Summary
Analysis of Selected Transportation Fuel Issues Associated with Proposed Energy Legislation

Introduction

On June 17, 2002, Senator Jeff Bingaman, Chairman of the Senate Committee on Energy and Natural Resources, requested that the Energy Information Administration (EIA) provide analyses of eight issues related to the Senate-passed fuels provisions of H.R. 4, the Energy Policy Act of 2002. In response, EIA prepared a series of analyses discussing the market impacts of each of these issues. Because of the rapid delivery time requested by Sen. Bingaman, each requested issue related to the Senate-passed bill was analyzed separately, without analyzing the interactions among the various provisions. In addition to the Senate-passed provisions, assumptions about State actions, such as their implementation and timing of methyl tertiary butyl ether (MTBE) bans can influence the results. Discussions about some of these interactions have been included in order to explain the interconnected nature of these issues.

The impacts of the proposed H.R. 4 changes discussed in the analyses provided to Sen. Bingaman focus on three areas: supply, price, and price volatility. If meeting a proposed change results in a reduction of production capability, then actions to fill the "lost" volumes will generally be more costly than their current alternatives and result in higher prices to consumers. Supply losses in the short term can translate into transition problems that lead to price volatility during a changeover. Changes in distribution and storage infrastructure add costs and become part of the transition issue. Factors that increase the difficulty of any fuel transition include the magnitude of the change required, the cost of new or additional components, and regulatory and market uncertainties.

Background

Most of the issues raised by Sen. Bingaman are associated with the following H.R. 4 proposed provisions: a Federal ban on MTBE with allowing State waivers; the removal of the oxygen requirement[1] for reformulated gasoline (RFG); a Renewable Fuel Standard (RFS), and a provision allowing States to seek exemption from the Federal Reid vapor pressure (RVP) waiver.[2] Many of EIA's responses to these issues dealt with the increased use of ethanol. Loss

[1] Currently, reformulated gasoline is required to contain at least 2 percent oxygen by weight. Oxygenates are materials with high oxygen content, such as ethers or alcohols. MTBE, which is an ether, generally has been the most economic oxygenate to use. Ethanol, an alcohol, has been used widely in the Midwest, where fuel ethanol is produced.

[2] RVP measures the tendency of a material to evaporate. It is measured in pounds per square inch (psi), sometimes just referred to as "pounds." Adding ethanol to gasoline increases the RVP and requires that further refining adjustments be made, particularly when producing RFG and low-RVP conventional gasolines. The low-RVP requirement in the summer adds more complications to using ethanol during this season than during the winter, in addition to summer being the period of highest demand.

of MTBE in gasoline will result in the use of more ethanol in RFG; the Renewable Fuel Standard essentially requires more use of ethanol, as this alcohol is the only widely available renewable fuel in the near term; and the provision to allow States exclusion from the RVP waiver when blending ethanol in conventional gasoline is directed towards concerns that the RFS could result in an increase in a State's emissions of volatile organic compounds (VOCs).

Ethanol, or gasoline containing ethanol, cannot be moved practically through today's pipeline system, because it tends to get pulled into the water that usually exists in petroleum pipelines and tanks. Instead, ethanol is blended into gasoline at terminals near the end users. Ethanol-blended product must be kept separate from product not containing ethanol, necessitating separate handling all the way to the gasoline pump. The separation is needed because movement of a small amount of ethanol (from the ethanol-blended mixture) to gasoline without ethanol can increase the vapor pressure of that gasoline mixture substantially, potentially pushing it above required VOC limits. Thus, ethanol must be moved through an independent distribution system until it is close to the end user, where it then is added before being delivered to retail stations. In the case of RFG, a special blend called reformulated gasoline blendstock for oxygenate blending (RBOB) is created, which is an unfinished gasoline that will meet RFG requirements after ethanol is added at terminals near consumers.

Refiners must also make changes to be able to blend ethanol into RFG. While ethanol has better emission properties than many other gasoline components and has high octane content, its effects on gasoline are different from those of MTBE. It has higher toxics emissions than MTBE and raises the tendency of gasoline to evaporate, as measured by RVP, which is the major parameter that affects VOC emissions from gasoline. Thus, refiners must also change their production facilities to remove other high RVP components to compensate for the addition of ethanol and to remove sulfur, benzene, and other aromatics in order to compensate for the increase in toxics.

These proposed H.R. 4 transportation fuel changes are taking place on top of existing regulations that require major industry investments, making it more difficult to achieve all of them simultaneously. In particular, Tier 2 low-sulfur gasoline requirements in 2005 and ultra-low-sulfur diesel fuel requirements in mid-2006 are expected to necessitate unprecedented capital investment levels and, in the case of ultra-low-sulfur diesel fuel, large distribution and storage challenges to maintain the integrity of the new product. Also, some MTBE bans are scheduled to begin in 2004 in a number States, including California, New York, and Connecticut, which will require many production and infrastructure changes, including more ethanol production in the Midwest and movement of ethanol to the East and West coasts.

Issue Analysis Summary

The summary of EIA's responses to Sen. Bingaman's concerns is listed below beginning with the issue that has the highest impact on supply, price, and price volatility – the proposed MTBE ban. While supply and price were not quantified in all issues, the ethanol and RFS issues that are discussed after the MTBE ban are not expected to have as much impact on supply and price as the MTBE ban. The 8 hour ozone rule is also not expected to have a large impact. The last

issue, which was a proposal to establish a Federal menu of fuels to help reduce fuel proliferation was discussed qualitatively and not quantified.

MTBE Ban and Availability of Ethanol

The first three issues below relate to supply implications of MTBE bans, and the potential availability of ethanol during the next few years, both to help make up for the loss of MTBE and to meet RFS requirements, which are discussed further in subsequent issues.

The expected volumetric shortfall in fuel supplies with an effective MTBE ban in 2004

MTBE is used mainly in RFG. It has low emission properties and has good engine performance qualities such as high octane and distillation characteristics. Ethanol, which also has good gasoline properties, is expected to replace about half of the MTBE that would be removed under a ban. However, ethanol's engine performance and air quality properties are not as good as MTBE's, and a net volume loss of gasoline will occur as less volumes of ethanol replace MTBE and as additional petroleum components are removed to re-balance the gasoline characteristics needed to meet emissions and performance requirements.

The analysis concludes that in 2007, if a Federal MTBE ban is imposed on top of the currently proposed State MTBE bans, the combined effect will be that refiners will lose about 180,000 barrels per day of gasoline productive capacity. Depending on availability and economics, this volume loss would be replaced by more ethanol in some areas than the currently required 2 weight percent, added crude oil inputs to refineries, and/or increased product imports. This analysis assumes Gulf Coast refiners and importers provide California with additional high quality gasoline materials in 2004 when their ban is effective. However, it does not take into account additional RFG supply losses that the Mobile Source Air Toxics Rule (MSAT) could create on the East Coast when MTBE is banned.

State bans result in MTBE being banned at different times in different regions. The California State ban in 2004 affects about 40 percent of U.S. RFG supply, and the supply transition market pressure for the West Coast will appear at that time. The Gulf Coast is seen as playing an increasingly important role in resolving California's supply loss. The East Coast States with scheduled bans in 2004 are New York and Connecticut, which represent about 26 percent of East Coast RFG.

The Mobile Source Air Toxics Rule (MSAT) locks refineries into the level of toxic emissions for gasoline that they were producing in 1998 through 2000. This is becoming a problem as MTBE bans evolve. Refiners producing a large percentage of RFG with MTBE in 1998-2000 had very low toxic emission levels. If these refiners switch to ethanol, the toxics emissions would increase in violation of MSAT without further changes, such as reducing sulfur content and/or reducing benzene and other aromatics.[3] Some of these refineries have already reduced sulfur and aromatics significantly and simply may not be able to reduce these physical properties further to counter the effects of ethanol. As a result, these refineries may have to reduce their production

[3] Toxic emissions are reduced by lowering sulfur content and by removal of toxic components such as benzene.

of RFG in an MTBE-ban world. Other refineries that had higher toxic emissions in 1998-2000 may be able to fill in the volumes more economically. Also, the timing of some East Coast State MTBE bans in advance of the Tier 2 low-sulfur gasoline program may create some transition difficulties for these States, if refiners cannot advance their sulfur reduction programs for Tier 2 requirements in order to reduce toxic emissions to help meet MSAT requirements when switching to ethanol.

The loss of MTBE is expected to have the largest supply, price, and price volatility impact of all the issues covered in Senator Bingaman's request. EIA's analysis indicated that in a case where most of the country bans MTBE (87-percent MTBE reduction), RFG prices could be expected to increase 7.0 cents per gallon, compared to a case in which no States implement their MTBE bans. This does not consider regional or local price volatility that may occur during transitions. To eliminate MTBE from RFG, refineries and the distribution and storage system must change to accommodate the increased use of ethanol, particularly on the East and West Coasts. Historically supply problems have occurred during fuel specification transitions. Given the uncertainties associated with the transition to an MTBE ban, localized and/or regional supply problems could occur during such a transition. Market and even regulatory uncertainties will provide strong disincentives for both the domestic industry and many foreign import refiners to make many speculative investments in advance of the transition. As the market sorts itself out, it will be clearer where more investment is needed and how much time it might take to resolve potential problems.

The proposed removal of the oxygen requirement in RFG is one provision in H.R. 4 that has potential to reduce costs to consumers. In a region banning MTBE, this proposal allows producers of RFG the option to produce a fuel without ethanol, adding flexibility to producers' choices. However, EIA expects ethanol to be used in many areas even if the oxygen requirement is removed, since it likely will be economic in the short-run in many cases. However, removal of the oxygen requirement could reduce long-run price increases and add flexibility during the transition period, which could help reduce price volatility. This implies that removal of the oxygen requirement would be most beneficial to supply if it occurs coincident with the time of the first MTBE ban. However, because ethanol-blended fuels require complete segregation from other fuels, oxygen-free RFG must be distributed and stored separately from ethanol and gasoline blendstocks to be mixed with ethanol, creating an increase in proliferation of fuel types.

Renewable fuels production capacity, supply, and price

The renewable fuels capacity analysis projects that the ethanol industry can supply the volumes of ethanol required to phase out the use of MTBE, as passed by 17 States beginning in 2004, and meet the proposed renewable motor fuels requirement by its intended implementation date of 2004. Existing plants and those under construction will have more than the capacity needed to meet the RFS in 2004 and 2005. To meet the RFS or an 87-percent reduction[4] in MTBE volume in 2007, if enacted, from 9 to 18 new plants (40 million gallons each) will be needed. There is sufficient time for additional plants to be constructed. As indicated above, the 87-percent ban

[4] For comparison purposes with prior EIA cost analyses, an 87 percent MTBE ban was used to represent a Federal ban with State waivers. This case assumed that Texas might opt out of the Federal MTBE ban, an assumption provided by Senators Murkowski and Daschle for an earlier analysis.

case implies an increase in RFG prices of about 7 cents per gallon, which, when averaged with conventional gasoline results in an increase of 2.8 cents per gallon. Thus, while the increase in ethanol production required to provide adequate supply by 2004 is large, construction underway today indicates that such capacity should be in place to meet State MTBE bans and the proposed renewable fuel standard.

Inter-regional transportation issues and associated costs for renewable fuels

Probably the largest issue associated with increased ethanol use is distribution. Since EIA has not performed detailed analysis of ethanol transportation issues, the EIA transportation paper largely summarizes recent work by Downstream Alternatives, Inc., (DAI) for the U.S. Department of Energy. The DAI analysis found that expanding the market for ethanol to 5.1 billion gallons per year results in an estimated average national cost of about 8 cents per gallon of ethanol to transport it to markets. This translates to a cost of about 1 cent per gallon of gasoline when 10 percent ethanol is used. Delivery infrastructure issues requiring attention before demand reaches this level include: rail terminals able to unload more than a few cars, constraints on the Inland Waterway System, and a possible shortage of Oil Pollution Act of 1990-compliant Jones Act vessels. However, our analysis concludes that the major transportation mode for ethanol will be rail. The number of entities needing to invest to make the needed infrastructure changes is large, and breakdowns in pieces of the chain could affect ultimate supply availability. This implies that the transitions beginning in 2004, particularly the large volumes of ethanol required to flow to California, could result in some initial supply dislocations and price volatility. Even after the transition periods, coastal RFG areas dependent on ethanol, which requires a separate distribution system from gasoline that includes railcar and water transport, could experience increased price volatility if distribution becomes hampered due to events such as flooding and winter storms, as has been the case with other fuel disruptions.

Renewable Fuel Standard (RFS)-Related Issues

The next three issues are associated with supply concerns relating to the proposed Renewable Fuel Standard. Two of the concerns focus on timing of the start of the program. The RFS is currently scheduled to begin in 2004, which is when some significant State MTBE bans are scheduled to begin and right before the low-sulfur gasoline and ultra-low-sulfur diesel fuel programs are scheduled to begin in 2005 and 2006 respectively. The third RFS issue looks at the supply implications of allowing States to opt out of the 1-pound RVP waiver currently allowed for conventional gasoline using 10 percent ethanol. None of these RFS issues are expected to have large supply or price impacts. However, any changes required on top of the ambitious low-sulfur programs already being pursued can create further transition complications. Still, compared to the MTBE-ban issues, the RFS impacts on supply in the early part of the program are small.

The potential effect of operating the renewable fuel mandate on a fiscal year (i.e. beginning in October) vs. calendar year basis

The EIA paper examines whether changing the start of the RFS program from the middle of winter to the normal seasonal transition for gasoline at the end of the summer would help ease the transition. The RFS program is currently scheduled to start in January 2004, which is several

months ahead of the transition period to the summer gasoline season. Starting in the middle of winter should allow adequate time for adjustments prior to the summer transition. Because the ethanol industry is expected to have production capacity that exceeds the RFS target for 2004, and because 17 States have already banned MTBE from future use, the petroleum industry is expected to be using ethanol in volumes that exceed the RFS target in 2004. Thus, additional shifts in physical production and distribution to accommodate the start of the program should be minimal. While total RFS volumes will likely be met, refiners must still meet their individual quotas based on gasoline market shares that EPA is directed to assign. This requires that the administrative aspects of the program (e.g. credit trading) function adequately at the onset of the program.

The impact of the simultaneous implementation of the low sulfur and Mobile Source Air Toxic (MSAT) gasoline regulations and a national ethanol mandate

EIA examined whether shifting the close relative start dates for the RFS (January 2004), low-sulfur gasoline (January 2005[5]), and ultra-low-sulfur diesel (June 2006) programs could ease the supply impacts of those transitions. The close proximity of the RFS and low-sulfur gasoline start dates does not seem to be a problem. EIA expects the 2004 RFS target to be met since the industry is likely to be using at least this amount of ethanol in 2004 due to the State MTBE bans. However, the close proximity of the low-sulfur gasoline program and the ultra-low-sulfur diesel program remains a concern, as expressed earlier in a previous EIA study.[6] The magnitude of changes required for both the gasoline and diesel fuel programs and the outstanding issues that will affect diesel fuel production plans, such as requirements for off-road diesel fuel, need to be studied to ensure adequate supply during the transition. However, any proposal to change the timing of the ultra-low-sulfur diesel fuel introduction must take into account synchronization with the heavy-duty vehicle changes required in model year 2007. (MSAT's relationship to low-sulfur programs is discussed under the MTBE ban issue.)

The potential cost and supply impacts associated with individual States seeking to protect air quality through the removal of the one-pound vapor pressure waiver for gasoline blended with ethanol

EIA examined the supply impacts of allowing States to be exempt from the 1-pound RVP waiver when ethanol is added to conventional gasoline to produce a 10-percent blend. When ethanol is added to gasoline, it increases RVP. The waiver allows refiners to add ethanol and make few if any changes to the underlying petroleum base. When the waiver is removed, refiners must remove light, high-RVP materials to counter ethanol's RVP increase. In some cases, the driveability index is affected, and refiners may have to remove even more materials. There are two volume impacts of removing the waiver. The first is the impact on total gasoline volumes. The analysis indicates that making up the lost conventional volumes in aggregate if the waiver is

[5] Beginning January 2005, most refiners and importers must meet a 30 ppm average sulfur level, a corporate 90 ppm average and a per gallon cap of 300 ppm. However, the first phase of the Tier 2 gasoline program begins in January 2004, when suppliers are subject to a 300 ppm per gallon cap (close to the national average level) and 120 ppm corporate average.

[6] Energy Information Administration, *The Transition to Ultra-Low-Sulfur Diesel Fuel: Effects on Prices and Supply*, SR/IOAF/2001-01 (Washington, DC, May 2001).

removed should not be difficult, since conventional gasoline supply does not face the same production challenges as RFG. While local supply issues could still arise, the proposed legislation requires EPA to study any potential supply impacts when a State petitions for waiver exemption. The second volume impact of not using the waiver is from the perspective of the contribution of renewables to gasoline supply. The analysis shows that removal of the waiver could reduce renewables contribution to supply by 30 to 40 percent. While this provision could add to the fuel proliferation problem and might potentially result in some local problems, it does not appear to have major overall supply impacts.

Other Issues

The last two issues concern the potential gasoline supply impacts of the increased number of non-attainment areas arising from the new 8-hour ozone standard and whether a limited Federal menu of gasoline types might help to ameliorate local price volatility stemming from the increased number of distinct fuel types that have arisen.

The impact on gasoline price and supply, particularly RFG, when many additional ozone non-attainment areas come under the new 8-hour ozone standard

This issue involved concerns over the potential need for more RFG as well as the potential growth in boutique fuels. The new standard changes the ambient air standard for ozone from 0.12 parts per million (ppm) averaged over a 1-hour period to 0.08 ppm averaged over 8 hours. VOCs and nitrogen oxides, which are precursors to ozone creation, are the emissions States control to deal with ozone compliance. By 2007, further nitrogen oxide reductions from motor vehicles will become increasingly costly, as gasoline and diesel sulfur reduction programs remove growing amounts of nitrogen oxides from the air. States with continuing VOC emissions problems are likely to address these emissions with low-RVP gasoline, rather than more-costly RFG. Therefore, it is unlikely that the 8-hour ozone standard will lead to much increase in RFG consumption. While this standard could add to fuel proliferation, it is not expected to have a major impact on supply or price to consumers.

The potential effect/role of implementation of a national menu of fuels to address the proliferation of boutique fuels

Many of the fuel provisions in H.R. 4 would result in an increase in the number of fuel types in the system, and as such raise the question of whether near-term actions can be taken to reduce the strain on the distribution system with its associated increase in the potential for local supply disruptions and price volatility.

Fuel-type proliferation grew unexpectedly following the Clean Air Act Amendments of 1990, and in some areas, the unique fuels were accompanied with increased price volatility. Price volatility associated with a boutique fuel (versus world crude oil price variations that affect all fuels) is a function of volume of the distinct fuel, geographic distance from supply sources, number of suppliers, and uniqueness of the fuel type. The two boutique fuels that have experienced the largest price volatility are California RFG and the summer ethanol-blended RFG produced in the Chicago-Milwaukee area. In the near term, it would be difficult to devise a Federal menu of fuels that would have much impact on gasoline price volatility because of the

number of distinct fuel programs already in place. For example, reducing the number of low-RVP fuels that can be used would not reduce the geographic locations of distinct fuel usage. A distinct fuel would still have to travel to an isolated area, and the area would still be exposed to potential short-term shortages since it cannot use fuel from neighboring areas if a temporary shortfall occurs. In the longer term, while reducing fuel types to one or two of the cleanest-burning fuels would reduce the fuel-type strain on the distribution system, the solution could be costly for many consumers not needing the cleaner fuels because of increased production costs incurred by the refiners.

Conclusion

Many of the transportation fuel changes being proposed in H.R. 4 are directed at environmental and other goals and require changes from the way in which the market operates today. The proposed changes affect the entire supply chain. Of the issues explored for Sen. Bingaman, the proposed Federal MTBE ban has the largest impact on supply, price and price volatility. MSAT, in combination with an MTBE ban, exacerbates the supply losses, particularly in the Northeast. Many of H.R. 4's changes would result in an increased use of ethanol in the long term. While large increases in ethanol production will be required during the next few years due to State MTBE bans or the RFS proposal, needed construction is already underway to meet these requirements. The largest transition issue associated with increased ethanol volumes probably derives from the changes needed to transport the product. RFS requirements by themselves, however, seem to present relatively small supply and price effects in the early years of the program analyzed for these issues. In general, the changes in H.R. 4 would tend to increase the number of distinct fuels in the supply system, on top of the increasing number of fuels resulting from State initiatives such as State MTBE bans and early low sulfur gasoline programs, adding to the potential for price volatility on a local or regional basis.