The ClimateTrust®

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Promoting Washington Biogas: Feasibility Study of the DeRuyter Dairy

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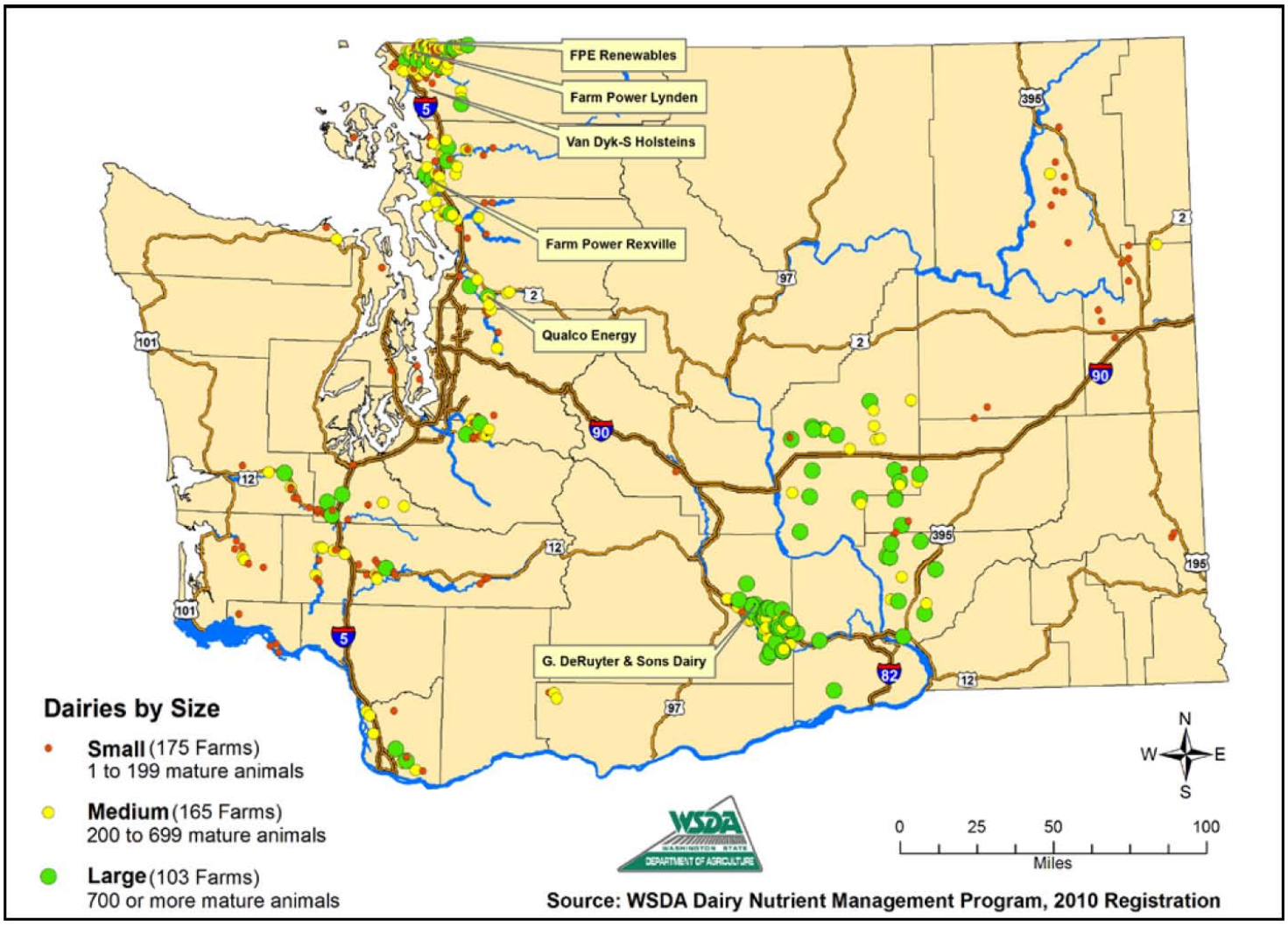
Washington's largest opportunity to develop anaerobic digesters at dairy farms is in the Columbia Basin, yet only one project – the DeRuyter digester—has been developed there. This is due, in large part, to low power prices. While projects on the west side of the Cascades sell their power to Puget Sound Energy (a utility now known for working to promote biogas), projects in the Columbia Basin sell their power to PacificCorp, who has only been willing to pay the required "avoided cost" rates for power from digesters. These low power prices explain why the majority of digesters in Washington have been developed on the west side of the Cascades, despite the prevalence of big dairies on the east side.

Figure 1. Washington's dairies and its six dairy digester projects. While over 70% of Washington's large dairies are in the Columbia Basin, the DeRuyter digester, built in 2006, is the only project in the region.



What can be done to increase the adoption of biogas in the Columbia Basin? As part of a team commissioned by the Washington Department of Commerce and Washington State University (WSU), and with the support of the Kongsgaard-Goldman Foundation, The Climate Trust conducted a study to analyze whether or not two new technologies, **biogas as transportation fuel** and **nutrient recovery**, could be part of the solution.

Current Operation

Before this question could be answered, however, we needed to model and understand the current economics at DeRuyter. Because there has been so little adoption of digesters in the region, we assumed that generating electricity at dairy farms was not profitable in the Columbia Basin. A full economic model of the project, however, demonstrated that this is not true; the project, as currently designed, is projected to be profitable over the next twenty years.

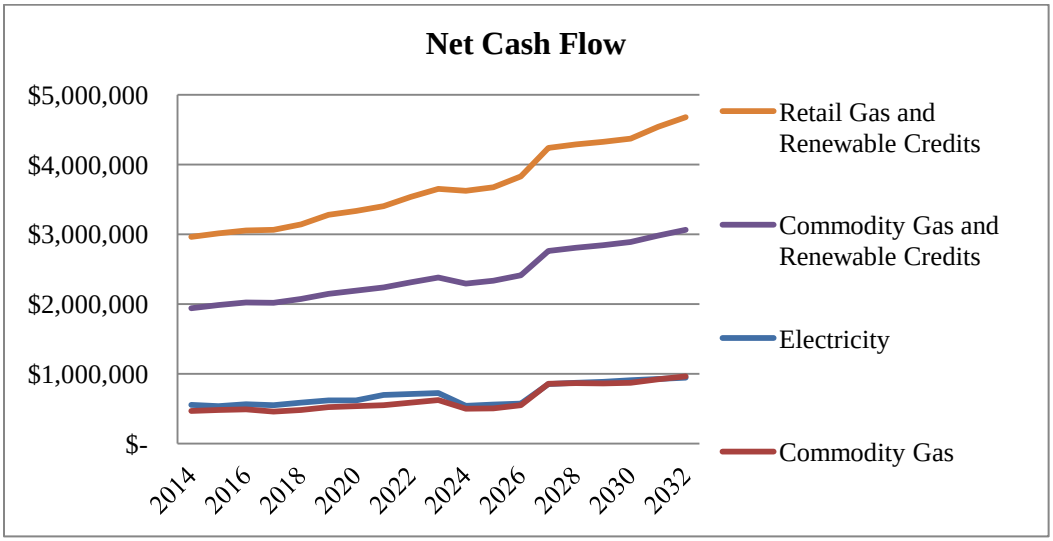
Despite low electricity prices, the DeRuyter project has processed the effluent that comes out of the digester into two valuable revenue streams: a peat-moss substitute and a phosphorous-rich fertilizer. Despite extremely low margins on the electricity produced by the project, the value of these co-products makes the DeRuyter digester profitable. In the later years, these products are predicted to make up 70% of the revenue generated by the project.

Key Conclusion:
Detailed economic analysis of the current DeRuyter digester demonstrates that, through fiber and nutrient sales, dairy digesters have the opportunity to be profitable in the Columbia Basin despite extremely low electricity prices.

Transportation Fuel:

At DeRuyter and most other dairy digesters in the United States, biogas is combusted to make electricity. This study asked if more revenue could instead be generated by cleaning, compressing and using biogas to fuel vehicles. Different scenarios were considered, from simply injecting clean gas into the pipeline for someone else to compress into vehicle fuel, to selling fuel and its associated renewable credits at the dairy itself.

Figure 2: Net cash flow (revenue – operating costs – debt service) for the entire DeRuyter digester under various scenarios for biogas utilization.



As illustrated by the "Commodity Gas" net cash flow, by cleaning biogas, injecting it into the pipeline and selling it at commodity prices, the project can generate about the same profits as selling electricity. There is great potential to earn additional profits when selling transportation fuel. First projects have the opportunity to earn Renewable Identification Numbers, valuable credits under the federal Renewable Fuel Standard. These credits are currently worth almost three times the commodity value of the gas itself. When selling gas at commodity prices and incorporating the value of these renewable

credits, profits are much higher, as illustrated by the "Commodity Gas and Renewable Credits" net cash flow. Rather than selling gas at commodity prices to later be turned into transportation fuel, the project also has the opportunity to instead make vehicle fuel on site. This analysis assumes the project could sell its fuel for more than four times the commodity price of the fuel. This "Retail Gas and Renewable Credits" net cash flow is the most profitable.

Key Conclusion:
Selling transportation fuel rather than electricity has significantly more potential to earn revenue for the project.

The study identified several key barriers that could impede the DeRuyter project from pursuing this potentially more profitable use for its gas:

- **Additional substrates must be obtained:** DeRuyter currently only makes about half the biogas that is needed to economically run gas cleaning and compression equipment. The project would therefore need to obtain roughly 70,000 gallons of high energy substrates to supplement the manure that is currently digested. These substrates are hard to find in Eastern Washington.
- **Significant debt must be assumed:** The study estimates the gas cleaning, compression and injection equipment will cost between $5 to $6 million. The dairy does not feel comfortable assuming this level of debt, so a third-party developer is needed.
- **Environmental credits are uncertain**: The prices for the renewable credits are extremely uncertain. The renewable credits associated with ethanol, for example, were once very valuable and then crashed quickly when supply spiked. The same could happen for biogas renewable credits. The significant investment required therefore cannot be justified on the basis of the renewable credits alone.

Nutrient Recovery

Beyond bringing in additional revenue, digesters could be encouraged in the Columbia Basin by solving the nutrient overloading that occurs at many concentrated animal feeding operations (CAFOs). According to the U.S. Department of Agriculture, 36% and 55% of CAFOs are in state of nitrogen or phosphorous overload, respectively. Digesters alone do not remove these nutrients. They do, however, convert a larger portion of nitrogen to an inorganic form. This enables nutrient recovery.

WSU has patented an ammonia stripping system with the potential to remove 50% of a digester's nitrogen effluent and then condense it into exportable fertilizers. This study analyzed the economic feasibility of such a system. Net cash flow analysis estimates that this system is not likely to be profitable at DeRuyter—at low fertilizer prices the system would lose over $300,000 in a sample year and at high prices it would make only $38,000.

Removing nitrogen from the farm also reduces the farm's N_2O emissions (a potent greenhouse gas) thereby producing important climate benefits. If the farmer were paid for these reductions through the carbon market, could the system be made profitable? After modeling the potential reductions under the simplified existing methodology for calculating N_2O emissions, The Cilmate Trust concluded that removing half the nitrogen from the DeRuyter effluent would only reduce 1,200 metric tons of carbon dioxide equivalent emissions per year. This is insufficient to justify the transaction costs associated with monitoring and verifying a carbon reduction project. However, a more advanced biogeochemical model than what currently exists could take into account the timing, place and type of fertilizer application; this advanced modeling would likely yield significantly more carbon credits, potentially justifying investment in nutrient recovery technologies.

Most protocols for modeling N_2O emissions focus on nitrogen applications to corn; this study uncovered the large potential for N_2O reductions at CAFOs that cannot be modeled accurately under existing protocols and therefore requires additional study.

Project Outcomes

This study has ultimately advanced our understanding of the barriers and opportunities for biogas, particularly dairy biogas, in Washington's Columbia Basin. These projects can deliver important additional revenues streams for dairy farmers who face challenges to ensure the ongoing profitability of their operations. Therefore assessing how to increase the profitability of dairy digesters through transportation fuels, nutrient recovery, or from carbon credits is of great value to the sector. While we have identified opportunities to increase revenues for the DeRutyer digester, and identify it as a model for other projects in the region, there remain key barriers that need to be addressed. The Climate Trust will continue to work with Washington's dairy sector to overcome such hurdles by advocating better policies, providing technical expertise on the state of the carbon market, and testing and promoting innovative practices that contribute to the sustainability of the industry.