Anaerobic Digestion Biogas Potential in Support of Renewable Energy Development

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Introduction

Biomass Residuals

that contain a

Substantial Amount of Carbon

may produce

Renewable Energy in an Anaerobic Digestion System

Anaerobic digestion is complex, requiring substantial planning and feasibility testing to develop a successful design that meets objectives.

Biogas production, and consequently renewable energy, is maximized by strategically blending feed stocks.

Objective

Develop an iterative process to site and screen the potential for a centralized digester that treats blended biomass from multiple sources.

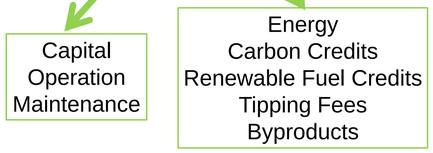
1. Establish objectives such as environmental protection, nuisance avoidance, renewable energy production, carbon credits or a combination.
2. Locate the facility and estimate feed stock constituents and energy potential.
3. Design an optimized feed stock produced from blended biomass sources.
4. Conduct a biogas assay to determine if the estimated energy potential is realistic and further consideration of the anaerobic digestion system is warranted.

Technique

1. Establish Objectives and Define Success

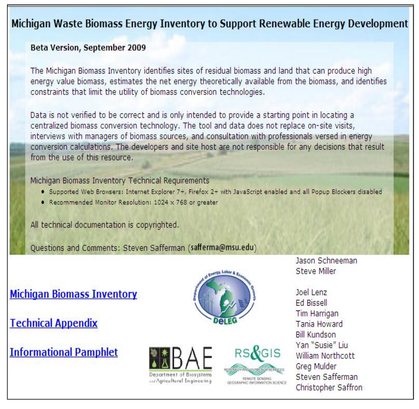
Economic Success

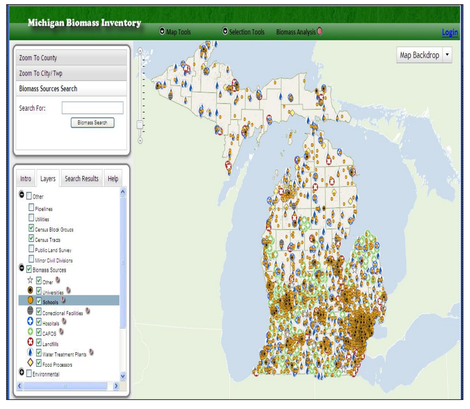
Expenses / Revenues

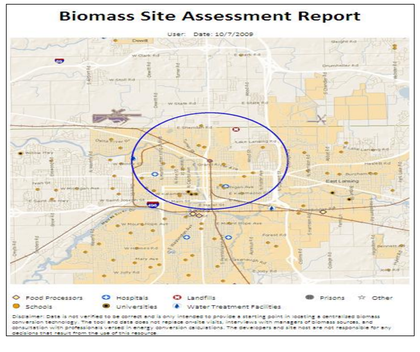


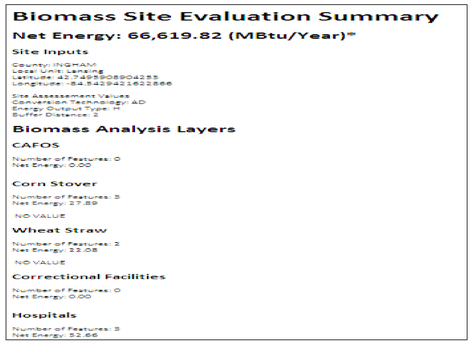
Environmental Protection: odor, pathogen, and nutrient control

2. Locate Facility and Estimate Energy Potential







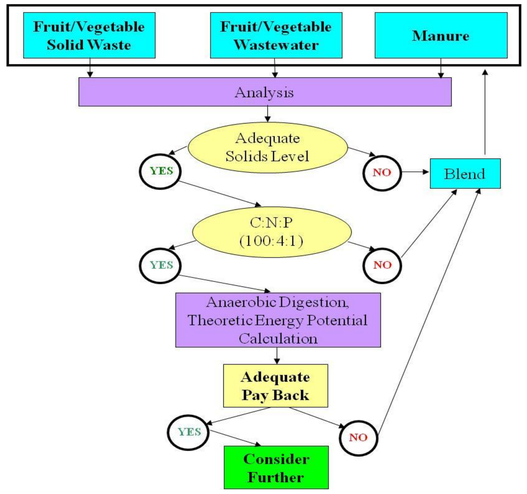


Michigan Waste Biomass Inventory Tool

http://mibiomass.rsgis.msu.edu/

(Schneemann, J., Miller, S., Liu, Y., Safferman, S. 2009. "Waste Biomass Energy Inventory to Support Renewable Energy Development," *2009 ASABE Annual International Meeting,* Reno, Nevada)

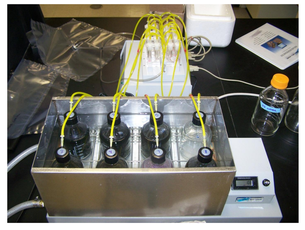
3. Determine Theoretical Optimized Blend



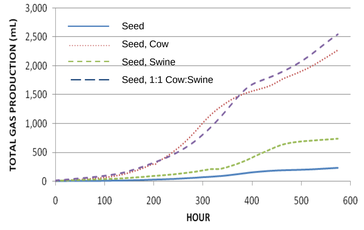
Biomass Source Blending Decision Model

(Adapted from Liu, Yan, Miller, S. A., Safferman, S. I. 2008. "Alternative Treatments of Food and Manure for Biogas Production." *Biofuels, Bioproducts & Biorefining,* 3:30-31)

4. Biogas Assay to Determine if Objectives Realized



Anaerobic Respirometry



Sample, Cumulative Volume

Vessel	Initial pH*	Initial Alkalinity** (mg $CaCO_3$)	Initial Ammonia+ (mg N)	COD				Volatile Solids			
				Initial (mg)	Final (mg)	Destroyed (mg)	% Reduction	Initial (mg)	Final (mg)	Destroyed (mg)	% Reduction
Seed	7.96	1885	254	5558	4761	797	14	3974	3171	803	20
Seed, Cow	7.08	3523	505	15909	11009	4900	31	8412	7204	1208	14
Seed, Swine	7.98	2691	478	8954	7256	1698	19	5392	4410	981	18
Seed, 1:1 Cow:Swine	7.74	4173	724	17721	14463	3258	18	10856	8785	2071	19

Sample, Constituents Before and After Assay

(Henderson, E. M., Safferman, S. I. 2007. "Anaerobic Digestion Feasibility Protocol for Fruit and Vegetable Processors," Proceedings, *2007 ASABE Annual International Meeting*, Minneapolis)

Acknowledgements