Jaton, C., Malchiodi, F., Fleming, A., Sweett, H., Van Doormaal, B., Sloan, D., Lohuis, M., Miglior, F. (2026) Balancing methane reduction and genetic gain: insights from methane efficiency evaluations in Canadian Holsteins, Proceedings 13th World Congress on Genetics Applied to Livestock Production 24350: https://doi.org/10.31274/wcgalp.24350 © 2026 *Jaton, et al.* CC BY-NC-ND

Balancing methane reduction and genetic gain: insights from methane efficiency evaluations in Canadian Holsteins

C. Jaton[1*], F. Malchiodi[2], A. Fleming[1], H. Sweett[1], B.J. Van Doormaal[1], D. Sloan[2], M. Lohuis[2], and F. Miglior[1,3]

[1]Lactanet, Guelph, ON, Canada; [2]Semex Alliance, Guelph, ON, Canada; [3]University of Guelph, Guelph, ON, Canada; [*]Corresponding author: cjaton@lactanet.ca

Introduction

Enteric methane production in dairy cattle is genetically unfavourably correlated with milk production traits, particularly fat yield (correlation ~0.40). Because fat yield is a major determinant of milk price and strongly influences Canada's national selection indexes, Lifetime Performance Index (LPI; Van Doormaal et al., 2025) and Pro$ (Van Doormaal et al., 2015; Sweett & Fleming, 2025), selecting animals for lower methane emissions without considering the unfavourable correlation between methane production and fat yield could inadvertently reduce fat yield and compromise economic returns, an outcome dairy producers would find unacceptable. To avoid this unintended trade-off, Canada's Methane Efficiency (ME) evaluation was designed to be genetically independent of milk production yields, enabling selection to reduce enteric methane without penalizing progress in economically important traits (Oliveira et al., 2024). Canada introduced genetic evaluations for ME in April 2023 for the Holstein breed, becoming the first country to publish evaluations aimed at directly reducing methane emissions in dairy cattle (Van Doormaal et al., 2023). Since implementation, knowledge transfer initiatives have focused on promoting ME adoption and supporting the Dairy Farmers of Canada's net-zero objective. The objective of this study was to quantify how selecting sires at progressively higher ME thresholds affects response for Pro$ and LPI and correlated production and health traits, including a comparison of trends for sires with public versus non-public ME evaluations.

Materials & Methods

The dataset included 774 sires with at least 100 insemination records in Canada between April 1, 2024 and March 31, 2025, which represents a 12-month period one year after the introduction of ME evaluations. A total of 785,034 inseminations were included in the analysis. Genetic evaluations from December 2025 were used to assess the genetic merit of the sires. Weighted averages for Pro$, LPI, ME, yields of milk, fat and protein, Herd Life, Mammary System, Feet & Legs, Daughter Fertility, Mastitis Resistance, Metabolic Disease Resistance, Feed Efficiency and Body Maintenance Requirements were calculated using insemination counts as weights. To evaluate the effect of ME-based selection, minimum thresholds corresponding to the Holstein breed average and one or two standard deviations above average (ME ≥100, ≥105, ≥110, respectively) were applied.

Not all ME evaluations are public for bulls in Canada. Therefore, the publication status was considered in the analysis to evaluate differences in average values between the two groups of bulls as ME thresholds were applied. The full dataset was split into public and non-public datasets, including 594,083 insemination records from 395 sires and 190,951 insemination records from 379 sires, respectively.

Results & Discussion

Weighted averages for the two national selection indexes and ME are shown in Table 1 using different thresholds for ME. Across all 785,034 inseminations, the weighted average for Pro$,

LPI and ME were 2,021, 3,541 and 101, respectively. When restricting to sires with ME ≥100 (532 sires, 543,528 inseminations) or ME ≥105 (203 sires, 216,365 inseminations) or ME ≥110 (40 sires, 30,180 inseminations), the weighted averages for Pro$, LPI, and ME all increased (Table 1). This indicates that sires used in Canada from April 2024 to March 2025 tended to rank higher for Pro$ and LPI as their ME increased, suggesting that selecting for higher ME would not impact overall genetic progress as measured by the two national selection indexes. Relative to the unrestricted set (All), Pro$ increased by +175 (+8.7%), +360 (+17.8%), and +660 (+32.7%) at ME thresholds of ≥100, ≥105, and ≥110, respectively. LPI rose by +67 (+1.9%), +134 (+3.8%), and +204 (+5.8%) across the same thresholds. These consistent gains align with the designed goal of ME being independent of production yields at the index level.

Table 1. Weighted average Pro$, LPI and ME under different ME thresholds.

Threshold			Weighted Average		
	Inseminations	Sires	Pro$	LPI	ME
All	785,034	774	2021	3541	101
ME ≥ 100	543,528	532	2196	3608	104
ME ≥ 105	216,365	203	2381	3675	107
ME ≥ 110	30,180	40	2681	3745	111

Taking the analysis one step further, the weighted averages based on the number of inseminations were calculated for some of the individual traits and the results are presented in Table 2. Trait-level weighted averages revealed a clear pattern: as ME thresholds increased, average milk volume declined slightly, while component yields (fat and protein) increased. Given that Canadian milk payment systems emphasize component yields, the improvement in fat and protein yields can offset reduced milk volume in economic terms, which is reflected in the rising Pro$ with higher ME selection. Mastitis Resistance (MR) and Metabolic Disease Resistance (MDR) also trended upward with stricter ME thresholds, while Herd Life (HL), Mammary System (MS), Feet & Legs (FL), Daughter Fertility (DF), Feed Efficiency (FE) and Body Maintenance Requirements (BMR) remained broadly stable, with small deviations at ME ≥110 likely reflecting the smaller number of sires represented.

Quantitatively, Milk Yield averaged 848 kg across all inseminations and declined by -41 kg (-4.8%), -141kg (-16.6%), and -209 kg (-24.6%) at ME ≥100, ≥105, and ≥110, respectively. By contrast, Fat Yield increased by +10 kg (+12.2%), +20 kg (+24.4%), and +28 kg (+34.1%), and Protein Yield by +4 kg (+8.0%), +5 kg (+10.0%), and +9 kg (+18.0%). Mastitis Resistance improved incrementally (+1 (+1.0%), +2 (+2.0%), +3 (+3.0%)), and other traits increased more gradually or remained steady overall.

Table 2. Weighted average for individual traits under different ME thresholds.

	Weighted Average										
Threshold	Milk	Fat	Protein	HL	MS	FL	DF	MR	MDR	FE	BMR
All	848	82	50	103	6	7	99	101	101	100	97
ME ≥ 100	807	92	54	103	5	7	99	102	101	101	97
ME ≥ 105	707	102	55	103	5	7	99	103	102	100	98
ME ≥ 110	639	110	59	105	4	5	101	104	103	102	98

Since not all ME evaluations are publicly available, the weighted Pro$ trends between inseminations associated with public (594,083 from 395 sires) were compared to those associated with non-public ME evaluations (190,951 from 379 sires). Both groups exhibited similar increases in Pro$ as ME thresholds rose (Figure 1), indicating that, once available, direct selection on ME can be implemented without undermining progress in Pro$.

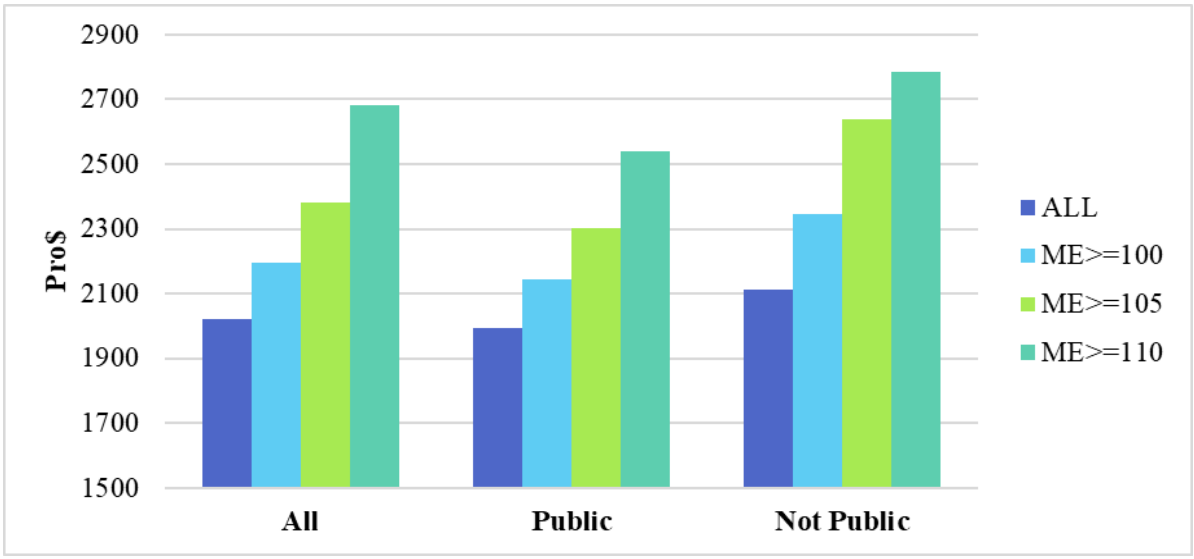

Figure 1. Weighted average for Pro$ based on different ME thresholds and the public status of the ME evaluations.

Practical Implications & Limitations

There are multiple noteworthy implications and limitations associated with this analysis. First, the evaluation window of inseminations during a 12-month period only captures an early adoption phase, during which breeding companies and producers may still be adjusting to ME information. It is therefore expected that future cohorts could show stronger directional use of high-ME sires. Second, weighting by insemination counts appropriately reflects realized selection, but it also amplifies the influence of a small number of very popular sires. Further analysis with sire-level (unweighted) summaries would help confirm robustness of results. Third, the smallest stratum (ME≥110) contains relatively few sires and inseminations, so estimates in that tier carry wider uncertainty. Finally, while ME was designed to be genetically independent of production traits, observed component gains alongside reduced milk volume suggest that selection on ME may subtly shift the production profile toward higher solids, a potentially desirable outcome under component-based pricing but one that merits monitoring within broader breeding goals.

Conclusions

These findings indicate that selecting sires with higher genetic evaluations for ME can reduce methane emissions without compromising overall genetic progress as measured by LPI and Pro$. These results support incorporating ME into sire selection strategies aimed at climate mitigation. Future work should quantify realized methane reductions at the herd level, evaluate correlated responses in energy-corrected milk and feed efficiency, and examine longer-term trends as ME information becomes universally available.

Acknowledgements

This study was part of the Net-Zero Dairy Genome Project (NDGP; https://www.ndgp.ca) and the Agricultural Funding Consortium, grant number AFC-2023F252R and AFC-2025F3716R. We gratefully acknowledge all funding and support, as administered by Genome Canada, Genome Alberta, Ontario Genomics, Genome Quebec, and contribution of Alberta Innovates, the Ministry of Technology and Innovation, Government of Alberta, Lactanet, Dairy Farmers of Ontario and Quebec, Alberta Milk.

References

Oliveira H.R., Sweett H., Narayana S.G., Fleming A., Shadpour S. et al(2024) . JDS Comm. 5:756–760. doi.org/10.3168/jdsc.2023-0431

Sweett H., and Fleming A. Celebrating 10 Years of Pro$: Canada's Profit Index. Available at : https://lactanet.ca/en/celebrating-10-years-of-pro-canadas-profit-index/, visited on 26-11-2025.

Van Doormaal B.J., Kistemaker G.J., Beavers, L., and Sullivan P.G. (2015) Interbull Bulletin 49, 103-110. https://journal.interbull.org/index.php/ib/article/view/1603/1605

Van Doormaal B.J., de Oliveira HR., Narayana S.G., Fleming A., Sweett H., Malchiodi F., Jamrozik J., Kistemaker G.J., Sullivan P.G., and Miglior F. (2023) Implementation of Methane Efficiency Evaluations for Canadian Holsteins. Interbull Bulletin 59, 74-82. https://journal.interbull.org/index.php/ib/article/view/1906/1881

Van Doormaal B.J., Jaton C., Sweett H., Sullivan P.G., Fleming A., Miglior F., and Richardson C.M. (2025) Modernizing Canada's Lifetime Performance Index (LPI). Interbull Bulletin 61, 203-212. https://journal.interbull.org/index.php/ib/article/view/1988