ORANGE WATER AND SEWER AUTHORITY

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

MEMORANDUM

TO: **Natural Resources and Technical Systems Committee**

Terri Buckner (Chair)	Will Raymond
Stephen Dear	Amy Witsil
Michael Hughes	John Young
Heather Payne	Alan Rimer (*ex officio*)
Dana Raborn	

THROUGH: Ed Kerwin EK

FROM: Ruth Rouse

DATE: September 6, 2013

SUBJECT: September 11, 2013 NRTS Committee Meeting

The NRTS Committee will meet on Wednesday, September 11, 2013 from 5:30 to 7:00 PM in the OWASA Boardroom. The purpose of this meeting is to provide the Committee information on renewable energy; background information is attached for your review prior to the meeting.

Pat Davis, Sustainability Manager, will make the presentation and address the following topics:

1. 2014 NRTS meetings
2. Overview of OWASA Energy Policy and Use
3. Renewable Energy (RE) Strategies
   A. What RE technologies are being used in the water and wastewater utility industry?
   B. How have RE projects been implemented?
   C. What RE technologies does OWASA now use?
   D. Have we evaluated other RE technologies?
   E. What RE technologies might be worth evaluating further?
4. Discussion of Policy Questions
5. Next Steps
6. Next Meeting

The background information includes an overview of our energy efficiency initiatives. If there is time at the end of the meeting, staff would be glad to receive and address the Committee's questions and comments regarding that overview. We look forward to seeing you on September 11. Please let us know if in advance of the meeting you have any questions or comments regarding the attached information.

Ruth C. Rouse

Ruth Rouse, AICP
Planning and Development Manager

c: Robert Epting, OWASA General Counsel

ORANGE WATER AND SEWER AUTHORITY

BACKGROUND MATERIALS FOR SEPTEMBER 11, 2013 NRTS COMMITTEE MEETING
(September 6, 2013)

SECTION 1.
OVERVIEW OF RENEWABLE ENERGY STRATEGIES

1. **What renewable energy (RE) technologies are being used in the water and wastewater utility industry?**

   The attached table provides an overview of several renewable energy technologies and projects in place at utility facilities in the U.S. and for one in Canada. Where possible, we have indicated whether or not the RE technology might be feasible for our operations.

   (We are not aware of any comprehensive assessment of the use of renewable energy strategies by water and wastewater utilities in the U.S.)

2. **How have other water and wastewater utilities implemented their RE projects?**

   Based on our research, the two most common approaches that water and wastewater utilities have used to implement RE projects are:

   - ✓ Finance and own the RE project and either use the power on-site or sell it to the electric utility. Many projects have been made possible by grants from state governments or rebates or other incentives from electric utilities, especially in states that require electric utilities to meet a specified percentage of their power generation from RE technologies. In some areas, very high electricity rates have been a key factor driving implementation of RE projects.
   - ✓ "Host" the RE project which is financed, built, owned, and operated by a private party. The private party sells the power to the water/wastewater utility (if allowed by State law) or to the local utility. The water/wastewater utility leases the site, enters into a power purchase agreement, if applicable, and has the right to purchase the system at some future date.

3. **What RE technologies does OWASA now use?**

   As noted in the table, we have implemented a few different renewable energy technologies at our facilities, including:

   - ✓ Use of biogas at the Mason Farm WWTP to fuel boilers that heat the anaerobic digesters.
   - ✓ Installation of a solar hot water system at the Operations Center.

- ✓ Use of B20 diesel fuel (20% biodiesel and 80% regular diesel) in many of our vehicles and equipment.

We previously used untreated biogas as fuel for an engine that powered a blower that provided air for the activated slue treatment process at the Mason Farm WWTP. That engine ceased working in 2011.

We did a pilot project using 100% biodiesel but discontinued that due to fuel quality problems.

4. What are some key constraints that may affect our RE options?

The capital costs of RE technologies are high and our utility rates are relatively low; therefore, in the absence of supplemental funding support, there may not be a positive financial return on our investment or the financial payback period will be very long.

Our CIP does not include any funding for RE projects. If we decide to implement RE projects at our customers' expense, other capital and/or operating costs will need to be deferred or eliminated, and/or additional rate revenue will be required.

We cannot purchase and use electricity from a third party that finances, builds, owns, and operates a renewable energy system. State law requires that third parties sell the power to Duke Energy.

We are not eligible to receive federal and state tax credits for construction and operation of renewable energy systems. Current solar photovoltaic (PV) system tax credits amount to about 65% of the installed cost and provide a substantial incentive for the private sector to develop RE projects.

Our water and wastewater treatment plant sites are very limited in area, and unused space should be reserved for future treatment facilities. We must also ensure that essential construction and maintenance activities (and related equipment access) are not impeded if we decide to implement RE systems at either of those facility sites.

Solar PV systems require about 6 acres of land per megawatt of capacity. The site must be mostly level, have road access, be adjacent to a three-phase power line, and be within about two miles of an electrical substation. This will limit the potential use of our large land tracts for a solar PV project.

5. Have we evaluated other RE technologies?

Yes. As noted in the table, staff believes some RE technologies are technically and/or economically infeasible for our operations. Expanded use of biogas at the WWTP is technically feasible; however, it has at best a very long financial payback unless we receive supplemental financial support.

In 2009, Duke Energy issued a request for potential sites to host solar PV installations. We offered several of our sites for consideration; however, Duke Energy did not select any of our sites for further evaluation.

6. What RE technologies might be worth evaluating further?

We believe that our highest priority should be to seek a cost-effective strategy for maximizing the beneficial use of the biogas produced at the Mason Farm WWTP. Based on our studies to date, the most promising approaches appear to be to implement a biogas-to-energy combined heat and power (CHP) project or a biogas-to-vehicle fuel project. We will continue to evaluate alternative CHP project design strategies and the feasibility of partnering with others on a biogas-to-vehicle fuel project.

Charlotte-Mecklenburg Utilities District (CMUD) recently evaluated the feasibility of implementing a biogas CHP project at the McAlpine Wastewater Treatment Plant. CMUD concluded that such a project would have a very long payback period, and in March 2013 issued a request for proposals for private sector financing, construction, ownership and operation of the potential project. No bids were received. CMUD is again considering implementing the project with its own funds.

A second priority would be to seek proposals that would involve us hosting privately-financed, owned and operated renewable energy projects (such as a rooftop solar PV system or solar PV "farm") at one or more of our facilities. The third party would sell Duke Energy the electrical power produced by the system, and we would retain the right to purchase the system at a future date, after which we could either sell the power or use it on-site. We could decide if any proposals are worth further consideration.

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SECTION 2.
ENERGY EFFICIENCY AND USE OF RENEWABLE ENERGY: SOME POLICY QUESTIONS FOR CONSIDERATION

Core Mission

1. Should we establish a financial payback threshold for energy efficiency and renewable energy investments, such that if a project is within the payback threshold we automatically proceed with it?

2. As we consider funding needs for energy efficiency and renewable energy strategies and compare those against other operating and capital needs, what evaluation criteria should we use and how much weight should we give to each factor (such as the expected environmental benefits, risk/reliability benefits, and other benefits compared to economic/affordability considerations)?

3. Should cost savings from energy efficiency and renewable energy projects be:

    - Reinvested in further energy efficiency and other sustainability initiatives (such as renewable energy projects), or
    - used to reduce upward pressure on our rates, or
    - used for operating and maintenance needs or capital projects as determined in a given budget cycle?

Going Above and Beyond Requirements (No federal or state mandates to do these things)

4. Should we establish time-bound targets for reductions in our use of non-renewable energy and related greenhouse gas emissions? If so, what should be the technical basis for establishing those targets? (*We do not have such targets and timeframes.)*

5. Should we establish time-bound targets for the percentage of our energy needs that should be met from renewable energy sources? (*We do not have such targets and timeframes.)*

6. Should we designate funding specifically for energy efficiency improvements, renewable energy projects, GHG reduction efforts, or other sustainability projects? *(Under our current approach, the need for and costs and benefits of such projects are evaluated against other operating and capital needs and funds are allocated based on organizational priorities.)*

7. Should we allow other parties to construct, own and operate renewable energy facilities on OWASA lands or facilities, such as a rooftop solar photovoltaic (PV) system at the Administration Building or a biogas-to-energy project at the WWTP? *(We have never done this; however, it is a strategy that many other utilities have implemented.)*

8. To help meet targets that may be established per #4 and #5 above, should we "purchase" renewable energy on the open market (such as through NC GreenPower), or otherwise pay other parties to reduce their carbon emissions (such as through purchase of renewable energy credits or carbon credits)? *(We have never done this but are aware of some that have. Most were in response to their state's regulatory requirements.)*

9. What information and analyses does the Board desire at this point for considering renewable energy/GHG reduction issues? What data does the Board desire in future reporting of energy and GHG information?

<u>**SECTION 3.**</u>

USE OF ELECTRICITY AND NATURAL GAS FOR THE PERIOD FY 2007 – FY 2013

<u>**Electrical Energy (Table 1)**</u>

- In FY 2013, we used about 21.82 million kilowatt hours (kWh) of electricity supplied by Duke Energy and Piedmont Electrical Membership Cooperative. The cost of that electricity (including demand and energy charges) was about $1.36 million. Most of the electricity we used was for pumping water, wastewater, and reclaimed water and for running blowers that provide air used in the water and wastewater treatment processes. Other uses were for lighting, office equipment and computers, monitoring and control systems, HVAC systems, etc.

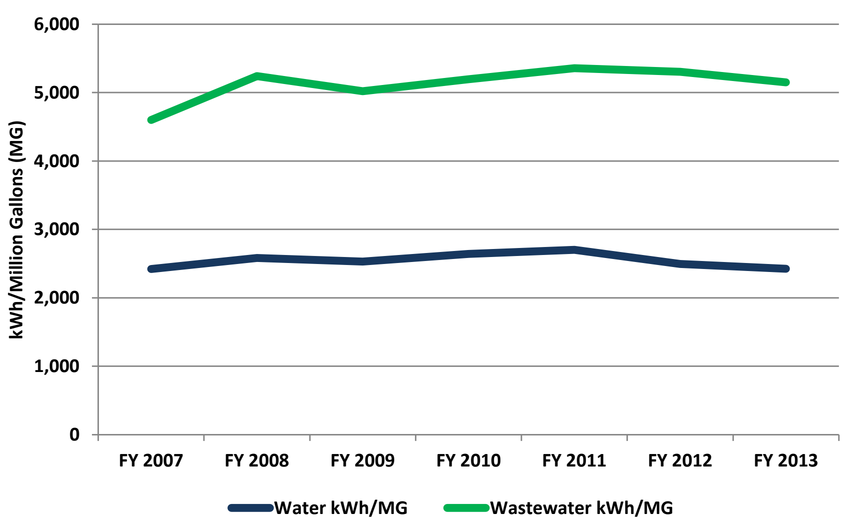
- In FY 2013, we used 5.84 million kWh (27% of our total use) for Water Supply, Treatment, and Distribution services. That was about 2,420 kWh per million gallons of drinking water we pumped into our system (2.42 kWh per 1,000 gallons).

- In FY 2013, we used 15.145 million kWh (69% of our total use) for the Wastewater Collection, Treatment and Disposal services, including reclaimed water production and distribution. That was about 5,150 kWh per million gallons of wastewater treated (5.15 kWh per 1,000 gallons).

- As shown in Figure 1, electrical use per million gallons of water and wastewater treated has remained relatively stable during the period FY 2007 through FY 2013.

<u>**Figure 1.**</u>

Electrical Energy Use Per Million Gallons of Drinking Water Pumped and Wastewater Treated (Including Reclaimed Water Production) For Fiscal Years 2007 Through 2013*



* Excludes electrical energy use for support facilities such as Administration Building, Operations Center, etc.

- According to the U.S. Energy Information Administration, our total electrical energy use in FY 2013 equals the amount used each year by about 1,930 homes in the U.S. (www.eia.gov/tools/faqs/faq.cfm?id=97&t=3)

- Use in FY 2013 was about 1% higher than FY 2007, but about 4.5% lower than FY 2010.

- Excluding the Wastewater Treatment and Disposal function, use in FY 2013 was 19% lower than FY 2007.

- Water Supply, Treatment and Distribution use was almost 23% lower than FY 2007.

- Office and Support Facilities use was about 6% lower than FY 2007.

- Wastewater Collection use was 6% lower than FY 2007.

- Wastewater Treatment and Disposal use was almost 18% more than FY 2007.

- The reclaimed water system, which was implemented in April 2009 and includes new pumps with a combined capacity of 775 horsepower, accounts for about 6% of the electrical energy use at the Mason Farm WWTP and is one contributing factor to the increase in electrical energy use at the plant in recent years. However, the use of reclaimed water is one reason why energy use has declined in the Water Supply, Treatment and Distribution function. We estimate that it takes about 35% less energy to meet water demands with reclaimed water instead of drinking water from our reservoirs and water treatment plant.

- Additional process units, the new dewatering facilities and associated filtrate treatment requirements, new odor control equipment, etc. are other factors contributing to the increase in electricity use at the WWTP since 2007.

- Duke Energy reports that in 2011, each kWh it generated resulted in about 0.92 pounds of CO_2 emissions. Based on that, our FY 2013 electricity use corresponds to about 9,106 metric tons of carbon emissions in a year.

- According to the U.S. Environmental Protection Agency (EPA), the carbon emissions associated with the electrical energy we use is equivalent to about:

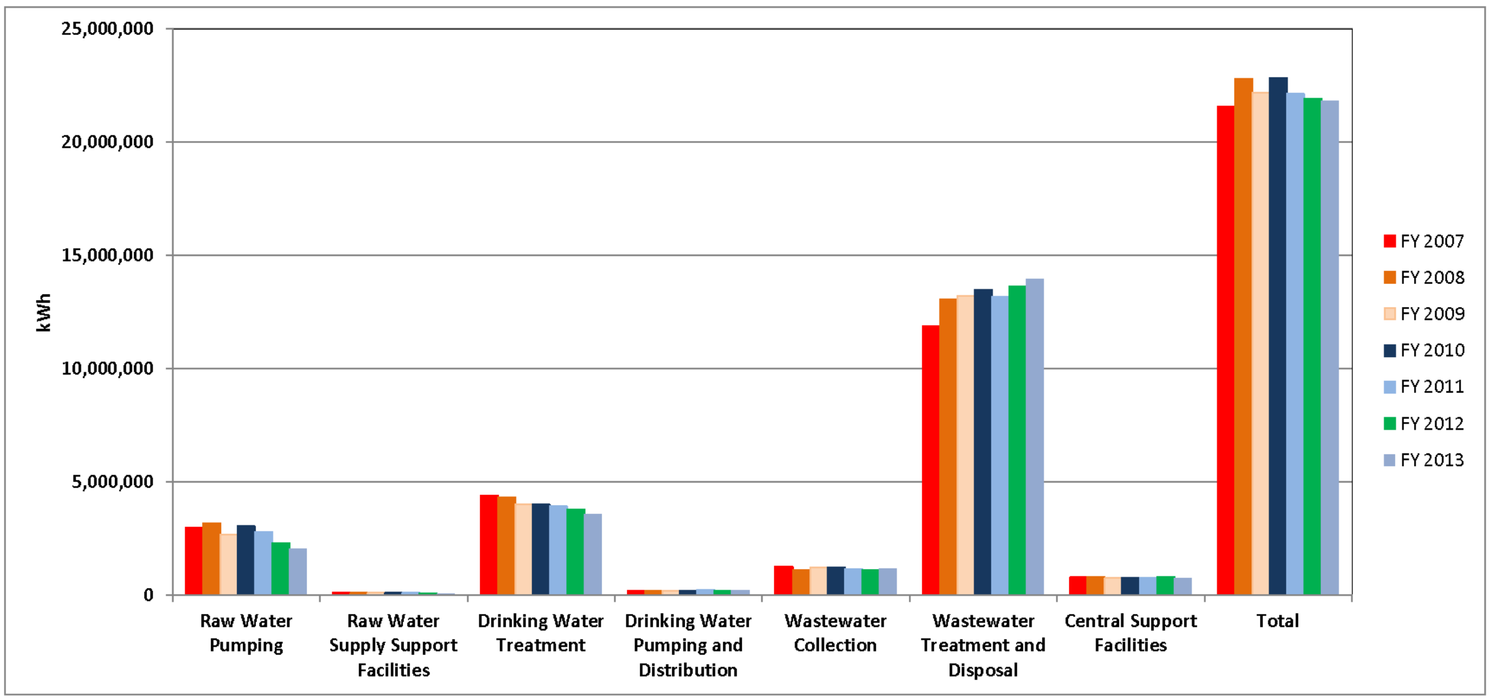
  - ✓ the carbon emissions from more than 1,900 cars or
  - ✓ the amount of carbon sequestered per year in 7,460 acres of average U.S. forest land

  (http://www.epa.gov/cleanenergy/energy-resources/calculator.html#results)

TABLE 1.

ORANGE WATER AND SEWER AUTHORITY
SUMMARY OF ELECTRICAL ENERGY PURCHASES, BY FUNCTIONAL AREA OF OPERATIONS
FOR THE PERIOD FISCAL YEAR 2007 THROUGH 2013 (Values shown are kWh)

Fiscal Year	Raw Water Pumping	Raw Water Supply Support Facilities	Drinking Water Treatment	Drinking Water Pumping and Distribution	Wastewater Collection	Wastewater Treatment and Disposal	Central Support Facilities	Total
FY 2007	2,967,203	102,664	4,402,048	199,655	1,263,683	11,864,080	789,344	21,588,677
FY 2008	3,178,200	98,537	4,334,048	194,083	1,118,247	13,070,400	806,704	22,800,219
FY 2009	2,680,800	103,906	4,016,448	198,139	1,217,109	13,233,120	752,352	22,201,874
FY 2010	3,043,800	107,177	4,006,848	206,423	1,237,591	13,477,120	758,352	22,837,311
FY 2011	2,793,140	105,637	3,918,848	224,677	1,161,878	13,160,480	767,328	22,131,988
FY 2012	2,286,080	79,292	3,777,248	209,745	1,118,198	13,646,040	817,712	21,934,315
FY 2013	2,040,240	84,631	3,588,448	211,191	1,188,745	13,956,480	751,216	21,820,951



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Natural Gas (Table 2)

- In FY 2013, we used a total of 90,054 therms of natural gas. The cost of that natural gas was nearly $76,000.

- We use natural gas as a supplemental fuel for the boilers that heat the anaerobic digesters at the Mason Farm WWTP. We also use it in the heating systems at the Administration Building, Operations Center, and Water Treatment Plant.

- According to PSNC/SCANA Energy (our natural gas utility), our natural gas use in FY 2013 was about the same amount used by 140 typical single-family homes served by PSNC/SCANA Energy.

- Our total natural gas use in FY 2013 was almost 47% lower than FY 2007.

- Wastewater Treatment use was 68% lower than FY 2007.

- Water Treatment, Administration Building, and Operations Center use was about 41%, 24%, and 31% higher, respectively, than FY 2007.

- EPA estimates that each therm of natural gas use generates about 11.7 pounds of CO_2 emissions. Based on that, our use of natural gas corresponds to about 478 metric tons of carbon emissions in a year.

- According to the EPA, the carbon emissions associated with our use of natural gas is equivalent to:

  - ✓ carbon emissions from about 100 cars or
  - ✓ the amount of carbon sequestered a year by about 392 acres of average U.S. forests

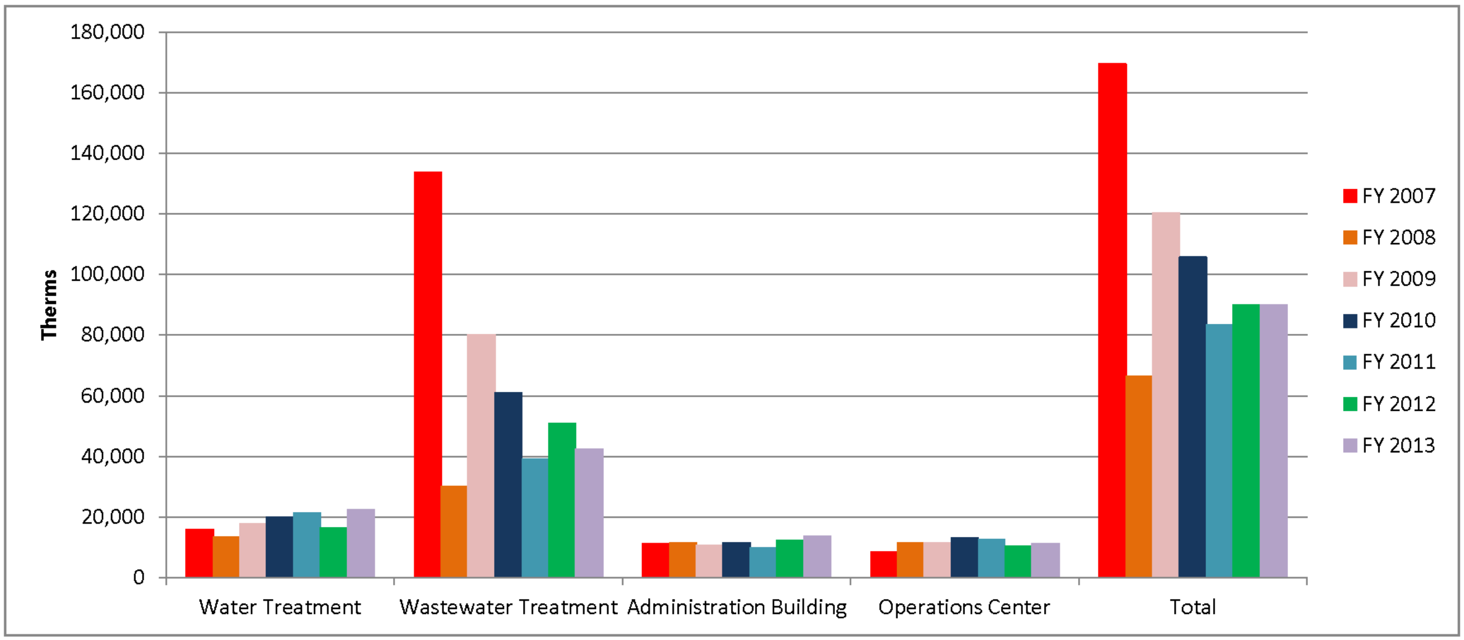
  (http://www.epa.gov/cleanenergy/energy-resources/calculator.html#results)

One kWh is equal to 3,413 BTUs. One therm of natural gas equals 100,000 BTUs, which is the equivalent energy value of 29.31 kWh. One BTU is the amount of energy needed to heat one pound of water by one degree Fahrenheit.

TABLE 2.

ORANGE WATER AND SEWER AUTHORITY
SUMMARY OF NATURAL GAS PURCHASES, BY FUNCTIONAL AREA OF OPERATIONS
FOR THE PERIOD FISCAL YEAR 2007 THROUGH 2013 (Values shown are Therms)

Fiscal Year	Water Treatment	Wastewater Treatment	Administration Building	Operations Center	Total
FY 2007	15,973	133,719	11,110	8,608	169,410
FY 2008	13,281	30,038	11,491	11,556	66,366
FY 2009	17,879	80,226	10,538	11,548	120,191
FY 2010	19,920	60,964	11,555	13,225	105,664
FY 2011	21,423	39,184	10,059	12,828	83,494
FY 2012	16,370	50,912	12,266	10,407	89,955
FY 2013	22,556	42,385	13,809	11,304	90,054



SECTION 4.
ENERGY EFFICIENCY IMPROVEMENTS AT OWASA

Targeted Audits and Studies Help Inform Energy Efficiency Opportunities and Investments

- *University Lake Raw Water Pump Station: Pump Station Evaluation for Addition of a One (1) MGD Raw Water Pump*. August 2006. McKim & Creed.
- *Cane Creek Raw Water Transmission Facility Improvements*. February 1, 2002. Hazen and Sawyer. This study included an evaluation of the existing 2-speed raw water pumps at Cane Creek Reservoir.
- *HVAC Energy Survey Report for Orange Water and Sewer Authority*. December 31, 2007. State Energy Office and NCSU Industrial Extension Service.
- *Lighting Energy Survey Report for Orange Water and Sewer Authority*. December 31, 2007. State Energy Office and NCSU Industrial Extension Service.
- *Mason Farm Wastewater Treatment Plant Hydraulic and Treatment Capacity Study*. March 2010. Hazen and Sawyer.
- *OWASA Biogas Utilization Study*. August 24, 2011. Brown and Caldwell.

Examples of Our Energy Efficiency Strategies

- Energy use for water and wastewater pumping and treatment has declined as our customers have become more efficient in their use of water***. We estimate that our water and wastewater pumping and treatment facilities use about 2.42 and 5.15 kWh, respectively, for each 1,000 gallons of service we provide.***
- We have saved energy by meeting certain water demands with reclaimed water instead of drinking water. We estimate that ***it takes about 35% less energy to meet water demands with reclaimed water instead of drinking water*** from our reservoirs and water treatment plant.
- In September 2002 we implemented a system to recycle treated process water back to the head of the Jones Ferry Road Water Treatment Plant (WTP). This system reduces raw water demands and energy requirements for pumping by about 7%. At current raw water withdrawal rates and energy use, the ***estimated annual energy savings is more than 140,000 kWh***.
- We have installed more efficient pumps, motors and associated controls at many of our facilities. Examples are:
  - ✓ the new variable speed, horizontal split case pump at the WTP;
  - ✓ installation of VFDs such as at Finished Water Pump #7;

- ✓ installation of a new low-flow pump with VFD at the University Lake raw water pump station; and
- ✓ replacement of the Heritage Hills Wastewater Pumping Station (annual energy use has dropped by about 10,000 kWh, or 20%).

- During condition assessments for our comprehensive asset management program, we identified several pumps and motors in need of corrective maintenance. Although none of those needs were major, some measures would improve pump and motor efficiency.

- We have eliminated several wastewater pumping stations by extending the gravity sewer system. Pumping stations removed from service in the last five years include: Lloyd Street; Starlite Drive; Cleland Drive; and North Forest Hills. The ***estimated annual energy savings is about 18,500 kWh***.

- We are installing a new fine bubble diffuse aeration system, blowers and mixers at the Mason Farm WWTP. These improvements are scheduled for completion in December 2014. The ***estimated annual energy savings is projected to be about 2.57 million kWh***. That is about a 19% reduction from the WWTP's FY 2013 use, and almost a 12% reduction in our total electrical energy use.

- We shift pumping needs to off-peak periods when possible to save costs. This measure is particularly applicable to the WTP, since our water storage tanks enable us to maintain flow and pressure during the day and refill during the off-peak nighttime period. This measure helps reduce our peak demand on Duke Energy's generation capacity and reduce our costs under Duke Energy's time-of-day electrical rates.

- We have installed more efficient lights and lighting controls at several facilities, including the Administration Building and Operations Center. We have also installed more efficient lighting at the WWTP and WTP. Just recently, we replaced the lights on a portion of the exterior basins at the WTP and eliminated one-third of the fixtures.

- We have upgraded and replaced heating and air conditioning systems and associated controls.

- Several of our information technology improvements have improved the energy efficiency of our operations. Some key strategies have been:

  - ✓ Servers, PCs, monitors, printers and copiers are Energy Star rated.
  - ✓ Through server virtualization, we have significantly reduces the amount of equipment in our server room. Excluding the phone system (which we cannot presently virtualize) we have reduced the number of physical servers from 24 to 8. This has reduced electrical consumption for the servers and also reduced the waste heat generated which reduces our cooling requirements.
  - ✓ We have deployed mobile technology so field personnel can remotely access GIS and asset information in the field, and to receive and complete service and work orders

electronically. These improvements help reduce our costs, the use of vehicle fuel, and the use of paper, printing and copying.

- ✓ We have implemented technologies such as PhoneTree, an automated call system that we use to notify customers that their accounts are overdue and they could be disconnected for non-payment. Since implementation, the average monthly cutoffs have fallen from approximately 160 per month to 80 per month. That represents 80 fewer trips in a crew truck to turn water off and then turn water back on. This reduces fuel use and carbon emissions, and reduces our costs.

<u>Potential Opportunities Remain for Additional Energy Savings</u>

- We have several older pumps and motors that are running properly and do not need to be replaced; however, we could replace them with new, high efficiency models if that is determined to be cost-effective.

- We have additional opportunities to install controllers such as variable frequency drives and soft starters, to improve the efficiency of some pumps and motors.

- We can replace older, less efficient lights with new lighting technologies (such as LEDs), install more lighting controls, reduce the number of fixtures, reduce the number of lighting hours, etc.

- We can improve the efficiency of our HVAC systems. The CIP includes funding for two near-term projects: $33,000 for an FY 2014 study of HVAC control system needs for the Administration Building, and $84,000 for replacement of the Administration Building chiller in FY 2015.

- We can better inform our employees of the importance of energy conservation and specific actions they can take to help us reduce our use of energy and related costs.

<u>Two Potential Strategies</u>

- Our most recent lighting audit was completed in 2007. Substantial advancements in energy efficient lighting have occurred since that time, such as Light Emitting Diode (LED) technology. We could benefit by having a qualified lighting expert complete a comprehensive assessment of cost-effective opportunities for lighting improvements throughout our facilities (including energy cost savings, savings in lighting maintenance costs, etc.).

- We could benefit from having an expert conduct a comprehensive, systematic evaluation of water and wastewater pumps including efficient curves, pumping and water storage characteristics, current operation methods, hydraulic and water quality constraints, diurnal demand patterns, electric rates, and power monitoring capabilities. By incorporating all of these elements, a comprehensive energy optimization evaluation can be performed that will identify energy saving opportunities and provide OWASA with the tools and guidance needed to better manage pumping-related energy use and costs. This evaluation would focus on our larger pumps.

The potential costs and benefits of the above evaluations have not yet been estimated. No funds are included in our annual budget or CIP for either of the above projects.

If the Board concurs, we could issue requests for qualifications and proposals for those services and select the most qualified parties to complete the evaluations and assist us with implementation.

ORANGE WATER AND SEWER AUTHORITY
MATRIX OF EXISTING AND POTENTIAL RENEWABLE ENERGY STRATEGIES (September 6, 2013)

RENEWABLE ENERGY STRATEGY	TYPE OF FACILITY/PROJECT	SOME OTHER UTILITIES THAT HAVE IMPLEMENTED THE TECHNOLOGY			SCALE	APPLICABILITY TO OWASA?		COMMENTS
		UTILITY/FACILITY	PROJECT OVERVIEW	LINK		ALREADY IN PLACE (Note 1)	FEASIBILITY	
Solar Photovoltaic (PV) *Generation of electricity from solar radiation. Concentrating solar PV uses an array of magnifying glasses to concentrate sunlight onto tiny chips. CSP works well only under clear sunny skies. Fixed PV panels can capture diffuse light from cloudy skies.*	Rooftop/Parking Lot	Raleigh Water Plant	Privately-owned, operated and financed; owner leases site from City for 20 years, and sells power to Duke Progress; PV array is on WTP clearwell; City has option to purchase system; no capital investment by City	http://www.raleighnc.gov/home/content/AdminServSustain/Articles/WTPsolararray.html	250 kW		Likely financially infeasible without supplemental funding and/or third party involvement	
		Morristown, NJ WWTP	Solar canopy over tank; $1.46 million rebate from NJ Clean Energy Program; they sell the RECs; 8-year payback	http://www.wwdmag.com/solar-	578 kW; 40% of plant's needs			
	Solar Farm	Gilbert, AZ WWTP	Privately-owned, operated and financed; 20-year license/lease agreement; PPA; $10 million project; no capital investment by City	http://www.gilbertaz.gov/environment/solar/	2 MW; 40% of WWTP needs		Likely financially infeasible without supplemental funding and/or third party involvement	5 to 6 acres of land is needed for each MW of generating capacity; site needs to be mostly flat and preferrably have south-facing slope; needs to be adjacent to 3-phase electrical wires and have good road access; site needs to be within about 2 miles of an electrical substation
		Raleigh WWTP	Privately-owned, operated and financed; no capital investment by City; owner leases 10 acres from City; owner sells power to Duke Progress	http://www.raleighnc.gov/home/content/AdminServSustain/Articles/WTPsolararray.html	1.3 MW			
Solar Thermal *Generation of heat from solar radiation*	Solar Hot Water	OWASA Operations Center	Rooftop solar hot water system provides hot water for building			YES	In Place	
	WWTP Digester Heating	No Examples Found						
	Solids Drying (greenhouse type solar dryer)	Tooele, UT WWTP	First of its kind in U.S.; 49,000 square feet facility at 2.5 MGD plant; $4.9 million, including dewatering; reduces solids volume by 75%				Insufficient land area at WWTP	Approximately acres of land area is required per dry ton per day of solids production assuming a solids concentration of 20%.
	Power Generation	No Examples Found						
Mico-Hydro *Generation of electricity (or direct-drive power) from energy from water flow and pressure*	In-Pipe Turbines *(generate electricity by extracting excess pressure from 24-inch and larger pipes)*	Portland Water Bureau	UNDER CONSTRUCTION; Privately-owned, operated, and financed; four 42" turbines in a 48" finished water line (75 mgd with 12' of head); cost $1.6 million; no capital investment by PWB, which leases line for 20 years; power sold to electric utility; PWB has option to buy in 20 years	www.lucidenergy.com	172 KW (1,100 mWh/year); City estimated payback at 18 to 25 years so they did not provide funding		**Technically feasible; economically infeasible**	Manufacturer has advised that we do not have enough flow or pressure in any of our largest pipelines to justify implementing this technology.
	Hydropower at Reservoirs						**Technically feasible; economically infeasible**	Hazen and Sawyer's analysis concluded this would not be cost-effective for OWASA. The volume and frequency of spill events would be very low, while capital costs would be very high.

RENEWABLE ENERGY STRATEGY	TYPE OF FACILITY/PROJECT	SOME OTHER UTILITIES THAT HAVE IMPLEMENTED THE TECHNOLOGY			SCALE	APPLICABILITY TO OWASA?		COMMENTS
		UTILITY/FACILITY	PROJECT OVERVIEW	LINK		ALREADY IN PLACE (Note 1)	FEASIBILITY	
WWTP Biogas *Generate electrical or mechanical power and/or heat from energy value in the biogas*	Fuel for Boilers	OWASA Mason Farm WWTP	Untreated biogas is used as fuel for the two boilers that provide heat for digesters			YES	In Place	Very common practice at WWTPs
	Fuel for Power Production	Thousand Oaks, CA WWTP	Privately owned and financed; City has right to purchase system			PRIOR	**Technically feasible; very long payback**	Estimated capital cost for a 300 - 330 KW CHP system and gas treatment is in the range of $2 to $3 million; Payback is estimated to be around 30 years.
	Fuel for Vehicles/Equipment	Janesville, WI WWTP (17.75 MGD)	Gas treatment and compression system with fast-fill fueling station; used by four City vehicles and lawnmower; also has high-strength waste receiving with CHP system				**Technically feasible; uncertain end market and economics**	Would require major conversion of our vehicle fleet and/or partnership with another fleet owner/operator that would use the compressed biogas
	Co-Digestion of High-Strength Wastes to Increase Gas Production	Johnson County, KS WWTP	12,000 gpd high-strength waste receiving facility (peak 30,000 gpd) with odor control					Several utilities in the U.S. have implemented this practice at WWTPs to enhance gas and power production.
Biofuels *Produce and/or use biofuels for fuel for vehicles and equipment*	Biodiesel for Vehicles/Equipment	OWASA	B20 being used in our fleet and mobile equipment;			YES	In Place	We also piloted use of B100 in our biosolids transport vehicles; however, fuel quality was not acceptable.
	Biofuel Crop Production	Raleigh WWTP Land Application Farm	27 acres of sunflowers; produced 29,700 pounds of seed which created 1,258 gallons of biodiesel (46 gallons/acre of land); City crushes seed and produces biofuel; SYSTEM IS PART OF City's major land application farming operation next to WWTP	http://www.raleighnc.gov/home/content/AdminServSustain/Articles/Biofuels.html			Technically feasible; uncertain economics	Have discussed this possibility with Piedmont Biofuels, which acquired but subseqeuntly sold its crusher and decided to foxus on prioduing fuel from waste products rather than raw seed crops.
Wind	Wind Turbines	Cascade, WI WWTP	2 100 kW windmills provide 100% of the electricity required by the WWTP				**Infeasible**	Insufficient winds in ourr region; USDOE National Renewable Energy Laboratory Wind Resource Map
Geothermal/Heat Recovery From Wastewater	Sewage Geothermal	Vancouver, Canada	First utility in North America to recover waste heat from untreated wastewater. Meets 70% of heating demand for area including Olympic Village.	http://vancouver.ca/home-property-development/neighbourhood-energy-utility.aspx			Likely infeasible at our scale	
	Geothermal	Nederland, CO WWTP	Geothermal ground loop system preheats outdoor air and uses that to help heat WWTP and a nearby building.				Likely infeasible at our existing facilities	