**OBJECTIVES**

- Achieving a NZE WWTP by:
  - Energy Efficiency Opportunities (EEOs)
  - Combined Heat & Power (CHP)
  - Renewable energy

**METHODOLOGY**

- The approach of this goal is shown in figure below. First, EE is targeted to reduce the energy consumption as much as possible before introducing expensive measures.

- Then CHP and energy recovery are utilized followed by renewable energy on-site generation. This will reduce the initial cost of such investment and provide a shorter payback period. Since renewable has the highest initial cost, they should be the climax of a NZE approach in any project.

1) **Energy Efficiency Opportunities (EEOs):**

- EEOs generated through the audits are categorized into 8 groups. Motors, lighting, compressed air, VFD, heat recovery, load shifting, blowers and HVAC.

   - Motors
     - Energy Efficient belts
     - Synthetic lubricants
   - Lighting
     - Energy Efficient lighting fixtures
     - Lighting controllers (motion, daylight)
   - Comp. Air
     - Install air intake in coolest area
     - Reduce set pressure
   - VFDs
     - Pump motors
   - Heat Recovery
     - Heat generation as by-product
     - Use to preheat air/water
   - Load Shifting
     - Load management
     - Shift processes to off-peak hours
   - Blowers
     - VFD
     - Maintain leaks in network
   - HVAC
     - Setback temperature & optimize setpoint
     - Replace equipment and heaters

2) **Combined Heat & Power (CHP):**

The objective of installing CHP in the WWTPs is to reduce the energy needed for the anaerobic digestion, plus utilizing both, heat recovery and electricity generation. Common types: reciprocating engines and micro-turbines.

**For this case study:**

- Two 60 kW micro-turbine
- Total capacity 120 kW
- Energy potential 6715 MMBlu/year

3) **On-site Renewable Energy Generation:**

The forms of renewable energy on site generation used in this approach are wind energy and solar photovoltaic panels. System Advisor Model developed by the National Renewable Energy Lab was utilized to optimize the selection of these two systems.

**RESULTS**

1) **EEOs:**

Below chart represents the energy savings and energy cost savings percentages of all WWTPs. Through the EEOs, the energy consumption in the plant is reduced by 18.1% and the cost is reduced by 15.7%. Although WWTP-5 showed a higher energy saving percentage among the rest of the WWTPs, WWTP-3 was chosen because WWTP-5 is a small scale plant.

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