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The Role of Fossil Fuels in the U.S. Food System and the American Diet

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What Is the Issue?

The consumption of fossil fuels, nuclear power, and renewable energy by the ***U.S. food system*** was on par, in 2002, with the ***entire national energy budget*** for India and exceeded the combined energy budgets of all African nations. In addition, energy costs are a substantial and highly variable share of U.S. food costs. This intersection of food and energy commodity markets raises questions about how changing food choices (such as through nutrition promotion) and changing energy prices (such as through a CO_2 emissions tax on fossil fuels) relate. Our research addresses limitations of previous studies by examining the relationship between energy prices and food-system energy use over time and measuring the CO_2 emissions associated with fossil fuel use in the food system. With this information, we analyze whether potential outcomes of nutrition promotion and a hypothetical CO_2 tax are interrelated.

What Did the Study Find?

- **Changing energy prices are the principal cause of year-to-year changes in food-related energy use between 1993 and 2012.**

  Food industries are more sensitive to energy price changes than are nonfood industries. This helps explain why food-related energy use accounted for more than half of the increase in total U.S. energy use between 1997 and 2002 (a period of generally declining energy prices). This also helps explain why food-related energy use declined 7 percent between 2002 and 2007 as energy prices and total U.S. energy use were increasing.

- **Use of fossil fuels to produce the foods and beverages consumed by Americans in 2007 accounted for 13.6 percent of economywide CO_2 emissions from fossil fuels.**

  Domestic fossil fuel use linked to U.S. food consumption produced 817 million of the nearly 6 billion metric tons of CO_2 emissions economywide from fossil fuels in 2007. This disproportionate total is attributed to the food system's above-average reliance on fossil fuel energy sources. Whereas 86 percent of nationwide energy consumption in 2007 came from fossil fuels, the share of U.S. food-system energy from fossil fuels was 93 percent.

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- **Diet-related energy use in the United States could be reduced by 3 percent if average diets changed minimally to meet the Dietary Guidelines for Americans.**

  Many potential diets would meet the 2010 Dietary Guidelines for Americans (DGA), each with varying energy requirements, measured in British thermal units (Btu). We focus on two diets. The ***Realistic Healthy Diet*** results from a model that formulates a diet requiring minimal change from typical diets (as of 2007-2008) to meet the DGA. The Realistic Healthy Diet reduces diet-related energy use in the U.S. food system by 3 percent. To put this in context, this reduction is equivalent to the annual gasoline consumption of 3.7 million U.S. vehicles. The ***Energy Efficient Diet*** is predicated on a diet requiring the minimum energy necessary to meet the caloric and nutrient targets in the DGA, with no consideration for how much diets will actually change. In this diet, energy use (in Btu) is reduced by 74 percent.

- **For each $100 spent on food and beverages, a tax on CO_2 emissions from fossil fuels— reflecting the wide range of current estimates on the social cost of those emissions—results in an average cost increase of $1.70 for both current and Realistic Healthy Diets or $1.90 for the Energy Efficient Diet.**

  Our research indicates that a typical meal would cost 0.2 to 5.4 percent more with the CO_2 tax. This wide range reflects the uncertainty about the social cost of CO_2 emissions, with the average increase over this range at 1.7 percent for both the current and the Realistic Healthy Diets. Although the tax rate averages 1.9 percent for the Energy Efficient Diet, resulting tax revenue is substantially lower due to the food system's reduced reliance on fossil fuels as an energy source. If faced with the CO_2 tax, U.S. producers and consumers would adjust their behaviors in order to mitigate the higher costs. Given the U.S. food system's sensitivity to energy prices, a CO_2 emissions tax would likely result in reduced energy use.

How Was the Study Conducted?

To facilitate a joint analysis of nutrition promotion and fossil fuel CO_2 taxation, we have integrated the material-flows accounting framework adopted by the United Nations Statistical Commission into the existing food-system accounting structure of the ERS Food Dollar accounts. The result is a first-of-its-kind U.S. environmentally extended input-output data system and model called the Food Environment Data System (FEDS). We conduct regression analysis to examine how the intensity of electricity use throughout the food system adjusts to changes in energy prices.

Then, we use mathematical optimization to model healthy diets based on numerous data sources and model specifications. The Realistic Healthy Diet is obtained from a maximum likelihood model designed to identify a diet that meets the DGA and is closest to the average American diet as reported in the National Health and Nutrition Examination Survey (NHANES) in 2007-2008, the years that correspond with the most recent benchmark year of data in FEDS. Using the same modelling approach and data sources, the Energy Efficient Diet results from a model that minimizes energy use while meeting the caloric and nutrient targets in the DGA. The diet modeling was linked to FEDS for the integrated sustainable diet analysis.

Next, the study traced the total cost that would be passed on to food consumers from a carbon dioxide emissions tax. The tax rate reflects the range of current Federal estimates for social costs from CO_2 emissions. We assume that all taxes levied to fossil fuel users are completely passed on to consumers.