COSTS OF POTENTIAL BAN

OF MTBE IN GASOLINES

Presented by

Robert E. Cunningham

to

Blue Ribbon Panel to Review the Use of

Oxygenates in Gasoline

March 2, 1999

TURNER, MASON & COMPANY

Consulting Engineers

EXPERTISE – ROBERT E. CUNNINGHAM

Senior Vice President of Turner, Mason & Company
40 Years Refining Industry Experience
Published 9 Papers
Expert Witness at CEC, CARB, EPA and ADEQ
Baseline Auditor for Over 50% U.S. Gasoline
Leading Refining Industry Modeler

Managed Refining Industry Costs Studies for:

- **National Petroleum Council – 1985-6; 1991-3**
- **Federal Trade Commission – 1997**
- **New York State Energy Research and Development Authority – 1994**
- **Auto/Oil Air Quality Improvement Research Program – 1990-92**
- **American Petroleum Institute – 1987; 1989; 1992-3; 1996**
- **Western States Petroleum Association – 1990-91; 1991; 1994; 1997**
- **Morgan & Finnegan – 1995-8**

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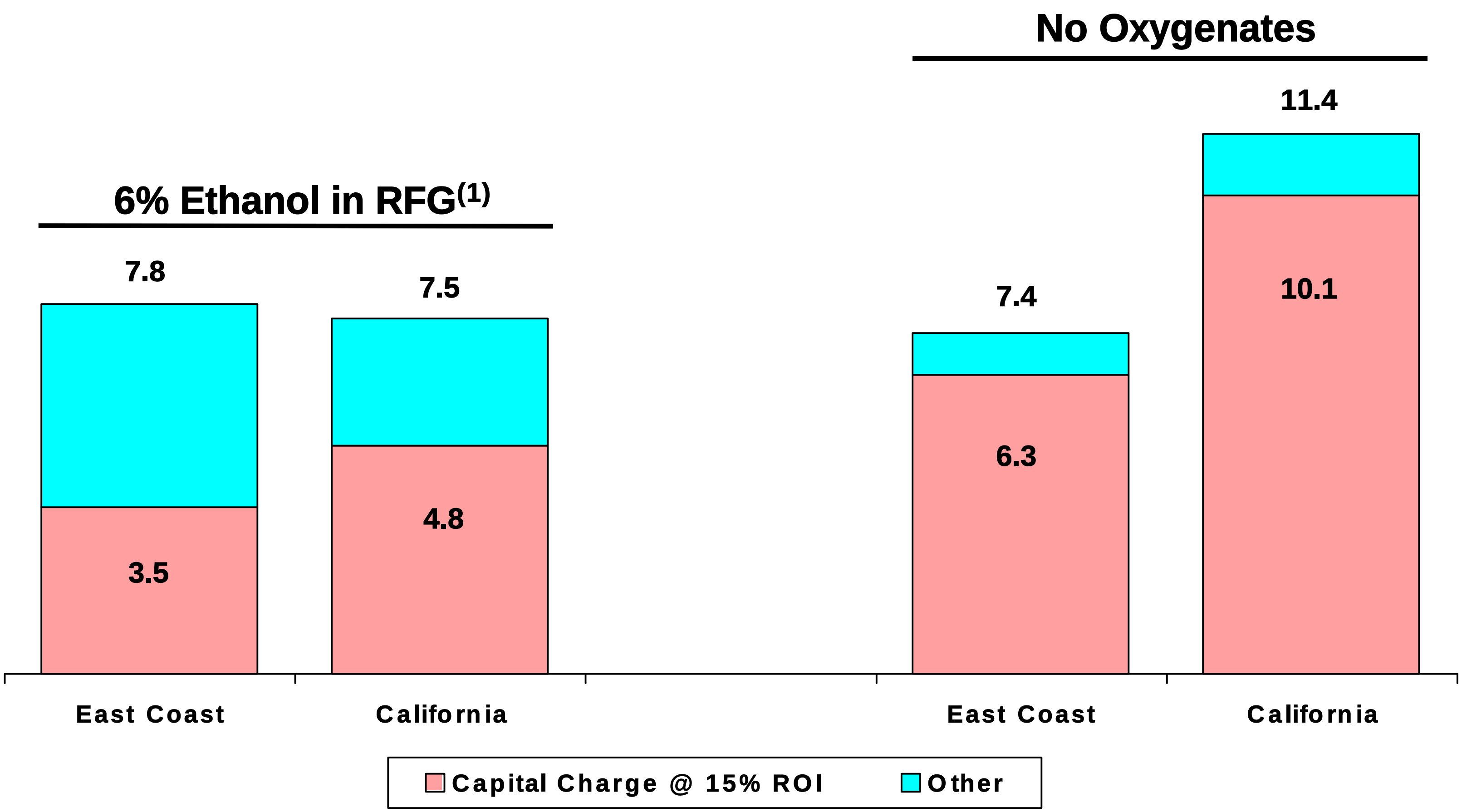
REFINING COSTS OF ETHER BAN IN 2005
(¢/gallon of RFG*)



*** In 1997 dollars.**
(1) Excludes federal tax credit of 3¢/gallon.

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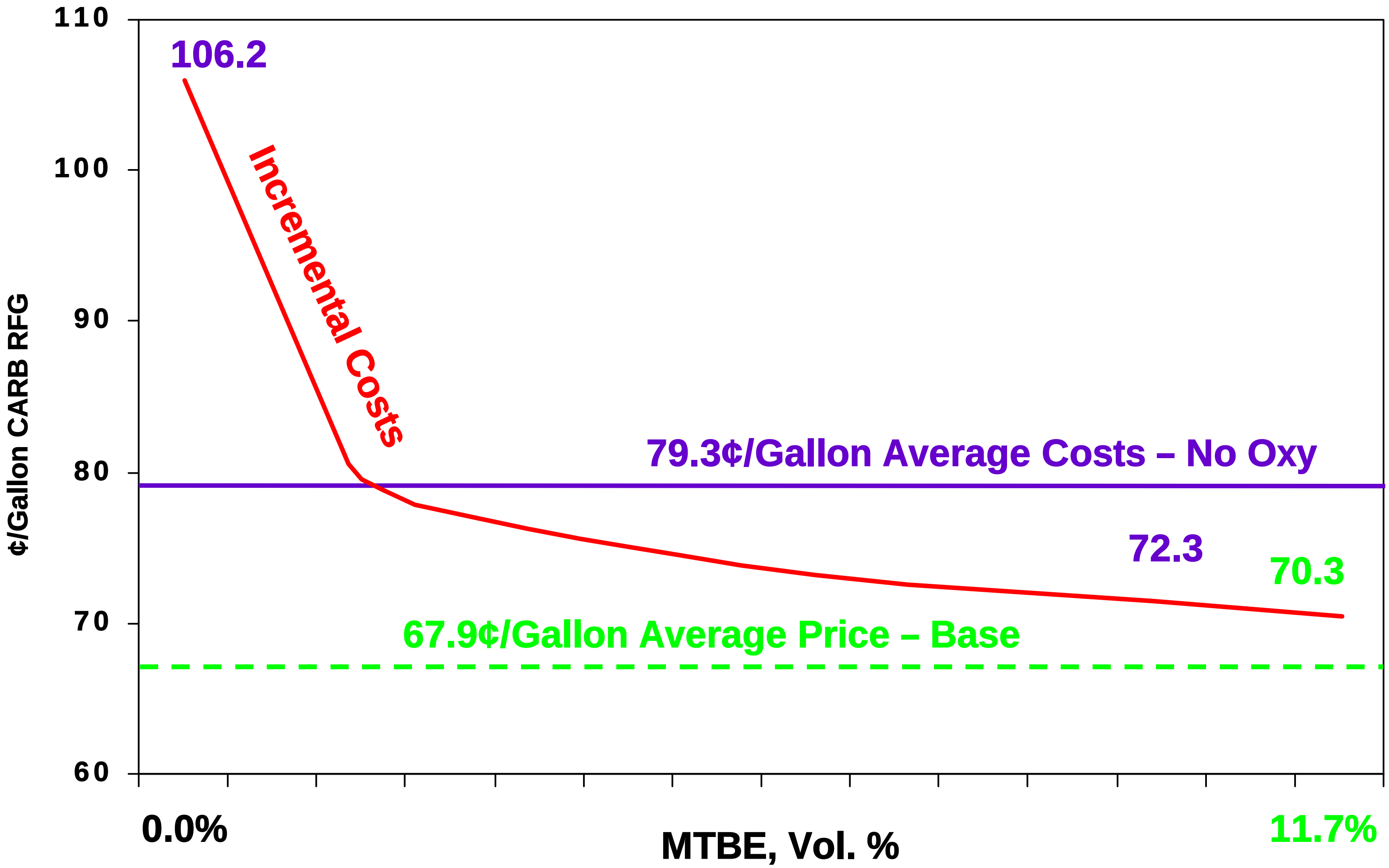
INCREMENTAL vs. AVERAGE REFINING COSTS OF BANNING OXYGENATES IN CALIFORNIA GASOLINE



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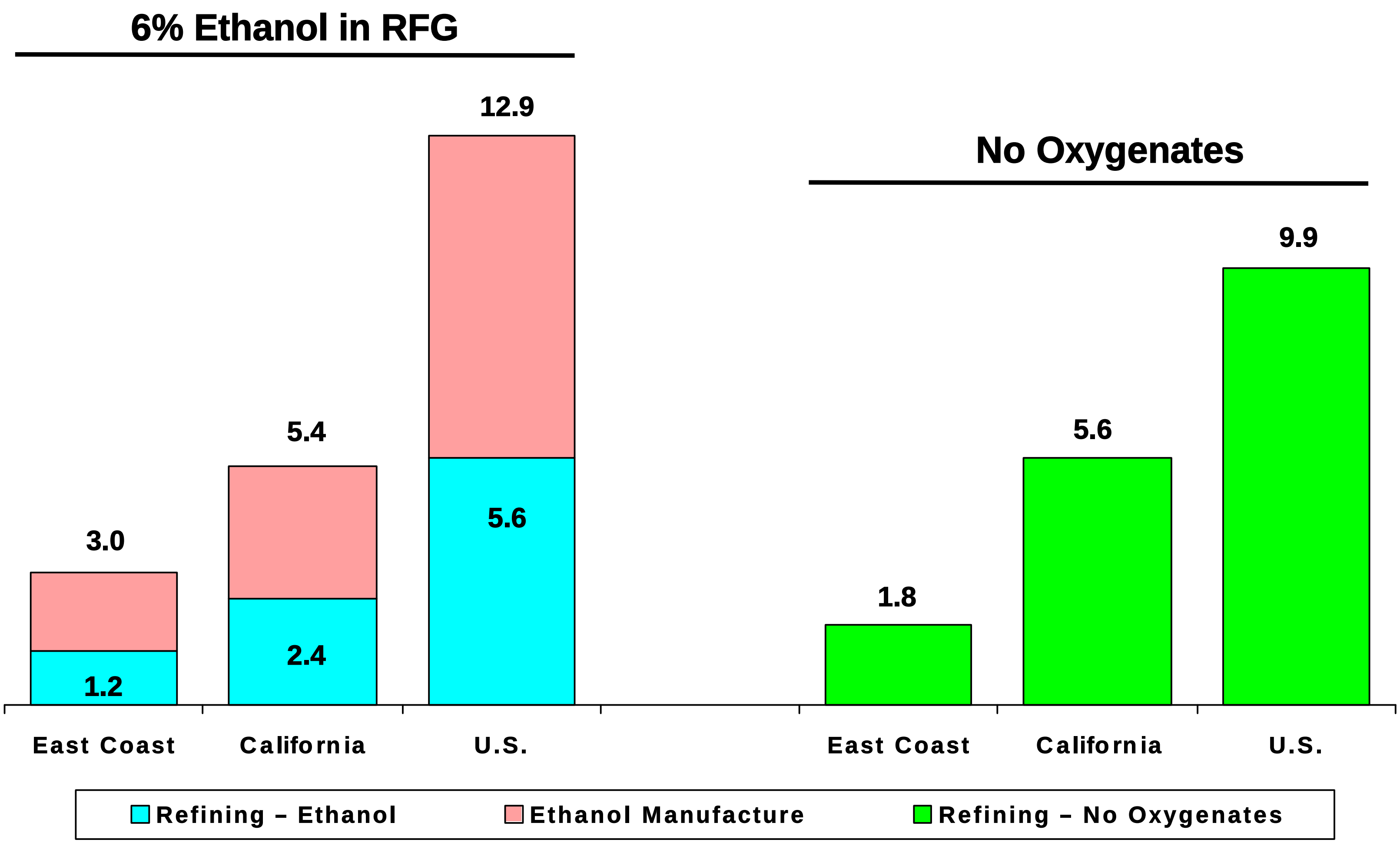
2005 INVESTMENTS REQUIRED
($ billions*)



*** In 1997 dollars.**

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2005 CARB RFG COSTS COMPARISONS

COST OF POTENTIAL BAN OF MTBE IN GASOLINES

(¢/Gallon)

	6% Ethanol in RFG			No Oxygenates		
	MathPro[1]			MathPro[1]		
	Original	Supplemental	TM&C	Original	Supplemental	TM&C
As Reported	2.4	2.7	7.5	3.7	4.3	11.4
Adjustments						
CARBOB and Alky Pricing	0.5	–		2.0	–	
Isobutane	–	–		–	0.6	
Oxygenates Pricing	1.5	2.0		0.5	0.2	
Tax Subsidy	4.2	4.2		–	–	
Free Refining Capacity	–	–		1.0	1.0	
LP Over-Optimization	–	–		4.2	5.0	
As Adjusted	8.6	8.9		11.4	11.1	

(1) Based on average CARB 2 RFG limits.

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MAJOR CONCLUSION – LONG TERM
COSTS OF BAN OF MTBE IN GASOLINES IN 2005+

Either Ethanol in RFG or No Oxygenates

- **Costs and investments about 3 times those in CEC study**
- **Wastes huge MTBE investment – $12 billion**
- **Requires large U.S. refining industry investment – $5-10 billion**
- **Base returns on refining assets have been extremely low at 2-6%**
- **Probably no return on added refining investments (none on prior mandates)**
- **Destroys marginal and small refineries and increases product imports**
- **Significantly increases driveability/distillation index**

6% Ethanol in RFG

- **Requires big ethanol investment – $7 billion**
- **Requires more railcars, increases train traffic and terminal blending**

No Oxygenates

- **Added refining investments close to base refining asset values**
- **California refining investments exceed CARB 2 RFG investments in 1993-95**
- **Very difficult and costly to maintain emissions of CARB RFG**
- **Costs of last increment of CARB RFG extremely high at +35¢/gallon**
- **Auto-Oil/TM&C showed 7.4¢/gal Δ costs for 75% less MTBE, no prem RFG**

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MAJOR CONCLUSION – SHORT TERM IMPACTS OF BAN OF MTBE IN GASOLINES BEFORE 2004

Either Ethanol in RFG or No Oxygenates

- **Drastic and politically unacceptable impacts**
- **Lower quality RFG with significantly increased air emissions and smog**
- **Alternative is big loss of RFG supply meeting emissions limits**
- **Inability to supply premium grade RFG meeting emissions limits**
- **Major reformulated gasoline shortages**
- **RFG shortages would hurt economy and cause recession**
- **Increase costs of gasoline several fold or force rationing and gasoline station lines**
- **Public anger and outcry**
- **Increased gasoline imports and exports; shipping traffic and port congestion**

Ethanol in RFG

- **WSPA/TM&C California study showed 20¢/gallon Δ costs with 43% shortage**
- **CEC/MathPro California study showed 7.5¢/gallon Δ costs with 17% shortage**
- **Increased VOC emissions – inability to meet EPA RFG VOC or CARB RVP limits**
- **Inadequate ethanol supply**
- **Huge ethanol price increase**
- **Increased ethanol imports**
- **Most terminals unable to splash blend ethanol**
- **Increase ethanol railroad traffic**

No Oxygenates

- **DOE/ORNL East Coast study showed 10¢/gallon Δ costs with 26% shortage, no prem gaso**
- **CEC/MathPro California study showed 12.8¢/gallon Δ costs with 42% shortage**
- **Increased toxics emissions – inability to meet toxics standards**

GASOLINE BLENDING IMPACTS OF REMOVING MTBE ON CARB 2 RFG PROPERTIES, EMISSIONS AND VOLUME

	Base 1997Average CARB 2 RFG CEC Survey	Revised Base w/o MTBE – Sub-Regular (@ Base RVP)	Adjusted Base w/o MTBE – Normal Grades[1] (@ Base Octane, RVP)	Adjusted Base Less Base
Octane, (R+M)/2	88.5	85.9	88.5	0.0
MTBE, Vol. %	11.7	0.0	0.0	(11.7)
Aromatics, Vol. %	23.0	26.4	32.6	9.6
Olefins, Vol. %	4.1	4.6	5.8	1.7
Benzene, Vol. %	0.57	0.65	0.75	0.18
RVP, psi	6.8	6.8	6.8	0.0
Distillation				
T10, ^oF	138	140	141	3
T50, ^oF	198	210	215	17
T90, ^oF	303	308	310	7
E200, %	50.5	45.2	42.4	(8.6)
E300, %	88.4	88.0	87.5	(1.7)
Driveability Index	1,104	1,148	1,167	63
Sulfur, wpm	19	20	21	2
Volume, MBPD	899	796	762	(137)
Emissions, MG/mi[2]				
VOC	1,027	1,054	1,074	47
NOx	1,143	1,152	1,163	20
Toxics	54.47	61.14	66.10	11.63
Change From Base, %				
VOC	0.0	+2.6	+4.6	+4.6
NOx	0.0	+0.8	+1.8	+1.8
Toxics	0.0	+12.2	+21.4	+21.4

(1) Restore octane by increasing reformer severity and FCC octane.
(2) Based on EPA complex model Phase 2 (some properties exceed CARB model limits).

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TECHNICAL APPENDIX

COSTS OF POTENTIAL BAN

OF MTBE IN GASOLINES

Prepared for
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MAJOR ASSUMPTIONS

Use most of the assumptions detailed in the August 1993 National Petroleum Council (NPC) study, *U.S. Petroleum Refining, Meeting Requirements for Cleaner Fuels and Refineries*. These assumptions and premises are detailed in the Turner, Mason & Company (TM&C) tables "A" in Volume 5, *Refining Capability Appendix*. Update these assumptions as follows:

- Update supply and demand, refining input and products, plus crude production and imports to 1997 actual using the Department of Energy (DOE) 1997 *Petroleum Supply Annual PSA* and DOE California data plus California Department of Conservation crude production data by field.

- Update product qualities and grade splits using 1996 and 1997 data from American Petroleum Institute/National Petrochemical Refiners Association (API/NPRA) and California Energy Commission (CEC) surveys.

- Update refinery unit capacities to capacities available or under construction on January 1, 1999.

- Update investment costs to mid-1997 dollars.

- Update raw material and product prices to summer 1997 average.

- Update supply and demand to 2005 using the CEC forecast for California and the fall 1998 *Oil & Gas Journal* U.S. consensus forecast growth rates for PADD I.

- Update domestic crude production forecast to 2005 using DOE EIA *Annual Energy Outlook, 1998*.

- Reduce maximum sulfur specification in all domestic gasolines to 30 ppm in anticipation of planned Environmental Protection Agency (EPA) regulations.

- Use the California Air Resources Board (CARB) predictive model to determine CARB 2 reformulated gasoline (RFG) emissions. Limit emissions to 1997 weighted average based on CEC survey.

- For emission calculations for RFG and conventional gasoline (CG) anti-dumping use EPA complex model phase 2.

! Use required reductions from statutory for EPA RFG target emissions limits.

! Use CG emissions limits based on weighted average of 1990 refinery baseline emissions limits.

STUDY METHODOLOGY

! Use refinery linear program (LP) models that have been reviewed in detail and approved by task forces of industry experts in prior studies for NPC, Auto/Oil, API and Western States Petroleum Association (WSPA).

! Set 2005 product specifications at regulatory requirements. Add a 30 ppm sulfur limit for all gasolines to anticipate this probable EPA change in the regulations.

! Fix most major raw material and product volumes to keep the model from reaching unreasonable solutions that are not supportable and to simplify the case study costs analysis.

! Add flexibility to the LP models to allow them to meet the potentially stringent conditions to be evaluated:
- Allow new capacity investment; and
- Allow reasonable low value export disposition of unusable gasoline blend stocks or regular gasoline.

! Allow ethylene recovery from the fluid catalytic cracker (FCC) and alkylate production and blending as a high-octane low-T50 distillation point and low-Reid vapor pressure (RVP) component to substitute for some of lost methyl-tertiary-butyl-ether (MTBE).

! Run base cases for 2005 for California and Petroleum Allocation District for Defense (PADD) I. These are the only U.S. refining areas with over 67% RFG production; hence, they would be most affected by a potential ether ban.

! Consider any investment the LP model makes to meet the 2005 base cases as sunk cost.

! Run incremental cases to study potential MTBE and oxygenates policy changes as follows:
- Optimum MTBE use; and
- MTBE and ether ban

- No oxygenates; and
- 6% ethanol in RFG.

! Compare each of the incremental cases to the base case for each area.

! Adjust costs and investment changes for costs which could not be included in the LP models, such as mogas blender, enhanced debutanizers to reduce RVP and ethylene recovery.

! Adjust refining margins from the high 1997 summer level to typical 1998 summer level based on the West Texas Intermediate (WTI) crude Gulf Coast 3:2:1 crack spread. It shifted from $3.82/barrel in summer 1997 to $2.88/barrel in summer 1998, which is more typical of the summer average during the past five years.

! Report solutions for the base cases and the incremental costs and investment changes to the solutions for the incremental cases.

! Tabulate results for gasoline properties, material balances and unit rates on the attached tables.

TABLE A-1A
REFORMULATED GASOLINE POOL PROPERTIES PADD I
COSTS OF POTENTIAL BAN OF MTBE IN GASOLINES

					Ether Banned			
	Base		Optimum MTBE		No Oxygenates		Ethanol in RFG	
Octane, (R+M)/2	89.2	*	89.2	*	89.2	*	89.2	*
Oxygen, Wt. %	2.12	*	1.28		0.00	*	2.10	*
MTBE, Vol. %	11.7	*	7.0		0.0	*	0.0	*
Ethanol, Vol. %	0.0	*	0.0	*	0.0	*	6.0	*
Aromatics, Vol. %	27.8	#	29.8	#	30.2		31.0	
Olefins, Vol. %	11.5		12.7		12.2		13.4	
Benzene, Vol. %	0.95	*	0.95	*	0.86		0.95	*
Sulfur, wppm	30	*	30	*	30	*	30	*
RVP, psi	6.7	#	6.5	*	6.5	*	6.5	*
Distillation, °F								
T10	144		146		148		146	
T50	194		208		207		214	
T90	346	#	350		339		345	
E200	51		47		46		43	
E300	83		82		85		84	
Driveability Index	1,144		1,194		1,181		1,206	
Distillation Index	1,144		1,194		1,181		1,248	
<u>% Reduction from EPA-Required Emissions Limits</u>								
VOC	0.8	*	0.4	*	(0.4)	*	(0.1)	*
NOx	3.5		2.6		3.0		2.7	
Toxics	8.5		3.1		0.6	*	0.8	#

* Input limit – both grades.
# Input limit – one grade.

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TABLE A-1B
CONVENTIONAL GASOLINE POOL PROPERTIES PADD I
COSTS OF POTENTIAL BAN OF MTBE IN GASOLINES

					Ether Banned			
	Base		Optimum MTBE		No Oxygenates		Ethanol in RFG	
Octane, (R+M)/2	88.3	*	88.3	*	88.3	*	88.3	*
Oxygen, Wt. %	0.00		0.99		0.00	*	0.00	*
MTBE, Vol. %	0.0		5.4		0.0	*	0.0	*
Ethanol, Vol. %	0.0	*	0.0	*	0.0	*	0.0	*
Aromatics, Vol. %	39.0		37.7	#	41.2		37.1	
Olefins, Vol. %	11.3		11.3		11.7		12.3	
Benzene, Vol. %	1.42		1.79		1.14		1.58	
Sulfur, wppm	30	*	30	*	30	*	30	*
RVP, psi	8.7	*	8.7	*	8.7	*	8.7	*
Distillation, °F								
T10	130		127		132		126	
T50	227		215		238	#	212	
T90	353		353		356	*	356	*
E200	40		45		37		48	
E300	71	#	70	#	67		66	#
Driveability Index	1,229		1,188		1,269		1,180	
Distillation Index	1,229		1,188		1,269		1,180	
% Reduction from Average 1990 Baseline Emissions Limits								
VOC	N/A		N/A		N/A		N/A	
NOx	11.4		11.0		11.2		10.0	
Toxics	0.2	*	0.1	*	0.2	*	0.4	*

* Input limit – both grades.
# Input limit – one grade.

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TABLE A-2
AVERAGE PADD I REFINERY MATERIAL BALANCE
COSTS OF POTENTIAL BAN OF MTBE IN GASOLINES

		2005			
				Ether Banned	
	1997 Actual	Base Case	Optimum MTBE	No Oxygenates	Ethanol In RFG
Raw Materials, BPCD					
Crudes	139,385	157,737	160,175	177,210	175,026
Gasoline Components	17,017	11,000	11,000	11,000	11,000
Oxygenates	6,801	6,500	5,552	0	3,951
LPG	416	329	100	2,286	100
Other	9,289	9,039	8,861	8,625	8,625
Total	172,908	184,605	185,688	199,121	198,702
Products, BPCD					
Gasolines					
Conventional	31,168	29,500	29,500	29,500	29,500
EPA RFG	61,373	65,846	65,846	65,846	65,846
Other Finished	11	0	0	0	0
Components	1,598	1,197	1,200	1,200	1,200
Subtotal Gasolines	94,149	96,543	96,546	96,546	96,546
Distillates - Finished	49,773	55,400	55,400	55,400	55,400
No. 6 Finished	12,464	10,783	11,459	24,161	22,455
Other Black Oils	11,536	9,877	9,657	9,757	9,841
LPG	4,505	5,521	5,871	5,377	7,168
Other	1,231	1,000	1,000	1,000	1,000
Plant Fuel	5,675	11,393	11,691	12,230	12,139
Loss	(6,425)	(5,913)	(5,936)	(5,352)	(5,846)
Total	172,909	184,604	185,688	199,119	198,703

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TABLE A-3
2005 PADD I AVERAGE REFINERY PROCESS UNIT RATES
COSTS OF POTENTIAL BAN OF MTBE IN GASOLINES

			Ether Banned	
	Base Case	Optimum MTBE	No Oxygenates	Ethanol In RFG
Unit Charge Rates, BPCD				
Crude Distillation	157,737	160,175	177,210	175,026
Coker Delayed	4,100	4,100	4,100	4,100
Coker Fluid	4,900	4,900	4,900	4,900
Coker L Gaso DS/SPL				280
Solvent Deasphalter	1,900	1,900	1,900	1,900
Naphtha Hydrotreater	38,900	39,542	42,102	41,169
FCC/Coker C6 H2 Tr			107	29
Distillate HDS	34,352	33,797	32,335	31,799
FCC Feed Hydrofiner	21,460	23,351	23,750	24,761
Cat Reformer 450 P (92.3)	9,300	9,300	9,300	9,300
Cat Reformer 200 P (97.5)	12,593	14,176	18,525	14,845
Cat Ref(Cont)100 P (100.6)	10,900	10,900	10,900	10,900
Reformate Fractionation	11,586	15,000	20,546	19,765
Aromatic Extract/Fractionation	4,103	3,387	8,100	8,100
Benzene Saturation			1,528	43
Fluid Cat Cracker (78.4)	60,629	63,670	65,400	65,400
FCC Gaso Splitters	14,133	14,622	15,457	15,037
FCC Gaso Fractionation	34,470	35,664	36,930	36,675
Gaso FCC Desulfurization	8,753	9,219	9,246	9,482
Hydrocracker – 2-Stage	2,400	2,400	2,400	2,400
Pen/Hex Isomerization	1,624	1,530	6,502	6,148
TIP Pen/Hex Isomerization			110	
Product Rates, BPCD				
Ethylene Alkylation	0	0	2,293	207
Alkylation Plant	7,800	7,800	9,824	8,048
Olefin Cat Poly	1,075	1,600	1,116	1,961
MTBE Unit	1,184	673	0	0
Lube/Wax Plant	1,000	1,000	1,000	1,000
Butane Isomerization	1,100	1,100	1,100	1,100
Hydrogen Plt MBPD FOE	270	270	270	270
Sulfur Plant, MLT/D	91	93	101	100

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TABLE B-1
CARB 2 GASOLINE POOL PROPERTIES CALIFORNIA
COSTS OF POTENTIAL BAN OF MTBE IN GASOLINES

	Base		Optimum MTBE		Ether Banned: No Oxygenates		Ether Banned: Ethanol in RFG	
Octane, (R+M)/2	88.4	*	88.4	*	88.4	*	88.4	*
Oxygen, Wt. %	2.12	*	1.84		0.00	*	2.10	*
MTBE, Vol. %	11.7	*	10.1		0.0	*	0.0	*
Ethanol, Vol. %	0.0	*	0.0	*	0.0	*	6.0	*
Aromatics, Vol. %	19.0		19.3		22.6		22.1	
Olefins, Vol. %	4.6	#	4.6		3.5	#	3.6	
Benzene, Vol. %	0.80	*	0.80	*	0.80	*	0.80	*
Sulfur, wppm	30	*	30	*	10		18	
RVP, psi	6.8	*	6.8	*	6.8	*	6.8	*
Distillation, °F								
T10	134	#	132		132		138	
T50	195		195		183		200	
T90	298		298		286		289	
E200	52		52		59		50	
E300	90		90		94	#	92	
Driveability Index	1,084		1,081		1,033		1,097	
Distillation Index	1,084		1,081		1,033		1,139	
% Reduction from CARB Average Emissions Limits								
VOC	1.0	#	0.6	*	0.4	*	(0.1)	*
NOx	(0.1)	*	0.1	*	0.7	*	0.3	*
Toxics	0.2	*	0.3	*	6.6		0.7	*

* Input limit – both grades.
# Input limit – one grade.

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TABLE B-1A
REFORMULATED GASOLINE POOL PROPERTIES CALIFORNIA
COSTS OF POTENTIAL BAN OF MTBE IN GASOLINES

					Ether Banned			
	Base		Optimum MTBE		No Oxygenates		Ethanol in RFG	
Octane, (R+M)/2	88.4	*	88.4	*	88.4	*	88.4	*
Oxygen, Wt. %	2.12	*	1.62		0.00	*	2.10	*
MTBE, Vol. %	11.7	*	8.9		0.0	*	0.0	*
Ethanol, Vol. %	0.0	*	0.0	*	0.0	*	6.0	*
Aromatics, Vol. %	35.1	#	38.0	*	34.5		39.9	
Olefins, Vol. %	12.0	*	11.8		17.8	#	15.0	*
Benzene, Vol. %	0.95	*	0.95	*	0.45		0.54	
Sulfur, wppm	30	*	30	*	30	*	30	*
RVP, psi	6.7	*	6.5		6.5	*	6.5	*
Distillation, °F								
T10	135	#	139	#	141		138	
T50	200		210		239	#	234	#
T90	330		337		282		289	
E200	52		47		34		37	
E300	84		84		96		93	
Driveability Index	1,133		1,177		1,210		1,199	
Distillation Index	1,133		1,177		1,210		1,241	
% Reduction from EPA-Required Emissions Limits								
VOC	(0.2)	*	(0.3)	*	(1.2)	*	(0.2)	*
NOx	3.4		3.9		0.6		2.9	
Toxics	4.0		(1.1)		(0.1)	*	(0.2)	*

* Input limit – both grades.
# Input limit – one grade.

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TABLE B-1B
CONVENTIONAL GASOLINE POOL PROPERTIES CALIFORNIA
COSTS OF POTENTIAL BAN OF MTBE IN GASOLINES

	Base		Optimum MTBE		Ether Banned: No Oxygenates		Ether Banned: Ethanol in RFG	
Octane, (R+M)/2	88.2	*	88.2	*	88.2	*	88.2	*
Oxygen, Wt. %	0.00		0.42		0.00	*	0.00	*
MTBE, Vol. %	0.0		2.3		0.0	*	0.0	*
Ethanol, Vol. %	0.0	*	0.0	*	0.0	*	0.0	*
Aromatics, Vol. %	40.7		42.6		47.2		40.0	
Olefins, Vol. %	9.9		9.2		5.0		9.5	
Benzene, Vol. %	1.23		1.16		0.76		1.40	
Sulfur, wppm	30	*	30	*	30	*	30	*
RVP, psi	7.8	*	7.8	*	7.8	*	7.8	*
Distillation, °F								
T10	133		137		136		131	
T50	239		246	*	244	#	227	
T90	355		355		354	#	356	#
E200	37		33		30	#	44	
E300	65	#	65	#	71	#	65	*
Driveability Index	1,272		1,298		1,289		1,232	
Distillation Index	1,272		1,298		1,289		1,232	
% Reduction from 1990 Average Baseline Emissions Limits								
VOC	N/A		N/A		N/A		N/A	
NOx	3.5		4.2		5.6		3.0	
Toxics	0.9	*	0.1	*	0.7	*	1.0	*

* Input limit – both grades.
# Input limit – one grade.

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TABLE B-2
AVERAGE CALIFORNIA REFINERY MATERIAL BALANCE
COSTS OF POTENTIAL BAN OF MTBE IN GASOLINES

		2005			
				Ether Banned	
	1997 Reference	Base Case	Optimum MTBE	No Oxygenates	Ethanol In RFG
Raw Materials, BPCD					
Crudes	140,517	157,725	160,192	194,942	174,073
Gasoline Components	2,000	2,001	2,001	2,001	2,001
Oxygenates	8,583	8,648	7,525	0	5,028
LPG	954	990	873	204	2,385
Other	7,710	7,539	7,536	7,209	7,196
Total	159,764	176,903	178,127	204,356	190,683
Products, BPCD					
Gasolines					
Conventional	10,192	10,192	10,192	10,192	10,192
EPA RFG	4,667	5,231	5,231	5,231	5,231
CARB RFG	76,003	78,564	78,564	78,564	78,564
Other Finished	494	462	462	4,379	5,784
Components	753	693	693	693	693
Subtotal Gasolines	92,109	95,142	95,142	99,059	100,464
Distillates - Finished	43,295	52,077	52,077	52,077	52,077
No. 6 Finished	7,088	14,068	14,853	31,235	19,057
Other Black Oils	12,256	8,653	8,817	8,854	8,834
LPG	5,094	5,412	5,310	8,327	8,050
Other	2,268	2,384	2,384	2,384	2,384
Plant Fuel	9,862	11,687	12,081	15,417	12,939
Loss	(12,207)	(12,520)	(12,538)	(12,997)	(13,122)
Total	159,764	176,903	178,126	204,356	190,683

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TABLE B-3
2005 CALIFORNIA AVERAGE REFINERY PROCESS UNIT RATES
COSTS OF POTENTIAL BAN OF MTBE IN GASOLINES

			Ether Banned	
	Base Case	Optimum MTBE	No Oxygenates	Ethanol In RFG
Unit Charge Rates, BPCD				
Crude Distillation	157,725	160,192	194,940	174,073
Crude Depentanizer			3,700	5,050
Heavy Naphtha Splitter	3,117	4,700	5,522	8,787
Coker Delayed	27,800	27,800	27,800	27,800
Coker Fluid	5,200	5,200	5,200	5,200
Flexi-Coker	1,800	1,800	1,800	1,800
Solvent Deasphalter	3,500	3,500	3,500	3,500
Naphtha Hydrotreater	30,385	30,849	45,555	31,900
FCC/Coker C6 H2 Tr			1,576	114
Distillaty HDS	25,200	25,200	33,406	30,681
FCC Feed Hydrofiner	50,141	51,432	58,153	51,700
Cat Reformer 450 P (91.2)	14,600	14,600	14,600	14,600
Cat Reformer 200 P (91.8)	5,987	7,084	17,854	8,564
Cat Ref(Cont) 100 P (97.1)	8,000	8,000	18,300	15,257
Reformate Fractionation	14,073	16,779	43,535	20,792
Aromatic Extract/Fractionation	726	726	770	770
Benzene Saturation	3,501	4,222	9,591	6,212
Fluid Cat Cracker (70.0)	45,164	46,327	52,383	48,435
FCC Gaso Splitter	21,600	21,600	31,052	21,600
FCC Gaso Fractionation	28,221	28,809	32,607	29,104
FCC Gaso HDS	7,100	7,100	3,600	7,100
Diesel Aromatics Saturation	1,388	1,370	4,487	5,356
Hydrocracker - 2-Stage (73.6)	28,644	28,481	28,800	28,800
Alkylate Splitter			1,361	
Pen/Hex Isomerization	6,517	6,630	8,100	5,671
TIP Pen/Hex Isomerization			1,180	
Product Rates, BPCD				
Ethylene Alkylation	0	0	1,428	1,292
Alkylation Plant	10,496	11,000	13,368	12,005
Olefin Cat Poly	400	400	308	308
MTBE Unit	820	820		
TAME Unit	340	340	0	0
Lube/Wax Plant	1,638	1,638	1,638	1,638
Butane Isomerization	1,400	1,400	1,400	4,613
Hydrogen Plant, MBPD FOE	4,250	4,250	4,565	4,493
Sulfur Plant, MLT/D	196	200	219	217

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