Strategies for Reducing Greenhouse Gas Emissions

Benefits and Opportunities from Anaerobic Digestion at Wastewater Treatment Plants

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CH2MHILL

Drivers for Change

- Climate Change
- Global Economic Downturn
- Oil Reserve Uncertainty
- Global Increase in Standard of Living
- Security

- Aggressive Governmental Policy Change

- Sustainable Systems

Wastewater Treatment Plants…

- Cleaner effluents => More sludge
- Larger treatment plants => More Complex Technologies (Anaerobic Digestion and Incineration)
- PRASA uses incineration at its flagship plant and anaerobic digestion at a few smaller plants
- Anaerobic digestion can *reduce* GHG if the biogas is used for energy production, and can process other wastes (food, FOG, high-strength) together with sewage sludges) into biogas

Today's Focus–Anaerobic Digestion

- Anaerobic Digestion yields a biogas – 60 to 70% methane (CH_4)
- Biogas is not a clean fuel – must be treated for uses such as cogeneration of electricity and heat for digester heating
- Electricity in the Caribbean is uniquely expensive => a great incentive to find projects that work

What makes a cogeneration project work?

1st Requirement – A Digester

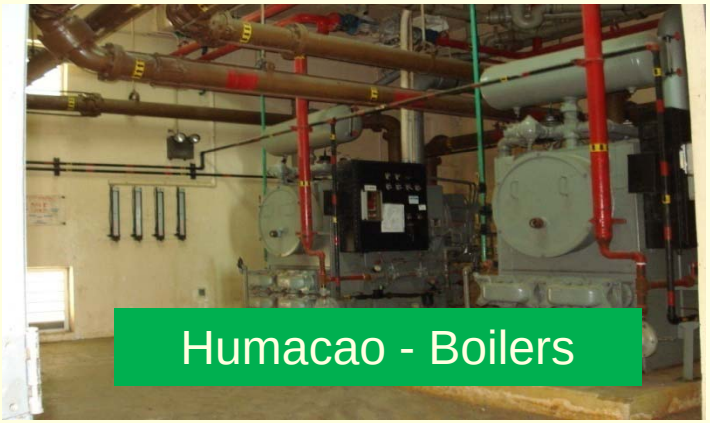
PRASA digesters:

- Humacao WWTP
- Ponce WWTP
- Cayey WWTP
- Guayama WWTP
- Largest facilities are at Ponce and Humacao.

2nd Requirement – Support Systems

- Receiving facilities
- Grit removal
- Sludge Thickening
- Sludge and digester heating
- Biogas treatment
- Gas storage
- Gas utilization
- Energy connections

Ponce – Grit Removal


Humacao - Boilers

How can we make more biogas?

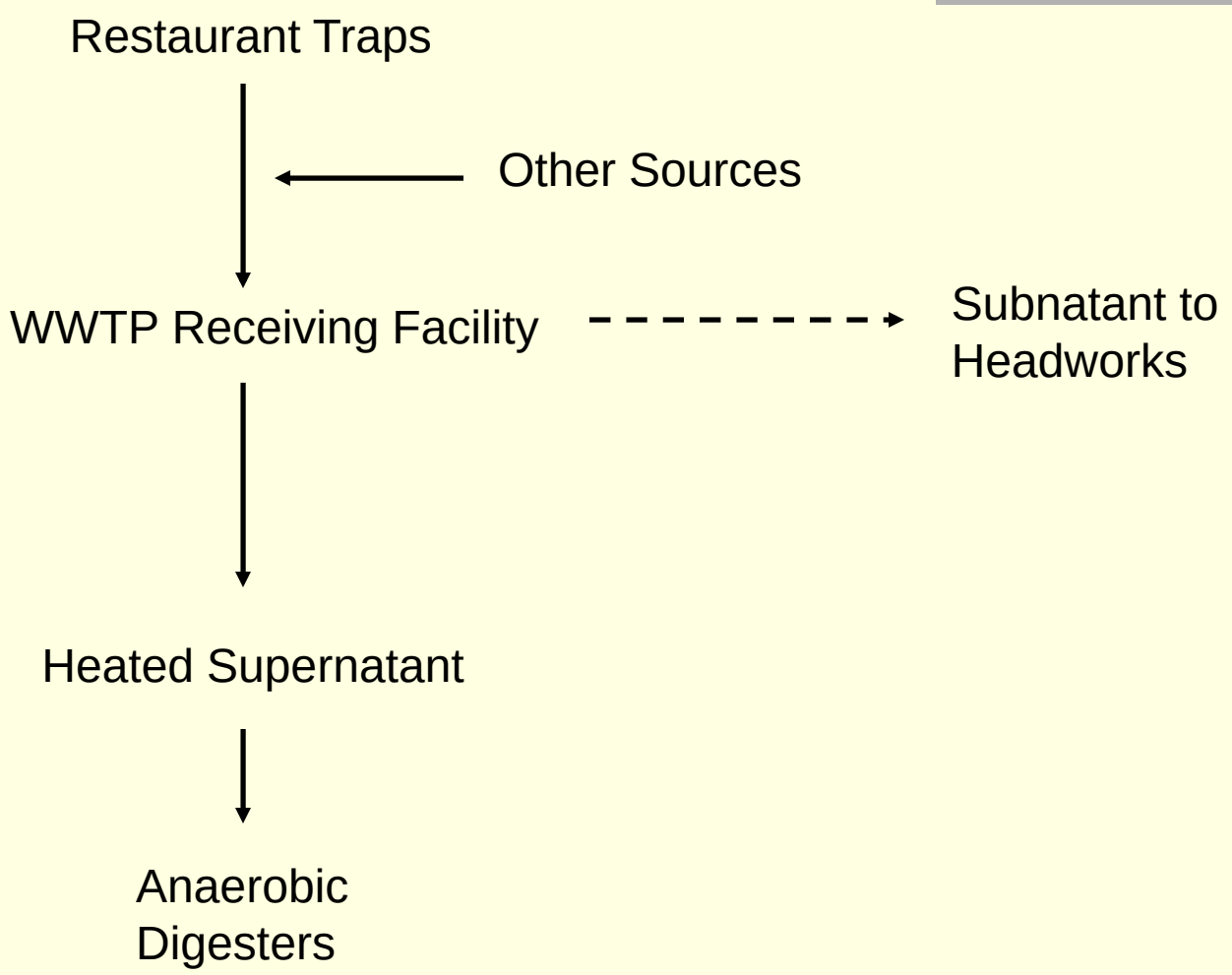
- Add to the sludge feedstock
  - FOG wastes (~100% volatile solids)
  - Food wastes (diverse characteristics)
  - High-strength organic wastes
- Advanced Anaerobic Digestion
- Pre-conditioning before anaerobic digestion

Today's Focus – Adding to the Feedstock

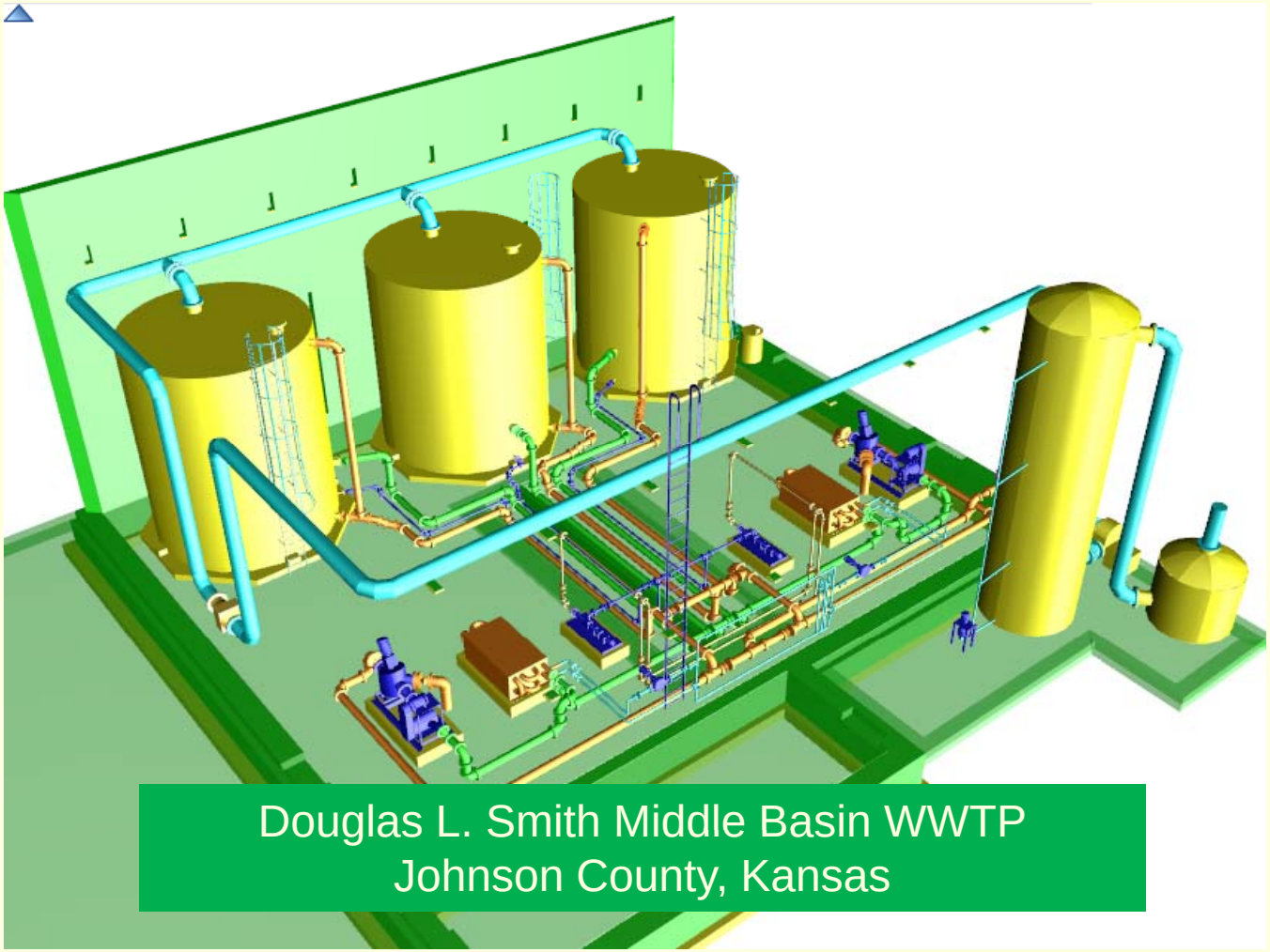
Food Wastes

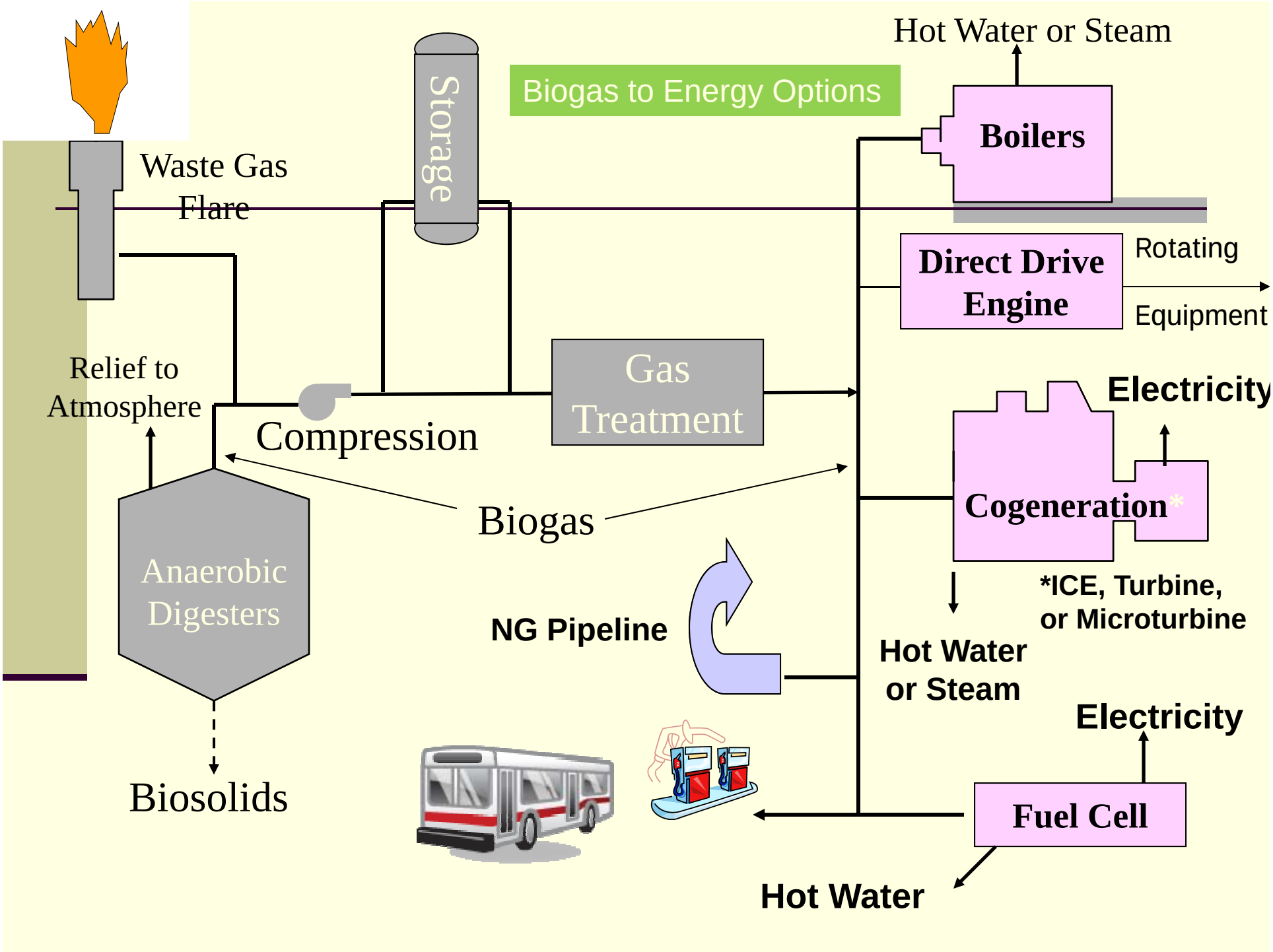
- Energy yield ~ COD loading
- Receiving facility design depends upon:
  - waste availability (liquid, solid, etc.)
  - what waste preparation can be done off-site
  - typical preparation – screening, maceration, blending & equalization
- Principal challenges – loading variability (hourly, daily & seasonally); odor control; truck traffic & impact on digester (grit, scum, etc.)

FOG to Anaerobic Digestion …



FOG Waste Receiving Station …




Biogas to Energy Options
Hot Water or Steam
Boilers
Storage
Waste Gas
Flare
Direct Drive
Engine
Rotating
Equipment
Relief to
Atmosphere
Gas
Treatment
Electricity
Compression
Cogeneration*
Biogas
Anaerobic
Digesters
*ICE, Turbine,
or Microturbine
NG Pipeline
Hot Water
or Steam
Electricity
Biosolids
Fuel Cell
Hot Water

Combined Heat and Power System Choices

	Engine Generator	Turbine Generator	Micro Turbine	Fuel Cell
Unit Size, kW	150 to 1500	Over 1000	30	1000
Appropriate Plant Size	Small to Large	Large	Small	Large
Efficiency, %	30	24 to 30	27	37
Thermal Efficiency, %	50	50	50	50
Overall Efficiency, %	80	74 to 80	77	87
Typical Costs				
Maintenance, $/kWh	0.022	0.032	0.018	0.032 – 0.04
Installed, $/kW	2000	2000	2200	7200 - 9200

Source: LCAMER WERF

Sorting the Strategies – Two New Tools from WERF make it easier …

LCAMER

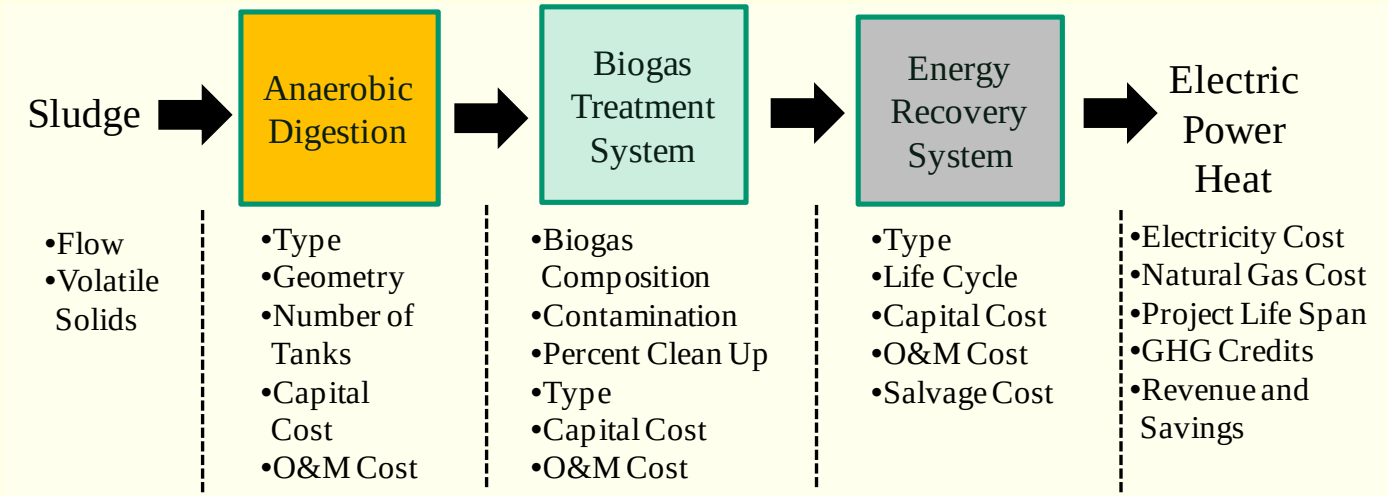
- Life Cycle Assessment Manager for Energy Recovery
- Prediction of optimized energy recovery from anaerobic digestion facilities

CHEApet

- Carbon Heat Energy Assessment plant evaluation tool
- Optimization of how to meet plant-level goals for energy management, resource recovery, process optimization

LCAMER Development Drivers

- **Growing interest in biogas cogeneration by Wastewater Treatment Plants (STPs)**
  - Rising electric power costs
  - Opportunity to achieve sustainable & carbon neutrality goals
  - Generate revenue in tough financial times using natural forming biogases
- **"Simplify" the daunting task of life cycle evaluation for optimized energy recovery**
  - Anaerobic digestion options
  - Biogas pretreatment and energy recovery options
  - Price of electricity and natural gas
  - Loan discount rates and monetary grants
  - Meet air emissions standards



LCAMER - Objectives & Success Criteria

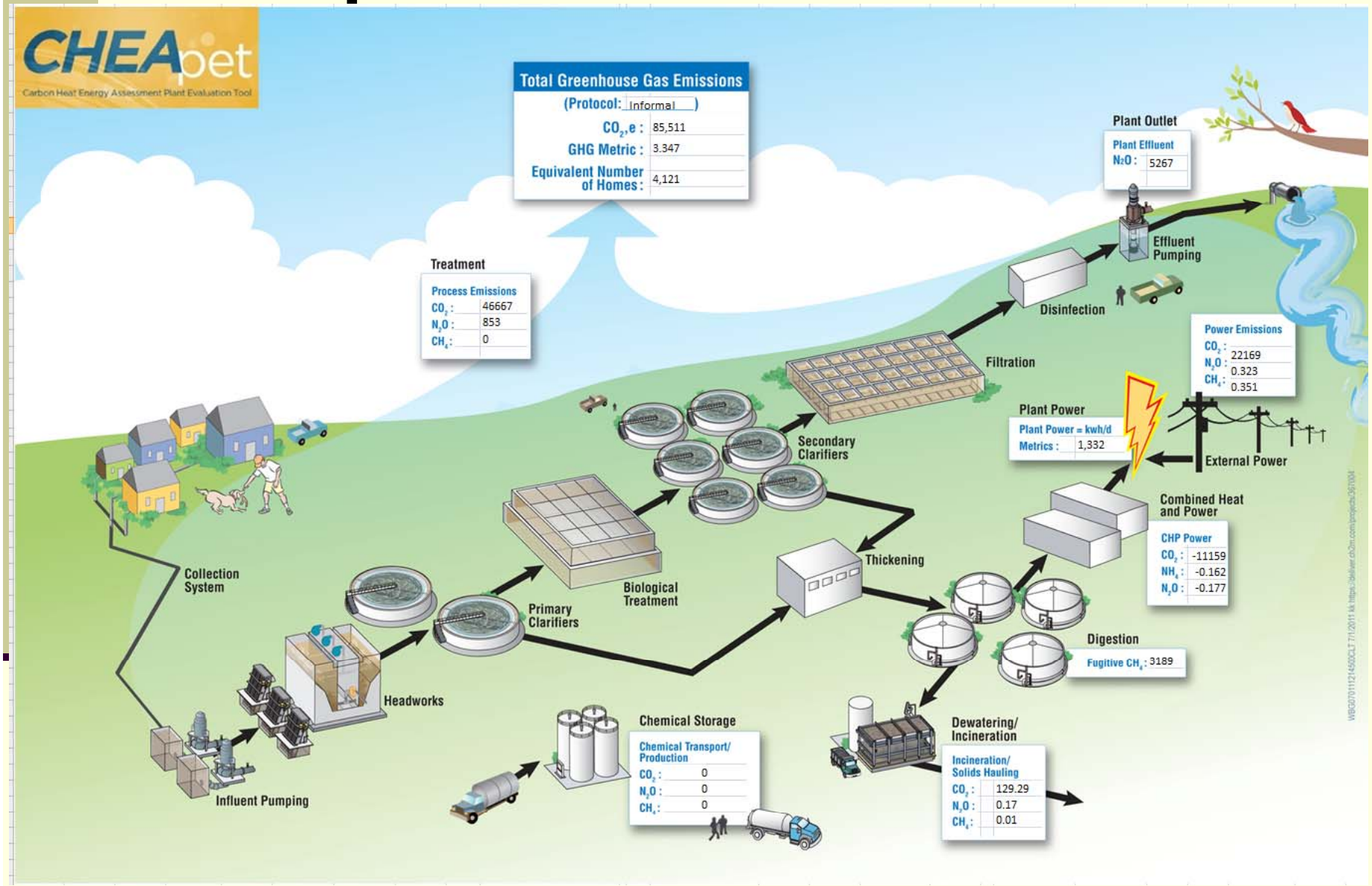
- Demonstrate Applicability & Effectiveness At Two Locations:
  - Gwinnett County Department of Water Resources, Lawrenceville, Georgia
  - Pinellas County Utilities, Clearwater, Florida
- Focus Areas Covered by
  - Internal combustion engines (ICE)
  - Gas turbines
  - Microturbines
  - Stirling Engines
  - Fuel cells

F. Wayne Hill Water Resources Center

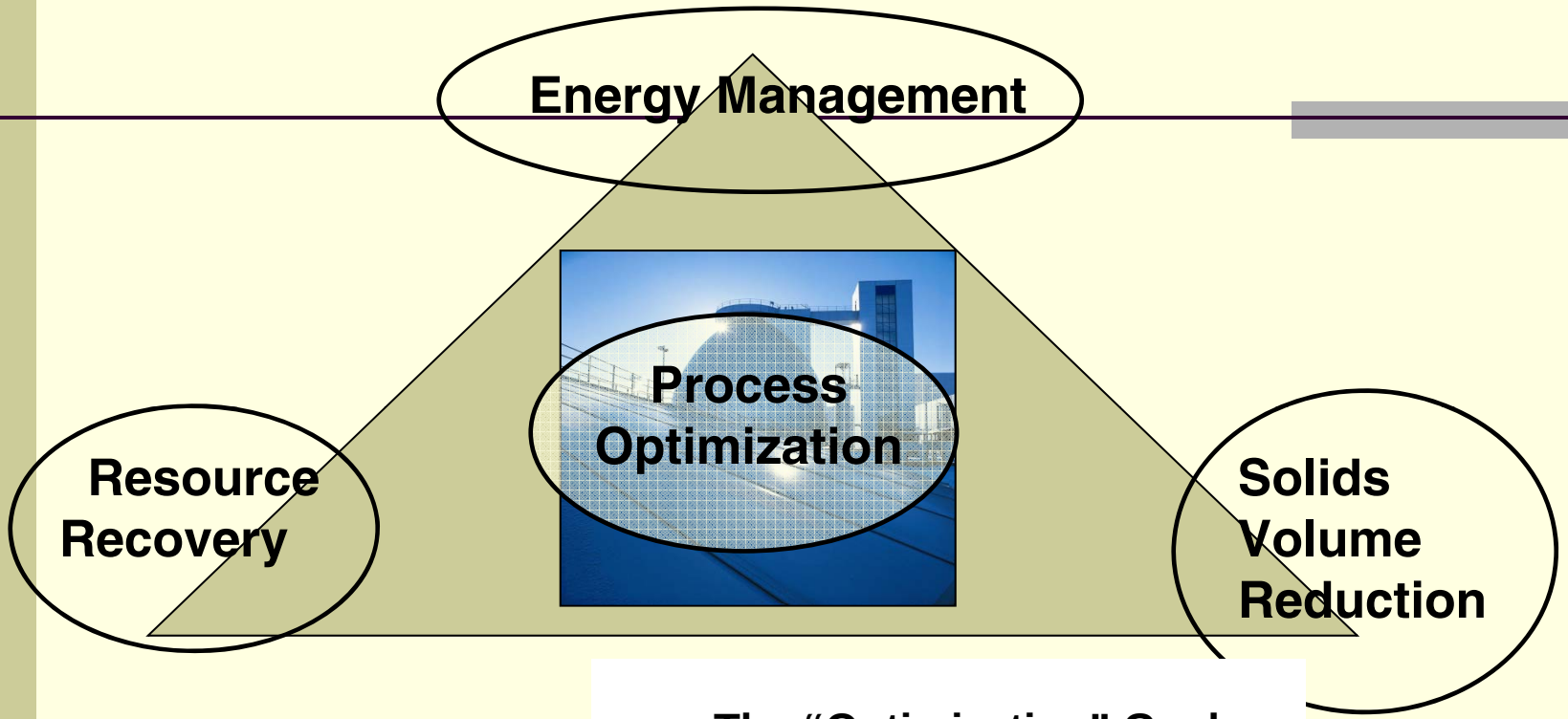
South Cross Bayou Water Reclamation Facility

- Overall Success Criteria
  - Successful demonstration
  - Familiarize WERF subscribers with LCAMER Tool
  - Identify areas of improvement – LCAMER Version 2

CHEApet Tool addresses GHGs



WERF CHEApet Optimization Challenge



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Carbon Heat Energy Assessment Plant Evaluation Tool

The "Optimization" Goal

To develop and demonstrate economical and environmentally responsible processes that improve wastewater and solids treatment operations efficiencies and costs by at least 20%:

- **20% less energy**
- **20% more resource recovery**
- **20% less solids produced**

These goals can be achieved at most WWTPs…

Opportunities for PRASA?

Ponce and Humacao WWTPs

- Upgrading digesters and support systems
- Adding cogeneration facilities
- Moving sludge now landfilled to either facility as upgraded capacity allows for blending and co-digestion
- Adding FOG and food waste receiving facilities for additional biogas production

Thank you!