

CALIFORNIA STRATEGIC FUELS RESERVE

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CALIFORNIA STRATEGIC FUELS RESERVE

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For

The California Energy Commission

Pursuant to California State Assembly Bill AB 2076

July 3, 2002

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GLOSSARY

AG	Arabian Gulf, aka Persian Gulf
ANS	Alaska North Slope, term used to designate crude oil of that region
API	American Petroleum Institute
ARB	Air Resources Board
Bbl	Barrel
BOE	Board of Equalization, the California agency that collects taxes, including fuel taxes
BPD	Barrels per Day
CAA	Clean Air Act of 1977
CAAA	Clean Air Act Amendments of 1990
CAAA Title V	Section of the CAAA requiring Operating Permits, promulgated in 1992
CARB	California Air Resources Board
CARBOB	California Reformulated Gasoline Base Oxygenated Blendstock
CEC	California Energy Commission
CIOMA	California Independent Oil Marketers Association
CMAI	Chemical Markets Associates, Inc.
cpg	Cents per Gallon
CSLC	California State Lands Commission
DOE	US Department of Energy
DOER	Massachusetts Division of Energy Resources
DTW	Dealer Tank Wagon
DWT	Deadweight Ton
EIA	Energy Information Agency
EIR	Environmental Impact Report
EPCA	Energy Policy and Conservation Act of 1976 as amended
EOR	East of the Rockies
EPA	US Environmental Protection Agency
ETBE	Ethyl Tertiary Butyl Ether, an oxygenate produced from ethanol and isobutylene
EU	European Union
FCC	Fluidic Catalytic Cracker, primary gasoline producing unit in a refinery
FOB	Free on Board
FPPR	Federal Petroleum Product Reserve
FTC	US Federal Trade Commission
HO	Heating Oil
HVR	High Volume Retailer

ICE	Intercontinental Exchange
IEA	International Energy Agency
ILTA	Independent Liquid Terminals Association
IPE	International Petroleum Exchange
Jobber	Independent distributor of petroleum products
KM	Kinder Morgan
LP	Linear Program
MB	Thousand barrels
MLP	Master Limited Partnership
MM	Million
MOTERP	Marine Oil Terminal Engineering Regulations Project of the CSLC
MTBE	Methyl Tertiary Butyl Ether
NHOR	Northeast Heating Oil Reserve
NGO	Non Governmental Organization
NYH	New York Harbor
NYMEX	New York Mercantile Exchange
OPA 90	Oil spill Prevention Act of 1990
OPEC	Organization of Petroleum Exporting Countries
OPIS	Oil Price Information Service
p.a.	Per annum
PADD	Petroleum Administration for Defense District PADD V includes Hawaii, Alaska, Washington, Oregon, California, Arizona and Nevada
Platt's	An international energy pricing service
PoLA	Port of Los Angeles
PoLB	Port of Long Beach
RFG	Reformulated Gasoline meeting the requirements of the CAAA
RPPR	Regional Petroleum Product Reserve
RPR	Regional Petroleum Reserve
RVP	Reid Vapor Pressure, a measurement of the volatility of gasoline
SARA	Superfund Amendments and Reauthorization Act of 1986
SCAQMD	South Coast Air Quality Management District
SFR	Strategic Fuels Reserve
SPR	Strategic Petroleum Reserve
T50	Temperature at which 50% of components will evaporate from a gasoline
TAME	Tertiary Amyl Methyl Ether, a type of oxygenate
TBD	Thousand Barrels per Day
TEU	Twenty-foot Equivalent Unit, standard used for cargo containers

TPY	Ton Per Year, usually referring to US short tons of 2000 lbs
TVA	Temporary Voluntary Allowance
UDS	Ultramar Diamond Shamrock
USGC	US Gulf Coast
VDU	Vapor Destruction Unit
VGO	Vacuum gas oil
VLCC	Very Large Crude Carrier, a tanker capable of carrying 1.5 – 2 million barrels
VMT	Vehicle Miles Traveled
VOC	Volatile Organic Compound(s), and emissions thereof
WSPA	Western States Petroleum Association
WTI	West Texas Intermediate

CHARTER

In 1999, following a series of refinery outages that caused significant price spikes in the California fuels markets, the Attorney General's office created a taskforce to investigate causes and recommend solutions to prevent recurrence. The efforts of this taskforce resulted in Assembly Bill 2076, which called for the California Energy Commission:

“..to examine the feasibility of operating a strategic fuel reserve and to examine and recommend an appropriate level of reserves. If the commission finds that it would be feasible to operate such a reserve, the bill would require the commission to report this finding to the Legislature and request specific statutory authority and funding for establishment of a reserve.”

The bill also provided general directions for the work to be performed

(a) By January 31, 2002, the commission shall examine the feasibility, including possible costs and benefits to consumers and impacts on fuel prices for the general public, of operating a strategic fuel reserve to insulate California consumers and businesses from substantial short-term price increases arising from refinery outages and other similar supply interruptions. In evaluating the potential operation of a strategic fuel reserve, the commission shall consult with other state agencies, including, but not limited to, the State Air Resources Board.

(b) The commission shall examine and recommend an appropriate level of reserves of fuel, but in no event may the reserve be less than the amount of refined fuel that the commission estimates could be produced by the largest California refiner over a two week period. In making this examination and recommendation, the commission shall take into account all of the following:

(1) Inventories of California-quality fuels or fuel components reasonably available to the California market.

(2) Current and historic levels of inventory of fuels.

(3) The availability and cost of storage of fuels.

(4) The potential for future supply interruptions, price spikes, and the costs thereof to California consumers and businesses.

(c) The commission shall evaluate a mechanism to release fuel from the reserve that permits any customer to contract at any time for the delivery of fuel from the reserve in exchange for an equal amount of fuel that meets California specifications and is produced from a source outside of California that the customer agrees to deliver back to the reserve within a time period to be established by the commission, but not longer than six weeks.

(d) The commission shall evaluate reserve storage space from existing facilities.

(e) The commission shall evaluate a reserve operated by an independent operator that specializes in purchasing and storing fuel, and is selected through competitive bidding.

This Study was performed within the specific framework of the Legislation, to answer as a minimum the questions asked, by the stated deadline. In addition, in cooperation with the consultant retained by the Commission for this study, Stillwater Associates of Irvine, CA, the Commission deemed it appropriate to evaluate other factors that contribute significantly to the volatility of California's fuel markets, such as

breakdowns in market mechanisms for gasoline, and the inadequacy of the logistics infrastructure serving the fuels market.

APPROACH

The approach taken by Stillwater and the CEC for this study is to:

(i) Conduct a survey amongst industry stakeholders, such as refiners, traders, logistic survey providers, and other concerned parties such as industry associations representing independent gasoline marketers, port authorities, and market intelligence providers. The purpose of the survey was not only to gather relevant information and data such as supply and demand factors, but also to gain a full understanding of market mechanisms and barriers to entry that contribute to the price spikes that a reserve aims to prevent.

(ii) Using the requirement of AB2076 for two week's capacity of the largest refinery as the basis, evaluate requirements for the reserve other than size, and with these, derive such factors as optimal location, infrastructure needs, and costs for several options meeting the initial requirements. Since the study did not include funding of actual engineering work, costs are treated at order of magnitude levels only.

(iii) Evaluate the effectiveness of the selected options for the reserve in terms of their anticipated capacity to mitigate price spikes in the California fuel markets due to unplanned refinery outages, using historical statistical data to predict the probability and duration of occasions when reserve volume would be drawn down. If warranted by the predicted effectiveness, adjust the design reserve volumes from the suggested two week's capacity basis and reiterate.

(iv) Using insights gathered during the survey meetings, design release mechanisms for the reserve volumes, also taking into account experience gathered with strategic reserves operated elsewhere.

(v) Develop derivative opportunities such as using a reserve to create forward liquidity in the California fuel markets.

(vi) Evaluate next steps and implementation plans, and identify potential barriers to implementation, such as delays in permitting processes.

(vii) Collect feedback from the industry in an open forum workshop, and adjust where necessary the recommended alternatives.

(viii) Present the final conclusions and recommendations to the legislature.

Initially, it was assumed that this study would be based on a supply/demand scenario for which the issue of the impending phase out of MTBE in terms of timing and impact would have been resolved. When it became clear that additional efforts would be required to provide decision tools for this critical issue, the CEC charged Stillwater Associates to conduct a parallel study specifically focused on the MTBE phase out.

Where necessary for the sake of clarity and consistency, the reports issued by Stillwater Associates for this Strategic Fuels Reserve Study and the MTBE Phase Out Study make extensive use of the same materials.

Throughout the work done for this Study, Stillwater Associates has closely collaborated with Dr Tiny Finizza, who in a parallel effort, developed a rigorous statistical analysis of refinery disruptions and price volatility in the California gasoline market, in order to quantify the potential benefits of a Strategic Fuels Reserve.

EXECUTIVE SUMMARY

Stakeholder Survey

The initial phase of the study consisted of interviews and survey meetings with a total of 44 oil industry participants, including major refiners, suppliers from outside the State, traders, independent retailers, logistic service providers and other stakeholders. The primary conclusions from these meetings are that:

(i) Overall, the industry opposes the concept of a state-run reserve and fears that the existence of a reserve may be counterproductive to resolving long-term supply/demand imbalances.

(ii) If a reserve is to be created, the industry strongly prefers that it will not use already scarce existing storage, is privately operated, has clear and fair release mechanisms, and is deployed in such a way as to improve import opportunities and market liquidity.

(iii) The California gasoline market suffers from insularity caused by its unique specifications, a subsequent lack of liquidity, inability to lock in pricing for forward trades, and impediments to market entry by outside sources. These factors contribute significantly to price volatility, in addition to the supply disruptions identified as a cause of price spikes in the legislation that led to this study.

(iv) California's infrastructure for petroleum products, comprising of pipelines, terminals and dock facilities, has insufficient capacity to handle current and anticipated demand. Capacity additions are hampered by lengthy and costly permitting procedures, and by policies practiced by the ports that favor other land uses over bulk liquid storage.

The findings of the interviews and survey meetings with stakeholders were a key consideration throughout the further analysis and when drafting the proposals.

Data Collection and Analysis

Extensive analysis of market data and underlying commercial and technical principles, as shown in this report, confirmed that:

(v) The output of California's refineries has not been able to keep up with demand growth in recent years and the State has become a net importer of all categories of petroleum products. Moreover, the outlook is that permitting restraints and technical limitations will make it more difficult for refiners to continue to realize small gains in production capacity, which have averaged approximately 0.7% per year since 1995, when refineries first started to run at or near maximum sustainable operating rates.

(vi) The growing import dependency is met primarily through foreign imports, with supplies from the US Gulf coast refineries stagnating because this capacity is fully utilized serving other US markets, while Jones Act shipping capacity is unavailable and faces significant further reductions as single hull product tankers are phased out.

(vii) Not only are foreign imports of gasoline and blending components indeed constrained by lack of tank capacity in marine terminals, but in addition significant commercial barriers exist because of lack of hedging opportunities which forces importers to incur significant risk in the volatile California markets.

(viii) Additional barriers to entry are also formed by the Unocal patents, which discourage traders or independent importers from attempting to bring finished products to the market, leaving only the California refiners capable of blending around the patent or absorbing the cost of licensing fees. The detrimental effects of the Unocal patents extend also to loss of production capacity, because refinery streams that might have been accretive to the gasoline pool are diverted to avoid patent infringement, while blending around the patent results in gasoline qualities that have sub-optimal emission performance.

(ix) The chronic shortage of gasoline in the California market is likely to worsen when the phase out of MTBE takes effect by year-end 2003, or earlier if refiners who make the switch to ethanol before that date on a voluntary basis, cannot timely solve supply issues. The prognosis is that a temporary shortfall of 5 to 10% will result, affecting primarily the Los Angeles Basin gasoline supplies. This level of supply reduction will cause prices in California to rise significantly over those of world markets. This in turn will attract other supplies, and prices are expected to level off at significant premiums over world markets.

(x) Under this scenario, the impact of temporary supply disruptions caused by refinery outages will be significantly more pronounced, since some of the initial price elasticity has already been absorbed.

(xi) The expectation is that the import dependency and chronic undersupply will cost gasoline consumers in California between \$0.5 – 1.5 billion per year over what they would pay in a market where supplies are unrestrained. In addition, it is expected that on average, one major and several smaller supply disruptions will occur every year, resulting in a temporary price spikes that add at least another \$0.5 billion to California's collective gasoline bill. It is estimated that for the largest part, the incremental revenues from gasoline sales will flow to energy companies outside the State.

Recommendations and Proposals

The recommendations formulated at this stage are:

(xii) The State of California is to provide a legislative framework that will enable the industry to better respond to market needs in terms of refining capacity and logistic infrastructure. Specific recommendations are:

a) To create a central authority to coordinate and expedite the permitting processes for projects related to energy infrastructure in general, similar to the one-stop shopping, fast-track permitting process created for projects related to California's electrical power supply.

b) To create a framework whereby refiners and other industry participants can expand production capacity and infrastructure capabilities without causing overall net additions to the State's emission inventories. Notably, a trade-off between reductions in mobile emissions through voluntary improvements in fuel quality beyond the minimum requirements can create room for refiners to offset stationary emission increases associated with capacity expansions. Currently, no framework exists within which emission reduction credits can be exchanged within stationary and mobile sources.

(xiii) The State of California is to issue a tender for the creation of 5 million barrel of versatile petroleum product storage under long-term lease agreements, 3 million of which would be in the LA basin and 2 million in the Bay Area. In both locations, this storage is to be provided with deepwater access and connections to the main product distribution pipeline systems. The tender is to be issued to qualified commercial terminal operators.

(xiv) At 5 million barrels, the capacity is twice the proposed volume of actual reserves and as part of the storage lease agreements, the State will require the contract operator of this tankage to sublease half of the new capacity to interested third party market participants, with the State only providing a minimal financial guarantee in case storage is not occupied for a certain amount of time. This guarantee will enable commercial terminal operators to obtain financing without the need for long term contracts, thus satisfying the need for short-term tank rentals serving the import market.

(xv) The State of California will purchase 2.5 million barrels of gasoline and gasoline blending components to form the basis for a Fuels Bank, from which qualified industry participants can withdraw volumes against a fee, with an obligation to re-supply the borrowed volumes within an agreed time span. Potentially, some of the State's obligations to purchase power can be exchanged for purchases of fuels using hedging and exchange mechanisms to offset corresponding intrinsic energy values. Equally, there may be opportunities to offset some of the purchase costs with a corresponding sale of crude oil from the Federal Strategic Petroleum Reserve under a provision in the Energy Policy and Conservation Act. The initial fill will have to be purchased during the winter blending season, preferably from offshore sources, and at a rate of purchase that will not create shortages or run-ups in prices.

(xvi) The fee for the temporary usage of the product is to be determined in periodic electronic auctions, whereby the qualified participants can bid for the privilege of the time value for prompt lifting of the product with repayment in kind within a pre-agreed time period, not exceeding 6 to 8 weeks. Minimum fees should be set such that the operational cost of maintaining the State's share of the inventories is largely covered. In times of shortage, i.e., when a refinery outage has been announced, these fees can be expected to be bid up sharply, but as a derivative, their overall impact on the cost of supply is expected to be considerably less than run ups in the price itself in times of shortage.

(xvii) In this way, not only is a reserve created that will suppress price excursions in a cost effective way, with savings to California gasoline consumer far outweighing the cost to the taxpayer, but a physical delivery point and hedging mechanism is created that will facilitate imports and significantly reduce the State's risk of import dependency for its transportation fuels.

(xviii) A descriptive example of how a Strategic Fuels Reserve for California may work in the context of global gasoline markets, when such a reserve is designed to allow time-swaps and enable forward trades, is given in Attachment B. However, because of the complex nature of the proposals, which go well beyond the simple building of tanks and holding of stagnant inventories contemplated in earlier proposals for a California Strategic Fuels Reserve, it is recommended that following this initial feasibility study, funds are allocated to conduct a definition phase study during which:

- a) an inventory is made of problems associated with current permitting procedures, leading to detailed recommendations for a framework that will allow a faster and more efficient response by the industry to important market needs without compromising California's environmental safeguards;
- b) bids are obtained from commercial service providers for the tankage, so that costs of operating the reserve can be defined with the level of accuracy and confidence necessary for budget decisions;
- c) options for the initial fill can be worked out in detail, possible even to the extend whereby tenders are answered and cost are locked in or hedged;
- d) detailed working principles are defined for the operation and oversight of the SFR as currently proposed in concept only, including an auction mechanism for the use of volumes from the reserve;
- e) further rounds of feedback on the detailed proposals are obtained from industry participants and other stakeholders; and
- f) detailed proposals are prepared to enable final decisions by the legislature.

1 CALIFORNIA FUELS MARKET

The California market for petroleum products is insular in nature, isolated from the main US continental markets by the Rocky Mountains to the East and from most other major fuels markets by the Pacific Ocean in the West. The geographical isolation is aggravated for gasoline and diesel by the unique fuel specifications that were mandated by the State in the past decade to protect its air quality, a process that is still continuing with the anticipated introduction of CARB Phase III reformulated gasoline specifications in the near future.

Even within the California market, a certain amount of insularity occurs. The Northern California market, with the Bay Area as its main center, and the Southern market structured around Los Angeles, are not linked by pipelines for petroleum products and behave in many ways semi-autonomously. A third production center around Bakersfield has only limited capacity for gasoline and distillates. Within the San Joaquin Valley, other insular niche markets exist such as the markets for diesel in agricultural centers. External and internal insularity are major factors when evaluating the effectiveness and optimal locations for an eventual Strategic Reserve.

In the past California exported small excess quantities of certain fuels. In recent years however, the State has become a net importer of all petroleum products including finished gasoline, blend stocks, diesel and jet fuel, and the State's shortfall is expected to increase significantly over the coming years¹. The State receives limited supplies from refiners in nearby Washington, but California has to cover the bulk of its shortfall of petroleum products with imports from remote sources such as the US Gulf Coast, the Canadian East Coast, the Caribbean, Europe, Asia, and the Middle East. It is important to note that the shortfall is not only caused by demand for fuels within the State, but that the California refiners also supply markets in Nevada and parts of Arizona, including fast growing population centers such as Las Vegas and Phoenix.

The proposed phase out of MTBE, currently scheduled for year-end 2003, concurrent with the introduction of the more stringent CARB Phase III requirements, will cause a reduction in supplies by 5 to 10%. This shortfall will predominantly affect the LA Basin market and is as yet not covered. Even if available import sources were to be identified within the global refinery network, the State would lack the infrastructure to handle a diverse mixture of blending components. Under scenarios in which the State is chronically undersupplied, the volatility of fuel pricing can be expected to grow progressively worse. Below, supply and demand will be analyzed for several scenarios, in particular with regard to imbalances that will increase price volatility and hence, the value of an eventual SFR.

¹ *Energy Outlook 2020*, California Energy Commission Staff Report, Docket No. 00-CEO-Vol II, August 2000

1.1 Current Supply

Forecasting the supply of clean petroleum fuels into California requires an analysis of its refineries and their capability for expansion, and an evaluation of import opportunities in terms of sources, logistical infrastructure and economical feasibility.

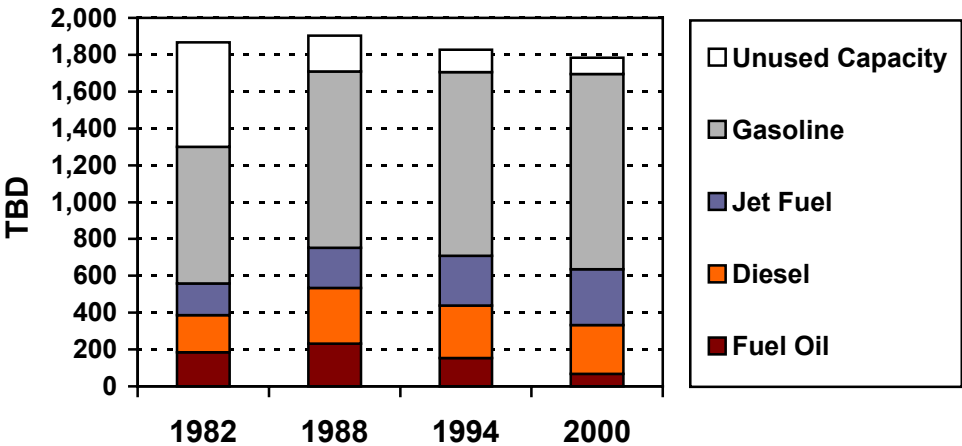
1.1.1 Refining Capacity in California

Historically, two factors have contributed to rationalization and concentration of refining capacity in California:

- The deregulation of the markets for petroleum products in 1981², which accelerated the closure of many uneconomic refineries nationwide.
- The requirements of the Clean Air Act Amendments (CAAA) of 1990, which for several refineries could not be achieved economically.

The concentration of production that took place from the mid 80-ies through the mid 90-ies has not only resulted in high utilization rates of remaining capacity, but the investment programs to meet the requirements of the CAA and subsequent amendments also led to a significant increase in gasoline production of lighter components at the expense of heavy fuel oil. As a result, the remaining gasoline-producing refineries in California are highly sophisticated full conversion facilities.

Figure 1.1 – CA Refinery Capacity Utilization³



² Executive Order 12287, Providing for the Decontrol of Crude Oil and Refined Petroleum Products, Jan 28, 1981.

³ Source EIA and CEC data. Stream day capacities.

Figure 1.1 shows how since the mid 90-ies, unused refining capacity in California is less than 5%, indicating that all remaining refineries in California have essentially been running at the maximum practically feasible operating rate given the average age and the mechanical complexity of the installations. It also shows that the remaining refining capacity is predominantly geared towards production of gasoline at the detriment of fuel oil output, as a result of heavy investments into cracking and coking capacity in the late 80-ies and early 90-ies.

Out of the 15 refineries currently operating in California, only 12 facilities, owned by 7 companies, are capable of producing California specification gasoline and diesel. The capacities of these refineries are summarized below in Table 1.1 below.

Table 1.1 – California Fuels Production 1995-2001⁴

	TBD	1995	1996	1997	1998	1999	2000	2001
NORTHERN CA								
CARB RFG		48.4	320.1	381.3	387.0	369.1	392.2	402.0
Oxygenated Gasoline		106.1	22.1	0.2	-	-	-	-
Other Finished Gaso		277.1	110.6	62.9	68.7	33.5	51.7	58.3
CARB Diesel		128.8	126.5	133.0	2.2	81.8	104.9	115.4
EPA Diesel		n/a	n/a	n/a	115.3	30.1	19.0	22.5
High S Diesel		19.2	15.1	4.3	2.4	7.7	8.1	5.2
Jet Fuel		97.0	111.6	111.5	102.0	84.5	94.5	101.4
SOUTHERN CA								
CARB RFG		405.1	464.4	493.2	399.0	584.9	548.6	552.3
Oxygenated Gasoline		3.6	-	0.8	n/a	3.9	5.5	3.1
Other Finished Gaso		126.3	71.6	61.5	65.9	52.9	52.5	40.2
CARB Diesel		122.7	125.1	127.3	1.7	56.8	69.4	74.1
EPA Diesel		n/a	n/a	n/a	139.6	102.4	76.8	81.4
High S Diesel		19.8	19.4	12.8	10.8	4.6	6.3	1.5
Jet Fuel		148.2	169.0	164.4	157.4	143.6	149.4	139.0
TOTAL CA								
CARB RFG		453.4	784.5	874.5	786.0	954.0	940.8	954.4
Oxygenated Gasoline		109.7	22.1	1.1	n/a	3.9	5.5	3.1
Other Finished Gaso		403.4	182.2	124.4	134.6	86.4	104.2	98.5
CARB Diesel		n/a	n/a	n/a	3.9	138.6	174.3	189.5
EPA Diesel		n/a	n/a	n/a	254.9	132.5	95.8	103.9
High S Diesel		39.1	34.4	17.0	13.3	12.3	14.4	6.8
Jet Fuel		245.2	280.6	275.9	259.3	228.1	243.9	240.4

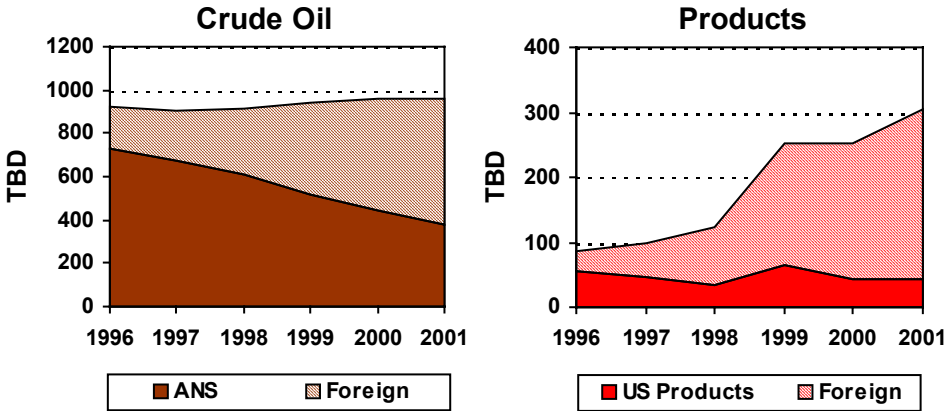
The production numbers for gasoline cited in Table 1.1 include blending components and unfinished gasoline blend stocks imported by the refineries. These imports play an increasingly important role in the refiner's abilities to meet California's fuels demand, and a detailed analysis of the imports of petroleum products will be provided below.

⁴ Data from CEC weekly reported production numbers.

1.1.2 Imports of Petroleum Products

In the past, California was a net exporter of petroleum, either as crude oil or as refined distillates and partially refined feedstocks. In recent years however, internal demand has grown, and even though the refineries have become more sophisticated as California crude oil production has declined, the net effect is that imports of both crude oil and refined products have grown substantially, making the State a significant net importer of foreign crude and petroleum products, as shown in Figure 1.2 – CA Foreign and Domestic Petroleum Imports.

Figure 1.2 – CA Foreign and Domestic Petroleum Imports⁵



Over the past 5 years, imports of foreign crude oil and other refinery feedstocks into California have effectively tripled, from about 193 TBD in 1996 to 579 TBD in 2001. While refinery crude runs have been nearly constant, the increased foreign imports are replacing both Alaska North Slope crude (ANS), as well as California crude production. The impact of the increased imports of foreign crude is relevant for the need to create a Strategic Fuels Reserve because:

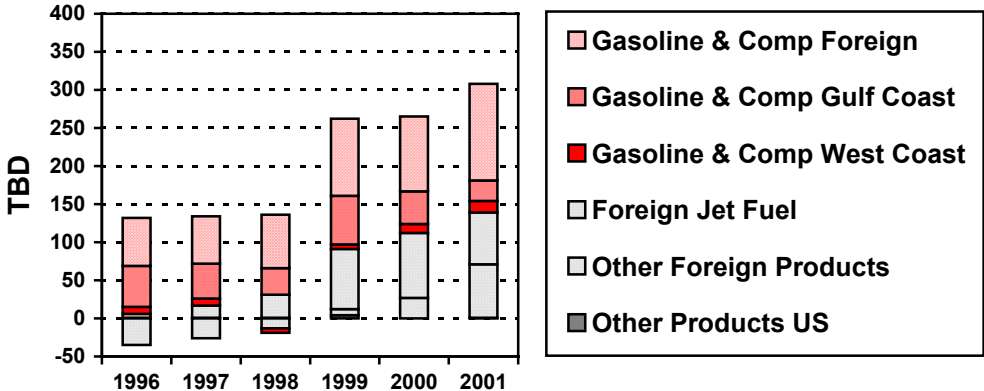
- Foreign crude is sourced increasingly from remote locations such as the Middle East, requiring Very Large Crude Carriers (VLCCs) to achieve economical freight rates. The logistics of receiving larger cargoes from more remote locations increases the risk of supply disruptions.
- At many terminals and refineries, crude and product receipts share common infrastructure such as docks, transfer lines and sometimes even tankage. The

⁵ Data from EIA, CEC, Port Import Export Reporting Services/JOC Group, and US Army Corps of Engineers

additional maritime receipts of crude oil create an additional strain on product import capabilities.

Net product imports have grown from a small volume that resulted as the net sum of almost balancing imports and exports, to more than 300 TBD of net imports. Figure 1.3 shows the details of net imports by product category and origin.

Figure 1.3 – CA Imports of Petroleum Products⁶



* Components include oxygenates such as MTBE, ETBE, etc

As can be seen from Figure 1.3, the increase in imports is most significant in jet fuel and gasoline, but in all major fuel categories including diesel and miscellaneous other fuels (fuel oil, distillate blendstocks, lube stocks and additives), California has become import dependent, with gasoline and gasoline blending components forming the largest import category. Imports of petroleum products are a function of refinery performance and regional demand. The California refineries operated reliably in 1998, but significant refinery problems were encountered in 1999. The large increase in imports from 1998 to 1999 as seen in Figure 1.3 reflects this difference in refinery performance. The underlying trend is an annual increase in imports of petroleum products in California of 30 to 40 TBD per year, or approximately 1.6 to 2% per year of the total fuels capacity of the State’s refineries. What is more significant, however, is the increase in waterborne imports itself: **since 1996, the volumes of clean products handled through the State’s marine receipt facilities have effectively tripled.** It is this sharp rise in import volumes coupled with a stagnating infrastructure, which is in large part responsible for the current supply difficulties.

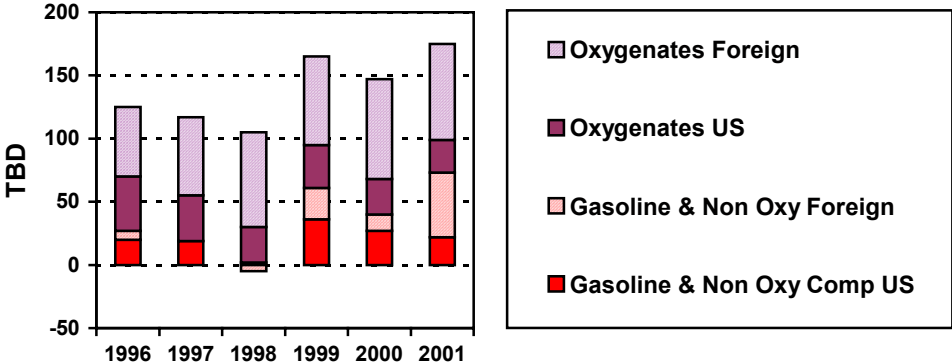
⁶ Based on EIA data and Port Statistics collected by the US Army Corps of Engineers

Figure 1.3 also shows that, while in 1996 California still was a net exporter of distillates and miscellaneous refined products, it now has a net import requirement in all product categories. Moreover, while in 1996 foreign imports accounted for approximately 50% of California’s imported shortfall of gasoline and blending components, by 2001 the share of foreign imports had grown to more than 80%.

The imports into the gasoline pool are a combination of finished gasoline, blending components and oxygenates. Components include alkylate, naphtha, reformate, raffinate, and natural gasoline. Oxygenates in the form of MTBE and ethanol make up the largest part of the imports of gasoline and blending components in California, with MTBE representing over 90% of the total volumes. Indigenous Californian production of MTBE, TAME and ethanol is less than 12 TBD, underscoring the import dependency of California for this fuel additive. Figure 1.4 shows gasoline imports by component.

As can be seen in Figure 1.4, foreign imports accounted for approximately 50% of California’s imported shortfall of gasoline and blending components in 1996. By 2000, the share of foreign imports had grown to 70%, and it is important to note that in fact, the entire increase in California’s imports of gasoline over the period has been met by foreign imports rather than imports from other US refining centers.

Figure 1.4 – CA Gasoline and Component Imports ⁷



The increasing dependency on foreign imports represents significant exposure for the future capability to keep the State supplied with gasoline because only a limited number of foreign refineries is capable of producing CARB spec fuels, and this number will shrink even further as some of these refiners will not be able to produce CARB Phase III CARBOB. To the foreign refiners, exports to California are only an incidental

⁷ Based on EIA data and Port Statistics collected by the US Army Corps of Engineers

occurrence with uncertain margins given the shipping delays, the volatility of the Californian market, and the lack of a futures market. Under these conditions, it is difficult for these refiners to justify investments in the necessary upgrades.

1.1.3 *Interstate Product Movements*

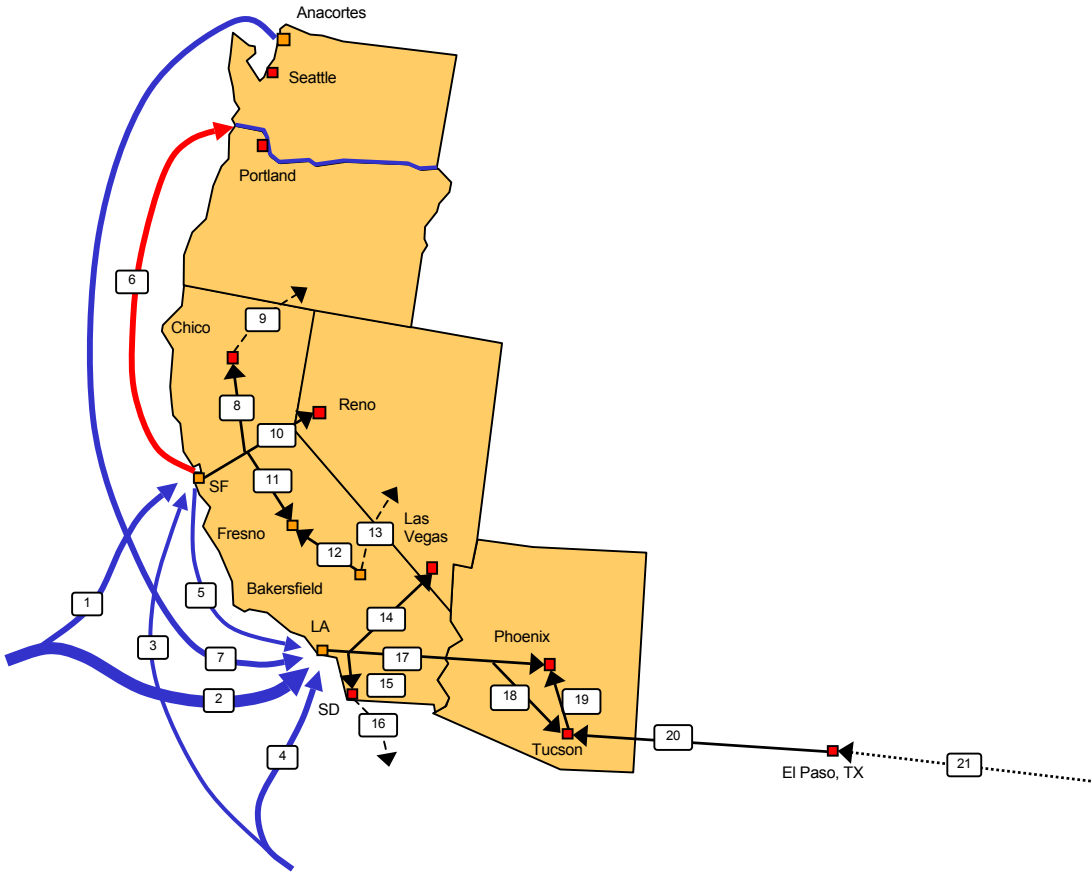
The import volumes shown in Figure 1.4 for the West Coast represent the balance of imports and exports to the Pacific Coast states, which have a considerable volume of petroleum movements between the various producing and consuming enclaves. Refineries in the Bay Area ship conventional gasoline to the Pacific Northwest, primarily to Portland, OR. The refineries on Puget Sound send somewhat larger volumes of reformulated gasoline or components down to San Francisco or Los Angeles by tanker or barge.

Besides maritime imports, pipeline and truck movements play an important role in the supply of California and the neighboring states for which California refineries provide a significant share of their fuels demand. There are two major pipeline systems, both owned and operated by Kinder Morgan Energy Partners LLC, one exporting products from the Bay Area refiners to Northern and Central California, as well as Northern Nevada, and the other taking products from the LA Basin refiners to Southern California, Southern Nevada and Arizona.

Kinder Morgan also owns a pipeline system that moves products produced in Texas and New Mexico from El Paso to Tucson and Phoenix. Capacity on this system is oversubscribed, and capacity for users of this line is prorated. Figure 1.5 gives an overview of movements on product pipelines and other means of transportation between California and its neighboring states. Numbers are for the year 2000 and are based on data obtained from EIA, CEC and the US Army Corps of Engineers.

Also shown in Figure 1.5 is the Longhorn Pipeline, a former crude oil pipeline system that was built to transport Alaskan Crude landed in Los Angeles by tankers to refineries on the US Gulf Coast. This pipeline system is currently in the process of starting up in clean product service to bring US Gulf Coast products to Western Texas and Arizona. However, until new pipeline capacity is added between Tucson and Phoenix, this new pipeline will not substantially contribute to California's requirements for clean fuels, nor will it significantly diminish the quantity of products supplied by LA Basin refiners into Southern Nevada and Arizona.

Figure 1.5 – CA 2000 CA Product Movements



Year 2000, TBD	Gasoline	Diesel	Jet
1 Foreign Imports into N-CA	29.8	0.6	13.0
2 Foreign Imports into S-CA	68.4	19.0	71.9
3 PADD III Imports into N-CA	6.8	n/a	n/a
4 PADD III Imports into S-CA	22.1	n/a	n/a
5 Ship/barge SF to LA	24.5	31.1	n/a
6 Ship/barge SF to Portland	28.0	2.7	n/a
7 Ship/Barge WA to LA	38.0	16.2	n/a
8 Kinder Morgan SF to Chico	17.6	n/a	n/a
9 Truck Chico into S-OR	0.4	0.5	n/a
10 Kinder Morgan SF to Reno	17.3	13.2	5.6
11 Kinder Morgan SF to Fresno	n/a	n/a	n/a
12 Kinder Morgan B'field to Fresno	n/a	n/a	n/a
13 Truck Bakersfield to W-NV	2.5	5.0	n/a
14 CALNEV LA to Las Vegas	45.9	32.3	32.7
15 Kinder Morgan LA to San Diego	n/a	n/a	n/a
16 Truck SD to Mexico	n/a	n/a	n/a
17 Kinder Morgan LA to Phoenix	60.9	28.4	29.5
18 Kinder Morgan LA - Tucson	4.1	2.6	0.5
19 Kinder Morgan El Paso - Phoenix	41.0	3.2	3.6
20 Kinder Morgan El Paso - Tucson	28.0	7.4	4.9
21 Longhorn	n/a	n/a	n/a

1.1.4 Supply Reliability Factors

When refiners state calendar day capacity (actual expected annual production divided by 365 days) and stream day capacity (highest operating rate sustainable on a single day), the difference for major refinery units such as distillation or cracking is typically around 5%. This means that refiners expect that on average, these installations will be out of service for 18 days per year for scheduled inspections, preventive maintenance, operational activities such as catalyst changes, and project work. Since 1995, the California refineries have been running at operating rates equal to 95% of published nameplate capacity, which means that effectively, they have been running as close to their maximum sustainable rates as can be expected, given the age and complexity of the installations. This operating record reflects favorably on the skill level and experience of operating personnel and refinery management.

Nevertheless, unplanned outages occur, sometimes for reasons that are completely outside the scope of control of the refinery management. An extensive study into the occurrence and impact of refinery disruptions, which was conducted by Dr A.J. Finizza in parallel to the SFR Study concluded that⁸:

- For all of California's refineries combined, evidence was found in publicly available information that between February 1996 and April 2001, a total of 49 refinery disruptions occurred with measurable effects.
- The average duration of these refinery outages was found to be 2.7 weeks, while the average net capacity loss was 20 TBD of gasoline production. The longest outage lasted 22 weeks, while the highest net capacity loss was 60 to 70 TBD.
- Given the frequency of occurrence and the duration of disruptions, there is a small but real chance of almost 8% that 2 of California's refineries are experiencing production outages at the same time.

With inventories on hand in the refineries that average only 10 days of supplies, and with long supply routes requiring lead times of 6 to 8 weeks for imports, the effect of supply disruptions is to cause temporary shortages that in turn result in market driven price spikes, with prices running up until demand will be reduced to a level that corresponds with the reduced supplies. Given the highly un-elastic price/demand behavior of gasoline, even small shortfalls in supply can cause very significant price swings. There is also ample evidence, as will be shown in

⁸ Dr A.J. Finizza, *Economic Impact of Refinery Disruptions*, Study for the California Energy Commission, April 2002

Section 8 of this report, that even if incidents are confined to only one of the California refining centers, the entire California gasoline market moves up.

Supply reliability factors are not the only cause of price volatility. For instance, the lack of liquidity leaves the market vulnerable to sharp increases or decreases in posted prices on only a few reported deals. Yet in the majority of the cases, a real or imagined supply disruption is at the root of price volatility. In the most severe example, the refinery incidents in 1999 resulted in a capacity loss of 5 – 10%, and caused spot prices to double at their peaks, while retail market increased by 50% over prolonged periods.

In general, price volatility in the California gasoline market has significantly worsened in recent years, as the insularity of the market increased while the spare capacity available within the California refining system to make up for supply disruptions decreased.

Figure 1.6 – Gasoline Spot Price Differential LA – US Gulf Coast⁹

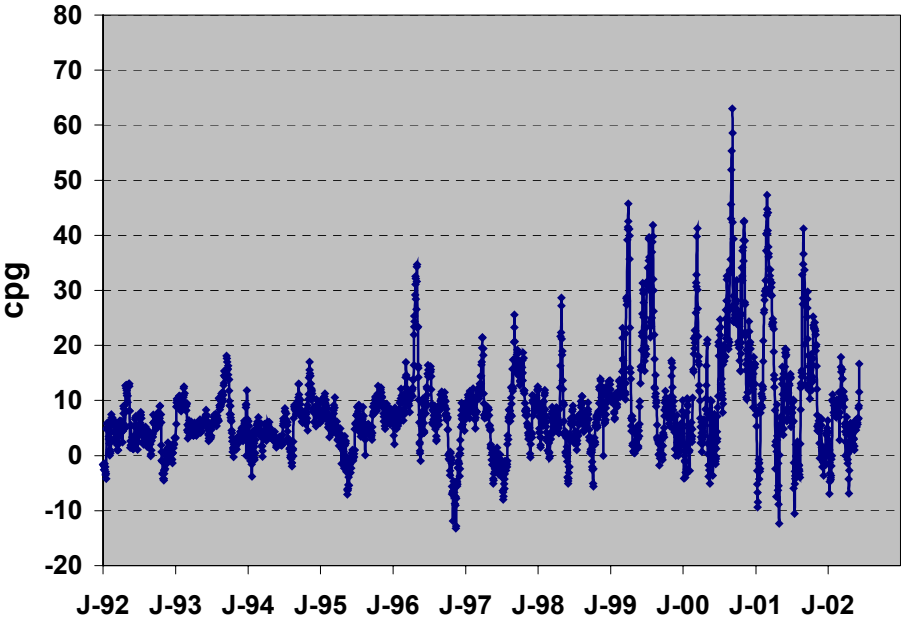
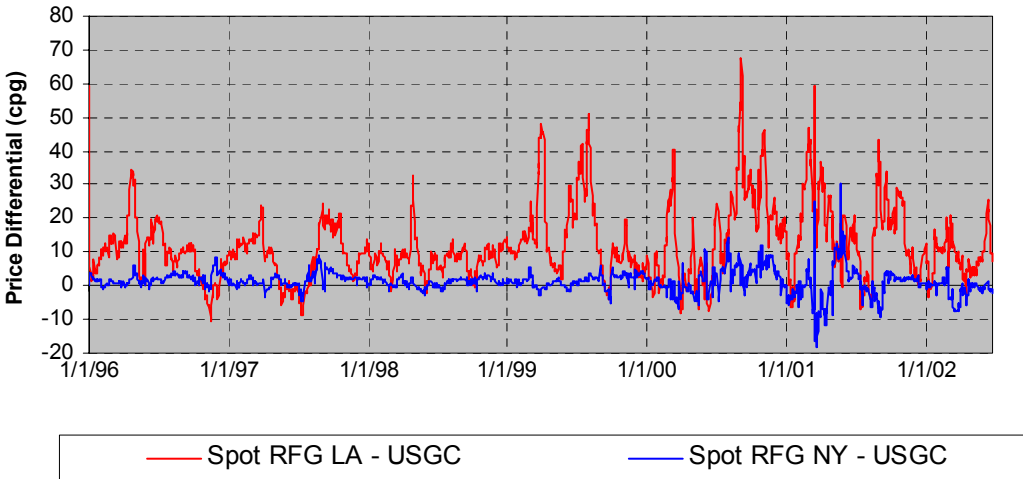


Figure 1.6 shows the premium of the LA conventional spot gasoline price over the spot price at the US Gulf Coast, the latter being a highly relevant marker price for gasoline worldwide. It is clear that the CA prices have gradually increased over world market levels, and that the volatility has significantly increased since 1995, when CARB Phase II was introduced.

⁹ EIA Daily gasoline spot prices Los Angeles and US Gulf Coast.

The same conclusion is drawn when comparing prices for Reformulated Gasoline (RFG), as shown in Figure 1.7.

Figure 1.7 – Differential of LA Spot RFG over USGC RFG to NY RFG



It is clear that the volatility of the Los Angeles price differentials for regular spot RFG gasoline over the US Gulf Coast pricing is far more severe than that of the New York markets for RFG. Although from the data it would appear that the underlying tendency is for both markets to become more volatile, the California market volatility is an order of magnitude worse than that of New York.

Whereas an earlier price spike in 1996 led promptly to additional shipments from the US Gulf Coast to California at a rate equivalent to 50 TBD, more recent price spikes that far exceeded that of 1996 in amplitude and duration have failed to attract more than 10 to 15 TBD. Although the market still functions in so far that no actual shortages have occurred at the pump, it must be concluded from Figure 1.6 that currently, the California gasoline market is not efficiently supplied. In a well functioning market, supplies would be attracted at levels just above transportation and sourcing cost differentials, and prices would not have to run up until demand is reduced to match the insufficient offering.

1.2 Demand

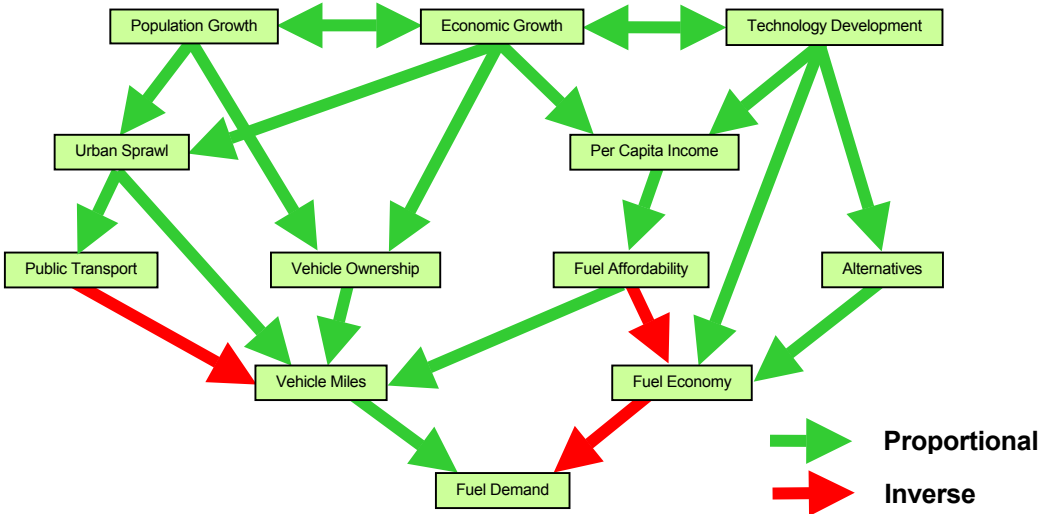
To estimate future demand for transportation fuels in California, this report will make extensive use of the results of a separate study launched by the CEC concurrently, with the specific

purpose of forecasting energy demand in the State¹⁰. The main findings of this study are summarized below.

1.2.1 Growth Drivers

Demand for transportation fuels is the product of the total miles driven by all vehicles and the average fuel consumption per vehicle over the entire fleet. These two key factors, in turn are impacted by a complex set of interdependent factors as shown in Figure 1.8 below.

Figure 1.8 – Drivers for CA Gasoline Demand



For the key factors, the following historical and forecasted numbers were used:

- **Population Growth.** Over the past two decades, California’s population grew by an average of 1.9% per year, a rate that is expected to slow to 1.4% per year over the next 20 years, resulting in a total population of 45 million people in the State by 2020.
- **Population Density.** Land development patterns in California are characterized by urban sprawl, leading to jobs and communities that are increasingly further apart. This trend is expected to continue.
- **Fuel Affordability.** Over the past 20 years, the average annual increase in per capita income in California was 3.1% per year, for an aggregate real increase

¹⁰ Base Case Forecast of California Transportation Energy Demand, CEC Staff Report, December 2001

of 45% (1.9% per year). Over the same period, the real cost of gasoline in the State fell by 30%. Per capita income is forecasted to increase on average 1.5% per year, and primary energy cost to stay flat in constant dollar terms (the price of gasoline in CA may vary significantly depending on supply scenarios, but this effect is taken into account separately).

- **Vehicle Miles Traveled (VMT).** The factors cited above contributed to an increase in total Vehicle Miles Traveled of 3.3% annually over the past 20 years. For the immediate future, the forecast is for an annual increase of 1.8%.
- **Substitution.** Public transportation and alternative fuel vehicles can substitute demand for conventional gasoline powered personal cars. However, the CEC estimates do not show a significant impact of alternative technologies in the near future.

1.2.2 Scenarios

For near term future gasoline demand scenarios, i.e., forecasts that extend up to five years out, the most leveraging differentiators are general economic climate and basic energy price levels, in particular the price of crude oil. Other factors, such as demographic changes of changes in fleet composition and average fuel efficiency, move too slowly to have a significant impact within a five-year time horizon.

Three scenarios were evaluated:

- A base case that assumes the current economic slowdown to level off, with a moderate recovery over the next two years and slower growth afterwards than seen over the past five years, resulting in an average increase in gasoline demand of 1.6% per year
- A high growth scenario that assumes rapid economic recovery to similar levels as seen over the past five years, averaging 2.1% per year.
- A low case assuming a deepening and longer lasting recession, with gasoline demand growth slowing to 1.1% per year

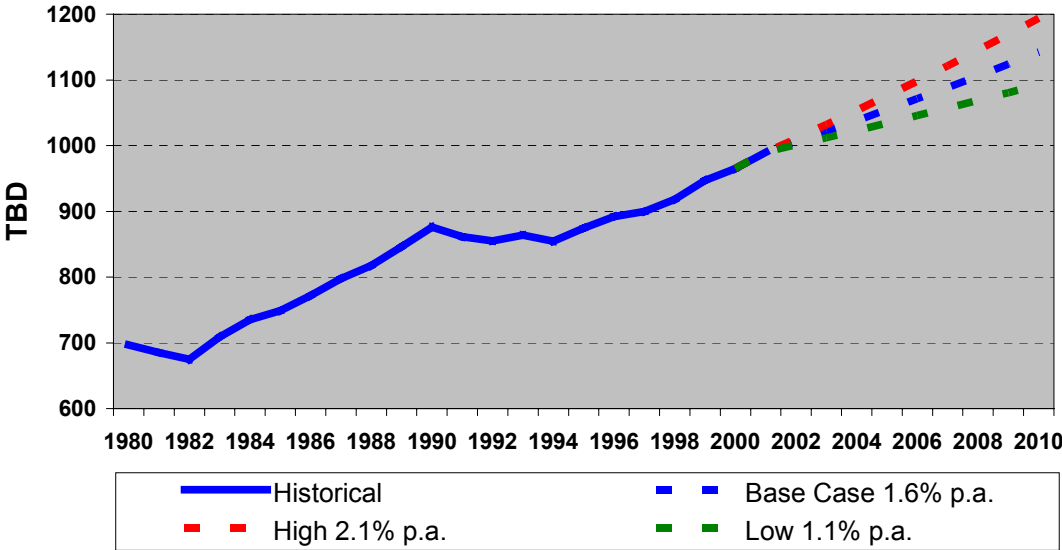
All scenarios assume that crude oil prices will stay moderate, i.e., in a range of \$20 per barrel, plus or minus \$5. Because crude oil pricing is an almost straight direct cost pass through in gasoline prices, higher and lower crude prices will impact gasoline demand with essentially the same price elasticity as gasoline price excursions caused by local

market supply imbalances. A high growth scenario could therefore also occur when economic recovery is delayed but crude prices revert to the low prices seen in the late nineties. It would take a combination of very high crude prices and a severe recession, similar to what was observed in the early eighties and early nineties, to cause gasoline demand to stay flat or show negative growth. The probability of this reoccurring is deemed extremely unlikely, especially in the light of statistics from the Board of Equalization (BOE) which show that demand in 2001 grew at nearly 3% over that of 2000, despite the economic downturn.

1.2.3 Demand Projections

Figure 1.9 shows the historical demand of gasoline in California, excluding the gasoline demand for those parts of Arizona and Nevada that are supplied out of California.

Figure 1.9 – California Gasoline Demand Forecast



The base case growth forecast is a close approximation of the long-term average annual increase over the entire period 1980 through 2000, while the upside and downside cases represent periods of rapid economic expansion and moderate recession respectively. Only a severe recession caused by or coinciding with crude oil prices in excess of \$30/bbl have led in the past to scenarios in which gasoline demand in California stayed flat, or even showed modest decreases. This was the case in 1980 and in 1990 – 1993, but current signs of economic recovery as well as a stated policy by OPEC and non-cartel producing states to manage crude oil prices within ranges that do not harm world economies make a return of similar conditions unlikely in the

immediate future. In fact, taxable sales in 2001 were up nearly 3% over those reported for 2000, and early indications for 2002 also show no signs of slackening demand.

1.2.4 Arizona/Nevada Demand

As shown in Section 1.1.3, California refiners supply fuels to Nevada and Arizona, which includes some of the fastest growing urban centers in the US. Table 1.2 shows the demand forecast for the California sourced demand in these states.

Table 1.2 – Arizona and Nevada Gasoline Demand

Growth Drivers	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Northern Nevada Growth (1)	2.9%	2.8%	2.7%	2.6%	2.5%	2.4%	2.3%	2.2%	2.1%	2.0%	1.9%
Southern Nevada Growth (2)	6.4%	5.2%	4.5%	3.9%	3.4%	3.0%	2.7%	2.4%	2.2%	2.1%	2.1%
Arizona Population Growth (4)	2.4%	2.4%	2.3%	2.3%	2.2%	2.2%	2.1%	2.1%	2.0%	2.0%	2.0%
Gasoline Demand (TBD)											
Nevada											
Northern NV (3)	21.0	21.6	22.2	22.7	23.3	23.9	24.4	25.0	25.5	26.0	26.5
Southern NV (3)	41.0	43.1	45.0	46.8	48.4	49.9	51.2	52.5	53.6	54.8	55.9
	62.0	64.7	67.2	69.5	71.7	73.8	75.6	77.4	79.1	80.8	82.4
Arizona											
West Line Sourced	87.0	89.1	91.1	93.2	95.3	97.4	99.4	101.5	103.5	105.6	107.7
East Line Demand	75.0	76.8	78.6	80.4	82.1	83.9	85.7	87.5	89.3	91.0	92.9
East Line Supply (5)	75.0	75.0	75.0	75.0	75.0	75.0	185.1	189.0	192.8	196.7	200.6
Total West Line Supply (6)	87.0	90.9	94.7	98.6	102.4	106.3	0.0	0.0	0.0	0.0	0.0
Total California Sourced Demand	149.0	155.6	161.9	168.2	174.2	180.1	75.6	77.4	79.1	80.8	82.4

1 Nevada State Energy Office estimate 2.8% in 2001 vs. 2.9% in 2000, a decline assumed to continue

2 As per Clark County Advanced Planning Division - "Clark County Demographics Summary"

3 Lynn Westfall, UDS presentation to CIOMA, April 2001

4 AZ Dept of Economic Security data - <http://www.de.state.az.us/links/economic/webpage/page16.html>

5 Assumes replacement of West Line supplies by Longhorn extension to Phoenix in 2006

6 Assumes all AZ pipeline growth until start up of Longhorn extension to be put on West line due to East Line proration

The main event that will impact the supply of California sourced gasoline to Arizona is the anticipated completion of a new parallel or "looped" pipeline from Tucson to Phoenix, which will allow US Gulf Coast refiners to substitute California supplied volumes. The assumption here is that the US gulf coast refiners, who currently operate at capacity, will be able to make these volumes available through refinery expansions, or by shifting products away from their current markets, which in turn would have to look for imports from foreign sources.

1.2.5 Total Demand

The total demand for gasoline to be supplied from California is shown in Table 1.3.

Table 1.3 – Total Demand for California Sourced Gasoline

	TBD	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Base Case												
Northern California	372	378	384	390	396	403	409	416	422	429	436	
Northern Nevada	17	18	18	19	19	20	20	21	22	22	23	
Oregon	28	28	29	29	30	30	31	31	32	32	32	
	417	424	431	438	445	453	460	468	476	483	491	
Southern California	591	600	610	620	630	640	650	660	671	682	693	
Southern Nevada	41	43	45	47	48	50	51	53	54	55	56	
Western Arizona	87	91	95	99	102	106	0	0	0	0	0	
	719	734	750	765	781	796	701	713	725	737	749	
Total CA Base	1136	1159	1181	1204	1226	1249	1161	1181	1201	1220	1240	
High Growth Case												
Northern California	372	380	388	396	404	413	421	430	439	449	458	
Northern Nevada	17	18	18	19	19	20	20	21	22	22	23	
Oregon	28	29	29	29	30	30	31	31	32	32	33	
	417	427	435	445	453	463	472	483	493	503	514	
Southern California	591	603	616	629	642	656	669	684	698	713	728	
Southern Nevada	41	44	45	47	49	50	52	53	54	55	56	
Western Arizona	87	92	96	100	103	107	0	0	0	0	0	
	719	739	757	776	795	813	721	737	752	768	784	
Total CA High	1136	1165	1192	1220	1248	1277	1194	1219	1245	1271	1298	
Low Growth Case												
Northern California	372	376	380	384	389	393	397	402	406	410	415	
Northern Nevada	17	18	18	19	19	20	20	21	22	22	23	
Oregon	28	28	29	29	30	30	31	31	32	32	32	
	417	422	427	432	437	443	448	453	459	464	470	
Southern California	591	598	604	611	617	624	631	638	645	652	659	
Southern Nevada	41	43	45	46	48	49	51	52	53	54	55	
Western Arizona	87	90	94	98	101	105	0	0	0	0	0	
	719	730	742	755	767	779	682	690	698	706	715	
Total CA Low	1136	1152	1169	1187	1204	1222	1129	1143	1157	1171	1185	

Since no official scenarios were developed for demand growth in Arizona and Nevada, it is assumed that high growth in these states would be 1% per year above base case growth, while a reasonable assumption for low growth is 1% below base case.

1.3 Forward Looking Supply/Demand Balance

Ignoring inventory effects, supply and demand will have to balance. The total demand shown in Table 1.3 above is the latent demand, i.e., the demand that will exist if sufficient product is

available to meet the demand at prices that are not significantly different from historical numbers. The main event impacting the supply is the phase-out of MTBE.

1.3.1 Impact of MTBE Phase Out

Table 1.4 below shows the impact of the MTBE phase-out by region.

Table 1.4 – Impact of MTBE Phase Out¹¹

	TBD	N-CA	S-CA	Total CA
MTBE Balance				
RFG production		386	549	935
Ethanol Based CARB RFG		40	70	110
MTBE Based CARB RFG		346	479	825
MTBE Required @ 11%		38	53	91
MTBE imports foreign		24	51	75
MTBE imports US Gulf Coast		7	10	17
MTBE production		7	3	10
Total MTBE supply		38	64	102
Excess MTBE		0	11	11
Direct Impact				
Removal of MTBE		-38	-64	-102
Ethanol addition for oxygen requirement		21	34	55
Removal of butanes & pentanes		-17	-29	-46
Other Losses to meet distillation specs		-4	-6	-10
		-38	-65	-103
Capacity Compensation				
Major refinery capacity additions		22	0	22
Small CARB III mods, MTBE C4 to alky		3	2	5
Capacity Creep 2001 - 2002, 1%		4	6	10
Identified blendstock imports by refiners		0	10	10
		29	18	47
Net Shortfall		-9	-47	-56

The 11 TBD shown in Table 1.4 as excess MTBE is the sum of 3 TBD shipped down the Kinder Morgan pipeline to Phoenix, an unknown quantity that was used because of supply problems with ethanol for the current substitution of MTBE by some refiners, and a significant quantity, possibly as high as 6 or 7 TBD of MTBE used by LA refiners to make up for volume and quality problems by blending in more than 11%.

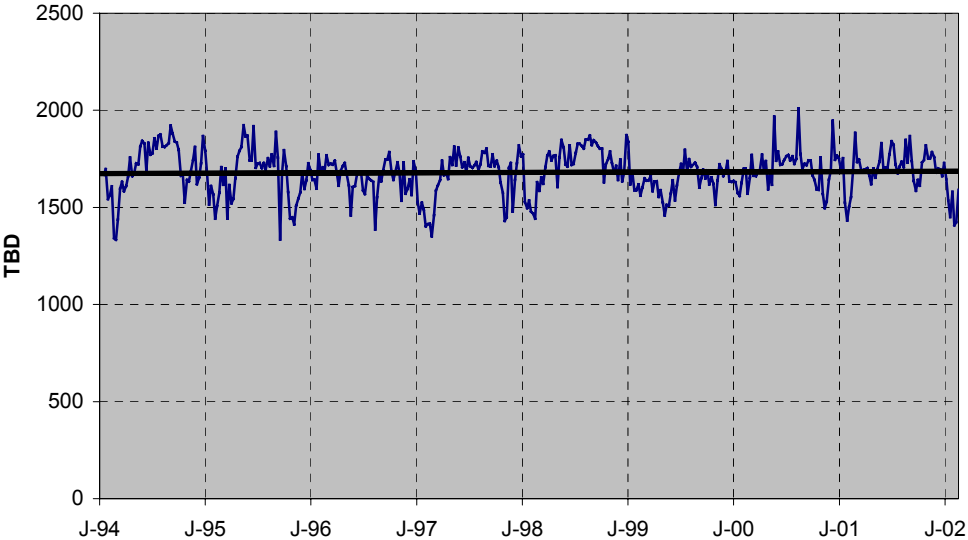
¹¹ Source of Data: CEC, CARB Phase III Compliance Plans as submitted by refiners Q4, 2001

The major addition in refinery capacity of 22 TBD shown in Table 1.4 above is not a net addition, but a partial conversion of conventional gasoline production into CARB Phase III grades ¹². It is clear from Table 1.4 that the southern California market will be impacted much more severely by the MTBE phase out than its northern counterpart. Moreover, the LA Basin is more constrained in terms of import capabilities than the Bay Area, making the south more vulnerable to supply shortages.

1.3.2 Capacity Creep

Capacity creep is the term used for the result of ongoing small plant improvements in refinery operations. Even though small, capacity creep is an important phenomenon because it can compensate for a significant portion of demand growth. In the absence of major expansion projects, capacity creep can be derived from production numbers over time. Figure 1.10 shows the weekly reported crude runs of California refineries.

Figure 1.10 – Reported Crude Runs by CA Refiners



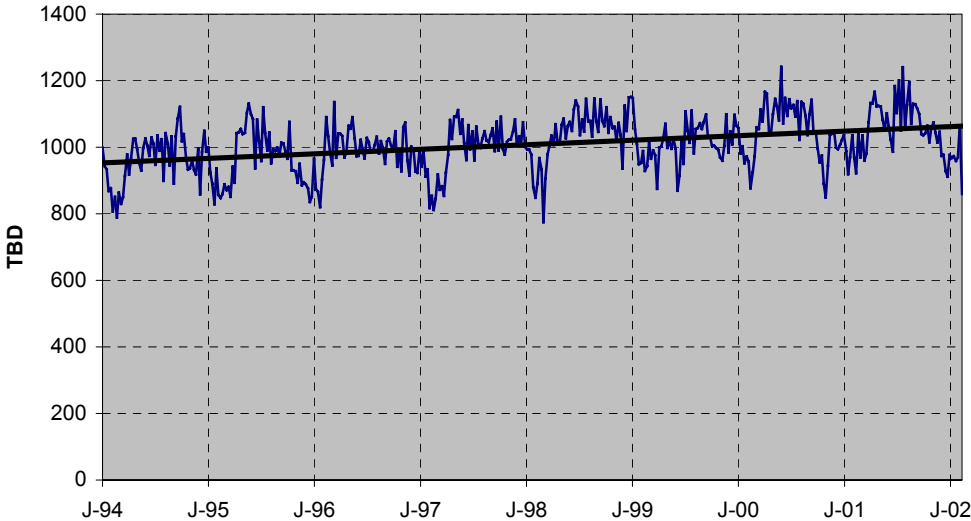
Although crude runs by California refiners have stayed virtually flat over the last 8 years, gasoline production has seen a small but significant increase in production, as shown in Figure 1.11 below.

Gasoline supplies by California refineries have grown on average by 1.3% per annum over the period 1994 through 2001, for an overall increase in average reported

¹² Information received during Stakeholder Meetings.

gasoline production of close to 100 TBD. Of this additional volume, approximately 40 TBD is due to increased receipts of imported blending components, which get reported as production after being blended off. The remainder, or 60 TBD, is the effect of the result of minor expansion projects and ongoing improvements in operations, which equates to approximately 0.6% per year. Although insignificant as fraction of total supply, capacity creep is important because it can represent up to half of the anticipated increase in demand.

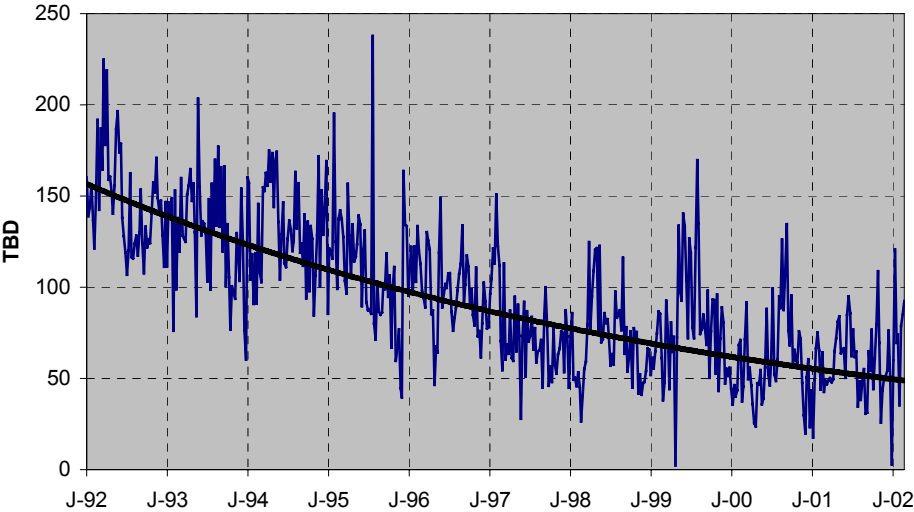
Figure 1.11 – CA Weekly Reported Gasoline Production



As can be seen in Figure 1.11 and Figure 1.12, the increase in gasoline production by California refiners by about 100 TBD was accompanied by a corresponding decrease in production of residual fuels, confirming that within the virtually flat crude conversion, refiners have been able to convert more of the heavy end of the barrel into gasoline. A small shift in distillate production can also be observed, but is not shown here. It is clear from Figure 1.12 that the capability to convert more heavy components into gasoline is reaching a point where further improvements are not physically possible.

In a market where supplies are tight, and where economic justification for small improvement projects can readily be found, capacity creep is likely to continue at historical rates. However, it is becoming increasingly difficult for refiners to expand capacity even by small increments because of restrictions imposed by their CAAA Title V operating permits, and the costs of additional emission credits in the absence of feasible offsets.

Figure 1.12 – CA Weekly Reported Production of Residual Fuels



For the base case projections, the annual increase of gasoline production is assumed to 1.0% per year. This rate of increase does not include known or expected discrete capacity additions through major debottleneck or expansion projects, nor does it account for the impact of specific programs such as the CARB Phase III compliance. This estimate is probably too optimistic in the light of the diminishing returns on further upgrading of the bottom of the barrel and the restrictive permitting climate for refinery projects in California.

1.3.3 Major Refinery Projects

Other than the project to convert 22 TBD of conventional gasoline into CARB RFG in the Bay Area, there are few other major expansion projects that have been announced. It is estimated that a prolonged period of high price levels will provide a justification for other capital projects and may result in an additional 23 TBD of gasoline in the Bay to come on stream in 2005, which is the reason for the increased supplies shown in Figure 1.13 below for Northern California.

Other major projects, such as the expansion of a crude unit in LA and the restart of the idled Powerine refinery by CENCO, met with strong environmental opposition, which, in conjunction with marginal economics, has caused these projects to be abandoned.

1.3.4 Northern California Supply/Demand Balance

For the base case demand, Figure 1.13 and Figure 1.14 show the supply/demand balance for Northern and Southern California respectively.

Figure 1.13 – Northern CA Gasoline Supply/Demand Balance

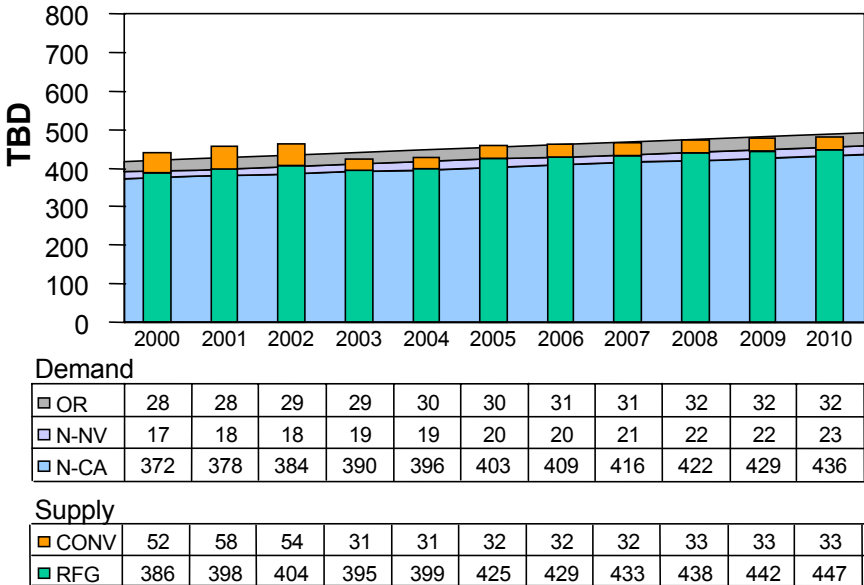
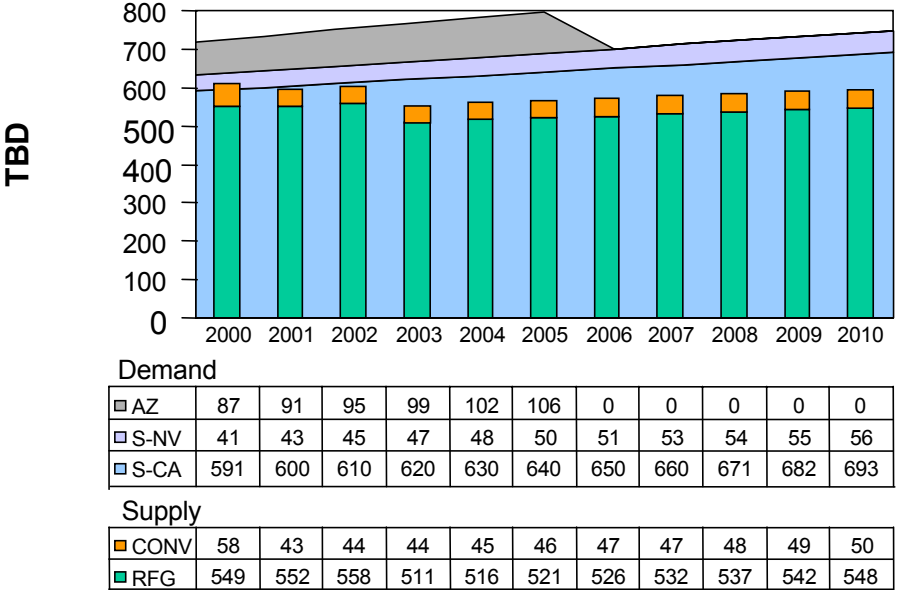


Figure 1.14 – Southern Gasoline CA Supply/Demand



From Figure 1.13 and Figure 1.14 it will be clear that whereas northern California is only minimally impacted by the MTBE phase out, southern California will see its import dependency – which is represented in the charts as the difference between the areas and the bars – approximately double. More importantly, the south currently depends for its shortfall in CARB RFG on barge imports from the Bay Area to the LA Basin by barge.

While the Bay area will be roughly balanced again once the all planned major refinery projects are completed, the south will still be significantly short even when the capacity of the East Line pipeline to Phoenix will be expanded. The shortfall will be even more acute when a rapid economic recovery will spur the demand to growth rates of 2% and more, as seen in 1996 – 2001.

1.3.5 Price and Volatility Effects of Shortfall

The effect of price on demand of gasoline, commonly referred to as the price elasticity of gasoline demand, is defined as the percentage change in the demand of gasoline divided by the percent change in price. Thus, a price elasticity of – 0.1 for example, suggests that a 20% increase in price would correspond to a 2% fall in demand.

The price elasticity for gasoline is not a constant number over a wide price range, but will be a function of other factors. For instance, the overall price level will play an important role: at low overall price levels, i.e., when crude oil and energy prices are low, a price increase by a certain percentage will not have the same impact on demand as the same percentage increase when prices are already high. Also, general economic conditions and substitution factors such as readily available public transportation will play a significant role. The latter may vary by region; for instance, in the Bay Area, where a well functioning public transportation alternative exists, short-term responsiveness will be different from the LA Basin, where public transportation options are more limited.

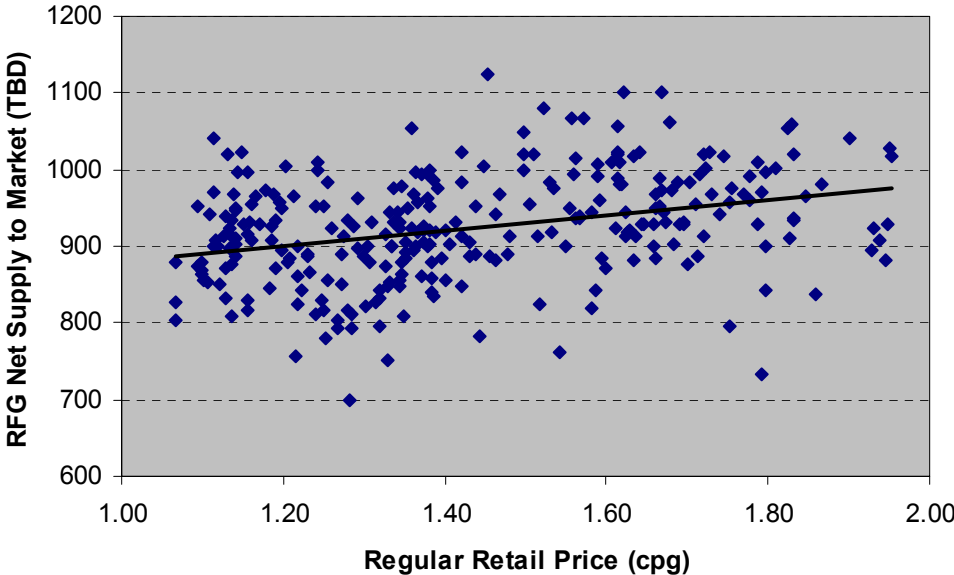
Moreover, there will be a significant difference between short-term responsiveness and long-term elasticity. Longer term, the effect of continued high pricing, such as that caused by fuel tax policies in many parts of the world, will have an impact on overall vehicle fleet fuel economies, use of alternatively powered cars, additions of public transportation infrastructure, and changes in demographic factors such as urban sprawl. Most of these factors take between 5 and 10 years to have a noticeable effect on consumer behavior. Short-term, the effect of these factors is negligible. Therefore it is not surprising that estimates given in Table 1.5 below have fairly wide ranges.

Table 1.5 – Gasoline Price Elasticity¹³

	Short-Term	Long-Term
FTC (2001) Midwest Gasoline Investigation	- 0.1 to - 0.4	Not reported
WSPA (2001) (PIRINC study)	- 0.05	Not reported
API (Porter) (1996)	- 0.19	- 0.71
Haughton & Sarkar (1996)	- 0.12 to - 0.17	- 0.23 to - 0.35
Espey (1996)	Not reported	- 0.53
Goel (1994)	- 0.12	Not reported
Goodwin (1992)	- 0.27	- 0.71 to - 0.84
Sternner (1992)	- 0.18	- 1.0
World Bank (1990)	- 0.04 to - 0.21	- 0.32 to - 1.37
Dahl (1986)	- 0.13 to - 0.29	-1.02

The combined sources of reported numbers as shown in Table 1.5 put short-term elasticity in the range of – 0.04 to – 0.40, and long-term elasticity in the range of – 0.23 to – 1.37. Below, an attempt will be made to derive more specific numbers for California.

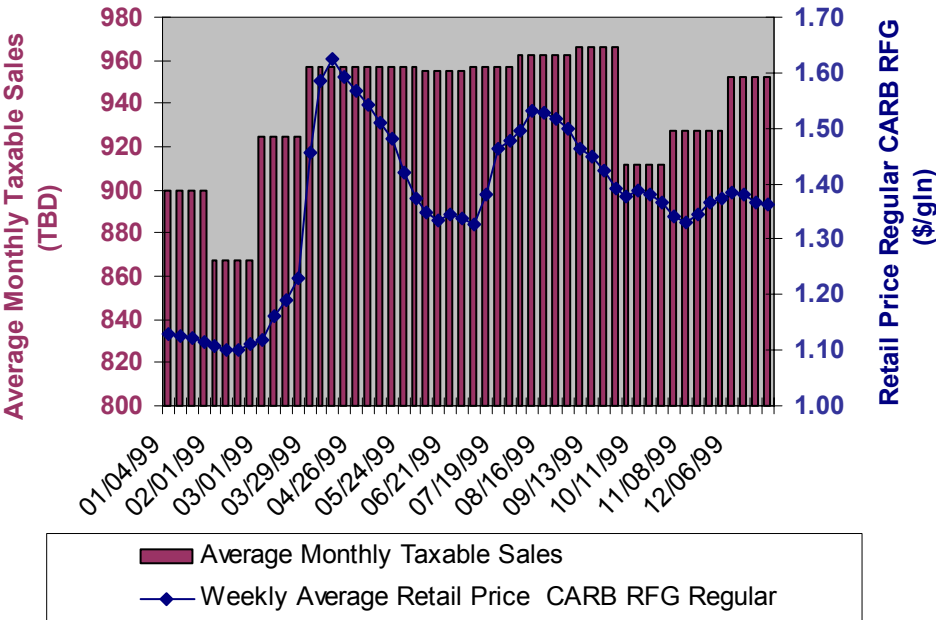
Figure 1.15 – Correlation CA Retail Price and Demand 1997 – 2001



¹³ Table from Anthony J. Finizza Ph.D., *Economic Impact of Refinery Disruptions*, CEC Study, June 2002; full bibliography references are provided in this report.

Figure 1.15 shows the weekly average net supply of CARB RFG (weekly production plus refinery inventory change) versus the weekly average retail price of regular grade gasoline over the period 1997 through 2001. Since inventory effects in the distribution chain are relatively small, and with the short supply lines typical for the California gasoline market, the weekly supplies are a reasonable approximation for implied demand. What is interesting to note in Figure 1.15, is that it in fact would indicate positive price elasticity, i.e., prices are higher in periods when demand is high. This implies a supply driven pricing mechanism, whereby competitive pressures lead to lower prices in periods of reduced demand (i.e., the winter driving season), with complete consumer indifference to any effect of prices when competitive pressures lessen during the higher demand summer season. Another contributing factor is that of world crude oil prices, which increased over the period 1997 through 2001, but did not slow down the economic growth nor California gasoline demand.

Figure 1.16 – Short-Term Price and Demand Effects



California’s gasoline consumption therefore appears to be relatively indifferent to medium term price effects. In the short term, the shock factor of sudden price spikes can be expected to affect demand somewhat. In 1999, a series of supply disruptions in the period March through August caused a 5 -10% shortfall in supply that was only partially made up from inventories and by imports. Price spikes in the spot market and at their peak reached values of more than double the prior levels (See Figure 1.16 above and also Figure 7.2 and Figure 8.2). Whereas the spot market can move

sharply, retail prices generally follow more slowly, for reasons discussed in 7.2. As shown in Figure 1.16, the effect of the outages on retail prices was that Regular Grade CARB RFG Gasoline in California increased from a level of \$1.10 per gallon to between \$1.40 and \$1.60 per gallon, an increase by 30 to 45%. The reaction of the market to these price spikes was not instantaneous, and in fact, taxable sales numbers do not show a significant drop. However, actual sales numbers do not take show how high sales might have been in the absence of a price spike. A better way to approach the issue may be to look at the price impact of the 1999 supply disruptions by comparing the average rate of taxable sales in the second and third quarter of 1998 with those over the same period of 1999, while estimating the growth in latent demand over the summer driving season to be at least equal to the total increase in gasoline usage over these years of 2.9%, which is likely to be a conservative approach.

Table 1.6 – Implied Demand Elasticity Comparison 1998/1999

	Q2/Q3 1998	Q2/Q3 1999
Average Retail Price Regular CARB RFG	\$1.18/gln	\$1.46/gln
Average Daily Taxable Sales	921 TBD	928 TBD
Expected 1999 sales rate, 2.9% growth		948TBD
Implied Demand Elasticity		- 0.09

In summary, the anecdotal evidence of the 1999 price spikes seems to confirm that the California market behaves in terms of price and demand elasticity well within the range of reported numbers from other sources. In his more rigorous quantitative analysis, Dr Tony Finizza¹⁴ uses a range of – 0.10 to – 0.20 to evaluate the financial impact of supply disruptions on the California gasoline markets.

1.4 Alternatives to make up Shortfall

In the absence of any real possibilities to increase production within California over the capacity creep and discrete projects already taken into account in the base case supply, alternative supplies to make up the projected shortfall consists in the short term of increased imports from other US producing regions, or from foreign sources. Longer term, supplies can be anticipated from pipeline projects now under development and refinery expansions which are as yet unannounced..

¹⁴ Dr A.J Finizza, *Economic Impact of Refinery Disruptions*, Study for the California Energy Commission, April 2002

1.4.1 *Supplies from US Gulf Coast*

The US Gulf Coast is the largest refining center in the US, and as such is a logical place to consider when looking for alternative supplies to meet California's shortfall. It has always been recognized that the CARB Phase III requirements would make sourcing finished product or CARBOB from the PADD III refineries difficult, but it is the availability of other blendstocks that needs to be evaluated, as well as the capabilities of the transportation system to move any available product to the West Coast.

Currently, several US Gulf Coast refineries are capable of producing gasolines that at or near CARBOB II specifications and most of these have made occasional shipments to California in the past. However, it is not economical for these refineries to invest in the necessary upgrades to be able to produce Phase III base blendstock, because of the limited overall production capability of the boutique quality material, the incidental nature of the export shipments, and the emergence of other premium markets for the these type of blendstocks such as the Chicago market, where high margins can be realized without the need for additional investments¹⁵.

Not only is there no justification for Gulf Coast refiners to upgrade their capabilities to meet California specifications, there is also not much spare capacity in the PADD III system overall. Much like the refineries in California, the refining centers on the Gulf Coast are currently also operating at or near maximum sustainable operating rates. Refineries in the US as a whole and on the Gulf Coast in particular, have seen a steady increase in overall capacity utilization as expressed in total crude runs, from average levels of 85% in the early nineties to at or even above calendar day capacity during the seasonal peak demand periods in recent years¹⁶. Similarly, capacity utilization in the main gasoline-producing unit within most Gulf Coast refineries, the Fluidic Catalytic Cracker (FCC), has seen a steady increase and the total FCC capacity is fully utilized. In fact, demand now consistently exceeds capacity, and New York harbor depends on foreign imports to balance supply and demand. This means that any product shipped from the Gulf Coast to California will back out pipeline volumes to New York and will result in additional foreign imports into the Eastern states.

Besides finished gasoline or near finished blendstocks, a key gasoline component exported from the US Gulf Coast is alkylate. The choice blending component, which

¹⁵ Information received during a Stakeholder Survey Meeting conducted for the CEC's Strategic Fuels Reserve Study.

¹⁶ Source data: EIA

best fits the particular needs of the California refiners, is C7 alkylate, which is produced by combining propylene and butanes in a reaction that is catalyzed by sulfuric acid or hydrofluoric acid in a process that requires some of the most stringent safety and environmental precautions of any refinery installation.

Because alkylation units are inherently more hazardous than most other refinery operations, they have been more difficult to build and to expand because permitting is not always possible. Also, the uncertainties surrounding feedstock availability and alternative market values make investment decisions difficult. As a result, while the Gulf Coast refiners have been able to increase their capacity in FCCs and cokers, alkylate capacity has remained virtually flat. Moreover, alkylation units compete with many chemical industries for propylene, which usually commands much higher prices in chemical applications than its value in the automotive fuel pool.

The issues of competing uses for propylene (impacting the availability of C7 alkylate), and the difficulty of substituting C8 alkylate given current T50 restrictions, were extensively discussed by Cal Hodge¹⁷ in the context of a CARB workshop held November, 2000. The conclusion drawn at the time still seems valid, in that alkylates may play some role in meeting California's projected shortfall, but their overall contribution is likely to be limited to small volumes, i.e. one cargo per month, at a significant premium.

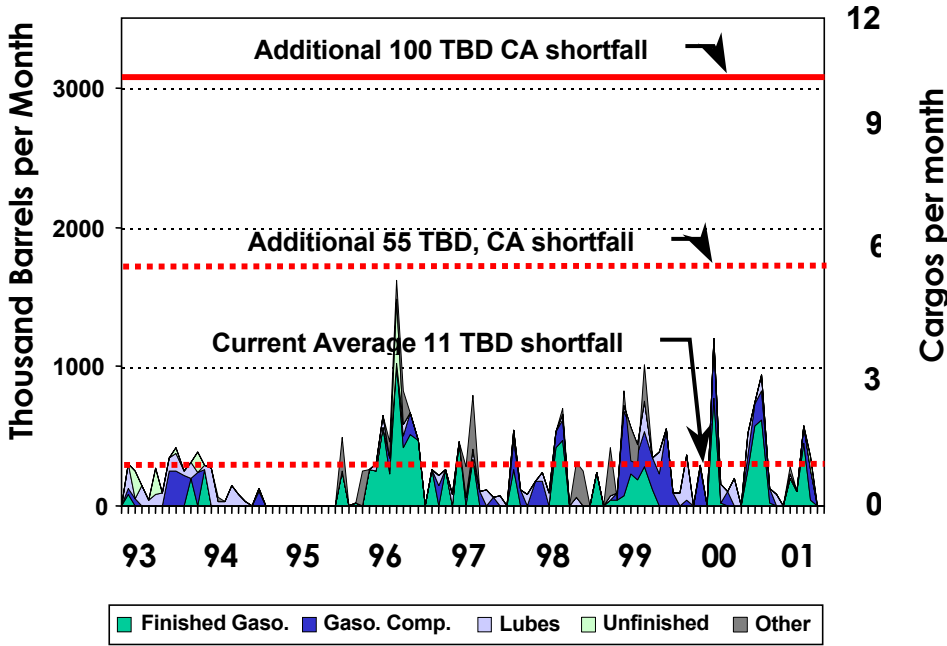
Finally, even if the US Gulf Coast were capable of producing additional gasoline blendstocks or components, there would not be sufficient Jones Act (prohibits the use of foreign flag vessels between US ports) product tankers available to transport quantities of 55 to 100 TBD, which is five to 10 times higher than the current volumes moved from the USGC to California. The impending phase out of single hull product tankers under OPA 90 severely reduces the availability vessels even further, making it necessary to rule out the US Gulf Coast as a short-term supply source.

It was shown earlier in Figure 1.6, that there is a rising trend with increasing volatility in the premium that California is paying over the Gulf Coast for its gasoline supplies. But while a price spike in 1996 was able to attract volumes from the US Gulf Coast at a rate corresponding to approximately 50 TBD, (see corresponding spike in shipping volumes in Figure 1.17 below), subsequent sustained and higher price differentials in recent years have triggered only moderate volumes to be shipped from the Gulf Coast.

¹⁷ Letter by Cal Hodge, A2Opinion, to Alan C. Lloyd, Ph.D., Chairman of CARB, December 15, 2000

This confirms that increasingly, the US Gulf Coast and California have become disconnected markets, with quality requirements and lack of logistical means acting as barriers to supply.

Figure 1.17 – Maritime Movements of Petroleum Products USGC – CA



The conclusions that can be drawn from the analysis of US Gulf Coast supply options are that:

- Finished or near finished gasoline will not be available for CARB Phase III in any significant quantities.
- Components will be available at premiums that correspond to local blending value plus replacement imports costs.
- The choice blending component, C7 alkylate, is not available as a segregated stream and can only be sourced as a blend of mixed alkylates at premiums corresponding to alternate use of propylene as chemical feedstock.
- Even if blendstocks can be located, there will not be sufficient shipping capacity to move the products from the US Gulf Coast to California

The development of the gasoline price differential between California and the Gulf Coast over recent years supports these conclusions.

1.4.2 *Supplies from Other West Coast States*

The State of Washington has a major refining center on Puget Sound. In 2000, the Washington refineries shipped around 47 TBD of gasoline and blending components to California, while California exported 35 TBD to Oregon of conventional gasoline¹⁸. California refiners also own all major refineries in Washington, and often move products between Washington and California in order to optimize their material balances. Given prevailing market incentives, it appears that the current volumes represent the maximum feasible interstate exchanges, i.e. if significant spare capacity had existed, it would have been used. It is anticipated that a chronic shortage of fuels in California will lead to further optimization of these inter-refinery balances and that Washington refineries, after investments, may be able to increase their exports to California by up to 25 TBD.

1.4.3 *Foreign Imports*

Imports of foreign gasoline and blending components other than oxygenates have increased from erratic small net exports or imports in the early nineties to a level of 20 to 25 TBD in recent years. As with US Gulf Coast supplies, the availability and the logistics will have to be examined in order to establish what role foreign sources can play in alleviating a California supply shortfall.

Currently, several foreign refiners are capable of producing conforming CARB Phase II gasoline or “near-BOB”, base-stock gasoline that only needs the addition of MTBE to be on spec. Most of these have shipped occasional cargoes to California over recent years. A survey of these refiners completed as part of the Strategic Fuels Reserve Study currently underway revealed that only the Irving refinery in New Brunswick will be able to supply Phase III CARBOB, in quantities of up to two cargoes per month or the equivalent of 18 TBD. These supplies do not require Jones Act shipping and can therefore be delivered at competitive freight rates (8 cpg) and at relatively short notice (3.5 weeks transit). It is likely that most or all of this material will find its way to California if supply shortages will cause prices in California to depart substantially from East Coast levels, where the New Brunswick refinery currently sells most of its output.

Another potential source of Canadian material is Alberta’s Envirofuels, which is likely to convert its 18.5 TBD of MTBE production into an estimated 11 TBD of isooctane. This material is targeted for the California market, and the project is likely to be driven by the

¹⁸ US Army Corps of Engineers Waterborne Commerce Statistics Center

need to move condensates from natural gas production rather than stand-alone economics, which would have forced Envirofuels to require significant premiums, given the conversion cost and the complicated logistics to move product from Edmonton, Alberta, to CA. Chevron, who is part owner in this venture, is likely to keep their share of the output within the Chevron system and use infrastructure released from MTBE service, while shareholder Neste may put their volume onto the open market.

In the Middle East, a new venture currently produces approximately 10 TBD of Phase II RFG, based on blends of isomate and reformat. This facility has plans to increase production to 25 TBD, and make improvements to meet CARB Phase III specs. With current freight rates of 10 to 12 cpg, first supplies from this source have started moving into California in the fall of 2001.

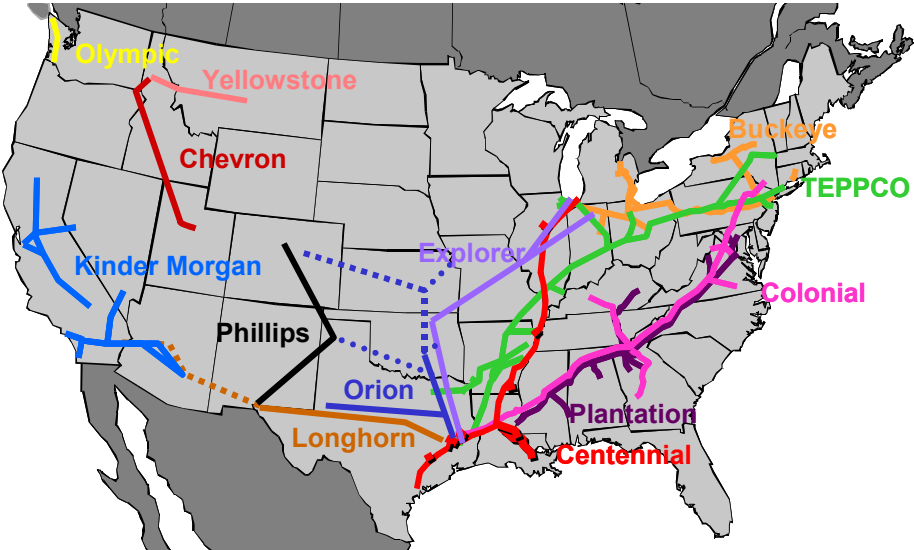
Other than the three specific foreign sources of CARB Phase III blendstocks, it can be safely assumed that the international majors such as ExxonMobil, BP and Shell, will be able to optimize the availability and usage of high quality blending components within their global refining systems, such that these materials will be routed to California when a price departure offers an opportunity to maximize corporate revenues on a global basis.

All in all, it would appear therefore that additional supplies up to 50 TBD could be mobilized at premiums over world market pricing that are not too different from price levels at which California currently buys its incremental barrel, although this volume does not appear to be committed to California at this time. Whether global availability of premium blendstocks will allow sourcing of 100 TBD seems a little more doubtful at this stage, but given sufficient incentive, i.e., if California's prices were to remain for a pronged period at levels of more than 50% over world markets, then it is likely that the State will attract every available conforming barrel that refiners around the world can segregate and ship. *The problem therefore becomes one of import logistics, and herein lies one of the key contributions a Strategic Fuels Reserve can make, provided it is designed to increase the State's capacity to imports fuels.*

1.4.4 Pipeline Supplies

One of the alternatives to supply California's shortfall is to transport products by pipeline from the US Gulf Coast. The issue here is not just that it requires pipelines that will move finished products from the refining center on the US Gulf Coast to the West Coast across 1500 miles of distance, but also that the availability of West Coast quality products on the US Gulf Coast is uncertain.

Figure 1.18 – Overview of US Long-Distance Product Pipelines



Once completed, the Longhorn pipeline will link the Eastern and Western gasoline supply systems in the USA, as shown by the dotted line in Figure 1.18. In principle, this would enable an arbitrage to be established between the two markets based on differentials in pipeline tariffs, fuel quality and transfer times¹⁹. However, the linkage is not effective until sufficient capacity is available at the connection point, which as explained below, may not happen in the foreseeable future.

Currently, the bulk of West Coast sourced demand in Arizona goes to Maricopa County (Phoenix and the surrounding cities). The stringent quality of gasoline for this area is very similar to California’s gasoline quality. The issue is that demand for low sulfur gasoline will increase dramatically east of the Rockies (EOR) when the EPA reduces sulfur levels of all grades of gasoline in 2005. In the face of increasing local demand, supplies of low sulfur RFG will have to be bid away from local markets in order to move them to Arizona. This supply equation will be further complicated if Arizona decides to blend ethanol with gasoline in Maricopa County in the summer. An ultra low RVP blendstock, similar to CARBOB will be required.

The existing pipeline network for Southern California, Southern Nevada, and Arizona originates in Los Angeles. Product is moved by Kinder Morgan Energy Partner’s pipeline from Los Angeles to San Diego, Las Vegas, and Phoenix. The LA to Phoenix

¹⁹ Interliance, Pipeline Study for the CEC, March 2002, and Drew Laughlin, CEC Consultant Report , March 2002

system is known as the West Line. Some volume from Los Angeles also moves past Phoenix to Tucson.

Longhorn Pipeline is in the process of building a line from the refining center in Houston to El Paso. The company completed construction in June 2002, after the project has been significantly delayed by objections of the City of Austin, Texas. These issues now appear to have been resolved and the first products are expected be delivered into El Paso in the September 2002. The initial rate will be 75 TBD. The line's capacity can be expanded to 225 TBD with the construction of additional pump stations²⁰.

Because demand for the existing Kinder Morgan East Line from El Paso to Tucson and Phoenix exceeds its capacity, with flows for each customer being prorated, this line will have to be de-bottlenecked or a separate pipeline will have to be built to move the product that Longhorn can deliver to the Tucson and Phoenix markets. It is estimated that this separate line, or loop, in pipeline terms, could be completed at the soonest by late 2005 or early 2006, but industry feedback and Longhorn's dismal experience in obtaining pipeline permits and right-of-ways indicate that it would be optimistic to expect a fast track completion for such a project. However, if the pipeline were to be extended and if products are available from the Gulf Coast, they could displace all or part of the 93 TBD forecasted to be exported from California in 2006.

²⁰ Meeting with Longhorn Pipeline, CEC, CARB, Interliance, and Stillwater Associates, December 12, 2001, and subsequent contacts.

2 GENERAL REQUIREMENTS FOR A STRATEGIC RESERVE

The assignment contained in State Assembly Bill AB2076 is to evaluate the feasibility and costs of a reserve equal to two weeks of production of the largest refinery in California. Based on incidents occurring in recent years, a period of two weeks was considered to be a good order of magnitude fit with observed unplanned outages of refineries in California. For CARB gasoline, two week's worth of the largest individual production by a refinery in the State corresponds approximately to 2.3 million barrels. For CARB diesel and jet fuel, this number is 0.6 million and 0.9 million barrel respectively.

Because of unusable space in tanks (i.e., a tank will have a "heel", the minimum amount of liquid necessary to keep a floating roof from landing on the bottom, and a "freeboard" which is a minimum height to be left at the top), the nominal shell capacity of the tankage will be closer to 2.5 million barrels. Additional requirements for the reserve need to be formulated to ensure that the reserve is adequate to satisfy not just the letter of the Bill, but also the intention of the lawmakers, namely to ensure a certain degree of price stability at reasonable cost.

2.1 Requirements for Price Stability

A more detailed analysis of the effectiveness of a reserve based on two week's capacity of the largest California refinery will be provided in Section 8. However, some general operational requirements for a reserve can be formulated even when assuming that the two week's capacity requirement is a given. For instance, price spikes currently are almost instantaneous reactions in the spot market to supply disruptions that often last only days or weeks. If an unplanned refinery outage occurs at a time when industry inventories are already low, an intervention with volumes drawn from a reserve will have to be quick, i.e., within days rather than weeks, in order to have effect in stabilizing prices.

The need for reserve inventories to be immediately accessible translates into requirements not only for release procedures, but also for the logistics of moving product from the reserves into the markets. Even before conducting a detailed analysis of the reserves interaction with market mechanisms, it can be concluded that in order to bring price stability to a market where prices can move up by as much as 20 cpg on the same day that an announcement is made about a refinery outage, the reserve should have the capability, credible to the marketplace, to deliver product into the market within at the most one or two days at rates comparable to the lost capacity.

2.2 Fuel Quality Requirements

Typically, a California producer of gasoline may have to store and blend as many as 6 different qualities of gasoline during each of two separate seasons, a winter season which in most parts of California lasts from November into February, and a summer season which lasts the remainder of the year and is characterized by more stringent vapor pressure requirements. The diversity of gasoline grades, the seasonal changes, and other quality aspects such as the limited shelf life of gasoline in general, impose particular challenges for the eventual creation of a strategic reserve.

Moreover, given the likelihood of imports needed to replenish the reserve after a drawdown of stocks, and the fact that such imports will largely consist of blending components rather than finished products, the reserve will have to be designed in such a way that it offers flexibility in terms of storing various grades of unfinished products and blending components, and the ability to blend final products to customer specifications prior to delivery into the common carrier pipeline grid.

For this reason, it is recommended that tank sizes will be limited to 150,000 bbl, a size generally considered as not too big to store blending components cost effectively, and not too small so that at most two tanks are needed to receive waterborne shipments in full cargo loads. The tanks will have to be designed for multiple product use with drain-dry bottoms. Also, blending and circulation pumps will be highly desirable, as well as a Vapor Destruction Unit (VDU), that will enable collection and incineration of vapors displaced under a floating roof when it is refilled after the tank has been fully drained, with the roof landing on its supports. When considering those alternatives that involve newly built storage, the costs of the above facilities will be taken into account.

Even if the reserve is built as part of larger new storage terminals in which state-sponsored tankage is made available against commercial rates to qualified third parties, i.e., built 5 million barrels of capacity, keep 2.5 million for the reserve and lease the other half to commercial third parties to create a large commingled pool of gasoline and components, it is recommended to augment the number of tanks rather than the tank size. This will allow individual storage for all commonly used blendstocks and components, and will create the operational flexibility to maintain reserve inventories that can be blended to meet the specific requirements of a particular supply disruption.

2.3 Logistics Requirements and Site Selection

In determining the best location for the reserve, it is necessary to evaluate the logistics of delivery of fuels from the reserve into the market, as well as those of restocking the reserve

after drawing down inventories. In order for the reserve to effectively compensate for an unplanned outage of a major refinery, it is important that fuels released from the reserve can reach the markets quickly, as concluded under 2.1 above. This translates into infrastructure requirements that will prevent the logistics involved of becoming a bottleneck in itself and still cause price spikes in the market.

Since California effectively consists of two separate markets served individually by the main refining centers in the LA Basin and in the Bay, a single location for the reserve would greatly reduce its effectiveness. In the absence of a pipeline link for products between the Northern and Southern refining centers, a single reserve would only be able to provide immediate relief to the market in which it is located, whereas a significant logistics effort would be required before product could be delivered to the other market. For instance, if a reserve were to be located in the Bay Area, and a supply disruption such as an unplanned outage of a major refinery occurred in the LA Basin, then at least 100 TBD of products would have to be transported over an average distance of approximately 400 miles, for a total transport requirement of 40 million barrel-miles per day.

Very little gasoline moves by rail in California and as a consequence the rail infrastructure in terms of tank cars and handling facilities is incapable of playing any role whatsoever in moving barrels from a reserve to market. Equally, the probability is low of finding and positioning a US flagged product tanker within days, the timeframe required to respond to a refinery outage before prices would be affected, also ruling out this transportation mode as an option. This leaves trucks and barges as the only remaining alternative, but here the issue is whether or not the transport system can mobilize sufficient additional capacity at short notice.

On average, delivery of gasoline to the retail stations involves an estimated 30 million barrel-miles per day of tank truck movements, while shipments of petroleum products and crude oil by coastal barge along the West Coast were 4.6 billion ton-miles²¹ in 1999, or approximately 100 million barrel-miles per day. Clean product movements make up approximately one third of this volume. This means that to transport fuels from a reserve location in the Bay Area to LA or vice versa in case of a major refinery outage would require more than doubling daily truck and barge movements. It is not realistic to expect so much transport capacity to be available at short notice (i.e., as spare capacity, not otherwise utilized).

Given these logistical constraints it will be clear that if a reserve is to be created, it will have to consist of at least two separate storage centers, one for each main market. Other locations

²¹ US Maritime Administration, "*Highlights Coastal Tank Barge Market*", Staff report, May 2001.

may be considered in addition, for instance at the existing staging terminals for the main long distance pipelines. However, if reserve volumes are located further downstream in the distribution system, they should not exceed the demand of the downstream market over the time period to be covered. If larger reserves were to be created further downstream in the distribution system, the volumes in excess of local demand would require reversal of normal distribution flows in order to be of any use, which in most cases is impractical if not impossible.

In general, given the high degree of utilization of the California infrastructure for fuel deliveries (terminals, gathering systems, long distance pipelines, truck, rail and barge fleets), it will vastly increase a reserve's effectiveness if it can be integrated into the refining centers in such a way that in order for the reserve volumes to reach the market, they will use the same logistical assets as the refinery volumes they replace.

Another important logistics consideration in determining suitable locations for a reserve is that of re-supply. Since California is overall short in production capacity for all its fuels, with refineries running at maximum capacity and achieving utilization rates of 95% or more, any lost production due to an outage of a major refinery must either be made up by imports or balanced by reduced demand caused by price increases. Since the latter is the undesired effect the reserve hopes to prevent, it follows that any volumes drawn from the reserve will have to be made up either directly or indirectly by imports, while additionally any short-notice delivery from the reserve must utilize existing infrastructure capabilities. Therefore the logistical requirements for an eventual reserve can be summarized as follows:

- The separate northern and southern California markets will each have to be served by its own reserve.
- The reserves will have to be integrated into the two refining centers in such a way that product from the reserve can be delivered to the market using the existing infrastructure, seamlessly replacing the lost volumes.
- The reserves will have to be provided with deepwater access so that they can be restocked directly with imported products.

The locations that meet these requirements are (i) in the North, the Eastern Bay area within the gathering system connecting the local refineries and commercial terminals with the Kinder Morgan pipeline head in Concord, and (ii) in the LA Basin, the Wilmington/Carson/Watson area with access to all major refineries, and tied into the feeder system for the Kinder Morgan pipelines at Colton. Further downstream, additional storage can be provided at Concord and Colton, or other pipeline hubs.

The problem that arises when locating separate reserves in each of the major refining centers is that of the distribution of the volume. If the requirement for two week's production of the largest refinery were applied to each of the centers, then the LA Basin reserve would have to be 2.2 MM bbl, and the Bay Area reserve 1.7 MM bbl. However, if a first reserve can provide immediate relief to the market in which it is located, volumes from the second reserve can be brought in over time across the distance separating the two markets within the restraints of the available logistical means. For the purpose of further evaluation, it will therefore be assumed that the total volume of all reserves will be kept at two week's capacity of the largest refinery, or 2.2 MM bbl, to be split into 1.3 MM bbl in the LA Basin and 0.9 MM bbl in the Bay Area, volumes that not only correspond to the ratio of gasoline consumption in the respective markets, but also to the ratio of the production capacity of the largest refinery in each center. These volumes would allow approximately one week's of autonomous coverage within each region, which provides adequate time to mobilize logistic resources to utilize reserves stocked in the other region if necessary.

2.4 Requirements for Extraordinary Events

Besides unplanned outages of California's refineries, there are other events that can cause even more severe supply disruptions and price spikes, i.e., earthquakes, acts of terrorism, crude oil supply disruptions resulting from environmental disasters (as was the case after the Exxon Valdez disaster), or geopolitical events such as embargoes and wars. In fact, as will be shown in Section 3 below, most countries that maintain a Strategic Fuel Reserve do so for reasons of national security rather than market stabilization. In such cases, the reserve volumes are much more substantial, i.e., in the range of several months of total consumption rather than two week's capacity of a single refinery.

While the creation of a reserve for reasons of national or State security is not included in the scope of this study, it is relevant to look at the potential value of a reserve in case of an earthquake. Whereas events such as wars and embargoes will have an impact on a national scale that requires very large reserves, the effects of an earthquake tend to be local and previous reserve studies were specifically commissioned to cover this event.

When evaluating the potential value in the event of an earthquake of a smaller reserve designed for commercial market stabilization, it becomes quickly apparent that the locations identified above for logistical reasons render the reserves vulnerable. The East Bay Area and the Watson/Wilmington/Carson area essentially share the same geologically unsound coastal structures as the major Californian refineries, and in that respect, they are not ideal because they too are likely to be affected to some extent by the same quake that might damage one of the refining centers.

Yet, to design a reserve capable of providing adequate coverage of fuel needs in the wake of a major earthquake is not practical and was evaluated in earlier studies as not cost effective. The reserve in that case would have to provide for many weeks of equivalent capacity to not one but likely several major refineries, for events that have a very low probability of happening during the technical and economical lifespan of the reserve.

For extraordinary events, for which the extent of the shortfall and the duration of the outage are likely to require a very large amount of fuels in reserve to mitigate the effects of the outage, but which have a very low probability of ever happening, a better approach than the creation of a reserve is a temporary relaxation of California fuel quality requirements, so that alternative supplies can be brought in from a wide array of supply options outside the State.

3 DESCRIPTION OF OTHER STRATEGIC FUEL RESERVES

National Petroleum Reserves became part of an overall emergency response plan orchestrated by the International Energy Agency (IEA) under the 1974 Agreement on an International Energy Program (EIP) of which the United States is a signatory. Every five years the IEA publishes an exhaustive report on its Member countries' preparations to respond to major oil supply disruptions. Most of the 28 countries maintain oil stocks well above the 90 days of net imports to which they are committed. IEA countries also have viable demand restraint programs and are monitored for weaknesses in their response systems. Those response mechanisms include: stock drawdown, demand restraint, fuels switching, extra oil production and the sharing of oil supplies.²² Below, several of the domestic and international reserve initiatives will be evaluated in order to see whether experience gained with the creation and operation of these reserves has relevance for the situation in California.

3.1 General Aspects of Strategic Fuel Reserves

Some of the key aspects of strategic fuel reserves in general are the sizing, inventory management and release mechanisms

3.1.1 Sizing of Strategic Fuel Reserves

Almost all national SFR's are maintained by countries that are significant net importers of petroleum products, and the size of the inventories is designed to protect these countries from being held hostage by their supplying nations. Usually, such reserves are sized as a function of the total fuels demand of the nation as a whole, with typical quantities of fuels stored ranging from 90 to 120 days.

There are only a few instances where, as would be the case for California, a reserve is designed for price stability. Examples are the Northeast Heating Oil Reserve and the Massachusetts Heating Oil reserve, which were designed to protect their populations against price spikes as well as the physical dangers from running out of heating oil in abnormally cold winters.

There is no known example of a reserve specifically created to counteract supply disruptions caused by internal production problems, although the reserves created in other island economies such as Korea and Japan used to have, will have a somewhat dampening effect on prices, as will be discussed below.

²² International Energy Agency website – <http://www.iea.org>

3.1.2 *Inventory Management of Reserves*

Many countries store petroleum products in addition to or instead of crude oil as part of their oil stockpiling programs. A broad range of stockholding mechanisms have been adopted by IEA and European Union (EU) members, none of which match the commercial or logistical features of California but are useful to consider as points of reference. There are three primary mechanisms:

- **Government Stocks.** These stocks are owned and controlled by member governments and account for 26 percent of stocks in IEA countries. Germany, Italy, Ireland, Japan and the United States hold government stocks.
- **Agency Stocks.** These stocks are held by agencies created by members for purposes of holding stocks and collaborating between government and industry. Agency stocks are much the same as government stocks, in that they fall under government procedures, are segregated, are of the same quality as government stocks, and are subject to government control. Agency stocks account for 5 percent of stocks in IEA countries.
- **Company Stocks.** These are privately held stocks, which count toward a member's IEA reserve commitment. In 1993, company stocks accounted for 69 percent of stocks in IEA countries. The only IEA member countries that do not impose compulsory stockholding requirements on companies are the two net oil exporters, Canada and Norway, and Australia, the United States and New Zealand. Under this approach, strategic stocks may be held by the oil industry on behalf of the government, usually as a legal requirement. Obligations are calculated and monitored by the government. Strategic stocks are part of or considered alongside operational stocks.²³

The U.S. opted for a centralized government reserve, rather than the "industrialized petroleum reserve" or agency concept. Advantages of a government reserve are complete control over storage with release and use of stocks under central control with minimum disruption to the oil industry. Disadvantages are high initial set-up costs and administrative and technical burdens to the government. An amalgamated system provides flexibility but makes it difficult for the government to know how much oil is available in an emergency.

²³ Report to Congress on the Feasibility of Establishing a Heating Oil Component to the Strategic Petroleum Reserve, June 1998, Appendix F.

The U.S. differs from many other IEA countries in its means of financing the Reserve. In contrast to the United States, where the costs of the reserves are borne fully by the Government and financed out of general revenues, in countries such as Japan, Germany, and Italy, the costs are shared by the petroleum industry and the end-user.

Advantages of the agency approach to stockpiling are use of oil industry expertise for management, increased consideration of oil industry interests and flexibility in storage and distribution arrangements. Disadvantages are the high costs to set up such a program unless existing stocks and storage are already available, and the need for arbitration of various industry interests. In the case of a California SFR being adopted, this model had the strongest positive feedback among the stakeholders. Unanimously, the industry did not want to see the government operating a petroleum reserve. An Agency arrangement would be more responsive to California's unique supply, scheduling and pricing environments.

3.1.3 Trigger Mechanisms

One of the most critical components of any SFR is its trigger mechanism for release of inventory. For most national strategic fuel reserves, the authority to release inventories is vested at high levels in a country's executive branch, under conditions that meet a number of predefined criteria, which are usually so narrowly defined that the existence of the reserve is not really a factor in day-to-day market considerations.

For a reserve whose aim it is to prevent price spikes rather than to be there for national emergencies, a trigger mechanism needs to be broader defined. There is a widespread concern that if this vital element is mismanaged then price spikes could be prolonged rather than remedied. Uncertainty over when SFR inventories might be sold into a tight and rising market could actually inhibit out-of-state suppliers from sending cargoes to California. They would fear that after putting a California-bound cargo on the water, the SFR might dump product, driving down the price and undermining the value of their cargo position. Since there is no futures market in the State, an offshore supplier would be subject to this unintended risk.

The same concern was voiced by a number of participants in the Federal Petroleum Products Reserve (FPPR), during the feasibility assessment phase of the Heating Oil project. Even today, with the FPPR a well-defined and ongoing operation, a number of prominent companies believe that unfettered supply and demand forces are still the best antidotes to skyrocketing prices. They assert that when prices rise sharply, an immediate commercial incentive is created to deliver new supplies into that market

from NW Europe, the Caribbean, from the US Gulf Coast and South America. Technical analysis of the efficacy of the Federal HO trigger mechanism still reveals flaws in the internal logic of that program.²⁴ *An eventual California reserve must be designed such that its use does not invoke an arbitrary, event driven trigger mechanism that caused importers to withhold shipments.*

3.2 Federal Strategic Petroleum Reserve

The Strategic Petroleum Reserve (SPR) was created in 1975 in the aftermath of the first oil crisis when President Ford signed the Energy Policy and Conservation Act ²⁵ (EPCA42 U.S.C. §6231, et seq.). Several earlier attempts to create a national oil storage reserve during WWII and the Suez Crisis, and lastly by the Cabinet Task Force on Oil Import Control in 1970, all had failed. The SPR was commissioned in 1977 and it still is the largest emergency oil stockpile in the world, with a design capacity of up to 1 billion barrels. Together, the facilities and crude oil represent more than \$20 billion in national investment. The emergency crude oil is stored in caverns created deep within the massive salt deposits that underlie most of the Texas and Louisiana coastline. The caverns offer the best security and are the most affordable means of storage, costing up to 10 times less than aboveground tanks.

The EPCA gives the Department of Energy (DOE) statutory authority to implement the Plan for a Strategic Petroleum Reserve, which is to acquire and operate the storage facilities. Equally, the DOE has the authority to acquire petroleum products for the SPR. The EPCA also authorizes the establishment of Regional Petroleum Reserves (RPR) as part of the SPR, and requires that the SPR Plan provide for the establishment of an RPR for each Federal Energy Administration region that relies on refined product imports for more than twenty percent of its demand.

Finally, the EPCA authorizes the Secretary of Energy to establish an Industrial Petroleum Reserve, which is defined as that part of the SPR consisting of petroleum products owned by importers or refiners (rather than owned by the Federal Government), and grants the Secretary discretionary authority to require refiners and importers of petroleum products to maintain readily available inventories equal to three percent of the previous years' throughput or imports.

The volumes of the SPR may only be used when the President determines that implementation of the Distribution Plan foreseen by the EPCA is required by a "severe energy supply interruption or by obligations of the U. S. under the international energy program", i.e., when

²⁴ PIRA report

²⁵ DOE Fossil Energy – Strategic Petroleum Reserve: Website – http://www.fe.doe.gov/spr/spr_facts.shtml

the President determines that there is a significant reduction in supply, causing such a severe increase in the price of petroleum products that it is likely to cause a major adverse impact on the national economy.

Two exceptions permit sales from the SPR without a Presidential declaration under the emergency conditions, either as test sales in amounts not to exceed 5,000,000 barrels, or in amounts not to exceed 30 million barrels in total or for more than 60 days, both under narrowly defined conditions.

Relevance for California: The relevance of the EPCA for an eventual California Fuels Reserve lies in the federally mandated requirement for the creation of a Regional Strategic Petroleum Product Reserve for regions that are dependent on imports for more than 20% of their fuel requirements. California's foreign imports currently amount to approximately 25% of its crude and 15% of its petroleum products, percentages that are both expected to increase significantly. Thus, if the State were to constitute a region in its own right, it would have to create reserve for crude now and one for products in the not too distant future.

3.3 Northeast Heating Oil Reserve

The Northeast Heating Oil Reserve (NHOR) was created as a Regional Petroleum Product Reserve (RPPR) under EPCA, at the initiative in 1996 of several Members of Congress who were concerned that low inventory levels of heating oil might cause severe price spikes or outages in case of a severe winter²⁶.

The basic volume requirement for the reserve was set by estimated heating oil consumption in the Northeast during a severe winter, with a duration and with temperatures that can be expected to occur only once every 100 years, based on the statistic evidence of meteorological data collected for the region since the middle of the 19th century, which happened to correspond to conditions that prevailed in 1989. This calculation resulted in a volume requirement of 6 million barrels, but since only 2 million barrels could be placed in existing terminals in the Northeast itself, it was decided to limit the regional reserve to this volume, while provisions such as a waiver of the Jones Act would enable quick re-supplies from other inventories available in the SPR caverns in the Gulf Coast.

Three private companies were selected to store and manage the NHOR in leased storage at three terminals, located in New Haven, CT and Woodbridge, NJ. The reserve is commingled with commercial volumes in active tanks to avoid quality problems with aging inventories. Also,

²⁶ Department of Energy, *Heating Oil Component to the Strategic Fuel Reserve*, Report to Congress, June 1998

the commercial operators are occasionally allowed to dip into the reserve volumes with prior approval of the DOE.

The Northeast Heating Oil Reserve has special relevance for this study because it is one of the few examples of a reserve created specifically to provide price stability, rather than for reasons of national security. Moreover, the reserve was designed to meet certain criteria of cost effectiveness, and the methodology used in the study that justified its creation was based on sophisticated statistical evaluations.

During stakeholder survey meetings (see section 9), the issue was raised with companies that market fuel oil on the East Coast, and several meetings were dedicated specifically to this subject. The conclusion from these discussion is that, even though the reserve has not yet been put to the test of the once in a 100-year winter for which it was designed, the reserve is not expected to be effective in the opinion of the industry involved in the heating oil business in the region. The perceived shortfalls are:

- The 2 million barrels of reserves equate to only three days of average winter demand in the Northeast, less than two days in case of peak demand during a cold snap.
- The reserve occupies existing tankage that was well used by the industry and usually would be kept full at the onset of the winter heating season anyway (this argument was addressed in the heating oil study and was one of the reasons for only using up 2 million barrels of space).

Relevance for California: Because the Northeastern Heating Oil Reserve is one of the few reserves specifically designed to mitigate price volatility, and was executed within similar size tankage as would be the case for a California SFR, this reserve merits a more detailed comparison. In table 3.1 below, a comparison is made between the various factors that together constitute the framework for requirements and effectiveness for a Regional Petroleum Product Reserve.

From the comparison below, it will be clear that the requirements for an eventual California Strategic Fuels Reserve are far more complex but also more urgent than those of the Heating Oil Reserve in the Northeast. It would seem that if a reserve for heating oil in the Northeast could be justified on economic grounds, then a gasoline reserve in California could also be warranted by an economic justification. In this context it is interesting to note that the inventories for the Northeastern Heating Oil were in part funded at federal level by selling off equivalent quantities of crude oil from the Federal Reserve.

Table 3.1 – Northeast Heating Oil versus CA Gasoline Reserve

	Northeast HO*	CA Gasoline
Demand	0.7 MM BPD winter average	1.0 MM BPD year round
Available Inventory Range	20 to 60 MM bbl = 40 MM bbl	18 – 10 MM bbl = 8 MM bbl
Effective days inventory	70 days av. winter demand	8 days regular demand
Product Fungibility	Readily fungible	Unique to CA
Product Grades	One	Multiple Summer and Winter
Blending restrictions	None	Unocal Patent, CARB cert.
Market Liquidity	1000+ trades/day	<20 trades/day
Futures Market	Broad, up to 1 year deep	Narrow, next month only
Market participants	Large Community	Closed Market
Pricing	Transparent	Limited reporting
Demand	Seasonal Only	Year Round
Import options	100s of refineries worldwide	3 – 5 refineries
Shipping time	1 – 2 weeks	5 – 8 weeks
Import terminals	68 in 26 ports	16 in 2 ports (incl. refineries)
% of Population Affected	11% (54% in Maine)	>90%

* basis: 1996 DOE Study

3.4 Massachusetts

Shortly after the initiation of the Federal Heating Oil Reserve, the State of Massachusetts adopted a somewhat different program to ensure adequate supplies for the state through the winter of 2000, 2001.²⁷ Discussions with consultants involved in crafting the alternative plan, and review of the provisions of the actual program adopted, reveal a deliberate departure from the “hold, auction and sell” philosophy that underpins the two million barrel Federal Reserve described above. The view was that incentives could be offered to private sector companies to hold certain minimum target inventories through the potentially high-demand months of

²⁷ Commonwealth of Massachusetts Office of Consumer Affairs and Business Regulation – Heating Oil Inventory Program, A Report by the Division of Energy Resources, March 2001

December through March. The supply, demand and general market pricing factors that compelled the Governor of Massachusetts to urge the Legislature to fund an emergency inventory program were these:

- Heating oil inventories were at historic low levels and only about one-fourth the level at the start of the previous heating season.
- Crude oil prices were extremely high and there was uncertainty if they would increase or drop.
- In October, Massachusetts retail heating oil prices were 50% higher than the previous year.
- Increases in world crude oil production would not eliminate heating oil market vulnerability.
- The market was in 'backwardation' (a term used when prices in future markets are below the prompt market) and Massachusetts heating oil suppliers did not want to store heating oil if they might lose money.
- Cold to colder-than-normal temperatures would also lead to price spikes and increases in consumer heating bills.

Innovative Program: Rather than the State leasing storage and holding inventory, the program establishes a price insurance program for winning bidders that takes the backwardation out of the market for the key months. Essentially, the winning bidders were expected to purchase and store a minimum block, or 10,000 barrels of heating oil. The bidder could submit bids for one or more blocks, and had to specify a bid price and specific storage location for each block. Winning bidders were required to hold the oil until January 16, 2000. Thereafter, the winning bidders could release the oil for sale to Massachusetts's consumers. The decision to release oil before the program date was left to the winning bidders. If the market dictated a need for oil, and winning bidders decided to use the program oil, winning bidders could sell the oil before the program end date (early release). Notification of an early release had to be provided to DOER on the date of the early release. Because early release of program inventory was contrary to the goals of the program, an adjustment would be made to reduce the payment to a winning bidder that executed an early release. The payment adjustment provided an incentive to winning bidders to store the oil until the program end date.

A review of the success of the program after the winter showed:

- Heating oil inventory levels were higher than expected despite colder weather.
- Wholesale prices in Massachusetts were 2-3 cents lower than in surrounding states.
- Massachusetts' retail heating oil prices remained around \$1.50 per gallon in December and January with no price spikes even though the weather was about 10% colder than normal.

The entire scope of the program is described in detail on the Massachusetts Energy Website²⁸.

Relevance for California: Storage for heating oil by winning bidders under the Massachusetts program is distributed in independent terminals around the State. In California, there is no such distributive storage in the hands of independents. As will be shown in Section 4 below, inventory capacity for fuels in California is extremely tight already. Consequently, an incentive program such as that adopted by the State of Massachusetts is not practical in California. It should be kept in mind however, that if the SFR initiative leads to new tankage being built, then a Massachusetts style incentive program might have to be revisited.

3.5 European Reserves

The fundamental purpose that underlies all European and IEA Strategic Reserves is that of national emergency and supply interruption preparedness, with systems designed and maintained for major events such as wars, sabotage, and natural disasters. The Reserves are part of a more comprehensive emergency civil response plan under which the EU requires its members to hold emergency stocks of oil products for three major categories (gasoline and related feedstocks, middle distillates, and heavy fuel oil) equivalent to 90 days domestic consumption of the previous year. The level of 90 days must be maintained for each category. Members may substitute crude oil for product stocks, but the crude oil and feedstocks are converted into finished product equivalents in the three categories for purposes of meeting the EU requirements.

The European systems range from distributive stocks held by the private sector but under government supervision in Italy, to complex mechanisms that have evolved over time in countries as diverse as France and the Netherlands. In Germany, Italy and Ireland, the government owns the Strategic Reserves. Denmark, France and the Netherlands hold agency stocks, with some agencies established under pressure from the industry rather than by government on its own accord.

²⁸ Massachusetts Department of Energy Website: <http://www.state.ma.us>

Relevance for California: Most European countries store their reserves in large volumes kept outside the normal distribution channels, in salt dome caverns (Germany, France) or in cavities excavated in granite and other hard rocks (Scandinavia), or in extensive aboveground tank farms (The Netherlands). Because for the most part, the European reserves are not operational, the inventories need to be periodically rotated to prevent product degradation. For many years, for example, straight run (non cracked) gasoline was held in tank without rotation in the Netherlands. After a change of specs was introduced and various streams of cracked hydrocarbons entered the gasoline pool, the reserves had to be commingled with industry stocks for rotation purposes. The turning of large volumes of old inventory created artificial price collapses and volatility, a lesson to be learned for California.

Because the release mechanisms for the European product reserves are designed for exceptional circumstances only, the presence of very large reserves does not affect normal market mechanisms in terms of supply and demand, with its associated volatility, other than the impact from the occasional stock rollovers for reasons of quality control.

3.6 Japan

Japan has a history of oil stockpiling going back to 1972 after the first oil shock, when the government introduced the “Petroleum Reserve Law” creating a 60 day reserve supply, which was increased to 90 days in 1976 and relaxed in April 1996 to 70 days. These requirements apply to all producers and importers, and to crude oil as well as to refined products, with quantities based on actual import levels for the preceding twelve months.

The change in 1996 was part of a deregulation effort when the country repealed a law that restricted imports. Since then, non-refiners are allowed to import gasoline, diesel and kerosene into Japan, so long as they maintain a rolling inventory that complies with the Law ²⁹. The idea behind this policy is that some level of reserves must be maintained for emergency situations, but in normal times the competition on the international petroleum markets should prevail, even in Japan.

Relevance for California: The parallel with California is that for petroleum products, both are de facto island economies. But while Japan is moving away from its self imposed isolation by opening its markets for imports while maintaining certain minimum reserve requirements, California has been moving the opposite way when it imposed unique fuel specifications and

²⁹ Petroleum Association of Japan: <http://www.paj.gr.jp> Annual Report “Overview of the Japanese Petroleum Industry”

lost import infrastructure assets in the ports. The market lessons from Japan will be discussed in more detail in Section 7.

3.7 Korea

In South Korea, the Minister of Commerce, Industry and Energy has wide ranging powers under the “Petroleum Business Act”³⁰, which grants rights to set the target amount for petroleum reserve not just for major events but also for price stabilization and control of the petroleum markets. It is important to note that Korea has some of the largest refineries in the world with capacities at LG Caltex, Yosu and Yukong (SK) in Ulsan, each in the range of 800 to 900 TBPD. Refinery capacity is overbuilt and geared toward export markets. Consequently the Korean Strategic Reserve has been set aside for crude oil rather than petroleum products.

Relevance for California: Because the markets for petroleum products in Korea is only just now starting a process of deregulation with import opportunities opening up and arbitrage pricing mechanisms linking these markets to world supply and demand, it is too early to tell whether or not the presence of the reserves and the way in which the reserves were managed, had any stabilizing effect on pricing, or caused imbalances between natural supply and demand.

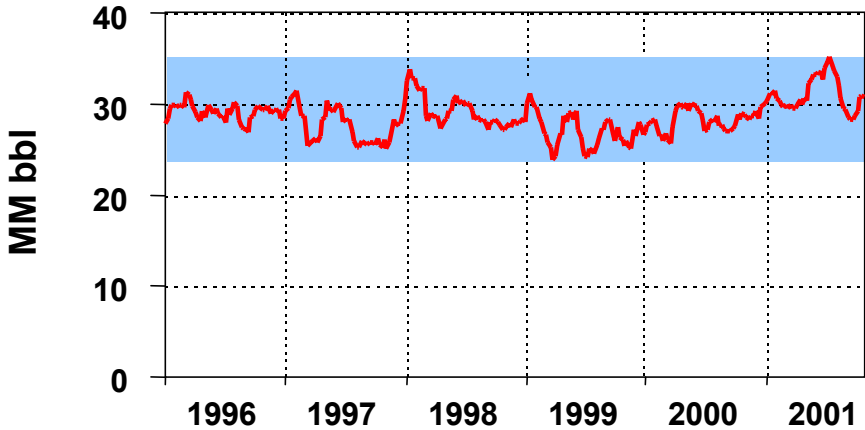
³⁰ Korea’s Petroleum Business Act – Article 15; <http://www.petronet.org/english/law/pact.htm>

4 OVERVIEW OF INVENTORY CAPACITY AND USAGE

Besides the refiners, several traders and some of the larger buyers currently maintain their own inventories of fuels in California. The refiners also retain title to most of the products in the downstream distribution system, i.e., product in transit in pipelines and kept in distribution terminals.

The refiners and some of the terminals report their inventories on a weekly basis to the EIA and to the CEC. Unfortunately, most refiners consolidate their numbers for PADD V and do not separately report data by state.

Figure 4.1 – Weekly Reported Total Gasoline and Components PADD V



As can be seen in Figure 4.1, the total reported PADD V gasoline and blendstock inventories move in a fairly narrow band around 30 million barrels. When inventories fall below 27 million bbl, the market begins to anticipate shortages and product in general will be hard to find. When inventories start to climb over 30 million barrel, spot prices will start to fall, reducing the incentive to run crude or bring in imports. The 30 MM barrels of average stock represents approximately 18 days of supplies. This is lower than stocks elsewhere in the US, where inventories on average cover 30 to 35 days of supply.

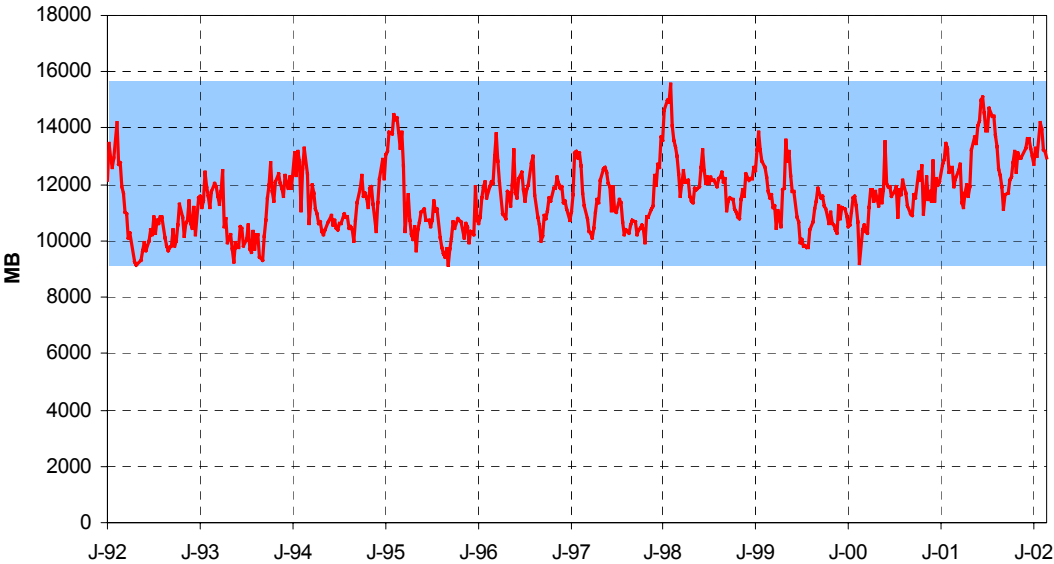
The industry attaches great importance to these inventory numbers as they are reported on a weekly basis, notably to determine whether the market is long or short, i.e., what the short-term trend in the supply/demand balance is. Yet it is generally not well understood how these inventories are distributed between the States within a PADD, or between the various parts of the distribution chain. Nor is it well understood what the total holding capacity is in the distinct northern and southern California markets, and how the industry manages inventory levels. Moreover, the current reporting system to the CEC does not capture all inventories held in the system. Yet to evaluate the effectiveness of a potential Strategic Fuels Reserve, the total current inventory capability in the State must be known, and current operational aspects must be understood. This Section addresses these questions.

Another interesting observation around Figure 4.1 is that of the narrowness of the range in proportion to the absolute inventory levels. The explanation is that the total number of tanks included in the PADD V inventory numbers is in excess of one thousand. Inventories in most of these tanks are driven by operational reasons, i.e., inventories in distribution tanks or tanks at refineries will cycle between full and empty on a regular periodic basis, sometimes as frequent as several times per week, with the time-weighted average equal to 50% of the workable range. The sum of a large number of such inventories will narrowly approach the average.

4.1 Refinery Inventory Capacity

California refinery inventory data are collected separately by the CEC. These inventories as reported also include certain inventories held at commercial terminals in the Bay area, but not in the LA Basin, and are shown in Figure 4.2.

Figure 4.2 – CA Refinery Inventories of Gasoline and Components ³¹



As can be seen in Figure 4.2, gasoline and component inventories held at the California refineries move within a range of 8 to 16 million barrels. The total shell barrel capacity for tanks at the refineries dedicated to gasoline and gasoline components is approximately 13.3 million barrels for the Bay area refineries and 13.7 million barrels in the LA basin ³². At their highest historical reported level, actual inventories represented therefore approximately 60% of the total available shell capacity, and at their lowest 30%. This percentage confirms that most

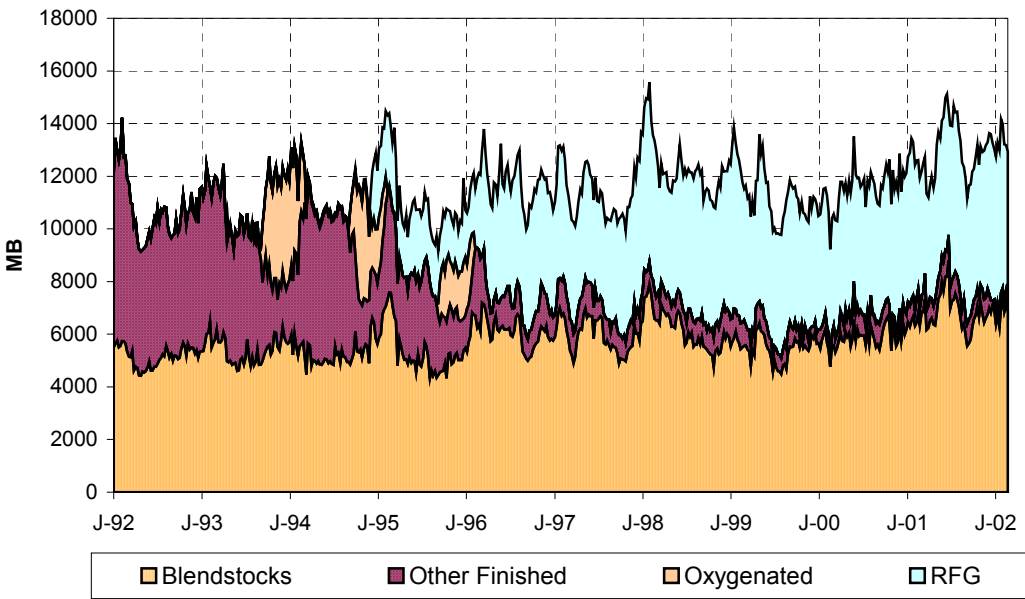
³¹ CEC Weekly Reported Inventory Data

³² Based on information received during the Survey Meetings conducted for this Study

refiners cannot use the tankage at their refineries as an internal reserve for strategic purpose or market tactics, but that operational considerations determine how tankage gets used, with most tanks cycling between full and empty as production is run down into tanks before a batch is pumped out on a pipeline.

For instance, in 1999 when prices were high at the time when major refinery outages occurred, refiners would have had every incentive to use available inventories to the maximum extent possible. That actual inventories never dipped below 8 million barrels confirms that this level represents a collective operational “heel”, the minimum stock of blendstocks and finished products that is needed to maintain operations.

Figure 4.3 – Breakdown of CA Refinery Gasoline & Blendstock Inventories ³³



As can be seen in Figure 4.3, blendstock components, including oxygenates, make up over half of the total reported inventories at any point in time. Also noteworthy is that although Other Finished Gasoline constitutes only a small fraction of total inventories, supplying two distinct types of gasoline means that some tankage each in different octane grades, means an inherently less efficient use of tankage.

4.2 Inventory at Commercial Terminals

Most of the capacity in commercial bulk liquid petroleum terminals in California is concentrated in the Bay Area and in the Los Angeles Basin, where several commercial storage companies

³³ CEC Weekly Reported Refinery Inventories

operate facilities, most of which are tied in to deepwater berths as well as the refinery pipeline infrastructure. In addition to the commercial terminals, there are a few terminals owned by the refiners that provide commercial services to third parties if capacity allows.

Table 4.1 – LA Basin & Bay Area Commercial Petroleum Terminal Capacity ³⁴

	MM bbl	Total Tank Capacity	Clean Product ¹ Tanks	Gasoline & Components ²
Bay Area				
Commercial Operator		8.5	5.7	3.8
Owned by Refiner		<u>0.6</u>	<u>0.6</u>	<u>0.6</u>
Total		9.1	6.3	4.4
LA Basin				
Commercial Operator		22.0	5.7	4.6
Owned by Refiner		<u>7.7</u>	<u>7.2</u>	<u>6.8</u>
Total		29.7	12.9	11.4
Total		38.8	19.2	15.8

1. Difference between total tank capacity and clean products is made up by crude oil and black oil tankage.

2. Difference between Clean Products and Gasoline is made up by diesel and jet fuel tankage.

Within clean product tankage, terminals cannot change service easily from gasoline to distillates unless the tanks are relatively new and designed as “drain/dry” tankage. On average, market information indicates that at any point in time, approximately 80% of tanks permitted for clean products at the major commercial terminals are in service for gasoline or blending components, including oxygenates.

It is important to note how in Southern California, refiners own the majority of the commercial storage for clean products. This is a legacy of two events, the closure of a refinery with tankage being retained as terminal, and the discontinuation of ANS pipeline exports, which freed up storage at the head of the pipeline. In both cases the refiners decided to monetize these assets by making them available to third parties in commercial service. Now that the LA storage market has grown very tight, while for these refiners internal demand for tankage has grown, this storage increasingly is only available to third parties when the refiner’s own operations allow. Moreover, most of the storage at the commercial terminals is leased out to refiners under long-term contracts, because commercial operators prefer the security of longer-term agreements with highly creditworthy customers to potentially higher rates from short-term agreements with trading companies or importers.

³⁴ Sources: OPIS Petroleum Terminal Handbook, ILTA Handbook, and Survey Meetings with Stakeholders

4.3 Distribution Terminals

Besides the inventories kept at the refineries and in the main commercial terminals, most integrated producers and marketers of gasoline maintain inventories of finished gasoline in the distribution system. Typically, these distribution terminals are connected to the main pipelines, and the facilities include loading racks to serve local distribution by tank truck to retail stations or large consumers. In addition, the pipeline operators maintain storage at strategic locations along the pipeline to serve their own operational requirements as well as customers' needs for distribution tankage.

Table 4.2 – CA Tank Capacity at Distribution Terminals ³⁵

MM bbl	Total Tank Capacity	Clean Product ¹ Tanks	Gasoline & Components ²
Northern California			
Commercial Operator	3.3	3.0	2.4
Owned by Refiner	<u>3.5</u>	<u>3.2</u>	<u>2.6</u>
Total	6.8	6.2	5.0
Central California			
Commercial Operator	0.6	0.6	0.5
Owned by Refiner	<u>0.1</u>	<u>0.1</u>	<u>0.1</u>
Total	0.7	0.7	0.6
Southern California			
Commercial Operator	2.2	2.2	1.8
Owned by Refiner	<u>4.6</u>	<u>4.5</u>	<u>3.6</u>
Total	6.8	6.7	5.4
Total	14.3	13.6	11.0

1. Difference between total tank capacity and clean products is made up by crude oil and black oil tankage.
2. Difference between Clean Products and Gasoline is made up by diesel and jet fuel tankage.

Again, within the total clean product tankage available, it is assumed that at any given point in time, approximately 80% is in gasoline service.

4.4 Pipeline Inventories

Long distance transportation pipelines for petroleum products will hold considerable volumes of distillates and gasoline that are in transit. For instance, a 300-mile long, 16" diameter pipeline will hold approximately 400,000 bbl of product, typically consisting of two or three sequential batches of diesel, jet fuel and gasoline.

Pipeline inventories are sometimes included in reported stocks, but overall, total gasoline hold-up at any given time is likely to be less than one million barrels. This volume cannot be readily

³⁵ Source: OPIS Petroleum Terminal Handbook, ILTA Handbook, and Survey Meetings with Stakeholders.

manipulated to play a role in working inventories in times of shortages and price spikes, although in theory, temporary substitution of batches of gasoline by other products might free up gasoline at the head of the pipeline. In practice however, given the limited storage for diesel and jet along the system in comparison with gasoline and the time, cost, and undesired operational consequences of changing tanks in service, pipeline inventories are not a factor in the total consideration of workable ranges for gasoline inventories in the State, and will not be taken into account here.

4.5 Reconciliation of Reported Inventories and Total Storage Capacity

The total storage capacity of tanks in service in California for gasoline and blendstocks appears to be around 53 million barrels, of which 26 are within the refineries, 16 million are at commercial terminals, and 11 million barrels are spread throughout the State at distribution terminals.

Reported actual inventories for PADD V on the other hand cycle between 25 and 35 million barrels. If inventories are assumed to be distributed in proportion to gasoline production and consumption, then California's share of these reported inventories would be around 70% of the total PADD V numbers, or between 18 and 25 million barrels. These numbers are low in comparison with the total shell capacity of 53 million barrels for all identified gasoline storage in California. However, a number of factors need to be taken into account when comparing reported actual inventories with total shell barrel capacity:

- Published industry tankage capacities are mostly based on nominal shell barrel capacity. Most tanks in gasoline service are of a floating roof design. To minimize the vapors that would be displaced by a rising liquid level under a fixed roof and thus cause hydrocarbon emissions, such tanks have a roof that floats on the surface of the liquid by means of pontoons, with specially designed seals between the shell and the roof edge that prevent the escaping vapors to cause emissions. The roofs have legs that will support it on the bottom when liquid levels drop to a minimum, in order to protect the pontoons and to keep the roof structure above other tank internals, such as suction lines or mixers. In normal operations however, the roof has to be kept afloat, which means that floating roof tanks cannot use the lower 5 to 10% of their shell height. On a statewide basis, this represents 3 to 5 million barrels of unusable capacity.
- Under applicable industry standards (API 653) tanks in gasoline service are required to be inspected on a 10-yearly cycle, although some operators will extend inspection intervals longer. Given the average duration of such inspection, which is often used to upgrade or modify tanks at the same time, as well as outages for operational reasons

such as grade changes, up to 5% of the available storage can be expected to be out of service at any given point in time. This effectively removes 3 million barrels of listed capacity.

Most operational tankage in gasoline service sees heavy use and will cycle between full and empty on a continuous basis, with some of the tanks being turned over more than once a week. Other operational considerations also cause average inventories to be around half of the total available range:

- In the production process, enough empty tank space has to be available to allow continued rundown, even if a downstream process fails. Buffer tanks between processes that produce gasoline components and the final blending tanks cannot be kept full, but will typically be run between 40 and 60% of their capacity, to allow upside as well as downside swings.
- In the distribution chain, the same barrel passes through many tanks in a sequential process whereby each tank cycles between full and empty, with the average over a prolonged period being close to 50%. For instance, a blending tank in which a batch is prepared for pipeline dispatch will be empty, or only contain a minimum heel, before the batch is prepared. Once blended, the batch is pumped out to on a pipeline, where an empty tank must be awaiting it at the other end. To have all three tanks in the chain being full would result in an un-operable situation.
- Gasoline tankage is fragmented over as many as two-dozen components and blendstocks and for some refiners up to nine grades of final products. This fragmentation inherently causes tank space to be used less efficiently. For instance, a tank in service for a high octane blending component maybe almost empty, but will not help in storing rundown of treated naphtha.

Based on the above assumptions, it is now possible to reconcile the overall tank capacity for gasoline and blending components in California with the reported inventories for the State:

Nominal Tank Capacity California	53 MM bbl
Ullage, heels, non-operable capacity, 15%	<u>- 8 MM bbl</u>
Effective Total Capacity	45 MM bbl
Expected Average Inventory, 50%	22 MM bbl
Expected Average for CA as 70% of PADD V	21 MM bbl

Similarly, storage capacity and reported inventory numbers at California refineries can be reconciled:

Nominal Tank Capacity Refineries	26 MM bbl
Ullage, heels, non-operable capacity, 15%	<u>- 4 MM bbl</u>
Effective Total Capacity	22 MM bbl
Expected Average Inventory, 50%	11 MM bbl
Reported Average Inventory	12 MM bbl

Overall, despite apparent discrepancies, reported inventories can be reconciled with installed shell capacities. Some interesting conclusions now present themselves when looking at these inventory numbers:

- Inventories at refineries and in the distribution system are almost entirely determined by operational considerations, with tanks cycling continuously between their minimum and maximum practical inventory limits, averaging a little less than 50% of shell capacity.
- The only storage capacity that could be used to serve inventory strategies is that contained in commercial terminals, but total capacity is limited and is largely owned by or contracted out to the refiners.

4.6 The Market for Commercial Terminals in California

Commercial terminals in California are concentrated in the refining centers in the Bay Area and the LA Basin. In both areas, the commercial terminal industry has seen significant consolidation over the past decade as part of a nationwide trend whereby large companies that are structured as Master Limited Partnerships have a tax advantage over smaller independent operators.

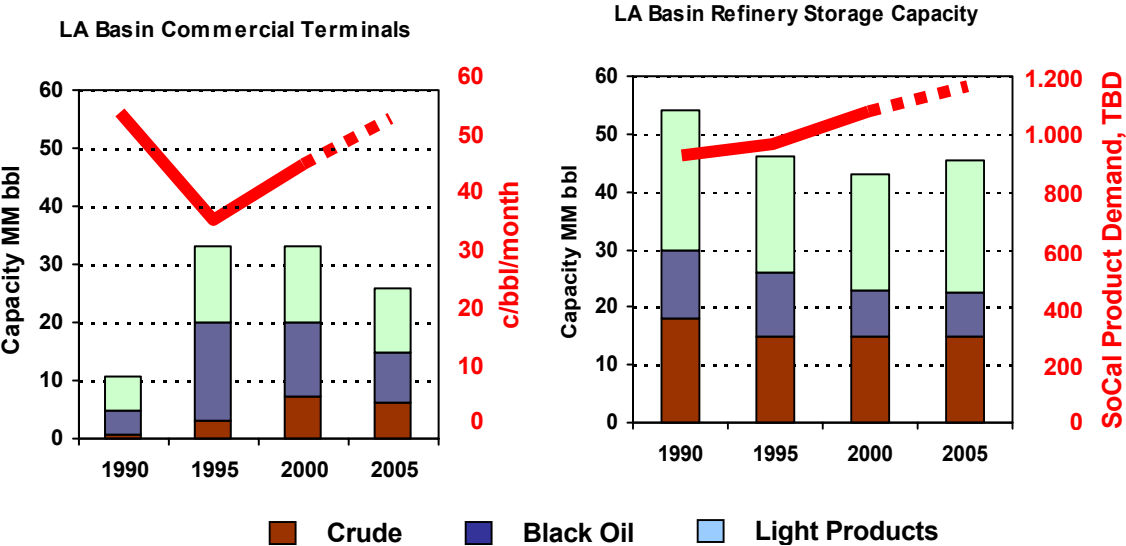
Other factors that impacted the commercial storage market were refinery closures and the conversion of power generation from residual fuels to natural gas in the late eighties and early nineties. Both caused significant additions to terminal capacity, predominantly in storage for black oil. In the Bay Area, some 4 MM bbl of tank capacity were added, while in the LA Basin the commercially available tank capacity effectively tripled by additions by the LA department of Water and Power, Edison, Shell Carson and ARCO's tank capacity linked to inland pipeline transportation of Alaskan crude oil.

Even though most of the overcapacity was in tankage only suited for low vapor pressure products such as black oil and certain crudes, by the mid-nineties the glut of tank capacity

caused rental rates, which historically had been in the range of \$0.50 to 0.60 per shell barrel of tank capacity per month, to drop to rates as low as \$0.30/bbl/month across the market.

Since then however, the market for commercial tankage in California has seen a remarkable recovery. This recovery is due in part to the industry consolidation referenced above, but mainly because of voluntary or forced capacity reduction, such as terminal closures forced by non-renewal of permits or leases. Also, conversion of tankage from black oil to crude oil or light products helped to restore prices. Moreover, demand for tankage continued to grow strongly as California became more import dependent. These phenomena particularly affected the LA Basin, as shown in Figure 4.4.

Figure 4.4 – Commercial Storage Market in the LA Basin



Currently, all spare capacity that was present in the LA Basin commercial terminal market has been used up. In the tightening market, the remaining tankage has essentially been signed up by the refiners under term contracts, and traders or incidental importers cannot find spot tankage capacity. As a consequence of the tightening market, rates have increased and are currently back up to historical highs of \$0.50 to 0.60 per shell barrel per month. At these rates, commercial terminal operators have sufficient margins to justify new investments, and in a well functioning market new capacity additions can be expected.

Two factors however prevent a spate of new building so far. One is the extraordinary difficulty in obtaining permits for projects of any kind in the industrial areas of the LA Basin. The other is the fact that commercial tank farm operators need to have long-term bankable contracts with a

creditworthy customer in order to justify building new tankage. With most of the existing storage under long-term contracts, the displaced demand and most of the increased demand is for short-term or spot rentals.

4.7 Inventory Planning

Inventory planning is different of each group of inventory holders, such as refiners, traders and large jobbers:

- The refiners balance financial, operational and commercial requirements. On the one hand, they would like to minimize inventories in order to reduce the costs of working capital, while on the other hand they have to resort to very costly measures when they are threatened running out of product. Operational flexibility demands that they leave themselves sufficient room to operate, both on the upside and the downside.
- Unlike refiners, traders usually do not own their tankage, but lease it from commercial service providers. The predominant operational requirement for most traders is that the size of the storage is determined by the cargo sizes of vessels. Traders sometimes want to hold on to inventory until market conditions are favorable to a sale. Often the costs of renting storage and the working capital costs are lesser considerations than the gain or loss on the cargo traded.
- The jobbers who maintain fuel inventories do so in order to reduce their vulnerability to market volatility. They have to offset the cost of working capital and rented storage against the advantage of being able to buy when prices are low, and to stay out of the market when supplies are tight.

Since the refiners control by far the largest inventories, and as producers and importers control the volume swings that are to a large extent the cause of market volatility, a more detailed analysis is provided below of factors that impact refinery inventory management.

4.7.1 *Inventory Planning Processes*

The planning processes can be thought of in three different time horizons. These are strategic, tactical, and operational. Strategic inventory planning is long range, one year or greater, and is normally done for the purpose of financial modeling by central corporate planning departments. At this level, turnaround planning is coordinated between a company's different refineries, and the basis is provided for long-term crude oil and feedstock supply contracts, tanker fleet charters, and other long-term

commitments. At this stage, inventory targets are set as a function of overall working capital costs and as financial targets for management to achieve.

Tactical planning for inventory is usually the purview of middle management and generally covers the current month and out three to six months. It covers actual volume planning around turnarounds, crude runs, and expected market movements, such as those caused by seasonal specification changes. At this level, planning involves optimization using Linear Programming (LP) models of the refineries.

Operational inventory management is the responsibility of schedulers and occurs in the current timeframe, from right now to out six weeks or the duration of the scheduler's time horizon. It is the scheduler's job to keep product moving out of the refinery to the terminals to ensure that customer demand is met. At this stage, an actual forecast is made showing inventories for each tank, based on production and blending operations, ship and barge movements, pipeline cycles and demand forecasts.

4.7.2 Refinery Inventory Management

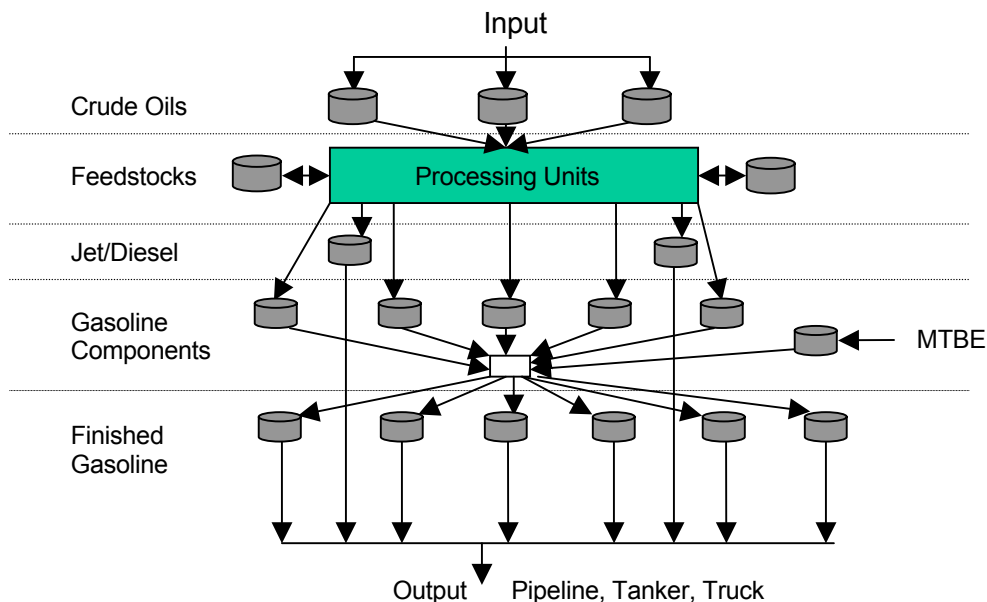
The fuel distribution systems in California have not changed in some time and it is safe to assume that the refiners' inventory managers have determined their minimum operating inventory levels with a certain degree of precision. As seen above, minimum operating inventories are typically determined within a timeframe that spans from current to six weeks out. Any inventories carried above the minimum levels are termed "discretionary inventories" for the purpose of the following discussion.

Minimum operating inventory levels are set so that all requirements of the distribution system can be met without disruption or exceptional effort, without having excessive inventory volumes on hand. Gasoline components are available for blending to finished products, which are certified and pumped into the pipeline on schedule, and are delivered to the distribution terminal in time to be trucked to a gas station, plus some additional stocks to accommodate routine variances of supply and demand due to small refinery upsets, pipeline shipping delays or variances in actual retail demand versus forecast demand, for example.

As shown in Figure 4.5 below, refinery inventories consist of many different products in tankage that is usually dedicated to a specific service. For gasoline components and finished gasoline, a refiner may need to store between 20 to 30 different products and grades. Interchangeability is usually limited to tanks within a certain class, represented in Figure 4.5 as a horizontal band. Thus, it would be possible, although not necessarily

easy, for a refiner to switch tanks between various components such as raffinate, alkylate, and isomerase, or change between finished product tanks for CARB RFG, conventional, and regular or premium grades. Switching service between different classes of service is usually not feasible because of physical location, connecting lines and permit restrictions.

Figure 4.5 – Various Types of Refinery Inventories



The large number of different and dedicated tanks in a refinery means that the minimum operating inventory works out to be a fairly large number, because each tank will have its own minimum service requirements. For instance, it does not help a refiner that there still is a fair amount of isomerase on hand when he needs alkylate to blend a finished gasoline. This analysis and historical data indicate that the minimum operating inventory for the California refining system is about fifteen to seventeen days of supply, or about 16 to 18 million barrels. The fact that even in periods of severe shortage and extremely high prices, inventories never dropped below these levels confirms the fact that these operating constraints form hard limits.

In Section 4.5, it was shown that normal California inventories of gasoline and blending components range from 18 to 22 million barrels. This implies discretionary inventories, those inventories held in excess of target operating ranges, amount to 0 to 4 million barrels, or 0 to 4 days of supply.

Discretionary inventories are held for a number of purposes and generally fall within the Tactical Inventory planning horizon, usually for one of the following reasons:

1. Uncertainties surrounding demand forecasts or refinery production.
2. For coverage of a turnaround.
3. To accumulate cargoes for ship movements or as a result of having received full cargo imports.
4. In anticipation of rising prices – speculative inventory.

Turnaround coverage is probably the single most important reason for holding discretionary inventories. In Figure 4.2 above, a distinct seasonal pattern can be observed whereby stocks are built up in late fall and winter and drawn down in early spring, when most refiners prefer to execute turnaround. The inventory drawdown during the planned outage corresponds to the need for low inventories when the switch to summer grade is made. The magnitude of this seasonal effect is 2 – 4 million barrels, confirming the analysis made above.

Other discretionary inventory is sometimes an unwanted effect of lower than anticipated demand or exceptionally strong production performance. Reasons for demand drop can be a spurious price increase, i.e., a price increase driven by rumor or market anticipation that is of sufficient duration and length to work its way from the spot market into retail. It is not always possible for refiners to adjust production rates quickly to a drop in demand because of commitments in crude oil shipments and limited crude oil storage. Equally, imports already headed for the California market often cannot be turned away at short notice. In such cases, inventories may run up above minimum operating levels. These and other non-seasonal effects are likely to be at the root of observed inventory fluctuations of up to 2 MM bbl.

Speculative stocks are likely to be held by refiners who did not have a major turnaround, or have had strong production runs and emerge from the winter season with ample stocks, or by traders who brought in imported material. Unlike the pre-turnaround season build-up, there is no clear indication of late-spring speculative stockpiling in the inventory data and the fact that such stockpiling is lost in the randomness of the numbers indicates that the speculative inventories at most add up to 1 million barrels even at the best of times.

In summary, it can be concluded that the industry in California currently manages inventories within the following ranges:

- Minimum Operating Inventories: 16 – 18 MM bbl
- Turnaround Preparation (Seasonal): 0 – 4 MM bbl
- Other Discretionary Inventories: 0 – 2 MM bbl
- Speculative Inventories: 0 – 1 MM bbl

For PADD V as a whole, these numbers are:

- Minimum Operating Inventories: 21 – 24 MM bbl
- Turnaround Preparation (Seasonal): 0 – 5 MM bbl
- Other Discretionary Inventories: 0 – 3 MM bbl
- Speculative Inventories: 0 – 1 MM bbl

Below, a further analysis will be provided of some of the inventory management aspects, and of the potential impact of a reserve on inventory management.

4.7.3 *Inventory Management for Planned Outages*

An oil refinery is made up of a number of processing units that require routine maintenance, such as inspection and repairs, catalyst replacement or regeneration, or upgrading for new technology and replacement of equipment that has reached the end of its service life. A process unit that is down for maintenance is said to be in turnaround. The turnaround cycle for each unit can vary from as little as three months to as long as four years depending on permitting requirements, severity of operating conditions, market conditions, unit performance, and the like.

Normally the maintenance on the units is grouped together such that a number of units are in turnaround simultaneously. A major turnaround typically occurs every three to four years when a refiner brings down its crude unit, catalytic cat cracker, hydrocracker, and/or coker. The duration of a major turnaround normally is 30 to 40 days, although the planning may have started eighteen months earlier.

The turnaround timing and duration are established well in advance. Refiners time their turnarounds so that they occur during the slack demand season. In California the

major turnaround season occurs in the period January through March so that the refineries are back in operation for the summer's peak gasoline demand. A secondary turnaround season happens in October/November, after the peak demand.

Refiners do not coordinate the timing of turnarounds with one another, due to anti-trust concerns, but they do track one another's activities. Maintenance contractors frequently have to fulfill a role of go-between and coordinate the refiners' operations because their people and equipment will be at work in a number of refineries at the same time.

The impact of the turnaround on the refinery's fuel production is forecasted and managers responsible for supply and planning are charged with ensuring that sufficient fuel supplies are arranged to meet the refinery's demand forecasts, usually through pre-staging inventories through increased own production, purchases from other refiners or traders, or imports. Rented storage may be arranged when available, and external supplies are scheduled to be delivered through the refinery's own systems during the turnaround.

Generally, planned turnarounds do not create price spikes. The coverage for turnarounds is well planned and turnarounds are generally spaced out. A recent example was seen in the Los Angeles market during the spring of 2001 when a major refiner had an FCC turnaround. The Fluidic Catalytic Cracker (FCC) is the biggest producer of regular gasoline in most refineries. Industry publications reported that the refiner brought its FCC down suddenly, which normally means that the market will spike up as the refiner's traders scramble to cover the unplanned shortfall. In this case the market showed little reaction because the FCC went down on a planned turnaround, for which the refiner's Supply Department had planned adequate coverage, so that they did not have to go into the market at the last minute to cover demand³⁶.

Prices frequently will rise if the turnaround is extended past the scheduled completion date and the refiner's traders have to go into the spot market to cover the additional supply shortfall. One can observe, for example, that prices frequently rise in late March or early April as refineries are struggling to complete their maintenance.

³⁶ Information received during Stakeholder Meetings.

4.7.4 *Reactions to Unplanned Supply Reductions*

With most refiners, the Supply Department is not located in the refinery. Therefore, it may take the Supply Department some time to discover that their refinery has had an unplanned supply disruption. Supply disruptions could be as dramatic as a refinery explosion or as subtle as the loss of the pump that delivers product to the pipeline.

When a supply disruption occurs, the refiner's supply department will try to cover their requirements quickly and in such a way as to minimize the impact of the disruption on its own financial bottom line. This implies that if the disruption is not immediately apparent to the public, as is the case for most outages that do not involve a fire or explosion, the refiner will keep a tight lid on information related to its operational difficulties, and go into the market through parallel channels, either directly with its own traders approaching other refiners, or indirectly through multiple brokers and traders, in order to cover its shortfall before a market run-up occurs.

Eventually, the refiner's problems will become known in the market and, depending on the total inventory situation, this news will usually result in a price spike.

4.7.5 *Impact of a Reserve on Industry Inventory Management*

Some critics of government sponsored reserves have postulated that companies will reduce their inventories because of the availability of the government volume. Clearly, as seen above, refiners will manage inventories for reasons of operability and costs, and in how much the presence of a reserve will be factored into these equations will depend on the operational and commercial design of the reserve. An analysis is given below for each of the inventory components identified above: minimum operating inventories and discretionary inventories including speculative stocks.

- **Minimum Operating Inventories.** The presence of a reserve, even if tied in by pipeline to the refinery, will not reduce the inventories a refiner has to hold for to meet minimum operating requirements. Operating inventories have to be on immediate call and cannot be dependent on whatever release mechanism is designed for the reserve. The fact that currently, even at periods of major supply disruptions and record prices, refiners are physically unable to dig deeper into the operating stocks, makes it very unlikely that the presence of a reserve will enable a reduction of these inventories.
- **Turnaround Coverage.** Conceivably, a refiner may elect to use volumes from a reserve for turnaround coverage. However, a refinery turnaround is usually a

major project for which each detail will be meticulously planned. It is highly unlikely that a refiner will enter into a turnaround without having assured coverage, and leave it to up to the ad hoc ability to lift volumes from the reserve to cover his retail. What is likely however is that the presence of a reserve will enable a refiner to reduce the amount of contingency coverage for the eventuality that the turnaround will last longer than foreseen. In any case, turnarounds are usually planned outside the summer season, when the role of a reserve is less critical.

- **Speculative Stocks.** A reserve, if successful in suppressing price spikes, is likely to reduce the incentive for refiners or traders to stock product in anticipation of price increases. However, speculative stocks are rarely held deep into a price spike and most traders will prefer forward predictability rather than a blind gamble that a disruption will occur. The trade will create speculative inventories when the market is in contango, i.e., shows a small but predictable price increase. During such periods, the reserve would not be used by the trade to conduct prompt trades with forward redelivery, which is of value only in a backwardated market. Speculative stocks are therefore likely to remain a complimentary inventory component. In any case, as seen in Section 4.7.2 above, speculative stocks currently do not play a significant role in California's total inventories.

In summary, it can be concluded that industry inventories in California are almost exclusively serving the bare minimum operational requirements and are not drawn down between the habitual minimum levels even when it would be extremely lucrative for holders of such inventories to realize additional sales. It is therefore very unlikely that the presence of a reserve, limited to only 2.3 million barrels and designed with a release mechanism that creates forward liquidity, will have any significant impact on inventories currently held by the industry.

5 GOVERNMENT ISSUES

There are a number of current regulatory initiatives in the State of California that will negatively impact the supply capability of the petroleum industry in the State, either temporarily or permanently. This section will attempt to quantify the impact of each of these initiatives and their relevance for the creation of an eventual Strategic Fuels Reserve.

5.1 CARB Phase III and MTBE Phase Out

On February 19, 2002, a public workshop was held by the CEC to discuss the impact of the phase out of MTBE by year-end 2002, as mandated by the Governor's Executive Order of 1999. The conclusions of a separate study by Stillwater Associates were discussed at this workshop. The scope of this study was limited to the impact of the phase out on gasoline supplies and infrastructure, and the main conclusions of the report are no different than the points raised in the supply and demand section of the Strategic Reserve Study:

- Phase out by year-end 2002 will cause a 5 – 10% reduction in supply. The bulk of the supply shortfall occurs in the LA Basin. If left unfilled, such shortfall is likely to cause a 50 to 100% increase in prices.
- There are no suitable substitutes available from the US Gulf Coast, and even if there were, US flagged shipping would not be available in sufficient numbers.
- Sources for suitable blending components can be identified abroad, but given the currently already constrained import logistics, it is inevitable that the already severe pricing volatility will be aggravated.
- The economic impact of the initial price spike and the subsequent increased volatility were estimated to cost the California gasoline consumer between \$1 and 3 billion per year.
- The recommendation was to delay phase out of MTBE by three years, until additional infrastructure for imports can be realized, and exports to Arizona can be kept within the State as pipeline supplies from the US Gulf Coast reach Phoenix.

As far as the actual scope of the study was concerned, comments during the workshop centered on the economic assumptions, projections of production capacity in the State, and impact of price spikes. Comments outside the scope mainly focused on the adequacy of ethanol supplies, and various environmental issues with viewpoints largely depending on the particular interest of the party.

The result of the various reports and briefings has been that the Governor issued Executive Order EO D-52-02 on March 15, 2002, delaying the phase out of MTBE by one year until December 31st, 2003. Subsequently two major refiners, BP and Shell, have announced that they will maintain a schedule that will result in an earlier, voluntary switch to ethanol. An important consideration in such decisions is likely to be the exposure of California refiners and MTBE suppliers to law suits brought by several parties claiming damages from MTBE leaked into ground and surface water. Under these circumstances, refiners have little to gain and a lot to lose by continuing to blend MTBE, while on the other hand, they stand to gain substantially from the price increases that are expected as a result of the volume loss when summer grade gasoline is oxygenated with ethanol rather than MTBE.

5.2 AQMD 1178

As part of a consent decree that resulted from the settlement of a lawsuit brought against the South Coast Air Quality Management District (SCAQMD) by several environmental organizations, the SCAQMD agreed to create new regulations that will result in further reductions in emissions of Volatile Organic Compounds (VOCs) in the Los Angeles basin by 8 short tons per year (8 TPY).

Of these target emission reductions, a total of 3 TPY are to be achieved in three consecutive phases through additional control measures in large-scale petroleum and petrochemical industrial installations. After an initial evaluation of the options, the SCAQMD decided that in the first phase, between 1 and 1.5 TPY of VOC reductions could be achieved by measures that will reduce evaporative emissions from bulk liquid storage tanks. The proposed measures included improving the tightness of roof fittings and constructing domed roof over open floating roof storage tanks containing high vapor pressure petroleum products. Subsequently, the SCAQMD instigated a workgroup with participants from the affected industries in order to discuss feasibility, cost effectiveness and implementation schedules for the proposed regulation.

The new regulation as proposed by the SCAQMD, Rule 1178, called for doming of all crude oil and product tanks at facilities with total VOC emissions greater than 20 TPY, under a program of which the first phase, comprising of the vast majority of all crude oil and product tanks at the LA refineries and at some of the main commercial terminals, was to have been completed by 2006. The cost effectiveness of the program was questionable for the larger tanks, in particular for those containing crude oil, and the 4-year implementation schedule was deemed unfeasible and considered a risk to supply security. Feedback from the affected parties, industry organizations and the CEC (assisted by Stillwater Associates), caused the SCAQMD to reconsider the scope and implementation schedule.

The regulation, as adopted by the District's Board in a public hearing on December 21, 2001, requires that 75% of the tanks for gasoline and gasoline components are to be domed by December 31st, 2006 and the remainder by December 31st, 2008. The rule no longer includes a requirement for doming of crude oil tanks because it is not cost effective. Even with this extended schedule, there is still cause to be concerned that supply reliability in the LA basin may be impacted by the number of crucial storage tanks that will be out of service at any given moment for project work. Under the applicable standard, API 653, aboveground atmospheric storage tanks are normally taken out of service for internal inspection and maintenance on a 20-year schedule, and the 7-year schedule with additional project work extending the down-time, means that on average during the next seven years, the amount of storage that is not available to accommodate demand swings or refinery problems is 3 to 5 times more than normal.

There is no doubt that the creation of a Strategic Reserve, or any other measure that will enable more storage to become available to the LA refiners within the extended timeframe of the new Rule, will help to alleviate the pressure on an already very tight market for bulk storage of petroleum products in the LA Basin and lessen the impact of Rule 1178 on the availability of storage.

The creation of Rule 1178 is illustrative of the tight regulatory framework within which the refiners in the LA Basin have to operate. In an environment in which upwards of \$140 MM in investments are necessary to obtain a relatively insignificant reduction in VOC emissions, it is very difficult to justify projects to create incremental capacity, but have associated incremental emissions as well.

An idea developed by Stillwater Associates and currently presented to the industry is to allow refiners to take credit for voluntary improvement in fuels, which – using CARB's predictive model – can be translated in reductions in tailpipe emissions. Given California's unique market structure, in which the majority of the transportation fuels is consumed in the same confined geographical area in which the refineries are located, it would make a lot of sense to allow refiners a possibility to achieve the mandated reductions in the mobile source emissions caused by the fuels they produce, rather than by squeezing the last ounce out of sources within the refinery fence.

5.3 Ports of Los Angeles and Long Beach

Although joined by common waterways and infrastructure, the ports of Los Angeles and Long Beach are separate entities, each governed by a Board whose members are appointed by the elected officials of the two cities, with authority derived under a mandate from the State Lands

Commission. The management mandate for both Port Authorities resides within a Master Plan for land use and development that is approved by the State Lands Commission (CSLC). Even within the Master Plan, certain decisions concerning land use and development will be subject to review by the City Council of each port and the CSLC.

Current policies in both ports do not favor bulk liquid operations for petroleum products, and the closure of existing facilities and lack of development opportunities for new capacity could severely impact the capability of the State to meet future requirements for fuels through imports. Almost all terminals in both ports are built on leased land, and as the leases come up for renewal, the ports will reassess the land usage, with the result that over time, more terminals will have to make way for large scale container operations or other land uses with higher revenue than can be offered by bulk liquids.

5.3.1 Port of Los Angeles

The current long term Master Plan for the Port of Los Angeles (PoLA) provides for the creation of a common bulk liquid terminal for crude oil and petroleum products on the newly created landfill area of Pier 400. The plan assumed that some of the existing petroleum terminals that were located in areas for which the PoLA had other plans would be relocated to this new bulk liquid terminal area on Pier 400 when their current leases expired. This plan, which dates back over 10 years, never gained acceptance within the industry, mainly because the proposed site at Pier 400 is remote, requiring significant investments in pipelines in order to provide access into the existing refining infrastructure.

Given the lack of interest from the side of the industry, the PoLA has meanwhile granted most of the land of Pier 400 in leasehold to container terminal operators, with only a limited footprint remaining for bulk liquid facilities. The remaining area of 25 acres would allow building at the most three tanks of 0.5 million barrels each, which in combination with an 80-foot draft berth and a large capacity crude oil pipeline connection to the inland refineries will enable offloading of a fully loaded VLCC. The PoLA and several potential users are still evaluating the options for development of a crude oil terminal at Pier 400. In any event, it is very unlikely that any future development scenario for the site will include facilities for handling of clean products, and the net result will be that several clean products and black oil facilities will have been shut down in the PoLA without the anticipated replacement at Pier 400 being realized.

There are two other developments in the PoLA that could negatively impact the port's capability to handle imports of fuels. The first is formed by heightened community concerns about the safety of bulk petroleum storage as potential targets for terrorist attacks, which has led to a request by Council members to study the closure or relocation of three terminals in San Pedro and Wilmington. The second issue is that of Environmental Justice, a term used by NGOs protesting the disparity between the exposure to pollutants in the communities surrounding the Ports, with the poorer, largely minority populated communities bearing the brunt of the exposure.

Although understandable from a local perspective, these initiatives, if carried through, could lead to a further reduction in fuel receipt facilities in the PoLA and will make future expansion very difficult.

5.3.2 *Port of Long Beach*

The Port of Long Beach (PoLB) faces problems that are to a certain extent different from those in Los Angeles. Both ports face an increasing demand for container handling – in fact, the projections for the PoLB call for a doubling of containers from the current 5 million TEU (Twenty-foot Equivalent Units) to 10 million by 2010 and then to double again to 20 million by 2020. Much of this growth will be realized by creating mega-terminals, container facilities with at least 400 acres of storage yards and capable of handling the new 10,000 TEU container vessels.

However, Long Beach does not face the same pressure from individuals or action groups concerned about safety or environmental justice. Yet the need to create space for container terminals is so acute that it is still uncertain whether the PoLB will be able to accommodate two existing bulk liquid storage facilities in the plans it has for expansion of the Pier A container terminal.

As is the case for the PoLA with its Pier 400 project, the Port of Long Beach has plans for a new deepwater receipt facility for crude oil at Berth 123, adjacent to the current crude oil berth shared by three refiners. A request for proposals has been issued by the PoLB, with expressions of interest due July 17. The footprint for the new facility is limited to just 5 acres and will not allow for any storage at all. As for the LA Pier 400 plans, there are no plans for additional receipt facilities for petroleum products.

The lack of storage space set aside for this terminal and the accelerated schedule at which the Port wants to move forward make it unlikely that resulting operations will represent the best possible solution for California's energy supply security.

5.3.3 *Summary of Port Issues*

In Section 1.4.2 of this study, it was shown how California has become increasingly dependent on imports for its requirements of crude oil and petroleum products, and how the sources of these imports are shifting from domestic sources to remote foreign locations requiring larger scale receipt facilities. In Section 1.3 it was shown how predominantly, the shortfall occurs in the southern California market, which relies on the ports of LA and Long Beach for its imports.

The current trends and policies in the ports of Los Angeles and Long Beach are not favorable to bulk liquid storage facilities, and although plans exist in both ports to accommodate future requirements for crude oil imports, there are no established plans for increases in clean petroleum products such as gasoline and gasoline components.

5.4 **Military fuels**

Jet fuel was not part of original study, especially military jet fuel, but the terrorist attacks have changed this outlook. Defense Energy Supply personnel in California would like to meet with staff and contractors. Proposed work would examine quantities and locations of military jet that should be stored and will examine delivery infrastructure constraints.

5.5 **MOTERP**

After the 1994 Northridge earthquake, and other earthquakes in which marine terminal facilities were damaged, the California State Land's Commission initiated a project to create a set of uniform engineering standards that would ensure that marine oil terminals would be equally resistant to earthquakes as the refineries to which they are linked.

Currently the CSLC has a final draft in preparation of new regulations that will require the owners of a high-risk facility (risk of a spill of more than 1,200 bbl of petroleum products in a standardized accident scenario), to inspect their docks and shore facilities within 30 months after the regulations take effect. These inspections will follow a detailed protocol and an action plan must be developed to mitigate any findings. Lower risk facilities have 48 months in which to carry out the inspection program.

The CSLC will evaluate each plan on an individual basis, and in general, does not impose a hard time limit for completion to allow the concerned terminal operator to design a workable schedule, which minimizes impact on operations. In general, the CSLC believes that most facilities can be remediated within 6 to 8 years.

Given the scheduling flexibility, it is not expected that MOTERP implementation will lead to an immediate reduction in available import facilities, as is the case for SCAQMD Rule 1178. Nevertheless, there are likely to be facilities for which the cost of the upgrades cannot be justified by the operator, and which will therefore close down.

6 OPTIONS FOR A STRATEGIC FUEL RESERVE

A fundamental choice for creating a Strategic Fuels Reserve is whether to use existing inventory capacity or to build new tankage. As seen in the previous Section 4, by conventional logistic standards existing tankage is already inadequate for the volumes currently handled. Moreover, during the stakeholder meetings, the shortage of existing storage capacity was widely reported as one of the major problems the industry currently faces (see Section 8.1). This study will therefore focus on adding new storage capacity or converting existing tankage currently not in petroleum products service as the only viable way to create an eventual reserve in California.

This study does not attempt to develop any of the considered options to a level of detail where cost estimates can be prepared with the accuracy normally required for an investment decision. At this stage of early feasibility analysis, order of magnitude estimates are used, where possible based on factorial comparison with known costs for similar projects, or based on published information and industry practice.

6.1 New Tankage

For new tankage, the primary considerations is the selection of a location, in particular whether the storage needs to be built as a grassroots project requiring its own infrastructure development, or whether it can be built as an extension to existing facilities and share in already available infrastructure such as roads, docks, pipeline connections, and utilities. For the first option, reference will be made to existing studies, while for the latter two locations are examined in more detail.

6.1.1 Findings of 1993 Study

In 1993, an extensive study was carried out by Invictus Corporation of Wilton, CA, to determine the feasibility and cost for a single reserve of petroleum products, capable of holding an inventory of 5 million barrels³⁷. The costs of the project, including acquisition of a 215 acre site and connections to the main product distribution pipelines, but excluding the cost of an initial fill of the reserve, were estimated at \$131 to \$143 million (1995 \$). Operating cost for the facility were evaluated at \$6.6 to \$7.9 million per year, with the high end of the range representing a location in Stockton that included operating a dock. The other locations that were evaluated for the reserve besides Stockton were Fresno and Roseville. These three locations were retained after

³⁷ *Feasibility Study of a Regional Petroleum Product Reserve in California*, December 1993, Invictus Corporation, Wilton, CA, Resource Decisions, San Francisco, CA, and Capital Research, Chevy Chase, MD.

an initial survey that included a total of 15 sites, mainly inland and chosen for reasons of earthquake security rather than connectivity with existing petroleum infrastructure.

If escalated for inflation from 1995 to current³⁸, the construction cost for the Stockton option would amount to \$154 million, or \$31 per barrel of shell capacity, and operating cost of \$0.16 per shell barrel per month. These numbers are similar to numbers quoted by major oil companies as fully loaded costs. In general, commercial terminal operators reported substantially lower numbers for new grassroots construction, claiming that they are able to build and operate terminals cheaper than the major oil companies or the State because of their specialized knowledge and lower overheads. If the project were to be realized as an expansion of an existing facility, with infrastructure already in place, costs could fall to half the numbers used by Invictus, based on information received from commercial terminal operators currently involved in expansion projects.

In addition to the construction and operating costs, Invictus evaluated the cost of filling the reserve at more than \$150 million at then prevailing fuel prices. The conclusion of the Invictus study, using an economic model to predict the price moderation effect of the reserve in case of a major supply disruption, was that the costs of building, filling and operating the single 5 million barrel reserve was not warranted by the increase in security of supply.

The 1993 study did not address the logistics of moving product in and out of the reserve, other than the pumping costs for the initial fill, and as has been shown in section 2.1.3 above, the concept of the single, central reserve would have been flawed because of the inability of the existing transportation system to deliver products to the different markets in a timely manner. Also, the concept of tying the reserve into the distribution grid with a single 8" line would have proven impractical, since it would have taken almost two months to draw down or replenish the reserve. Yet the cost estimate is representative for grassroots investment, and will be used in the build-or-buy analysis below.

6.1.2 New Storage Built and Operated by the State

For new storage to be built and operated by the State, the following overall scope will be assumed to meet requirements for full integration into local refining centers and import capability:

³⁸ Bureau of Labor Statistics Data, *Producer Price Index All Industries*. 1995: 124.2; 2001(p): 133.5

- Bay Area: 6 x 150,000 bbl drain-dry open floating roof tanks, 15 acre site owned fee simple, dock 800 feet long, 35 feet draft, VDU, 5 mile 16” pipeline connection to main grid.
- LA Basin: 9 x 150,000 bbl drain-dry floating roof tanks with dome, 20 acre leased site, use of 3rd party dock, 2 mile 16” connection to main grid.

The differences in scope between the Bay Area storage and the LA Basin facility reflect a reasonable estimate of prevailing local conditions, i.e., leased versus owned land and SCAQMD requirements.

If the reserve is to be part of a larger project, i.e., if double the volume is deemed necessary, or if additional storage were to be built simultaneously for lease to third parties as part of a larger, commingled terminal in which both the State and private entities maintain inventories, then there will be certain economies of scale from which the State would benefit on a proportional basis. For the time being, as a conservative first approach, the costs for building the reserve will be calculated on an individual project basis.

Summary of construction and operating costs (for details see Attachment A):

Table 6.1 – Cost Summary of State Owned and Operated Reserve

	Bay Area	LA Basin	Total
Investment, \$ MM	39	36	75
Fixed Costs, \$ MM/year	8	9	17
Throughput Cost, \$/bbl			
Pipeline In/Pipeline Out	0.34	0.34	
Pipeline In/Barge Out	0.25	0.44	
Vessel In/Pipeline Out	0.23	0.41	

The total investment costs of \$75 MM for 2.2 MM bbl are consistent with the figure of \$154 MM of escalated costs for the 5 MM bbl storage of the earlier Invictus study, in that it would imply an exponential scaling factor of 0.88, which is conservative when compared to the value of 0.7 to 0.8 generally used in the industry for this type of installation (a higher number means a more linear relationship between scale and

costs, a lower number means that on a per unit basis, smaller installations are more expensive).

The throughput costs are the cost related to moving material in and out of the reserve, such as the fees for using the 3rd party owned pipeline gathering systems, port fees, dock fees paid to 3rd parties for options where the dock is not owned, and the cost of physical losses associated with the movement of the material, such as evaporative and trans-mix losses, which are estimated to average 0.1%.

6.1.3 *New Storage Built and Operated by a Commercial Service Provider*

Market information obtained during the survey meetings has confirmed that commercial terminal operators in the Bay Area and in the LA Basin are willing to build new storage capacity under a long-term, i.e., 10 year contract at currently prevailing market rates of \$0.45 to \$0.55 per barrel of shell capacity per month.

Table 6.2 – Cost Summary for Leased Reserve

	Bay Area	LA Basin	Total
Investment, \$ MM	0	0	0
Fixed Costs, \$ MM/year	5.4	7.2	12.6
Throughput Cost, \$/bbl			
Pipeline In/Pipeline Out	0.33	0.33	
Pipeline In/Barge Out	0.25	0.44	
Vessel In/Pipeline Out	0.23	0.41	

The fixed costs are based on the minimum fixed tank rental of \$0.50/bbl/month, which under the terms customary in the industry includes the right to store and withdraw the tank volume once per month (one “turn”). Any excess throughput in a given month incurs an additional throughput fee, usually in the order of \$0.20/bbl. However, no excess throughput charges are included in the Through Put Costs as listed, since it is unlikely that a reserve could be utilized and replenished more than once during one month. The throughput cost for the leased tankage in terms of pipeline and port fees, and inherent product losses, are virtually equal to those for owned tankage. The slight reduction for the pipeline in/out option is due to the energy cost for pumping, which is included in the base cost for leased storage.

It will be clear from a comparison of Tables 6.1 and 6.2 that it will be difficult to justify building state-owned and operated tankage, given the very competitive prevailing market rates of commercial service providers. The disparity between commercial rates and fully loaded costs incurred by large corporations is further explained below and is consistent with market information received during the survey meetings with industry stakeholders as conducted for this Study (Section 10.1).

6.2 Incentives for Increased Inventories by Current Inventory Holders

An idea that was floated during the stakeholder survey meetings was that of an industry-held component to an eventual reserve, i.e., that by providing incentives to compensate for the cost of working capital associated with larger stocks, the current holders of inventories could be enticed to increase the amount of product held at any point in time, and would only dip into a certain portion of their inventories under pre-agreed conditions or when specifically authorized to do so. On reviewing inventory data and from feedback received during the stakeholder meetings, it became immediately clear however that there is little or no room to increase inventories within the California refining and distribution system.

The same arguments that apply to inventories at refineries also apply to those held at commercial terminals: space is tight and even when provided with incentives to compensate for working capital cost plus tank rental expense, owners of fuels would not be able to find more space.

This leaves the option to provide incentives to the industry that will result in more storage capacity being built. These incentives can take the form of providing financial aid, such as investment guarantees or subsidies, but can also include measures to remove the barriers that currently prevent normal free market mechanisms to cause supply to match demand,

6.2.1 *Financial Incentives to Increase Storage Capacities*

Currently the contract rental rates for petroleum product tankage are around \$0.45 to \$0.50 per bbl per month in the Bay Area, and \$0.50 to \$0.55 per bbl per month in the LA Basin. Spot contracts can be between 5 to 10 cents higher. At these rates, commercial terminal operators have reinvestment economics, but large refiners would need higher numbers to justify building new tankage for themselves under the criteria that most of these companies apply for internal rates of return.

There are several reasons why a large refiner's costs are higher, and they are relevant when considering what incentives may be needed to promote infrastructure investments:

- A large refiner's project costs are generally substantially higher than those of smaller specialized firms because of allocated corporate overheads, more elaborate company standards, and higher cost of the owner's project management team.
- Required internal rates of return are higher in oil companies where projects generally carry significant risk and therefore need higher rewards, versus the service industry whose projects are usually backed by long term contracts with low risk and are therefore acceptable at utility level returns.
- Oil companies do not benefit from certain tax advantages available to most commercial terminal operators, who are often structured as Master Limited Partnerships (MLP).
- Capital resource allocation decisions in oil companies will favor investments in core businesses such as exploration, production and refining, rather than in infrastructure projects.

These factors have led to a proportional under-investment by refiners in storage, causing their inventory capacity to lag behind their increases in production capacity. In general, storage capacity will only be added at refineries when justified by operability issues rather than economic reasons.

Trading companies or large purchasers of fuels, who also maintain inventories, face similar obstacles to investment in wholly owned terminals and pipelines. In addition, these companies are generally not well equipped to run capital projects of this nature, have even higher internal hurdle rates for investment, and have a forward demand that is not always predictable.

The logical conclusion would be for refiners, traders, and large buyers to outsource their storage requirements to specialized third party service providers. For short-term requirements that can be met with existing capacity, this is indeed how the industry functions. However, this solution of choice becomes more complicated when the service provider has to invest in new facilities to meet the demand. For new investment, given their inherently lower utility level rates of return, the service companies need long-term commitments from the principals before they can invest, usually in the order of 5 to 15 years.

Unfortunately, it is almost as difficult for refiners, traders and buyers to commit to a long-term contract, as it is to obtain approvals to spend the capital internally. Long-term

capital commitments are also referred to as pseudo-capital commitments, which have to be footnoted in financial statements and may impact a company's borrowing capability in a similar way as debt incurred to finance investments. Thus the problem becomes a vicious cycle, in which the holders of inventory are reluctant to invest in owned infrastructure, nor eager to commit to long-term contracts, and the service providers unable to invest without such commitments.

A measure available to the State to promote new infrastructure investment in the petroleum sector would be to offer guarantees for certain projects under well-defined conditions. For instance, rather than renting storage for 0.9 MM bbl of state-owned reserve in the Bay and 1.3 MM bbl in LA, the State could:

- Offer a tender for commercial storage operators to build the required volumes of tankage.
- The commercial storage operators rent out tankage at normal rates to refiners, traders and marketers under short-term agreements.
- If for some reason, tankage is not rented out for longer than a certain minimum delay period, the State would reimburse the operator for the fixed cost and capital recovery part of the monthly rental fee, but not the profits.
- Contracts for the guarantees would be awarded to those commercial terminal operators offering the lowest required monthly guarantee, after the longest delay, over the shortest overall number of years of validity of the guarantee.

The advantage of this option is that it is unlikely that it will ever require the State to spend any real money, but that it will allow the commercial operators to build tankage without long-term commitment from customers. This solution can be combined with other initiatives, whereby the State would rent part of newly built reserves itself and fill it with State owned reserves, while allowing the commercial terminal operator to rent out the remainder under the guarantee program in commingled tankage. The resulting combination is one of the solutions of which the economic effectiveness will be evaluated in Section 8.

6.2.2 *Removal of Barriers to Infrastructure Projects*

The main reason why normal laws of supply and demand do not function in the market for bulk liquid storage for petroleum products is the formidable efforts that must be undertaken to obtain the necessary permits. Even permits for a relatively modest

expansion took over three years to obtain. This project was located in a heavily industrialized area, for tankage that was in fact a replacement of military fuel storage removed nearby, and was undertaken by one of the leading companies in the field ³⁹.

Several factors complicate the permitting process:

- In the refinery centers in the Bay and the LA Basin, the areas where storage is most in demand, the permitting process for new tanks involves approval processes with multiple regulatory agencies. These processes are largely sequential and involve public review at several stages.
- Even when approved after all due regulatory review, projects can be held up indefinitely in court by Non Government Organizations (NGOs) representing interests of communities, even if projects are located in remote areas zoned for industry with no residential habitation in the direct vicinity.
- The NGOs that represent the local interest operate nationwide, are relatively well funded, and benefit from better central coordination and more favorable press relations than the industry.
- Permit applications for individual projects may require a lengthy procedure to update the Master Plan for land use in the ports as laid down in the State Land grants under which the Ports operate, while granting an exemption leaves the Port Authorities vulnerable to suits filed by opponents.
- The Port Authorities and other local regulatory agencies that have control over land use are not always aware of the greater interests at stake, and may have to give priority to interests of local electorate.
- The momentum in the Ports is building against bulk liquid terminals, with several terminals in the Bay and in the LA Basing closed down in recent years, and several more currently under scrutiny.

In summary, the current regulatory environment is such that it is easy and cheap to prevent infrastructure from being built, while filing project applications is uncertain and costly. Measures that the State could consider as options to ensure an adequate infrastructure for fuels, including a Strategic Fuels Reserve, are:

³⁹ Information received during Stakeholder Meetings.

- Centralizing the permitting process for bulk liquid storage and pipeline projects for fuels (“one stop shopping”)
- Preparing blanket Environmental Impact Reports (EIR) for major changes, such as CARB Phase III implementation, whereby the overall macro-environmental impact factors are defined centrally, so that for individual projects, only local factors need to be considered.
- Introduction of a fast track procedure for fuels infrastructure projects that improve overall fuel supply reliability in the State.

These measures will enable normal market supply to meet the inherent demand without direct intervention or significant expenditure of taxpayer money. Similar measures were enacted for the power generation and transmission infrastructure, but only after 13 years had passed in which no new capacity was added, and a real crisis had sprung up. The challenge is to implement this type of program as a preventive measure rather than in a crisis environment, given the political hurdles at local level.

6.3 Recommissioning of Idle Tankage

Given the tightness of the bulk liquid storage market in California, there is no tankage that is currently left idle that does not have some significant problems associated with it that prevent its re-commissioning.

6.3.1 Idle Tankage linked to Refinery Infrastructure

A survey of the LA Basin and the Eastern Bay Area, the primary areas for location of an eventual strategic fuels reserve, revealed some terminals with decommissioned or otherwise idle storage with sufficient capacity to be considered for service as a Strategic Fuels Reserve. This tankage is mainly associated with power stations and closed-down refineries.

Table 6.3 – Summary of Idle or Decommissioned Tankage

	Bay Area	LA Basin	Total
Tankage at Closed Refineries	0.0	1.7	1.7
Fuel Oil Storage at Power Plants	4.0	3.5	7.5
Total	4.0	5.2	9.2

Several factors make it unlikely that the idle storage identified in Table 6.3 can be brought on-line again economically:

- For 1.0 MM bbl of refinery storage in the LA Basin, rates quoted by the owner for rental of the recommissioned tanks are 60 to 80% higher than the cost of new built tankage. This high cost is likely to be due to the factors quoted in Section 6.2.1 listing some of the reasons why large refiners incur substantially higher net project costs.
- The remaining 0.7 MM bbl of idle refinery tankage is associated with a refinery that may still be reactivated and its storage is not separately available.
- In total, 3.5 million barrels of idle power station fuel oil storage was identified in the LA Basin, and up to 4 million barrels in the Bay area. This idle tankage consists for the most part of older tanks that are neither suitable nor permitted for storage of high vapor pressure products. To make these tanks suitable will require significant investments, and the permitting process will be similar to that for new tankage. Moreover, the individual tanks are usually very large, i.e., in the range of 300,000 to 500,000 bbl per tank, which renders them less useful for product storage (see Section 2.2), while pipeline connections with the clean products distribution system would have to be created using whatever black oil lines are available.

Despite the obstacles, it seems likely that using existing tankage will result in some savings in time and project costs versus building new tanks for the reserve. Evaluating each of these options in sufficient detail to quantify cost savings versus new construction requires a level of engineering work not foreseen in the scope of this study. At this stage of early feasibility evaluation, it seems reasonable to assume that if a tender for the creation and operation of a reserve were issued to service industries operating in the LA Basin and in the Bay Area, and if those companies would be able to offer services at more competitive cost by using the idled power station tankage, then normal market forces would drive inclusion of these alternatives in the proposals to the State. For now, no significant cost reductions will be assumed.

6.3.2 *Tankage Not Tied to the Distribution System*

Only a few instances have been identified of idle tankage outside the refining centers, not connected to the main distribution system.

- In Ventura, 800,000 bbl of tank capacity associated with the former USA refinery. This tankage has been out of service for 15 years and would require major investment to be brought up to code. Moreover, dock facilities have been removed and substantial investment would be involved in converting an idled crude pipeline to products.
- In various coastal power stations, a total of 3 million barrels of former fuel oil tankage has not yet been removed. Most of these tanks are in poor shape, have no longer access to single point moorings or dock facilities, and are in locations where pipeline connections to the refining centers would require new pipelines through environmentally sensitive areas.

In total, the volume of such tanks that could in theory still be rehabilitated and made fit for service in light products may exceed the 2 million bbl required for the reserve. For all of the sites however, it makes no economic sense to attempt upgrade and connect the storage by pipeline to the refining centers, because even grassroots investment within the refining centers is bound to be more cost effective.

6.4 Conversion of Tanks Currently in Black Oil or Crude Oil Storage

In both the northern and southern refining centers, some tanks are currently used in black oil service (heavy fuel oil, VGO, bunkers, crude oil) that are capable of and permitted for storage of clean petroleum products. While surveys did not produce a complete inventory of all tanks with dual capability in California, with 1.5 MM bbl of identified tankage with commercial terminal operators in the LA Basin and at least 0.5 MM bbl in the Bay, it is estimated that total volume of such tankage exceeds the proposed volume of a Strategic Fuels reserve in each area.

However, using these tanks for a Strategic Reserve in light petroleum products is unlikely to bring an overall improvement of supply reliability in the State. Storage for black oil and crude is also very tight in both refining centers, and although commercial terminal rates for these products tend to be slightly below those of clean products in the current markets, the actual costs of the facilities that can handle the heavy products is higher. More often than not, black oil tanks and pipelines have to be heated and insulated, and pumps and other equipment have to be designed for highly viscous products.

If 2.3 MM bbl of tankage that has dual capability were to be removed from black oil and crude service to create a Strategic Reserve, this would represent less than 10% of available storage volumes for these products in the State. However, at less than 15 days of storage, crude oil inventory capability in California is already dangerously low by standards applied in most other

parts of the world. Especially with the crude supply situation changing rapidly and the State becoming increasingly dependent for its crude oil supplies on foreign imports from remote locations requiring Very Large Crude Carriers (VLCC), it would not be prudent to recommend creating a Strategic Fuels Reserve for light products in current crude oil tankage with light product capability.

Black oil storage capacity, in contrast, seems more generous, with more than 20 MM bbl of tankage available in commercial terminals alone. However, black oil storage requirements are not determined to the same extent as gasoline or crude oil in terms of days of throughput, but rather by operational requirements for intermediate product storage allowing refinery units to function somewhat independently from each other, in particular to enable partial shutdowns and turnarounds of upstream units such as cokers and distillation units, and downstream upgrading sections. As it is, black oil storage available to refiners has declined by over 8 MM bbl over the past years, with aboveground tankage being scrapped or converted to crude oil, and the last of the large in-ground reservoirs has been decommissioned. It is therefore not recommended to attempt creating a Strategic Fuels Reserve in either black oil or crude oil storage capable of handling lighter products.

6.5 Floating Storage using Converted Tankers

Worldwide, many instances can be found where laid-up or obsolete tankers have been used to provide floating storage, usually as a floating dock and surrogate marine terminal, capable of receiving cargoes through a board-board transfer from a similarly sized or smaller vessel.

To evaluate this option as an alternative for a Strategic Fuel Reserve in California, a number of factors need to be considered, such as size and availability of vessels, the logistics of moving product in and out of the floating storage, and of course the approximate cost of maintaining tankers as storage.

Table 6.4 below compares a number of alternatives. From this table, it will be clear that it is not practical to assume that a reserve can be created using product tankers, simply because of the number of vessels that would be required and the cost involved. Even though availability is not the issue (it is estimated that in the next two years, 11 single hull US flagged product tankers will be retired⁴⁰), the cost of maintaining the vessels at anchor and operating them as a floating terminal are likely to be prohibitive at an estimated \$24,000 per tanker per day. Moreover, at least in LA, the space is simply not available to anchor 5 of these vessels.

⁴⁰ MARAD, *OPA Schedule for retirement of Single Hull Product Tankers*, Jan 2001

Table 6.4 – Alternatives for Floating Storage

	VLCC	Product Carrier	Reserve Fleet
Provenance	Foreign, newly retired vessels	OPA single hull retirement	NDRF
Size (DWT)	250 – 300,000	35 – 40,000	18 – 35,000
Draft (feet)	50 - 60	35 - 40	30 - 35
Capacity (bbl)	1.5 – 2 MM	250 – 300,000	175 – 300,000
Vessels required, Bay / LA	1 / 1	3 / 5	3 / 5
Costs (\$/bbl/month)	\$0.75 - \$1.00	\$2 - \$2.50	?
Cost product in/out (\$/bbl)	>\$0.75	>\$1.00	?

While also expensive, the use of one retired VLCC in the Bay and one in the outer harbor of Los Angeles, both permanently moored and equipped with fenders and loading arms for board-board transfers, is at least doable from a practical point of view. The difficulty here will be to obtain a waiver for the Jones Act requirement, since no US flagged VLCCs were ever built, and to obtain permitting for a single hull vessel to be used as floating storage. All these factors, as well as the high cost, make this an option of last resort, since it has the advantage of being able to be implemented at short notice, i.e., in less than 4 to 6 months.

6.6 Incentives to Increase Fuel Production in California

The need for an SFR is borne out of a chronic supply shortage of gasoline in California, where refiners run close to or at maximum capacity with import options limited by commercial and physical barriers. In such a situation, each unplanned refinery outage immediately translates into a price spike. If somehow, production capacity could be increased so that a healthy margin of spare refining capacity existed, as was the case up to the mid-nineties (see Figure 1.1), other refiners would be able to take up the slack and compensate for the loss of production due to unplanned outages.

It is clearly not within the mandate of AB2076 to evaluate whether the State should enter into the refining business. However, there are measures the State could consider with regard to increasing refinery capacity that could achieve the same goal of suppressing price spikes at potentially comparable or lower cost than are likely to be incurred in the creation of an SFR. In particular, the State could contemplate measures to streamline and expedite the permitting

process for projects that increase fuel production in California similar to the legislation introduced in order to accelerate capacity additions for power production.

Currently, the political climate in California is not conducive to the expansion of fuel production in the State. The consensus opinion amongst industry participants is that no new refineries will ever be built, although CEC forecasts of gasoline demand require the supply equivalent of an additional two refineries to be built between now and 2020, despite expected advances in fuel economies of cars⁴¹.

Problems that refiners face when contemplating even small capacity additions are:

- Many refiners are up against hard constraints in their CAAA Title V Operating Permit. Even a small debottleneck of one unit may require applying for a new overall operating permit. In many cases, this renders the project uneconomical.
- Emission credits are expensive and offsets are hard to achieve, which again means that small projects are often not attractive.
- NGO's have proved to be adept at slowing or eliminating needed expansions. Part of the decision that CENCO Refining made to abandon plans to restart the Powerine refinery can be attributed to lawsuits brought by environmental groups. Unions have delayed the permitting of CARB Phase III projects in refineries in Northern California.

Government agencies have enforced their own agendas to the detriment of fuel production and logistics. The Port of Los Angeles has tabled the relocation of terminals in their port. The South Coast Air Quality Management District's Rule 1178 will put pressure on the distribution system, risking supply disruptions because of tankage that is taken out of service for doming. Permitting is a time consuming process. It took Kinder Morgan two years to get permits for the construction and operation of three new jet fuel tanks at their tank farm in Watson.

Government can create incentives to increasing fuel production by reducing the barriers that government has created. These include a coordinated permitting process, a new look at permitting requirements, and one-stop shopping for all energy related projects, not just electrical power.

⁴¹ *Energy Outlook 2020*, California Energy Commission Staff Report, Docket No. 00-CEO-Vol II, August 2000

7 MARKET CONSIDERATIONS

The California markets for gasoline, diesel and jet fuel are each different in key aspects such as structure, liquidity, and forward trading opportunities. Of the three major liquid fuels, the gasoline market is not only the largest market by far, but also the most complex because of such factors as the uniqueness of the fuel specifications, the overall tightness of supplies and the relative inelasticity of demand. These and other factors underlie the severe volatility of the gasoline market and will be evaluated below, with the other markets, in particular the market for jet fuel, used only as a frame of reference.

7.1 General Description of the California Gasoline Markets

The California gasoline market has a layered structure, formed by four separate but interrelated markets:

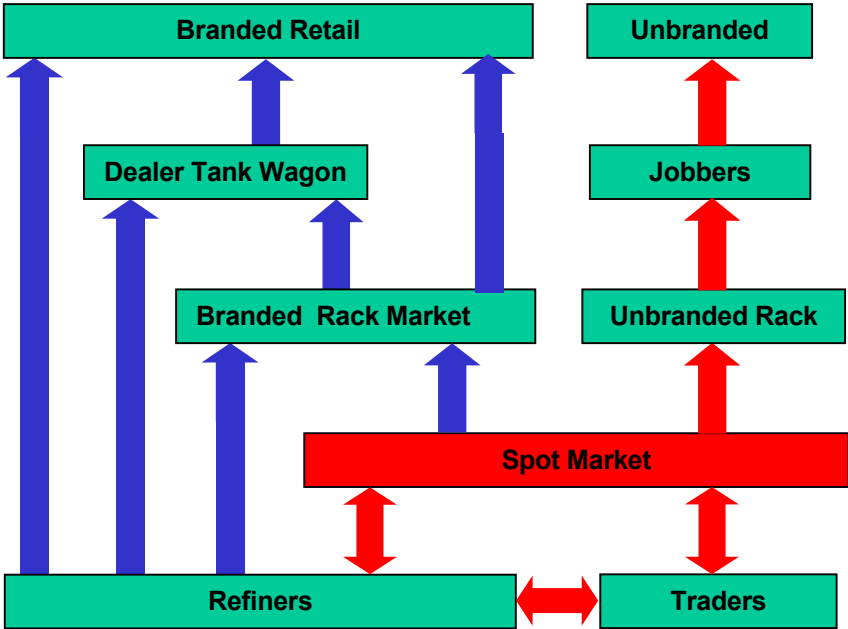
- **Spot.** The spot market consists primarily of the trade at the refinery level. Traded gasoline volumes are typically 25 MB (approximately 1 million gallons, also referred to as a “piece”) and are delivered into a pipeline at a place and time specified by the buyer. Most deals are “prompt”, meaning the first open cycle on the pipeline, usually within one or two weeks. There are some twenty to thirty participants in the West Coast spot market, including refiners who buy and sell products between themselves to balance out volume requirements, trading houses, brokers, and the large independent marketers. The spot market moves with the perceived change in refinery supply and demand.
- **Rack.** The rack market consists of wholesale buyers such as independent retailers and bulk customers who operate their own truck fleet (“jobbers”) and who take delivery of their product at a truck loading rack situated at a terminal, or sometimes directly at the refinery. Rack market participants may buy branded products destined for branded stations, or unbranded products destined for independent service stations or commercial/industrial accounts. In general, branded rack prices tend to move in relation to street prices. Unbranded rack prices tend to move with the spot market.
- **Dealer Tank Wagon.** The price of gasoline delivered to a branded retail site is termed Dealer Tank Wagon (“DTW”). In a stable market, DTW is set by review of competitive prices. In an unstable market, DTW tends to move with the change in spot prices, although the magnitude and duration of the changes can be different than those of the spot market.

- **Retail Market.** The retail market is where pump prices are posted. Street prices are normally set relative to prices of other local gasoline stations. Recently, a new force in retail is emerging in the form of High Volume Retailers (“HVR”), which are operated by large chain stores aim at large volumes at low margins. HVR’s tend to price their gasoline on cost, rather than local competition.

7.2 Pricing Mechanisms

The spot market is essentially an over the counter market, with deals negotiated on an individual basis between participants. Reporting of deals and posting of pricing by reporting services such as OPIS or Platt’s occurs when both buyer and seller confirm the deal. In the California spot market, which includes deals made for supplies into Nevada and Arizona, there are between 20 and 30 active participants, and a “liquid day” is a day that sees four or five deals being concluded. More typical are days with only one or two deals. Not all reported deals are physical deals: pieces can be bought and resold several times, and become physical only when delivery is due by the final seller in the chain at the scheduled slot in the pipeline cycle.

Figure 7.1 – CA Gasoline Market Structure



Daily spot prices are driven by prompt market imbalances in supply and demand that are brought to a head by the weekly pipeline schedule requiring prompt physical delivery. Every spot purchase by definition is a one-time event. The buyer and the seller incur no obligation for future transactions, although forward deals may be transacted as adjunct to, or independently

from, the spot purchase. The cumulative effect of these transactions propels the price up when markets are tight, with several buyers chasing limited supply. In down markets, the price will descend in the absence of firm deals as sellers look for buyers at lower prices, while buyers back away. These imbalances can be as small as ten thousand barrels (10MB), with 25MB being the average 'piece'. If a refiner, marketer or trader is 'short' that amount of product and must 'cover', or purchase in the prompt spot market in order to meet physical delivery obligations, that transaction can push the spot price, as reported by OPIS up five to seven cents per gallon in a tight market. In other words, 25MB moves the deemed value of the entire gasoline inventory in the State because it represents, "the last deal done".

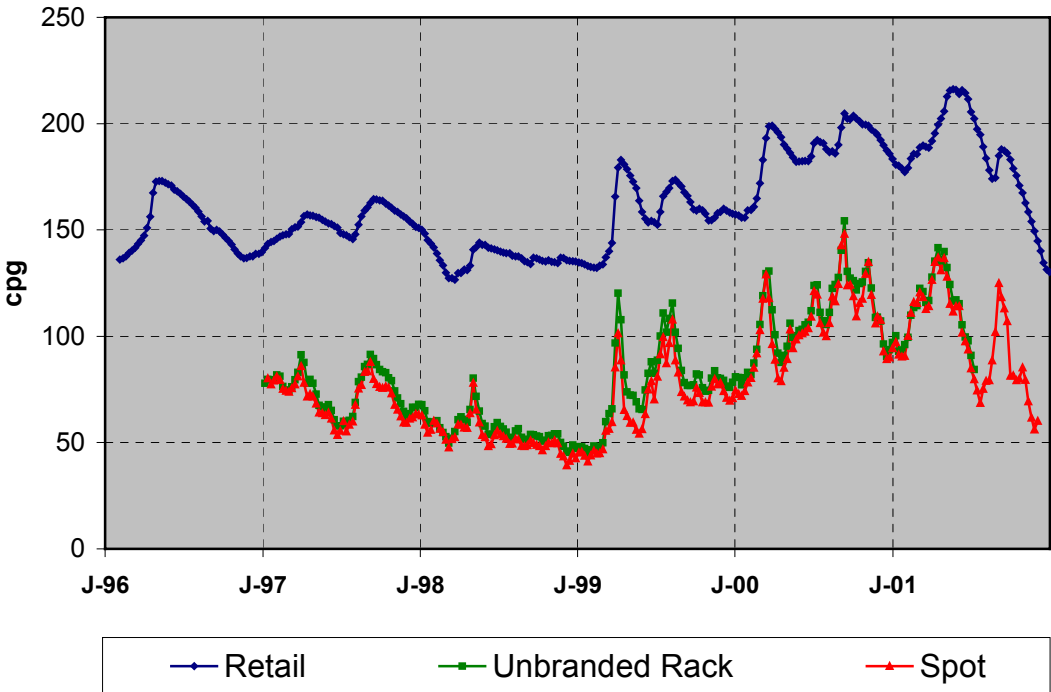
Rack pricing for gasoline is broken into two segments: Branded and Unbranded. Pricing of gasoline for these two classes of trade is complex, dynamic and interrelated. Branded gasoline wholesalers are subdivided into classifications of "jobbers" and DTW (Dealer Tank wagon) accounts. DTW prices represent the wholesale price paid by the dealer to a refiner for gasoline delivered in bulk to that dealer's retail outlets. Often the DTW price is higher than the unbranded rack, plus transportation. The branded dealer has, in effect, traded off the opportunity to take advantage of steep wholesale price declines during periods of oversupply, for a greater consideration of security of supply and an acceptable guaranteed margin over the long term. Imbedded in the DTW price is the deemed value of the supplying company's brand name.

Jobbers are those companies that service the market sector from the refiners' truck loading racks to end-user retail and consumer accounts. They establish credit lines with the refining companies sufficient to service their customer base and pick up their loads against pre-negotiated contracts. A jobber may service both branded and the unbranded accounts. They take title to the product as it passes the truck flange but may be restricted by contract to deliver certain loads only to branded customers in particular market zones. The refiners structure their contracts with the jobbers to prevent the delivery of 'unbranded rack' priced truckloads to 'branded dealers' when the unbranded and spot market prices are weaker. Conversely, they are not allowed to 'over-lift' branded gasoline during tight market and deliver those loads to the unbranded sector. Because of differences in zone pricing, even in the 'branded' sector the same jobber may pick up several loads from the same refiner on any given day and be charged a different price for each through a long-established value of TVA discounts (Temporary Voluntary Allowance).

Competition among the major brands in various metropolitan and even outlying areas rises and falls in intensity based on market-share strategies and promotions. Each market zone will be charged a price approximating what that particular market will bear, given its demographic position and a number of secondary factors such as traffic count, corner location and deemed

price-elasticity, nearest competitor, etc. The integrated refiners also operate their own truck fleets dedicated to branded gas station deliveries under the DTW system. Surveys of the major refining & marketing companies in the state have found that most do not post a meaningful 'unbranded rack' price. They remain balanced to short with respect to their refining capacity and their branded dealer downstream demand. Through recent mergers, the number of refiners supplying the unbranded rack market in significant quantities has been reduced from two to one.

Figure 7.2 – CA Gasoline Spot and Retail Prices



It is clear from Figure 7.2 that the unbranded rack price closely tracks the spot price, and that retail pricing, which includes a significant mark-up from federal, state and local taxes, follows the movements of spot and rack not only with a slight delay, but also with movements that are somewhat dampened by the fact that the refiners will protect their branded retail to some extent on the upswing, while holding on to margins a little longer on the downward slope.

Another important element of pricing is that of the transfer pricing policies within the integrated refining and marketing companies. The integrated oil companies produce crude oil, refine it, and distribute the products through their branded retail locations. None of major oil companies operating in California are completely integrated, since all of them are somewhat dependent on other companies (or countries) for crude oil supply upstream of the refinery and product supply

or offtake downstream of the refinery. In order to help measure their performance, the refiners have to have a benchmark for the crude oil and products markets. In general, they use the spot market for this gauge. They assume they are buying crude oil from their producing company at the spot, refining it, and selling the products to their retail organization at spot prices. The retail organization receives product at a spot price and sells it at retail. Their relative profitability can be described as DTW or Rack Price minus Spot Price minus expenses. This permits a company to quantify the relative profitability of each link in its supply chain.

7.3 Effect of Insularity

For petroleum products, California is an insular market, separated from world markets not just by geographical distance, but also by product quality aspects, commercial barriers and infrastructure limitations, all of which cause price differentials above mere transportation cost. There are many examples of markets that are insular in nature, sometimes because they literally are islands, such as is the case for Hawaii or Japan, sometimes because of protective tariffs, and sometimes, as is the case for California, because of a complex set of factors that prevent a free flow of goods when price differentials would dictate they do.

The relationship between price differentials between markets and the total cost to move goods between them, including transportation, duties, storage, time value of money, etc., is referred to as geographical arbitrage, or “arb”. The arb is said to be open when the differential is large enough to leave a profit to the importer, and the arb is closed when differentials do not justify movements.

In closed economies, local prices can be substantially above world market plus transportation costs because of restrictions on imports or duty barriers. Usually, high local prices then are indicative of inefficient production or limited competition, or a combination of the two.

In open economies, such as is the case for California, local prices should be at world market prices plus transport cost. However, sometimes for prolonged periods, California prices are substantially higher. Since California refineries are amongst the most sophisticated in the world, and since temporary situations of oversupply during winter months immediately result in severe price drops – as was the case as recently as December 2001 through January 2002 – it can be concluded that the insularity of the California market has not resulted in inefficiencies or uncompetitive practices. The only remaining explanation for the prolonged price excursions above world market plus arb is therefore that import options are indeed restrained by physical reasons (terminal capacity) and commercial factors (price volatility),

It is important to note that because on average, California refineries are efficient and low-cost, and are engaged in open competition, imports are not necessarily going to lower the average price. Rather, the import dependency has caused an increase in the incremental cost of supply, which in turn raises the price of the entire market and increases refining margins. The effect of an eventual SFR maybe to lower the cost of imports and reduce price spikes, but it will not lower the price of gasoline to the incremental cost of production within the State itself.

7.4 California Fuels Forward and Futures Markets

A forward market is a market in which a buyer and seller agree to a physical transaction with a future delivery date, but for which prices and delivery terms are agreed at the time of the transaction. The advantage of a forward market is that it allows a buyer and seller to lock in margins over cost on a specific shipment. However, both buyer and seller take a risk that the market may shift and either party to the agreement stands to lose or gain substantially on the deal when compared to the market conditions that may prevail at the time of physical delivery. A forward transaction implies integrity on the part of both parties to honor the commitment despite market changes. The spot market in Los Angeles currently has only a very thinly traded forward market component, i.e. only one or two forward trades are typically conducted per week and rarely for more than one month into the future.

A futures market is a market in which non-physical trades are conducted using standardized contracts under which factors such as product specifications and delivery terms are defined. Futures are transacted between licensed traders in open auctions on a trading floor rather than directly between principals, with the exchange acting as the clearinghouse for all transactions. Futures markets, such as the NYMEX (New York Mercantile Exchange) in New York and the IPE (International Petroleum Exchange) in London are subject to government regulation. Since buyers and sellers do not deal directly with each other, but rather through the institution, or clearing house, a system of margin calls and allowable "open interest" (total number of contracts, long or short, in a given month for a given company) is strictly enforced to ensure the integrity of the Exchange. At the NYMEX, futures are traded for crude oil, gasoline, and heating oil. The advantage of a futures market is that it allows parties to a forward contract not just to lock in prices and margins over costs, but also to lock in prices relative to prevailing market conditions at some future point in time. Using standardized futures, a seller can hedge a physical forward sale by offsetting it with a non-physical forward buy of another commodity that generally moves in the market at a fixed differential to the commodity he wants to sell at some future date. The process of reducing future market risk by entering into offsetting selling and buying agreements is called hedging.

A thinly traded forward paper market does exist in California but with insufficient volume to provide a bridge to a traditional futures contract. In the absence of a forward or futures market, a trader or importer bringing products into California takes a significant gamble, given the volatility of the market. The importance of the existence, or rather lack thereof, of future or forward markets for the California fuels situation lies in the insularity of the California markets in general. A potential importer of a cargo of gasoline typically has to take a decision to produce and load a cargo 6 to 8 weeks before it will reach the market. Even though the spread between production costs plus shipping costs and the California market price may be very attractive at the moment a decision has to be taken, the situation may be reversed by the time the cargo finally reaches the market. Many importers would prefer to lock in a known margin of 1 or 2 cpg at the time of shipment, rather than take a gamble that a 20 cpg price spike in the California market will last until their cargo arrives⁴². A cargo of gasoline arriving on Friday could be valued at twenty cents per gallon lower than one arriving on Monday of the same week, a potential loss of millions of dollars.

Because the lack of forward price protection inhibits out-of-State suppliers from delivering cargoes to California, price spikes are exacerbated and become long plateaus of relative price elevation. A futures market would enable hedging and liquidity, which in turn will attract cargo re-supply when needed.

The question now becomes, what can be done to promote liquidity and create forward and futures markets for California gasoline. A survey of a broad range of market participants, including Futures Markets planners and administrators, confirmed that the prerequisites for a commodity futures contract to take root in any market are:

- **Market Liquidity.** There must be a minimum number of buyers and sellers in the market, each with different business orientations, who together form sufficient critical mass to conduct a minimum number of transactions daily.
- **Fungibility.** There needs to be an established transaction flow in a product with a common specification or with established price differentials to other commonly traded commodities. Heating oil, for example, has been a very successful NYMEX commodity because its specifications can cross over to a number of markets: Jet fuel, transportation diesel, home heating oil, kerosene, etc. Diversion from this basic commodity spec can be evaluated in the physical market between buyers and sellers. The NYMEX contract can still be used as a basis for exchange after factoring in such value differentials. California

⁴² Information received from all traders and importers during the Survey meetings with industry Stakeholders.

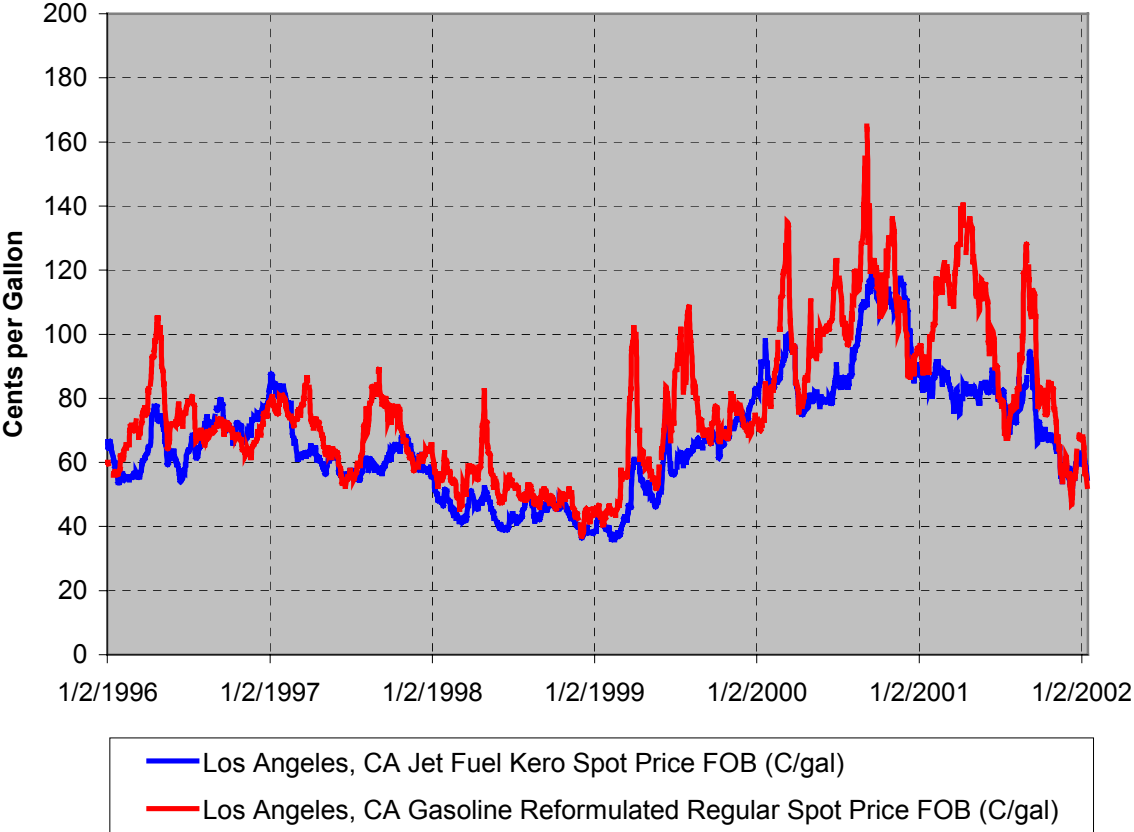
gasoline and CARB diesel, on the other hand, are unique formulations that contribute to the isolation of the State and to price volatility. This is one of the major obstacles for establishing a liquid futures market in California.

- **Physical Delivery Point.** A futures contract buyer, also known as 'a holder of a long position' retains the legal right to demand physical delivery of the commodity upon expiration of that contract. Without a basis in guaranteed physical delivery, a commodity futures market would be merely an arena for speculating on price movement in the absence of underlying value. Given this necessity for physical delivery, California has never been seen as a fertile field for a traditional futures market, such as NYMEX to take root. There is no common storage available to non-California refiners or international traders. It has been noted that the Kinder Morgan (KM) pipeline gathering system could serve as such a delivery point, if it were to be linked to common storage accessible to various classes of trade. Existing refineries and most product terminals are already connected to the KM gathering system. A State sponsored SFR commingled with private sector inventories could provide the common storage that could form the physical delivery point for a standardized futures commodities contract.
- **Multiple Supplies.** There should be a variety of supply points into the locus of the futures contract. NYH is easily accessible by vessel from such diverse points as Northwest Europe, South America, the US Gulf and Caribbean areas.
- **Diversity of participants.** Besides diversity of geographical supply points, the participants should also represent a diversity of interest in order to ensure market liquidity. For example, in New York Harbor (NYH), besides the refiners and global traders, there are over twenty-five local companies involved in shipping, blending, trading, marketing, etc. These spot-market oriented companies tend to depress price spikes by blending batches to meet local demand. Gasoline blending is not feasible in California outside the refining systems due to the lack of available storage, the Unocal Patent barrier and the severe penalties attached to off-test blends. The greatest part of a futures market's liquidity actually comes from non-integrated traders and energy companies. The integrated majors tend to regard their integrated supply chains (i.e., Crude ⇒ Refinery ⇒ Distribution System ⇒ End Customer), as a natural hedge against price aberrations that occur at any point in the value chain, such as local price spikes in gasoline or heating oil.
- **Day-to-Day Participation.** A commodity market is most effective when buyers and sellers enter the market every day. A stop and start system, as would be engendered in

a boutique fuels market such as California gasoline, does not lend itself to a viable futures market.

One finds most of these prerequisites fulfilled in connection with the Los Angeles jet fuel market, but not in gasoline where there is no common specification, no common storage and no established transaction flow from alternate sources. Consequently, the price volatility for jet fuel is far lower than for gasoline as illustrated in Figure 7.3. While jet fuel tracks the same underlying trend as gasoline, which is mainly related to crude oil pricing, the jet prices do not show the spikiness and volatility of gasoline.

Figure 7.3 – LA Spot Prices for Jet Fuel and Gasoline⁴³



It should be noted that futures trading has sometimes failed in other markets. The NYMEX U.S. Gulf Coast Heating Oil and Gasoline contracts, for example, could not generate enough liquidity (transaction volume) because the Gulf Coast is essentially a supply center rather than a consuming center. In theory the contract had a chance to work, in that Gulf Coast refiners might want to hedge their production locally. Instead, they preferred to continue using the

⁴³ Source: EIA daily spot prices

destination market of NYH on a net back basis (NY price minus a differential). Singapore crude oil was another failed experiment. A Brent vs. Dubai (European vs. Asian) crude contract was established in the mid nineties to capture more efficiently the international flow of cargoes and prices. The contract was ultimately under-subscribed, largely because of an Asian business culture that prefers negotiated deals to anonymous, electronic transactions. Basically, these experiments lacked one or more of the prerequisites indicated. Nonetheless, a California futures market for gasoline, diesel and perhaps blend stocks could emerge in the private sector through the operation of an SFR if the following strategic elements are incorporated into it:

- SFR inventories are commingled with private sector inventories.
- The tankage is connected to the Kinder Morgan gathering systems in the Los Angeles basin and in the Bay Area.
- Use of the SFR inventory is triggered by time-trades, or buy-sell agreements rather than outright sales.
- Access to the SFR inventories is open to various, pre-qualified classes of trade.
- The SFR has direct waterborne access for incoming cargoes and can serve as the physical delivery point for a futures market.

8 DESIGN AND EFFECTIVENESS OF THE RESERVE

Based on the above, the most effective design of a reserve will be that which will function not as a stagnant inventory set-aside program, but as highly liquid physical delivery point for imports, fully integrated into the refining infrastructure, marine terminals, and distribution pipeline systems, with its volume accessible to qualified participants as a “bank” from which supplies may be drawn against a fee, with repayment in kind within a specified time frame.

The very existence of such a bank will provide a center for discharging incoming products cargoes. By virtue of being located at the head of the distribution pipeline systems the SFR will provide a clearing center for price and transaction liquidity. By commingling any State-owned inventory with private sector supplies (similar to the Heating Oil Reserve in NYH), a double benefit can be gained. First, the commingled product will be constantly “turned over” in the normal flow and scheduling process. This will insure seasonal quality integrity and prevent quality degradation. Whether release of State-owned SFR inventories are to be triggered by pre-defined price formula, or unscheduled refinery events under one model, or by a regular withdrawal allowance system as an “oil bank” under an alternative model, the effect of such release will be to draw the island of California more rationally into regional price and logistic patterns (geographic arbitrage).

8.1 Tank Space

The rigorous quantitative analysis carried out by Dr Tony Finizza⁴⁴ indicated that a volume of 900,000 bbl is sufficient to cover all but 10% of refinery disruptions. However, several factors make that the originally planned net volume of 2.3 MM bbl (2.5 MM bbl gross), is still the right number:

- As shown in Section 2.3, logistic factors call for reserve volumes to be fully integrated with both the LA Basin and the Bay Area refining centers, forcing a split in total volume. At just over 1 MM bbl each, according to Dr Finizza’s analysis, these local reserves would be individually capable of dealing with a major disruption in their respective refining center.
- The use of the reserve as a forward market mechanism to facilitate imports will imply that at any given point in time, a significant portion of the reserve may be lent out and somewhere in transit on its way back.

⁴⁴ Anthony J. Finizza, Ph.D., *Economic Impact of Refinery Disruptions*, CEC Study, June 2002

- Although not specifically designed to deal with major emergencies, the value of the reserve to also act as a safeguard for California's gasoline supplies in case of a major disaster such as an earthquake or terrorist act, the value of a reserve for these purposes would be greatly diminished if reduced to a bare minimum.
- Dr Tony Finizza's analysis is based on historical numbers and the expectation is that California's gasoline supply situation will worsen considerable over the coming years, as shown in Section 1.4.

Based on the findings of Section 6 above, tank space will have to be newly created, and the most cost effective way of doing so is by issuing a tender for bids by qualified commercial storage operators for a long-term, i.e., 10-year contract for storage space. To suppress the cost of the State's share and to help create storage space for use by third parties not normally capable of entering into the long-term agreements tank operators need as financing prerequisites for new storage, the State could request double the amount of tankage to be built, but offering only minimal guarantees for the excess capacity, with would oblige the commercial operator to exercise best efforts to find lessors.

Assuming that the base 2.5 MM bbl can be leased for \$0.50 per bbl per month for a cost of \$15 million per year, and that the State's guarantee for the additional 2.5 MM bbl will be \$0.35/bbl/month, and the guarantee on average will be evoked for 10% of the time, costing the State an additional \$1 million per year, then the total cost for the storage will be \$16 million per year.

With the tanks operated as a fuel bank, all additional operating costs identified in Section 6 above, such as volume losses and pipeline fees, will be absorbed by the parties drawing from the reserve and replacing it.

8.2 Fuel Quality

As discussed in 2.2, the reserve will have to be designed such that all requirements for gasoline quality will be met. The most cost effective way of ensuring that compliant gasoline can be delivered from the reserve as needed, is to store only summer grade CARBOB in the SFR tanks. The chances that a reserve would be called upon during the winter driving season is low, and even in the unlikely event that gasoline would have to be supplied from the reserve during the winter season, it would not be too difficult or onerous in terms of costs to increase vapor pressure by blending in lighter components to ensure usability of the fuel in colder regions of the State.

However, if only summer grade CARBOB is allowed in the reserve tankage, while most imports that will be brought in to backfill the SFR after usage are likely to consist of blendstocks or near-conforming gasoline blends, facilities must be created to enable receipt of other than finished gasoline imports, which can subsequently be blended off to produce conforming CARBOB. It is therefore proposed that in addition to the 2.5 MM barrel capacity of the SFR itself, measures are taken to facilitate the building of additional storage integrated with the SFR.

Figure 8.1 – SFR and Satellite Commercial Storage

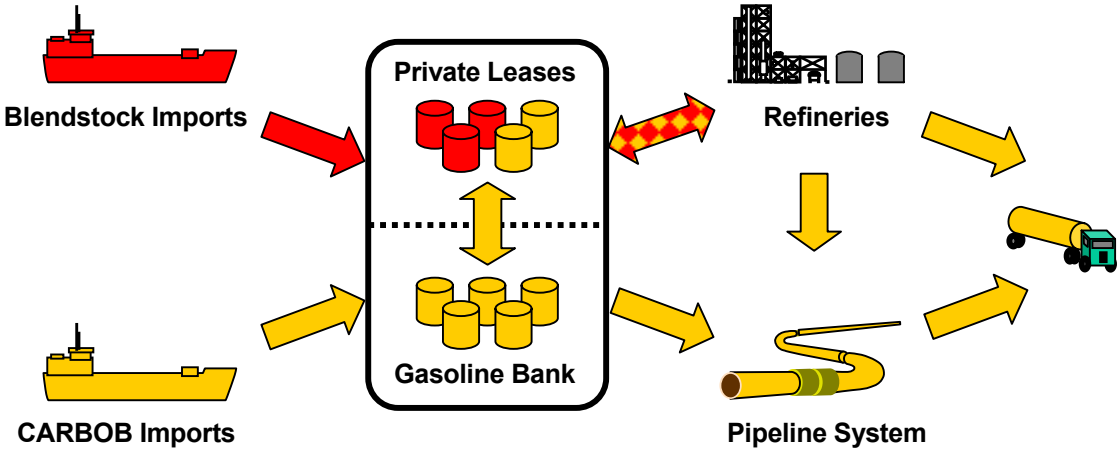


Figure 8.1 shows the concept whereby additional tankage is created for private leases next to the State owned inventories that form the gasoline bank. This will enable users of the SFR to bring in blendstocks and blend these off in cooperation with local refiners to conforming CARBOB for repayment of volumes borrowed from the SFR.

8.3 Initial Fill

Based on a recent-years historical range of gasoline prices from 50 to 130 cpg, the initial fill of 2.5 MM bbl can cost anywhere from \$50 to \$140 million. There are however several alternatives open for the State to minimize the upfront capital outlay for this purchase.

Firstly, a partial offset can be claimed against the Federal Petroleum Reserve, because volumes held in reserve as products in California need not be covered by a corresponding amount of crude oil in the Texas caverns. This mechanism was also used in part to fund the Eastern Heating Oil Reserve.

Secondly, the fuel will not be consumed, but will remain substantially in place as collateral, with guarantees in place from qualified participants for volume lent out at any point in time. It should therefore be possible to secure debt against the collateral, possibly subject to margin calls if the underlying risk of fuel price fluctuations cannot be entirely secured by forward rolling hedge mechanisms.

A reasonable estimate therefore seems to be that the costs of the initial fill can be reduced to the cost of the debt service on part of the purchase costs, possibly in the range of \$5 to \$10 million per year.

In order not to cause a market disruption, it will be important to purchase the initial fill quantity gradually, preferably during the winter season and from remote sources. Contrary to what has been suggested in AB2076, it is recommended to include local refiners in the parties allowed to bid on tenders for the initial fill. During the winter season, some spare capacity usually exists in the California refining system, and the local refiners would be able to use imported blendstocks to complement local capacity to produce CARBOB for storage in the SFR.

8.4 Participants

Access to the reserve volumes is one of the key questions that was raised during the Stakeholder Meetings. The options on this issue range from an entirely open forum, whereby even non Industry participants capable of posting financial guarantees would be invited to an SFR auction, to a highly selective core group of major oil companies. Each of these options is discussed in detail below.

- **Open Forum.** It can be argued that a truly democratic approach to operating the SFR would be to open the bidding for supply to all financially capable applicants. This approach was tried with the Federal Crude Oil Reserve with disastrous results. The winner of the initial purchase bid turned out to be a non-industry party who was not capable of performing under the terms of the contract upon winning the bid. This caused confusion, and became an embarrassing waste of time and money. Since the recommended solution for the California SFR is a “time swap” mechanism rather than an outright sale of product, (see “Operating Mechanism below), the system will require a high degree of familiarity with contractual and operational issues, such as scheduling pipelines and vessels, product quality details, etc. There will be an obligation incumbent upon any successful bidder to physically perform the contracts on both the inventory drawdown side and the product replacement side. Product will move into and out of the SFR on a contractually binding schedule. This will require a measure of professional

expertise with the California supply and distribution system. Financial ability alone will not suffice to qualify an applicant to participate in the auction process.

- **Refiners Only.** Another theory advanced has been that only California refiners should be allowed to draw product from the reserve. Since price spikes are primarily caused by unscheduled events in a refinery, such as fires, explosions, unit downtime, etc. it could be argued that it is the refiners alone who should avail themselves of the product held in reserve by the State. If not limited to the particular refiner suffering the problem, then the field of auction participants should at least be narrowed down to the Refining class of trade. On the other side of this argument stands the widely acknowledged fact that a price spike caused by a supply interruption at a particular refinery impacts the statewide gasoline market, to some degree. The laws of 'force majeure' do not relieve a commodity supplier from delivery obligations under contract, so long as alternative supplies of that commodity are available, at some price, in the market. So too, a refinery suffering an unscheduled event that causes production curtailment and a price spike remains bound to cover his contract obligations so long as alternative supplies can be purchased or acquired through trade. That refiner, and the refining class of trade as a whole, should have the right to bid for product from the SFR, but it is not an exclusive right any more than California petroleum products are an exclusive market. Business Interruption Insurance is available to the manufacturing sector of any industry.

- **Qualified Stakeholders.** The balanced approach is to invite Industry professionals to participate, subject to predefined financial and performance criteria. Under this scheme all market sectors in California would be allowed to compete for product released from the SFR in volume increments consistent with their operational needs and credit limits. It may be necessary to install volume limits for individual companies in order to prevent too much of the SFR falling into too few hands, thereby creating a market control situation. A concerted effort must be made to ensure that qualified Independents have access to the SFR system.

8.5 Effect of Mobilizing Reserve Volumes

When the creation of the Northeast Heating Oil Reserve was being discussed, there was speculation that inventory managers would take the government's inventories into account when planning their inventories⁴⁵. The theory was that creating a reserve could lead to lower inventories because the government would be there as a backstop. Similarly, during the

⁴⁵ Statement of Neal L. Wolkoff, Executive VP, NYMEX before the US House of Representatives Committee on Commerce, Subcommittee on Energy and Power, October 19, 2000

Stakeholder meetings, several companies suggested that a fuel reserve could reduce commercial inventories.

In the course of the Stakeholder Meetings conducted for this study, a number of companies who are participants in the Northeast Heating Oil Reserve were interviewed. None of them thought that the existence of the Reserve impacted commercial inventory planning practices. However, the Northeast Reserve has only been in existence since the fall of 2000 and seemed to be a non-factor in the heating oil market after it was filled.

The workable inventory range for gasoline at the refineries is between 8 and 16 million barrels (see Figure 4.2), which equates to a mere 8 days of production. Over half of this inventory consists of blendstocks and components. In Section 4.7 it was shown that the primary considerations for refiners in setting inventory targets are operational necessities. This was borne out by information received during the Stakeholder Meetings, during which refiners without exception reported that their operational considerations are paramount, with inventories resulting from fluctuations in demand and production that are largely unplanned.

The presence of a reserve can be a concern however to importers, who may be reluctant to commit to a cargo that would arrive 6 to 8 weeks after the onset of a price spike if volumes from a reserve are overhanging the market. To avoid these concerns, criteria can be formulated for release mechanisms:

- Release mechanisms must be clearly formulated and strictly applied.
- If an event driven trigger mechanism is chosen, the conditions for release should be set so high as to apply only to exceptional emergencies, as is the case for most large scale Strategic Reserve's. The presence of such reserves seems not to interfere with day-to-day market operations.
- Because the purpose of the California SFR is to mitigate price spikes, which are frequent events, it is by definition impossible to create sufficient distance between normal market levels and an event that would trigger release of reserve volumes. If an event driven trigger mechanism were chosen for the California SFR, it would likely have an adverse effect on marginal supplies. *Therefore, release mechanisms for the California SFR need to be designed for continuous use, whereby the primary goal of the reserve is to function as a mechanism for forward trades and facilitate rather than hamper marginal supplies.*
- Access to the reserve must be open to all classes of regular suppliers and distributors of gasoline and components, with an option to borrow and repay in kind (time swap).

Some “gaming” of the release rules can be expected and trading around the lifting rights or obligations to replenish are expected to create a satellite market which is likely to improve overall market liquidity in California. The potential for misuse of the reserve volumes can further be minimized by providing adequate oversight. Since the use of the reserve volumes involves prompt physical lifting with physical replacement of volumes borrowed, and involves only a limited number of participants, it is an easier process to oversee and regulate than many of the current commodity trading hubs.

8.6 Operating Mechanisms

Given the considerations above, the proposal is to operate the reserve volumes as a base volume for time-swaps. This trigger mechanism has distinct advantages over event driven triggers, which have the problem that hurdle levels can be set either too low (preventing normal market re-supply), or too high (requiring real economic damage to occur first). The time-swap operation also answers best to the requirements formulated in AB 2076:

“The commission shall evaluate a mechanism to release fuel from the reserve that permits any customer to contract at any time for delivery of fuel from the reserve in exchange for an equal amount of fuel that meets California specification and is produced from a source outside California that the customer agrees to deliver back to the reserve within a time period to be established by the commission, but no longer than six weeks.”⁴⁶

At this stage of early feasibility study, the evaluation of the release mechanisms is limited to conceptual considerations. As appropriate for an early stage feasibility study, the means are currently not available to complete the detailed design necessary for final investment decision and commencement of operations. Four alternatives for the operation of the SFR are currently deemed viable, and will merit further evaluation:

- **Daily scheduled auctions.** Auctions for the use of the reserve’s volumes would be held daily, preferably in a fully transparent format, i.e., on an electronic exchange, whereby a pre-qualified participant can bid on a fee to pay for prompt lifting with redelivery within 6 weeks. To prevent an early stock-out, the quantities that can be auctioned off on a daily basis must be limited to a prorated portion of the reserve. For instance, a workable solution may be to limit the amount of gasoline and blending components to be auctioned

⁴⁶ California Assembly Bill 2076, Chapter 8.2, Section 25720, para (4) (c)

of for prompt lifting with redelivery 6 weeks later, to 50 TBD. Then, because there are 30 working days with auctions in the intervening period, on average 1.5 million barrels will always be on the water, with a remaining reserve of 1 million barrels in storage. A volume of 50 TBD daily is relevant to the shortfall that is predicted after the phase out of MTBE, and is also relevant to the production loss of 29 TBD, which is the average reported number for refinery disruptions. A limit of 50 TBD would not allow all California imports to be hedged through forward swaps using the reserve volumes. Moreover, a limit of 50 TBD will not allow an importer to cover a full cargo of up to 300,000 bbl in one transaction. However, not all imports need to be covered through forward transactions in order for the material to make its way to California. For instance, the major refiners currently bring significant volumes to the State from within their global refining systems, and will average out gains and losses over the long term.

- **Weekly scheduled auctions.** Weekly auctions would be similar to the daily model described above, with the quantity raised to 300,000 bbl. A weekly event would reduce overheads somewhat, and has the advantage of enabling to bid on a quantity that corresponds to a full cargo size. Moreover, the weekly auction could be timed to fit the weekly pipeline notification schedule.
- **On Call Auctions.** Auctions would be held within a pre-agreed format and venue, but only when called for by one of its accredited participants. This model will be better suited if the predominant use of the forward time-swapping mechanisms is mitigation of refinery disruptions rather than as a means to facilitate a forward pricing mechanism for regular imports.
- **Fixed Fee Usage.** Rather than having to bid for the time-value of the product within the backwardation of the market, users of the reserve for forward time-swaps could be charged a simple fixed fee. This will make it easier for importers to take decisions on available cargoes, in that they can commit to a sale before having to wait what the auction fee for the forward swap will be. On the other hand, the fixed fee doesn't allow market forces to place a value on the backwardation, but would effectively set the backwardation at whatever the fixed fee would be.

At this stage of early feasibility study and conceptual analysis, it is sufficient to say that each of these alternatives appears imminently viable, and that there do not appear to be any fundamental reasons why a forward time-swap mechanism utilizing volumes made available by the State cannot be made to work. Given the tremendous potential for consumer benefits as outlined in the remainder of this study and as confirmed by the analysis of Dr Tony Finizza, a next step that would involve a detailed design of operating mechanisms seems fully justified.

8.7 Fees

In the light of historical values of market backwardation is not unreasonable to assume an average fee of 2 cpg for eliminating a 6-week price risk. At this rate, and assuming 250 trading days with an average of 50 TBD in volumes, the gross revenues for the State from the reserve's operation as a bank for forwards time-swaps will be approximately \$10 million per year.

8.8 Reserve Management and Oversight

There is currently no State agency that has the necessary experience or qualifications to perform the operational duties involved in managing a petroleum product terminal. In order to be cost effective, the function of managing the SFR will therefore have to be outsourced to private industry on a competitive bid basis. Operating the SFR means both managing its physical aspects, such as safety, quality assurance and scheduling, as well as managing the auctions, credit and collections of the State-owned inventory. For the latter, the best suited private industry entities are not the same as those who can run the terminals, and the best approach is likely to be for the State to issue separate tenders for each of the two functions.

Even when the State will outsource both the physical and commercial management of the reserve, the requirement will remain to create an oversight function within a suitable State Agency, that would be empowered to supervise the reserve's operations, with authority to issue the tenders for building or converting the required terminal capacity under long-term contracts, and for the purchase of the initial fuel inventory. This Agency will further need the authority to regulate the auction process for the forward time-swaps of fuels in the reserve, to qualify participants and to oversee the usage of the fuels by the participants, with the powers to revoke trading privileges in the event a participant is delinquent on timely redelivery of borrowed volumes, or is caught using the reserve volumes for speculative purposes.

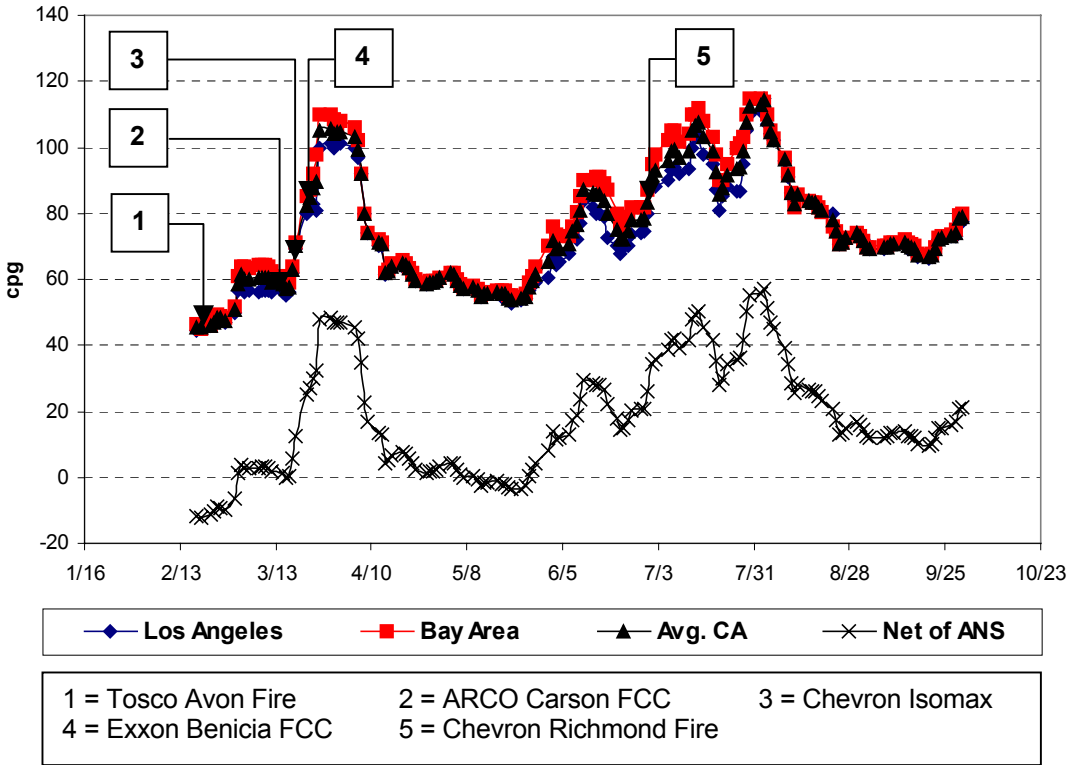
8.9 Effectiveness

At 2.5 million barrels, of which an estimated 2.3 million are effectively usable, the proposed reserve represents only little more than 2 days of the combined demand of gasoline supplied out of California. If the time-swap mechanism is adopted to create a forward market and stimulate imports, then the inventories at hand at any point in time may be as low as 1 million barrels only, with 1.5 million barrels on the water, on its way to California. Moreover, this volume will be divided between the two refining centers in the Bay area and the LA Basin. To evaluate the effectiveness of the reserve, it must be shown that such a relatively small volume can indeed mitigate the impact of refinery disruptions. Separately, in Section 9, it will be shown to what extent benefits of mitigating the price spikes outweigh the cost of the reserve.

A rigorous analysis of refinery disruptions and their effects on inventories and prices was carried out in parallel to this study, also on behalf of the CEC, by Dr Tony Finizza⁴⁷ who concluded that the mean expected value of the volume impacted by a refinery disruption (disrupted barrels = capacity loss x duration of the outage) is around 400,000 bbl. The 90th percentile (i.e., only exceeded by 10% of the disruptions) was just under 900,000 bbl. As outlined in Section 8.1 above, the proposed volumes for the reserve cover at least the 90th percentile refinery disruption for each of the refining centers and can therefore be considered effective.

In addition to Dr Finizza’s detailed approach, an analysis is provided below of the California gasoline market equivalent of the 100-year storm for which the NE Heating Oil Reserve was designed. The events that marked the worst year in the recent history of refineries in California occurred in 1999, when a series of fires and operating problems at several refineries caused two significant price spikes.

Figure 8.2 – 1999 CA Refinery Outages and Price Spikes



⁴⁷ Anthony J. Finizza Ph.D., *Economic Impact of Refinery Disruptions*, CEC Study, June 2002

As can be seen in Figure 8.2, a series of refinery events, two fires and several minor outages, caused a rapid run-up in prices between February and April. Although prices had almost returned to normal by late May, they started moving upward under pressure of the summer driving season while supplies and inventories had not fully recovered from the earlier supply disruptions. When in July another major refinery fire occurred, the market reacted with a prolonged run-up in prices.

Figure 8.3 shows to what extent supplies and inventories were affected during these events.

Figure 8.3 – 1999 CA Gasoline Inventories and Weekly Production⁴⁸

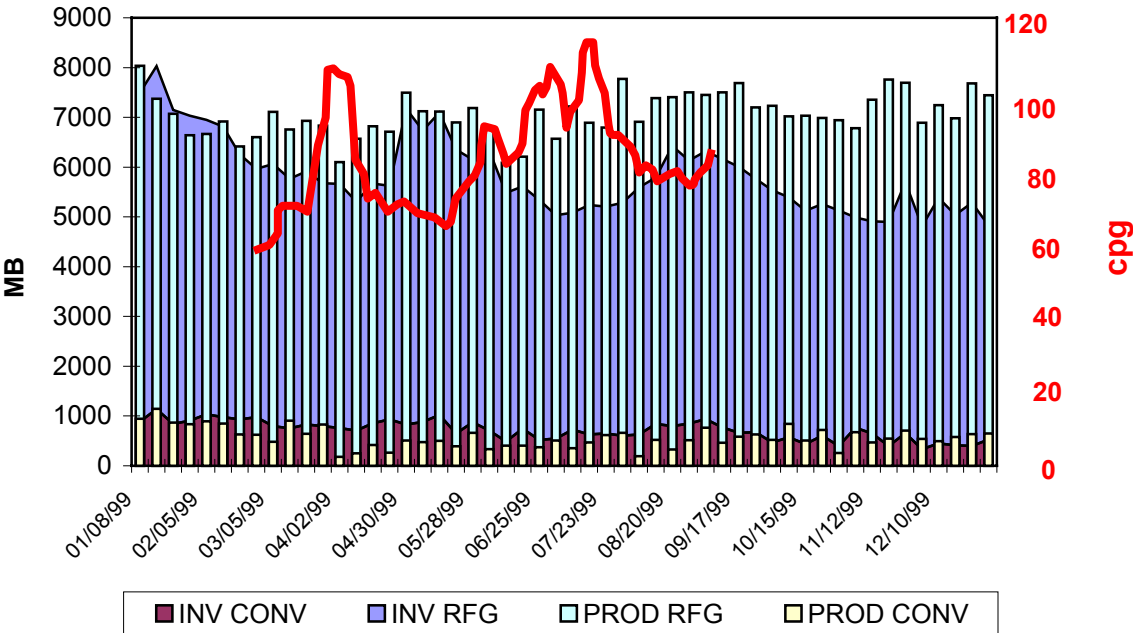


Figure 8.3 shows how the inventory of finished RFG and non-RFG gasoline during the 1999 price spikes dropped from an average of 7.5 to a low of 5 million bbl, while the variations in total weekly production of RFG and conventional gasoline were from a high of around 8 million barrels per week to a low of 6 million (1140 to 850 TBD). Equally important is that the average rate of decline in inventories during the first series of events was 125 MB/week, and in the second price spike 200 MB/week.

If a reserve of 2 million barrels had been available, it would have enabled an additional supply of 200 MB/week over a period of 10 weeks, well beyond the delay within which additional

⁴⁸ Source of Data: EIA, CEC, Weekly Fuels Watch

imports could have been mobilized. Moreover, with the forward time-swap mechanism offering price protection to importers, cargoes would have been launched earlier. By contrast, without forward protection, an importer who would have bought a cargo in mid March 1999, at the while a steep run-up was in progress, could have lost a substantial amount of money by the time his cargo arrived in late April.

The conclusion is that a modest reserve of 2 to 3 million barrels can be effective in mitigating the effects of even severe supply outages if it is deployed in such a way that it will facilitate imports. If a reserve were to be created as an offline pool that is not part of the normal flow of imports and trades, it is likely that its deployment during the first price spike would have prevented any imports from coming in. In the absence of imports, there would have been no way to replenish either the reserve or industry inventories before the second series of events, and at the height of the summer driving season, the result might well have been even more onerous for the California gasoline consumer than was the case in 1999.

8.10 Commercial Effectiveness: Convergence of Physical and Paper Markets

Certain stakeholders have suggested that a forward market could be stimulated by economic incentives, or by converting government contract purchases to forward contracts. An analysis is presented below that shows how California's unique requirements call for more than paper instruments and how the proposed SFR will be effective where mere stimulation would not.

8.10.1 Physical versus Paper Markets

In certain circles the proposed SFR is perceived as an unnecessary government intrusion, and that an SFR is not the proper tool to create a forward market. Admittedly, the two issues are not inextricably linked (SFR and Forward Markets). But it is the physical nature of the problem that is overlooked by paper market solutions. Dr Phillip Verleger illustrates this point in his work on physical and paper markets prepared for the California Energy Commission⁴⁹. Dr Verleger's inductive conclusion that "*inventories tie markets together*" confirms the issues raised in this study about the physical barriers to entry caused by California's lack of infrastructure. However, his observation that, "*spreads between spot and forward or futures prices are correlated with the level of inventories*" must be modified when one focuses on California. This insight may be an axiom in integrated commodity markets, such as NYMEX Heating Oil. But the 'island effect' in California causes a significant lag factor to enter the

⁴⁹ The Status of Paper Markets for Energy, Philip K. Verleger, Jr. Senior Advisor to the Brattle Group and President, PKVerleger LLC, September 25, 1997

equation, which intensifies and prolongs price spikes. The problems are storage and liquidity.

The implementation of the California SFR, triggered by a time exchange auction, provides a unique solution for circumventing many of the market barriers described in this report. It does so by lessening the *uncertainty factor*. It creates a physical correlation between shipping and price arbitrage opportunities from remote supply points (The U.S. Gulf, Australia, Finland, The Caribbean, The Arabian Gulf, etc.) It introduces a new set of pricing dynamics, more in line with the Nash equilibrium than with island oligopoly.

Such an assertion draws attention to another of Dr. Verleger's observations, "Markets are Linked by Arbitrage", wherein he borrows from the American Heritage Dictionary in defining the term: "*The purchase of securities on one market for immediate resale on another market in order to profit from price discrepancy.*"⁵⁰ As amply illustrated throughout this report, the island of California is disconnected from such arbitrage opportunities because of a lack of third-party storage.

Dr. Verleger also points out by example that, "attempts to distinguish between markets (paper and physical) based on the method by which prices are established are meaningless. The way prices are set is simply a form of convenience to the parties, except in the case of organized futures markets."⁵¹

It can be argued, of course, that the mere existence of storage tanks will be sufficient for the California gasoline market to achieve rationalization against the global arbitrage through private market competition. That there is no need for the State to hold inventories, since the unseen hand of the market will always supply the demand if physical access is available. But tanks alone will not annihilate distance, as does the SFR. The private market will have no incentive to hold inventories and promote imports by creating forward time swaps in order to mitigate price spikes caused by refinery disruptions. The SFR time-swap mechanism proposed herein will serve several purposes which private industry is ill equipped to serve. It will provide the arbitrage linkage as described by Dr. Verleger. It will fulfill his accurate prescription that, "Inventories Tie Markets Together"⁵² Finally, it will serve as the physical basis for more

⁵⁰ Ibid Page 11

⁵¹ Ibid Page 10

⁵² Ibid – Section IV Heading, Page 12

robust forward and paper markets, thereby eliminating the “meaningless distinction” between them.

In some quarters these observations raise another set of questions with respect to the role of government in the process. The SFR swap mechanism will not put the state in the market in terms of price setting, but rather as a facilitator of trade. This is a far cry from the Hawaii legislative model of wholesale and retail price caps. Prices will continue to react to the laws of supply and demand, driven by private sector competitions. The difference from today’s captive market lies in the SFR’s capacity to bridge time and distance and to act as a fire extinguisher on price spikes driven by the flames of speculation and by spot market shortages. Such a buffer stock mechanism will be increasingly necessary for market stability with the phase out of MTBE and with the introduction of Ethanol. It has been illustrated in a separate Stillwater Report on MTBE Phase Out that that transition will result in an increased needs for imports of 5% to 10%, or up to 100,000 barrels per day.

8.10.2 Lessons of the Past

In Section 7.3 of this report, gasoline market aspects were analyzed of other island economies: Hawaii, Japan, Australia, and the U.K, where global arbitrage had been inhibited and island prices inflated by the lack of independent storage and distribution capability, which were corrected by the creation of storage and opening of cargo trade. There are other useful lessons of petroleum products history that should be brought to bear on our analysis, namely:

Jet Fuel Market Evolution. In Section 7.4 it was shown how jet fuel prices are far less volatile than gasoline and explained the underlying reasons: (1) Fungible Specification, (2) Ample storage in third party hands, (3) Forward Market liquidity, (4) End user participation, and (5) Global arbitrage accessibility.

This salient set of circumstances is not fortuitous. The Airlines were once *locked out* of access to airports from a fuel supply perspective. Jet Fuel storage facilities had been in the hands of major oil companies until the oil embargo of the mid seventies. In those days, the local price of aviation fuel was controlled by refiners who, in essence, also controlled the means of storing and delivering the product. The Carter Administration oil shock, with its resultant widespread shortages, sent every Airline Company into a global scramble in the cargo markets. But, in order to bring a cargo from, let us say, Singapore into LA and/or San Francisco Airports, the Airline Company would need to pass through the storage tanks owned and operated by the local refiners. This could

not be done without changing the system. Storage and distribution facilities were “proprietary”, while imports were presumably the province of the major oil companies. By pooling their demand and investing in storage tanks, the airlines transitioned from their weak position as captured customers, with open access to international supply but no access to local distribution, to the powerful, market-balancing role that they play today.

Gasoline, as a private party commuter fuel, is much more of a gallon-by-gallon market than jet fuel, which is bought and sold in bulk. In aggregate, however, it is a far greater and more integral part of the California energy equation. Because of the barriers to supply that have grown up around gasoline, it becomes incumbent upon the state to restore competitive balance through the SFR operation. There is no identifiable incentive in the private sector to do so. And whereas the Airline Companies were able to ‘hedge’ their inventories against the commoditized NYMEX Heating Oil contract, the SFR exchange will enable gasoline wholesale consumers to hedge more effectively because its forward value will be transparent.

NYMEX Evolution. The second lesson of history is NYMEX itself. Before its Heating Oil contract was launched in the early eighties, the New York Mercantile Exchange conducted extensive market research as to which market sectors were most likely to subscribe to it. The first order of business was to locate the storage facilities in and around NY Harbor that could serve as delivery points. Physical deliverability was seen as absolutely essential to the legal and commercial foundation of the contract. Initially there was great resistance, particularly among the refiners, to the idea that an instrument commonly associated with grain, coffee beans and pork bellies might be applied to the ‘liquid gold’ of petroleum. Over time, even the major oil companies began to subscribe to the NYMEX in order to hedge their own price risk and expand market liquidity. The California SFR will meet the same initial resistance. But it appears to be the best solution to the complex supply, price and logistics problems that are described in this report.

Summary. Both the evolution of the jet fuel consortium and of the NYMEX petroleum contracts illustrates the absolutely essential role that storage plays in the areas of both geographic and price arbitrage. These perceptions are borne out in theory and in fact by Dr. Verleger’s work and by a common sense view of the situation. Terms such as: “extreme volatility”, “geographic isolation”, and “supply dislocations” belong to the vocabulary of captive markets. In the case of California, arguments will be heard that lay the blame wholly at the feet of the unique specifications for CARB gasoline. “Create

a fungible spec and price spikes will disappear” is commonly voiced as a panacea. But there are many more sides to the problem as explained in the body of this report.

The SFR time swap moderates price spikes. It stimulates liquidity without sacrificing either the clean-air quality of CARB gasoline, or the State’s position of leadership in this vital area. It is practical and relatively cheap. On these grounds, we recommend that CEC take the next step by entering the more detailed phase of the SFR feasibility analysis.

9 OVERALL COST/BENEFIT EVALUATION

For the purpose of this study, which is to establish the conceptual feasibility and does not yet incorporate engineering level cost estimates or firm offers for services, costs and benefits will only be evaluated at an order of magnitude level. A more detailed and more rigorous quantitative analysis of the benefits of the reserve, notably with regard to reducing market volatility caused by refinery disruptions, is provided by Dr Tony Finizza in a separate report⁵³. Dr Finizza's conclusions are in good agreement with the overall numbers presented here.

9.1 Cost

The costs as calculated in Sections 6 and 8 can be summarized as follows:

- Lease of 1 MM bbl of new tank capacity in the Bay Area @ \$0.50/bbl/month: \$6.0 MM
- Lease of 1.5 MM bbl of new tank capacity in the LA Basin @ \$0.55/bbl/month: \$9.9 MM
- Call on loan guarantees on \$40 MM for 10% of time, at 8% interest \$0.3 MM
- Interest on bonds to finance initial fill, 2.3 MM bbl at \$40/bbl, @ 6% \$5.5 MM
- Cost of rolling hedge to protect value of reserve, insurance and fees \$1.3 MM
- Cost of oversight, audits and surveying \$2.0 MM

Total gross annual cost of reserve \$25.0 MM

These costs will be offset in part by the fees charged for use of the reserve. With a 2 cpg minimum charge for prompt delivery and return in 6 weeks, while during periods of outages the backwardation may be worth as much as 5 cpg, and an average throughput of 50,000 bpd, the revenues from fees may be in the order of \$5 to 10 MM per year. Moreover, if offsets from the sale of crude oil can be used to finance the purchase of the initial fill, a possibility provided for under the Energy Policy and Conservation Act, then cost would be reduced by a further \$3 to 5 MM per year.

At this stage of early feasibility study, in the absence of firm bids for the operation of the reserve and given the lack of definition for certain cost elements of the reserve's trading

⁵³ Anthony J. Finizza Ph.D., *Economic Impact of Refinery Disruptions*, CEC Study, June 2002

mechanisms, a reasonable estimate for the net annual cost of the reserve seems to be \$15 to \$20 MM.

9.2 Benefits

The reserve, as currently envisaged, will not function as a stagnant inventory overhanging the market, but rather create a tool for forward trading and a physical delivery hub for imports, linking California's gasoline market to whatever suitable blendstocks and blending components are available in the worldwide refining system. As such, three separate benefits can be identified:

- Reduction of chronic shortages due to physical and commercial supply barriers.
- The prevention of smaller, often spurious price spikes.
- The mitigation of significant price spikes caused by major supply disruptions.

For each of these potential benefits, an order of magnitude analysis of cost savings to the California gasoline consumer will be provided below.

9.2.1 *Prevention of Chronic Shortages*

As seen in Section 1.3.1, the phase out of MTBE and the mandated usage of ethanol to replace it will cause a shortfall of 50 to 100 TBD in California's supplies of gasoline, mostly in Southern California. Amongst alternative solutions to prevent these shortages are measures such as additional refinery capacity, demand reduction programs, pipeline supplies from Texas into Arizona, and relaxation of fuel standards. While some or all of these alternatives may be realized to some extent, the most likely scenario, certainly in the short to medium long term, is that California will become increasingly import dependent.

Although foreign sources of conforming base gasoline blendstocks are limited, there are a number of refineries worldwide that can from time to time supply components or blendstocks to California if market conditions are right. As has been shown earlier in this report, potential importers face a number of problems:

- Physical barriers: lack of terminal space, particularly in the LA Basin.
- Commercial barriers: lack of liquidity in forward markets, no mechanism for hedging against volatility in the California market, only refiners are capable of blending final product, Unocal patents pose threat to blending by importer.

As is currently already the case, these barriers mean that prices have to rise well above the normal arbitrage level (the differential in market prices that will cover all transportation costs, duties, cost of hedging, etc.), before an independent importer will attempt to bring in a cargo. The use of the SFR volumes to conduct prompt trades on import cargoes that will arrive 6 to 8 weeks later will remove the major physical and commercial barriers to imports, and will limit California’s pricing to world market prices plus quality premiums and import costs. The table below illustrates the difference the SFR will make on an importer’s decision process.

Table 9.1 – Example: Import Decision Processes with and without SFR

Current Situation without SFR	Future Situation with SFR in Place
<p>The California market is tight as the summer blending season starts and prices are steadily rising.</p> <p>When the spot price reaches 97 cpg, Refiner A in Country C starts talking to global Trader B. A has a cargo of suitable blendstocks that he could send to California if he tops off with alkylate to produce CARBOB. His added production costs are 5 cpg, and his shipping cost to CA are 8 cpg. A’s alternative is to send the cargo to New York for a netback of 77 cpg FOB.</p> <p>On a prompt basis a sale to CA would create a 7 cpg profit, or \$800k for the cargo, over the NY alternative. However, the LA forward market for next month delivery is backwardated by 5 cpg. This would still leave a 2 cpg margin, but trying to sell a full cargo in this thinly traded market would suppress the forward price by more than 2 cpg. Moreover, B can’t find a tank to offload the cargo. The deal doesn’t work.</p> <p>The CA price continues to rise, and reaches 105 cpg. Trader B can do some forward pieces at 97 cpg for one third of the cargo and</p>	<p>The California market is tight as the summer blending season starts and prices are steadily rising.</p> <p>When the spot price reaches 97 cpg, Refiner A in Country C starts talking to global Trader B. A has a cargo of suitable blendstocks that he could send to California if he tops off with alkylate to produce CARBOB. His added production costs are 5 cpg, and his shipping cost to CA are 8 cpg. A’s alternative is to send the cargo to New York for a netback of 77 cpg FOB.</p> <p>Trader B buys the cargo from Refiner A at 84 cpg FOB and starts selling prompt pieces out of the SFR at 97 cpg, paying on average 5 cpg when bidding for the usage of the SFR volumes, equivalent to the backwardation of the market. He realizes an average prompt margin of 2 cpg. Refiner A and Trader B both realize \$200k profit on the shipment.</p> <p>The cargo arrives 5 weeks later and is offloaded into the reserve without problems.</p>

<p>decides to take a gamble on the rest. He buys the cargo from Refiner A at 84 cpg FOB, for a 92 cpg landed cost 5 weeks later. B realizes a margin of 5 cpg on the forward trades, but incurs substantial demurrage cost on the vessel because he cannot find tankage. Trader B makes a small loss on the remainder of the cargo before he can sell it to a refiner.</p>	
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The example of Table 9.1 is based on observed price differentials, but is otherwise of course just an anecdotal illustration of decision processes such as they occur every day in the global gasoline trade. Moreover, it is the simplest case, where an offshore refiner, at incremental production cost, can actually produce a conforming grade of gasoline that can be offloaded directly into the SFR to backfill the volumes lifted into the prompt market.

In reality, use of the SFR as envisaged may involve complex deals, involving several parties. For instance, if the offshore refiner has high value blendstocks available but cannot produce a conforming CARBOB, the deal may involve offsetting trades around the backfill volumes, whereby the blendstocks get sold to a local refiner who in turn fulfills the obligation to backfill the SFR.

The underlying principle however does not change: currently, a certain class of offshore producers and traders will only sell into the California market if there is a premium to compensate for the risks that cannot be hedged. These risks are the volatility of the California market relative to markets that can be hedged, i.e., the NYMEX, and the risk of being unable to physically offload the cargo when its gets there.

Obviously, there are other classes of import trade that are not affected by the unsecured risks currently inherent when importing gasoline or blending components into California from remote sources. The global refiners are integrated from the foreign source all the way into the branded retail, and although they will still have to optimize returns on a global basis, any losses or gains on individual trades between operating entities are offset on a corporate level. Also, the refineries owned by global majors operating in California are more capable of handling the physical aspects of the imports, although some are better equipped than others in terms of terminals and tank capacity.

When taking into account the increasing import dependency of California however, especially after the phase out of MTBE, when import volumes may have to double over current rates, there will be periods when the incremental barrel that sets the price of the market will be imported from independent foreign sources who will have to build compensation for unsecured risk into their decision processes.

An order of magnitude cost impact for this phenomenon can be construed as follows:

- During 86% of the time, there are no refinery disruptions⁵⁴, but during the summer season, the market is still import dependent even when no disruptions occur. What happens during price spikes is the subject of separate analysis and will be excluded here.
- If import dependency is assumed during 75% of the 86% corresponding to the summer grade blending season, and if it is assumed that for only 20% of this time, the spot market is determined by imported barrels from independent, non-integrated sources, then such sources set the spot market price during 13% of the time overall.
- Based on observations and market feedback, a conservative assumption for the risk premium is 5 cpg for independent importers is at least 5 cpg. This premium affects primarily the spot market, but whereas price spikes are not passed on directly to the retail market, long term trends do (even spikes eventually get passed through, at lower levels but over longer periods).
- The total consumer benefit associated with removing forward market risk and physical restraints for independent importers of gasoline or blending components into the California gasoline market is therefore estimated at 13% of 15 billion gallons per year at 5 cpg, or approximately \$100 MM/year, with a range of + or – 50%, or \$50 to 150 million.

9.2.2 *Prevention of Small Price Spikes*

Given the vulnerability of California's gasoline infrastructure and the volatility of gasoline prices, the market currently overreacts from time to time to rumors of supply disruptions. The system is vulnerable to manipulation, and instances are known when the market moved over 10 cpg on a single day on relatively few reported deals, fueled

⁵⁴ Anthony J. Finizza, Ph.D., *Economic Impact of Refinery Disruptions*, CEC Study, June 2002

by unfounded rumors of refinery problems or in overreaction to real events that were quickly resolved and did not cause much actual production loss. Usually such market reactions occur in times when inventories are low and demand is anticipated to be high, i.e., during the summer blending season.

In a parallel study commissioned by the CEC, Dr. Anthony J. Finizza conducted an extensive statistical analysis⁵⁵ of supply disruptions that occurred over a five year period from 1996 through 2001. His analysis concluded that small, spurious price spikes occur on average 25 days per year, with an average value of price increase over the duration of the spike of 4.2 cpg. Most of these spikes are short lived, but effects in the retail market can persist over one or to two weeks. The longevity of retail price effects after spot prices have subsided was extensively analyzed by Dr Tony Finizza.

It is likely that the very presence of the SFR will suppress these spurious price spikes. If no real shortage occurs and the retail market is kept adequately supplied, retail prices will not move driven by price elasticity, and it will be difficult to move the market on rumor alone. An approximation for the benefits to the California gasoline consumer of eliminating the small price spikes is 25 days per year at an average of 4.2 cpg, or \$40 million. If it is assumed that not all small spikes are preventable, or that in some cases costs of mobilizing reserve volumes will be passed on, then a reasonable range for these benefits would be \$20 to \$40 million.

9.2.3 *Mitigation of Significant Price Spikes*

Dr Tony Finizza's study (ibid) focused on the mitigation of significant disruptions. Through a statistical analysis of historical data of disruptions and subsequent modeling of market response to supply changes under several assumptions for price elasticity of demand, he produced a detailed analysis of consumer benefits as well as gains in total welfare associated with mitigation of the gasoline market volatility. As was done in Section 8.1 for analyzing the effectiveness of the proposed SFR in terms of capacity, a check will be performed below to match the results of Dr Finizza with results derived earlier using a more empirical approach.

For the purpose of this study, significant price spikes were defined as events that involve either a large net capacity loss, or last over prolonged periods. Table 9.2 shows

⁵⁵ Anthony J. Finizza, Ph.D., *Economic Impact of Refinery Disruptions*, CEC Study, April 2002

how, based on data from Dr Finizza's study, a total of 17 significant disruptions occurred over a 5-year time frame.

Table 9.2 – CA Refinery Disruptions 1996 - 2001

	Short 1 Week	Medium 2-3 Weeks	Long > 6 Weeks	Total (Significant)
Small < 10 TBD	13	1	1	15 (1)
Medium 10 - 30 TBD	18	4	2	24 (6)
Large > 30 TBD	3	2	5	10 (10)
Total (Significant)	34 (3)	7 (6)	8 (8)	49 (17)

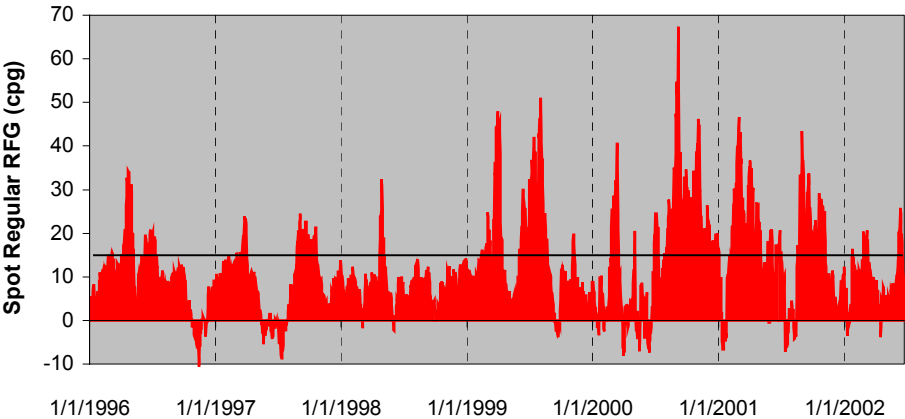
Dr Finizza used detailed statistical analysis to show how only those disruptions that occurred during periods of normal or below normal inventories resulted in price spikes. His analysis also showed that, based on probabilities of events as derived from the 1996 through 2001 statistics, and assuming an average retail market price of \$1.50/gln and a market elasticity of – 0.20, the potential direct consumer benefits of an SFR would be \$465 million per year. With an elasticity of – 0.15, the benefits increase to \$767 MM/yr while at the low end of the range of sensitivities studied, benefits could drop to the low \$200 MM/yr range, still an order of magnitude higher than the predicted costs.

This analysis only takes credit for significant disruptions in periods of normal or below normal inventories, and furthermore assumes that the California shortage will translate in a price spike of 10 cpg in landed cost of replacement materials into the SFR because of the limited availability of suitable blendstocks worldwide. If materials can be brought in through the SFR at an incremental spot price of 5 cpg, the benefits increase to \$631 MM/yr, while at 15 cpg incremental cost, savings are still \$363 MM/yr.

A check against historical data is presented in Figure 9.1. The area in red represents the differential of LA Spot Regular RFG over US Gulf Coast RFG FOB Spot price plus a 15 cpg premium for transportation and quality premium. This area represents a value \$2.8 BN or \$430 MM/year. If the reserve is more effective and can attract import volumes and blendstocks at average premiums of only 10 cpg over US Gulf Coast and other world market prices, than the savings would have amounted to \$4.6 BN, or \$708 MM/yr. On the other hand, an assumption that it would take a premium of 20 cpg over

world markets before products will move reduces the advantage to \$1.6 BN, or \$246 MM/yr.

Figure 9.1 – Margins of LA Spot RFG over US GC plus Transport



These numbers refer to spot markets and as was shown in Section 7.2, the retail market behaves different than the spot market in that price spikes are generally lower, but last over longer periods.

Figure 9.2 – CA Retail and Refining Margins

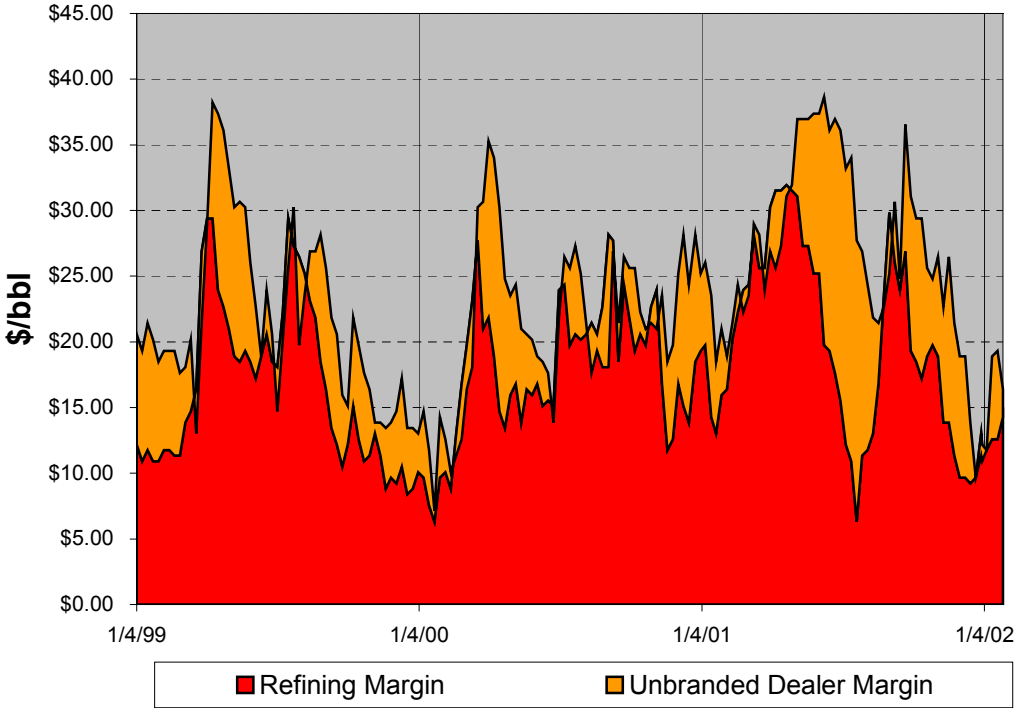


Figure 9.2 shows how during the price spikes of 1999 through 2002, refining margins after deducting all applicable taxes, dealer mark-ups and average crude oil cost, were in the range of \$10 to \$30/bbl. If it is again assumed that the SFR will be able to attract supplies from external sources at world market prices plus a 15 cpg (\$6.30/bbl) premium, and that the refineries capable of producing suitable products or blendstocks are able to operate at crack spreads of \$10/bbl, then savings to the consumer from reducing the peaks amount to \$408 MM/yr.

These numbers are similar to those found by Dr Tony Finizza, who as described above, used a more rigorous quantitative analysis. Regardless of the details in these numbers, it will be clear that the costs of chronic undersupply and price spikes caused by supply disruptions is at least one order of magnitude higher than the costs of the proposed fuels reserve.

10 RESULTS OF MEETINGS AND WORKSHOPS

One of the primary considerations of the study was to fully involve the various stakeholders in the industry. In the early stage of the study, the objective was to collect opinions and ideas through a series of meetings with individual stakeholders, whereas at a later stage, feedback was solicited on concepts and alternatives through a workshop, open to all interested parties.

10.1 Survey Meetings with Industry Participants and Other Stakeholders

From late August through early October 2001, the CEC and its contractor, Stillwater Associates, met with representatives of:

- All eight gasoline-producing refiners in California. For some of these, separate meetings were held with individual operating entities, while for others, a single meeting was held with corporate staff and/or representatives of several facilities.
- Six refiners operating facilities outside California, but selling blendstocks or finished products into the California market.
- Ten major international traders who regularly import fuels and blendstocks into CA and who have representation in the State, and one major brokerage house.
- Five independent marketers of gasoline in CA.
- Four major logistic service providers, owning and operating terminal facilities and pipelines for clean petroleum products in California, two of which are subsidiaries of major oil companies.
- Stakeholders from miscellaneous backgrounds, including the State of Arizona, an industry association, two publications, and the Southern California Port Authorities.

A separate confidential report was prepared by the CEC and its consultant to document the individual discussions held with the selected stakeholders. Although supply and demand for diesel and jet fuel were discussed as well, the discussions heavily focused on the gasoline markets, and in particular jet fuel was often used in the discussions only by way of example of a well functioning, stable market. Moreover, the discussions were generally qualitative in nature, with most parties reluctant to share numbers or referring to data already available in the public domain through other reporting channels.

A summary of some of the main issues raised during the meetings by the various constituents is given below.

10.1.1 *Strategic Reserve*

The broad consensus opinion of industry participants is that the California market is not broken and does not need the fix of a Strategic Reserve. Virtually all supply-side market participants expressed a clear resentment of intrusion by the government into the private market, and thought that an intervention in the natural forces of supply and demand would be detrimental to the long-term development of new sources.

Despite this initial aversion, most survey participants freely contributed constructive ideas once it was clear that the study will evaluate a broad range of alternatives, including some that might improve market liquidity as a whole, or solutions whereby the government's role might be limited to that of a facilitator of private industry efforts. The most frequently heard contributions are summarized below.

- **Location.** Although a few participants favored locations downstream in the distribution system, the more commonly held view was that the Strategic Reserve, if it were to be created, should:
 - a) Be in more than one location, with as a minimum separate coverage for the Northern and Southern California markets;
 - b) Be directly tied into the refinery supply and distribution system, i.e., at the head of the Kinder Morgan pipeline networks; and
 - c) Have access to deep water in order to be able to receive direct imports in order to be replenished from outside sources after a supply interruption, and to improve supply options in general.

The locations that meet these criteria are Concord in the Bay Area, Watson and Carson in the LA Basin, and to a lesser extent (because it lacks direct deep water access), Colton at the head of the Southern and Eastern pipeline systems. The industry insights are born out by this Study's analysis of location options and logistics requirements in Section 2 above.

- **Tankage and Inventory Options.** All participants, without exception, reported a shortage of tank capacity. For operational reasons, most refiners would not be able to increase on-site inventories in existing tankage, even when compensated

through special incentives for the higher costs of working capital and other operating and marketing costs associated with larger inventories. Traders and importers complained about their inability to find storage to land products. Given the shortage of tankage in the main distribution centers, the overwhelming consensus of the participants was that if an SR were to be created, it should not use existing tankage. This industry opinion confirms the results of Section 4 and 6 above.

- **Release Mechanisms.** None of the participants had a specific proposal for release mechanisms for eventual inventories held in the reserve. However, several stakeholders warned that whatever release mechanisms were chosen, they had to be “fair”, and “clear”. Concerns were voiced that if threshold price levels for release were set too low, the existence of a reserve would prevent the influx of additional supplies, and could cause an early stampede on the reserve by anybody with empty storage space who could then hoard the supplies until a delayed price spike occurred. Most participants stressed that a reserve should only be released to prevent real stock-outs at the pump, when prices had risen already sufficiently to ensure additional supplies from higher cost sources.
- **Quality Aspects.** With the different vapor pressure requirements for gasoline in summer and winter, and because of other quality and performance parameters for gasoline that are affected by the time over which it is stored, it will be necessary to turn over the reserve at least twice per year. This is one of the reasons why most participants favored locations within the current distribution system, so that the reserve effectively would be a bulge in the pipeline that could see continuous throughput if required.

10.1.2 Barriers to Entry into the California Gasoline Markets

With the exception of some of the major refiners and the refiner-owned logistic service providers, all industry participants complained about barriers that currently prevent the influx of products from outside the State. Since the Bay Area is currently a net exporter of products while the LA Basin is short, these problems are more relevant for the Southern California market than for the north. The major concerns can be summarized as follows.

- **Lack of CARB Spec Fuels outside CA.** The single most important difficulty mentioned by current or potential importers and out-of-state suppliers are the unique quality requirements for California gasoline and diesel. This problem is

going to be aggravated by the introduction of CARB Phase III. Of the five out-of-state suppliers that were interviewed, only one claimed to be capable of producing CARBOB for Phase III. None of the others thought that the investments required to comply with Phase III would be justified given the incidental nature of export shipments to California, and the increasing opportunity to realize premium values for higher quality fuels in other markets. Moreover, few would be able to avoid contamination with MTBE above the *de minimis* requirements for MTBE post Phase III, given the nature of the storage and the costs of draining and cleaning tanks and ships for incidental shipments.

An additional complication when bringing in finished gasoline is that certain quality requirements, notably low sulfur levels, require analytical tools that are rarely available in surveyor's laboratories outside California. Material certified in a foreign port as in compliance with the specifications, may fail a retest on arrival resulting in significant financial risk to the importer.

- **Infrastructure.** All potential suppliers of out-of-state gasoline or blending components, as well as some of the major refiners with limited on-site tankage, mentioned lack of adequate infrastructure as a major obstacle to bringing in cargoes and efficiently distributing products to meet market shortages. The providers of commercial services in this area all complained of permitting barriers that prevent investment in facilities despite a viable demand. Common themes were:
 - a) There is an acute shortage of bulk liquid storage space in the ports of Los Angeles and Long Beach, which is aggravated by current policies of the Port Authorities favoring other land uses such as container and car terminals over bulk liquid storage.
 - b) Terminal facilities owned by refiners which in the past provided third party commercial services now have ceased to provide such services under the short term contracts that typically fit the needs of occasional importers.
 - c) Commercial pipeline systems are approaching capacity, especially in the gathering systems.
 - d) Projects to increase infrastructure capacity, such as additional storage or increasing pipeline capacity, meet with considerable delays in the permitting

process. Increasingly, such delays are caused by well financed, nationally operating interest groups. Delays of up to three years were mentioned.

- e) Several new legislative initiatives currently in development threaten to make this situation even worse. Of particular concern is the recently adopted Regulation 1178 of the South Coast Air Quality Management District, which will require installation of domed roofs over all open floating roof storage tanks, and the Marine Oil Terminal Environmental Review Process (MOTERP) proposed by the State Lands Commission. Both initiatives will result not only in very significant cost increases, but require key assets such as storage tanks and docks to be out of service for prolonged periods. These comments were the reason that this Study was expanded to include regulatory developments in Section 5.

The shortage in storage capacity, and the breakdown of normal supply and demand mechanisms in the storage market because of permitting delays for new projects were compared by several participants to the situation in the power industry, where years of lagging investments contributed to the power crisis.

- **Unocal Patent.** Most potential importers expressed a concern that even when finished CARB spec products were to be available outside California, they would be reluctant to attempt importing the finished product because of the risk of infringement of the Unocal patent and the associated punitive penalties. For occasional importers, licensing fees would add a prohibitive cost to an already risky trade.

Also mentioned was that the Unocal patent puts a further strain on the already scarce tankage. Blending around the patent leaves only very narrow margins, and refiners typically now need more time to prepare an on-spec blend whereas previously, final blends were prepared just in time before scheduled pipeline dispatch. This requires more tank space, while off-spec or near-spec batches resulting from an incomplete blending operation might take a longer time to blend off.

One participant mentioned that a patent recently awarded to Snamprogetti of Italy on blends of isooctanol and ethanol may add similar difficulties post CARB Phase III implementation, and aggravate the blending tankage situation even further.

- **Difficulties of Blending Finished Products.** With finished gasoline meeting CARB specs hard to find outside the state, importers resort to bringing in blending components. The possibility to do so is limited by a number of factors.
 - a) As stated above, the Unocal patent presents a significant risk that only a refiner with alternative resources and multiple blending options can afford to take.
 - b) Certification of the final blended product requires in-depth knowledge of complex administrative procedures.
 - c) The lack of adequate infrastructure makes it difficult for occasional importers to find cost effective blending and storage facilities.

As a result of these restrictions, traders bringing in blending components will sell such cargoes to the major refiners, who will produce the finished gasoline.

- **Lack of a liquid Futures Market.** All participants, without exception, reported the lack of liquidity in the forward market for gasoline as an impediment to imports. The inability to negotiate a price in advance for when imported product arrives, exposes the importer to considerable price risk. To produce a cargo of CARBOB, a producer typically requires two weeks lead time to schedule blending components and tankage within the refinery. Typically, this is also the time required to find shipping space. Sailing times from the closest out-of-state sources (Caribbean, US Gulf Coast and Eastern Canada Seashore) range between two and three weeks. An importer would therefore need a futures market with enough liquidity for next month or two months out in order to lock in a margin.

10.1.3 Market Mechanisms

The California gasoline market has a layered structure, formed by four separate but interrelated markets: Retail, DTW, Rack, and Spot, which are described in detail in Section 7.1.

The feedback received from participants in the various markets stresses the spot market as the primary source of volatility in the event of supply disruptions. This is the market where pricing is “made”, and as such would be where a reserve would have to intervene if it is to be successful in reducing volatility. Participants confirmed that the spot market can move as much as 5 cpg on one or two trades, and instances were

quoted in which market shifts of 20 cents or more have occurred with no more than 40,000 bbl of product changing hands.

The prices in the spot market translate almost directly to the rack market, while the retail market is often sheltered against abrupt price spikes by the major refiners, who are afraid to lose market share if they increase pump prices ahead of competitors. When the retail price lags the spot price too much, rack and spot based DTW customers are sometimes caught in an “inversion”, when their purchase price exceeds the pump retail price. On the other hand, on the down slope of a temporary price spike, branded retailers often manage to hold on to margins for a while, with pump prices only coming down slowly over several weeks after the spot prices has already returned to pre-spike levels. In these periods, rack and DTW customers make up for losses incurred at the onset of the spike.

It is clear from this input that release mechanisms from an eventual reserve will have to be designed to fit the needs of the spot market.

10.1.4 *Futures Market*

One message that came across loud and clear from the participants is that the lack of liquidity in forward markets for California is a major impediment to imports, and a significant contributing factor to instability, since virtually all trades are done on a prompt basis.

Several participants pointed to the jet fuel market as an example of a well functioning futures market, with forward deals possible as far as 6 months or even one year into the future. In the opinion of most participants, the main reasons why the forward market for jet fuel works, whereas for gasoline it does not, are:

- **Fungibility.** Jet fuel is a readily fungible product, with only a few different specifications shared on a worldwide basis.
- **Liquidity.** Because of its fungibility and ample storage facilities, many traders and importers can participate in the jet fuel market.
- **Hedging.** Because of fixed differentials between jet fuel and heating oil based on alternative uses and transportation cost, forward trades of jet fuel can be pegged to fuel oil futures, which allows traders to hedge their risk.

- **Future Demand.** Airlines have a need to buy a certain quantity of fuel forward because they also sell a certain fraction of their capacity well into the future through advance bookings. Moreover, they like to work against fixed budgets whenever possible.

Given the fact that California gasoline is not a readily fungible product, that there are no suitable forward traded commodities against it can be hedged, and that the largest market sector, the retail market, is not well suited to forward commitment on price, creating mechanisms for a futures market will be a challenge.

Many participants however thought that if a reserve was to be created in which market participants were to be allowed to use the top half of the inventory to lift product prompt and replace it within a certain period, with a bidding process to establish a value for the use of the product over time, then this would not only establish liquidity, but also offer importers a mechanism to obtain fixed forward values for product before it is put on the water.

10.1.5 Inventory Planning Practices

Current inventory planning practices varied considerable between industry participants. For some refiners, operational considerations are the dominant factor, and those refiners generally prefer to run with relatively low inventories. Other refiners, especially those who sell a significant portion of their production into the merchant market rather than into their own branded retail, will set inventory targets according to their expectations of market trends. These refiners will run their tanks as full as operationally possible if they expect prices to go up. In any case, most refiners have very little room to play with and most dismissed the concept of creating a reserve by compensating refiners to hold more inventory as not feasible.

The way market participants interpret reported industry inventory numbers is currently undergoing some changes, according to feedback received. Whereas previously the market would begin to feel tight when PADD V inventory levels fell to 25 million barrels, currently supply begins to tighten at levels around just below 30 (these numbers include finished gasoline, as well as blendstocks and unfinished products). Since the highest reported inventories are in the range of 34 to 35 million barrels, this means that effects of blending around the Unocal patent and increases in production capacity without corresponding increases in storage, apparently do affect the buffering capability of inventory.

Most participants use public sales and inventory data as provided by API and EIA, the accuracy of which was sometimes questioned. Not all were aware that the CEC provides more detailed, State specific information.

10.2 Meetings with CEC Staff

To be completed after key presentations have been made.

10.3 Workshops

A preliminary workshop was held on March 13, 2002, to discuss the results of the various Contractor Studies with the public. Given the complexity of the issue and the relatively short time span that was available for the industry and other interested parties to review the studies, it was decided to schedule a second workshop later in the year.

10.3.1 CEC Workshop of March 13, 2002

At the Workshop held March 13, 2002, in the auditorium of the California Energy Commission in Sacramento, presentations were made by Stillwater Associates regarding the Strategic Fuel Reserve, by Drew Laughlin regarding supply options from the US Gulf Coast, while the results of the Interliance, Inc. study regarding the pipeline supply options were presented by Gordon Schremp of the CEC itself. Dr Tony Finizza presented his analysis of supply disruptions and a preliminary evaluation of the economic benefits of an SFR.

A detailed overview of comments on the Strategic Fuels Reserve presentation is provided in Attachment B. Comments made during the workshop itself were relatively few and mostly concerned clarification of issues. After the workshop, a more in depth discussion ensued between on the one hand members of the Western States Petroleum Association (WSPA) and consultants retained by WSPA, and on the other hand representatives of the CEC and their consultants. Key points of this discussion can be summarized as follows:

- There is no fundamental disagreement on the analysis of the supply situation, infrastructure problems and barriers to supply. The industry would welcome more streamlined permitting processes as a means to enable the refiners to meet current and anticipated demand.
- The industry is generally skeptical of the State's ability to manage projects and processes that interact with market forces. A stagnant, classical reserve is

deemed to be counterproductive in improving supply reliability. The more complex proposal developed by Stillwater Associates involving time-swaps as a means to promote forward liquidity and create a physical entry point for imports was not fully understood by all members at the time of the workshop, and the consensus opinion of the industry was that the difficulty in realizing this novel concept would be in designing its operational framework (“the devil is in the details”).

- The evaluation of benefits as presented in the first workshop included an example of refinery economics obtained from public information regarding a recently acquired California refinery. The example was not quoted in the right context and the economic evaluation of the benefits of a reserve has since been superceded by a more rigorous statistical analysis by Dr Finizza.

Subsequent to the workshop, feedback was received from various sides, including experts within the California Energy Commission. These comments were highly constructive and have been helpful in preparing the current version of the study. Where necessary, errata have been addressed, and a wider range of scenarios has been developed for evaluation of the benefits.

However, since the current study is conceptual in nature and since the funding provided by the CEC covers an initial feasibility study only, in line with the request by the legislature, it is at this time not appropriate to proceed with a detailed design of the reserve, which would include issuing a Request for Proposals from commercial service providers in the logistic industry, and designing a detailed framework for the operation and governance of the reserve.

10.3.2 *Workshop Held* _____

To be completed after the next workshop.

11 CONCLUSIONS AND RECOMMENDATIONS

Based on the findings of this study, both in qualitative and quantitative terms, a number of conclusions and recommendations are formulated below. In addition, a long-term outlook will be formulated for a scenario in which no pro-active measures are adopted, and compared with the expected long-term results of the proposed measures.

11.1 Conclusions

The major findings of the study are listed below in a sequence that is in part causal, whereby increasing shortfalls, market insularity and infrastructure deficiencies combine to produce partially dysfunctional and unstable markets, in particular for gasoline, which result in significant damage to the State's economy.

11.1.1 Increasing Shortfall

California's refineries have not been able to keep up with demand growth over recent years and California has become dependent on imports for all categories of petroleum products. Most of the growth in import requirements has been satisfied from foreign sources, because refining capacity and transportation options from within the US are also constrained. The outlook is that in-state capacity additions will be increasingly difficult to realize because of permitting restrictions. The chronic shortfall has led to market instability and increasing vulnerability to unplanned supply disruptions. The phase-out of MTBE as currently foreseen by year-end 2002 will increase the need for imports beyond the current infrastructure capabilities.

11.1.2 Market Insularity

The California gasoline market suffers from insularity caused by its unique specifications, a subsequent lack of liquidity and inability to lock in future pricing, and impediments to market entry by outside sources. These factors contribute significantly to price volatility, in addition to the supply interruptions identified as a cause of price spikes in the legislation that led to this study.

11.1.3 Inadequate Infrastructure

California's infrastructure for petroleum products, comprising of pipelines, terminals and dock facilities, is currently already constrained and has insufficient capacity to handle and anticipated incremental demand. Capacity additions are hampered by lengthy and

costly permitting procedures, and by policies practiced by the ports that favor other land uses over bulk liquid storage. Import terminals are predominantly owned or leased under long-term contracts by the refiners, and access to markets has become increasingly difficult for traders and importers whose business interest are short-term in nature.

11.1.4 Restrictive Patents

The Unocal patents are a significant additional burden on California's ability to meet growing demands for transportation fuels while improving air quality. The licensing fees and punitive damages are such that incidental importers will not dare to attempt to blend finished gasoline, while refineries who blend outside the patent's envelope lose capacity by diverting products from the gasoline pool and in doing so actually increase evaporative emissions.

11.1.5 Limited Classes of Supply

There is no indication of unlawful market practices and competitive forces do still result in deep price cuts at times of temporary oversupply in the market. However, for gasoline in particular, supply of finished product is limited to the in-state refiners, and despite the fact that the market has become import dependent, with the incremental import barrel determining the price of the market as a whole, neither independent importers upstream of the refiners nor independent marketers of finished product downstream of the refiners currently have the means to bypass the refinery controlled infrastructure.

11.1.6 Economic Impact

The increasing import dependency of California requires incremental supplies from remote foreign sources that meet unique specifications and carry significant manufacturing and transportation cost. These supplies will set the market price, and the premium that California will have to pay for its import dependency is likely to be in the range of 20 to 30 cpg. This represents a value of \$3 to \$4.5 billion per year, but this is not a number that will be affected by the creation of a reserve. The economic impact of a price spike of 50 to 60 cpg over a period of 4 to 6 weeks is \$0.6 to \$1 billion. The effect of these incremental expenditures on the State's economy is somewhat similar to the legacy of the higher electricity prices caused by the power crisis: a significant portion of the gross impact will flow to out-of-state corporations or foreign entities at the expense of discretionary spending by California households and businesses.

11.2 Recommendations

The recommendations below are provisional, in that they represent the Contractor's viewpoint based on the analysis performed and feedback from the first Workshop held March.

11.2.1 Regulatory Processes

In order for the industry to be able to respond in a timely fashion to California's market needs in terms of production capacity and logistic infrastructure for transportation fuels it is recommended that:

- A complete inventory is made of current permitting and regulatory processes governing capacity additions in key areas of energy infrastructure, such as refineries, marine terminals, pipelines and distribution facilities.
- A detailed survey is conducted amongst stakeholders, such as industry participants, regulatory agencies, environmental interest groups and local communities, to identify bottlenecks and inefficiencies.
- A system is designed to accelerate and streamline the proceedings, while maintaining guarantees for due review. It seems likely at this stage that such a system would incorporate the creation of a single, central authority to coordinate and manage the permitting process.
- Novel avenues must be explored to reconcile the contradicting needs for the petroleum industry to keep up with market demand, and the need to safeguard the public from adverse affects associated with increased production and consumption of transportation fuels. One such avenue is a mechanism whereby refiners can receive and trade emission credits associated with voluntary improvements of fuel quality beyond regulatory limits, thus reducing mobile emissions, against stationary emissions associated with the refining process.
- It is strongly recommended that the regulatory review and the design of any measures outlined above shall be part of a concerted and integrated approach within a long-term visionary framework for use of transportation fuels in California, as a way to prevent over-building or capital wastage by the industry as well as chronic or acute shortages of essential commodities in the State.

11.2.2 Definition Phase Study for SFR

Given that there is overwhelming evidence that the consumer benefits associated with the creation of an SFR as a physical trading hub and mechanism for forward market liquidity is an order of magnitude larger than the cost to the consumer of the current price spikes, a next phase is warranted in the process to create and operate such a reserve. Given the complexity of the proposals, it is recommended to allocate sufficient funds to proceed with the following steps:

- Draft a Request for Proposals for the construction and operation of 5 MM bbl of versatile clean product storage, 2 MM of which are to be located in the Bay Area to be fully integrated within that region's refining infrastructure, and 3 MM bbl in the LA Basin to be similarly integrated into the local infrastructure, complete with deepwater access and linked to the Kinder Morgan distribution pipelines. The proposals from established service providers in the petroleum industry shall include provisions for renting out half of the new capacity to interested third parties under guarantees provided as part of the State's SFR contract.
- Evaluate the proposals. Award of contract considerations shall include duration of term, fixed and variable costs and other fees, extent of guarantees needed for the additional storage to be leased out to third parties, etc. The evaluation shall include a verification of physical capabilities for each proposal, such as the existence of bottlenecks in pipeline gathering systems, the connectivity and access to marine terminal facilities for each location and other factors that will impact the operability and effectiveness of proposed facilities.
- Developing rules for operation of the reserve including detailed procedures for the auction mechanism, if an auction is retained as tool for usage of reserve volumes by third parties. The design will include the physical aspects of the reserve such as they will be proposed by the service industry with their respective tenders. If warranted, proposals will be invited from qualified parties, i.e., operators of current auctions or trading platforms, to submit competing proposals for the operation of the forward swap market proposed for the SFR.
- Design a system for oversight of the reserve, including the assignment of proper authority to ensure that the SFR is operated in the best interest of the California gasoline consumer.

- Conduct a review of the proposed systems with all relevant stakeholders in the industry. Revise systems as necessary.

- Prepare a comprehensive report for the legislature, including investment level cost estimate for facilities and operations. Confirm the viability and perform a final cost benefit evaluation.

It is important to note that these recommendations do not represent a delay associated with more studies, but rather represent the normal steps by which projects of such magnitude and complexity usually proceed. The sequential nature of the various design and execution phases of a project (feasibility study, definition phase, preliminary engineering, detailed design, procurement and construction, and start-up), merely mean that at each juncture, a decision is called for to proceed with the next phase and allocate the funds required to complete them. It is estimated that the work outlined in the steps above can be completed for \$0.5 MM to \$1 MM.

Attachment A - Cost Estimate for Reserve**Capital Cost Estimate - Bay Area Reserve**

Tanks	Item Cost	Unit	Qty	Cost	Subtotal	Total
Shell Material & Labor, 225,000 bbl @ \$8/bbl	\$ 1,800,000	ea	4	\$ 7,200,000		
Foundation, paving and bund walls	\$ 120,000	ea	4	\$ 480,000		
Floating Roof	\$ 500,000	ea	4	\$ 2,000,000		
Dome Roof	\$ 700,000	ea	0	\$ -		
					\$ 9,680,000	
Process Equipment & Piping						
Pipeline Delivery Pumps, 4000 bbl/hr, 300 hp	\$ 60,000	ea	2	\$ 120,000		
Blending & Circulation Pumps, 6000 bbl/hr	\$ 40,000	ea	2	\$ 80,000		
Piping, 20% of tank shell cost	\$ 360,000	ea	2	\$ 720,000		
Plant Air System	\$ 300,000	ea	1	\$ 300,000		
					\$ 1,220,000	
Safety & Environmental						
Firewater & Foam Systems	\$ 800,000	ea	1	\$ 800,000		
Vapor Destruction Unit	\$ 1,200,000	ea	2	\$ 2,400,000		
API Separator	\$ 200,000	ea	1	\$ 200,000		
					\$ 3,400,000	
Pipelines						
16" Underground, incl. ROWs	\$ 800,000	mile	5	\$ 4,000,000		
Metering, Cathodic Protection	\$ 300,000	ea	1	\$ 300,000		
Pig traps	\$ 50,000	ea	2	\$ 100,000		
Tie-in	\$ 100,000	ea	1	\$ 100,000		
					\$ 4,500,000	
Dock						
Jetty, 800 ft long, 40 ft draft	\$ 6,000,000	ea	1	\$ 6,000,000		
Loading arm, 16"	\$ 200,000	ea	2	\$ 400,000		
Piping, 24"	\$ 100,000	ea	1	\$ 100,000		
					\$ 6,500,000	
Electrical & Instrumentation						
HV Transformer & Switchgear	\$ 200,000	ea	1	\$ 200,000		
Lighting, other electrical	\$ 300,000	ea	1	\$ 300,000		
Level Gages, Overfill Protection	\$ 50,000	ea	4	\$ 200,000		
SCADA, computers, radios, telcom	\$ 200,000	ea	1	\$ 200,000		
					\$ 900,000	
Civil						
Land purchase	\$ 100,000	acre	15	\$ 1,500,000		
Site prep, grading, drainage	\$ 10,000	acre	15	\$ 150,000		
Control room, MCC	\$ 40,000	ea	1	\$ 40,000		
Fencing, gates, site security	\$ 15,000	acre	15	\$ 225,000		
Roads & Paving	\$ 10,000	acre	15	\$ 150,000		
					\$ 2,065,000	
						\$28,265,000
Project Overheads						
Preliminary Engineering and Permitting			2%	\$ 565,000		
Detailed Design & Procurement			8%	\$ 2,261,000		
Construction Supervision			5%	\$ 1,413,000		
					\$ 4,239,000	
Contingency			20%		\$ 6,501,000	
Total Capital Cost						\$39,005,000

Capital Cost Estimate - LA Basin Reserve

Tanks	Item Cost	Unit	Qty	Cost	Subtotal	Total
Shell Material & Labor, 225,000 bbl @ \$8/bbl	\$ 1,800,000	ea	6	\$ 10,800,000		
Foundation, paving and bund walls	\$ 120,000	ea	6	\$ 720,000		
Floating Roof	\$ 500,000	ea	6	\$ 3,000,000		
Dome Roof	\$ 700,000	ea	6	\$ 4,200,000		
					\$ 18,720,000	
Process Equipment & Piping						
Pumps, 4000 bbl/hr pipeline, 300 hp	\$ 60,000	ea	2	\$ 120,000		
Piping, 20% of tank shell cost	\$ 360,000	ea	2	\$ 720,000		
Plant Air System	\$ 300,000	ea	1	\$ 300,000		
					\$ 1,140,000	
Safety & Environmental						
Firewater & Foam Systems	\$ 800,000	ea	1	\$ 800,000		
Vapor Destruction Unit	\$ 1,200,000	ea	1	\$ 1,200,000		
API Separator	\$ 200,000	ea	1	\$ 200,000		
					\$ 2,200,000	
Pipelines						
16" Underground, incl. ROWs	\$ 1,000,000	mile	2	\$ 2,000,000		
Metering, Cathodic Protection	\$ 300,000	ea	1	\$ 300,000		
Pig traps	\$ 50,000	ea	2	\$ 100,000		
Tie-in	\$ 100,000	ea	1	\$ 100,000		
					\$ 2,500,000	
Dock						
Jetty, 800 ft long, 40 ft draft	\$ 4,000,000	ea	0	\$ -		
Loading arm, 16"	\$ 200,000	ea	0	\$ -		
Piping, 16"	\$ 100,000	ea	0	\$ -		
					\$ -	
Electrical & Instrumentation						
HV Transformer & Switchgear	\$ 200,000	ea	1	\$ 200,000		
Lighting, other electrical	\$ 300,000	ea	1	\$ 300,000		
Level Gages, Overfill Protection	\$ 50,000	ea	6	\$ 300,000		
SCADA, computers, radios, telcom	\$ 200,000	ea	1	\$ 200,000		
					\$ 1,000,000	
Civil						
Land purchase (leased land)	\$ -	acre	20	\$ -		
Site prep, grading, drainage	\$ 10,000	acre	20	\$ 200,000		
Control room, MCC	\$ 40,000	ea	1	\$ 40,000		
Fencing, gates, site security	\$ 15,000	acre	20	\$ 300,000		
Roads & Paving	\$ 10,000	acre	20	\$ 200,000		
					\$ 740,000	
						\$ 26,300,000
Project Overheads						
Preliminary Engineering and Permitting			2%	\$ 526,000		
Detailed Design & Procurement			8%	\$ 2,104,000		
Construction Supervision			5%	\$ 1,315,000		
					\$ 3,945,000	
Contingency						
			20%		\$ 6,049,000	
Total Capital Cost						\$ 36,294,000

The Strategic Fuel Reserve in its Local and Global Context

A majority of stakeholders reading this report may not be familiar with the working dynamics of either domestic or international cargo markets in an arbitrage context. Considering the overwhelming importance that those dynamics will play in connecting the island of California, through the SFR, to the rest of the global economy in gasoline, we will set out on a conceptual journey to see it in action. Our voyage will be an exposition of the obvious for some, for others – a tutorial. For many, it will provide enlightenment.

A narrative camera will guide us from one gasoline supply port to the next. Readers who have traded in the international petroleum markets will suffer the shock of recognition as we sit at the desks of traders from Long Beach, California, to Sydney Australia, to the Arabian Gulf. From each perspective we will wrestle with the invitation to bid into the California Strategic Fuels Reserve. The jolt of reality will be inescapable, for we are dealing with the fundamental building blocks of global petroleum markets: Specifications; Transportation costs; Storage fees; Scheduling; Logistics; Arbitrage, and Price. A chart on the Global Arbitrage Matrix has been inserted at the end of the scenarios to recapitulate the raw cost and revenue assumptions from each port that will be factored into the competition.

We have elected to invite upon our voyage the illustrious Dr. John Nash, the enigmatic hero of the film, “Beautiful Mind”. His presence, through the creative precision of his economic insights, will provide both a frame of reference and an antidote to ideological responses against any form of government intervention that might otherwise gloss over the benefits of this specific proposal.⁵⁶ Although the tone and tenor of this Addendum steps beyond the confines of standard government reports, we trust that readers will recognize the intrinsic merits of its arguments and illustrations.

Similarly, that segment of the academic community who may have long ago rejected the very notion of government-held “buffer stocks” as economically unfeasible will also find grounds to reassess that position when the time-swap auction, and the lack of a defined trigger point enters the equation. The obvious benefits of connecting the island of California to the rest of the world in gasoline will be

⁵⁶ “Nash mathematically clarified the distinction between cooperative and noncooperative games. – Because noncooperative games are common in the real world, the discovery revolutionized game theory. – He recognized that in noncooperative games there exist sets of optimal strategies (so-called Nash equilibria) used by the players such that no player can benefit by unilaterally changing his or her strategy if the strategies of the other players remain unchanged. The theory of games applies statistical logic to the choice of strategies.

seen through the prism of the Nash equilibrium and the robust competition of “non-cooperative games”.⁵⁷

SFR – THE LOCAL VIEW

California: In the following scenarios the SFR auction process will be viewed from a number of international supply ports. In California, the SFR Administrator will see only the bid differential submitted by each company. The differential represents the amount that each participant is willing to pay to the SFR for the right to lift prompt inventory. By understanding the *content* of each player’s analysis, within the *context* of his regional market matrix, one can appreciate the immense complexity of trying to anticipate who the most competitive player will be in any particular SFR transaction. Each participant will assess an SFR tender from his own geographical position, against alternative marketing and shipping options. Published prices for key global supply points, (i.e. Singapore, NYH, Rotterdam), do not tell the whole story, as amply illustrated in the ensuing scenarios. They do not provide a road map, but rather a preliminary set of directional reference points. Another level of complexity will be introduced when unfinished gasoline and blendstocks come into the equation through “outer ring”⁵⁸ storage and hedging strategies. The SFR will sit at the center of these pro-active strategies. The consumer benefits from all of them. The Nash equilibrium helps explain the underlying economics involved in a consistent manner.

Despite the complexities described in the ensuing scenarios, despite the wide-flung non-cooperative games focused on the SFR, despite the joint ventures of convenience and the juggling of ship schedules, specifications and price trajectories, the functioning of the SFR itself remains clear and simple. It is the “black box” that acts as a magnet for competitively priced, high-quality gasoline. It is not disruptive. It serves a common good.

A central principle driving the conceptual design of the SFR has been that of non-government interference with market forces. The controlling idea, in fact, is that, unlike European, Asian and U.S. Federal Reserve systems, California SFR inventories will not be sold at all. Its gasoline will be “time-traded”. A barrel out equals a barrel in. Contractual volumes will be loaned out on the next

⁵⁷ www.encyclopedia.com/html/g/games-th.asp

⁵⁸ “Outer Ring” refers to the private, third party storage that will surround the SFR, but will not be governed in any way by its regulations. “Surround” in this sense does not necessarily mean contiguous to, or encircling the SFR. The point is that the private storage, wherever it is located, will be connected to the SFR by pipeline.

pipeline cycle for replenishment within “x” number of weeks. The SFR will be a rolling inventory that provides a physical basis for greater forward liquidity in the private sector. In essence, competitors in the free market, by bidding for prompt SFR gasoline, will define price backwardation⁵⁹ in the market. It facilitates trade. It renders the forward market transparent. It stimulates competition. The island of California, through the SFR time swap, will be re-connected with the rest of the world’s sophisticated refineries, but not necessarily to the detriment of California refiners.

Steep ‘backwardation’ can be another way of describing a price spike, although price backwardation occurs naturally in commodity markets during times of economic downturn. (Commodity manufacturer’s reluctance to hold inventory creates a prompt scarcity.) By the same token, price backwardation is a normal market reaction to spot shortages, refinery disruptions, and to various specification and seasonal changes. The unique and disruptive elements of gasoline backwardation (price spikes) in California are dictated by the State’s island situation, as well as by its unusual specifications, as explained in the Study. Being at least four weeks away from re-supply, and without a robust forward market for hedging the price-risk of potential incoming cargoes, what would be temporary backwardation in more open markets, becomes a plateau of elevated prices that must ultimately be passed on to the California consumer.⁶⁰ And one must not overlook the fact that the means of access to this particular island, namely third-party tanks, are in the hands of local manufacturers who have a natural, institutional bias against imports, other than to service their own down-stream systems.

The SFR system recommended here will accomplish a number of useful purposes:

1. Create much-needed logistical infrastructure (tanks and pipeline connections) that will be built by the private sector, through government incentives.
2. The loan out of SFR gasoline supplies will serve to bridge the time gap to other markets. It is a cheaper and more globally effective alternative to constructing a USGC to California pipeline.
3. The “outer ring” of private tanks will interact with the SFR so that it becomes the ultimate balancing point of the non-cooperative games heretofore described. Through that

⁵⁹ Backwardation refers to those markets conditions wherein the future price of a given commodity is lower than the prompt price

⁶⁰ See CEC Study “Economics Impacts of Refinery Disruptions – Implications for a Strategic Reserve” April 2002 - by Anthony Finizza, Ph.D. (AJF Consulting)

competition for California business, high quality gasoline and blend stocks will be attracted to the State at competitive prices.

4. Independent marketers of gasoline will not only be able to stay in business, but will source their supply more creatively, thereby insuring a healthy mix of competition in the State.

NOTE: California refiners will also participate in the SFR time-swap process, thus ensuring equal access to the system.

One Alternative for the Operation of the SFR

As outlined in Section 8.6 of the SFR Study, there are a number of alternative to the operation of the Reserve. Below is another alternative:

The Request for Supply: Instead of a trigger mechanism based on price or event and subject to bureaucratic review, the SFR will respond to *Requests for Supply* from the private market. These may be submitted by any of the pre-qualified participants and will be subject to a minimum transaction rate. For the sake of example, let us assume that the transaction rate is a minimum of 2 cpg with a minimum volume of 25MB. Intrinsic to the *Request for Supply* will be a “firm offer” by the initiating party, obliging them to accept the contract at that minimum transaction rate if no other parties elect to participate. This feature will discourage companies from ‘toying with the system’. It also assumes that the initiator sees the market in backwardation by at least that amount, or that a privileged source of cheaper blend stocks or CARBOB supply is available to him within six weeks. Otherwise he would not be in the company’s economic interest to initiate the *Request*.

The Timing Element: Tenders may be structured to allow for different replacement schedules, say: four, five and six weeks within a “Not Later Than (NLT)” context. Or, a fixed return schedule may be decided upon. If a single, fixed time schedule is adopted, then pre-defined penalties will be incorporated into the contract for late delivery. This is a common feature of other government-run petroleum tender systems. Off-specification claims will be handled under prevailing legal remedies.

The Participants: In keeping with its Public Sector responsibilities the SFR, upon receipt of a *Request for Supply*, will be obliged to open an *Invitation to Bid* to all qualified companies. The ‘qualification process’ will require both financial and performance guarantees to be filed with the SFR Administration.

The Terms and Conditions: Attached is a simple frame contract that can be used as a reference when drawing up the formal documents under the detailed planning phase of the SFR project. This style of contract is familiar to petroleum traders around the world.

The Tender Format: A *Request for Supply* that has been received by the SFR Administrator will be converted into an *Invitation to Bid* upon review of the SFR's inventory balance and its operational schedules. After assuring that the *Request* can be accommodated by the SFR, and that its initiator is in good standing from a credit and performance point of view, the bid invitation will be sent out electronically to qualified classes of trade. (It has yet to be determined whether separate Classes of Trade should be defined in SFR procedures in order to insure access to small companies.) As for the methodology of the transactions, there are a number of proven e-commerce auction formats already in use in the Petroleum Industry. One of these may be adapted to the needs of the SFR. Alternatively, a new system may be designed, as was the case with the Federal Heating Oil Reserve in the Northeast. The question of whether a traditional auction format will be most appropriate is yet to be resolved. We are reminded that participants will not be bidding on price, but rather on the time-value of the prompt barrels in light of prevailing market backwardation, or offshore replacement costs. Consequently, it can be expected that bid increments may be in fractions of a cent.

For example, if market backwardation to the next month is deemed to be 10 cpg based on published reports, then that number will presumably set the ceiling as to the differential that any company might be expected to bid for the prompt barrel. Otherwise, they would be losing money. A traditional auction process (i.e. E-Bay) would incrementally approach that 10 cpg until the most competitive counter party reaches his optimum equilibrium bid and others dropped out. With this fractional reality in mind, it may be prudent to elect a single, blind bid system, as is common in government tenders in many petroleum markets.

The SFR Tender Screen: It follows that there are at least two possible formats for computer displays that the SFR Administrators may be working with:

- 1) An Auction Format that allows the Administrator to see all bids submitted and that informs him as to which company is submitting each bid. Competing companies, looking at their own screens, will see only the highest bid at the moment, the "number to beat", so to speak. They will not see who submitted that number or what strategies other non-cooperative game players have in mind.

- 2) A Single Blind Bid format might be adopted, either exclusively or in conjunction with an auction format. If there is to be an auction element, then the bidding will run to a certain strike price at which time all participants will be asked electronically to submit their fixed and final bid. Alternatively, a single bid without preliminary auction might become the format elected in order to simplify the process.

Note: The foregoing commentaries provide only a preliminary sketch of the SFR mechanism on a conceptual scale. The procedures and e-commerce platforms that will be ultimately adopted are subject to a considerable amount of additional analysis and work with the Industry.

General Comments on Geographic Arbitrage

Geographic arbitrage is the term used to define the margins for trading between geographically separated market, taking into account price differentials between these markets and transportation costs. In traders parlance “the arb is open” means that market differentials are sufficient to justify transport cost. Trades between different geographical regions over long distances involve lengthy transit times, which translate into working capital expense and risks from price volatility. Other risks include product quality, i.e., through transport contamination, currency risk, and many other factors, all of which will impact a decision on individual trades.

With regards to the SFR:

- From an arbitrage point of view, replacement of SFR inventory may be CARBOB as the most straightforward. Alternatively, gasoline components, i.e. alkylate, reformate, etc. might be shipped to California for their blending value.
- Unfinished gasoline and components would be delivered first to private storage, or to a refinery for blending to meet CARBOB specs. Only summer-grade gasoline (CARBOB) will be accepted into the SFR. No blending or substitution of quality will be allowed within the SFR. This rule will be strictly enforced.

- Based on standard practice, FOB value of gasoline, blend stocks, or components in Asia (Australia in this example) will be pegged to MOPS (Mean of Platt's Singapore) prices for Naphtha.
- SFR participants based in Pacific Rim countries (Japan, China, Korea, Taiwan, Singapore, Australia) will evaluate the difference between prompt prices of gasoline in LA or SF (SFR origin) to its replacement cost based on the FOB value of cargoes in the region, plus freight, insurance and cost of money.

In the following sections, a number of typical arbitrage scenarios are described for trading products through the SFR.

A View from Down Under

Australia: A Los Angeles based refiner or trading company, upon receiving notice of an SFR tender contacts his Sydney, Australia office to inquire as to the cost of delivery into the SFR (or into leased storage) within six weeks. Let us assume the SFR's tender is for 200MB. Under this scenario the Sydney/LA trading team is confronted with three alternatives:

1. CARBOB specifications delivered directly into the SFR on a full cargo basis (300MB). The LA office must decide how to dispose of the additional 100MB and at what price in order to offset the cost of dead freight. For example, freight on a one-to-one port basis from Sydney to LA might be quoted at lump sum \$1,135,000. On a full cargo basis this works out to a transportation cost of 9 cents per gallon (cpg)⁶¹. If only 200MB is hauled, the cost per unit (gallon) becomes 13.5 cpg, an increase of 4.5 cpg on the whole cargo.⁶² Under these transportation conditions the LA office will decide whether to take the risk on the additional cargo. Their evaluation will directly impact the team's decision on the differential they should bid to the SFR. On the sell-side they must also calculate the weighted average value they expect to realize for the prompt SFR barrels that will either be sold into the spot market, or used to cover pre-committed sales.

⁶¹ $\$1,135,000 \div 300\text{MB} = \$3.78/\text{bbl} \div 42 = 9 \text{ cpg}$

⁶² $\$1,135,000 \div 200\text{MB} = 5.67/\text{bbl} \div 42 = 13.5 \text{ cpg}$

2. Alkylate (100MB) and other gasoline components (100MB) available in Australia can be delivered as part cargo into leased storage in LA, or taken directly into a refinery. In this case let us assume that the balance of the cargo is jet fuel that can be delivered into LAX Fuels at a break-even, thereby eliminating the 'dead-freight' element (4.5 cpg) The LA office must calculate the presumed value of this particular component and blend stock cargo against CARBOB replacement costs into the SFR. They will need to either exchange the cargo, while on the water, with a California refiner for CARBOB, or take the components into storage where it will be blended or exchanged at a later date. If the leased storage option is chosen, then the LA office must take the additional cost of approximately 2.0 cpg per month of terminalling and handling charges into account. At the same time, they will evaluate the presumed value of the prompt SFR barrels as the other side of the equation.
3. The Sydney office will also look at alternative disposition options to the SFR auction such as: Domestic spot market sales that will weaken local prices. Cargo sales into northeast Asia (Korea, China, etc.) involving different elements of risk. Sale to gasoline blenders in Singapore, and so forth.

Market Comments: To complete the picture, let us assume that the FOB Australia value of CARBOB is 80 cpg, calculated as a differential against MOPS Naphtha price. Singapore prices are weak, with the market in backwardation. Prompt shipping; however, is available at below market rates of 9 cpg due to a backhaul opportunity on an incoming chemical/products carrier. The LA office, meanwhile estimates that prompt SFR barrels can be sold at a weighted average price of 96.5 cpg, assuming the sale of 100MB on the next pipeline cycle at 98 cpg, followed by 50MB at 96 cpg and 50MB at 94 cpg in successive pipeline cycles.

Profile of the Trade

FOB Sydney:	80 cpg based on MOPS Naphtha differential – Singapore Market in backwardation reduces forward value of the cargo in the region.
Transportation:	9 cpg based on lump sum one-to-one spot charter at USD 1,135,000 for 300,000 barrels
Insurance & Cost:	1 cpg (includes cost of working capital)
Total landed cost:	90 cpg
LA-SFR Sales:	100MB @ 98 cpg, 50MB @ 96 cpg, 50MB @ 94 cpg
Average revenue:	96.5 cpg
Estimated margin:	6.5 cpg

SFR Bidders' Considerations: From the point of the view of the FOB Australia supplier, raw published numbers do not tell the whole story. Alternative dispositions of the cargo will be taken into his calculations, as well as the local market effect of exporting the cargo (firming local prices). Without the possibility of going to California, for example, his next optimum destination may be as blending stock in Singapore, where prices are weak and tank availability is tight. On the other hand, the next shipping position, after the prompt 'backhaul opportunity' posited in this example, may be at a much higher rate. In concert with his LA office he will also assess the SFR supply probabilities from other regions such as the Caribbean or the US Gulf Coast in order to anticipate what the competition might bid to the SFR. We draw attention to these influences because they are part of the matrix of options within which this particular cargo will be evaluated. The Australia bid will need to compete with a broad range of alternate supply possibilities made possible through the SFR auction process. We can see that in this case Australia shows a margin of 6.5 cpg on the CARBOB portion of the cargo, which translates to a profit of US\$546,000⁶³. In conjunction with his LA office, the company must decide exactly how much, if not all, of this deemed margin to sacrifice in order to win the business.

This complex, dynamic, but entirely realistic commercial situation fits the description of noncooperative games as defined mathematically in Dr. John Nash's Nobel Prize winning paper. Dr. Nash's observations offer a much more realistic way to describe and understand the principles

⁶³ 6.5 cpg x 42 gallons per bbl = \$2.73/bbl x 200MB = \$546,000

that will drive the California SFR than do the inert platitudes of traditional economics that preceded him (“supply, demand and the “unseen hand of the market”).⁶⁴ More will be said about this game theory in subsequent stops on our global tour.

A View from South Korea

Korea: A Seoul-based refiner can supply 100MB of alkylate; another can supply 100MB of high octane, low sulfur reformat in the same time frame. Both become aware of the California SFR tender through traders and international oil companies with offices in Los Angeles. A 200MB cargo can be “topped off” with 100MB of conventional gasoline meeting Oregon specifications but not suitable for California. Based on a two-port load, two-port discharge voyage plan the trading arm of the international oil firm, Alpha Company calculates a total freight cost of 7.8 cpg.

The international trader from “Z” Company calculates the same cost since both are talking to the same ship owner, in case they win the business. The trader places the ship on subjects, with firm validity until close of the SFR tender. The international oil company, being a refiner in California, calculates the value of the high octane alkylate and reformat according to the internal economics provided by the Process Engineering section of his California refinery. He does not wish to take a position on the Oregon grade “top up” parcel of 100MB, but does so reluctantly in order to maintain competitive shipping economics. “Z” Company, on the contrary, considers the probabilities surrounding the value of these blend stocks in forward months, in the event that he should discharge the cargo into leased tanks and trade around that future value to secure replenishment CARBOB supplies for the SFR within six weeks.

Market Comments: Both Alpha and “Z” company offices in LA have estimated the prompt value of the SFR barrels, according to their matrix of options, in the same manner as the Australia oriented company in “A” above. At the same time, the two Korean refiners are calculating the alternative

⁶⁴ “Nash took a novel tack; he simply finessed the process. He visualized a deal as the outcome of either a process of negotiation or else independent strategizing by individuals each pursuing his own interest. Instead of defining a solution directly, he asked what reasonable conditions any division of gains from a bargain would have to satisfy. He then posited four conditions and, using an ingenious mathematical argument, showed that, if the axioms held, a unique solution existed that maximized the product of the participants’ utilities. Essentially, he reasoned, how gains were divided and how much the deal is worth to each party and what other alternatives each has.” Quoted from: “The Essential John Nash”, Harold W. Huhn (Editor) Sylvia Nasar (Editor)

value of their respective part-cargoes by looking at export possibilities in the form of finished gasoline to Japan and/or China/Taiwan. They enter into FOB sales negotiations with both interested parties simultaneously. The California SFR tender will close the next day. Assuming, for the sake of this illustration, that the international oil company wins the SFR tender. “Z” Company must give up ‘subjects’ on the ship. Alpha Company puts it on charter and is looking at the following set of economics:

Profile of the Trade	
FOB Yosu & Onsan	82 cpg Based on MOPS Naphtha differential, adjusted for blending value to an equivalent gasoline price.
Transportation:	7.8 cpg Based on lump sum \$885,000 (one-to-one for 300MB Plus \$100,000 for one additional load and one additional discharge port, including ‘reverse geographical rotation’ $(\$885,000 + \$100,000) / 300MB = \$3.29/bbl \div 42 = 7.8 \text{ cpg}$
Insurance & Cost	1 cpg (including cost of working capital)
Total landed cost:	90.8 cpg
LA-SFR Sales	100MB @ 98 cpg, 50MB @ 96 cpg, 50MB @ 94 cpg
Average revenue:	\$96 cpg
Estimated margin:	5.7 cpg

SFR Bidders Considerations: Similar to the Australia example (“A”) the raw published numbers do not tell the whole story. In this example we have stated that Alpha Company, bidding on the Korea Alkylate and Reformate supply, was the winner of the SFR tender. This is entirely possible, despite the fact that his landed cost in LA is deemed to be slightly higher than the Australia competition, due primarily to the higher FOB equivalent price for the blend stocks. There are any number of reasons why Alpha Company would have bid more aggressively than “Z” Company who was also considering the Korea supply, or the Australia company who had slightly better economics “on paper”. For example, it might have been unscheduled unit problems in his LA refinery that caused the price spike in LA. He may have not been looking for speculative profit, but rather to cover an “in house” shortage at break-even. Or his Trading Department might have wanted to establish a customer track record with the Korean suppliers, thereby causing them to bid higher for the FOB barrels than the trading company would consider. The whole scenario, of course, could have resulted in no supply at all coming out of Korea, if markets for premium gasoline into Japan

and/or Taiwan looked stronger in the eyes of the Korean suppliers than did the FOB part-cargo sales under discussion.

The point of this value matrix description is to, once again, draw attention to the noncooperative gamesmanship involved. Each party, including the suppliers in Korea and the purchasers of prompt SFR barrels in Los Angeles would be working toward a point of maximum profitability with minimum downside risk exposure. The beneficiary of this intense and complex competition, fought out in different corners of the globe, is the California gasoline consumer. In effect, the California market has been able to successfully bridge its isolated island situation through the mechanism of the SFR time trade. At the same time, a momentum has been created in the forward market that can provide the physical base for the private sector to unleash its creativity, arbitrage and risk-management skills.

And let us not forget the Nash equilibrium in all this – Nash’s Nobel-prize-winning idea- has become *“the analytical structure for studying all situations of conflict and cooperation.”* His biographer, Sylvia Nasar summarizes his work this way:

“Obviously, each participant in a negotiation expects to benefit more by cooperating than by acting alone. Equally obviously, the terms of the deal depend on the bargaining power of each. Beyond this, economists had little to add. – They too had come up empty.”

“It is easy to see why: real-life negotiators have an overwhelming number of potential strategies to choose from – what offers to make, when to make them, what information, threats, or promises to communicate, and so on.”⁶⁵

This paper is not intended as an academic study, but rather as a foundation document for an entirely new and unique method of managing gasoline inventories through global competition focused on the State of California. The purpose of introducing the Nash equilibrium is to place the focus of that equilibrium squarely in the State’s Strategic Fuels Reserve. The SFR will act as a magnet and a catalyst, as the NYMEX has done for heating oil and gasoline in New York Harbor. But the high-stakes complexities described above will occur ‘beyond the fence’. Managers of the SFR will not be required to participate in, or to even comprehend those complexities. The SFR will be the still center of a swirling world in gasoline and gasoline components. But its operation will be clear-cut and disarmingly simple.

⁶⁵ “The Essential John Nash” Harold W. Kuhn (Editor) Sylvia Nasar (Editor)

A View from the US Gulf Coast

Houston: The East-of-the-Rockies Supply Department of Beta Company, an integrated oil conglomerate with refining/marketing assets both in California and in the U.S. Gulf Coast (USGC), receives notice of a tender for 200MB to be lifted promptly from the SFR and replaced within six weeks. Currently, NYMEX (RFG) gasoline is priced at 80 cpg in the first contract month (futures market), but the price is in backwardation by 3 cpg for each of the second and third months. Premium gasoline commands a 6 cpg price spread over Regular grade, the commodity traded on the NYMEX. The Gulf Coast is trading at a 4 cpg discount off of NY Harbor, reflecting the downward trend of the forward months. In order to supply CARBOB to a vessel sailing for California, the USGC refinery must borrow high-octane components from its blend stock pool, thereby creating a shortfall in Premium gasoline production that must be made up by purchases in the spot USGC market. His calculated FOB Houston break-even price would be:

78 cpg	NYMEX 1 st & 2d month split
(4)	USGC location differential to NYH
74	
+ 6	Octane and RVP premium to make CARBOB
80 cpg	FOB value

American Flag shipping is available at 12 cpg on a full ship basis (275MB). The refinery can 'top off' the cargo with 75MB of additional blending components to defray 'dead-space' costs. The LA office estimates that it can sell 100MB prompt SFR barrels at 98 cpg. They are less bullish on the second 100MB, estimating a second cycle value of 94 cpg. Consequently, their weighted average sales estimate is 96 cpg.

<u>Profile of the Trade – Beta Company</u>	
FOB Houston	80 cpg
Transportation	12 cpg
Insurance & Costs	2 cpg (including Canal tolls, Cost of money, and demurrage)
Total Landed Cost	94 cpg
SFR Sale Revenue	96 cpg
Deemed Margin:	2 cpg

Meanwhile, an international trader, “Y” Company, holding leased storage in both the USGC and in LA, with connections to the SFR, evaluates the SFR tender from the perspective of stored Alkylate and Reformate inventories that have been hedged against the NYMEX, producing an attractive ‘book profit’. In order to realize that book profit, the trader pegs his blend stock cargo on a CARBOB-equivalent basis, at 78 cpg FOB the USGC. He is looking at the same shipping economics as confronts Beta Company, but his LA office is more bullish than the competition on the prompt value of SFR barrels, which they estimate can be sold at an average price of 97 cpg. For the sake of illustration, the trading company’s position would be scribbled on the back of an envelope like this:

<u>Profile of the Trade – “Y” Company</u>	
FOB Houston	78 cpg based on value of blendstocks
Transportation	12 cpg
Insurance & Costs	2 cpg (including Canal tolls, Cost of money, and demurrage)
Total Landed Cost	92
SFR Sale Revenue	100 MB @ 96 cpg
	100 MB @ 96 cpg
Average Revenue	97 cpg
Deemed Margin:	5 cpg

SFR Bidders Considerations: In this scenario the “Y” Company trader holds the advantage of having stored alkylate and reformate in the USGC and hedged those products against the NYMEX at a time when octane value was lower than on the day of the SFR tender. He does; however, face a different kind of risk when bringing those blend stocks to California with the intent of bartering them for finished CARBOB in order to replenish the SFR. On one side (USGC) he translates embedded book value into a ‘wet transaction’. On the California side, he assumes an element of liquidity risk. On the basis of these variables he will seek the “Nash Equilibrium” by enhancing his position; that is, by moving the blend stocks closer to a higher value market. His acquisition and immediate sale of the prompt SFR barrels will ‘lock in’ that higher value. With this strategy in mind, his company will bid aggressively, bidding to the SFR more than 75% of the deemed point-to-point margin in the trade (Paying 3.75 cpg for the prompt barrel)

A View from the Caribbean

Caribbean: The Caribbean- based refiner, “H” Company looks at the California market from a unique perspective. Situated in a Free-Trade Zone in the Virgin Islands, he is allowed by Law to employ foreign-flag shipping. This provides him with a significant transportation-cost advantage over the USGC refiner who must use American Flag (Jones Act) shipping. The voyage cost can range from 50% to 100% higher on the American Flag ship. He is also in a position to regularly optimize his cargo sales into the highest netback market: New York Harbor (NYH), the USGC, Puerto Rico, Mexico, or California, opportunistically aiming at the random price spikes that occur in those markets. Actually, it is not known whether the Caribbean-based refiner will be capable of producing Phase III CARBOB after MTBE phaseout. But for the sake of illustration, let us assume that his refinery does invest in that capability. (Alternatively, unfinished gasoline components might be chosen as the barter commodity as described in the USGC example above.) Because he is only four sailing days away from NYH, the Caribbean refiner can realize first month NYMEX value, plus 5 cpg for the prompt physical supply of RFG quality. Ocean freight, Insurance and incidental costs are 3.5 cpg. He finds that the NY delivery option is more attractive than selling lower quality gasoline into Puerto Rico. This local market reality narrows his options to NYH and the California SFR. His value matrix appears as follows:

<u>Destination Option Comparison</u>		
(1) NYH option:	80 cpg	NYMEX 1 st month contract
	<u>0,5 cpg</u> +	Prompt cargo premium
Revenue	80.5 cpg	
Shipping cost	<u>(3.5)cpg</u>	
FOB netback	77 cpg	
(2) CA-SFR option	97 cpg	Per LA brokers assessment
Shipping cost	<u>(8) cpg</u>	Includes canal tolls + cost of money
FOB netback	89 cpg	
Estimated margin:	12 cpg	(based on the optimized economics)

Note: For the sake of simplicity we are assuming no premium component penalty for the Caribbean refiner, unlike the USGC refiner who must borrow Alkylate from his premium gasoline pool to produce CARBOB.

The differential of 12 cpg for the CA SFR over New York Harbor shows an overwhelming advantage to compete for the SFR outlet at this time. But a decision must be made as to how much of that margin should be offered to the SFR in order to win the tender.

As is often the case, an international trader from Random Company is also assessing that Caribbean refiner as a potential supply source for the SFR tender in question. The trading company has its own ship on long-term charter working the region. They anticipate additional profit opportunities on this particular voyage to California by way of first discharging the SFR cargo in LA, then sailing north to Washington, where their LA office informs them that a clear gasoline cargo will be available for backhaul delivery to Mexico. This shipping advantage and incremental trading advantage compels them to propose a joint venture approach to the Caribbean refiner. Both parties will share the total cost, risk and revenue of the voyage transaction. Let us assume that the added J/V revenue is 3 cpg. This would be added to the 12 cpg base case for a 15 cpg margin accruing to the joint venture.

We add this random ‘arbitrage opportunity’ element not only because it is a common strategy, but because it illustrates one more element of “the Nash equilibrium”.

“Nash also introduced the concept of bargaining, in which two or more players collude to produce a situation where failure to collude would make each of them worse off.”⁶⁶

The joint venture, of course, must still decide how much of the venture’s deemed margin to sacrifice to the SFR in bidding the tender. They can only infer from reported gasoline prices and shipping rates in other regions what their competition might bid to the SFR. Before the advent of Nash, this element of competitive uncertainty had been a recognized part of “cooperative game theories” originally conceived and published in 1942 by the renowned mathematicians, Oskar Morgenstern and John Von Neumann, for describing game competitions where the ground rules were known and agreed upon by all the players:

“Whenever an optimizing agent expects a ‘reaction’ from other agents to his own actions, his payoff is determined by other player’s actions as well, and he is playing a ‘game’. Game theory provides general methods of dealing with interactive optimization problems; its methods and concepts, particularly the notion of strategy

⁶⁶ The Columbia Encyclopedia, Sixth Edition

*and strategic equilibrium. – A game consists of a set of rules governing a competitive situation in which from two to 'n' individuals or groups of individuals choose strategies designed to maximize their own winnings or to minimize their opponent's winnings; the rules specify the possible actions for each player, the amount of information received by each as play progresses, and the amounts won or lost in various situations.*⁶⁷

It is easy to see that Nash's models on "noncooperative games" are far more applicable to the California SFR operation than the earlier "cooperative game" theories when the SFR is seen in its dynamic context of international price arbitrage. Not only do the various players act in isolation from each other, and with imperfect knowledge of the various positions on the playing field, i.e. the international oil market on any given day, but the rules under which each player decides his own course of action are imperfectly drawn. The overwhelming advantage to the California consumer, as a passive agent in this complex and dynamic global game, is that the SFR acts as the ultimate point of "equilibrium" toward which all competitors are striving. Their competition, based on the rational self-interest of each party, brings harmony to the market. The SFR's time-exchange mechanism is the metronome that sets the cadence of that harmony and brings rational order out of the chaos of price spikes.

Views from Newfoundland and New Brunswick

North Atlantic: The refineries in New Brunswick and Newfoundland, Canada share a foreign-flag shipping advantage over the USGC, but are disadvantaged in comparison with the Caribbean by about four days sailing time and three to five cents per gallon additional shipping costs. Their primary export market for gasoline and heating oil is New York and Boston Harbors, where highly liquid cargo markets are linked to NYMEX prices. Almost without exception the value matrix that North Atlantic refiners will refer to when evaluating California SFR auctions will consist of four elements:

1. Prompt RFG cargo market values in Boston and New York
2. Shipping costs, through the Panama Canal to California

⁶⁷ See J.Von Neumann and O. Morgenstern, *Theory of Games and Economic Behavior* (3d Ed. 1953)

3. Cost of covering existing supply obligations in NY and New England through replacement cargo, or local purchases.

4. Value of prompt gasoline borrowed from the SFR

It is expected that one of these refiners will be capable of producing California Phase III CARBOB (after MTBE phase out). The other will be capable of producing “NEARBOB”⁶⁸ and high-octane blend stocks. These “outer ring” products will be an increasingly significant part of the trading currency in California gasoline over the next few years. They will form the basis of another sub-set of non-cooperative games that will benefit the California consumer.

Market Scenario: The trading headquarters of the Newfoundland refinery has taken a short position on 150,000 bbls in the California pipeline market, expecting that prices will soften in the near term. A local refinery incident causes wholesale prices to run up suddenly in Los Angeles. The company is looking at losses on this prompt position of 8 cpg or about a half million dollars⁶⁹ unless they are able to “cover” that short position in the prompt market. Winning the SFR tender (electronic auction) will provide them with that “cover”. But in order to win that prompt supply, they must coordinate with the Newfoundland refinery. The company must calculate an overall cost/benefit analysis of the SFR transaction. They must look at their matrix of options and ask: “What is the value of alternative disposition of the cargo in New York Harbor?” If another party wins the SFR tender, will we be able to cover our position without being caught in a short-squeeze? If we do win the tender and decide to bring NEARBOB into our leased ‘Outer Ring’ storage tanks, what will it cost for terminalling, and for blending that product up to SFR specifications, or for swapping it for finished CARBOB in order to replenish the Reserve?”

While Newfoundland and Houston are engaged in these abstruse cogitations, the New Brunswick refinery looks at a much simpler equation. They can cover their RFG commitments in New England by purchasing an incoming European cargo at 1 cpg over the screen. (NYMEX first-month contract) Freight costs to LA will be 11 cpg, including insurance and deemed demurrage. Brokers in LA promise to arrange sales for the prompt 200MB of SFR gasoline at 96 cpg. The comparative economics of the SFR transaction as seen by the two neighboring refineries would look like this:

⁶⁸ “NEARBOB” is a California market term used to describe gasoline that comes close to meeting the CARBOB specification, but needs additional blending in order to actually meet that legally defined quality.

<u>Profile of the Trade</u>	
<u>FOB New Brunswick</u>	78 cpg (81cpg NYH value, less 3 cpg freight & ins.)
Transportation to LA	10 cpg
Insurance & cost	1 cpg
Total Landed Cost	89 cpg
LA SFR Sales	200MB @ 96 cpg
Revenue	96 cpg
Estimated margin	7 cpg
<u>FOB Newfoundland</u>	76 cpg (81 cpg NYH value, less 2 cpg quality upgrade penalty to finished RFG and 3 cpg freight & Insurance)
Transportation to LA	10 cpg + 1 cpg for Insurance
Total Landed Cost	87 cpg
LA SFR Sales	100MB @ 97 cpg, 100MB @ 96 cpg
Revenue	96.5 cpg
Other costs/benefits	2 cpg (- 2 cpg terminal & blending, + 4 cpg short cover adv.)
Estimated margin:	10.5 cpg

Coopetition: Borrowing a term that came into vogue during “dot.com mania” in this country, one finds that despite their different reading of the SFR transaction value, netted back to their respective refinery gates, there is still room for both competition and cooperation between them. Neither company knows what the other will bid, while the dead freight element will be perceived by both as putting them at a disadvantage against other supply points. (The shared shipping dilemma echoes John Nash’s view of the bargaining problem within the larger context of non-cooperative games.)

More specifically, the Newfoundland refiner, and his non-cooperative competitor across the water in New Brunswick are evaluating the SFR tender from different perspectives: One seeks to cover an existing short position, using non-conforming gasoline as trade currency. The other simply wishes to improve his netback economics, as compared to his normal outlets in NYH and New England, by delivering an ‘on-spec’ SFR cargo. But since they do share a common vulnerability on shipping, they may decide to strike a deal and split the proceeds on the SFR sale. There are a number of

⁶⁹ 8 cpg x 42gallons per bbl x 150MB = \$504,000

ways for this freight and cargo joint venture to play out. For the sake of illustration, we need only to recognize that the possibility is a real one, and is a not uncommon part of everyday cargo markets. The point lies in the elegant convergence of theory and practice with respect to the Nash model for non-cooperative games. The application of this convergence to SFR time-swaps is obvious.

“For two centuries after the publication of Adam Smith’s *The Wealth of Nations* there were still no principles of economics that could tell one how the parties to a potential bargain would interact, or how they would split up the pie. ---Mathematical models captured the results of competition but the consequences of cooperation remained elusive.”⁷⁰

“Obviously parties to a bargain were acting on the expectation that cooperation would yield more than acting alone. The striking feature of Nash’s paper is not its difficulty, or its depth, or even its elegance or generality, but rather that it provides an answer to an important problem. – The notion that the bargain depended on a combination of the bargainers’ back-up alternatives and the potential benefits of striking a deal.”⁷¹

A VIEW FROM NW EUROPE

Finland & NW Europe: The Neste Refinery in Finland had been a consistent source for CARB gasoline until Arco purchased the Thrifty independent gas station chain in the mid nineties. Thrifty had been Neste’s primary customer, while Neste, being the government owned refining company of Finland had been the first refinery in Europe to upgrade to clean burning fuels that could comply with CARB specifications. Terminal space had been available at the time and a price formula between the independent retailer and the offshore refiner was negotiated. This arrangement maintained strong price pressure on the California refiners.

During the intervening years the California gasoline market has been consolidating into fewer and stronger hands through: a) The merger of refining/marketing companies and b) the trend toward “branding up” among independent retailers, in other words, converting to major brands and becoming part of their downstream network. The commercial effect has been more centralized control of the distribution chain and downstream prices. At the same time, specifications in Europe and in New York Harbor have tightened.

⁷⁰ *A Beautiful Mind: a biography of John Forbes Nash Jr.; winner of the Nobel Prize in economics, 1994/ Author: Silvia Nasar (Published by Simon & Shuster)*

⁷¹ Ibid

The CARB spec remains a stumbling block that is compounded by the Unocal Patent in the eyes of European traders. Recently the multi-national oil companies have sourced cargoes of California gasoline from other refiners in Northwest Europe. For the sake of illustration the region will be treated as a single supply source regardless of which refiner might supply the gasoline or blendstocks in the future. Traders point out that it is not only the specification that has prevented European sourced gasoline cargoes from coming to California over the past few years.

The lack of tanks and the lack of a forward market are even more severe hurdles. Ample liquidity and the ability to “lock in a margin” in NY Harbor renders that destination far more attractive from a risk/reward standpoint. Shipping costs to California from NW Europe are about 4 cpg higher than the NYH destination. An SFR in California, available to European suppliers, would solve the problem for forward liquidity on the basis of the time-swap auction. Since tank space would also be available, the two major barriers to supply from the European point of view will have been remedied.

The SFR bid process from the European perspective would resemble that of the Canadian refiner and, in some respects, the Caribbean refiner. Each will be evaluating alternative dispositions for their cargoes when preparing bids to the SFR. The NYMEX will be their basis for comparison. The prompt selling price in California, the cost and availability of shipping and timing issues will enter their evaluation. In other words, regional supply & demand conditions will influence the decision of each bidder in a unique way. For example, the Caribbean refiner might find strong demand in Central America and Puerto Rico, while the Finland refiner confronts weak demand in NW Europe.

Recognizing these shifting realities one can readily observe that prices reported through Industry publications only show approximate value. With these facts in mind, let us assume that NW Trader receives an invitation to bid for 200MB from the SFR. He is looking at the same NYMEX screen as his noncooperative competitors in the Caribbean and in Canada, and he must make a similar evaluation.

The value of high octane blendstocks in NW Europe must be taken into account, as well as his ability to dispose of the balance 100MB of products that he will co-load with the SFR cargo in order to defray freight costs. His freight cost from Rotterdam to NYH is 4.5 cpg with an additional 4 cpg for the onward voyage to LA, including Panama Canal tolls. A broker in LA informs him that he will be able to sell the prompt SFR barrels at 96 cpg. His evaluation is relatively straightforward, in that there are no J/V, or ship optimization opportunities available to him at the moment. His economics look like the following:

Profile of the Trade	
FOB Rotterdam	76 cpg (0.80 NYMEX 1st Month, less 4 cpg freight & insurance)
Transportation	95 cpg (including Canal tolls)
Ins. & finance	1 cpg
Uncertainty factor ¹	2 cpg
Total Landed Cost	87.5 cpg
LA SFR Sales	200MB @ 96 cpg
Revenue	96 cpg
Estimated margin	11.5 cpg

The European supplier is uncertain as to the marketability of the balance cargo that he will load on the ship (110MB). He has chosen to load Jet Fuel but does not have time to fix the selling price in LA. Consequently he assumes a 2 cpg loss on that portion of the cargo as a conservative accrual.

A VIEW FROM THE ARABIAN GULF

Arabian Gulf: Supplies of CARBOB and/or high octane blending components sourced from the AG through the multinational oil companies are treated as part of the “local view” section below. The multinationals will enjoy economies of scale, shipping and blending flexibilities within their California refineries that will not be apparent to non-integrated competitors in the spot market. Besides, SFR transactions are designed to capture the marginal barrel’ of supply at the lowest cost, the growing segment of demand in California that has outgrown the state’s production capacity.

Non-major suppliers also operate in the Arabian Gulf. Their primary marketing objective, in fact, is the US West Coast, often the highest price gasoline market on the planet. Under today’s situation, any cargo sourced in the AG and bound for California will, by necessity, pass through the hands of one of the local refiners. The SFR auction system will open the market for different kinds of marketing alliances. Whereas the global scenarios sketched above indicate a set of complex regional alternative surrounding each SFR bidder, the AG supplier will, most likely, look for marketing alliances within California itself to dispose of cargo lots. His shipping alternatives are more one-dimensional. His marketing flexibility will be played out at the receiving end. Often this will occur through the ‘outer-ring’, or private sector tanks that surround the SFR. These assets are apt

to be equipped with truck loading racks in order that incoming cargo lots can be sold incrementally to independent marketers.

The SFR's time-swap mechanism will provide the forward price protection to this "long haul" supply source. The ability to move product between the SFR and the 'outer ring' system will add the marketing flexibility at Jobber and Distributor level that will bring more robust competition to the street. For example, a delivery of 200MB of gasoline from the AG to the SFR may be sold through a combination of brokered pipeline batches and through truck deliveries over the course of a month at a pre-agreed price with a Super-Jobber. With these observations in mind one can see that the AG supply equation will usually be evaluated against much less economically attractive markets, such as Europe and Asia. Consequently, the AG supplier will look at the NYMEX and the IPE in Europe as overall market indicators, rather than as strict indicators of cargo value as they are to the NW Europe, Caribbean and North Atlantic suppliers. The AG supplier might fill out the ship with high octane blend stocks that he calculates as a break even for the sake of his SFR bid.

Profile of the Trade

FOB Arabian Gulf	72 cpg (Next best alternative disposal less freight)
Transportation	13 cpg (including Canal tolls & cost of working capital)
Late Penalty ¹	2 cpg
Total Landed Cost	87 cpg
LA SFR Sales ²	200MB @ 97 cpg
Revenue	97 cpg
Estimated margin:	10 cpg

The voyage time from the AG is thirty-three days. Another week is required to prepare the cargo and arrange the FOB vessel. The SFR Auction calls for delivery within six weeks. A late penalty of 2 cpg per week is imposed by the SFR for late delivery. The AG Supplier has taken this into account in his economics, although he expects to arrive within the six-week deadline.

The AG Supplier has arranged a marketing alliance with a Super Jobber in LA whereby a price of 97 cpg has been guaranteed.

Summary

At this point in our global voyage let us pause and take stock of the key principles involved as they apply to arbitrage competition into the California SFR:

1. Each potential supplier outside the state will evaluate his options within a matrix of alternative cargo dispositions, including that of selling the product in his own domestic market.
2. Each player's equilibrium point will be defined as that disposition which produces the maximum netback price with the minimum risk, or negative market impact.
3. "Risk", as defined in this context will include such elements as:
 - a) Relative firmness of the selling price. (SFR vs. other alternatives)
 - b) Relative probability of the profit margin.
 - c) Relative reliability of the buyer in terms of credit and performance.
 - d) Direct and indirect consequences of choosing alternative dispositions.
 - e) Corporate "bottom line" consideration, such as: Covering an affiliate office's short position. Relieving downward price pressure on local markets, etc.
4. The matrix evaluation of one supplier, i.e. in Korea, will not be transparent to his competitors in another region, such as the U.S. Gulf Coast, the Caribbean, or Newfoundland. In this respect, each potential supplier will be participating in a non-cooperative game.
5. Each non-cooperative competitor may; however, forge and alliance, a joint venture, or some form of risk/reward sharing scheme with a competitor to strengthen his position and lessen his risks as compared with other competitors.
6. Each competitor will strive for equilibrium within the netback matrix of his own market
7. The California SFR will provide the ultimate equilibrium point through its electronic time-exchange auction process.
8. The California gasoline consumer will be the ultimate beneficiary of these non-cooperative games by virtue of:
 - a) Lessening the "island effect" of California's gasoline supply, by providing a time-bridge through the SFR exchange process.

- b) Increasing competition in the State for high quality gasoline and components by opening the market through the SFR.
- c) Enabling independent marketers to service their customers on more equal footing with local refiners by virtue of the open-access features⁷² of the SFR auction process.

The following chart shows the matrix of costs, selling prices and deemed margins extracted from the above scenarios that could form the basis of a typical SFR time-exchange auction:

Global Arbitrage Matrix – SFR Supply

Supply Source	FOB Value (cpg)	Trans & Insurance (cpg)	Delivered Cost (cpg)	Selling Price (cpg)	ETA (Days)	Deemed Margin (cpg)
Australia	80	10	90	96.5	20	6.5
Korea	82	8.8	90.8	96.5	16	5.7
USGC(a)	80	14	94	96	18	2
USGC(b)	78	14	92	97	18	5
Caribbean	77	8	85	97	14	12
Caribs-JV	77	8	85	97	14	15
Newfoundland	78	11	89	96	17	7
New Brunswick	76	11 + 2 quality diff	89	96.5	17	7.5
NW Europe	0.76	9.5+ 2 risk factor	87.5	96	23	11.5
Arab Gulf	0.72	13 + 2 Late penalty	87	97	33	10
Int'l Major Oil		Aussie	90	98	20	8
		Korea	89	98	16	9
		USGC	92	98	18	6
		Caribbean	90	98	14	10

⁷² "Open Access" means, open to those companies who have demonstrated both the financial and operational capability to perform under the terms and conditions of SFR Exchange Contracts

Note: Bids to the SFR may be made on the basis of other considerations than the flat margins shown above. Each participating company will decide how much of its deemed margin to “give up” in order to win the SFR tender. Each will be blind to the economics being considered by their competitors. This set of “noncooperative games” will establish the equilibrium point for California gasoline on the basis of the prevailing international arbitrage for high quality octane components and CARBOB

LOCAL ADVANTAGE

Every petroleum market, regardless of its level of transparency or commoditization, provides certain niche advantages to local players. In New York Harbor heating oil and gasoline for example, where international and domestic prices converge, and where the full weight of billion dollar speculative “hedge funds” is played out in the futures market, there still exists an array of local traders who break bulk, who blend incoming cargoes; who swap prompt barge lots against forward contracts and who perform various downstream arbitrage functions.

The same level of local competition is found in other actively traded markets, such as Rotterdam and Singapore. California will be no exception after adoption of the SFR time-swap system. California refiners will still retain the very substantial advantages that their years of servicing and investing in the market have brought them. California jobbers and independent retailers will not surrender their local advantage. Imports into the SFR will be defined, in economic terms, as “the marginal barrel”. In other words, the last increment of supply to enter the market after local refiners have exhausted their ability to cover prompt demand beyond their own downstream networks (unbranded sector).

The dramatic difference will be more open accessibility to alternative sources of supply from outside the state. Through the SFR an efficient, relatively low-cost system will exist to fill the supply gaps that contribute to price spikes and which cost consumers hundreds of millions of dollars per year.⁷³ The refiners themselves will share access to this innovative SFR system but, unlike today’s situation, access to external supply will no longer be their exclusive domain.

Part of the so-called, “local advantage” will inhere in the SFR’s basic operational requirements. In order for any pre-qualified company to win an SFR tender, that company must be able to dispose of

⁷³ See Dr. A. J. Finizza’s related study for the California Energy Commission at: www.energy.ca.gov

the prompt SFR barrels in the California market. They will also need a certain level of local market and operational knowledge to execute their contractual obligations on the scheduling and re-supply sides. It is not unlikely that new alliances will be formed that will link California trader/marketers to external supplies in order to “complete the circle” with respect to both lifting and replacing SFR inventories. It should be emphasized that government will have no hand in these realignments. They will come about by virtue of the open-access feature of the SFR and by its time and distance bridging capabilities, as described in foregoing scenarios. The end result will be lower prices to California consumers by virtue of both the more diverse mix of market competitors, and by the reduction of price volatility and hedging capability.

CA SFR and Local versus offshore Players

Local Perspective: From the vantage point of its home base in Southern California we will now consider three competing scenarios. The first is the arbitrage view of an SFR auction as seen by the Trading Manager (TM) of an integrated multinational oil firm. Call it, “Alpha Company”. This will be followed by the Independent Retailers’ view (“Beta Company”) and, finally by brief comments on the role of arbitrage-opportunity traders. (“Z Company”)

Alpha Company

Alpha Company, having been invited to an SFR tender, is quickly in contact with all of its major supply centers in the world. The prompt SFR inventory can be readily sold through its downstream network, without disturbing current spot market prices of 0.98 cpg. Against this known revenue Alpha’s TM collects the following SFR replacement options from his or her worldwide network.

- a) Australia promises a NEARBOB cargo that can be delivered within five weeks for a landed price of \$0.87 cpg. Alpha Company’s refinery estimates they can blend the product up to SFR specifications (CARBOB) for \$0.02 cpg. An additional \$0.01 cpg must be accrued for pipeline, dock and other handling charges. Fully weighted replacement costs in five weeks, therefore is: \$0.90 cpg
- b) South Korea contacts Alpha Company’s Singapore office to inform them that they can deliver a combined Alkylate and Reformate cargo within four weeks, for a delivered priced of \$0.93 cpg. The refinery estimates the value of these high-octane blending components to be CARB gasoline, plus \$0.04 cpg. Since this enhanced value must be equated with CARBOB, its landed cost, on a CARBOB equivalent basis, will be: \$0.89 cpg.

- c) Alpha Company's US Gulf Coast (USGC) refinery, through the Houston supply department, can deliver conforming CARBOB with three weeks at 0.92 cpg.
- d) Houston also informs the TM that a Caribbean sourced cargo is available through brokers at a floating NYMEX related price that equates to 0.90 cpg for delivery within four weeks. It's floating price element will require the TM to decide when to 'lock in' the actual cost when submitting his SFR bid.
- e) An Arabian Gulf supplier promises delivery of a complying CARBOB cargo at 0.88 cpg, but cannot guarantee delivery until eight weeks, rather than the six weeks required by the SFR. (The TM will, thereby be required to borrow inventory from his own system to repay the SFR, then back-fill with the AG cargo.)

In aggregate, Alpha Company has a range of options to choose from, some in strict conformity to the SFR tender, others needing adjustment in terms of timing or specifications. These adjustments are well within Alpha Company's capability. The TM's job is to select the most favorable offer and to bid accordingly. At this stage of its conceptual development it is not outside the SFR's operating parameters to consider multiple offers based on shipping distances and scheduling. For example:

<u>Differential bid to SFR</u>	<u>Delivery Basis</u>
4 cpg	Within three weeks
5 cpg	Within four weeks
6 cpg	Within five weeks
7 cpg	Within six weeks

Assuming that no such delivery schedule flexibility is built into the governing rules of the SFR, then Alpha Company's TM must make a market decision on the basis of a specific time frame. This decision must be made contemporaneously with all the non-cooperative game players who will participate in this tender and who's behavior the TM cannot fully anticipate.⁷⁴

⁷⁴ "In noncooperative games, unlike cooperative ones, no outside authority assures that players stick to the same predetermined rules...."

Beta Company

Beta Company is a high-volume independent retailer. It may be a Gasoline marketing specialist with convenient stores, similar to the major branded systems. Or, it may be a “big box” hypermarketer, where gasoline is sold at a discount at the pump island to attract customers into its primary store. In any event, the marketing company may bid on SFR supplies either through alliance with a California refiner, a local Jobber with trading company connections, an offshore refinery capable of delivering CARBOB to the SFR, an international trading company, or through the commercial relationships of its Gasoline Supply Manager who may call upon any combination of the above. Under these types of strategic relationships Beta Company provides the downstream liquidity for the SFR transaction.

The alliance partner, or partners may propose a range of profit and risk sharing options. These options could include the tank transfer of prompt SFR inventories into the “outer ring” (private storage) to be lifted ratably by Beta Company over the net “x” number of weeks, by which time the alliance partner will be obliged to replace the inventory according to the terms of the SFR tender.

Z Company

“Z” Company is a speculative, or opportunity trader. This style company assumes market risks that lie beyond the business scope of either Alpha or Beta Company. Its local office may be part of a regional, or worldwide network. Such companies enter the market in a long or short position, depending on their view of emerging price trends. They serve a useful function in many Energy markets by enhancing the level of liquidity through assumption of price risk, and by creating robust secondary (derivative) contracts and instruments. It is entirely possible that “Z” Company will bid aggressively on an SFR tender without lining up exactly to whom the prompt barrels will be sold, or from which source they will be replaced. But the SFR contract will be performed, even at a great loss if necessary, because this non-asset based class of trade cannot survive the legal or market stigma of non-performance. The consumer benefits by “Z Company’s” presence through the added liquidity and hedging tools that they offer, and by the added level of competition that it brings to bear upon the market.

WHAT THE SFR ADMINISTRATOR SEES

We have described scenarios by which the SFR transactions can be understood from a number of international and local perspectives. We have illustrated, by way of specific reference, how the economic dynamics involved reflect the kind of *search for equilibrium through non-cooperative games* that were modeled so creatively by Dr. John Nash in his Nobel Prize winning work. We have shown how the famous “Nash equilibrium” will find its ultimate focal point in the SFR through its convenient time-swap mechanism, and how the California consumer will become the beneficiary of that creative competition. We have asserted that the SFR operation itself is not complex at all. It simply compels the multitudinous markets surrounding it to perform their independent evaluation, each based on their own matrix of alternative options, - and to place a bid. SFR barrels are not for sale. The absolute price of gasoline will not be tampered with in any way by government action. The open access time-swap is a thoroughly unique approach to managing a strategic inventory. The usual objections that are raised in connection with other types of strategic reserves simply do not apply. i.e. government involvement in the market, unpredictable trigger mechanisms, stagnant inventories, etc. All competition will take place in the free market. California consumers will benefit. Capitalism trumps oligopoly.

However, after absorbing the rich complexities of international trade in gasoline and blending components as laid out in the forgoing scenarios, how can one feel confident that the SFR itself will not become entangled in the far-flung mesh of those non-cooperative games? The answer becomes self evident when one stands in the shoes of the SFR Administrator and see what he sees. The Administrator can be blind to the intricacies of the private sector maneuvers taking place ‘beyond the fence’ of the strategic reserve and still be effective. He only needs to care about swap differentials and contractual performance. The market will take care of itself.

Who bids what?

On the basis of the raw numbers shown in the matrix, one would expect that the J/V cargo from the Caribbean would walk away with the prize. Their deemed margin of 0.15 cpg places them well ahead of the competition from around the globe. But, just as the published prices for markets around the world cannot tell the whole story that drives the strategies of each player, so too, the

deemed margin that each player calculates will not determine exactly what price he will bid to win the auction.

An element of guesswork enters the equation. A process of, once again, evaluating the alternatives enters the heated moment. The nature of this phase of decision-making is more intense than that of 'lining up the deal' on paper. As time draws near to 'pull the trigger' and to submit a firm offer to the SFR, each player will wrestle with the possible outcomes. "What if I bid too aggressively and leave too much money on the table? How will my boss react?" thinks the trader in Australia, blind as he is to the economics of his competition in the Caribbean, or the Arabian Gulf.

"Game theory is a theory of rational behavior for interactive decision. Problems. In a *game*, several agents strive to maximize their (expected) utility index by choosing particular course of action, and each agent's final utility payoffs depend on the profile of course of action chosen by *all* agents. The interactive situation, specified by the set of participants, the possible courses of action of each agent, and the set of all possible utility payoffs, is called a *game*."⁷⁵

It is also possible that the Caribbean J/V that produces such a robust profit margin (15 cpg) is a fragile one. It may fall apart before the final bids are placed, with each party deciding to 'go it alone.'

Meanwhile, the major oil company Supply Manager who is also considering a bid on the basis of a Caribbean sourced cargo might discover that he has been 'counting the same barrels'. That particular cargo could slip out of his hands if his Houston office cannot work a deal to bring it 'firm' before the bid deadline. This compels him to rely on his next best option out of Korea at 9 cpg.

"In competitive markets (competitive market equilibrium), it is enough that each player optimizes regardless of the behavior of other traders. As soon as a *small* number of agents are involved in an economic transaction, however, the payoff's to each of them depend on the other agents' actions."⁷⁶

But having shifted his strategy to the Korea source, he unknowingly enters a netback margin territory shared with non-cooperative players from NW Europe and the Arabian Gulf. Beside, he

⁷⁵ <http://www.sfb504.uni-mannheim.de/glossary/game.htm>

⁷⁶ Ibid

needs to keep part of the proceeds of the SFR deal for his own profit center and to share the balance with his counterpart in Seoul.

Often the players participating in a government tender will call each other, either directly or through brokers, to ‘get a feel’ of what the competition is thinking. But this process seldom yields real dividends. No player wants to reveal his strategy for fear that any leaked information will be used against him.

“Although the word ‘game’ suggests peaceful and ‘kind’ behavior, most situations relevant in politics, psychology, biology, and economics involve rather strong conflicts of interest, competition, and cheating, apart from leaving room for cooperation or mutually beneficial actions.”⁷⁷

In the final analysis the winner of an SFR auction will not necessarily be the company with the greatest ‘deemed margin’ built into his economics, but rather that company who is willing to give up the greatest share of his deemed profit in order to secure the business. Or the winning bid might come from unsuspected quarters. In this case the trader for the company in the Arabian Gulf is looking at rather bleak alternatives if he loses the SFR opportunity. He is willing to give up half of his deemed margin to secure the business. He decided to bid 5 cpg to the SFR, thinking that his competitors will not match this level of margin sacrifice.

But the wild card in the competition turns out to be “Z Company”, the international arbitrage trader who owns no refineries anywhere. Because he is not locked into any particular supply source, he is free buy from any and all of them on the strength of his company’s credit and performance record. “Z Company” will assess the forward price trajectories of all global markets over the next six weeks and place its bid in the confidence that its traders will be able to ‘cover the short position’ at a profit. All, or part of that coverage may, in fact, come from the California spot market itself, if prices fall after the auction. In this instance, “Z Company’s ‘read’ of the local and international price trends, lead is to bid 7 cpg to the SFR. This bid wins the auction. As a result, holders of cargoes in all of the aforementioned markets remain long. They must sell those parcels elsewhere, or to “Z Company”, in another example of bargaining within the context of noncooperative games.

⁷⁷ <http://www.sfb504.uni-mannheim.de/glossary/game.htm>

Note: These hypothetical cases are not far-fetched. They are intended to illustrate the dynamic complexity of the SFR in action. California becomes the hub of global gasoline trading, as it should be. Local refiners retain their significant advantage, but a new level of competition stretches from Asia, Europe and the Arabian Gulf to the streets of San Francisco. It is only the California gasoline consumer who comes out a winner in every scenario.

SFR – ALTERNATIVE TO A FUTURES MARKET

The SFR as outlined above, both in its administrative profile and in the global scenarios described, resembles the workings of a Futures Market. But that is not the primary intent of this proposal. Forward liquidity, linked to the physical flow of prices and products, will be enabled by the time-swap auction, but there will be no “clearing house” function involved. Various stakeholders and active East Coast participants in the NYMEX⁷⁸ point out that California gasoline will never provide the enormous liquidity that is common to the NY Heating Oil, or WTI (West Texas Intermediate) Crude Oil Contracts.

Even with the common delivery point that an SFR would provide, there will still be boutique fuel and Unocal Patent issues to contend with. CARB gasoline will not become a fungible commodity like Jet Fuel. Some see the comparison with NYMEX as beside the point. They remind us that the NYMEX has grown accustomed to being the clearinghouse for thousands of petroleum contracts that are traded by non-petroleum interests, such as fund managers, cross-commodity technical traders and financial institutions.

European and South American traders, not to mention the entire U.S. Gulf Coast refining complex, use the NYMEX as a hedging mechanism for physical cargoes and pipeline shipments. Traders of weather derivatives, of natural gas, of electricity and other hydrocarbons find both a ‘leading indicator’ and a risk diversification tool in NYMEX futures contracts. But these diverse, big money interests have been drawn to the NYMEX commodity exchange over a course of twenty years.

The brief history sketched below reminds us of its halting beginnings in petroleum. California, on the other hand, has no history to fall back on. But it has tremendous potential. And new electronic systems exist that can, when used in conjunction with the SFR auction, provide. If an SFR is to be

⁷⁸ New York Mercantile Exchange

established in the state, then these tools should be used for control, for convenience and to provide market transparency.

- **NYMEX Model:** The size of the California gasoline market is small compared with products traded in New York Harbor. The Eastern Seaboard is a destination market for refining centers in the Gulf Coast, as well as for arbitrage cargoes from South America and Europe. But with adequate private sector storage, connected to the SFR, a physical delivery point for forward contracts would be established. It would link the State to the rest of world without incurring the expense of building a pipeline from the U.S. Gulf Coast. With such a system in place, one would expect liquidity in today's thinly traded forward markets to expand exponentially. Nonetheless, a traditional NYMEX floor-brokered system would not be justified in the foreseeable future.
- **E-Commerce Model:** The NYMEX and Europe's IPE models are based upon a guaranteed performance and margin call structure, whereby the clearinghouse stands between buyers and sellers, becoming a principle to every transaction. But an array of alternative trading methods have emerged across the Internet in the past few years. Such trading platforms as: Houstonstreet.com, Redmeteor.com, [Inter Continental Exchange \(ICE\)](http://InterContinentalExchange.com), and certain home grown models such as Energyswap.com⁷⁹ have been introduced with various degrees of success. Credit and performance parameters must be pre-approved between the counter-parties, as would be the case with the SFR. The electronic systems offer varying degrees of flexibility for defining specifications, delivery terms and conditions, etc. They are not pure commodity markets. The fact that these platforms already operate east of the Rockies, begs the question, "Why are they not used in California today? The answer lies in the lack of underlying liquidity, or transaction intensity described throughout this Study. The SFR bridges that gap.

Additional Scenarios:

⁷⁹ See websites: www.enrononline.com, www.houstonstreet.com, www.redmeteor.com, www.ice.com; www.energyswap.com;

Example 1 – Present Situation: A cat cracker in a major refinery goes down unexpectedly. The spot market gasoline price in California shoots up by fifteen cents per gallon, from say 85 cpg to \$1.00 per gallon. The notional cost of CARB spec gasoline in the Caribbean, or in East Coast Canada is 80 cpg. Freight costs from either location are 10 cpg. Calculating the cost of money, insurance and storage fees in LA (total of 2 cpg) either cargo could land within three weeks for a cost of 92 cpg, an apparent margin of 8 cpg. On the face of it, this scenario would yield the offshore supplier a **profit of \$1,008,000** (one million and eight thousand dollars) on a typical 300,000 BBL cargo. ($\$0.08 \times 42 = \$3.36/\text{BBL} \times 300,000 \text{BBLs} = \$1,008,000$). But in many cases neither cargo will set sail for California.

In the mind of offshore refiners and traders, the price spike could evaporate as quickly as it appeared. Most cargo traders would rather “lock in” a margin of, say \$0.02 cpg than take a chance on a million dollar windfall. Experience teaches that a windfall profit on paper can become a devastating loss in the course of a voyage. There is no “lock in” mechanism in California because there is no robust forward market. There is no forward market because there are no waterborne storage facilities available to international traders and offshore refiners. All waterborne storage is in the hands of integrated refining/marketing companies. There is a strong economic incentive for these companies to “keep the market tight”. These are simply the facts.

Example 2 – SFR Release: Given the same scenario, a Request for Supply (RFS) would be submitted to the SFR by one or more market participant. Responding to that request the SFR would initiate a time-exchange auction as described above. The auction releases “prompt” barrels of gasoline, in exchange for replacement in four to six weeks. (To be explicitly defined.) The auction results in a bid by offshore supplier “x” to pay six cents per gallon to the SFR for the privilege of drawing prompt inventories that can be sold into the market at the current price. This cost is subtracted from his cargo economics from Example 1, leaving a “locked in margin” of \$0.02 cpg, or a cargo **profit of \$252,000** ($\$0.02 \text{ cpg} \times 42 = \$0.84/\text{BBL} \times 300,000 \text{BBLs} = \$252,000$). Of course the value of 300,000BBLs being released into the spot market would moderate the price spike, and would be taken into account by all participants in the auction. In reality, there should be no requirement that replacement barrels come from outside the state. If the price spike solves itself through other means, then participants in the auction should be free to avail themselves of local supply to replenish the SFR inventory.

Example 3 – Private Sector Solution: The most probable result of the very existence of an SFR as herein described would be that more vigorous forward liquidity would be created in the private sector by virtue of new import storage being available. This will be even more likely if the SFR inventory is connected to such private sector storage (the “outer ring”), as is the case with the Federal Heating Oil Reserve on the East Coast. There are no incentives in the private sector; however, to provide this inventory bridge. The ‘rolling’ of the SFR inventory through the in-and-out transactions of the auction process, will define the ‘forward curve’, which is the perceived shape of the commodity’s value at various points in the future. It will also serve to keep the inventory fresh from a quality shelf-life perspective.

Other Examples: Much of California’s recent electricity crisis, particularly the collapse of the major Public Utilities, can be attributed to a failure to understand, or utilize available ‘forward curve’ pricing instruments for “locking in” costs or margins. The alternative faced by the Utilities was to remain perpetually naked to the intense pressures of the prompt (daily and hourly in electricity) market. In the absence of such a forward market, California gasoline is traded as electricity was traded during the most severe days of the crisis. Under the now defunct “PX” system in electricity, the last kilowatt traded in a particular session would set the price for the entire grid. All competitors in an auction to supply the “PX” would be paid the optimum price for that session. This market absurdity was eventually understood by government authorities and, billions of dollars later, the PX was laid to rest. In today’s California *gasoline* market; however, the last ‘deal done’ and in many cases the last ‘rumor of a deal done’ sets the price for the entire “unbranded rack” and spot pipeline price throughout the state (Adjusted for SF vs. LA differentials), very much like the now-defunct PX system. A spot transaction of 25,000bbls, or 2.5% of the state’s gasoline pool, is enough to accomplish this. Of course, price spikes occasionally do occur within a futures market, but they are symptomatic of a much larger supply & demand phenomenon, often global in scope, than the “hiccups” that become “convulsions” in California.

Postscript: We have called upon the work of Dr. John Nash throughout the global scenarios in order to illuminate the nature of the trading patterns that will emerge, and the particular dynamics that will be at play, with the advent of the California SFR. We have written to Dr. Nash at Princeton to ask for his comments on the aptness of our applications. The Nash references have not been meant as a “stamp of authority” from a figure so recently in the public eye. On the contrary, it is the logically disciplined, yet thoroughly original nature of his work that has helped us tie together global trading patterns that would otherwise be seen as an incomprehensible jumble of options. In the same spirit, the SFR time-exchange auction system proposed herein provides the State with a logically disciplined and thoroughly original solution to taming price spikes and connecting the State to the rest of the world.