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Poultry's Place in Minnesota's Economy

George W. Morse

While people talk about attracting more firms like 3M or Northwest Airlines to Minnesota, the cumulative impact of many small firms often goes unnoticed and unappreciated.

Take the poultry industry. Minnesota is the second largest turkey producer in the nation and the seventh largest egg producer. But just how big is that? How many Minnesota citizens have jobs that depend on the state's poultry industry? Take a guess! Is it 5,000? 15,000? 25,000? Or 30,000? Come on! Don't be chicken! Guess!

If you guessed 25,000, you would have been almost right. Our recent study of the state's poultry industry estimated 26,300 jobs, after you count those who work on farms, in processing plants, in support industries, and in customer industries that serve the workers.

Traditionally, we think of the poultry industry as the combined efforts of poultry producers growing turkeys, broilers, or eggs, and of poultry processors. Of the four thousand people producing poultry, 70% grow turkeys, 11 % grow broilers, and 19% produce eggs.

Spin-off Industries Add More Jobs

Spin-off industries are those sectors that depend on another industry for a part of their existence. There are two types: suppliers that provide goods or services to the poultry industry, and consumer industries that sell goods or services to the employees of the poultry industry and their suppliers.

Poultry-industry purchases alone are the source of more than ten thousand jobs in Minnesota. Most of us think of corn and soybeans as the supplier industry that supplies feed for poultry. But while these are the largest direct inputs to poultry, they are not the largest suppliers when the entire chain of suppliers is considered.

Consider for a minute the other industries and jobs involved in selling soybean meal to a turkey farm. The soybean farmer must purchase seed, fertilizer, equipment, land, and labor. Trucking is needed. The trucking company has to buy its equipment, maintain the trucks, gas them up, and pay the drivers.

After all of the linkages are traced, 351 of Minnesota's 461 industries (or 76%) sell directly or indirectly to the industry.

Over five thousand people work in industries such as food stores, eating establishments, recreation, health care, housing, and others where poultry industry employees spend their money. Actually, most industries are both "supplier" and "employee consumer" industries, selling some of their goods

(See *Poultry* page 2)

Energy Use in Minnesota Agriculture

Barry Ryan and Douglas G. Tiffany

Nine commodities dominate Minnesota's agricultural output and, by extension, the state's agricultural energy use. This article reports on the amount and type of fuel each commodity group uses to produce, transport, and process the state's agricultural bounty.

No direct measures of farm, transportation, or processor energy consumption exists, so we conducted a series of calculations to form the necessary estimates. Published farm budget data on direct energy-related expenditures were allocated to various fuel types and physical input units were estimated on a per acre, per head, or hundredweight basis. Statewide values were calculated by applying these averages to overall crop and livestock production levels.

Energy-consumption data in the transportation and processing sectors are even more limited, so our analysis relied on industry experts and published sources before applying these to the various commodity flows.

Corn

Minnesota is the nation's fourth-largest corn producing state, with 6.7 million acres planted in 1995, the year of our analysis. At the farm level, corn is also the largest user of diesel, gasoline, and LP gas, and it requires the second highest usage of electricity. Corn requires the most diesel for transportation but a relatively small amount of energy is used in processing.

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*(**Poultry** continued from page 1)*

and services to the firms producing goods and services and some of them to employees for their personal consumption. Even though most do both, we are able to split out the amount spent by customers versus that spent by either the poultry industry or its suppliers.

Estimating the number of employee consumer industry jobs that are dependent on the poultry industry is tricky because of the nature of the model used—regional input-output analysis. Economists generally agree that omitting these types of jobs understates the total impact, but that including 100% of the additional income earned overstates the impacts.

Overestimation of impacts can occur because the models assume you will spend the same percent of your budget on each product at every income level. In other words, if you get a 20% raise this year, you would spend 20% more on everything you bought last year. While we know this isn't correct, the model's mechanics don't allow us to change it. To deal with this shortcoming, our study assumed that only 50% of the new income would be spent.

In total, the spin-off industries employ over 16,000 people or 1.6 times the number employed directly. Adding the two together, we estimate that the poultry industry supports a total of 26,344 jobs in Minnesota.

Two questions are common about the employment estimates.

Question 1: Are these full-time jobs, full-time equivalents, or part-time jobs? All of the estimates of jobs in this study include both full- and part-time jobs rather than full-time equivalents. This is the case for poultry production and processing, the supplier industries, and the employee consumer industries.

Question 2: Do the estimates for the supplier industries include a) all of the people in that industry—including those who are supporting other non-poultry industries? or b) only those jobs that depend on the poultry industry? Option b is correct. Without the poultry industry, the supplier industries would employ ten thousand fewer people—assuming that nothing else came in to fill the gap.

Figure 1. Direct Minnesota Poultry Industry Employment: 1996

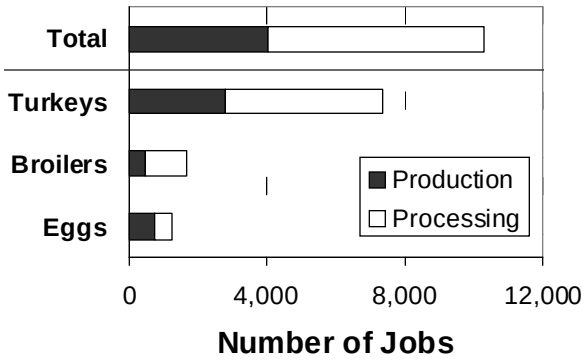


Table 1. Jobs Due to Poultry Industry in Minnesota: 1996

Industry	Turkeys	Broilers	Eggs	Total	Percent of Total
Agricultural services	1,454	280	228	1,962	7
Soybeans	1,109	218	159	1,486	6
Corn/feed grains	712	217	103	1,032	4
Veterinarians	100	13	24	137	1
Business services	987	128	193	1,308	5
Retail	821	146	233	1,200	5
Wholesale	820	86	118	1,024	4
Transportation	653	91	107	851	3
Feed processing	645	154	92	891	3
Health/medical	416	77	130	623	2
Eating places	391	69	115	575	2
Paper products	371	28	49	448	2
Other manufacturing	323	50	65	438	2
Personal services	300	50	78	428	2
Food processing	219	42	40	301	1
Banking	214	33	49	296	1
Construction	212	28	37	277	1
Government	210	37	60	307	1
Housing	201	33	44	278	1
Entertainment	140	24	40	204	1
Insurance	133	24	37	194	1
Utilities	77	13	12	102	<1
Communications	65	8	12	85	<1
Other sectors	1,180	225	183	1,588	6
Total spin-off jobs	**11,753**	**2,074**	**2,208**	**16,035**	**61**
Production	2,810	477	755	4,042	15
Processing	4,550	1,200	517	6,267	24
Total direct jobs	**7,360**	**1,677**	**1,272**	**10,309**	**39**
Grand Total	**19,113**	**3,751**	**3,480**	**26,344**	**100**

Source: IMPLAN estimates by author

How Many Industries?

Combining the supplier industries and the employee consumer industries, 393 of Minnesota's 461 industries (85%) have a part of their business that depends on the poultry industry. If six out of ten jobs created by the poultry industry are outside the industry, where are these jobs?

Table 1 shows the jobs created by the poultry industry on an industry-by-industry basis. Agricultural services employ the greatest number, with 1,962 jobs. One of the reasons that "agricultural services" show the largest impacts is that in the model we use, expenditures for chicks or poults are included here. In addition, as discussed above, the spin-offs are not entirely due to sales directly to the poultry industry. Rather, they include the sales to any of the other industries that sell directly to the poultry industry. For example, soil preparation, crop services, and management services purchased by corn and soybean producers would show up in the agricultural services industry.

The agriculturally related industries (agricultural services, soybeans, corn, and veterinarians) account for 28% of the total spin-off jobs and 18% of the total jobs depending on the poultry industry (see table 1). Poultry farm production (15% of the total), processing (24% of the total), and production from agriculturally related industries, in total, account for 57% of the 26,344 jobs in Minnesota that depend on the poultry industry.

The remaining 43% of Minnesota jobs fall into business categories that are not classified as agricultural. As shown in table 1, the spin-off employment due to the poultry industry in business services and in personnel services is greater than the employment in the corn and feed grain sectors

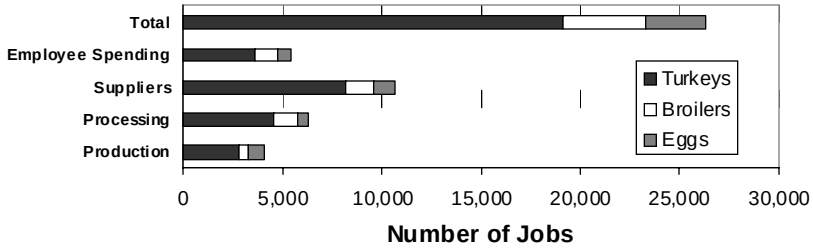
How Many Jobs?

The spin-off jobs due to each major component of the poultry industry also are shown in table 1. The turkey industry creates 73 percent of the total spin-off jobs. Eggs account for 14 percent and broilers for 13 percent.

Space does not permit reporting the impacts for all 393 sectors that sell directly or indirectly to the poultry industry, but table 1 does show the impacts for the major sectors. Some of these go far beyond what are generally considered related to the poultry industry. This is due to employee spending. For example, you can see that eating places had 391 jobs due to the spending by turkey employees, 69 jobs due to the spending by broiler employees, and 115 jobs due to the spending by the egg industry employees.

The information is table 1 is presented graphically in figure 2, but with a twist. The 4,041 grower jobs, the 6,267 processing jobs, the 10,633 supplier-industry jobs, and the 5,402 jobs in employer consumer industries add to the total of 26,344 Minnesota jobs noted above.

Figure 2. Jobs Depending on Minnesota Poultry Industry: 1996



Income Impacts

In total, the poultry industry added $905 million to the gross state product in 1996. As shown in figure 3, about 16% of the additional value-added income came from production, 18% from processing, 43% from suppliers, and 23% from employee consumption industries.

Figure 2, which shows added jobs, and figure 3, which shows added income, are broadly comparable. When producers, processors, suppliers, and employee consumer industries are compared, suppliers employ the most workers and earn the most income. The processing plants contribute less to value-added income than producers do, even though the processors employ more people. Nearly all of this difference is due to the estimate for the egg sector, which has higher earnings per worker.

Impact Comparisons

Imagine poultry production and processing as a single firm called "Poultry." In this case, "Poultry," with 10,308 jobs, would be the 13th-largest employer in Minnesota and the 9th-largest private-sector employer.

To continue with this mental picture, think of the spin-off industries as a single firm, called "Spin-Off." This would make "Spin-Off," with 16,035 jobs, the 6th-largest private-sector employer.

Now assume that "Poultry" buys "Spin-Off" and creates a new firm called "Total Poultry Dependent." This new firm, with 26,344 jobs, would be the 2nd-largest private-sector employer in the state.

Figure 4 shows how these three hypothetical firms would compare with the employment and income from two well-known Minnesota firms, namely 3M and NWA. The firm "Total Poultry Dependent" would employ more people than either 3M (the state's 4th-largest private employer) or NWA (the state's 5th-largest private employer). While we

Figure 3. Income Generated by Minnesota Poultry Industry: 1996

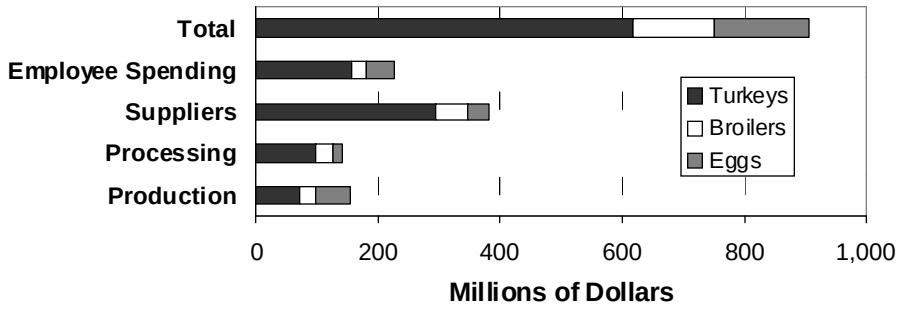
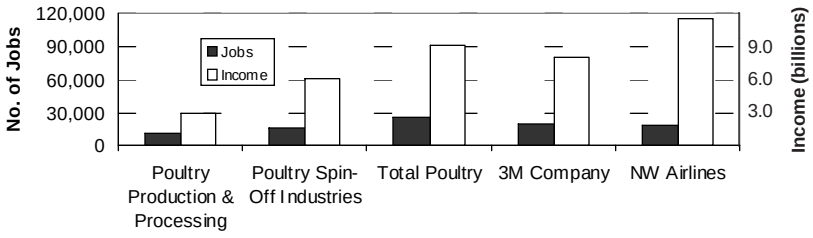


Figure 4. Minnesota Poultry Jobs and Income vs. Large Firms: 1996



tend to think of agriculture as paying lower wages (and it does), the total income earned by "Total Poultry Dependent" matches our estimate of income for 3M and is close to that of NWA. The income shown in figure 4 reflects earnings for labor, capital, and land rather than just employee compensation.

But wait, isn't this an apples-and-oranges comparision? Yes, a part of it is. The firm "Total Poultry Dependent" adds the direct effects from the poultry producers and processors to their spin-off industry effects, but neither 3M nor NWA has its own spin-offs shown in the figure. Even so, these comparisons give a more tangible picture of the size of the components of the poultry industry.

Study Methodology

This study used a regional input-output model (IMPLAN) to estimate the linkages between the poultry industry and the spin-off sectors. This approach has two major shortcomings: the limitation imposed by the regional input-output models and the data available for estimating the direct impacts.

Regional input-output models such as IMPLAN provide tremendous detail, but they rely on our first accepting a number of major assumptions: 1) the supply of labor and other intermediate resources is not limited, so growth will not increase wages or other prices; 2) the proportion of supplies purchased outside the region will stay the same as growth occurs; 3) household consumption of each item increases in direct proportion to income; 4) there is no underemployment; 5) there are no economies of scale; and 6) there will be no substitution between inputs due to price changes.

If the first three assumptions are not correct, impacts are likely to be overestimated when there is economic growth. In our study, fortunately, the first assumption is not likely to be a problem. The poultry industry, while sizeable, is not large enough to influence wages or other prices on its own.

The second assumption is not a problem here because we examine only existing linkages. If the model were used to examine increases in the industry, we would need to be more careful with this one.

The third assumption would definitely be a problem in this study if full income were used to estimate induced employee-spending impacts. To correct for this, we decided to use only one-half of the income stemming from the industry for household consumption spending.

If the purpose of this project was to examine an expansion in the poultry industry, assumptions 4 and 5 would be problematic. However, for the structural linkage study done here, these assumptions do not present a problem because only the existing linkages were examined in this study.

Assumption 6 is unlikely to be a problem since prices are not changed in a linkage study. Even for an impact study, this is seldom a problem for individual plants. Of course, it could be a major problem if we were looking at tax policies or other national policies that lead to changes in relative prices.

You can obtain copies of our full report from the Extension Distribution Center. Ask for "Economic Impact of Minnesota's Poultry Industry," item #MI-7020. To order, call (800) 876-8636.

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*(**Energy** continued from page 1)*

Field operations—from tillage, to planting and harvesting—consumed 9.4 gallons of diesel fuel per acre, plus another 1.1 gallons of gasoline.

Most of the corn crop needs post-harvest drying. Although the amount of moisture removed varies from year to year, producers used 9.6 gallons of LP gas per acre for drying in 1995. Finally, growers used an average 35.6 kWh (kilowatt-hours) per acre to produce the crop.

While these farm-level amounts of energy are relatively modest considering the amount of corn produced, aggregate statewide consumption still amounted to 63 million gallons of diesel fuel, 64 million gallons of LP gas, 235 million kWh of electricity, and 8 million gallons of gasoline.

Of the total crop, about 100 million bushels are processed into corn sweeteners and ethanol, 300 million are fed to livestock in the state, and the remainder (over 300 million bushels in 1995) is exported out of state. The diesel fuel needed to transport the 1995 crop, either within the state or to the state border, totaled 10.8 million gallons.

Of the 100 million bushels of corn processed within the state, about 70 percent goes to produce ethanol, while the rest is wet-milled into corn sweeteners, starches, and some additional ethanol. For every 100 bushels of corn used in ethanol production, 25 kWh of electricity and 1.6 Mcf (thousand cubic feet) of natural gas are required. Wet-milling requires 2.5 Mcf of natural gas and 100 kWh of electricity per 100 bushels. The combined energy demand for corn processing totaled 1.9 million Mcf of natural gas and 47.5 million kWh of electricity.

Soybeans

Minnesota's 1995 soybean crop totaled 235 million bushels and ranked third among the states. Soybean production in Minnesota represented the second-highest usage of diesel and gasoline at the farm level. Field operations required 7.4 gallons of diesel fuel per acre and 0.9 gallon of gasoline. In addition, 27.5 kWh of electricity and only 0.75 gallon of LP gas were needed because soybeans typically do not

require drying. Statewide there were 5.8 million acres planted in soybeans, which required a total of 43.8 million gallons of diesel fuel to cultivate and harvest.

Soybean processors are the largest agricultural users of electricity in the state and the second largest of natural gas. Soybeans generally are processed near the animals that will eventually consume the soybean meal. Roughly half the state's soybean crop is crushed in Minnesota, while the other half is exported from the state. The amount of diesel fuel used for moving soybeans to the processor or state border totaled 6.1 million gallons. In addition, soybean processing plants use physical and chemical methods to separate the crude soy oil and soybean meal from the raw, unprocessed beans. The initial separation of meal and oil, plus refining the oil into a stable product, requires 4.2 Mcf of natural gas and 167 kWh of electricity for every 100 bushels processed. Processing half of the 1995 soybean crop required 4.9 million Mcf of natural gas and 196 million kWh of electricity.

Wheat

Minnesota is the number three wheat producing state in the U.S. In 1995, 2.25 million acres were planted, resulting in a crop worth $331 million. Farm-level fuel use averaged 7.2 gallons of diesel per acre, 0.9 gallon of gasoline, 0.8 gallon of LP gas, and 30 kWh of electricity.

Total statewide production of wheat was considerably less than soybeans, simply because fewer acres of wheat were planted. In total, wheat growers used 16.3 million gallons of diesel fuel, 2.0 million gallons of gasoline, 1.8 million gallons of LP gas, and 67 million kWh of electricity.

In 1995, moving wheat to milling facilities required 4.9 million gallons of diesel fuel. The milling process includes grain cleaning, grinding, sifting for size and density, material handling, and packaging. In flour production, the largest single operating expense is the cost of electricity used to run the motors that power the grain conveyors and roller mills. Each bushel of wheat turned into flour requires 1.74 kWh.

The total amount of electricity needed to process Minnesota's 71.8-million-bushel harvest of wheat exceeds 125 million kWh, which makes wheat milling the third highest user of electricity in the state, behind milk and soybean processing.

Dairy

Minnesota dairy farms produced 9.41 billion pounds of milk in 1995, which makes Minnesota the number five dairy state in the nation. The state ranks third in milk used for making manufactured products such as butter and American cheese.

Electricity is the largest single energy expense for dairy operators. At the farm level, dairy farmers used 376 million kWh of electricity, or 600 kWh per year for a typical cow producing 15,000 pounds of milk annually.

The total diesel fuel requirements to transport raw milk to a bottling plant are estimated at 9.4 million gallons. This is the second largest transportation use among Minnesota farm commodities; it is due to the many trips that bulk-milk trucks make at less than full capacity.

Of the milk produced on Minnesota farms, 51 percent is made into cheese, 35 percent is dried, and 14 percent is used as liquid for bottling. Milk processors use energy to pump, pasteurize, homogenize, dry, package, and sanitize milk and milk products.

The dairy industry is the largest user of natural gas and the second highest user of electricity among agricultural processors in the state. Drying milk requires 0.16 Mcf of natural gas and 2.57 kWh of electricity per (raw) hundred pounds of milk. Thus, milk that is dried requires four times as much natural gas and nearly twice the electricity consumption of milk used for cheese making. In contrast, bottling milk requires just 20 percent of the natural gas and 25 percent of the electricity used for making cheese.

In summary, processing the 9.5 billion pounds of milk produced statewide into dried-milk products, cheese, and bottled milk requires 7.3 million Mcf of natural gas and 161.8 million kWh of electricity.

Swine

In the swine industry, production at the farm level can be divided into farrowing (breeding and raising young pigs up to 25–40 pounds) and finishing (fattening hogs for slaughter at about 240 pounds). While some operators specialize in one or the other, many take the animals all the way from farrow to finish. Combining these two stages, swine production requires the third-largest amount of electricity at the farm level.

Minnesota is the number three swine producer in the U.S. Hogs and pigs totaled 4.85 million head at the start of 1995 and over 2 billion pounds of live hogs were slaughtered. Annual farrowings totaled one million litters in 1995 with an average litter size of 8.6 weaned pigs.

Young pigs must be maintained in a comfortable environment, which translates into heating and ventilation costs. Electricity is the largest single energy expense here; one litter of farrowed pigs requires about a quarter of the electricity required for one dairy cow. About half of the pigs farrowed are shipped to another facility for finishing, which uses nearly half-a-million gallons of diesel fuel per year. Transporting the state's 7.0 million finished hogs to market requires another 1.41 million gallons of diesel.

Slaughtering livestock is a rather standard process with common features regardless of the animal being butchered. The hide or feathers, entrails, and blood are removed, and the carcasses chilled. All species require automated equipment, conveyors, and coolers. Steam heat is often used in cleanup tasks. The two principal energy sources in all kill facilities are electricity and natural gas. In 1995, Minnesota's production of slaughtered hogs totaled 2.0 billion pounds and required 740,000 Mcf of natural gas and more than 74.8 million kWh of electricity to process.

Beef

Cattle enterprises can also be characterized by stages in the animal's life cycle. Some operators specialize in raising calves up to about 500 pounds. Other operators feed these fattened calves to a market weight of 1,100 pounds.

Minnesota had 420,000 calves and 530,000 cattle at the start of 1995. During the year 1.5 billion pounds of live cattle were sent to slaughter. Diesel fuel accounts for the largest energy costs, estimated at 124,320 gallons of diesel fuel for shipping calves and 530,000 gallons of diesel for shipping finished steers to market.

By applying the energy factors described above for swine to beef slaughter, we estimated that processors use 543,900 Mcf of natural gas and 55.0 million kWh of electricity.

Turkeys

Minnesota is the number two turkey producer in the U.S., with production that totaled 40 million head in 1995. This translates into 854 million pounds of live birds. Turkeys are typically hatched in specialized facilities, then transported to brooder facilities.

Chicks are kept at 100 degrees F for their first week of life. Barn temperatures are gradually lowered as the birds gain feathers during their first five to six weeks of life, at which point they are generally moved into grower barns.

In barns, ventilation requirements are often handled by computer-controlled doors, windows, and eave vents that permit natural venilation—especially in grower barns. Alternatively, a smaller (and declining) number of growers feed turkeys seasonally "on the range" where the turkeys are given minimal shelter and fed in large fields.

LP gas is the dominant fuel used to heat turkey brooder barns and grower barns, which makes turkey production the second largest user of LP gas at the farm level after corn drying. Using a year-round factor of 0.023 gallon of LP gas per pound of turkey produced, 0.5 gallon of LP gas is used to produce a turkey with a statewide average slaughter weight of 21.8 pounds. Electricity requirements for raising turkeys were 1.24 kWh per head, which is comparable to swine after adjusting for the smaller size of a turkey. Diesel fuel requirements were 0.091 gallon per head and gasoline usage was 0.011 gallon per head.

When turkeys are ready for market they are hauled by semitrailers, which require 0.0115 gallon of diesel fuel per bird. Thus, the total energy required to transport turkeys in Minnesota is 467,107 gallons of diesel fuel.

Most turkeys raised in Minnesota are slaughtered here, too. National figures for the energy requirements of slaughter per bird are 0.9 kWh of electricity and 0.009 Mcf natural gas. This provides us with an estimate of total turkey processing energy needs of 360,000 Mcf of natural gas and 36.4 million kWh of electricity.

Sugar Beets

The sugar beet crop totaled 7.43 million tons produced on 427,000 acres. Diesel fuel usage was 28.9 gallons per acre at the farm level. From remote storage sites to processing plants, transportation charges accrue to processors for hauling beets. Transportation requires about 4.9 million gallons of diesel fuel.

At a sugar beet processing facility, pulverized coke and ground limestone are placed in kilns to produce carbon dioxide and milk of lime, which is then used to purify the sugar beet juice. In most plants, bituminous coal is used to produce steam in the boilers and to produce some of the electricity used by the plant; the remainder is purchased from the local grid. Natural gas is used for some of these heating processes.

Processing the total Minnesota sugar beet crop requires 440,366 tons of coal, 4.43 million Mcf of natural gas, and 68.36 million kWh of electricity.

Sweet Corn and Green Peas Used for Processing

Minnesota ranks number one nationally in sweet corn and green peas grown for canning and freezing. In 1995, these crops had combined farm marketing receipts of $81 million. Sweet corn was grown on 134,000 acres and peas on 92,900 acres. Sweet corn requires about 1.19 million gallons of diesel fuel to transport from field to processor and green peas 382,000 gallons.

Natural gas is used to produce steam in canning plants and electricity is used to run conveyors and pumps—as well as to run freezing units. Making steam requires 143,738 Mcf of natural gas and more than 15 million kWh of electricity.

The total energy requirement for processing corn and peas amounts to 278,000 Mcf of natural gas and 29 million kWh of electricity.

Summary

Nearly all activities supporting farm production and commodity processing in the state require energy. This article reports the amount of energy used in the production, transportation, and processing of the state's 1995 agricultural output. The totals are estimated at 241 million gallons of diesel fuel, 24 million gallons of gasoline, 123 million gallons of LP gas, 23 billion cubic feet of natural gas, and 2.27 billion kWh of electricity.

Compared to total statewide energy consumption, farm-to-processor agriculture uses 30 percent of all LP gas, 21 percent of all diesel fuel, 4 percent of all electricity, 6.5 percent of all natural gas, and 1 percent of all the state's gasoline.

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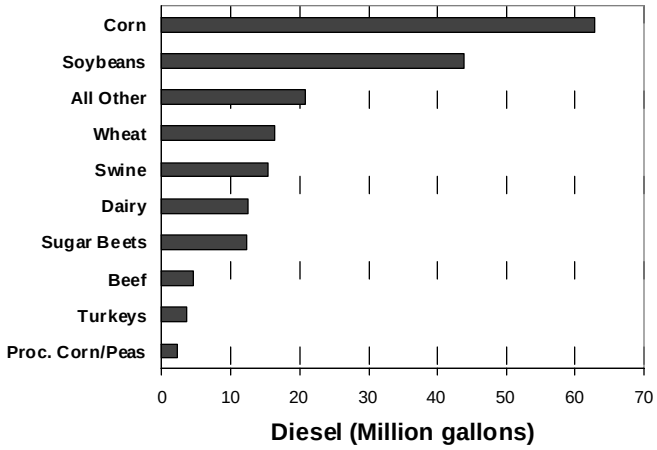
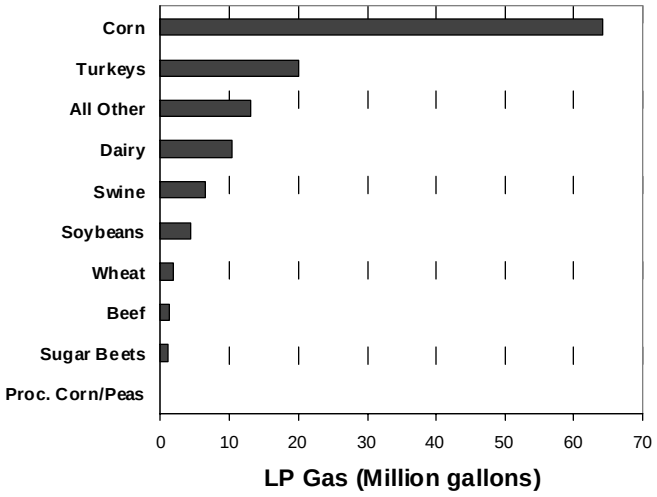
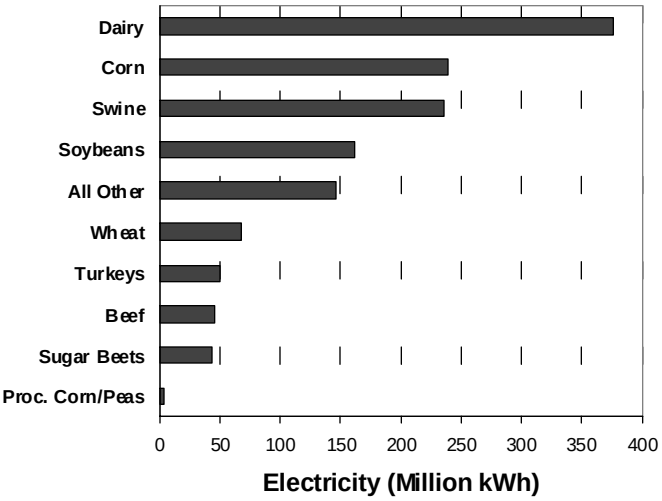
Estimated Energy Use in Minnesota Agriculture

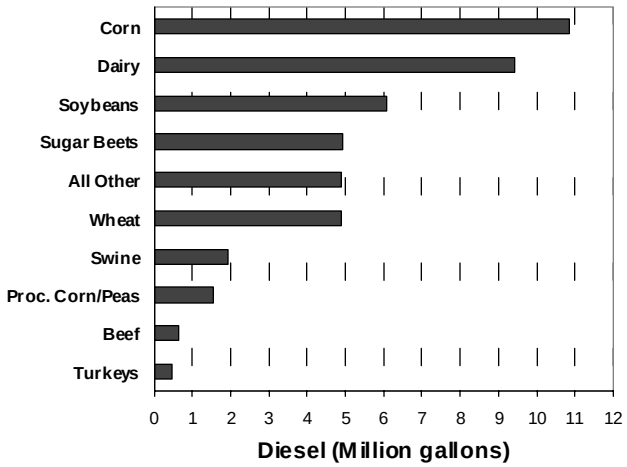
Farm

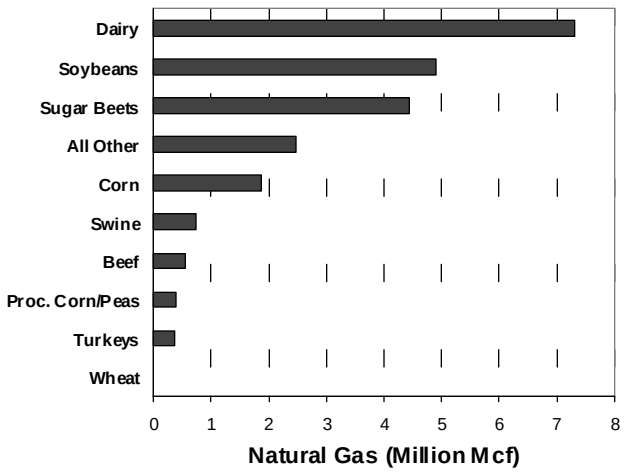


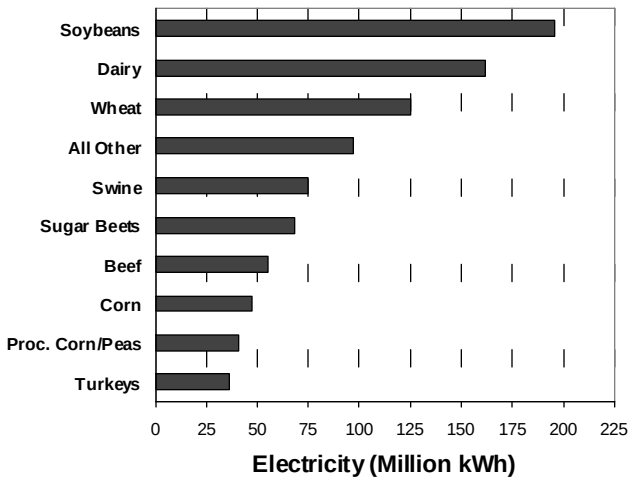




Transportation and Processors







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