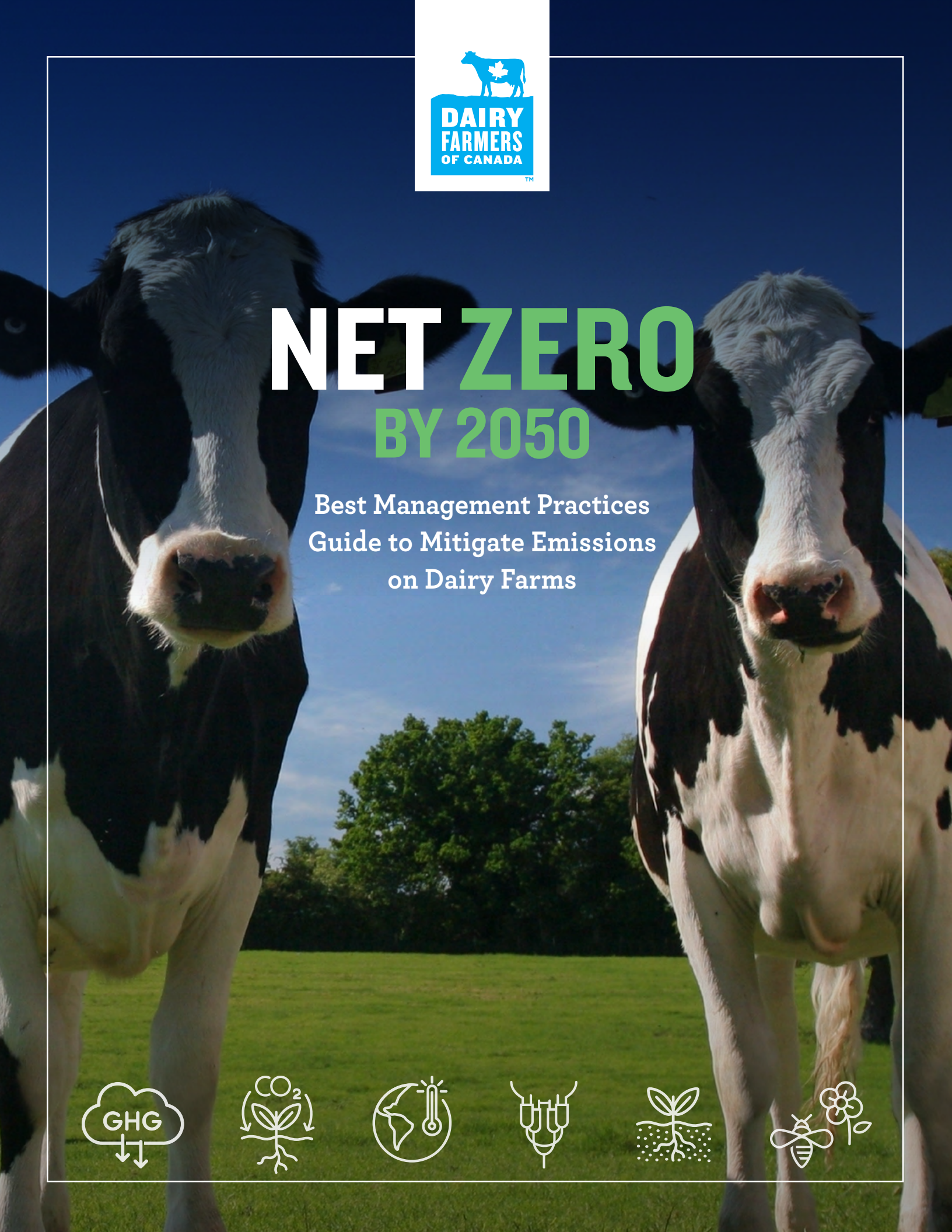
DAIRY FARMERS OF CANADA™

NET ZERO BY 2050

Best Management Practices Guide to Mitigate Emissions on Dairy Farms



WHY NET ZERO BY 2050?

Consumers want to know that dairy farmers are committed to caring for the environment.

Eight in ten Canadians say it is necessary or somewhat necessary for Canada's dairy farms to achieve net-zero greenhouse gas (GHG) emissions by 2050.[1] Consumers need to see tangible progress from the dairy farm sector in order to continue to feel confident enjoying the dairy products they love.

We want to see a thriving dairy farm sector for years to come.

What's good for the environment is good for business. Prioritizing sustainability leads to increased production efficiency, which can result in cost savings and additional revenue streams for farms. We should all be very proud of the dairy sector's continued progress on sustainability, and continue to take our role as leaders seriously. Dairy farming is more than a job – it's a way of life. Strengthening climate adaptation and mitigation efforts not only provides benefits to the environment and production efficiency, but it also supports a pathway towards building resilient dairy farming communities. Doing our part to meet the needs of the present without compromising the ability of future generations to meet their own needs is in our DNA.

Farmers are being impacted directly by changing weather patterns.

Canada's climate is warming two times faster than the global average, with farmers being among the first to experience extreme weather events.[2] In the last few years alone, droughts, floods, wildfires and hurricanes have significantly impacted dairy farmers in different parts of the country. Reducing GHG emissions can help to lessen the impacts of these events, while conservation practices can increase a farm's ability to be resilient to their effects when they do occur.

How Will We Get There?

Canadian dairy farmers are already recognized as leaders in sustainability. Our most recent Life Cycle Assessment (LCA) demonstrated the carbon footprint of milk produced in Canada is among the lowest in the world, at less than half the global average. We will continue building on this progress through the adoption and improvement of BMPs with the goal of achieving net zero.

Net zero means achieving an overall balance between GHGs emitted, and the GHGs removed from the atmosphere. To reach 'net zero' by 2050, we need to **increase adoption of best management practices (BMPs)** that reduce emissions as much as possible, and remove what's left by increasing carbon sequestration (capturing and storing carbon from the atmosphere). The following graph demonstrates how reductions (blue) and removals (yellow) will bring the balance to net zero.

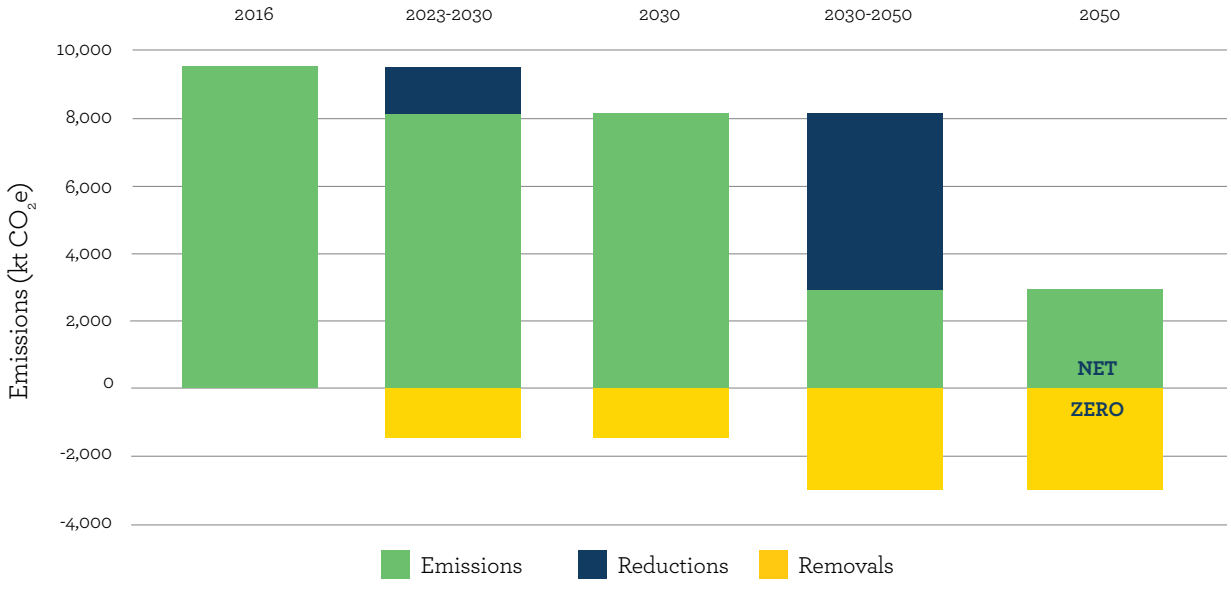
DFC worked with Viresco Solutions, experts in low carbon and sustainable agriculture, to assess options to reduce GHG emissions on dairy farms. They evaluated available research to determine on-farm emissions mitigation potential, estimated return on investment, and co-benefits. Dairy farmers in every region across Canada participated in focus groups to provide input on the BMPs and the feasibility of implementation. Viresco Solutions then consulted with experts and modeled the potential impact of the most feasible BMPs.

proAction® and Net Zero

The net zero by 2050 initiative is separate from proAction, but closely linked. Each of proAction's six modules supports sustainability – from increased milk quality, to improved animal health and disease prevention, to the entire Environment module. In fact, results from the Environmental Questionnaire will help inform progress!

Enhancing or adopting best management practices that are proven to reduce GHG emissions under the

EMISSIONS TRAJECTORY



This graph demonstrates the emissions reduction and removals needed to achieve net zero relative to the dairy sector's total emissions in 2016.

Source: Viresco Solutions, 2022

net-zero initiative also helps drive progress under proAction's standards of excellence. For example, steps taken to improve cattle longevity to drive sustainability could naturally also improve cattle health objectives under proAction's Biosecurity Risk Assessment. Therefore, while the two initiatives are separate, they work hand-in-hand.

How To Use This Guide

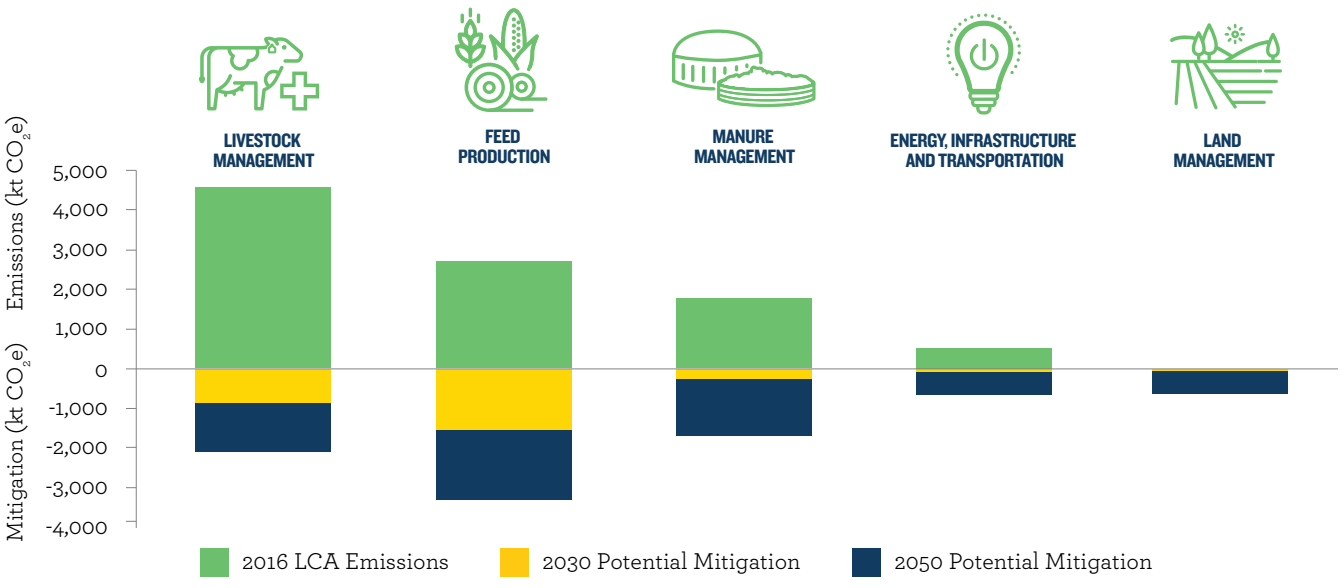
This guide is designed for dairy farmers to be a source of inspiration for your future farm planning, and should also help you identify some of the practices you are already undertaking on your farm that are contributing to the sustainability of your operation. It is likely that you are already implementing some of the practices that will help reach the 2050 target. Every farm has the opportunity to voluntarily contribute to reaching net zero by continuing to implement BMPs with the goal of reducing emissions and increasing carbon sequestration.

Choosing BMPs

Every farm is unique, and that means that different strategies will work for different operations. We've highlighted a wide range of practices in this guide so you can choose the ones that will work best for your farm. The BMPs are organized according to the four categories in DFC's Life Cycle Assessment: Livestock Management, Feed Production, Manure Management, and Energy, Infrastructure and Transportation, as well as a fifth category for Land Management, which includes additional practices aimed at carbon sequestration and biodiversity enhancement. While practices in this final category may have a smaller emissions mitigation potential, they provide important environmental benefits that help farms to be more resilient and adapt to the effects of climate change, like severe temperatures, wildfires, drought and flooding.

The following chart shows the current emissions (in green) as well as the potential mitigation (reductions and removals) for 2030 (yellow) and 2050 (blue). As you can see, the largest source of emissions is from livestock management, and while several practices contribute to the reduction of emissions in this category, they cannot be completely eliminated, so mitigation in other categories will help to bring the overall balance to zero.

CURRENT EMISSIONS AND POTENTIAL FOR MITIGATION



Please note that this graph does not show carbon storage and sequestration in 2016, as it was not measured at that time. DFC is undertaking its first study of carbon sequestration in 2023.

Source: Viresco Solutions, 2022

In the following pages, you will find information on each identified BMP, including recommendations on further resources to consult.

Learning With Others

You will also find testimonials from farmers who have already adopted some of these practices. The best way to learn about a new strategy is from someone who has gone before you! We encourage you to consult with your neighbours and on-farm service providers (e.g., vet, agronomist/agrologist) to evaluate the most suitable practices for your operation.

Your Environmental Farm Plan and Environmental Questionnaire results from the Environment module of proAction provide a good starting point for considering actions in certain areas. We encourage you to reach out to your local farmer organizations to keep up to date on provincial and regional Knowledge and Technology Transfer (KTT) opportunities and initiatives.

Ongoing Research

This guide includes only the practices which were identified by Viresco Solutions in the net-zero modelling exercise, and which have sufficient research behind them to be able to estimate GHG reductions or removals. As we discover new practices through advances in research and technology, we will continue to provide additional guidance and information.

DFC has developed a new five-year National Dairy Research Strategy, released in the fall of 2021, to guide investments in science. Under the Dairy Farm Sustainability priority area, key targeted outcomes have been defined to sustain feed cropping system long-term productivity; reduce GHG emissions, maximize carbon sequestration and adapt to climate change; better use and conservation of water on dairy farms, and increase biodiversity. Also included under this area is the importance of factoring in social and economic implications of any practices studied.

The most up-to-date information will be available at https://dairyfarmersofcanada.ca/en/dairy-research.

Contributors

DFC wishes to thank Viresco Solutions, Lactanet, *Coordination services-conseils*, Fertilizer Canada, the Sustainability Working Group, and the Farmer Sustainability Advisory Group for their support in developing this guide.

QUICK REFERENCE

	Benefits								Farms using this practice			
	Reduced GHG emissions	Carbon sequestration	Increased resiliency to the effects of climate change	Improved production efficiency	Improved soil health	Enhanced biodiversity	Estimated return on investment[1]	On-farm emission mitigation potential[2]	2022[3]	Goal for 2030[4]	Goal for 2050[5]	Page number
LIVESTOCK MANAGEMENT												
Optimizing Animal Health	x		x	x			High	++	15%	50%	95%	9
Enhancing Herd Genetics	x			x			High	+++	15%	22%	52%	10
Improving Feed Efficiency	x			x			High	+++	74%	84%	94%	11
Optimizing Animal Diets	x			x			High	+++	69%	83%	95%	12
FEED PRODUCTION												
Minimizing Tillage	x	x	x		x	x	High	+++	58%	70%	70%	14
Cover Cropping		x	x		x	x	High	+++	40%	70%	92%	15
Optimizing Crop Rotation		x	x		x	x	Medium	+++	56%	70%	95%	16
Incorporating Perennials		x	x		x	x	Low	+++	82%	96%	96%	17
Practicing 4R Nutrient Stewardship												
Right Source												
Organic Amendments	x	x			x	x	High	++	91%	95%	95%	18
Enhanced Efficiency Fertilizers	x						Low	++	5%	19%	54%	19
Right Time	x						High	+	30%	37%	37%	20
Right Rate	x						High	+	28%	35%	55%	21
Right Place	x						Low	+	21%	28%	28%	22
MANURE MANAGEMENT												
Covering Manure Storage	x						Low	+++	46%	49%	74%	24
Separating Solids and Liquids	x						Low	+	6%	9%	29%	25
In-Vessel Manure Composting	x						Low	+++	1%	6%	28%	26
Reducing Manure Storage Duration[6]	x						Low	See note	10%	10%	10%	27
Anaerobic Digestion	x						Low	++	1%	2%	14%	28

	Benefits								Farms using this practice			
	Reduced GHG emissions	Carbon sequestration	Increased resiliency to the effects of climate change	Improved production efficiency	Improved soil health	Enhanced biodiversity	Estimated return on investment[1]	On-farm emission mitigation potential[2]	2022[3]	Goal for 2030[4]	Goal for 2050[5]	Page number
ENERGY, INFRASTRUCTURE AND TRANSPORTATION												
Improving Energy Efficiency	x						Medium	+	69%	94%	94%	30
Producing Solar Energy	x						Medium	+	6%	13%	13%	31
Producing Wind Energy	x						Medium	+	1%	8%	8%	32
Purchasing Renewable Energy	x						Medium	+	4%	11%	11%	33
Converting to Alternatively Powered Machinery	x						Low	++	4%	5%	55%	34
Managing Plastics Responsibly	x						Low	+	30%	64%	64%	35
LAND MANAGEMENT												
Rotational Grazing		x	x		x	x	Medium	+++	20%	22%	37%	37
Practicing Silvopasture (Agroforestry)		x	x		x	x	Medium	+	30%	35%	50%	38
Conserving Wetlands		x	x		x	x	Medium	+	27%	34%	50%	39
Protecting Riparian Buffer Zones		x	x		x	x	Medium	+	27%	34%	64%	40
Maintaining Grasslands		x	x		x	x	Low	+	30%	31%	53%	41
Planting Trees, Hedgerows, Shelterbelts		x	x		x	x	Medium	+	50%	78%	80%	42

Notes:

[1] The estimated return on investment (ROI) categories were determined in consultation with experts. Costs can vary regionally and farmers should evaluate the potential ROI for their farm on an individual basis.

[2] This column presents the estimated emissions mitigation potential when a farm goes from not implementing the practice to fully implementing it on their farm (e.g. with all animals, on all fields). It includes both reduction and carbon sequestration potential.

+ represents an emissions mitigation potential of up to 5% of on-farm emissions

++ represents an emissions mitigation potential of up to 15% of on-farm emissions

+++ represents an emissions mitigation potential of above 15% of on-farm emissions

The emissions mitigation potential was calculated by Viresco Solutions based on the current scientific literature. The coordinating research study or studies are listed on each BMP page. Please note that these are estimates and that adding up the potential reductions will result in over 100%. This is because some practices overlap, while others are not stackable.

It is also important to note that practices with a lower mitigation potential still offer important environmental benefits, which is why they have been included in this guide.

[3] The numbers in this column represent the estimated percentage of dairy farms in Canada that are implementing the specified BMP as of September 2022. They were determined using data from the Government of Canada, as well as the proAction Environmental Questionnaire.

[4,5] The numbers in these columns represent the total percentage of dairy farms in Canada that needed to have adopted the specified BMP to reach the net zero target. They were determined by Viresco Solutions based on current adoption rates and in consultation with farmers at regional focus groups.

[6] A DFC-supported research study shows that completely emptying a liquid manure storage tank in the spring reduces methane emissions from newly loaded manure in the following months by up to 40%. However, due to the study's design, an emissions factor cannot be calculated, which is needed to estimate the on-farm mitigation potential.

LIVESTOCK MANAGEMENT

Thanks to improvements in cow health and comfort, enhanced diets and genetics, and advances in technology, fewer cows are needed to produce the same amount of milk. Today, the average healthy Canadian dairy cow produces three times more milk than 50 years ago. Fewer cows generally mean fewer GHG emissions and optimizing dairy cattle health, genetics and diets can further reduce methane emissions while lowering production costs.

BEST MANAGEMENT PRACTICES IN THIS CATEGORY:

OPTIMIZING ANIMAL HEALTH

You are already taking steps in optimizing animal health, for example through proAction. An increased focus on herd health for the purpose of reducing GHG emissions includes practices that optimize milk production at the herd level over time, such as cattle health management, herd longevity and reproductive management. Having sick animals increases medication costs, reduces milk production and therefore production efficiency. Continuously improving production efficiency will reduce costs of production and GHG emissions.

Benefits

- Reduced GHG emissions
- Improved production efficiency
- Increased resiliency to the effects of climate change

Estimated return on investment
High

On-farm emission mitigation potential ++

Implementation Tips

- Conduct regular herd health checks, keep detailed health records and review them regularly with a vet to identify trends and opportunities for improvement.
- Prevent disease introduction and spread through biosecurity protocols.
- Work with a vet to develop disease and treatment protocols (e.g., mastitis, lameness).
- Plan for replacement animals based on health performance, reproduction and culling rate.
- Track, evaluate and improve reproductive management performance, such as pregnancy rates.
- Optimize the transition of cows after calving to reduce metabolic problems.
- Optimize colostrum management to facilitate the transfer of immunity to calves.

Resources

- **Factsheets:** proAction Animal Care Resources, Dairy Farmers of Canada (dfc-plc.info/OAH1)
- **Webpage:** Milk Recording & Analysis, Lactanet (dfc-plc.info/OAH2)
- **Webpage:** Herd Sustainability Index, Lactanet (dfc-plc.info/OAH3)
- **Research study:** Lorenz, H., Reinsch, T., Hess, S., Taube, F., 2019. Is low-input dairy farming more climate friendly? A meta-analysis of the carbon footprints of different production systems. Journal of Cleaner Production 211, 161–170. (dfc-plc.info/OAH4)

CATTLE HEALTH POTENTIAL FOR REDUCING GHG EMISSIONS

A 2019 study by the Global Research Alliance explored the effect of proactive animal health management, using Animal Health Improvement Measures (AHIM) on GHG emissions on dairy farms in Chile, Kenya and the United Kingdom (UK). They found that implementing AHIM is likely to offer a reduction in GHG emissions as well as a significant return on investment at the individual farm level. The following chart shows the potential reductions in GHG emissions intensity for the average and bottom 10% of herds in the UK, whose production systems are most similar to Canada's.

Condition	Potential reductions in GHG intensity (UK)	
	Average herd	Bottom 10% of herds
BVD	4%	11%
Mastitis	6%	12%
Infertility	7%	16%

"Herd genetics and animal health are priorities on our farm. We do genomic tests to select replacement animals. This leads to an increase in the cows' longevity and thus a decrease in the number of replacement animals needed. In addition, our cows wear collars with movement and chewing detection, which helps in health monitoring and heat detection."

— Gabriel, a dairy farmer in Quebec

ENHANCING HERD GENETICS

Quality genetics are fundamental to optimizing milk production, including breed selection and other high-yielding selection factors. When choosing herd genetics, focus on high-yielding milk production, fertility, health, longevity, feed efficiency and reduced enteric methane production.

Benefits

- Reduced GHG emissions
- Improved production efficiency

Estimated return on investment
High

On-farm emission mitigation potential +++

Implementation Tips

- Conduct genomic sampling on females and bulls and send in for testing with a chosen genotyping program provider.
- Work with technical advisors to interpret test results, identify desirable genomic traits and create a genetic plan to assist with herd selection and herd management decisions.
- Work with genotyping program representatives to conduct herd audits, continue to apply and adjust plans, develop on-farm testing procedures and evaluate testing strategies.

Resources

- **Factsheet:** Getting the Dairy Herd You Want Through Improved Genetic Selection, University of Wisconsin Extension (dfc-plc.info/ENHA1)
- **Webpage:** Genetic Evaluations, Lactanet (dfc-plc.info/ENHA2)
- **Webpage:** New Genetic Evaluations Coming in April 2023, Lactanet (dfc-plc.info/ENHA3)
- **Research study:** Uddin, M.E., Aguirre-Villegas, H.A., Larson, R.A., Wattiaux, M.A., 2021. Carbon footprint of milk from Holstein and Jersey cows fed low or high forage diet with alfalfa silage or corn silage as the main forage source. Journal of Cleaner Production 298, 126720. (dfc-plc.info/ENHA4)
- **Research Study:** C. I. V. Manzanilla-Pech, P. Løvendahl, D. Mansan Gordo, G. F. Difford, J. E. Pryce, F. Schenkel, S. Wegmann, F. Miglior, T. C. Chud, P. J. Moate, S. R. O. Williams, C. M. Richardson, P. Stothard, and J. Lassen., 2021 Breeding for reduced methane emission and feed-efficient Holstein cows: An international response. Journal of Dairy Science, 104-8. (dfc-plc.info/ENHA5)

Effective April 2023, Methane Efficiency will be added to the portfolio of traits evaluated by Lactanet for the Holstein breed. Lactanet is very proud to make Canada the first country worldwide to introduce genetic evaluations to help our industry reduce methane emissions from dairy herds across the country. Methane Efficiency is an important genetic selection tool that allows dairy producers to achieve an expected 20% to 30% reduction in methane emissions from their herd by 2050, without negatively affecting production levels.

— Brian Van Doormaal, Chief Services Officer, Lactanet

IMPROVING FEED EFFICIENCY

Higher-producing cows typically emit less methane per unit of milk than lower-producing cows. Talk to your dairy nutrition advisor to create a balanced ration to maximize milk production potential. To further maximize feed efficiency, work with a genotype program provider to conduct genetic evaluations for feed efficiency which can help reduce feed costs, enhance herd productivity and increase farm profitability.

Benefits

- Reduced GHG emissions
- Improved production efficiency

Estimated return on investment
High

On-farm emission mitigation potential +++

Implementation Tips

- Consult a dairy nutrition advisor to balance rations.
- Promote good feeding behavior and optimal rumination by ensuring good ventilation, cow comfort and homogeneous ration mixing.
- Practice feed bunk management to maximize feed intake.
- Harvest quality forages and store them well.
- Work with a genotype program provider and develop a genetics strategy that evaluates feed efficiency traits.
- Monitor herd progress through monthly measurement and testing of feed efficiency.

Resources

- **Factsheet:** Livestock Management Practices to Mitigate Greenhouse Gases, proAction Environment Resources, Dairy Farmers of Canada (dfc-plc.info/IMFE1)
- **Webpage:** Introducing Feed Efficiency, Lactanet (dfc-plc.info/IMFE2)
- **Booklet:** Understanding Forage Quality, American Farm Bureau Federation (dfc-plc.info/IMFE3)
- **Research study:** Dutreuil, M., Wattiaux, M., Hardie, C.A., Cabrera, V.E., 2014. Feeding strategies and manure management for cost-effective mitigation of greenhouse gas emissions from dairy farms in Wisconsin. Journal of Dairy Science 97, 5904–5917. (dfc-plc.info/IMFE4)
- **Research study:** Lorenz, H., Reinsch, T., Hess, S., Taube, F., 2019. Is low-input dairy farming more climate friendly? A meta-analysis of the carbon footprints of different production systems. Journal of Cleaner Production 211, 161–170. (dfc-plc.info/IMFE5)

> *We feed our cows with a self-propelled feed wagon that we have purchased with an NIR unit which allows for continuous adaptation to feed dry matter variance and nutritional quality variance. This feed wagon allows for notably less feed shrink meaning less wasted feed, less fuel consumption due to the efficiency of the machine, and a more stable diet for our cows. The more stable diet results in more consistent, and I believe higher, production because changes in feed typically requires the animal to adapt to these changes, alters the targeted ideal diet, and therefore hampers her ability to produce most effectively. We are also working with Lactanet to evaluate the genotypes and phenotypes of dairy animals in order to breed more feed-efficient animals – allowing for similar production to other animals but with less feed. This has an impact on the environment because we will need to harvest less feed due to these animals eating less. We can also expect that there will be less manure produced. Also, because the animals feed intake is lower per unit of production, we will have less methane produced per animal.*
>
> — JP, a dairy farmer in Alberta

OPTIMIZING ANIMAL DIETS

Dairy cattle diets can be formulated to modify rumen fermentation to reduce methane emissions. For example, higher quality forages can improve the palatability for cattle and additional processing can lead to production efficiencies. These practices can also reduce feed waste and production costs. Additionally, feeding supplemental dietary fat – including those with unsaturated fatty acids in some ingredients and by-products – has the potential to decrease methane production in the rumen.

Benefits

- Reduced GHG emissions
- Increased production efficiency

Estimated return on investment
High

On-farm emission mitigation potential +++

Implementation Tips

- Consult a dairy nutrition advisor to adapt your herd's diet. This may include adding fats, using feed grain, improving feed digestibility, reducing protein, etc.
- Work with a forage specialist to test the nutritional value and overall quality of forages.
- Improve quality of forage through harvest timing and storage improvements.
- Process forage to ensure optimal particle length (e.g., chopping, grinding, pelleting).
- Consider incorporating legumes and pulses into the diet.

Resources

- **Factsheet:** Livestock Management Practices to Mitigate Greenhouse Gases, proAction Environment Resources, Dairy Farmers of Canada (dfc-plc.info/OPAD1)
- **Wepage:** Optimizing Forage Production and Use, Lactanet (dfc-plc.info/OPAD2)
- **Booklet:** Understanding Forage Quality, American Farm Bureau Federation (dfc-plc.info/OPAD3)
- **Research study:** Veltman, K., Rotz, C.A., Chase, L., Cooper, J., Ingraham, P., Izaurralde, R.C., Jones, C.D., Gaillard, R., Larson, R.A., Ruark, M., Salas, W., Thoma, G., Jolliet, O., 2018. A quantitative assessment of Beneficial Management Practices to reduce carbon and reactive nitrogen footprints and phosphorus losses on dairy farms in the US Great Lakes region. Agricultural Systems 166, 10–25. (dfc-plc.info/OPAD4)

FEED PRODUCTION

Producing feed using sustainable practices provides opportunity to increase crop and soil health while strengthening resiliency to the effects of climate change, such as droughts and increased temperatures. Practices such as minimized tillage, cover cropping, optimizing crop rotation, incorporating perennials and 4R nutrient stewardship improve the soil's ability to store and capture carbon and reduce GHG emissions. Building soil carbon improves nutrient levels, water retention and soil structure which enhances crop health, productivity and can reduce fertilizer costs.

BEST MANAGEMENT PRACTICES IN THIS CATEGORY:

MINIMIZING TILLAGE

Reducing tillage and soil disturbance have several benefits related to GHG mitigation. Tillage disrupts soil fungi that are important for soil structure, so reducing it can help to protect carbon stores and increase carbon sequestration. Minimal tillage or no-till also improves soil quality, promotes biodiversity in and around soil, reduces soil erosion and avoids soil compaction. Fuel use and cost is also reduced from fewer equipment passes across the field.

Benefits

- Reduced GHG emissions
- Carbon sequestration
- Improved soil health
- Increased resiliency to the effects of climate change
- Enhanced biodiversity

Implementation Tips

- Consult an agronomist or agrologist for tillage recommendations best suited for your soil management needs.
- Reduce tillage by selecting attachments that till at shallower depths and are applicable to your soil composition and field conditions.
- Reduce the number of tillage passes and minimize tillage operations up and down slopes.
- Try incorporating cover cropping as part of your weed management.

Estimated return on investment
High

On-farm emission mitigation potential +++

Resources

- **Factsheet:** proAction Environment Resources, Dairy Farmers of Canada (dfc-plc.info/MT1)
- **Website:** Soil Conservation Council of Canada (dfc-plc.info/MT2)
- **Research study:** Yanni, S.F., Laporte, A.D., Rajsic, P., Wagner-Riddle, C., Weersink, A., 2021. The environmental and economic efficacy of on-farm beneficial management practices for mitigating soil-related greenhouse gas emissions in Ontario, Canada. Renewable Agriculture and Food Systems 36, 307–320. (dfc-plc.info/MT3)

COVER CROPPING

Cover crops, sometimes referred to as 'green manure,' help to protect against soil erosion and improve soil structure and soil fertility by catching nutrients after annual cropping. Planted right after harvest into standing crop stubble, cover crops include cool-season grasses like oats or annual ryegrass; warm-season grasses such as millet; brassicas such as radish or yellow mustard; broadleaves like buckwheat; and legumes such as clover. When cover crops are plowed down, the decomposition of plants, shoots and roots release nutrients, particularly nitrogen, into the soil.

Benefits

- Carbon sequestration
- Increased resiliency to the effects of climate change
- Improved soil health
- Enhanced biodiversity

Estimated return on investment
High

On-farm emission mitigation potential +++

Implementation Tips

- Plant cover crops following annual crop harvest. Consult an agronomist/agrologist for crop recommendations.
  - **West:** Some cover crop choices for farms in B.C. include various clovers and sweet clovers, bird's-foot trefoil, hairy vetch, field pea or forage pea.
  - **Prairies:** Consider trying oats, clover varieties, peas, radish, hairy vetch and/or fall rye in the Prairie region.
  - **Central:** Incorporate rye, winter wheat, red or sweet clover, or buckwheat into cover cropping in central Canada.
  - **Atlantic:** Try implementing hairy vetch, radishes, ryegrass, clovers, buckwheat or sorghum if located in the Atlantic region.
- Cover crop seed can be applied with manure applications to reduce field passes.
- Cover crops can provide new grazing options for operations with rotational grazing.
- Consider intercropping or relay cropping radish, peas, faba bean or crimson clover between a main crop, such as corn. Benefits include improved crop and soil stability, a reduction in inputs, fertilizer and crop protection products, weed suppression and possible yield improvements.

Resources

- **Webpage:** Establishing Your Field with the Best Cover Crop, Lactanet (dfc-plc.info/COCR1)
- **Factsheet:** Best management practices inter-seeding cover crops, OMAFRA (dfc-plc.info/COCR2)
- **Website:** Soil Conservation Council of Canada (dfc-plc.info/COCR3)
- **Research study:** Yanni, S.F., Laporte, A.D., Rajsic, P., Wagner-Riddle, C., Weersink, A., 2021. The environmental and economic efficacy of on-farm beneficial management practices for mitigating soil-related greenhouse gas emissions in Ontario, Canada. Renewable Agriculture and Food Systems 36, 307–320. (dfc-plc.info/COCR4)

> *I started cover cropping after corn silage is harvested so that the soil remains stable for the remaining eight months of the year. We apply liquid manure to all the harvested fields. As each tanker of manure is being loaded, we throw approximately 4 lbs. of oil seed radish seed into the tanker. The fields are tilled with a vertical tillage implement and miraculously the cover crop is uniform across the field. The oil seed radish flourishes during the fall and creates a lush mat of green matter which dies off over the winter and provides organic matter for the soil in the spring. The only trick is to have someone dedicated to throwing the seed in the tanker at the fill-site.*
>
> — Kevin, a dairy farmer in Ontario

OPTIMIZING CROP ROTATION

Optimal crop rotations deliver environmental benefits by improving soil structure and nutrient management by reducing erosion and allowing greater flexibility in pest management. For dairy farmers, optimizing crop rotation could mean adding pulses, forage or legumes into the rotation as another way to provide environmental benefits. Adding a legume, for example, will reduce fertilizer needs (nitrogen) the following growing season.

Benefits

- Carbon sequestration
- Increased resiliency to the effects of climate change
- Improved soil health
- Enhanced biodiversity

Implementation Tips

- Plan your crop rotation to maximize soil nutrients and carbon storage. Consult an agronomist/agrologist for recommendations.
- Consider incorporating a legume before a nitrogen-intensive crop.
- Diversify crop rotations with perennials, small grain cereals, cover crops, or add one or more annual crops in your cropping sequence. Consider spacing crops susceptible to the same diseases in the crop rotation cycle. Avoid growing the same crop two years in a row in the same field, especially soybeans (susceptible to Sclerotinia) and wheat (susceptible to Fusarium).
- Consider rooting depth and time to maturity in your crop rotation to optimize water conservation.
- Incorporate perennial forages for a minimum of three years in the rotation (see following BMP).

Estimated return on investment
Medium

On-farm emission mitigation potential +++

Resources

- **Webpage:** Principles and Practices of Crop Rotation, Government of Saskatchewan (dfc-plc.info/OPCR1)
- **Webpage:** Crop Rotation, Saskatchewan Soil Conservation Association (dfc-plc.info/OPCR2)
- **Webpage:** Strategies to Improve Winter Survival of Legumes, Lactanet (dfc-plc.info/OPCR3)
- **Research study:** Diverse crop rotations shown to increase yields, improve soil health and lower GHGs, Agriculture and Agri-Food Canada (dfc-plc.info/OPCR4)

INCORPORATING PERENNIALS

Perennials maintain the soil cover and have higher root biomass than annuals, thus providing soil stability, enhanced soil health, and increased carbon sequestration potential. You can incorporate perennials into your crop rotation or convert a field to permanent perennials. Increasing the proportion of perennials in rotation results in two times more carbon sequestration compared to annual cropping with the same nitrogen input, while permanent perennial cover can be harvested numerous times for up to 10 years for crops and much longer for forages, shrubs and trees.

Benefits

- Carbon sequestration
- Increased resiliency to the effects of climate change
- Improved soil health
- Enhanced biodiversity

Estimated return on investment
Low

On-farm emission mitigation potential +++

Implementation Tips

- Convert some annual crops to perennials. Perennial crops are effective in capturing and fixing carbon, returning nutrients to the soil and improving soil health. They are often less challenging to manage than annual crop rotations, but they may require different planting/harvesting equipment.
- Work with an agronomist to determine which perennial species are appropriate for your site conditions and operation. Consider species in the following categories:
  - Legumes (e.g., alfalfa, clover)
  - Grasses (e.g., timothy, fescue)
  - Flowering forbs (e.g., phacelia, flax)
  - Biomass perennials (e.g., switchgrass, giant miscanthus)
- Plant a mixture of forages for increased resiliency to the effects of climate change, such as drought, as well as a range of regrowth capacity after harvest.

Resources

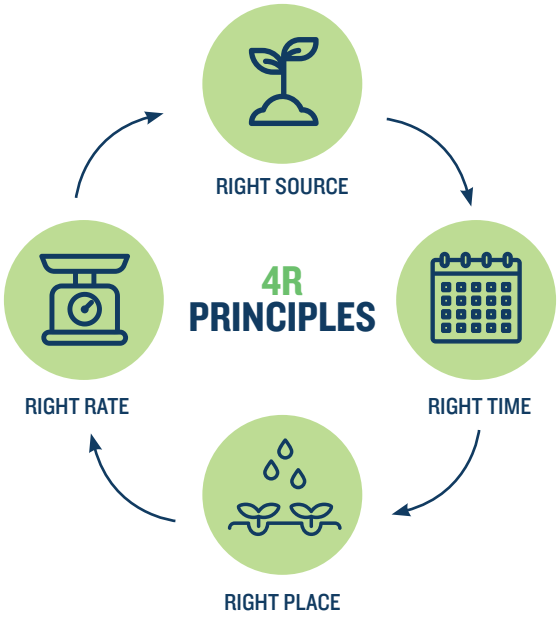
- **Website:** Soil Conservation Council of Canada (dfc-plc.info/IP1)
- **Manual:** Forage BMP Manual, Canadian Forage and Grasslands Association (dfc-plc.info/IP2)
- **Research study:** Farm-scale Assessment of Greenhouse Gas Mitigation Strategies in Dairy Livestock-Cropping-Systems (dfc-plc.info/IP3)
- **Research study:** Yanni, S.F., Laporte, A.D., Rajsic, P., Wagner-Riddle, C., Weersink, A., 2021. The environmental and economic efficacy of on-farm beneficial management practices for mitigating soil-related greenhouse gas emissions in Ontario, Canada. Renewable Agriculture and Food Systems 36, 307–320. (dfc-plc.info/IP4)

"We're starting to plant in all perennials. The local watershed district has a cost-share program that allows us to plant alfalfa and grass in low-lying areas. We have some land beside an aquifer, so it's better in perennials. I am also in the planning stage for my dairy cows to graze, I have started planting some land in grazing feed. It can't be done overnight, but I have a plan in motion and it's cutting down on costs, too."

— Marianne, a dairy farmer in Manitoba

PRACTICING 4R NUTRIENT STEWARDSHIP

Fertilizer is an important crop input and responsible use can help mitigate GHG emissions. This section details BMPs that follow the 4R principles for nutrient stewardship – right source, right time, right rate, right place. In addition to reduced GHG emissions, there are many environmental benefits to using these approaches, including reductions in soil erosion, reductions in energy use, and improvements in recycling of crop nutrients from crop residues and livestock manures.



RIGHT SOURCE

ORGANIC AMENDMENTS

Selecting organic amendments for your fields like manure or compost, over commercial fertilizers, can offer advantages when it comes to managing soil health. Organic amendments are proven to improve soil structure, texture and aeration, increase water retention abilities and stimulate healthy root development. It's important to test manure and or other organic amendments for nutrient content to ensure your crop nutrient needs are met. It may be necessary to supplement crop needs with commercial fertilizers but making organic amendments a priority is preferential.

Benefits

- Reduced GHG emissions
- Carbon sequestration
- Improved soil health
- Enhanced biodiversity

Estimated return on investment
High

On-farm emission mitigation potential ++

Implementation Tips

- Conduct regular soil testing to confirm crop nutrient needs.
- Nutrient test organic amendments, like manure.
- Consult an agronomist or agrologist to develop a nutrient management plan for your soil and crop management needs.

> *When dairy manure is applied on a field in consecutive years, there may be a higher level of secondary and micronutrients available to the growing crop, as soil microbiology will release nutrients from the previous year's application of organic material (manure). With proper management, secondary and micronutrients will reduce fertilizer purchases.*
>
> — Richard Halopka, a crops and soils agent at University of Wisconsin Extension

RIGHT SOURCE

ENHANCED EFFICIENCY FERTILIZERS

Enhanced efficiency fertilizers (EEFs) are innovative formulations that control fertilizer release or alter reactions that lead to less nutrient loss. Enhanced efficiency fertilizers such as a nitrification, urease or double inhibitor can reduce nitrogen loss that typically occurs from leaching, immobilization and volatilization. These fertilizers can include additives, physical barriers or different chemical formulations which allow for increased fertilizer efficiency and availability in the soil. EEFs help protect against environmental damage, increase crop productivity, and provide potential cost-savings over time.

Implementation Tips

- Use an enhanced efficiency fertilizer to reduce nitrogen losses.
- Work with an extension educator to develop split trials on your fields, monitor harvest data and conduct data analysis to determine which EEF works best for your crop and soil conditions.
- Consider rate, timing and placement and choose an EEF that best complements your operations.
- Choose to implement EEFs in parts of the field, such as low spots or poorly drained areas, that are prone to saturation in the growing season.

Benefits

GHG Reduced GHG emissions

Estimated return on investment
Low

On-farm emission mitigation potential ++

Resources

- **Webpage:** 4R Nutrient Stewardship, Fertilizer Canada (dfc-plc.info/RS1)
- **Factsheet:** proAction Environment Resources, Dairy Farmers of Canada (dfc-plc.info/RS2)
- **Manual:** Forage BMP Manual, Canadian Forage and Grasslands Association (dfc-plc.info/RS3)
- **Webpage:** When do enhanced efficiency fertilizers make sense? Canola Digest (dfc-plc.info/RS4)
- **Research study:** Yanni, S.F., Laporte, A.D., Rajsic, P., Wagner-Riddle, C., Weersink, A., 2021. The environmental and economic efficacy of on-farm beneficial management practices for mitigating soil-related greenhouse gas emissions in Ontario, Canada. Renewable Agriculture and Food Systems 36, 307–320. (dfc-plc.info/RS5)

RIGHT TIME

Get the best value out of your fertilizer by optimizing application timing over the growing season. This helps to avoid losses and increase agronomic value. Optimal timing may vary for different regions of Canada, but always avoid applying any fertilizer, including manure, on frozen, snow-covered or saturated soil across Canada. There is no agronomic value in applying manure in these conditions and the potential for surface water contamination increases significantly because the soil cannot absorb the applied nutrients.

Implementation Tips

- Change from fall or spring fertilizer application to a sidedress application.
- Try implementing a split nitrogen application to avoid providing all the crop's nitrogen requirements with a single treatment prior to, or at, planting.
- Avoid applying manure or fertilizer on frozen, snow-covered or saturated soil.
- Incorporate manure within 24 to 48 hours of application.
- Incorporate mineral fertilizer (granular or liquid) rather than broadcasting it on the surface.

Benefits

GHG Reduced GHG emissions

Estimated return on investment
High

On-farm emission mitigation potential +

Resources

- **Webpage:** 4R Nutrient Stewardship, Fertilizer Canada (dfc-plc.info/RT01)
- **Factsheet:** proAction Environment Resources, Dairy Farmers of Canada (dfc-plc.info/RT02)
- **Manual:** Forage BMP Manual, Canadian Forage and Grasslands Association (dfc-plc.info/RT03)
- **Webpage:** When do enhanced efficiency fertilizers make sense? Canola Digest (dfc-plc.info/RT04)
- **Research study:** Yanni, S.F., Laporte, A.D., Rajsic, P., Wagner-Riddle, C., Weersink, A., 2021. The environmental and economic efficacy of on-farm beneficial management practices for mitigating soil-related greenhouse gas emissions in Ontario, Canada. Renewable Agriculture and Food Systems 36, 307–320. (dfc-plc.info/RT05)

RIGHT RATE

By optimizing the rate of fertilizer applied over the growing season, you are taking into consideration the availability of nutrients from all sources (crop residue from previous crops, cover crops, the use of legumes and any nutrient applications). Be sure to account for available nutrients already in the soil before applying additional sources by conducting regular soil testing.

Benefits

Reduced GHG emissions

Estimated return on investment
High

On-farm emission mitigation potential +

Implementation Tips

- Work with an agronomist or agrologist to conduct regular soil testing to confirm how much nitrogen crops need.
- Use precision technology such as variable rate application and GPS.
- Reduce the rate of fertilizer application over the growing season by matching the nitrogen fertilizer application rate to crop requirement.
- Adjust fertilizer rates depending on whether the crop requires fertilizer placed near or with the seed as this may impact the rate of starter fertilizer needed and make sure you are accounting for all nutrients that you are applying.

Resources

- **Webpage:** 4R Nutrient Stewardship, Fertilizer Canada (dfc-plc.info/RR01)
- **Factsheet:** proAction Environment Resources, Dairy Farmers of Canada (dfc-plc.info/RR02)
- **Manual:** Forage BMP Manual, Canadian Forage and Grasslands Association (dfc-plc.info/RR03)
- **Webpage:** When do enhanced efficiency fertilizers make sense? Canola Digest (dfc-plc.info/RR04)
- **Research study:** Yanni, S.F., Laporte, A.D., Rajsic, P., Wagner-Riddle, C., Weersink, A., 2021. The environmental and economic efficacy of on-farm beneficial management practices for mitigating soil-related greenhouse gas emissions in Ontario, Canada. Renewable Agriculture and Food Systems 36, 307–320. (dfc-plc.info/RR05)

RIGHT PLACE

Injecting amendments directly into the soil or band spreading (using dribble bars to place manure in rows within the soil) are two options that can improve fertilizer placement when compared to broadcast application. These methods place the fertilizer below the soil surface where they can be taken up by growing roots when needed and can reduce the risk of nutrient loss from runoff. Respect recommended setback distances for nutrient application near waterways.

Benefits

Reduced GHG emissions

Estimated return on investment
Low

On-farm emission mitigation potential +

Implementation Tips

- Apply manure using injection, band spreading or dragline application.

Resources

- **Webpage:** 4R Nutrient Stewardship, Fertilizer Canada (dfc-plc.info/RP01)
- **Factsheet:** proAction Environment Resources, Dairy Farmers of Canada (dfc-plc.info/RP02)
- **Manual:** Forage BMP Manual, Canadian Forage and Grasslands Association (dfc-plc.info/RP03)
- **Webpage:** When do enhanced efficiency fertilizers make sense? Canola Digest (dfc-plc.info/RP04)
- **Research study:** Yanni, S.F., Laporte, A.D., Rajsic, P., Wagner-Riddle, C., Weersink, A., 2021. The environmental and economic efficacy of on-farm beneficial management practices for mitigating soil-related greenhouse gas emissions in Ontario, Canada. Renewable Agriculture and Food Systems 36, 307–320. (dfc-plc.info/RP05)

> *"We've pioneered dragline application of manure. We have a pressurized supply line that goes out to the field to pump the manure and inject it directly into the soil. Then we don't have nutrient loss, especially nitrogen. We use a 1200-foot flat rubber hose with an 8-inch mainline and a 5-inch dragline. You can go up to two miles, but you need a pump every mile to ensure an adequate flow. It can cover 40 acres of land with one set up and can be rolled up and stored when not in use. We always do a fall application and sometimes in the spring as well. We're looking to try some in-crop application. Getting it into the soil and sealed there, that's the secret. We've had some exceptional growth in areas that wouldn't have grown much otherwise."*
>
> — Blaine, a dairy farmer in Saskatchewan

MANURE MANAGEMENT

Proper manure management can maximize the benefits of manure, minimize costs and reduce negative impacts on crop production systems and the environment. 'Wetter' conditions (less oxygen) favour the production of methane, while drier conditions (such as in a crust on top of manure) result in methane consumption (breaking it down). Management practices that avoid methane production and promote methane consumption help mitigate GHG emissions. Manure can also contribute to the production of renewable energy using the process of anaerobic digestion.

BEST MANAGEMENT PRACTICES IN THIS CATEGORY:

COVERING MANURE STORAGE

Covering liquid manure storage systems can reduce GHG emissions by preventing them from being released into the atmosphere. It can be as simple as applying a straw cover, which can reduce methane emissions during storage by up to 15%. This decreases ammonia emissions and reduces odour and hydrogen sulfide production as well. The cover also provides rain protection that can reduce storage size, lessen manure hauling costs and prevent overflow. For larger farms, air-tight covers can be installed together with flares to capture and burn off methane.

Benefits

Reduced GHG emissions

Estimated return on investment
Low

On-farm emission mitigation potential +++

Implementation Tips

- Add a straw cover of at least 15 cm to liquid manure storage. The storage must be completely covered 100% of the time in order to reduce emissions.
- Consult an engineer to develop a manure storage cover and flare system. Note that cold climates may not produce sufficient methane to continually run a flare.
- Have only liquid manure go into the covered storage by implementing a separator system.
- Have a water management plan, as the cover may collect rainwater.

Resources

- **Factsheet:** Manure Management Practices to Mitigate Greenhouse Gases, proAction Environment Resources, Dairy Farmers of Canada (dfc-plc.info/CMS1)
- **Webpage:** Feasibility and Impact of Manure Storage Covers, Progressive Dairy Canada (dfc-plc.info/CMS2)
- **Webpage:** For dairy farms, flaring methane offers mitigation option, Cornell University (dfc-plc.info/CMS3)
- **Research study:** Veltman, K., Rotz, C.A., Chase, L., Cooper, J., Ingraham, P., Izaurralde, R.C., Jones, C.D., Gaillard, R., Larson, R.A., Ruark, M., Salas, W., Thoma, G., Jolliet, O., 2018. A quantitative assessment of Beneficial Management Practices to reduce carbon and reactive nitrogen footprints and phosphorus losses on dairy farms in the US Great Lakes region. Agricultural Systems 166, 10–25. (dfc-plc.info/CMS4)

SEPARATING SOLIDS AND LIQUIDS

Separating manure into the solid and liquid portions offers many advantages, including reducing greenhouse gas emissions. Using gravity or mechanical systems, like composting or anaerobic digestion manure can be separated to increase efficiencies in time and energy use, like fuel for manure handling and transportation. Manure separation can also increase flexibility in managing manure nutrients. Solid-liquid separation can reduce greenhouse gas emissions and odours from liquid manure storage, especially when combined with anaerobic digestion.

Benefits

GHG Reduced GHG emissions

Estimated return on investment
Low

On-farm emission mitigation potential +

Implementation Tips

- Access equipment to separate manure that is complementary to your manure management system (e.g., settling basins, inclined or vibrating screens, belt or screw presses).
- Consider the amount of water in the manure as this will determine the amount of separation already taking place (low moisture results in lower separation and high moisture results in higher separation).
- The timing of solid-liquid separation is dependent on the objectives of your manure handling and storage systems.

Resources

- **Factsheet:** Solid-Liquid Separation of Manure and Effects on Greenhouse Gas and Ammonia Emissions, University of Wisconsin Extension (dfc-plc.info/SSL1)
- **Webpage:** Solid-Liquid Manure Separation, Livestock and Poultry Environmental Learning Community (dfc-plc.info/SSL2)
- **Research study:** Garcia, M.C., Szogi, A.A., Vanotti, M.B., Chastain, J.P., Millner, P.D. 2009. Enhanced solid–liquid separation of dairy manure with natural flocculants. Bioresource Technology 100:22, 5417-5423. (dfc-plc.info/SSL3)
- **Research study:** Aguirre-Villegas, H.A., Larson, R.A., Sharara, M.A. 2019. Anaerobic digestion, solid-liquid separation, and drying of dairy manure: Measuring constituents and modeling emission. Science of The Total Environment 696, 134059. (dfc-plc.info/SSL4)

IN-VESSEL MANURE COMPOSTING

Applying composted manure to your fields can improve soil health, increase yields and support carbon sequestration. You can add to these benefits by using an in-vessel system to speed up the composting process and reduce emissions from manure storage. These mechanical systems are designed to minimize odour and process time by controlling environmental conditions such as airflow, temperature and oxygen concentration. Composted manure is lighter, easier to handle and free of weed seeds and germs, which can reduce labour costs.

Benefits

Reduced GHG emissions

Estimated return on investment
Low

On-farm emission mitigation potential +++

Implementation Tips

- Install equipment to separate manure (see previous BMP).
- Compost solid manure using an in-vessel composting system.

Resources

- **Factsheet:** In vessel composting (dfc-plc.info/IVMC1)
- **Research study:** Guest, G., Smith, W., Grant, B., VanderZaag, A., Desjardins, R., McConkey, B., 2017. A comparative life cycle assessment highlighting the trade-offs of a liquid manure separator-composter in a Canadian dairy farm system. Journal of Cleaner Production 143, 824–835. (dfc-plc.info/IVMC2)
- **Research study:** Veltman, K., Rotz, C.A., Chase, L., Cooper, J., Ingraham, P., Izaurralde, R.C., Jones, C.D., Gaillard, R., Larson, R.A., Ruark, M., Salas, W., Thoma, G., Jolliet, O., 2018. A quantitative assessment of Beneficial Management Practices to reduce carbon and reactive nitrogen footprints and phosphorus losses on dairy farms in the US Great Lakes region. Agricultural Systems 166, 10–25. (dfc-plc.info/IVMC3)

Researchers at Agriculture and Agri-Food Canada conducted a comparative life cycle assessment based on a dairy farm located in Ontario that recently adopted an active composting system that incorporated a screw-press solids/liquids separator prior to in-vessel composting.

Results indicated that the active composter system on this farm

REDUCED THE CARBON FOOTPRINT OF MILK PRODUCTION BY CO_2 36%

Photo credit: Progressive Dairy

REDUCING MANURE STORAGE DURATION

Completely emptying a liquid manure storage tank in the spring – to eliminate aged manure in the tank – reduces methane emissions from newly loaded manure in the following months by up to 40%. The more manure removed, the better. Even emptying the tank to 5% of its total volume of manure will reduce methane emissions.

Implementation Tips

- Fully empty manure storage at least twice per year.
- Consider what manure removal equipment will work best for your storage tank and the purpose of the manure (e.g., vertical pumps, side-mounted pumps, earthen manure storage pumps).
- To ensure the right moisture content for agitating and pumping, thoroughly mix the manure to get the settled solids mixed in with the liquid portion before removing most of the liquid.
- Take several manure samples throughout the pumping when filling the tanker to analyze nutrient and dry matter as part of your nutrient management plan.

Benefits

GHG Reduced GHG emissions

Estimated return on investment
Low

On-farm emission mitigation potential

A DFC-supported research study shows that completely emptying a liquid manure storage tank in the spring reduces methane emissions from newly loaded manure in the following months by up to 40%. However, due to the study's design, an emissions factor cannot be calculated, which is needed to estimate the on-farm mitigation potential.

Resources

- **Factsheet:** Manure Management Practices to Mitigate Greenhouse Gases, proAction Environment Resources, Dairy Farmers of Canada (dfc-plc.info/REMSD1)
- **Webpage:** Removing Liquid Manure From Storage, OMAFRA (dfc-plc.info/REMSD2)
- **Research study:** Rennie, T.J., Gordon, R.J., Smith, W.N., VanderZaag, A.C. 2018. Liquid manure storage temperature is affected by storage design and management practices—A modelling assessment. Agriculture, Ecosystems and Environment, [online] 260 47-57. (dfc-plc.info/REMSD3)
- **Research study:** Petersen, S.O., Blanchard, M., Chadwick, D., Del Prado, A., Edouard, N., Mosquera, J., Sommer, S.G. 2013. Manure management for greenhouse gas mitigation. Animal 7:2, 266-282. (dfc-plc.info/REMSD4)
- **Research Study:** Wood, J.D., VanderZaag, A.C., Wagner-Riddle, C. et al 2014. Gas emissions from liquid dairy manure: complete versus partial storage emptying. Nutr Cycl Agroecosyst 99, 95–105. (dfc-plc.info/REMSD5)

ANAEROBIC DIGESTION

Anaerobic digestion processes manure in a biodigester to produce biogas that can be used to generate electricity, heat or renewable natural gas. One of the by-products is a nutrient-rich manure called digestate, which can be used as fertilizer. Biodigesters also create financial opportunities through the sale of digestate, electricity or renewable natural gas.

Benefits

Reduced GHG emissions

Estimated return on investment
Low

On-farm emission mitigation potential ++

Implementation Tips

- Visit farmingbiogas.ca to assess your farm's suitability for a digester and for additional resources.
- Herd size is an important consideration when determining the use of an anaerobic digester and ensure that the scale of digester meets the needs of your operation.
- If your herd size is not at a size of profitability for digester investment, consider collaborating with neighbouring farms to create a manageable size of herd to support and profit from a digester.
- Work with an anaerobic digester provider to determine location, size, and space to put it, as well as to evaluate operating costs and potential for return on investment.

Resources

- **Website:** Farming Biogas (dfc-plc.info/AD1)
- **Report:** Canadian Agricultural Biogas Study, Canadian Biogas Association (dfc-plc.info/AD2)
- **Webpage:** Funding and Incentives, Canadian Biogas Association (dfc-plc.info/AD3)

> *We created our own system in 2009, composed of two 1,000 m3 anaerobic digesters, a mix tank and a receiving tank. We milk about 150 cows, so we take all the manure from our farm into the mix tank and add in the same amount of off-farm waste (about 8,000 tonnes per year). We feed this mix into the digesters every hour. We collect the gas under a dome, which is fed back through a generator. We have a 250-kW contract with a local hydro company and use about 1/5th of the energy we produce to power our farm, as well as a portion of the heat generated from the digester. We noticed an increased fertilizer value from the digestate that comes out the back end – almost a 15% increase in crop yield by year three. Researchers from the University of Guelph monitored our methane levels before, during, and for a few years after construction, and we were able to take out 90-97% of the emissions from our manure storage pit. It's a bit like taking care of an animal, it needs to be fed and cleaned, and if you treat it well, it will treat you well back.*
>
> — Korb, a dairy farmer in Ontario

ENERGY, INFRASTRUCTURE AND TRANSPORTATION

Reducing energy use, producing renewable energy, or purchasing renewable energy are all ways to mitigate GHG emissions and generate cost-saving benefits for your farm. These green energy innovations can offset energy use and consumption costs, and, in some cases, provide additional revenue streams for the farm.

BEST MANAGEMENT PRACTICES IN THIS CATEGORY:

IMPROVING ENERGY EFFICIENCY

Energy efficiency includes any changes to reduce on-farm energy demand. An energy audit is a good place to start to identify where energy use is high and which areas could benefit from retrofitting. Installing energy-efficient lighting, ventilation or milking equipment will benefit the environment and reduce energy consumption costs. Energy-efficiency can also be applied to field practices, where adoption of reduced tillage reduces fuel use.

Benefits

GHG **Reduced GHG emissions**

Estimated return on investment
Medium

On-farm emission mitigation potential +

> *The most logical and cost-effective time to adopt new technology or upgrade existing equipment, is at the end of the useful life of the equipment. Another time equipment changes may be cost effective is if the operation is expanding in size and new equipment is brought online.*
>
> — Government of Alberta

Implementation Tips

- Conduct an energy audit.
- Install energy-efficient lighting, ventilation and milking equipment.
- Minimize tillage on fields to reduce fuel usage.

Resources

- **Factsheet:** proAction Environment Resources, Dairy Farmers of Canada (dfc-plc.info/IEF1)
- **Factsheet:** Energy Efficiency on Dairy Farms, Government of Alberta (dfc-plc.info/IEF2)
- **Webpage:** Farm Lighting Energy Efficiency Checklist and Tips, Farm Energy (dfc-plc.info/IEF3)

PRODUCING SOLAR ENERGY

Solar panels can generate renewable energy for your farm. The energy generated can offset farm energy use and reduce energy costs, leading to lower greenhouse gas emissions. Solar panels can be installed on the roofs of barns or outbuildings or ground-mounted, free-standing panels can be located in fields or pastures. As more Canadian farmers adopt renewable energy sources, solar continues to be the most popular option[3]. Solar panels can last 25 to 40 years and offer an alternative energy generation or revenue stream.

Benefits

Reduced GHG emissions

Estimated return on investment
Medium

On-farm emission mitigation potential +

Implementation Tips

- Obtain several quotes from different solar contractors and make sure to ask questions that allow you to choose the right solar panels for your farm set-up.
- The type of system (e.g., tracking system vs. stationary system) you choose will depend on where the solar panels will be located on your farm.
- Know the voltage types needed and consult with solar contractors and your local hydro provider to ensure you choose the correct set-up and reduce the chance of unforeseen costs.

Resources

- **Report:** Implementing Solar Electricity On-Farm, British Columbia Ministry of Agriculture (dfc-plc.info/PSE1)
- **Webpage:** Solar Electric Systems, OMAFRA (dfc-plc.info/PSE2)
- **Webpage:** Shade and energy: solar panels used as shades in grazing pasture, University of Minnesota Extension (dfc-plc.info/PSE3)

We had the opportunity to install a solar system. For the price of a pick-up truck, I was able to put this on the roof of my barn. It returns income to me every day and runs flawlessly. Not only did we see a huge reduction in the bill, but we also are making power out of the sun, and it's awesome.

— Jordan, a dairy farmer in Alberta

PRODUCING WIND ENERGY

Wind is a renewable source of energy that can be generated from on-farm wind turbines. Wind energy can offset farm energy costs while reducing the amount of electricity generation from fossil fuel, which results in lower greenhouse gas emissions and air contaminants. Wind energy make sense on farms where winds are strong enough – for example on ridges, or wide-open windy spaces, to harness that wind power to generate renewable energy.

Benefits

GHG Reduced GHG emissions

Estimated return on investment
Medium

On-farm emission mitigation potential +

Implementation Tips

- Consider available wind resources, zoning regulations and aesthetic issues (neighbors and community members) during the planning process of installing wind turbines.
- Ensure that the scale of the wind turbine aligns with the amount of energy used on your farm (e.g., farming equipment, ventilation system of barn).

Resources

- **Webpage:** Electricity generation using small wind turbines for home or farm use, Government of Ontario (dfc-plc.info/PWE1)
- **Webpage:** Is A Wind Turbine Right For Your Rural Property?, Green Building Canada (dfc-plc.info/PWE2)
- **Webpage:** Putting wind in our sails, University of Alberta (dfc-plc.info/PWE3)

> *The quality of the local wind conditions is a significant factor in determining if a turbine will be economically viable for the home or farm. The Canadian Wind Energy Atlas (CWEA) is available online through an interactive wind map that produces wind speed data for a site with 200-m (656-ft) resolution.*
>
> — Government of Ontario

PURCHASING RENEWABLE ENERGY

Switching to renewable energy sources or offsetting a portion of your farm energy use with renewable energy is a proactive approach to minimizing your farm's carbon footprint. If building renewable energy systems like wind turbines, solar panels, geothermal or anaerobic digestors doesn't make sense for your farm, consider purchasing renewable energy.

Benefits

GHG Reduced GHG emissions

Estimated return on investment
Medium

On-farm emission mitigation potential +

Implementation Tips

- Consult a green energy provider to determine which energy source meets the needs of your farm.
- Contact your utility provider to see if renewable options are available in your area. Options may include green electricity, green natural gas, or green fuel (fuel that is repurposed from waste streams).
- Use websites such as energyrates.ca when determining what green options are available in your province and compare green energy rates across Canada.
- Explore financial incentives or programs offered by your province to assist with costs associated with purchasing renewable energy.

Resources

- **Webpage:** Canada's Renewable Power, Canada Energy Regulator (dfc-plc.info/PRE1)
- **Webpage:** Compare Green Energy Plans & Renewable Solutions, EnergyRates.ca (dfc-plc.info/PRE2)
- **Webpage:** Financial incentives by province, Natural Resources Canada (dfc-plc.info/PRE3)

CONVERTING TO ALTERNATIVELY POWERED MACHINERY

From electric batteries to biomethane and hydrogen, more and more options are coming on to the market to reduce GHG emissions from farm machinery. As machinery manufacturers continue to invest in research and innovation, these and other types of low-emissions options are expected to become more available in the coming years. Next time you need to replace a piece of equipment, ask your equipment dealer about these options.

Implementation Tips

- Consult your equipment dealer about alternatively powered (e.g., electric, hydrogen) farm equipment options that will meet your farm management needs.

Benefits

GHG Reduced GHG emissions

Estimated return on investment
Low

On-farm emission mitigation potential ++

Resources

- **Webpage:** Alternative fuels for farm machinery, Cornish Mutual (dfc-plc.info/CAPM1)
- **Webpage:** An electric tractor may be in your future, Successful Farming (dfc-plc.info/CAPM2)
- **Webpage:** The Hydrogen Fueled Farm of the Future, Washington State University (dfc-plc.info/CAPM3)
- **Webpage:** Electrifying agriculture: how Canada's farm industry is starting to transition, Electric Autonomy (dfc-plc.info/CAPM4)
- **Webpage:** Financial incentives by province, Natural Resources Canada (dfc-plc.info/CAPM5)

MANAGING PLASTICS RESPONSIBLY

Responsible plastic management has its own set of 4Rs: Refuse, Reduce, Reuse and Recycle. First, seek non-plastic options where available, then reduce plastic use, then reuse plastics on farm or return them using a take-back program, and finally recycle. If no other options are available, dispose of plastics at a landfill. This type of management reduces the emissions from new plastics being produced as well as the emissions associated with poor on-farm plastic management.

Benefits

GHG Reduced GHG emissions

Estimated return on investment
Low

On-farm emission mitigation potential +

Implementation Tips

- Choose compostable products or biodegradable materials in lieu of plastics.
- Choose products containing less plastic packaging.
- Divert waste by reusing or repurposing plastics.
- Return plastics through take-back programs.
- Recycle plastics.
- Where no other options are available, dispose of plastic waste at a landfill.

Resources

- **Website:** Cleanfarms (dfc-plc.info/MPR1)
- **Website:** Agricultural Plastics Recycling Group (dfc-plc.info/MPR2)
- **Webpage:** Recycling Farm Plastic Films, OMAFRA (dfc-plc.info/MPR3)

I started recycling bale wrap, bunker silo plastic and shavings bags in the spring of 2021. We purchased a plastic compactor that is basic, relatively inexpensive and easy to use. Before you start recycling plastic, determine what the final destination is for the bales, as this will determine what plastic you can put in the bale. Recycling facilities want a specific density of plastic and may not accept multiple sources of plastic. My best advice is to keep the compactor under a roof, if possible, or build a hinged plywood cover to prevent snow and rain from getting at the compactor. Used plastic should be put into the compactor immediately. Once it's full, it takes about 20 minutes with two people to tie-off and eject the bale. Place the bale on a skid for easy transport.

— Kevin, a dairy farmer in Ontario

LAND MANAGEMENT

Healthy soils and biodiverse areas help dairy farms to be more resilient to the effects of climate change like severe temperatures, wildfires, drought and flooding. Managing your land with biodiversity in mind provides diverse habitats and reduces environmental risks. Support on-farm biodiversity by preserving, protecting and enhancing natural systems such as grasslands, wetlands, tame pastureland, forests, riparian buffer zones, shelterbelts and hedgerows. These activities are critical ways to reduce the impact of climate change and include shading, carbon storage in woody biomass and soil, improved biodiversity and pollinator activity, reduced wind erosion of soil, watercourse and groundwater quality.

BEST MANAGEMENT PRACTICES IN THIS CATEGORY:

ROTATIONAL GRAZING

Grazing cattle on pasture is a way to improve pasture management, sequester carbon in the soil and optimize grazing for soil health purposes. Building healthier soils can promote more carbon capture and biodiversity. Rotational grazing can also spread out the concentration of natural fertilizer, or manure, across a wider area. The benefits of grazing on fresh pasture extend across the entire dairy herd, including lactating cows.

Benefits

- Carbon sequestration
- Increased resiliency to the effects of climate change
- Improved soil health
- Enhanced biodiversity

Implementation Tips

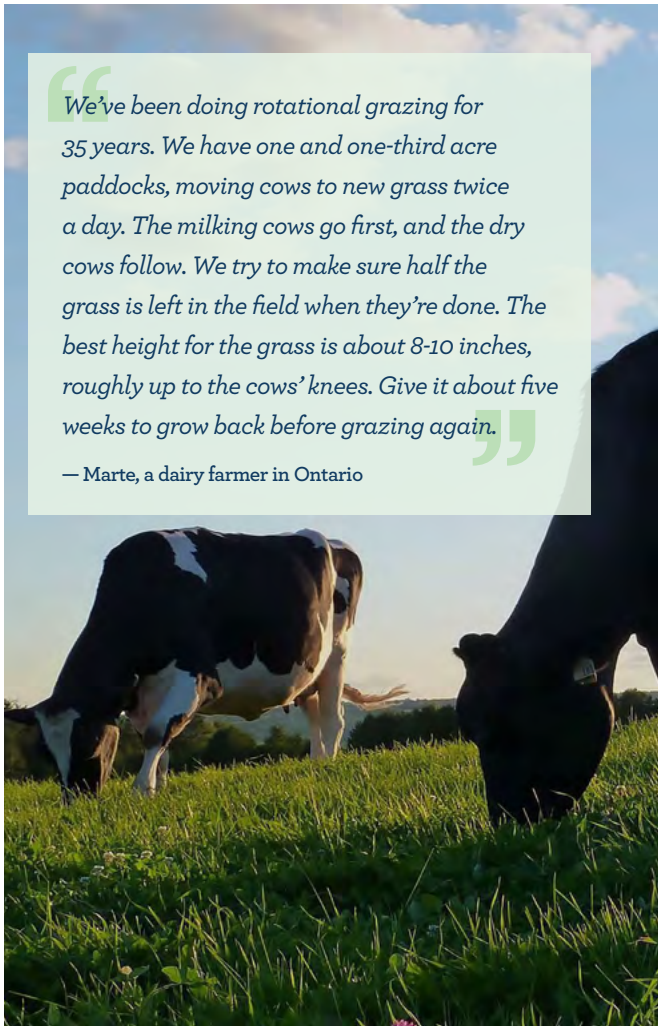
- Establish an appropriate ratio of cattle to pasture acres to manage nutritional requirements.
- Provide access to water and shade for grazing animals.
- Develop a schedule for cattle to rotate through pastures to ensure pastures, plant and soil health is maintained.
- Space grazing at least 30 days apart to allow for sufficient regrowth.
- Consult a dairy nutrition advisor to manage your herd's nutritional needs, like adding mineral supplements to a forage grazing diet.

Resources

- **Webpage:** Dairy Cows on Pasture: Myths versus Facts, Lactanet (dfc-plc.info/ROTG1)
- **Website:** Advanced Grazing Systems, Canadian Forage and Grasslands Association (dfc-plc.info/ROTG2)
- **Manual:** Forage BMP Manual, Canadian Forage and Grasslands Association (dfc-plc.info/ROTG3)
- **Research study:** Dutreuil, M., Wattiaux, M., Hardie, C.A., Cabrera, V.E., 2014. Feeding strategies and manure management for cost-effective mitigation of greenhouse gas emissions from dairy farms in Wisconsin. Journal of Dairy Science 97, 5904–5917. (dfc-plc.info/ROTG4)

Estimated return on investment
Medium

On-farm emission mitigation potential +++



"We've been doing rotational grazing for 35 years. We have one and one-third acre paddocks, moving cows to new grass twice a day. The milking cows go first, and the dry cows follow. We try to make sure half the grass is left in the field when they're done. The best height for the grass is about 8-10 inches, roughly up to the cows' knees. Give it about five weeks to grow back before grazing again."

— Marte, a dairy farmer in Ontario

PRACTICING SILVOPASTURE (AGROFORESTRY)

Agroforestry is an overarching land-use system that implements woody perennials (e.g., trees, shrubs) on the same land management system as crops and/or animals. Silvopasture is an agroforestry system that combines the farming of livestock, trees and land management to sustain healthier soil, higher biodiversity and reduce greenhouse gas emissions through carbon sequestration. Silvopasture improves pasture management, promotes soil health and extends grazing opportunities by using marginal land. The practices of agrosilvopastural systems offers efficiencies by combining grazing cattle, forages and trees into one, properly managed area. Cattle also have regular access to wind and weather protection, shade and cooler environments during hot summer months.

Benefits

- Carbon sequestration
- Increased resiliency to the effects of climate change
- Improved soil health
- Enhanced biodiversity

Estimated return on investment
Medium

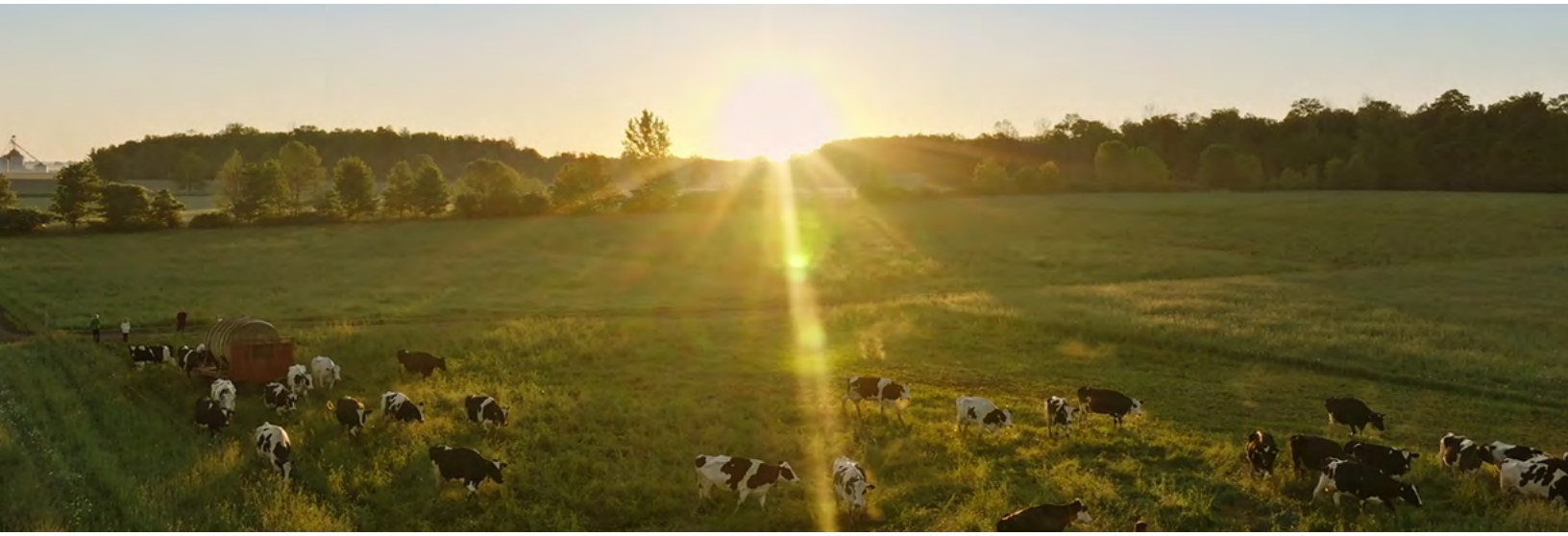
On-farm emission mitigation potential +

Implementation Tips

- Convert a small forested area into a silvopasture or consider planting trees or other high biomass perennials within existing pastures.
- Consult a woodlot specialist to learn best management practices for local conditions and conduct a site assessment.
- Consult an agronomist/agrologist for forage seeding recommendations.

Resources

- **Webpage:** Silvopasture Canada (dfc-plc.info/PS1)
- **Webpage:** Silvopasture, Beef Cattle Research Council (dfc-plc.info/PS2)
- **Factsheet:** Agroforestry: Opportunities to Integrate Production, Diversification and Conservation, Agroforestry British Columbia (dfc-plc.info/PS3)



CONSERVING WETLANDS

Wetlands have a natural ability to store carbon, keeping it from being released into the atmosphere. These areas also conserve biodiversity, improve water quality and can help manage droughts and floods. In many areas, wetlands have been removed for agricultural use, but it's important to note that wetland restoration is helpful for mitigating the effects of climate change, like flooding, drought, sea-level rise and biodiversity loss. In places where there are no wetlands left to conserve, consider restoring wetlands on your farm. Avoid draining wetlands on your farm to maintain this beneficial ecosystem.

Benefits

- Carbon sequestration
- Increased resiliency to the effects of climate change
- Improved soil health
- Enhanced biodiversity

Estimated return on investment
Medium

On-farm emission mitigation potential +

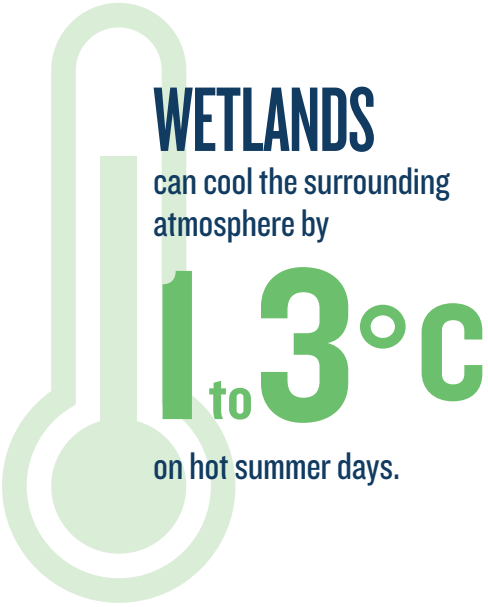
Implementation Tips

- Avoid draining wetlands. They are an important carbon sink and wildlife habitat.
- Restore or enhance wetlands.
- Increase the native plant diversity in or around wetland areas.
- Partner with conservation organizations to receive assistance from technical experts on how to restore wetlands that have been drained or altered on your farm.
- Consider improving habit features that will attract important species to your wetland and increase biodiversity (e.g., log piles, snags, rock piles).

> *"We restored the wetlands in the back corner of our field. It prevents topsoil erosion, it helps us manage water, especially during drought, and it preserves the natural habitat. Water plants started growing... We didn't put them in, they came in naturally when the habitat was there for them. Since then, we've put in even more plants, shrubs and trees to increase biodiversity. Farming is a long game; even small changes now will make huge differences tomorrow."*
>
> — Mary Ann, a dairy farmer in Ontario

Resources

- **Webpage:** Agriculture Programs, Ducks Unlimited Canada (dfc-plc.info/COW1)
- **Webpage:** Restoring Wetlands, Growing with Nature (dfc-plc.info/COW2)
- **Factsheet:** Wetland Restoration and Rehabilitation, Ontario Nature (dfc-plc.info/COW3)
- **Factsheet:** proAction Environment Resources, Dairy Farmers of Canada (dfc-plc.info/COW4)
- **Research Study:** Drever, C.R., Cook-Patton, S.C., Akhter, F., Badiou, P.H., Chmura, G.L., Davidson, S.J., Desjardins, R.L., Dyk, A., Fargione, J.E., Fellows, M., Filewod, B., Hessing-Lewis, M., Jayasundara, S., Keeton, W.S., Kroeger, T., Lark, T.J., Le, E., Leavitt, S.M., LeClerc, M.-E., Lemprière, T.C., Metsaranta, J., McConkey, B., Neilson, E., St-Laurent, G.P., Puric-Mladenovic, D., Rodrigue, S., Soolanayakanahally, R.Y., Spawn, S.A., Strack, M., Smyth, C., Thevathasan, N., Voicu, M., Williams, C.A., Woodbury, P.B., Worth, D.E., Xu, Z., Yeo, S., Kurz, W.A., 2021. Natural climate solutions for Canada. Science Advances 7, eabd6034. (dfc-plc.info/COW5)



PROTECTING RIPARIAN BUFFER ZONES

Supporting and enhancing natural riparian buffer zones is important for ecosystem conservation and water quality. Preserving and maintaining any riparian area on your farm is the first step to enhancing this natural system. Improving the health and biodiversity of a riparian area can include reducing grazing near bodies of water or incorporate rests periods in grazing areas, as well as planting trees and other natural species. Riparian buffer zones allow for greater benefits such as reducing erosion, increasing watershed storage, lowering the number of contaminants in bodies of water, and enhancing soil development.

Benefits

- Carbon sequestration
- Increased resiliency to the effects of climate change
- Improved soil health
- Enhanced biodiversity

Estimated return on investment
Medium

On-farm emission mitigation potential +

Implementation Tips

- Protect or create riparian strips between cultivated areas and water environments along creeks, streams, gullies, rivers and wetlands. These areas provide wildlife habitat, streambank stability or a corridor for wildlife to pass through.
- Consider planting trees, wildflowers, grasses or other natural species. Maintain habitats for wildlife, such as rock piles for reptiles and standing dead trees for birds.
- Avoid removing vegetation to plant annual or forage crops.
- Plan for riparian buffer redesign if soil is being lost to the stream.
- Sign a conservation/stewardship agreement to set aside parts of your farm for wildlife habitat.

Resources

- **Webpage:** Riparian Area Management, Government of Canada (dfc-plc.info/PRBZ1)
- **Webpage:** Riparian Buffer Zones, Teagasc (dfc-plc.info/PRBZ2)
- **Factsheet:** proAction Environment Resources, Dairy Farmers of Canada (dfc-plc.info/PRBZ3)
- **Research study:** Drever, C.R., Cook-Patton, S.C., Akhter, F., Badiou, P.H., Chmura, G.L., Davidson, S.J., Desjardins, R.L., Dyk, A., Fargione, J.E., Fellows, M., Filewod, B., Hessing-Lewis, M., Jayasundara, S., Keeton, W.S., Kroeger, T., Lark, T.J., Le, E., Leavitt, S.M., LeClerc, M.-E., Lemprière, T.C., Metsaranta, J., McConkey, B., Neilson, E., St-Laurent, G.P., Puric-Mladenovic, D., Rodrigue, S., Soolanayakanahally, R.Y., Spawn, S.A., Strack, M., Smyth, C., Thevathasan, N., Voicu, M., Williams, C.A., Woodbury, P.B., Worth, D.E., Xu, Z., Yeo, S., Kurz, W.A., 2021. Natural climate solutions for Canada. Science Advances 7, eabd6034. (dfc-plc.info/PRBZ4)

MAINTAINING GRASSLANDS

Grasslands and grasslands ecosystems provide carbon sequestration and storage. Grazing cattle on grasslands or tame on-farm pastures offers a host of environmental benefits. These natural systems can reduce greenhouse gas emissions, benefit water quality, help alleviate flood and droughts, improve soil health and air quality and promote biodiversity and species at risk preservation and enhancement.

Benefits

- Carbon sequestration
- Increased resiliency to the effects of climate change
- Improved soil health
- Enhanced biodiversity

Implementation Tips

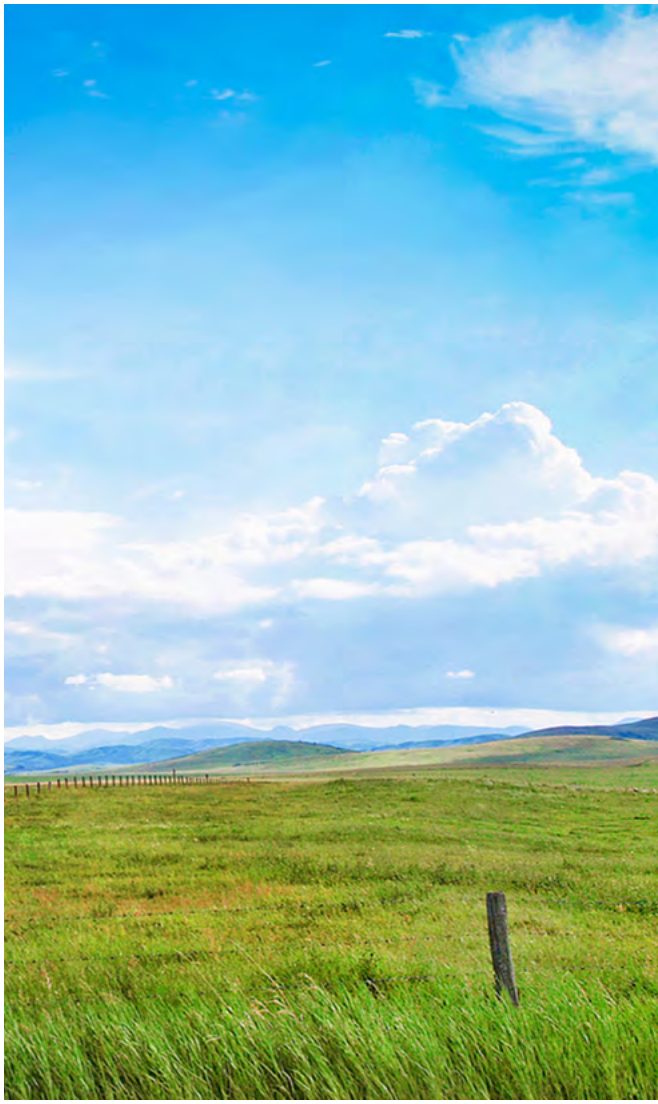
- Conduct soil testing. Consult an agronomist to fertilize the grasslands according to their nutrient requirements.
- Evaluate the winter survival of your grasslands. If winter losses are too great, consider reseeding the prairie (by zones or as a whole) to avoid weed growth. In case of significant winter losses, think about planting emergency grasslands (e.g., sudangrass).
- Control invasive plants as much as possible.
- Identify grassland bird priorities for your fields and consider implementing grassland management systems that support those species.

Resources

- **Factsheet:** proAction Environment Resources, Dairy Farmers of Canada (dfc-plc.info/MG1)
- **Research study:** Grazing livestock could reduce greenhouse gases in the atmosphere, study shows, University of Alberta (dfc-plc.info/MG2)
- **Research study:** Drever, C.R., Cook-Patton, S.C., Akhter, F., Badiou, P.H., Chmura, G.L., Davidson, S.J., Desjardins, R.L., Dyk, A., Fargione, J.E., Fellows, M., Filewod, B., Hessing-Lewis, M., Jayasundara, S., Keeton, W.S., Kroeger, T., Lark, T.J., Le, E., Leavitt, S.M., LeClerc, M.-E., Lemprière, T.C., Metsaranta, J., McConkey, B., Neilson, E., St-Laurent, G.P., Puric-Mladenovic, D., Rodrigue, S., Soolanayakanahally, R.Y., Spawn, S.A., Strack, M., Smyth, C., Thevathasan, N., Voicu, M., Williams, C.A., Woodbury, P.B., Worth, D.E., Xu, Z., Yeo, S., Kurz, W.A., 2021. Natural climate solutions for Canada. Science Advances 7, eabd6034. (dfc-plc.info/MG3)

Estimated return on investment
Low

On-farm emission mitigation potential +



PLANTING TREES, HEDGEROWS, SHELTERBELTS

Establishing and maintaining hedgerows and shelterbelts by planting new trees or conserving existing trees or shrubs will naturally protect soil, improve air and water quality, enhance wildlife habitat, and beautify the landscape. As a natural barrier to wind flow, they can have positive effects on crop production by moderating plant water use, reducing physical damage, changing air and soil temperature, as well as impacting CO2 levels and relative humidity. Shelterbelts and hedgerows can be created by planting adapted species of trees or shrubs, or in some cases, allowing natural plant communities to establish by protecting selected areas from grazing cattle or cropping.

Benefits

- Carbon sequestration
- Increased resiliency to the effects of climate change
- Improved soil health
- Enhanced biodiversity

Estimated return on investment
Medium

On-farm emission mitigation potential +

Implementation Tips

- Conserve existing shelterbelts.
- Conduct a site assessment to determine the site conditions and characteristics and determine what your goals are (e.g., providing habitat to native species, healing water cycles).
- Determine the high waterline (on average in the springtime) and then plant above this line.
- Examine the above ground competition from weeds and implement measures to protect seedlings.
- Leave a 5-metre buffer between the edge of the trees and where the cropland starts to reduce impacts of drift on seedlings.
- Consult an agroforestry or woodlot extension advisor to receive assistance with planting project design, implementation, tree health assessments, restoration planning and maintenance of forested areas.

> *In the 1960s, my parents started planting maple trees along our drive, and it's just kept going from there. We're up to a couple acres of trees now, and three kilometres of walking trails which we keep open to the community. Now the trees, they do take a bit of maintenance, but that's how we support biodiversity and it creates new habitat in our area. We, us, the farm, the family, we're all part of a larger system. The farm isn't separate from our environment. When we support it today, it supports us tomorrow.*
>
> — Holger, a dairy farmer in British Columbia

Resources

- **Webpage:** Tree Planting Guide, Tree Canada (dfc-plc.info/PTHS1)
- **Webpage:** Plant trees on farmland, Conservation Evidence (dfc-plc.info/PTHS2)
- **Guide:** Shelterbelts, Agriculture and Agri-Food Canada (dfc-plc.info/PTHS3)
- **Research Study:** Drever, C.R., Cook-Patton, S.C., Akhter, F., Badiou, P.H., Chmura, G.L., Davidson, S.J., Desjardins, R.L., Dyk, A., Fargione, J.E., Fellows, M., Filewod, B., Hessing-Lewis, M., Jayasundara, S., Keeton, W.S., Kroeger, T., Lark, T.J., Le, E., Leavitt, S.M., LeClerc, M.-E., Lemprière, T.C., Metsaranta, J., McConkey, B., Neilson, E., St-Laurent, G.P., Puric-Mladenovic, D., Rodrigue, S., Soolanayakanahally, R.Y., Spawn, S.A., Strack, M., Smyth, C., Thevathasan, N., Voicu, M., Williams, C.A., Woodbury, P.B., Worth, D.E., Xu, Z., Yeo, S., Kurz, W.A., 2021. Natural climate solutions for Canada. Science Advances 7, eabd6034. (dfc-plc.info/PTHS4)

FREQUENTLY ASKED QUESTIONS

Why are we doing this?

For years, farmers have been taking steps to improve sustainability voluntarily. At DFC's Annual Policy Conference in February 2021, farmer delegates challenged DFC to find ways to align these individual efforts under a common goal. Following an exploration of possible targets, the DFC Board of Directors approved the objective to reach net zero by 2050. This united effort will support net-zero commitments being made across the Canadian dairy value chain to ensure consumers continue to feel confident about the dairy products they love.

What's in it for me? For the industry?

What's good for the environment, what's good for the herd, and what's good for business go hand-in-hand-in-hand. Farmers are among the first to experience the effects of climate change, from droughts and floods to forest fires and hurricanes. By adopting sustainable practices that reduce GHG emissions and boost resilience, farmers can mitigate the impacts of these extreme weather events. This contributes to slowing climate change and ensuring that we have a stable, sustainable supply of milk so that Canadians can continue enjoying the dairy products they love. Many of the BMPs in this guide can also generate cost savings or even create new revenue streams for farmers – generating green energy and selling that energy back to provincial grids, for instance.

Is participation mandatory?

Dairy farms have the opportunity to voluntarily implement strategies to reduce emissions and increase environmental benefits that make sense for their operation. We know that a one-size-fits-all initiative would not be practical. Every change made on individual farms is important and will help achieve the net-zero target. Our collective efforts will contribute to a thriving and efficient future for our sector.

How will progress be measured?

Progress will be measured through a variety of mechanisms already in place. The carbon footprint, water consumption and land use are measured at the national level through the Life Cycle Assessment, and uptake of many best management practices is measured through the Environmental Questionnaire that is part of the Environment module of proAction. Farmers are not expected to collect additional data but for those who are interested, DFC is currently exploring the development of an on-farm carbon footprint measurement tool. Farmers can also consider monitoring individual progress using Lactanet's Herd Sustainability Index.

Is this part of proAction?

The net zero by 2050 initiative is separate from proAction, but closely linked. Many of your efforts through each of proAction's six modules support sustainability, from increased milk quality to improved animal health and disease prevention, to all the requirements of the environment module.

In particular, the results from your Environmental Farm Plan will help inform your progress and take note of your positive on-farm actions with respect to the environment, as well as identify practices that could further benefit your farm and mitigate impacts of climate change. The BMP Reference provides you the opportunity to explore practices that target additional sustainability areas that contribute to the overall efficiency of your farm. Aggregated answers to the Environmental Questionnaire will enable DFC to communicate your hard work and progress.

Which practice has the most benefits?

Each practice has different benefits, so it depends on your priorities and what will work best for your farm. The Quick Reference at the beginning of this guide is the easiest way to compare the benefits of each practice (see p. 6).

Is funding available?

DFC will continue to explore opportunities for financial support to farmers, including conducting economic analysis and promoting economic opportunities related to sustainable farm practices. DFC will advocate for programs and funding at the federal level, and will inform farmers of ongoing economic opportunities that support BMP adoption.

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[1] National survey conducted by Nanos for Dairy Farmers of Canada, October 2021

[2] "Preparing for Climate Change," Environment and Climate Change Canada, June 2022, https://publications.gc.ca/collections/collection_2022/eccc/En4-469-2022-eng.pdf

[3] 2021 Census of Agriculture, Statistics Canada, May 2022, https://www150.statcan.gc.ca/n1/daily-quotidien/220511/dq220511a-eng.htm

NET ZERO BY 2050

Best Management Practices Guide to Mitigate Emissions on Dairy Farms

DAIRY FARMERS OF CANADA™