cow is at turning feed into milk instead of waste.

According to Mitloehner, in both the US and Canada a single dairy cow produces 20,000 pounds (9072 kg) of milk per year, but in Mexico it takes five cows to produce the same amount. He said the less milk a cow produces the higher her contribution to the overall GHG emissions of the herd. Conversely, the more milk a cow produces the lower her lifetime contribution to the herd's GHG emissions because she's utilizing the energy in her feed for milk production, not expelling it as waste. Mitloehner said this is one reason going back to small farms makes no sense at all if people believe livestock are responsible for rising GHG emissions.

Mitloehner suggested two ways to reduce a heifer's environmental footprint. The first is earlier calving which means earlier lactation. In a published paper he explained that early in life a heifer drinks milk which she digests and turns into lean body tissue without relying on emission producing rumen microbes. Once on regular feed, which travels through the rumen and activates microbes, the heifer begins producing GHG. While she grows the feed she consumes is only used to produce muscle tissue, not milk, but her GHG output contributes to the herd's emission levels. He said 2007 USDA figures indicate the current national average age at first calving is 25.2 months. That's two years of inputs and GHG emissions without any milk production. Other research indicates the time between birth and first lactation can be reduced, according to Mitloehner.

Mitloehner said input efficiency also reduces the environmental footprint of the dairy herd when it results in increases in first lactation milk yields as well as lifetime milk yields but cautioned, "It has to be sustainable and include food safety, worker safety, and animal welfare."

The second strategy to reducing GHG emissions by dairy cattle is to improve the longevity of dairy cattle. Mitloehner said the North American rate of culling mature cows in a herd raises the overall GHG emissions of a herd because of the need to be raising replacement heifers which aren't producing milk for the first two years of their lifespan. He said improved nutrition in adult cows supports longevity and fertility. And, because, culling is often undertaken because of conception failure, attention to nutrition is especially important. Mitloehner said the variability in culling rates reported across the country indicates that cull rates can be mitigated through genetics and optimal diet.

Michael VandeHaar from Michigan State University said finding the optimal diet for a dairy herd is something dairy producers should focus on in the future. It's all about getting more milk for each unit of feed the cow ingests.

He said feed efficiency has many definitions depending on whether you're talking about a single cow or the global cow population.

The equation VandeHaar uses to define the feed energy in a unit of feed goes like this.The gross energy of feed minus the energy lost as feces, gas, urine, and heat for processing (digesting) the food provides the net energy of the feed. Subtract the amount of heat the cow needs to convert energy into body tissue or maintaining her body from the net energy and the result is the amount of energy available for actual milk production. When the cow is just maintaining body mass instead of building it by growing fat she has more energy available for milk production.

VandeHaar said biological feed efficiency can be as high as 10,000 to 15,000 kg of milk per year for mature Holsteins weighing just under 700 kg. But he doesn't advocate breeding for size alone. It's not all about the size of a cow he said; it's about milk production, cow health, and fertility.

And, as a US researcher, VandeHaar's advice to nutritionists on evaluating the efficiency of feed is based on an open marketing dairy system, but it can be applied to other systems as well. That advice is to pay attention to the spread between feed costs and the income earned from the milk. Supplying expensive feed may not be efficient from a financial standpoint but there are