Water and Sewage Treatment Energy Management Joint Conference

Hosted By:
Delaware Valley Regional Planning Commission,
PA DEP southeastern Regional office,
EPA Region III.

Montgomery County Community College
April 25, 2012

Agenda :

Identify ways that energy can be conserved or recovered in Water and Wastewater Treatment.

Typically energy saving opportunities are more prevalent in Wastewater than Water Treatment.

Water Treatment;
Example: Energy Savings Measures

- Energy Recovery by using raw or finished water for heat recovery. To be installed at the Ridley water treatment plant
- Chemical Dose Optimization.
- Pumps and Motors.
- Process Changes.
- Cyclic operation; if possible.

Water Treatment Case Studies; Energy Savings Measures

Bristol Water Treatment Facility Upgrade

Retrofitting two sedimentation basins with plate settlers increased basin settling capacity ten-fold over the typical settling capacity

Operating costs have been reduced by 22 percent.

Upgrade to the Morrison Coulter Water Treatment Facility at Ingrams Mill

Retrofitting sedimentation basins with plate settlers increased basin capacity from 2 mgd to 7 mgd per basin. The upgraded basins provide improved settled water quality, reduced chemical usage, and increased filter run times.

Operating costs have been reduced by 25 to 30 percent.

Water Treatment Case Studies; Energy Savings Measures

Chester Water Authority
Octoraro Water Treatment Plant Pretreatment Improvements

Construction of a baffled blend tank to mix the two water sources achieves hydraulic mixing with no additional energy cost. Four existing settling basins were retrofitted with inclined plate settlers, increasing treatment capacity from 10 MGD to 15 MGD per basin.

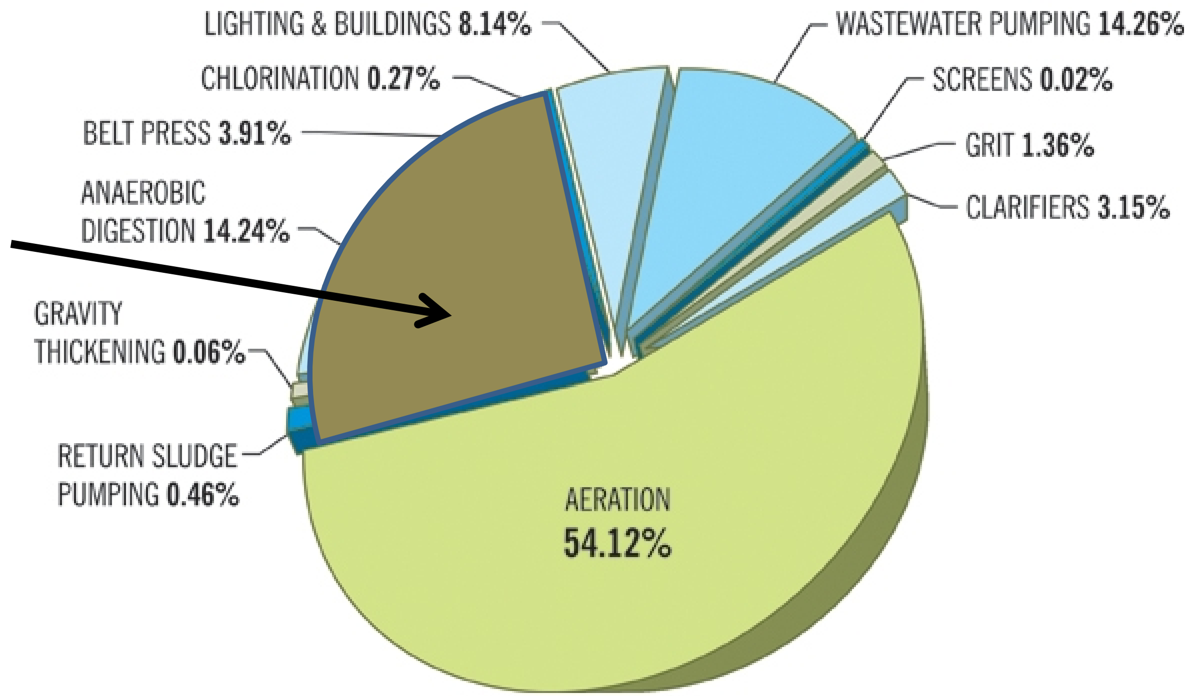
55 percent reduction in settled water turbidity. The reduction in settled water turbidity has allowed increase average filter run times from 48 to 72 hours, reducing backwash water consumption by 33 percent

Wastewater Treatment Energy Profile

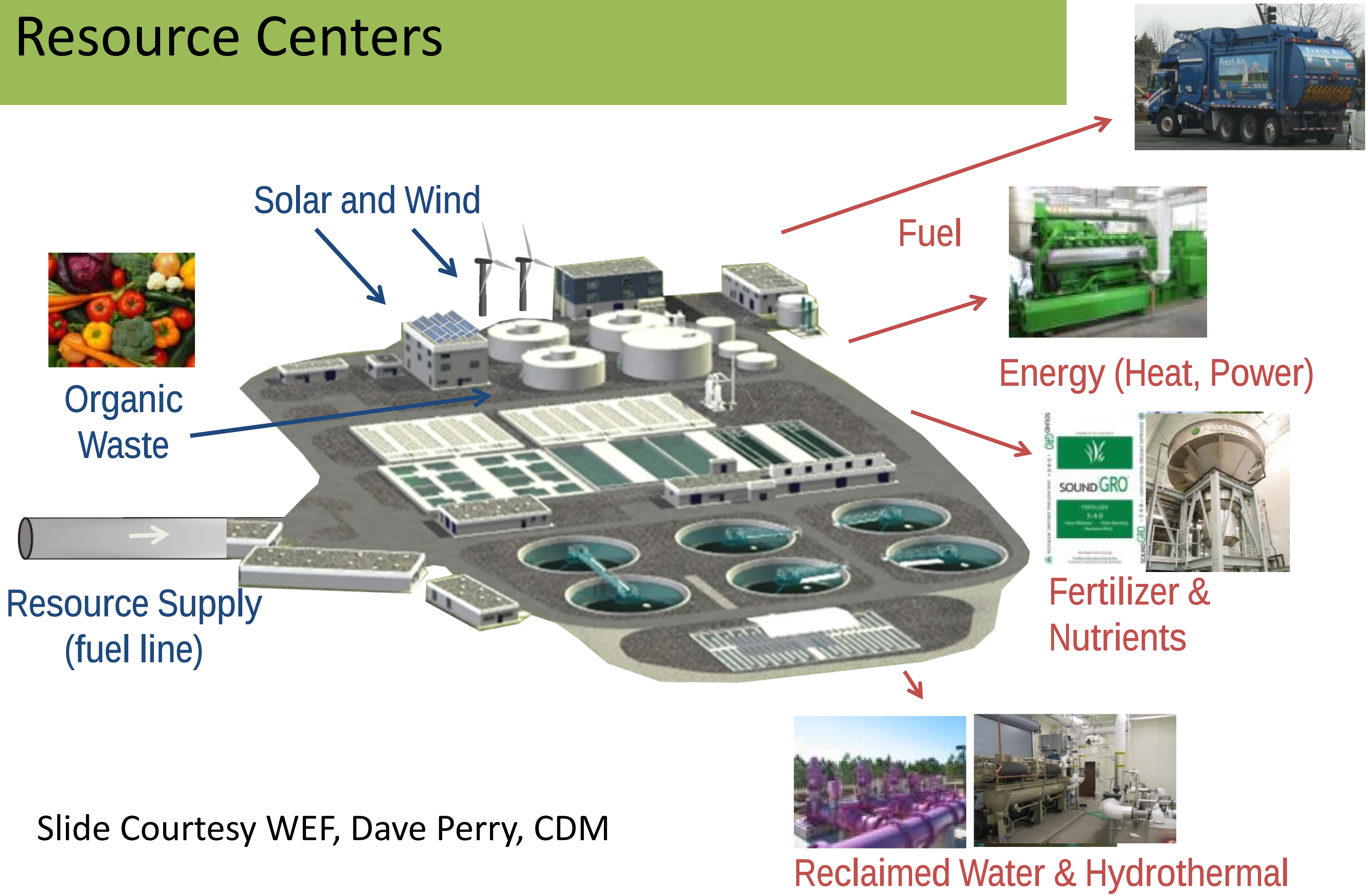
Wastewater treatment typically consumes about 35% of municipal energy budgets.

Aeration and Solids Handlings are typically the largest energy users.

Solids Handling 20 to 25%

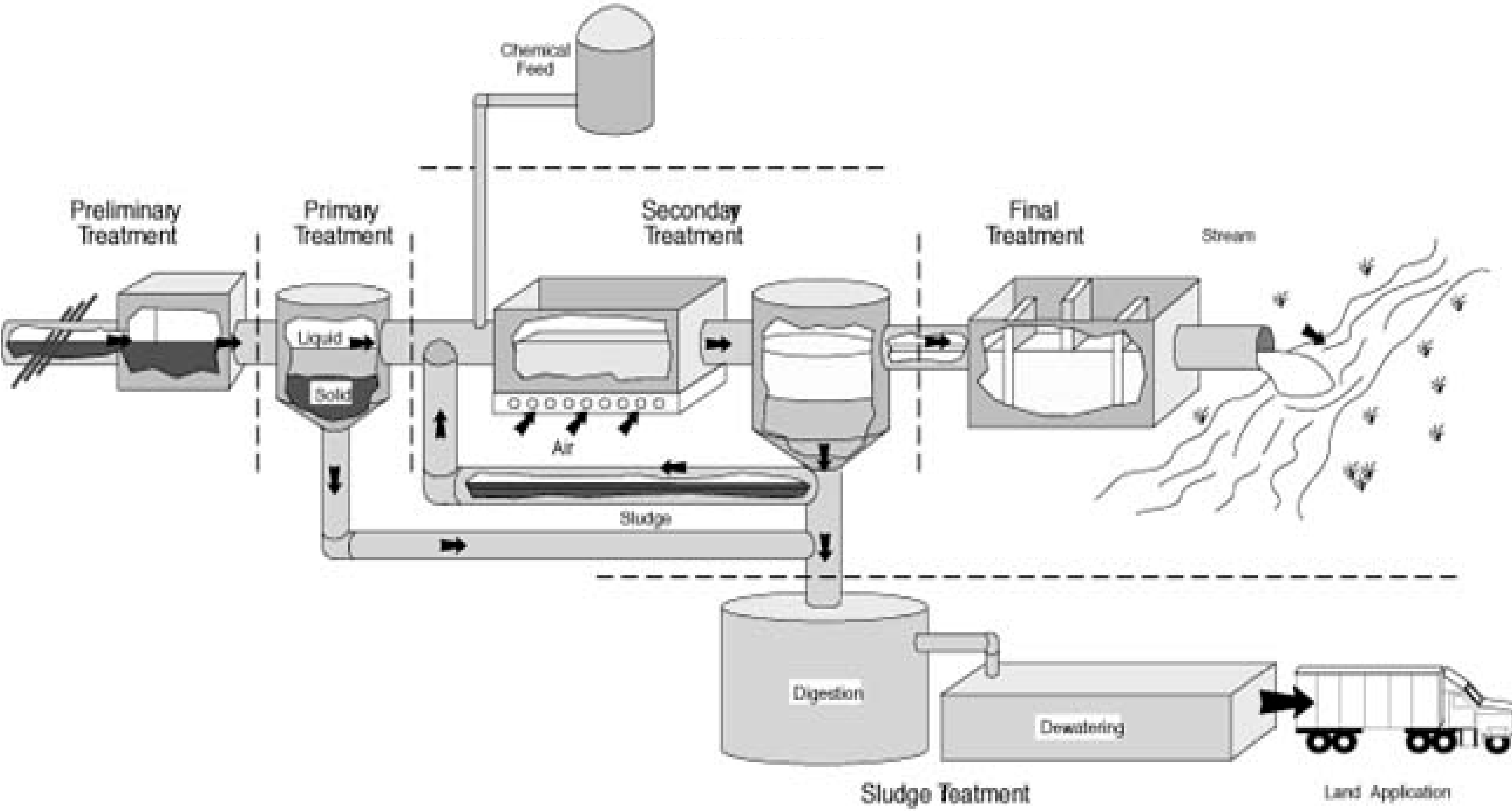


Wastewater Plants Are Being Viewed as Resource Centers



Slide Courtesy WEF, Dave Perry, CDM

Wastewater Flow Sheet



Aeration System Blowers

Multi Stage Centrifugal

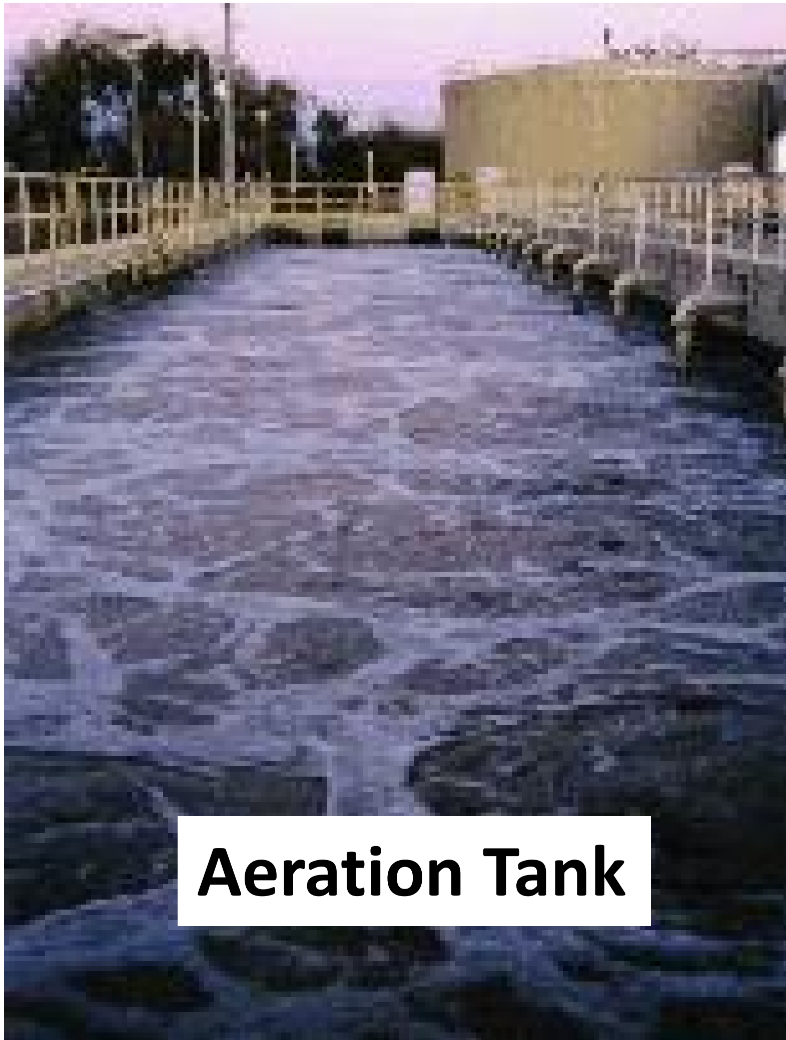
Inlet Throttled
Efficiency 50 to 70%
VFD Driven Efficiency
60 to 70%

Single Stage Centrifugal

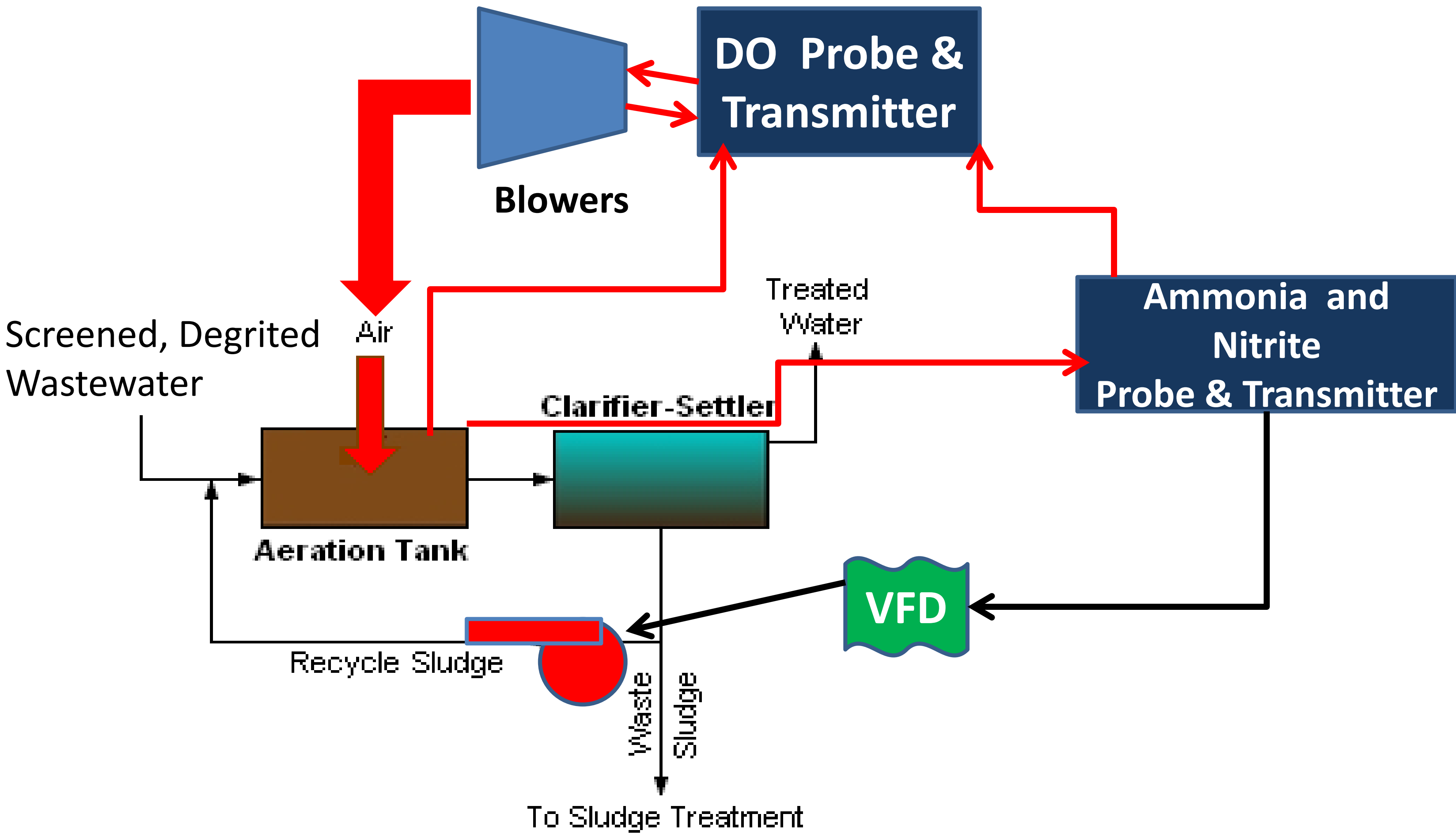
Dual Vane Control
Efficiency 70 to 85%

Positive Displacement

VFD Driven Efficiency
45 to 60%



Aeration System Instrumentation



Nitrification and Denitrification

Nitrification removes ammonia by conversion of the ammonia to Nitrate and Nitrite.

Nitrification:

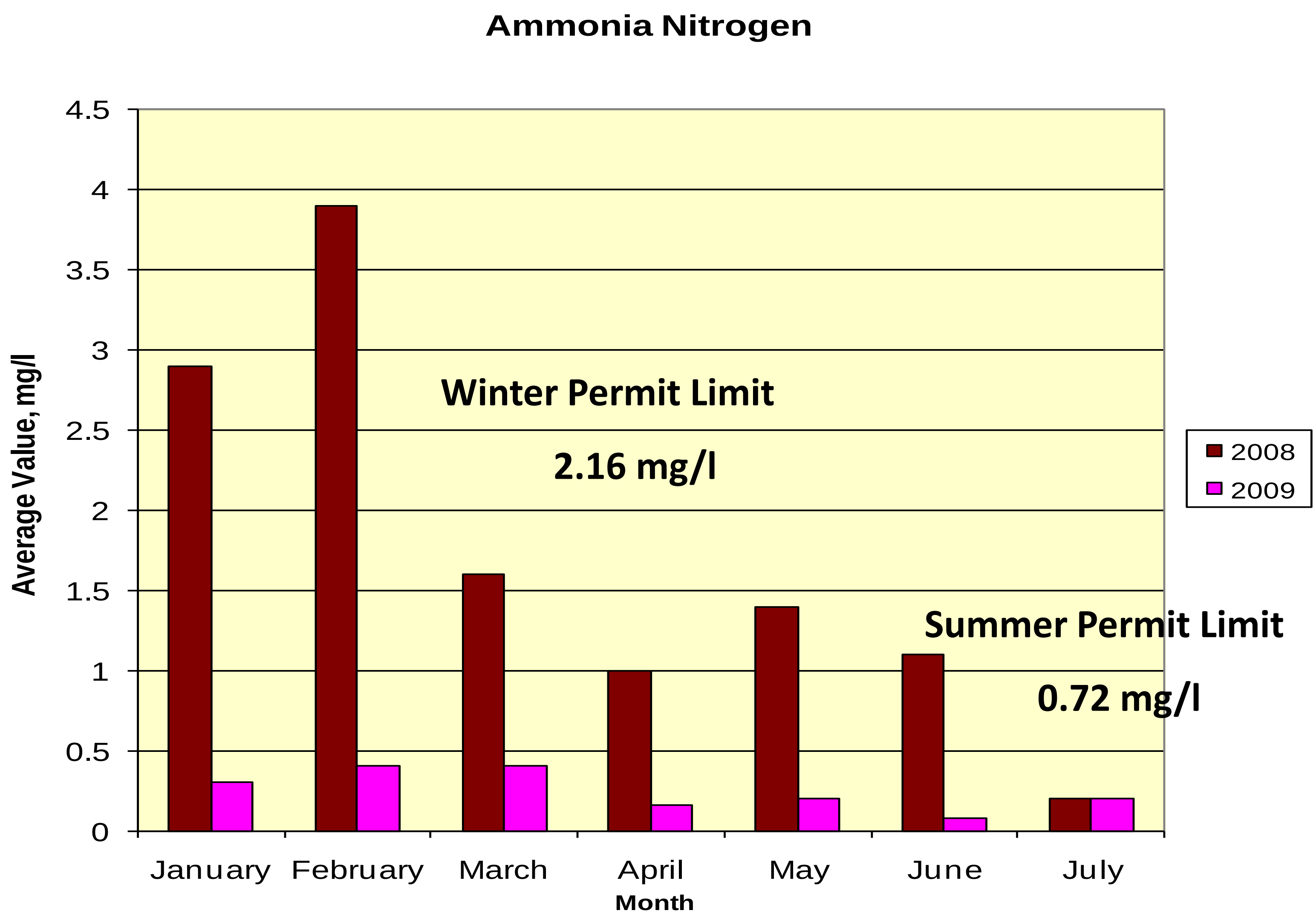
- Consumes significant electrical power
- Consumes Alkalinity.

Denitrification removes Nitrate and Nitrite made by Nitrification step to elemental Nitrogen.

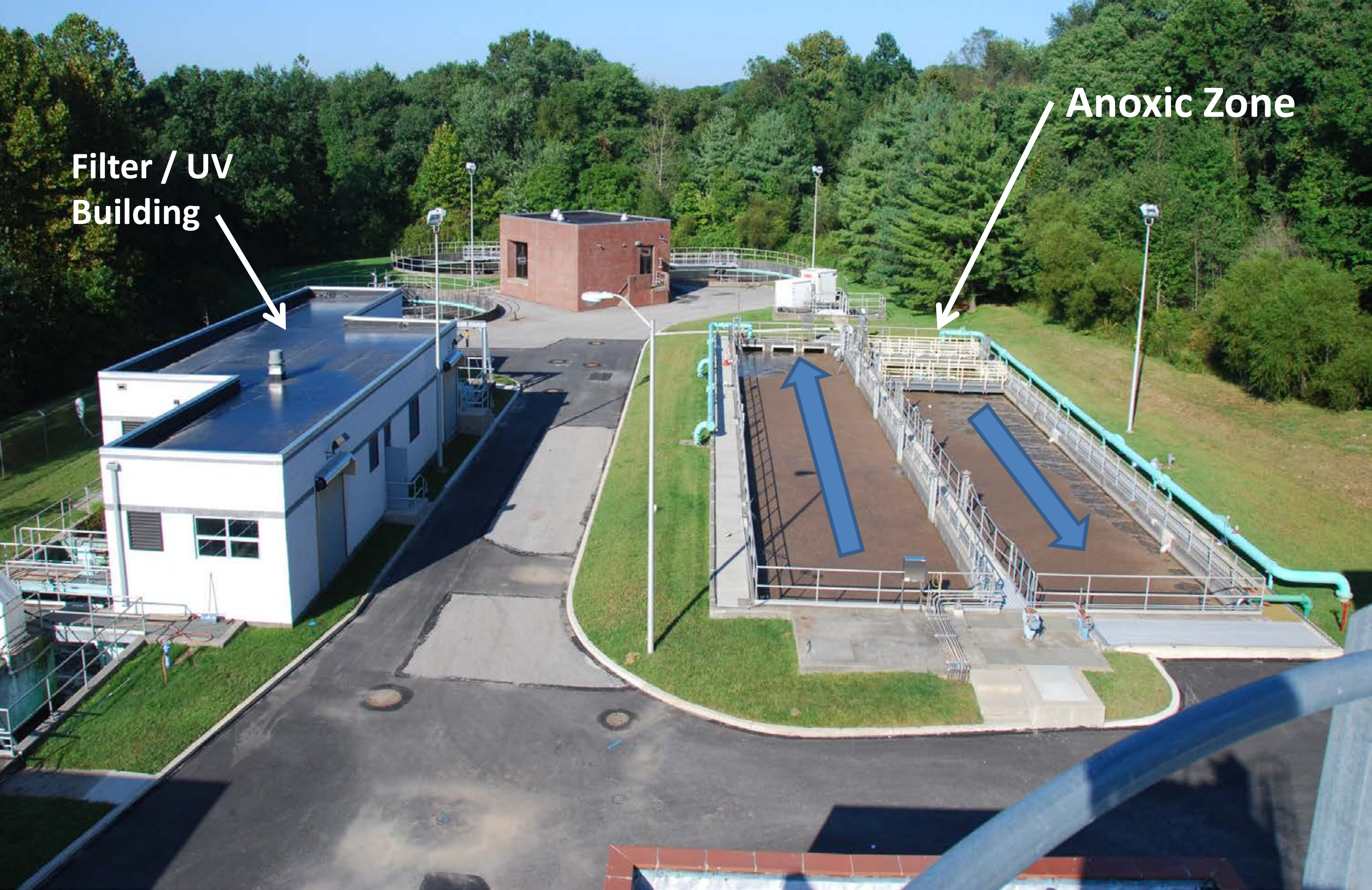
Denitrification:

- Recovers some of the power required by Nitrification (25 to 35%)
- Recovers some Alkalinity (25 to 40%)

Case Study; Abington Township WWTP 3.91 MGD
NEEDS STATEMENT



Post Project Configuration

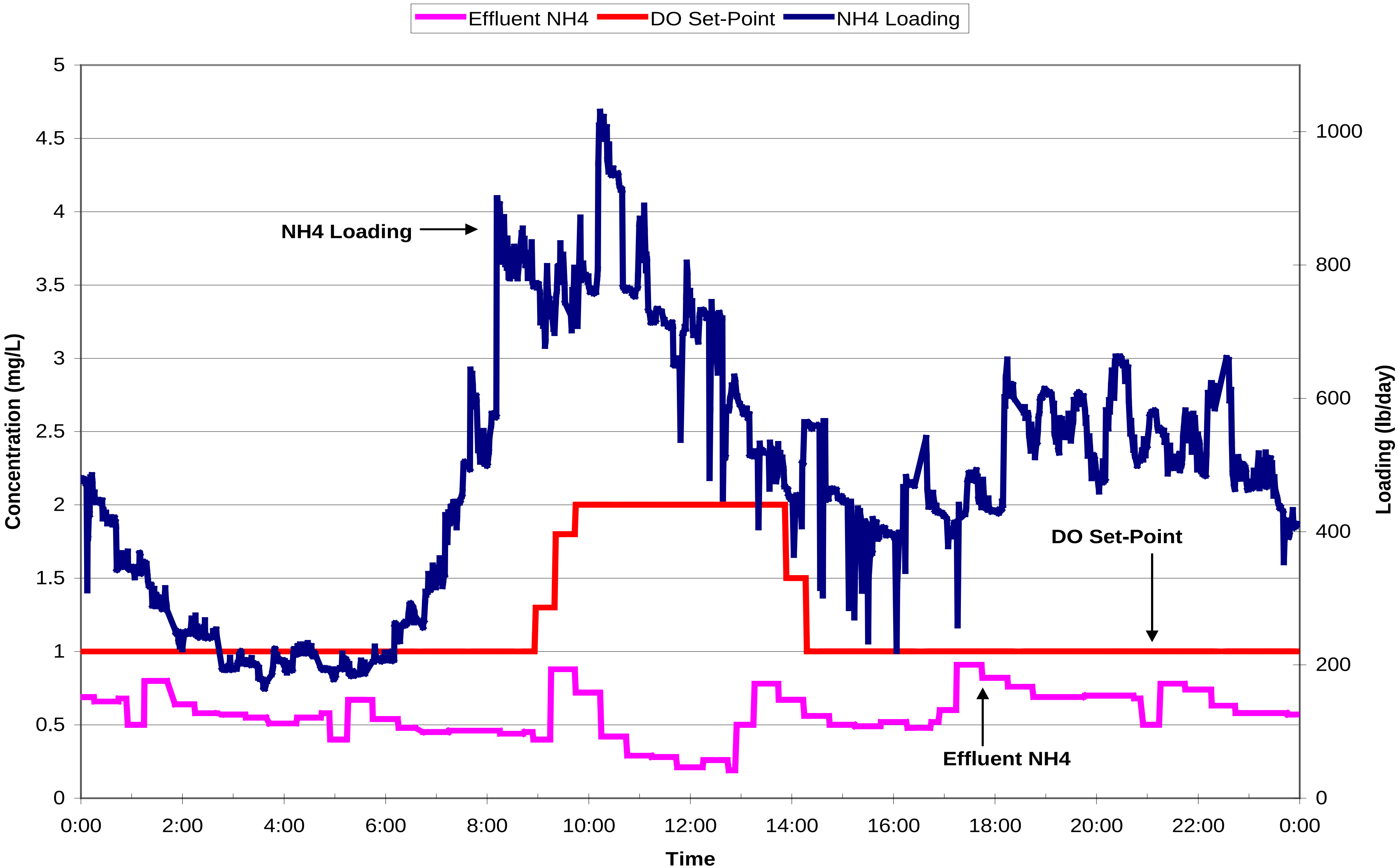


Aeration Energy Control at Abington Township – Nitrification / Denitrification WWTP

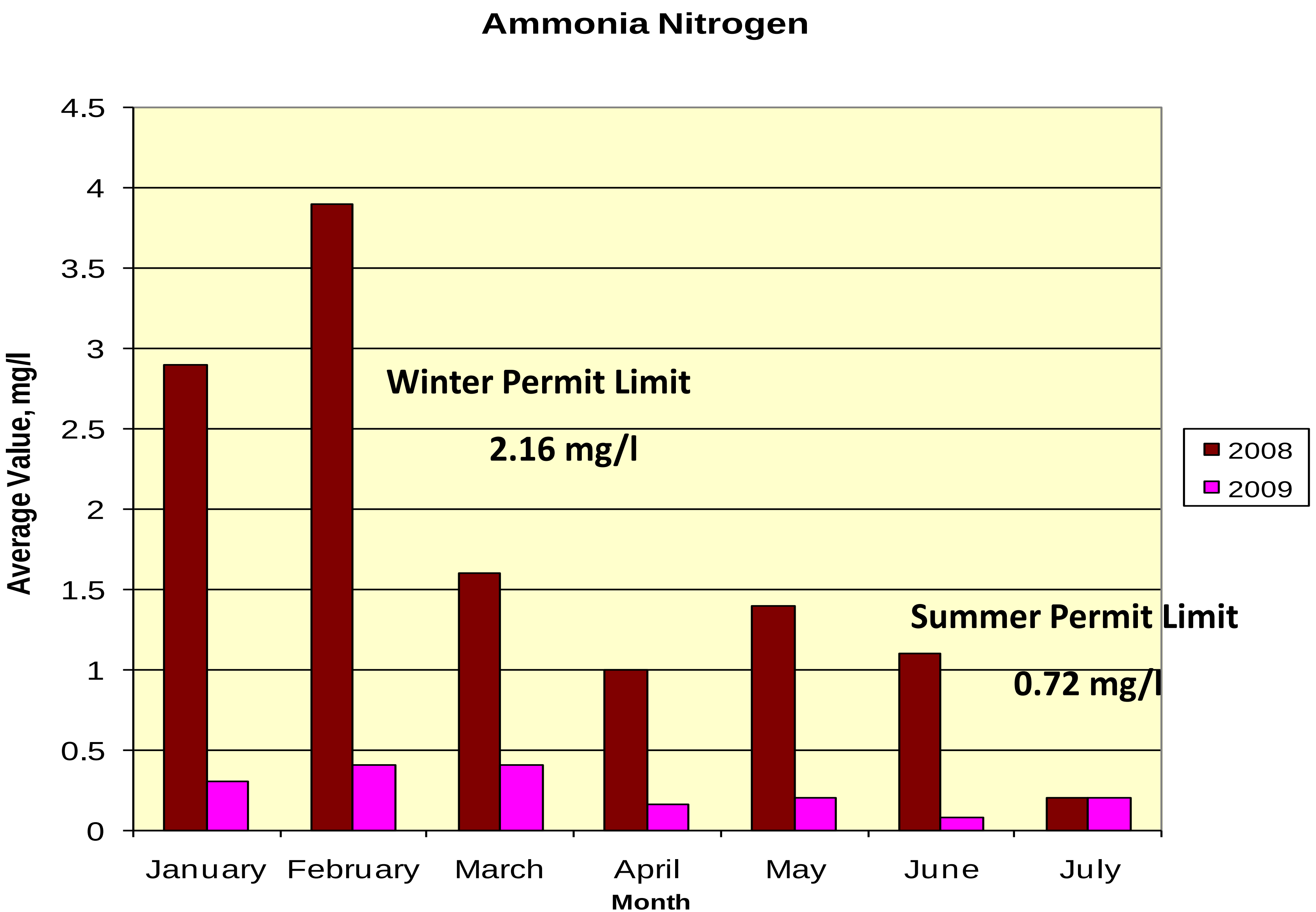
BIOS Optimal Control System

Courtesy; Biochem Technologies

Variable DO Setpoint Control



Post Project -Effluent Ammonia

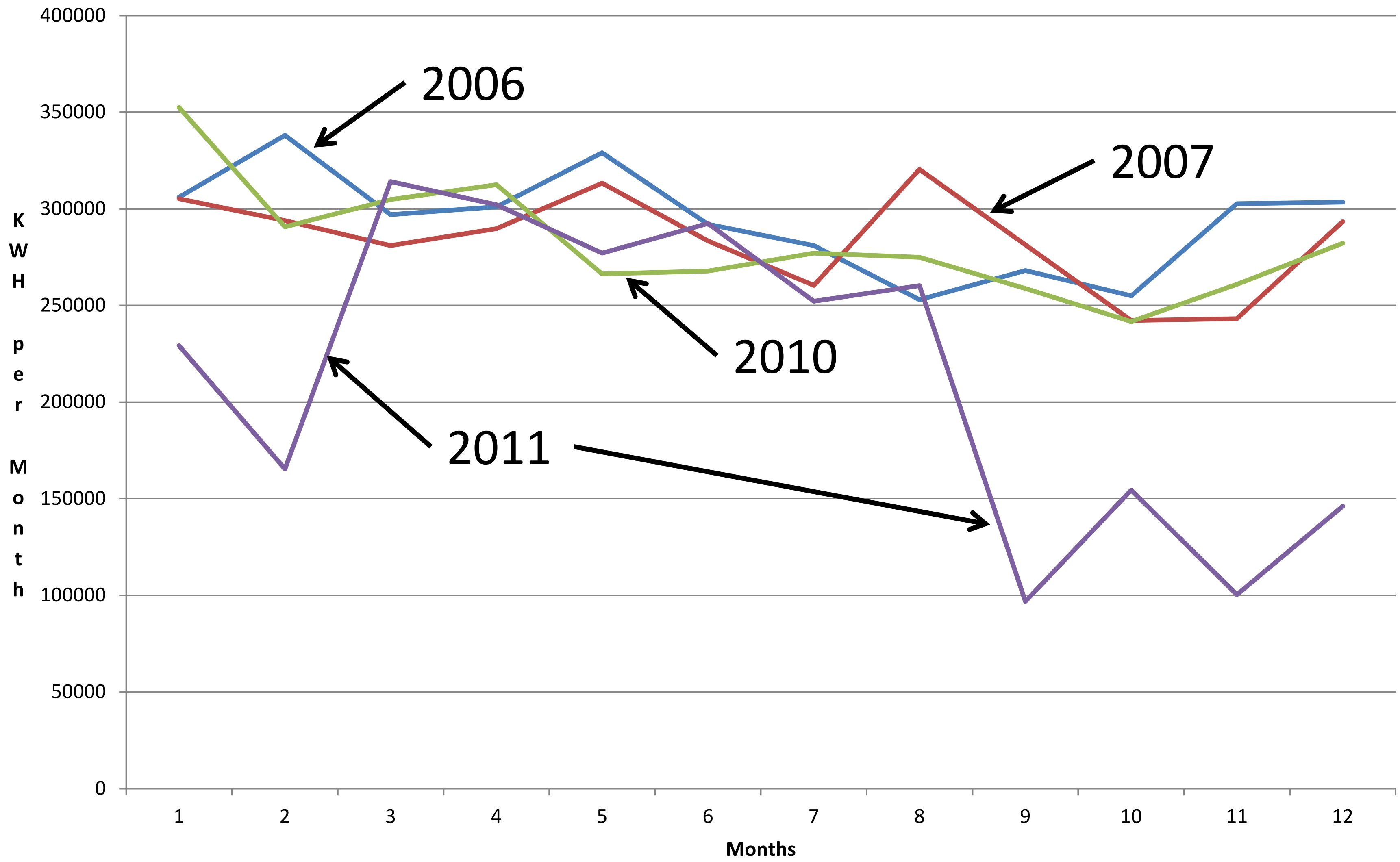


Abington WWTP - Added Electrical Load

Third Aeration Reactor – About 50 kw	(1,200 KWH / day)
Pumping Station – About 30 kw	(720 KWH / day)
Filters – About 10 kw	(240 KWH / day)
Mixers, Chem. Feed – About 7 kw	(150 KWH / day)
TOTAL	2,310 KWH / day
	69,300 KWH / month

About 20 to 25% increase

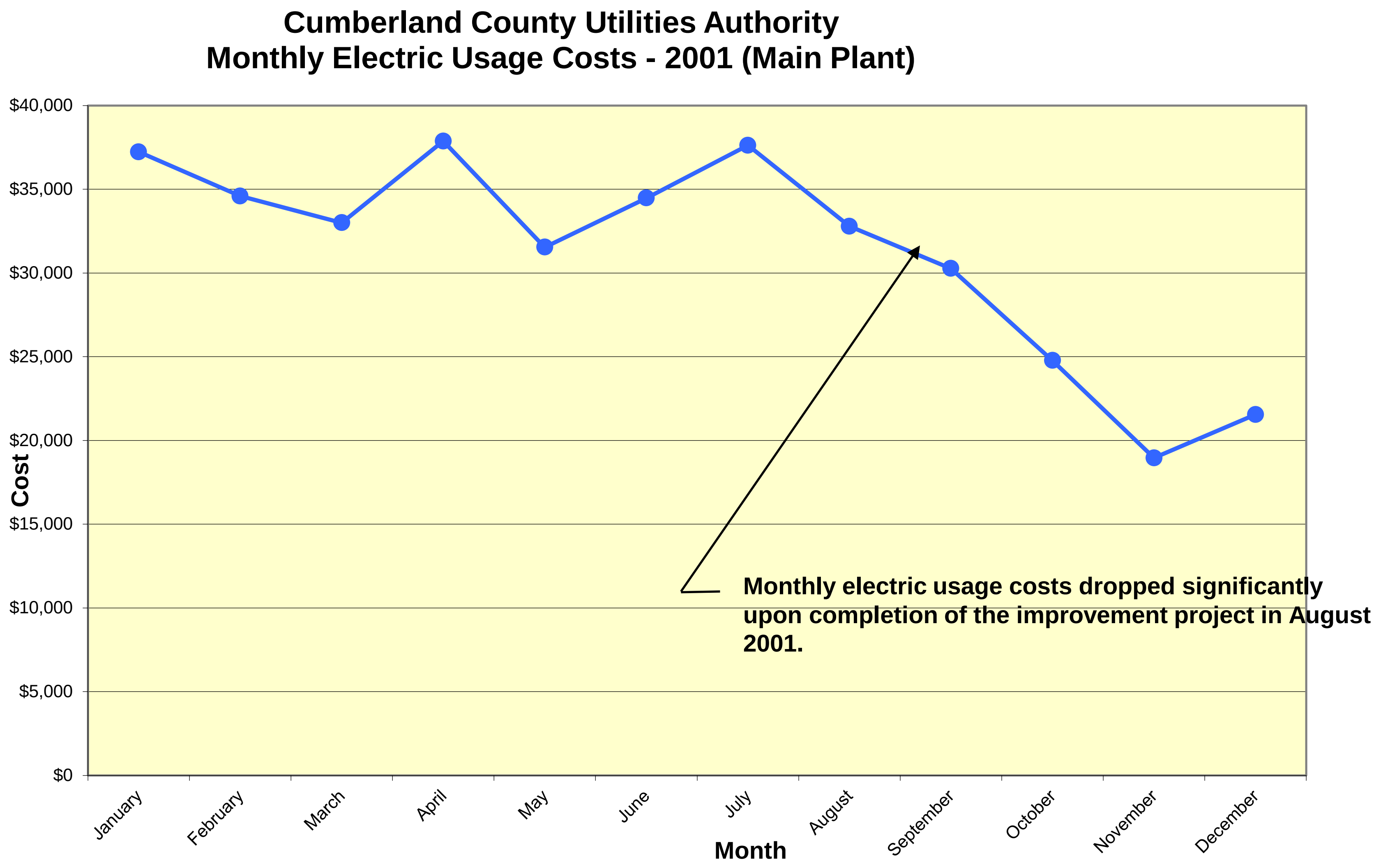
Abington Township
Before and After Electrical Energy Demand



WASTEWATER TREATMENT PLANT UPGRADE PROJECT

- Costs
  - Construction Cost total $11,216,578.
  - $815,387 grant awarded by PA DCED for the project.
  - Interest of $239,990 earned on the bond was made available to supplement project funds.
  - Change orders totaled $138,801, less than 1.25% of construction cost.

Cumberland Co. Utilities Authority Electrical Demand Profile



Other Energy Conservation and Recovery opportunities in Wastewater Treatment

Pumping & Screening

Power Factor Correction

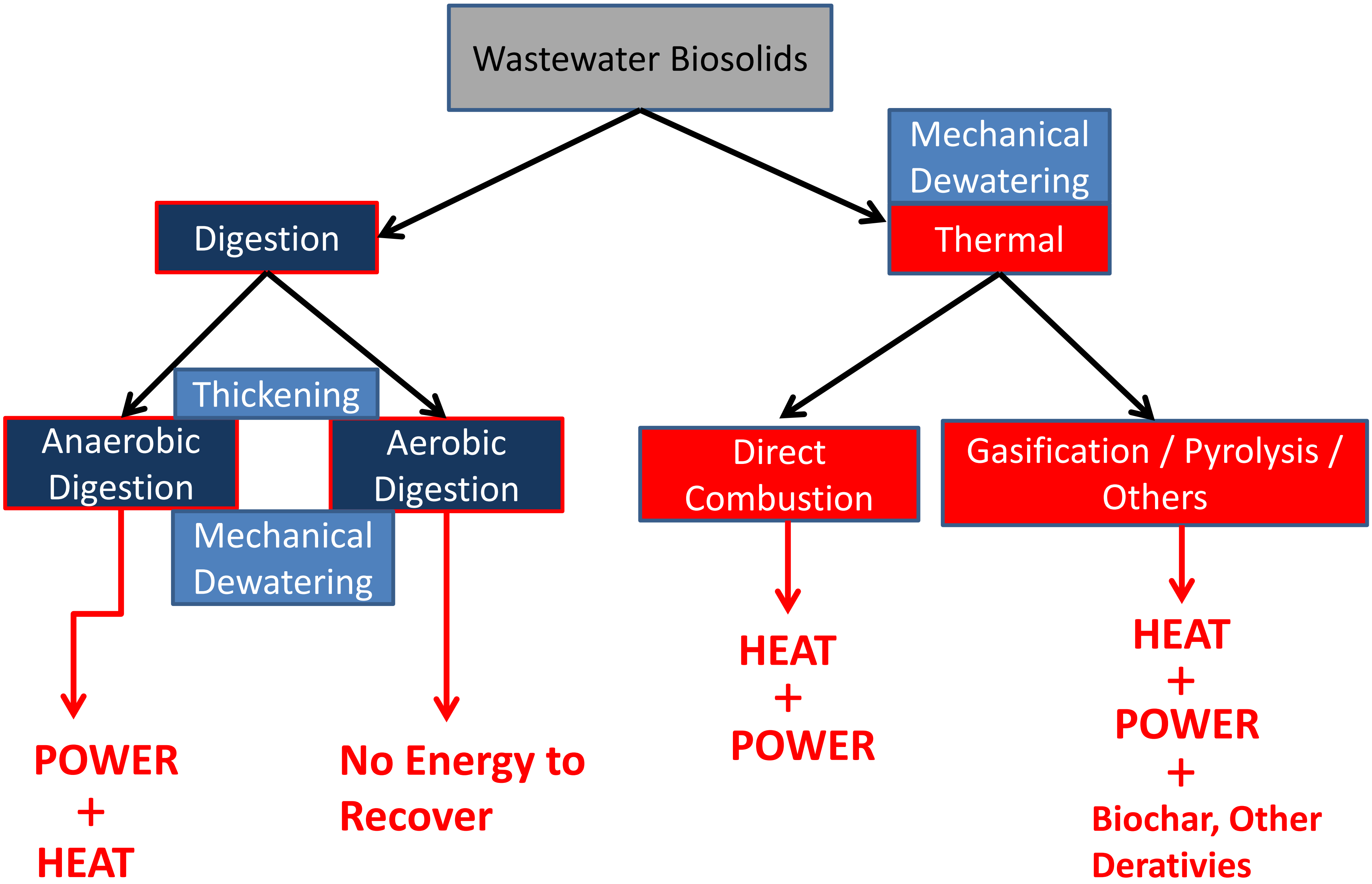
Primary Settling (optional)

Disinfection

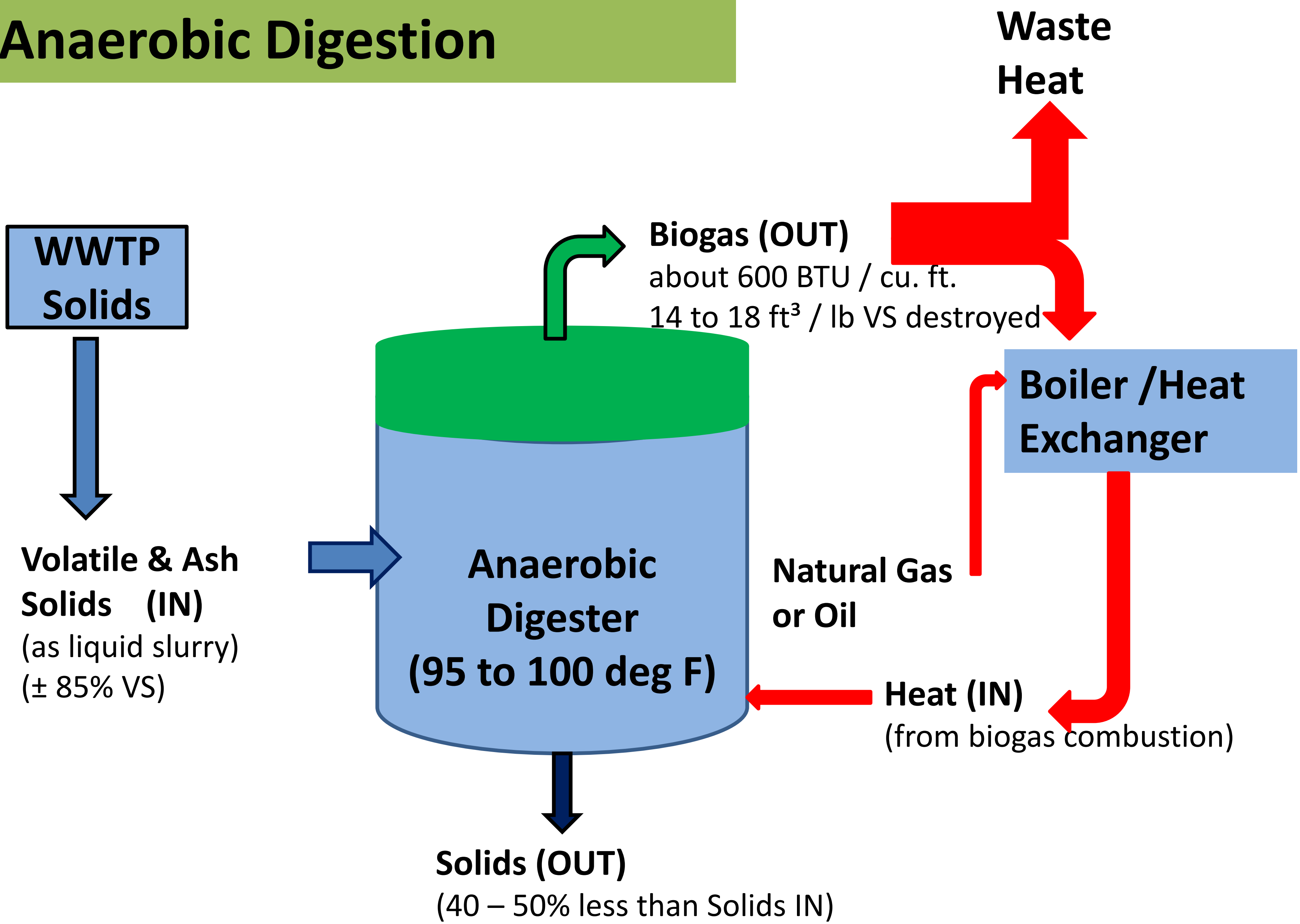
Chemical Addition

Solids Handling Systems

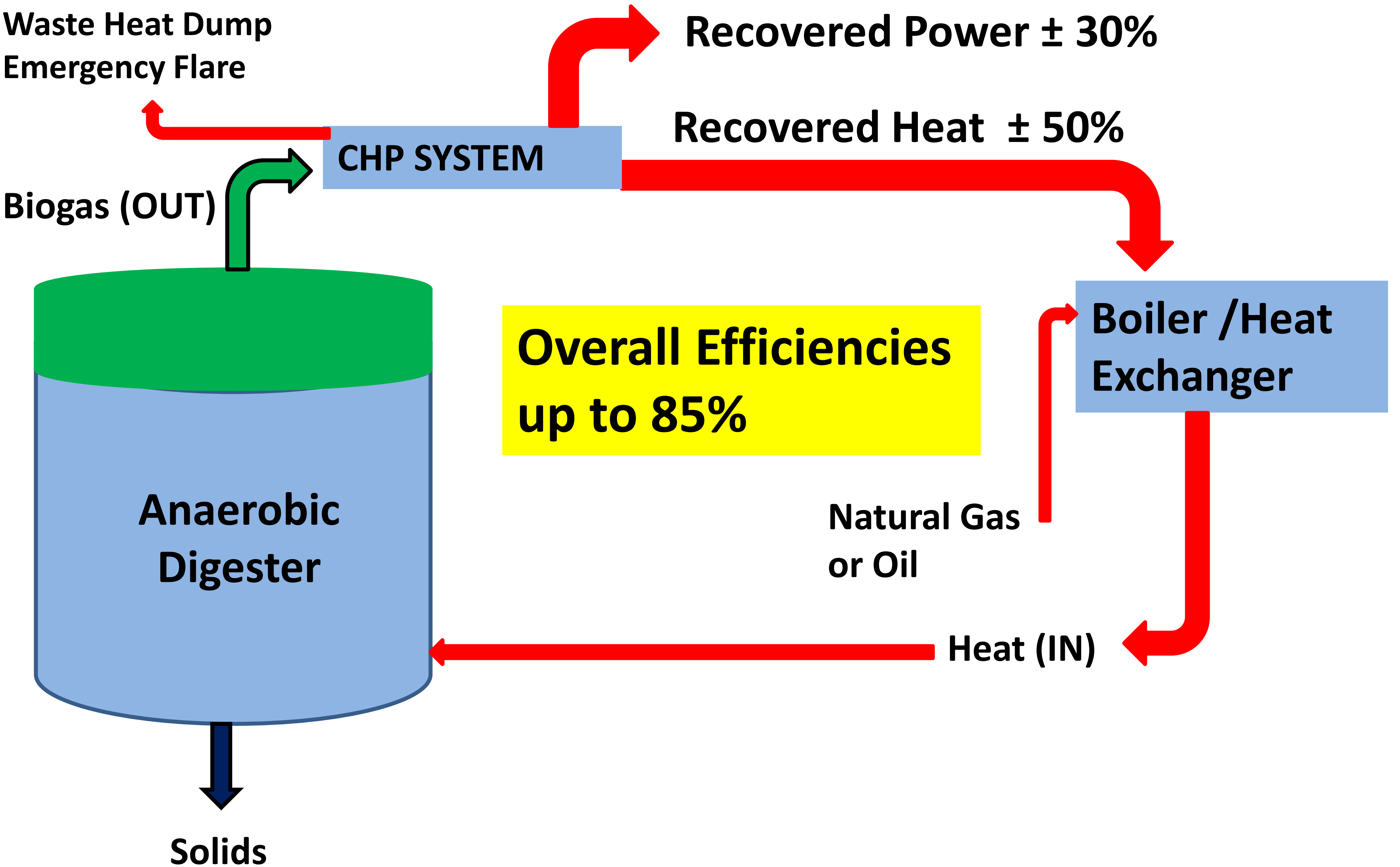
Biosolids – Energy Recovery Pathways



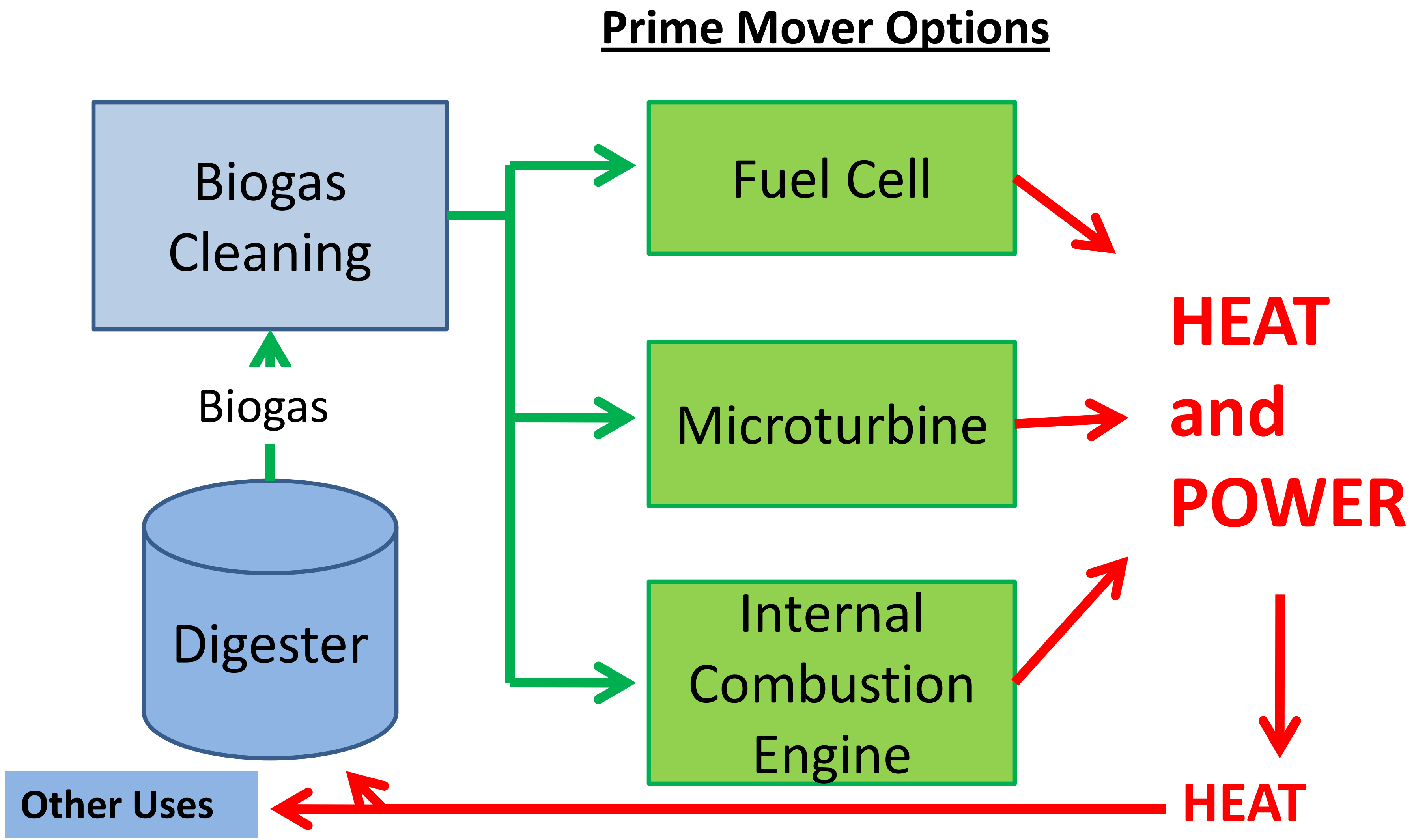
Wastewater Treatment Anaerobic Digestion



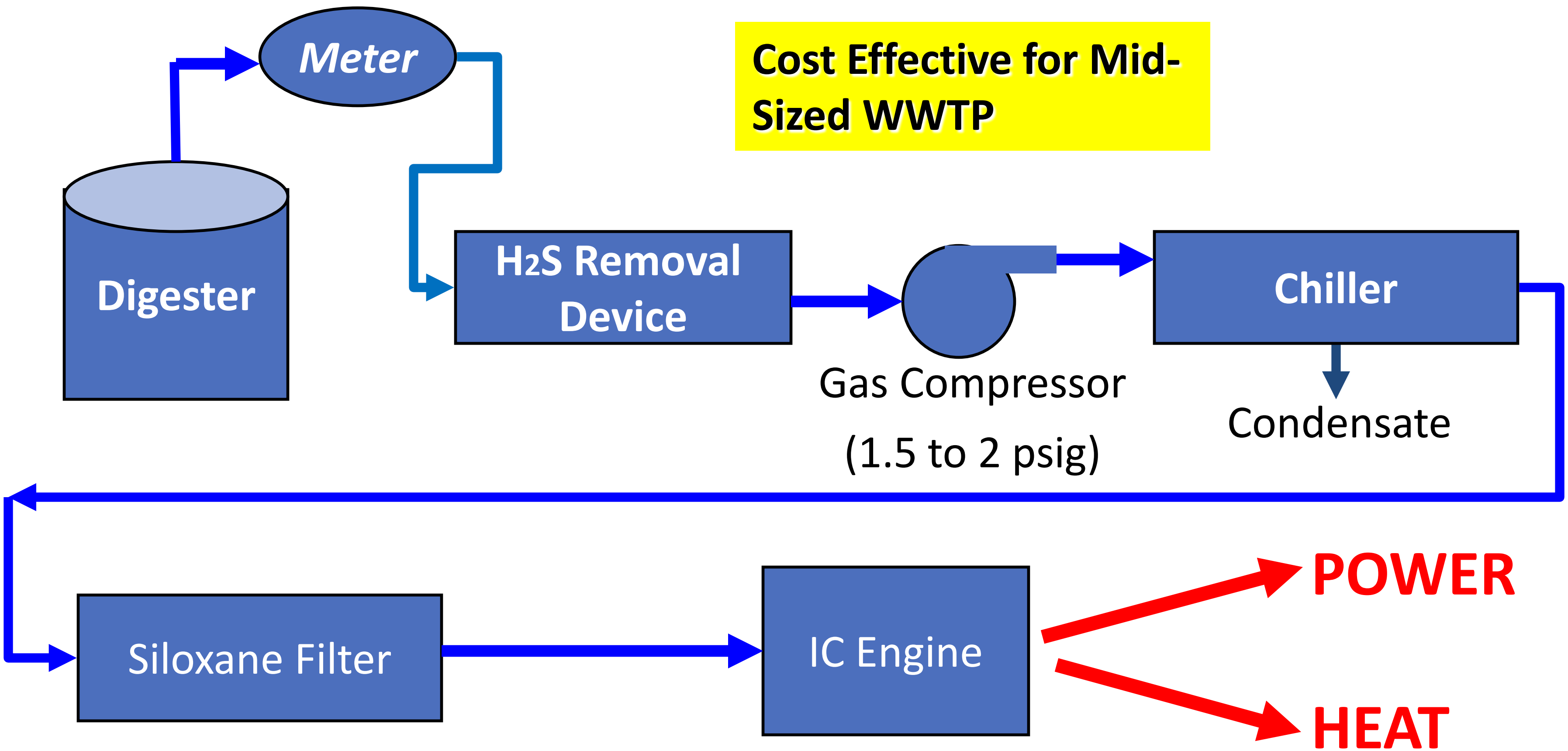
Anaerobic Digestion with Combined Heat and Power (CHP) Cogeneration



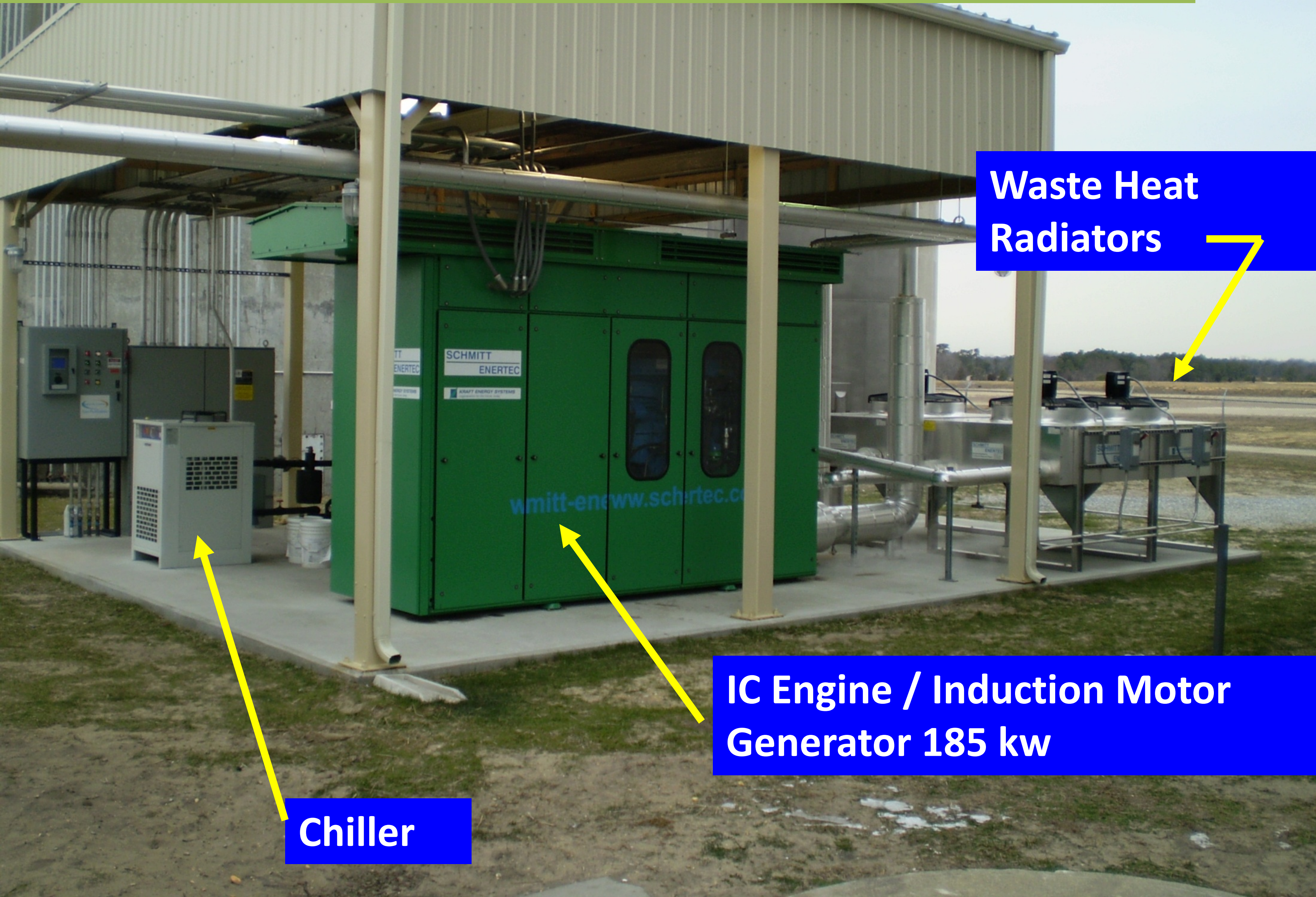
Combined Heat and Power Cogeneration



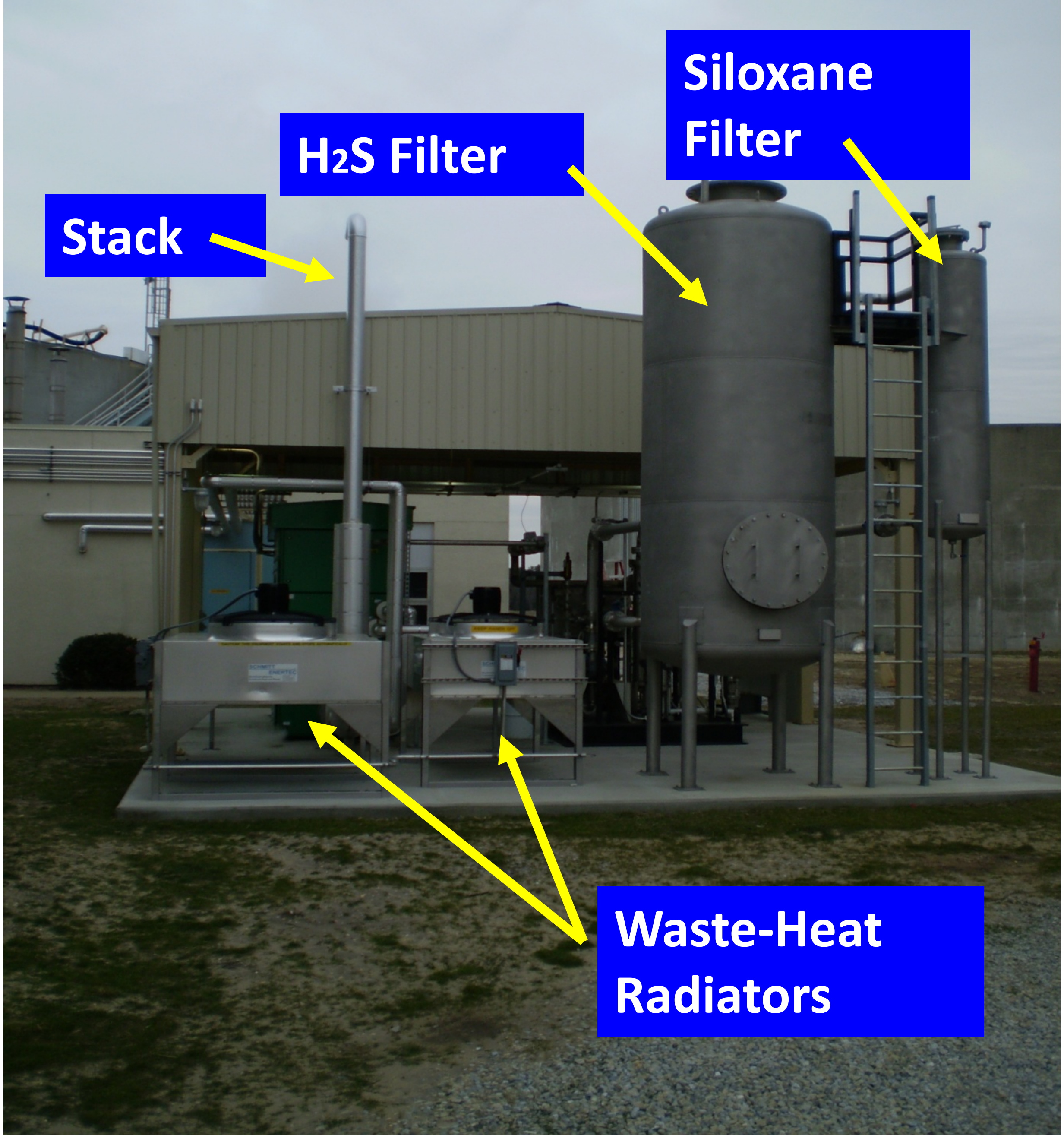
Biogas Conditioning and Utilization Flow Schematic



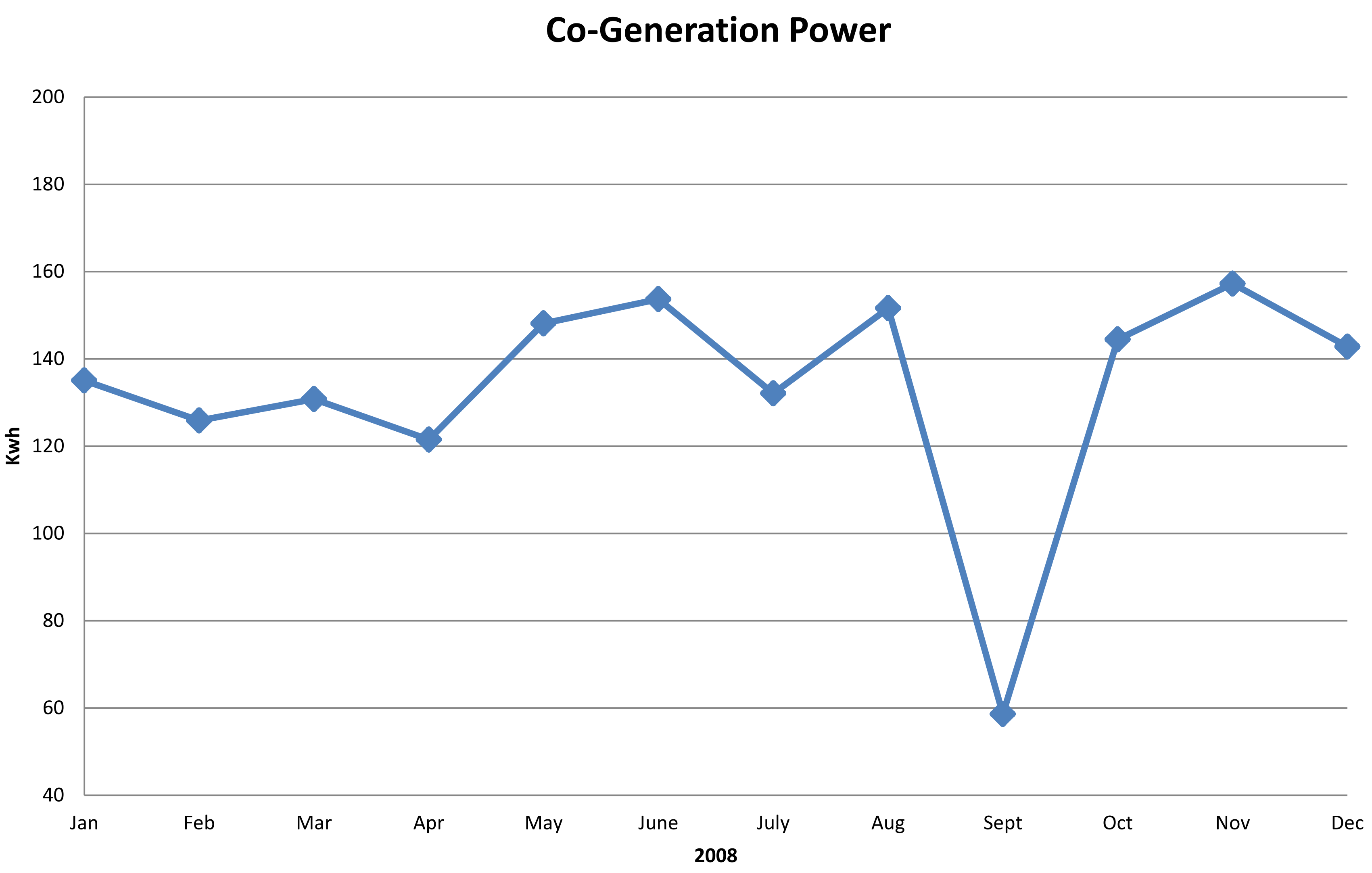
Landis Sewerage Authority CHP System



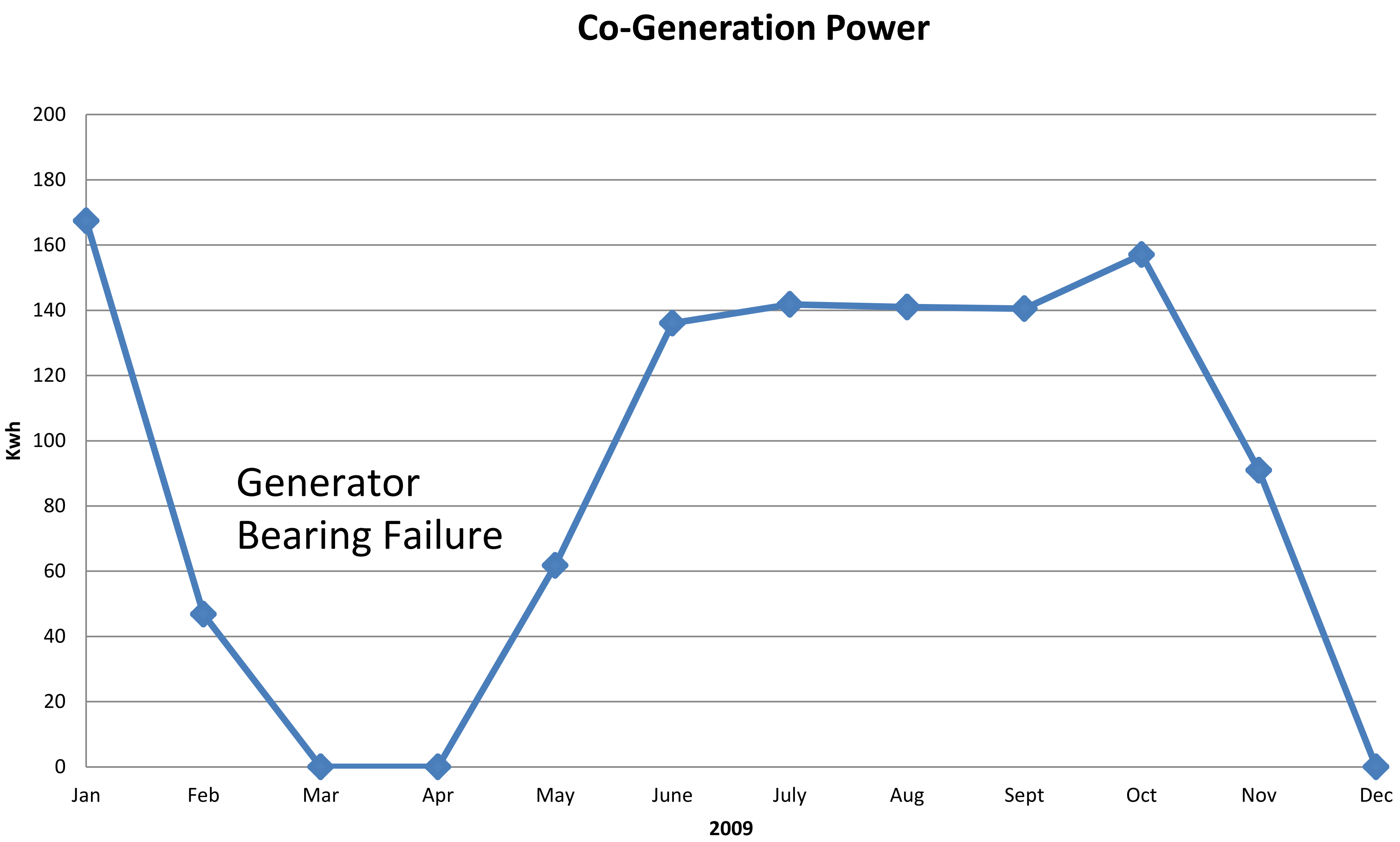
LSA – CHP SYSTEM



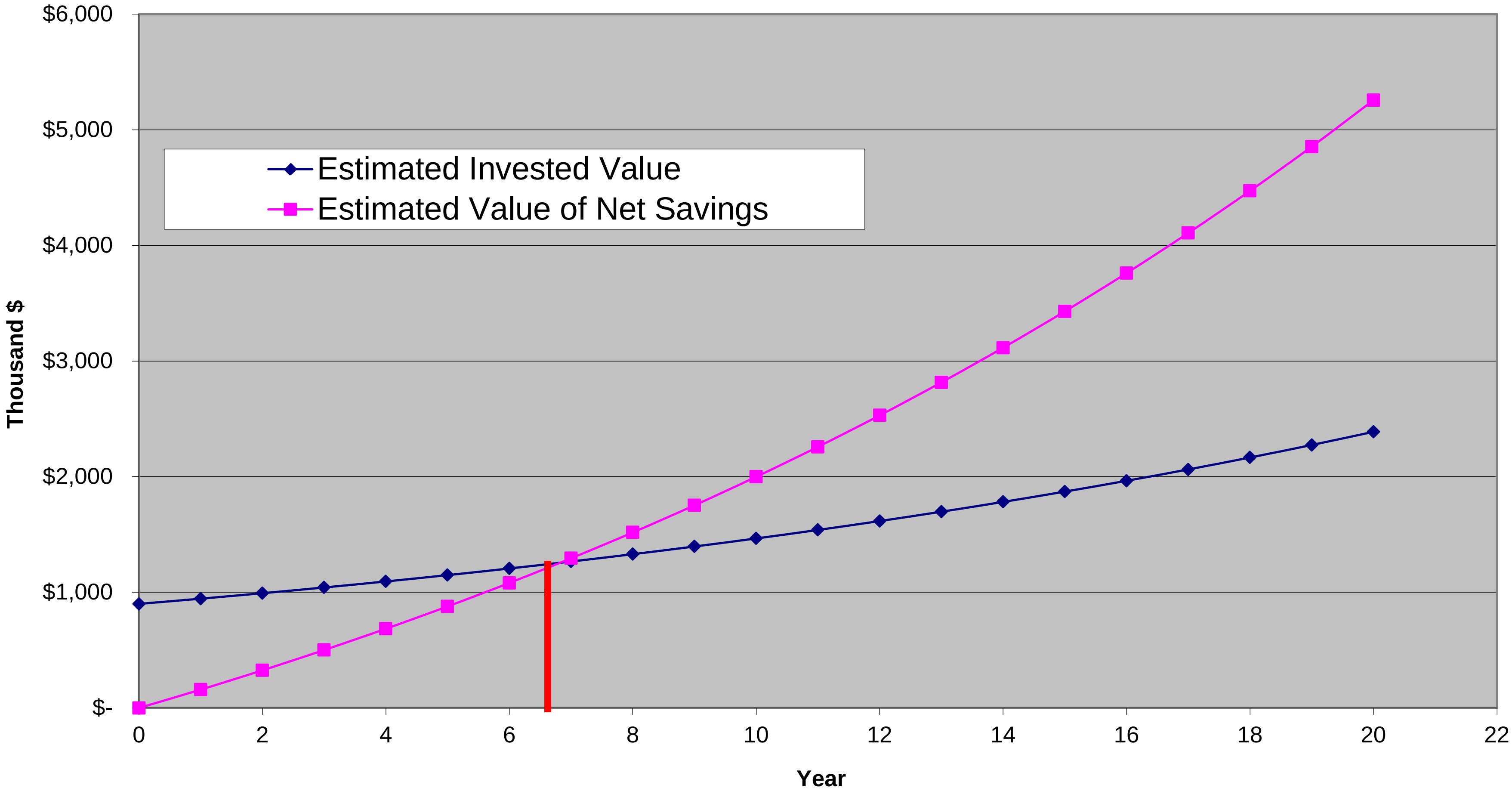
_LSA Power Generated less Parasitic Losses 2008



LSA Power Gless Parasitic Losses 2009



CoGen Investment Breakeven Analysis
(36 CFM Gas, 5% Interest, $500K Grant)



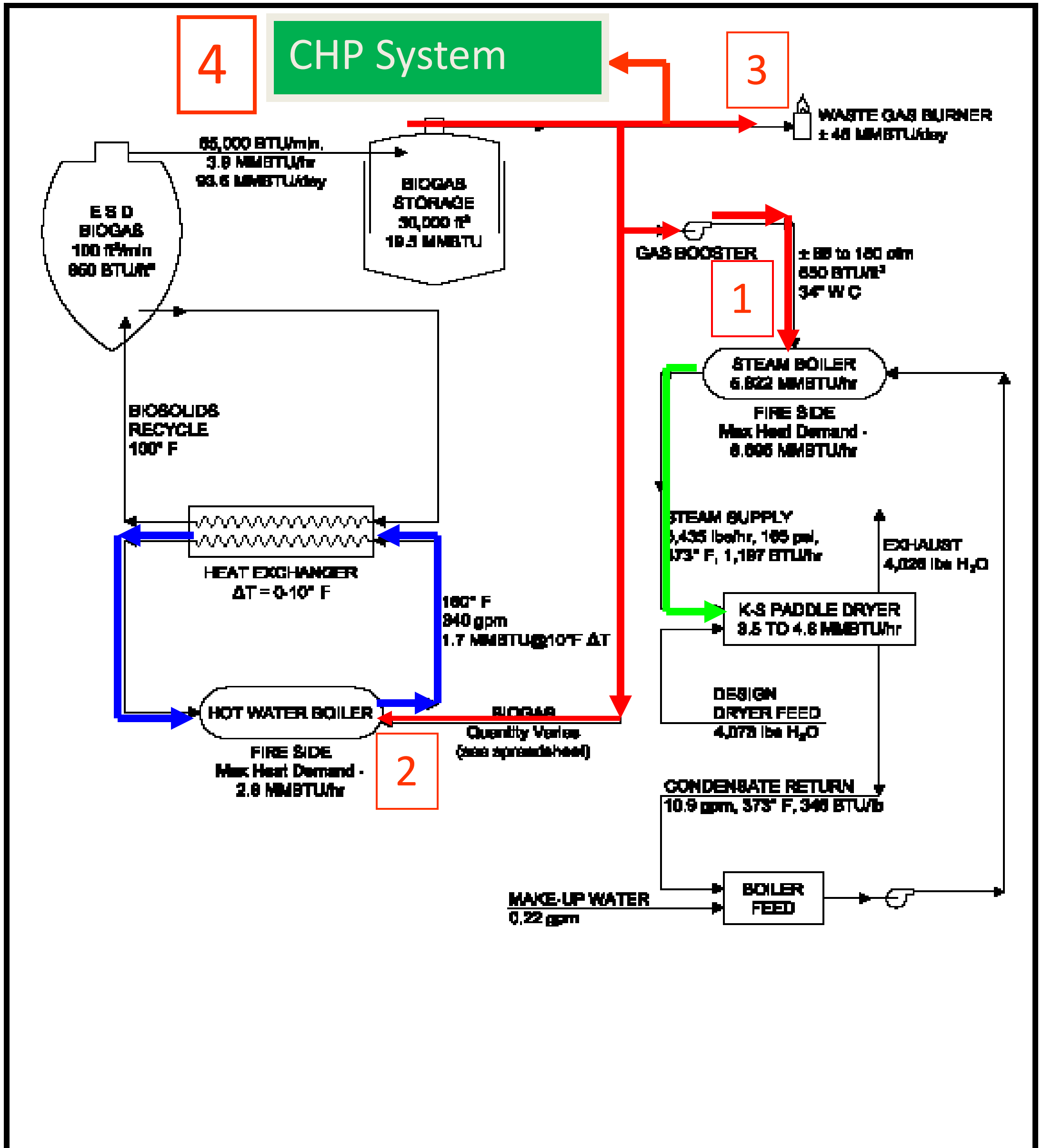
Case Study Derry Township Municipal Authority, Hershey, PA

5.0 MGD WWTP — **Currently operated at 3.8 MGD**

Co - digested Grease Waste and pretreated sludge from Hershey Foods

Biogas Conditioning – 300 scfm — **Engine Biogas Demand – 90 scfm max.**

Construction Cost - $2.0 Million — **Grant Amount - $500,000.**



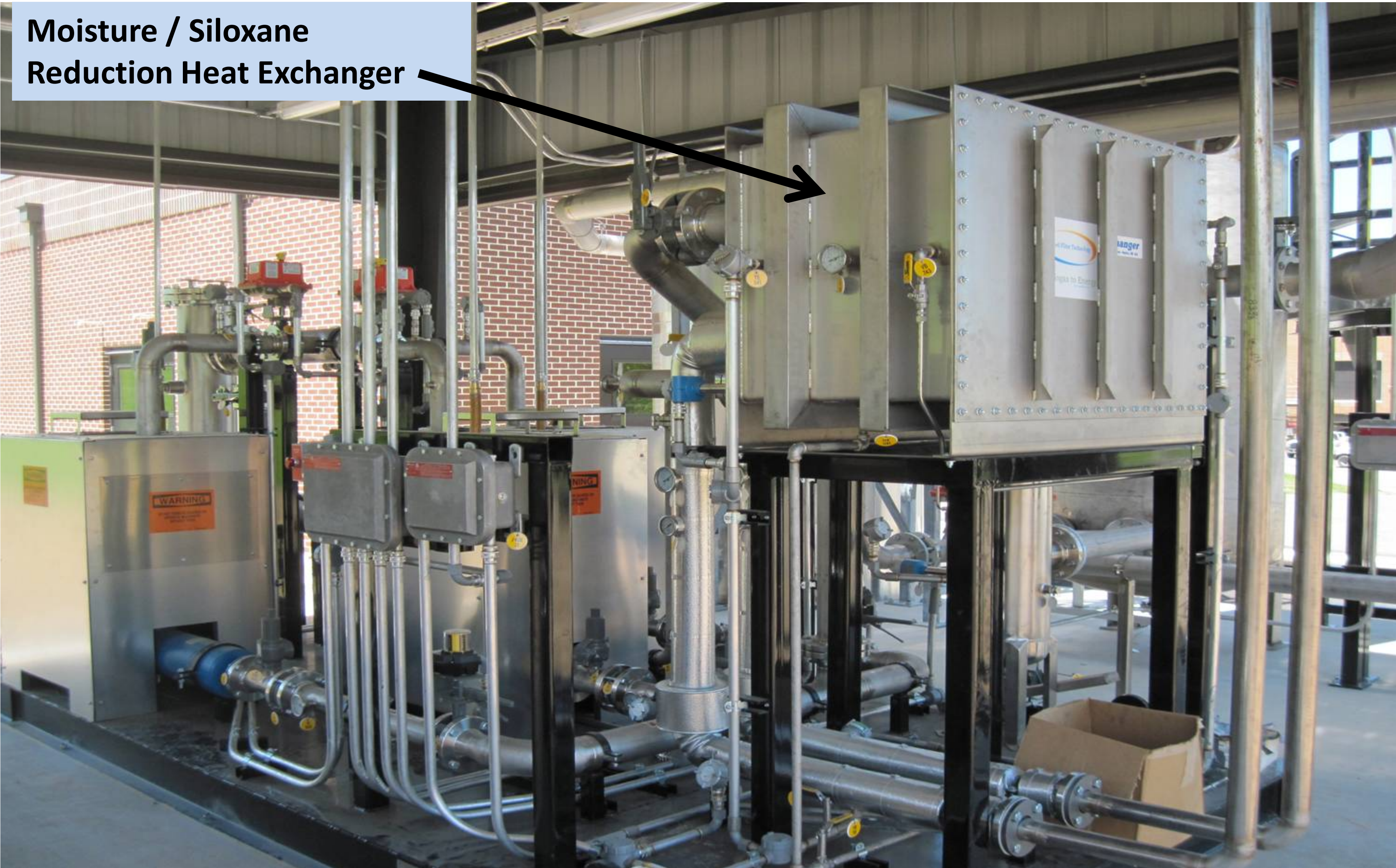
DERRY TOWNSHIP MUNICIPAL AUTHORITY

EXISTING BIOGAS UTILIZATION

JULY 2008	*CET Engineering Services* HARRISBURG, PENNSYLVANIA	FIGURE 1

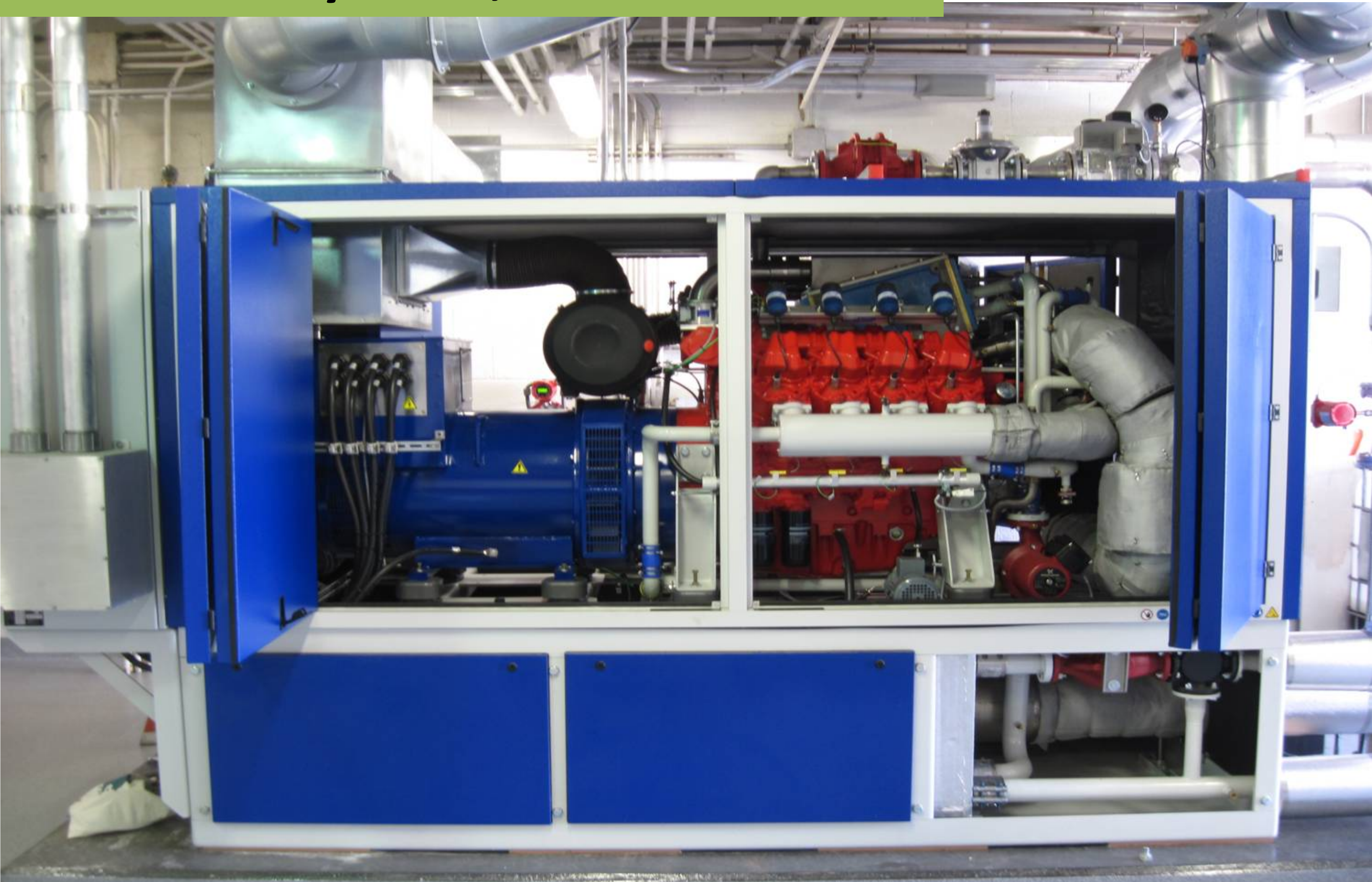
DTMA Biogas Conditioning System

DTMA Biogas Conditioning System

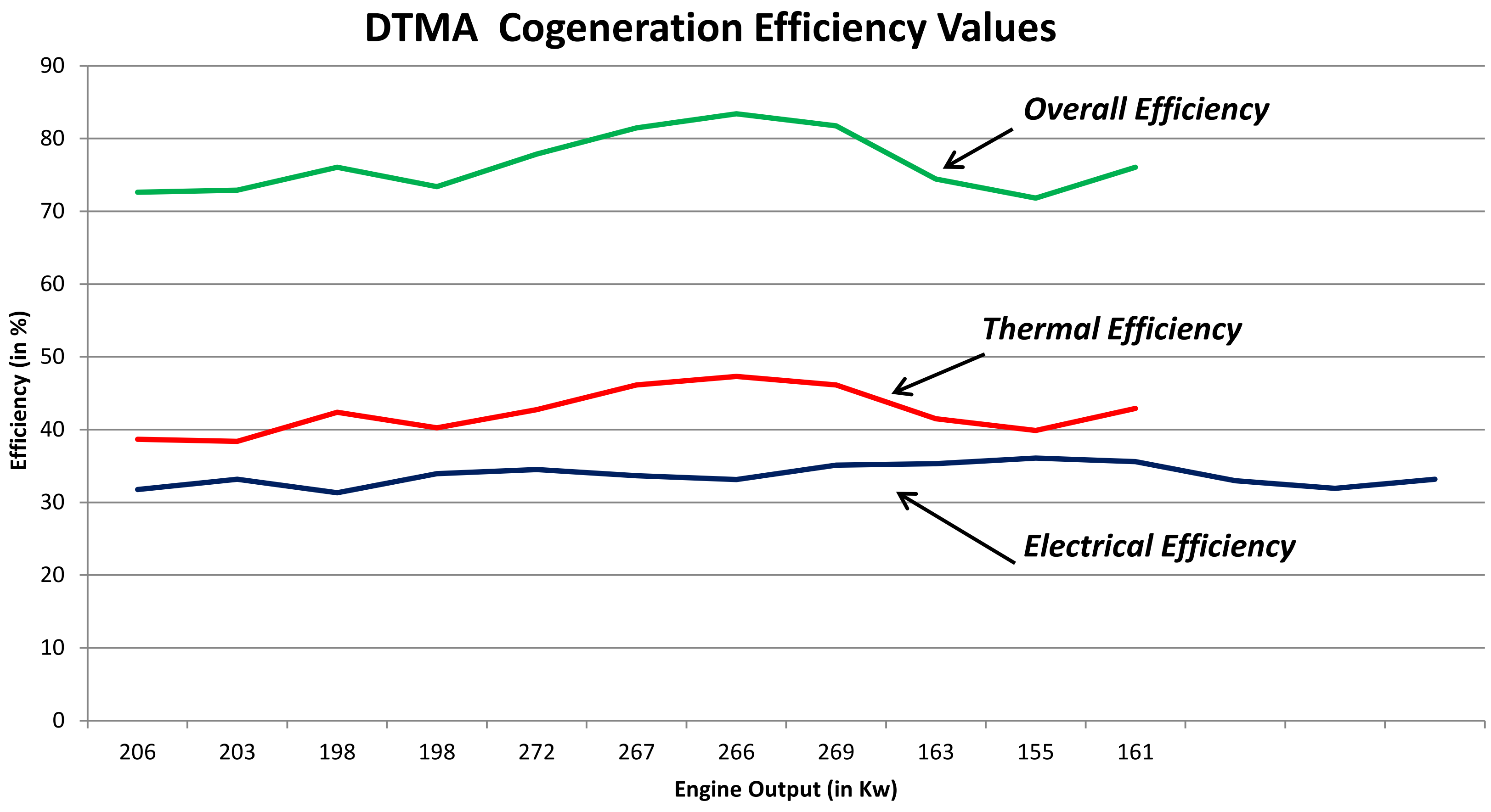


DTMA 280 kw, 375 HP Cogen Engine Housing

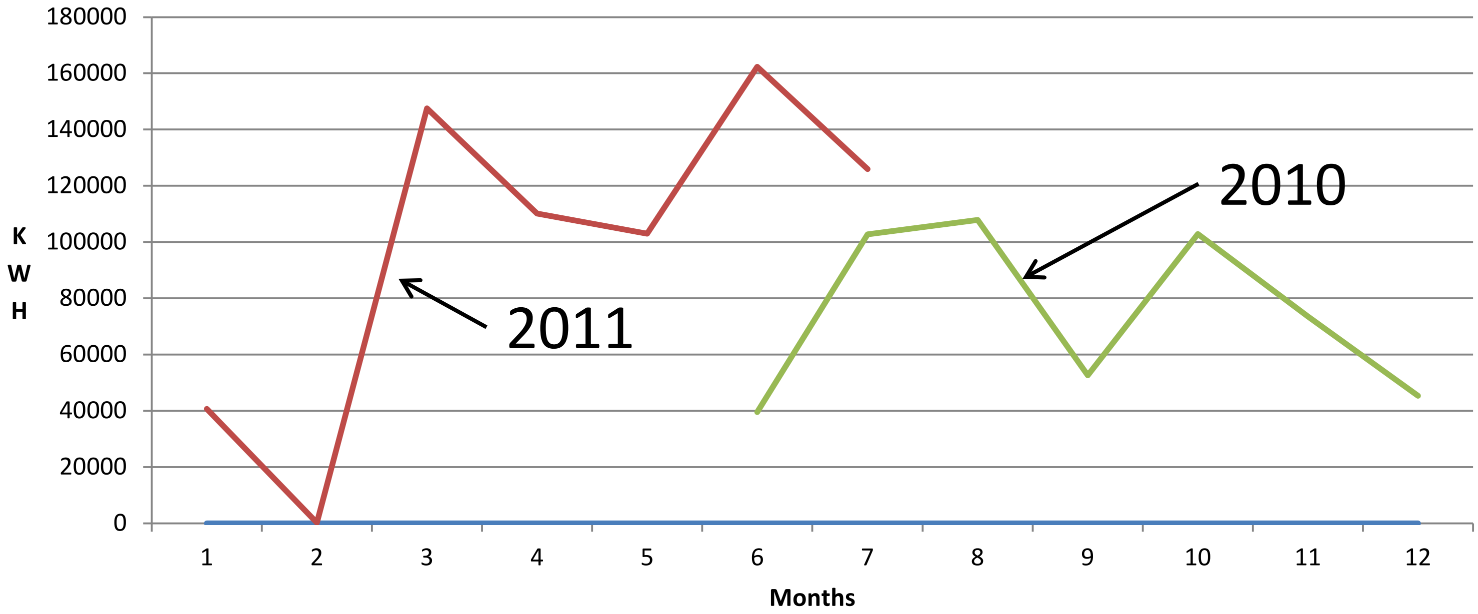
DTMA 280 kw, 375 HP Cogen Engine 8 cylinder, Lebeir

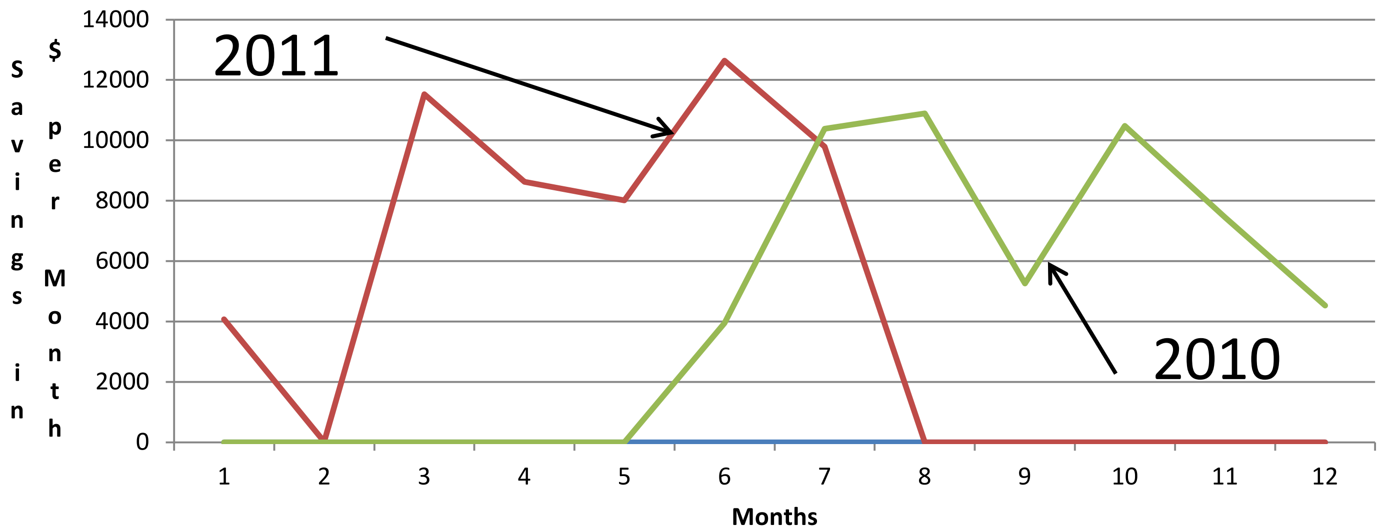


DTMA Electrical Power Profile

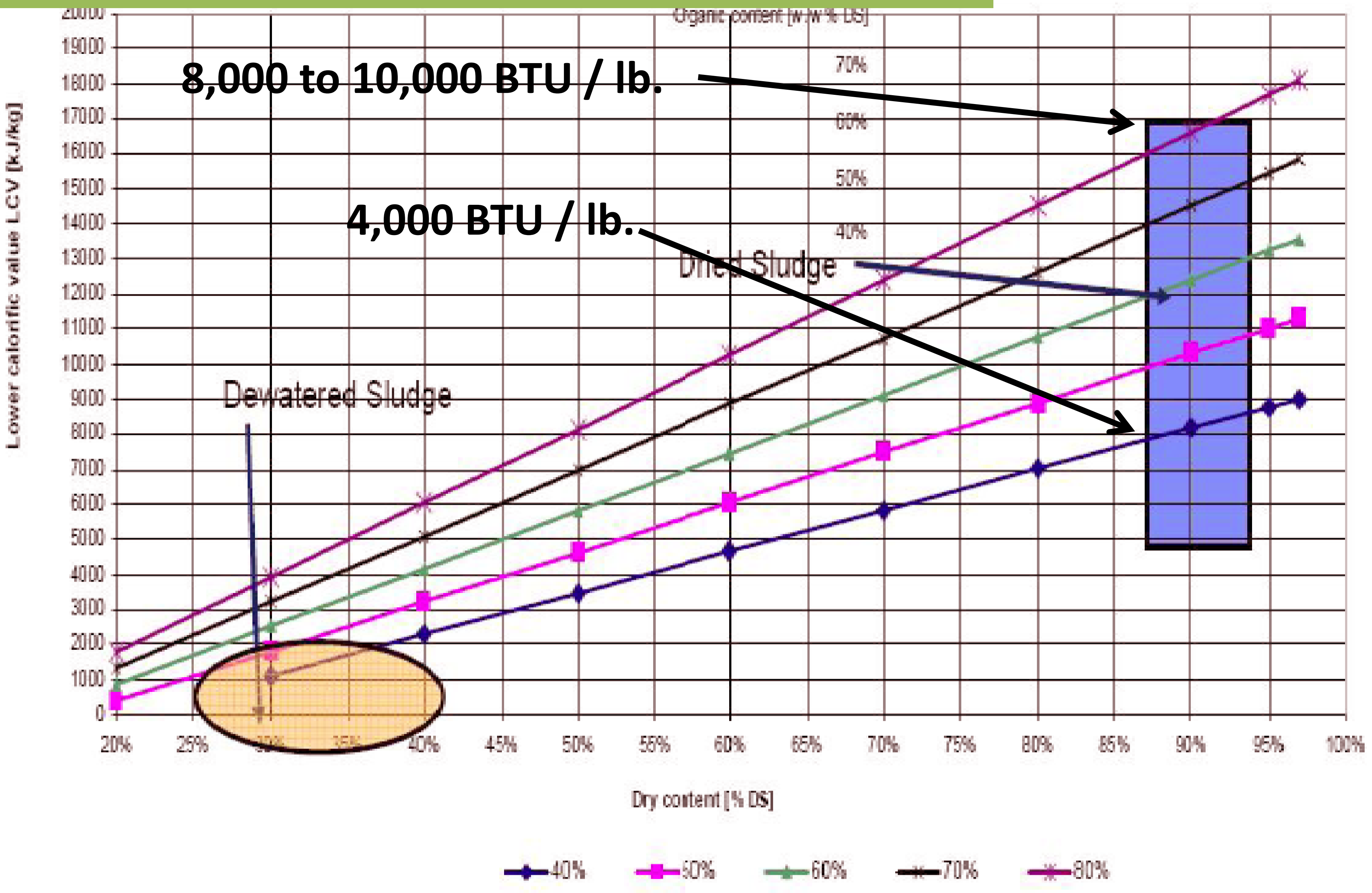


DTMA Electrical Power Profile and Savings





Thermal Bioenery Potential Of Biosolids



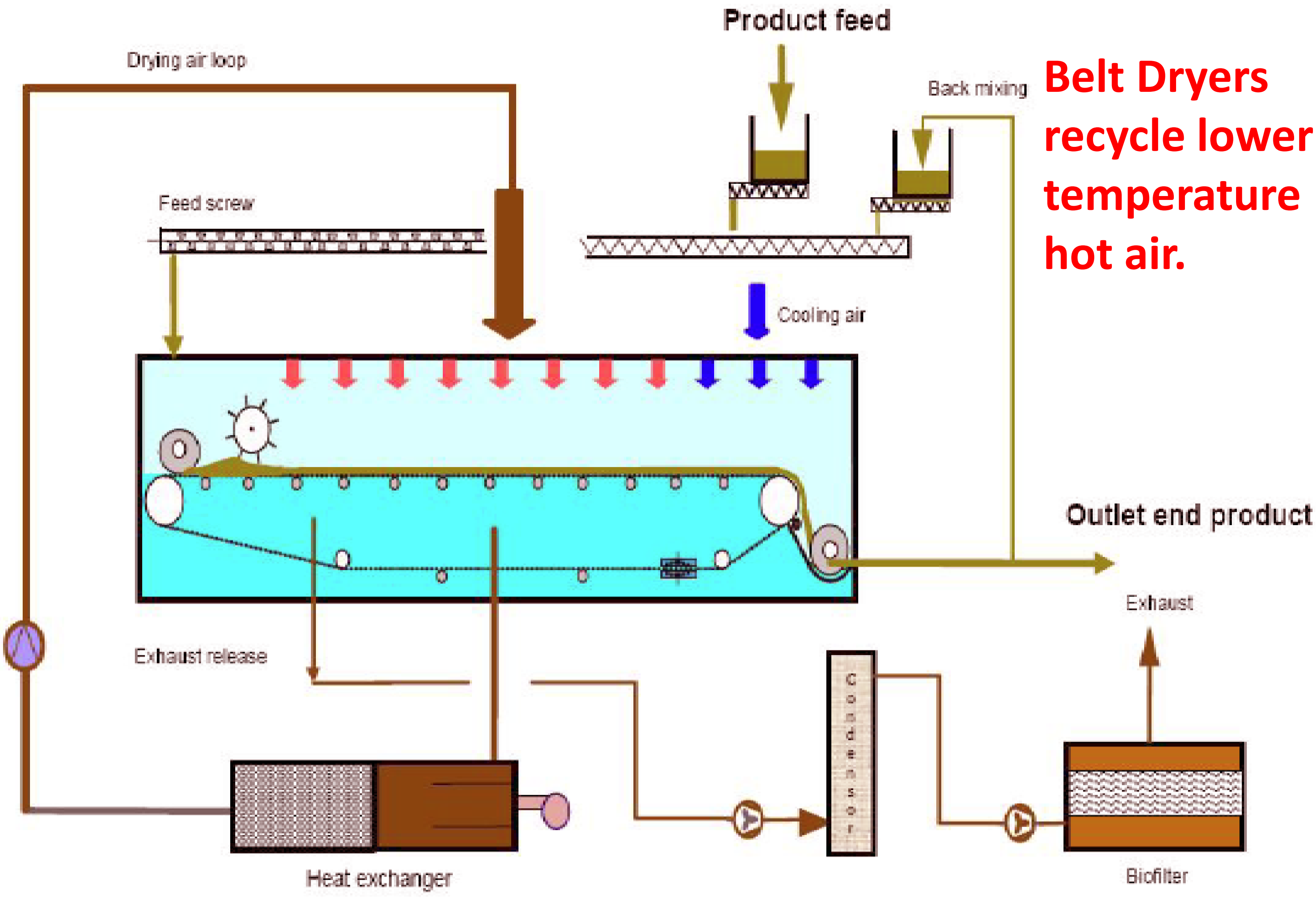
Indirect Dryers

Indirect dryers use hollow metal paddles or trays with hot fluids inside to dry the biosolids

Hot fluids include:

- Steam
- Thermal fluid (high flash point oil)

Belt Dryers



Belt Dryers recycle lower temperature hot air.

Inside Belt Dryer

Solar Sludge Drying

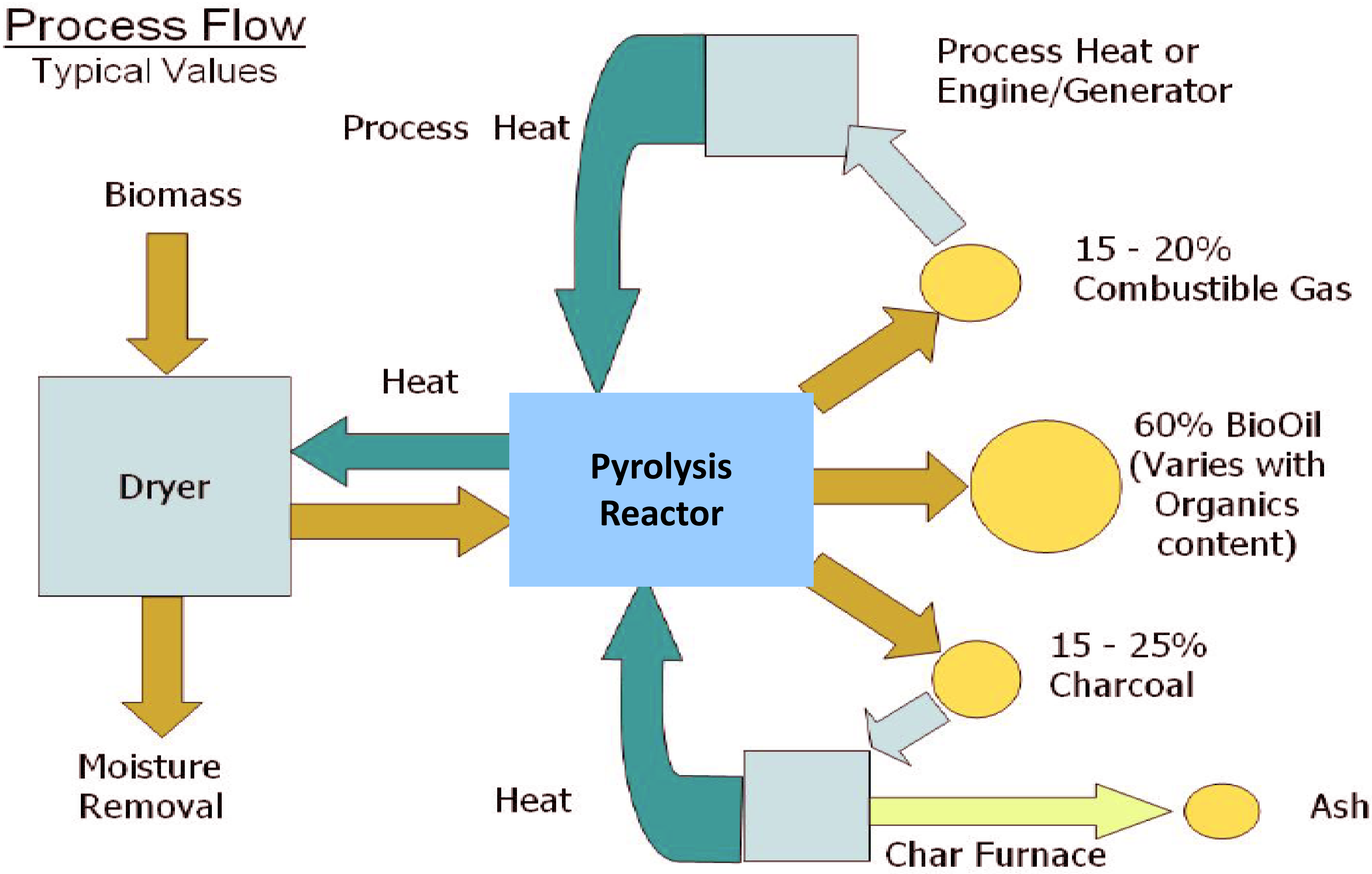
Worlds Largest Solar Dryer

Palma De Mallorca, Spain

Estimated Energy Comparison

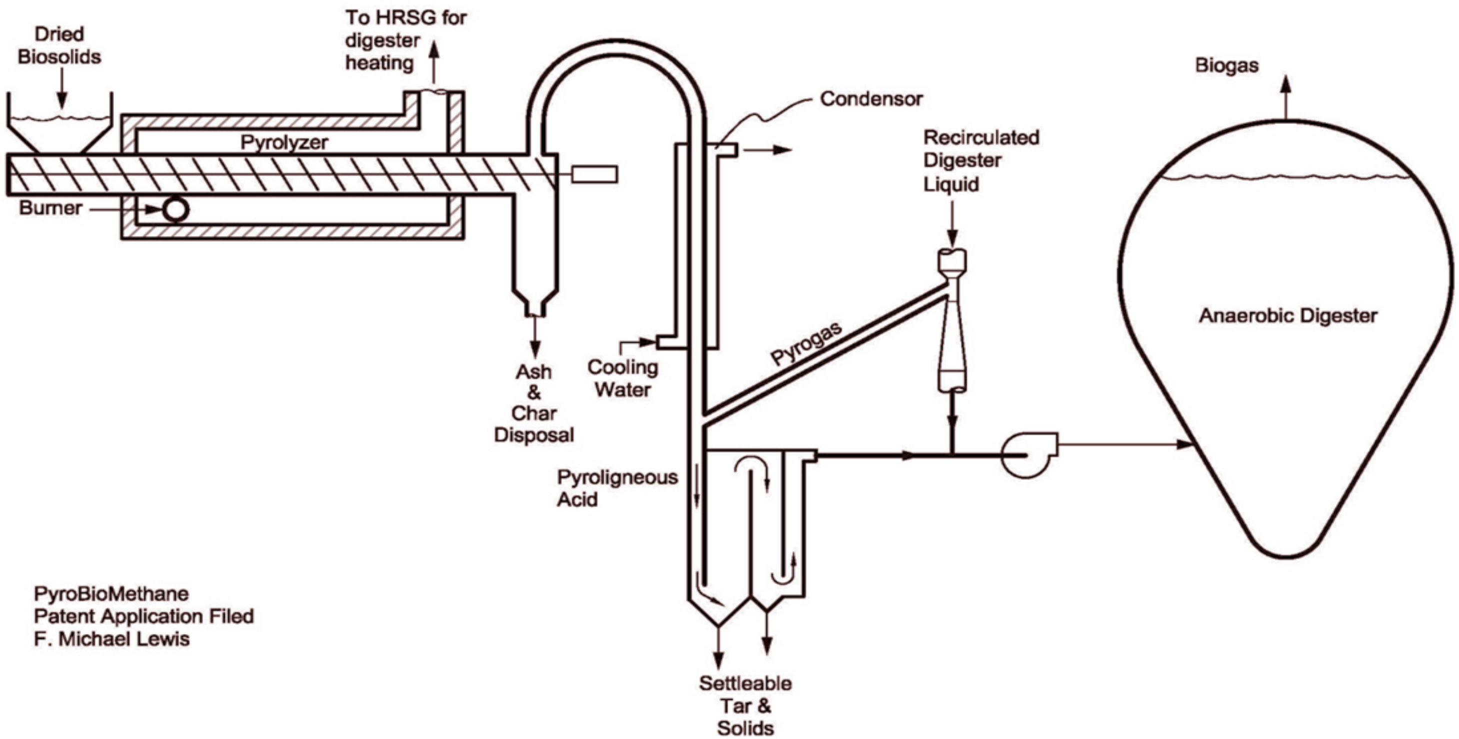
Thermal energy consumption	**Gas Fired Dryer**	**Solar Dryer**
Energy needed (BTU) per ton of H_2O evaporated	3,100,000	**Free**
Price per Million BTU's (approximate)	$10.00	$10.00
Cost per ton of water evaporated	**$ 31**	**Free**
Electricity consumed (equipment)		
Consumption per ton of H_2O evaporated [kWh]	100	30
Cost per kWh	$ 0.10	$ 0.10
Cost per ton of H_2O evaporated	**$ 10.00**	**$ 3.00**
Total energy cost per ton of H_2O evaporated (approx. at today's cost)	**$41.00**	**$3.00**

Pyrolysis Typical Heat & Material Balance



PyroBioMethane

The PyroBioMethane Process (patent application filed) converts ligno-cellulosic materials which are recalcitrant to anaerobic digestion into digestible compounds that can then be converted into biogas (~65% CH4; 35% CO2).



The PyroBioMethane process incorporates a slow, low temperature pyrolysis step. This is not to be confused with the numerous flash pyrolysis processes attempting to produce a “bio-oil” from biomass.

Other Case Studies

Case Studies:

Facility	*Capital Improvement*	*Capital Cost ($)*	*Energy Saved (in KWHs/yr)*	*Payback (in Years)*
Green Bay WWTP (8.0 MGD)	6 New Blowers; air bearing turbo type	$850,000 (2004)	2,143,974 (50% reduction)	13
Cumberland Co. Utilities Auth. NJ, (7.0 MGD)	New VFD driven multi-stage cent. blowers; new diffusers, new DO controls, new RAS system	$1.2 Million	Annual Revenue $10,000 to $20,000	Self Amortizing Project
Hatfield Township Municipal Auth., PA	ReHeat Oxidization new Multiple Hearth Furnace system.	$10 Million	50,000 Million BTU/yr	Paid for in 4 to 5 yrs.
Burlington, VT	New turo Blowers, DO Controls	$56,000 Rebate, electrical utility $21,000	250,000	1

Case Studies:

Facility	*Capital Improvement*	*Capital Cost ($)*	*Energy Saved (in KWHs/yr)*	*Payback (in Years)*
DELCORA	Change from fuel oil to natural gas for incineration system	$2.3 Million	Parallel Furnace Operation: Oil - $4,000 Gas - $650	5
Derry Twp. Mun. Auth., PA	280 kw (350 HP) CHP Cogeneration	$2.1 Million	1.5 to 2 Million KWH 17,000 gal. Fuel Oil	9
Landis Sewerage Auth., NJ	185 kw (240 HP) CHP Cogeneration	$1.4 Million	0.75 to 1.25 Million	6
East Norriton, Plymouth, Whitpain JSA, PA	ReHeat Oxidization system on Multiple Hearth Furnace	$1.2 Million	25,000 to 45,000 MMBTU/yr	6 to 7

Example Projects/Measured Benefits

Client	Project	Energy Reduction Results	Cost Benefits
Landis Sewerage Authority	Biogas Recovery and Cogeneration Facilities	About 1,000 Mw-hrs per year	$155,000 savings in 2008
New York State Energy Research & Development Authority	Energy Performance Evaluation Through Submetering Municipal Wastewater Treatment Plants	Varies for all of the 11 WWTPs evaluated; the total recommended savings was 7,400 Mw-hrs	Total annual savings was approximately $833,000
Cumberland County Utilities Authority	Aeration Process Optimization Project	200 HP	$102,000 savings annually

NYSERDA

Cost Savings

WWTP Location	Existing Energy Costs	Energy % Savings	Electrical $ Saved	Gas\Oil $ Saved	Operational $ Saved	Total $ Saved
Village of Marcellus (0.4 mgd)	$ 50,495	28%	$ 13,715	$ 315	$ 5,700	$ 19,730
Village of Clayton (0.5 mgd)	41,889	35%	14,800		59,000	73,800
Village of Heuvelton (0.5 mgd)	105,745	45%	48,000			48,000
South & Center Sewer (2 mgd)	152,345	14%	21,600			21,600
Town of Grand Island (2.1 mgd)	195,174.	22%	42,000			42,000
Town of Bethlehem (3.5 mgd)	162,725	21%	34,000			34,000
Erie Co. Big Sister (4.9 mgd)	381,145	21%	77,325	$ 4,100	151,000	232,425
Orangetown (7.5 mgd)	150,374	52%	78,000			78,000
Saratoga Sewer Dist. (21 mgd)	787,563	11%	8,680	$75,365		84,045
Onondaga County (80 mgd)	1,615,965	12%	200,000			200,000
Total	**$3,643,420**	**17%**	**$538,120**	**$79,780**	**$215,700**	**$833,600**

QUESTIONS

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