Introduction

Minnesota is a major corn producer. A bushel of corn converted to ethanol can be sold for more than the raw commodity.

Ethanol production complements Minnesota's agricultural economy because Minnesota, one of the nation's leading corn producing states, exports most of its corn as a raw commodity. Although ethanol can be commercially produced from various materials, over 95 percent of fuel ethanol production in the nation and in Minnesota uses corn as the raw material.

In 1995 Minnesota was the fourth largest corn producer among the states, with 6.70 million acres planted, and 6.15 million acres harvested. The value of the corn harvested for grain in Minnesota was $2.1 billion in 1995. Between 1988 and 1995, Minnesota produced an average of 655 million bushels annually. For the same period, U. S. average annual production was 7.6 billion bushels. Thus, during this eight-year period, Minnesota produced 8.6 percent of the nation's corn.

In 1993, according to Minnesota Department of Agriculture estimates, about 62 percent of the corn grown for grain in Minnesota was exported out of the state as a raw commodity. About 33 percent was fed to livestock and 5 percent was processed into other products including ethanol. It is a goal of economic development policy to process a greater share of the state's agricultural products within the state in order to add value to raw products and improve the state's economy, especially the rural economy. A bushel of corn converted into ethanol and co-products can be sold for more than the corn itself, so ethanol production is one way to add value to the grain that would otherwise be sold at a lower price.

Minnesota has enacted a set of programs designed to promote the production and use of ethanol. Minnesota's ethanol programs are based on the sound assumption that the state as a whole, and the corn-growing regions of Minnesota in particular, will benefit if a profitable ethanol industry is established. As we will see, taken together these programs represent a level of effort that exceeds that of any other state. These programs have succeeded in fostering the growth of ethanol production capacity that has grown from almost nothing in the mid-1980s to 92 million gallons per year in 1996. The state has supported the industry through subsidized loans, producer payments, tax credits, and a requirement to use oxygenated gasoline that will become a statewide, year-round mandate in 1997. As a result, Minnesota has a sizable investment in the future of the industry.

Ethanol subsidies are a controversial issue nationally and in Minnesota, and questions have been raised about the benefits of ethanol use and the need for continued taxpayer support. The Minnesota Legislature heard some testimony questioning

ethanol subsidies last year, and the Legislative Audit Commission asked the Office of the Legislative Auditor to carry out a study that would look further into the costs and benefits of the state's ethanol programs.

This report asks:

- **What are Minnesota's ethanol programs and how much do they cost?**
- **To what extent have the programs succeeded in promoting the establishment and growth of ethanol production facilities in Minnesota?**
- **What are the economic and environmental benefits of ethanol production and use?**
- **Are ethanol plants profitable at current prices? At what future prices of corn and ethanol will the Minnesota ethanol industry be profitable? Will continued state and federal subsidies be required for future profitability?**
- **What are the major risk factors affecting the future viability of ethanol production in Minnesota?**

To answer these questions, we reviewed the history of Minnesota's ethanol programs and discussed the programs with officials in the Minnesota Department of Agriculture responsible for administering them. We also visited six Minnesota ethanol plants and talked to plant managers about their experience in building and operating the facilities. We obtained production and financial data from each plant in order to put together a composite picture of production costs. In many cases we talked to public officials and others in the communities we visited who were involved in the effort to build or locate a plant in the community.

We reviewed the national literature and past Minnesota studies relating to the environmental and economic issues connected to ethanol use and production. We interviewed experts in several state and federal agencies on various technical questions, and in order to carry out the economic analysis reported here, we obtained data and specialized software that allows an estimate of the direct and indirect economic impact of an expanded ethanol industry.

Our report is organized in four chapters. Chapter 1 provides background information on Minnesota's ethanol programs, including data on ethanol production and the cost of each major program. Chapter 2 presents our analysis of the state and local economic benefits of ethanol production. Chapter 3 presents a review of scientific findings on the environmental benefits of ethanol use, along with an examination of studies of ethanol's effect on fuel economy and mechanical performance. Chapter 4 is a discussion of major risks to the future profitability of the ethanol industry in Minnesota.