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En*Vantage's Special Report: The Impact of Removing MTBE in Gasoline

Note to Clients: Recently the press has expressed concerns that removing methyl tertiary-butyl ether (MTBE) from gasoline and replacing it with ethanol this coming summer could cause spot shortages of gasoline during the height of the driving season. After reviewing this topic we find there are a number of erroneous interpretations and misrepresentations of what might happen. So, as an addendum to this week's Energy Report we are providing a special analysis on MTBE's removal and its possible implications for gasoline, crude, NGLs and natural gas. This topic is complex and we are not under the pretext that we can adequately explain all the scenarios that could unfold this summer. Most of our analysis is "back of the envelope", but hopefully our analysis will shed some light on this topic for our non-refining clients.

For fun and as part of our discussion surrounding MTBE and ethanol we would like to present our clients a true or false quiz to measure your IQ on this topic. Just circle true or false to the questions below.

1. The federal government is mandating the removal of MTBE from gasoline starting this summer? *True or False*

2. Most, if not all, of the gasoline that contains MTBE is reformulated gasoline? *True or False*

3. The areas of the country that will be most affected by the removal of MTBE from gasoline this summer will be the West and East Coasts? *True or False*

4. The federal government is mandating the blending of ethanol to replace MTBE in gasoline this summer? *True or False*

5. Oxygenates in gasoline are no longer mandated in reformulated gasoline starting this summer? *True or False*

6. Gasoline that contains ethanol can be transported in US pipelines? *True or False*

7. All common pipeline carriers of gasoline have banned the shipment of gasoline containing MTBE starting this Spring? *True or False*

8. US ethanol production capacity is currently insufficient to produce the ethanol volumes required to replace all of the MTBE eliminated from gasoline this summer? *True or False*

9. RBOB (pronounced R Bob) is the name of the new reformulated gasoline that will be sold to consumers at retail stations starting this summer? True or False

10. Since ethanol is derived from biomass (corn, sugar cane, switch grass) and not petroleum, its replacement of MTBE in gasoline will actually decrease US demand for crude oil? *True or False*

11. Foreign refiners <u>will not</u> be able to make the types of gasoline blendstocks or finished gasolines required by the US market this summer? *True or False*

12. Motorists that buy conventional gasoline in regions outside of reformulated mandated areas may have to buy ethanol blended gasolines whether they want to or not? *True or False*

13. Ethanol blended gasoline will improve drivability and gasoline mileage? *True or False*

14. Producers of NGLs (primarily gas processors) will be adversely affected by the elimination of MTBE and the addition of ethanol in gasoline? *True or False*

15. Natural gas is used directly as a feedstock in the production of MTBE? *True or False*

16. Replacing MTBE with ethanol should have very little impact on natural gas producers? *True or False*

Answers to these test questions are provided at the end of this report. If you got 12 or more of these questions right you should be writing this report instead of us. If you got less than 8 questions right, don't worry that is what we scored about 2 weeks ago before we extensively researched the topic.

In no particular order, the justification for all the answers to the quiz will be provided in the following discussion.

Discussion

Background

Last year a number of refiners and gasoline marketers announced their intent to remove MTBE from their gasoline pools by the summer of 2006 and replace MTBE with ethanol. The shift in gasoline composition containing MTBE is due to a number of factors:

- Ethers, such as MTBE, and alcohols, such as, ethanol, are oxygenates. Up to this time, refiners either blended MTBE or ethanol to meet the oxygenate specifications of RFG. The Energy Policy Act of 2005 passed by Congress and signed by the President on August 8, 2005 removes the minimum oxygenate content required in reformulated gasoline (RFG) as of May 6, 2006. The federal Act does not specifically mandate the removal of MTBE from gasoline until December 31, 2014. The Act does specify that motor fuels sold in the US contain a certain amount of renewable fuels each year that starts at 4 billion gallons in 2006 and increases to 7.5 billion gallons in 2012.

- Ethanol is categorized as renewable fuel, but the Act does not specify that ethanol has to be used.

- Reformulated gasolines containing at least 2% of oxygen by weight were first mandated by the Clean Air Act Amendments of 1990 in the following air quality non-attainment areas shaded in green on the map below:

  - However, in the early days of reformulated gasoline, in the 1990's, MTBE was widely used due its availability and its superior blending qualities such as it oxygenate content, high octane level, low vapor pressure and other clean burning properties.
  - Plus, gasolines containing MTBE can be shipped by pipeline whereas gasolines containing ethanol are restricted in product pipelines or common storage facilities due to ethanol's affinity to water (moisture).

If ethanol-blended gasoline interfaces with water, the ethanol is pulled from the gasoline into the water. As a result ethanol is shipped by rail or truck and stored separately to market adjacent terminals where it is splash blended into an unfinished gasoline called reformulated gasoline blendstock for oxygenate blending or RBOB for short.

- Currently about one-third of the 9.2 million bpd of gasoline consumed in the US is RFG (including California CARB gasoline which is a form of reformulated gasoline made specifically for the California market).

➢ Over the past several years a number of states in RFG areas have switched to ethanol and have banned MTBE due to water contamination concerns: New York and Connecticut on the East Coast, most Midwestern states, and California.

➢ Today, the East Coast (excluding New York and Connecticut) and Texas are the largest, remaining consumers of RFG containing MTBE. We estimate, from EIA sources, that about 1.3 million bpd of RFG with MTBE is consumed on the East Coast and about 0.4 million bpd of RFG with MTBE is consumed in Texas. MTBE volumes contained in the RFG consumed on the East Coast and in Texas are approximately 100,000 bpd and 45,000 bpd, respectively.

➢ Consequently, the decision by gasoline producers and marketers to eliminate about 145,000 bpd of MTBE has been driven by State bans due to water contamination concerns, continuing liability exposure from adding MTBE to gasoline, and the perceived potential for increased liability exposure due to the elimination of the oxygen content requirement for RFG included in the Energy Policy Act of 2005.

➢ Although oxygenates like ethanol are no longer required, replacing the octane provided by MTBE is difficult. While ethanol is not as clean-burning as MTBE, it is a cleaner component than most other blendstocks because of its high oxygen content.

Blending Ethanol and its Volume Implications for RFG Production

Substituting MTBE with ethanol is not a one to one replacement on a volume basis due to the different physical and chemical properties of each component.

Blending Properties		
	MTBE	Ethanol
Octane (R+M)/2	110	115
RVP, psi	8	18[1]
Oyxgen: wt%	18.2	34.7

[1] RVP impact of ethanol is non-linear. Adding 5% ethanol to a base 9 RVP gasoline raises the RVP slightly over 1 psi, w hile adding 10% ethanol raises the RVP less than 1 psi.

Because ethanol's octane content is greater than MTBE, less ethanol has to be blended in the gasoline pool to meet RFG's current octane content. When balancing all the differences in properties between the 2 components, it is estimated that 130,000 bpd of ethanol will be needed to replace the 145,000 bpd of MTBE that is currently in RFG (see Table below).

Potential Impact of Removing MTBE from the remaining Reformulated Gasoline Pool -- MBPD								
envantage Region	Reformulated Gasoline Supplied[1]	Estimated MTBE in RFG	Additional Ethanol Needed to Replace MTBE in RFG	Net Gasoline Volumes after Replacing MTBE with Ethanol[2]	Removal of other Blendstocks to Adjust for RVP and Distillation Impacts of Replacing MTBE with Ethanol	Adjusted RFG Volumes with Ethanol[3]	**Net Loss of Gasoline Volumes due to the "New RFG"**	**Effective Volumes lost due to Drop in Gasoline Mileage**
East Coast	1,300	100	90	1,290	65	1,225	**75**	**31**
Texas	400	45	40	395	20	375	**25**	**9**
Total	1,700	145	130	1,685	85	1,600	**100**	**40**

[1] The EIA estimates that about 36 MBPD of ethanol is presently in RFG currently supplied to the East Coast. [2] The addition of 130 MBPD of ethanol along with the existing 36 MBP of ethanol in RFG will put the ethanol content of RFG at about 10%. The addition of 10% ethanol to the RFG pool will increase the RVP of the RFG by about 1 psi. To reduce this increase in RVP, lighter blendstocks like n-butane must be removed. [3] The RBOB contract that will be traded on the NYMEX will have the composition to accomodate a 10% ethanol blend.

However, to counter ethanol's higher evaporative properties, as measured by Reid Vapor Pressure (RVP), and to counter the higher toxic emissions and distillation characteristics of ethanol, refiners will need to back out 85,000 bpd of lighter, more evaporative components in their gasoline pool such as normal butane and C_5 hydrocarbons, particularly during the summer months when RVP standards are more restrictive. Note: of the 85,000 bpd removed from RFG gasoline nearly half will be normal butane, the remaining components removed from RFG might be equivalent to natural gasoline in gravity or natural gasoline itself.

So, removing MTBE, adding ethanol and then removing other higher volatile components, results in a net volume loss of about 100,000 bpd.

In addition, because the energy content of ethanol blended RFG is less than MTBE blended RFG there is a fuel efficiency loss of about 2.5% which adds another 40 MBPD to effective gasoline volumes lost to ethanol blending.

Therefore, we estimate that during the summer months the overall reduction in RFG volumes due to replacing MTBE with ethanol is somewhere around 140,000 bpd +/- 10,000 bpd which constitutes a 1.5% reduction in the total gasoline pool supplied to the US market.

Before we discuss how this volume loss will be made-up, we will first focus on the availability of ethanol in the short-run and the logistic problems this may pose of getting the ethanol bended RFG to the consumer.

Ethanol Availability and Distribution

As we previously mentioned it is estimated that an additional 130 MBPD of ethanol will be required to replace the 145 MBPD of MTBE currently in RFG, the East Coast will need 90 MBPD of ethanol and the remaining 40 MBPD will be required in Texas. There are two major questions concerning ethanol availability to meet the additional demand of 130 MBPD.

1. Will there will a “rapid reduction” of MTBE as the EIA claimed in their March 2006 report based on their “informal discussions with a number of suppliers”?

-Or-

2. Will RFG producers and marketers phase out MTBE in stages to give time for new ethanol capacity to catch up as the Renewable Fuels Association claims?

In the 1st quarter of 2006, ethanol demand in the US is estimated to be 305 MBPD. US ethanol plant capacity is 290 MBPD producing 280 MBPD. Since existing ethanol plants are virtually running at capacity, the US must import about 25 MBPD of ethanol. The US ethanol industry also has about 5.5 million barrels in storage or 18 days demand coverage, which would be considered extremely low if this were crude oil, gasoline or distillate.

The Renewable Fuels Association reports show that there is currently 134 MBPD of ethanol capacity under construction. This new capacity should exactly match the incremental demand for ethanol. However, there is no way that this new ethanol capacity can start soon enough to meet all of the incremental demand for ethanol this summer if there is a rapid reduction of MTBE from RFG.

Ethanol Capacity and Demand		
	1000 Barrels per day	Billion of Gallons per Year
Current US Ethanol Capacity	290	4.45
Dec 05 Production	280	4.29
Ethanol Imports	25	0.38
Estimated Current Demand	305	4.68
Additional Demand in 2006	130	1.99
Capacity under construction	134	2.05

In a rapid MTBE reduction scenario, some of the 130 MBPD of incremental ethanol demand can be met from new capacity production and some by increased imports from areas like Brazil. However, Brazil's government has recently begun to "closely monitor" the country's ethanol producers to make sure they provide ample supply to the domestic market before exporting more product.

In order to bridge the supply and demand gap for ethanol, some ethanol will need to be removed from conventional gasoline in the Midwest and shipped to the East Coast and Texas for RFG blending. We estimate that about 140 MBPD of ethanol is currently being blended in conventional gasoline.

The feasibility of removing ethanol from conventional gasoline is unknown. From a political and physical point of view, it appears difficult. Although many farm states use ethanol blended gasoline by choice and not by mandate. So, trading their ethanol for more polluting conventional gasoline may not set well with Midwesterners. Also, removing ethanol from conventional gasoline reduces the volume of gasoline available to the market. Replacing lost conventional gasoline is easier than replacing lost RFG volumes, but it still is an additional cost to the Midwest.

Another concern is that the ethanol from the Midwest will have to be railed and barged to the East Coast and Texas and there are no assurances that are enough barges and rail cars available to meet this need if MTBE is rapidly eliminated.

To counter EIA claims that there will be a swift reduction of MTBE blending this spring, the Renewable Fuels Association (RFA) wrote EIA in a letter this past Tuesday that US refiners are phasing out gasoline MTBE in stages. The RFA goes on to say that while ethanol supplies will be strained, a phased reduction will allow a smoother transition than that projected by the EIA. They cited Colonial Pipeline's reversal of an earlier decision to ban MTBE on its line by mid-April as evidence that the industry is in a phased approach.

The RFA also claims that “The US ethanol industry has been planning for this transition for months and has already taken the necessary steps to ensure that every drop of ethanol produced in this country makes it to the areas that need it. There are 33 ethanol plants under construction and many more completing planning stages. Many participants in the ethanol industry have begun to restructure how they deliver ethanol to local markets, freeing up rail capacity to deliver product to the East Coast. Others are staging barges to ship ethanol via waterways or have begun pre-filling storage facilities on the East Coast in advance of the transition away from MTBE”.

The actual situation is probably in between the claims of the EIA and the RFA with concerns to the availability of ethanol and whether MTBE will be rapidly reduced or phased out. However, evidence is building that there could be distribution problems because of the lack of storage capacity to needed to handle RBOB and the ethanol.

OPIS is reporting that as refiners prepare to transition from MTBE to ethanol they are beginning to look at their available storage - and some are finding it falls short of their needs.

Shell, for example, has warned jobbers in conventional fuel areas in Texas that it may have to provide them with ethanol RFG.

"Due to limited product storage, many terminals may only inventory the RFG base gasoline and ethanol," Shell said in materials sent to marketers. "This terminal constraint may impact some or all of your outlets located outside the designated RFG areas normally supplied conventional gasoline."

If conventional fuel isn't available at a jobber's primary terminal, and supply elsewhere is either not available, or impracticable, then Shell will supply ethanol-blended RFG. That means marketers in conventional fuel areas would have to take the same tank-cleaning steps as marketers in RFG areas. It also means that marketers might have to pay anywhere from 5cts to 15cts/gal more for their gasoline, based on projected conventional versus RFG ethanol blend costs.

The Dallas/Ft. Worth market is particularly vulnerable, Shell officials acknowledge. Other potential problem spots where conventional gasoline may disappear include Baltimore, Richmond and Fairfax, some analysts fear.

Until now, demand for conventional premium in Dallas/Ft. Worth has been sufficiently low that suppliers typically have blended down RFG premium for use as conventional midgrade and premium, which meant they needed terminal storage for only one product grade. However, due to RVP regulatory requirements for ethanol, refiners have to maintain separate storage for multiple grades, which shrinks available tankage.

Also gasoline jobbers and suppliers are warning gasoline dealers (retailers) they will be responsible for insuring that their gasoline storage tanks at the stations are free of water. Most suppliers will suspend deliveries to any dealer with water in his tanks to avoid liability. Chevron is advising its jobbers to have extra filters on hand during the first two or three weeks that ethanol fuels are sold and to be prepared for customer complaints because with ethanol blends, there's a drop of 3.4% in energy content and 2.6% in fuel economy, Chevron says. Ethanol fuels can also lead to vapor lock and cold start 'drivability' problems.

Making-up for lost production

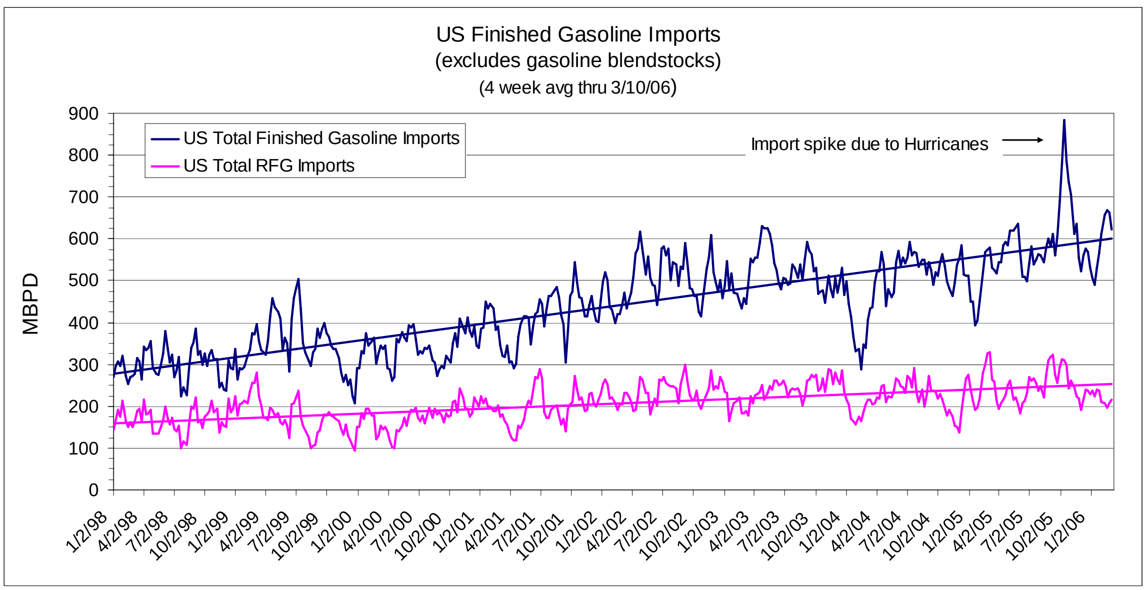
Not only is there the issue of getting the “right” gasoline and blending components delivered to the market place but there is also the problem of making-up for the effective volume loss of about 140 MBPD when MTBE is replaced by ethanol. It is not simple. There are only 3 basic ways that this can be done and a combination of some or all the 3 options might be needed to keep the market balanced:

- Increase crude oil throughput.
- Increase production of clean-blending components like iso-octane and alkylate.
- Increase RBOB and gasoline blendstock imports.

The effective reduction in gasoline volumes of 140 MBPD this summer is equivalent to about 250 MBPD of crude oil refined in an average US refinery, meaning that US refiners east of the Rockies would have to increase their utilization rates by 1.8%. It is doable, but it will tighten available refining capacity during the summer months and increase volumes of other products such distillates, jet fuel and fuel oils that the market may not necessarily need.

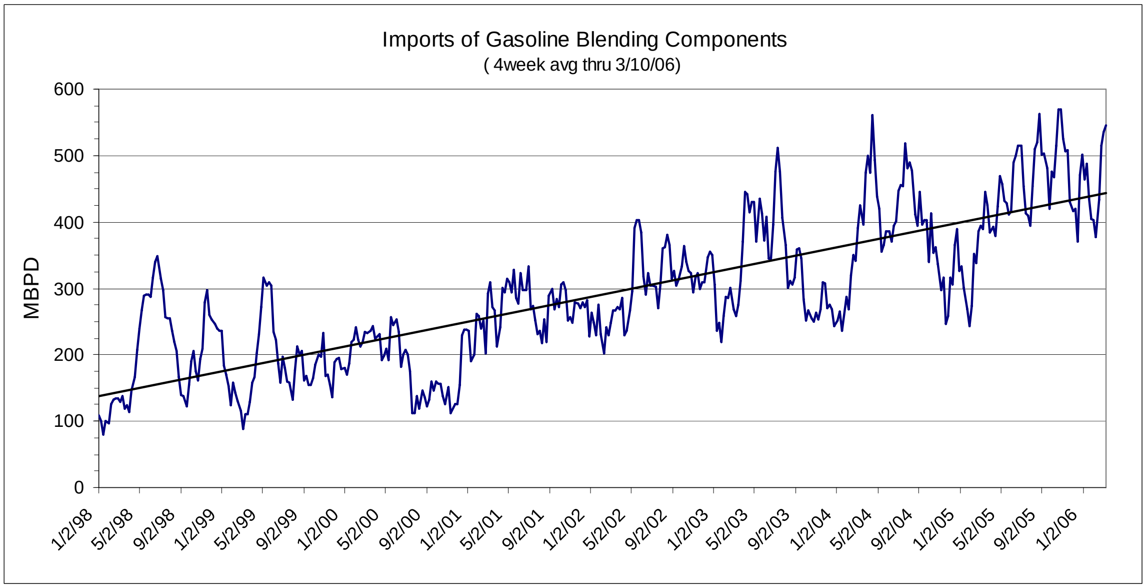
In tandem to increasing runs to some degree, refiners will need to increase the production of clean-blending components like alkylate and iso-octane. These gasoline blendstocks have very few harmful emission effects because they contain no sulfur, aromatics, or olefins, have low RVPs and good distillation profiles from an emission and drivability standpoint. Large incremental increases of clean-blending components could take time as refiners for the past several years have focused on adding desulphurization capacity to meet Tier II sulfur specs for gasoline and diesel. Certainly some amount of alkylate production can currently be increased, but current merchant and internal cat-cracker MTBE plants will have to be converted to produce components like iso-octane and iso-octene in large quantities.

Because the East Coast receives about 90% of total US gasoline (finished) imports and 100% of the US RFG imports, increasing imports of individual gasoline blending components and RBOB could certainly help make-up some of the production loss due to MTBE elimination. Recently, there have been some doubts expressed in the market place of whether foreign refiners can make MTBE-free gasoline and low-RVP, high quality blendstocks needed for the US market. However history has shown that despite all the changes in gasoline specs that have occurred over the past few years, gasoline imports have steadily increased as shown in the chart below:



Total US finished gasoline imports, which includes conventional and RFG gasolines, have doubled since 1998. When RFG imports are broken out separately the growth rate is considerably less increasing from 150 MBPD in the late 1990s to about 250 MPD currently.

More impressive is that the imports of gasoline blending components have more than doubled in the past 7 years and continue to increase in the 1st quarter of 2006. Ninety percent of RFG imports and gasoline blending components come from three sources: Canada, Western Europe and the Virgin Islands.



With regards to this summer, Chevron has publicly stated that its refineries in Europe will be capable to export a variety of MTBE free reformulated blendstocks to the East Coast. And, EIA analyst Joanne Shore told a conference call on Feb. 28th that although the US may lose some gasoline import suppliers Western Europe, Canada and the Virgin Islands all have the potential to provide more reformulated blendstocks suitable for ethanol blending.

Again in any transition year when there are large fuel specification changes, there is always uncertainty and logistical challenges depending on the speed of the transition. If refiners and marketers choose a phased approach it will lessen the difficulties of the transition; if not, we can have a difficult summer with possible spot shortages of gasoline until the industry ramps up its ability to increase the production of MTBE free RFG and ethanol.

Implications

The removal of MTBE from RFG and replacing it with ethanol will have several major implications for the market and the industries that operate in the energy arena:

- The equivalent volume loss of replacing MTBE with ethanol could widen gasoline crack spreads this summer and out upward on WTI prices.
- The supply/demand for ethanol will now play a role in influencing gasoline and crude prices.
- Midstream product companies (refined product storage, terminal and pipeline companies) may be the real beneficiaries of the shift to ethanol, as refiners and marketers will require more services and infrastructure in sorting out the logistics of getting ethanol blended gasoline to the market place.

- Also the transportation services of railroad and barging companies will be more in demand as the need increases to transport ethanol to Texas and the East Coast.

- The gas processing industry may be one sector that is adversely affected by ethanol blended RFG. The elimination of MTBE and the backing out of high RVP components from the gasoline pool due to ethanol addition will combine to negatively affect the demand and price for n-butane. The normal butane volumes that would have normally gone into the production of MTBE and that are blended directly into gasoline will have to seek the lower valued petrochemical feedstock market, competing with ethane and propane. During natural gas price spikes, the probability increases that gas processors will see negative butane frac spreads on a more frequent basis.

- Although natural gas is not directly used as a feedstock for the production of MTBE or ethanol, the shift in RFG this summer could have a mixed affect on gas producers. On the positive side, if the shift in RFG quality elevates crude prices, this will positively impact natural gas prices. On the negative side, gas producers who have their gas processed may incur conditioning fees from gas processors more frequently if butane frac spreads go negative.

Test Answers

Answers to Test Questions			
Question	Answer	Question	Answer
1	FALSE	9	FALSE
2	TRUE	10	FALSE
3	FALSE	11	FALSE
4	FALSE	12	TRUE
5	TRUE	13	FALSE
6	FALSE	14	TRUE
7	FALSE	15	FALSE
8	TRUE	16	FALSE

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