



# ERS *Report Summary*

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## Energy Use in the U.S. Food System

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Energy is used throughout the U.S. food supply chain, from the manufacture and application of agricultural inputs, such as fertilizers and irrigation, through crop and livestock production, processing, and packaging; distribution services, such as shipping and cold storage; the running of refrigeration, preparation, and disposal equipment in food retailing and foodservice establishments; and in home kitchens. Dependence on energy throughout the food chain raises concerns about the impact of high or volatile energy prices on the price of food, as well as about domestic food security and the Nation's reliance on imported energy. Use of energy in the food chain could also have environmental impacts, such as through carbon dioxide emissions.

### What Is the Issue?

A number of Government and academic studies over the past four decades have examined food-related energy use in the United States. Taken together, these studies indicate that food-related energy use has remained a substantial share of the total national energy budget, that food-related energy use of households has been the largest among supply chain stages, and that food-related energy flows may have increased significantly over the past decade. These results, however, do not explain why energy use has changed over time and may not provide a valid measure of these changes since the various studies rely on different data sources and different model assumptions.

This report compares estimates of energy use in 1997 and 2002 by using data exclusively from two Federal agencies and employing the same energy-flow model over each year of analysis. A projection of food-related energy use in 2007 is also reported. This approach complies with well-established international "best practices" for the measurement of energy use throughout a national economy and facilitates valid comparisons of energy flows over two or more periods. The report provides policymakers and analysts with information to assess which stages of the food supply chain and what industries are the largest energy users, which stages and industries have experienced the fastest rates of energy-use growth, what factors have influenced increases in energy use in the food sector, and what factors are likely to influence changes in the future.

### What Did the Study Find?

During 1997-2002, per capita energy use in the United States declined 1.8 percent, while per capita food-related energy use in the United States increased by 16.4 percent. The population of the United States grew by more than 14 million over the period, pushing total energy use up by 3.3 percent and effecting an increase in total food-related energy use of 22.4 percent. As a share of the national energy budget, food-related energy use grew from 12.2 percent in 1997 to 14.4 percent in 2002.

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Several economic factors can influence the use of energy throughout the U.S. food system, such as labor and energy costs, the ability to substitute between these inputs as their costs change, the time availability of households for food-related activities, and household affluence. Findings suggest that about half of the growth in food-related energy use between 1997 and 2002 is explained by a shift from human labor toward a greater reliance on energy services across nearly all food expenditure categories. High labor costs in the foodservices and food processing industries, combined with household outsourcing of manual food preparation and cleanup efforts through increased consumption of prepared foods and more eating out, appear to be driving this result. Increases in per capita food expenditures (adjusted for inflation) and population growth also helped drive up food-related energy use over this period, with each trend accounting for roughly a quarter of the total increase.

Energy use and growth varied across all stages of the U.S. food supply chain (agriculture, processing, packaging, transportation, wholesale/retail, foodservice, and household). Household operations accounted for the highest food-related energy use in 1997 and 2002. Food processing, however, showed the largest growth in energy use over this period, as both households and foodservice establishments increasingly outsourced manual food preparation and cleanup activities to the manufacturing sector, which relied on energy-using technologies to carry out these processes. Over this period, the food processing and foodservice industries faced increasing labor costs, while energy prices in this period were lower and far less volatile than they have become since 2002. In agriculture, the largest percentage increases in energy use were attributed to producers of vegetables and poultry products. The freight services industry accounted for a small share of the increase in overall food-related energy use but a substantial share of the increase attributed to some food commodities—particularly fresh fruit and poultry products.

A projection of food-related energy use based on 2007 total U.S. energy consumption and food expenditure data and the benchmark 2002 input-output accounts suggests that food-related energy use as a share of the national energy budget grew from 14.4 percent in 2002 to an estimated 15.7 percent in 2007. Although energy prices were high and volatile over the 2002-07 period, households and the foodservice industry continued to outsource food preparation through the purchase of prepared foods with high energy-use requirements.

## **How Was the Study Conducted?**

Using a framework known as input-output material flow analysis, this study traced the measured flows of all energy sources used as fuel in the United States to final markets in three interrelated steps: (1) measure all known quantities of energy directly used in each domestic production activity, including household operations, organized into roughly 400 industry classifications; (2) trace the flow of energy embodied in each of the energy-using industry products throughout the production economy and into a complete accounting of final market sales; and (3) identify all food-related final markets and assess the food-related energy embodied in all final market sales. This analysis uses data from two Federal sources: the Bureau of Economic Analysis Benchmark Input-Output tables and the Energy Information Administration's State Energy Data System.