Washington State Conservation Commission

Pathways for Change:

Understanding and Supporting Washington Dairies in Contributing to Washington's Climate Goals




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Executive Summary

In order for Washington State to achieve its climate goals, a broad range of public and private actions will be necessary. Although agriculture comprises only 6% of Washington State's direct emissions (Waterman-Hoey, 2022), the dairy sector has an opportunity to make substantial contributions through reductions in emissions from manure management, enteric fermentation, energy use, and crop/field management. Additionally, contributions from soil carbon sequestration, water quality improvements and renewable energy production can provide benefits beyond what this emissions figure captures.

This statewide motivation to reduce greenhouse gas (GHG) emissions and advance sustainable agriculture is matched by substantial commitments within the dairy industry itself. Washington's legislated climate targets—reducing emissions to 45% below 1990 levels by 2030, 70% by 2040, and achieving net-zero by 2050—underscore the urgency for action across all sectors, including agriculture (WA Department of Ecology, 2020). Nationally, the U.S. dairy industry has committed to achieving climate neutrality by 2050 (Innovation Center for U.S. Dairy, 2023) and is responding to Scope 3 climate goals set by dairy purchasers (e.g. Starbucks, Danone, Nestlé) as well as the sustainability expectations of consumers and investors (Nyoni, 2023; VanAsten, 2023).

The Washington dairy sector has the potential to achieve significant emissions reductions over the next decade by adopting targeted mitigation strategies. In addition to reducing emissions, these strategies can improve operational efficiency, reduce costs, and enhance farm resilience. While a few dairies have taken steps in this direction, understanding current emissions and identifying appropriate mitigation strategies remains challenging for most producers, particularly in the context of constrained dairy economics (Neibergs and Gibson, 2022). This project sought to address that challenge directly.

The project conducted comprehensive assessments of the current climate footprint of 19 dairies across the Washington dairy sector, representing a diverse set of dairy sizes, production systems, and geographies. Each farm received a custom Sustainability Plan outlining their current emissions footprint and individualized recommendations for reductions. Data from across all dairies were aggregated to inform the development of a draft statewide roadmap. The project approach and findings provide a scalable model that can be adapted for broader application across the state's agricultural sectors.

To realize these opportunities, coordinated technical assistance, financial incentives, and policy support will be critical to help dairy producers adopt sustainable practices on a scale. This project was conducted in partnership with key academic, industry, and government stakeholders including Washington State University, Northwest Dairy Association/Darigold, Newtrient, LLC, the Washington State Department of Agriculture, the Washington State Conservation Commission, and Whatcom Conservation District. The variety of partners highlights the importance of multi-sector collaboration in meeting Washington's climate goals.

Introduction

As with most food production and economic activity, dairy production contributes to GHG emissions. Key sources include enteric fermentation, manure management, and field crop production, with smaller but still important contributions from on-farm energy use (Rotz et al. 2021). Existing analyses have shown that there is substantial variability in emissions —both regionally across the U.S. and between individual farms (Rotz et al., 2021; Thoma et al., 2013; Naranjo et al, 2020; Naranjo et al., 2023). This variability, even between similar types of farms, suggests that targeted mitigation strategies can have a meaningful impact.

Despite this potential, many dairy producers face barriers in understanding their current emissions and identifying practical reduction strategies. Decisions are inherently farm-specific and often shaped by financial and operational constraints (Neibergs and Gibson, 2022). While a few high-profile dairies have taken steps that reduce their emissions, most producers still struggle with accessing the tools and information needed to take action (Edmonds, personal communication; Gearhart, personal communication).

To address this gap, this project evaluated GHG emissions using FARM-ES—the most widely utilized decision-support tool in the U.S. dairy industry (Thoma, 2013; Asselin-Balençon, 2013; NMPF, n.d.). These evaluations provided a comprehensive picture of the emissions landscape across Washington's dairy sector. By combining broad emissions assessments with in-depth analysis of a small sample of dairies—including their context, management plans, and operational realities—we aimed to identify the mitigation strategies most feasible in the short-, mid-, and long-term.

Together, these two datasets — emissions profiles and farm-specific insights— will be combined with economic analysis to inform the development of a statewide roadmap that outlines strategies for the development of more climate-smart dairies in Washington.

Methods

The project team carried out two related objectives to complete this project:

Objective 1: After separating dairies in the state into cohorts of related size, geography (east versus west) and production systems (organic or conventional), we collaborated with a subset of dairies and on-the-ground state partners (conservation districts, WSDA, NDA) to assess viable climate strategies and develop grounded, cohort-specific, prioritized recommendations for cost-effective changes that can be made in the short-, medium, and long-term. These recommendations address manure management, enteric emissions, energy, and crop/field management to reduce greenhouse gas emissions and improve water quality, as well as concrete next steps to guide implementation and adoption.

The team worked with partners to divide dairies across the state into meaningful cohorts and then identify representative dairies for in-depth engagement. Initially, the project aimed to conduct in-depth analysis of 10 dairies, a number shaped by budget constraints and the goal of balancing representative detail with broader applicability. However, through Amendment 1, the project scope was expanded to include 10 additional dairies, doubling the number of Sustainability Plans developed from 10 to 20. Ultimately, 19 farms were recruited and completed the process, allowing

the team to significantly broaden the base of technical assistance and improve the quality and relevance of the statewide roadmap.

Newtrient and its third-party data collection partner, Eocene Environmental Group (formerly Sustainable Environmental Consultants), conducted detailed GHG footprint analyses of each dairy utilizing the FARM-ES platform. This analysis was supported by farm visits to confirm data, discuss farm goals and broader business plan, and assess the technological, economic, and operational feasibility of potential strategies – critical steps in developing a tailored plan of action. Results from the FARM-ES analysis, the site visit, and additional assessments were combined into comprehensive individual Sustainability Plans, further described below.

Visits and the process were collaborative between Newtrient, WSU, and others as appropriate (conservation district staff, NDA, Dairy Farmers of Washington), building technical capacity across the state. In particular, the project strengthened understanding of how to best help dairy producers interpret and use FARM-ES results. The team leveraged trusted producer networks to facilitate conservation planning and decision support.

Each Sustainability Plan summarized the farm's current GHG footprint, contextual considerations, and rough implementation costs. Plans included farm-specific recommendations, estimated environmental impacts, implementation timing (short-, medium- and long-term), and associated costs and financial opportunities. Where applicable, NRCS EQIP payment schedules and Conservation Practice Standards with funding incentives were used to frame recommendations. Once developed, individual producers reviewed and approved the recommendations within the Sustainability Plans. Upon approval, the individual farms will be equipped to identify and access state, federal, and market funding opportunities, indicating that they have completed much of the baseline assessment and planning necessary to apply for EQIP, CSP, or other sustainability projects.

In summary, Sustainability Plans served three purposes:

- Provided in-depth, tailored information for participating farms,
- Built technical capacity among agricultural professionals across the public and private sectors, and
- "Ground-truthed" the assumptions and priorities needed to inform broader statewide recommendations developed under Objective 2.

Objective 2: Analyze the insights gained from individual dairy visits and analysis to develop an initial statewide dairy sector roadmap to guide future progress.

In this task, we utilized the in-depth analyses from 19 individual dairy farms to inform the development of a Washington Dairy Climate-Smart Roadmap. Organized by cohort, the roadmap presents recommendations based on environmental impact, timing, and associated costs and financial opportunities.

Note that within this objective, project partners had originally proposed utilizing anonymized versions of existing climate footprint evaluations (using the *FARM ES* platform) to provide additional insights into current climate footprints and potential pathways to reducing emissions. However, obtaining the anonymized data proved more time-consuming than the project timeline allowed.

Results

Objective 1: Assess viable climate strategies and develop grounded, specific, prioritized recommendations for cost-effective changes that can be made in the short-, medium, and long-term to manure management, enteric emissions, energy, and crops/field management to reduce greenhouse gas emissions, as well as concrete next steps to guide implementation and adoption.

The team began by working extensively with existing Washington State Department of Agriculture data and drawing on the qualitative expertise of the project team to analyze the diversity of dairies across the state. Dairies were grouped into categories based on shared characteristics such as size, geography, and production systems, while ensuring that each group was large enough to maintain producer anonymity. Internal team discussions—particularly around manure management systems—helped refine these categories and guided recruitment to ensure the sample of dairies selected for in-depth analysis reflected the diversity of Washington's dairy sector.

After developing these categories, 19 dairies were recruited to participate in the project (Table 1). The team worked with participating farms to collect data allowing the team to utilize FARM-ES to quantify the dairy's current GHG footprint. On-farm visits were conducted in December 2024 (east side of the state) and January 2025 (west side of the state). These multi-hour visits focused on understanding the dairy's business priorities, operational context, and current practices, as well as providing an opportunity to explore and discuss strategies for reducing emissions and improving water quality. After the farm visits, Newtrient prepared an individualized Sustainability Plan for each dairy based on FARM-ES results, the site visit, and follow-up analyses. To protect farm-level business confidentiality, these reports are not included in this public report.

Table 1. Number of dairy farms in each cohort included in the Objective 2 farm assessments.

Region and Type	**Small** (<1000 cows)	**Medium** (1000-3000 cows)	**Large** (>3000 cows)	**Total**
Conventional, Eastern WA	**3**	**4**	**3**	**10**
Conventional, Western WA	**4**	**3**	**-**	**7**
Organic, Statewide	**2**	**-**	**-**	**2**
Total	**9**	**7**	**3**	**19**

Each report included a farm overview, current GHG footprint, and a set of tailored recommendations for improving environmental outcomes, particularly GHG footprint. Where possible, potential GHG reductions were quantified. Strategies were sequenced to reflect implementation feasibility and the farm's stated priorities. Each report was reviewed with the participating farm and revised based on feedback before being finalized.

Objective 2: Analyze the insights gained from individual dairy visits and analysis to develop an initial statewide dairy sector roadmap to guide future progress.

To inform broader statewide planning, the team drew on the in-depth farm assessments and contextualized them using national and regional GHG benchmarks.

At the national level, greenhouse gas emissions from dairy production are attributed roughly as follows: production (35%), manure management (33%) and feed (26%) each contribute substantially to the climate footprint, with on-farm energy use (6%) representing a smaller, but still important component (Figure 1; Thoma, 2013).

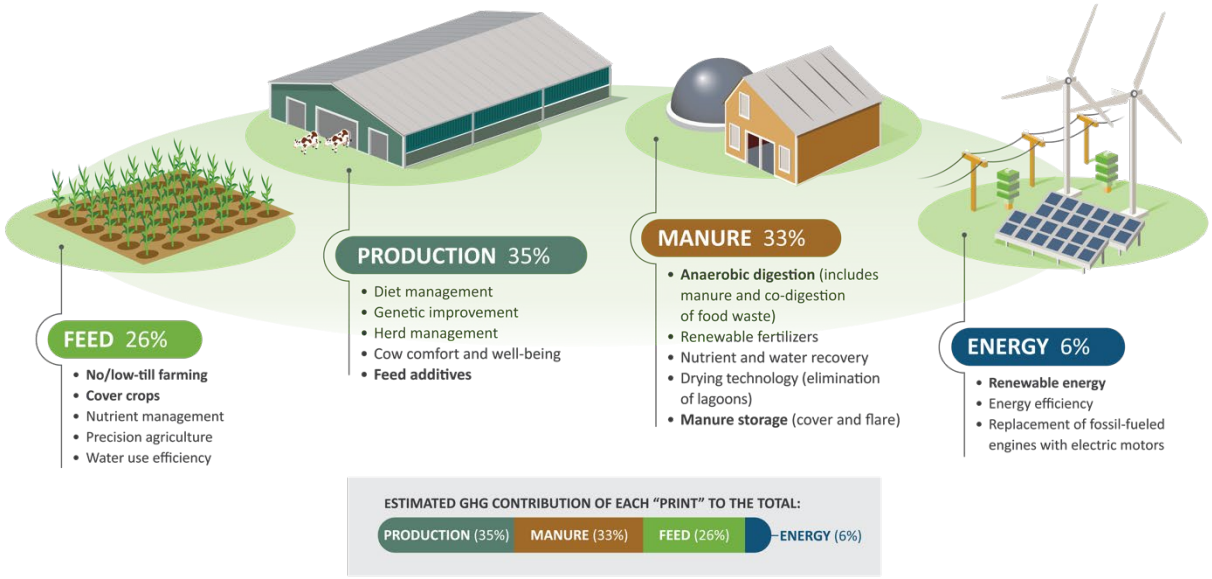

Figure 1: U.S. dairy's greenhouse gas footprint (Adapted from Thoma 2013, Regional Analysis of greenhouse gas emissions from USA dairy farms. A cradle-to-farmgate assessment of the American dairy industry, circa 2008).

Within the region, based on modeling by Rotz et al. (2021), the average GHG footprint of a dairy farm in the Pacific Northwest (PNW) region is approximately 2.2 lbs CO_2e (carbon dioxide equivalent) per lb. of fat- and protein-corrected milk (FPCM). This is slightly lower than the national average of 2.23 lbs. CO_2e/lb. FPCM, which ranges from 1.52-3.19 lb. CO_2e/lb. FPCM (Rotz et al., 2021). The lower footprint in the PNW is largely due to factors such as higher milk yields (which they estimate to be around 24,260 lbs./cow/year) and regional advantages like a cooler climate and access to a clean energy grid, which help reduce the overall carbon intensity of milk

production. Organic dairies, which often utilize pasture-based systems, may achieve even lower footprints, around 1.94 lb. CO_2e/lb. FPCM) (Rotz et al., 2021).

The components of the climate footprint for a Pacific Northwest dairy are shown in Figure 2.

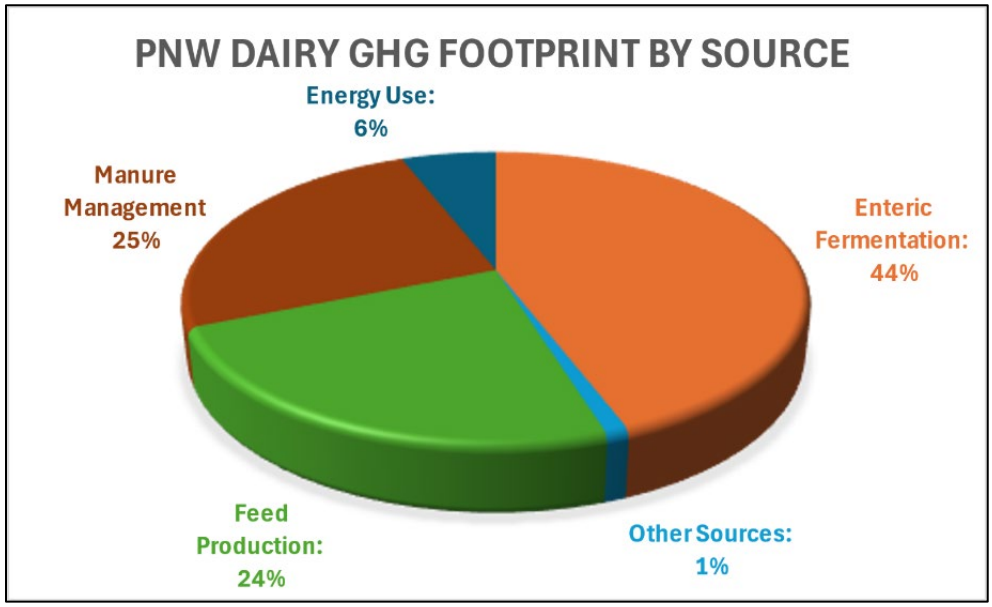

Figure 2: Pacific Northwest dairy footprint (Adapted from Rotz et al. 2021).

Table 2. Greenhouse gas contribution summary for Pacific Northwest dairies (based on Rotz et al. 2021). Note that greenhouse gas footprints vary based on farm practices (e.g. anaerobic digesters reduce manure emissions, organic systems lower enteric emissions)

Enteric Fermentation	44%	Methane from cow digestion due to high feed volume. Mitigated by diet optimization.
Manure Management	25%	Methane and nitrous oxide from anaerobic lagoons and holding ponds. Technologies exist to reduce these emissions.
Feed Production	24%	Carbon dioxide and nitrous oxide from crop cultivation and transport. Conservation practices and local feeds reduce emissions.
Energy Use (On-Farm)	6%	Carbon dioxide from electricity and fuel. Low in the Pacific Northwest due to Washington's hydropower-dominated grid.
Other Sources	1%	Minor emissions from refrigerants, off farm transport, etc.

Newtrient used the insights from individual dairy visits to develop an initial 47-page statewide dairy sector roadmap. This roadmap includes the following information:

- A description of project motivations and context;
- An overview of dairy GHG footprints at the national and state level;
- Statewide recommendations and priorities, covering feed, production, manure management, and energy, with a description, corresponding NRCS practice standard (if relevant), cost estimate, and estimated GHG reduction potential for applicable practices;
- Regional recommendations specific to eastside, westside, and organic dairies;
- Detailed implementation recommendations and considerations.

The report is currently under internal and partner review and is expected to be finalized and publicly released in late 2025.

Conclusions & Discussion

While this project alone is not sufficient to drive widespread emissions reductions on Washington dairy farms, many participating producers commented that the process helped deepen their understanding of climate impacts and clarified actionable steps to reduce their emissions. The Dairy Farmers of Washington is actively pursuing additional funding to expand farm assessments, aiming to support any interested dairy in the state with tailored sustainability planning. Meanwhile, both state and national partners have expressed strong interest in the Washington Dairy Climate-Smart Roadmap, recognizing its potential to inform policy, investment, and continued technical assistance efforts.

This project represents an important first step, but substantial and sustained progress will require more comprehensive action. Across the dairy sector, the most significant hurdle to implementing sustainable practices remains economic viability. Washington's producers—like many across the country—face tightening margins, increasing regulatory expectations, and uneven access to markets that reward environmental outcomes. Without sustained financial support or participation in value-added markets, most farms cannot shoulder the risk of adopting new technologies or practices, regardless of their environmental merit. Notably, the economic outlook for Washington's dairy sector worsened in early 2025, coinciding with the project's completion, further intensifying these challenges.

Smaller and mid-sized dairies are disproportionately constrained by these dynamics. In addition to limited operating margins, they frequently lack the financial resources, technical expertise, or dedicated staff needed to evaluate and implement new technologies or engage with emerging environmental markets. While public incentive programs like NRCS's EQIP or CSP provide valuable support for practice adoption, they are not designed to generate sustained income. To scale impactful solutions—such as anaerobic digestion or nutrient recovery systems—producers need access to long-term, market-based revenue streams that align environmental stewardship with economic viability.

Yet, the project also identified promising paths forward. By building detailed, farm-specific Sustainability Plans and modeling potential GHG reductions, the project created a tool that can inform both individual farm decisions and broader public investment strategies. The roadmap is already helping state and regional partners align their priorities. More importantly, it can serve as a catalyst for new partnerships and investments that help Washington's producers move from planning to implementation.

Following completion of this project, the following priorities have been highlighted to guide ongoing efforts:

- **Policy and funding alignment:** Structured, data-driven farm assessments—like those used in this project—can strengthen broader climate programs by ensuring investments are grounded in real-world opportunities. Integrating these assessments into planning efforts allows funders to better target support, reduce risks, and tailor strategies to farm-specific realities. Still, long-term success will require sustained funding and market incentives to overcome the financial barriers to adoption.
- **Public–private collaboration:** The collaborative approach in this project—bringing together producers, academia, conservation districts, agencies, and national partners—proved essential. Ongoing success will depend on continuing to bridge sectors to design programs that are both grounded in science and responsive to on-the-ground realities.
- **Technical capacity-building**: This project highlighted the critical need to build technical expertise within public agencies, conservation groups, and industry partners to support expanding sustainability efforts. Recent proposed NRCS staffing cuts threaten access to essential technical assistance, underscoring the urgency to invest in training and staffing. Strengthening regional capacity will be vital to helping farms implement sustainable practices and access available resources.
- **Data and decision-support tools with continuous improvement:** The Sustainability Plans and tools developed here offer a scalable model for tailored emissions reduction strategies. Future efforts can enhance this foundation by integrating real-time data, predictive modeling, and automated benchmarking to boost usability and impact. Equally important, the roadmap should function as a living document, incorporating regular feedback and updates as technologies advance and farms implement changes, ensuring it remains relevant and effective over time.
- **Transferability:** While the roadmap is tailored to Washington, the process and framework offer a replicable model for other dairy regions. The cohort-based analysis, producer-led planning, and integration of both environmental and economic considerations can be adapted to a range of contexts.
- **Ongoing research and piloting:** Future efforts should include piloting promising practices identified through the roadmap, with evaluation of both environmental and financial outcomes. This kind of applied research will help refine the roadmap, improve incentive program design, and strengthen confidence in the feasibility of recommended strategies—especially for smaller and mid-sized dairies.

Washington’s dairy sector is uniquely positioned to show that environmental stewardship and agricultural resilience are mutually achievable goals. By aligning incentives, enhancing technical support, and fostering sustained public-private partnerships, Washington can lead the way in implementing practical, scalable strategies that reduce emissions, protect natural resources, and strengthen rural communities. With continued commitment and collaboration, the state can equip its dairy producers with the necessary tools, resources, and guidance to meet climate and water quality objectives while preserving the long-term viability of this vital industry.

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