

A Wastewater View Of Sustainability

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Have you noticed...

- People are talking about becoming more sustainable.
- Wastewater treatment plants have been practicing sustainability for many, many years.
- But, we are challenged to do better
- And we can...

For example

- A University of Toronto research study, published in an August issue of the Journal of Energy Engineering stated the following:
 - The raw municipal wastewater in the Toronto area contained enough organic material to potentially produce 113 megawatts of electricity or close to 990 million kilowatt hours a year.
 - With a 20 per cent recovery and conversion into electricity, the wastewater treatment plants needs would be satisfied. Excess could be sent to the grid.
 - Researchers stated "We're moving towards a future where we see our wastewaters and other wastes as resources."



Another example

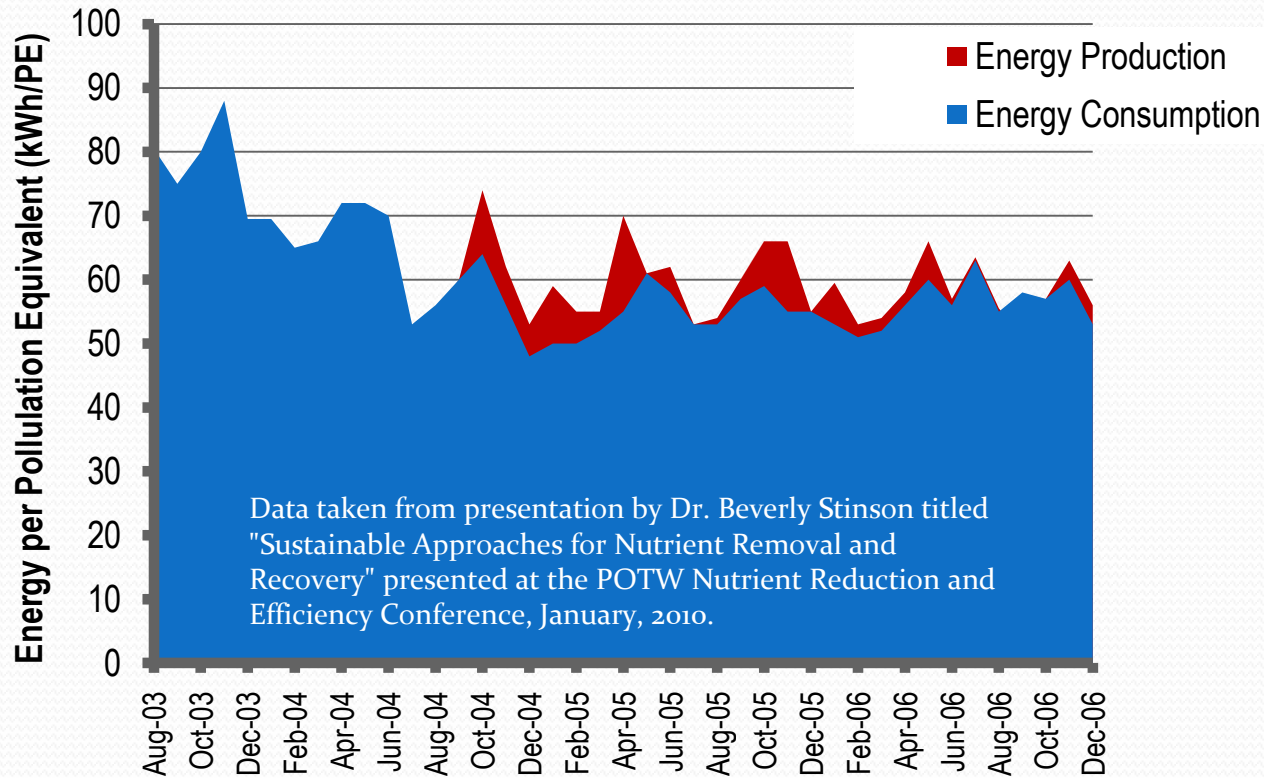
- In August 2008, a new wastewater treatment plant for the Greater Amman and Zarqa area of Jordan was inaugurated.



- What is unique about this plant is that it will produce 95% of the electricity required for treatment through hydraulic turbines installed upstream and downstream, combined with gas turbines powered by digestion biogas

And yet a third example

**Figure 1: European Wastewater treatment plant
Energy Data
August 2003 to December 2006
Production vs. Consumption**



Not just Wastewater treatment

- Wastewater is a resource
 - It contains nutrients that can be removed and reused
 - It contains water that can be recycled
 - It contains organic matter that has value
- Treatment plants are becoming centers for reclaiming, recycling, and reusing.

The Focus for today

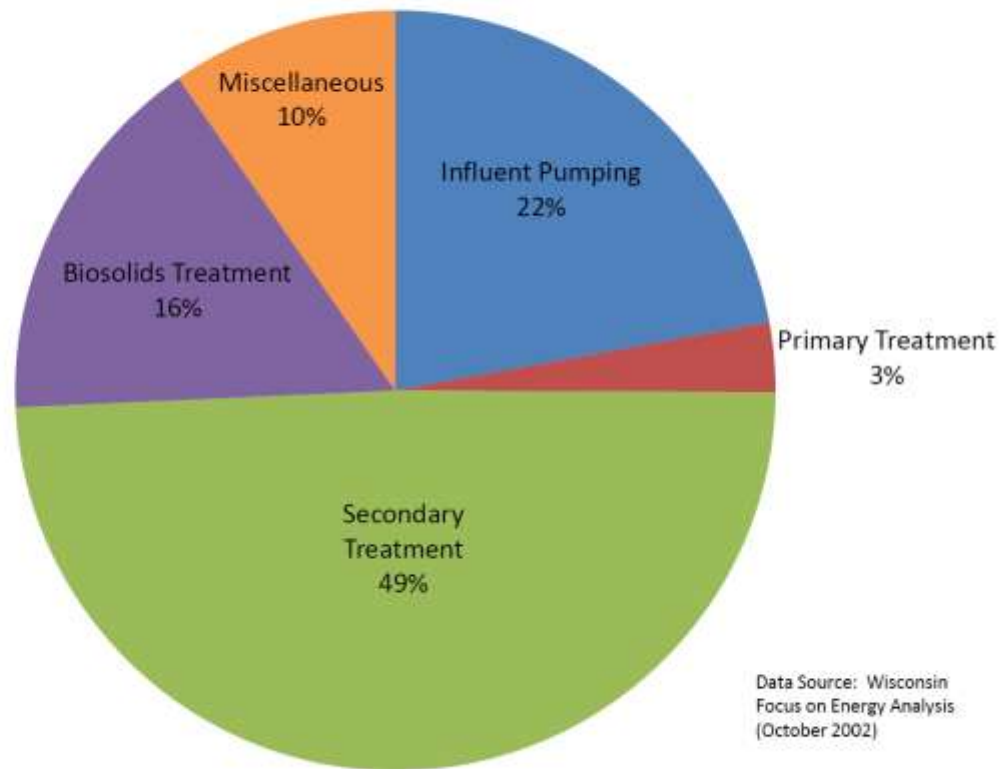
- Consider energy
- Treatment plants can be net zero energy consumers
- To accomplish this, we need to know how energy is being used,...
- Where energy can be recovered, ...
- Where energy can be generated

- This presentation will attempt to uncover these questions.



Where is energy being used?

**Figure 6: Percent of Total On-site Energy
(Green Bay Facility)**



Prepared by:
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Rebecca Vanderbeck, 11-13-09

Data Source: Wisconsin
Focus on Energy Analysis
(October 2002)



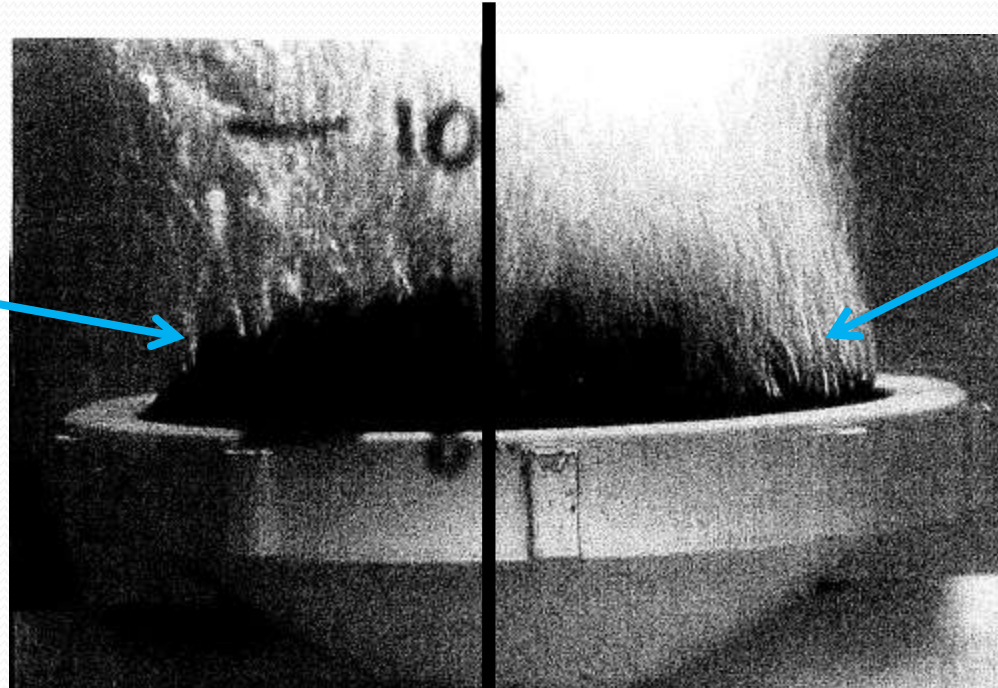
Refine treatment?

- *Can you capture more influent TSS?*
 - *Why? Increasing capture can:*
 - *Reduce organic load to aeration*
 - *Increase organic load to anaerobic digestion, increasing biogas production*
- *Can you improve process control?*
 - *Why? Reduced energy needs:*
 - *Did you know that it requires 15% more air to hold a 3 mg/L dissolved oxygen concentration vs. a 2 mg/L.*
- *Are your diffusers clean?*
 - *Need to understand your system*
 - *Yes, membrane diffusers need cleaning*



Fine Bubble Membrane Diffuser

Less Active
Diffuser Surface



Highly
Active
Diffuser
Surface

Dirty Diffuser

Clean Diffuser

Picture copied from presentation by Dr. Michael Stenstrom titled "Aeration Systems – Past, Present and Future and What to Expect from Aeration System Upgrades", April 1, 2008

Where is the energy?

- Hydraulic Energy – Water flowing
- Carbon source energy – Stored in organic materials found in wastewater
- Others
 - Geothermal
 - Solar
 - Wind



Energy capture summary

- Hydraulic – Turbine
- Carbon – Thermal destruction
 - Direct – Combustion of organic material
 - Indirect – Combustion of anaerobic decay by-product
- Geothermal – by means of a collector, normally involving phase changes of some substrate
- Solar – Either in the form of heat or direct conversion to electricity
- Wind – Turbine, similar to hydraulic capture.



Example of energy capture

- Anaerobic Digestion of organic materials
 - Natural process
 - Not an easy process
 - Produces Biogas (Methane & CO₂)
 - Biogas heat value 500 to 700 BTU/cuft
 - Natural gas heat value 1,000 BTU/cuft
 - Biogas can be filtered to be a direct replacement for natural gas.



Other opportunities

- Other organic wastes can serve as sources suitable for energy recovery.
- Public-Private or Public-Public partnerships can be effective.
- Increased organic loading produces more biogas
- Potential waste sources include:
 - Whey or other cheese residuals
 - Food production, cafeteria, and restaurant waste
 - Fats, oils, and greases
 - Paper making solids
 - Distiller grains or other biofuel waste
 - Amino acids and other supplements

How to get started?

- Perform an energy audit
- Target individual processes for improvement
 - Minimize energy use
 - Maximize performance
 - Evaluate results
 - Consider alternatives
- Survey your region for partners



Some examples

- Sheboygan, WI – Receives cheese waste, generates electricity and heat
- Lafayette, IN – Partnership with cafeteria, generates electricity and heat
- Milwaukee, WI – Will be receiving biogas from landfill, generating electricity and heat or just heat
- Municipality in Sweden – Using biogas as fuel for buses

Summary

- Sustainability is not new to WWTP's
- WWTP offer great potential for energy recovery, maybe even energy production
- To accomplish this, we need to know how energy is being used,...
- Where energy can be recovered, ...
- Where energy can be generated

- This is the beginning of an important discussion.



Questions?



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