FEASIBILITY STUDIES: WHY AND WHAT SHOULD THEY ENTAIL?

P. Ries
Asset Resource Management LLC

I have been asked to present a paper addressing feasibility studies, as they relate to consideration of a digester project for large dairies.

I am hoping to answer the following questions, so that you, as a dairy producer, can properly address whether or not a digester project fits within your overall business model, that is, successfully managing and operating a large scale dairy operation. As I said, the questions I hope to answer for you are as follows:

1. What is a feasibility study?
2. Why is a feasibility study important?
3. What should be included?
4. Who should do a feasibility study?
5. How much should they cost?

1. What is a feasibility study?

A feasibility study is an analysis and evaluation of a proposed project to determine if it is

a. technically feasible;
b. is feasible within the estimated cost; and
c. will be profitable.

I am focusing my presentation on feasibility studies of digester projects, because that is why I've been asked to make this presentation. However, one should be able to use these same concepts when considering any opportunity your farm might consider, especially where large sums of money are at stake.

With respect to digester projects, the technical concepts of collecting the cow manure, pumping it into a digester, producing methane gas, and using this methane gas to power turbines, which in turn produce electricity, is a proven technology, and no further evaluation of the technical feasibility of this concept is necessary. However, there are always some twists that a producer might want to consider, especially if the amount of electricity a project can generate cannot all be used on the farm, or if there is no capacity in the local electric grid to accept the power being generated from the project.

Another alternative one might want to consider is to convert the methane to a usable fuel for truck fleets, or for powering the equipment on the farm. This too requires an understanding of the power unit conversion costs, storage, distribution, and other local considerations.

Other issues that are addressed include will the farm own and operate the “digester project”; or will it be owned and operated by a developer? This may seem like a pretty simple question to answer, but you will find that as vendors propose their systems to you, the promise of making a 15% return on your investment is pretty hard to turn down.

That is why you, as the individual farmer, should conduct a feasibility study.

Do you have the capital to devote to a digester project?
Do you have the time to develop a digester project?
Do you have the manpower resources to own and operate a digester project?

And probably many other questions requiring answers before you pursue this type of project.

2. Why is a feasibility study important?

It is my understanding that these types of projects typically involve a milking herd size of 1,000 cows, or more. Frequently, the farmer will indicate that they intend to grow their dairy herd over the lifetime of a digester project. Let’s assume that they say they will increase the number of cows they are milking, from 1,000 head, to 1,300 head over the next five years. That is a 30% increase in your business over a 5 year period. Even if you break this down to an annual growth rate, a 6% increase in your business would be considered pretty aggressive in any business environment. If you are going to use your capital reserves to develop the digester project, where will the money come from to increase the capacity of your milking parlor, free stall barns, calf care, raising out replacement heifers, additional land required for feed and manure application, labor, and additional or bigger equipment? What impact will these capital requirements have on your profit/loss and balance sheets? Do you have a lending institution that is willing to partner with you on a project of this scale?

The questions asked in the previous paragraph show why a feasibility study is important. It forces you to look at the “big picture”. While addressing the issues above should not scare you away from considering an energy project, it will have you consider where your farm business has been and where it will be 5, 10 or 15 years from now. By answering the questions posed, you might find that you have to adjust your accounting methods of your farm operation, to make them conform to normal business practices and what banks or investors are looking for when considering financing a business expansion.

3. What should be included?

I find that developing a narrative about the farm and its’ operation is very useful. By actually writing this down, this allows the farmer to see how the farm operation has developed over the past 5, 10, or even 25 years. This narrative should include how the farm started. Usually this is a family operation. It is important to document the origins of the farm, who started it, how long ago, original size, both in acreage and numbers of livestock.

Getting into the current operations, the qualifications of the family members and/or key employees should be discussed. Backgrounds in farming, education, and other attributes of the “key” members should be presented.

Another element of what should be included is a presentation of past financial performance. This will include three to five years of profit/loss statements and balance sheets. Not only will this be some of the first questions asked by the bank/investor, it should also help you in deciding if you are ready to take the next step into the growth of your business.

While you think that this might not be necessary, you will find that when you approach your lending institution and/or an investment group, these will be some of the first questions they will ask. By having this done beforehand, you will accelerate the financial borrowing/investment process and you will impress the bank/investors on your organization skills. This will be one aspect in demonstrating that you are ready to take on more growth in your business.

The next part of your business plan (like it or not, this is actually what you are doing) you will describe the expansion you are considering. For purposes of this presentation, we are talking about a digester project, producing energy from manure. Before you identify the requirements of your energy project, you need to address the items I have previously identified. Besides the energy project, what components of your existing operation are going to have to change to accommodate this project? Will you need to increase:

- i. The capacity of your milking parlor?
- ii. The capacity of your free stall barns?
- iii. Calf care?
- iv. The capacity to raise out replacement heifers?
- v. Additional land required for feed and manure application?
- vi. Labor? and
- vii. Additional or bigger equipment?

The capital requirements to address these items will probably not come from your cash flow. If it can, you probably don’t need to consider an energy project. Once you make it past these considerations, and decide that you have the financial ability to address this growth, you are now ready to study the feasibility of your energy project.

Are you going to own and operate the energy project or will you have a vendor own and operate the energy project? Your background is raising and milking cows, planting and harvesting crops, and probably some minor maintenance on your power units. Operating large capacity pumps, managing the proper environment for your biologic microorganisms, measuring feedstocks, methane production, operating turbines to produce electricity, and making sure this biologic reactor produces energy 24/7 is probably not something you thought you would be doing next year. Of course, there are individuals who can perform these functions, and are ready to move their family to your remote location to work for you.

Vendors will come and begin to study your dairy operation. They will evaluate all of the components that will be the waste stream to be considered for the energy project. They will know how much wash water is used, what your bedding is comprised of, and how the manure is moved from the barns to a point where it can be directed into a digester.

The first thing they will tell you that your project will have an internal rate of return of over 20% and that you will have a project payback of 4 to 6 years. Who wouldn't jump at this opportunity?

Then you start reviewing their spreadsheets. You know that you have 1,000 milking cows, and you plan on expanding to 1,300 within the next 5 years. You see that in the pro formas presented by the vendors, they have assumed 1,500 milking cows and 1,000 heifers contributing to the energy project, from day one. If this isn't your operation, you cannot count on the rate of return or the projected payback.

You will be approached by many vendors who want to develop your energy project. Typically, they will want to perform a feasibility study on your operation to determine if the proposed energy project will successful. I was retained by a local dairy to assist them in the evaluation of the feasibility studies provided by the vendors, perform detailed evaluations of the pro forma's from the vendors, evaluate the impact to cash flow to the dairy, and assist in evaluating financing options.

Due to confidentiality claims made by the vendors for my project, I cannot provide copies of their feasibility studies on which I made comments. However, I will provide excerpts from their feasibility studies on which some of my comments were based.

For example, the vendor provided an estimated cost to construct the energy project. Table 1 presents their construction estimate. This is the exact table the vendor provided for their cost estimate. My comments are shown in red. You will see this same presentation in Table 2 and 3 as well.

You can see that I felt more detail was needed in evaluating this vendor's proposal.

The vendor then showed the inputs they used in developing the financial model for their proposal. Table 2 presents those inputs and my comments.

Table 1. Construction Estimate

	Capital Cost
General Conditions	64,000
Digester	898,350
Site Piping	455,500
Mechanical Building	219,100
Generator	330,000
Solids Handling	82,500
Flare	30,000
Freight and Installation	410,000
Engineering and Construction Management	149,367
GC Fee	248,945
Contingency	124,473
Total Construction Estimate	3,012,235

Need more detail

Table 2. Inputs

The economic evaluation is based on the following inputs. The kWh are based on the existing dairy loads and the expected additional load of the digestion plant. Sale to the grid is limited to 200 kW and the sale amount is based on 200 kW sold over 8500 hours per year.

Cash Flow Distribution

Dairy	100%					
Total	100%					
Type of facility	Dairy					
# of animals	1,350	Mix				
Gas produced	88,877	cf/day				
kW equivalent	300	kW				
kWh produced	2295000	annual kWh				
kWh Dairy	477960					
Kwh AD	488808	annual kWh				
kWh for export	1806192	annual kWh				
Project capital cost	$3,012,235		330,000	Generator Cost		
9006 Grant amount	0	0%				
State Grant	$ 500,000					
Total capex	$2,512,235					
% equity	10%					
Equity required	251,223					
Debt required	2,261,011	75% of Project Cost				
Interest rate	8%					
Financing period	15					
Revenue Potential						
Electric Onsite	$ 0.092	$/kWh	477,960	annual kWh		
Electric Market	$ 0.093	$/kWh	1,700,000	annual kWh		
Federal incentives	$ -	$/kWh	1,806,192	annual kWh		
Gas sales	$ 6.00	$/MMBTU		annual MMBTU		
GHG credits	$ 3.85	$/ton	6,075	annual tons		
Thermal savings	$ 15.00	$/MMBTU	2,700	annual MMBTU		
Bedding savings	$ 14.50	$/cy	6750	annual cy	11,871	9 cy/milker
Fiber sales	$ 8.50	$/cy	5,121	annual tons		
Processing fee	$ -	$/gallon		annual gallons		
Inflation factor	2%					
Depreciation Term	10					

The vendor then presented a financial analysis, which showed the project would generate sufficient revenues to cover operating costs, pay the debt service on the loan and generate profits for the operation. Table 3 presents the financial analysis.

Table 3. Financial Analysis

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8
Electric Onsite	43,972	44,852	45,749	46,664	47,597	48,549	49,520	50,510
Electric Market	158,100	161,262	164,487	167,777	171,133	174,555	178,046	181,607
Federal incentives	0	0	0	0	0	0	0	0
Gas sales	0	0	0	0	0	0	0	0
GHG credits	23,380	23,857	24,334	24,820	25,317	25,823	26,340	26,866
Thermal savings	40,500	41,310	42,136	42,979	43,839	44,715	45,610	46,522
Bedding savings	97,875	99,833	101,829	103,866	105,943	108,062	110,223	112,428
Fiber sales	43,526	44,397	45,284	46,190	47,114	48,056	49,017	49,998
ITC	682,682	0	0	0	0	0	0	0
TOTAL INCOME	1,070,054	415,509	423,820	432,296	440,942	449,761	458,756	467,931
O&M digester	67,056	68,397	69,765	71,160	72,583	74,036	75,516	77,026
O&M Generator	34,425	35,114	35,816	36,532	37,263	38,008	38,768	39,544
O&M gas clean-up	0	0	0	0	0	0	0	0
Labor	27,000	27,540	28,091	28,653	29,226	29,810	30,406	31,015
Interest	180,881	174,219	167,024	159,254	150,862	141,799	132,011	121,439
Depreciation	301,223	301,223	301,223	301,223	301,223	301,223	301,223	301,223
Property taxes, ins	2,500	2,550	2,601	2,653	2,706	2,760	2,815	2,872
Monitoring Fee	0	0	0	0	0	0	0	0
TOTAL COGS	613,085	609,043	604,500	599,478	593,864	587,636	580,740	573,119
	456,968	-193,534	-180,701	-167,180	-152,922	-137,875	-121,984	-105,188
	456,968	-193,534	-180,701	-167,180	-152,922	-137,875	-121,984	-105,188
Depreciation	301,223	301,223	301,223	301,223	301,223	301,223	301,223	301,223
Cash Flow	758,190	107,690	120,522	134,044	148,302	163,348	179,239	196,036
Principal payment	83,272	89,934	97,128	104,899	113,291	122,354	132,142	142,714
	674,920	17,756	23,394	29,145	35,011	40,994	47,097	53,322
Invest (301,223)	674,920	17,756	23,394	29,145	35,011	40,994	47,097	53,322

	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15
Electric Onsite	51,521	52,551	53,602	54,674	55,768	56,883	58,021
Electric Market	185,239	188,944	192,722	196,577	200,509	204,519	208,610
Federal incentives	0	0	0	0	0	0	0
Gas sales	0	0	0	0	0	0	0
GHG credits	27,404	27,952	28,511	29,081	29,663	30,256	30,861
Thermal savings	47,452	48,401	49,369	50,357	51,364	52,391	53,439
Bedding savings	114,676	116,970	119,309	121,696	124,129	126,612	129,144
Fiber sales	50,998	52,018	53,058	54,119	55,202	56,306	57,432
ITC	0	0	0	0	0	0	0
TOTAL INCOME	477,290	486,835	496,572	506,504	516,634	526,966	537,506
O&M digester	78,567	80,138	81,741	83,376	85,043	86,744	88,479
O&M Generator	40,334	41,141	41,964	42,803	43,659	44,532	45,423
O&M gas clean-up	0	0	0	0	0	0	0
Labor	31,635	32,267	32,913	33,571	34,243	34,927	35,626
Interest	110,022	97,692	84,376	69,993	54,460	37,684	19,567
Depreciation	301,223	301,223	0	0	0	0	0
Property taxes, ins	2,929	2,988	3,047	3,108	3,171	3,234	3,299
Monitoring Fee	0	0	0	0	0	0	0
TOTAL COGS	564,711	555,449	244,040	232,851	220,576	207,122	192,393
	-87,421	-68,614	252,532	273,653	296,058	319,844	345,112
	-87,421	-68,614	252,532	273,653	296,058	319,844	345,112
Depreciation	301,223	301,223	0	0	0	0	0
Cash Flow	213,802	232,609	252,532	273,653	296,058	319,844	345,112
Principal payment	154,131	166,461	179,778	194,160	209,693	226,469	244,586
	59,672	66,148	72,754	79,493	86,365	93,375	100,526
Invest (301,223)	59,672	66,148	72,754	79,493	86,365	93,375	100,526

Table 4 presents my comments on one of the feasibility studies I reviewed for the local dairy. Some of my comments may seem rather insignificant, and I'm sure I didn't capture all of the issues that others may raise if it were to reviewed by others.

Table 4. Comments on Review of XXXX Feasibility Study, dated XXX, XX, 2010

1. Cannot read captions in the process flow diagram.
2. The "Financial Feasibility" section does not provide any details as to what is included in the various cost components. For example, new air permits will need to be prepared. There is no cost for the interconnect fee with Utility.
3. The cost analysis uses 1350 cows. This is not the starting point for the Dairy. The Dairy has 1100 cows, with a planned growth of 10% per year.
4. There is no reference on how the basis for electric generation was made. It all starts with manure production per animal, percent (%) solids in manure, conversion to total solids of the manure, percent volatile solids in manure on a dry basis, etc. Additional water flow to the system needs to be provided. Basically, a mass balance needs to be shown to support the calculations for electric generation and gas generation. In addition, assumptions for converting the methane gas to electricity needs to be shown. Without this information, the Dairy cannot evaluate the pro forma.

5. There is no basis for the $500,000 State Grant. Is this a flat grant amount, or is there a specific method in determining the amount of the grant?
6. This pro forma assumes the Dairy will provide $251,223 in capital for this project.
7. Financing period is shown over a 15 year period, while the depreciation is over a 10 year period.
8. Pro forma shows sales of electricity to the dairy operation as income. This will still be an expense to the Dairy.
9. Pro forma shows sales of electricity increasing at rate of 2% per year. Based on our meeting with the Utility, it was my understanding that the rate is fixed every two years. According to the Utility, the Utility has excess capacity, and the likelihood of these rates increasing for the next time interval are very slim.
10. Income from Greenhouse Gas credits should not be included. There is no basis for this income.
11. Thermal savings. I believe this is a “cost avoidance” on the dairy side of the operations. Again, there is no calculation provided demonstrating that there is excess thermal energy to be used by the dairy.
12. Bedding savings. I believe this is a “cost avoidance” on the dairy side of the operations. I’m assuming this is the cost of trucking only to bring bedding into the dairy at it’s current rate. This also is increasing at a rate of 2% per year. No justification is provided for these numbers.
13. Fiber sales. I am assuming this includes fiber sales to the dairy operation. No support for the amount of fiber produced, fiber used by the dairy, and therefore excess fiber available for off-farm sale is provided.

Comments on Electric Generation: Using Vendor’s pro forma, I was able to construct a spreadsheet that addressed assumptions necessary to determine the amount of energy produced from the digester project. Based on the 1100 head herd currently in use, and based on the current electric needs of the dairy, there is not enough electricity produced to sell 200 kWh to the Utility. I arrive at approximately 130 kWh that is available to the Utility. All of the assumptions that are included in calculating manure generation to methane production to electric generation need to be understood before moving forward.

Comments on Fiber Generation: Using Vendor’s pro forma, I was able to construct a spreadsheet that addressed assumptions necessary to determine the amount of fiber produced from the digester project. I calculated a similar number to what is provided in the feasibility study. I am concerned that fiber sales might decrease over time as more becomes available from other dairies.

As my comments in Table 4 reflect, it is necessary to know the components that are necessary to conduct a mass balance. This will provide a picture of the volumes of materials you will be dealing with. Components of the mass balance are found in Table 5.

Table 5. Components of the Mass Balance

	Unit	Per Cow
Total Number of Cows - Scrape		
Manure per animal	gallons	
Manure per animal	lbs	
Milk Production per cow per day	lbs	
Manure correction factor		
Corrected Manure per animal		
Correction Factor for Thickened Flush Manure		
Corrected Manure per animal - Flush	lbs	
Total Manure produced	lbs	
Total Manure as liquid (8.34 lbs/gal)	gallons	
Parlor Water added	gallons	
Total Water Volume	gallons	
Total diluted manure volume	gallons	
Solids as Bedding	lbs	
Percent Total Solids in Manure		
Solids in Manure Dry Basis	lbs	
Percent Volatile Solids in Manure		
Volatile Solids Available	lbs	
Total Solids	lbs	
Total Volume to Digester	gallons	
Total Volume to Digester (8.34 lbs/gal)	lbs	
Total Solids to Digester	lbs	
Total Volatile Solids available to Digester	lbs	

Many of the components of the mass balance are “book” values or “rules of thumb” values. Table 6 presents the same information as shown in Table 5, however, I have included information that can be used by the Dairy in determining the inputs. I have highlighted in yellow the values that are specific to the Dairy or values that should be properly sourced. Table 6 also shows the amount of biogas available for electrical generation and thermal generation.

Table 6. Mass Balance

Dairy/Vendor Analysis

	Unit	Per Cow	Per Day	Per Year
Total Number of Cows - Scrape		1200		
Manure per animal	gallons	26.4		
Manure per animal	lbs	220.176		
Milk Production per cow per day	lbs	60		
Manure correction factor		0.85		
Corrected Manure per animal		187.1496		
Correction Factor for Thickened Flush Manure		1		
Corrected Manure per animal - Flush	lbs	187.1496		
Total Manure produced	lbs		224,579.52	81,971,524.80
Total Manure as liquid (8.34 lbs/gal)	gallons		26,928.00	9,828,720.00
Parlor Water added	gallons	10	12,000.00	4,380,000.00
Total Water Volume	gallons		12,000.00	4,380,000.00
Total diluted manure volume	gallons		38,928.00	14,208,720.00
Solids as Bedding	lbs	5	6,000.00	2,190,000.00
Percent Total Solids in Manure		12.00%		
Solids in Manure Dry Basis	lbs	22.45795		
Percent Volatile Solids in Manure		80.00%		
Volatile Solids Available	lbs	17.96636	21,559.63	7,869,266.38
Total Solids	lbs	27.45795	32,949.54	12,026,582.98
Total Volume to Digester	gallons		38,928.00	14,208,720.00
Total Volume to Digester (8.34 lbs/gal)	lbs		324,659.52	118,500,724.80
Total Solids to Digester	lbs		32,949.54	
Total Volatile Solids available to Digester	lbs		21,559.63	
Energy Generation				
Estimated Volatile Solids Destruction Rate		40.00%		
Total manure VS converted into methane	lbs		8,623.85	3,147,706.55
Estimated CFT of CH4 per lb VS destroyed		8		
Methane generated from manure	CFT		68,990.83	25,181,652.42
Estimated Methane Content of Biogas		60.00%		
Total Biogas produced	CFT		114,984.71	41,969,420.70
Energy Potential - Biogas	BTU	600	68,990,828.54	25,181,652,418.56
Organic Solids (dry basis) (Volatile Solids Available)	lbs		21,559.63	7,869,266.38
Organic Solids Recovered	lbs	40.00%	8,623.85	3,147,706.55
Organic solids (70% moisture)	lbs		28,746.18	10,492,355.17
Manure Volume Reduction	lbs			
Energy Generation			**Per Day**	
Energy Potential - Biogas	BTU		68,990,828.54	
Electrical Energy Efficiency			36.20%	
Thermal Energy Efficiency			40.00%	
System Energy Efficiency (Electrical + Thermal)			76.20%	
Energy Lost			23.80%	
Biogas Available for Electrical Generation				
Total Biogas Energy Converted to Electrical Energy	MMBTU/day		24.97467993	
Total Biogas Energy Converted to Hot Water	MMBTU/day		27.59633142	
Total Biogas Energy Lost	MMBTU/day		16.41981719	
Total Biogas Available	MMBTU/day		68.99082854	
Thermal Energy Equivalent to 1 kWh	BTU/kWh		3,412.00	
Total Electrical Energy Generated per day (GROSS)	kWh/day		7,319.66	
Heat Rate to Generate 1 kWh of electrical energy	BTU/kWh		9,425.41	
Heat Rate to Generate 1 kWh of electrical energy	BTU/kWh			
Hours/day	hrs/day		24	
Electrical Power Generation with zero % downtime	kW		304.99	
Uptime Percentage for Engine/Generator Set			90.00%	
Power Generation w/Availability Factor	kW		274.49	
Average Electrical Energy Available to Utility	kWh/day		6,587.69	
Electrical Load Usage by Digester System			20.00%	of Gross Elect Generated
Electrical Energy Consumed by Digester System	kWh/day		1,317.54	
Electrical Load Usage by Dairy			32.00%	of Gross Elect Generated
Electrical Energy Used by Dairy	kWh/day		2,108.06	
Net Electrical Energy Available to Utility	kWh/day		3,162.09	**or 131.75 kWh**
Biogas Available for Thermal Generation				
Total Biogas Energy Converted to Hot Water	MMBTU/day		27.60	
Assumed Influent Temperature	degree F		35	
Required Digester Temperature	degree F		100	
Available Hot Water that is used to Heat Anaerobic Digester			69.50%	
Thermal Energy Needed to Heat the Anaerobic Digester @ 80% Efficiency	MMBTU/day		19.18	
Thermal Energy for Sale to Dairy @ 80% Efficiency	MMBTU/day		6.73	

After you develop the information found in Table 6, you can then begin projecting what your cash flow might look like. Table 7 presents a pro forma, using information presented in the tables above to estimate the net income to the dairy. I have presented the first year in this pro forma, which includes the current cow population. The fourth year is result of growing 10% per year, until 1500 cows are realized (in this case, 1597). The fifteenth year is presented because that is the last year of the loan. In year 15, the "Net Income after Dairy Electric Savings" is over ($48,012). The story doesn't end here however.

There should be savings to the dairy because of the bedding the digester process creates. In this case, the Dairy was trucking into the operation bedding. This trucking expense will disappear when the digester is up and running. There also is projected to be excess bedding material produced, that will be able to be marketed. I did not participate in this portion of the pro forma, but was told that the net income to the Dairy for bedding was estimated to be $20,000 per year.

The other component not discussed here is the concrete lined manure pit this Dairy was required to install. This pit cost over $400,000.00. This pit was also necessary for holding effluent from the digester.

The dairy also did not calculate what the savings would be in land application of the effluent from the digester. Because they were currently limited by the phosphorus in their manure, the amount of acres required for disposal of manure was assumed to be greater than the acreage needed for manure application using the effluent from the digester.

Bottom line is that this paper presents the cost feasibility of a digester project up to a certain point. As mentioned earlier, the entire farming process needs to considered when evaluating an energy project.

In this dairy's case, the project was put off for about 18 months. This allowed the dairy to get some of the it's finances in order. This dairy ultimately chose a vendor who would own and operate the digester, and the manure pit. In order to make this a more feasible project, the vendor will size the project to produce more energy than what this dairy could produce on its' own and will import additional substrate to the digester. The additional substrate will probably have more volatile solids, thereby having the potential of creating more methane.

Table 7. Projected Cash Flow

Dairy
Projected Cash Flow

Year	1	4	15
kW/hr Produced	304.99	405.89	405.89
Efficiency	90%	90%	90%
Annual kW Production	2,404,541	3,200,037	3,200,037
Daily kW Production	6587.78	8767.22	8767.22
Hourly kW Production	274.49	365.30	365.30
Number of Cows	1200	1,597	1,597
Number of Heifers	0	0	0
Total Number of Animals	1200	1597.2	1597.2
Annual kW Production/Animal	2003.78	2003.53	2003.53
Annual Manure Produced (gallons/year)	9,828,720	13,080,388	13,080,388
Gallons/kW	4.09	4.09	4.09
Current Dairy Animal Population	1,200		
Projected 10% Growth Per Year until 1500 cows	1,200	1,597	1,597
Annual Manure Produced (gallons/year)	9,828,720	13,080,388	13,080,388
Gallons/kW	4.09	4.09	4.09
Actual Annual kW Production	2,404,541	3,200,037	3,200,037
Daily kW Production	6587.78	8767.22	8767.22
Hourly kW Production	274	365	365
Electrical Load Usage by Digester System	20%	14%	14%
Electrical Energy Consumed by Digester System (kW/day)	1318	1227	1227
Electrical Load Usage by Dairy	32%	26%	26%
Electrical Energy Used by Dairy (kW/day)	2108	2279	2279
Net Electrical Energy Available to Utility (kW/day)	3162	5260	5260
Net Electrical Energy Available to Utility (kW/hr)	131.76	219.18	219.18
Average Utility Rate ($/Kwh)	$0.1082	$0.1082	$0.1082
Yearly Revenue from Utility	**$124,882.25**	**$207,746.39**	**$207,746.39**
Expenses (increase 2% per year)			
Engine Genset	$46,319	$49,154	$61,117
Digester	$4,632	$4,916	$6,112
Misc			
Labor	$14,600	$15,494	$19,264
Total Expenses	$65,551	$69,563	$86,493
P&I On Loan	$259,289	$259,289	$259,289
Total Annual Expenses	**$324,840**	**$328,852**	**$345,782**
Net Income	($199,958)	($121,106)	($138,036)
Farm Electric			
Electrical Energy Used by Dairy (kW/day)	2108	2279	2279
Value of Electricity Used by Dairy	$83,255	$90,023	$90,023
Net Income after Dairy Electric Savings	($116,703)	($31,082)	($48,012)

4. Who Should Do A Feasibility Study?

The dairy farmer could certainly do many of the components of the feasibility study, assuming they have the time and knowledge to collect, analyze, and perform the analysis required. I am a civil engineer by training. Many local civil engineering firms perform feasibility analyses on a routine basis. Most engineering projects require a feasibility analysis to be performed for the same reason we are discussing a feasibility study for an energy project. Typically, the owners who the engineer works for want to make sure their project will make money for them. Your accountant may also have a role in developing the total cost savings (or losses) by considering other aspects of the dairy operation.

Performing a feasibility study for an energy project may require some knowledge of the dairy operations and what components are necessary to address in the digester project. Obviously, the best team to perform the feasibility study would include the farmer, your engineer or business consultant, your accountant, and the vendors who would build the energy project. Once a project can be defined, other decisions have to made, that is does the dairy own and operate the energy project or will the vendor own and operate the energy project? The dairy then would be an energy customer to the vendor.

5. How Much Should They Cost?

Typically, the vendors who might compete for your energy project will provide much of the information on costs for their process, what their land requirements will be, operating costs, and any costs related to connections to the grid. They will provide proposals to you, which in turn you have to evaluate, perhaps using some of the tools I've provided in this paper.

I would propose that my role in evaluating the feasibility of the digester project would be under $10,000.00. However, you can see that the complete feasibility of the project went beyond my role, in that the farmer took it upon himself to determine the other costs/benefits when considering this project.

If a vendor is proposing to own/operate the energy themselves, there might not be a need to conduct a feasibility study. However, even if the vendor will be the owner/operator, they will be contracting with your dairy for certain volumes of manure (substrate). You will still need to make sure that what they are requiring from you, you will be able to provide. In this case, your other partner might be your attorney.