The Future of Sustainability in the Dairy Industry: A Focus on Net Zero

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Take Home Messages

- Greenhouse gas neutrality or Net Zero for dairy production will require significant changes in emissions, especially reductions in methane emissions.
- More evidence-based solutions are required to reduce emissions.
- Technical solutions without the right financial incentives or focus on social acceptability are likely to fail to achieve wide scale adoption.

Introduction

Sustainability is a growing topic of interest; however, it could be argued sustainability is a label for issues that the dairy industry, and agriculture more broadly, has been grappling with for decades. Those issues include environmental stewardship, the long-term viability of farm businesses and communities, the need for high quality human nutrition, and social responsibility toward people and animals in the farming system. While the broad categories of sustainability issues may be relatively unchanged, changing societal expectations and new challenges have been added to the long list of considerations dairy producers face. One such example is climate change and efforts to reduce the climate impacts of dairy production.

Greenhouse Gas Emissions from Dairy Cattle Production

The U.S. and Canadian dairy industries have set ambitious goals to achieve greenhouse gas (GHG) neutrality and Net Zero emissions, respectively, by 2050. To better understand these goals, we must understand the GHG emissions profile of dairy cattle production. Rotz et al. (2021; Table 1) evaluated U.S. dairy cattle production and determined the activities with producing milk from dairy cattle (not including impacts from the dairy supply chain beyond the farm gate like processing) produced 99 million metric tons of carbon dioxide equivalents (CO_2e) in 2019. Thus, U.S. dairy cattle production represented around 1.5% of total U.S. greenhouse gas emissions in 2019.

Importantly, 62% of the CO_2e emissions emitted from U.S. dairy cattle production are methane emissions, both from enteric and manure sources. This presents both an opportunity and challenge for achieving climate goals because methane is potent at trapping heat but has a short atmospheric lifetime. The practical reality is that strong reductions in methane emissions from dairy production can reduce the sector's warming contribution in the near-term; however, increases in methane emissions can mean contributions to increased warming. As a result, reductions in methane emissions are a key opportunity for dairy, especially as zero methane emissions are not required to achieve no further warming contributions from the industry (Place et al., 2022).

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Table 1. Greenhouse gas emissions from U.S. dairy cattle production (Rotz et al., 2021)

Emissions Source	Percent of Total[1]
Enteric methane emissions	43
Manure methane emissions	19
Manure nitrous oxide emissions	6
Cropland nitrous oxide emissions	4
Indirect nitrous oxide emissions	3
Resource production[2]	22
Anthropogenic carbon dioxide[3]	3

[1]The 100-year global warming potential values of methane and nitrous oxide were 28 and 265, respectively.
[2]The impact of producing farm inputs including fuel, electricity, lime, machinery, purchased feed, seed, and chemicals.
[3]Carbon dioxide emissions from liming and fuel combustion on farm.

However, reductions in methane emissions will require significant changes from business as usual because methane emissions from U.S. dairy cattle enteric fermentation and managed manure have increased since 1990 (Figure 1). In short, historic emissions trends continued into the future will not result in achieving GHG neutrality nor Net Zero for the North American dairy industry.

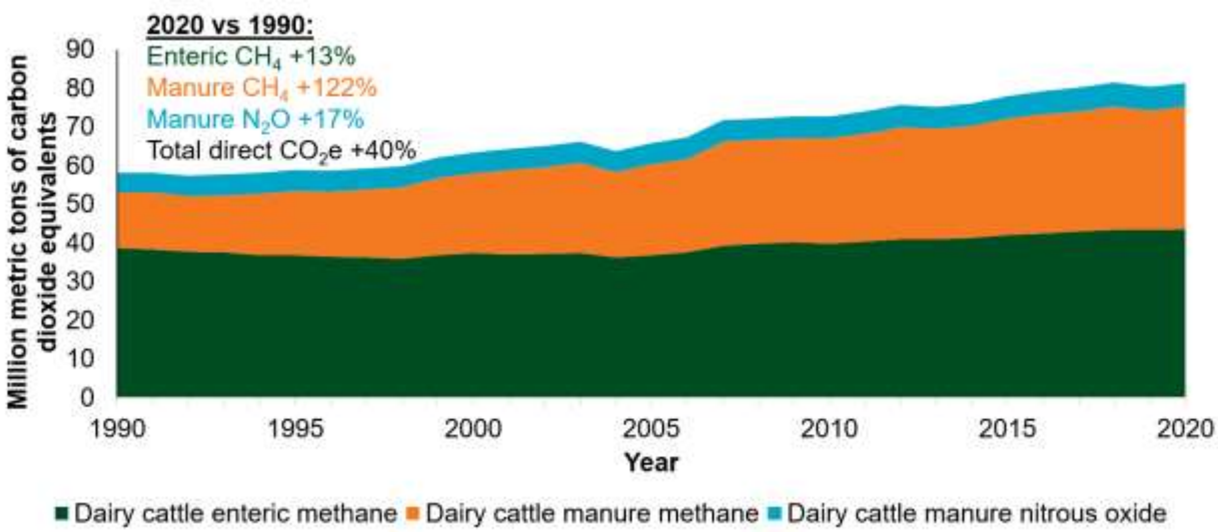

Figure 1. Trends in GHG emissions from U.S. dairy cattle according to the U.S. Environmental Protection Agency (EPA, 2022).

Solutions Need to Consider Adoption

Increasing the number of evidence-based solutions to reduce GHG emissions from dairy cattle production is critical to achieve climate goals. However, just as important as research and development activities to discover new technical solutions are economic and social systems that allow for adoption and long-term viability of solutions. Consideration needs to be given to how potential solutions will impact quality of life of producers and dairy workers (e.g., will a technical solution add complexity to production and labour requirements?). Additionally, we need solutions that can at least be cost neutral or ideally improve margins for cattle producers. For example, as demonstrated in Figure 2, if a feed additive can reduce enteric methane emissions from lactating dairy cattle by 20%, but has no positive effect on productivity, producers will need to receive a carbon price premium to simply breakeven. If the feed additive costs US$0.15 per cow per day, the dairy producer will need to be paid a carbon price of US$75 for the reductions they generate by adopting the feed additive. For context, current voluntary carbon prices are US$2-3 in the U.S. Without adequate compensation, the cost of new feed additives to reduce enteric methane emissions would add to the total costs of milk production, negatively impacting the financial sustainability of dairy cattle production.

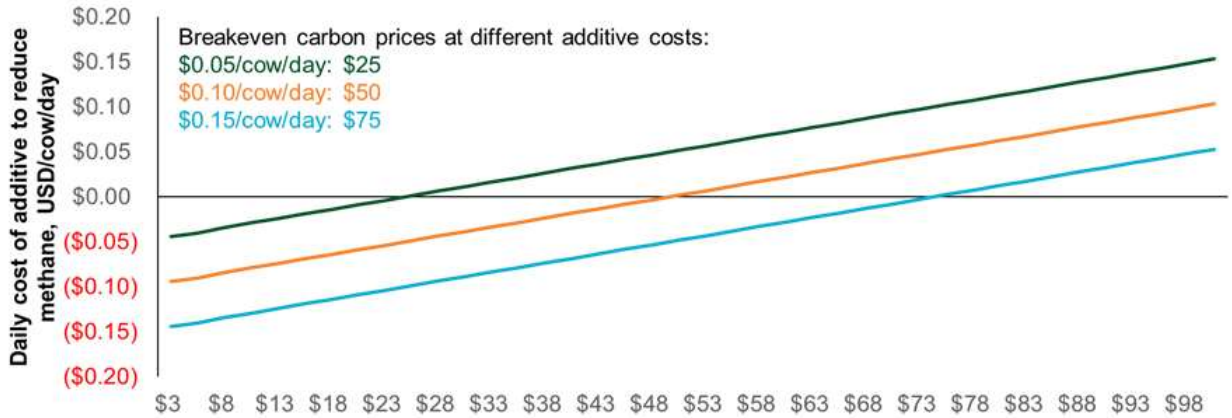

Figure 2. Enteric mitigation example with a 20% reduction per lactating cow in enteric methane emissions and no productivity effects. Assumes 405 g of enteric methane emitted per cow per day. Carbon prices indicate the price the dairy producer receives.

▪ Conclusion

In conclusion, achieving climate commitments will require significant departures from business-as-usual dairy cattle production. New technologies and management strategies are required; however, without considering the economic and social impacts of adopting new technologies, wide scale adoption will likely be limited.

▪ References

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