

OWASA'S ENERGY MANAGEMENT PLAN UPDATE

This document provides an update of Orange Water and Sewer Authority's (OWASA) use of energy in our facilities and what we've done and plan to do to use energy more efficiently, use renewable energy sources, and reduce our greenhouse gas (GHG) emissions. By reducing our use of energy and increasing our use of renewable energy sources, we can help reduce the demand for water resources, improve environmental impact of our operations, reduce costs, and improve reliability and resiliency.



ORANGE WATER AND SEWER AUTHORITY

*A public, non-profit agency providing water, sewer and reclaimed water services to the
Carrboro-Chapel Hill community.*

March
2019

Background

OWASA uses a lot of energy to operate our water, wastewater and reclaimed water facilities, protect the environment, and provide service to about 83,000 residents through about 21,650 customer accounts in the Carrboro-Chapel Hill community. In Calendar Year 2018, our facilities used about 67 billion BTUs of energy – enough to power about 1,800 homes for a year. That energy came at a cost of \$1.2 million, comprising about 5% of our annual operating expenses in Fiscal Year 2018.

On the other end of the wire, it takes a lot of water to produce the electricity we use. By reducing our use of energy and increasing our use of renewable energy sources, we can help reduce the demand for water resources, improve environmental impact of our operations, reduce costs, and improve reliability and resiliency.

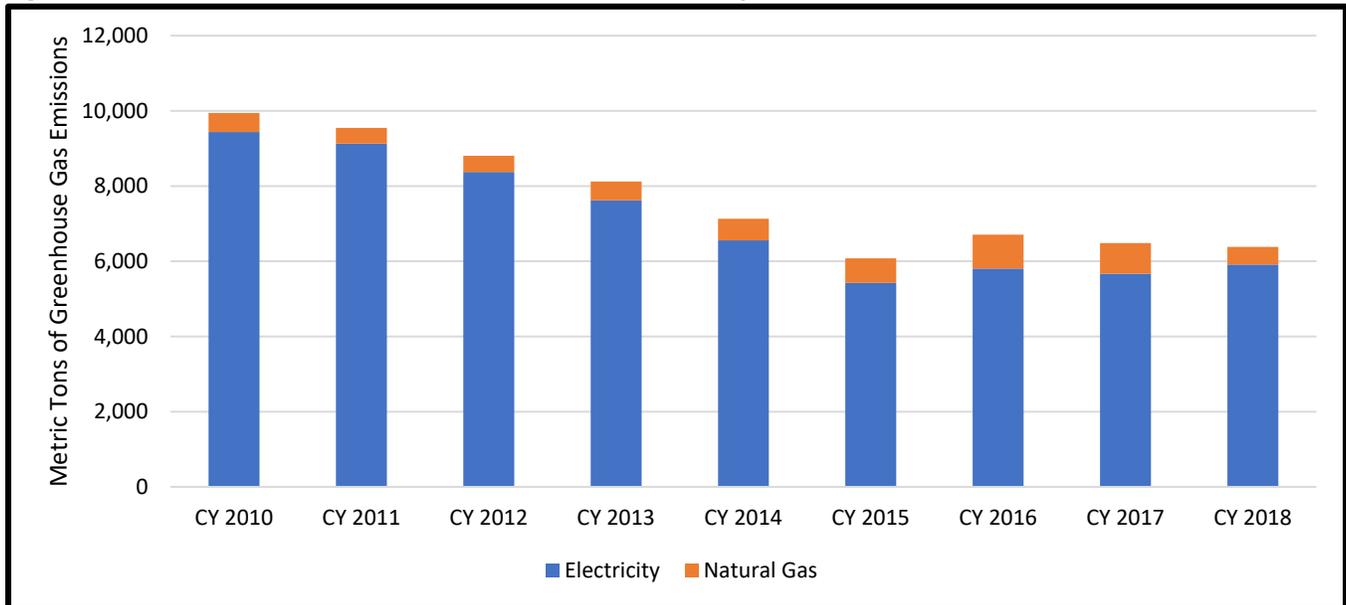
In 2014, the OWASA Board of Directors identified the “Implementation of an Energy Management Program” to be a top strategic priority for the organization. Since that time, with the assistance of OWASA staff, the OWASA Board of Directors has reviewed an assessment of OWASA’s energy use, established Calendar Year (CY) 2010 as the baseline year, identified concrete goals and objectives against that baseline, worked with staff to define an energy management program, and developed and approved a plan that seeks to achieve the following objectives:

- Objective 1: Reduce use of purchased electricity by 35% by the end of Calendar Year 2020 compared to the Calendar Year 2010 baseline.
- Objective 2: Reduce use of purchased natural gas by 5% by the end of Calendar Year 2020 compared to the Calendar Year 2010 baseline.
- Objective 3: Beneficially use all WWTP biogas by 2022¹, provided the preferred strategy is projected to have a positive payback within the expected useful life of the required equipment.
- Objective 4: Formally engage local governments and partners in discussion about potential development of biogas-to-energy project at the Mason Farm WWTP.
- Objective 5: Seek proposals for third-party development of renewable energy projects on OWASA property.

In the pursuit of these objectives, OWASA is committed to reduce our direct emissions of greenhouse gases. **Since 2010, we have reduced our greenhouse gas emissions associated with our use of purchased natural gas and electricity by 40%**, from about 10,600 metric tons per year to 6,400. Approximately 1,300 metric tons of this reduction is due to a decline in the carbon intensity of Duke Energy’s generation portfolio (from 0.93 pounds per kWh in 2010 to 0.76). The remaining reduction is due to OWASA’s improved energy efficiency and conservation. Figure 1 shows the annual greenhouse gas emissions attributed to OWASA’s electricity and natural gas over the past nine years.

¹ In 2018, the OWASA Board of Directors determined that there was no apparent and cost-effective strategy to achieve this goal by 2022. As a result, the OWASA Board abandoned the 2022 deadline, but maintained the commitment long-term.

Figure 1: Greenhouse Gas Emissions from OWASA’s Electricity and Natural Gas Use



OWASA’s Energy Management Program is designed to systematically identify and evaluate energy management opportunities and to pursue those deemed to be cost-effective for the organization (defined as having a positive net present value within the rated life of the asset). It is also structured to more directly integrate energy management and clean energy strategies into our everyday decision-making. OWASA’s Energy Management Program involves staff from across the organization, including a committed group of individuals serving on the organization’s Energy Team, as well as numerous partners and stakeholders. Our program employs a comprehensive, systematic methodology for identifying, evaluating, and prioritizing clean energy strategies that will increase the sustainability of our organization and community for years to come. (Appendix A summarizes the criteria that the OWASA Energy Team uses to prioritize clean energy strategies, as well as how each of the new proposed strategies compare to this framework.) Our Energy Management Plan is a result of the collective contributions of all those involved in our Program.

This document serves as an update to OWASA’s 2017 Energy Management Plan (EMP), OWASA’s first formal, organization-wide evaluation of ways to better manage energy across all our facilities and the 2018 Energy Management Plan Update. It documents our progress towards our energy management goals and objectives and presents updated recommendations and proposed strategies for further improving our use of energy and reducing our carbon footprint.

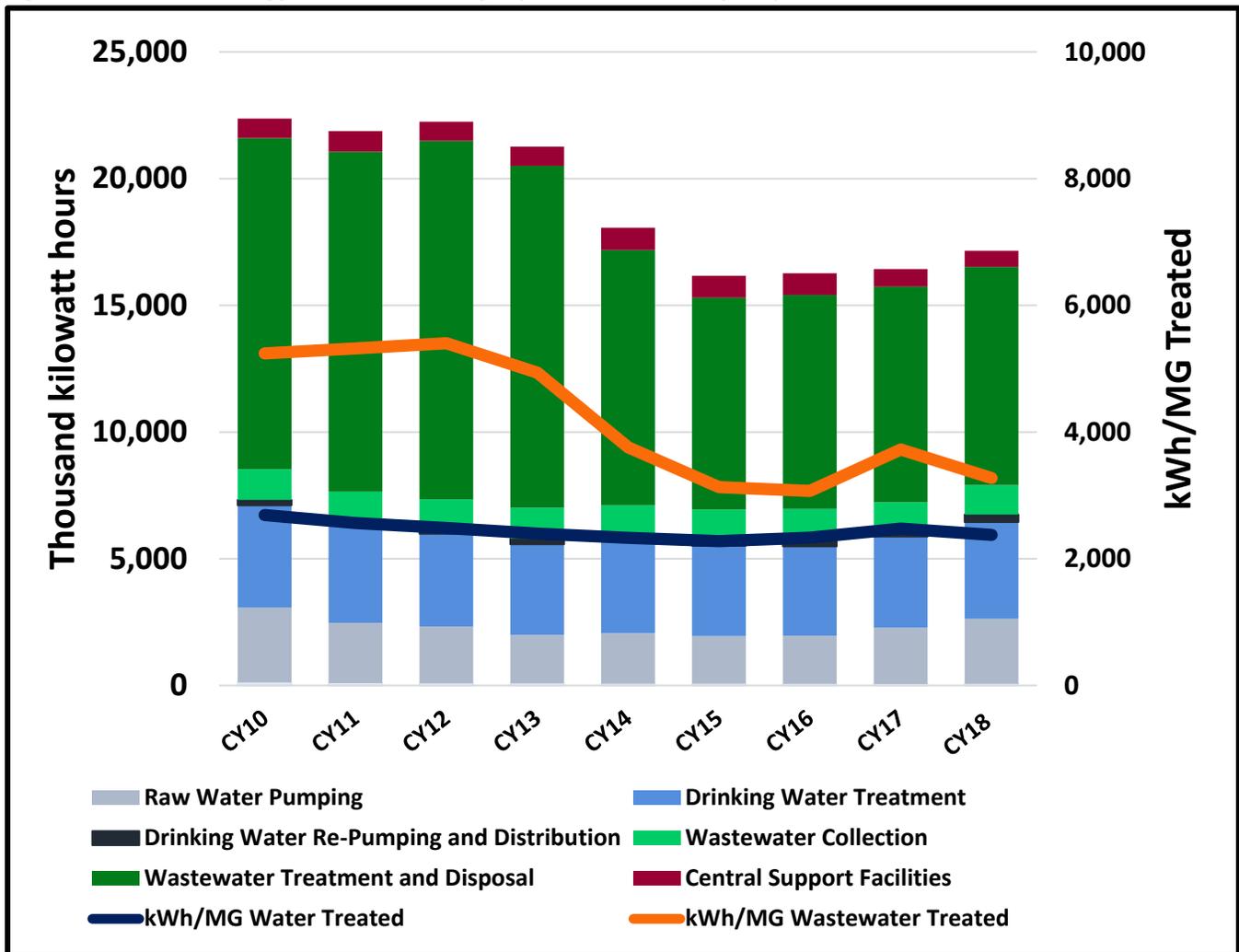
The remainder of this document is organized around the five goals and objectives of OWASA’s Energy Management Program. Each section provides an update of our progress against each goals and proposes next steps in moving forward on each objective.

Objective 1: Reduce use of purchased electricity by 35% by the end of Calendar Year 2020 compared to the Calendar Year 2010 baseline.

Trends in Electrical Energy Use and Costs

Figure 2 shows nine years of historical electrical energy use across all OWASA facilities, by major functional area (served by Duke Energy Carolinas and Piedmont Electric Membership Corporation). The trend demonstrates a significant and sustained reduction in energy use throughout this time, realized from investments in more energy efficient equipment and processes. **In 2018, OWASA collectively used 23% less electrical energy than in 2010.**

Figure 2: Electrical Energy Use and Intensity, by Calendar Year, by Major Functional Area



In 2010, OWASA was billed \$1.26 million for electricity at an average of \$0.0575 per kWh. In 2018, we were billed \$1.13 million at an average of \$0.0672 per kWh. In absolute dollars, we spent about \$132,000 less on electricity in 2018 than in 2010. However, if we had used the same amount of electrical energy in 2018, as we did in 2010, but were charged at 2018 levels, we would have paid about \$345,000 more.

Through our energy management efforts, we avoided over \$345,000 in annual operating and maintenance expenses in FY18.

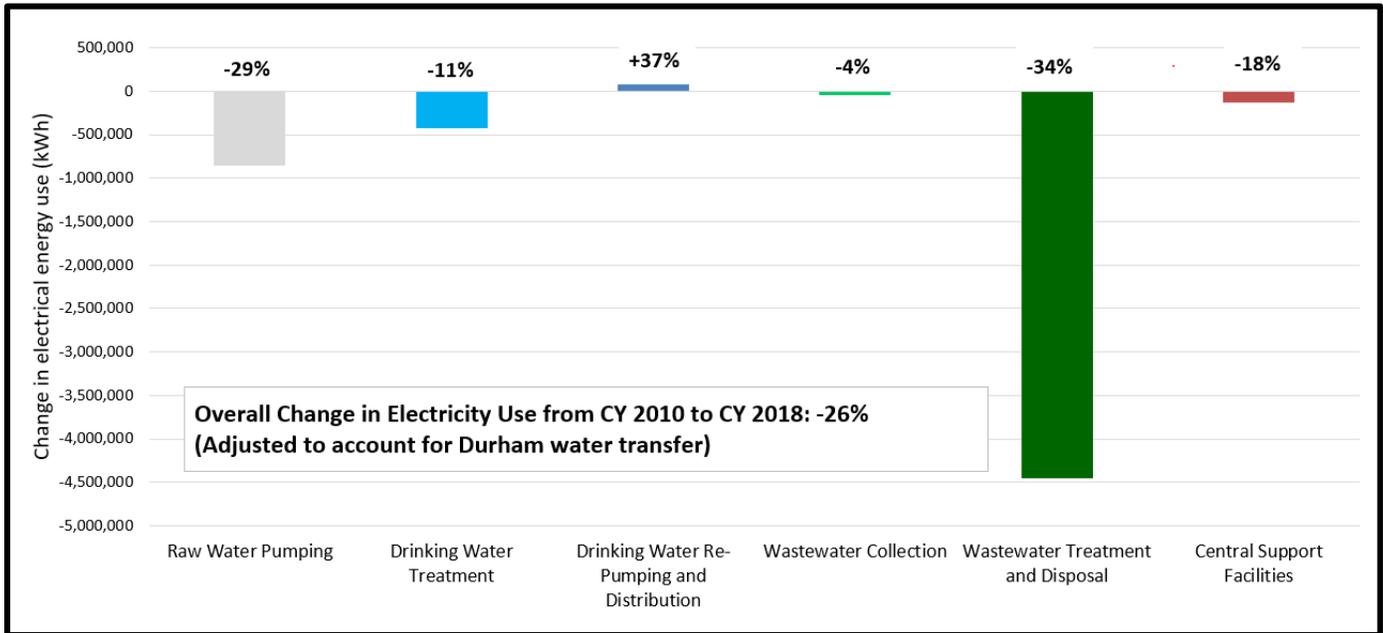
Additionally, our energy management efforts involve a detailed and regular analysis of our energy tariffs and contract demands. As such, our avoided costs are lower than what they would have been without these efforts. In other words, we have made changes over the last nine years that have brought down our blended per kWh rate. For example, we adjusted the contract demand for three facilities, which we estimate avoided an additional \$13,000 each year in energy costs. After a cost-benefit analysis, we opted out of participation (i.e. contribution) to Duke Energy's energy efficiency rider at the Wastewater Treatment Plant and Cane Creek Reservoir complex. We estimate this saved OWASA approximately \$50,000 last year. In 2020, we will opt out of this rider at the 400 Jones Ferry Road complex to save another \$25,000 per year. Additionally, we intentionally shift demand to off-peak periods when we can to reduce our demand charges.

Summary of Implemented Energy Management Strategies

When taken on the whole, in 2018, we actually used about 700,000 kWh more than in 2017 (as shown in Figure 2). That increase almost directly translates to the estimated additional energy required to provide the City of Durham with about 375 million gallons of finished drinking water in 2018. OWASA provided this finished drinking water to the City of Durham at their request while they conducted maintenance on their two drinking water plants. Three hundred and seventy five million gallons is equivalent to about 2 months of OWASA's typical demand. The additional energy required to pump and treat 375 million gallons of raw water and to pump 375 million gallons of treated water to Durham increased our energy use by an estimated 677,000 kWh.

Figure 3 shows the change in electrical energy use since 2010, by functional area, after adjusting (i.e. subtracting) for the additional energy required to supply the City of Durham. The size of the bar represents the amount of absolute change in electrical energy use, while the text within the figure shows the percent change for that functional area. **When adjusted for our water supply to Durham, OWASA used 26% less electrical energy in 2018 than in 2010.**

Figure 3: Change in Electrical Energy Use Since Calendar Year 2010, by functional area



These reductions are attributable to the following projects and practices:

Increase in Aeration Efficiency at Wastewater Treatment Plant (WWTP): The most significant reduction in electrical energy use over the past nine years has been in wastewater treatment and disposal, primarily due to a \$8.4 million investment in energy efficient blowers, mixers, and fine bubble diffused aeration system (funded with a 20-year, 0% interest loan from the NC State Revolving Fund). This capital project has resulted in a reduction of about 4.0 million kWh/year and represents, about an 18% reduction against our 2010 baseline.

Raw Water Pumping Efficiency Upgrade: We've also seen a significant decrease in the amount of energy used for raw water pumping. This is in-part due to the installation of a new, low-flow pump and variable frequency drive (VFD) at the University Lake Pump Station which has enabled us to better optimize system-wide raw water pumping across a wide range of demand conditions. The University Lake Pump Station Improvement project cost about \$300,000, most of which was funded with an American Reinvestment and Recovery Act grant. We estimate that this project is responsible for a reduction of about 500,000 kWh per year, representing a 2% reduction against our 2010 baseline.

Water Conservation and Use of Reclaimed Water: Our customers' water use stewardship has helped to reduce our use of energy across the board, from pumping raw water, treating and delivering drinking water, collecting wastewater, and treating and disposing of wastewater. In 2018, we treated about 274 million less gallons of water than in 2010, despite a 6.2% increase of customer accounts.

About half of this demand reduction can be attributed to a concurrent increase in reclaimed water demands. Since 2010, we increased our annual production and delivery of reclaimed water from about 195 million to 245 million gallons which we estimate uses about three-quarters of the energy required to pump and treat raw water from our reservoirs. Given current energy use intensity estimates for finished drinking water, wastewater treatment, and reclaimed water treatment and delivery, we estimate that our

customers' increased water use stewardship corresponds to an estimated annual energy savings of about 650,000 million kWh per year (about 3% of the 2010 baseline).

LED Lighting: We estimate that another 50,000 kWh of the reduction of electricity use is attributable to LED lighting replacement. Over the next year, as we realize the savings of a now-almost-comprehensive replacement of lighting with LED, we anticipate these savings to grow to 300,000 kWh/year (1% of 2010 baseline).

Energy-Minded Decision Making: We estimate that the remaining 3% of the baseline reduction is the result of a suite of energy efficiency projects, such as cool roof installations on buildings, HVAC upgrades, replacement of pumps, motors, and motor controls with more efficient equipment and VFDs, and an ongoing commitment to optimization in our operations with energy management in-mind.

Organizational Energy IQ: There are also a series of strategies implemented in recent years to develop the energy "IQ" of the organization and integrate energy data into day-to-day decision making. It is difficult to quantify the impact of these initiatives but overtime their impact can be significant.

Over the last two years, we have received outside funding to host two in-depth energy workshops in our facilities. Last year, the NC State University Industrial Assessment Center funded an expert in pump efficiency from the Department of Energy (DOE) to teach a two-day course at OWASA, using our pump stations as class examples.

Additionally, we have deployed a series of online tools to help inform the maintenance and replacement of our infrastructure with energy in mind. Access to energy data can be powerful for energy savings as well as asset management. For example, last summer (2018), we noticed that energy use at the Calvander Finished Water Pump Station had almost doubled (from 7,500 kWh/month to 14,500 kWh/month). Triggered by this dramatic increase in energy use, our maintenance team investigated and found that a check valve was sticking, causing the pumps to work much harder than necessary. Fixing the problem in a timely manner prevented energy waste and protected the health of the pump.

We have also piloted a dynamic pump optimization tool that provides real-time information (based on actual pump curves) on the most energy efficient pumping scheme to achieve desired flows. This resources helps to inform real time energy efficient decision-making by our Operations Team.

Update on Electrical Energy Management Strategies (described in detail in Appendices A and B)

To meet our goal of 35%, we need to reduce our annual electrical energy use by an additional 1.9 million kWh, another 9 percentage points of the 2010 baseline. The 2017 EMP and the 2018 EMP Update identified a series of energy management strategies to pursue and evaluate. We have continued to identify and evaluate new and upcoming energy management strategies.

The following section provides a summary of strategies that have been recently completed, are underway, and are proposed to pursue or evaluate. Table 1 below lists each of these strategies, their estimated electrical energy reduction potential (if enough information is available to develop an estimate), a four-year timeline, cost estimates, and assignment of the responsible party for moving forward with each strategy. Appendix B provides a more detailed description of each one.

Projects recently completed: We have recently completed a suite of energy management strategies for which it is too early to fully measure their impact on energy use. **We estimate that these projects will ultimately reduce our use of purchased electricity by at least 412,000 to 497,000 kWh per year (1.8-2.2% of the 2010 baseline).**

Projects underway: There is another suite of energy management strategies that are currently underway. **For those strategies for which we can estimate savings, we estimate that these projects will ultimately reduce our purchased electricity by at least 87,650 to 175,300 kWh per year (0.4-0.8% of the 2010 baseline).**

Projects currently in CIP: Of the projects in our CIP, seven have the potential to improve the energy efficiency of our operations. For these projects, the reduction in energy savings is a secondary rather than primary objective. From preliminary information that we have on some of these projects, **we estimate that this suite of strategies has the potential to reduce purchased electricity by at least 178,000 to 597,000 kWh per year (0.8-2.7% of the 2010 baseline).** Other projects are too early in the engineering and design phase to estimate energy savings. (Please note that timing of these projects may change in the FY20-FY24 CIP.)

Strategies to implement: Based on a favorable evaluation against the six criteria of OWASA's Energy Management Program, the Energy Team recommends the implementation of four additional strategies in the coming years. **This suite of strategies is estimated to reduce our use of purchased electricity by at least an additional 460,000 to 600,000 kWh per year (about 2.1-2.7% of the 2010 baseline).** These projected savings would result from the installation of solar photovoltaic (PV) systems installed at the Cane Creek Reservoir and/or Biosolids Management Land.

Strategies to evaluate: Based on their potential but given current uncertainty about their specific cost and benefits, the Energy Team recommends further evaluation of six additional strategies. These projects have potential, but for many, it is currently unclear what the realized energy impact would be. For those that we can estimate, **this suite of strategies could potentially reduce our use of purchased electricity by 48,000 to 65,000 kWh per year (about 0.2-0.4% of the baseline).**

Table 1: Project Plan for Electricity Management Strategies and Estimated Energy Savings and Costs

Energy Management Strategy	Estimated Potential Energy Savings (kWh)	Timeline and Cost (in \$1,000s)				Project Management
		Light shading: Study		Dark shading: Implement		
Recently Completed						
Admin Building Heating, Ventilation, and Air Conditioning (HVAC) System Upgrade (280-06)	175,000 - 200,000					Engineering
High-Performance SCADA System (278-73)	NQ					Engineering
LED Lighting Retrofit (Admin Building, WTP, and Ops Center) (280-12)	232,000-290,000 ²					Sustainability
Pump Training Course	NQ					Sustainability
Electricity Sub-Metering	NQ					Plant Staff/CITI
Online OWASA Energy Dashboard	NQ	3	3	3	3	Sustainability
Optimize WWTP Filter Backwash	10,000 - 15,000					WWTP Operations
Controls on WWTP Headworks Conveyor System	5,000-7,000					WWTP Ops/Maintenance
Advanced Metering Infrastructure Early Leak Detection	TBD					D&C/Customer Service
Underway						
Pump Optimization Tool (Finished Water Pump Station)	TBD	6	6	6	6	Sustainability/Ops
Motor Management Program	TBD	12				Sustainability/Maintenance
Pump Station Operational Assessments	TBD		88	Pursue cost-effective recommendations		Engineering
WWTP Non-Potable Water Conservation	20,000-40,000					Sustainability/Maintenance
HVAC: Equipment Replacement (As needed and >15 years old) (272-51)	67,650-135,300	45	10	125	55	Maintenance
WWTP UV System Energy Assessment	TBD					WWTP Ops and Maintenance
Partnership for Clean Water Self-Assessment and Optimization	TBD					WWTP Ops and Maintenance
Real-Time Nitrification Control System at WWTP	TBD		30			WWTP Ops & Eng.

² Energy use reduction mitigated by increases in energy use during HVAC upgrade
 FINAL VERSION: Approved by the OWASA Board of Directors on March 28, 2019
 Please direct any questions to Mary Tiger, 919-537-4241, mtiger@owasa.org

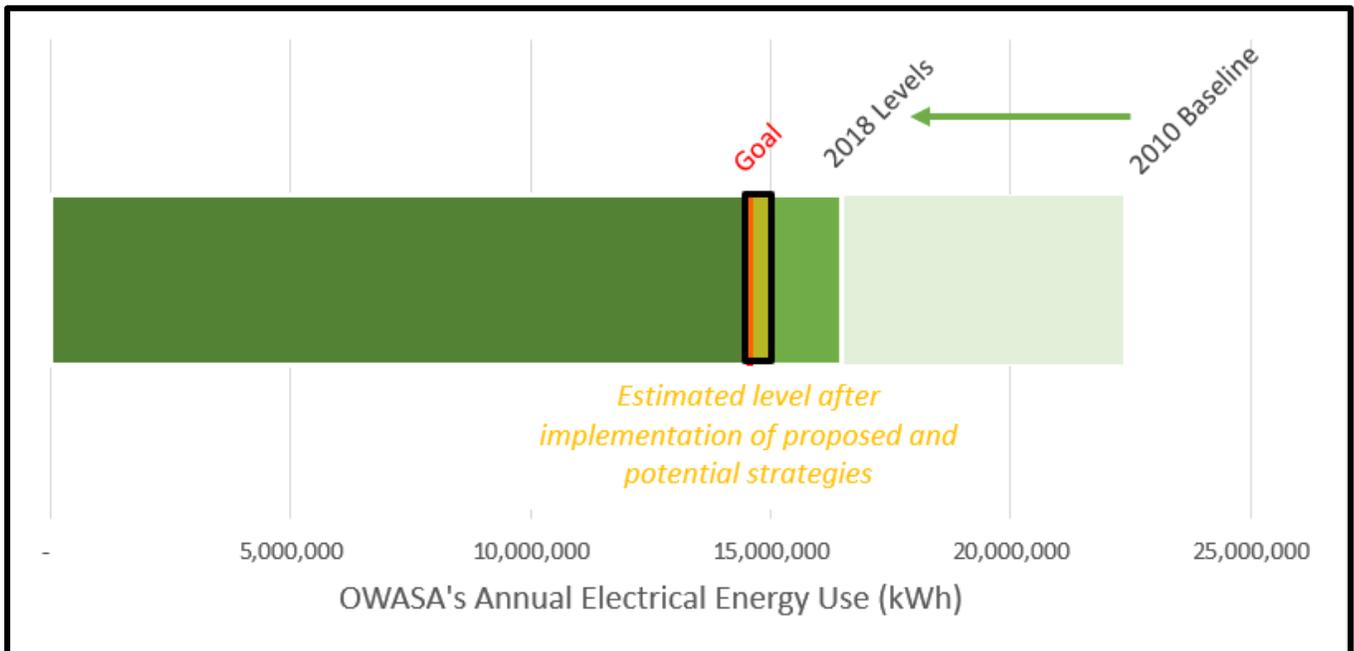
Energy Management Strategy	Estimated Potential Energy Savings (kWh)	Timeline and Cost (in \$1,000s)				Project Management
		Light shading: Study		Dark shading: Implement		
Currently In CIP						
University Lake Pump Station Improvements (270-11)	40,000-120,000					Engineering
Reduction of Inflow and Infiltration in Wastewater System (276-17 & 18)	NQ					Engineering
Building Envelope Rehabilitation (278-68)	TBD					Engineering
Cane Creek Raw Water Transmission Main (271-05)	TBD					Engineering
Cane Creek Pump Station Improvements (270-16)	138,000–227,000					Engineering
Off-Site Biosolids Mixing Project (TBD)	TBD					Engineering
Finished Water Pump Rehabilitation and Replacement (272-42)	TBD					Engineering
Implement and Evaluate						
Pilot pump monitoring tool on 2 pump stations	TBD		32	3	3	Sust/WWTP Ops/ Maintenance
Distribution System Pressure Zone Balance	TBD					Sustainability/ WTP Ops
Solar PV Lease at Cane Creek Reservoir and/or Biosolids Management Lane	460,000-600,000					Sustainability
Balance WWTP Odor Control System	TBD		40			WWTP Ops & Maintenance
Analysis of Operational Changes with Odor Control System	TBD		10			WWTP Ops & Sustainability
Increase level of Morgan Creek Wet Well	TBD					WWTP Ops & Maintenance
Expanded Use of Integrated Pump Optimization Tool	TBD					Sustainability and Operations
Pilot Fine Bubble Diffusion Technology	40,000 – 50,000					Engineering/Ops/ Sustainability
Water tank-mounted micro-wind turbine	8,000-45,000					Engineering/ Sustainability
Battery back-up analysis	TBD					Engineering

Fiscal Year 2020 Budget: In addition to what is budgeted for projects currently in the CIP, the following is requested in the FY20 budget to pursue evaluation and implementation of the strategies listed above:

- Technical Assistance and Consultants: \$40,000 for Odor Control System Balancing + \$10,000 for Odor Testing at Aeration Basins
- Operating Budget:
 - Admin: \$3,000 (Online Energy Dashboard) + \$42,000 (Design and First Year Lease Payments for solar PV system)
 - WTP: \$6,000 (Pump Optimization Tool)
 - WWTP: \$30,000 (Real-time nitrate and ORP probes) +\$32,000 (Lift Station Guardian)

Figure 4 shows our current progress towards Objective 1 and the estimated range of electrical use levels anticipated after implementation of proposed strategies (illustrated by the black outline).

Figure 4: Summary of Progress Towards Objective 1



The projects for which we can currently assign energy savings potential will likely get us very close to our energy objective, with two important caveats described below.

- 1) Meeting our goals requires successful implementation of a large scale (about a 400-500 kW) solar photovoltaic installation. Based on preliminary analysis, the 2018 EMP recommended the installation of an OWASA-financed 733 kW ground-mounted solar PV system at the Cane Creek Reservoir. Upon a more detailed analysis of the time-of-production versus our time-of-use rates, it was determined that too much energy would be generated (and subsequently sold or offset) at off-peak times (i.e. lower rates), thereby making the project financially unviable. Without this project, we expected to fall short of meeting our goal by 100,000 to 900,000 kWh/year.

In the last year, a lease program for smaller scale systems became available in our energy market at the scale at which we are interested. Under a solar lease, an approved third-party finances and

installs a solar PV system for the host party (OWASA). During the lease term, the third-party takes advantage of federal tax incentives, not available to non-profit and governmental organizations, which effectively brings down the price of the system for OWASA. Throughout the lease term, the third-party maintains the system and OWASA realizes the savings on our energy bill. At the end of the lease term, OWASA would have the option to purchase the solar PV system at fair-market value, or to extend or terminate the lease.

This program could be potentially economically viable for OWASA if the fair-market value is competitive and/or if the social cost of carbon is incorporated into the analysis.

Staff recommends that we issue a Request for Proposals for a solar lease for one or two sites: a small portion of cleared land at the Cane Creek Reservoir (400 kW) and/or the Biosolids Management Land (100 kW). If one or more proposals have the potential to provide a positive net present value within 20 years (with or without accounting for the social cost of carbon), staff will bring a summary and analysis of these proposals to the Board for approval before moving forward.

- 2) If the energy savings from the projects for which we can quantify savings are realized, we are likely to get very close to our goal. Moreover, there are many "TBD" projects identified for which it is too early to estimate and assign energy savings. Regardless, it is very unlikely that our energy reduction goal will not be met by the end of Calendar Year 2020. Given the timing of some of the larger Capital Improvement Projects with the greatest potential to reduce our use of electricity, achievement of our goal to reduce purchased electricity by 2020 will be delayed by about 2 years (end of 2022). Staff recommends adjusting our energy management goal to 2022.

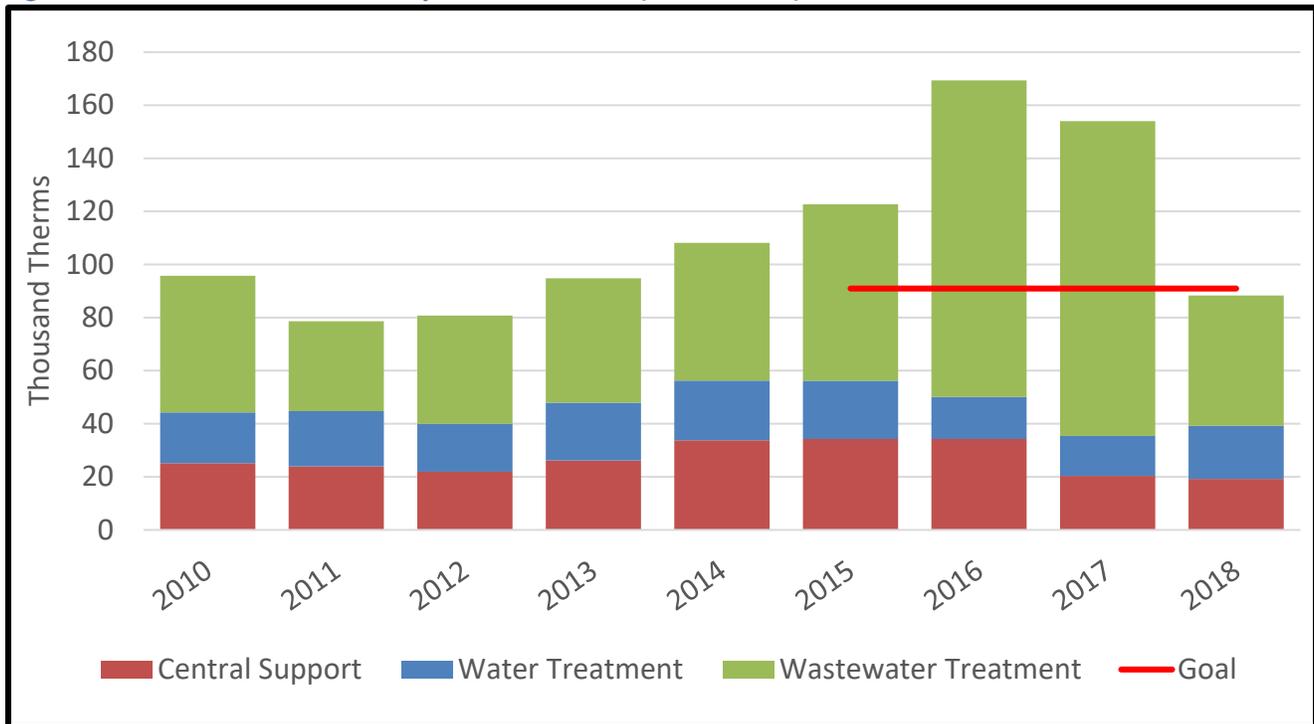
Objective 2 – ACHIEVED!

Reduce use of purchased natural gas by 5% by the end of Calendar Year 2020 compared to the Calendar Year 2010 baseline.

Trends in Natural Gas Use and Costs

Figure 5 shows historical natural gas use across the major functional areas, based on monthly billing data for our nine different natural gas accounts over the past nine years and how this use compares to our goal of reducing purchased natural gas by 5% from 2010 levels.

Figure 5: Purchased Natural Gas, by Functional Area (2010 – 2018)



In 2018, we surpassed our goal and used 8% less natural gas than in 2010. We anticipate using even less in 2019.

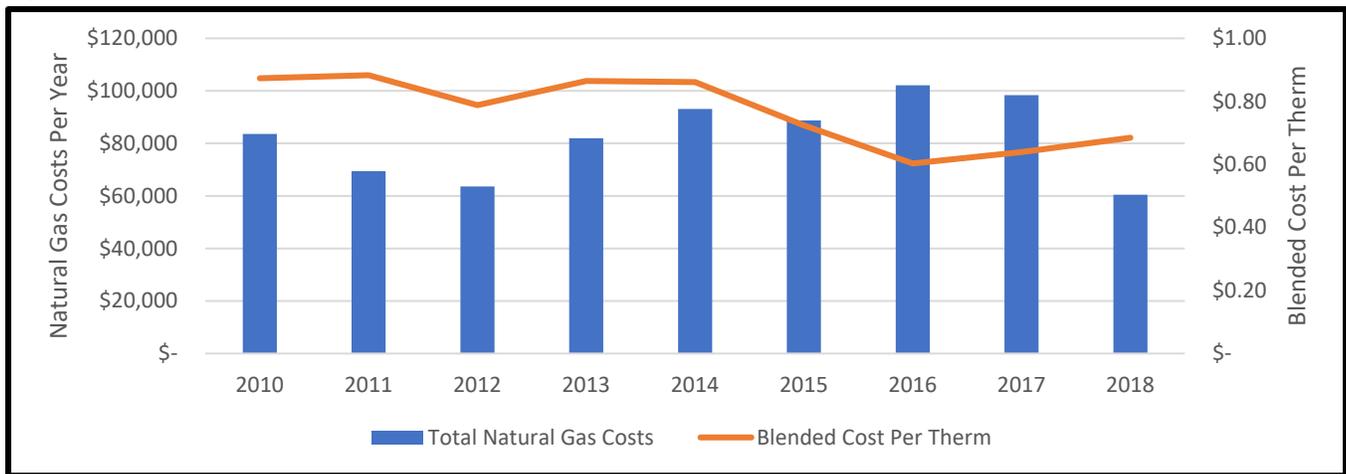
The primary driver for meeting this goal was bringing the biogas-to-boiler system back online at the Mason Farm WWTP, which has historically accounted for the largest amount of natural gas we use. Primarily natural gas is used mostly as a supplemental fuel for running the two boilers that heat anaerobic digesters for solids treatment. Methane – or biogas – is produced as a by-product of the digestion process, and under normal operations, is used as the primary fuel in our boilers at the plant. However, from 2015 through March 2018, we had to rely almost exclusively on natural gas to heat the boilers while two digesters and our gas storage unit were undergoing major rehabilitation. In restoring the biogas-to-boiler system in March 2018, we reduced our natural gas use at the WWTP by about 70,000 therms.

We also use natural gas for space and water heating at our 400 Jones Ferry Road campus. The new HVAC system in the Administration Building will significantly reduce our use of natural gas for space heating. Once fully commissioned, we expect that the system will result in a savings of 7-11,000 therms per year.

In other spaces, adjustments to thermostats, improvements to building insulation, and investment in high efficiency HVAC equipment is expected to further help reduce our use of natural gas.

Figure 7 summarizes trends in natural gas costs over the past nine years. **Our natural gas conservation resulted in about \$23,000 less in expenditures in Calendar Year 2018 than in 2010.** This conservation will be even more valuable to the organization if and when natural gas prices increase to the levels they were earlier in the decade.

Figure 7: OWASA’s Natural Gas Costs (2010 – 2018)



We are committed to sustaining our reduction in natural gas use and continuing to identify cost-effective opportunities to further decrease our use of natural gas, alongside a reduction in electricity use.

Objectives 3 and 4

Beneficially use all WWTP biogas by 2022, provided the preferred strategy is projected to have a positive payback within the expected useful life of the required equipment.

Formally engage local governments and partners in discussion about potential development of biogas-to-energy project at the Mason Farm WWTP.

Given financial uncertainties regarding analyzed options to beneficially use all WWTP biogas and the lingering potential for regional collaboration on a more economically feasible project, in 2018, the OWASA Board of Directors agreed to repair the biogas-to-boiler system, support complementary analysis of potential regional partners, and abandon a previously set goal to have a biogas-to-energy project completed by 2022. The following section summarizes updates from last year.

Repair the biogas-to-boiler system: Over the past year, OWASA staff focused on repairing and maintaining the biogas-to-boiler system, which is estimated to beneficially use about half of the methane-rich biogas generated at the WWTP. By restoring this system, we reduced our use of purchased natural gas by about 70,000 therms and our natural gas bill by about \$40,000 and reduced our greenhouse gas emissions by about 350 metric tons (equivalent to about 73 passenger vehicles driven for one year).

Support complementary analysis of potential partners

Town of Carrboro to use/purchase renewable compressed natural gas (rCNG): We have evaluated various options to convert all of the biogas generated at its WWTP into energy of various forms, including renewable compressed natural gas (rCNG) for vehicle fuel. We estimate that at current production rates, this biogas could be refined to generate about 125,000 diesel gallon equivalents (DGE) or about 140,000 gasoline gallon equivalents (GGE) of rCNG vehicle fuel each year.

OWASA has conducted a preliminary financial analysis to assess the viability of investing in the infrastructure required to convert and utilize the biogas generated as rCNG. On its side, OWASA considered the costs of a gas treatment system, a fueling station, tube trucking to mobilize the fuel, and the cost of converting and supporting a small CNG-fueled fleet.

Currently, there are outside funding opportunities to help recover the costs of this infrastructure. In fact, the economic viability of converting wastewater biogas into vehicle fuel by OWASA is driven heavily by the sale of Renewable Identification Numbers (RIN). A RIN is a tracking mechanism (and corresponding marketplace tool) established to help achieve the national renewable fuel standard. Currently, RIN values for vehicle fuel generated from cellulosic sources (such as wastewater) can be sold for a high value as a D3 fuel. Potential funding sources on the fleet conversion side include North Carolina's share of funds from the national settlement of the VW lawsuit and other federal grant programs.

Interestingly, the economics are more influenced by the sale of RINs than the gas itself. It is critical, for the viability of the project, to be able to use all of the gas, in order to sell associated RINS.

In recent years, OWASA's vehicle fleet uses much less vehicle fuel equivalents than could be produced by a biogas-to-rCNG fuel system at the Mason Farm WWTP. Our fleet would likely use only about 20% of the vehicle fuel produced by such a system. Therefore, it would be essential to partner with one or more other agencies that would be willing to purchase and use the excess rCNG for their own vehicle fleet, thereby enabling us to realize the full revenue potential from the sale of the associated RINs.

In the Summer of 2017, OWASA staff met with potential partners across the region to assess the interest and readiness to convert a fleet to CNG-powered vehicles and purchase rCNG from OWASA. The Town of Carrboro expressed an interest in evaluating alternative fleet fueling

strategies for the Town's entire fleet. On an annual basis, the Town of Carrboro uses about 83,000 gasoline gas equivalents to fuel vehicles. At the surface, this seemed a good fit.

In the summer of 2018, OWASA hosted an Environmental Finance Center Leaders in Environment and Finance (LEAF) Fellow; she conducted an analysis of the economic viability of the Town of Carrboro's potential fleet conversion to CNG-ready vehicles.

As a basic cost-benefit analysis filter, her analysis only evaluated vehicles for which the cost of conversion (even new vehicles must be upgraded to run off of CNG) would be recovered in fuel savings, based on their fuel-efficiency and number of miles driven. In other words, vehicles that are not driven a lot would not be converted because the cost of conversion would not be made up by fuel savings. The lower the cost of rCNG, the more vehicles that it makes sense to convert. For some vehicles that are driven very little, even at \$0.00 per GGE of rCNG, it did not make financial sense to pay the additional costs of vehicle conversion.

Although her analysis went on to consider the individual economic viability of fueling the Town of Carrboro's fleet, the fact that (a) it did not make sense to convert all of the Town's fleet to CNG-ready vehicles (even at \$0.00 per GGE) and (b) therefore, it could not utilize more than 61,000 gallons of rCNG per year, undercut the financial viability of the cost of generating a usable rCNG at the Mason Farm WWTP and the infrastructure required to refuel vehicles. In other words, because we could not sell all of the high-dollar RINS, the project was no longer economically viable for OWASA.

Support for Orange County Waste Reduction Plan: Some communities have increased the production of biogas by co-digesting other organic wastes at their wastewater plant digesters. Such a strategy increases the economic and/or environmental benefits of their biogas-to-energy project. Recognizing the potential benefits of such an approach, OWASA submitted a letter of support to Orange County Solid Waste Department for their Waste Reduction Plan. In the letter, OWASA expressed interest in working with Orange County to explore collaborative approaches to incorporating our digester facility into a regional organics recycling strategy. The County has not yet issued a Request for Proposals (RFP) for preparation of its Solid Waste Reduction Plan; however, we will closely follow the County's work and provide assistance in evaluating this and other opportunities for collaboration.

Other Updates: OWASA staff are in-discussions on the timing and scope of an update to a Wastewater Treatment Plant Master Plan. Biogas-to-energy, as well as FOG receiving and co-digestion strategies, will be an important consideration in any update to the Master Plan.

Although, there are no obvious paths forward at this time, we will continue our commitment to identify a cost-effective strategy to utilize 100% of the biogas generated at the WWTP. In the meantime, we will remain diligent in our efforts to utilize at least ½ of the gas in our boilers needed to heat the digesters.

Objective 5

Seek proposals for third-party development of renewable energy projects on OWASA property

After the OWASA Board of Directors set an objective to seek proposals for third-party development of renewable energy projects on OWASA property in 2015 (with solar in-mind), North Carolina legislators passed House Bill 589 (Session Law 2017-198). House Bill 589 significantly changed the regulatory framework and process for solar development in the state. Over the past year, the North Carolina Utilities Commission has worked with Duke Energy and other stakeholders to define the programs defined in the law. OWASA staff have tracked the development of these programs to assess their viability for OWASA. Below is a high-level summary of various program authorized under the law and their potential application, or lack-thereof, to OWASA.

- **Competitive Procurement for Renewable Energy:** The first of four “Tranches” of competitive proposals issued by Duke Energy for large-scale solar development are currently under-review. The winning bids are expected to be announced in late March 2019. Preliminary analysis suggests that the average cost proposed for such solar generation projects will be around 0.00673/kWh, which is much less than the “avoided cost” terms available through Duke Energy’s traditional Power Purchase Agreement that was in place in North Carolina. It appears that the scale that is needed to compete in the RFP process does not lend itself to small projects (<10 MW), like the kind that OWASA would likely be interested in pursuing.
- **Green Source Advantage (GSA):** GSA is designed to allow participants to offset some/all of their energy consumption with new renewable energy resources. Participants in GSA pay a monthly amount to support an offsite renewable energy facility and realize an equivalent amount of dollar savings on their energy bill. Unfortunately, the way that the program is structured, participants will spend more than they save for an indefinite amount of time. Participation in this program would be a sound economic investment for OWASA compared to other strategies for energy use reduction and/or carbon reduction strategies.
- **Solar Lease Program:** The law authorized a framework for small-scale solar generation project leasing. Given that OWASA is unable to take advantage of tax breaks for renewable energy project investments, this is potentially a viable option to mitigate the upfront costs of solar PV development. It allows another party to monetize the incentives of such a project. As discussed previously in this report, pursuit of this option has been integrated into our strategy to meet Objective 1.
- **Solar Rebates:** House Bill 589 provides for a \$0.75/watt rebate for solar energy projects, up to a maximum of \$75,000 for municipal/government customers like OWASA. This rebate can be integrated into a solar lease project and will be pursued by OWASA if and when a solar lease project is initiated.

As imagined, the large-scale public-private partnership upon which this objective was modeled is not currently a viable strategy in North Carolina. Moreover, in 2017, we worked with solar project developers about a large-scale solar project, but they were determined to be economically and technically unviable. The smaller scale solar lease option has been integrated into strategies for meeting Objective 1. Given this, OWASA staff recommend that we abandon this as a stand-alone objective.

Summary

OWASA's Energy Management Program is a comprehensive and inclusive approach to electricity and natural gas use across the organization. Through implementation of the program, we have realized and sustained energy use and greenhouse gas emission reductions.

In approving this update of the Energy Management Plan, the OWASA Board of Directors is specifically requested to approve:

1. Pursuit of implementation of energy management strategies at a cost of \$153,000 in FY20
 - a. \$42,000 of this request is allocated to the estimated upfront cost and one year of lease payments for two solar PV systems. If the RFP results in cost-effective proposals, staff will bring a summary back to the Board of Directors for approval.
2. Deadline extension of Objective 1 from 2020 to 2022
3. Integration of Objective 5 into Objective 1 and abandonment as a stand-alone objective

Background Resources

[OWASA's Strategic Plan](#) that identifies "Implementation of an Energy Management Program" as Strategic Initiative #4 (adopted on June 9, 2016)

[Baseline Assessment of Energy Use and Management Efforts and Potential Goals and Objectives for the Energy Management Plan](#) (approved by the OWASA Board on June 25, 2015) provides (a) a baseline assessment of OWASA's energy use; (b) an overview of energy management strategies to date; and (c) the following goals and objectives for Energy Management.

- Objective 1: Reduce use of purchased electricity by 35% by the end of Calendar Year 2020 compared to the Calendar Year 2010 baseline.
- Objective 2: Reduce use of purchased natural gas by 5% by the end of Calendar Year 2020 compared to the Calendar Year 2010 baseline.
- Objective 3: Beneficially use all WWTP biogas by 2022, provided the preferred strategy is projected to have a positive payback within the expected useful life of the required equipment.
- Objective 4: Formally engage local governments and partners in discussion about potential development of biogas-to-energy project at the Mason Farm WWTP.
- Objective 5: Seek proposals for third-party development of renewable energy projects on OWASA property.

[Revised Charter for Energy Management Plan](#) (approved to the OWASA Board on May 20, 2016) outlines a timeline and methodology for developing OWASA's Energy Management Plan.

[Energy Management Program and Project Evaluation Framework](#) (approved by the OWASA Board on September 8, 2016) summarize an approach to instituting an Energy Management Program at OWASA that objectively and sustainably meets goals and objectives. In addition, staff designed the program to:

- Foster a clean energy culture at OWAS through employee engagement and continuous improvement and innovation,
- Ensure strategic and prompt pursuit of clean energy opportunities, and
- Pursue cost-effective clean energy strategies

[Energy Management Program: Stakeholder Engagement Plan](#) (approved by the OWASA Board on September 8, 2016) outlines how to engage defined stakeholders in the implementation of the Energy Management Program, including reference to supplemental Community Engagement Plans for high-profile, community-oriented clean energy projects.

[Using a Social Cost of Carbon to Evaluate Clean Energy Projects: A Potential Policy Approach for OWASA](#) On September 8, 2016, the Board agreed to incorporate the social cost of carbon (SCC) in our business case evaluations of clean energy projects, and to base the economic value of carbon emission reductions on the Federal Interagency Social Cost of Carbon Working Group's central value for the SCC (2018 value of \$40 per metric ton of carbon dioxide emissions, at a 3% discount rate). The Board agreed that inclusion of the SCC in business case evaluations would influence, but not on its own propel the pursuit of a clean energy project. This provides a method for quantifying and engaging the community in a discussion about the willingness to pay for carbon emission reductions.

[2017 Energy Management Plan](#) was approved by the OWASA Board of Directors on April 13, 2017. This plan summarizes OWASA's Energy Management Program and the strategies proposed to meet the goals and objectives set by the OWASA Board of Directors.

[Update on Exploration of Potential Biogas-to-Energy Project Partnership Opportunities](#) (presented to NRTS Committee on September 26, 2017) provides an update on staff's efforts to further explore biogas-to-energy project partnership opportunities with technical staff from our local government partners.

[Potential Biogas-to-Energy Project Opportunities](#) (presented to NRTS Committee on December 5, 2017) provides an update of considerations and options for moving forward with a biogas-to-energy project at the Mason Farm Wastewater Treatment Plant, including case study information, an assessment of partnership potential, and staff commentary.

[2018 Energy Management Plan Update](#) was approved by the OWASA Board of Directors on March 8, 2018. This document provides an update of OWASA's energy use in our facilities and strategies proposed and underway to use energy more efficiently, use renewable energy sources, and reduce our greenhouse gas emissions.

Appendix A: Strategy Evaluation Summary

The following strategies were identified by OWASA staff and advisors as opportunities to reduce our use of purchased electricity and/or natural gas. Each strategy in the table is linked to an energy strategy summary in Appendix B.

After reviewing energy strategy summaries, the OWASA Energy Team met on March 6, 2019 to review, discuss, and prioritize each of the energy strategies. As reviewed, discussed, and accepted by the OWASA Board of Directors, the OWASA Energy Team evaluated each strategy qualitatively against the following six criteria (and guiding considerations). Each cell of the table below is color-coded to indicate whether a strategy is **favorable**, neutral, or **unfavorable** against each criterion.

1. Financially Responsible (High level)
 - a. Likely a good use of public funds
 - b. Financial viability of similar projects in similar organizations and circumstances
 - c. Opportunities for outside funding/financing
2. Realistic/Implementable
 - d. Degree to which the strategy has been proven at a scale relevant to our operation
 - e. Organizational capacity to undertake and manage the project
 - f. Reasonable amount of staff time to implement
3. Operational Impacts
 - g. Consistent with how OWASA wants to operate
 - h. Degree to which strategy helps to resolve an existing or expected problem
 - i. Impact on safety, comfort, and productivity
4. Energy/Carbon Reduction Potential
 - j. Potential to reduce OWASA's energy use and/or carbon emissions
5. Coordination with Other Projects
 - k. Interdependence with other project(s)
 - l. Potential to take advantage of economies of scale to save money and/or staff time
6. Community Impacts
 - m. Stakeholder enthusiasm
 - n. Coordination with community initiatives

Each Team Member provided a recommendation as how to best move forward with the strategy: **implement (1-4)**, **study (5-10)**, **defer until upgrade of related unit (11)**, or **defer indefinitely (none)**.

Energy Strategy	Financially Responsible (High level)	Realistic/Implementable	Operational Impacts	Energy/Carbon Reduction Potential	Coordinates with Other Projects	Community Impacts
1 Use of Lift Station Guardian at Two Wastewater Pump Stations	Modest cost	Relatively new technology from proven company; relatively easy to install	Calculates flow and can proactively predict pump failure	Potential energy savings from identification of less than ideal pumping conditions	Units are mobile, can be used to estimate inflow and infiltration	NA
2 Distribution System Water Balance Analysis	Modest requirement of staff time	Yes	Develops a KPI that can be tracked regularly	Potential energy savings from identification of wasteful pumping	Operational use of AMI data	NA
3 Issue Request for Solar Lease Proposals at Cane Creek Reservoir and/or Biosolids Management Sites	No up-front investment; during lease term, likely paying more for lease than savings; financial benefit comes once system purchased; risk if fair market value is not competitive	New program approved in North Carolina for this scale of solar development	Maintenance of PV systems covered in lease Minor complications of mowing in area	Significant impact on reducing purchased electricity (offset ~500,000-700,000 kWh/year; ~2-3% of baseline)	No	Represents a significant clean energy investment Potential concerns of neighbors regarding reflectivity

Energy Strategy		Financially Responsible (High level)	Realistic/ Implementable	Operational Impacts	Energy/Carbon Reduction Potential	Coordinates with Other Projects	Community Impacts
4	Recommission odor control system	Modest investment	Yes	Output will inform day-to-day operations of odor control system	As one of the largest energy-using systems at the WWTP, opportunity in optimization	Impacts processes throughout plant	No
5	Impact evaluation of operational changes with aeration basin odor scrubbers	Ultimately, minor marginal costs for large savings in energy	Potential political obstacles	Relatively none	Potentially large impact (up to 500,000 kWh/year)	Approaching time to replace filter media in carbon scrubbers dedicated to aeration basins	Large potential community backlash; opportunity for community conversation
6	Increase level of Morgan Creek wet well	Operational strategy that requires minimal upfront investment beyond monitors and controls	Has potential, but also some challenges, if it complicates operations at the Plant	Need to investigate ways to automate Morgan Creek wet well levels	To be determined – impacts significant energy using process at WWTP	No	Important to ensure that any adjustments do not cause objectionable off-site odors or sanitary sewer overflows
7	Expanded use of integrated pump optimization tool	If appropriate application, modest investment	Yes	Use of the right pump for the right flow condition can reduce pump wear and tear Better control of pump start/stop operations	Potential to reduce modest portion of the energy used for finished water pumping	Helpful in developing baseline prior to comprehensive pump station upgrade	No
8	PERLEMAX Harmonic Oscillator for Fine Bubble Diffusion	If effective, on the cusp of being financially responsible at the low-end of projected savings	Very new technology; unknown impact on critical process	Easy to turn off and on Potentially extends life of membranes Potentially complicates operations	If fully implemented, has the potential to reduce energy used by blower by 150,000 – 400,000 kWh (savings from improved aeration and avoiding turning on second blower)	No	No
9	Water tank-mounted micro-wind turbine	Low cost, but low impact, as well	Impact unknown; new technology	None	Modest unique energy generation opportunity (~15,000 kWh/year per turbine)	No	No
10	Use of batteries to improve system resilience, reduce energy costs, and utilize renewable energy	Unknown; cost of batteries has come down and are expected to continue to decline	Rapidly changing environment and new approach to back-up power supply Uncertain interconnection environment	Potential to avoid deploying mobile generators when power is out	If partnered with renewable energy, has the potential to reduce energy use Otherwise, more of an energy optimization project	Initial analysis could be incorporated into generator fuel study planned for FY21	Yes, would temporarily reduce noise associated with generators
11	Hyperboloid mixer in onsite biosolids tank	High-cost, not likely recovered by energy savings alone	Yes	Current mixing technology is not effective and creates issues with screw press thickener	Energy saving potential in recent analysis is likely inflated; however, it would result in measurable energy savings	No	No

Appendix B: Energy Management Summaries – 2019 Update

Energy Management Strategies Recently Completed

Administration Building Heating, Ventilation, and Air Conditioning (HVAC) System Upgrade (280-06): This project will be completed in Spring 2019. Once completed, it is projected to reduce energy use in the Administration Building by about 200,000 kWh per year (~1% of our baseline), 11 kW in electric demand, and 7,000 -12,000 therms of natural gas use per year (~7-13% of our 2010 baseline). We applied for a Custom Energy Efficiency Incentive from Duke Energy and were offered a \$14,000 upon completion.

High Performance SCADA System at Wastewater Treatment Plant (278-73): We are currently finalizing this project. Among other things, this project allows us to generate reports and dashboards for many different factors, including energy use, and will help us better understand and manage energy use at the wastewater treatment plant. Based on our experience at Mason Farm, we will consider the development of a similar system at the Jones Ferry Road Water Treatment.

LED Lighting Retrofit (280-12): In early 2018, we retrofitted approximately 1,500 light fixtures on the 400 Jones Ferry Road campus (Admin Building, Water Treatment Plant, and Operations Center). We also finished retrofitting the laboratory at the Mason Farm WWTP and various pump stations across the service area with LED lighting. We project that these retrofits will save a combined total of about 250,000 kWh/year. The total lighting retrofit on the Jones Ferry campus cost \$120,000, but we received a Duke Energy incentive that brought the final cost down to \$65,000. Ultimately, this project has a net present value of +\$90,000 over the thirteen-year life of the lights (~\$120,000, if accounting for the social cost of carbon).

Pump Training Course: In July 2018, a pump expert from the Department of Energy taught a two-day course on pumping system assessment. This workshop provides an in-depth discussion of energy efficiency factors for pumping systems, with an emphasis on considering the system instead of just individual components. Seventeen OWASA staff members (operators, maintenance, engineers, managers, and directors) participated in the training that used OWASA pump systems as course examples. The cost of the course was covered by the NC State University Industrial Assessment Center; NCSU students participated, as well.

Electricity Sub-Metering: We are sub-metering some of our largest energy using processes at both Plants, including the Finished Water Pump Station (WTP), Backwash Pump (WTP), Aeration Basin Blowers (WWTP), and the Reclaimed Water Pump Station (WWTP). The data from these sub-meters are incorporated into the SCADA dashboard, so that operators can analyze trends in energy use and incorporate those trends into real-time decision-making and plant process simulation models. Additionally, these data are archived for subsequent in-depth analysis.

Online OWASA Energy Dashboard: In 2018, we partnered with Facility Dude's, a private company, to implement its Energy Manager online database and dashboard for OWASA's energy bills. By putting this data into a database that is accessible by OWASA staff, we can better track, trend, and understand our energy use. For example, last summer (2018), we

noticed that energy use at the Calvander Finished Water Pump Station had almost doubled (from 7,500 kWh/month to 14,500 kWh/month). Triggered by this dramatic increase in energy use, our maintenance team investigated and found that a check valve was sticking, causing the pumps to work much harder than necessary. Fixing the problem in a timely manner prevented energy waste and helped to protect the health of the pump. On a smaller scale, in monitoring energy use data at the Cane Creek Reservoir, we identified that a heater in an on-site well pump house was constantly running and driving up energy use and cost.

Optimize WWTP Filter Backwash: We have six denitrification filters at the Mason Farm Wastewater Treatment Plant that require backwashing to remove solids that accumulate on the filters and reduce filter performance. We use two 50-horsepower pumps (installed in 2005) to backwash the filters, but only one runs at a time. We also use two air blowers (at 100 and 150 hp each). We backwash filters based on time.

In 2018, we reduced the number of backwashes from 14 times per week to 10 times per week with no measurable adverse impact to solids concentrations in our effluent. We estimate that this operational change reduced energy use of the system by about 15,000 kWh/year.

Controls on Headworks Conveyor System (WWTP): When wastewater enters the WWTP, large debris and grit are removed from the influent and conveyed into dumpsters. Currently, the conveyor is controlled by a timer. During a walk-through conducted as part of the US Department of Energy's In-Plant Energy Management Training at the WWTP in May 2017, it was observed that the conveyor was running even though no debris or grit was on it. Based on the horsepower and run-time of the system, the existing system is only estimated to use about 28,000 kWh/year. We recently installed paddles to reduce the time that the conveyors are running with nothing on them. Assuming it reduces the time the conveyor runs by about 25 percent, this strategy will save about 7,000 kWh/year.

Advanced Metering Infrastructure – Early Leak Detection: Throughout 2018, OWASA upgraded most all water meters in the service area with Advanced Metering Infrastructure. The hourly water use data reported back to OWASA on a daily basis is extremely effective at detecting leaks. In 2016, the Residential End Uses of Water Survey estimated that 12% of household water use is lost to leaks. In 2018, OWASA residential customers used over 815 million gallons of water. With an energy use intensity of 2,377 kWh/MG for water supply, saving 12% of 815 million gallons could result in over 200,000 kWh of savings per year. This does not include the additional savings in wastewater treatment for leaks into wastewater system (e.g. toilet leaks).

While it is too early to quantify the benefit of early leak detection to OWASA customers, this investment will no doubt have a positive impact on OWASA's electricity use.

Energy Management Projects Underway

Pump and Motor Asset Management Program: OWASA uses most of its energy running pumps and motors. Therefore, optimization of pump and motor operations, maintenance, and repair and replacement decisions has a significant potential to reduce energy use at OWASA. OWASA's asset management program includes more than 350 motors and 350 pumps, with the largest being the 700 horsepower pumps at the Cane Creek Reservoir raw water pump station.

OWASA staff researched different approaches and strategies for monitoring and using energy use information to inform how our pumps and motors can be operated in a more energy efficient manner, as well when and how they are maintained and replaced. This analysis has led to the pump and motor management strategies that are underway.

Pilot of Pump Optimization Tool at Finished Water Pump Station: In 2018, we launched the application of a dynamic pump optimization tool that provides real-time information on the actual and potential specific energy (kWh/MG) of running one or more finished water pumps. The tool also assesses real-time pump performance (against the pump curve) and calculates a financial analysis on repair/replacement value for each pump based potential energy savings. The Water Treatment Plant Operators are currently using this system in advisory mode, however, there is the option to run it in automatic mode, where it selects the most efficient level at which to operate the pump station.

Our finished water flows are relatively consistent and not very dynamic. Ultimately, the tool has revealed the fact that there is one pump that is efficient at typical flows. (An exception being when it was first launched, and we were supplying water to Durham. The tool informed us that in using Pumps 4 and 7 to meet Durham’s concurrent needs, we would use about 70 kWh LESS per million gallons pumped. In making this change, we saved an estimated 15,000 kWh over the final two weeks that we supplied water to Durham.) Despite this experience, the tool has had limited value in “normal” day-to-day decision-making at this particular pump station, as currently designed, from an energy management perspective.

However, the tool has been a resource in the current evaluation of the pump station, helping to inform the value of VFDs and pumping configurations. We will keep this too in service through the pump station upgrade (CIP Project No. 272-42).

Motor Management Program: OWASA has engaged Advanced Energy to assist in developing a complete inventory of our motor fleet and conducting a comprehensive cost-benefit analysis of repair and replace decisions. OWASA will use the results of this analysis to inform more formal repair versus replacement rules. In addition, Advanced Energy will provide motor management training to staff from maintenance, engineering, purchasing, management, and plant operations.

Pump Station Operational Assessments: It is difficult to apply broad design specifications to pump stations. The design, hydraulics, and operating environment must be considered on an individual basis to determine if and how improvements (i.e. structural, safety, energy, mechanical, electrical, etc.) can be made.

OWASA has engaged Kimley-Horn to evaluate operations at twelve wastewater pump stations. Each pump station evaluation will include pump performance testing, condition assessment, and energy usage analysis. Kimley-Horn will develop a report for each pump station that provides recommendations on efficient operations and asset condition. The following stations will be evaluated as part of this project.

Pump Station Name	Annual Energy Use (kWh)	Number of Associated Pump	Total Associated horsepower

Rogerson Drive	750,000	4	800
Morgan Creek	580,000	4	400
Reclaimed Water	550,000	4	650
NSL	440,000	4	300
Intermediate Pump Stations #1 and #2	400,000	6	330
Non-Potable Water	92,000	3	75
Countryside	67,000	2	68
Lake Ellen	41,000	2	60
Eastowne	28,000	2	100
Knolls	25,000	2	60
Meadowmont #1	22,000	2	30

Energy saving opportunities that are identified in the assessments will vary due to size, pump and motor characteristics and condition, volumes pumped, etc.

Wastewater Treatment Plant Non-Potable Water (NPW) Conservation: Non-potable water (i.e. wastewater treatment plant effluent) is re-used throughout the Mason Farm WWTP for various processes that require water. The current non-potable water system provides process water throughout the plant and runs underground. While we have metered total NPW use for a little over a year (we use about 360,000 gallons of non-potable water use per day), we do not meter it on a process level. We anticipate a 30% reduction in NPW energy use from the new pumps and the NPW water use reduction from the new rotary drum presses for solids, taking energy use from the system from about 11,500 kWh per month to 8,000 kWh per month for an annual savings of about 40,000 kWh. Assuming water conservation could reduce pump run time by 25 percent, the energy use of this system could be reduced another 24,000 kWh per year.

The proposed next steps for this project are:

- Meter NPW use throughout the plant to help quantify the amount of water lost to leaks (cost to meter individual systems throughout the plant)
- Audit NPW water uses for water conservation opportunities (cost to audit the water system and repair)

This project has been delayed a year. We anticipate installing the meters in FY20. However, it will be difficult to get a full picture of NPW system energy and water use until after the Solids Thickening Improvement Project is complete in 2021.

HVAC Energy Efficient Upgrade of Equipment Greater than 15 Years Old: A 2016 Energy Assessment of OWASA’s HVAC Equipment conducted by Advanced Energy recommended that OWASA replace cooling units at the end of their rated service life (15 years) with high efficiency units. High efficiency cooling units have features such as advanced controls, larger heat transfer surfaces, and electronically commutated (EC) motors. They also use significantly less energy than their standard efficiency counterparts. Although high efficiency units (equal to or greater than 15 SEER) cost more than standard efficiency, Advanced Energy calculated the average payback of the additional cost to be 2.35 years without considering the social cost of carbon, and 1.9 years with accounting for the social cost of carbon.

In the past, we have operated smaller HVAC units until it was not functioning well and could not cost-effectively be repaired (i.e. run to failure). Our strategy accelerates replacement in order to achieve energy savings. By planning ahead, we can spend the time to research the most cost-effective equipment with the highest sensible energy rating.

The following equipment is expected to be replaced, as part of this and other CIP projects.

Location	HVAC Unit	Estimated Energy Savings (kWh/yr)	Associated Project	
WTP	Belt Press S. Electric Room	8,000	WTP Belt Filter Press Replacement (272-37)	
WTP	Belt Press N. Electric Room	8,000		
WTP	Thickened Solids Pump Station	2,500	WTP Sedimentation Basin Rehabilitation (272-38)	
Ops	Vehicle Maintenance Office	300	HVAC Replacement Program (272-51)	
Ops	Operations Building	17,000		
Ops	Maintenance Office	1,000		
Ops	Maintenance Meter Shop	500		
WWTP	Switchgear Building	20,000		
WWTP	Laboratory	27,000		
WWTP	Screen Headworks	10,00		
WWTP	Filter Building	25,000		
WWTP	IPS #1	1,000		WWTP Intermediate Pump Station Rehabilitation (278-54)
WWTP	IPS #2	25,000		
Total		135,300 kWh/year		

UV System Energy Assessment (WWTP): The UV Disinfection System at the Wastewater Treatment Plant is estimated to use about 5% of the annual electrical energy use at the WWTP (about 400,000 kWh per year). Currently, our UV banks are flow-paced (banks and lamps turn on and off, depending on the flow), and we use high-efficiency light bulbs. Although we are measuring the transmissivity of the water, it is not directly being used to control the system. If we can incorporate a real-time transmittance information and control system, we could potentially turn down the UV system light intensity automatically when it is not demanded by the water quality. Additional investigation is needed to determine if this is possible and cost-effective given our existing UV system.

Wastewater treatment plant maintenance staff are bringing in the manufacturer of the UV System (WEDECO) for 4 days of maintenance and training in the Spring or Summer of 2019. We are requesting that energy management be incorporated into this discussion and analysis be conducted on the energy savings potential of a change in operations and maintenance of the UV system.

The City of Grand Rapids, Michigan moved from an exclusively flow-paced UV disinfection system to one that incorporated real-time monitoring of % ultraviolet transmittance (%UTV) and light intensity. They reduced energy use of the system by 65%. A 65% reduction in the amount of energy that we use for UV disinfection would reduce energy use at our WWTP by an estimated 210,000 kWh per year, but we don't yet know if we could achieve this level of savings.

Partnership for Clean Water Self-Assessment: In 2019, OWASA staff will conduct an in-depth self-assessment in pursuit of the Partnership for Clean Water at the WWTP. The self-assessment will involve detailed review of unit processes, including energy use intensity. It is anticipated that through this self-assessment staff will identify low to no-cost opportunities to optimize operations and reduce energy use.

Utility Participant in Water Research Foundation Research Project on “Application of Big Data for Energy Management in Water Utilities”: OWASA volunteered to serve as a utility participant on a Water Research Foundation (WRF) project to research how to better understand how big data can be successfully utilized to manage and optimize current energy management schemes in water and wastewater utilities. The project is being funded by WRF, a national organization of which OWASA is a member. In volunteering to engage with the team that is awarded the funding, we hope to glean lessons learned from leaders inside and outside the utility industry on how we can better use our energy data to optimize our energy use and energy-using equipment.

Finished Water Pump Rehabilitation and Replacement (272-42) AECOM is conducting an operational assessment of the finished water pumping systems. This will include a review of recent SCADA records and the recently installed pump optimization tool (Specific Energy) to identify, evaluate, and quantify the near- and long-term energy efficiency and conservation opportunities of the entire finished water pump station and associated processes, operations, and equipment. Prior water distribution system hydraulic model calibration/development work by AECOM indicated undefined pressure head restrictions in the mains around the WTP that AECOM will investigate as part of this assessment.

Real-Time Nitrification Control System (WWTP): Although we have achieved great energy efficiency in our aeration system at the Mason Farm WWTP, this process still uses about 25% of the electricity used at the Plant (approximately 1.6 million kWh per year). Energy is used to power blowers in aerated basins that help to reduce nutrients and organic matter in the water; mixers run in all basins to maintain an environment that supports the necessary biology. The aeration system is run to maintain dissolved oxygen concentrations at optimum levels for the biological treatment process. By optimizing the biological treatment process and aeration system, wastewater treatment utilities can reduce energy and chemical use while improving treatment performance.

In 2019, we will install real-time nitrate and ORP (oxidation reduction potential) probes that will help us optimize the biological treatment process and aeration system. We will install two

probes at the back-end of the process. If these prove valuable in optimizing operations, we will consider installing more probes. The data will be integrated into the SCADA system and will allow for real-time “dialing” of blowers and mixers. The system is expected to cost \$30,000.

Projects Currently in the CIP Identified with Potential to Reduce Energy Use

University Lake Pump Station Improvements (270-11): Historically, the energy use intensity (kWh used to pump a million gallon of water) to pump raw water has been lower for the Cane Creek Pump Station, despite being almost 10 miles further from the Jones Ferry Road Water Treatment Plant. This project will replace three of the existing four, old raw water pumps at University Lake with two efficient pumps with VFDs. The VFDs will help achieve energy savings across a wide range of flows and eliminate the need for energy-wasting throttle valves.

Ultimately, this upgrade will give us higher efficiency at flow rates greater than 3 MGD (when we would be using one of the larger pumps). Moreover, it increases our flexibility to decrease energy intensity of raw water pumping.

Estimated energy savings: 40,000-120,000 kWh/year (depending on flow rates from University Lake)

Reduction of Inflow and Infiltration (I&I) in Wastewater Collection System (276-57): We have begun a sewer modeling project in which we are installing flow monitors and rain gauges throughout the collection system to better quantify the amount of I&I in our system. This information will help inform and prioritize collection system repair and replacement projects with the goal to reduce I&I. It is difficult to quantify the energy impact of this project.

Building Envelope Rehabilitation (278-68): This project includes the rehabilitation of building envelope systems (roofs, walls, windows, etc.) at a prioritized set of OWASA’s buildings and structures as recommended by a FY 2017 condition assessment. This project has the potential to reduce heating and cooling load on the impacted buildings. Impacts on energy use will be incorporated into decision-making for these projects.

Cane Creek Raw Water Transmission Main Capacity Study (271-05): In advance of the planned upgrade of the Cane Creek Pump Station, the Capital Improvement Program (CIP) includes a project in FY19 to evaluate the friction coefficient of the existing 24-inch diameter raw water main from the Cane Creek Reservoir to the Quarry Reservoir. This test will help determine if the main needs to be cleaned to restore its designed carrying capacity. This study and any related follow-up work are planned to be completed prior to initiation of design on the pump station improvements.

Additionally, the 2017 Energy Management Plan evaluated in-pipeline turbines for hydropower generation and recommended that pursuit of this specific strategy be “delayed until upgrade”. This Main Capacity Study is an opportunity to consider current technology and infrastructure upgrades that could be viable for generating in-line hydropower in the raw water transmission line. It has been estimated by previous studies that there is enough flow and fall from Cane Creek Raw Water Main to the head of the Jones Ferry Road Water Treatment Plant to generate about 250,000 kWh/year.

Cane Creek Pump Station Improvements (270-16): Funds are included in the CIP for adding automatic generator transfer switchgear, building a permanent enclosure for the generator, and installing variable frequency drives (VFD) on the two 700 horse power (dual speed) pumps. An analysis conducted by the NC State University Industrial Assessment Center estimated that the installation of VFDs at the Cane Creek Pump Station could result in a savings of 138,000 – 227,000 kWh per year. In addition, early on in our design review process, we will evaluate the potential to incorporate the integration of battery storage and renewable energy strategies for extended back-up generation into early design reviews.

This project, combined with the University Lake Pump Station Improvements, has the potential to significantly reduce our energy use for raw water pumping.

Off-Site Biosolids Mixing Project (TBD): Use of our off-site biosolids storage tanks has increased significantly over the past few years, as we work to meet our goal of applying 75% of our biosolids directly to agricultural land as a liquid. The off-site storage tanks serve as a buffer and help us to manage biosolids volumes when conditions (such as weather) do not allow us to apply biosolids directly to farmland. In 2018, we used 500,000 kWh to load, unload, and mix biosolids at the off-site storage facility. That was twelve times more energy than we used at this facility in 2010.

The FY20 Capital Improvement Plan will propose funding for an analysis of mixing alternatives for the off-site storage tanks. This request is primarily driven by the need to improve the effectiveness of mixing in the storage tanks; however it has the added potential benefit of improving the efficiency of mixing.

Energy Management Strategies to Pursue and Evaluate

- 1. Use of Specific Energy's Lift Station Guardian Software-as-a-Service at Two Wastewater Pump Stations:** The Lift Station Guardian (LSG) is a related product to the pump optimization tool (Specific Energy) piloted at the Jones Ferry Road WTP Finished Water Pump Station. This product is similar to the pump optimization tool because it conducts pump performance analysis (monthly rather than daily) and provides recommendations on when the cost of pump repair or replacement is less than energy savings. LSG conducts high resolution monitoring of lift station behavior to track pump health and support preventative maintenance decisions. Our current practice is to run a pump to failure provided we have pumping system redundancy. This can be a challenge under current situations where it may take up to 16 weeks to replace a pump. Knowing ahead of time when a pump might fail could help us get ahead of this.

The Lift Station Guardian calculates flow. Because wastewater flow is more difficult to measure, the Lift Station Guardian utilizes a method to calculate flow from the tank shape. These interval flow calculations would be valuable in tracking inflow and infiltration. The tool can also be configured to provide alerts to maintenance and operations staff with amperage is high given the flow, an indication the pump may need to be unclogged. In sum, there are likely more operational benefits to this technology than energy savings, but it is all integrated.

This technology could be valuable at lift stations that do not have flow meters and/or have historic issues with inflow and infiltration. From an energy perspective, the larger (i.e. more energy intensive) candidates would be the Lake Ellen³, Heritage Hills, Countryside, Knolls and Eastowne Pump Stations. According to Specific Energy, the data has the potential to be integrated into the Ignition SCADA system. The Lift Station Guardian unit is mobile and can be removed and reinstalled at another pump station.

The Mustang Special Utility District in Aubrey, Texas has installed the LGS on 20 lift stations. They are primarily using it in lieu of a typical PLC. They can get a unit installed in about 4 hours.

The Energy Team (with the support of the Wastewater Treatment and Biosolids Recycling Manager) recommends the purchase and use of one unit at a wastewater collection pump station and one unit at an in-plant pump station.

Initial costs are about \$14,000 per unit plus \$1,500 in annual fee. The total cost of this pilot would be about \$32,000 for installation and \$3,000 ongoing costs, which could be discontinued at any time, if the system was deemed ineffective. Units are mobile and could be moved between pump stations, which could be helpful in estimating inflow and infiltration at other pump stations.

- 2. Conduct water balance between drinking water distribution system pressure zones:** OWASA has two pressure zones in its distribution system: the 740 (elevation) zone and the 642 zone. All of the water in the 740 pressure zone is “imported” from the 640 pressure zone. There are isolation valves between the two systems that should be closed on a regular basis but can be opened if needed to release water from the 740 zone to the 642 zone. With AMI data, we can now conduct a mass balance analysis to determine if all of the water pumped into the 740 zone is “consumed” in the 740 zone, or if there is the potential that water is “leaking” back into the 640 zone. Leaking water equates to wasted energy to pump the water into the 740 zone.

The proposed strategy is to conduct and establish an ongoing analysis to determine if this occurring. It is anticipated that this analysis can be conducted by staff, with the assistance of a summer intern.

- 3. Issue Request for Solar Lease Proposals at Cane Creek Reservoir and/or Biosolids Management Land:** OWASA’s 2018 Energy Management Plan Update recommended the installation of an OWASA-financed ground-mount solar system at the Cane Creek Reservoir. The project was projected to be economically viable when using the blended average cost of electricity (\$0.068/kWh). However, a more detailed, follow-on financial analysis that aligned the time-of-solar production with time-of-use tariffs charged to the Cane Creek Pump Station determined that the average avoided cost of energy produced by the solar system would be closer to \$0.044/kWh. This destroyed the economics for an OWASA-financed solar PV System. Under current electricity rates, successful development of a solar PV project will require partnership with a private third party that can take advantage of federal tax credits and incentives.

In 2017, North Carolina passed the Competitive Energy Solutions for NC (HB 589) bill. This new law authorized various programs identified to advance solar development in the state. Over the last

³ Lake Ellen pumps are the oldest pumps listed (circa 2005).

year, the Utilities Commission has been working with Duke Energy and other stakeholders to define the specific parameters of those programs.

One potentially viable solar program for OWASA purposes is a solar lease. Under a solar lease, an approved third-party finance and installs a solar PV system for use by another party, such as OWASA. During the lease term, the third-party takes advantage of federal tax incentives, which are not available to non-profit and governmental organizations, which effectively brings down the price of the system. Throughout the lease term, the third-party maintains the system, and OWASA realizes savings on our energy bill while reducing its use of electricity produced by fossil fuels.

At the end of the lease term, OWASA could (a) purchase the system at fair market value determined at time of purchase; (b) upgrade system and sign new lease term; or (c) remove system at no cost. It is unlikely that, during the lease term, the energy savings will exceed the annual lease payment. This arrangement is likely to result in a positive cash flow once the system is purchased back from the lessor, assuming the fair market value is competitive. If OWASA was not ready to purchase the system at the determined fair market value, it would be in the interest of the lessor to negotiate a competitive lease agreement, as the system would have little value to them upon removal.

Currently, there are two companies approved by the NC Utilities Commission to offer solar leases: Duke Energy and Eagle Solar and Light. With the consult of the National Renewable Energy Laboratories and solar developers, OWASA staff have identified two potential sites to install a ground-mount solar PV system: at the Cane Creek Reservoir Site and on a portion of Field 1 on the biosolids management site.

Preliminary analysis shows that the Cane Creek Reservoir could support a 400-kW ground-mount solar system and that the Biosolids Management Site could support a 100-kW system, which would offset a combined total of about 460,000-600,000 kWh/year (about 2-3% of the baseline) with an estimated lease payment of \$27,000 - \$38,000/year. As stated before, these systems would likely not result in positive cash flow during the lease term. However, when taking into account the social cost of carbon and/or a competitive buy-back cost (or releasing agreement), both systems are economically viable (i.e. positive net present value within 20 years).

The Energy Team recommends that we move forward with issuing a Request for Proposals for a lease agreement for a ground-mount solar PV system at the Cane Creek Reservoir and Biosolids Management Sites. If at least one of the proposals is economically viable, staff will submit information on the viable proposal(s) to the OWASA Board of Directors for approval.

For planning purposes, we are requesting a budget placeholder of \$42,000 for FY20 based on a preliminary analysis of a solar lease agreement.

- 4. Recommission odor control system (WWTP):** The Mason Farm WWTP has multiple odor control systems located throughout the plant. Air from various processes in the plant are pumped to chemical and dry media scrubbers. The odor control system is estimated to use approximately 900,000 kWh per year. In 2018, Hazen and Sawyer conducted a high-level balancing assessment of the odor control system that included a review of duct sizing, air intakes, and the ability to appropriately balance the system. As a follow-on, it was recommended that OWASA conduct a recommissioning of its odor control system to ensure that there is balance in the system. This process would help ensure that the odor control system is working as efficiently and effectively, as

possible. It could also inform settings for changes in operations, to help maintain balance in the system. The potential energy savings that could be realized from commissioning the odor control system are uncertain, but as one of the largest energy-using systems at the WWTP, fine-tuning odor control operations has great potential. The cost of this service is estimated to be about \$40,000.

- 5. Impact and cost evaluation of operational changes with aeration basin odor scrubbers (WWTP):** There is potential value in reassessing the costs and benefits of how the dry media scrubber system for the aeration basins are operated. This system, alone, is estimated to use about 500,000 kWh/year. It is an opportune time to assess the costs/benefits, as it is nearing the time to replace the carbon in the filters (about \$50,000 project).

The odor control system was designed to treat the air from all aerated cells, as well as the nitrified sludge (NSL) basins. However, about two years ago, plant staff adjusted how the aeration basins are operated, and began aerating two uncovered cells – without a significant change in observed odors by staff or odor complaints from neighbors.

The Energy Team recommends, due the significant contribution of this system to the Plant’s energy use, an analysis of the value of the current level of operation of the odor system for these basins. The Team does not make this recommendation lightly, knowing the requirements of the Plant’s Special Use Permit from the Town of Chapel Hill to receive no odor complaints. Nonetheless, it seems a timely and worthy consideration to evaluate the impact and costs of current operations. If analysis identified a modified schedule/mode of operations is technically feasible, the next step would be to engage neighbors and stakeholders in a discussion on the costs-and-benefits, perhaps accompanied by a blind study.

The initial step proposed is to conduct an odor assessment (estimated cost \$10,000). Additionally, operation of the carbon scrubbers on the aeration basins will be incorporated into the odor control system recommissioning.

- 6. Increase operating level of Morgan Creek Pump Station Wet Well (WWTP):** We currently keep the Morgan Creek Wet Well at an elevation of about 3.2 feet. Based on horsepower and run-time, we estimate that the Morgan Creek Pump Station uses about 933,000 kWh per year. Running the system with higher wet well levels would decrease static head in the system and reduce the amount of energy required to pump influent into the plant (given that we have VFDs on these pumps).

The Morgan Creek Pump Station is one of the twelve pump stations that will be evaluated in the Pump Station Evaluation Project. From that analysis, staff will calculate the energy benefits associated with running the wet well higher, and compare that against the operational risk. The Energy Team recommends that analysis be factored into consideration of running the wet well at higher levels.

- 7. Expanded use of integrated pump optimization tool ([Specific Energy Dynamic Pump Optimization Software-As-Service](#)):** In 2018, we launched the application of a dynamic pump optimization tool

that provides real-time information on the actual and potential specific energy (kWh/MG) of running one or more finished water pumps. The tool also assesses real-time pump performance (against the pump curve) and calculates a financial analysis on repair/replacement value for each pump based potential energy savings.

Ultimately, installing the Dynamic Pump Optimization Tool on the Finished Water Pump Station cost \$16,500 in set up fees (\$7,500 for the tool and \$9,000 for system integration) and \$6,075 in an annual license. Fees are based on connected horsepower and whether or not there is a VFD. Now that the initial station has been integrated, we anticipate that CITI costs will be lower for set-up.

Although the tool has provided useful information as to the operations of the Finished Water Pump Station, our experience with the tool has shown that, for day-to-day conservation, it would likely result in more energy savings if installed on a pump station with more variable flows and pump options. Potential applications include: University Lake Pump Station (once upgraded with new pumps and VFDs), Reclaimed Water Pump Station, and/or Rogerson Drive Pump Station. We do anticipate that the use of the tool will be valuable in projecting the energy savings potential in the Finished Water Pumping Study and operating the pump station post-upgrade. If this proves true, it could be a valuable resource to install on pump stations prior to a significant upgrade. Moreover, the tool is also a valuable resource in informing prescriptive maintenance. It calculates when the value of repair or replacement (from an energy perspective) exceeds the cost.

The Energy Team recommends that we continue to consider the use of this tool with other pump stations, in particular the University Lake Pump Station once upgrades are completed.

- 8. PERLEMAX Harmonic Oscillator for Fine Bubble Diffusion (WWTP):** This patented technology decreases the size of bubbles produced by fine bubble diffusion in order to increase Oxygen Transfer Rate. The unit requires two drop legs of approximately equal demand (+/- 50%). The air oscillates between the two sides at a rate faster than the bubbles of the fine bubble diffuser naturally form, thereby causing smaller diameter bubbles. The decrease in bubble size leads to an increase in surface area for oxygen transfer into the water. There is an increase in pressure on the header from the oscillator but the increased energy usage resulting from the higher pressure is more than offset by the decrease in the aeration energy requirements to meet oxygen demand in the system.

The current configuration of the aeration basins has two aerated cells next to each other fed from the main header. This is reportedly ideal for the geometry of the PERLEMAX unit. The system would be installed in such a way that it can be isolated and the existing aeration process returned to pre-oscillator installation configuration by closing a pair of isolation valves at each drop leg. The near-term intention is to install a single oscillator as a pilot-scale test and proof of concept.

The first installation will resolve conflicts with header design and may require some field fabrication of piping. However, the final configuration should be replicable to the two other sets of aeration drops. Once installed on all three pairs of aerated cells, the plant should see a noticeable reduction in aeration demand, and a reduction in the amount of time that a second blower is required to be in service. The second blower may be required only during those times when flows or oxygen demands are abnormally high.

The system is estimated to cost about \$60,000 - \$80,000 per unit for a total cost of about \$180,000 - \$240,000 for the existing plant. In other applications, this technology has reduced energy use by 15-20%. Based on our energy monitoring data, our aeration blowers use about 1.6 million kWh/year.

If fully implemented and it achieves the energy savings claimed by the manufacturer, the PERLEMAX system could reduce WWTP electricity use about 250,000 kWh per year (about \$15,000 per year in power costs) at current flows and treatment levels. There are potentially additional energy savings that could be realized if this technology could help reduce instances where a second blower was needed. In addition, this technology has the potential to increase the longevity of fine bubble diffusion membranes and time between blower maintenance.

This technology has been piloted in the United Kingdom (Sheffield) on a pilot scale equivalent to one set of our basins. The pilot was initiated for costs savings and stabilization of the process. They have realized an 18% reduction in energy demand. Other pilots have been performed in the UK and Europe.

The Energy Team sees a lot of potential in this technology but has concerns about the upfront costs combined with a relatively new technology. Thus, the Energy Team recommends that OWASA continue to monitor the use of the PERLEMAX system with other utilities and seek opportunities to get financial support for an experimental installation of 1 oscillator (at \$60,000 - \$80,000). Research funding could be sought to help monitor and verify aeration performance by noting average aeration demand for cells before and after installation.

9. Water tank-mounted micro-wind turbine: The 2017 Energy Management Plan considered the installation of large-scale wind turbines and found such an approach for OWASA unviable given the generally low average wind speeds in our region. However, micro-wind turbines have recently emerged as potentially promising for installation on elevated water tanks. The installations would be relatively simple and for water tanks with associated or nearby energy use, could help offset small but continuous energy needs. These turbines (such as this <https://www.halo.energy/technology>) are relatively small, 20-kW installations with the potential to generate 8,000 – 15,000 kWh per year. They are designed to take advantage of the wind tunnel created by the round shape of the tank itself. It is estimated that a unit would cost about \$20,000 to purchase plus installation costs. Although the generation potential is relatively small, the Energy Team recognizes the unique nature of this renewable energy generation potential and recommends additional analysis of a potential pilot application at the Nunn Mountain Elevated Tank.

10. Use of batteries to improve system resilience, reduce energy costs, and utilize renewable energy:

According to Bloomberg New Energy finance, the price of a lithium-ion battery dropped 73% since 2010, due in part to technology improvements and economies of scale. We are approaching a time where batteries could be used to provide back-up power for small pump stations, which would potentially be a more resilient approach than mobile generators for managing power outages. Moreover, when partnered with renewable energy generation, batteries can provide options for significantly reducing our use of purchased electricity and evening out our demand on the grid. As OWASA considers power resiliency for the future, the Energy Team recommends that analysis of what situations and at what price points do batteries become a viable option for system resiliency, energy cost reduction, and renewable energy integration in OWASA's operations. In particular, the Energy Team recommends that the upcoming study of diesel fuel capacity needs at our pump

stations include a consideration of the incorporation of batteries for back-up generation needs (particularly at smaller pump stations).

Energy Management Strategies to Delay Until Upgrade

- 11. Hyperboloid mixer in onsite biosolids tank (WWTP):** Currently, we use a 128 horsepower diffused air mixing system in the onsite biosolids storage tank. This system includes a fixed coarse bubble diffuser grid located near the floor of each of the biosolids holding tanks (fed by the blowers used for aeration). The system is operated intermittently prior to scheduled removal of the material. Due to settling between operation, transfer pumps are used to recirculate material to supplement the current system. Nonetheless, material still accumulates, and the tanks are taken off-line for cleaning about twice per year.

In 2018, CDM Smith conducted a business case analysis of replacing the current system with a more effective hyperboloid mixer. (They also analyzed the operational costs and benefits of running the current diffused air mixing system continuously.) In their analysis, they estimated that the current system uses about 300,000 kWh/year assuming our current intermittent operating strategy. (If it ran continuously, it would use approximately 839,000 kWh/year.) Assuming the same intermittent operating strategy, CDM Smith estimated that two new 30-hp gear-driven hyperboloid mixers would use about 140,000 kWh/year. The up-front cost for the new mixers is estimated to be approximately \$410,000.

On costs alone, this is not likely to be an economically viable choice when compared to current operations. However, CDM recognizes that the new system would likely be more reliable, relieve the demands on the main aeration system, and reduce the impact of mixing equipment on the odor control system. The Energy Team recommends that a hyperboloid mixer be considered when operational needs require the upgrading of the biosolids storage tank mixing system.