

CALIFORNIA POLICY BRIEFING MEMO – MOTOR VEHICLE FUEL DIVERSIFICATION

August 27, 2013

IMPACT OF CALIFORNIA TRANSPORTATION POLICIES ON LONG TERM FUEL DIVERSIFICATION, FUEL PRODUCER MARKET POWER, AND MOTOR VEHICLE FUEL (GASOLINE AND DIESEL) PRICES

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I. INTRODUCTION

In California, a handful of major oil companiesⁱ control import and production of over 90 percent of the transportation fuel market. This present day market dynamic is the product of over several decades of industry streamlining – including mergers, acquisitions and closure of uncompetitive facilities. At the same time, demand for fuel has steadily increased and environmental regulations to clean up California air and water quality have created a limit on the types of fuel that can be sold. Consequentially, California has what is known as a well-documented “fuel island,” dominated by a few companies.

Increasingly, California and the federal government have developed policies which diversify the fuel mix used in the state. The increasing use of emerging alternative fuelsⁱⁱ (i.e. “fringe fuels”) produced by new and established market participants, developed pursuant to these policies, competes for the gas and diesel market share currently occupied by major oil companies doing business in California.

As emerging alternative fuels grow their market share and move from fringe to mainstream status, the market power of existing oil companies over transportation fuel generally is reduced, leading to decreased market price for gasoline.

Similarly, to the extent that emerging alternative fuels are cost competitive with mainstream gasoline and diesel, overall consumer choice for cost competitive fuels is increased, and average consumer prices are reduced.

Policies currently being implemented that facilitate emerging alternative transportation fuels in California include the California Low Carbon Fuel Standard (“LCFS”), Governor Brown's Electric Vehicle (“EV”) Deployment Strategy, the AB 32 Cap-and-Trade regulation, the AB 118 Alternative Fuels and Vehicles Technology Deployment Program, and the Federal Renewable Fuels Standard. Additionally, California is implementing policies to reduce total fuel use such as vehicle efficiency standards and sustainable development efforts. Working together, these policies create new market signals and opportunities for emerging alternative fuels, while also ensuring the growth of the fuel market remains in check.

The LCFS, for example, requires the carbon intensity of transportation fuels in California be reduced incrementally to meet the state's 2020 target. The LCFS establishes an incentive to increase production of low-carbon fuels such as natural gas, biofuels, electricity, and hydrogen fuel cells, in addition to gasoline and diesel produced with less carbon-intensive methods. Increased production of alternative fuels by

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emerging and new market entrants decreases the market share currently occupied by large integrated oil companies, providing consumers with more choice and decreasing oil company market power.

Presently, alternative fuels have only a modest effect on overall fuel prices; this reflects their small market share. As greater market share is captured by the alternatives through fuel diversification, fuel prices for gas and diesel may drop markedly.

II. IMPACT OF CALIFORNIA TRANSPORTATION POLICIES ON LONG TERM DIVERSIFICATION

California's complementary fuel policies, when fully implemented, will result in diversification of the transportation market. Aggregate estimates of alternative fuel penetration resulting from implementation of these policies by 2020 range from 15 – 24% of the total fuel pool. This amounts to approximately 2.3 – 3.7 billion gallons of alternative fuel in gasoline gallon equivalents.

Estimated volumes of emerging alternative fuel penetration in California include:

Alternative Fuel Type	Year 2020 Projected Volume	Volume of displaced gasoline gallons in CA in 2020	% of fuel market share of cars and trucks (gasoline and diesel) in CA in 2020
Natural Gas - cars	95 MM therms sold	76 million gallons per year	0.50%
Natural Gas - trucks	15 – 35% new heavy duty trucks	199 million – 221 million gallons per year	1.3%-1.5%
Biofuel - ethanol	1.6 billion – 2.4 billion gallons	1.6-2.4 billion gallons per year	10.9%-16.4%
Biofuel - biodiesel	5% blend – 15% blend into diesel	200 million - 600 million gallons per year	1.3%-4.0%
Electricity and hydrogen passenger vehicles	500,000 – 1,000,000 vehicles on the road	160.5 million- 321 million gallons per year	1%- 2%
		Total displaced gallons: 2.3 – 3.7 billion	Market share of alt. fuels: 15%-24%

III. COMPETITION AND MARKET POWER IN CALIFORNIA'S GASOLINE MARKET

The cost of gasoline in California has continued to soar upwards over the past decade. At the same time, concentration of market control amongst a few firms, and a lack of consumer choice in alternatives has been the source of much scrutiny and concern.

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While the elevated gasoline prices in California may be consistent with those of competitive markets, California's fuel market is also characterized by circumstances that are likely to incentivize oil companies to exercise market power; these include relatively inelastic demand, capacity-constrained supply and the difficulties out-of-state fuel suppliers must confront if they wish to enter the California market.ⁱⁱⁱ These market qualities can contribute to high prices through the basic mechanisms of supply and demand. Similarly, concentrated market share in a limited number of companies under these conditions can also incent strategic under-supply of the market in order to drive prices upward and maximize profits.^{iv}

Diversification of California's transportation fuels market can therefore contribute to reduced fuel prices through two distinct mechanisms.

The first follows the most fundamental economic logic: that the introduction of cost-competitive alternatives to traditional fuels would increase consumer choice and create a more competitive market, driving price downward.

Second, policy interventions that facilitate entry by alternative fuels are likely to force the currently dominant industry to reduce prices and forego market share, limiting existing oligopoly firms' ability to price fuel above the competitive market price.^v Thus, alternative fuel policies can interrupt the normal condition where oligopolists who are taking into account their influence on other oligopolists can mimic functional monopolies: where firms restrict output and raise price above competitive levels. Accordingly, when there is a group of alternative fuel producers, the existence of a rising amount of fringe fuel serves as a constraint on the oligopolists' ability to distort prices.^{vi}

The following section demonstrates in greater depth the potential of an expanded alternative fuels market to reduce the market power of traditional fuel companies and create a more favorable market environment for California's consumers.

IV. MOTOR VEHICLE FUEL PRICE REDUCTION THROUGH FUEL DIVERSIFICATION (IMPACT ON "OIL MAJOR" MARKET POWER)

To illustrate the market power of major traditional fuel companies and the potential for a larger alternative fuels market to lower fuel prices, suppose a group of oil refiners or fuel trading institutions are collectively acting as a dominant firm that faces a group of alternative fuel producers termed the "competitive fringe".^{vii,viii}

Before determining the market price set collectively by the oil companies in this monopoly scenario, we must first establish the oil companies' so-called "residual" demand curve (D_R) which accounts for all market demand not satisfied by alternative fuels. To do so, we calculate total market demand (D_T) and supply of alternative fuels (S_F) at a variety of prices. The companies' demand curve D_R is then set by identifying the horizontal difference between the y-axis and the intersection of the overall demand (D_T) with the alternative fuel supply (S_F) curves, as shown in Figure 1. The oil companies' marginal revenue

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curve, (MR_R), is associated with this residual demand curve and represents the additional revenue brought in by oil companies for each additional unit of fuel sold.

The oil companies also have a marginal cost function that reflects the cost of refining additional gallons of gasoline, using the cheapest refinery to produce each additional gallon. It is important to note that the identity of the “cheapest” firm will likely change as volumes change, so that in the end all refineries produce some gasoline, but those that are more efficient produce more than those that are less efficient. In Figure 1, the marginal cost curve of the oil companies is labeled as MC_R .

To identify the production level that maximizes the oil companies' profits (taking into account the presence of the alternative fuel producers), we find the output where oil companies' marginal revenue (MR_R) and marginal cost curves (MC_R) intersect. This point represents the production level at which the revenue generated from selling the last additional gallon of gasoline is exactly equal to the cost of its production. Beyond this point, the marginal cost exceeds marginal revenue for each additional gallon produced. The common dollar value at this point is labeled as m_r^0 in Figure 1, and the profit-maximizing output is labeled as Q_R^0 .

By exercising their market power within their share of the market, oil companies are able to establish a price above their marginal cost (i.e. above the perfectly competitive market price). That price, which we find from the residual demand curve at the profit-maximizing output, is labeled as P^0 in Figure 1. Based on that price, total market output is found from the market demand curve; it is labeled as Q^0 . In equilibrium, the alternative fuel producers supply the difference between the quantity demanded by the market in Q^0 , and the quantity supplied by the oil companies, Q_R^0 . In Figure 1, this amount is relatively small, indicating the alternative fuel producers have only a small market share.

How does an expansion of the alternative fuels market change the overall market equilibrium? Figure 2 describes the mechanics. The alternative fuel producers' supply curve has shifted out to S_F' ; this outward shift could reflect adoption of cheaper technology, an increase in the number of alternative fuel producers, an increase in the production at individual fuel firms, or a combination of the three. Assuming the total market demand remains constant, this increase in alternative fuel supply reduces the residual demand of the oil companies. The old demand curve, taken from Figure 1, appears as the dashed (and unlabeled) line, while the new demand curve is labeled as D_R' . Associated with this new residual demand curve is a new marginal revenue curve, MR_R' ; again, the old marginal revenue curve appears as a dashed (and unlabeled) line.

Similar to Figure 1, the new scenario in Figure 2 shows that oil companies continue to maximize profit by producing where marginal revenue and marginal cost are equal, but as the marginal revenue curve has shifted downward, the oil companies produce less gasoline. **However, the expanded alternative fuels market is more than sufficient to offset this decrease in traditional fuel production, allowing for the market price to fall;** the new price is labeled as P^1 in Figure 2. Based on that price, total market output is found from the market demand curve; it is labeled as Q^1 – and it becomes apparent that market price has fallen, while output has risen. Note also that the oil companies produce less, reducing their market share and market power. Additionally, the oil companies are now selling at a lower price, which implies a reduction in their profits. In equilibrium, alternative fuel producers supply the difference between the

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quantity demanded by the market in Q^1 , and the quantity supplied by the oil companies, Q_R^1 . In Figure 2, this amount is considerably larger than we saw in Figure 1, indicating a substantial increase in the alternative fuel producers' market share.

The policies (such as LCFS, AB118, etc.) which lead to an expansion of alternative fuels supply therefore result in a reduction of the difference between price and oil companies' marginal cost (a measure of the distortion of resources) and a considerably lower market price.

V. CONCLUSION

California's fuel diversification policies are providing multiple benefits to California's consumers. In addition to contributing to global climate stabilization, creating jobs in the clean economy, and improving air quality across the state, fuel diversification can also protect Californians at the pump.

By introducing cost-competitive alternatives into California's fuel market, these policies address both the dangerously concentrated market shares and the true scarcity in the market that contribute to high prices.

Facilitating the transition to alternative transportation technologies, California's fuel diversification policies are aligning incentives to create a truly competitive fuels market that will drive innovation, fuel economic growth, and protect California's consumers through reduced prices associated with the exercise of market power and lack of diversification.

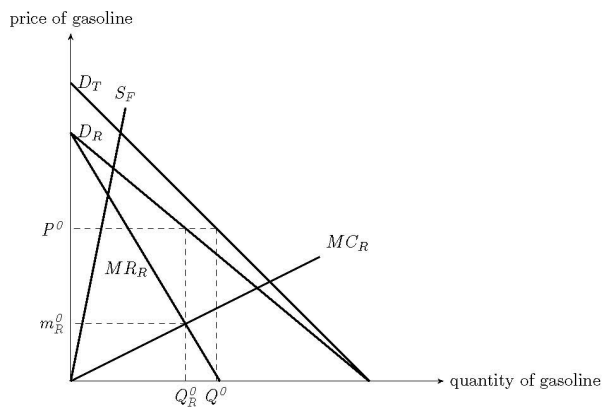


Figure 1

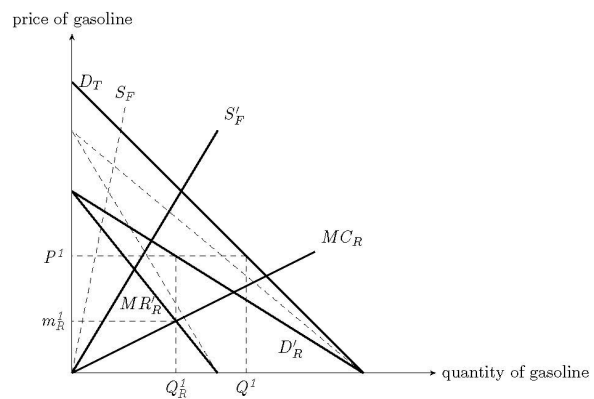


Figure 2

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ⁱ California's major oil companies include BP, Chevron, ConocoPhillips, ExxonMobil, Shell, Tesoro and Valero.

ⁱⁱ Emerging alternative motor vehicle fuels include, but are not limited to natural gas, ethanol, biodiesel, renewable diesel, electricity, hydrogen, low carbon gasoline, and renewable gas.

ⁱⁱⁱ While inelastic demand is characteristic of many markets within the US, the barriers to entering the fuel market are particularly important in California. This difficulty is linked to the specific requirements for gasoline and diesel the state imposes. To meet these requirements an out-of-state firm that wishes to sell in California must adjust its fuel production, a process that is generally costly. As such there are substantial economies of scale associated with producing fuels that are suitable for California, and these scale economies have historically impeded entry into the market. To some extent, these entry barriers interact with features that induce highly inelastic demand, such as lack of alternative fuel fueling stations, the initial price of alternative fueled vehicles, high price of some alternative fuels, etc. These are market failures due to a chicken-egg problem that the LCFS and other alternative fuel policies have the potential to address.

^{iv} The California oil market is best characterized as a highly concentrated oligopoly. Such markets have features that are similar to monopoly, in that restricting production so as to elevate profits is often in firms' individual best interests.

^v Oligopoly (definition): a market situation in which control over the supply of a commodity is held by a small number of producers each of whom is able to influence prices and thus directly affect the position of competitors

^{vi} Policies that lead to an increase in alternative fuel production, and which affect refineries, will likely cause the refining costs to increase and change the shape of the cost and supply functions. We abstract away from these cost increases in this document for simplicity of exposition. While the results herein hold for a range of increased refining costs (and may be reversed under extreme increases in costs), the MC shift is expected to be small in comparison to the outward shift in supply. Hence, these results hold under reasonable changes in marginal costs.

^{vii} To understand how an oil price manipulation scheme may be constructed, see U.S. Commodity Futures Trading Commission v. Parnon Energy et. al., filed May 24, 2011 in US District Court for the Southern District of New York.

^{viii} Generally, oligopoly results in prices and quantities which are somewhere between the equilibrium outcomes of pure competition and monopoly given the strategic interaction between the players. Unfortunately, this strategic outcome is more difficult to represent analytically. While the relationship between the market power exercised by major oil companies and the emergence of alternative fuels holds under a legal oligopoly outcome, our assumption of a single dominant firm allows for a more straightforward analysis.