Treading Lightly

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After three years of intensive surveys and analysis, the U.S. dairy industry can now lay claim to a very light carbon footprint: an underwhelming 2% of total U.S. carbon emissions, with the farm component of that—from growing feed to delivering milk to the farm bulk tank—at about 1.5%.

The estimate represents 17.6 lb. of carbon dioxide (CO_2) equivalent per gallon of fluid milk consumed. At the farm level, most of the emissions come from enteric sources (emissions from the rumen as microbes digest feed) and manure storage. Energy use accounts for most of processors' emissions. Surprisingly, the transportation from farm to processor to supermarket to homes accounts for less than 10% of the total.

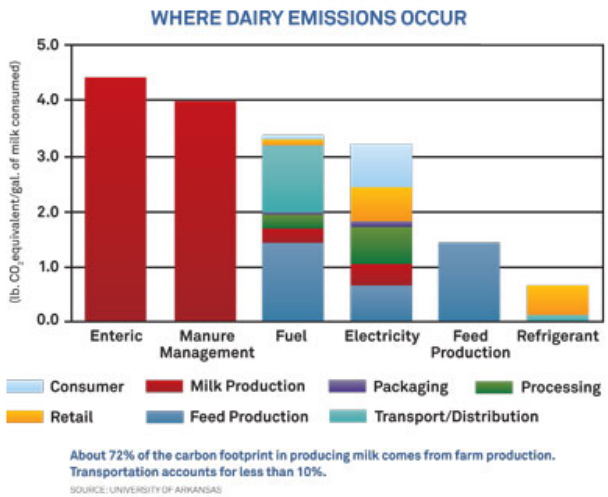
The numbers are based on surveys of 500 dairy farms, 50 fluid processing plants and more than 200,000 round trips transporting milk from farm to processor, with additional trips from grocery stores to home refrigerators.

"What this study does is create a baseline that the dairy industry can use to define and defend future progress," says Greg Thoma, a professor of chemical engineering with the University of Arkansas. Thoma specializes in mathematical modeling and is lead author of the milk greenhouse gas (GHG) life cycle assessment. The study was funded by the Innovation Center for U.S. Dairy.

In 2007, a study by the United Nations' Food and Agriculture Organization suggested that 18% of global GHGs were coming from livestock production. Some environmental groups were claiming that U.S. dairy production was contributing 18% to U.S. emissions.

"In 2007, the industry did not have a good study on what dairy's GHGs actually were," says Erin Fitzgerald, vice president of sustainability for the Innovation Center. So the Center undertook the arduous task of surveying farms and fluid processing plants to come up with a defensible number, she says.

The farm surveys, completed by producers in 37 states, asked detailed questions on production practices and energy use and took hours to complete. Surveyed herds ranged from six to more than 10,000 cows, with production practices ranging from intensive grazing operations to total confinement.



The milk transport component of the study includes some 210,000 round trips from farm to plant. "Some of the co-ops have GPS units on the trucks, so we had actual mileage," Thoma says. For other producers, Thoma used the latitude and longitude of the farm along with Google maps to estimate distances.

Processing plants also completed surveys, detailing their energy use and packaging along with distribution to grocery stores. The final component was estimates of consumer shopping trips through home refrigerator use.

The total GHG estimate is based on the amount of milk actually consumed, not merely purchased. USDA food loss data reports 12% loss at retail and 20% loss at consumption. For example, milk left in the cereal bowl did not go into the denominator, though all the energy to produce that milk went into the numerator, Thoma says.

When Thoma started the study, he thought herd size and region of the country would be big factors in dairies' carbon footprint. "As we did the analyses, those became a weak hypothesis," he says. "What we discovered is that how a farm is managed is much more critical than where it is located or how big it is."

The critical finding of the study is the large variability among farms, Fitzgerald says. The wide range in feed efficiency and manure management offers ways to improve emissions and the bottom line. "Even though your operation may be efficient, there is always room for improvement through new concepts and practices used successfully by other dairies," Fitzgerald says.

"Fuel and electricity usage offer the biggest opportunity for short-term mitigation and cost efficiency," she adds. "That's where the Innovation Center is focusing its current research. Longer-term, we'll have projects looking at ways to reduce emissions from enteric and manure."

Feed conversion and manure management are dairy's Achilles' heel. "Feed conversion is no big surprise," Thoma says. As feed efficiency increases, less land, energy and fertilizer are needed to produce each gallon of milk while less manure and enteric methane are produced.

The study found that anaerobic lagoons and deep-bedded manure packs have a higher carbon footprint than other manure handling systems. Again, this makes sense, Thoma says, since these systems allow microbes to break down the fiber and create methane during storage.

Dairies that graze animals for much of their feed intake do have a slightly higher carbon footprint. But there is large variability, with the most efficient graziers having fewer emissions than low-efficiency confinement operations.

"Enteric emissions should be higher on pasture because the rumen microbes break down the forage and create methane in the process,"

Thoma says. "But grazing cows also have the benefit of distributing their own manure, which decreases their carbon footprint to some extent."