SOUTHERN ONTARIO WATER CONSORTIUM
LE CONSORTIUM POUR L'EAU DU SUD DE L'ONTARIO

ONTARIO CLEAN WATER AGENCY
AGENCE ONTARIENNE DES EAUX

Getting to Net Zero

Workshop Notes

March 22, 2016

Prepared by Sage Solutions

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Getting to Net Zero

Workshop Notes

London – March 22, 2016

The purpose of this one-day event was to facilitate a structured engagement between researchers, companies and end-users (including wastewater treatment plant operators), focused on the following key question:

What specific actions or changes would facilitate transforming wastewater treatment to water resource recovery via the uptake of innovative approaches and technologies?

The Southern Ontario Water Consortium (SOWC) and the Ontario Clean Water Agency (OCWA) convened the session. It comprised three panels, each followed by interaction with/among the approximately 50 people in attendance *(see Appendix A for detailed participant list)*. It also included a visit to the SOWC London Wastewater Demonstration Facility.

Each introductory panelist from OCWA presented for ten minutes (slides attached), followed by five-minute remarks from each of the other panelists, intended to catalyze discussion based on their experience and all with a focus on how to increase uptake of innovative approaches and technologies.

This event was envisioned to be the first of several of its kind, likely culminating in a synthesis document and perhaps event in Fall 2016.

These notes include highlights of each presentation and a synthesis of the feedback received from participants.

Panel #1

Getting to Net Zero: From Wastewater Treatment to Resource Recovery

Rob Andrews, CEO, OCWA

(See Appendix B for presentation slides)

- These are conversations that need to be had within this industry
- What does Ontario need to do as a global water technology hub?
- There is a global trend toward technology that saves energy – it must do so
- Note the evolution in language from a "sewage" plant to the wastewater treatment (WWT) plant to "resource recovery facilities." A shift from "from waste streams to value streams."
- The goal of the utility of the future: to be a net zero energy facility – which is achieved through both reduced energy consumption and increased resource production
- Examples from Singapore, Austria, Washington DC that could be considered in Ontario, involving ambitious targets, annamox, biological nutrient removal etc.

Tom Kaszas, Director of Innovations Branch, Ontario Ministry of the Environment and Climate Change

- People tend to come to him with "solutions looking for a problem," often at too small a scale
- These are economic and political problems, not primarily technological ones
- Municipalities will face competition for resource recovery, as point-of-use gas recovery, net zero buildings, etc. catch on
- Example of recent OMAF phosphorous recovery workshop
- Need to consider indirect and direct re-use of water

Peter Gallant, CEO, WaterTAP

- WaterTAP is Ontario's water innovation accelerator, with water as a provincial strategic objective
- Task is to promote the sector, but also to remove barriers to innovation within it
- Timely, as federally and provincially there appears to be openness to regulatory innovation, particularly related to Climate Change
- Example from Germany, where WWT is 118% positive in energy, enough to power its water side
- This is not about new gadgets or "rocket science." It's about optimizing conventional treatment using really solid engineering, operations and control systems
- Know the full, true cost per cubic metre and use this to develop baselines and benchmarks
- Key issues are related to procurement policy and regulation
- Use benchmarks, validation to shape procurement guidelines. "If five vendors are required to be innovative, how truly innovative will it be?"
- Market push/pull, yes, but within a truly enabling regulatory environment

- We need to reconfigure business models. WWT facilities are not currently set up to sell fertilizer!

Tim Constantine, Global Technology Leader, CH2M Hill

- Technology is a way to facilitate change. In this field, microbiology is the simpler part – it does its thing – while the "macrobiology" (i.e. the people) is often the barrier to change.
- Case study of VCS Denmark, which met and exceeded its goal of energy self-sufficiency by 2014
- How?
    - Utility leadership
        - Clear, challenging goals with autonomy re: how to meet them
        - Celebrate success but also do not punish failure – at all levels of the organization
        - Truly triply bottom line, not just lowest cost. Best solution may not be the cheapest.
    - Integration of engineering and operations
        - Seamless integration of these two areas
        - Operations staff fully engaged (e.g. presenting at conferences; clearly trying to do things better etc.)
    - Government support
        - Ambitious goals
        - Well-funded green energy sector
        - Set the targets, but collaborate with regulators re: how to meet them
    - Public engagement
        - Accepting of ideas that will benefit health of the country
        - Low taxes not the only or highest value

Brenda Lucas, Executive Director, SOWC

- Policy context: Need a forward-thinking policy framework as an explicit goal of our collective efforts, including alignment of federal and provincial goals.
- Be clear what the utility of the future should look like. This group could shape that, then help policymakers get there.
- We have not yet set the bar quite high enough – Ontario has been a leader, but needs to stay ahead of the curve. Set broader adoption of innovative clean technologies as an explicit goal.
- Federal context is more supportive than previously – support for green infrastructure, innovation in WWT
- All levels of government aligning is a big opportunity
- Three suggested steps to get there:
    - Align infrastructure funding opportunities explicitly to support innovation
        - Numerous funding sources exist to support pilots and scaling
        - Align these to make innovation the norm
        - Make net zero/innovation a requirement for funding

    - Align planning and procurement tools
        - Set the bar high and help municipalities to get there, as good “clients of innovation”
        - Fund sustainable asset management and planning
    - Align regulation
        - Regulation can and does drive innovation
        - Current federal WWT regulations set a low bar – we can get beyond secondary treatment without incurring significant extra cost
- Then measure and share successes

Question & Answer Period

Themes discussed in the brief Q&A period included:

- The need for strong performance indicators – monitoring systems and benchmarks. We need to collect the data we need to achieve the goal we set. Not just any data, but real time data at the proper level of granularity that operators and others understand and can use as a basis for informed decision making.
- Status of phosphorous recovery – largely at the demonstration stage, depending on where you are and what type of treatment centre you are running. No domestic sources of phosphorous currently. Example from Lake Simcoe – WWT at zero phosphorous but made no net difference. Plus, what would the price actually need to be to make something viable?

Panel #2

Energy Reduction

Indra Maharjan, Program Manager, Energy Conservation, OCWA
(See Appendix C for presentation slides)

- Presenting an "Energy Road Map"
- Not as simple as increasing energy efficiency:, as
    - Increasing energy prices may offset any intended cost savings
    - Behavioural changes are also key. For example, the energy use differential between peak and off-peak times is not yet significant – the cost differential needs to be larger to drive the desired behaviour change.
    - Cogen energy may not be optimized when energy efficiency is optimized
- Therefore need a strategy, supplemented by a culture and communication system that supports energy reduction – not just about technology
- Municipalities are the second largest user of energy in province, with water/wastewater accounting for 40% of that usage
- Need baselines per plant as "conversation starters" and benchmarks. Then revisit those numbers regularly, as levels of energy savings shift over time. Be sure energy savings are included in SCADA system data.
- The potential return on investment for energy savings is substantial
    - 5-7% potential savings from behaviour and operational changes alone
    - Aging assets are an opportunity for right sizing and retrofits
- Ontario examples from Clarkson and Stratford

Hongde Zhou, Advanced Wastewater Treatment Chair, University of Guelph

- Net zero is achievable
- Look holistically – fine tune existing systems for optimization rather than just applying new technology. Requires being systematic.
- Also requires leadership. Consulting engineers are strong in this regard – their expertise needs to be combined with researchers'.
- University research, although interesting, is often piecemeal. Needs to be more collaborative.
- Ontario is innovative – could be moreso if we combined the examples/pilots/ experiences together

Wayne Parker, Acting Dean of Engineering, University of Waterloo

- This conversation is really about how we expend energy for carbon and nitrogen oxidization
- In the short term, with existing technology – there is lots we can do by optimizing existing systems

- In the medium term (5-10 years), some of the technologies showing promise are:
    - Mainstream annamox
    - Anaerobic membrane bioreactors
    - Physical chemical ammonia removal
    - Algae systems for recovery of nutrients (in some climates)
- Long term – use community planning to turn a problem into a value
    - Not using our water systems as waste disposal systems, e.g.:
        - Urine separation
        - Sewer mining
        - Vacuum toilets
- Long term training and development are key to be able to maintain these systems, as the new technology tends to be sophisticated
- Most of what we talked about today is for large scale systems – these technologies often require a large scale. Yet Ontario (unlike Europe) has few large scale systems. How do we incorporate smaller scale systems sustainably in innovation?

Emily Moore, Global Director of Water, HATCH

- An outsider to the municipal sector, but experience in water minimization in industrial (mining) applications may be useful here
- Internal re-use is key
- Often not set up for it – don't tend to look at water as their 'product'
- Measurements is also critical – what key data points are we going to track to minimize water/energy use?
- A good idea to develop a provincial framework that domesticates lessons learned internationally and from other industries. For example, the mining industry uses well-tested tools to evaluate energy tradeoffs – they could be brought into the municipal space.
- Strategic asset management also has strong potential to translate databases into real action to drive significant decision making and energy adaptation

Ted Mao, VP, Research, Trojan Technologies

- Highlighting the challenges faced in bringing technology to industry
    - Business return on investment
        - Takes time (measured in 15-20 year time frames)
        - Considerable risk
        - Need large reductions to make it worth it
        - Example of Zenon UV system
    - Adoption
        - Need initial installation sites (e.g. demonstration site in London)
        - Then need the first 100 installations in a geography to build momentum
        - Requires other stakeholders to collaborate (e.g. consultants; municipalities)

- See WWT as “three factories”
    - Water factory
    - Energy factory
    - Product factory

Group Table Discussion

This panel was followed by a brief exercise where each table was asked, in light of the previous panel presentations, to answer the key question “What specific actions or changes would facilitate transforming wastewater treatment to water resource recovery via the uptake of innovative approaches and technologies” through identifying who should do what. Full verbatim answers are provided here, with the separation of rows indicating separate tables.

A (Who)	B (What action or change)
MOECC	- Performance based regulations - Not in ECA, not in compliance - Too bureaucratic - How you go to end of pipe shouldn’t matter - No reward for innovation, just punishment for out of compliance
Operating Facilities	- Must improve training of operators on energy reduction by enhancing the understanding of operators of how the plant is designed and at what levels of operating *parallels* should it be run
Regulators	- Should mandate the measurement of energy consumption to facilitate benchmarking
Industry, Universities & Government	- Collaborate closely on a process optimization – funding for overall municipalities to be provided by government
Utilities	- Collection of energy/process data and benchmark
Utility Leaders	- Leadership from decision makers
Funding Agency	- Energy efficiency achievements

A (Who)	B (What action or change)
Ministry of Environment & Climate Change Conservation Authorities	- A new plan (correcting of equipment/ technology in a facility) interim - Relief from compliance (expert/industrial blips during start-up) - Need to focus on other areas – not just compliance - Compliance – be more holistic, not just efferent quality - Need to harmonize regulation and talk more holistic - Balancing return on investment on receivers of sediment vs. air, sanitary effluent, solid waste management
Ministry	- Remove barriers – flexibility in ECA's to allow for trial of technology (not only side streams) - Removal of punitive approach
Ministry of Energy Ministry of Environment & Climate Change IESO Technology Companies STDC	- Energy performance benchmarking - Legislative requirements - Assign/kWhr energy loading benchmarks for Ministry of Energy to regulate - Demonstration funding to support new systems - Ability to operate several project developments concurrently – one at a time is not enough - Bring to Ontario
MOECC	- Greenhouse Gas emission standards/penalties - Benchmarking - Data availability/access

A (Who)	B (What action or change)
Utilities Province	- Measure energy efficiency where there is an intention to make positive change - Linked energy management plan requirement to water/ wastewater management
MOECC	- Establish a benchmarking framework to characterize energy consumption per unit of waste water treated at all municipal wastewater treatment plants - Have a standardized conversion of energy consumption to GHG
IESO MOECC	- Should require LOC's to pull together data for benchmarking performance standards in Ontario - Could require plants to measure energy, carbon footprint and report data - Regulate more than just effluent quality - Improve procurement standards to facilitate use of innovative technologies
Regulators	- Acceptance of alternative/ innovative technologies - Adoption mechanisms

Panel #3

Energy Production and Resource Recovery

Don Hoekstra, Director, Project Development, OCWA
(See Appendix D for presentation slides)

- Energy production is about combining heat and power
- Lots of WEF sessions about digester enhancement technology. Still have concerns about residuals, flare.
- Example of Clarkson WWTP – using a water-powered turbine in outfall – possibly unique in North America
- Resource recovery involves both producing products for cost recovery, such as fertilizer, fuel cells, ash, and achieving greater energy efficiency
- Challenges include:
    - Municipalities are ill prepared to sell commodities
    - Storage requirements
    - Limited usefulness of recovered products
    - "Constituents of concern"

John Lucas, Director of Water and Wastewater, City of London

- Municipalities are risk adverse – we therefore need to be excellent risk managers
- How to get an innovative project to happen in a municipal setting:
    - Pilot projects, to build success and momentum.
    - Apply for an innovation award – win it and give it to Council as theirs. Self-proclamation does not work – need third-party recognition.
    - Go with the slant you have currently on Council (e.g. into the environment? Highlight that…)
    - Be patient and the regulators will catch up
- Example from London
    - 700 kW generated using an organic Rankin cycle engine. Worked with TSSA to engage in a $10 million pilot that is about to start, carefully.

Kiran Suresh, Plant Manager, Wastewater Services, City of Guelph

- Likes the move toward "water resource recovery facility"
- Lots of WWT pilots in Guelph, such as re-use of bio-solids, membrane research, annamox, various lab-scale tests etc.
- Operators optimized to understand the data they collect and empowered to make decisions about it
- Have cogen engines that offset greenhouse gas emissions by roughly 30%. Heats the facilities and saves about $250,000 per year.
- Have a truck that runs on digester gas, based on an employee's idea – hoping to transform the fleet

George Nakhla, Professor, Western University

- Diverting carbon from mainstream is what is needed – represents 50-60% of treatment cost
- Municipalities are looking for non-intrusive technologies that do not increase capital costs
- He is an expert in anaerobic digestion
- Greater potential in post-treatment than pre-treatment technologies. It is difficult to document the benefits of pre-treatment unless done in patterns (e.g. with a 'control' digester). These work at short (i.e. 10 days) SRPs.
- Provided several examples of post-treatment pilots, including Lystek biosolids and anaerobic digestion; green fuel (using biohydrogen and methane for jet fuel); 'dewatering'; extrusion to recover hydrogen and methane; digestion using food waste; recycling iron and phosphate with Trojan; recovering carbon through recycling Lystek in Chicago.

Mark Masotti, Business Development Manager, Mitsubishi Corporation

- With the power machinery and infrastructure group, responsible for transferring Japanese innovation into the Canadian market
- Focus on 2 technologies here:
    - ORC Turbines
        - Makes formerly uneconomic materials into electricity
        - Operate independently – no need for stationary engineers
        - Within existing paradigm
        - Regulated [poorly] by the Ministry of Consumer Affairs currently
    - Pyrolosis ("roasting of biosolids in the absence of oxygen")
        - Converting biosolids into biocoal – first commercialize in Japan in 2006
        - In Ontario, not much of a market for bio-coal, but cement kilns do use it
        - "Biochar" can be used for soil amendment, as an alternative to activated carbon
        - A dry process – no odour or ammonia production; independent operation
- P3 does not work well in this space – who will take on the market risk? Can municipalities?
- Look to countries like Japan where the pressures are greater for lessons re: commercialization.

Youngseck Hong, New Technology Research Lead, GE

- GE has commercialized two Net Zero initiatives so far:
    - Singapore (20 months of testing)
    - London (with Trojan)
        - A fourfold improvement in energy efficiency using power biogas generation
- Highlighted example of GE/Zenon MBR technology
    - 50% of market share, showing 25-50% reduction in energy consumption

    - Working with universities throughout the world
    - Now focusing on reducing bioprocess energy
    - Struggle to find Ontario demonstration sites – have taken technological innovations elsewhere (e.g. Singapore, California)
- Now working on biological hydrolosis
- GE wants to look at Net Positive, not just Net Zero

Group Table Discussion

After this panel, participants were invited to engage in the same exercise at their tables, identifying who needs to do what to encourage uptake of innovative approaches. Full verbatim responses are shown here.

A (Who)	B (What action or change)
Regulators	- Focus on outcomes rather than means: o Wastewater quality o Energy efficiency o Solid waste diversion - "Outcome-based regulation"
Ministry GCS/TSSA	- Amend O Reg. 2/9/01
MOECC Federal & Provincial government Municipalities Industry as a whole	- Relaxing regulations while testing or starting up new technologies - Providing incentive programs (funding) to reward improvements - Measure where you are on energy production relative to other plants so you have a benchmark so you can prove improvement - Find way to improve marketability of recovered end-products (e.g. fertilizer)
Government Industry-government Utilities	- Green energy and resource incentives - To exploit existing relationship to exploit innovative technology - Operational incentives

A (Who)	B (What action or change)
MOECC and municipal governments should work together	- Policy change to emphasize the resources recovery - Introduce the incentives to compensate the costs and other issues to adopt new technologies - Shifting from wastewater treatment to resource recovery requires the resources, but could be win-win situation - Work with other stakeholders such as pulp industry - Find the energy uses for different opportunities
TSSA Regulators – part of the process Ministry of Economic Development	- Relax regulations to allow unlicensed ___ for ORC - Create environment of "early adaptors" for new technologies - Funding
Government Municipality?	- Provide funding for pilot project - Short term council (4 years) making decisions with long term payback (20+ years)
Owners	- Encouraged technology partnerships shared risk…this would really help advance

Wrap-up Plenary Session

In the wrap-up plenary session, participants were invited to write down their single highest leverage idea and what it would take to get there. Responses have been clustered here, but provided in their entirety.

"Highest Leverage Idea"

Ambitious Vision/Goals

- Idea of "Net Zero Initiative in waste water technology"
- Changing perception of "waste" water to resources
- Change in focus of wastewater treatment to be more energy efficient
- Shift toward 3 factory concept:
    1. Water recovery
    2. Energy production
    3. Resource recovery
- Turn Ontario into the place to be for technology early adoption, e.g., like Singapore, California, etc.
- Eliminate "waste" from dialogue, to substitute with language that will trigger value shift for water. Reframe the issue.
- Energy generation at pollution control plant
- Ontario working as a true innovation "hub" – all of these perspectives working together
- Conduct a comprehensive study on the whole concept of net-zero and use a holistic approach to evaluate it – specific case studies for North America

Measurement and Benchmarking

- Benchmarking through better process monitoring in order to evaluate benefit
- Need for province-wide benchmarking of w/w treatment plants on sustainability metrics
- Energy framework for municipal WWT systems
- A program to approach EM
- Measure energy performance in all plants
- Legislated KPIs
- Need metrics
- Benchmarking your WRRF's performance and looking for areas of improvement

Regulations

- Change regulations to ban/limit organics to landfill

Funding

- Funding tied to specific/explicit targets
- Requirements for GHG emissions
- Financial supports from governments

- Requirement for benchmark energy efficiency in upgrade to obtain provincial/federal funding

Specific Technologies/Ideas

- Energy saving waste water process technology (e.g. Annamox)
- Point of use – nutrient recovery
- "Utility of the future" program
- Struvite production from waste water
- Nutrient trading scheme
- Cap and trade for $P_1NH_4^+$
- Power generation from effluent out fac/energy recovery
- Integrated testing facilities for wastewater technologies

Internal Structures/Culture

- Need to look at the entire process and integrate
- Need for stronger collaboration between industry and government
- Engineering and operations gap
- Do not punish failure…celebrate successes…but at least try
- Don't focus on lowest cost but educate and train to gain acceptance
- Operators need to take risk
- Incentivize innovation

General

- Facilitate Implementation
- Synergy of multiple innovative technologies

What would it take?

Paradigm Shift

- Foster collectivity and pride in Ontario water and technology sector
- Paradigm shift of utilities and regulators
- Education, get the message out that can actually be achieved

Policy Shift

- Policies similar to CO_2 emissions

Structural/Cultural Shift toward Greater Integration

- Bring technology fields into operations
- Closer dialogue, seed funding for innovation
- Industry association – Municipality – MOECC collaboration
- An industry culture shift to risk management

- Multi-stakeholder panel – recommendation to provincial regulator
- Collaboration between industry, institution and government
- Coordination between MOECC and MoEI
- Better partnerships to share in risk/reward to fund
- Systematic approach for energy and resource recovery

Funding

- Resources
- Funding
- Substantial funding for large scale pilot, collaboration with international end-user
- Industry focused funding program

Funding Requirements and Incentives

- Incentives to municipality by government (2)
- Introduction of energy reduction targets through process reporting requirements
- Changing funding requirements (need to have energy efficiency component)
- Incentives $$, education, requirement by regulators
- Standard templates, regulated?
- Financial incentives for clean-tech

Return on Investment

- Return on investment analysis and council buy-in

Regulatory Changes

- Guideline for baseline data collection
- Legislative/regulation change
- Flexible/efficient approval process
- MOECC – include energy performance in ECA
- For technology early adoption, remove:
    - Regulatory barriers
    - De-risking for municipalities
    - Improve procurement process for new technology
- Provide incentives for improvement and be flexible with regulations
- Regulatory promotion of trials and NEW technology
- Regulatory support for new technology
- Regulators are risk averse to accepting new technology

Technology Showcase

- A marquis showcase project at a leading municipal facility
- Technology development and research
- Demonstration

Education

- Funding, training, education, practicality
- Community acceptance
- Education

Will

- Public will
- Council decision making; provincial government strength in understanding technology and risk
- People without fear
- Trusted channel allies

The group then spoke briefly in plenary about themes, surprises and lessons learned. It was noted that the shift toward viewing waste as a resource was quite new but seemed to have considerable alignment and support. Similarly, the importance of good data, baselines and benchmarking was noted, particularly the ability to see evaluation data as a helpful tool and motivator for change rather than as something punitive. A lack of technology does not seem to be a barrier. There was some contradictory feedback regarding the need/lack of need for funding and/or tighter regulations.

Next Steps

The organizers of the event were very pleased with the dialogue and the interactions that resulted from the day. The enthusiasm of participants to continue with this type of engagement was clear. Given the relevance to all three of our organizations, SOWC, OCWA and WaterTAP have committed to work together to continue with this type of forum. We'll plan at least two in the next year. Our intention is to use a similar format to focus on additional sub-sectors (for example drinking water and smart monitoring). We'll also follow up specifically on the topic of transforming wastewater treatment to water resource recovery. The London event also brought to light opportunities for a similar engagement from a trans-disciplinary perspective (e.g. data and performance measures, or nutrient reuse). We will explore these options as we plan ways to continue this high level strategic engagement between researchers, companies and end-users, focused on the key question of "What specific actions or changes will facilitate the uptake of innovative approaches and technologies?