Economics of Digester Integration into an Energy/Nutrient Management System and Cogeneration

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Virtual Field Day on Anaerobic Digesters as a Tool for Energy Production, Manure/Nutrient Management and Revenue Generation

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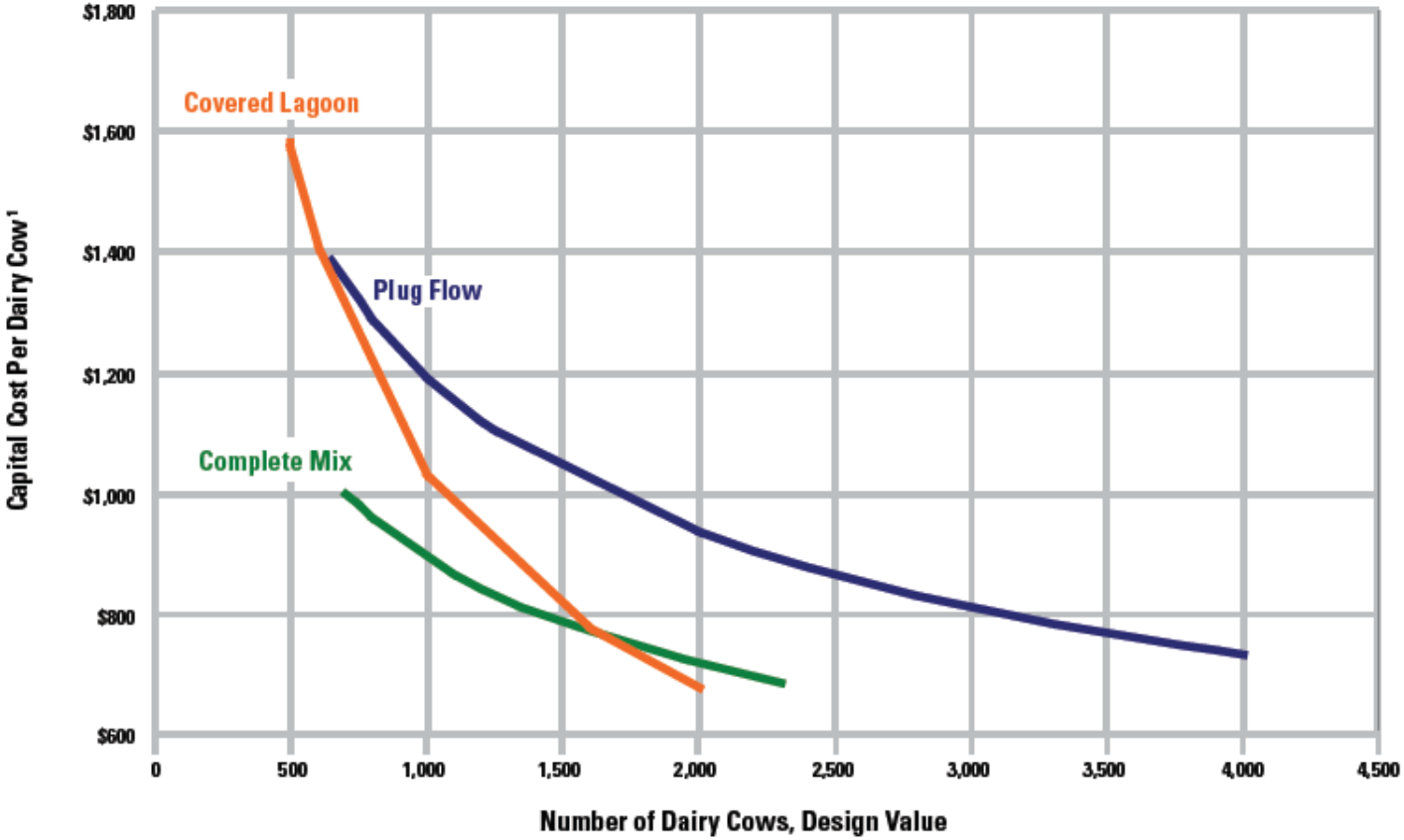
WHAT IS THE VALUE OF A DIGESTER IN AN INTEGRATED DIGESTER/NUTRIENT MANAGEMENT SYSTEM?

- Most digesters generate electricity, but electricity generally doesn't cover costs.
- Increasing interest in integrated digester/nutrient management systems.
  - There are also many dairy farms with only separators without digesters.
- Do tighter nutrient regulations call for high-efficiency separators that require a lot of energy – making digesters more valuable?

HOW MUCH DOES A DIGESTER COST TO INSTALL?



[1] *Costs are stated in September 2009 dollars.*

Figure 2. Capital cost per dairy cow for complete mix, plug flow, and covered lagoon AD systems

Source: AgSTAR data, 40 digesters

ASSUMPTIONS FOR ECONOMIC SCENARIOS

Investment Requirement:

Investment requirement at two example farm sizes:

1,400 cows -	$1.3 million	$929/cow
2,800 cows -	$2.3 million	$821/cow

Based on $320,864 + $563/dairy cow from 13 complete-mix digesters, with utility connection charges, H2S treatment, and inflation adjustment

Capital cost (6%, 20 year life): 9% of investment/year

Operation and maintenance costs: 3% of investment/year

Electricity output: 1,041 kWh/cow/year less 50 kWh/cow/year to operate

Carbon price: $7/metric tonne

ECONOMIC SCENARIOS

	1,400 cows	2,800 cows
Investment	$1.3 million	$2.3 million
Electricity breakeven prices (cents/kWh)		
▪ No subsidies or other value	11.0 cents	9.7 cents
▪ REAP 25%	8.9	7.9

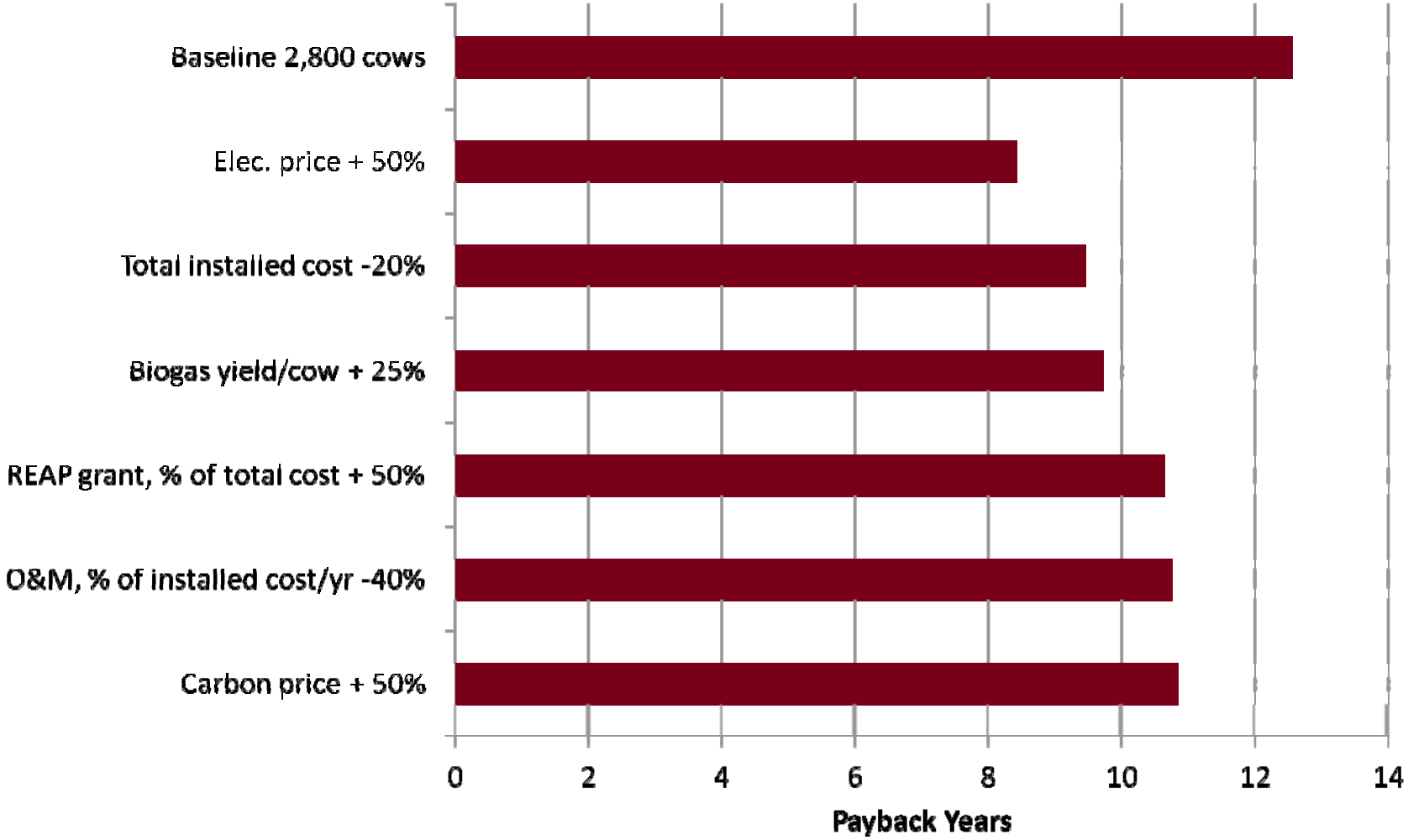
Electricity market

- Retail price (EIA, 1/11): U.S. average 9.8 cents, NM 8.1 cents
  range 6 cents (WY) to 17 cents (CT)

Price for excess electricity sold back to grid?

Value of manure solids, odor control, RECs, other??

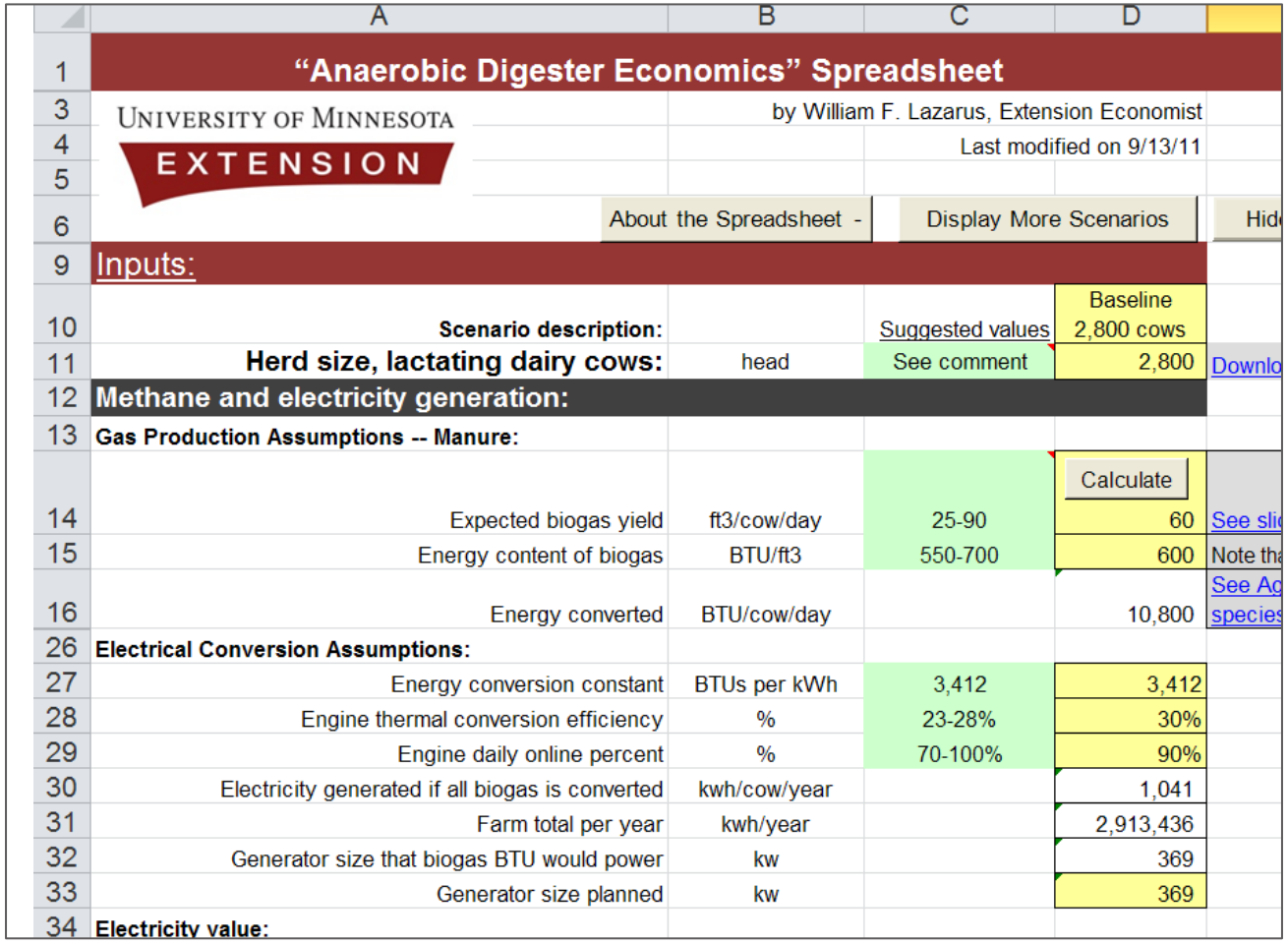
2,800-Cow Farm, 6-cent Electricity, 25% REAP, 3% O&M, $7 Carbon Price



IDEAS FOR FUTURE RESEARCH

- AgSTAR database of operating digesters is great, but I wish I knew more about their nutrient management components, nutrient limits or trading as a motivating factor, and solids utilization.
- Economics of compressing biogas for transportation fuel, or injecting it into the natural gas grid?
- Other …

MY SPREADSHEET FOR ANALYZING DIGESTER ECONOMICS



	A	B	C	D
1	"Anaerobic Digester Economics" Spreadsheet			
3	UNIVERSITY OF MINNESOTA EXTENSION		by William F. Lazarus, Extension Economist	
4			Last modified on 9/13/11	
5				
6		About the Spreadsheet -	Display More Scenarios	Hid
9	Inputs:			
10	**Scenario description:**		Suggested values	Baseline 2,800 cows
11	**Herd size, lactating dairy cows:**	head	See comment	2,800
12	**Methane and electricity generation:**			
13	**Gas Production Assumptions -- Manure:**			
14	Expected biogas yield	ft3/cow/day	25-90	Calculate 60
15	Energy content of biogas	BTU/ft3	550-700	600
16	Energy converted	BTU/cow/day		10,800
26	**Electrical Conversion Assumptions:**			
27	Energy conversion constant	BTUs per kWh	3,412	3,412
28	Engine thermal conversion efficiency	%	23-28%	30%
29	Engine daily online percent	%	70-100%	90%
30	Electricity generated if all biogas is converted	kwh/cow/year		1,041
31	Farm total per year	kwh/year		2,913,436
32	Generator size that biogas BTU would power	kw		369
33	Generator size planned	kw		369
34	**Electricity value:**			

http://z.umn.edu/digester

Thank you.

LINK TO SPREADSHEET: http://z.umn.edu/digester