

# Agricultural Utilization Research Institute (AURI)

## Center for Producer- Owned Energy (CPOE)

Adding Value to Minnesota Agriculture

Wayne Hansen  
Project Director



# *“Off-farm Uses for Methane Produced On-Farm”*

Presented to  
CERTS Workshop  
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# West River Dairy - City of Morris

- Feasibility of utilization of agricultural resources in Stevens County
- Energy sources analyzed
  - *Manure digestion (biogas)-pipeline methane to Morris industrial park*
  - *Stover combustion (electricity)*
  - *Stover gasification (biogas)*
- **Sebesta Blomberg - Contractor**



# West River Dairy - City of Morris

- 5,800 Cows
- Anaerobic Digester \$ 3,300,000 \$570/Cow
- Methane Refining Train \$ 1,100,000
- Undefined Design Detail \$ 440,000
- Pipeline 12 Mi. \$ 1,658,140 \$138-250,000/Mi
- Total \$ 6,498,140



# West River Dairy - City of Morris

Total \$ 6,498,140

- 15% after-tax return on equity
  - *Equity (5% of Project Cost)*
- Annual Revenue Required \$1,146,646.
- Annual Methane 1.08 Million Therms
  - *186 Therms / Cow / Year*
- Break-even required \$1.06 / Therm



# Small Methane Digester - Kandiyohi Co

- Feasibility of producing methane at small dairies (<300 cows) and transporting to local user with minimal cleanup and minimal cost
- Dr. Phil Goodrich, U of MN
  - *Dept of Bioproducts & Biosystems Engineering*



# Biogas Production – Small Digester

- On-farm 300 lactating cows
- 93 Cu Ft/ Cow/Day                      27,900 Cu Ft/Day
- 40% --heat the digester                      NET 16,740
- 40% -- loss in cleanup to upgrade biomethane for transportation and sale off the farm

NET / Day

10,000 Cu Ft Methane

100 Therms

NET / Year

122 Therm/Cow

36,500 Therm



# Standards

- On farm consumption -- raw state, less important
- Being transported and or sold -- quality very important
- The transport and sale of Hazardous gas as defined by the MN Department of Transportation
- Industry standards must be met to insure the safety of the public
- Hydrogen sulfide and water vapor can cause corrosion in the tanks
- Impurities may also render safety devices inoperable



# Gas Transport and Distribution Options

- **1.** An underground pipeline from the farm to the purchaser location.
- **2.** A single large department of transportation (DOT) approved specialized high-pressure tank truck for reloading
- **3.** A group of smaller high-pressure steel tanks are affixed onto a pallet in a livestock trailer.
- **4.** Smaller Department of Transportation approved trailer using containing nine carbon fiber wound tubes.



# Value Comparison for Methane from Anaerobic Digester

Energy Source	Avg.Btu	Unit	Retail cost	100,000 BTU Cost(1 therm)
Methane	1,000,000	BTU/1,000 Ft <sup>3</sup>		
Propane	91,333	BTU/Gal	\$1.50 gal.	\$1.64
Gasoline	125,000	BTU/ Gal	\$2.00 gal.	\$1.60
#2 fuel oil	140,000	BTU/Gal	\$2.20 gal.	\$1.57
Nat'l gas	1,000,000	BTU/1,000 Ft <sup>3</sup>	\$9.00 /1000 Ft <sup>3</sup>	\$0.90
Electricity	3,413	BTU/Kwh	\$0.08 Kwh	\$2.34
	3,414	BTU/Kwh	\$0.04 Kwh	\$1.17
	3,415	BTU/Kwh	\$0.03 Kwh	\$0.88



# Value Comparison for Methane from Anaerobic Digester / Cow / Year

Energy Source	100,000 BTU Cost(1therm)	Annual /Cow Production	Replace Value	Tax Credit \$/.41/Therm	Total Value
Methane		122 Therm			
Propane	\$1.64	122 Therm	\$200.37	\$50.02	\$250.39
Gasoline	\$1.60	122 Therm	\$195.20	\$50.02	\$245.22
#2 heat'g	\$1.57	122 Therm	\$191.71	\$50.02	\$241.73
Nat'l gas	\$0.90	122 Therm	\$109.80	\$50.02	\$159.82
Electric.	\$2.34	49 Therm	\$114.85	\$50.02	\$164.87
\$.04	\$1.17	49 1,460	\$57.41	\$50.02	\$107.43
\$.03	\$0.88	49 Kwh	\$43.05	\$50.02	\$93.07



# Small Methane Digester

- Digester \$ 890 / Cow (Goodrich & Lazarus)
- \$116 / Cow /Yr PV Operating & Capital Cost
- Discounted at a 7% cost of capital and a 35% tax rate.
- \$37 / Cow / Yr Bedding Value
- \$79 / Cow / Yr NPV Digester



# Pallet System Transport

- \$ 96 / Cow /Yr Pallet System Transport
- \$116 / Cow /Yr Clean & Compress Gas
- \$212 / Cow /Yr Total Cost T&C
- \$110 / Cow /Yr Revenue 122 Therms @ \$0.90
- (\$102) / Cow / Yr Transport Net Loss
- \$291 / Cow /Yr Total Cost, Incl Digester
- (\$181) / Cow / Yr Total Net Loss, Incl Digester

\$2.38

Breakeven / Therm

**(Propane \$2.05)**





## Dynetek Trailer for Biogas without cover



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# Dynetek Trailer Transport

- \$ 68 / Cow /Yr      Dynetek Transport
- \$116 / Cow /Yr      Clean & Compress Gas
- \$184 / Cow /Yr      Total Cost T&C
- \$110 / Cow /Yr      122 Therms @ \$0.90
- (\$ 74) / Cow / Yr      Transport Net Loss
- \$263 / Cow /Yr      Total Cost, Incl Digester
- (\$153) / Cow / Yr      Total Net Loss, Incl Digester

\$2.16

Breakeven / Therm

**(Propane \$2.05)**



# HDPE Underground Pipe Transport

- \$6 / Linear Ft      Install 6 inch HPDE Pipe
- \$31,680      Install 1 mile -      5 Yr Payoff
- \$ 25 / Cow /Yr      HDPE System Transport
- \$116 / Cow /Yr      Clean & Compress Gas
- \$141 / Cow /Yr      Total Cost
- \$110 / Cow /Yr      Revenue 122 Therms @ \$0.90
- (\$ 31) / Cow / Yr      Transport Net Loss
- \$1.16      Breakeven / Therm
- (\$110) / Cow / Yr      Total Net Loss, Incl Digester
- \$1.80      Breakeven / Therm **(Propane \$2.05)**



# Substitution of biogas for purchased fuels

- May make more sense than to sell the gas off-farm
- Heating hot water in the dairy & house
- Drying grain in the fall and winter
- Fuel for light tractors –LP conversion
- Engine to power the vacuum pumps used for milking
- Supply nearby farmer who needs much more heat

Confinement -- Hogs or chickens



# Who Do YOU Want to Be Your Fuel Supplier ?

