

FINANCIAL FEASIBILITY OF BIODIGESTER DEVELOPMENT IN WASHINGTON STATE

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INTRODUCTION AND METHODOLOGY

David Paul Rosen & Associates (DRA) was retained by the Washington State Housing Financing Commission (WSHFC) to analyze the financial feasibility of anaerobic biodigester development in Washington State. DRA interviewed biodigester developers, operators, contractors and consultants to identify issues and obstacles regarding the feasibility of biodigester development in the State.

DRA found that the biodigester industry in Washington State is rapidly changing as new sources of feedstocks and new revenue sources from biodigester by-products are tested and developed. In addition, funding sources that assisted development of the first six operating dairy-based biodigesters in the State are in flux.

Under State law, certain anaerobic biodigesters are allowed to operate without a solid waste permit, provided operators meet certain conditions. Anaerobic biodigesters located on or near dairies that co-digest organic wastes with manure may qualify for this permit exemption if other conditions are met. In order to qualify for the exemption, the digester must use at least 51 percent livestock manure and may include up to 30 percent pre-consumer organic waste. On-farm wastes may comprise the other 20 percent. Other conditions must also be met.

DRA modeled the financial feasibility of two prototypical dairy biodigester projects, with 2,000 and 750 cows, respectively, assuming the biodigester owner sells the electricity it produces to the local utility provider.

DRA modeled the supportable first mortgage debt based on the projected net operating income from the biodigester prototype assuming a 1.5 debt coverage ratio, a maximum loan-to-value ratio of 80%, and an interest rate of 8.0%, with a 20-year amortization period, based on input from the biodigester interviews. We also modeled a second alternative assuming tax-exempt bond financing at a 5.0% interest rate.

We then calculated the amount of equity that may be raised assuming a required internal rate of return (IRR) for the equity investment of 20 percent. DRA also modeled a second alternative assuming an IRR of 15 percent.

The difference between the total development cost of the prototype and the combined total of debt and equity equals the funding shortfall that would need to be filled by subsidized gap financing sources.

All six of the currently operating biodigesters in Washington State received government financial assistance, such as federal stimulus funds, the 30% Treasury grant in lieu of an investment tax credits, and USDA Rural Energy for America (REAP) grants to close the gap between the amount of serviceable debt and total development costs. However, given the demise of these funding sources, DRA analyzed financial feasibility of digester development without gap financing to determine if, and under what conditions, biodigester development is financially feasible without subsidy. The assumptions used in DRA's financial analysis are described below.

EXISTING OPERATING DIGESTERS IN WASHINGTON STATE

DRA gathered information in June 2011 on the six dairy-related anaerobic biodigesters currently operating in Washington State.¹ Characteristics of these biodigesters are described in Table 1 and summarized as follows:

- Three of the biodigesters are located in Whatcom County, with one each in Skagit, Snohomish and Yakima counties.
- Two of the biodigester projects are owned by Farm Power Northwest, three are owned by the dairies on which they are located, and one is owned by a nonprofit corporation involving representation from local dairy owners, the Tulalip Tribe, and a salmon recovery organization.
- Five of the biodigesters were designed by GHD/Andgar; the sixth biodigester was designed by DariTech.
- Production capacity of the biodigesters ranges from 400 kW to 1.2 MW.
- The number of cows feeding the biodigesters ranges from 1,000 to 5,300.

FINANCIAL ANALYSIS ASSUMPTIONS

Electricity Prices and Generation

In Washington, the three investor-owned utilities (IOUs) – Pacific Power, Avista Corporation, and Puget Sound Energy – are required to set and publish tariffs for their purchase of renewable energy at its avoided cost. Avista and Pacific Power's avoided cost rates apply to qualified renewable energy projects that are 1 MW of rated capacity or less. Puget Sound Energy's rates apply to qualified projects that are up to 2 MW. For contracts executed in 2010, Puget Sound Energy paid \$0.08467 per kWh for power produced in 2010 and increases the purchase price throughout the term of the contract until it reaches \$0.10838 in 2020.

¹ Does not include all biodigester operations in Washington. Wastewater treatment plants and industrial facilities also use biodigester technology.

Table 1: Currently operating agricultural/dairy anaerobic biodigesters, Washington State, July 2011

Digester Name	FPE Renewables	George DeRuyter & Sons	Qualco Energy	Farm Power Rexville	Farm Power Lynden	Van Dyk-S Holsteins
Town	Lynden	Outlook	Monroe	Rexville	Lynden	Lynden
County	Whatcom	Yakima	Snohomish	Skagit	Whatcom	Whatcom
Start of operation	Nov. 2004	Nov. 2006	Dec. 2008	Aug. 2009	Nov. 2010	Jun. 2011
Number of Cows Feeding Digester	1,100 (2 dairies)	5,300 (2 dairies)	1,100 (1 dairy)	1,200 (2 dairies)	2,000 (1 dairy)	1,000 (1 dairy)
Digester Designer	GHD/Andgar	GHD/Andgar	GHD/Andgar	GHD/Andgar	GHD/Andgar	DariTech
Digester Type	Hybrid plug flow-complete mix	Hybrid plug flow-complete mix	Hybrid plug flow-complete mix	Hybrid plug flow-complete mix	Hybrid plug flow-complete mix	Complete mix
Additional solids treatment	None	Addition of bacteria	Two DariTech composters	None	None	DariTech composter
Rated production capacity	600 kW	1200 kW	450 kW	750 kW	750 kW	400 kW
Utility purchasing electricity (PSE)	Puget Sound Energy (PSE)	Pacific Power	Snohomish PUD wheels to PSE	Puget Sound Energy	Puget Sound Energy	Puget Sound Energy
Products sold/used from digester	Electricity Solids (bedding) Tipping fees Carbon credits	Electricity Solids (peat moss replace.) Tipping fees Carbon credits	Electricity Tipping fees Carbon credits	Electricity Solids (bedding) Tipping fees Carbon credits	Electricity Solids (bedding) Tipping fees Carbon credits Heat	Electricity Solids (bedding) Tipping fees Maybe carbon credits

Avista's avoided cost for a project beginning operation in 2010 was \$0.06276 per kWh for a one-year contract. The rate increases with the length of the PPA signed with the renewable energy producer until it reaches \$0.06454 per kWh for a 5-year contract. Pacific Power's avoided cost rate is \$0.06133 per kWh plus \$1.46 per kW per month for power delivered in 2010.

The three IOUs' avoided cost tariff schedules show annual increases in the tariffs. The average annual increase for the three schedules is 2.1 percent. We have used this figure as the annual electricity purchase price inflation factor.

DRA estimates electricity output from manure alone at 0.25 kW per cow. Adding 10% food waste is estimated to increase electrical production by 25%. Adding 20% food waste is estimated to increase electrical production by 50% compared to manure alone. A dairy that uses a flush disposal process for manure is estimated to produce 20% less electricity.

Estimations for biogas production were as follows. For scrape dairy manure, 0.25 kW/WCE where WCE refers to a Wet Cow Equivalent, or the manure production from a mature lactating Holstein. Production for flush dairy operations was slightly reduced to 0.20 kW/WCE as present systems require various forms of manure concentration for suitable energy balance, with concentration causing a corresponding loss of some of the energy value in the manure. Co-digestion is a more difficult scenario to obtain a suitable rule of thumb. Braun et al (2003) and Kumke et al (2000) in their review of European dairy manure digesters have stated that biogas production can be elevated by a range of 20-400% depending upon degree and type of supplementation with outside organics. Frear et al (2011), during a long-term analysis of a Washington State dairy biodigester, have shown that a 20% pre-consumer food processing wastes with dairy manure resulted in approximately a 100% increase in biogas production as compared to a manure-alone control. Historical review of European co-digestion practices and economics as well as early findings in localized environments with Washington State have shown that availability, distribution forms and received prices can be strongly affected over time with development of a mature industry with increased biodigester concentration. In particular, many digesters in Europe have turned to digestion of less energy-intensive supplementary organics such as field grasses, grains and residues and away from high-energy food processing waste, fats and greases. This lowers their biogas increase to the lower end of that stated by Braun et al (2003) and Kumke et al (2000).

In anticipation of industry changes for future farm-based biodigester projects and with an eye on conservative evaluation, a generalized rule of thumb for co-digestion with dairy manure has been used in this study. That rule is for 10% volumetric supplementation, an increase in biogas production of 25% and for 20% supplementation, an increase of 50%. While these numbers are half of that shown in the case study of Frear et al (2011), we believe it is a fair but conservative value reflecting future organic waste distribution and form.

Renewable Energy Credits

Renewable energy credits (RECs) are purchased from renewable energy producers at a set rate per kWh of electricity produced. The REC purchase price is set in a contract negotiated and executed annually between the buyer and seller of the REC. The Bonneville Environmental Foundation estimates that a renewable energy system that begins operations in 2012 can sell its RECs at a rate of \$0.012 per kWh in the project's first year in service, increasing by \$0.001 per kWh per year until it reaches a negotiated, pre-determined cap.

State law (RCW 19.285.040) allows RECs purchased from distributed generation facilities to count at double the facilities' output for the utility company purchasing the RECs. Anaerobic biodigesters with a rated capacity of 5 MW or less qualify as distributed generation facilities under this section. Therefore, one would expect that anaerobic biodigester owners should be able to sell the RECs associated with their facilities at double the market REC price.

The biodigester operators we interviewed sell their RECs along with their produced electricity to the local utility provider. They report receiving rates in the \$0.01 per kWh range for their RECs.

DRA initially assumes that the biodigester prototype sells RECs at a rate of \$0.01 per kWh in its first year of operation, increasing by \$0.001 annually. We analyze the sensitivity of the financial feasibility of the prototype to doubling the REC price.

Fiber Sales/Avoided Costs

Substantial research has and is occurring in Washington State regarding the potential use of fiber produced as a by-product to a biodigester operation. Currently, most of the existing dairies that own or contribute manure to biodigesters use the fiber as bedding for their dairy cows, or sell it as bedding to neighboring farmers. We calculate the avoided bedding cost to the farmer at 10 cubic yards per cow per year, with 50% of the fiber used as bedding at an avoided cost of \$9.00 per cubic yard.

Fertilizer Sales/Avoided Costs

Research is also being done on nutrient extraction from biodigester effluent, which may be sold as fertilizer in liquid or pelleted form. Currently, most dairies that own or contribute manure to biodigesters use the liquid effluent on their own fields. Since the use of fertilizer by-products from the biodigester may just replace the use of manure itself, the benefit is difficult to quantify. We have not assumed any sales revenue or avoided cost from fertilizer in our financial modeling.

Tipping Fees

The feasibility of the prototype is analyzed with and without tipping fees. Tipping fee revenue, when included, is estimated at \$12 per ton of food waste used in the biodigester each year.

Carbon Credits

The carbon credit market is in flux and has yet to be stabilized. Our baseline financial analysis assumes no revenue from carbon credits, while our sensitivity analysis examines the effect of carbon credit sales assuming 3.5 tons of carbon credits per cow, and a carbon credit price per ton of \$8.00.

Operating Costs

Operating costs are estimated at \$0.028 per kWh based on our research and interviews. This includes maintenance on equipment in the engine room at \$.007 per kWh, maintenance on the separator at \$0.007 per kWh, and long-term maintenance agreement for major problems at \$0.008 per kWh, and sinking fund at \$0.006 per kWh. It also includes daily monitoring costs and insurance costs estimated at \$20,000 per year.

Escalation Rates

As noted above, electricity rates are escalated at 2.10 percent annually. Other revenues (from fiber, tipping fees and carbon credits) are escalated at 2% annually. Operating costs are escalated at 4% annually.

RESULTS

The findings of the financial sensitivity analysis are summarized in Table 2, for the 2,000 cow biodigester, assuming an internal rate of return on equity of 20%, and Table 3 assuming a 15% IRR on equity. The table shows whether each scenario is feasible without additional gap financing. The findings are summarized as follows:

- With tipping fees, the prototype is feasible at the Puget Sound Energy electricity purchase rate assuming 10% waste feedstock and a 20% IRR on equity.
- At the Pacific Power electricity rate, the prototype is feasible with 10% waste feedstock, tipping fees, carbon credits, and a lower interest rate.
- The prototype is close to being feasible with 20% waste feedstock without tipping fees at the lower Pacific Power electricity rate.

Table 2: Financial Sensitivity Analysis Scenarios, 2000 Cow Dairy Anaerobic Biodigester, 20% Return on Equity

Scenario	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
% Food Waste	10%	10%	10%	10%	10%
Tippling Fees?	No	Yes	No	Yes	Yes
Dairy Manure Disposal System	Scrape Dairy	Scrape Dairy	Scrape Dairy	Scrape Dairy	Scrape Dairy
Electricity Purchaser	Puget Sound	Puget Sound	Pacific Power	Pacific Power	Pacific Power
Other					Carbon Credits
Equity	\$900,000	\$953,101	\$700,000	\$850,000	\$1,000,000
Loan Financing	\$2,613,759	\$3,046,899	\$1,926,055	\$2,359,196	\$2,731,143
Gap Financing Required	\$486,241	\$0	\$1,373,945	\$790,804	\$268,857
Total Sources/Uses:	\$4,000,000	\$4,000,000	\$4,000,000	\$4,000,000	\$4,000,000
Annual Loan Interest Rate	8.00%	8.00%	8.00%	8.00%	8.00%
Amortization Period (Years)	20	20	20	20	20
Required Debt Coverage Ratio (DCR)	1.50	1.50	1.50	1.50	1.50
Max. Loan to Value Ratio (LTV)	80%	80%	80%	80%	80%
Max. Ann. Debt Service Based on DCR	\$262,350	\$305,826	\$193,324	\$236,799	\$274,132
Debt Serv. Based on Min. of DCR/LTV	\$262,350	\$305,826	\$193,324	\$236,799	\$274,132
Min. Required Return on Equity (IRR)	20%	20%	20%	20%	20%
Projected Return on Equity (IRR)	20%	22%	20%	20%	20%

Table 2 (Continued): Financial Sensitivity Analysis Scenarios, 2000 Cow Dairy Anaerobic Biodigester, 20% Return on Equity

Scenario:	<u>Scenario 6</u>	<u>Scenario 7</u>	<u>Scenario 8</u>	<u>Scenario 9</u>
% Food Waste	10%	20%	0%	10%
Tipping Fees?	Yes	No	No	Yes
Dairy Manure Disposal System	Scrape Dairy Pacific Power	Scrape Dairy Pacific Power	Scrape Dairy Pacific Power	Scrape Dairy Pacific Power
Electricity Purchaser				
Other	Double REC Price	Carbon Credits	Carbon Credits	Carbon Credits
Equity	\$900,000	\$1,000,000	\$650,000	\$800,000
Loan Financing	\$2,660,294	\$2,752,199	\$2,336,872	\$3,200,000
Gap Financing Required	\$439,706	\$247,801	\$1,013,128	\$0
Total Sources/Uses:	\$4,000,000	\$4,000,000	\$4,000,000	\$4,000,000
Annual Loan Interest Rate	8.00%	8.00%	5.00%	5.00%
Amortization Period (Years)	20	20	20	20
Required Debt Coverage Ratio (DCR)	1.50	1.50	1.50	1.50
Max. Loan to Value Ratio (LTV)	80%	80%	80%	80%
Max. Ann. Debt Service Based on DCR	\$267,021	\$276,246	\$185,068	\$307,377
Debt Serv. Based on Min. of DCR/LTV	\$267,021	\$276,246	\$185,068	\$253,423
Min. Required Return on Equity (IRR)	20%	20%	20%	20%
Projected Return on Equity (IRR)	20%	20%	20%	31%

Table 2 (Continued): Financial Sensitivity Analysis Scenarios, 2000 Cow Dairy Anaerobic Biodigester, 20% Return on Equity

Scenario:	Scenario 10	Scenario 11	Scenario 12	Scenario 13
% Food Waste	10%	10%	10%	10%
Tipping Fees?	No	No	No	No
Dairy Manure Disposal System	Scrape Dairy	Scrape Dairy	Scrape Dairy	Flush Dairy
Electricity Purchaser	Puget Sound	Puget Sound	Pacific Power	Puget Sound
Other	Carbon Credits	PTC	PTC	PTC
	Lower Int. Rate	Lower Int. Rate	Lower Int. Rate	Lower Int. Rate
Equity	\$800,000	\$800,000	\$750,000	\$625,000
Loan Financing	\$3,200,000	\$3,200,000	\$3,200,000	\$2,981,892
Gap Financing Required	\$0	\$0	\$50,000	\$1,193,108
Total Sources/Uses:	<u>\$4,000,000</u>	<u>\$4,000,000</u>	<u>\$4,000,000</u>	<u>\$4,800,000</u>
Annual Loan Interest Rate	5.00%	5.00%	5.00%	5.00%
Amortization Period (Years)	20	20	20	20
Required Debt Coverage Ratio (DCR)	1.50	1.50	1.50	1.50
Max. Loan to Value Ratio (LTV)	80%	80%	80%	80%
Max. Ann. Debt Service Based on DCR	\$299,684	\$295,594	\$307,377	\$236,150
Debt Serv. Based on Min. of DCR/LTV	\$253,423	\$253,423	\$253,423	\$236,150
Min. Required Return on Equity (IRR)	20%	20%	20%	20%
Projected Return on Equity (IRR)	34%	29%	32%	20%

Table 3: Financial Sensitivity Analysis Scenarios, 2000 Cow Dairy Anaerobic Biodigester, 15% Return on Equity

Scenario	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
% Food Waste	10%	10%	10%	10%	10%
Tipping Fees?	No	Yes	No	Yes	Yes
Dairy Manure Disposal System	Scrape Dairy Puget Sound	Scrape Dairy Puget Sound	Scrape Dairy Pacific Power	Scrape Dairy Pacific Power	Scrape Dairy Pacific Power
Electricity Purchaser					
Other					Carbon Credits
Equity	\$1,300,000	\$953,101	\$950,000	\$1,100,000	\$1,268,857
Loan Financing	\$2,613,759	\$3,046,899	\$1,926,055	\$2,359,196	\$2,731,143
Gap Financing Required	\$86,241	\$0	\$1,123,945	\$540,804	\$0
Total Sources:	\$4,000,000	\$4,000,000	\$4,000,000	\$4,000,000	\$4,000,000
Financing Assumptions					
Annual Loan Interest Rate	8.00%	8.00%	8.00%	8.00%	8.00%
Amortization Period (Years)	20	20	20	20	20
Required Debt Coverage Ratio	1.50	1.50	1.50	1.50	1.50
Maximum Loan to Value Ratio	80%	80%	80%	80%	80%
Max. Ann. Debt Service Based on DCR	\$262,350	\$305,826	\$193,324	\$236,799	\$274,132
Debt Service Based on Min. of DCR/LTV	\$262,350	\$305,826	\$193,324	\$236,799	\$274,132
Min. Required Return on Equity (IRR)	15%	15%	15%	15%	15%
Projected Return on Equity (IRR)	15%	22%	15%	15%	16%

Table 3 (Continued): Financial Sensitivity Analysis Scenarios, 2000 Cow Dairy Anaerobic Biodigester, 15% Return on Equity

Scenario	Scenario 6	Scenario 7	Scenario 8	Scenario 9
% Food Waste	10%	20%	0%	10%
Tipping Fees?	Yes	No	No	Yes
Dairy Manure Disposal System	Scrape Dairy	Scrape Dairy	Scrape Dairy	Scrape Dairy
Electricity Purchaser	Pacific Power	Pacific Power	Pacific Power	Pacific Power
Other	Double REC Price	Carbon Credits	Carbon Credits	Carbon Credits
USDA Value Added Producer Grant (4)	\$0	\$0	\$0	\$0
Equity	\$1,250,000	\$1,247,801	\$900,000	\$800,000
Loan Financing	\$2,660,294	\$2,752,199	\$2,336,872	\$3,200,000
Gap Financing Required	\$89,706	\$0	\$763,128	\$0
Total Sources:	\$4,000,000	\$4,000,000	\$4,000,000	\$4,000,000
Financing Assumptions				
Annual Loan Interest Rate	8.00%	8.00%	5.00%	5.00%
Amortization Period (Years)	20	20	20	20
Required Debt Coverage Ratio	1.50	1.50	1.50	1.50
Maximum Loan to Value Ratio	80%	80%	80%	80%
Max. Ann. Debt Service Based on DCR	\$267,021	\$276,246	\$185,068	\$274,132
Debt Service Based on Min. of DCR/LTV	\$267,021	\$276,246	\$185,068	\$253,423
Min. Required Return on Equity (IRR)	15%	15%	15%	15%
Projected Return on Equity (IRR)	15%	17%	15%	30%

Table 3 (Continued): Financial Sensitivity Analysis Scenarios, 2000 Cow Dairy Anaerobic Biodigester, 15% Return on Equity

Scenario	Scenario 10	Scenario 11	Scenario 12	Scenario 13
% Food Waste	10%	10%	10%	10%
Tipping Fees?	No	No	No	No
Dairy Manure Disposal System	Scrape Dairy	Scrape Dairy	Scrape Dairy	Flush Dairy
Electricity Purchaser	Puget Sound	Puget Sound	Pacific Power	Puget Sound
Other	Carbon Credits	PTC	PTC	PTC
	Lower Int. Rate	Lower Int. Rate	Lower Int. Rate	Lower Int. Rate
USDA Value Added Producer Grant (4)	\$0	\$0	\$0	\$0
Equity	\$800,000	\$800,000	\$800,000	\$850,000
Loan Financing	\$3,200,000	\$3,200,000	\$3,200,000	\$2,981,892
Gap Financing Required	\$0	\$0	\$0	\$968,108
Total Sources:	\$4,000,000	\$4,000,000	\$4,000,000	\$4,800,000
Financing Assumptions				
Annual Loan Interest Rate	5.00%	5.00%	5.00%	5.00%
Amortization Period (Years)	20	20	20	20
Required Debt Coverage Ratio	1.50	1.50	1.50	1.50
Maximum Loan to Value Ratio	80%	80%	80%	80%
Max. Ann. Debt Service Based on DCR	\$299,684	\$295,594	\$307,377	\$236,150
Debt Service Based on Min. of DCR/LTV	\$253,423	\$253,423	\$253,423	\$236,150
Min. Required Return on Equity (IRR)	15%	15%	15%	15%
Projected Return on Equity (IRR)	34%	29%	30%	15%

- Reducing the interest rate to 5% eliminates the need for gap financing for most of the scenarios modeled, except for the Pacific Power electricity rate and 0% waste feedstock.
- Modeling a flush dairy, as opposed to a scrape dairy, with its assumed higher development costs and lower electricity production, generates a gap even at the Puget Sound Energy power rate, a production tax credit and the lower interest rate.
- Reducing the required IRR on equity to 15% makes almost all of the scenarios modeled feasible.

Table 4 shows the results for the 750-cow biodigester, assuming an internal rate of return on equity of 20%. All of the scenarios generate a gap at both a 20% internal rate of return and a 15% internal rate of return.

REFERENCES

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- Kumke, G.W. and G. Langhans. 2000. Plant scale co-fermentation of farm manure and industrial organic wastes. *Annu. Residuals Biosolids Manage. Conf.*, 14th: 657.
- Frear, C., T. Ewing, and S. Chen. 2011. Evaluation of co-digestion at a commercial dairy anaerobic digester. *Clean: Soil, Air, Water.*

Table 4: Financial Sensitivity Analysis Scenarios, 750-Cow Dairy Anaerobic Biodigester, 20% Return on Equity

Scenario	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
% Food Waste	10%	10%	10%	10%	10%
Tipping Fees?	No	Yes	No	Yes	Yes
Dairy Manure Disposal System	Scrape Dairy	Scrape Dairy	Scrape Dairy	Scrape Dairy	Scrape Dairy
Electricity Purchaser	Puget Sound	Puget Sound	Pacific Power	Pacific Power	Pacific Power
Other					Carbon Credits
Equity	\$320,000	\$360,000	\$225,000	\$275,000	\$330,000
Loan Financing	\$917,892	\$1,080,319	\$660,003	\$822,431	\$961,911
Gap Financing Required	\$1,762,108	\$1,559,681	\$2,114,997	\$1,902,569	\$1,708,089
Total Sources/Uses	\$3,000,000	\$3,000,000	\$3,000,000	\$3,000,000	\$3,000,000
Annual Loan Interest Rate	8.00%	8.00%	8.00%	8.00%	8.00%
Amortization Period (Years)	20	20	20	20	20
Required Debt Coverage Ratio	1.50	1.50	1.50	1.50	1.50
Maximum Loan to Value Ratio	80%	80%	80%	80%	80%
Max. Ann. Debt Service Based on DCR	\$92,131	\$108,435	\$66,246	\$82,550	\$96,550
Debt Service Based on Min. of DCR/LTV	\$92,131	\$108,435	\$66,246	\$82,550	\$96,550
Min. Required Return on Equity (IRR)	20%	20%	20%	20%	20%
Projected Return on Equity (IRR)	20%	20%	20%	20%	20%

Table 4: Financial Sensitivity Analysis Scenarios, 750-Cow Dairy Anaerobic Biodigester, 20% Return on Equity

Scenario	Scenario 6	Scenario 7	Scenario 8	Scenario 9
% Food Waste	10%	20%	0%	10%
Tipping Fees?	Yes	No	No	Yes
Dairy Manure Disposal System	Scrape Dairy	Scrape Dairy	Scrape Dairy	Scrape Dairy
Electricity Purchaser	Pacific Power	Pacific Power	Pacific Power	Pacific Power
Other	Double REC Price	Carbon Credits	Carbon Credits	Carbon Credits
Equity	\$315,000	\$350,000	\$220,000	\$375,000
Loan Financing	\$935,342	\$969,807	\$797,408	\$1,376,560
Gap Financing Required	\$1,749,658	\$1,680,193	\$1,982,592	\$1,248,440
Total Sources/Uses	\$3,000,000	\$3,000,000	\$3,000,000	\$3,000,000
Annual Loan Interest Rate	8.00%	8.00%	5.00%	5.00%
Amortization Period (Years)	20	20	20	20
Required Debt Coverage Ratio	1.50	1.50	1.50	1.50
Maximum Loan to Value Ratio	80%	80%	80%	80%
Max. Ann. Debt Service Based on DCR	\$93,883	\$97,342	\$63,150	\$109,016
Debt Service Based on Min. of DCR/LTV	\$93,883	\$97,342	\$63,150	\$109,016
Min. Required Return on Equity (IRR)	20%	20%	20%	20%
Projected Return on Equity (IRR)	20%	20%	20%	20%

Table 4: Financial Sensitivity Analysis Scenarios, 750-Cow Dairy Anaerobic Biodigester, 20% Return on Equity

Scenario	Scenario 10	Scenario 11	Scenario 12	Scenario 13
% Food Waste	10%	10%	10%	10%
Tipping Fees?	No	No	No	No
Dairy Manure Disposal System	Scrape Dairy	Scrape Dairy	Scrape Dairy	Flush Dairy
Electricity Purchaser	Puget Sound	Puget Sound	Pacific Power	Puget Sound
Other	Carbon Credits	PTC	PTC	PTC
	Lower Int. Rate	Lower Int. Rate	Lower Int. Rate	Lower Int. Rate
Equity	\$435,000	\$325,000	\$250,000	\$250,000
Loan Financing	\$1,340,132	\$1,320,770	\$993,917	\$1,035,081
Gap Financing Required	\$1,224,868	\$1,354,230	\$1,756,083	\$2,314,919
Total Sources/Uses	<u>\$3,000,000</u>	<u>\$3,000,000</u>	<u>\$3,000,000</u>	<u>\$3,600,000</u>
Annual Loan Interest Rate	5.00%	5.00%	5.00%	5.00%
Amortization Period (Years)	20	20	20	20
Required Debt Coverage Ratio	1.50	1.50	1.50	1.50
Maximum Loan to Value Ratio	80%	80%	80%	80%
Max. Ann. Debt Service Based on DCR	\$106,131	\$104,598	\$78,713	\$81,973
Debt Service Based on Min. of DCR/LTV	\$106,131	\$104,598	\$78,713	\$81,973
Min. Required Return on Equity (IRR)	20%	20%	20%	20%
Projected Return on Equity (IRR)	20%	20%	20%	20%