

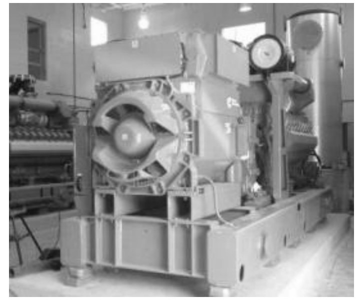

Summary of WERF Methane and Biogas-CHP-Related Research

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Collaboration. Innovation. Results.

Methane Expo 2013

Brown AND Caldwell

John Willis, Brown and Caldwell
Lauren Fillmore, Water Environment Research Foundation

March 14, 2013

WERF NYSERDA • Brown and Caldwell • Black & Veatch • Hemenway Inc. • NEBRA

Today's Presentation

- Barriers to Biogas Use
- Barriers to Biogas Use Economics
- LCAMER
- Fugitive Methane Research:
  - Flare Emissions Estimator
  - Collection Systems
  - Lagoons and Ponds

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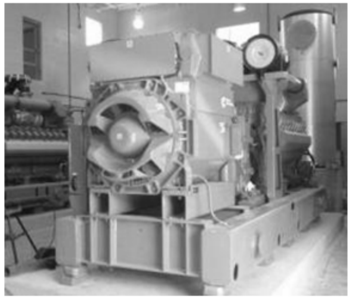


Barriers to Biogas Use

Project Overview

PHASE I
Establish Framework

- Conduct Kickoff Mtg. to Align Goals and Objectives
- Collect and mine relevant project experience
- Develop online survey content and define output requirements

PHASE II
Develop and Launch Survey

- Develop electronic survey
- Roll-out to utilities
- Analyze survey results

PHASE III
Conduct Focus Group Meetings

- Conduct meetings (over course of project)
- **WEF Nutrient Mgmt. (Jan. 9, 2011, Miami)**
- **NYWEA 2011 (Feb. 9, 2011 New York)**
- **WEF R&B 2011 (May 25, 2011 Sacramento)**
- **WEF Water & Energy 2011 (Aug. 3, 2011 Chicago)**

PHASE IV
Analyze Results/Summarize

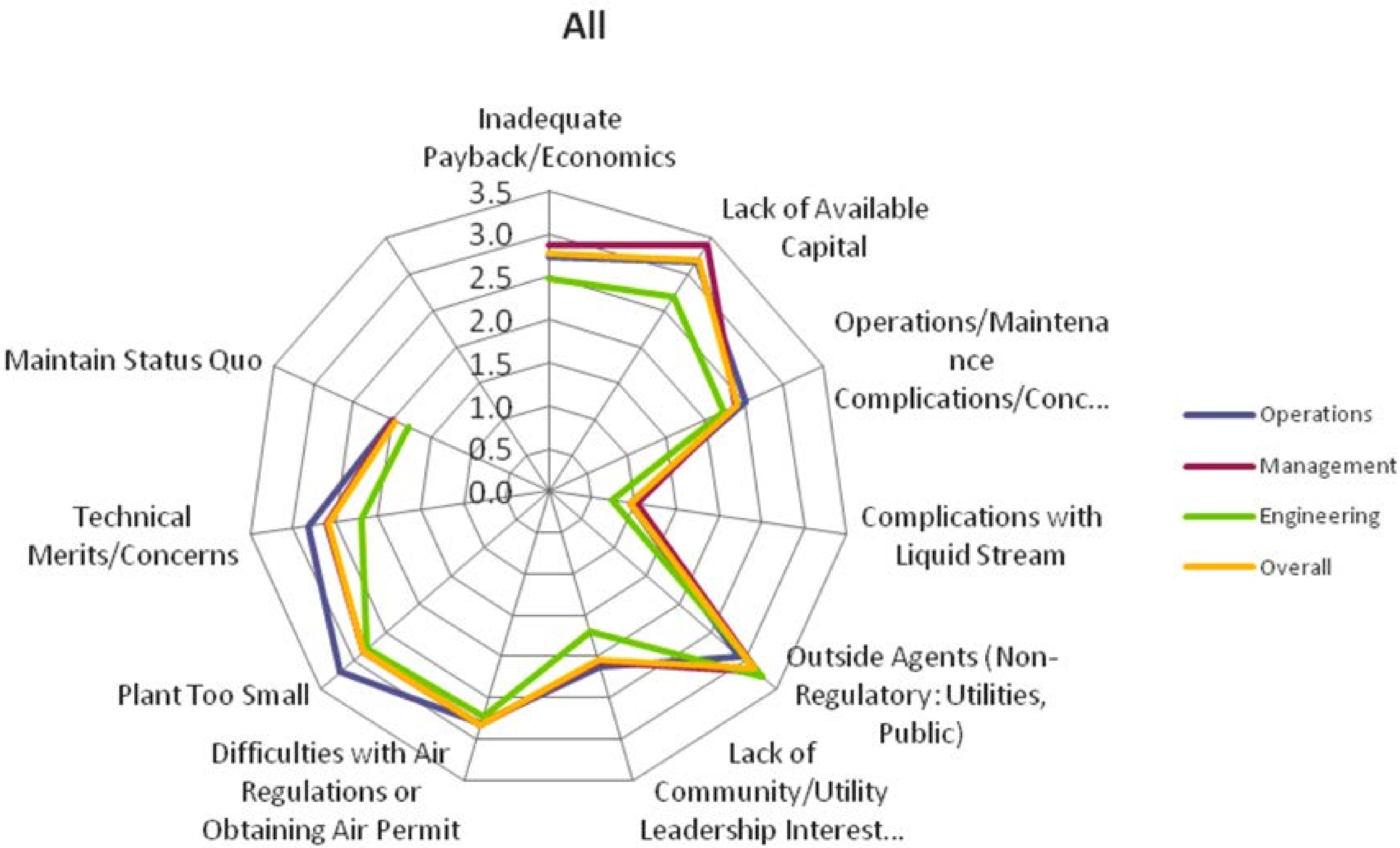
- Analyze barriers
- Identify strategy recommendations to overcome barriers
- Summarize – Draft and Final Reports including Utility Profiles

Final Report is Available from WERF

- Executive summary
- Introduction
- Biogas uses for renewable energy
- Online survey overview, results & interpretation
- Focus group summaries
- Small plant barrier mitigation
- Non-utility perspectives on barriers
- Conclusions and recommended next steps
- Plus: case studies, focus group minutes

Report is available at:
http://www.werf.org/a/ka/Search/ResearchProfile.aspx?ReportId=OWSO11C10

Survey Data – Example of Data Presentation



Conclusions

- The most significant barriers to biogas use are economic:
  - higher priority demands on limited capital resources
  - perceptions that economics do not justify investments
- Outside agents like power utilities can be barriers
- Air permitting can be a significant barrier in specific geographies/permitting situations
- Public agencies' decision-making practices often hinder biogas use

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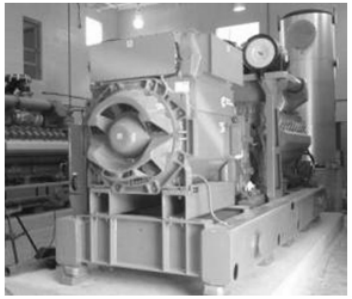
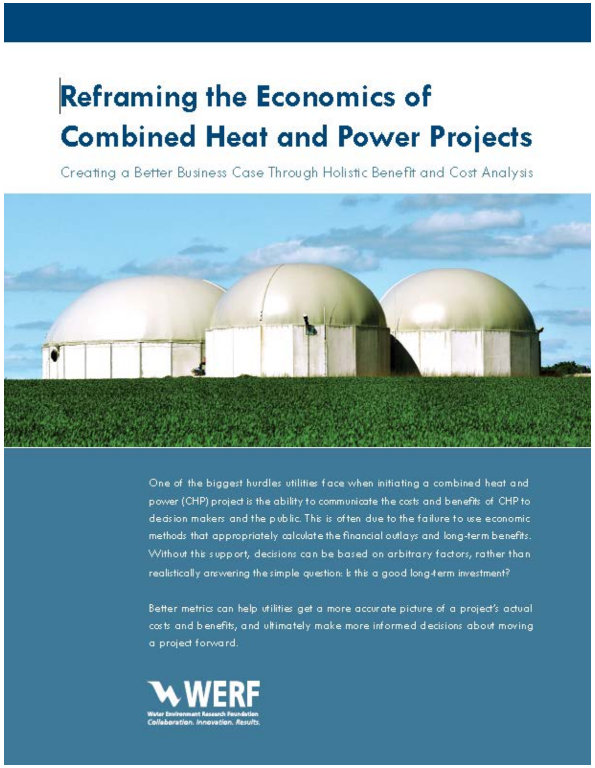
    

Barriers to Biogas Use Economics

Simple Payback is used Too Often, but has Significant Shortcomings

- Does not consider time-value of money
- Does not consider impact on cash flow
- Criterion: Allows a sliding scale for determination of suitability



Other Options Provide more Comprehensive and Definitive Treatment

- Net present value (NPV)
- Benefit cost ratio (BCR)
- Internal rate of return (IRR)
- Equivalent uniform annual net value (EUAV)

- These Options:
  - Do consider time-value of money
  - Do consider impact on cash flow

Case Study in Factsheet shows Juxtaposition:

Table 1. Financial Results for Alternative Metrics

	Item	Alternative 1 – Constant	Alternative 2 – Escalated
	Capital Cost	$4,200,000	$4,200,000
	Annual Operating Savings	$334,257	$367,264
???/???	Payback Period	12.6 years	11.4 years
	Project Action	Dependent on utility's requirements for payback period, this value can result in the project being rejected	Dependent on utility's requirements for payback period, this value can result in the project being rejected
	Present Value of Savings (or Benefits)	$9,681,618	$9,929,725
	Present Value of Costs	$9,299,692	$9,162,267
GO/GO	Net Present Value	$381,925	$767,457
	Project Action	NPV > 0, so consider accepting CHP project	NPV > 0, so consider accepting CHP project
GO/GO	BCR	1.041	1.084
	Project Action	BCR >1, so consider accepting CHP project	BCR >1, so consider accepting CHP project
	Discount Rate, i	3.5%	3.5%
GO/GO	IRR	4.5%	5.5%
	Project Action	IRR > i, so consider accepting CHP project	IRR > i, so consider accepting CHP project
	EUAB	$681,209	$698,666
	EUAC	$654,336	$644,667
GO/GO	NUV	$26,873	$53,999
	Project Action	NUV > 0, so consider accepting CHP project	NUV > 0, so consider accepting CHP project

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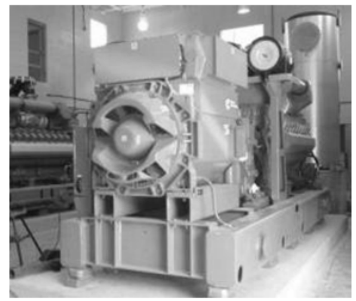


LCAMER

(Slides Courtesy of Hugh Monteith, Hydromantis)

What Digestion/CHP System is Right for Me?

Electricity Cost?

Plant size?

Natural Gas Cost?

Methane Content?

Borrowing cost?

Biogas Production?

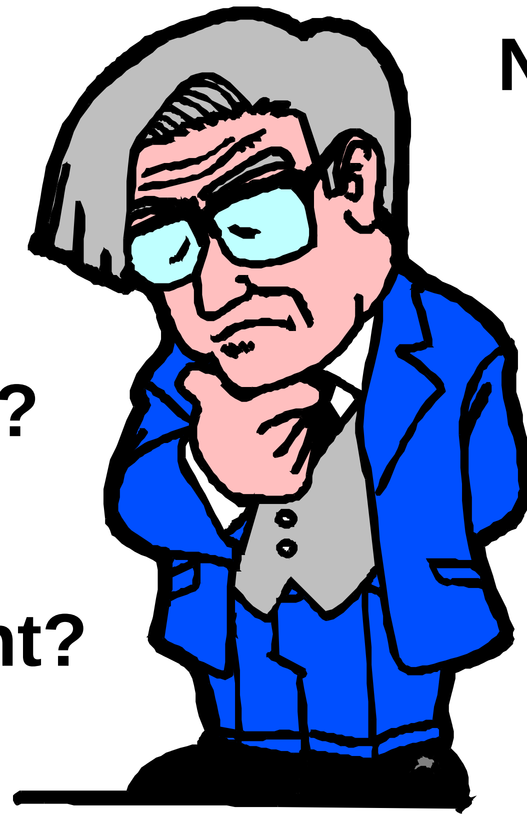
GHG Credits?

Biogas Pretreatment?

Sell electricity or use onsite?

Emission Regulations?

Government Assistance?



LCAMER was developed to:

- Create a tool for comparing the benefits and costs of digester energy recovery over the lifetime of a WWTP
- Predict the most economically viable solids treatment and energy recovery alternatives for given data sets

LCAMER Worksheets:

- 5 worksheets non-modifiable by users
  - Info to users
  - Energy Recovery System (ERS) emission factors
  - Default temperatures for States/Provinces
  - hydrolysis constants for VSR in digesters
  - replacement costs for ERS
- 3 worksheets user-accessible
  - Basic conversion factors
  - Technical inputs and models
  - Economic inputs and models

Validation of LCAMER

- Focus was on demonstrating the applicability, effectiveness, and areas of improvement for LCAMER
- Process variables and financial cost factors were adjusted to meet actual conditions at the 2 sites, resulting in successful implementation of LCAMER
  - Reinforced choice of ICE for CHP at Gwinnett County (GA)
  - Provided basis for choice of ICE at Pinellas County (FL)

Examples of LCAMER Uses:

- Compare economics for
  - Different energy recovery processes
  - Convert from mesophilic to thermophilic operation (same energy recovery system)
  - Use of advanced sludge treatment to enhance volatile solids reduction for increased gas production
  - Imported digester feedstocks
  - Evaluation of peak load shifting

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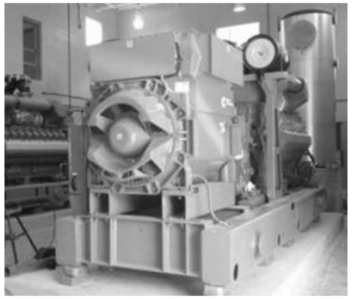
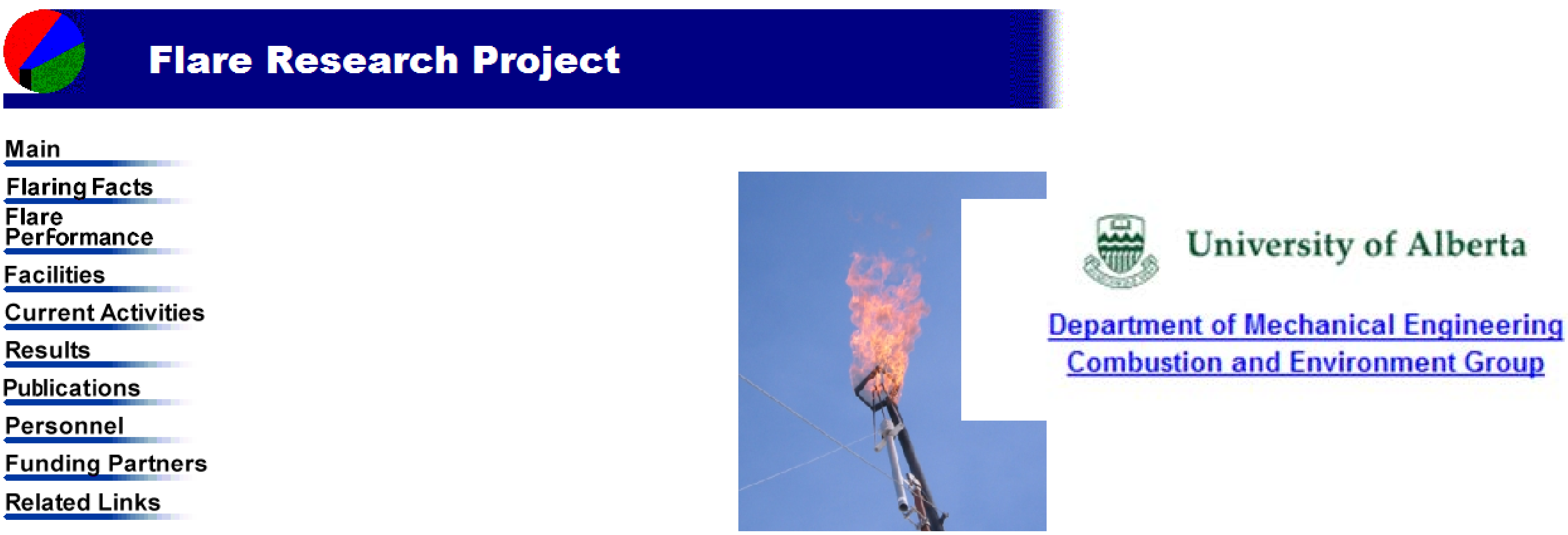


Fugitive Methane Research: Flare Emissions Estimator

WERF Flare Efficiency Calculator

- Model developed by University of Alberta from data collected during Flare Research Project
- Developed for digester gas and landfill gas



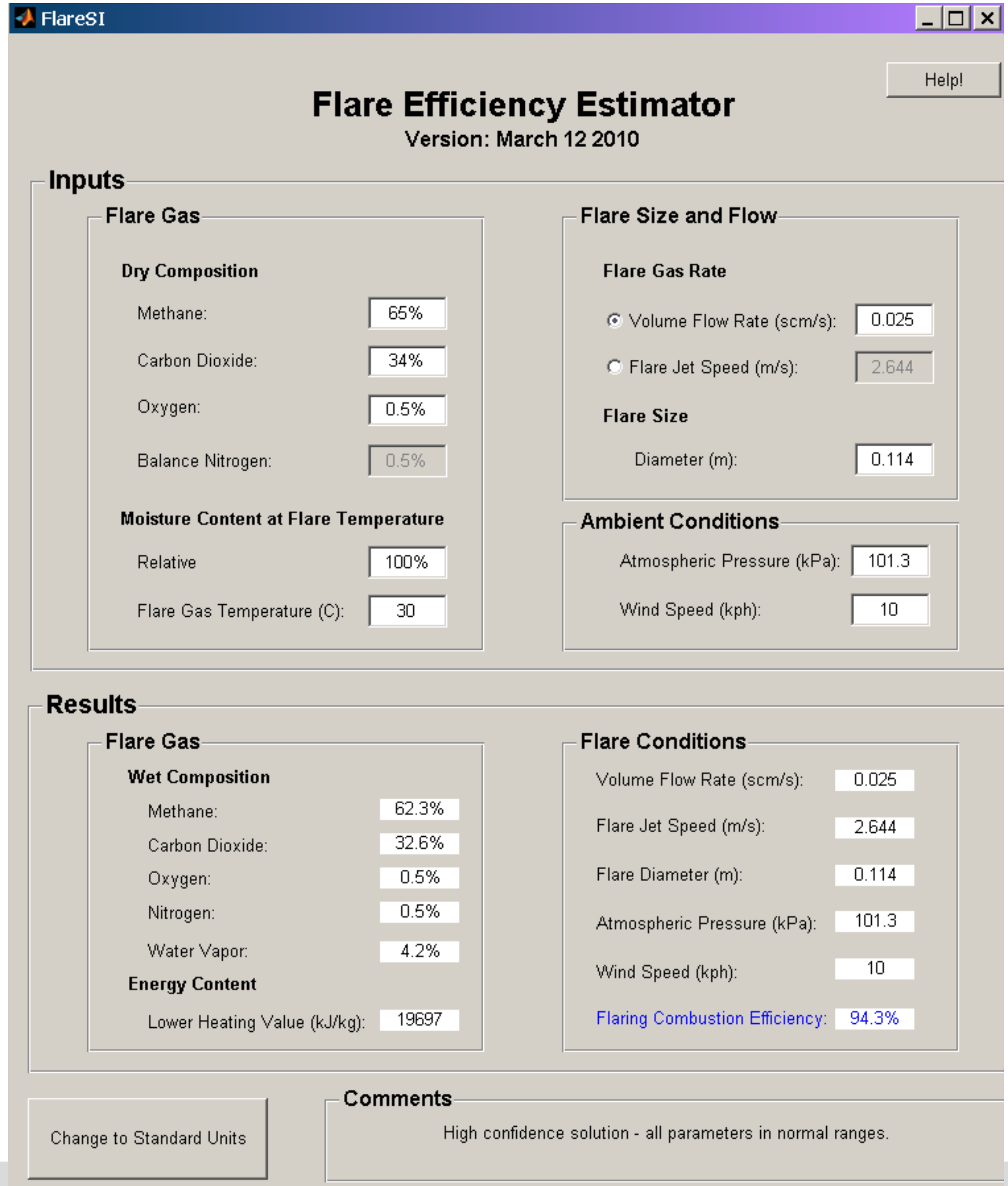
Model Inputs Include:

- Dry Gas CH_4, CO_2,and O_2 Fractions
- Temperature of Gas
- Relative Humidity of Gas
- Gas Flowrate and Nozzle Diameter calculate Flare Jet Speed
- Wind Speed

- Output is Flare Efficiency

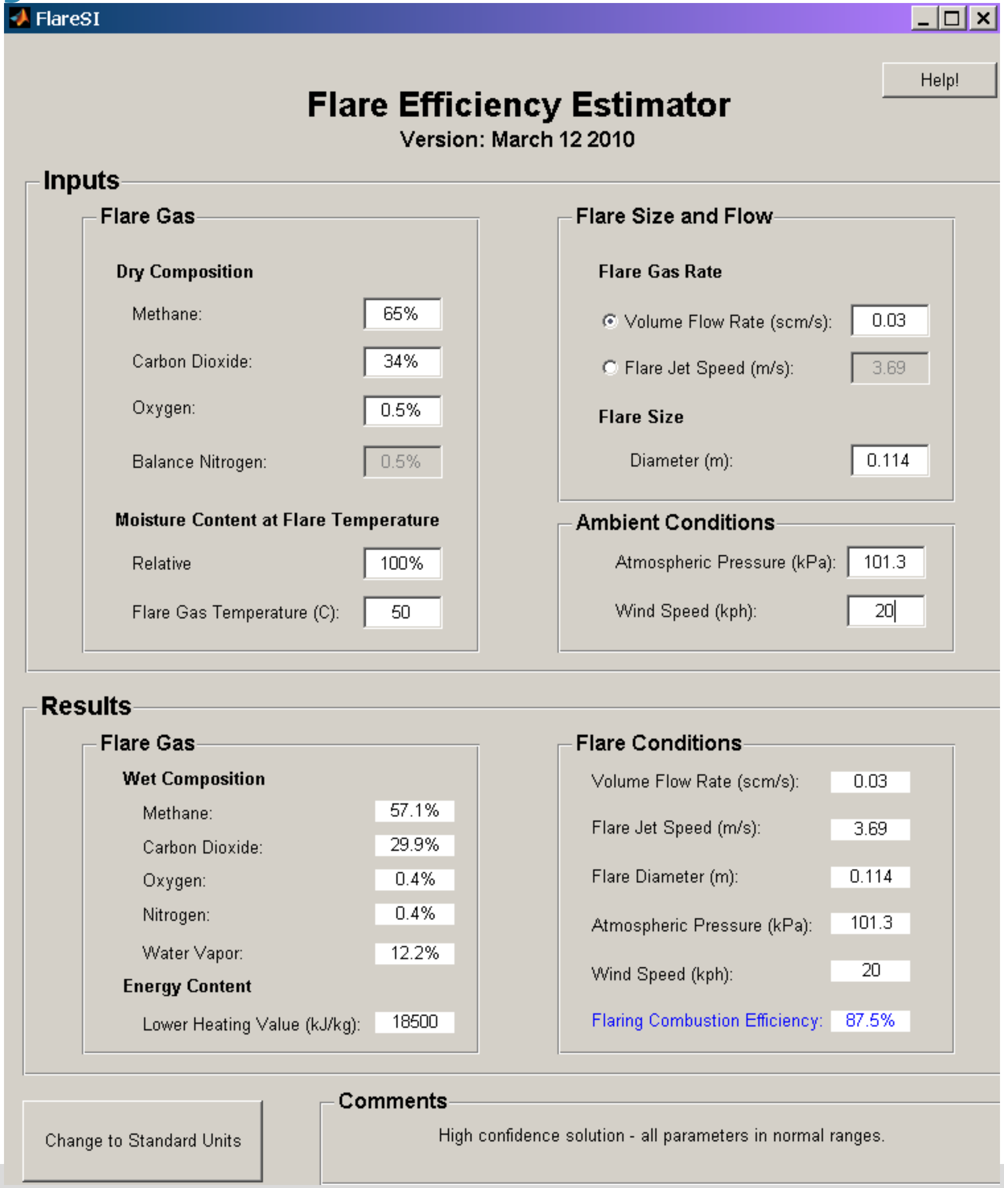
How Efficient are Conventional Flares?

- USEPA assumes 99% efficiency
- **Model predicts 94.3%for**



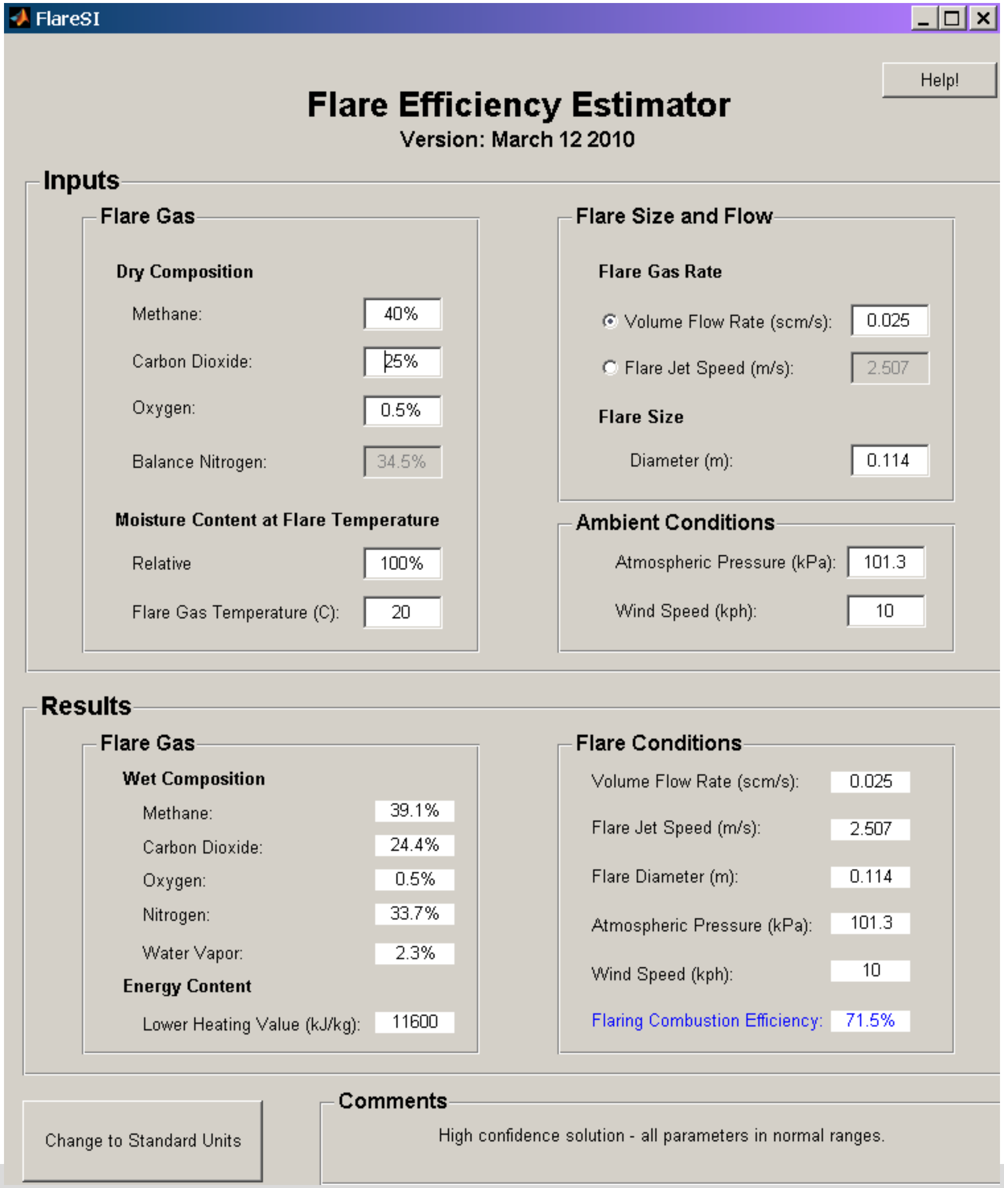
Thermophilic and Windy?

- USEPA assumes 99% efficiency
- **Model predicts 87.5%for thermophilic biogas with 20mph winds**



Landfill Gas and Moderate Winds?

- USEPA assumes 99% efficiency
- **Model predicts 71.5% for landfill gas with 10mph winds**

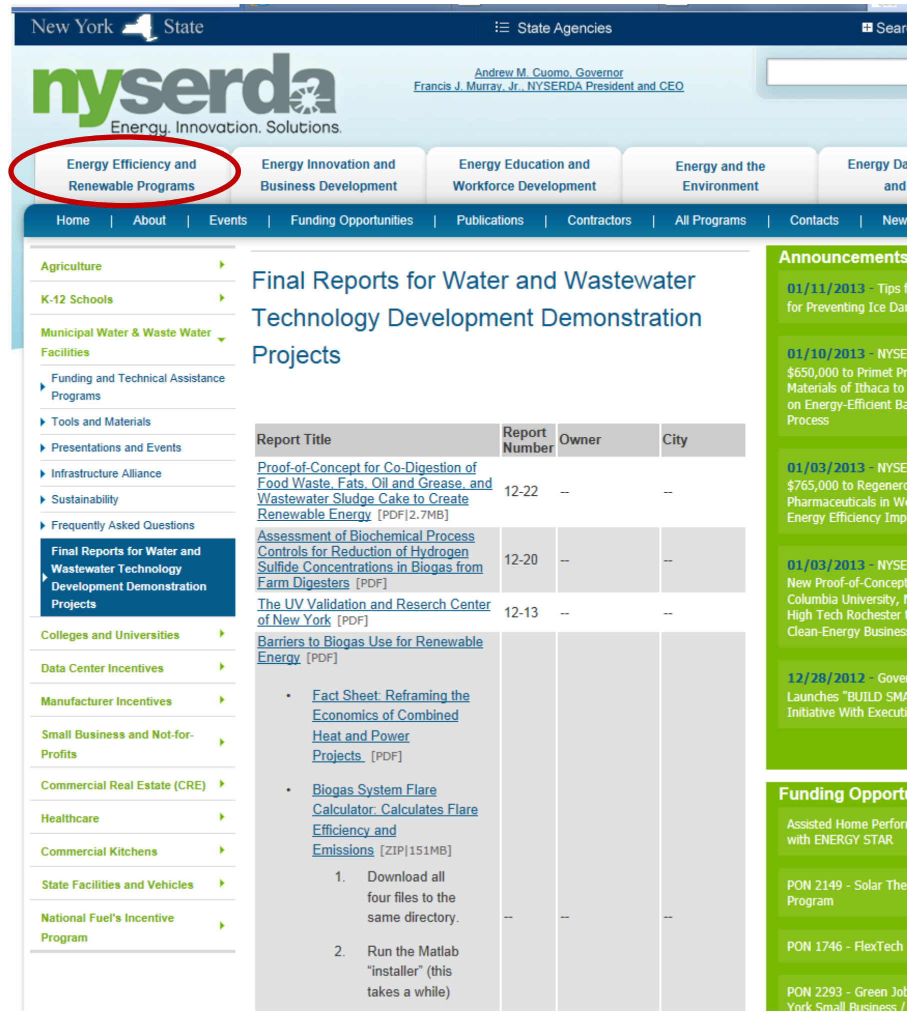


How Significant is the Difference?

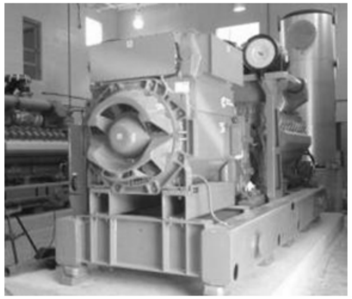
- WWTP in Georgia treating 34 mgd:
  - EPA at 99% assumed efficiency = 116 MT CO_2e/year
  - Flare tool estimated efficiency of 94.5% = 638 MT CO_2e/year
- WWTP in Tennessee treating 80 mgd:
  - EPA at 99% assumed efficiency = 205 MT CO_2e/year
  - Flare tool estimated efficiency of 96.6% = 693 MT CO_2e/year

Flare Emissions Estimator is Housed at NYSERDA.NY.gov

- Energy Efficiency and Renewable Program
- Commercial and Industrial
- Municipal Water and Wastewater
- Final Reports
- Barriers to Biogas
  - Flare Calculator







Fugitive Methane Research: Collection Systems

WERF Collection-System Methane is Centered in Two, Sequential Projects

- Results of First Project are published in

Global Water
Research Coalition

IWA affiliate

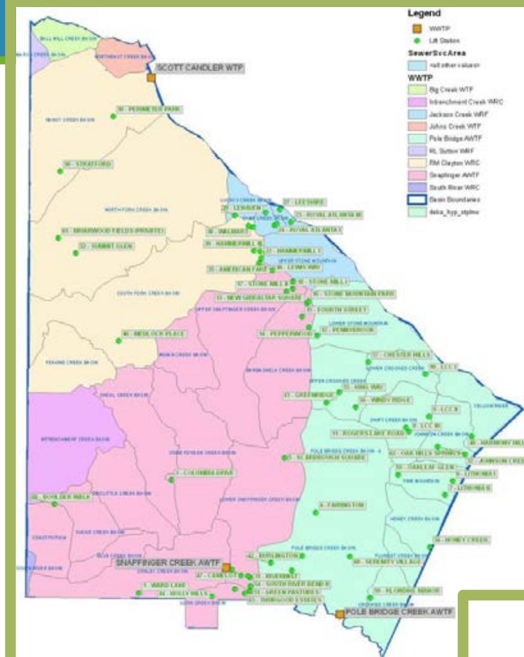
N_2O and CH_4 Emission from Wastewater Collection and Treatment Systems

State of the Science Report

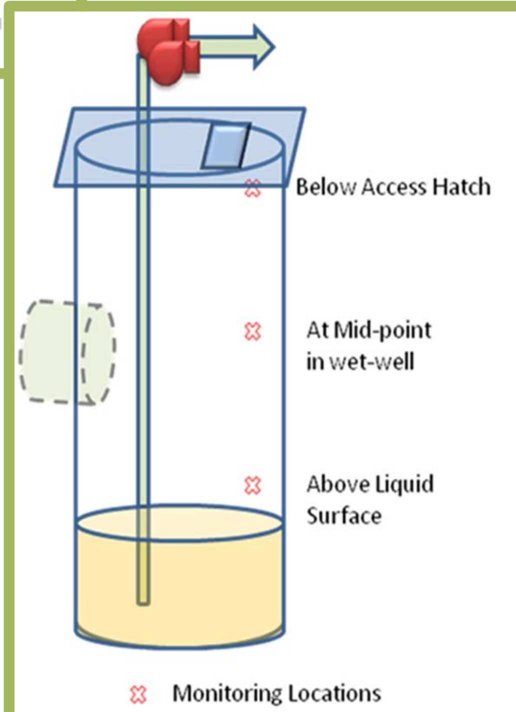
Global Water Research Coalition
www.globalwaterresearchcoalition.net

DeKalb County (GA) was First Project Site

- Serves over 600,000
- 64 sanitary sewage lift stations

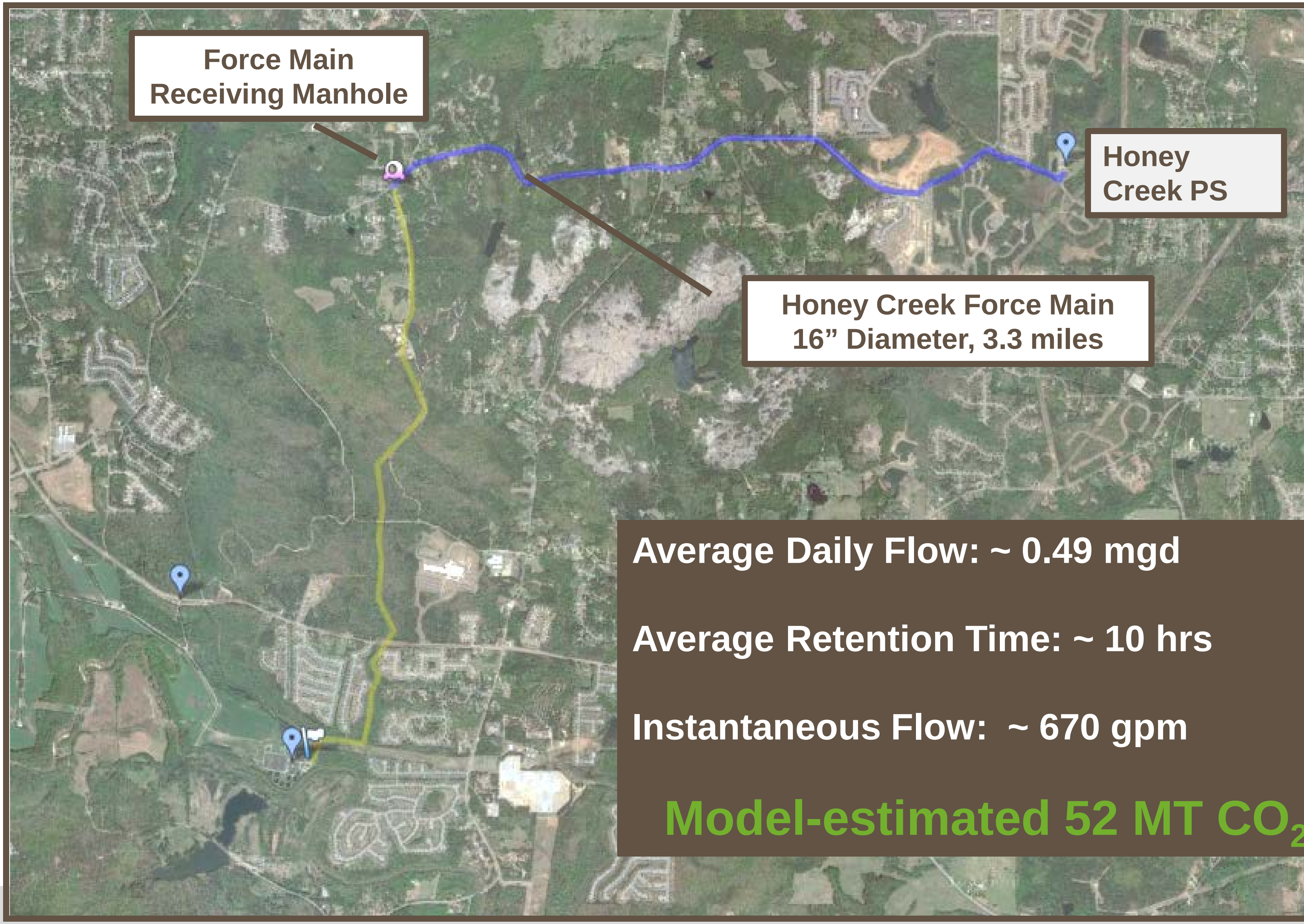


	Summer CH_4 (lb/half yr)	Winter CH_4 (lb/half yr)	Annual CH_4 (lb/yr)	Annual CO_2e (lb/yr)	Annual CO_2e (MT/yr)
Totals:	75,110	23,371	98,481	2,068,107	940



- Found to have 940 MT CO_2e/yr of CH_4

Honey Creek PS and FM



Average Daily Flow: ~ 0.49 mgd

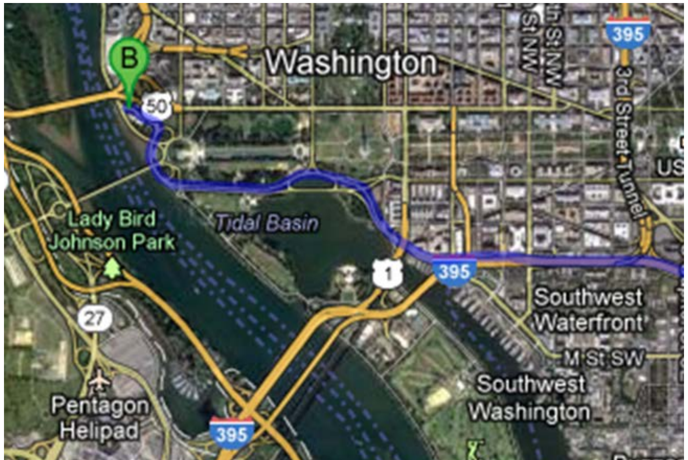
Average Retention Time: ~ 10 hrs

Instantaneous Flow: ~ 670 gpm

Model-estimated 52 MT CO_2e

New Project (CAPS) will Model DCWater's Collection-System-wide CH_4 Emissions

- Calibration of
  - Potomac Interceptor
  - Potomac Forcemain
- Estimation of system-wide emissions
- Parallel H2S investigation
- Calibration/testing of mitigation chemicals



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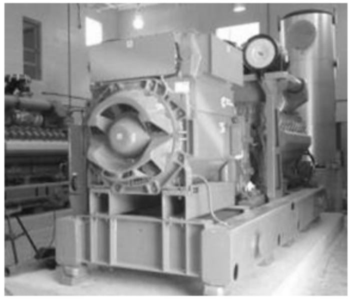
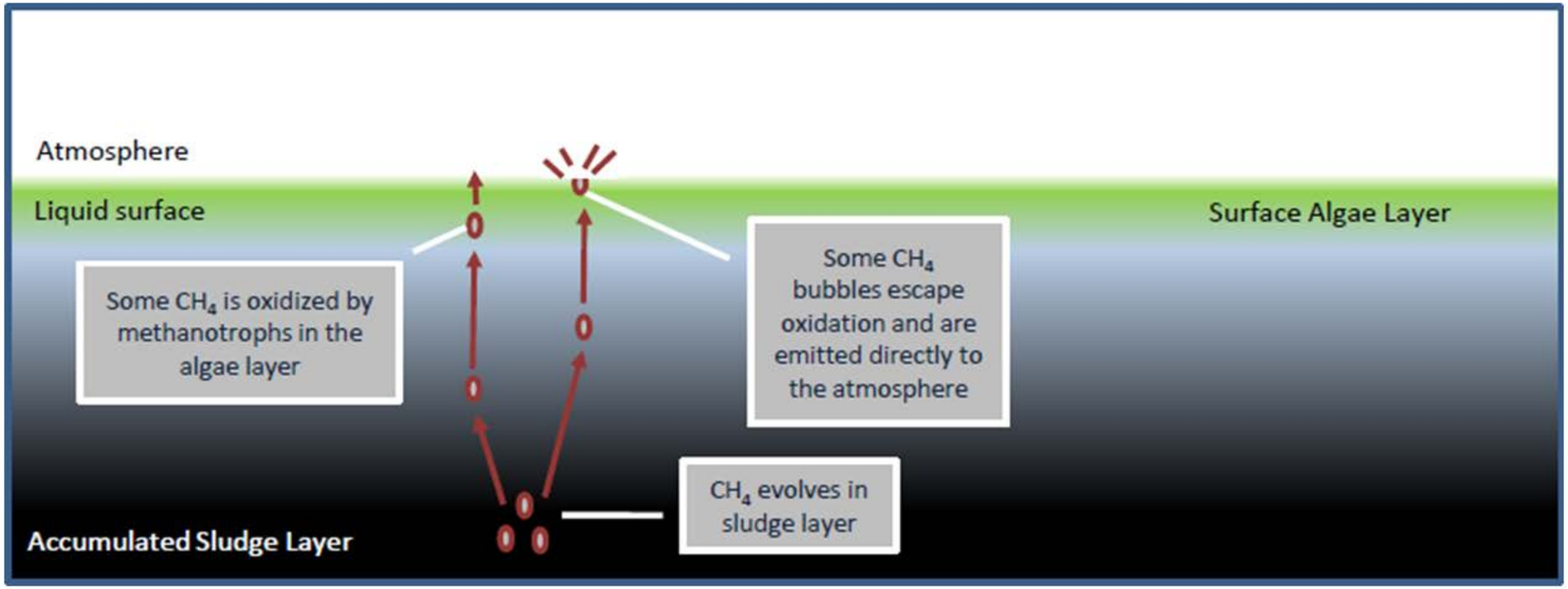
    

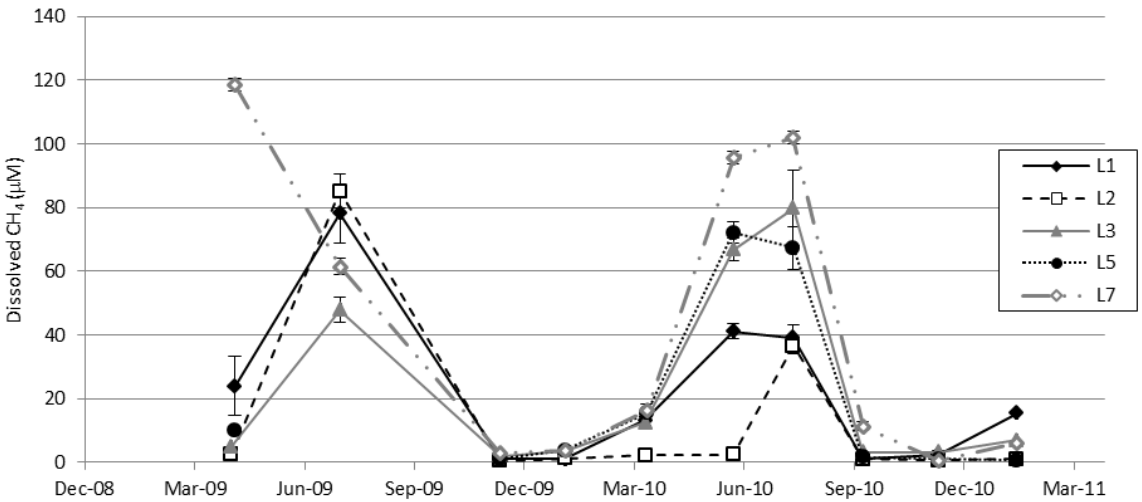
Fugitive Methane Research: Lagoons and Ponds

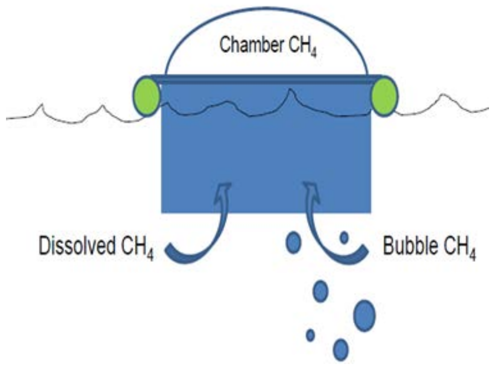
Explored Methane Evolution, Processing and Emissions from Low-Energy Treatment Processes

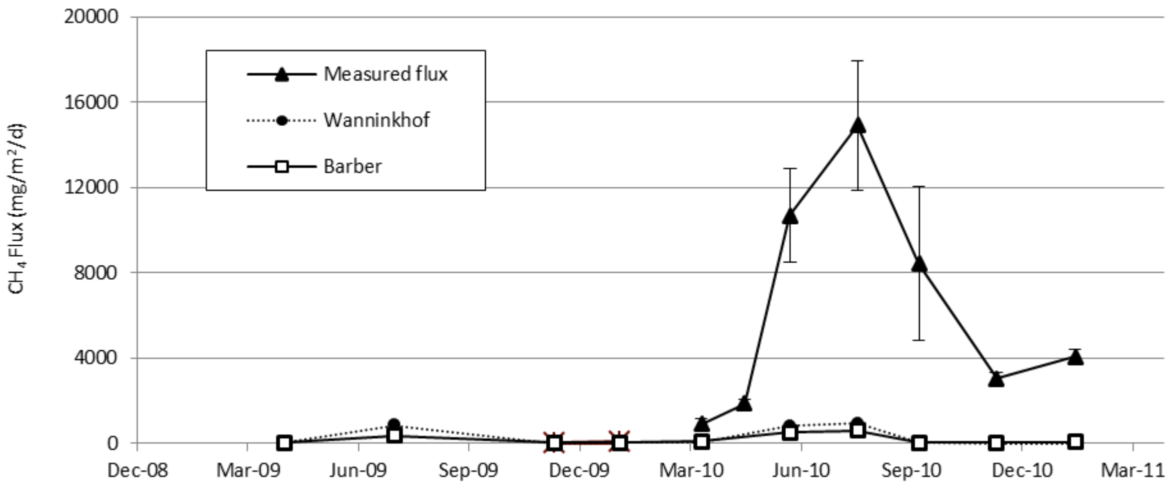
- Teamed with Ames (NASA)
- Tested Photosynthetic Oxidation Ponds and Facultative Sludge Lagoons (fed from digesters)



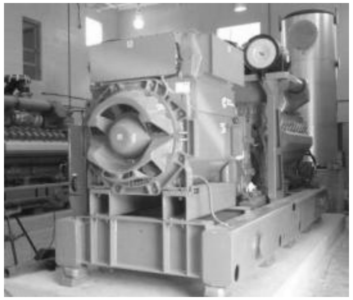
Results to be Published in next 6 months









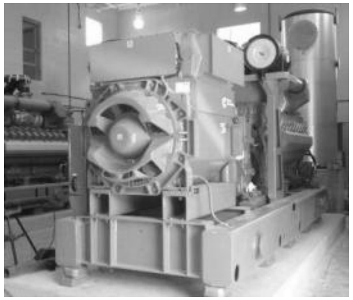


Summary

Summary

- WERF has been doing quite a bit of wastewater treatment research on:
  - How to Enhance Energy Production from Wastewater Treatment
  - Determination of Greenhouse Gas Emissions
- Log-on to www.WERF.org and become a subscriber





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