



MINNESOTA DEPARTMENT
OF AGRICULTURE

Legislative Report on Ethanol

Review of E20



Ralph Groschen, 651-201-6223
625 Robert St. N., St. Paul, MN
www.mda.state.mn.us

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Executive Summary

Currently, all gasoline in Minnesota is blended with 10 percent ethanol—commonly referred to as “E10.” According to Minnesota Statutes §239.791, subdivision 1a, all gasoline sold or offered for sale in the state of Minnesota must contain 20 percent ethanol by August 30, 2013. Minnesota could meet this mandate either by increasing its sales of E85 and other midlevel blends, or by increasing the amount of ethanol blended into gasoline to 20 percent (E20).¹ Current data indicates that Minnesota is unlikely to achieve this requirement through E85 and midlevel blend sales alone. To meet the requirement by selling all fuel in Minnesota as E20, the U.S. Environmental Protection Agency (EPA) must grant a waiver to the Clean Air Act by December 31, 2010, certifying E20 as a legal fuel. A waiver application must be submitted by industry that contains data demonstrating that E20 will not cause more pollution than gasoline and will not adversely affect engines or fuel and emissions control systems. Preliminary state- and federal-level studies indicate that the use of E20 fuels does not present problems for current automotive or fuel dispensing equipment. However, much federal-level research is ongoing and must be completed before a waiver application can be submitted.

The use of E20 fuel throughout Minnesota would have a significant positive impact on the state’s ethanol industry and its consumers. Minnesota currently has the capacity to produce approximately 850 million gallons of ethanol per year; however, Minnesotans only consume about 280 million gallons through E10 and E85 sales. Increasing the percentage of ethanol that is blended into gasoline from 10 to 20 percent would increase consumption of ethanol to about 540 million gallons per year, thereby doubling the market for ethanol in Minnesota. The certification of E20 by EPA would also double the nation’s potential ethanol market from 14 to 28 billion gallons. This new market would protect investments in existing corn ethanol plants and stimulate development in the emerging cellulosic ethanol industry in Minnesota and across the nation.

Consumers would also benefit from the implementation of the E20 requirement in Minnesota. Since the year 2000, the average net price of one gallon of ethanol² has been approximately 23 cents less than a gallon of gasoline.³ Ethanol also increases the octane value of fuel—for instance, blending one gallon of ethanol with nine gallons of gasoline results in E10 with an octane rating equal to “super unleaded” gasoline. This type of gasoline typically costs 10 cents more than unleaded regular gasoline at retail. Using more lower-cost, higher-octane ethanol in gasoline provides an opportunity to reduce costs and pass savings onto consumers.

¹ E85 is a blend of 85 percent ethanol and 15 percent gasoline; midlevel blends are those containing over 10 percent but less than 70 percent ethanol; E20 is a blend of 20 percent ethanol and 80 percent gasoline.

² The average net price is the price of ethanol at the rack (wholesale) minus the 51 cent tax credit to the blender. The tax credit was reduced to 41 cents per gallon as of January 2009.

³ Gasoline refers to 87 octane unleaded regular gasoline.

Introduction

This report is submitted pursuant to Laws of Minnesota 2005, Chapter 52, Section 4:

“The commissioner of agriculture in consultation with the commissioners of employment and economic development and the Pollution Control Agency, shall review the information and data collected in the evaluation of any federal waiver request for the use of E20 fuel in Minnesota. The commissioner shall use existing budgetary and staff resources in conducting the review. The review must include:

- (1) issues involving the use of E20 fuel if such fuel is mandated in Minnesota;*
- (2) effects of E20 on development of Minnesota’s ethanol industry; and*
- (3) effects of E20 on Minnesota consumers.*

The commissioner shall present an initial report to the legislative committees having jurisdiction over agriculture and environment policy and finance on the findings of the review to the legislature by January 15, 2009 and present an updated report to those committees on January 15, 2011.

The initiative to implement the August 31, 2013 requirement for blending the state’s gasoline with 20 percent ethanol began with the passage of Laws of Minnesota for 2005, Chapter 52, which established the requirement in Minnesota Statutes §239.791, subd. 1a. In addition, Chapter 1, Article 1, Section 71 of the 2005 Special Session amended Minnesota Statutes §41.09 to include subd. 9, authorizing Ethanol Combustion Efficiency Grants to develop data that would lead to EPA authorization of E20 as a legal fuel.

Background

Minnesota has long been a leader in the ethanol industry: it was the first state to implement an E10 requirement, and is on track to be the first state to require statewide use of E20. However, Minnesota’s ethanol industry, like many industries in the United States and around the world, is currently feeling the impact of volatile commodity price swings and the worst economic turmoil in decades. Recently, the price of gasoline has fallen more rapidly than the price of corn and ethanol, creating a painful price squeeze for ethanol producers. The U.S. ethanol industry is also facing a situation where the current 10.5 billion gallons of nationwide ethanol production capacity (following an increase of 5 billion gallons since 2007) is confronted with a national ethanol market for about 9.5 billion gallons. It is estimated that an additional 2 billion gallons of ethanol production capacity is under construction, totaling 12 billion gallons, thereby creating even greater potential pressure on ethanol prices.

The Renewable Fuels Standard (RFS), expanded by the federal Energy Independence and Security Act (EISA) of 2007, requires nationwide production of 36 billion gallons of biofuels by 2022, including 15 billion gallons of ethanol from corn and 21 billion gallons of biofuels from other biomass feedstocks. Assuming that the United States consumes about 140 billion gallons of gasoline, the exclusive use of E10 would utilize as much as

14 billion gallons of ethanol, or more likely, around 11.5 to 12.2 billion gallons—slightly less than the projected 12.5 billion gallon ethanol production capacity. This is commonly referred to as the 10 percent “blend wall”—the point at which the ethanol market can no longer accommodate production capacity.

The proximity of current ethanol production capacity to the potential 10 percent blend wall foretells an urgent need to expand the ethanol market considerably. Without additional outlets for ethanol and other biofuels, there may not be a sufficient market to encourage or accommodate ethanol production from corn or other biomass-based feed stocks. Currently, E85 and midlevel blends represent promising options to overcoming the 10 percent blend wall, but E20 may offer the best venue for addressing the regulatory hurdles confronting the general use of midlevel blends.

E20 Use and Issues

According to Minnesota Statutes §239.791, unless 20 percent of the total volume of gasoline sold in Minnesota is ethanol by December 31, 2010 (i.e., through the consumption of E85 and E10), then all gasoline sold or offered for sale in the state of Minnesota must contain 20 percent ethanol by August 30, 2013. Current data suggests that attaining the 20 percent requirement through E85 and E10 alone would call for extraordinary growth; thus, the state is also pursuing the use of E20 as a general fuel.

EPA Waiver

Before Minnesota’s E20 requirement can be implemented, the EPA must grant a waiver to the provisions of the Clean Air Act certifying E20 for general use in gasoline engines. A waiver application must be filed by industry that includes data demonstrating that E20 will not cause significant problems in the following areas:

- Fuel system materials compatibility;
- Vehicle drivability/engine operation characteristics;
- Exhaust and evaporative emissions;
- Fuel and emissions systems and engine durability; and,
- Health effects.

The EPA has up to nine months (270 days) to respond to a waiver application. Therefore, an application submitted to the EPA by March 31, 2010, would require the agency to respond by December 31, 2010, triggering the Minnesota requirement for E20 to be implemented on August 30, 2013.⁴ An application submitted at a later date may also allow time for the EPA to respond by December 31, 2010 (*see Appendix A, “Minnesota’s E20 Roadmap”*). During the EPA’s certification process, vehicle, dispenser and equipment manufacturers will register an opinion with the EPA on the suitability of E20 for use in the products they make. This process of certification requires the EPA to

⁴ Minnesota Statutes §239.791

review data presented by interested parties, take relevant issues into consideration and make a decision, ensuring minimal impact on consumers of E20 and the environment.

E20 Testing and Certification

Pursuant to an EPA waiver, a 2005 legislative appropriation was made allowing the Minnesota Department of Agriculture, with support from the Minnesota Corn Growers Association and the Council of Great Lakes Governors, to initiate grants with the University of Minnesota Mechanical Engineering Department for a Drivability study and with Minnesota State University-Mankato for a Materials Compatibility study. The work was completed and reports for these studies were posted on the Minnesota Department of Agriculture website in March of 2008 (<http://www.mda.state.mn.us/renewable/ethanol/default.htm>). In general, these studies concluded that vehicles operating on E20 performed as well as those running on E10 or pure gasoline. The tests also found that using the higher E20 ethanol blends did not cause significant problems for a wide range of materials, including metals, plastics, rubbers and fuel pumps used in these vehicle fuel systems

In the second quarter of 2007, subsequent to the passage of the 2007 EISA, the U.S. Department of Energy (DOE) along with the EPA, the U.S. Department of Agriculture (USDA), and others launched a \$40 million research program on “Mid-Level Ethanol Blends.” This is an extensive program pursuant to EPA certification of E20 and involves testing many aspects of vehicles; small non-road engines including lawn equipment and generators; and specialty engines such as marine, snowmobile and motorcycle engines. In spite of the extensive nature of the ongoing testing, more testing will be required on vehicles and small engines. As such, DOE plans to expand their testing program (*see Appendix B, “E20 Testing and Reporting Plan”*).

As discussed, if the EPA does grant E20 certification under of the Clean Air Act, the Minnesota requirement will be implemented in August of 2013. By this time, the vast majority of vehicles on the road will likely be models from the year 2000 or later—less than 13 years old. The University of Minnesota Drivability study tested vehicles from 2000 to 2006 and found that these vehicles performed well. Small engines are also being tested by the DOE and others. Before E20 is approved for general use, the results of these studies will be reviewed to evaluate any impact from general usage of the fuel.

Discussion—Brazil’s Example

It is clear that the products of many vehicle and small engine companies common to the U.S. market are being used in Brazil, where gasoline/ethanol blends have fluctuated between 20 and 26 percent since 1978. These include manufacturers of:

- a. Vehicles (GM, Ford, Chrysler, Toyota, Honda, Nissan, Suzuki, Mitsubishi, Subaru, Lexus, Hyundai, VW, Fiat, Alfa Romeo, Audi, BMW, Mercedes Benz, Porsche, Ferrari, Jaguar, Land Rover, Maserati, Peugeot, Citroen, Renault, Volvo);
- c. Small and specialty engines (Honda, Toyama, Shindaiwa, Briggs, Murray, MTD);

- d. Boat engines (Honda, Yamaha, Suzuki, Kawasaki, Mercury, Toyama, PCM, Crusader Marine, Sea Doo, Evinrude); and,
- e. Flex Fuel Vehicles (GM, Ford, VW, Fiat, Peugeot, Citroen, Renault, Toyota, Honda and Mitsubishi. Next year Nissan is expected to launch a model).

The fact that so many manufacturers familiar to U.S. consumers manufacture equipment for Brazil suggests that compatibility and operability issues could be addressed in the U.S. market over time. Brazil's environmental regulations are not as strict as those in the United States; however, their vehicles are equipped with catalytic converters, and their existing emission limitations apply to light trucks and are getting tighter. As in Brazil, various issues associated with midlevel ethanol blends can be addressed in the United States, as they continue are being addressed across the country with the growing use of E10. Prior to the implementation of E10 blends, some vehicle and small engine manufacturers and environmentalists suggested that the blend was not compatible with equipment or environmental regulations. As time progressed, however, E10 has proven to be a fuel that functions well in virtually all applications, has helped make gasoline burn cleaner, and has become a crucial part of EPA's reformulated gasoline program (designed to reduce ambient ozone levels in the country's largest metropolitan areas).

Impact on Minnesota's Ethanol Industry

The implementation of Minnesota's E20 requirement, along with continued use of E85 and other mechanisms for market expansion, will have a significant impact on Minnesota's ethanol industry.

Market Impact of E20

As of January 2009, Minnesota's ethanol production industry included 18 plants capable of producing about 850 million gallons of fuel ethanol per year. At an E20 level of blending, Minnesota could consume approximately 540 million gallons of ethanol, leaving an annual net export capacity of over 300 million gallons.

The use of gasoline blended with 10 percent ethanol is currently spreading across the country. According to estimates by the EPA and others, the maximum level of U.S. ethanol use in the nation's 140 billion gallons of gasoline as E10 could be as much as 14 billion gallons but is more likely to be 11.5 to 12.2 billion gallons per year.⁵ At the same time, the annualized national ethanol production capacity estimate for December of 2008 was approximately 10.8 billion gallons.⁶ This means the U.S. market for ethanol could

⁵ The current RFS exempts "small refiners" from the obligation to blend ethanol in their gasoline. Thus, under these provisions, the EPA and others have estimated that the total actual volume of ethanol required by the RFS to be blended with gasoline at 10 percent would be somewhat lower than exactly 10 percent of total nationwide gasoline consumption.

⁶ Renewable Fuels Association, 2008.

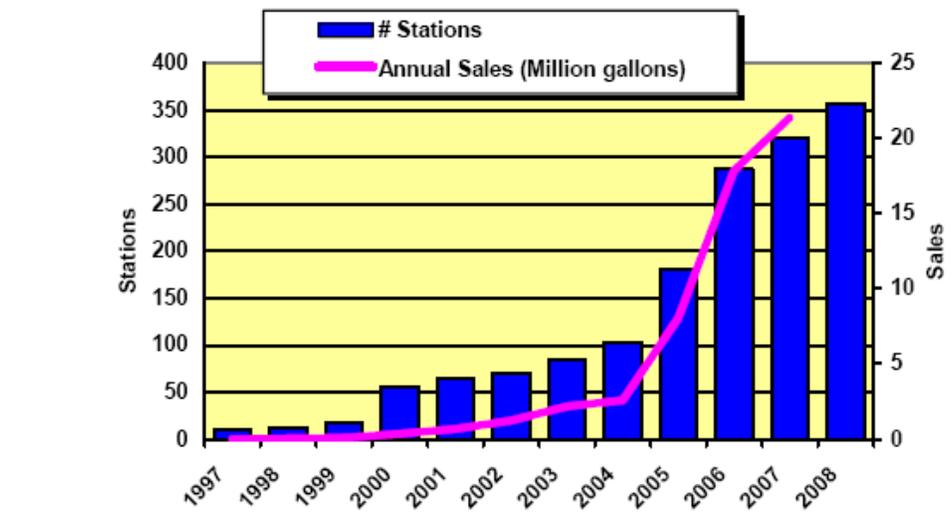
be saturated soon unless a new market is developed. As such, Minnesota's new ethanol industry could be negatively impacted by continued low prices.

If Minnesota is successful in obtaining EPA certification of E20 this will double the potential U.S. market, accommodating existing ethanol production plants as well as cellulosic ethanol production facilities in Minnesota and across the country. Without market expansion the entire ethanol industry could experience extreme ethanol price depression.

Market Impact of E85 and Blender Pumps

The estimated national consumption of E85, between 100 and 150 million gallons per year, is relatively small but could provide a significant additional market for ethanol. At the end of October 2008, estimated E85 sales for Minnesota totaled approximately 19.8 million gallons, suggesting that the state will exceed last year's record sales of over 21 million gallons (see Figure 1).

Figure 1. Minnesota's E85 Sales, 1997-2008⁷



Blender pumps are another potential market for greater ethanol use in the U.S. These pumps deliver various ethanol blends including E10, E20 E30, E50 or E85. There are currently about 36 blender locations in Minnesota. A strong increase in the use of blender pumps could also provide a significant additional market for ethanol. Similarly, the use of blender pumps could increase with the certification and use of E20 in conventional vehicles.

⁷ "Economic Impact of the Corn and Ethanol Industry in Minnesota," Minnesota Department of Agriculture, 2008.

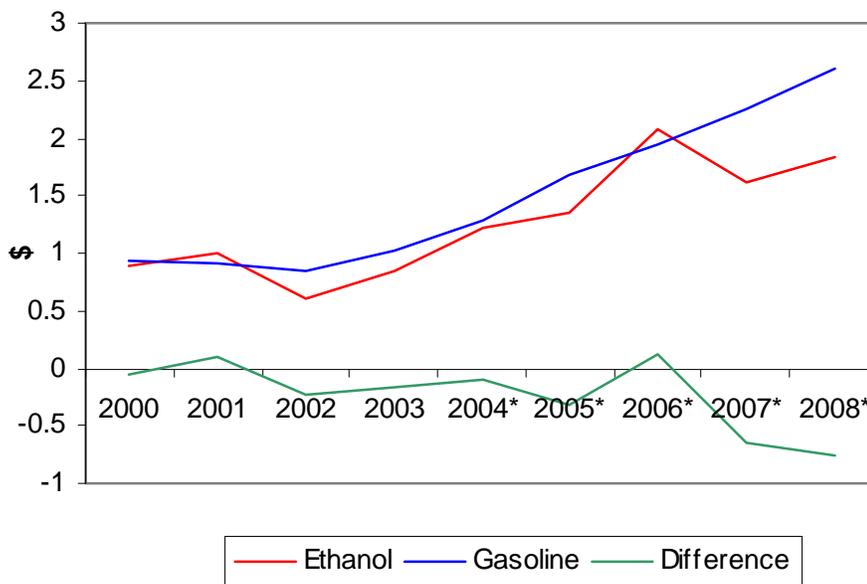
Impact on Minnesota Consumers

The benefits of Minnesota's ethanol industry and E20 requirement will be passed onto consumers in the form of lower fuel prices, increased tax revenues, and more jobs.

Ethanol and Gasoline Prices

In general, the average net price of a gallon of ethanol⁸ has been less than a gallon of 87 octane unleaded regular gasoline⁹. Specifically, over the past 8 years, the average net price of one gallon of ethanol to a commercial blender in the Twin Cities was 23 cents less than a gallon of 87 octane unleaded regular gasoline, and in 2008, the net price of ethanol averaged \$0.90 cents per gallon less than unleaded regular (see Figure 2). (See also Appendix C, "Minnesota's Ethanol and Gasoline Price Trends")

Figure 2. Minnesota's 8-Year Ethanol¹⁰ vs. Gasoline¹¹ Price Trends, 2000-2008



It is important to note that 2008 was a particularly volatile period for commodity prices, and ethanol and gasoline were no exception. For example, the average net wholesale price of ethanol rose to a high of \$2.46 in mid-July of 2008 and then fell to \$1.15 by December. Similarly, average wholesale gasoline prices rose to a high of \$3.68 in mid-July and dropped to \$0.94 in December. These and similar fluctuations

⁸ Net ethanol rack (wholesale) price after tax credit.

⁹ 87 octane gasoline rack (wholesale) price.

¹⁰ Net ethanol rack (wholesale) price after tax credit.

¹¹ 87 octane gasoline rack (wholesale) price.

in the corn, crude oil and many other commodity markets caused considerable turmoil for consumers and businesses alike.

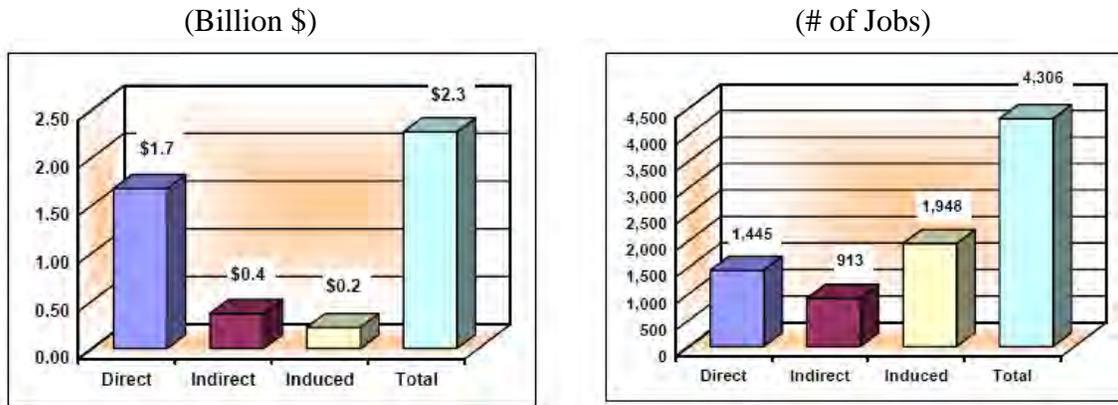
Ethanol also reduces the cost of gasoline by increasing its octane value: one gallon of ethanol adds 2 points to the octane value of nine gallons of the gasoline with which it is blended. For instance, one gallon of ethanol blended with 9 gallons of 87 octane regular unleaded gasoline results in 10 gallons of an E10 blend of 89 octane “super unleaded” gasoline. Twin Cities retail stations have traditionally sold super unleaded for 10 cents per gallon more than unleaded regular gasoline. Therefore, lower-cost, higher-octane ethanol reduces the cost of gasoline at the blender level and provides an opportunity to pass savings on to the customer.

Employment and other Economic Indicators

As discussed, ethanol is currently equivalent to about 10 percent of Minnesota’s gasoline consumption. This reduces the amount of crude oil required to meet the state’s gasoline needs and keeps jobs and tax revenue in the state.

It is estimated that, thanks to our ethanol industry, Minnesota enjoyed the economic impact of approximately \$2.3 billion dollars and 4,300 jobs in 2007 (see Figure 3).

Figure 3. Economic Impact of Minnesota’s Ethanol Industry, 2007^{12, 13}



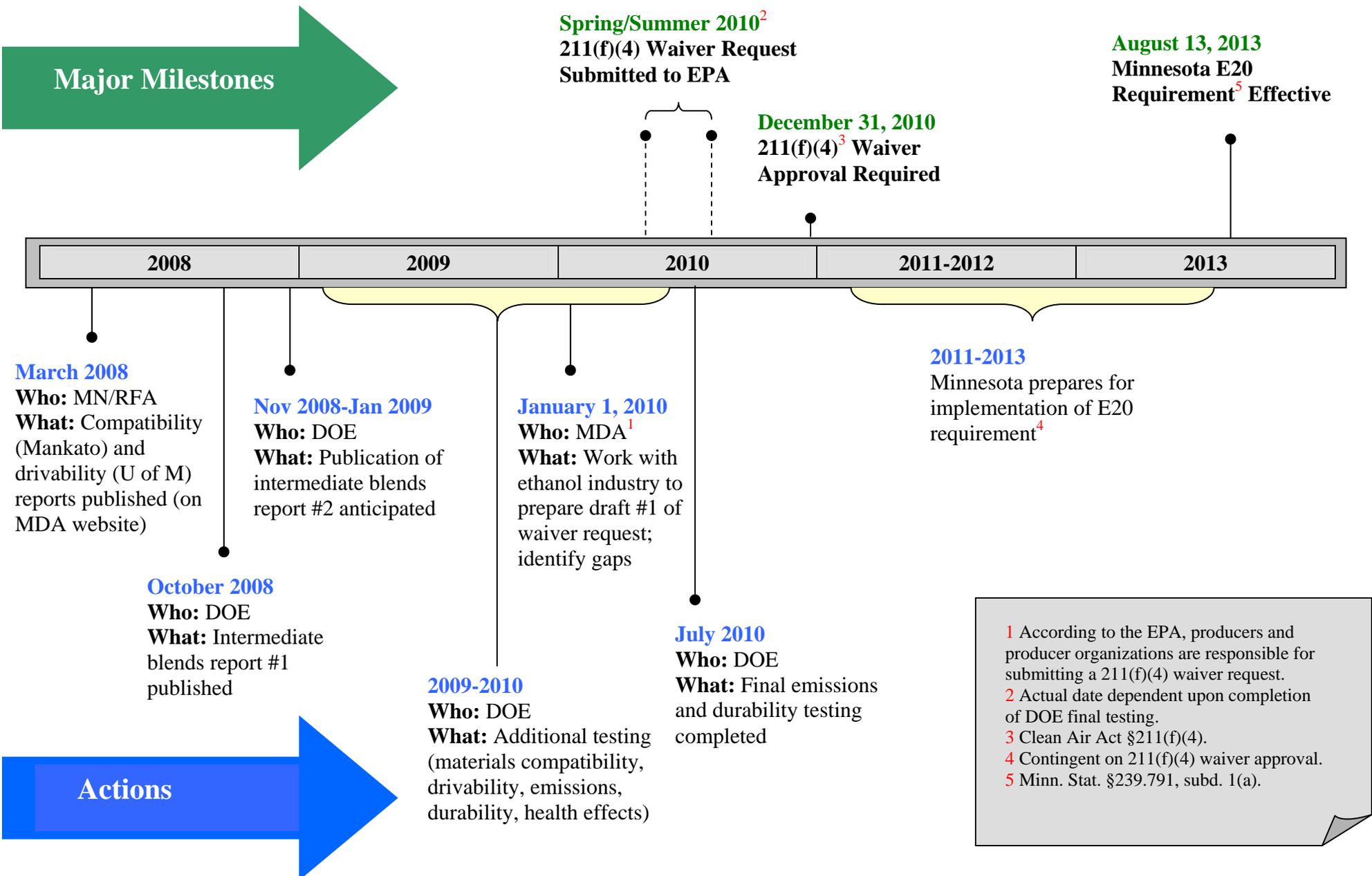
¹² “Economic Impact of the Corn and Ethanol Industry in Minnesota,” Minnesota Department of Agriculture, 2008.

¹³ Direct Impact represents the effect of ethanol production output. Indirect Impact represents the effect on all other economic sectors due to purchases by the ethanol industry to generate the aforementioned output. Induced Impact represents the effect on all economic sectors due to the expenditures of new income generated by the direct and indirect impacts. Total Impact is the sum of direct, indirect and induced impacts.

Conclusions

Minnesota—a national leader in the ethanol industry—is well-poised to take another step forward by implementing statewide use of E20. Many challenges must first be overcome, such as obtaining a waiver from the EPA ensuring that a higher blend of ethanol in gasoline will not adversely affect vehicles and the environment; however, the attainment of Minnesota's E20 requirement will lead to state and nationwide expansion of the ethanol market. The state's economy and its consumers will no doubt reap the benefits of this effort for years to come.

Appendix A: Minnesota's E20 Roadmap



Appendix B: E20 Testing and Reporting Plan

Category	Testing	Agency/Org	Status	Testing Completion Date	Report
Materials Compatibility	Fuel system materials compatibility (metals, plastics, rubbers, fuel pumps/components)	MN/RFA	Complete	Winter 2007	MSU Materials Compatibility Studies (Feb 2008) ¹
	Vehicle materials compatibility	DOE/CRC	In progress	2008-2009	unknown
	Fleet study (fuel economy, maintenance costs, etc.)	DOE/RIT	In progress	2008-2009	DOE Report #1 (Oct 2008) ² ; DOE Report #2 (anticipated Dec 2008-Jan 2009)
	Fuel system materials compatibility (expand to include ORNL stir tanks)	DOE/CRC	In progress	Fall 2009	unknown
Drivability	40 pairs (80 vehicles) restricted to E20 or gas use (plus subsequent evaluation of additional 10 pairs)	MN/RFA	Complete	Winter 2007	UMN E20 Drivability Study (March 2008, Revised Nov 2008) ³
	Vehicles and small engines	DOE	Possibly deferred	unknown	unknown
	Cold start/drivability (6 vehicles)	DOE/CRC	In progress	2008-2009	Initial report anticipated Nov 2008; additional report unknown
	Fuel/lubricating oil dilution (repetitive cold starts and short drives)	DOE	Planned	2009	unknown
	On-board diagnostics	DOE/CRC	Planned	2009	unknown
	Expanded drivability (more vehicles, additional operating conditions, medium and heavy-duty gasoline vehicles)	DOE	Possibly deferred	unknown	unknown
Exhaust and Evaporative Emissions	Emissions and catalyst temperature (16 vehicles)	DOE	In progress	2008-2009	DOE Report #1 (Oct 2008); DOE Report #2 (anticipated Dec 2008-Jan 2009)
	Tailpipe emissions (22 vehicles; 31 fuels)	DOE/EPA	In progress	unknown	unknown
	Evaporative emissions	DOE/EPA/CRC	In progress	2008-2010	Initial report anticipated Nov 2008; additional report expected March 2010

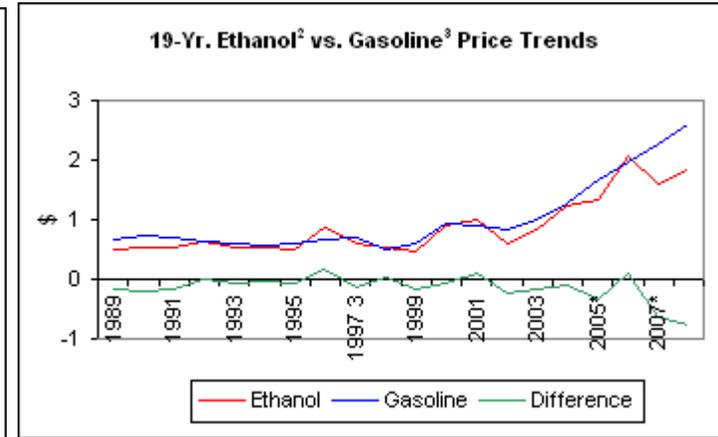
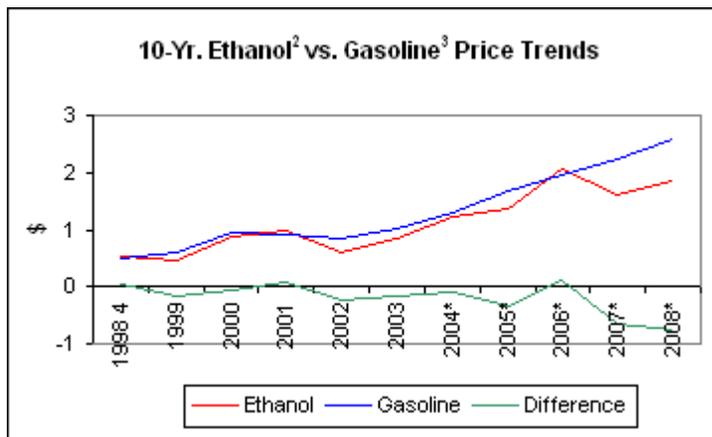
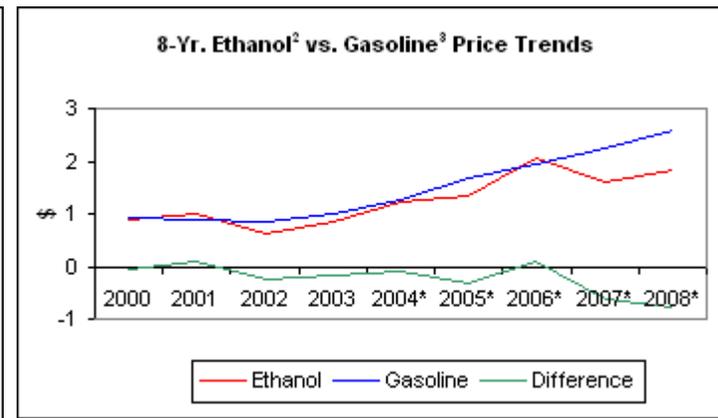
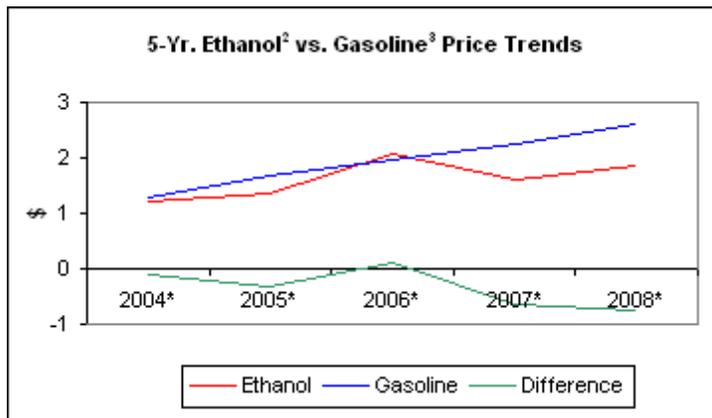
	Fleet study (baseline emissions tests)	DOE/RIT	In progress	2008-2009	DOE Report #1 (Oct 2008); DOE Report #2 (anticipated Dec 2008-Jan 2009)
	Fuel/lube emissions (expand to E20)	DOE	Possibly deferred	unknown	unknown
	Preliminary test of three vehicles	RFA	In progress	2009	awaiting report
	SNRE (6 engines) emissions and exhaust Temp Pilot Study	DOE	Complete	May 2008	DOE Report #1 (Oct 2008)
	SNRE full useful life-cycle emissions	DOE	Complete	unknown	DOE Report #1 (Oct 2008)
Health Effects	E10 health effects study -- may apply to E20	EPA	Complete	2005	awaiting report
Durability	Vehicles and small engines	DOE	Possibly deferred	unknown	unknown
	Fuel pump durability	MSU/MCGA	In progress	January 2009 (anticipated)	unknown
	Catalyst durability and aging (80 vehicles)	DOE/CRC	In progress	Spring 2009 (first 25 vehicles); July 2010 (final results)	unknown
	Engine durability	DOE	Possibly deferred	unknown	unknown
	Materials durability (expanded fuel system components, dispensing materials, long-term durability of evaporative emissions control parts)	DOE	Possibly deferred	unknown	unknown

Acronyms

RFA	Renewable Fuels Association	1	"The Effects of E20 on Plastic Automotive Fuel System Components," Minnesota State University - Mankato, Feb. 2008
DOE	U.S. Department of Energy		
CRC	Coordinating Research Council		"The Effects of E20 on Automotive Fuel Pumps and Sending Units," Minnesota State University - Mankato, Feb. 2008
RIT	Rochester Institute of Technology		
ORNL	Oak Ridge National Laboratory		"The Effects of E20 on Metals Used in Automotive Fuel System Components," Minnesota State University - Mankato, Feb. 2008
UMN	University of Minnesota		"The Effects of E20 on Elastomers Used in Automotive Fuel System Components," Minnesota State University - Mankato, Feb. 2008
EPA	U.S. Environmental Protection Agency		
SNRE	Small Non-Road Engines	2	"Effects of Intermediate Ethanol Blends on Legacy Vehicles and Small Non-Road Engines, Report 1," U.S. Department of Energy, Oct. 2008
MSU	Minnesota State University - Mankato		
MCGA	Minnesota Corn Growers Association	3	"Demonstration and Drivability Project to Determine the Feasibility of Using E20 as a Motor Fuel," U of M and RFA, Nov. 2008 (revised)

Appendix C: Minnesota's Ethanol and Gasoline Price Trends

	Average Ethanol Price ¹	MN Tax Credit	Federal Tax Credit	Net Ethanol Cost ²	Average Gasoline Price ³	Difference (Net Ethanol vs. Gasoline) ⁴
5 years (2004-2008)	\$2.13	\$0.00	\$0.51	\$1.62	\$1.95	-\$0.33
8 years (2000-2008)	\$1.79	\$0.00	\$0.52	\$1.27	\$1.50	-\$0.23
10 years (1998-2008)	\$1.65	\$0.00	\$0.52	\$1.13	\$1.32	-\$0.19
19 years (1989-2008)	\$1.49	\$0.07	\$0.54	\$0.88	\$1.02	-\$0.14



- 1 Ethanol price at rack
- 2 Net ethanol cost to the blender, after tax credit
- 3 87 octane gasoline price at rack
- 4 Net ethanol cost to blender minus 87 octane gasoline price at rack