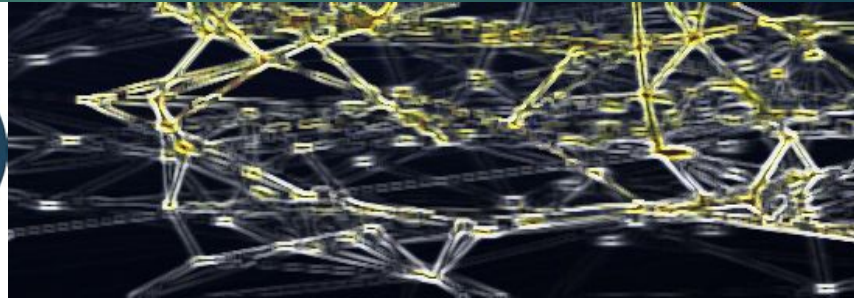


Progress Towards a Long-Term Energy Management Strategy



2022 New England Water Environment Association
Annual Conference

Michael Wilson, P.E., South Essex Sewerage District
David Michelsen, P.E., South Essex Sewerage District
Richard Delacono, South Essex Sewerage District
Peter Pommersheim, P.E., South Essex Sewerage District

January 25, 2022



Acknowledgements

- ▶ Alan F. Taubert, P.E.
- ▶ South Essex Sewerage District Operations & Maintenance Personnel
- ▶ National Grid
- ▶ CEI/Cascade Energy
- ▶ Massachusetts Department of Clean Energy
- ▶ Many Talented Consultants!



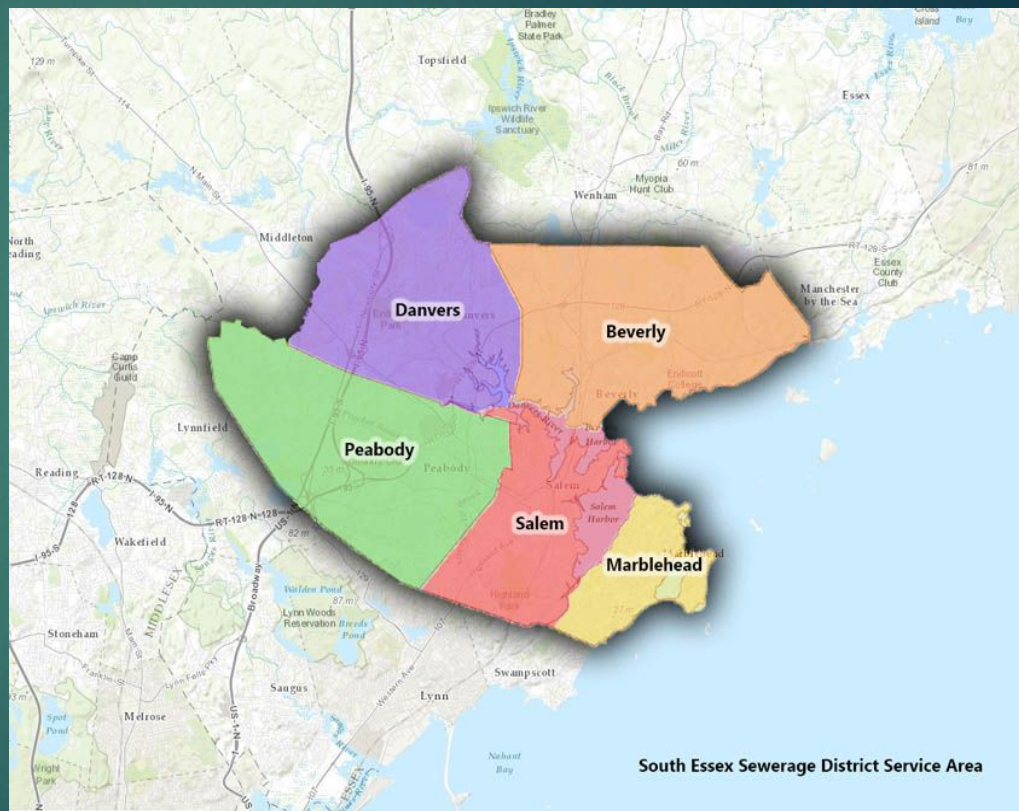
Agenda

- ▶ History & Mission
- ▶ The Challenges and Opportunities
 - ▶ Background
- ▶ Why Do It?
 - ▶ Energy Audit & Energy Use
- ▶ Energy Management Improvement Process
- ▶ Better to Best-In-Class Energy Management
- ▶ Methods and Examples
- ▶ Next Steps
- ▶ Summary & Conclusions



History & Mission

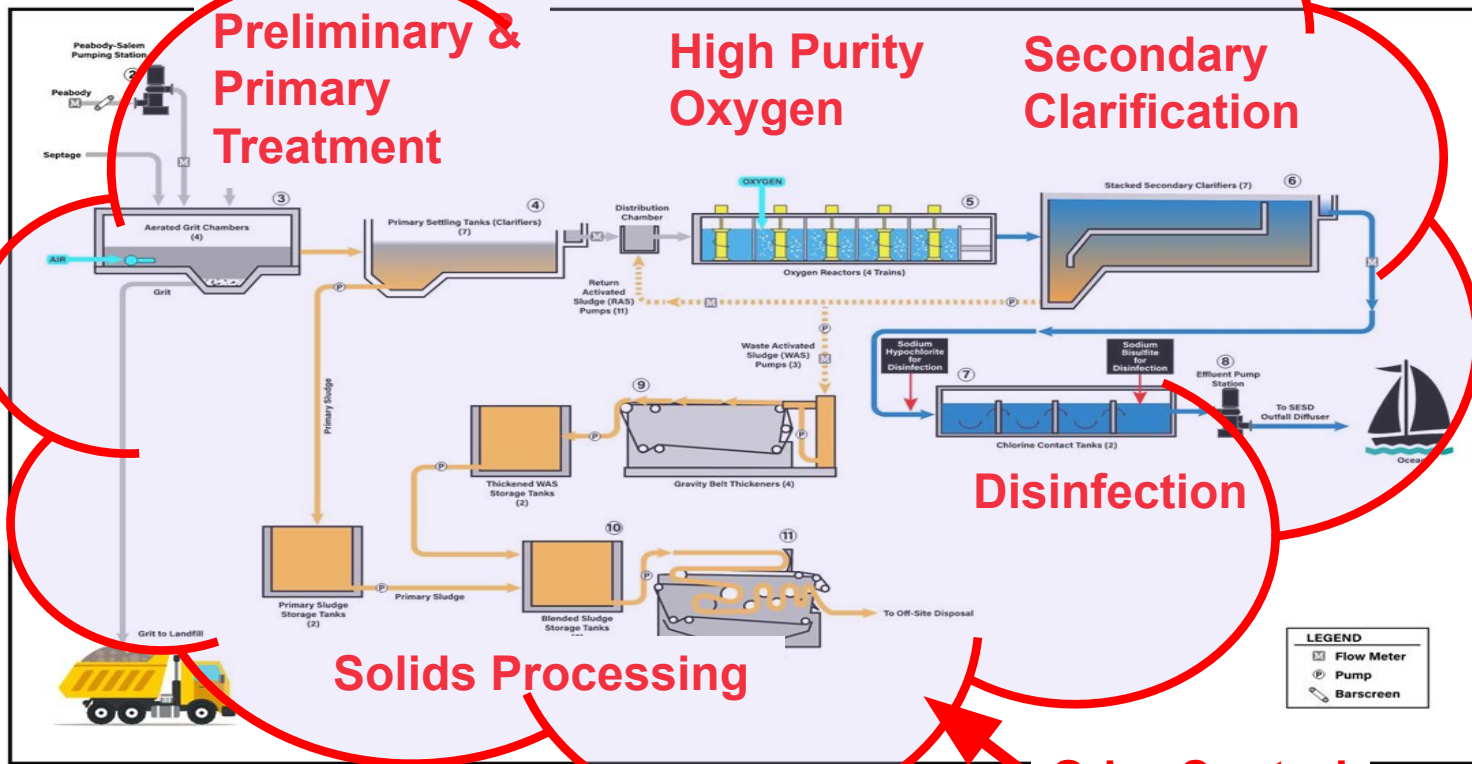
- ▶ Regional Wastewater Utility
- ▶ Enacted by Massachusetts Legislature in 1925
- ▶ Protect Public Health and Enhance Regions Water Quality through Efficient and Reliable Wastewater Treatment and Conveyance
- ▶ Service Area includes Beverly, Danvers, Marblehead, Peabody, Salem, a small portion of Middleton and State Institutions
- ▶ 185,000 Residents



South Essex Sewerage District Service Area



The Challenge – An Odor Control Facility that Treats Wastewater

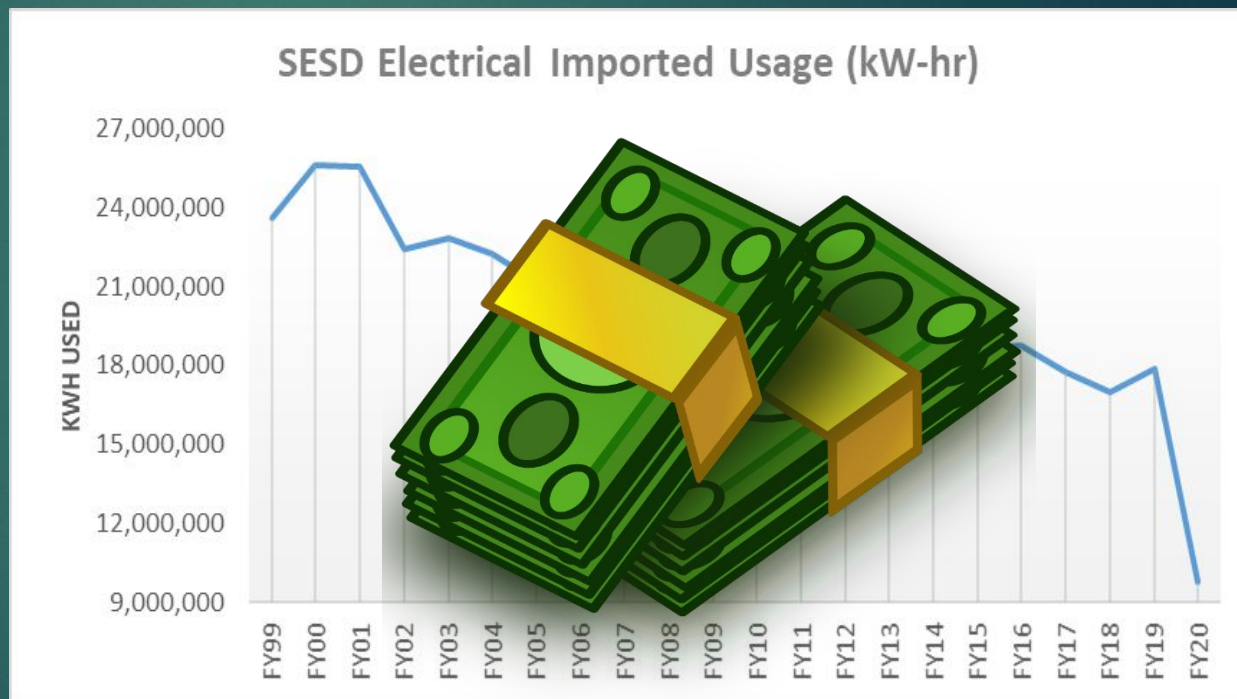


South Essex Sewerage District
Wastewater Treatment Plant
Process Flow Schematic



Why Did the District Start an Energy Management Program?

- ▶ Offset Budget Impacts As Energy Costs Increased
- ▶ Stabilize Budget
- ▶ Fund Long-Term Capital Improvements
- ▶ Reduced Environmental Impact and Increased Efficiency





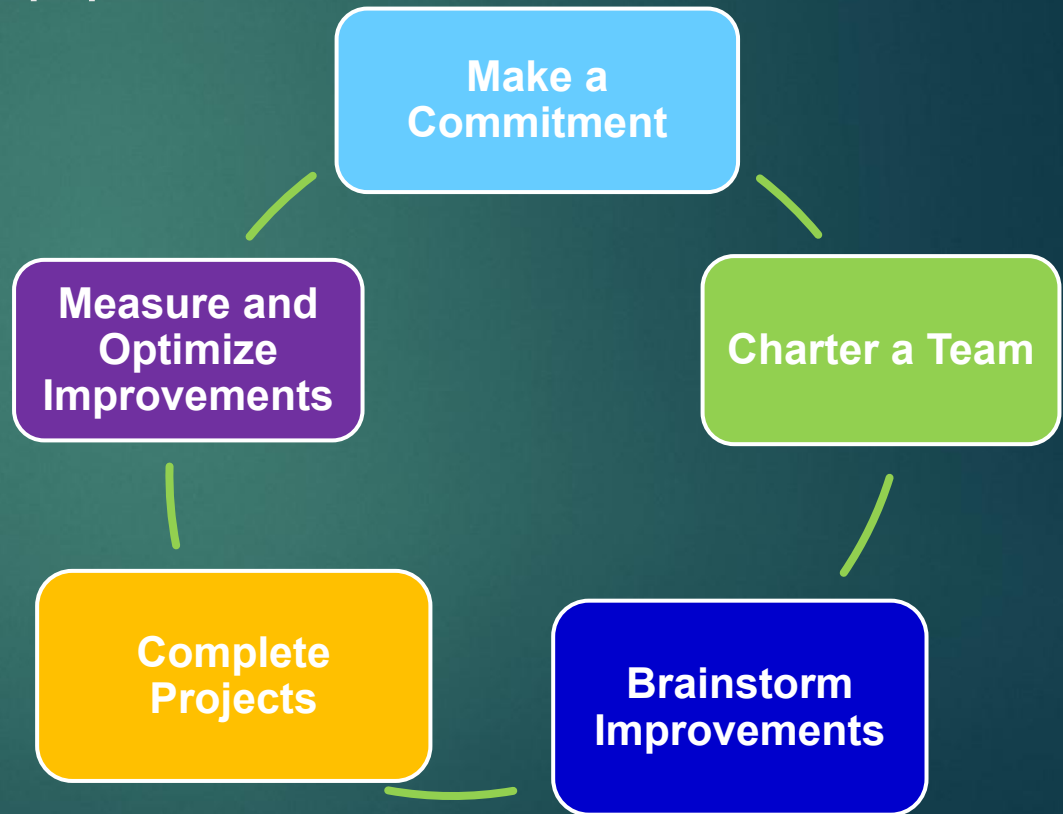
Background on Energy Management Program

- ▶ Started in 2002 to assist in reduction of O&M costs
- ▶ Formed Energy Use and Conservation Team
- ▶ Worked with electric and natural gas utilities and suppliers
 - ▶ Investigated rebate and incentive programs
 - ▶ Certified Building Operator/Energy Manager
 - ▶ Motor Management Plan
 - ▶ 5 Year Rotating Electrical System preventative maintenance and CIP Plan



Energy Management Improvement Process – SESD's Approach

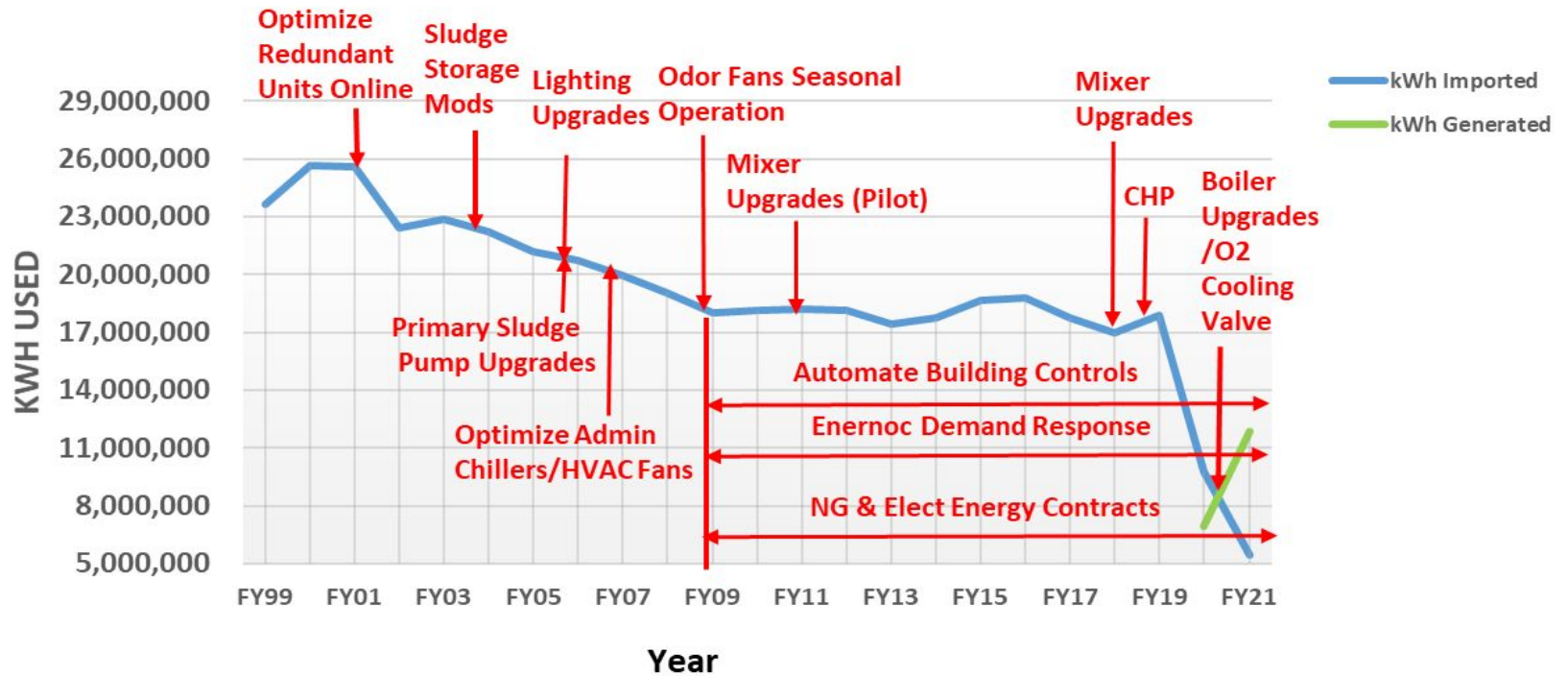
- ▶ Make a Commitment
- ▶ Charter a Team
- ▶ Brainstorm Energy Improvements
 - ▶ Treasure Hunt
- ▶ Complete Projects (ECM's)
- ▶ Measure and Optimize Improvements

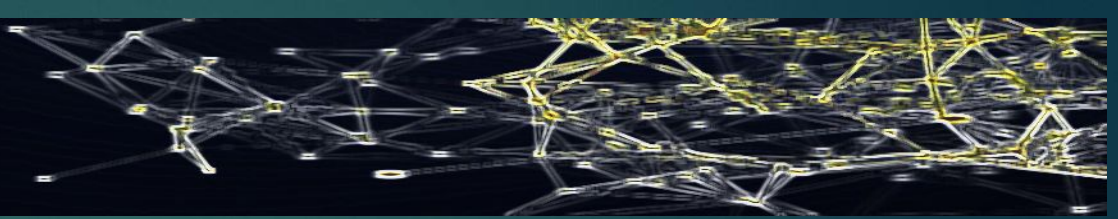




Energy Audit and Energy Conservation

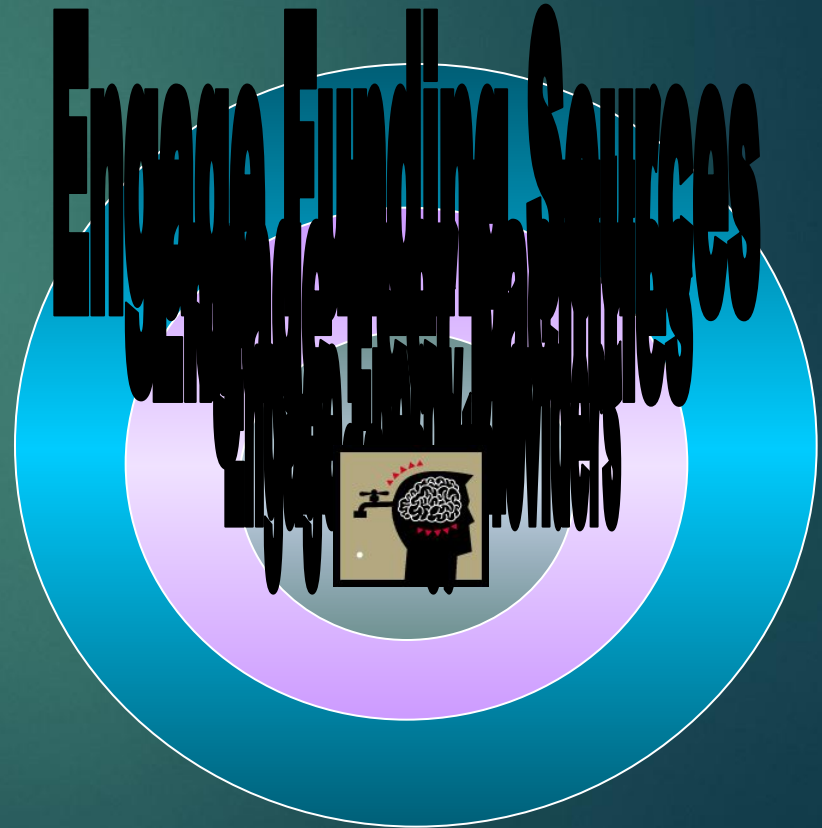
Progress Towards Energy Conservation Measures and Savings (kWhrs)





Better to Best-in-Class Energy Management Practices

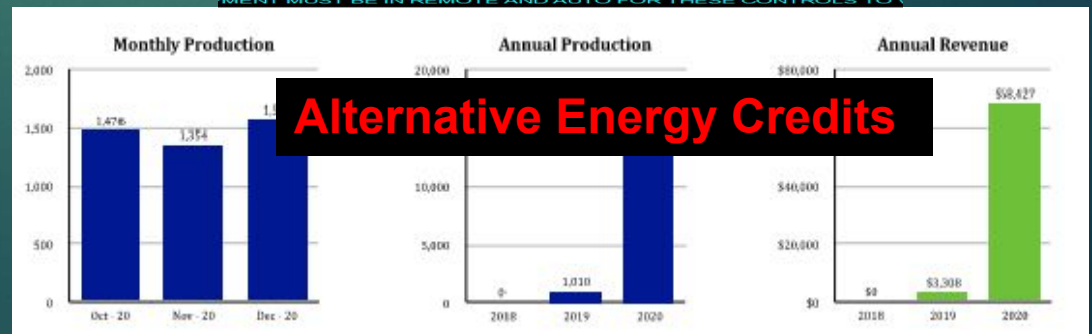
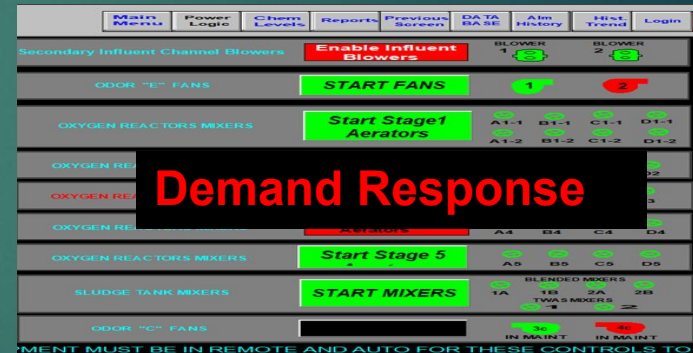
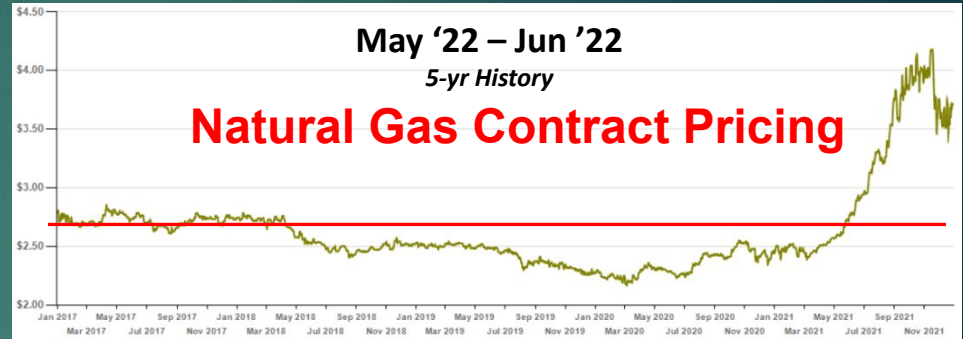
- ▶ Engage Staff Resources
 - ▶ Training and Certification!
 - ▶ Develop an Asset Management Plan (Measure Metrics)
 - ▶ Continuous Energy Improvement
- ▶ Engage Energy Providers
 - ▶ Ask for Help!
- ▶ Engage Peer Facilities
 - ▶ Cascade/CEI
 - ▶ Benchmarking and Feedback
- ▶ Engage Funding Sources and Incentives
 - ▶ National Grid
 - ▶ Alternative Energy Credits (CHP)
 - ▶ Be Creative!





Methods to Save Energy and Obtain Revenue

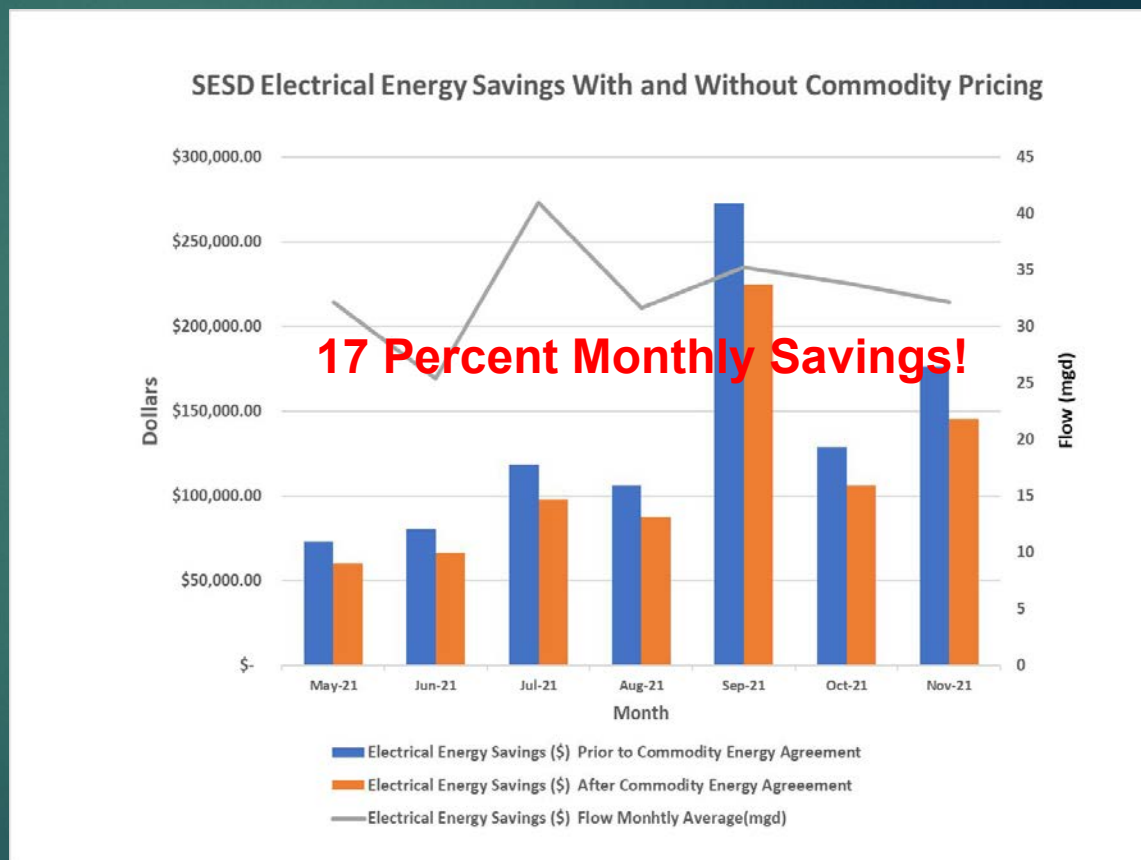
- ▶ Energy Provider Contracts
 - ▶ Natural Gas & Electricity
- ▶ Energy Conservation Measures (ECMs)
 - ▶ New, Retrofit and Optimization
- ▶ Demand Response Programs
- ▶ Alternative Energy Credits





Energy Provider Contracts

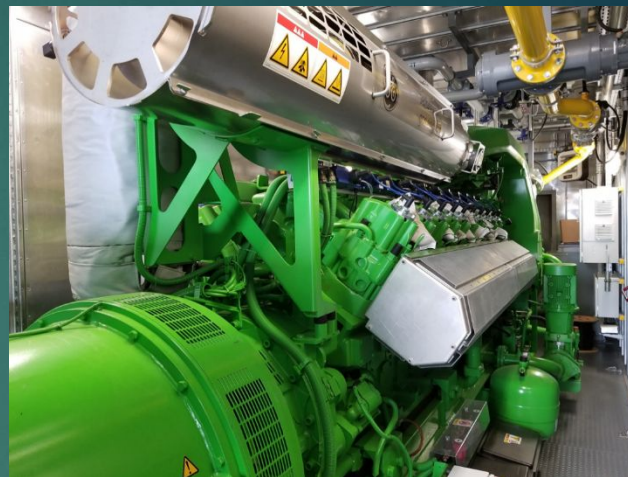
- ▶ Monitoring Electrical and Natural Gas Energy Markets and Pricing Contracts
- ▶ Locked into an Electrical Energy Provider Contract for 4 years
- ▶ 17% Monthly Electrical Savings
- ▶ Estimated \$1.3 million electrical savings over the contract

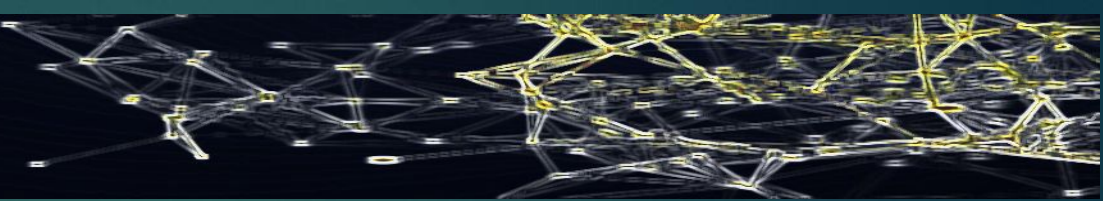




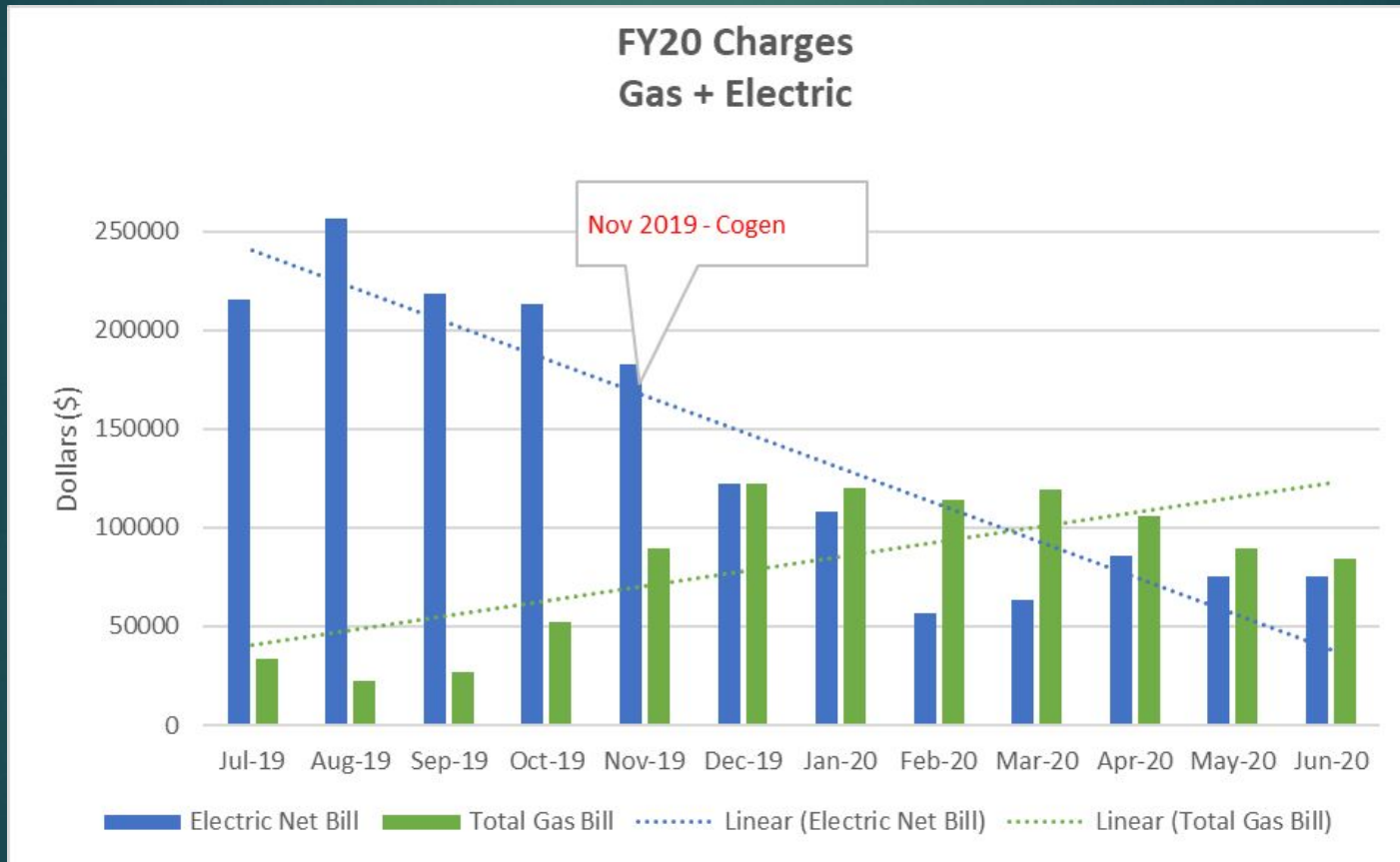
Combined Heat & Power (2019)

- ▶ Year- round thermal demand
 - ▶ Identified in 2013 as a method to satisfy and control dehumidification for Odor Control System
- ▶ Readily available and relatively low cost of natural gas
- ▶ Two (2) existing independent heating plants
 - ▶ Conventional cast iron boilers
 - ▶ Main Heating Plant Converted from Steam to Hot Water to New Hot Water Boilers with Heating Water Loop from CHP
- ▶ CHP Pre-packaged Engine/SCR Emissions Unit Identified as a Viable Alternative





CHP Impact on Energy Profiles- Cont'd





CHP Impact on Energy - Cont'd

Project Costs	Cost
Total Project Construction Cost	\$ 5,925,000.00
Engineering, Legal and Other Costs	\$ 2,061,000.00
Total Project Capital Cost	\$ 7,986,000.00
Project Grant Funding Total	\$ 1,969,500.00
National Grid Grant	\$ 1,069,500.00
DOER Gap Funding Grant	\$ 200,000.00
DOER Resiliency Grant	\$ 700,000.00
Total District Capital Cost	\$ 6,016,500.00
Summary of Annual Savings	
Offset Electrical Savings	\$ 1,850,000.00
Annual APS Revenue	\$ 57,700.00
Annual Operating Costs (Supp. Gas + O&M)	\$ (920,000.00)
Estimated Total Annual Savings from CHP	\$ 987,700.00



1.4 MW CH&P Engine Generator



Energy Conservation Measure

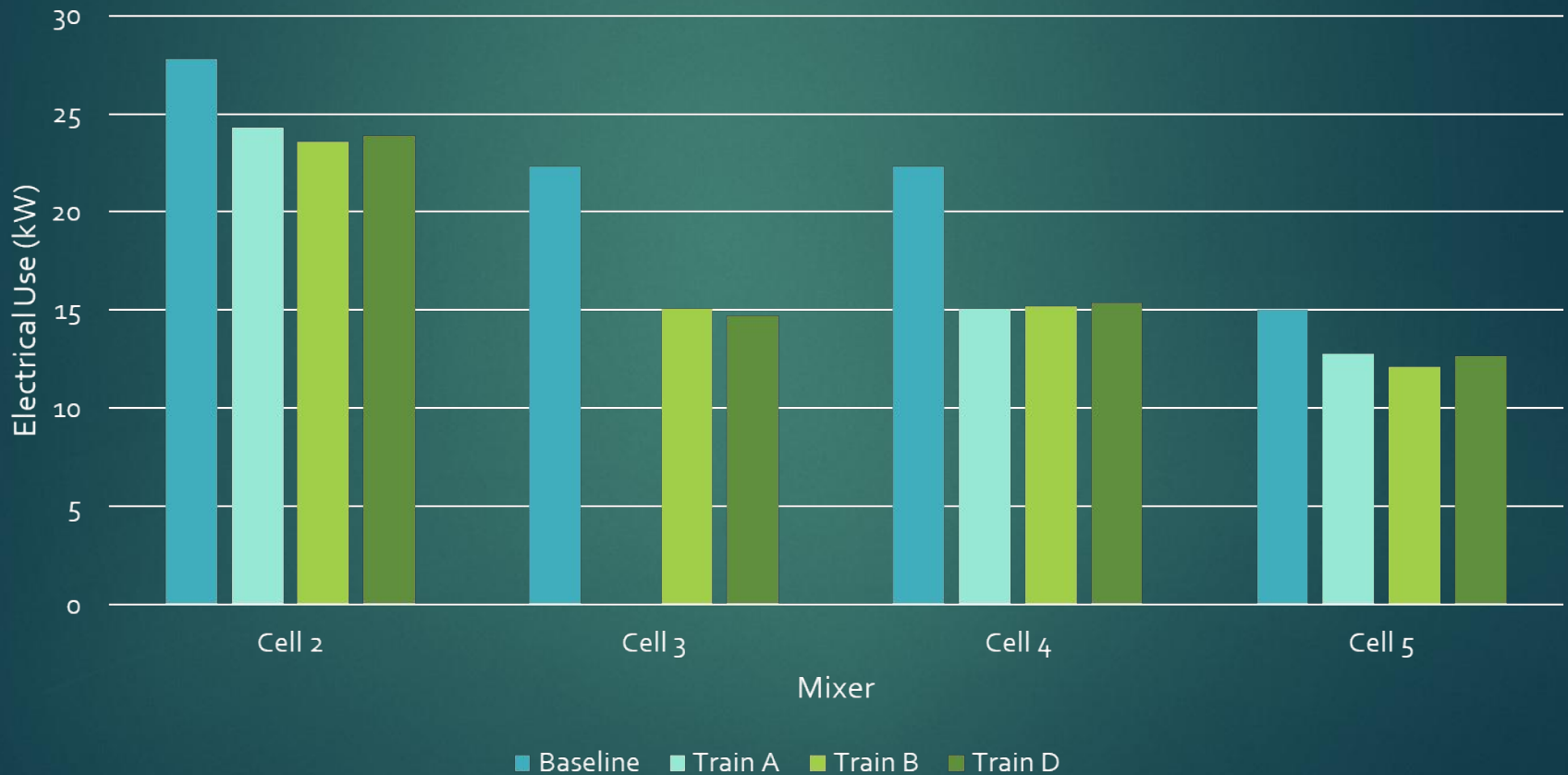
- ▶ Mixer Upgrades (2011, 2018)
 - ▶ Four Trains (A, B, C, D)
 - ▶ Five Stages (A2-A5, B2-B5, C2-C5, D2-D5)
 - ▶ Installed High Efficiency Impellers on Aerator Mixers (M2T/Hi-Flow)
 - ▶ Energy Savings 25 percent
 - ▶ Oxygen Transfer Efficiency Increase 33 percent
 - ▶ Total Cost \$ 1,770,000
 - ▶ Energy Incentive \$138,000





Energy Conservation Measure

Reduction of Electrical Power Use





Energy Conservation Measure

- ▶ New mixer impellers show a 24% reduction in power use versus baseline.
- ▶ Based on seasonal use and flow patterns :
 - ▶ Annual Energy Reduction of $\approx 180,000$ kWh per train.
- ▶ Assuming two trains active and \$0.16 / kWh rate:
 - ▶ Annual power savings of \$56,000.



New HPO Mixer Assembly



Energy Conservation Measures

- ▶ Boiler Upgrades (2020-2021)
- ▶ Replace Four (4) Steam to Hot Water Boilers with New Hot Water Boilers and New Recirculating Pumps
- ▶ Connect with CHP Heating Loop
- ▶ Increase in Efficiency Due to Removal of HX and Steam
- ▶ Total Cost \$1.3 million
- ▶ Incentives \$49,000 (NGRID)



New Hot Water Recirculating Pumps



New 5MM Btu/hr Hot Water Boilers



Energy Conservation Measures

- ▶ Energy Efficiency/ Optimize Odor Control Systems (2010-2021)
- ▶ Added Fan VFDs
- ▶ Added High Efficiency Motors
- ▶ Winter/Summer Operational Changes
 - ▶ Winter (Nov-June) Reduce Fan and Recirc Pump Use by 295 hp
 - ▶ Save 970,000 kWhrs Annually
 - ▶ Electric Cost Savings \$155,000 Annually



Odor Control Facility A Scrubbers and Fan Building



Energy Conservation Measures

- ▶ Heating, Ventilation Upgrades
- ▶ Replaced In- House
- ▶ Install New Heating/Ventilation Fan Units
- ▶ Installed on Ground to Increase Access and Eliminate Roof Maintenance
- ▶ Increase Unit Efficiency with VFD Driven Fan
- ▶ Savings \$520/yr



Example of Outdoor HV Unit



Energy Conservation Measure

- ▶ Oxygen Compressor Aftercooler Control Valve (2021)
- ▶ Install Control Valve to Reduce Cooling Water Flow to Compressors Based on Temperature Setpoint
- ▶ Save 600 gpm plant water
- ▶ Save 65,000 kWhrs Annually
- ▶ Annual Electric Savings of \$10,400
- ▶ Energy Incentive \$23,000
- ▶ Capital Cost \$51,500

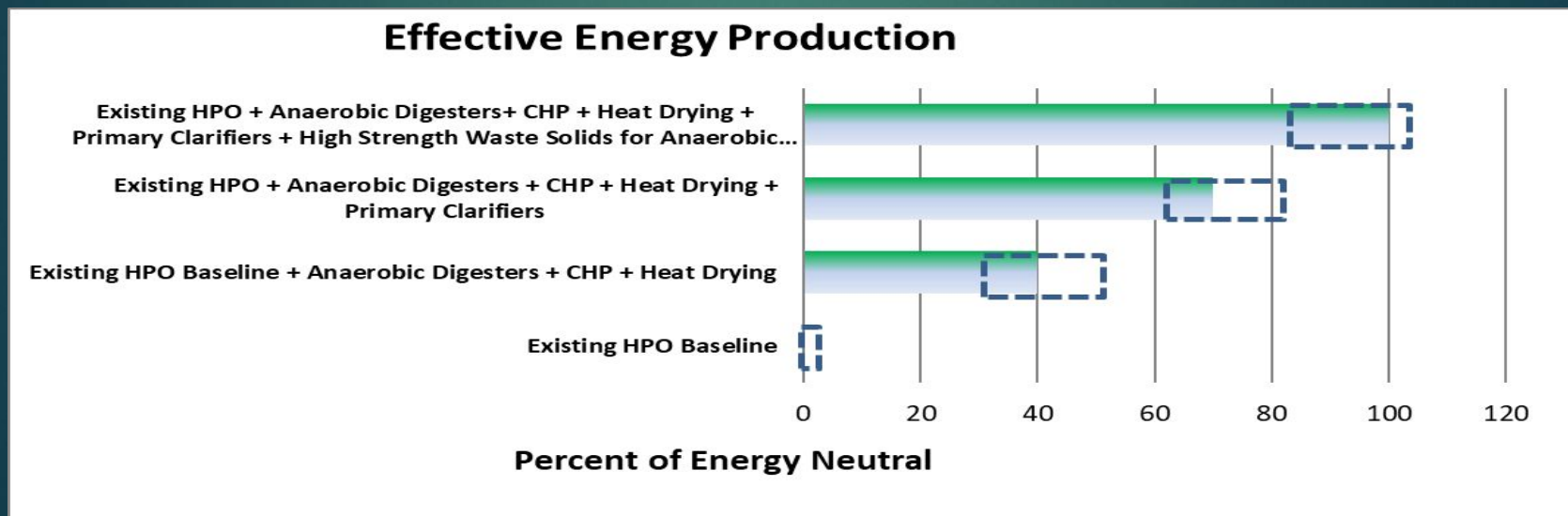


Process Cooling Water Control Valve



Next Steps

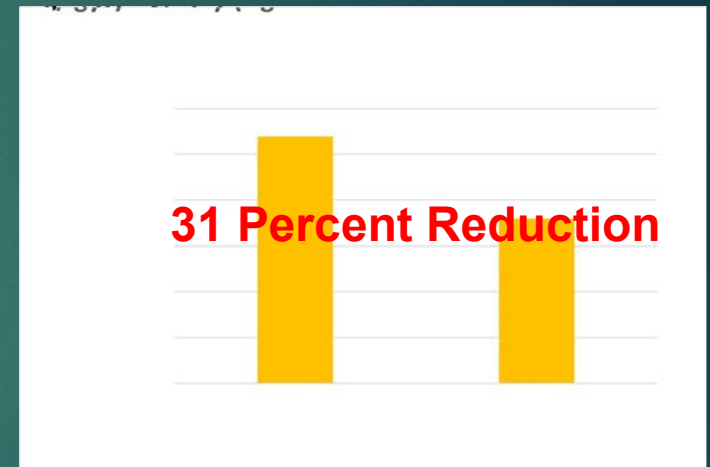
- ▶ Wastewater Facilities Plan
 - ▶ How Do We Become Energy Neutral?
 - ▶ Assess Solar PV – 250 kW (300,000 kWhrs/yr)- TBD
 - ▶ Possibly \$40,000 Annual Savings
- ▶ Investigate Coupled Thermal Processes, Digestion and Solids Reduction





Summary & Conclusions

- ▶ Reduced Electricity Imported by 31 Percent Since 2000
- ▶ Saved 7,700,000 kWhrs (2000-2021); 25 million kWhrs to 17.3 million kWhrs
 - ▶ 2700 kW-hrs/MG to 1800 kW-hrs/MG
- ▶ CHP Reduced NG and Electric Usage (Net) \$82,300/month
 - ▶ \$987,000 in Energy Savings Reduced Annually
- ▶ Demand Response Reduced Electric Costs \$89,000 Annually
- ▶ Reduced Annual Energy Costs through Energy Conservation measures by 3 percent





Summary & Conclusions

- ▶ Sold Over 9500 credits for Alternative Energy Portfolio of \$48,000 in 2020
- ▶ Energy Provider Contract Negotiations Saves \$1,300,000 in Electricity Costs in the contract over next 4 years.
- ▶ Future Plant Water Upgrades Projected to Reduce Another \$25,600 Annually or 160,000 kWhrs/yr
- ▶ **Small incremental energy conservation measures add up; be persistent!**



Hidden -Treasure of Gold



Questions?

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