

CRS Report for Congress

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Energy Costs and Agriculture

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Summary

U.S. agriculture is not an especially energy-intensive industry, but energy does account for about 6% of farm production costs. (Mining, including oil and gas extraction, has energy expenses of about 10%, while all manufacturing is at about 2% — see *1997 Economic Census*, and *1999 Annual Survey of Manufactures*. U.S. Census Bureau). Additionally, farming is a highly mechanized industry and requires timely energy supplies at particular stages of the production cycle in order to achieve optimum yields. A substantial part of energy use by agriculture is indirect—embodied in the chemicals applied and machinery used on farms.

Although there are many kinds of farm operations performed in the different types of farms, nearly all apply technologies that use either a petroleum product or electricity. Recently, dramatically higher natural gas prices have increased farm energy costs directly, and indirectly through farmers' use of fertilizer. Nevertheless, the relative contributions of energy types vary distinctly, if not dramatically, by type of farm and product.

The impact of possible oil and/or electricity price rises is potentially greater on agriculture (especially for field crop production) than on most other sectors, given the dependence by farming upon petroleum and electricity, and limited scope for fuel switching. It is to be expected that farmers will, as they have in the past, reduce energy use to ease the cost impact of price rises. A sustained increase in energy prices could have an impact on consumer food prices as higher costs are passed on through the food production/processing industry.

Continued low commodity prices in the farm economy exacerbate the problem of higher energy costs. In response, legislation has been introduced in Congress to assist farmers and other industries in dealing with increased energy costs, including emergency loans and encouraging alternative energy sources.

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Energy Costs and Agriculture

Background

There is concern that a sustained rise in energy prices may have serious consequences on energy-intensive industries. Agriculture, like many other sectors, requires energy as an important input to production. Farming accounts for only 2-3% of all energy consumption in the United States. (Manufacturing accounts for about 25%, transportation 13%, and mining 2%.)¹ However, farming is a highly mechanized enterprise and requires timely energy supplies at particular stages of the production cycle in order to achieve optimum yields.

Natural gas prices, particularly, have had financial consequences for agriculture, with the surge in prices beginning in 2000. On-farm agricultural production requires the consumption of natural gas (used primarily for irrigation and crop drying) and electricity. Animal agriculture is affected, with poultry farmers being hit hard with higher heating costs for their poultry houses. In addition to the direct consumption of energy on the farm, substantial amounts of energy also are used off the farm to manufacture two major inputs to production: fertilizer and pesticides. Virtually all nitrogenous fertilizers used in the United States require natural gas as a production input, and most pesticides have a petroleum base. Fertilizer production uses approximately 3% of all natural gas consumed in the United States, and represents a significant portion of total energy consumed by the farm sector.

Since a large portion of on-farm energy use is for the operation of machinery used in crop production, agricultural energy consumption tends to vary according to the level of planted acreage. The impacts of higher energy costs vary widely from farm to farm:

- Some farmers irrigate from more costly deep wells, others from less costly shallow wells.
- Some burn a lot of fuel by cultivating often to rid fields of weeds, others make one herbicide application. Relatedly, some farmers makes several passes over the land for tilling and planting, while others use no-till during planting.
- Some locked in relatively low prices by contracting early for fuel and fertilizer, others gambled and hoped prices would drop.

Among farmers, higher energy prices will have greater impacts where irrigation-related energy inputs are required (i.e., corn, wheat, and cotton in the Plains States). Rising energy prices likely will have a less severe effect on most specialty crops (sugar

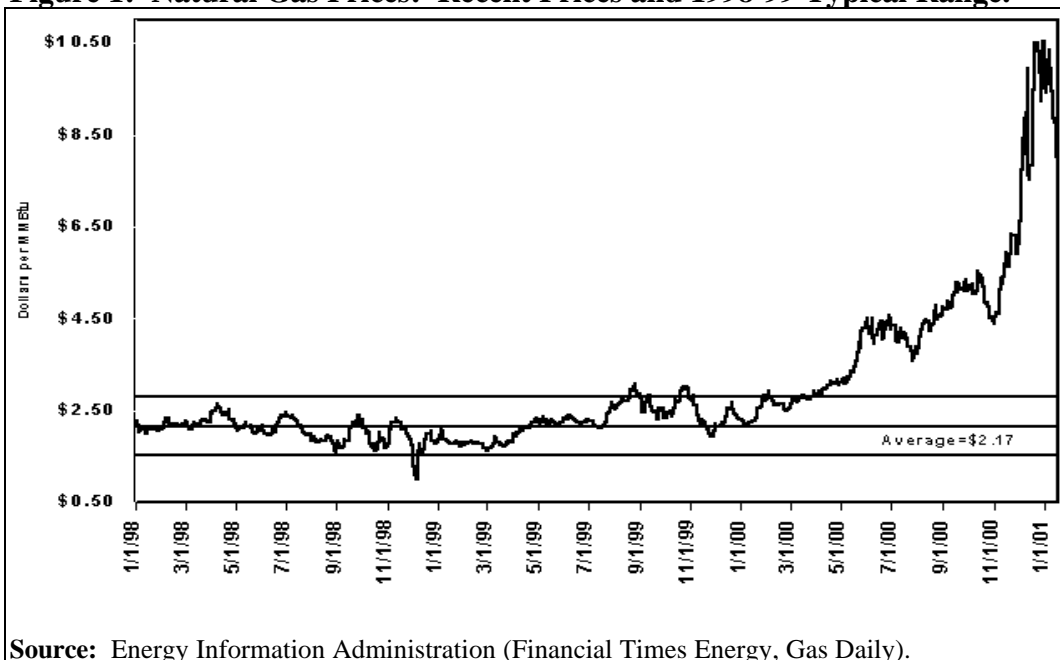
¹Analysis of data from the *Census of Manufactures*, U.S. Census Bureau; and *Monthly Energy Review*, Energy Information Administration, U.S. Department of Energy.

beets, peanuts, and tobacco) than on other major field crops because energy inputs comprise a smaller portion of operating costs. Among specialty crops, costs of producing flue-cured tobacco will be most affected because of natural gas costs for curing the tobacco. According to the U.S. Department of Agriculture's (USDA) Economic Research Service (ERS), 1999 energy related expenses for field crops comprised 24% to 31% of total variable costs. For producers of fruits and nuts, vegetables, and nursery and greenhouse products, the range was 10% to 15%, while the range was 9% to 18% for livestock producers. Fertilizer accounted for 64% of energy expenses, fuels (gasoline, diesel, natural gas, LP gas) 25%, and electricity 11%, for all farm energy-related expenses.²

Natural Gas³

Higher energy costs are reflected especially in natural gas prices, which have increased several fold over the last year (Figure 1). Prices have come down from their highs earlier in the year, but remain well above previous year levels and the effects are being felt by farmers. Increased natural gas prices raise the cost of production aspects that use natural gas such as for irrigation pumps, crop drying, and heating costs.

Figure 1: Natural Gas Prices: Recent Prices and 1998-99 Typical Range.



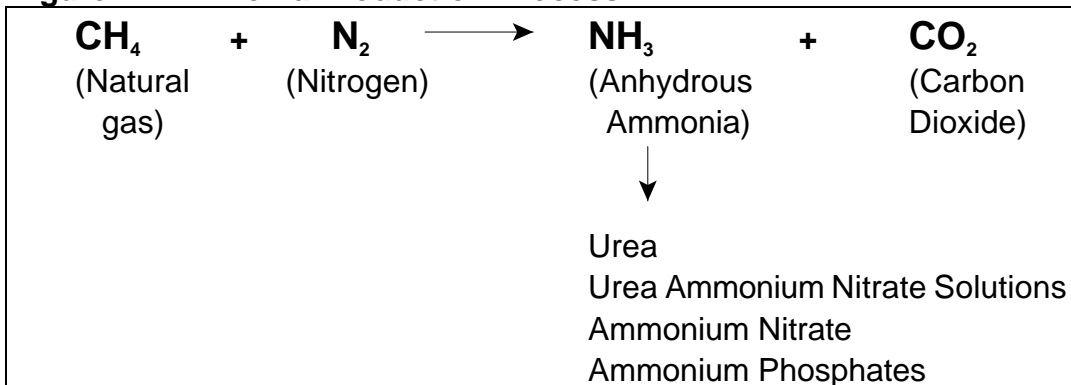
²Economic Research Service, U.S. Department of Agriculture. Staff analysis. February 13, 2001.

³For a further discussion on natural gas, please see CRS Report RL30815, *Natural Gas Prices: Overview of Market Factors and Policy Options*.

Fertilizer

The production process of fertilizer involves a catalytic reaction between elemental nitrogen derived from the air, with hydrogen derived from natural gas (Figure 2). Anhydrous ammonia is used directly as a commercial fertilizer and also is used as the basic building block for most other forms of nitrogen fertilizers, with natural gas used as a process gas in the manufacture of other fertilizers from anhydrous ammonia. Anhydrous ammonia also is used in non-agricultural industries such as adhesives, plastics, resins, and rubber.

Figure 2: Ammonia Production Process.

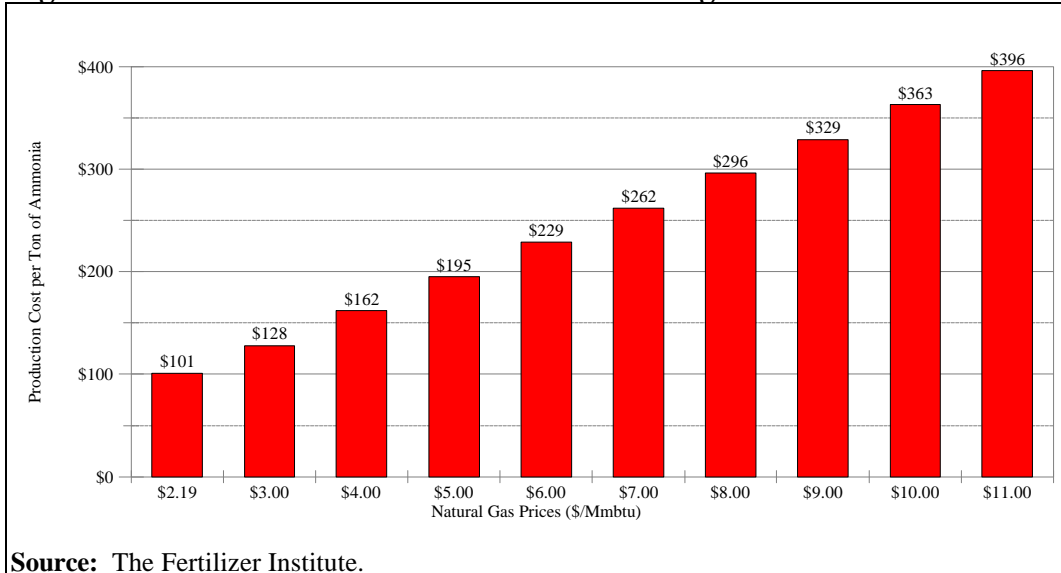


The rise in natural gas prices has had a severe impact on both the profitability and operating rate of the U.S. fertilizer industry. By the end of 2000, high natural gas prices had forced up fertilizer production costs to the point where fertilizer producers could not cover production costs, according to industry sources. Natural gas makes up 75-90% of the cost of production for nitrogen fertilizer. One ton of ammonia requires 34 million British Thermal Units (Mmbtu) of natural gas. At a natural gas price of \$2.19 Mmbtu (the average price during 1999), production costs for a typical producer are approximately \$100 per ton, with gas being about 75% of the cost of production. At \$4.50 Mmbtu, cash costs are \$180, with 84% for natural gas. Figure 3 shows the rise in production costs for ammonia as the natural gas price increases. In early 2000, with natural gas prices at \$2.37 Mmbtu, anhydrous ammonia prices were \$105 per ton. When natural gas prices increased to \$9.90 in January 2001, anhydrous prices rose to \$360.

With the increased production costs due to higher natural gas prices, producers were forced to cut back on fertilizer production. Of the 19 million tons of total nitrogen capacity in the United States, approximately 7.5 million tons were idled in January 2001, with the remaining capacity operating at reduced levels. As a result, the industry operated at 54% of capacity, compared with 95% average over the last 10 years. During the summer of 2000, 24% of U.S. nitrogen capacity was closed because of high natural gas prices. For the first half of FY01, U.S. nitrogen production is down 13% from year-earlier levels, and approximately 25% below the

average level for the 1997-99 period. According to The Fertilizer Institute⁴, July 2000-January 2001 production of ammonia was 20% lower than that of one year earlier. For the month of January 2001, production of anhydrous ammonia was 48% less than January 2000 production. Nitrogen inventories were down 18% in January 2001 compared to January 2000.

Figure 3: Ammonia Production Costs at Increasing Natural Gas Prices.



In the March Index of Prices Paid by Farmers (Table 1), the Fertilizer Index was at 144, up 3.6% from February (139) and 36% more than March 2000 (105). Prices were higher for nitrogen fertilizers, mixed fertilizers, and potash and phosphate materials. The price index for nitrogen fertilizers, particularly, was 75% higher in February 2001, and almost 81% higher in March 2001, than respective year earlier levels. For the year 2001, the nitrogen price index rose 5% in February, and an additional 5% in March.

Table 1: Index of Prices Paid for Fertilizer (1990-92 = 100)

	Feb 00	Mar 00	Jan 01	Feb 01	Mar 01
Fertilizer	106	106	134	139	144
Mixed	108	108	112	113	114
Nitrogen	101	103	168	177	186
K & P	116	109	107	109	112

Source: National Agricultural Statistics Service, USDA. Monthly. *Agricultural Prices*.

In some areas of the country, farmers were expected to pay up to 60% more for fertilizer than a year ago, with prices for nitrogen fertilizers having risen from \$87 per ton to \$140. Since November 2000, liquid nitrogen had nearly doubled from \$80-100

⁴The Fertilizer Institute (TFI) represents by voluntary membership, producers, manufacturers, retailers, trading firms, and equipment manufacturers of the fertilizer industry.

per ton to nearly \$200 by February 2001. Reported ammonia prices delivered to Midwest dealers rose from \$160 per ton in January 2000, up to \$240 in July, and \$350 in December. Prices have changed from \$160-195 per ton a year ago to \$260-400 per ton earlier this year (2001).

Natural gas also is used as a process gas when upgrading anhydrous ammonia to urea. Producing a ton of urea requires 0.58 ton of ammonia and approximately 4.2 Mmbtu of natural gas for processing. Therefore, at \$2 Mmbtu gas, production costs are \$80 per ton of urea. At \$9 Mmbtu, production costs are over \$210. Urea prices also have shown a tremendous increase. According to various accounts in newspapers and farming magazines, in 2000, prices ranged from \$110-185 per ton, and have been \$220-270 this year.

Domestic producers account for 75-80% of total ammonia supply, 70-75% of urea, and 95% of urea ammonium nitrate (UAN). Because most of the U.S. fertilizer demand has been met by domestic production, some have said it will be difficult for imports to fulfill current demand. A key limitation for imports is infrastructure. Historically, virtually all the direct application ammonia market has been supplied by U.S. production with some additional supplies from Canada, while offshore imports have been used mostly for ammonium phosphate production and in the industrial market. Consequently, the infrastructure to offload ammonia and move it to the primary direct application markets is extremely limited, according to industry experts. The current infrastructure for offloading, storing, and transporting, thus, could create a practical limitation on the amount of imported fertilizer that can be transported to farmers.

In addition to delivery delays, farmers face the likelihood of receiving less total fertilizer nitrogen than they would like to purchase. Additionally, fertilizer nitrogen may be available only in an unfamiliar form or one they are not optimally equipped to use.

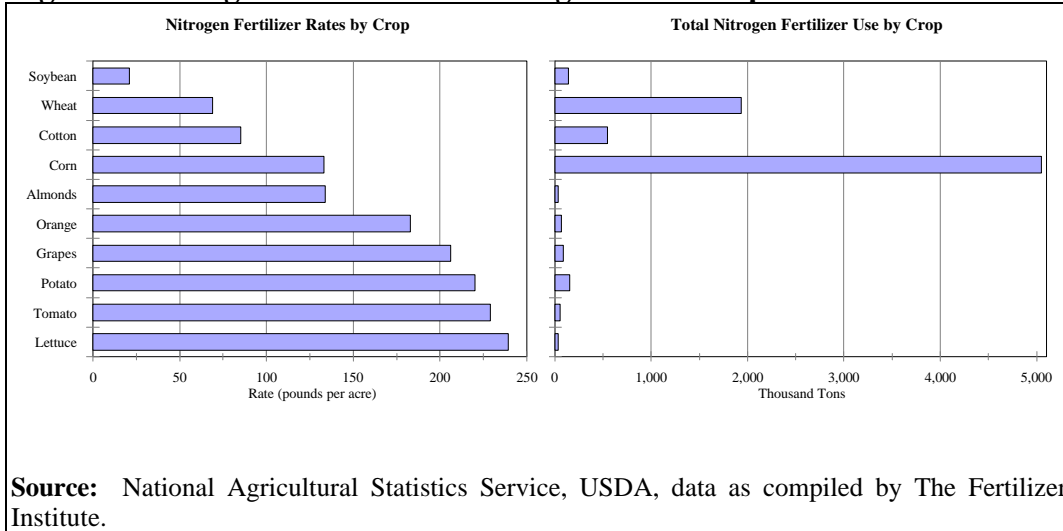
There are many factors that impact fertilizer use, but application rates and planted acreage are the most important. Because application rates typically do not change a lot from year to year, most changes in nutrient use can be predicted from changes in crop acreage—especially corn acreage.⁵ Figure 4 shows rates of nitrogen fertilizer use for various crops. Nitrogen rates typically are much higher for fruits and vegetables than for field crops. However, due to planted acreage, total nitrogen use is greatest for corn, as shown. Therefore, much of the recent context of the fertilizer discussion has been relative to corn plantings and whether corn acreage in the United States would decrease if producers switched to alternative crops with lower energy costs.

Energy-input costs per acre for cotton production are nearly as high as those for corn (\$57 vs. \$62), but comprise a much smaller proportion of total operating costs

⁵The Fertilizer Institute, at the annual meeting of the Kentucky Fertilizer and Agricultural Chemical Association. November 8, 2000. (The Fertilizer Institute represents by voluntary membership producers, manufacturers, retailers, trading firms, and equipment manufacturers of the U.S. fertilizer industry.)

(23% vs. 40%), according to the ERS. Reducing fertilizer and energy costs may provide an incentive to switch crop acreage from feed grains and wheat, to soybeans or cotton, which have lower energy costs. This could be an unappealing prospect for traditional growers of soybeans and cotton, who already are suffering the impact of low prices and surplus production.

Figure 4: Nitrogen Fertilizer Use Among Various Crops.



Source: National Agricultural Statistics Service, USDA, data as compiled by The Fertilizer Institute.

There have been reports in the press about farmers switching crops (e.g., sorghum and sunflowers instead of corn) in order to reduce irrigation needs. Corn and soybeans typically are grown in rotation (alternate yearly between planting corn and soybeans) and growing soybeans in consecutive years likely will reduce soybean yields and increase risk of disease. Additionally, reduced corn production and increased soybean production will raise corn prices and lower soybean prices. Therefore, most reports believe it is unlikely that a significant number of acres will be switched from corn to soybeans.

Current Fertilizer Situation

The supply situation for nitrogen fertilizers has improved significantly since the beginning of the year, according to industry reports. As a result of easing in natural gas prices, a large portion of the capacity that had been idled is back on-stream. As of the end of March 2001, nitrogen fertilizer availability for the United States was 92% of normal levels (Table 2). Nevertheless, some western states still are 10-15% below normal levels.

For the period July 2000 - January 2001, U.S. nitrogen imports increased by 28 percent over the same period July 1999 - January 2000. Nitrogen imports into the U.S. are likely to hit record levels this year, according to The Fertilizer Institute.

Table 2: Nitrogen Fertilizer Available: Percent of Normal Supply

State	% of Normal	State	% of Normal	State	% of Normal	State	% of Normal	State	% of Normal
AL	93	IL	94	MN	95	NC	95	TX	91
AZ	95	IN	91	MS	95	ND	86	UT	95
AR	97	IA	81	MO	81	OH	88	VT	100
CA	100	KS	96	MT	85	OK	93	VA	100
CO	89	KY	97	NE	87	OR	98	WA	100
CT	100	LA	95	NV	100	PA	75	WV	100
DE	100	ME	100	NH	100	RI	100	WI	85
FL	94	MD	92	NJ	70	SC	100	WY	85
GA	93	MA	100	NM	95	SD	85		
ID	95	MI	95	NY	100	TN	96	US	92

Source: “*Weekly Weather and Crop Bulletin.*” April 3, 2001. National Agricultural Statistics Service, U.S. Department of Agriculture.

Data for the month of January 2001, show anhydrous ammonia imports up 74% over January 2000. For the period covering July 2000 – January 2001, ammonia imports are up 22% over the previous year. According to The Fertilizer Institute, these figures are understated since they do not include data on imports of ammonia from Russia and the Ukraine, which are not available from the Commerce Department. It is estimated that annual U.S. imports from these two countries range from 750,000 to 1.2 million tons.

There remains concern the California energy crisis will contribute to increase in fuel and fertilizer costs for farmers. The state’s recent electricity shortage has been blamed for boosting the price of natural gas, a fuel for many California power plants.

Farm Income Effects

According to USDA’s Economic Research Service (ERS), as of January 2001, net farm income for 2001 is forecast at \$41.3 billion, which compares to \$45.4 billion in 2000. Average net farm income for 1990-2000 was \$45.3 billion. According to ERS, the lower 2001 forecast hinges on an assumption that government payments will be approximately \$8 billion less in 2001 than in 2000. Government payment assumptions are the main reason for a decline in the farm income forecast, since the value of commodity receipts is on an upward trend. Government payments were a record \$22.1 billion in 2000, up \$1.5 billion from 1999. Additional emergency farm assistance accounted for \$8.9 billion of total government payments in 2000. In 2001, emergency assistance is limited to the payments for which farmers remain eligible

under the legislation enacted in 2000, and is forecast to be \$3.6 billion, as of this writing.

According to ERS, total commodity production expenses are forecast to rise \$1.0 billion in 2001 (1% above 2000), topping \$200 billion for the first time. Even though planted acreage is expected to fall, fertilizer expenses should increase 3-4% due to the impact of significantly higher production costs for nitrogen fertilizer. Petroleum is one of the main inputs in pesticide products, but pesticide expenses are forecast up less than 2%. Factors other than petroleum account for a larger share of pesticide production costs, so pesticide expenses are not expected to increase as much as fertilizer expenses.

Energy costs for agriculture will rise slightly in 2001, according to ERS projections made in January 2001. This assumes fuel expenses will be similar to 2000, as the recent price increases fall off toward the end of the year. As shown in Table 3, the Fuels Index during March 2001, was at 140, down 2.1% from February 2001,

Table 3: Index of Prices Paid for Fuel (1990-92 = 100)

	Feb 00	Mar 00	Jan 01	Feb 01	Mar 01
Fuels	125	134	143	143	140
Diesel	127	133	141	137	129
Gasoline	125	137	134	135	132
LP Gas	117	136	172	188	205

Source: National Agricultural Statistics Service, USDA. Monthly. *Agricultural Prices*.

but up 4.5% from March 2000. Compared to February 2001, prices were lower for diesel fuel and gasoline, but 9% higher for liquefied petroleum (LP) gas during March 2001. In 2000, expenditures for fuels increased by \$2.3

billion over 1999, which was the highest year-to-year jump since 1980, when they rose by almost the exact same dollar amount. The highest percent increase occurred in 1974, when fuel costs soared 43%.

Incentives for farm operators to seek cost saving practices, such as adopting fuel-saving cultivation and other production processes, are likely to offset some of the recent rise in production expenses. Farmers across the nation used conservation tillage (no-till, ridge till, and mulch-till) on more than 109 million acres of farmland in 2000, over 36% of U.S. planted cropland area, up from 26% in 1990. Expansion of no-till accounts for most of the growth in conservation tillage in the last decade. In 2000, no-till was used on over 52 million acres of 297 million cropland acres planted (17.5%) a threefold increase in no-till acreage since 1990.⁶ Conservation tillage requires fewer trips across the field and generally less horsepower for field operations. The outlook for increased use of conservation tillage adoption for the 2001 growing season likely will be positively influenced by a combination of low commodity prices and higher input costs, especially for diesel fuel. This will encourage farmers to seek potential cost-savings from conservation tillage without sacrificing yield, according to ERS.

⁶“Conservation Tillage Firmly Planted in U.S. Agriculture.” *Agricultural Outlook* March 2001. Economic Research Service, U.S. Department of Agriculture.

If fuel supplies were disrupted due to unforeseen circumstances, expenditures for fuels could rise above current levels, according to ERS. California farmers, who are heavy users of electricity, currently are considering alternative fuel sources and energy-conserving practices to offset the rising costs of electricity. Farmers in other parts of the country, who are dependent on natural gas, LP gas, and propane also are evaluating alternatives.

Because individual farmers are “price-takers” and lack the capability to quickly pass on higher costs through the food marketing chain, net farm income likely would be reduced in the short term by the equivalent amount of any rise in production expenses. Moreover, nearly half of all nitrogen fertilizers consumed in the United States are produced and marketed by farmer-owned co-ops. Thus, losses to this sector are likely to have impacts on farmers invested in co-ops.

Options for Farmers

It seems likely that farmers will reduce fertilizer application rates, with a resulting reduction in crop yield. The current fertilizer situation makes it more critical that fertilizer management be geared toward achieving maximum efficiency. Options available to farmers include soil tests, realistic yield goals, and applying fertilizer later in the growing season.

Farmers also can alter their production mix and switch to different crops to reduce fertilizer/energy costs. One of the principal reasons for USDA’s prediction that soybean acreage is likely to increase in 2001, while corn acreage decreases is that soybeans use less nitrogen-based fertilizer than does corn. Soybeans fix their own nitrogen from the air, so require very little fertilizer. Therefore, farmers may switch from corn to soybeans. In order to reduce irrigation costs, farmers may switch from corn to cotton, sorghum, or sunflowers, for example, which require less water. Another option for farmers is switching to a different form of nitrogen fertilizer. Using urea, for example, instead of anhydrous ammonia, might be an option because urea prices have not risen as much.

Some have suggested current fertilizer prices offer an increased incentive to use animal waste such as poultry litter or hog waste as fertilizing agents, although this approach has some limitations. Approximately 15 truckloads of poultry litter are needed to achieve the same nitrogen level as one truckload of commercial fertilizer. Moreover, hog waste typically is in liquid form, and might only be practical where it can be piped in. Environmental concerns (including manure odor) also might accompany large scale uses of these alternatives. However, in some parts of the country where animal waste is produced in amounts that exceed available disposal space, this may be a viable option.

For heating purposes, some farmers are switching from natural gas to propane because of lower prices. Also, rising prices for fossil fuels and falling grain prices have prompted some farmers to switch to grain furnaces, which can burn grain such as corn, wheat, barley, etc. According to research, one bushel of corn will generate about as much heat as five gallons of liquid propane. Burning grain has a potential

economic advantage if the grain has lesser value; e.g., is low quality, mildewed, or for some other reason unmarketable.

Food Prices

A sustained increase in energy prices could be translated into higher food prices for consumers. Energy use adds to food production costs and consumer food prices beyond the farm gate in three stages: (1) food manufactured with energy intensive technologies, (2) transportation of food products to regional markets in climate controlled cargo areas, and (3) storage and distribution of food items in environmentally controlled facilities. Food retailers are likely to use considerably more energy than the average retailer to control the environment for perishable food products around the clock, according to ERS.

ERS estimates 3.5% of the cost of food is attributable to energy expenses, and 4% is attributable to transportation expenses (Figure 5). (The energy bill includes only the costs of electricity, natural gas, and other fuels used in food processing, wholesaling, retailing, and foodservice establishments. Transportation fuel costs, except for those incurred for food wholesaling, are excluded.)

Figure 5: Distribution of a Dollar Spent on Food, 1999.



Farmers receive 24 cents for every \$1 of consumer expenditures on food. This means that 76 cents of the consumer food dollar is attributable to the marketers of food. These food processors, transporters, wholesalers, and retailers, have a greater capability than farmers of passing on their higher costs through the production-marketing system, and eventually to the consumer.

Congressional Action

In response to the energy situation, Congress has introduced various legislation that would encourage alternative sources of energy, allow emergency loans for businesses affected by high energy costs, and allow for further exploration in protected areas. Additionally, several Senators have requested the General Accounting Office (GAO) study various energy-related issues. Currently, GAO reportedly is setting up a way to do a broad-based study that would combine all requests.

Legislation

S. 60 (Byrd). National Electricity and Environmental Technology Act. Authorizes accelerated research and development programs for advanced clean coal technologies for use in electricity generating facilities; amends the Internal Revenue Code to provide financial incentives to encourage retrofitting, repowering, or replacement of coal-based electricity generating facilities to protect the environment and improve efficiency and encourage the early commercial application of advanced clean coal technologies. Introduced January 22, 2001, and referred to Finance Committee.

H.R. 301, H.R. 302 (Shows). Amend the Consolidated Farm and Rural Development Act to authorize the Secretary of Agriculture to make emergency loans to poultry farmers whose energy costs have increased substantially. Introduced January 30, 2001, and referred to the Agriculture Committee.

H.R. 396 (Pickering). Amends the FY01 Agriculture Appropriations Act (P.L. 106-387) to direct the Secretary of Agriculture to provide emergency assistance to crop, livestock, and poultry producers, and greenhouse operators who have incurred economic losses due to increased energy prices in 2000 or 2001. Introduced February 6, 2001, and referred to the Agriculture Committee.

H.R. 478, H.R. 479, H.R. 480 (Shows). Directs the Secretary of Agriculture to provide emergency loans under the Consolidated Farm and Rural Development Act, to agricultural producers who have experienced qualifying energy cost increases. Such assistance would not depend upon the existence of a natural disaster in the affected farm's county. Introduced February 6, 2001, and referred to the Agriculture Committee. On March 22, Congressman Shows wrote a "Dear Colleague" letter urging support for H.R. 478.

S. 295 (Kerry). Introduced as the "Small Business Energy Emergency Relief Act of 2001," and passed the Senate as the "Small Business and Farm Energy Emergency Relief Act of 2001." The Small Business Committee adopted an amendment (originally introduced as S. 380 by Senator Kohl) to include farmers. Section 4 relates specifically to agriculture and amends the Consolidated Farm and Rural Development Act, to authorize USDA to make disaster loans to assist farmers to recover from economic injuries resulting from sharp and significant increases in energy costs. Authorizes USDA to provide loans for this purpose for two years. Directs the Secretary to submit a report on the effectiveness of such loans, together

with recommendations for improvements, if any, to the Agriculture Committee and the Small Business Committee in both the Senate and House.

S. 295 was introduced on February 8, 2001, and referred to the Small Business Committee. On February 28, the Committee ordered the bill to be reported favorably with an amendment in the nature of a substitute, which included the agricultural provision. On March 26, the bill passed the Senate by unanimous consent. On March 27, the bill was received in the House and referred to the Agriculture Committee and the Small Business Committee.

H.R. 1010 (Tom Udall). Small Business and Farm Energy Emergency Relief Act of 2001. Companion bill to S. 295, including agricultural provisions. Introduced March 13, 2001, and referred to the Agriculture Committee and the Small Business Committee.

S. 568 (Sessions). Amends the FY01 Agriculture Appropriations Act (P.L. 106-387), to provide 2000 and 2001 emergency assistance to crop, livestock, and poultry producers, and greenhouse operators who have or are likely to have increased energy-caused operating costs. Introduced March 20, 2001, and referred to the Agriculture Committee.