



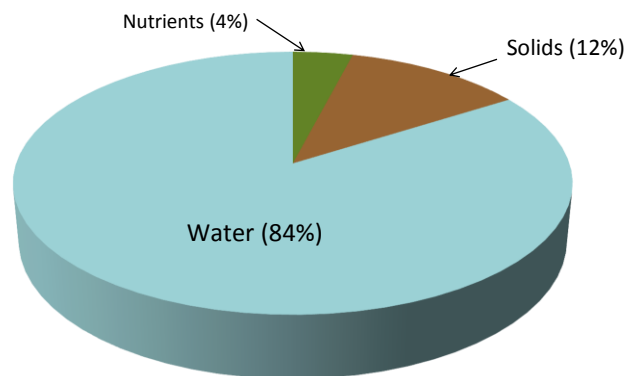
## Manure: A Value-Added Approach?

Dr. T.A. (Terry) Fonstad, P.Eng. and Dyan Pratt, M.Sc., P.Eng.

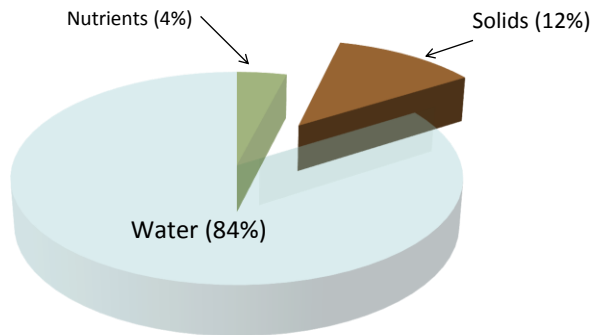
Dairy Info Day

January 11, 2013

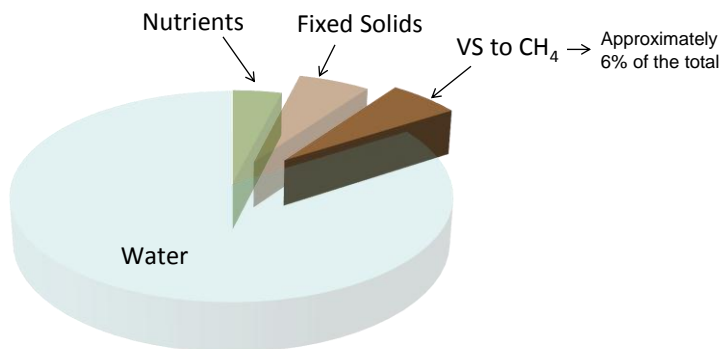
## Flushed Dairy Manure Composition



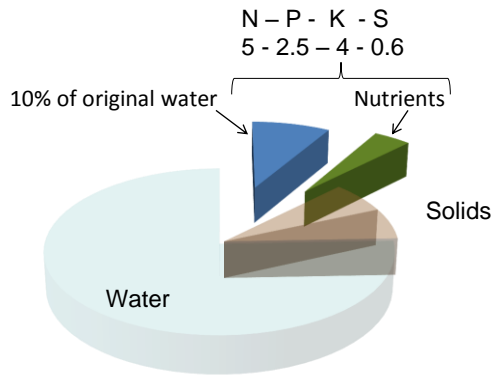
## Solids Recovery



## Convert the Volatile Solids to Natural Gas



## Recover the nutrients with some water for a fertilizer concentrate



## Storage and Field application



- Solid Separation



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## Where can we add value???

- Solid Separation

- Solids?
  - Compost
  - Bedding
  - Biogas
  - Gasification



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## Where can we add value???

- Liquid Separation
  - Nutrient concentrate
  - Land application
  - Biogas
  - Clean up for water reuse



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## Adding Value?

- Biogas or Syngas production
  - Offset heating and electricity costs
  - Anaerobic digestion generally feasible for farms larger than 400 head with government incentives
    - Electrical grid buyback programs
    - Green Energy grants, etc
    - Supplemental feedstocks from other industries nearby

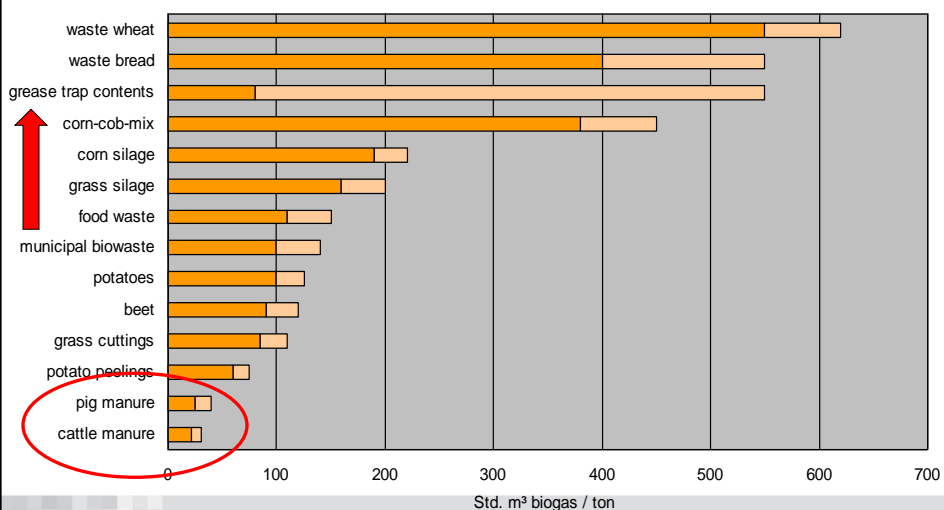
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## Biogas/Energy Production Technologies

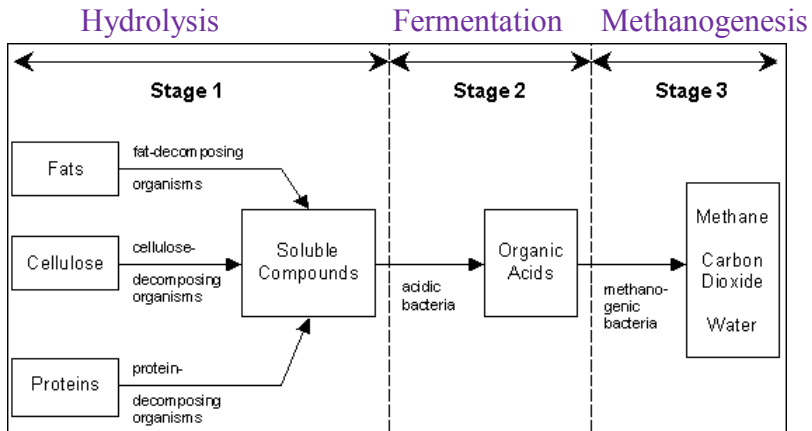
- Anaerobic Digestion
  - Liquid
  - Solid
- Gasification
  - Solids
  
- Yields approx. \$0.20 to \$0.40 per cow per day

## Biogas Yields of Various Feedstocks

This slide courtesy of Martin Schneider, Biogas Mission to Europe

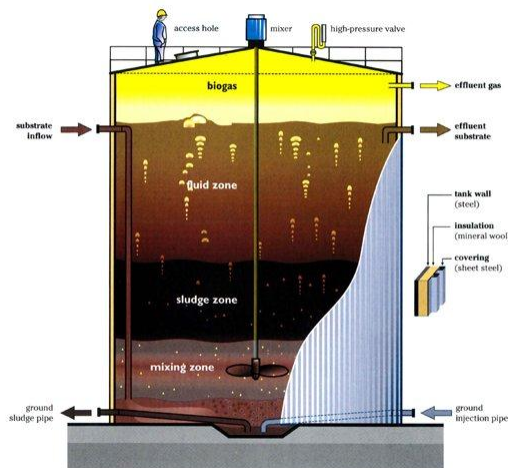


# Stages of Anaerobic Digestion



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# Anaerobic Digestion



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# Gasification

- Combustion of biomass with little to no oxygen to yield  $H_2$  and CO (Syngas)

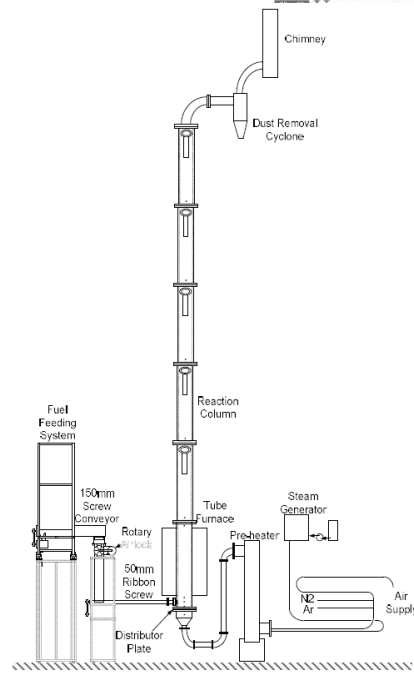


Figure 2: FBG pilot plant schematic

# Bakerview Eco Dairy, Abbotsford, BC









# Farm Power, Lynden, WA

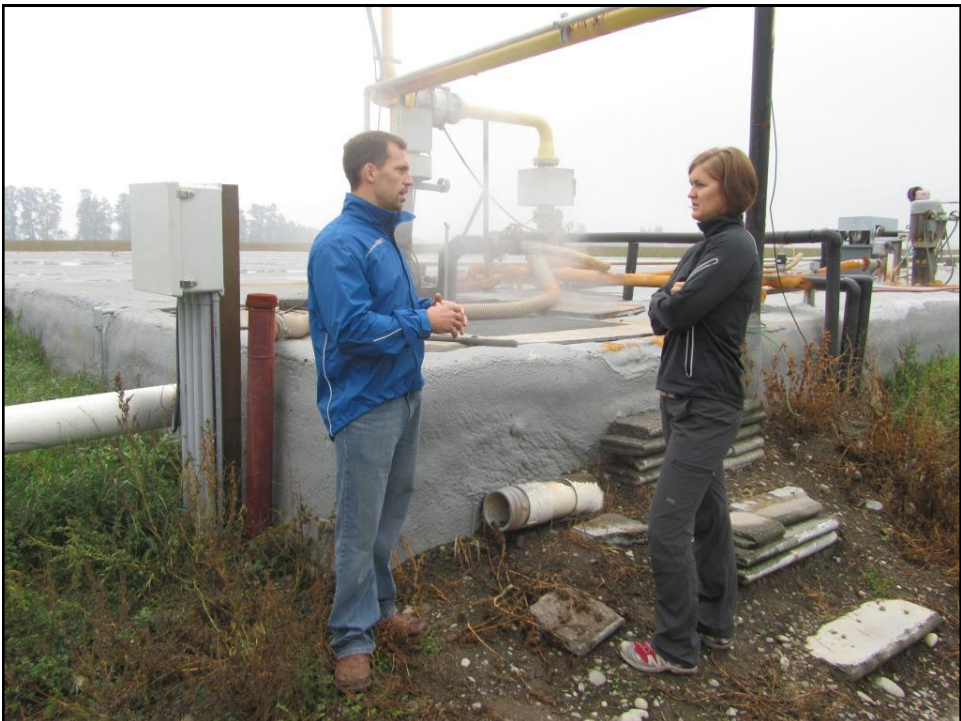


500 Cow Dairy



[www.usask.ca](http://www.usask.ca)















# Farm Power, Lynden, WA



2000 Cow Dairy



[www.usask.ca](http://www.usask.ca)









# Solids Separation for Bedding, Saskatchewan Dairy



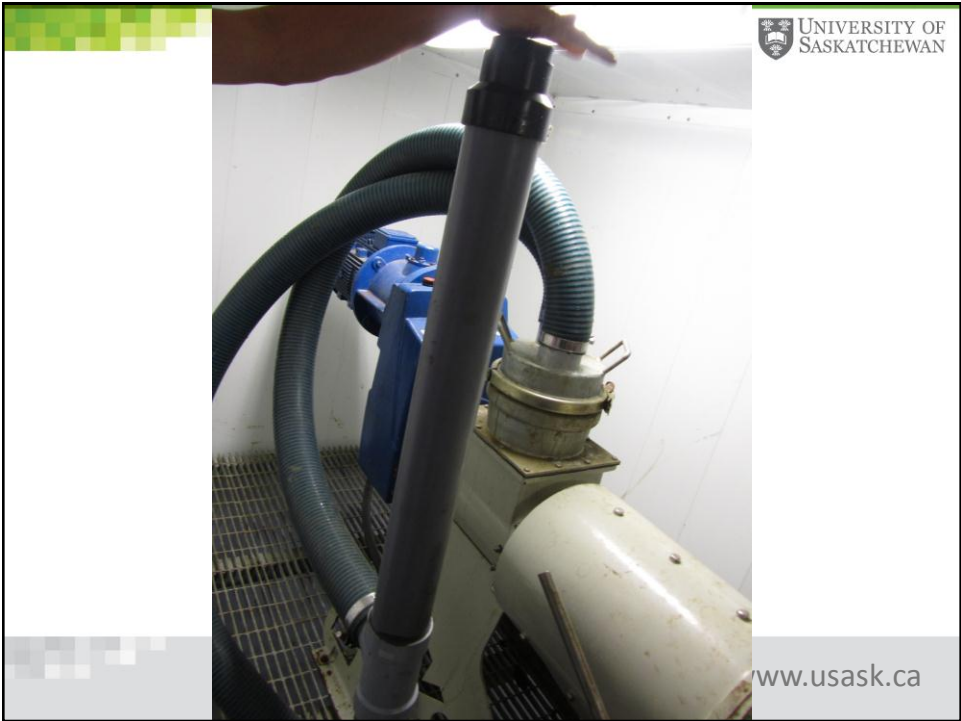
mjstc.en.alibaba.com

500 Cow Dairy (?)



[www.usask.ca](http://www.usask.ca)







## Economics

(Equipment (Yes), Systems (Maybe), O&M (No))

- Storage and Field Application (Yes)
- Solids Separation for Bedding (Maybe)
- Anaerobic Digestion or Gasification (No)
- Liquid Fertilizer Concentrate (No)
- Impact of outside materials (No)

## University of Saskatchewan

How can we help?



## Economics of Liquid/Solid Separation

- Liquid-solid separation systems
  - Gravity (settling ponds)
  - Mechanical
    - Screw press
    - Screens
    - Membrane filters
- Chemical

## Estimated Capital Costs of Separation Systems (Fleming & MacAlpine 2003)

Costs not including shelter and maintenance for each system

		L per kW-hr
SWECO Vibrating Screen	\$22,000	3000
SEI Screw Press	\$27,000	4800
Rotating Drum Screen	\$40,000	4300
Vibrating Screen + hydrocyclones	\$100,000	10500
VSEP Reverse Osmosis	\$400,000	95

# Flushed Dairy Manure Composition

