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Report to the Ranking Democratic Member, Committee on Agriculture, Nutrition and Forestry, U.S. Senate

September 2003

NATURAL GAS

Domestic Nitrogen Fertilizer Production Depends on Natural Gas Availability and Prices

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GAO-03-1148

September 2003

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Highlights

Highlights of GAO-03-1148, a report to the Ranking Democratic Member, Committee on Agriculture, Nutrition and Forestry, U.S. Senate

NATURAL GAS

Domestic Nitrogen Fertilizer Production Depends on Natural Gas Availability and Prices

Why GAO Did This Study

Natural gas is the most costly component used in manufacturing nitrogen fertilizer. Therefore, when natural gas prices increased in 2000–2001, U.S. companies that produce nitrogen fertilizer reported adverse financial consequences resulting from much higher production costs. Concerns also arose that the nation's farmers would face much higher nitrogen fertilizer prices and that there might not be an adequate supply of nitrogen fertilizer to satisfy farmers' demands at any price. Responding to congressional concerns, GAO undertook a study to determine (1) how the price of natural gas affects the price, production, and availability of nitrogen fertilizer and (2) what role the federal government plays in mitigating the impact of natural gas prices on the U.S. fertilizer market.

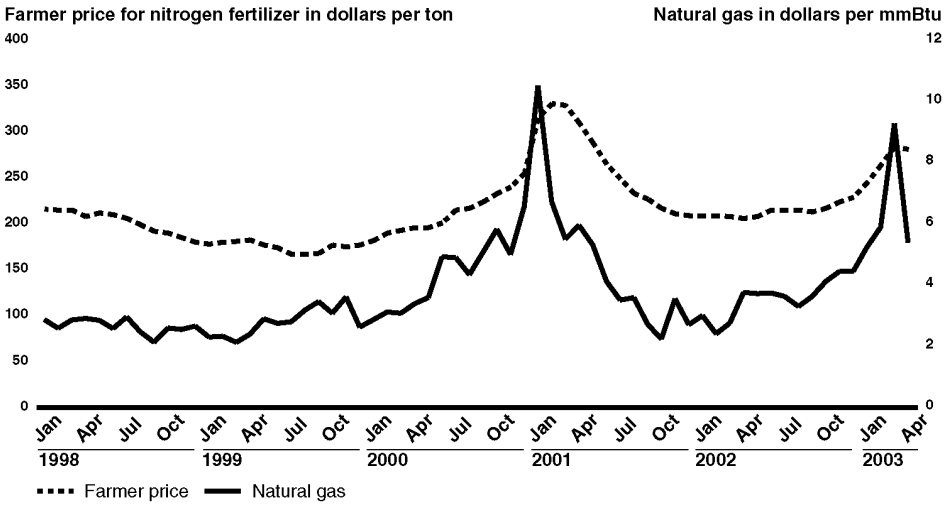
www.gao.gov/cgi-bin/getrpt?GAO-03-1148.

To view the full product, including the scope and methodology, click on the link above. For more information, contact Jim Wells at (202) 512-3841, wellsj@gao.gov.

What GAO Found

Higher natural gas prices have contributed to higher nitrogen fertilizer prices and reduced domestic production. The following figure shows the relationship between natural gas prices and the farmer price for nitrogen fertilizer.

Farmer Price for Nitrogen Fertilizer Relative to Natural Gas Prices, January 1998–March 2003



Sources: GAO analysis of USDA, National Agricultural Statistics Service, and industry data.

Higher gas prices in 2000–2001 also led to a 25 percent reduction in domestic production of nitrogen but, despite this decline, the supply of nitrogen fertilizer was adequate to meet farmers' demand in 2001. Demand was met because U.S. nitrogen production was supplemented by a 43 percent increase in nitrogen imports and a 7 percent decrease in agricultural consumption of nitrogen fertilizer.

The federal government does not set natural gas prices, and it has a limited role in managing the impact of natural gas prices on the U.S. fertilizer market. Three federal agencies—(1) the Federal Energy Regulatory Commission, (2) the Commodities Futures Trading Commission, and (3) the Energy Information Administration—are responsible for ensuring that natural gas prices are determined in a competitive and informed marketplace. Moreover, the federal government has no role in controlling fertilizer prices, but the U.S. Department of Agriculture (USDA) does monitor developments in the agricultural sector, including fertilizer markets, that could affect farmers. Also, in 2001, USDA collected additional survey information in response to concerns about the price and availability of nitrogen fertilizer.

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Abbreviations

CFTC	Commodity Futures Trading Commission
EIA	Energy Information Administration
ERS	Economic Research Service
FERC	Federal Energy Regulatory Commission
NASS	National Agricultural Statistics Service
TFI	The Fertilizer Institute
UAN	urea ammonium nitrate
USDA	U.S. Department of Agriculture

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Accountability * Integrity * Reliability

United States General Accounting Office
Washington, D.C. 20548

September 30, 2003

The Honorable Tom Harkin
Ranking Democratic Member
Committee on Agriculture, Nutrition
and Forestry
United States Senate

Dear Senator Harkin:

Nitrogen, the plant nutrient and fertilizer component most widely applied by American farmers, is essential for maintaining the high yields achieved for major crops such as corn, wheat, and cotton in this country. Natural gas is a key component in the production of nitrogen, and the cost of natural gas can account for up to 90 percent of nitrogen fertilizer production costs. When natural gas prices in this country increased in late 2000 and early 2001, U.S. fertilizer producers reported financial losses resulting from the significant increase in their costs of producing nitrogen fertilizer. These higher production costs also made it difficult for U.S. producers to compete with foreign nitrogen fertilizer producers, who could buy natural gas at lower prices and export their products to the United States. At about the same time, concerns arose that the nation's farmers would face much higher nitrogen fertilizer prices—and even that there might not be an adequate supply of fertilizer to satisfy farmers' demand at any price. Such an outcome was considered possible if U.S. fertilizer producers were forced to significantly decrease their production, because in recent years domestic producers have supplied more than one-half of the nitrogen fertilizer used by American farmers. According to fertilizer industry officials, higher natural gas prices in 2003 are again having a negative financial impact on the U.S. nitrogen fertilizer industry, threatening to irreversibly cripple it.

In this context, you asked us to determine (1) how the price of natural gas affects the price, production, and availability of fertilizer and (2) what role the federal government plays in managing the impact of natural gas prices on the U.S. fertilizer market. To address the first issue, we examined government and industry price data pertaining to natural gas and nitrogen fertilizer to determine how nitrogen fertilizer prices, both major market

spot prices[1] and retail prices paid by farmers, behaved when the price of natural gas increased in 2000–2001 and again in early 2003. Specifically, we determined the extent to which a correlation exists between the price of natural gas at the Henry Hub[2] and prices for three major types of nitrogen fertilizer products: anhydrous ammonia, urea, and urea ammonium nitrate (UAN). We selected these three products because they are widely used by American farmers. We also examined data obtained from the Department of Commerce and industry sources to determine how nitrogen fertilizer production behaved when natural gas prices spiked in 2000-2001 and the results of a U.S. Department of Agriculture (USDA) survey aimed at determining how farmers reacted to higher fertilizer prices in 2001. To determine how higher natural gas prices have affected the supply of nitrogen fertilizer, we obtained the results of a second USDA survey aimed at determining the availability of fertilizer. In addition, we analyzed sources, supplies, and consumption of nitrogen from fertilizer years 1996 through 2002.[3] To address the second objective, we reviewed the responsibilities of federal agencies relevant to the natural gas and fertilizer markets and their efforts to monitor and collect information on these markets. We also reviewed relevant documents provided by agriculture and fertilizer industry representatives and interviewed these officials to obtain their views on what actions, if any, the federal government should take to mitigate the effects of high natural gas prices on the U.S. fertilizer market. We performed our review from February through August 2003 in accordance with generally accepted government auditing standards. A detailed description of our objectives, scope, and methodology is contained in appendix I.

[1]Spot prices are the current cash prices at which fertilizer is sold at various locations. For the purposes of our review, we used prices at two major market locations: the U.S. Gulf Port, whose price is considered the benchmark for fertilizer prices in North America, and the Mid Cornbelt. Unless otherwise specified, fertilizer prices referred to in this report are Gulf Port prices.

[2]The Henry Hub is one of the largest gas market centers in the United States. Its price often serves as a benchmark for wholesale natural gas prices across the country. The price of natural gas is commonly measured in dollars per million British thermal units (mmBtu), which is approximately 1,000 cubic feet of gas.

[3]Information on nitrogen and fertilizer production and consumption is reported in industry sources on a fertilizer year basis—which represents the time from July 1 to June 30. Thus, fertilizer year 2002 represents the time between July 1, 2001 and June 30, 2002. Unless noted, all references to nitrogen and fertilizer production and consumption are on a fertilizer year basis.

Results in Brief

Higher natural gas prices have contributed to higher nitrogen fertilizer prices and reduced domestic production, but supplies of fertilizer have been adequate during periods of high natural gas prices in the past primarily because of increased imports. For example, between January 2000 and January 2001, the average price of natural gas increased by more than 300 percent, from $2.52 to $10.16 per mmBtu. Because natural gas is the most costly component used in manufacturing nitrogen fertilizer, the higher gas prices led to higher prices for nitrogen fertilizer. For example, between January 2000 and January 2001, the U.S. Gulf Port spot price for anhydrous ammonia, one of the most commonly used nitrogen fertilizers, increased by 144 percent, from $119 to $290 per ton. Higher natural gas prices during 2001 led to higher production costs for U. S. nitrogen fertilizer producers and this in turn led to a 25 percent reduction in domestic nitrogen production in 2001. Despite this significant decline in production, a USDA survey found the supply of nitrogen fertilizer was adequate to meet farmers' demand. According to this survey, conducted from April to June 2001, while nitrogen fertilizer supplies were below normal early in the year, they had returned to normal levels by June. Our analysis shows that the demand for nitrogen fertilizer was met in 2001 because (1) U.S. production was supplemented by an increase of about 43 percent in nitrogen imports and (2) agricultural consumption of nitrogen fertilizer decreased from 12.3 million tons in 2000 to 11.5 million tons in 2001. According to industry officials, gas prices in 2003 are again resulting in unacceptably high production costs and, as a result, a decline in production levels is occurring.

The federal government has a limited role in managing the impact of natural gas prices on the U.S. fertilizer market. Although the federal government does not set natural gas prices, three federal agencies—(1) the Federal Energy Regulatory Commission, (2) the Commodities Futures Trading Commission, and (3) the Energy Information Administration—are responsible for ensuring that natural gas prices are determined in a competitive and informed marketplace. Moreover, the federal government has no role in controlling fertilizer prices, and nitrogen fertilizer products imported from other countries are generally not subject to U.S. trade restrictions, such as quotas or tariffs. However, as part of its overall mission, USDA monitors developments in the agricultural sector that could affect farmers. Regarding the fertilizer market, USDA collects information on fertilizer prices and, in 2001, in response to concerns about fertilizer prices and availability, conducted two surveys of the fertilizer market. These surveys showed that there was no problem with fertilizer availability

in 2001, and most farmers surveyed did not reduce their use of nitrogen fertilizer.

Background

Natural gas is a key feedstock in the manufacturing of nitrogen for which there is no practical substitute. Manufactured nitrogen—also known as anhydrous ammonia—is used as a fertilizer itself and is also the primary building block used to manufacture all other nitrogen-based fertilizers. Some of this nitrogen also is used for industrial purposes such as promoting bacterial growth in waste treatment plants, making plastics, and as a refrigerant. U.S. manufacturers supplied almost 14 million tons of nitrogen during fertilizer year 2002 and an additional 7 million tons were imported. Fifty-six percent of the total nitrogen supply was consumed by U.S. agricultural demands. Since natural gas is the most costly component of nitrogen, the profitability of the U.S. nitrogen fertilizer industry depends, to a large degree, on the price of natural gas in the United States. As we reported in December 2002,[4] natural gas prices can be volatile, and small shifts in the supply of or demand for gas are likely to continue to cause relatively large price fluctuations. In addition to facing a volatile natural gas market, which sometimes leads to price spikes, America's nitrogen fertilizer producers must also compete in a marketplace where many competitors pay much lower prices for natural gas. For example, industry data show that recently, when the U.S. market price for natural gas was $5 per mmBtu, lower gas prices were available to nitrogen fertilizer producers in other parts of the world. The price of gas in the Middle East was 60 cents per mmBtu; in North Africa, 40 cents; in Russia, 70 cents; and in Venezuela, 50 cents. According to The Fertilizer Institute (TFI),[5] fertilizer products operate in a world market, and U.S. prices are influenced by numerous variables other than the price of natural gas in the United States.

[4]U.S. General Accounting Office, *Natural Gas: Analysis of Changes in Market Prices*, GAO-03-46 (Washington, D.C.: Dec. 18, 2002).

[5]TFI represents, by voluntary membership, manufacturers, retailers, trading firms, and equipment manufacturers of the U.S. fertilizer industry. The Institute employs a full-time Washington, D.C. staff in various legislative, education, and technical areas.

Higher Natural Gas Prices Have Contributed to Higher Nitrogen Fertilizer Prices and Reduced Domestic Production but Have Not Affected Availability of Fertilizer

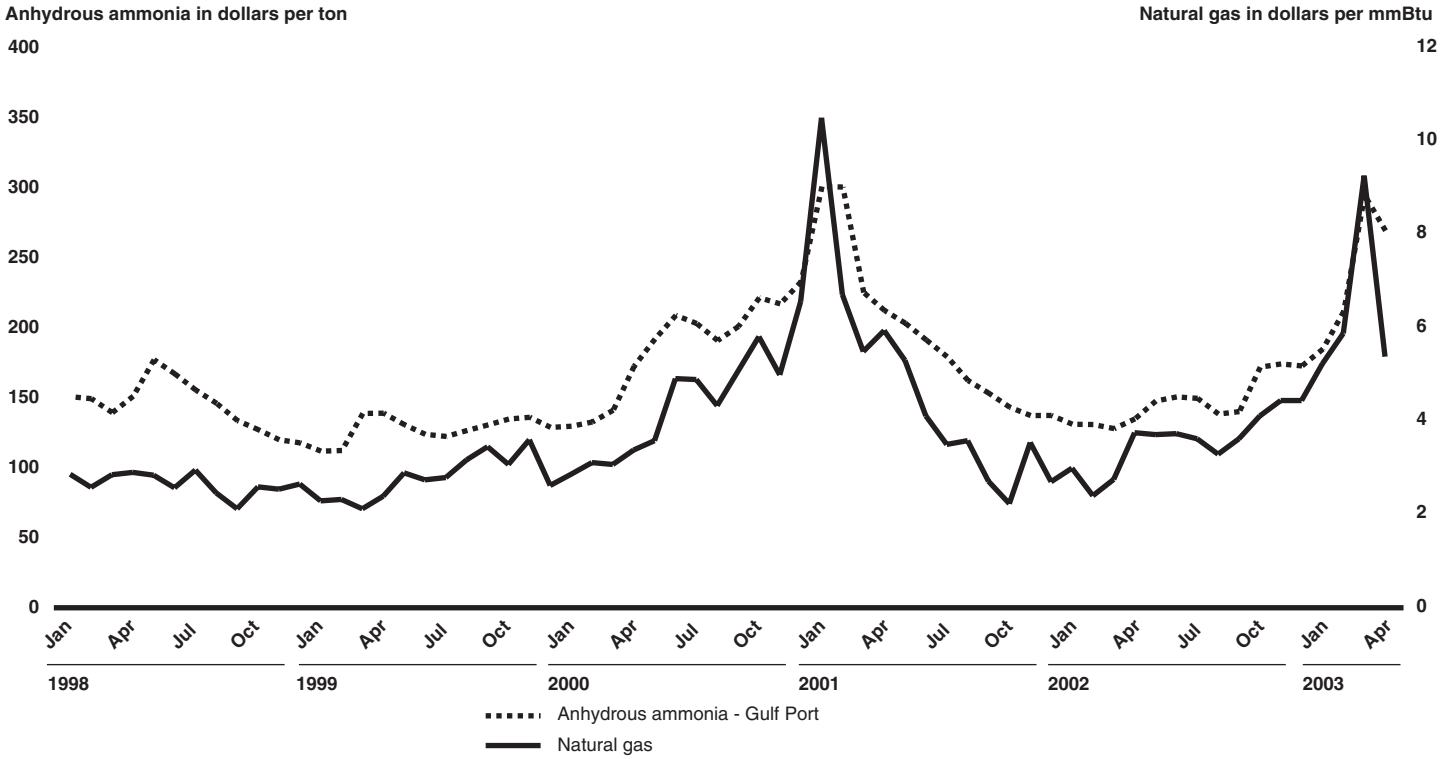
Because the cost of natural gas accounts for such a large percentage—up to 90 percent—of the total costs of manufacturing nitrogen fertilizer, nitrogen fertilizer prices tend to increase when gas prices increase. When gas prices increased in 2001 and 2003, prices for nitrogen fertilizers increased throughout the marketing chain. The higher natural gas prices in 2001 also led to higher production costs for the U.S. nitrogen fertilizer manufacturing industry and resulted in a significant reduction in the amount of nitrogen produced in this country that year. Despite this decline in the production of nitrogen, supplies of nitrogen fertilizer were adequate to meet farmers' needs in 2001 primarily because of a significant increase in imported nitrogen.

Natural Gas and Nitrogen Fertilizer Prices Are Closely Related

Higher natural gas prices have contributed to higher prices for nitrogen fertilizer throughout the marketing chain. When gas prices increased significantly in 2001 and 2003, spot market prices, as well as the prices farmers paid for fertilizer, increased for all three nitrogen-based products included in our analysis—anhydrous ammonia, urea, and UAN. Further, the high prices seen in 2001 could have been even higher, if the volume of fertilizer imports had not increased to compensate for the reduction in domestic production of nitrogen. The relationship between gas prices and fertilizer prices was the strongest for anhydrous ammonia, at least in part, because anhydrous ammonia contains the highest concentration of nitrogen of the three fertilizer products—82 percent—and natural gas is by far the most costly component used in manufacturing nitrogen. Anhydrous ammonia is the nitrogen-based fertilizer used most often in the United States, and is also the primary building block for urea and UAN. As shown in figure 1, prices for anhydrous ammonia and natural gas prices moved closely in relation to each other during the period from January 1998 to March 2003. When gas prices increased or decreased, the spot market price for ammonia tended to follow the same trend. More specifically, both the price of natural gas and the price of ammonia peaked in January 2001 and again in March 2003. Closer review of the data shows that the monthly price of natural gas in January 2000 of $2.52 per mmBtu had risen 1 year

later to $10.16 per mmBtu, an increase of 303 percent. Over the same time period, the price of anhydrous ammonia rose from $119 per ton to $290 per ton, an increase of 144 percent.[6]

Figure 1: Anhydrous Ammonia and Natural Gas Prices, 1998–2003



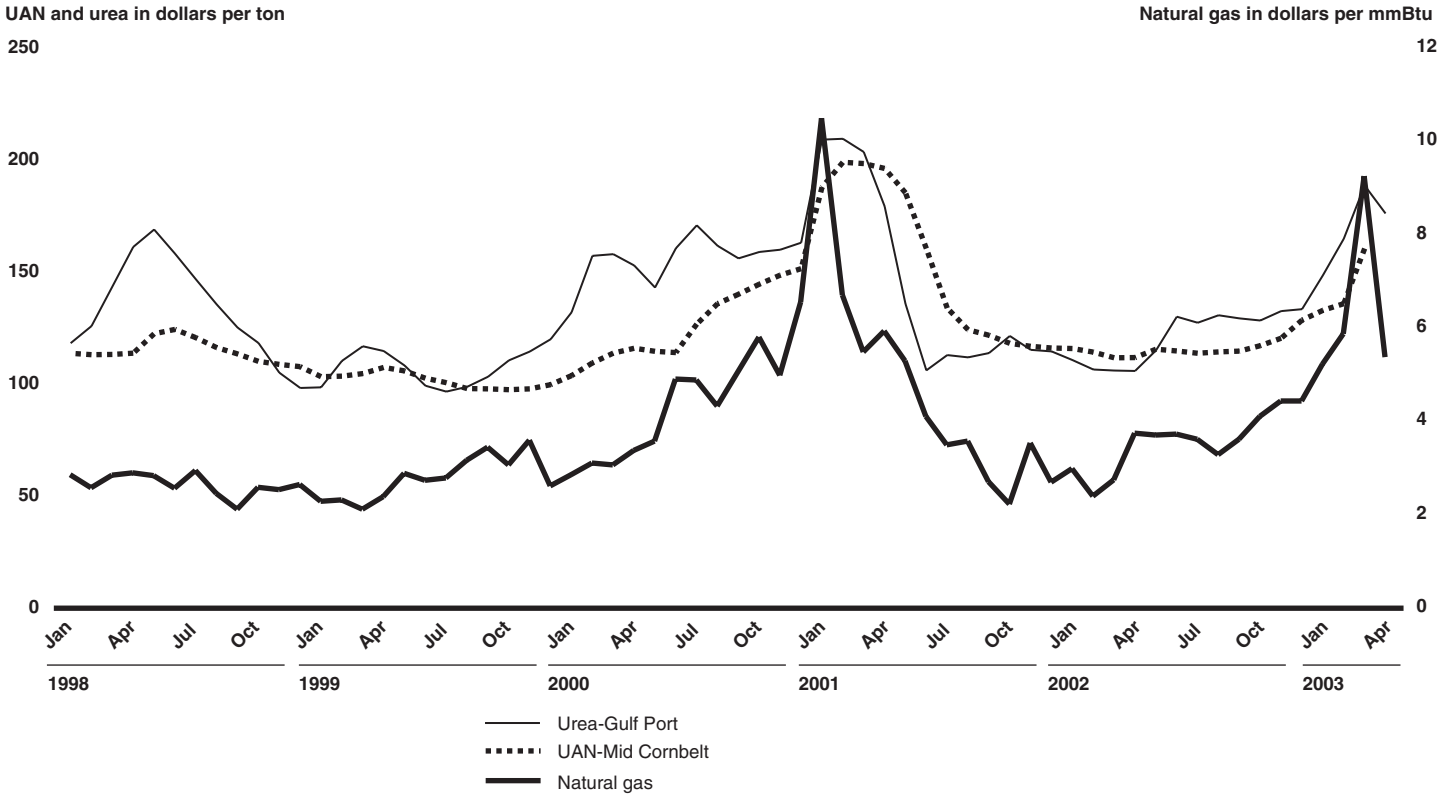
Source: GAO analysis of industry data.

From January 1998 to March 2003, prices of urea and UAN also reflected natural gas prices. However, as shown in figure 2, the relationship between the two was not as close as that between natural gas and anhydrous ammonia prices because urea and UAN contain considerably less nitrogen

[6]Although there is a strong correlation between natural gas prices and nitrogen fertilizer prices, many other variables influence the supply and demand market forces that ultimately determine fertilizer prices. In addition, U.S. companies that produce nitrogen use various purchasing techniques to manage their natural gas price risks; therefore, they do not purchase all their gas at the prevailing market price.

than anhydrous ammonia: 46 percent and 32 percent nitrogen, respectively. Because urea and UAN prices reflect lower nitrogen concentrations, they did not always move in direct relationship with natural gas prices. For example, in May 1998, urea prices increased to $162 per ton, while gas prices remained basically flat.

Figure 2: Urea, UAN, and Natural Gas Prices, January 1998–March 2003



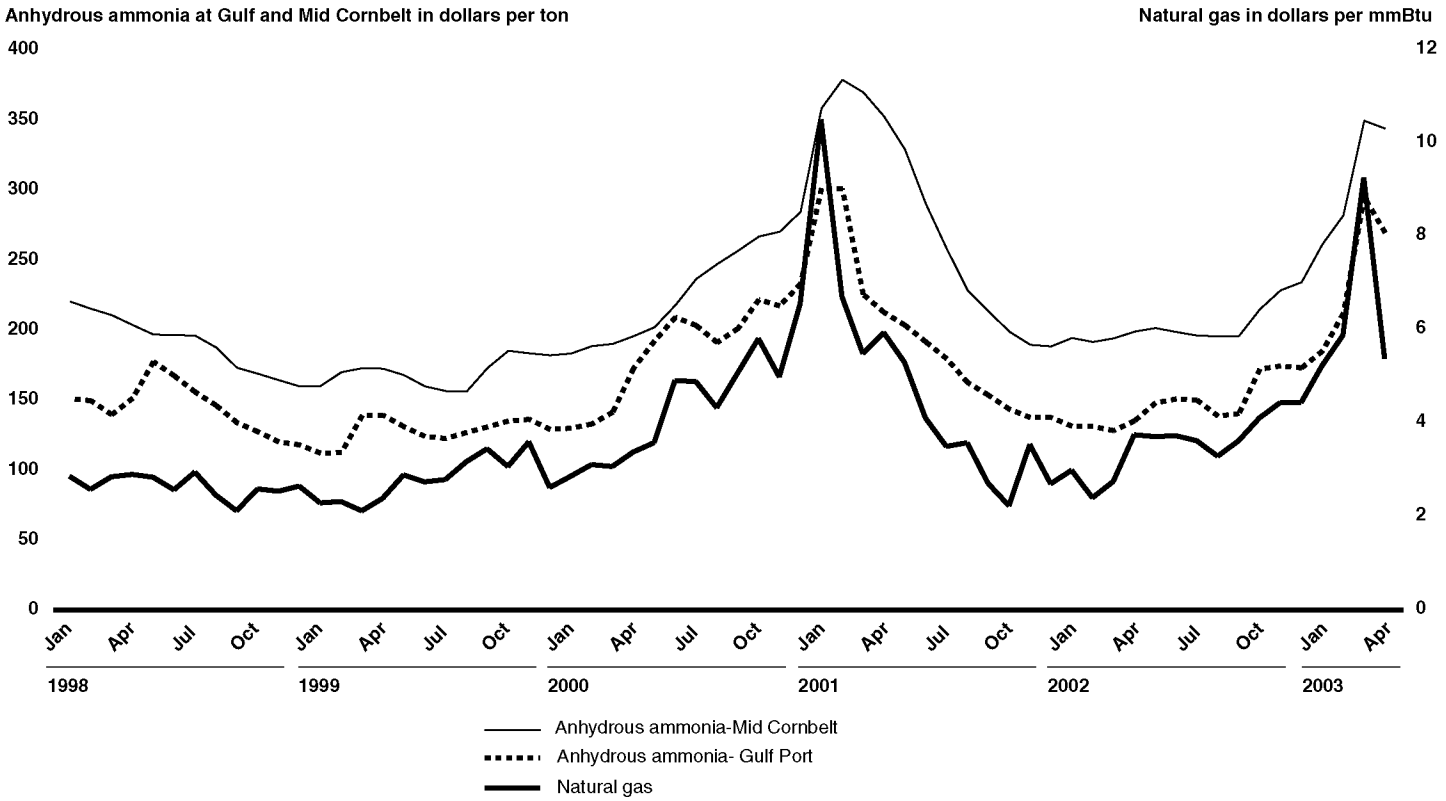
Source: GAO analysis of industry data.

Note: UAN prices are shown in dollars per ton for a 32 percent nitrogen solution.

Moreover, the prices of nitrogen fertilizer can differ depending upon how much further along the marketing chain prices are recorded. For example, as shown in figure 3, the price for anhydrous ammonia in the Mid Cornbelt, where this fertilizer is primarily used, was higher than the price in the U.S. Gulf. This difference reflects the cost of transporting the ammonia from the Gulf, where it is produced, to the Mid Cornbelt. Also, changes in the price

of nitrogen fertilizer can lag behind changes in natural gas prices, depending upon where in the marketing chain prices are recorded. For example, as shown in figure 3, the price for anhydrous ammonia in the Mid Cornbelt peaked in February 2001—about 1 month after natural gas prices spiked that year. Other increases and decreases in the price of Mid Cornbelt ammonia lagged behind natural gas price changes on other occasions. We believe these lags reflect the time associated with transporting the fertilizer from its point of origin to the farmers who ultimately use the product.

Figure 3: Prices of Anhydrous Ammonia in the U.S. Gulf Port and Mid Cornbelt Relative to Natural Gas Prices, January 1998–March 2003

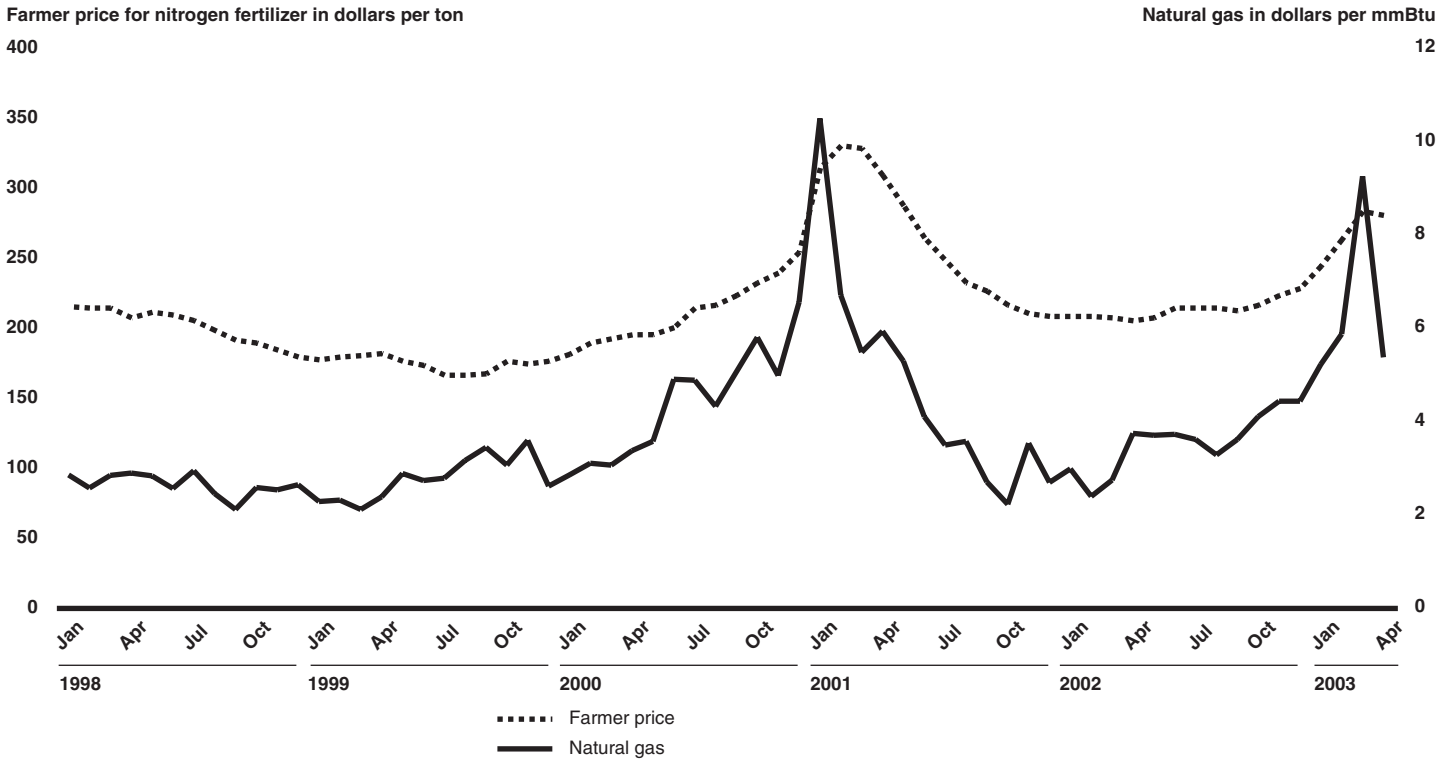


Source: GAO analysis of industry data.

Retail prices for nitrogen fertilizer, or those prices paid by farmers, also tend to rise sharply when natural gas prices increase. As shown in figure 4, the USDA-reported farmer prices for nitrogen fertilizer reflected the

natural gas price spikes that occurred in January 2001 and March 2003. However, the 2001 spike in fertilizer prices lagged behind the increase in gas prices by about 1 month. The February 2001 price for nitrogen fertilizer was about 79 percent higher than it was the previous year.

Figure 4: Farmer Prices for Nitrogen Fertilizer Relative to Natural Gas Prices, January 1998–March 2003



Sources: GAO analysis of USDA, National Agricultural Statistics Service, and industry data.

Note: Nitrogen fertilizer prices were calculated using USDA price indices and the amount of nitrogen contained in anhydrous ammonia, urea, and UAN.

Furthermore, according to USDA data, the average U.S. farm-level price for nitrogen fertilizer during the spring, when farmers' demand for nitrogen fertilizer is the highest, tracked natural gas prices. Specifically, the April monthly price for natural gas increased approximately 84 percent from April 2000 to April 2001. Over the same time period, the April farm-level price for anhydrous ammonia increased 76 percent from $227 to $399 per ton. By April 2002, gas prices had decreased by 39 percent, and ammonia

prices had dropped by 37 percent from the previous year's level. In April 2003, the price of natural gas was again higher, increasing by 48 percent, and the average farm-level price of anhydrous ammonia followed this trend by increasing 49 percent. However, it is difficult to determine the extent of financial harm farmers suffered because of increased fertilizer prices in 2001. A USDA study directed at determining how corn farmers responded to higher fertilizer prices in 2001 found that about 34 percent of the responding producers of corn—a crop that requires large quantities of nitrogen fertilizer—purchased a majority of their nitrogen fertilizer at prices that were set prior to January 2001 and, therefore, were not affected by the sharp rise in fertilizer prices that year. Further, these producers were among the largest corn-producing farms and applied the most nitrogen fertilizer per acre. Eleven percent of the corn producers that responded to the USDA survey reported adjusting their nitrogen application rates or practices in response to higher prices, and the remaining 55 percent of respondents—generally smaller corn farms that applied the least amount of nitrogen fertilizer—reported they took no action in response to higher nitrogen fertilizer prices in 2001.

Higher Natural Gas Prices Had Financial Consequences for U.S. Nitrogen Fertilizer Producers and Led to Reduced Production

The sharp rise in gas prices in 2001 had financial consequences for the U.S. nitrogen fertilizer manufacturing industry because of the sharp increase in their production costs. These higher production costs, which could not be recovered through higher fertilizer prices, led to plant closures and a significant reduction in domestic nitrogen production. According to industry data, several companies that manufacture nitrogen fertilizer reported decreased revenues or financial losses in 2001, and each cited higher natural gas prices as contributing to or causing the financial consequences. For example, one large interregional cooperative that produces nitrogen fertilizer for U.S. farmers and ranches reported a loss of more than $60 million in 2001. The company's 2001 annual report cited high natural gas prices as a primary reason for the financial loss.

Industry data obtained from the International Fertilizer Development Center[7] showed that between January 2001 and June 2003, eight U.S. nitrogen fertilizer manufacturers permanently closed their plants, and a ninth plant had not operated since 2001. Industry officials also told us that

[7]The International Fertilizer Development Center is a public, nonprofit organization dedicated to increasing agricultural productivity through the development and use of sound plant nutrient technology.

natural gas prices in 2003 have remained well above historic averages and are continuing to exact a financial toll on the domestic nitrogen fertilizer manufacturing industry. These officials cite the fact that, in June 2003, the U.S. industry was operating at only 50 percent of capacity as evidence of this toll. Further, they said the industry has suffered through several years of extreme financial hardship, caused in part by higher gas prices driving up production costs and foreign competitors who have access to less expensive natural gas and, if gas prices in this country remain relatively high, more U.S manufacturers are likely to curtail nitrogen production, and some could permanently shut down their plants.

The production and consumption of fertilizer is often measured by the amount of nutrient content in the fertilizer applied. For nitrogen fertilizer products, the primary nutrient that is measured is nitrogen. Manufacturers supply nitrogen that is consumed in both the agricultural and industrial sectors. Table 1 below provides estimates of nitrogen supply and demand in the United States over the last 7 years, including the nitrogen nutrient content in fertilizer products consumed by the agricultural sector. As the price of natural gas, the key component in the manufacturing of nitrogen spiked in 2001, nitrogen production fell. As shown in table 1, U.S. manufacturers produced 25 percent less nitrogen in 2001 than in 2000.

Table 1: U.S. Nitrogen Supply and Demand, June 30, 1996–2002

000 tons							
Supply and demand	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**
Producers beginning inventory	2,415	2,047	1,799	1,956	2,585	1,856	2,468
Production	14,469	14,593	15,092	14,634	14,186	10,583	11,519
Imports	4,963	4,497	5,066	6,114	6,289	8,978	7,273
Total supply	**21,847**	**21,137**	**21,957**	**22,704**	**23,060**	**21,417**	**21,260**
Consumption	16,813	16,965	17,028	17,270	17,254	16,373	16,809
Agricultural	12,303	12,352	12,313	12,452	12,334	11,535	12,009
Industrial	4,510	4,613	4,715	4,818	4,920	4,838	4,800
Exports	3,292	3,365	3,390	3,458	3,442	2,768	2,945
Producers ending inventory	2,047	1,799	1,956	2,585	1,856	2,468	1,690
Total demand	**22,152**	**22,129**	**22,374**	**23,313**	**22,552**	**21,609**	**21,444**

Sources: GAO analysis of Department of Commerce, Bureau of Census, and TFI data.

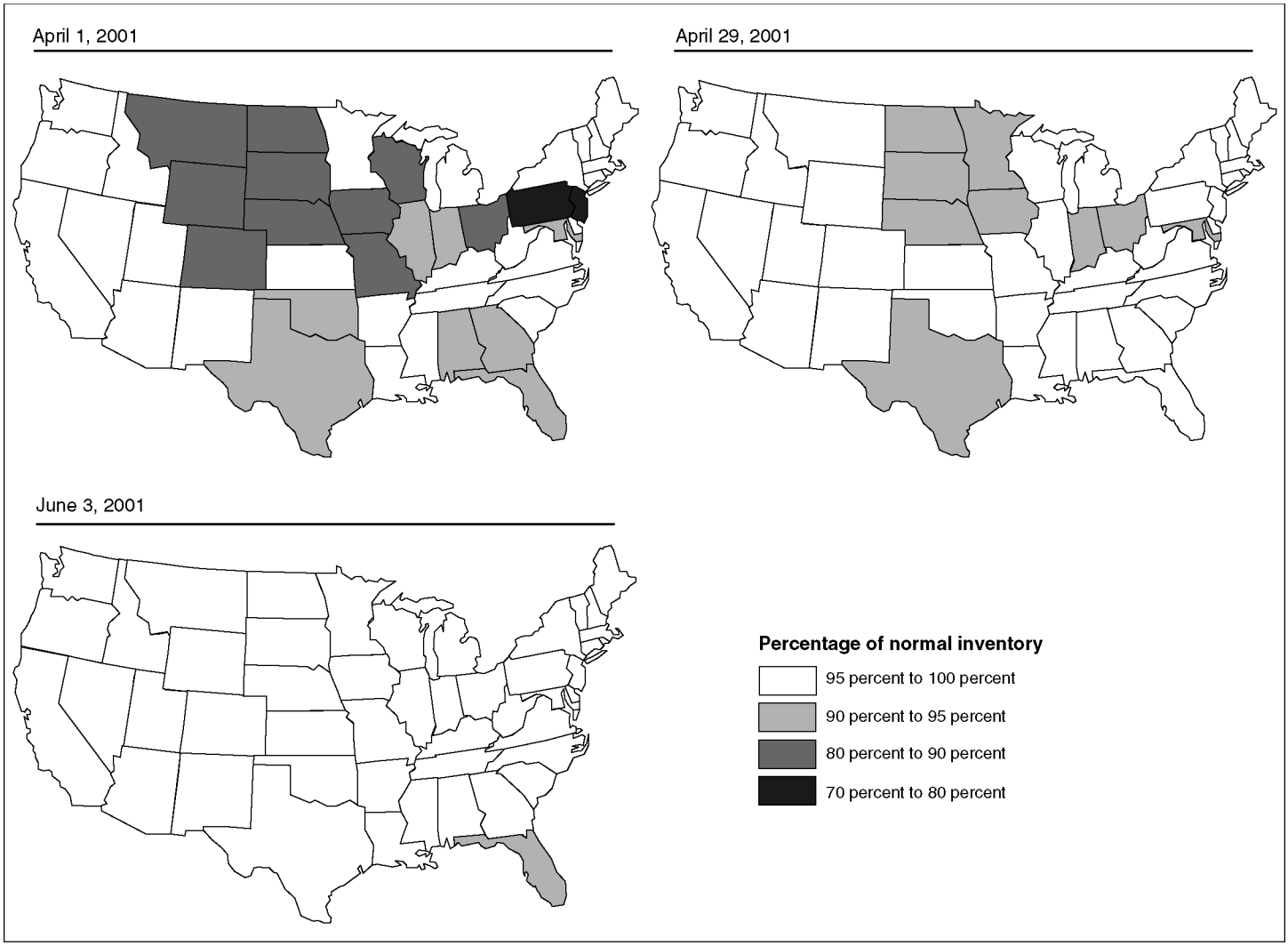
Note: Total supply and total demand differ primarily because the components are derived from several independent sources, as explained in appendix I.

Imports Have Helped Maintain Availability of Nitrogen Fertilizer

Despite the significant decline in domestic production of nitrogen in 2001, supplies of nitrogen fertilizer were adequate to meet farmers' demand that year primarily because of an increase in imports. USDA collected additional survey information from April to June 2001 to determine whether farmers were facing problems in obtaining nitrogen fertilizer. The results of this survey show that the supply of nitrogen fertilizer was adequate to meet farmers' 2001 demand. As shown in figure 5, while nitrogen fertilizer supplies were below normal in several states in April 2001, they had returned to normal levels in all but one state by June of that year. Nationally, nitrogen fertilizer supplies were at 92 percent of normal levels in early April 2001, while only 12 states reported supplies at less than 90 percent of normal levels. Only two states—Pennsylvania and New Jersey—reported supplies at less than 80 percent of normal levels. However, by early June nitrogen fertilizer supplies were at 97 percent of normal levels nationally, and all but one state reported supplies at 95 percent or more of normal levels. By June 30, 2001, USDA officials concluded that there were sufficient supplies of nitrogen fertilizer, and they stopped the survey. Furthermore, USDA did not conduct a similar survey in

2003, when gas prices and fertilizer prices again increased, because it was unaware of any concerns about the availability of nitrogen fertilizer.

Figure 5: Nitrogen Fertilizer Availability, 2001



Source: GAO analysis of USDA, National Agricultural Statistics Service, data.

The results of USDA's survey are consistent with our analysis, which found that although domestic production of nitrogen declined 25 percent in 2001, the overall demand was met primarily because imports increased by about

43 percent. As shown in table 1, nitrogen imports increased from 6.3 million tons in 2000 to approximately 9 million tons in 2001. Although most nitrogen fertilizer imported into the United States has for the past several years come from Canada, the amount of nitrogen fertilizer imported from Canada decreased by almost 13 percent in 2001. On the other hand, nitrogen fertilizer imports from Trinidad Tobago, Venezuela, and Ukraine increased by 19 percent, 59 percent, and 469 percent, respectively, in 2001. The price of natural gas in these three countries was considerably lower than the price of gas in the United States; thus, fertilizer producers in these countries were able to produce nitrogen fertilizer at much lower costs than domestic producers.

Table 1 also shows that domestic agricultural consumption of nitrogen decreased from 12.3 million tons in 2000 to 11.5 million tons in 2001—or about 7 percent. At least part of this reduction can be attributed to the impact of higher fertilizer prices on the country's farmers. For example, according to USDA's survey aimed at determining how corn farmers responded to higher fertilizer prices in 2001, 11 percent of responding farmers reported they adjusted their nitrogen fertilizer rates or practices in response to higher nitrogen fertilizer prices that year. About 80 percent of these farmers reduced their nitrogen fertilizer use by an average of 23 percent.

Federal Government Has a Limited Role in Managing the Impact of Natural Gas Prices on the Fertilizer Market

The federal government has a limited role in managing the impact of natural gas prices on the domestic fertilizer market. For example, the government does not determine the price of natural gas; however, two federal agencies—the Federal Energy Regulatory Commission (FERC) and the Commodity Futures Trading Commission (CFTC)—play important roles in promoting competitive natural gas markets by deterring anticompetitive actions. In addition, the Energy Information Administration (EIA) is responsible for obtaining information about and analyzing trends in the natural gas market that are used by industry and government decision makers. As with natural gas, the federal government does not set or control prices for nitrogen fertilizer. However, as part of its overall mission, USDA does monitor developments in the agricultural sector that could affect farmers. Regarding the fertilizer market, USDA collects, analyzes, and disseminates information on fertilizer prices and uses and, in 2001, collected additional information on the supply of nitrogen fertilizer and how higher fertilizer prices affected farmers. Lastly, USDA provides insurance and commodity price support programs to assist

America's farmers in managing risks associated with crop yields and revenues.

Federal Role in the Natural Gas Market Is Focused on Ensuring a Competitive Marketplace

As we reported in December 2002, in today's deregulated market the federal government does not control the price of natural gas. However, two federal agencies are responsible for ensuring that natural gas prices are determined in a competitive marketplace. Specifically, FERC plays a major role in overseeing the natural gas marketplace to ensure that prices are just and reasonable and free from fraud and market manipulation. Similarly, CFTC exercises regulatory oversight of natural gas derivatives[8] that are traded on federally regulated exchanges, such as the New York Mercantile Exchange, to protect traders and the public from fraud, manipulation, and abusive practices.

Following the price increases that occurred in the natural gas market during 2000–2001, both FERC and CFTC initiated investigations into possible fraud or manipulation. In August 2002, FERC reported that it had found indications that several companies may have manipulated spot prices upward for natural gas delivered to California during 2000–2001.[9] In March 2003, FERC reported that it had found evidence of manipulation of both electricity and natural gas markets, and that spot market gas prices were not produced by a well-functioning competitive market.[10] FERC staff made several recommendations to FERC commissioners aimed at correcting the deficiencies they found in the electric as well as the natural gas market. In a statement before the National Energy Marketers Association on April 4, 2003, the Chairman of CFTC acknowledged that the commission had imposed monetary penalties and filed complaints in federal court against several companies in connection with false reporting and attempts to manipulate natural gas prices and operating an illegal futures exchange. The Chairman also said that CFTC was actively engaged in other energy sector investigations, and further charges might be filed.

[8]These natural gas derivatives are futures and options contracts whose value is derived from the price of natural gas itself. These contracts can be bought and sold by entities that are interested in protecting themselves against increases in the price of natural gas.

[9]FERC, *Initial Report on Company-Specific Separate Proceedings and Generic Reevaluations: Published Natural Gas Price Data; and Enron Trading Strategies*, August 2002.

[10]FERC, *Final Report on Price Manipulation in Western Markets*, March 2003.

Following the price spike that occurred in the natural gas market in February 2003, FERC and CFTC again undertook investigations of possible market manipulation. On July 23, 2003, they issued a joint statement saying that neither investigation had identified evidence of market manipulation. FERC concluded that gas prices had risen in apparent response to underlying supply and demand conditions and in a manner consistent with those conditions.[11] CFTC said that it found nothing that suggested manipulative activity in the natural gas futures and options market during the week of February 24, 2003.

A third federal agency—EIA—analyzes energy price movements and provides market information that gas industry analysts use as an indicator of both supply and demand. For example, in May 2002, EIA began reporting estimates on the volume of gas in storage, which is a key predictor of future natural gas prices. EIA also provides weekly and monthly updates on the natural gas market and special reports on various issues affecting the gas market. In its August 2003 energy outlook, EIA reported that gas prices at the Henry Hub, one of the largest gas market centers in the United States, fell below $4.70 per mmBtu during the last week in July 2003. This was considered significant because these prices had been considerably above $5 per mmBtu on a monthly basis since the beginning of the year. However, EIA advised that gas prices are at risk for volatility and industrial users who rely on spot market purchases for their gas, such as nitrogen fertilizer producers, face the greatest risk of higher natural gas prices.

[11]FERC, *Report on the Natural Gas Price Spike of February 2003*, July 2003.

Federal Role in the Fertilizer Market Is Limited

The federal government does not control prices for nitrogen fertilizer, and nitrogen fertilizer products imported from other countries are generally not subject to U.S. trade restrictions, such as quotas and tariffs.[12] However, as part of its overall mission, USDA does monitor and report on developments in the agricultural sector that could affect farmers and offers certain programs to help farmers manage the risks associated with crop yield and revenues. The National Agricultural Statistics Service (NASS) collects information on agricultural acreage, production, stocks, prices, income, and information on fertilizer prices and uses. For example, the annual *Agricultural Chemical Usage* report provided by NASS includes information for targeted crops by major producing states on how much and what type of fertilizer was applied per acre. NASS also reports monthly price indices for three major fertilizer types—nitrogen, phosphate, and potassium—and actual prices paid by farmers for several fertilizer products in April of each year.

In addition to its routine surveys, USDA collected additional information in 2001 about nitrogen fertilizer availability and prices. According to officials from the Office of the Chief Economist, this information was collected because Congress and others had raised concerns about higher natural gas prices and the possible impact these prices would have on the availability and price of fertilizer. In order to collect this information, questions were added to USDA's ongoing *Crop Progress* survey aimed at determining the availability of nitrogen fertilizer in 2001 and to the *Agricultural Resource Management Survey* to determine how corn growers responded to the higher nitrogen fertilizer prices that occurred in 2001. The results of this additional survey information are discussed elsewhere in the report.

[12]Although nitrogen fertilizer is generally imported into the United States under a free trade arrangement, the United States International Trade Commission has, since 1999, ruled on four cases alleging that certain nitrogen fertilizers exported from several countries were being sold in the United States at less than fair value. In three of these cases —(1) Solid Urea from Armenia, Belarus, Estonia, Lithuania, Romania, Russia, Tajikistan, Turkmenistan, Ukraine, and Uzbekistan, USITC Pub. 3248, Inv. Nos. 731-TA-339 and 340-A-1 (October 1999); (2) Certain Ammonium Nitrate from Russia, USITC Pub. 3338, Inv. No. 731-TA-856, (August 2000); and (3) Certain Ammonium Nitrate from Ukraine, USITC Pub. 3448, Inv. No. 731-TA-894, (August 2001) —the Commission found that certain fertilizers imported from the cited countries were being sold at prices that materially injured the industry in the United States. Therefore, the price of certain nitrogen fertilizers imported from Armenia, Belarus, Estonia, Lithuania, Romania, Russia, Tajikistan, Turkmenistan, Ukraine, and Uzbekistan was restricted, either by order or agreement. These restrictions are still in effect.

USDA also offers insurance and commodity price support programs to help farmers manage risk associated with crop yields and revenues, but it currently does not offer similar programs to cover the risks associated with farm production costs, such as the cost of fertilizer. For example, in 2002, USDA's insurance program covered crops valued at $41 billion, and commodity price support payments have averaged more than $10 billion per year since 1996. According to USDA officials, the agency does not offer insurance to cover the risks associated with farm production costs because these risks tend to be small compared with the risks associated with crop prices. Since a farmer's income per acre from a crop equals the crop price times the yield, changes in either crop price or yield are directly and fully reflected in a farmer's income. As shown in table 2, crop prices can change significantly over time and from year to year. From 1996 to 2001 the average price of corn declined by $.98 per bushel, or 35 percent, and average corn prices declined by $.61 per bushel—24 percent—from 1997 to 1998. Overall, from 1996 to 2001, average corn yields increased only 11 percent—from 130 bushels per acre to 144 bushels per acre. In addition, while national average yields are relatively stable from year to year, the actual yields for individual farmers can vary significantly from year to year as a result of natural causes, such as weather conditions and the extent of loss caused by insects and diseases.

Table 2: Average Corn Prices, 1996–2001

Crop prices/yields	1996	1997	1998	1999	2000	2001
Price (dollars per bushel at harvest	2.82	2.52	1.91	1.69	1.77	1.84
Yield (bushels per planted acre)	130	130	136	135	138	144

Source: USDA, Economic Research Service.

In contrast, a farmer faces fewer risks with costs of production because these costs tend to remain stable from year to year. As shown in table 3, total production costs per acre for a corn farm remained relatively stable from 1996 through 2001, and changes in different cost categories often offset one another. For example, although average fertilizer costs increased by $8.68 per acre from 2000 to 2001, this large increase was offset by a decrease of $8.24 in fuel, lube, and electricity costs. Other production costs also decreased and, as a result, total production costs decreased by $3.84, or about 2 percent.

Table 3: Average Costs of Materials Used per Acre on Corn Farms, 1996–2001

Cost categories	1996	1997	1998	1999	2000	2001
Fertilizer	$47.04	$46.21	$41.44	$38.75	$39.04	$47.72
Seed	26.65	28.71	30.02	30.29	30.02	32.34
Chemicals	27.42	26.87	27.36	28.40	28.82	26.44
Fuel, lube, and electricity	24.43	24.55	22.96	23.04	29.12	20.88
Repairs	15.78	16.17	16.65	17.17	17.55	13.76
Custom operations	11.30	11.30	11.29	11.37	11.48	10.94
Manure	0.60	0.56	0.51	0.49	0.48	2.65
Interest on operating capital	3.86	3.96	3.61	3.50	4.53	2.60
Other variable cash expenses	0.30	0.32	0.31	0.31	0.31	0.22
Soil conditioners (lime)	0.16	0.16	0.16	0.17	0.16	0.12
Total costs	**$157.54**	**$158.81**	**$154.31**	**$153.49**	**$161.51**	**$157.67**

Source: USDA, Economic Research Service.

Similarly, although USDA provides information to farmers through the Cooperative State Research, Education and Extension Service to help them participate in farm commodity futures markets, there is relatively little information regarding farm production costs, such as fertilizer. According to a state extension service official, the extension service has issued several publications that provide information on farm commodity futures markets because farmers are generally familiar with these markets and have access to the information needed to participate successfully in these markets. However, the extension service generally does not encourage farmers to participate in futures markets involving farm production cost items, such as fuels, because farmers are not as familiar with these markets. Instead, farmers generally use various prepayment methods to control the costs of items used in producing crops.

Observations

Natural gas is the most costly ingredient used in manufacturing nitrogen fertilizer products. However, the price of natural gas can vary significantly in different markets throughout the world. Unfortunately for domestic nitrogen fertilizer manufacturers, the price of natural gas in the United States can far exceed its price in other parts of the world. As a result, domestic manufacturers are at a competitive disadvantage when domestic natural gas prices rise. Manufacturers can close plants in response to periodic price spikes and resume production when prices drop again, but higher prices sustained over the long term may result in more permanent

curtailment of domestic production. In the past, farmers' needs for fertilizer have been met by increases in imports when domestic production has been curtailed, as it was in 2001. However, it remains to be seen how well the market will respond to further reductions in the domestic production of nitrogen fertilizer that may be caused by more sustained higher natural gas prices in the future. Earlier this year, increased natural gas prices once again caused higher production costs for the nation's fertilizer manufacturing industry, which in turn contributed to a reduction in the amount of nitrogen being produced and an increase in nitrogen fertilizer prices. Although it is too early to determine whether these higher gas prices will have the same adverse effect on the fertilizer manufacturing industry as higher gas prices did in 2001, some within the industry contend that continuing higher gas prices are threatening the industry.

Agency Comments

We provided USDA and TFI with a draft of this report for review and comment. We received oral comments from USDA and TFI officials, who agreed with our facts and observations.

As agreed with your office, unless you publicly announce the contents of this report earlier, we plan no further distribution until 30 days from the report date. At that time, we will send copies to the USDA Secretary, The Fertilizer Institute, and other interested parties. We also will make copies available to others upon request. In addition, the report will be available at no charge on the GAO Web site at http://www.gao.gov.

Questions about this report should be directed to me at (202) 512-3841. Key contributors to this report are listed in appendix II.

Sincerely yours,

Jim Wells
Director, Natural Resources
and Environment

Objectives, Scope, and Methodology

In our study of the natural gas and nitrogen fertilizer markets, we determined (1) how the price of natural gas affects the price, production, and availability of nitrogen fertilizer and (2) the federal government's role in managing the impact of natural gas prices on the U.S. fertilizer market.

To address these objectives, we reviewed pertinent documents and obtained information and views from a wide range of officials from both the federal government and the private sector. We interviewed staff and/or obtained information from the Department of Agriculture's (USDA) Office of the Chief Economist, Economic Research Service, National Agricultural Statistics Service, and Cooperative State Research, Education and Extension Service; the Department of Commerce; the Department of Energy's Energy Information Administration; the Federal Energy Regulatory Commission; the Commodity Futures Trading Commission; and the International Trade Commission. We also discussed the relationship between the natural gas and nitrogen fertilizer markets with representatives from various industry organizations, including The Fertilizer Institute (TFI); the International Fertilizer Development Center; the American Farm Bureau Federation; Agrium Incorporated; CF Industries, Incorporated; and Terra Industries, Incorporated.

To determine how the price of natural gas affects the price of nitrogen fertilizer, we examined industry-supplied natural gas prices and industry, as well as government, price data for nitrogen fertilizer and determined how fertilizer prices behaved when gas prices increased in 2000–2001 and again in 2003. We determined the extent to which a correlation existed between the price of natural gas and prices for three nitrogen fertilizers, anhydrous ammonia, urea, and urea ammonium nitrate, which were included in our analysis because they are widely used by American farmers. We compared natural gas and nitrogen fertilizer prices for the period January 1998 through March 2003. More specifically, we obtained industry prices for natural gas at the Henry Hub from Global Insight (USA), Inc. We selected Henry Hub prices because this market center is one of the largest in the country and often serves as a benchmark for wholesale natural gas prices across the country. We obtained monthly spot prices, or the current cash prices at which nitrogen-based fertilizers are sold at various locations, from an industry source—*Green Markets: Fertilizer Market Intelligence Weekly. Green Markets*, a Pike & Fischer, Inc., publication, collects independent spot price quotes for 19 fertilizer commodities every week. Our analysis of the market data included fertilizer prices at two major market locations: (1) the U.S. Gulf Port, whose prices are considered the benchmark for fertilizer prices in North America, and (2) the Mid Cornbelt, where large quantities of

nitrogen fertilizer are used. In addition, we compared the relationship between the prices paid by farmers for nitrogen fertilizer and natural gas prices. To do this, we calculated the monthly prices paid by farmers for nitrogen fertilizer. We used the April prices paid by farmers for anhydrous ammonia, urea ammonium nitrate (32 percent nitrogen solution) and urea (46 percent nitrogen). Since these prices are reported only once a year in April, we applied the monthly prices paid index for nitrogen fertilizer published by USDA to the April prices in order to calculate a monthly price for nitrogen fertilizer. We did this by using the appropriate weights, supplied by USDA, for each of the fertilizer components (anhydrous ammonia, urea ammonium nitrate, and urea). The index for nitrogen fertilizer is based on the Producer Price Index series (PPI) and appropriate subcomponents from the Bureau of Labor Statistics. The April fertilizer prices are obtained by survey from establishments selling fertilizers to farmers.

To determine the effect of natural gas prices on domestic nitrogen fertilizer production, we examined nitrogen inventory, production, and consumption data obtained from government and industry sources from 1996 through 2002. These data (shown in table 1) reflect the estimated quantity of nitrogen in the United States, including the nitrogen nutrient in several fertilizer products—anhydrous ammonia, ammonium nitrate, ammonium sulfate, aqua, nitrogen solutions, urea, and other nitrogen materials. The estimated nitrogen production, imports, and exports were derived from the Department of Commerce, Bureau of Census, quarterly report *Inorganic Fertilizer Materials and Related Products (MQ325B)*. The inventory data were taken from a TFI report, *Fertilizer Record*, which reflects the results of a TFI monthly survey of domestic nitrogen fertilizer producers. The agricultural consumption data were derived from reports filed by fertilizer users with state fertilizer control officials. These reports are tabulated by the Association of American Plant Food Control Officials, Inc. (AAPFCO) and TFI and published by TFI in *Commercial Fertilizers*. Because of the incompleteness of the state fertilizer consumption reports, an unknown but significant amount of missing data, particularly for the most recent year, are imputed based on historical information by AAPFCO and TFI. The estimates described above were used in this report for several reasons. First, the estimates of total supply and total demand, which reflect the combination of data from several independent sources, differ only slightly. Second, the trends in consumption from the trade source are consistent with those in the related Census Bureau series. Third, these data are widely used by companies that produce nitrogen fertilizer. In addition, we reviewed financial reports and other industry documents that describe how

the nitrogen manufacturing industry responded to higher natural gas prices and interviewed industry and government officials to obtain their views and comments.

In determining the effect of higher natural gas prices on the supply of nitrogen fertilizer, we relied primarily on the results of a USDA survey on fertilizer availability in 2001. According to USDA officials, they added questions concerning nitrogen fertilizer supplies to the ongoing *Crop Progress* survey[1] because this was the most efficient and reliable survey vehicle available on short notice. USDA asked respondents to report on the adequacy of nitrogen fertilizer supplies that were available to producers in their area. Although the responses were subjective, those people providing the responses are widely respected as the most knowledgeable about agricultural situations in their respective counties. The results of the survey questions used to gather information on the availability of nitrogen fertilizer were presented in the National Agricultural Statistical Service's *Crop Progress* report dated June 4, 2001. We also examined data contained in our supply and demand table (table 1) to determine sources, supplies, and consumption of nitrogen fertilizer over the 7-year period ending in June 2002.

To determine what role the federal government plays in managing the impact of natural gas prices on the U.S. fertilizer market, we reviewed the responsibilities of federal agencies regarding the natural gas and fertilizer markets and their efforts to monitor and collect information on these markets. We reviewed relevant documents provided by agriculture and fertilizer industry representatives and interviewed these officials to obtain their views on what actions, if any, the federal government should take to mitigate the effects of high natural gas prices on the U.S. fertilizer market. We also reviewed relevant documents and interviewed USDA and state extension service officials regarding how farmers manage the risks associated with their production costs and the federal government's role in assisting farmers in managing these risks. Finally, we reviewed the results

[1]USDA, National Agricultural Statistics Service conducts crop progress surveys on a weekly basis from early April to the end of November to collect specific data and the overall condition of selected crops in major producing states. The surveys are nonprobability surveys that include a sample of more than 5,000 people who make visual observations and have contact with farmers in their counties.

of a USDA analysis of the 2001 *Agricultural Resource Management Survey*, which was used to gather information on how American farmers who grow corn responded to the higher nitrogen fertilizer prices in 2001.[2] The results of this analysis were presented in the USDA, Economic Research Service's *Agricultural Income and Finance Outlook* report dated September 26, 2002.

We performed our review from February through August 2003 in accordance with generally accepted government auditing standards. While we did not independently verify the accuracy of natural gas and fertilizer prices and other data obtained from industry sources, we did compare these data with other relevant data to ascertain the reasonableness of the data we used. We also interviewed knowledgeable government and industry officials to determine the reasonableness of the data and our use of them. We determined that the data were sufficiently reliable for the purposes of our report.

[2]The Agricultural Resource Management Survey, conducted by USDA's Economic Research Service, is an annual, state-by-state survey of farms and agricultural commodities conducted to obtain information about the financial condition, production practices, resource use, and economic well being of America's farm households. Trained enumerators conduct personal interviews of a statistical sample of farm operators to collect data for this survey.

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Staff Acknowledgments

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