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LIFT Scholarship Exchange Experience for Innovation & Technology (SEE IT)

Sponsored by: WRF, WEF, and NACWA

TRIP REPORT

SCHOLARSHIP UTILITY: *Water Environment Association Ontario / Ontario Clean Water Agency*

SCHOLARSHIP UTILITY CONTACT: *J.Y. Ho, Biosolids Program Manager*

ATTENDEES: *J.Y. Ho*

TRIP DATES: *2025 June 15 – June 21*

UTILITIES/SITES VISITED:

House of Green, Copenhagen

Copenhagen Harbour Baths and HOFOR (Greater Copenhagen Utility) pumping station

Lynetten WWTP

Topsil manufacturing on-site water production

Hillerød WWTP

Kalundborg Utility (WTP, WWTP)

Novinosis industrial site

Nye neighbourhood surface water collection & non-potable WTP

Risvangen neighbourhood stormwater diversion

Aarhus Vand Utility

Søndersø WWTP

Ejby Mølle WWTP

TECHNOLOGIES/INNOVATIONS SEEN:

- Danish Water & Wastewater Association treatment benchmarking
- Harbour water quality forecasting
- District heating & natural gas from wastewater
- Sludge mineralization pilot
- Water re-use for ultrapure application
- Surface water treatment
- Integrated stormwater routing/storage
- Surface water treatment for non-potable use
- Biosolids steam drying & pyrolysis
- Wastewater operations heat capture for district heating
- Flue gas electrolytic emission reduction/carbon capture/hydrogen production

TRIP BACKGROUND and RATIONALE:

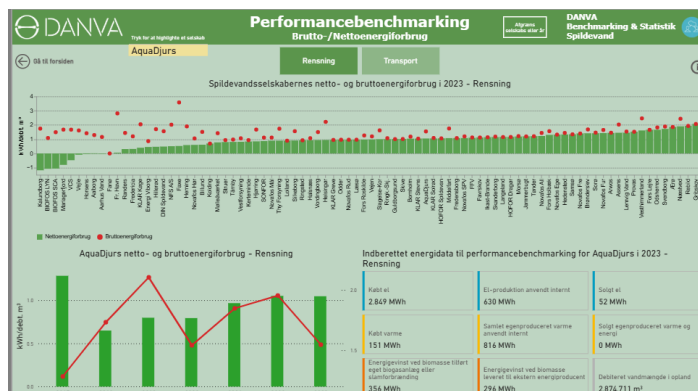
The Center for Sustainable Infrastructure (an American non-profit organization; this effort partially supported by WEF) organized Wastewater Symbiosis Tour for wastewater operators & management staff to learn and knowledge-exchange with Danish counterparts. Through the course of the study tour, the Danish approach to infrastructure and economic development is



demonstrated, where one sector's wastes – energy, water, materials – become resources for other sectors. The resource recoveries examined in this study tour are implemented at wastewater treatment plants. The study delegation includes operators and regulators from several U.S. states (Virginia, South Carolina, Michigan, Oregon, etc.) and Canada's Region of Halton.

TRIP SUMMARY:

The study tour looked at Denmark's approach to wastewater utilization to meet the country's political priorities of climate and energy neutrality, in the context of their limited fossil fuel and water sources. There was an overview of benchmarking and regulatory strategies from the Danish Water and Wastewater Association. This transparency and prompt reporting provides peer performance insight as well as establishing trust between operators, regulators and municipal owners. There were also workshops held to meet with technology providers, to understand applications in Denmark, challenges in both Denmark and North America, including transfer barriers.



(left: Danish Water and Wastewater Association benchmarking across plants; right: Danish Industry workshop)

Site visits spanned multiple Danish plants which are leading examples of resource efficiency, recovery and/or innovative technology implementation. We began with visiting the Lynetten Wastewater Treatment Plant, the largest plant in the country, treating municipal wastewater from Copenhagen. The full plant tour included a walkthrough of their recently retrofitted aeration (from surface to bottom fine bubble diffusers) works, which has reduced energy demand of the process. The degree of efficiency and resource harvesting in their solids digestion process allows for biogas and heat production, such that their production serves much of the city's gas network and contributes to district heating. At the Hillerød Utility wastewater treatment plant, we saw both the opportunities and challenges of an underground wastewater plant constructed to be an accessible part of the local community space. We also visited a privately run water treatment system, part of a silicon manufacturing process, with emphasis on water reuse in spite of their limitation in requiring ultra-pure quality for critical parts of their process.

One highlight of the tour is the Kalundborg Symbiosis, which has had a functioning materials exchange for fifty years between its local industrial facilities, water & wastewater treatment and energy utilities. We had a tour of both the water and wastewater treatment facilities (both with



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remarkably impressive industrial hygiene standards – similar to the other plants we saw in Denmark). We also passed by their recently concluded sludge mineralization/vegetation beds pilot, which tested the different stabilized sludge feeding regimes and plants.



(sludge mineralization pilot building)

There were talks to explain how Kalundborg creates the material exchanges through resource mapping, and how they adapt as industries and consequent material flows change through time. The co-investment in the required infrastructure, development of interface points of data and controls between the different participants had to be underpinned by established trust, open dialogue and a lot of technical “grit”.



(Kalundborg - left: Symbiosis talk – industry/utilities mapping; heat extraction for district heat)

We then had the opportunity to visit a unique surface water treatment plant (as drinking water in Denmark is sourced from groundwater) at Nye, operated by Aarhus Vand. As it was a new greenfield area development, urban planning with a dedicated intent towards water conservation was possible and actually executed. The plant is architecturally striking, with all the components of a drinking water plant and producing essentially potable water (including contentious usage of chlorine disinfectant – which is not used in Danish drinking water).



Nye's "secondary water" output is distributed in dedicated purple pipes for laundry and toilet flushing use. A walking tour of the Nye neighbourhood showed the care and thought taken to maximize surface water capture and minimize source pollution (and thereby reduce demands and cost on the treatment process). Measures included a restricted area for car washing and bicycle maintenance so that detergents and mechanical greases are captured in an underlying containment/wastewater drainage,

vegetated sloping around communal stormwater/surface water ponds which are focal (and downgradient collection) points around which residences are located. These ponds and the treatment plant are very visible in the neighbourhood, which are quite different from the way such structures are usually situated in our region (hidden from public sight with large buffer zones, security fencing etc.). The visibility and central location seem to invite residents to be stakeholders in their (at least secondary) water supply at Nye. We concluded our day in the Aarhus region with a visit to Aarhus Vand, the water/wastewater utility company (who also operates Nye) and participating in a dialogue with Water Valley Denmark on treatment challenges and ways to foster new technologies.





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Our tour concluded in Odense, in which we visited pilot technologies (sludge steam drying and pyrolysis) Sønderød and the Ejby Mølle Water Resource Recovery Facility. We heard about the challenges with the treatment technologies and product market at the former facility and saw the biochar production process in action. At Ejby Mølle, we were introduced to their microbial hydrolysis process (using a specialized bacteria and a hyperthermophilic temperature of 75degC) that enhances their subsequent anaerobic digestions. We also toured a large electrolysis pilot that separated carbon dioxide and hydrogen from flue gases as a means of hydrogen production and carbon dioxide capture.

(right: biosolids to biochar process; bottom: electrolysis unit)



Why did you select the specific utility and technology for the visit?

The utilities and technologies were selected by tour organizer CSI and its Danish partners, as being relevant for wastewater operations & demonstrating applications of resource recovery.

On your visit, do you think this technology/approach works for your utility?

As several of the tour delegates observed, some of the technologies/approaches are underpinned by the local culture & commitment in prioritizing climate change mitigation & environmental protection, which is not an imminently replicable situation in North America. Several approaches, such as ammonia-based aeration control, and pyrolysis, are being trialed or considered for future pilots in our facilities. It was useful to understand the firsthand operator experiences of these approaches which are already implemented in the sites we visited. For my own biosolids program work, I plan to apply the inventorying and benchmarking similar to that shown by DANVA. I would also like to explore intra-regional links and sharing of biosolids management options/pilots like Sønderød, as well as potentials for private industries to have roles beyond wastewater dischargers and rate-payers.

How useful was the trip in your decision-making process?

The trip will be very useful in our decision-making process. We tend to “diagnose & treat” each plant in isolation, but a perspective shift to how a plant could connect with the local community (as exemplified in the Kalundborg resource mapping), or with other plants regionally, is likely to change the technologies & biosolids management pathways in our consideration. The first-hand challenges and lessons learnt we heard from operators there through their implementation experience of technologies we are considering will help inform us on the preparation of future pilots for us. I also consider the information we had from the study tour to be of higher confidence than that we normally are provided by technology providers, given what we heard in Denmark were generally from the perspective of the operators and included often-overlooked adaptation and maintenance issues.

What were some of the trip highlights and takeaways?

A highlight of the trip was the exposure to the local mentality/culture of willingness to adopt new technologies with the aim of resource self-sufficiency, even at great initial costs and technical complications. The operators and plant staff were very forthright about successes, failures and limitations of the technologies & applications. While it is infeasible to change the social mentality in our region (although we can contribute to more educational outreach and visibility), we can look at changing culture in a “micro”-scale. For example, many of the utility offices we visited included lunches at welcoming cafeterias, where we saw operational, technical and administrative staff co-mingling. This is quite different from the work/rest space separation I have normally see in our utilities and could be an enabler in fostering conversations outside of our work silos and cross-thinking.

A takeaway was their attitude of ownership – for example, that wastes should be dealt with where it is generated, and in seeking to, which partly drives their hunt for efficiency and new technologies. As land and infrastructure development options become limited in our regions, and in light of the current financial penalties on inter-regional commerce, that should be a perspective we start to adopt seriously as well.

A much-appreciated aspect of the trip was being able to spend extended periods of time with fellow delegates (operators, regulators etc.). In past conferences I have attended, meeting with others in the industry tend to be time-pressed and more in the form of one-on-one, target-oriented conversations. Having the opportunity to spend this much time with each other in both structured (e.g. the hosted workshops and industry meetings) and unstructured conversations was very beneficial. Beyond the technical exchanges, getting to know each other’s journeys and experiences is very impactful and a source of continued motivation as we continue in the wastewater industry.