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The Move to Biofuels – Will California's Transportation Network be up to the Challenge?

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The Move to Ethanol

The United States stands at the threshold of transitioning from an economy with a transportation sector that is dominated by the use of fossil fuels to one that is based on low carbon fuels such as ethanol and biodiesel. Beginning with decisions in California and New York to phase out the oxygenate methyl tertiary-butyl ether ("MTBE"), gasoline refiners are increasingly using ethanol to meet the reformulated gasoline program required by the Clean Air Act of 1990.

The Energy Security Act of 2005 has further driven the nation's movement to ethanol and biodiesel as transportation fuels. The statute established the first-ever Renewable Fuels Standard ("RFS") in federal law, which required that at least 4 billion gallons of ethanol and biodiesel be used in 2006, ramping up to at least 7.5 billion gallons in 2012. For 2013 and each year thereafter, the statute requires the Environmental Protection Agency to establish a new RFS of not less than the percentage of 7.5 billion gallons to the total volume of the U. S. gasoline supply in 2012. In addition, the RFS includes a separate element calling for at least 250 million gallons of cellulosic ethanol starting in 2013.

In his 2007 State of the Union address, President Bush upped the ethanol "ante" even further. He urged the nation to reduce its gasoline usage by 20 percent in the next 10 years, stating that "To reach this goal we must increase the supply of alternative fuels by setting a mandatory fuels standard to require 35 billion gallons of renewable and alternative fuels in 2017 — and that is nearly five times the current target."[1]

In addition to these actions taken by the federal government, California has taken steps to reduce transportation-related Green House Gas ("GHG") emissions, potentially increasing the demand for ethanol and biofuels significantly. In June 2005, Governor Schwarzenegger signed Executive Order S-3-05. The Executive Order established certain GHG emission reduction targets for California:

- By 2010, reduce GHG emissions to 2000 levels;
- By 2020, reduce GHG emissions to 1990 levels; and
- By 2050, reduce GHG emission to 80 percent below 1990 levels.

In 2006, the California legislature enacted AB 32, the California Global Warming Solutions Act. This law codified the 2020 goals and charged the California Air Resources Board ("CARB") with adopting regulations to control GHG emissions by no later than 2012. In addition, AB 32 authorizes CARB to identify "discrete early action measures" that can be put into place by 2010.

In January of this year, Governor Schwarzenegger signed Executive Order S-01-07 establishing a Low Carbon Fuel Standard ("LCFS") for transportation fuels sold in California. Under the LCFS, California, which is the largest consumer of gasoline in the nation,[2] would be required to reduce the carbon content of transportation fuels sold in California by 10 percent by 2020. In addition, the Executive Order directed CARB to determine if the LCFS could be adopted as a discrete early action

under AB 32. The LCFS applies to all refiners, blenders, producers or importers of transportation fuels in California.[3]

In compliance with the mandates of Executive Order S-01-07, the University of California examined a number of scenarios to determine how California might meet the LCFS. [4] The scenarios included not only the use of ethanol and biodiesel in place of gasoline, but other options such as innovation and investment in vehicle technologies as well. While the increased demand for ethanol differs under each scenario, it is nonetheless fair to conclude that the demand for ethanol in California will increase significantly in the relatively near future. For example, even under low-GHG biofuels commercialization scenarios, California would need 1.4 billion gallons of gasoline equivalents.[5] This is about 3.84 million gallons per day, or over 90,000 barrels per day. Under other scenarios and timeframe goals, California's requirements for biofuels could be much greater—perhaps as much as 11 billion gallon of gasoline equivalents per year (approximately 30 million gallons per day, or 700,000 barrels per day).[6]

How Increased Ethanol Production Can Meet the LCFS

Both the government and the private sector have recognized that steps must be taken to satisfy the growing demand for ethanol. Currently, the United States has the capacity to produce about 5.4 billion gallons of ethanol per year from its 111 bio-refineries located in 19 predominantly Midwestern states. The U. S. Department of Energy ("DOE") estimates that starch-based ethanol production in the United States will top out at 12 billion gallons per year, unless the industry taps into food crops. New technologies for producing inexpensive cellulosic ethanol will have to be developed. In recognition of this fact, the DOE announced in February 2007 that it would invest up to $385 million in six cellulosic ethanol plants located throughout the United Sates, including $40 million for the Bluefire Ethanol, Inc. plant in California. The Bluefire facility is expected to produce approximately 19 million gallons of ethanol per year from landfill wastes.

The private sector has also recognized the need to develop vast new quantities of ethanol. According to the energy technology venture capital firm Nth Power, U.S venture capitalists' investment in biofuels in 2006 totaled $813 million, or approximately one third of the total U.S. venture investments in energy technologies of $2.4 billion.[7] More venture capital money was invested in biofuels than solar, batteries, fuel cells, or energy information and intelligence.[8]

Ethanol and the Existing Energy Transportation Infrastructure

While government and private investors have concentrated on how to develop vast amounts of low carbon fuels, there has been less focus on how to transport these new fuels to be made available to customers. The potential problems associated with transporting large quantities of ethanol are daunting.

The United States' petroleum based transportation economy is based on an extensive pipeline and terminal structure that has developed over the decades. This energy infrastructure is a very efficient system. According to the most recent statistics issued by the Association of Oil Pipe Lines[9] pipelines remain the most popular means for transporting petroleum products. Of the total petroleum product movements in 2004, pipelines which carry only light products carried 59.8 percent of the total 528.4 billion ton-miles transported. Water carriers transported 29.9 percent of the total petroleum product ton-miles transported in 2004; motor carriers transported 6.3 percent; and railroads 4.0 per cent. Pipelines can carry a number of products and travel about 3 to 8 miles per hour depending on line size, pressure and density of the liquid being transported. A typical pipeline movement from the Gulf Coast to Chicago takes about 12 days; from Houston to New York takes about 14 to 22 days.

Although there is an extensive, efficient oil pipeline structure in place, it may not be available to move ethanol—at least in the batched modes that the industry has historically employed. Because its transportation by pipeline is difficult, most pipelines will not accept ethanol. Multi-product pipelines have problems maintaining the quality of the fuel when operating in a batched mode. Ethanol has an affinity for water picked up as the product flows through the pipeline network. In current multi-product pipelines, small amounts of water enter the pipeline system through fuels, terminals and tank roofs. While not a problem for other refined products, water contaminates ethanol and makes it unusable as a fuel. And ethanol transported in a multi-product pipeline can result in a scouring effect on the internal pipeline surface, leading to additional fuel quality issues. Interfaces between products are also problematic. The answer may be to use pipelines that are strictly dedicated to shipping neat ethanol. These pipelines can be linked to terminals and tank

farms with closed floater storage tanks that prevent rainwater ingestion. Having a dedicated ethanol pipeline also reduces problems associated with scouring and product interfaces.

According to the Association of Oil Pipe Lines and the American Petroleum Institute ("API"), there is also evidence that the presence of ethanol in pipelines can lead to stress corrosion cracking. This damage may be accelerated at weld joints or "hard spots" where the steel metallurgy has been altered. More studies are being conducted in this area.

Legislation was introduced in the 110th Congress to study the feasibility of constructing dedicated ethanol pipelines. The Ethanol Infrastructure Expansion Act (S.4003 and H.R. 2426) would direct the Secretary of Energy to conduct an ethanol pipeline feasibility study to analyze the technological, economic, regulatory and financial issues involved in transporting ethanol via dedicated ethanol pipelines. The legislation would also require the Department of Energy to research the technical factors preventing the transportation of ethanol and bio-diesel in existing pipelines.

Particularly acute could be the issues surrounding the transportation of sufficient volumes of ethanol to satisfy California's LCFS. Currently, California imports most of its ethanol, transporting 95% of it by rail to transfer points where it is then conveyed by truck. The remaining 5% of the ethanol is imported by barge or marine tanker from the Caribbean and Brazil.[10]

At the time that California and other states were considering phasing out MTBE and replacing it with ethanol, a number of studies addressed the transportation logistics involved. In 2001, California Energy Commission ("CEC") presented one of these studies at a CARB hearing,[11] and in 2002, the Office of Integrated Analysis and Forecasting of the Energy Information Administration presented another study.[12] While the quantities of ethanol being considered for shipment were far less than the enormous amounts of ethanol that could be required to satisfy California's LCFS, the studies found significant logistical hurdles, many of which remain today. Some of the conclusions and observations reached are summarized below:

Marine Vessels

- The Jones Act requires that products shipped between U.S. ports must be transported in ships built in the United States, U.S. flagged, and manned by U.S. personnel. The availability of such ships and barges is a concern, as are shipping rates, which are considerably higher than the rates for foreign vessels.
- In some areas of the U. S. inland waterway system where ethanol is produced, large movements of fuel are already experiencing congestion and delay at certain locks and are subject to freezing during the winter.
- Not all ethanol facilities have the capability to load barges.
- Shipping by ocean vessel can be unreliable. Transit times for product shipped to California via the Panama Canal can run over a month and be plagued with unanticipated delays. As a contingency, terminals would likely need to add more storage in order to accommodate the backup inventory.

Rail

- Unit trains are the most economical and rapid means to transport ethanol from the Midwest to California, but there is currently no capability for handling long lines of rail cars at California terminals. If all of California's ethanol demand were supplied by train, between 1,270 and 3,650 rail cars would be required to supply the State continuously. This is equivalent to between 60 and 87 rail cars per day.[13]
- There may be a lack of yard space for rail receipt.
- The number of terminals able to handle rail cars may be limited. Those that can are further limited in the number of cars they can spot at a given time. Some terminals can spot only 3-5 cars, and even larger terminals can spot only 15-20 cars. A unit train would have to be broken into segments.
- Terminals would need to be equipped with new off-loading facilities.
- A significant number of rail cars would have to be constructed.
- Turnaround times for rail cars can vary depending on whether the cars are a small shipment or a unit train. Single cars or groups of a few cars are moved less consistently, taking as much as twice as long to reach their destination compared to unit trains. Unit trains would take approximately 15-16 days round-trip.

Marine Terminals

- Also of concern is the ability to handle greater varieties and volumes of imports. Ethanol imported from other than Caribbean countries carry a 51 cent tariff penalty.
- Spare tankage at marine terminals is scarce.

Terminals

- Ethanol would not be blended at the refinery, but only at the terminal when the tanker truck is loaded.
- Most terminals are unable to receive ethanol via railroad cars, and tanker trucks must be used to transport it to terminals.
- Truck traffic will increase in proximity to terminals.

Retail Outlets

- Blends with a higher ethanol content, such as E85,[14] would require service station owners to install E85 pump and storage equipment.

The Time to Examine the Changes that are Required to be Made to California's Liquid Fuel Infrastructure is Now

The infrastructure that has handled crude oil and petroleum California over the last century is significant. Much of California's Sacramento and San Joaquin Valleys already have a well developed system of gathering pipelines and trunklines that were developed as part of California's large oil and natural gas production industry. Fortunately, these pipelines tend to be located in many of the agricultural areas that will produce ethanol in the future.

There is no doubt that pipelines provide an extremely efficient means for transporting liquid products. According to calculations by the API, replacing a 150,000 barrel per day pipeline would require 750 trucks per day, arriving and unloading every two minutes. Replacing the same pipeline with a unit train of 2000-barrel tank cars would require one 75-car train arriving and unloading every day. California has a well developed pipeline infrastructure, and now is the time to assess which of these pipelines are potentially suited for dedication to ethanol service. California should help take the lead in overcoming any technical issues involving the transportation of ethanol by pipeline. This vast pipeline network is by far too valuable an asset to ignore as California moves to a low carbon fuel transportation economy.

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Footnotes:

[1] 2007 State of the Union Address, January 23, 2007.

[2] California currently consumes about 12 percent of the nation's total gasoline supply, or approximately 16 billion gallons per year, or about 42 million gallons per day.

[3] On June 15, 2007, CARB announced that it had approved changes to its reformulated gasoline regulations and the predictive model, a tool used by oil refiners to formulate lower-emitting gasoline in Califonia. The refinements include greater use of ethanol.

[4] *A Low Carbon Fuel Standard for California*, May 29, 2007.

[5] This is equivalent to approximately 3.84 million gallons per day, or over 90,000 barrels per day.

[6] To put this into context, California consumed approximately 15.7 billion gallons of gasoline and 893 million gallons of ethanol in the transportation sector in 2004. California's current in-state production capacity for ethanol is about 71 million gallons per year. Thus, of the approximately 900 million gallons of ethanol used in transportation, most was imported with about 90 percent coming from the Midwest.

[7] To put this further in perspective, from 1993 through 1998, there was only $380 million of venture capital money invested in energy technology of all kinds. *Alternative Fuel is Attracting Venture*

Capital, Wall Street Journal, February 2, 2006.

[8] *Clean Energy Trends 2007,* Nth Power and CleanEdge, dated March 6, 2007.

[9] Association of Oil Pipe Lines annual report dated June 14, 2006.

[10] There is a 51 cent tax on ethanol imported from Brazil.

[11] *MTBE Phase Out Update – Costs, Supply, Logistics & Key Challenges*, Gordon Schremp, California Energy Commission, July 26, 2001.

[12] *Review of Transportation Issues and comparison of Infrastructure Costs for a Renewable Fuels Standard*, Office of Integrated Analysis and forecasting, Energy Information Administration, September 2002.

[13] With the greater demands for ethanol that result under some scenarios to achieve LCFS, the number of rail cars would be potentially much greater.

[14] E85 is 85% ethanol and 15% gasoline.