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# UNITED STATES ETHANOL CONSUMPTION OUTLOOK

ATTACHMENT 2

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*Prepared by:*



and

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## I. Projected United States Ethanol Consumption

The current structure of the fuel ethanol market in the U.S. developed after Congress passed amendments to the Clean Air Act in 1990. Two programs were established to reduce automobile pollution: the reformulated gasoline program for areas in non-attainment for smog forming emissions, and the oxygenated fuels program for areas in non-attainment for carbon monoxide. Both of these programs rely on the addition of oxygenates (i.e., additives that boost oxygen content) in automotive fuels to make them burn more completely to reduce pollution. The four major oxygenates are methyl tertiary butyl ether (MTBE), ethanol, ethyl tertiary butyl ether (ETBE), and tertiary-amyl methyl ether (TAME). MTBE currently holds the largest market share but has come under attack as of late because of water pollution concerns. Ethanol holds the second largest market of the oxygenate market and is also commonly used as an octane enhancer in conventional gasoline.

For the purposes of this discussion, the market for fuel ethanol was divided into three components.

- Ethanol consumed in Reformulated Gasoline (RFG) Program areas;
- Ethanol consumed in Oxygenated Fuels (OXY) Program areas during wintertime program periods; and
- Ethanol consumed in conventional gasoline (CVG), defined as all gasoline other than RFG and OXY.

The federal RFG Program covers roughly 34% of total United States gasoline consumption. Since the program was first introduced in the mid-1990s, the only change to the required areas, has been the addition of Sacramento, CA. Currently, ten metropolitan areas of the country are required to be in the program:

- Los Angeles, CA
- San Diego, CA
- Sacramento, CA
- Milwaukee, WI
- Hartford, CT
- New York, NY
- Philadelphia, PA
- Chicago, IL
- Baltimore, MD
- Houston, TX

In addition to these ten areas, another twelve areas have opted into the program on a voluntary basis:

- St. Louis, MO
- Dallas-Fort Worth, TX
- Springfield, MA
- Richmond, VA

- Norfolk-Virginia Beach, VA
- Essex, NY
- Portions of Kentucky around Cincinnati and Louisville
- A portion of Maryland around Washington, DC
- Kent & Queen Anne's Counties in Maryland
- A portion of New Hampshire around Boston
- A portion of Virginia around Washington, DC

Six states have initiated statewide RFG programs; they include:

- Connecticut
- Delaware
- New Jersey
- Massachusetts
- District of Columbia
- Rhode Island

RFG programs are also run on the state level outside of the federal RFG program in Phoenix, Arizona, Portland, Maine, and the entire state of California. See Appendix C for a complete list of the states and counties that fall under the RFG program.

The OXY Program is smaller than the RFG Program but still covers a sizable portion of the total U.S. gasoline demand, at roughly 7%. The number of areas required to participate in the program has been cut roughly in half since the program was first introduced in 1992, due to improvements in air quality. Areas still required to participate in the program include:

- Anchorage, AK
- Denver-Boulder, CO
- El Paso, TX
- Los Angeles, CA
- Las Vegas, NV
- Fort Collins, CO
- Missoula, MT
- Medford, OR
- Provo-Orem, UT
- Phoenix, AZ
- Reno, NV
- Spokane, WA

Three areas continue to participate in the OXY Program for maintenance of air quality gains, even though they are no longer required by federal law to participate:

- Albuquerque, NM
- Portland, OR
- Tucson, AZ

The state of Minnesota has also implemented a statewide oxygenated fuels program, that requires a blend rate of 10% ethanol in all gasoline sold in the state. Although this program is technically separate from the federal OXY program, Minnesota is included alongside the federal OXY Program for the forecasts contained in this report, since its use is mandatory (rather than voluntary, as inclusion of Minnesota's ethanol

consumption in the CVG category would imply). See Appendix C for a complete list of the metropolitan statistical areas that fall under the OXY program.

In this outlook, it was recognized that the set of areas required or choosing to participate in each program would not necessarily remain static over the forecast period. Some areas will likely exit the programs as they attain air quality goals, while others may enter due to increases in gasoline consumption and the associated pollution. (Any new entries would likely be limited to the RFG Program.) However, because there is no reliable source from either the federal government or state and local governments on which areas may enter or exit the programs, or especially the timing of such changes, the assumption was made that the program areas would remain static over the forecast period. A couple of areas that are in the process of being redesignated were omitted from the OXY Program list. There has been some discussion that the San Joaquin Valley of California may have to enter the federal RFG Program but it was not included in the forecasts because its entry has not yet been officially announced and the timing is far from clear.

A model was constructed to forecast each of the three components of fuel ethanol consumption and then to aggregate the components into a forecast of total fuel ethanol consumption in the U.S. covering the 2001-2010 period. Forecasting potential consumption involved the following broad steps:

- **Step 1:** Based on population forecasts and calculated per capita gasoline consumption by state, forecast total gasoline consumption for each state through 2010.
- **Step 2:** Based on per capita estimates for each state, forecast gasoline consumption in individual RFG areas and individual OXY areas during program periods.
- **Step 3:** Calculate the amount of ethanol consumed in RFG and OXY program areas during program periods.
- **Step 4:** Calculate annual ethanol consumption in CVG over the forecast period.
- **Step 5:** Aggregate the OXY, RFG, and CVG ethanol consumption forecasts to arrive at a forecast for total ethanol consumption in the U.S. through 2010.

## **A. SCENARIOS**

Five different scenarios were investigated in the model of potential ethanol consumption over the 2001 to 2010 forecast period:

**Scenario 1** illustrates the continuation of current trends.

**Scenario 2** also models the continuation of current trends but takes into account the elimination of MTBE by 2003-2004 in the eleven states that have already banned its use.

**Scenario 3** models the continuation of current trends until 2004, when a nationwide ban on MTBE is assumed to be implemented.

**Scenario 4** models the effects of the renewable fuels standard contained in the Hagel / Johnson bill (S. 1006). In order to garner more support for such legislation in Congress, it is likely that an MTBE ban and oxygenate waiver would be added on to this legislation. Accordingly, for this scenario, it is assumed that MTBE is banned nationwide and an oxygenate waiver is granted, along with the renewable fuels standard.

**Scenario 5** models the effects of the Dashle / Lugar bill (S. 670) if it were implemented as proposed with its version of the renewable fuels standard, MTBE ban, and oxygenate waiver.

## KEY ASSUMPTIONS

THERE ARE A NUMBER OF KEY ASSUMPTIONS THAT ARE SHARED AMONG ALL FIVE SCENARIOS:

- **No areas enter or exit either the OXY or RFG programs.** As has been mentioned, there are no official government statements regarding which areas are expected to exit or enter the programs during the next ten years, and it would be impossible to foretell what the air quality status in individual areas will be during the later half of the decade. So it was assumed that no further exit or entry takes place beyond what is already in process.
- **No major supply shocks** to either the petroleum or the grain markets occur during the forecast period. Both of these markets play a key role in determining how much ethanol is produced and used. Price shocks in either market could produce dramatic effects in the ethanol market.
- **No major technological breakthroughs** are discovered in either the ethanol or petroleum refining processes.
- **The majority of ethanol continues to be produced from corn**, as biomass-to-ethanol technology is not forecast for widespread commercialization until at least 2010. (This is addressed in detail in Chapter VIII: Biomass Technologies.)
- **Continuation of current tax incentives** for ethanol production and use continue throughout the entire forecast period. Ethanol is dependent on these tax subsidies, and any change in the amounts could greatly affect the ethanol market.

### **1. Scenario 1: Continuation of Current Trends in Ethanol Consumption**

Under Scenario 1, the current trends in ethanol consumption are maintained throughout the entire forecast period. This assumes that MTBE is not banned and continues to be used in all areas that currently use it. Trends were estimated based on actual ethanol usage rates in the individual RFG and OXY areas, as contained in annual data provided by the EPA. Under this scenario, total ethanol consumption increases by only 343 million gallons, from 1.646 billion gallons in 2000 to 1.989 billion gallons in 2010. Ethanol consumed in RFG is projected to increase from an estimated 542 million gallons in 2000 to over 664 million gallons in 2010. Ethanol consumed in the OXY program is projected to increase from an estimated 425 million gallons of ethanol in 2000 to over 530 gallons in 2010. All of these forecasted increases in ethanol consumption are based on population and fuel consumption growth trends rather than the entry of any new program areas or an increase in ethanol's market share in existing markets.

Not only is ethanol used as an oxygenate in the RFG and OXY programs, it is also used in CVG, mainly as an octane booster. The level of ethanol in CVG is not required like oxygen content is mandated in the RFG and OXY programs, so its usage in CVG can be more volatile. Forecasts of ethanol consumed in CVG were based on historical data from the DOE and the Federal Highway Administration. It was assumed that the (relatively high) percentage of ethanol currently used in CVG for each state will continue throughout the forecast period, with ethanol use increasing due to trends in overall gasoline use.

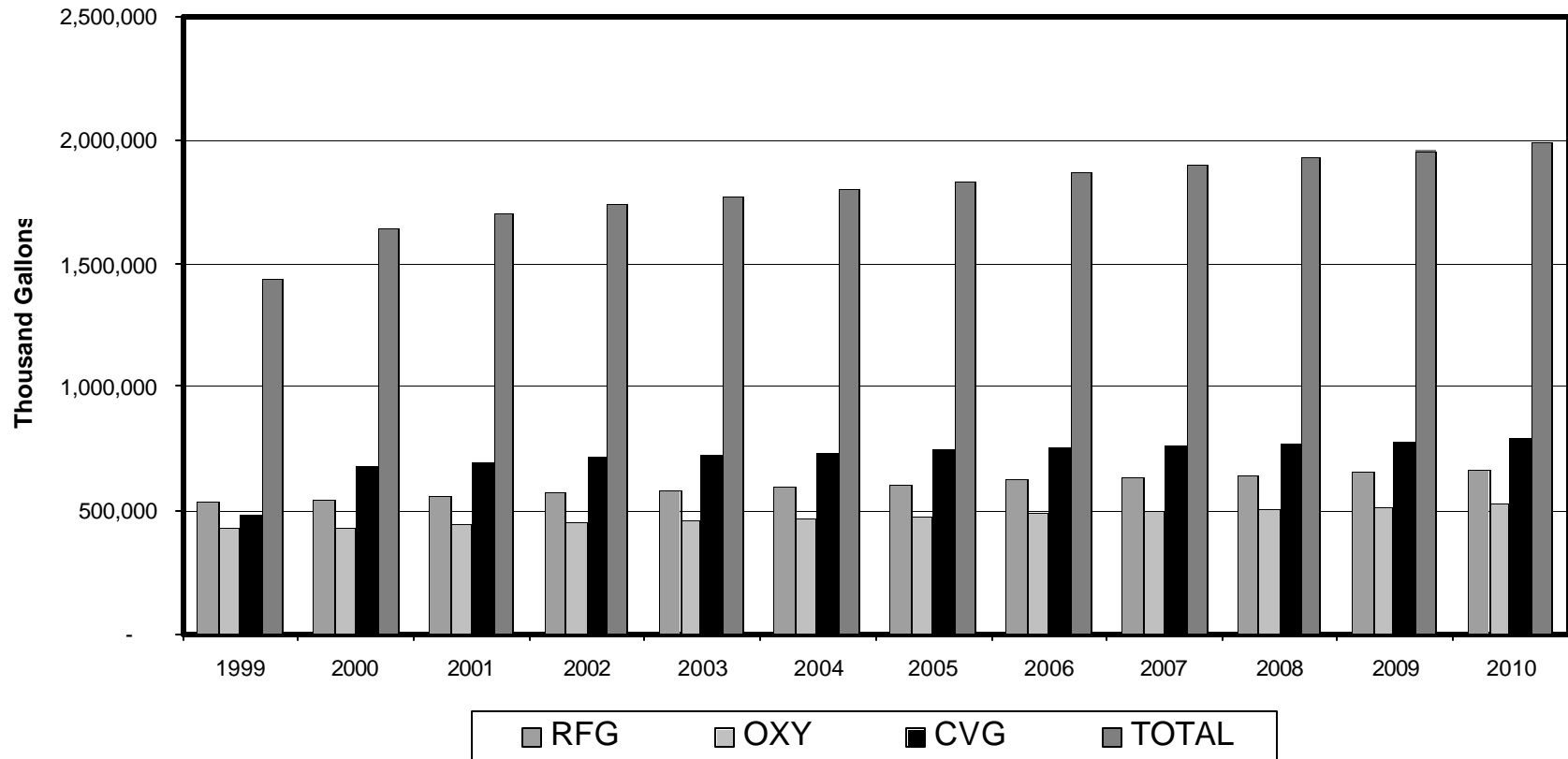
The largest ethanol consumption areas are located in the Midwest near ethanol production facilities. Chicago is by far the largest consumption center at an estimated 345 million gallons of ethanol consumed (in the RFG program) in 2000, and the city is forecast to use over 421 million gallons by 2010. Another large consumption center is the state of Minnesota, with its state mandated 10% oxygenate requirement. It consumes an estimated 256 million gallons of ethanol a year and is forecast to consume almost 300 million gallons by 2010. Milwaukee is the third largest ethanol consuming area, with an estimated 80 million gallons in 2000, and over 90 million gallons by 2010. St. Louis also consumes a fairly large amount of ethanol at an estimated 38 million gallons in 2000 and forecast consumption of over 44 million gallons by 2010. Most of the ethanol consumed in the Midwest is consumed at the 10% blend rate.

In some of the largest RFG and OXY markets (in terms of gasoline usage), including California and the Northeast, ethanol consumption remains low as MTBE is the oxygenate of choice. Currently, ethanol accounts for less than 7% of the oxygenate market in California and less than 2% oxygenate market in the Northeast. MTBE holds the largest share of the RFG oxygenate market, with 85%. Ethanol is a distant second with only 8% of the RFG oxygenate market.

In the OXY program, ethanol holds the largest market share at around 60%. Ethanol has the largest market share in every OXY area except Los Angeles. This demonstrates the size of the Los Angeles area, as it represents almost 38% of the OXY market and 11% of the RFG market.

Scenario 1 serves as the lower bound of the forecasts of ethanol consumption since it ignores growing pressure to remove MTBE from the fuel market. As a result, current ethanol consumption is already close to what is forecast in 2010. It should also be noted that ethanol production capacity already exceeds ethanol consumption under this scenario. Scenarios two and three will show the effects of an MTBE ban on ethanol consumption. By comparing ethanol consumption across the first three scenarios the magnitude of the impact on the elimination of MTBE can be measured.

Figure 1: Scenario 1 – Summary: Continuation of Current Trends



## **2. Scenario 2: Elimination of MTBE in States That Have Already Banned its Use**

Scenario 2 illustrates the elimination of MTBE in the states that have already banned its use. As of September 2001, thirteen states have banned the use of MTBE in gasoline sold in their states. This ban was put in place over worries that MTBE was contaminating groundwater. Two of these states, California and Arizona, had planned on a phase-out date at the end of 2003 but have recently been extended by one year. This scenario does still show California and Arizona with 2003 phase out dates, this is actually helpful in demonstrating the volume of ethanol needed to replace MTBE in this large market. The other eleven states – Colorado, Connecticut, Illinois, Iowa, Kansas, Maine, Michigan, Minnesota, Nebraska, New York, and South Dakota – have various phase-out dates in 2004.

Under Scenario 2, total ethanol consumption is projected to increase from 1.646 billion gallons in 2000 to 3.649 billion gallons by 2010. With the absence of competition from MTBE in certain key markets (i.e., Los Angeles and New York), the amount of ethanol used in the RFG Program increases dramatically from 541 million gallons in 2000 to 1.574 billion gallons in 2010. The amount of ethanol used in the OXY Program also showed large increases, from 425 million gallons in 2000 to 844 million gallons by 2010. The amount of ethanol in CVG is forecast to increase from almost 679 million gallons in 2000 to over 1.231 billion gallons by 2010.

Where MTBE is banned, ethanol replaces MTBE in CVG on an octane basis. For every 100 gallons of MTBE, 95.6 gallons of ethanol is required to achieve the same octane level. If ethanol were to become scarce or increase in price drastically, one would expect to see that less ethanol would go into CVG and instead be used first in the mandated RFG and OXY program areas.

### a) California

Roughly 70% of the gasoline sold in the state of California is required to participate in the federal RFG program; in addition, the Los Angeles area is also required to participate in the OXY Program. The remaining 30% of California gasoline is covered under a state-run reformulated gasoline program. However, this portion was not included in the analysis because California is not required by the federal government to continue this portion of the program. There has been some indication that it may decide to discontinue the oxygenate provision if MTBE is phased out and only ethanol can be used.

Historically, California has almost exclusively used MTBE. After banning its use, California had hoped to be granted a waiver from the oxygenate requirements in the federal RFG Program. California argued that refiners could produce fuel that met air quality standards set by Congress without the use of an oxygenate. The EPA has denied California's request for a waiver from the oxygenate content requirement, although it is still trying to pursue a lawsuit that would accomplish this. It does not appear likely that any further attempts will succeed.

Barring any unforeseen developments, the ban on MTBE in California opens a potentially large market for ethanol. Under this scenario, total ethanol demand in California is estimated at over one billion gallons of ethanol by 2010. This is a dramatic increase from current estimated ethanol consumption in 2000 of only 58 million gallons. The RFG Program is forecast to account for 425 million gallons of ethanol in 2010, while the OXY Program accounts for 283 million gallons. The remaining 353 million gallons comes from ethanol used in conventional gasoline. MTBE accounted for roughly 7% of the total gasoline supply in California in 2000, and in this analysis all the MTBE used in CVG was assumed to be replaced with ethanol on an octane basis. However, it is likely that if ethanol supplies are tight, the level of ethanol consumed in CVG would decrease.

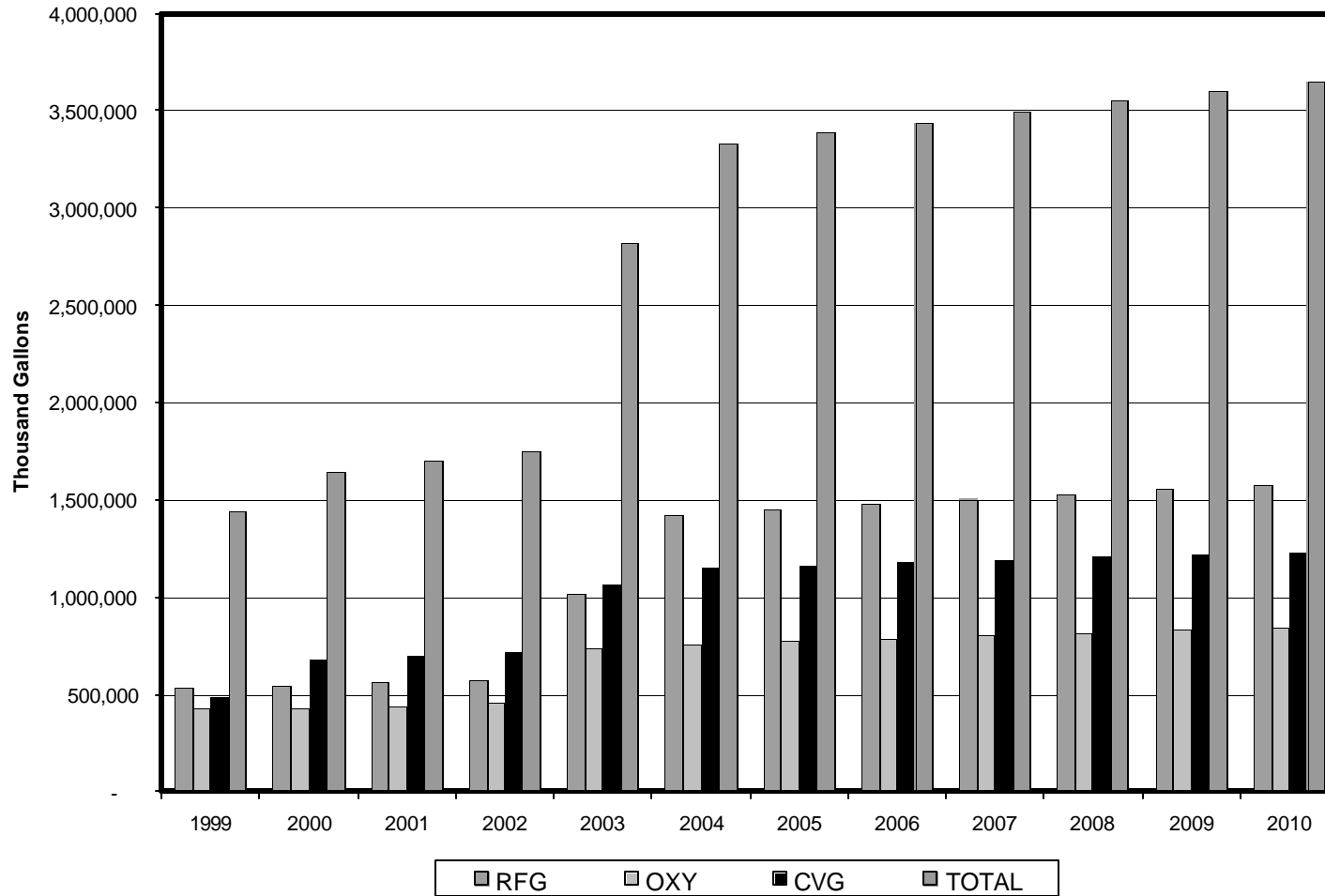
#### b) Other Key States

After the ban on MTBE is implemented, three other states (i.e., Connecticut, Arizona, and New York) showed large increases in ethanol consumption. All three of these areas, like California, relied heavily on MTBE to meet their oxygenate needs. In Arizona, ethanol consumption is projected to increase from over 160 million gallons to 202 million gallons by 2010. In Connecticut, ethanol consumption is forecast to increase from only 3 million gallons in 2000 to over 100 million gallons by 2010. In New York, ethanol consumption is forecast to increase from an estimated 9 million gallons to over 293 million gallons by 2010.

In Colorado, Illinois, and Minnesota, the impact of the MTBE ban is minimal because they have historically used ethanol to meet their oxygenate needs. In the other states, the MTBE ban had little effect since they were not required to be in either the RFG or OXY Programs, and only small amounts of MTBE were used in CVG. It is also important to note that many of the states that banned MTBE are also large producers of ethanol. These states include Illinois, Iowa, Minnesota, Kansas, Nebraska, and South Dakota.

Scenario 2 closely resembles the political developments that have taken place to date affecting the ethanol market. However, it is likely that more states may join in banning MTBE, in which case more ethanol would be consumed. Scenario 3 looks at what would happen if this was taken to the extreme and a nationwide ban on MTBE were implemented.

Figure 2: Scenario 2 – Summary: Elimination of MTBE in States that have Already Banned Its Use



### **3. Scenario 3: Elimination of MTBE Nationwide**

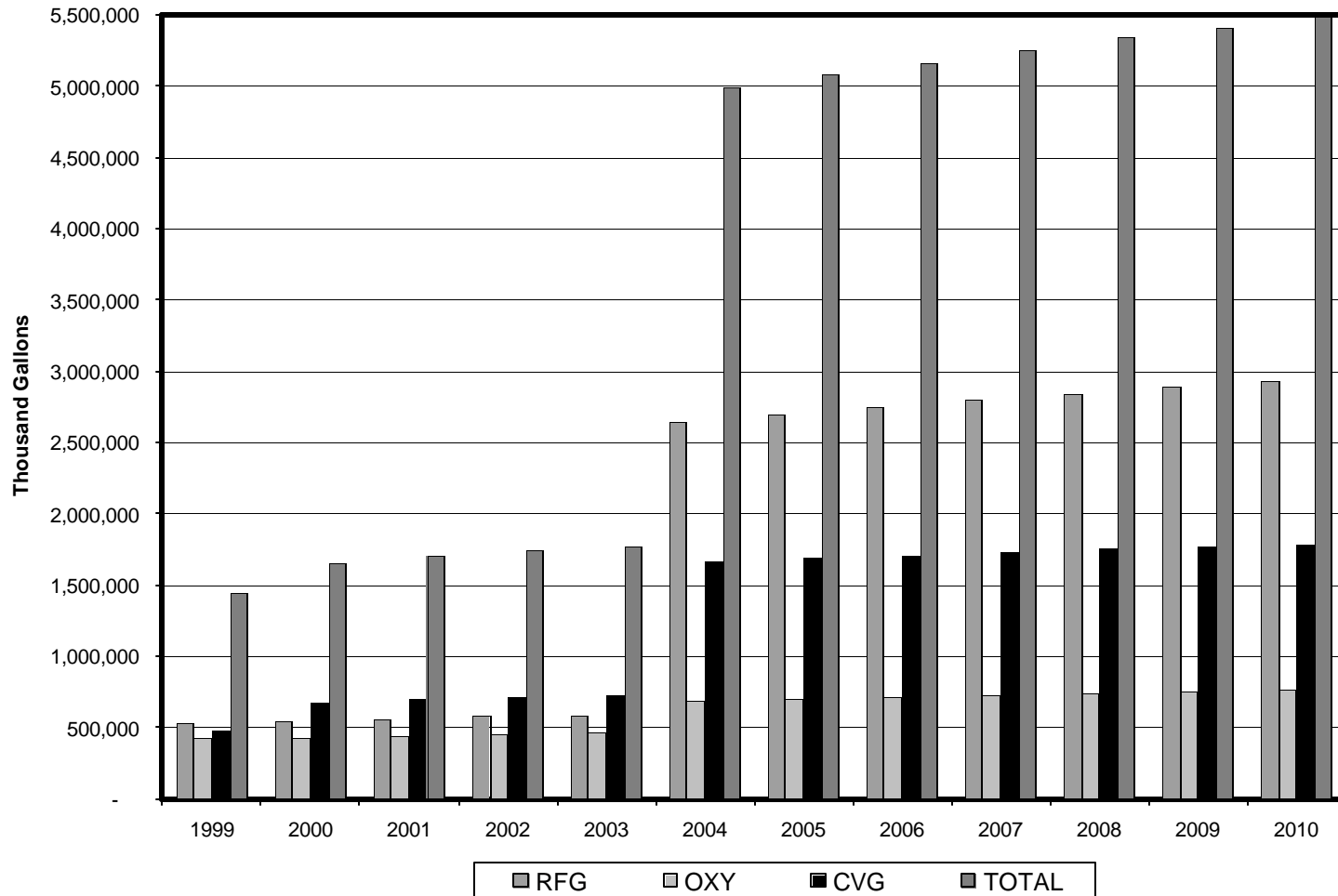
Scenario 3 illustrates a nationwide ban on MTBE that is assumed to become effective in 2004. It is assumed that the oxygenate requirement is maintained, and only ethanol is used in RFG and OXY fuels. Ethanol also replaces MTBE in CVG. Under this scenario, ethanol consumption is quite large, with forecast ethanol consumption at over 5.4 billion gallons by 2010. Ethanol consumption in RFG areas is forecast at 2.928 billion gallons by 2010, and 768 million gallons of ethanol expected to be used in OXY by 2010.

There is not much of a change in OXY consumption from Scenario 2, as most of the OXY program areas were already using 100% ethanol. The difference comes in Nevada, switching to a 100% ethanol blend from a 75% ethanol / 25% MTBE blend. The major increases in the RFG ethanol consumption come from the Northeast states.

The largest consumer of ethanol under this scenario is still California because of the program requirements of RFG and OXY. Coming in a distant second in consumption would be Texas. Texas has areas in both the RFG and the OXY Programs but has traditionally used MTBE, in large part because of the large petroleum industry based in Texas and access to supplies that could be shipped in via the Gulf of Mexico. New York, New Jersey and Chicago also would be large consumers of ethanol because of RFG requirements.

This scenario also assumed, like the other scenarios, that all MTBE would be replaced in CVG. If ethanol were to replace all of the MTBE in CVG plus keep its traditional share of CVG, 1.617 billion gallons would be consumed in CVG by 2010. If it were assumed that ethanol would not capture any of the CVG market share once MTBE was banned, total ethanol consumption would still be over 4.3 billion gallons in 2010.

Figure 3: Scenario 3 – Summary: Elimination of MTBE Nationwide



#### 4. Scenario 4: The Hagel / Johnson Bill (S. 1006)

Scenario 4 illustrates the current version of the Hagel / Johnson Bill (S. 1006). The main purpose of this bill is to create a renewable fuels standard that would require that the nation's fuel supply contain a certain percentage of renewable fuels.

The definition of renewable fuel would include biodiesel, ethanol, or any other liquid fuel produced from biomass or biogas that is used to reduce the quantity of fossil fuel present in a fuel mixture used to operate a motor vehicle. The program requires that any motor vehicle fuel sold or introduced into commerce in the United States by a refiner, blender, or importer shall, on a 6-month average basis, be comprised of a quantity of renewable fuel, measured in gasoline-equivalent gallons (as determined by the Secretary), that is not less than the applicable percentage (see Table 1) by volume for the 6-month period. The renewable fuel standard would cover both gasoline and diesel fuel.

One important component of the Hagel / Johnson Bill is a trading credits program. With the credit program companies that use larger amounts of renewable fuels like ethanol than what is required can earn credits. They can then sell these credits to companies with lower amounts of renewable fuels use.

**Table 1. Hagel / Johnson Bill S. 1006 Renewable Fuel Standard Requirements**

<b>Hagel / Johnson Bill S. 1006 Renewable Fuel Standard</b>			
<b>Year</b>	<b>Applicable %</b>	<b>Year</b>	<b>Applicable %</b>
2002	0.80%	2011	3.00%
2003	0.90%	2012	3.42%
2004	1.10%	2013	3.84%
2005	1.30%	2014	4.24%
2006	1.50%	2015	4.63%
2007	1.70%	2016	5.00%
2008	2.00%		
2009	2.30%		
2010	2.60%		

As shown in Table 1 the renewable fuels standard that is being proposed in this bill currently is very aggressive. Under this bill, the renewable fuels standard would start off at a low .80% of total U.S. gasoline consumption in 2002 and rise every year until it

reaches a level of 5% by 2016. Representatives in Senator Hagel's office have said that discussions are under way to add language to the bill that would ban the use of MTBE in the next three to five years. It also was hinted that an oxygenate waiver might also be added to the bill to garner more political support. With MTBE banned, it would leave the market wide open for ethanol; however, with an oxygenate waiver, companies in areas like California, the Northeast, and Texas would be free to utilize less ethanol in meeting clean air standards. Thus, ethanol would still most likely find its largest market in the Midwest. Total ethanol consumption would most likely mirror that of the renewable fuels standard, as other areas can purchase credits to offset lower use.

Under this scenario, ethanol consumption would more than double over the next ten years, rising to somewhere between 6-8 billion gallons by 2010 (see Figure 4). It remains unclear as to the exact amount of ethanol consumption because of the issue of renewable content in diesel fuel. There are several interrelated issues regarding diesel that make ethanol consumption difficult to forecast:

- Diesel engine manufacturers have not yet revised the terms of their warranties to cover ethanol-diesel mixtures (also referred to as E Diesel) specifically. There have been problems with the use of ethanol in diesel, such as fuel separation in cold weather and fuel injector "leakage" and "hot starts" due to the lower viscosity and lubricity of ethanol, though most problems reportedly can be overcome through the use of additives. Still, rigorous testing by engine manufacturers and the establishment of standards for E Diesel are only now in process or being planned, and it may be 2005 or later before this hurdle is overcome.
  
- Ethanol would face competition from Biodiesel as a renewable fuel in the diesel market. Biodiesel is made from vegetable oils or rendered animal fats. It is already further along in the achieving engine certification from diesel engine manufacturers and is better established and used on a large scale in Europe, though it is used only in niche markets in the U.S. However, biodiesel costs between \$1.25 and \$2.25 per gallon, depending on the feedstock, volume and delivery costs.<sup>1</sup> This is higher than the typical range for gross ethanol prices, even before the partial exemption of ethanol blends from the diesel excise tax is considered. Soybean oil-based biodiesel typically costs \$0.65 to \$0.75 per gallon more than biodiesel made from

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<sup>1</sup> Department of Energy. Technical Assistance Fact Sheet: Biodiesel Offers a Better Alternative to Petroleum Diesel. May 2001.

yellow grease. However, the Federal Bioenergy Program subsidizes only biodiesel made from vegetable oils, so the small U.S. industry has swung primarily to using soybean oil as a feedstock.

- Senators Hutchinson and Dayton have introduced S. 1058, the Biodiesel Renewable Fuels Act, which would provide (vegetable oil-based) biodiesel blends a partial exemption from the diesel excise tax; however, it is unknown whether this bill will pass and whether it will be extended to cover rendered fats.
- Provisions for trading credits in the renewable fuel bills may allow additional volumes of renewable fuels to be used in gasoline in lieu of use in diesel. In its current form, the Hagel / Johnson Bill would appear to allow for extensive shifting of renewable fuel use from diesel to gasoline. Thus, if ethanol is less expensive than biodiesel but diesel engine warranties do not yet cover ethanol, additional ethanol beyond the mandated renewable fuels standard can be used in gasoline, and less biodiesel than would be implied by the renewable standard can be used in diesel.

Because of some of these uncertainties, an upper and lower bound of future ethanol consumption was constructed for Scenario 4. The lower bound is based on the assumption that ethanol is only used as a renewable fuel in gasoline, with biodiesel being used exclusively in diesel fuel. The upper bound is based on the assumption that ethanol is the only renewable fuel used in both gasoline and diesel fuel. If the Hagel / Johnson bill were to pass, ethanol consumption would most likely fall somewhere in-between these two bounds.

The likelihood of such an aggressive renewable fuels standard passing into law appears fairly remote as it would be hard to garner much political support outside of the Midwest and it would require the U.S. ethanol industry to quadruple in size in less than 15 years. A tamer version of the renewable fuels standard may be more appealing to most politicians.

Table 2: Ethanol Consumption under Hagel / Johnson S. 1006 - Minimum Case

**Before MTBE Ban and Oxygenate Waiver**

(Consumption in million gallons)	2000	2001	2002	2003	2004
Projected Gasoline Consumption**	131,943,178	135,893,272	139,299,934	141,354,256	143,721,759
Ethanol Required by Renewable Fuels Requirement	N/A	N/A	1,650,473	1,884,165	2,341,439
Estimated Renewable Fuels Requirement	N/A	N/A	0.80%	0.90%	1.10%

**After MTBE Ban and Oxygenate Waiver\***

(Consumption in million gallons)	2005	2006	2007	2008	2009	2010
Projected Gasoline Consumption**	146,100,011	148,389,277	150,758,924	153,048,179	155,181,082	157,152,097
Ethanol Required by Renewable Fuels Requirement	2,812,945	3,296,563	3,795,767	4,533,418	5,286,085	6,051,473
Estimated Renewable Fuels Requirement	1.30%	1.50%	1.70%	2.00%	2.30%	2.60%

\*Includes the likely assumption that a MTBE ban and an oxygenate waiver would be attached to this bill.

\*\*Numbers are shown in gasoline equivalents on a BTU basis

Table 3: Ethanol Consumption under Hagel / Johnson S. 1006 - Maximum Case

**Before MTBE Ban and Oxygenate Waiver**

(Consumption in million gallons)	2000	2001	2002	2003	2004
Projected Gasoline Consumption**	131,943,178	135,893,272	139,299,934	141,354,256	143,721,759
Projected Diesel Consumption**	-	36,476,134	37,792,919	38,849,232	39,743,312
Projected Total Fuel Consumption**	131,943,178	172,369,406	177,092,854	180,203,488	183,465,072
Ethanol Required by Renewable Fuels Requirement	N/A	N/A	2,147,298	2,458,715	3,059,827
Estimated Renewable Fuels Requirement	N/A	N/A	0.80%	0.90%	1.10%

**After MTBE Ban and Oxygenate Waiver\***

(Consumption in million gallons)	2005	2006	2007	2008	2009	2010
Projected Gasoline Consumption**	146,100,011	148,389,277	150,758,924	153,048,179	155,181,082	157,152,097
Projected Diesel Consumption**	40,800,526	41,905,509	42,913,152	43,807,232	44,587,750	45,400,714
Projected Total Fuel Consumption**	186,900,537	190,294,786	193,672,076	196,855,411	199,768,831	202,552,810
Ethanol Required by Renewable Fuels Requirement	3,684,534	4,329,479	4,994,554	5,973,139	6,971,265	7,991,192
Estimated Renewable Fuels Requirement	1.30%	1.50%	1.70%	2.00%	2.30%	2.60%

\*Includes the likely assumption that a MTBE ban and an oxygenate waiver would be attached to this bill.

\*\*Numbers are shown in gasoline equivalents on a BTU basis

Figure 4: Potential Consumption under Hagel / Johnson Bill S. 1006

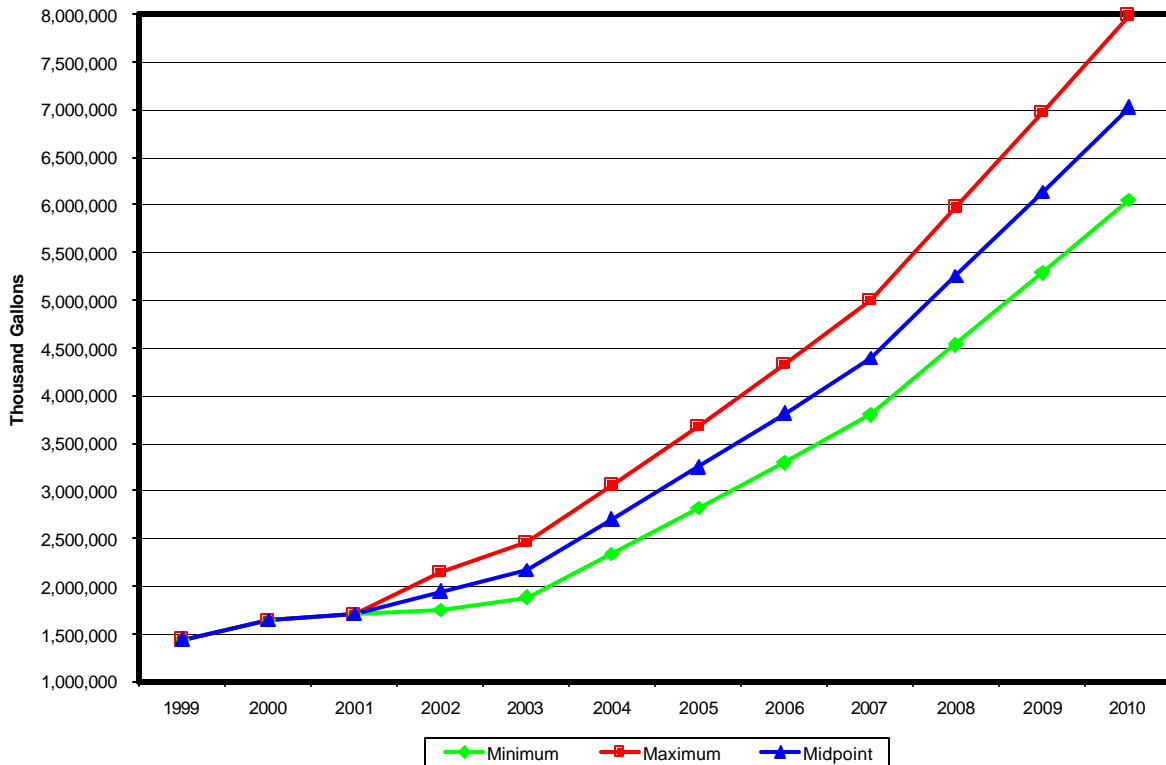


Table 4: Potential Consumption under Hagel / Johnson Bill S. 1006

	Minimum	Maximum	Midpoint
1999	1,442,274	1,442,274	1,442,274
2000	1,645,837	1,645,837	1,645,837
2001	1,698,701	1,698,701	1,698,701
2002	1,745,152	2,147,298	1,946,225
2003	1,884,165	2,458,715	2,171,440
2004	2,341,439	3,059,827	2,700,633
2005	2,812,945	3,684,534	3,248,740
2006	3,296,563	4,329,479	3,813,021
2007	3,795,767	4,994,554	4,395,161
2008	4,533,418	5,973,139	5,253,279
2009	5,286,085	6,971,265	6,128,675
2010	6,051,473	7,991,192	7,021,333

### 5. Scenario 5: The Daschle / Lugar (Bill S. 670)

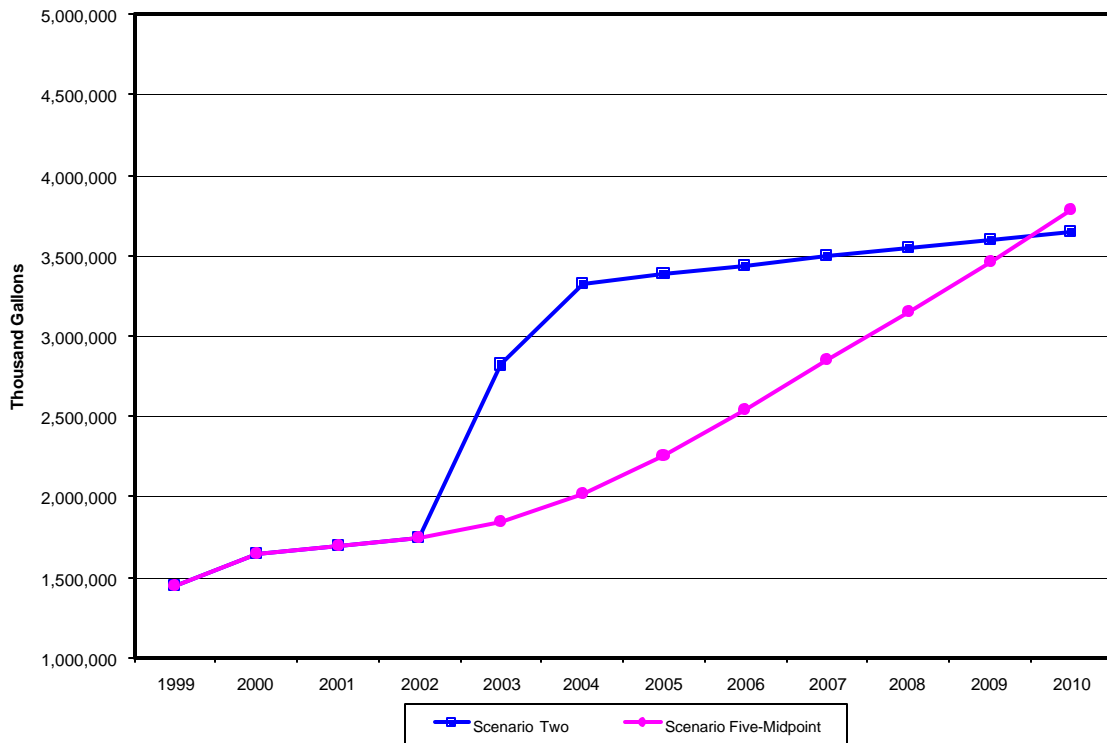
Scenario 5 illustrates the current version of the Daschle / Lugar Bill (S. 670). This bill is similar to the Hagel / Johnson Bill discussed in Scenario 4 but proposes a much less ambitious renewable fuels standard. The Daschle / Lugar Bill imposes limits on the degree to which trading credits can be utilized. This bill also includes a nationwide MTBE ban and an oxygenate waiver. In the Daschle / Lugar Bill, the renewable fuels requirement starts at 0.60% in 2002 and increases up to a maximum rate of 1.5% in 2011 (see Table 5).

Table 5: Daschle / Lugar Bill S. 670 Renewable Fuel Standard Requirements

<b>Daschle / Lugar Bill S. 670 Renewable Fuel Standard</b>	
<b>Year</b>	<b>Applicable %</b>
2002	0.60%
2003	0.70%
2004	0.80%
2005	0.90%
2006	1.00%
2007	1.10%
2008	1.20%
2009	1.30%
2010	1.40%
2011	1.50%

Some people in agricultural associations and the ethanol industry believe that this bill is not ambitious enough and would prefer higher RFS standards and a quicker phase in requirement. They correctly point out that under current market conditions, similar to Scenario 2, the ban on MTBE in some states will already push ethanol's percentage of total gasoline above what the RFS requirement in this bill would require. This would not be a problem as long as the oxygenate requirements of the RFG and OXY Programs kept ethanol consumption at higher levels. However, this bill includes an oxygenate waiver, and it is unlikely that any areas outside of the Midwest would continue to consume more ethanol than is required by the RFS. If this portion of this bill would be put into effect around 2004, as is currently talked about, then it is assumed that most areas outside of the Midwest would exercise their waiver rights and ethanol consumption would fall to the minimum amount required in the renewable fuels standard. Figure 5, shows the differences between forecasted ethanol consumption between Scenario 5 and Scenario 2.

Figure 5: Differences in Consumption between Scenarios 2 &amp; 5



The effect on forecasted ethanol consumption by enacting the RFS proposed by Daschle / Lugar could potentially double ethanol consumption by 2010. Critics of this bill assert that the RFS proposed in this bill grows ethanol consumption too slowly and that current market dynamics (i.e., state MTBE bans) already push up ethanol consumption faster.

Like the Hagel / Johnson Bill modeled in Scenario 4, ethanol consumption under the RFS proposed by Daschle / Lugar is somewhat uncertain because of some uncertainties regarding the use of ethanol in diesel fuel. The minimum case for ethanol consumption would be that ethanol is only used as a renewable fuel in gasoline, with bio-diesel being used exclusively in diesel fuel. The maximum case for ethanol consumption would involve ethanol being the only renewable fuel used in both gasoline and diesel fuel. If the Daschle / Lugar bill were to pass, ethanol consumption would most likely fall somewhere in-between these two bounds, especially considering that there are some constraints on the volumes that can be shifted among companies through the use of trading credits.

Table 6: Ethanol Consumption under Daschle / Lugar S. 670 - Minimum Case

**Before MTBE Ban and Oxygenate Waiver**

(Consumption in million gallons)	2000	2001	2002	2003	2004
Projected Gasoline Consumption*	131,943,178	135,893,272	139,299,934	141,354,256	143,721,759
Ethanol Required by Renewable Fuels Requirement	N/A	N/A	1,237,855	1,465,462	1,702,864
Estimated Renewable Fuels Requirement	N/A	N/A	0.60%	0.70%	0.80%

**After MTBE Ban and Oxygenate Waiver**

	2005	2006	2007	2008	2009	2010
Projected Gasoline Consumption*	146,100,011	148,389,277	150,758,924	153,048,179	155,181,082	157,152,097
Ethanol Required by Renewable Fuels Requirement	1,947,423	2,197,708	2,456,084	2,720,051	2,987,787	3,258,485
Estimated Renewable Fuels Requirement	0.90%	1.00%	1.10%	1.20%	1.30%	1.40%

\*Numbers are shown in gasoline equivalents on a BTU basis

Table 7: Ethanol Consumption Under Daschle / Lugar S. 670 - Maximum Case

**Before MTBE Ban and Oxygenate Waiver**

(Consumption in million gallons)	2000	2001	2002	2003	2004
Projected Gasoline Consumption*	131,943,178	135,893,272	139,299,934	141,354,256	143,721,759
Projected Diesel Consumption*	-	36,476,134	37,792,919	38,849,232	39,743,312
Projected Total Fuel Consumption*	131,943,178	172,369,406	177,092,854	180,203,488	183,465,072
Ethanol Required by Renewable Fuels Requirement	N/A	N/A	1,610,473	1,912,334	2,225,329
Estimated Renewable Fuels Requirement	N/A	N/A	0.60%	0.70%	0.80%

**After MTBE Ban and Oxygenate Waiver**

	2005	2006	2007	2008	2009	2010
Projected Gasoline Consumption*	146,100,011	148,389,277	150,758,924	153,048,179	155,181,082	157,152,097
Projected Diesel Consumption*	40,800,526	41,905,509	42,913,152	43,807,232	44,587,750	45,400,714
Projected Total Fuel Consumption*	186,900,537	190,294,786	193,672,076	196,855,411	199,768,831	202,552,810
Ethanol Required by Renewable Fuels Requirement	2,550,831	2,886,319	3,231,770	3,583,884	3,940,280	4,302,949
Estimated Renewable Fuels Requirement	0.90%	1.00%	1.10%	1.20%	1.30%	1.40%

Figure 6: Potential Consumption under Daschle / Lugar Bill S. 670

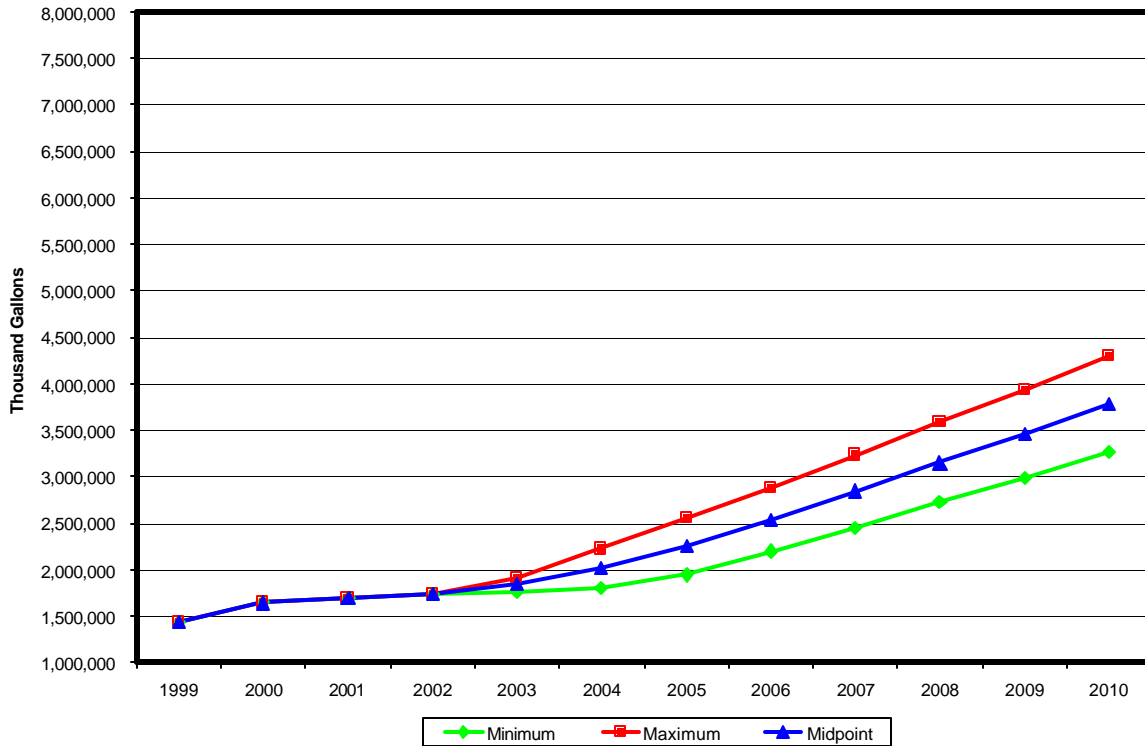


Table 8: Potential Consumption under Daschle / Lugar Bill S. 670

	Minimum	Maximum	Midpoint
1999	1,442,274	1,442,274	1,442,274
2000	1,645,837	1,645,837	1,645,837
2001	1,698,701	1,698,701	1,698,701
2002	1,745,152	1,745,152	1,745,152
2003	1,770,705	1,912,334	1,841,520
2004	1,803,082	2,225,329	2,014,206
2005	1,947,423	2,550,831	2,249,127
2006	2,197,708	2,886,319	2,542,014
2007	2,456,084	3,231,770	2,843,927
2008	2,720,051	3,583,884	3,151,968
2009	2,987,787	3,940,280	3,464,034
2010	3,258,485	4,302,949	3,780,717

## B. SUMMARY OF ETHANOL CONSUMPTION SCENARIOS

Five different scenarios illustrating ethanol consumption over the next decade have been discussed in detail. Scenario 1 acts as the lower boundary on possible ethanol consumption over the forecast period. In this scenario, current trends and market conditions were used to forecast future demand. This scenario did not take into account any decrease in MTBE use. Scenario 3 acts as the *likely* upper boundary on ethanol consumption over the forecast period, with 5.484 billion gallons of ethanol consumption by 2010; the Hagel / Johnson bill would result in even higher consumption, but it is likely to be modified if it is to pass, as discussed. In Scenario 3, ethanol's main competitor in the oxygenate markets, MTBE, is banned nationwide. Ethanol, in effect, becomes the only oxygenate available in both the RFG and OXY programs.

The largest ethanol consumption is forecast under Scenario 4, at over 7 billion gallons by 2010. However, this scenario is unlikely to happen for a number of reasons. First, the renewable fuels standard proposed in this bill is extremely aggressive and would most likely garner little political support outside of the Midwest corn-growing region. Second, assumption underlying this bill that biomass-to-ethanol technology will be fully commercialized by 2010 appears unlikely, which means nearly all ethanol production would need to come from corn. A lower renewable fuels requirement would stand a better chance of passing, given that powerful Senators Tom Daschle and Richard Lugar have sponsored a bill with a considerably lower renewable standard. However, many farm groups are lukewarm toward the Daschle / Lugar bill because it does not mandate any more ethanol consumption than is already expected to occur. If a renewable fuels standard is passed, the percentage would most likely fall somewhere in-between the Hagel / Johnson and Daschle / Lugar bills. Because of the effects of 9/11 a more aggressive version of a RFS bill may stand a better chance of gaining political support. It could be argued that a higher RFS would lessen the US's reliance on foreign oil as most ethanol would continue to be produced domestically.

At this point in time, the volumes forecast for Scenario 2 appear to be the most likely, with some but not all states banning MTBE. It makes a significant difference which states eventually ban MTBE. If the Midwestern states were to all ban MTBE, there would be little increase in ethanol consumption because these states already use a high percentage of ethanol. It is only in large states like California, New York, or Texas that rely almost solely on MTBE that a ban on MTBE would have a large impact on ethanol consumption.

The volumes of ethanol that would be consumed in each program, in conventional gasoline and in the nation's overall fuel supply under the different scenarios are shown in Figures 6 through 9 and Tables 8 through 11.

Figure 7: Ethanol Consumption in RFG

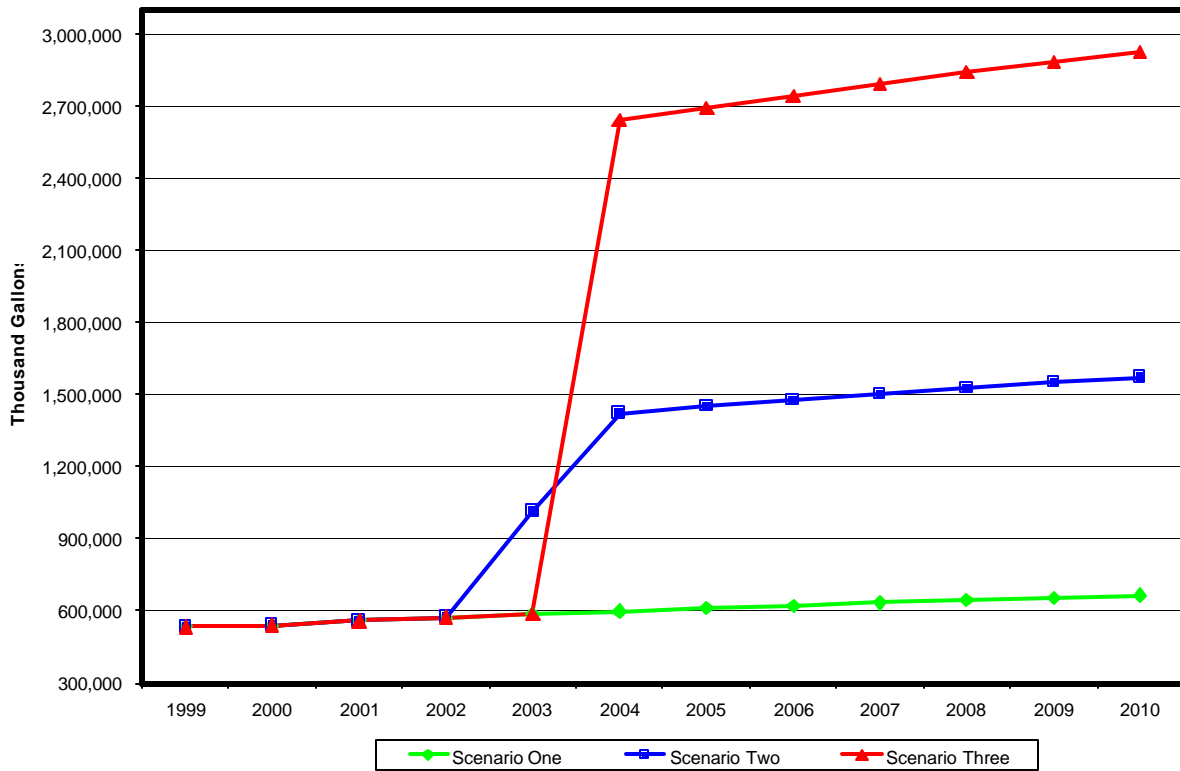


Table 9: Ethanol Consumption in RFG

	Scenario One	Scenario Two	Scenario Three
1999	532,931	532,931	532,931
2000	541,692	541,692	541,692
2001	559,229	559,229	559,229
2002	575,742	575,742	575,742
2003	586,190	1,015,394	586,190
2004	598,657	1,422,517	2,646,115
2005	610,954	1,451,750	2,696,121
2006	621,495	1,476,953	2,744,315
2007	633,735	1,503,891	2,794,265
2008	644,345	1,528,962	2,842,303
2009	654,578	1,552,264	2,886,163
2010	664,811	1,573,924	2,928,144

Figure 8: Ethanol Consumption in OXY

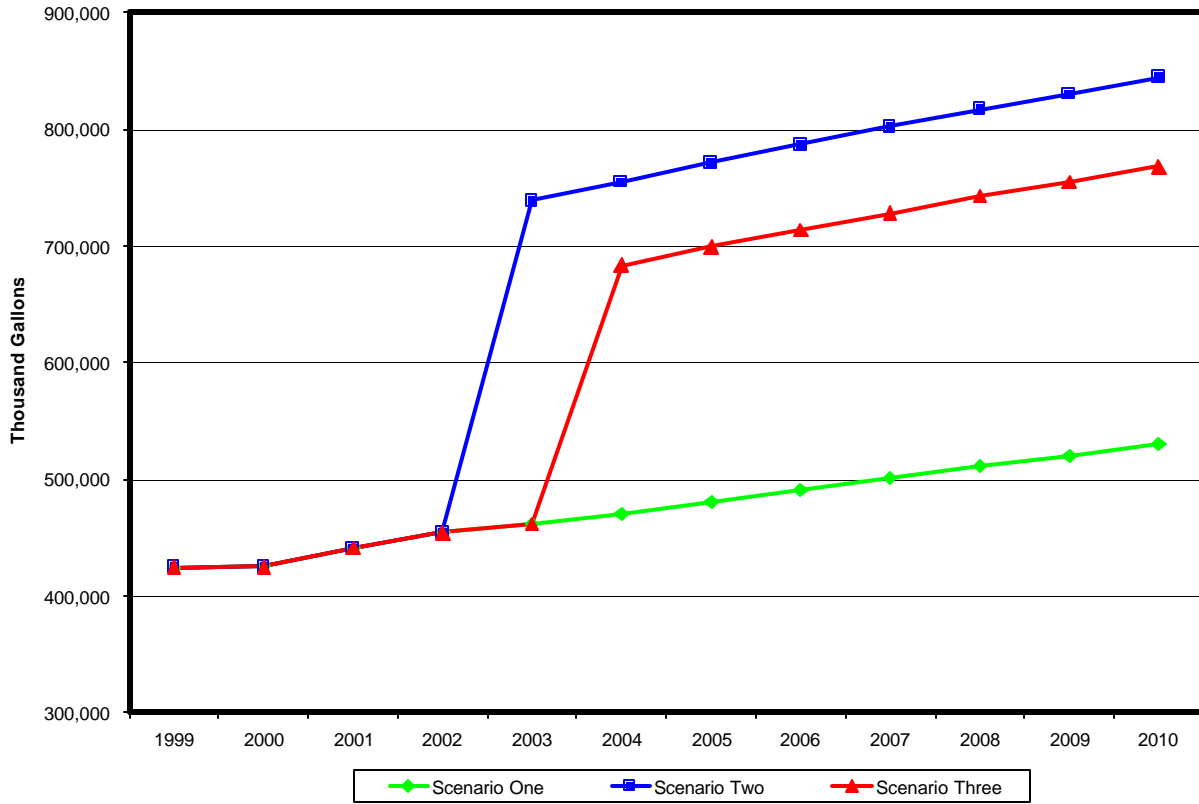


Table 10: Ethanol Consumption in OXY

	Scenario One	Scenario Two	Scenario Three
1999	424,927	424,927	424,927
2000	425,276	425,276	425,276
2001	441,136	441,136	441,136
2002	454,644	454,644	454,644
2003	461,582	738,786	461,582
2004	470,610	754,525	683,283
2005	480,761	771,565	699,308
2006	491,059	786,857	713,681
2007	501,394	802,100	728,011
2008	511,764	817,290	742,296
2009	520,065	830,323	754,899
2010	530,333	844,245	767,965

Figure 9: Ethanol Consumption in CVG

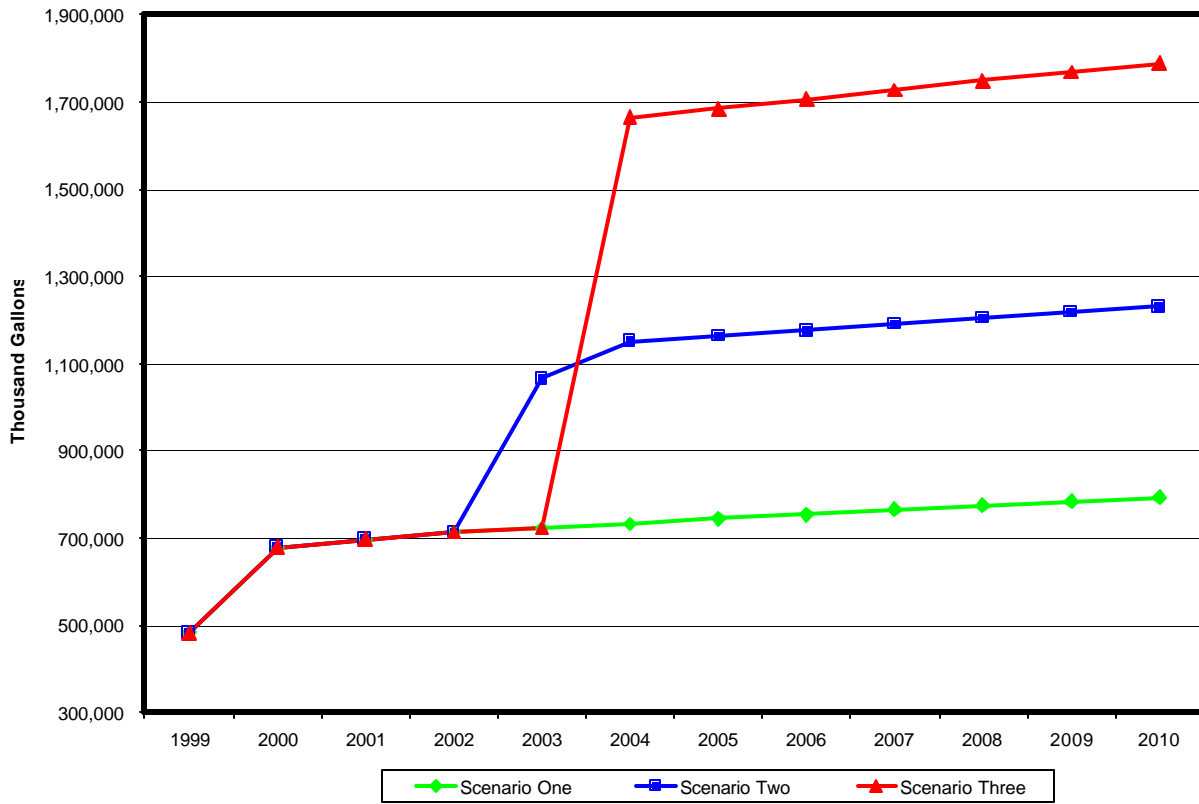


Table 11: Ethanol Consumption in CVG

	Scenario One	Scenario Two	Scenario Three
1999	484,416	484,416	484,416
2000	678,870	678,870	678,870
2001	698,336	698,336	698,336
2002	714,766	714,766	714,766
2003	722,934	1,066,189	722,934
2004	733,816	1,151,414	1,664,980
2005	745,204	1,162,776	1,684,740
2006	755,048	1,176,333	1,705,634
2007	766,215	1,191,501	1,728,316
2008	776,090	1,205,504	1,749,600
2009	784,952	1,218,471	1,769,513
2010	794,377	1,231,233	1,788,296

Figure 10: Total Ethanol Consumption

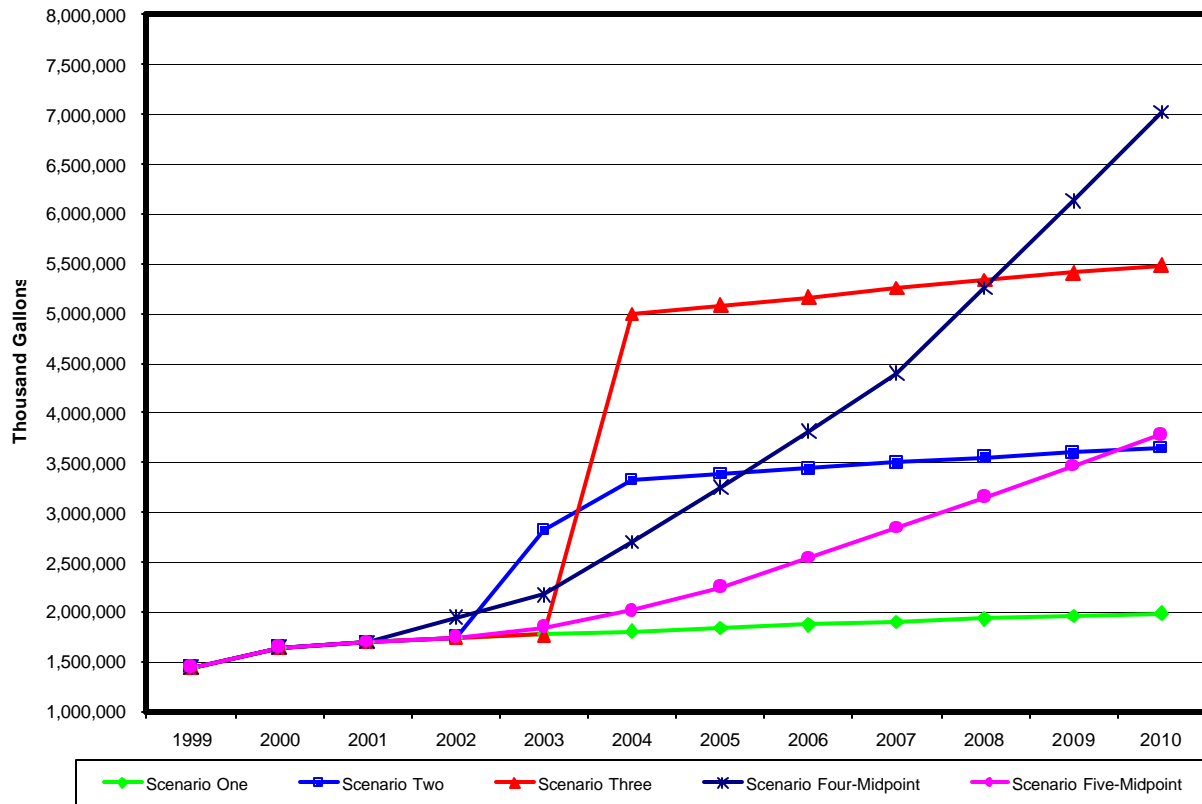


Table 12: Total Ethanol Consumption

	Scenario One	Scenario Two	Scenario Three	Midpoint Scenario Four	Midpoint Scenario Five
1999	1,442,274	1,442,274	1,442,274	1,442,274	1,442,274
2000	1,645,837	1,645,837	1,645,837	1,645,837	1,645,837
2001	1,698,701	1,698,701	1,698,701	1,698,701	1,698,701
2002	1,745,152	1,745,152	1,745,152	1,946,225	1,745,152
2003	1,770,705	2,820,369	1,770,705	2,171,440	1,841,520
2004	1,803,082	3,328,455	4,994,378	2,700,633	2,014,206
2005	1,836,918	3,386,090	5,080,169	3,248,740	2,249,127
2006	1,867,602	3,440,143	5,163,630	3,813,021	2,542,014
2007	1,901,345	3,497,492	5,250,593	4,395,161	2,843,927
2008	1,932,199	3,551,756	5,334,199	5,253,279	3,151,968
2009	1,959,595	3,601,058	5,410,575	6,128,675	3,464,034
2010	1,989,521	3,649,402	5,484,406	7,021,333	3,780,717