Documentation for zFacts.com

zFacts on ethanol

See yellow highlights on the following page(s).

Fact: **The traditional pricing mechanism for ethanol pays it the same as gasoline after credits are taken into account. This covers energy, octane and negative attributes.**

Source: Review of Market for Octane Enhancers. National Renewable Energy Laboratory, May 2000, NREL/SR-580-28193. (Google-search this title if you want the complete document.)

Notes: This study of octane enhancers discusses ethanol at length and presents no evidence of the market paying a premium for ethanols combined attributes (octane, solubility in water, vapor pressure). While ethanol's octane has value, its affinity for water means it cannot be transported by pipeline, which means it cannot be blended at the refinery. This lowers its octane value. The fact that it increases gasoline's vapor pressure subtracts from its value.

As a result the Midwest octane market appears merely to remove a discount to ethanol's trading price that occurs when octane is not valued.

Because, there is no observational evidence for a premium, and the report indicates that a 5 cent price difference is enough to shift trading patters, zFacts uses a net "octane" value of 5 cents as a way of giving ethanol the benefit of the doubt. It is probably an overstatement, and unlikely to be an understatement of the combined value of ethanol's non-energy attributes.

May 2000 • NREL/SR-580-28193

Review of Market for Octane Enhancers

Final Report

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Prepared under Subcontract No. TXE-0-29113-01

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Contract No. DE-AC36-99-GO10337

destination terminal and a throughput charge at the destination terminal (in the case of third-party terminals and throughput agreements). However, these later charges are experienced in all other markets and are not particularly relevant. Thus, from the Midwest to California handling costs will be $0.146–$0.187/gal of ethanol. Similar distances and costs could be involved with transporting and delivering OCTAlig. If shorter distances are involved, costs would be proportionally lower.

Given the uncertainty of projecting gasoline prices, projecting prices for OCTAlig becomes equally difficult. However, producers would likely redirect production for as little as $0.05 incremental margin per gallon of ethanol if it were for a market involving long-term commitments (9). Consequently, ethanol could be drawn to California from the Midwest octane market for this margin improvement plus transportation ($0.196–$0.237/gal of ethanol).

Again, the lowest valued ethanol markets are the octane enhancement markets in states without state tax credits. The ethanol octane blend market in the Midwest has traditionally been priced at the rack price of unleaded plus $0.54/gal (the value of the federal motor fuels excise tax credit). Although the formula of unleaded plus $0.54/gal somewhat undervalues the octane value of ethanol, it is the traditional pricing mechanism and the one currently used. To induce blenders to use ethanol, a blend margin incentive, traditionally provided by the unleaded price plus $0.54, must be provided. This incentive is estimated to be $0.05/gal. Based on January 2000 prices for octane blending components (see Table 23), the blending value for aromatics is $0.007–$0.009/octane gal. Thus, if OCTAlig had an ON of 106, its theoretical octane premium would be $0.14–$0.19/gal, but if a $0.05 incentive is needed, the realizable price might be $0.09–$0.14 /gal over unleaded regular gasoline price.

Ethanol sells at a discount to its octane blend value, at least partly because of its unfavorable effect on gasoline vapor pressure.

PRICING BASED ON REFINERY OPERATIONS

The value of an octane barrel (i.e., the value in excess of the price of a barrel of regular gasoline that a refiner would pay for a barrel of gasoline blending component having a blending octane number one number higher than the refinery's average output) is highly variable, depending on each refinery's configuration and its normal feedstock.

To increase the ON of its gasoline, a refinery has three major process options (11):

- Catalytic reforming of the naphtha
- Alkylation of olefins
- Isomerization of paraffins

Different refiners will have different best options, but the value of a purchased octane enhancer will be the saving to the refinery resulting from not having to add capacity for one of these processes. Basically, the value to most refineries is whatever the refinery saves in not having to run the reformer or expand reformer capacity. Studies have shown this value to be $0.30–$0.60/octane bbl ($0.0071–$0.0143/octane gal) (5). The value of an octane barrel is also highly influenced by the vapor pressure and other characteristics. If the octane enhancer also contains oxygen, additional value might be obtained.

SUMMARY

FUEL COMPOSITION REQUIREMENTS

Certain specific compositional requirements for gasoline limit the level of aromatic compounds in gasoline. For federal Phase II RFG, the limits are 1% benzene and 25% by volume total aromatics. In California, the Phase III RFG specification is an average of 22% aromatics or less. For non-RFG gasoline, the aromatic content is limited to the refinery's 1990 baseline level.

FUEL PERFORMANCE REQUIREMENTS

To be completely accepted, an octane enhancer would have to demonstrate the following characteristics when blended into gasoline:

- No increase in volatility
- No decrease in startability
- No increase in driveability index
- No residue on distillation at 200ºC
- No increase in temperature at 90% distilled point
- No increase in emissions of CO, NO_x, NMOG, and particulates

EPA'S NEW SPECIFICATION FOR SULFUR CONTENT

The sulfur-in-gasoline rule, issued in December 1999, greatly reduces the amount of sulfur allowed in gasoline by January 1, 2005. The most logical way for a refinery to reduce the sulfur level of its product is to hydrotreat either the products or the reformer feedstock, or both. This process will reduce the average aromatics content of gasoline by about 1.7% and opens the door for introducing 1.7% of an aromatic octane enhancer.

NEED FOR OCTANE

The predicted phase-out of MTBE, used as an oxygenate and an octane enhancer, will result in a nation-wide shortage of octane. Although ethanol could be used more widely as an octane enhancer, its high vapor pressure and its solubility in water are undesirable characteristics in the market for gasoline blending agents.

FEDERAL TIER II AND CALIFORNIA LEV-II EMISSION STANDARDS

These new emission control regulations for LDVs greatly reduce the allowable emissions of NO_x, NMOG, and particulates. The same standards, in terms of g/mi pollutant emitted, will apply to all LDVs regardless of size, including the largest pickup trucks and SUVs. The automakers say that these standards can be achieved only if virtually sulfur-free gasoline is available.

CHANGING AUTOMOTIVE TECHNOLOGY

Three potentially major changes in automotive technology could affect the future need for high-octane fuel:

- GDI engines
- A shift from gasoline to diesel engines
- Fuel cell vehicles

GDI engines do not require as high an ON as conventional engines. Although GDI engines are predicted to win a large market share in the future, the effect on octane requirement is relatively small.

A large shift from gasoline to diesel would eliminate the need for high-octane fuels. Although this may occur in Europe, it is considered unlikely in the United States.

Fuel cell vehicles likewise would eliminate the need for octane enhancers. Fuel cells may succeed in the marketplace in 15–20 years.

COMPETITION FROM AROMATICS IN GASOLINE

Benzene, toluene, and xylene are high-octane components of gasoline and are important feedstocks in the petrochemicals markets. BTX moves back and forth between the gasoline and petrochemicals markets depending on small price changes. Because BTX is widely available and an excellent octane enhancer, an aromatic lignin-derived octane enhancer (OCTAlig) would have to compete directly with BTX.

COMPETITION FROM ETHANOL

Ethanol is expected to capture a significant share of the future market for octane enhancers. However, ethanol has two unfavorable characteristics for blending into gasoline:

- It increases the vapor pressure of gasoline.
- Its solubility in water prohibits its use in pipeline and conventional blending tanks.

For these reasons ethanol sells at a discount with respect to its theoretical value as an octane increaser. OCTAlig would not be subject to this penalty, but it would suffer some of the same high transportation and distribution costs because production plants are located far from refinery sites.

COST AND PRICING CONSIDERATIONS

One conventional way for a refinery to meet increased octane requirements is to increase catalytic reformer capacity or operating severity. Thus, the value of a purchased octane enhancer can be calculated as being equal to the saving from not having to add reforming capacity. Using this method we estimate the value of OCTAlig (hypothetical octane index of 112) delivered to the refinery to be $0.17–$0.34/gal higher than the price for unleaded regular. Assuming transportation costs similar to ethanol (say $0.16/gal) yields a netback price at the OCTAlig production plant of $0.01–$0.18/gal higher than the price of unleaded regular gasoline. Shorter transportation distances could change these numbers to $0.09–$0.26.

PRICE PROJECTION TO 2020

The Energy Information Administration's *Annual Energy Outlook for 2000* gives a reference case projected oil price of $22.04/bbl for 2020 (compared to $26.22 in January 2000). Depending on assumptions for refinery operation margins, a 112-octane OCTAlig would be worth $0.83–$1.00/gal at the refinery. This yields a netback price at the production plant of $0.57–$1.00, depending on distance.

MARKET PROJECTION

The future required desulfurization of gasoline will probably reduce average aromatics levels in gasoline by 1.7% and create a loss of 0.5 ONs. This opens the window for introducing an aromatic octane blending agent without increasing the historical aromatics content. If OCTAlig has the same octane rating as xylene, 1.7% could be blended to remedy the octane loss without exceeding the original aromatics content in gasoline. On this basis, the total theoretical U.S. market for OCTAlig could be 142,800 bbl/d or 2.2 billion gal/yr. This can be compared to the current total U.S. production capacity for ethanol of 1.5–1.8 billion gal/yr.

If OCTAlig proves to have nega-toxics value, it could have much wider applicability by substituting for aromatics in gasoline at levels much higher than 1.7%.