Metropolitan Water Reclamation District of Greater Chicago

WELCOME

TO THE JANUARY EDITION

OF THE 2020

M&R SEMINAR SERIES

BEFORE WE BEGIN

- **SAFETY PRECAUTIONS**
  - **PLEASE FOLLOW EXIT SIGN IN CASE OF EMERGENCY EVACUATION**
  - **AUTOMATED EXTERNAL DEFIBRILLATOR (AED) LOCATED OUTSIDE**
- **PLEASE SILENCE CELL PHONES AND/OR SMART DEVICES**
- **QUESTION AND ANSWER SESSION WILL FOLLOW PRESENTATION**
- **PLEASE FILL EVALUATION FORM**
- **SEMINAR SLIDES WILL BE POSTED ON MWRD WEBSITE** (https://mwrd.org/seminars)
- **STREAM VIDEO WILL BE AVAILABLE ON MWRD WEBSITE** (https://mwrd.org/seminars - after authorization for release is arranged)

Nicholas J. Menninga, PE, DEE

- **Mr. Menninga** is the General Manager at the Downers Grove Sanitary District, where he has worked since 2004. He has over 35 years of experience in the wastewater industry, including roles in a state regulatory agency, as a consulting engineer, and practicing public utility management.
- Mr. Menninga received his Bachelor of Science in Chemical Engineering from the University of Illinois, Urbana. He is an Illinois licensed Professional Engineer, an Illinois Class 1 Wastewater Treatment Plant Operator and a Diplomate of the American Academy of Environmental Engineers (DEE). He has been the president of IAWA and co-chair of NACWA Energy Committee.

Pursuit of Energy Neutrality at the Downers Grove Sanitary District

Nick Menninga, General Manager

January 24, 2020

Downers Grove Sanitary District

Agenda

- Background
- Improved Efficiency / Energy Reduction
- Energy Production / Use Of Resources

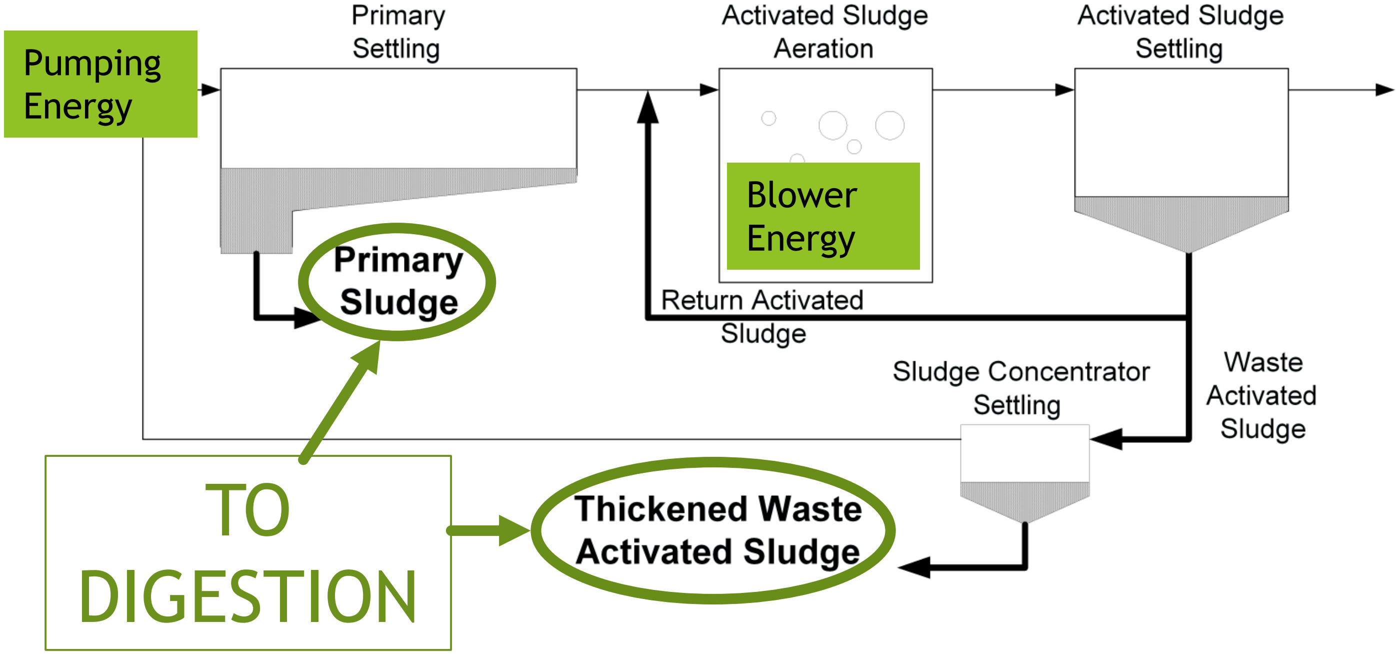
Downers Grove Sanitary District

- 11/22 MGD average/peak full treatment capacity
- Primary clarification
- Single-stage nitrification
- Tertiary sand filtration
- *Oversized* anaerobic digestion
- Sludge dewatering and aging
- Excess flow primary and disinfection to 110 MGD total

Wastewater Treatment Energy Needs

- Pumping
- Secondary Treatment – Aeration
- Buildings – HVAC/Lighting
- Other Small Process Motors
- Sludge Digestion – Heat/Mixing

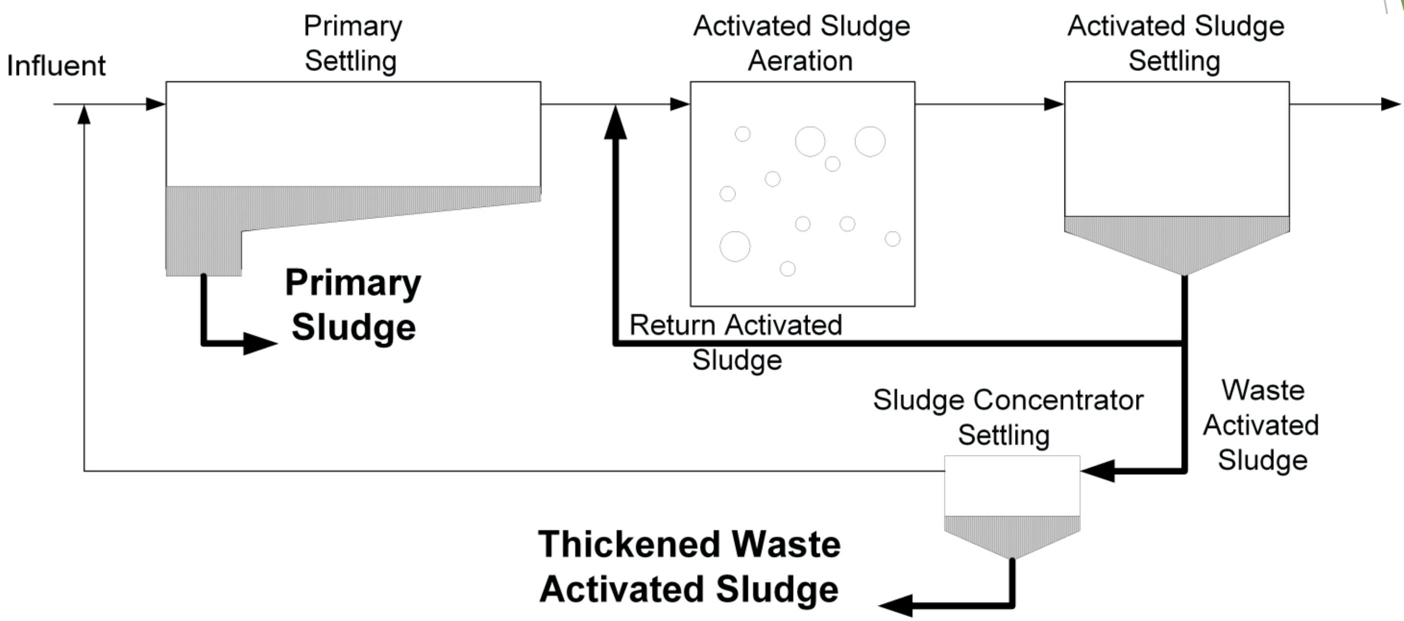
Basic Treatment Scheme



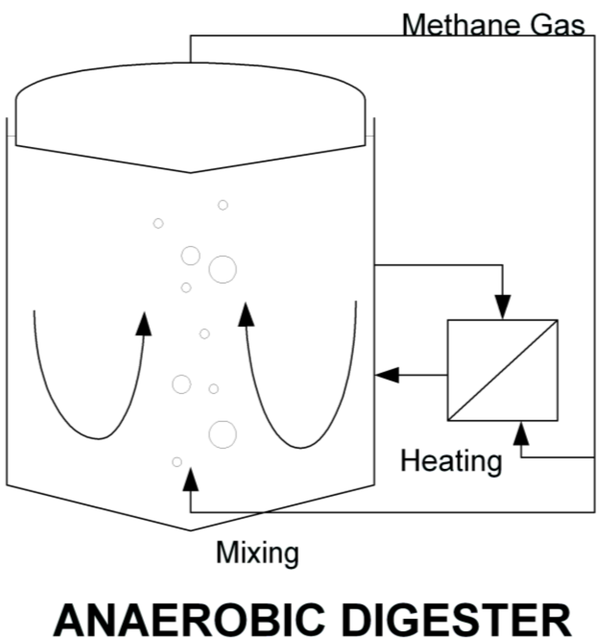
Pumping

- Centrifugal Pumps
- Electric Motors
- 40 Feet Vertical Lift
- 11 Million Gallons per Day

Activated Sludge/Aeration



Anaerobic Digestion



Building Spaces

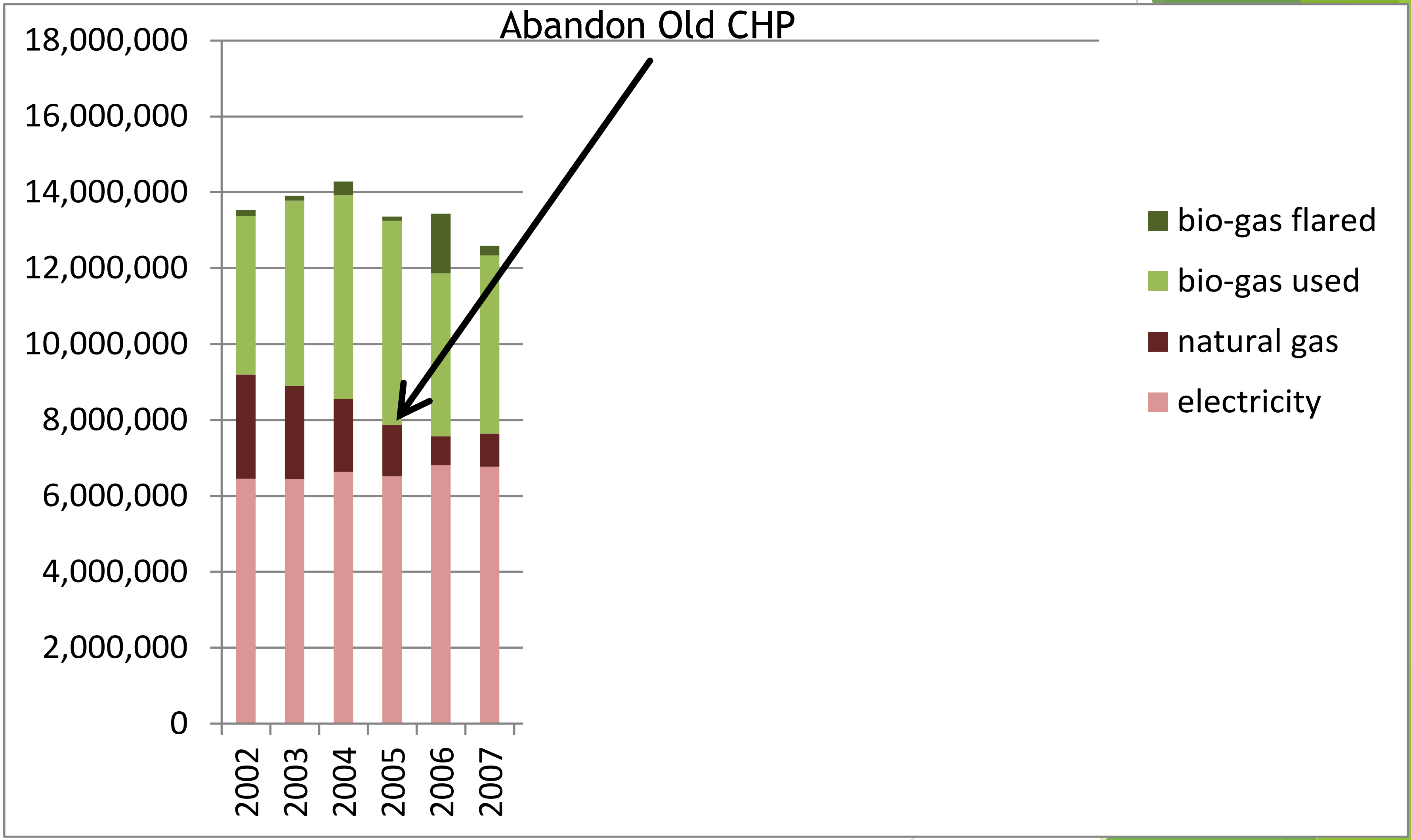
The Management Challenge

- Energy: 15% of operating budget
- Cost-effective reductions: good business practice / expected by rate payers
- Synergies
  - Staff skills
  - Automation/controls
  - Existing energy infrastructure
  - Available technologies
  - External funding

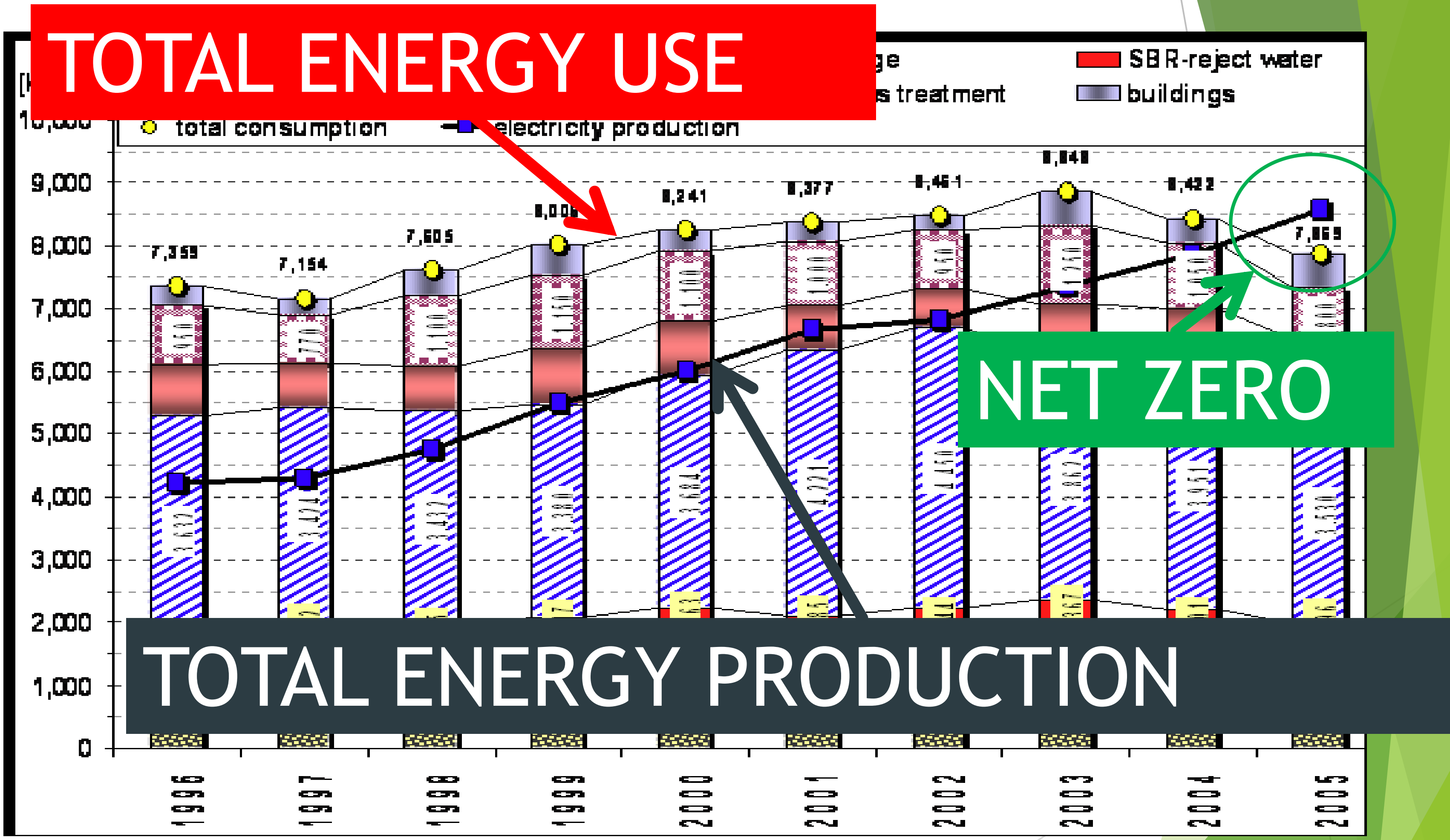
Energy Types and Needs

- Electricity
  - Pumping
  - Aeration
  - Other process
  - Support (buildings, outside lighting, etc)
- Natural Gas
  - Heating – Building
  - Heating - Process
- Digester Gas
  - Heating - Process

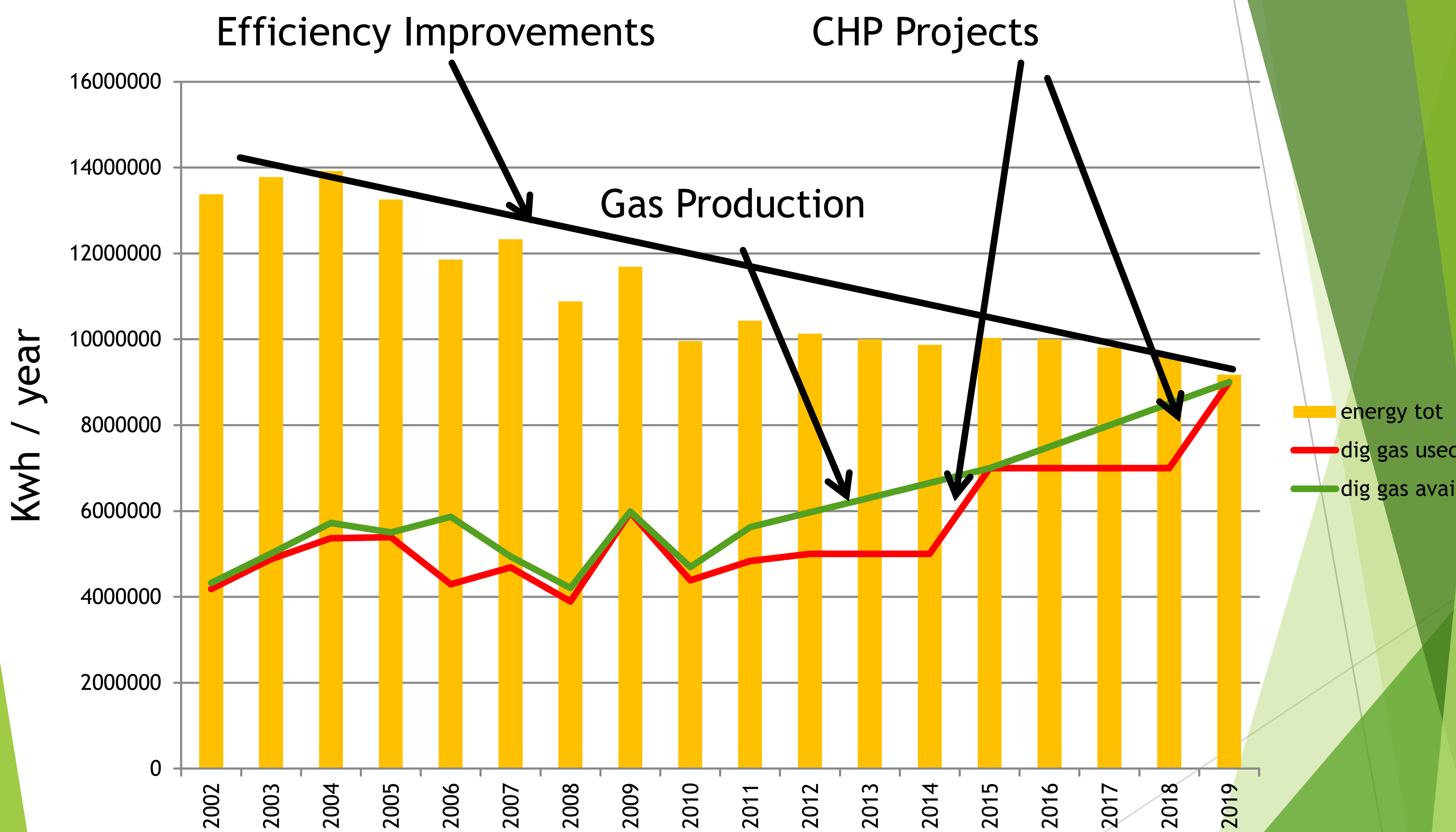
Historic Energy Use



Model Program – Strass, Austria



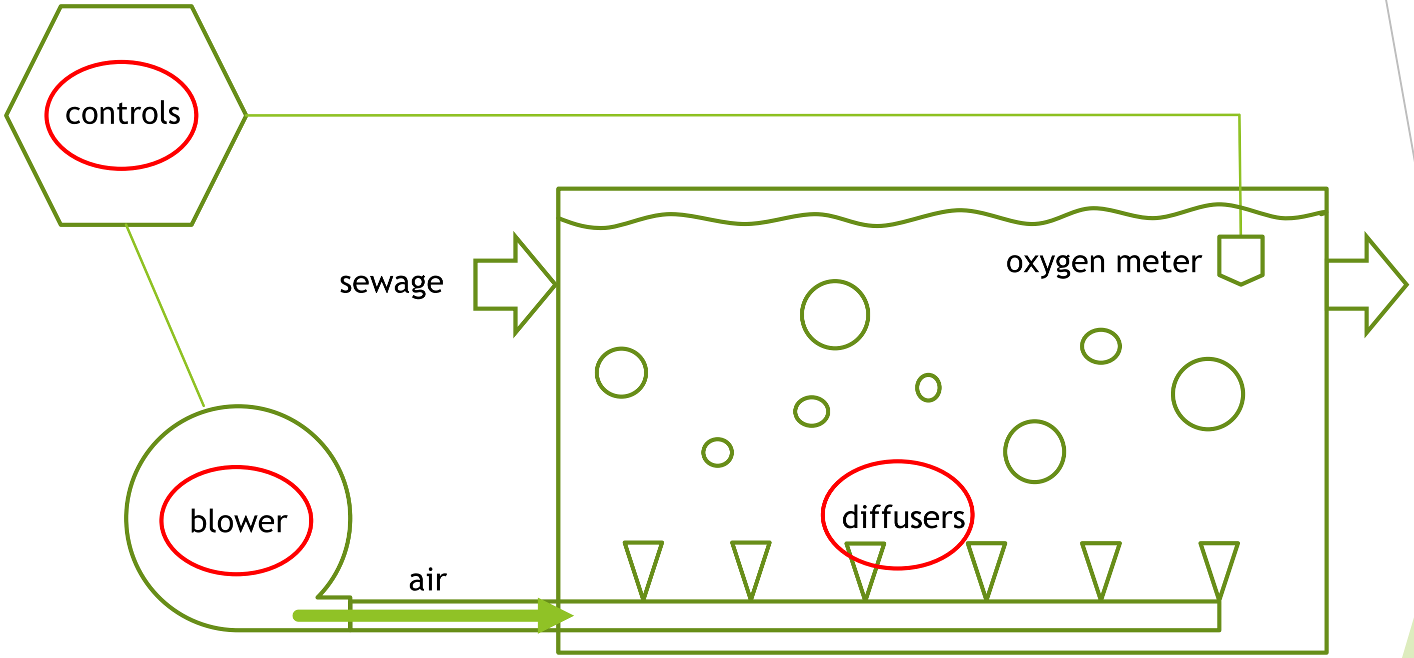
Matching the Model



Energy Reduction/Efficiency

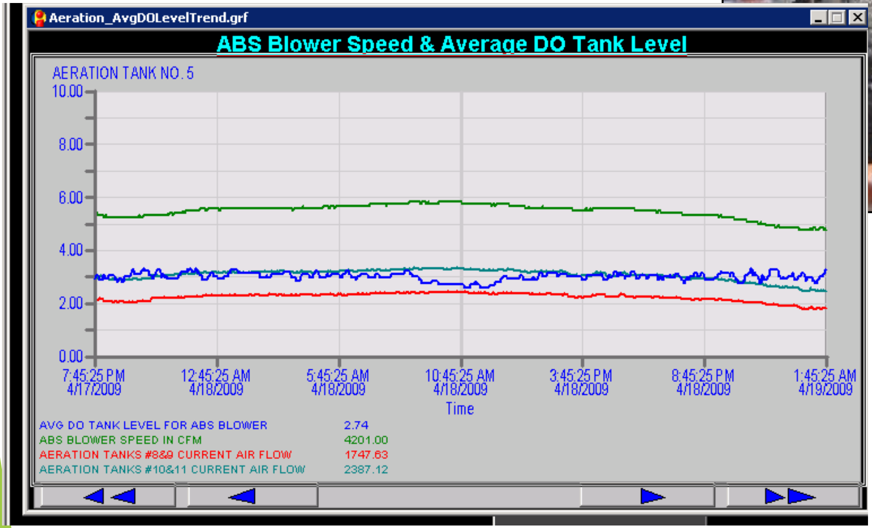
- Aeration System Improvements – 7 year payback on $1 million (after $250,000 grant)
- Pumping Station VFDs – 3 year payback on $50,000 (after $20,000 grant)
- Lighting Upgrades – 3 year payback on $25,000 (grant funding varies)
- HVAC
  - Desiccant Dehumidifier – 8 year payback on $100,000
  - Geothermal/Effluent Water Heat Pumps – 0 year payback (replacement program as old units fail - $5,000 per year)
  - Absorption Chiller – 7 year payback on $10,000
- MORE TO COME

Aeration in wastewater treatment



Energy Reduction/Efficiency

- Aeration System Improvements – 7 year payback on $1.15 million (after $250,000 grant)
- New turbo-blower
- New diffusers
- New tank configuration
- DO/Amm control



Energy Reduction/Efficiency

- Pumping Station VFDs – 3 year payback on $50,000 (after $20,000 grant)
- Replaced Flo-matchers at two lift stations
  - Liquid rheostat tied to water level
  - 10% electric efficiency
- One VFD per pump
- SCADA controls using pressure level sensor (Birdcage)
- 95% + electric efficiency

Energy Reduction/Efficiency

- Lighting Upgrades – 3 year payback on $25,000 (grant funding varies)
- Conducted up-front inventory study
- Systematically retro-fitted entire plant over 7 years
- Fluorescents, LEDs, and timer switches
- District staff installed

Energy Reduction/Efficiency

- HVAC
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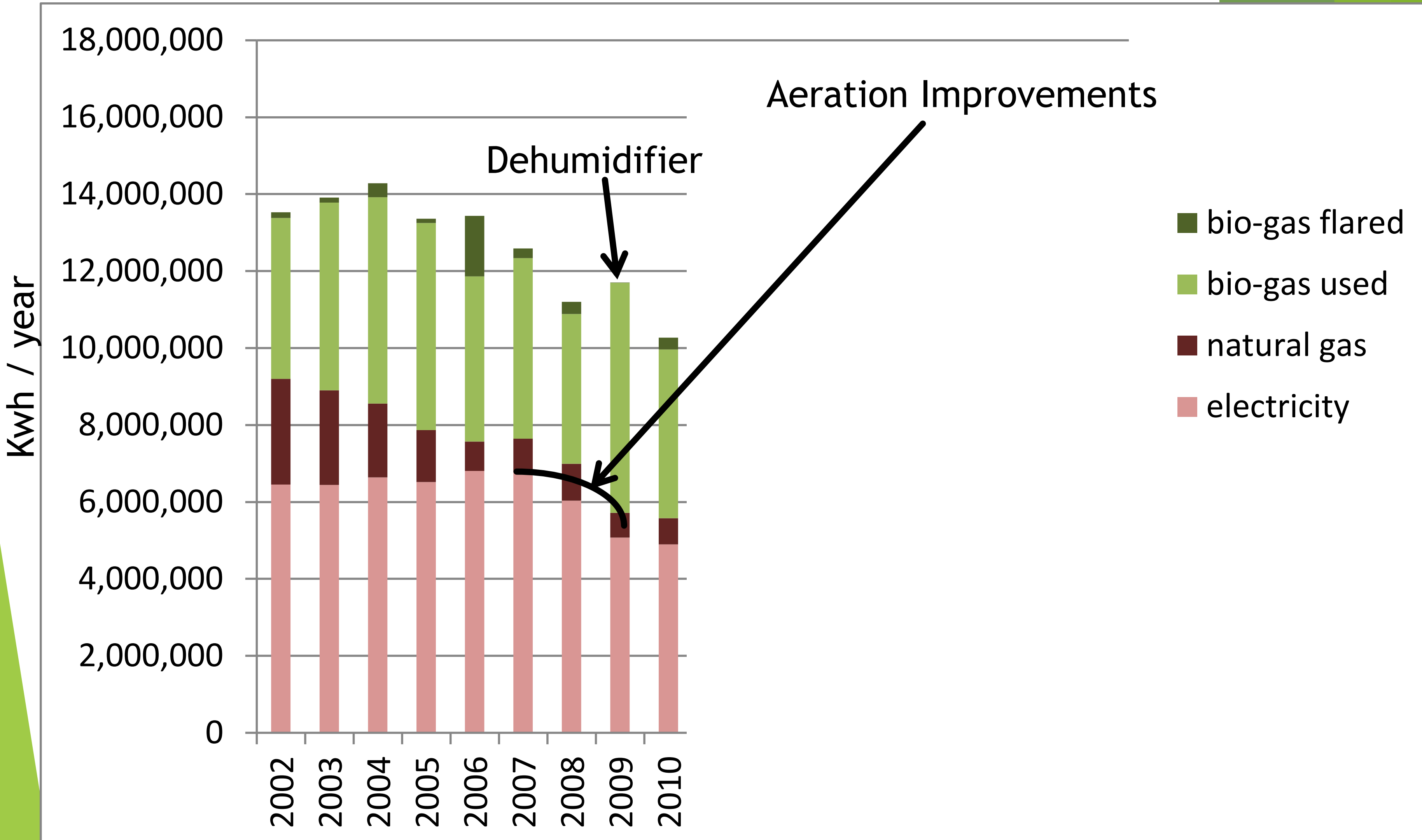
Energy Reduction/Efficiency

- Grit Blower – 3 year payback on $12,000 (after $22k grant)
- Replaced 8-stage centrifugal
- Rotary lobe
- ½ the energy use

Energy Reduction Trend

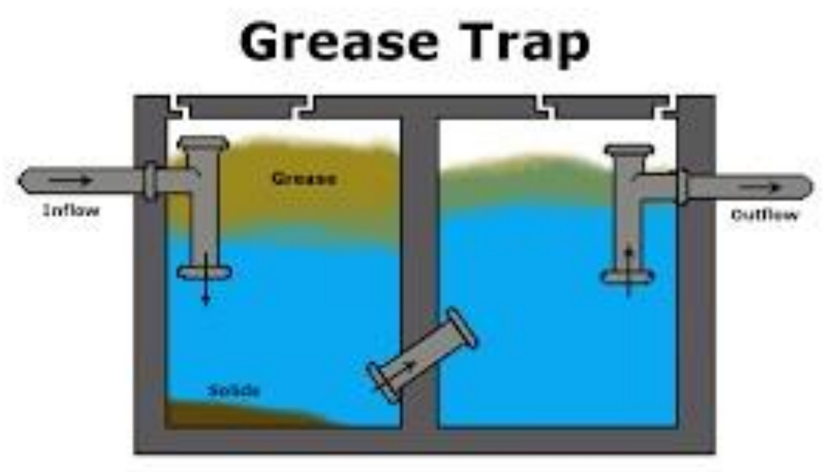


Energy Production
Available Resource: Sludge

- Incineration – need to dewater first – net energy concerns
- Bio-fuel cell – very early stages of development
- Improved Gas Production
  - More feed stock (grease, food, etc)
  - Improved feed stock (WAS lysis, improved thickening)
  - Better digester mixing

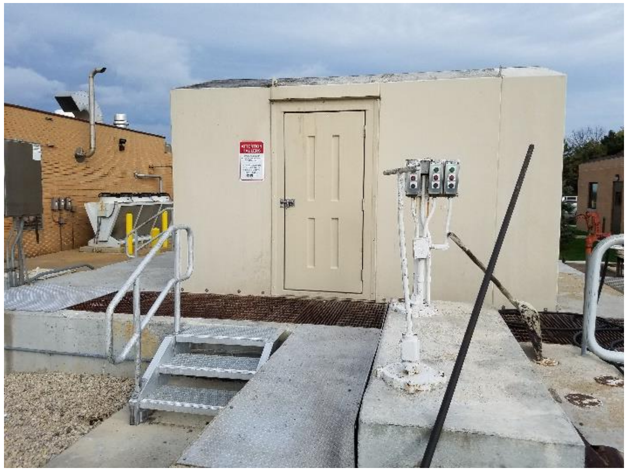
Grease Trap Cleaning and Hauling

- Restaurant Sewer Interceptors
- Needed for Sewer Operation
- Require Regular Pumping
- Pumped Liquid has Limited Uses
- Pumped Liquid needs Transportation
- Co-Digestion Provides Benefits



Grease Receiving Equipment

- Converted grit tank (10,000 gallons) with screen and modified submersible mixer
- Second dedicated tank (30,000 gallons) with same features



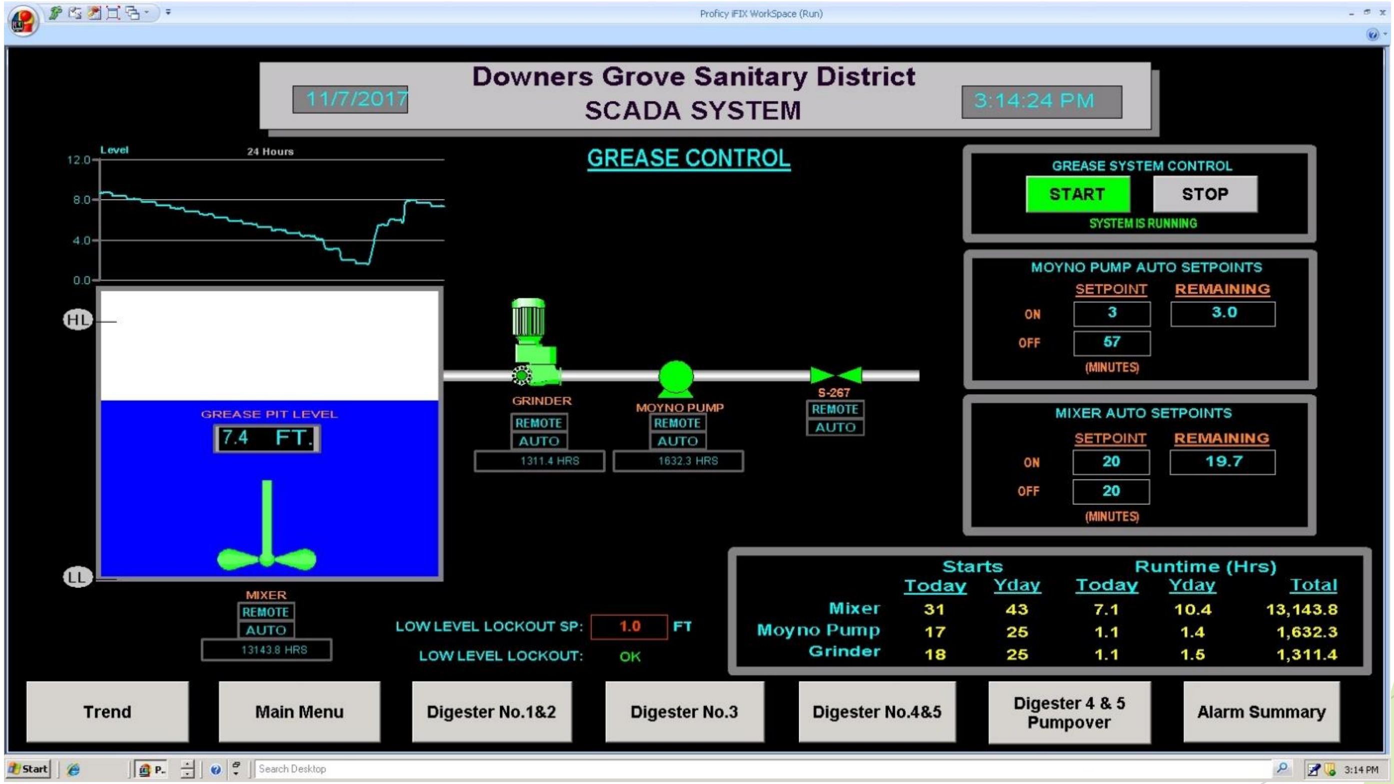
Grease Pumping Set-up

- Progressive cavity pump
- Grease grinder

- Piping Clean-out

Controls

- SCADA timers, tank level



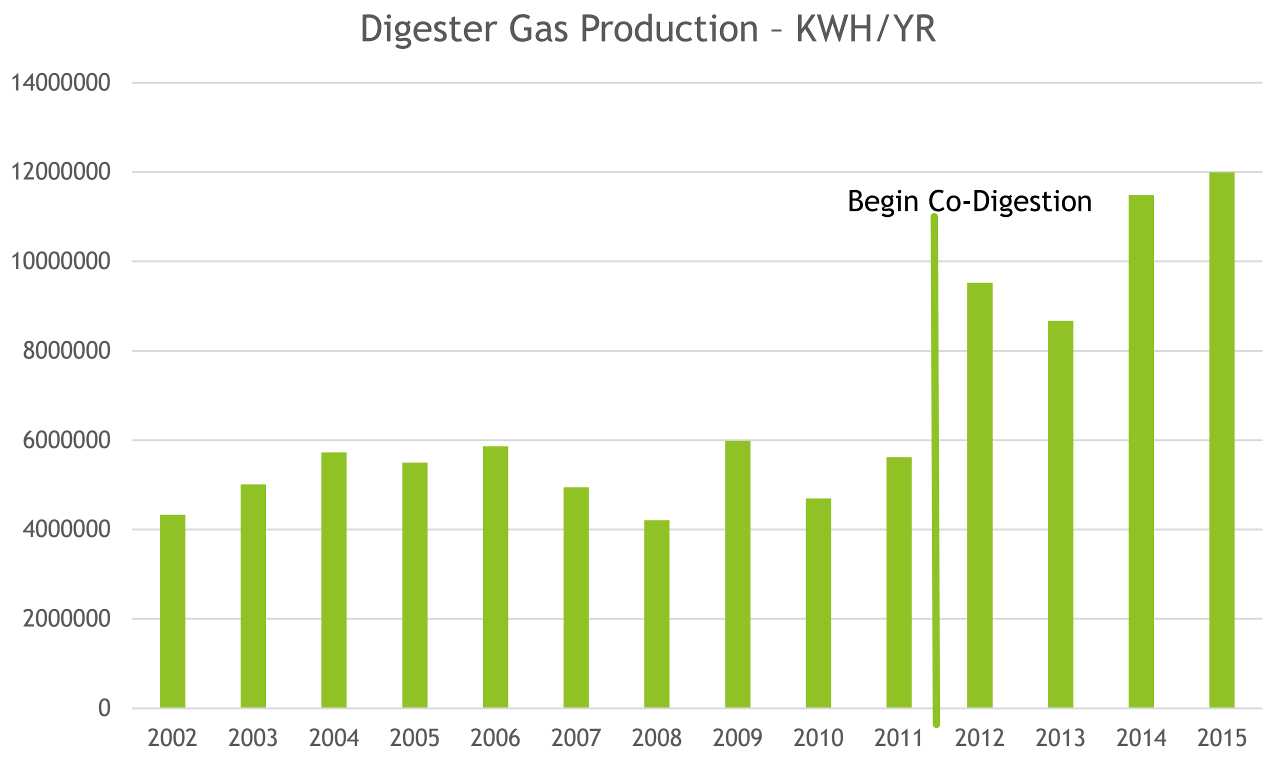
Revenue

- Typical Charge - $50/1,000 gallons
- Minor Compared to Total User Billing – 2-3%
- Variety of Compatible Hauled Wastes:
  - Septage
  - FOG
  - Landfill Leachate
  - Industrial
  - Commercial Food Waste

High Strength Waste Characteristics

- Main digestate: liquid with 2-5% solids in solution (70-80% volatile)
- High strength waste desired: liquid/slurry, compatible (food-type), highly volatile
- Selected restaurant sewer grease trap waste
  - Pump-able slurry
  - Haulers use ‘single use’ (sewage/food) vehicles
  - 90%+ volatile content
- Trying different food-waste slurries case-by-case

Gas Production – 20% More Sludge Flow



Challenges

- Material handling
  - Pipes clog
  - Material coagulates
  - Comes with debris
- Consistent supply
- Limited supply
- Carbon/energy balance in plant

Digester Mixing

- Pearth Mixers in 2 Primary Digesters
- Replaced CRP system with gas-mix system in 3rd
- Critical digestion effectiveness
- Secondary Digesters for Fill and Draw, Gas Storage

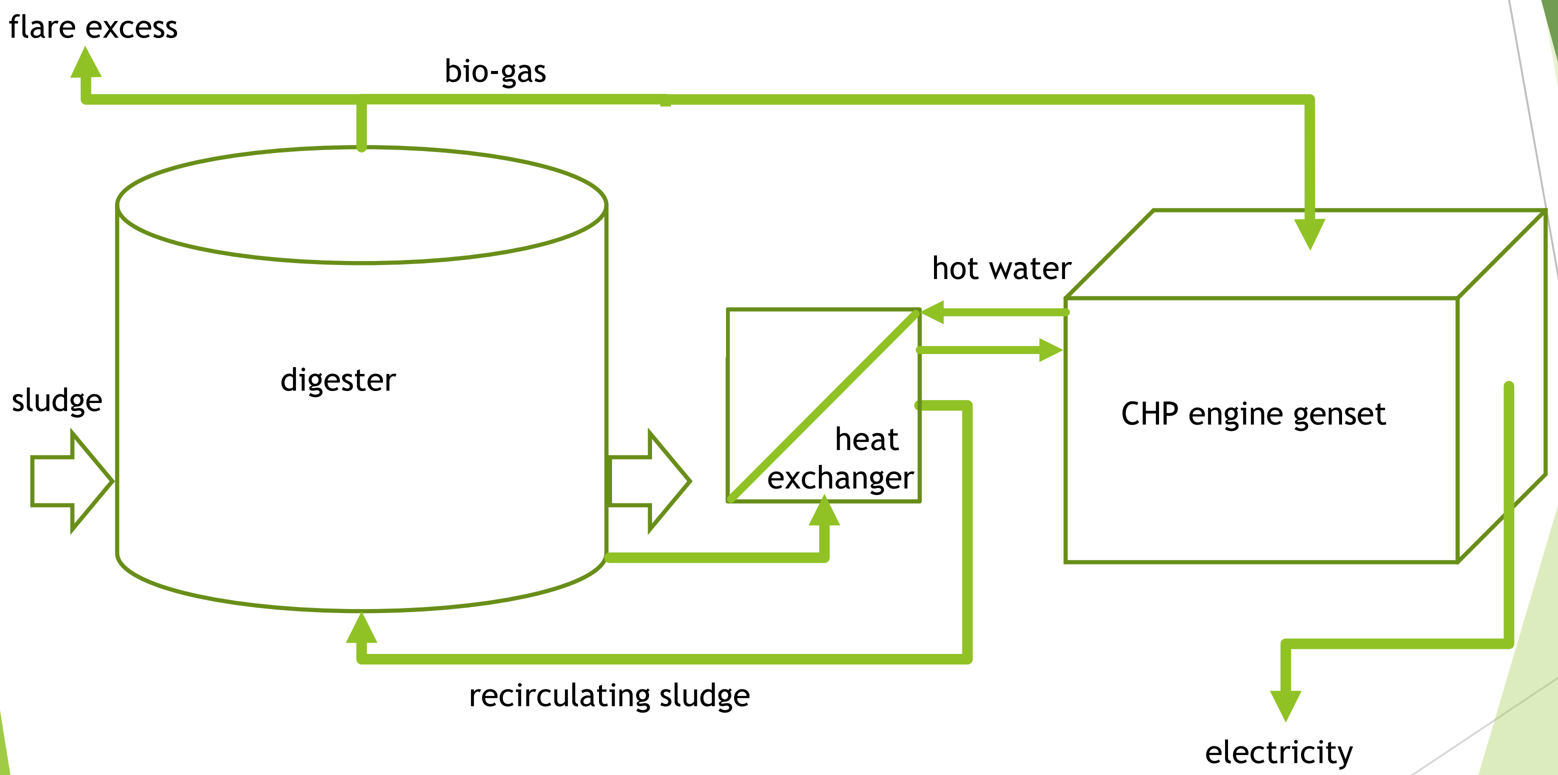
Energy Generation Projects

- Goal: Produce sufficient energy to meet reduced energy demand
- FOG/Food Waste Receiving Station = Increased Biogas Production – ARRA funding
- Combined Heat and Power - > $1 million grant funding
  - Electricity Generation
  - Digester Heating

Gas Use

- Gas Cleaning
  - Iron sponge – H_2S
  - Dehumidification
  - Carbon - siloxanes
- Combined Heat and Power
  - Engine Fuel
  - Electric Generator
    - Off-set grid power $
    - Renewable Energy Credits $
  - Hot Water – Digester heat
- Direct Fuel – HVAC
- Pipeline gas?
- Vehicle fuel?

Combined Heat and Power and Anaerobic Digestion



Energy Generation Projects

- Combined Heat and Power Phase 1 - $670,000 grant funding
  - Gas cleaning
  - Electricity Generation
  - Digester Heating

Energy Generation Projects

- Combined Heat and Power Phase 2 - $500,000 grant funding
  - Second engine genset with heat recovery
  - Minor gas cleaning system upgrades
  - Total CHP investment $3.5 million after grants, 10-year payback

Challenges

- Understanding electricity and REC market
- Coordination with electric utility
- High-maintenance equipment – new ‘normal’

Sludge Dewatering

- Gravity Sludge Drying Beds – Auger used to aid dewatering
- Belt Filter Press – Polymer and Electricity

Biosolids Disposal

- Class A product
- Public distribution
- Soil supplement with fertilizer value
- Long holding time (3-year) process
- Increased production from co-digestion

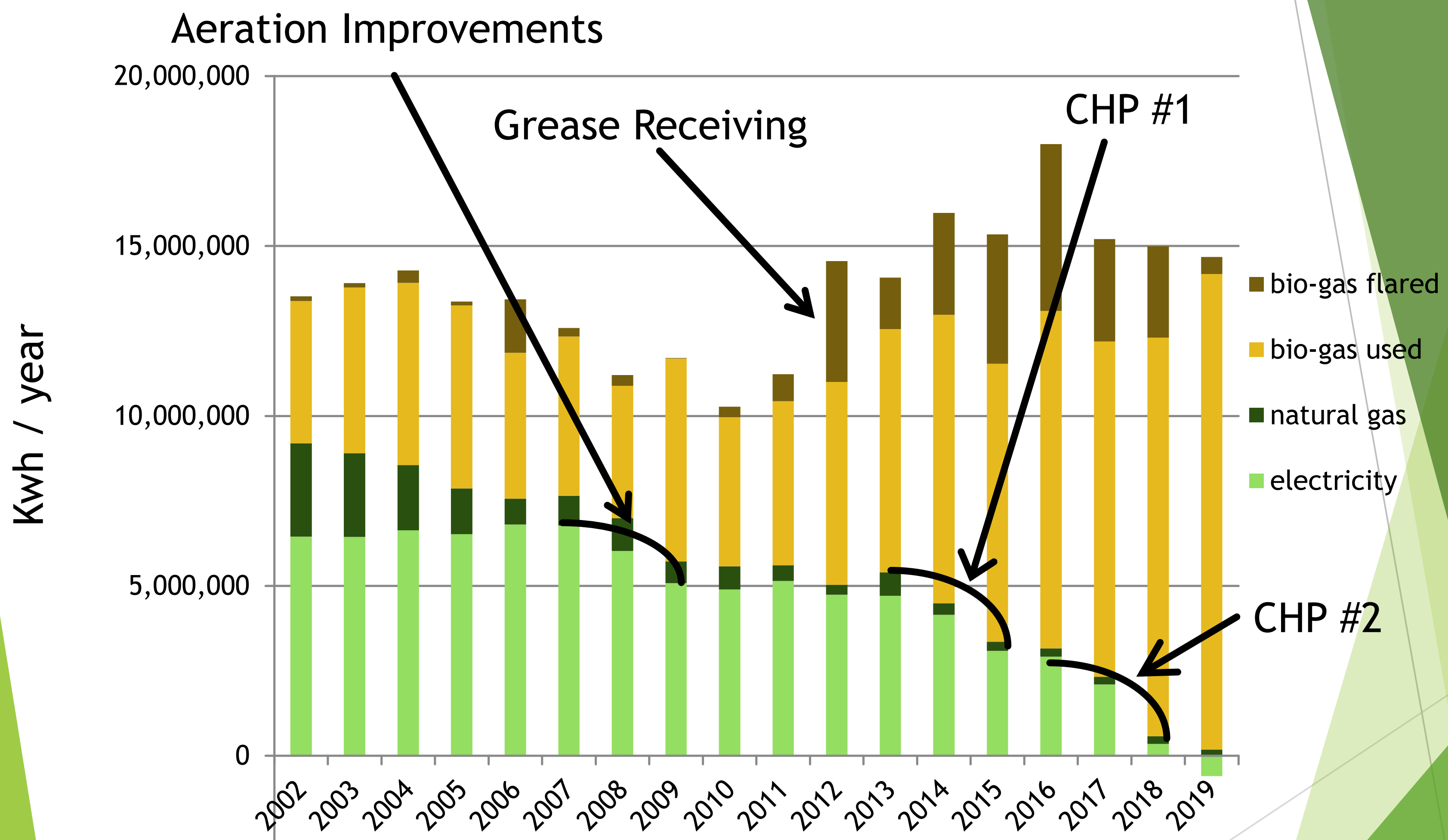
Analytical Testing in Biosolids

- Fertilizer Content – N/P/K
- Toxic Metals/Organics – 129 Priority Pollutants
- Pathogens – Salmonella, Fecal Coliform, Helminth Ova, Enterovirus
- Vector Attraction – Volatile Solids Reduction

Financial Impacts

- Project Capital Costs (from Capital Reserves): $6.9 million
- Grant Funding (from IDCEO, ICECF): $1.5 million
- Annual Reduction in Energy Cost: $350,000
- Annual Revenue Collecting FOG: $250,000
- Typical Customer Monthly Cost Savings: $2.50 (~8% of $30 monthly bill)

Energy Production and Use



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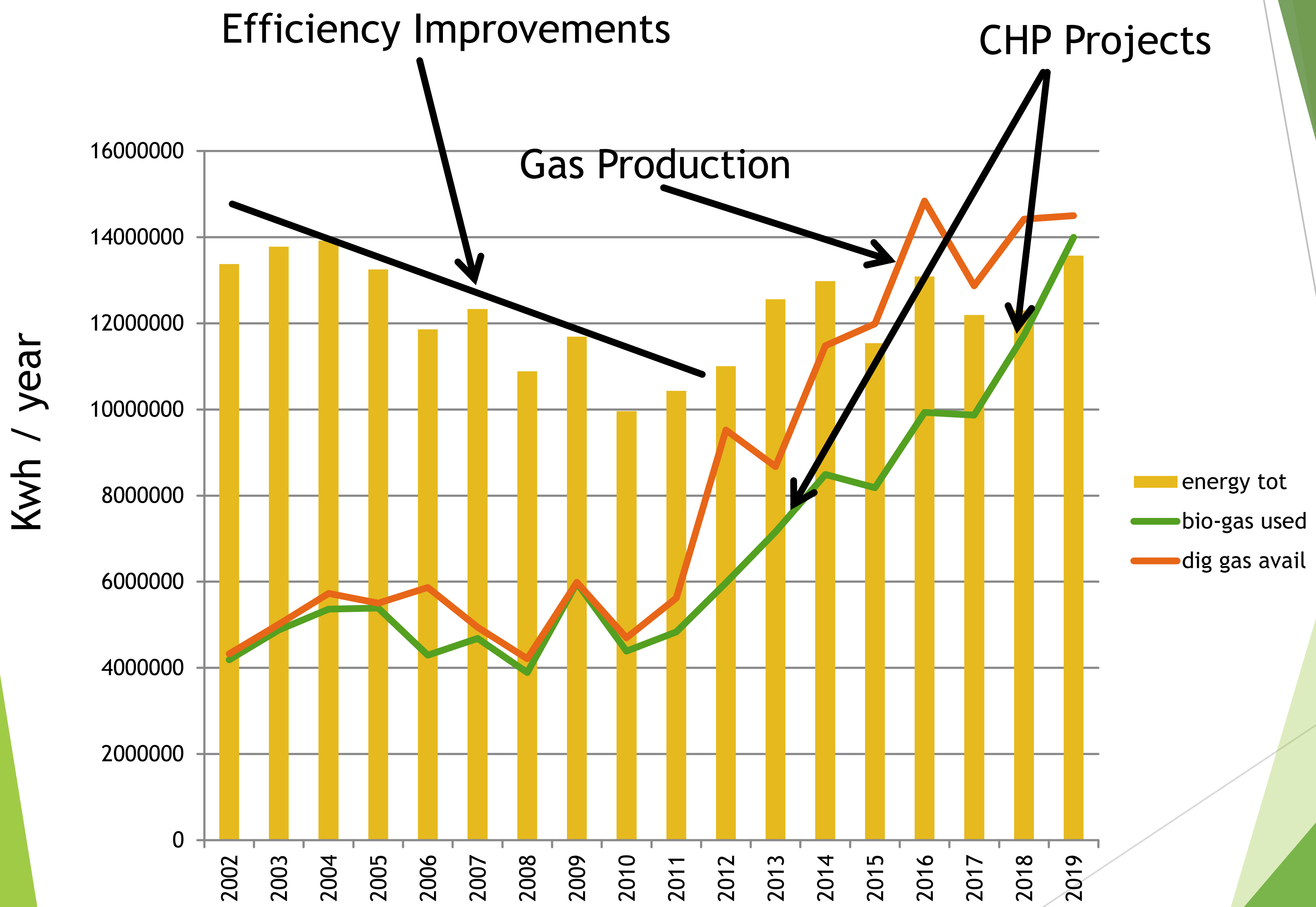

Monthly Scoreboard

		Energy Used	Energy Produced	Net Energy
July	2018	548 MWH	607 MWH	-59 MWH
August	2018	654 MWH	579 MWH	75 MWH
September	2018	739 MWH	599 MWH	140 MWH
October	2018	942 MWH	715 MWH	227 MWH
November	2018	957 MWH	911 MWH	46 MWH
December	2018	995 MWH	817 MWH	178 MWH
January	2019	1,014 MWH	861 MWH	153 MWH
February	2019	862 MWH	864 MWH	-2 MWH
March	2019	958 MWH	1,005 MWH	-47 MWH
April	2019	845 MWH	846 MWH	-1 MWH
May	2019	873 MWH	888 MWH	-15 MWH
June	2019	826 MWh	893 MWH	-67 MWH

Strategic Partnerships

DENMARK

WTA

Downers Grove Sanitary District

Public Relations

- Web Page
- Newsletter
- Coordination with EAGs
- Open House
- Education Tours

Conclusions

- Energy is a controllable expense
- Energy reduction technologies are compatible with wastewater O&M skill-sets
- Energy reduction is cost-effective
- Opportunities of all sizes are available
- Grant / other funding opportunities continue

Conclusions

- Getting to net-zero is a process
- Each step/project needs to provide value
- Getting to net-zero takes time
- Grant opportunities are important incentives

Questions

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