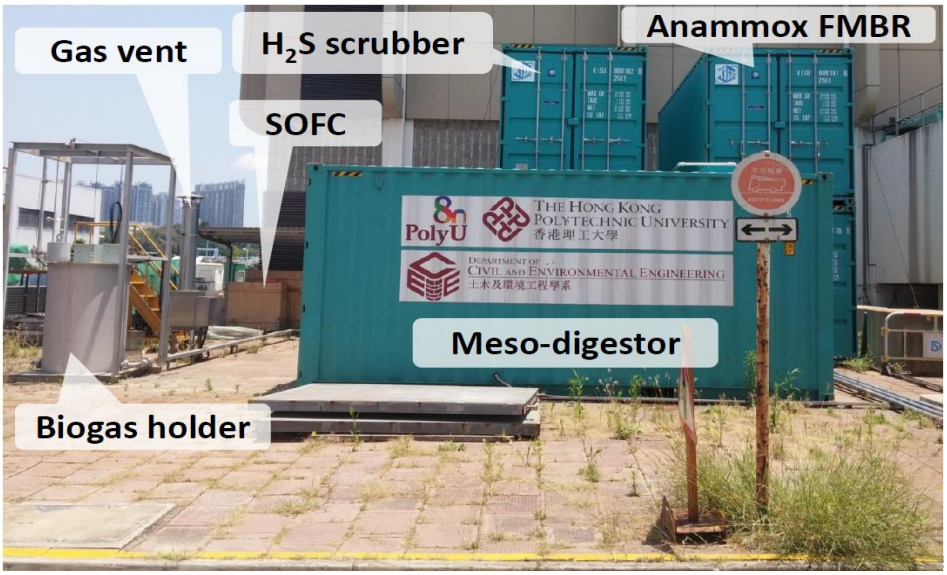
News Article for RISUD Strategic Focus Area (SFA) Scheme

		Name	Department
1.	**Principal Investigator**:	Prof. Xiangdong LI	CEE
2.	**Name of SFA:**	Urban Water Management	
3.	**Project Title:**	New Paradigm of Integrated Urbanwater Management	

4. **Second Year Progress/Achievement**

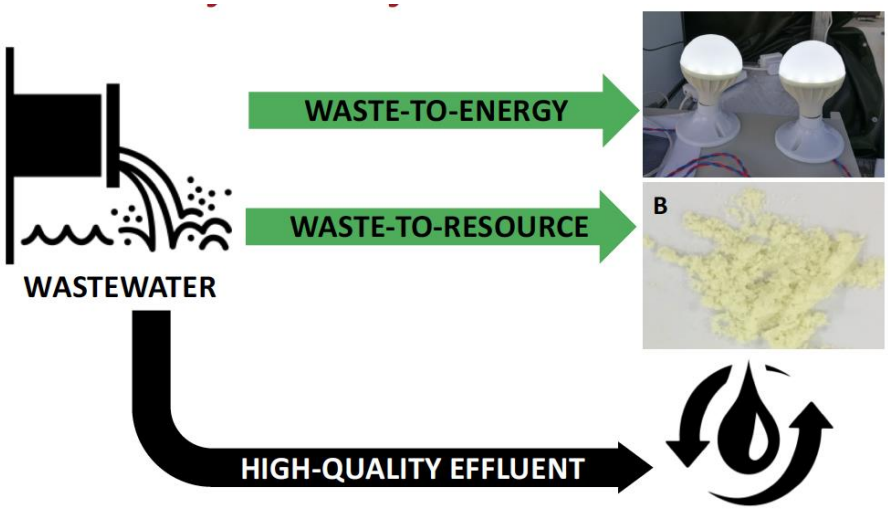
A three-year SFA project led by Prof. Xiangdong LI was commenced from 1st March 2017 and has been conducting for two years. In the 2nd year period, a few key progress and achievements are summarized as follows:

1. A R&D research project entitled "Wastewater-derived Energy for Smart Towns" was financially supported by an ITF grant ($8.9M) and collaborated with the Drainage Service Department (DSD) of HKSAR Government since June 2016. This research project developed an efficient, green and energy-producing system, which consists of pilot-scale mainstream Anammox fluidized-bed membrane bioreactor (FMBR), laboratory-scale meso-digester, laboratory-scale twin hydrogen sulfide (H_2S) scrubber, and pilot-scale solid oxide fuel cell (SOFC) for conversion of wastewaters into electricity."

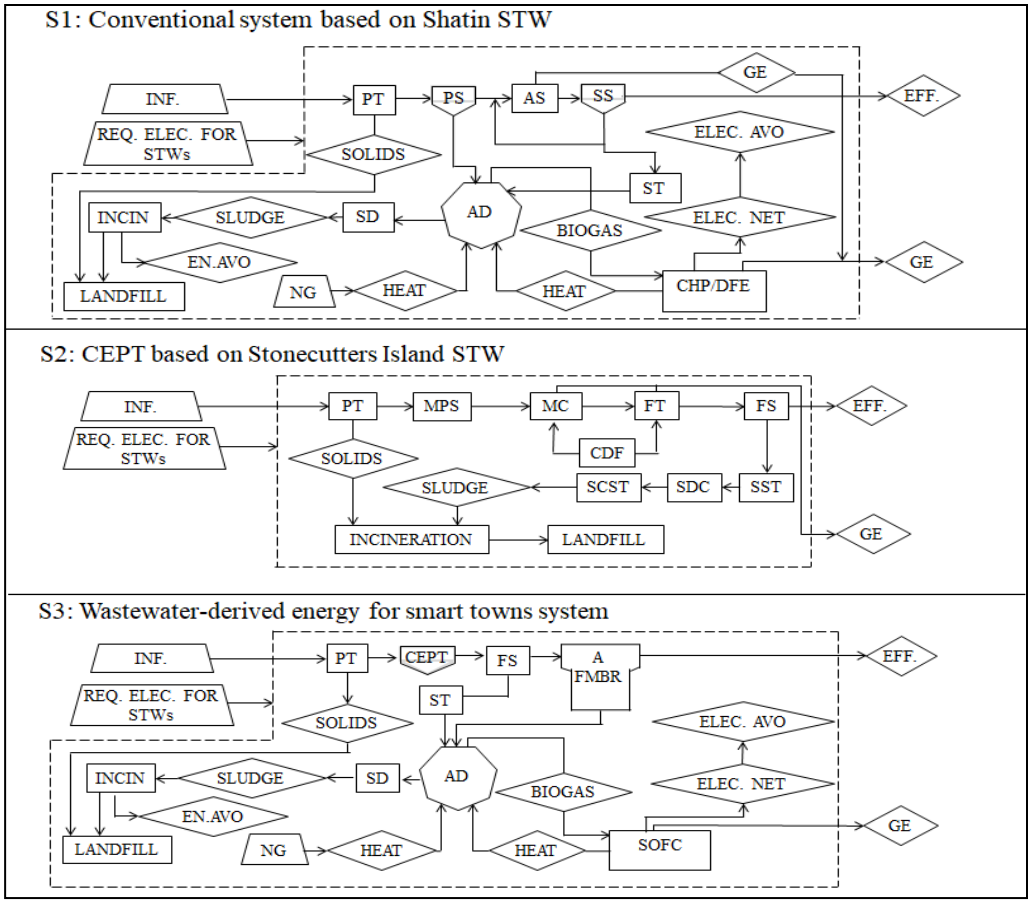


This R&D research work demonstrates the proof-of-concept for (1) the Anammox FMBR technology in treating CEPT saline sewage. Under stable operation at 6-h HRT, which corresponded to a treatment capacity of 4 m^3/day, the prototype achieved good effluent quality, meeting the general effluent criteria for BOD_5, TSS and ammonium-nitrogen; (2) the meso-digestor technology to handle

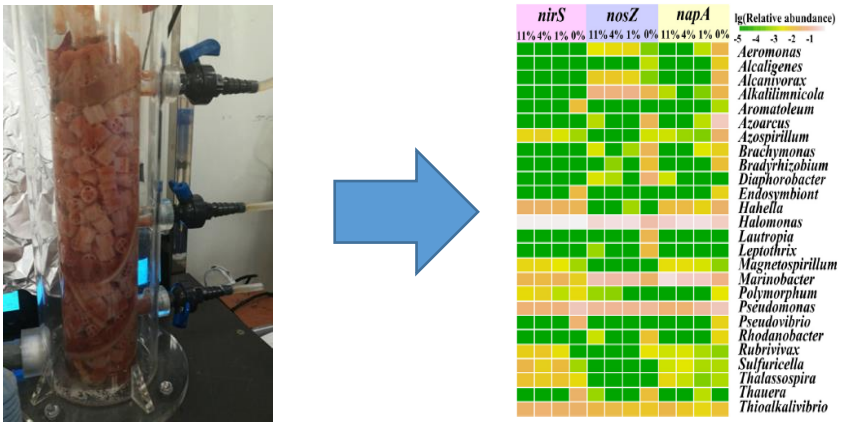
CEPT saline sludge anaerobically and convert it into biogas as a form of bioenergy. The reactor performance was stable at 15-20 days HRT to produce the biogas at a rate of 1200 to 3870 mL/day (0.16 - 0.52 m^3/kg [dry sludge]) with CH_4, CO_2 and H_2S ranging between 50 to 70%, 30 to 50% and 1,000 to 5,000 ppm, respectively; (3) A set of laboratory scale and pilot scale hydrogen sulfide scrubber system were developed to remove hydrogen sulfide from biogas produced from anaerobic meso-digestor, reaching a removal rate of 99.1%; and (4) one set of prototype SOFC system for generating electricity from simulated biogas with a capacity of up to 10 kWh/day was designed, fabricated, and installed in a local sewage treatment works, and its efficiency of electricity generation by feeding with H_2S-free biogas has been successfully tested to achieve an energy converting efficiency of 35%.



2. A Life-cycle assessment (LCA) for the wastewater-derived energy for smart towns (ITF system) as compared to Stonecutter and Shatin wastewater treatments (WWTs) in Hong Kong is being studied now. The goal of this study is to quantify the environmental impacts of the control and operation strategies that achieve a balance between COD/ammonia/sulfide removal performances and energy production of the ITF system. Three scenario are selected for this study as shown below: a conventional treatment including activated sludge (AS) for the water line, anaerobic digestion (AD) for sludge treatment, combined heat and power (CHP) and dual fuel engines (DFE) for energy production (S1) based on Shatin sewage treatment works (STW); a CEPT without sludge treatment in the plant (S2) based on SCISTW; and the ITF system (S3) including CEPT and Anammox FMBR for the water line, AD for sludge treatment, and SOFC for energy production. S3 represents the integration of the ITF system into the current operation of the SCISTW. All the sludge generated in the STW was assumed to be delivered to the incineration facility (T-Park) followed by landfill. The scope of this study includes construction, operation and maintenance and dismantling of the system. The functional unit (FU) is "1 m^3 of treated sewage" in a lifetime of 30 years. The geographical boundary is Hong Kong; but given the use of the Ecoinvent database for missing data, then Switzerland and China are also included.



3. A further developed anammox-based BNR process has been studied at a lab-scale for mainstream wastewater treatment, in which some key species of the anammox bacteria group have been well identified, and they are growing well under a laboratory environment as shown below.



4. This water research team has been actively collaborated with local government departments and industries to develop R&D projects through the University-Government-Industry (UGI) Consortium for Sustainable Urban Development. So

far, the two annual forums were conducted in April 2017 and April 2018, respectively, and the 3rd UGI workshop is also scheduled in June 2019.