Session 6.6 – Carbon Circularity
20 April 2022 (Wednesday)
1100 – 1230 hours

Session Co-Chairs: Tao Li, IWA (China), Tina Arrowood, DuPont Water Solutions (United States)

Hydrogen Circular Economy: Viability, Scalability, And Risk For Water Industry

Arash Zamyadi. Water Research Australia (Australia)

Integration of sustainable hydrogen (H2) and hydrogen peroxide (H2O2) production into wastewater treatment plant (WWTP) processes may facilitate water industry contributions to an emerging circular economy. Recycled wastewater (RWW) produced at WWTPs may provide an alternative feedstock to the already scarce freshwater resources conventionally used for this process. Energy efficiency opportunities also reside in excess renewable energy utilisation. Australian water utilities have however raised key concerns regarding scalability, technological/economic viability, and risks associated with incorporating hydrogen production into WWTPs. A state-of-knowledge is therefore required to address these concerns and provide site-specific guidance to prospective utilities.

Smart Thermal Grid With The Integration Of Aquifer Thermal Energy Storage And Surface Water To Decarbonize The Buildings Heating And Cooling Systems, Floriade 2022 Case Study, Netherlands

Saleh Mohammadi, Jair Smits, Taco Postma. Witteveen+Bos N.V. (Netherlands)

The world horticultural exhibition Floriade 2022 will be held in the Dutch municipality of Almere. In addition to showcasing the latest technology in horticulture, energy transition towards the gas-free neighborhood is one of the Expo's main objectives. Therefore, an innovative energy system is applied to mitigate the CO2 emission by utilizing Aquifer Thermal Energy Storage (ATES) and surface water for heating and cooling to decarbonize the building environment. A collective energy system based on the Smart Thermal Grid (STG) with a temperature of about 12 °C has been designed which consists of collective ATES, thermal energy exchange with surface water and heat pumps (HPs). ATES systems as a sustainable thermal energy storage method reuse and recycle heating and cooling across seasons. To balance the heating and cooling of the ATES system, thermal energy from the surface water was recovered from the nearby lake. The STG as a backbone connects the main system components to the apartments and utility buildings and regulates temperature and flows throughout the system across the seasons. Our study shows that the proposed system of ATES, surface water and STG can play a major role in mitigating carbon emissions compared to conventional natural gas systems and aircon.

Techno-Economic Analysis Of Electrochemical CO2 Reduction For Biogas Upgrading To Ethanol Or Pure Methane.

Huan Jiang, Olivier Lefebvre. National University of Singapore (Singapore)

Biogas generated during anaerobic digestion shows great potential as a renewable source of energy, but the large CO2 content (40-45%) [1] reduces the heat value of biogas and may corrode pipelines, on top of being a greenhouse gas. In this context, we evaluate the techno-economic feasibility of electro-converting CO2 in biogas into valuable products (C2H5OH or CH4). After setting up realistic target conditions achievable in the short term, we show that electro-conversion of CO2 to C2H5OH would generate an economic gain > 180 USD/tonne. In the long term, three cost reduction strategies are proposed to lower the cost of CH4 production to < 400 USD/tonne. In addition, as a fossil fuel, the market price of CH4 is expected to increase in the future, suggesting the significance of producing CH4 as a final product in the future. In conclusion, both options (C2H5OH and CH4) are interesting to study though their timelines to application are different.

Climate Mitigation In The Water-Cycle: The Greenhouse Gas Abatement Selection Procedure

Thomas De Groot. Arcadis (Netherlands)

The Paris agreement pushes organisations to come-up with a planned approach to reduce their carbon emissions. Specifically, water companies have a strong societal push to fulfil these obligations due to their exemplary function. Many of these companies struggle with the second step: from strategy to implementation. Arcadis has developed a (GRASP-GReenhouse gas Abatement Selection Process) model to support the management decision process to come to a transparent and well substantiated/informed action plan to reduce the company's carbon footprint. GRASP helps them to map, select, prioritize, and plan the carbon reduction opportunities in future. The model consists of a multi-criteria analysis of identified carbon reduction measures, factsheets per identified measure with quantitative and qualitative indicators, a roadmap feature where opportunities can be plotted over time, estimations of the expected effect of identified measures on the carbon emissions over a pre-defined implementation period, and other indicators of relevance for the drinking water and wastewater sector.