

This Generic Report was generated from a large POTW and was chosen based on the range of Energy Efficiency recommendations made. Your energy savings are dependant on the energy currently consumed, previous energy efficiency projects undertaken, and the volume of water treated. This report provides an example of the areas covered during the assessment and the types of recommendations generated.

Illinois Sustainable Technology Center (ISTC) Energy Assessment Report

Sanitary District

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Facility Location:	
Site Visit Dates:	May 31 and June 7, 2018
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Executive Summary

This report by the Illinois Sustainable Technology Center evaluated five energy cost reduction measures (ECRMs) for potential application by the Sanitary District to reduce electrical and natural gas consumption and thereby save on utility costs. After thorough evaluation, four of the measures are recommended for implementation based on their effective rates of return.

The facility management and operators should be commended for their ongoing efforts to reduce energy consumption by having made a significant capital investment in improving aeration efficiency and the inclusion of the enhanced biological phosphorous removal (EBPR) system, completed in August 2017.

By also participating in the ISTC energy assessment, the facility is exhibiting a sharpened focus as an organization dedicated to energy management practices. Undergoing an energy audit analysis is not only a wise thing to do, but it also sends an important message to one's community of a solid commitment to energy efficiency and sustainable business practices.

ISTC recommends that the energy savings initiatives identified in this report be implemented to decrease the building's overall energy consumption. A total reduction of 6,301,117 kWh is possible through the implementation of the suggested ECRMs shown in Table E1. ISTC recommends implementing this package, which includes:

- Measure-1: VFDs on Blowers, Fans and Pumps
- Measure-2: Interior Lighting Upgrade to LED
- Measure-3: Exterior Lighting Upgrade to LED
- Measure-4: Solar PV

The suggested measures will significantly reduce the electrical consumption of the facility while providing an estimated annual total electric utility savings of \$315,056 (at current rates).

Due to the Sanitary Districts large size, two site visits were conducted by Dan Marsch and Troy Walker of the Illinois Sustainable Technology Center on May 31 and June 7, 2018.

The items included in this report are the primary elements of creating and managing a sustainable facility; they are to serve as guides to implementation. Table E1 presents the results of the analysis performed on the measures.

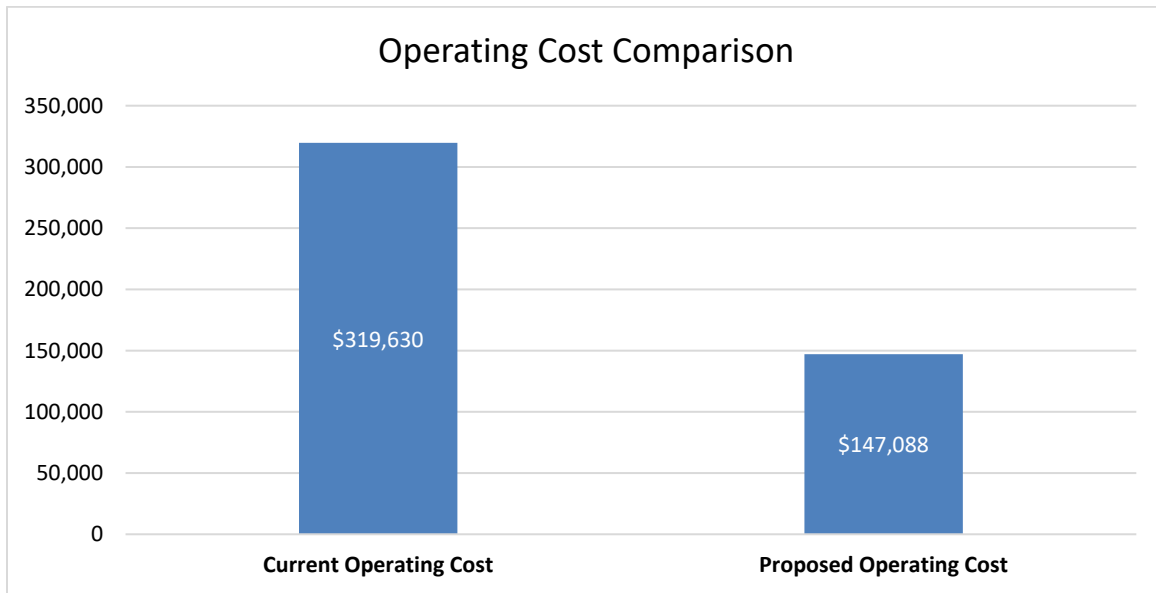
Table E1: Energy Cost Reduction Measure Analysis

Measure #	Description	Potential Energy Savings				Estimated Project Cost	Potential Incentive	SPB w/o Incentive (yrs) ¹	SPB w/ Incentive (yrs) ¹
		kW	kWh	Therm	\$				
1	VFDs on Blowers, Fans and Pumps	550	2,817,709	0	\$140,885	\$237,663	\$163,876	1.7	0.5
2	Interior Lighting Upgrade to LED	106	387,251	0	\$19,363	\$92,246	\$35,607	4.9	3.0
3	Exterior Lighting Upgrade to LED	67	245,887	0	\$12,294	\$67,675	\$25,720	5.5	3.4
4	Solar PV	-	2,850,270	0	\$142,514	\$3,105,000	\$1,642,395*	21.8	10.3
	Measures	723	6,301,117	0	\$315,056	\$3,502,584	\$1,867,598	11.1	5.2

¹ "SPB" Refers to Simple Payback, or the amount of time for projected energy savings to exceed the Estimated Project Cost

*5-Year Solar Renewable Energy Credits (SRECs) valuation. SRECs are a solar incentive that is a tradable, non-tangible energy commodity. One SREC is created for every megawatt hour (MWh) of electricity produced by a solar generator and are sold separately from the electricity they produce.

Each of the four measures is discussed in detail in this report. Recommendations on process improvements, equipment, lighting and renewable energy are included along with suggestions for additional cost reduction measures.



The graph above shows the operating cost comparison (before/after) arising from the implementation of the recommended VFD and lighting improvements (Measures 1, 2 and 3, comprising \$172,542 savings. The graph does not include \$142,514 savings derived from Solar PV, since it would be a new addition and has no prior grounds for comparison.

Automating control of blowers, fans and pumps with variable frequency drives (VFDs) should improve process efficiency while simultaneously realizing significant energy savings. Upgrading to LED will improve lighting conditions and save energy. Additionally, improved lighting will likely enhance operators' ability to perform their jobs and improve workplace safety.

The implementation of all of the recommended ECRMs will have no adverse impact on the quality of the effluent since no changes will be made to the wastewater treatment process itself.

Table E2 presents the facility's utility information, as obtained from utility bills. Table E3 reports the facility's energy intensity per million gallons processed.

Table E2: Utility Information for May 2017 through April 2018

Facility		Sanitary District						
Fuel	Utility	Rate Class	Annual Consumption		Annual Cost (\$/yr)	Annual Cost (%)	Unit Cost*	
Electricity	Ameren IL	DS-4	14,483,726	kWh	\$700,321	93%	\$0.048	/kWh
Natural Gas	CenterPoint Energy	-	91,730	therm	\$50,492	7%	\$0.55	/therm
Totals					\$750,813	100%		

Table E3: Facility Energy Intensity Per Million Gallons

	Millions Gallons Processed Per Year	Electricity Use Intensity (kWh/MG)	Natural Gas Use Intensity (Therms/MG)	Annual Energy Cost (\$)	Energy Cost Intensity Per MG Processed (\$/MG)
Current State	6,949.2 MG	2,084	13	\$750,813	\$108.04
Future State	6,949.2 MG	1,177	13	\$435,757	\$62.71

*Note: Unit Cost are blended averages which include all taxes and demand charges.

The Energy Cost Intensity (ECI) shown above indicates the total amount of electricity and natural gas used by the facility per year and the millions of gallons of treated water. The ECI is a good measure of the efficiency of the treatment processes and the buildings that house those

processes. The Current State identifies the energy consumed to treat 6,949.2 Million gallons. The Future State shows the energy that would be consumed to treat the same volume of water if the four Energy Cost Reduction Measures (ECRMs 1-4) were implemented. As indicated, a significant reduction in ECI would be achieved.

1 Review of Existing Best Practices

BP-1: Aeration Upgrade

In August 2017, the Sanitary District completed an aeration upgrade comprising five turbo-blowers, fine bubble aeration with automated controls in its enhanced biological phosphate removal (EBPR) process. Plant officials have reported an approximate 20% energy reduction.

BP-2: Variable Frequency Drives on Select Motors

Over the years, the facility has sporadically installed VFDs on several motors which control pumps and mixers in the facility where the application of VFDs was cost effective or for process control. This results in energy savings and decreased wear and tear on liquid pumping equipment.

BP-3: Efficient Fluorescent Lamps

As part of the Administration Building upgrade in 2010, aged T12 fluorescent and HID fixtures were replaced with more efficient T8 and T5 fluorescent fixtures and lamps. This resulted in energy savings and a reduction in maintenance costs due to increased lifespan of the lamps.

BP-4: Daylighting

Many of the buildings incorporate free, natural daylight as part of the lighting scheme, comprising windows, perimeter lighting and skylights. Harvesting daylight reduces energy consumption and provides superior light vs. artificial lighting systems.

BP-5: Good Maintenance Practices

Good maintenance improves equipment efficiency, prolongs equipment life and minimizes repair and replacement costs. The facility is 87 years old with numerous additions, expansions and upgrades over the years. It appears that the staff has been diligent in repairs and maintenance, since the buildings and equipment appeared to be in good condition and properly operating.

2 Low/No Cost Improvements

Improvement-1: Replace Existing T8/T5 Fluorescent Lamps with LED Replacement Lamps

The Ameren Illinois Instant Incentives for Lighting Program provides substantial instant incentives to its business customers to upgrade current T8/T5 fluorescent fixtures with LED replacement lamps.

LED benefits include:

- Use existing fixtures with electronic ballasts
- Easy one-for-one swap out
- Over 50% energy savings
- 50,000 hours, 5-year warranties
- Low cash outlay with fast payback (typically 3 – 6 months)

LED lamps are available through Ameren's participating Trade Allies.

Note: Energy Cost Reduction Measure 2 incorporates LED replacement lamps as well as new LED fixtures, as part of an overall strategy to upgrade lighting to 100% LED facility-wide.

3 Description of Recommendations

3.1 Measure–1 VFDs on Blowers, Fans and Pumps



Project Cost	
Investment (\$)	\$237,663
Utility Incentives (\$)	\$163,876
Total (\$)	\$73,787
Savings	
Consumption (kWh)	2,817,709
Consumption (therms)	n/a
Savings (\$)	\$140,885
MtCO2e*	2,716
Simple Payback (yrs) 0.5	

*Metric Tons of Carbon Dioxide Equivalent (MtCO2e) is a measure of the total greenhouse gas (GHG) emissions, including carbon dioxide (CO₂), methane (CH₄), and nitrous oxide (N₂O) gases released into the atmosphere as a result of energy consumption at a specified location. GHG emissions are expressed in carbon dioxide equivalent (CO₂e).

Issues and Observations:

The facility utilizes numerous motors which drive a variety of centrifugal blowers, fans and pumps throughout the treatment process, from the headworks to effluent discharge. The assessment team reviewed 24 process applications, comprising 60 motors, totaling 4,565 horsepower (HP). Motors currently controlled by variable frequency drives (VFDs) were not included in the assessment.

District officials directed the team to identify the best-VFD-applications as Tier 1 and the remaining as Tier 2 candidates. Tier 1 were defined as those with longer operating hours, lower capital cost (equipment and installation), utility incentive-eligible and shorter payback.

Tier 1s include the high service, WAS, RAS and IPS pumps with horsepower ranging from 40HP – 125HP, respectively. This category also includes many of the smaller applications (5HP – 30HP) which would normally not be considered, but when bundled together, makes them economically viable. Tier 1 represents 17 applications, 40 motors and 1,395HP.

Tier 2 candidates were defined as those having either low hours, high capital costs or longer payback. Typically Tier 2 included the largest medium voltage (2,300V and 4,160V) motors which would require addition cost to rewind motors to 480V or purchase very expensive higher voltage VFDs which would equate to less attractive ROI. These primarily include: the five 100HP and 125HP by-pass pumps and the six 400HP screw pumps, the largest remaining motors, plus several smaller pumps. Tier 2 represents 7 applications, 20 motors and 3,170HP.

The District has 16-18 pump houses (lift stations) throughout its sewer system. Since 1995, new constructions have incorporated pumps with VFDs. These comprise over half of their pumps, including the largest motors. Pre-1995 constructions, consist of original pumping equipment, without VFDs and are typically smaller pumps. These were not included in the assessment at this time.

Recommendations:

It is recommended that VFDs be installed on all Tier 1 applications initially. VFDs offer significant energy savings, highest utility incentives and the best ROI. VFDs do this by controlling the frequency of the electrical power supplied to the motor. It converts incoming 60Hz AC power into other desired frequencies, which allows for AC motor speed control. VFDs enhance process control and provide energy savings by matching motor speed with load requirements. Centrifugal fans, pumps and blowers power consumption is equal to the cube of the speed. One-half the speed requires one-eighth (.5³) the power (see table below). This means significant energy savings are available by reducing motor speed. Speed is expensive.

Speed	Flow	Required Power
100%	100%	100%
90%	90%	72.9%
80%	80%	51.2%
70%	70%	34.3%
60%	60%	21.6%
50%	50%	12.5%
40%	40%	6.4%
30%	30%	2.7%

Correlation of Motor Speed, Flow and Power



VFD Image

Once VFDs are installed on Tier 1 applications, then the Tier 2 and the remaining lift station applications should be assessed and prioritized by facility officials. Ameren Illinois Energy Efficiency Program standard VFD incentives are available through registered Program Allies.

3.2 Measure–2 Interior Lighting Upgrade to LED



Project Cost	
Investment (\$)	\$92,246
Utility Incentives (\$)	\$35,607
Total (\$)	\$56,639
Savings	
Consumption (kWh)	387,251
Consumption (therms)	n/a
Savings (\$)	\$19,363
MtCO2e	373
Simple Payback (yrs)	3.0

Issues and Observations:

The interior lighting systems throughout GPSD’s 29 buildings are a combination of T12, T8 and T5 fluorescent fixtures and high intensity discharge (HID) fixtures, comprising metal halide, high pressure sodium and mercury vapor lamps of varying age, wattages and operation hours. Those fixtures with magnetic ballasts (T12 and all HID) consume energy, even with burn-out lamps or turned off, causing unnecessary energy consumption 24/7 with no visible benefit.

Recommendations:

There are opportunities to improve lighting efficiency and lower maintenance costs by upgrading to LED. LED fixtures and lamps are more energy efficient than previous technologies and have a longer lifespan which reduces bulb change outs and maintenance.

It is recommended that GPSD upgrade to LED, 100% facility-wide, which include the following:

- Replacing existing T8/T5 fluorescent lamps with LED replacement lamps (low-cost improvement)
- Installing new LED fixtures

Ameren Illinois Energy Efficiency Program standard lighting incentives are available through registered Program Allies.

3.3 Measure–3 Exterior Lighting Upgrade to LED



Project Cost	
Investment (\$)	\$67,675
Utility Incentives (\$)	\$25,720
Total (\$)	\$41,955
Savings	
Consumption (kWh)	245,887
Consumption (therms)	n/a
Savings (\$)	\$12,294
MtCO2e	237
Simple Payback (yrs)	3.4

Issues and Observations:

The exterior HID lighting is comprised of a combination of metal halide, quartz and high pressure sodium fixtures with lamps ranging from 70W, 175W, 400W, 500W and 1,000W. Exterior lighting is a great energy efficiency opportunity since fixtures operate year-round, 12/7.

Recommendations:

Replace all exterior HID fixtures with new LED fixtures. LED is ideally suited for exterior lighting. It provides clean, white low-glare light which improves visibility, safety and security. Ameren Illinois Energy Efficiency Program standard lighting incentives are available through registered Program Allies.

3.4 Measure–4 Solar PV (Photovoltaic)



Project Cost	
Investment (\$)	\$3,105,000
SREC Incentives (\$)	\$1,642,395¹
Total (\$)	\$1,462,605
Savings	
Consumption (kWh)	2,850,270
Consumption (therms)	n/a
Savings (\$)	\$142,514
MtCO ₂ e	2,747
Simple Payback (yrs)	10.3

¹5-Year Solar Renewable Energy Credits (SRECs)

Issues and Observations:

Solar PV offers a clean, renewable energy alternative. Reducing energy consumption makes solar more viable and attractive. The current climate in the State of Illinois for renewables, presents a business-case for on-site generation of solar energy due to the following activities:

- Illinois SB2814, “Future Energy Jobs Act” passed in December 2017
- Illinois’ Solar Renewable Energy Credits (SRECs) Program
- Available 30% Federal Tax Credit (private-sector)
- Maturing solar technology
- Solar market expansion and penetration
- Declining prices

Solar PV can be one element of a renewable energy portfolio to reduce purchased electricity costs from the local utility and help bring the District closer to becoming a net zero energy consumer.

The Illinois Clean Energy Community Foundation’s Net Zero Energy Wastewater Treatment Program awards grants to facilities committed to achieving site net zero energy performance, or better. The Program encourages facilities to take a holistic approach integrating energy efficiency, renewable self-generation and best practices.

Recommendations:

Investigate installing a 2.0 MW ground-mounted system, which is the largest system allowed by the Illinois Power Agency (IPA) to receive Illinois’ SRECs. Systems typically come with a 25 year warranty on the panels and a 10 year warranty on the components. Systems should have a lifespan in excess of 25 years. Some things to consider and discuss with contractors:

- Downtime - service after installation (regional vs. out-of-state)

- Equipment and component construction, quality and warranties (US vs. imports)
- Maintenance schedule and staff training
- Real-time monitoring
- Referrals

The District could generate power for behind-the-fence use, off-set energy peak loads and power consumption and **lower monthly power bills approximately 20%**.

ISTC would highly recommend that the District investigate entering into a Public-Private Partnership (PPP) Agreement with a private business or individual. This will take advantage of the federal depreciation tax deduction and the 30% federal solar tax credit, which in turn, will significantly improve payback, likely in the range of 3 – 5 years.

PPPs are long term infrastructure contracts which involve a contract between a private party and a government entity, for providing a public asset or service, in which the private party bears significant risk and management responsibility. Remuneration is linked to performance.

4 Facility Description

4.1 General

The analysis of the facility was based on engineering calculations, rule of thumb assumptions, and experience of the engineers. The sections which follow describe details and important input parameters of the calculations.

4.2 Site Conditions and Building Details

The District facility is located in Illinois and was put into operation in 1931. It serves an area of approximately 66 square miles.

The facility has 154 GPD (millions of gallons per day) peak flow capacity, a design capacity of 37 MGD and an average flow of approximately 19.0 MGD (May 2017 – April 2018). The plant has 6 certified operators, a staff of 72 full-time employees and is occupied year-round.

Figure 1: Labeled Aerial View

4.3 System Description

System Layout:

Influent enters the facility from two interceptor sewers. The sewer system encompasses a network of 716 miles of lines. The treatment process consists of physical separation of solid material and biological treatment of oxygen demanding (BOD) waste.

This process begins at the headworks, comprising a series of bar screens and grit removal tanks. Following grit removal, two large 10' diameter Archimedes screws pump the raw

wastewater to a level to allow it to flow through the next treatment processes. Each screw has a capacity of 60 MGD, with additional centrifugal pumps available for increased flow capacity. The screw pumps transfer the raw water to four primary clarifiers for solids settling and removal. Clarified water flows over the top of the clarifiers to twelve 47' secondary aeration tanks (4 batteries with 3 passes) for microbial digestion of dissolved solids and contaminants, including an enhanced biological phosphorous removal process. Settling of solids occur in eight secondary clarifiers. The overflow water is pumped by intermediate process pumps (IPS) to eighty-four rotating biological contactors (RBCs) which remove ammonia, producing solids which settle in two tertiary clarifiers. The clarified water flows to a lined pond, unlined pond and then into an effluent channel, but before the water is discharged, it undergoes a final chemical disinfection process involving chlorination and dechlorination (sodium bisulfite). Then four 10' Archimedes screws pump the reclaimed water to a public waterway.

Solids removed from the three treatment processes are thickened using gravity belt thickeners, removing water prior to digestion. Four anaerobic digesters heat the bio-solids to 95°F for one month, then dried with a centrifuge. Much of the dried bio-solids produced by the treatment plant are used as fertilizer on local agricultural land. The remaining bio-solids are used by landfills for daily cover.

Biogas produced from the process, is captured and used to heat the digesters. Biogas is also used to heat and cool some of the buildings in the winter and summer months. In the summer, excess biogas is flared-off.

Pumping:

Large centrifugal pumps (40HP – 400HP) are used throughout the treatment process, including, the raw water screw pumps, by-pass pumps, RAS pumps, WAS pumps, IPS pumps, high service pumps and effluent screw pumps, none of which are controlled by VFDs. Installation of VFDs on these pumps would provide improved process control while simultaneously saving energy.

Smaller pumps (5HP – 30HP) are located in numerous locations and applications, from the pretreatment building to the dewatering building. VFD opportunities exist for many of these as well, providing improved control and energy savings.

Blowers and Control Scheme:

In August 2017, the District completed a multi-million dollar aeration upgrade, including enhanced biological phosphorous removal. The upgrade addressed both process efficiency and energy efficiency. The new process utilizes five Neuro high speed 350HP turbo-blowers, fine bubble aeration and automated controls. The staff have observed a significant energy reduction, approximately 20% savings.

Small blowers support makeup air units and HVAC systems in various buildings, ranging from 7.5HP to 30HP, mostly for supply or exhaust, none controlled by VFDs. Installation of VFDS would result in additional energy savings.

Building Descriptions:

The complex consists of 29 buildings of various size, structure (primarily brick and masonry and metal), and age. Original 1931 brick structures still stand and are currently in use, for example, the Pumps & Blowers and the Operations buildings. The Administration building underwent a major upgrade, completed in 2010, involving significant renovation of the interior structures, surfaces, treatments and HVAC and a lesser renovation of the exterior.

The buildings and grounds are well-maintained, including perimeter metal fencing and security lighting.

4.4 HVAC Systems

Four anaerobic digesters produce approximately 300,000 ft³ of biogas daily (63,000 Therms annually) to the site's nine boilers, comprising two 1,500,000 Btu, two 2,553,000 Btu, two 3,348,000 Btu and three 6,500,000 Btu units.

This biogas is used to: 1) provide winter heating in some of the buildings, 2) provide year-round heating to the anaerobic digesters and 3) provide year-round heating and cooling of the Administration building. However, natural gas is utilized to improve the chiller's operational efficiency, due to natural gas' higher Btu value. Any excess biogas not used in the summer is flared-off.

In the 2010 Administration building upgrade, the HVAC chiller was not addressed. Its 1970's Trane Absorption Cold Generator (chiller) is still in place. This chiller is at the end of its lifecycle, and GPSD would like to replace it in the near future, leaving them open to alternative energy technologies. They might consider capturing waste heat opportunities within the treatment process.

The plant has a consistent source and temperature of wastewater flowing through the treatment process. It may be possible to capture waste energy from this water, through a series of heat exchangers, and use it to heat and cool the facility's buildings. Similarly, waste heat from the Neuro turbo-blowers' air or exhaust may be captured and used in heating as well.

4.5 Lighting and Internal Loads

The facility has a diverse mix of interior T12, T8 and T5 fluorescent fixtures and an equally diverse mix of HID fixtures, including metal halide, high pressure sodium and mercury vapor. Daylight is harvested (skylights) in many of the buildings to supplement artificial lighting. Most buildings are adequately lit, but the lighting may be improved with more efficient LED fixtures and lamps, while simultaneously saving energy.

Exterior lighting primarily consists of metal halide, quartz and high pressure sodium fixtures with lamps ranging from 70W, 175W, 400W, 500W and 1,000W. These are great candidates for an LED upgrade, since fixtures operate year-round, 12/7. LED lighting would also improve exterior visibility, safety and security.

The facility has a variety of other pieces of office equipment that consume energy which would include staff computers and peripherals, vending machines and refrigerators.

4.6 15 Year Description of Upgrades

The District has completed the following two major upgrades of its buildings and treatment process:

- Administration Building – 2010
 - Interior – lighting, walls, floors, furnishings, boilers, air handling system.
 - Exterior – lighting, added perimeter windows and skylights.

- Aeration – completed August 2017
 - High speed turbo-blowers
 - Fine bubble aeration'
 - Automated controls

Over the years, the District has installed VFDs on select pumps and new process equipment as needs arose. A small number of interior and exterior LED fixtures have randomly been installed.

5 Energy Consumption Analysis

The building's energy consumption was obtained from utility bills and data provided. Utility bills were analyzed for a twelve month time-frame from May 2017 to April 2018. The facility is supplied with electricity distributed and purchased from Ameren Illinois. Natural gas is distributed by Ameren and purchased through CenterPoint Energy.

The facility paid a total of \$700,321 for electricity in this time frame and \$50,492 for natural gas. The total utility cost for the facility was \$750,813 and the total treated water was 6,949.2 MG.

Figure 2 represents the comparison of electricity consumption (kWh) and treated flow. This allows a trend comparison to determine how much of the electricity consumed is used for water treatment as opposed to other needs.

As indicated in the graph, electricity use is loosely correlated with flow. There appears to be fixed operational costs, an electrical base load from non-process related equipment or process equipment which is run continuously, regardless to flow.

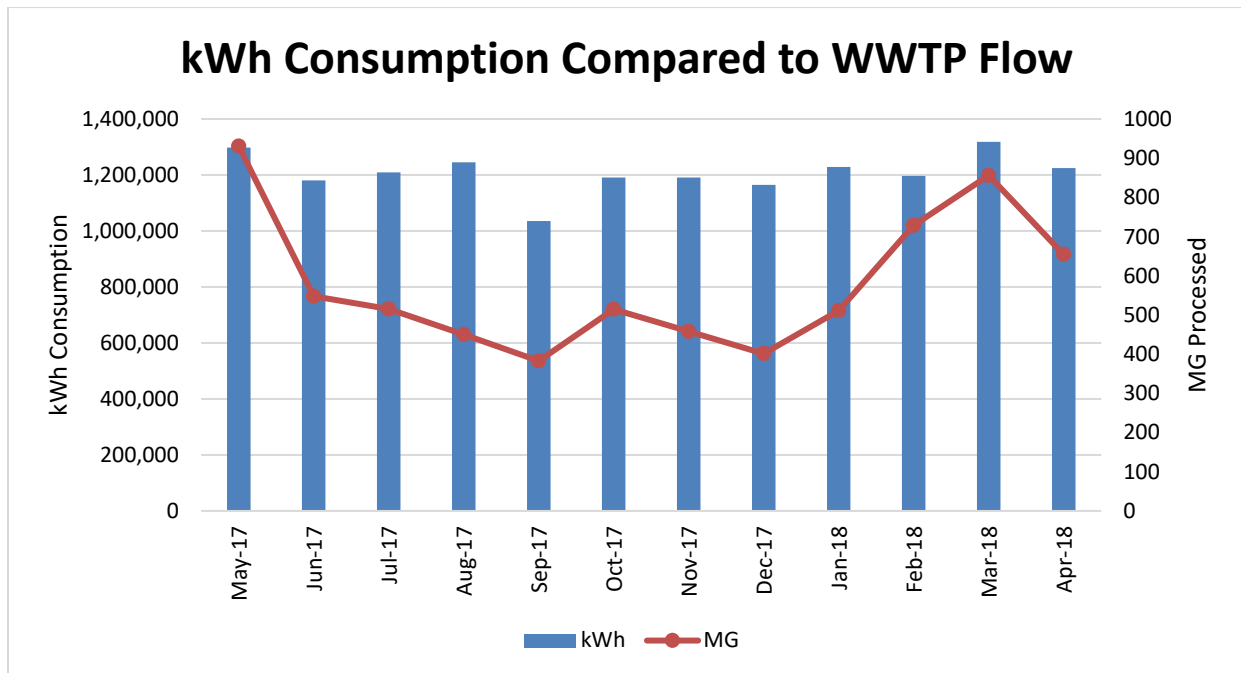


Figure 2: Comparison of WWTP Flow versus kWh

Figure 3 represents the comparison of natural gas consumption (therms) and annual heating degree days (HDD). Degree days is a measure of the extremeness of the weather and measures how far from 65° F the average outdoor weather was for a day. Average temperatures above 65° F will typically require cooling and temperatures below 65° F typically require heating.

As indicated in the graph, there appears to be a direct correlation of gas use and HDD in the winter; however, the summer's gas use is inversely correlated. This is likely attributed to the use of natural gas to supplement the biogas in the operation of the Administration building's Trane absorptive chiller in the summer cooling season.

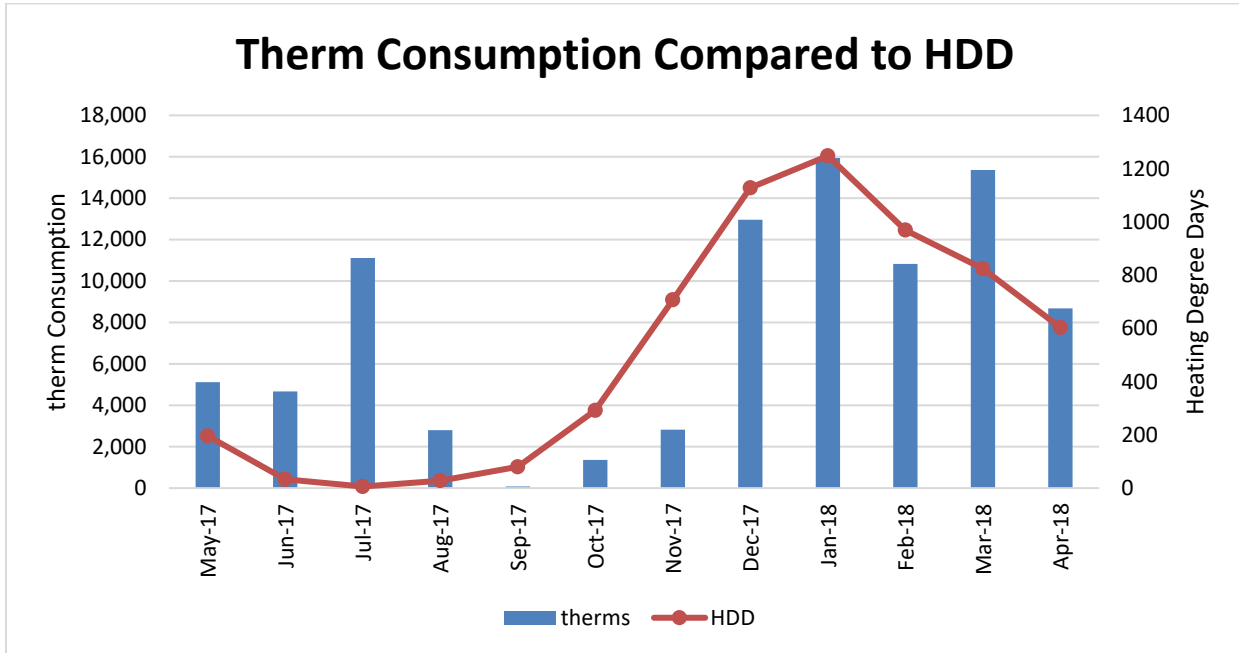


Figure 3: Comparison of Regional Heating Degree Days versus Therms

6 Programs

6.1 US DOE Sustainable Wastewater Infrastructure of the Future (SWIFt)

The Better Buildings Sustainable Wastewater Infrastructure of the Future (SWIFt) Accelerator works to share best practices to accelerate a pathway toward a sustainable infrastructure. SWIFt aims to catalyze the adoption of innovative and best-practice approaches in data management, technologies, and financing for infrastructure improvement. More information may be found on the US Department of Energy's Better Buildings website at: <https://betterbuildingsinitiative.energy.gov/accelerators/wastewater-infrastructure>

6.2 Illinois EPA Revolving Loan Fund

The Wastewater/Stormwater and Drinking Water loan program, also called the Illinois Clean Water Initiative (CWI), provide low-interest loans through the State Revolving Loan Fund (SRF). The CWI includes the Water Pollution Control Loan Program (WPCLP) which funds both wastewater and stormwater projects. This program is annually the recipient of federal capitalization funding which is combined with state matching funds, interest earnings, repayment funds, and the sale of "AAA" rated bonds to form a perpetual source of financing for infrastructure projects. More information can be found on the Illinois EPA's website at: <http://www.epa.illinois.gov/topics/grants-loans/state-revolving-fund/index>

6.3 Illinois Clean Energy Community Foundation: Net-Zero Energy Waste Water Grant

The Illinois Clean Energy Community Foundation has a grant program for improvements to publicly owned and operated wastewater treatment facilities that have a path to net-zero energy. This includes grants of up to \$500,000 per grant cycle for facilities that make a commitment to move to achieve and maintain site net-zero energy performance, make the energy performance publicly available, and provide public access for educational purposes. Projects over \$1 million may be considered for funding beyond the \$500,000. More information can be found at www.illinoiscleanenergy.org. For those plants who wish to apply, the first step is to contact the Foundation at 312-372-5191 to learn more and discuss the project before beginning the application.

6.4 Ameren Illinois Energy Efficiency Program

Ameren Illinois offers standard and custom program incentives for energy efficiency improvements involving electricity and natural gas conservation measures. Customers who purchase electricity or gas from third party suppliers but use Ameren's distribution system are also eligible. More information can be found on Ameren Illinois Energy Efficiency Program website at: www.amerenillinoisavings.com

6.5 Database of State Incentives for Renewables and Efficiencies (DSIRE)

DSIRE is a comprehensive source of information on incentives and polices that support renewables and energy efficiency in the United States. It contains links to available state and

federal incentives and is a great starting point. More information may be found at the DSIRE website at: www.dsireusa.org.

6.6 ComEd Energy Efficiency Program

Did you know that you can save as much as 20 percent on your water or wastewater treatment plant's energy use through energy efficiency improvements? Whether water or wastewater treatment is your primary business or it's just one component of your operations, ComEd can help you begin saving money and energy. Incentives are available for aeration, pumping, anaerobic digestion and more. Get incentives worth 21 cents per kWh saved on high-efficiency blowers, aeration diffusers and controls, or receive a fully funded comprehensive energy study of your water/wastewater treatment plant. Visit ComEd.com/WWT for more info.

6.7 Illinois Municipal Electric Agency (IMEA) Electric Efficiency Program

IMEA Electric Efficiency program is available to the membership (and members' retail customers) of the IMEA. It is administered and funded through IMEA. FY2018-19 of the program runs from May 1, 2018 through April 30, 2019. Funds are allocated to IMEA members based on a prorated share of their electric purchases from the IMEA. Commercial/ industrial and public-sector facilities served by members can apply for funds through FY2018-19 or until the program ends. More information may be found at the IMEA website at: www.imea.org.

7 Conclusion

This report by the Illinois Sustainable Technology Center evaluated five measures for potential application by the District to reduce electrical and natural gas consumption and thereby save on utility costs. After thorough evaluation, four of the measures are recommended for implementation based on their effective rates of return.

The facility management and operators should be commended for their ongoing efforts to reduce energy consumption by having made a significant capital investment in improving aeration efficiency and the inclusion of the Enhanced Biological Phosphorous Removal system, completed in August 2017. By also participating in an ISTC energy assessment, the facility is exhibiting a sharpened focus as an organization dedicated to energy management practices. Undergoing an energy audit analysis sends a very strong message to one's community of a solid commitment to energy efficiency and sustainable business practices.

ISTC recommends that the energy savings initiatives identified in this report be implemented to decrease the building's overall energy consumption. A total reduction of 6,301,117 kWh is possible through the implementation of the suggested measures shown in Table E1. ISTC recommends implementing this package, which includes:

- Measure-1: VFDs on Blowers, Fans and Pumps
- Measure-2: Interior Lighting Upgrade to LED
- Measure-3: Exterior Lighting Upgrade to LED
- Measure-4: Solar PV

The suggested measures will significantly reduce the electrical consumption of the facility while providing an estimated annual electric utility savings of \$315,056 (at current rates).

The items included in this report are the primary elements of creating and managing a sustainable facility; they are to serve as guides to implementation.

To demonstrate its effectiveness to the State of Illinois, we ask that you keep us apprised of progress and success with implementation of our recommendations; this information will allow us to accurately reflect subsequent savings. We will also contact you periodically to discuss, answer questions, and review status.

Thank you for the opportunity to be of service. Please do not hesitate to contact us if we may be of further assistance.

8 Acknowledgements and Disclaimers

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This report was prepared as the result of work by staff of the Smart Energy Design Assistance Center (SEDAC) and the Illinois Sustainable Technology Center (ISTC). It does not necessarily represent the views of the University of Illinois, its employees, or the State of Illinois. ISTC, SEDAC, the State of Illinois, its employees, contractors and subcontractors make no warrant, express or implied, and assume no legal liability for the information in this report; nor does any party represent that the uses of this information will not infringe upon privately owned rights. This report has not been approved or disapproved by the Illinois EPA or the US Department of Energy, nor has it passed upon the accuracy or adequacy of the information in this report. Reference to brand names is for identification purposes only and does not constitute an endorsement. All numerical data are order of magnitude estimates and the number of digits shown is an artifact of the calculation procedure; they are not meant to imply greater accuracy or precision.

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Appendix A Additional Energy Cost Reduction Measure Descriptions

A.1 ECRM-5 Hydro-Thermal System for Heating and Cooling Buildings

Issues and Observations:

(Excerpts from a District Review prepared by Energy Resources Group, Inc., dated 7/30/2018 are shown in italics.)

The literature on the absorber was indefinite regarding tonnage. The date of manufacture (literature from 1971) and apparent size lead me to believe that it is in the 50 – 75 ton range. The absorber is well past normal life expectancy for the equipment and should be replaced with newer more efficient equipment.

The influent flow varies by volume and temperature. There is a large amount of heat/cooling available from this influent. A water source heat pump can readily manage all of the building heating and cooling loads as well as provide heat for the digesters. This is much akin to the presently decommissioned heat exchanger that may have provided condensing water for some of these loads in the past. At the minimum, it should be easy to develop 800+ Million BTU/Day from influent water with a temperature drop or rise of 10°F. Obviously, not all of the water would be needed. System can be readily sized for mission critical requirements.

	MGD	Temp Δ°F	Avail MMBTU/Day @10°F ΔT
Max	132.0	75	10,992
Min	9.9	52	821
Average	22.7	66	1,887

With the potential value of the biogas RINs being ~\$30+/MMBTU, it would make economic sense to clean up the biogas and use the heat pumps to generate digester heat. During cooling seasons, the heat pump could easily generate 110-120°F temperatures for maintaining the digesters, while it also provides cooling for the buildings. Further analysis is recommended.

Alternatively, there are 5 blowers in an n+1 arrangement. Four blowers often run at 7,200 CFM (suction) at a temperature of 200+ °F. Heat recovery on this air stream can easily produce water at 150°F for winter space heating and all year long digester maintenance heat. Potentially, this can replace 68,000 of the purchased 91,700 purchased boiler therms/year. At \$5.50/MMBTU, this has a value of \$37,500 annually. Further analysis is recommended.

Recommendations:

1. Secure a board resolution that provides clear economic criteria for investing in energy efficiency and renewable energy efforts.
2. Perform an energy audit of existing plant to establish actual heating and cooling requirements.
 - a. Buildings

- b. Digesters*
 - c. Generate Energy Efficiency Measures (EEMs) that meet board investment criteria to reduce usage prior to moving to renewable energy production.*
- 3. Develop preliminary design for EEMs and price estimates for installation.*
- 4. Secure financing and install Best Available Technologies (BAT) to deliver EEMs.*
- 5. Install 2MW of solar panels (~20% of existing kWh usage. 10-year payback is likely within board economic criteria).*
- 6. Consider combined heat and power (CHP) to meet thermal loads while generating power.*
- 7. Once local investments in efficiency and solar produce new baselines of energy usage, secure power purchase agreement from renewable energy to eliminate carbon producing purchased energy and become 100% carbon neutral and, effectively, eliminate utility bills.*

A.2 Potential Measures Not Evaluated

Combined Heat and Power (CHP)

This measure requires extensive investigation and is not addressed in this report due to reporting time constraints and the magnitude of the project. However, in initial discussions between ISTC, District officials and the Energy Resources Group, there appears to be merit in better utilizing the 300,000 ft³ of biogas which is produced daily from the anaerobic digesters for potential power generation. ERG has submitted the District data to the USDOE Midwest CHP Technical Assistance Partnership for preliminary analysis.

Exit Signs: Signs were not observed or documented during the audit as to the feasibility for energy savings. ISTC would recommend replacing all incandescent or fluorescent exit signs with an LED sign that consumes less energy, has a longer lamp life and has less associated maintenance cost. A typical LED sign draws 2W and has a 25 year life expectancy. LED exit signs are available through Ameren's Instant Incentives for Lighting Program for approximately \$5 each, with free shipping (limits may apply). More information may be found at: www.amerenillinoisavings.com/for-my-business/explore-incentives/instant-incentives



Tankless Water Heaters vs. Standard Water Heaters: Installing instantaneous (or tankless water heaters) would save the facility energy; however, it is likely that the amount of electricity or natural gas used for domestic/sanitary hot water would be insignificant in respect to the site's total energy footprint. The savings and ROI associated with this would be limited and the total initial cost would be high due to the number of water heaters to be replaced. For these reasons, a project such as this may not be warranted.

Programmable Thermostats with Temperature Setback: The facility presently heats and cools some of its buildings year-round. Thermostat set points were not observed or documented during the audit as to the feasibility for energy savings.

ISTC would recommend replacing any existing dial or digital non-programmable thermostats which waste energy which keep spaces conditioned all day, every day at the same temperature set point. Significant energy savings are possible through the proper use of a programmable units. Thermostats should be set back in off-hours when spaces are unoccupied or in use (nights and weekends). Save 2-3% energy per 1° F.

Temperature Setback Recommendations:

- Summer 74 - 80°F
- Winter 68 - 60°F