The Use of Ethanol in California Clean Burning Gasoline

Ethanol Supply/Demand and Logistics

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Report Prepared for:
The Renewable Fuels Association

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Downstream Alternatives Inc. was retained by the Renewable Fuels Association to evaluate the potential for ethanol to be used as a replacement oxygenate should the use of MTBE be limited by regulatory or marketplace barriers in the California market. This evaluation includes ethanol supply and demand as well as transportation and logistic information. This report is based on numerous information sources as well as the company's familiarity with the ethanol and fuels marketplace. All projections are based on information available at the time the report 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 report to be accurate at the time of printing and that all projections have been made with reasonable caution.

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Executive Summary

Downstream Alternatives Inc. was requested to assess the viability of ethanol as a replacement oxygenate for the California market in the event that regulations or marketplace barriers eliminate the use of methyl tertiary butyl ether (MTBE).

Based on our assessment, adequate supplies of competitively priced ethanol could be supplied to the California market almost immediately. Terminal preparation is the real variable. But even here it is clear that well over half the terminals offering gasoline could make ethanol available in six months or less. In turn, these terminals could be utilized to supply ethanol for gasoline sourced from other terminals thereby increasing the amount of ethanol blending that could be achieved in a short time frame. It is not necessary to have ethanol in all gasoline terminals to achieve 100% market penetration.

This study was performed under contract to the Renewable Fuels Association. Objectives included:

1. Estimate the demand for ethanol in California reformulated gasoline.
2. Determine current ethanol production capacity and plants under construction.
3. Estimate current nationwide ethanol demand and resulting net availability of ethanol for California.
4. Assess logistic considerations and costs for transporting ethanol to California.
5. To the extent possible, determine what terminaling facilities could be prepared to handle distribution of ethanol and the time frame for any necessary preparations.
6. Provide an overview of cost considerations and anticipated cost factors to bid ethanol away from competing markets (for use in California).

Projected oxygenate demand was calculated for two scenarios. Scenario #1 is based on the use of 5.7 volume % ethanol in all gasoline sold in federally mandated reformulated gasoline areas in California. These areas are currently required to meet the oxygen content requirement for federal RFG. Scenario #2 includes an additional demand component based on the assumption that 30% of gasoline sold

in the remainder of the state would need to contain 5.7 volume % ethanol to meet predictive model requirements. This is based on the fact that, absent any other oxygenate, ethanol use may be necessary to meet predictive model requirements or to meet octane requirements in a portion of the gasoline pool. Demand for scenario #1 is ~ 550,000,000 gallons of ethanol per year. Demand for scenario #2 is ~ 628,000,000 gallons per year.

Ethanol availability for the California market was also assessed. With new plants online, ethanol production capacity for 1999 will reach 1,838,800,000 gallons. Production for 1998 was approximately 1,394,400,000 gallons. New plant start ups and utilization of idle production could then provide 444,400,000 gallons of ethanol for the California market. Another 50 million gallons will be imported from plants qualifying under the Caribbean Basin Initiative (CBI). This brings total ethanol availability to 494,400,000 gallons equating to 89.89% of ethanol demand for scenario #1 and 78.73% of ethanol demand for scenario #2. The remaining demand for ethanol would be met by redirecting product from the lower valued octane markets in Midwestern states. Any shortfall in projected production increases could also be met from this market which currently exceeds 744,000,000 gallons.

Transportation personnel were contacted to determine capability, costs, and time frames for shipping ethanol to the California market. Product would be delivered by a combination of marine cargo and rail car shipments. Transit time would run from 2 weeks to 3 weeks by rail and a minimum of 34 days by water. Shipping costs range from 14 to 17 cents per gallon.

Ethanol would typically be shipped to larger terminals where it would later be removed for delivery, by transport truck, to final destination terminals.

Surveys and phone interviews were conducted with most terminal operators. Of the sixty-nine gasoline terminals analyzed, we were able to obtain definitive answers about ethanol storage from 51 terminals. Of these, 32 (62.75%) indicated they could offer ethanol storage in six months or less. However this too may understate the markets ability to distribute ethanol because terminals are of various storage capacities and throughputs. Generally it is the larger, high volume terminals which indicated they either have ethanol distribution capabilities or could have in a short time frame. Furthermore these terminals are geographically distributed in a manner that provides a high degree of coverage in all major California markets.

These terminals could supply ethanol for blending to CARBOB lifted within the terminal but could also be used to supply ethanol for CARBOB from other nearby terminals which do not have ethanol available. While this is not a desirable scenario over the long term, it could prove advantageous in the early months of an ethanol program while some terminals may still be preparing tankage. This was done quite widely in the Midwest during development of the ethanol blends market there.

Although a detailed projection of ethanol prices was beyond the scope of this study, some general calculations and projections are made, since any California supply exceeding excess capacity would be redirected from the Midwest octane blending market. We estimate that California delivered ethanol prices could range from $1.05 to $1.15 per gallon at current rack gasoline prices in the Midwest (the octane enhancement markets from which product would be redirected). If gasoline prices approach $0.60 per gallon in the Midwest , ethanol delivered to California could reach the $1.30 to $1.35 per gallon range. However, the higher net back prices to the plants resulting from such a price range would result in increased production placing somewhat of a price ceiling at this range.

Introduction

The 1990 Clean Air Act Amendments (CAAA) set forth requirements to use oxygenates in gasoline to reduce mobile source emissions. The CAAA required that oxygenates be added to gasoline in all carbon monoxide (CO) non-attainment areas (during winter months when CO violations are highest) beginning in 1992. Further, the amendments required that the worst ozone non-attainment areas implement year round reformulated gasoline (RFG) programs beginning in 1995. Federal reformulated gasoline is also required to contain oxygenates.

Oxygenates are alcohols and ethers that contain oxygen in their molecular structure. While a number of oxygenates could legally be used to achieve compliance, ethanol and methyl tertiary butyl ether (MTBE) are the only two that are generally used. This is due primarily to their widespread availability, cost, and blending characteristics.

California, through its Air Resources Board (CARB), has implemented its own RFG program referred to as The California Cleaner Burning Gasoline (CBG) Program.

California's RFG program differs from the federal program in several ways. Key among these are that the required/permitted oxygenate levels have been different, and that gasoline meeting the emissions requirements of the predictive model are not required to contain oxygenates. Furthermore, due to a combination of vapor pressure restrictions and maximum oxygen levels, ethanol has been excluded from any meaningful role in the California market. Consequently, MTBE has been the oxygenate of choice and it enjoys near exclusive use in the California markets. CARB has recently lifted the maximum permitted oxygen content to a level that would allow up to 10 volume percent ethanol in its RFG.

Recently, MTBE has frequently been detected in groundwater and has contaminated some drinking water sources. The odor/taste thresholds of MTBE are very low and can therefore render drinking water unpalatable at very low contamination levels. Further, at higher levels there are concerns that MTBE may pose health risks. In response to these concerns, California has been considering alternatives to MTBE. In fact, California issued a legislative directive[1] requiring the California Energy Com-

(1) Items 3360-001-0465 of the Supplemental Report on the 1997 Budget Act

mission (CEC) to prepare and submit a report giving a detailed evaluation of alternatives that could replace MTBE.

The CEC issued its report entitled "Supply and Cost of Alternatives to MTBE in Gasoline" in October 1998. The CEC study explores a broad range of issues that the CEC deemed to be important considerations. The report, though written by CEC, is based on information compiled by contractors.

The CEC report included projections for ethanol supply and demand as well as cost and time line projections for distribution infrastructure improvements necessary to facilitate ethanol blending.

This study also analyzes the possibility of using ethanol as a replacement oxygenate should regulatory or marketplace barriers ever eliminate the use of MTBE in the California market. However certain base assumptions used in this analysis differ from those used in the above referenced CEC study.

Study Objectives

The primary objective of this analysis is to assess the ability of the ethanol industry to supply ethanol to meet the oxygen requirements for California RFG in the federally mandated ozone non-attainment areas. In addition, the analysis includes various logistic considerations, not only for shipping the ethanol but also for terminaling and distribution once delivered to the California market. Specifically the following issues are examined:

1. Estimate of the demand for ethanol in California RFG.
2. Determination of current ethanol production capacity and identification of plants under construction.
3. Estimate current nationwide ethanol demand and resulting net supply availability of ethanol for California.
4. Assess logistic considerations and costs for transporting ethanol to California.
5. To the extent possible, determine what terminaling facilities could be prepared to handle distribution of ethanol and the time frame for any necessary preparations.
6. Provide an overview of cost considerations and anticipated cost factors to bid ethanol away from competing markets (for use in California).

In some cases our projections and conclusions differ from those in the aforementioned CEC study. It should be kept in mind that unlike the CEC study, this analysis focuses on one oxygenate, ethanol. Further, that focus is on supply and distribution of the ethanol only. The intent is to assess the capability of industry supplying sufficient volumes of ethanol to replace MTBE in the California market and to what degree in-state terminaling facilities could accommodate the distribution of ethanol.

Furthermore, this analysis does not examine whether or not MTBE should be totally or partially replaced with ethanol but rather the possibility of doing so should regulatory or marketplace circumstances ever dictate.

California Oxygenate Demand

The mandated oxygenate requirements for California can basically be divided into three categories

- Oxygenated fuel program requirement
- CARB RFG requirement
- Federal RFG requirement

All of the CO non-attainment areas (exclusive of the federal RFG required areas) have recently applied for and received redesignation as achieving attainment. Consequently there is no longer any mandated oxygenate requirement for these areas.

The CARB regulations permit the sale of oxygenate-free CaRFG provided it meets the emissions requirements based on the predictive model. So there is no mandated oxygenate requirement in these areas. However, some refiners may not be able to meet the predictive model requirements for all gasoline produced without the use of an oxygenate.

Under current law, gasoline sold in areas required to meet federal RFG requirements must contain an average of 2.0 wt.% oxygen. It is these areas that face a mandated oxygen requirement. In California this would encompass the LA-Anaheim-Riverside market as well as Sacramento and San Diego.

To calculate the gasoline demand for these areas, we must first look at their population as a percent of California's total population.

TABLE 1 - California Federal RFG Area Population

California state total	29,760,000	(100.00%)
LA-Anaheim-Riverside	15,495,000	(52.07%)
Sacramento	2,073,000	(6.97%)
San Diego	2,655,000	(8.92%)
All federal RFG areas	**20,223,000**	**(67.95%)**

Sources: US Census Bureau, Place and County Subdivision Population Estimates

EPA "List of Reformulated Gasoline Program Areas" July 1998

Using population percentages to project gasoline demand for areas within a state is reasonably accurate. While there are various considerations in each area they tend to offset each other. For instance the LA-Anaheim-Riverside area has a greater mass transit structure which could reduce gasoline consumption on a per capita basis. However average vehicle miles traveled may be higher for many motorists and fuel economy may be reduced due to traffic congestion. Additionally, logistic circumstances may result in some modest spillover (sale of fuel in non-mandated areas). Accordingly we have used population percentages to project RFG demand in the subject areas.

Table 2 - Historic California Gasoline Sales - Gallons

1995	13,258,139,000	
1996	13,519,082,000	(1.97% increase over 1995)
1997	13,722,720,000	(1.51% increase over 1996)

Source: *USDOT-FHA Monthly Motor Fuel Reported by State*

Based on gasoline sales from the 1995-1997 time frame, it is likely that gasoline sales will continue to increase in the 1.5% to 2.0% per year range. A factor of 1.75% is used in the following table.

Table 3 - Projected California Gasoline Demand - Gallons

1998	13,962,867,000
1999	14,207,217,000
2000	14,455,843,000

Since the intent here is to look at near term capability to supply ethanol to the California market, we are utilizing projected 1999 gasoline volumes to calculate California RFG demand and the resulting ethanol requirements. The 1999 demand for California RFG is projected to be 9,655,203,000 gallons.

Table 4 - California Federally Mandated RFG Volume Projected 1999 - Gallons

State total	@ 100%	14,207,217,000
LA-Anaheim-Riverside	@ 52.07 %	7,397,677,000
Sacramento	@ 6.97%	990,243,000
San Diego	@ 8.92%	1,267,283,000
Total demand for federal RFG areas	@ 67.96%)	9,655,203,000

To meet a 2.0 wt. % oxygen requirement with ethanol requires the addition of 5.7 v% denatured ethanol. Corresponding ethanol volume requirements are projected in the next table.

Table 5 - California Federally Mandated RFG Ethanol Requirements Projected 1999- Gallons

Area	Gasoline volume	5.7 v% ethanol
LA-Anaheim-Riverside	7,397,677,000	420,527,589
Sacramento	990,243,000	56,443,851
San Diego	1,267,283,000	72,235,131
Totals	**9,655,203,000**	**549,206,571**

From the above table we can see that the subject areas would require ~ 550,000,000 gallons per year of ethanol to meet federally mandated oxygen content requirements.

Oxygenates are not required in order to meet the requirements of the predictive model in the remainder of the state. However in order to meet the predictive model requirements, some refiners may find it necessary to utilize oxygenates in at least a portion of their gasoline. The removal of additional olefins and aromatics to meet predictive model requirements could result in some octane reduction across the gasoline pool. The octane of ethanol is higher than that of gasoline raising the anti-knock index (AKI) by approximately 2 to 2.5 numbers (1 to 1.4 numbers for motor octane number

and 3 to 3.7 for research octane number). Some refiners may also be able to use ethanol for its impact on distillation curve which can also favorably impact the predictive model. If MTBE were not available in the marketplace, this role would likely need to be filled by ethanol.

Therefore, a second scenario for California ethanol demand is also considered. In this case it is assumed that 30% of the gasoline sold outside the federal RFG areas would also require 5.7 v% ethanol. The 30% level was chosen because it closely approximates the California market share of premium and midgrade products. It is these grades that put the greatest octane requirement on the gasoline pool because of their higher octane level. Using the gasoline projections from Table 4 these calculations are presented in the following table.

Table 6 - Optional Scenario - 30% Ethanol Use In Non-federally Mandated Areas

Projected 1999 Gallons

State total	14,207,217,000	
Less RFG areas	9,655,203,000	
Non-federal areas	4,552,014,000	
	x 30% of market share	
Scenario #2	1,365,604,200	(30% market share)
	x 5.7% ethanol	
Additional ethanol demand	77,839,439	

The optional scenario would add approximately 78,000,000 gallons of demand to the base demand case listed in Table 5. In this second scenario ethanol demand would then be approximately 628 million gallons annual.

Table 7 - California Ethanol Demand Scenarios - Gallons

Scenario #1	Federal RFG mandate areas only	550,000,000
Scenario #2	Add 30% non-mandate market	628,000,000

Ethanol Production and Supply

Appendix A provides a list of operating plants (A-1) and plants that are under construction (A-2). While additional plants in various stages of planning, engineering, and financing are also listed in Appendix A (A-2), they are not included in this analysis. Only operating plants and plants that are already under construction are considered as supply sources. These plants have a combined annual capacity of 1,838,800,000 which represents total supply availability for mid 1999 and later. Note that we have listed additional plants in A-3. These plants were included as potential supply sources in the CEC study but are omitted from this analysis because we could not confirm their operational status or because their production may not be directed to the fuel grade market.

There are other sources of ethanol supply. However most are not considered viable sources for U.S. fuel grade ethanol use. Ethanol has a variety of uses including pharmaceutical, beverages, solvents, and as a chemical intermediate. Most production outside of North and South America goes to those uses and is not considered in this assessment. Fuel grade ethanol sources in North and South America are discussed briefly below. Only sources of ethanol produced from the fermentation process are considered since synthetic ethanol would not qualify for the federal tax incentive afforded fermentation based ethanol.

Canada: Canadian production is currently estimated at 40-50 million gallons and is used in Canada for their own programs. It does not represent any major potential for export to the California market.

Brazil: Ethanol production in Brazil exceeds that of the U.S. and is estimated to be nearly 4 billion gallons per year. Traditionally Brazil has used their ethanol in their own fuel programs but has sporadically exported ethanol to the U.S. Current estimates indicate that Brazil's ethanol demand would require approximately 85% of its production output. While the remainder may be available for export to the U.S. we have not included it as a supply source since volume availability is uncertain and ability to deliver to the U.S. market on a competitive basis is questionable.(1)

(1) While gasoline ethanol blends made with Brazilian ethanol qualify for the partial exemption to the motor fuels excise tax, the imported ethanol is subject to a $0.54 per gallon tariff

Caribbean Basin: Under the Caribbean Basin Initiative (CBI) fuel grade ethanol from Caribbean Basin Countries can be imported to the U.S. duty-free. Imports receiving duty-free treatment cannot exceed seven volume percent of U.S. ethanol production. CBI ethanol is typically produced by importing wine alcohol into a qualifying country where it is redistilled/upgraded and then sent to the U.S.

Under current U.S. production scenarios as much as 80 to 100 million gallons of CBI ethanol per year could be imported duty-free. This supply source may seem insignificant compared to total world production or even total U.S. production. However it could be an important supply source for a California ethanol program since it could be sourced by marine cargo. It is likely that all CBI ethanol production would be directed to the California markets. Although this supply source could be as high as 80-100 million gallons of supply per year, it has been averaging 35-40 million gallons in recent years. We have taken the conservative position that such supply may be limited to 50 million gallons per year.

Current Ethanol Production: Also in Appendix A is a breakdown of U.S. fuel ethanol production from 1997 and the first ten months of 1998 (A-4). From this we can determine that a significant portion of current production is underutilized. In addition plants under construction will result in increased supply.

Table 8 - Ethanol Supply Projections

1999 ethanol production capability	1,838,800,000
1998 production rate projected	1,394,400,000
Underutilized capacity	444,400,000
CBI ethanol	50,000,000
Total ethanol supply available	494,400,000

Scenario #1 demand 550,000,000
Scenario #2 demand 628,000,000

494,400,000 gallons of ethanol = 89.89% of scenario #1 demand and 78.73% of scenario #2 demand.

From the above table we can see that for 1999 underutilized ethanol production would be 494,400,000 gallons annually. This equates to 89.89% of scenario #1 demand (federally mandated RFG areas only) or 78.73% of scenario #2 demand (scenario #1 + 30% of remaining gasoline market blended with 5.7 v% ethanol).

Underutilized capacity represents the primary ethanol supply source for the California market. However it is insufficient to meet total demand. In addition to underutilized capacity additional ethanol would be needed. This additional need would be met with ethanol redirected from a lower valued use.

The Renewable Fuels Association estimates that approximately 650 million gallons of ethanol per year are used to comply with the oxygen requirement in the oxygenated fuels and RFG programs. From this it can be estimated that, based on 1998 projected production, 744,400,000 gallons are still utilized in the lower valued octane enhancement market. The remainder of ethanol required for any California program would be redirected from this use. Likewise if underutilized capacity is not brought completely back on stream, any shortfall would be redirected from the octane enhancement market.

In short, any ethanol demand created by a California ethanol program would be met through a combination of currently underutilized capacity, new plants (those already under construction), and redirection of product from the lower valued octane enhancement market. (For a discussion of the cost considerations associated with redirection of these supply sources, see the "Discussion of Ethanol Costs Considerations" section of this report).

Ethanol Transportation to California Markets

The transportation of ethanol within any given market is fairly standard. The distance between ethanol production facilities, located primarily in the Midwest, and the California market however results in transportation issues in shipping to the destination market area that should be examined.

Due to the distance involved, there are only two viable transportation alternatives, rail shipments or marine cargoes.

With an estimated scenario #1 demand of 550,000,000 gallons monthly, shipments would average about 46 million gallons per month but could be as high as 50 million gallons during higher volume summer months.

Some ethanol plants are land locked and for them only rail shipments are viable. Lower production capacity plants (under 80 million gallons annual capacity) are also not likely to ship by marine cargo due to the inability to rapidly amass the required volume for such shipments. Consequently these plants would also be limited to rail shipments. Larger plants located on the water would have the option to ship waterborne cargoes and in some cases are likely to do so.

Rail Shipments: Rail shipments typically consist of one or more 30,000 gallon rail cars typically loaded at ~ 29,000 gallons. Transit time from Midwestern ethanol plants to the various California markets can range from 2 to 3 weeks. Considering time to return the rail car to the plant, one complete turnaround could take 4 to 6 weeks. Using the average of 5 weeks one can assess how many rail cars would be required.

If all product, 46 million gallons per month, were moved exclusively by rail, this would equate to 1586 rail car movements. With a total 5 week turn around this would require approximately 1982 rail cars. However it is not likely that all product would move by rail due to various logistical considerations.

Typical rail costs for shipping ethanol from the Midwest to California range from 14 to 17 cents per gallon depending on the plant of origin and market destination.

Marine Cargos: Larger plants located on navigable waters would likely ship a large portion of their California destined ethanol via marine cargo. This would typically be accomplished as follows: Product would be shipped down the Mississippi via multiple 10,000 barrel river barges. The product would be staged at a terminal facility in New Orleans until sufficient quantities of ethanol are accumulated to warrant shipment. Such shipments could be as small as one compartment of an ocean going vessel or as large as an entire ship. This would depend to some degree on the capacity of the destination terminal(s). Shipments could be as small as one million gallons or as large as 10-12 million gallons and are most likely to be in the 4-5 million gallon range.

Once staged in New Orleans and loaded on to ships, the product would go south through the Panama Canal and then north to California ports. The entire process requires slightly more time than rail shipments. Shipping from Illinois to New Orleans via river barge requires approximately 14 days while shipping from New Orleans to California ports via the Panama Canal requires at least 20 days. Consequently the entire process takes a minimum of 34 days.

It should be noted that the movement of ethanol between U.S. ports would require use of Jones Act vessels. The Jones Act requires that product shipped between U.S. ports must be shipped in vessels that are U.S. owned, flagged, and manned and must have been built in the U.S. While the Jones Act might require assessment for larger volume product movements, the amount of ethanol that would be moved from the gulf coast to California is relatively small. Furthermore 30,000 to 40,000 barrels per day (1.2 to 1.7 million gallons per day) of MTBE is currently shipped from the gulf coast to the west coast in Jones Act vessels. If MTBE were not being shipped to California, capacity could be redirected for ethanol transportation.

The cost of moving ethanol by marine cargo does not present major economic incentives over rail. While the cost of shipping ethanol from New Orleans to the west coast in a Jones Act vessel could be as low as 8 to 10 cents per gallon, this process also has the cost of barge movement from the plant to New Orleans and a terminaling fee to amass product prior to loading the ship. Plant transportation personnel have indicated that total marine cargo movement costs are nearly the same as rail or may, in some cases, present a slight cost advantage. The main benefit of marine cargoes will be to the destination terminal which in many cases will prefer single shipments of large quantities as opposed to the

more time consuming task of spotting, inspecting, and unloading rail cars. Additionally, this would reduce strain on the ethanol producers rail car fleets.

Ethanol Transportation Within the California Market

The most likely scenario for distribution of ethanol shipped to California is that product would be shipped via rail or waterborne cargo to large terminals from which product would be removed by transport truck for shipment to final destination terminals. This would result in additional transportation charges as well as charges for throughputting ethanol at the centralized terminaling facility.

In some cases final destination terminals can receive product by rail and in those cases product would typically be shipped directly from the ethanol plant to the terminal.

Costs for redistribution from a central terminaling facility to destination terminals will vary depending on location but would typically be similar to costs experienced in the Midwest.

Ethanol Storage & Distribution

Terminals vary widely in their degree of flexibility to handle new or additional products. Ethanol would represent such a product due to its special handling characteristics and delivery methods. To determine the viability of widespread distribution of ethanol in California requires a reasonably detailed assessment of product terminals where ethanol would be blended with gasoline for final distribution to the retail outlet or other final destination. Likewise, it is necessary to identify terminals which could serve as a central ethanol redistribution point, receiving rail or marine cargos, storing product and providing outbound truck delivery to outlying terminals.

Because ethanol absorbs moisture it is almost always blended at the final destination terminal. This is usually accomplished in one of three ways.

Tank Blending: Ethanol and gasoline (in this case CARBOB) could be blended in one or more terminal tanks. A few terminals in the Midwest, especially those with recirculation capability (in tank devices to recirculate/stir the product) have distributed ethanol blends in this manner. However this method is the least preferred of the methods available due to the potential for the blend to encounter excessive moisture which could result in the ethanol phase separating from the blend. Additionally terminal tankage is not routinely equipped with recirculation/mixing devices.

Top-off Blending: In this scenario, ethanol and gasoline are injected separately into the transport truck with the agitation from loading and transport accomplishing the blending process. Volumes are controlled by preset meters activated by loading cards. This could be done within a single terminal (i.e. one loading rack) or by loading the ethanol at one terminal and the gasoline at another terminal (both terminals in the same proximity). This method was successfully used throughout the Midwest for a number of years and is still utilized at some terminals although in-line/injection blending is now the more common method.

In a developed market, in-line/injection blending is preferred because of the greater control and less potential for blending errors. However in a newly established or developing market, top-off blending actually offers certain advantages. Primary among these is more rapid conversion time frames via

cross utilization of terminals. It is not likely that every terminal would have ethanol available in a short time frame. In this case a terminal without ethanol could still load out gasoline that could be top-off blended with ethanol at a nearby terminal. Terminals are, of course, usually located adjacent to or near other terminals.

By utilizing top-off blending, terminals without ethanol could meet the oxygen requirement by utilizing ethanol available at other terminals. When this is done there is usually a "stop charge" for the transport to make the additional stop. This usually equates to $0.003 to $0.005 per gallon of finished product.

In-line/Injection Blending: The preferred method for an established or mature ethanol blend market is in-line or injection blending. In this case, the ethanol and gasoline (in this case CARBOB) are blended in-stream prior to the meter and a single finished product is metered .

This method eliminates potential for blending errors and provides better quality control. Additionally, it provides greater reporting ease for program compliance. This is typically the preferred blending method but as discussed above it is neither necessary nor, in the case of a developing market, in every case desirable.

Other Modifications: Some terminals will need to make modifications to offer ethanol even if tankage is adequate. Such modifications may include addition of a floating internal cover to the storage tank, repiping to the loading rack, meters, additional loading arms, and if applicable in-line blending equipment. Such alterations can be made with "off-the-shelf" equipment and typically do not require an extensive permitting process. Injection blenders can be purchased as prefabricated "skid mounted" units that are delivered ready to go except for necessary piping connections. The earlier mentioned CEC report estimates that such modifications would increase the average cost of ethanol blends by 0.1 cents per gallon even including modifying or building segregated storage tanks. We do not disagree with the cost estimate but as noted in our terminal analysis it appears that construction of tankage will, in many cases, not be necessary.

The ability of California terminals to handle ethanol within various time frames has been the subject of debate and various hypothetical scenarios. At least one study [1] attempts to quantify the degree of preparation needed and the likely time frame needed to accomplish such preparation. However, no place in the printed literature were we able to find a definitive assessment conducted on a terminal by terminal basis. Consequently an effort was undertaken to identify which terminals would be able to handle ethanol, which might require modification, and if modifications were necessary, what type of time frame might be required.

Our first step to conduct such an assessment was to identify area terminals. To do this we utilized the *OPIS Petroleum Terminal Encyclopedia (1999-10th edition)*. The California section of the terminal encyclopedia is contained in Appendix B as B-1. Working from this list we eliminated those terminals which did not have outbound transport truck capability since redistribution of ethanol or delivery of blended product would require such capability. This left us with a list of approximately 70 terminal targets to survey. That listing is also included in Appendix B as B-2. Initially we sent a survey form directly to each terminal. From this mailing we received about a 10% response and three surveys were returned as undeliverable. Our next step was to begin calling company contacts for all the terminals to compile as much non-proprietary information as possible. A detailed synopsis of these survey results is contained in Appendix B (item B-3).

A total of 79 terminals were included in our final assessment. We have taken the information from the survey synopsis and placed them in a table format for inclusion in this section of our report as Table #9. The table lists terminals by geographic market area, indicates if they would be able to distribute ethanol and within what time frame. In some cases we were unable to obtain the necessary information or the terminal operator was unable to give a definitive answer. Those terminals are marked as uncertain. Terminals indicating that they didn't believe their terminal could handle ethanol (for instance, due to storage constraints) are marked as unable.

Among the 79 terminals assessed, 10 did not distribute gasoline. In some cases this was because they were a distillate or lube oil terminal, or a pressurized product terminal. In other cases the terminals were closed or gasoline transport load out was not available. These terminals have been shaded and indicated by footnote in the table.

(1) Supply and Cost Alternatives to MTBE in Gasoline, California Energy Commissions, October 1998

Table 9 - Terminals by Geographic Areas
Projected Time Requirement to Offer Ethanol

Terminal	Location	0-3 months	4-6 months	7-12 months	12+ months	uncert	unable
LOS ANGELES							
Chevron USA	El Segundo						š
Mobil Oil Corporation	Torrance					?	
G.P. Resources Inc. (1)	Term. Island						
Equilon Enterprises	Wilmington		š				
GATX Terminals Corporation	Wilmington					?	
Paktank Corporation	Wilmington		š				
Shore Terminals (1)	Wilmington						
Arco Terminal Services Corp.	Signal Hill	š					
Arco Terminal Services Corp.	Long Beach	š					
Equilon Enterprises LLC	Long Beach	š					
Petrodiamond	Long Beach					?	
Equilon Enterprises LLC	Ventura		š				
Tesoro Marine Inc. (1)	Port Hueneme						
Chevron U.S.A. Inc.	Van Nuys						š
Equilon Enterprises LLC	Van Nuys		š				
Equilon Enterprises LLC	Los Angeles		š				
Mobil Oil Corporation	Los Angeles					?	
Mobil Oil Corporation	Los Angeles					?	
Tosco (Center Street)	Los Angeles				š		
Tosco (Broadway)	Los Angeles				š		
Arco Products Company	South Gate	š					
Chevron U.S.A. Inc.	Montebello						š
Powerine Oil Company (2)	Santa Fe Springs						
Tosco	Santa Fe Springs				š		
Tosco	Rialto				š		
Equilon Enterprises LLC	Bloomington		š				
Kinder Morgan Pacific	Bloomington					?	
Tosco	Bloomington			š			
Chevron U.S.A. Inc.	Huntington Beach						š
Arco Products Company	Carson	š					
Westway	Los Angeles					?	
Arco	Colton	š					
Kinder Morgan	Orange					?	
L.A. Resources (1)	Los Angeles						
Equilon	Carson		š				
Tosco Refining (Marine Dock)	Los Angeles	š					

(1) Lube/Distillate Terminal - does not handle gasoline
(2) Terminal not currently in operation
(3) No gasoline load out capability
(4) Pressurized product terminal - does not handle gasoline

Terminal	Location	0-3 months	4-6 months	7-12 months	12+ months	uncert	unable
SAN DIEGO							
Chevron U.S.A. Inc.	San Diego				š		
Equilon Enterprises LLC	San Diego		š				
Kinder Morgan Pacific	San Diego					?	
Kinder Morgan Pacific	Niland					?	
Kinder Morgan Pacific	Imperial					?	
Arco	San Diego	š					
SACRAMENTO							
Chevron U.S.A. Inc. (1)	Sacramento						
Tosco	Sacramento				š		
Kinder Morgan Pacific	Rancho Cordova					?	
Equilon Enterprises LLC	West Sacramento		š				
Arco	West Sacramento	š					

(1) Lube/Distillate Terminal - does not handle gasoline
(2) Terminal not currently in operation
(3) No gasoline load out capability
(4) Pressurized product terminal - does not handle gasoline

Terminal	Location	0-3 months	4-6 months	7-12 months	12+ months	uncert	unable
SAN FRANCISCO							
Exxon Company U.S.A.	Benicia						š
Shorel Terminals	Crockett	š					
San Francisco Marine (1)	San Francisco						
Kinder Morgan Pacific	Brisbane					?	
Equilon Enterprises LLC	So. San Francisco		š				
Gibson Environmental (2)	Redwood City				š		
Chevron U.S.A. Inc.	San Jose						š
Equilon Enteprises LLC	San Jose		š				
Kinder Morgan Pacific	Milpitas					?	
Arco Products Company	Richmond	š					
GATX Terminal Corp. (3)	Richmond	š					
Time Oil	?					?	
Int. Matex Tank Terminal	Richmond	š					
Time Oil Company	Richmond	š					
Tosco	Richmond	š					
Chevron USA	Tracy						š
Arco Products Company	Stockton	š					
Equilon Enterprises LLC	Stockton		š				
Kinder Morgan Pacific	Stockton					?	
ST Services	Stockton	š					
Tesoro Refining,.	Stockton						š
Tosco	Stockton				š		
Tosco (formerly Diablo Services)	Pittsburg				š		
Chevron U.S.A. Inc.	Martinez						š
Tosco	Martinez	š					
Equilon Enterprises LLC	Martinez		š				
BAKERSFIELD							
Coast Gas Inc. (4)	Bakersfield						
Kern Oil & Refining Company	Bakersfield		š				
Equilon Enterprises LLC	Bakersfield		š				
OTHER							
Kinder Morgan Pacific	Fresno					?	
Kinder Morgan Pacific	Chico					?	
Chevron U.S.A.	Eureka						š

(1) Lube/Distillate Terminal - does not handle gasoline
(2) Terminal not currently in operation
(3) No gasoline load out capability
(4) Pressurized product terminal - does not handle gasoline

As can be seen from Table #9, a number of terminals could offer ethanol in a fairly short time frame. In fact among those terminals from which we could get a definitive answer (a total of 51 gasoline terminals), a total of 32 (62.75%) indicated they could offer ethanol in six months or less. Another 9 (17.65%) indicated they could offer ethanol over a longer time frame usually a year or more. Only 10 terminals (19.61%) indicated they would be unable to offer ethanol.

There are 18 terminals in the uncertain category. We were unable to obtain information on some of these terminals (e.g. Mobil). However 11 of the terminals are operated by Kinder-Morgan which might be able to offer ethanol under certain operating circumstances and depending on shipper requirements as discussed in the survey synopsis in Appendix B. In this case the number of terminals offering ethanol would increase dramatically.

In order to assess geographic availablity of ethanol storage, it is necessary to review the terminals in Table 9 based on the market areas they serve. In Table 10 we have separated and recapped terminals by market area and listed the time frames within which they could offer ethanol.

Table #10 - Geographic Distribution of Terminals that Could Offer Ethanol

Market Area	0-3 months	4-6 months	7-12 months	1 year +
Los Angeles	7	7	1	4
San Diego	1	1		1
Sacramento	1	1		1
San Francisco	8 (1)	4		2 (2)
Bakersfield		2		

(1) plus an additional central distribution terminal

(2) plus an additional terminal at Redwood City that is not currently in operation

By market specific areas, LA has 14 terminals that could offer ethanol in six months or less. This is 60.87% of terminals which provided a definitive answer. An additional terminal could convert

within one year and four more terminals in time frames exceeding one year. A total of eight terminals were in the uncertain category, two of which are Kinder-Morgan terminals (see previous discussion).

San Diego has two terminals that could offer ethanol in six months or less. This is 66.66% of terminals providing definitive answers. One additional terminal indicated a conversion time table exceeding one year. The three terminals in the uncertain category were all Kinder-Morgan terminals and again the previous discussion pertaining to their operations apply.

Sacramento has two terminals that could be converted in six months or less representing 66.66% of terminals providing definitive answers. An additional terminal could convert given a time frame in excess of one year and the remaining terminal is a Kinder-Morgan facility.

San Francisco has 12 terminals that could be readied for ethanol in six months or less or 63.16%. Three more terminals indicated necessary time frames in excess of one year. Three of the four terminals in the uncertain category are Kinder-Morgan facilities.

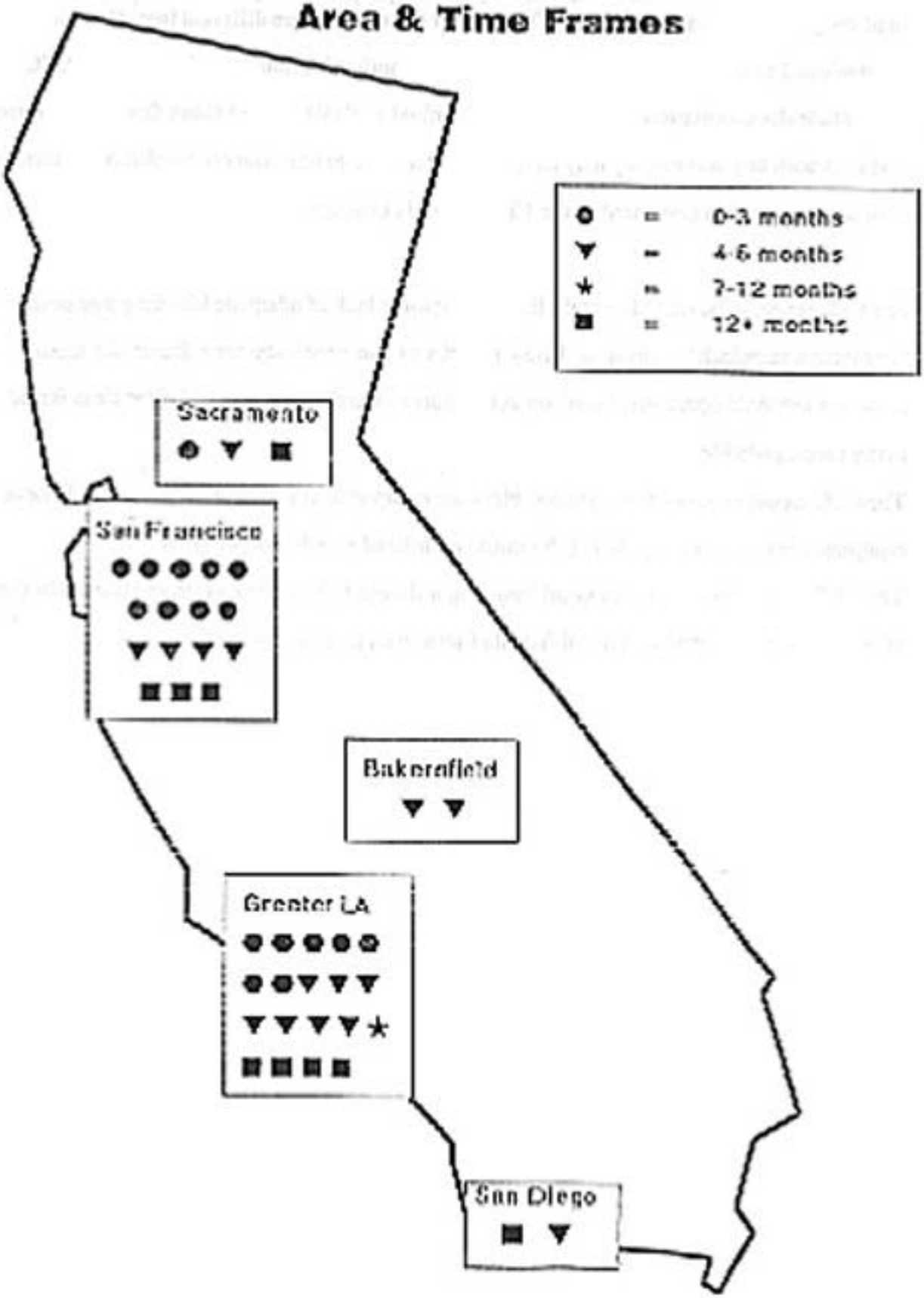
In Bakersfield both gasoline terminals indicated they could offer ethanol within a six month time frame (100%).

Of the remaining markets, terminals listed in Fresno and Chico are Kinder-Morgan terminals while Chevron in Eureka indicated they could not offer ethanol in their current configuration.

Clearly there are a number of terminals in all the major market areas that could make ethanol available in a very short time frame. The map on the following page displays graphically the terminals & time frames for conversion by market area.

Table 11:

Terminals by Geographic Area & Time Frames



From our survey results, we conclude that it would be possible to distribute ethanol for a large portion of the gasoline in a six month time frame. Our conclusions are different from those in the CEC report (mentioned earlier) which projects an 18 to 24 month minimum time frame. The CEC report does not include documentation of a terminal by terminal analysis so we cannot directly compare our survey results with any survey they may have conducted. We believe our conclusion of a shorter time frame for implementation compared to the CEC report is because:

- The CEC report indicated "The main limiting factor is lack of adequate blending equipment at the distribution terminals" indicating 18-24 months as the necessary time frame for modification. However terminal operators, based on actual surveys, indicate a much shorter time frame is, in many cases, possible.
- The CEC report assumes that injection blending equipment is necessary whereas we believe such equipment is not necessary during the initial months of an ethanol program.
- The CEC report does not take top-off blending utilizing two terminals into consideration (i.e. one ethanol terminal supplying ethanol for other terminals as discussed earlier).

Discussion of Ethanol Cost Considerations

A detailed cost analysis is beyond the scope of this study. However since some ethanol supply for California would be redirected from lower valued uses, we felt a discussion of those cost aspects was warranted.

Ethanol has traditionally been priced on the basis of margin improvement, octane value, or oxygenate value. In the early years of ethanol use, i.e. 1980s, ethanol was sold largely by pricing it in a fashion that, net of tax credits, it was slightly cheaper than gasoline allowing blenders to lower their total product cost. As state tax credits diminished and ethanol began to achieve more widespread acceptability, it began to be priced more for its octane value. This involves two approaches. In some cases a refinery might make a sub-octane gasoline so that, when blended with ethanol at the terminal it would meet the required octane specification. The second and more common method is to add ethanol to unleaded regular, selling the resulting blend as mid-grade, and/or blending unleaded regular with a small amount of premium and ethanol to achieve the octane requirement of a premium grade product. More recently a large portion of ethanol produced has been sold for its value as an oxygenate to comply with the oxygen requirements of oxygenated fuel and reformualted gasoline programs.

The Renewable Fuels Association estimates that in 1998 approximately 650,000,000 gallons of ethanol was used to meet oxygen standards. Based on 1998 production figures this would indicate that about 740,000,000 gallons will be sold into the octane market. Todays low gasoline prices and the absence of state tax credits preclude the use of ethanol solely as a product extender/margin improver.

Ethanol supply available for any California program would come from production increases in underutilized production, new plant production, and by redirecting products from the lower valued octane market. While ethanol is priced based on its octane and/or oxygenate values, its production costs are dictated by the unrelated price of corn. Production costs do not have a major impact on pricing decisions since product must be priced to compete based on its value to the end user. Production costs due however have an impact on production volume. Large well financed plants can alter their production to market conditions and often have contractual agreements for pricing and volume. Smaller plants will typically operate as long as their net plant price exceeds production costs. Although

this typically results in selling at a price that is below total operating costs inclusive of debt service and amortization, it does at least allow some payment toward debt service. Once sales prices fall to a level that does not allow a gross margin above production costs, smaller plants will typically shut down temporarily.

The majority of ethanol sold into current oxygenate markets is supplied by large producers with some product supplemented by smaller plants. A large portion of this product is sold based on contracts or long term commitments, Consequently plants starting production in 1999 will find themselves initially relegated to the octane enhancer market and would need to price their product accordingly.

Ethanol for California, whether from new plants or existing production, would come from the octane enhancement market since that represents the current lowest price use of fuel grade ethanol. The octane market can be divided into two distinct groups, those states with state tax credits and those without. Product sold in states with tax credits sells at a higher price due to the blenders ability to recoup higher costs through the tax credit. There are only a few states with tax credits remaining and those are recapped below in Table # 12.

Table #12 - States with Tax Credits for Ethanol

	Cents per gallon	percent	
Alaska	$.06		
Connecticut	$.01		
Hawaii		4%	
Idaho	$.025		
Illinois		2%	(sunset 2003)
Iowa	$.01		(sunset 2007)
South Dakota	$.02		

Source: The Energy Independent, Bryan & Bryan Inc., June/July 1998

The states listed in the table provide credits or exemptions from the gasoline pump tax (state motor fuels tax) or sales tax and are available to the blender. A few other states offer producer credits to the production facility but there is no requirement for these plants to sell their product in state.

From the above table and preceding discussion we can see that it would not likely be economically feasible to supply California's ethanol from certain higher valued markets. The estimated 650,000,000 gallons sold into the oxygenate market makes up this first block of such product. Although there are no mandates that ethanol be used in these markets, historical use indicates it is the oxygenate of choice in certain markets. Within the octane enhancer market it is necessary to first look at state tax credits and/or exemptions.

Alaska: Ethanol sales in Alaska are primarily to meet the requirement of the winter time oxygenated fuels program requirement for Anchorage. This volume would be included in the RFA estimate. In any event gasoline sold in Alaska and corresponding ethanol needs are very small.

Connecticut: Any ethanol sold in the state would be largely for meeting oxygen requirements and would be included in the RFA estimate.

Hawaii: Ethanol is not currently blended in Hawaii.

Idaho: To draw product from this state to the California market would require an additional $.25 per gallon compared to a state with no credit.

Illinois: A large portion of ethanol sold in Illinois is to meet the oxygen requirement in the Chicago market and would be included in the RFA estimate for program use. However ethanol is sold outside the Chicago market for octane value. In the later case it would take a price approaching $.15 per gallon higher to draw product from this market, compared to a state with no credit.

Iowa: Ethanol used in Iowa is strictly for octane enhancement. To draw product from this market

would take a price approximately $.10 per gallon higher than a state with no credit.

South Dakota: Ethanol sold in South Dakota is sold into the octane enhancer market. It will take $.15 to $.20 per gallon more to draw product from this state compared to one with no credit. Gasoline volume in South Dakota is relatively low as is corresponding ethanol demand.

From the above states, only Idaho, Iowa, and South Dakota and a portion of Illinois present higher priced markets within the octane market segment. Consequently ethanol from the octane enhancement market would be redirected from other states, primarily in the Midwest.

California would be similar to other markets where ethanol is priced primarily for its value as an oxygenate. This is turn would be driven by the price of gasoline since in the case of an elimination of MTBE from the market place, ethanol prices would be keyed off of gasoline prices absent a competing oxygenate with significant market presence. These prices would be set based on the value of product in California and transportation costs would not figure into the pricing equation because price would be based on value to the blender. However ethanol producers would consider transportation costs when determining whether or not to meet the necessary market price.

As discussed in the "Ethanol Transportation to California Markets" section, the cost of shipping ethanol to the California market will fall in a range of 14-17 cents per gallon of ethanol. In addition use of a central breakout terminal will result in handling charges of 25-70 cents per barrel ($0.006 to $0.017 per gallon) depending on the type of storage/throughput agreement and volumes involved. In most cases there will also be the cost of transporting the ethanol from the central breakout terminal to the destination terminal and a throughout charge at the destination terminal (in the case of third party terminals and throughput agreements). However these later charges are experienced in all other markets and are not particularly relevant. Compared to the Midwest octane market, transportation and handling costs will range from $0.146 to $0.187 per gallon of ethanol. Ethanol producers would need to recoup this amount plus some premium to the Midwest octane market to induce them to supply ethanol to California.

NOTE: When considering relevant values it should be noted that gasoline prices of California RFG have traditionally exceeded conventional gasoline prices in the Midwest by a significant amount. Appendix C (C-1) lists the average spot price of conventional gasoline in Chicago, a traditional Midwestern market to the spot price of California RFG in L.A. This is also displayed graphically in Appendix C (C-2). As can be seen from Appendix C, the LA RFG price is, with minor exception, higher than the Chicago conventional gasoline price by an average of more than 8 cents per gallon. Since ethanol prices are driven in large part by gasoline prices, ethanol is generally worth 8 cents per gallon more in California thereby offsetting approximately half its transportation cost.

Given the uncertainty of projecting gasoline prices, it becomes equally as difficult to project ethanol prices. However it is not difficult to predict the minimum price premium required to draw ethanol from the Midwest octane market to the California market. Producers would anxiously redirect production for as little as $0.05 incremental margin per gallon of ethanol providing it were for a market involving long term commitments. Consequently ethanol could be drawn from the Midwest market for this margin improvement plus transportation, or in other words for as little as $0.196 to $0.237 per gallon of ethanol.

To get some idea of what type of prices this might lead to, it is necessary to look at historic gasoline prices in some of the Midwest markets from where California ethanol supplies would need to be drawn. Again these are the lowest valued markets, i.e. octane enhancement markets without state tax credits. We have chosen Michigan, Indiana, and Ohio as representative markets within this group. Table #13 lists the average rack prices for unleaded for each of these terminals for the period of July 1, 1997 through June 30, 1998.

Table #13 - Annual Average Gasoline Rack Price
(time frame 7-1-97 to 6-30-98 - average of all suppliers)

Terminal location	87 octane unleaded
Indianapolis IN	.6040
Columbus OH	.5735
Detroit MI	.5813
Los Angeles CA	.6450

Source: OPIS Historical Yearly Rack Average by Supplier

The ethanol octane blend market in the Midwest has traditionally been priced at the rack price of unleaded plus 54 cents per gallon (the value of the federal motor fuels excise tax credit). Prices would be higher in states with state tax credits but this is not relevant here since it is states without credits from which product would be redirected. While the formula of unleaded plus 54¢pg somewhat under-values the octane value of ethanol, it is the traditional pricing mechanism and the one currently used.

Table #14 - Ethanol Pricing Calculation

Midwest 3 market average unleaded rack price (from Table 13)	.5863
Value of federal credit	.5400
Resulting Rack Price	$1.1263
Less Transportation/Distribution Costs	.0400
Projected Resulting Plant Net Back Price	$1.0863

Averaging the three markets in Table #13 we arrive at an average market price of $.5863 per gallon of unleaded regular . In order to induce blenders to use ethanol in this fashion, it is necessary to provide a blend margin incentive which has traditionally been provided by the unleaded price plus 54 cents

formula. In this case ethanol at the rack would be worth a $1.1263 per gallon in the Midwest averaged across the indicated time frame. With transportation and distribution costs, price net back to the plant would be approximately $1.08 - $1.09 per gallon. Obviously gasoline prices are much lower today with prices in the mid 30 cent per gallon range not at all uncommon. Consequently ethanol prices at the rack (which move largely in tandem with gasoline in these markets) has fallen below the $1.00 per gallon mark in many markets. For projection purposes it would then be safe to assume a near to mid term Midwest ethanol price range(FOB production plant) of $.85 to $1.10 per gallon. As mentioned earlier, it would likely take 5 cents per gallon improvement in plant net back prices to result in redirection of this product to the California market. This can provide some idea of the range of prices as listed in Table #15.

Table #15 - Price Range - California Ethanol

Ethanol price range (FOB plant)	$.850	-	$1.100
Price incentive	.050	-	.050
Transportation/handling costs	.146	-	.187
Projected California price range	$1.046	-	$1.337

It is very unlikely that prices would exceed the upper end of the price range. At any corn price below $3.00 per bushel, an ethanol price (FOB production facility) of $1.10 would stimulate increased production from underutilized capacity, new plant start ups, and restarting of idle plants. Consequently it is unlikely that ethanol costs, laid in to California would exceed the $1.30-$1.35 range and this would only be in a case where gasoline rack prices in the Midwest recover to a level near $0.60 per gallon. Prices conditions, as of January 1999, would likely result in California delivered ethanol prices in the $1.05-$1.15 range at the current time. Net of the federal tax credit this equates to $.51-$.61 per gallon which is extremely competitive with MTBE when ethanols higher oxygen content is considered.

Conclusions

Before listing our primary conclusions, it is important to note a few assumptions made in this analysis since they may differ from other such studies. Our assessment assumes that regulatory or market place conditions result in the removal of MTBE from the California marketplace only, that ethanol would be blended at 5.7 v% in federally mandated RFG markets (scenario #1) and that the remaining California markets may require 30% of gasoline sold to contain 5.7 v% ethanol to meet predictive model requirements (scenario #2). California ethanol demand is projected at ~ 550,000,000 for scenario #1 and ~ 628,000,000 gallons for scenario #2.

This analysis is focused on the availability of ethanol supply, transportation, and terminaling and does not include any assessment of necessary steps to make the appropriate CARBOB available.

Based of the above, we conclude that:

- Ethanol supply is more than adequate to meet California ethanol demand in both above referenced scenarios.

- California ethanol supply would come from three primary sources: new plant production, increases in currently underutilized production, and redirection from lower valued uses, primarily the Mid-west octane enhancement market.

- Ethanol would be transported to California by both rail and marine cargo. The use of marine cargo would minimize any initial strain on rail capacity.

- Transportation costs from Midwest ethanol plants to the California market will range from $0.14 to $0.17 per gallon.

- A total of 69 gasoline terminals were assessed. Among the 51 terminals providing definitive answers, 32 (62.75%) indicated they could offer ethanol in six months or less. Further the number

could be much higher depending on the shipping requirements of shippers/throughputers on the Kinder-Morgan system.

- Furthermore these terminals are geographically dispersed in such a manner that storage for ethanol would exist in the greater LA market and San Francisco, as well as Sacramento, San Diego, and Bakersfield.

- If top-off blending is utilized in a portion of these terminals, they could provide ethanol for gasoline loads sourced from other nearby terminals. This would enable ethanol blending in a larger portion of the market than indicated by the number of terminals offering ethanol. It is not necessary for every terminal to offer ethanol to achieve 100% market penetration.

- Although complete analysis of projected ethanol prices was beyond the scope of this study, we believe that current California delivered ethanol prices would be in the $1.05-$1.15 per gallon range. If rack gasoline prices in the Midwest were to recover to a level near $0.60 per gallon, ethanol prices in California could increase to the $1.30 to $1.35 per gallon range.

- It is unlikely that long term California ethanol prices could exceed $1.35 per gallon. Such prices would equate to net back prices (FOB production facility) above $1.15 per gallon. This would result in increased production from underutilized or idle production thereby precluding prices from rising above that range for any extended period ,absent any other source of increased demand in the oxygenate market.

APPENDIX A

Ethanol Supply

U.S. Ethanol Plants - Operational

A-1

Company	Location	Capacity-MGY
ADM	Decatur, IL	780
	Peoria, IL	
	Cedar Rapid, IA	
	Clinton, IA	
	Walhalla, ND	
Minnisota Corn Processors	Columbus, NE	85
Marshall, MN		35
Williams Energy Services	Pekin, IL	100
Cargill	Blair, NE	100
Eddyville, IA		
New Energy Corp.	South Bend, IN	85
Midwest Grain	Pekin, IL	78
Atchison, KS		30
A.E. Staley	Loudon, TN	42
High Plains Corp.	York, NE	40
Colwich, KS		20
Portales, NM		15
Chief Ethanol	Hastings, NE	40
AGP	Hastings, NE	30
Nebraska Energy	Aurora, NE	30
Chippewa Valley Ethanol	Benson, MN	17
Corn Plus	Winnebago, MN	15
Al-Corn	Claremont, MN	15
Ethanol 2000	Bingham Lake, MN	15
Agri-Energy	Luverne, MN	15
Minnesota Energy	Buffalo Lake, MN	11
Alchem	Grafton, ND	10
Heartland Corn Products	Winthrop, MN	10
Grain Processing Corp.	Muscatine, IA	10
Reeve Agri-Energy	Garden City, KS	10
Pro-Corn	Preston, MN	10
Heartland Grain Fuel	Aberdeen, SD	8
Morris Ag Energy	Morris, MN	8
Georgia-Pacific	Bellingham, WA	7
Broin Enterprises	Scotland, SD	7
Mandildra Ethanol	Hamburg, IA	7
Parallel Products	Louisville, KY	7
Cucamonga, CA		3
Wyoming Ethanol	Torrington, WY	4
J.R. Simplot	Caldweel, ID	3
Burley, ID		3
Golden Cheese	Corona, CA	3
Merrick/Coors	Golden, CO	1.5
Kraft Inc.	Melrose, MN	1.5
Minnesota Clean Fuels	Dundas, MN	1.3
Jonton Alcohol	Edinburg, TX	1.2
ESE Alcohol	Leoti, KS	1.1
Pabst Brewing	Olympia, WA	0.7
Vienna Correctional	Vienna, IL	0.5
TOTAL		1715.8
		million gallons per year (mgy)

Source: Bryan & Bryan Inc. and the Renewable Fuels Association

U.S. Ethanol Plants - Under Construction

Company	Location	MGY
Exol Corporation	Albert Lea, MN	30
Atkins Energy	Lena, IL	30
BC International	Jennings, LA	20
Nebraska Nutrients	Sutherland, NE	15
Central Minnesota	Little Falls, MN	15
Heartland grain Fuels	Huron, SD	8
Sunrise Ethanol	Blairstown, IA	5
Total		**123**
		million gallons per year (mgy)

Source: Bryan & Bryan Inc. and the Renewable Fuels Association

U.S. Ethanol Plants - Engineering/Planning Stage

Company	Location	MGY
American Agri-Technology	Great Falls MT	30
CORN-er Stone Farmers Coop	Luverne MN	15
RDO	Rapid PArk MN	15
Dawson Project	Dawson MN	20
Renewable Oxygenates Inc.	Madison MN	15
EMEC	Preston MN	10
Arkenol	Sacramento CA	12
Quincey Library Group	CA	20
Gridley Project	CA	12
Total		**149**

Source: Supply and Cost of Alternatives to MTBE in Gasoline, Technical Appendices-Report on the Oxygenate Market: Current Production Capacity, Future Supply Prospects and Costs Estimates, California Energy Commission, October 1998

Plants Included in CEC Report Not Included In This Analysis

Company	Location	MGY
Self Enterprises	Garland TX	20
Hubinger Co.	Keokuk IA	17.5
ROI	Plover WI	2
Permeate Refining	Hopkinton IA	1.5
Farm Tech USA	Spring Green WI	0.5
Kor Ethanol	White SD	0.25
Total		**41.75**
		million gallons per year (mpy)

Supply and Cost of Alternatives to MTBE in Gasoline, Technical Appendices-Report on the Oxygenate Market: Current Production Capacity, Future Supply Prospects and Costs Estimates, California Energy Commission, October 1998

U.S. Ethanol Production Rates 1997-1998 A-4

	1997			1998		
Month	**TBPD (000)**	**GPD**	**Gal/pm**	**TBPD (000)**	**GPD**	**Gal/pm**
January	80	3360000	104160000	96	4032000	124992000
February	82	3444000	96432000	85	3570000	99960000
March	86	3612000	111972000	88	3696000	114576000
April	77	3234000	97020000	85	3570000	107100000
May	89	3738000	115878000	81	3402000	105462000
June	75	3150000	94500000	83	3486000	104580000
July	77	3234000	100254000	85	3570000	110670000
August	80	3360000	104160000	87	3654000	113274000
September	80	3360000	100800000	98	4116000	123480000
October	87	3654000	113274000	103	4326000	134106000
November	98	4116000	123480000	-		
December	98	4116000	127596000	-		
TOTALS			**1289526000**			**1138200000**

Assuming a production rate of 100,000 BPD for November and December, this would equate to 256,200,000 additional gallons bringing annual projected production for 1998 to 1,394,400,000

APPENDIX B

California Terminal Information
California Refinery Listing

Please note that sections B-1 and B-4 of this appendix are copyrighted material and are not included with this copy.

Terminals Originally Surveyed by Mail

Mr. R.A. Reid	Coast Gas Inc.	P.O. Box 1974	Bakersfield, CA 93303
Mr. Bruce Cogswell	Kern Oil & Refining Company	7724 East Panama Lane	Bakersfield, CA 93307
Mr. Greg M. DeMarzo	Exxon Company U.S.A.	3410 Easy 2nd Street	Benicia, CA 94510
Mr. C. Davis	Equilon Enterprises LLC	2307 South Riverside Avenue	Bloomington, CA 92316
Mr. P.J. Johnson	Equilon Enterprises LLC	2337 South Riverside Avenue	Bloomington, CA 92316
Mr. R.E. York	Kinder Morgan Pacific	P.O. Box 447	Bloomington, CA 92315
Mr. Hank Johnson	Tosco	2301 S. Riverside Avenue	Bloomington, CA 92316
Mr. J.E. Dean	Kinder Morgan Pacific	P.O. Box 415	Brisbane, CA 94005
Mr. M. Billings	Arco Products Company	2149 Easy Sepulveda Blvd.	Carson, CA 90745
Mr. L.G. Armes	Kinder Morgan Pacific	P.O. Box 1447	Chico, CA 95927
Mr. Larry Hosler	Wickland Oil Terminals	#90 San Pablo Avenue	Crockett, CA 94525
Mr. Terry Pecor	Chevron U.S.A.	3400 Christie Street	Eureka, CA 95501
Mr. R.E. Kennedy	Kinder Morgan Pacific	4149 South Maple Avenue	Fresno, CA 93725
Mr. Travis Erwin	Chevron U.S.A. Inc.	17881 Gothard Street	Huntington Beach, CA 92647
Mr. R.E. Shirley	Kinder Morgan Pacific	P.O. Box 578	Imperial, CA 92251
Mr. Michael W. Abrams	ST Services	P.O. Box 416	Imperial, CA 92251-0416
Mr. Art Diefenbach	Arco Terminal Services Corp.	5905 Paramount Blvd.	Long Beach, CA 90805-3709
Mr. L.D. Yates	Equilon Enterprises LLC	2457 Redondo Avenue	Long Beach, CA 90806
Mr. Jason Burnett	Ultramar Inc.	P.O. Box 93102	Long Beach, CA 90809
Mr. M. Watson	Equilon Enterprises LLC	2015 Long Beach Avenue	Los Angeles, CA 90058
Attn: Terminal Manager	Mobil Oil Corporation	P.O. Box 58863	Los Angeles, CA 90058
Attn: Terminal Manager	Mobil Oil Corporation	P.O. Box 58863	Los Angeles, CA 90058
Mr. Roland Parker	Tosco	501 N. Center Street	Los Angeles, CA 90012
Mr. Roland Parker	Tosco	13707 South Broadway	Los Angeles, CA 90061
Mr. John Larkin	Chevron U.S.A. Inc.	611 Solano Way	Martinez, CA 94533
Mr. Don Nathlich	Tosco	Solano Way	Martinez, CA 94553
Mr. A.W. Housley	Kinder Morgan Pacific	P.O. Box 360064	Milpitas, CA 95036
Mr. Dave Vanderveen	Chevron U.S.A. Inc.	601 South Vail Avenue	Montebello, CA 90640
Mr. R.E. Shirley	Kinder Morgan Pacific	P.O. Box 244	Niland, CA 92257
Mr. Bud Hauser	Diablo Services	595 East 3rd Street	Pittsburg, CA 94565
Mr. Mike Harmuth	Tesoro Marine Inc.	141 West Port Hueneme Road	Port Hueneme, CA 93041
Mr. D.L. Thurman	Kinder Morgan Pacific	P.O. Box 175	Rancho Cordova, CA 95741
Mr. Donald K. Shaman	Gibson Environmental	475 Seaport Blvd.	Redwood City, CA 94063
Mr. Hank Johnson	Tosco	271 East Slover Avenue	Rialto, CA 92376
Mr. Clifford Cunningham	Arco Products Company	1306 Canal Blvd.	Richmond, CA 94807
Attn: Terminal Manager	GATX Terminal Corporation	1140 Canal Blvd.	Richmond, CA 94804
Mr. R. Courtney	IMTT-Richmond, California	100 Cutting Blvd.	Richmond, CA 94804
Mr. B.K. Pack	International Matex Tank Terminal	100 Cutting Blvd.	Richmond, CA 94804
Richard Brandes	Time Oil Company	488 Wright Avenue	Richmond, CA 94804
Mr. Dave Streeter	Tosco	1300 Canal Blvd.	Richmond, CA 94804
Mr. Craig Anderson	Chevron U.S.A. Inc.	2420 Front Street	Sacramento, CA 95818
Mr. John Sherman	Tosco	76 Broadway	Sacramento, CA 95818
Mr. Ray Porter	Chevron U.S.A. Inc.	2351 East Harbor Drive	San Diego, CA 92113
Mr. P. Johnson	Equilon Enterprises LLC	9950 San Diego Mission Blvd.	San Diego, CA 92108
Mr. P. Johnson	Equilon Enterprises LLC	9966 San Diego Mission Blvd.	San Diego, CA 92108
Mr. T.D. Bailey	Kinder Morgan Pacific	9950 San Diego Mission	San Diego, CA 92108
Mr. Rudy Reyes	San Francisco Marine	2950 Hyde Street	San Francisco, CA 94109
Mr. Roger Staehr	Chevron U.S.A. Inc.	1020 Berryessa Road	San Jose, CA 95133
Mr. C.J. Cauller	Equilon Enteprises LLC	2165 O'Toole Avenue	San Jose, CA 95131
Mr. Michael Abbasford	Powerine Oil Company	12345 East Lakeland Road	Santa Fe Springs, CA 90670
Attn: Terminal Manager	Tosco	9645 Santa Fe Springs Road	Santa Fe Springs, CA 90670-0628
Mr. Art Diefenbach	Arco Terminal Services Corp.	2350 Hathaway Drive	Signal Hill, CA 90806-4002
Mr. R. Bateson	Equilon Enterprises LLC	135 North Access Road	So. San Francisco, CA 94080
Mr. P.M. Billings	Arco Products Company	8601 South Garfield Avenue	South Gate, CA 90280
Mr. Charles Jerev	Arco Products Company	2700 West Washington Street	Stockton, CA 95203
Mr. T. Eikmeirer	Equilon Enterprises LLC	3515 Navy Drive	Stockton, CA 95203
Mr. J.J. Mason	Kinder Morgan Pacific	2947 Navy Drive	Stockton, CA 95206
Mr. Mark Sperling	ST Services	2941 Navy Drive	Stockton, CA 95206-1149

Mr, David H. Taylor	Tesoro Rfg., Mktg. Supoly Co.	P.O. Box 867	Stockton, CA 95201
Mr. Delbert Gilmore	Tosco	3505 Navy Drive	Stockton, CA 95201
Mr. Joe Schilling	G.P. Resources Inc.	1028 South Seaside Avenue	Terminal Island, CA 90731
Attn: Terminal Manager	Mobil Oil Corporation	3700 West 190th Street	Torrance, CA 90509
Mr. Dan Hilburger	Chevron U.S.A. Inc.	15359 Oxnard Street	Van Nuys, CA 91411
Mr. R. Pace	Equilon Enterprises LLC	8100 North Haskell Avenue	Van Nuys, CA 91406
Mr. R. Pace	Equilon Enterprises LLC	3284 North Ventura Avenue	Ventura, CA 93001
Mr. T. Eikmeirer	Equilon Enterprises LLC	1509 South River Road	West Sacramento, CA 95691
Mr. Alan M. Hawickhorst	Tesoro Refining, Mktg/Suppy Co.	P.O. Box 655	West Sacramento, CA 95691
Mr. Ken Miller	Equilon Enterprises	1926 East Pacific Coast Hwy	Wilmington, CA 90744
Attn: Terminal Manager	GATX Terminals Corporation	M.A. Marine Term, Berth 172	Wilmington, CA 90744-6405
Mr. Jay Johnston	Paktank Corporation	401 Canal Street	Wilmington, CA 90744
Mr. Michael Coleman	Wickland Oil Terminals	841 La Paloma	Wilmington, CA 90744
Mr. John Larkin	Chevron USA	22888 South Kasson Road	Tracy, CA 95376

Synopsis of Results From Mail Survey & Phone Interviews B-3

Arco Terminal Services: Arco has already analyzed their system and is prepared to handle ethanol in all of their terminals on very short notice. Although some of their northern terminals have rail capability, any program they initiate would likely be based on receiving marine cargoes of ethanol at their Long Beach Terminal. From there, product would be shipped via transport truck to the following terminal locations:

Terminal Locations

Sacramento	Carson (LA)	Stockton (SF/Oakland)
Richmond (SF)	Long Beach (LA)	West Sacramento (formerly Tesoro)
Colton (LA/SB)	Signal Hill (LA)	San Diego
South Gate (LA)		

ST Services: (Stockton) ST Services operates a third party (independent terminal) in Stockton CA. This terminal has approximately 20 throughput/storage customers. The terminal has in excess of 700,000 barrels of storage and handles about 600,000 barrels of gasoline per month. Product receipt is available by marine, rail, or transport. The terminal is located on the Kinder Morgan pipeline (formerly Santa Fe Pacific Pipeline) and is near other terminals (Equilon, Arco, and Tesoro) at the Port of Stockton. They have, in the past, distributed ethanol from this terminal. ST services indicates they are "positioned to provide ethanol, receipt, storage, and handling service to all". A total of 300,000 barrels could currently be used for ethanol storage and additional tankage could be added depending on the level of customer commitment. The facility could offer automated blending equipment and in-line blending and could be ready to handle ethanol in 30 to 90 days depending on the degree of service required.

International Matex Tank Terminal (IMTT): (Richmond) This terminal is supplied by Barge, pipeline, rail, and transport truck. Terminal currently has 10,000 barrels of storage that could be reassigned to ethanol in April 1999. This tank could be piped to the rack with some minor modification requiring perhaps 90 days. An additional 100,000 barrels of storage could be reassigned to ethanol if demand and customer needs warrant. The terminal can spot 8 rail cars but ideal operations may require some repiping from the rail spur.

Shore Terminals LLC: (Wilmington) This terminal, purchased from Wickland in November 1990, is a fuel oil/lube oil terminal and is not suited for ethanol.

Shore Terminals LLC: (Crockett/Selby) This terminal purchased from Wickland in November 1998 currently handles ethanol. The terminal has a total storage capacity of over 3 million barrels. Current storage capacity available for ethanol is 80,000 barrels. Product can be received by marine, rail, and transport. The terminal currently receives ethanol by rail. It is automatically injected in CARBOB to provide ethanol blended regular, midgrade, and premium for an existing terminaling customer.

Paktank Corporation: (Wilmington) This terminal has over 2 million barrels of storage and handles a wide range of chemicals, vegetable oils, and refined products. It could receive ethanol by marine or transport. The terminal does not currently store ethanol but indicates that tankage could be reassigned if a customer was willing to commit to a long term throughput agreement. This tankage is not currently piped to the gasoline rack but alterations could be made to do so. In-line injection equipment could be added if desired. Lead time for such modification would depend on negotiations with the customer but could take up to 6 months. Over a longer period of time additional tankage could be added.

Time Oil: (Richmond) This terminal has over 600,000 barrels of storage and carries a wide range of petroleum products. It does not currently handle ethanol but has done so in the past. It does currently handle methanol. The terminal currently has 158,000 barrels of storage that could be used for ethanol and personnel indicate that more could possibly be made available. The tankage is piped to the loading rack and product could be received by marine, rail, or transport. Terminal estimates necessary lead time to handle ethanol at 2 months.

Kern Oil & Refining: (Bakersfield) This terminal has relatively small storage capabilities but does handle all three grades of gasoline. They do not currently handle ethanol but indicate they have stored ethanol in the past. They do not currently have tankage that could be reassigned but could add tankage given a customer commitment. Estimated lead time for addition of a small tank is six months. Size of tanks would depend largely on customer commitments.

Tosco: Tosco operates a number of terminals in California and throughputs product at 30 additional third party terminals. Tosco has already publicly stated that they wish to move away from MTBE and utilize ethanol. They already have ethanol at their Martinez terminal and provide ethanol blends at several of their retail outlets which are serviced from that terminal. Tosco indicates that they have underutilized storage at their refinery in LA. Richmond could also be considered to receive marine cargoes with minor alterations in a three to four month time frame. The dock at the LA refinery could also be prepared to receive ethanol in a reasonably short time frame. Tosco indicated that in a situation where such conversion was necessary they could prepare their terminals to handle ethanol in time frames ranging from 3 months to one year depending on the specific terminal. Tosco indicated that if necessary they could convert retail units to ethanol in a matter of days by utilizing third party terminals many of which already have ethanol available.

Terminal Locations

Richmond (Central marine terminal)	Rialto (SB)
Los Angeles (refinery & marine dock)	Sacramento
Bloomington	Santa Fe Springs (LA)
Los Angeles (Center St)	Stockton
Los Angeles (Broadway)	Pittsburg (SF) (formerly Diablo Services)
Martinez	

Kinder Morgan: Kinder Morgan (Formerly Santa Fe Pacific Pipeline) has numerous terminals in California and operates the common carrier pipeline which supplies these terminals.

Terminal Locations

Imperial (SD)	Niland	Brisbane(SF)
Stockton (SF)	Milipitas (SF)	Bloomington (LA)
San Diego	Fresno	Orange (LA)
Rancho Cordova	Chico	

Being a common carrier pipeline/terminal operator, Kinder Morgan terminals are fairly large with most in the 400,000 to 900,000 barrel range. A few terminals such as Orange, Stockton, and Niland are under 200,000 barrels. Kinder Morgan indicated that although they have handled ethanol at a number of terminals in the past they do not currently offer ethanol. Some of the terminals still have the blend-

ing equipment in place but none of the terminals currently have tanks available for ethanol storage. Their Business Development manager indicated that as a common carrier they base their programs on shipper needs. With the introduction of RFG they did not have sufficient requests for an ethanol CARBOB to justify handling it and consequently quit handling ethanol as well. They indicated that under a scenario where both MTBE and ethanol were used they wouldn't have adequate space for CARBOB and ethanol unless several major shippers desired that option. However in a scenario where MTBE were eliminated, if all, or most, shipments were CARBOB an ethanol program would be less problematic. However any such change would require a full and detailed assessment of their system, product mix, and shipper requirements. Consequently they could not offer an exact time frame that would be involved.

Ultramar: We were unable to reach a contact at Ultramar.

GP Resources: This is a very small terminal handling primarily diesel and as such is not suited for ethanol distribution.

Tesoro Refining & Marketing: Tesoro indicated that their West Sacramento terminal had been sold to Arco. They do have a terminal in Stockton but indicated it is too small to handle any additional products such as ethanol.

Tesoro Marine: (Port Huenene) This terminal handles primarily distillate and simply indicated they did not have space to store ethanol at the current time.

Redwood City Bulk Terminal: (Redwood City) This terminal (formerly Gibson Environmental) has approximately 380,000 barrels of storage. However there are currently environmental problems at this facility and it is not likely that the facility will be prepared to handle transportation fuels for at least one year. They would however be interested in handling ethanol when problems are corrected.

Exxon: (Benecia) Exxon indicated they couldn't assign space for ethanol and had little interest in offering the product.

GATX: (Richmond) This terminal has in excess of 600,000 barrels of storage but no gasoline load out. Consequently it could serve only as a breakout point, receiving rail cars and shipping transport tanks of ethanol to final destination terminals. They have a dual track spur capable of spotting 28 rail cars. Availability of tankage would depend on customer commitment for volume and duration of agreement and would require approximately 90 days lead time.

GATX: (Wilmington) This terminal has no rail capability and they were uncertain about receipt of ethanol by marine shipment. Additional details would be needed to properly assess this facility.

Coast Gas: (Bakersfield) This is primarily a pressurized product terminal so we did not pursue further analysis.

San Francisco Marine: (San Francisco) This terminal handles only diesel and lubricants so further analysis was not undertaken.

LA Resources Inc: (Los Angeles) This terminal, in south Los Angeles, is very small and handles mostly diesel. No further analysis was done.

Mobil: We tried various contacts at Mobil but received no response to our inquiries. Terminal Directories indicate that Mobil has two terminals in L.A., one with 44,000 barrels of storage, the other with 237,500 barrels. Both could be supplied with ethanol via transport truck but status of tankage availability is unknown. Their third terminal is in Torrance but again we were unable to obtain detailed information about the terminal.

Equilon: Equilon (a joint venture of Shell & Texaco) has numerous California terminal locations.

Terminal Locations

Ventura (LA)	Signal Hill (Long Beach/LA)	Van Nuys
San Diego	Wilmington (LA)	S. San Francisco
Carson (LA)	Bloomington (LA)	West Sacramento
Los Angeles	San Jose (SF)	Stockton
Martinez	Bakersfield	

Equilon indicated that they could offer ethanol at all of their terminals within a fairly short lead time. Their strategy would be to ship volume shipments to their Carson terminal which is already capable of marine receipt and could easily be modified for rail receipt of ethanol. Where tankage is not already available, day tanks (smaller volume tanks) would be reassigned or installed at destination terminals. Product would then be shipped from Carson to each terminal.

Chevron: Chevron has numerous terminals in California

Terminal Locations

Eureka	Sacramento	Tracy
Martinez (SF)	Huntington Beach (LA)	Montibello (LA)
San Jose (SF)	San Diego	Van Nuys (LA)
El Segundo (LA)		

Among the above listed terminals, Van Nuys, Montibello, Tracy, San Diego, and Huntington Beach indicated they did not have space for ethanol and that it would be difficult to install additional tankage. We received no information on the San Jose terminal. Martinez said they might be able to reassign 5000 barrels of storage while Eureka said they might be able to install additional tankage given a 2-3 year time frame (and assuming they could get necessary permits from the Coastal Commission.) The Sacramento terminal is a diesel and jet fuel terminal.

Other Terminals: Through the course of our conversations with various terminal operators, other terminals were also mentioned, although most of this information is from sources without complete or detailed information. Such terminals include the following:

Time Oil: (Stockton) Some terminal operators indicated that Time Oil had handled ethanol in the past and might have tankage available.

Powerine: Terminal is out of business and industry sources indicate it may lose it's permits to operate.

Westway: (LA) Industry sources indicate this terminal could handle ethanol.

Petrodiamond: (Long Beach) Industry sources indicate this terminal has handled ethanol in the past and would do so again if customers requested.

Additional Information: Undertaking any survey of this type is problematic and difficult. Many terminal operators treat throughput volumes, exchange agreements, and things of this nature as proprietary. In addition we found some of the information in the OPIS Petroleum Terminal Encyclopedia to be less than current and in some cases contradictory despite this being the 1999 edition of the directory. Some terminals had changed hands and many of the phone numbers and contacts had changed. The OPIS map of terminal locations (also in this Appendix as B-4) lists 107 terminal locations while only 94 are listed in their directory. The terminals on the map and not listed in the directory are as follows:

Chevron	Walnut Creek (SF)
GP Resources	Long Beach (LA)
GATX	Carson (LA)
GATX	San Pedro (LA)
GATX	San Pedro (LA)
Golden West	Santa Fe (LA)
Kinder Morgan	Los Angeles (LA)
Petrodiamond	Irvine (LA)
Sun Valley	Sacramento (SAC)
Tesoro	Long Beach (LA)
Texaco R & M	Universal (LA)
Time Oil	Stockton (SF/SAC)
Wickland Oil	Sacramento (SAC)

It appears that the above discrepancies occur for a variety of reasons. Some are simply not listed in the directory but are in fact in operation (e.g. Petrodiamond and GATX), others may be inadvertently listed twice due to some being referenced to as a given location but having a mailing address in another. Some may be a result of a terminal at or adjacent to a refinery not being listed in the terminal directory (e.g. Texaco R&M). Our area of focus was on the terminals actually listed in the directory section and did not include the above listed locations.

Refinery Tankage: It is also possible that some ethanol could be received, stored, and shipped directly from the refinery. Although refineries were not originally designed with receiving clean products in mind, many can in fact do so. Obviously all receive MTBE for blending. However ethanol would not be blended at the refinery except in those cases where a refinery has a terminal to facilitate rack blending. However with some reconfiguration some refiners may be able to receive ethanol for redistribution to destination terminals via transport truck. Tankage capacity and utilization of refineries are difficult to assess given the proprietary nature of such information. Nonetheless, it is likely that some refiners will at least consider this option. A list of California refineries is also included in this Appendix as B-5.

California Refinery Profile B-5

Capacity of Operable Petroleum Refineries as of 01-01-97

(Barrels per stream day)

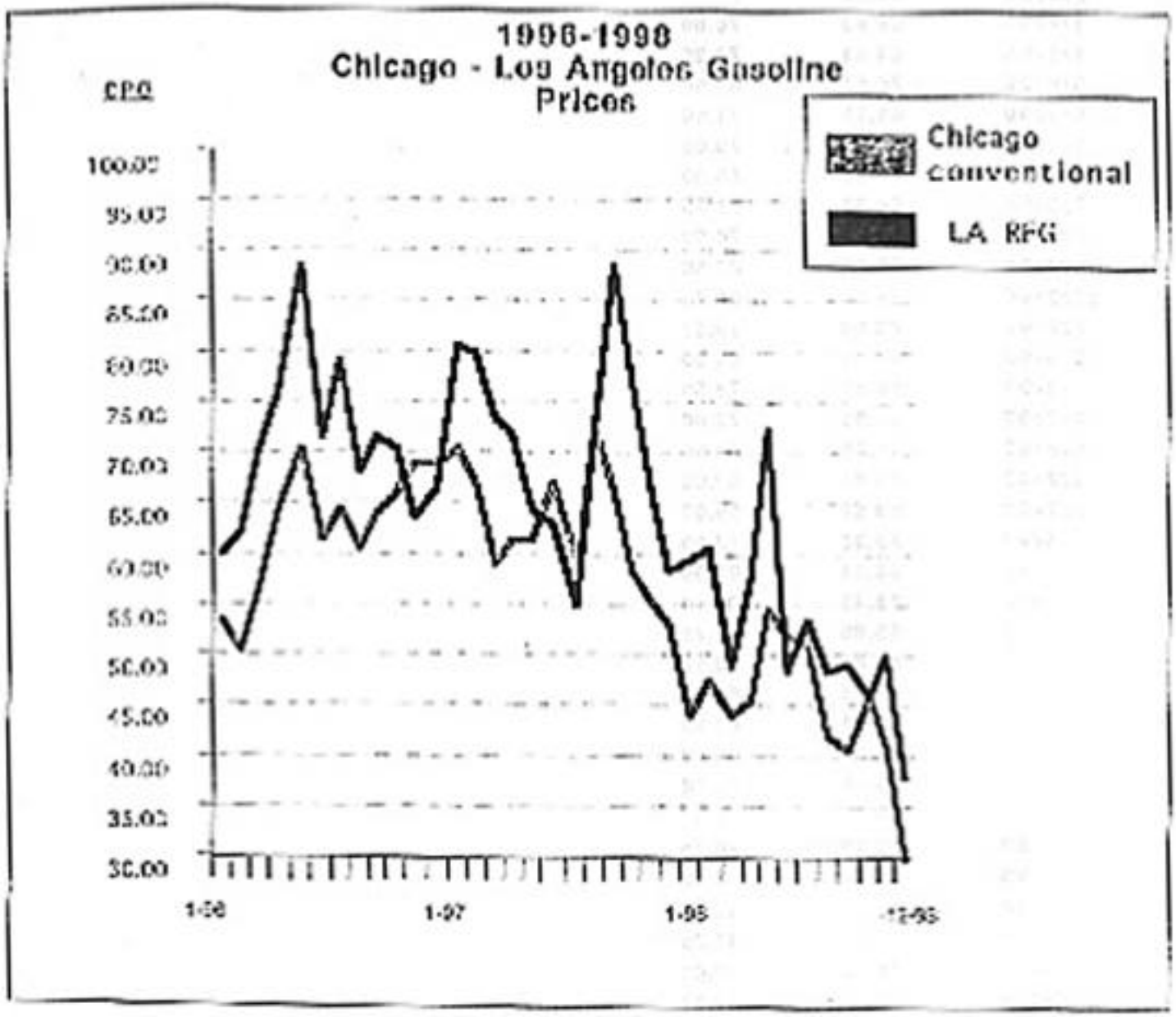
Refinery	Location	Capacity
Arco Products Co.	Los Angeles	255000
Chevron USA Inc.	El Segundo	273000
Chevron USA Inc.	Richmond	240000
Exxon Co. USA	Benicia	132000
Huntway Refining Co.	Benicia	9000
Huntway Refining Co.	Wilmington	6000
Kern Oil & Refining Co.	Bakersfield	23000
Lunday Thagard Co.	South Gate	8500
Mobil Oil Corp.	Torrance	143000
Pacific Refining Co.	Hercules	0
Paramount Petroleum Corp.	Paramount	45000
Petroleum Fuel & Terminal	Long Beach	15000
San Joaquin Refining Co. Inc.	Bakersfield	15000
Sanata Maria Refining Co.	Santa Maria	10000
Shell Oil Co.	Martinez	163000
Tenby Inc.	Oxnard	5000
Texaco Refining & Mrktg Inc.	Bakersfield	60400
Texaco Refining & Mrktg Inc.	Wilmington (L.A.)	70000
Tosco Refining Co.	Martinez (Avon)	160000
Ultramar Refining	Wilmington (L.A.)	70000
Unocal Corp.	Arroyo Grande (Santa Maria)	44000
Unocal Corp.	Rodeo (San Francisco)	77000
Unocal Corp.	Wilmington (L.A.)	128000
Witco Corp	Oildale	0
Total		**1951900**

Source: U.S. Refinery Directory, OPIS Energy Associates

APPENDIX C

Gasoline Price Comparison

Date	Chicago	LA
1/2/96	53.58	60.00
2/5/96	50.28	62.25
3/4/96	56.63	70.00
4/1/96	64.48	76.25
5/6/96	70.57	88.50
6/3/96	61.28	71.50
7/1/96	64.63	79.00
8/5/96	60.58	68.00
9/3/96	64.23	71.75
10/7/96	65.88	70.50
11/4/96	68.88	63.50
12/2/96	68.88	66.75
1/6/97	70.53	80.50
2/3/97	67.18	80.00
3/3/97	59.13	73.50
4/7/97	61.33	72.00
5/5/97	61.38	64.50
6/2/97	66.87	63.00
7/7/97	59.57	55.00
8/4/97	72.35	72.50
9/2/97	66.14	88.50
10/6/97	58.43	77.50
11/3/97	55.68	66.75
12/1/97	52.83	58.50
1/5/98	43.85	59.50
2/2/98	47.28	60.50
3/2/98	44.13	49.00
4/6/98	45.38	57.50
5/4/98	54.38	72.50
6/1/98	52.13	48.75
7/6/98	50.90	53.50
8/3/98	42.00	48.75
9/8/98	40.51	49.25
10/6/98	45.80	46.00
11/2/98	40.94	50.00
12/7/98	30.08	38.00
Total	**2038.70**	**2333.50**
Average	**56.63**	**64.82**

Source: Motor Gasoline Watch, Energy Information Administration, Office of Oil & Gas

Spot Gasoline Price Price-Chicago Conventional and LA RFG - Graphic