Minnesota's Ethanol Programs

CHAPTER 1

Many midwestern states promote the production and use of ethanol by offering low-interest loans and by various promotional activities. What sets Minnesota apart from other states is the scope and variety of its programs, including a broad mandate to use oxygenated gasoline, a producer payment of 20 cents per gallon, and a highway tax credit for ethanol blends.

Minnesota promotes the production and use of ethanol through a variety of programs.

This chapter asks:

- **What are the incentives and requirements for ethanol production and use in Minnesota?**
- **How much do the programs cost?**
- **How do Minnesota's ethanol programs compare with programs offered by other major corn-producing states?**
- **What are the federal policies governing ethanol production and use in Minnesota?**
- **What is Minnesota's ethanol production capacity and how has it grown in recent years?**
- **To what extent have these programs succeeded in promoting the creation and expansion of the ethanol industry in Minnesota?**

MINNESOTA ETHANOL PROGRAMS

In the following sections we will describe each of Minnesota's ethanol programs, and present cost data on each. We will also take a look at ethanol programs in other states. Finally, we will present some information on the ethanol industry in Minnesota and the United States, and examine the question of whether Minnesota's ethanol industry owes its existence to the state ethanol programs.

Oxygenate Mandate

Starting in October 1997, oxygenated gasoline will be required statewide.

The 1990 amendments to the federal Clean Air Act require the use of oxygenated gasoline between October 1 and January 31 in federally designated carbon monoxide non-attainment areas.[1] During this period, gasoline must contain 2.7 percent oxygen by weight, and this is achieved with a mixture of about 7.7 percent ethanol (by volume) in gasoline. A 10 percent concentration of ethanol achieves a concentration of oxygen of approximately 3.5 percent. In Minnesota, the 10 county Twin Cities metropolitan area is included in the carbon monoxide (CO) non-attainment area.[2] This federal requirement was put into effect in October 1992.

In 1991, Minnesota enacted a year-round requirement that gasoline sold for motor vehicle use in air quality non-attainment counties must have a minimum oxygen content of 2.7 percent. This requirement went into effect in the Twin Cities area in October 1995 and is scheduled to become effective statewide in October 1997.[3] Thus,

- **Minnesota has significantly extended the geographic area and the time period in which oxygenated gasoline is required over that required by federal law.**

Ethanol is the only oxygenate currently used in Minnesota although about two thirds of the oxygenate used nationwide is methyl tertiary butyl ether, (MTBE) produced from methanol.

Producer Payment

Minnesota pays ethanol producers 20 cents per gallon.

The state of Minnesota pays ethanol producers 20 cents per gallon up to a per plant limit of $3 million and a statewide limit of $30 million for all plants. In general, payments last 10 years from the start of production. The producer payment was enacted in 1986 (Laws of Minn., Ch. 1) and payment rates and maximums (as well as actual payments) have increased over time. Table 1.1 presents a summary of legislative adjustments to the producer payment over the years. From 1986 to 1995, the rate per gallon increased from 15 cents per gallon to 20 cents and the maximum rose from $10 million to $30 million per year.[4]

The significance of changes in limits on the producer payment, of course, depends on whether actual production reaches these limits. In the aggregate, the producer payment can now pay 20 cents per gallon on 150 million gallons of ethanol production statewide. In the past, when the statutory cap in the producer payment appeared to be inhibiting investment in ethanol production facilities, the payment

1 These are areas that are out of attainment with U. S. Environmental Protection Agency standards governing atmospheric concentration of carbon monoxide.

2 The Duluth area was originally designated a CO non-attainment area, but was redesignated by the EPA as complying with CO standards in 1993.

3 *Minn. Stat.* 239.791, Subd. 1.

4 In 1994 the rate and per plant maximum were higher, but the law was changed before these provisions went into effect.

Table 1.1: Producer Payment History

Minnesota Legislation		Effective Dates	Payment Rate[1]	Annual Maximum (in millions) Single Plant	Annual Maximum (in millions) All Plants
1986 Special Session	Ch. 1	FY 1987	$0.15		$0.20
1986 Special Session	Ch. 1	FY 1988-92	.20	$3.00	10.00
1991	Ch. 302	FY 1992-00	.20	3.00	4.50
1992	Ch. 513	Through FY 2000	.20	3.00	8.50
1994	Ch. 632	FY 1994-95	.20	3.00	20.00
1994	Ch. 632	FY 1996-00	.25	3.75	20.00
1995	Ch. 220	Until 2000[2]	.20	3.00	30.00

Source: Minnesota Department of Agriculture.

[1]Full payment is for pure anhydrous alcohol. Payment is reduced for wet alcohol.

[2]*Laws of Minnesota*, 1995, Ch. 220 provides for payment until 2000 or 10 years after the start of production, whichever is later.

cap was increased. While the current statewide maximum has not been reached and probably will not be reached in the next five years, two plants have already reached the $3 million dollar cap on payments to a single plant.

Blender's Credit

The blender's credit has been the state's largest ethanol subsidy, but it is scheduled to end in October 1997.

The blender's credit provides a tax credit to wholesalers or retailers of ethanol-blended gasoline, so that gasohol is exempt from part of the tax due on straight gasoline. In 1994 and 1995 the Legislature enacted changes that will phase out the blender's credit by October 1997.[5] The credit was 20 cents per gallon (of pure ethanol) until October 1994, 15 cents until October 1995, 8 cents until October 1996, and 5 cents per gallon until October 1997. The decision to phase out the blender's credit was made in conjunction with the decision to expand the amounts paid and payable through the producer payment. Some form of the blender's credit dates back to the early 1980s.[6]

The blender's credit has been the state's largest ethanol subsidy in recent years. According to the Minnesota Department of Revenue which administers the blender's credit, the credit totaled $11.9 million in fiscal year 1992, $20.2 million in 1993, $24 million in 1994, $22.9 million in 1995, and $13.7 million in 1996. The blender's credit will reach zero for fiscal year 1999.

5 *Laws of Minnesota*, 1994, Ch. 632, and *Laws of Minnesota*, 1995, Ch. 220.

6 *Laws of Minnesota*, 1980, established a 4 cent per gallon tax exemption, Laws of Minnesota, 1983, Ch. 17, established a 2, 4, and 8 cent per gallon tax exemption applicable to different time periods and for different purposes. In 1985, the Legislature established a 40 cent per gallon tax credit to distributors of fuel grade alcohol blended with gasoline and an 80 cent per gallon tax credit to distributors of fuel grade alcohol blended with gasoline and sold in bulk to government or for school transportation.

Loan Programs

The Minnesota Department of Agriculture (MDA) administers two loan programs designed to assist the financing of ethanol plants, the Ethanol Production Facility Loan Program and the Value-Added Agricultural Processing Loan Program also known as the Stock Loan Program. Ethanol plants are also eligible for economic recovery grants through the Minnesota Department of Trade and Economic Development and tax increment financing through local units of government.

Minnesota offers several loan programs designed to assist in the financing of ethanol plants.

The Ethanol Production Facility Loan Program was established in 1993 to help finance ethanol plants with low-interest loans of up to $500,000 per plant.[7] The purpose of the program, as explained by MDA, is to encourage private lenders through a demonstration of state commitment and interest and to fill in gaps in the financing arrangements that ethanol plant developers are able to put together. The 15 million gallon per year plants recently built cost $18-25 million for construction and $25-30 million in total capitalization, so a loan of $500,000 can only supplement other financing sources. Generally the state's security interest is subordinate to that of other lenders. The exact details of each loan contract vary; the term of the loan is 7 to 10 years and the interest rate is 6 percent per year. As we discuss later in this chapter, the Minnesota producer payment involves much more money (up to $3 million per year per plant), and is essential to obtaining bank financing for most of the recently built ethanol plants. The production facility loans play a lesser role because of the small size of the subsidy (reduced interest on a maximum of $500,000).

Production facility loans are administered by the Agriculture Finance Division of the Minnesota Department of Agriculture. The production facility loans are financed through the Ethanol Development Fund. Appropriations to the fund totaled $1 million in 1993, $1,475,000 in 1994 and $350,000 in 1995. Repayment of the loans is deposited back into the Ethanol Development Fund to be used for further ethanol production facility loans.

As of the end of fiscal year 1996, loans had been issued to most of the operating ethanol plants in Minnesota, specifically the plants located in Benson, Winnebago, Winthrop, and Morris. In addition, loan commitments had been made to plants in Claremont, Buffalo Lake, and Little Falls. As of March 31, 1996 the uncommitted balance of the Ethanol Development fund was zero. According to agriculture department officials, repayment of all loans is current.

The Value-Added Agricultural Product Loan Program, also known as the Stock Loan Program, was enacted to help farmers finance the purchase of stock in a cooperative proposing to build or purchase and operate a facility to process agricultural crops.[8] The loan can be used to finance the purchase of stock in various farmer owned cooperatives, including ethanol plants. The program was funded by 1994 and 1995 appropriations totaling $450,000 to the Value-Added Agricultural

7 *Laws of Minnesota* 1993 Chapter 342, *Minn. Stat*. 41B.044.

8 *Laws of Minnesota* 1994 Chapter 642.

Product Revolving Fund.[9] The program is also administered by the MDA's Agriculture Finance Division. Interest and principal payments return to the fund and are available for further loans.

The loans provide 45 percent of the loan principal to a maximum of $24,000 to farmers applying for a loan through local lenders. The lender applies for state participation on qualifying loans. Loans are for a maximum of eight years, and loan payments of interest only are permitted for up to two years, with a fully amortized repayment schedule calculated for the remaining years. Interest on the state's portion of the loan is 4 percent or one-half of the lender's effective rate at the time of closing, whichever is lower. At the end of fiscal year 1996, a total of $466,191 in loans had been made, most of these to purchase stock in ethanol plants.

Ethanol plants also qualify for economic recovery grants administered by the Department of Trade and Economic Development. Morris Ag Energy, Corn Plus in Winnebago, and Heartland Corn Products in Winthrop each received $150,000, and Al-Corn in Claremont received $85,000.

Finally, most of the operating ethanol plants have received tax increment financing.[10] In 1993, the Legislature enacted a tax increment financing provision that sets a limit of $1,000,000.[11] Ethanol plants were also exempted from certain statutory provisions providing for reduction in state education and local government aids.[12] The TIF limit was raised to $1,500,000 in 1995 and broadened to include all agricultural processing facilities.[13]

COST OF MINNESOTA PROGRAMS

This section summarizes the cost of the major ethanol programs described above. The producer payment, the blender's credit, and the oxygenate mandate have cost implications many orders of magnitude greater than all three state loan programs put together. Adding in the value of the subsidized loans would not materially affect our estimate of the total cost of ethanol programs.

The costs of the three major programs are borne in three different ways. The producer payment is financed through an appropriation, the blender's credit is a tax expenditure, (it reduces revenues that would otherwise accrue to the trunk highway fund), and the cost of the oxygenate mandate is due to the fact that ethanol costs more than gasoline and causes an increase in the cost of gasoline to the consumer.

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9 In 1995 the appropriation totaled $1,000,000, but part was earmarked for use as an incentive to locate a large processing plant or for use in an interest buy-down program that was never implemented.

10 These include the plants in Benson, Claremont, Winnebago and Winthrop in recent years.

11 *Laws of Minnesota*, 1993, Chapter 250.

12 *Minn. Stat.* 273.1399 Subd. 3-4.

13 *Laws of Minnesota*, 1995, Chapter 264.

We calculate:

- **The producer payment cost $22.1 million in the three years 1994 to 1996. It will cost about $66.1 million in the next three year period, 1997 through 1999 according to MDA projections.**

- **The blender's credit cost $61.2 million between 1994 and 1996, and is projected to cost about $8.7 million from 1997 to 1999.**

Together, the blender's credit and the producer payment have cost an average of $27.8 million per year over the last three years (fiscal years 1994-96) in direct expenditures and foregone tax revenue. In the future the producer payment will continue to increase while the blender's credit is phased out. Together, the programs will still total $24.9 million per year in fiscal years 1997 to 1999.

As Table 1.2 shows, a total of about $39 million has been spent on the producer payment since 1987. The producer payment totaled $10.8 million in fiscal year 1996, and $22.1 million in fiscal years 1994-96. Based on MDA projections, ethanol production will increase in the future as additional plants begin operating and existing plants expand their output. MDA currently projects that ethanol production will reach 159 million gallons per year and the cost of the producer payment will climb to $26 million by fiscal year 1999.

Table 1.2: Producer Payments and Ethanol Production, FY 1987-96 with Projections, FY 1997-2001

Fiscal Year	Payment	Ethanol Produced (millions of gallons)
1987	$215,777	1.0
1988	493,175	8.0
1989	2,009,057	10.0
1990	2,197,123	11.0
1991	3,357,706	17.0
1992	4,950,454	35.0
1993	3,599,545	38.0
1994	4,796,247	41.0
1995	6,460,215	51.0
1996	10,799,192	69.5
Total Spent 1987-96	$38,878,491	281.0
PROJECTIONS		
1997	$16,910,000	99.1
1998	23,550,000	140.8
1999	25,660,000	159.2
2000	26,530,000	171.2
2001	23,200,000	177.8

Source: Minnesota Department of Agriculture.

The cost of the blender's credit is calculated by the Minnesota Department of Revenue. As we show in Table 1.3**,** the tax credit was worth $13.7 million in fiscal year 1996. For fiscal years 1994-96, the total was $61.2 million. Although the blender's credit is in the process of being phased out, residual tax credits will still accrue through part of fiscal year 1998.

Table 1.3: Blender's Credit, in Millions of Dollars

Fiscal Year	Amount
1992	$11.85
1993	20.21
1994	24.63
1995	22.92
1996	13.68
1997	5.92
1998	2.75
1999	0

Source: Minnesota Department of Revenue.

Gasoline containing ethanol generally costs more than straight gasoline.

EXTRA COST OF OXYGENATED GASOLINE

Minnesota's requirement to use gasoline with 2.7 percent oxygen year-round will cost consumers an amount that should be considered a cost of the program. Exact calculation of this cost is somewhat difficult because a federal oxygenated gasoline requirement is in effect for the Twin Cities area for one-third of the year, and because the state year-round requirement is being phased in over time, and the schedule of the phase-in does not correspond either to calendar years or the state's fiscal years.

In addition, the exact method of calculation can be debated. Nevertheless, for reasons explained below:

- **We estimate that the retail price of gasohol will exceed the price of conventional gasoline by about 2 to 3 cents per gallon over the next several years.**

Our estimate of the higher cost of gasohol considers retail prices in October and December 1996 and January 1997, and wholesale prices 1994 through 1996. Over this period, oxygenated gasoline has generally cost at least 2 to 3 cents more than nonoxygenated gasoline nationally, regionally, and in Minnesota, as far as the numbers can be determined from available data. It also considers the cost of ethanol mixtures based on wholesale prices for ethanol and gasoline.

Retail Prices

Data from the United States Department of Energy compare the price of gasoline in carbon monoxide (CO) non-attainment areas, such as the Twin Cities, ozone

non-attainment areas, and areas governed by neither of these requirements. CO non-attainment areas must use a mixture of ethanol or another oxygenate containing 2.7 percent oxygen, while ozone non-attainment areas must use "reformulated gasoline" (RFG) that contains 2.0 percent oxygen.

The retail price of oxygenated gasoline exceeded the price of conventional gasoline by 2 to 9 cents in the Midwest in late 1996 and early 1997.

Between October 7 and October 28, 1996, the difference between the national average retail price of conventional gasoline and oxygenated gasoline varied by about 8 to 11 cents. Between December 23, 1996 and January 20, 1997, this difference varied between 1.8 and 2.5 cents. Table 1.4 shows these prices, along with the price of reformulated gasoline which contains less oxygenate and is intermediate in price between conventional and oxygenated gasoline. For example, on October 28, 1996 the national average retail price of gasoline in oxygenated areas was $1.323 per gallon and in conventional areas it was $1.247, a difference of 7.6 cents. The difference on October 7 was 11.2 cents. The price of reformulated gasoline was intermediate to prices in conventional and oxygenated areas, 6.4 cents more than conventional areas on October 7, and 2.5 cents more on October 28.

Table 1.4 also presents retail gasoline price data for a large multi-state region that includes Minnesota and 14 other midwestern states from Oklahoma to the Canadian border.[14] In this region, however, Minnesota is the only state with an oxygenated gasoline requirement, so the prices for oxygenated gasoline for the region are the Minnesota prices. The prices for other types of gasoline are for all RFG areas or conventional areas in the region.

Table 1.4: 1996-1997 Retail Gasoline Prices, All Grades

	Oct. 7	Oct. 14	Oct. 21	Oct. 28	Dec. 23	Dec. 30	Jan. 6	Jan. 13	Jan. 20
NATIONAL PRICE DATA									
Conventional Areas	$1.216	$1.230	$1.233	$1.247	$1.267	$1.263	$1.259	$1.276	$1.276
Oxygenated Areas [a]	1.328	1.317	1.315	1.323	1.292	1.281	1.280	1.300	1.300
RFG Areas [b]	1.280	1.280	1.273	1.272	1.295	1.295	1.300	1.311	1.314
Amount Price Exceeds Conventional Gasoline									
Oxygenated Areas	$0.112	$0.087	$0.082	$0.076	$0.025	$0.018	$0.021	$0.024	$0.024
RFG Areas	0.064	0.050	0.040	0.025	0.028	0.032	0.041	0.035	0.038
MIDWEST PRICE DATA									
Conventional Areas	$1.194	$1.219	$1.216	$1.244	$1.247	$1.240	$1.232	$1.266	$1.264
Oxygenated Areas	1.282	1.275	1.300	1.290	1.308	1.307	1.299	1.291	1.287
RFG Areas	1.277	1.290	1.292	1.309	1.352	1.345	1.338	1.348	1.344
Amount Price Exceeds Conventional Gasoline									
Oxygenated Areas	$0.088	$0.0567	$0.084	$0.046	$0.061	$0.067	$0.067	$0.025	$0.023
RFG Areas	0.083	0.071	0.076	0.065	0.105	0.105	0.106	0.082	0.080

Source: U.S. Department of Energy, Motor Gasoline Price Survey, Form EIA-878.

[a]Oxygenated Areas are those in which a gasoline mixture containing 2.7 percent oxygen is required.

[b]RFG (reformulated gasoline) areas are those in which 2.0 percent oxygen is required.

14 This region is one of five Petroleum Administration for Defense (PAD) districts, and it includes Illinois, Indiana, Iowa, Kansas, Kentucky, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, Oklahoma, South Dakota Tennessee, and Wisconsin.

The premium for oxygenated gasoline ranged from 8.8 cents on October 7 to 4.6 cents on October 28. For the five-week period ending January 20, 1997, the regional price difference ranged from 6.7 cents to 2.3 cents.

Wholesale Price Differences

We also looked at wholesale oxygenated and conventional gasoline prices (net of taxes) for the nation, the region in which Minnesota is located, and for Minnesota for 1995. Table 1.5 shows that there is little difference between the large 15 state region in which Minnesota is located and the nation as a whole, but while oxygenated gasoline is about the same price in Minnesota as in the nation as a whole, conventional gasoline prices are higher in Minnesota, and the difference between oxygenated and non-oxygenated gasoline prices is lower. In 1995, the wholesale price of regular grade gasoline in Minnesota was 60.0 cents in conventional areas and 62.4 cents in oxygenated areas, for a difference of 2.4 cents. The difference is 2.2 cents for all grades of gasoline in Minnesota compared to a difference of 5.4 cents nationally and 4.8 cents in the region. One possible reason for the smaller difference in Minnesota is that the comparison between oxygenated and non-oxygenated areas in Minnesota is also a comparison between gasoline prices in the Twin Cities area and the balance of the state. Gasoline prices may be higher outside the Twin Cities because distribution costs are higher and there is less retail competition.

In 1995, the wholesale price of oxygenated regular grade gasoline was 2.4 cents higher than conventional gasoline in Minnesota.

Table 1.5: Comparison of Prices for Conventional, Oxygenated, and Reformulated Gasoline, 1995

	Cents Per Gallon		
Wholesale Prices	U.S.	Midwest	Minnesota
REGULAR GRADE			
Conventional	57.2¢	57.0¢	60.0¢
Oxygenated	63.0	62.5	62.4
RFG	61.0	61.0	NA
Price Differences			
Oxy minus Conventional	5.8	5.5	2.4
RFG minus Conventional	3.8	4.0	NA
ALL GRADES			
Conventional	59.2	58.5	61.1
Oxygenated	64.6	63.3	63.3
RFG	63.5	62.9	NA
Price Differences			
Oxy minus Conventional	5.4	4.8	2.2
RFG minus Conventional	4.3	4.4	NA

Note: Oxygenated gasoline (oxy) contains 2.7 percent oxygen. Reformulated gasoline (RFG) contains 2.0 percent oxygen. See text for definition of the Midwest Region.

Source: U.S. Department of Energy, *Petroleum Marketing Annual 1996*, Tables 32, 33, 34, 44.

Weighted Average Estimates

We also estimated the price difference between oxygenated gasoline and conventional gasoline by taking an average of the wholesale price of ethanol and gasoline, and calculating the price of a 10 percent mixture. The wholesale cost of regular gasoline has averaged 56 to 58 cents per gallon in 1994 and 1995, and averaged 65 to 67 cents in 1996. The cost of ethanol has averaged about $1.22 per gallon in 1994 and 1995, and averaged $1.51 in 1996. The 54 cent federal tax credit and the 5 cent Minnesota blender's tax credit now bring down the cost of ethanol a total of 59 cents per gallon, although the blender's credit will disappear in October 1997 and should be ignored in looking to the future.

We can estimate the additional cost of gasohol mixed at 10 percent ethanol or at some other concentration if we specify prices for both ethanol and gasoline net of the tax credits we want to include.[15] Table 1.6 shows that at a price of ethanol of $1.51 and a price of gasoline of $.67, (average 1996 prices) a 10 percent mixture of ethanol and gasoline costs 75 cents a gallon rather than 67 cents for straight gasoline. If we net out the federal credit of 54 cents from 1.51, the effective ethanol price is $0.97, and as the table shows, the price difference for gasohol is 3.0 cents. If we net out the 5 cent blender's credit and the federal credit, the difference is 2.5 cents.

If we choose a lower price for ethanol, the premium for an ethanol mixture is less. For example, using 1994 and 1995 average prices of $1.22 for ethanol and $.58 for gasoline and current federal and state credits, the price difference is one-half of one cent per gallon.

Table 1.6: Effect of Ethanol on Gasoline Prices

	Price Per Gallon					Price Difference (in Cents)	
	Ethanol	Gasoline		10 Percent Mix		10 Percent Mix	
	Twin Cities[2]	Twin Cities[2]	Midwest Region[3]	Twin Cities	Midwest Region	Twin Cities	Midwest Region
1996 AVERAGE PRICES[1]							
No Tax Credits	$1.51	$0.67	$0.65	$0.75	$0.74	8.4	8.6
Less State 5 cent credit	1.46	0.67	0.65	0.75	0.73	7.9	8.1
Less Federal 54 cent credit	0.97	0.67	0.65	0.70	0.68	3.0	3.2
Less Federal and State credits	0.92	0.67	0.65	0.70	0.68	2.5	2.7
1994-95 AVERAGE PRICES							
No Tax Credits	1.22	0.58	0.56	0.64	0.63	6.4	6.6
Less State 5 cent credit	1.17	0.58	0.56	0.64	0.62	5.9	6.1
Less Federal 54 cent credit	0.68	0.58	0.56	0.59	0.57	1.0	1.2
Less Federal and State credits	0.63	0.58	0.56	0.59	0.57	0.5	0.7

[1]1996 averages represent the period January to October only.

[2]Source: Minnesota Department of Agriculture.

[3]Source: U.S. Department of Energy, *Petroleum Marketing Monthly*, January 1997, Tables 32 and 33.

15 The term gasohol refers to a mixture of alcohol and gasoline, usually around 7-10 percent ethanol.

We have not separately counted the 54 cent federal tax credit for ethanol in previous discussions of ethanol program costs, although Minnesotans pay a share of the cost of this credit as a federal tax expenditure. The rough cost is 54 cents per gallon times the number of gallons of ethanol consumed annually in Minnesota. When oxygenated gasoline use becomes mandatory statewide, Minnesota ethanol consumption will be about 200 million gallons, and the federal tax credit on Minnesota consumption will equal about $108 million each year.

Oxygenated gasoline costs more even considering its value as an octane enhancer.

Ethanol contains about 33 percent less energy than gasoline, and proportionally less mileage is obtained from ethanol mixtures. Mixed at 10 percent, ethanol lowers mileage by about 3 percent. This effect is not specifically considered in the weighted averages calculated in Table 1.6, although this can be done by reducing the price of gasoline by about 30 percent and recalculating the numbers. If we counted the fact that a gallon of ethanol contains 30 percent less energy than a gallon of gasoline, we would add about 2 cents to our estimates of the difference in fuel costs per gallon between gasoline and a 10 percent ethanol mix.

There is one factor that works in the opposite direction, however. Ethanol has an octane rating of about 115 and raises the octane value of the fuel with which it is mixed. Under some circumstances, ethanol has value as an octane enhancer. Ethanol can be blended with a cheaper, lower grade of gasoline and the resulting product meets higher octane specifications.

We talked to representatives of the three refiners serving the Minnesota market. One company says they do not blend ethanol with a special low-octane blend in order to get regular-grade gasoline. (Regular gasoline accounts for about 70 percent of gasoline sold.) Two refiners said they did blend lower octane gasoline with ethanol for the Twin Cities, but not the outstate market. The lower-octane gasoline costs .5 to 1.25 cents less than regular grade, but induces additional storage and handling costs.

Where oxygenated gasoline is required, and with state and federal tax credits that lower the cost of ethanol, ethanol blends have a value of .5 to 1.25 cents per gallon as an octane enhancer (ignoring additional storage costs). However, if we take account of the octane enhancement value and the energy content factor, both of which are left out of our weighted average calculations, the 2 to 3 cent estimate we have been using is increased a penny per gallon or so. Still, for the purpose of subsequent cost analysis, we stay with a conservative estimate of 2 to 3 cents per gallon.

About 2 billion gallons of gasoline are consumed each year in Minnesota. Each penny per gallon is equivalent to $20 million in the cost of fuel to consumers.

Roughly 2 billion gallons of gasoline are consumed each year in Minnesota. For each penny that the ethanol mixture costs over straight gasoline, the cost of fuel consumed goes up $20 million per year. As noted, starting in October 1997, the use of oxygenated gasoline will be required statewide for the entire year, but before October 1995, the only legal requirement was the federal requirement for wintertime use in the Twin Cities area. Part of the extra cost of oxygenated gasoline before October 1997, therefore, is due to the federal mandate, not the state requirement and should be subtracted from our calculation of the cost of using gasohol.

The federal government requires oxygenated fuel use in the Twin Cities area for four months per year. If one half the vehicle miles traveled in Minnesota annually take place in this area, and four months represents one-third of the year, then only five sixths of the total 20 million should be counted as extra cost induced by the state oxygenate mandate.

Our estimate, therefore, is that after October 1997, when the oxygenated gasoline requirement is in force statewide,

- **Minnesota consumers will pay $33.3 to $50 million (five-sixths of $40 to $60 million) more for gasohol than they would pay for straight gasoline each year, and this equals about $100-$150 million over a three year period, assuming annual consumption of 2 billion gallons of fuel. Taking the mid-point of this range yields an estimate of nearly $42 million per year or $125 million over the three years.**

These numbers are based on a 2 to 3 cent premium price for oxygenated gasoline which is lower than other estimates of the premium price of oxygenated gasoline, including the October 1996 retail prices from the Department of Energy quoted above. It is also lower than the price difference of 3 to 5 cents quoted this summer by an official of the Minnesota Department of Agriculture.[16]

Table 1.7 summarizes the cost of the major ethanol programs. These estimates do not include the cost of subsidized loans and grants received by ethanol plants. Together, the cost of these loans is much less than the cost of the major programs. If the 6 percent interest rate charged by these loans is half of the market rate that would otherwise have to be paid, each of the $500,000 production facility loans constitutes a subsidy of about $30,000 per year for 7 to 10 years.[17] Adding all the loans and grants together might add a few hundred thousand dollars to our estimate of the total cost of ethanol programs assuming that all the loans are paid back. Since the estimates presented above can not be calculated to this level of precision, these amounts are left out of the total.

In the future, the blender's credit will be phased out but the producer payment and consumer costs will increase. The producer payment is projected by the MDA to increase to about $25 million in fiscal year 1998 and $26 million in fiscal year 1999. The total cost of the major ethanol programs will continue to increase for several years. However, the producer payment expires for the earliest participants in the program in 2000, and it is scheduled to expire for others 10 years after production begins. As Table 1.2 showed, MDA estimates that total payments through the producer payment program will decline after fiscal year 2000.

16 Ralph Groschen, MDA quoted by Lee Egerstrom,"The Ethanol Gap," St. Paul Pioneer Press, Tuesday, July 31, 1996. This estimate is in line with our data for this period.

17 Six percent of 500,000 is worth $30,000 each year.

We estimate that ethanol programs will cost about $67 million per year in the next three years.

Table 1.7: Ethanol Program Cost Summary (Dollars in Millions)

	1994-96	Annual Average	1997-99	Annual Average
Producer Payment	$22.1	$7.4	$66.1	$22.0
State Oxygenate Mandate	NA[a]	NA	125.0[b]	41.7
Blender's Credit	61.2	20.4	8.7	2.9
Total	$83.3	$27.8	$199.8	$66.6

Note: NA = Not Applicable.

Source:

[a]Starting in October 1995 the Twin Cities area, with about half the state's drivers, was gover ned by a year-round oxygenate requirement. The cost of this requirement equals one-half (of the drive rs) times two-thirds (of the year) time 2-3 cents (the premium price of gasohol) time 2 billion, the statew ide amount of gasoline consumed. This yields an estimate of $6.67 million to $10.0 million per ye ar starting October 1995.

[b]The cost of the mandate is computed as though it were in effect year round and statewide. This will not occur until October 1997. Other costs are computed for fiscal years.

PROGRAMS IN OTHER STATES

We looked at the ethanol incentives offered by other states and found:

- **Minnesota's approach to promoting the production and use of ethanol is far-reaching and comprehensive compared to the ethanol incentives offered by other midwestern corn-producing states.**

We looked in some detail at programs offered in a number of midwestern states: Illinois, Indiana, Iowa, Nebraska, North Dakota, South Dakota, and Wisconsin. This group of states includes most major corn producers and most major ethanol producers.

As Table 1.8 shows, all the states listed promote ethanol use through the state department of agriculture or another office. A number of states, including Minnesota, operate a fleet of ethanol-powered or flexible fuel vehicles. Minnesota is unique among this group of states in that it mandates oxygenated fuel use beyond the time period and geographic area required by federal regulations that apply in CO or ozone non-attainment areas. There is no state-mandated oxygenate or ethanol use in the other midwestern states we examined.

Of the states listed on Table 1.8, only Iowa and Minnesota offer a subsidized loan program specifically for ethanol production facilities. In Minnesota and presumably some other states, ethanol plants qualify for loans through other state or local economic development programs.

Table 1.8: Ethanol Programs in Selected States

State	Federally Mandated Use[1]	State Mandated Use	Producer Payment	Maximum Producer Payment	Blender's Credit	Subsidized Loan Programs	Ethanol Promotion Activities	Number of Ethanol Plants
Minnesota	Ozone - No CO - Yes	Year round in CO nonattainment areas	20 cents per gallon	$30 million	8 cents per gallon	Yes	Minnesota Department of Agriculture	8
Illinois	Ozone - Yes CO - No	Government vehicles only	No	NA[2]	No	No	Illinois Department of Commerce and Community Affairs	4
Indiana	Ozone - Yes CO - No	No	No	NA	No	No	Indiana Lt. Governor's Office	1
Iowa	Ozone - No CO - No	Government vehicles only	No	NA	No	Yes	Iowa Department of Agriculture	7
Nebraska	Ozone - No CO - No	Government vehicles only	20 cents per gallon	$26 million	No	No	Nebraska Ethanol Development Board	7
North Dakota	Ozone - No CO - No	No	40 cents per gallon	$5 million[3]	No	No	North Dakota Agricultural Products Utilization Commission	2
South Dakota	Ozone - No CO - No	Government vehicles only	20 cents per gallon	$10 million	2 cents per gallon	No	South Dakota Corn Utilization Council	4
Wisconsin	Ozone - Yes CO - No	Government vehicles only	No	NA	No	No	Wisconsin DOA[4] Energy Office and the Wisconsin Department of Agriculture	2

Source:

[1]In either ozone or carbon monoxide nonattainment areas.

[2]Not applicable.

[3]Dependent on date plant went into operation and amount of ethanol produced.

[4]Department of Administration.

Only Minnesota and South Dakota offer a blender's credit, but several states in addition to Minnesota offer a producer payment of 20 cents or more per gallon. Nebraska has a producer payment of 20 cents per gallon, as does South Dakota. North Dakota pays producers 40 cents per gallon, but payments under this program are capped at $5 million. The Nebraska cap is $25 million, close to Minnesota's limit of $30 million; South Dakota's maximum annual producer payment limit is $10 million. Several states, including Illinois and Iowa, do not offer major production incentives or tax credits, but are nevertheless the locus of major ethanol production facilities.

ETHANOL USE IN MINNESOTA AND THE NATION

Minnesota leads the nation in the percentage of gasoline that contains ethanol.

In this section we look at statistics on ethanol use and production in Minnesota and the United States. A look at this information shows:

- **In 1994, even before the state requirement to use gasohol became effective, Minnesota led the nation in the percentage of gasoline mixed with ethanol.**

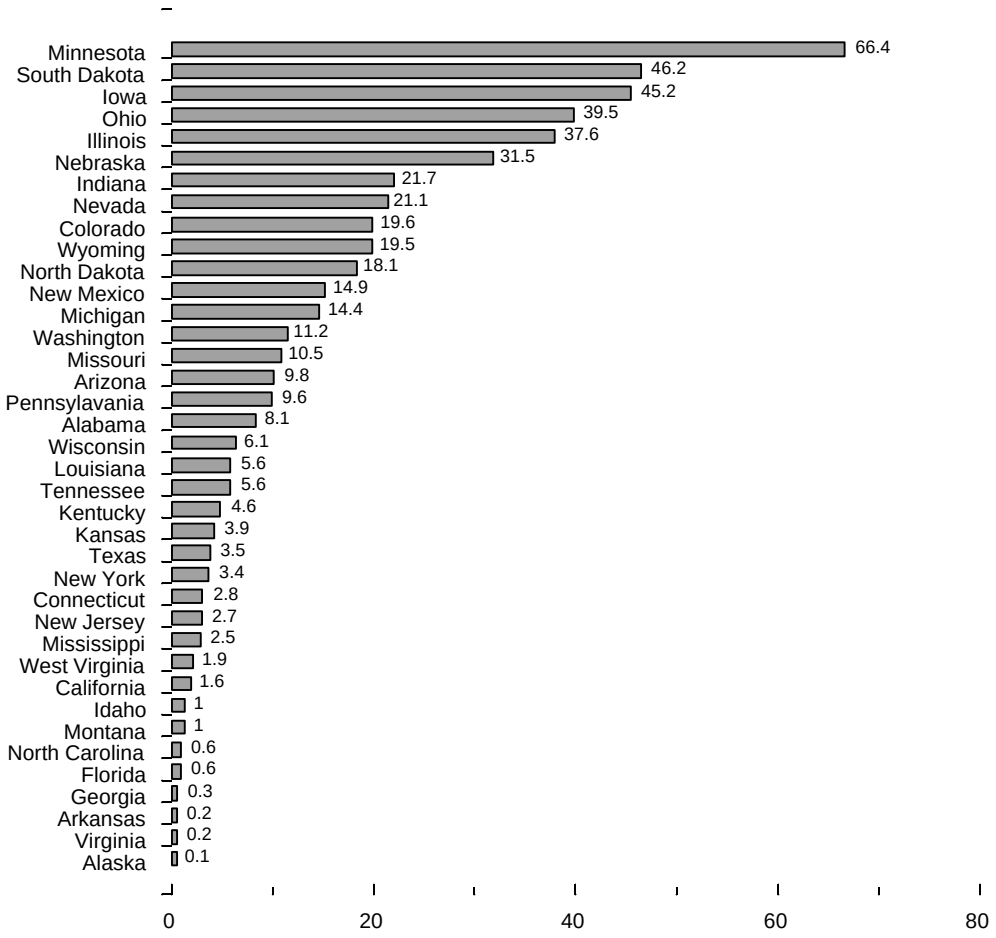
As Figure 1.1 shows, in 1994, before any state requirement for ethanol use was in place, 66 percent of the gasoline for highway use in Minnesota was mixed with ethanol. This percentage led the nation in 1994, the most recent year for which we have this information. Over 45 percent of the gasoline in Iowa and South Dakota was mixed with ethanol. Other midwestern corn-producing states use a high proportion of gasohol, including Ohio, Illinois, Nebraska, and Indiana. In Wisconsin, though, only about 6 percent of gasoline was mixed with ethanol.

Table 1.9 shows that in 1994 over one billion gallons of ethanol was used in gasoline nationwide. In fact, as the table shows:

- **In 1994, Minnesota was the third highest user of ethanol, at over 125 million gallons. Only Illinois and Ohio, states with much larger populations, used more ethanol in gasoline.**

As a generalization, the states that use a lot of ethanol are the same states with a significant ethanol production capacity. In the next section, we look at ethanol production facilities in Minnesota and the United States.

Figure 1.1: Gasohol as a Percent of Gasoline for Highway Use, 1994



Source: U.S. Department of Transportation Highway Statistics, 1994.

ETHANOL PRODUCTION IN MINNESOTA AND THE UNITED STATES

Figure 1.2 shows the location of ethanol plants in the United States. The plants owned by the largest producers are concentrated in Illinois, Iowa, Nebraska and Indiana. According to data compiled by the Renewable Fuels Association, as of January 1996 United States ethanol production capacity was about 1.5 billion gallons per year.

Table 1.9: Estimated Use of Gasohol, 1994

State	In Thousands of Gallons: Total Ethanol Used in Gasohol	In Thousands of Gallons: Total Gasohol
Alabama	14,385	143,850
Alaska	26	260
Arizona	7,073	80,708
Arkansas	278	2,783
California	27,497	482,396
Colorado	19,998	234,571
Connecticut	3,729	37,590
Delaware	--	--
District of Columbia	--	--
Florida	3,595	35,950
Georgia	1,093	10,926
Hawaii	--	--
Idaho	551	5,514
Illinois	174,741	1,747,412
Indiana	59,762	597,625
Iowa	62,773	627,730
Kansas	4,655	46,546
Kentucky	8,755	87,546
Louisiana	10,563	105,626
Maine	--	--
Maryland	--	--
Massachusetts	--	--
Michigan	63,119	631,188
Minnesota	125,280	1,431,263
Mississippi	3,343	33,428
Missouri	29,240	292,398
Montana	--	--
Nebraska	18,489	184,894
Nevada	--	--
New Hampshire	--	--
New Jersey	3,215	40,125
New Mexico	5,192	55,525
New York	6,956	79,284
North Carolina	10,114	107,993
North Dakota	5,893	58,935
Ohio	186,690	1,866,896
Oklahoma	--	--
Oregon	--	--
Pennsylvania	18,882	192,703
Rhode Island	--	--
South Carolina	--	--
South Dakota	18,333	183,326
Tennessee	28,560	285,603
Texas	12,605	126,969
Utah	--	--
Vermont	--	--
Virginia	9,400	100,403
Washington	76,215	882,104
West Virginia	1,629	16,287
Wisconsin	13,312	133,124
Wyoming	6,011	60,113
TOTAL	1,041,952	11,009,594

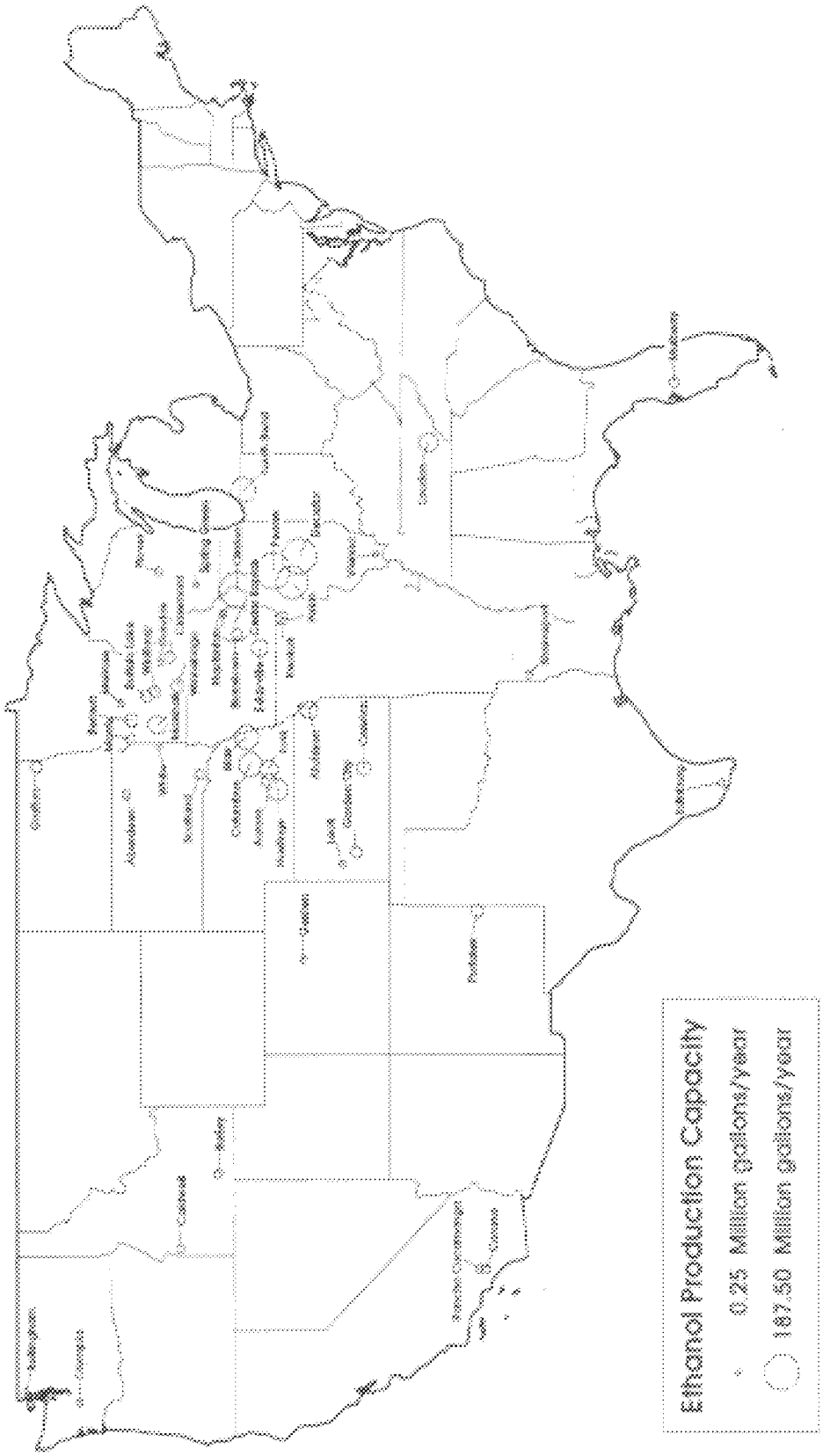
Source: Federal Highway Administration, *Highway Statistics 1994.*

Ethanol production is highly concentrated, and most ethanol production is carried out in a few large plants. As Table 1.10 shows, Archer Daniels Midland can produce 750 million gallons per year in its four plants, which accounts for about half of total U.S. capacity. The five largest producers on the list own about 1.156 billion gallons of annual production capacity or about 74 percent of the total.

Most of the large plants, but not all, are "wet mills" that can separate the germ from the corn kernel and permit the refinement of a wide variety of corn products including corn oil, corn syrup, and high fructose corn syrup. Minnesota has one moderately sized ethanol refinery that is part of a large wet mill owned by Minnesota Corn Processors in Marshall. This company also owns a plant in Nebraska. "Dry mills" can produce ethanol and animal feed as well as efficiently as wet mills, but cannot produce corn oil, corn sweeteners, and certain other products.

Figure 1.3 presents a map showing the location of Minnesota's operating and planned ethanol plants. Total capacity of the plants in operation is about 92

Figure 1.2: U.S. Ethanol Plants, 1996



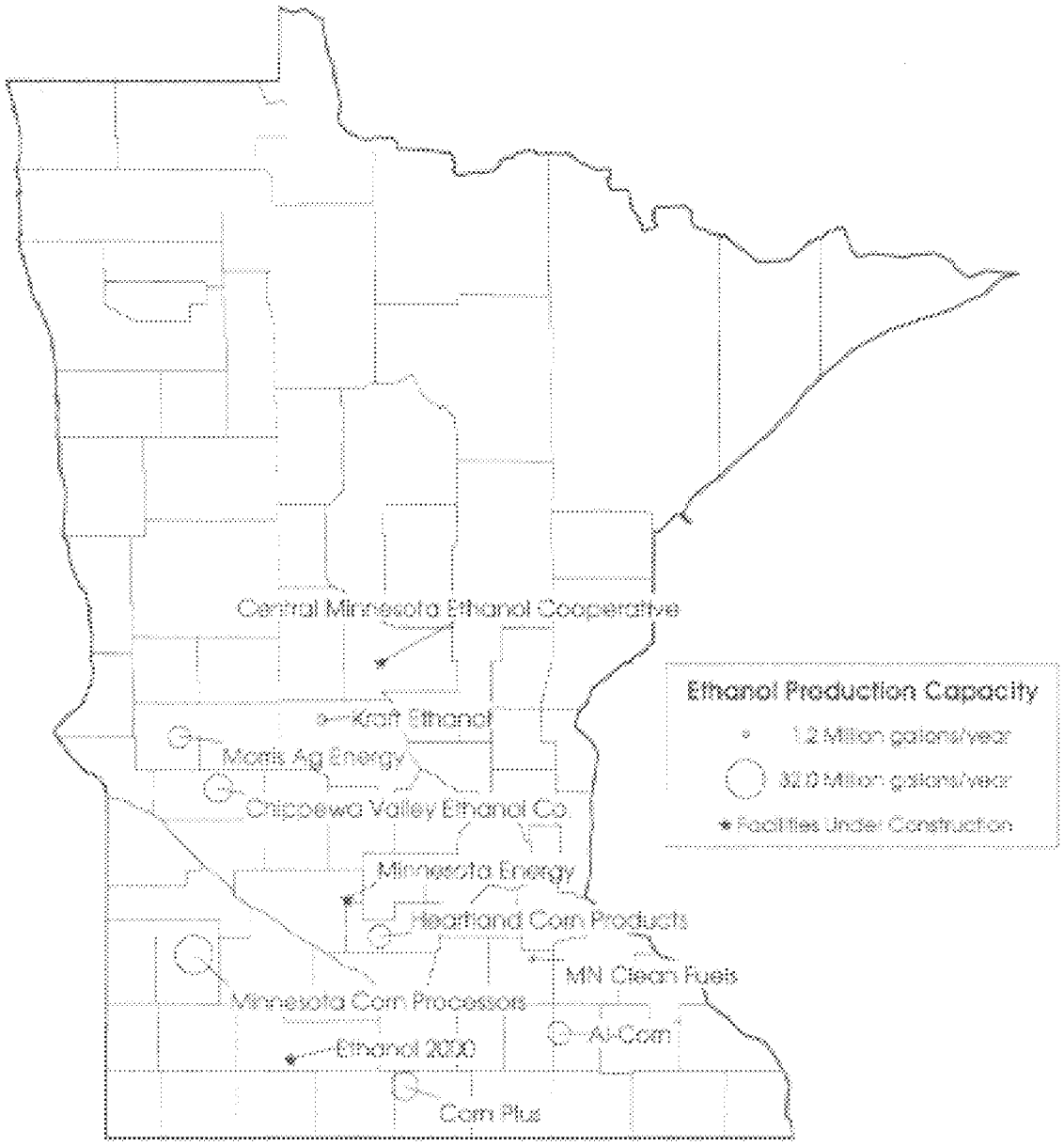
Note: The circles for Pokin, IL and Hastings, NE each represent two plants.

Table 1.10: U.S. Ethanol Production Capacity

Company	Location	Million Gallons per Year
A.E. Staley	Louden, TN	42.0
AGP	Hastings, NE	30.0
Ag Power of Colorado	Golden, CO	1.4
Alchem	Grafton, ND	10.5
Al-Corn	Claremont, MN	10.0
Archer Daniels Midland	Decatur, IL	--
	Peoria, IL	--
	Cedar Rapids, IA	--
	Clinton, IA	--
	Total	750.0
Arkenol	Mulberry, FL	6.5
Broin Enterprises	Scotland, SD	7.0
Cargill	Blair, NE	110.0
	Eddyville, IA	
Chief Ethanol	Hastings, NE	30.0
Corn Plus	Winnebago, MN	15.0
CVEC	Benson, MN	15.0
ESE Alcohol	Leoti, KS	1.1
Farm Tech USA	Spring Green, WI	.5
Georgia-Pacific Corporation	Bellingham, WA	7.0
Giant Industries	Portales, NM	13.5
Golden Cheese of California	Corona, CA	2.7
Heartland Corn Products	Winthrop, MN	10.0
Heartland Grain Fuel	Aberdeen, SD	4.0
High Plains Corporation	York, NE	40.0
	Colwich, KS	20.0
J.R. Simplot	Caldwell, ID	3.0
	Burley, ID	3.0
Jonton Alcohol	Edinburg, TX	1.1
Kraft, Inc.	Melrose, MN	1.5
Kor Ethanol	White, SD	0.25
Midwest Grain Products	Pekin, IL	60.0
	Atchison, KS	30.0
Minnesota Clean Fuels	Dundas, MN	1.2
Minnesota Corn Processors	Columbus, NE	76.0
	Marshall, MN	32.0
Minnesota Energy	Buffalo Lake, MN	10.0
Morris Ag Energy	Morris, MN	7.5
Nebraska Energy	Aurora, NE	25.0
New Energy Company of Indiana	South Bend, IN	85.0
Pabst Brewing	Olympia, WA	0.7
Parallel Products	Rancho Cucamonga, CA	3.0
Pekin Energy Company	Pekin, IL	100.0
Permeate Refining	Hopkinton, IA	1.5
Reeve Agri-Energy	Garden City, KS	9.0
Reyncor Industrial	Shreveport, LA	2.5
ROI	Plover, WI	2.0
Roquette America	Keokuk, IA	14.5
Sunrise Energy	Blairstown, IA	9.0
Vienna Correctional	Vienna, IL	0.5
TOTAL		1.5 Billion

Source: Renewable Fuels Association. Minnesota data from Minnesota Department of Agri culture.

Figure 1.3: Minnesota Ethanol Plants, 1996



million gallons per year, not counting the plant in Buffalo Lake which is about to start operations. Fiscal year 1996 production was close to 70 million gallons. Minnesota plant capacity is now about 6 percent of national ethanol production capacity, and this number will presumably move up as operating plants expand and new plants come on line.

Minnesota is a significant ethanol producing state and, as we will see, almost all this production capacity has been developed since the mid 1980s. All but one of Minnesota's major ethanol plants are dry mills of 8-15 million gallon capacity. To put the matter into perspective, however, Minnesota's total ethanol production capacity is only about equal to one-half of one of Archer Daniels Midland's large factories. We will discuss in Chapter 4 the risk for Minnesota producers of competition from larger, more efficient producers.

USE OF CORN FOR ETHANOL

About 7 percent of the nation's average annual corn production was used to make ethanol in 1995.

As Figure 1.2 shows, ethanol production is concentrated in the midwest corn-producing region of the country. Table 1.11 presents data on corn production in Minnesota and the United States between 1988 and 1995. In 1995, for example, about 732 million bushels of corn were produced in Minnesota. In the U. S. as a whole, 7.37 billion bushels were produced in 1995. Minnesota's production averaged 8.6 percent of the nation's production from 1988 to 1995.

As we noted, in the United States, total annual ethanol production was approximately 1.5 billion gallons in 1995. About 95 percent of this ethanol was produced from corn. Since about 2.5 gallons of ethanol can be produced from a bushel of corn, about 532 million of 7.645 billion bushels were used in the process.[18] Nationally, this amounts to just under 7 percent (6.96 percent) of the nation's annual average corn production between 1988 and 1995. In Minnesota 28 million bushels of corn were consumed in making 70 million gallons of ethanol. This is equal to about 4.3 percent of Minnesota's average corn crop between 1988 and 1995.

EFFECTIVENESS OF ETHANOL PROGRAMS

One important objective of our study was to learn whether Minnesota's ethanol programs have accomplished their primary goal--to promote the development of an ethanol industry in Minnesota. Prior to the mid-1980s, before the enactment of the producer payment and expansion of the blender's credit, there was very little ethanol production in Minnesota. Thus, the timing of the construction of the ethanol industry in Minnesota strongly suggests that the programs were important, but to explore the issue further, we looked at how each of the ethanol plants that have come on line in recent years was financed, and we discussed the development of

18 The yield of 2.5 gallons per bushel of corn is the national average most often used. Minnesota's newer plants are more efficient, and we use a yield of 2.6 gallons for Minnesota's dry mills.

Table 1.11: Corn Production, Minnesota and United States

	Corn for Grain					
	Thousands of Acres					
Minnesota	Planted	Harvested	Yield	Bushels (thousands)	Annual Average Price	Value (thousands)
1988	5,700	4,700	74	347,800	$2.40	$834,720
1989	6,200	5,600	125	700,000	2.27	1,589,000
1990	6,700	6,150	124	762,600	2.17	1,645,842
1991	6,600	6,000	120	720,000	2.22	1,598,400
1992	7,200	6,500	114	741,000	1.91	1,415,310
1993	6,300	4,600	70	322,000	2.26	727,720
1994	7,000	6,450	142	915,900	2.23	1,923,390
1995	6,700	6,150	119	731,850	2.90	2,122,365
Total	52,400	46,150	888	5,241,150	$13.69	$11,856,747
Average 1988-95	6,550	5,769	111	655,144	$2.28	$1,482,093
	Millions of Acres					
United States	Planted	Harvested	Yield	Bushels (millions)	Annual Average Price	Value (millions)
1988	67,717	58,250	84.6	4,929	$2.54	$12,661
1989	72,322	64,783	116.3	7,532	2.36	17,897
1990	74,166	66,952	118.5	7,934	2.28	18,192
1991	75,957	68,822	108.6	7,475	2.37	17,864
1992	79,311	72,077	131.5	9,477	2.07	19,723
1993	73,235	62,921	100.7	6,336	2.60	16,032
1994	79,175	72,887	138.6	10,103	2.26	22,158
1995	71,245	64,995	113.5	7,374	3.21	23,597
Total	593,128	531,687	912.3	61.160	$19.69	$148,124
Average	74,141	66,461	114	7,645	$2.46	$18,516
Percent Minnesota				8.5696%		

Source: USDA National Agriculture Statistics Service; Minnesota Department of Agricult ure, Minnesota Agricultural Statistics.

the ethanol industry with officials in the Minnesota Department of Agriculture. We also visited each major ethanol plant operating in the summer of 1996 and talked to plant managers, board members, local public officials, and others knowledgeable about how each project was developed. We also talked to a representative of one of the two banks responsible for most Minnesota ethanol plant financing. Based on what we learned, we conclude:

- **The programs are directly responsible for the development of a sizable ethanol production capacity in Minnesota.**

Minnesota has developed a significant ethanol industry since 1987 when the producer payment program started. Table 1.12 presents information on all currently operating plants as well as those proposed and under construction. Before the mid-1980s there was almost no ethanol production in Minnesota; of those currently operating, only the Kraft plant with about one million gallon annual production was

in operation. Now, as Table 1.12 shows, there are eight plants operating with a total capacity of 92 million gallons per year. Three more plants are under construction. One of these, the Minnesota Energy Plant in Buffalo Lake, is due to start operation in the fall of 1996. There are additional plants in some stage of planning.

Minnesota's ethanol plants were built because of the state's ethanol programs, especially the producer payment.

A case-by-case examination of the history of each major operating plant leads us to conclude that the plants were built because of the state's ethanol programs, especially the producer payment. Below, we go over the history of each of the major plants to learn how Minnesota's programs aimed at encouraging ethanol production influenced the decision to build the plant.

Minnesota Corn Processors

The Minnesota Corn Processors (MCP) plant in Marshall is a wet mill that began operating in 1982, producing various products including corn syrup and sweeteners and began producing ethanol in 1987. MCP is organized as a farmer-owned cooperative with about 5,000 shareholders, 4,000 of them in Minnesota. It operates ethanol plants in Minnesota and Nebraska. According to plant managers, the state of Minnesota approached MCP 1986 and asked the company to develop an ethanol refining capacity, promising a producer payment of 20 cents per gallon as an incentive.

The MCP plant in Marshall is a large factory that grinds more corn than all the other Minnesota ethanol plants put together. Ethanol is not its main product, but the plant still produces about 32 million gallons per year, about twice as much ethanol as any other plant, as Table 1.12 shows. This plant is expanding its corn-grinding capacity and, when complete, it will grind 160 thousand bushels of corn per day, or about 58.4 million bushels per year. In comparison, a 15 million gallon dry mill grinds about 6 million bushels of corn each year. If the Marshall plant converted all its corn starch to ethanol, it could produce about 146 million gallons of ethanol per year. This level of production would make it one of the nation's largest plants.

The producer payment reaches a maximum of $3 million per plant at 15 million gallons of annual production. MCP produces around twice this amount of ethanol and has reached the maximum payment under Minnesota's program. MCP recently built an ethanol plant in Nebraska. Nebraska also has a producer payment of 20 cents per gallon, and this may have been a factor in MCP's decision to expand outside of Minnesota.

Recently Built Dry Mills

Four plants started up between 1994 and 1996 are dry mills of 10 to 15 million gallon per year capacity. These are the mills in Benson, Claremont, Winnebago, and Winthrop. All of these are farmer-owned cooperatives. In these companies, each share of common stock obligates the shareholder to deliver one bushel of corn to the plant per year. Typically, the co-op member receives 80 percent of the prevail-

Table 1.12: Minnesota Ethanol Plants Operating, Under Construction, and Proposed, September 1996

	Location	Start Up	Capacity	FY 1996 Production
OPERATING				
Chippewa Valley Ethanol Co. (CVEC)	Benson	1996	15	2,459,240
Al-Corn	Claremont	1996	10	1,043,148
Minnesota Corn Processors (MCP)	Marshall	1987	32	29,610,255
Morris Ag Energy	Morris	1990	7.5	6,347,166
Kraft Ethanol	Melrose	Early 1980s	1.5	1,482,869
Minnesota Clean Fuels	Dundas	1992	1.2	805,188
Corn Plus	Winnebago	1994	15	15,871,592
Heartland Corn Products	Winthrop	1994	10	11,858,349
Total Operating			92.2	69,477,807
UNDER CONSTRUCTION				
Minnesota Energy	Buffalo Lake	1996	10	--
Central Minnesota Ethanol Cooperative	Little Falls	1997	15	--
Ethanol 2000	Bingham Lake	1997	12.5	--
Total Under Construction			37.5	
PROPOSED				
RDO	Park Rapids	--	15	--
Exol-So. Central MN Agrifuels Co-op	Albert Lea	--	30	--
Cornerstone	Luverne	--	15	--
Renewable Oxygenates, Inc.	Madison	--	15	--
Dawson Project	Dawson	--	20	--
South East MN Ethanol Co-op (SEMEC)	Preston	--	10	--
Total Proposed			105	
GRAND TOTAL			234.7	

Source: Minnesota Department of Agriculture.

ing market price at the time of delivery and later receives an additional amount and, potentially, a share of the profits. Typically the minimum initial investment is 5,000 shares. In some companies, non-farmers are allowed to purchase shares, but they, too, have to supply corn each year.

The total capitalization of a 15 million gallon per year ethanol plant is about $25 to $30 million. In a $30 million plant, roughly $8 million goes to construction, $10 million to equipment, $6 million in engineering and design, and $6 million in working capital for the start up of operations. While the exact terms of each Minnesota project are different, the sale of common stock financed about 40-50 percent of the cost of building these four plants, and bank loans or other debt with a term of 7 to 10 years financed most of the remaining cost. In the case of each of the four dry mills built between 1994 and 1996, the plants received a Minnesota ethanol facility production loan of $500,000 at 6 percent interest, and up to $1 million in tax increment financing.[19]

19 Benson, $1 million; Claremont, $657 thousand; Winnebago, $556 thousand, and Winthrop, $525 thousand.

The Morris Ag Energy plant in Morris is owned by the Milsolv Corporation, an ethanol marketing company headquartered in Milwaukee. Unlike all the other operating plants discussed so far, the company is not a cooperative nor is Milsolv a publicly-owned company. The Morris plant was moved to Minnesota from Illinois and began operations in 1990. According to the plant's general manager, Milsolv went into ethanol production to assure a steady supply of the product they were marketing. Building on this marketing expertise, Morris Ag Energy markets the ethanol for two other plants, CVEC in Benson and Al-Corn in Claremont. According to MDA, Morris has plans to expand production from about 6 million gallons in fiscal year 1996 to 12 million in 1999, and more in future years.

Small Producers

Two of the plants listed in Table 1.12 are small producers of about 1 million gallons per year capacity. The Kraft plant in Melrose is an adjunct to a cheese making operation and uses dairy whey as a feedstock. The Minnesota Clean Fuels Plant in Dundas uses starch that is a waste product of a Twin Cities food processing operation. Together these plants account for about 2-3 percent of Minnesota ethanol production. We did not visit these plants or study their financing or operations. The Kraft plant was in operation before the state ethanol incentives were enacted. The plant has plans to expand ultimately to about twice its current output, and these plans may be related to the existence of state programs.

In summary, as of September 1996, the Minnesota ethanol industry consisted of eight operating plants with a total production capacity of about 92 million gallons per year. All but one of the major plants (Morris Ag Energy) is a farmer-owned cooperative. All the plants use corn as a feedstock except for two small plants with a combined capacity of less than 3 million gallons per year. One plant is a wet mill (MCP) with a corn-grinding capacity well in excess of all the others put together. Ethanol production is an important part of their operation, but not the major part. Five plants are medium sized (8-15 million gallons per year) dry mills that have come into existence since 1990. About five of the currently operating plants have plans to significantly increase production, and as noted earlier, counting these plans and projections of new plants coming on line, MDA forecasts that ethanol production will increase from about 69 million gallons in fiscal year 1996 to 159 million gallons in 1999 and 178 million gallons in 2001.

A key question about the Minnesota programs designed to promote the development of an ethanol industry is whether the industry would have come into existence or have these expansion plans without the state programs. We discussed the history of each project with plant managers and in many cases we talked with local officials who were involved in the process. Considering the four medium sized dry mills and the wet mill in Marshall, we conclude that:

- **The producer payment was critical to the construction of the ethanol industry in Minnesota and much less ethanol production would exist in its absence.**

Agriculture department officials, plant managers, and lenders all pointed to the crucial role of the producer payment in providing a secure revenue stream for ten years that is about equal to the cost of constructing the plant. A 15 million gallon plant receives $3 million per year (at 20 cents per gallon of ethanol production) Over ten years, this provides $30 million which, as we have seen, is enough money to build the plant and capitalize the company.

The producer payment is limited to 15 million gallons of production per year. It is not coincidental that all recently built plants have a capacity of 15 million gallons or less.

Banks have been willing to lend money for 7 to 10 years to finance about half the project costs. Under these terms, bankers do not have to assume that the plant will be profitable. In fact, the loans are likely to be repaid even if the ethanol plant is an economic failure since state requirements assure the continuation of local demand for ethanol, state producer payments subsidize the cost of production, and shareholder equity can cover operating losses for a time.

In our view it is not a coincidence that all recently built ethanol plants in Minnesota are dry mills of under 15 million gallons per year capacity. Dry mills are cheaper to construct than wet mills, and the size of the plants reflects the fact that the producer payment is limited to 15 million gallons of production per plant each year.

In quite a few cases among the successful projects we studied, it was not easy to put together a financing package, and project developers were required to cobble together loans from diverse sources and to reduce plant capacity below what was originally planned for. In one case, the engineering firm that designed and built the plant had to take a sizable ownership interest in the plant as well as on-going operational responsibility. In other cases, higher-interest loans had to be obtained to complete the financing package. In most cases local tax increment financing was a key factor in the location of the plant.

FEDERAL ETHANOL PROGRAMS AND REQUIREMENTS

One point needs to be kept in mind when looking at ethanol programs in Minnesota or other states.

- **Given the cost of production, little ethanol would be used as automotive fuel without the 54 cents per gallon (of ethanol) federal subsidy now in place.**

The wholesale price of ethanol averaged $1.27 between 1987 and 1995.[20] The wholesale price of unleaded regular gasoline was less than half of this price (between 50 and 60 cents per gallon August 1995 to August 1996). In late summer 1996, ethanol prices were strong, around $1.60 per gallon. Unless mandated or subsidized, little ethanol would be used as an automotive fuel at these prices. The analysis reported in Chapter 4 of this report suggests quite strongly that Minne-

20 Computer Petroleum Corp. cited in MDA Economic Impact of the Ethanol Industry in Minnesota, May 1996.

sota's ethanol plants would go out of business without the 54 cent per gallon federal tax credit.

The federal government tax credit for ethanol of 54 cents per gallon of ethanol brings the ethanol price to the point where it is more competitive with gasoline. Subtracting 54 cents from $1.27 yields a price of 73 cents for ethanol compared to 50-60 cents per gallon. As we have seen, ethanol still adds at least 2 to 3 cents per gallon to the cost of automotive fuel, but this has not met with a lot of consumer resistance. An issue facing ethanol producers for the future and potential ethanol plant lenders now is that the federal tax credit may not be extended beyond 2000.

The ethanol industry depends on the federal tax credit of 54 cents per gallon.

The federal government also mandates the use of oxygenated gasoline in 39 CO non-attainment areas and 9 ozone non-attainment areas. At 73 cents per gallon with the 54 cent per gallon tax credit, ethanol is competitively priced as an oxygenate. The other oxygenate in widespread use, methyl tertiary butyl ether (MTBE), costs around 79 cents per gallon on the gulf coast (August 1996 price), 83 cents per gallon in New York, and 87 cents in Los Angeles. MTBE is manufactured from methanol produced from natural gas as a by-product of oil refining. Comparing oxygenate costs in Minnesota means we have to add shipping costs since little MTBE is produced here. It costs 15 to 20 cents per gallon to ship MTBE to the midwest from the Gulf Coast.

A 15 percent mixture of MTBE in gasoline achieves the same level of oxygen as a 7.7 percent mixture of ethanol. So ethanol (with the 54 cent credit) is competitive with MTBE in Minnesota, even at 1.60 per gallon.[21] Ethanol is the oxygenate of choice in Minnesota and other midwestern states where little MTBE is produced and a lot of ethanol is produced. It would be even more competitive at lower ethanol prices such as the average 1987-95 wholesale price of $1.27. There are some advantages to using MTBE over ethanol in the summer that could potentially affect the competition between the two oxygenates, however. This issue is discussed in Chapter 3.

MTBE is cheaper to produce than ethanol, however, and is used more widely than ethanol around the country, especially in the vicinity of oil refineries. As shown elsewhere, very little ethanol is mixed in gasoline in Texas, New York, and California, states which nevertheless have large populations living in CO and ozone non-attainment areas.

In summary, federal air quality standards and a 54 cent per gallon ethanol tax credit make it possible for ethanol to compete with MTBE as an oxygenate and to be added to gasoline without increasing the price of gasoline so much that there is significant consumer resistance. Ethanol could not be profitably produced in Minnesota without the federal subsidy, and loss of all or part of this subsidy is the biggest concern of many of the ethanol producers with whom we talked.

21 At a wholesale price of $1.60, the subsidized cost is 54 cents less, $1.06 per gallon. One gallon of ethanol adds as much oxygen as 1.5 gallons of MTBE so MTBE at 79 cents with 15 cents shipping equals 84 cents and this sum times 1.5 equals $1.26 compared to ethanol at $1.06.