

The Use of Ethanol in California Clean Burning Gasoline

Ethanol Supply/Demand and Logistics

May 2000 Review and Update

**Report Prepared for:
The Renewable Fuels Association**

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Downstream Alternatives Inc. has prepared this brief update to its 1999 report “The Use of Ethanol in California Clean Burning Gasoline-Ethanol Supply/Demand and Logistics”. The 1999 report included detailed analysis of supply/demand and logistics based on numerous information sources. This update relies primarily on the findings of the original report but includes updated information on supply and demand.

All projections are based on information available at the time this update was prepared. Forecasts and projections always carry a degree of uncertainty because of the potential for unforeseen circumstances. However, Downstream Alternatives believes all information contained in the update to be accurate at the time of printing and that all projections have been made with reasonable caution.

Introduction

This brief report was prepared as an update to our February 1999 report entitled “The Use of Ethanol in California Clean Burning Gasoline-Ethanol Supply/Demand and Logistics”

As with the original report, the intent of this report is to assess the ethanol industry’s ability to replace MTBE as the oxygenate in California Clean Burning Gasoline (CBG). This update focuses only on those items which differ from the original report. Readers may wish to review the original report in its entirety to provide the proper background and content for this report update.

Observations and Key Findings

- Addition of the San Joaquin Valley as a federal RFG area (i.e. requiring 2.0 wt% oxygen) would increase the amount of ethanol required to replace MTBE in California. The ethanol required to replace MTBE is now 631.25 million gallons. For scenario #2 where 30% of non-federal RFG sold in California requires 5.7 v% for octane enhancement (for mid-grade and premium), ethanol demand to replace MTBE in California is now 684.82 million gallons.
- Total ethanol production capacity (including CBI imports) for the year 2000 is 1.91 billion gallons and will reach 2.04 billion gallons in 2001.
- If unutilized production capacity is directed to California it would be necessary to redirect only 61.7 to 115.2 million gallons of ethanol from the Midwest octane markets to the California CBG market.
- In fact, despite the additional demand from the San Joaquin Valley, the ethanol industry could supply a larger percentage of California’s ethanol from underutilized capacity than was possible one year ago.

- Raw blend economics (based on prices as of mid April) indicate that a switch to ethanol blends would result in a blend price 3¢+ per blended gallon lower than MTBE blends. This should be more than sufficient to cover the cost of volatility adjustment and pentane removal.
- One additional development has been that pipeline operators are now examining the feasibility of shipping ethanol from its port of entry to California terminals via pipeline. This would dramatically reduce or eliminate transport truck delivery of ethanol to terminals and reduce transportation expense.

California Oxygenate Demand

DAI's projected gasoline demand for California for 1998 was 13,962,867,000 versus an actual of 14,003,803,000⁽¹⁾. In our original report 67.95% of state gasoline sales were in areas requiring federal reformulated gasoline (RFG) which would be required, under current law, to meet the 2.0 wt% oxygen content requirement.

This did not, however, include the San Joaquin Valley which will also be required to meet federal RFG standards in the future due to its reclassification as a more severe ozone non-attainment area. The California Air Resources Board (CARB) has estimated that the San Joaquin Valley area represents approximately 10% of state demand. Based on this revision, California demand for federal RFG and resulting ethanol demand for 1999 would have been as follows:

1998 California Gasoline Demand	14,003,803,000
1999 California Gasoline Projected Demand	14,207,217,000
% Federal RFG (including San Joaquin)	77.95%
1999 volume of required Federal RFG	11,074,525,652
% Ethanol required to meet demand	5.7%
Total Scenario #1 ethanol demand	631,247,962

(1) Monthly Motor Fuel Reported by State, January 1999, US DOT/FAA

Our original report also included an Optional Scenario where ethanol would be used in 30% of non-federally mandated RFG areas for octane enhancement (primarily in mid-grade and premium). This calculation is now revised as follows:

California Gasoline Demand (1999)	14,207,217,000
Less Federal RFG	11,074,525,652
Non-Federal RFG	3,132,691,348
30% of Non-Federal RFG	x 30%
Non-Federal RFG Requiring Ethanol	939,807,404
% Ethanol Added for Octane	5.7%
Total Additional Ethanol Octane Demand	53,569,022

Scenario #1	631.25 million gallons
Scenario #2	684.82 million gallons

The above ethanol demand increases compared to our original report result almost exclusively from inclusion of the San Joaquin Valley in the calculations.

Ethanol Production and Supply

In the original study, nameplate capacity of operational ethanol plants was projected to be 1.838 billion gallons per year (exclusive of CBI ethanol). Appendix A includes an updated list of currently operating plants indicating that current nameplate capacity for operational plants is now 1.8558 billion gallons. Appendix B lists plants that are under construction as of March 2000. Total increased capacity

for these new plants (which will come on stream in 2000 or 2001) equals 134 million gallons. In addition, the CBI imports continue to be projected in the 50 million gallon range. The aforementioned supply sources are recapped in Table #4

Operational as of April 2000	1.8558
CBI imports	.0500
Total	1.9058
1999 Production Rate	1.4702
Under utilized capacity 1999	.4356
Additional capacity on line 2000/2001	.1340
Total excess production available for 2001	.5696

The figures in Table #4 do not include any of the proposed ethanol plants that are in the development stage. If all such proposed plants were built, this would add slightly over one billion gallons.⁽¹⁾ Of course, not all of these plants will be built. Of those that will ultimately be constructed, it is not currently possible to predict when such plants would come on line.

DAI prefers to error on the side of caution and use only operational plants and plants that are already financed and under construction in its projections. However it should be noted that existing ethanol plants are modular in nature and can increase capacity in very short periods of time.⁽²⁾ Estimates of such capacity increase range from 10% to 30% of existing capacity (185 million to 556 million gallons). One recent study⁽¹⁾ puts established expansion at existing plants at 420 million gallons for 2001.

Table 5 lists ethanol production and ending stocks over the past fourteen months. These figures are also depicted graphically in Figure 1.

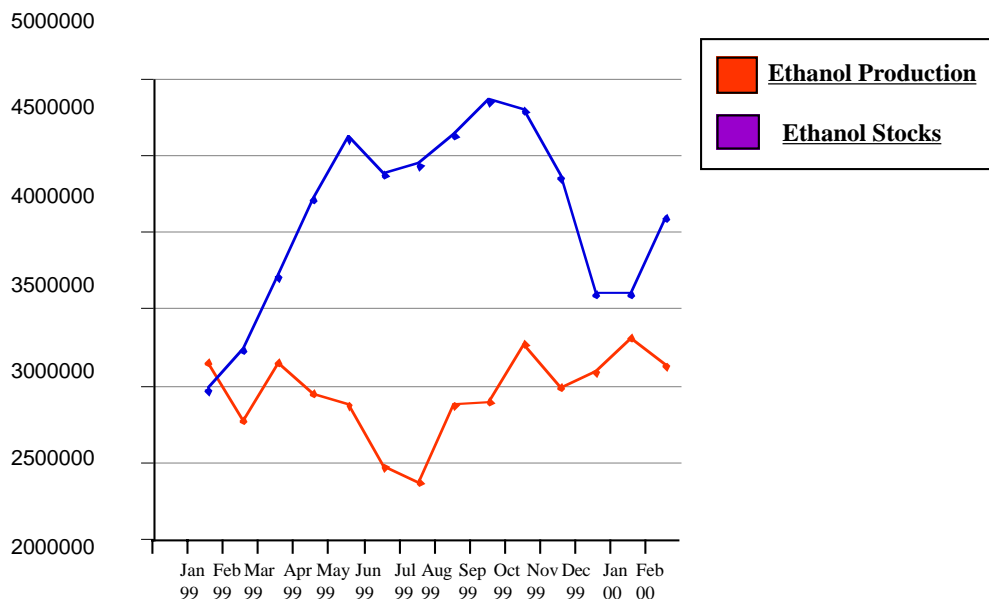
(1) *Ability of the U.S. Ethanol Industry to Replace MTBE, AUS Consultants*

(2) *Jack Huggins, Pekin Energy (William's BioEnergy) before EPA's Blue Ribbon Panel on Oxygenates*

Table 5 - Ethanol Production and Ending Stocks

<u>Date</u>	<u>Ethanol Production</u> <u>Barrels per month</u>	<u>Ethanol Stocks</u> Barrels
Jan 99	3162000	2973000
Feb 99	2772000	3240000
Mar 99	3162000	3722000
Apr 99	2970000	4222000
May 99	2883000	4624000
Jun 99	2490000	4382000
Jul 99	2387000	4440000
Aug 99	2883000	4640000
Sep 99	2910000	4868000
Oct 99	3286000	4798000
Nov 99	3000000	4362000
Dec 99	3100000	3592000
Total BPY (1999)	35005000	
Jan 00	3317000	3603000
Feb 00	3132000	4097000

Figure 1 Monthly Ethanol Production/Stocks



Source: Energy Information Administration, March 2000

This graph represents recent trends in production rates and inventory draws. You will note that beginning in February 1999, inventory begins to build very dramatically as the CO/oxyfuel season ends. The trend continues with inventory levels peaking in September despite dramatic production cutbacks between May and August. There is a draw down of inventory in the November/December time frame representing deliveries for CO/oxyfuel programs. Inventory begins to climb again in February 2000. The decrease in summer months production far exceeds any that would be attributed to wet miller swing capacity and represents, in part, reduced production due to the lack of ethanol market share in summer RFG.

In any event using only available capacity results in the following supply/demand balance.

Table 6 - California Ethanol Supply/Demand			
(million gallons)			
	<u>Ethanol demand</u>	<u>Available supply</u>	<u>Imbalance</u>
Scenario #1	631.3	569.6	61.7
Scenario #2	684.8	569.6	115.2

Depending on whether Scenario #1 or #2 is used, the shortfall in ethanol production is 61.7 to 115.2 million gallons. Despite the addition of the demand from the San Joaquin Valley, the ethanol industry can supply a higher percentage of demand today than they could have one year ago - 90.23% of Scenario #1 demand and 83.18% of Scenario #2 demand.

As noted in our original report, the remainder of ethanol required for any California program would be redirected from the lower valued octane markets in Midwestern states. With the imbalance between California demand and current production capability equating to only 61.7-115.2 million gallons, such redirection of product amounts to only 3.2% to 6.0% of total ethanol availability.

Consequently even if no new plants were ever brought on line, existing ethanol supply is sufficient to meet demand for California RFG.

Blending Economics

Obviously another significant change since our original analysis has been the extreme increases in gasoline prices. We are therefore providing updates on gasoline and ethanol prices and resulting blend economics.

Posted gasoline and ethanol prices for comparative purposes are as follows:

Table 7 - Posted Gasoline and Ethanol Prices Used in Comparison
(as of 4/17/00-wholesale price per gallon)

	<u>Gasoline RFG</u> ⁽¹⁾	<u>Ethanol</u> ⁽²⁾
Los Angeles	80.50¢	\$1.32
New York	79.05¢	\$1.28
Chicago	71.55¢ (conv)	\$1.24

(1)Source: Motor Gasoline Watch, Energy Information Administration 4/19/00.

(2)Source: Actual average price quoted by ethanol suppliers

The non-California markets are for illustration purposes to demonstrate primarily that the price differential between Midwest conventional gasoline and California RFG still exists. As mentioned in our original report, this differential usually averages 6-8 cents per gallon which in turn increases ethanol's value by a similar amount on the west coast. Consequently, ethanol producers can recoup a large portion of their additional freight expense while maintaining ethanol's relative values to gasoline.

The above referenced prices for gasoline and ethanol also provides the foundation to calculate current ethanol blending economics.

Those economics and a comparison to MTBE blends are discussed below and recapped in Table 8.

The vast majority of CBG continues to be blended with MTBE. During the time frame for this

analysis MTBE was selling for \$1.06 per gallon in Los Angeles. Although \$1.06 is used in the analysis to be consistent in time frame prices it should be noted that MTBE prices have since increased to \$1.10-\$1.11 per gallon region. Since MTBE comprises 11% of a gallon of RFG, one can assume that exclusive of refinery adjustments (octane and volatility) the cost contribution of MTBE is \$0.1166 per gallon. In other words the cost of the 89% gasoline (priced at \$.8050) in the blend represents \$0.6884. This equates to a gasoline base price before oxygenate addition of \$0.774. This price is used in the following table.

Table 8 - Current California Oxygenate Blend Economics (Los Angeles)

MTBE Blend

Base gasoline price	$\$0.774 \times 89\% =$		\$0.6889
Base MTBE price	$\$1.06 \times 11\% =$		\$0.1166
Total before refining adjustment			\$0.8055

Ethanol Blend

		10 v%	5.7 v%
Base gasoline price	$\$0.774 \times 90\%/94.3\% =$	\$0.6966	\$0.7299
Ethanol price (net of tax credit)	$\$0.78 \times 10\%/5.7\% =$	\$0.0780 (1)	\$0.0445 (1)
Total before refining adjustments		\$0.7746 (2)	\$0.7744 (2)

(1) Based on ethanol price of \$1.32 less \$0.54 federal tax credit.

(2) Does not include octane and volatility adjustment or any loss in volume.

The calculations in Table #8 portray the difference in oxygenate blend economics of both a 10 v% and 5.7 v% ethanol blend compared to an 11 v% MTBE blend. These calculations do not include octane adjustments (which would be minimal comparing MTBE to ethanol since their values are similar). Nor do they include the volatility adjustments or any volume lost from removing pentanes to accommodate ethanol's volatility increase. However it is worthy to note that on raw blend economics,

the ethanol blends are \$0.0309 per gallon cheaper before such adjustments are made. We are unaware of any studies that put the cost of volatility adjustment debits or volume loss calculations (due to pentane removal) at levels approaching three cents per gallon.

Transportation, Storage, & Distribution

With regards to transportation, storage, and distribution of ethanol for the California markets, there has been only one major change from the costs and considerations covered in our original report.

The costs and operational consideration of rail and waterborne ethanol cargoes from plants located in the Midwest to west coast markets remains the same. However there now appears to be at least some willingness on the part of pipeline operators to explore the possibility of shipping ethanol to California terminals via pipeline.(1)

If ethanol is moved from its port of entry to terminals via pipeline this would, of course, lower deliveries of ethanol via transport truck and result in lower distribution costs. Our original report did not consider pipeline shipments of ethnaol.

(1) Russ Kinzig - Kinder Morgan at the DOE Ethanol Workshop (Sacramento), October 5, 1999

U.S. Ethanol Production Capacity (Nameplate) million gallons per year (mmgy)				
COMPANY	LOCATION		FEEDSTOCK	mmgy
A.E. Staley	Loudon	TN	Corn	45
AgPower Inc.	Commerce City	CA		2
AGP	Hastings	NE	Corn	45
Agri-Energy	Luverne	MN	Corn	18
Alchem	Grafton	ND	Wheat	12
Al-Corn	Claremont	MN	Corn	18
Archer Daniels Midland (total capacity)	Decatur	IL	Corn	750
	Peoria	IL	Corn	
	Cedar Rapids	IA	Corn	
	Clinton	IA	Corn	
Broin Enterprises	Scotland	SD	Corn	8
Cargill (total capacity)	Blair	NE	Corn	105
	Eddyville	IA	Corn	
Central Minnesota	Little Falls	MN	Corn	18
Chief Ethanol	Hastings	NE	Corn	62
Chippewa Valley Ethanol	Benson	MN	Corn	20
Corn Plus	Winnebago	MN	Corn	17.5
DENCO, LLC.	Morris	MN	Corn	15
Eco Products of Plover	Plover	WI	Whey/potato waste	4
ESE Alcohol	Leoti	KS	Seed corn	1.1
Ethanol2000	Bingham Lake	MN	Corn	15
Exol, Inc.	Albert Lea	MN	Corn	18
Farm Tech USA	Spring Green	WI	Corn	0.5
Georgia-Pacific	Bellingham	WA	Paper waste	3.5
Golden Cheese	Corona	CA	Whey	2.8
Grain Processing Corp.	Muscatine	IA	Corn	10
Heartland Corn Products	Winthrop	MN	Corn	17
Heartland Grain Fuel	Aberdeen	SD	Corn	8
	Huron	SD	Corn	12
High Plains Corporation (total capacity)	York	NE	Corn/milo	74
	Colwich	KS		
	Portales	NM		
Hubinger	Keokuk	IA	Corn	18
J.R. Simplot	Caldwell	ID	Potato waste	4
	Heyburn	ID	Potato waste	3
Jonton Alcohol	Edinburg	TX	Corn	1.2
Kraft, Inc.	Melrose	MN	Whey	3
Manildra Ethanol	Hamburg	IA	Corn/milo/wheat starch	7
MMI/ETOH (Merrick/Coors)	Golden	CO	Brewery waste	1.5
Midwest Grain (total capacity)	Pekin	IL	Corn/wheat starch	108
	Atchison	KS		
Minnesota Clean Fuels	Dundas	MN	Waste sucrose	1.5
Minnesota Corn Processors * (total capacity)	Columbus	NE	Corn	122
	Marshall	MN	Corn	
Minnesota Energy*	Buffalo Lake	MN	Corn	12
New Energy Corp.	South Bend	IN	Corn	88
Pabst Brewing	Olympia	WA	Brewery waste	0.7
Parallel Products	Louisville	KY	Beverage waste	10
	R. Cucamonga	CA	Beverage waste	2
Permeate Refining	Hopkinton	IA	Sugars & Starches	1.5
Pro-Corn*	Preston	MN	Corn	19
Reeve Agri-Energy	Garden City	KS	Corn/milo	10.5
Stroh's Brewery	Winston Salem	NC	Beverage waste	2
Sunrise Energy	Blairstown	NE	Corn	5
Vienna Correctional	Vienna	IL	corn	0.5
Williams Energy Services	Pekin	IL	Corn	100
Nebraska Energy (Williams Energy)	Aurora	NE	Corn	30
Wyoming Ethanol	Torrington	WY	Corn	5
Total Capacity-March 2000				1855.8

Source: Ability of the U.S. Ethanol Industry to Replace MTBE, AUS Consultants

Plants Currently Under Construction

COMPANY	LOCATION		FEEDSTOCK	MMPY
Golden Triangle	St. Joseph	MO	Corn	14.0
Adkins Energy	Lena	IL	Corn	30..0
BC International	Jennings	LA	Bigasse/rice hulls	20.0
Nebraska Nutrients	Sutherland	NE	Corn	15..0
NE Missouri Grain Processors	Macon	MO	Corn	15..0
Total Under Construction Capacity (by 2000)				134.0

Source: Ability of the U.S. Ethanol Industry to Replace MTBE, AUS Consultants, March 2000