ALTERNATIVE ENERGY SOURCES - A HOG PRODUCER'S PERSPECTIVE OF ON-FARM ANAEROBIC DIGESTERS

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BACKGROUND

First some background to the farm that has lead me to this bodacious idea. Not everyone wakes up one morning and says, "Hey, I think I'm going to invest three quarters of a million dollars and make electricity and hot water from pig manure."

My father, Kase Vanden Heuvel, really set the foundation for all this to happen. He started a construction company 10 years after he emigrated from Holland with $100 in his pocket. Ten years later, 1972, he started pig farming for some unknown reason. Due to an error in communication with OMAF who designed the farrowing barn, the sow farm that was supposed to support a 500 head finishing barn turned into almost 500 sows. Not wanting to waste any foundation wall, he kept the 128 farrowing spaces and just built around it. 500 sows in 1972 was not the norm. That's the style of farming that I know. Not necessarily normal. I've grown up feeling very comfortable farming in a 'not-so-normal' way. It's really **all** I know. The really amazing thing is that my father is not a pig farmer. He never took any training in pig husbandry, the only chores he ever did was feed that original 500 head finishing barn after he got home from the construction site. And as soon as he could he had staff take that job over too.

He understood what **could** be possible after some research and talking to knowledgeable people he trusted. He surrounded himself with good people, used quality equipment and embraced technology that made sense to the farm.

The most important part of that is seeing what COULD be possible. Some stay focused on what HAS BEEN possible, some see only what IS possible, but at our farm we are always looking at what the next thing is to help us farm better. When I say better I don't just mean only for more profit. Better can mean less manual labour, safer working conditions, more information to make better decisions, easier on the environment and on and on.

When I purchased the farm from my father five and a half years ago I developed the most important document of a business that I'm going to be running. What's your most important document? It's not a projected cash flow (sorry bankers), it's not the share cropping contract, it's not the mortgage, and it's not our staff benefits package. The most important document is our Mission Statement. My staff needs to know what I stand for, my banker needs to know what kind of business man I am, and even my feed company needs to understand what's important to me so we stay on the same page.

Values: (core beliefs)

- Be honest even if it hurts
- Treat all with respect and encouragement
- Our work environment should be a positive one
- Look for new/better ways to do things
- Listen, look and learn
- When you need to make a decision, make one, and go from there
- Treat associates fairly and expect the same in return

Mission: (T-shirt summary)

Believe in what you do, Do what you believe

Vision: (picture of the future)

- To be an organization that
  - Is true to my Christian beliefs
  - Is an enjoyable and learning place for me and all employees
  - Makes a profit to support all families involved, create reserve for low price years, to sustain growth and to stay competitive
  - Is in the top 5% in industry for production levels
  - Optimizes technology and skills of all involved to improve production and minimize waste
  - Leaves this land better for the next generation

This document isn't just nice words. As an organization we use this to guide our decisions. Examples:

- What types of companies we deal with is guided by our expectation to be treated fairly and always looking to improve.
- How we handle manure is guided by our commitment to leaving the land better for our children.
- The amount of lighting in the barn must be in line with our belief that our workplace needs to be an enjoyable place to be.

That's a lot of background but it's important to understand that installing and running an Anaerobic Digester isn't just a financial decision. Taking on a project like this one has to have a deeper meaning than just money to make it through the rough patches and get it working in the long run. We all need to know that there will be some times when you are pulling your hair out and wonder why you ever got into this in the first place. You need to believe in it, really believe deep down that this is the right thing to do.

In 2004, I hired an engineering company to find the break-even point in cents per kWh to produce electricity at our farm. The number by their calculations was a little over 20 cents per kWh. A lot has been learned since 2004. We have been looking at many manure treatments to reduce our manure spreading costs. Just about all of them cost us money, not saved us money. After listening to the first bunch of manure treatment ideas, I found a question that would cut through all the "money making" schemes. The first question you should ask is,

"How will this make me / save me money?" if the salesman doesn't have a direct answer then you need to move on.

An Anaerobic Digester has the potential to make money. Good money. At the same time it leaves all the nutrients in place to feed your soil without the smell, the methane that normally escapes to the environment is harnessed and the pathogens are 98% gone.

To me there are too many pluses to pass this by.

I am part of the Huron Anaerobic Digester Working Group. This is a sub committee of Huron County Water Protection Steering Committee. The group believes that Anaerobic Digestion is a technology that will work.

Purpose Statement:
The County of Huron, with its partners on the Huron County Water Protection Steering Committee, is interested in facilitating the development of an on-farm demonstration project of an anaerobic digester using manure as feedstock to produce electricity for sale to the grid.

Working in this group gives the project much higher chances of success. I saw the value with surrounding the project with highly qualified people instead of trying to do this alone. Having OMAFRA engineers, Huron County planning heads, and local citizens that see the connection between water quality and such a project around the table at planning meetings is a huge asset.

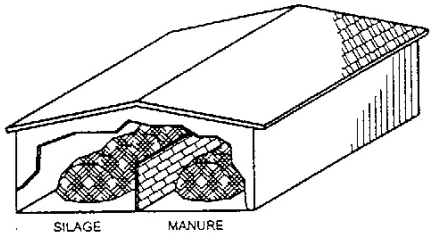
The project is shaping into a 250 kW generator. We are looking at this size since this is where a good return on investment starts. Any smaller really doesn't work financially. Ontario has put a moratorium on anything bigger then 250 kW in our area.

We will be using the raw manure from a 3200 head finishing barn as our base product. That is nowhere close to producing enough methane to run the engine for 250 kW. To top up the nutrients to create this methane we will be separating the manure at our sow farm and transport the solids to the Anaerobic Digester. We still need about 15% more product from an outside source. I'm very confident that we will be able to find an agricultural or food industry by-product or grow a crop that will fill in the last 15%.

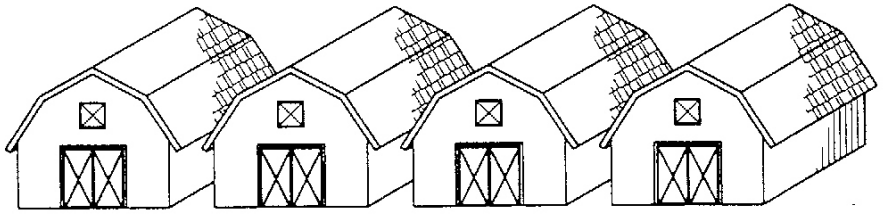
DETAILS FROM OUR FEASIBILITY STUDY (Refer to 5 pages that follow)

Done by Martin Lensink, P. Eng. of CEM Engineering

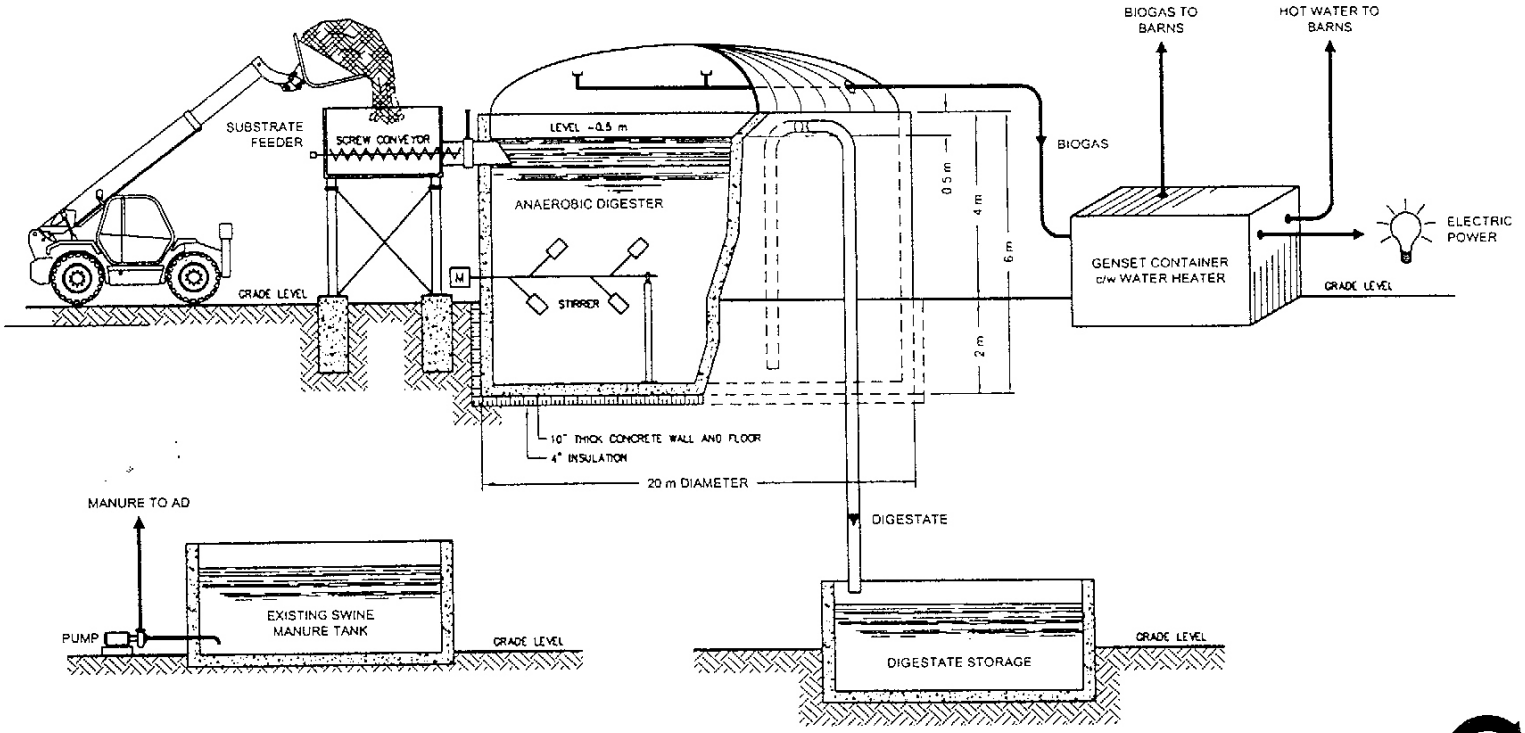
ANAEROBIC DIGESTER COMBINED HEAT AND POWER SYSTEM



MANURE STORAGE



SWINE BARNS



FROM THE HILL FARMS LTD.

HURON COUNTY

CEM ENGINEERING
COGENERATION & ENERGY MANAGEMENT

Sensitivity Analysis on Main Variables

CEM ENGINEERING
COGENERATION & ENERGY MANAGEMENT

3.5 Sensitivity Analysis on Main Variables in Option #4 (250 kW_e)

Variable	Price Paid for Power ($/kW.h)	Biomass Cost Delivered ($/tonne)	Capital Cost and Grant % ($000's)	10 Year IRR After Tax* (%)
Base	**0.116**	**25**	**912**	**6**
1A	**0.128** (+ 10%)	25	912	**10**
1B	**0.139** (+ 20%)	25	912	**13**
2A	0.116	**15**	912	**12**
2B	0.116	**5**	912	**17**
2C	0.116	**-5**	912	**22**
3A	0.116	25	**730** (- 20%)	**10**
3B	0.116	25	**547** (- 40%)	**17**
Best Case	**0.128** (+ 10%)	**15**	**730** (-20%)	**20%**
Worst Case	**0.116**	**35**	**1,003** (+ 10%)	**-2%**

* but before Financing

Technical and Financial Assumptions

Scenario #1:

Tech Assumptions		
AD CHP Electrical Output	250	kW
AD CHP Thermal Output	260	kW
AD CHP Thermal Output	887,120	Btu/hour
Biogas Consumption by CHP (@50% CH4 Content)	112	m3/hour
Efficiency of Existing Boilers Assumed	80%	HHV
Parasitic / Auxiliary Power	1%	
Pilot Oil Used by ICE	2.3	liter / hour
Pilot Oil Used by ICE	19,044	liters / year
System operation	360	days / year
Net Power Generation	2,115,000	kW.h / year
Purchased Power Displaced	0	kW.h / year
Surplus Power Sold	2,115,000	kW.h / year
Potential Propane Displace Via Energy / Heat Recovery	393,466	L /year
Biogas Needed	967,680	m3/hour
Biogas From one site Swine Manure	90,720	m3/hour
Biogas from separated swine manure	876,960	m3/hour
Biogas from Additional Organic Matter (bean pods)	750	m3/hour
Organic Matter needed to Supple ICE	1,186	tonnes / year

Financial / Economic Assumptions		
Avoided Cost of Electricity	0.122	$ / kW.h
Value of Surplus Power Sold	0.12	$ / kW.h
Delivered Cost of Propane	0.45	$/Liter
% Recoverable Heat Actually Used	10%	
Cost of Biomass (Delivered)	10	$ / tonne
Unit Cost of Lube / Pilot Oil	0.65	$ / liter
Escrow Account for Engine Maintenance	0.009	$ / kW.h
Corporate Income Tax Rate	30%	
Unit Capital cost Assumed (Supply and install - no grant)	4000	$ / kWe
Discount Rate (for NPV Analysis)	10%	
Operation / Repair Labour	0.009	$ / kW.h
Escalation on Propane Costs	4%	per year
Escalation on Electricity Cost	2%	per year
Escalation on Other Costs	1.5%	per year

Proforma Analysis -- $000's per year (CAD)

Year	0	1	2	3	4	5	6	7	8	9	10
Calendar	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Purchased Power Displaced											
Surplus Power Sold		254	259	264	269	275	280	286	292	297	303
Propane Displaced Via Enigne heat Recovery		12	12	13	13	14	15	15	16	16	17
Hot water Revenue		0	0	0	0	0	0	0	0	0	0
Total Gross Savings and Revenues		**266**	**271**	**277**	**283**	**289**	**295**	**301**	**307**	**314**	**320**
Cost of Biomass Delivered		10	10	10	10	11	11	11	11	11	11
Lube and Pilot Oil		12	13	13	13	13	13	14	14	14	14
Engine Maintenance Reserve		19	19	20	20	20	21	21	21	21	22
Operation and Repair labour		19	19	20	20	20	21	21	21	21	22
Transportation of Digestate											
Total Annual O&M Expenses		**60**	**61**	**62**	**63**	**64**	**65**	**66**	**67**	**68**	**69**
Earnings Before Interest and Taxes	**$**	**205**	**$ 210**	**$ 215**	**$ 220**	**$ 225**	**$ 230**	**$ 235**	**$ 240**	**$ 246**	**$ 251**
Capital Cost (supply, install and commission)	$ 1,000										
Grant Income	$ -										
Net Capital Costs	**$ 1,000**										
Capital Cost Allowance (Class 43.2)		220	343	192	108	60	34	19	11	6	3
Corporate Income Tax		0	0	4	21	31	36	40	43	45	46
Interest costs (6%)		60	47	26	15	8	5	3	1	1	0
Earnings After Taxes	**$**	**145**	**$ 163**	**$ 184**	**$ 184**	**$ 186**	**$ 189**	**$ 192**	**$ 196**	**$ 200**	**$ 205**
Simple Payback	$	145	309	493	677	863	1,051	1,244	1,440	1,640	1,845

With current returns on electricity sales and no grant $ and no hot water revenue payback is almost 6 years

Scenario #2:

Tech Assumptions		
AD CHP Electrical Output	250	kW
AD CHP Thermal Output	260	kW
AD CHP Thermal Output	887,120	Btu/hour
Biogas Consumption by CHP (@50% CH4 Content)	112	m3/hour
Efficiency of Existing Boilers Assumed	80%	HHV
Parasitic / Auxiliary Power	1%	
Pilot Oil Used by ICE	2.3	liter / hour
Pilot Oil Used by ICE	19,044	liters / year
System operation	360	days / year
Net Power Generation	2,115,000	kW.h / year
Purchased Power Displaced	0	kW.h / year
Surplus Power Sold	2,115,000	kW.h / year
Potential Propane Displace Via Energy / Heat Recovery	393,466	L /year
Biogas Needed	967,680	m3/hour
Biogas From one site Swine Manure	90,720	m3/hour
Biogas from separated swine manure	876,960	m3/hour
Biogas from Additional Organic Matter (bean pods)	750	m3/hour
Organic Matter needed to Supple ICE	1,186	tonnes / year

Financial / Economic Assumptions		
Avoided Cost of Electricity	0.122	$ / kW.h
Value of Surplus Power Sold	0.16	$ / kW.h
Delivered Cost of Propane	0.45	$/Liter
% Recoverable Heat Actually Used	10%	
Cost of Biomass (Delivered)	10	$ / tonne
Unit Cost of Lube / Pilot Oil	0.65	$ / liter
Escrow Account for Engine Maintenance	0.009	$ / kW.h
Corporate Income Tax Rate	30%	
Unit Capital cost Assumed (Supply and install - no grant)	4000	$ / kWe
Discount Rate (for NPV Analysis)	10%	
Operation / Repair Labour	0.009	$ / kW.h
Escalation on Propane Costs	4%	per year
Escalation on Electricity Cost	2%	per year
Escalation on Other Costs	1.5%	per year

Proforma Analysis -- $000's per year (CAD)

Year	0	1	2	3	4	5	6	7	8	9	10
Calendar	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Purchased Power Displaced											
Surplus Power Sold		338	345	352	359	366	374	381	389	396	404
Propane Displaced Via Enigne heat Recovery		12	12	13	13	14	15	15	16	16	17
Hot water Revenue		0	0	0	0	0	0	0	0	0	0
Total Gross Savings and Revenues		**350**	**358**	**365**	**373**	**380**	**388**	**396**	**405**	**413**	**421**
Cost of Biomass Delivered		10	10	10	10	11	11	11	11	11	11
Lube and Pilot Oil		12	13	13	13	13	13	14	14	14	14
Engine Maintenance Reserve		19	19	20	20	20	21	21	21	21	22
Operation and Repair labour		19	19	20	20	20	21	21	21	21	22
Transportation of Digestate											
Total Annual O&M Expenses		**60**	**61**	**62**	**63**	**64**	**65**	**66**	**67**	**68**	**69**
Earnings Before Interest and Taxes	**$**	**290**	**$ 296**	**$ 303**	**$ 309**	**$ 316**	**$ 323**	**$ 330**	**$ 337**	**$ 345**	**$ 352**
Capital Cost (supply, install and commission)	$ 1,000										
Grant Income	$ -										
Net Capital Costs	**$ 1,000**										
Capital Cost Allowance (Class 43.2)		220	343	192	108	60	34	19	11	6	3
Corporate Income Tax		0	0	21	38	48	54	58	61	63	65
Interest costs (6%)		60	47	26	15	8	5	3	1	1	0
Earnings After Taxes	**$**	**230**	**$ 249**	**$ 256**	**$ 257**	**$ 260**	**$ 265**	**$ 270**	**$ 275**	**$ 281**	**$ 287**
Simple Payback	$	230	479	735	993	1,253	1,518	1,787	2,063	2,344	2,631

With higher returns on electricity sales and no grant $ and no hot water revenue payback is almost 4 1/2 years

Scenario #3:

Tech Assumptions		
AD CHP Electrical Output	250	kW
AD CHP Thermal Output	260	kW
AD CHP Thermal Output	887,120	Btu/hour
Biogas Consumption by CHP (@50% CH4 Content)	112	m3/hour
Efficiency of Existing Boilers Assumed	80%	HHV
Parasitic / Auxiliary Power	1%	
Pilot Oil Used by ICE	2.3	liter / hour
Pilot Oil Used by ICE	19,044	liters / year
System operation	360	days / year
Net Power Generation	2,115,000	kW.h / year
Purchased Power Displaced	0	kW.h / year
Surplus Power Sold	2,115,000	kW.h / year
Potential Propane Displace Via Energy / Heat Recovery	393,466	L /year
Biogas Needed	967,680	m3/hour
Biogas From one site Swine Manure	90,720	m3/hour
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Biogas from Additional Organic Matter (bean pods)	750	m3/hour
Organic Matter needed to Supple ICE	1,186	tonnes / year

Financial / Economic Assumptions		
Avoided Cost of Electricity	0.122	$ / kW.h
Value of Surplus Power Sold	0.12	$ / kW.h
Delivered Cost of Propane	0.45	$/Liter
% Recoverable Heat Actually Used	10%	
Cost of Biomass (Delivered)	10	$ / tonne
Unit Cost of Lube / Pilot Oil	0.65	$ / liter
Escrow Account for Engine Maintenance	0.009	$ / kW.h
Corporate Income Tax Rate	30%	
Unit Capital cost Assumed (Supply and install - no grant)	4000	$ / kWe
Discount Rate (for NPV Analysis)	10%	
Operation / Repair Labour	0.009	$ / kW.h
Escalation on Propane Costs	4%	per year
Escalation on Electricity Cost	2%	per year
Escalation on Other Costs	1.5%	per year

Proforma Analysis -- $000's per year (CAD)

Year	0	1	2	3	4	5	6	7	8	9	10
Calendar	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Purchased Power Displaced											
Surplus Power Sold		254	259	264	269	275	280	286	292	297	303
Propane Displaced Via Enigne heat Recovery		12	12	13	13	14	15	15	16	16	17
Hot water Revenue		10	10	10	10	10	10	10	10	10	10
Total Gross Savings and Revenues		**276**	**281**	**287**	**293**	**299**	**305**	**311**	**317**	**324**	**330**
Cost of Biomass Delivered		10	10	10	10	11	11	11	11	11	11
Lube and Pilot Oil		12	13	13	13	13	13	14	14	14	14
Engine Maintenance Reserve		19	19	20	20	20	21	21	21	21	22
Operation and Repair labour		19	19	20	20	20	21	21	21	21	22
Transportation of Digestate											
Total Annual O&M Expenses		**60**	**61**	**62**	**63**	**64**	**65**	**66**	**67**	**68**	**69**
Earnings Before Interest and Taxes	**$**	**215**	**$ 220**	**$ 225**	**$ 230**	**$ 235**	**$ 240**	**$ 245**	**$ 250**	**$ 256**	**$ 261**
Capital Cost (supply, install and commission)	$ 1,000										
Grant Income	$ 500										
Net Capital Costs	**$ 500**										
Capital Cost Allowance (Class 43.2)		110	172	96	54	30	17	9	5	3	2
Corporate Income Tax		0	0	24	33	38	41	44	46	47	48
Interest costs (6%)		30	23	13	7	4	2	1	1	0	0
Earnings After Taxes	**$**	**185**	**$ 197**	**$ 188**	**$ 190**	**$ 192**	**$ 196**	**$ 200**	**$ 204**	**$ 208**	**$ 213**
Simple Payback	$	185	382	570	759	952	1,148	1,347	1,551	1,760	1,972

With current returns on electricity sales but significant grant payback is less then 3 years