FARMERS FOR CLIMATE SOLUTIONS

Anastasia Fyk (middle), fourth generation buckwheat farmer with her father Don Fyk (left) and her uncle Ben Fyk (right), measuring the nutritional quality of their buckwheat
FFF Farms in Garland, Manitoba
Photo: Atom Dzaman

A Down Payment for a Resilient and Low-GHG Farm Future

$300 million to reduce agricultural GHGs by 10 Megatonnes and lay the groundwork for widespread adoption of climate-friendly farming in APF 2023

Budget 2021 Recommendation

Executive Summary

Intercropping wheat and peas to support nitrogen management
FaspaFarm, Manitou, MB
Photo: Karen Klassen

FARMERS FOR CLIMATE SOLUTIONS (FCS) is a national coalition of farmer-led and farmer-supporting organizations representing over 20,000 Canadian farmers and ranchers from coast to coast. FCS member farmers are already implementing beneficial management practices (BMPs) on their farms and ranches that are known to reduce greenhouse gas emissions (GHGs), sequester carbon, and increase climate resilience. Public policies and other support mechanisms are needed to significantly broaden adoption of these practices. These supports must acknowledge the diversity of farmers and farming operations in Canada and the different needs and barriers the face. Tailoring supports to these diverse realities is essential.

Well-designed programs can bring environmental benefits, important returns on investment for producer livelihoods, enhance equity, diversity and inclusion in agriculture, and ensure the competitiveness of our sector in the clean economy of the 21st century. FCS assembled an expert Task Force in September 2020 with farmers and experts to advance pragmatic policy proposals that scale adoption and acceptance of immediately implementable BMPs by quantifying the GHG and economic impacts of the most promising climate-friendly farming practices and tailoring these proposals to meet the needs of both broad acre and small scale farmers as well as different regions and ecosystems of production. The Task Force is chaired by two farmers, and convened members with expertise in agricultural economy, GHG modeling, domestic and international agricultural policy analysis, and equity and diversity. This budget request represents the first phase of the Task Force's work.

Recent announcements by the federal government are encouraging. FCS applauds the government's recognition of farmers and ranchers as key players in the fight against climate change, and its commitment to support our efforts to reduce emissions and build resilience.[1] Funding and measures announced in the 2020 Fall Economic Statement and Canada's strengthened climate plan reinforce this commitment. However, even with this new funding, Canada still lags far behind other jurisdictions. The EU spends over 73 times more than Canada on agri-environmental programs on a per-acre basis. The US spends 13 times more. Federal spending on climate change mitigation and adaptation in agriculture is also much lower than spending in other sectors, such as transportation and energy, even though farmers are on the frontlines of worsening climate impacts and also need support to learn and implement new techniques and technologies.

1 This unprecedented commitment was made in the Speech from the Throne 2020 [https://www.canada.ca/en/privy-council/campaigns/speech-throne/2020/speech-from-the-throne.html]

GHG research on a PEI potato farm
Photo: David Burton

A $300 million investment in Budget 2021 will reduce agricultural emissions by 10 megatonnes. It will jump-start GHG reduction efforts by Canadian farmers, fuel increased awareness, acceptance and adoption of climate-friendly BMPs, and gather the information necessary to advance a strong APF in 2023.

The new Canadian Agricultural Policy Framework (APF), due in 2023, is a crucial opportunity to close this funding gap, empower all farmers to see themselves in climate solutions, and reverse the trend of rising GHG emissions in Canadian agriculture. With only nine growing seasons left to achieve Canada's Paris climate target2, we can't afford to wait until 2023 to get started. A strategic $300 million investment in Budget 2021 will jump-start GHG reduction efforts by Canadian farmers, fueling increased awareness, acceptance and adoption of climate-friendly BMPs, and gathering the information necessary to advance a strong APF in 2023. The proposed $300 million investment is allocated to six high-impact program proposals that together have the potential to reduce agricultural GHG emissions by more than ten million tonnes CO_2e, and allow for on-farm information gathering and farmer feedback to guide the next APF and beyond, charting a course for a more productive, competitive and resilient farm sector. The proposals allow many farm types to take advantage of these supports, from market gardeners to ranchers and grain growers. Transparent and publicly-available monitoring and evaluation is integral to each of these programs, and requires upfront planning and dedicated investments.

2 The Paris agreement is a legally binding international treaty on climate change. It was adopted by 196 parties at COP 21 in 2015, with a goal of limiting global warming to well below 2 degrees Celsius, preferably 1.5 degrees, compared to pre-industrial levels. (https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement)

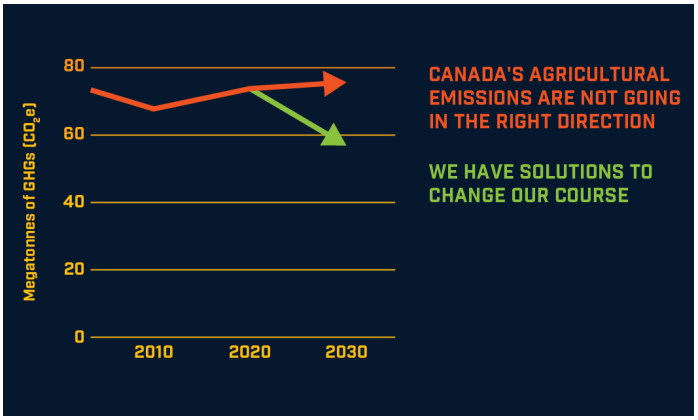
Program	GHG mitigation (CO_2e)	Average Abatement Cost ($/tonne CO_2e)	Program value ($/year)
1 Doing more with less nitrogen *Agronomists and farmers working together to improve nitrogen management through a cost-share program* ▸ 15% new and improved adoption	**2,900,000** CO_2e	**$40/t**	**$115** million
2 Increasing adoption of cover cropping *Supporting farmers to plant cover crops through a per-acre payment program* ▸ 1% new adoption in Prairies, 15% new adoption in rest of CA	**2,200,000** CO_2e	**$51/t**	**$115** million
3 Normalizing rotational grazing *Supporting ranchers to implement rotational grazing through a cost-share program for planning and infrastructure* ▸ 5% new adoption per year	**302,000** CO_2e	**$77/t**	**$25** million
4 Protecting wetlands and trees on farms *Reinforcing farmers as stewards of the land through a reverse auction pilot program to conserve existing forests and wetlands* ▸ 33,000 acres per year of wetlands and trees at high risk of conversion protected for 20 years	**4,100,000** CO_2e	**$8/t**	**$30** million
5 Powering farms with clean energy *Transitioning on-farm energy beyond diesel through pilot programs*	Not known	Not known	**$10** million
6 Celebrating climate champions *Shining a light on farmers who implement climate-friendly practices through an awards program and awareness campaigns*	N/A	N/A	**$5** million

Shannon McCreary helping out with harvest
McCreary Land & Livestock Ltd.
Bladworth, SK
Photo: Shannon McCreary

Introduction

Canadian farmers are uniquely positioned to play a pivotal role in climate adaptation and mitigation.

Farmers are on the front lines of worsening climate impacts, with increasingly severe and unpredictable weather events posing significant threats to our sector[3]. At the same time, agricultural emissions are projected to increase to 2030. This trend is not only inconsistent with Canada's commitment to the Paris Agreement[4] and also threatens our competitiveness and market share in local and global supply chains as buyers seek to reduce GHGs from farm to fork and chart pathways to low carbon economies.



Canadian farmers and ranchers are critical to Canada's economy, food security and rural landscape, and must be supported to reduce emissions and build resilience. In doing so, Canadian farmers will be better equipped to provide public goods and services that benefit all Canadians, like clean air, water, soil, and biodiversity.

The challenge of reducing emissions in our sector is immense: tens of thousands of farmers need to come on board quickly for climate-friendly farming to be adopted across millions of acres. All farmers take a substantial risk in adopting new practices, but quickly build confidence by seeing new practices in action on neighbouring fields. In addition, it is important to recognize that there is no one-size fits all climate solution.[5] BIPOC, young, new, women, and 2SLGBTQ+ face enhanced barriers to enter and succeed in this sector. Many of these farmers are on the leading edge of climate-resilient farming, implementing techniques such as winter cover cropping, intensive rotational

3 Severe weather events in 2018 led to $2 billion in damages to Canadian farms, one of the highest costs on record (https://www.canada.ca/content/dam/eccc/documents/pdf/climate-change/climate-plan/healthy_environment_healthy_economy_plan.pdf)

4 Canada's commitment to the Paris agreement is to reduce emissions by 30% by 2030 from 2005 levels

5 Often this diversity is missed in programs that generalize the farming population. For instance, small-scale and often new farmers need specialized programs to implement bold, climate mitigating techniques, as they are often unable to take advantage of support through standard crop insurance and cost-share programs due to their size, lack of matching capital, or lack of yield history.

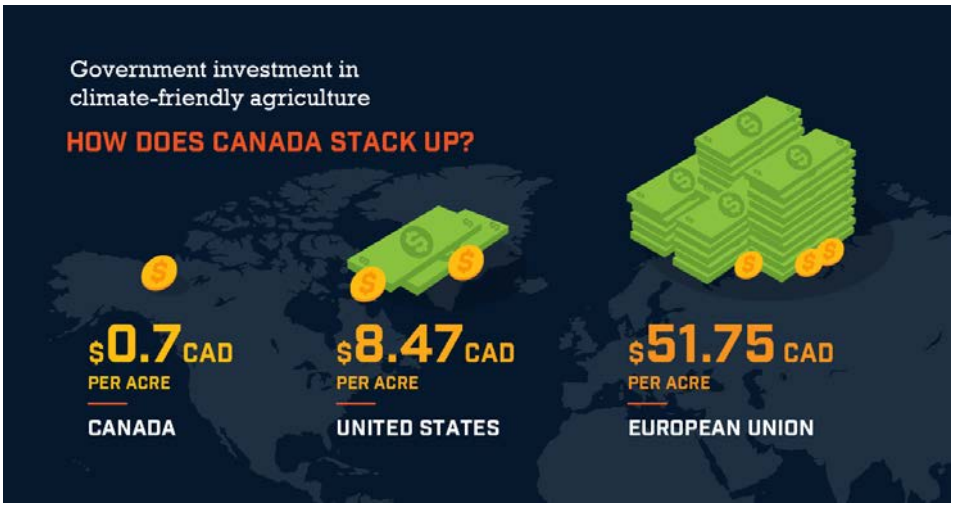
grazing, agroforestry, and low-till market gardening. Both the barriers to entry and success as well as the contributions these farmers are making need to be recognized and supported.

There are only nine growing seasons left to achieve Canada's 2030 Paris target.

Canada recently made an unprecedented commitment to support farmers and ranchers to reduce emissions and build resilience.[6] Acting immediately to honour this, the Federal Government introduced a new Nature-Based Solutions Fund at $185 million over ten years, and a new Canadian Agri-Environmental Strategy.[7] Canada's new Climate Plan commits $165 million over seven years to the development and adoption of clean technology in agriculture, and sets a fertilizer emission reduction target.

If every dollar of these new investments directly supported farmers, it would only provide **each farmer with less than $205 a year for adoption and implementation of climate-friendly practices.**[8]

These new investments also pale in comparison to recent investments in other countries that have placed a more sustainable food and farming system at the centre of their COVID-19 recovery efforts. For example, the EU's COVID-19 Recovery Plan commits 7.5 billion Euros over the next two years to improve farming sustainability, and is being topped up by many EU countries that are increasing agri-environmental program spending in their own recovery plans.[9] These new mega-investments are serving to quickly widen an already large gap between Canada and its competitors. Previously, investments in agri-environmental programming per-acre in the EU were 73 times more than Canada's. The US's are 13 times more.[10] Without comparable support, Canadian farmers will fall behind as consumers increasingly demand low-GHG food.



6 First announced in the Speech from the Throne, September 23 2020 (https://www.canada.ca/en/privy-council/campaigns/speech-throne/2020/speech-from-the-throne.html) and later confirmed in Supplementary Mandate letter (https://pm.gc.ca/en/mandate-letters/2021/01/15/minister-agriculture-and-agri-food-supplementary-mandate-letter)

7 Fall Economic Statement 2020, https://www.budget.gc.ca/fes-eea/2020/home-accueil-en.html

8 It must be noted that this is a high-level estimation because a large portion of these new investments are not going directly to farmers to encourage adoption.

9 Climate Action in Agriculture Policy Around the World, 2020

10 Authors' calculation based on: Treasury Board Secretariat. 2017. Public Accounts of Canada: 2016. Government of Canada.; Statistics Canada. 2020b. Table 32-10-0153-01: Total Area of farms and use of farm land, historical data. Government of Canada; United States Department of Agriculture [USDA] - Farm Services Agency. n.d. Conservation Programs. Government of the United States of America; USDA - National Agricultural Statistics Service. 2020. Farms and Land in Farms 2019 Summary (February 2020). Government of the United States of America.; OECD. 2020. Producer and Consumer Support Estimates Database (EU-28). OECD.; Eurostat. (2020). Farm indicators by agricultural area, type of farm, standard output, legal form and NUTS 2 regions (EF_M_FARMLEG). European Commission. All estimates were converted to 2019 Canadian dollars using historical exchange rates from https://www.ofx.com/, and the OECD's database of national and regional consumer price indexes

Meanwhile, Canadian farm debt is at a record high, and in many cases, business margins are tight and narrowing. Our sector also generates approximately $4.3 billion in net environmental damages annually.[11] Farmers cannot afford to reduce emissions alone, and without meaningful support, farmers' total share of emissions in Canada will grow as other sectors are better supported to transition to the clean economy. Farmers don't want to fail, or even to trail behind. They can be supported and encouraged to lead.

The next Canadian Agricultural Policy Framework (APF), covering the period 2023-2028, is a crucial opportunity to support farmers and reverse the current trend of rising GHG emissions in Canadian agriculture. Now is the time to set the groundwork to scale up adoption of climate-friendly farming and build broad sector engagement. This means increasing awareness of BMPs and their value and impact at the farm level. Publicly-funded programs are immediately required to incent increased adoption and gain immediate GHG reductions, and to gather information for participating farmers to better understand how and why BMPs can benefit the environment and their livelihoods. These monitoring and evaluation programs will enable the farm sector and government to gather information on incentive levels, regional variations in BMP applicability and cost-benefits, unique farmer feedback, and on-farm GHG reduction variability to inform the next five year, $3 billion APF.

A $300 million allocation in Budget 2021 will jump-start GHG reduction efforts by Canadian farmers, gather the on-farm data and farmer feedback necessary to inform a strong APF in 2023, and help to build the regional support necessary to secure buy-in from coast to coast to coast. FCS has identified six short-term policy recommendations that together have the potential to reduce agricultural GHG emissions by over ten million tonnes of CO_2e and set us on a course for a more productive, competitive and resilient farm sector in the future.

Experts working with farmers to recommend climate policy solutions

To develop this budget request, Farmers for Climate Solutions is working with a Task Force of experts, chaired by two practicing farmers, and convened members with expertise in agricultural economy, GHG modeling, domestic and international agricultural policy analysis, and equity and diversity. More information on the Task Force members and their roles can be found here.

Our budget request has prioritized practices based on:

- GHG reduction potential, considering regionality, scales of farms, types of production and potential adoption rates
- Analysis of private costs and benefits of implementation for farmers and ranchers
- Co-benefits, particularly as they relate to climate adaptation but also including water, soil, and biodiversity
- Ease of implementation, prioritizing practices and policies that are immediately implementable and accessible to farmers, ranchers and decision-makers
- Cost-effectiveness for government
- Applicability to a diversity of farmers, and that encourage new, young, small-scale, women, BIPOC and 2SLGBTQ2+ farmer participation and leadership in our sector

11 Canadian Agricultural Policy Institute, 2020, Measuring Externalities in Canadian Agriculture: Understanding the Impact of Agricultural Production on the Environment. https://capi-icpa.ca/explore/resources/measuring-externalities-in-canadian-agriculture-understanding-the-impact-of-agricultural-production-on-the-environment/

Our analysis shows that many practices have important GHG reduction potential and high return on investment, but could have either a positive or negative effect on farm incomes. To support GHG mitigating practices, external supports through public policy are necessary in many cases. While some practices are mutually beneficial to farmers and the environment, their lack of adoption indicates the need for short-term support to encourage more widespread adoption. The six policy priorities, and their return on investment, are summarized in the table and paragraphs below. Each priority and program, as well as the substantiating analysis, is described in more detail in the following pages. Every program proposal is dependent upon on-farm information gathering and measurement, as well as farmer feedback, so that this near-term investment strategically informs the next APF.

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In addition to the programs summarized above, our sector needs to continue to innovate, especially when it comes to transitioning farm machinery and equipment beyond diesel to zero emission technologies. Canada is prioritizing an energy transition across most sectors, but agriculture has been mostly left out. For this reason, a fifth program – **Powering farms with clean energy** – for $8 million will support early steps in an energy transition in agriculture.

The GHG reduction potential and average abatement cost for this program have not been calculated given the relative novelty of zero emission technologies and significant regional variability (in the

carbon intensity of the electrical grid, for example) and diversity of farm types and use patterns. This program is designed to spread awareness, early adoption and learning that can deliver some near-term GHG reductions, but more importantly inform the development of future programs.

The sixth program **Celebrating climate champions** for $5 million celebrates farmers who are adopting climate-friendly BMPs and awards them for their innovation. Change is by its nature challenging, and sociological research on climate action shows that maintaining positivity and building community are critical for success. Farmers learn from other farmers, and a public program that shines a light on a wide diversity of farmers who are successfully implementing climate-friendly farming will allow other farmers to see success on operations like their own and start to see themselves in the transition. Through small financial gifts, farmer-led storytelling, communications campaigns and information collection on-farm, this program will inspire adoption more broadly and support data-gathering that will inform the sector's future transition policies. This program's primary objective to motivate widespread adoption in future years, and it is therefore not associated with a specific GHG reduction potential or an average abatement cost, which could only be calculated based on the program's reach over time.

All six programs are detailed in the following pages. Critical to all is monitoring and evaluation, which must be integrated and receive dedicated resources from the beginning. Monitoring and evaluation should be transparent and publicly available to support farmers and the sector in better understanding climate solutions on-farm, their outcomes, their challenges, and their measured impact for both farmers and for GHGs. This information will be critically important in helping to guide the next APF 2023, as well as helping farmers and Canadians understand agriculture's opportunities and potential as a climate solution.

.Earth Works Farm, Red Deer, AB
Photo: Brenda Barritt

Equity, Diversity and Inclusion:
Considerations for Policy

Just Food,Ottawa, ON
Photo: Kath Clark/SeedChange

FARMERS FOR CLIMATE SOLUTIONS is committed to policy and program proposals that acknowledge and where possible serve the diversity within our sector. At a minimum policies must not increase inequity. Ideally, we aim to enhance the participation and leadership of farmers and food producers who are currently under-represented in mainstream agricultural leadership and policy decision-making. Our sector will be stronger with decreased barriers to entry and better opportunities to succeed for youth, women, farmers with disabilities, Black farmers, Indigenous farmers and food providers, farmers of colour, small-scale farmers, 2SLGBTQ+ farmers, and new Canadians.

To this end, the FCS Task Force was mandated to include a foundational equity analysis to inform the policy proposals included in this report. Initial focus groups were held to identify current equity issues and equity-related barriers to entry into our sector. The data from these initial discussions were not available at the time of writing of this report. The reader is advised that the content of this report is not informed by a fulsome analysis, but rather equity considerations raised by task force members while developing its policy recommendations. FCS will complete this analysis and share this information in a subsequent report.

We believe that efforts to enhance equity, diversity and inclusion in agriculture must be led by those most impacted by existing inequities. FCS hopes to support this leadership, contribute data and policy proposals that support both climate resilience and equity, and participate constructively in dialogue and action for reconciliation, equity, diversity and inclusion in our sector.

PROGRAM 1 $115 MILLION

Doing more with less nitrogen

Annie Richard, assessing soil condition
Kitchen Table Seed House
Wolfe Island, ON
Photo: SeedChange

Agronomists and farmers working together to improve nitrogen management through a cost-share program

NITROGEN FERTILIZER use in Canada has increased dramatically over the past several decades, particularly in the Prairies.[12] Its use has contributed to major environmental impacts including N_2O emissions,[13] NH_3 volatilization and NO_3 leaching to groundwater.[14] Production of nitrogen fertilizer is also an important contributor of GHGs.

GHG mitigation potential:
2,900,000 tonnes CO_2e

Average Abatement Cost:
$40/tonne CO_2e

Adoption inducement:
15% new acres in improved nitrogen management

GHG Mitigation potential in 2030:
3,200,000 tonnes CO_2e/yr

Increasing nitrogen use efficiency is key to decreasing overall N use while sustaining or increasing yields. The fertilizer industry, in conjunction with many soil scientists, have developed a suite of practices known as 4R that are intended to improve nitrogen use efficiency. However, increased knowledge of 4R concepts among farmers has not resulted in reductions in N use. In fact, surveys of corn and canola farmers have shown that increased awareness of 4R corresponds with *increased* N application rates.[15] Growers report that they rely primarily on past experience when determining application rates, rather than on soil test results or advice from agrologists. 4R provides a useful framework for managing nutrients on the farm, but it does not provide the advice, analysis and documentation that farmers need to reduce overall N use and increase N use efficiency. To realize the full potential of 4R nitrogen management and to reduce nitrogen pollution, farmers require independent agronomic support to determine and implement best practices for their soils and crop rotations

Canada's new climate plan introduced an emissions reduction target for nitrogen fertilizer.[16] This sets a benchmark for fertilizer reduction from Canadian agriculture, however, farmers will be unable to meet this target without direct agronomic support to create tailored, farm-level plans that optimize N use and reduce over N application rates.

Knowledge of advanced nitrogen management practices among farmers is incomplete and not yet widespread.[17] Currently, fertilizer retailers can become certified to promote 4R practices to farmers, however, farmers continue to lack support to implement these practices and to evaluate and document the outcomes and value of their adoption. Barriers to adoption of 4R practices include costs of detailed soil tests, costs of soil mapping, and costs of enhanced efficiency fertilizers, as well as the potential risks of reduced yield and financial loss. There is a need for independent agronomists to overcome these knowledge barriers, and provide implementation support, on-farm verification and documentation so that farmers are aware of the benefits of 4R.

12 FCS GHG Analysis and Quantification Report, 2021

13 Greenhouse gas emissions from fertilizer, https://open.canada.ca/data/en/fgpv_vpgf/5fec775d-7c91-4ab5-bb63-6db4627e52a0

14 NH3 volatilization, which can have adverse impacts on surrounding ecosystems, and reduced NO3- leaching to groundwater which is a major concern in a number of provinces. These other environmental services may prove to be at least as important as the reduction of GHG emissions in terms of both impact on the environment and in motivating governments and producers to adopt improved N management practices.

15 Stratus Ag Canada surveys, produced for Fertilizer Canada, 2019, show that for Ontario corn growers, producers who indicated they were very familiar or somewhat familiar with 4R applied 28% higher rates of N fertilizer than those that were not familiar with 4R practices, and for prairie canola growers, producers who indicated they were very familiar or somewhat familiar with 4R applied 12% more N fertilizer than those that were not familiar 4R practices

16 A Healthy Environment and a Healthy Economy, https://www.canada.ca/content/dam/eccc/documents/pdf/climate-change/climate-plan/healthy_environment_healthy_economy_plan.pdf

17 FCS GHG Analysis and Quantification Report, 2021

Program Objective

- Train public and private agronomists to work with farmers to adopt and document improved nitrogen management. On-farm documentation supports farmers to understand the outcomes of advanced nitrogen management and allows the government to assess its environmental impact at a national level. This information will inform the design of future programs, with the ultimate goal of maximizing nitrogen use efficiency, reducing nitrogen waste,[18] reducing absolute nitrogen use and achieving Canada's emissions reduction target.

Program Design

- Two year program to bridge to next APF 2023, at $115 million per year, delivered as a 50% cost-share for agronomic services in improved nitrogen management.
- Program provides accreditation for public and private agronomists in improved nitrogen management, so that they are able to support farmers in implementing, managing, monitoring, and documenting the management practices. The program provides support to agronomists to conduct and document at least one fall residual soil N sample and a mid-season tissue sample as part of the improved nitrogen management service. Agronomic support will help farmers overcome the barriers to adopting existing 4R programs and broaden adoption.
- Program offers 50% cost-share[19] for farmers to access the agronomists trained to offer advanced nitrogen management service described above.
- Program is projected to induce adoption of nitrogen management on 15% new acres, and graduate those already practicing some form of nitrogen management into more improved levels of nitrogen management over the lifetime of the program.

18 Nitrogen waste is fertilizer that has not been absorbed by crops, which translates into excess costs for farmers (economic loss) and leads to nitrous oxide emissions, ammonia volatilization, and nitrate leaching.

19 Some provinces already offer cost-share for agronomic services. In these cases, the federal government would top up the cost-share already offered by provinces.

Current Challenges and Opportunities

One of the on-farm challenges in implementing advanced nitrogen management is understanding where and when nitrogen pollution is occuring, and evaluating the success of practices to control nitrogen loss. One practical on-farm measure for enhancing nitrogen use efficiency is to measure the amount of nitrate[20] remaining in the soil following the harvest of the crop. Residual soil nitrogen (RSN), is also one of Agriculture and Agri-Food Canada's Agri-environmental Indicators[21] and is estimated on a national scale as the difference between N inputs (N fertilizer, manure, crop residue) and N outputs (harvest N). Residual soil N is an indicator of the potential for environmental impact on water, primarily as nitrate leaching, and air, as a result of N_2O emissions. Measurement of nitrate remaining in the soil following harvest is a direct measure of RSN.

RSN in Canadian agriculture has gone from negative to positive since 1985, a trend that indicates a change from net removal of N from Canadian agroecosystems[22] to net N additions. This trend and current positive values of RSN correspond with increased potential for N loss.[23] This increased potential has resulted in damages to society from negative environmental impacts, and excess costs for farmers in N inputs wasted to the environment.

The fertilizer industry initiated the 4R Nutrient Stewardship Program to promote improved fertilizer management. The 4R nutrient stewardship program refers to four key practices in nutrient management:

1. **Right source** – choose plant-available nutrient forms that provide needed nutrients with release matched to crop demand,
2. **Right rate** – ensure an adequate, but not excessive, amount of all limiting nutrients are applied to meet plant requirements,
3. **Right time** – time nutrient applications considering the interactions of crop uptake, soil supply, environmental risks, and field operation logistics, and
4. **Right place** – place nutrients to take advantage of the root-soil dynamics, spatial variability within the field, and potential to minimize nutrient losses from the field.[24] 4R practices have been defined by basic, intermediate and advanced levels of implementation.

20 Measuring nitrate is most appropriate and often sufficient as it is the form from which most N losses emanate and it is the primary form of plant available nitrogen that would be present in the soil at the end of the growing season.

21 Clearwater, R. L., Martin, T., and , and Hoppe, T. (2016). "Environmental sustainability of Canadian agriculture: Agri-environmental indicator report series – Report #4.," Ottawa, ON.

22 Primarily originating from soil N mineralization

23 FAO, 2020. FAOstat URL: http://www.fao.org/faostat/en/#data. Food and Agriculture Organization of the United Nations, Rome.

24 Reetz, H.F.J., Heffe, r.P., Bruulsema, T.W., 2015. 4R nutrient stewardship: a global framework for sustainable fertilizer management. In: Drechsel P, Heffer P, Magen H, Mikkelsen R, Wichelns D (Eds.), Managing Water and Fertilizer for Sustainable Agricultural Intensification. International Fertilizer Industry Association (IFA), International Water Management Institute (IWMI), International Plant Nutrition Institute (IPNI), International Potash Institute (IPI), Paris, France, pp. 65-83.

Mixed forage oats and peas with canola in the background on Ian Robson's 900 acres farm
Deleau, MB

Currently, we estimate that approximately 30 to 40% of Candian farmers are practicing basic 4R nitrogen management, 10 to 20% intermediate, and approximately 10% advanced[25]. We estimate that 40% of Canadian farmers are not implementing any 4R practices. This program would increase 4R adoption across all levels with a goal of having 70 - 90% of all farms practicing some level of 4R in the lifetime of the program. This leads to cost savings for farmers, reduced nitrate pollution, improved soil health, improved documentation and broader sector engagement with farmers on the importance and value of improved nitrogen management, and new jobs for agronomists in rural areas.

25 FCS GHG Analysis and Quantification Report, 2021

PROGRAM 2 $115 MILLION

Increasing adoption of cover cropping

Mowed down fall rye cover crop
The New Farm, Creemore, ON
Photo: Brent Preston

Supporting farmers to plant cover crops through a per-acre payment program

A **COVER CROP** is an unharvested crop grown in addition to crops grown for harvest. Cover crops build soil organic carbon, reduce soil erosion, reduce nutrient leaching, and reduce the need for nitrogen fertilizer when they include legumes. In a recent meta-analysis, Daryanto et al. (2018) found that ecosystem services from cover crops are positive and they should be a recommended practice for all cropland[26].

There are currently 630,000 ha of cover crops grown in Canada every year. This demonstrates their applicability for Canadian farming, but also highlights relatively low levels of adoption. Current adoption in the Prairies is about 0.5%, while adoption in the rest of Canada is about 14%[27].

Farmers who cover crop often report reduced loss of nutrients from soil erosion and leaching, better soil biological health, which improves soil structure and nutrient cycling, and less intensive and expensive management of weeds, diseases, and pests (Bergtold et al. 2017; Roesch-McNally et al. 2018). Many of these benefits increase over time and some only occur periodically (depending on weather conditions). Three to five years of continual cover cropping might be necessary for full cost-recovery (benefits exceeding annual costs for seeding) (Myers et al. 2019). This program is designed to help drive adoption by covering the initial costs of cover cropping.

GHG mitigation potential:
2,200,000 tonnes CO_2e

Average Abatement Cost:
$ 51 /tonne CO_2e

Adoption Inducement:
15% increased adoption in ROC, 1% increased adoption in Prairies

GHG Mitigation Potential of cover cropping in 2030:
8,660,000 tonnes CO_2e/yr

Equity considerations:
consider a cap to ensure funds are distributed across a number of farms; includes partner cost-share program catered to small-scale farmers

Program Objective

- Drive adoption of cover crops to normalize the practice in BC, central Canada and the East, and gather information and experience on the Prairies

Program Design

- Two year program at $115 million per year to bridge to APF 2023, based on a per-acre payment for unharvested cover crop.
- Farmers receive a payment per-acre planted with unharvested winter cover (living or winter-kill).
- Farmers receive a top-up per-acre payment if they plant cover crops and maintain less than 21 consecutive days of bare soil at any time during the year (offers additional soil and GHG benefits).
- Per-acre payment is available to all farmers who meet the criteria, not only as an incentive for new adoption. Program should consider a cap on total eligible acreage to ensure that very large farms do not receive a disproportionate share of the funding.

26 There is some concern that cover crops could increase P losses (Daryanto et al. 2018; Liu et al. 2019) . However, some field studies on cover crops in Canada have not shown an increase in loss (Lozier et al. 2017; Schneider et al. 2019) . The use of cover crops may not be favourable where P loss is a particular concern, such as the Lakes Winnipeg and Erie basins, but further investigation is needed on P losses to surface water to investigate the potential need for limited cover crop restrictions (Liu et al. 2019) .

27 Based on the 2017 Farm Management Survey (D. Cerkowniak, AAFC, personal communication), we estimated there are currently 630,000 ha of cover crops, ranging from 13.5% of cropland in the Mixed Wood Plains to 0.4% in the Black soil zone of the Prairie.

- Program requires farmer-to-farmer mentorship and/or agronomic extension services, as well as information collection on subscribing farms (measurement of environmental and economic impact, as well as farmer feedback on the program and incentive level).
- Program includes support for research and demonstration farms on the Prairies, where climate conditions make cover crops more challenging to adopt and where adoption rates remain critically low.
- Program contains a small subset program that provides cost-share for cover crop seeds for small-scale farmers. Small-scale farmers do not benefit from per-acre payment programs because they are often farming on less than ten acres of land.
- Program is projected to triple adoption of cover cropping in Prairies (current adoption at 0.5% acres), and double adoption of cover cropping in the rest of Canada (current adoption at 14% acres) over the two year lifetime of the program.

Current Challenges and Opportunities

Cover crops are either interseeded (planted within) a cash crop or seeded after cash crop harvest. Cover crop growth continues after crop harvest in the fall, or, for a winter cover crop, continues to grow the next spring before the next crop is grown.[28]

Cover crops mitigate GHG emissions through increased C sequestration (Abdalla et al. 2019; Bai et al. 2019). The most favourable climate for cover crops in Canada is BC and central and eastern Canada. While adoption in the Prairies is possible and desirable, cover crop growth is limited by cold weather and lack of fall soil moisture, and C sequestration rates are lower. Non-legume cover crops also reduce annual N_2O emissions in cold climates (Abdalla et al. 2019; Basche et al. 2014; Han et al. 2017; Muhammad et al. 2019; Poeplau and Don 2015).

Cover crops reduce wind erosion (Baumhardt et al. 2015), increase biodiversity of soil organisms (Elhakeem et al. 2019) and improve animal habitat by providing nectar and/or cover. Cover crops reduce soil erosion, and increase soil health including organic carbon (Daryanto et al. 2018) . They reduce nitrate leaching (Thapa et al. 2018) and can reduce nutrient loss in runoff and water contamination (Dabney et al. 2001). Increased adoption of cover crops would drive economic opportunities in rural areas for

"Cover crops are one of those simple practices that make sense on every level—for the climate, biodiversity, soil health, profitability—and they're something all farmers can agree on."
—Brent Preston, ON farmer

28 Forages established within or immediately after a cash crop are not considered cover crops when the forage grows for one or more subsequent growing seasons. This practice, often called companion cropping, is already considered a normal practice for forage establishment. An intercrop, when two or more crop types are grown together but all harvested, is not considered to be a cover crop.

growing and processing cover crop seed and for potential contracted services for planting and/or terminating cover crops.

These important public benefits of cover crops, including and beyond GHG mitigation, rationalize public investments that help to minimize the initial cost barrier to adoption. The private benefits of cover crops increase over time for the farmer (after three to five years of ongoing cover cropping) at which point the public program can be reduced or removed. This program is offered to both existing and new cover cropped acres because:

- Current early adopters of cover crops are often in their first year or two of experimenting with cover cropping. These farmers should be supported to maintain the practice until the private benefits outweigh costs after three to five years of implementation, otherwise early adopters risk abandoning the practice.
- Carbon sequestration benefits improve over time if acreage is maintained in cover crops – long-term implementation is the goal.
- It is more straightforward administratively because cover cropped acres in the season of the program can be easily identified, in comparison to acres cover cropped in years past. Administratively difficult programs hinder adoption of BMPs.
- If the program only awards new acres, it may signal to farmers to abandon cover cropping for one season in order to qualify for the program the following year. This interrupts the GHG and private benefits of the practice.

Equity considerations

Small-scale farmers with less than 5 ha in production don't benefit from per-acre payments as the total dollar amount is low and provides a low incentive for them to adopt the practice. Additionally, overall participation in programs that might be used to deliver per-acre payments is also low among small-scale farmers. Providing a cost-share for seed instead of a per acre payment for small-scale farmers enables these growers to benefit from cover cropping and incentivizes uptake in small-scale production.

PROGRAM 3 $25 MILLION

Normalizing rotational grazing

Practicing advanced rotational grazing
Local Valley Beef, Fredericton, NB
Photo: Chris Parent

Supporting ranchers to implement rotational grazing through a cost-share program for planning and infrastructure

ROTATIONAL GRAZING is the practice of moving grazing animals through a set of paddocks. Animals are kept at high stocking densities but remain in each paddock for a short period of time. Rotational grazing is distinguished from continuous grazing, where cattle are in a single paddock throughout the grazing season. The main advantages of rotational grazing are increased vegetation growth (Alemu et al. 2019; Sanderman et al. 2015) and better forage quality, which improves herd health, speeds weight gain and allows more animals to be raised on a given area of pasture. (Wang et al. 2015).[29] Advanced rotational grazing contributes to improved soil health and soil carbon sequestration, increased above and below ground biodiversity, and reduced nitrogen use. Grazing generally increases soil organic carbon (McSherry and Ritchie 2013) with rates of 72 to 190 kg C/ha/yr in the northern Great Plains (Wang et al. 2014; Wang et al. 2016).

GHG mitigation potential:
302,000 tonnes CO_2e

Average Abatement Cost:
$ 77/tonne CO_2e

Adoption Inducement/year:
5% new acres under improved grazing management

GHG mitigation potential in 2030:
3,649,247 tonnes CO_2e/yr

Currently, about 50% of beef producers use rotational grazing according to the 2016 Census of agriculture (Beef Cattle Research Council 2019), and Sheppard et al. (2015) shows that only 25-35% of beef producers reported using continuous grazing[30]. Rotational grazing is becoming a more widely accepted practice, but the major barriers to further adoption and graduating more farmers toward advanced grazing are a lack of time/labour, infrastructure and planning. Normalizing advanced grazing requires supporting farmers to create a detailed plan, and to invest in new infrastructure like fencing and water sources. A public program that supports this would be a widely accepted and a cost-effective GHG reduction tool for our sector.[31]

"Using intensive grazing management principles on my farm resulted in a complete transformation of the production system. Resting the grass and managing animal impact has allowed me to double the herd size on the same landbase and leave enough room for the birds and other wildlife that we share the space with. It's built resiliency that carries me through during wet and dry years."
—Cedric MacLeod, NB cattle rancher and agronomist

photo: Chris Parent

29 Popp et al. (1997) found no significant effect on either herbage or quality from rotational grazing in Manitoba

30 A limitation of our analysis is that we did not include considerations for the Canadian dairy herd. This could increase both the potential and scale of the program.

31 Emissions-reduction tonnages calculated here are based on a constant herd size. Because rotational grazing can enable higher stocking densities and, thus, more cattle on a given grazing area, policies will be needed to ensure that higher cattle numbers and resulting enteric emissions do not offset sequestration gains from enhanced grazing. Alternatively, higher stocking densities coupled with a static regional herd size could lead to conversion of grazing land to cropland, with attendant release of soil carbon. Policies will be needed to avoid such conversion.

Program Objective

- Increase stocking rate and grazing interval for ruminant livestock on pasture with legume integration, decreasing CO_2 and N_2O emissions, and increasing carbon storage.

Program Design

- Two year program to bridge to APF 2023, at $25 million year for a 50% cost-share for development of an advanced grazing plan with an agronomist or grazing mentor, and for purchase of equipment and infrastructure that allows for improved rotational grazing, up to $10,000 total value.
- Cost-share is offered for agronomists and/or advanced grazing mentors to create farm-level advanced rotational grazing plan, which includes the integration of legumes into tame pasture. The plan encourages increased adoption of rotational grazing and an overall shift toward advanced rotational grazing where pasture area is suitable (dependent on water sources and topography).
- With the creation and implementation of the plan, the farmer also qualifies for 50% cost-share for infrastructure and equipment to implement the plan (permanent and temporary fencing, water, legume and forage seed, etc.), up to a total value of $10,000.[32]
- This program is projected to drive adoption of improved grazing by 5% new acres per year, for 10% total new and improved adoption over the two year program.

Current Challenges and Opportunities

There is a wide range of practices within rotational grazing. Basic rotational grazing implies animals are rotated through multiple paddocks at least once, while advanced or intensive rotational grazing implies multiple paddocks grazed for less time, with more time for recovery. Basic rotational grazing provides opportunity for grazed plants to recover, while advanced – or intensive – rotational grazing maintains a much shorter grazing period to reduce stress on the plant from grazing (sometimes referred to as avoiding the "second bite" of any plant during a grazing period) and allows for sufficient time for plant recovery after grazing.

The grasslands of Canada are generally a carbon sink, gaining an average of 130 kg C/ha/yr during the early 2000s (USGCRP 2018). Grasslands cannot be expected to be a perpetual sink as they will reach an equilibrium, after which there will not be sustained increase in C stocks (Smith 2014). Rates of sequestration vary widely by year, and grasslands can be a source of carbon in drought years.

Much of the observed increases in soil organic carbon in grasslands may be due to recent improved grassland management that restored soil organic carbon that was lost from past poor management, particularly over-stocking, in the first half of the 20th century (Wang et al. 2014). New adoption of rotational grazing represents an opportunity to increase soil organic carbon on pastures (Byrnes et al. 2018).

A complete advanced rotational grazing plan will ensure that all natural and tame pasture under advanced or intensive grazing are managed so that they have sufficient legumes to provide the nitrogen needs of the sward. An advanced grazing plan will therefore ensure additional GHG reduction

32 This program should be partnered with a program that encourages avoided conversion of grasslands and pasture. It will have the most significant GHG impact if it encourages increased backgrounding on grass, rather than an increased herd size in Canada.

potential related to nitrogen use, because synthetic N fertilizer is typically applied under continuous and basic management. Having legumes in pasture has been shown to improve C sequestration (Conant et al. 2017; Fornara and Tilman 2008; Henderson et al. 2015) and improve herbage quality (Bélanger et al. 2017; Peprah et al. 2018). The recovery periods and reduced grazing stress with rotational grazing improves longevity and maintenance of seeded legumes.

Equity considerations

Not all cattle farmers are able to practice advanced rotational grazing. In BC's North and Interior, many farmers graze their cattle on Crown, forested land. While this system is a huge benefit for community fire suppression, fencing small areas and moving cattle daily is not possible. Additionally, many new and young beef farmers are practicing intensive rotational grazing but are doing so on a small scale due to labour and infrastructure limitations. Cost-share support would enable them to purchase more fencing to allow them to expand this practice.

PROGRAM 4 $30 MILLION

Protecting wetlands and trees on farms

Riparian buffer on a PEI potato farm
Photo: David Burton

Reinforcing farmers as stewards of the land through a reverse auction pilot program to conserve existing forests and wetlands

TREES SEQUESTER CARBON throughout their growth, and provide important habitat for wildlife. They also serve other ecological functions for farmers such as reducing erosion, improving water retention and reducing wind stress on crops. While wetlands emit methane, they also act as carbon sinks and are important for biodiversity, habitat conservation and species at risk.

Between 2010 and 2017 Canada lost 12,000 ha of forest to agriculture every year (Drever et al. 2020, accepted). Conversion to cropland of narrow linear trees (shelterbelts and hedgerows) and areas less than one ha (e.g. trees associated with small wetlands) are not included in that estimate. From 2008 to 2016, 2,500 km of shelterbelts were removed in Saskatchewan (Ha et al. 2019).

Drever et al. (2020, accepted), estimated that there are 356,000 ha of wetlands on the prairies that are threatened by conversion to cropland.

GHG mitigation potential: *4,100,000 tonnes CO_2e*

Average Abatement Cost: *$8/tonne CO_2e*

Adoption inducement/year: *33,000 acres of wetlands and trees most at risk of conversion protected/20yrs*

GHG mitigation potential in 2030: *3,300,000 tonnes CO_2e/yr*

A program that incentivizes the protection of existing trees and wetlands, particularly those at high risk of conversion, is important for climate change mitigation and biodiversity conservation.

Furthermore, planting additional trees on farm land offers unique opportunities that are both good for GHGs and strategic for farmers. For instance, strategic linear tree planting in the form of alley cropping, shelterbelts, and hedgerows provide not only carbon, but also windbreak and shade benefits (Kulshreshtha and Kort 2009; Kulshreshtha and Rempel 2014; Tsonkova et al. 2014). Trees planted in riparian areas reduce the transport of pesticides and sediment into water bodies. Silvopasture combines trees and pastures to provide productivity benefits for forage production and grazing.[33] Ensuring that farmers are eligible for programming under the two billion tree initiative will benefit the environment as well as farmers.

Program Objective

- Conserve existing trees and wetlands on farm lands, as a temporary stopgap program before a more substantial program can be launched in the next APF. The secondary objective—to increase strategic planting of trees on agricultural lands - depends on ensuring that farmers are able to access and benefit from the two billion tree initiative.

Program Design

- Primary program is a two year program to bridge to APF 2023, at $30 million per year for a reverse auction pilot for existing wetlands and forests at high risk of conversion. This program is projected to preserve 33,000 acres of wetlands and trees on agricultural lands at the highest risk of conversion for 20 years, in each year of the program.
- In addition to this program, the $3.16 billion tree initiative should a) ensure that tree nurseries grow regionally-specific and farmer-appropriate trees for strategic planting on agricultural land and b) offer direct payments to farmers to plant new trees in strategic linear planting and in environmentally sensitive areas such as water ways and reclaimed wetlands on agricultural lands.

33 Silvopasture Canada, 2020, https://silvopasturecanada.wordpress.com/

Current Challenges and Opportunities

Conserving existing forests has a significant GHG impact: Drever et al. (2020, accepted) estimate the average GHG emission reduction potential for avoided deforestation in Canada at 188 Mg CO_2/ha, which includes above and below ground growth and soil organic carbon loss. It must be noted that trees continue to sequester carbon throughout their growth. For example, Amichev et al. (2016b) found that white spruce in Saskatchewan was still sequestering carbon at an age of 60 years. Therefore, conversion of treed areas to cropland not only causes loss of stored carbon but also prevents ongoing sequestration.

While wetlands emit methane, they are also generally carbon sinks. The amount of carbon sequestered through sediments, trees and shrubs is highly site specific (Kayranli et al. 2010). Nevertheless, Drever et al. (accepted, 2020) estimated the carbon loss from drainage and conversion of wetland to cropland as 326 Mg CO_2e/ha over 20 years or 16.3 Mg CO_2e/ha/yr. In the US, Spawn et al. (2019) estimated that wetlands lose an average of 135 Mg C over 100 years when converted to cropland.

Under a reverse auction program, eligible farmers submit competitive bids to implement permanent conservation easements or long-term contracts to maintain the targeted trees and wetlands. The Government of Canada is the centralized 'buyer' of the conservation benefits, and the program is delivered through local service providers. Auction bids would be assessed by an environmental benefits index, based on the environmental characteristics of the eligible land and the characteristics of the conservation practices, specifically, the extent to which they result in expected GHG mitigation/sequestration benefits. Examples of environmental benefits indexes include Manitoba's cost-share programs under the Canadian Agricultural Partnership (Government of Manitoba 2020), and Ducks Unlimited Canada's program for protecting wetlands with permanent conservation easements (Brown et al., 2011). In a reverse auction, bids are ranked in terms of the ratio of environmental benefits to costs, and bids are accepted from highest to lowest value until the funds are exhausted. Winning bidders could be eligible for supplementary cost-share assistance to conduct habitat enhancement and restoration measures.

Concerning the strategic environmental planting of new trees on farm land, Liu et al. (2017) identified 9.5 M ha of marginal agricultural land suitable for trees. Drever et al. (accepted, 2020) identified 0.2 M ha of land for 30 m wide riparian buffers across Canada in forestable vegetation zones that did not have a natural buffer already.

Ian McCreary working around a prairie pothole (wetland) in his grain field
McCreary Land & Livestock Ltd.
Bladworth, SK
Photo: Shannon McCreary

Currently albedo (i.e. reflectance of solar radiation) effects are not included in quantification of anthropogenic global warming for national inventories. Nevertheless, albedo effects are well recognized and are increasingly being considered in climate change mitigation policy regarding forest management and tree species selection (Matthies and Valsta 2016) . As a result of albedo effects, some trees can increase global warming potential (Betts et al. 2007). More specifically, albedo effects greatly reduce the mitigation benefit of conifers (Mykleby et al. 2017). New trees for agricultural lands should therefore be deciduous trees and shrubs, except for a potential exception in the Pacific Maritime where snow cover is usually both infrequent and short-lived so albedo effects for coniferous trees are smaller than elsewhere in Canada.

PROGRAM 5 $10 MILLION

Powering farms with clean energy

Tony Neale, using Solectrac's prototype, electric tractor, powered by the farm's 10kW solar array
Wheelbarrow Farm, Sunderland, ON
Photo: Debbie Kinoshita

Transitioning on-farm energy beyond diesel through pilot programs

ON-FARM ENERGY USE greenhouse gas emissions are dominated by combustion of diesel (76%) and gasoline (12%), creating an estimated 4.4 million tonnes of CO_2 pollution in 2014.[35]

To date, limited attention has been paid to greenhouse gas emissions from on-farm energy use. Many other Canadian sectors are making plans to rapidly move beyond diesel. Agriculture has not been prioritized in the clean energy transition, and technology development and adoption lag relative to other sectors.

GHG mitigation potential in 2030
264,000 tonnes CO_2e/yr[34]

34 Assumes a goal of achieving a 6% reduction GHGs from use of diesel/gasoline in the agricultural sectors, which aligns with the scale of reductions expected from the transportation sector in the federal climate plan. This would require measures beyond those included in our recommendations, and is subject to technology availability.

Canada's new climate plan hinges on an increasing price on pollution, and while on-farm use of diesel is currently exempt from the carbon tax, this may not always be the case. Regardless, given the contribution of diesel combustion to emissions from on-farm energy use, it is an emission source that must be mitigated. While fuel switching from diesel to battery electric and/or hydrogen fuel cell zero emission vehicles is the ultimate solution, limited commercial availability warrants near-term consideration of retrofits to existing vehicles. To further spur adoption of on- and off-road zero emission vehicles by farmers, up-front capital cost and charging/re-fueling infrastructure barriers must be overcome. There is an opportunity to draw on experience and programming in other sectors to design targeted programs for agriculture. The use of propane, natural gas and other fossil fuels for heating barns, buildings and greenhouses, powering machinery and drying grain is a smaller but significant source of farm emissions. These operations are much easier to convert to electricity than farm vehicles, but still involve up-front costs to farmers. Past and existing retrofit incentive programs have been underfunded and poorly publicized, leading to minimal uptake.

Program Objective

- Encourage adoption and promotion of agriculture's energy transition

Program Design

Six pilot programs:

1 Heavy Duty Farm Vehicle, Equipment and Building Efficiency Program

Natural Resources Canada should work with Agriculture and Agri-food Canada to develop and administer a **Heavy Duty Farm Vehicle, Equipment and Building Efficiency Program** that includes (i) a mandatory educational component for program participants on optimizing tractor fuel use,[36] (ii) pilot a Heavy Duty Farm Vehicle Efficiency Retrofit Incentive offering rebates of up to 50% of the cost of the retrofit and its installation, up to a cap of $4,000 per engine. This program should be capitalized with **$1 million ($800,000 for retrofits, $200,000 for education) over 2 years**, with the intent of **retrofitting 200 diesel tractors (100 per year)**. The pilot should focus on retrofitting a diversity of tractor types across a variety of farm uses across Canada (iii) a Farm Efficiency Retrofit program to aid in the transition to clean power for heating barns, buildings and greenhouses, powering machinery and drying grain offering rebates of up to 50% on the cost of retrofits and their installation. As a requirement of participating in these programs, farmers would need to share qualitative and quantitative data on vehicle performance, fuel savings and

35 J. Dyer et al., "The Fossil Energy Use and CO_2 Emissions Budget for Canadian Agriculture," in Sustainable Energy Solutions in Agriculture (Boca Raton: CRC Press, 2014).
36 For example, see https://www.farmingforabetterclimate.org/wp-content/uploads/2018/02/optimising_tractor_fuel_use.pdf

emission reductions. If successful, the pilot retrofit program could be expanded in scope and scale in subsequent years.

2 Capital cost allowance class for off-road automotive vehicles and equipment
Finance Canada should follow through on plans[37] (originally intended for Budget 2020 but whose current status is uncertain) to introduce **a new capital cost allowance (CCA) class (Class 56) for qualifying zero-emission (fully electric or powered by hydrogen) off-road automotive vehicles and equipment.** Similar to the Class 54 and Class 55 capital cost allowance classes introduced in Budget 2019 (for qualifying zero emission vehicles designed for use on highways and streets), it should **offer a temporary enhanced first-year CCA rate of 100%.**[38]

3 Zero Emission Vehicle Infrastructure Program for farms and ranches
Natural Resources Canada should expand the Zero Emission Vehicle Infrastructure Program[39] to include a specific fund for off-road zero emission vehicle charging/refuelling infrastructure, with a dedicated tranche for farms and ranches. This funding should be additional to the $130 million over five years (2019-2024) allocated for on-road ZEV charging/re-fuelling in Budget 2019. In Budget 2021, **NRCAN should be allocated $3 million (over two years) to develop and implement a targeted incentive program supporting on-farm charging/re-fuelling infrastructure (for both on- and off-road vehicles).**

4 Targeted Tax Incentive for ZEV Pick-up Trucks on Canadian farms
Finance Canada should create **a distinct capital cost limit for zero emission pick-up trucks within Class 54** (or create a new Class) for zero emission pick-up trucks that reflects their higher purchase price. Finance Canada may wish to consider limiting this tax benefit to those businesses, such as registered farm businesses, with a demonstrable need for the functionality of a pick-up truck to conduct their business.

5 Farmer Education and Engagement on Vehicle Retrofits, ZEV and Infrastructure
Natural Resources Canada and Agriculture and Agri-food Canada should be allocated **$1 million (over 2 years) to develop and deliver[40] an education and engagement program for farmers** to raise awareness of available technologies, their performance, and related government programs.

6 Better on-farm energy use data
Natural Resources, Agriculture and Agri-food Canada, and Statistics Canada should allocate $3 million (over two years) to **co-develop (2021) and conduct (2022) a new Farm Energy Use survey**, to deliver up-to-date data to inform the policy and programs related to on-farm energy use, costs and emissions that might be considered in the next Canadian Agricultural Partnership.

Current Challenges and Opportunities

As noted by Dyer et al. (2014), "…in modern agriculture, the diesel engine has become the overwhelmingly dominant choice for powering farm machinery." According to Statistics Canada, in 2016

37 See https://www.canada.ca/en/department-finance/news/2020/03/business-investment-in-zero-emission-automotive-vehicles-and-equipment.html

38 This initiative does not require a budget expenditure but does have a fiscal cost that will need to be estimated by Finance Canada.

39 See https://www.nrcan.gc.ca/energy-efficiency/energy-efficiency-transportation/zero-emission-vehicle-infrastruc/zero-emission-vehicle-infrastructure-program-expression-interest-faq/21878

40 This could be delivered by the departments directly or by third parties, modelled off the Zero Emission Vehicle Awareness Initiative https://www.nrcan.gc.ca/energy-efficiency/energy-efficiency-transportation/electric-alternative-fuel-infras/zero-emission-vehicle-awareness-initiative/22209

there were nearly 700,000 tractors in use on Canadian farms. Fuel switching from diesel to battery electric and/or hydrogen fuel cell powered zero emission tractors and machinery will prove the ultimate solution, but these technologies are still under development with limited commercial availability, with only a single, smaller battery electric tractor (Solectrac[41]) on the market.

Even once these alternatives become readily available (most major tractor manufacturers have battery electric and/or hydrogen fuel cell models under development), it is important to acknowledge the significant greenhouse gas emissions associated with the manufacturing of equipment currently in use, and the resulting "emission penalty" that would arise from early retirement and replacement with zero emission equipment. Research has shown that the CO_2 emissions associated with tractor manufacturing are highly sensitive to the period of depreciation, suggesting that "…the longer farmers can keep their older tractors running, the lower the source of fossil CO_2 emissions from manufacturing replacement machinery will be."[42]

In light of these considerations, the prospect for retrofitting existing diesel machinery to reduce fuel consumption offers a critical opportunity to reduce greenhouse gas emissions in the near-term. The Scottish Government's *Farming for a Better Climate* initiative conducted a pilot program with a "bolt-on" hydrogen electrolyser, designed to retrofit a conventional diesel tractor engine rather than replace it. As of 2019, the equipment had been used for 15 months, delivering a 20% reduction in fuel consumption.[43] In addition to fuel cost savings, the cleaner, faster and more efficient burn means that diesel particulate filters need to be replaced less often, and oil change hours are extended.[44]

"Farmers want to reduce their reliance on fossil fuels, but solar panels, electric tractors, and alternative energy infrastructure all have heavy capital costs."
—Arzeena Hamir, BC farmer

41 See https://www.solectrac.com/ & Lyseng, Ron. Electric tractors hit Canadian fields with a whir. The Western Producer. April 4, 2019. https://www.producer.com/crops/electric-tractors-hit-canadian-fields-with-a-whir/

42 J. Dyer et al., "The Fossil Energy Use and CO_2 Emissions Budget for Canadian Agriculture," in Sustainable Energy Solutions in Agriculture (Boca Raton: CRC Press, 2014).

43 Improving fuel use; hydrogen technology. Case Study. Farming for a Better Climate. https://www.farmingforabetterclimate.org/downloads/nether-aden-improving-fuel-use-hydrogen-technology/

44 Mark, Oliver. Aberdeenshire farmer's retrofit hydrolyser cuts diesel use by 20%, May 30, 2018. Farmers Weekly. https://www.fwi.co.uk/machinery/technology/aberdeenshire-farmers-retrofit-hydrolyser-cuts-diesel-use-20

In effect, this technology turns diesel vehicles into hybrids, and because the hydrogen is produced on board via electrolysis (passing an electric current through water), it doesn't require hydrogen production, distribution and re-fueling infrastructure (as will be required for future hydrogen fuel cell tractors).

Similar technology is commercially available in Canada[45] and is being actively used in a variety of diesel vehicles (with engines ranging in size from 6 to 16 litres). However, to date it has primarily been marketed toward long-haul freight trucks, in large part due to government incentive programs targeting this sector. Both the federal and B.C governments have programs in place to encourage the adoption of diesel retrofit technology by the freight sector—but no similar program supports its adoption by the agricultural sector.

In 2018, Natural Resources Canada launched the Green Freight Assessment Program,[46] investing $3.4 million over four years to help companies make data-driven investment decisions (offering up to $10,000 for a third-party fleet energy assessment providing tailored fleet recommendations) and supporting investments in implementation (offering up to $100,000 toward investments in retrofit equipment or lower-carbon) to reduce their emissions and fuel costs.

Through a partnership between the B.C. Ministry of Transportation and Infrastructure and the B.C. Trucking Association, the CleanBC Heavy Duty Vehicle Efficiency Program[47] has been capitalized with $1.4 million annually, for up to three years. The program cost-shares the purchase and installation of fuel-saving equipment for heavy-duty vehicles with qualified companies and supports education about driving practices that significantly reduce fuel usage and related GHG emissions. The Heavy-duty Vehicle Efficiency Program Course is a prerequisite to apply for CleanBC Heavy-duty Vehicle Efficiency Program Incentives, which offer rebates of up to $10,000 per vehicle or $100,000 per fleet, for qualifying fuel-saving equipment.[48] Hydrogen Fuel Enhancement Systems, as described above, are eligible for a rebate of up to 50% of the cost of the device and its installation, up to a cap of $4,000 per device[49,50]

Agriculture and Agrifood Canada can learn from these programs in other sectors, and adapt them to meet the needs of Canadian farmers and ranchers and to the current level of availability of technology and infrastructure specific to farms.

45 For example, Empire Hydrogen Energy Systems Inc. https://empire-hydrogen.com/

46 See https://www.nrcan.gc.ca/energy-efficiency/energy-efficiency-transportation/greening-freight-programs/green-freight-assessment-program/20893

47 See https://news.gov.bc.ca/releases/2019TRAN0194-002086

48 See https://www.bctrucking.com/content/new-cleanbc-heavy-duty-vehicle-efficiency-program

49 See https://www.bctrucking.com/news/backgrounder-cleanbc-heavy-duty-vehicle-efficiency-program-qualifying-equipment

50 For context, the Empire Hydrogen Energy Systems Inc. device retails for approximately $7,000.

PROGRAM 6 $5 MILLION

Celebrating climate champions

George Klassen is one of Canada's exemplary farmers implementing climate-friendly practices
FaspaFarm, Manitou, MB
Photo: Karen Klassen

Shining a light on farmers who implement climate-friendly practices through an awards program and awareness campaigns

INSPIRE CHANGE from fence post to fence post! Social science research on climate action reveals that a successful transition depends on inspiring positivity and hope, and requires celebration of milestones along the way. This includes showcasing and amplifying stories and impacts of early adopters who are charting the path for sector-wide change.

Farmers learn best from other farmers, and from seeing practices being implemented with success. Canadian agriculture is remarkably diverse in the scale of farm sizes, climate challenges, ecosystem differences, and the diverse types of production and commodities. Farmers, too, are also diverse. Farmers need to see successful farmers who remind them of themselves, on similar operations. This helps us to see ourselves in the transition.

Equity implications
Canadian farms and farmers are diverse. Award-winning farmers should represent a wide range of types, scales, and regions of production, as well as identities of farmers, so that other farmers can see their operations and themselves in the stories and experiences of success.

Program Objective

- To shine light on a diversity of farms and farmers that are implementing climate-friendly BMPs through communications campaigns and farmer-led storytelling, with other farmers as the key audience. Measure the environmental and economic impact of these BMPs on-farm to help farmers understand gains, to reinforce farmer-led storytelling and to inform future policies.

Program Design

- Two year program to build acceptance of climate-friendly farming in advance of 2023, at $5 million per year. Offer 100 prizes of $15,000 each for farmers who are implementing climate-friendly farming practices. Ensure that prizes are offered to a wide diversity of farm operations and farmers.
- Prize-winning farmers are supported by communications experts who help to tell the story of the farmer through various tools and tactics. Farmers are also supported by technical experts, who are able to measure the impact of the practice on the farm, to reinforce the sector's understanding of the benefits of the practice and to supplement storytelling.
- Where appropriate, prizes could be administered through third party organizations that could be invited to match or to provide in-kind support in storytelling or in technical expertise.

Current Challenges and Opportunities

Prize-winning farmers would be featured in various communications campaigns in regional networks and across the country. These communications would be both virtual and in-person, and targeted to other farmers. This program needs to be delivered or co-delivered through third party organizations, which could increase the profile of the prize and the showcased farmers, could offer technical expertise in measuring and monitoring impact of the farm, could offer capacity supporting information gathering on farm and from the farmer, and communications capacity to increase the reach of the storytelling.

Prize-winning farmers would be supported in collecting impact assessment data, described below, that is relevant for storytelling (and to help inform future policies) and would be available for interviews for media and other photo or video productions.

Collecting data on GHG impacts and other metrics on prize-winning farms will be an essential component of this program and therefore most of the funds allocated to this program will go to data collection, monitoring and evaluation of impact. Featured farms will be supported to quantify GHG mitigating impacts of BMPs, to help substantiate farmer-led storytelling to help understand the benefits at farm, regional and national levels. This measurement will help both the farmer and Canada better understand how to prioritize and adapt BMPs to achieve desirable GHG outcomes. Where possible, this measurement should include baseline data gathered from neighbouring farms who have not implemented the BMP.

"Farmers learn best from other farmers, and farmers implementing climate-friendly practices have inspiring stories to share. By celebrating and showcasing diverse types of farmers practicing climate solutions, other farmers will see themselves in the climate transition, too."
—Gillian Flies, ON farmer

The investment in the evaluation process is important to the ongoing success of Canadian agriculture's progress on climate change mitigation and resilience for a number of reasons. Canada needs to continue to broaden the base of professionals skilled in monitoring and measuring GHG mitigation in agriculture. The Climate Champions program is an opportunity to enhance monitoring and evaluation capacity at partner organizations, universities and in the private sector. Most importantly, the data collected can help inform future programing and to identify the highest priority climate BMPs.

Aerial view of FFF Farms
Garland, MB

Integrating Monitoring and Evaluation into every program

CANADIAN AGRICULTURE NEEDS THE ABILITY TO MANAGE OUR CLIMATE IMPACT AND WE CANNOT MANAGE THAT WHICH WE CANNOT MEASURE.

These program proposals are designed as stepping stones to the next APF 2023. They aim to broaden acceptance of climate-friendly BMPs and to scale-up adoption to start to reduce sector GHGs as soon as possible. These programs are also integral to informing the next APF 2023 and the future of a more resilient and competitive sector.

In implementing these and other climate policies, it is essential for the government to include monitoring and evaluation in every phase of implementation. The Task Force process engaged leading scientists and economists alongside farmers who can assess the real-world impacts of the policy proposals. However, much of the data included significant variability by region, ecology and crop type, and annual variability due to weather and market conditions. The proposals in this budget request are based on the best available science, but much work remains to be done to hone and prioritize GHG-reducing BMPs and the policies to encourage their adoption.

In light of these needs, Budget 2021's down-payment on climate action and the next Agricultural Policy Framework should embed experimental designs into agri-environmental policies and programs - such as by randomly assigning farmers to different program designs, incentive payments, or outreach approaches. This will provide essential information on which program designs are best aligned with farmers' preferences, and ensure the greatest environmental benefit from public funds.

Program implementation should provide enough flexibility for implementing partners to adjust and change as new monitoring and evaluation information becomes available. Monitoring should include: BMP adoption and compliance, on-farm measurement, farmer feedback on the incentives, and more -- so that the government, farmers and the rest of the sector can continue to make well-informed decisions about on-farm practices, policies, and investments toward a cleaner, more prosperous agriculture sector in Canada.

About Farmers for Climate Solutions

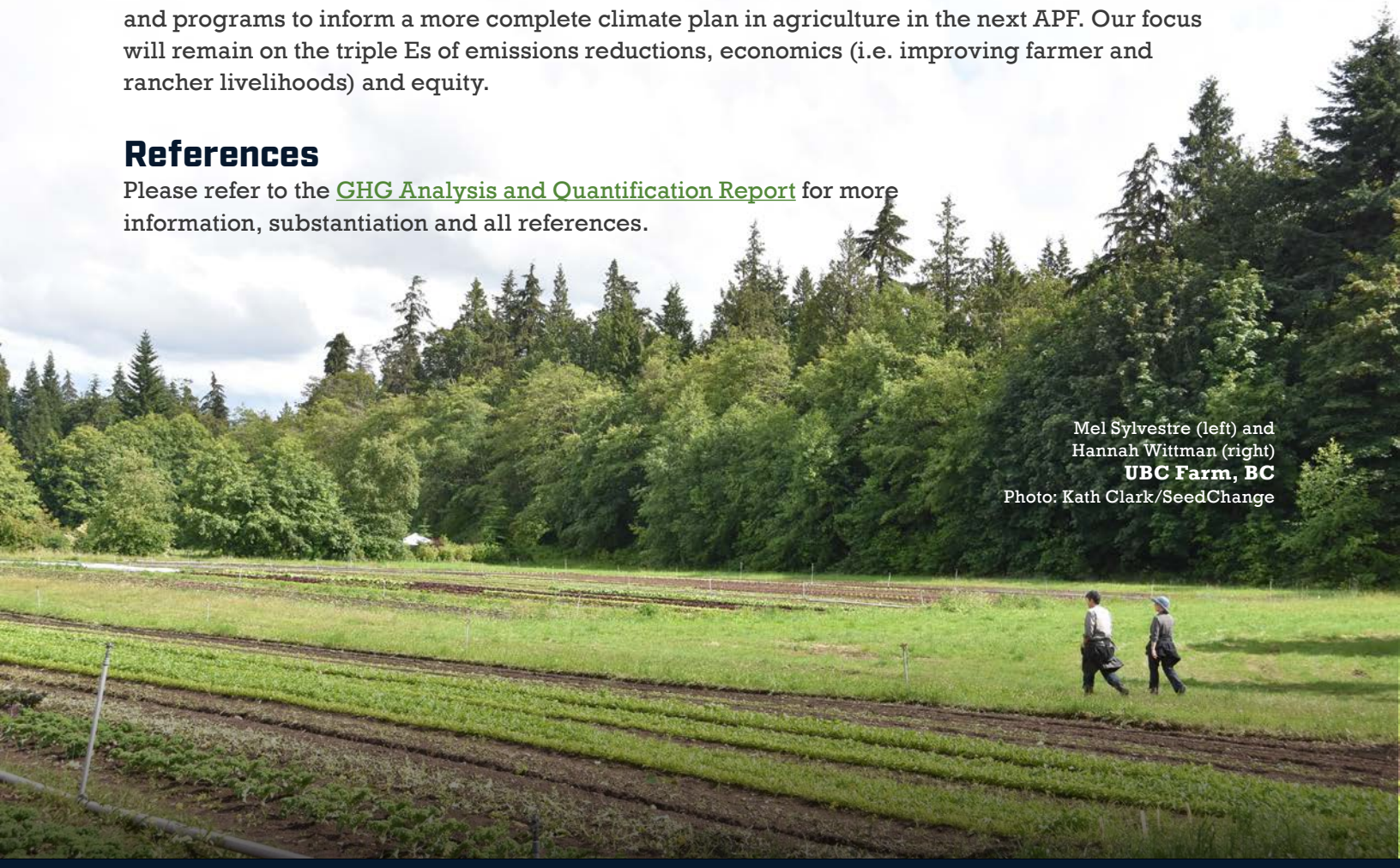
Farmers for Climate Solutions is a pan-Canadian coalition led by farmers who want agriculture to be part of Canada's climate solutions. We represent over 20,000 farmers and ranchers from coast to coast, across all scales, types and regions of production. Our work is dedicated to advancing policies that support farmers and ranchers to implement low-GHG, highly resilient practices. We position farmers as leaders in Canada's climate solutions.

The Task Force's next steps

The Farmers for Climate Solutions Task Force has focussed our efforts on short-term, immediately implementable policies for Budget 2021. These programs are important to jump-start our sector's emission reductions, but do not represent all that will be necessary to sufficiently reduce emissions by 2023. Once Budget 2021 is announced, Farmers for Climate Solutions, supported by Task Force members and other experts will turn our attention to proposing a comprehensive suite of practices and programs to inform a more complete climate plan in agriculture in the next APF. Our focus will remain on the triple Es of emissions reductions, economics (i.e. improving farmer and rancher livelihoods) and equity.

References

Please refer to the GHG Analysis and Quantification Report for more information, substantiation and all references.



Mel Sylvestre (left) and Hannah Wittman (right)
UBC Farm, BC
Photo: Kath Clark/SeedChange

FARMERS FOR CLIMATE SOLUTIONS

Contact Farmers For Climate Solutions
Karen Ross, Director
kross@weseedchange.org
514-577-9112

farmersforclimatesolutions.ca
fermierspourlatransitionclimatique.ca

@farmersfermiers @farmersclimate | @fermiersclimat