Centralized Biogas Feasibility Factsheet

This factsheet discusses the feasibility of multiple dairy farms jointly sharing an on-farm biogas facility

Introduction

Anaerobic Digestion (AD) technology, also referred to as biogas, produces renewable natural gas (RNG) and digestate.

Digestate is a manure-like, nutrient rich byproduct of the AD process which offers several benefits over raw dairy manure such as odour reduction, improved nutrient availability, and weed seed reduction. The AD process transforms organic nutrients in manure and food waste into a more readily available form for crops which enhances the efficiency of nutrient uptake and promotes improved crop growth. Odour from digestate tends to be reduced when compared to raw manure since the compounds responsible for much of the odour are broken down in the AD process.

Biogas production is a positive impact on reducing GHG emissions. Biogas facilities decrease the release of methane, the main component of RNG, which would naturally occur from the decomposition of food and manure. By capturing and harnessing biogas, farmers can diversify their incomes while reducing agriculture-specific GHG emissions.

Biogas facilities in BC have been economically viable for farms that have at least 250 – 300 milking cows (not including replacements). With the average farm milking 160 cows, biogas remains out of the possibility for a single, average-sized dairy farm.

As a result, the BC Ministry of Agriculture and Food (AF) retained GHD Ltd. to carry out an analysis to determine if a cluster of small to medium-sized dairy farms would be a viable option for a biogas facility.

The Study included the development of a model to assess feasibility of different clusters of dairy farms, an assessment of several potential clusters using actual BC dairy farms, and further assessment of what factors influence dairy farm cluster feasibility. Full details of the Study and findings are available in the Dairy Biogas Cluster Feasibility Study report.

Content in this factsheet is subject to the limitations outlined in Section 1 of the accompanying report.

Dairy Farm Cluster Setup

To be able to compare each cluster of farms, every scenario was assumed to have the following:

- Feedstock to be 49% food waste and 51% manure;
- $25/tonne tipping fee for food waste;
- Centrifuge needed for nutrient recovery, and
- RNG is injected into the natural gas distribution network and sold at $30/GJ.

These default features and additional inputs outlined in the accompanying report were used for all dairy farm clusters. To assess the simplest version of a potential cluster, the baseline scenario used Cluster 3 data but did not include nutrient recovery.

Feasibility Assessment Results

A number of BC dairy farmers provided information regarding their manure production, dairy herd, replacement stock, acreage, and other farm-specific information for the study. This information was used along with the default inputs to assess 10 potential clusters using the feasibility model.

The model measures feasibility by estimating Net Present Value (NPV) which is a measure of a project's profitability over its lifetime.

The results of the analysis are presented in Table 1.

Table 1 Estimated Feasibility of Assessed Dairy Farm Clusters

Cluster	Total Herd Size (MCE)*	Manure (tonnes/ year)	Food Waste (tonnes/ year)	Estimated NPV ($)	RNG Production (GJ/year)	Max Distance Between Farms
Cluster 1	690	19,000	18,500	$5,100,000	110,000	20 km
Cluster 2	500	17,500	17,000	$6,100,000	105,000	5 km
Cluster 3	380	13,500	13,000	$2,000,000	80,000	10 km
Cluster 4	520	17,000	16,000	$4,200,000	96,000	20 km
Cluster 5	500	14,000	13,500	$2,700,000	84,000	15 km
Cluster 6	240	7,500	7,000	-$4,000,000	43,000	80 km
Cluster 7	380	9,500	9,000	-$1,800,000	53,000	5 km
Cluster 8	470	13,000	12,500	$600,000	75,000	50 km
Cluster 9	410	11,000	10,500	-$1,000,000	63,000	40 km
Cluster 10	390	12,000	11,500	$100,000	68,000	5 km

* MCE = (Lactating Cows) + (Dry Cows / 1.9) + (Heifers / 2) + (3 – 10 month Calves / 4) + (0 – 3 month Calves / 10)

The assessment found that all clusters, except 6, 7, and 9, were estimated to be feasible ranging from a NPV of $100,000 up to $6.1 million depending on the cluster. As the model does not take every aspect of individual farms into account, it is important to understand that the results are meant to act as a guide for producers in determining if doing a farm or cluster-specific feasibility study would be worthwhile.

The total herd size, expressed as Milking Cow Equivalents (MCE), is calculated by the equation denoted under Table 1. It is helpful to express a cluster's total her size as MCE because of varying replacement stock numbers between farms.

Breakeven Cluster Size

The results from Table 1 were plotted to a graph of herd size vs NPV in Figure 1 (below). breakeven herd size for a cluster is 400 head (MCE). This is the approximate size that is estimated to have an NPV of $0. It is more likely that assessed clusters with over 400 head are feasible, and those with less than 400 not feasible. However, the Ministry of Agriculture is able to provide producers with their farm or cluster-specific feasibility estimate.

The breakeven point can act as a preliminary assessment to determine if a dairy farm cluster is large enough to be profitable. This assessment of profitability is more reliable the further a cluster exceeds 400 head of dairy cattle. NPV will fluctuate based on what the cluster requires for equipment, digestate management, transportation, and other varying inputs.

The accompanying report also determined the RNG production breakeven point of 68,800 GJ/year. It was found RNG was a more reliable breakeven as it accounted for variability in cluster specific data such as manure solids content, and estimated manure biogas production.

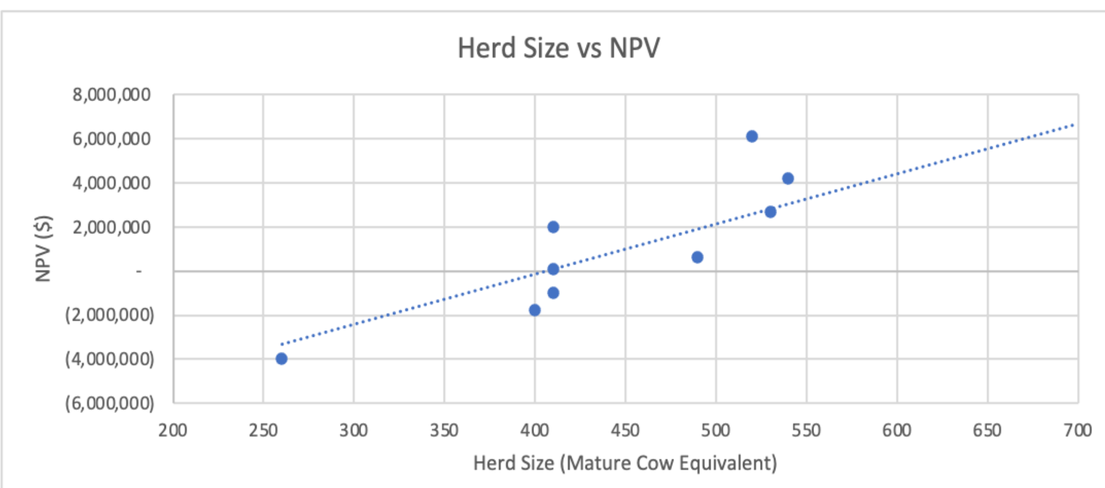

Figure 1: Herd Size vs NPV

Input Assessment

The input assessment investigated how changing default inputs used in the Model might impact estimated feasibility. Using the baseline cluster, inputs were adjusted and if estimated NPV was impacted by over 10% (~$300,000) the input was considered significant. The assessment found the following inputs were significant:

- Adjusting inputs to include operator salaries.
- Using different nutrient recovery technology.
- Transporting RNG 25 km or more by truck instead of by pipeline.
- Adjusting biogas production by 25% or more.
- Adjusting food waste tipping fees by 10% or more.
- Adjusting accepted food waste tonnage by 5% of more.
- Increasing distance between farms by 15 km or more.

The assessment found the following were not significant:

- Transporting RNG 10 km or less by truck instead of by pipeline.
- Adjusting food waste tipping fees by 5% or less.

This assessment outlines that there are several inputs that could have a significant impact on NPV should they be altered.

Ownership Models

The final assessment in the Study was outlining potential cluster ownership models and how costs and revenues would be shared between owners. The baseline cluster was used for each model. Results are presented in Table 2.

Table 2 Ownership Models

Ownership Model	CAPEX	OPEX	NPV (Revenue)
Equal Ownership	Farm 1: $10,050,000 Farm 2: $10,050,000	Farm 1: $250,000 Farm 2: $250,000	Farm 1: $1,550,000 Farm 2: $1,550,000
Proportional Ownership by Herd Size	Farm 1: $12,700,000 Farm 2: $7,400,000	Farm 1: $315,000 Farm 2: $185,000	Farm 1: $1,950,000 Farm 2: $1,150,000
Proportional Ownership by RNG Generation	Farm 1: $13,100,000 Farm 2: $7,000,000	Farm 1: $325,000 Farm 2: $175,000	Farm 1: $2,050,000 Farm 2: $1,050,000
Single Farm Ownership	Farm 1: $20,100,000	Farm 1: $500,000	Farm 1: $3,100,000

CAPEX and OPEX refer to capital costs and operational costs, respectively.