research	97.4	97.4	0.0
Motor	87.2	87.6	0.4
(R+M)/2	92.3	92.5	0.2
RVP, psi	9.1	8.7	(0.4)
20 V/L, °F	142	144	2
Distillation, °F			
IBP	93	92	(1)
10%	128	129	1
50%	228	227	(1)
90%	332	332	0
EP	406	405	(1)

(1) NIPER data.
(2) Excluding high altitude gasoline.

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TABLE A-9
SUMMER/WINTER GASOLINE PROPERTIES(1)
U.S. AVERAGE(2)
STUDY OF EFFECTS OF HITEC 3000 USE

UNLEADED REGULAR	Winter '89 - '90	Summer 1989	Delta
Gravity, °API	62.2	58.2	4.0
Sulfur, wt %	0.041	0.033	0.008
Benzene, vol %	1.63	1.76	(0.13)
Octane Number			
Research	91.7	91.9	(0.2)
Motor	82.6	82.5	0.1
(R+M)/2	87.2	87.2	0.0
RVP, psi	13.2	9.1	4.1
20 V/L, °F	116	137	(21)
Distillation, °F			
IBP	82	94	(12)
10%	104	123	(19)
50%	194	211	(17)
90%	334	343	(9)
EP	406	414	(8)
UNLEADED MIDGRADE			
Gravity, °API	61.2	57.1	4.1
Sulfur, wt %	0.029	0.029	0.000
Benzene, vol %	1.53	1.65	(0.12)
Octane Number			
Research	93.9	94.0	(0.1)
Motor	84.5	84.2	0.3
(R+M)/2	89.3	89.1	0.2
RVP, psi	13.0	9.2	3.8
20 V/L, °F	117	139	(22)
Distillation, °F			
IBP	82	93	(11)
10%	106	125	(19)
50%	200	219	(19)
90%	329	342	(13)
EP	404	416	(12)
UNLEADED PREMIUM			
Gravity, °API	58.7	55.3	3.4
Sulfur, wt %	0.014	0.011	0.003
Benzene, vol %	1.74	1.87	(0.13)
Octane Number			
Research	97.3	97.4	(0.1)
Motor	87.4	87.2	0.2
(R+M)/2	92.4	92.3	0.1
RVP, psi	13.3	9.1	4.2
20 V/L, °F	119	142	(23)
Distillation, °F			
IBP	82	93	(11)
10%	106	128	(22)
50%	217	228	(11)
90%	325	332	(7)
EP	398	406	(8)

(1) NIPER data.
(2) Excluding high altitude gasoline.

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TABLE A-10
AVERAGE 1989 SUMMER GASOLINE PROPERTIES AS PRODUCED BY PADDS(1) STUDY OF EFFECTS OF HITEC 3000 USE

	III	U.S. TOTAL
LEADED REGULAR		
Octane, (R+M)/2	89.1	88.4
Sulfur, ppm	330	383
Aromatics, vol %	28	28
Olefins, vol %	14	14
Benzene, vol %°	1.53	1.67
RVP, PSI	9.1	9.2
ASTM Dist.		
10%	123	122
30%	164	161
50%	209	207
70%	262	258
90%	340	334
UNLEADED REGULAR		
Octane, (R+M)/2	87.2	87.1
Sulfur, ppm	381	384
Aromatics, vol %	29	30
Olefins, vol %	15	14
Benzene, vol %°	1.46	1.54
RVP, PSI	9.3	9.5
ASTM Dist.		
10%	119	119
30%	148	154
50%	207	205
70%	261	260
90%	344	339
UNLEADED PREMIUM		
Octane, (R+M)/2	92.7	92.5
Sulfur, ppm	141	143
Aromatics, vol %	38	38
Olefins, vol %	7	7
Benzene, vol %°	1.54	1.62
RVP, PSI	9.8	9.6
ASTM Dist.		
10%	121	123
30%	164	174
50%	223	224
70%	270	269
90%	335	330
POOL BY GRADES		
Octane, (R+M)/2 - Clear	89.0	88.7
Sulfur, ppm	305	321
Aromatics, vol %	32	32
Olefins, vol %	12	11
Benzene, vol %°	1.49	1.58
RVP, PSI	9.4	9.5
ASTM Dist.		
10%	120	120
30%	155	160
50%	212	210
70%	263	262
90%	342	336
COMPONENT POOL		
Aromatics, vol %	32	32
Olefins, vol %	13	13

(1) Based on 1989 NPRA survey data. ° Niper data.

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TABLE A-11

REFINERY PROCESS CAPACITIES BASIS

STUDY OF EFFECTS OF HiTEC 3000 USE

- Start with all operable refineries as of January 1, 1989 reported by DOE in the 1988 *PSA*.
- Exclude refineries that reported no inputs to DOE in 1988.
- Add refineries that have announced restarts and have actively begun the restart process.
- Delete refineries that have announced pending shutdowns. Deletion of some downstream equipment when indicated by announcement.
- Add process unit capacity that is under construction or completed since 1/1/89 according to *Hydrocarbon Processing* and *Oil & Gas Journal*.
- Include units at partially operating refineries. Do not include in refinery count if crude unit is idle (except for Valero at Corpus Christi).
- Add some 1/1/90 unit capacities indicated in NPRA survey not shown by published data.
- Assume following maximum utilizations of stream day capacities:

	IIIC	
	2nd and 3rd Qtrs.	1st and 4th Qtrs.
Crude	96	93
FCC/Coking	95	88
Hydrocracking	88	85
Dependent Downstream[1]	88	85
Other Downstream	95	92

[1] Units for which operation is dependent on simultaneous operation of other downstream units, i.e., alkylation, polymerization, C_4 isomerization, hydrogen and MTBE.

Sulfur recovery maximum utilization of stream day capacities is: 66% in model IIIC.

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TABLE A-13

PADD III SMALL REFINERY PRODUCTION

STUDY OF EFFECTS OF HiTEC 3000 USE

(thousand barrels per day)

	Summer	Winter
Unleaded Regular Gasoline	30	29
Naphtha Jet Fuel	35	35
Kero Jet/Kero	11	12
Diesel Fuel, 0.25% Sulfur	47	49
Residual Fuel	20	21
Asphalt/Road Oil	24	16
Naphthas and specialties	16	16
Lube/Wax	19	19
Miscellaneous	8	8
Total Products	210	205

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REFINERY OPERATIONS

PURPOSE:

Determine the effect on refinery operations of adding HiTEC 3000 to unleaded gasoline

METHODOLOGY:

Use Turner, Mason & Co's PADD III LP model
Use 1990 gasoline volumes and grade ratios
Set 1995 RFG, Oxy and conventional gasoline specifications
Run summer and winter cases, with or without HiTEC 3000

MODELLING PARAMETERS

Waiver Date	May, 1990	July, 1991
Year Represented	1994	1995
Areas Modelled, PADDS	I, III	III
Gasoline		
Volume, m B/D, U.S.	7,280	6,959
Pool Octane, (R+M)/2	89.3	88.7
Grade Ratios, UP/UM/UR/LR	34/14/49/3	21/10/69/0
RFG, Oxy Gaso.	No	Yes
Diesel Fuel Oil		
Volume, m B/D	3,020	2,925
Diesel Sulfur, Wt. %	0.05	0.05

EFFECT OF HiTEC 3000 ON US REFINING OPERATIONS

Waiver Date	July, 1991		July, 1991	
Ozone Non-Attainment Areas	9 Cities		All Opt-In	
Gasoline Quality	Summ	Wint	Summ	Wint
% RFG @ 2.1% Oxygen	25.3	8.6	63.3	31.2
% RFG @ 2.7%	----	16.7	----	32.1
% OXY @ 2.7%	----	20.0	----	4.6
% Conv @ 0%	74.7	54.7	36.7	32.1

EFFECT OF HiTEC 3000 ON US REFINING OPERATIONS

Waiver Date	July, 1991	July, 1991
Ozone Non-Attainment Areas	9 Cities	All Opt-In
Average HiTEC 3000 Concentration mg Mn/Gal	17	11
Annual Savings in Crude Oil, m B/D	85	47
Reductions in Refinery Emissions, Tons/Year		
NOx	2,700	1,650
CO	2,150	1,220
Particulates	1,980	1,080
SOx	3,760	2,360
CO2 (Thousands)	1,800	1,180

DRAFT

TABLE 1

U.S. CRUDE OIL SAVINGS

STUDY OF EFFECTS OF HiTEC 3000 USE

(thousand barrels per day)

	Summer	Winter	Annual
Minimum Reformulated Gasoline	142	28	85
Maximum Reformulated Gasoline	70	24	47

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TABLE 2

REFINERY EMISSIONS CHANGES

1995 CASE RESULTS – ESTIMATED U.S.

MANGANESE CASE DECREASE FROM BASE CASE

STUDY OF EFFECTS OF HITEC 3000 USE

(tons per year)

	Summer	Winter	Annual
Minimum Reformulated Gasoline			
NO_x	4,390	1,010	2,700
CO	3,580	720	2,150
Particulates	3,330	630	1,980
SO_x	6,370	1,150	3,760
CO_2 (thousands)	2,860	750	1,800
Maximum Reformulated Gasoline			
NO_x	2,560	740	1,650
CO	1,970	460	1,220
Particulates	1,790	370	1,080
SO_x	4,080	650	2,360
CO_2 (thousands)	1,760	590	1,180

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TABLE B-1

REFINERY RAW MATERIALS INPUT RATES DETAIL

IIIC 1995 SUMMER BASE(1) RESULTS - MBPCD

STUDY OF EFFECTS OF HITEC 3000 USE

	Minimum Reformulated		Maximum Reformulated	
	Summer	Winter	Summer	Winter
Domestic Crudes	2,164	2,164	2,164	2,164
Foreign Crudes	4,291	3,709	4,025	3,590
Sub Total Crudes	6,455	5,873	6,189	5,754
Natural Gasoline		47	6	53
Reformate, 100 RONC	(72)	(72)	(72)	(72)
Naphtha	2	7	2	7
Vacuum Gas Oil	231	231	231	231
Vacuum Resid	14	14	14	14
Normal Butane	85	238	86	247
Iso-Butane	63	37	66	32
MTBE	38	154	182	238
Propane	9	9	9	9
Nat. Gas Fd to H2, FOE	20	20	20	21
Methanol	20	17	19	16
Total Input	6,865	6,575	6,752	6,551
Nat Gas for Fuel, FOE	134	172	161	185

(1) Without HITEC 3000.

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TABLE B-2
REFINERY PRODUCT RATES DETAIL
IIIC 1995 SUMMER BASE(1) RESULTS - MBPCD
STUDY OF EFFECTS OF HiTEC 3000 USE

	Minimum Reformulated		Maximum Reformulated	
	Summer	Winter	Summer	Winter
Motor Gasolines				
Unleaded Regular	1,548	1,095	761	644
Unleaded Intermediate	290	205	142	121
Unleaded Premium	512	362	252	213
Reformulated Regular	536	930	1,337	1,391
Reformulated Intermediate	100	174	250	260
Reformulated Premium	177	308	442	460
Total Gasoline	3,163	3,074	3,184	3,089
Aviation Gasolines	14	14	14	14
Naphtha Jet	62	62	62	62
Kero Jet / Kerosene	634	693	634	693
Distillate Fuels - 0.05% S	1,019	1,067	1,019	1,067
Distillate Fuels - 0.25% S	208	218	208	218
Residual Fuels				
< 0.3% Sulfur	8	9	8	9
0.7 - 1.0% Sulfur	45	48	45	48
1.0 - 2.0% Sulfur	151	160	151	160
> 2.0% Sulfur	187	148	112	128
Sub Total	391	365	316	345
Asphalt / Road Oil	111	73	111	73
Marketable Coke - 400#	172	160	172	160
Benzene	29	21	29	21
Toluene	10	19	10	20
Xylene	36	36	36	36
Spcl. Naph. / Misc.	87	87	87	87
Petrochem Naphtha	46	46	46	46
Lubes / Wax	92	92	92	92
Petrochem Gas Oil	187	187	187	187
Carbon Black Feed	39	39	39	39
Propene	66	66	66	66
Butanes / Butene	146	10	146	17
Propane	156	129	142	123
Plant Fuel	517	408	466	382
(Gain) / Loss	(318)	(292)	(313)	(285)
Total Products	6,865	6,575	6,753	6,551

(1) Without HiTEC 3000.

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TABLE C1-1

RUN BASIS AND GASOLINE POOL PROPERTIES

1995 CASE RESULTS – IIIC – MAXIMUM REFORMULATED GASOLINE

STUDY OF EFFECTS OF HiTEC 3000 USE

	Summer		Winter	
Reformulated Limits°	No Mn	With Mn	No Mn	With Mn
Aromatics, %, Maximum	25.0	25.0	25.3	25.3
Ethers, %, Minimum	11.7	11.7	13.5	13.5
Olefins, %, Maximum	13.2	13.2	11.9	11.9
90% Point, °F, Maximum	342	342	333	333
Sulfur, ppm, Maximum	305	305	365	365
Reid Vapor Pressure, psi, Maximum	7.4	7.4	12.5	12.5
Benzene, %, Maximum	0.95	0.95	0.98	0.98
Ethers, % Pool				
Purchased	5.7	5.7	7.7	7.7
Manufactured	1.7	1.7	1.5	1.5
Reformulated Requirement				
% Base Pool	63.3	63.3	67.9	67.9
Gasoline Pool Properties				
(R+M)/2 Octane, Clear°	88.8	88.8	88.8	88.8
HiTEC 3000, mg Mn/gal		15		7
Aromatics, %	26.2	25.1	20.7	20.2
Ethers, %	7.4	7.4	9.2	9.2
Oxygen, %	1.3	1.3	1.7	1.7
Olefins, %	12.3	12.4	10.8	10.8
Benzene, %	1.15	1.15	0.92	0.83
Sulfur, WPPM	278	266	214	228
Reid Vapor Pressure, PSI°	7.6	7.6	12.5	12.5
Temperature at V/L = 20, °F	144	144	116	116
Distillation				
90%, °F	13	12	20	20
130°F, %	21	21	28	28
170°F, %	35	35	43	43
212°F, %	52	51	58	59
257°F, %	69	68	73	73
300°F, %	81	81	84	84
356°F, %	92	92	94	94
10%, °F	120	121	88	84
50%, °F	207	208	189	189
90%, °F	342 °	342 °	333 °	333
Heat Content, MBTU/G	112.7	112.6	110.1	110.1

° Input limit.

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TABLE C1-1A

RUN BASIS AND REFORMULATED GASOLINE POOL PROPERTIES

1995 CASE RESULTS – IIIC – MAXIMUM REFORMULATED GASOLINE

STUDY OF EFFECTS OF HiTEC 3000 USE

	Summer		Winter	
Reformulated Limits°	No Mn	With Mn	No Mn	With Mn
Aromatics, %, Minimum	25.0	25.0	25.3	25.3
Ethers, %, Minimum	11.7	11.7	13.5	13.5
Olefins, %, Maximum	13.2	13.2	11.9	11.9
90% Point, °F, Maximum	342	342	333	333
Sulfur, ppm, Maximum	305	305	365	365
Reid Vapor Pressure, psi, Maximum	7.4	7.4	12.5	12.5
Benzene, %, Maximum	0.95	0.95	0.98	0.98
Reformulated Gasoline Pool Properties				
(R+M)/2 Octane, Clear°	88.8	88.8	88.8	88.8
HiTEC 3000, mg Mn/gal		15		6
Aromatics, %	24.1	22.8	19.1	18.6
Ethers, %°	11.7	11.7	13.5	13.5
Oxygen, %°	2.1	2.1	2.4	2.4
Olefins, %	13.2 °	13.0	10.5	11.0
Benzene, %°	0.95 °	0.95 °	0.85	0.82
Sulfur, WPPM	298	244	272	196
Reid Vapor Pressure, PSI°	7.4	7.4	12.5	12.5
Temperature at V/L = 20, °F	145	144	116	116
Distillation				
90%, °F	12	12	20	19
130°F, %	20	20	27	26
170°F, %	37	38	45	45
212°F, %	54	55	61	62
257°F, %	69	69	74	75
300°F, %	81	81	84	84
356°F, %	92	92	94	93
10%, °F	123	125	84	82
50%, °F	203	200	183	182
90%, °F	342 °	342 °	333	333
Heat Content, MBTU/G	111.8	111.5	109.2	109.1

° Input limit.

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TABLE C1-1B

RUN BASIS AND CONVENTIONAL GASOLINE POOL PROPERTIES

1995 CASE RESULTS – IIIC – MAXIMUM REFORMULATED GASOLINE

STUDY OF EFFECTS OF HiTEC 3000 USE

	Summer		Winter	
Conventional Limits°	No Mn	With Mn	No Mn	With Mn
Aromatics, %, Maximum	31.6	31.6	28.7	28.7
Ethers, %, Minimum	-	-	-	-
Olefins, %, Maximum	13.2	13.2	11.9	11.9
90% Point, °F, Maximum	342	342	333	333
Sulfur, ppm, Maximum	305	305	365	365
Reid Vapor Pressure, psi, Maximum	7.9	7.9	12.5	12.5
Benzene, %, Maximum	1.49	1.49	1.36	1.36
Conventional Gasoline Pool Properties				
(R+M)/2 Octane, Clear°	88.8	88.8	88.8	88.8
HiTEC 3000, mg Mn/gal		15		8
Aromatics, %	30.0	29.3	24.0	23.6
Ethers, %				
Oxygen, %				
Olefins, %	10.7	11.3	11.6	10.3
Benzene, %	1.49 °	1.49 °	1.08	0.85
Sulfur, WPPM	244	305	105	297
Reid Vapor Pressure, PSI°	7.9	7.9	12.5	12.5
Temperature at V/L = 20, °F	142	143	117	116
Distillation				
90%, °F	14	14	22	22
130°F, %	24	22	31	32
170°F, %	31	28	38	38
212°F, %	48	45	53	52
257°F, %	68	66	71	71
300°F, %	81	81	83	83
356°F, %	92	92	94	94
10%, °F	116	113	89	90
50%, °F	214	223	203	203
90%, °F	342 °	342 °	334 °	332
Heat Content, MBTU/G	114.3	114.5	112.2	112.1

° Input limit.

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TABLE C1-2

REFINERY RAW MATERIAL AND PRODUCT RATE CHANGES
1995 CASE RESULTS – IIIC – MAXIMUM REFORMULATED GASOLINE
MANGANESE CASE INCREASE OVER BASE CASE – MBPCD
STUDY OF EFFECTS OF HITEC 3000 USE

	Summer	Winter
Raw Materials		
Domestic Crude		
Foreign Crude	(32)	(11)
Subtotal Crudes	(32)	(11)
Natural Gasoline	1	1
Naphtha		
MTBE	1	
Methanol		2
NC4	7	
IC4	(3)	
Natural Gas to H2 Plant Feed		
Total	(25)	(8)
Natural Gas to Fuel	13	3
Products		
Motor Gasolines	4	2
No. 6 Bunker	(7)	(3)
Normal Butane		
Propane	(3)	(1)
Plant Fuel	(18)	(5)
Isobutane		
Marketable Coke		
Loss(Gain)	(1)	(1)
Total	(25)	(8)
Gasoline Demand Increase, %(1)		
Results	0.1	0.1
Target	0.1	0.1

(1) To maintain constant vehicle miles travelled.

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TABLE C-1

RUN BASIS AND GASOLINE POOL PROPERTIES

1995 CASE RESULTS – IIIC – MINIMUM REFORMULATED GASOLINE

STUDY OF EFFECTS OF HiTEC 3000 USE

	Summer		Winter	
Reformulated Limits°	No Mn	With Mn	No Mn	With Mn
Aromatics, %, Maximum	25.0	25.0	26.6	26.6
Ethers, %, Minimum	11.7	11.7	14.4	14.4
Olefins, %, Maximum	13.2	13.2	11.9	11.9
90% Point, °F, Maximum	342	342	333	333
Sulfur, ppm, Maximum	305	305	365	365
Reid Vapor Pressure, psi, Maximum	7.4	7.4	12.5	12.5
Benzene, %, Maximum	0.95	0.95	1.13	1.13
Ethers, % Pool				
Purchased	1.2	1.2	5.0	5.0
Manufactured	1.8	1.8	1.6	1.6
Reformulated Requirement				
% Base Pool	25.3	25.3	45.3	45.3
Gasoline Pool Properties				
(R+M)/2 Octane, Clear°	88.8	88.8	88.8	88.8
HiTEC 3000, mg Mn/gal		26		8
Aromatics, %	29.4	27.6	22.0	21.3
Ethers, %	3.0	3.0	6.6	6.6
Oxygen, %	0.5	0.5	1.2	1.2
Olefins, %	12.5	12.5	11.5	11.4
Benzene, %	1.35 °	1.35 °	1.08	0.99
Sulfur, WPPM	303	273	265	279
Reid Vapor Pressure, PSI°	7.8	7.8	12.5	12.5
Temperature at V/L = 20, °F	143	143	116	116
Distillation				
90%, °F	13	13	21	21
130°F, %	22	22	29	29
170°F, %	32	32	42	42
212°F, %	50	50	58	58
257°F, %	68	67	73	73
300°F, %	81	81	84	84
356°F, %	92	93	94	94
10%, °F	116	116	84	84
50%, °F	212	211	192	192
90%, °F	342	343	333 °	333 °
Heat Content, MBTU/G	113.8	113.6	110.7	110.7

° Input limit.

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TABLE C-1A

RUN BASIS AND REFORMULATED GASOLINE POOL PROPERTIES

1995 CASE RESULTS – IIIC – MINIMUM REFORMULATED GASOLINE

STUDY OF EFFECTS OF HiTEC 3000 USE

	Summer		Winter	
Reformulated Limits°	No Mn	With Mn	No Mn	With Mn
Aromatics, %, Maximum	25.0	25.0	26.6	26.6
Ethers, %, Minimum	11.7	11.7	14.4	14.4
Olefins, %, Maximum	13.2	13.2	11.9	11.9
90% Point, °F, Maximum	342	342	333	333
Sulfur, ppm, Maximum	305	305	365	365
Reid Vapor Pressure, psi, Maximum	7.4	7.4	12.5	12.5
Benzene, %, Maximum	0.95	0.95	1.13	1.13
Reformulated Gasoline Pool Properties				
(R+M)/2 Octane, Clear°	88.8	88.8	88.8	88.8
HiTEC 3000, mg Mn/gal		21		8
Aromatics, %	23.1	20.9	19.0	18.6
Ethers, %	11.7 °	11.7 °	14.4 °	14.4 °
Oxygen, %	2.1 °	2.1 °	2.6	2.6
Olefins, %	13.2 °	13.2 °	11.9 °	11.7
Benzene, %	0.95 °	0.95 °	0.96	0.83
Sulfur, WPPM	305	305	224	285
Reid Vapor Pressure, PSI°	7.4	7.4	12.5	12.5
Temperature at V/L = 20, °F	145	143	116	116
Distillation				
90%, °F	11	12	19	19
130°F, %	19	22	26	25
170°F, %	38	42	46	45
212°F, %	58	59	63	62
257°F, %	71	71	75	75
300°F, %	81	81	84	84
356°F, %	92	92	94	94
10%, °F	124	124	86	82
50%, °F	198	190	179	183
90%, °F	342 °	342 °	333 °	333 °
Heat Content, MBTU/G	111.5	110.9	108.9	109.0

° Input limit.

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TABLE C-1B

RUN BASIS AND CONVENTIONAL GASOLINE POOL PROPERTIES

1995 CASE RESULTS – IIIC – MINIMUM REFORMULATED GASOLINE

STUDY OF EFFECTS OF HITEC 3000 USE

	Summer		Winter	
Conventional Limits°	No Mn	With Mn	No Mn	With Mn
Aromatics, %, Maximum	31.6	31.6	28.7	28.7
Ethers, %, Minimum	-	-	-	-
Olefins, %, Maximum	13.2	13.2	11.9	11.9
90% Point, °F, Maximum	342	342	333	333
Sulfur, ppm, Maximum	305	305	365	365
Reid Vapor Pressure, psi, Maximum	7.9	7.9	12.5	12.5
Benzene, %, Maximum	1.49	1.49	1.36	1.36
Conventional Gasoline Pool Properties				
(R+M)/2 Octane, Clear°	88.8	88.8	88.8	88.8
HITEC 3000, mg Mn/gal		28		8
Aromatics, %	31.6 °	30.0	24.5	23.7
Ethers, %				
Oxygen, %				
Olefins, %	12.3	12.3	11.1	11.2
Benzene, %	1.49 °	1.49 °	1.18	1.13
Sulfur, WPPM	302	262	299	274
Reid Vapor Pressure, PSI°	7.9	7.9	12.5	12.5
Temperature at V/L = 20, °F	143	143	116	116
Distillation				
90%, °F	14	14	22	23
130°F, %	23	22	31	32
170°F, %	31	29	38	39
212°F, %	48	47	53	54
257°F, %	67	66	71	71
300°F, %	81	81	84	84
356°F, %	92	93	94	94
10%, °F	114	114	89	84
50%, °F	216	219	202	199
90%, °F	342 °	342 °	333 °	333 °
Heat Content, MBTU/G	114.5	114.5	112.3	112.1

° Input limit.

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TABLE C-2

REFINERY RAW MATERIAL AND PRODUCT RATE CHANGES
1995 CASE RESULTS – IIIC – MINIMUM REFORMULATED GASOLINE
MANGANESE CASE INCREASE OVER BASE CASE – MBPCD
STUDY OF EFFECTS OF HiTEC 3000 USE

	Summer	Winter
Raw Materials		
Domestic Crude		
Foreign Crude	(64)	(12)
Subtotal Crudes	(64)	(12)
Natural Gasoline	1	
Naphtha		
MTBE	1	
Methanol		
NC4	11	3
IC4	3	(1)
Natural Gas to H2 Plant Feed		1
Total	(49)	(9)
Natural Gas to Fuel	27	6
Products		
Motor Gasolines	3	4
No. 6 Bunker	(9)	(2)
Normal Butane		
Propane	(8)	(1)
Plant Fuel	(34)	(8)
Isobutane		
Marketable Coke		
Loss(Gain)	(1)	(2)
Total	(49)	(9)
Gasoline Demand Increase, %(1)		
Results	0.1	0.1
Target	0.1	0.1

(1) To maintain constant vehicle miles travelled.

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