The New Jersey Water Environment Association
The John J. (Jack) Lagrosa 102nd Annual Conference and Exposition

ARCADIS Design & Consultancy for natural and built assets

AAEES WORKSHOP

ENERGY MANAGEMENT FOR WATER AND RESOURCE RECOVERY FACILITIES

The Sustainable Wastewater Facility

Matthew Yonkin, PE, BCEE, CEM, ENV SP

Agenda

- Discuss what makes a facility sustainable
- Review energy use at a typical facility
- Discuss opportunities for improved energy management
- Highlight case studies to demonstrate success

What does Sustainable Mean?

- Environmentally sustainable
- Financially sustainable
- Organizationally sustainable
- Physically/functionally sustainable

Effective Energy Management Supports All of These

Defining Energy Management

Energy management includes planning and operation of energy production and energy consumption units. Objectives are resource conservation, climate protection and cost savings, while the users have permanent access to the energy they need.

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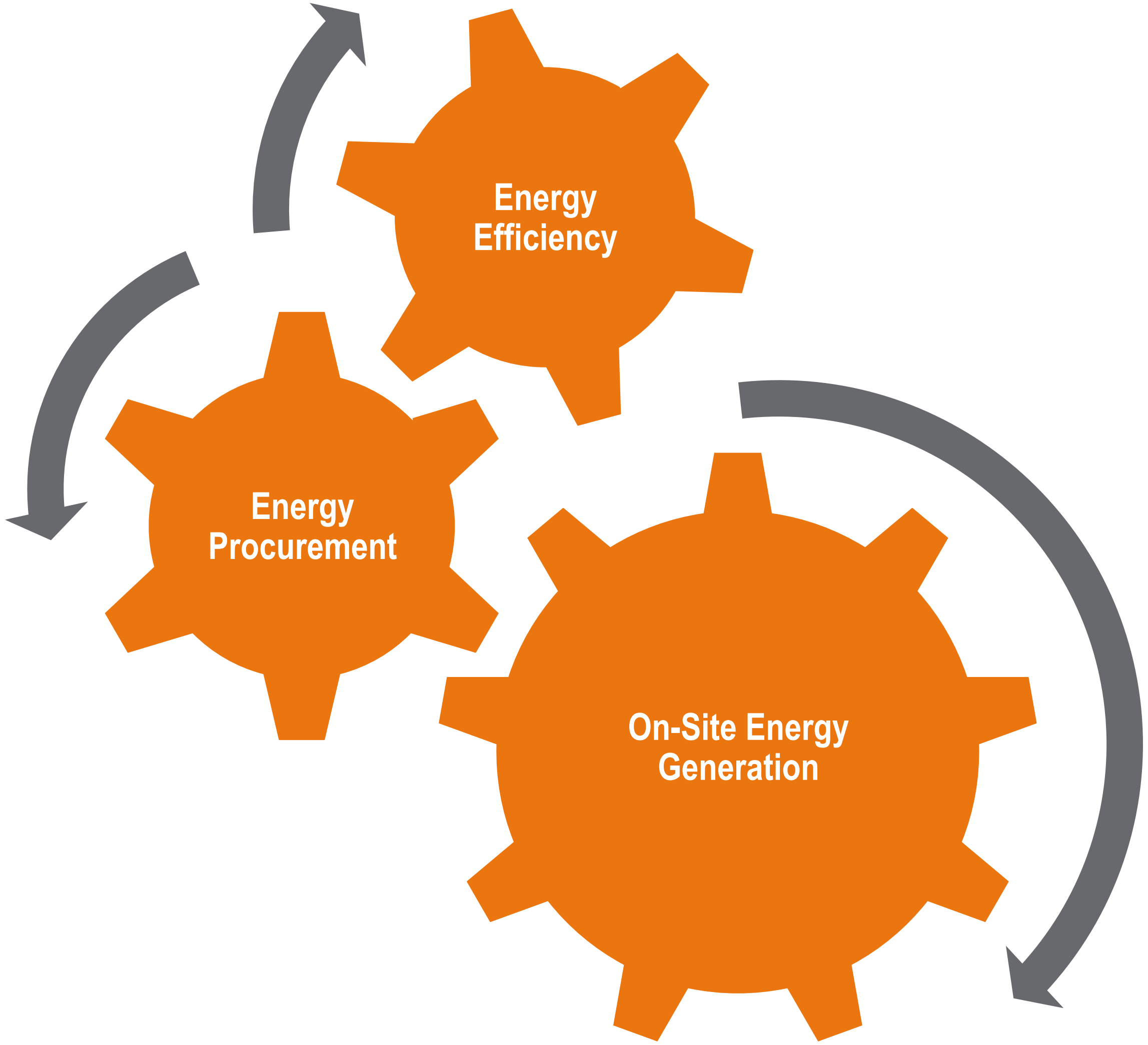
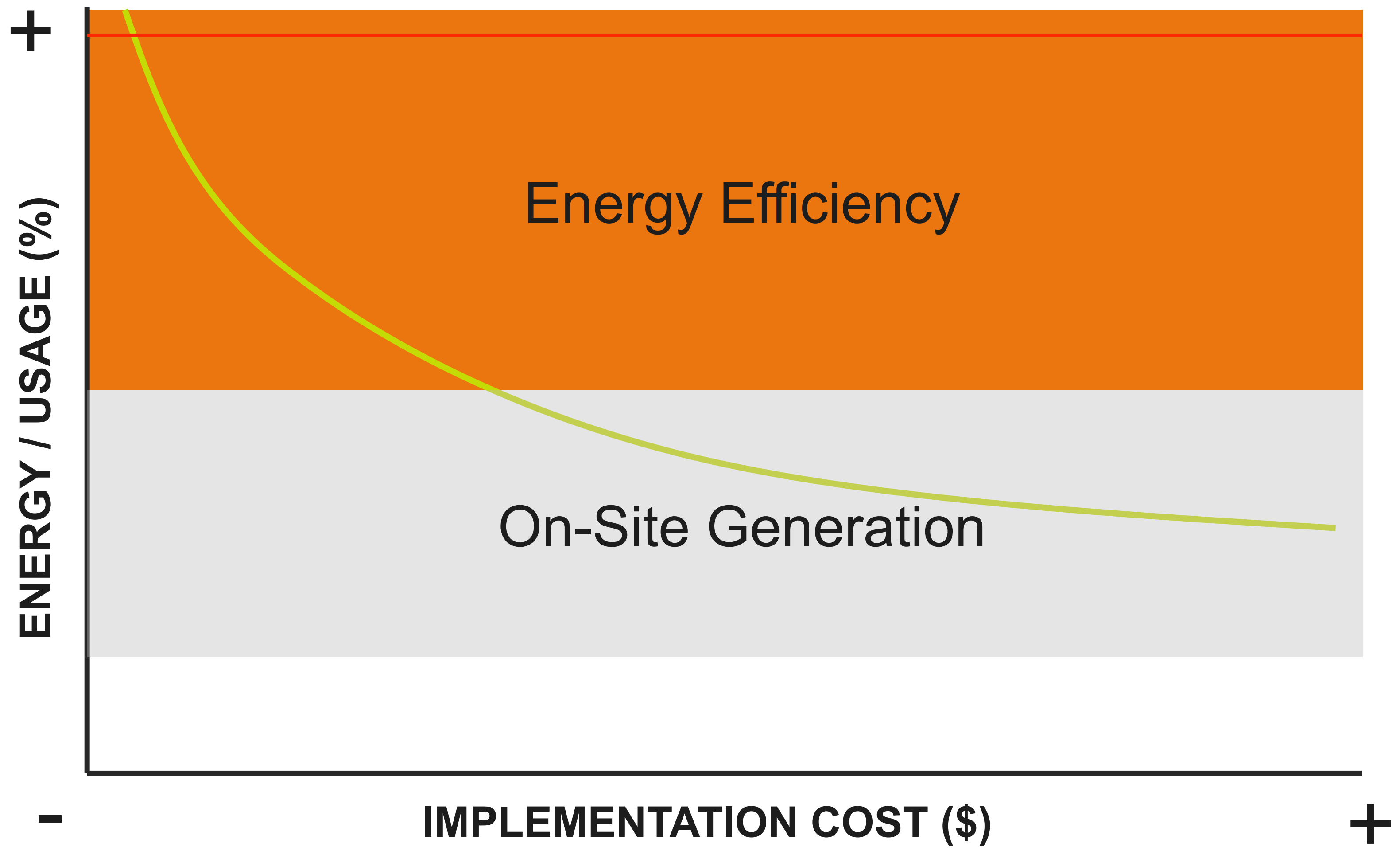
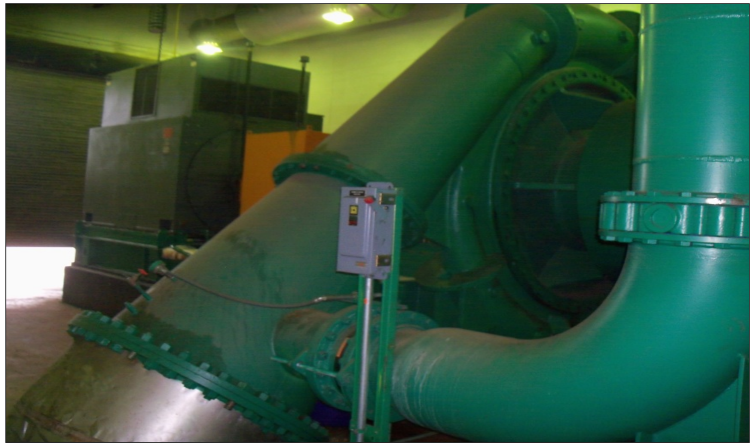


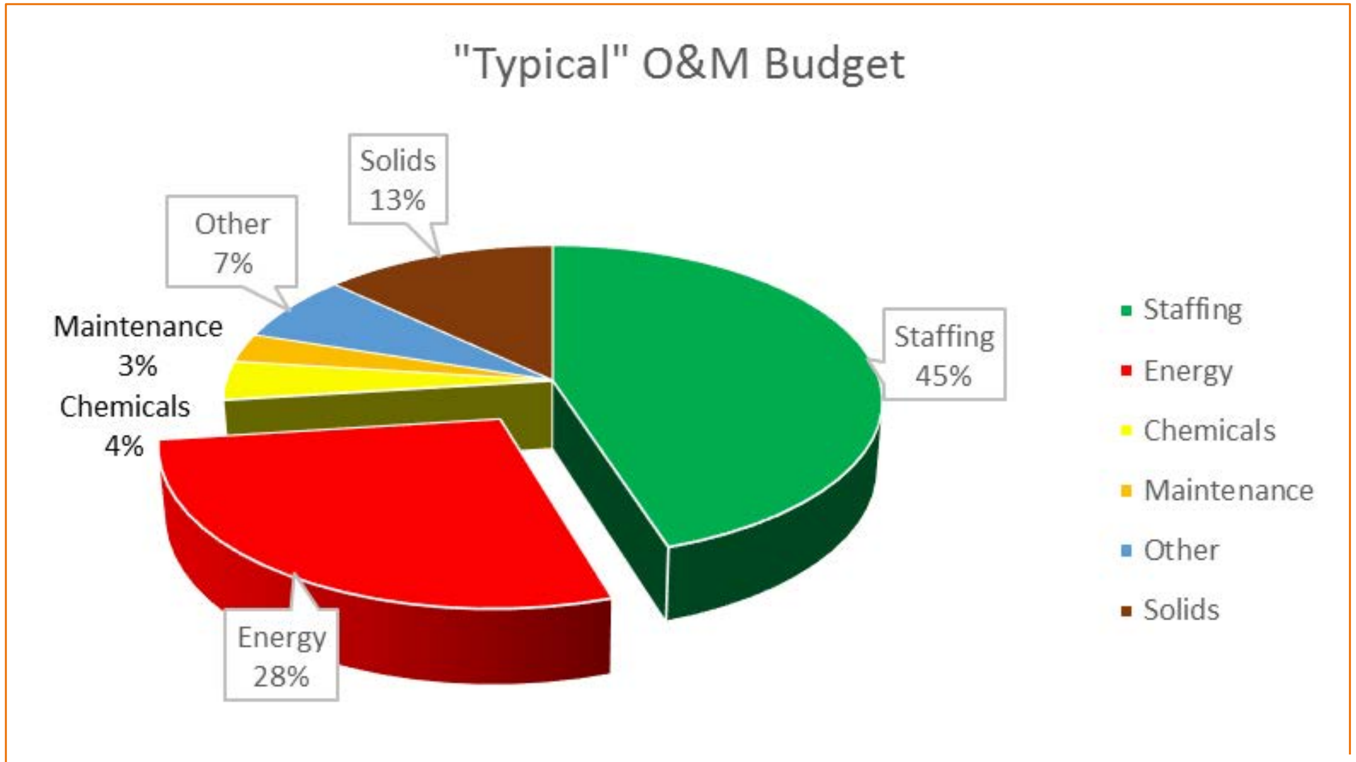
As initiatives mature, considerations change



Overview of Energy Use in Wastewater Sector



Energy Costs Represent a Significant Portion of the Operating Budget



Source: Jones, Ted. "Municipal Water/Wastewater Breakout Session." CEE. 18 January 2007.

Narrow Focus Can Create Unintended Consequences

- A focus solely on energy reduction may miss other opportunities
- Acceptance of feedstocks may affect downstream treatment and solids handling processes
- Not fully addressing authority/legal control can significantly affect outcomes
- Project delivery models can affect realized savings
- Overly aggressive designs may affect future flexibility and operations
- Focusing solely on short-term payback projects may limit magnitude of benefits
- Not understanding utility interconnection requirements may affect distributed generation

Keep the "Big Picture" In Mind with All Projects

Typical Electricity Usage [1]

Biological Aeration	39%
Aerobic Digestion	35%
Pumping	14%
Lighting / Buildings	6%
Thickening / Dewatering	3%
Clarifiers	2%
Headworks	1%
Chlorination	<1%

[1] Water Environment Federation MOP 32 Energy Conservation in Water and Wastewater Facilities 2009. *Appendix C Table C.2. Activated Sludge WWTP – 5 MGD.*

Common Demand-Side Strategies

Energy Efficiency

- Aeration upgrades (blowers, diffusers, controls)
- Pumping system upgrades (pumps, VFDs, controls)
- Biological process improvements/modifications
- Improved ultraviolet disinfection system controls
- Motor replacement, ventilation, lighting

Solids Thickening, Dewatering, and Disposal

- Improvements to dewatering or thickening
- Mechanical dewatering or drying
- Improved digestion (aerobic or anaerobic)
- Alternative solids destruction processes/preconditioning
- Upgrade to Class A biosolids

Chemical Savings

- Conversion to biological phosphorus removal
- Optimized chemical feed system operation
- Odor control system replacement
- Conversion to UV Disinfection
- Process conversion/upgrade to eliminate carbon use

Common Generation/Recovery Strategies

Waste Heat/Heat Recovery

- Economizers on ventilation systems
- Effluent geoexchange
- Engine heat recovery
- Incinerator heat recovery

Other Generation

- Effluent hydroelectric generation
- In-process hydrokinetic generation
- Photovoltaic electrical or thermal production
- Wind electrical generation
- Battery storage
- Fossil fuel-based on-site cogeneration
- "Green Power" purchase agreements

Digester Gas Opportunities

- Boiler fuel
- Engine driven equipment
- Combined heat and power
- Pipeline injection
- Compressed natural gas for fueling
- CO_2 recovery
- Augmentation with FOG or feedstocks

Case Study: Pump Station

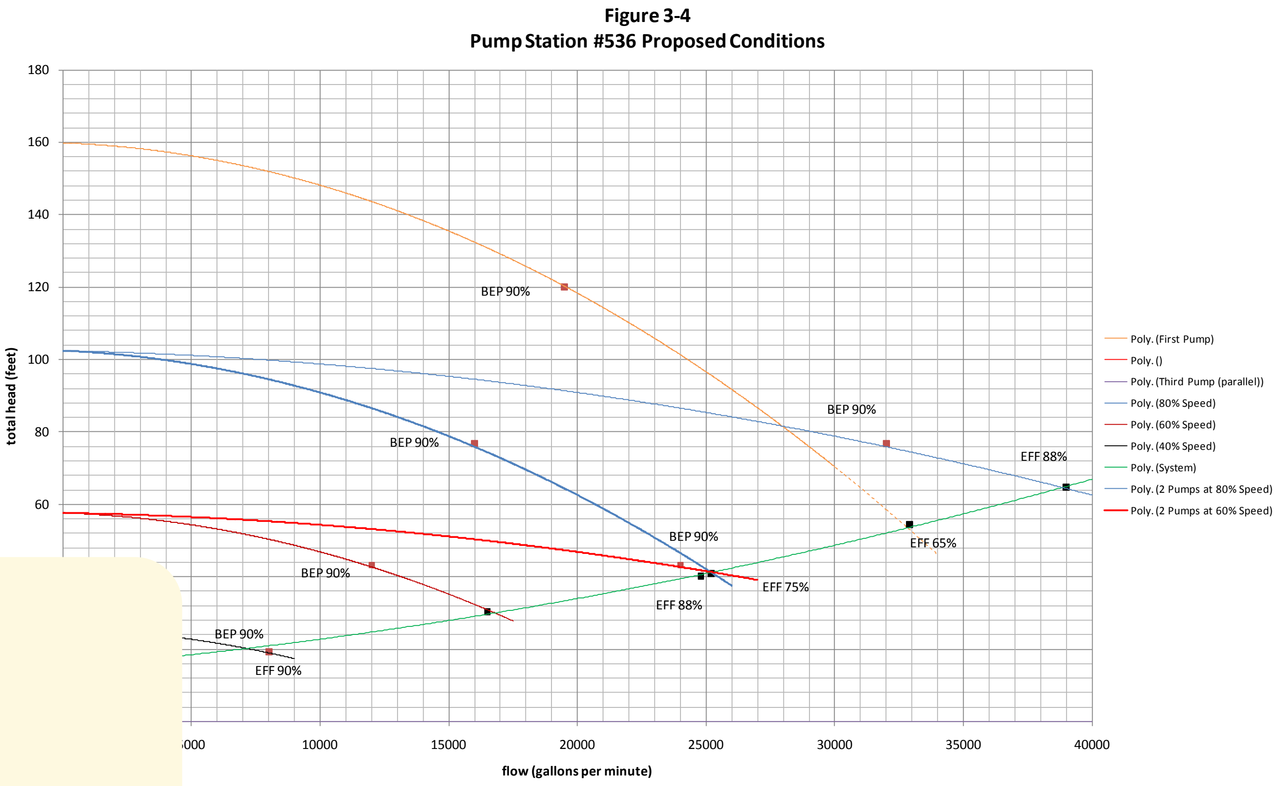
Lift Station Variable Speed Operational Changes

Existing

- 1 pump @ 100% speed: 72% efficiency

Energy Upgrades

- 2 pumps @ 65% speed: 85% efficiency



Annual Energy Reduction:	460,000 kWh
Annual Energy Cost Savings:	$46,000
Capital Cost:	$0
Simple Payback:	Immediate

Case Study: 6 MGD WWTP

Aeration System Improvements

Existing

- Two 100-HP constant speed multi-stage centrifugal blowers
- Oversupplying air at normal conditions

Energy Upgrades

- 150-HP turbo blower, VSD, DO controls

Annual Energy Reduction:	458,000 kWh
Annual Energy Cost Savings:	$64,000
Capital Cost:	$334,000
Simple Payback:	5.2 years

Case Study: Gloversville-Johnstown Joint WWTF

- Low median household income area
- Shrinking industrial user base
- Desire to stabilize user rates at the same time significant capital investment was needed
- Desire to become more sustainable – environmentally & financially
- Desire to be a catalyst for regional economic development and growth

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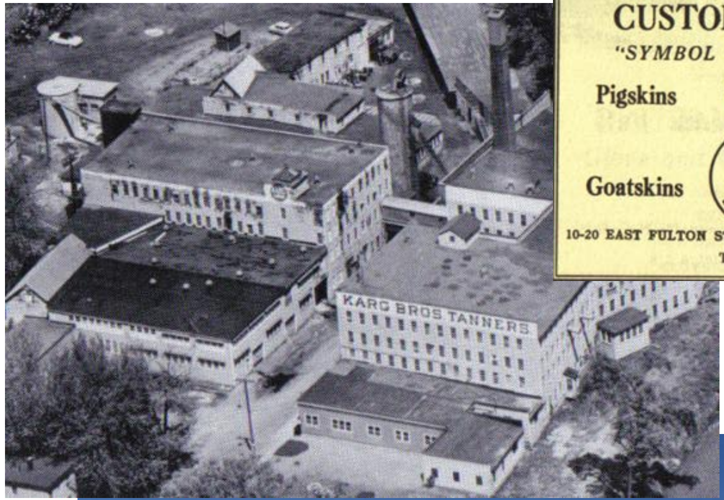
Case Study: Gloversville-Johnstown Joint WWTF



Over a 10-Year Period, Net Neutrality Achieved!

Steps Taken to Achieve Energy Neutrality

Aeration System Upgrades

- Right size blowers, diffusers, DO controls, improved flow equalization

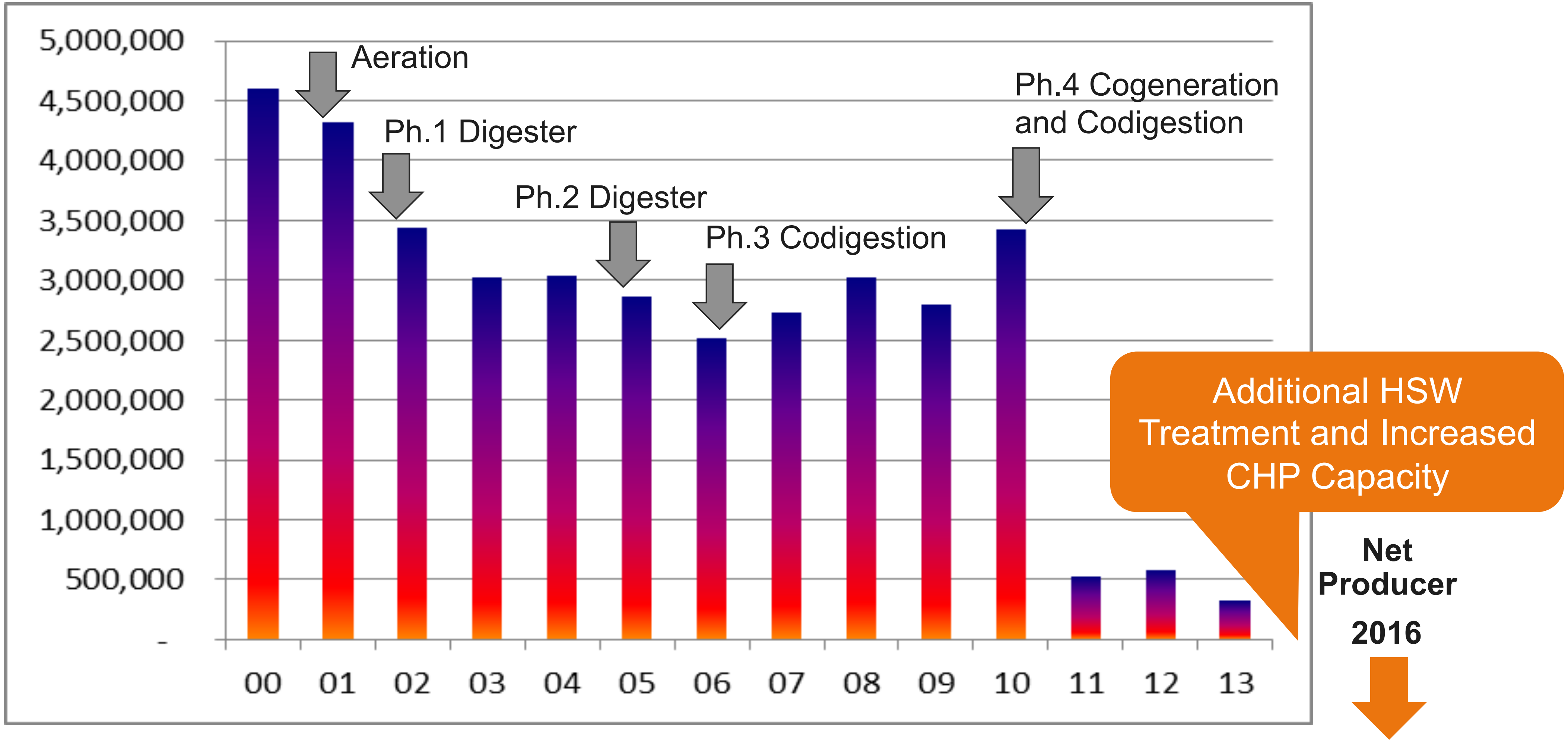
Anaerobic Digestion Optimization

- Phase I: biogas piping and AD mixing system, overhauled ICE generators
- Phase II: biogas storage, safety equipment

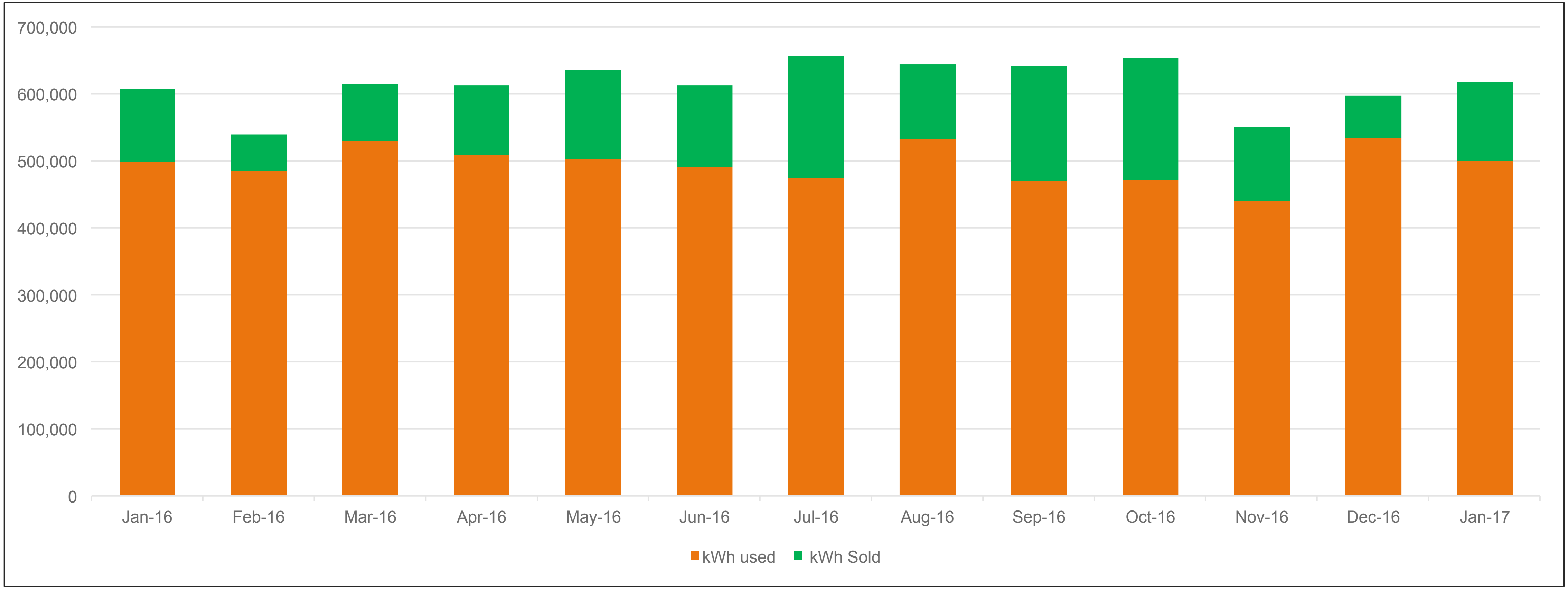
Co-digestion

- Phase III: accepting dairy whey, whey equalization
- Phase IV: increased CHP to 700 kW, sludge thickening, sludge dewatering upgrade, dairy washwater daft pretreatment, recuperative thickening
- Currently 1 MW of on-site generation and net exporter of electricity

Purchased kWh Reduction

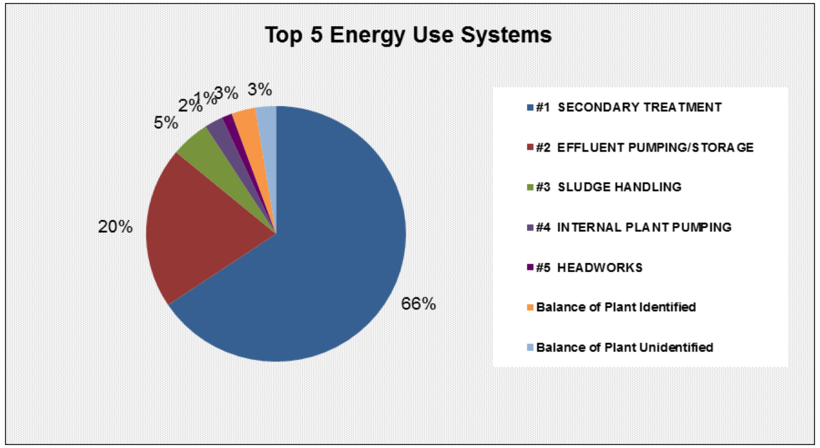


2016 Electricity Generation



Conclusions

- Environmental sustainability is only a portion of what makes a utility sustainable
- Effective energy management can support all aspects of utility sustainability
- Energy efficiency, generation and procurement all play a role in effective energy management
- To avoid unanticipated consequences, it is essential to maintain a broad perspective when evaluating and implementing improvements



Major Process/Top Energy Use Systems	Electric Energy Use (%)	Electric Energy Use (kWh)	Electric Energy Cost ($)
#1 SECONDARY TREATMENT	65.62%	6,959,534	$728,780
#2 EFFLUENT PUMPING/STORAGE	20.41%	2,164,851	$226,696
#3 SLUDGE HANDLING	4.83%	512,590	$53,677
#4 INTERNAL PLANT PUMPING	2.31%	245,266	$25,683
#5 HEADWORKS	1.28%	135,726	$14,213
Balance of Plant Identified	2.99%	316,761	$33,170
Balance of Plant Unidentified	2.56%	271,308	$28,410
Total	100.00%	10,606,036	$1,110,630

Questions

Matthew Yonkin, PE, BCEE, CEM, ENV SP
Mobile: 518-415-2155
Email: Matthew.Yonkin@arcadis.com