INDUSTRIAL ENERGY EFFICIENCY AND CLIMATE CHANGE

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Overview

Today's concerns about greenhouse gases (GHG) are a worldwide issue. Wastewater treatment plants (WWTPs) partially contribute to this problem. Furthermore, water recycling can help the environment and can contribute to reducing waterborne diseases. Processes performed in WWTPs vary, but they typically include headworks, grit removal, mixing, clarifying, nutrients removal, filtering, disinfection, discharging to local water bodies or open fields, and handling and proper disposal of solid objects. In some plants, biogas is generated. Although wastewater treatment is a mature technology, there is significant potential for improvements from the standpoints of their economics, their energy efficiency, and their potential to reducing greenhouse gas emissions.

Methods

Through energy assessments, the energy consumption, GHG emissions, waste management, and productivity data from 10 WWTPs in Florida are presented. The plants range in their processing capacity from 5.5 to 55 million gallons/day of wastewater treated. For all plants, both an energy use baseline and a carbon dioxide ($CO_{2\text{-}e}$) emissions baseline have been established. Several assessment recommendations (ARs) have been identified. These ARs were all evaluated technically and economically aiming to ensure a speedy payback. Areas of potential improvements included motors, pumps, aerators, blowers, lighting, compressed air, occupancy sensors, disinfection systems, boilers, combined heat and power systems, biogas utilization and processing equipment, insulation, heat recovery systems, photovoltaics, power generators, nutrients recovery systems, and energy management systems. Many of these improvements show great opportunities for GHG reduction. It has been observed that the electric energy rate structure has a significant impact on the operational costs of WWTPs. Plants that further treat their sludge when biogas is being generated onsite, can produce biofertilizers of high grade and can sell it for profit, reducing $CO_{2\text{-}e}$ and recovering some nutrients.

Results

The overall cost savings for all WWTPs studied were as high as $10 million, with an associated reduction in energy consumption and emissions reduction per plant of about 18%. After the evaluation of electric energy costs, and the potential savings that have been identified, a carbon credit cost of about $155/ton $CO_{2\text{-}e}$ has been proposed as an incentive, that will significantly reduce the payback of energy projects.

Conclusions

- There are opportunities for on-site power generation using CHP.
- Non-Conventional Renewable Energy (NCRE) systems such as photovoltaics (PV) can be made part of the plants' energy use portfolio.
- The correlation of electric energy usage with the amount of wastewater treated for plants with only electric energy capability is low. The same is true for the linear correlation of natural gas energy usage with the

amount of wastewater treated. Poor linear correlation has also been observed between the electric energy usage and the amount of wastewater treated for those plants that use both modes of energy.

- Energy used per MG of WW treated is below recommended values by the US - DOE.
- Equipment runs a fraction of the annual hours of operation, but not necessarily at the same time, and at low electric loads.
- Electric equipment has different operating parameters, efficiencies, and capacities.
- Plants that do not further treat their sludge have great opportunities to generate biogas and biofertilizers and self-generate power through CHP systems, all with very appealing savings.
- Emissions of $CO_{2\text{-}e}$ can be 100% avoided since biogas is a NCRE source.
- The equivalent cost of tons of $CO_{2\text{-}e}$ should be scaled to the energy rates.
- After consideration of the current cost of carbon credits, a more significant value is proposed that will raise the implementation of energy efficiency projects by significantly improving their payback, and consequently reducing the greenhouse gases emissions.
- We believe that the numerical value of the proposed carbon credits will have a significant impact on industry, the energy market, and on the climate in a sustainable fashion.
- Although the present work shows results from WWTPs, we believe that similar results will be true for many, if not all, manufacturing facilities.