1. Introduction

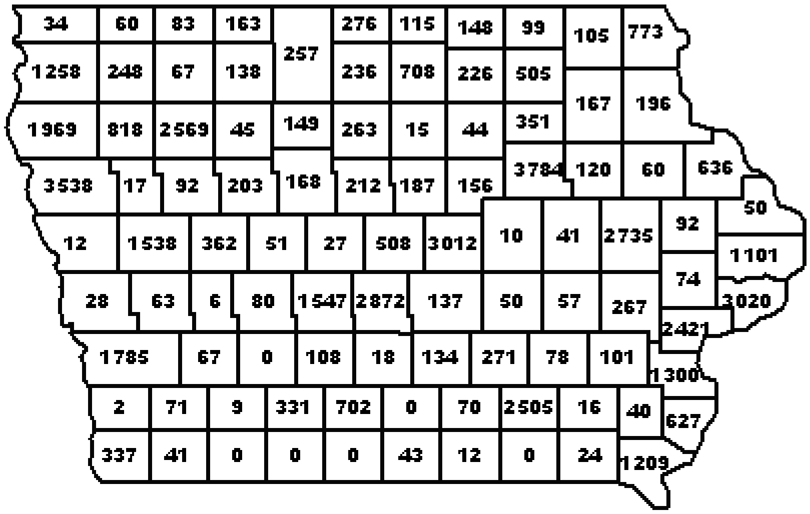

Figure 1.1 – Food processing employees in Iowa

DEFINITION OF FOOD PROCESSING

Food processing is defined as converting edible raw materials into higher value consumer food products. The conversion process utilizes significant amounts of labor, machinery, and energy. In addition, it relies increasingly on scientific knowledge to both improve food quality and safety, and to reduce production costs.

The North American Industry Classification System (NAICS) groups businesses into categories based on their primary activities. NAICS has replaced the older Standard Industrial Classification (SIC) codes to provide a common basis for economic data collection and analysis for the U.S., Canada, and Mexico. Food processing is part of the manufacturing sector: its NAICS classification code is 311. The sub-sectors are:

3111 Animal Food Manufacturing
3112 Grain and Oilseed Milling
3113 Sugar and Confectionery Product Manufacturing
3114 Fruit and Vegetable Preserving and Specialty Food Manufacturing
3115 Dairy Product Manufacturing
3116 Animal Slaughtering and Processing
3117 Seafood Product Preparation and Packaging
3118 Bakeries and Tortilla Manufacturing
3119 Other Food Manufacturing

Beverage manufacturing is classified in NAICS category 312 Beverage and Tobacco Product Manufacturing.

ECONOMIC IMPORTANCE

Food processing is one of the largest and most important of all manufacturing sectors in the U.S. Data from the Advance Report of the 2002 Economic Census show that food manufacturing includes 26,300 individual companies with combined sales exceeding $457 billion, annual payrolls of over $45 million, and a combined workforce of more than 1.5 million employees. Within the manufacturing sector (NAICS Codes 31 through 33) food processing is second in sales, third in workforce size, fourth in number of individual businesses, and fifth in annual payroll. Based on a comparison of the 1997 and 2002 economic census, food processing is the only sector in manufacturing that reported growth in all four categories.

Food processing is a significant component of Iowa's employment activity with all but five of the 99 counties engaged in some aspect of it (see Fig. 1.1). Fifty-five counties have over 100 workers employed by food processors. According to 2002 data from the Bureau of Economic Analysis, food processing in Iowa contributes $4.3 billion to the Gross State Product (GSP). This is 21% of the manufacturing GSP, making it the largest sector in manufacturing, both in sales volume and number of employees. Currently Iowa has 682 food industry employers with a combined workforce of 51,341 employees.

HISTORY

The development of the food processing industry has been driven by two primary factors: food safety and the need for a longer "shelf life." The earliest forms of food processing were heat-dried food products. The French, in the 1790s, were the first to record efforts at using heated air to dry food. They were encouraged in their efforts by their emperor, Napoleon Bonaparte, who offered a prize for the development of foods that could be preserved for his army. French chef and candy-maker Nicolas Appert won the prize by cooking and then reheating food in glass bottles sealed with wax corks, and, for this reason, Appert is recognized to be the "father of canning." The fragile bottles were eventually replaced, beginning in England, with durable metal containers.

The next step in the evolution of food processing occurred in the 1860s when Louis Pasteur discovered that partial sterilization (by heating to a temperature well below that required in canning) of liquids such as milk, orange juice, wine, and beer would destroy disease-causing and other undesirable organisms.

In the early 1900s Clarence Birdseye, an American field naturalist working for the government near the Artic Circle, noticed that freshly caught fish, frozen in snow, retained its fresh qualities after thawing. After years of experimentation, Birdseye developed a process to freeze fish (and, later, other food) between two flat, refrigerated surfaces under pressure. On March 6, 1930, in Springfield, Massachusetts, Birdseye's company launched the retail frozen foods market with 26 items, including 18 cuts of frozen meat, spinach and peas, a variety of fruits and berries, blue point oysters, and fish fillets.

Modern food processing still involves using energy to raise and/or lower the temperature of a product to make it safer and extend its shelf life. Dehydration is also a common process used to extend shelf life, and it has its own energy requirements. As a result of these advancements, consumers can spend less of their food dollars on basic meat, eggs, and dairy products, which gives them additional resources to invest in value-added products that provide convenience (and quality).

ENERGY CONSUMPTION

Food processing is an energy intensive activity. In 1998, it consumed 7%—more than 213 trillion Btu—of the total electricity used nationwide by the manufacturing sector.

According to the American Council for an Energy Efficient Economy, less than 8% of the energy used by manufacturing is for non-process uses such as facility heating/cooling, lighting, ventilation, etc. Therefore, the main focus of managers who want to reduce energy costs must be on process-related uses.

PURPOSE OF THIS PUBLICATION

The mission of the Iowa Energy Center (IEC) includes striving to improve energy efficiency in all areas of Iowa's energy use. Obviously, industry is a significant consumer of energy, and the IEC has funded the work behind this publication with the intent of improving energy efficiency in Iowa's largest manufacturing sector, food processing.

APPROACH

Energy efficiency can be improved in at least two ways: (1) directly through means that reduce consumption and/or waste at the point of use, or (2) indirectly through means that reduce the required amount of energy per unit of product produced. An example of direct savings would be replacing an oven burner with a more efficient design, thus reducing the natural gas consumed by the oven. An example of indirect savings would be improving the mechanical efficiency of a mixing process by changing the physical shape of the container, the shape of the mixing device, and/or the movement of the two, thereby reducing mixing time for a given volume of product. The energy requirement per unit of output for that process would be reduced. Thus, the energy efficiency would be improved because the ratio of product produced to energy consumed was improved.

This publication will focus primarily, but not exclusively, on the direct means of reducing energy consumption and/or waste at the point of use. It will, however, also present means to indirectly reduce energy requirements through increased efficiencies in processes.

The heart of this publication is the chapter titled Energy Management. The remaining chapters are organized by process type, not by industry sector. Because processes are common to many different sectors, it was believed that the document would be more effective organized in this way.

There are also several appendices that provide information on many existing resources that food processors can use in their efforts to improve energy efficiency.